Mitigating Opioid Use Disorder and the Opioid Epidemic in the United States

by

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ABSTRACT

Latest estimates show that roughly 188 individuals in the United States die every day due to an opioid-related overdose. This dissertation explores three avenues for mitigating opioid use disorder (OUD) and the opioid epidemic in the United States (1.) How can researchers and public health professionals identify areas most in need of treatment for OUD in an easy-to-use and publicly accessible interface?; (2.) What do practitioners see as opportunities for reducing barriers to treatment?; and (3.) Why do differences in opioid mortality exist between demographic groups? To address question one, I developed an interactive web-based to assist in identifying those counties with the greatest unmet need of medically assisted treatment (MAT). To answer question two, I conducted a study of stakeholders (medical providers, peer support specialists, public health practitioners, etc.) in four New Mexico counties with high unmet need of MAT. to identify cultural and structural barriers to MAT provision in underserved areas as well as opportunities for improving access. To answer the third question. I conducted a systematic review of peer-reviewed literature and government reports to identify how previous research accounts for race/ethnic and sex disparities in opioid-related mortality. While many opioid mortality studies show demographic differences, little is known about why they exist. According to the findings of this systematic review, research needs to go beyond identifying demographic differences in opioid-related mortality to understand the reasons for those differences to reduce these inequities.

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CHAPTER 1

INTRODUCTION

"We know what works. The problem is we aren't doing enough of it." Former United States Surgeon General Vivek Murthy used these words to describe current strategies for reducing opioid dependence at the 2017 National Prescription Drug Abuse and Heroin Summit in Atlanta, Georgia (Murthy, 2017). Current estimates show that an average of 188 individuals a day died in the United States due to an opioid-related overdose (Centers for Disease Control and Prevention, 2023).

This dissertation explores three avenues for mitigating opioid use disorder (OUD) and the opioid epidemic in the United States (1.) How can researchers and public health professionals identify areas most in need of treatment for OUD in an easy-to-use and publicly accessible interface?; (2.) What do practitioners see as opportunities for reducing barriers to treatment?; and (3.) Why do differences in opioid mortality exist between demographic groups?

As a foundation for answering these questions, this chapter (1) reviews what is an opioid and the history of the current epidemic; (2) outlines current opioid mortality statistics; and (3) describes the treatment options available for OUD. It concludes by detailing how the subsequent chapters address questions surrounding unmet need of treatment for MAT and avenues of future research on opioid mortality.

1. *How Opioids Work, Opioid Classification, and a History of the Recent Epidemic*

Opioids function by attaching to opioid receptors (μ, κ, and δ) in the brain, spinal column, and peripheral tissues, making it difficult for the brain to register pain (Freynhagen, Geisslinger, & Schug, 2013). In addition to a reduction in pain, the attachment of opioids to opioid receptors also slows breathing and can create a sensation

of relaxation and euphoria (Johnson et al., 2012; Vaughan et al., 1997). While our bodies naturally produce opioids, the human body cannot produce enough to block severe pain, chronic pain, or to induce an overdose (Savage et al., 2003).

There are typically three ways that opioids are classified-natural opiates, semi-synthetic opioids, and synthetic opioids (National Institutes of Health, 2018). Natural opiates are derived entirely from the opium poppy plant, commonly found in warm and dry areas, such as Afghanistan, Turkey, and Pakistan (*Opioid Data Analysis and Resources*, 2017). A drug made entirely from the opium poppy plant is considered a natural opiate, referring to chemical compounds extracted or refined from the plant matter, typically poppy sap and fibers (Jones et al., 2018). Examples of natural opiate narcotics include morphine, codeine, and thebaine (Brownstein, 1993). It is not until the addition of synthetic material to natural entities that the drug then becomes a semi-synthetic opioid (Reddy et al., 2014). Examples of semi-synthetic opioids include heroin, hydromorphone, oxycodone, and etorphine (United States Drug Enforcement Administration, n.d.). Synthetic opioids are narcotics made in a laboratory without any components from the opium poppy plant, but are developed to mimic the effects of natural and semi-synthetic opioids (Centers for Disease Control and Prevention, 2016). Fentanyl and Methadone represent two of the most commonly known synthetic opioids (Armenian et al., 2018; Frank & Pollack, 2017; Martin et al., 1973; Suzuki & El-Haddad, 2017).

While there is no definitive agreement on the first cultivation of the opium poppy plant to produce opioid narcotics, a majority of scholars believe that traders from the Arab states of Western Asia, the Horn of Africa, and North Africa began bringing opium products to India and parts of China as early as the 8th century (Brownstein, 1993). Over ten centuries later, a German pharmacist named Friedrich Wilhelm Adam Sertü isolated

components of the opium poppy to create Morphine in 1803 (Schmitz, 1985). An English chemist named Charles Romley Alder Wright, developed heroin in 1874 while working to synthesize new morphine products (Sneader, 1998). Heroin is derived from morphine but is more potent and takes less time to block pain receptors in the brain (Carnwath & Smith, 2002). In the late 19th and early 20th centuries, pharmaceutical companies marketed heroin as a type of miracle drug that could cure a variety of ailments, ranging from quieting teething children, to diarrhea, and fevers (Carnwath & Smith, 2002).

In the United States around this time, there was a lack of laws and regulations regarding opium and cocaine use (Jones et al., 2018). With the widespread use of morphine and other similar products during the Civil War combined with minimal regulations on heroin and cocaine , the turn of the 20th century saw a massive increase in recreational opioid use (Fernandez & Libby, 1998). As a result, the federal government passed the Harrison Narcotics Tax Act in 1914, which not only threatened to take away the licenses of physicians that prescribed opioids to addicted individuals (as addiction did not meet the classifications of a disease at that time) but also limited the flow of opioids in the United States by restricting manufacturing, importation, and distribution practices (Clarke et al., 2016). This is often regarded as the beginning of the war on drugs and had long-standing repercussions that impacted opioid culture (Fernandez & Libby, 1998). Focusing specifically on prescribing practices, The Harrison Narcotics Tax Act required physicians to only prescribe medication "in the course of (the physician's) professional practice only." (Public Acts of the Sixty-Third Congress, 1914) and provided means for a $2,000 fine or even a 5-year jail sentence if a physician incorrectly reported their prescriptions to the Department of Treasury or incorrectly prescribed medication (Hohenstein, 2001).

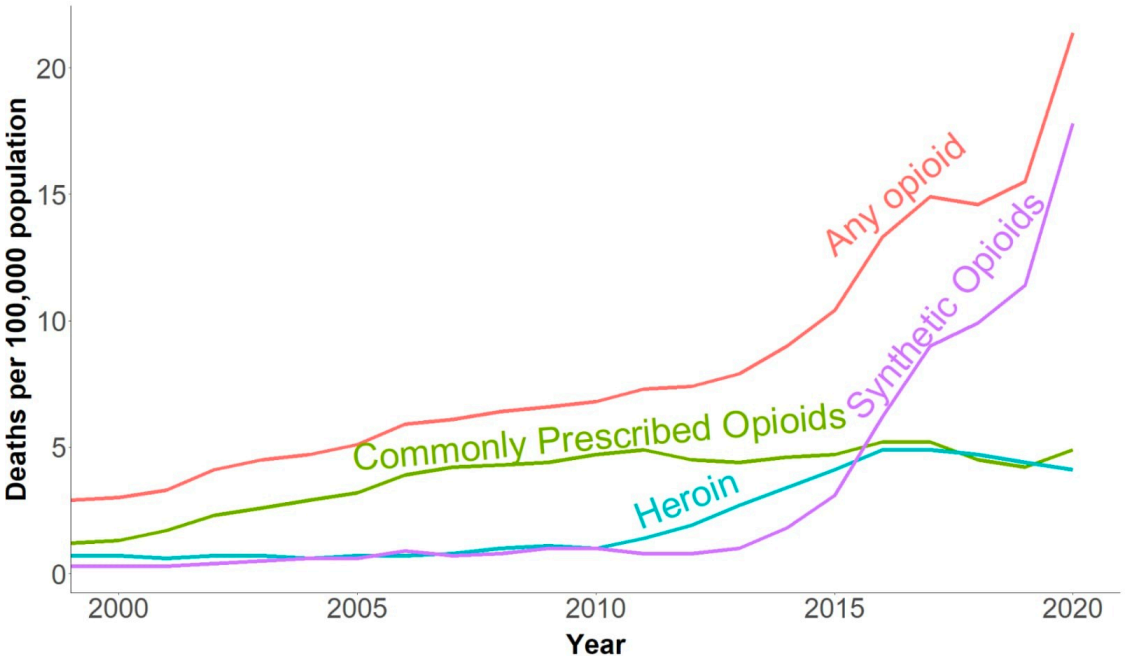
Apprehension of physicians in opioid prescribing practices continued until the 1990s (Jones et al., 2018). Historians that study the current opioid crisis in the United States discuss the epidemic as moving in three waves (Kertesz & Gordon, 2018). The first wave of the opioid epidemic took place in the 1990s after Purdue Pharma introduced OxyContin to the pharmaceutical market under heavy promotion and marketing campaigns (Van Zee, 2009). In their promotion of OxyContin, Purdue Pharma made considerable efforts to minimize perceptions of the risk of dependency and adverse outcomes, bringing about prescribing practices similar to those before the Harrison Narcotics Act (Rhea, 2010). Information in the mid-2000s revealed that many of the studies referenced by Purdue Pharma in these marketing materials contained fabricated information and in 2006 the company and three executives pleaded guilty to the misbranding of OxyContin and paid over $600 million in fines (Meier, 2018). Unfortunately, before the criminal case exposing the falsifying of information surrounding OxyContin and prescription opioids, the number of prescriptions written for opioid products increased from 25 million in 1991 to roughly 207 million in 2013 (Banta-Green et al., 2013).

The increase in prescription opioids corresponded with an increase in prescription opioid-related deaths. Between 1999 and 2009, there was a four-fold increase in the mortality rates for prescription opioids (Centers for Disease Control and Prevention, 2012). In response, the federal government began a crackdown on “pill mills,” which were clinics dispensing opioid prescriptions at high rates because they were not following prescribing best practices, as well as a crackdown on doctor shopping among patients (Chakravarthy et al., 2011). In response to this crackdown, it became more difficult to receive legitimate prescriptions for opioids through traditional medical means (Penm et al., 2017). A sharp increase in heroin use and heroin related overdose

soon followed (Kolodny et al., 2015). In the black market, heroin is typically easier to find and cheaper to purchase, while achieving a similar euphoric effect (Fernandez & Libby, 1998). Finally, the third wave of the opioid epidemic began in 2013 with an increase in overdose deaths due to synthetic opioids, especially illicitly manufactured fentanyl (Seth, Rudd, & Bacon, 2018). Fentanyl is 40 times stronger than regular street heroin and 50-100 times more potent than morphine, making it especially dangerous and likely to result in overdoses (Jones, 2013). Fentanyl can be added to heroin to make it stronger, but the product frequently gets advertised to buyers as "highly potent heroin," and users are often unaware they are purchasing a product with fentanyl (U.S Department of Justice-Drug Enforcement Administration, 2017). Opioids also constitute a large portion of overall drug-related overdose deaths, with six types of opioids in the top 10 and fentanyl and heroin being the top two most common drugs involved in overdose deaths (representing over 50% of drug overdose deaths).

Figure 1 displays the mortality rate for opioid-related deaths from 2000-2016 for all opioids, commonly prescribed opioids, synthetic opioids, and heroin. Trends in mortality rates follow descriptions of the three waves of the opioid epidemic, with an increase in prescription opioid-related overdoses beginning in the 1990s, followed by a sharp increase in heroin-related overdoses in 2010 and an increase in fentanyl-related overdoses after 2013.

Figure 1. Visual of 3 Waves of the Opioid Epidemic

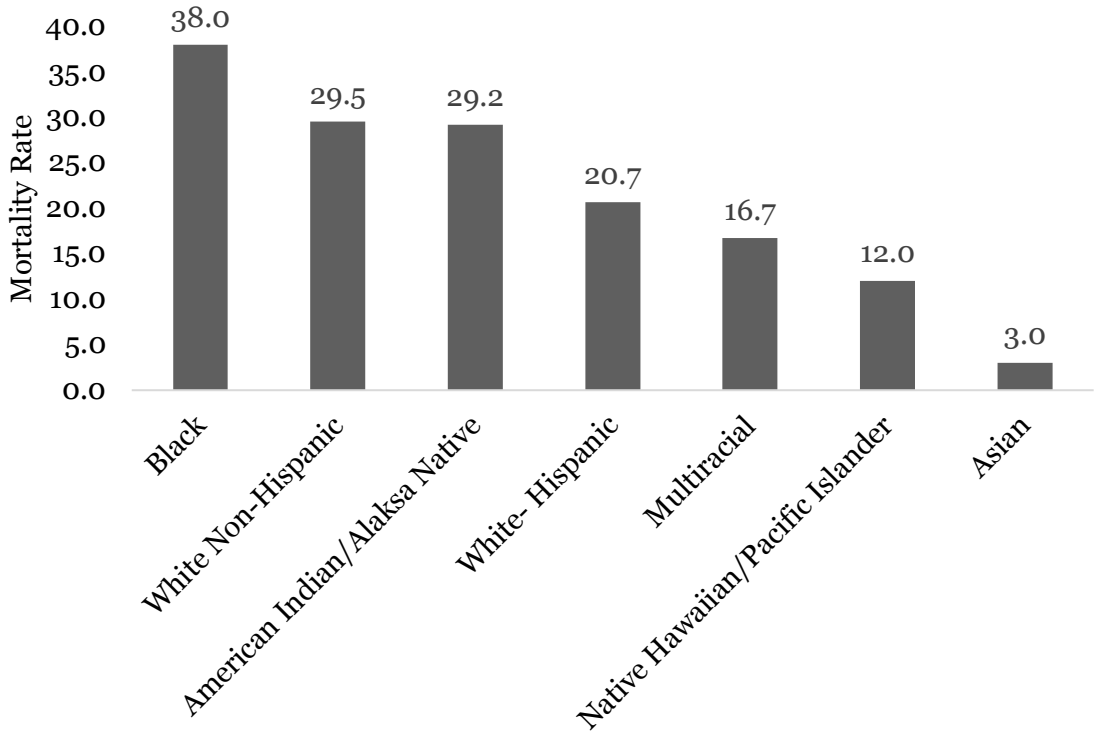


(Centers for Disease Control and Prevention, 2017)

2. *Current Opioid Mortality Statistics*

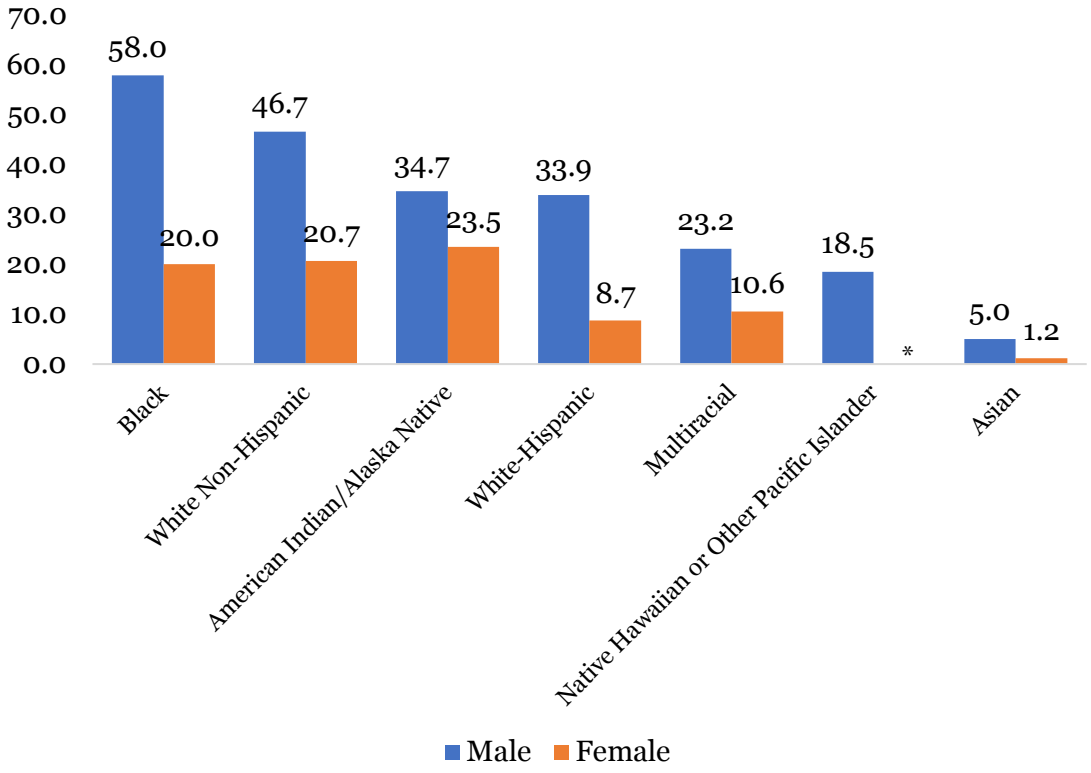
Any individual can be affected by the opioid epidemic, regardless of their race/ethnicity, sex, socioeconomic status, education level, or location (Jalal et al., 2018; Jamison et al., 2010; Jones, 2013; Paulozzi & Xi, 2008; Unick et al., 2013). Yet, epidemiological studies in the United States also indicate substantial demographic differences in opioid mortality (Altekruse et al., 2020; Nechuta et al., 2018; Tuazon et al., 2019). Figure 2 shows age-adjusted opioid mortality in 2021 based on race/ethnicity. Based on Figure 2, Blacks and White Non-Hispanics have the highest opioid mortality rates in 2021 at 38.0 and 29.5, respectively. Indigenous individuals have a rate just below White Non-Hispanics at 29.2.

Figure 2. 2021 age-adjusted opioid mortality rates in the United States by race/ethnicity per 100,000 population.



It is possible to see more demographic differences when adding sex differences to opioid mortality as well. Figure 3 shows the breakdown of opioid mortality by race/ethnicity and sex with 2021 statistics.

Figure 3. 2021 United States age-adjusted opioid mortality rates by race/ethnicity and sex per 100,000 population.



** Native Hawaiian or Pacific Islander females had unreliable data, which is why there is no bar graph for that demographic group*

When looking at opioid mortality by race/ethnicity and sex, black males have the highest rate at 58.0, followed by White Nin-Hispanic men at 46.7, and then American Indian/ Alaska Native men at 34.7. For women, American Indian/ Alaska Native women had the highest opioid mortality rate in 2021 at 23.5, followed by White Non-Hispanic females at 20.7, and then Black females at 20.0.

In addition to race/ethnicity and sex, opioid-related deaths also vary across several different axes. Unemployed individuals and those living in poverty are at greater risk of having a fatal opioid overdose (Altekruse et al., 2020). There is also substantial geographic variation in overall rates and the disparities that exist between demographic

groups, creating what some scholars have called sub-epidemics (Lippold & Ali, 2020). Research has shown that rural counties may be more likely to face problems with prescription opioid mortality, while urban areas, with easier access to the interstate or other ports, may have larger problems with synthetic or semi-synthetic opioids, like fentanyl and heroin (Peters et al., 2020). Other work has shown that the most important takeaway from understanding the demographic differences in opioid mortality is that the epidemic does not fit a one size fits all approach. Therefore, it is imperative to invest time and effort into understanding how the epidemic presents itself within regions, states, counties, and communities.

3. *Medication-Assisted Treatment (MAT)*

Several strategies exist to reduce the severity and reach of the opioid epidemic, including harm reduction approaches of needle exchange programs and increased access to Naloxone as well as limiting provider prescriptions for opioids (Green et al., 2015; Penm et al., 2017; Wermeling, 2010). While these are all important strategies for treatment, another approach involves treatment options for dependent individuals to address the root causes of their dependency (Connery, 2015). However, the majority of individuals misusing opioids are not participating in treatment (Grant et al., 2015, 2016; Peterson et al., 2010). This poses a major concern to health professionals looking to address the opioid crisis, particularly due to the availability of a variety of courses of treatment. These vary from committing to an abstinence-based approach, taking medications, and receiving counseling (Fu et al., 2013; Mattick et al., 2009b).

The National Institutes of Health and the U.S. Department of Health and Human Services currently recommend medication-assisted treatment (MAT) for treating OUD (Substance Abuse and Mental Health Services Administration, 2023; U.S. Department of Health and Human Services, 2018). This approach is recommended for addressing the

physical and emotional components of dependency through the combination of medications approved by the U.S. Food and Drug Administration and cognitive and behavioral therapies (Vashishtha et al., 2017).

The earliest references to the use of prescribed medication to treat opioid dependency took place in New York City in the 1960s, when methadone became a medical option to reduce heroin use (Mattick RP et al., 2009). Currently, there are three medications commonly used by medical providers with MAT participants- methadone, naltrexone, and buprenorphine (Maglione et al., 2018). Methadone is an agonist medication to reduce the symptoms of withdrawal that functions by imitating some of the effects of opioids without the euphoric sensation (Rettig & Yarmolinsky, 1995). Legal restrictions limit the dispensing of methadone to opioid treatment programs that are certified by SAMHSA due to the addictive properties still present in methadone (Substance Abuse and Mental Health Services Administration, 2015a).

