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The Opioid Crisis and Crime: Understanding the Relationship Between Opioid Dispensing Rates and Crime Rates in the United States

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ABSTRACT

From 1999-2021, nearly 645,000 people died from an opioid overdose, including both prescription and illicit opioids (CDC, 2023). These overdoses, along with opioid use disorder, or addictions, largely began as the number of opioid prescriptions rose in the late 1990s and continued into the 2000s. This thesis sought to understand how dispensing rates of opioid prescriptions impacted crime rates throughout these counties for these crime types. Data from the Centers for Disease Control and Prevention regarding the opioid dispensation rates of opioid prescriptions from 2006 to 2020 was used in this study in comparison with data from the Uniform Crime Report regarding crime rates from the same period for all crimes, violent crimes, and property crimes within one of 36 counties in the United States. The analysis of this data through correlations analyses and fixed-effects regression models revealed a strong positive relationship between dispensing rates and total crime and property crime rates within the counties studied, and a negative relationship between dispensing rates and violent crime rates. These findings are largely consistent with Paul J. Goldstein's tripartite model explaining the nexus between drugs and violence, explaining that drugs and violence can be related in three ways: the psychopharmacological model, the economic compulsive model, and the systemic model. Goldstein also argued that drug users, specifically opiate users, are less likely to engage in violent crimes; the evidence presented from this study was consistent with Goldstein's findings. Following this analysis' findings, further empirical research into the relationship between opioid dispensation rates and crime rates throughout the greater United States should be pursued.

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Chapter 1
Literature Review

Overview

From 1999-2021, nearly 645,000 people died from an opioid overdose, including both prescription and illicit opioids (CDC, 2023). An overlooked crisis for some time, the opioid crisis is now front and center in government policy, healthcare practices, and even recent headlines. Just in December 2023, the United States Supreme Court listened to arguments regarding the legality of a bankruptcy settlement involving Purdue Pharma, the creator of OxyContin — the highly addictive opium-based pain medication that became the drug at the front of the opioid crisis. If this deal continues, it may lead to massive financial support for addiction treatment resources among other efforts to combat the opioid crisis (Kruzel, 2023).

Understanding the relationships between the opioid crisis and crime rates can better inform policy on opioid dispensing, create resource allocation for addiction treatment programs and mental health services, and guide the implementation of prevention strategies focused on reducing opioid-related harms and crime. Not only will this thesis provide information that can aid the many systems that are still attempting to help those affected by the opioid crisis, but it will also evaluate Paul J. Goldstein's tripartite conceptual framework of the drugs/violence nexus. This model argues that violence and drugs are connected through three ways: the psychopharmacological model, the economic compulsive model, and the systemic model. Through this framework, I will examine to what extent the county-level dispensing rates of opioid prescriptions — retail opioid prescriptions dispensed per 100 U.S. residents in that county

collected by the Centers for Disease Control and Prevention — related to the county-level total crime rates, violent crime rates, and property crime rates. First, I will review literature discussing the opioid crisis and crime, including Goldstein's tripartite model, then I will conduct an analysis and provide the outcomes, and finally, I will discuss the significance of my findings in relation to the literature this study reviewed.

The Opioid Crisis

Since the early 1990s, there has been a dramatic increase in drug overdose deaths in the United States. By 2017, two-thirds of all overdose deaths involved opioids, killing 47,600 people that year alone and making the total number of opioid-related deaths 500,000 since 1999 — almost the same amount of U.S. soldiers who died in World War II (Alpert et al., 2021).

There is not one determined cause of the opioid crisis. Some scholars suggest that it was caused by demand factors created by a series of cultural and economic conditions that drove drug misuse and overdoses (Alpert et al., 2021). Other scholars argue that it was caused by supply factors; in the mid-1990s, the American Pain Society argued that pain was the "fifth vital sign" in addition to body temperature, blood pressure, pulse, and respiratory rate. It argued that patients with pain were undertreated, and that pain needed to be aggressively assessed and treated within all patients. Without any quantitative ways to determine pain, physicians must acknowledge patient self-reports of their pain levels (Mandell, 2016).

This new analysis of pain introduced new ways to promote and sell pain medications, including opium-based narcotics like OxyContin. Companies and drug manufacturers — like Purdue Pharma — were known to fund presentations, publications, gifts, and other incentives, targets toward physicians that promoted their drugs and therefore increased their prescribing

rates (Mandell, 2016). In 2000, even The Joint Commission published a book for physicians as part of a series of education seminars that states studies have found “there is no evidence that addiction is a significant issue when persons are given opioids for pain control” — a book funded by the sponsorship of a drug manufacturer (Mandell, 2016).

In 1996, Purdue Pharma released OxyContin, which, over the almost three decades of the opioid overdose epidemic, has become a major force behind the crisis. The release of this drug contributed to the categorized “first wave” of the epidemic. The opioid crisis has been separated into three distinct “waves” based on the types of drugs being used and distributed during that time. The first wave began during that observed increase in opioid prescriptions and opioid overdose deaths in the 1990s; the second wave began in 2010 with an increase in overdose deaths related to heroin; the third wave began in 2013 with an increase in overdose deaths involving synthetic opioids, including fentanyl (CDC, 2023).

In the first wave, overdoses related to opioid pills began rising in 2000 and grew through 2016. The high number of overdoses can be attributed to the tripling of opioid prescriptions starting in the 1990s and peaking around 2011 (Kolodny et al., 2015). Prescription opioids prescribed during this wave used extended release long-acting (ERLA) formulations, which was a technological advance in drug formulation that allowed higher, longer lasting doses in a single pill or capsule (Ciccarone, 2019). However, those who became addicted to these medications and who came to suffer from opioid use disorder (OUD) could easily avoid the delayed release mechanisms that the medications had by discharging the whole dose at once through crushing and snorting or injecting it (Ciccarone, 2019). During this time there was also an aging population that reported rises in pain and disability, economic distress, declining social cohesion,

and rising rates of mental illness that may have created a large at-risk population to seek or be prescribed opioids in the first place (Ciccarone, 2019).

The second wave of the opioid crisis has largely been due to rising use and overdose deaths involving heroin. Many young and inexperienced heroin users frequently mention switching to heroin from opioid pills, as their need for the drugs grew, necessitating a larger and more regular supply of pills, which they had to acquire either through prescriptions or by purchasing them on the street through illegal drug networks (Ciccarone, 2019). Heroin was even made more accessible than prescription opioid pills because of its low cost, making it even more logical to switch to from prescription medications. Overdoses caused by heroin began to increase in 2011, but in late 2010, OxyContin was reformulated to be abuse-deterrent, which may have driven a small portion of the at-risk or already addicted population to heroin (Ciccarone, 2019).

The opioid crisis's third wave is what currently threatens drug and opioid users across the United States: synthetic opioids, specifically the increasing use of fentanyl. Illegally produced fentanyl is mixed into the black-market drug inventory and marketed as 'heroin' in powder form or disguised as fake opioid or benzodiazepine tablets (Ciccarone, 2019). Nonetheless, fentanyl is nearly 50-100 times more potent than morphine and possesses a high-fat solubility, enabling rapid penetration into the central nervous system, thereby heightening the likelihood of addiction and overdose. Even just two milligrams can be lethal (*Fentanyl: The third wave of the opioid crisis*). From 2013 to 2015, overdose deaths related to synthetic opioids tripled. This category is largely led by fentanyl, and the U.S. had over 112,000 fentanyl-related overdose deaths in 2023 alone. Many of these people took it without knowing, believing it was another drug, only adding to the dangers of drug use; however, many are seeking fentanyl out. People already with opioid addictions are drawn to drugs with higher potencies, leading them to heroin, and fentanyl soon

after (*Fentanyl: The third wave of the opioid crisis*). Alongside the strength of fentanyl, some studies suggest a potentially heightened risk: fluctuations in potency and purity, along with diverse combinations of heroin, fentanyl, and its counterparts. Studies on heroin overdoses indicate that variations in street heroin purity, especially when averaging at higher levels, independently forecast fatal overdoses. Changes in potency, purity, and mixture within the fentanyl street market could greatly impact overdose rates in certain areas (Ciccarone, 2019).

