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What Happens Next? Syndemic Connections to Treatment for Substance Use among Men who have Sex with Men Living in Los Angeles, CA

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What Happens Next? Syndemic Connections to Treatment for Substance Use among Men who have Sex with Men Living in Los Angeles, CA

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Epidemiology

by

Julia Jan Koerber

2024

ABSTRACT OF THE DISSERTATION

What Happens Next? Syndemic Connections to Treatment for Substance Use among Men who have Sex with Men Living in Los Angeles, CA

by

Julia Jan Koerber

Doctor of Philosophy in Epidemiology

University of California, Los Angeles, 2024

Professor Pamina M. Gorbach, Chair

BACKGROUND: Substance use drives worse HIV outcomes among men who have sex with men, while reducing substance use can improve physical and mental health. Despite this, there has been limited research on the outcomes that men who have sex with men experience in the community after they have exited treatment for substance use. This dissertation examines the factors that are associated with community-based men who have sex with men engaging with treatment for substance use, as well as the substance use and mental health outcomes that follow treatment.

METHODS: This dissertation uses data from men who have sex with men participating in the mSTUDY cohort based in Los Angeles, CA (2014-2024). Chapter 2 examines the socioeconomic, substance use, and health factors that are associated with engaging with treatment for substance use. Chapter 3 assesses how treatment for substance use impacts reductions in the frequency of methamphetamine, cannabis, binge alcohol, and tobacco use over time. Chapter 4 examines the prevalence of high depression and anxiety symptoms in the time period after treatment for

substance use, and analyzes the impact of 12-step group participation on mental health among men in recovery.

RESULTS: Factors associated with treatment for substance use included homelessness, incarceration, methamphetamine use, and living with HIV. After adjusting for other factors, Black and Latinx men were less likely than white men to enter treatment for substance use during follow up. Treatment for substance use at different time points was associated with reduced frequency of methamphetamine and cannabis use, as well as increased high frequency binge alcohol use. Twelve-step group participation was associated with reduced frequency of methamphetamine, cannabis, and binge alcohol use. Men in recovery had worse depression and anxiety symptoms than men who had not received treatment, but 12-step participation was also associated with improved depression and anxiety symptoms.

CONCLUSION: These analyses found that factors that are known to be syndemic with the HIV epidemic are also associated with engagement in and outcomes following treatment for substance use. Community-based, equity-focused interventions to support men who have sex with men who use substances could improve quality of life in recovery.

The dissertation of Julia Jan Koerber is approved.

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2024

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Chapter 1 Introduction

It has long been known that substance use impacts human immunodeficiency virus (HIV) prevention and treatment outcomes in multiple ways. Substance use can facilitate transmission of HIV through direct contact, like through needle sharing, [1] or through sexual contact. [2-6] Additionally, substance use can make it more difficult for people to continue use of anti-retroviral therapy (ART) and pre-exposure prophylaxis (PrEP). [7-13] Decreased substance use is associated with improved HIV viral suppression. [14,15] Despite the positive role that decreasing substance use may have on decreasing transmission of HIV, there has been less research on men who have sex with men's outcomes following treatment for substance use from a longer-term, public health perspective. People who use substances often experience multiple experiences with treatment for substance use and re-initiate substance use after treatment because of the nature of substance addiction. [16] Understanding the factors that are associated with engaging with treatment for substance use, as well as the outcomes that follow treatment once men have returned to the community, could clarify how to support men who have sex with men in recovery, improving quality of life and HIV outcomes. This dissertation aims to contribute to this research gap by examining the overlapping socioeconomic, structural, and health factors that are associated with men who have sex with men in Los Angeles entering treatment for substance use and the substance use and mental health outcomes that follow treatment.

Epidemiology of substance use and treatment for substance use among men who have sex with men

Within national and regional samples, data has shown that substance use and dependence disproportionately impact men who have sex with men. Data from the 2017-2019 National Surveys of Drug Use and Health (NSDUH) found disparities in prior year and past month

substance use between gay and bisexual men and heterosexual men across substances that are used more commonly (such as tobacco (38.8% vs 36.1%), cannabis (35.5% vs. 18.9%), and alcohol (10.3% vs. 8.7%)), and substances that are used more rarely overall (such as cocaine (7.6% vs. 2.8%), prescription opioids (7.3% vs. 4.1%), methamphetamine (2.8% vs. 0.9%), and heroin (0.8% vs. 0.4%)). [17] This analysis also found that gay and bisexual men were more likely than heterosexual men to report a substance use disorder for cannabis, nicotine, alcohol, and illicit substances. [17] Among men who have sex with men reached through street outreach in Los Angeles from 2008-2011, the rates of all past 30-day substance use were higher than national averages, with the most common substances used being alcohol, cannabis, methamphetamine, amyl nitrate, ecstasy, and cocaine. [18] Examining the epidemiology of substance use among communities of men who have sex with men is important to improve the health of men who have sex with men in the United States – substance use is known to be associated with numerous negative mental and physical health effects, including HIV outcomes, [17,19] and negatively impacts a person's quality of life. [20]

Based on data from the 2018 National Survey of Drug Use and Health, 20.8 million adults in the US are estimated to currently be in recovery from substance use, among whom 40.4% have ever received treatment for substance use. [21] Men who have sex with men are more likely than straight men to report having previously experienced treatment for substance use and to report current unmet needs for treatment. [22,23] There are evidence-based modalities available to treat use of different substances that span a large scope, including inpatient and outpatient behavioral and psychosocial interventions, pharmaceutical treatments, and supportive services. [24,25] People who use substances may also undergo medically observed withdrawal from substances (detoxification); while this intervention is necessary, it is different than other types of treatment for substance use due to its acute nature, and frustrating gaps between detoxification and connection to other treatment programs have been documented. [26-28] People may receive support after exiting

treatment for substance use through entering recovery housing, which encapsulates a variety of housing arrangements that are substance-free and organized around fostering recovery in a supportive community setting. [29,30] Mutual aid groups, such as 12-step programs, while not formal treatment programs, offer an informal form of social support that people experiencing problems with substance use may enter in isolation or in combination with formal treatment. [24,25] There have also been interventions specialized for men who have sex with men seeking to reduce substance use, [31-33] seen in adaptations of the contingency management [34-36] and matrix model [37] approaches. Approaches to aftercare following treatment for substance use have also been adapted for men who have sex with men and people living with HIV with mental health conditions, such as in the creation of specific recovery communities. [38,39]

Syndemics theory and its connections to substance use, treatment, and HIV outcomes

Sydnemics theory describes how multiple epidemics (such as substance use, experiences of violence, and HIV) [40] fundamentally interact with each other under the influence of socioeconomic structures and cause disparate health outcomes. [40,41] Syndemics research has named the oppressive structural roles that racism, [42,43] poverty, [42,43] homophobia, [43,44] incarceration, [42,43,45-48] interpersonal violence, [40,44,49,50] and homelessness [45,51] play in HIV outcomes, as well as their interconnections to substance use [51] and mental health. [45,52-54] Wilson et al. 2014 provides a thorough example of the application of syndemics theory that demonstrates how racism, poverty, incarceration, and substance use impact HIV outcomes among Black and Latinx men who have sex with men in New York. [43]

The structural factors that syndemics theory research has connected to HIV outcomes can also be connected to outcomes related to treatment for substance use. Racism and classism cause structural and interpersonal barriers to accessing and completing satisfactory treatment for

substance use that prevent people of color and economically disadvantaged people from having optimal treatment outcomes. [55-61] Additionally, in clinic-based samples, men who have sex with men in treatment for substance use were underserved by treatment programs that did not consider the overlaps of sexuality with substance use. [62-64] Although people living with HIV and mental health conditions have unique considerations for treatment for substance use, [65-67] an analysis of the substance use treatment programs within the National Drug Abuse Treatment Clinical Trials Network conducted in 2011 found that while almost 88% of all clinics had clients living with HIV, 29.8% reported lacking critical medical services for HIV management due to programmatic and structural barriers. [68] High prevalence of homelessness and criminal legal system involvement have also been associated with entering treatment for substance use among national data from the Treatment Episodes Dataset, [69-71] but have also been associated with not finishing treatment. [72-74] This evidence highlights the importance to examine the syndemic socioeconomic and structural factors that are associated with treatment for substance use.

The syndemic factors related to HIV and treatment for substance use can be seen overlapping in Los Angeles County. According to the "Ending the HIV Epidemic in Los Angeles County Executive Summary" released by the Los Angeles County Department of Public Health (LACDPH) in January 2023, there are 58,000 people living with HIV in Los Angeles County, among whom 40% are Latinx men who have sex with men and 23% are Black men who have sex with men, respectively exceeding the proportion of Latinx and Black men in the County population overall. [75] In addition to prioritizing a public health response among Black and Latinx men who have sex with men, LACDPH also recognizes that addressing homelessness, barriers to medical treatment, and substance use are critical targets for intervention to address the HIV epidemic. [75] In Los Angeles County, methamphetamine is the most common primary substance used in public treatment settings, representing 30% of all admissions for public treatment for substance use and 47.5% of admissions from lesbian, gay, bisexual, trans, and queer (LGBTQ) clients from 2022-

2023. [76] Among the 2,305 LGTBQ clients treated for substance use in that year, 47.7% were experiencing homelessness, 70.5% had mental health concerns, and 21.7% had been involved in the criminal legal system. [76] The rate of admission to public treatment settings for methamphetamine use was highest among Black Angelenos (323 admissions per 100,000 people 12 years and older) and Latinx Angelenos (257 admissions per 100,000 people ages 12 years and older). [77] On a national and a local level, fatalities from overdose related to methamphetamine use have increased in recent years, with Black individuals experiencing the highest increase. [77,78] Thus, there is a public health imperative to address the syndemic factors that contribute to the HIV epidemic and impact substance use and treatment for substance use in Los Angeles County. Chapter 2 will examine the socioeconomic, health, and substance use factors that are associated with men who have sex with men reporting a history of treatment for substance use at their baseline visit of the mSTUDY cohort, as well as which factors are associated with entering treatment for substance use during follow up. The purpose of this analysis is to identify areas for intervention to better support men who have sex with men who use substances and may benefit from treatment.

What happens after treatment for substance use? Available epidemiologic perspectives

Most clinical research assesses the efficacy of individual treatment interventions by observing subsequent substance use outcomes over a short period of time; while it is intuitive to gather evidence that a treatment intervention meets treatment goals in the immediate term, there has been more limited insight about the outcomes individuals face longitudinally after leaving the treatment environment, and through subsequent experiences with treatment. [16] This idea is reflected in the substance abuse treatment career theory described by Hser et al. 1997, a lifecourse theory that posits that individuals' experiences with multiple rounds of engagement and exit from treatment for substance use over time and the socioeconomic and structural contexts of their lives inform their composite experience with treatment and their post-treatment outcomes. [16]

Viewing treatment outcomes from a longitudinal perspective is reasonable given how common return to substance use and treatment are over time. [16,79-84]

Additionally, most clinical research has focused on achieving abstinence from substance use following treatment, which is an approach to reducing substance use that may not be desirable for every person who uses substances. [85,86] There has been a movement towards adopting harm reduction approach to substance use. As described in the Substance Abuse and Mental Health Services Administration's *Harm Reduction Framework*, harm reduction is an approach to addressing substance use that is guided by the goals and empowerment of people who use substances, and focuses on holistically supporting individuals who use and mitigating any negative impacts on substance use through a variety of practices. [85] Reduced substance use without abstinence can be a harm reduction goal, [85] and has been associated with improved health outcomes. [87] For example, reduced methamphetamine and opioid use has been associated with improvements in HIV viral load among men who have sex with men living with HIV. [14,51]

Community-based cohort studies have looked at some post-treatment outcomes among people living with HIV, primarily among people who inject substances. The AIDS Link to Intravenous Experiences (ALIVE) cohort in Baltimore, MD follows up 2,946 people who used intravenous drugs, 37.7% of whom are people living with HIV. [80,88] A study observing ALIVE cohort outcomes from 1988-2000 demonstrated that people living without HIV, people who were stably housed, and people who underwent detoxification or methadone maintenance therapy had shorter times to injection cessation, while people living with HIV, people experiencing homelessness, and people who were recently incarcerated had faster times to subsequent return to use. [80] Another study from the same time period expanded this analysis by examining how these factors were associated with longitudinal injection use patterns, finding that 29% of people maintained injection

use, 51% had one or more experiences with relapse, and 20% stopped injection altogether. [88] From Vancouver, Canada, the Vancouver Injection Drug Users Study (VIDUS) and the AIDS Care Cohort to Evaluate Exposure to Survival Services (ACCESS) have respectively followed-up community-based people who inject drugs and people living with HIV who report any substance use, with enrollment beginning in 1996. [89-91] Two studies examining treatment for substance use in these cohorts have assessed the overlap of methamphetamine use and treatment for opioid use, finding that factors like homelessness, other substance use, and riskier sexual behaviors were associated with methamphetamine use while engaged in opioid agonist therapy, [89] and identified frequent methamphetamine use as a predictor of disengaging from methadone maintenance therapy. [90] One study identified that people facing more economic stressors were less likely to be engaged in treatment for substance use other than for opioid use. [91] The ALIVE, VIDUS, and ACCESS cohorts have contributed enormously to understanding the role of socioeconomic and structural factors in substance use treatment-related outcomes, and there are remaining gaps examining differences in post-treatment outcomes among men of color who have sex with men and men who use substances other than opioids. Chapter 3 will address this gap by looking at the frequency of methamphetamine, cannabis, binge alcohol, and tobacco use following treatment for substance use among men in the mSTUDY cohort. These analyses examine if treatment is associated with reduced frequency of use for all these substances in order to examine substance use outcomes following treatment for substance use through a harm reduction lens.

Treatment for substance use, mental health, and social support in recovery

Around one-third (35%) of men who have sex with men globally are estimated to have depression. [92] Among men who have sex with men who use substances, substance use has been associated with worse depressive symptoms [93,94] and mental health, [95] and higher anxiety and depression

symptoms have been associated with less successful maintenance to antiretroviral therapy (ART). [96-99] Higher depression and anxiety symptoms were associated with more harmful polysubstance use among a sample of Black and Latinx people living with HIV in New York. [100] Across different study populations, decreasing substance use is associated with improved depression and anxiety outcomes, [87,101,102] and supporting mental health can prevent return to substance use for people who have been in treatment. [82,103,104]

Research has demonstrated that social support plays a critical role in both substance use and mental health [53,105-107] outcomes among men who have sex with men. A cross-sectional analysis of 450 men who have sex with men living with HIV in China found that anxiety was associated with self-reported likelihood of future substance use only among individuals with low social support. [106] Additionally, among Black men who have sex with men in the HPTN 061 cohort, higher social support was also protective against syndemic exposures to violence, internalized homophobia, trauma, and depression, and was associated with decreased substance use. [53] Self-help, peer-led recovery groups, such as 12-step programs, can be an important source of social support for people in recovery. [108-110] Qualitative research conducted among men who have sex with men has shown that having peers who use substances can complicate recovery, [64,111] while also highlighting the positive potential for recovery-oriented social support from peers, including in the context of 12-step groups. [38,64,112-114] Chapter 4 will examine the depression and anxiety symptoms that follow treatment for substance use among community-based men who have sex with men, which has been less well researched. Additionally, the analysis will assess if participation in 12-step groups is associated with better mental health outcomes for men who have experienced treatment for substance use.

Conceptual model

This thesis applies an adaptation of the Gelberg-Andersen Behavioral Model for Vulnerable Populations. [115] This model conceptualizes that at the population level, there are factors that predispose individuals to certain health conditions and behaviors, enable or prohibit access to appropriate care, and influence the perception and evaluation of healthcare needs. These population-level characteristics were originally conceptualized to be in a mutual feedback loop with individuals' health behavior, healthcare service utilization, and satisfaction. [115]

In the following model adaptation (Fig. 1-1), the population-level (predisposing, enabling, and need) factors have been renamed as health context factors, which distinguish the health needs that an individual may face as well as the factors that drive root health and healthcare access and outcomes. This change was inspired by Ford et al. 2018, who adapted the Behavioral Model for Vulnerable Populations to include structural and institutional racism as drivers of health disparities in lieu of the original model's use of race and ethnicity, following the guidelines of critical race theory. [116] Following this example, structural and interpersonal racism are conceptualized in this adaptation as a healthcare influencing factor because evidence shows that racism is the cause of disparities seen in people of color accessing, receiving, and completing satisfactory treatment for substance use. [56-61,117,118] In these analyses, race and ethnicity are used as a proxy for exposure to racism that operates across these levels, with the acknowledgment that race is a sociopolitcal construct and differences in health outcomes by race are caused by racism. [119-121] Additionally, health insurance, housing, employment, incarceration, and education are included as syndemic socioeconomic factors that can exacerbate health that are shaped by poverty and structural racism. [122-124] On an interpersonal level, racism, poverty, homophobia, and anti-HIV stigma are conceptualized as having overlapping impacts [125] on healthcare outcomes based on if individuals receive culturally competent care, feel welcomed or aggressed against in the treatment

environment, or have felt stigmatized against by care providers because of their race or ethnicity, sexuality, substance use, and/or HIV status. [36,62-64,112,126-136] An adapted version of the Multiple Discrimination Scale (MDS) [137] was administered to mSTUDY participants beginning in 2023, assessing participants' personal lifetime experiences of discrimination across a variety of settings related to race, sexuality, and HIV status. Results from the modified MDS are included to give additional context to the analyses in Aim 1.

To clarify how race and ethnicity are defined [125] in mSTUDY, participants are asked to choose which race and ethnicity option they identify with the most, with options including "American Indian or Alaskan Native; Asian (Japanese, Korean, Chinese, Vietnamese, Filipino, Hmong, Laotian, Thai, Cambodian, etc.); Asian Indian; Black or African American; Native Hawaiian or Pacific Islander (Guamanian or Chamorro, Samoan, Fijian, etc.); White; Hispanic/Latinx/Spanish; Other race." From these responses, most people identified as Black or African American, Hispanic/Latinx/Spanish, or white. A smaller number of people identified as American Indian or Alaskan Native, Asian, Asian Indian, Native Hawaiian or Pacific Islander, or as another race, and due to sample size considerations, these individuals were all included as having another racial or ethnic background. It is critical to note that people who are categorized into the same group have a wide variety of lived experiences that are not reflected by this categorization. [120,138]

Some of the measured individual-level factors include engagement with treatment for substance use, including return to treatment, as well as multiple substance use, social support (measured by Multidimensional Scale of Perceived Social Support, MSPSS [139]), depression symptoms (measured by Center for Epidemiologic Studies Depression Scale, CES-D [140]), and anxiety symptoms (measured by Generalized Anxiety Disorder-7, GAD-7 [141]). The boxes and arrows have been reserved for showing the relationships between key exposures and outcomes of each dissertation aim. Aim 1 describes the socioeconomic and health factors associated with having experience with treatment for substance use as well as entering treatment for substance use

during follow up in mSTUDY. Aim 2 will examine the association of treatment for substance use to frequency of substance use outcomes following treatment among mSTUDY participants. Aim 3 will examine the association between experience with treatment for substance use and depression and anxiety symptom outcomes among mSTUDY participants as they are modified by 12-step group participation, reflected by the purple arrows. The grey, double headed arrows between substance use, 12-step participation, depression, and anxiety reflect the bidirectional associations between these outcomes that have been observed in the literature.[53,54,87,93,101,102,105,106,114]

This dissertation aims to further the research on the factors that are associated with men who have sex with men engaging in treatment for substance use, and the outcomes that follow treatment over time. The goal of this research is to assess potential loci of intervention that address interlocking, syndemic factors of HIV, racism, homelessness, incarceration, and substance use in order to promote better outcomes accessing and following treatment for substance use for men who have sex with men in Los Angeles.

