ABSTRACT

Title of Dissertation:	THE INTERSECTING EFFECT OF SUBSTANCE USE STIGMA, METHADONE TREATMENT STIGMA, AND RACIAL DISCRIMINATION ON METHADONE TREATMENT OUTCOMES
	Mary Buckley Kleinman, Doctor of Philosophy, 2024
Dissertation directed by:	Dr. Jessica Magidson, Psychology

Methadone treatment (MT) has demonstrated efficacy for treating opioid use disorder (OUD), but adequate engagement in treatment is a persistent challenge. Racially minoritized individuals with OUD disproportionately evidence poor outcomes. Stigma surrounding both substance use disorder (SUD) and MT negatively impact MT engagement. Racially minoritized individuals with OUD also routinely experience race-related stigma. This study aims to evaluate experiences of stigma in a population of patients receiving MT who identify as Black/African American and assess the impact on MT engagement. Participants (N=76) were recruited from an outpatient addiction treatment center in Baltimore City. Self-reported perception of enacted (experience of discrimination from others) and internalized (negative beliefs applied to self) stigma related to MT, SUD, and race were measured using the MT Stigma Mechanism Scale, SU Stigma Mechanism scale, Everyday Discrimination Scale, and an adapted internalized racism scale. Dosing data were collected from medical records over the subsequent 30 days. Correlations

between stigma scores were calculated and negative binomial regressions conducted predicting MT engagement by individual stigma measures as well as moderation models looking at the impact of racial stigma on relationship between MT/SUD stigma and MT engagement. All stigma measures were positively correlated with one another. Longitudinal models indicated significant association between higher SU stigma enacted by healthcare providers and lower MT engagement, but no other direct relationships between stigma measures and MT engagement. In moderation models, across all significant moderating effects observed between racial stigma and MT/SU stigma, lower racial stigma appeared to heighten the negative effect of MT/SU stigma on MT engagement. This finding contradicts our original hypothesis based on an expected compounding effect of multiple sources of stigma. Attribution theory, especially related to perceived controllability and blame associated with stigmatized identities, may explain these findings and warrants further exploration in future research within this population. Shame associated with perceived controllability of substance use or need for methadone treatment may cause some patients to engage in avoidance coping strategies, such as disengaging in healthcare or treatment. Better understanding the role of racial identity in this context could help inform integration of intervention strategies to best support MT in the future.

THE INTERSECTING EFFECT OF SUBSTANCE USE STIGMA, METHADONE TREATMENT STIGMA, AND RACIAL DISCRIMINATION ON METHADONE TREATMENT OUTCOMES

by

Mary Buckley Kleinman

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Advisory Committee:
Associate Professor Jessica Magidson, Chair
Associate Professor Jonathan Mohr
Associate Professor Ethan Mereish
Assistant Professor Annabelle Belcher
Associate Professor Lauren Porter, Dean's Representative

Dedication

This work is dedicated to anyone whose life has been impacted by the isolating disease of addiction.

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And, to my family, who have truly made anything I do possible. Keith Kleinman, you and Camper make every day meaningful, as will tiny Kleinman when she arrives. My parents, Jeremiah and Deborah Buckley, instilled in me the passion to seek out and help those in need, and to do so with great perseverance (*perseverando*). Anne and Gretta Buckley, I do not know who I would be without you. Thank you for always demonstrating the importance of quiet observation and the value of humor.

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List of Abbreviations

African American (AA)

Everyday Discrimination Scale (EDS)

Medication for Opioid Use Disorder (MOUD)

Methadone Treatment (MT)

Opioid Use Disorder (OUD)

Stigma Mechanism Scale (SMS)

Substance Abuse and Mental Health Services Administration (SAMHSA)

Substance Use Disorder (SUD)

University of Maryland Addiction Treatment Center (UMATC)

Chapter 1: Introduction

Section 1: General background

There are an estimated 2.5 million people living with opioid use disorder (OUD) in the United States, yet only about 20% received medication treatment in the past year (C. M. Jones et al., 2023). In 2021, over 81,000 Americans are estimated to have died from opioid overdose, continuing the upward trend that spiked in 2020 with a 20% increase over the previous year (National Institute on Drug Abuse, 2023). Medication treatment for opioid use disorder, including methadone treatment, has demonstrated efficacy in the treatment of OUD (Ayanga et al., 2016; Sordo et al., 2017), yet there are challenges with access and retention (C. M. Jones et al., 2015). The OUD treatment cascade highlights where gaps in care exist, pointing to the need to support engagement in care and retention in medication treatment (A. R. Williams et al., 2019). According to the cascade, only about 5% of individuals with OUD in the US are retained in medication treatment for at least six months (approximately half of those who initiate MOUD) (A. R. Williams et al., 2019). For methadone treatment specifically, people who drop out of care experience 3.2 times the rate of all-cause mortality and 4.8 times the rate of overdose mortality compared to people who remain on treatment (Sordo et al., 2017). There is a critical need to improve OUD treatment retention, as it is highly predictive of future relapse, functioning, quality of life, and mortality (Hser et al., 2007; Sordo et al., 2017; Timko et al., 2016).

Maryland is at the center of the opioid overdose crisis in the US, in the top 10 for highest age-adjusted rate of opioid-related fatalities by state (Kaiser Family

Foundation, 2022). Baltimore drives the opioid crisis in Maryland, with an overdose fatality rate higher than any metropolitan county in the US (Baltimore City Health Department, 2018; Maryland Behavioral Health Administration, 2021). Fentanyl surpassed heroin as the most common cause of overdose deaths in the City, accounting for almost 84% of all recent overdose fatalities (Maryland Behavioral Health Administration, 2021; Maryland Opioid Operational Command Center: 2020 Annual Report, 2021). Baltimore has a long history of prevalent heroin use, and significant racial and economic disparities that contribute to an overdose mortality rate that is 30% higher than the rest of the State (Maryland Behavioral Health Administration, 2021). Baltimore City is a prime location to study barriers to successful medication treatment for OUD that will help inform development of strategies to combat the OUD crisis, particularly for Black/AA individuals.

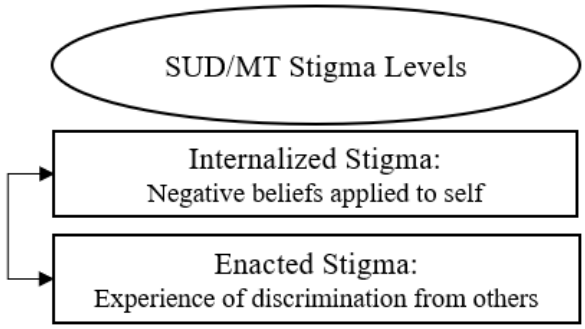
Racial/ethnic minoritized individuals with OUD face disproportionately high rates of morbidity and mortality due to OUD (Khatri et al., 2021; Larochelle et al., 2021; Patel et al., 2021) and disparities in medication treatment outcomes (Manhapra et al., 2017; Proctor et al., 2015; Samples et al., 2018). Recently, overdose deaths have increased over twice as fast among Black and African Americans (Black/AA) as compared to Whites (Scholl, 2019). In 2021, Maryland had the second highest number of opioid overdose deaths among Black/AA compared to any state in the US (Kaiser Family Foundation, 2023). There is an urgent need to better understand the specific challenges faced by Black/AA individuals seeking treatment for OUD.

Section 2: Substance use and methadone treatment stigma

Stigma surrounding both substance use disorder and methadone treatment have been shown to be key drivers of poor treatment outcomes (Brener et al., 2010; Hammarlund et al., 2018; L. V. Jones et al., 2014). Past research demonstrates that stigma is a complex, cross-cutting factor that occurs across multiple domains (i.e. substance use disorder and methadone treatment) and impacts methadone treatment outcomes (Earnshaw et al., 2013; Hammarlund et al., 2018; Madden, 2019; van Boekel et al., 2013). Stigma, defined as "an attribute that is deeply discrediting that reduces someone from a whole and usual person to a tainted, discounted one," (Goffman, 1963, p. 3) exists at multiple levels—self, public, and structural, all of which lead to social devaluation, inequality, and discrimination (Committee on the Science of Changing Behavioral Health Social Norms et al., 2016). As depicted in Figure 1, within the level of "self," stigma can be further categorized, based on how individuals respond to and process stigma, into the experience of internalized, or self-stigma, as well as enacted stigma from others. Enacted stigma, also referred to as discrimination, is typically a result of public stigma that occurs at the level of the individual and leads to internalization of that stigma attached to the individual's illness or attribute (Tsai et al., 2019).

Figure 1.

Conceptual Model: Stigma Mechanisms Framework



Adapted from Earnshaw et al., 2013

Research indicates that substance use disorder stigma, a condition-related stigma, can precipitate morbidity and mortality through multiple mechanisms, including weak social relationships, unstable housing, unemployment, and reluctance to engage in healthcare and treatment (Livingston et al., 2012). Compounding the effects of substance use disorder stigma, methadone treatment stigma, an intervention-related stigma, is the result of attitudes toward unique features of methadone and other medication treatment for OUD. Though medication treatment is considered the standard of care (Zerger et al., 2014), stigma can exist through beliefs around 'replacing one drug with another' and ideas about methadone treatment being incompatible with abstinence (Madden, 2019). Furthermore, methadone treatment is often portrayed using images of Black individuals who use heroin and are involved in criminal behavior, which creates challenges related to engagement and retention for people experiencing multiple sources of marginalization (Goedel et al., 2020). Previous research suggests that stigma mechanisms (internalized and enacted), though correlated with one another, uniquely and independently influence negative health

outcomes among people living with socially devalued characteristics (Earnshaw, Smith, Chaudoir, et al., 2013; Smith et al., 2016).

Section 3: Racial discrimination impacting health outcomes

Racial stigma is well cited as playing a prominent role in OUD treatment (Cooper et al., 2012; Entress, 2021; Pro & Zaller, 2020). In addition to stigma related to substance use and methadone treatment, Black/AA individuals with OUD also experience race/ethnicity-related stigma and discrimination (Zerger et al., 2014). The Substance Use and Mental Health Services Administration (SAMHSA) put out an urgent report in 2020 calling attention to Black/AA communities experiencing dramatic increases in opioid overdose deaths while resources and other attention have been focused primarily on White suburban and rural communities affected by the opioid epidemic (SAMHSA, 2020). This report highlights discriminatory views of Black/AA individuals as drug-seeking, untrustworthy, and criminal compared to White counterparts living with the disease of addiction who are represented as needing "compassion, understanding, treatment, and recovery" (SAMHSA, 2020, p. 7). Fear and expectation of negative outcomes can prevent Black/AA patients from fully engaging in treatment for OUD. More broadly, racial discrimination is known to impact overall health outcomes beyond substance use; stress associated with perceived racial discrimination has been linked to cardiovascular disease, cancer, antibody responses to infection, depression symptoms, and many others (D. R. Williams & Mohammed, 2009). Importantly, these effects persist beyond other factors such as socioeconomic status and education, pointing to a complex and enduring role of racial discrimination (Mays et al., 2007; D. R. Williams & Mohammed, 2009).

Section 4: Chronicity of stigmatizing experiences on health outcomes

A body of research has demonstrated that experiences of perceived discrimination and stigma lead to heightened stress responses and participation in unhealthy behaviors along with nonparticipation in healthy behaviors (Borrell et al., 2010; Jackson et al., 2010; Pascoe & Richman, 2009; Sims et al., 2016), including medication nonadherence (Bogart et al., 2010). One mechanism by which this relationship is believed to occur is through erosion of energy and mental resources for making health behavior choices when dealing with stigmatizing experiences (Pascoe & Richman, 2009). This erosion occurs through chronic exposure to stigma and discrimination over time and studies have shown that stressors that are persistent and repeated may more adversely affect health outcomes than those that are episodic or isolated events of greater magnitude (Bennett et al., 2010; D. R. Williams et al., 2003).

