

RACIAL AND GEOGRAPHICAL DISPARITIES IN MEDICATION-ASSISTED
TREATMENT COMPLETION FOR INDIVIDUALS WITH OPIOID USE DISORDER IN
THE APPALACHIAN REGION

BY

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THESIS

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ABSTRACT

The opioid crisis is devastating people's health across the United States, taking their free will and their lives. Through the approval of OxyContin to the mix of fentanyl with other substances, opioids have a stronghold on the American people, affecting any individual who may cross paths with it. In this study, I aimed to highlight the disparities in medication-assisted treatment completion so that future studies can target barriers that these individuals are most affected by in the epidemic. This study employed a national data set, given by SAMHSA, to examine the current landscape of opioid use and treatment completion. Analysis of the sample illuded to necessary research into racial and geographic disparities.

Compared to non-Hispanic White individuals, minority individuals have less of a chance of completing treatment across all setting types. Also, individuals who live in states outside of the Appalachian region are almost three times more likely to complete medication-assisted treatment than the individuals who live within the region. This explicitly shows the necessary research into why there are racial disparities and why they continue to persist. Rural America struggles with treatment completion due to a multitude of reasons, including long distances to a treatment facility and provider to patient low ratios. Policy change surrounding treatment providers is necessary to help these affected individuals.

Analysis of treatment completion in the detoxification, rehabilitation/residential, and ambulatory settings revealed some consistencies with previous studies and some conflicting results. The results from the variables gender and age presented evidence that is debated by other studies. The variable length of stay showed that the longer an individual remains in treatment, the more of a chance the individual has of completing treatment.

Overall, the treatment completion rate across the nation is low. More research is necessary to diminish disparities, especially racial and geographic disparities. The most recent data (2020) should be explored and compared to studies like this one to examine the impact of the Covid-19 pandemic on the landscape of the opioid crisis and response.

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To My Family

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LIST OF ACRONYMS

SAMHSA	Substance Abuse and Mental Health Services Administration
HHS	U.S. Department of Human Health and Services
CDC	Centers for Disease Control and Prevention
ED	Emergency Department
AHRQ	Agency for Healthcare Research and Quality
ARC	Appalachian Regional Commission
SUD	Substance Use Disorder
OUD	Opioid Use Disorder
MAT	Medication-Assisted Treatment
SES	Socioeconomic status
DATA	Drug Addiction Treatment Act
NSDUH	National Survey on Drug Use and Health
TEDS	Treatment Episode Data Set
TEDS-D	Treatment Episode Data Set Discharges
TEDS-A	Treatment Episode Data Set Admissions
DSM	Diagnostic and Statistical Manual of Mental Disorders
MOUD	Medication for Opioid Use Disorder
COVID-19	Coronavirus Disease 2019
FIPS	U.S. Federal Information Processing Standard
GED	General Education Development
OTP	Opioid Therapy Programs

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CHAPTER 1: BACKGROUND

Opioids are natural, synthetic, or semi-synthetic chemicals used to reduce or eliminate pain. The pain relievers can be prescribed for a short amount of time at regulated doses but not without side effects. Short-term effects include but are not limited to, pain relief, headache, constipation, drowsiness, lethargy, and feelings of euphoria (Keller, 2020). Long-term effects may include addiction, irregular heartbeat, hormonal imbalances, depression, and tolerance (Keller, 2020). The opioid epidemic seemed to begin with the rise in overdose deaths due to an increase in prescription opioids.

Prescriptions for opioids peaked in 2012 when more than 255 million were authorized across the United States (U.S. Department of Human Health and Services [HHS], 2019). Since then, a decline in opioid prescriptions has been observed with policy changes and provider restrictions. The 14% increase in opioid prescribing since the early 90s indicates that the opportunity for abuse is high (Centers for Disease Control and Prevention [CDC], 2016). The CDC cites three waves of the opioid epidemic that correspond with a heightened number of overdose deaths. The first wave started in the 1990s with a rise in prescription opioid overdose deaths, peaking in 1999. Then, the second wave started in 2010 when there was a rise in heroin overdose deaths. Finally, the third wave began in 2013 and continues to this day with a rapid increase in overdose deaths involving fentanyl, an illicit, synthetic drug (CDC, 2021). There has been a rise in opioid use since the early 2000s; however, since the start of the COVID-19 pandemic in May of 2020, there has been a 46% increase in overdoses with a 13% increase in overdose deaths in the United States (Manchikanti et al., 2021). The rise of opioid use is associated with opioid-related Emergency Department (ED) visits. Within the Midwest region,

there was a 70% increase in opioid overdose ED visits in a one-year span (CDC, 2019). In 2018, the national rate of inpatient cases due to opioids was 286.1 per 100,000 (Agency for Healthcare Research and Quality [AHRQ], 2018). Within the Appalachian region, the mortality rate of overdoses due to substance abuse in 2018 was 43% higher than in the rest of the United States (Appalachian Regional Commission [ARC], 2021). Although there are many organizations like ARC that are working to limit the overdose deaths in Appalachia, the epidemic continues to disproportionately disrupt the life of those in the region.

When addiction occurs, substance use disorder (SUD) may be diagnosed and treated. Medication-assisted treatment (MAT) is one common treatment used with those diagnosed with SUD, especially those with Opioid Use Disorder (OUD). MAT is the use of medications, such as methadone, buprenorphine, or naltrexone, that act as opioid agonists, binding to the same receptors in the body to block the effects of opioids. MAT can be used in combination with behavioral therapies for a holistic approach for the treatment of SUD.

CHAPTER 2: LITERATURE REVIEW

2.1 DISPARITIES IN RECEIVING OPIOIDS

Prescription opioids are used to manage or suppress pain, intended for after surgery or for special health situations like cancer. Starting in the early 2000s, there was an acceptance of prescribing opioids for chronic pain, non-cancer patients, such as those who have chronic back pain or arthritis (CDC, 2017). With the rise in opioid prescriptions, disparities in receiving opioids have been discovered.

When taken in appropriate doses, opioids can be extremely effective at relieving pain, but there are disparities in who is prescribed the analgesics. The challenge in prescribing medication is rooted in the reason for the visit to the ED or doctor's office and why the patient may need analgesics. There are definitive conditions that suggest opioid prescriptions for pain management, such as when a fracture is present on an x-ray. Other times, there may not be physical evidence that gives verification for the necessary use of analgesics, like a headache. This can manifest controversy in the dosage and prescription for pain because the amount given to the patient now relies upon the physician's judgement without definitive evidence (Singhal et al., 2016). Definitive and non-definitive conditions are not the only variables for determining who gets prescribed opioids, but race/ethnicity seems to have an important influence on the decision.

Race is one of the important factors determined when conducting a study due to the differences in demographics and is an identity people can associate with. The racial disparity in prescribing opioids is supported by data that indicates black patients and other minorities are prescribed fewer opioid equivalents than white patients (Groenewald et al., 2018; Hausmann et

al., 2013; Pletcher et al., 2008). This disparity is even seen in children, as White children are more likely to receive opioids as compared to Black, Hispanic, and Asian children (Groenewald et al., 2018). However, more research is needed to determine the exact reason why children of color receive fewer analgesics. In a study determining beliefs, those who reported biological differences in pain levels among different races gave lower ratings in pain to Black patients (Hoffman et al., 2016). Race-based medicine is a place to start when looking to abolish racial disparity. It is also crucial to conduct retrospective studies to look at recent ED visits that required opioid prescriptions to look at how trends in prescription opioids have changed. There are clear discrepancies in prescribing opioids among different races, and other variables like age provide more demographics to investigate for disparities.

Since a body's reaction to exogenous substances changes throughout the life course, it is necessary to study different age ranges with respect to substance use treatment. Lately, there has been a shift in the way elderly medicine is analyzed, including looking at both physical and mental health. When analyzing the trends of the opioid epidemic, the elderly was not seen as an issue group in completing treatment or even needing treatment because the prevalence of the elderly using opioids was not problematic. However, with the rise in ED visits by the elderly due to opioids, it is clear that the age group needs to be studied. It was found that older adults do respond appropriately to treatment after a hypothesis considered the opposite and should be covered in the data (Dufort & Samaan, 2021). The rise in opioid prescriptions in the 2000s into the 2010s was recorded by health officials but not yet examined to see what demographics the highest risk factors were. After the peak of the number of opioid prescriptions given out, it was determined that older adults, ages 55 and older, had been receiving first-time treatment for OUD at a higher rate than ever before (Huhn et al., 2018). This indicates that older adults were being

prescribed and using opioids more than ever recorded. There has been an increase in opioid prescriptions given to adults, but the data on age also intersects with disparities in socioeconomic status. With the rise in admission to substance use treatment facilities by the elderly, it is evident that the current literature landscape needs more data on the health of older adults.

The other variables in research that give key information to trends include socioeconomic status and insurance status. Those who belong to the lowest socioeconomic status are least likely to receive prescriptions for opioids in the ED, compared to the other statuses, especially those in the highest quartile (Joynt et al., 2013). The same conclusion has been determined for the homeless. The data shows that they are least likely to receive opioid prescriptions compared with those in temporary and/or permanent housing (Krawczyk et al., 2020). It has also been found that those who have insurance are more likely to be prescribed opioids, but even those who are prescribed the painkillers belong to the minority group in percentages overall in receiving them (National Academies of Sciences, Engineering, and Medicine, 2019). More needs to be done to analyze the relationship between socioeconomic status and insurance categories and whether they are independent or dependent on each other for receiving analgesics. Along with this further research, there also needs to be a study of how to reduce the disparities in receiving opioids.

There are common factors that show a higher probability of receiving an opioid prescription, such as being a White patient, having health insurance, having a definitive cause for analgesics, and belonging to higher SES quartiles. There are other more specific reasons why someone may have a higher probability of receiving a prescription. Patients who are male and using opioids through the intranasal route were admitted to treatment at a higher rate, also being prescribed opioids at an increased rate (CDC, 2016; Huhn et al., 2018). The known data on those

who are most likely being prescribed opioids gives an indication of where to begin research on those who have OUD.