A second medication used in MAT is Buprenorphine, which is a partial agonist. This means that buprenorphine contains properties similar to a full agonist (such as methadone, morphine, or heroin) but has much lower maximum effects (Wilcock & Twycross, 2013). A physician can prescribe Buprenorphine, which can allow for easier access than methadone because a dependent person needs to access a certified provider rather than an entire clinic (Substance Abuse and Mental Health Services Administration, 2016a). A final medication used in MAT is naltrexone. Naltrexone is an opioid antagonist that blocks the opioid receptors in the body, which takes away the euphoric high associated with opioid use (Substance Abuse and Mental Health Services Administration, 2016b). Unlike methadone and buprenorphine, naltrexone does not have a risk of dependency, therefore any licensed medical provider is legally allowed to write a prescription for naltrexone (Chisolm et al., 2012). However, Naltrexone is only a

possibility for treatment once an individual is completely detoxed from opioids, thus making it not as popular of an option when initiating MAT treatment (Comer et al., 2006). Table 1 provides an overview of the different medications used in MAT as well as the delivery method and the legal restrictions for prescribing the drug.

Table 1. Overview of Medications Used in MAT

Name of Drug	Mechanism	Delivery Method	Legal Restriction
Methadone	Agonist	Oral tablet or liquid	SAMHSA certified opioid treatment program
Buprenorphine	Partial agonist	Oral tablet or extended-release implant	Medical provider licensed by the Drug Enforcement Administration (DEA)
Naltrexone	Antagonist	Oral tablet or injection	None

(Substance Abuse and Mental Health Services Administration, 2023)

In addition to medications, a key component of MAT is cognitive therapy, both in the form of group or individual therapy. The therapy component is also a condition for a program to qualify for the federal requirements of a MAT program. While therapy presents a significant component of MAT programming, there are considerably fewer studies addressing best practices for behavioral therapies. One study did discuss the benefit of engaging in enhanced outreach counseling (identifying individuals previously enrolled in MAT programming but had dropped out) and brief reinforcement based intensive outpatient therapy (which provides incentives such as housing, food stipends, and activities for engaging in therapy) compared to traditional counseling methods (Mayet et al., 2014). While another study found no significant differences in outcomes among MAT participants receiving counseling services weekly in an extended setting compared to brief weekly counseling sessions (Fiellin et al., 2006). This leads to the possibility of the need for future research to continue studying MAT therapy techniques and identifying best practices.

The efficacy of MAT has been well documented and includes outcomes ranging from increased survival and improved measures of quality of life (Mattick et al., 2009a; Molero et al., 2018). Methadone and buprenorphine are associated with a reduction in opioid overdoses when compared to other treatment options, such as inpatient detoxification or behavioral therapy alone (Knopf, 2020; Wakeman et al., 2020). This reduction has been linked to decreasing cravings of individuals taking one of the three MAT medications (National Academies of Sciences, 2019). MAT also decreases illicit opioid use and risky drug use behaviors that could contribute to the transmission of infectious diseases, like hepatitis C (Tsui et al., 2014; Wakeman et al., 2020). Research has shown that individuals in a MAT program have improved rates of graduation from school (Gallagher et al., 2018) and an improved ability to gain and maintain employment compared to other forms of OUD treatment options (Canadian Center on Substance Use and Addiction, 2017; Mattick et al., 2014). Additionally, the behavioral therapy component of MAT is associated with better outcomes than medication treatment alone. This is due to the therapy component contributing to improved retention in long-term therapy (Berry et al., 2021; Timko et al., 2016).

Barriers to MAT

A lack of access to physicians or clinics offering MAT approved medication represents one of the many challenges cited as a barrier to receiving MAT programming. Understanding how clinicians and patients discuss these challenges allows for a complete framework to begin addressing ways to increase MAT enrollment. It is important to note that just because a county has certified providers that does not mean that the providers are engaging in MAT. As many as one in five certified providers do not actively engage in MAT, and as many as 50% do not accept health insurance (Parran et al., 2017).

A variety of barriers exist that contribute to the underuse of MAT programming from both the provider and patient levels. MAT barriers commonly cited by providers are conflicted feelings about the use of medications to reduce dependency. Many medical providers view MAT as simply replacing one addiction with another, especially when recommending Methadone or Buprenorphine (Allen et al., 2019; Wakeman & Rich, 2018). This opinion is so widespread that the SAMHSA has an official statement on its website addressing this issue:

> *"A common misconception associated with MAT is that it substitutes one drug for another. Instead, these medications relieve the withdrawal symptoms and psychological cravings that cause chemical imbalances in the body. MAT programs provide a safe and controlled level of medication to overcome the use of an abused opioid. And research has shown that when provided at the proper dose, medications used in MAT have no adverse effects on a person's intelligence, mental capability, physical functioning, or employability" (Substance Abuse and Mental Health Services Administration, 2015b).*

Furthermore, the American Medical Association now classifies addiction as a chronic condition (i.e. in the same category as diabetes, hypertension, etc.)(Leshner, 2001), following the principles that "as diabetes is a disease of the pancreas, addiction is a disease of the brain" (Smith, 2011). With this framework, the medications for MAT contribute to the daily maintenance of the symptoms of addiction as a chronic disease, which is a very different framework than swapping one addiction out for another.

Patients are also impacted by stigma when it comes to engaging in MAT services. A 2010 survey of 550 pain physicians in the United States found that roughly 50% of

physicians licensed to prescribe methadone listed social stigma as the contributing factor to patients not engaging in MAT based therapies (Shah & Diwan, 2010). Stigma also exists in the way physicians view MAT patients. One study revealed that over 25% of physicians currently not certified in prescribing Buprenorphine had concerns that earning the certification and prescribing Buprenorphine would contribute to medication diversion to family members or friends (Huhn & Dunn, 2017). The idea of stigma serving as a barrier to MAT treatment can be seen in other literature from the patient's perspective as well. Shame and stigma prove influential in actively seeking treatment for opioid use disorder through fears of losing family support, losing custody of children, immigration status, and the financial burden through medical costs or missing work for treatment (Gueta, 2017). This feeling of stigma was of concern for being stigmatized by both their family, friends, and peers as well as the medical providers administering treatment (Nyamathi et al., 2007). One study that used focus groups to discuss why individuals either never opted to begin MAT treatment or ended their treatment before completing the program found that "some doctors and nurses also looked down on them and do not want anything to do with drug-addicted patients, making them feel as if they are a 'cockroach or something'; demonstrating 'no warmth . . . no compassion" (Nyamathi et al., 2007).

Structural barriers to MAT also contribute to low use among patients and providers. For patients, structural barriers can include access to MAT services in terms of geographic proximity as well as access through insurance coverage. This often contributed to logistical barriers with insufficient funding for the programs themselves as well as a shortage of doctors willing and able to provide the services (H. Knudsen et al., 2010). Those living in low-income or rural areas tend to have reduced access to a MAT treatment facility or provider within a reasonable distance to receive care (Hansen

et al., 2011). Even if an individual has a clinic or provider licensed to write prescriptions for MAT there is also the challenge of the cost of care and lack of insurance (Meinhofer & Witman, 2018). Studies have shown increased utilization of MAT in states that have undergone Medicaid expansion (Meinhofer & Witman, 2018; Mohlman et al., 2016). Similarly, the Affordable Care Act (ACA) increased access to substance use disorder treatment that moves beyond the scope of Medicaid expansion. The ACA also required an expansion of the 2008 Mental Health Parity and Addiction Equity Act, which mandated that private insurance companies cover treatment for substance use disorders in a way that parallels their coverage for other medical or surgical procedures (Abraham et al., 2017).

Structural barriers also exist for physicians that might contribute to lower use of MAT. Some physicians worry about the time commitment associated with MAT. Logistical barriers, such as inadequate funding or already having a full patient load, can prevent providers from engaging in MAT services due to perceptions that it is a complicated process (H. Knudsen et al., 2010). A strategy to improve provider buy-in argues the need to integrate substance abuse identification and treatment more directly into medical and nursing school curriculums (H. K. Knudsen et al., 2011; Lien et al., 2021). In response to a push for training students on MAT, SAMHSA granted a $450,000 grant to the University of Massachusetts Medical School to develop and pilot a MAT training program for medical, nurse practitioner, and physician assistant students (Gray, 2018). Integrating education and training about MAT and substance abuse in general during schooling could address the scarcity of providers knowledgeable and able to engage in MAT programming (Volkow et al., 2014). There were only eight medical schools in the United States that required courses on substance abuse treatment in 1992 (Fleming et al., 1994). By 2016, this had increased to 136 of the 141 medical schools

identifying substance abuse as part of the curriculum in required courses, but it is unknown to what extent substance abuse is included and if substance abuse treatment, such as MAT, has a role in this curriculum (Association of American Medical Colleges, 2016).

The financial impact on providers may be another barrier to MAT, highlighting how policy acts as a structural barrier. With the expansion of Medicaid in many states and the requirement that Medicaid and Medicare plans cover substance dependency treatment, many states saw an increase in Buprenorphine prescriptions and reimbursements (Sharp et al., 2018), some as much as 70% after expansion (Meinhofer & Witman, 2018). While increasing access to coverage is seen as a positive for getting more individuals enrolled in MAT, this push from Medicaid policies may be financially problematic for doctors. This is because Medicaid tends to reimburse providers less than private insurance companies (American Medical Association, 2016). Studies have also explored payment delays in Medicaid reimbursement reducing a physician's likelihood to serve Medicaid patients (Cunningham & O'Malley, 2009). The financial aspect of not getting reimbursed as much money for MAT services compounds with the stigma still associated within the medical community surrounding MAT in terms of it exchanging one dependency for another or enabling medication diversion to friends and family.

SAMHSA is tasked with the accreditation process for clinics to prescribe methadone and, until January 2023, certified individual providers with a document called an X-Waiver to prescribe buprenorphine (Substance Abuse and Mental Health Services Administration, 2019). SAMHSA works in conjunction with the Drug Enforcement Administration (DEA) to make sure providers are following proper channels in their prescribing practices. Under the Controlled Substances Act, providers can prescribe medications to address opioid dependency if they 1) have the proper

certifications; 2) Use drugs approved by the Food and Drug Administration; 3) Use appropriate counseling services; 4) meet patient limit guidelines (<30 for the first year and <250 after that); and 5) Keep detailed records of MAT prescriptions and treatment plans according to DEA guidelines (United States Department of Justice, 2018). The collaboration between the DEA and SAMHSA also opens up the possibility of a medical audit (McClure et al., 2011). The DEA can make unannounced inspections at clinics or offices with providers prescribing MAT medication that can result in a $10,000 fine, suspension of license, or prison time if a provider is found negligent and non-compliant (United States Department of Justice, 2018). Fears of the regulations placed on providers engaging in MAT medication and potential repercussions from a DEA audit could contribute to the lack of buy-in seen among providers to engage in MAT programming.

Contributions of this Research to Opioid Research

This dissertation explores three avenues for mitigating the opioid epidemic in the United States (1.) How can researchers and public health professionals identify areas most in need of treatment for OUD in an easy-to-use and publicly accessible interface?; (2.) What do practitioners see as opportunities for reducing barriers to treatment?; and (3.) Why do differences in opioid mortality exist between demographic groups?

Chapter 2 (*Developing an Interactive Online Opioid Treatment Dashboard: Metric Development to Visualization*) focuses on developing an online dashboard tool that highlights clusters of counties in the United States with the highest unmet need for MAT. While all communities may benefit from increased MAT services, limited resources and funding are available to address the opioid problem. To assist policymakers in identifying counties with the greatest unmet need for opioid use disorder (OUD), we developed a dashboard in ArcGIS Online, which provides county-level statistics and

metrics related to both current need and MAT provision. We calculated an unmet need metric--the ratio of the number of opioid providers to the standardized opioid mortality rate--using public data from the Centers for Disease Control and Prevention (CDC) and SAMHSA. Pinpointing counties with the highest unmet need allow for a deeper dive into those specific communities, which can lead to more specific steps to address opioid treatment in that county. The dashboard approach also makes the data easily accessible and puts data directly into the hands of policymakers and practitioners.

Chapter 3 (*Improving Systems of Care for Individuals with Opioid Use Disorder in New Mexico*) looked to identify what practitioners see as opportunities for reducing barriers when it comes to the opioid epidemic. To understand the barriers and opportunities for improving access, I conducted semi-structured interviews with stakeholders (medical providers, peer support specialists, public health practitioners, etc.) in three New Mexico counties with high unmet MAT need. Many strategies exist to mitigate the impact of the opioid epidemic, but practitioners may have the best insight into the specific needs of their communities. Interview questions focused on the current treatment landscape in their counties, strategies they have seen to increase MAT options in their county, and the optimal treatment future in their county. Findings from these interviews contributed to the development of a policy brief that will be shared within the New Mexico public health, medical, and legislative sectors. The policy brief highlights nine key strategies to increase MAT options. An optimal MAT landscape could incorporate many of these nine key strategies. New Mexico policymakers and practitioners can use this policy brief to brainstorm solutions to improve systems of care and MAT provision.

Chapter 4 (*What Causes Race/Ethnicity and Sex Demographic Differences in the Opioid Epidemic? A Systematic Review*) moves from the unmet need of MAT to focus on

the unmet attention of opioid mortality demographic differences. Prior research over the last several decades shows evidence that opioid-related mortality varies by race/ethnicity and sex (as noted in the *Current Opioid Mortality Statistics section)*, but little is known about why these demographic differences exist. Chapter 4 discussed a systematic review of articles published from 1995-2020 that reported demographic differences in opioid mortality. The purpose of this chapter is to explain that studies should look beyond identifying demographic differences in opioid-related mortality to understand why those differences exist. That way we can find ways to reduce the inequities in opioid-related mortality moving forward.

CHAPTER 2

DEVELOPING AN INTERACTIVE ONLINE OPIOID TREATMENT DASHBOARD: METRIC DEVELOPMENT TO VISUALIZATION

Abstract:
The latest estimates show that roughly 188 individuals in the United States die every day due to an opioid-related overdose. The National Institutes of Health and the U.S. Department of Health and Human Services recommend medication-assisted treatment (MAT) as the gold standard for treating opioid use disorder. While all communities might benefit from increased MAT services, limited funding and resources exist to address the opioid problem. To assist policymakers in identifying counties with the greatest unmet need for opioid use disorder (OUD), we developed a dashboard in ArcGIS Online, which provides county-level statistics and metrics related to both current need and MAT provision. Data from publicly available datasets through the Centers for Disease Control and Prevention (CDC) and the Substance Abuse and Mental Health Services Administration (SAMHSA) were used to calculate an unmet need metric--the ratio of standardized opioid mortality rate to the number of providers per person. Calculating this metric, as well as other variables included in the dashboard, like prescribing and mortality rates, at the county level allows for a comparison of the treatment landscape across and within state boundaries. Discussions with policymakers and practitioners informed the included data and data visualization to maximize dashboard applicability for advocacy, grant applications, policy development, and education. The dashboard allows community stakeholders, practitioners, and policymakers to review and interact with substantial amounts of valuable information at a glance, empowering them to make data-driven decisions.

Introduction:

Opioid Use Disorder and Medication-Assisted Treatment

"We know what works. The problem is we aren't doing enough of it (Murthy, 2017)." These were the words used by former United States Surgeon General, Dr. Vivek Murthy at the 2017 National Prescription Drug Abuse and Heroin Summit in Atlanta, Georgia to describe current efforts in opioid dependency reduction strategies (Centers for Disease Control and Prevention, 2021a). Previous research on the opioid epidemic has affirmed this statement (Barnett, 2006; Desapriya & Ratnaweera, 2017; Horn, Pack, Trestmann, & Lawson, 2018). Latest estimates show that roughly 188 individuals in the United States die every day due to an opioid-related overdose with almost 1 million total deaths since 1999 (Centers for Disease Control and Prevention, 2023).

A dependency on opioids, called Opioid Use Disorder (OUD), is a diagnosable condition using the Diagnostic and Statistical Manual of Mental Health Disorders, 5th Edition (DSM-5). A person has diagnosable OUD if they meet at least two of 11 criteria over 12 months (American Psychiatric Association, 2013a). Criteria include but are not limited to, taking more opioids than intended; failing to carry out important roles at home, work, or school because of opioid use; withdrawal symptoms when opioids are not taken; or giving up or reducing other activities because of opioid use (American Psychiatric Association, 2013b). The number of items out of the 11 measurements a patient identifies with influences the severity of their OUD. If a patient is identified with 2-3 measurements, they have mild OUD, 4-5 measurements are moderate OUD, and six or more measurements are considered severe OUD.

The National Institutes of Health and the U.S. Department of Health and Human Services currently recommend medication-assisted treatment (MAT) for treating OUD (Substance Abuse and Mental Health Services Administration, 2023b; U.S. Department

of Health and Human Services, 2018). As a two-pronged treatment option, this approach is recommended for addressing the physical and emotional components of dependency through the combination of medications approved by the U.S. Food and Drug Administration and cognitive and behavioral therapies. (Substance Abuse and Mental Health Services Administration, 2023b; Timko et al., 2016). There are currently three medications commonly used by medical providers with MAT participants- methadone, naltrexone, and buprenorphine (Maglione et al., 2018). The type of MAT pharmaceutical does not seem to impact criminal justice outcomes (Evans et al., 2019), but recent work has found that buprenorphine may be more effective at reducing opioid cravings (McAnulty et al., 2022) and lowering all-cause and suicide mortality compared to methadone (Gottlieb et al., 2023). While Naltrexone is also an effective MAT option, Naltrexone is only a possibility for treatment once an individual has not consumed any opioids for 7-14 days, which can present a challenge for early-stage dependency management (Substance Abuse and Mental Health Services Administration, 2022b). SAMHSA works in conjunction with the Drug Enforcement Administration (DEA) to make sure providers are following proper channels in their buprenorphine prescribing practices.

Qualified buprenorphine prescribing practitioners include Physicians, Nurse Practitioners (NPs), Physician Assistants (PAs), Clinical Nurse Specialists (CNSs), Certified Registered Nurse Anesthetist (CRNAs), and Certified Nurse-Midwifes (CNMs) (Substance Abuse and Mental Health Services Administration, 2023a). The Substance Abuse and Mental Health Services Administration (SAMHSA) is tasked with the accreditation process for clinics to prescribe methadone and, until January 2023, certified individual providers with something called an X-Waiver to prescribe buprenorphine (Substance Abuse and Mental Health Services Administration, 2019).

This work will discuss the X-Waiver because identifying buprenorphine prescribing certified individuals played a pivotal role in this research.

The efficacy of MAT has been well documented and includes outcomes like improved patient survival, an increase in the ability to gain and maintain employment, and a decrease in opioid misuse (Mattick et al., 2009; Molero et al., 2018). Despite the proven efficacy of MAT, current estimates show that roughly 30-40% of all counties in the United States do not have any providers licensed to prescribe buprenorphine. That percentage increases to roughly 54% when looking specifically at rural counties. (Andrilla & Patterson, 2022). Estimated from 2019 showed that fewer than 35% of individuals with OUD received dependency treatment in 2018 (Jones & McCance-Katz, 2019).

Existing Efforts to Provide Opioid Data

It is possible for stakeholders to obtain data through many different strategies. One such strategy is providing data in dashboards. Data dashboards facilitate the visualization of relevant health information from various sources in an accessible, digestible, and timely manner (Concannon et al., 2019; Dasgupta & Kapadia, 2022). Dashboards are often developed as a way to monitor pressing health issues (e.g. the ongoing COVID-19 pandemic) (Dong et al., 2020; Fareed et al., 2021; World Health Organization, 2022), yet minimal examples of comprehensive federal dashboards of the opioid epidemic in the United States exist (Drake, *unpublished data*). Most monitoring of opioid-related data has been done at the state level (Centers for Disease Control and Prevention, 2022a; Kaiser Family Foundation, 2023). This type of monitoring provides state-level data for all 50 states. Federal public health surveillance data are typically presented at the state level, however, such a broad classification system can obscure the variations affecting communities within states. The opioid epidemic is an example of

how not understanding these community nuances can distort our understanding of opioid epidemic patterns. For example, research has shown substantial differences can exist in prescribing rates within a state, depending on the county or city (McDonald et al., 2012; Sears et al., 2020). Medical care and transportation may also be less reliable in rural areas than in urban areas, contributing to a difference in the opioid epidemic's presentation within the same state (Monnat, 2019; Wunsch et al., 2009). The federal government could make it easier to access opioid-related data at county levels, similar to the surveillance reporting that was available during the COVID-19 pandemic (Centers for Disease Control and Prevention, 2022c).

