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Impact of Community Factors on Naloxone Overdose Reduction in Ohio

Theophilus Oduro Frimpong
Walden University

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Walden University

College of Health Sciences and Public Policy

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Theophilus Oduro Frimpong

has been found to be complete and satisfactory in all respects,
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Walden University
2025

Abstract

Impact of Community Factors on Naloxone Overdose Reduction in Ohio

by

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MPH, Benedictine University, 2020

BSN, University of Colorado, Colorado Springs, 2016

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

The opioid crisis in Ohio, driven by fentanyl, persists due to inequitable access to naloxone despite its proven effectiveness. This study examined how socioeconomic status (SES), race/ethnicity, population density, and hospital availability per capita predicted naloxone overdose reversals (dependent variable) in Ohio. Social-ecological theory guided this quantitative historical correlational analysis of Ohio's Project DAWN index data ($N = 5,280$). Inclusion criteria included individuals ages 18 to 65 with naloxone-related overdose reversals (dependent), naloxone distribution (moderator), and community factors (independent). Multiple linear regression results showed that SES ($p > .50$), race/ethnicity (% White, $p = .588$; % Black, $p = .495$; % American Indian, $p = .682$; % Asian, $p = .091$; % Native Hawaiian, $p = .119$), and healthcare access ($p > .306$) were not statistically significant predictors of naloxone overdose reversals. However, population density ($p < .015$) was significantly associated with naloxone overdose reversals. Naloxone distribution significantly moderates the relationships among household income, population density, and hospital availability per capita, explaining a substantial portion of variance in outcomes. These findings indicate that structural characteristics - particularly population density - play a critical role in predicting naloxone overdose reversals, underscoring the need to tailor distribution strategies to community context. The moderating effect of naloxone access highlights that equitable availability can strengthen overdose response outcomes. Overall, the study highlights the need for community-based naloxone initiatives that advance health equity and positive social change.

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Dedication

My most excellent thanks go to Lord Almighty, who made all this possible.

Next, I will thank my family for their staunch support and encouragement throughout the dissertation journey. To my wife, Comfort Serwaa Frimpong, I applaud you for always standing by me. To my children, Theo Afoakwa Frimpong Jnr and Martha Serwaa Frimpong, I say thanks for your patience, understanding, and boundless support as I pursued this academic endeavor. I wish my mom, Martha Afoah, were here to share this great occasion and achievement with me. May your soul rest in peace.

Lastly, I also dedicate this work to those affected by the opioid epidemic, including individuals, families, and communities striving for solutions and leverage. I pray this research brings about the positive and meaningful change you yearn for.

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I extend my deepest gratitude to my program chair, Dr. Edward O. Irobi; Dr. Leah Miller; Dr. Tammy Root; and a dear friend and classmate from Kumasi Academy (Kumaca), Dr. Daniel Oduro Okyere, Boston, Massachusetts, who guided and inspired me along the way. Your encouragement and wisdom have been invaluable, and I am honored to share this achievement with you.

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Section 1: Foundation of the Study and Literature Review

The opioid epidemic, which began with the overprescription of opioid painkillers and evolved into a complex public health problem, remains a considerable problem in the United States. As of 2023, there were 105,007 overdose deaths in the United States, the vast majority of which were from synthetic opioids such as fentanyl (Spencer et al., 2024). Though the share of these deaths attributed to synthetic opioids reduced by 4% from 2022 to 2023, the opioid epidemic is far from a solved problem (Humphreys et al., 2022). One important tool to combat the opioid epidemic is naloxone. Naloxone is an overdose reversal medication and, specifically, an opioid receptor antagonist. As such, naloxone is especially effective for reversing opioid overdose (Ghosh et al., 2024). However, practical access to naloxone remains uneven across different communities (Pérez-Figueroa et al., 2023).

Section 1 introduces the study. Section 1 begins with the background of the key topics. Second, the section addresses the research problem, followed by the purpose of the study. Third, the research questions for the study are established, along with the theoretical framework. Fourth, the nature of the study is overviewed. Fifth, there are the various aspects of the literature review. Sixth, key definitions are presented, along with the delimitations, limitations, and assumptions. Finally, the section concludes with the significance and a summary.

Background

The opioid epidemic in the United States began in the late 1990s, with a high level of chronic pain in the U.S. population (Maclean et al., 2022). In response,

pharmaceutical companies developed more potent painkillers, such as the synthetic opioid fentanyl (Lim et al., 2022). These synthetic opioids were considerably cheaper to manufacture than traditional opioids such as heroin or morphine, creating high profit margins (Humphreys et al., 2022). As a result, pharmaceutical companies pushed the prescription of synthetic opioids, offering various benefits to doctors who were willing to prescribe synthetic opioids more freely than they should have (Maclean et al., 2022). This pattern resulted in the widespread use of synthetic opioids, often leading to addiction (Humphreys et al., 2022). Because of their potency, synthetic opioids could also easily cause overdoses and lead to deaths. Around 2015, synthetic opioid-related overdose deaths became the leading cause of overdose deaths in the United States and quickly overtook all other causes (Spencer et al., 2024). The rate of overdoses from synthetic opioids continued to climb from 2015 to 2022, only decreasing slightly from 2022 to 2023 despite significant efforts to reduce the prescription and use of synthetic opioids (Spencer et al., 2024). One reason for the continuing increase was the entry of Mexican drug cartels into the synthetic opioid market, filling the space left by the efforts to crack down on prescriptions (Lim et al., 2022).

Amid this landscape of overdose deaths, overdose reversal is valuable as a form of lifesaving care. Overdose reversal involves the use of a receptor antagonist to block the effects of a drug and prevent/reverse the effects of overdosing on that drug (Britch & Walsh, 2022). In the case of opioids, the most widely used overdose reversal treatment is naloxone (also known by the brand name Narcan), an opioid receptor antagonist with high efficacy in reversing overdoses resulting from traditional and synthetic opioids (Ghosh et

al., 2024). Given its ability to reverse opioid overdoses and save lives, naloxone has been widely considered a potential public health intervention to help prevent opioid deaths (Taylor et al., 2022).

However, even when made available freely, such as through a standing order, naloxone access can be complex and fraught. Naloxone prescriptions ordered through public orders are among the most common types not to be picked up (Connolly et al., 2022). Access to naloxone without a prescription can be problematic, especially in some communities (Lai et al., 2022). Knowledge of naloxone, the protection it provides, and how to use it may be an important barrier to use against some communities (Lee et al., 2024). Socioeconomic conditions may also worsen overdose risk and reduce access to naloxone (Mitra et al., 2023).

Overall, there is significant reason to believe some community-level factors affect access to and utilization of naloxone for overdose reversal (Yi et al., 2022). However, the precise nature of these factors and how they affect the effective use of naloxone remains unclear. Further research is necessary to better understand the community-level factors affecting naloxone use and overdose reversal (Chatterjee et al., 2022; Mitra et al., 2023; Vadie et al., 2024). The current study addressed these factors in the context of Ohio, a state significantly affected by the opioid epidemic.

Problem Statement

The problem addressed in this study was the unknown extent to which community-level demographic factors, such as socioeconomic status (SES), urban/rural status, race, and health care access, affect the availability and successful use of naloxone

in Ohio to prevent overdose-related deaths. SES has been strongly connected to the risk of overdose death from drugs, especially opioids (van Draanen et al., 2023). This pathway runs through several mechanisms, the most obvious of which is that those from low SES backgrounds may have financial difficulties obtaining treatments such as naloxone (Lai et al., 2022). Naloxone is an overdose reversal treatment that has proven highly effective (Ghosh et al., 2024). However, access to naloxone may be complicated by factors that go above and beyond the availability of prescriptions (Connolly et al., 2022), attesting to the complexity of naloxone distribution and access as a public health problem. For example, various underserved communities, such as African Americans, have been demonstrated to experience worse rates of naloxone access (Pérez-Figueroa et al., 2023). On the other hand, other disadvantaged populations, such as people experiencing homelessness, receive naloxone at a highly elevated rate (Abramson et al., 2023). As such, the topic was in need of further research.

Community-level characteristics may be important in understanding the effectiveness of efforts to improve naloxone uptake (Yi et al., 2023). Of such characteristics, race and socioeconomic status may be critical (Lee et al., 2024). Further research is needed to explore the relationship between community-level factors and access to naloxone (Chatterjee et al., 2022). Further research is needed regarding the factors associated with successful naloxone distributions (Vadiei et al., 2024). In addition, research is needed to explore further issues related to overdose survival using non-self-reported data (Mitra et al., 2023).

Purpose of the Study

The purpose of the current quantitative historical study was to examine what relationship, if any, exists between community factors (at the county level) such as SES, urban/rural status, race, and health care availability and the outcome of successful naloxone overdose reduction per population in Ohio. The study may offer a better understanding of how community factors at the county level affect the effectiveness of naloxone distribution through a state program called Deaths Averted With Naloxone (DAWN) in the state of Ohio. Findings from this study may help improve the program and offer insights into what communities may need to be supported with extra effort in other naloxone distribution programs.