2.2 CHARACTERISTICS OF PATIENTS WITH OUD

A disorder does not show bias of whom it affects, but there are certain risk factors that have been studied that show those who have a higher risk of developing a disorder. People with mental health issues show higher chances of developing OUD and/or SUD (Kalapatapu & Sullivan, 2010; Marel et al., 2019). This common factor needs to be further studied because it is uncertain whether developing OUD leads to mental illness or if having a pre-existing mental illness incites OUD. Age is another common determinant that has been studied to look at risk factors. It has been concluded that being of younger age is associated with a higher risk of developing OUD while being of older age is associated with a greater probability of completing treatment for OUD (Dufort & Samaan, 2021; Krawczyk et al., 2021). One other common risk factor seen in those who develop OUD is co-use of another substance and/or having another SUD due to withdrawal, tolerance, euphoric effects, and more (CDC, 2016; Krawczyk et al., 2021). One more common risk factor is belonging to a lower quartile in socioeconomic status (SES). SES is a standing dependent upon an individual or a group's education, income, and occupation. Sometimes, SES is determined by the area where an individual lives or works. It has been shown that those who live in poverty are more likely to die from an overdose associated with OUD compared to those who live above the poverty line (Altekruse et al., 2020). These risk factors are common in most people who develop OUD and have been researched in many studies, but there are certainly other unique factors that can predispose an individual to this disorder.

While most studies include the common risk factors for developing OUD, it is important to look for other signs and factors so that individuals can be aware of their lifestyles. One study that sought to look at specific risks of those who are prescribed opioids, the findings suggest those who are most likely to develop OUD are patients with prior nonfatal overdoses, patients with sleep disorders, pregnant women, and patients with renal or hepatic insufficiency (CDC, 2019). In another distinct study, it was found that those who are most at risk are those who are homeless, co-using methamphetamine, and being referred to treatment by the criminal justice system (Krawczyk et al., 2021). Statistics vary with demographics, but more specifically, men, people ages 35-54, and those in the Midwest show the greatest elevation in opioid-related ED visits (CDC, 2019). As studies are being done throughout the world, there will be variation in the data, but there are some common risk factors shown in almost all, like having a mental illness as a comorbidity, the ages of the patients depending on where they live, belonging to the lowest SES quartile, and co-using another substance.

In short, there are common risk factors that have been studied in those who have been diagnosed with OUD. These risk factors are compiled when the data of those who are admitted to the ED or die of an overdose are looked at and analyzed. They can also be studied over the years using trends of past studies. These common risk factors include race/ethnicity, age, co-using other substances, having a mental health issue, and socioeconomic status. With these common risk factors come more specific variables, such as insurance status, stigma against the elderly and adolescents, misconceptions of gender minorities, employment status, geographic regions, and possible disabilities. The risk factors that are studied are unique to specific research across the country and around the world. That is why there are so many variables that are

studied, and more studies need to be done to address the covariates of the ever-changing world. When risk factors are identified, treatment is the next necessary step.

2.3 BARRIERS TO MAT FOR OUD

Medication-assisted treatment (MAT) is the use of medication to overcome OUD by blocking the effects of opioids. There are several different kinds of medications used in MAT, such as buprenorphine, methadone, and naltrexone, and naloxone is used as a temporary fix. Buprenorphine acts as an opioid partial agonist, meaning it produces mild to moderate feelings of euphoria or respiratory depression. For this reason, it should be taken in the early stages of opioid withdrawal. As withdrawal effects are no longer felt in the patient, the dose of buprenorphine can be adjusted. Methadone is a full opioid agonist acting to diminish the effects of opioids. After stabilization of the patient, the dose of methadone should be decreased. Naltrexone acts to block opioid receptors, and it is not an opioid nor is it addictive so there is no abuse potential. Naltrexone is used to suppress opioid cravings. Naloxone is an opioid antagonist that is used to reverse an opioid overdose. It works by binding to opioid receptors and can reverse and block the effects of other opioids. Buprenorphine, methadone, and naltrexone can be used for long periods of time, but naloxone does not last long. MAT is often paired with behavioral therapy to provide a well-rounded approach to treatment. Behavioral therapy provides support and aid to the patient while undergoing rewiring of the brain with the medicine. MAT is used to rebalance the brain chemistry, decrease the euphoric feelings associated with substances, and return to homeostasis that is appropriate for the human body. The combination of behavioral therapy and MAT has been effective in treating opioid use disorder (Stahler et al., 2021).

Common medications used in MAT are included in an abundance of research since they have proven to be effective, but access to these medications is limited.

Of those who are diagnosed with OUD, very few receive MAT and even fewer receive behavioral therapy (Barry et al., 2019; Jones et al., 2015; Sofuoglu et al., 2018). There are many barriers to the receipt of MAT and behavioral therapy, ranging from larger societal issues to individual factors. With the growing issue of the opioid epidemic as indicated by the CDC, there is a need for change within policy and action regarding OUD treatment. The change will need to come in the initiation rates, retention, treatment completion, and access to medication-assisted treatment, as well as behavioral therapy, or a version of mixed therapy.

A societal issue that endangers access to MAT for those in need is geographical limitations. These limitations include a lack of facilities within a short distance and fewer providers for the number of patients that are within the area. Those in rural America have fewer options and must travel further to reach a facility or provider of MAT (Drake et al., 2021; Kane & Topmiller, 2022; Pullen & Oser, 2014). The time it takes to drive to a provider reduces the time spent at work, at home, or at other life events. Adding more treatment centers or providers in rural areas can change access limitations. Changing the access to medication like buprenorphine has been the spotlight in research because buprenorphine is successful in reducing opioid effects (Jones et al., 2015; Livingston et al., 2021). A similar societal barrier to geographical limitations is the availability of medication in different parts of the country. There is a concept known as Substance Abuse Treatment Deserts that critically defines low access and availability of opioid use disorder treatment. It has been studied that low MAT use is attributed to limited resource availability (Lowe et al., 2021). There is limited availability of providers including treatment centers which results in lower numbers of MAT usage. For support, there is

data showing that 60% of small nonmetropolitan county residents still lived in an opioid treatment shortage area (Chang et al., 2019). Related to the lack of availability of medication in different regions, an aspect of MAT barriers related to larger societal issues is provider factors.

Providing medication to counteract the effects of opioids requires certification, and there is a laborious path to this resulting in the limited availability of providers. Since the beginning of the opioid epidemic, the CDC has recognized that provider factors need to change. For one, there are a limited number of physicians seeking the Drug Addiction Treatment Act (DATA) waiver and among those who have received it, few are willing to use it for treatment due to liability issues (Jones et al., 2015). Adding to the number of those who can supply medication-assisted treatment and changing the policy surrounding the liability may be solutions to this lack of availability (Chang et al., 2019; Hyder et al., 2021). In a research article, the researchers cite some common barriers to receiving MAT, such as provider willingness to prescribe and low provider confidence in addressing addiction (Jones et al., 2015). While it is evident that provider factors contribute to the issue of low MAT use, there are individual factors that need to be addressed, as well.

Even though treatment has been shown to be effective, access and initiation to treatment are limited. There are multiple individual factors for this, such as access to transportation, socioeconomic statuses involving education and employment, policy restrictions with insurance, familial status, and motivation to receive MAT (Altekruse et al., 2020; Krawczyk et al., 2017; Stein et al., 2017). Different age groups are evaluated, as well as patient history. Why these factors affect the prescription of OUD treatment is less studied. There is controversy surrounding the use of MAT due to its possible side effects and effects on society, especially among older adults. This can be seen in the policies for methadone and buprenorphine use. The conflict may

limit the number of physicians willing to be licensed to include medication for treatment. This shows the connection between larger societal and individual factors that affect the receipt of MAT for OUD.

2.4 FACTORS RELATED TO THE COMPLETION OF MAT

The completion of treatment for substance abuse disorder (SUD) is defined by many standards and variables, but the main objective of the programs is to lessen or eliminate the cravings for the substance. There is a possibility of discontinued treatment due to lack of ability to afford it, insurance issues, lack of motivation, and more. According to the National Survey on Drug Use and Health (NSDUH, 2021), approximately 20 million people have reported having a SUD in the last year. There is a need for a push of treatment completion as the rate of overdoses continues to increase. It is known that completion rates overall are low, with the overall completion rate in 2019 being 33% (Treatment Episode Data Set Discharges [TEDS-D], 2021).

There are many features related to the completion of MAT including race. Although many factors are linked together, it is possible to look at them independently, such as the single variable of race. Looking at the specific years of 2018-2020, only 28% of patients completed treatment within this time frame, and of these, Blacks and Hispanics were less likely than Whites to complete treatment (Stahler & Mennis, 2018; Suntai et al., 2020). It has been studied that Blacks have an 8.3% rate of completing treatment (CDC, 2022). Many studies show that minorities show a disadvantage in rates of completion; the direct cause of this statistic is unknown but currently being researched (Arndt et al., 2013; Lucabeche & Quinn, 2021; Stahler & Mennis, 2018; Suntai et al., 2020). There are many more Caucasians that are admitted to treatment facilities than any other patients of color. More research needs to be conducted to

investigate whether there are more Whites who complete treatment because there are more admitted or because of individual factors that limit completion like race. While the reason for the disparity is still being studied, there is an understanding that completion rates need to increase. Some demographics that could influence the rate of completion are still being studied as there is conflicting information.

Age is another important factor that can influence the completion of treatment. One study shows that the younger patients are more willing to overcome hurdles and drive a longer time for treatment, while another study found that a risk factor for treatment termination is being younger (Alibrahim et al., 2022; Krawczyk et al., 2021). If young people are more willing to drive further for treatment and overcome challenges that are in the way for completion, that may indicate they are more likely to complete treatment, especially in areas where treatment facilities are scarce. However, older patients have shown more persistence and attention to health. Retired adults have more time to dedicate to treatment, giving more time for completion. More research is needed to resolve the discrepancies in the attention the elderly gives to health versus the persistence in younger patients. There are disparities in treatment that need to be studied more, but different modes of treatment also need to be studied to increase the rate of completion.

There is a need for more research and awareness because only 18% of those in residential settings for treatment have medication for opioid use disorder (Stahler & Mennis, 2022). The mode of OUD treatment reception has mildly changed with the COVID-19 pandemic, as telemedicine has drastically increased. It has been studied that telemedicine can increase completion rates by 20% (Haggerty et al., 2022). A conclusion from that study is that those with inflexible hours in their jobs are more likely to complete telemedicine visits. There is research into out-patient versus in-patient treatment settings and how each affects rates of completion.

MAT use in outpatient settings has increased by 60% since 2012, allowing for a better percentage in completion rates than detoxification (Dunn et al., 2019). Though there have been studies that research some treatment settings, it is evident that treatment completion across different setting types is necessary. Along with the mode of treatment given in different treatment settings, the source of referral is important for completion rates. The court/criminal justice system is the largest reason why people are referred to treatment programs (Arndt et al., 2013). Aside from the system, others themselves report they are the ones to refer themselves. The largest percentage of those who complete treatment are referred to by their employer (Arndt et al., 2013). The source of referral is important when studying completion rates, but a lot more needs to be researched in the Appalachian region.

