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## Identifying Best Practices for Increasing HIV Pre-exposure Prophylaxis (PrEP) Use and Persistence in the United States: a Systematic Review

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### Abstract

A qualitative systematic review was conducted to evaluate pre-exposure prophylaxis (PrEP) interventions, describe characteristics of best practices for increasing PrEP use and persistence, and explore research gaps based on current PrEP interventions. We searched CDC's Prevention Research Synthesis (PRS) Project's cumulative HIV database (includes CINAHL, EMBASE, Global Health, MEDLINE, PsycInfo, and Sociological Abstracts) to identify PrEP intervention studies conducted in the U.S., published between 2000 and 2022 (last searched January 2023). Eligibility criteria include studies that evaluated PrEP interventions for persons testing negative for HIV infection, or for healthcare providers who prescribed PrEP; included comparisons between groups or pre/post; and reported at least one relevant PrEP outcome. Each eligible intervention was evaluated on the quality of study design, implementation, analysis, and strength of evidence ([PROSPERO registration number: CRD42021256460](#)). Of the 26 eligible interventions, the majority were focused on men who have sex with men (n=18) and reported PrEP adherence outcomes (n = 12). Nine interventions met the criteria for Best Practices (i.e., evidence-based interventions, evidence-informed interventions). Five were digital health interventions while two implemented individual counseling, one offered motivational interviewing, and one provided integrated medical care with a PrEP peer navigator. Longer intervention periods may provide more time for intervention exposure to facilitate behavioral change, and engaging the community when developing, designing and implementing interventions may be key for effectiveness. For digital health interventions, two-way messaging may help participants feel supported. Research gaps included a lack of Best Practices for several populations (e.g., Black persons, Hispanic/Latino persons, persons who inject drugs, and women of color) and evidence for various intervention strategies (e.g., interventions for promoting provider's PrEP prescription behavior, peer support). These findings call for more collaborative work with communities to develop interventions that work and implement and disseminate Best Practices for increasing PrEP use and persistence in communities.

## Keywords

HIV; Interventions; Systematic Review; Evidence-Based Practice; Pre-exposure Prophylaxis; PrEP User; PrEP Persistence

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## Introduction

Pre-exposure Prophylaxis (PrEP) taken as prescribed before HIV exposure is effective in preventing HIV infection among people exposed to HIV through sex or injection drug use [1]. The Ending the HIV Epidemic (EHE) initiative and the HIV National Strategic Plan 2021–2025 highlight PrEP as one of the key strategies to reduce new HIV infections [2,3]. It has been more than 10 years since the U.S. Food and Drug Administration (FDA) approved the first PrEP medication to prevent HIV transmission in 2012 [4]. Yet, there were still 36,136 HIV diagnoses in the U.S. in 2021; groups most affected are men (79%), gay, bisexual and other men who have sex with men (collectively referred to as MSM) (67%), Black/African American (hereafter referred to as Black) or Hispanic/Latino persons (59%), people aged 13 to 34 (56%), and those living in South (52%) [5]. Overall, PrEP prescriptions have been increasing among persons in the U.S. who could benefit, but still remain lower than the national goals [6,7]. Despite these increases, PrEP coverage is far from equal and substantial disparities persist among subgroups (e.g., Blacks and Hispanic/Latinos have lower rates of PrEP prescriptions than White persons). Identifying effective interventions for increasing PrEP use is important in reaching national HIV prevention goals.

To inform national prevention efforts, the U.S. Centers for Disease Control and Prevention's (CDC's) Prevention Research Synthesis (PRS) Project [8] has conducted an on-going evaluation of PrEP interventions since 2020. The PRS Project has been identifying evidence-based interventions (EBIs) and evidence-informed (EIs), collectively referred to as Best Practices, for increasing PrEP use and persistence in its Compendium, a compilation of effective HIV interventions [9]. The purposes of this study are to 1) summarize the characteristics of Best Practices for increasing PrEP use and persistence in the U.S. and 2) explore the research gaps based in the current PrEP behavioral intervention literature.