Research Questions and Hypotheses

The following research questions and hypotheses guided this study:

RQ1: What relationship, if any, exists between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H_01 : There is no significant relationship between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_a1 : There is a statistically significant relationship between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ2: What relationship, if any, exists between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H₀2: There is no significant relationship between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_a2: There is a statistically significant relationship between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ3: What relationship, if any, exists between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H₀3: There is no significant relationship between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_a3: There is a statistically significant relationship between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ4: What relationship, if any, exists between the predictor of health care availability and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H₀4: There is no significant relationship between the predictor of health care availability and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_a4: There is a statistically significant relationship between the predictor of health care availability and the outcome of overdoses reversed using naloxone at the county level in Ohio.

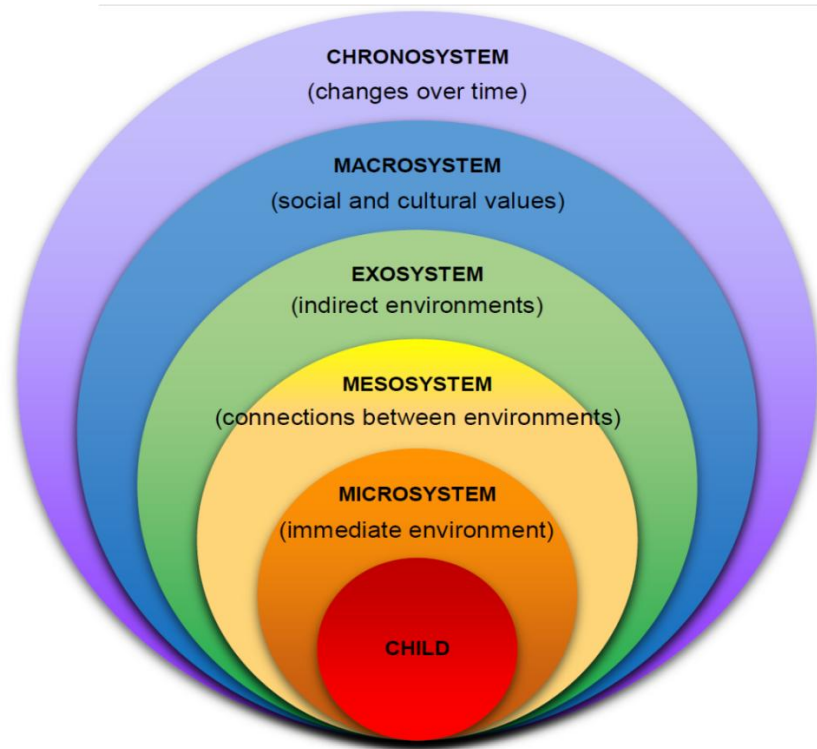
RQ5: To what extent, if any, does the quantity of naloxone supplied moderate the relationships in RQ1–RQ4?

H_o5: There is no significant moderation effect for any of RQ1–RQ4.

H_a5: The quantity of naloxone supplied moderates one or more of the relationships in RQ1–RQ4.

Theoretical Framework

The theoretical framework for the current study was the social-ecological perspective, also called ecological systems theory. The social-ecological perspective originated as a theory of human development meant to explore how the social context around a child affects development (Bronfenbrenner, 2000). Over time, however, the social-ecological perspective was extended to several other fields including public health (Slimmen et al., 2024). The social-ecological perspective addresses the nested contexts within which an individual exists. These contexts come in various layers of interaction (see Figure 1).

Figure 1*Social-Ecological Perspective*

The first level is microsystems, or the individual contexts within which a person exists (Bronfenbrenner, 2000). Microsystems might include, for example, a racial/ethnic community. The second level is mesosystems. Mesosystems reflect the interaction of two or more microsystems (Bronfenbrenner, 2000). For example, a mesosystem might be the interaction of the racial/ethnic community and the socioeconomic peer community. Next, exosystems represent externalities or outside contexts that interact with one or more microsystems (Bronfenbrenner, 2000). For example, an exosystem might be the effect of county- or state-level policymaking on a racial or ethnic community. Macrosystems represent holistic contexts (Bronfenbrenner, 2000). A macrosystem might be the state or

the country in which a person lives. Finally, chronosystems reflect the effect of the passage of time on other systems (Bronfenbrenner, 2000). For example, a chronosystem might be the effect of growing up within a specific community context. Overall, the social-ecological perspective provides an in-depth understanding of the complex factors that can combine to create community-level effects.

The social-ecological perspective was appropriate for the current study because it facilitated understanding of how community factors may affect naloxone availability and use. From the social-ecological perspective, it is evident that such factors should have an important effect on the behavior of communities, as well as the resources to which community members have access. Despite a concerted effort such as Ohio's Project DAWN intended to distribute naloxone, these factors are likely to affect the access to and uptake of the treatment. Therefore, the social-ecological perspective offered an ideal framework for the current study. At the same time, the study may be used to further develop the social-ecological perspective by representing a specific case of how social-ecological factors affect an important public health outcome. Therefore, the social-ecological perspective was an ideal framework for the study.

Nature of the Study

The research methodology for the study was quantitative. Quantitative research is a closed-ended method of research used to understand the existence and strength of the relationship(s) between variables (Zyphur & Pierides, 2020). Quantitative research typically focuses on either inherently quantifiable factors or those that can be expressed in quantitative form using theoretically supported definitions and instruments (Scharrer &

Ramasubramanian, 2021). Quantitative researchers draw on large sample sizes to create statistical power (Zyphur & Pierides, 2020). The closed-ended and numerical nature of quantitative data makes such sample sizes feasible. Quantitative methodology was appropriate for the current study for several reasons. First, the study was relational, being intended to examine what relationship, if any, exists between community factors (at the county level) such as SES, urban/rural status, race, and health care availability and the outcome of successful naloxone overdose reduction per population in Ohio. Second, the factors in the study were all quantifiable. Third, a large quantitative data set appropriate for the study was available.

The quantitative design was historical. Historical research is a type of correlational research that draws on existing data sets (Seeram, 2019). Correlational research, in general, is appropriate when the topic is more feasible to examine using real-world data rather than data collected in an experimental setting (Leavy, 2022). Historical correlational research is also appropriate when examining the predictors of a continuous outcome (Seeram, 2019). Historical correlational research was appropriate for the current study for several reasons. First, the study had an existing data set upon which to draw. Second, experimental research on opioid overdoses would have been highly unethical in addition to being unfeasible. Third, the outcome of this study is continuous, and the study explored its predictors.

The dataset for the study was Ohio's Project DAWN data set (DataOhio, 2025). Project DAWN is a naloxone distribution program enacted by the state of Ohio to distribute naloxone and train individuals regarding overdose prevention and reversal.

Project DAWN data include distributions of naloxone and overdoses reversed from 2019 to 2024. These data are available at the county level and on a monthly basis. As such, 2019-2024 in Ohio's 88 counties represented a total set of 5,280 possible data points. The data were collected from the DataOhio (2025) website, which is available to the public. Data were analyzed using multiple linear regression with Statistical Package for the Social Sciences (SPSS) software.

Study Variables

The proposed study will be a quantitative historical, correlational research study because there is an existing dataset to draw upon, the outcome of this study is continuous, and the study will explore its predictors. The methods and design are detailed below, as shown in the study section and Chapter 3. The independent variables will be socioeconomic status, population density, race/ethnicity composition, and number of hospitals per capita, while the dependent variable will be successful overdose reversals using naloxone. A moderating variable will be the amount of naloxone distributed in a county in Ohio.

Literature Search Strategy

The literature review for this study was conducted using a comprehensive search strategy across multiple databases, libraries, and search engines to ensure a thorough and well-rounded collection of sources. The libraries accessed included academic institutions and online academic repositories. The databases searched included PubMed, Google Scholar, PsycINFO, and JSTOR, which are known for their extensive collections of peer-reviewed journal articles and seminal literature in public health and social sciences. I

used Google as the search engine to find additional grey literature and government reports.

Key search terms included *social-ecological perspective* OR *ecological systems theory*, *the opioid epidemic*, *naloxone access*, *community-level factors*, *socioeconomic status*, *opioid overdose*, *race and naloxone distribution*, *urban/rural opioid overdose rates*, and *healthcare availability and naloxone*. Combinations of search terms were used to refine the search results, such as *social-ecological perspective* OR *ecological systems theory* AND *public health* OR *opioid epidemic* OR *naloxone*, *naloxone* AND *socioeconomic status*, *naloxone* AND *population density*, *naloxone* AND *race/ethnicity*, *naloxone* AND *number of hospitals per capita*, *naloxone* AND *overdose reversals*, and *naloxone* AND *amount of naloxone distributed in a county*. More detailed search terms and combinations can be found in the appendix.

The literature review focused on studies published within the last 5 years (2021–2025) to ensure the inclusion of the most up-to-date research. I incorporated foundational seminal literature for the theoretical framework and current peer-reviewed articles. I found plentiful research on this subject, making it possible to comprehensively analyze the literature review and study findings.

