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Access to Medication-Assisted Treatment for Opioid Dependence in the United States – Identifying Implications for Policy and Practice

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ACCESS TO MEDICATION-ASSISTED TREATMENT FOR OPIOID DEPENDENCE IN THE UNITED STATES – IDENTIFYING IMPLICATIONS FOR POLICY AND PRACTICE

By

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Approval of The Dissertation Committee

This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Mofoluwake Adeniyi as fulfilling the scope and quality requirements for meriting the degree of Doctor of Public Health.

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ABSTRACT

Access to Medication-Assisted Treatment for Opioid Dependence in The United States –
Identifying Implications for Policy and Practice

By
Mofoluwake Adijolola Adeniyi

Claremont Graduate University: 2020

Americans make and use the most opioids in the world. Although comprising somewhat less than 5% of the world's population, the United States (US) produces approximately 90% of the global supply of Hydrocodone and consumes an estimated 80% of the total international supply. It is not surprising, therefore, that the American opioid epidemic, particularly as it involves adults (those 18 years and older), is worsening—Indeed, President Trump declared it a national public health emergency. Many therefore anticipate that the US Congress will enact evidence-informed policies to address the opioid crisis.

Opioid-Use Disorder (OUD) is a pattern of opioid use that leads to such adverse consequences as hormonal dysfunction, immune-system suppression, overdose, and death. The gold standard for OUD therapy is medication-assisted treatment (MAT), best described as managing OUD using methadone, buprenorphine, or naltrexone in addition to counseling and behavioral therapy. MAT access is low in the US.

This study investigates access to MAT by age group in the US. Its primary aim is to investigate barriers faced by adults diagnosed with OUD in accessing MAT by examining the constructs in a conceptual framework that includes the influence of policy, environment, population features, health behavior, and health outcomes on access to MAT. Given the huge

burden of OUD, findings from this project have important implications for policy and practice. Results suggest that barriers for adults diagnosed with OUD in accessing MAT include being male, being a young adult, and having some post-high school education but not at a four-year school. Other barriers are being an Alaskan Native/ American Indian, Asian/ Pacific Islander/ Native Hawaiian, or having another single or multiple racial background.

In light of the implications drawn from these findings, it is recommended that policymakers develop better policies aimed at addressing the identified MAT access issues. It is also recommended that US public health organizations and practitioners implement effective age-friendly and culturally competent MAT programs to lower these barriers. Findings from this study also provide guidance for future opioid research and OUD-management initiatives at a time when the opioid crisis will compete with the current COVID-19 pandemic for already-scarce resources.

DEDICATION

I am dedicating this paper to my parents, husband, and children. Thank you all for your support

and sacrifice.

ACKNOWLEDGMENTS

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DEFINITION OF TERMS IN THIS STUDY

Young adults: Individuals between the ages of 18 and 44 years.[42,81]

Middle-aged adults: Individuals between the ages of 45 and 64 years.[34]

Older adults: Individuals aged 65 years and older.[93]

Pharmacokinetics: The mode of action of medications or drugs in the human body.[117]

Opioid-use disorder: A new term coined in a bid to destigmatize the condition previously called opioid addiction and behaviors that signify opioid addiction.[83,125]

Non-medical use of prescription opioids: The use of prescription opioids not as prescribed for a particular condition or their use with a dose, frequency, or duration other than prescribed.[68]

Invasive routes: Routes of medication administration that involves introducing instruments into the body or the body's cavities. Examples are intramuscular and intravenous routes.[54]

Medication-assisted Treatment: Treating opioid-use disorder using methadone, buprenorphine, or naltrexone.[6,96,126]

Opioid abuse: Premeditated, non-therapeutic use of opioids to bring about a desired psychological or physiological effect (such as the use of opioids to get high).[23,125]

Diverted opioids: Opioids passed on from lawful to unlawful possession.[23,125]

Opioid misuse: Premeditated therapeutic use of opioids in an inappropriate manner excluding behavior(s) that can be defined as abuse (such as the use of an opioid to relieve symptoms of withdrawal or to help abstain from other opioids).[23,125]

Opioid-overdose death: Opioid overdose resulting in death. It usually presents initially as loss of consciousness and respiratory depression.

Opioid waivers: In order to become eligible to prescribe buprenorphine, physicians are required by law to obtain buprenorphine waivers by completing an eight-hour online OUD course, which

is offered by the American Society of Addiction Medicine.[108] Physician assistants and nurse

practitioners are required to complete a 24-hour online OUD course. Upon successful completion

of the online course, providers receive an opioid waiver.[99,108]

Heroin: An illicit opioid that has no medical use. [106]

Direct-observation therapy: Dispensing medications in a controlled system with a requirement

that patients visit the facility daily or weekly for medication administration.[28] This involves

facilities requiring daily visits to assess patients and give them medications such as methadone.

These medications are used while being observed by a provider. Facilities require weekly urine

screens. A positive urine screen indicates that patients have been taking their methadone. A

negative result indicates that patients have not been doing so. Weekly take-home doses of

methadone are dispensed to patients with positive urine drug screens.[28]

CHAPTER 1: INTRODUCTION

THE UNITED STATES' OPIOID EPIDEMIC AND ACCESS TO MEDICATION-ASSISTED TREATMENT

According to the Centers for Disease Control and Prevention (2017), drug overdose is "a leading cause of injury-related deaths in the US" (n.p.), and approximately 70% of drug overdose deaths are traced to a prescribed or illicit opioid.[18] In 2016, drug overdoses were responsible for the deaths of 64,000 Americans, of which an estimated 67% were due to opioid use.[14] Moreover, this exponential rise in drug-related mortality rates in America was first observed when prescription opioids became easily available.

In the last three decades, the rates of drug-related mortality have continued to rise.[119,122] Drug overdose death rates rose from 1.76 per 100,000 in women and 1.4 per 100,000 in men from 1980 to 24.4 in women and 36.5 in men in 2014.[122] In addition, the current opioid epidemic was responsible for a 200% increase in opioid-overdose deaths between 2000 and 2014, when they reached approximately 28,647.[66,99] Thus, in those ten years, prescription opioid use and OUD were implicated in the nation's high drug-related mortality rates.[119] There is an obviously urgent need to combat America's opioid epidemic.

Although opioids are prescribed by American providers to manage pain, such medications are not recommended for managing chronic pain.[103] First, prescription opioids do not have a long-lasting analgesic effect.[93] Second, chronic opioid use creates a state of drug dependence[33] and increases an individual's potential for the abuse and misuse of opioids. Long-term use of opioids also increases an individual's risk of developing OUD.[66]

To reiterate, Americans are the largest producers and consumers of opioids globally.[98] Although they comprise somewhat less than 5% of the global population,[38] the US produces

1

approximately 90% of the global supply of Hydrocodone and consumes an estimated 80% of the total international supply.[98] Approximately 214 million opioid prescriptions were written by providers in the US in 2016.[7] Each year, an estimated 1.9 million Americans who had never done so before use opioids, making them the second-most common medication used for the first time in the US.[98] These statistics help explain why more than 5 million Americans have OUD.[23,50,56] An estimated 2.1 million Americans developed OUD from the non-medical use of prescription opioids (NMUPO). An additional 467,000 developed the condition from the use of illicit opioids such as heroin.[43,52]

OUD destroys lives and families by increasing an individual's risk of abusing illicit substances, taking an accidental opioid overdose, or contracting viral infections.[32,72] Public-health specialists fear, too, that administering illicit opioids through invasive routes will increase Human Immunodeficiency Virus (HIV) and Hepatitis B and C infection rates.[23,98,103] OUD destroys families by increasing an individual's risk of developing such comorbidities as depression, antisocial personality syndrome, and suicide.[32,72] OUD burdens society through the loss of productivity and income, the expenses of providing first-response services (such as emergency calls for overdoses), higher healthcare costs for treating overdoses and addiction treatment, and the increased expenses incurred by the criminal justice system.[11,18,57]

In the US in 2009, the annual economic burden of OUD was approximately $55.7 billion.[31] An estimated $5.1 billion of that came from criminal justice expenses, and $25.6 billion from workplace costs, including truancy, productivity losses, disability payments, and loss of both personal and firm income due to employee death.[72] In 2015, the annual economic burden of OUD came to $78.5 billion, whereas that of the opioid epidemic totaled $504 billion.[23] Despite these alarming effects and the probability of an impending increase in HIV and Hepatitis B/ C

infections, the US opioid epidemic is quickly becoming a pandemic.[12,67,95]

The gold standard for treating OUD is MAT, the use of methadone, buprenorphine, or naltrexone.[6,96,126] Despite the wealth of scientific evidence supporting the use of MAT in managing OUD, gaining access to it is still difficult in the US.[3,77] Without insurance or adequate coverage many Americans cannot access MAT.[42] If they do, they are burdened with huge bills.[49] Populations commonly diagnosed with OUD, such as young (18 to 44), middle-aged (45 to 64), and older adults (65 and older) all lack access to MAT.[93,110] One of the primary deterrents to access and adherence to MAT is the lack of health insurance. Even though some pay out-of-pocket for healthcare, most Americans have medical insurance.[49] Not having health insurance or having inadequate coverage, such as a policy excluding MAT or placing limits on it, are deterrents to care.[48,65] Approximately 30% of individuals diagnosed with OUD have no health insurance as compared to the proportion of individuals not diagnosed with OUD.[42]

Given these statistics, several states have used numerous approaches in the last decade to increase access to OUD treatment.[25,31,60] These approaches include expanding Medicaid and also its coverage of MAT, funding provider education and opioid waivers, expanding MAT capacity, and increasing provider reimbursements.[25,60,123] An example of such program to increase access to OUD treatment is Vermont's "Hub and Spoke Model" (n. p.), which provides its residents with specialized MAT services and continuous OUD care under the roof of one facility.[51] In this program, stable patients are referred to primary-care facilities to continue management.[51] Although access to MAT increased in Vermont following the implementation of its Hub and Spoke model, some new patients waited longer to access MAT.[51] While this and other programs have been successfully adapted at the local level, an estimated 80% of Americans diagnosed with OUD still do not have access to this lifesaving evidence-based therapy.[36,67] Increasing access to

MAT remains crucial to reducing America's OUD prevalence and incidence rates.[3,25,77]

OPIOIDS AND THEIR PHARMACOKINETICS

Opioids act on the central nervous system to relieve pain.[6] They also cause sedation and euphoria. Commonly used prescription opioids in the US are HydroCodone, OxyCodone, Diphenoxylate, Hydromorphone, and Fentanyl.[52,79,80] The most commonly used illicit opioid in America is heroin. It is more dangerous than almost all opioids except maybe Fentanyl. The ease or cost of finding it is why people move from prescription opioids to heroin.[106]

Several factors explain both the predisposition to use opioids[6] and the motivation to continue taking opioids.[62,98] These include:

i.   Direct genetic factors (such as having a first-degree relative develop OUD).

ii.   Having seen others use opioids to cope with stress.[62]

iii.   A physiological predisposition to stress and having experienced repeated rewards from drug use to relieve it.

iv.   Indirect genetic factors such as the predilection for choosing peers who introduce one to opioid use.[62]

v.   The new balance created in the reward and stress-related pathways observed in patients with chronic pain who misuse opioids.[98]

Other factors that increase one's risk of developing OUD include youth or old age, male gender, a history of substance use, the use of diverted or illicit opioids such as heroin, poorly managed psychiatric disorder(s), and post-traumatic stress disorder.[84,85,125]

Pharmacokinetics is the description of how the body absorbs, distributes, metabolizes,

and excretes a medication or drug.[117] When administered orally, opioids are absorbed into the blood stream through the small intestine. When administered through invasive routes, opioids enter the blood stream directly.[52,54,85,88] Once opioids enter the blood stream, they cross the blood-brain barrier and attach to receptors located in the brain, spinal cord, gut, and peripheral sensory neurons. The body recognizes exogenous opioids as naturally occurring opioids; thus, these exogenous opioids overpower the body's naturally occurring opioid receptors in the brain's reward center. They release endorphins and dopamine, causing a powerful rush of extreme happiness, a sense of achievement, relaxation, disconnection, and an end of pain.[61,104] As opioid levels in the body fall, these feelings wear off, bringing about anxiety, irritability, and renewed pain.

The process of opioid levels falling, the feelings of the rush wearing off, is described as a cycle of coming down, dysphoria, and lack of pleasure. The desire to manage this cycle causes many individuals to increase either their dose or frequency of opioid use.[61,79,89,104] With prolonged use of exogenous opioids, the body reduces its production of naturally occurring ones. The liver metabolizes exogenous opioids using an alternate metabolic pathway and cytochrome. This alternate pathway affects how people experience the drugs. Opioids are excreted from the body by the liver and kidneys.[101]

The pharmacokinetics of opioids, as described above, aid in understanding why the urge to continue using opioids never really disappears in individuals diagnosed with OUD.[6,32] It underscores that discontinuing exogenous opioids without seeking professional help results in an inability of the body to experience pleasure on its own. This lack of pleasure becomes severe and creates a distressing and intolerable negative mood.[61,104] Overall, it suggests that long-term opioid use is a risk factor for developing OUD.[84,85,125]

OPIOID-USE DISORDER

OUD is a chronic relapsing condition associated with high morbidity and mortality rates.[104] It involves brain reward, memory, motivation, and related circuitry changes which lead to relapses, cravings for the drug, and continued use despite knowing that those who use opioids experience adverse outcomes. OUD is progressive and potentially fatal if left untreated or poorly treated.[125] It often involves illicit and prescribed opioids.[83] The Diagnostic and Standard Manual of Mental Disorders (DSM) defines OUD as a pattern of opioid use leading to clinically significant impairment or distress.