## Methods

A protocol was registered in PROSPERO (CRD42021256460) [10]. Our report followed the guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRSIMA) Statement [11].

## Systematic Search Strategy

The PRS Project has an overarching goal to synthesize the published scientific research literature to help inform policy decisions, guidelines, programmatic efforts, and future research in HIV prevention. The project has built a cumulative database that supports synthesis of HIV intervention research. The database includes five topics areas in HIV prevention intervention research including (1) behavioral risk reduction, (2) medication adherence, (3) linkage/retention/re-engagement in HIV care, (4) PrEP, and (5) systematic

reviews. We first searched the CDC PRS cumulative database for relevant interventions studies [12].

Librarians routinely update the cumulative database by using automated searches conducted annually and manual searches conducted quarterly [13]. The automated search component involves searching the following electronic bibliographic databases: CINAHL (EBSCOhost), EMBASE (OVID), Global Health (OVID), MEDLINE (OVID), PsycINFO (OVID), and Sociological Abstracts (ProQuest). The automated searches are developed in MEDLINE (OVID) database using indexing and keyword terms cross-referenced with Boolean operators with no language limits. The finalized search is tailored to the other databases to adhere to each proprietary indexing system. The MEDLINE searches as implemented in the platform are included in the appendix [13]. The manual search consists of regularly reviewing journals to identify articles not yet indexed in the electronic databases. Currently, the journal list totals 27 titles (see appendix) and is modified annually based on which journals yield the most relevant citations for each PRS efficacy review. Quarterly, PRS staff members screen the most recent issues of these journals to locate newly published relevant articles. In addition, staff members also examine the reference lists of published articles, HIV/AIDS Internet listservs, and unpublished manuscripts that have been submitted to PRS by study authors. PRS staff members screen all citations uploaded to the PRS cumulative database. They screened titles and abstracts to identify HIV prevention intervention reports with PrEP behavioral or biological outcomes published in English. For this systematic review, authors reviewed these PrEP intervention studies published in 2000 – 2022, last searched in January 2023.

**Study Selection**—Citations were included if they met the following criteria: 1) evaluated PrEP interventions for persons testing negative for HIV infection, or for healthcare providers who prescribed PrEP in the US; 2) reported relevant PrEP outcome data with appropriate measures (e.g., PrEP medical visits documented in medical or agency records or surveillance reports, self-reports of PrEP use, PrEP drug level assays as proxies for PrEP adherence, provider's PrEP prescribing behavior); 3) included comparisons between groups or pre-post; and 4) published or accepted for publication in peer-reviewed journals between 2000 and 2022. Exclusion criteria included reports that: 1) were non-specific to HIV PrEP (e.g., HIV post-exposure prophylaxis); 2) did not have pre-intervention data for one-group study designs; 3) were not primary research studies (e.g., systematic review, conference abstract, commentary), and 4) were non-US-based.

**Coding Procedures**—Pairs of trained reviewers independently screened each citation to determine eligibility based on the inclusion criteria above. All citations describing the same intervention are considered linked reports and are included in the coding for that intervention study. Reviewers independently evaluated each study using an established set of evaluation criteria on the quality of study design, quality of study implementation and analysis, and the strength of evidence [14]. The EBI and EI (Best Practices) criteria were developed through an extensive review of various methodological sources and multiple internal and external consultations with CDC, the National Institutes of Health (NIH), and non-governmental subject matter experts [15]. The evaluation criteria were developed to reflect the current state

of the research literature on PrEP-related behavioral interventions. More specifically, EBI criteria were developed to evaluate studies comparing two groups in these domains: quality of study design (e.g., appropriate and concurrent comparison arm, random allocation of participants to groups or use of methods that allocate participants to study arms and do not cause substantial concern), quality of study implementation and data analysis (e.g., adequate follow-up assessments, at least 60% retention rate in both arms), and strength of evidence (e.g., significant positive effect on a relevant PrEP outcome). EI criteria were developed to evaluate one-group pre-post designs or two-group studies with fewer study participants (i.e., less than 40 and at least 25 per arm). EBI criteria are more rigorous than EI criteria in terms of assessing the risk of bias related to study participant selection, allocation, and differential attrition. EI criteria required studies to have a significant positive effect on a relevant PrEP outcome and no significant negative effects for any PrEP-related outcome. By applying the evaluation criteria to each eligible intervention study, we determined if an intervention was a Best Practice or not (see CDC PRS PrEP Best Practices Criteria) [14].