Focusing on opioid data for more fine-grained geographic areas is available in select contexts. Most dashboards that provide county-level data typically focus on counties within a single state. Typically, these dashboards come from the respective state health departments of the counties being represented. While these dashboards provide data at smaller geographic areas, having individual dashboards from a state's health department has several limitations. First, opioid-related data is presented at different geographic scales across states. Second, metrics displayed are different because the process of data collection and analysis can vary from state to state. For example, the states of Arizona and Wisconsin both have opioid-related dashboards that present opioid mortality in each of the state's counties. However, these county-level measures are not directly comparable because they were not analyzed in the same manner. The Arizona dashboard displays total opioid mortality (Arizona Department of Health Services, 2022), while Wisconsin displays only opioid type-specific mortality rates (Wisconsin Department of Health Services, 2022). The functionality of county-level data is limited when it is not comparable across state boundaries.

What Policymakers and Practitioners Want

As noted above, most studies use opioid mortality rates to indicate areas of high need for opioid intervention (Arizona Department of Health Services, 2022; Kaiser Family Foundation, 2023; Wisconsin Department of Health Services, 2022). I consulted with key stakeholders (medical providers, public health workers, community organizations, and research groups) in Arizona, New Mexico, and California to determine the types of data platforms they would want in their work. The goal of these conversations was to improve on existing approaches to opioid data and visualization by focusing on the types of data needed and how people want to interact with that data. First, stakeholders expressed the importance of having access to a data platform that is free and easily accessible. Second, they discussed the need for data at finer-grain geographic levels across state boundaries. A public health professional in New Mexico spoke of the desire to compare treatment options in their rural county to other rural counties in New Mexico and the neighboring states of Arizona and Texas. With a grant deadline nearing at the time of our conversation, they thought comparing data in their county to other rural counties of similar size in the southwest could strengthen their grant application. However, they were not aware of any platform with that type of data. Stakeholders also discussed a desire for a platform with various data they could use for grant writing, reports, policy development, education, and advocacy. This was noted as being especially important with data that are currently unavailable to them or difficult to interpret.

Finally, the stakeholders I spoke with consistently mentioned increasing access to MAT as a topic of high priority. They also reiterated that researchers, professionals, and policymakers often must reconcile the need for increasing MAT options with the reality of limited financial, labor, and time resources. There was a desire for a more

comprehensive system to assess MAT access (in addition to mortality rates) through an interactive dashboard platform. Three main priorities emerged from these stakeholder discussions. Stakeholders were interested in a platform that was 1) easy to use; 2) flexible (meaning there were multiple data to choose from; and 3) put the data directly into their hands. We focused specifically on one metric of interest to policymakers—the unmet need for MAT.

We aimed to achieve these three priorities and provide a more comprehensive metric of MAT provision that went beyond mortality rates. To do this, we developed a measure of unmet need of MAT. The aim of this measure was to pinpoint high-priority areas for targeted intervention. This dashboard also looked to provide county-level data for the entire United States, allowing for a comparison of counties in different states. In addition to using a metric beyond mortality to access MAT provision, this dashboard also includes other useful data, like prescribing and mortality rates.

Developing an Unmet Need of MAT Metric

Developing the metric required several decisions. A ratio provides a calculation that would allow for a single comparative number for all counties in the United States. The ratio uses the problem (as it relates to OUD treatment) as the numerator and resources available to fix the problem as the denominator.

$$\text{Unmet Need of MAT} = \frac{The\ problem}{Resources\ available\ to\ fix\ the\ problem}$$

Estimating this metric requires both a denominator and numerator that are readily available for many U.S. counties. This required identifying appropriate datasets to use to calculate the metric. Datasets had to meet certain criteria to meet metric needs, this included being publicly available, having data at the county level, and having data

about the problem (as it related to OUD treatment) or an attempt to fix the problem. Initially, opioid overdose data was considered for the problem (as it related to OUD treatment). However, hospitalization and emergency management data are not easily accessible to the public. Looking specifically at mortality presented another option for a metric looking at the problem (as it related to OUD treatment). Mortality could be simplified to representing risk and opioid-related mortality is available at the county level through CDC Wonder. CDC Wonder is an integrated information system that provides a variety of health information, including mortality data from death certificates (Centers for Disease Control and Prevention, 2022b).

That then left the identification of a dataset with county-level data on attempts to mitigate risk. The number of opioid-related public health programming and education campaigns or the efficacy of the programming and education efforts provide one possible metric, but those are difficult to quantify and track at a county level. That shifted the focus from risk mitigation to care provision. Buprenorphine was chosen as the proxy for care provision due to its documented efficacy in treating OUD. Since providers need the X-Waiver to prescribe buprenorphine, SAMSHA has a database of all waivered providers in the United States available publicly on their website using their "Buprenorphine Practitioner Locator" feature (Substance Abuse and Mental Health Services Administration, 2022a).

The county-level data from the CDC Wonder and SAMHSA are publicly available and easily accessed. Using mortality as a proxy for risk and the number of buprenorphine waivered providers as a proxy for care provision allows for the calculation of the unmet need of MAT metric.

Unmet Need of MAT =

$$\frac{Risk\ (mortality)}{Care\ Provision\ (\#\ of\ providers)}$$

After the identification of the CDC Wonder and SAMHSA datasets, conversations with researchers, public health practitioners, and policymakers confirmed the practicality of this type of metric. They also provided feedback on other pieces of information that would be helpful in an interactive online dashboard. This included information already collected for the metric, for example, the opioid-related mortality rate for a given county. It also included identifying other data useful for education, grant applications, or advocacy, such as county-level opioid prescribing rates, which are released yearly by the CDC.

Data Collection and Cleaning

Risk Metric (Opioid Mortality Rates)

The Multiple Cause of Death database in CDC Wonder allows for queries grouped by U.S. counties (n=3,142) to assess crude and age-adjusted mortality rates based on selected ICD-10 codes. SAMSHA provides training materials that direct researchers on the proper combination of ICD-10 codes to use in the query to accurately calculate opioid-related mortality rates related to accidental poisoning (Substance Abuse and Mental Health Services Administration, 2018). The mortality analysis used X40-X44[1] values for the underlying cause of death and T40.0- T40.6[2] codes for the contributing

[1] X40: Accidental poisoning by and exposure to non-opioid analgesics, antipyretics and anti-rheumatics; X41: Accidental poisoning by and exposure to antiepileptic, sedative-hypnotic, anti-parkinsonism and psychotropic drugs, not elsewhere classified; X42: Accidental poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified; X43: Accidental poisoning by and exposure to other drugs acting on the autonomic nervous system; X44: Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances

[2] T40.0: Poisoning by Opium; T40.1: Poisoning by Heroin; T40.2: Poisoning by Other Opioids; T40.3: Poisoning by Methadone; T40.4: Poisoning by Other Synthetic Narcotics; T40.6: Poisoning by Other and Unspecified Narcotics

cause of death. Opioid mortality rates were calculated based on 2017-2021 data, which represented the most recent data available at the time of analysis. About two-thirds of US counties had suppressed (n=1,549) or unreliable (n=412) rates according to CDC Wonder. Unreliable rates included a total number of deaths in a county as well as the population included in the CDC Wonder dataset. The mortality rates were manually calculated for these unreliable counties. The number of suppressed counties varied greatly by state, with some states having nearly all counties suppressed (e.g., 96.8% of Nebraska counties and 95.5% of South Dakota counties) and others having few counties suppressed (e.g., 8.1% of New York counties and 9.1% of Ohio counties). There are also 6 states (CT, DE, ME, NH, NJ, and RI) and the District of Columbia that had data for all counties from CDC Wonder.

Calculating opioid mortality for suppressed counties involved a multistep process. First, a state-level query in CDC Wonder calculated the total number of opioid-related deaths and the state population over the 2017-2021 period. Next, the sum of opioid deaths among counties with calculated data were tabulated for each state. The difference in opioid deaths from the total number of deaths in a state and the deaths from non-suppressed and unreliable counties gave a residual number of deaths. These residual deaths were used as the number of opioid-related deaths in the suppressed counties. Each state's suppressed county population was added together. This gave a single variable of the total number of deaths in suppressed counties per state and the total population of suppressed counties per state. The number of deaths and total population of suppressed counties made it possible to calculate a mortality rate that could be applied to all suppressed counties in each state. Now, every county in the United States had an opioid mortality rate either through the CDC Wonder calculation or this suppressed county workaround.

Care Provision Metric (Number of Providers)

SAMSHA has a publicly available database of all providers with the X-Waiver to prescribe Buprenorphine. This database includes the provider's full address, including state and county name. This allowed for calculating the number of buprenorphine waivered providers standardized by population for each United States county. This analysis approach was developed before the removal of the X-Waiver requirement in January 2023.

Building a Single Dataset

Counties were matched across datasets by county name and state abbreviation. This required a minimal amount of hand matching typically due to slight variations in spelling (e.g., De Kalb County, GA vs DeKalb County, GA) or changes to county names and boundaries. Only one major change to Census areas at the county level occurred during the 2017-2021 period of data analysis. In 2019, Valdez-Cordova Census Area, Alaska split to form two new county-equivalents, Copper River and Chugach Census Areas (US Census United States Census Bureau, 2022). However, both the CDC Wonder and SAMHSA datasets provided data for the now obsolete Valdez- Cordova Census Area rather than Copper River and Chugach. In this case, the risk and care provision metrics for Valdez-Cordova Census Area were applied to Copper River and Chugach Census Areas for the dashboard until both counties have their own data publicly available.

Handling Zero Denominators

The merged dataset included the data from both the CDC Wonder query and the SAMSHA provider database. For a county to have a ratio of risk-to-care provision, there needed to be at least one X-waivered provider in that county. Counties without a waivered provider were coded in one of two ways:(1) having no provider and a low

opioid-related mortality rate (<=10.0) and (2) having no provider and a high opioid-related mortality rate (> 10.0).

The process of designating a county as having high unmet need of MAT involved a two-step process. First, all counties with a mortality rate below 10.0 were designated as low-mortality counties and those with a mortality rate of 10.0 or above were designated as high-mortality counties. After imputations of the crude rates for all of the unreliable and suppressed counties, the median mortality rate per 100,000 was 8.02, while the mean was 12.27. A morality rate of 10 was selected as the cutoff as a salient number that roughly meets centrality tendencies.

Next, counties with a mortality rate above 10 were divided into unmet need categories based on the unmet need metric for each county. The county unmet need calculations were separated by 0-0.24; 0.25-0.99; 1.0-.199; 2.0-3.99; and greater than 4.0. If a county had a mortality rate below 10 or an unmet need metric between 0-0.24 that county was classified as having "low mortality or low unmet need of MAT." If a county had a mortality rate above 10 and an unmet need metric of 0.25-0.99 it was designated as "high mortality and slightest unmet need of MAT." If a county had a mortality rate above 10 and an unmet need metric between 1.0-1.99 it was designated as "high mortality and slight unmet need of MAT." If a county had a mortality rate above 10 and an unmet need metric between 2.0-3.99 it was designated as "high mortality and high unmet need of MAT." Finally, if a county had a mortality rate above 10 and an unmet need metric above 4.0 it was designated as "high mortality and highest unmet need of MAT." The unmet need of MAT calculations was divided into seven tiers as shown in Table 1 below.

Table 2. Classification of unmet need categories used in the dashboard.

Mortality Rate (per 100k)	**Unmet Need Metric**	**Classification**
< 10.0	Any value	Low mortality or low unmet need of MAT
>10.0	< 0.25	Low mortality or low unmet need of MAT
	0.25-0.99	High mortality and slightest unmet need of MAT
	1.0-1.99	High mortality and slight unmet need of MAT
	2.0-3.99	High mortality and high unmet need of MAT
	> 4.0	High mortality and highest unmet need of MAT
	Not calculated due to no known providers	High mortality, but no known providers

In determining the cutoffs for unmet need metrics, the aim was to highlight hotspot counties without oversaturating the dashboard map, making it difficult to identify areas of greatest need. The selected cutoff meant that the categories of high

mortality with some level of unmet need all had roughly 130-330 counties assigned to each cutoff.

These classifications create a two-stage process to decide whether a place has high need of MAT. The first focuses on mortality and the second focuses on the unmet need metric.

The previous common strategy of data platforms focusing on the mortality rate would highlight counties such as Floyd County, Kentucky as needing prioritization of increasing treatment efforts. Floyd County had a 2017-2021 crude mortality rate of 35.3. At the time of data analysis, Floyd County had 34 waivered buprenorphine providers for a standardized rate of nearly 96 providers per 100,000 population. This is an example of an area having a problem with opioid-related morality but access to treatment may not be the top priority. Further investigation into Floyd County using the dashboard data reveals a 2020 opioid prescribing rate of 133.4, which is the 40th highest opioid prescription rate of any county in the United States. Public health and policy efforts in Floyd County, KY may be better served by focusing on addressing prescribing practices rather than the number of providers engaging in MAT.

Furthermore, in the same way the two-stage process is important to look beyond just mortality rates, it is also necessary to look beyond the unmet need metric. For example, Victoria and Angelina Counties in Texas both have unmet need metrics of 3.0, which would place them in the high unmet need category based on the previously described cutoffs. However, the opioid mortality rates in Victoria and Angelina, TX are 3.27 and 3.46, respectively. This shows an example of counties that may need more providers when looking strictly at the current landscape of MAT (both Victoria and Angelina, TX only had 1 waivered provider each at the time of analysis), but the low mortality rates indicate that the opioid epidemic may not be impacting these counties as

severely as other counties in Texas. If the goal of the dashboard is to help highlight counties in the United States broadly, or even within state boundaries that could benefit from a prioritization of MAT efforts, the two-stage process helps to complete that goal.

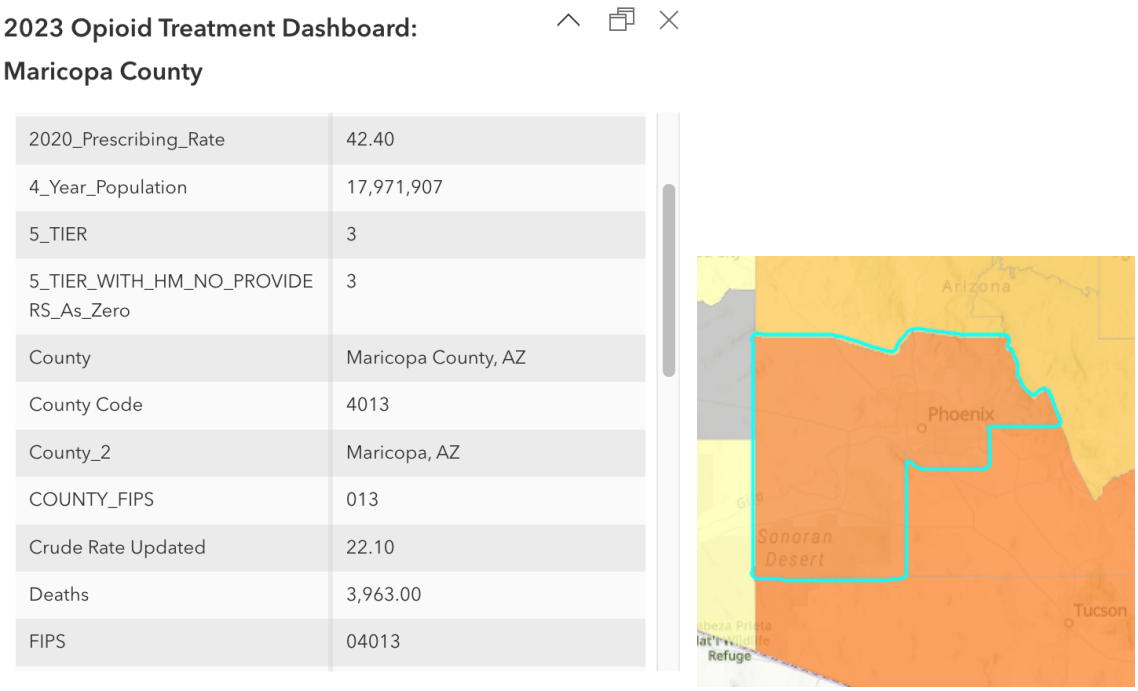
Building the Interactive Dashboard

To achieve this first aim of designing a platform that is easy to use, we embedded the final dataset into ArcGIS Online. ArcGIS Online is a free and publicly accessible platform, making it simple to share information among all stakeholders and community members. ArcGIS Online is also a user-friendly platform with many guides and tutorials available for users. By hosting the dashboard on this free and publicly available platform, we achieved the third aim of putting data directly into stakeholders' hands. Everyone with an email and an internet connection has access the dashboard and all of the data it contains.

Creating the dashboard in ArcGIS Online involved using the Environmental Systems Research Institute, Inc. (ESRI) counties layer and matching on FIPS codes to bring in the unmet need dataset. For the symbology of the dashboard map, counties without any waivered providers were separated from the color gradient and highlighted in grey. Upon designation of tiers, the map was stylized with a gradient of colors with the lighter colors representing the tiers with lower unmet need and the darker colors representing the tiers of highest unmet need of MAT. Data that stakeholders identified as useful for their work were also included in the dataset to achieve the second stakeholder goal of having a flexible data platform. For example, opioid prescribing rates for each county were added to the dataset in response to a stakeholder saying they had been looking for prescribing rate data for a grant proposal the previous year but could not find any. Having other data points in the dashboard, such as prescribing rates and the number of providers standardized by population, allows stakeholders the flexibility to in

having different data options to assist in their work. Unlike the unmet need metric, other flexible data points, such as prescribing rate, do not have a color gradient visualization, but individuals can click a county on the map to view a table with those data points. A screenshot of the other data points available in the dashboard is shown in Figure 4. This figure shows other data points, like the mortality and prescribing rates for Maricopa County, Arizona.

Figure 4. Screenshot of the dashboard for Maricopa County, AZ



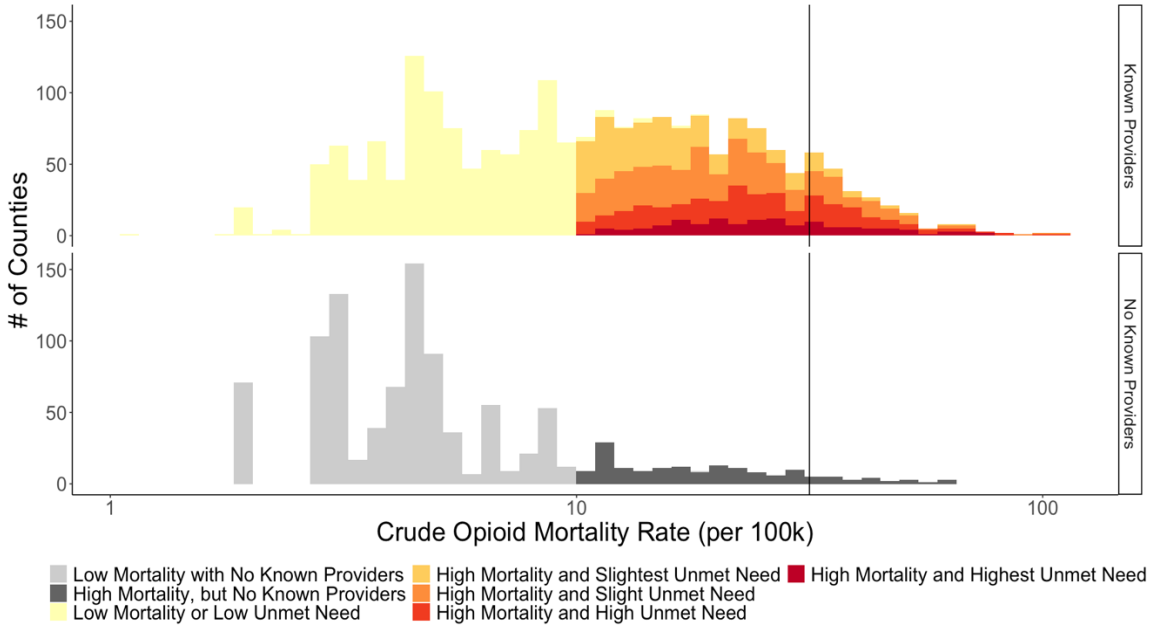
Results

Unmet Need Metric, Crude Mortality Rates, and Standardized Provider Rates

The development of the dataset and subsequent dashboard allows for a single variable that can compare the need of treatment for opioid use disorder across all United States counties. Results of the calculated metrics ranged from 0- 16.6 with an average

unmet need ratio of 1.16 and a median of 0.76. Figure 5 shows stacked histograms of the crude mortality rate for counties with and without a known buprenorphine provider.

Figure 5. Histograms of unmet need of MAT crude opioid mortality rate by US county.



The coloring of these histograms corresponds to the colors used in the dashboard platform to identify the different tiers of unmet need. The darker a county is highlighted, the more unmet need for MAT that county faces. The black vertical line signifies the 90th percentile cutoff. Therefore, if practitioners prioritized the top 10% of counties with the highest opioid mortality rates, many areas designated as high and highest unmet need with the new metric would not be captured. If stakeholders were only to look at the top 10% of opioid mortality rates, a majority of counties identified as having very high unmet need would be missed according to our metric (62% of counties of highest unmet need counties and 64% of high unmet need counties).