Although the use of opioids affects people across the United States, there is a large percentage of use and overdoses within the Appalachian region. In 2018, the overdose mortality rate was 43% higher in Appalachia than in the rest of the country (ARC, 2021). This may be due to geographical regions and the ratio of providers to patients within the region. The ongoing investigation about how to solve this problem has been difficult. There is a start when discussing the allowance of other medical professionals to provide MAT, expanding the access to providers (Kane & Topmiller, 2022).

Substance use disorder (SUD) has disproportionately affected the Appalachian region in the United States, especially in the rural areas, as indicated by the rise of overdoses. Within the Appalachian region, there are many areas that limit the ratio of physicians to patients due to geographic reasons. This presents an issue when treatment is necessary and only specific healthcare workers can provide the treatment. One study showed there was a steady increase in the number of SUD Medicaid claims in Alabama from 2015 to 2019 (Albright et al., 2022). The

number of patients who need treatment has increased, but the number of providers has not kept up with the growing number of patients. The ratio is getting larger each year. There needs to be more research into why there is a lack of providers and how to solve this issue. Some possible explanations may be due to stigma around substance use for the providers or the community, the inadequacy of preparation for challenges relating to the number of patients needing treatment, or limited knowledge of cultural context (Oser & Pullen, 2014). One study showed the ratio of those in need of treatment to the number of providers was low due to the poorly drawn boundary lines in rural counties when studying the ratio in Appalachia (Drake et al., 2021). The boundaries were drawn so that one small space that included a lot of people had an adequate number of providers. The space given to one provider was deemed appropriate because of the poorly drawn boundary lines. The other areas included large spaces with a limited number of people and providers that gave a small ratio of patients to providers. The poorly drawn lines made it seem like the number of providers was sufficient for fair treatment in these large areas. This would misguide the data to show there are enough providers, whether in a densely populated or an area with scattered numbers of people. Also, even if these boundary lines were drawn correctly, the drive time to a treatment facility would be too much for those in a large area. This study was necessary to show the misguided information in the Appalachian region, so there is an ongoing investigation about how to decrease the lack of access to buprenorphine prescribers within this region (Drake et al., 2021). Telehealth has been explored as a possible solution to train providers on how to start prescribing for a burdened community, but it was concluded that providers preferred in-person training (Sherbuk et al., 2020). This may translate into patients and/or providers favoring in-person appointments. There are many reasons why the Appalachian region is suffering, and many solutions are needed.

Numerous rural areas need help in many areas of healthcare. Mental health services are needed now more than ever. There is a lack of OUD treatment providers in these areas, making treatment completion rates low. When treatment is offered, there needs to be more of an idea about how to retain patients in order to increase completion rates. In-patient versus out-patient setting types in the rural regions need to be researched and how each affects completion rates. Telehealth has been explored, but the implementation of the new mode of provision has not provided significant improvements in buprenorphine treatment capacity (Sherbuk et al., 2020). Exploration into the mutual influence of the source of referral and mental health comorbidities affecting the rate of treatment completion is necessary. Research into treatment completion in the rural areas may be sufficient for substantial paramount policy change. The lack of and inadequacy of treatment resources is gaining momentum in the opioid use literature. With studies showing a positive trend in opioid use since the early 1990s (Albright et al., 2022; Choi & DiNotti, 2020; Huhn et al., 2018; Kalapatapu & Sullivan, 2010; Shoff et al., 2021) and the rise in opioid-related overdose deaths (CDC, 2020), research into the factors relating to opioid use and treatment completion is proven necessary.

2.5 STUDIES THAT USED TEDS-D

Substance Abuse and Mental Health Services Administration (SAMHSA) collects Treatment Episode Data Set (TEDS) in order to gain insight into the landscape of the mental and physical health of the nation. There are two types of TEDS, TEDS-A which records admissions, and TEDS-D which records discharges. Each state collects data identifying the number of disorders related to substances from public facilities about the admissions to and discharges from treatment. States collect data annually, and SAMHSA produces a compiled report from the states

each year. The most recent data submitted by the states and reported at a national level is from 2020, published in 2022. However, the national data may be skewed due to the pandemic temporarily shutting down non-essential businesses and activities. Therefore, the data reported in 2020 may not give the most accurate depiction of the current landscape. The data from 2021 is now being sent to SAMHSA and analyzed and will be reported in 2023.

TEDS provides information about a single admission or discharge so that a single individual could not be identified using the data for privacy and confidentiality reasons. Therefore, the data reported is about the case, not individual persons. Demographic information, like age, sex, race/ethnicity, marital status, education, living arrangements, and employment status is documented, and the data only represents individuals who are 12 years or older. Substance abuse characteristics are also listed, such as route of use, frequency of use, number of previous admissions, previous substance use treatment episodes, substances used, and age at first use. Regional information included encompasses censuses from the Federal Information Processing System codes, US regions, and US divisions. Specifics about treatment are described using the type of treatment service/setting at admission and discharge, medication-assisted opioid therapy, length of stay in treatment, and reason for discharge. The frequency of certain drugs reported at admission is displayed in separate categories, such as alcohol reported at admission and cocaine/crack reported at admission. Other personal information is collected, like a DSM diagnosis, co-occurring mental and substance use disorders, health insurance, payment source, and attendance at substance use self-help groups in the past 30 days prior to admission. With all this information collected, there is an option to not answer, so there may be missing information.

The TEDS datasets have been used in many studies to indicate the pressing issue of the opioid epidemic, as well as to identify specific areas of research. Some studies have utilized the

datasets to understand the overall prevalence of SUD, including OUD (Choi & DiNotti, 2020; Huhn et al., 2018; Kalapatapu & Sullivan, 2010). The studies from Choi and DiNotti (2020) and Huhn et al. (2018) show the increasing trend of SUD, especially in older adults. A study with the CDC and TEDS-D highlighted the recent surge in mortality because of fentanyl and other substances being laced with fentanyl and other synthetic drugs (Jones et al., 2020). To explore the prevalence of substance use, a study involving adults reporting substance use communicates that OUD is common in those who co-use methamphetamine, the largest co-use group with OUD (Ware et al., 2021). Although there are specific risk factors associated with disorders, studies done by Mennis et al. and Suntai et al. conclude that SUD, specifically, OUD, spans across all races, ages, and ethnicities as no group is immune to the disorder.

TEDS-A and TEDS-D have been used to identify significant risk factors related to SUD. Age has been a common variable analyzed when using the TEDS-D data. One study shows there is a rise in SUD in older adults and the need for treatment completion in this age group is very crucial (Huhn et al., 2018). Another study revealed there was a 50% increase in the number of older adults with a prescription use disorder from 2005 to 2007 and a 70% increase in the rate of treatment needed for this age group (Kalapatapu & Sullivan, 2010). A study done by Krawczyk et al. (2017) indicates that nearly a third of all those diagnosed with OUD also have a psychiatric comorbidity. Studies like the one from Zacny et al. (2003) have tried to speculate why risk factors are present and what makes them risk factors instead of prevention factors, but many conclude that there needs to be further investigation to limit those at risk.

Many of the current studies investigate the role of medication in the treatment plans for those with OUD. This is a crucial topic for the opioid epidemic, so there has been a lot of research using TEDS for treatment. There is controversy in studies using TEDS surrounding the

number of patients that have MAT in their treatment plan, as the percentage has been as low as 18% and as high as 36% (Krawczyk et al., 2021; Stahler & Mennis, 2020). Individual states have completed their own research on the percentage of diagnosed OUD patients with MAT in the treatment using TEDS. It has been studied that Rhode Island shows a greater tendency to include MAT as part of the treatment compared to the rest of the states (Burke, 2019). Another TEDS study discloses that veterans are less likely to report MAT usage than non-veterans at 2.58% compared to 4.28%, respectively (Albright et al., 2021). In a similar study, it was determined that older veterans were more likely to receive MAT than younger veterans (Pickard et al., 2021). One study concluded that those admitted to treatment who were referred by the criminal justice system were less likely to have MOUD included in their treatment plan (Stahler et al., 2022). It is essential to provide MAT/MOUD when necessary, so the number of treatment admissions that include medication in the treatment plan is also important to the completion rates. If MAT is not being offered, completion rates are unable to be studied. TEDS-D data can give insight into the use of MOUD in treatment plans to investigate completion rates and guide future protocols and policies.

TEDS seeks to inform the public on national health. Therefore, many studies make use of these data sets and the notable variables collected. Comorbidity is commonly included in studies that use TEDS. Recently, it has been common to study substance use along with mental illness. In a study using TEDS, it has been shown that in 2009-2011, 28% of all patients admitted to SUD treatment programs in the US had a psychiatric comorbidity (Krawczyk et al., 2017). Research that includes TEDS has been investigating the relationship between mental health and substance use. One study concluded the percentage of mental health and substance use treatment facilities has grown from 2012 to 2019 (Choi & DiNotti, 2020). A related study using TEDS

showed that the amount of mental health and substance use services that were dedicated to older adults increased over a seven-year period (Choi & DiNotti, 2020). Another study showed that those with a mental illness diagnosis are more likely to have MAT included in their treatment plan but are less likely to use medication for treatment of OUD (Por et al., 2020). More research needs to be done to conclude how to increase MAT usage when prescribed. Psychiatric comorbidity was associated with treatment non-completion, as stated by a study using TEDS (Krawczyk et al., 2017). Research using TEDS data shows the association between mental illness and OUD, as well as how the disorder affects minorities and their treatment completion rates.

Along with mental illness as a comorbidity, there are differences in treatment completion among minorities. For those who have been diagnosed with OUD, medication has been shown to be an effective treatment, especially when combined with behavioral therapy. Although this is known, the receipt of MAT is low compared to the percentage of those diagnosed. Black and Hispanic patients are less likely to complete treatment, but the duration for all races/ethnicities of those who do complete treatment is similar (Mennis et al., 2019; Suntai et al., 2020). The solution of offering treatment in short-term residential treatment settings has been explored and showed increased numbers of completion for Black patients, as shown in one study using TEDS (Stahler et al., 2021). Many studies have concluded that minorities are less likely to complete treatment, both in long- and short-term facilities (Arndt et al., 2013; Lucabeche & Quinn, 2021; Stahler & Mennis, 2018; Suntai et al., 2020). However, it was shown that African Americans were seeking treatment for OUD at higher rates in 2004-2015 than before (Huhn et al., 2018). Along with minorities being at a disadvantage in receiving MAT, those who are referred to treatment by the criminal justice system are less likely to complete MAT, too (Stahler et al., 2022). There are many disparities discussed using the TEDS data.

This data set has rich information that allows the nation and individual states to assess the standard of healthcare related to substance use. The discharge data gives a glance at how efficient and effective the treatment settings are. However, more research is needed for completion rates to improve tremendously. TEDS-D can give very important information, especially in the research of OUD treatment.

