2022

The Impact of Telemedicine Availability on Fatal Opioid Overdose Rates in Texas, 2020

Cara W. Hall
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral study by

Cara Hall

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Donna Clews, Committee Chairperson, Health Sciences Faculty
Dr. Mary Garbowski, Committee Member, Health Sciences Faculty
Dr. James Rohrer, University Reviewer, Health Sciences Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2022

Abstract

The Impact of Telemedicine Availability on Fatal Opioid Overdose Rates in Texas, 2020

by

Cara Hall

MS, University of North Texas at Denton, 2016

BAAS, University of North Texas at Denton, 2014

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

May 2022

Abstract

Substance use disorders (SUDs) and fatal overdoses are a significant problem in the United States. A viable and effective method for treating SUDs is through telemedicine (tele-SUD) visits. Tele-SUD visits are an effective means of meeting with patients virtually, especially in the post-COVID-19 environment; however, a problem in health care exists concerning the availability of tele-SUD services in middle America. The purpose of this study was to investigate the impact of tele-SUD availability on rates of opioid overdose deaths in the state of Texas. Donabedian's model of health care quality evaluation was used as the theoretical framework. A quantitative, independent samples, *t*-test analysis was used to investigate the relationship between telemedicine services and opioid overdose deaths in 254 counties in Texas in 2020. A regression analysis was conducted to determine if the amount of telemedicine availability per capita made a difference in fatal overdoses in each county of Texas. Data were collected from the U.S. Department of Health and Human Services' Substance Abuse and Mental Health Services Administration and the University of Wisconsin's County Health Rankings and Roadmaps. The independent variable was availability of tele-SUD, and the dependent variable was rates of countywide opioid overdose deaths in 2020. The results of the analysis revealed no statistically significant connection between the presence of telemedicine in a given county and its opioid overdose death rate. Findings from this study may be used for positive social change by tele-SUD administrators in designing their programs.

The Impact of Telemedicine Availability on Fatal Opioid Overdose Rates in Texas, 2020

by

Cara Hall

MS, University of North Texas at Denton, 2016

BAAS, University of North Texas at Denton, 2014

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

May 2022

Dedication

To my “Cloud of Witnesses” (Hebrews 12:1) that are now watching me from the Heavens: Forever grateful to: Fessie Onia Mosley (Mentor), Erma (Granny) Jean Moore Jackson, Bernice (Grandmother) Humble Hall Kyle, Lucille Thomas, Mable Nelson, Peggy Madison, Leslie (Aunt B) Hillard, and Beverly (Aunt Faye) Hall Woodard. Each one of you played a vital part in me becoming who I am at this moment. Oh, how I wish you all were here to celebrate this major milestone with Royalty. This journey has brought me through the Good, the Bad, and The Ugly that Life has thrown my way. But as Royalty reflects on the many Powerful stories of wisdom, encouragement, prayers, the beatdowns (with Love), and impartation, I am still here, by the Grace of God. I laugh now because God put the feistiest women with warrior souls in my path to train me for the many battles that I have endured, as well as the ones to come. I am stronger, wiser, humbler, and better for these experiences. Yet, when my troubles are too great for me to handle alone, I leave it in the Hand of the Lord to fix. In other words, Royalty learned how to hold her peace and pray, praise, and worship in the spiritual realm. I am forever humble, honored, and grateful that God chose me for you all to take under your wings to pour into you all as well as receive the journey.

To my original elders that are still here to celebrate with me: BJ Nelson and Tim Thomas. Thank you for the words of encouragement and prayers. I am truly honored as well as humbly grateful to not only serve but also Love each one of you.

To my Father Carl Wayne Hall, Sr.: even though our relationship was distant until the last month of your days here on earth. I would like to say thank you because it was

your seed that allowed me to experience this amazing journey called Life. Forgiveness was necessary for me to heal and continue to grow. Your “Puff n Stuff” went on and became a Doctor. Thank you and all is well.

Love,

Royalty

Acknowledgments

First of all, I would like to give all the Praises, the Honor, and the Glory to my God and Savior who has kept, strengthened, provided, led, guided me through everything.

To Valerie Williams Nickerson, thank you for being obedient to the voice of God. Never could have guessed that volunteering at the age of 13 under your supervision would lead (me/us?) to answer God's call to serve the elderly population. Many looked down on me and disregarded my gifts; however, you have always nourished them. I have come to realize not everyone has the capacity to Love at such magnitude, but I am Thankful that God has chosen me for the task. I learned how to humbly walk on this journey by watching you. I will forever tell my testimony on how my journey with the elderly population began with you.

To Dr. Keith Whisnant Turner, PhD., my bonus father: By the Grace of God, your daughter Royalty became a doctor. We are bonded not biological but through Love. Thank you for seeing in me that I never ever imagined for myself. After I completed the master's program at University of North Texas at Denton, you gave me one year to regroup before telling me to locate an accredited doctoral program and enroll. I was a little hesitant because I hadn't considered getting a doctorate at the time, but I placed my faith in your vision. Every time we speak, you give me greater confidence in my sense of promise. I am so appreciative of you for getting me to the door. I wish we could've walked this process all the way to the end. I will forever be grateful for your wise, firm feedback and for always cheering me on from afar. To my favorite doctor, Robert T.

Gunby, MD, thank you for your continued Love and support all these years. To my Attorney, T. A. Sneed, thank you for the support through my master's and Doctoral program.

To my mother Deborah Marie Jackson Hall Jackson, Doctoral Candidate at GSU: I am so proud of you for pursuing your dream. I appreciate your love and support through this process. Also, I would like to Thank you for how, when I was battling dyslexia until the 5th grade, that you not only did therapy at home, but you continued to work with my schoolteachers and Dr. Richard Collier to ensure that I thrived in the mainstream classroom. It took patience to be able to stay calm while your child was reading and writing backwards. We laugh now at how I would love to write "God" & "I Love Jesus" backwards with the big red heart. The hard work and therapy paid off.

To my "Good" brother Carl W. Hall II, the best girl dad, businessman, and provider for your family unit (Tomeka, Brianna, & Nelson the dog). I am so proud of your growth, both professionally and on a personal level over this last year. I appreciate you for our special sibling relationship despite our ups and downs. Thank you for the love, gifts, and support doing this process. To Brianna, my niece and my bonus child through Love. As a little girl, you always would tell me, "Auntie, God said you going to have everything you need -- I mean everything." Through God's grace, you have been proven right every time. I am so proud of the young woman that you're becoming. I pray that I have influenced you to continue to set goals and pursue your dreams.

To my sisters/friends, Samanthia Jackson, Sharonda Woods, Tiffany Briscoe-Jackson, and Erron Richardson-- my prayer warriors, support-team, always loyal and

trustworthy: I am so grateful for how you all have stood by me through my good, bad and the ugly. I am so proud of you all as wives, mothers, sisters, grandmothers, and businesswomen. We may not be biological kin, but we are still sisters through Love. I know that I missed some special milestones in each of your lives while in this program, however you were all understanding and supportive throughout the process. I wish you all the best in your new leadership roles at your companies. Sharonda, congratulations on graduating from college -- it is time to go back.

To Patrick Murray Sr.: this, by far, has been the most challenging and rewarding part of the journey for me. I was always told if you can love an elder then you can love anyone. I came to realize that was not true for me. I was trying for the first few years to understand how God would interrupt my so-called plans, but I am happy He did. Furthermore, learning to love beyond the chatter from the outside world was challenging, but I eventually achieved it. I appreciate you as a Man of God, a provider, and a great father (Jalen, Lil Patrick II, & Shaun Michael). I am so proud of your recent accomplishment of becoming a realtor. Despite the ups and downs, I am so Thankful for you praying with and for me whether I asked through this tedious process. To my bonus kids, through Love: Jalen, Lil Patrick II, & Shaun Michael: God gave me the capacity to Love each of you without qualification. Through distance, forgiveness, continued growth, and just embracing each other as we are, we have become family. I am so proud of the young men you all are becoming and pray that I have influenced you all to pursue your dreams without fear. I look forward to your success stories. I appreciate and love you three for sticking by my side and cheering me on.

To my Aunt Felecia Lynn “Chief Jackson: Thank you for your love, support and constant prayers. I know you have a direct line to connect to God as you tell us He answers all your prayers. To my Uncle Enuh “Pete” Jackson Jr.: Thank you for your love, prayers, encouragement, and -- prior to braces -- my favorite snacks.

To my special friend Linda Manning, I am so honored and grateful to have crossed paths with you on this journey called Life. Thank you for my daily devotional, love, wise conversations, prayers, and laughter. I will never forget your famous speech about each house that has a roof has an issue, which always rings true. I pray that God continues to shower you with unprecedented blessings, strength, peace, and protection.

Finally, I would like to especially thank my chair, Dr. Donna Clews, committee member Dr. Mary Garbowski, and my URR, Dr. Rohrer. I appreciate all the feedback, guidance, and the encouragement throughout the Doctoral process. A special Thank you goes out to Dr. Zin, who sacrifice many weekends appointments to speak with me regarding my data analysis and methodology.

Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

In the United States, rates of drug overdose have drastically risen. National data showed that between 2000–2014, national rates of death by drug overdose more than tripled and became a more common cause of fatality than automobile accidents (Rudd et al., 2016). Various causes for these epidemic rates of drug overdose deaths have been identified, including chronic over-prescription of opioids by medical professionals and the increased distribution of fentanyl (Katz, 2017; Rudd et al., 2016). In order to properly address this widespread issue, adequate standards of substance abuse patient care must be extended to patients in all different economic circumstances and geographical regions. One such approach is through telemedicine visit to treat substance use disorders (tele-SUD) programs, in which patients with substance use disorders (SUDs) receive remote medical and psychological care, often through teleconferencing (Uscher-Pines et al., 2020).

The aim of this study was to determine if the expansion of telemedicine services can have positive outcomes for patients with SUDs in the state of Texas (see Mehrotra, 2017). Donabedian's (1966, 1988) model of health care quality evaluation was used as the theoretical framework. In this study, I used the availability of telemedicine as a measure of structure quality and the number of fatal overdoses per capita in a given county was a measure of outcome elements (see Donabedian, 1966, 1988).

Problem Statement

The opioid overdose pandemic in the United States has continued to steadily increase, despite awareness of its existence across the nation (Katz, 2017). The average lifespan within the United States declined between 2015 and 2016 (Wakeman & Barnett, 2018). Wakeman and Barnett (2018) detailed a large number of deaths from accidental injuries, including nonfatal overdoses, and looked at the myths of opioid use and SUDs compared to the realities, then proposed policy solutions to address the discrepancies. The researchers proposed many solutions to the opioid crisis that addressed different aspects of the problem and could be scaled up or down to work on local or national levels, however, they provided little analysis of the costs and benefits of implementation (Wakeman & Barnett, 2018).

Since the 1960s, lifespans in the United States have seen a decrease in longevity, which many believe has been caused by the opioid crisis (Wakeman & Barnett, 2018). Regardless of race, gender, religion, lifestyle preference, and social status, the opioid crisis continues to worsen, impacting both individuals and families. As the problem continues to worsen, the capacity of the health care system for treatment is decreasing (Wakeman & Rich, 2017). Approximately 80% of U.S. citizens who meet the guidelines for SUDs do not receive treatment (Makary et al., 2017). Further study relating to SUD treatment revealed that tele-SUD visits are an effective means of meeting with patients virtually, especially in the post-COVID-19 environment (Huskamp et al., 2018). Telemedicine continues to gain popularity and can be a valuable tool for treating patients with SUDs because it provides a means of providing high-need individuals who are not able to receive support for SUDs in their communities with quality care (Browne et al.,

2016). However, an operational problem in health care exists concerning access to tele-SUD services (Browne et al., 2016; Huskamp et al., 2018; Substance Abuse and Mental Health Services Administration (SAMHSA), 2016). There is a gap in the literature regarding the use of telemedicine visits to decrease the rate of fatal opioid overdoses (Huskamp et al., 2018). Better addressing the opioid crisis and the need to care for individuals with SUDs may be accomplished by evaluating the effectiveness of telemedicine visits to promote health and prevent nonfatal overdoses by SUD patients.

Purpose of the Study

The purpose of this quantitative study using secondary data was to evaluate whether the availability of tele-SUD visits in the state of Texas decreased the patients' risk of fatal opioid overdose per capita. According to Katz (2017), opioid drug addiction is prevalent throughout middle America, particularly in the Midwest and the South. However, in such areas, there is a shortage of services for the treatment of SUDs, and nonfatal overdoses do occur (Huskamp et al., 2018). The use of telemedicine to treat mental health conditions, such as SUDs, may be a viable option for decreasing fatal opioid overdose (Mehrotra et al., 2017). For this study, the independent variable was availability of telemedicine, and the dependent variable was per capita rate of opioid overdose death.