If there were discrepancies between two coders, the coders discussed until the discrepancies were reconciled. As needed, authors were contacted for additional information to assist in determining whether interventions met the criteria for being classified as evidence-based or evidence-informed. The response rate of author contact was 67%.

**Data Synthesis**—In this review, a narrative synthesis was used to summarize the included interventions. We also described the study and intervention characteristics of Best Practices which included EBIs and EIs.

## Results

As of January 2023, there were 3,974 PrEP-related citations in the CDC PRS cumulative database (Figure 1). The majority were not behavioral interventions and excluded from our review. After we screened 266 full reports to assess for eligibility and excluded studies that did not report relevant outcomes, 24 eligible intervention studies were identified. Among the 24 studies, the majority of studies (n=14, 58%) were published in or after 2020. Sample sizes ranged from 10 to 29,262 with a median of 121 (interquartile: 54–316). Most (n=18, 75%) were conducted with sexually active MSM as defined by the authors [16–33] (Table 1). The majority of studies were RCTs (n=14, 58.3%) [16–18,20–22,24,26–28,30–32,34] while others were either pre-post studies (n=8, 33.3%) [19,23,29,33,35–38] or serial cross-sectional (n=2, 8%) [21,39].

Most common PrEP-related outcomes reported were PrEP medication adherence (n=12, 50%) [17,19,20,22,23,26–29,33,35,38]. Eight (33%) studies [19,22,26,28,29,32,33,40] used digital health technologies.

Of the 24 intervention studies, nine (37%) were determined to be Best Practices (4 EBIs [26,28,31,32] and 5 EIs [27,29,30,33,39]) (Table 2). The remaining studies (n = 15, 63%) did not meet Best Practices criteria (see appendix) because of either null/non-significant findings (n=14, 93%) [16–24,34–38] or small sample size (i.e., <25 per arm) (n=1, 7%) [41].

## PrEP Best Practices (9 interventions)

As seen in Table 1, almost all Best Practices (n=8, 89%) focused on MSM. The sample sizes ranged from 50 to 1,220 with a median of 86 (interquartile: 52–298). The most commonly reported PrEP outcomes were PrEP adherence (n=5, 56%), followed by PrEP initiation/uptake (n=2, 22%), linkage to PrEP care (n=1, 11%), PrEP use (n=1, 11%), and retention in PrEP care (n=1, 11%). Six of the nine studies (67%) were RCTs [26–28,30–32]. The other three studies were one-group pre-/post [29,33] or serial cross-sectional studies [39]. Among the nine Best Practices, the EBIs had longer intervention periods (i.e., twice with a week apart between sessions [31], 3 months [32], 9 months [28] and 12 months [26]) compared with the four EIs (i.e., once [30,39], 6 weeks [33], 3 months [27,29]).

### Characteristics of Best Practices: Evidence-Based Interventions (EBIs) (n=4)

—As seen in Table 2, three of the four EBIs utilized digital health. Individualized Texting for Adherence Building (iTAB) is an individual-level mobile Health (mHealth) intervention that uses two-way, automated daily personalized health promotion and text messages that improved PrEP adherence among MSM and transgender persons [26]. PrEPmate, another mHealth intervention, improved retention in PrEP care and PrEP medication adherence among young MSM [28] with short-message service (SMS) and youth-tailored interactive online content [28]. The third mHealth intervention, Mobile Messaging for Men (M-Cubed), increased PrEP use and HIV testing among MSM via a mobile app which included a PrEP eligibility screener, ordering platform for delivery of at-home HIV/STI screening kits, and service locators for HIV/STI testing and PrEP care [32]. One non-mHealth EBI, PrEPare-to-Start, was a brief (2 weekly) behavioral intervention by sexual health clinic counselors at the time of HIV or other sexually transmitted infections testing using motivational interviewing techniques to improve linkage to PrEP care among MSM [31].