All three waves of the opioid crisis are inextricably connected. Although the drugs of choice used in each wave are different, each one led to the next in terms of strength, supply, and demand. Each wave had supply-side drivers, including the excessive prescribing of medications, new sources of heroin imported or created within the U.S., and a new source of synthetic opioids corrupting heroin and pills (Ciccarone, 2019). Demand of these opioids also drove each wave, as demand for opioid pills encouraged later demand for heroin, and demand for heroin encouraged later demand for synthetics (Ciccarone, 2019).

Although the opioid crisis is largely seen as a problem for Big Pharma, physicians, and the healthcare industry in general, this epidemic is far from over, or even improving. In the years 2020-2021, opioid-involved death rates increased by over 15%, and prescription opioid-involved death rates remained stagnant at about 16,700 deaths per year (CDC, 2023; U.S., 2023).

Prescribing

To battle this epidemic, the CDC, federal and state governments, and individual healthcare systems have monitored trends to better understand the crisis and have created guidelines for prescribing opioid medications after the high volume of opioid prescribing from the 1990s to 2000s contributed as a major driver of the beginning of the opioid crisis. While non-

prescription opioids such as heroin and synthetic opioids currently account for most opioid overdose fatalities, approximately 30% of opioid overdoses in 2019 included prescription opioids (Tormohlen et al., 2022).

The opioid crisis began with a failure in prescribing when prescribers failed to understand the levels of addictiveness these opioid medications had. The sprawling effort to reduce pain in patients was misled by the aggressive and incorrect marketing of long-acting opioids — like OxyContin by Purdue Pharma — to physicians all over the country.

Several studies have shown that the use of opioids for chronic pain may worsen pain and functioning, while the risk and prevalence of opioid addiction or dependence may be as high as 26% among patients in primary care receiving opioids for chronic non-cancer-related pain (Frieden & Houry, 2016).

Previous opioid prescribing practices, including high dosages and long-duration prescriptions, have been associated with increased risk of opioid-related overdoses and opioid overdose deaths (Tormohlen et al., 2022). Overdose risk increases, at least doubling, when patients take doses up to 50-99 morphine milligram equivalents (MMEs) per day and can increase up to nine times the risk when taking doses of 100 MMEs or more per day, as compared with dosage sizes of less than 20 MME per day (Frieden & Houry, 2016). Frieden and Houry found that one of every 550 patients using opioid medications died of opioid-related causes in an average of 2.6 years after their first opioid prescription; this proportion was as high as one of every 32 patients dying after receiving doses of 200 MME or higher (Frieden & Houry, 2016). Over the past decade, many states have enacted prescribing cap laws, which curb these high-risk prescribing practices by limiting the dose prescribed to a patient or the duration for which the patient takes the dose.

In 2016, the Centers for Disease Control and Prevention (CDC) released the "Guideline for Prescribing Opioids for Chronic Pain" to support clinicians and prescribers trying to care for patients who are not experiencing active cancer treatment, palliative, or end-of-life care. The Guideline, updated in 2022, maintains its core principles for opioid prescription in chronic pain management. It now emphasizes the advantages and drawbacks of nonopioid pain therapies, urging prescribers to prioritize their utilization. Opioid treatment initiation should only occur if anticipated pain relief and functional enhancement outweigh potential risks. Moreover, prescribers are advised to commence opioid therapy at the minimal effective dose, assess individual risks and benefits before dosage adjustments, and refrain from escalating doses beyond levels where benefits diminish compared to risks (Dowell et al., 2022).

As this study will be considering prescribing practices and the dispensing rates of opioids between 2006 and 2020, the CDC's 2016 Opioid-Prescribing Guideline will be more accurate in terms of prescribing practices during this time. The twelve guidelines are as follows (Frieden & Houry, 2016):

1. Nonpharmacologic therapy and nonopioid pharmacologic therapy are preferred for chronic pain. Clinicians should consider opioid therapy only if expected benefits for both pain and function are anticipated to outweigh risks to the patient. If opioids are used, they should be combined with nonpharmacologic therapy and nonopioid pharmacologic therapy, as appropriate.
2. Before starting opioid therapy for chronic pain, clinicians should establish treatment goals with all patients, including realistic goals for pain and function, and should consider how therapy will be discontinued if benefits do not outweigh risks. Clinicians should continue

opioid therapy only if there is clinically meaningful improvement in pain and function that outweighs risks to patient safety.

3. Before starting and periodically during opioid therapy, clinicians should discuss with patients known risks and realistic benefits of opioid therapy and patient and provider responsibilities for managing therapy.
4. When starting opioid therapy for chronic pain, clinicians should prescribe immediate-release opioids instead of extended-release/long-acting (ER/LA) opioids.
5. When opioids are started, clinicians should prescribe the lowest effective dosage. Clinicians should use caution when prescribing opioids at any dosage, should carefully reassess evidence of individual benefits and risks when increasing dosage to ≥50 morphine milligram equivalents (MME) per day, and should avoid increasing dosage to ≥90 MME per day or carefully justify a decision to titrate dosage to ≥90 MME per day.
6. Long-term opioid use often begins with treatment of acute pain. When opioids are used for acute pain, clinicians should prescribe the lowest effective dose of immediate-release opioids and should prescribe no greater quantity than needed for the expected duration of pain severe enough to require opioids. Three days or less will often be sufficient; more than 7 days will rarely be needed.
7. Clinicians should evaluate benefits and harms with patients within 1–4 weeks of starting opioid therapy for chronic pain or of dose escalation. Clinicians should evaluate the benefits and harms of continued therapy with patients every 3 months or more frequently. If benefits do not outweigh harms of continued opioid therapy, clinicians should optimize other therapies and work with patients to taper opioids to lower dosages or to taper and discontinue opioids.

8. Before starting and periodically during continuation of opioid therapy, clinicians should evaluate risk factors for opioid-related harms. Clinicians should incorporate into the management plan strategies to mitigate risk, including considering offering naloxone when factors that increase risk for opioid overdose, such as history of overdose, history of substance use disorder, higher opioid dosages (≥50 MME/day), or concurrent benzodiazepine use are present.
9. Clinicians should review the patient's history of controlled substance prescriptions using state prescription drug monitoring program (PDMP) data to determine whether the patient is receiving opioid dosages or dangerous combinations that put him or her at elevated risk for overdose. Clinicians should review PDMP data when starting opioid therapy for chronic pain and periodically during opioid therapy for chronic pain, ranging from every prescription to every 3 months.
10. When prescribing opioids for chronic pain, clinicians should use urine drug testing before starting opioid therapy and consider urine drug testing at least annually to assess for prescribed medications as well as other controlled prescription drugs and illicit drugs.
11. Clinicians should avoid prescribing opioid pain medication and benzodiazepines concurrently whenever possible.
12. Clinicians should offer or arrange evidence-based treatment (usually medication-assisted treatment with buprenorphine or methadone in combination with behavioral therapies) for patients with opioid-use disorder.

Three key principles underlie the CDC's recommendations (Frieden & Houry, 2016):

1. Nonopioid therapy is the preferred option for managing chronic pain unless it relates to active cancer treatment, palliative, or end-of-life care.
    a. Opioids should only be considered as an adjunct to other treatments for chronic pain when the expected benefits for pain relief and improved functionality are anticipated to outweigh the significant risks associated with this medication class.
    b. Nonpharmacological therapies offer effective relief for chronic pain with lower risks to patients.
2. When prescribing opioids, it is advisable to prescribe the lowest effective dose possible to mitigate the risks of opioid use disorder and overdose.
3. Clinicians should proceed with caution when prescribing opioids and maintain close monitoring of all patients. They should take the following precautions, among others, when treating patients who have been prescribed opioid medications:
    a. Mitigate risk by avoiding concurrent use of benzodiazepines.
    b. Review data from Prescription Drug Monitoring Programs (PDMPs) when deciding whether to start or continue opioid therapy.
    c. Offer naloxone to patients who are at a greater risk of overdose.
    d. Have a clear “off-ramp” plan to taper and discontinue opioid therapy.
    e. Reevaluate the necessity and dosage of opioid therapy regularly.
    f. Obtain urine toxicology screening at the start of treatment and perhaps throughout maintaining the patient's safety.