Research Questions and Hypotheses

This study was guided by two research questions and their corresponding hypotheses:

RQ1: What is the relationship between the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine service?

$H_0$1: There is no statistically significant difference in the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine services.

$H_1$1: There is a statistically significant difference in the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine services.

Test statistic: Independent samples *t* test.

Predictor variable: Presence or absence of telemedicine services in a county (i.e., two groups).

Dependent variable: rate of opioid overdose deaths per capita in a county.

RQ2: What is the relationship between the number of telemedicine service services and rate of opioid overdose deaths (per capita) in Texas counties?

$H_0$2: There is no statistically significant relationship between the number of telemedicine service points and rate of opioid overdose deaths (per capita) in Texas counties.

$H_1$2: There is a statistically significant relationship between the number of telemedicine service points and rate of opioid overdose deaths (per capita) in Texas counties.

Test statistic: Simple linear regression.

Independent variable: Number of telemedicine service services in a county.

Dependent variable: Rate of opioid overdose deaths per capita in a county.

Theoretical Foundation

I chose the Donabedian model as the theoretical foundation for this study. The Donabedian model is a conceptual framework used to evaluate health care services and quality of care (Donabedian, 1966) and helped me address the problem of nonfatal overdoses by effectively treating adult patients with SUDs using telemedicine in rural areas of the United States. The Donabedian (1966) framework consists of three different elements, structure, process, and outcome, all of which contribute to the quality of patient care. Within the Donabedian (1966, 1988) model, the structure consists of evaluating care delivery and includes practical underpinnings, such as staff, equipment, financing, hospital buildings, and associated elements, necessary for providing health care services. The process consists of evaluating the relationships that occur between patients and services throughout the health care delivery process. The outcome element consists of assessing the effects of health care delivery on quality of life and the health status of populations and patients, at any level.

Researchers and health care professionals use these three classifications of care to determine whether the level of care is good, bad, or fair (Samuels et al., 2019). The three elements of the Donabedian framework were crucial for this research study designed to explore the availability of telemedicine visits in the state of Texas. In this study, the availability of telemedicine was used as a measure of structure, the rate of telemedicine

usage for the SUD population measured the process element, and the number of fatal overdoses per capita in each county in Texas in 2020 measured outcomes.

Nature of the Study

In this quantitative study, I conducted an independent *t*-test analysis to measure the relationship of the availability of tele-SUD in counties of Texas and the counties' respective per capita rates of opioid overdose death. Secondary data were used for the analyses. Data analysis was conducted using county opioid overdose data and telemedicine availability data collected from the SAMHSA and the University of Wisconsin's County Health Rankings and Roadmaps. I used SAMHSA data to both identify behavioral health treatment facilities in Texas that offer treatment for substance abuse and determine which of these treatment facilities offer telemedicine resources. County Health Rankings and Roadmaps data were used to determine rates of opioid overdose per capita in each county in Texas. The data sets were combined and used to determine if there was a statistically significant relationship between the number of telemedicine service points in a given county and the rate of opioid overdose death per capita in that county.

Literature Search Strategy

There were several extant studies related to physicians' treatment of adult patients with SUDs and opioid overdoses published in peer-reviewed journals the past 5 years. To obtain these sources, I searched the following databases in the Walden University Library: SAGE, MEDLINE, and ProQuest. Keyword search terms included *opioids crisis, opioids addictions, nonfatal overdose, overdose, adults, minority, perceptions,*

attitudes, opinions, stigma, service, physician, substance use disorder, opioid use disorder, race, gender, demographic area, and *the United States*.

Literature Review Related to Key Variables and Concepts

The purpose of this quantitative study using secondary data was to investigate the impact of tele-SUD availability on opioid overdose rates per capita among counties in Texas. The independent variable was countywide access to telemedicine services. The use of telemedicine to treat mental health conditions, such as SUDs, may be a viable option for decreasing nonfatal overdoses for SUDs patients in rural areas (Mehrotra et al., 2017). Tele-SUD services have been shown to be accessible and intuitive for both medical professionals and patients, which may have positive implications for efficacious SUD treatment (Lai et al., 2020).

The dependent variable was the rate of fatal opioid overdoses per capita in Texas counties in 2020. According to Katz (2017), opioid addiction is prevalent across the United States, particularly in the South, Midwest, and Appalachia. In these areas, there is a shortage of services for the treatment of SUDs, and nonfatal overdoses do occur (Huskamp et al., 2018). In this study, I sought to determine whether there is a statistically significant relationship between the availability of tele-SUD and the per capita rate of opioid overdose in Texas counties.

Telemedicine

Telemedicine is the use of remote diagnosis through a live video teleconference where a patient can get diagnosed and treated outside of a hospital or medical facility by a specialty health clinician (Huskamp et al., 2018). Telemedicine for the use of treating

mental illness is growing dramatically, and it has proved successful in some cases for this type of treatment (Huskamp et al., 2018). The use of tele-SUD visits is much less documented in the literature but considering the relationship that mental health illnesses have to SUDs, tele-SUD treatments should be beneficial.

Telemedicine is substantially less expensive and more accessible than in-person visits for many patients. Nord et al. (2018) surveyed 650 patients who had received care from a telemedicine service about the alternative care they would have sought out had they not used telemedicine and what care was received after the telemedical visit. The researchers also collected data about the patients' cost of care and, based on data derived from existing literature on health care costs, estimated the difference in cost the patients had to pay. They found that nearly three quarters of patients studied felt that their health care concerns were adequately addressed by their telemedical visit; patients were estimated to have saved between $19-$121 by choosing telemedicine instead of an in-person visit (Nord et al., 2018). This finding demonstrates the significant changes in medical efficacy that are possible with telemedicine and how telemedicine can be used to extend care options to lower-income patients.

Telemedical care has been shown to lead to high levels of patient satisfaction. In an effort to determine the level of patient satisfaction among telemedicine patients, Rizzi et al. (2020) surveyed both orthopedic surgeons and orthopedic surgery patients after 612 telehealth appointments that took place between April 6th, 2020 and May 22nd, 2020 via phone call and video conference. After the appointments, the patients and surgeons were reached via telephone to gauge their satisfaction with their visits using a Likert scale-

inspired tool to evaluate the quality of their appointment on a 5-point scale from *highly satisfied* to *highly unsatisfied* (Rizzi et al., 2020). Ninety-five percent of patients were either "highly satisfied" or "satisfied" with their telemedicine experience, and 93% of patients stated that they would schedule another telemedicine encounter in the future. Eighty percent of surgeons who participated in a phone-based telemedicine encounter and 86% of surgeons who participated in a teleconferencing appointment indicated that they were either "highly satisfied" or "satisfied" with their telemedical encounters. The surgeons surveyed found that in roughly 78% of cases, telemedical encounters effectively replaced in-person visits. Rizzi et al.'s (2020) findings demonstrate how telemedical care can be effective for health care services and adequately respond to patient standards of comfort.

Telehealth and SUD Treatment

The benefits of telemedicine are unique and can be life-changing to many patients. Eibl et al. (2017) studied whether telemedical delivery of opioid antagonist therapy was as successful as in-person treatment, using therapy retention rate as a metric of success. The researchers used a cohort of 3,733 opiate use disorder patients 15 years or older who had no prior history of methadone or buprenorphine use at 58 different clinics in Ontario, Canada. Patients were followed from the beginning of their methadone or buprenorphine treatment to 30 days after the end of their treatment, from January 1st, 2011 to June 17th, 2012. Forty-seven percent of patients received over 75% of their doctors' visits over telemedicine, 42% of patients received under 25% of their doctor's visits over telemedicine, and the remaining 11% of patients received a mix of telemedical

and in-person visits. Patients whose medical visits were primarily via telemedicine were significantly likelier to stay in therapy for a year (i.e., 50% of patients) than patients who primarily met with doctors in person (i.e., 30% of patients). Telemedical patients also found the most drastic reduction in rates of nonreplacement opioid use at the end of the study; 25% of telehealth patients tested positive for non-replacement opioids at the end of the study period, a drop of 56.6%, compared to in-person (27% with a decrease of 48.7%) and mixed-method patients (26.9% with a decrease of 40.6%). The researchers concluded that telemedical approaches to opioid antagonist therapy could be as effective as in-person or mixed-method approaches.

Telemedicine in Urban Areas

Prior to the COVID-19 pandemic, most telemedicine users lived in urban areas, despite the attention telemedicine received in rural areas (Barnett et al., 2018). To model and study growth in telemedicine from 2005–2017, Barnett et al. (2018) used demographic data from OptumLabs Data Warehouse, a claims database that collects information from both Medicare enrollees and privately insured individuals encompassing 383,565 telemedicine visits and 217,851 patients. The mean age of telemedicine users was 38.3 years old, with 63% of the users being female and 83.3% residing in urban areas (Barnett et al., 2018). The researchers also found that users of primary care telemedicine were younger on average than the users of telemedicine for mental health treatment. They were also more likely to reside in more urban areas, with 87.1% primary health care telemedicine users and 75.2% of mental health telemedicine users residing in urban areas. Interestingly, the researchers suggested that this urban

telemedicine trend was purely owing to a concern for convenience rather than a lapse in availability of health care options. If this is true, it may bode well for future attempts at telehealth expansion; however, because the sample drew significantly from southern Medicare enrollees, economic disparities and infrastructural challenges for low-income enrollees may have impacted this study in ways the researchers did not fully acknowledge.

Telemedicine in Rural Areas

Telemedicine may be particularly important and beneficial in rural areas. According to Samuels et al.'s (2018) multi stakeholder framework for addressing opioid addiction and overdose, opioid use disorder treatment does not yet have a consistent standard of care in emergency departments (Browne et al., 2016). Since emergency departments are often the only source of care for SUD patients in rural areas, lacking in SUD treatment options, the lack of standards of care for opioid use disorder treatment in emergency departments is concerning. Research has suggested that this lack of standards of care is often the case either due to stigma around SUDs, a lack of available outpatient addiction medicine resources, or gaps in the knowledge and training of medical services (Samuels et al., 2018).

Rural communities face unique situations and community members in rural areas have concerns about the efficacy of SUD treatments (Browne et al., 2016). Browne et al. (2016) interviewed 40 key stakeholders and 40 clients at nine different rural substance abuse agencies in a state in the southeastern United States to identify barriers and opportunities for SUDs treatments. The researchers found four primary barriers to SUD

treatment in rural communities: the lack of access to up-to-date technology used to treat clients and maintain smooth agency functioning, the financial burden of high-quality treatment the availability and presence of services for clients to take advantage of in rural communities, and the stigma of having a SUD. These barriers are essential to consider and address in considering methods of treatment for SUDs, including telemedicine. Telemedicine may pinpoint many of these barriers that may appear, if not all of them. Browne et al. targeted individuals in rural areas to determine ways that tele-SUD could provide adequate services and found that schedule-based accommodations, for example, were cited as a potentially meaningful intervention. This is particularly in the case in areas where many people have common work schedules or have substantial religious time commitments (Browne et al., 2016). The researchers did not, however, show how the barriers found impact client care, access, and experience. Their findings also may not be applicable nationwide because only one state was studied (Browne et al., 2016).

Rural communities also have a lot of unique barriers that prevent individuals from getting the help that they need. Browne et al. (2016) identified several of these barriers, including: “limited referrals for substance abuse services, limited behavioral health services availability, lower utilization and treatment completion rates, higher financial burdens to pay for services, exacerbated stigma, and privacy concerns.” Medicare regulations prior to COVID-19 only allowed telemedicine coverage in rural areas due to some of these barriers, but even then, patients had to be hosted at a local clinic or health care facility to receive the treatment (Huskamp et al., 2018).

Of the people who live in rural areas and have a SUD, very few receive treatment, often due to the lack of SUD services (Huskamp et al., 2018). Huskamp et al. (2018) analyzed claims data from the period between 2010 and 2017 to determine how frequently SUD treatment was provided via telemedicine, who was receiving tele-SUD treatment, and the extent to which tele-SUD is used with in-person care. The claims data demonstrated that use rates of tele-SUD treatment are low, even amid rising telemedicine usage for other concerns, such as mental health. While tele-SUD telemedicine visits increased significantly over the period, only 1.4% of all telemedicine visits were for the treatment of SUDs, and tele-SUD users were found to have significantly more severe SUDs. Tele-SUD users were significantly more likely to have an opiate use disorder, were more likely to live in rural areas, and often used tele-SUD visits to receive support from medical experts after an inpatient experience for SUD treatment. These findings are notable given the rise in SUDs that have accompanied the opioid epidemic in the United States. More information on which forms of telemedicine are used to successfully treat SUDs could improve the opportunities for care (Huskamp et al., 2018). Although the rates of rural tele-SUD visits were higher than the rates of tele-SUD visits elsewhere, only 7.7% of tele-SUD visits were servicing rural individuals. Expanding tele-SUD approaches could be a significant opportunity for telemedicine growth and could be a good way to improve SUD outcomes in rural areas.