In conclusion, the opioid epidemic is detrimental, and research is necessary to produce solutions to the large societal and individual problems that exist. A substance use disorder is defined by the inability to control one's use of substances and the reliance on those substances to live. SUD affects all kinds of people, especially those who have a mental illness, belonging to a minority group, belonging to a lower SES quartile, and co-using other substances. Medication-assisted treatment has been proven to be successful in treating SUD using opioid agonists, but the percentage of those who have MAT in their treatment plans is low. There are barriers to receiving MAT, such as geographical limitations, substance availability, provider issues, and insurance coverage. The Appalachian region shows the highest number of overdose deaths in recent years. Research has begun to improve that statistic by approving more healthcare workers as providers of MAT. As indicated by the literature review, there is a need for solutions and policy change to improve the lives of all.

CHAPTER 3: METHODS

3.1 SAMPLE

The data, Treatment Episode Data Set – Discharges (TEDS-D), from Substance Abuse and Mental Health Services Administration (SAMHSA) from 2019 was used for this work. Each year, the administration collects data from publicly funded treatment facilities gathering the discharge data. While trying to depict the landscape of all the discharges from substance use treatment, the data set cannot represent all the possible discharges because of the different guidelines and criteria in each state. For example, some states track the discharges from substance use treatment in correctional facilities, while other states do not include that in the TEDS-D report to SAMHSA. All data that fit the inclusion criteria for this study was included to give the best depiction of the current scene. According to SAMHSA (2021), prevention programs were not included in the data set because they were not considered continued treatment. For the states that did offer OUD treatment, Medication-Assisted Treatment was considered as the general treatment for these episodes. The following states were excluded in the 2019 survey due to insufficient data: Oregon, Washington, and West Virginia.

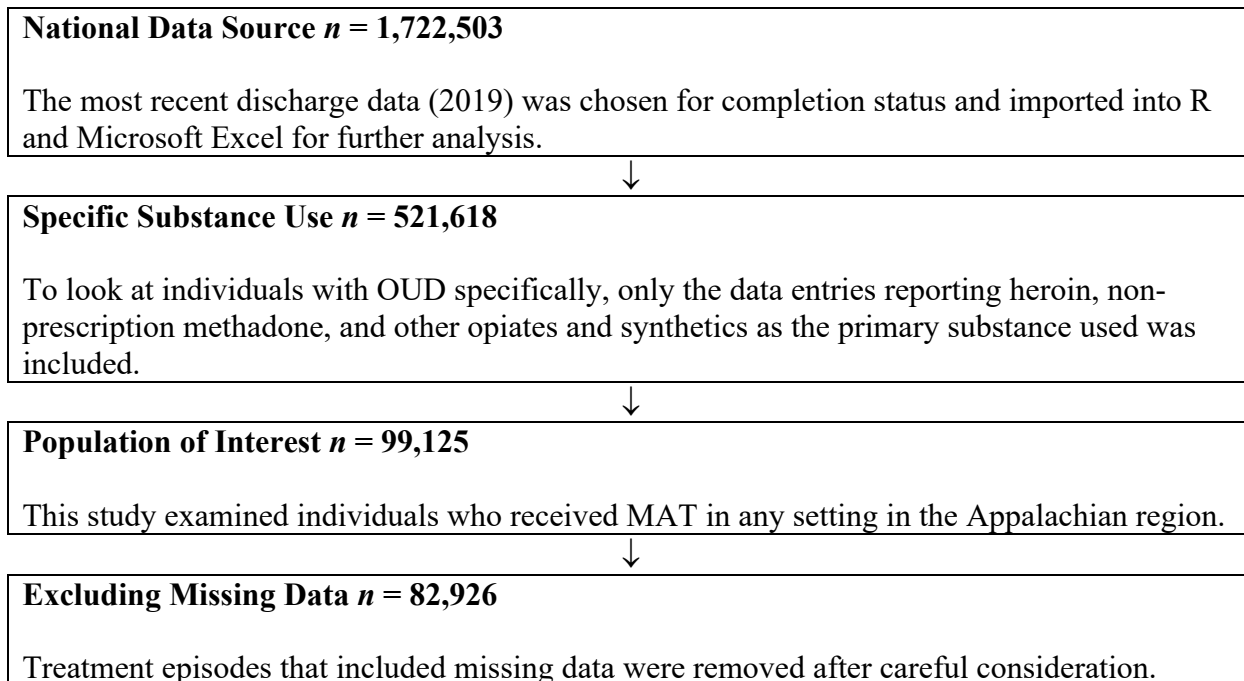


Figure 1. A flow chart to represent how the final sample (N = 82,926) was chosen.

The Treatment Episode Data Set – Discharges 2019 was chosen instead of the admission data for the completion variable and reason for discharge to represent the most recent data and current landscape of discharges across the United States. Completion status was the main dependent variable in the study. The data from 2020 was not used due to the COVID-19 pandemic effects and was not available when analysis was completed. The data set was imported to R for statistical analysis of such a large data set.

The study targeted individuals with OUD or conditions relating to opioids, so the primary substance reported at admission was used as the indication of a disorder or condition. The data was filtered to include only those who reported heroin, non-prescription methadone, and/or other opiates and synthetics. The use of one did not have to be dependent on the other, but primary use of any combination or all three substances was also included.

The inclusion criteria were further defined to include those who received MAT in any treatment setting. MAT needed to be included in the treatment episode of the patient, but it did

not have to be completed. Analysis of completion was constructed from this. A variable called “APP” for the Appalachian region was created by dichotomizing the census state FIPS code for states considered in the Appalachian region. Those states included: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.

When the data was reported to SAMHSA, some of the episodes had missing data in assorted variables. Any missing/unknown/not collected/invalid data in the set was coded as “-9” by the Substance Abuse and Mental Health Services Administration. Using R and a logistic regression model, it was calculated that the episodes that included missing data did not statistically change the results if removed. Therefore, the data inputs that included a missing value from any of the significant variables measured were removed from the data set. This is the last exclusion criterion that gave the final sample of $n = 82,926$.

3.2 MEASURES

Completion status from substance use treatment from TEDS-D 2019 was the main outcome variable examined in this study. It was dichotomized as completion and non-completion, meaning any of the reasons given for stopped treatment other than completion. The data was stratified by completion status to focus on risk factors for incompleteness. The covariates that were used were separated into groups to characterize the models used in the data analysis to show how different areas of life could influence completion status probabilities.

Although the data set was a rich piece of work, dense with a lot of statistics, only specific variables were sought to be analyzed. For this study, we use the following variables: (1) 18 years or older, (2) at least some level of education, (3) employed (part- or full-time) or not employed, (4) non-Hispanic White, Hispanic, non-Hispanic Black, or non-Hispanic other, (5) male or

female, (6) living with co-occurring mental and substance use disorders or not, (7) alcohol, benzodiazepine, or marijuana co-use reported at admission, (8) self-referral or court/criminal justice system referral, (9) one or more days in treatment , (10) receiving treatment in the detoxification, rehabilitation/residential, or ambulatory setting, and (11) living within the Appalachian region or outside of it. Figure 1 shows the sampling and data processing process. A literature review provided guidance on how to group each variable into categories.

The first model contained the demographic covariates to group together the variables that describe people. Age was coded into groups that included 18-34 years old, 35-64 years old, and 65+ years old. Age was grouped into categories to protect individuals from possibly being identified. Race and ethnicity were combined into groups that were represented by non-Hispanic White, Hispanic, non-Hispanic Black, and non-Hispanic other. Non-Hispanic others included individuals who reported their ethnicity as non-Hispanic and their race as Alaska Native, American Indian, Asian or Pacific Islander, Asian, other single race, two or more races, or Native Hawaiian or other Pacific Islander. These individuals were grouped together since the singular races did not make up a substantial amount of the data to be significant in the data analysis. Education was dichotomized as those who have received a Grade 12 education/GED or less and those who have some college level/trade school education or more. Employment was bisected as employed (full-time or part-time) and unemployed. The gender variable was separated into male and female. The data reported to SAMHSA only gave the options of male, female, and missing. This gender variable refers to the sex assigned at birth to individuals. As seen in other literature, on average, these variables portrayed the demographics of individuals adequately.

The next set of variables was added to the demographics model to represent the exogenous activities interacting with the individuals who are represented by the episodes in the data set. Alcohol, benzodiazepine, and marijuana co-use were all dichotomized to substance not reported at admission and substance reported, as separate variables based on substance type. Co-occurring mental and substance use disorders was bisected as Yes or No, meaning being diagnosed with both a mental disorder and a substance use disorder or not. Co-substance use was included to show how the possible interaction of other drugs with opioid-related drugs could affect completion from substance use treatment. Co-occurring mental and substance use disorders was included to explore how mental illness could affect completion of treatment.

The next model included the following variables added to the demographics and exogenous activities to portray the aspects of treatment relating to the actual stay. Length of stay was coded by 1 day, 2-30 days, and 1+ month. Referral source was sorted by self-referral, court/criminal justice system, and other. This study contained these variables to explore the elements of treatment and how they could possibly affect completion status for the patient.

Finally, the last model included all variables in the demographics, exogenous, and treatment models and added the Appalachian region. The census state FIPS codes were dichotomized into the states that are included in the Appalachian region and those that are outside this area. This variable was necessary because this study investigated the disparity of completion probabilities of episodes within this region since the literature shows a lack of treatment completion for patients with OUD living in this region.

The models were analyzed based on setting type to explore the significant results. Service settings were grouped into those who receive treatment by detoxification, in rehabilitation/residential settings, or in ambulatory settings. It was important to separate the

settings since out-patient treatment is different than in-patient treatment and would be inappropriate to analyze the probability of completion if the settings were combined. The detoxification setting episodes were temporarily thought to be insignificant due to the temporality of the treatment. To keep statistically relevant data, the proportion of episodes that received treatment in the detoxification setting was compared to the those who received treatment in the rehabilitation/residential and ambulatory settings using R. Each setting needed to have a significant number of episodes to provide accurate results. There were enough episodes in the detoxification setting to be significant if removed from the data set. Therefore, all three settings were included in the sample.

All “other” groups in this study were used to combine the data in each variable that represented a small proportion of the sample and could not contribute to the results in a significant manner. These groups do not diminish the importance of any data but was necessary to group together to add to the literature.

3.3 ANALYSES

To get the final sample that was necessary for this study, many steps of modifications were essential. The R file from the SAMHSA website was downloaded into Microsoft Excel. The primary substance that was studied was opioid-related drugs. Therefore, using the filter tool in Excel, the episodes that included heroin, non-prescription methadone, and/or other opiates and synthetics as the primary substance reported upon admission were the only episodes included. Although there was no report on individuals being diagnosed with OUD, the primary substance use was substituted to represent an opioid-related condition. The data was cleaned, and missing

data was represented by “-9” in each variable. The remaining sample of the original data set from SAMHSA needed to be analyzed to report significant findings.