Figure

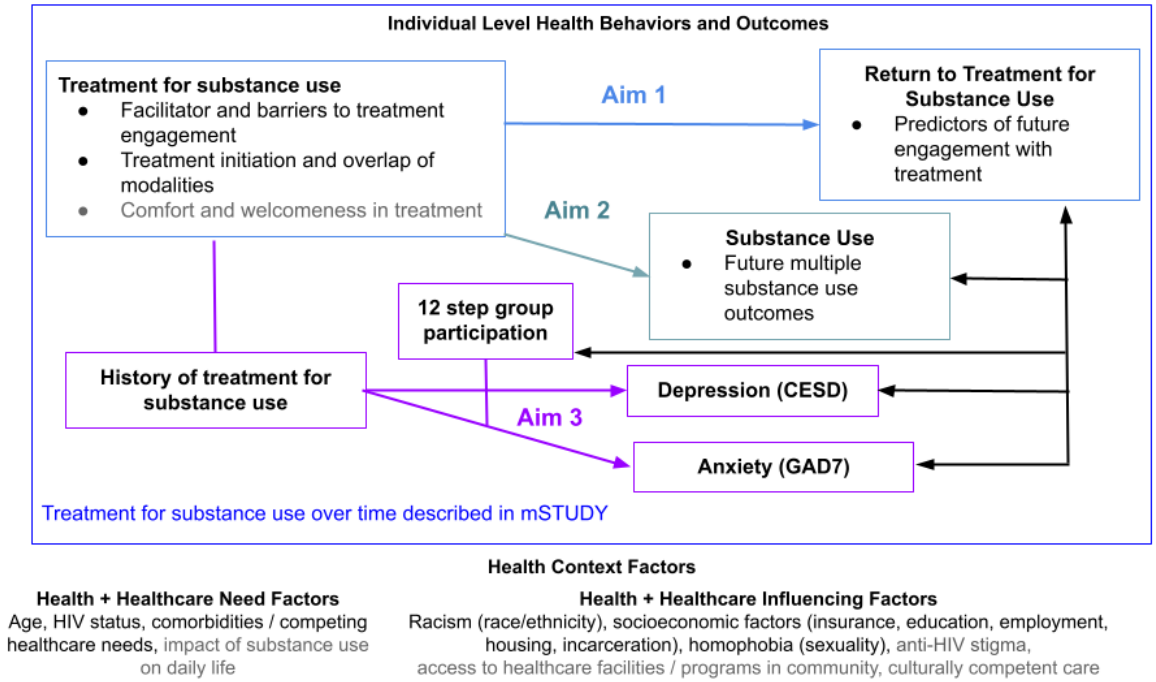


Figure 1-1: Adaptation of Behavioral Health Model for Vulnerable Populations

Chapter 2 Identifying syndemic connections to treatment for substance use among community-based men who have sex with men living with and without HIV in Los Angeles, CA (Aim 1)

Introduction

Men who have sex with men face disparities in both access to and outcomes from treatment for substance use due to overlapping barriers. While national estimates have found that few men who have sex with men report treatment for substance use overall, a higher proportion reported prior treatment as well as unmet treatment needs than men who have sex with women only did. [22,23] A meta-analysis of 36 papers identified that people with substance use disorders and mental health conditions face interpersonal, programmatic, and structural barriers to care, particularly among patients of color and economically disadvantaged patients. [142] The barriers to accessing and completing sufficient, satisfactory treatment for substance use and mental health that Black and Latino men face have also been observed in national US surveys, [56,57] and have led to calls to address racist and socioeconomic barriers to treatment. [58] Research has documented how additional treatment consideration also needs to be paid to people living with HIV who are in treatment for substance use and face mental health conditions, [65-67] which is salient given that 61.4% of people living with HIV in the US have engaged in mental health care or treatment for substance use. [143] Research from the ALIVE, VIDUS, and ACCESS cohorts have demonstrated that people living with HIV, people experiencing homelessness, and people who have recently been incarcerated face additional barriers to treatment and recovery from opiate use. [80,89,91] These findings demonstrate the interconnectedness of homelessness, incarceration, and HIV status on substance use treatment outcomes.

These barriers to treatment and successful recovery can be conceptualized as syndemics, or overlapping epidemics that drive health outcomes through their interaction in society. [40,41]

Syndemics research has demonstrated that HIV outcomes are interconnected to substance use, [51] racism, [42,43] poverty, [42,43] incarceration, [42,43,45-48] and homelessness. [45,51] These interconnections can be seen in Los Angeles County, where Black and Latinx men who have sex with men are over-represented among people living with HIV, [75] and Black and Latinx men disproportionately face homelessness, [144,145] incarceration, [144,145] and fatalities from methamphetamine overdose. [77,146] Knowing that these overlapping epidemics are connected with access to and outcomes following treatment for substance use, and that decreasing substance use is key to prevent the transmission of HIV [147] and to improve HIV care outcomes, [14,15] it is imperative to assess how these factors influence connection to treatment for substance use among men who have sex with men who use substances.

Little research in community settings has examined which factors are facilitators and barriers to engagement with treatment for substance use among men who have sex with men who use substances other than opiates. Research on treatment among community-based Black and Latinx men who have sex with men is particularly limited. This analysis uses data from the ongoing mSTUDY cohort to address this gap, and examines how baseline socioeconomic factors, substance use, and HIV status are associated with a history of treatment for substance use reported at baseline as well as with engaging with treatment during follow up in order to identify the factors that may promote better access to treatment for substance use among men who have sex with men in Los Angeles, CA.

Methods

Study design, data collection, and ethical approval

This study used data collected from men who have sex with men participating in the mSTUDY cohort in Los Angeles, CA. mSTUDY is an open-enrollment, prospective cohort that began in

2014, and people are able to join if they were assigned male at birth, were either living with HIV at the time of study enrollment or had unprotected anal intercourse with someone assigned male at birth within six months prior to enrollment, and provided informed consent to participate. Additional study details have been published elsewhere. [148] Based on the recruitment design, half of mSTUDY participants are people living with HIV and half of participants are people living without HIV. Study participants return to study visits every six months, completing computer-assisted self-interview questionnaires on socioeconomic factors, substance use, and health behaviors, and providing laboratory samples to assess substance use, sexually transmitted infections, and HIV status or viral load. mSTUDY has been approved by the Institutional Review Board at UCLA (IRB#18-000876). This paper is a secondary analysis that uses de-identified data and is approved by the Institutional Review Board at the University of California, Los Angeles.

Inclusion and exclusion criteria

This analysis examines how socioeconomic, substance use, and mental health factors measured at participants' baseline visit in mSTUDY is associated with their prior history of and future engagement with treatment for substance use. There are 145 trans and gender non-conforming people enrolled in mSTUDY, but this analysis could not be replicated in this sample due to sparse data across key covariates. A table describing history of substance use and baseline substance use among trans and gender non-confirming individuals was added to provide some insight on this important population, who also face barriers to accessing treatment for substance use. [149,150] This analysis was thus restricted to mSTUDY participants who identify as cisgender men. The model examining the association of baseline level factors with history of treatment for substance use at enrollment included all baseline visits from men (n = 512), while the model that examined the association of baseline level factors with future entry into treatment for substance use included the baseline visits from men who had at least two visits in mSTUDY (n = 462).

Outcome of interest: Treatment for substance use

Treatment for substance use has been assessed several ways throughout the duration of mSTUDY. At each visit, participants were asked if they were currently in any type of treatment for substance use. Additionally, from 2014 to 2018, participants were asked to report at each visit how many times in their life they had even been in or received i) inpatient treatment, ii) outpatient treatment, iii) sober living / rehabilitative housing, iv) medication for opiate use disorder or alcohol use disorder, and v) detoxification. After 2018, the questions were adapted to ask participants how many times in the past six months they had received each of these five modalities of treatment for substance use. Information on length of stay and treatment setting are not available.

We adapted the methods used by Harawa et al. 2022 [151] to process the data on treatment for substance use. Accordingly, to define prior exposure to treatment for substance use at baseline for visits that occurred between 2014-2018, lifetime exposure to any type of treatment for substance use reported at the baseline visit was coded as prior treatment for substance use. Men who reported being currently in treatment for substance use at their baseline visit were also considered as having prior treatment for substance use. Additionally, for any baseline visits that occurred after 2018, reporting any type of treatment for substance use that occurred within six months prior to enrollment in mSTUDY was considered having prior history of treatment for substance use. This variable was used both as the outcome for Model 1, assessing baseline level factors with history of treatment for substance use prior to mSTUDY enrollment, and as a covariate for the models assessing the association of baseline level factors with future engagement with treatment for substance use among men with and without baseline history of treatment for substance use.

Additionally, the methods from Harawa et al. 2022 were adapted to define which participants entered treatment for substance use during mSTUDY follow up. [151] To define this outcome for the models that assesses the association of baseline level factors with future experience with treatment for substance use, data were examined across all available study visits. If a man reported being currently in treatment at a mSTUDY visit after baseline, or if they reported any type of treatment for substance use within the past six months of a mSTUDY visit that occurred after baseline, they were considered as someone who entered treatment for substance use during follow up. Additionally, for visits conducted from 2014-2018, a man would be considered as entering treatment for substance use during follow up if their reported lifetime experience with a given treatment type was reported as a value higher than their baseline value across at least two visits. This summary variable was then added to data from the baseline visit, so that it could be used as an outcome for the models examining the association of baseline factors with engaging with treatment for substance use during follow up.

Participants were also asked if they were currently participating in a 12-step program. While 12-step programs are an accessible form of support that may aid people who wish to stop using substances, these groups are not formal substance use treatment programs. Thus, engagement in 12-step programs alone, without any sign of other formal treatment engagement, was not defined as exposure to treatment for substance use for the purpose of these analyses.

Baseline covariates of interest

Covariates of interest were measured at the baseline visit. Demographic variables included age, categorized into age ranges that were thought to be more relevant to substance use outcomes than continuous age, with groups including 18-24, 25-29, 30-39 and 40-49 years. Education was defined as fewer than 12 years of school, high school graduate or some college, and college

graduate. Insurance type was defined as government insurance, private insurance, other insurance, and no insurance. Participants were also asked if they had experienced incarceration within six months prior to joining mSTUDY, as well as how many nights they spent in the past six months living in a temporary shelter or place not meant for human habitation, as a measure of housing instability.

Participants were asked to select which race and ethnicity they most closely identified, with options including Black or African American, Hispanic, Latinx or Spanish, white, American Indian or Alaskan Native, Asian, Asian Indian, Native Hawaiian or Pacific Islander, or another race and ethnicity. Based on sample size considerations in this analysis, people who identify as American Indian or Alaskan Native, Asian, Asian Indian, Native Hawaiian or Pacific Islander, or another race and ethnicity were listed as "other" race or ethnicity. As per the conceptual model applied in this dissertation based on Ford et al. 2018's adaptation [116] of Gelberg-Andersen Behavioral Model for Vulnerable Populations, [115] race and ethnicity is being included as a covariate as a way to detect disparities in treatment engagement across people of different races and ethnicities that are understood to result from structural [123] and interpersonal racism. Additionally, in 2023, mSTUDY participants were asked to complete a modified version of the Multiple Discrimination Scale (MDS), [137] which asks participants to describe how often they have experienced different types of discrimination related to their race, sexuality, race and sexuality, and HIV status (among people living with HIV) within their lifetime. Each subscale has 13 items that cover discriminatory events related to relationships, health care, housing, and more. Each item is scored in a range of 0 to 2 points, which 0 meaning having never experienced the event, 1 meaning the event has happened "a little", and 2 meaning the event has happened "a lot." Scores were categorized based on the sum across the 13 items in each subscale, with the categories being 0 points, 1-9 points, and 10-26 points. Results from these scales (both sums of each subsection and results for how many times the participant experienced discrimination in health care) were used to assess

discrimination among Black and Latinx men who did and did not enter treatment during mSTUDY follow up.

Substance use was captured through both a self-reported frequency measure adapted from the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) [152] and confirmed through urine toxicology panels. If a participant either self-reported any methamphetamine use within the past six months, or if they screened positive for methamphetamine in their urine sample, they were categorized into the any methamphetamine use category. If the participant did not use methamphetamine, but reported use of cocaine, poppers, ecstasy, party drugs, off-label prescription medications, opiates, or other illicit substances, they were placed in the other substances category. Urine toxicology results were available for cocaine, opiates, and ecstasy to help confirm this assignment. If a participant did not self-report or screen positive for any of these substances, but self-reported or screened positive for cannabis use, they were placed in the any cannabis use category. The final category was for people who reported any alcohol use, or no substance use at all, and did not have a positive urine toxicology result for any other substance.

HIV status was defined as people living with HIV who were virally suppressed based on laboratory confirmation of their HIV viral load, people living with HIV who were not virally suppressed, and people living without HIV. High depression symptoms were defined based on the Center for Epidemiologic Studies – Depression Scale (CES-D) [140] score. Based on prior research about optimizing detection of depression symptoms among people living with HIV, [93,153] a participant living with HIV was considered to have high depression symptoms if they screened above 23 points, and a participant living without HIV was considered to have high depression symptoms if they screened above 16 points. [140]

Analytic strategy

Univariate analyses were run for all variables of interest, and missing observations for any time-invariant variables were imputed where reasonable. Bivariate descriptive tests, including chi-square tests for categorical variables, ANOVA for age, and Kruskal-Wallis tests for CES-D score were run to calculate p-values assessing how baseline covariates of interests varied among men who did and did not have a history of treatment for substance use at baseline.

Binary logistic regression multivariable models were used to assess the association of baseline characteristics with history of treatment for substance use reported at baseline (Model 1), and engaging with any modality of treatment for substance use during mSTUDY follow up (Model 2). All models included covariates measured at baseline, including age, race and ethnicity, HIV and treatment status, education, insurance, past six-month experience with homelessness, past six month experience with incarceration, past six month substance use, and CES-D score. Additionally, Model 2 adjusted for baseline history of treatment for substance use, and adjusted for time spent in mSTUDY in months, as per Harawa et al. 2022. [5] All analyses were conducted in SAS OnDemand for Academics (SAS Institute Inc., Cary, NC, USA). Figure 2-1 was made with R Statistical Software, using the packages UpSetR [154] and tidyverse. [155]

Results

Sample characteristics

Data was collected from the baseline visits from 512 men, among whom 133 (26%) had experienced treatment for substance use either currently during the baseline visit or at any time before the visit, and 379 (74%) had never experienced treatment for substance use (Table 2-1). The average age was 32 years (SD 7 years). 41% of men were Black, 41% were Latinx, 6% were another race or ethnicity and 12% were white. 51% of men were living with HIV. 88% had

completed 12 or more years of school, and 56% had government health insurance. Almost one-third of men had experienced incarceration within the past six months (29%) and a quarter had experienced at least one day of unstable housing in the past month (25%). Almost half (46%) of men reported methamphetamine use and had a CES-D depression symptom score above cutoff levels (49%).

Compared to men who did not have a history of treatment for substance use, men with a history of treatment for substance use were slightly older (mean age 34, SD = 7, 21% ages 40-49 versus mean age 31, SD = 7, 14% ages 40-49, p-value <0.01, Table 2-1). Additionally, compared to men without a history of treatment for substance use, fewer men with a history of treatment for substance use were Black (32% versus 44%) and more were Latinx (48% versus 38%), identified as another race or ethnicity (8% versus 5%), or white (13% versus 12%), although this distribution was not statistically significant. Most men with a history of treatment for substance use at baseline were living with HIV and had a suppressed viral load (47%). More men without a history of treatment for substance use were living without HIV (54%), but the proportion of men living with HIV that was not virally suppressed was higher in this group compared to men with a history of treatment (23% versus 19%) (HIV status p-value <0.01). Completing high school or some college was the most common experience with education across both groups (62% overall), as was being covered by government insurance (56% overall), but compared to men with a history of treatment for substance use, more men without a history of treatment for substance use were college graduates (30% versus 16%, p-value <0.01) and had no insurance (14% versus 8%). More men with a history of treatment for substance use reported experiencing unstable housing within six months of their baseline mSTUDY visit than men without a history of treatment (40% versus 20%, p-value <0.01), incarceration within 6 months prior to enrolling in mSTUDY (44% versus 24%, p-value <0.01), and have a CES-D screener above threshold (56% versus 46%, p-value <0.05).

Most men with a history of treatment for substance use reported using methamphetamine at baseline (64% versus 40% among men without a history of treatment, p-value <0.01).

Among men who had a history of treatment for substance use, 40.7% reported currently being in treatment during their baseline mSTUDY visit. Among them, the most common subtype of prior treatment was in-patient treatment (74%), followed by outpatient treatment (62%), sober living / rehabilitative housing (59%), detoxification (38%), and medication for opiate or alcohol use disorder (MOUD) (19%) (data not shown). Additionally, 54% of men who had previously experienced treatment for substance use were participating in a 12-step support group during their baseline visit, compared to 5% of men who had never previously experienced a formal treatment for substance use (data not shown). Figure 2-1 graphically represents the overlap of different formal modalities of treatment for substance use.

Table 2-2 describes that among trans and gender non-conforming mSTUDY participants, 47 (32%) of participants reported history for substance use at baseline. Among people who had a history of treatment for substance use, 68% reported using any methamphetamine at baseline, compared to 46% of people who did not have a history of substance use. The use of substances other than methamphetamine was more common among people without a history of treatment for substance use (24% versus 4%). Additional variables were not included in this table in the interest of maintaining participant privacy, as some cell sizes of descriptive variables were small.

Factors associated with history of treatment for substance use at baseline visit

In a multivariable logistic regression model assessing the association of baseline characteristics with history of treatment for substance use reported at baseline among 462 men, men living with HIV who were virally suppressed had an adjusted odds of having a history of treatment that was

2.9 times that of men living without HIV (aOR = 2.87, 95% CI 1.49-5.44, Table 2-3). Men who finished their education before completing high school (aOR = 4.09, 95% CI 1.65-10.15) and who completed high school or some college (aOR = 2.78, 95% CI 1.38-5.59) had higher adjusted odds of having a history of treatment for substance use than men who graduated college. Men who experienced housing instability within six months before enrolling in mSTUDY had 2.9 times the adjusted odds of having a history of treatment for substance use than men who did not experience housing instability (aOR = 2.86, 95% CI 1.60-5.10). Men who experienced incarceration within six months of enrolling in mSTUDY had an adjusted odds of having a history of treatment for substance use that was 2.6 times that of men who had not experienced incarceration in that time frame (aOR = 2.61, 95% CI 1.53-4.47). Men who used substances other than methamphetamine (aOR = 0.23, 95% CI 0.1-0.53) or cannabis (aOR = 0.15, 95% CI 0.04-0.59) at baseline had significantly lower odds of reporting history of treatment than men who reported using alcohol or no substances.