Surprisingly, most counties without a known buprenorphine provider do not have high opioid mortality rates. There are, however, some counties in darker gray with no known providers and high mortality rates that might be important to target MAT efforts.

Figure 6. Histogram of buprenorphine providers by number of US counties standardized by population.

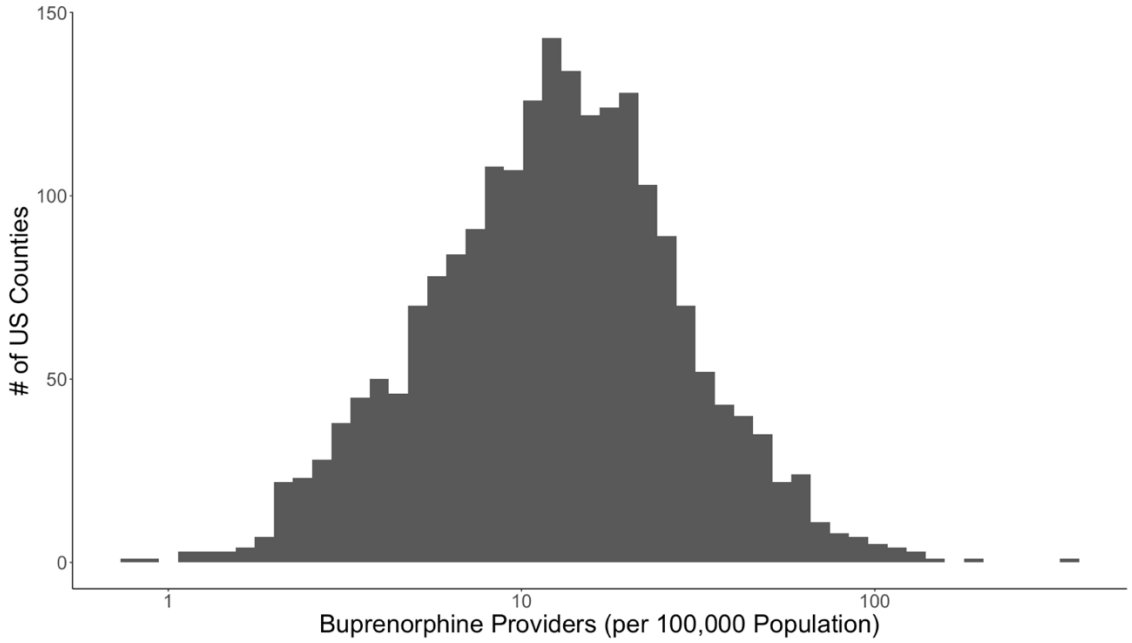
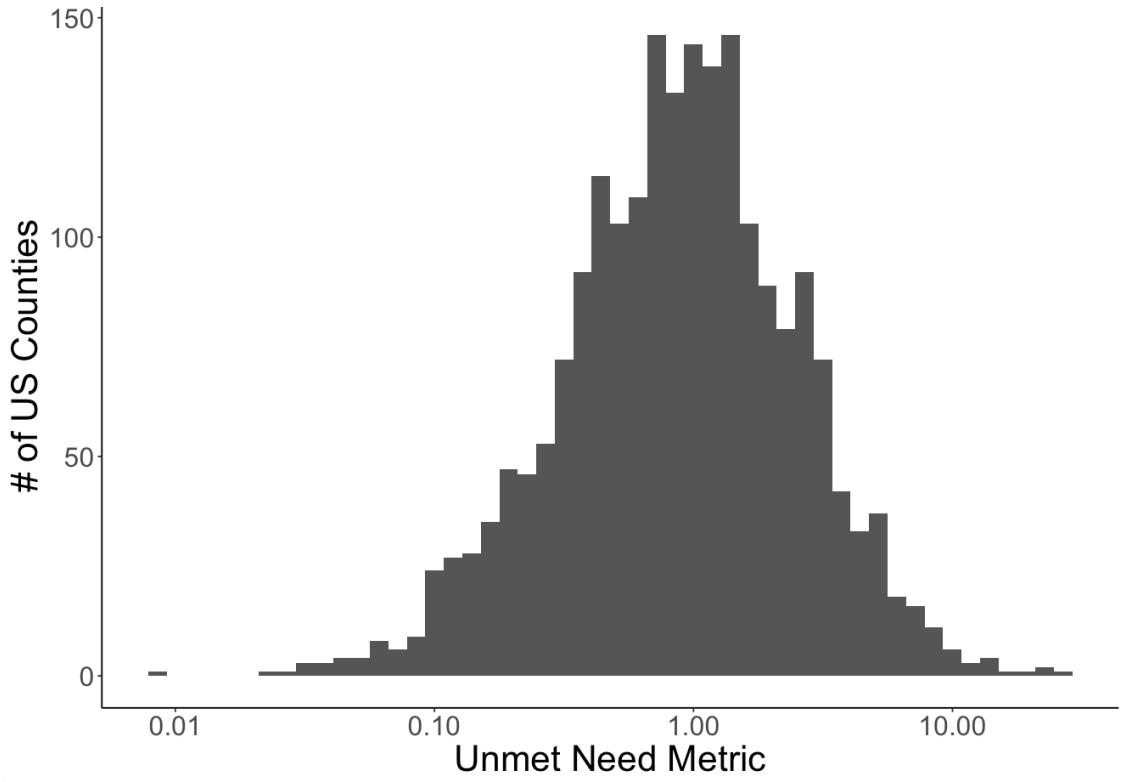


Figure 6 highlights the number of buprenorphine waivered providers standardized by population. The standardized provider metric was only calculated for counties with at least one known Buprenorphine provider. 1,037 counties did not have a known buprenorphine provider compared to 2,108 counties that did have at least one known provider. The range of standardized provider rates across the United States was 0.80 per 100,000 population (King County, TX) to 366.97 per 100, 000 population Hidalgo.,

TX. The mean standardized provider rate of counties with a known provider was 17.36 and the median was 12.64.

Figure 7. Histogram of unmet need metric



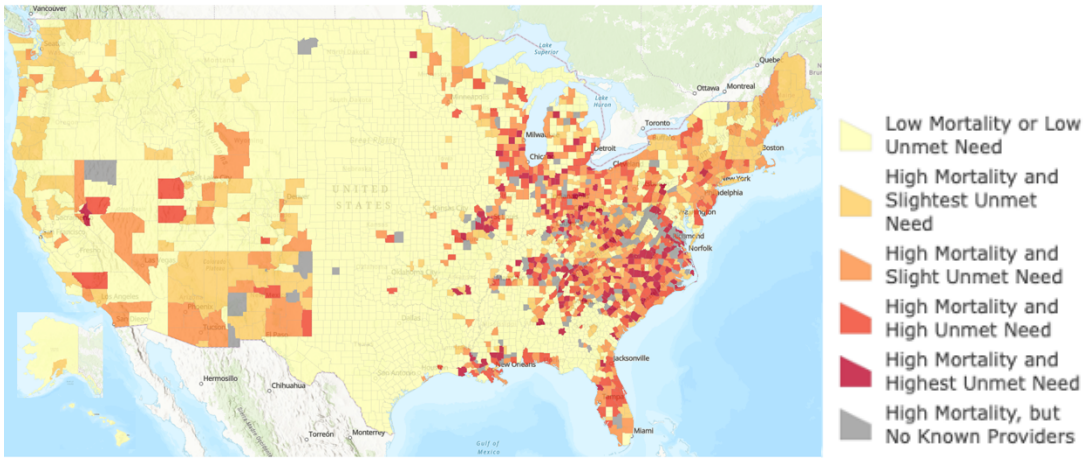
Finally, the histogram of the unmet need metric shows the unmet need calculations for counties with at least one known provider. The range of the unmet need metric was 0.008-26.48. The mean unmet need metric of counties with a known provider was 1.45, and the median was 0.91.

The Dashboard Platform

When someone logs into the ArcGIS Online dashboard, they will see a platform with a United States map with county boundaries, as demonstrated in Figure 8. The darker a county is highlighted, the more unmet need for MAT that county faces. Based on the map following the visualization highlighted in the methods section, it is possible

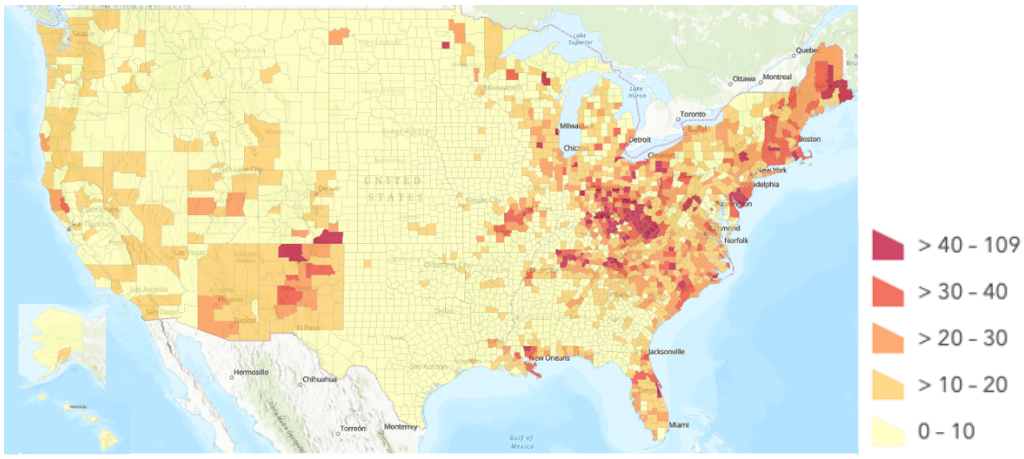
to see pockets of high unmet need throughout the country. The darker colors of counties in parts of the southwest, Midwest, and mid-Atlantic allow for clear visualization of areas facing the high unmet need of MAT. It also allows for the visualization of a vertical stretch in the middle of the country across the plains that do not have a provider with an X-Waiver at the time of data collection. These counties are highlighted in grey, with the darker grey counites representing areas without any known buprenorphine providers but high mortality.

Figure 8. The unmet need of MAT dashboard with counties symbolized based on level of mortality and unmet need.



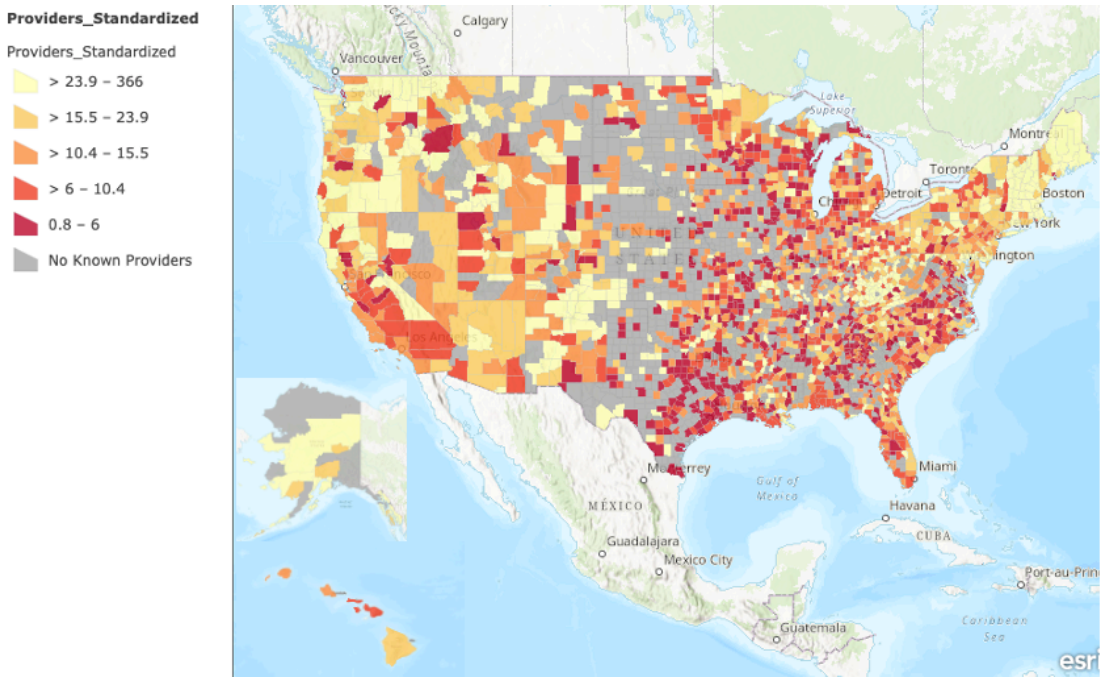
There are 136 counties classified as having the highest unmet need and high mortality in the United States. The 136 counties are found in 21 different states, with Virginia having the most counties (20) with the highest unmet need.

Figure 9. Map of crude mortality rate by county



Compared to the map of the unmet need metric, the map of the crude mortality rate has some similar areas highlighted. However, there are some key differences between areas with the highest mortality (darkest red) and those with high mortality and highest need in Figure 8. For example, New Mexico and Arizona are highlighted as having high mortality and high unmet need in both maps. Similarly, Florida and the Gulf Coast are also identified in both maps. One key difference though is that the counties along the southwestern Louisiana coast are not identified as having high mortality, but they are identified as having high unmet need. There are also pockets in Georgia, Nevada, Indiana, and Virginia that seemingly have lower mortality rates but high or highest unmet need. When looking at New England in the mortality map, much of that region is colored in the darkest red or orange for high mortality. Yet, most of these same counties are not identified as having high unmet need. This shows an example of how focusing solely on mortality rates could take limited resources away from areas with more of a problem with unmet need of MAT.

Figure 10 Map of standardized provider rate by county



In comparison to the unmet need map in Figure 8, the standardized provider map highlights some key differences in areas with the fewest standardized providers (darkest red) compared to areas with high mortality and the greatest need. These calculations take the number of buprenorphine-waivered providers and standardize the number of waivered providers per 100,000 population. While the number of providers is not commonly used to assess the need for MAT, it seems to closely mirror the high unmet need areas in Figure 8 compared to the high mortality areas in Figure 9.

Unmet Need Hotspots

The unmet need of MAT map highlights several hot spot areas in the United States. We see high mortality and high or highest unmet need in pockets around the 4 corners states of New Mexico, Colorado, Utah, and Arizona; western Nevada; a small area along the Gulf Coast stretching from Louisiana to Florida; the Midwest in counties neighboring Lake Michigan; parts of the Atlantic coast stretching from Florida to New

Jersey; and pockets near Appalachia ranging from Northern Georgia up through parts of Tennessee, West Virginia, and Ohio. Table 3 summarizes these hot spot areas.

Table 3. Table of key high and highest unmet need hotspots

Hot Spot Description	Rough Number of Counties	Rough Population Size of Hot Spot	States Included in Hot Spot
4 Corners States	25	7,456,512	AZ, NM, UT, CO
Western Nevada	2	83,243	NV
Gulf coast	19	3,298,029	LA, MS, AL, FL
Atlantic Coast	126	19,058,548	FL, SC, NC, VA, NJ
Pockets of Appalachia	102	10,355,488	GA, TN, NC, WV, OH, PA
Midwest-Lake Michigan	40	7,687,881	MI, OH, IL, WI
Midwest- Eastern Missouri	7	1,166,907	MO

Reasons for Higher Mortality Rates

There may be many reasons some counties have higher mortality rates, and these reasons can vary by local context. Some areas have high opioid prescribing rates, meaning that there are many prescription opioids out in the community (Joynt et al., 2013; McDonald et al., 2012). Research has also found that urban centers and places in close proximity to interstates and highway systems may have easier access to illicitly made opioids such as fentanyl (Dismukes, 2018). Insurance rates in counties can also affect opioid mortality both positively and negatively. Counties with high rates of insured individuals may have an easier time accessing opioid prescriptions through medical

providers (Cahir et al., 2014; Heins et al., 2006). However, insurance can also play a positive role in making it easier for individuals to access MAT if they are insured (Calcaterra et al., 2013; Meinhofer & Witman, 2018).

Reasons for Lower Provision of Care

There are also many reasons why some counties may have a lower provision of care compared to others. Many counties in the US face provider shortages for many types of medical care, including substance use treatment providers (Cloutier et al., 2023; Dick et al., 2015). Especially in rural counties, providers may worry about the time commitment associated with MAT (Polydorou et al., 2008). Insufficient funding for the programs themselves often compounds this time commitment fear, making providers less inclined to engage in MAT services due to a perception that it is a difficult process (Knudsen et al., 2010). Many counties also face challenges surrounding the stigma of MAT (Allen et al., 2019). Many medical providers view MAT as simply replacing one drug dependency with another, especially when recommending Methadone or Buprenorphine (Allen et al., 2019; Wakeman & Rich, 2018).

More specific case studies of hot spot areas are highlighted in the next section. A deep dive into the Eastern Missouri and Western Nevada Hotspots can be found in Appendix 1.

Discussion

Stakeholders in Arizona, California, and New Mexico expressed a desire for a more comprehensive system to assess MAT access (other than mortality rates) through an interactive platform like a dashboard. They were interested in a platform that was 1) easy to use; 2) flexible (meaning there were multiple data to choose from; and 3) put the data directly into their hands. This work looked to achieve the three aims laid out by

stakeholders that would use this type of tool. This user friendly and publicly available dashboard provides county-level data for the entire United States, allowing for a comparison of counties in different states. We developed a measure of unmet need of MAT (opioid mortality rate/provider rate) to move beyond using opioid mortality rate to identify high-risk areas. This measure was designed to identify high-priority areas for targeted intervention. The dashboard includes also other points of data identified by stakeholders as useful, such as opioid prescribing rates.

Results from the unmet need metric showed a more comprehensive view of treatment need in the United States. Calculated data at the state level showed 136 counties classified as having the highest unmet need and high mortality in the United States. These 136 counties were found in 21 different states. When comparing the maps of the unmet need metric and opioid mortality, some counties with the highest unmet need and high morality overlap. However, the unmet need metric does identify counties that would otherwise be missed by only using mortality rate as a proxy for MAT need. Southwest Louisiana along the Gulf Coast, pockets of Georgia, parts of Indiana, and Virginia all have counties that are easier to identify as having high unmet need using the unmet need metric. Compared to using opioid mortality, the unmet need metric also makes it easier to separate potential high-priority areas in the same region. Based on the mortality map, North Carolina and Tennessee both have high mortality rates, making pinpointing areas in need of special attention difficult. The unmet need metric makes it easier to identify counties that may benefit from getting priority of intervention attention.

The focus on identified hotspots also highlights the factors that might contribute to high unmet need. Some areas have high opioid prescribing rates, which means there are a lot of prescription opioids out in the community. Highways and interstates may

also increase access to illicitly made opioids such as fentanyl. Additionally, insurance rates can affect mortality both positively and negatively by making it easier to obtain prescription opioids in the first place, as well as by facilitating treatment for substance use disorders. Identifying hotspots also allows for a better understanding of factors contributing to low care provision. Provider shortages, funding, and time constraints may all influence care provision in high-priority counties. By identifying the hotspots, we can more easily identify counties that require deeper dive context, as is demonstrated by the examples of eastern Missouri and western Nevada.

Applicability of the Metric and Dashboard

Comparing unmet need of MAT across counties can make it easier to identify areas of high priority to increase MAT services. Most counties in the United States may benefit from increasing the number of MAT services available. However, limited financial, personnel, and time resources often require identifying areas of high priority. Public health professionals, medical personnel, and community organizations may benefit from knowing where to focus efforts on increasing MAT.

The developed metric and dashboard allow for a more systematic way to select counties that may benefit from being a first priority of focus. By embedding the dataset into ArcGIS Online, policymakers, community organizations, and practitioners can use the tool for advocacy, grant applications, policy development, and education. The dashboard meets the needs of what communities want by providing a flexible platform (meaning data can be used in multiple ways), is easy to use, and puts data into their hands. Based on stakeholder discussions, there are several ways this type of dashboard can be used. An individual from a small rural health department expressed challenges in the past stemming from not having an epidemiologist or someone trained in data

analysis on their staff. They said this type of dashboard could allow them to make their grant applications for MAT education or Narcan training more competitive because they could include data to highlight the way opioids were impacting their community. Another individual working for a statewide nonprofit said it can be difficult to decide where to focus their efforts in the state since the epidemic is seemingly everywhere. For them, having a tool that can assist in prioritization of resoruces would help coordinate their intervention efforts.

Future Work

This work focused specifically on the current level of unmet need compared to other counties. In the future, it would be interesting to develop a way to measure expected unmet need in a given area based on geographic location (urban vs rural), population size, or demographic factors (such as socioeconomic status or insurance rates). For example, would rural counties with a population of 25,000 or less be expected to have an unmet need metric in a particular range based on what we know about provider shortages and access to care. If there is a way to predict the expected unmet need metric of a county there could then be an assessment of whether certain counties are exceeding expected rates of unmet need. This would allow for the identification of deviations from the expected unmet need.