The data in Excel was then imported into R for investigation. Upon the conclusion of the literature review, the covariates were identified and used to create a new data set using the combine function in R containing only the certain covariates in the episodes that reported opioid-related drugs as the primary substance used. To study treatment completion, it was necessary to exclude the episodes in which MAT was not reported. The filter function in R completed this exclusion criterion.

To receive significant results, the information that came from episodes reporting treatment in the detoxification setting was examined. The proportion of MAT started or completed in detoxification was thought to be too scant to contribute to the analysis. After careful deliberation and examination using the table function in R and analysis through proportions, the episodes in the detoxification setting were considered significant enough to remain in the final sample.

Multivariate logistic regression was performed using the generalized linear model function in R to predict the likelihood of MAT completion across all independent variables. This initial investigation of the likeliness of completing treatment revealed the deficiency of the results stemming from the missing data. Inquiry into the importance of the missing data, removal of the episodes containing a “-9” value solved this issue. The results of the logistic regression models with the missing data and without the missing data did not reveal any significant changes. Therefore, discarding the episodes was endorsed. This initial review of the logistic regression model disclosed the concern of insignificant data.

A logistic regression model that was stratified by completion was run to examine the probabilities of completing MAT using each of the covariates in the whole model. However, some categories, like the age group 35-64-year-olds and the marijuana co-use group, reported not significant when running the variables together. To show significant results, the model was broken down into the setting type and examined from there.

Univariate logistic regression models, shown in Appendix A, were run to test the significance of each independent variable on treatment completion. The results showed that some variables were not providing significant data, so the separation of settings was necessary.

Multivariate logistic regression models were run to explore the probabilities of treatment completion of independent variables in each setting. Within each setting type, four different logistic regression models were run. The demographic model included the covariates age, race/ethnicity, gender, education, and employment. The exogenous model included the variables in the demographic model and the covariates alcohol, benzodiazepine, and marijuana co-use and co-occurring mental and substance use disorders. The treatment model included the demographic and exogenous covariates and length of stay and referral source. The geographic model included all the previous covariates along with the Appalachian region variable. The covariates were separated into these models to examine the source of the insignificance in the logistic regression model of the whole sample. The results were compared across and within settings to provide discussion to contribute to the literature.

The results from this study were compared with the results of past studies. The goal was to provide support to some research topics and add to the literature in a unique way. The investigation of odds ratios of independent variables in different settings was unique to this

study, as best understood. The inclusion of the Appalachian region was also a new investigation, according to the current literature landscape.

CHAPTER 4: RESULTS

4.1 SAMPLE CHARACTERISTICS

Of the 1,722,503 original treatment episodes, only 99,125 episodes met the criteria of reporting heroin, non-prescription methadone, and/or other opiates and synthetics as the primary substance used and MAT receipt. Some treatment episodes were missing values, so these episodes were excluded after checking the statistical significance of removing data from the filtered data, leaving the final sample of $n = 82,946$ treatment episodes. Table 1 shows the descriptive statistics of the episodes in the final sample of the data set.

Table 1. Descriptive statistics for final sample

Number of episodes	82,926	
Stratified by	Not Completed	Completed
Demographics		
Age, n (%)		
18-34 years old	33,038 (45.9)	5,420 (49.8)
35-64 years old	37,514 (52.1)	5,311 (48.8)
65+ years old	1,494 (2.1)	149 (1.4)
Education, n (%)		
Grade 12/GED or less	54,295 (75.4)	8,316 (76.4)
Some college/trade school or more	17,751 (24.6)	2,564 (23.6)
Employment status, n (%)		
Unemployed	15,719 (21.8)	2,164 (19.9)
Employed (full- or part-time)	56,327 (78.2)	8,716 (80.1)
Race/Ethnicity, n (%)		
Non-Hispanic White	51,759 (71.8)	8,645 (79.5)
Hispanic	8,137 (11.3)	765 (7.0)
Non-Hispanic Black	8,193 (11.4)	939 (8.6)
Non-Hispanic Other	3,957 (5.5)	531 (4.9)
Gender, n (%)		
Male	42,115 (58.5)	6,901 (63.4)
Female	29,931 (41.5)	3,979 (36.6)
Co-occurring mental and substance use disorders, n (%)		

Table 1 (cont.)

Yes	32,012 (44.4)	4,941 (45.4)
No	40,034 (55.6)	5,939 (54.6)
<i>Co-substance use</i>		
Alcohol, <i>n (%)</i>		
No	65,713 (91.2)	9,338 (85.8)
Yes	6,333 (8.8)	1,542 (14.2)
Benzodiazepine, <i>n (%)</i>		
No	67,568 (93.8)	9,846 (90.5)
Yes	4,478 (6.2)	1,034 (9.5)
Marijuana, <i>n (%)</i>		
No	62,279 (86.4)	9,593 (88.2)
Yes	9,767 (13.6)	1,287 (11.8)
<i>Treatment</i>		
Referral source, <i>n (%)</i>		
Other	14,977 (20.8)	3,245 (29.8)
Court/criminal justice system	3,875 (5.4)	840 (7.7)
Self	53,194 (73.8)	6,795 (62.5)
Length of stay, <i>mean (SD)</i>	2.45 (0.67)	2.53 (0.54)
Services/settings, <i>n (%)</i>		
Detoxification	6,323 (8.8)	2,912 (26.8)
Rehabilitation/residential	3,644 (5.1)	1,760 (16.2)
Ambulatory	62,079 (86.2)	6,208 (57.1)

Of the final sample, only about an eighth completed treatment (13.1%). Majority of the sample consisted of patients who received a GED/Grade 12 education or below (75.5%), who received ambulatory services (82.3%), referred to treatment by themselves (72.3%), were unemployed (78.4%), were ages 35-64 years old (51.8%), were Non-Hispanic Whites (72.8%), were male (59.1%), who did not report alcohol co-use (90.5%), who did not report benzodiazepine co-use (93.3%), and who did not report marijuana co-use (86.7%). Regarding length of stay in treatment, those who completed treatment spent an average of 2.53 (SD = 0.54)

days compared to those who did not complete treatment staying an average of 2.45 (SD = 0.67) days.

4.2 PREDICTING TREATMENT COMPLETION

Using the generalized linear model function in R, the samples were analyzed to predict the treatment completion probabilities. The whole sample was run first to assess the final sample together. Then, the odds ratios of the independent variables in the model were produced in the three setting types.

4.2.1 WHOLE SAMPLE LOGISTIC REGRESSION MODEL

The logistics regression model using the final sample was run using stratification by completion, shown in Figure 2. Some of the results upheld current knowledge, while others were unique to this study. Individuals who were 35-64 years in age are less likely to complete MAT treatment (OR = 0.95, 95% CI = 0.91-1.00) than those 18 years of age or younger. Along with that age group, individuals who were 65+ years of age are also less likely to complete MAT treatment (OR = 0.84, 95% CI = 0.70-0.99) than those who were 18 years of age or younger. The results show that an individual with an older age was predicted to complete treatment with less probability than those of a younger age. Individuals with a higher education had a lesser chance of completing MAT treatment (OR = 0.92, 95% CI = 0.87-0.96) compared to those with a Grade 12/GED level of education. Patients who received treatment in rehabilitation or residential settings and in ambulatory settings had less of a chance of completing MAT treatment (OR = 0.67, 95% CI = 0.62-0.73, OR = 0.13, 95% CI = 0.12-0.14, respectively) compared to those who received treatment in detoxification settings. Individuals who reported to treatment from a

mandate of the criminal justice system were more likely to complete MAT treatment (OR = 1.24, 95% CI = 1.21-1.28) than those who reported to treatment by self-referral. Hispanic individuals were less likely to complete MAT treatment (OR = 0.68, 95% CI = 0.63-0.74), along with non-Hispanic Black individuals (OR = 0.66, 95% CI = 0.61-0.72) and non-Hispanic individuals who were neither Black nor White (OR = 0.88, 95% CI = 0.80-0.97) compared with non-Hispanic White individuals. Individuals who lived within the Appalachian region were less likely than those who lived outside of the region to complete MAT treatment (OR = 0.72, 95% CI = 0.67-0.77). Female patients were less likely than males to complete treatment (OR = 0.92, 95% CI = 0.88-0.97). Individuals who did not report alcohol co-use were less likely to complete MAT treatment (OR = 0.78, 95% CI = 0.73-0.84). Individuals who did not report benzodiazepine co-use were less likely to complete treatment (OR = 0.96, 95% CI = 0.89-1.04). Finally, individuals who did not report marijuana co-use were more likely to complete MAT treatment (OR = 1.06, 95% CI = 0.99-1.13).

Table 2. Results from logistic regression model for completion

Variable	Odds Ratio	95% confidence interval	p value
Demographics			
Age			
18-34 years old [reference]			
35-64 years old	0.95	[0.91, 1.00]	0.03*
65+ years old	0.81	[0.68, 0.97]	0.02*
Education			
Grade 12/GED or less [reference]			
Some college/trade school or more	0.92	[0.87, 0.96]	<0.01**
Employment status			
Unemployed [reference]			
Employed (full- or part-time)	1.17	[1.11, 1.24]	<0.01**
Race/Ethnicity			
Non-Hispanic White [reference]			

Table 2 (cont.)

Hispanic	0.68	[0.63, 0.74]	<0.01**
Non-Hispanic Black	0.66	[0.61, 0.72]	<0.01**
Non-Hispanic Other	0.88	[0.80, 0.97]	0.01**
Gender			
Male [reference]			
Female	0.92	[0.88, 0.97]	<0.01**
Co-occurring mental and substance use disorders			
Yes [reference]			
No	1.44	[1.37, 1.51]	<0.01**
<i>Co-substance use</i>			
Alcohol			
No [reference]			
Yes	0.78	[0.73, 0.84]	<0.01**
Benzodiazepine			
No [reference]			
Yes	0.96	[0.89, 1.04]	0.36
Marijuana			
No [reference]			
Yes	1.06	[0.99, 1.13]	0.10
<i>Treatment</i>			
Referral source			
Self [reference]			
Court/criminal justice system	1.24	[1.21, 1.28]	<0.01**
Length of stay			
1 day [reference]			
2-30 days	1.94	[1.85, 2.04]	<0.01**
Services/settings			
Detoxification [reference]			
Rehabilitation/residential	0.67	[0.62, 0.73]	<0.01**
Ambulatory	0.13	[0.12, 0.14]	<0.01**
<i>Region</i>			
Appalachian			
No [reference]			
Yes	0.72	[0.67, 0.77]	<0.01**

* $p \leq 0.05$ ** $p \leq 0.01$

Inspection of the results from the logistic regression model using the final sample revealed some insignificant data. To further explore the association of treatment completion with the demographics, exogenous activities, treatment aspects, and geographical information of the episodes, logistic regression models were run for each setting type. The setting types were split and analyzed since there has not been a study to review this, according to the search.