These EBIs varied in how they measured outcomes. iTAB and PrEPmate measured PrEP adherence with tenofovir diphosphate (TFV-DP) concentrations [26,28]. M-Cubed [32] measured PrEP use with self-report; PrEPmate measured retention in PrEP medical care using completed PrEP study visits [28]; and PrEPare-to-Start measured linkage to PrEP care by chart review [31].

### Characteristics of Best Practices: Evidence-Informed Interventions (EIs)(n=5)

—Table 2 shows five EIs that utilized various intervention strategies including digital health, counseling, and peer navigation services. More specifically, Life Steps for PrEP is a nurse-delivered, cognitive-behavioral intervention and improved PrEP persistence [27]. iText is a preliminary study of PrEPmate, an individual level mHealth intervention designed to improve PrEP adherence [29]. The PrEP Counseling Center is a tailored individual counseling intervention by healthcare providers or counselors for young, Black MSM and increased PrEP initiation/uptake [30]. Integrated Pharmacy and PrEP Navigation Services is a structural intervention that integrates routine medical care with a peer navigator providing insurance navigation and an on-site pharmacy [39]. The DOT Mobile App combined personalized PrEP pill reminders and daily educational or motivational texts and improved PrEP adherence among MSM [33].

EIs measured outcomes in multiple ways. PrEP adherence was measured by either using an electronic pill storage device [27] or clinic-based pill counts and self-reports [29]. The two remaining studies measured PrEP initiation/uptake by either self-report [30,33] or medication pick-up records [39].

## Discussion

Given the importance of increasing PrEP prescription and use for EHE efforts, it is encouraging to have identified nine PrEP Best Practices in the United States to date. The nine Best Practices represent 37% of eligible PrEP interventions reviewed (i.e., 9 out of 24). More than half of Best Practices are mHealth interventions and conducted with MSM. No Best Practices were found for women, Hispanic/Latino persons, and persons who inject drugs (PWID). HIV continues to have a disproportionate impact on these populations and the PrEP coverage remains uneven [6,7]. These gaps call for additional research.

We offer observations from this systematic review and supplement our discussion by highlighting upcoming studies we obtained from the NIH Research Portfolio Online Reporting Tools (RePORTER) and what we have seen in Best Practices for other HIV outcomes (e.g., risk reduction, linkage to and retention in HIV care). First, three of four EBIs (i.e., iTAB, PrEPmate, M-Cubed) and two of five EIs (i.e., iTEXT, DOT Mobile App) use mHealth strategies. This finding aligns with the recently released recommendation by the Community Guide that digital PrEP interventions are effective for PrEP outcomes [42]. Our review findings also suggest that a longer intervention duration and bi-directional messaging may be important for improving PrEP outcomes such as adherence. Longer intervention periods may provide more time for intervention exposure to facilitate behavioral change and two-way messaging may help participants feel supported. An upcoming study, the PrEP-3D intervention, is a pharmacist-led PrEP program that uses mobile apps and bi-directional messages to improve PrEP use among MSM [43], which may contribute further knowledge about the effectiveness of pharmacist-led PrEP programs and bi-directional messaging.