These guidelines were established to enhance communication between healthcare providers and patients regarding the risks and benefits of opioid therapy for chronic pain, enhance the safety and efficacy of pain management, and mitigate the dangers associated with

prolonged opioid use, such as opioid use disorder and overdose. While also remaining concerned about addiction and overdose, the CDC's guidelines could have a significant impact on opioid-related crime. Although these guidelines seem sufficient in reducing excessive prescribing, there are two main hypotheses for how these guidelines and other prescribing cap laws might influence opioid overdoses and opioid overdose deaths (Tormohlen et al., 2022):

1. Limiting opioid prescriptions could potentially decrease overdose rates by reducing the number of individuals receiving high-dose, long-duration opioid prescriptions, which are linked to overdoses.
2. Enacting laws to cap opioid prescribing may inadvertently push patients dependent on prescription opioids towards heroin or synthetic opioids due to reduced access to prescription opioids, potentially resulting in an uptick in opioid overdoses.

Framework to View the Opioid Crisis and Crime

Drug use has been related to physical and mental health problems, poor school performance, family disruption, and crime. As a result, drug use and drug trafficking can be seen and studied as contributing factors when considering how violence is created. Paul J. Goldstein created a conceptual framework to examine this connection between drugs and violence, which states that these can be related in three ways: the psychopharmacological, the economically compulsive, and the systemic (Goldstein, 1985).

The Psychopharmacological Model

This model suggests that some individuals, because of the consumption of prescribed or illicit substances, "may become excitable, irrational, and may exhibit violent behavior" (Goldstein, 1985). Goldstein makes clear that the use of opiates and marijuana have not been

found to cause violent behavior. This point is made originally by Lawrence Kolb in his 1925 paper, “Drug Addiction and its Relation to Crime,” where he found the idea that narcotic-drug addiction was driving violent crime was false; no opiate ever directly influenced addicts to commit violent crime (Kolb, 1925). However, Goldstein argues that this is true with one exception: the irritability associated with the withdrawal symptoms from opiates can lead to violence and crime.

This finding may also argue that the increase in prescribing which triggered the opioid crisis, addicting and killing almost 645,000 people in the U.S. between 1999 and 2021, may have also led to an increase in crime due to the withdrawal symptoms addicts experience without the opioids they have been prescribed.

The Economic Compulsive Model

This model claims that individuals who use drugs may resort to financially driven criminal activities, like robbery, to sustain their expensive drug habits. Economically driven individuals are usually motivated by obtaining money or other items of value that can be exchanged for drugs they desire, rather than by impulses towards violence. Instances of violence in these cases usually arise from various social factors surrounding the economic crime, like the perpetrator's anxiety, the victim's reaction, the presence or absence of weapons, or the potential intervention of bystanders (Goldstein, 1985).

Research suggests that heroin users tend to avoid violence when engaging in financially motivated crimes if non-violent options are available. This behavior is likely due to the perceived higher personal risk associated with violent crimes, such as increased chances of imprisonment if caught, indicating that these offenders may not inherently lean towards violent behavior.

Additionally, studies indicate that most crimes committed by drug users are nonviolent in nature, such as shoplifting, prostitution, and drug dealing, despite there being limited data available regarding the proportion of violent economic crimes related to drug use (Goldstein, 1985).

The Systemic Model

Violence is an inherent aspect of involvement with illicit substances, manifesting systemically through aggressive patterns within the drug distribution and use network. Examples of systemic violence, as outlined by Goldstein in 1985, include:

1. Territorial disputes among rival drug dealers.
2. Assaults and homicides within drug dealing hierarchies to enforce norms.
3. Robberies of drug dealers and subsequent violent retaliation.
4. Elimination of informants.
5. Punishment for distributing adulterated or fake drugs.
6. Punishment for unpaid debts.
7. Conflicts over drugs or drug-related items.
8. Robbery-related violence in areas where drugs are purchased.

Violence often stems from "norm violation," occurring when individuals within the drug trade, including street dealers, suppliers, and buyers, contravene established rules, whether spoken or unspoken. These violations typically align with the aforementioned categories but can also be primarily motivated by financial gains. Some studies propose that analyzing systemic violence within the drug trade may be more crucial than examining the individual user's relationship with crime.

Applications to the Current Study

As of 1985 when this model was created by Goldstein, not much data on the relationship between drugs and crime existed, both in scientific study and in crime reports. However, in 2004, 17% of state prisoners and 18% of federal prisoners said they committed their current offense for money to buy drugs (*Drug use and crime*). With the opioid crisis now existing as an exacerbating factor when considering the relationship between drugs and crime, Goldstein's tripartite model comes back into play. This study will use this model to consider the effects that the opioid crisis and the fluctuations in dispensing rates of prescription opioids over the years have had on crime rates in multiple different counties in the southern United States.

These three models relating drugs and violence can be inextricably seen within many of the core issues that have driven and continue to drive the opioid crisis to this day. "Individuals caught in this lifestyle value the experience of substance use, recognize the risks involved, and struggle for survival daily. That struggle is clearly a major contributor to the total volume of crime and violence in American society" (Goldstein, 1985). This struggle for survival has not changed within the treatment and understanding of drug users and their crimes today. The opioid crisis has only amplified their struggles. It is important to view criminal behavior committed by drug users from a multitude of angles, but the three models that Goldstein proposed because of their applicability to the opioid crisis and its repercussions.

The Opioid Crisis and the Criminal Justice System

The opioid crisis and crime rates are inexplicably tied together. Criminal justice data related to opioid-related incidents is underrepresented when considering policy changes regarding opioid dispensation and the effect of the opioid crisis. Using the National Incident-Based Reporting System (NIBRS), it has been found that between 2005 and 2016 there was an

increase from 32.0 to 91.4 per 100,000 residents of incident rates for all opioid-related crimes, followed by a decrease to 78.3 per 100,000 from 2016 to 2018. The first significant increase from 2005 to 2016 was caused by prescription opioid dispensation and incidents, which caused an increase of 19.6% per year between 2005 and 2010 (Chen et al., 2022). Between 2010 and 2015, the increase came from illicit opioid-related incidents which increased by 21.6% per year (Chen et al., 2022).

Prescription opioids are still being dispensed throughout the country and physicians are doing so within numerous laws that either attempt to limit the supply or demand of opioids. There are three main subsets of legislation that address the opioid crisis by focusing on opioid dispensation: Prescription Drug Monitoring Programs (PDMP), Pain Management Clinics Laws (PMCL), and Doctor Shopping Laws (DSL). These regulations either aim to reduce the amount of prescription opioids dispensed on the supply side from physicians, healthcare professionals, and overall prescribers (PDMP and PMCL) or on the demand side from patients (DSL).

The supply-side laws (PDMP and PMCL) focus on controlling prescribers and the act and amount of opioid dispensation. PDMP is the implementation of systems that collect information on prescriptions of these narcotics and that allow physicians and pharmacists to view a patient's prescribing history (Deiana & Giua, 2021). PMCLs are sets of regulations concerning the minimum requirements for a pain management clinic to be allowed to dispense prescription drugs (Deiana & Giua, 2021). The main demand-side law, DSL, obliges patients to be transparent to prescribers about previous prescriptions received from other doctors and prohibits obtaining narcotics through fraud, deceit, misrepresentation, etc. (Deiana & Giua, 2021). It has been found that PDMP and PMCL produce, respectively, a 4 and 15% reduction in the per capita

drug units dispensed, while DSL does not have any significance on prescription rates (Deiana & Giua, 2021).

Despite PDMP and PMCL's reduction of the legally dispensed opioids, when studied alongside crime rates, these policies might coincide with an increase in drug-related crimes due to users turning to the black market in search of drugs (Deiana & Giua, 2021). However, the reduced legal availability of these narcotics might also mean reduced illegal availability, which will then contribute to the reduction in arrests for drug-related crimes, such as sale or possession (Deiana & Giua, 2021).