Limitations and Future Directions

One limitation of this study is the focus on Buprenorphine waivered providers as a representative for MAT. While Buprenorphine is a major pharmaceutical used in MAT, there are other options, such as Methadone. Future work should focus on a way to integrate multiple types of pharmaceuticals used in MAT. It is also important to note that focusing only on waivered providers does not account counties without enough providers nor counties with certified buprenorphine providers, but these providers are

not engaging in providing treatment. Having the waiver only shows that someone could prescribe medication for MAT, it doesn't necessarily mean that they are prescribing medication. These facts mean that our current estimates on the availability of MAT may only be a best-case scenario.

Another potential limitation is the exclusion of counties without an X-Waivered provider in the ratio metric. This means roughly a third of U.S. counties are not comparable in terms of their unmet need of treatment. Future work can look to identify ways to assess the unmet need in counties without providers certified to prescribe buprenorphine. Finally, the process of developing the metrics and integrating the information into the dashboard is labor intensive. The most recent capture of X-Waivered providers took place in July 2021; therefore, some of the calculations may no longer be accurate based on changes in waivered providers and mortality rates for each county. Future work will also need to identify a way to capture providers engaging in Buprenorphine treatment now that the X-Waiver is no longer required.

Finally, while this study highlighted counties that may benefit from prioritizing treatment options, there are concerns that this kind of metric will negatively impact those counties not identified as having high unmet need. When presenting the pilot dashboard at a health council meeting, some individuals expressed concerns about ways this metric could have negative impacts. Specifically, fear that legislators or funding agencies may tell them treatment is not a concern if their counties weren't classified as having high or highest unmet needs. This presents a political concern of developing a metric prioritizing some counties over others. The goal of the metric is to facilitate the allocation of resources most efficiently, however, it is important to recognize that this form of efficiency may not be universally accepted. Some counties may feel that they have a problem with treatment access that is not represented in the metric.

Unfortunately, the allocation of scarce resources can often be a contentious and challenging process. The hope is that this work does not make it more difficult for counties to receive the types of resources they need to address the opioid epidemic in their communities.

Conclusion

This work builds on the dashboard data previously available for the opioid epidemic. Prior work focused almost exclusively on mortality rates when identifying areas needing priority focus for OUD intervention and treatment. These platforms also typically focused on state-level data for platforms covering the entire United States. This meant that the data were only comparable across states, losing small geographic nuances. This research built an online dashboard with county-level data for the entire United States. The dashboard includes a variety of data, including the developed unmet need metric, to provide new approaches to assess treatment need. The developed metric and dashboard allow for a new systematic way to select counties that may benefit from being a first priority of focus for increasing MAT. Most importantly, the dashboard fulfilled the three aims laid out by stakeholders to have an opioid data platform that is 1. Easy to use 2) flexible and 3) puts data into policymakers' and practitioners' hands.

CHAPTER 3

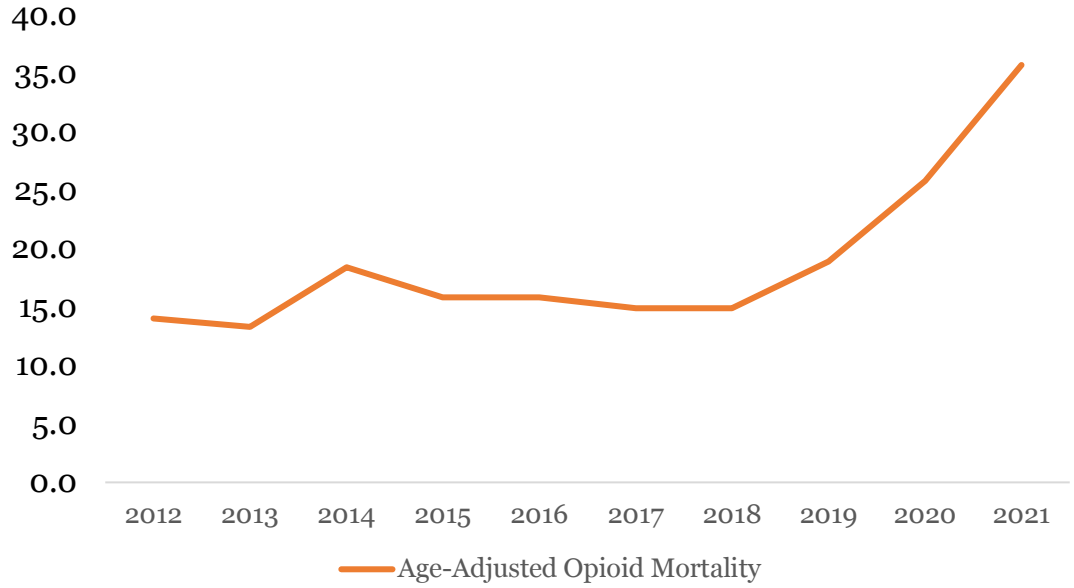
IMPROVING SYSTEMS OF CARE FOR INDIVIDUALS WITH OPIOID USE DISORDER IN NEW MEXICO

Improving Systems of Care for Individuals with Opioid Use Disorder in New Mexico
Policy Brief

Opioid Epidemic: The Numbers in New Mexico

Roughly two New Mexicans died a day in 2021 due to an opioid overdose, with a total of 717 deaths (Centers for Disease Control and Prevention, 2023). New Mexico has seen an increase in the number of opioid-related deaths and mortality rates over the last decade. The overall number of deaths due to an opioid increased from 276 in 2012 to 717 in 2021. Similarly, Figure 11 shows that the age-adjusted opioid mortality rate has more than doubled in the past decade from 14.0 per 100,000 in 2012 to 35.7 per 100,000 in 2021.

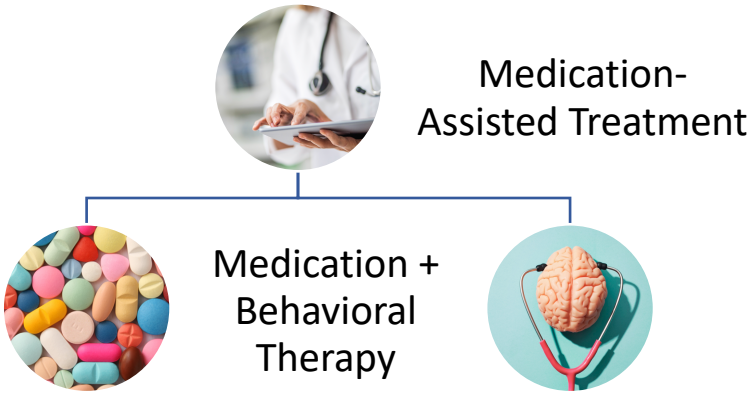
Figure 11. Age-adjusted opioid mortality rates in New Mexico from 2012-2021



Medication-Assisted Treatment (MAT) is currently considered the gold standard for treating opioid use disorder (OUD) (Jerry & Collins, 2013). Due to its combination of

pharmaceutical intervention and cognitive and behavioral therapy, many people consider MAT to be the ideal treatment method because it addresses the physical and emotional components of dependency (Vashishtha et al., 2017). Buprenorphine and methadone, two of the most commonly prescribed medications in MAT, have been associated with a reduction in opioid overdoses compared to other treatment options, such as inpatient detoxification or behavioral therapy alone (Knopf, 2020; Wakeman et al., 2020). Studies have shown improved outcomes with the behavioral therapy component of MAT because it increases retention in long-term treatment (Berry et al., 2021; Timko et al., 2016).

Figure 12 Representation of MAT



Current MAT Landscape in New Mexico

New Mexico has taken several steps to minimize the impact of the opioid epidemic.

- The Office of Substance Abuse Prevention has implemented key state priorities, including the First Responders-Comprehensive Addiction Recovery Act grant and the distribution of federal funding from the Substance Use and Mental Health Services

Administration to 22 coalitions throughout the state (New Mexico Prevention, 2023).

- Project ECHO provides a platform for medical providers and public health professionals to connect on a variety of substance use topics.
- New Mexico serves as a superhub for Peer Prison Education Programs, Opioid Addiction, and Medication for Opioid Use Disorder. These superhubs have made great strides in getting more providers engaged with treatment for opioid use disorder (The University of New Mexico, 2023).

Despite these great efforts, the New Mexico Department of Health completed a gap analysis in 2020 and found that an estimated 40,000 individuals in the state are living with opioid use disorder, and about 7,000 of them are not currently engaged in treatment (New Mexico Department of Health, 2020).

Several potential barriers exist in accessing and providing MAT. Some of the most commonly cited barriers to MAT include a shortage of providers willing and able to provide services (Knudsen et al., 2010), geographic barriers due to transportation issues or clinics not located close to individuals in rural areas (Knudsen et al., 2011), and funding to run programs (Ferguson et al., 2019; Knudsen et al., 2011).

Before 2023, there was an additional certification required to administer, dispense, and write a Buprenorphine prescription called the X-Waiver (Substance Abuse and Mental Health Services Administration, 2022). In January 2023, the Consolidated Appropriations Act removed the federal requirement for medical practitioners to have a special waiver to prescribe MAT medications (Substance Abuse and Mental Health Services Administration, 2023). This will hopefully dramatically improve access to MAT across the U.S. and in New Mexico. However, despite the dramatic expansion of eligible

prescribers, prior experience suggests that other factors, including stigmatization and lack of education, may create friction in accessing MAT.

Executive Summary

"It should be easier to get into treatment than to go to your dealer… we really need to advocate for better treatment access." New Mexico community health coordinator

This document summarizes the perspectives and insights of New Mexico practitioners and health workers on key obstacles to accessing MAT and potential strategies for increasing access in the state. Six medical providers, peer support specialists, and public health professionals in Eddy, Taos, and Luna counties were interviewed to build this policy brief. Interviews took place over Zoom, and questions focused on the current MAT landscape in their communities and their priorities for addressing the opioid epidemic in their counties.

These key strategies ranged from systems-level interventions (e.g., carceral system programs, insurance reimbursements, or loan repayment programs) to individual-level strategies that focus more on communication and education.

The nine key strategies below outline several ways to increase provider engagement, ranging from increased education to loan repayment programs.

- Increase education efforts to reduce provider stigma.
- Develop stronger programs to connect people in the carceral system to treatment when they are incarcerated and released.
- Ensuring individuals have access to housing while they are going through treatment.
- Offer loan repayment to providers properly engaging in MAT.
- Encourage medical centers to accept Medicaid.
- Ease Methadone access by expanding mobile van options.

- Increase pharmacy capacity to provide more Buprenorphine prescriptions.
- Have all services in one place.
- Build better relationships between Federally Qualified Health Centers and Hospitals.

More details about these nine key strategies are discussed below. Policymakers can assess which

strategies for increasing MAT access will be most feasible or effective in their communities.

Nine Key Strategies

1. Increase education efforts to reduce provider stigma.

   Getting more providers to engage in MAT services was the highest priority listed in interviews about the MAT landscape in New Mexico. One strategy to increase the number of engaged providers is to reduce the stigma providers may have against MAT. Project ECHO and other organizations are making great strides in educating providers about MAT but increased state support to offer additional educational sessions and continuing education credits could further expand this impact. Potential areas to expand the reach of education includes using social media platforms (e.g., Facebook Live events). Other research has shown the benefits of integrating MAT education in medical or professional school training (Lien et al., 2021).

"The highest priority is education surrounding what OUD is …People who need and don't have this education are politicians, hospital administrators, doctors, behavioral health professionals, families, community members, and anyone who works with high-risk populations. I think education comes first and action comes later."

– Medical provider

2. Develop stronger programs to connect people in the carceral system to treatment when they are incarcerated and released.

Prisoners and jail inmates are 10-40 times more likely to die from an opioid overdose when released to the community than the general population. This risk of an overdose is especially acute in the time immediately following someone's release from prison or jail (Joudrey et al., 2019). One study found that individuals were 129 times more likely to die from an overdose in the first two weeks of being released from the carceral system compared to the general public (Binswanger et al., 2007). Increasing treatment options while incarcerated also improve recidivism upon release (Horn et al., 2020). Developing bridge programs with strong MAT care provision in the carceral system and then ensuring individuals are connected to care upon release can reduce risk of an opioid-related overdose (Scott et al., 2021; Sufrin et al., 2020).

New Mexico has been a leader when it comes to developing jail-based MAT programs. Bernalillo County Behavioral Health Services Department and the Bernalillo County Metropolitan Detention Center (MDC) developed the first privately owned Opioid Treatment Program in the country. In 2016, Rhode Island became the first state to implement a comprehensive program for its correctional system (Clarke et al., 2018). New Mexico state could benefit from following Bernalillo's successful MDC model and adding components of the Rhode Island model. An evaluation of the New Mexico program found a decrease in recidivism for participants and an increase in community-based treatment upon release (University of New Mexico, 2013). These programs also decreased the likelihood of opioid use post-release compared to those without comprehensive systems while incarcerated (Moore et al., 2019). To develop similar comprehensive systems seen in Bernalillo's MDC model and the Rhode

Island, these protocols could become standards for all New Mexico jails and prisons:

- Screen all individuals for OUD upon intake.
- Have individuals identified as possibly having OUD undergo an assessment with a team of diverse providers (nurse, physician, counselor)
- Offer MAT with all medications approved by the Food and Drug Administration (Methadone, Buprenorphine, and Naltrexone)
- All patients receiving MAT are trained in using Naloxone to properly respond to someone overdosing.
- Organize follow-up care at discharge so people have a designated provider to see upon release.
- Individuals leave the correctional facility with Naloxone in hand and information about where to get more Naloxone if needed.

To implement these protocols, the carceral system may need to reprioritize or rethink funding models to emphasize prevention care. The White House and the Legislative Analysis and Public Policy Association discussed a report in 2023 highlighting the importance of corrections-based MAT programs funded through a state fund or federal funds from the Bureau of Justice Assistance, U.S. Department of Justice, of the Substance Abuse and Mental Health Services Administration (Kunkel, 2023). Inmates receiving outpatient substance use treatment are currently not eligible for Medicaid reimbursements because of a Medicaid inmate payment exclusion (Congressional Research Service, 2021). Despite the outright cost, research has also found that preemptively investing in substance use treatment in the carceral system can save

money in the long run. A New Mexico study found a reduction in long-term spending for individuals using a jail-based MAT compared to those with opioid use disorder not receiving MAT (Horn et al., 2020). Based on the reduction in recidivism, carceral MAT was found to be cheaper in the long run than incarceration alone.

3. Ensuring individuals have access to housing while they are going through treatment.

Supportive housing is an important component during recovery. This is especially important for individuals that may otherwise be homeless or recently released from the carceral system. Adopting a Housing First model in the state of New Mexico can make it easier for individuals to access housing. A Housing First model emphasizes providing immediate housing to individuals without requirements like sobriety or a lack of a criminal record (Tsai, 2020; Woodhall-Melnik & Dunn, 2016).

Focusing on a Housing First model in New Mexico is especially important in guaranteeing housing for individuals going through recovery. For example, some transitional housing for those recently released from the carceral system or some homeless shelters do not allow take-home treatment medications in their facilities (Russell et al., 2022). Others do not allow an individual to be on any medication to assist in dependency management and require someone to be completely detoxed from any type of opioid (McLaughlin et al., 2021). Adopting a statewide model of Housing First gives people stability of a place to live while they are undergoing treatment for their OUD. Housing-first models were seen to significantly lower substance use and increase treatment retention compared to treatment-first approaches for substance use disorder (Padgett et al., 2011).

New Mexico has a nationally recognized Housing First model for example. Mesilla Valley Community of Hope in Doña Ana County is an alliance of community leaders, homeless services, and faith organizations that provide services for individuals that are unhoused, near-homeless, disabled, and living in poverty. The alliance offers a variety of housing options for those in need, including permanent supportive housing, rapid housing, and veteran housing (Mesilla Valley Community of Hope, 2023).

4. Offer loan repayment to providers properly engaging in MAT.

Offering loan repayment to providers properly engaging in MAT is another strategy to increase the number of people providing MAT services. The National Health Service Corps (NHSC) launched a program in 2019 that relieves $75,000 in student loads for providers that are engaged in opioid dependency treatment in underserved communities. This type of program can serve as a model to further expand loan repayment offerings. The NHSC program works with providers in health professional shortage areas. While this greatly helps expand care in more rural areas and parts of urban centers, there may be providers that could benefit opioid treatment outcomes in their communities but are not working in shortage areas. Additional incentives could also be considered for individuals contributing to treatment without directly providing care provision, for example, peer support specialists. Loan repayment has proven an effective strategy to recruit medical providers to rural areas (Miller & Crittenden, 2001). The idea of offering loan repayments to MAT providers has also been noted by several other scholars as a strategy for increasing MAT in the United States (Amiri et al., 2021; Haffajee et al., 2018) and some communities can offer

these services already if they happen to be part of the National Health Service Corps, but those positions are limited (Cloutier et al., 2023).

5. Encourage medical centers to accept Medicaid.

A current barrier in New Mexico exists because many treatment centers and providers do not accept Medicaid insurance. As a state with adopted and implemented Medicaid expansion in 2014, the state should enact policies to require treatment, medical, and rehabilitation centers to cover the full continuum of MAT services. In 2017, 54% of people in the United States receiving OUD treatment used Medicaid coverage, due in large part to states with Medicaid expansion (Orgera et al., 2019). However, ensuring that all facilities and centers accept Medicaid reduces the burden of finding treatment options, especially for those living in more rural parts of the state.

"There's not a community of people in recovery supporting other people. We have really expensive rehabs that don't take Medicaid." – Peer support specialist

6. Ease Methadone access by expanding mobile van options.

In June 2021, the Biden-Harris Administration expanded access to methadone by allowing preexisting clinics to offer methadone vans (The White House, 2021). New Mexico can make a more concerted effort to increase the number of methadone vans operating in the state. State grants could help support smaller clinics in handling the financial burden of starting such a project. Having mobile vans can also greatly alleviate potential transportation issues in parts of the state. Rhode Island launched a 27-foot-long new van in 2022 with a dispensary examination/treatment room, a counseling room, a fully equipped security system, a waiting area, and a restroom (Knopf, 2022). This type of

system could be repeated in New Mexico to help provide care to individuals unable to reach physical clinics or to better serve rural communities.

7. Increase pharmacy capacity to provide more Buprenorphine prescriptions.

   Some pharmacies in the state do not have a large enough supply of Buprenorphine to meet demand in their community. Work can be done at the state and federal levels to ensure that pharmacies not only have the amount of medications they need, but also have the capacity to properly administer the medication to patients. In a recent survey of pharmacists across the U.S., only 68.1% indicated that they could usually or always fill a prescription for Buprenorphine immediately when the script was received (Hill et al., 2023). While this percentage may seem high, minor delays in someone taking their Buprenorphine prescription can potentially have huge implications on their recovery, including being kicked out of treatment programs (Gryczynski et al., 2014).

8. Have all services someone might need early on in treatment in one place.

   Several interviewees noted the benefit of having all services someone undergoing MAT may need. This would include the same location offering services such as medical care, psychological services, peer support, supportive housing, a community center that hosts family and wellness events, and childcare for people as they receive treatment.

"There would just be like a treatment center with access to a lot of peer support …they have a treatment center that's you can walk in, at any time of day. They have peer support workers there. They have weekly family nights where all of their family members can play bingo and do stuff together, like, on Tuesdays they can go get

acupuncture and like take art classes and do social fun activities together." – Behavioral health professional

9. Build better relationships between Federally Qualified Health Centers and Hospitals.

Especially in rural parts of the state, the isolation to the nearest hospital is not only geographically distant but also figuratively distant. Many federally qualified health centers (FQHCs) and hospitals have no direct communication regarding treating and referring patients. Developing a type of mechanism to better connect FQHCs and hospitals can make it easier for providers to coordinate continuity of care for patients.

An optimal MAT landscape could incorporate many of these potential solutions to improve systems of care for MAT in New Mexico.

CHAPTER 4

WHAT CAUSES RACE/ETHNICITY AND SEX DEMOGRAPHIC DIFFERENCES IN THE OPIOID EPIDEMIC? A SYSTEMATIC REVIEW

What Causes Race/Ethnicity and Sex Demographic Differences in the Opioid Epidemic? A Systematic Review

Abstract

Many studies of opioid-related mortality present demographic differences by race/ethnicity and sex, but less is known about why these demographic differences exist. This project systematically reviewed how articles published from 1995 to 2020 that reported demographic differences in opioid-related mortality explained these differences. The study reviewed 52 peer-reviewed journal articles and data reports. Findings from these studies showed a spectrum of demographic differences in opioid mortality, but only 6 of the 52 articles (11.5%) proposed explanations for different mortality rates among diverse demographic groups. These causes included variations in prescribing practices for prescription opioids, delays in activating emergency medical response based on race/ethnicity, differences in insurance rates impacting accessing opioid dependency treatment, and differences in insurance rates impacting the likelihood of receiving a prescription for an opioid. Studies need to go beyond identifying demographic differences in opioid-related mortality to understanding the reasons for those differences to find ways to reduce these inequities in opioid-related mortality.