Section 5: Intersectionality

Intersectionality, as a defined term, has its roots in law and policy (Crenshaw, 1989), and has only relatively recently been adopted into the field of psychology and public health as a theoretical framework (Grabe, 2020). Intersectionality describes the experience of people occupying the intersections of social categories and acknowledges how social categories derive meaning from one another (Cole, 2009). Intersectional stigma occurs when people experience multiple forms of stigma (like related to race and substance use/methadone treatment; Stangl et al., 2019; Turan et al., 2019). By measuring and better defining the intersecting effect of multiple stigmas, the fields of psychology and public health seek to increase the ability to target and tailor

programs and interventions to best support those people most affected by marginalization and associated morbidity and mortality. Leaders in the field call for particular attention to the role of structural racism and intersectional discrimination as "risk factors for psychopathology and treatment utilization" (del Río-González et al., 2021, p. 34). However, much of the literature on stigma to date still focuses on the consequences of only one form of stigma in isolation, which vastly limits our understanding of true experiences impacting health outcomes. Some research has pointed to health consequences of stigma varying as a result of other components of identity. For example, people who experience HIV-related stigma experienced statistically significantly worse mental health outcomes only if they also experienced internalized SU stigma (Earnshaw, Smith, & Copenhaver, 2013) and other research has shown that a greater number of discrimination experiences (across HIV stigma, sexual orientation stigma, and racism) were associated with worse treatment adherence (Bogart et al., 2010). Considering the socially constructed link between substance use, methadone treatment, and race, such a relationship may also exist at the intersection of racial stigma, SU stigma, and MT stigma. As substance use and methadone treatment have unique, negative, associations within the context of Black/African American race (Goedel et al., 2020; Hart & Hart, 2019), racial stigma may uniquely make experiences of SU and MT stigma salient and impactful.

Section 6: Preliminary findings

Our team has led qualitative research examining factors impacting methadone treatment outcomes. Qualitative findings on barriers to successful treatment outcomes described by both patients and treatment providers identified multiple levels of

barriers (individual/self, social, institutional/structural, community/environmental), and stigma was found to be a cross-cutting theme across all levels (Anvari et al., 2022; Kleinman et al., 2020, 2021). Participants identified experiences of internalized and enacted and methadone treatment and substance use stigma, and described these as barriers to treatment engagement and retention. Patients described methadone treatment stigma as following them during their treatment experience; some, well into methadone treatment stabilization, described still feeling as though they were using drugs due to conceptualizing methadone treatment as using "yet another substance." Our team's qualitative results also point to the intersection of methadone treatment and substance use stigma with racial/ethnic discrimination. One interview participant described: "there are just so, so many layers of stigma that can be attached to basically being a poor person of color in Baltimore City with a heroin addiction." In this qualitative study, although we did not probe specifically for experiences of racial discrimination as a barrier to methadone treatment, this theme preliminarily emerged and prompted further exploration in the current study.

Section 7: Current study

Despite widespread acknowledgement of the impact of stigma on OUD treatment outcomes, morbidity, and mortality, to our knowledge, no studies to date have conducted a prospective analysis of the impact of intersecting stigmas on treatment outcomes. Only within the last few years have validated measures that specify stigma mechanisms for substance use and methadone treatment been developed. Recent findings suggest that people receiving methadone treatment experience stigma related to substance use and methadone treatment as distinct, but

intersecting forces rather than continuation of one stigmatized identity (substance use disorder, as previously conflated) (Smith et al., 2020). Similarly, though studies have demonstrated discriminatory prescribing practices in methadone treatment based on race (Pollack & D'Aunno, 2008), to date, no studies have quantified the effect of racial stigma on methadone treatment outcomes. Furthermore, very few studies have looked at the intersection of substance use/methadone treatment stigma and racial stigma (Pro & Zaller, 2020).

To address gaps in the current literature, and building off of the Intersectionality Theoretical Framework (Bowleg, 2012) and the Stigma Mechanisms Framework (Chaudoir et al., 2013; Earnshaw et al., 2013), this study aims to elucidate the effects of methadone treatment stigma, substance use disorder stigma, and racial stigma on methadone treatment engagement among Black/AA individuals with OUD. Poor methadone treatment engagement (missed daily dosing) is predictive of opioid withdrawal symptoms, substance use, and lower likelihood of long-term treatment retention (Durand et al., 2021; Greenwald, 2002). The present study focuses specifically on a low-income, ethnoracial minoritized population that has been significantly underserved in healthcare and treatment for substance use disorders (SAMHSA, 2020).

While research has demonstrated substantial disparities related to OUD morbidity and mortality among Black/AA populations, investigation of the experiences that affect poor treatment outcomes have been limited but have the potential to further inform future interventions (Parlier-Ahmad et al., 2021). The overall aim of this study is to measure substance use and methadone treatment stigma

as well as racial stigma among Black/AA receiving methadone treatment and investigate their intersecting effects on treatment engagement. Specific Aims include:

Aim 1: Relationships Between Substance Use Stigma, Methadone Treatment Stigma, and Racial Stigma

To describe the experience of internalized and enacted racial stigma and the intersection with internalized and enacted substance use and methadone stigma among Black/AA patients receiving methadone treatment.

Hypothesis 1. There will be a significant positive relationship between substance use stigma, methadone treatment stigma, and racial stigma.

We have based our hypotheses for aim 1 on the idea that people with multiple marginalized social identities experience greater discrimination than people with single marginalized social identities and thus experience compounding stigma-related stress (Earnshaw et al., 2018; Grollman, 2014).

Aim 2: Impact of Stigma and Racial Discrimination on Methadone Treatment Outcomes

To prospectively examine the effect of stigma on subsequent methadone treatment engagement.

Hypothesis 2. Higher reported methadone treatment stigma, substance use stigma, and racial stigma at all levels (internalized and enacted) will all be independently associated with poorer methadone treatment engagement compared to lower reported stigma.

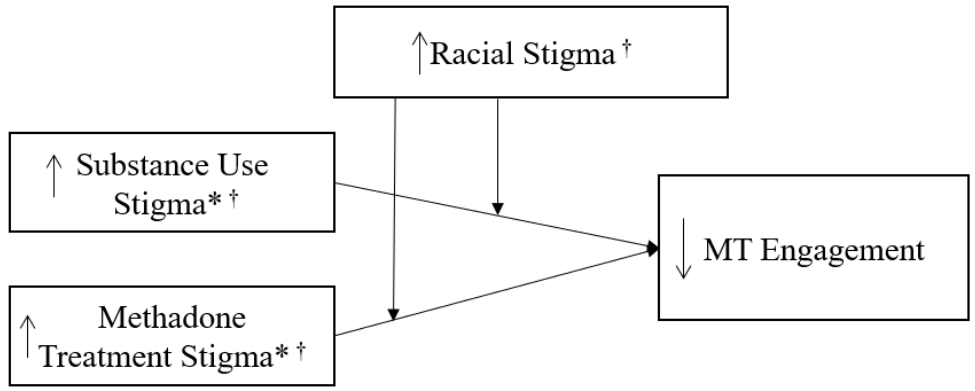
Aim 3. (Exploratory): Moderating Effect of Racial Discrimination

To evaluate interactive effects of racial stigma and SU/MT stigma on methadone treatment engagement, we will test racial stigma (internalized and enacted) as a moderator of the relationships between SU/MT stigmas and methadone treatment engagement.

Hypothesis 3. Higher racial stigma (both internalized and enacted) will worsen the effects of all other forms of stigma (substance use and methadone treatment stigma; internalized and enacted) on methadone treatment engagement (see Fig. 2).

Figure 2

Proposed Conceptual Moderation Model



*separate models for SU stigma and MT stigma
†separate models for internalized and enacted stigma
MT= methadone treatment; SU= substance use

Chapter 2: Methods

Section 1: Participants and recruitment

Participants (*N*=76) were recruited from the University of Maryland Addiction Treatment Center (UMATC), a large, urban community-based, outpatient substance use treatment program in Baltimore City. UMATC includes a methadone treatment program that has over 550 active patients, the majority of whom (65%) identify as Black/AA, and 83% report having earned less than $15,000 in the past twelve months. Eligibility criteria for this study include: 1) adult (≥18 years); 2) Black/AA race; and 3) currently receiving methadone treatment at UMATC. Exclusion criteria: (1) untreated or undertreated psychosis or mania that would interfere with study participation; and/or (2) inability to give informed consent in English.

A protocol is in-place at UMATC that allows patients to indicate at treatment intake if they are willing to be contacted for potential research opportunities. Patients who were eligible and interested in participating had the study procedures fully described to them by a member of the study staff. If still interested, the participants were provided informed consent and completed baseline survey measures.

Section 2: Procedures

We assessed self-reported methadone treatment stigma, substance use stigma, and racial stigma and then collected dosing data from medical records to determine number of doses taken over the subsequent 30 days. Assessment questionnaires were conducted in a private research space at UMATC, with questions read aloud to participants by trained researchers. Medical chart review took place in the following

30 days after baseline assessment completion. Participants were compensated $15 for the approximately 30-minute assessment session. All study procedures were approved by the University of Maryland, College Park IRB (IRBNet 1910410).

Section 3: Measures

All measures collected for this study are provided in Appendix A.

Substance Use and Methadone Treatment Stigma Measures

Substance use stigma was assessed using the Substance Use Stigma Mechanism Scale (SU-SMS) (Smith et al., 2016). The SU-SMS measures experiences of internalized substance use stigma, as well as enacted substance use stigma from family and health care providers (each in separate subscales). Questions for the internalized SU-SMS subscale ask participants to rate the degree to which they agree or disagree with statements such as "I feel I'm not as good as others because I use(d) substances." The enacted subscale asks about frequency of past experiences for statements such as "Healthcare workers have thought that I'm pill shopping or trying to con them into giving me prescription medications to get high or to sell." This scale has been validated previously among underserved individuals with OUD, including a population of racial/ethnic minoritized patients (Smith et al., 2016).

Methadone treatment stigma was assessed using the Methadone Maintenance Treatment Stigma Mechanism Scale (MMT-SMS). The MMT-SMS assesses internalized methadone treatment stigma as well as enacted stigma from three sources (family, healthcare provider, and employer) (Smith et al., 2020). Questions for the internalized MMT-SMS subscale ask participants to rate the degree to which they agree or disagree with statements such as "Receiving methadone treatment makes me feel like I am a bad person." The enacted MMT-SMS subscale asks about frequency of past experiences for statements such as "Family members have thought that I cannot recover [because I receive methadone treatment]."

Responses to the SU-SMS and MMT-SMS are given on a 5-point Likert-type scale with higher scores indicative of higher experiences of stigma, respectively. Items are averaged to create composite scores for each stigma mechanism scale and subscale.