According to the DSM, OUD diagnosis is confirmed by the presence of two or more symptoms of OUD in a 12-month period.[29] These symptoms include opioid withdrawal, tolerance, and dependence.[29] The DSM also categorizes symptoms of OUD into four classes with various degrees of severity: "impaired control, social impairment, risky use, and pharmacological properties (physical tolerance and withdrawal symptoms)" (p. 4).[98]

Opioid tolerance refers to the need to increase the dose or frequency of opioid use to obtain the same effect. Opioid dependence is the compelling need to seek and use opioids and is also described as an unsuccessful attempt to control one's use of opioids or combining opioids with tranquilizers and alcohol.[18,104,125] Opioid withdrawal includes symptoms experienced when an individual stops taking opioids without the support of a professional team. These symptoms include cravings, sweating, nausea, vomiting, body aches, fever, diarrhea, and an inability to sleep.[6,80]

The clinical course of OUD is similar to that of chronic noncommunicable diseases characterized by "periods of exacerbation and remission" (p. 359).[95] As such, effective management of OUD requires access and adherence to medically supervised MAT.[36,95] OUD

presents itself through a variety of symptoms, including respiratory depression, reduced energy, decreased libido,[81,103] anxiety, weakened focus, and poor judgment.[104]

Other features of OUD are opioid intoxication, increased sensitivity to pain (hyperalgesia), severe constipation, narcotic-bowel syndrome, hormonal dysfunction, immune-system suppression, mental confusion, somnolence, accidents and legal problems, overdose, and death.[29,72,98,104] The effects of OUD are systemic and long lasting.[11] The consequences of OUD (e.g., substantial functional, clinical, and social impairment)[72] are often most serious in individuals who have existing mental health conditions and weak social support systems.[11]

Given the severity of these symptoms as defined in the DSM, Severino et al. (2018) examined whether new opioid formulations could relieve pain without causing dependence and tolerance. The study was conducted by reviewing literature on properties of opioids and how each opioid's pharmacokinetic profile advances its likelihood of being misused or abused. Severino et al. (2018) found that the incidence of OUD is higher in patients suffering from pain than in patients without pain. Globally, OUD is one of the main reasons for admissions to substance-use disorder (SUD) treatment facilities.[29]

Prevalence in the United States

Though opioids are prescribed to individuals aged 12 to 17 years, prescription opioid abuse and misuse are more common among young, middle-aged, and older adults,[72] with prescription opioid overdoses increasing more than three-fold among adults from 2000 to 2010.[14] The incidence rate of abusing OxyContin in one's lifetime in the US increased from 0.1% in 1999 to 0.4% in 2001.[98] Research has shown that as the use of prescription opioids increased, the nation's rates of NMUPO, heroin use, opioid overdose, and death also increased.[50,84,85,111,125]

Brady, McCauley & Back (2016) found that approximately 12.5 million Americans reported NMUPO in 2012, a huge increase from the 4.9 million in 1992. Similarly, in 2016, more than one in 20 Americans aged 12 years and older reported NMUPO,[50] and approximately 900,000 Americans reported using heroin.[111]

According to Heath (2019), NMUPO was responsible for 1,200,000 emergency-room visits in the US in 2011. Since 2013, an estimated 1000 persons have been treated daily in emergency rooms for NMUPO,[98] and 420,040 emergency-room visits for the treatment of opioid overdose were reported in 2011.[72] Prescription opioids were responsible for more than 50% of drug overdose deaths traceable to opioids, a proportion greater than the number of deaths associated with illicit drug overdose.[14]

In 2016, 91 Americans died daily from opioid overdose.[57] In 2017, the opioid epidemic caused more than 130 deaths daily.[46] Opioid-related deaths were reported as one cause of the decrease in US life expectancy that began in 1993.[98] American public-health organizations and practitioners are trying to curb the nations' opioid epidemic by reducing NMUPO through the prescription-monitoring program. They are also preventing some opioid-overdose deaths by training emergency responders to administer parenteral naloxone.[105]

The Need for Further Research

OUD has been diagnosed in individuals from all walks of life.[95] The factors predisposing some people to OUD, its clinical course, and the pharmacokinetics of opioids together help to explain the underlying compulsion of those diagnosed to use opioids.[96] In addition, OUD rewires the brain in ways that make achieving and sustaining recovery difficult without access and adherence to MAT.[26]

According to Abraham et al. (2018), the lack of health insurance is a significant barrier that limits access to MAT. Although there is an essential relationship between age and access to MAT, we need studies examining and directly comparing access to MAT among various age groups, especially among young adults (18 to 44).

Given these concerns, a quantitative examination is needed to investigate health access issues experienced among adults diagnosed with OUD. In view of the important relationship between health insurance and access to MAT, we need to examine the effects of the Affordable Care Act (ACA) and public and private health insurance on access to MAT. Research is also needed to investigate disparities in MAT access by age, comparing access to MAT among young, middle-aged, and older adults. Such research will focus on the development of effective policies aimed at addressing issues experienced by adults in accessing MAT. Findings from the study can potentially contribute to effective implementation of OUD-management programs.

PROJECT OVERVIEW

Public-health organizations focusing on reducing NMUPO through prescription-monitoring programs and preventing opioid-overdose deaths by training emergency responders to administer parenteral naloxone have not curbed the opioid crisis.[61,95] First, reducing NMUPO prevents new cases of OUD and worsening of existing OUD cases. Second, preventing opioid-overdose deaths does not prevent opioid overdoses overall. One episode of non-fatal opioid overdose significantly predicts recurring overdoses[8] and substantially increases the risk of opioid-overdose death.[26] Thus, public-health efforts should focus more on preventing opioid overdose. Reducing NMUPO and preventing overdose deaths are not methods of treating OUD.

There is scientific evidence that MAT is an effective way of treating and reducing the nation's OUD rates as well as preventing opioid overdoses more generally.[36,119] For these reasons, there is an immediate need to increase access to the gold standard for managing OUD.[77]

SPECIFIC AIM

To address the research needs mentioned above, the specific aim of this quantitative study is to examine health access issues experienced among adults diagnosed with OUD. This study focuses on identifying barriers to MAT among adults diagnosed with OUD in multiple facilities and those with public health insurance, private insurance, or who are uninsured. This study also compares the effect of age on access to MAT.

CHAPTER 2: LITERATURE REVIEW

History of the United States Opioid Epidemic

Americans have experienced three consecutive waves of the opioid epidemic. The first wave came between 1979 and the mid-1990s. This affected Black and White Americans more than it did Hispanics, and other ethnic groups. Use of heroin predominated.[61,76] The second wave, experienced between the mid-1990s and 2010, affected White Americans more than Blacks, Hispanics, and other ethnic groups. This time, however, prescription opioids were the most used.[61,76] The third and current wave started in 2010 and has affected Black and White Americans more than Hispanics, and other ethnic groups. This one has been marked by the use of both illicit and prescription opioids.[61,76]

Approximately 650,000 opioid prescriptions are dispensed daily in the US.[111] More than half of these prescriptions are written for adults diagnosed with mental health disorders (an estimated 16% of the American adult population).[84] McCarberg (2015) reported that enough opioid pain relievers were sold in the US in 2010 to medicate every adult in the nation with the equivalent of 5 mg of Hydrocodone every four hours for four weeks. An estimated 259 million opioid prescriptions were written in America in 2012, although it was reported that opioid prescriptions dropped slightly from 2011 to 2013.[72] Still, the estimated number of opioid prescriptions written in 2012 was enough to provide every adult in the US with a bottle of opioid pills.[72] Consequently, America's "opioid prescribing practices" (p. 1) are a main contributor to the nation's high rates of NMUPO and OUD.[119]

There is a positive association between prescription opioid consumption and the development of NMUPO.[43] NMUPO increases an individual's risk of using heroin by 40 times.[96] Between 2003 and 2010, NUMPO increased by approximately 75%.[63] Susman (2017) reports

that more than 50% of illicit opioid (i.e. heroin) users develop OUD from NMUPO.[111] An estimated 80% of new heroin users were first exposed to opioids through prescriptions.[29] Drug-related deaths in the US have increased significantly since the inception of the opioid epidemic.[119] For each case of opioid-overdose death, there were 461 cases of NMUPO, 161 incidents of opioid dependence or abuse, nine hospitalizations for opioid abuse, and 35 emergency room visits for opioid overdose.[72] Given these alarming facts, there is a need for an effective and sustainable strategy to treat OUD among adults in the US.[119]

Young Adults and Opioid-use disorder

The risk of developing OUD begins at a young age, and the prevalence of OUD is rising among young adults (18 to 44) in the US.[8,21] About 67% of adults enrolled in MAT programs mentioned that they first used opioids before they turned 25.[118] Many young adults are first exposed to opioid use and successive misuse or abuse through prescription opioids following dental and surgical procedures.[118]

Heroin use among young adults (18 to 25) has increased by more than 200% from 2010 through the first half of 2020.[21] Of the 250,000 opioid-related emergency-room visits by teenagers and young adults between 2008 and 2013, approximately 90% were in young adults (18 to 21).[118] Young adults have distinct developmental features predisposing them to SUD. One is having a less advanced inhibitory than reward system of the brain.[8,21] In addition, young adults living with untreated or poorly treated OUD are at risk for developing developmental and cognitive disorders later in their lives.[112]

Young adults do not always have access to MAT, although experts have reported that there is a critical need for programs aimed at increasing young adults' access to MAT[26] and

beginning such treatment as early as possible after diagnosis.[118] Bagley et al. (2019) conducted a retrospective cohort study to describe the features of 15,281 young and middle-aged adults who survived opioid overdoses and their access to MAT. Findings from this study show that only 28% of 1,209 young adults (18 to 21), 36% of 3,059 young adults (22 to 25), and 36% of 11,013 young and middle-aged adults (26 to 45) received MAT within the first year of their overdose.[8]

Essentially, even though timely access to MAT following an episode of opioid overdose helps prevent "the long-term physical and social consequences" of OUD in young adults,[8] only 33.3% of participants in the Bagley et al. (2019) study received MAT within a year of surviving an opioid overdose (p. 36). Because early initiation of MAT has a high probability of bringing about meaningful intermediate and long-term outcomes,[119] there is a need for MAT programs that are specifically developed and implemented to keep young American adults in treatment.

Middle-age Adults and Opioid-use disorder

According to Meyeroff (2019), the prevalence of pain increases with each decade of life. Middle-aged and older adults live with and manage pain because of individual diseases, comorbidities, and other vulnerabilities.[34] This helps explain why many Americans prescribed opioids for pain management are older than 45.[40] Middle-age increases the risk of opioid overdose death because middle-aged adults take "longer acting opioids" (n. p.) at doses associated with an increased risk of overdose death.[40] This explains in part why opioid-related mortality is higher in middle-aged adults than in other age groups.[125]

Although middle-aged adults (45 to 64) have ranked highest in statistical studies of opioid abuse, OUD, and opioid deaths from 1990 to 2020,[53,102] they have not been viewed as a population vulnerable to the opioid epidemic. Moreover, middle-aged adults are "a demographic

to keep an eye on" (n. p.), partly because they tend to live alone following a divorce or their children's having moved out of the house.[40]

The highest increase in opioid overdose death rates (approximately 500%) was among middle-aged adults (55 to 64)—from 4.2 per 100,000 in 1999 to 21.8 per 100,000 in 2015.[91] Since 2009, the greatest increase in opioid-related overdoses and admissions was also among middle-aged adults—an estimated 85% increase.[93] In 2013 and 2014, an estimated 44% to 50% of American opioid overdose deaths were among middle-aged adults (45 to 64).[20,40,58] In 2015, opioid overdose death rates among middle-aged adults were also the highest—30 per 100,000.[75,91] Despite these alarming statistics, middle-aged American adults, just like young adults, lack access to MAT.[81] Expanding access to MAT services will help combat America's opioid epidemic and enable middle-aged American adults diagnosed with OUD to become healthy and productive citizens.[95]

Older Adults and Opioid-use disorder

Opioid-related mortality increases with age.[128] The rate of emergency-room visits following prescriptions of opioids written for older adults increased by approximately 121% from 2005 to 2011.[93] It is postulated that by the end of 2020, middle-aged and older adults (50 years and older) who abuse prescription opioids will increase to 2.7 million.[20] In addition, opioid misuse is likely to be increasing from 1.2% in 2004 to 2.4% in 2020 among older adults.[1]

As the population diagnosed with OUD grows older, the demands placed on the OUD treatment system will increase unless the opioid crisis is better addressed.[61,127] This is because many older adults live with and manage long-term pain following falls or surgery, or have empty-nest syndrome, sleep disturbances, and medical conditions such as osteoarthritis, cancer,

and musculoskeletal neuropathy.[93] Around 67% of older American adults have two or more

ailments and some of those diseases are managed with pain medications such as opioids.[91]

Because opioids cause euphoria and mood elevation,[93] older adults sometimes misuse them to

cope with both general anxiety and depression and with anxiety accompanying the burdens of

disability and the losses of loved ones or social roles.[110]