When compared to crime rates, Deiana & Giua found the PDMP is not associated with any changes in drug-related crime, PMCL has a positive impact on the possession and sale of drugs as arrest rates rose by 21%, and DSL remains to have no statistical significance on crime rates. This study showed that policies that target the supply side of opioid dispensation by restricting the availability of legally dispensed opioids have important indirect effects on drug-related crime rates, which are driven by the sale and possession of drugs and emphasize the close relationship between the legal and illegal markets for drugs (Deiana & Giua, 2021).

The current study aims to assess the effect of the county-level dispensing rate of opioids on county-level arrest rates by cross-examining the opioid dispensation rates and arrest rates of 36 different counties. I aim to examine and answer three questions:

1. To what extent is the county-level dispensing rate of opioids — retail opioid prescriptions dispensed per 100 U.S. residents in that county collected by the Centers for Disease Control and Prevention — related to the county-level arrest rates?

2. To what extent is the county-level dispensing rate of opioids related to the county-level arrest rates specifically for property crimes?
3. To what extent is the county-level dispensing rate of opioids related to the county-level arrest rates specifically for violent crimes?

County-Level Dispensing Rate of Opioids & Overall County-Level Arrest Rates

The county-level dispensing rate of opioids can be defined as the retail opioid prescriptions dispensed per 100 U.S. residents in that county collected by the Centers for Disease Control and Prevention. The number of opioids prescribed in the U.S. peaked in 2010 and then declined each year. However, despite this decline, the number of opioids prescribed was about three times as high in 2015 as it was in 1999 (Guy et al., 2017). The reduction in opioid prescribing may be related to increasing awareness of the opioid overdose epidemic and addiction risks associated with opioids, as well as state-level policies like PDMP, PMCL, and DSL that aim to reduce opioid prescribing rates (Guy et al., 2017).

Despite this reduction, there is a continuous increase in opioid overdose deaths, which are now largely attributed to the use of illicit opioids like heroin and synthetic opioids. This increase in illicit opioid use and deaths related to illicit opioid use are related to prescription opioid use. According to Guy et al., 24 of the 69 people in Rhode Island who died from an illicit fentanyl overdose between January 2012 and March 2014 filled an opioid prescription within 90 days of their death (Guy et al., 2017).

Not only does limiting opioid dispensation not improve the opioid overdose death rate, but creating laws to limit opioid prescriptions does not limit actual opioid dispensation or crime. Most of the prescription drugs distributed through the illicit drug market are originally

distributed by doctors and then redistributed illegally by patients (Meinhofer, 2016). The illicit drug market is still an extremely prevalent resource for prescription opioids. Prescribers continue to over-prescribe, causing the continuation of the opioid black market or further distribution to family members or friends (Deiana & Giua, 2021). Also, creating laws to limit opioid prescriptions can result in increases in the illegal drug market, specifically in sales of opium, cocaine, and synthetic narcotics — including fentanyl (Deiana & Giua, 2021). Fentanyl has become a cheaper option compared with other opiates that are becoming harder to find and buy in the illicit drug market due to these new laws and policies that aim to limit opioid dispensation. Still, it is also a more dangerous and potent alternative. The price of legitimate prescription opioids has now pushed the drug market toward dangerous alternatives, like fentanyl, which might be why the U.S. is still seeing an increase in opioid overdose deaths (Beletsky & Davis, 2017).

There are conflicting findings as to whether laws to limit opioid prescriptions also limit opioid dispensing and crime. With PDMP, ordinary PDMP reduces the quantity of Morphine Gram Equivalent (MGE) units by 4.5% while mandated PDMP decreases the prescriptions and quantity of MGEs by an additional 8.5%, creating an overall drop of 13% (Deiana & Giua, 2021). However, there is no association with changes in drug-related crime and PDMP. PMCLs impose more aggressive restrictions on Pain Management Clinics (PMCs) which creates an overall decrease in MGEs dispensed by PMCs by 15% (Deiana & Giua, 2021). This is the most severe drop created by an opioid-dispensation-related policy and shows a positive impact on drug-related crime, particularly within the possession and sale of drugs (Deiana & Giua, 2021). DSL has not shown any significant impact in decreasing the quantity of per capita MGE units dispensed. This could be attributed to the fact that demand-side policies receive less attention

and funding than supply-side policies, but it must also be noted that DSL might bring about a slight increase in the amount of MGE units per capita dispensed due to the overall lack of system surveillance since heavy users might be more motivated to avoid disclosing their prior prescription records to healthcare professionals to be prescribed, and therefore obtain, more narcotics than necessary (Deiana & Giua, 2021).

I expect that county-level dispensing rates of opioids will be related to county-level crime rates, and laws that limit opioid prescription writing will have a negative relationship on opioid use and crime rates.

Chapter 2

Data and Methods

Data

The data I will be using to conduct my analysis and draw conclusions from is collected by the Centers for Disease Control and Prevention regarding the dispensing rates of prescription opioids by county in the United States. For this study's purposes, I will draw from six different states and six counties from each state, resulting in 36 different counties and their data. I will also collect data from these counties from 2006 to 2020, creating 15 years of data overall. This allows for in-depth information about the way dispensing rates have changed among multiple counties across the U.S. between years that were crucial to the awareness and development of the opioid crisis and opioid overdose epidemic. I will also be using data collected by the Uniform Crime Report regarding all crimes, violent crimes, and property crimes committed within these specific counties between 2006 and 2020.

The six states selected for this study were Alabama, Arkansas, Kentucky, Louisiana, Mississippi, and Tennessee. These states were selected, non-randomly, because they had the highest rates of opioid dispensation rates across the country as of 2020, and according to recently published data from the CDC, they still do as of 2022 (*Opioid dispensing rate maps,* 2023). High opioid dispensing rates can be found all over the country, as can crime, but according to both the CDC's dispensing rate maps and data from the Federal Bureau of Investigation's Crime Data Explorer, southern states are disproportionately represented as having the highest rates of opioid dispensing and crime (*Opioid dispensing rate maps,* 2023, *Federal Bureau of Investigation*

Crime Data Explorer). The counties selected from each state were randomly selected to ensure more differentiation in demographics, including population size, rural versus urban settings, differences in opioid dispensing rates and crime, etc.

For each county, the opioid dispensing rate and crime rate are presented by each county, by each year, in the analysis method.

Analytic Plan

Analyses are conducted in several stages, including bivariate analysis. The first step in this analytic plan is to understand the sample and data better through a descriptive table of the data, identifying different variable averages, midpoints, and standard deviations of the data. The next step in the analytic plan is to create a figure displaying the average dispensing rates for all 36 counties observed from 2006 to 2020. This should show the trends in dispensing rates in a more palatable image that properly demonstrates changes in overall dispensing rates for all counties. Then, I will conduct bivariate analyses with Pearson Correlation. This method is employed in statistics to gauge the extent of association between two variables. It ranges from –1 to 1, with values of 1, 0, and –1 representing a strong positive correlation, no correlation, and a strong negative correlation, respectively. Pearson Correlation does not suggest a causal connection between two variables since there might be another variable that acts as the root cause of the variation (Nettleton, 2014).

This technique is trying to show the strength of the relationship between two variables, in this case, between opioid prescription dispensing rates and crime rates. The main results will suggest how the dispensing rate varies with rates of crime. A correlations analysis between all variables, including dispensing rate, all crime, violent crime, and property crime, will provide an

idea of the relationship between each variable and how strong that relationship may be. Finally, I will estimate Poisson fixed-effects regression. Poisson models are used in this study because I am measuring rates of dispensing and crime.

Bivariate Analysis

This study chose to use a bivariate analysis in the form of a correlation analysis using Pearson Correlation. A correlation analysis will be used to better understand the relationship between two variables, in this case, between opioid dispensing rates and crime rates. This analysis will help determine the strength and direction (positive or negative) of the relationship between variables. Pearson Correlation can reveal whether the variables are positively correlated (increase and decrease together), negatively correlated (one increases while the other decreases), or uncorrelated. We can also assess whether the correlations between the variables are significant, which shows whether the probability of the association could have occurred by chance.

By conducting this bivariate analysis regarding the correlation between dispensing rates and crime rates, I can compare the relationships between these variables and identify potential differences or patterns among this data.