Enacted Racial Stigma

Common experiences of racial discrimination (enacted racial stigma) were assessed using the Everyday Discrimination Scale (EDS) (D. R. Williams et al., 1997). The measure includes ten items that assess discriminatory experiences, like being treated with less courtesy and respect than others as well as being threatened or harassed. We used a modified version, asking participants to respond specifically for experiences based on race (e.g., "You are treated with less respect than other people because of your race"), as has been done by others investigating experiences of racial discrimination (Le & Iwamoto, 2019). Responses are given on a 6-point Likert-type scale with higher scores indicating higher frequency of experiences (from "Never" to "Almost every day"). This scale has demonstrated good reliability and validity among Black/AA adults (Krieger et al., 2005; T. R. Taylor et al., 2004). Items are averaged to create composite scores. We also included an open-ended inquiry at the end of the assessment asking participants to rate what they believe to be their primary source of experiences of discrimination (as an exploratory question to guide future research), if any item was endorsed as being experienced at least "a few times a year" or more frequently.

Internalized Racial Stigma

Internalized racial stigma was measured using items adapted from the Nadanolitization Scale (Earnshaw et al., 2021; Taylor & Grundy, 1996). In previous research, three items were found to have acceptable internal reliability and face validity among Black gay and bisexual men (V. Earnshaw, personal communication, September 19, 2022).

Participants responded to three items describing their feelings about their race, such as "I sometimes struggle with negative feelings about my race." Responses are measured on a 6-point scale ranging from strongly disagree (1) to strongly agree (6). Items were averaged to create a composite score.

Methadone Treatment Outcomes

Methadone treatment engagement was calculated as the number of methadone doses missed over the 30-day follow-up period. Participants who transfer to another treatment program during that time were still followed for dosing data based on consent to collect dosing data from another treatment program. As part of an existing research infrastructure at UMATC (R33DA057747; PI: Magidson), a report was run monthly to pull methadone dosing data and urine toxicology results from the electronic health record (Methasoft, Netalytics, Greer, SC) and formatted for upload to a REDCap database where study assessment data are documented. As part of this process, dosing data are screened for potential outliers (based on dose volume) and duplicate information for the same day and any necessary corrections are made through consultation with a member of the medical team at UMATC.

Within the first several months of methadone treatment, patients typically receive daily, observed dosing five days per week with take-home doses on Saturday and Sunday. Saturday in-person dosing is also available and provided, based on medical team determination, to patients who demonstrate need for additional support (i.e. concern about safety of medication storage in the setting of unstable housing, concern about medication diversion, etc). Depending on medication adherence (missed doses) and routine (approximately monthly) urine toxicology results, patients can receive up to 28 days of take-home doses of methadone medication, provided at increasing intervals based on discussion across the treatment team (addiction medicine providers and addiction counselors).

Patients who receive take-home bottles are required to return empty bottles at their next visit. Daily methadone dosing data, including take-home bottle returns, are documented in the electronic medical record. For the purposes of this analysis, documented take-home doses were counted as dosed/not missed, though they were not directly observed.

Covariates

Demographic characteristics, including race and gender, were assessed using a validated questionnaire that is administered as standard practice at UMATC during MT intake. Participants confirmed their race, gender, and age at the time of study enrollment based on self-report. Male gender (Durand et al., 2021; Kelly et al., 2011; Marsh et al., 2021), younger age (Deck & Carlson, 2005; O'Connor et al., 2020), polysubstance use (Deck & Carlson, 2005; O'Connor et al., 2020), and incarceration history (Deck & Carlson, 2005; Kelly et al., 2011) have all been found to be associated with poorer MOUD treatment retention, while time since starting MOUD has been associated with better MOUD retention (Deck & Carlson, 2005). Gender was measured as categorical (male, female, transgender man, transgender woman, genderqueer, additional identity); age was measured continuously; polysubstance use was measured dichotomously as greater than two different classes of drugs positive on most recent toxicology test; incarceration history was measured as continuous total number of months incarcerated in lifetime; history of MOUD engagement was measured as dichotomous; and time since starting MOUD was measured as continuous (days since most recent methadone treatment intake). Other variables captured in the participant survey to describe our sample include: sexual orientation, current substance use severity, and level of education.

Section 4: Data analytic plan

***Aim 1*. To describe the experience of racial stigma and its intersection with substance use and methadone stigma.** We employed descriptive statistics to estimate the levels of substance use, methadone treatment, and racial stigma (separately for internalized and enacted) and calculated Pearson correlation coefficients to test the relationships between all three as well as correlation between stigma measures and relevant covariates (listed above). Point-Biserial correlations were calculated to evaluate association of stigma scores with categorical variables. We employed two-tailed tests for the most conservative investigation of these relationships.

***Aim 2*. To prospectively examine the effect of substance use stigma, methadone treatment stigma, and racial stigma on subsequent treatment engagement.** To account for the positively skewed nature of missed methadone doses over 30 days, with a large proportion of participants missing no doses during that follow-up (32.9%, see figure 3 below), we modeled MT engagement using multiple negative binomial regression. Negative binomial regression was chosen to address the observed right-skewed count data and overdispersion (Green, 2021). Overdispersion was evaluated to assess appropriate application negative binomial over a Poisson model (Cameron & Trivedi, 1990). We calculated adjusted score equations for median bias reduction to address bias introduced by the maximum likelihood estimator in negative binomial models with moderate sample size (Kenne Pagui et al., 2022).

We ran separate models for each stigma subscale to evaluate the independent effects of each on 30-day methadone treatment engagement, first simple models and then controlling for time in MT as a potential confounding variable. Time in

treatment was determined as a potential confounder due to theoretical as well as observed association with both the predictors (stigma measures) and outcome of MT engagement and not thought to be a mediator of the relationship between stigma and MT engagement (Kahlert et al., 2017; VanderWeele, 2019). As a secondary analysis, we also ran models for each stigma sub-scale, including sources of enacted SU and MT stigma (family, healthcare workers, and employers).

Aim 3 **(Exploratory). To evaluate interactive effects of racial stigma and multiple forms of stigma on methadone treatment engagement.** We evaluated the potential moderating effect of both enacted racial stigma and internalized racial stigma (separately) on the relationship between substance use/methadone treatment stigmas and subsequent one-month methadone treatment engagement by running separate negative binomial regression models and including racial stigma measures as interaction terms. Again, we calculated adjusted score equations for median bias reduction. To reduce multicollinearity, continuous variables were mean centered for these analyses. If significant interactions are identified, we probed by creating separate regression lines testing the effect of stigma at low (one standard deviation [SD] below sample mean), mean, and high (one SD above sample mean) levels of internalized and/or enacted racial stigma.

All analyses were conducted in R statistical package.

Chapter 3: Results

Between August 2022 and August 2023, seventy-six participants were enrolled in this study. During that time, 142 patients at the drug treatment center were screened for enrollment (all with medical records that indicated Black/AA and receiving methadone treatment); of those, two were deemed ineligible due to untreated psychosis or mania, seven declined participation, and fifty-seven did not follow-up with researchers to learn more about study participation. Therefore, 53% of those screened went on to provide data for this study. Baseline demographics are described in Table 1. Mean age of participants was 52.8 years, 59% of participants identified as male, and 82% reported previous methadone treatment history, with an average of 56 days since the start of most recent methadone treatment episode. Seventy-five percent of participants reported incarceration history with a mean of 24 months total incarceration time across all participants. During the 30-day follow-up after baseline completion, participants missed an average of 4.4 days of methadone dosing (SD 6.2; range 0 to 29; see Figure 3). Twenty-five participants did not miss any doses during 30-day follow-up.

Figure 3

Histogram of Missed Methadone Doses Over 30-day Follow-up

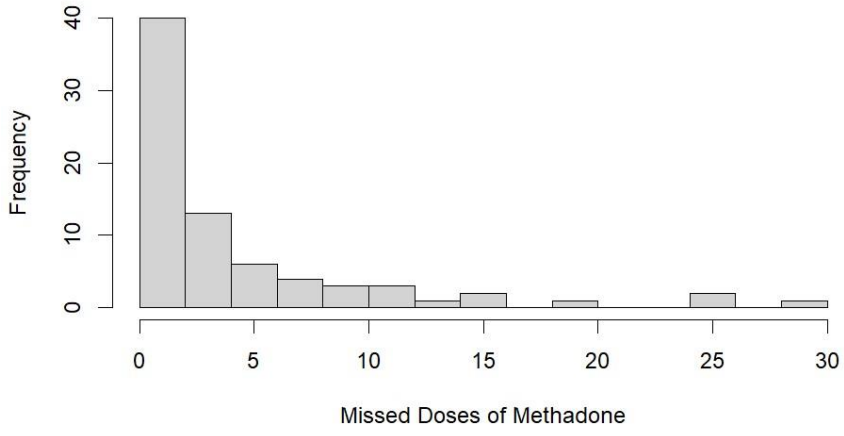


Table 1

Baseline Demographics and Other Characteristics

Characteristics	*n* (%) *N*=76	α*
Age; mean (SD)	52.8 (11.2)	
Gender		
Male	45 (59.2)	
Female	31 (40.8)	
Other specified	0 (0.0)	
Sexual Orientation		
Straight	69 (90.8)	
Bisexual	4 (5.3)	
Gay	2 (2.6)	
Lesbian	1 (1.3)	
Lifetime incarceration (months); median (IQR)	24 (83.6)	
Multiracial (in addition to Black/AA)	10 (13.2)	
Highest level of education		
Less than HS diploma	24 (31.6)	
HS or GED	40 (52.6)	
Some college, no degree	5 (6.6)	
Associates degree	4 (5.3)	
Bachelor's degree	2 (2.6)	
Don't know	1 (1.3)	
Unhoused	3 (4.0)	
Working (full or part time)	12 (15.8)	
Previous MT history	62 (81.6)	
Days since MT start; median (IQR)	56 (982.8)	
Within 30 days of MT start	30 (39.5)	
Current opioid use (TAPS)[†]	53 (69.7)	
Current opioid use, on toxicology results [‡]	46/55 (83.6)	
Polysubstance use, on toxicology results [‡]	14/55 (25.5)	
% take-home doses; mean (SD) [§]	31.8% (22.5)	
Internalized SU stigma; mean (SD)	2.85 (1.02)	0.86
Enacted SU stigma; mean (SD)	2.14 (0.91)	0.83
Internalized MT stigma; mean (SD)	1.86 (0.75)	0.86
Enacted MT stigma, mean (SD)	2.18 (0.96)	0.89
Enacted racial stigma (EDS); mean (SD)	1.55 (1.26)	0.91
Internalized racial stigma; mean (SD) [¶]	1.35 (1.54)	0.86

*****Cronbach's alpha for self-report stigma measures

[†]TAPS= Tobacco, Alcohol, Prescription medications, and other Substance Tool; score of 2 used as a cutoff for SUD (McNeely et al., 2016).

[‡]*N*=55 for participants who had toxicology data available +/- 7 days of study assessment date

[§]Measured over 30-day follow-up, proportion of doses counted as "taken" that were take-home
[¶]*N*=61 for participants who answered internalized racial stigma questions because these were added to the assessment after enrollment had started

To look at potential differences between those participants who missed no doses versus those who missed at least one dose during follow-up, we created separate demographic tables for each of these sub-groups and compared characteristics of these groups using t-tests (for continuous variables) and chi-square or Fisher's exact tests (depending on sample size, for categorical variables). Appendix Table B1 includes sub-group descriptor data and *p* values for comparison tests. The two groups differed such that those who missed no methadone dose over 30-day follow-up had been in treatment longer (median 91 days compared to 49 days) and had a higher proportion of take-home doses (42% compared to 27%).