A lack of mental health specialists in some rural communities is another challenging circumstance for many people (Mehrotra et al., 2017). Telemedicine can fill a need in these communities because the specialists do not need to be local in order to

provide care. Mehrotra et al. (2017) performed an analysis of Medicare data from 2004 to 2014 to examine changes in rural policyholder use of telemedicine for mental health, which is also known as tele-mental health. The researchers used zip codes on claims data and Diagnostic and Statistical Manual of Mental Disorders definitions of *mental illness* to identify Medicare beneficiaries who lived in a rural community and suffered from mental illness. They then identified and characterized tele-mental health visits based on the information from insurance claims these individuals made. Over the decade-long period analyzed, the number of tele-mental health visits increased about 45% per year, and by the end of the period studied, the number of visits per 100 rural individuals was 5.3 for mental illness and 11.8 for serious mental illness. Those taking advantage of the service were often younger than 65 years old, eligible for Medicare due to a disability, and in underresourced communities. The researchers found a fair amount of variation between states in the study, with some states having more visits per 100 individuals and some having zero, but this was likely due to state-by-state differences in laws and insurance regulations.

Mehrotra et al. (2017) found a wide variety of uses for telemedicine across the United States. In their analysis, they studied 10 years of data from Medicare. One of the benefits of the study was the timeframe of data; 10 years of data allowed the researchers to look at trends and draw conclusions about the use of telemedicine across the country. Additional research on the topic could involve data from more insurance services than just Medicare and could use more recent data.

In terms of mental health, using telemedicine to access and treat patients has been comparable and, in some cases, even superior to in-person treatment, depending on the physical location and quality of in-person services (Mehrotra et al., 2017). In rural areas, challenges, such as transportation, service shortage, cost, and general stigma, stand in the way of substance abuse treatment (Mehrotra et al., 2017). Stigma is a barrier particularly in rural areas due to the fact that there are small populations and the invasion of privacy of a client may prevent them from seeking the care that they need (Browne et al., 2016). Telemedicine provides an alternate route to get medical help for sensitive disorders without the stigma or a loss of privacy. Financial barriers, such as paying for gas, paying for childcare, taking time off work, and the cost of treatment, are particularly difficult in rural areas (Browne et al., 2016). Telemedicine provides flexible services, service diversity, and greater service availability, providing rural patients the flexibility and accessibility necessary for proper care (Browne et al., 2016).

Tele-SUD

Prior to the COVID-19 pandemic, tele-SUD was typically used to complement in-person treatments and was primarily used by patients with a severe SUD (Huskamp et al., 2018). Now, as a result of the pandemic, there has been an accelerated use of tele-SUD treatments, paving a never before possible pathway into the homes of many patients (Kleykamp et al., 2020). By paying respect to quarantining and social distancing, the result is that patients who had previously been unable to receive treatment due to logistical, physical, or distance limitations are now benefitting from a more robust digital communication infrastructure. Options for group telehealth provide unique therapeutic

settings that had also previously been impossible for some patients in less populated areas (Kleykamp et al., 2020).

Prescriptions for SUD drugs have been impacted by the COVID-19 crisis as well. The Department of Health and Human Services made a public declaration in March of 2020 stating that the U.S. Drug Enforcement Administration registered practitioners had permission to issue prescriptions for all schedule II-IV substances without an in-person subscription (Kleykamp et al., 2020). Prescriptions are allowed to be issued as long as they are for a legitimate medical purpose and the telehealth communication occurred with an audio-visual, real-time, two-way interactive conversation (Kleykamp et al., 2020).

Tele-SUD Availability

Tele-SUD provides greater availability of treatment to a much larger population of people. There are five sub-themes associated with the availability of tele-SUD: service shortage, integrated services, transportation, flexible service provision, and service identity (Browne et al., 2016). Particularly in rural communities, there is a lack of inpatient and mental health services, causing local emergency departments to be one of the only sources of treatment options available to patients suffering from SUD (Browne et al., 2016). Tele-SUD treatments would allow for a reduction in the service shortages in these areas. Oftentimes, integrated service between several medical fields are necessary for an adequate diagnosis which can be provided with more ease through telemedicine in communities with service shortages. A lack of transportation has frequently been mentioned as a barrier to attending substance use services. Many workers in rural areas also need the schedule of their treatments to be flexible with their schedule. Particularly

religious areas might provide treatments that do not align with the beliefs of a patient, once again limiting the availability of SUD treatment (Browne et al., 2016). Telemedicine can address each of these availability concerns in terms of treatment. One of the greatest benefits of treating SUD through telemedicine is the ability to enhance the availability of services and expand the amount of individuals who receive the help that they need.

Uscher-Pines et al. (2020) conducted semistructured interviews with leaders of health centers to explore both the ways in which telemedicine was being utilized in treatment of opioid use disorders and the reasons why health centers choose to not adopt telehealth strategies for opioid use disorder patients. The researchers used the SAMHSA Behavioral Health Treatment Services Locator database to create a 22-organization sample of mental health centers (Uscher-Pines et al., 2020). The researchers found that of the 22 health centers surveyed, eight offered teleSUD services (Uscher-Pines et al., 2020). The researchers found that there was a tremendous diversity in tele-SUD offerings between different tele-SUD services; while some health centers offered a variety of tele-SUD resources and some offered single services (Uscher-Pines et al., 2020). The most commonly cited telemedical services offered to opiate use disorder patients were prescription management, individual psychotherapy and group therapy (Uscher-Pines et al., 2020). Health center leaders cited high levels of patient and staff buy-in for tele-SUD treatment, saying that clients appreciated the added convenience of remote appointments and staff appreciated the extended outreach capabilities afforded to their organizations (Uscher-Pines et al., 2020). Overwhelmingly, the reasons why surveyed services did not

provide tele-SUD services had to do with inefficiencies in public policy. The Ryan Haight Act -- a law which demands that doctors meet in person with patients before controlled substances can be prescribed to them -- makes remote opiate replacement therapy impossible; additionally, many state Medicaid services do not cover telemedicine visits, making many potential patients inaccessible (Uscher-Pines et al., 2020). This speaks to both the newness of the tele-SUD field and the myriad legal and logistical obstacles many rural care services and patients face.

Telemedicine lessens the logistical and transportation burdens for patients allowing caregivers, workers, and travelers access to high-quality health care (Kleykamp et al., 2020). The impact of distance between SUD patients and healthcare services on medical treatment outcomes is significant. Beardsley et al. (2003) studied the impact which distance between outpatient drug treatment service and patient had on patient outcomes. The researchers used data from the City of Baltimore's Centralized Intake and Referral Management Information System to study 1,735 patients in outpatient SUD treatment programs to determine if there was a relationship between patient distance from outpatient treatment service and the rate at which patients completed treatment. The researchers identified non-completion of treatment as being referred to a different facility, voluntarily leaving, or being ejected from a treatment program due to noncompliance. The researchers found that patients who had to travel shorter distances to their outpatient treatment facilities were significantly likelier to successfully complete their treatment program than those who lived at greater distances, and that patients who lived closer to their treatment facilities were more likely to attend treatment for longer periods of time.

As telemedicine seeks to drastically reduce the physical gaps between SUD patients and services -- ideally, giving patients in-home access to healthcare resources -- this study suggests that telemedicine may bode well for SUD care.

Substance Use Disorder

In order to adequately depict the challenges which tele-SUD services face, a more general overview of substance abuse disorder is required. Substance abuse disorder is a condition in which a patient has an inability to control how they use drugs and other illicit substances (Ashu-Ngang, 2020). Substance use disorder affects people of all types and ages and has a significant impact on the economy, mortality, health, and mental health of the United States (Ashu-Ngang, 2020). SUD or substance use disorder affects a person's brain and behavior and is known as an addiction, drug dependence, drug use, or illicit substance use (Katz, 2017). SUD often begins as a medical prescription drug and develops into a dependence on the drug beyond what was prescribed. SUD begins due to a variety of reasons such as peer influence, parental and family influences, medical or health related treatments, mental health issues or treatments, post-traumatic stress disorder, or poor childhood experiences (Ashu-Ngang, 2020). Ashu-Ngang (2020) explored the connection between mental health problems and substance abuse in their study. In the interest of better understanding the comorbidity of mental illness and substance abuse disorder, Ashu-Ngang conducted an intervention in an outpatient mental health clinic in which, over an eight week period, all incoming patients were required to take both the Alcohol Use Disorder Identity Test (AUDIT) and Drug Abuse Screening Test (DAST). The AUDIT and DAST tools are two brief questionnaires which were

designed to indicate whether or not an individual has problems with alcohol or drug abuse. The group included 47 adult patients, ages 21 and over, who were presented to the health clinic for intake assessments during the eight week period. Through these tests and subsequent referrals, the researchers found that approximately 24.5% of adults with an opioid use disorder had been diagnosed with a mental illness within the past year, and 29.6% of adults with one opioid use disorder had been diagnosed with a serious mental illness.

Opioid Drug Use Crisis

Rates of SUD have risen drastically in America, with 2.3 million Americans who are already addicted to narcotic drugs (Haffajee et al., 2018). On average, two percent of individuals that died in 2015 were addicted to some kind of narcotic drug (Katz, 2017). Rudd et al.(2016) studied rates of drug overdose deaths. The researchers used national data collected by the Center for Disease Control to study the changes in rates of drug overdose deaths from 2000-2014. Specifically, the researchers were seeking to determine changes in drug overdose deaths overall, changes in which types of drug were used in drug overdose deaths, and changes in demographic and geographic drug overdose trends. The researchers found that the rate of drug overdose had more than doubled over the 14-year period, with significant increases in overdose death in 14 different states and significant increases in overdose deaths across people ages 25-65 (Rudd et al., 2016). Overwhelmingly, victims of drug overdose death had died from taking opioids; opioid overdose rates tripled in the 14-year period studied, and more people died in 2014 from drug overdoses than from motor vehicle accidents (Rudd et al., 2016). This demonstrates

the urgent, widespread nature of the opiate crisis, and how much the United States has lost as a result. The researchers suggested that the primary means through which this explosion of opiate overdose death could be addressed is through improvement of practices surrounding opioid prescription (Rudd et al., 2016).

Katz's (2017) *New York Times* overview of the opiate epidemic draws from various governmental entities — including the National Center for Health, Centers for Disease Control and Prevention, and World Health Organization to give a comprehensive overview of the opiate crisis in the United States. Katz's (2017) argued that the prevalence of opiate use in the United States stems from two problems: a.) over prescription of opiates by health professionals, and b.) the rise of synthetic opiates. In the late 20th century, the pharmaceutical industry began aggressively advertising prescription opiates to doctors, which led to much higher rates of prescription and, consequently, much higher rates of abuse. Leung et al. (2017) performed a bibliometric analysis on an oft-cited 1980 letter from Jane Porter and Hershel Jick of the Boston Collaborative Drug Surveillance Program at Boston University Medical Center which was printed in the *New England Journal of Medicine* (Porter & Jick, 1980). The extremely concise letter baselessly stated that opioid treatment for mitigating pain symptoms rarely led to opioid addiction in individuals who did not have a history of addiction. The researchers analyzed the frequency with which this letter was cited and the contexts in which this letter was cited to determine how and why this letter was being used by scholars (Leung et al., 2017). The researchers found that the article was being widely misinterpreted as a significant study rather than as an unsubstantiated claim. Conspicuously, the researchers

also found that the number of citations increased substantially after the introduction of Oxycontin to the market. The claims about opioid addictiveness made in the paper which Leung et al. discussed have been scientifically disputed. Shah et al. (2017) studied a sample of patients who were prescribed opioids for pain management purposes in order to determine the level of risk which patients are at for continued opioid use, based on initial opioid prescription. The researchers utilized 1,294,247 patient records from the International Medical Statistics Lifelink+ database during the period of 2006-2015 to study patients 18 or over who were prescribed opioids for pain after a six-month period of insurance enrollment before their first opioid prescription (Shah et al., 2017). Patients with a substance abuse disorder or cancer were ineligible for the study (Shah et al., 2017). The researchers followed the patients from the date of their first opioid prescription until a 180-day period free of opioid use was reached, the study's end date was reached, or the patient was no longer enrolled with their healthcare plan (Shah et al., 2017). The researchers found that about 6% of all patients who were prescribed opioids were still using prescribed opioids a year later, 13.5% of patients whose first period of use lasted for eight days or more were still using opioids a year later, and 29.9% of patients whose first period of use lasted for over a month were still using opioids a year later. The researchers recommended that opioids be prescribed for the briefest effective period possible and warned that authorizing a refill of opiates doubles the risk of a patient continuing use for a year (Shah et al., 2017). This bolsters Rudd et al.'s (2016) assertion that physician restraint is a primary driver of opioid safety and demonstrates the potential negative impacts of opioid over prescription for patients.

