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Demographic, psychosocial, and behavioral predictors of pre-exposure prophylaxis (PrEP) persistence among men who have sex with men (MSM) in the southern United States

By

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Epidemiology

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By

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2017

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfilment of the requirements for the degree of
Master of Public Health
in Epidemiology

2021

Abstract

Demographic, psychosocial, and behavioral predictors of pre-exposure prophylaxis (PrEP) persistence among men who have sex with men (MSM) in the southern United States

By Sagarika Das

Objective: Examine the relationship of urbanicity, self-efficacy, HIV knowledge, and sexual behavior stigma with PrEP discontinuation among PrEP-using MSM in the southern United States

Introduction: Men who have sex with men (MSM) in the southern United States bear a disproportionate burden of new HIV diagnoses, including in rural areas. PrEP is an effective once-daily pill that can reduce the risk of contracting HIV from sex. However, southern MSM face barriers to PrEP uptake, adherence, and persistence. Factors such as lack of HIV knowledge, low self-efficacy, and sexual behavior stigma may influence PrEP discontinuation. These barriers might be exacerbated for MSM in rural areas due to increased stigma and reduced access to culturally competent care.

Methods: We analyzed data from the Emory PrEP study (October 2019 to July 2020), an observational longitudinal pilot study of an online cohort of PrEP-using MSM in the southern U.S. Our exposures of interest included urbanicity, HIV knowledge, self-efficacy, and sexual behavior stigma, and our outcome was self-reported PrEP discontinuation. We calculated descriptive statistics for all demographic variables, stratified by PrEP persistence. We estimated crude and adjusted prevalence ratios and confidence intervals for PrEP discontinuation using logistic regression with the predicted margins approach.

Results: Of 72 participants, 10 (13.9%) MSM discontinued PrEP. Unadjusted analyses showed that MSM who avoided healthcare had a moderate positive association with PrEP discontinuation (cPR=2.66, 95% CI= [0.80, 8.87]). After adjustment, they had a strong positive association with PrEP discontinuation, compared to their counterparts who did not avoid healthcare (aPR=3.31, 95% CI= [1.12, 9.76]). MSM who experienced gossip from healthcare workers had a moderate positive association with PrEP discontinuation (cPR=2.06, 95% CI= [0.32, 13.27]). After adjustment, they had a slightly stronger association with PrEP discontinuation (aPR=3.59, 95% CI= [1.02, 12.60]), compared to non-stigmatized MSM.

Discussion: PrEP-stable MSM experiencing sexual behavior stigma of healthcare avoidance and gossip from healthcare workers are more likely to discontinue PrEP compared to MSM who do not experience these stigmas. Stigma may play a role in PrEP discontinuation, and future work should address longitudinal fluctuations in HIV risk and reasons for PrEP discontinuation.

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Introduction

Men who have sex with men (MSM) are disproportionately impacted by HIV in the United States (U.S.) (1,2). Across most states in the U.S., about one in every 10 MSM is living with diagnosed HIV (2). Nearly 69% (out of 37,968) of newly diagnosed HIV cases across the U.S. in 2018 were among adult and adolescent MSM, and young (aged 25-34) MSM experienced the greatest percentage increase in new HIV diagnoses since 2014 (3).

HIV diagnoses among MSM are not evenly distributed across the U.S.; the southern U.S. accounts for the largest number (12,540) of HIV diagnoses among regions in the country and nearly 50% of all new cases (3). The largest percentage of infections among MSM in the southern U.S. is among Black MSM (48%), followed by Latinos (26%), and whites (23%) (3).

MSM in rural areas are especially vulnerable to HIV and other sexually transmitted infections (STIs) (4,5). Rural MSM seeking HIV preventive care face barriers such as insufficient HIV knowledge, poverty and low educational attainment, lack of transportation, a shortage of health providers with expertise in HIV-related care, and scarce funding for public health programs (6–9).

For key populations including rural MSM, pre-exposure prophylaxis (PrEP) can be an effective means for preventing HIV (10). Among those MSM who initiate PrEP, adherence (the extent to which patients follow recommendations for taking a medication) and persistence (the continuation of a medication for its prescribed time) are key to maximizing the protection conferred by PrEP (11). The once-daily PrEP pill can reduce the risk of contracting HIV from sex by 99% when taken as prescribed (10). High PrEP adherence and persistence are achieveable and has been demonstrated in studies of community-based delivery (10,12,13).

In 2015, 1.2 million people in the U.S. were eligible for PrEP, among whom 41% were MSM (14). However, by 2018, only about 16% (188,546/1,200,000) of all PrEP-eligible people were using PrEP in the U.S. (15). In 2016, the southern U.S. only accounted for 27.2% of all PrEP users and a quarter of all PrEP-providing clinics, despite having the largest number of HIV diagnoses among MSM (16,17). A focus on PrEP-related research and strategies tailored to the southern U.S. is warranted.