Every year, an estimated 10 million older American adults fill at least one opioid

prescription.[93] The number of opioid prescriptions older adults received from 1996 through 2010

increased about nine times.[110] Of 10 older adults, more than five use at least five medications

daily, increasing their risk of non-intentional NMUPO, drug interactions and reactions, opioid

overdose, and OUD.[31,80,93] In addition, older adults experience age-related changes that make

them more sensitive to opioids.[74,91,93] These include slowing metabolism, a decline in liver and

kidney function, and changes in vision, cognition and memory, the ratio of muscle to fat, and in

balance and coordination.[74,91,93]

Another danger of opioid use is interactions with other medications.[91] Antidepressants

such as fluvoxamine increase the plasma concentration of methadone, which increases the risk of

opioid withdrawal when fluvoxamine is discontinued.[71] The effects of equivalent doses of

opioids are more visible in older adults than in younger age groups.[93] For instance, the excretion

of opiates such as hydromorphone and morphine, which are primarily cleared by the kidneys, are

changed by age-related reductions in renal function. As a result, hydromorphone and morphine

last longer and are more potent in older adults.[22]

Other effects of opioids in older adults are the increased incidence of coma, worsened

overall health, permanent brain damage, and loss of the ability to respond to stress.[91] The

prognosis of OUD is also worse in older adults.[115] In addition, the societal burden of opioid

overdose (emergency-room visits, admissions, and deaths) posed by older adults is higher and increasing very quickly.[93] For all these reasons, older adults diagnosed with OUD have an increased risk of dying from any opioid-related cause compared to young and middle-aged adults.[63,93]

Though they need treatment to prevent the physical, mental, and clinical impairments associated with OUD, older adults also lack access to MAT.[39] Yet there is sparse information and a scarcity of literature about evidence-based approaches to how best to increase the "growing and understudied" population" (n. p.) of older adults' access to MAT.[39] As explained earlier, a huge barrier to accessing MAT is cost,[36] which is particularly noticeable among older adults because their insurance coverage often changes to Medicare.[93] Even though Medicare partly covers buprenorphine for the treatment of OUD, it does not cover methadone.[39,93] Fear of stigma, a huge barrier to accepting MAT,[36] is also pronounced in older adults because when they were growing up in their time, OUD brought great disapprobation (n. p.).[109] Thus, it is common for older adults to deny misusing or abusing opioids and their diagnosis of OUD.[109]

Older adults are also more unwilling to access MAT.[109] Yet only 18% of opioid treatment programs (OTPs) in the US considered older adults' unique needs during planning and implementation.[93] Older adults are, for example, uncomfortable attending counseling sessions, MAT programs, and group therapy with younger adults. In addition, older adults who receive care from home-health agencies or live in long-term facilities are prescribed opioids for long-term pain management.[93] Even though "there are no structural facilities in place for administering" (n. p.) MAT in those facilities,[39] there is scientific evidence that referring older adults to "'elder-friendly'" (n. p.) OTPs helps to reduce their sense of being stigmatized.[93] Nonetheless, this is neither the standard nor the norm. Certainly, there is a need to develop and

implement enough elder-friendly OTPs in the US.

Access to Medication-Assisted Treatment in the United States

Most individuals diagnosed with OUD in the US report low or no access to MAT. According to Haffajee et al. (2019), of the 3,142 counties in the US, 23.9% have high opioid-overdose mortality rates (greater than 12.5 per 100,000 residents). Hence, treatment plans are needed to combat the rising rates of OUD and opioid overdose deaths in the US.[46]

A huge gap exists between the number of Americans diagnosed with OUD and US public-health organizations' capacity to provide MAT.[9] In 2012, a gap of roughly 914,000 to 1.4 million MAT opportunities for individuals existed in the US system (counting only methadone and buprenorphine treatment capacities).[2] This was partly due to insufficient numbers of OTPs (1,200 available in the US)[3] and the limited capacity of existing programs to serve the nation's needs.[2]

Most OTPs are in urban areas, further limiting rural and suburban dwellers' access to MAT.[2] In 2017, approximately 46.4% of all 3,142 US counties and an estimated 71.2% of the 1,328 rural counties lacked publicly available MAT providers.[46] The 2016 Comprehensive Addiction and Recovery Act (CARA) was enacted to help increase access to MAT in underserved rural American communities.[113] One of its strategies is expanding buprenorphine-prescribing privileges to physician assistants and nurse practitioners who obtain opioid waivers.[113] Despite this expansion of MAT prescribing privileges to non-physician providers, some states insist that nurse practitioners and physician assistants only prescribe MAT under close physician supervision.[113]

Though the ACA included MAT coverage in its essential health benefit (EHB), it did not

mandate MAT coverage by health plans.[47] Thus, most insurance plans either limit the duration

for which they will cover MAT or do not cover it at all.[47] Taken together, these findings highlight

the low rates of access to MAT in America. President Trump's declaration of the opioid

epidemic as a national public health emergency[82] has been matched by US policymakers'

commitment to curbing it and the congressional allocation of resources to addiction-treatment

programs.[46] Indeed, one of the 2018 Support Act's strategies to address the opioid crisis in the

nation is to provide access to OUD prevention, treatment, and recovery services.[114]

The Effect of the Affordable Care Act and Public and Private Health Insurance on Access

 to Medication-Assisted Treatment in the United States

There is a positive association between the lack of health insurance and lower odds of

accessing MAT.[17,128] According to Grubb (2019), individuals diagnosed with OUD are

substantially less likely to have health insurance than individuals not diagnosed with OUD. This

explains in part why federal and state governments are the single largest payers for MAT through

Medicare, Medicaid, and the Civilian Health and Medical Program of the Uniformed

Services.[27,128]

Medicare beneficiaries (older adults and the disabled)[27,31] are the largest and fastest-

growing population diagnosed with OUD.[91] Although the Center for Medicare and Medicaid

Services (2017) reported that more than six of every 1000 Medicare beneficiaries are diagnosed

with OUD, Medicare does not cover OUD treatment with methadone; it covers only treatment

with buprenorphine and naltrexone.[27,28] Because federal regulation requires that methadone

prescribed for OUD treatment should be dispensed under direct observation at a federally

approved clinic, the drug doesn't meet Medicare's Part D requirement that medication be

dispensed by a retail pharmacy[28].

It is not enough for Medicare to cover only buprenorphine and naltrexone for managing OUD since methadone is the most effective of the three medications used to treat MAT.[10,28] Methadone prevents withdrawal symptoms, enhances compliance, and increases treatment retention rates.[10,28] Medicare beneficiaries taking methadone for OUD incur high out-of-pocket costs. Dual Medicare and Medicaid beneficiaries go to great trouble to have their out-of-pocket costs reimbursed.[28] They often have no choice but to pay them themselves.[28]

Dual Medicare and Medicaid beneficiaries are expected to first submit claims "to Medicare to await denial" (p. 339) before submitting them to Medicaid.[28] Although Medicare partially covers the cost of buprenorphine, older adults (especially suburban and rural dwellers) find it difficult to locate buprenorphine-waivered providers who participate in Medicare, are willing to manage OUD, and agree to prescribe buprenorphine.[93] Additionally, many older adults cannot afford to pay that part of buprenorphine's cost not covered by Medicare.[93] Thus, Medicare beneficiaries' access to MAT could increase if more MAT providers who accept Medicare insurance would prescribe naltrexone and become licensed to prescribe buprenorphine.[27,31]

The number of Medicaid enrollees who have coverage for MAT increased significantly following the expansion of Medicaid under the ACA. The ACA required that health insurance plans cover MAT and MAT services alongside other health services in healthcare facilities.[3,84] Between 2011 and 2016, Medicaid-covered MAT increased from $394.2 million to $929.9 million.[81]Despite a 236% increase in Medicaid coverage, access to publicly funded MAT is still low. As a matter of fact, several areas in "Arkansas, Kentucky, Louisiana, Mississippi and Tennessee" (p. 397) that record high rates of OUD and MAT need also report high Medicaid coverage gaps for MAT.[3]

Less than 67% of MAT programs in the US accept Medicaid. These are either for-profit or cannot obtain a Medicaid provider certification and employ staff who are eligible for Medicaid reimbursement. For-profit MAT programs cannot receive payments from Medicaid. More than 60% of for-profit MAT programs and facilities located in the Southern US do not accept Medicaid.[3] In 2009, it was reported that MAT programs in approximately 40% of US counties did not accept Medicaid.[3] However, Medicaid beneficiaries (18 to 64 years) are more likely to be prescribed opioids, have higher rates of diagnosed OUD, and report more negative health effects of OUD than privately insured individuals of the same age group.[3,81]

Although private health insurers are also high payers of SUD treatment, there is a scarcity of literature on the fraction of MAT funded by private insurance.[121] However, Krause et al. (2016) report that having private health insurance is better than having public insurance or being uninsured in accessing MAT. Being uninsured significantly limits access to MAT.[3,17] Private insurance's reimbursement rates are significantly higher than those of public insurance.[64] Thus, private insurance payment acts as an incentive for providers to serve fewer patients with public insurance and more patients with private insurance.[64]

Geographical variations in Medicare reimbursement rates is another variable that explains why access to MAT might be easier for privately insured individuals.[13] Additionally, many providers do not accept Medicaid because its reimbursement rates are significantly lower than those of Medicare. Public insurance's lower reimbursement rates have negative effects on MAT access and adherence in the US, especially in geographic regions where Medicare reimbursement rates are lower.[64]

There is no consensus in the literature about the effects of public and private health insurance on access to MAT. For example, Wu et. al. (2016) examine the demographic features

and behavioral health of individuals 12 years and older diagnosed with OUD. The study analyzes the 2005-2013 National Surveys on Drug Use and Health data and found that having public insurance increases access and having private insurance is no different than not having insurance in accessing MAT.

In the same way, Cantone et al. (2019) investigate the prevalence of OUD and patient characteristics of those who began MAT. This study analyzes data from electronic health records obtained from two primary healthcare facilities. Both had an interdisciplinary OUD-management program. The study concludes that although public insurance covers MAT and office visits, uninsured and publicly insured individuals diagnosed with OUD have lower odds of accessing MAT as compared to their privately insured counterparts.

The existing literature does not ascertain how well private or public health insurance influences access to MAT. Private insurance covers almost 54% of US population, whereas public insurance funds an estimated 47%.[13] Thus, it is essential to determine whether private or public insurance inhibits or facilitates access to MAT. This gap in the literature calls for further quantitative studies to examine and directly compare the effect of private and public health insurance on access to MAT in the US.

The Effect of Age on Access to Medication-Assisted Treatment in the United States

Age is a vital variable to examine when investigating patterns of health service use as there is an important relationship between age and access to health care[15] and MAT.[42,43,81] Although it has been reported that MAT access is lower for certain age groups, there is no consensus in the literature on rates of access to MAT among young, middle-aged, and older adults. If left unexamined, there will be no agreed-upon scientific evidence on the disparities in

access to MAT among young, middle-aged, and older adults in America.

For instance, Cantone et al. (2019) report that the odds of accessing MAT is lowest among older adults. Alternatively, the lowest rates of access to MAT have been reported among youths (13 to 22) and younger adults (18 to 29) who benefit from publicly funded MAT.[42,81] To illustrate this point, Hadland, Park & Bagley (2018) describe the situation of three young adults who experienced significant stigmatization related to their OUD treatment. They also report that youths and younger adults are unlikely to access MAT, comply with MAT, and be retained in treatment.[44]

Similarly, compared to the situation of middle-aged and older adults (especially among Medicaid beneficiaries), access to MAT was significantly lower among younger adults under 25 years and between the ages of 18 and 29.[81] Hadland, Wharam & Larochelle (2017) identify disparities and trends in MAT prescription for American youths diagnosed with OUD. The Hadland, Wharam & Larochelle (2017) retrospective cohort study analyzes commercial insurance data. Hadland, Wharam & Larochelle (2017) report that the odds of accessing MAT among individuals diagnosed with OUD is "lower with younger age" (p.758).

According to Grubb (2019), most youths and young adults are offered only behavioral therapy for OUD.[42] This is because treatment providers are reluctant to prescribe a medication that causes physical dependence to these age groups.[43] Further, youths and younger adults require referrals to specialists because their primary-care providers do not offer MAT, and insurance firms require prior authorization for MAT prescriptions.[42] Additionally, some schools of thought are opposed to the use of MAT in managing OUD in youths and younger adults due to concerns that MAT prolongs addiction[42,43] and prolonged exposure to MAT can result in enduring alterations in the brain.[72] Nevertheless, under-prescribing MAT for young adults is not

in accordance with OUD treatment guidelines.[42,81] There is a need to pay attention to MAT gaps

as they affect young adults[81].