The rise of Oxycontin coincided with a significant decrease in global heroin prices which ultimately led to drug suppliers attempting to build new markets for heroin in suburban and rural areas (Katz, 2017). More recently, fentanyl — an extremely powerful synthetic opioid — has been distributed throughout the United States, leading to a massive uptick in opiate-related death. While many fentanyl-related deaths are of casual drug users who take fentanyl without knowing, some people with opiate use disorders do become addicted to fentanyl (Katz, 2017). O'Donnell et al. (2017) did a study of the impact of fentanyl and fentanyl analogs on drug overdose deaths in ten different states over a six month period in 2016. The researchers used data collected by the State Unintentional Drug Overdose Reporting System to determine the percentage of accidental overdose deaths which toxicology reports found to involve fentanyl (O'Donnell et al., 2017). The researchers found that of 5,152 fatal opioid overdoses in the ten states from July to December of 2016, 56.3% involved either fentanyl or fentanyl analogs; in overdose deaths which involved fentanyl, the drug was identified as a primary cause of death in 97.1% of cases (O'Donnell et al., 2017). At this time, fentanyl overdose death rates widely varied by region; while southwestern states like Oklahoma and New Mexico found fentanyl-related death occurred in 15-25% of drug overdose deaths, states in the northeast -- particularly, New England -- found fentanyl caused between 60%-90% of drug overdose deaths (O'Donnell et al., 2017). Nearly three quarters of victims were male, over 80% were White, and slightly over half were in the 25-44 age range (O'Donnell et al., 2017). This demonstrates how profoundly deadly fentanyl is and

demonstrates the destructive potential which fentanyl can have over whole geographical regions.

Only about 40 percent of users suffering from SUD have sought programs for help (Haffajee et al, 2018). To bring this percentage up and increase the care of SUD patients there are several approaches that can help. Educational seminars, decreasing the fees for services, addressing insurance coverage, and providing authorization to accommodate addictions in adults positively can contribute to mitigating nonfatal overdoses (Haffejee et al., 2018).

Nonfatal Overdose and Naloxone

Nonfatal overdose has been researched in connection to mortality rates after the incident. Olfson et al. (2018) studied data from 75,556 adult Medicaid patients who had been diagnosed with opiate overdose to see if the rate of relapse could be predicted. The researchers analyzed a longitudinal cohort of patients in order to find commonalities, and risk factors for overdose, both fatal and repeated (Olfson et al., 2018). The researchers compared a data set of Medicaid policyholders who experienced opiate overdose in 45 states from 2001-2007 to a data set from the National Death Index which collects national data on mortality (Olfson et al., 2018). While it is worth acknowledging that the period from which this study draws information cannot accurately depict the current state of the opioid epidemic, this study still contains data relevant to discussing the nature of overdose in opioid addicts (Katz, 2017; Olfson et al., 2018). Roughly 19% of the subjects who experienced nonfatal opioid overdoses had repeated opioid overdoses during the follow-up period (Olfson et al., 2018). About 1% of these nonfatal overdose patients died

from an overdose within the next year of their lives (Olfson et al, 2018). Opioid overdose victims treated in an outpatient setting were at the highest risk of repeated overdose, which is a significant trend for tele-SUD services who primarily work in an outpatient capacity (Olfson et al., 2018). It was also found that in the 180 days prior to their initial overdose, 64.8% of the studied overdose patients had had their prescriptions renewed (Olfson et al., 2018).

Weiner et al. (2020) studied the one-year mortality rate of roughly 11,000 people who experienced a nonfatal opioid overdose in Massachusetts. The researchers used data collected by the Massachusetts Department of Public Health to identify patients who were treated for their first opioid overdose between July 1st, 2011 and September 30th, 2016; then, overdose patients' information was compared with information from the Registry of Vital Records and Statistics in order to identify a.) which patients had died within a year of their initial overdose, b.) what the gap in time between the initial overdose and death was, and, c.) what the cause of the patient's death was (Weiner et al., 2020). Weiner et al.'s (2020) methodology had significant overlaps with Olfson et al.'s (2018); both studies used large bodies of data to determine how individuals diagnosed with opioid overdose fared during the subsequent year. This compressed time period is a wise approach to studying contemporary opiate addiction, as Katz's (2017) overview of the contemporary opiate crisis demonstrates how the increasing availability of fentanyl in particular makes opioid addictions significantly more dangerous. The researchers found that 5.5% of opioid overdose patients died within a year; 67.4% of these patients died of

opioid overdoses (Weiner et al., 2020). The highest risk periods following a nonfatal overdose were the first month and in particular, the first two days following the overdose.

Research shows that nearly all survivors of an opioid overdose continue to receive a prescription opioid, even after their nonfatal overdose (Larochelle et al., 2016). Larochelle et al.'s (2016) studied the opioid treatment patterns of 2848 adult patients who survived a nonfatal opioid overdose while taking prescribed opioids for pain. The researchers identified 2,848 patients aged 18-64 who a.) had been diagnosed with their first opioid overdose, b.) were receiving ongoing opioid treatment, c.) were not diagnosed with cancer, and d.) were commercially insured (Larochelle et al., 2016). The researchers followed up with patients over the next two years to see if they were given prescribed opiates by a doctor after their overdose and if they experienced a subsequent overdose (Larochelle et al., 2016). The researchers found that 91% of patients received another opioid prescription after an overdose; by two years, 7% of patients had overdosed again; and that the termination of opioid prescription after overdose was associated with a lower risk of a repeated overdose (Larochelle et al., 2016). The study used the Optum database, which has a limited number of patients and data. However, the study did review a wide breadth of time in order to analyze opioid use patterns. This study demonstrates how easy it is for patients with opioid addictions to maintain potentially dangerous opiate prescriptions despite past overuse, be their overuse accidental or intentional, and how easy it is for low-dose opioid prescriptions to lead to potentially life-threatening situations.

Hospitalizations due to nonfatal overdose provide the medical field an opportunity to intervene and guide patients in order to prevent an overdose death in the future. The statistical significance of death after a nonfatal overdose highlights the necessity of changes in the medical field with regards to addiction treatment. In about 25% of cases the overdose occurred in a place of residence, and the median age of the patients who died was only 39 years old (Weiner et al., 2020). Hospitals need to rapidly adopt medications for addiction treatment programs and other interventions in order to help save lives.

Literature Review Summary

The opioid crisis has made rates of SUD significantly rise over the last decade; this has been particularly impactful in rural areas with limited access to high-quality healthcare (O'Donnell et al., 2017; Rudd et al., 2016). Telemedicine is a means through which this gap in care can be addressed. The existing literature suggests that telemedicine can be an effective means of providing patient care, both for general-population patients and SUD patients (Eibl et al., 2017; Nord et al., 2018; Rizzi et al., 2020). Some research has suggested that tele-SUD's ability to give SUD patients easy access to care encourages better outcomes (Eibl et al., 2017). While telemedicine access and tele-SUD access is growing, many rural SUD patients have ongoing barriers to tele-SUD resources (Barnett et al., 2018; Browne et al., 2016; Huskamp et al., 2018). The advent of COVID-19 has positively impacted tele-SUD availability, as pushing medical visits online whenever possible has allowed doctors to remotely offer a greater variety of treatments (Browne et al., 2016; Usher-Pines et al., 2020). Nonfatal opioid overdose has been found to have

statistically significant relationships with future fatal opioid overdose (Larochelle et al., 2016; Olfson et al., 2018). While several studies have explored the extent to which SUD patients are utilizing tele-SUD treatment approaches (Huskamp et al., 2018; Mehrotra et al., 2017), there is no existing literature which explicitly examines the efficacy of this approach in the context of Texas. This study sought to determine whether there is a relationship between countywide adoption of telehealth resources and rates of opioid overdose death in Texas counties.

Definitions

Nonfatal overdose: Overdoses that do not result immediately in death. Research shows about one percent of those patients die from an overdose within the next year (Olfson et al., 2018).

Rural: Areas that are not considered urban areas, such as areas that have populations under 2,500. The areas must still include residents or a population. Within the context of this study, rural populations also had limited access to services such as substance use treatment options (SAMHSA, 2016).

Substance use disorder (SUD): The way in which someone's brain and behavior are altered by and dependent on intoxicating substances. Also known as addiction, drug dependence, drug use, or illicit substance use (Katz, 2017).

Substance use disorder patients: Patients who have a pattern of use of a particular substance which is causing them physical, economic, or mental distress (Katz, 2017). For the sake of this study, patients were also those who were seeking treatment for their SUD through telemedicine.

Tele-SUD services: Telemedicine visits made with the intention of treating SUDs (Huskamp et al., 2018).

Telemedicine: The use of remote diagnosis through a live video teleconference where a patient can get diagnosed and treated outside of a hospital or medical facility by a specialty health clinician (Huskamp et al., 2018).

Urban: Areas with populations of 2,500 or more people. Both large and small metropolitan regions are considered "urban" (SAMHSA, 2016).

Assumptions

In research, assumptions are considered elements of the study that are non-validated and that cannot be supported by tangible evidence (Cudziło et al., 2018). In the case of this study, there were some assumptions present. First, it was assumed that at least some telehealth patients are seeking treatment for opioid use disorders. Second, it was assumed that the statistics relating to opioid overdose deaths have been accurately represented and not mischaracterized. Third, it was assumed that some patients used telehealth programs when they were offered.

Scope and Delimitations

There were some limitations and/or challenges that need to be addressed within this proposed study. Within this study, the scope consisted of individuals living in the state of Texas in 2020. This data incorporated information on geographical distribution of telehealth services in the state of Texas and rates of opioid overdose per capita in the state of Texas. This scope was chosen to limit research to a specific population, rather than any U.S. adult who has had treatment for substance use. This scope also analyzed the efficacy

of telemedicine in areas where state-level public health approaches to opioid usage are constant.

A delimitation is a boundary a researcher intentionally sets in order to limit the scope of the research and prevent scope creep (Saunders et al., 2016). The main delimitation in this study was that the researcher only utilized quantitative data relating to telemedicine. This survey had a limited scope and did not include the personal perspectives or experiences of the users of telemedicine.

Limitations

Limitations are aspects of the study that are outside of the researcher's control (Antwi & Hamza, 2015). These are present in all research studies, and they have different effects on each study's results. In most cases, there are limitations that are a result of shortcomings of empirical research itself, while others are a result of the design of a specific study. In this case, the study investigated the efficacy of telemedicine in the reduction of fatal opioid overdose using quantitative regression analysis. One of the limitations that came from this was the limited amount of data available to analyze, here encompassing only the year 2020. Another limitation of the study was the fact that no covariates were used to control for particular demographic factors which may have impacted the outcome. Covariates may have included average per capita income, country poverty rates, and percentage of elderly people per county.

Significance

SUDs have been affecting a progressively larger percentage of the population over time. As the instances of SUDs have increased, the treatment options for them have

increased, too. Particularly among certain populations, such as communities that are in quarantine due to the COVID-19 pandemic, telehealth solutions are growing in feasibility and popularity. However, existing research does not provide much information on the efficacy of telemedicine in reducing rates of fatal opioid overdose.

This study examined the efficacy of telehealth treatment as an affordable and accessible means of addressing opioid overdose rates. Regarding social change, telehealth offers increased care availability to low-income patients, many of whom are people of color. This study data allows policymakers to make telemedicine even more accessible, such as by changing pricing models among insurance services and changing credentialing policies across state lines. Making telemedicine more accessible and less stigmatized could decrease the number of fatal overdoses across both Texas and the country at large. Overall, this study could have a strong effect on telemedicine, treatment, and drug-related policies, advocating for greater social and economic equity across the United States. Telemedicine is a growing field which has a unique opportunity to contribute to the national fight against opioid addiction.