Increasing PrEP coverage is a cornerstone of the "Ending the HIV Epidemic: A Plan for America" (EHE) initiative (18). Six southern states in the U.S. with large non-urban regions are included in the priority jurisdictions of the EHE plan (18). Uptake and adherence are two key components of the PrEP continuum of care which have been researched extensively, and there are several factors associated with PrEP uptake and adherence among MSM in rural settings. These factors include sexual behavior stigma, lack of information about PrEP, cost, lack of insurance and underinsurance, and lack of access to care (19–21). MSM living in rural areas are more likely to live in PrEP deserts (i.e., areas with limited access to PrEP) resulting in longer commute times to a PrEP provider compared to MSM in urban areas (Siegler et al., 2019). While uptake and adherence have been studied, there remains a dearth of research on facilitators and barriers of PrEP persistence among rural MSM.

PrEP persistence is important to understand in order to effectively target PrEP implementation strategies and messaging. PrEP demonstration projects have recorded PrEP discontinuation rates as high as 37-62% at the end of 6 months (13,22–24). High discontinuation rates have also been observed among young and Black MSM (13,24). Lessons from the existing literature on uptake and adherence can be leveraged to guide research on PrEP persistence, inluding investigating facilitators and barriers of PrEP discontinuation.

Some factors that may interfere with PrEP persistence include sexual behavior stigma, low self-efficacy, and a lack of HIV knowledge. Rural and southern MSM experience greater levels of sexual behavior stigma (hereafter referred to as stigma) due to pervasive conservative attitudes and social norms (25). Stigma has been repeatedly associated with reduced rates of seeking testing, prevention, and treatment services for HIV; increased condomless anal sex; and increased avoidance of healthcare (26–29). Stigma is also a barrier to PrEP uptake and adherence (30,31). However, the quantiative nature of the relationship between stigma and persistence of PrEP remains to be understood.

In addition to stigma, self-efficacy has been identified as an important factor in relation to HIV prevention. Where stigma acts as a barrier, self-efficacy acts as a facilitator. Self-efficacy is defined as developing adaptive responses to challenges that an individual faces, including barriers to seeking and using effective HIV prevention strategies (32,33). For example, self-efficacy has been shown to positively affect uptake of HIV prevention behaviors like testing among MSM in China, and MSM willing to utilize PrEP score more favorably on measures of self-efficacy than men unwilling to use PrEP among MSM in Myanmar (33,34). MSM in rural areas in China have lower self-efficacy compared to MSM in urban areas, and low self-efficacy likely impacts HIV prevention behaviors like PrEP uptake and adherence (33,35). While these studies show positive relationships between high self-efficacy, HIV prevention behaviors, and PrEP use, there is a need for similar research among rural MSM in the southern United States.

Finally, HIV knowledge, is also a key component to effective HIV prevention. Lack of HIV knowledge and PrEP are barriers for rural MSM to reeive proper HIV prevention and care (9). A study of young (aged 16-20) HIV-negative MSM in Chicago in 2009 showed that MSM with more knowledge about HIV were more likely to uptake PrEP. However, there are few

studies that assess the relationship between HIV knowledge and PrEP persistence (36). MSM among demographic groups for increased risk of HIV generally have a low risk perception for HIV (37,38). For example, studies of young MSM, a particularly vulnerable group for HIV, have demonstrated a disconnect between self-perceptions of risk and PrEP indications (39,40). An understanding of the relationship between HIV knowledge and PrEP presistence among rural and southern MSM is an unfilled gap in the literature.

In order to effectively utilize PrEP as part of comprehensive HIV prevention strategies, there is a pressing need to understand predictors of PrEP persistence among MSM in the southern U.S. To this end, the current study uses data from the Emory PrEP Study in order to examine demographic, psychosocial, and behavioral predictors of PrEP persistence among PrEP-using MSM in the southern U.S. We also assess the potential modifying effects of rural areas on PrEP persistence as compared to their urban counterparts. We hypothesized that MSM who lived in rural areas, scored low on HIV knowledge and self-efficacy, and reported facing stigma would be more likely to discontinue PrEP during the follow-up period.

Methods

Study Design

Data for this analysis were obtained through the Emory PrEP Study, which was a longitudinal pilot study of an online cohort of PrEP-using MSM in the southern United States from October 2019 to July 2020. Eligible participants identified as cisgender male, were 18–34 years old, lived in the southern United States with plans to be there for at least 16 weeks, were proficient in English, had anal sex with a man in the 6 months prior to study enrollment, self-reported being HIV-negative, and self-reported being a current user of oral PrEP for HIV.

Participants were recruited through advertisements on Facebook and Grindr and direct emails to participants of the American Men's Internet Survey who agreed to be contacted about future research opportunities (Zlotorzynska et al., 2017).