4.2.2 DETOXIFICATION SETTING LOGISTIC REGRESSION MODEL

Detoxification included any 24-hour services safe withdrawal of a substance, according to SAMHSA (2021).

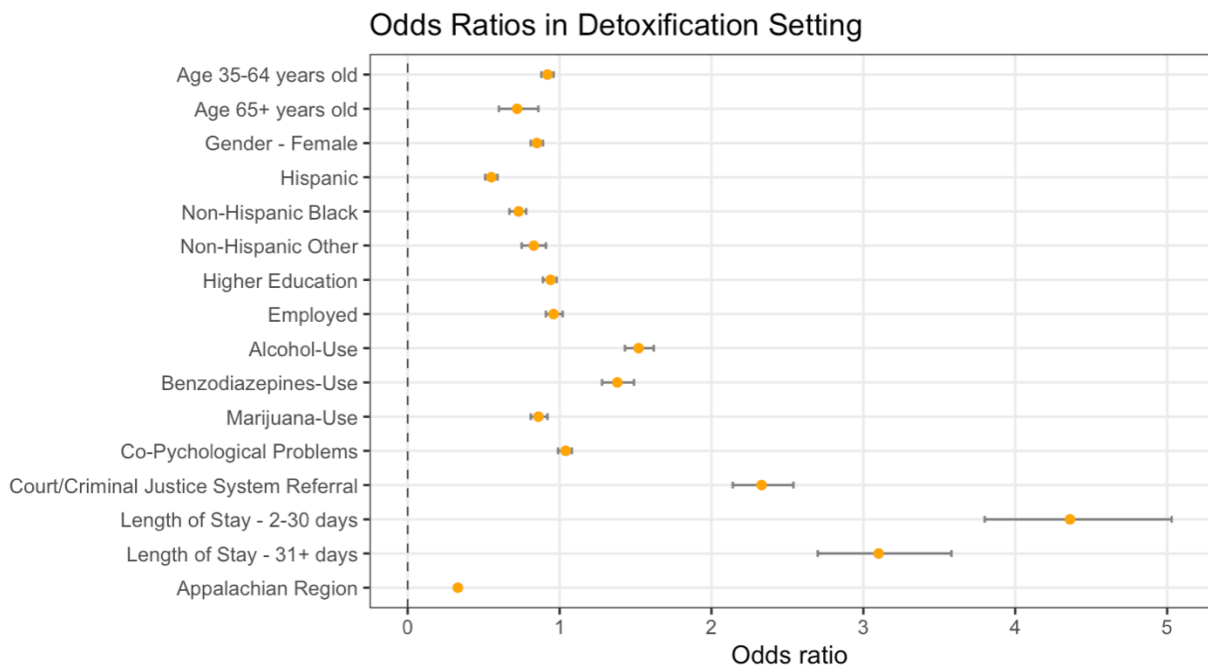


Figure 2. Odds ratios and confidence intervals for variables in detoxification setting logistic regression model

Figure 2 shows the results of the odds ratios and confidence intervals of each covariate in the four different models within the detoxification setting. In general, older age was associated with a lower chance of completing treatment, along with higher education, being employed, being a minority, co-using marijuana, being female, and living within the Appalachian region.

On the contrary, co-occurring mental and substance use disorders, alcohol and benzodiazepine co-uses, referral from the court/criminal justice system, and staying in treatment for more than one day were all associated with a higher chance of completing treatment. The associations of co-using benzodiazepine and marijuana with treatment completion were significant in this model and could be able to provide further explanation considering the insignificance of these covariates in the full model.

4.2.3 REHABILITATION/RESIDENTIAL SETTING LOGISTIC REGRESSION MODEL

The rehabilitation/residential setting was considered medical care in a facility with treatment services for substance use and dependency, and it may have included different living arrangements (SAMHSA, 2021). It was necessary to isolate this setting to analyze the difference in significance.

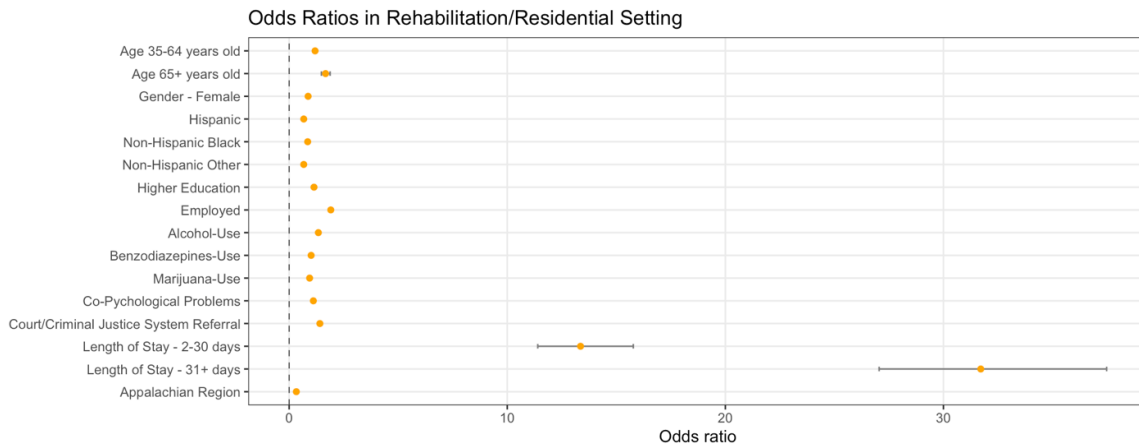


Figure 3. Odds ratios and confidence intervals for variables in rehabilitation/residential setting logistic regression model

The odds ratios and confidence intervals for the rehabilitation/residential setting for each independent covariate is exhibited in Figure 3. Largely, being of older age, having higher education, being employed, co-using alcohol, having co-occurring mental and substance use disorders, being referred by the court/criminal justice system, and staying in treatment for longer

than one day was associated with a higher chance of completing treatment. In contrast, being a minority, being female, co-using benzodiazepines and marijuana, and living within the Appalachian region was associated with a lower chance of completing treatment. The results of the covariates co-using benzodiazepines and marijuana were significant in this model, counter to the full model.

4.2.4 AMBULATORY SETTING LOGISTIC REGRESSION MODEL

The ambulatory setting is unique in that the service was out-patient and only provided for a certain number of hours a week (SAMHSA, 2021). The ambulatory setting was different than the detoxification and rehabilitation/residential settings and can be explained through the odds ratios and confidence intervals.

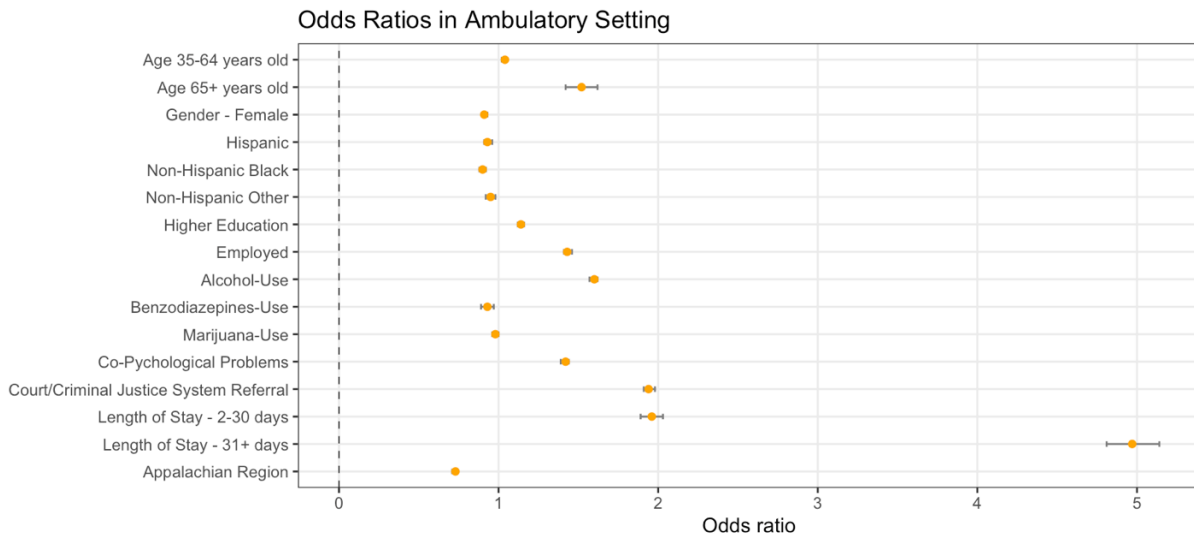


Figure 4. Odds ratios and confidence intervals for variables in ambulatory setting logistic regression model

Figure 4 generally presents that being of older age, having a higher education, being employed, being a minority, co-using alcohol, being male, having co-occurring mental and substance use disorders, being referred by the court/criminal justice system, and staying in

treatment for longer than a day was related to a higher chance of completing treatment. However, being a minority, being female, co-using benzodiazepines and marijuana, and living within the Appalachian region was linked to a lower chance of completing treatment. By separating the setting types, the insignificant results can be further examined, and the odds ratios and p-values can be explored for significance and direction.

CHAPTER 5: DISCUSSION

5.1 OVERVIEW

This study aimed to explore the association and likelihood of MAT completion for individuals with OUD across different setting types when controlling for demographics, exogenous activities, and treatment aspects. It is known that there are racial and geographic disparities in the treatment completion likelihood, and this study further proved that. Analysis of treatment completion in the Appalachian region was necessary to contribute to the literature to elucidate the crisis in this area. Results from logistic regression models prove the emergent assistance needed to dissolve the racial and geographic disparities in treatment completion.

5.2 FACTORS ASSOCIATED WITH MAT COMPLETION

Across the literature landscape, it is known that minority individuals, those who are not non-Hispanic White, have less of a chance of completing treatment. Those results are generally found in this study and in many others (Lucabeche & Quinn, 2021; Stahler & Mennis, 2018; Suntai et al., 2020). There could be multiple reasons for these results, but Hoffman et al. explored some of the reasons. They found that the pain level for Blacks is believed to be less than their counterparts in some instances (2016). There could be inherent bias or systemic racism affecting this. More needs to be done within the literature and healthcare system to overcome this disparity.