Summary and Conclusions

In this study, I analyzed the extent to which there is a statistically significant relationship between telemedicine availability and rates of fatal opioid overdose in the state of Texas. The literature on the topic shows that opioid drug use and addiction are on the rise throughout the United States, with extremely deadly results. This has coincided with an increase in the use of telemedicine to treat patients throughout the country, partially due to the COVID-19 outbreak. The possibilities for the application of

telemedicine in SUD treatment are varied and range from educational seminars to decreasing costs and increasing access. These options increase the likelihood of people having the opportunity to take advantage of treatment, which could be life-changing or even lifesaving. Due to the likelihood of comorbidity of SUDs and other mental illnesses, and the lack of substance abuse resources available to much of middle America, telemedicine is a strong alternative to other forms of treatment and mental health services.

This study sought to determine if there is a relationship between the availability of telemedicine and rates of fatal opioid overdose in the state of Texas, in the hopes of improving care for SUDs and decreasing the nonfatal overdoses in both Texas and the United States at large. This data could help improve intervention for SUDs for many people and help provide a model for statewide telehealth implementation. In the next section, the design of the research, including the sampling methods, populations studied, data analysis method, threats to validity, and ethical procedures, was outlined.

Section 2: Research Design and Data Collection

Studies have suggested that opioid addictions are ravaging the United States, killing thousands; however, telemedicine can be an effective means of helping individuals with SUDs (Eibl et al., 2017; Katz, 2017; Nord et al., 2018; Rizzi et al., 2020). The purpose of this quantitative study was to analyze the extent to which the presence of tele-SUD treatments in a Texas county is associated with changes in rates of fatal opioid overdose. In this section, I provide an overview of the research design, data collection methodology, plans for data analysis, threats to validity, and ethical assurances.

Research Design and Rationale

In this quantitative study, I used both an independent sample *t* test and a simple linear regression test. To determine if telemedicine's presence in a given county in Texas is associated with that county's rate of opioid overdose deaths (to address RQ1), an independent sample *t* test was performed. I placed Texas counties into two groups: those with telemedicine services and those without telemedicine services. These functioned as independent groups. An independent sample *t*-test was used to evaluate the extent to which the presence of telemedicine in a given county in Texas influences the rate of opioid overdose deaths per capita in that county by comparing the mean number of opioid overdose deaths per capita in counties that have telemedicine services to the number of opioid overdose deaths per capita in counties without telemedicine services.

To determine if there is a statistically significant relationship between the number of telemedicine service points and the rate of opioid overdose deaths per capita in a given

county in Texas, I used linear regression analysis. The number of telemedicine service points in each county in Texas functioned as the independent variable, and the number of opioid overdose deaths per capita in each county in Texas functioned as the dependent variable.

Population

This sample included data from 254 counties in the state of Texas collected over the period of 2020 from the University of Wisconsin's County Health Rankings and Roadmaps and from 715 behavioral health centers collected by the U.S. Department of Health and Human Services' SAMHSA. The University of Wisconsin's (2021) County Health Rankings and Roadmaps has publicly reported statistics on fatal opioid overdoses by county for the period of 2020. SAMHSA (2021) publicly provides a nationwide list of all behavioral health units, information on their locations, and information on whether they offer telemedicine resources to their patients. In this study, I focused on opioid overdose victims in all counties in the state of Texas and all behavioral health services working in the state of Texas.

Sampling and Sampling Procedures

The sample for this study was collected by SAMHSA (2021) and the University of Wisconsin (2021). The sample consisted of all individuals residing in the state of Texas in 2020. The University of Wisconsin reviewed the information both independently collected and collected from various data sets compiled by government agencies, including the National Center for Health Statistics, the United States Department of Agriculture, Medicare, and the Bureau of Labor. The National Center for

Health Statistics' mortality files were used to determine the countywide rates of fatal opioid overdose (see University of Wisconsin, 2021). SAMHSA conducted a survey of all nationwide services of behavioral health care on their services offered, locations, and contact information to create a searchable database so individuals in need of care could find relevant care within their area. Telemedicine is one such type of care discussed in the SAMHSA data set. No permissions were necessary to access this data because it is publicly available at https://www.countyhealthrankings.org/app/texas/2020/downloads and https://findtreatment.samhsa.gov/locator.html.

To determine the proper sample size needed to confirm a statistical relationship, a researcher must conduct a power analysis. I used G*Power 3.1.9.7. to perform a power analysis. With the alpha set at .05, the power set at .8, and the effect size was set at .5, G*Power determined that the minimum sample size for this study was 128. Because there are 254 counties in Texas and all were included in this study, the sample size was appropriate.

Instrumentation and Operationalization of Constructs

In the case of RQ1, the availability of telemedicine was coded as "yes" or "no" for each county. Fatal overdoses for opioid overdose patients were measured in rate per capita in each county. In the case of RQ2, I determined the number of behavioral health centers that offer telemedicine services in each county in Texas. To accomplish this, I first used the University of Wisconsin's Texas county data on population and opioid overdose rates to create lists of (a) all Texas counties, (b) the annual population in each Texas county, (c) the number of annual fatal opioid overdoses in each county, and (d) the

rate of fatal opioid overdoses per capita in each county. A list of behavioral health care services based in Texas was then created according to SAMHSA's national list of behavioral health care services. SAMHSA lists both the counties and the states in which each behavioral health care service is located. I then cross-referenced this list with the list of all Texas counties to determine (a) whether a given county has a behavioral health service that offers telemedical services and (b) how many such services it has.

Data Analysis Plan

I conducted an independent sample *t* test to determine if there is a statistically significant relationship between telemedicine service presence in a county and rates of fatal opioid overdose. Independent sample *t*-tests are used to compare the means of two independent groups to determine if their population means are significantly different from each other (Kent State University, 2021). To run an independent sample *t*-test, a data set must have a continuous dependent variable and a categorical independent variable (Kent State University, 2021). The two groups, in this case, were counties with telemedicine services and counties without telemedicine services, and the dependent variable was the number of fatal opioid overdoses in a county.

In RQ2, I used a simple linear regression test to determine if there is a statistically significant relationship between the number of telemedicine services in a county and rates of fatal opioid overdose in that county. Linear regression creates a model between two variables to explore the extent to which the explanatory variables can act as predictors of the dependent variable (Hoffman, 1993). In this study, more than one independent predictor variable was used, the number of telemedicine opportunities available counties

of Texas, and one dependent variable, the rates of fatal opioid overdoses per capita in counties in Texas. Before this linear regression test took place, I used regression diagnostics to test regression assumptions. The distribution of the rates variable was determined by scatterplot to confirm that a linear regression was appropriate. A Durbin-Watson test was also conducted to confirm that there was no correlation between the residuals in the data set. A rank transformation was also used to correct for any skew. Outliers were removed in counties with extremely low populations (e.g. under 2,000 people) with disproportionately high rates of opioid overdose death. I used Z-score analysis to identify such outliers. Any outliers were identified and controlled to maintain the integrity of data. Normality was explored using Q-Q testing. I used Statistical Package for the Social Sciences (SPSS) 27 to simplify these statistical processes.

Threats to Validity

There are two ways in which validity can be threatened in a given study. External validity refers to the extent to which a study is generalizable and applicable across contexts (CITE). Internal validity refers to the extent to which a researcher can control for unforeseen variables which they have not predicted (CITE).

In the case of this study, the main threat to external validity was the geographical specificity of the sample. The state of Texas has a very distinct set of demographics, a very distinct sociopolitical culture, and very distinct population distribution. Though it is possible that these situational specificities make it so the current study results have limited cross-applicability, the fact that Texas has large rural and urban populations, and

that the data represents a four year span of time may help illuminate certain trends relating to opioid abuse in the southern region of the United States.

The main threat to internal validity in this study was the fact that individuals in different areas of Texas who use telemedicine may call into centers located outside of their county. Because telemedicine allows individuals to remotely get in contact with medical professionals, the location of the telemedicine office may not be pertinent for all patients with opioid use disorders. Another threat to the study's internal validity was the fact that I did not control for demographic factors in the study, which may have impacted the outcome variable. The impact of telemedicine services being introduced to a given county may be disproportionately felt on low-income individuals or elderly individuals. Medicare and Medicaid enrollment, average income per capita, county poverty rates, and percentage of elderly people in each county may have been useful covariates.

Ethical Procedures

I used publicly available secondary data to explore the target phenomena in this study. No data were collected for the purposes of this study using human subjects. It was unnecessary for me to use permissions or consent forms to ethically conduct this study. I strictly used the data collected and published by SAMHSA and the University of Wisconsin and avoided making any modifications to the data in order to ensure its validity.

I contacted Walden University's Institutional Review Board which provided IRB approval (no. 10-04-21-0971955) before the study commenced to ensure that its methodology was in line with Walden University's ethical standards. I will continue to

store the data for a seven year period to ensure that the study's validity can be proven in the event that its data are made unavailable to the public. The data are stored on a flash drive and will be locked away for the seven year period. At the end of the period, the drive will be destroyed.

Summary

The purpose of this quantitative study was to examine the relationship between telemedicine availability and rates of fatal opioid overdose in counties across the state of Texas. I sought to determine whether telemedicine availability and number of tele-SUD services available impacted rates of fatal opioid overdose in Texas during 2020. In this section, I provided an overview of the research design, the population studied, sampling procedures, conceptual instrumentation, validity threats, and ethical procedures. The research design and rationale subsection included a discussion of the different variables included in the study and the design employed to do so. The population subsection contained an explanation of what groups were studied and why. In the sampling procedures subsection, I described the types of sampling used in the data sets and the power analysis conducted. The instrumentation and operationalization subsection included definitions of the different variables used in the study and an exploration of how the data were analyzed. In the validity threats subsection, I described the different ways in which my approach to the study subject may have limited its accuracy, and in the ethical procedures subsection, I presented the ethical procedures used in the study as they related to human subjects and privacy. Section 3 will include a discussion of the study's findings.

Section 3: Presentation of the Results and Findings

The purpose of this study was to analyze the extent to which there is a statistically significant relationship between telemedicine availability and rates of fatal opioid overdose in the state of Texas. I conducted this study to determine whether telemedicine availability has an impact on rates of opioid overdoses. The research problem and the data available guided my methods of analysis and data collection. The first research question I sought to explore was: What is the relationship between the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine service? The alternative hypothesis for RQ1 was: There is a statistically significant difference in the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine services. The second research question was: What is the relationship between the number of telemedicine services available and rate of opioid overdose deaths (per capita) in Texas counties? The alternative hypothesis for RQ2 was: There is a statistically significant relationship between the number of telemedicine service points and rate of opioid overdose deaths (per capita) in Texas counties. This hypothesis was rejected.

In this section, I detail the secondary data sets used and the statistical analyses performed to address the two research questions. The sources of the secondary data sets, how the data in the data sets were collected, and how secondary data sets were compiled is discussed. Then, the data analyses are described and discussed with the aid of figures and tables from the SPSS analysis.

Data Collection of the Secondary Data Set

I collected data for this study from two publicly available sources that required no additional permissions: the University of Wisconsin's County Health Rankings and Roadmaps and the U.S. Department of Health and Human Services' SAMHSA. The University of Wisconsin's (2021) County Health Rankings and Roadmaps program collected county-level data on fatal opioid overdose from all 254 counties in the state of Texas during 2020. SAMHSA (2021) provided a list of all behavioral health units, information on their locations, and information on whether they offer telemedicine resources to their patients in 2020. I searched SAMHSA data to determine which counties in Texas did or did not have a telehealth service in 2020. Counties were either coded as having a telehealth service or not having a telehealth service. Counties were also coded for countywide number of telemedical services overall. University of Wisconsin data on countywide fatal opioid overdose rates in 2020 was paired with this SAMHSA data in a single data set.

Results

Research Question 1

To investigate RQ1, I conducted an independent samples *t*-test using SPSS to evaluate if there is a statistically significant difference between the mean rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine services.

Table 1 details the overall frequency distribution of telemedicine facilities in the state of Texas in 2020. Approximately three fourths of the counties have no telemedicine services, and about one fourth have at least one telemedicine service available. Due to several counties not reporting mortality rate the final total of counties used for the analyses for RQ1 and RQ2 for facilities without telemedicine was 39 and counties with telemedicine facilities was 52.

Table 1

Frequency Table for Texas Counties With and Without Telemedicine Facilities, 2020

	Frequency	Percent	Valid Percent	Cumulative Percent
County without telemedicine facilities	192	75.6	75.6	75.6
County with telemedicine facilities	62	24.4	24.4	100.0
Total	254	100.0	100.0	

Table 2 and Figure 1 demonstrate the descriptive statistics of the dependent variable of drug overdose mortality rate. There appears to be a roughly normal distribution of drug overdose mortality rates, with a slight rightward skew indicating that while many Texas counties had relatively low rates of drug overdose mortality, there were some with above average rates.