Once enrolled, participants were administered a baseline survey, seven biweekly check-in surveys on sexual behavior and PrEP use, and a final survey that included questions on plans for future PrEP use. An additional ad hoc survey on experiences during COVID-19 was administered in June 2020 (41). Surveys were administered using Alchemer (formerly SurveyGizmo, Boulder, CO), a HIPAA-compliant survey platform. All surveys were self-administered and could be accessed on a mobile telephone or computer. Participants were compensated for their participation. All study procedures were approved by the Emory University Institutional Review Board.

Measures

Participants reported on demographic characteristics including age, race/ethnicity, sexual identity, education completed, annual household income, insurance status, and ZIP code in the baseline survey; experiences of stigma; self-efficacy; and HIV knowledge. Age was categorized into two groups, 18-24 and 25-34 years. Race/ethnicity was categorized as Hispanic, non-Hispanic Black, non-Hispanic white, and other/multiple races. Sexual identity was categorized as homosexual/gay and bisexual. Education completed was categorized as completing high school/secondary school or less and at least some college. Annual household income was categorized as $0 to $39,999 and greater than $40,000. Insurance status was dichotomized as having insurance and not having insurance. We determined ubanicity of residence based on a participant's self-reported ZIP code (U.S. Department of Housing and Urban Development,

2018). The ZIP code was cross-walked to a county using an established algorithm and counties were classified according to the National Center for Health Statistics urban-rural classification scheme (43). Central and fringe metro were categorized as urban, and small metro, medium metro, micropolitan, and non-core were categorized as urban.

Sexual behavior stigma was assessed using individual questions taken from the American Men's Internet Survey (Appendix 2, Questions 1-11) in addition to questions categorized as verbal harassment, physical assault, and discrimination, previously described by Balaji and colleagues (Appendix 2, Questions 12-14) (44,45). For questions 1-11 (Appendix 2), participants were dichotomized as "yes" for having experienced that stigma or "no" for not having experienced that stigma. Verbal harassment was classified as "yes" or "no" for having been called names or insulted in the past 12 months because someone knew or assumed the respondent was attracted to men. Physical assault was also classified as "yes" or "no" for having been physically attacked or injured in the past 12 months because someone knew or assumed the respondent was attracted to men. Discrimination was assessed as participants having experienced any discrimination in the past 12 months, by: 1) receiving poorer services than others in restaurants, stores, businesses, or agencies; 2) being treated unfairly at work or school; or 3) being denied or given lower quality health care.

HIV knowledge was calculated as a composite score of eight true or false HIV-related questions that assessed participants' knowledge on HIV (Appendix 3). The composite score ranged from 0 to 8, with a score of 8 indicating correct responses for all items. Any participant missing a response to any one of the individual eight questions was given a missing composite score. The scores were grouped into three categories for analysis: low (4-5 points), medium (6-7 points), and high (8 points).

Self-efficacy was calculated as a composite score of nine items using a 0 to 3 Likert scale for the responses (Appendix 4). The composite score ranged from 0 to 27. Participants missing any one of the individual nine questions was given a missing composite self-efficacy score. Self-efficacy scores were dichotomized at the median score of 21. A score equal to or greater than 21 was considered high self-efficacy, and a score below 21 was considered low self-efficacy (46).

In the biweekly check-in surveys and final survey, participants responded to questions about PrEP use and sexual behavior over the previous two weeks. The outcome of interest, PrEP discontinuation, was dichotomously categorized as "yes" for any participant having discontinued PrEP during any follow-up assessment and "no" for any participant who did not discontinue PrEP during any follow-up assessment.

Statistical Analyses

We assessed the effects of urbanicity, sexual behavior stigma, HIV knowledge, and self-efficacy on self-reported PrEP discontinuation. Descriptive statistics were calculated for all demographic variables, stratified by PrEP persistence (Table 1). Models were constructed using existing literature and a directed acyclic graph (Appendix 1). Logistic regression with the predicted margins approach was used to estimate crude and adjusted prevalence ratios and confidence intervals for PrEP discontinuation. Multivariable models were adjusted for race, urbanicity, education, income, insurance, and HIV knowledge scores. All statistical analyses were conducted in SAS software, Version 9.4 (Cary, NC, USA) and SUDAAN software, Version 11.01.3 (Research Triangle Park, NC, USA).

Results

Participant Characteristics

Of the 78 MSM who participated in the Emory PrEP Study, 72 completed at least one follow-up survey and were included in the analysis. Over half (n = 41, 56.9%) of participants were 18-24 years old, and non-Hispanic white MSM were the largest represented racial/ethnic group (n=34, 49.3%). Most participants identified as homosexual/gay (n=68, 94.4%), completed at least some college (n=62, 88.6%), and were insured (n=64, 88.9%). A majority of participants reported an income over $40,000 (n=41, 61.2%). 10 (13.9%) participants discontinued PrEP (Table 1).