Baseline factors associated with engaging with treatment for substance use during follow up

In a multivariable logistic regression model examining the association of baseline characteristics with engaging with treatment for substance use during mSTUDY follow up among 388 men, having a history of treatment for substance use at baseline was strongly associated with subsequent treatment (aOR = 24.79, 95% CI 11.1-55.37, Table 2-4). Black men had an adjusted odds of engaging with treatment for substance use during follow up that was 0.39 times that of white men (aOR = 0.39, 95% CI 0.15-1.02). Latinx men had an adjusted odds of engaging with treatment for substance use during follow up that was 0.37 times that of white men (aOR = 0.37, 95% CI 0.14-0.95). Men living with HIV who were virally suppressed at baseline had an adjusted odds that was 3.41 times that of men living without HIV (aOR = 3.41, 95% CI 1.54-7.54). Men with private insurance at baseline had an adjusted odds of engaging with treatment for substance

use that was 0.3 times that of men with government insurance (aOR = 0.30, 95% CI 0.11-0.82). Men who experienced unstable housing within six months of baseline had an adjusted odds of engaging with treatment for substance use that was 2.3 times that of men who had not experienced unstable housing (95% CI 1.12-4.76). Men who had been incarcerated within six months of entering mSTUDY had 1.75 times the adjusted odds of engaging with treatment for substance use during follow up than men who had not experienced incarceration (aOR = 1.75, 95% CI 0.91-3.35). Men who used methamphetamine at baseline had an adjusted odds of engaging with treatment for substance use that was 3.87 times that of people who used alcohol or no substances at baseline (aOR = 3.87, 95% CI 1.52-9.89).

To give context to the findings that Black and Latinx men had lower adjusted odds of entering treatment for substance use during follow up than white men, men's self-reported experiences with discrimination based on their race, sexuality, race and sexuality, and HIV status were described looking at results from the modified Multiple Discrimination Scales (MDS). MDS results were examined to describe what types of discrimination Black and Latinx men in mSTUDY experienced, and if it varied among men who did and did not enter treatment for substance use during follow up (Table 2-5). Based on timing of when the MDS was launched in mSTUDY, data were available from 77 Black men and 96 Latinx men. More than half of Black and Latinx men reported experiencing discrimination based on their race (respectively 56% and 50%). Discrimination based on sexuality and both race and sexuality were also common, respectively 39% and 47% among Black men and 49% and 42% among Latinx men. Around half of men living with HIV experienced discrimination based on their HIV status (46% among Black men and 50% among Latinx men). A quarter of Black and Latinx men reported being mistreated in a health care setting due to discrimination from any factor. When comparing across men who did and did not receive treatment for substance use during mSTUDY follow up, a higher proportion of men who

received treatment in both groups had elevated subscale scores than men who did not receive treatment, and this difference was statistically significant among Latinx men.

Discussion

This analysis examined the structural, socioeconomic, and health factors that are associated with engaging with treatment for substance use among a community-based sample of men who have sex with men in Los Angeles. About a quarter of men reported prior experience with treatment for substance use at baseline, among whom almost half reported experiencing unstable housing (40%) or incarceration (44%) within six months of their baseline visit, and approximately two-thirds were using methamphetamine (64%) at baseline. All these factors, as well as HIV status, were associated with entering treatment for substance use during follow up. Additionally, Black and Latinx men had lower adjusted odds of entering treatment for substance use during follow up than white men. These findings have different implications for how to support men who have sex with men in recovery from substance use and point towards areas for potential intervention on improving treatment for substance use.

Men who were homeless at baseline had three times the odds of having a history of treatment for substance use at baseline compared to men who were not homeless, and twice the odds of entering treatment during follow up. This increased odds of contact with treatment for substance use makes sense in the context of the treatment ecosystem in Los Angeles County, where publicly funded substance use treatment programs are available to income eligible County residents or people referred to from County programs, such as drug court. [156] From 2022 to 2023, Los Angeles County provided treatment for over 12,000 people experiencing homelessness, who represented one-third of all public treatment patients. [76] Over half of admissions were for residential treatment programs, and only around one-third of patients reported having stable housing available to them

upon completion of treatment. [76] Data from California state Medicaid patients from 2016-2019 showed that people who were experiencing homelessness had significantly lower chances of reaching successful discharge from treatment, including from residential treatment. [72] Qualitative research from people experiencing homelessness demonstrates that the available time in residential treatment may not be sufficient, and that without housing available, people will likely begin using substances again. [111,157] This demonstrates that while treatment may be available, it may not be sufficient to meet the wholistic treatment needs of people experiencing homelessness, which has led to calls for increasing housing and wraparound services to be available to people experiencing homelessness after leaving treatment. [72,111,157] In light of the tragic increase of overdose fatalities among people experiencing homelessness, Los Angeles County Department of Public Health Substance Abuse Prevention and Control division has taken movement in this direction, announcing plans to expand harm reduction services, access to residential beds, and criminal justice diversion to people experiencing homelessness. [146]

The positive association of incarceration and housing instability at baseline with prior and future treatment for substance use, along with the disparities in Black and Latinx men who have sex with men accessing treatment during follow up, emphasizes the need to center racial equity in treatment for substance use. Black and Latinx men are overrepresented among people experiencing incarceration and homelessness in LA County, [144,145] and in this study, men who experienced unstable housing or incarceration at baseline both had almost three times the odds of reporting prior treatment for substance use at baseline and twice the odds of entering treatment for substance use during mSTUDY follow up. Housing instability is associated with polysubstance use among men who have sex with men, [100] and incarceration is a risk factor for homelessness. [158] People who use substances and people experiencing homelessness are more likely to be incarcerated, [159] and while the time period after release is known to be a risk factor for return to substance use, [160] there is a notable lack of formal resources for treatment for substance use

available in LA County jails or upon re-entry to the community. [111] Additionally, after controlling for other covariates, Black and Latinx men had lower odds of entering treatment for substance use compared to white men during follow up, and 29% of Black men who entered treatment for substance use and 37% of Latinx men who entered treatment for substance use reported experiencing discrimination in a healthcare setting. Racial disparities in accessing and completing satisfactory treatment for substance use have been well documented and stem from structural and interpersonal racism that needs to be addressed to ensure equity in treatment outcomes. [56,57,161,162] These results emphasize that anti-racist action is required to address homelessness, incarceration, and access to equitable treatment for substance use for men who have sex with men in Los Angeles. [58,144] Initiatives like the Mobile-Enhanced Prevention Support Study offer an example of actionable approaches to increasing access to treatment for substance use among men who have sex with men and transgender women who are leaving incarceration in Los Angeles. [163]

Men who reported methamphetamine use at baseline had four times the odds of entering treatment for substance use during follow up compared to men who used alcohol or no substances. Prior research from the mSTUDY cohort has demonstrated that reductions in methamphetamine use are associated with improved underlying health, [51] and that receiving treatment is associated with reductions in use at six month follow up. [148] Given the lack of widely available and effective pharmacological treatment options, psychosocial interventions are the most common approach to treatment for methamphetamine use. [164,165] Modalities of treatment that also address socioeconomic stressors, such as the matrix model or contingency management approaches, have been successful in interventions tailored for communities of men who have sex with men. [34-37] In a qualitative study, Black men who have sex with men who use methamphetamine echoed that supportive programs would ideally incorporate case management and facilitation to resources for food and housing, as well as facilitate safe therapeutic spaces

that center the experiences of Black men who have sex with men who use methamphetamine. [112] Given that return to methamphetamine use after treatment is very common, [166] culturally tailored services that can facilitate connection to supportive resources should continue to be made available to men who have sex with men who use methamphetamine, and additional modalities of treatment with improved efficacy should be developed, recognizing that people who use meth often experience cyclical treatment and return to use. [167]

Most men who had experienced treatment for substance use in this sample were living with HIV (66%). Encouragingly, 71% of the men living with HIV who had received treatment for substance use previously were virally suppressed at baseline. Men living with HIV that were virally suppressed had three times the odds of reporting prior treatment for substance use at baseline and entering treatment during mSTUDY compared to men living without HIV. This may be due to people living with HIV having access to Ryan White funded clinics, which can offer both support in managing HIV and can facilitate access to treatment for substance use. [168] Conversely, 29% of men who had a history of treatment for substance use at baseline and were living with HIV were not virally suppressed at baseline. This emphasizes the importance of addressing any programmatic barriers that prevent the needs of men who have sex with men who use substances and are living with HIV from being met in treatment, [169] particularly given that substance use is a barrier to achieving viral suppression among Ryan White patients. [170]

This study is limited by using self-reported data for several sensitive topics, including treatment for substance use, experiences with incarceration and unstable housing, and substance use. To reduce measurement error from social desirability bias, participants were able to fill out answers to these questions using computer assisted self-interview interfaces and results from urine toxicology screens were combined with self-reported substance use to reduce misclassification. These results may also be subject to selection bias because participants are only able to complete

study visits if they are in the community, so individuals who are incarcerated or in inpatient treatment for substance use will not be able to complete as many visits as participants who are not incarcerated or in inpatient treatment. Additionally, the results from this study sample may not be transportable to the broader community of men who have sex with men living in Los Angeles, given the prevalence of housing instability and methamphetamine use in this sample. The strength of this analysis is that it offers an opportunity to look at the factors that are associated with entering substance use treatment from a cohort of diverse, community-based men who have sex with men, offering insight that has not been available from clinic-based samples.

Conclusion

This analysis demonstrates that the syndemics of methamphetamine use, homelessness, incarceration, and HIV status have significant overlaps with men who have sex with men accessing treatment for substance use. In Los Angeles County, Black and Latinx men who have sex with men are disproportionately impacted by these syndemics because of structural racism, so structural changes and interventions to support men who have sex with men in Los Angeles who use substances should prioritize equitable and accessible resources that cross all of these domains, with a central focus on the experiences of Black and Latinx men who have sex with men.

Tables and Figures

Table 2-1: Baseline sociodemographic characteristics of mSTUDY participants (n=512) at baseline visit by history of treatment for substance use.

	Overall N=512 (100%)	History of treatment N=133 (26%)	No history of treatment N=379 (74%)
Age (mean, SD) **	32 (7)	34 (7)	31 (7)
18-24	89 (17.4)	12 (9)	77 (20.3)
25-29	121 (23.6)	28 (21.1)	93 (24.5)
30-39	218 (42.6)	64 (48.1)	154 (40.6)
40-49	81 (15.8)	28 (21.1)	53 (14)
Race and ethnicity			
Black or African American	210 (41)	42 (31.6)	168 (44.3)
Hispanic, Latinx, or Spanish	209 (40.8)	64 (48.1)	145 (38.3)
Other	30 (5.9)	10 (7.5)	20 (5.3)
White	63 (12.3)	17 (12.8)	46 (12.1)
HIV Status **			
MWH, virally suppressed	148 (28.9)	62 (46.6)	86 (22.7)
MWH, not virally suppressed	112 (21.9)	25 (18.8)	87 (23)
MWOH	246 (48.1)	42 (31.6)	204 (53.8)
Education **			
Less than high school	63 (12.3)	23 (17.3)	40 (10.6)
High school / some college	316 (61.7)	89 (66.9)	227 (59.9)
College graduate	133 (26)	21 (15.8)	112 (29.6)
Insurance			
Private	90 (17.6)	19 (14.3)	71 (18.7)
Government	288 (56.3)	83 (62.4)	205 (54.1)
Other	69 (13.5)	21 (15.8)	48 (12.7)
None	64 (12.5)	10 (7.5)	54 (14.3)
Unstable housing in past 6 months **			
1+ days	129 (25.2)	53 (39.9)	76 (20.1)
Incarceration in past 6 months **			
Yes	149 (29.1)	59 (44.4)	90 (23.8)
CES-D (median, IQR) *	18 (18)	23 (18)	16 (18)
Above cutoff	249 (48.6)	75 (56.4)	174 (45.9)
Categorical substance use **			
Any methamphetamine use	234 (45.7)	85 (63.9)	149 (39.3)
Any other substances	151 (29.5)	20 (15)	131 (34.6)
Any cannabis use	55 (10.7)	3 (2.3)	52 (13.7)
Alcohol use or no substance use	72 (14.1)	25 (18.8)	47 (12.4)

SD: Standard deviation. MWH: Men living with HIV. MWOH: Men living without HIV. CES-D: Center for Epidemiologic Studies Depression screener score. IQR: Inter-quartile range. Totals may not equal 100% because of missing data. * = p-value <0.05. ** = p-value <0.01

Table 2-2: Substance use and baseline history of treatment for substance use among trans and gender diverse mSTUDY participants (n=145).

	Overall n=145 (100%)	**History of treatment** n=47 (32%)	**No history of treatment** n=90 (62%)
Gender Identity			
Gender non-conforming	116 (80)	37 (78.7)	71 (78.9)
Trans or intersex	29 (20)	10 (21.3)	19 (21.1)
Baseline Substance Use			
Any methamphetamine use	81 (55.9)	32 (68.1)	41 (45.6)
Any other substance use	24 (16.6)	2 (4.3)	22 (24.4)
Any cannabis use	14 (9.7)	2 (4.3)	12 (13.3)
Alcohol use or no substance use	25 (17.2)	11 (23.4)	14 (15.6)

Gender non-conforming reflects the following gender identities: genderqueer, realness, butch queen, gender non-conforming, genderfuck, femme queen, crossdresser, other, not listed, or refused. Trans or intersex included the following gender identities, combined due to smaller counts: transgender (male to female), transgender (female to male), or intersex. Rows may not add up due to missing data.

Table 2-3: Multivariable adjusted odds ratio estimates between baseline characteristics and history of treatment for substance use reported at baseline (Model 1; n = 462).

	Baseline history of treatment for substance use aOR (95% CI)
Age	
18-24	0.47 (0.2-1.08)
25-29	0.61 (0.32-1.19)
40-49	0.99 (0.5-1.94)
30-39	Ref.
Race and ethnicity	
Black or African American	0.86 (0.38-1.94)
Hispanic, Latinx, or Spanish	2.04 (0.92-4.51)
Other	1.4 (0.4-4.88)
White	Ref.
HIV Status	
MWH, VS	2.87 (1.49-5.55)
MWH, not VS	1.05 (0.52-2.13)
MWOH	Ref.
Education	
Less than high school	4.09 (1.65-10.15)
High school/ some college	2.78 (1.38-5.59)
College graduate	Ref.
Insurance	
No insurance	0.68 (0.25-1.8)
Other	0.92 (0.45-1.9)
Private	1.62 (0.78-3.39)
Government	Ref.
Unstable housing in past 6 months	
1+ days vs 0 days	2.86 (1.6-5.1)
Incarceration in past 6 months	
Yes vs no	2.61 (1.53-4.47)
CES-D score	
Above vs below threshold	1.38 (0.82-2.32)
Categorical substance use	
Any methamphetamine	0.57 (0.28-1.15)
Any other substances	0.23 (0.1-0.53)
Any cannabis use	0.15 (0.04-0.59)
Alcohol use or no substance use	Ref.

MWH: Men living with HIV. MWOH: Men living without HIV. VS: HIV viral suppression. CES-D: Center for Epidemiologic Studies Depression Scale score, with threshold score 23 points or higher for men living with HIV and 16 points or higher for men living without HIV. aOR = adjusted odds ratio. CI = confidence interval.

Table 2-4: Multivariable adjusted odds ratio estimates between baseline characteristics and engaging with treatment for substance use during mSTUDY follow up (Model 2; n=388).

	Future engagement with treatment for substance use aOR (95% CI)
Baseline history of treatment for substance use (Yes vs No)	24.79 (11.1-55.37)
Age	
18-24	1.61 (0.6-4.33)
25-29	1.24 (0.56-2.72)
40-49	0.59 (0.25-1.38)
30-39	Ref.
Race and ethnicity	
Black or African American	0.39 (0.15-1.02)
Hispanic, Latinx, or Spanish	0.37 (0.14-0.95)
Other	0.33 (0.07-1.48)
White	Ref.
HIV Status	
MWH, VS	3.41 (1.54-7.54)
MWH, not VS	1.19 (0.51-2.75)
MWOH	Ref.
Education	
Less than high school	1.07 (0.38-3.06)
High school/ some college	0.63 (0.3-1.32)
College graduate	Ref.
Insurance	
No insurance	1.8 (0.67-4.86)
Other	0.97 (0.4-2.33)
Private	0.3 (0.11-0.82)
Government	Ref.
Unstable housing in past 6 months	
1+ days vs 0 days	2.3 (1.12-4.76)
Incarceration in past 6 months	
Yes vs No	1.75 (0.91-3.35)
CES-D score	
Above vs below threshold	1.07 (0.57-2)
Categorical substance use	
Any methamphetamine	3.87 (1.52-9.89)
Any other substances	1.76 (0.63-4.93)
Any cannabis use	0.62 (0.12-3.14)
Alcohol use or no substance use	Ref.

MWH: Men living with HIV. MWOH: Men living without HIV. VS: HIV viral suppression. CES-D: Center for Epidemiologic Studies Depression Scale score, with threshold score 23 points or higher for men living with HIV and 16 points or higher for men living without HIV.

Table 2-5: Modified Multiple Discrimination Scale results among Black and Latinx men in mSTUDY, by incident treatment for substance use during follow up.

		Black men (n= 77)	No incident treatment (n = 56)	Incident treatment (n = 21)		**Latinx men (n = 96)**	No incident treatment (n = 61)	Incident treatment (n = 35)
MDS - Race					**			
0		34 (44%)	24 (43%)	10 (48%)		48 (50%)	33 (54%)	15 (43%)
1 to 9		26 (34%)	20 (36%)	6 (29%)		35 (37%)	25 (41%)	10 (29%)
10 to 26		17 (22%)	12 (21%)	5 (23%)		13 (14%)	3 (5%)	10 (29%)
Mistreated in health care		16 (21%)	11 (20%)	5 (24%)	*	14 (15%)	5 (8%)	9 (26%)
MDS - Sexuality					**			
0		47 (61%)	34 (61%)	13 (62%)		49 (51%)	32 (53%)	17 (49%)
1 to 9		13 (17%)	12 (21%)	1 (5%)		32 (33%)	25 (41%)	7 (20%)
10 to 26		17 (22%)	10 (18%)	7 (33%)		15 (16%)	4 (7%)	11 (31%)
Mistreated in health care		15 (20%)	10 (18%)	5 (24%)		16 (17%)	8 (13%)	8 (23%)
MDS - Race and Sexuality					**			
0		41 (53%)	28 (50%)	13 (62%)		55 (58%)	40 (66%)	15 (43%)
1 to 9		19 (25%)	17 (30%)	2 (10%)		25 (26%)	16 (26%)	9 (26%)
10 to 26		17 (22%)	11 (20%)	6 (29%)		16 (17%)	5 (8%)	11 (31%)
Mistreated in health care		13 (17%)	8 (14%)	5 (24%)	**	16 (17%)	4 (7%)	12 (34%)
MDS - HIV		**n = 42**	**n = 27**	**n = 15**		**n = 66**	**n = 36**	**n = 30**
0		23 (55%)	16 (59%)	7 (47%)		33 (50%)	20 (56%)	13 (43%)
1 to 9		17 (41%)	11 (41%)	6 (40%)		24 (36%)	15 (36%)	11 (37%)
10 to 26		2 (5%)	0 (0%)	2 (13%)		9 (14%)	3 (8%)	6 (20%)
Mistreated in health care		7 (17%)	4 (15%)	3 (20%)		13 (20%)	4 (11%)	9 (30%)
Any mistreatment in health care		29 (25%)	13 (23%)	6 (29%)	*	24 (25%)	11 (18%)	13 (37%)

*= p-value <0.05; **=p-value <0.01 from chi-square or Fisher's exact test.

