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## A Systematic Review of Implementation Research on Determinants and Strategies of Effective HIV Interventions for Men Who Have Sex with Men in the United States

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### Abstract

Men who have sex with men (MSM) are disproportionately affected by HIV, accounting for two-thirds of HIV cases in the United States despite representing ~5% of the adult population. Delivery and use of existing and highly effective HIV prevention and treatment strategies remain suboptimal among MSM. To summarize the state of the science, we systematically review implementation determinants and strategies of HIV-related health interventions using implementation science frameworks. Research on implementation barriers has focused predominantly on characteristics of individual recipients (e.g., ethnicity, age, drug use) and less so on deliverers (e.g., nurses, physicians), with little focus on system-level factors. Similarly, most strategies target recipients to influence their uptake and adherence, rather than improving and supporting implementation systems. HIV implementation research is burgeoning; future research is needed to broaden the examination of barriers at the provider and system levels, as well as expand knowledge on how to match strategies to barriers—particularly to address stigma. Collaboration and coordination among federal, state, and local public health agencies;

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#### AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the conception of the review and the acquisition, analysis, and interpretation of data. All authors drafted and critically revised the review for important intellectual content, approved the final version, and agreed to be accountable for all aspects of the review in ensuring that questions related to the accuracy or integrity of any part of the article are appropriately investigated and resolved. A.Q., B.M., D.L., and N.B. wrote the Introduction; A.Q., a.z., and J.L.M. wrote the Methods section; A.Q., a.z., J.L.M., and J.P.Z. wrote the Results section; and all authors contributed to the writing of the Discussion section.

#### DISCLOSURE STATEMENT

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community-based organizations; health care providers; and scientists are important for successful implementation of HIV-related health innovations.

### Keywords

implementation science; men who have sex with men; HIV; preexposure prophylaxis; HIV testing; linkage-to-care

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## INTRODUCTION

Over the past 40 years, treatment innovations have produced striking declines in deaths due to HIV/AIDS in the United States. However, dramatic disparities in infections and challenges in implementing effective prevention persist (Figure 1). New diagnoses of HIV rose exponentially in the early 1980s; major declines into the early 1990s were produced by community-led efforts at behavioral risk reduction (e.g., condom use, fewer partners) (Darrow 2021). The advent of antiretroviral therapy (ART) led to substantial declines in deaths but also created new Black–White racial disparities due to unequal access. The past decade has been characterized by the ascent of new biomedical interventions, such as pre-exposure prophylaxis (PrEP) to reduce infection and viral suppression by HIV treatment with ART to eliminate onward transmission (i.e., undetectable equals untransmittable). Despite these innovations, the rate of new cases has declined only modestly, particularly among men who have sex with men (MSM), and improvements in treatment have not produced dramatic shifts in mortality of the kind observed upon ART’s initial introduction. Put simply: Pills have gotten better and better, but cases among MSM have not fallen correspondingly. The challenge is implementation—the delivery and integration of these interventions into practice—and it is time for science to shift toward improving delivery of effective interventions to who, when, and where they are needed.

Launched in 2019, the US Ending the HIV Epidemic initiative (EHE) set an ambitious goal to effectively end HIV transmission in the United States by 2030 through better implementation of effective tools already in hand: highly sensitive tests to diagnose HIV infection, interventions to prevent and treat infection, and cutting-edge technologies to identify outbreaks (Fauci et al. 2019). To achieve this goal, EHE specifically calls for implementation research to (a) identify how to best use new and existing HIV prevention tools; (b) adapt evidence-based interventions to local environments to maximize uptake, sustainability, and reach to priority populations; and (c) rapidly and effectively translate new discoveries into practice at the local level with fidelity. To summarize current implementation knowledge and highlight areas needing further research, we systematically review the implementation determinants and strategies for select HIV prevention interventions among MSM.

## IMPLEMENTATION SCIENCE

Implementation science is the “scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services” (Eccles & Mittman 2006).

Implementation science has its roots in multiple disciplines, having risen in parallel out of social sciences, industry, and medicine since the mid-twentieth century before coalescing into a formal science of its own (Brownson et al. 2017). Psychologists and other behavioral scientists have significantly shaped and remain at the forefront of the field (Baumann et al. 2022, Nilsen 2015). For example, many of the leaders in the field, including editors of the leading journals *Implementation Science* and *Implementation Research and Practice*, were trained as psychologists (Baumann et al. 2022).

*Implementation determinants*, also referred to as barriers and facilitators, explain why implementation of an innovation (or intervention) may succeed or fail in a specific context. Determinants exist at multiple levels, ranging from individual to organizational and societal (Table 1). Given the vast number of possible determinants and the desire for generalizability, researchers have proposed numerous frameworks, of which the Consolidated Framework for Implementation Research (CFIR) has become the most widely cited (Damschroder et al. 2009). The updated CFIR 2.0 (Damschroder et al. 2022a) includes five domains: *outer setting*, *inner setting*, the *innovation* (or intervention), the *implementation process*, and *characteristics of individuals*, with multiple constructs and subconstructs within each domain (Table 1). These domains are applied to those who deliver or make decisions around delivery and sustainment of the intervention. However, both deliverers and recipients (e.g., patients or participants) are highlighted in the *characteristics of individuals* domain, which includes constructs based on the *capability, opportunity, and motivation* framework for understanding and supporting behavior change (COM-B; Michie et al. 2011). Because of its comprehensiveness and prominence in the field, we use CFIR as our guiding determinant framework for this review.

In implementation science, understanding contextual determinants is a precursor to selecting relevant implementation strategies, which are not included in CFIR. Implementation strategies are techniques to enhance adoption, implementation, and sustainability of a clinical program or practice. Whereas determinants are characteristics of a situation or context, strategies act upon individuals and entities in the delivery system to facilitate and support innovation implementation. Strategies can vary widely in terms of size and complexity and are frequently used in multifaceted bundles to target multiple determinants simultaneously (e.g., supporting clinicians while also providing education to patients) or in sequence over time (e.g., training clinicians before implementation and then providing feedback after implementation has begun) (Powell et al. 2012, 2015; Waltz et al. 2015). The most widely used taxonomy, Expert Recommendations for Implementing Change (ERIC), identified nine broad groups: *engage consumers, use evaluative and iterative strategies, change infrastructure, adapt and tailor to context, develop stakeholder interrelationships, utilize financial strategies, support clinicians, provide interactive assistance, and train and educate stakeholders* (Powell et al. 2015). For this review, we use ERIC to classify implementation strategies because of its ubiquity in the field, and we combine it with the Proctor et al. (2013) specification framework to specify the strategies toward replication.

While strategies act upon the deliverer or delivery system, adjunctive interventions support uptake, adherence, or continued engagement with the health intervention (J.D. Smith, D.H. Li, B. Keiser, B. Mustanski & N. Benbow, manuscript submitted) and therefore act upon the

recipient (i.e., the patient or participant). Adjunctive interventions are often critical to the success of the overall implementation of an innovative intervention and are often developed by behavioral scientists. The differentiation between strategies, adjunctive interventions, and health interventions is a newer area of implementation science, and we do not include adjunctive interventions in our analysis but do discuss the concept in future directions.

## POPULATIONS OF FOCUS

In the United States, MSM have a new HIV diagnosis rate 17 times greater than that of people who inject drugs and 144 times higher than that of heterosexuals. These disparities are growing (Crepaz et al. 2019) and are driven by biology (e.g., HIV is more transmissible via anal than vaginal sex), denser male–male sexual networks in comparison to male–female sexual networks, and higher numbers of sexual partners among MSM, alongside several implementation barriers (Mayer et al. 2021). We focus on MSM as a key population in the US HIV epidemic. Disparities are layered, with Black and Hispanic/Latino MSM having considerably higher new diagnosis rates than non-Hispanic White MSM. Drivers of Black–White HIV disparities are not caused by group differences in HIV risk behaviors but rather by differences in structural factors such as sexual network density and homophily, differences in health care outcomes, stigma, abuse, and incarceration (Goodreau et al. 2017, Mustanski et al. 2019a, Oster et al. 2011). Given these racial disparities, we approach this review from an intersectional perspective (L.R. Smith et al. 2022, Sullivan et al. 2021).

## EFFECTIVE HIV INTERVENTIONS

Our analysis focuses on three key interventions: HIV PrEP, testing, and linkage-to-care. PrEP is an effective biomedical intervention that can prevent HIV acquisition (Fonner et al. 2016). The US Food and Drug Administration has approved three medications for use as PrEP: two daily oral medications and an injection given every 2 months. While all three forms of PrEP are highly effective, prevention depends strongly on adherence and sustained use during periods of risk exposure (Chou et al. 2019).