Urbanicity

The majority of participants resided in an urban area (n=51, 70.8%). 7 (13.7%) and 3 (14.3%) of urban and rural participants discontinued PrEP, respectively. There was a weak positive unadjusted association between living in a rural area and discontinuing PrEP (crude prevalence ratio (cPR) =1.04, 95% CI= [0.29, 3.76]) (Table 2). Based on the directed acyclic graph (Appendix 1), there was no adjusted model for urbanicity.

HIV Knowledge

Most participants scored in the medium category between a 6-7 on the HIV knowledge scale (n=44, 61.1%); 25.0% (n=18) of participants scored in the high category (8 points). 4 (22.2%) and 6 (13.6%) of high-scoring and medium-scoring (6-7 points) MSM discontinued PrEP, respectively. Medium scoring participants had less discontinuation of PrEP in both the unadjusted and adjusted models, relative to those scoring high (cPR=0.68, 95% CI= [0.15, 3.10];

adjusted prevalence ratio (aPR)=0.55, 95% CI= [0.14, 2.25]). No participants with a low HIV knowledge score discontinued PrEP.

Self-Efficacy

The median self-efficacy score was 21 (standard deviation=3.70). 5 (12.8%) and 5 (15.2%) of high-scoring (≥21) and low-scoring (<21) MSM discontinued PrEP, respectively. Participants with low self-efficacy had a weak positive association with a higher discontinuation of PrEP compared to participants with high self-efficacy (cPR=1.18, 95% CI= [0.36, 3.84]). After adjusting for income, education, HIV knowledge, and insurance status, we observed a stronger positive association between low self-efficacy and PrEP discontinuation compared to participants with high self-efficacy (aPR=2.32, 95% CI= [0.70, 7.71]) (Table 4).

Stigma

The most commonly reported experiences of stigma were family gossip (n=30, 44.8%) and being scared in public (n=22, 31.0%). 3 (30.0%) and 2 (9.0%) of MSM reporting family gossip and being scared in public discontinued PrEP, respectively. MSM who avoided healthcare had a weak positive association with PrEP discontinuation (cPR=2.66, 95% CI= [0.80, 8.87]), and after adjustment for race and urbanicity, had a strong positive association with PrEP discontinuation, compared to their counterparts who did not avoid healthcare (aPR=3.31, 95% CI= [1.12, 9.76]). MSM who experienced gossip from healthcare workers also had a weak positive association with PrEP discontinuation (cPR=2.06, 95% CI= [0.32, 13.27]), and after adjustment for race and urbanicity, had a slightly stronger association with PrEP discontinuation (aPR=3.59, 95% CI= [1.02, 12.60]), compared to non-stigmatized MSM.

MSM who faced family exclusion, family gossip, friend rejection, being afraid to seek healthcare, police refusal to protect, being scared in public, rape, and verbal harassment had a weak positive association with discontinuation of PrEP compared to those not experiencing the stigma, for both unadjusted and adjusted models (Table 5). No participants who reported poor healthcare treatment, blackmail, discrimination, and physical assault discontinued PrEP.

Discussion

The purpose of this analysis was to understand the relationship between several demographic, psychosocial, and behavioral predictors of PrEP persistence among MSM in the southern United States. Using multivariate logistic regression with the predicted margins approach, we found several predictors that may play a role in PrEP discontinuation among MSM. From our findings, HIV knowledge and several forms of stigma (healthcare avoidance and healthcare worker gossip) are associated with PrEP discontinuation. These results are an important addition to a small body of literature and can advance the evidence base of PrEP use among rural MSM to help inform targeted HIV prevention and PrEP strategies.

We found that MSM having medium HIV knowledge had a negative association with PrEP discontinuation. Our study is one of a few to assess the relationship specifically between HIV knowledge and PrEP discontinuation, as opposed to PrEP knowledge and PrEP discontinuation. Existing literature on knowledge and PrEP uptake suggests that knowledge may be lacking in the most high risk MSM (47–49). A study of young (aged 16-29) MSM in Chicago found that individuals who did not perceive themselves to be at risk for HIV accounted for 19% of all MSM who discontinued PrEP during the study period (50). A cohort of young (aged 18-29) Black MSM on PrEP in Atlanta had low persistence, with 22% of MSM discontinuing PrEP

two or more times over a 24-month follow-up period, despite having support services to ensure PrEP adherence and persistence (51). Low persistence is likely amplified for MSM like the ones in our study because MSM will face larger challenges to wrap around services and support to remain on PrEP (9). Low health literacy is also more prevalent in the southern United States than in any other census region, especially among rural areas, and lack of HIV knowledge of prevention strategies like PrEP is endemic at the community level in rural regions (9,20,52).