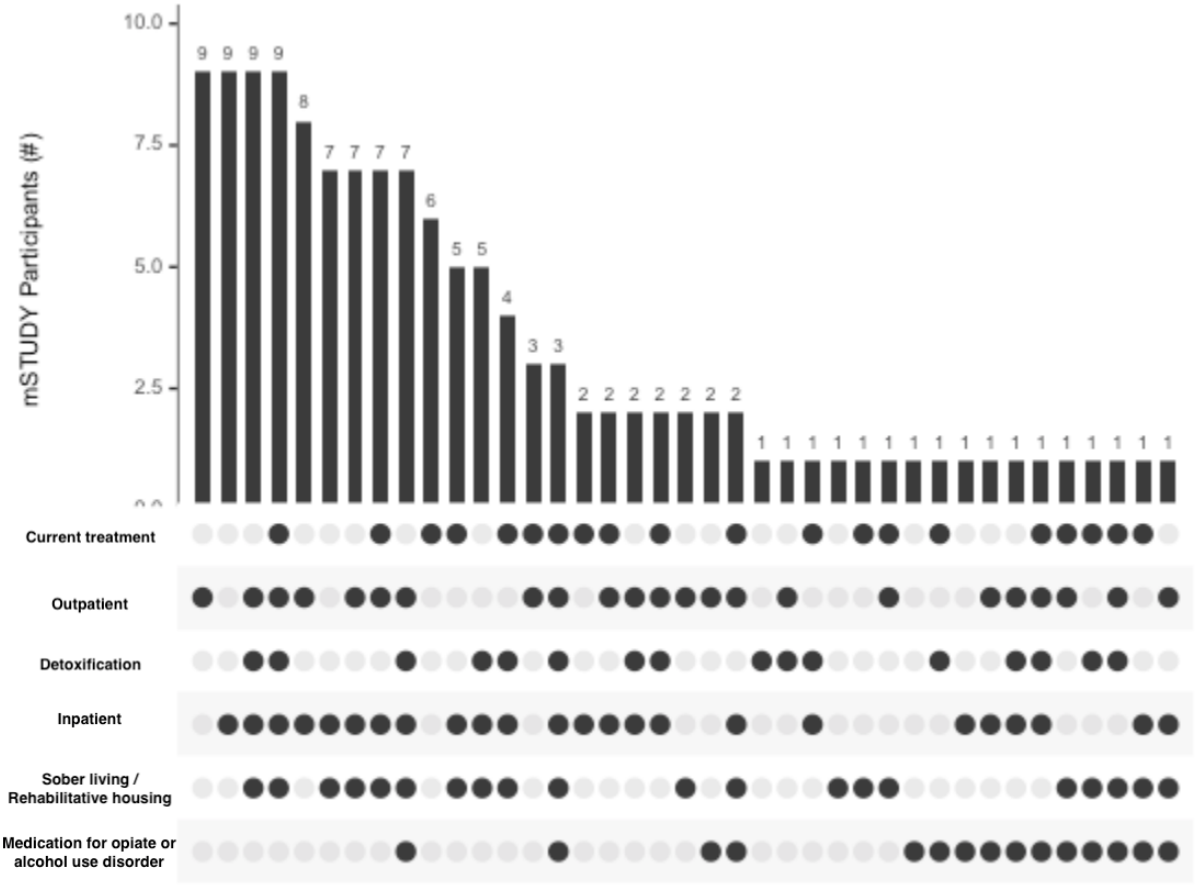
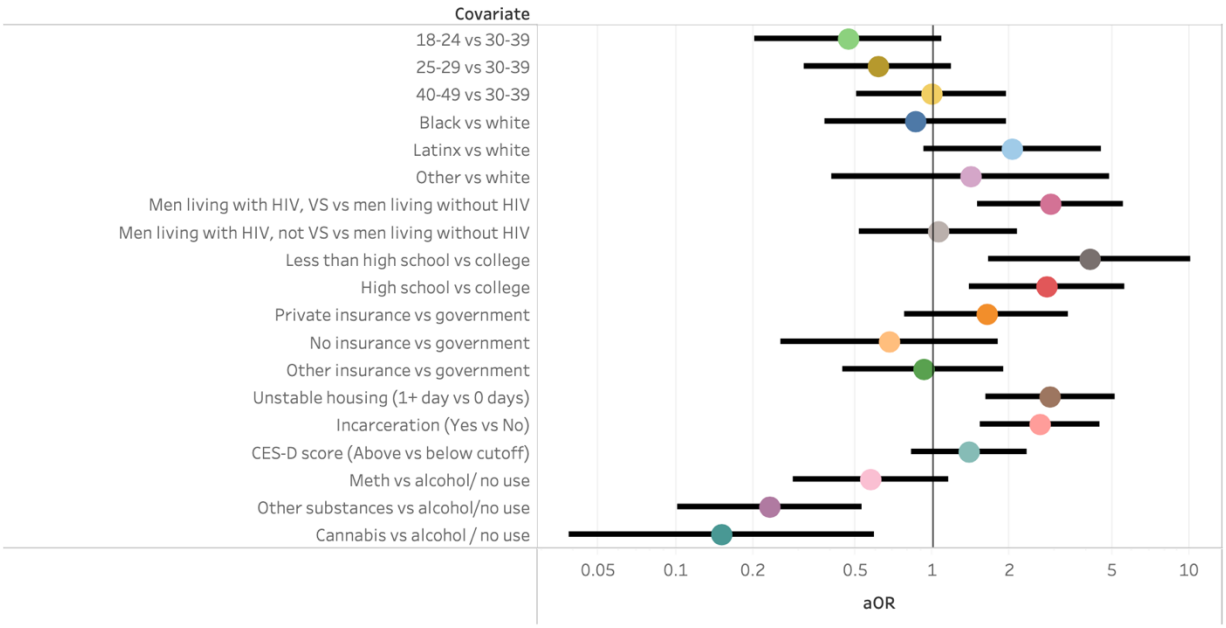
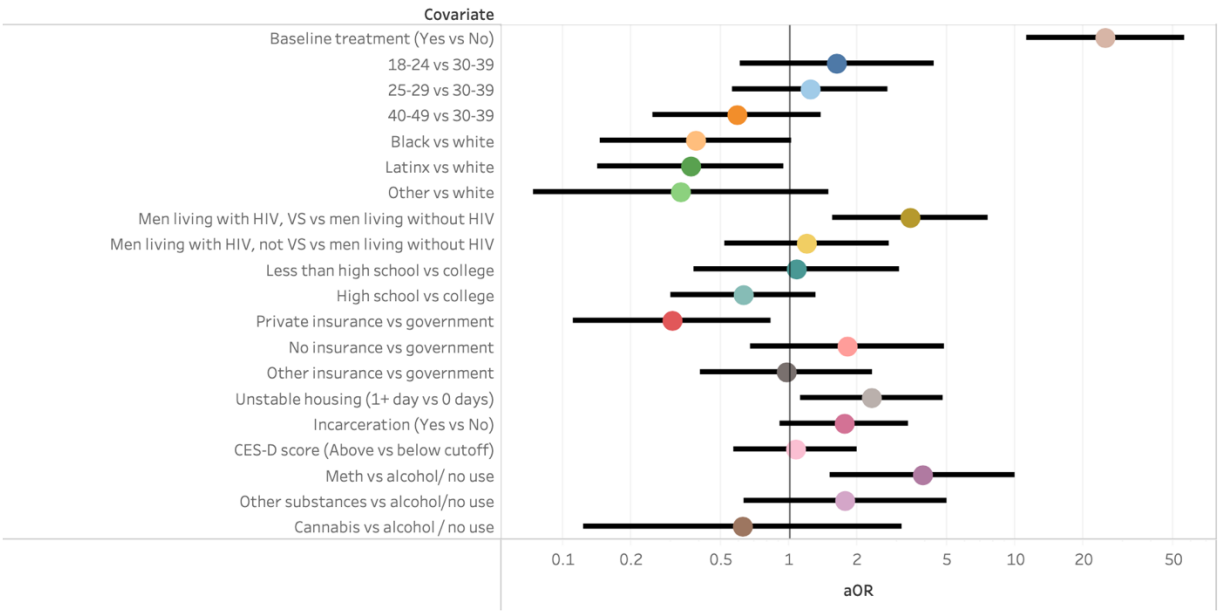


Figure 2-1: Overlap of prior experience with different modalities of treatment for substance use reported among mSTUDY participants at baseline visit (n=133).



VS = Viral suppression. CES-D = Center for Epidemiologic Studies Depression screener.

Figure 2-2: Adjusted odds ratios (aOR) of baseline covariates with baseline history of treatment for substance use (Model 1; n=462).



VS = Viral suppression. CES-D = Center for Epidemiologic Studies Depression screener.

Figure 2-3: Adjusted odds ratios (aOR) of baseline covariates with incident treatment for substance use during mSTUDY follow up (Model 2; n=388).

Chapter 3 Longitudinal substance use outcomes following treatment for substance use among men who have sex with men in Los Angeles, CA (Aim 2)

Introduction

Data from the 2017 to 2019 National Surveys on Drug Use and Health (NSDUH) demonstrate that compared to heterosexual men, more men who have sex with men reported past month or past year use of tobacco, cannabis, alcohol, and methamphetamine use, and more report having a substance use disorder. [17] Substance use among communities of men who have sex with men and people living with HIV has been an area of critical health research, and is known to be associated with negative health effects, including HIV outcomes, [17,19] and lower quality of life. [20] Robust research has demonstrated that reducing substance use promotes less risky sexual behavior [171] and improvement in HIV viral suppression and other health outcomes among men who have sex with men, [14,37,51] such that treatment for substance use can be considered a strategy to prevent HIV transmission. [147]

There is comparatively less research available on treatment for substance use among men who have sex with men, and specifically substance use outcomes following the time after treatment. Most substance use treatment research is conducted through clinical trials, which have been critical at showing the impact of treatment modalities designed for men who have sex with men [31-33] on reducing substance use, including in adaptations of the contingency management [34-36] and matrix model [37] approaches. However, by nature of recruiting from clinic-based samples, fewer studies have been able to assess how multiple substance use outcomes change over time among community-based men who have sex with men, comparing outcomes across men who received treatment for substance use and those who did not. Additionally, because most clinic-based studies assess the effect of treatment on substance abstinence, there has also been less research assessing the impact of treatment on reducing substance use without abstinence. From the lens

of harm reduction, reducing the frequency of substance use can be a meaningful treatment outcome that can improve the quality of life of people who use substances. [85] These are important gaps to fill because return to substance use after treatment is a common part of the recovery process that is expected over a lifetime, [16] and people who use substances may not be interested in abstaining from all future substance use but could still benefit from reducing use. [85]

This analysis aims to describe if men participating in the mSTUDY cohort, a cohort of community-based men who have sex with men living in Los Angeles, CA, reduced their frequency of methamphetamine, cannabis, binge alcohol, and tobacco use after treatment for substance use. Use outcomes were described chronologically across a period of three years relative to experiencing treatment for substance use, and models assessed if recent and prior treatment for substance use were independently associated with lower frequency of substance use across study visits spanning up to ten years of follow up.

Methods

Study Design, Data Collection, and Ethical Approval

Data was collected from 400 members of the mSTUDY cohort, who completed 3,571 visits between 2014 and 2024. The mSTUDY cohort is a longitudinal, community-based cohort based in Los Angeles, CA. The recruitment methods have been detailed elsewhere. [148] People are eligible to join mSTUDY if they are cisgender men, transgender women, and gender diverse individuals assigned male at birth who have sex with individuals assigned male at birth and provided informed consent to join the study. This analysis was restricted to mSTUDY participants who identify as cisgender men because there are 145 trans and gender diverse people enrolled in the cohort, and the analyses here would not be feasible among that number of people. By recruitment design, approximately half of the cohort members are people living with HIV.

Participants return for study visits every six months and are asked to complete questionnaires through computer assisted self-interview covering socioeconomic factors, mental and sexual health, and substance use. Additionally, participants provide laboratory samples for urine toxicology panels for substance use, HIV viral load testing, sexually transmitted disease testing, and general clinical laboratory measures. This analysis was completed from de-identified data, and this study has been approved by the Institutional Review Board at the University of California, Los Angeles.

Exposure of Interest: Treatment for substance use

Treatment for substance use is defined in this analysis through a composite of self-reported variables collected at each visit, echoing the procedure defined in Harawa et al. 2022 analyzing incarceration outcomes. [151] At each visit from 2014 to 2018, participants were asked how many times in their life they had experienced inpatient treatment, outpatient treatment, detoxification, medication for opiate or alcohol use disorder, and rehabilitative housing / sober living. From 2018 to 2024, the question format was updated to ask participants how many times they had experienced these five modalities of treatment for substance use within the past six months. Additionally, at every study visit, participants were asked if they were currently in any type of treatment for substance use at the time of the study visit.

The lifetime, past six month, and current treatment time exposures were all used to calculate exposure to treatment at each mSTUDY visit in different ways. If a participant had not reported treatment for substance use at a given visit or any prior mSTUDY visit, as indicated by reporting no current treatment and no lifetime or past six-month exposures to any given treatment subtype, their exposure would be listed as “never received treatment for substance use.” However, once a participant reported having experience with treatment for substance use, all subsequent visits

were recorded as either “recent/current treatment for substance use” if there was indication of treatment reported since their last mSTUDY visit, or “treatment for substance use, prior to six months” if there is no indication of new treatment. A signal for new treatment was determined by mSTUDY participants reporting i) any current treatment for substance use, ii) any positive number of experiences with any subtype of treatment within the past six months, or iii) reporting an increased number of lifetime experiences with any subtype of treatment for substance use compared to prior visits.

For participants who reported a positive number of experiences for any given subtype of treatment and/or current treatment for substance use at their baseline visit, follow up visits were coded as either “recent treatment” if there was any signal of the participant engaging in new or current treatment, or “prior treatment” if there was no signal of more recent treatment to reflect that these individuals experienced treatment at some point prior to entering mSTUDY. If an individual did not report any treatment for substance use at baseline and was surveyed from 2014 to 2018 about their lifetime exposure, participants needed to report a positive number of lifetime treatment experiences across at least two visits to be counted as a positive signal of treatment (if lifetime exposure for a given treatment type was only reported at one visit, this was considered to be an entry error). Additionally, any lifetime exposure reported at the last visit prior to the implementation of the six month recall questions was treated as a signal of treatment, as per Harawa et al. 2022.[151] The choice was made to combine all the different subtypes of treatment into one indicator of receiving treatment because overlap between treatment modalities within the same six month recall window was common across participants, and because the variable for current treatment for substance use does not distinguish types of treatment modalities.

Frequency of substance use

The outcomes of interest were daily or weekly methamphetamine use, daily or weekly cannabis use, daily or weekly binge alcohol use, and any tobacco use collected in the audio-computer assisted self-interview each visit using a modified version of the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) questionnaire. [152] The outcomes of daily or weekly methamphetamine, cannabis, and binge alcohol use were chosen to reflect a decrease in higher levels of use and serves as a proxy for a positive harm reduction impact of treatment for substance use. Frequency of binge alcohol use was assessed by the number of times a participant reported having six or more drinks within the same occasion, adapted from the Alcohol Use Disorders Identification Test (AUDIT-C). [172] Because frequency of substance use is the primary outcome of interest, these data were collected using self-reported data recalled over a six-month window. Frequency of tobacco use is not available in the data, so tobacco use outcomes were defined as a binary any use versus no use variable and is inclusive of both self-reported smoking and vaping.

Covariates of Interest

In order to reduce some of the variability in the context in which mSTUDY participants engaged with treatment for substance use, the models restricted for baseline use of each respective substance (methamphetamine, cannabis, alcohol, and tobacco) and additionally adjusted for frequency of use at baseline, receiving prior treatment for substance use reported at baseline, age, race and ethnicity, HIV status, insurance status (defined as private, government, other insurance or no insurance), current participation in a 12-step program, as well as if the mSTUDY visit occurred during the time period of the COVID-19 shutdown, defined as March 16, 2020 to June 15, 2021 based on recommendations from LA County. [173] Age was categorized into the groups 18-24, 25-29, 30-39, 40-49, and 50-59 with the rationale that age range may be a better reflection of changes in accessing treatment for substance use and changing substance use patterns rather than a single year change of age. Participants self-identified which race or ethnicity

they most closely identified with from the options including American Indian or Alaskan Native, Asian, Asian Indian, Black or African American, Native Hawaiian or Pacific Islander, white, Hispanic, Latinx, or Spanish, or another race or ethnicity. Because of sample size considerations, these responses were categorized into Black, Latinx, white, or other race and ethnicity in this analysis. Race and ethnicity were adjusted for in these models as a proxy for exposure to racism, which is known to create barriers into entry for treatment for substance use and disparities in treatment outcomes. [56-58,117,118,142] Additionally, the model adjusted for experiencing any housing instability within the past six months prior to the visit, defined as spending at least one night in an emergency shelter, temporary housing, or sleeping in a place not designed for sleeping, and experiencing incarceration within the past six months prior to the mSTUDY visit.

Analytic Strategy

Descriptive statistics, including the mean, range, standard deviation, and distribution, were used to assess the distribution of different socioeconomic, health, and substance use outcomes by type of visit in relation to treatment for substance use (never treated, in treatment within the past six months, and more than six months out from treatment). Chi-square or ANOVA tests were used to calculate p-values, as appropriate.

Multivariable logistic generalized estimating equation models were used to assess the association between relative timing of treatment for substance use to daily or weekly use of methamphetamine, cannabis, and binge alcohol, as well as any tobacco use reported across 3,571 mSTUDY visits conducted from 2014 to 2024. Each model was given random intercepts and an autoregressive correlation structure to account for the covariance between different study visits.

The available data do not describe the context in which mSTUDY participants engaged with treatment for substance use, including their treatment priorities in terms of substance use outcomes. To make the models most comparable, each model was non-exclusively subset to individuals who reported any use of each respective substance (methamphetamine, cannabis, alcohol, or tobacco) at baseline, and included all visits that occurred after baseline. In order to subset models based on baseline substance use, the analysis was thus restricted to 400 men who each had at least 2 mSTUDY visits. The frequency of daily or weekly substance use reported at baseline was described. Models adjusted for baseline frequency of use (for methamphetamine, cannabis, and binge alcohol use) or use at baseline (tobacco), age, race and ethnicity, HIV status, experience with homelessness within past six months, experience with incarceration within past six months, insurance status, treatment for substance use reported at baseline, current participation in a 12-step program, and if visit occurred during the COVID shutdown. Analyses were conducted using SAS OnDemand for Academics (SAS Institute Inc., Cary, NC, USA).

Results

Sample Characteristics

This analysis includes data from 252 men who reported never receiving treatment for substance use and 148 men who received treatment either before enrolling in mSTUDY or during follow up. These 400 men were seen across 3,571 mSTUDY visits, of which 2,441 were from men who reported no prior treatment for substance use, 400 were from men who were either currently in treatment or had been in treatment within six months of the mSTUDY visit (“Recent Treatment”), and 730 were from men who had previously been in treatment for substance use but not within the six months prior to the mSTUDY visit (“Prior Treatment”). Within the visits where participants reported prior treatment or recent treatment, participants were older (respectively 51% and 32%

ages 40-59) than patients who had never been treated (24% ages 40-59), and were more likely to be living with HIV (respectively 83% and 72% versus 47%) (Table 3-1).

There were fewer Black men represented in the visits where participants reported recent (27%) or prior (34%) treatment compared to visits where participants reported no prior treatment (41%), while there were more Latinx men (54% of recent treatment visits and 46% of prior treatment visits versus 45%) and white men (14% among recent and prior treatment visits compared to 11%) represented in the treatment visits (Table 3-1). Men with other racial or ethnic backgrounds were represented in approximately 5% of all visits. Fewer participants reported having no insurance at visits where people reported recent (5%) or prior treatment (4%) compared to visits where people reported having never been treated (10%). Experiencing housing instability and incarceration within the past six months was higher among visits from men who had recently been in treatment (respectively 25% and 23%) or previously been in treatment (15% and 18%) than visits from men who have never been in treatment (9% and 12%).