Rapid diagnosis is critical to improving the health of people living with HIV and reducing the risk of onward transmission. Testing late after HIV infection continues to fuel the epidemic, as undiagnosed and untreated individuals continue to spread HIV; indeed, 30.2% of HIV transmissions are attributable to individuals who are undiagnosed (Skarbinski et al. 2015). Therefore, the Centers for Disease Control and Prevention (CDC) recommend that MSM should test every 3–6 months. Linkage-to-care refers to accessing medical care after being diagnosed (Cohen et al. 2016). According to CDC data, of those who received an HIV diagnosis in 2019, 81% were linked to care within 1 month (Dep. Health Hum. Serv. 2022).

## METHODS

### Database Retrieval, Screening, and Extraction

The full protocol of our initial systematic review has been described elsewhere (Li et al. 2022, Merle et al. 2023). The protocol is registered with the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42021233089) and

followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All screening and extraction were completed using Covidence software (see <https://www.covidence.org>; for the PRISMA diagram of each study and full details of exclusion, see Figure 2). The search was conducted from November 2020 to January 2022. The extracted sample-level data were used to identify studies that included MSM as a priority population of focus. Included articles were separated into groups focused on determinants and implementation strategies.

### Determinant Coding

All papers identified as measuring *implementation* determinants associated with MSM were uploaded to MAXQDA and qualitatively coded using CFIR 2.0. A companion article to CFIR 2.0 was used to differentiate *implementation* determinants, which “capture setting-level barriers and facilitators that predict and/or explain... implementation outcomes” from deliverers, from *innovation* determinants, which “capture recipient-level characteristics and/or experiences with the innovation that predict and/or explain innovation outcomes” from recipients (Damschroder et al. 2022a). Therefore, under each domain, we coded whether the determinants described the deliverers or the recipients; we recognize that different frameworks are available for recipient-level determinants (Damschroder et al. 2022a,b), but we chose to use CFIR for its broad applicability across studies. Additional codes included determinant valence (barrier or facilitator), data collection method (quantitative, qualitative, mixed/multimethod), and HIV innovation (PrEP, testing, linkage-to-care). After the first round of coding, we processed all results and the conclusions sections from each included paper by using a lexical-type analysis technique in IRaMuTeQ (Ratinaud & Marchand 2012), which maps associations and connections between words across papers, using chi-square tests. The results of these analyses guided the mapping of themes across papers and the iterative construction of a second-round codebook, which was applied to all papers in MAXQDA.

### Implementation Strategy Coding

We included studies that evaluated one or more implementation strategies. Overall, we assessed strategies in multiple ways. These included the components used within each strategy to effect change, the outcomes assessed, the study design, the extent of specification for future replicability, whether an underlying theory was used in the strategy development, and whether equity was considered. The following categories guided the coding: (a) strategy structure, which delineates the discrete strategies within multicomponent or bundled strategies used to effect implementation outcomes; (b) the ERIC taxonomy domain and code associated with each discrete strategy (Powell et al. 2015); (c) the measured implementation outcome(s) (Proctor et al. 2011); (d) the study design (Hwang et al. 2020); and (e) the degree of strategy specification provided (which allows for future replication), according to established standards (Proctor et al. 2013).

Additionally, informed by literature on assessing and conceptualizing equity in implementation research (Baumann & Cabassa 2020, Brownson et al. 2021, McNulty et al. 2019), we classified each study as (a) not having a health disparities or equity focus, (b) identifying a health disparity, (c) conducting an implementation trial among a priority

population that experiences disparities, or (d) comparing the effectiveness of a strategy between a priority population and the general population. Our team coded each strategy on a continuum of effectiveness at influencing the intended implementation outcome: positive (significant improvements), mixed (at least one significant improvement and at least one not significant), null (no significant improvements), negative (worsening outcomes compared with the control), and NA (lack of comparison or baseline condition). Finally, we coded the underlying theory used to develop the strategy.

### Coding Procedures

Due to the complexity of coding, each article was coded in Excel by two independent coders, and consensus was reached for each code. If consensus could not be reached, a third reviewer adjudicated.

### Analyses

Analysis of variance (ANOVA) testing was conducted to test the hypothesis that a greater number of strategies used in a study would be associated with higher effectiveness.

## RESULTS

### Determinants

Our analysis included 134 papers, most ( $n = 126$ ) focused on PrEP and the rest ( $n = 8$ ) focused on HIV testing and linkage-to-care. Table 1 presents the distribution of determinants by CFIR 2.0 constructs. Most papers on PrEP reported recipient-focused determinants, particularly in the *characteristics of individuals* domain, followed by *innovation* and *outer setting*. Among determinants of intervention deliverers, the most common domains were *characteristics of individuals*, *outer setting*, and *innovation* (in order). Among the subset of papers on testing/linkage-to-care, recipient-focused determinants were, again, mostly in the *characteristics of individuals* domain, while deliverer determinants were mostly in the *characteristics of individuals* and *inner setting* domains. Process determinants were the least frequently measured, in part due to extensive conceptual overlap with implementation strategies (i.e., training, planning, adapting), described below, so we do not include them in this article. In the following sections, we highlight some of the specific constructs found in each of the five CFIR domains and describe their relationship to deliverers or recipients.

**Characteristics of individuals.**—As described above, the *characteristics of individuals* domain is grounded in COM-B. Constructs including *need*, *capability*, *opportunity*, and *motivation* were evaluated for a range of roles, from high-level leaders to recipients. We found limited information on the types of individuals evaluated and therefore simply reported on two predominant and encompassing groups—deliverers and recipients.

### PrEP deliverers.

Among studies of PrEP, most deliverer determinants were related to *motivation* ( $n = 139$ ) and *capability* ( $n = 98$ ). For instance, clinician (i.e., physician, nurse, medical assistant) beliefs that PrEP was better suited for general primary care settings and feeling uncomfortable prescribing PrEP were a barrier to implementation in other systems.

Determinants associated with deliverers' perceived *opportunities* included training ( $n = 52$ ). For example, clinicians in non-HIV clinics were also less likely to have access to or to have read the CDC's guidelines on PrEP (Doblecki-Lewis & Jones 2016, Shaeer et al. 2014). Additional barriers were measured in *other implementation support* ( $n = 8$ ): perceptions of individuals who support the implementation team to implement the innovation. For instance, some nonclinical personnel did not feel as though discussions of PrEP were suited for them in their current capacity (Hakre et al. 2016). Notably, no determinants assessed the *perceptions of opinion leaders or implementation facilitators*. While papers often delved into recipients' perceptions of providers' motivations and attitudes, there is a noticeable gap in addressing the providers' own perspectives and perceptions within the context of PrEP implementation for MSM.

### Testing/linkage-to-care deliverers.

The most common HIV testing/linkage-to-care construct was individual-level demographics that serve as proxies for larger, structural, or social barriers, coded as *characteristics otherwise not associated with behavior* ( $n = 13$ ). The second- and third-most-reported testing/linkage-to-care constructs were *capability* ( $n = 5$ ) and *motivation* ( $n = 5$ ). Deliverers' perceived *capability* (or self-efficacy) to provide testing and connect someone to care was a facilitator. A lack of knowledge regarding how to provide testing in different clinical settings was a barrier (e.g., delivery in non-HIV-specific clinics, such as pharmacies or dental clinics). Determinants about motivation focused more on deliverers' rationale to support or provide testing in their setting. For example, clinicians at a non-HIV-specific clinic stated that they would be more willing to implement testing in their setting if they had access to outcomes from other testing sites (Parish & Santella 2018).

### Recipients.

Determinants often came from studies that were focused on specific populations, like Black MSM (41%), Latino MSM (21%), MSM who inject drugs (17%), young MSM (8%), and transgender MSM (i.e., men who were assigned female at birth and who have sex with men; 7%). *Capability* relates to recipients' psychological proficiency (or self-efficacy) to know where to access PrEP, how to use PrEP, and what PrEP is (the most common construct in this domain). Across studies, MSM participants identified a lack of confidence in their ability to adhere to oral daily PrEP. Lelutiu-Weinberger & Golub (2016) found that this concern was greater for Black and Latino MSM, but Rolle et al. (2017) found that White men were more likely than Black MSM to cite this lack of confidence as a reason they did not intend to use PrEP. Other factors related to concerns regarding recipients' ability to take PrEP daily, such as remembering to take a pill, having pills available when away from home, and HIV pill stigma, were associated with oral PrEP (John et al. 2018). Another aspect of *capability*, awareness, differed across subpopulations of MSM. White and Northeastern MSM are more aware of PrEP than Black and Southern MSM. Latino MSM, MSM with lower levels of educational attainment, and low-income MSM are less likely to be aware of PrEP than other MSM (Garcia & Harris 2017). Cisgender MSM have greater awareness of PrEP than transgender men.