Additionally, MSM may have "seasons of risk" during which they utilize PrEP during times of increased sexual risk and discontinue use during times of decreased sexual risk. A national sample of MSM found that 18% of MSM reporting PrEP use discontinued over the course of a 2 year study enrollment period, and 50% of men cited lower perceived HIV risk as their reason for discontinuation (38). Recognizing that rural MSM in the southern U.S. face particular challenges to accessing and adhering to healthcare, there is a need to quantify the relationship between HIV knowledge and PrEP persistence in order to effectively tailor PrEP implementation and HIV risk messaging. We did not consider longitudinal fluctuations in HIV risk or the reasons participants cited for PrEP discontinuation; however, these factors will be examined in future analyses of these data.

Of the sexual behavior stigma forms that we assessed, healthcare avoidance and healthcare worker gossip were significantly associated with PrEP discontinuation. In our analysis, discrimination included MSM who felt they were denied or given lower quality health care because someone knew or assumed they were attracted to men. While there appears to be no existing literature looking specifically at the association between sexual behavior stigma and PrEP persistence, experiences of stigma are negatively associated with uptake of other HIV prevention behaviors like seeking testing and increased condomless anal sex (45). Existing

literature also demonstrates that PrEP-related stigma, which is similarly attributed to individuals as sexual behavior stigma, is a reason for PrEP discontinuation (31,53).

Healthcare avoidance and poor healthcare treatment have been commonly documented among MSM populations and are barriers to PrEP use. Malta et al., found that MSM delayed seeking medical care for sexually transmitted infections and were reticent to discuss healthcare issues with clinicians because of previous negative experiences with disclosing their sexual behaviors (54). Similarly, Currin et al. reported that rural MSM in Oklahoma who were uncomfortable with disclosing their sexual orientation were also less likely to seek mental health care (55). In a 2016 study of sexual behavior stigma among MSM in sub-Saharan Africa and the United States, healthcare avoidance and blackmail were most commonly reported among rural MSM compared to urban MSM (45). Blackmail and physical assault have been associated with discordant condomless intercourse, (44); if these experiences are also more likely to lead to PrEP discontinuation then that will result in heightened HIV risk among MSM. Sexual behavior stigma may play a role in PrEP discontinuation.

Our results indicate that urbanicity and having a low self-efficacy score have a weak positive association with PrEP discontinuation, and our results are in agreement with previous research. Rural MSM are more likely to live in PrEP deserts and be far from PrEP providers leading to greater barriers for PrEP adherence and persistence than for urban MSM (Holloway et al., 2020; Siegler et al., 2018). Owens et al. found that high self-efficacy is important to PrEP persistence, congruent with our findings of a weak positive association of a higher self-efficacy score with lower PrEP discontinuation. HIV prevention-related self-efficacy is generally higher among men willing to use PrEP (33,35,56).

Strengths

There are several strengths to this study. This analysis contributes to a small but growing body of research describing PrEP use among rural MSM in the southern U.S., and an even smaller set of literature on PrEP adherence and related factors. The study had a longitudinal design with biweekly assessments which allowed for frequent capture of PrEP use measures including the outcome, PrEP discontinuation, of this analysis. Additionally, this study leverages online recruitment methods which may allow for easier recruitment of MSM populations who might be otherwise reticent to participate in such research through in-person recruitment methods due to privacy and confidentiality concerns.

Limitations

There are several limitations to this study. The small sample size likely our data analysis capability resulting in imprecise estimates and our ability to adjust for potential confounding variables. Secondly, we enrolled existing PrEP users, so our results are biased toward MSM who have already persisted on PrEP for some amount of time. This analysis also did not include whether PrEP discontinuation was indicated. For example, if someone entered a mutually monogamous relationship with a HIV-negative partner or HIV-positive partner with a suppressed viral load then PrEP might no longer be indicated. The study did not enroll its initial goal of 100 participants (50 urban and 50 rural), and some participants were followed during March and April 2020 of the COVID-19 pandemic, and sexual behavior declined over this time period (41). Following the start of the COVID-19 pandemic, five participants discontinued or changed how often they took PrEP; this analysis did not take into account how COVID-19 may have affected

PrEP use (41). Future studies should be conducted with larger samples of MSM and should assess reasons for PrEP discontinuation.

Conclusion

MSM in the southern United States face the greatest burden of new HIV cases in the U.S. Rural MSM are especially minoritized due to sociocultural, structural, and geographical constraints. PrEP is an effective tool for preventing new infections and PrEP use is increasing; however, PrEP use in the southern U.S. and in rural areas is limited (9,16). Once on PrEP, continued use during periods of sexual risk is key to maximizing the benefits of PrEP, particularly among high risk MSM (57). Findings from this study underscore the role that HIV knowledge and sexual behavior stigma can play in PrEP persistence. MSM with medium HIV knowledge and those facing healthcare-related stigma are more likely to discontinue PrEP than other MSM. Haberer et al. have suggested that the complex nature of PrEP adherence merits a new definition of adherence called the “prevention-effective adherence”, which contextualizes a person’s adherence by taking into consideration their HIV risk and use of other HIV prevention methods (58). In this regard, future work should expand upon our results by not only assessing HIV knowledge among PrEP-stable MSM but also seeking to understand the relationships between knowledge, discontinuation reasons, and individual risk.