Second, Black persons, especially MSM, are disproportionately affected by HIV. Increasing PrEP access and use in these communities with unmet needs is essential, but the results for culturally tailored interventions to improve PrEP initiation/uptake for Black persons are mixed. One Best Practice is the PrEP Counseling Center which was conducted with young Black MSM (i.e., the ages of 16–25 years old) and consisted of a personalized comprehensive PrEP counseling session with a staff member who identified as a Black MSM and had extensive outreach and counseling experience related to HIV prevention and PrEP needs [30]. Two other culturally tailored interventions evaluated in this review (EnPrEP and Passport to Wellness) [17,18] did not show evidence of improving PrEP initiation/uptake among Black persons. They implemented culturally-informed, peer-based and client-centered peer support or support groups led by a peer navigator [17,18]. EnPrEP and Passport to Wellness included older populations while the PrEP Counseling Center focused on young Black MSM. One upcoming study by Arnold and colleagues is implementing Acceptance and Commitment Therapy PrEP (ACTPrEP), a culturally-tailored intervention for young Black MSM [40]. The intervention is based on the modified



social ecological model of HIV infection risk that acknowledges multilevel domains such as individual (e.g., perception of HIV risk), social and sexual networks (e.g., stigma), community (e.g., lack of medical services), and public policy (e.g., cost of care). A PrEP navigator will be addressing barriers by promoting awareness and engagement in behaviors to improve PrEP uptake, persistence, and adherence. More culturally tailored interventions to address barriers to PrEP uptake and use are warranted to better understand what strategies work for different populations.

Third, the majority of Best Practices are for MSM although the current U.S. Public Health Services PrEP clinical practice guideline recommends to inform all sexually active adults and adolescents about PrEP and prescribe PrEP to people who request it, even if they do not report sexual or drug-injection practices that may put them at risk of acquiring HIV [44]. Populations that warrant attention are Hispanic/Latino persons, PWID, and women of color, especially Black women. An upcoming study in NIH's RePORTER focuses on young Hispanic/Latino MSM and aims at improving PrEP use by reducing intersectional stigma for HIV testing and PrEP uptake [45]. For PWID, we identified one study but the study was not included in this review due to lack of pre-intervention data [46]. The study found feasibility and high acceptability of the bio-behavioral community-friendly health recovery program integrated in HIV prevention intervention to improve PrEP adherence. A more rigorous evaluation with comparison or pre-post data is encouraged.

Fourth, we identified only one Best Practice from peer-based interventions. Three studies (i.e., EnPrEP, Passport to Wellness, PrEP Peer Leaders) [17,18,24] that used peer-based support did not meet the PRS Best Practice criteria due to non-significant intervention effects. Among the three studies, EnPrEP was conducted in person to improve PrEP initiation and use while Passport to Wellness and PrEP Peer Leaders were done remotely to increase adherence. However, the CDC's PRS project has identified 31 peer-based Best Practices to improve various HIV-related outcomes such as increasing consistent condom use [47,48], increasing HIV testing [49], and improving HIV care outcomes [50–55]. HIV peer navigation services is one of the public health practices for the EHE's Treat Pillar (<https://www.cdc.gov/hiv/effective-interventions/treat/index.html>). The null results of peer-based PrEP interventions call for more research. One upcoming study is evaluating the effectiveness of mobile peer support interventions to reduce sexually transmitted infections among Black MSM PrEP users [56]. Another upcoming peer-based support intervention is intended to improve PrEP adherence and retention in PrEP care among youth MSM ages 18–29 years [57]. The findings from these upcoming studies will provide additional evidence of peer-based interventions for improving PrEP outcomes.

Fifth, almost all of the nine Best Practices utilized community engagement in the various stage of the intervention: seven reported community engagement in the development of interventions [26–29,31,32,39]; eight engaged communities when designing/developing the intervention content and how best to deliver the intervention [26–29,31–33,39]; and three implemented community engagement in the implementation of the intervention and included important community representatives [30,32,39]. EBIs involved the community by conducting focus groups of PrEP candidates to revise text messages [26], implementing preliminary qualitative research prior to the start of the actual study to get feedback from

participants [31], or utilizing input from community members to tailor an existing HIV prevention app for the PrEP intervention [32]. Engaging the community when developing, designing, and implementing PrEP interventions may be key for effectiveness.