The next most common construct was *motivation*, including *automatic* (emotions and impulses arising from associative learning and/or innate dispositions) and *reflexive* (evaluations and plans) *motivation*. *Automatic motivation* included apathy, fear of HIV, fear of disease, trust, and ambivalence. For example, Black MSM are less likely to trust doctors when recommended to take PrEP. Fear, worry, and anxiety were particularly prominent as determinants related to *automatic motivation* for both testing and PrEP. For some, a fear of disclosure or learning their own status was a barrier to testing. For others, fear and worry facilitated testing, returning for results, and PrEP uptake as mechanisms to relieve those feelings. This facilitative role of PrEP functioned through a sense of relief and peace of mind among individuals who use drugs, engage in casual sex, and/or engage in condomless sex, as well as individuals in serodiscordant relationships. Many studies found that MSM fear discussing sex with a provider, how much they would have to divulge, or that their results would be disclosed to others if they tested positive for HIV. While these findings held among all MSM, rates of such fears were higher among Black and Latino MSM. Additional *reflexive motivations* that hindered intent to uptake PrEP included low sexual activity, which Rolle et al. (2017) identified as more common among Black MSM. Participants who felt otherwise healthy did not desire to take a pill that they perceived to have a potentially high toxicity.

Multiple determinants were associated with recipients' perceived *physical* and *social opportunities*. For example, availability of testing or PrEP outside of a doctor's office was a facilitator, and access to support or counseling (including text-based) increased PrEP uptake. However, barriers to PrEP and testing included a lack of access to transportation, lower rates of educational attainment, lower income, lack of access to insurance, and not having a primary care provider. Facilitators related to *social opportunity* included access to community, connections, and social support (e.g., LGBTQ groups). MSM were more likely to use and adhere to PrEP if they had supportive parents or partners. Higher rates of *caballerismo*, or Latino MSM's self-perceptions of "chivalry, familial ties, and emotional connectedness," significantly increased PrEP awareness, use, and adherence (Rivera et al. 2021).

As found in other domains, multiple types of stigma in the *opportunity* construct were also key barriers to PrEP and testing. For example, higher rates of anticipated stigma of PrEP were associated with lower uptake. Stigmatizing labels were attached not only to PrEP users but to the pills themselves, with participants referring to PrEP as the "bareback pill," "slut pill," or "recreational pill" (Dubov et al. 2018). Internalized stigma led to some MSM being afraid to acknowledge that they have sex with men. MSM also experienced external stigma from other MSM and providers; deliverers perceived youth who want PrEP as naïve and promiscuous or as fearing that PrEP would increase promiscuity. Stigma decreased testing, PrEP use, and adherence (Dubov et al. 2018), and in one study only half of MSM reported that they were proud to be on PrEP (Siegler et al. 2020).

Least examined were determinants related to the recipients' *need*, that is, whether recipients and/or deliverers believed MSM recipients truly needed PrEP. For example, some MSM felt that PrEP is only for individuals who engage in "very high risk" sex.



Commonly identified *characteristics not otherwise associated with behavior* included race, income, education, age, and relationship status as proxies for larger structural issues of racism and classism. Racial disparities in PrEP awareness, uptake, and adherence were prevalent (Ojile et al. 2017, Terndrup et al. 2019, Tripathi et al. 2012). Some studies reported income as a barrier to retention in PrEP care, PrEP awareness, intent to continue use of PrEP, willingness to use PrEP, and history of testing for HIV, while other studies did not. It is possible that discrepancies between studies that found associations and those that did not are due to differences in how income was defined across studies. In addition, education, age, and relationship status shaped innovation access, uptake, and adherence. Facilitators of PrEP use included being single and being in a serodiscordant relationship. However, being in a relationship was a barrier to testing, as was younger age for MSM. While Maksut et al. (2021) found no association between age and PrEP awareness, Whitfield et al. (2020) found that PrEP use increased with age. Finally, education was a determinant of PrEP use, particularly increased education as a facilitator of PrEP use, though increases in educational attainment led to decreased desire for long-acting injectable PrEP.

**Characteristics of innovation.**—The domain *characteristics of innovation* assesses the qualities of the innovation itself—such as complexity, cost, trialability, and evidence—that may influence its use. Most of the determinants identified in this domain were for PrEP, specifically *cost* ( $n = 82$ ), *complexity* ( $n = 89$ ), *design* ( $n = 17$ ), *other characteristics* ( $n = 186$ ), *relative advantage* ( $n = 52$ ), and *evidence base* ( $n = 60$ ). The *design* of PrEP medications stands out as a facilitator, as do the frequency and adherence of injectable PrEP in particular.

*Cost*-related determinants were often identified as barriers for recipients and deliverers. In particular, price hindered young MSM's capacity to access PrEP, given privacy concerns related to parents' insurance or ineligibility for assistance programs (D'Angelo et al. 2021, Greene et al. 2017). Some deliverers also refrained from offering PrEP due to the *cost* of the drug for recipients. The *evidence base* for PrEP was a relevant determinant for recipients and deliverers alike. Studies found deliverers and recipients to be skeptical of PrEP and highlighted the need for better dissemination of evidence. Innovation recipients were more likely to question injectable PrEP's effectiveness compared with that of oral PrEP. MSM desired PrEP advertisements with greater clarity on the number and frequency of necessary appointments and HIV/STI (sexually transmitted infection) screening, the reality that PrEP does not protect against other STIs, and the possibility of side effects. However, John et al. (2018) found that frequency of appointments and HIV/STI screening was not a major concern for most MSM.

**Outer setting.**—*Outer setting* determinants are sociocultural, political, and environmental factors that affect implementation. No studies identified determinants related to *critical incidents* (e.g., disruption due to a natural disaster or mass shortage of supplies) or *societal pressure* (e.g., mass media campaigns, advocacy groups); however, the studies were conducted prior to the COVID-19 pandemic. Outer setting determinants were most often identified as barriers—for example, how racism impedes equitable uptake of PrEP for Black and Latino MSM. The most frequently measured determinants related to *local attitudes* ( $n$

= 187) and *local conditions* ( $n = 80$ ), followed by *systemic* and *structural oppression* ( $n = 139$ ), *financing* ( $n = 58$ ), *partnerships and connections* among organizations and health care agencies ( $n = 47$ ), *policies and laws* ( $n = 22$ ), and *market pressure* (i.e., to compete with growing supply and demand;  $n = 2$ ).

*Local attitudes* were a facilitator of PrEP in some contexts. However, numerous types of stigmas (anticipated, internal, and experienced) about sexual orientation, HIV, and PrEP itself were counterbalancing barriers. In addition, structural racism, medical mistrust, access, and poverty were barriers to PrEP awareness, willingness, uptake, and adherence. Cahill et al. (2017), for instance, conducted focus groups with MSM and highlighted the roles of medical mistrust and distrust of HIV researchers and government officials as barriers to PrEP uptake among Black MSM, while nearly all Black MSM participants in the study also experienced housing instability. Finally, access played a significant role in PrEP delivery and receipt, with nearly a quarter of MSM having to travel 30 min or more—and 10% having to travel 60 min or more—to access PrEP (Siegler et al. 2018).

**Inner setting.**—Determinants related to the *inner setting*, the specific context where the innovation is implemented, were reported mostly in studies of PrEP and described only deliverers. The most identified constructs were *available resources* ( $n = 64$ ), *structural characteristics* ( $n = 25$ ), *compatibility* ( $n = 22$ ), and *culture* ( $n = 12$ ).

Clinical protocol and effective workflows were important facilitators for PrEP and testing, mainly for deliverers but also in terms of respecting recipients' time. While *culture* was the least identified construct within the inner setting, it included some of the richest data. For instance, Krakower et al. (2012) found that providers adopted a passive approach to PrEP provision, such that they relied on patients' requests for PrEP instead of routinely assessing whether patients would benefit from its use. Other cultural barriers included lack of on-site psychological support and/or sensitivity to patients' emotional needs (Brant et al. 2020).

## Implementation Strategies

Out of 78 articles identified via extraction, 44 were included in the strategy review (23 PrEP, 21 testing/linkage-to-care). Across all articles, the study designs included seven observational studies, 26 within-site designs, 10 between-site designs, and one simulation (Hwang et al. 2020). Regarding the stage of research (Smith et al. 2020a), 19 were pilot trials, 22 tested/trialed implementation strategies, and three were tests to compare strategies (Hwang et al. 2020). Two studies included elements across more than one stage, but none self-identified as hybrid effectiveness–implementation studies (Curran et al. 2022). A total of 37 bundled/blended strategies (i.e., packages of discrete strategies delivered together) were included across studies (18 PrEP, 19 testing/linkage-to-care); within those bundles, 175 discrete strategies were evaluated. On average, each study used 4 discrete strategies (minimum, 1; maximum, 11).