Introduction

Over 188 people in the United States die each day from an opioid-related overdose (National Institute on Drug Abuse, 2021) and in 2019, over two-thirds of all drug overdoses involved an opioid (Centers for Disease Control and Prevention, 2021). The opioid epidemic has the potential to impact any individual regardless of race/ethnicity,

sex, socioeconomic status, education level, or geographic area (Jalal et al., 2018; Jamison et al., 2010; Jones, 2013; Paulozzi & Xi, 2008; Unick et al., 2013). However, epidemiological studies in the United States also show substantial demographic differences in opioid mortality (Clausen et al., 2009; Evans et al., 2015; Monnat, 2019).

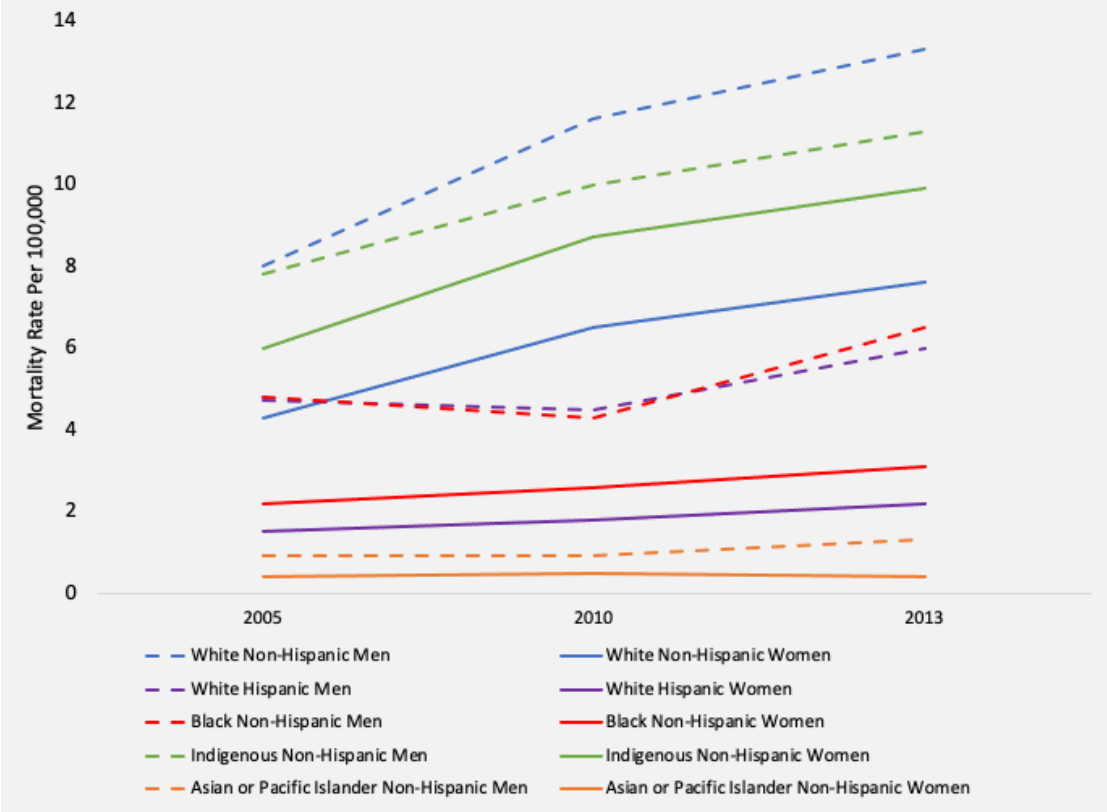
The current opioid epidemic in the United States has followed three waves of opioid-related overdoses and deaths. The first wave of the opioid epidemic took place in the late 1990s and early 2000s after Purdue Pharma introduced OxyContin to the pharmaceutical market under heavy promotion and marketing campaigns (Van Zee, 2009). In their promotion of OxyContin, Purdue Pharma took considerable efforts to minimize the risk of addiction and adverse outcomes associated with opioids to medical providers, bringing about increased prescribing practices (Wisniewski et al., 2008). At this same time, the American Pain Society promoted pain as a 5th vital sign, along with temperature, heart rate, blood pressure, and respiration (Max et al., 1995). This new promotion put pressure on providers to better manage their patient's self-reported pain. The Harrison Narcotics Act of 1914 made providers apprehensive about prescribing opioids. This act required physicians to prescribe medication only "in the course of (their) professional practice," meaning not to control an individual's dependency (Public Acts of the Sixty-Third Congress, 1914) As a result, physicians who misreported their prescriptions to the Treasury Department or who prescribed medications incorrectly could face a fine of $2,000 or even a five-year jail sentence (Hohenstein, 2001). After the push of pain as a 5th vital sign in the 1990s, however, the number of prescriptions written for opioid products increased from 25 million in 1991 to roughly 207 million in 2013 (Banta-Green et al., 2013).

Between 1999 and 2009, there was a four-fold increase in the mortality rates for prescription opioids (*CDC Wonder*, 2019). In response, the federal government began a

crackdown on pill mills, which were clinics dispensing opioid prescriptions at high rates because they were not following prescribing best practices, as well as a crackdown on doctor shopping among patients (Chakravarthy et al., 2011). In response to this crackdown, it became more difficult to receive legitimate prescriptions for opioids through traditional medical means (Penm et al., 2017). This led to a second wave based on a sharp increase in heroin use and heroin-related overdoes soon followed (Kolodny et al., 2015). Finally, the third wave of the opioid epidemic began in 2013 with an increase in overdose deaths due to synthetic opioids, especially illicitly manufactured fentanyl (Seth et al., 2018). Fentanyl is 40 times stronger than regular street heroin and 50-100 times more potent than morphine, making it especially dangerous and likely to result in overdoses (Jones, 2013).

At the national level, marked disparities in opioid mortality rates by race/ethnicity and sex have arisen throughout the three waves of the current opioid epidemic (Figure 13).

Figure 13. Opioid mortality rates per 100,000 by race/ethnicity and sex during 2005 (first wave), 2010 (second wave), and 2013 (third wave) of the current opioid epidemic.



When looking at these rates, White Non-Hispanics, and Indigenous Non-Hispanics, regardless of sex, had some of the highest rates of mortality during all three waves of the current opioid epidemic. In 2005 during the first wave, Black Non-Hispanic men (4.8) and White Hispanic men (4.7) had higher rates of opioid mortality than White Non-Hispanic Women (4.3), but that pattern switched in 2010, the second wave of the epidemic, with White Non-Hispanic Women (6.5) having a higher opioid mortality rate than white Hispanic men (4.5) and Black Non-Hispanic men (4.3). Except for Black Non-Hispanic men, White Hispanic men, and Asian or Pacific Islander Non-Hispanic Women, all other racial/ethnic and sex groups saw increases in overall opioid mortality between 2005 (first wave) and 2013 (third wave). These data show large differences in mortality patterns by race/ethnicity as well as sex. In all cases, men for each racial/ethnic group have higher mortality rates than women in the same racial/ethnic

group. As seen in Figure 1, mortality rates can vary greatly depending on demographic characteristics, like race/ethnicity and sex.

While many studies have explored demographic differences in opioid mortality and readily available public datasets make it easy to calculate statistics on opioid mortality at a demographic level, there is little review of the explanations proposed for these differences. This paper systematically reviews research studies and data reports that have presented demographic differences in opioid-related mortality over the last two decades, to: (1) identify which demographic differences they have focused on, and (2) document how they have explained these differences.

Methods

This project used a five-person research team consisting of both graduate and undergraduate students to systematically review pertinent articles.

Search Strategy

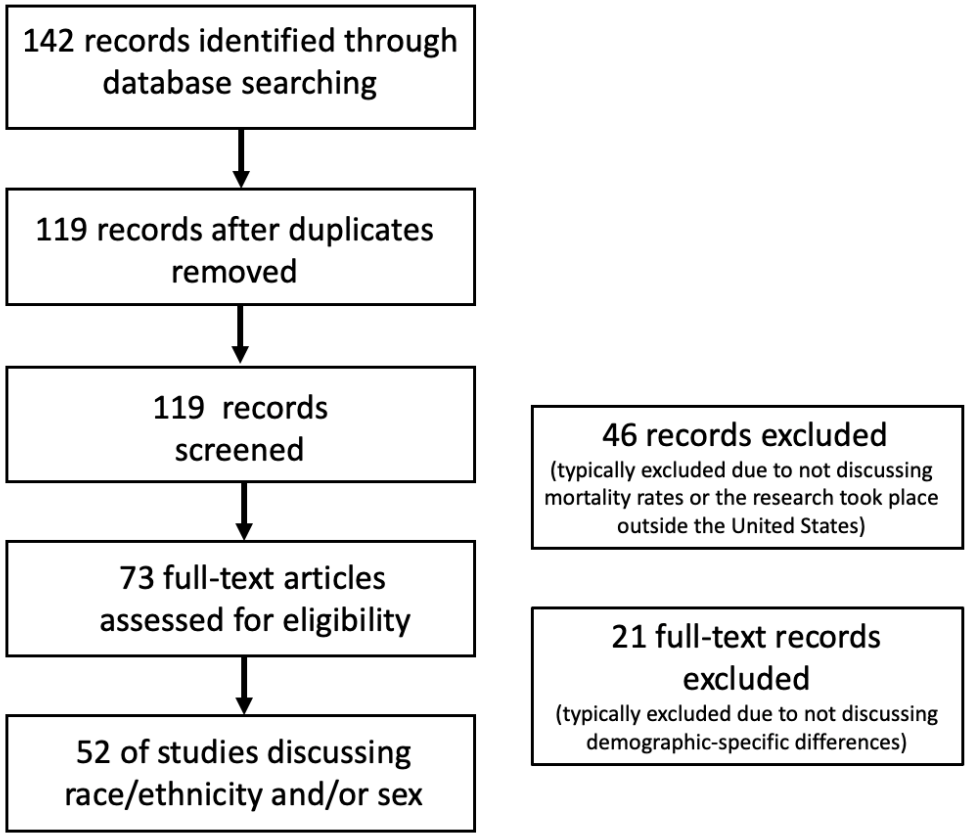
The team used The Cochrane Collaboration data collection form as the initial tool to identify potential articles for inclusion. Set keywords decided on by the research team contributed to automated searches. Searches used 20 words and phrases, including but not limited to “race”, “ethnicity”, “sex”, and “gender.” PubMed, Science Direct, and the ASU DOI served as the three databases used for the literature search. The supplemental material includes a full list of the words and phrases used in the search criteria.

Inclusion Criteria

Reports met inclusion criteria if they 1) had a publication date since 1995 2) included research that specifically took place in the United States (at the national, state, county, and/or city level) 3) were written in English and 4) discussed opioid mortality by race/ethnicity or sex.

The review of articles involved a multi-step process. This process is depicted in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram flowchart in Figure 14. The research team ran a pilot where each researcher completed both a data extraction form and an inclusion or exclusion decision for the same article. The team then met to compare and discuss answers provided in the data extraction form. These meetings allowed for the updating and clarification of the protocol as well as discussions about articles to exclude.

Figure 14. PRISMA flowchart of research article inclusion for the final analysis.



Two researchers reviewed each article to decide whether that article should be included in the final analysis. If the two researchers disagreed on the inclusion or exclusion of an article, that team discussed the case at a team meeting until there was a consensus about inclusion or exclusion. Initially, the team identified 119 unique peer-

reviewed articles or data reports for review based on article titles and abstracts. Forty-six articles did not meet inclusion criteria due to exclusion factors like discussing opioid mortality outside of the United States (most commonly in the United Kingdom) or articles covering drug mortality broadly, but not opioid mortality specifically. After those inclusion discussions, the research team read 73 full-text articles and reports. The team deemed an additional 21 articles did not qualify for inclusion after this review. The most common reason for exclusion at this stage was an article talking about opioid mortality broadly without going into specific demographic differences in opioid mortality. This left a final total of 52 articles included for the analysis of this review that provided data regarding opioid mortality. Of the 52 articles, 33 (63.5%) provided clear data tables or figures embedded within the text or the article. The other 19 (36.5%) provided opioid mortality data in a narrative format. The important consideration here, however, is that all 52 included articles provided a breakdown of opioid mortality rates by race/ethnicity and/or sex in either a table or narrative format.

Data Extraction

Variables included publication metadata (e.g., author(s) name(s), year of publication, journal of publication, and publication status (used to differentiate between peer-reviewed articles and data report publications), geographic setting (e.g., location (city, county, state, region, or nation), the name of the city, state, or region if the article was about a specific place, and urban vs. rural setting) demographic breakdowns considered in the article (e.g., race/ethnicity and sex), and hypotheses provided for why there were demographic differences in opioid mortality.

Originally, the codebook used a code for gender rather than sex. Discussions about gender differences in this review focused exclusively on the gender binary. Although the codebook had a code for opioid mortality discussions for non-binary or gender-fluid

individuals, no identified articles included in this review used this code. Due to this, the language for analysis shifted to sex rather than gender since the included articles typically followed language found in the U.S. Census Bureau.

Each article underwent independent coding by two researchers. The collection of independent codes collated in the master list underwent a review to assess percent agreement and Cohen's Kappa. The Kappa for codes included in the analysis (race/ethnicity categories based on census classification and sex) ranged from 0.88-to 1.0 with an average Kappa score of 0.93. Any codes that did not have perfect agreement were discussed in the weekly group meetings. A consensus on the code was then finalized as a group so the final document for analysis had a perfect agreement for all codes within the 52 documents.

Data Analysis

We calculated how frequently papers reported demographic differences in mortality rates in each demographic variable (sex, race/ethnicity) as well as how frequently they proposed explanations for demographic differences and what kinds of explanations were proposed. Hypotheses from the selected articles had to include specific and concise reasons certain demographic groups are at an increased risk for opioid mortality, rather than general concepts. Articles that included explanations of demographic differences were coded using MAXQDA qualitative analysis software to identify common themes of these hypotheses.

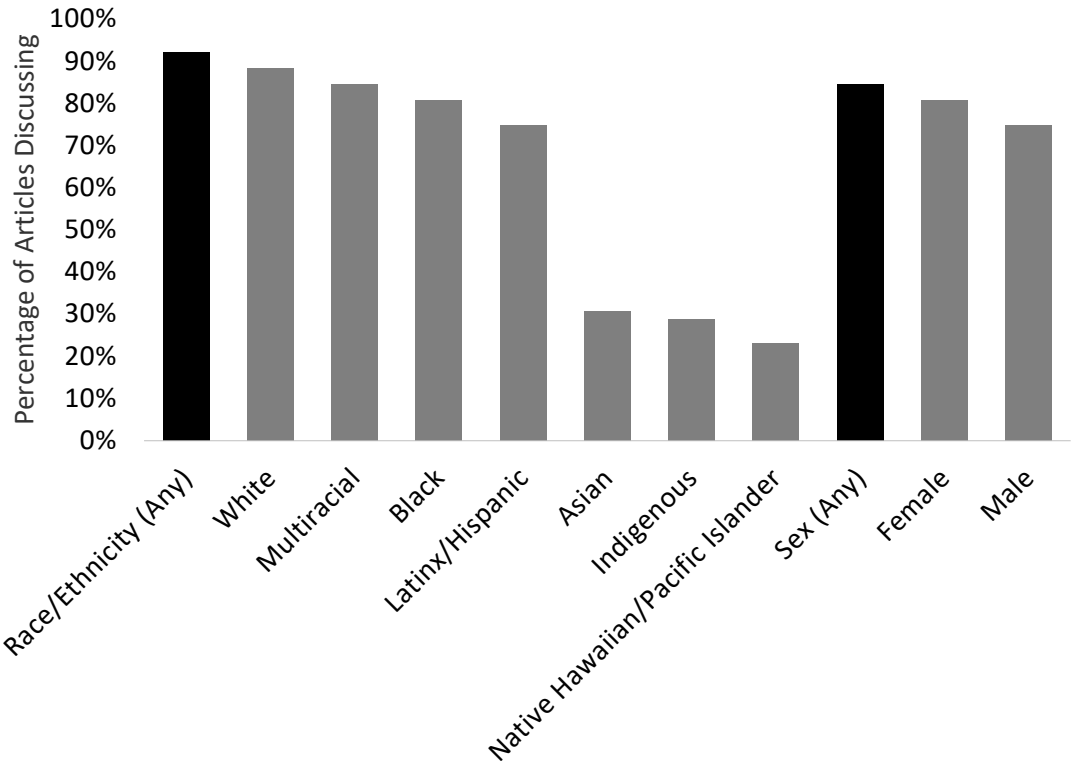
Results

Figure 15 shows the breakdown of demographic groups written about in the 52 included articles for analysis. As Figure 3 shows, 92.3% (n=48) of articles provided data about opioid mortality by race/ethnicity. White (88.4%), Multiracial (84.6%), and Black (80.8%) were the three most frequently discussed specific racial/ethnic demographic

groups with Native Hawaiian/Pacific Islander (23.1%) and Indigenous (28.8%) being the least discussed specific racial/ethnic groups.

Out of the 52 articles, 84.6% (n=44) had opioid mortality data by sex. These data regarding sex fell on the binary with 80.8% of articles providing data about opioid mortality among women and 75.0% providing opioid mortality data for men.

Figure 15. Graph describing the percentage of articles included in the systematic review with data on race/ethnicity or sex.



Proposed explanations. While 52 articles met the criteria of providing demographic data breakdowns for opioid mortality by race/ethnicity or sex, only six (11.5%) presented a discussion about why demographic differences exist. Of the six proposed explanations of demographic differences in opioid mortality, we identified two key types, including access to care, and activating emergency response to an overdose. All six articles

discussing a hypothesis focused on racial/ethnic demographics. This means that our review found no evidence of articles discussing the factors contributing to differences in opioid mortality by sex.

Table 4 shows the frequencies of these different kinds of explanations.

Table 4. Hypotheses about why differences in opioid mortality among different racial/ethnic groups exist in the 6 of 52 total review articles that discussed a hypothesis. Note that all six articles discussing a hypothesis focused on racial/ethnic demographics, which is why there are not any listed hypotheses about sex differences in opioid mortality in Table 4.

Hypothesis for how race/ethnicity plays a role	Percentage of Six Articles Discussing Hypothesis
Access to Care	**5 (83.3%)**
receiving an opioid prescription	2 (33.5%)
accessing insurance to obtain an opioid prescription	1 (16.7%)
accessing insurance to receive opioid dependency treatment	1 (16.7%)
receiving prescriptions for opioids or overdose antidotes	1 (16.7%)
Activating Emergency Response to an Overdose	**1 (16.7%)**
minority populations delaying seeking emergency care for an overdose	1 (16.7%)

Access to Care

Access to care represented the most frequently discussed hypothesis about why demographic differences in opioid mortality exist. This was further broken down into four categories of access to care. All four of these categories specifically discuss the role that race/ethnicity can play in accessing care.

1) Race/ethnicity plays a role in receiving an opioid prescription

The role that race/ethnicity plays in accessing an opioid prescription appeared in two of the six articles discussing a hypothesis. These articles discussed specific racial/ethnic groups by saying that Black and Hispanic individuals are less likely to receive a prescription for opioids, and are put under a stricter level of surveillance if an opioid prescription is prescribed (Tuazon et al., 2019). While the other article discussed racial and ethnic minorities broadly without naming specific groups but still describes that racial and ethnic minorities are less likely to receive an opioid prescription even if they present in a clinical setting with the same symptoms as their White counterparts (Cerdá et al., 2013).

A major focus of the literature on race/ethnicity in the opioid epidemic looks at prescribing practices (Groenewald et al., 2018; Joynt et al., 2013; Singhal et al., 2016; Tamayo-Sarver et al., 2003; Pletcher et al., 2008). The first wave of the opioid epidemic in the late 1990s saw a substantial increase in the writing of prescriptions for opioids as a pain reliever (Von Korff & Franklin, 2016). Much of the literature on prescribing practices focuses on the demographics of race/ethnicity in terms of potential providers' bias to be less likely to prescribe opioids to BIPOC individuals (Lee et al., 2009; Stepanikova & Oates, 2017). Nearly all previous studies on race and opioid prescribing practices found White Non-Hispanic individuals received opioid prescriptions more frequently than other races and ethnicities presenting similar symptoms (A. Heins et al., 2006; J. K. Heins et al., 2006; Joynt et al., 2013; Pletcher et al., 2008). It is important to note that while most studies showed a correlation between race and the likelihood of prescribing, other studies found no such evidence (Tamayo-Sarver et al., 2003).

These differences in opioid prescribing practices are not unique. Similar findings of provider preference exist in the prescription of antipsychotics (Covell, Jackson, Evans, & Essock, 2002), antibiotics (Gerber et al., 2013), hormone replacement therapy (Brown et

al., 1999), and antidepressants (Olfson et al., 1998). While there seems to be expansive literature about the way race/ethnicity may influence one's likelihood of receiving an opioid prescription, only two of the articles discussing opioid morality brought up race/ethnicity possibly contributing to differences in opioid mortality rates by race/ethnicity.

Feeling unable to advocate for yourself could also possibly contribute to a lack of engagement in activating an emergency response. Research shows that historically, Black patients (Saha et al., 2008) and people of color (Dickason et al., 2015) tended to feel less capable of being assertive with providers, especially in terms of advocating for their pain management (Dickason et al., 2015).