This review has several limitations. First, we only include published studies or those that have been accepted for publication in peer-reviewed journals. We may be missing non-published interventions. Second, PRS criteria for identifying Best Practices primarily focus on internal validity. Evidence related to external validity, clinical significance, implementation, cost, and population-level impact warrant further examination. Third, one of the Best Practices criteria requires having statistically significant findings. Some studies may have failed this criterion due to a lack of power from having a small sample size. Fourth, due to different intervention strategies and participant characteristics, comparing interventions can be challenging. However, this limitation might be mitigated as more studies become available for synthesis.

Despite the limitations, strengths of this review include using well-established systematic review procedures and evaluation criteria to identify Best Practices for PrEP use and adherence. This review also found research gaps for several populations disproportionately affected by HIV, including Black persons, Hispanic/Latino persons, PWID, and women of color. More research is also needed to explore how to effectively implement mHealth in various settings and gather evidence on peer support, and how to implement the Best Practices for PrEP in real world settings and evaluate their effectiveness. All Best Practices mentioned in this review are listed in the PRS Compendium [8]. Health care and prevention programs providers can use the Best Practices identified in serving their communities to help reach national goals for preventing HIV.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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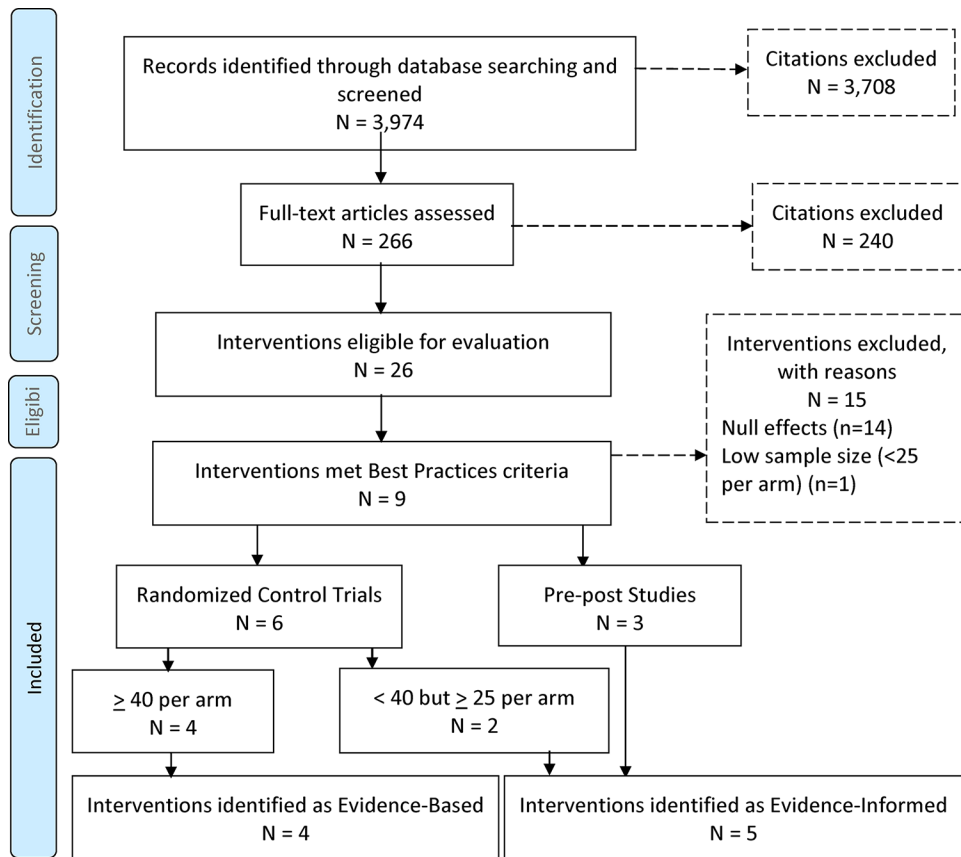
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**Figure 1:**  
Flow diagram of evidence-based and evidence-informed interventions

**Table 1:**

Characteristics of Included Studies and PRS Best Practices (N=24)