CHAPTER 3: CONCEPTUAL AND EMPIRICAL FRAMEWORK

Ron Andersen's Behavioral Model of Health Services Use demonstrates various determinants of access to services that are relevant to this current study. It includes feedback loops among constructs that illustrate the reciprocal influence on health outcomes of policies, environments, population characteristics and health behavior.[5,7,37,90] The constructs are measures of access that also act as barriers to access for individuals diagnosed with OUD.[5,7,37,90]

Figure 1. A Conceptual framework for this study identified in the work of Babitsch, Gohl & Lengerke (2012); Fortin, Cao & Fleury (2018); Rashid & Antai (2014).
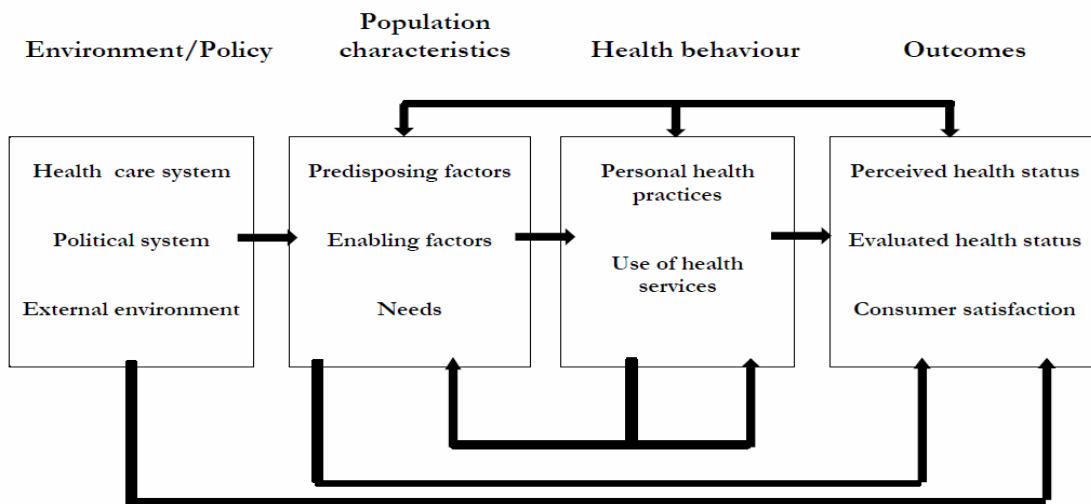
For the purpose of this study, the construct environment or policy can be described as the conditions and environment in which patients access MAT. The model classifies environment or policy into healthcare system, political system, and external environment.[5]

The health care system is described as organizational factors, health provider-related factors, and community features measured as aggregate levels in an environment.[5] These aggregate levels range from small family units to the national healthcare system in an

environment.[5] The health care system is measured by social networks and interactions and demographic factors such as age, gender, and marital status.[5] For instance, available health facilities and services in an environment composed mainly of older adults will be different from that in which most of the population is comprised of children and young adults.

The political system consists of policies that govern how the healthcare delivery system is organized, financed, distributed, made accessible to members of a community, and structured to provide healthcare services.[5] The political system is measured by public policies such as the ACA. For instance, states that expanded Medicaid under the ACA increased access to MAT compared to states that did not adopt this policy.[25] The political system is also measured by private policies, the rules established by health insurance plans concerning insurance coverage, and the supply of healthcare services.[5] Examples of such private policies are limits to the coverage of MAT and the distribution of healthcare facilities and personnel.[5]

The external environment depicts how well populations' health and access to MAT is supported or hindered by its members, those who live and/or work in a particular geographical area.[5] The external environment is influenced by demographic factors such as race and ethnicity, educational attainment, crime rate, and employment status. It is also influenced by health-related environmental measures such as the quality of air or housing, injury rates, and death rates. Additionally, the external environment is measured by population health indices such as condition-specific morbidity and mortality rates.[5]

The model classifies population features into predisposing, enabling, and need factors. Predisposing factors are an individual's social and cultural characters that were in existence before either their illness or their need to access health care.[5,7,99] At the contextual level, they refer to cultural norms, community demographic structures, community social structures,

organizational values, and collective values.[5,7,99] Predisposing factors are influenced by such

demographic factors as age, gender, race, and ethnicity. Predisposing factors are also affected by

knowledge, values, and attitudes toward health and the healthcare system.[5,7,99] In addition,

predisposing factors are affected by social factors such as educational attainment, culture, family

status, occupation, social networks, and social interactions.[5,7,99]

Enabling factors help to make possible the use of health care services. At the contextual

level, they refer to healthcare policies, community health service resources, and methods of

provider reimbursement.[5,7,64] First, enabling factors are shaped by financial factors such as

income, cost of health care, size of copay, and health insurance coverage.[15,64,67,99] Second,

enabling factors are influenced by organizational features such as regular access to a source of

care and travel, travel and wait time to access health care, and facility density.[31] Third, enabling

factors are influenced by community health education programs as well as by the clarity,

understandability, and perceived trustworthiness of health information. Finally, enabling factors

are influenced by numbers, array, location, and distribution of health personnel and facility.[5,7]

Need factors are determined by perceived and evaluated demand for health care

services.[5,7] At the contextual level, they refer to environmental health conditions which are

measured by health indices such as. morbidity, mortality, disability, and death rates.[5,7] Perceived

need is described as how individuals view or experience their own health, symptoms of ill health,

and functional state.[5,7] Perceived need is measured by accessing healthcare since ones'

perception of the importance and magnitude of ones' symptoms will determine if one will access

health care and adhere to treatment.

Evaluated need is defined as a professional's objective assessment of an individual's

health status and demand for care.[5,7] Evaluated need is measured by an individuals' diagnosis

and a health care providers' assessment of the prognosis of the individual's health conditions .[5,7]

The model further groups health behavior into personal health practices and use of health services. Personal health practices are lifestyle factors measured by adherence to medical care or concomitant substance use. Use of health services is measured by length of stay in therapy, number of health care services received, or provider visits.[7,37,90]

Finally, the model also groups outcome into perceived health status, evaluated health status, and consumer satisfaction.[5] Perceived health status and perceived need are similar and measured the same way. This is true, too, of evaluated health status and evaluated need. Consumer satisfaction is how well an individual is satisfied with the health care he or she receives. It is measured by patients' ratings of travel and waiting time to access care, provider communication, and healthcare service received.[5]

CONSTRUCTS OF THE FRAMEWORK THIS STUDY'S VARIABLES MEASURES

Part of the Ron Andersen's Behavioral Model of Health Services Use is applied in this study. As depicted by the feedback loops in Figure 1, the constructs of the model influence each other in many ways. Thus, many of this study's variables measures more than one construct. This study looks at how the constructs delineated by the model act as barriers to accessing MAT among individuals diagnosed with OUD. The following variables measured the constructs of the model:

i.   Having coverage for MAT-methadone, naltrexone, or buprenorphine

ii.   Number of days of MAT-Service use

iii. Concomitant use of illicit substances at admission to SUD treatment facilities

iv.   Living arrangement at admission to SUD treatment facilities

v.   Highest level of educational attainment

vi.   Social or emotional support

vii.   Number of days waiting to enter treatment

viii.   Employment status at admission to SUD treatment facilities

ix.   Gender

x.   Race and ethnicity

xi.   Census state FIPS code

xii.   Primary source of payment for treatment

xiii.   Co-occurring mental and substance-use disorders

xiv.   Age group

The following are descriptions of how this study's variables are used to measure the constructs of the model:

Environment or Policy and Its Measurement: The political system is measured by census state FIPS code and primary source of payment for treatment. The health care system is measured by number of days waiting to enter treatment, age group, gender, employment status at admission to SUD treatment facilities, living arrangement at admission to SUD treatment facilities, and social or emotional support. The external environment is measured by race and ethnicity, highest level of educational attainment, and employment status at admission to SUD treatment facilities.

Population Characteristics and Its Measurement: Predisposing factors are measured by age group, gender, race and ethnicity, highest level of educational attainment, employment

status at admission to SUD treatment facilities, living arrangement at admission to SUD treatment facilities, and social or emotional support. Enabling factors are measured by primary source of payment for treatment and number of days waiting to enter treatment. Perceived need is measured by having coverage for MAT and co-occurring mental and substance-use disorders. Evaluated need is measured by OUD with or without co-occurring mental and substance-use disorders.

Health Behavior and Its Measurement: Personal health practices are measured by concomitant use of illicit substances at admission to SUD treatment facilities. The use of health services is measured by number of days of MAT-Service use.

Outcome and Its Measurement: Evaluated health status is measured by OUD with or without co-occurring mental and substance-use disorders. Perceived health status is measured by co-occurring mental and substance-use disorders and having coverage for MAT. Consumer satisfaction is not measured in this study. Measuring consumer satisfaction is not appropriate since none of this study's variables assessed participants' ranking of their travel or waiting time to access care, provider communication, or their evaluation of services received. Also, comorbidities such as co-existing health conditions are not measured in this study because this study's data set does not include those measures.

Recoding, categorization, and measurement of this study's variables are described in detail in the appendix (See pages 68 to 72). For instance, the variable census state FIPS code is categorized by combining states with similar policy applications. For the purpose of this study, these policy applications are described as: (i) *Policy One*: policies involving the ACA to increase MAT access (ii) *Policy T*wo: policies that did not involve the ACA to increase access to MAT (iii) *Policy Three*: policies that increased Medicare beneficiaries' access to MAT (iv) *Policy*

Four: policies that increased the access to MAT of beneficiaries with both Medicare and Medicaid.

States that adopted policy One filled a vital gap in addressing America's opioid crisis.[60] According to the Kaiser Family Foundation (2019), states that expanded Medicaid under the ACA provided insurance coverage for a disproportionate share of young and middle-aged adults diagnosed with OUD as well as a greater share of low-income Americans.

CHAPTER 4: EMPIRICAL METHODS AND RESULTS

RESEARCH QUESTION

The research questions that guides this study are:

1. What is the current status of access to MAT among young (18 to 44), middle-aged (45 to 64), and older adults (65 years and older)?

2. Do middle-aged and older adults have more access to MAT than young adults?

STUDY HYPOTHESES

Research and Null Hypotheses

American adults diagnosed with OUD lack access to MAT.[81] However, in the last decade, the most severe increases in opioid-related overdoses, admissions, and deaths have been reported in middle-aged adults.[20,75,93] Similarly, prescription opioid-related emergency-room visits are highest among older adults.[93] Thus, older adults diagnosed with OUD are more likely to die from opioid-related causes than other age groups.[63,93]

The research hypothesis predicts that middle-aged and older adults experience significantly more barriers of access to MAT services than do young adults. Therefore, middle-aged and older adults will have a significantly lower chance of access to MAT. Presently, the null hypothesis expects that there will be no significant difference in the number of barriers to accessing MAT services experienced among young, middle-aged, and older adults.

DATA SOURCE

This project uses the Substance Abuse and Mental Health Data Archive's (SAMHDA) 2017 Treatment Episode Data Set (TEDS)—discharges dataset (2017 TEDS-DS0001).[107] The Substance Abuse and Mental Health Services Administration (SAMHSA) oversaw the 2017 TEDS- DS0001 survey.[107] The TEDS discharges dataset collects statistics on demographic, clinical, substance use and abuse, patient's clinical outcomes, and records of annual discharges from diverse groups of people.[107]

These diverse groups of people are individuals who receive SUD therapy from both public and private SUD treatment facilities that receive public funds.[107] The 2017 TEDS-DS0001 dataset includes nationwide statistics on discharges from SUD treatment facilities in 2017. It excludes discharge data from the states of Georgia, West Virginia, and Oregon.

For this study, analyses are restricted to participants aged 18 years and older diagnosed with OUD. The data set's total sample size is 246,980 participants, although only 77,299 eligible participants are included in this study. As calculated from the dataset, the crude rate of participants able to use MAT services is 29.8% of the sample used here. Meanwhile, the crude mean of number of days of MAT services being used is 82.80.

MEASURES

Study participants are individuals between the ages of 18 to 65 years and older diagnosed with OUD. The dependent variables include number of days of MAT-Service use and having coverage for MAT. The covariates are living arrangement at admission to SUD treatment facilities and concomitant use of illicit substances at admission to SUD treatment facilities. The primary predictors are gender, race and ethnicity, census state FIPS code, co-occurring mental

and substance-use disorders, age group, and primary source of payment for treatment. Primary

source of payment for treatment includes insurance, self-pay, special research funding, free

treatment, charity care, and teaching payments. The secondary predictors are highest level of

educational attainment, social or emotional support, number of days waiting to enter treatment,

and employment status at admission to SUD treatment facilities.

ANALYSIS PLAN

Study Design

A quantitative design is the most appropriate approach for answering these questions.

Statistical Software

All statistical analyses are conducted using International Business Machines (IBM)

version of Statistical Package for the Social Sciences (SPSS) Analysis Software (Version 25).[55]

Analyses

Preliminary descriptive analyses are conducted to examine variable distributions,

proportion of missing data, and any cases with out-of-range values. Results of descriptive

statistics are summarized in Table 4. Descriptive analyses (e.g., proportions, means and standard

deviations) describe the current status of access to MAT among young, middle-aged, and older

adults. The dichotomized variable "having coverage for MAT" and the continuous variable

"number of days of MAT-Service use" are both used as the dependent variables (DVs) in the

analysis. Logistic regressions are conducted to compare the odds of having coverage for MAT

(HCFMAT) among young, middle-aged, and older adults. Based on the distribution of the number of days of MAT-Service use, linear regressions are employed with number of days of MAT-Service use (MAT Days) as the continuous outcome variable. A hierarchical modeling strategy with three blocks of variables is adopted in both proposed logistic and linear regression analyses. Variables in Block One are the covariates to be controlled in the analyses.

Table 1. Study Variables in Block One

Full Name of Variable	Abbreviated Name of Variable
Living Arrangement at Admission to SUD Treatment Facilities	LIVARAG_2
Concomitant Use of Illicit Substances at Admission to SUD Treatment Facilities	CUISA

Block-Two variables are the secondary predictors in the conceptual model.

Table 2. Study Variables in Block Two

Full Name of Variable	Abbreviated Name of Variable
Living Arrangement at Admission to SUD Treatment Facilities	LIVARAG_2
Concomitant Use of Illicit Substances at Admission to SUD Treatment Facilities	CUISA
Highest Level of Educational Attainment	EDUCS_2
Social or Emotional Support	SES
Number of Days Waiting to Enter Treatment	DAYWAIT_2
Employment Status at Admission to SUD Treatment Facilities	EMPLOY_2

Variables of the third block are the primary predictors of this study.