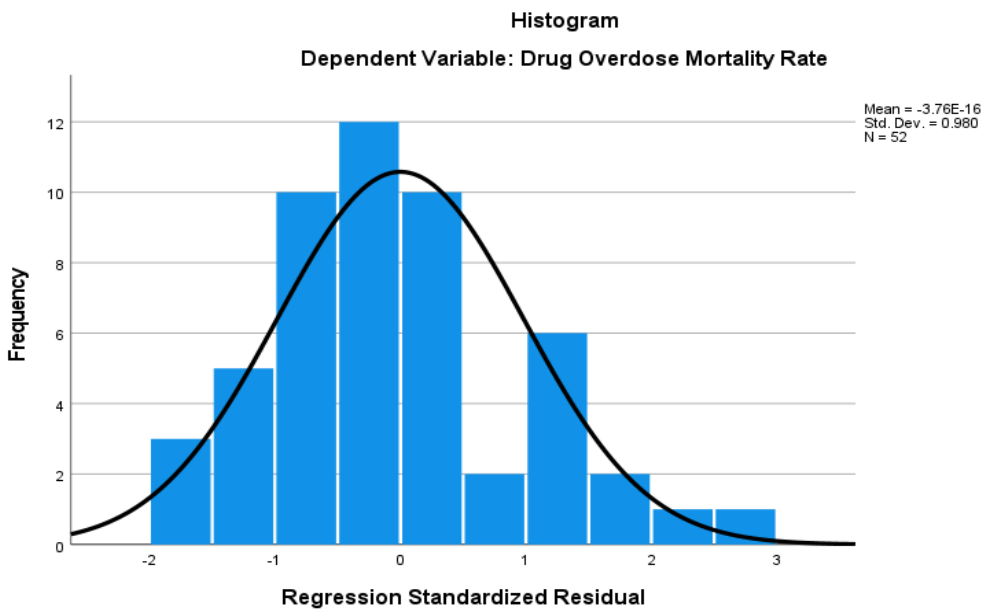
Table 2

Descriptive Statistics of Drug Overdose Mortality Rate Data for Counties With Telemedicine Services Reported in 2020

	N	Minimum	Maximum	*M*	*SD*
Drug overdose mortality rate	91	3.81	24.65	11.8262	4.15252
Number of telemedicine facilities	62	0	28	3.52	5.999
Valid *N* (listwise)	52				

Figure 1

Histogram of Drug Overdose Mortality Rate Data Reported in 2020



Even though the rate of opioid overdose deaths (per capita) for Texas counties without telemedicine services is numerically higher than for Texas counties with telemedicine services (see Table 3), the results of the independent samples *t* test (see

Table 4) showed that the mean opioid overdose deaths (per capita) for Texas counties without telemedicine services (M = 12.38, SD = 4.21, n = 39) and for Texas counties with telemedicine services (M = 11.41, SD = 4.10, n = 52) was not statistically significant, t (97345) = 1.1, df = 97345, $p > .05$. Therefore, the null hypothesis that there was no significant difference in the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine service failed to be rejected.

Table 3

Group Statistics for Counties With and Without Telemedicine Services That Reported Mortality Rate in 2020

	Telemedicine Facilities	*N*	*M*	*SD*	Std. Error *M*
Drug overdose mortality rate	County without telemedicine facilities	39	12.3825	4.21282	.67459
	County with telemedicine facilities	52	11.4090	4.09775	.56826

Table 4

t-*Test Results for Drug Overdose Mortality Rates in Texas Counties With and Without Telemedicine Services*

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	*T*	*Df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
	Equal variances assumed	.273	.602	1.108	89	.271	.97345	.87851	-.77214	2.71904
	Equal variances not assumed			1.104	80.763	.273	.97345	.88204	-.78160	2.72850

Table 5

Descriptive Statistics and t-*Test Results for Drug Overdose Mortality Rate and Telemedicine Facilities*

	M	*SD*	*N*
With telemedicine facilities	11.409	4.09775	52
Without telemedicine facilities	12.3825	4.21282	39

Note. $T = 1.1$. $df = 93745$. $p = 0.05$.

Research Question 2

To investigate RQ2, I conducted a linear regression analysis. Before the linear regression test necessary for RQ2 took place, regression diagnostics were used to test necessary assumptions. I conducted preliminary analyses to assess the assumptions of normality, linearity, homoscedasticity, and independence of residuals. There were 163 counties that did not report mortality rates, so they were removed. There were no extreme outliers, so no data points needed to be removed.

Table 6

Overdoses per Capita in Texas Counties With Telemedicine Services That Reported Mortality Rate in 2020

County	# Telemedicine Services	Mortality Rate
Bastrop	2	9
Bell	5	11
Bexar	11	12
Brazoria	6	11
Brazos	2	4
Cameron	6	5
Collin	6	7
Comal	3	10
Dallas	28	13
Denton	8	7
El Paso	9	11
Fort Bend	4	6
Frio	2	0
Galveston	5	16
Grayson	2	10

County	# Telemedicine Services	Mortality Rate
Gregg	4	9
Harris	25	12
Hays	2	8
Hidalgo	2	4
Kerr	2	17
Lubbock	2	15
Midland	2	7
Montgomery	4	15
Nueces	5	16
Orange	2	19
Potter	5	16
Smith	2	8
Tarrant	24	9
Taylor	2	11
Tom Green	2	8
Travis	18	13
Webb	2	11
Wichita	3	13
Williamson	2	6

Table 7

Overdoses per Capita in Texas Counties Without Telemedicine Services That Reported Mortality Rate in 2020

County	# of Telemedicine Services	Mortality Rate
Angelina	0	12
Cherokee	0	13
Childress	0	0
Coleman	0	0
Dimmit	0	0
Ector	0	13
Ellis	0	9
Fannin	0	10
Gray	0	0
Guadalupe	0	8
Haskell	0	0
Howard	0	15
Jasper	0	17
Kleberg	0	0
Liberty	0	13
Maverick	0	0
McLennan	0	11
Medina	0	0
Montague	0	20
Tyler	0	25
Upshur	0	10
Uvalde	0	0
Van Zandt	0	8
Waller	0	11

County	# of Telemedicine Services	Mortality Rate
Wharton	0	12
Wise	0	13

Figure 2 shows a P-P plot of drug overdose mortality rate statistics. Because there are no drastic deviations from the normality line, the data can be said to be normally distributed.

Figure 2

P-P Plot of Regression Standardized Residual for Overdose Mortality Rate

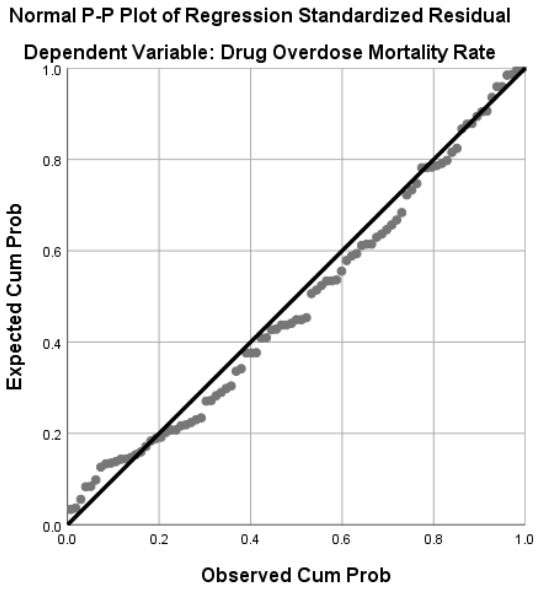


Figure 3 is a scatterplot of regression-standardized residual values. The imaginary line in this graph is approximately at zero, indicating a roughly equal number of points above and below the zero x-axis and to the left and right of zero on the y-axis. This indicates that the level of homoscedasticity is low.

Figure 3

Scatterplot of Regression Standardized Residuals for Number of Telemedicine Facilities

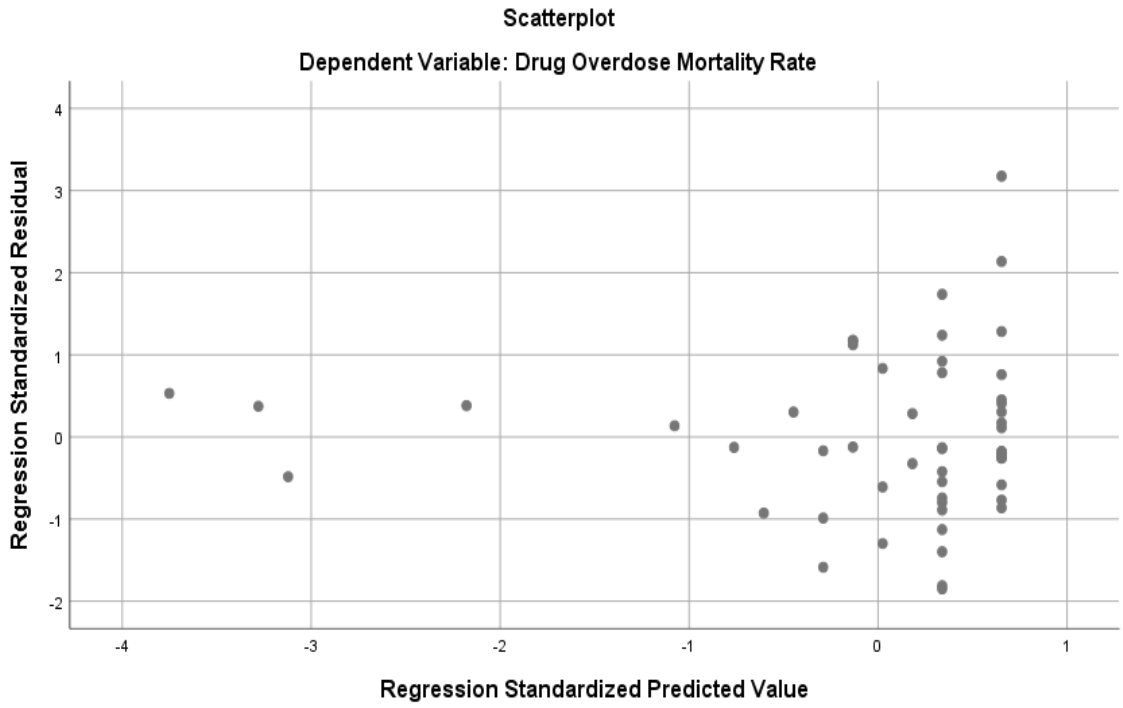


Figure 4 is a simple scatterplot with a line of fit, which tests the presumption of linearity. There appears to be a slight decrease in mortality rates as the number of telemedicine facilities increase. There is significant rightward skew in this scatterplot because a significant number of counties reported having zero telemedicine facilities.

Figure 4

Simple Scatterplot With Fit Line of Drug Overdose Mortality Rate by Number of Telemedicine Facilities

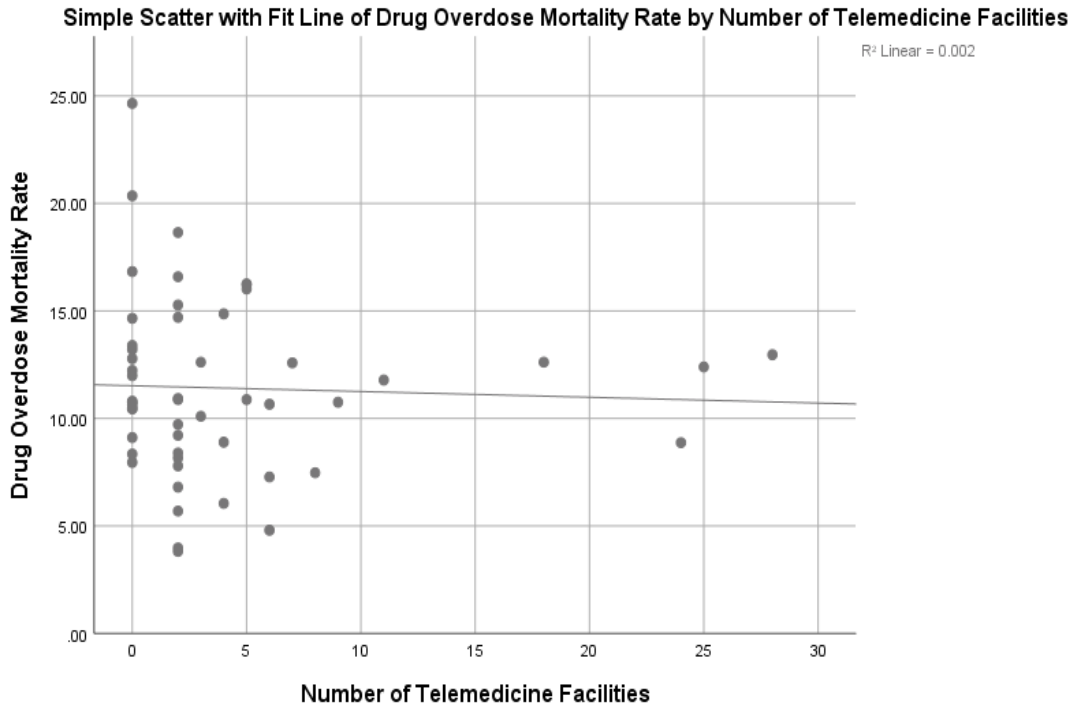


Table 8

Summary of Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.042	.002	-.018	4.13493	1.660

A value of 1.66 for the Durbin Watson indicates there is no autocorrelation in the sample. Values under 2 are consistent with no autocorrection.