Section 1: Aim 1

To describe the experience of racial stigma and its intersection with substance use and methadone stigma

All stigma measures were found to have statistically significant positive cross-sectional correlation with one another, indicating that higher levels of all stigmas (SU, MT, and racial) were associated with each other, except internalized SU stigma and enacted MT stigma (not accounting for sources of enacted stigma sub-scales). Low to moderate correlation coefficients indicate that these scales of internalized and enacted stigma are measuring distinct constructs both within and across assessments (e.g. internalized distinct from enacted and internalized MT stigma distinct from internalized SU stigma). Highest correlation (at a moderate level, $r>0.5$) was found

between enacted MT stigma and internalized racial stigma (r=0.54), enacted SU stigma and internalized racial stigma (r=0.52), enacted SU stigma and enacted racial stigma (r=0.65), and enacted racial stigma and internalized racial stigma (r=0.58).

In addition to looking at the overall enacted MT and SU stigma scores, as a secondary analysis, we evaluated each of these by sources of enacted stigma (family, healthcare providers, and employers). Correlations between stigma scores described above remained largely consistent across sub-categories of sources of enacted stigma. However, in the observed relationships between MT and SU enacted stigma scores and internalized racial stigma, reported experiences of enacted stigma from family were more highly correlated with higher internalized racial stigma than other sources of enacted stigma. See Appendix Table B2 for all stigma measure correlation coefficients.

Regarding relevant covariates for consideration in subsequent models, increased age was found to be associated with lower enacted racial stigma scores (r=-0.26, p=0.02). Women were found to report lower internalized racial stigma than men (r=-0.33, p=0.01). Greater time since starting methadone treatment was associated with lower enacted SU stigma scores (r=-0.27, p=0.02), lower internalized SU stigma scores (r=-0.34, p=0.002), and lower enacted racial sigma scores (r=-0.27, p=0.02). See Appendix Table B3 for all stigma measure and covariate correlation coefficients.

Open-ended Feedback on Sources of Stigma

As part of the EDS questionnaire, following questions specifying experiences of racial discrimination, participants were asked to share what they feel is the primary cause of those experiences. Race, as well as other identity options, were listed along with an “other,

specified" options. Participants could choose more than one option if they felt those aspects of identity were equally relevant in their experiences of discrimination. Of 60 participants who endorsed experiencing any of the ten EDS items at least "a few times a year," 43 (71.7%) identify race as a primary reason for those experiences and 26 (43.3%) identify substance use as a primary reason, either as relevant (14; 53.8%) or more relevant (12; 46.2%) than race. Table 2 describes other reasons that participants gave for why they believe they have experienced discrimination.

Table 2

Everyday Discrimination Scale (EDS) Free Response on Reasons for Discrimination

Reason	*n* (%) *N*=60
Race	43 (71.7)
Substance use	26 (43.3)
Physical appearance (weight, height, other)	15 (25.0)
Gender	11 (18.3)
Education or income level	7 (11.7)
Physical disability	5 (8.3)
Age	5 (8.3)
Religion	1 (1.7)
Sexual orientation	1 (1.7)
Other*	4 (6.7)

*2 specified "how I dress," 1 "outspoken," and 1 "attitude and behavior toward others"

Section 2: Aim 2

Effect of substance use stigma, methadone treatment stigma, and racial stigmas on subsequent treatment engagement

In the simple negative binomial regression models, SU stigma enacted by healthcare providers (*b*(SE)=0.38(0.17), *p*=0.03) and enacted racism (*b*(SE)=0.27(0.14), *p*=0.05) both positively significantly predicted missed methadone doses during follow-up. Based on these findings, if the measure of perceived SU stigma enacted by healthcare providers increases by one unit, the rate of missed MT

doses would be expected to increase by 46% (IRR 1.46, 95%CI 1.05-2.02). If EDS score increases by one unit, the rate of missed MT dose would be expected to increase by 31% (IRR 1.3, 95%CI 1.00-1.71). Also, age was found to be a significant predictor of missed methadone doses (*b*(SE)=-0.03(0.01), *p*=0.04) such that one year increase in age is associated with a 3% decrease in the rate of missed MT doses (IRR 0.97, 95% CI 0.94-0.99). Based on prior literature and potential as a confounding variable, we ran multiple regression controlling for time since MT initiation. Controlling for time since MT initiation, SU stigma enacted by healthcare providers remained a significant predictor of missed methadone doses (*b*(SE)=0.35(0.18), *p*=0.05), but enacted racism did not (*b*(SE)=0.24(0.14), *p*=0.09). See Appendix Table B4 for details on all models predicting treatment engagement.

Section 3: Aim 3

Interactive effects of racial stigma and multiple forms of stigma on methadone treatment engagement (exploratory).

Internalized racism moderated the relationship between internalized MT stigma and MT engagement (*b*(SE)=-0.48(0.16), *p*<0.01), such that the impact of internalized MT stigma on MT engagement was in opposite directions based on level of internalized racism. At *low* levels of reported internalized racism, higher reported internalized MT stigma was associated with significantly more missed methadone doses (poorer MT engagement; *b*(SE)=0.83(0.32), *p*=0.01), such that a 129% increase in the rate of missed doses is expected with one unit increase in the measure of internalized MT stigma. At mean and higher levels of internalized racism, no

statistically significant relationship was observed between internalized MT and MT engagement (see Figure 3a).

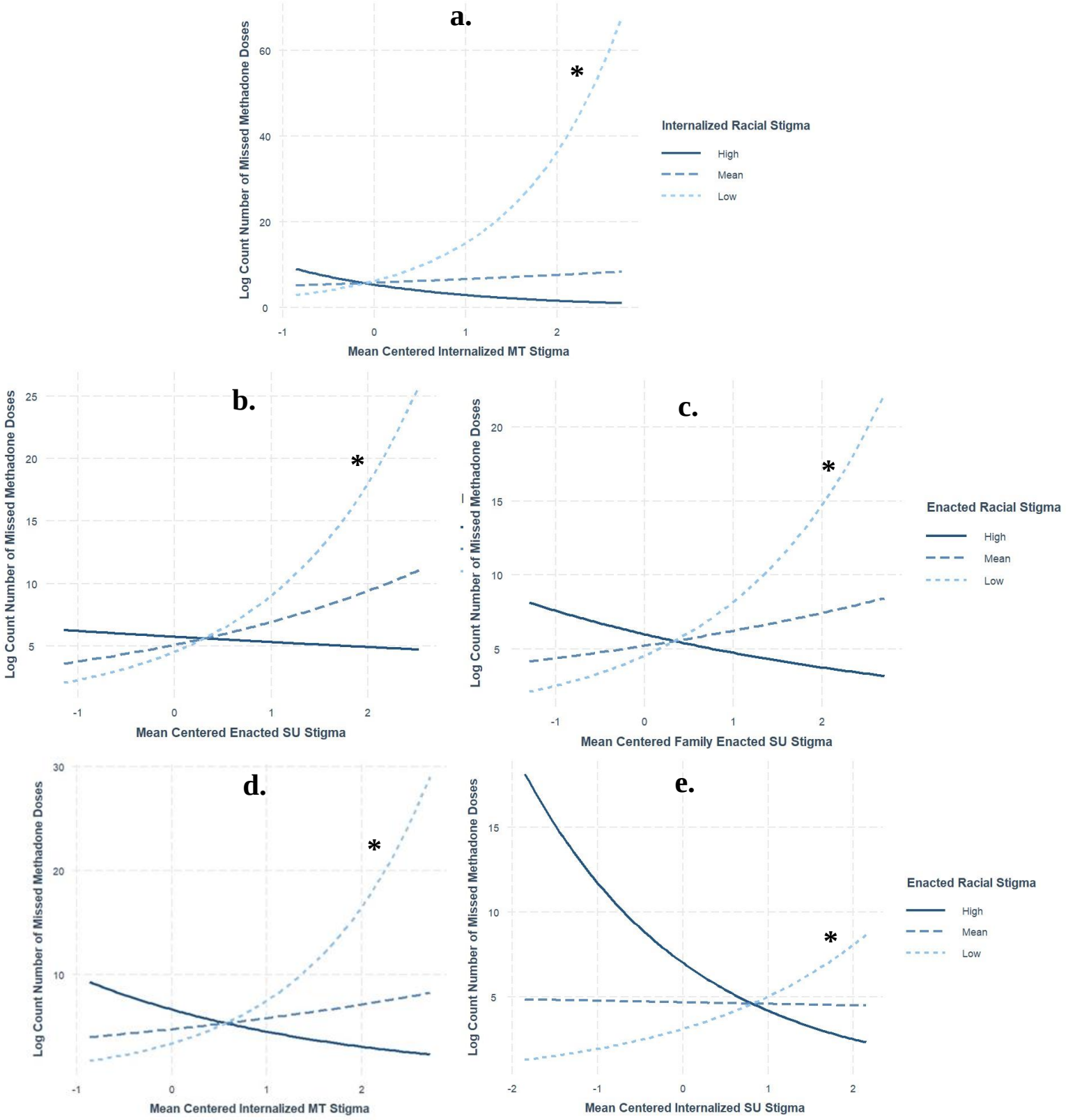
Enacted racism also moderated the relationship between enacted substance use stigma and MT engagement (*b*(SE)=-0.30(0.15), *p*=0.04), such that the impact of internalized MT stigma on MT engagement was in opposite directions based on level of enacted racism. When probed, at *low* levels of reported enacted racism, higher reported enacted SU stigma was associated with significantly more missed methadone doses (poorer MT engagement; *b*(SE)=0.68(0.33), *p*=0.04), such that a 97% increase in the rate of missed doses is expected with one unit increase in the measure of enacted SU stigma. At mean and higher levels of enacted racism, no statistically significant relationship was observed between enacted SU stigma and MT engagement (see Figure 3b). When looking at sources of enacted SU stigma, enacted racism also moderated the relationship between SU stigma enacted by family and MT engagement (*b*(SE)=-0.33(0.12), *p*=0.01). At *low* levels of reported enacted racism, higher reported SU stigma enacted by family was associated with a significantly more missed methadone doses (*b*(SE)=0.58(0.24), *p*=0.02; see Figure 3c); one unit increase in the measure of perceived SU stigma enacted by family would be associated with a 79% increase in the rate of missed MT doses. The same was true for enacted racism moderating the relationship between internalized MT stigma and MT engagement (*b*(SE)=-0.47(0.16), *p*<0.01). At *low* levels of reported enacted racism, higher reported internalized MT stigma was associated with a significantly more missed methadone doses (*b*(SE)=0.76(0.31), *p*=0.01; see Figure 3d); one unit increate in the measure of internalized MT stigma would be associated with a 114% increase in the

rate of missed MT doses. Finally, enacted racism moderated the relationship between internalized SU stigma and missed MT doses (*b*(SE)=-0.39(0.14), *p*<0.01). Again, when this moderation relationship was probed, At *low* levels of reported enacted racism, higher reported internalized SU stigma was associated with a significantly more missed methadone doses (*b*(SE)=0.47(0.24), *p*=0.05; see Figure 3e); one unit increate in the measure of internalized SU stigma would be associated with a 60% increase in the rate of missed MT doses.

All other models were not found to have significant interaction between internalized or enacted racial stigma and MT or SU stigma measures and are reported in Appendix Table B4. Also, moderation models run without controlling for time in MT produced similar findings.