Table 3. Study Variables in Block Three

Full Name of Variable	Abbreviated Name of Variable
Living Arrangement at Admission to SUD Treatment Facilities	LIVARAG_2
Concomitant Use of Illicit Substances at Admission to SUD Treatment Facilities	CUISA
Highest Level of Educational Attainment	EDUCS_2
Social or Emotional Support	SES
Number of Days Waiting to Enter Treatment	DAYWAIT_2
Employment Status at Admission to SUD Treatment Facilities	EMPLOY_2
Gender	GENDER_2
Race and Ethnicity	ETH
Census State FIPS Code	FIPS Code
Primary Source of Payment for Treatment	PRIMPAY_2
Co-occurring Mental and Substance-use disorder	CMSUD
Age Group	AGEG

A series of nested regression models are built with the three blocks of variables. The final parsimonious models are determined by comparing the deviance for the nested logistic regressions (the likelihood ratio tests of Blocks One, Two, and Three are conducted) with the R-squares for the nested linear regressions. Marginal means of number of days for MAT-Service use across groups of the major categorical predictors (i.e., Block Three variables) are estimated through the general linear model.

Logistic Regression Equation for the Study

Y_i is the dichotomized DV HCFMAT and β_0 is the intercept.

Model with Block-One variables: Log Odds of $Yi = \beta_0 + \beta_1 LIVARAG\_2 + \beta_2 CUISA$.

Model with Block-One & Block-Two variables: Log Odds of $Y_i = \beta_0 + \beta_1 LIVARAG\_2 + \beta_2 CUISA + \beta_3 EDUCS\_2 + \beta_4 SES + \beta_5 DAYWAIT\_2 + \beta_6 EMPLOY\_2$.

Model with Block-One, Block-Two, & Block Three variables: Log Odds of $Y_i = \beta_0 + \beta_1 LIVARAG\_2 + \beta_2 CUISA + \beta_3 EDUCS\_2 + \beta_4 SES + \beta_5 DAYWAIT\_2 + \beta_6 EMPLOY\_2$

$+\beta_7$GENDER_2 $+ \beta_8$ETH $+ \beta_9$FIPS code $+ \beta_{10}$PRIMPAY_2 $+ \beta_{11}$CMSUD $+\beta_{12}$AGEG.

Linear Regression Equation for the Study

$\mathbf{Y_i}$ is the continuous DV MAT Days, $\boldsymbol{\beta_0}$ is the intercept, and $\boldsymbol{\varepsilon_I}$ is the residual.

Model with Block-One variables: $Yi = \beta_0 + \beta_1$LIVARAG_2 $+\beta_2$CUISA $+ \varepsilon_I.$

Model with Block-One & Block-Two variables: $Y_i = \beta_0 + \beta_1$LIVARAG_2 $+\beta_2$CUISA $+$

β_3EDUCS_2 $+\beta_4$SES $+\beta_5$DAYWAIT_2 $+\beta_6$EMPLOY_2 $+ \varepsilon_I.$

Model with Block-One, Block-Two, & Block Three variables: $Y_i = \beta_0 + \beta_1$LIVARAG_2

$+\beta_2$CUISA $+ \beta_3$EDUCS_2 $+\beta_4$SES $+\beta_5$DAYWAIT_2 $+\beta_6$EMPLOY_2 $+\beta_7$GENDER_2 $+$

β_8ETH $+ \beta_9$FIPS code $+ \beta_{10}$PRIMPAY_2 $+ \beta_{11}$CMSUD $+\beta_{12}$AGEG $+ \varepsilon_I.$

Dummy variables of the categorical predictors are generated and used in the analysis.

Results

Table 4. General Characteristics among Participants aged 18 years and older Diagnosed with Opioid-use disorder from the substance abuse and mental health data archive's 2017 treatment episode dataset: discharges dataset.

Variables and their Measurements	N (%)	Range	Mean	Standard Deviation
Opioid-use disorder				
Yes	77,299 (31.3%)			
No	169,681 68.7%)			
Age Group				
18 to 44 years old	62,385 (80.7%)			
45 to 64 years old	14,294 (18.5%)			
65 years and older	620 (0.8%)			
Gender				
Male	46,017 (59.5%)			
Female	31,282 (40.5%)			
Having Coverage for Medication-Assisted Treatment				
Yes	22,999 (29.8%)			
No	54,300 (70.8%)			
Number of Days of Medication-Assisted Treatment-Service Use		1 – 365	82.80	101.46
Race and Ethnicity				
Non-Hispanic White	56,465 (75.6%)			
Hispanic	4,482 (6.0%)			
Alaska Native/ American Indian	542 (0.7%)			
Asian/ Pacific Islander/ Native Hawaiian	547 (0.7%)			
Black or African American	11,781 (15.8%)			
Other Single Race or two or more races	872 (1.2%)			
Employment Status at Admission to SUD Treatment Facilities				
Unemployed and not in labor force	61,472 (79.5%)			
Part-time employment	5,056 (6.5%)			
Full-time employment	10,771 (13.9%)			
Census FIPS Code				
Alabama, Florida, Idaho, Kansas, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Wisconsin and Wyoming	8,868 (11.5%)			
California	0 (0%)			
Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota,	68,431(88.5%)			

Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, Washington and Puerto Rico				
Primary Source of Payment for Treatment				
Uninsured	6,795 (8.8%)			
Private health insurance	4,206 (5.4%)			
Public health insurance	66,298 (85.8%)			
Social or Emotional Support				
Yes	8,588 (11.1%)			
No	68,711 (88.9%)			
Co-occurring Mental and Substance-Use Disorders				
Yes	35,588 (46.0%)			
No	41,711 (54.0%)			
Concomitant Use of Illicit Substance at Admission to SUD Treatment Facilities				
Yes	76,810 (99.4%)			
No	489 (0.6%)			
Highest Level of Educational Attainment				
Elementary school	2,362 (3.1%)			
Middle school	15,632 (20.2%)			
High school	42,635 (55.2%)			
Some post-high school education but not at a four-year school	12,453 (16.1%)			
Bachelors degree or higher	4,217 (5.5%)			
Living Arrangement at Admission to SUD Treatment Facilities				
Homeless	8,315 (10.8%)			
Dependent living—clients living in a supervised setting	16,943 (21.9%)			
Independent living—clients living alone or with others without supervision	52,041 (67.3%)			
Number of Days Waiting to Enter Treatment		0 – 31	3.18	6.48
Zero day	48,114 (62.2%)			
One to seven days	20,819 (26.9%)			
Eight to fourteen days	3,716 (4.8%)			
Fifteen to thirty days	2,834 (3.7%)			
Thirty-one or more days	1,816 (2.3%)			

The general sample characteristics are summarized in Table 4.

Of the whole sample, 59.5% are male and 40.5% are female. The sample distribution across age groups is 80.7% ages 18 to 44, 18.5% are ages 45 to 64, and 0.8% are 65 years and older. The proportions of primary source of payment for treatment are 8.8% uninsured, 5.4% private health insurance, and 85.8% public insurance. Among all participants, 31.3% report having been diagnosed with OUD at some time. In this sample, about 29.8% report having coverage for MAT and 46.0% also report having co-occurring mental and substance-use disorders. The average number of days of MAT-Service use in the past year is 82.80 with standard deviation of 101.46.

MAT current access is 27.5% among young adults (18 to 44), 39.0% among middle-aged adults (45 to 64), and 40.8% among older adults (65 and older). There is a significant difference in MAT access across the three age groups ($p < 0.0001$). Middle-aged and older adults have more access to MAT. Multivariate linear regressions are conducted with MAT Days as the DV. The final parsimonious model is determined by comparing the R-squared statistics among the nested models. The adjusted R-squared of the final model is 0.04.

Table 5. Results of Having Coverage for Medication-Assisted Treatment of eligible study participants from the substance abuse and mental health data archive's 2017 treatment episode dataset: discharges dataset

	Adjusted Model 1		Adjusted Model 2		Adjusted Model 3	
	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Living Arrangements at Admission to SUD Treatment Facilities						
Homeless (reference)	1		1		1	
Dependent living—clients living in a supervised setting	0.74 (0.69 – 0.79)	<0.001	0.75 (0.70 – 0.80)	<0.001	0.74 (0.70 – 0.80)	s***[1]
Independent living—clients living alone or with others without supervision	1.88 (1.77 – 1.98)	<0.001	1.86 (1.76 – 1.97)	<0.001	1.86 (1.75 – 1.97)	s***
Concomitant Use of Illicit Substances at Admission to SUD Treatment Facilities						
No (reference)	1		1		1	
Yes	(7.02) 4.82 – 10.23	<0.001	7.20 (4.94 – 10.50)	<0.001	8.03 (5.51 – 11.72)	s***
Highest Level of Educational Attainment						
Elementary school			1		1	
Middle school			0.97 (0.88 – 1.07)	0.53	1.07 (0.97 – 1.17)	0.21
High school			0.86 0.79 – 0.95)	0.002	0.98 (0.89 – 1.07)	0.62
Some post-high school education but not at a four-year school			0.72 (0.66 – 0.80)	<0.001	0.86 (0.78 – 0.95)	s***
Bachelors degree or higher			0.90 (0.81 – 1.01)	0.06	0.97 (0.87 – 1.09)	0.63
Social or Emotional Support						
No (reference)			1		1	
Yes			1.05 (1.00 – 1.11)	0.04	1.03 (0.97 – 1.08)	0.34
Number of Days Waiting to Enter Treatment			1.00 (1.00 – 1.00)	0.20	1.00 (1.00 – 1.00)	0.21
Employment Status at Admission to SUD Treatment Facilities						
Unemployed and not in labor force (reference)			1		1	
Part-time employment			1.15 (1.08 – 1.22)	1.15	1.21 (1.13 – 1.28)	s***
Full time employment			1.05 (1.00– 1.10)	1.05	1.14 (1.09 – 1.19)	s***
Gender						
Female (reference)					1	
Male					0.84 (0.81 – 0.87)	s***
Race and Ethnicity						
Non-Hispanic White (reference)					1	

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[1] Please note that statistical significance such as *p*< 0.001 is shown with s***

Hispanics		1.34 (1.26 – 1.43)	s***
Alaska Native/ American Indian		0.60 (0.48 – 0.76)	s***
Asian/ Pacific Islander/ **Native Hawaiian**		0.59 (0.48 – 0.74)	s***
Black or African American		1.03 (0.98 – 1.09)	0.18
Other Single Race or two or more races		0.39 (0.31 – 0.47)	s***
Census FIPS Code			
Alabama, Florida, Idaho, Kansas, **Mississippi, Missouri, Nebraska, North** **Carolina, Oklahoma, South Carolina,** **South Dakota, Tennessee, Texas, Utah,** **Wisconsin and Wyoming (reference)**		1	
Alaska, Arizona, Arkansas, Colorado, **Connecticut, Delaware, District of** **Columbia, Hawaii, Illinois, Indiana,** **Iowa, Kentucky, Louisiana, Maine,** **Maryland, Massachusetts, Michigan,** **Minnesota, Montana, Nevada, New** **Hampshire, New Jersey, New Mexico,** **New York, North Dakota, Ohio,** **Pennsylvania, Rhode Island, Vermont,** **Virginia, Washington and Puerto Rico**		2.37 (2.23 – 2.52)	s***
Primary Source of Payment for Treatment			
Uninsured (reference)		1	
Private health insurance		1.16 (1.06 – 1.26)	s***
Public health insurance		0.94 (0.89 – 1.00)	0.04
Co-occurring Mental and Substance-Use **Disorders**			
No (reference)		1	
Yes		1.05 (1.02 – 1.09)	s***
Age Group			
18 to 44 years old (reference)		1	
45 to 64 years old		1.58 (1.51 – 1.65)	s***
65 years and older		1.59 (1.34 – 1.88)	s***
-2 Log Likelihood	88942.09	88793.61	86845.04
Cox & Snell R-Square	0.03	0.03	0.06
Nagelkerke R-Square	0.04	0.05	0.08

Hierarchical logistics regression models are employed with the dependent variable: having coverage for medication-assisted treatment. Variable(s) entered for Model 1: living arrangements at admission to SUD treatment facilities and concomitant use of illicit substance at admission to SUD treatment facilities. Variable(s) entered for Model 2: living arrangements at admission to SUD treatment facilities, concomitant use of illicit substance at admission to SUD treatment facilities, highest level of

educational attainment, social or emotional support, number of days waiting to enter treatment, and employment status at admission to SUD treatment facilities. Variable(s) entered for Model 3: living arrangements at admission to SUD treatment facilities, concomitant use of illicit substance at admission to SUD treatment facilities, highest level of educational attainment, social or emotional support, number of days waiting to enter treatment, employment status at admission to SUD treatment facilities, gender, race and ethnicity, census state FIPS code, primary source of payment for treatment, co-occurring mental and substance-use disorders, and age group.

Results of multivariate logistics regressions run with having coverage for medication-assisted treatment as the dependent variable are summarized in Table 5.

The final parsimonious models are determined by comparing the deviances among the nested logistic regressions. The Cox & Snell and Nagelkerke R-squares for the final model are 0.06 (0.08) respectively. The magnitude of the pseudo-r-square in the logistic regression and R-square in the linear regression are not large.