Theoretical Framework

The proposed study's theoretical framework is the social-ecological perspective, also known as ecological systems theory. Bronfenbrenner (2000) originally developed this theory to examine how the social context surrounding a child influences their development. The social-ecological perspective suggests that individuals exist within

interconnected and nested contexts structured into microsystems, mesosystems, exosystems, macrosystems, and chronosystems (Bronfenbrenner, 2000). Microsystems refer to the immediate environments in which individuals interact, such as family and racial or ethnic communities (Fry et al., 2023). Mesosystems encompass the interactions between multiple microsystems, like those between a racial or ethnic community and a socioeconomic peer community (Hawk et al., 2021). Exosystems include external environments indirectly influencing individuals, such as county- or state-level policies affecting racial or ethnic communities. Macrosystems represent broader societal contexts, including states or countries. Finally, chronosystems capture the influence of time and an individual's life course on these other systems (Bronfenbrenner, 2000).

The opioid epidemic is a significant public health issue in the United States. A crucial tool in addressing this crisis is naloxone (Ghosh et al., 2024). Nonetheless, access to naloxone is inequitable across various communities (Pérez-Figueroa et al., 2023). Therefore, this proposed study investigates the community-level factors influencing naloxone accessibility and the success of overdose reversals. Therefore, the social-ecological perspective is particularly well-suited for the proposed study because it aids in understanding how community-level factors affect naloxone availability and usage. Variables such as SES, population density, racial and ethnic composition, and the number of hospitals per capita can significantly impact access to and utilization of naloxone (Fry et al., 2023; Hawk et al., 2021; Kahn et al., 2022). For instance, communities with higher SES may have better access to healthcare services (Lin et al., 2022), while areas with a lower population density may face challenges in the distribution and accessibility of

naloxone (Marotta et al., 2021; Oser et al., 2023). This framework recognizes the complex interactions among these factors within various layers of the ecological system, providing a thorough approach to understanding community-level effects (Maina et al., 2021; Russell et al., 2022; Sistani et al., 2023).

Previous applications of the social-ecological perspective in public health research have demonstrated its effectiveness in analyzing community-level determinants of health outcomes, especially regarding the opioid crisis. For example, Abbas et al. (2021) studied pharmacy-level factors associated with naloxone stocking in New York City based on a socioecological perspective. In a similar study, Marotta et al. (2021) used a socioecological perspective to understand pharmacy-level factors in New York City; although similar to Abbas et al. (2021), Marotta et al. (2021) focused on buprenorphine stocking. In other opioid studies in 2021, researchers used the socioecological model or perspective to understand the opioid epidemic during the COVID-19 pandemic (Cowan et al., 2021) and understand client/patient reflections or perspectives on opioid use, prevention, and recovery (Hawk et al., 2021; Maina et al., 2021).

In 2022, research continued to use the socio-ecological perspective to study opioid use. For instance, Kahn et al. (2022) conducted a qualitative study to examine people who used opioids and their treatment experiences, analyzing findings using a social-ecological approach. In another study, Lin et al. (2022) analyzed individual, interpersonal, and neighborhood measures associated with opioid use stigma, finding the socioecological perspective effective in findings analysis. To further study on the

socioecological model and opioid use, Russell et al. (2022) focused on justice-related community reintegration experiences of people who were on opioid treatments.

The prevalence of this perspective's use in research continued into 2023, with many public health researchers using the theory to understand opioid-related issues. For instance, Brady et al. (2023) used the model to create a diagram of opioid misuse and overdoses to provide a visual perspective, while Green et al. (2023) used it to investigate post-overdose program implementations in Massachusetts. Fry et al. (2023) used the social-ecological model to understand stigmatizing views of medication-assisted recovery of people recovering from addiction. Kleinman et al. (2023) furthered expanding the model for use in understanding how psychological challenges affected patient-defined medication for opioid use disorder. Also, regarding medication treatment, Oser et al. (2023) studied social-ecological factors for opioid use disorder in justice-involved persons, while Sistani et al. (2023) used the model to understand overdose prevention. In more practical applications, Bayly et al. (2025) used the theory to predict opioid-involved overdoses. Based on the prevalence of available public health research, including its use in recent publications (Bayly et al., 2025), the socio-ecological perspective is a valid theoretical framework to use in this study.

The social-ecological perspective offers several strengths when applied to public health issues. It provides a holistic understanding of factors contributing to health outcomes, encouraging the consideration of the interplay between individual, community, and societal influences (Hawk et al., 2021; Lin et al., 2022; Maina et al., 2021). This comprehensive approach includes assessing the role of policy, cultural values, and

economic conditions in shaping health behaviors (Bayly et al., 2025). By recognizing these interconnected layers, public health leaders can develop targeted interventions that address multiple levels of influence, enhancing their effectiveness (Sistani et al., 2023). For example, interventions can encompass community education initiatives to increase awareness of naloxone alongside policy efforts to ensure wider access to this life-saving medication (Abbas et al., 2021). Such multifaceted strategies are essential for creating sustainable changes in community health outcomes (Lin et al., 2022).

The social-ecological perspective serves as a valuable framework for understanding intricate issues, yet its application is not without limitations. One significant drawback is the inherent complexity of the framework itself, which may lead to challenges when attempting to operationalize and measure various constructs across different levels of analysis (Brady et al., 2023); despite this complexity, Brady et al. (2023) still used the model to identify 80 unique conditions grouped into 16 categories for practical application, and Brady et al. (2025) created a matrix to predict fatal overdoses. However, the framework's complexity may still hinder researchers and practitioners looking to apply the theory in real-world settings, as it requires a nuanced understanding of the interplay between various social and ecological factors, as displayed by Brady et al. (2023, 2025). Implementing this perspective often necessitates extensive data collection across multiple contexts to adequately capture the nuanced relationships among variables (Brady et al., 2023). This process can be resource-intensive, requiring significant time, funding, and personnel investments. Consequently, smaller

organizations or studies with limited resources may find it challenging to adopt this approach.

On a more positive note, the constructs of the social-ecological perspective align closely with the research questions and problem statement of this study, providing a solid foundation for the investigation. For instance, the identified independent variables - such as SES, population density, and race/ethnicity composition - are critical factors corresponding to various ecological levels. Each of these variables interacts within the ecological system, influencing the dependent variable, which, in this case, is the successful reversal of overdoses using naloxone. Additionally, the moderating variable, specifically the amount of naloxone distributed within a county, plays a vital role in shaping these interactions.

Through this lens, one can understand how these varied elements interact to affect outcomes related to naloxone use. The subsequent section delves into a comprehensive literature review, focusing on the key variables identified in this study. This review will further explain the relationships and dynamics at play, adding depth to understanding the social-ecological framework in the context of overdose reversals.

Opioids

Opioids are a class of drugs that include both naturally occurring substances derived from the opium poppy and synthetic analogs. They are widely used in medicine for their analgesic properties but also carry a high risk of misuse, dependence, and overdose. In the United States, the opioid crisis has evolved in three major waves: the first driven by the overprescription of opioid analgesics in the late 1990s, the second

marked by a resurgence of heroin use beginning around 2010, and the third, which continues today, dominated by synthetic opioids such as fentanyl (Spencer et al., 2024). Synthetic opioids are particularly dangerous due to their potency, low production cost, and widespread availability, with fentanyl now implicated in the majority of overdose deaths (Humphreys et al., 2022). Opioids exert their effects primarily by binding to mu-opioid receptors in the brain, producing analgesia and euphoria, but also depressing respiration—an effect that underlies the lethality of overdoses (Britch & Walsh, 2022). Understanding the pharmacology, patterns of use, and sociocultural drivers of opioid consumption is crucial to contextualize why naloxone, as an antagonist, has become such a vital tool in combating opioid-related mortality.

Naloxone

Naloxone is an opioid receptor antagonist that rapidly displaces opioids from mu-receptors, thereby reversing respiratory depression and other life-threatening effects of overdose (Ghosh et al., 2024). It can be administered intranasally or intramuscularly, making it accessible in community and emergency settings. Since its approval in the 1970s, naloxone has become central to overdose prevention strategies, and in recent years, its distribution has expanded through standing orders, community programs, and pharmacy access initiatives (Connolly et al., 2022). Evidence consistently demonstrates naloxone's effectiveness in reducing fatal opioid overdoses, particularly when distributed widely and accompanied by public education (Taylor et al., 2022; Abdelal et al., 2022). However, disparities in naloxone access remain a significant barrier. Studies show that socioeconomic status, racial and ethnic inequities, and geographic location affect who

receives naloxone and who does not (Pérez-Figueroa et al., 2023; Lai et al., 2022). Moreover, stigma among healthcare providers and communities can impede distribution and use (Kruis et al., 2022). Despite these challenges, naloxone represents one of the most cost-effective and immediately lifesaving interventions available in addressing the opioid epidemic. Examining naloxone in relation to community factors provides insight into the broader structural inequities that shape overdose outcomes.