In each of the settings, individuals who lived within the Appalachian region have less of a chance of completing treatment compared to those who did not live in the Appalachian region. Many studies have investigated substance use in the Appalachian region, especially with the rise of overdoses, but there have not been many studies exploring the probabilities of treatment

completion of those who are diagnosed with OUD, to our knowledge. Treatment is very rarely offered in rural America (Albright et al., 2022; Drake et al., 2021), and that may contribute to the lack of treatment completion. Behringer (2020) found that the stigma around substance use may be the reason for the lack of treatment. There have been models proposed for the solution of the lack of treatment, like the hub-and-spoke, to expand access (Winstanley et al., 2020). Since the onset of the COVID-19 pandemic, telehealth has been used more abundantly. Policy changes of providers can change the access to treatment for many individuals. Nonetheless, there is a clear disparity in the access of treatment and treatment completion for individuals who live in the Appalachian region.

Analysis of the logistic regression models revealed that the odds ratios for the independent variables are very similar in the rehabilitation/residential and ambulatory settings. The direction of the odds ratios is all the same, but the magnitudes are not identical. This similarity may suggest that the differences in p-values and odds ratios in the full model are due to the detoxification setting data.

The data from the detoxification setting differed from the data in the rehabilitation/residential and ambulatory settings. An interesting difference was that older age in the detoxification setting was associated with lower chances of completing treatment but higher chances in the other two settings. Age is a variable that is often grouped together to diminish the chances of recognition of a specific client, and each study decides how to group the ages together for themselves. Therefore, there are many different age groups across the literature for MAT completion. Some previous studies show a similar trend of those of an older age having a lesser chance of completing MAT than the youth (Haggerty et al., 2022; Krawczyk et al., 2021; Ware et al., 2021). Nonetheless, there are other previous studies that found that the youth is the age

group that has less of a chance to complete treatment (Arndt et al., 2013; Dunn et al., 2019). It can be difficult to determine why a certain age group has more likely of a chance of completing treatment, but some studies have tried to explore some explanations. For example, Haggerty et al. (2022) found that those 55+ years of age are less likely to use telemedicine, a way for patients to receive and complete treatment. Another study done by Alibrahim et al. (2022) found that the younger generation is more likely to drive to a treatment facility at a greater distance from their home, allowing for a greater capacity of completion. One other reason for the difference in results may be that some states were excluded from the Arndt et al. study and primary substance use was grouped differently. Further research into why different age groups have a difference in treatment completion is necessary. Despite these findings, it is clear there is a disparity in treatment completion for the youth.

Looking at the results of each setting, another difference in the detoxification setting compared to the other two was that co-using benzodiazepines was associated with a higher chance of completing treatment. It was intriguing that each of the co-use substances show a different direction (above or below 1.00) in the odds ratios. This may suggest research into how brain chemistry is modified and different with each substance use relating to perseverance and completing a task. A previous study also looked at co-use groups and reported that alcohol, benzodiazepine, and marijuana co-use groups all had a higher chance of completing MAT than the methamphetamine co-use group (Ware et al., 2021). Choi et al. (2021) looked at the completion rates and correlates for those who use heroin and prescription opioids, and they found that MAT was associated with more of a chance of treatment completion for individuals in the residential setting but less of a chance for those in the detoxification and outpatient treatment. This study used TEDS-D from 2015-2018, so there may be a reason for some of the

discrepancies. There is a lot of literature on the co-use of opioids with tobacco, but these treatment completion chances of those who live in the Appalachian region need to be explored.

Employed individuals, in this study, had more of a chance of completing treatment than those who were unemployed in the rehabilitation/residential and ambulatory settings but less of a chance in the detoxification setting. A study completed by Lucabeche and Quinn (2022) showed that those who are unemployed generally have a higher chance of treatment completion compared to those who are employed. In the study by Lucabeche and Quinn (2022), individuals who were referred to treatment from the court were studied. In this study, all referrals were included. This may account for the differences in the results from this study. Appointment times or time off may affect the treatment completion chances for those who are employed.

Many of the results come to no surprise as previous studies have found similar outcomes. The results generally show that having a higher education was associated with a higher chance of completing treatment, and this is shown in many other studies (Arndt et al., 2013; Suntai et al., 2020). For example, Suntai et al. found that clients with the highest education (16+ years) were most likely to successfully complete treatment compared to those with less years of education (≤ 8 , 9-11, 12, and 13-15 years) (2020). With Alabama, Arizona, New Mexico, Pennsylvania, Wisconsin, and North Carolina excluded and non-prescription methadone combined in a group with other opiates and synthetics in the Suntai et al. study, these differences may be able to explain the discrepancy in the results. However, previous studies have shown similar results of higher education leading to a less likely chance of completing MAT (Guerrero et al., 2021; Krawczyk et al., 2021; Stahler & Mennis, 2018). This study contributes to the argument that having a higher education is a protective factor for treatment completion.

In terms of gender and treatment completion, this study found that female patients were less likely to complete MAT compared to males in each of the treatment settings. There is quite some controversy surrounding this finding as previous studies have found the same results (Arndt et al., 2013; Krawczyk et al., 2021; Stahler & Mennis, 2018; Stahler et al., 2022; Ware et al., 2021). However, other previous findings have found the opposite results showing females have a higher chance of completing MAT (Dunn et al., 2019; Suntai et al., 2020). Suntai et al. used an older population than in this study, and Dunn et al. used data from 2006-2015. These details may account for the differences in results. The proportion of males to females may also have influenced the likelihood of treatment completion. The number of males ($n = 49,016$) accounted for 59.1% of the reported cases, leaving the number of females ($n = 33,910$) to account for the other 40.9% of the clients. With more males reporting discharge from treatment, this data result may be more accurate with a larger sample size. With that, each setting shows there is a disparity in treatment completion based on gender.

The results of the logistic regression models presented odds ratios that were much higher for length of stay than any other variable, such as values between ten and forty. Analysis into the proportion of the individuals who have not completed treatment separated by the length of stay revealed the small number of cases of those in treatment for one day. This causes the odds ratios of those in treatment for longer than a day to be much higher. This is likely the reason for unusually high odds ratios for length of stay. It is important to recognize that the direction of the odds ratios remain the same across the models, as they are above one for all.

In general, this study found evidence to support some previous work, but this work contributed to the literature with exploration into MAT completion for those in the Appalachian region, shown in separate treatment settings. It is clear there is geographic disparity for MAT

completion, evident from this study. Racial disparities in MAT completion have been an issue for some time, as indicated by past studies, and this work continues to press upon this difference.

5.3 IMPLICATIONS

The sheer number of individual episodes that reported opioid-related substance use suggests that prevention in substance use is necessary. The growing numbers of opioid overdoses within the United States is alarming and needs to be addressed soon. According to the sampling, increased access to education and treatment is imperative. This can promote safe practices and detect illicit opioid supply and demand.

There are many aspects of this study that support previous research, such as minorities having a lesser chance of treatment completion. Considering the continuation of these results into the present, this seems to imply that cultural context can be an explanatory variable. It is not enough to divide individuals into race and ethnic categories, but results show a need for research into culture surrounding these individuals.

This study was one of the first analyses of treatment completion of individuals with OUD that reside in the Appalachian region and separation of setting types into detoxification, rehabilitation/residential, and ambulatory, to our knowledge. Each setting showed that living within the Appalachian region is associated with a lower chance of completing treatment, and the commonality in each model demonstrates the need for further investigation into this disparity.

There is growing concern for the loads of literature surrounding the racial disparity in treatment completion. This study adds to the alarming data that needs to be investigated as to why there is this disparity. After investigating the odds ratios and confidence intervals across the

treatment settings, the differences in the data for the detoxification setting give reasons for additional studies.

The length of stay variables showed quite the difference in treatment completion probability between one day and more than a day. These results were common across each setting type. This may suggest that treatment retention is an important variable relating to completion.

5.3.1 FUTURE RESEARCH

A path of additional research could be policy change to increase the number of providers to decrease the inaccessibility, especially within the Appalachian region. Expanding the pool of providers by decreasing the requirements of becoming a provider would allow for different professionals to supply treatment to those who need it. Another area of research for the geographic disparity is the inclusion of the exploration into mobility of homes and families. How often households move and to where should be considered in the future. Telehealth is part of new technology that could help decrease drop-out or incompleteness.

To address the racial disparity around treatment completion, future research should include socioeconomic status and job flexibility. Exploration into different jobs held by minority individuals should be considered when investigating treatment access and completion. Another area of analysis should be how many dependents an individual has. For example, it is common in Hispanic culture to live with extended family, so the effect that this situation has on an individual's success of completion should be explored.

According to this study, length of stay in treatment needs further investigation. The enhancement of retention of individuals in treatment and recovery should be considered when exploring ways to increase treatment completion probabilities.

5.4 LIMITATIONS

The data presented in TEDS-D from SAMHSA excluded episodes from Oregon, West Virginia, and Washington since the proportion of episodes reported was not significant to the overall data. Therefore, the conclusions cannot be generalized for all areas of the United States. Moreover, the guidelines and qualifications are different in each state, so the reports are not standard and could not be accurate. The data reported to SAMHSA could be inconsistent and not represent the episodes fully. Furthermore, not all the states have Opioid Therapy Programs (OTP) and could not give data on that topic. These states were still included in the analysis so that the largest sample could be represented. Without the OTP in some states, this is only a general conclusion. The completion variable was dichotomized into completion and non-completion, but completion is not always attributed to the individual. The results cannot give data about people; rather, the results depict associations about episodes.

There is only data from publicly funded facilities, so these associations do not represent the full scope of discharges from treatment. Private hospitals and group meetings, like Alcoholic Anonymous, were not represented in the data set and analysis. In a related manner, since the analysis was completed, a more recent data set has been released. Therefore, this study contributes to the literature but is not the most current landscape.

In conclusion, the use of TEDS-D and the logistic regression models gives associative results, not causation outcomes. This study contributes to the literature in the details of racial and

geographic disparities, but the results are not definitive.

CHAPTER 6: CONCLUSION

As opioid overdoses continue to increase across the United States, it is important to investigate treatment completion for all individuals, especially those with Opioid Use Disorder. It is paramount to expand access to treatment to include all areas, including those within the Appalachian region. Racial and ethnic disparities in treatment completion continue to cover headlines of many studies, like this one, and demand research into better understanding of why they persist and how to eradicate them. Year after year, the Substance Abuse and Mental Health Services Administration receives data from all states, and the results continue to show lack of progress towards higher treatment completion. These results call for future research into OUD treatment accessibility and retention. Treatment completion and prevention protocols may be life-saving measures for those who are repeatedly and disproportionately affected by the opioid crisis.