In the final model with all three blocks of variables included, participants who received some post-high school education but not as a four-year school have 14% significantly lower odds of access to MAT compared to those with elementary-school education. First, no significant odds ratios are observed comparing participants with any other level of education attainment with the reference group who completed elementary-school education. Second, no significant odds ratios are observed with having social or emotional support compared to not having social or emotional support and comparing number of days waiting to enter treatment. Third, no significant odds ratios are observed comparing Black or African Americans with the reference group, Non-Hispanic Whites.

Finally, no significant odds are observed comparing participants having public insurance to those with no health insurance. However, significant odds ratios are observed comparing participants having private health insurance to their counterparts with no health insurance. Participants having private health insurance have a 16% higher chance of access to MAT compared to participants with no health insurance coverage. Compared to participants who are not in the labor market, participants who are employed either part time or full time have 21% or 14% significantly greater odds of access to MAT correspondingly.

Males have 16% lower odds of access to MAT compared to females. Hispanics have 34%

significantly higher odds of access to MAT compared to non-Hispanic Whites. Meanwhile, 40%, 41%, and 61% significantly lower odds are observed for Alaskan Natives/ American Indians, Asians/ Pacific Islanders/ Native Hawaiians, and other single-race or multiple racial backgrounds accordingly. States that enacted Policies One, Two, Three, and Four have 137% higher odds of access to MAT compared to states that enacted Policies Two, Three, and Four alone. Having co-occurring mental and substance-use disorders is significantly related to 5% greater odds of access to MAT. Compared to the reference group, young adults (18 to 44), middle-age adults (45 to 64), and older adults (65 and older) have 58% and 59% significantly greater odds of access to MAT accordingly.

Table 6. Results of Number of Days of Medication-Assisted Treatment Service Use of eligible study participants from the substance abuse and mental health data archive's 2017 treatment episode data set: discharges dataset

	Adjusted Model 1			Adjusted Model 2			Adjusted Model 3		
	β	t	p value	β	t	p value	β	t	p value
Living Arrangements at Admission to SUD Treatment Facilities									
Homeless (reference)									
Dependent living—clients living in a supervised setting	12.28	9.09	<0.001	11.05	8.22	<0.001	13.17	9.64	s***
Independent living—clients living alone or with others without supervision	32.19	27.03	<0.001	27.55	22.97	<0.001	27.10	22.34	s***
Concomitant Use of Illicit Substances at Admission to SUD Treatment Facilities									
No (reference)									
Yes	30.66	6.70	<0.001	27.45	6.03	<0.001	26.03	5.69	s***
Highest Level of Educational Attainment									
Elementary school (reference)									
Middle school				- 1.29	- 0.58	0.56	2.30	1.03	0.30
High school				- 6.01	- 2.84	0.01	0.25	0.12	0.91
Some post-high school education but not at a four-year school				0.56	0.25	0.80	4.25	1.86	0.06
Bachelors degree or higher				-13.19	- 5.12	<0.001	- 8.98	- 3.44	s***
Social or Emotional Support									
No (reference)									
Yes				11.47	9.94	<0.001	9.13	7.83	s***
Number of Days Waiting to Enter Treatment				- 0.91	- 19.85	<0.001	- 0.92	- 19.78	s***
Employment Status at Admission to SUD Treatment Facilities									
Unemployed and not in labor force (reference)									
Part-time employment				19.96	13.53	<0.001	21.41	14.38	s***
Full-time employment				17.21	16.16	<0.001	22.41	20.37	s***
Gender									
Female (reference)									
Male							- 13.13	- 17.22	s***
Race and Ethnicity									
Non-Hispanic Whites (reference)									
Hispanics							15.15	9.69	s***
Alaska Native/ American Indian							- 5.51	- 1.28	0.20
Asian/ Pacific Islander/									

Native Hawaiian		- 8.40	- 1.97	s***
Black or African American		- 6.11	- 5.35	s***
Other Single Race or two or more races		- 4.98	- 1.47	0.14
Census FIPS Code				
Alabama, Florida, Idaho, Kansas, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Wisconsin and Wyoming (reference)				
Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North, Dakota, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, and Puerto Rico		- 8.19	- 7.08	s***
Primary Source of Payment for Treatment				
Uninsured (reference)				
Private health insurance		- 57.52	- 29.06	s***
Public health insurance		- 22.26	- 17.17	s***
Co-occurring Mental and Substance-use Disorders				
No (reference)				
Yes		5.00	6.73	s***
Age Group				
18 to 44 years old (reference)				
45 to 64 years old		18.46	17.64	s***
65 years and older		19.48	4.75	s***
Adjusted R-square	0.02	0.03		0.05

General linear models were employed with the dependent variable: number of days of medication-assisted treatment-service use. Variable(s) entered for Model 1: living arrangements at admission to SUD treatment facilities and concomitant use of illicit substance at admission to SUD treatment facilities. Variable(s) entered for Model 2: living arrangements at admission to SUD treatment facilities, concomitant use of illicit substance at admission to SUD treatment facilities, highest level of educational attainment, social or emotional support, number of days waiting to enter treatment, and employment status at admission to SUD treatment facilities. Variable(s) entered for Model 3: living arrangements at admission to SUD treatment facilities, concomitant use of illicit substance at admission to SUD treatment facilities, highest level of educational attainment, social or emotional support, number of days waiting to enter treatment, employment status at admission to SUD treatment facilities, gender, race and ethnicity, census state FIPS code, primary source of payment for treatment, co-occurring mental and substance-use disorders, and age group.

Results of general linear models with MAT Days as the DV are summarized in Table 6.

In the first model with Block-One variables, the covariates account for 2% of the variance. In the second model with Block-One and Block-Two variables, the secondary predictors explain an additional 3% of the variance. In the final model with all blocks of variables included, the primary predictors account for an additional 5% of the MAT Days. All variables together account for 10% of the variance.

Those with middle school, high school, and some post-high school education but no additional degrees show a positive beta weight but are not associated with MAT Days. However, those with bachelors degree or higher level of educational attainment are negatively associated with MAT Days. Having social or emotional support, Hispanics, participants who are employed part time or full time, having co-occurring mental and substance-use disorders, middle-aged adults aged 45 to 64, and adults aged 65 and older are positively associated with MAT Days.

Negative associations with MAT Days appear for these variables: number of days waiting to enter treatment, Male gender, Asians/ Pacific Islanders/ Native Hawaiians, Blacks or African Americans, states that enacted Policies One, Two, Three, or Four, and participants having either private health insurance or public insurance. Though the variables measuring Alaskan Native/ American Indian and other single or multiple racial heritage, show a negative beta weight, they are not associated with MAT Days. The addition of highest level of educational attainment status to the second model reduces the effect of concomitant use of illicit substances at admission to SUD treatment facilities so that it is no longer statistically significant except for bachelors degree or higher level of educational attainment.

Yet adding social or emotional support to the model improves the model fit. With the

inclusion of social or emotional support, all the variables remain significant except for the Alaska Native/ American Indian and other single or multiple racial backgrounds. Adding census state FIPS code to the final model also improves the model fit. The model remains significant with the addition of census state FIPS code, primary source of payment for treatment, co-occurring mental and substance-use disorders, and age group. The observed power of the general linear model is 1; hence, a real effect exists in this study's analysis.

Table 7. Summary of Estimated Marginal Means of Number of Days of Medication-Assisted Treatment Service use for the Final General Linear Model from the substance abuse and mental health data archive's 2017 treatment episode data set: discharges dataset

	Adjusted Means	Standard Errors	p value
Gender			
Females (reference)	89.03	3.15	-
Males	76.01	3.11	s***
Race/Ethnicity			
Non-Hispanic Whites (reference)	84.32	2.93	-
Hispanic	99.65	3.25	s***
Alaska Native/ American Indian	78.37	5.13	0.17
Asian/ Pacific Islander/ Native Hawaiian	75.83	5.16	s***
Black or African American	78.00	2.97	s***
Other Single Race or Two or More Races	78.96	4.44	0.12
Census State FIPS code			
Alabama, Florida, Idaho, Kansas, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Wisconsin and Wyoming (reference)	86.25	3.24	-
Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, Washington and Puerto Rico	78.79	3.08	s***
Primary Source of Payment for Treatment			
Uninsured (reference)	108.91	3.26	-
Private Health Insurance	51.97	3.41	s***
Public Health Insurance	86.68	3.07	s***
Co-occurring Mental and Substance-use Disorders			
No (reference)	79.90	3.12	-
Yes	85.14	3.14	s***
Age Group			
18-44 years old (reference)	70.00	2.79	-
45-64 years old	88.45	2.91	s***
65 years old and older	89.11	4.93	s***

Other variables adjusted as covariates in the final general linear model: living arrangements at admission to SUD treatment facilities, concomitant use of illicit substance at admission to SUD treatment facilities, highest level of educational attainment, social or emotional support, number of days waiting to enter treatment, and employment status at admission to SUD treatment facilities. #p value was obtained for comparison of estimated marginal means between reference group and each of the other groups.

Adjusted means of MAT Days across groups of the major categorical predictors are

determined. Results are summarized in Table 7.

First, the magnitude of adjusted means obtained for gender with females as the reference

group is slightly higher than for males. Second, the magnitude of adjusted means obtained for

primary source of payment for treatment for participants with no health insurance coverage as

the reference group is slightly higher than for participants with private health insurance or public

insurance. Third, the magnitude of adjusted means obtained from census state FIPS code for

states that enacted Policies Two, Three, and Four as the reference group is slightly higher than

for states that enacted Policies One, Two, Three, and Four.

In addition, the magnitude of adjusted means of having co-occurring mental and

substance-use disorders with those who do not as the reference group is slightly lower than for

participants who have co-occurring mental and substance-use disorders. In addition, the

magnitude of adjusted means obtained for age with those from 18 to 44 as the reference group is

slightly lower than for middle-aged adults (44 to 64) and those 65 years and older.

In addition, the magnitude of adjusted means obtained for race and ethnicity with non-

Hispanic Whites as the reference group is slightly lower than for Hispanics. In conclusion, the

magnitude of adjusted means obtained from race and ethnicity with non-Hispanic Whites as the

reference group is slightly higher than for Alaska Native/ American Indian, Asians/ Pacific

Islanders/ Native Hawaiians, Black or African American, and those of other single-race or

multiple racial ancestry.

The significance of adjusted means fades away with the addition of Alaska Native/

American Indian and becomes borderline significant upon the addition of Asians/ Pacific

Islanders/ Native Hawaiians. The same trend is observed upon the addition of other single-race

or multiracial individuals and census state FIPS code of states that enacted Policies One, Two, Three, and tour; the result does, however, become significant upon addition of census state FIPS code.

Overall, the results suggest that fewer numbers of young adults have access to MAT than middle-aged and older adults. Fewer numbers of participants have access to MAT if they are male, have earned some post-high school education but not at a four-year school, and are Alaskan Native/ American Indian, Asians/ Pacific Islanders/ Native Hawaiians, and those of other single-race or multiple racial backgrounds. More numbers of participants have access to MAT if they are Hispanic, middle-aged or older, and have either full- or part-time employment, private health insurance, and co-occurring mental and substance-use disorders.

There is greater access to MAT for participants from states that enacted Policies One, Two, Three, and Four than their counterparts from states that enacted Polices Two, Three, and Four alone. In the same way, the results confirm no significant interaction between participants who have any other level of educational attainment, number of days waiting to enter treatment, being Black or African American, having social or emotional support, having public health insurance, and having coverage for MAT.

Results from this study demonstrate differential effects of the constructs of Ron Anderson's Model of Behavioral Health Use on number of days of MAT-Service use. For example, bachelors degree or higher level of educational attainment, number of days waiting to enter treatment, male gender, Asians/ Pacific Islanders/ Native Hawaiians, Black or African American, states that enacted Policies One, Two, Three, or Four, and participants having either private health insurance or public insurance are negatively associated with number of days of MAT-Service use.

Similarly, the number of days of MAT-Service use is positively associated with participants who are of Hispanic origin, middle-aged or older adults, employed part or full time, and have social or emotional support and co-occurring mental and substance-use disorders. Although a significant interaction was not confirmed between number of days of MAT-Service use for those having a middle school, high school, or some post-high school education but not at a four-year school, Alaska Native and American Indian origin, and other single-race or multiracial heritage. Compared with participants with elementary-school education or below, participants having middle school, high school, and some post-high school education but no additional degrees have greater numbers of days of MAT-Service use. Likewise, participants who are Alaska Native/ American Indian and other single-race or multiracial backgrounds have fewer numbers of days of MAT-Service use compared to Non-Hispanic White.

CHAPTER 5: DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

DISCUSSION AND IMPLICATIONS

This study hypothesizes that fewer middle-aged and older adults have access to MAT services compared to young adults. It also hypothesizes there will be no significant difference in the odds for case numbers of access to MAT services among young, middle-aged, and older adults. The primary purpose of this study is to investigate barriers for adults diagnosed with OUD in accessing MAT as well as to determine access to MAT by age group in the US. Findings from this study show that middle-aged and older adults experience significantly fewer barriers to accessing MAT services than do young adults.

The findings conflict with the initial hypotheses. Results of this study do not support the research hypothesis that fewer numbers of middle-aged and older adults will have access to MAT services compared to young adults. This study's findings thus fail to reject the null hypothesis that there will be no significant difference in the number of barriers to accessing MAT services experienced among young, middle-aged and older adults. Moreover, findings from this study also show that specific types of MAT access barriers for individuals diagnosed with OUD are male, have some post-high school education but not at a four-year school, have ancestry of Alaska Native/ American Indian, Asians/ Pacific Islanders/ Native Hawaiians, and those with other single or multiple racial backgrounds, and being a young adult. Next, results of this study show the following variables increase access to MAT: living in states that enacted Policies One, Two, Three, and Four, being Hispanic, being a middle-aged or older adult, having part- or full-time employment, private insurance, and co-occurring mental and substance-use disorders.