2) *Race/ethnicity plays a role in having insurance to access prescription opioids*

One article broke down differences in opioid mortality among different groups that are classified as Hispanic. This article specifically discussed higher opioid mortality rates among Puerto Rican heritage Hispanics potentially stemming from the fact that Puerto Rican heritage Hispanics have higher rates of medical insurance compared to other Hispanic groups (Cano, 2020). The article discusses results from the 2017 American Community Survey to further validate this claim (US Census Bureau, 2017). When looking at national-level insurance data, Asians have the highest percentage of insured individuals at 93%, followed by Whites at 92%, Blacks at 89%, Native Hawaiian or Pacific Islanders at 87%, Hispanics at 80%, and Indigenous at 78% (*CDC Wonder*, 2019).

Despite Asians having the highest percentage of insured individuals, they have the lowest opioid mortality rates (Centers for Disease Control and Prevention, 2023). A needs assessment found that Asian Americans, Native Hawaiians, and Pacific Islanders are hesitant to seek medical care for pain and are generally less likely to want to use medications to regulate pain (Asian Pacific Partners for Empowerment, Advocacy, and

Leadership, 2020). This needs assessment also described a potential hesitancy among Chinese immigrant and Chinese- American populations, specifically as a result of the sharing of family stories of the Opium Wars of 1839-1860 (Asian Pacific Partners for Empowerment, Advocacy, and Leadership, 2020). Minimal peer-reviewed work has looked to identify the factors contributing to Asians having high insurance rates but lower opioid mortality rates.

3) *Race/ethnicity plays a role in having insurance to access opioid dependency treatment*

In contrast with the previous two articles that discussed how having insurance makes it easier to obtain opioid prescriptions in the first place, another article discussed the benefits of insurance, namely the ability to get treatment. This shows that insurance can affect opioid mortality both positively and negatively. One of the articles discussed lower rates of health insurance as a reason for Indigenous communities having a difficult time accessing treatment for opioid use disorder (Calcaterra et al., 2013). This stemmed from Indigenous individuals having the lowest percentage of insurance coverage (78%) compared to other racial/ethnic groups as discussed previously (*CDC Wonder*, 2019). The low insurance coverage to access treatment is further exacerbated by transportation difficulties that are present in rural reservation communities (Calcaterra et al., 2013).

Insurance coverage is frequently listed as a barrier to accessing treatment for opioid use disorder (Hall et al., 2021). Medicaid expansion states have seen an increase in opioid dependency treatment admissions by nearly 18% as more individuals gained access to treatment options (Meinhofer & Witman, 2018). The importance of insurance to access treatment is a common theme in substance misuse broadly with the value of insurance also influencing access to treatment for the misuse of alcohol (Saunders et al.,

2006), tobacco (Tan et al., 2018), cocaine (Mutter et al., 2015), and methamphetamine (Cucciare et al., 2019).

Activating Emergency Response to an Overdose

One article in the review described a decreased likelihood of racial/ethnic minority populations seeking emergency medical treatment during an overdose (Galea, 2003). This also includes a mistrust stemming from slower emergency service response time in certain neighborhoods. It is important to note that this article was published in 2003. While many efforts over the last nearly two decades have addressed this issue, research from the last 5 years still shows lower socioeconomic neighborhoods experience slower response times to emergency medical services (Hsia et al., 2018).

Discussion

Findings from this research showed that articles frequently present breakdowns of opioid mortality by race/ethnicity and sex. However, articles rarely examine the factors driving these demographic differences. Only six of the reviewed articles provided a hypothesis about why demographic differences in opioid mortality exist, and it is important to note that all six hypotheses focused on racial/ethnic demographic differences while there were no given hypotheses for mortality rate differences due to sex. Having an increased understanding of the causes of demographic differences can prove helpful to efforts looking to reduce opioid mortality within demographic groups.

Demographic Groups Discussed in Review

Race/Ethnicity

Race/ethnicity research consisted of studying White Non-Hispanic, Black, or Hispanic/Latinx individuals specifically in 68.4%-80.7% of articles while Indigenous,

Asian, and Native Hawaiian/Pacific Islander individuals were discussed only when researchers looked at all ethnicity categories in the United States Census 21.1%-28.1% of articles.

One interesting takeaway from these findings is that Indigenous Non-Hispanic individuals have had the second-highest opioid mortality rate over the last 5 years with an age-adjusted rate of 17.8 per 100,000 (*CDC Wonder*, 2019). Only White Non-Hispanics have a higher rate of 19.9 per 100,000 and Black Non-Hispanics have the third highest rate of 16.2 per 100,000. Despite Indigenous communities suffering from the second-highest opioid mortality rates between 2016 and 2020, only 26.3% of articles discussed opioid mortality among the Indigenous demographic group. The 15 articles discussing Indigenous opioid mortality did so by highlighting the spectrum of race/ethnicities included in the Census, rather than taking a particular interest in the high mortality rate among Indigenous populations. This is especially troublesome when looking at opioid misuse in Indigenous communities because there seems to be a lack of literature and research on opioid misuse in these communities even though they have some of the highest rates of opioid mortality. This raises the question of why research is not focusing on Indigenous opioid mortality rates.

Sex

Research has shown that transgender and gender-diverse individuals can have an increased risk of substance use (Fuxman et al., 2021; Hughto, Quinn, et al., 2021; Hughto, Restar, et al., 2021) along with comorbidities associated with substance misuse, such as depression (Benotsch et al., 2013). While research on transgender and gender-diverse opioid mortality exists, this review showed that research comparing demographic differences in opioid mortality operates on the binary of male and female sex. Future

research would benefit from taking a more inclusive assessment of opioid mortality as it related to sex and gender.

Included articles failed to provide hypotheses about why demographic differences in opioid mortality rates based on sex exist even though mortality data clearly shows differences in opioid mortality by sex.

Hypotheses

Access to Care

While all included studies show demographic differences, the majority do not talk about why demographic differences in opioid mortality might exist. Identifying the factors that influence mortality presents an important strategy for public health practice. If practitioners do not understand the reasons why demographic differences in opioid mortality exist, it is difficult to design effective programming and intervention efforts to reduce opioid morbidity and mortality. Only having 15% of reviewed articles include any type of discussion about the causal factors influencing these demographic differences makes it exceedingly difficult for the development of effective public health programming efforts.

As laid out by Marmot and Wilkinson (2005) it is important to look at the "causes of causes," meaning it is important that researchers are focusing on the causal factors influencing health behavior (Marmot & Wilkinson, 2005). It is widely accepted that public health programs can have the greatest positive impact when they are tailored to meet the needs, behaviors, and environments where they take place (Glanz & Bishop, 2010; Glymour & Spiegelman, 2017; Pickett & Pearl, 2001).

Limitations

The findings in this report are subject to some limitations. First, coding was conducted by two alternating coders, meaning people were randomly assigned articles to

code with different reviewers. This might have made it difficult to identify specific individuals contributing to disagreement in the codes. Having the weekly discussions about codes with disagreement as a research team looked to mitigate any mistakes stemming from this coding process, yet it is possible that mistakes still occurred. Second, even with careful inclusion criteria and multiple strategies to identify articles, it is possible that some articles that met the inclusion requirements were missed in the literature search. Articles were identified using the DOI database of Arizona State University, PubMed, and Science Direct. While this covers a large spectrum of articles, it is possible that some articles could have been found through other search engines. These articles might have discussed more hypotheses about why demographic differences in opioid mortality exist or focused on demographic groups understudied, including non-Hispanic Indigenous populations. Third, it is unknown what type of publication bias exists in peer-reviewed articles and reports discussing opioid mortality demographic differences.

Conclusion

While study results from this systematic review identified opioid mortality rates broken down by race/ethnicity and sex, information missing from this review proved more interesting. Future research should also take care to study a spectrum of demographic differences, especially among groups with high opioid mortality rates, such as the non-Hispanic Indigenous. There has also been a lack of research on opioid mortality in nonbinary and transgender demographic groups. Work should be done in the future to incorporate a broader definition of gender and gender's impact on opioid mortality. The 52 reviewed articles largely lacked discussions about the factors influencing differences in opioid mortality rates, with only six of the 52 articles providing any hypothesis about what contributed to demographic differences. Without a better

understanding of the structures, cultures, and systems influencing opioid mortality rates, it is difficult to design interventions to address the problem. Future work on demographic differences in opioid mortality (and public health broadly) should have a distinct focus on understanding the factors driving demographic differences in mortality.

CHAPTER 5

CONCLUSION

In the United States, opioid-related overdoses result in an average of 188 deaths every day (Centers for Disease Control and Prevention, 2023). The preceding chapters focused on understanding how to improve public health programming and research efforts for the opioid epidemic. The history of the present opioid epidemic is complex, as demonstrated in the introduction, highlighting the difficulties in mitigating the epidemic. The current opioid epidemic began in the 1990s. During the three waves of the opioid epidemic, the prescription opioid mortality rate increased fourfold in the first wave from 1999-2009 (Centers for Disease Control and Prevention, 2012). After a crackdown on providers prescribing opioids, it became harder to obtain legitimate prescriptions for opioids through traditional medical channels (Penm et al., 2017). Overdoses associated with heroin soon increased as the second wave of the opioid epidemic began in 2010 (Kolodny et al., 2015). Heroin is typically easier and cheaper to purchase on the black market while providing similar euphoric effects (Fernandez & Libby, 1998). Finally, the third wave of the opioid epidemic began in 2013 with increased overdose deaths due to synthetic opioids, especially illicitly manufactured fentanyl (Seth, Rudd, & Bacon, 2018). The potency of fentanyl is 40 times greater than regular heroin and 50-100 times greater than morphine (Jones, 2013).

While the opioid epidemic still dramatically impacts the United States, various treatment options exist to treat those with OUD. This research focused on MAT due to its proven efficacy (Auriacombe et al., 2004; Lagisetty et al., 2017; Schwartz et al., 2013). Previous literature has described a variety of barriers contributing to a lack of access to MAT. It is common for providers to cite conflicting feelings about using medications to reduce dependency as a barrier to MAT. Medical providers often view MAT as simply

substituting one addiction for another (Allen et al., 2019; Wakeman & Rich, 2018). Shame and stigma can play an essential role in those with OUD actively seeking treatment due to fears of losing family support, custody of children, immigration status, or financial hardship due to medical costs or time off from work (Gueta, 2017).

This dissertation explores three avenues for mitigating opioid use disorder (OUD) and the opioid epidemic in the United States (1.) How can researchers and public health professionals identify areas most in need of treatment for OUD in an easy-to-use and publicly accessible interface?; (2.) What do practitioners see as opportunities for reducing barriers to treatment?; and (3.) Why do differences in opioid mortality exist between demographic groups?

Chapter 2 (*Developing an Interactive Online Opioid Treatment Dashboard: Metric Development to Visualization)* addressed the first avenue for mitigating OUD and the opioid epidemic in the United States. Conversations with stakeholders revealed their desire for a more comprehensive system to assess MAT access (other than mortality rates). They were interested in an interactive interface that was 1) easy to use; 2) flexible (meaning there were multiple data to choose from; and 3) put the data directly into their hands. The developed user-friendly and publicly available dashboard provides county-level data for the entire United States, allowing for a comparison of counties in different states. We developed a measure of unmet need of MAT (opioid mortality rate/provider rate) to identify high-priority areas for targeted intervention.

This unmet need of MAT metric moves beyond using opioid mortality rate to identify high-risk areas. The dashboard includes other metrics, like mortality and prescribing rates, that can assist stakeholders in their opioid related work.

The unmet need metric identified 136 counties with high mortality and the highest unmet need. Of those 136 counties, only 54 would have been identified by

looking at the top 10% of US counties with the highest opioid mortality rates. The unmet need metric makes it easier to identify counties that may benefit from getting priority of intervention attention. The metric also made separating potential high-priority areas in the same region easier.

The factors listed above highlight a sample of the reasons for providers not engaging in MAT. Developing the dashboard in Chapter 2 (*Developing an Interactive Online Opioid Treatment Dashboard: Metric Development to Visualization)* allows for identifying counties with high unmet need. The counties identified as having the highest or high unmet need in the dashboard are areas that can take priority in receiving public health attention. This can identify the barriers providers face to engaging in MAT within specific localized contexts.

The second dissertation goal of answering the question "what do practitioners see as opportunities for reducing barriers to treatment?" was answered in Chapter 3 (*Improving Systems of Care for Individuals with Opioid Use Disorder in New Mexico*). This work involved interviews with stakeholders (medical providers, peer support specialists, public health practitioners, etc.) in three New Mexico counties with high unmet need of MAT. Participants were asked about the current treatment landscape in their counties, strategies they have seen to enhance MAT options, and their outlook for the future of treatment. These interviews have led to the development of a policy brief to be shared among the medical, legislative, and public health sectors in New Mexico. The policy brief highlights nine strategies that can be used to increase the availability of MAT. Many of these nine strategies could be part of a thriving MAT landscape. This policy brief can be used by policymakers and practitioners in New Mexico to begin conversations about potential solutions for improving MAT availability.

The final overarching goal of this dissertation, "Why do differences in opioid mortality exist between demographic groups?" was addressed in Chapter 4 (*What Causes Race/Ethnicity and Sex Demographic Differences in the Opioid Epidemic? A Systematic Review*). Previous research over the last several decades has demonstrated that opioid-related mortality varies by race/ethnicity and sex. Nevertheless, even though there are clearly demographic differences in opioid mortality, little is known about why these demographic differences exist. Only six of the 52 reviewed articles provided any hypothesis about what contributed to demographic differences in opioid mortality.

Additionally, some demographic groups were surprisingly absent in previous research despite having high mortality rates

Research should examine a spectrum of demographic differences, especially among groups with high opioid mortality rates, like non-Hispanic Indigenous. Opioid mortality research has also been lacking in nonbinary and transgender demographic groups. Future research should incorporate a broader definition of gender and gender's impact on opioid mortality. Interventions to reduce opioid mortality rates are difficult to design without a better understanding of the structures, cultures, and systems influencing the problem. Future work on demographic differences in opioid mortality should concentrate on understanding the factors driving these differences.

Chapters 2-4 of this dissertation provide future directions for research about the opioid epidemic. Ultimately, this type of work aims to reduce opioid morbidity and mortality by using data-driven information.

<u>Strengths and Limitations of This Work</u>

The projects discussed in the preceding chapters have several strengths and weaknesses that will be outlined below.

Strengths

A strength of this work was the continued feedback from stakeholders that informed project decisions. Conversations with stakeholders heavily influenced the development of the dashboard. This included using an interactive online dashboard interface and the data included in the dashboard. Feedback from stakeholders also informed the design of the policy brief. New Mexico professionals called for a comprehensive document outlining a variety of effective strategies to increase access to MAT. They also noted the importance of having easily accessible data, which is why the first page of the policy brief has a figure with age-adjusted opioid mortality rates in New Mexico from 2012-2021.

The three chapters also focus on practical policy and research outcomes. The work highlighted in Chapter 2 (*Developing an Interactive Online Opioid Treatment Dashboard: Metric Development to Visualization)* resulted in a usable dashboard product for stakeholders. This tool can be used to identify areas of first priority for increasing MAT efforts. It also provides stakeholders with data for grant applications, advocacy, education, report writing, or policy development. The policy brief highlighted in Chapter 3 (*Improving Systems of Care for Individuals with Opioid Use Disorder in New Mexico*) describes nine key strategies to increase MAT options. It is possible to incorporate many of these nine key strategies into an ideal MAT landscape. Policymakers and practitioners in New Mexico can use this policy brief to brainstorm solutions for improving systems of care and MAT provision. Finally, the systematic review in Chapter 4 (*What Causes Race/Ethnicity and Sex Demographic Differences in the Opioid Epidemic? A Systematic Review*) provided clear directions for future research on opioid mortality. This future work should focus on identifying the structural and cultural factors influencing differences in opioid mortality. Additionally, future work should diversify the

demographic groups being focused on in opioid morality research. This may be particularly important for research on Indigenous and gender-diverse populations.

Limitations

While the overall project addressed unique perspectives of the opioid epidemic, each of the three research chapters focused on different topics related to the epidemic. There has not been an attempt to integrate the findings from these three chapters across different domains.

This research also focused solely on MAT as a treatment approach. While MAT is a heavily recommended approach with proven efficacy, it is not the only treatment option. Expanding this research to focus on the spectrum of treatment for OUD rather than MAT alone may have caused different results or recommendations for future work.

Finally, the opioid epidemic is a fast-changing situation in terms of the epidemic itself and the policies surrounding epidemic. This impacted some of the projects highlighted in this dissertation. For example, the removal of the X-Waiver requirement to prescribe buprenorphine in January 2023 was a major national win for increasing provider MAT engagement, but it has unknown implications on the accuracy of the dashboard. Similarly, it is unknown if and how the X-Waiver removal may influence Mat care provision in New Mexico, which may influence the nine key strategies described in the policy brief.

Future Directions for This Work

Dashboard

The dashboard was built based on conversations with community organizations, providers, and public health professionals to have easy-to-use and accessible data. The most immediate direction for this work is to share the dashboard as broadly as possible.

This will include presenting at health council meetings, conferences, and community events. Feedback from individuals in these organizations can inform ways to make the dashboard interface more user-friendly in the future.

After the public launch this spring, I plan to continue updating and expanding this dashboard tool. This way, the community can continue using the publicly available dashboard for advocacy, grant applications, policy development, and education. I want to expand the dashboard to include other types of substance misuse (such as alcohol dependency) or cancer screening. To do this, I intend to work with local health departments and community organizations to identify other afflictions to incorporate in the dashboard for which analogous unmet need metrics can be determined. The dashboard represents the end product of Chapter 2 (*Developing an Interactive Online Opioid Treatment Dashboard: Metric Development to Visualization).* Future exploration could evaluate whether certain counties exceed expected levels of unmet need, even considering similar factors. For example, can we compare the unmet need metric of a rural county of a particular population size to other rural counties of a similar population size? Future work could also explore a way to have an unmet need metric that factors in all medications used in MAT (Buprenorphine, Methadone, and Naltrexone) rather than just looking at Buprenorphine. I also want to work with other scholars to develop a dashboard allowing users to select different metrics to highlight on the map quickly. This current dashboard has multiple links to show a map with the unmet need metric, opioid mortality rates, and Buprenorphine provider rates standardized by population. In the future, I suggest having all of those embedded into a singular map so users can easily switch between them rather than going to new links.

Policy Recommendations

In this chapter, interviews with pertinent stakeholders (medical providers, peer support specialists, public health practitioners, etc.) were conducted in four New Mexico counties identified as having a high unmet need of MAT. Stakeholder interviews then contributed to developing a policy brief that will be shared within the New Mexico public health, medical, and legislative sectors. Future work could include conducting deeper dives in other counties highlighted as having a high unmet need in the dashboard. Using the dashboard to identify areas needing more individual attention can be useful since epidemics and treatment landscapes vary by local context.

The policy brief section of this dissertation also highlights the importance of translating academic work to contribute to policy change when applicable. Especially in public health, scholars should consider how their work may help inform policymakers. As described by the Scholar Strategy Network, an organization committed to connecting academics with legislators, "researchers and research institutions have an important role in improving policy and strengthening democracy. When decisions are informed by the best research, public policy strengthens communities and spurs innovation (Scholars Strategy Network, 2023). " Scholars should be encouraged to think about how their research might contribute to policy recommendations or help inform policy moving forward.

Opioid Mortality Research

Chapter 4 (*What Causes Race/Ethnicity and Sex Demographic Differences in the Opioid Epidemic? A Systematic Review*) highlighted that previous research on opioid mortality showed differences in opioid mortality by demographic groups. Yet, very few of these studies discussed why these differences by demographic group exist or even provided hypotheses. Understanding the structures, cultures, and systems influencing opioid mortality rates is crucial to designing interventions to address the problem. In the

future, work on demographic differences in opioid mortality should focus specifically on understanding the factors underlying those differences. In the future, there should be a distinct focus on understanding the factors driving demographic differences in opioid mortality. Other health ailments could be studied using a demographic approach, focusing on factors driving demographic differences to develop more targeted interventions.

Moving Towards a Future with Less OUD

As highlighted above, this dissertation represents the beginning of a body of scholarly work to address the opioid epidemic. To truly reduce the impact of OUD in the United States, there must be continued collaborative efforts with academic scholars, government officials, public health practitioners, medical providers, peer support specialists, and community organizations. The foundation of this collaborative work has already been laid over the last three decades.

I look forward to continuing to contribute to this work however I can.

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APPENDIX A

DASHBOARD HOT SPOT DEEP DIVE

Dashboard Hot Spot Deep Dive

Eastern Missouri Hot Spot

Missouri is one of the 21 states with a county classified as having high mortality and highest unmet need, with a total of 5 counties meeting those criteria (Franklin, Jefferson, Lincoln, Pulaski, and St. Charles). Franklin, Jefferson, Lincoln, and St. Charles counties are clustered together to the west of St. Louis.