Literature Review Related to Key Variables

The review of literature presents the existing research related to the opioid epidemic, focusing on the accessibility and effectiveness of naloxone in reversing opioid overdoses. The opioid crisis, which has significantly impacted public health in the United States, necessitates a thorough understanding of various community-level factors that influence naloxone distribution and usage. This review synthesizes findings from recent studies to provide a comprehensive overview of how socioeconomic status, population density, racial and ethnic composition, and healthcare availability affect naloxone access and overdose outcomes. By exploring these variables, the literature review aims to identify gaps in current knowledge and highlight areas where further research is needed to enhance public health interventions and reduce opioid-related mortality.

The opioid epidemic, which started with the excessive prescription of opioid painkillers, has developed into a significant public health crisis in the United States. As of 2023, there were 105,007 overdose fatalities, most of which involved synthetic opioids like fentanyl (Spencer et al., 2024). Naloxone serves as a crucial tool in fighting the epidemic, but access to naloxone remains inconsistent across various communities

(Pérez-Figueroa et al., 2023). Thus, this study aims to investigate the community-level factors linked to naloxone availability and the success of overdose reversals. In doing so, the research will promote positive social change by contributing to efforts against the opioid crisis.

The review is organized around the following key variables of the study: SES, population density, racial and ethnic composition, number of hospitals per capita, successful overdose reversals using naloxone, and the amount of naloxone distributed within a county. Each section will summarize relevant studies, justify the selection of variables, and highlight areas of controversy and gaps in the literature. By examining these factors, this literature review aims to provide a solid foundation for understanding the complexities of naloxone access and its impact on opioid overdose outcomes (Taylor et al., 2022; Van Arsdale et al., 2025).

Socioeconomic Status

SES is a fundamental determinant of health outcomes and access to healthcare resources, influencing a variety of factors that contribute to overall well-being. Therefore, this section examines how SES affects naloxone access and utilization, elucidating the disparities experienced by different socioeconomic groups across various regions and communities, such as Massachusetts (Chatterjee et al., 2022) and California (Van Arsdale et al., 2025). Understanding the intricate role of SES is not merely an academic pursuit; it is vital for addressing persistent health inequities and improving public health interventions that are aimed at effectively reducing the alarming rates of opioid overdose deaths (Pérez-Figueroa et al., 2023).

Researchers have identified the significance of SES as a predictor for issues with naloxone treatment availability. In research that crossed over with other variables related to naloxone treatment, evidence has shown that community size influenced this issue when combined with SES factors (Chatterjee et al., 2022). Chatterjee et al. (2022) based their study on standing orders treatment of naloxone in Massachusetts, finding SES factors influenced whether naloxone was distributed at higher rates. After multivariable zero-inflated negative binomial analysis, the findings showed that less distribution occurred in communities with lower SES. This finding was mirrored by Kruis et al. (2022) when studying first responders' views and biases associated with naloxone use. After conducting a web-based survey and multivariable analysis, the authors found that stigma was related to low SES individuals regarding administering naloxone. This study showed implications extending beyond the current study's scope, as low SES factors influenced caregivers' perspectives when distributing aid, and deaths are still increasing despite standing orders (Taylor et al., 2022).

Moreover, both Pérez-Figueroa et al. (2023) and Van Arsdale et al. (2025) found that community-based naloxone sites would increase accessibility for those from low SES regions or backgrounds, emphasizing the need for targeted interventions and policy changes to increase and ensure equitable access for vulnerable populations. Despite the many studies showing generalized issues with SES and access to and use of naloxone, some studies suggest that factors such as racial and ethnic composition may wield a more significant influence than SES alone (Pérez-Figueroa et al., 2022). Furthermore, a gap

exists in research regarding how specific components of SES - such as employment status - directly affect naloxone accessibility.

Due to its influence on health outcomes and access to healthcare resources, I chose SES as an independent variable for this study. The literature has linked lower SES to limited access to naloxone (Chatterjee et al., 2022; Van Arsdale et al., 2025) and bias associated with medical providers distributing naloxone as a treatment (Kruis et al., 2022). This finding corresponds with the social-ecological perspective, which highlights the necessity of considering various levels of influence, including SES factors, on health outcomes. By examining SES, this proposed study seeks to clarify how economic disparities influence rates of opioid overdose and naloxone access. This understanding is critical for guiding targeted public health interventions that aim to alleviate the burden of opioid overdoses in vulnerable populations (Van Arsdale et al., 2025).

In summary, SES serves as a crucial factor in determining access to naloxone and the ensuing outcomes of opioid overdoses. The studies reviewed underscore significant and consistent disparities in naloxone availability and bias based on criteria such as income, education, and employment levels (Chatterjee et al., 2022). Based on these findings, the study is needed to help raise awareness and recognize the urgent need for policy interventions informed by SES realities. Socioeconomic factors significantly shape both the distribution and accessibility of naloxone, as well as individuals' capacity to respond effectively to an overdose crisis (Chatterjee et al., 2022; Taylor et al., 2022). Addressing these disparities is essential for creating impactful public health interventions that may be applied in Ohio and pave the way for a healthier, safer society. The next

section will explore the impact of population density on naloxone access, providing further insights into the multifaceted dynamics of healthcare disparities.

Population Density

Researchers have shown that population density significantly affects the availability of healthcare resources and emergency services, creating marked differences in healthcare access across different regions (Kattan & Alshareef, 2024). This section examines how urban and rural environments influence naloxone distribution and overdose reversal rates. By analyzing the impact of population density, the study may provide insights into the challenges and opportunities for enhancing naloxone access in various communities, thus highlighting the importance of tailored interventions (Holmes et al., 2022; Nesoff et al., 2022; Pérez-Figueroa et al., 2023; Yi et al., 2022).

Because of the prevalence of opioid-related deaths in rural areas compared to urban areas, researchers have studied population density related to naloxone distribution (Pérez-Figueroa et al., 2023; Yi et al., 2022), adherence (Connolly et al., 2022), survival rates (Holmes et al., 2022), prevention (Nesoff et al., 2022), and coverage equity based on racial/ethnic minorities (Nolen et al., 2022). One study applied population density toward understanding amounts of resources and stigma levels (Yi et al., 2022). Extensive research also indicates that urban areas tend to have a more substantial concentration of healthcare resources and quicker access to emergency services (Nolen et al., 2022). This increased availability of resources can lead to more effective overdose reversals in urban settings, thereby showing the critical need for immediate and accessible support (Nolen et al., 2022; Yi et al., 2022). Chatterjee et al. (2022) analyzed data from urban and rural

communities in Massachusetts, revealing significant disparities in naloxone accessibility that indicate an urgent need for targeted strategies. Specifically, the study found that urban environments had greater access to naloxone resources and emergency medical services compared to rural communities, which often struggle because of limited healthcare infrastructure and longer response times (Chatterjee et al., 2022; Kruis et al., 2022).

Such issues can be alleviated by increasing access to prevention facilities. However, a gap existed in the literature in this regard, with only one study showing improvements occurred because of efforts to reduce distance to care (Nesoff et al., 2022). Through logistic regression and negative binomial regression, Nesoff et al. (2022) found that when access improved in higher poverty neighborhoods because of distance improvement to reach prevention programs, fewer deaths occurred, and prevention success rates increased. With similar findings to Nesoff et al., Holmes et al. (2022) collected and analyzed data from the Pennsylvania Overdose Information Network and the American Community Survey, with data indicating that both survival and naloxone administration rates were lower in less populated counties. Pérez-Figueroa et al. (2023) corroborated these findings through examining the influence of population density on naloxone distribution over time. Similar to Chatterjee et al. (2022) and Holmes et al. (2022), Pérez-Figueroa et al. (2023) identified that rural areas encounter greater challenges in accessing naloxone due to constrained healthcare infrastructure, which can exacerbate the risks associated with opioid overdose.

I chose population density as an independent variable for this study because of its impact on healthcare resources and the need for increased access to targeted interventions—an approach shown to have success by Nesoff et al. (2022). The literature consistently shows that urban areas are better equipped and respond more rapidly to naloxone-related emergencies, while rural areas face considerable barriers that affect naloxone access and overall health outcomes (Chatterjee et al., 2022; Nesoff et al., 2022; Nolen et al., 2022; Pérez-Figueroa et al., 2023). This finding aligns with the social-ecological perspective, highlighting the importance of considering various layers of influence on health-related outcomes, including environmental factors like distance and geographic location. By investigating the intricacies of population density, evidence has shown that urban and rural settings distinctly affect naloxone access and opioid overdose outcomes, possibly guiding the development of targeted public health interventions (Nesoff et al., 2022).

Although the literature generally supports the influence of population density on naloxone access and opioid overdose outcomes, some positive findings were shown when the distance to aid was decreased (Nesoff et al., 2022), indicating that despite its complexity, interventions may still offer support. There remains a gap in research regarding how to practically apply methods to increase access and prevention efforts, as only one study identified a practical application (e.g., Nesoff et al., 2022); therefore, more still needs to be understood how may address disparities in population density and access to treatment and prevention efforts directly influence naloxone accessibility and related outcomes. Future researchers should further examine the relationship between

population density and other significant social determinants of health and enhance understanding in this area. The next section explores race/ethnicity composition related to naloxone distribution, use, and outcomes.