Results from this study have significant implications for adults diagnosed with OUD, the

field of opioid research, and public-health policymakers and administrators. First, the result supports existing research showing that young adults experience more barriers to accessing MAT compared to middle-aged and older adults.[42,43,81] A recent case study that described the experiences of three young adults diagnosed with OUD concludes that opioid-mortality rates are increasing among young adults because they experience significant barriers in accessing MAT.[44] Another recent study, conducted by Neighbors et al. (2019), found that the percentage of older age groups diagnosed with OUD who received MAT was significantly larger than that of younger counterparts.[81]

The Neighbors et al. (2019) study describe the age distribution of SUD treatment by analyzing New York Medicaid claims data. They also found that 49.2% of adults from18 to 29, and 62.4% of those from 30 to 39 received MAT as compared to 68.4% of those 40 to 49, 74.9% of those 50 to 59, and 84.4% of those 60 to 64. The study also found that although young adults (18 to 29) were the largest proportion (25%) of adults in treatment, those from 18 to 39 years were less likely to be prescribed MAT compared to those from 40 to 64.[81]

Young adults are also the largest proportion of participants in this study (80.7%). This proportion could have been biased in both this and in the Neighbors et al. (2019) studies through sample-selection bias. In other words, young adults might be over-represented in both samples. A probable explanation for the observed proportion of young adults in both could be that the primary source of payment for the treatment of a majority of participants in this study was public insurance (85.8%) and all participants in the Neighbors et al. (2019) study could have had public insurance through Medicaid.

In addition, Neighbors et al. (2019) reports that the average length of Medicaid eligibility was lower among younger age groups compared to older ones. According to Neighbors et al.

(2019), the mean lengths of Medicaid eligibility for young (30 to 39), young and middle-aged (40 to 49), middle-aged (50 to 59) and middle-aged adults (60 to 64) were 10.9, 11.1, 11.4, and 11.5 months correspondingly. Although the observed variations in average length of Medicaid eligibility reported in the Neighbors et al. (2019) study were minimal, one could infer from its findings that there is an unexplored relationship between insurance coverage, age, and access to MAT.

The undiscovered relationship that could explain the dual effect of age and type of insurance coverage (public or private health insurance) on access to MAT is unclear. This undetermined dual effect of age and type of insurance on access to MAT could be responsible for the underrepresentation of middle-aged and older adults and overrepresentation of young adults observed in MAT programs. If left unexamined and unaddressed, certain age groups might continue to be underserved by evidence-informed health policies that could be enacted in the future to address America's opioid epidemic.

Findings from this study support existing research showing that being male increases an individual's risk of developing OUD.[84,85] The majority of participants in this study are males (59.5%). A possible explanation for the proportion of males in this study could be that more males are diagnosed with OUD and so experience significantly more barriers in accessing MAT.

That this study shows that participants who have some post-high school education but not at a four-year school experience more barriers in accessing MAT is also consistent with findings from previous work. Examples are a retrospective cohort study and a face-to-face survey showing that there is no association between some post-high school education but not at a four-year school and adherence to MAT.[30,87]

This study's findings showing that Alaska Native/ American Indian, Asians/ Pacific

Islanders/ Native Hawaiians, and those with other single or multiple racial backgrounds experience significant barriers in accessing MAT, also support findings from the Rieckmann et al. (2017) study, which determines Alaska Natives'/ American Indians' use of MAT services by analyzing the Centers for American Indian and Alaska Native Health's (p. 1137) Substance Abuse Treatment project data. Rieckmann et al. (2017) report that only 28% (53 of 192) of the OTPs surveyed had initiated MAT among Alaska Native/ American Indians. Venner et al. (2018) also report that Alaska Native/ American Indians diagnosed with OUD would choose to control their use of opioids on their own rather than access MAT. This result is also consistent with findings from the Acevedo et al. (2018) study. Acevedo et al. (2018) investigate the effect of community characteristics on access to MAT across ethnic and racial groups by analyzing the State of Washington's SUD treatment data. They find that Black Americans and American Indians living in underserved communities experience more barriers in accessing MAT than non-Hispanic Whites.

This observed disparity can be partly explained in that Black Americans and American Indians live in rural areas and other geographical environments in which MAT access is lower and patients must travel longer distances to access OUD care.[4] Other barriers Black Americans and American Indians experience include MAT expenses and such logistical constraints as the cost of childcare, transportation, and services.[4] There is a dearth of existing literature on Asians/ Pacific Islanders/ Native Hawaiians and those with other single or multiple racial backgrounds and access to MAT in the US. Future studies should examine these issues empirically.

Results of this study showing that being Hispanic increases access to MAT is an important finding. It is consistent with findings from the Krawczyk et. al. (2017) study, which investigates ethnic and racial differences in access to MAT in America. According to Krawczyk

et al. (2017), Hispanics and Blacks experience fewer barriers to accessing MAT than non-Hispanic Whites. This is because Hispanics and Blacks are more likely to have access to specialty OTPs at any point following either longer durations of opioid use or severe OUD. This finding helps bridge the gap in the literature on racial and ethnic differences in access to MAT. It directs attention to racial and ethnic barriers that policymakers and public-health practitioners could address while attempting to curb America's opioid epidemic.

In addition, this study's findings that participants who reside in states that enacted Policies One, Two, Three, and Four (e.g. California) experienced significantly fewer barriers to accessing MAT supports the findings of existing reports that show access to MAT is greater in states that enacted these four policies.[16,25,120] For instance, the California Health Care Foundation (2019) policy brief highlighting the impact of California's MAT expansion program shows 650 new MAT access points across the state. These include 18 hubs, 40 primary-care sites, 200 spokes, 52 hospital emergency departments, 12 Indian Health Programs, 29 county jail system programs, 22 sites specifically for youths, 10 mental health/ SUD clinics, and 270 community access points.[16] In addition, 21,800 new patients diagnosed with OUD received care under California's MAT expansion project.[16]

Findings from this study showing those with private health insurance and co-occurring mental and substance-use disorders have increased access to MAT support the results of the Cantone et al. (2019) study. Cantone et al. (2019) report that participants who use tobacco or are diagnosed with psychiatric conditions experience significantly fewer barriers to accessing MAT. The Cantone et al. (2019) study report that participants having private health insurance experienced significantly fewer barriers to accessing MAT than those who were uninsured or had public insurance. Those with private coverage were offered behavioral therapy along with MAT.

Behavioral therapists who work at OTPs screen individuals diagnosed with OUD, recommend providers to prescribe MAT to those who have mental and substance-use disorders, and refer those patients to MAT services.[17]

According to Cantone et al. (2019), there is a need for research examining the relationship between prior behavioral therapy and access to MAT. They also find that individuals with co-occurring mental and substance-use disorders might be more likely to accept MAT because all their disorders can be managed by providers at the OTPs.[17] There is a dearth of research supporting or contradicting findings of this study showing that having part- or full-time employment increases access to MAT. Future studies should also examine these issues empirically.

The Need to Increase Access to Medication-Assisted Treatment

There is strong scientific evidence to substantiate the effectiveness of MAT in managing OUD,[19,25,35,72,87] and yet access to MAT remains low in the US.[3,31,77,81] As illustrated by the findings from this study, certain age groups are underrepresented in American OTPs. Such evidence is supported by a report prepared for the US Department of Health and Human Services Office of the Assistant Secretary for Planning and Evaluation, which concludes that almost every state in America has OUD rates that exceeds its MAT capacity.[51]

Despite these findings, current OUD-management guidelines recommend the use of MAT in managing OUD. MAT replaces prescribed or illicit opioids with longer-lasting ones that induce less euphoria and have less potential for abuse.[27] It increases treatment retention rates, improves outcomes, and improves prognosis.[69] MAT also reduces illicit drug use, fatal opioid overdoses by 50–70%, and opioid deaths.[10,116,126] This notion highlights the need to increase

access to MAT in America.

Currently, US public-health organizations and practitioners face the double challenge of combating the US opioid epidemic and the COVID-19 crisis[86] when there is a high possibility of an economic slowdown in America.[35,70] Additionally, economic or financial crisis affects mental health.[40] To cope with isolation, economic problems or poverty, anxiety, and mental health issues caused by pandemics such as the ongoing COVID-19 crisis, US adults are further likely to engage in NMUPO, opioid misuse, and opioid abuse.[40] These multiplicative consequences of pandemics will unquestionably worsen America's opioid crisis in the current context.[35,40] In fact, findings from responses of surveyed US healthcare workers showed that 45% of participants recommend that Americans need mental health support during this current COVID-19 pandemic.[40]

Another consequence of the COVID-19 crisis is disruption in OUD care and recovery services.[97] This disruption will result in an increase in NMUPO, opioid overdose, and opioid-related morbidity and mortality rates.[35,40] It is expected that effects of this disruption will worsen the opioid epidemic in rural American communities.[100]

Efforts at reducing NMUPO and preventing opioid overdose[31,61,95] are yet to curb the American opioid epidemic.[47] Thus, there is an urgent need to increase access to MAT in the US.[3,31,77] However, this author anticipates that using findings from this study to enact evidence-informed policies and implement effective interventions aimed at increasing US adults' access to MAT will compete with already-scarce resources during the pandemic. In view of the ongoing COVID-19 crisis, such bold efforts as translating findings from opioid research to evidence-informed health policies are needed to ensure that individuals living with OUD continue to have access to the lifesaving therapy of MAT.[9,35] Otherwise, disastrous effects could result from both

the COVID-19 pandemic and the opioid epidemic.[35]

LIMITATIONS

The use of the 2017 TEDS-DS0001 data is not representative of the US' population diagnosed with OUD because it does not include discharges from SUD treatment facilities that do not receive public funds and are not managed by federal agencies such as the Department of Defense, Bureau of Prisons, and Department of Veterans Affairs. Nonetheless, some SUD treatment facilities managed by the Indian Health Service are included. It also does not cover SUD treatment programs in the states of Georgia, Oregon, and West Virginia. Additionally, SUD treatment programs might target special populations such as pregnant women because of constraints imposed by public funding sources.[107]

The findings from this study may not be generalized to the population of individuals diagnosed with OUD in the US. However, the individuals in this study are identified with OUD, accessing MAT, having no health insurance coverage, and having public or private insurance coverage—which covers a large percentage of individuals diagnosed with OUD in the US. Second, much of the data in the 2017 TEDS-DS0001 dataset were obtained through self-reporting at the time of admission to SUD treatment facilities. An example is demographics. Considering the nature of self-reported data, results of this study are prone to response bias.

Third, as mentioned earlier, findings from this study could have been influenced by a sample-selection bias. Finally, this study's sample includes only individuals diagnosed with OUD. Not all individuals who receive MAT have been formally diagnosed with OUD.[80] Sometimes, the use of MAT is employed in treating other SUDs such as alcohol-use disorder.[79,80]

FUTURE DIRECTIONS

In keeping with US public-health strategies to combat the opioid crisis, future research is encouraged.

First, to replicate the results of this project utilizing other national data sets in which a majority or all participants' primary source of payment for their treatment is through private health insurance. Second, these findings call for quantitative studies to examine and directly compare the effect of public and private health insurance on access to MAT in the US. Third, additional research is needed to identify specific barriers to MAT access faced by young adults' in accessing MAT. Fourth, there is a need for empirical studies examining (i) Asians/ Pacific Islanders/ Native Hawaiians and those with other single or multiple racial backgrounds in the US along with (ii) supporting or contradicting the association between having part- or full-time employment and access to MAT as shown by the results of this study.

Fifth, further research is needed to investigate culturally competent MAT programs that will effectively serve Alaska Native/ American Indian, Asians/ Pacific Islanders/ Native Hawaiians, and those with other single or multiple racial backgrounds while meeting their cultural needs, organizational fit, and treatment culture. Finally, further research is needed to identify and directly compare the possible dual effect of age and type of insurance coverage (public or private health insurance) on access to MAT. Explanations of findings from such studies could advance the American public-health efforts at increasing access to MAT.

RECOMMENDATIONS

This study's findings have important implications for policymakers, US public-health

organizations, and Americans generally. Scientific evidence generated from this study could be used by policymakers to inform health policies aimed at increasing MAT access—particularly among populations underserved by existing MAT programs. Policy is one of the constructs of this study's conceptual framework to influence MAT access. Hence, it is hoped that the next administration will enact the following recommended evidence-informed health policies aimed at increasing access to MAT in America.

First, all states in the nation could be encouraged to adopt and implement Policies One, Two, Three, and Four. Second, US policymakers could enact health insurance reforms that mandate MAT coverage by all health plans and eliminates limits on the duration of MAT coverage.[64] Such health insurance reform could enable regulatory changes as one to require a comparable Medicare reimbursement rate across geographical areas in the nation. Other evidence-informed regulatory insurance changes could include bridging the gap in public and private health insurance MAT coverage and reimbursement rates.[64] Third, US policymakers could increase government funding for opioid waivers, equitably distribute waivered providers and MAT programs throughout the nation, and mandate state removal of restrictions on buprenorphine- prescribing privileges of non-physician waivered providers.