Figure 3

Enacted and Internalized Racism Moderating Substance Use and Methadone Treatment Stigmas



*statistically significant finding at α=0.05.
Note. Figure 3a shows associations between internalized MT stigma and log count of missed methadone doses estimated at high (1 standard deviation (SD) above group's mean; non-significant), mean (group's mean, non-significant), and low (1 SD below group's mean; significant) levels of internalized racial stigma. Figure 3b shows associations between enacted SU stigma and log count of missed methadone doses at high (1 SD above group's mean; non-significant), mean (group's mean, non-significant), and low (1 SD below group's mean; significant) levels of enacted racial stigma. Figure 3c shows associations between SU stigma enacted by family and log count of missed methadone doses at high (1 SD above group's mean; non-significant), mean (group's mean, non-significant), and low (1 SD below group's mean; significant) levels of enacted racial stigma. Figure 3d shows associations between internalized MT stigma and log count of missed methadone doses at high (1 SD above group's mean; non-significant), mean (group's mean, non-significant), and low (1 SD below group's mean; non-significant) levels of enacted racial stigma. Figure 3e shows associations between internalized SU stigma and log count of missed methadone doses at high (1 SD above group's mean; non-significant), mean (group's mean, non-significant), and low (1 SD below group's mean; non-significant) levels of enacted racial stigma.

Chapter 4: Discussion

Section 1: Discussion of findings

This study uniquely approached assessment of methadone treatment outcomes looking at the impact of intersecting experiences of stigma related to substance use, methadone treatment, and race. As hypothesized, we found positive correlation between all stigma mechanism measures and their sub-scales. None of the calculated correlation coefficients were above what is generally considered a "moderate" level of correlation, suggesting that the stigma measures reflect independent, though related, constructs. This is consistent with prior findings looking at SU stigma mechanism scale and MT stigma mechanism scale results (Smith et al., 2016, 2020). However, to our knowledge, relationships between SU stigma, MT stigma, and racial stigma have not been quantified previously. Importantly, we found significant correlations between enacted MT and SU stigma and race-related stigma (both internalized and enacted). Knowing that race, substance use, and methadone treatment are linked from a structural stigma standpoint (Lynch et al., 2023; Pro & Zaller, 2020; Substance Abuse and Mental Health Services Administration, 2020), these findings make sense at the individual patient level.

In use of the Everyday Discrimination Scale (EDS), Williams and colleagues point to the importance of analyzing follow-up questions to allow for a more complete understanding of how people experience discrimination related to social categories (D. R. Williams et al., 2019). Though we chose to modify the EDS questions to ask specifically about experiences of enacted *racial* stigma, analysis of

the open-ended follow-up questions revealed substance use as a perceived primary reason for experiencing discrimination, even when questions about discrimination were specified as related to race. This is consistent with the relatively high positive correlation observed between reported experiences of enacted SU stigma and enacted racial stigma in our Aim 1 analysis. Importantly, we also observed high correlations between reported experiences of enacted SU stigma and internalized racial stigma. The same was not true for internalized SU stigma correlation with either enacted racial stigma or internalized racial stigma (both relatively low positive correlation, $r<0.3$). Thus, experiences of enacted SU stigma may overlap with experiences of enacted racial stigma and solidify internalization of racial stigma.

Though this has not before been applied to the intersection with substance use, other studies have demonstrated that racial discrimination's impact on psychological distress is more pronounced when racial stereotypes are internalized (Gale et al., 2020; Sosoo et al., 2020; Willis et al., 2021). As described in the introduction, institutional/structural racism contributes to the unique intersection of substance use and race such that the "War on Drugs" has disproportionately impacted low-income communities and Black/AA communities (A. Cohen et al., 2022) and treatment options/priorities have racialized certain treatments with negative messages about replacing one drug with another and punitive treatment environment (Frank, 2020; Goedel et al., 2020). Although Aim 1 findings are cross-sectional, and temporality cannot be established, there is value in future research examining the link between enacted SU stigma and internalized racism. Interventions addressing this link might include patient-level education about the historical and structural link between

substance use and racial discrimination and emphasis on critical consciousness. Critical consciousness includes a process by which a person becomes aware of the implications and impacts of their lived experience and sociopolitical environments (e.g., exposure to racism) and then engages in actions in response to their reflection (Mosley et al., 2021). To inform these types of interventions, constructs such as racial centrality and racial ideology should be further explored in this population.

Aim 2 multiple regression models of stigma scores indicated that SU stigma enacted by healthcare providers predicted MT engagement. This finding is consistent with prior qualitative and quantitative research describing the impact of negative attitude of health professionals towards patients with SUD (van Boekel et al., 2013). Various educational interventions aimed at reducing stigmatizing beliefs among healthcare providers have been developed and are being implemented in different settings. Such interventions should be supported and broadened across the range of healthcare provider types (Bielenberg et al., 2021; Regenauer et al., 2024). Simple models indicated that enacted racism was also associated with more missed methadone doses, but the association, though indicating a trend ($p<0.1$), did not persist when controlling for time in MT. As described below, future studies should investigate these relationships in a larger sample and consider additional means of measuring MT engagement. Also, interestingly, we observed that higher age was associated with higher 30-day MT engagement. This finding is consistent with prior literature on MOUD retention (Deck & Carlson, 2005; O'Connor et al., 2020), but is unique in the way that our study looks at 30-day treatment engagement. Further study

of the mechanism by which older age may be protective in the context of MT engagement is warranted.

Though Aim 2 models did not show direct relationships between all stigma measures and MT engagement, Aim 3 moderation models elucidated some potential nuance. Across all significant moderating effects observed between racial stigma and MT/SU stigma, lower racial stigma appeared to heighten the negative effect of MT/SU stigma on MT engagement. This was the case for both internalized and enacted MT and SU stigma, but in these models stigma enacted by family seems to have more of a negative impact than stigma enacted by healthcare providers or employers. The moderation findings contradict our original hypothesis based on an expected compounding effect of multiple sources of stigma. However, there are some interesting potential explanations for these findings that warrant further exploration. Based on attribution theory (Cronan et al., 2016; Weiner, 1985), SU stigma (a condition-related stigma) and MT stigma (an intervention-related stigma) are distinct from racial stigma in terms of how they may be categorized based on psychological versus physical and controllable versus uncontrollable. Psychological stigmas (including substance use disorders) are driven by attributions of responsibility and blame (Cronan et al., 2016). We observed, in Aim 1, that enacted racial stigma and enacted SU/MT stigma are highly correlated. If a patient attributes their overall experience of enacted stigma to their substance use and/or methadone treatment, they may internalize negative messages about the controllability of their disease, leading to greater experiences of shame. While self-stigma or internalized stigma specifically refers to negative attitudes and beliefs, shame is the emotion that often exists along

with these thoughts (Luoma & Platt, 2015). Future research should include assessment of shame and proneness to shame, as a potential mediator of the relationship between stigma and treatment outcomes. This could include a scenario-based assessment, like the Test of Self-Conscious Affect–3 (Tangney et al., 2015).The specific impact of stigma enacted by family should also be further investigated as, based on our findings, it may amplify the effect of enacted stigma attribution.

Shame associated with perceived controllability of substance use or need for methadone treatment may cause some patients to engage in avoidance coping strategies, such as disengaging in healthcare or treatment (Batchelder et al., 2021), consistent with our findings. Among those patients who report higher experiences of racial stigma, it is possible that they internally put more emphasis on the perceived stable/uncontrollable aspect of stigmatized identity, internalizing less blame. We did find that both enacted racial stigma and internalized racial stigma had similar effects of SU/MT stigma association with MT engagement. Therefore, there appears to be something different in the process or experience of internalized racism compared to internalized SU or MT stigma (possibly explained by attribution). Of note, Cronan et al. (2016) do not investigate race as a stigmatized identity in their study of attribution; so, this discussion is extrapolating their health condition-focused findings to other aspects of identity.

Section 2: Design considerations and limitations

We had several design considerations and made decisions to maximize both the feasibility of this project and potential impact. First, the sample size of 70 was

selected to ensure feasibility of data collection and provide sufficient power for Aims 1 and 2. However, we recognize that even with a sample size of 70, we may have limited power (i.e., for exploratory Aim 3). We were able to enroll 76 participants for this analysis and enrollment is ongoing in the context of a larger trial with the potential for repeated analysis using a larger sample size, increasing statistical power. We hope that our findings guide future, larger-scale studies testing interactive relationships between stigmas and racial discrimination, and their impact on methadone treatment outcomes. We also recognize that 30-day medication treatment engagement does not directly reflect longer-term treatment retention. While daily dosing adherence is a good indicator of broader treatment outcomes (Durand et al., 2021), future investigation should consider longer-term follow-up for retention outcomes. It will also be important to take into account the potential impact of incarceration, which is not consistently captured as a reason for discontinuation of MT. Also, more precise means of measuring adherence to take-home dosing is warranted, possibly through electronic dose monitoring, like video observed therapy (Hallgren et al., 2022) or a measure of the proportion of days prescriptions were appropriately picked up (different denominator of days, depending on frequency of take-home doses). It will also be important to consider other, more patient-centered measures of successful methadone treatment engagement and substance use disorder recovery.

We remain conscious of the scope of what we are measuring in this study and aim in future research to capture broader effects of racism and systematic factors among people living with OUD. Thought leaders have described how perceived

discrimination/enacted racial stigma has been a largely neglected component of the racially minoritized experience that adversely affects health, but that we also cannot assume that enacted and internalized racial stigma capture the full effect of racism in society (D. R. Williams & Mohammed, 2009). We also acknowledge debate in the field about how to assess experiences of racial discrimination/enacted racial stigma-whether or not to explicitly ask respondents to ascribe experiences specifically to race (Kressin et al., 2008). We understand the value in asking about discriminatory experiences broadly before soliciting self-reported attribution, as that process both ameliorates some sensitivity related to racial discrimination questions and addresses attribution ambiguity (D. R. Williams et al., 2003). However, in order to measure experiences of substance use, methadone treatment, and racial stigma separately for our analyses, we chose to modify the Everyday Discrimination Scale to inquire about experiences based on race, as has been done in other studies (Le & Iwamoto, 2019). We also included an exploratory open-ended question about attribution of experiences of discrimination to guide future research.

We acknowledge the range of theories contributing to understanding of how race-related stigma impacts health and health behaviors. We chose to assess enacted racial stigma in the context of everyday experiences, based on the idea that chronic, frequent stressors are strong predictors of negative health outcomes (S. Cohen et al., 1997). However, future research may benefit from inclusion of measures asking about lifetime major or acute experiences of racism (like being fired from a job or prevented from moving into a neighborhood) (D. R. Williams et al., 2008). Other studies that have investigated both chronic and major experiences of enacted racial stigma have

found that perceived chronic discrimination but not major experiences was associated with poorer metal health outcomes (Bennett et al., 2010). We are mindful of our limitation of how many measures could include in our one-time survey based on time participants are able to provide while attending a routine clinic visit with many competing demands.

We recognize that there are many ways to quantitatively assess intersectional stigma (Bauer, 2014; Turan et al., 2019). While the moderation method that we employed has limitations, including the selection and operationalizing of intersectional positions, this approach has been recommended as appropriate by thought leaders studying intersectional stigma and health (Turan et al., 2019). We also acknowledge that intersectionality itself is not quantitatively testable and, while interaction analyses are more in-line with the goal of intersectionality theory than many other statistical approaches (del Río-González et al., 2021), no study can be powered to detect or able to measure all potentially relevant intersecting identities. One future opportunity to further elucidate intersectionality of different levels and sources of stigma on methadone treatment engagement is latent class analysis, which would also require a larger sample size. Latent class analysis would allow the data to define distinct exposure classes of stigma, as has been demonstrated in other studies of intersectional stigma (Layland et al., 2022). Different combinations of SU, MT, and racial stigma may have more nuanced meaning than can be assessed through moderation analysis in the current study. Principal components analysis (PCA) could also inform these next steps.