Table 9

ANOVA Test for Drug Overdose Mortality Rate and Number of Telemedicine Facilities

Model		Sum of Squares	Df	Mean Square	F	Sig
1	Regression	1.485	1	1.485	.087	.769
	Residual	854.884	50	17.099		
	Total	856.369	51			

Table 10

Coefficients Table for Drug Overdose Mortality Rates

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	Constant	11.520	.687		16.769	.000	10.141	12.900
	Number of Telemedicine Facilities	-.027	.091	-.042	-.295	.769	-.210	.156

A linear regression analysis was conducted to evaluate the prediction of drug overdose mortality rate from the number of telemedicine facilities. The results of the simple linear regression analysis revealed no statistically significant association between the number of telemedicine facilities and the rate of drug overdose mortality rates. p= .769. The regression coefficient B-0.27, 95% CI (-.210, .156) associated with the number of telemedicine facilities suggests that for each additional telemedicine facility the drug overdose mortality rate decreases by approximately 5%. The R 2 value of .042 associated with this regression model suggests that the variation in the number of telemedicine facilities available accounts for 4.2% of the variation in mortality rate, which means that 58% of variation cannot be explained by the number of telemedicine facilities alone. The confidence interval associated with the regression analysis does contain a zero, which means the null hypothesis, there is no statistically significant

relationship between number of telemedicine facilities and drug overdose rates in the state of Texas, can be accepted.

In order to address the skew caused by the high number of counties without telemedicine facilities, three categories describing levels of in-county telemedicine presence were created. Of the 91 counties which reported drug overdose mortality rates, 26 counties reported that they had zero telemedicine service available, 21 indicated that they had between two and four telemedicine services, and 15 indicated they had between five and 28. These were grouped into three tiers telemedicine service: LMH 1 = 0, LMH 2 = 2-4, LMH 3 = 5-28. Table demonstrates the variable creation for these groupings of per county telemedicine provider frequencies. These changes did not impact the conclusion.

Table 11

Variable Creation for Categories of Telemedicine Frequency

	Label
LMH_1	FacilitiesLMH 1 = 0
LMH_2	FacilitiesLMH 2 = 2-4
LMH_3	FacilitiesLMH 3 = 5-28

Table 12 and Figure 5 represent population breakdowns of each tier of telemedicine presence.

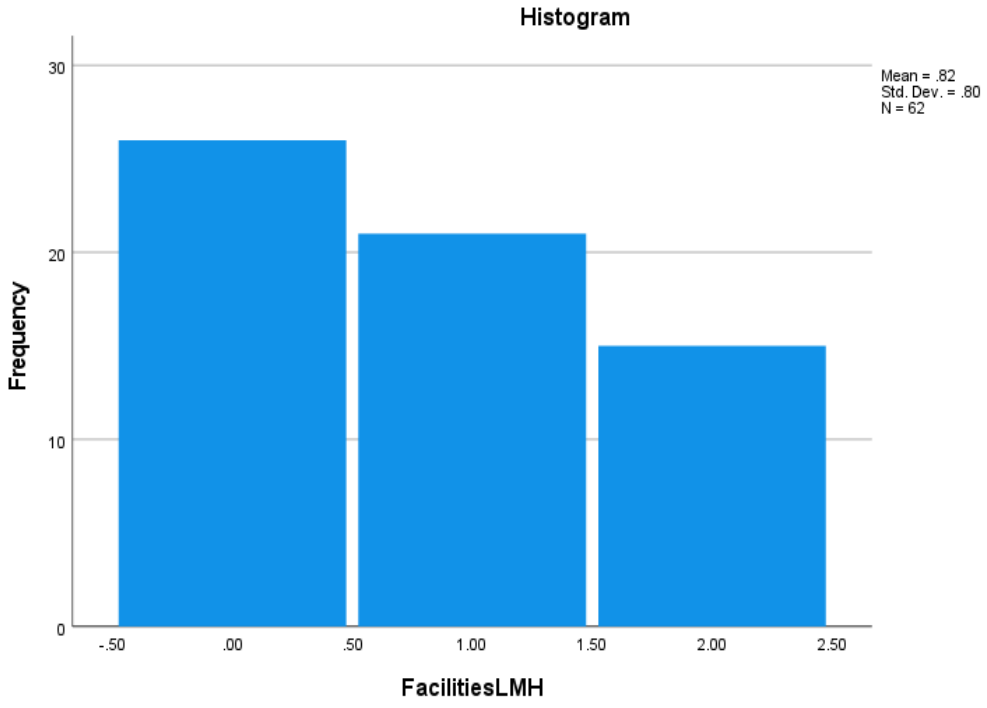
Table 12

Frequency Table for Categories of Telemedicine Frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LMH 1 = 0	26	10.2	41.9	41.9
	LMH 2 = 2-4	21	8.3	33.9	75.8
	LMH 3 = 5-28	15	5.9	24.2	100.0
	Total	62	24.4	100.0	
Missing	System	192	75.6		
Total		254	100.0		

Figure 5

Histogram of Categories of Telemedicine Frequency



Tables 13, 14, and 15 show the summaries of the regression model, the ANOVA test, and the coefficients table. Both the ANOVA and Coefficient tables demonstrate

significance levels of .135, .322 for counties without telemedicine, and .354 for counties with telemedicine, respectively. This echoes the original set of findings.

Table 13

Model Summary of Grouped Data

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	Durbin-Watson
1	.280[a]	.078	.041	4.01321	1.503

[a.] Predictors: (Constant), Facilities LMH = 0, Facilities LMH = 1.= 2-4.
[b.] Dependent variable: Drug overdose mortality rate.

Table 14

ANOVA Summary of Grouped Data

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	67.182	2	33.591	2.086	.135[b]
	Residual	789.187	49	16.106		
	Total	856.369	51			

[a.] Dependent variable: Drug overdose mortality rate.
[b.] Predictors: (Constant), Facilities.

Table 15

Coefficients Table for Grouped Drug Overdose Mortality Rates

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	Constant	11.437	1.036		11.038	.000	9.355	13.520
	Facilities LMH 1 =0	1.422	1.422	.164	1.000	.322	-.1.435	4.278
	Facilities LMH 2 = 2-4	-1.282	1.371	-.154	-.935	.354	-4.037	1.473

Summary

The purpose of this quantitative study was to investigate the relationship between countywide drug overdose mortality rate per 100,000 people and the number of telemedicine facilities in a county. Data concerning two research questions was analyzed in this section. Based on an independent samples *t*-test comparing the overdose mortality rates in Texas counties with and without telemedicine services, the researcher accepted the null hypothesis of RQ1 and conclude that there is no statistically significant difference in the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine services. Based on a regression analysis of the relationship between countywide drug overdose mortality rate per 100,000 people and the number of telemedicine facilities in a county, the researcher accepted the null hypothesis of RQ2 and concluded that there is no statistically significant relationship between the number of telemedicine service services and rate of opioid overdose deaths (per capita) in Texas counties.

Section 4: Application to Professional Practice and Implications for Social Change

The purpose of this quantitative study was to determine if there was a statistical relationship between the countywide drug overdose mortality rate per 100,000 people and the number of telemedicine facilities in a county in the state of Texas. I used an independent sample *t* test and regression analysis were used to answer the following research questions:

RQ1: What is the relationship between the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine service?

RQ2: What is the relationship between the number of telemedicine service services and rate of opioid overdose deaths (per capita) in Texas counties?

The null hypotheses of both research questions failed to be rejected at the .05 level.

Interpretation of the Findings

The findings of this study suggested that telemedicine availability did not have a statistically significant impact on rates of opioid overdose death per capita in the state of Texas. Telemedicine is still an emergent field, and data on the efficacy of telemedicine will likely be coming out in greater droves as the COVID-19 pandemic is continually studied (Kleykamp et al., 2020). The majority of the extant research on tele-SUD and its affordances has focused primarily on individuals in rural contexts who were actively seeking remote treatment for opioid use disorders (Browne et al., 2016; Eibl et al., 2017; Huskamp et al., 2018). Though it is certainly possible that telehealth is presently being used in new and potentially generative ways to address SUDs, in this study I could not

conclusively determine a statistically significant link between the availability of tele-SUD treatments and changes in opioid overdose deaths.

Limitations of the Study

There are several limitations of this study that must be acknowledged. First, there is a possibility that tele-SUD patients do not use telemedicine services located in their area. Rizzi et al. (2020) and Barnett et al. (2018) suggested that accessing telehealth services in areas near to the patient is somewhat common; however, it is possible that geographical or political differences make it so this is not the case in Texas. Second, not all telemedical patients are tele-SUD patients, so this study's focus on the impact of telemedicine on opioid overdose death may be a projection on how people in the state of Texas use telemedicine. Third, this study has significant geographical and temporal limitations because of my focus on the use of telemedicine in the state of Texas in 2020. As Kleykamp et al. (2018) discussed, the COVID-19 pandemic has completely changed many individuals' abilities to obtain in-person care. Because it is unclear how the shift to remote care will impact the medical field in the future, this study may ultimately represent either a fluke year for telemedicine or the beginning of a wider transitory period.

Recommendations for Further Research

Based on this study, I have identified many opportunities for further research. First, to address the limitation of not understanding the frequency with which tele-SUD approaches are used, future researchers should perform surveys on telemedicine services in demographic areas to determine who, how, and where Americans are using tele-SUD.

This could help improve the research being done on tele-SUDs in the ultimate interest of making such treatment more effective. Second, to address the geographical and temporal limitations of the current study, I recommend that a similar study be conducted in different state-level contexts. States in the northeast with high levels of fentanyl poisoning should be targeted for such studies because the ravages of the opioid crisis are being felt more keenly in those areas (O'Donnell et al., 2017). Third, studies on opioid users' willingness to use telemedicine should be completed using targeted samples of opioid users who have not formally entered treatment yet. Anonymous surveys on interest in tele-SUD treatment at a needle exchange, for example, may be a generative way of gauging interest.

Implications for Professional Practice and Social Change

Regarding professional practice, this study's outcomes primarily suggest that additional data collection should be carried out by health care services who work in telehealth. Though the existing research suggests that telehealth can be an incredible tool in fighting illicit opioid usage, data on how that can best be accomplished is still lacking. Telehealth services should be diligent in collecting information on their patients in the interest of furthering scientific approaches towards recovery. With this study, I sought to encourage positive social change through actively raising questions about how to expand opioid treatment resources to the broadest possible patient base. For example, this study demonstrates the deficits of existing data on how telemedicine is used to reach SUD patients and the challenges with current methods of exploring the efficacy of tele-SUD treatment. Though telehealth is an affordable and accessible treatment option that has

helped change the lives of many people with SUDs (Browne et al., 2016; Eibl et al., 2017; Huskamp et al., 2018), more information must be gathered concerning how tele-SUD treatment should work and for whom tele-SUD treatment is effective. With this study, I implore health care professionals and researchers alike to consider how to improve the quality of telehealth care for individuals with opioid use disorders, something which is critically important in the ongoing fight against the opioid crisis (see Katz, 2017).

Conclusion

Two research questions guided this study. In the case of RQ1, I concluded that there is no statistically significant difference in the rate of opioid overdose deaths (per capita) between Texas counties with and without telemedicine services. In the case of RQ2, I found that there is no statistically significant relationship between the number of telemedicine service services and rate of opioid overdose deaths (per capita) in Texas counties. Though the study results suggested that there is not a relationship between telemedicine availability and opioid overdose death, this study represents an early attempt to explore the efficacy of telemedicine with data tools in need of improvement. It is my hope that the increased telecommunications-related opportunities provided by the COVID-19 pandemic will generate more in-depth, complete data on telemedicine. I am hopeful that similar methodologies will be used to advance further research on opioid overdoses in the future.