At visits where participants had recently been in treatment, 29% of participants reported daily or weekly methamphetamine use, 23% reported daily or weekly cannabis use, 13% reported daily or weekly binge drinking, and 49% reported smoking or vaping tobacco, which is a similar distribution to substance use patterns among people who had been in treatment prior to six months (24% daily/weekly methamphetamine use, 27% daily/weekly cannabis use, 11% daily/weekly binge alcohol use, and 43% smoking/vaping) (Table 3-1). In contrast, daily/weekly methamphetamine use (13%) and smoking/vaping tobacco (31%) were much less common among visits from men who had never been in treatment, while daily/weekly binge drinking was similar (10%) and daily/weekly cannabis use was more common (35%).

Substance use over time

To describe how substance use frequency changed over time, the frequency of daily/weekly methamphetamine use, daily/weekly cannabis use, daily/weekly binge alcohol use, and any tobacco smoking were plotted over a three year period, comparing outcomes across men who experienced treatment for substance use between the index visit and year 1 (the time of which is indicated by the vertical lines) and men who did not enter treatment (Fig. 3-1). Each panel represents the percentage of men who reported any use of each respective substance at the index visit who used methamphetamine, cannabis, or binge alcohol on a daily or weekly basis, or who smoked or vaped any tobacco, across the period of three years. It should be noted that not every participant had an observation at each time point, either due to loss to follow up or not having accrued up to three years of follow up, so the number of participants surveyed at each time point was recorded. Also, men in the treatment group may have additional experiences with treatment for substance use reported prior to or after the experience between index visit and year 1, which are not reflected in Fig. 3-1.

Among men who reported any methamphetamine use at baseline, just over half (54%) of both men who did and did not enter treatment reported using methamphetamine on a daily or weekly basis (Fig. 3-1). Higher frequency methamphetamine use significantly decreased over time in both groups, with an additional decrease among the treatment group at years 1 and 2 (29% and 27% versus 41% and 44% in the non-treatment group) that upticked at year 3 (39% treatment versus 27% non-treatment). Conversely, approximately half of men in both the treatment and non-treatment groups who used cannabis at baseline continued to use daily or weekly cannabis across all three years.

Among men who drank alcohol at baseline, binge drinking decreased over three years in both groups, and was consistently higher among the treatment group (30% at baseline to 18% at year

3 compared to 13% to 9% in the non-treatment group) (Fig 3-1). Across all mSTUDY participants, the prevalence of smoking or vaping tobacco tended to decrease over time, with men who received treatment for substance use (52% at index to 40% at year 3) maintaining higher prevalences of tobacco use across time than men who did not receive treatment (38% at index to 27% at year 3).

Substance use outcomes associated with treatment for substance use

Among men who used any methamphetamine at baseline, 52% reported methamphetamine use on a daily or weekly basis, making methamphetamine the most frequently used substance among this group (Table 3-2). Cannabis was the second most frequently used, with 39% of men who used methamphetamine at baseline reporting daily or weekly use. Among men who used any cannabis at baseline, cannabis was the most frequently used substance (58% used daily or weekly), followed by methamphetamine (20% used daily or weekly). Among men who drank alcohol or smoked tobacco at baseline, respectively 40% and 44% used cannabis on a daily or weekly basis and 18% and 31% used methamphetamine on a daily or weekly basis.

Men who used methamphetamine at their baseline visit did not have significantly lower adjusted odds of using methamphetamine on a daily or weekly basis if they had received treatment within the prior six months (respectively aOR = 0.74, 95% CI 0.36-1.50), but treatment prior to six months was significantly protective against higher frequency methamphetamine use (aOR = 0.44, 95% CI 0.21-0.95) compared to receiving no treatment (Table 3-3). Treatment both within six months (aOR = 0.32, 95% CI 0.14-0.74) and prior (aOR = 0.23, 95% CI 0.09-0.60) were associated with lower adjusted odds of daily or weekly cannabis use among men who used cannabis at baseline. Treatment at both time points was not protective against higher frequency of binge alcohol drinking (aOR = 2.45, 95% CI 1.28-4.69 and aOR = 1.47, 95% CI 0.72-2.99) or for tobacco use

(aOR = 1.89, 95% CI 0.93-3.84 and aOR = 1.45, 95% CI 0.75-2.83) among men who respectively drank alcohol or used tobacco at baseline.

Higher frequency of baseline use of each respective substance was associated with daily or weekly methamphetamine, cannabis, and binge alcohol use, and baseline use of tobacco was associated with future tobacco use (Table 3-3). Compared to white men, Black men (aOR = 2.49, 95% CI 1.0-6.17, Latinx men (aOR = 3.08, 95% CI 1.26-7.54), and men of other races and ethnicities (aOR = 3.87, 95% CI 1.16-12.97) had higher adjusted odds of daily or weekly methamphetamine use. Unstable housing reported within six months of the visit was associated with higher frequency methamphetamine (aOR = 1.61, 95% CI 1.10-2.36) and binge alcohol use (aOR = 1.65, 95% CI 1.14-2.39). Participation in 12-step programs was significantly protective against higher frequency methamphetamine (aOR = 0.51, 95% CI 0.31-0.85), cannabis (aOR = 0.52, 95% CI 0.27-1.0), and binge alcohol use (aOR = 0.50, 95% CI 0.30-0.82).

Discussion

This study examined how higher frequency substance use changed following treatment for substance use among 400 men who have sex with men living in Los Angeles, analyzing substance use outcomes i) following an index experience of treatment for substance use across a three-year period, and ii) following all experiences with recent and prior treatment for substance use across up to 10 years of follow up. Trends in methamphetamine, cannabis, binge alcohol, and tobacco use varied by treatment and over time. Results suggested that treatment could offer harm reduction benefits to methamphetamine and cannabis use but suggest racial disparities in methamphetamine use. The findings also highlight the impact of experiencing homelessness and participation in 12-step programs can have on substance use following treatment for substance use.

While higher frequency methamphetamine use generally decreased over time, daily or weekly methamphetamine use after treatment was common, which may have implications for treatment and supportive approaches for men who have sex with men who use methamphetamine. Daily or weekly methamphetamine use was reported across almost one-third of visits after recent treatment for substance use, and almost one-quarter of visits where participants reported prior substance use. Looking chronologically, almost one-third of men who used methamphetamine at baseline and reported treatment for substance use used methamphetamine on a daily or weekly basis at Years 1 and 2, which was a smaller proportion than among men who used methamphetamine at baseline and did not report treatment, but still significant. Concordantly, after adjusting for covariates of interest, recent treatment for substance use was not significantly associated with lower odds of daily or weekly methamphetamine use among men who used methamphetamine at baseline (aOR = 0.74, 95% CI 0.36-1.50). Prior research from the mSTUDY cohort showed that participants who reported current treatment for substance use had significantly higher chances of decreasing methamphetamine use from daily to less than daily use at their next study visit. [148] By combining daily and weekly use into one outcome, this study cannot reflect the impact of treatment on reducing methamphetamine use from daily to weekly use, which would be an example of successful harm reduction that could promote improved physical and mental health outcomes. [51] Encouragingly, treatment for substance use prior to six months ago was significantly associated with decreased odds of daily or weekly methamphetamine use among men who used methamphetamine at baseline (aOR = 0.44, 95% CI 0.21-0.95). Other studies have found that treatment is not significantly associated with abstinence over time: one Australian community-based study found that treatment was not associated with methamphetamine abstinence after one year, [174] echoing a study of people exiting public treatment programs in Los Angeles County which found that 61% of people returned to methamphetamine use within a year of exiting treatment. [175] There is also some evidence that

treatment is associated with reduced frequency of methamphetamine use short of abstinence, with one study identifying that residential treatment was protective against higher frequency methamphetamine use at one year, but not three years after treatment. [176] Altogether, these results suggest that methamphetamine use continued in the time period after treatment, but treatment may have offered some additional protective benefit against higher frequency methamphetamine use over time. This highlights the need for effective treatment approaches to methamphetamine use, as well as for additional support to be available for men who have sex with men who use methamphetamine outside of treatment settings, such as peer support [175,177] and wraparound services, [112,178] and for the creation of sustained medication support such as the medications available for opioid use disorder (MOUD). [69] These results also emphasize the importance of a harm reduction approach that acknowledges that not every person who uses methamphetamine may desire to abstain from future use. [85,86]

However, results also indicated that among men who used methamphetamine at baseline, the adjusted odds of higher frequency methamphetamine use were elevated among Black men, Latinx men, and men of other races and ethnicities in comparison to white men. Across all mSTUDY visits, daily or weekly methamphetamine use was more prevalent among Black men (18%), Latinx men (18%), and men of other races and ethnicities (26%) in comparison to white men (10%) (data not shown). This finding differs from national trends in methamphetamine use seen in the general population; national data from 2019 demonstrated that the rate of methamphetamine use per 100,000 people was highest among American Indian individuals, followed by white and Hispanic individuals who used methamphetamine at similar rates, while Black and Asian or Pacific Islander individuals used at very low rates. [78] Although the population prevalence of methamphetamine use among men who have sex with men of different races and ethnicities living in Los Angeles is not available, there has been evidence of emerging disparities in New York City, where the proportion of Black and Hispanic or Latino men who have sex with

men who use methamphetamine increased from 2011 to 2017, during which time use among white men plateaued. [179] Disparities in substance use among people of different races and ethnicities derive from structural racism, [117] which has also been shown to impact access to treatment for methamphetamine use. [118] Black men who have sex with men who use methamphetamine interviewed in qualitative studies identified facing additional barriers to treatment for methamphetamine use compared to white gay men, [135] as well as difficulty accessing satisfactory, trauma-informed mental health care, which increases substance use. [135,136] Results from this study also suggest possible disparities in treatment outcomes. Across visits where men reported having recent or prior treatment for substance use, daily or weekly methamphetamine use was more prevalent among Black men (34%), Latinx men (23%), and men of other races and ethnicities (41%) in comparison to white men (9%) (data not shown). This emphasizes the need for equity-focused solutions to improve treatment for substance use. [117] In a qualitative study, Black men who have sex with men who use methamphetamine living in New York City identified that an ideal treatment program would provide culturally-relevant mental and physical health care, case management, and connection to supportive resources. [112] Finally, it is critical to note that overdoses from methamphetamine have increased in Los Angeles County across all racial and ethnic groups since 2019, with the largest increase among Black individuals. [77] Given how common higher frequency methamphetamine use across post-treatment visits was across men of color in this study, and increase of overdoses resulting from methamphetamine and opioids in Los Angeles, [77] these findings may contribute to the call to incorporate equitable harm reduction strategies for opioid use, such as education on and resources for naloxone use and fentanyl testing strips into treatment settings for methamphetamine use, [69,180] as well as expanding community-based harm reduction services for people who inject drugs. [181] Los Angeles County has recommended such interventions to prevent overdoses, identifying Black and Latinx people experiencing homelessness who use methamphetamine and fentanyl as priority populations. [146]

Higher frequency cannabis use remained relatively stable over time, with around half of men who reported any cannabis use at baseline in both the treatment and no treatment groups continuing to use on a daily or weekly basis over three years. When looking across all visits which reflect multiple experiences of treatment, daily or weekly cannabis use was reported at one-fifth of mSTUDY visits with recent treatment, just over a quarter of prior treatment visits, and just over a third of no treatment visits. Among men who used cannabis at baseline, those who received recent (aOR = 0.32, 95% CI 0.14-0.74) and prior (aOR = 0.23, 95% CI 0.09-0.60) treatment had lowered adjusted odds of daily or weekly cannabis use compared to men who received no treatment. Since cannabis was the most frequently used substance among men who used any cannabis at baseline (58% reported using daily or weekly), it is likely that cannabis may have been a target substance for many of the men who entered treatment among this group. Accordingly, men who used cannabis at baseline and experienced treatment for substance use would be expected to decrease cannabis use more than men who did not experience treatment, especially given how prevalent frequent cannabis use is among this group. These findings do not suggest that cannabis use increases after treatment for substance use, as may be expected in the event of using cannabis instead of more harmful substances. [182] Clinical trials of interventions to reduce cannabis use have found that most participants did not abstain from cannabis use in the time after treatment, [183-187] so these results underscore the importance of examining reductions in cannabis use, which have been associated with improvements in mental and physical health outcomes even without abstinence. [188,189]

Binge alcohol and tobacco use decreased over three years of follow up among men who had and had not experienced treatment for substance use, but prevalence of both remained higher among men who had received treatment for substance use. Examining prevalence of daily or weekly use across all visits, binge alcohol use was reported at about one-tenth of all visits regardless of treatment status, and tobacco use was reported at around one half of all visits with recent or prior

treatment and a third of visits with no treatment. While treatment at either time period was not associated with a decrease in tobacco use, the odds of binge alcohol use were higher across visits where participants were recently in treatment compared to visits where people were never in treatment (aOR = 2.45, 95% CI 1.28-4.69). It is worth noting that among men who drank any alcohol at baseline, both daily or weekly methamphetamine use and cannabis use were more common than binge alcohol use, so alcohol may not have been the target of treatment intervention for as many of these participants. It is also possible that men who exited treatment for substance use for other substances increased alcohol use as a type of substance replacement, which has been documented in a study of people abstaining from cannabis use, [190] but overall has been understudied with mixed findings. [191] Additionally, these data also do not suggest widespread increase in tobacco use after treatment for substance use, as would be expected in a situation of substance replacement. [190] However, intervening to decrease tobacco use can improve a variety of substance use outcomes among adults in treatment, [192] including increasing the amount of time people abstain from substances and decreasing the urge to use stimulants. [192-194] These results suggest possible substance replacement with alcohol in the immediate term after treatment for substance use, and may suggest the value of interventions to support decreasing alcohol and tobacco use after treatment for substance use among men who have sex with men.

Participation in a 12-step group was independently associated with decreased odds of daily or weekly methamphetamine, cannabis, and binge alcohol use. 12-step programs are local, free, peer supported self-help groups that share an orientation towards recovery that encourages abstinence from all substances and building fellowship, accountability, and self-responsibility through group participation. [25,108,195] It follows that men participating in 12-step groups would have lower odds of high frequency substance use for these substances. There was not a significant protective association of 12-step involvement with tobacco use, which may be because group members opt to not target tobacco use while focusing on decreasing use of other substances, as

has been observed in formal treatment settings as well. [196-198] Some people do not resonate with the 12-step philosophy due to its traditional Christian lens and prioritization of abstinence, [25] but group participation, the supportive social network, and the building of coping and behavioral skills have been identified as critical facets of what can make 12-step successful for individuals who do participate. [109,110,199-201] The positive association of 12-step group participation with reduced substance use frequency is evidence in favor of fostering accessible social support environments that encourage reduced substance use for men who have sex with men in recovery.

Experiencing homelessness within the past six months was associated with higher methamphetamine and binge alcohol use, independent of treatment and other covariates. We cannot tell from this data if participants experienced homelessness prior to and/or after treatment for substance use, but housing instability has been shown to drive substance use in multiple ways. The experience of coping with homelessness may motivate or necessitate people to use substances in order to manage stressors, discomfort, and safety concerns. [202-204] Additionally, people experiencing homelessness who have experienced treatment for substance use or have re-entered the community after being incarcerated have described difficulty maintaining sobriety because of factors including the increased availability of substances and contact with other people who are using substances. [111,202] These findings iterate that solutions to homelessness, including providing housing support to people in treatment for substance use, [111,202] are important to maximizing the positive impact of treatment on reducing substance use.

In this study, the definition of treatment for substance use is broad and incapsulates many different experiences with formal treatment for substance use. Notably, this analysis cannot adjust for if participants entered treatment voluntarily, [205] the specific treatment curriculum, length of stay, and treatment completion. [206] Additionally, the visits classified as having “Prior Treatment” will all represent treatment for substance use that occurred at different lengths in the past, and based on

the substance abuse treatment career theory, [16] prior experiences with treatment may also influence use outcomes after more recent treatment. For this reason, the models adjusted for history of treatment for substance use reported at baseline. Additionally, data was not available on which substance or substances participants wished to decrease use of when entering treatment, which may have helped explain change in use of some substances over time. To reduce this variability, each model was restricted to men who used each respective substance at baseline. Altogether, the expansiveness of different experiences captured within this definition of treatment for substance use may partially explain why treatment for substance use was not associated with additional reductions in substance use. Additionally, the models combined both daily and weekly substance use, which means that the statistical models were not able to reflect any decreases in daily to weekly use, which may still be a meaningful reduction in use that could be attributed to treatment. Frequency of substance use was self-reported, and participants may be less likely to share higher frequency of substance use due to social desirability bias, although analyses have shown that self-reported substance use data has a sensitivity of 82% and a positive predictive value of 92%. [51,207] Finally, the mSTUDY cohort includes a large proportion of men who have experienced housing instability and use methamphetamine, which may make results from this sample not transportable to the broader population of men who have sex with men who use substances in Los Angeles.

Conclusion

The strength of this analysis is that it offers the ability to compare the frequency of use of multiple substances among community-based men who have sex with men, assessing the impact of both more recent and prior treatment for substance use on outcomes across a ten-year period. This data presents a more realistic picture of substance use following treatment than has been seen in clinic-based samples with a more restricted follow up period. Altogether, these results reiterate

that treatment was associated with lower frequency methamphetamine and cannabis use, and that men who have sex with men who have received treatment for substance use may benefit from additional, equity-focused supportive interventions in the community setting in order to sustain less harmful levels of substance use over time.

Tables and Figures

Table 3-1: Sociodemographic and substance use characteristics across mSTUDY visits 2014-2024 relative to treatment for substance use (visits = 3571).

	All visits = 3571	%	Never treated (visits = 2441)	%	Recent treatment (visits = 400)	%	Prior treatment (visits = 730)	%
Age (mean, SD)**	35 (7)		34 (7)		36 (7)		38 (7)	
18-24	242	6.8	205	8.4	21	5.3	16	2.2
25-29	663	18.6	508	20.8	57	14.3	98	13.4
30-39	1580	44.3	1140	46.7	194	48.5	246	33.7
40-49	1013	28.4	550	22.5	123	30.8	340	46.6
50-59	73	2.0	38	1.6	5	1.3	30	4.1
Race and ethnicity**								
Black	1369	38.3	1010	41.4	109	27.3	250	34.3
Latinx	1597	44.7	1049	43.0	215	53.8	333	45.6
Other	179	5.0	120	4.9	19	4.8	40	5.5
White	426	11.9	262	10.7	57	14.3	107	14.7
HIV status**								
Men living with HIV	2005	56.2	1150	47.1	331	82.8	524	71.8
Men living without HIV	1566	43.9	1291	52.9	69	17.3	206	28.2
Insurance**								
Private	894	25.0	680	27.9	57	14.3	157	21.5
Government	1905	53.4	1237	50.7	252	63.0	416	57.0
Other	459	12.9	267	10.9	70	17.5	122	16.7
No insurance	304	8.5	252	10.3	21	5.3	31	4.3
Past 6 month incarceration**								
1+ days	509	14.3	284	11.6	91	22.8	134	18.4
Past 6 month unstable housing**								
1+ days	442	12.4	229	9.4	101	25.3	112	15.3
Substance Use								
Methamphetamine (Daily/Weekly)**	613	17.2	324	13.3	115	28.8	174	23.8
Binge drinking (Daily/Weekly)	376	10.5	247	10.1	50	12.5	79	10.8
Cannabis (Daily/Weekly)**	1152	32.3	863	35.4	90	22.5	199	27.3
Tobacco (Any)**	1251	35.0	744	30.5	194	48.5	313	42.9
Current 12 step participation**	501	14.0	42	1.7	235	58.8	224	30.7

P-values calculated from chi-square or ANOVA tests.* = p-value <0.05, ** = p-value < 0.01. Rows may not sum to 100% due to missing data.