With interpretation of our findings, it is important to keep in mind some limitations around generalizability. Specifically, we look at experiences of patients receiving only one type of MOUD (methadone), though others are used more frequently in other settings. For example, suboxone treatment is much more common than methadone treatment in rural settings due to prescriber availability (Joudrey et al., 2022). Also, our study took place in a city whose population is predominately Black/African American (about 61%, *U.S. Census Bureau QuickFacts*, n.d.) and experiences of race-related stigma may be distinct from other urban centers with different racial distributions. Beyond just focusing on methadone treatment, selection bias may have played a role in participation such that higher experiences of stigma (and shame) may have prevented patients from engaging in the study to begin with. So, those patients who are at most risk of negative outcomes related to stigma may have been least likely to participate. Also, those patients who were experiencing difficulty with medication engagement (missing doses) would have spent less time at the clinic, where recruitment was taking place, and, thus have less opportunity to be enrolled in the study. If we consider broader recruitment options in the future, community-based recruitment, beyond a methadone treatment program, would give a broader sample of experiences of stigma.

Though individual-level interventions may be informed by findings, we recognize that that the onus in reducing stigmas should be on the stigmatizing structures and not the stigmatized (del Río-González et al., 2021). Thus, although internalized stigma is a potentially modifiable target in individual-level interventions, we must also acknowledge the broader systematic factors that perpetuate both

substance use/methadone treatment stigma and racial discrimination. Though the proposed study will focus on stigma and discrimination processes at the individual level, we recognize that stigma is influenced at the individual, interpersonal, organizational, community, and public policy levels (Stangl et al., 2019), which will be a consideration in next steps from this work, including multi-level data and modeling.

Despite the limitations of this study, findings related to the effect of intersectional racial, SU, and MT stigmas are novel and strengthened by the longitudinal study design as well as quantification of stigma mechanisms (internalized and enacted). The message of Aim 3 moderation findings is not that racial stigma is protective. However, our understanding of the complex interactions between the experience of multiple stigmas may inform the future of interventions. For example, there is evidence supporting the idea that stigma can foster resilience in marginalized populations, fueling advocacy that can bring about change in access to treatment for some stigmatized conditions (e.g. HIV; Stangl et al., 2019). Though we know that the stigmatization process overall reinforces prejudice that causes social inequalities. This continued line of research will be critical in the effort to end morbidity and mortality associated with OUD.

Appendices

Appendix A: Assessment Measures

Demographics and Other Information

1) How old are you? (age in years)

2) What is your gender identity?
    a. Male
    b. Female
    c. Transgender man/ Transman
    d. Transgender woman/ Transwoman
    e. Genderqueer/ Gender nonconforming
    f. Additional identity (enter below)
        i. Please enter additional gender identity/identities

3) What sex were you assigned at birth?
    a. Male
    b. Female

4) How would you describe your sexual orientation?
    a. I prefer to have sex with only men
    b. I mostly prefer to have sex with men
    c. I prefer to have sex with either men or women
    d. I mostly prefer to have sex with women
    e. I prefer to have sex with only women

5) How would you describe your race? (more than one option can be selected)
    a. American Indian/ Alaska Native
    b. Asian or Asian-American
    c. Black or African American
    d. Native Hawaiian or Other Pacific Islander
    e. White
    f. Unsure
    g. Other (please enter below)
        i. Please enter other race(s)

6) How do you describe your ethnicity?
    a. Hispanic
    b. Non-Hispanic
    c. Unsure
    d. Other (please enter below)
        i. Please enter other ethnicity/ethnicities

7) What is the highest degree or level of school you completed?
    a. Less than high school diploma
    b. High school or equivalent/ GED
    c. Some college, no degree
    d. Associate degree
    e. Bachelor's degree
    f. Master's degree
    g. Professional degree
    h. Doctorate
    i. Don't know

8) Of any of the drugs or alcohol that you have use, which would you say has been your main substance of use in the past 12 months? (select all that apply)
    a. Heroin
    b. Fentanyl
    c. Prescription opioids
    d. Alcohol
    e. Cannabis/marijuana
    f. Cocaine
    g. Amphetamines
    h. Inhalants
    i. Sedatives or sleeping pills
    j. Hallucinogens
    k. PCP
    l. K2
    m. Other (specify below)
        i. Please elaborate on any substances here

9) Have you previously received medication (Methadone, Buprenorphine, etc) for opioid use?
    a. Yes (received medication for opioid use disorder prior to coming to this program)
    b. No (current program is my first time receiving medications for opioid use disorder)
    c. Unsure

10) If yes, what type(s)? (select all that apply)
    a. Methadone
    b. Buprenorphine
    c. Suboxone
    d. Vivitrol
    e. Naltrexone
    f. Anabuse
    g. Other (please specify)
        i. Indicate other medication(s)

11) Is this your first time stating treatment at 1001 W. Pratt Street (University of Maryland Drug Treatment Center)
    a. Yes
    b. No
    c. Unsure
12) If no, how many prior times have you started treatment at this site? (number of times)

13) Have you previously participated or are you now receiving treatment in other substance use treatment programs (e.g. inpatient, outpatient, etc?)
    a. Yes
    b. No
    c. Unsure

14) How many other substance use treatment programs have you previously attended/ are you currently attending?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5
    f. 6
    g. 7+

15) Of those, at how many did you receive medication for opioid use disorder (MOUD)?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5
    f. 6
    g. 7+

16) What was the most recent substance use treatment program you were in? (program name)

17) Did you receive medication for opioid use disorder at this program?
    a. Yes
    b. No
    c. Unsure

18) About how many months ago did you last attend this program? If current, write 0 (# of months. Indicate days as the decimal of xx/30)

19) How long were you in this program? If current, indicate # of months that participant has been there (# of months. Indicate days as the decimal of XX/30)

20) Have you ever been incarcerated?

a. Yes
b. No
c. Unsure

21) If yes, how many times have you been incarcerated? (# of times)

22) How much total time have you spent in jail or prison in your lifetime? (# of months. Indicate days as the decimal of XX/30

23) Are you currently on legal supervision (on probation, parole)?
    a. Yes
    b. No
    c. Unsure

24) Were you legally mandated to engage in treatment here?
    a. Yes
    b. No
    c. Unsure

25) Are you currently facing any pending legal charges?
    a. Yes → What are those charges for?
    b. No
    c. Unsure

26) Are you a military veteran?
    a. Yes
    b. No
    c. Unsure

Substance Use Stigma Mechanism Scale

The following questions ask about your substance use history, this includes any past or current experiences using substances. Please think about each question and select your answer. The first group of questions asks about how people have treated you in the past because of your substance use history. The second group of questions asks about how people will treat you in the future because of your substance use history.

How often have people treated you this way in the past because of your substance use history?
Response options: Never, Not often, Somewhat often, Often, Very Often

1) Family members have thought that I cannot be trusted
2) Family members have looked down on me
3) Family members have treated me differently
4) Healthcare workers have not listened to my concerns
5) Healthcare workers have thought that I'm pill shopping or trying to con them into giving me prescription medications to get high or to sell
6) Health care workers have given me poor care

How likely is it that people will treat you in the following ways in the future because of your substance use history?
Response options: Very unlikely, Unlikely, Neither unlikely nor likely, Likely, Very likely

1) Family members will think that I cannot be trusted
2) Family members will look down on me
3) Family members will treat me differently
4) Healthcare workers will not listen to my concerns
5) Healthcare workers will think that I'm pill shopping or trying to con them into giving me prescription medications to get high or to sell
6) Health care workers will give me poor care

How do you feel about your substance use history?
Response options: Strongly disagree, Disagree, Neither disagree nor agree, Agree, Strongly agree

1) Having used substances makes me feel like I'm a bad person
2) I feel I'm not as good as others because I used substances
3) I feel ashamed for having used substances
4) I think less of myself because I used substances
5) Having used substances makes me feel unclean
6) Having used substances is disgusting to me

Methadone Treatment Stigma Mechanism Scale

The following questions ask about your methadone treatment, this includes any past or current experiences taking methadone. Please think about each question and select your answer. The first group of questions asks about how people will treat you in the future because of your methadone treatment. The second group of questions asks about how people have treated you in the past because methadone treatment.

How likely is it that people will treat you in the following ways in the future because of your methadone treatment?

Response options: Very unlikely, Unlikely, Neither unlikely nor likely, Likely, Very likely

1) Family members will think that I am a drug user
2) Family members will not support my methadone treatment
3) Family members will think that I cannot recover
4) Employers will think that I'm still a drug user
5) Employers will think that I am a bad employee
6) Employers will think that managing my methadone treatment schedule will be a problem
7) Healthcare workers will think that I'm still a drug user
8) Healthcare workers will give me poor care
9) Healthcare workers will not prescribe me the medication that I need

How often have people treated you this way in the past because of your methadone treatment history?

Response options: Never, Not often, Somewhat often, Often, Very often

1) Family members have thought that I am a drug user
2) Family members have not supported my methadone treatment
3) Family members have thought that I cannot recover
4) Employers have thought that I'm still a drug user
5) Employers have thought that I am a bad employee
6) Employers have thought that managing my methadone treatment schedule will be a problem
7) Healthcare workers have thought that I'm still a drug user
8) Healthcare workers have given me poor care
9) Healthcare workers have not prescribed me the medication that I need

How do you feel about your methadone medication?

Response options: Strongly disagree, Disagree, Neither disagree nor agree, Agree, Strongly agree

1) Receiving methadone makes me feel like I'm a bad person
2) I feel I'm not as good as others because I receive methadone
3) I feel ashamed of my methadone treatment
4) I think less of myself because I receive methadone
5) Receiving methadone makes me feel unclean
6) Being on methadone treatment is disgusting to me
7) Being on methadone treatment makes me feel like I'm still a drug user

Everyday Discrimination Scale

In your day-to-day life, how often do any of the following things happen to you because of your race/ethnicity?

Response Options:
Almost everyday
At least once a week
A few times a month
A few times a year
Less than once a year
Never

1. You are treated with less courtesy than other people are.
2. You are treated with less respect than other people are.
3. You receive poorer service than other people at restaurants or stores.
4. People act as if they think you are not smart.
5. People act as if they are afraid of you.
6. People act as if they think you are dishonest.
7. People act as if they're better than you are.

8. You are called names or insulted.
9. You are threatened or harassed.
10. You are followed around in stores.

Follow-up Question (Asked only of those answering "A few times a year" or more frequently to at least one question.): What do you think is the main reason for these experiences? (OPEN-ENDED RESPONSE)

Internalized Racial Stigma

We are all members of different social groups or social categories. We would like you to consider your race in responding to the following statements based on your lifetime experience:

Response Options:
Strongly Disagree
Somewhat Disagree
Slightly Disagree
Slightly Agree
Somewhat Agree
Strongly Agree

1. I go through periods when I'm down on myself because of my race.
2. I sometimes struggle with negative feelings about my race.
3. I sometimes don't feel as good as others because of my race.

TAPS Part 2

The TAPS Tool Part 2 is a brief assessment for tobacco, alcohol, illicit substance use and prescription medication misuse. Each of the following questions and sub-questions has two possible answer choices- either yes or no.
We will first ask you about your lifetime use for each substance.