Characteristic	TOTAL (N=24) n (Column %)	Best Practices (n=9)	
		n (Column %)	(Row %)
Target population (not mutually exclusive)			
MSM	<b>18</b> (75.0)	8 (88.9)	(44.4)
Women	<b>1</b> (4.2)	0 -	-
Transgender women	<b>2</b> (8.3)	1 (11.1)	(50.0)
Black persons	<b>6</b> (25.0)	1 (11.1)	(16.7)
Youth	<b>6</b> (25.0)	2 (22.2)	(33.3)
Care Provider	<b>1</b> (4.2)	0 -	-
Hispanic/Latino persons	<b>1</b> (4.2)	0 -	-
PWID	<b>1</b> (4.2)	0 -	-
Study Design			
Randomized controlled trial	<b>14</b> (58.3)	6 (66.7)	(42.9)
One-group pre-post	<b>8</b> (33.3)	2 (22.2)	(25.0)
Serial cross-sectional	<b>2</b> (8.3)	1 (11.1)	(50.0)
Outcomes measured (not mutually exclusive) <sup>1</sup>			
Screening for PrEP eligibility and referring to PrEP services	<b>2</b> (8.3)	0 -	-
Linkage to PrEP care	<b>1</b> (4.2)	1 (11.1)	(100.0)



Characteristic	TOTAL (N=24) n (Column %)	Best Practices (n=9)	
		n (Column %)	(Row %)
PrEP initiation/uptake	7 (29.2)	2 (22.2)	(28.6)
PrEP use	6 (25.0)	1 (11.1)	(16.7)
PrEP medical adherence	12 (50.0)	5 (55.6)	(41.7)
Retention in PrEP care	1 (4.2)	1 (11.1)	(100.0)
HIV incidence	2 (8.3)	0 -	-
PrEP prescribing behavior	1 (4.2)	0 -	-
Sample size			
Median ( $X_L - X_U$ )	121 (54 – 316)	86 (52 – 298)	
Frequency of Sessions (not mutually exclusive)			
Once	7 (29.2)	2 (22.2)	(28.6)
Daily	4 (16.7)	3 (33.3)	(75.0)
Weekly	4 (16.7)	2 (22.2)	(50.0)
Monthly	2 (8.3)	1 (11.1)	(50.0)
Others <sup>2</sup>	8 (33.3)	2 (22.2)	(25.0)
Intervention Duration (in weeks) for Multiple-Session Intervention			
Ongoing	4 (16.7)	0 -	-
Median ( $X_L - X_U$ )	18 (12 – 30)	12 (12 – 36)	
Intervention Strategy			
Digital health technology	8 (33.3)	5 (55.6)	(62.5)

Characteristic	TOTAL (N=24) n (Column %)	Best Practices (n=9)	
		n (Column %)	(Row %)
Counseling	4 (16.7)	2 (22.2)	(50.0)
Peer navigator/support	4 (16.7)	1 (11.1)	(25.0)
Education and Information	2 (8.3)	0 -	-
Motivational interviewing	2 (8.3)	1 (11.1)	(50.0)
Rapid screening and referral	1 (4.2)	0 -	-
Increasing PrEP care capacity	1 (4.2)	0 -	-
Objective risk scores	1 (4.2)	0 -	-
Alternative dosing	1 (4.2)	0 -	-

<sup>1</sup>Screening for PrEP eligibility and referring to PrEP services: assessed HIV risk behavior to identify a participant as an eligible PrEP candidate and referred those who were eligible to PrEP services (e.g., scheduled the first PrEP services appointment); Linkage to PrEP care: participant completed healthcare visit that includes being prescribed PrEP; PrEP initiation/uptake: initiation of PrEP among PrEP-naïve participants or those who were not PrEP users as defined by study authors via self-report or medical or pharmacy records (e.g., filled a prescription for PrEP, started taking PrEP); PrEP use: on PrEP (including lifetime, current use) based on self-report or medical or pharmacy records; PrEP medical adherence: taking PrEP on a regularly agreed to schedule (e.g., daily dose, on demand) measured by electronic data monitoring (e.g., Medication Event Monitoring System [MEMS] caps), pill count, pharmacy refill, self-reported adherence, or medical record; Retention in PrEP care: completed PrEP medical visit(s) over a period of time (e.g., attended one visit every 3 months for at least 6 months) that is self-reported or documented in medical records; HIV incidence: HIV infections that are self-reported or documented in medical records; PrEP prescribing behavior: self-reported by provider or documented in medical or pharmacy records

<sup>2</sup>Others are as much as they like, as needed, every other day, twice.