Table 3-2: Frequency of substance use at baseline visit among mSTUDY participants who used methamphetamine, cannabis, alcohol, or tobacco at baseline (non-exclusive).

	Men who used any methamphetamine at baseline (n = 167)	Men who used any cannabis at baseline (n = 242)	Men who drank any alcohol at baseline (n = 314)	Men who smoked any tobacco at baseline (n = 174)
Prevalence of daily or weekly substance use at baseline				
Methamphetamine	**86 (52%)**	48 (20%)	57 (18%)	54 (31%)
Cannabis	65 (39%)	**141 (58%)**	127 (40%)	77 (44%)
Cocaine	6 (4%)	10 (4%)	13 (4%)	8 (5%)
Ecstasy	2 (1%)	2 (1%)	3 (1%)	2 (1%)
Poppers	24 (14%)	39 (16%)	43 (14%)	21 (12%)
Opiates	4 (2%)	4 (2%)	2 (1%)	3 (2%)
Binge alcohol (6+ drinks/occasion)	27 (16%)	36 (15%)	55 (18%)	31 (18%)
Other substance use at baseline				
Alcohol (4+ days/week)	23 (14%)	33 (14%)	48 (15%)	31 (18%)
Any tobacco	95 (57%)	115 (48%)	140 (45%)	174 (100%)

Table 3-3:. Adjusted generalized estimating equation models assessing the association of treatment for substance use and substance use frequency among the mSTUDY cohort, 2014-2024.

	Daily or weekly methamphetamine use (visits = 1181)	Daily or weekly cannabis use (visits = 1581)	Daily or weekly binge alcohol use (visits = 2244)	Any tobacco use (visits = 2765)
Treatment for substance use				
Recent treatment	0.74 (0.36-1.5)	**0.32 (0.14-0.74)**	2.45 (1.28-4.69)	1.89 (0.93-3.84)
Prior treatment	**0.44 (0.21-0.95)**	**0.23 (0.09-0.6)**	1.47 (0.72-2.99)	1.45 (0.75-2.83)
No treatment	Ref.	Ref.	Ref.	Ref.
Treatment for substance use at baseline				
Yes versus No	2.06 (0.9-4.71)	2.06 (0.9-4.71)	0.84 (0.38-1.86)	1.06 (0.5-2.21)
Baseline frequency of substance use				
Daily/Weekly	4.18 (2.33-7.49)	8.16 (5.13-12.98)	-	-
Monthly or less	Ref.	Ref.	-	-
Baseline frequency of alcohol use				
Weekly	-	-	8.66 (4.85-15.45)	-
Less than weekly	-	-	Ref.	-
Baseline tobacco use				
Any vs None	-	-	-	24.08 (14.86-39.03)
Age				
18-24	0.49 (0.19-1.26)	1.3 (0.67-2.51)	0.9 (0.39-2.08)	1.1 (0.52-2.32)
25-29	0.55 (0.29-1.03)	0.74 (0.49-1.11)	0.38 (0.2-0.72)	0.84 (0.47-1.53)
40-49	1.62 (1.01-2.57)	2.05 (1.11-3.8)	0.66 (0.39-1.11)	0.56 (0.32-1)
50-59	1.67 (0.48-5.83)	2.05 (0.37-11.22)	0.85 (0.22-3.26)	1.43 (0.34-6.03)
30-39	Ref.	Ref.	Ref.	Ref.
Race and ethnicity				
Black or African American	2.49 (1-6.17)	1.79 (0.75-4.28)	0.64 (0.29-1.41)	0.7 (0.36-1.37)
Hispanic, Latinx, or Spanish	3.08 (1.26-7.54)	1.01 (0.43-2.38)	0.93 (0.39-2.2)	0.75 (0.37-1.51)
Other	3.87 (1.16-12.97)	1.36 (0.46-4.04)	0.69 (0.13-3.76)	1.96 (0.58-6.65)
White	Ref.	Ref.	Ref.	Ref.
HIV Status				
Men living with HIV	0.67 (0.35-1.29)	0.9 (0.55-1.48)	0.57 (0.3-1.08)	1.21 (0.73-2.03)
Men living without HIV	Ref.	Ref.	Ref.	Ref.

Insurance				
No insurance	1.04 (0.59-1.85)	1.67 (0.97-2.86)	1.31 (0.72-2.41)	0.97 (0.46-2.07)
Other	0.93 (0.61-1.41)	1.45 (0.82-2.57)	0.73 (0.4-1.34)	0.89 (0.54-1.48)
Private	0.86 (0.53-1.41)	1.08 (0.65-1.79)	0.64 (0.35-1.16)	0.58 (0.36-0.92)
Government	Ref.	Ref.	Ref.	Ref.
Unstable housing within past 6 months				
1+ days vs. 0 days	1.61 (1.1-2.36)	0.94 (0.51-1.71)	1.65 (1.14-2.39)	1.46 (0.95-2.25)
Incarceration within the past 6 months				
Yes vs No	1.14 (0.82-1.58)	1.03 (0.64-1.67)	1.41 (0.93-2.13)	1.82 (1.29-2.56)
Current participation in 12 step program				
Yes vs No	0.51 (0.31-0.85)	0.52 (0.27-1)	0.5 (0.3-0.82)	0.66 (0.35-1.23)
Visit during COVID shutdown				
Yes vs No	1.06 (0.79-1.43)	1.12 (0.83-1.51)	0.93 (0.65-1.32)	0.72 (0.54-0.96)

COVID shutdown period was defined as any study visit conducted between March 16, 2020 - June 15, 2021.

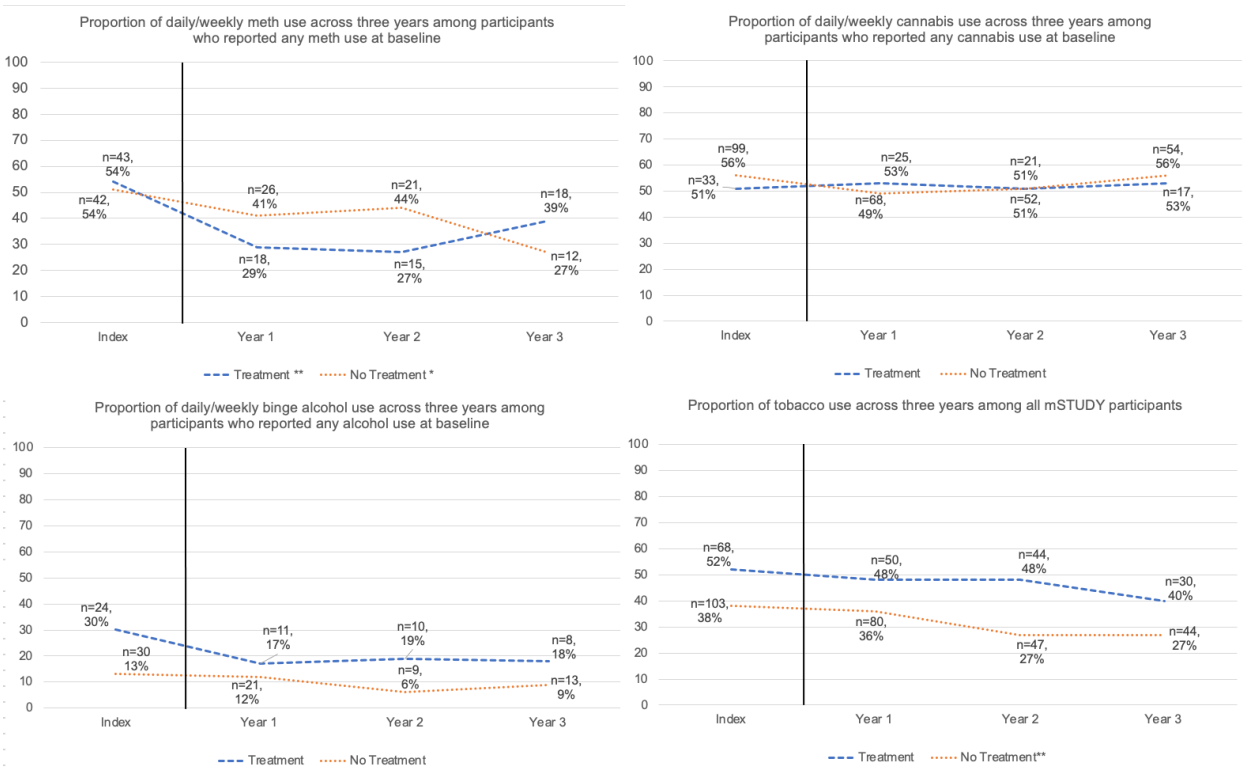


Figure 3-1: Substance use frequency over three years from index visit among mSTUDY participants by treatment for substance use.

P-values calculated through Cochran-Armitage one-sided test for trend. * = p-value <0.05, ** = p-value <0.01.

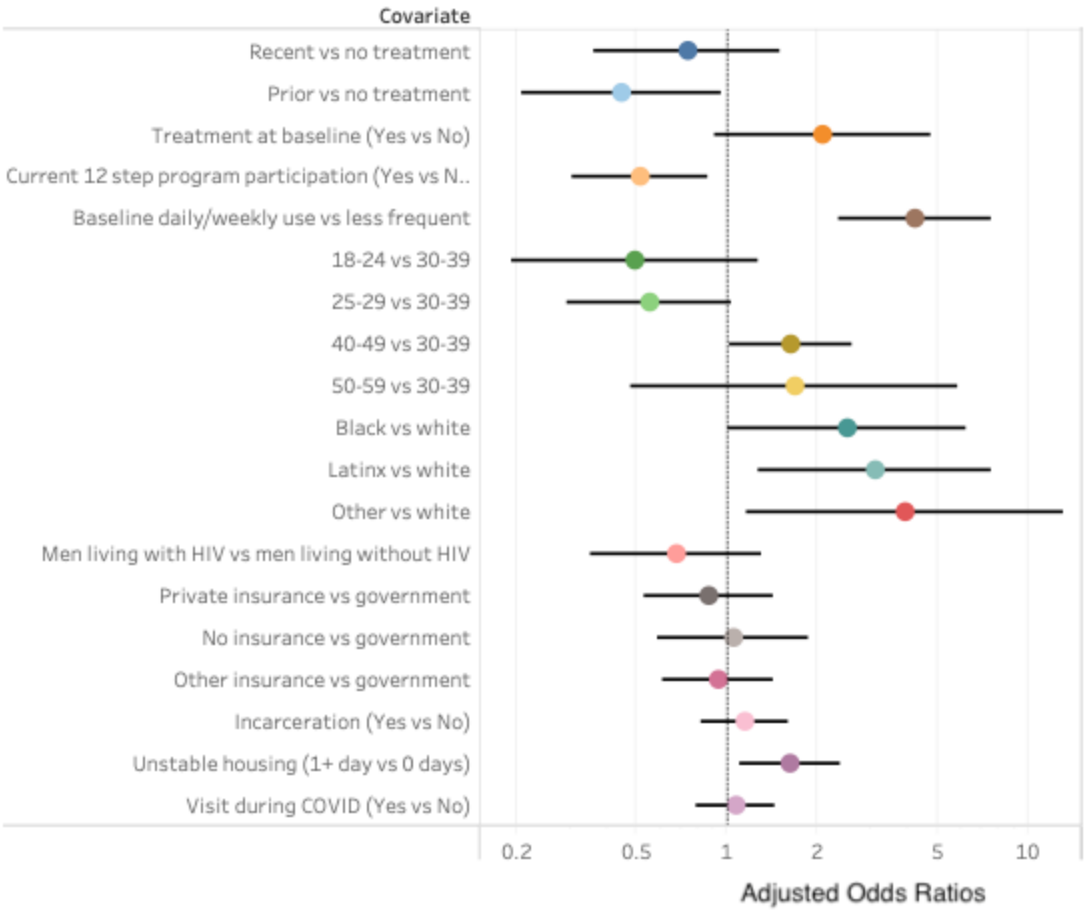


Figure 3-2: Association of treatment for substance use and covariates with daily or weekly versus less than weekly methamphetamine use during mSTUDY follow up, 2014-2024 (visits = 1181).

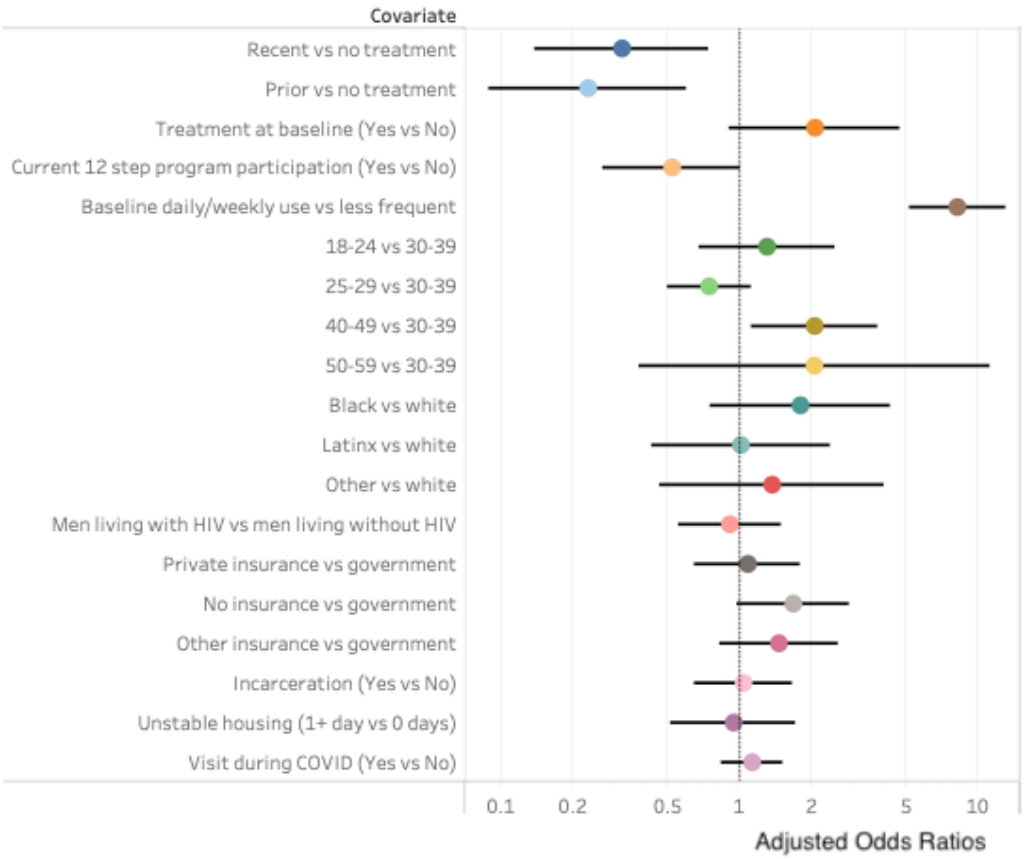


Figure 3-3: Association of treatment for substance use and covariates with daily or weekly versus less than weekly cannabis use during mSTUDY follow up, 2014-2024 (visits = 1581).

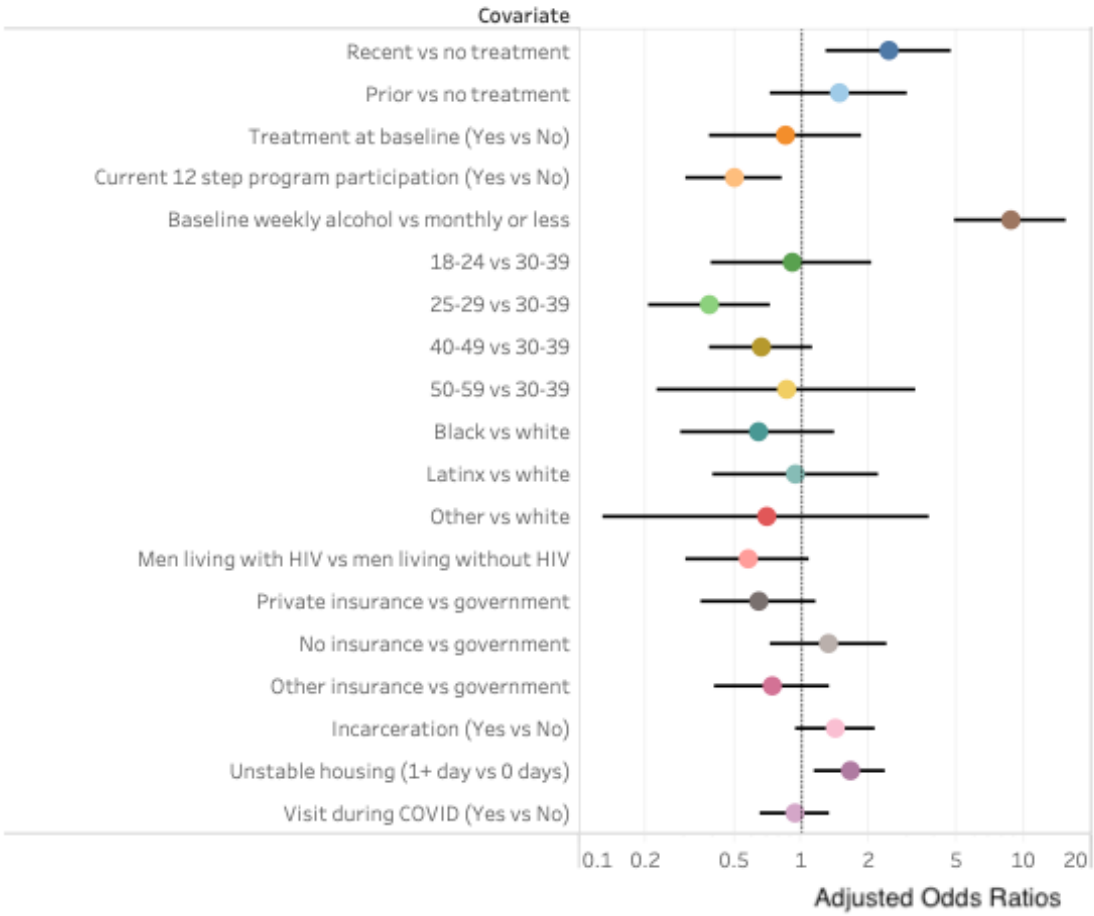


Figure 3-4: Association of treatment for substance use and covariates with daily or weekly versus less than weekly binge alcohol use during mSTUDY follow up, 2014-2024 (visits = 2244).