Reasons for High Mortality

The 2020 opioid prescribing rate for Missouri was 54.4 per 100 persons, making it the 12th highest-ranked prescribing state in the United States (Centers for Disease Control and Prevention, 2021b). These high prescribing rates could contribute to the high mortality rates seen in these counties. recent work has found that like St. Louis City, Jefferson, and Franklin counties are facing increasing numbers of overdoses from fentanyl (Stoecker et al., 2020). This could be due to the ease of fentanyl or fentanyl-laced drugs to be transported along the highway system from St. Louis to these closer counties (Stoecker et al., 2023).

Reasons for Low Provision of Care

Previous work has not identified reasons why this pocket of western Missouri has a low provision of care. It is possible that this could be because St. Louis receives the majority of resources and interventions to increase provider MAT engagement in the region.

Western Nevada Hot Spot

Reasons for High Mortality

Lyon County, Nevada is the only county in Nevada designated as having high mortality and highest unmet need. Lyon is located in the western part of the state southeast of Reno and had a population of 59,235 in 2020 (United States Census Bureau,

2022). A 2022 county-level needs assessment describes From 2014-2016, Lyon had the highest rate of EMS calls requiring the administration of Naloxone and the highest percentage of adults reporting the use of a painkiller to get high within the past month (Lyon County Human Services, 2022).

Reasons for Low Care Provision

Lyon county as the largest rural county in the state of Nevada (Lyon County Human Services, 2022). As a rural county, Lyon seems to be facing a provider shortage seen in other rural areas. There are no in-patient rehabilitation facilities in the county as well as limited outpatient clinics for substance use (Lyon County Human Services, 2022). To make matters worse, most of these already limited outpatient options are already at maximum capacity, making it difficult for new patients to receive care (Lyon County Human Services, 2022). Based on the dashboard, there is only one provider offering methadone services in Lyon County and only two Buprenorphine waivered providers.

Additional work would need to focus on why these two hot spot areas have high morality and low care provision. The additional work could also focus on increasing care provision in these hot spot areas.

APPENDIX B

SEMI-STRUCTURED INTERVIEW PROTOCOL OF NEW MEXICO STAKEHOLDERS

Health Professionals' Views of the Landscape of Medication- Assisted Treatment

for Opioid Use Disorder- Alexandria Drake Dissertation Interview Protocol

Question	Skip Logic
Individual Role	
1. Are you a medical provider?	**Yes → Q2** **No → Q3**
Notes	
2. What type of medical provider are you (PA, NP, MD, DO, etc.)?	**No→ Q3**
Notes:	
3. What is your professional involvement with treatment and treatment access in OUD in New Mexico?	**→ Q4**
Notes:	

Attitudes Towards MAT	
4. How easy or difficult do you think it is for individuals with OUD to access MAT in your county on a scale from 1-5, with 1 bring extremely difficult and 5 being extremely easy?	**→ Q5**
Notes:	
5. What is your reasoning for the answer you gave on the ease or difficulty for individuals to access MAT in your county?	**→ Q6**
Notes:	
6. How important do you think it is to increase access to MAT in your county?	**Important → Q7** **Not important → Q8**
Notes:	
7. Why do you think it is important to increase access to MAT in your county?	**→ Q9**

Notes:	
8. Why do you think it is not important to increase access to MAT in your county?	**→ Q9**
Notes:	
Challenges and Successes	
9. Do you or your colleagues have experience trying to connect individuals to MAT services that already exist in your county?	**Yes → Q10** **No → Q12**
Notes:	
10. What, if any, challenges did you or your colleagues face in getting individuals connected to MAT services that already exist in your county?	**→ Q11**
Notes:	

11. What are successes that contributed to you or your colleagues getting individuals connected to MAT services that already exist in your county?	**→ Q12**
Notes:	
12. Have you or your colleagues tried increasing the number of MAT services available in your county?	**Yes → Q13** **No → Q16**
Notes:	
13. What are the different ways you or your colleagues have tried to increase the number of MAT services available in your county?	**→ Q14**
Notes:	
14. What, if any challenges have you or your colleagues have faced in increasing the number of MAT services available in your county?	**→ Q15**

Notes:	
15. What strategies contributed to you or your colleagues increasing the number of MAT services available in your county?	**→ Q16**
Notes:	
16. What efforts, if any, have other people or organizations tried to increase access to MAT in your county?	**→ Q17**
Notes:	
17. Do you think these efforts were effective? Why or why not?	**→ Q18**
Notes:	
18. What, if anything, could have made these efforts to increase access to MAT in your county more effective?	**→ Q19**

Notes:	
Waiver and Professional Role	
If a medical provider	**Medical Provider → Q19** **Other Professional → Q27**
19. Are you waivered to prescribe buprenorphine?	**Yes → Q20** **No → Q25**
Notes:	
20. What, if any, challenges did you experience in obtaining your waiver?	**→ Q21**
Notes:	
21. What, if any strategies helped in the process of obtaining your waiver	**→ Q22**

Notes:	
22. Are you providing MAT services? Please specify if you are currently providing services or if you have in the past as well as how long you have been providing services	**Yes → Q23** **No → Q26**
Notes:	
23. What challenges, if any, do you face in providing MAT services now that you are waivered?	**→ Q24**
Notes:	
24. What helps facilitate your ability to provide services with your waiver?	**→ Q27**
Notes:	
25. What are your reasons for not obtaining the waiver?	**→ Q27**

Notes:	
26. What are your reasons for having the waiver but not providing MAT services?	**→ Q27**
Notes:	
27. How would you describe your professional role in relation to addressing the opioid epidemic in your community?	**→ Q28**
Notes:	
Future Innovations	
28. When you envision the optimal MAT landscape in your county in the short term of this time next year, what does the future look like?	**→ Q29**
Notes:	

29. When you envision the optimal MAT landscape in your county in the long term of 5+ years, what does that future look like?	**→ Q30**
Notes:	
30. Of the topics we have discussed so far, which one do you think is the highest priority in addressing MAT access in your county and why?	**→ Q31**
Notes:	
31. Is there anything else regarding MAT in your county that we should discuss?	
Notes:	

APPENDIX C

SEMI-STRUCTURED INTERVIEW OF NEW MEXICO STAKEHOLDERS CONSENT FORM

Understanding Attitudes About and Barriers to Medication-Assisted Treatment for Opioid Use Disorder

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Consent Form

Please read this document and ask any questions you may have before agreeing to participate in the study. Alexandria Drake, a PhD Candidate at the School of Human Evolution and Social Change, Arizona State University (ASU) is leading this research under the direction of professor Dr. Daniel Hruschka.

Background Information

This objective of this research is to help us understand attitudes about medication-assisted treatment (MAT) to address opioid use disorder (OUD) in your county.

What will I be asked to do?

If you agree to participate in this study, we will ask you to participate in an online interview via Zoom or phone lasting approximately 30-45 minutes. In the interview, you will be asked a series of general questions about MAT in your county and your personal involvement or professional role (or lack thereof) with MAT in your county.

You do not need to respond to every question and may choose to end the interview at any point. The interview will be audio recorded and then transcribed by the interviewer. The recordings will be destroyed after transcription is complete. Your responses will be anonymous and will never be tied to you or your organization/place of employment.

Do I have to participate?

Participation in this study is completely voluntary. You may decide not to participate or to withdraw at any time. If you decide to participate, you are free to refuse to answer any question.

What will I receive for participation in this research study?

If you choose to participate in the study, you will receive a $20 gift card to thank you for your time.

Whom do I contact with questions about the research?

If you have questions regarding this study, you may contact Alexandria Drake (ajdrake1@asu.edu) or Dr. Daniel Hruschka (dhruschk@asu.edu). If you have any questions about your rights as a participant in this research, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Oral Consent

Let me know if you would like to participate in this research project.

Your verbal agreement indicates your consent to participate.

Let me know if you are willing to have this interview audio recorded.

Your verbal agreement indicates your consent to audio record the interview.

APPENDIX D

SYSTEMATIC REVIEW INCLUSION PROTOCOL

Understanding Differences in Opioid Mortality Rates in the United States: A Protocol for a Systematic Review

Objectives:

1. Examine which demographic groups are most often written about in opioid related research
2. Compare the effect size of records to see how they compare to national level statistics found in large scale surveillance systems
3. Note any hypotheses listed as factors contributing to differences in opioid morbidity and mortality in the United States.

Methodology

Literature Search

This research will use the following online databases: PubMed, Cumulative Index to Nursing and Allied Health (CINAHL), Excerpta Medical Database (EMBASE), and ProQuest Dissertations and Theses Global to identify articles. The following is an example of string that will be used to identify articles. The following string is an example using PubMed:

"((opioid mortality rate) OR opioid morbidity rate) AND race" "((opioid mortality rate) OR opioid morbidity rate) AND gender" "((opioid mortality rate) OR opioid morbidity rate) AND rural OR urban" "((opioid morbidity) OR opioid mortality) AND age" "((opioid mortality) OR opioid morbidity) AND white" "((opioid mortality) OR opioid morbidity) AND Black" "((opioid mortality) OR opioid morbidity) AND African American" "((opioid mortality) OR opioid morbidity) AND Latino" "((opioid mortality) OR opioid morbidity) AND Latina" "((opioid mortality) OR opioid morbidity) AND

Hispanic" "((opioid mortality) OR opioid morbidity) AND Latinx" "((opioid mortality) OR opioid morbidity) AND Indigenous" "((opioid mortality) OR opioid morbidity) AND American Indian" "((opioid mortality) OR opioid morbidity) AND Native American" "((opioid mortality) OR opioid morbidity) AND Asian" "((opioid mortality) OR opioid morbidity) AND Pacific Islander" "((opioid mortality) OR opioid morbidity) AND mixed" "((opioid mortality) OR opioid morbidity) AND male" "((opioid mortality) OR opioid morbidity) AND female" "((opioid mortality) OR opioid morbidity) AND men" "((opioid mortality) OR opioid morbidity) AND women" "((opioid mortality) OR opioid morbidity) AND LBGT*" "((opioid mortality) OR opioid morbidity) AND suburban" "((opioid mortality) OR opioid morbidity) AND income" "((opioid mortality) OR opioid morbidity) AND sex" "((opioid mortality) OR opioid morbidity) AND non-binary" "((opioid mortality) OR opioid morbidity) AND low income" "((opioid mortality) OR opioid morbidity) AND middle income" "((opioid mortality) OR opioid morbidity) AND high income" "((opioid mortality) OR opioid morbidity) AND sex" "((opioid mortality) OR opioid morbidity) AND youth" "((opioid mortality) OR opioid morbidity) AND adult" "((opioid mortality) OR opioid morbidity) AND elderly"

The title and abstract of a publication will serve as the initial screening tools for an article. However, the entire article will be considered as well if pertinent information isn't collected in the abstract or title.

This protocol will use three methods to identify literature. The first being the previously mentioned method of identifying articles through PubMed, Cumulative Index to Nursing and Allied Health (CINAHL), Excerpta Medica Database (EMBASE), and ProQuest Dissertations and Theses Global. Abstracts and titles will first be assessed for inclusion. If the necessary information to include the article is not present in the abstract or title, then a 2 minute window will be given to skim the rest of the article to decide

whether or not it should be included. Secondly, the reference sections of selected articles will be reviewed with a backward and forward analysis approach. Finally, health bulletins and released from the Center for Disease Control and Prevention (CDC), National Health Institute (NIH), Mayo Clinic, Cleveland Clinic, and Johns Hopkins will be assessed for inclusion capabilities. Similar to the dissertation search, the inclusion of these health briefs will extend the grey literature search.

Inclusion and Exclusion Criteria

Rayyan QCRI will be used to assist in the inclusion and exclusion decision making process. This will allow for a systematic way to select articles.

Geographic location:

Only articles written about the United States will be included in the systematic review. Because different countries have many varying regulations and opinions on opioids, it would make the study less generalizable to include research that took place in other parts of the world. Any study that takes place in the United States can be included. This means studies looking at the entirety of the U.S as well as individual regions, states, counties, or towns.

Language: Only articles coded in English will be included.

Research design:

All research designs will be included in the review. This is due to the fact that there is already a limited number of articles on this topic. It is important to not further restrict inclusion based solely on research design.

Time period:

Only articles published since 1995 will be included in the review. This is because the opioid epidemic we see today did not begin until the late 1990's.

Variables:

We will include articles that report opioid morbidity or mortality rates at some type of demographic level (race/ethnicity, gender, geographic location, income, etc.). We will prioritize articles that include morbidity and mortality rates at the "per 100,000 population" level due to uniformity. If a study presents rates at a different proportion of the population the rates will be converted to follow the "per 100,000 population" proportion.

Animal studies:

Only studies with human participants will be included.

Coding

Effect Size:

For the purpose of this study, morbidity or mortality rates will be includes to assess for effect size. The rates will need to be standardized if they are not already in the typical "rate per 100,000 population" calculation.

Publication Bias:

Several measures are being taken to account for potential publication bias. One of these methods will be testing to see if publication status is a moderator. In this analysis, published studies will serve as the reference group with the intercept indicating the average effect size for the published studies. The slope will indicate the difference in the average effect between published work and grey literature. Having a significant slope (p, 0.05) suggests that the magnitude of the effect size varies between the published and grey literature. Additionally, a Egger test will be completed to also test for publication bias. This is a linear regression of the standardized effect on its inverse standard error

(Egger, Smith, Schneider, & Minder, 1997). This will be done using the metabias command in the meta package (version 4.9-2; Schwarzer, 2007) in the R platform.

Preliminary Search:

To improve the capacity of this study a preliminary search will be conducted. This will assist in improving and finalizing the inclusion and exclusion criteria as well as the search strings used to identify articles for inclusion.

Data Management and Data Selection Process

Data Management:

During the research project, records and data will be kept in a shared Google Drive among the research team as well as a shared link in Open Science Framework among all of the collaborators. Records will additionally be kept on the personal and laboratory computers of the involved researchers. Records will be organized in separate folders for literature, data analysis (including syntax), and notes.

Selection Process:

Two independent reviewers using a standardized data extraction form will be used for selecting studies to include in the review.

Reliability:

We created a coding manual that captures effect sizes and relevant study characteristics (see Table 1 in Appendix). Authors will code five studies together to refine the coding descriptions. Articles will be coded independently by two independent reviewers. All articles will be coded twice independently by both of the coders. Cohen's Kappa (κ) and intraclass correlations (ICC) as measures of interrater reliability for categorical and continuous data will be reported (Orwin & Vevea, 2009).

APPENDIX E

SYSTEMATIC REVIEW CODEBOOK

APPENDIX E

SYSTEMATIC REVIEW CODEBOOK

Code	Description
Researcher Reference (CODER_INITIALS)	Record your initials as a researcher reference.
Article Number (ID_A)	Record the ID number of the article.
Article Title (ID_R)	Record the title of the study
Report First Author's Last Name (NAME)	Record the first author's last name.
Year of Report (YEAR)	Record the year the journal article was published. If article is unpublished (e.g., dissertation), record its acceptance date. Record year in (YYYY) fashion.
Publication Status (PUB_STS)	Report whether the article is: 1 = Publication, peer reviewed 2 = Data report,

	weekly report, or report 3= Other
Journal Type (JOURNAL)	Record the Name of the Journal the article came from (XX)
Data Source (DATA)	1= CDC Wonder (also can be called CDC's Detailed Mortality File (DMF) or CDC's Multiple Causes of Death), National Vital Statistics 2= Other federal data (this includes federal databases used to pull data for specific states) 3= Local state level data 4= Local county level data 5= Local city level data 6= Other

Location (LOCATION)	1= City 2= County 3= State 4= Region 5= Nation
City (CITY)	If the study took place in a single city, code for the city with the full name (i.e. code "New York City" not "NYC"), if not applicable, put "0"
County (COUNTY)	XXXX- enter county name if article focuses on one county 1= multiple counties within the same state are discussed 2= multiple counties from different states are discussed If not applicable, put "0"

State (STATE)	If the study took place at the state level, code for the state with the state's full name (i.e. code "Arizona" not "AZ"), if not applicable, put "0" - do this if 1-5 states were discussed If more 6 or more states were discussed = Multiple
Region (REGION)	XXXX- enter region name(S) from article If not applicable, put "0"
Setting (SETTING)	Code for the geographic area the article specifically discusses 1=Urban, suburban, or metropolitan

	2=Rural or non-metropolitan 0=Does not specify **Code only for items that are explicitly discussed but note to the group if you run across an article that only lists one setting, leaving you to inference the other group (i.e., Clinton et al., 2019)
Race/Ethnicity (ETH)	Code for identified race/ethnicity characteristics (these categories follow Census classifications) *Code for all groups discussed even if they are combined in the article (e.g., Asian/Pacific Islander) 1=White

	2=Latinx/Hispanic 3=Black/African American 4=American Indian/ Alaska Native 5=Asian 6=Native Hawaiian/ Pacific Islander 7=Mixed 8=Other 0=Does not specify
Ethnicity Number (ETH_NUM)	0= No ethnicity discussed 1= 1 ethnicity discussed 2= 2 ethnicities discussed 3= 3 ethnicities discussed 4= 4 ethnicities discussed 5= 5+ ethnicities discussed

Sex and Gender (SEX)	Code for identified sex and gender characteristics 1=Male 2=Female 3=Non-Binary 4=Other 0=Does not specify
Age (AGE)`	Is age discussed? 1=Yes 0= No
Stratified by Age (AGE_STRAT)	Does the article not focus on age but include data stratified by age? 1=Yes 0= No
Focus on Age (AGE_FOCUS)	Does the article focus on age/is age the scope of this article? 1=Yes 0= No

Veteran (VETERAN)	Code for if veteran status is discussed. 1=Yes 0=No
Income (INCOME)	Code for if the article discusses income or poverty 1=Yes 0=No
Income Describe (INCOME_DESCRIBE)	If yes to "income" code, describe how income or poverty is discussed in the article
Family Use (FAMILY)	Code for the use of non-prescribed opioids among family members 0=No 1=Yes

Friends Use (FRIENDS)	Code for the use of non-prescribed opioids among friends 0=No 1=Yes
Hypotheses about why there are differences in demographic groups (HYPOTHESES)	Code for if the article talks about hypotheses as to why there are differences in opioid mortality among the various demographic groups (e.g., if an article were to talk about high prevalence of opioid mortality among Latinx populations in New Mexico because of intergenerational use) 0=No 1=Yes
Demographic Hypothesis (DEM_HYPO)	Code added in final stages of analysis to assess if the

	"HYPOTHESIS" code from the group actually talks about WHAT causes demographic differences in opioid mortality 0=No 1=Yes
Describe the hypothesis (DESCRIBE)	Briefly describe the proposed hypothesis from the previous code if coded 1 for "Yes"
Opioid Mortality Rate per 100,000 (RATE)	Code for whether or not the article presents opioid mortality rates per 100,000 population 0=No 1=Yes
Analysis (ANALYSIS)	Code for the types of analysis represented in the article 1= Mortality rates

	2= Odds ratios/ risk ratios 3= Proportions/ Percentages
Mortality Data (MORTALITY)	List page number, location, table, etc. in the text where the data you coded for the "ANALYSIS" code is listed. If not applicable, put "N/A"

APPENDIX F

IRB EXEMPTION LETTER

APPENDIX F

EXEMPTION GRANTED

Daniel Hruschka
CLAS-SS: Human Evolution and Social Change, School of (SHESC)
480/965-3087
Daniel.Hruschka@asu.edu

Dear Daniel Hruschka:

On 10/22/2021 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Health Professionals Views of the Landscape of Medication- Assisted Treatment for Opioid Use Disorder
Investigator:	Daniel Hruschka
IRB ID:	STUDY00014649
Funding:	Name: Arizona State University (ASU)
Grant Title:	
Grant ID:	
Documents Reviewed:	• Attitudes about MAT Protocol, Category: IRB Protocol; • Interview Protocol V9 9.17.21.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Understanding The Landscape of Medication Assisted Treatment Recruitment Form_10.18.21.pdf, Category: Recruitment Materials; • Understanding the Landscape of MAT Consent Form_10.22.21.pdf, Category: Consent Form;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 10/22/2021.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

REMINDER - All in-person interactions with human subjects require the completion of the ASU Daily Health Check by the ASU members prior to the interaction and the use of face coverings by researchers, research teams and research participants during the interaction. These requirements will minimize risk, protect health and support a safe research environment. These requirements apply both on- and off-campus.

The above change is effective as of July 29th 2021 until further notice and replaces all previously published guidance. Thank you for your continued commitment to ensuring a healthy and productive ASU community.

Sincerely,

IRB Administrator

cc: Alexandria Drake

APPENDIX G

CO-AUTHOR APPROVAL STATEMENT

APPENDIX G

CO-AUTHOR APPROVAL STATEMENT

Chapter 4 of this dissertation, “What Causes Race/Ethnicity And Sex Demographic Differences In The Opioid Epidemic? A Systematic Review” has not been submitted to a journal but is in preparation for submission. The co-authors of this paper have been involved in providing feedback during the writing process. They have given final approval for this paper to be included in this dissertation and then submitted for peer-reviewed publication.