MSM: gay, bisexual and other men who have sex with men; PWID: Persons who inject drugs; XL: Lower quartile; XU: Upper quartile

**Table 2.**

Characteristics of Evidence-Based and Evidence-Informed Interventions (N=9)

Author (Year)	Intervention Name	PrEP outcome (Measurement)	Target Population	N Study Design	Key Delivery Methods	Frequency of Sessions; Intervention Duration (Follow-up Visits) in Weeks
Evidence-Based Intervention (n=4)						
Moore (2017)	iTAB	Adherence (TFV-DP and FTC)	MSM & TGW	398 (IV:200, CO:198) RCT	Two-way automated text messages	Daily; 48 (48)
Liu (2019)	PrEPnate	Retention in care (study visit completed) Adherence (TFV-DP)	Young MSM	121 (IV:81, CO:40) RCT	- Two-way automated text messages - Interactive online contents	Daily; 36 (4, 12, 24, 36)
Sullivan (2022)	Mobile Messaging for Men (M-Cubed)	Use (self-report)	MSM	1,220 (IV:608, CO:612) RCT	Mobile phone application with ordering platform for delivery of at-home HIV/STI testing kits and service locators for HIV/STI testing and PrEP care	Every other day; 12 (12)
Chan (2021)	PrEPare-to-Start	Linkage to care (chart review)	MSM	86 (IV:43, CO:43) RCT	Motivational interviewing at STI clinic	Twice (a week apart between session); N/A (4, 12, 24)
Evidence-Informed Intervention (n=5)						
Mayer (2017)	LifeSteps for PrEP	Adherence (TFV and electronic pill storage device)	MSM	50 (IV:25, CO:25) RCT	Nurse-delivered counseling	Weekly @ 1 <sup>st</sup> month, Monthly @ 2&3 <sup>rd</sup> months; 12 (12, 24)
Fuchs (2018)	iText	Adherence (clinic-based pill counts and self-report)	MSM who are current PrEP users	56 One-group pre/post	Two-way automated text messages	Weekly; 12 (12)
Destrosiers (2019)	PrEP Counseling Center	Initiation/Uptake (self-reported taking PrEP within the last 3 months at the 3-months follow-up visit)	Young (age 16–25) black MSM	50 (IV:25, CO: 25) RCT	Culturally tailored counseling	Once; N/A (36)
Coleman (2020)	Integrated Pharmacy and PrEP Navigation Services	Initiation/Uptake (PrEP medication pick up)	New PrEP patients	198 (Pre: 118, Post: 80) serial cross sectional	Integrated routine medical care with a PrEP peer navigator	Once; N/A (ongoing)
Weitzman (2021)	DOT Mobile App	Adherence (self-report)	Culturally diverse young (age 20–29) MSM	54 One-group pre/post	Mobile phone application of pill reminder and daily educational or motivational texts	Daily; 6 (6)

CO: Control group; EBI: Evidence-based intervention; EI: Evidence-informed intervention; FTC: Emtricitabine (FTC > 350 ng/ml: dosing within the past 24 hours); iTAB: Individualized Texting for Adherence Building; IV: Intervention group; MSM: gay, bisexual and other men who have sex with men; N/A: not applicable; Pre: Pre-intervention; Post: Post-intervention; RCT: Pre: Pre-intervention; Post: Post-intervention; Randomized-controlled group; TFV: tenofovir (TFV 52 ng/ml: daily use); TFV-DP: tenofovir diphosphate (TFV-DV > 1246 fmol/punch: 7 doses in the past week; >700 fmol/punch: 4 or more doses in the past week); TGW: Transgender women