Race/Ethnicity Composition

Racial and ethnic disparities significantly impact health outcomes and access to healthcare resources. This section will explore in detail how race and ethnicity affect access to naloxone and the outcomes associated with opioid overdoses. Addressing these disparities is essential for the development of equitable public health interventions aimed at reducing opioid overdose deaths among minority populations (Khan et al., 2023; Nolen et al., 2022; Weiner et al., 2024).

Research indicates that racial and ethnic disparities have a considerable impact on both naloxone access and opioid overdose outcomes. In 2022, Nolen et al. examined how racial/ethnic groups achieved access to community-based naloxone located in Massachusetts based on data collected from the Massachusetts Department of Public Health, with findings indicating that racial/ethnic minorities had lower naloxone distribution rates compared to White residents; however, the study could not explain why the results occurred as they were based on already established data sets. Adding to the study of race/ethnicity by region, Takemoto et al. (2022) studied inequities in administering naloxone based on race/ethnicity in Pennsylvania from 2019 to 2021, finding similar results to Nolen et al. (2022). Evidence indicated that Black descendants had approximately 40% to 50% lower odds of receiving naloxone compared to White descendants. In 2023, similar findings persisted, as Khan et al. (2023) compared White,

Latinx, and Black people who used opioids in New York City to show opioid overdose prevention results. The evidence indicated that Black participants had lower odds of receiving education and information on naloxone access and use for protection during opioid use, resulting in more deaths from overdose for Black participants.

Furthermore, building on this premise and SES status, Pérez-Figueroa et al. (2023) utilized a longitudinal design to explore inequities in naloxone distribution across various racial and ethnic groups. Their findings showed that Black and Hispanic communities had lower rates of naloxone distribution, as well as higher rates of overdose mortality. In contrast to these studies' findings, Weiner et al. (2024) conducted a retrospective cohort study specifically examining patients from two academic centers and eight community hospitals regarding emergency room visits to treat opioid overdose for Hispanic White patients and non-Hispanic White patients and non-Hispanic Black patients. The findings starkly contrasted previous studies from earlier years (Khan et al., 2023; Nolen et al., 2022), with evidence indicating that Hispanic/Latino patients were more likely to receive a prescription than non-Hispanic White patients. This difference could be explained by other factors unaccounted for in the study, such as SES status or population density, indicating the need for more research to understand better these differing results.

I chose to examine race/ethnicity composition as an independent variable for this study because of its impact on health outcomes and access to healthcare resources for naloxone. The existing literature consistently demonstrates that racial/ethnic disparities can lead to heightened risks of opioid overdose (Pérez-Figueroa et al., 2023), constrained

access to and education of naloxone (Kan et al., 2023), and possible increased need for naloxone prescriptions (Weiner et al., 2024). These findings align with the social-ecological perspective, which underscores the necessity of considering various layers of influence, including racial and ethnic factors, on health outcomes. Although the literature generally corroborates the role of race and ethnicity composition in naloxone access and opioid overdose outcomes, some mixed findings persist (Weiner et al., 2024). There is a gap in research regarding how racial or ethnic groups in Ohio are uniquely affected by naloxone accessibility. Future researchers should endeavor to explore these complexities and examine the interplay between race, ethnicity, and other social determinants of health.

Number of Hospitals per Capita

The availability of healthcare facilities, particularly hospitals, plays a critical role in influencing access to emergency care and the distribution of naloxone, a vital medication for overdose reversal. This section delves deeply into the relationship between hospital density and the accessibility of naloxone, as well as its implications on overdose outcomes. Ensuring an equitable distribution of healthcare resources is paramount for the efficacy of overdose prevention and response strategies. This assertion is supported by recent studies highlighting the multifaceted impact of healthcare availability in shaping the trajectory of opioid overdose incidents (Freiermuth et al., 2023; McMichael, 2021); however, I could not find as many studies for this variable as others when conducting my literature search, indicating a gap in literature where more study is needed regarding naloxone and hospitals per capita.

Current research shows that areas with more hospitals per capita typically have better access to emergency care, resulting in improved overdose reversal rates (McMichael, 2021). However, most research on this subject was limited in focus and understanding; for example, McMichael (2021) solely focused on access-to-care relaxing restrictions on nurses regarding naloxone distribution in a large-scale program but did not explicitly discuss hospitals per capita. In another study, Freiermuth et al. (2023) focused on naloxone distribution in Ohio, like the proposed study, making it relevant to review; however, the per capita results focused on distribution rates and not the number of hospitals located in southwestern Ohio, indicating the need for the proposed study. The study found that the per capita distribution of naloxone was 1,275 cartons per 100,000 county residents, with an average annual rate of 588 per 100,000. Moreover, the results indicated no changes in opioid overdose mortality rates despite the large-scale distribution of naloxone, which might apply to hospital per capita results when considering that access should be increased, but increased access did not have positive effects in this case. Thus, the study only indirectly discussed hospital per capita and naloxone treatments.

Studies previously reviewed also generalized discussion of hospitals per capita, like McMichael (2021) and Freiermuth et al. (2023). For example, population studies came close to indirectly discussing hospital per capita but did not use it as a clear variable (Chatterjee et al., 2022; Nesoff et al., 2022; Nolen et al., 2022; Pérez-Figueroa et al., 2023). Moreover, studies on SES indirectly discuss hospital per capita but do not use it as a clear variable (Chatterjee et al., 2022; Van Arsdale et al., 2025).

I chose to select the number of hospitals per capita as an independent variable for this study because of its possible effects on access to emergency care and the distribution of naloxone, as well as the gap in the literature regarding its use as a variable. Literature shows some support that regions with more hospitals are equipped with improved access to naloxone, leading to higher rates of successful overdose reversals (Chatterjee et al., 2022; Van Arsdale et al., 2025). This finding substantiates the social-ecological perspective, which advocates for a comprehensive understanding of various layers of influence, including healthcare infrastructure, on health outcomes. Through an analysis centered on hospital density, this study may elucidate how variations in healthcare availability can considerably affect naloxone access and opioid overdose outcomes, possibly helping to fill this gap in the literature. Future research initiatives should also aim to explore these nuanced relationships critically and examine how hospital density interacts with other social determinants of health. The following section reviews the literature on successful overdose reversals using naloxone.

Successful Overdose Reversals Using Naloxone

Naloxone distribution programs primarily aim to reduce opioid overdose deaths. Understanding these factors is crucial for enhancing public health interventions and decreasing opioid-related mortality (Abdelal et al., 2022; Lemen et al., 2024; Paul et al., 2024; Pro et al., 2024). This section examines the effectiveness of naloxone in reversing overdoses and the elements that influence successful outcomes.

The literature confirms naloxone's effectiveness in reversing opioid overdoses, with significant reductions in overdose deaths observed in areas that have increased

naloxone distribution over time (Abdelal et al., 2022). When studying rates of multiple naloxone administration for reversing opioid deaths by conducting a narrative review, Abdelal et al. (2022) found that the rates ranged from 9% to 53% in emergency services-based studies and from 16% to 89% in bystander-reported studies. The findings indicated that increased distribution of naloxone helped with quicker administration. Lemen et al. (2024) also found that increased distribution of naloxone would increase dose administration, along with increasing education to bystanders on the adequacy of using two doses if facing fentanyl overdoses. Although focused on fentanyl overdoses, not opioid overdoses, the study still helped to understand overdose reversal outcomes related to naloxone, showing its effectiveness even with significantly dangerous street drugs.

In another study suggesting increased access and distribution reduced mortality and remission rates, Paul et al. (2024) conducted a retrospective analysis using U.S. Collaborative Network database data across 56 healthcare organizations. Although the study applied to the proposed research because it discussed reversal rates, Paul et al. included buprenorphine as well, finding that buprenorphine-naloxone was associated with significantly reduced mortality and increased remission rates for patients with opioid use disorder. Based on a sample of 459 clients who reported methamphetamine or opioid use from 2021 to 2022, Pro et al. (2024) conducted an explanatory mixed-methods design. The researchers aimed to identify factors associated with self-reported naloxone overdose reversals. The study revealed that the average number of reversals was 3.27, with nearly all clients (95%) reporting methamphetamine use. The combined use of methamphetamine and opioids was positively linked to a greater number of reversals.

I chose successful overdose reversals using naloxone as a dependent variable for this study due to their significant impact, as shown by the literature (Lemen et al., 2024; Paul et al., 2024; Pro et al., 2024), on reducing opioid overdose deaths. The literature consistently shows that naloxone is effective in reversing overdoses, including those caused by fentanyl (Lemen et al., 2024), methamphetamine (Pro et al., 2024), and opioids (Paul et al., 2024) when administered promptly and that community training and accessibility are crucial for achieving successful outcomes (Abdelal et al., 2022). This finding aligns with the social-ecological perspective, highlighting the importance of considering multiple layers of influence, including community factors, like educating bystanders on how to administer life-saving naloxone, on health outcomes. By examining successful overdose reversals, this study may show how variations in naloxone accessibility and training influence opioid overdose outcomes, ultimately informing targeted public health interventions.