## ERIC taxonomy coding.

We coded 175 discrete strategies to the nine ERIC domains (Powell et al. 2015). Of the 73 possible strategies listed in ERIC, 33 (45%) were used. Common domains were

*engage consumers* ( $n = 95$ ), followed by *train and educate stakeholders* ( $n = 25$ ), *develop stakeholder interrelationships* ( $n = 16$ ), and *change infrastructure* ( $n = 12$ ). Infrequent domains were *use evaluative and integrative strategies* ( $n = 3$ ) and *provide interactive assistance* ( $n = 3$ ). Regarding strategies, the most commonly used were: intervene with patients/consumers to enhance uptake and adherence ( $n = 49$ ), prepare patients/consumers to be active participants ( $n = 26$ ), and involve patients/consumers and families in the implementation effort ( $n = 14$ )—all focused on recipients. The next most common strategies, change service sites ( $n = 10$ ) and conduct ongoing training ( $n = 8$ ), focus on the deliverers. We added a further strategy that was not captured by the ERIC taxonomy: integrating HIV testing within an existing service. We created a new ERIC code (10.1) for this strategy because it fell outside the nine ERIC domains. Supplemental Table 1 provides the domain and the name, number, and definition of each strategy coded in this study.

### Strategy specification.

Proctor et al. (2013) provide strategy specification reporting guidelines that encourage authors to describe the actor, action, action target, temporality, dose, and justification of each strategy for replicability and comparability. For each element, we rated our confidence in the presence of this information on a four-point scale (where 3 indicates completely confident and 0 indicates not present or undeterminable). We used confidence rather than presence/absence given that these elements were rarely explicitly labeled using the Proctor et al. guidelines. Overall, strategies were well specified, though lower overall for the action category and for PrEP studies. Average ratings were 2.13 for actor [mean ( $M$ ) = 1.68 for PrEP;  $M = 2.54$  for testing/linkage-to-care], 2.04 for action ( $M = 1.96$  for PrEP;  $M = 2.13$  for testing/linkage-to-care), 2.41 for temporality ( $M = 2.34$  for PrEP;  $M = 2.48$  for testing/linkage-to-care), and 2.40 for dose ( $M = 2.26$  for PrEP;  $M = 2.54$  for testing/linkage-to-care). Notably, recipients were the action target for 41 (91%) of strategies. In addition, most studies ( $n = 43$ ; 95%) provided a justification for the strategies chosen.

### Theory underlying strategies.

Although most studies justified their strategies, the underlying theory was mentioned in only nine articles (20%). Multiple studies (Landovitz et al. 2017, Liu et al. 2019, Mitchell et al. 2018) described the adoption of the information–motivation–behavioral skills model of health behavior (Fisher & Fisher 2002). Another study (Desrosiers et al. 2019) developed its strategy using the self-determination theory of human motivation (Ng et al. 2012), where conditions supporting an individual's psychological needs foster motivation to engage in a healthy behavior. Social cognitive theory (Bandura 1986) was used to embed the Many Men, Many Voices (3MV) intervention into a PrEP delivery study (Hosek et al. 2013a) along with the strategies used by Alonzo et al. (2016) and Rhodes (2004). Other theories mentioned were the transtheoretical model (Prochaska & DiClemente 1982), social support (Clark et al. 1999), self-regulation theory (Baumeister & Heatherton 1996), developmental learning theory (Schank & Berman 2002), and the Pedagogy of the Oppressed (Freire 1970).

### Health equity.

We also captured whether studies focused on health disparities or health equity. Most commonly, studies ( $n = 15$ ) conducted an implementation trial among a priority population

or a population with an identified health disparity ( $n = 11$ ). Four studies compared the effectiveness of a strategy between a priority population and the general population, and 14 did not focus on health disparities/equity.

### Implementation outcomes.

A total of 102 implementation outcomes were coded. Most outcomes were at the patient level ( $n = 82$ ), with fewer at the provider level ( $n = 20$ ) (Table 2). The most frequently studied outcome was the acceptability, feasibility, or appropriateness of the strategy (19 were patient level and 9 provider level), followed by patient-level PrEP adherence ( $n = 16$ ), patient-level adoption/uptake of HIV testing or linkage-to-care ( $n = 11$ ), and patient-level reach of HIV testing ( $n = 9$ ). The most-studied provider-level outcomes were implementation costs ( $n = 6$ ) and intervention fidelity ( $n = 5$ ). At the provider level, no studies captured knowledge or awareness of PrEP and sustainment/ability. Other notable outcomes beyond our a priori categories included patient-level engagement with the implementation strategy and positivity rates.

### Strategy effectiveness.

Regarding effectiveness, 18 strategies were rated as having a positive effect ( $n = 7$  on PrEP;  $n = 11$  on testing/linkage-to-care), 15 had a mixed effect ( $n = 10$  on PrEP;  $n = 5$  on testing/linkage-to-care), 2 had a negative effect (PrEP), and 1 had a null effect (PrEP) (Table 3). Nine studies were rated NA ( $n = 2$  on PrEP;  $n = 7$  on testing/linkage-to-care) due to a lack of comparison. Table 2 displays the ERIC codes, research stage, and associated outcomes of the strategies rated as having a positive effect ( $n = 17$ ), and Supplemental Table 1 briefly describes the strategies provided by the studies' authors along with our ERIC codes. One-way ANOVA tests found no significant differences between the number of discrete strategies within a blended strategy and the strategy's effectiveness, indicating that, assuming all else equal, including more discrete strategies within a bundled package did not predict a higher effectiveness rating (for details, see Supplemental Table 2).

## DISCUSSION

We conducted this systematic review to better understand existing implementation research on PrEP and HIV testing/linkage-to-care interventions with MSM. Among the determinants we identified, nearly two-thirds described recipient-level characteristics regarding the use of PrEP or HIV testing/linkage-to-care; a smaller proportion were implementation determinants, which capture delivery-level barriers and facilitators that affect implementation. Most determinants focused on *characteristics of individuals* for PrEP and HIV testing/linkage-to-care. For deliverers, *capability* and *motivation* were key barriers; for recipients, stigma, mistrust, fear, intersections with racism and other oppressions, and access were important constructs. However, there are likely important gaps in knowledge here—no studies, for example, reported on administrative leadership or opinion leaders. While addressing *capability*, *motivation*, and *opportunities* is important for behavior change, the overwhelming focus on *characteristics of innovation* deliverers and recipients reveals a dearth of barriers related to other domains. Within the *innovation* domain, the characteristics of PrEP itself stood out as a facilitator, while *costs* and level of *evidence* were a concern for

deliverers and recipients. Within the *outer setting*, stigma again emerged as an important barrier to recipients in terms of local attitudes; however, there were few studies of policies, critical incidents (such as COVID-19), or market pressures, all of which may be more relevant to delivery systems. Finally, the *inner setting* domain focused on deliverer determinants, highlighting the importance of resources, workflows, and culture.

Unsurprisingly, among the discrete implementation strategies identified, more than half were at the recipient level (i.e., directed at MSM), and the majority were measured using recipient-level outcomes (e.g., PrEP acceptability). Only 33 of 73 potential strategies were reported—mostly education of either recipients or stakeholders, with a few focused on changing infrastructure. While most studies used an underlying theory to select their strategy, there may be a gap in addressing the most important barriers, particularly at the delivery level. In terms of effectiveness, most studies with a positive result used a combination of strategies, including patient engagement and stakeholder education; however, these were also the most common strategies overall.

Below we discuss gaps, future directions, and resources to advance HIV implementation science, including areas where the field of psychology can further contribute to implementation science in HIV, as well as integrating implementation into the development and testing of psychology-based interventions (Pyra et al. 2022).

### Literature Gaps and Future Directions

Our review has highlighted that most research was on PrEP, likely reflecting the advent of implementation science for HIV at the same time PrEP was being rolled out. We observed many common determinants across PrEP and HIV testing/linkage-to-care, particularly around *capacity* and *motivation* of providers; *capacity*, *motivation*, and *opportunity* of recipients, with an emphasis on stigma; *evidence* and *cost* of the innovation; and *inner setting* resources. Therefore, these determinants likely apply to emerging innovations carried out in similar settings. Effective system-level implementation strategies and adjunctive interventions to address common determinants can facilitate effective scale-up of new innovations (e.g., long-acting PrEP/ART) and scale-out (Aarons et al. 2017) to nontraditional settings such as pharmacy and syringe service programs or new delivery conceptualizations (e.g., status-neutral, rapid initiation).

Our literature review has identified limited research on young MSM, particularly among adolescents under the age of 18. Adolescent MSM have a high HIV incidence (Balaji et al. 2018, Garofalo et al. 2016, Mustanski et al. 2019b), poor HIV status awareness due to low rates of testing (CDC 2021b, Mustanski et al. 2020), and lower rates of viral suppression (CDC 2022), indicating a need for better services across the HIV prevention and care continuum. Furthermore, implementation determinants (e.g., parental permission and support) and strategies (e.g., school-based) are likely to differ for teens and therefore merit new implementation research.

Only 37 of the 73 ERIC strategies were present in the literature included, again with a focus on recipients over deliverers/systems. Expanding the use of strategies, particularly for deliverers and larger delivery systems, is an area of needed growth. We also note that

the ERIC taxonomy was a product of experts in mental health (Powell et al. 2015); while we believe many of these strategies are relevant to HIV (with some adaptation), there may be value in replicating the taxonomy's development with HIV subject matter experts to create an HIV-specific version of ERIC. In the meantime, the tools described below can help researchers and implementers select and test appropriate strategies based on the determinants identified in their context.