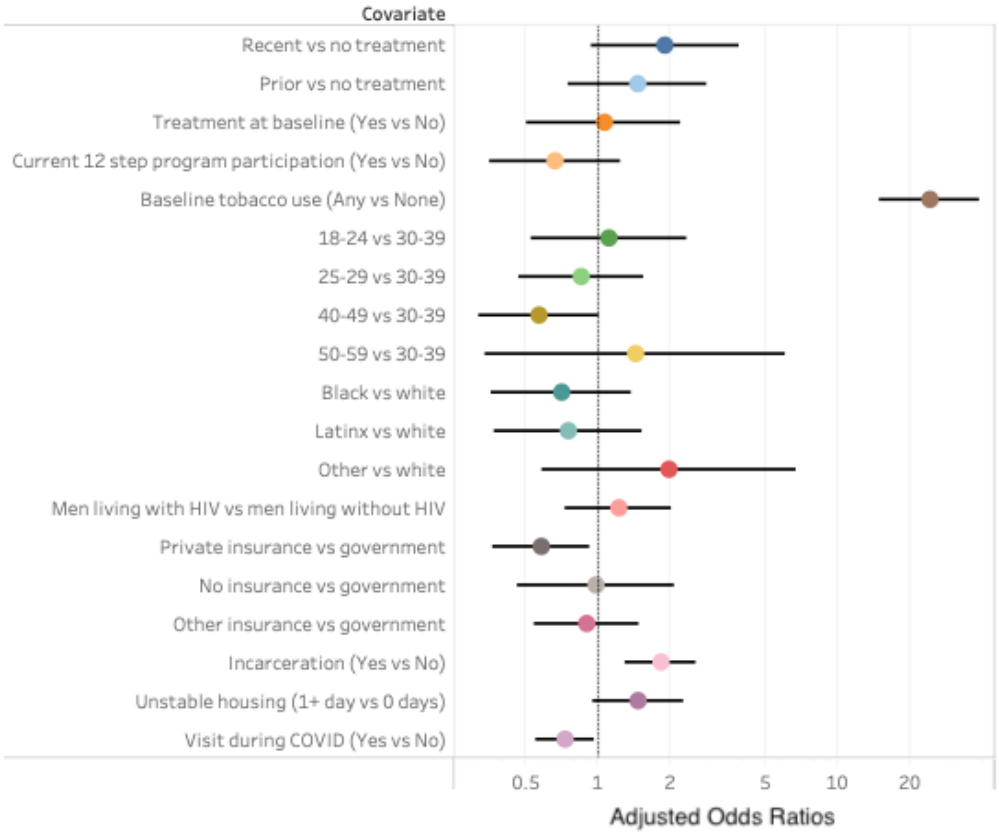


Figure 3-5: Association of treatment for substance use and covariates with any versus no tobacco use during mSTUDY follow up, 2014-2024 (visits = 2765).

Chapter 4 The impact of treatment for substance use and 12-step program participation on depression and anxiety symptoms among men who have sex with men in Los Angeles, CA (Aim 3)

Introduction

Men who have sex with men face a higher prevalence of depression and anxiety disorders than men who have sex with women only, [208,209] with 35% of men who have sex with men living without HIV and 47% of men who have sex with men living with HIV estimated to have depression globally. [92] Addressing anxiety and depression is a quality of life concern, [210,211] particularly among men who have sex with men who use substances. In previous research from the mSTUDY cohort of men who have sex with men in Los Angeles, substance use has been associated with higher depressive symptoms, with methamphetamine use strongly associated with the presence and longer duration of depressive symptoms [93] and self-reported, diagnosed psychological conditions. [95] Worse depression and anxiety symptoms have also been associated with more harmful polysubstance use. [100] Thus, in addition to improving quality of life, addressing anxiety and depression also has important implications for substance use outcomes among men who have sex with men.

Decreasing substance use can improve mental health. Research from the Centers for AIDS Research Network of Integrated Clinical Sites cohort found that people living with HIV who decreased use of amphetamine-type substances, cocaine, and cannabis experienced significant reductions in depression symptoms, [101] which echoes results from the RADAR and EleMENt cohorts of young sexual and gender minority individuals assigned male at birth. [212] Similar improvements in anxiety and depression symptoms have been found following decreases in alcohol [87] and polysubstance use. [102] Conversely, worse mental health symptoms and co-presenting mental health diagnoses have also been suggested to be a precursor for re-initiating substance use among people who have received treatment for substance use. [82,103,104] This

evidence suggests that reductions in substance use can improve mental health outcomes just as fostering better mental health can sustain better substance use outcomes in recovery.

Despite how intertwined depression, anxiety, and substance use are, there has been little research examining mental health outcomes among community-based men who have sex with men who have exited treatment for substance use. This is an important research gap to improve quality of life among men who have sex with men in recovery and to identify opportunities to support substance use reductions over time. Social support facilitates improved depression, [107] substance use, [53,105,106] and HIV [54] outcomes among men who have sex with men. Twelve-step programs, which are informal, peer-led support groups that aim to promote abstinence to substance use, can facilitate social support among men in recovery. [108-110] This analysis examines depression and anxiety symptoms that follow treatment for substance use reported by members of the mSTUDY cohort, a Los Angeles-based cohort of men who have sex with men, and assesses if participation in 12-step programs promotes better mental health outcomes after treatment for substance use.

Methods

Study Design, Data Collection, and Ethical Approval

This study uses data from 490 men who have participated in the Los Angeles, CA – based mSTUDY cohort across 4,359 visits between 2014 and 2024. To join mSTUDY, participants must be between the ages of 18-45 at enrollment, be assigned male at birth, either be living with HIV or have reported condomless anal intercourse within six months of enrolling, and consent to study protocols including returning for follow up study visits every six months. Additional details on mSTUDY protocol have been described elsewhere. [148] This analysis is subset to 490 mSTUDY cohort members who identify as cisgender men, most of whom are Black or African American

(42%) or Latinx (40%). There are 145 trans or gender non-conforming people in mSTUDY who were not included in this analysis due to the smaller sample size.

Study visits include both computer-assisted self-interview questionnaires covering a variety of socioeconomic, physical, sexual, mental health, substance use, and substance use treatment outcomes. Participants may skip any questions they do not wish to answer. Participants also complete an interview with a clinician to collect data on prescriptions and medical conditions, and are asked to provide urine samples for a toxicology and STI screening, and blood samples to test for HIV infection or HIV viral load, among other clinical markers. This secondary analysis was conducted on a de-identified dataset and was approved by the Institutional Review Board at the University of California, Los Angeles.

Treatment for substance use

Treatment for substance use was defined through a composite of self-reported treatment variables mirroring the methods Harawa et al. 2022 employed in their analysis on factors associated with incarceration. [151] From 2014 to 2018, participants were asked to self-report how many times in their life they had experienced inpatient treatment, outpatient treatment, sober living or rehabilitative housing, and detoxification, or had taken medication for opiate or alcohol use disorder. From 2018 onwards, participants reported how many times they had experienced each of the five treatment modalities within the past six months. Throughout the study, participants were also able to report if they were currently in any type of treatment for substance use. If a participant reported currently receiving treatment for substance use at the time of the study visit, having received any treatment subtype within the past six months, or having increased the total number of lifetime exposures to a given treatment subtype, they were considered to have recently received treatment for substance use ("Recent Treatment"). After a participant reported receiving any kind of treatment for substance use, every subsequent visit without any indication of additional

treatment would be considered to have happened after treatment ("Prior Treatment"). If a participant reported no experience with any type of treatment for substance use, they would be considered to have never received treatment for substance use ("No Treatment"). Information was not available on whether participants volunteered to receive treatment or what goals they had for treatment.

Mental health screeners

The validated Center for Epidemiologic Studies Depression Scale (CES-D) [140] and Generalized Anxiety Disorder – 7 (GAD-7) [141] screeners were respectively used to assess depression and anxiety symptoms. The threshold for identifying a higher burden of depression symptoms was set at a score of 23 or higher out of 60 for men living with HIV, based on prior studies validating the use of the CES-D screener among people living with HIV. [93,153] For men living without HIV, the cutoff score for higher symptom burden was set to 16. [140] The cutoff to identify a higher burden of anxiety symptoms was defined as a GAD-7 score of 10 out of 21 or higher. [141] The CES-D has been administered across every mSTUDY visit since 2014, with data available from 4,344 total visits. The GAD-7 was launched in mSTUDY in 2018, with data available from 2,638 total visits. Because high depression and anxiety symptoms were strongly associated in the sample, and mental health diagnoses often are present together, [213] the outcome of interest was a combined variable that reflected scoring above the cutoff threshold for either depressive and/or anxiety symptoms.

Covariates of interest

Age at visit was categorized into 18-24, 25-29, 30-39, 40-49, and 50-59 years old because different stages of life are associated with different substance use trends and depression and anxiety risks. [214] Race and ethnicity was defined as Black or African American, Latinx, white, or other race or ethnicity, which includes people who identify as American Indian or Alaskan Native,

Asian, Asian Indian, Native Hawaiian or Pacific Islander, or another race and ethnicity, and was adjusted for in order to identify disparities by race and ethnicity. HIV status was assessed at each visit and was adjusted for as a binary variable. At each visit, participants identified if they had experienced incarceration or had spent any nights at an emergency shelter or a place not meant for sleeping within the past six months. Insurance coverage was assessed at each visit, and was defined as private, governmental, other, or no insurance. Because of the impact of the COVID-19 pandemic on mental health and substance use treatment access, [215] models were adjusted for if the study visit occurred during the Los Angeles County COVID-19 lockdown from March 16, 2020 to June 15, 2021. [173] Current participation in a 12-step program or self-help group was assessed at each visit.

Analytic Strategy

Descriptive statistics, including the distribution of categorical variables, the mean and standard deviation of normally distributed variables, and the median and interquartile range of numeric variables with skewed distributions, captured the distribution of different covariates of interest by treatment group (No Treatment, Recent Treatment, Prior Treatment). P-values were calculated using appropriate tests for the given variable type, including chi-square tests, Kruskal-Wallis tests, and ANOVA.

Logistic generalized estimating equations (GEE) models were used to assess the association of recent and prior treatment for substance use with higher CES-D or GAD-7 scores, adjusting for covariates of interest including age, race and ethnicity, HIV status, insurance status, experience of housing instability, experience of incarceration, current participation in a 12-step program, and if the study visit occurred during the Los Angeles County COVID-19 shutdown period (March 16, 2020 to June 15, 2021). As a sensitivity analysis, multivariable logistic GEE models were run exclusively across visits where participants reported either current or prior treatment for substance

use to assess if participation in a 12-step program was associated with improved mental health symptoms among post-treatment visits specifically. Random intercepts and an autoregressive correlation structure were used to address the covariance from analyzing separate visits from the same study participants over time. The analyses were conducted using SAS OnDemand for Academics (SAS Institute Inc., Cary, NC, USA).

Results

This study included 3,571 visits from 2014 to 2024, among which 2,441 were visits where men reported no treatment for substance use, 400 were visits where men reported treatment for substance use within the past six months, and 730 were visits where men reported experience with treatment for substance use prior to six months ago (Table 4-1). Across visits with no treatment for substance use, men were slightly younger (29% <29 years versus 20% among visits where treatment for substance use was reported within six months and 16% among visits with prior treatment). Among visits where people reported never receiving treatment for substance use, 41% were completed by Black men, 43% by Latinx men, 11% by white men, and 5% by men with other racial and ethnic backgrounds. Among visits were men reported recent treatment for substance use, a smaller percentage were completed by Black men (27%), while more were completed by Latinx (54%) and white (14%) men, and the percentage completed by men with other racial and ethnic backgrounds was similar (5%). Among visits where men reported experiencing treatment for substance use prior to six months ago, 34% of visits were completed by Black men, 46% were completed by Latinx men, 15% were completed by white men, and 6% were completed by men with other racial and ethnic backgrounds. More visits where men reported experiencing treatment for substance use within the past six months were completed by men living with HIV (83% of recent treatment visits and 72% of prior treatment visits compared to 47% of no treatment visits).

The most common type of health insurance was through government plans (53% overall), followed by private insurance (25% overall), and more participants reported government insurance at visits where they reported experiencing treatment for substance use within six months (63%) and treatment prior to six months ago (57%) (Table 4-1). Men were more likely to report having no insurance at visits where no treatment for substance use was reported (10%) compared to visits where treatment for substance use was reported. Men reported incarceration within the past six months across 22% of visits where men reported experiencing recent treatment for substance use, and 18% of visits where men reported prior treatment for substance use (compared to 12% of visits where men reported no treatment for substance use). Likewise, men reported experiencing housing instability within the past month across 25% of visits where men reported recent treatment for substance use and 15% of visits where men reported prior treatment for substance use.

Across visits from men who had never experienced treatment for substance use, CES-D (median 12, IQR 8-23) and GAD-7 (median 10, IQR 7-14) scores were lower than visits where men had experienced treatment within the past six months (CES-D median 19, IQR 11-28.5; GAD-7 median 14, IQR 9-18) or prior to the past six months (CES-D median 17, IQR 9.5-27; GAD-7 median 13, IQR 8-16) (Table 4-1). Accordingly, high depression or anxiety symptoms were more common across visits with recent or prior treatment for substance use (64% and 63%) compared to visits with no treatment history (47%). Daily or weekly methamphetamine use was reported across 29% of visits where men reported recent treatment, a higher prevalence than across visits where men reported prior treatment (24%) and never receiving treatment (13%). Daily or weekly cannabis use, however, was more common among visits where men reported no treatment (35%) and prior treatment (27%) than among visits where men had recently received treatment (23%).

Both recent (aOR = 2.44, 95% CI 1.65-3.6) and prior (aOR = 2.57, 95% CI 1.66-3.98) treatment for substance use were positively associated with higher mental health symptoms in the multivariable model (Table 4-2). Additionally, experiencing unstable housing within the past six months (aOR = 2.17, 95% CI 1.59-2.96) and the COVID shutdown period (aOR = 1.61, 95% CI 1.31-1.97) were positively associated with higher mental health symptoms. Participation in 12-step programs (aOR = 0.55, 95% CI 0.38-0.79) were associated with lower mental health symptoms. Looking specifically among visits where men reported recent or prior treatment for substance use, participation in a 12-step program was associated with improved depression and anxiety symptoms (aOR = 0.68, 95% CI 0.47-0.99) (Table 4-3).

Discussion

This analysis demonstrates that elevated symptoms of depression and anxiety were common in the mSTUDY cohort overall and increased across visits where men reported treatment for substance use. Men reported high depression or anxiety symptoms across half of the visits where men had not experienced treatment for substance use, compared to two-thirds of the visits where men had received treatment for substance use. Treatment for substance use was associated with 2.5 times the odds of elevated depression and anxiety symptoms after adjustment for other factors, suggesting that men who are in recovery may face additional mental health stressors compared to men who are not in recovery. In a sensitivity analysis examining visits among men in recovery, participation in a 12-step program was found to promote better mental health outcomes. These findings help fill the knowledge gap of men who have sex with men's mental health in the time after treatment for substance use and suggests that initiatives that can improve social support in this time-period may help.

The association of post-treatment time periods to elevated depression and anxiety symptoms is contrary to what would be expected after treatment for substance use. The goal of treatment is to decrease substance use, which would be expected to decrease depressive and anxiety symptoms. [87,101,102,212,216] Indeed, studies among people who have exited treatment for substance use demonstrate that people who do not use substances have better mental health outcomes following treatment compared to people who re-initiate use. [82,102,217] Part of the association observed in this study could be explained by men continuing or returning to use substances after exiting treatment. Notably, daily or weekly methamphetamine use was reported across 29% of visits where men reported recent treatment for substance use, and 24% of visits where men reported prior treatment, compared to 13% of visits among men who have never been treated. Methamphetamine use has been associated with persistent depression symptoms in the mSTUDY cohort, with a larger impact on depression symptom trajectories than other illicit substances. [93] This highlights the importance of improving efficacy of treatment and long-term management strategies for men who use methamphetamine to improve longer term mental health. [33] Additionally, there is the possibility that the elevated depression and anxiety symptoms in the post-treatment period are related to pre-existing elevated depression and anxiety symptoms. People who are experiencing difficulties with substance use and mental health concurrently are more likely to seek treatment, [55] and mood and anxiety disorders are common among people in treatment for substance use. [218] Baseline depression has been associated with worse engagement in and one-year methamphetamine use outcomes following treatment for methamphetamine use, [219] showing the interconnectedness of depression and substance use in the face of treatment. Finally, qualitative research has described that people exiting residential treatment for substance use or incarceration settings often face difficulties maintaining reduced substance use over time upon re-entering the community because they are re-introduced to environmental conditions and social relationships that may promote substance use. [111,220] It is plausible that facing these stressors without the support of the treatment environment also

contribute to additional depression and anxiety symptoms in the time-period after treatment for substance use. Altogether, regardless of the precise mechanisms, depression and anxiety symptoms were higher across visits where men reported being in recovery. Knowing that supporting better mental health outcomes after treatment for substance use is important to prevent return to use, [82,103,104] this finding indicates that mental health support resources should be made available to men who have sex with men both within the shorter and longer term after treatment for substance use.

One such modality may be peer-led recovery group participation. In multivariable adjusted models, 12-step group participation was significantly protective against higher depressive or anxiety symptoms among men in recovery. Twelve-step programs create fellowship groups that create social circles focused on reductions, and typically abstinence, from substance use, [108-110] which may facilitate improved mental health by maintaining reductions in substance use and building social support. Among visits where men reported treatment for substance use within or prior to the past six months, daily or weekly methamphetamine use was much less prevalent among visits where men reported current 12-step group involvement (13% versus 34%, data not shown), as was high frequency cannabis or alcohol use, all of which are associated with improved depression outcomes. [87,93,101] Likewise, 12-step group involvement's ability to promote social support may be a component of the protective association identified in this study as well: looking across visits with available measures from the Multidimensional Scale of Self-Perceived Social Support (MSPSS), [139] high social support was reported at over half (59%) of visits where participants reported 12-step involvement, compared to 38% of visits where participants did not report 12-step involvement (data not shown). Higher levels of social support have been associated with improved depression outcomes among men who have sex with men. [53,107] It is encouraging to see that 12-step group participation improved mental health symptoms among men who have sex with men who have exited treatment for substance use. It is important to note

the limitations of the 12-step approach, which can be less effective for people who do not resonate with 12-step philosophy and can vary based on group dynamics of the specific chapters. [25] Notably, specialty 12-step affinity groups for gay men in recovery formed in response to avoiding homophobia and addressing components of recovery that are unique to gay men. [221] Furthermore, Black men who have sex with men who use methamphetamine who participated in a qualitative study described that while a 12-step program for methamphetamine use was available locally, attendees are predominantly white, making the space less accessible for Black men to participate. [135] Connections to other Black individuals in recovery could be more beneficial for some Black men who have sex with men, with participants in another qualitative study reporting interest in peer mentorship as a component of methamphetamine treatment. [112] Altogether, the findings from this study suggest that 12-step can be an effective way to support mental health outcomes among men who have sex with men in recovery and encourage interest in other culturally-tailored modalities to foster social support in recovery. Some potential examples include peer recovery support services, wherein people with lived experience with recovery are hired to establish and maintain connection with people in recovery, offering encouragement, helping navigate access to treatment, and providing aftercare check-ins, [112,222] as well as recovery-focused housing communities. [30,38,39,113,114,223]

The available data in this study does not describe men's treatment goals and motivations, [224] if treatment was voluntary, [205] length of stay, completion of treatment, [206] or time since receiving treatment, all of which could differently influence how treatment impacted men's mental health after treatment. Additionally, mSTUDY participants' retention in the cohort may have been influenced by receiving treatment for substance use or higher depression or anxiety symptoms, leading to the potential for selection bias of the sample. The mSTUDY cohort includes many people who have recently experienced homelessness and many people who use methamphetamine, which may make results not transportable to the broader community of men

who have sex with men who use substances in Los Angeles. While data was observed over a period of up to 10 years, and the exposure to treatment for substance use was defined relative to time since treatment, the methods used in this analysis do not describe a continuous, longitudinal picture of how anxiety and depression symptoms change over time and could not adjust for all time-varying confounding, for example by clinical mental health diagnoses. The strengths of this analysis are that it pools a snapshot of the association of treatment for substance use and depression and anxiety symptoms, comparing outcomes among men who have sex with men who experienced substance use treatment to those who did not. Men's mental health in the community after treatment for substance use has been understudied, and this study provides insight into the continued mental health needs of men who have sex with men in recovery.