Poisson Fixed-Effects Regression

This fixed-effects regression is used for multiple reasons in this analysis. First, multiple years of a single variable, i.e. dispensing rates or crime rates from 2006-2020, violates assumptions of multiple regression. One of these assumptions is that the observations are independent of each other. If you have multiple years of the same variable, the observations of one year may be correlated with the observations of another year. Second, there are differences

between counties that are unobservable that fixed-effects regression reduces, including social norms, local policies, impacts of policies, etc. Third, fixed-effects regressions estimate how changes in dispensing rate are related to changes in crime rate within the same county. The coefficient shows the average relationship across all the counties. This regression will begin by analyzing the dispensing rates against the total crime rates, violent crime rates, and property crime rates in three separate regression models.

Measures

Dispensing Rate Variables

The data for county dispensing rates was gathered by the Centers for Disease Control and Prevention from 2006 to 2020. The CDC mapped the geographic distribution, on both the state and county level, of retail pharmacy dispensed opioid, buprenorphine, and naloxone prescriptions by each year (CDC, 2023). Each dispensing rate used in this study is representative of prescription dispensing rates in that county per 100 United States residents.

These maps and the data they provide show that the dispensing rates for opioids vary widely across states and counties. However, opioid dispensing rates were highest in southern states, hence the choice to study the six states with the highest rates of dispensation. There was a peak in opioid dispensing rates in 2012, with 81 prescriptions per 100 people, resulting in approximately 255 million opioid prescriptions. Since then, the average dispensing rates in the U.S. have slowly decreased throughout the years. As of 2020, the overall dispensing rate in the U.S. is 43 per 100 residents, but some counties still have rates nine times higher than that. In the same year, enough opioid prescriptions were dispensed in 3.6% of U.S. counties for every person in those counties to have one.

Dispensing rate data will help to see any trends in opioid prescription levels that can then be compared to the crime rates of those same counties.

Crime Rate Variables

The data for county crime rates was gathered by the Uniform Crime Report, detailing the number of crimes committed within these counties between the years defined by the parameters of this study, 2006 to 2020. The data used for this study was taken from the UCR's actual arrests data, rather than the founded or unfounded, or baseless, data. The crime rates for all 36 counties included in the study were summed to provide averages for all years studied.

The UCR Program takes reliable statistics from law enforcement agencies all over the country, including data from more than 18,000 law enforcement agencies. The UCR accounts for violent crime, property crime, and clearances of these offenses. The expanded offense data within the UCR yearly reports includes trends in both crime volume and crime rate per 100,000 inhabitants.

The category of violent crime reported to the UCR includes murder and nonnegligent manslaughter, rape, robbery, and aggravated assault. Property crime, according to the UCR, includes burglary, larceny-theft, motor vehicle theft, and arson. This study will analyze the overall crime rates, all violent crimes, and all property crimes in each county per year.

Chapter 3

Results

Description of the Sample

The sample used to conduct this thesis involves data from two United States government agencies, the Centers for Disease Control and Prevention and the Uniform Crime Report produced by the Federal Bureau of Investigation. There were 36 counties from six states from which data was collected over 15 years, from 2006 to 2020. These counties included six counties from each of the six states, as listed below.

1. Alabama: Colbert County, Jefferson County, Mobile County, Montgomery County, Baldwin County, Shelby County.
2. Arkansas: Craighead County, Pulaski County, Benton County, Washington County, Faulkner County, Sebastian County.
3. Kentucky: Perry County, Knott County, Fayette County, Warren County, Daviess County, Boone County.
4. Louisiana: Caddo Parish, Orleans Parish, Vermillion Parish, East Baton Rouge Parish, St. Tammany Parish, Lafayette Parish.
5. Mississippi: Forrest County, Hinds County, Harrison County, Rankin County, Jackson County, Leflore County.
6. Tennessee: Madison County, Knox County, Hamilton County, Rutherford County, Williamson County.

The first variable measured was the prescription dispensing rate, which varied between counties and years. This dispensing rate was measured by the CDC for each of the 36 counties

included in this study between 2006 and 2020. This dispensing rate is representative of prescriptions per 100 people in the U.S. Each county cross-referenced with each year culminated in 540 observations for this variable. The data of dispensing rates by county by year ranged from 23 in Vermillion Parish, Louisiana in 2020, to 320 in Perry County, Kentucky in 2011. The average of all dispensing rates, all counties studied by all years studied, was 120, and the standard deviation being 47 indicates a fair amount of variability in the data collected. This is expected because of the 15-year period over which this data was collected, as new policies and awareness were generated regarding opioid dispensing practices.

The second variable measured was crime rates within these counties, which also varied between counties and years. The crime rates variable was split into three parts: all crime rates, violent crime rates, and property crime rates, and each part is representative of crime rates per 100,000 U.S. residents. Each part was examined according to the corresponding county and year. The average of all crime rates in this sample was 5,024, and the standard deviation was 2,394. This standard deviation also indicates that the crime rates in this sample vary significantly from the average, with some areas potentially having much higher or lower crime rates. This is also expected because of the changes in year and county. For example, Orleans Parish, Louisiana is home to New Orleans, a bustling city that attracts many tourists. It's been seen that areas with dense populations have more opportunities for criminal activities, specifically property crimes, due to the large number of people and properties in close proximity. This county currently has an estimated population of 364,136, so given the size of the county and its location, we might be able to expect higher crime rates. However, Vermillion Parish, Louisiana only has an estimated population of 56,992. There is high variability between counties within the same state, let alone counties across the southern United States.

The violent crime rate and property crime rate in this description is also representative of all violent crime rates and all property crime rates, respectively, of the counties studied for all years studied. The average violent crime rate was 449, with a standard deviation of 307. Once again, reported violent crime rates can vary considerably from the average of 449, with some areas potentially experiencing much higher or lower rates of violent crime. The average property crime rate was 3,234, with a standard deviation of 1,511. This means that the reported property crime rates can vary considerably from the average of 3,234, with some areas potentially experiencing much higher or lower rates of property crime. Understanding the factors contributing to this variability within violent crime rates and property crime rates would require further analysis, including examining demographic, socioeconomic, and law enforcement-related variables.

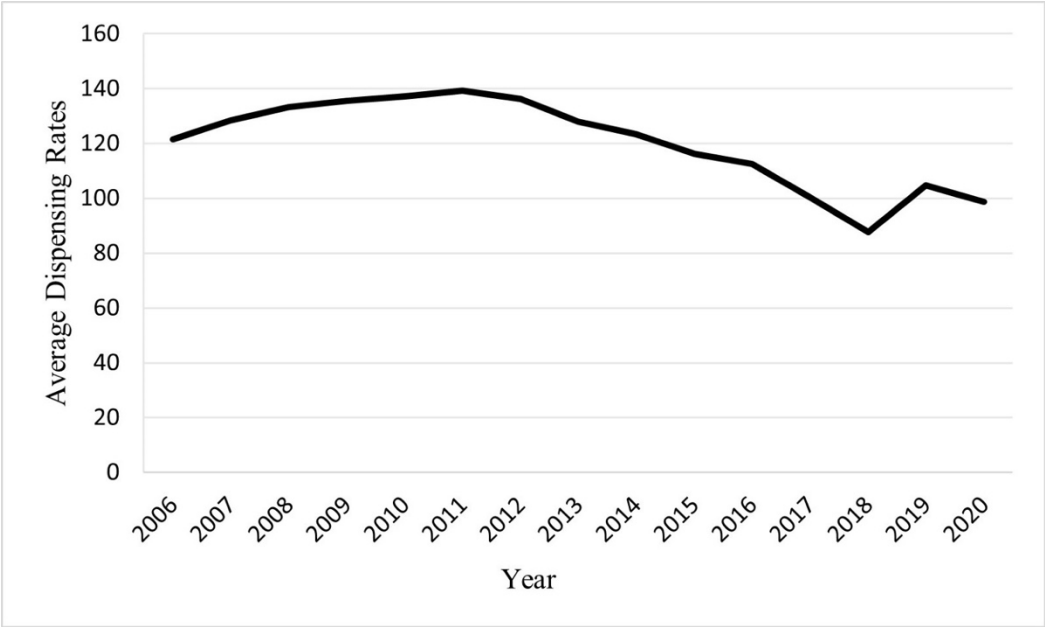
Table 1. Description of Sample

Variables	Mean	Std. dev.	Median
Dispensing Rate	120.19	47.2	111.3
Total Crime Rate	5024.42	2394.46	5165.98
Violent Crime Rate	449.56	307.81	380.59
Property Crime Rate	3234.67	1511.58	3430.19

Pattern of Opioid Dispensing Rates

According to the Centers for Disease Control and Prevention, prescription opioids currently contribute to opioid-related deaths, despite not being the main proponent of overdoses in the United States. Over the years, the overall dispensing rate has declined, with 2020 having the lowest dispensing rate since 2006. Research found that although the number of opioids prescribed decreased between 2010 and 2015, opioid dispensing rates remain three times higher than in 1999.