References

Amaram-Davila, J., Mallipeddi, T., & Reddy, A. (2020). Opioid prescribing with take-home naloxone: rationale and recommendations. *Current Anesthesiology Reports.* https://doi.org/10.1007/s40140-020-00419-0

Antwi, S. K., & Hamza, K. (2015). Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business and Management, 7*(3), 217-225.

Ashu-Ngang, G. N. (2020). *Substance use disorder and mental health issues* [Dissertation/Thesis]. ProQuest Dissertations Publishing.

Barnett, M. L., Ray, K. N., Souza, J., & Mehrotra, A. (2018). Trends in telemedicine use in a large commercially insured population, 2005-2017. *JAMA, 320*(20), 2147–2149. https://doi.org/10.1001/jama.2018.12354

Beardsley, K., Wish, E. D., Fitzelle, D. B., O'Grady, K., & Arria, A. M. (2003). Distance traveled to outpatient drug treatment and client retention. *Journal of Substance Abuse Treatment, 25*(4), 279-285. https://doi.org/10.1016/S0740-5472(03)00188-0

Browne, T., Priester, M. A., Clone, S., Iachini, A., DeHart, D., & Hock, R. (2016). Barriers and facilitators to substance use treatment in the rural south: A qualitative study. *Journal of Rural Health, 32*(1), 92–101. https://doi.org/10.1111/jrh.12129

Campion, E. W., Dorsey, E., & Topol, E. (2016). State of telehealth. *New England Journal of Medicine, 375*(2),154–161. https://doi.org/10.1056/NEJMra1601705

Cance, J. D., & Doyle, E. (2020). Changes in outpatient buprenorphine dispensing during the COVID-19 pandemic. *JAMA, 324*(23), 2442-2444. https://doi.org/10.1001/jama.2020.22154

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage Publications.

Cudziło, M., Voronina, R., Dujak, D., & Kolinski, A. (2018). Analyzing the efficiency of logistic actions in complex supply chains-conceptual and methodological assumptions of research. *Log Forum-Scientific Journal of Logistics, 14*, 171-184. https://doi.org/10.17270/j.log.255

Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank Memorial Fund Quarterly, 44*(3), 166–206. https://doi.org/10.2307/3348969

Donabedian, A. (1988). The quality of care: how can it be assessed? *JAMA, 260*(12), 1743–1748. https://doi.org/10.1001/jama.1988.03410120089033

Drake, R. E., Xie, H., & McHugo, G. J. (2020). A 16-year follow-up of patients with serious mental illness and co-occurring substance use disorder. *World Psychiatry, 19*(3), 397-398. https://doi.org/10.1002/wps.20793

Eibl, J. K., Gauthier, G., Pellegrini, D., Daiter, J., Varenbut, M., Hogenbirk, J. C., & Marsh, D. C. (2017). The effectiveness of telemedicine-delivered opioid agonist therapy in a supervised clinical setting. *Drug and Alcohol Dependence, 176*, 133-138. https://doi.org/10.1016/j.drugalcdep.2017.01.048

Grey, G., Schulman-Green, D., Knafl, K., & Reynolds, N. R. (2015). A revised self-and family management framework. *Nursing Outlook, 63*(2), 162–170. https://doi.org/10.1016/j.outlook.2014.10.003

Grossman, D., & Grindlay, K. (2017). Safety of medical abortion provided through telemedicine compared with in person. *Obstetrics & Gynecology, 130*(4), 778-782. https://doi.org/10.1097/AOG.0000000000002212

Haffajee, R. L., Bohnert, A. S. B., & Lagisetty, P. A. (2018). Policy pathways to address service workforce barriers to buprenorphine treatment. *American Journal of Preventive Medicine, 54*(6), S230–S242. https://doi.org/10.1016/j.amepre.2017.12.022

Hickman, M., Steer, C., Tilling, K., Lim, A. G., Marsden, J., Millar, T., Strang, J., Telfer, M., Vickerman, P., & Macleod, J. (2018). The impact of buprenorphine and methadone on mortality: A primary care cohort study in the United Kingdom. *Addiction, 113*, 1461– 1476. https://doi.org/10.1111/add.14188

Hollander, J. E. & Carr, B. G. (2020). Virtually perfect? Telemedicine for Covid-19. *New England Journal of Medicine, 382*, 1679-81. https://doi.org/10.1056/NEJMp2003539

Hoots, B. E., Xu, L., Kariisa, M., Wilson, N. O., Rudd, R. A., Scholl, L., ... & Seth, P. (2018). *2018 Annual surveillance report of drug-related risks and outcomes--United States.* https://www.cdc.gov/drugoverdose/pdf/pubs/2018-cdc-drug-surveillance-report.pdf

Huskamp, H. A., Busch, A. B., Souza, J., Uscher-Pines, L., Rose, S., Wilcock, A., Landon, B. E., & Mehrotra, A. (2018). How is telemedicine being used in opioid and other substance use disorder treatment? *Health Affairs, 37*(12), 1940-1947. https://doi.org/10.1377/hlthaff.2018.05134

Lacktman, N. M., Acosta, J. N., & Levine, S. J. (2019). *50-state survey of telehealth commercial payer statutes.* https://www.foley.com/-/media/files/insights/health-care-law-today/19mc21486-50state-survey-of-telehealth-commercial.pdf

Lai, J. T., Chapman, B. P., Carreiro, S. P., Costigan, A. D., Rodriguez-Perez, K. M., Gonzalez, G., & Babu, K. M. (2020). A pilot study of a telemedicine-based substance use disorder evaluation to enhance access to treatment following near-fatal opioid overdose. *Proceedings of the Annual Hawaii International Conference on System Sciences, 2020*, 3488–3496.

Katz, J. (2017, March 10). Short answers to hard questions about the opioid crisis. The *New York Times.* https://www.nytimes.com/interactive/2017/08/03/upshot/opioid-drug-overdose-epidemic.html

Kakko, J., Svanborg, K. D., Kreek, M. J., & Heilig, M. (2003). 1-year retention and social function after buprenorphine-assisted relapse prevention treatment for heroin dependence in Sweden: A randomised, placebo-controlled trial. *Lancet, 361*(9358), 662-668. https://doi.org/10.1016/S0140-6736(03)12600-1

Kleykamp, B. A., Guille, C., Barth, K. S., & McClure, E. A. (2020). Substance use disorders and COVID-19: The role of telehealth in treatment and research.

Journal of Social Work Practice in the Addictions, 20(3), 248-253. https://doi.org/10.1080/1533256X.2020.1793064

Larochelle, M. R., Liebschutz, J. M., Zhang, F., Ross-Degnan, D., & Wharam, J. F. (2016). Opioid prescribing after nonfatal overdose and association with repeated overdose: A cohort study. *Annals of Internal Medicine, 164*, 1-9. https://doi.org/10.7326/M15-0038

Leung, P. T. M., Macdonald, E. M., Stanbrook, M. B., Dhalla, I. A., & Juurlink, D. N. (2017). A 1980 letter on the risk of opioid addiction. *New England Journal of Medicine, 376*(22), 2194-2195. https://doi.org/10.1056/NEJMc1700150

Lin, L., Casteel, D., Shigekawa, E., Weyrich, M. S., Roby, D. H., & McMenamin, S. B. (2019). Telemedicine-delivered treatment interventions for substance use disorders: A systematic review. *Journal of Substance Abuse Treatment, 101*, 38-49. https://doi.org/10.1016/j.jsat.2019.03.007

Mahar, J. H., Rosencrance, G. J., & Rasmussen, P. A. (2018). Telemedicine: Past, present, and future. *Cleveland Clinic Journal of Medicine, 85*(12), 938-942. https://doi.org/10.3949/ccjm.85a.17062

Makary, M. A., Overton, H. N., & Wang, P. (2017). Overprescribing is major contributor to opioid crisis. *British Medical Journal*, Article 4792. https://doi.org/10.1136/bmj.j4792

Mehrotra, A., Huskamp, H. A., Souza, J., Uscher-Pines, L., Rose, S., Landon, B. E., Jena, A. B., & Busch, A. B. (2017). Rapid growth in mental health telemedicine use

among rural Medicare beneficiaries, wide variation across states. *Health Affairs, 36*(5), 909–917. https://doi.org/10.1377/hlthaff.2016.1461

Mitra, S., Carlyle, D., Kodumudi, G., Kodumudi, & V., Vadivelu, N. (2018). New advances in acute postoperative pain management. *Current Pain and Headache Reports, 22*(5), 35. https://doi.org/10.1007/s11916-018-0690-8

Nord, G., Rising, K. L., Band, R. A., Carr, B. G., & Hollander, J. E. (2018). On-demand synchronous audio video telemedicine visits are cost effective. *American Journal of Emergency Medicine, 37*(5), 890-894. https://doi.org/10.1016/j.ajem.2018.08.017

O'Donnell, J. K., Halpin, J., Mattson, C. L., Goldberger, B. A., & Gladden, R. M. (2017). Deaths involving fentanyl, fentanyl analogs, and U-47700 - 10 states, July-December 2016. *Morbidity and Mortality Weekly Report, 66*(43), 1197–1202. https://doi.org/10.15585/mmwr.mm6643e1

Olfson, M., Wall, M., Wang, S., Crystal, S., & Blanco, C. (2018). Risks of fatal opioid overdose during the first year following nonfatal overdose. *Drug and Alcohol Dependence, 190*(1), 112-119. https://doi.org/10.1016/j.drugalcdep.2018.06.004

Rizzi, A .M., Polachek, W .S., Dulas, M., Strelzow, J. A., & Hynes, K .K. (2020). The new 'normal': Rapid adoption of telemedicine in orthopaedics during the COVID-19 pandemic. *Injury, 51*(12), 2816-2821. https://doi.org/10.1016/j.injury.2020.09.009

Rudd, R. A., Aleshire, N., Zibbell, J. E., & Gladden, R. M. (2016). Increases in drug and opioid overdose deaths — United States, 2000–2014. *Morbidity and Mortality*

Weekly Report, 64(50), 1378-1382. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6450a3.htm

Rummans, T. A., Burton, C. M., & Dawson, N .L. (2018). How good intentions contributed to bad outcomes: The opioid crisis. *Hospital Internal Medicine, Psychiatry, and Psychology 93*(3), 344-350. https://doi.org/10.1016/j.mayocp.2017.12.020

Samuels, E. A., D'Onofrio, G., Huntley, K., Levin, S., Schuur, J. D., Bart, G., Hawk, K., Tai, B., Campbell, C. I., & Venkatesh, A. K. (2019). A quality framework for emergency department treatment of opioid use disorder. *Annals of Emergency Medicine, 73*(3), 237–247. https://doi.org/10.1016/j.annemergmed.2018.08.439

Shah, A., Hayes, C. J., & Martin, B. C. (2017). Characteristics of initial prescription episodes and likelihood of long-term opioid use - United States, 2006-2015. *Morbidity and Mortality Weekly Report, 66*(10), 265–269. https://doi.org/10.15585/mmwr.mm6610a1

Substance Abuse and Mental Health Services Administration. (2016). Rural behavioral health: Telehealth challenges and opportunities. (Issue Brief No. 9). https://store.samhsa.gov/sites/default/files/d7/priv/sma16-4989.pdf

Uscher-Pines, L., Raja, P., Mehrotra, A., & Huskamp, H.A. (2020). Health center implementation of telemedicine for opioid use disorders: A qualitative assessment of adopters and nonadopters. *Journal of Substance Abuse Treatment, 115*(1). https://doi.org/10.1016/j.jsat.2020.108037

Wakeman, S. E., & Barnett, M. L. (2018). Primary care and the opioid-overdose crisis—buprenorphine myths and realities. *The New England Journal of Medicine, 379*(1), 1–4. https://doi.org/10.1056/NEJMp1802741

Wakeman, S. E., & Rich, J. D. (2017). Barriers to post-acute care for patients on opioid agonist therapy; An example of systematic stigmatization of addiction. *Journal of General Internal Medicine, 32*(1), 17–19. https://doi.org/10.1007/s11606-016-3799-7

Weiner, S. G., Baker, O., Bernson, D., & Schuur, J. D. (2020). One-year mortality of patients after emergency department treatment for nonfatal opioid overdose. *Annals of Emergency Medicine, 75*(1), 13-17. https://doi.org/10.1016/j.annemergmed.2019.04.020