There is limited research specifically focused on naloxone distribution programs and their influence on overall opioid overdose rates, as most available studies combine naloxone with other medications (Paul et al., 2024) or study other types of drug overdoses (Lemen et al., 2024; Pro et al., 2024). Future research should explore these nuances and examine the relationship between naloxone accessibility, community training, and other factors that impact overdose reversals. The following section contains a literature review on the amount of naloxone distributed in a county.

Amount of Naloxone Distributed in a County

The distribution of naloxone is a vital factor for its accessibility and effectiveness in combating the opioid crisis. Ensuring widespread naloxone distribution may decrease opioid overdose deaths and enhance public health (Freibott et al., 2024; Newman et al., 2025; Smart et al., 2024; Zang et al., 2021). This section contains literature showing how the quantity of naloxone distributed in a county affects overdose reversal rates and broader public health outcomes and community well-being.

Research indicates that increased naloxone distribution is closely linked to higher rates of overdose reversals and improved public health outcomes. For instance, Zang et al. (2021) studied community-based naloxone distribution based on opioid overdose death rates using a descriptive analysis. The study took place in Massachusetts and Rhode Island, and the findings showed that counties with higher opioid overdose death rates received targeted naloxone distribution, but did not show whether that targeted distribution lowered the rates compared to other counties. As mentioned, Pérez-Figueroa et al. (2023) investigated inequities in naloxone distribution, revealing significant disparities in naloxone availability across different communities that negatively affected access to treatment.

Although unfocused on opioid-related deaths specifically, Newman et al. (2024) presented findings relevant to this proposed study. The study findings were still important in showing the importance of naloxone distribution across counties, specifically five (St. Louis City, St. Louis County, Franklin County, Jefferson County, and St. Charles County). The researchers conducted an interrupted time series analysis of fentanyl,

naloxone, and opioid-involved deaths based on an autoregressive model, finding that naloxone distribution in St. Louis City was associated with an immediate decrease in deaths. However, this action is not so easily implemented everywhere, as areas with a lower population density may face challenges in the distribution and accessibility of naloxone (Marotta et al., 2021; Oser et al., 2023).

In a different healthcare industry, Freibott et al. (2024) focused on pharmacy results across counties, conducting a longitudinal analysis of U.S. naloxone claims and finding that chain pharmacies had significantly higher claims rates. The study showed that these chain pharmacies were located in counties with higher rates because of larger populations, leading the researchers to suggest increased education on increasing availability and dispersion. Like Freibott et al. (2024), Smart et al. (2024) focused on the pharmacy distribution of naloxone but refined the focus to policies. Results showed that counties with shortages had higher naloxone dispensing in states with prescriptive authority policies. Smart et al. connected this increase to low out-of-pocket costs, highlighting the importance of addressing price barriers to boost naloxone purchases.

Given the urgent nature of the opioid epidemic, I selected the amount of naloxone distributed in a county as a moderating variable for this study because of the literature showing its influence on naloxone accessibility and opioid overdose outcomes. Existing literature consistently shows that increased naloxone distribution is positively correlated with higher rates of overdose reversals and improved public health outcomes (Lemen et al., 2024; Paul et al., 2024; Pro et al., 2024). This finding aligns with the social-ecological perspective, emphasizing the importance of considering multiple levels of influence,

including community factors, healthcare access, and societal norms, on health outcomes. By systematically examining naloxone distribution within the context of these broader influences, this study may clarify how variations in naloxone availability impact opioid overdose outcomes, ultimately guiding targeted public health interventions that are responsive to community needs and contexts.

The existing literature supports the effectiveness of naloxone distribution on opioid overdose outcomes (Lemen et al., 2024; Smart et al., 2024). However, the need for more research persists, with Chatterjee et al. (2022) requesting further research regarding the relationship between community-level factors and access to naloxone. Additionally, Pérez-Figueroa et al. (2023) and Van Arsdale et al. (2025) requested targeted interventions and policy changes to increase and ensure equitable access for vulnerable populations, mirroring Smart et al. (2024), who also suggested research and program efforts on naloxone use because of findings that laws focused on liability costs have minuscule effects on naloxone volume in pharmacies dispensed to the public. Freibott et al. (2024) suggested more research into naloxone across counties in different industries, while Newman et al. (2025) requested more research on naloxone use in different regions. The pervasiveness of the opioid epidemic, which may have crested but is far from subsiding, has created a need for effective distributions of naloxone (Pérez-Figueroa et al., 2023). The proposed study will address this call for research by exploring the importance of community-level factors at the county level in Ohio.

Definitions

The following key definitions underlie the proposed study.

Naloxone: Naloxone is an overdose reversal medication, and specifically an opioid receptor antagonist. As such, naloxone is especially effective for reversing opioid overdose (Ghosh et al., 2024).

Opioid epidemic: The opioid epidemic refers to the broad phenomenon of widespread opioid use and addiction in the United States, and especially synthetic opioids such as fentanyl (Humphreys et al., 2022).

Overdose reversal: Overdose reversal involves the use of a receptor antagonist to block the effects of a drug and thus prevent/reverse the effects of overdosing on that drug (Britch & Walsh, 2022).

Assumptions

Assumptions are the underlying truths upon which a study rests (Scharrer & Ramasubramanian, 2021). As such, truths are deeply foundational; they typically cannot be easily tested and must be assumed to hold (Zyphur & Pierides, 2020). All research, including this study, has assumptions. First, it will be assumed that all data for Project DAWN were collected in good faith. This assumption is reasonable given the official nature of the project. Second, it is assumed that the county level is reasonable when considering community-level factors. This assumption is needed as the county level is the most granular data that could be found for the study. Third, it is assumed that community-level factors are reasonable to expect to affect naloxone. The literature supports this assumption.

Scope and Delimitations

The delimitations of the study are deliberate limits on the scope set by the researcher (Scharrer & Ramasubramanian, 2021). Delimitations are necessary to ensure that the study is focused and relevant. The following delimitations will be present in the proposed study. First, in alignment with the research gap, the study will be delimited to community-level factors. Second, due to the availability of data and the importance of the opioid epidemic, the study will be delimited to Ohio. Third, the study will be delimited to the county level because of data availability. Fourth, in alignment with the research gap, the study will focus on naloxone specifically. Fifth, the proposed study will be delimited to the outcome of overdose reversals because of its practical significance for saving lives.

Limitations

Limitations are the drawbacks or shortcomings of a given study (Zyphur & Pierides, 2020). Limitations usually result from methodological choices and thus can only be mitigated, not prevented. There are several important limitations in the proposed study. First, the historical research design will limit the proposed study, which can only draw on data that already exist in a database (Leavy, 2022). This limitation is expected to have minimal adverse effect as the Project DAWN data contain the needed variables. Second, the study will be limited by the correlational nature of the analyses. Using historical rather than experimental data prevents the study's results from demonstrating causality. However, this will also enable the use of real-world data for a topic that cannot be easily explored in an experimental setting. Third, the study will be limited by any data

collection or reporting inaccuracies. As a governmental entity collects the data, the data are expected to be of good quality, but this cannot be guaranteed.

Significance

The significance of the proposed study is twofold. First, the proposed study will address a research gap academically. This research gap can be illustrated by examining their studies' calls for further research. First, Chatterjee et al. (2022) called for further research regarding the relationship between community-level factors and access to naloxone. The proposed study will address this call for research by exploring the importance of community-level factors at the county level in Ohio. Second, Vadieli et al. (2024) called for further research regarding the factors associated with successful efforts to deliver naloxone. The proposed study will address this research gap using data from Ohio's Project DAWN, a state effort to distribute naloxone. Third, Mitra et al. (2023) called for research regarding overdose survival that does not rely on self-reported data. Project DAWN data include county-level data on verified overdose reversals using naloxone.

In addition, the study is significant from a practical perspective. As an overdose reversal agent/treatment, naloxone is highly effective (Ghosh et al., 2024). The pervasiveness of the opioid epidemic, which may have crested but is far from subsiding, has created a need for effective distributions of naloxone (Pérez-Figueroa et al., 2023). However, it is less evident where naloxone is most effectively used and what communities may require extra effort to promote naloxone availability and uptake (Yi et al., 2022). Therefore, understanding the community-level factors associated with

successes using naloxone to reverse overdoses is of practical significance to continuing efforts to overcome the opioid epidemic in full. By helping address the opioid epidemic, a major social ill, the study will contribute to positive social change.

Summary and Conclusions

In summary, the problem is that it is not known to what extent community-level demographic factors such as socioeconomic status, urban/rural status, race, and healthcare availability affect the availability and successful usage of naloxone in Ohio to prevent overdose-related deaths. To address this problem, the purpose of the proposed quantitative historical study is to examine what relationship, if any, exists between community factors (at the county level), such as socioeconomic status, urban/rural status, race, and healthcare availability and the outcome of successful naloxone overdose reduction per population in Ohio. The study will be guided by five research questions: (a) What relationship, if any, exists between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio? (b) What relationship, if any, exists between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio? (c) What relationship, if any, exists between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio? (d) What relationship, if any, exists between the predictor of healthcare availability and the outcome of overdoses reversed using naloxone at the county level in Ohio? Moreover, (e) To what extent, if any, does the quantity of naloxone supplied moderate the relationships in RQ1-RQ4?