Figure 1. Summed Averages of Dispensing Rates per Year



Bivariate Correlations Between All Variables

The primary goal of correlations analysis is to identify and quantify relationships between two variables. In this study, I used Pearson Correlation, which measures the strength of the linear relationship between two variables. This analysis also determines the strength and direction of the relationships between the variables. Pearson Correlation provides a numerical value (r) that indicates the strength of the relationship between the two variables. A value close to 1 or -1 suggests a strong positive and negative linear relationship, respectively, while a value close to 0 indicates little to no linear relationship. The sign of the correlation coefficient (positive or negative) indicates the direction of the relationship. A positive correlation means that as one variable increases, the other variable tends to increase as well, while a negative correlation means that as one variable increases, the other variable tends to decrease. Pearson Correlation assumes a linear relationship between variables. By using this analysis, I am testing the hypotheses that changes in one variable (i.e. dispensing rate) are proportional to changes in the other variable (i.e. crime rate) (Nettleton, 2014).

The first bivariate correlation tested was between dispensing rate and all crime rate. These variables are represented through the summed averages of each county and year, with the dispensing rate variable representing that rate measured per 100 people, and with all crime rate variable representing that rate measured per 100,000 people. It was found that the bivariate correlation between dispensing rate and total crime rate is 0.14, which suggests a weak but significant positive relationship between these two variables (see Table 2). This indicates that as the dispensing rate increases, total crime rates tend to increase too. However, this relationship is weak, which can potentially be explained by the other correlations this study conducted detailing more specific types of crime.

The second bivariate correlation tested was between dispensing rate and violent crime rate. The same summed and averaged dispensing rate for all counties and all years found in this sample was that was used to conduct the correlation analysis between dispensing rate and all crime rate. The violent crime rate variable is measured per 100,000 people. It was found that the bivariate correlation between dispensing rate and violent crime rate is -0.01, indicating an insignificant and negative relationship between these two variables (see Table 2). This shows that there is almost no relationship at all between these variables. The analysis of violent crime rate in addition to all crime rate allows for a more targeted examination of the potential association between dispensing rate and crime rate and narrowing the scope of the correlation. As we can see, violent crime is not contributing at all to the association between dispensing rate and all crime rate. The bivariate correlation result of -0.01 reduces the bivariate correlation between dispensing rate and all crime rate, 0.14, down a little bit, but this first analysis remains positive and significant. The negative association with the violent crime rate analysis indicates a slight inverse association with dispensing rate, but the correlation is so close to zero that it is

deemed statistically insignificant. This insignificance implies that changes in the dispensing rate do not appear to have a meaningful impact on the occurrence of violent crimes based on the data analyzed in this study. While a lack of correlation in this study suggests no apparent relationship between dispensing rate and violent crime rate, it does not rule out the possibility of other factors influencing violent crime independently or in combination with the dispensing rate of opioids. This lack of relationship between dispensing rate and violent crime rate should prompt further inquiries into other factors that contribute to violent crime rates, such as socio-economic conditions, law enforcement strategies, community dynamics, or cultural influences.

The third bivariate correlation tested was between dispensing rate and property crime rate. The same summed and averaged dispensing rate for all counties and all years found in this sample was used to conduct this correlation analysis that was used to conduct the correlation analysis between dispensing rate and all crime rate. The property crime rate variable is measured per 100,000 people. It was found that the bivariate correlation between dispensing rate and property crime rate is 0.16, indicating a significant and positive relationship between these two variables (see Table 2). This suggests that as the dispensing rate increases, the property crime rate also increases. The analysis of property crime rate in addition to all crime rate and violent crime rate allows for a more targeted examination of the potential association between dispensing rate and crime rate and narrowing the scope of the correlation. As we can see, property crime is contributing to the association between dispensing rate and all crime rate. The bivariate correlation result of 0.16 increases the bivariate correlation between dispensing rate and all crime rate, 0.14, from the effect of the negative and insignificant correlation between dispensing rate and violent crime rate, helping the correlation between dispensing rate and all crime rate remain positive and significant. Analyzing the correlation between dispensing rate and

property crime rate sheds light on whether there is a notable association between the availability of certain substances, represented by the dispensing rate, and property-related criminal activities, such as burglary, theft, vandalism, and arson. The bivariate correlation coefficient of 0.16 indicates a statistically significant and positive relationship between dispensing rate and property crime rate, suggesting that as the dispensing rate increases, there is a corresponding increase in property crime rates. This relationship might have important implications for policymaking, law enforcement strategies, and public health interventions, and raises questions about the potential pathways or contributing factors linking dispensing practices to property crime rates. However, other variables and confounding factors may influence the property crime rates independently.

Table 2. Correlation Matrix

Variable	Dispensing	All Crime	Violent Crime	Property Crime
Dispensing	1.00			
All Crime	0.14	1.00		
Violent Crime***	-0.01	0.82	1.00	
Property Crime	0.16	0.96	0.75	1.00

**p<.05 **p<.01 ***p<.001*

Fixed-Effects Regression Models

This study employs Poisson fixed-effects regression models to analyze the data collected for this thesis. This model is often used when the dependent variable (i.e. arrest rates) represents the number of occurrences or events within the specified time of the study (i.e. 2006-2020). This technique is often used in the statistical analyses of many policy analyses as well. This model assumes that the counts follow a Poisson distribution, or a discrete distribution that measures the probability of a given number of events happening within a specified time period, in this case, the number of crimes, or arrest rates, reported each year (Kissell & Poserina, 2017).

Many policy-relevant variables in policy studies are count data, such as the number of crimes, making Poisson fixed-effects regression analysis the ideal model for analyzing this data.

Policy analyses often involve assessing the impact of interventions, policies, or external factors on outcomes over time. Although this study is not specifically studying policy intervention for opioid prescription dispensing rates, this regression model is well-suited for the analysis of this study's data because it accounts for the time-specific effects on the data, resulting in better estimates of the relationships of interest to this study (Kissell & Poserina, 2017). The Poisson model helps to analyze observations longitudinally across different entities, and in this thesis, it is used to analyze observations across years. By controlling for time variants, Poisson fixed-effects regression can improve the estimation of correlation between two variables, which is helpful when calculating the relationship between dispensing rate and crime rate in this thesis.

I conducted three separate regression models to analyze each crime variable (all crime rates, violent crime rates, and property crime rates) (see Table 3). The first model represents the change in dispensing rate with all crime rate, predicting changes in all crime rate (see Table 3, Panel A). A change in the dispensing rate per 100 persons is related to a change in the crime rate per 100,000 persons, so a one-unit change in the dispensing rate per 100 persons is associated with an increase in the log of expected counts in the total crime rate that is per 100,000 persons by 0.003. This relationship is very significant at the 0.000 level. In other words, as the dispensing rate increases, there's also an increase in total crime rate. This association is unlikely to have occurred by random chance alone, as the significance suggests a robust relationship between the variables.