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APPENDIX A: UNIVARIATE LOGISTIC REGRESSION RESULTS

Results from univariate logistic regression model for completion

Variable	Odds Ratio	95% confidence interval	<i>p</i> value
<i>Demographics</i>			
Age			
18-34 years old [reference]			
35-64 years old	0.86	[0.83, 0.90]	<0.01**
65+ years old	0.61	[0.51, 0.72]	<0.01**
Gender			
Male [reference]			
Female	0.81	[0.78, 0.85]	<0.01**
Race/Ethnicity			
Non-Hispanic White [reference]			
Hispanic	0.56	[0.52, 0.61]	<0.01**
Non-Hispanic Black	0.69	[0.64, 0.74]	<0.01**
Non-Hispanic Other	0.80	[0.73, 0.97]	<0.01**
Education			
Grade 12/GED or less [reference]			
Some college/trade school or more	0.94	[0.90, 0.99]	0.02*
Employment status			
Unemployed [reference]			
Employed (full- or part-time)	1.12	[1.07, 1.18]	<0.01**
<i>Exogenous</i>			
Alcohol			
No [reference]			
Yes	0.58	[0.55, 0.62]	<0.01**
Benzodiazepine			
No [reference]			
Yes	0.63	[0.59, 0.68]	<0.01**
Marijuana			
No [reference]			
Yes	1.17	[1.10, 1.24]	<0.01**
Psychological Problems			
No [reference]			
Yes	0.96	[0.92, 1.00]	0.06
<i>Treatment</i>			
Referral source			
Self [reference]			
Court/criminal justice system	1.00	[0.92, 1.09]	0.99
Length of stay			
1 day [reference]			
2-30 days	6.10	[5.34, 7.01]	<0.01**
31+ days	4.79	[4.20, 5.50]	<0.01**
Services/settings			
Detoxification [reference]			
Rehabilitation/residential	1.05	[0.98, 1.13]	0.19
Ambulatory	0.22	[0.21, 0.23]	<0.01**
<i>Geographic</i>			
Appalachian			
No [reference]			
Yes	0.33	[0.32, 0.36]	<0.01*

* $p \leq 0.05$ ** $p \leq 0.01$

APPENDIX B: DETOXIFICATION SETTING LOGISTIC REGRESSION RESULTS

Results from logistic regression models for the detoxification setting

Variable	Demographics	Exogenous	Treatment	Geographic
Age				
18-34 years old [reference]				
35-64 years old	(0.86** [0.83-0.90])	(0.88** [0.84-0.91])	(0.89** [0.85-0.93])	(0.92** [0.88-0.96])
65+ years old	(0.63** [0.53-0.74])	(0.66** [0.55-0.78])	(0.70** [0.58-0.83])	(0.72** [0.60-0.86])
Education				
Grade 12/GED or less [reference]				
Some college/trade school or more	(1.01 [0.96-1.05])	(0.94** [0.89-0.98])	(0.93** [0.88-0.97])	(0.94** [0.89-0.98])
Employment status				
Unemployed [reference]				
Employed (full- or part-time)	(0.84** [0.80-0.88])	(0.87** [0.83-0.92])	(0.92** [0.87-0.97])	(0.96 [0.91-1.02])
Race/Ethnicity				
Non-Hispanic White [reference]				
Hispanic	(0.57** [0.53-0.74])	(0.58** [0.53-0.63])	(0.60** [0.55-0.64])	(0.55** [0.51-0.59])
Non-Hispanic Black	(0.72** [0.67-0.77])	(0.72** [0.67-0.78])	(0.72** [0.67-0.78])	(0.73** [0.67-0.78])
Non-Hispanic Other	(0.85** [0.78-0.92])	(0.83** [0.76-0.91])	(0.84** [0.76-0.92])	(0.83** [0.75-0.91])
Gender				
Male [reference]				
Female	(0.79** [0.76-0.82])	(0.79** [0.76-0.83])	(0.81** [0.78-0.85])	(0.85** [0.81-0.89])
Co-occurring mental and substance use disorders				
Yes [reference]				
No		(1.06* [1.01-1.10])	(1.06** [1.02-1.11])	(1.04 [0.99-1.08])
Alcohol				
No [reference]				
Yes		(1.63** [1.54-1.74])	(1.56** [1.47-1.66])	(1.52** [1.43-1.62])
Benzodiazepine				
No [reference]				

Yes	(1.47** [1.37-1.58])	(1.43** [1.33-1.54])	(1.38** [1.28-1.49])
Marijuana			
No [reference]			
Yes	(0.82** [0.77-0.88])	(0.83** [0.77-0.88])	(0.86** [0.81-0.92])
Referral source			
Self [reference]			
Court/criminal justice system		(1.89** [1.74-2.05])	(2.33** [2.14-2.54])
Length of stay			
1 day [reference]			
2-30 days		(6.77** [5.92-7.78])	(4.36** [3.80-5.03])
31+ days		(5.75** [5.03-6.61])	(3.10** [2.70-3.58])
Appalachian			
No [reference]			
Yes			(0.33** [0.31-0.35])

* $p \leq 0.05$ ** $p \leq 0.01$

APPENDIX C: REHABILITATION SETTING LOGISTIC REGRESSION MODEL

Results from logistic regression models for the rehabilitation/residential setting

Variable	Demographics	Exogenous	Treatment	Geographic
Age				
18-34 years old				
[reference]				
35-64 years old	(1.19** [1.16-1.21])	(1.18** [1.15-1.21])	(1.20** [1.17-1.23])	(1.19** [1.16-1.22])
65+ years old	(1.85** [1.67-2.05])	(1.65** [1.47-1.85])	(1.77** [1.57-1.99])	(1.67** [1.48-1.88])
Education				
Grade 12/GED or less				
[reference]				
Some college/trade school or more	(1.34** [1.31-1.37])	(1.15** [1.12-1.18])	(1.16** [1.12-1.19])	(1.14** [1.11-1.17])
Employment status				
Unemployed				
[reference]				
Employed (full- or part-time)	(1.88** [1.82-1.95])	(1.58** [1.53-1.65])	(1.83** [1.76-1.90])	(1.91** [1.83-1.99])
Race/Ethnicity				
Non-Hispanic				
White [reference]				
Hispanic	(0.88** [0.85-0.91])	(0.86** [0.83-0.89])	(0.75** [0.72-0.78])	(0.67** [0.65-0.70])
Non-Hispanic Black	(0.75** [0.73-0.77])	(0.79** [0.77-0.82])	(0.82** [0.80-0.85])	(0.85** [0.83-0.88])
Non-Hispanic Other	(0.97 [0.93-1.01])	(0.94** [0.80-0.89])	(0.72** [0.69-0.76])	(0.67** [0.63-0.70])
Gender				
Male [reference]				
Female	(0.77** [0.76-0.79])	(0.83** [0.81-0.85])	(0.86** [0.84-0.88])	(0.87** [0.85-0.89])
Co-occurring mental and substance use disorders				
Yes [reference]				
No		(1.43** [1.40-1.47])	(1.18** [1.15-1.21])	(1.11** [1.08-1.14])
Alcohol				
No [reference]				
Yes		(1.36** [1.33-1.39])	(1.37** [1.33-1.40])	(1.34** [1.31-1.37])
Benzodiazepine				
No [reference]				

Yes	(0.89** [0.84-0.93])	(0.92** [0.87-0.97])	(1.01 [0.96-1.07])
Marijuana			
No [reference]			
Yes	(0.93** [0.90-0.95])	(0.94** [0.91-0.96])	(0.94** [0.92-0.97])
Referral source			
Self [reference]			
Court/criminal justice system		(1.38** [1.34-1.43])	(1.41** [1.36-1.45])
Length of stay			
1 day [reference]			
2-30 days		(16.7** [14.3-19.8])	(13.4** [11.4-37.8])
31+ days		(41.5** [35.4-49.0])	(37.7** [27.1-37.5])
Appalachian			
No [reference]			
Yes			(0.33** [0.32-0.34])

* $p \leq 0.05$ ** $p \leq 0.01$

APPENDIX D: AMBULATORY SETTING LOGISTIC REGRESSION MODEL

Results from logistic regression models for the ambulatory setting

Variable	Demographics	Exogenous	Treatment	Geographic
Age				
18-34 years old				
[reference]				
35-64 years old	(1.05** [1.03-1.06])	(1.01 [1.00-1.03])	(1.04** [1.02-1.06])	(1.04** [1.02-1.05])
65+ years old	(1.86** [1.76-1.97])	(1.71** [1.60-1.82])	(1.56** [1.46-1.66])	(1.52** [1.42-1.62])
Education				
Grade 12/GED or less				
[reference]				
Some college/trade school or more	(1.20** [1.18-1.22])	(1.07** [1.06-1.09])	(1.14** [1.12-1.16])	(1.14** [1.12-1.16])
Employment status				
Unemployed				
[reference]				
Employed (full- or part-time)	(1.88** [1.85-1.91])	(1.69** [1.66-1.71])	(1.44** [1.42-1.47])	(1.43** [1.41-1.46])
Race/Ethnicity				
Non-Hispanic				
White [reference]				
Hispanic	(1.36** [1.33-1.39])	(1.16** [1.14-1.19])	(0.98 [0.95-1.00])	(0.93** [0.91-0.96])
Non-Hispanic Black	(0.97** [0.95-0.99])	(0.91** [0.89-0.93])	(0.88** [0.86-0.90])	(0.90** [0.88-0.92])
Non-Hispanic Other	(1.14** [1.10-1.17])	(1.08** [1.05-1.09])	(0.98 [0.95-1.02])	(0.95** [0.92-0.98])
Gender				
Male [reference]				
Female	(0.78** [0.77-0.79])	(0.89** [0.87-0.90])	(0.91** [0.90-0.93])	(0.91** [0.90-0.93])
Co-occurring mental and substance use disorders				
Yes [reference]				
No		(1.81** [1.78-1.84])	(1.49** [1.47-1.52])	(1.42** [1.39-1.44])
Alcohol				
No [reference]				
Yes		(1.81** [1.78-1.83])	(1.63** [1.60-1.65])	(1.60** [1.57-1.62])
Benzodiazepine				
No [reference]				

Yes	(0.78** [0.75-0.81])	(0.90** [0.86-0.94])	(0.93** [0.89-0.97])
Marijuana			
No [reference]			
Yes	(1.15** [1.13-1.16])	(0.98 [0.97-1.00])	(0.98* [0.96-1.00])
Referral source			
Self [reference]			
Court/criminal justice system		(1.96** [1.93-2.00])	(1.94** [1.91-1.98])
Length of stay			
1 day [reference]			
2-30 days		(2.26** [2.18-2.34])	(1.96** [1.89-2.03])
31+ days		(5.99** [5.81-6.17])	(4.97** [4.81-5.14])
Appalachian			
No [reference]			
Yes			(0.73** [0.71-0.74])

* $p \leq 0.05$ ** $p \leq 0.01$