Most of the studies we evaluated were at an early stage on the implementation science continuum, with a focus on understanding determinants. Rigorous research designs to test and compare strategies occur later on the continuum, as do hybrid effectiveness–implementation studies that simultaneously test and evaluate the innovation and the implementation strategies. Many of the strategy studies were piloting or exploratory and had outcomes related to acceptability, appropriateness, and feasibility of the strategy. Some authors do not consider such outcomes to be formal implementation science outcomes but instead conceptualize them as perceptual or antecedent outcomes (Damschroder et al. 2022a, Reilly et al. 2020). More research is needed to include formal, summative implementation outcomes, such as adoption, reach, and sustainment (Smith & Hasan 2020). This aligns with a recent mapping review by Smith et al. (2020a), who found that around half of HIV implementation studies funded by the US National Institutes of Health (NIH) were implementation preparation studies, defined as studies conducted in preparation for a formal prospective evaluation or test of implementation strategies. Getting to testing of strategies is critical, and better methods of selecting strategies for context are needed to make it happen. This could be a fruitful area for psychologists advancing newer study designs to test strategies on the basis of appropriate theories (Curran et al. 2022, Hwang et al. 2020).

### Adjunctive Interventions

A significant proportion of articles studied adjunctive interventions to support clients so that they can benefit from intervention effects. For instance, many of the implementation strategies coded using the *engage consumers* domain of ERIC may be better conceptualized as adjunctive interventions (Smith et al. 2023). Adjunctive interventions act upon the recipient to influence innovation-level outcomes (uptake, adherence). For example, they often aim to increase patients' adherence to daily oral PrEP and their ability to accurately complete an at-home HIV rapid test. This distinction is important for two reasons. First, implementation strategies need to be identified to support delivery of the adjunctive intervention. Second, implementation of the adjunctive intervention alone will not affect the endpoint health outcome without main innovation (PrEP or testing/linkage-to-care).

Of the 44 articles involving MSM, 17 exclusively examined adjunctive interventions, 20 studied a mix of strategies and adjunctive interventions, and only 7 focused on strategies that solely targeted the delivery system. More accurately defining and studying adjunctive interventions—rather than the currently inconsistent conceptualization of them as implementation strategies or health interventions—would advance our understanding of unique challenges to implementation and the strategies required. Psychologists have played a substantial role in the development of many evidence-based adjunctive interventions and can help lead the development of the next generation (e.g., mHealth).

## TOOLS AND RESOURCES

### Tailoring Strategies to Determinants

Researchers and practitioners newer to implementation science are often comfortable assessing barriers and facilitators but struggle with selecting or developing appropriate strategies associated with those determinants. As we continue to synthesize literature around determinants and strategies, it is critical that we also build knowledge of which strategies effectively address which barriers to achieve which outcomes and then translate that knowledge for others to use. Experts in the broader implementation science field have attempted to match determinants to specific strategies through consensus (Waltz et al. 2019) but have found little consistency in recommendations linking the 39 barriers from CFIR 1.0 to the 47 ERIC strategies. This is an important area for psychologists to explore and develop additional theories and methods to improve matching of strategies to barriers. By narrowing the focus to HIV contexts, we may identify more homogeneity in published evidence. To this end, we are developing a tool that can recommend HIV implementation strategies given known contextual factors or identify determinants targeted by a given strategy type. We are also developing a tool to facilitate specification of the relationships among determinants, strategies, and outcomes using the implementation research logic model (Smith et al. 2020b).

### High-Quality and Comparable Measurement and Reporting Across Studies

The development of high-quality generalizable knowledge through research synthesis is contingent on the comparability of findings across studies. As observed in this review, standardization of determinant measurement, specification of strategies, and assessment of outcomes would greatly facilitate the development of the evidence base—a noted problem in implementation science (Martinez et al. 2014, Rabin et al. 2012). To that end, researchers have created a crosswalk of HIV implementation science outcomes that guides researchers in operationalizing outcomes for their respective projects and also serves as a data collection tool for harmonization across the 200-plus EHE projects funded by NIH (Mustanski et al. 2022, Queiroz et al. 2022). Relatedly, we found a need for better justification of the strategies selected and tested—that is, better use of theory and, although sometimes scant, empirical evidence. Adherence to reporting and specification standards could be enhanced with new methods for data collection on strategy use and modifications over time, developed by J.D. Smith et al. (2022) and others (Rabin et al. 2018).

These issues are critical for the synthesis of findings and replication of implementation research that would lead to generalizable findings. Without such efforts toward generalizability and improved rigor, the potential of this field to more efficiently and effectively translate effective innovations into practice could be unrealized.

### Sharing Data

Implementation researchers need to efficiently identify evidence on determinants and strategies germane to their context. A novel example is the use of interactive visualization dashboards, such as the HIV Implementation Review Dashboard (see <https://hivimpsi.northwestern.edu/dashboard>), which allows users to examine more than 1,900

determinants of PrEP implementation from 239 peer-reviewed articles from a systematic review (Li et al. 2022), coded by CFIR, population, region, and so forth. This tool was created to allow researchers to quickly take stock of evidence and complete their own analysis of subsets of the literature [e.g., the in-depth analysis of determinants of uptake and adherence to PrEP in transgender communities by Zamantakis et al. (2022)]. Implementers can also quickly find evidence for determinants (and, soon, strategies) for their population and context. A similar dashboard has been created for international HIV implementation science (see <https://idig.science/LIVE>).

## Equity Considerations

Health equity is a central focus of EHE and a growing area of emphasis in implementation science (Brownson et al. 2021, Schlechter et al. 2021), so we sought to code for it in our review. There are several ways to conceptualize implementation research addressing health inequities. We took the broad perspective of the overall study including or focusing exclusively on populations with known health disparities (McNulty et al. 2019). As this area of implementation science matures, we hope to be able to understand more-nuanced aspects of health equity, such as implementation strategies selected and used specifically to address barriers that caused the disparities in the first place. For instance, we hope to start seeing studies of equitable implementation, meaning the use of strategies that address underlying structural causes of the disparities, such as the disinvestment in communities of color that has resulted in scarce and underresourced health care systems (Smith et al. 2021).

Numerous studies identified determinants driving HIV-related inequalities; likewise, many strategy studies focused on priority populations or identifying additional health disparities. However, only a handful of studies examined or targeted implementation determinants related to structural racism or heterosexism, which are known drivers of HIV risk among young Black and Latino MSM (Babel et al. 2021, Mustanski et al. 2019a). There is a need for strategies and adjunctive interventions to address stigma (especially intersectional stigma) that are developed to address the deliverer, recipient, and system/community levels, another area where psychologists can help advance the field (Taggart et al. 2022). Furthermore, it is unclear whether the most effective strategies are being used to address inequity-driving determinants, given that few studies examined determinants among health leaders or used structural interventions, or whether all strategies have been identified to address the many determinants found in our review. Most studies focused on implementation determinants and strategies in settings where HIV testing and PrEP are traditionally offered, but the large percentage of people undiagnosed with HIV and the low percentage of people on PrEP among racial/ethnic minorities and young MSM call for studies of implementation in nontraditional settings that could maximize reach to those subpopulations that are less likely to access traditional health care services.

## Limitations

Our review of determinants and strategies was grounded in CFIR 2.0 and ERIC, respectively. While they are commonly used in the field, some factors we know to be salient to HIV intervention delivery and uptake (e.g., structural oppression, adjunctive interventions) are not captured. Our study focused on MSM, and a previous scoping review conducted by our



team (Zamantakis et al. 2022) highlighted the recurring difficulty of disaggregating results in studies lumping cisgender MSM and transgender women/transfeminine individuals. Transgender women more often experience determinants shaped by how contextual factors, institutions, and individuals interact with their gender and racial identities. As such, we discourage the lumping together of cisgender MSM and transgender women in future HIV implementation science and encourage greater attention to strategies for effective implementation of HIV services for transgender women.

## CONCLUSION

Ending the HIV epidemic in the United States will require implementation strategies tailored to priority populations, such as subgroups of MSM (i.e., youth, those living in the South), as generalized approaches will be insufficient to address their specific barriers. The increased federal HIV funding tied to EHE is essential to support prevention, testing, and treatment programs as well as research into new innovations and implementation strategies. Access to these programs needs to be expanded, and programs should work to reduce structural barriers such as cost and transportation issues. Many forms of stigma came up in our review as essential barriers—addressing intersectional stigma is an active area of HIV research (Dale et al. 2022), and we look forward to seeing strategies for implementing the resulting interventions.