The second model represents the change in dispensing rate (per 100 persons) with violent crime rate (per 100,000 persons), predicting changes in violent crime rate (see Table 3, Panel B). A change in the dispensing rate per 100 persons is related to a change in crime rate per 100,000 persons, so a one unit change in the dispensing rate per 100 persons is associated with an

increase in the log of expected counts in the violent crime rate that is per 100,000 persons by 0.001. This relationship is insignificant at the 0.501 level. In other words, as the dispensing rate increases, there is not an increase in the violent crime rate. There is no relationship observed from the data used within this study. This model reveals that as the dispensing rate increases, there is not a corresponding increase in the violent crime rate. This is important to the interpretations of the effects of opioid dispensing practices on different types of crime. While the first model that observed total crime rates indicated a positive relationship with dispensing rates, this model shows that this relationship does not extend to violent crimes specifically. The lack of significance in the relationship between dispensing rates and violent crime rates underscores the complexity of crime dynamics and the multitude of factors that influence violent crime rates. This emphasizes the need for comprehensive analyses that consider various contextual, socio-economic, and environmental factors when studying crime.

The third model represents the change in dispensing rate (per 100 persons) with property crime rate (per 100,000 persons), predicting changes in property crime rate (see Table 3, Panel C). A change in the dispensing rate per 100 persons is related to a change in the crime rate per 100,000 persons, so a one-unit change in the dispensing rate per 100 persons is associated with an increase in the log of expected counts in the violent crime rate that is per 100,000 persons by 0.004. This relationship is significant at the 0.000 level. In other words, as the dispensing rate increases, there's also an increase in property crime rate. The relationship indicates a very high level of statistical significance, implying that the observed association between dispensing rate and property crime rate is unlikely to have occurred by random chance alone. This significance level suggests a robust relationship between the variables.

Table 3. Regression Dispensing Rate Predicting Crime Rate (n=540 years; 36 counties)

Variable	b	Robust SE	p-value
Panel A			
Total Crimes***	0.003	0.001	0.000
Panel B			
Violent Crimes	0.001	0.001	0.500
Panel C			
Property Crimes***	0.004	0.001	0.000

**p<.05 **p<.01 ***p<.001*

Chapter 4

Discussion

Research Problem and Major Findings

The widespread knowledge and effects of the opioid crisis have not gone unnoticed by anyone in the United States, including the government, healthcare system, and citizens. The number of people who have died from an opioid overdose in the U.S. within the last quarter century is extensive and has shattered many perceptions of how potent medications like opioids should be used. Not only have the effects of this crisis left a hole in the population, but they may have detrimentally affected other aspects of life in this country, including crime. This thesis sought to understand the factors and relationships between opioid prescription dispensing rates and crime rates in the U.S. The results of this analysis may broaden the understanding of how the opioid crisis has affected crime rates in the U.S. and can also inform policy on prescription opioid dispensing.

When analyzing the bivariate correlations between all variables used in this study, I expected that the relationship between dispensing rates and crime rates would be positively related, as criminological theory often finds that crime and drug use are often tied together. I chose to analyze the total crime rate, violent crime rate, and property crime rate to see if there was any correlation between these and dispensing rates. The specificity of violent crime rates and property crime rates in addition to the broad category of total crime rates was intentional and was used to see if there was a pattern in type of crime that might be more closely associated with dispensing rate. The narrowed scope of these variables added information to the relationship between dispensing rates and total crime rates by allowing for a clearer understanding of the

direct impact of dispensing rates on total crime rates. This increased precision in identifying specific types of crime simplifies the analysis and interpretation of the results and allows me to better assess the correlation of these variables (Goldstein, 1985).

I nonrandomly selected six U.S. states to study because of their overall average dispensing rate. The six states selected — Alabama, Arkansas, Kentucky, Louisiana, Mississippi, and Tennessee — were chosen due to their abnormally high dispensing rates in comparison with the rest of the United States (CDC, 2023). These states had the highest dispensing rates out of all states in the U.S. I chose to analyze counties instead of U.S. states because counties within a certain state can exhibit significant variations in prescription opioid dispensing rates and crime rates. Studying county-level data allowed me to capture some of this variation to get a more accurate assessment of the relationships between these variables. This variation can be due to the county-to-county differentiation in geographic, demographic, economic, and social factors, all of which can influence the rates of these variables. This choice might also be helpful in terms of policy implementation, as studying county rates provides actionable insights for designing targeted interventions, policies, and programs aimed at addressing issues related to opioid misuse and crime at the local level within law enforcement agencies, healthcare providers, and community organizations. Counties also vary in population density, urbanization, and rural-urban composition. These factors can impact access to healthcare services, availability of prescription opioids, prevalence of substance use disorders, and types of crimes occurring. Analyzing the county rates allows consideration of these population-related factors in understanding the relationships between variables. Based on these rationalizations, 36 counties (six from each selected state) were randomly selected for this study. When conducting the bivariate correlations

analysis between all variables, the purpose was to identify the relationships between two variables. Three correlations analyses were made, and their findings were as follows:

1. Dispensing rate and total crime rate: Correlation is 0.14, suggesting a weak but significant positive relationship; indicates that as dispensing rate increases, total crime rates tend to increase too.
2. Dispensing rate and violent crime rate: Correlation is -0.01, suggesting an insignificant and negative relationship; indicates that dispensing rates do not have a meaningful impact on violent crime rates.
3. Dispensing rate and property crime rate: Correlation is 0.16, suggesting a significant positive relationship; indicates that as dispensing rate increases, property crime rates tend to increase too.

The relationships presented in the bivariate correlations analyses seem to also play out in the regression model for this study. This thesis estimated Poisson fixed-effects regression model, which is a strict regression model. Poisson regression uses count data to represent the frequency of occurrences of an event within a fixed time or space interval. The strictness of this model comes from its focus on and ability to accurately account for the unique characteristics of count data and controls for heterogeneity and time-invariant factors (Kissell & Poserina, 2017).

The directions and strengths of each correlation is also important when viewing and understanding this data. This study found a significant and positive relationship between dispensing rate and total crime rate, and dispensing rate and property crime rate, and found an insignificant relationship with no association between dispensing rate and violent crime rate. This information is crucial for understanding the impact of dispensing practices on crime dynamics and types of criminal activities and highlights the importance of differentiating between types of

crime. Violent crimes may have different underlying determinants or risk factors compared to property crimes, leading to varying associations with dispensing rates. This information can affect targeted interventions and local policy strategies that aim to address criminal activity.

Findings and Previous Research

Just as dispensing rates of prescription opioids have changed over the years, so have crime rates. It is not a question of whether the opioid crisis contributed to the rates of crime, as scholars already acknowledge this association, but rather whether the dispensing rates of prescription opioids contributed to the rates of crime. Drug use of all types has been associated with health, education, and family issues, in addition to crime. Paul J. Goldstein's drugs/violence nexus, which explains a three-part conceptual framework for analyzing and explaining the relationship between drug use and crime, specifically violence, aids this study through the explanations in which drugs and violence can be related: the psychopharmacological, the economically compulsive, and the systemic models. These models can help explain the associations this thesis found between prescription opioid dispensing rates and crime in multiple ways.

The Poisson fixed-effects regression analysis and the correlations analysis conducted for this study shows that an increase in opioid dispensing rates is associated with an increase in total crime rates and property crime rates, but not with violent crime rates. This finding can be explained using Goldstein's framework, specifically the economic compulsive model. According to Goldstein, the economic compulsive model suggests that some drug users engage in economically oriented violent crime, such as robbery, to support their costly drug use. However, Goldstein's research also indicates that most heroin users avoid violent acquisitive crime if viable non-violent alternatives exist. They prefer to engage in non-violent crimes like theft or other

property crimes to finance their drug habits, as these crimes are perceived as less dangerous and carry a lower risk of severe punishment.

In the context of the regression analysis, the positive relationship between opioid dispensing rates and property crime rates can be attributed to the economic compulsive model. As opioid dispensing rates increase, it is likely that opioid dependence rates also increase, which may lead them to commit property crimes, like theft, to obtain money or other valuable objects to support their drug use. These crimes are non-violent and high frequency in nature and align with Goldstein's findings that drug users often prefer non-violent alternatives when possible.