1. In your LIFETIME, have you ever used any tobacco product (for example, cigarettes, e-cigarettes, cigars, pipes, or smokeless tobacco)?
    a. No
    b. Yes
        i. At what age did you first use any tobacco product? (years)
        ii. In the PAST 3 MONTHS, did you use any tobacco product (for example, cigarettes, e-cigarettes, cigars, pipes, or smokeless tobacco)?
        No
        Yes:
            1. In the PAST 3 MONTHS, did you usually smoke more than 10 cigarettes a day? YES/NO
            2. In the PAST 3 MONTHS, did you usually smoke more than 10 cigarettes each day? YES/NO

2. In your LIFETIME, have you ever had a drink containing alcohol?
    a. No
    b. Yes
        i. At what age did you first have a drink containing alcohol? (years)
        ii. In the PAST 3 MONTHS, did you have *4 for female/ 5 for male* or more drinks containing alcohol in a day?
        No
        Yes:
            1. In the PAST 3 MONTHS, have you tried and failed to control, cut down or stop drinking? YES/NO
            2. In the PAST 3 MONTHS, has anyone expressed concern about your drinking? YES/NO
3. In your LIFETIME, have you ever used marijuana (hash, weed)?
    a. No
    b. Yes
        i. At what age did you first use marijuana? (years)
        ii. In the PAST 3 MONTHS, did you use marijuana (hash, weed)?
        No
        Yes:
            1. In the PAST 3 MONTHS, have you had a strong desire or urge to use marijuana at least once a week or more often? YES/NO
            2. In the PAST 3 MONTHS, has anyone expressed concern about your use of marijuana? YES/NO
4. In your LIFETIME, have you ever used cocaine, crack, or methamphetamine (crystal meth)?
    a. No
    b. Yes
        i. At what age did you first use cocaine, crack, or methamphetamine? (years)
        ii. In the PAST 3 MONTHS, did you use cocaine, crack, or methamphetamine?
        No
        Yes:
            1. In the PAST 3 MONTHS, did you use cocaine, crack, or methamphetamine at least once a week or more often? YES/NO
            2. In the PAST 3 MONTHS, has anyone expressed concern about your use of cocaine, crack, or methamphetamine? YES/NO
5. In your LIFETIME, have you ever used heroin?
    a. No
    b. Yes
        i. At what age did you first use heroin? (years)
        ii. In the PAST 3 MONTHS, did you use heroin?
        No
        Yes:

1. In the PAST 3 MONTHS, have you tried and failed to control, cut down or stop using heroin? YES/NO
2. In the PAST 3 MONTHS, has anyone expressed concern about your use of heroin? YES/NO

6. We just asked you about any past heroin use. We know that sometimes when people use opioids like heroin, there may be fentanyl mixed in (with or without their knowledge). Other times, though, people buy/use just fentanyl specifically. In your LIFETIME, have you ever used fentanyl that was not mixed in another substance
    a. No
    b. Yes
        i. At what age did you first use fentanyl that was not mixed in another substance? (years)
        ii. In the PAST 3 MONTHS, did you use fentanyl that was not mixed in another substance?
        No
        Yes
            1. In the PAST 3 MONTHS, have you tried and failed to control, cut down, or stop using fentanyl? YES/NO
            2. In the PAST 3 MONTHS, has anyone expressed concern about your use of fentanyl? YES/NO
7. In your LIFETIME, have you ever used a prescription opiate pain reliever (for example, Percocet, Vicodin, Methadone, any medication for opioid use disorder) not as prescribed or that was not prescribed for you?
    a. No
    b. Yes
        i. At what age did you first use prescription opiate pain relievers not as prescribed? (years)
        ii. In the PAST 3 MONTHS, did you use a prescription opiate pain reliever not as prescribed or that was not prescribed for you?
        No
        Yes:
            1. In the PAST 3 MONTHS, have you tried and failed to control, cut down or stop using an opiate pain reliever? YES/NO
            2. In the PAST 3 MONTHS, has anyone expressed concern about your use of an opiate pain reliever? YES/NO
8. In your LIFETIME, have you ever used a prescription medication for anxiety for sleep (for example, Xanax, Ativan, or Klonopin) not as prescribed or not prescribed for you?
    a. No
    b. Yes
        i. At what age did you first use medication for anxiety or sleep not as prescribed? (years)
        ii. In the PAST 3 MONTHS, did you use medication for anxiety or sleep not as prescribed or that was not prescribed for you?
        No
        Yes:

1. In the PAST 3 MONTHS, have you had a strong desire or urge to use medications for anxiety or sleep at least once a week or more often? YES/NO
2. In the PAST 3 MONTHS, has anyone expressed concern about your use of medication for anxiety or sleep? YES/NO

9. In your LIFETIME, have you ever used a medication for ADHD (for example, Adderall, Ritalin) not as prescribed or not prescribed for you?
    a. No
    b. Yes
        i. At what age did you first use medication for ADHD not as prescribed? (years)
        ii. In the PAST 3 MONTHS, did you use medication for ADHD not as prescribed or that was not prescribed for you?
        No
        Yes:
            1. In the PAST 3 MONTHS, did you use a medication for ADHD not as prescribed to you at least once a week or more often? YES/NO
            2. In the PAST 3 MONTHS, has anyone expressed concern about your use of medication for ADHD? YES/NO
10. In your LIFETIME, have you ever used any other illegal or recreational drugs (for example, ecstasy/molly, GHB, poppers, LSD, mushrooms, special K, bath salts, synthetic marijuana (‘spice’/’K2’), PCP, whip-its, etc)?
    a. No
    b. Yes
        i. What were the other illegal or recreational drugs(s) that you used in your lifetime (list and separate different drugs with semicolons (;))
        ii. At what age did you first use any other illegal or recreational drug(s)? (ask for each drug specified, years)
        iii. In the PAST 3 MONTHS, did you use any of these illegal or recreational drugs?
        No
        Yes:
            1. In the PAST 3 MONTHS, what other drugs did you use? (list and separate different drugs with semicolons (;))

Appendix B: Supplemental Tables

Table B1

Baseline Demographics and Other Characteristics, By Missed Methadone Dosing Group (N=76)

Characteristics	No missed doses *n* (%) *N*=25	≥1 missed dose *n* (%) *N*=51	*p*
Age; mean (SD)	54.8 (8.8)	51.8 (12.2)	0.23
Gender			0.40
Male	17 (68.0)	28 (54.9)	
Female	8 (32.0)	23 (45.1)	
Other specified	0 (0.0)	0 (0.0)	
Sexual Orientation			1.00
Straight	23 (92.0)	46 (90.2)	
Bisexual	1 (4.0)	3 (5.9)	
Gay	1 (4.0)	1 (2.0)	
Lesbian	0 (0.0)	1 (2.0)	
Lifetime incarceration (months); median (IQR)	24 (119)	18 (66)	0.40
Multiracial (in addition to Black/AA)	1 (4.0)	9 (17.6)	0.15
Highest level of education			0.14
Less than HS diploma	7 (28.0)	17 (33.3)	
HS or GED	13 (52.0)	27 (52.9)	
More than HS diploma	5 (20.0)	6 (11.8)	
Don’t know	0 (0.0)	1 (2.0)	
Unhoused	1 (4.0)	2 (3.9)	0.50

Characteristics	No missed doses *n* (%) *N*=25	≥1 missed dose *n* (%) *N*=51	*p*
Working (full or part time)	5 (20.0)	7 (13.7)	0.17
Previous MT history	21 (84.0)	41 (80.4)	0.95
Days since MT start; median (IQR)	91 (1559)	49 (700.5)	0.04*
Within 30 days of MT start	6 (24.0)	24 (47.1)	0.09
Current opioid use (TAPS)[†]	14 (56.0)	39 (76.5)	0.12
Current opioid use, on toxicology results [‡]	13/17 (76.5)	33/38 (86.8)	0.57
Polysubstance use, on toxicology results [‡]	4/17 (23.5)	10/38 (26.3)	0.50
% take-home doses; mean (SD) [§]	41.7% (28.4)	27.0% (17.3)	0.02*
Internalized SU stigma; mean (SD)	2.99 (1.03)	2.79 (1.02)	0.43
Enacted SU stigma; mean (SD)	1.95 (0.90)	2.23 (0.91)	0.21
Internalized MT stigma; mean (SD)	1.91 (0.87)	1.83 (0.69)	0.68
Enacted MT stigma; mean (SD)	2.13 (0.98)	2.21 (0.96)	0.74
Enacted racial stigma (EDS); mean (SD)	1.29 (1.29)	1.68 (1.23)	0.22
Internalized racial stigma; mean (SD) [¶]	1.87 (1.79)	0.13 (1.39)	0.13

*****Cronbach's alpha for self-report stigma measures

[†]TAPS= Tobacco, Alcohol, Prescription medications, and other Substance Tool; score of 2 used as a cutoff for SUD (McNeely et al., 2016).

[‡]*N*=55 for participants who had toxicology data available +/- 7 days of study assessment date

[§]Measured over 30-day follow-up, proportion of doses counted as "taken" that were take-home

[¶]*N*=61 for participants who answered internalized racial stigma questions because these were added to the assessment after enrollment had started

Table B2

Correlation Matrix Between Stigma Variables

	1	2	2a	2b	2c	3	4	4a	4b	5	6
1. Int MT	1.00	--	--	--	--	--	--	--	--	--	--
2. Enac MT	0.31**	1.00	--	--	--	--	--	--	--	--	--
2a. Enac MT, family	0.29*	--	1.00	--	--	--	--	--	--	--	--
2b. Enac MT, employer	0.22	--	0.65***	1.00	--	--	--	--	--	--	--
2c. Enac MT, healthcare	0.27*	--	0.50***	0.55***	1.00	--	--	--	--	--	--
3. Int SU	0.42***	0.17	0.16	0.22	0.13	1.00	--	--	--	--	--
4. Enac SU	0.33**	0.43***	0.35**	0.22	0.54***	0.34**	1.00	--	--	--	--
4a. Enac SU, family	0.26*	0.34**	0.382***	0.21	0.28*	0.33**	--	1.00	--	--	--
4b. Enac SU, healthcare	0.30**	0.40***	0.20	0.16	0.68***	0.24*	--	0.45***	1.00	--	--
5. Enac Racism	0.38**	0.54***	0.56***	0.36**	0.44***	0.27*	0.52***	0.51***	0.36**	1.00	--
6. Int Racism	0.27*	0.42***	0.38***	0.23*	0.48***	0.27*	0.65***	0.58***	0.51***	0.51***	1.00

NOTE. *$p < 0.05$; **$p < 0.01$; ***$p <0$ .001

Table B3

Correlation Between Stigma Variables and Covariates

	Int MT	Enac MT	Int SU	Enac SU	Int Racism	Enac Racism
Age	0.13	0.06	-0.04	-0.19	0.11	-0.26*
Male gender[2]	-0.11	-0.04	0.05	-0.18	-0.33*	-0.08
Incarceration history (months)	0.04	-0.04	0.07	0.07	0.06	0.14
Education level[1, 2]	0.08	0.07	-0.002	0.01	-0.07	-0.18
Employment[2]	-0.15	-0.18	-0.12	-0.07	-0.07	-0.03
Time since starting MT (days)	-0.12	-0.12	-0.34**	-0.27*	-0.15	-0.27*
Current OUD (TAPS) [2]	0.15	-0.08	0.10	0.17	-0.01	0.17
Polysubstance use (toxicology) [2]	0.12	-0.06	-0.08	0.11	-0.15	0.14

NOTE. *$p < 0.05$; **$p < 0.01$

[1]Education level: < high school diploma, high school diploma or GED, > high school diploma or GED

[2]Point-Biserial correlation coefficient (r_{pb})

TAPS= Tobacco, Alcohol, Prescription medications, and other Substance Tool; score of 2 used as a cutoff for SUD (McNeely et al., 2016).