Tables

Table 1. Characteristics of respondents to the Emory PrEP Study by PrEP discontinuation status

Participant Characteristics	Study Population n (%)	Discontinued PrEP n (%)	Continued PrEP n (%)
Age			
18-24 years	41 (56.9)	4 (40.0)	37 (59.7)
25-34 years	31 (43.1)	6 (60.0)	25 (40.3)
Race/Ethnicity[a]			
Non-Hispanic Black	16 (23.2)	2 (20.0)	14 (23.7)
Hispanic	11 (15.9)	1 (10.0)	10 (17.0)
Non-Hispanic White	34 (49.3)	4 (40.0)	30 (50.9)
Other/Multiple/Unknown	8 (11.6)	3 (30.0)	5 (8.5)
Sexual Identity			
Homosexual/Gay/Lesbian	68 (94.4)	9 (90.0)	59 (95.2)
Bisexual	4 (5.6)	1 (10.0)	3 (4.8)
Education Completed[b]			
High school/secondary school or less	8 (11.4)	0 (0.0)	8 (13.1)
At least some college	62 (88.6)	9 (100.0)	53 (86.9)
Annual Income[c]			
$0-$39,999	26 (38.8)	2 (20.0)	24 (42.1)
$40,000+	41 (61.2)	8 (80.0)	33 (57.9)
Insurance Status			
No insurance	8 (11.1)	1 (10.0)	7 (11.3)
Insurance	64 (88.9)	9 (90.0)	55 (88.7)
Urbanicity			
Urban	51 (70.8)	7 (70.0)	44 (71.0)
Rural	21 (29.2)	3 (30.0)	18 (29.0)

[a]3 missing, [b]2 missing, [c]5 missing

Table 2. Urbanicity among MSM by PrEP discontinuation status

Urbanicity	Study Population n (%)	Discontinued PrEP n (%)	Continued PrEP n (%)	cPR (95% CI)	aPR[a] (95% CI)
Urban	51 (70.8)	7 (70.0)	44 (71.0)	Ref.	Ref.
Rural	21 (29.2)	3 (30.0)	18 (29.0)	1.04 (0.29, 3.76)	--

[a]No adjusted model as per the directed acyclic graph (Appendix A)

Table 3. HIV knowledge among MSM by PrEP discontinuation status

HIV Knowledge Composite Score	Study Population n (%)	Discontinued PrEP n (%)	Continued PrEP n (%)	cPR (95% CI)	aPR[a] (95% CI)
High (8)	18 (25.0)	4 (40.0)	14 (22.6)	Ref.	Ref.
Medium (6-7)	44 (61.1)	6 (60.0)	38 (61.3)	0.68 (0.15, 3.10)	0.55 (0.14, 2.25)
Low (4-5)	10 (13.9)	0 (0.00)	10 (16.1)	--	--

[a]Adjusted for income and education completed

Table 4. Self-efficacy among MSM by PrEP discontinuation status

Self-Efficacy Composite Score	Study Population n (%)	Discontinued PrEP n (%)	Continued PrEP n (%)	cPR (95% CI)	aPR[a] (95% CI)
High (>= 21)	39 (54.2)	5 (50.0)	34 (54.8)	Ref.	Ref.
Low (< 21)	33 (45.8)	5 (50.0)	28 (45.2)	1.18 (0.36, 3.84)	2.32 (0.70, 7.71)