The theoretical framework for the proposed study will be the social-ecological perspective, also called ecological systems theory. The study will use a quantitative methodology with a historical, correlational design. The specific dataset for the proposed study will be Ohio's Project DAWN dataset (DataOhio, 2025). Data will be analyzed using multiple linear regression analysis using SPSS software. The research gap motivating the study is the need to better understand the community-level factors affecting naloxone usage and overdose reversal (Chatterjee et al., 2022; Mitra et al., 2023; Vadieli et al., 2024). Addressing this gap will contribute to positive social change. Next, Section 2 explores the research methods in greater depth.

Section 2: Research Design and Data Collection

The purpose of the current quantitative historical study was to examine what relationship, if any, exists between community factors (at the county level) such as SES, urban/rural status, race, and health care availability and the outcome of successful naloxone overdose reduction per population in Ohio. Section 1 presented an introduction to the study along with the literature review underlying it. Section 2 details the research methods by which the study was conducted. The section begins with a discussion of research methods and research design. The second section addresses the methodology. The methodology includes the study population, the original data set's sampling, the variables' operationalization, and the data analysis. The third section addresses the threats to the study's validity, including research ethics. Section 2 concludes with a summary of key points.

Research Design and Rationale

The research methodology for the study was quantitative. Quantitative research is a closed-ended approach that can be used to understand the existence and strength of the relationships between key variables (Zyphur & Pierides, 2020). Because quantitative researchers are concerned with relationships, quantitative research typically focuses on either inherently quantifiable factors or those that can be expressed in quantitative form using theoretically supported definitions and instruments (Scharrer & Ramasubramanian, 2021). As a result, the variables in quantitative research are closed-ended and narrowly defined (Zyphur & Pierides, 2020). This closed-endedness allows a quantitative researcher to collect data from large sample sizes and feasibly analyze the data (Scharrer

& Ramasubramanian, 2021). Because a quantitative study makes high-volume data collection viable, quantitative researchers typically collect data from large samples or use existing large-scale data sets (Zyphur & Pierides, 2020).

Quantitative methodology was well aligned with the current study for several reasons. First, the study's purpose was relational, being to examine what relationship, if any, exists between community factors (at the county level) such as SES, urban/rural status, race, and health care availability and the outcome of successful naloxone overdose reduction per population in Ohio. The variables identified for the research were also quantified or could be easily expressed in quantitative form. In addition, a large-scale data set from Project DAWN, which is a free resource with no special permit requirements, provided the necessary data to conduct the study. Therefore, the study warranted quantitative methodology.

There are numerous quantitative designs. The design for the current study was nonexperimental and historical. The two main kinds of quantitative inquiry are experimental and nonexperimental (Leavy, 2022). Experimental studies are ideal when feasible because they yield more substantial results (Erath et al., 2021). However, experimental research requires stringent conditions and the ability to manipulate the study variables (Erath et al., 2021). Given the county-level nature of the variables for this study, manipulation would be impossible. Therefore, a non-experimental design is appropriate and necessary. Non-experimental research cannot demonstrate causation but can be conducted using real-world data rather than experimental control (Leavy, 2022).

Within the non-experimental paradigm, the specific research design for the proposed study will be that of a historical design. Historical research is a type of correlational research that is conducted with the use of an existing dataset (Seeram, 2019). Correlational research, in general, is used to examine the predictive relationship between one or more predictors and an outcome (or outcomes) of interest (Leavy, 2022). Historical, correlational research is also appropriate when examining the predictors of a continuous outcome, specifically (Seeram, 2019).

Historical, correlational research is appropriate for this study for several important reasons. First, the proposed study can be conducted using an existing dataset, namely the data from Project DAWN. Second, the proposed study will examine the predictiveness of county-level factors over the outcome of naloxone overdose reversals, a predictive relationship. Third, the outcome of this study is continuous, and the study will explore its predictors. Therefore, a non-experimental historical, correlational research design is well aligned with the central tenets of the proposed study.

The proposed study has a set of six variables. The independent variables will be socioeconomic status, population density, race/ethnicity composition, and number of hospitals per capita. The dependent variable will be the successful overdose reversals using naloxone. The sixth variable will be a moderator, namely the amount of naloxone distributed in a county. All variables will be operationalized using data from Project DAWN or the United States Census.

Project DAWN (Deaths Avoided With Naloxone)

Project DAWN is a statewide naloxone distribution initiative launched by the Ohio Department of Health in 2012 to reduce opioid overdose deaths. The program provides free naloxone kits and education on overdose recognition, naloxone administration, and rescue breathing. Initially piloted in southern Ohio, it has since expanded to all 88 counties, partnering with local health departments, hospitals, and community organizations.

The program distributes naloxone to individuals at risk of opioid overdose as well as to their families, friends, and broader community members, thereby increasing the likelihood of timely intervention. Each kit typically includes two naloxone doses, informational materials, and basic rescue equipment. In addition, Project DAWN conducts public education sessions designed to reduce stigma and empower communities to act during an overdose emergency (Ohio Department of Health, n.d.).

Since its inception, Project DAWN has become a cornerstone of Ohio's overdose prevention strategy. Between 2019 and 2024, it distributed hundreds of thousands of naloxone kits, with thousands of confirmed overdose reversals documented statewide (DataOhio, 2025). Prior research indicates that counties with higher per capita naloxone distribution through Project DAWN are associated with lower overdose mortality, although disparities in access remain between urban and rural areas (Freiermuth et al., 2023). Despite these challenges, the program remains one of the most comprehensive and systematically evaluated naloxone distribution programs in the United States, making it an invaluable dataset for public health research.

Methodology

The research methodology addresses the key aspects of how the study will be carried out. The methodology includes the population and sampling procedures used in the dataset to be used, Project DAWN. The methodology also includes the operationalization of variables. Finally, the methodology addresses how the data will be analyzed.

Population

The population of interest for the proposed study is opioid users in the state of Ohio. Overall, the proposed study is intended to study the effects of community-level factors on the use of naloxone to reverse opioid overdoses. Therefore, though the population of interest is individual users, the study will be conducted at the county level. Data at the county level are available through Project DAWN, while data regarding county demographics are available through the US Census. While counties do not perfectly demarcate communities, the county level represents a foundational and feasible level to study community-level factors using existing data.

Sampling Procedures Used by Original Creators of the Data Set

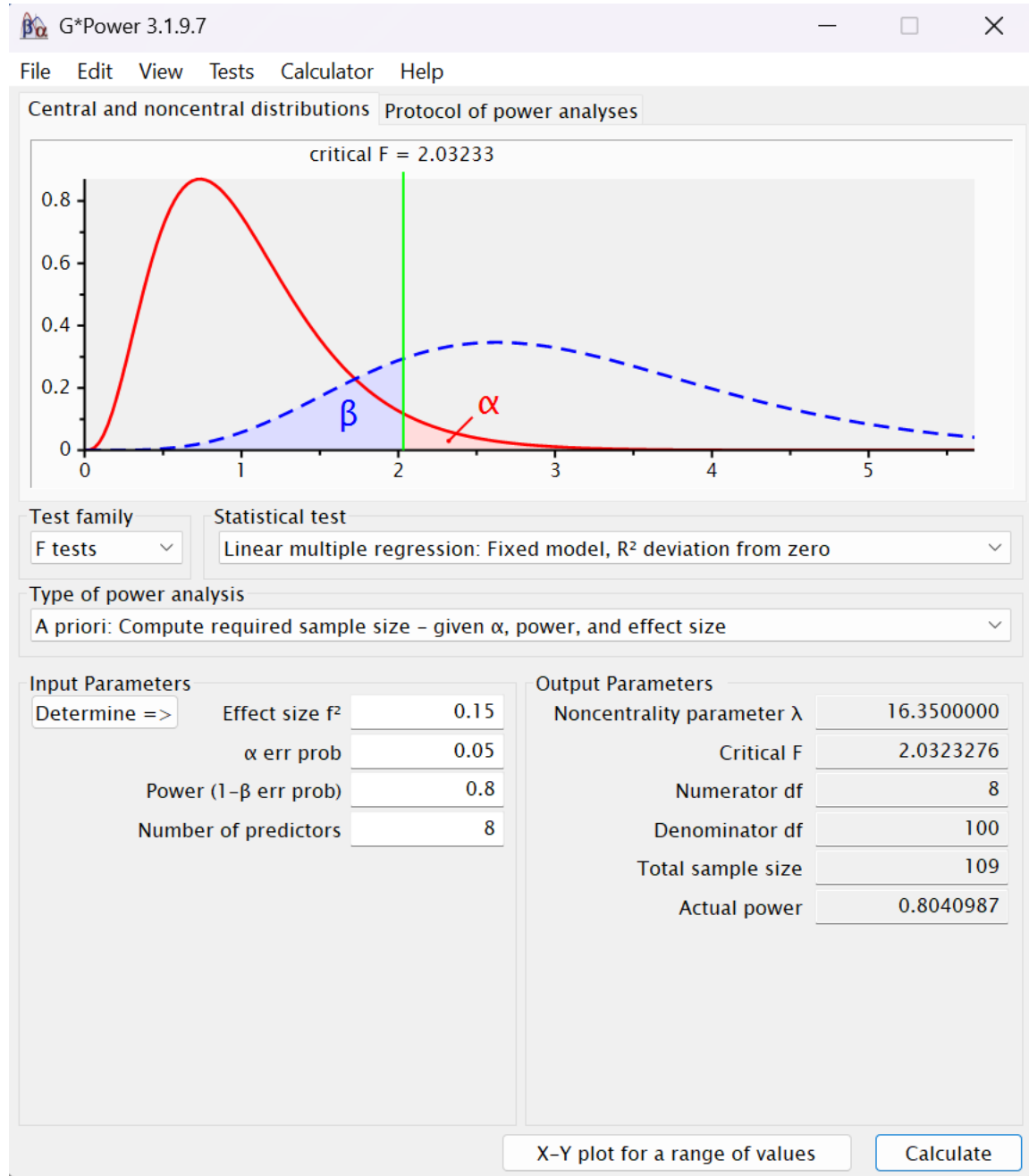
The specific dataset for the proposed study will be Ohio's Project DAWN dataset (DataOhio, 2025). Project DAWN is a naloxone distribution program enacted by the state of Ohio to distribute naloxone and train individuals regarding overdose prevention and reversal. Project DAWN data include distributions of naloxone and overdoses reversed from 2019-2024. These data are available at the county level and every month. As such, 2019-2024 in Ohio's 88 counties represents 5,280 possible data points (Ohio Department