Table B4

Negative Binomial Regression Models Predicting Missed Methadone Doses, Aim 2

	Simple Models			Controlling for Time since MT initiation		
Variable	*b*(SE)	IRR (95% CI)	*p*	*b*(SE)	IRR (95% CI)	*p*
Int MT	0.18 (0.23)	1.20 (0.77-1.87)	0.43	0.65 (0.51)	1.16 (0.74-1.83)	0.51
Enac MT	0.08 (0.18)	1.09 (0.77-1.54)	0.64	0.07 (0.18)	1.08 (0.76-1.54)	0.66
Enac MT, family	-0.002 (0.15)	1.00 (0.74-1.34)	0.99	0.02 (0.15)	1.03 (0.77-1.37)	0.86
Enac MT, healthcare	0.15 (0.16)	1.16 (0.85-1.58)	0.36	0.11 (0.16)	1.12 (0.81-1.53)	0.50
Enacted MT, employers	0.06 (0.14)	1.06 (0.80-1.40)	0.70	0.05 (0.15)	1.05 (0.79-1.40)	0.72
Int SU	0.08 (0.17)	1.08 (0.78-1.52)	0.62	0.04 (0.18)	1.04 (0.73-1.48)	0.84
Enac SU	0.32 (0.19)	1.38 (0.96-1.99)	0.08	0.32 (0.19)	1.38 (0.95-2.02)	0.09
Enac SU, family	0.13 (0.15)	1.14 (0.85-1.53)	0.38	0.18 (0.15)	1.19 (0.89-1.61)	0.24
Enac SU, healthcare	0.38 (0.17)	1.46 (1.05-2.02)	0.03*	0.35 (0.18)	1.42 (1.00-2.02)	0.05*
Int Racism	-0.13 (0.12)	0.87 (0.69-1.11)	0.27	-0.18 (0.12)	0.84 (0.66-1.06)	0.12
Enac Racism	0.27 (0.14)	1.31 (1.00-1.71)	0.05*	0.24 (0.14)	1.27 (0.97-1.68)	0.09

*statistically significant at α=0.05

Table B5

Moderation Models Predicting Missed Methadone Doses, Aim 3

	Simple Models			Controlling for Time since MT initiation		
Variable	*b*(SE)	IRR(95%CI)	*p*	*b*(SE)	IRR(95%CI)	*p*
Int MT	0.21 (0.23)	1.24 (0.78-1.95)	0.36	0.20 (0.23)	1.22 (0.77-1.93)	0.39
Enac Racism	0.28 (0.14)	1.33 (1.01-1.76)	0.05*	0.27 (0.15)	1.30 (0.97-1.74)	0.07
Int MT x Enac Racism	-0.48 (0.16)	0.62 (0.46-0.84)	<0.01*	-0.47 (0.16)	0.63 (0.46-0.86)	<0.01*
Int MT	0.13 (0.25)	1.13 (0.69-1.85)	0.62	0.14 (0.25)	1.13 (0.69-1.83)	0.59
Int Racism	-0.01 (0.14)	0.99 (0.75-1.31)	0.95	-0.05 (0.14)	0.97 (0.73-1.29)	0.72
Int MT x Int Racism	-0.49 (0.16)	0.61 (0.45-0.83)	<0.01*	-0.48 (0.16)	0.63 (0.47-0.86)	<0.01*
Enac MT	-0.01 (0.20)	0.99 (0.67-1.49)	0.97	0.02 (0.21)	1.02 (0.68-1.53)	0.92
Enac Racism	0.26 (0.15)	1.30 (0.97-1.75)	0.08	0.22 (0.16)	1.25 (0.92-1.79)	0.15
Enac MT x Enac Racism	-0.15 (0.13)	0.88 (0.68-1.14)	0.25	-0.14 (0.13)	0.87 (0.66-1.13)	0.28
Enac MT	0.22 (0.24)	1.25 (0.78-2.00)	0.35	0.28 (0.24)	1.32 (0.83-2.11)	0.25
Int Racism	-0.16 (0.15)	0.85 (0.63-1.14)	0.28	-0.23 (0.15)	0.79 (0.59-1.06)	0.12
Enac MT * Int Racism	-0.09 (0.12)	0.91 (0.72-1.15)	0.45	-0.09 (0.12)	0.92 (0.73-1.16)	0.46

	Simple Models			Controlling for Time since MT initiation		
Variable	*b*(SE)	IRR(95%CI)	*p*	*b*(SE)	IRR(95%CI)	*p*
Enac MT, family	-0.03 (0.16)	0.97 (0.71-1.33)	0.85	0.02 (0.16)	1.04 (0.76-1.43)	0.92
Enac Racism	0.27 (0.15)	1.31 (0.98-1.75)	0.07	0.21 (0.15)	1.19 (0.88-1.61)	0.16
Enac MT, family x Enac Racism	-0.16 (0.11)	0.85 (0.69-1.06)	0.16	-0.18 (0.11)	0.82 (0.66-1.02)	0.10
Enac MT, family	0.06 (0.20)	1.06 (0.72-1.56)	0.77	0.19 (0.19)	1.21 (0.83-1.77)	0.33
Int Racism	-0.09 (0.15)	0.91 (0.68-1.23)	0.55	-0.20 (0.15)	0.82 (0.61-1.10)	0.19
Enac MT, family x Int Racism	-0.12 (0.10)	0.89 (0.73-1.08)	0.24	-0.14 (0.10)	0.87 (0.71-1.06)	0.16
Enac MT, employer	-0.02 (0.15)	0.98 (0.72-1.31)	0.87	-0.01 (0.15)	0.99 (0.73-1.33)	0.93
Enac Racism	0.30 (0.14)	1.35 (1.02-1.78)	0.04*	0.26 (0.15)	1.30 (0.97-1.74)	0.08
Enac MT, employer x Enac Racism	0.05 (0.10)	1.05 (0.86-1.28)	0.65	0.03 (0.10)	1.03 (0.84-1.26)	0.76
Enac MT, employer	0.14 (0.17)	1.16 (0.82-1.62)	0.40	0.16 (0.17)	1.17 (0.84-1.64)	0.35
Int Racism	-0.16 (0.14)	0.85 (0.65-1.11)	0.24	-0.21 (0.14)	0.81 (0.62-1.05)	0.12
Enac MT, employer x Int Racism	-0.02 (0.09)	0.98 (0.82-1.17)	0.83	-0.02 (0.09)	0.98 (0.83-1.17)	0.86
Enac MT, healthcare	0.10 (0.19)	1.11 (0.77-1.60)	0.58	0.08 (0.19)	1.09 (0.75-1.58)	0.65
Enac Racism	0.22 (0.15)	1.25 (0.92-1.69)	0.15	0.21 (0.16)	1.23 (0.90-1.68)	0.19
Enac MT, healthcare x Enac Racism	-0.20 (0.13)	0.82 (0.63-1.06)	0.13	-0.19 (0.13)	0.83 (0.64-1.07)	0.15

	Simple Models			Controlling for Time since MT initiation		
Variable	*b*(SE)	IRR(95%CI)	*p*	*b*(SE)	IRR(95%CI)	*p*
Enac MT, healthcare	0.18 (0.19)	1.20 (0.83-1.74)	0.33	0.15 (0.19)	1.16 (0.80-1.69)	0.42
Int Racism	-0.14 (0.15)	0.87 (0.65-1.15)	0.32	-0.19 (0.15)	0.83 (0.62-1.10)	0.20
Enac MT, healthcare x Int Racism	-0.10 (0.12)	0.90 (0.71-1.14)	0.39	-0.06 (0.12)	0.94 (0.74-1.19)	0.63
Int SU	-0.02 (0.17)	0.98 (0.70-1.38)	0.91	-0.02 (0.18)	1.01 (0.70-1.44)	0.91
Enac Racism	0.32 (0.14)	1.38 (1.05-1.81)	0.02*	0.32 (0.14)	1.35 (1.01-1.80)	0.03*
Int SU x Enac Racism	-0.39 (0.14)	0.68 (0.52-0.89)	<0.01*	-0.39 (0.14)	0.71 (0.54-0.94)	<0.01*
Int SU	0.07 (0.19)	1.07 (0.73-1.57)	0.72	0.02 (0.20)	1.02 (0.69-1.50)	0.94
Int Racism	-0.16 (0.14)	0.85 (0.65-1.12)	0.26	-0.19 (0.14)	0.83 (0.63-1.09)	0.18
Int SU x Int Racism	0.05 (0.12)	1.05 (0.83-1.32)	0.69	0.05 (0.12)	1.05 (0.84-1.33)	0.66
Enac SU	0.27 (0.24)	1.31 (0.82-2.09)	0.36	0.31 (0.24)	1.36 (0.84-2.18)	0.21
Enac Racism	0.15 (0.17)	1.16 (0.83-1.62)	0.39	0.09 (0.17)	1.10 (0.78-1.54)	0.59
Enac SU x Enac Racism	-0.29 (0.15)	0.75 (0.56-1.00)	0.05*	-0.30 (0.15)	0.74 (0.55-0.99)	0.04*
Enac SU	0.45 (0.22)	1.57 (1.01-2.42)	0.04*	0.49 (0.23)	1.63 (1.05-2.54)	0.03*
Int Racism	-0.21 (0.15)	0.81 (0.60-1.09)	0.17	-0.25 (0.15)	0.78 (0.58-1.05)	0.10
Enac SU x Int Racism	-0.16 (0.13)	0.86 (0.66-1.11)	0.23	-0.20 (0.13)	0.82 (0.63-1.05)	0.12

	Simple Models			Controlling for Time since MT initiation		
Variable	*b*(SE)	IRR(95%CI)	*p*	*b*(SE)	IRR(95%CI)	*p*
Enac SU, family	0.09 (0.17)	1.10 (0.78-1.54)	0.58	0.18 (0.17)	1.19 (0.85-1.67)	0.31
Enac Racism	0.20 (0.16)	1.23 (0.90-1.68)	0.20	0.11 (0.16)	1.12 (0.81-1.54)	0.50
Enac SU, family x Enac Racism	-0.30 (0.12)	0.74 (0.58-0.94)	0.02*	-0.33 (0.12)	0.72 (0.57-0.92)	0.01*
Enac SU, family	0.17 (0.18)	1.18 (0.82-1.70)	0.36	0.26 (0.18)	1.30 (0.91-1.85)	0.14
Int Racism	-0.13 (0.16)	0.88 (0.64-1.20)	0.41	-0.19 (0.15)	0.82 (0.61-1.11)	0.20
Enac SU, family x Int Racism	-0.16 (0.12)	0.85 (0.67-1.08)	0.19	-0.23 (0.12)	0.79 (0.63-1.01)	0.06
Enac SU, healthcare	0.37 (0.21)	1.45 (0.97-2.17)	0.07	0.36 (0.21)	1.42 (0.94-2.17)	0.10
Enac Racism	0.11 (0.15)	1.12 (0.83-1.52)	0.46	0.11 (0.16)	1.12 (0.82-1.52)	0.48
Enac SU, healthcare x Enac Racism	-0.20 (0.14)	0.82 (0.62-1.07)	0.15	-0.20 (0.14)	0.82 (0.62-1.08)	0.16
Enac SU, healthcare	0.44 (0.19)	1.55 (1.07-2.25)	0.02*	0.39 (0.20)	1.47 (1.00-2.17)	0.05*
Int Racism	-0.22 (0.13)	0.80 (0.61-1.04)	0.09	-0.24 (0.14)	0.78 (0.60-1.02)	0.07
Enac SU, healthcare x Int Racism	-0.06 (0.11)	0.95 (0.77-1.17)	0.61	-0.03 (0.11)	0.97 (0.78-1.20)	0.77

*statistically significant at α=0.05

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