While most research to date has focused on recipients, understanding barriers at the deliverer and delivery system levels, as well as testing the appropriate strategies targeting deliverers, is another important and growing area. Concerning outcomes, as the field matures and strategies are formally tested and trialed, we hope to see more summative implementation outcomes, such as reach, adoption, and sustainment of interventions for MSM, as opposed to the preponderance of studies on acceptability and appropriateness of the intervention that pay little attention to the strategies and their effects. Finally, the ongoing collaboration and coordination among federal, state, and local public health agencies; community-based organizations; health care providers; and scientists that have been enabled by EHE (Purcell et al. 2022) will be critical to ensuring that scientific innovations can rapidly reach the people who most need them.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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### RELATED RESOURCES

HIV Implementation Literature Review Dashboard, version 1.0 (<https://hivimpsi.northwestern.edu/dashboard>). This interactive dashboard allows users to extract the articles included in this systematic review by key characteristics such as population of focus, setting, and CFIR domains.

Implementation Outcomes Crosswalk (<https://hivimpsi.northwestern.edu/implementation-outcomes-crosswalk>). The Crosswalk supports the identification of implementation outcomes for research studies ranging from exploratory to sustainment.

Implementation Science Navigation (<https://hivimpsi.northwestern.edu/is-navigation>). This online HIV implementation science curriculum has versions tailored to researchers, practitioners, and funders.

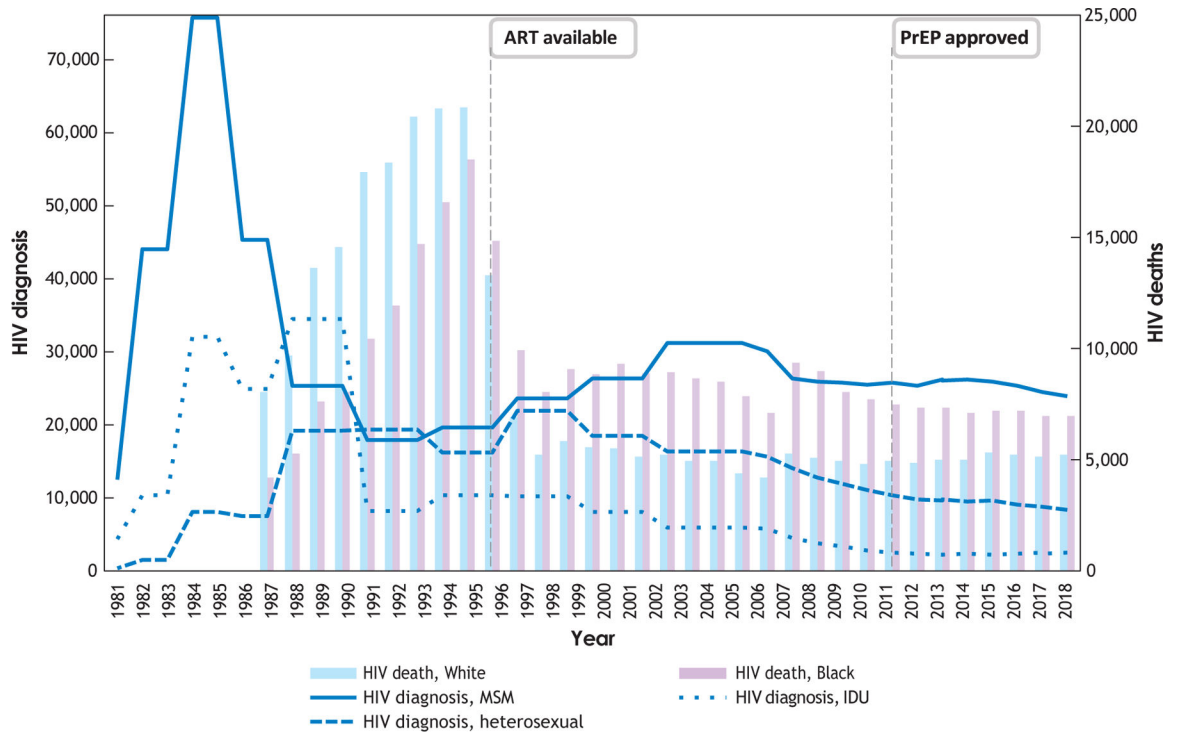
*JAIDS* Special Issue on Harnessing Implementation Science to Inform Strategies for Ending the HIV Epidemic in the United States (<https://journals.lww.com/jaids/toc/2022/06001>). This supplemental issue of *JAIDS* focuses on implementation science to help end the US HIV epidemic.

### SUMMARY POINTS

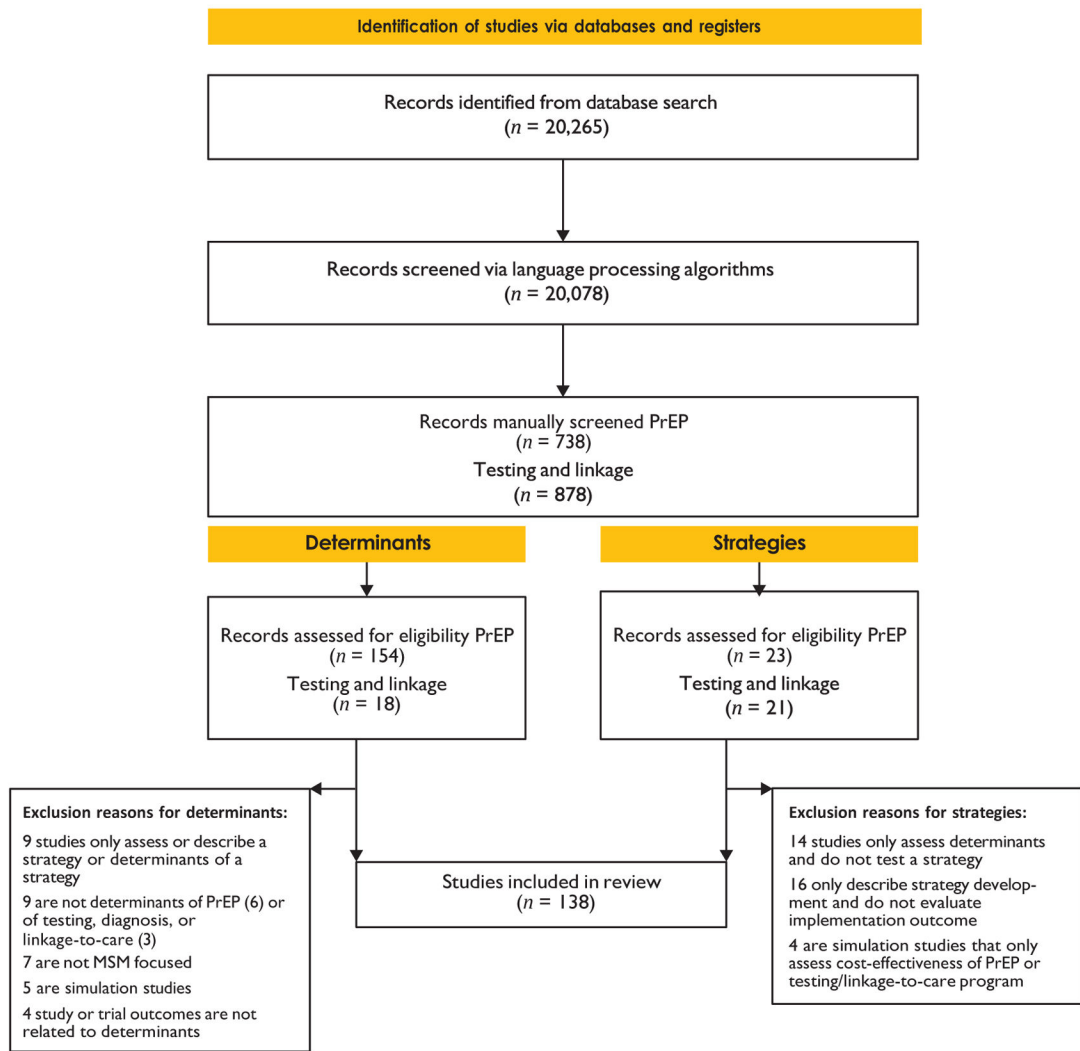
1. Implementation science is needed to advance efforts to end the HIV epidemic.
2. Most studies on pre-exposure prophylaxis (PrEP) uptake and use focused on non-Latino, White, cisgender men who have sex with men (MSM), with very few attending to the needs of Latino, Spanish-speaking, and/or transgender MSM.
3. Common PrEP determinants include difficulty integrating PrEP into daily routines; limited access to LGBTQ-affirming care; cost (barrier); evidence base (barrier); stigma (barrier); structural racism and poverty (barrier); inner setting culture (facilitator); provider capability (barrier); provider stigma (barrier); differences in PrEP awareness and access across race/ethnicity, income, and geography; patient-level stigma (barrier); and planning for implementation (facilitator).
4. Common testing/diagnosis/linkage-to-care determinants include ease of integrating testing into daily clinical routines (facilitator); provider knowledge (barrier); provider motivation (barrier); availability of testing outside of a doctor's office (facilitator); time and transportation (diagnosis barrier); structural, provider, and patient stigma (barrier); patient fear and worry (barrier); being in a relationship (barrier); and being a younger MSM (barrier).
5. There is much less of a focus on MSM populations in HIV testing/diagnosis/linkage-to-care implementation-related research compared with the PrEP literature.
6. Few papers attend to determinants within the inner setting (i.e., clinics or other settings where the innovation is being implemented) or the process of implementation.
7. Many interventions characterized in the literature as implementation strategies may be better conceptualized as adjunctive interventions.
8. There is a need for structural and system-level interventions and implementation strategies.