[a]Adjusted for income, education completed, HIV knowledge, and insurance status

Table 5. Sexual behavior stigma among MSM by PrEP discontinuation status

Stigma Category	Study Population n (%)	Discontinued PrEP n (%)	Continued PrEP n (%)	cPR (95% CI)	aPR[l] (95% CI)
Family Exclusion[a]					
No	50 (72.5)	8 (88.9)	42 (70.0)	Ref.	Ref.
Yes	19 (27.5)	1 (11.1)	18 (30.0)	0.33 (0.04, 2.58)	0.37 (0.05, 2.85)
Family Gossip[b]					
No	37 (55.2)	7 (70.0)	30 (52.6)	Ref.	Ref.
Yes	30 (44.8)	3 (30.0)	27 (47.4)	0.53 (0.14, 1.93)	0.63 (0.17, 2.33)
Friend Rejection[c]					
No	59 (83.1)	7 (70.0)	52 (85.3)	Ref.	Ref.
Yes	12 (16.9)	3 (30.0)	9 (14.8)	2.11 (0.62, 7.22)	2.17 (0.72, 6.49)
Afraid to Seek Healthcare[d]					
No	58 (81.7)	7 (70.0)	51 (83.6)	Ref.	Ref.
Yes	13 (18.3)	3 (30.0)	10 (16.4)	1.91 (0.55, 6.61)	2.37 (0.72, 7.81)
Healthcare Avoidance					
No	62 (86.1)	7 (70.0)	55 (88.7)	Ref.	Ref.
Yes	10 (13.9)	3 (30.0)	7 (11.3)	2.66 (0.80, 8.87)	3.31 (1.12, 9.76)
Healthcare Worker Gossip[e]					
No	66 (94.3)	8 (88.9)	58 (95.0)	Ref.	Ref.
Yes	4 (5.70)	1 (11.1)	3 (4.90)	2.06 (0.32, 13.27)	3.59 (1.02, 12.60)
Poor Healthcare Treatment[f]					
No	67 (94.4)	10 (100.0)	57 (93.4)	Ref.	Ref.
Yes	4 (5.6)	0 (0.00)	4 (6.6)	--	--
Police Refusal to Protect[g]					
No	68 (97.1)	9 (90.0)	59 (98.3)	Ref.	Ref.
Yes	2 (2.9)	1 (10.0)	1 (1.7)	3.78 (0.80, 17.81)	3.99 (0.93, 17.22)
Scared in Public[h]					
No	49 (69.0)	8 (80.0)	41 (67.2)	Ref.	Ref.
Yes	22 (31.0)	2 (20.0)	20 (32.8)	0.56 (0.12, 2.50)	0.69 (0.16, 2.89)
Blackmail[i]					
No	65 (91.6)	10 (100.0)	55 (90.2)	Ref.	Ref
Yes	6 (8.50)	0 (0.00)	6 (9.84)	--	--
Rape					

No	57 (79.2)	8 (80.0)	49 (79.0)	Ref.	Ref.
Yes	15 (20.8)	2 (20.0)	13 (21.0)	0.95 (0.22, 4.16)	1.18 (0.25, 5.48)
Verbal Harrassment[j]					
No	53 (74.7)	6 (60.0)	47 (77.1)	Ref.	Ref.
Yes	18 (25.4)	4 (40.0)	14 (23.0)	1.96 (0.61, 6.35)	2.27 (0.81, 6.40)
Discrimination[k]					
No	51 (77.3)	9 (100.0)	42 (73.7)	Ref.	Ref.
Yes	15 (22.7)	0 (0.0)	15 (26.3)	--	--
Physical Assault					
No	68 (98.6)	10 (100.0)	58 (98.3)	Ref.	Ref.
Yes	1 (1.5)	0 (0.0)	1 (1.69)	--	--

[a]3 missing, [b]5 missing, [c]1 missing, [d]1 missing, [e]2 missing, [f]1 missing, [g]2 missing, [h]1 missing, [i]1 missing, [j]1 missing, [k]6 missing, [l]Adjusted for race and urbanicity

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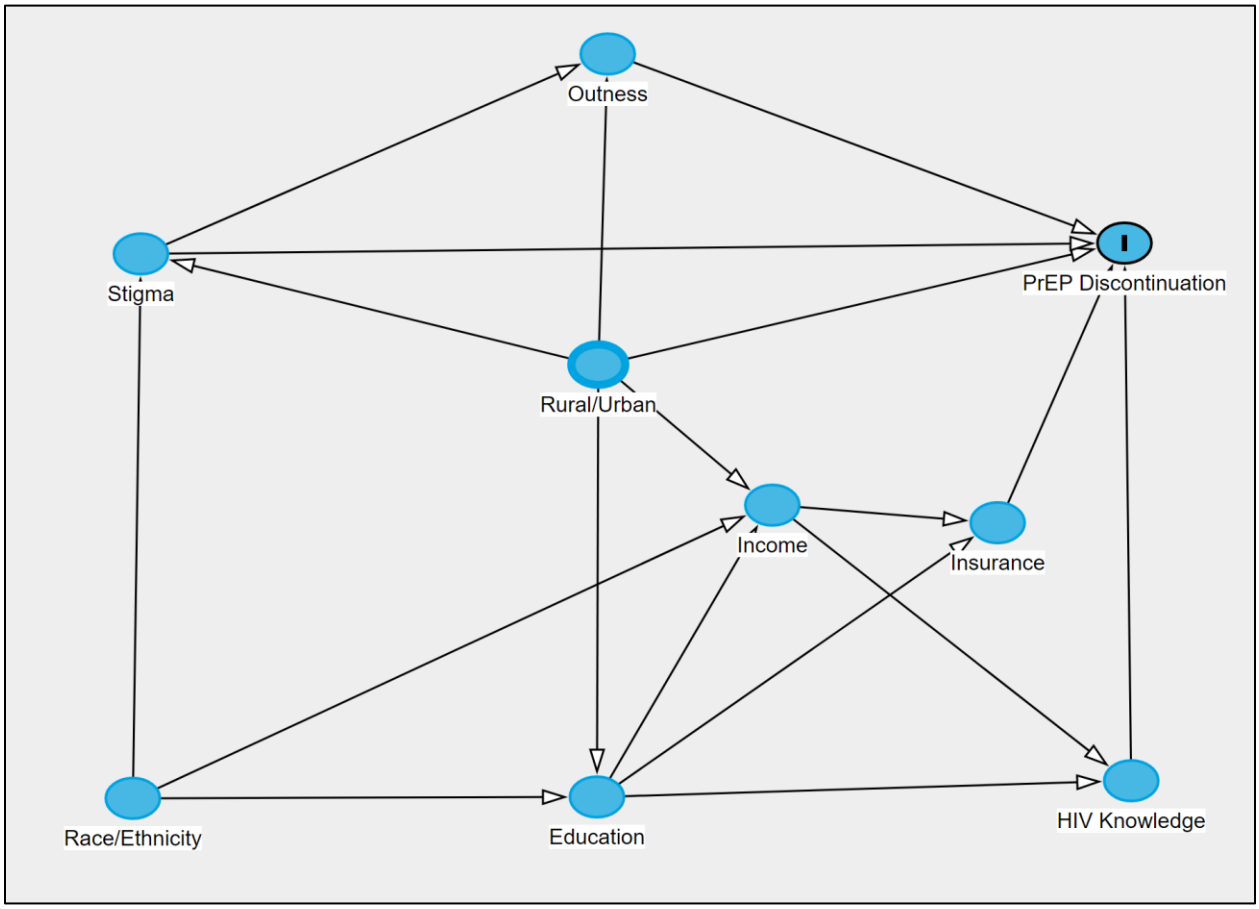
Appendix A. Directed Acyclic Graph