Conclusion

This analysis demonstrates that higher depression and anxiety symptoms are common among men who have sex with men who have experienced treatment for substance use, and that mental health resources should be available to support community-based men who have sex with men in the time after treatment for substance use. Initiatives that promote culturally-tailored, recovery-informed social support for men who have sex with men in recovery, such as 12-step programs or peer recovery support, could be an actionable target to facilitate better substance use and mental health outcomes after treatment for substance use.

Tables and Figures

Table 4-1: Sociodemographic, mental health, and substance use characteristics across mSTUDY visits relative to treatment for substance use (visits = 3571).

	Overall (visits = 3571)	%	Never treated (visits = 2441)	%	Recent Treatment (visits = 400)	%	Prior Treatment (visits = 730)	%
Age (mean, SD)	35 (7)		34 (7)		36 (7)		38 (7)	
18-24	242	6.8	205	8.4	21	5.3	16	2.2
25-29	663	18.6	508	20.8	57	14.3	98	13.4
30-39	1580	44.3	1140	46.7	194	48.5	246	33.7
40-49	1013	28.4	550	22.5	123	30.8	340	46.6
50-59	73	2.0	38	1.6	5	1.3	30	4.1
Race / ethnicity								
Black	1369	38.3	1010	41.4	109	27.3	250	34.3
Latinx	1597	44.7	1049	43.0	215	53.8	333	45.6
Other	179	5.0	120	4.9	19	4.8	40	5.5
White	426	11.9	262	10.7	57	14.3	107	14.7
HIV status								
Men living with HIV	2005	56.2	1150	47.1	331	82.8	524	71.8
Men living without HIV	1566	43.9	1291	52.9	69	17.3	206	28.2
Insurance								
Private	894	25.0	680	27.9	57	14.3	157	21.5
Government	1905	53.4	1237	50.7	252	63.0	416	57.0
Other	459	12.9	267	10.9	70	17.5	122	16.7
No insurance	304	8.5	252	10.3	21	5.3	31	4.3
Past 6 month incarceration								
1+ days	509	14.3	284	11.6	91	22.8	134	18.4
Past 6 month unstable housing								
1+ days	442	12.4	229	9.4	101	25.3	112	15.3
Daily/Weekly Substance Use								
Methamphetamine	613	17.2	324	13.3	115	28.8	174	23.8
Binge drinking	376	10.5	247	10.1	50	12.5	79	10.8
Cannabis	1152	32.3	863	35.4	90	22.5	199	27.3
Tobacco Use								
Any	1251	35.0	744	30.5	194	48.5	313	42.9
Current 12-step participation	501	14.0	42	1.7	235	58.8	224	30.7
High CES-D or GAD-7 score	1864	52.2	1151	47.2	256	64.0	457	62.6
CES-D Total Score (Median, IQR)	14 (8-24)		12 (8-23)		19 (11-28.5)		17 (9.5-27)	

GAD-7 Total Score (Median, IQR)	11 (7-15)	10 (7-14)	14 (9-18)	13 (8-16)

P-values calculated from chi-square, Wilcoxon rank sum, or ANOVA tests as appropriate. Rows may not sum to 100% due to missing data. CES-D = Center for Epidemiologic Studies Depression Screener. GAD-7 = Generalized Anxiety Disorder screener. SD = standard deviation. IQR = interquartile range.

Table 4-2: Adjusted generalized estimating equation models assessing the association of treatment of substance use and high depression and/or anxiety screening outcomes among men in mSTUDY, 2014-2024 (visits = 3254).

	High depression and/or anxiety symptoms (aOR, 95% CI)
Treatment for substance use	
Recent treatment (within six months)	2.44 (1.65-3.6)
Prior treatment	2.57 (1.66-3.98)
No treatment	Ref.
Age	
18-24	0.8 (0.49-1.31)
25-29	0.82 (0.61-1.12)
40-49	0.72 (0.52-1)
50-59	1.27 (0.57-2.86)
30-39	Ref.
Race and ethnicity	
Black or African American	0.76 (0.47-1.22)
Hispanic, Latinx, or Spanish	0.96 (0.6-1.54)
Other	1.2 (0.54-2.66)
White	Ref.
HIV Status	
Men living with HIV	1.03 (0.76-1.4)
Men living without HIV	Ref.
Insurance	
No insurance	0.86 (0.58-1.25)
Other	0.91 (0.64-1.31)
Private	0.94 (0.7-1.25)
Government	Ref.
Unstable housing within past 6 months	
1+ days vs. 0 days	2.17 (1.59-2.96)
Incarceration within the past 6 months	
Yes vs No	0.77 (0.57-1.03)
Current participation in 12 step program	
Yes vs No	0.55 (0.38-0.79)
Visit during COVID shutdown	
Yes vs No	1.61 (1.31-1.97)

aOR = adjusted odds ratio. CI = confidence intervals. COVID shutdown period classified as any visit in between March 16, 2020 - June 15, 2021.

Table 4-3: Adjusted generalized estimating equation models assessing the association of 12-step group participation and mental health screening outcomes among men in mSTUDY who have experienced treatment for substance use, 2014-2024 (visits = 1029).

	High depression and/or anxiety symptoms (aOR, 95% CI)
Current participation in 12 step program	
Yes vs No	0.68 (0.47-0.99)
Age	
18-24	0.4 (0.14-1.14)
25-29	0.74 (0.46-1.21)
40-49	0.72 (0.46-1.11)
50-59	1.18 (0.36-3.92)
30-39	Ref.
Race and ethnicity	
Black or African American	1.13 (0.5-2.58)
Hispanic, Latinx, or Spanish	1.23 (0.58-2.61)
Other	2.58 (0.71-9.38)
White	Ref.
HIV Status	
Men living with HIV	0.71 (0.41-1.23)
Men living without HIV	Ref.
Insurance	
No insurance	1.49 (0.79-2.82)
Other	1.03 (0.69-1.55)
Private	1.1 (0.72-1.69)
Government	Ref.
Unstable housing within past 6 months	
1+ days vs. 0 days	1.27 (0.85-1.89)
Incarceration within the past 6 months	
Yes vs No	0.71 (0.46-1.11)
Visit during COVID shutdown	
Yes vs No	1.15 (0.84-1.57)

aOR = adjusted odds ratio. CI = confidence intervals. COVID shutdown period classified as any visit in between March 16, 2020 - June 15, 2021.

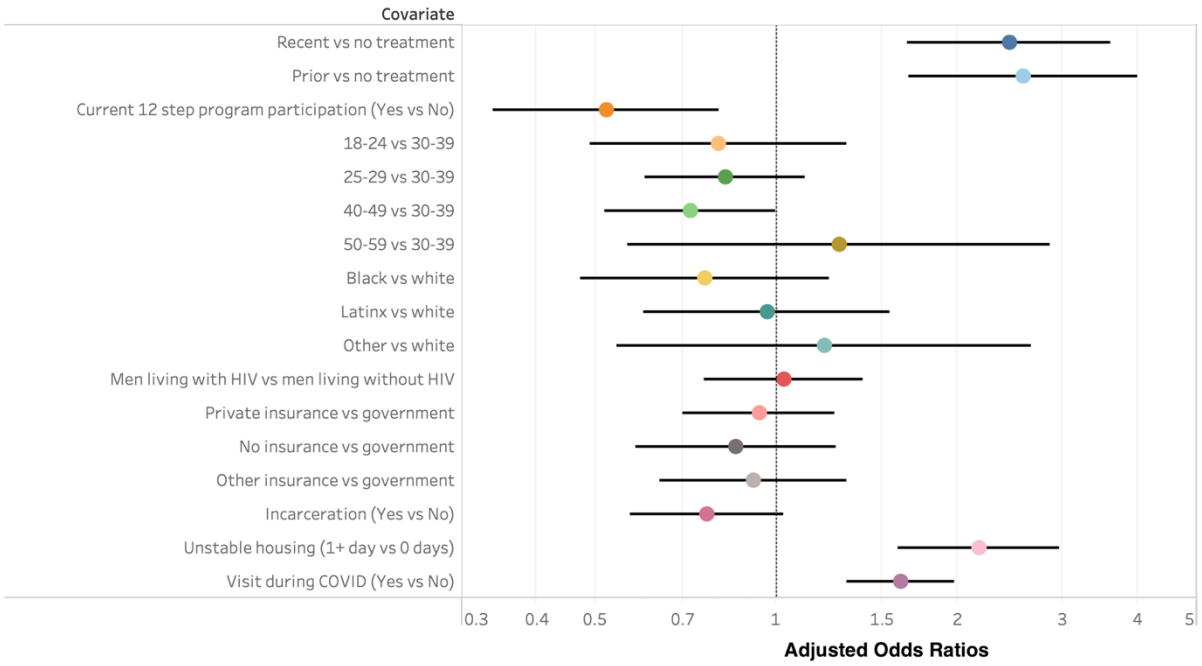


Figure 4-1: Association of treatment for substance use and mental health screening outcomes among men in mSTUDY, 2014-2014 (visits = 3254).

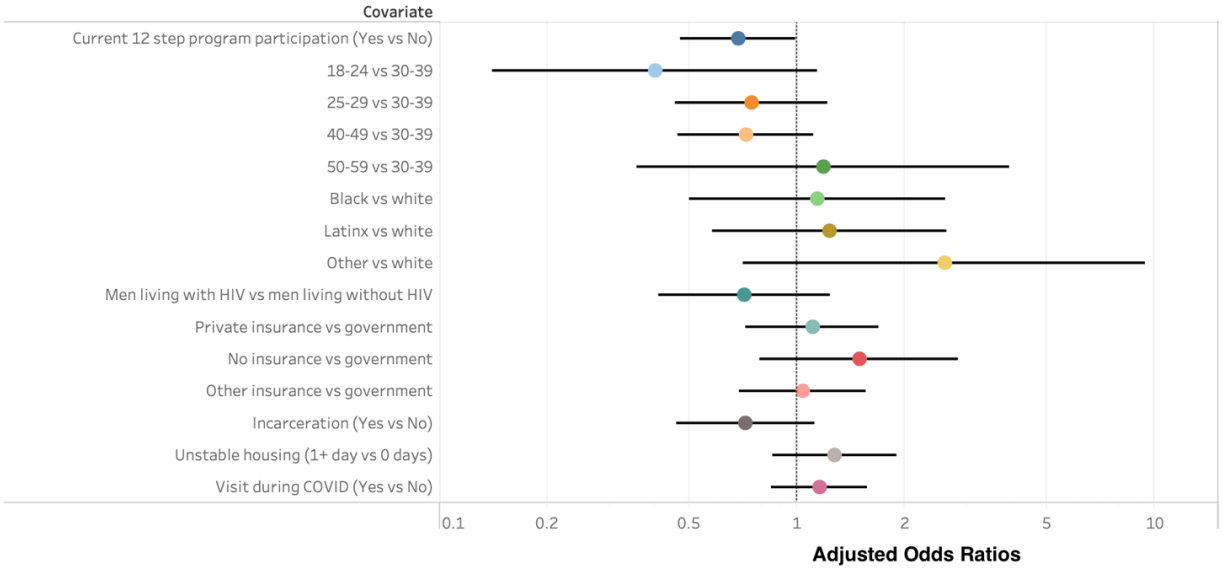


Figure 4-2: Association of 12-step group participation and mental health screening outcomes among men in mSTUDY who have experienced treatment for substance use, 2014-2024 (visits = 1029).

Chapter 5 Conclusion

This dissertation describes the syndemic socioeconomic and health outcomes that are associated with men who have sex with men in Los Angeles, CA entering into treatment for substance use, as well as the substance use, depression, and anxiety outcomes that follow treatment. These studies use data from the NIDA funded mSTUDY cohort (U01DA036267), which has been sustained over the past 10 years because of the over 600 participants who have ever shared their experiences with substance use, treatment, socioeconomic events, and mental health over time. The mSTUDY cohort, while not being reflective of the experiences of all men who have sex with men in Los Angeles, includes strong representation from men of color who have sex with men who have experienced homelessness and who use substances. The Ending the HIV Epidemic initiative at Los Angeles County Department of Public Health (LACDPH) identified that Black and Latinx men who have sex with men, people experiencing homelessness, and people who use substances are priority populations to target tailored interventions to prevent the transmission of HIV and to improve care outcomes among people living with HIV in Los Angeles. [75] Thus, findings from the mSTUDY cohort can offer insight into how to improve HIV prevention and treatment outcomes in Los Angeles. This dissertation addresses knowledge gaps around treatment for substance use among community-based men who have sex with men, and the findings offer insight on how public health interventions can improve substance use outcomes that may help address the HIV epidemic and support a higher quality of life for men who have sex with men who use substances and are in recovery in Los Angeles.

Chapter 2 discussed the baseline factors that were associated with men in mSTUDY having a history of treatment for substance use at baseline, as well as with entering treatment for substance use during follow up. The results identified factors that were both associated with ability to access care as well as factors that are known drivers of substance use that may exacerbate the need for

treatment. Men in the mSTUDY cohort who had experienced housing instability and incarceration were more likely to have previously experienced substance use treatment and to enter treatment during follow up. This result aligns with the eligibility for public substance use treatment programs in Los Angeles County, [156] as well as with the prior knowledge that homelessness and incarceration drive substance use. [100,111,202-204,225] These results thus echo other research that has examined the need for wraparound substance use support services to be available to people who are homeless or re-entering the community from being incarcerated, [72,111,157] such as the initiatives that LACDPH is implementing to support people experiencing homelessness who use substances, [146] or through interventions like the Mobile-Enhanced Prevent Support Study. [163] Homelessness and incarceration are problems that stem from structural racism, which was identified as a barrier to treatment in this study given the disparity in fewer Black and Latinx men accessing treatment during follow up compared to white men. Thus, structural interventions to address homelessness, incarceration, and disparities in treatment for substance use should center racial equity, which would be expected to decrease substance use among men of color who have sex with men in Los Angeles. Additionally, the analysis found that men who used methamphetamine at baseline were more likely to have a history of treatment for substance use and to engage with treatment for substance use during follow up than men who used alcohol or no substances, which reflects the common reality of returning to methamphetamine use after treatment. [167] This finding supports the need to innovate on treatment approaches for men who have sex with men who use methamphetamine [167] and to offer continued support after exiting treatment. Finally, men living with HIV who were virally suppressed had higher odds of reporting treatment for substance use prior to mSTUDY and during follow up than men living without HIV, which may be a reflection of men engaged in HIV care being better connected to treatment for substance use, such as through the Ryan White program in Los Angeles County. [168] Around one-third of men living with HIV who had a history of treatment for substance use at baseline were not virally suppressed, which emphasizes the need for treatment providers to consider HIV treatment

needs and substance use needs concurrently. [169] Homelessness, incarceration, racism, and substance use have been identified as syndemic factors for HIV, [42,43,45-48,51] so interventions to address these factors and improve treatment and support for men who have sex with men who use substances can also be expected to improve HIV outcomes in Los Angeles.

Chapter 3 described the frequency of methamphetamine, cannabis, binge alcohol, and tobacco use after treatment for substance use reported by participants in the mSTUDY cohort over years of follow up. Substance use outcomes were assessed using a harm reduction informed lens comparing daily and weekly use to less than weekly use, based on data that abstinence from substance use is not universally desirable and that reducing use of substances can offer major quality of life and health benefits. [85,87] Overall, the prevalence of daily and weekly methamphetamine use decreased over time for everyone who used methamphetamine at baseline, but was still reported across one-quarter of visits from men who had recent or prior treatment for substance use. The adjusted model identified that prior treatment for substance use was protective against higher frequency methamphetamine use, which offers promise of treatment promoting harm reduced methamphetamine use in the time after treatment. After adjustment for other covariates, racial disparities in higher frequency methamphetamine use were identified, where men of color had higher adjusted odds of using daily or weekly methamphetamine compared to white men in mSTUDY. This emphasizes the need to ensure high quality, equitable treatment for substance use and longer-term supportive services are available to all people who use methamphetamine in Los Angeles. Recent and prior treatment for substance use was associated with decreased odds of daily or weekly cannabis use, which suggests that treatment may offer a harm reduction benefit for cannabis use as well. The odds of higher frequency binge alcohol use were elevated among men who had recently received treatment for substance use, and tobacco use did not change relative to treatment status, which could point towards the value of interventions to reduce alcohol and tobacco use in the time period

after treatment for substance use. Finally, participation in 12-step programs was associated with decreased odds of higher frequency use of methamphetamine, cannabis, and binge alcohol, which supports the idea that recovery-focused social support available after treatment for substance use can offer additional harm reduction benefits. This study offers insight that treatment for substance use may offer longer-term harm reduction benefits for methamphetamine and cannabis use for men who have sex with men who use substances. Additionally, these results suggest that interventions to promote racial equity in treatment outcomes and to offer support for men who use substances outside of formal treatment settings could better promote harm reduction goals, which in turn could promote higher quality of life [87] and improved HIV outcomes for men who have sex with men in recovery. [14,37,51]

In Chapter 4, symptoms of anxiety and depression were common among mSTUDY participants and were elevated across visits where men reported recent or prior treatment for substance use. After adjustment, both recent and prior treatment for substance use were associated with elevated anxiety and depression symptoms among men in mSTUDY, which could suggest benefits of providing mental health care and support for men who have sex with men who are in recovery to promote better mental health outcomes and prevent return to substance use. [82,103,104] Among visits where men reported recent or prior treatment for substance use, participating in 12-step programs was associated with better depression and anxiety outcomes. This may be because men who participated in 12-step programs reported higher levels of social support than men who did not participate in 12-step programs, since social support is associated with improved mental health among men who have sex with men. [53,107] Research has shown that 12-step programs do not work for every person in recovery, [25,135] but evidence from this study indicates that they can have a positive mental health impact, and encourages research into other culturally-tailored interventions that foster recovery-oriented social support for men who have sex with men in recovery. [38,112-114] Knowing that mental health is an important component to quality of life [210,211]

and interconnected to substance use [87,93,100-102,212] and HIV outcomes, [52,107,128,211] these results suggest that initiatives to support mental health and promote social support would be beneficial for men who have sex with men following treatment for substance use.

This dissertation aimed to contribute knowledge to the research gap about the outcomes that men who have sex with men experience following treatment for substance use when they have returned to the community, and found that outcomes related to treatment for substance use shared syndemic overlaps with factors that influence HIV outcomes. Although this dissertation pulls from data collected over a period of 10 years, the analyses used methods that are cross-sectional in design, so results here should not be interpreted causally. Additionally, this dissertation uses data from the mSTUDY cohort, who do not represent the experiences of all men who have sex with men who use substances in Los Angeles. However, these findings do offer insight into how factors that are known to be syndemic with the HIV epidemic are also connected to engagement with and outcomes following treatment for substance use, including harm reduction outcomes. Thus, interventions that address structural barriers to care and syndemics of substance use and HIV could also promote better longer-term substance use and mental health outcomes for men who have sex with men in recovery, improving quality of life. These results build on the momentum of interventions to innovate equity-driven improvements to treatment for substance use in Los Angeles County that address several of these factors, seen in the development of the County's Alternatives to Incarceration report, which identified ways to support people who use substances in the community using human-centered, non-carceral approaches, [226,227] as well as different treatment expansion initiatives from LACDPH Substance Abuse Prevention and Control division. [146,228] Areas of future research should engage with community members to identify and implement culturally-tailored, equity-centered initiatives that can offer long-term support to Black and Latinx men who have sex with men and trans and gender non-conforming people, as well as people experiencing homelessness and incarceration, who use

substances and who are in recovery from substance use. We hope that these findings will contribute to interventions to promote racial, socioeconomic, and health equity for men who have sex with men who use substances during and after receiving treatment for substance use, helping to increase quality of life in recovery.

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