### FUTURE ISSUES

1. We identify many common determinants across PrEP and HIV testing/linkage-to-care, suggesting that effective system-level implementation strategies and adjunctive interventions can facilitate effective scale-up of new innovations and scale-out to nontraditional settings.
2. There is limited research on young MSM, particularly adolescents under 18, who have a high HIV incidence, poor HIV status awareness due to low testing rates, and lower rates of viral suppression.
3. Only 37 of the 73 ERIC strategies were coded, indicating significant room for new research to develop strategies in other domains, particularly those that address determinants in the inner and outer settings and at the policy level.
4. Better methods for selecting strategies for context are needed to move beyond early stages of implementation science and into testing of strategies.
5. Adjunctive interventions require their own implementation strategies to optimize delivery, but additional implementation strategies will be needed to ensure effective scale-up of innovations.
6. Developing tools that can recommend HIV implementation strategies given known contextual factors or identify determinants targeted by a given strategy type could help researchers and practitioners who are newer to implementation science.
7. The HIV implementation science literature continues to grow, and reporting results using standardized methods such as the Implementation Research Logic Model can help advance the field.



**Figure 1.** Total diagnoses and deaths due to HIV, 1981–2019. Abbreviations: ART, antiretroviral therapy; IDU, injection drug use; MSM, gay, bisexual, other men who have sex with men; PrEP, pre-exposure prophylaxis. Data for diagnoses, 1981–2007 (modeled), are from CDC (2021a). Data for total deaths, 1981–2007, are from CDC (1999, 2007). All data for the period 2008–2019 were obtained from <https://gis.cdc.gov/grasp/nchhstpatlas/tables.html> using the following variables: HIV diagnoses, HIV deaths, national, 2008–2019, white, Black/African American, cisgender male, male-to-male sexual contact, injection drug use.



**Figure 2.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 flow diagram for new systematic reviews that included searches of databases and registers only. Abbreviations: MSM, gay, bisexual, other men who have sex with men; PrEP, pre-exposure prophylaxis.

**Table 1**

Number of measured determinants by CFIR 2.0 construct among articles related to implementation of PrEP, testing, and linkage-to-care<sup>a</sup>

CFIR 2.0 domain and construct		Number of innovation determinants measuring HIV testing and linkage-to-care	Number of implementation determinants measuring HIV testing and linkage-to-care	Number of innovation determinants measuring PrEP	Number of implementation determinants measuring PrEP	Subtotal
<i>Characteristics of innovation</i>	Innovation source	0	0	1	0	1
	Evidence base	0	0	32	28	60
	Relative advantage	0	0	42	10	52
	Adaptability	0	0	3	0	3
	Trialability	0	0	1	1	2
	Complexity	0	1	60	29	90
	Design quality and packaging	1	2	15	2	20
	Cost	0	6	64	18	88
	Other intervention characteristic	1	1	123	63	188
	<b>Subtotal</b>	<b>2</b>	<b>10</b>	<b>341</b>	<b>151</b>	<b>504</b>
<i>Outer setting</i>	Critical incidents	0	0	0	0	0
	Local attitudes	0	0	116	71	187
	Local conditions	0	0	67	13	80
	Partnerships and connections	0	0	38	9	47
	Societal pressure	0	0	0	0	0
	Policies and laws	1	5	4	18	28
	Financing	0	1	0	58	59
	Structural or systemic oppression	8	2	66	5	81
	Market pressure: implementation determinant only	0	0	0	2	2
	Performance-measurement pressure: implementation determinant only	0	0	0	0	0
	<b>Subtotal</b>	<b>9</b>	<b>8</b>	<b>291</b>	<b>176</b>	<b>484</b>
<i>Inner setting</i>	Structural characteristics	NA	11	NA	25	36
	Relational connections	NA	1	NA	0	1
	Communication	NA	3	NA	0	3
	Culture	NA	9	NA	12	21
	Tension for change	NA	1	NA	0	1

CFIR 2.0 domain and construct		Number of innovation determinants measuring HIV testing and linkage-to-care	Number of implementation determinants measuring HIV testing and linkage-to-care	Number of innovation determinants measuring PrEP	Number of implementation determinants measuring PrEP	Subtotal
	Compatibility	NA	3	NA	22	25
	Relative priority	NA	0	NA	5	5
	Incentive systems	NA	5	NA	0	5
	Mission alignment	NA	0	NA	3	4
	Available resources	NA	1	NA	64	65
	<b>Subtotal</b>	NA	<b>34</b>	NA	<b>131</b>	<b>165</b>
<i>Characteristics of individuals</i>	High-level leaders	0	0	0	1	1
	Midlevel leaders	0	0	0	0	0
	Opinion leaders	0	0	0	0	0
	Implementation facilitators	0	0	0	0	0
	Implementation leads	0	0	0	0	0
	Other implementation support	1	0	0	8	9
	Innovation deliverers: need	0	2	4	1	7
	Innovation deliverers: capability (self-efficacy)	0	5	93	5	103
	Innovation deliverers: opportunity	0	2	48	4	54
	Innovation deliverers: motivation	0	5	139	0	144
	Innovation deliverers: characteristics not associated with behavior	11	2	0	3	16
	Innovation recipients: need	3	0	0	0	3
	Innovation recipients: capability (self-efficacy)	4	3	37	86	130
	Innovation recipients: opportunity	6	2	2	16	26
	Innovation recipients: motivation	24	9	14	60	107
Innovation recipients: characteristics not	36	8	260	35	339	



CFIR 2.0 domain and construct		Number of innovation determinants measuring HIV testing and linkage-to-care	Number of implementation determinants measuring HIV testing and linkage-to-care	Number of innovation determinants measuring PrEP	Number of implementation determinants measuring PrEP	Subtotal
	associated with behavior					
	<b>Subtotal</b>	<b>86</b>	<b>38</b>	<b>592</b>	<b>224</b>	<b>940</b>
<i>Process</i>	Teaming	0	0	0	2	2
	Assessing for needs	0	0	0	0	0
	Assessing context	0	0	0	0	0
	Planning	0	1	0	3	4
	Tailoring strategies	0	0	0	1	1
	Engaging innovation deliverers	0	1	0	2	3
	Engaging innovation recipients	0	8	0	4	12
	Doing	0	0	0	6	6
	Reflecting and evaluating	0	1	0	0	1
	Adapting	0	3	0	0	3
	<b>Subtotal</b>	<b>0</b>	<b>14</b>	<b>0</b>	<b>18</b>	<b>32</b>

<sup>a</sup>NA indicates that CFIR 2.0 does not include *characteristics of innovation* in the *inner setting*. Zeroes in the table represent domains and constructs that could be measured but did not appear in the existing literature.

Abbreviations: CFIR, Consolidated Framework for Implementation Research; PrEP, pre-exposure prophylaxis.