Appendix B. Sexual Behavior Stigma Questions

Sexual behavior stigma items (response options: yes/no)

1. Family Exclusion: Have you ever felt excluded from family activities because you have sex with men?
2. Family Gossip: Have you ever felt that family members have made discriminatory remarks or gossiped about you because you have sex with men?
3. Friend Rejection: Have you ever felt rejected by your friends because you have sex with men?
4. Afraid to Seek Healthcare: Have you ever felt afraid to go to health care services because you worry someone may learn you have sex with men?
5. Healthcare Avoidance: Have you ever avoided going to health care services because you worry someone may learn you have sex with men?
6. Healthcare Worker Gossip: Have you ever heard health care providers gossiping about you (talking about you) because you have sex with men?
7. Poor Healthcare Treatment: Have you ever felt that you were not treated well in a health center because someone knew that you have sex with men?
8. Police Refusal to Protect: Have you ever felt that the police refused to protect you because you have sex with men?
9. Scared in Public: Have you ever felt scared to be in public places because you have sex with men?
10. Blackmail: Have you ever been blackmailed by someone because you have sex with men?
11. Rape: Have you ever been forced to have sex when you did not want to? By forced, we mean physically forced, coerced to have sex, or penetrated with an object, when you did not want to.
12. Verbal Harassment: In the past 12 months, were you called names or insulted because someone knew or assumed you were attracted to men?
13. Discrimination: In the past 12 months, have any of the following things happened to you because someone knew or assumed you were attracted to men?
    a. You received poorer services than other people in restaurants, stores, other businesses or agencies.
    b. You were treated unfairly at work or school.
    c. You were denied or given lower quality health care.
14. Physical Assault: In the past 12 months, were you physically attacked or injured because someone knew or assumed you were attracted to men?

Appendix C. HIV Knowledge Questions

HIV knowledge items (Response options: true/false)

1. A person who has HIV can look healthy.
2. If a person is infected with HIV, they can show symptoms within a month of being infected.
3. There is a vaccine that can stop you from getting HIV.
4. Even if your partner has HIV, the risk for getting HIV is very low when deep kissing (tongue in partner's mouth).
5. Nearly all HIV transmission comes from having lots of boyfriends or hook-ups.
6. The risk of getting HIV is very low when having oral sex.
7. A person is more likely to get HIV from receptive sex (bottom) than insertive sex (top).
8. Showering or washing your genitals/private parts after having sex will make you less likely to get HIV.

Appendix D. Self-Efficacy Questions

Self-efficacy items (Response options: not at all true (0)/hardly true (1)/moderately true (2)/exactly true (3))

1. I can always manage to solve difficult problems if I try hard enough.
2. If someone opposes me, I can find the means and ways to get what I want.
3. It is easy for me to stick to my aims and accomplish my goals.
4. I am confident that I could deal efficiently with unexpected events.
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.
6. I can solve most problems if I invest the necessary effort.
7. I can remain calm when facing difficulties because I can rely on my coping abilities.
8. When I am confronted with a problem, I can usually find several solutions.
9. If I am in trouble, I can usually think of a solution.