Given the results of this study, MAT services provided under current health policies in the US underserve certain populations. It is recommended that US public-health organizations and practitioners develop and implement effective age-friendly and culturally competent MAT programs tailored to the varying needs of Americans and aimed at increasing access to MAT. Age-friendly MAT programs should focus on increasing young adults' access to MAT. Culturally competent MAT programs should focus on increasing access to MAT by Alaska Natives/ American Indians, Asians/ Pacific Islanders/ Native Hawaiians, and those with other

single or multiple racial backgrounds. Existing MAT programs could also be adapted to include age-friendly and culturally competent components to appropriately and better serve the varying needs of young adults and Alaska Natives/ American Indians, Asians/ Pacific Islanders/ Native Hawaiians, and those with other single or multiple racial backgrounds.

Finally, pending implementation of better MAT policies, US public-health organizations and practitioners are encouraged to widely disseminate the findings of this study by making it publicly available to members of the public-health community, health-policy advocates, and policymakers. In anticipation of future research that will inform effective implementation of culturally competent MAT programs, it is also recommended that US public-health organizations and practitioners develop and implement culturally competent public-health education programs aimed at educating the public about OUD and how to access MAT. Despite the ongoing COVID-19 pandemic, US public-health organizations and practitioners are encouraged to advocate the creation of these evidence-informed health policies and programs.

CONCLUDING REMARKS

Although there may be other extraneous variables that have not been controlled for (in this work, examples are psychosocial issues, social structure, and socialization), America's opioid epidemic is worsened by the extant ready access to prescription and illicit opioids and lack of access to the evidence-based and lifesaving therapy of MAT.[78,94] One of the goals of the US public-health system is to increase access to MAT in America.[73,95] The studies discussed in this dissertation make contributions toward resolving the lack of consensus on the effect of age

in accessing MAT in the US. Findings from this study also bridge the gap in the literature on

barriers faced by adults diagnosed with OUD in accessing MAT and the current status of access

to MAT among young, middle-aged, and older adults in the US. These findings will help to

inform policies and interventions aimed at increasing access to MAT in America. It will also

provide guidance for future opioid research that will inform the implementation of effective age-

friendly and culturally competent MAT programs.

APPENDIX

HOW THIS DISSERTATION ADDRESSES THE DOCTOR OF PUBLIC

HEALTH (DRPH)- COMPETENCIES

This dissertation addresses the DrPH foundational competencies 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 15, 16, 17, & 20 in the following ways:

Data and analysis: The studies this dissertation discusses use quantitative, qualitative, mixed methods, and policy analysis research and evaluation tools to address the US opioid epidemic at the individual, organization, community, and population levels. Some of the studies this dissertation discusses also explain the use and limitations of national surveys and surveillance systems in assessing, monitoring, and evaluating policies and programs intended to address a population's health. Examples of such work are the Cantone et al. (2019) research, the Clemans-Cope et. al. (2019) policy brief, and the Neighbors et al. (2019) research. This dissertation addresses America's opioid crisis at individual, organization, community, and population levels using quantitative research methods.

Leadership, Management & Governance: Findings from this study can help inform future health policies that might be enacted by diverse stakeholders. These findings could also encourage individuals at all levels of health literacy to adopt desired policies and behaviors. These not only include providers prescribing MAT to more young adults but individuals diagnosed with OUD access and adherence to MAT.

I also integrate knowledge from this research, its approaches, methods, and moral values and from the contributions of studies to address America's opioid epidemic. As depicted by the outline and methodology here, I create a strategic plan to determine the current status of access to MAT among young, middle-aged, and older adults—including barriers faced by individuals

diagnosed with OUD when trying to access MAT.

This study recommends strategies for improving health and eliminating health inequities, ones created to help organize such stakeholders as US policymakers, researchers, public-health practitioners, community leaders, and others. I then make strategic recommendations about using findings from this study. The recommendations describe a plan for how US policymakers, public-health organizations, and practitioners might increase access to MAT in the US. The fifth chapter lays out approaches for promoting inclusion and equity within public-health programs, policies, and systems. Next, I use these findings to recommend resources (human, financial, etc.) to help increase access to MAT in America. If this study's recommendations are implemented effectively, they could bring about organizational change strategies that could help increase access to MAT in America. They could also influence organizational change strategies by bridging a gap in opioid literature, informing stakeholders about MAT access barriers and populations underserved by America's current MAT policy. I then recommend how to address these issues. I also assess such strengths and weaknesses in leadership capacities as those involving cultural proficiency and make culturally proficient recommendations.

Policy and Programs: The findings here, integrated with knowledge of cultural values and practices, form the basis for a series of recommendations. One is to develop and implement culturally competent MAT programs to serve racial and ethnic groups currently underserved by America's MAT programs. This study integrates the use of scientific knowledge, regulatory and legal approaches, ethical frameworks, and varied stakeholder interests to analyze existing MAT polices and ways to increase access to MAT in America. The fifth chapter proposes inter-professional team approaches to improving population health.

Education and Workforce Development: This study is written using best practice

modalities in pedagogical practices. It was read and criticized by members of the dissertation committee and writing consultants at Claremont Graduate University's Center for Writing and Rhetoric. I have incorporated their suggestions. To help promote learning at the School of Community and Global Health, a member of the dissertation committee shared this dissertation's study proposal with other DrPH students.

This dissertation addresses the DrPH concentration/ discipline-specific competencies 1, 2, 3, 4, 5, 6, 7, and 8 in the following ways: It critically analyzes America's opioid epidemic and provides recommendations using its findings. It applies research methods to originate evidence-based research to local community, environmental, and social or economic circumstances. It also uses knowledge of components of a comprehensive population health system to fill in gaps in care in order to advance practice. For example, using findings from this study to enact evidence-informed health policies could help to address disparities in care and increase access to MAT in the US. This dissertation research involves an innovative approach to public-health leadership and management. It provides strategic and organizational direction and has the capacity to guide group-level decision making. It also cultivates a vision and articulates it to diverse groups (including individuals living with OUD), stakeholders (including US policymakers), and professional facilitators (such as US public-health organizations and practitioners) to achieve high performance standards and accountability, among other things, for addressing America's opioid epidemic by increasing access to MAT. This study illustrates and helps to develop an understanding of how public policy affects the leadership and management of efforts to combat the opioid epidemic. This study also suggests how multidisciplinary collaborative teams and partnerships might work together to build the capacity and sustainability of individuals, organizations, and communities. For example, US policymakers, along with public-health

organizations and practitioners, can sustain individuals living with OUD and improve the

capacity of public-health organizations and American communities to help them by working

together to implement recommendations from this study.

All variables are obtained from the 2017 TEDS-DS0001 dataset.

Study Population

OUD: "International Classification of Diseases (ICD) or DSM diagnosis codes (SuDS)" is renamed OUD. An opioid dependence or abuse diagnosis originally measured as (SuDS five and 12) is recoded as one. Other substance-abuse-disorder diagnoses also originally measured as SuDS one, two, three, four, six, seven, eight, nine, 10, 11, 13, 14, 15, 16, 17,18, and 19 are all recoded as zero and excluded from the study.

Dependent Variables: There are two DVs, which are HCFMAT and MAT Days.

HCFMAT: Planned medication-assisted opioid therapy is renamed HCFMAT. Its original measurement of one is retained. Not-HCFMAT, originally measured as two, is recoded as zero.

MAT Days: Length of stay in treatment is renamed MAT Days and measured as a continuous variable. The original coding of one day as 1, two days as 2, and so on through thirty are retained. The measurements of 31–45 days (originally coded as 31) is recoded as 38, 46–60 days (originally coded as 32) is recoded as 53, 61–90 days (originally coded as 33) is recoded as 75.5, 91–120 days (originally coded as 34) is recoded as 105.5, 121–180 days (originally coded as 35) is recoded as 150.5, 181–365 days (originally coded as 36) is recoded as 273, and more than a year (originally coded as 37) has been recoded as 365.

Covariates

LIVARAG_2: The name and original measurement of living arrangements at admission to SUD treatment facilities is retained. Being homeless (clients with no fixed address and clients living in shelters) is measured as one. Dependent living (clients living in a supervised setting and clients under 18 living with adults) and independent living (clients living alone or with others without supervision) are measured as two and three accordingly.

CUISA: Primary, secondary, and tertiary substance use at admission to SUD treatment facilities are combined and renamed CUISA. CUISA originally measured from two through 19 is recoded in all cases as one. No-CUISA, originally measured as one, is also recoded as zero.

Secondary Predictors

EDUCS_2: The name and original measurement of education attainment status are retained. Completed elementary school (eight years of schooling) or less is measured as one, middle school (nine –11 years of schooling) as two. Have secured a high school or General Education Development (GED) certificate as three. Work toward some post-high school education but not at a four-year school (13–15 years) as is measured as four, and having secured a bachelors degree or higher (16 years of education) or more as five.

SES: Marital status is renamed SES. Now married (originally measured as two) is categorized as having SES and recoded as one. Never married, separated, divorced, and widowed (originally measured as one, three, and four) are categorized as not having SES and recoded as zero.

DAYWAIT_2: The label "number of days waiting to enter treatment" is retained. The original label for waiting zero days from the first request for treatment until beginning clinical service is retained as zero. The original measurements for waiting one to seven, eight to 14, 15 to

30, and 31 days from the first request for treatment until beginning clinical service are recoded as four, 11, 23, and 31 appropriately.

EMPLOY_2: The name employment status at admission to SUD treatment facilities is retained. Full-time employment's original coding as one is recoded as two. Part-time employment, originally coded as two is recoded as one. Unemployed and not being in the labor force, originally measured as three and four, are recoded as zero. Those not working for compensation and not looking for such work (e.g., homemakers) are not considered part of the labor force.

Primary Predictors

GENDER_2: The label gender is retained. Male's original measurement as one is retained. Female originally measured as two is recoded as zero.

ETH: The variables race and ethnicity were combined. **Ethnicity:** The original coding for not of Hispanic or Latino origin was four; it has been recoded as zero. Puerto Rican, Mexican, Cuban, or other specific Hispanic originally measured as one, two, and three, and commonly categorized as of Hispanic or Latino origin, are recoded as one. Unspecified origin, originally measured as five, is recoded as missing data. **Race:** White, originally coded as five, is recoded as one. Alaska Native (Aleut, Eskimo, Indian) and American Indian (other than Alaska Native), originally coded as one and two, respectively, are recoded as two. Asian or Pacific Islander, Asian, and Native Hawaiian or other Pacific Islander, originally coded as three, six, and nine correspondingly, are renamed Asian/ Pacific Islander/ Native Hawaiian and recoded as three. Other single-race backgrounds, coded as seven, is recoded as four. Black or African American, originally coded as four, is recoded as five. Two or more racial backgrounds,

originally coded as eight, is recoded as six.

White recoded as one is categorized as Non-Hispanic White. It and Hispanic are recoded as zero and one, respectively. Alaska Native/ American Indian retains its recoding of two. Asian/ Pacific Islander/ Native Hawaiian's recoded measurement of three is also retained. Black or African American, recoded previously as five, is now recoded as four. Other single race and two or more races also recoded as four and six, is now recoded as five.

FIPS Code: The name census state FIPS code is retained. It was originally measured by stating participants' census state FIPS code from the US census bureau code. It was made a categorical variable by collapsing values representing similar policy applications because policies enacted in each census state determine access to MAT in each. These policies were classified and described as:

Policy One: Policies that increased access to MAT by expanding Medicaid under the ACA.

Policy Two: Policies that took approaches that did not involve the ACA to increase access to MAT.

Policy Three: Policies that increased Medicare-eligible individuals' access to MAT.

Policy Four: Policies that increased dual Medicaid- and Medicare-eligible individuals' access to MAT. States that adopted Policies Two, Three, and Four (Alabama, Florida, Idaho, Kansas, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma , South Carolina, South Dakota, Tennessee, Texas, Utah, Wisconsin and Wyoming), which were originally coded as one, 12, 16, 20, 28, 29, 31, 37, 40, 45, 46, 47, 48, 49, 55 and 56 are appropriately recoded as zero. States that adopted all four policies (Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New

Jersey, New Mexico, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, Washington and Puerto Rico, originally coded as two, four, five, six, eight, nine, 10, 11, 15, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 30, 32, 33, 34, 35, 36, 38, 39, 42, 44, 50, 51, 53, and 72 correspondingly, are recoded as one).

PRIMPAY_2: The name primary source of payment for treatment is retained. Self-pay and no charge (free, charity, special research, teaching), originally coded as one and six, are categorized as uninsured and recoded as zero. Private insurance (Blue Cross/Blue Shield, other health insurance including Health Maintenance Organizations, workers compensation), originally measured as two, is renamed private health insurance and recoded as one. Medicare, Medicaid, other government payments such as TRICARE formerly known as the Civil Health and Medical Program of the Uniformed Services (CHAMPUS), and other state payments, originally coded as three, four, five and seven, are categorized as public health insurance and recoded as two.

CMSUD: The name co-occurring mental and substance-use disorders is retained. Having CMSUD's original coding of one is also retained. Not having CMSUD, originally coded as two is recoded as zero.

AGEG: Age at admission is renamed AGEG. Ages 12 to 17, originally coded as one and two, are recoded as one and excluded from the study. Ages 18 to 44, originally coded as three, four, five, six, seven, and eight, are recoded as two. Ages 45 to 64, originally coded as nine, 10, and 11 are recoded as three, and ages 65 and older, originally measured as 12, are recoded as four.

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