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**Table 2**

Implementation strategy characteristics

Reference	Innovation	Strategy name	Unique ERIC code(s) included <sup>a</sup>	Research stage	Effectiveness rating
Amico et al. (2019)	PrEP	iNSC training	2.1, 5.1, 5.2, 5.3, 5.4, 5.6	Test/trial strategies	Positive
Burns et al. (2022)	PrEP	Meet Me Where I Am training	5.1, 5.4, 5.7	Test/trial strategies	NA
Chai et al. (2021)	PrEP	Digital pill systems	7.2	Pilot strategies	NA
Chen & Dowdy (2014)	PrEP	Decision analysis model	4.12, 6.1	Simulation	NA
Clement et al. (2019)	PrEP	PrEP model	1.2, 4.5, 4.6, 4.17, 5.3, 6.5, 7.3, 7.2, 8.6	Test/trial strategies	Mixed
Colson et al. (2020)	PrEP	enPrEP	2.3, 5.1, 7.1, 7.2, 8.4	Compare strategies	Negative
Desrosiers et al. (2019)	PrEP	PrEP counseling center	7.2	Pilot strategies	Mixed
Egan et al. (2020)	PrEP	Epi-PrEP	7.2, 7.3	Pilot strategies	Positive
Fuchs et al. (2018)	PrEP	iText	7.1, 7.2	Pilot strategies	Mixed
Havens et al. (2019)	PrEP	Pharmacist-led HIV screening and PrEP program	7.1, 7.2, 7.3	Pilot strategies	Mixed
Hosek et al. (2017)	PrEP	Comprehensive HIV prevention package	7.2	Pilot strategies	Mixed
Hosek et al. (2013b)	PrEP	3MV	4.10, 4.11, 7.2	Test/trial strategies	Positive
Hosek et al. (2013a)	PrEP	3MV	7.2	Pilot strategies	Mixed
King et al. (2014)	PrEP	PrEP counseling	5.3, 7.3	Test/trial strategies	Negative
Klein et al. (2017)	PrEP	Real Talk	7.3	Pilot strategies	Null
Koss et al. (2018)	PrEP	Wisepill wireless adherence monitoring device	7.2	Pilot strategies	Mixed
Lalley-Chareczko et al. (2018)	PrEP	PrEP administration, intervention, and augmented adherence monitoring	7.3, 6.1, 10.1	Test/trial strategies	Positive
Landovitz et al. (2017)	PrEP	PATH-PrEP	7.2, 7.3, 6.1	Test/trial strategies	Positive
Liu et al. (2019)	PrEP	PrEPmate	7.2, 7.3, 7.5	Pilot strategies	Positive
Mayer et al. (2021)	PrEP	Life-Steps for PrEP (nurse-led)	5.4, 6.1, 7.2, 7.3	Pilot strategies	Mixed
Mitchell et al. (2018)	PrEP	eHealth Contingency Management (mSmart)	7.2, 7.3	Pilot strategies	Positive
Moitra et al. (2020)	PrEP	PrEP motivational interview	7.2	Simulation	Mixed
Phillips et al. (2020)	PrEP	PrEP4Love	7.2	Test/trial strategies	Mixed
Alonzo et al. (2016)	Testing	Hola en Grupos	7.2	Test/trial strategies	NA
Avoudjian et al. (2019)	Testing	HIV testing integrated into syphilis partner services	9.2, 9.5, 10.1	Test/trial strategies	NA
Blank et al. (2005)	Testing	Hot Shot! Healthy Men's Night Out program	4.10, 4.17, 7.2, 7.5, 9.5	Test/trial strategies	NA

Reference	Innovation	Strategy name	Unique ERIC code(s) included <sup>a</sup>	Research stage	Effectiveness rating
Catania et al. (2020)	Testing	Oral self-implemented HIV testing training	7.2, 7.3	Pilot strategies	Positive
Daskalakis et al. (2009)	Testing	Bathroom-based testing	9.5	Test/trial strategies	Positive
Frye et al. (2021)	Testing	TRUST	7.2, 7.3	More than one stage	Positive
Grusky et al. (2010)	Testing	MTU	9.5	Compare strategies	NA
Halkitis et al. (2011) <sup>b</sup>	Testing	SNS	4.10, 5.2, 7.1, 8.4	Compare strategies	Positive
Halkitis et al. (2011)	Testing	Alternate venue testing	1.7, 3.4, 7.2, 9.5	Test/trial strategies	NA
Hirschfield et al. (2012)	Testing	Prevention digital media	7.1	Pilot strategies	Mixed
Jenkins Hall et al. (2017)	Testing	Mobile apps for prevention and testing, health educator	4.1, 7.5	Test/trial strategies	NA
Lightfoot et al. (2018)	Testing	Project T	4.1, 5.1, 5.4, 7.1	Pilot strategies	Positive
Maksut et al. (2016)	Testing	Self-administered at-home HIV testing with web-based counseling	7.2, 7.3, 9.5	Pilot strategies	Positive
Marlin et al. (2014)	Testing	Commercial voucher program	4.5, 6.3, 7.5	Test/trial strategies	Mixed
Martínez-Donate et al. (2010)	Testing	Hombres Sanos digital campaign	7.1, 7.5	Pilot strategies	Mixed
McCree et al. (2013)	Testing	SNS for testing	3.1, 4.1, 5.1, 8.4	Test/trial strategies	Mixed
McGoy et al. (2018)	Testing	SNS program	1.5, 2.2, 4.1, 8.4	Test/trial strategies	Mixed
Qureshi et al. (2018)	Testing	HIV and STI educational session	7.1, 7.2	Pilot strategies	Positive
Rhodes (2004)	Testing	Online public chat room with health educator	7.3	Test/trial strategies	Positive
Shrestha et al. (2020).	Testing	HIV self-testing	7.5, 9.2, 9.5	Test/trial strategies	Positive
Shrestha et al. (2010)	Testing	SNS to identify new HIV diagnoses	5.1, 7.2, 8.4	Test/trial strategies	Positive
Washington et al. (2017)	Testing	TIM	7.3	Test/trial strategies	Positive

<sup>a</sup>For the ERIC codes, as well as their names and descriptions, see Supplemental Table 1. Some strategies had multiple instances of the same ERIC code. Only the unique ERIC codes are listed here for each strategy.

<sup>b</sup>Two strategies were compared for the Halkitis et al. (2011) study, which is why there are 45 rows instead of 44 (which would match the total strategies noted in the text).

Abbreviations: ERIC, Expert Recommendations for Implementing Change; iSNC, Integrated Next Step Counseling; MTU, mobile testing unit; NA, not applicable; PREP, pre-exposure prophylaxis; SNS, social network strategy; STI, sexually transmitted infection; TIM, Testing Intervention Model; 3MV, adapted Many Men, Many Voices.

**Table 3**

Effective strategy characteristics and outcomes<sup>a</sup>

Reference	Strategy name(s)	Unique ERIC domains	Research stage	Patient-level outcomes	Provider-level outcomes
Amico et al. (2019)	iNSC training	2, 5	Test/trial strategies	PrEP feasibility and adherence	Strategy acceptability, appropriateness, and feasibility; strategy fidelity
Egan et al. (2020)	Epi-PrEP	7	Pilot strategies	PrEP adherence and sustainment	NA
Hosek et al. (2013b)	3MV	4, 7	Test/trial strategies	Strategy acceptability, appropriateness, feasibility	Strategy fidelity
Lalley-Chareczko et al. (2018)	PrEP administration, intervention, and augmented adherence monitoring	6, 7, 10	Test/trial strategies	PrEP fidelity and sustainment	NA
Landovitz et al. (2017)	PATH-PrEP	6, 7	Test/trial strategies	PrEP acceptability, appropriateness, adoption, adherence	NA
Liu et al. (2019)	PrEPmate	7	Pilot strategies	PrEP adherence, reach; strategy acceptability, appropriateness, feasibility	NA
Mitchell et al. (2018)	eHealth Contingency Management (mSmart)	7	Pilot strategies	PrEP adherence; strategy acceptability, appropriateness, feasibility	NA
Catania et al. (2020)	Oral self-implemented HIV testing training	7	Pilot strategies	Testing fidelity	Strategy fidelity
Daskalakis et al. (2009)	Bathhouse-based testing	9	Test/trial strategies	Testing reach; strategy acceptability, appropriateness, feasibility	Strategy acceptability, appropriateness, feasibility
Frye et al. (2021)	TRUST	7	More than one stage	Testing uptake, adherence, sustainment; strategy acceptability, appropriateness, feasibility	NA
Halkitis et al. (2011)	SNS	4, 5, 7, 8	Compare strategies	Testing reach	NA
Lightfoot et al. (2018)	Project T	4, 5, 7	Pilot strategies	Testing adoption/uptake	Strategy acceptability, appropriateness, feasibility
Maksut et al. (2016)	Self-administered at-home HIV testing with web-based counseling	7, 9	Pilot strategies	Testing adoption/uptake; strategy acceptability, appropriateness, feasibility	NA
Qureshi et al. (2018)	HIV and STI educational session	7	Pilot strategies	Testing adoption/uptake	NA
Rhodes (2004)	Online public chat room with health educator	7	Test/trial strategies	Strategy acceptability, appropriateness, feasibility	NA
Shrestha et al. (2020)	HIV self-testing	7, 9	Test/trial strategies	Testing reach	Costs
Shrestha et al. (2010)	SNS to identify new HIV diagnoses	5, 7, 8	Test/trial strategies	Testing adoption/uptake; strategy acceptability, appropriateness, feasibility	Costs; testing adoption/uptake

Reference	Strategy name(s)	Unique ERIC domains	Research stage	Patient-level outcomes	Provider-level outcomes
Washington et al. (2017)	TIM	7	Test/trial strategies	Testing knowledge/awareness, adoption/uptake, reach; strategy acceptability, appropriateness, feasibility	NA

<sup>a</sup>The table includes only the strategies rated positive. For additional descriptions of the strategies, see Supplemental Table 2.

Abbreviations: ERIC, Expert Recommendations for Implementing Change; iSNC, Integrated Next Step Counseling; NA, not applicable; PrEP, pre-exposure prophylaxis; SNS, social network strategy; STI, sexually transmitted infection; TIM, Testing Intervention Model; 3MV, adapted Many Men, Many Voices.