However, the lack of a significant relationship between opioid dispensing rates and violent crime rates can also be explained by Goldstein's framework. Violent crimes, such as robbery or assault, are typically associated with the psychopharmacological model, where the pharmacological effects of certain substances may induce violent behavior, or the systemic model, where violence is intrinsic to the drug distribution system and related conflicts. Opioids, specifically heroin, are not known to have strong psychopharmacological effects that directly lead to violent behavior (Goldstein, 1985). Additionally, the dispensing of opioids through legitimate medical channels may not necessarily involve the systemic violence associated with the illicit drug markets and distribution networks. Therefore, Goldstein's conceptual framework helps explain why the results of this study found a relationship between opioid dispensing rates and property crime rates, employing the economic compulsive model, but not with violent crime rates, which are more closely linked to the psychopharmacological and systemic models of drug-related violence.

It is important to note that these findings do not negate the potential for opioid misuse and addiction to contribute to violent crimes indirectly through other factors, such as economic

hardship, mental health issues, or involvement in illicit drug markets. However, the data and findings of this study, along with Goldstein's framework, suggest that the direct relationship between opioid dispensing rates and property crime rates is more prominent than that with violent crime rates.

Limitations

While the findings of this study might broaden the understanding of the effects that prescription opioid dispensing rates might have on crime rates, there remain several limitations of this study. One of which is the lack of controls present in this study. If produced again, this study should control for time-varying factors impacting the relationship between dispensing rates and crime rates. This includes the shift between waves of the opioid crisis when heroin and synthetic opioids like fentanyl became more popular opiates of choice than prescription opioids. The increase in prevalence of fentanyl found in opioid overdoses and overdose deaths might also suggest an overall increase of use across the populations of those struggling with opioid use disorder, as nearly 75% of overdose deaths in 2021 involving heroin also involved synthetic opioids, primarily fentanyl (National Institute on Drug Abuse, 2023). We can assume from this study that an increase in use might also cause an increase in crime, which might have affected the results found in this thesis (Pierce et al., 2017). However, because the opioid crisis originated with the mass dispensation of prescription opioids, it's arguable that any crimes committed that involve the use of heroin or synthetic opioids like fentanyl can be associated with the long-lasting impact of the opioid crisis, as the use of heroin and synthetics like fentanyl can be tied to the waves of the opioid crisis (CDC, 2023). Controlling for variables like these, though, would provide better insight into how specifically prescription opioid dispensing rates have affected crime rates over the years.

Future iterations of this research might also consider the state and local policies for prescription opioid dispensing. The states used in this study might have more relaxed policies in terms of opioid dispensing, resulting in higher averages of these rates as compared to other states. This study examined the states with the highest rates of opioid dispensation in the United States, so it might be worthwhile to look at other states and how their dispensing policies have affected their rates, along with their rates of crime, to get a more holistic idea of how opioid dispensing affects crime. Future research can also benefit from a comparative analysis that includes states with diverse opioid dispensing policies and rates. By examining states with strict dispensing policies alongside those with more lenient policies, researchers can assess the direct impact of policy interventions on opioid dispensing rates and crime rates. Insights gained from studying the interplay between opioid dispensing policies and crime rates can inform evidence-based policymaking as well. Future findings may guide policymakers in developing targeted interventions, implementing harm reduction strategies, and addressing substance abuse issues while also considering public safety concerns. This can also enhance prescription drug monitoring programs (PDMPs), which aim to reduce the amount of prescription opioids dispensed. This is a supply-side policy that intends to control what prescribers can and cannot dispense, which has been seen to produce a reduction in the per capita drug units dispensed. Despite the reduction in dispensing, these programs have not produced any changes in rates of drug-related crimes (Deiana & Giua, 2021). This research could potentially provide insight into ways to better these programs and make them more effective in limiting dispensing while also finding ways to limit drug-related crimes.

This study also uses all known arrest rates from the Uniform Crime Report to make its assumptions. Therefore, controlling for policing practices and laws across counties and states

would make this study more effective, as it doesn't reflect the usage rates of opioids, it reflects the actions of the criminal justice system. Arrest rates reflect law enforcement responses to criminal activities, including drug-related offenses. These rates may not directly reflect the actual prevalence or usage rates of opioids within communities. It's between arrest rates and substance usage rates when interpreting study findings related to opioids and crime. Controlling for these policing practices helps ensure that observed relationships between opioid-related variables and crime rates are not solely attributed to law enforcement actions. Failing to account for differentiating policing practices, legal frameworks, and opioid dispensing policies when analyzing arrest rates in relation to opioids and crime can lead to misinterpretation of study findings. For instance, a higher arrest rate for property crime in a particular county may not necessarily indicate higher opioid usage rates but could be influenced by aggressive law enforcement strategies or stricter drug enforcement policies.

Further Research

Future research directions when understanding the relationships between the opioid crisis and crime should include the relationship between heroin usage and property crime. Studies consistently show a strong correlation between heroin use and property crime. Individuals with heroin addiction often engage in criminal activities to support their drug habits, acquiring money or valuables to purchase heroin, which can lead to increased property crime rates in communities where heroin use and abuse is prevalent (Marel et al., 2013). The cyclical relationship between heroin abuse and property crime shows that substance abuse can lead to financial instability, unemployment, homelessness, and other socio-economic challenges, which in turn can increase the likelihood of engaging in property crime as a means of obtaining drugs or addressing basic needs for survival (Marel et al., 2013). The cycle of addiction and crime reinforces each other,

creating complex challenges for individuals and communities. It's also been found that programs targeting enhancements in job prospects and mental wellness, specifically, could decrease the likelihood of individuals with heroin addiction and substance use disorder engaging in criminal activities (Marel et al., 2013).

It might also be worthwhile to investigate healthcare system factors regarding the opioid crisis, including prescribing practices healthcare institutions uphold as their standard practice, and opioid prescribing behaviors among providers and prescribers. It has recently been found that many opioid prescribers were reluctant to prescribe opioids for patients with chronic cancer pain, which is one of the types of care that opioid prescribing is allowed for by the CDC, and many physicians also reported challenges when it came to dispensing opioids at pharmacies, both of which may be unintended consequences of opioid prescription policies resulting from the opioid crisis (Arthur et al., 2024). There might also be differentiation in interpretation of prescribing limits and policy on opioid dispensation between hospital administrators and physicians. While administrators were focused on policy compliance, physicians or prescribers were focused on the needs of their patients (Blackburn et al., 2021). It would be beneficial to understand how these differing mindsets are affecting opioid prescribing and what hospitals are doing to reconcile these concerns.

Chapter 5

Conclusion

The goal of this thesis was to understand the relationship between the opioid crisis and crime. This relationship was found through the investigation of opioid prescription dispensing rates and total crime rates, violent crime rates, and property crime rates. In this study, dispensing rates were found to be associated with an increase in total crime rates and property crime rates but had no relationship with violent crime rates. Although these findings are corroborated with correlations analyses and regression analyses, there are still several other factors that could cause an increase in crime rates within the counties studied.

The opioid crisis had three main waves: prescription opioids, heroin, and synthetic opioids. As of 2023, the United States finds that most opioid overdoses and overdose deaths involve synthetic opioids, specifically fentanyl (CDC, 2023). There are very few overdose deaths that result from solely prescription opioids anymore, though many overdose deaths involve multiple forms of opioids including prescription opioids (CDC, 2023). However, the opioid crisis resulted from a mass increase in opioid prescribing from physicians and doctors, some of which were misinformed by pharmaceutical companies like Purdue Pharma which manufactured OxyContin — the drug at the steering wheel of this epidemic (Gale, 2016). It's important to acknowledge that although this crisis has evolved, there was a root cause that triggered the many waves, casualties, and new information to come: prescription opioids (CDC, 2023). With this in mind, it is worthwhile to examine how dispensing rates of prescription opioids influenced crime rates in the U.S. throughout all phases of the opioid crisis.

Not only is there not much research on the opioid crisis's effects on crime, but the existing research tends to show that current U.S. policies regarding limiting opioid prescriptions might drive the illicit drug market, fueling the use of other opiates like heroin and fentanyl and resulting in the second and third waves of the opioid crisis (Beletsky & Davis, 2017). This warrants further research to provide better aid, information, healthcare, and protection for those addicted to opioids and those struggling with substance use disorders. Assisting those who remain addicted to opioids — whom our government and healthcare systems have been failing through their lack of policy and excessive opioid prescribing rates — should necessitate research in this area to further inform regulations and policy.

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