of Health, n.d.). The original data collection for Project DAWN was done by the project staff at the county level, including the amount of naloxone distributed per county and the number of overdose reversals that were reported to the program by local health authorities.

Power and Sample Size Calculations

Per Figure 2, a minimum sample size of 100 should be sufficient for the proposed hierarchical multiple linear regression when using a minimum effect size, a statistical power of 80%, and a significance level of 0.05.

Figure 2

*G*Power Analysis*

Operationalization

The variables for the study were operationalized as follows (see Table 1):

Table 1

Operationalization of Variables

Variable	Source	Level of measurement
Socioeconomic status	Census data	Continuous
Population density	Census data	Continuous
Race/ethnicity composition	Census data	Ratio
Number of hospitals per capita	State websites	Continuous
Successful overdose reversals using naloxone	Project DAWN	Continuous
Amount of naloxone distributed in a county	Project DAWN	Continuous

Socioeconomic Status

Socioeconomic status will be determined at the county level using data from the 2020 US Census. The median income for the county will be included as a continuous variable. In addition, a second measure of socioeconomic status will be the percentage of people in poverty (based on the federal definition thereof) within each county. Poverty will be reported as continuous data. Where available, census estimates for the data at an annual level will be used.

Population Density

Population density will be calculated at the county level using data from the 2020 US Census. The county's population on the 2020 census will be used along with official

state values for the county's land area to calculate population density. Population density will be measured as a continuous variable. Where available, census estimates for the data at an annual level will be used.

Race/Ethnicity Composition

Race/ethnicity composition will be measured at the county level using data from the 2020 US Census. For each county, the percentage of the residents indicating the census race categories of White, Black, Asian, American Indian, Alaska Native, Native Hawaiian, Other Pacific Islander, two or more races, or some other race will be reported. In addition, the percentage of the county population indicating Hispanic ethnicity will be included. All race/ethnicity variables will be continuous. Where available, census estimates for the data at an annual level will be used.

Number of Hospitals Per Capita

Number of hospitals per capita will be calculated at the county level using state-level data. State government-provided information about the number of hospitals in Ohio will be obtained from the state and combined with the county population to create hospitals per capita. Hospitals per capita will be treated as a continuous variable. Where available, census estimates for the data at an annual level will be used.

Successful Overdose Reversals Using Naloxone

The dependent or outcome variable of successful overdose reversals will be drawn from Project DAWN data. Project DAWN data include the number of known successful reversals per county monthly. For comparison, the number of overdose

reversals will be divided by the county population to yield overdoses prevented per capita. Overdoses prevented per capita will be measured as a continuous variable.

Amount of Naloxone Distributed in a County

The amount of naloxone distributed in a county under Project DAWN will be a moderating variable. The value will be obtained every month from the Project DAWN dataset. The amount of naloxone distributed in a county under Project DAWN will be measured as a continuous variable reflecting the absolute amount of naloxone kits distributed.

Data Analysis Plan

Data analysis for the proposed study will be conducted using SPSS software. The data analysis will include descriptive and inferential statistics to answer the research questions. Given the use of government data for all analyses, no cleaning of the datasets is expected to be necessary. The descriptive analysis will involve calculating each variable's statistical properties, including mean, range, and standard deviation.

Tabulations of the data will also be used to describe the sample.

To recall, the research questions guiding the proposed study are:

RQ1: What relationship, if any, exists between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H_0 1: There is no significant relationship between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_{a1}: There is a statistically significant relationship between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ2: What relationship, if any, exists between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H_{o2}: There is no significant relationship between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_{a2}: There is a statistically significant relationship between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ3: What relationship, if any, exists between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H_{o3}: There is no significant relationship between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_{a3}: There is a statistically significant relationship between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ4: What relationship, if any, exists between the predictor of healthcare availability and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H_04 : There is no significant relationship between the predictor of healthcare availability and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_a4 : There is a statistically significant relationship between the predictor of healthcare availability and the outcome of overdoses reversed using naloxone at the county level in Ohio.

RQ5: To what extent, if any, does the quantity of naloxone supplied moderate the relationships in RQ1-RQ4?

H_05 : There is no significant moderation effect for any of RQ1-4.

H_a5 : Quantity of naloxone supplied moderates one or more of the relationships in RQ1-4.

To answer these research questions, a multiple linear regression analysis and a hierarchical multiple linear regression analysis will be conducted. Multiple linear regression is ideal for examining the ability of multiple predictors to predict one or more outcomes (Laerd Statistics, 2023). The analysis for RQ1-RQ4 will include the same multiple linear regression. RQ5 will then add the interaction terms in a hierarchical model.

In both cases, the assumptions of multiple linear regression will need to be tested. The first three assumptions are that the predictors are continuous or categorical, that the outcome is continuous, and that the data are independent (Laerd Statistics, 2023). These assumptions are met based on the definition of the variables. The fourth assumption is that the relationships are roughly linear (Laerd Statistics, 2023). This assumption will be

checked via scatterplots. The fifth assumption is that the predictors are not perfectly colinear. This assumption will be tested using variance inflation factors. The sixth assumption is that the data demonstrate homoscedasticity, or same error variance (Laerd Statistics, 2023). The homoscedasticity of the data will be tested using plots of the studentized residuals against the unstandardized predicted values. The seventh assumption is that of no outliers or high leverage points (Laerd Statistics, 2023). This assumption will be tested using Cook's distance. The final assumption is the approximate normality of the errors (Laerd Statistics, 2023). This assumption will be tested using a histogram plus a normal P-P Plot. If the assumptions are not met, allowed transformations of the data such as the natural logarithm will be applied. If necessary, nonparametric regression may be used instead.

Once the assumptions are validated, a regression model will be developed. The model will include all dimensions of the predictors of socioeconomic status, population density, race/ethnicity composition, and number of hospitals per capita as independent variables and opioid overdoses reversed by naloxone as the outcome. First, the overall multiple R-squared for the model will be tested using an F-test. If the model is not significant, none of the null hypotheses can be rejected. If the model is significant, then the individual hypotheses will be tested using *t*-tests for the individual coefficients of regression. For each of RQ1-RQ4, the null hypothesis will be rejected if the coefficient of regression for at least one of the dimensions of the variable associated with that research question is significant.

To answer RQ5, a hierarchical model will be developed by adding the interaction terms between amount of naloxone distributed in a county and each of the predictors to the initial model. The multiple R-squared for the new model will be compared to the old. Unless the hierarchical model's multiple R-squared is significantly greater than the base model, the null hypothesis cannot be rejected. If the multiple R-squared significantly increases and at least one of the interaction terms is significant, then the null hypothesis for RQ5 will be rejected.

Ethical Procedures

Ethical research procedures will be adhered to throughout the proposed study. The Project DAWN and US Census data are both freely available online for use in research. No permission or authorization is needed to use either dataset from the US Census, although one is required to fill out a form to explain the intent for use when it comes to the dataset from Project Dawn. The data were anonymized at the individual level by the government. The data reflect the county name, but given the size of the counties, there is no need to anonymize such data at the county level. No informed consent will be needed as the study includes no human subjects. Data will not require special protection as all data is freely available to the public. IRB approval will be obtained prior to conducting the study.

Threats to Validity

The internal validity of the study has been carefully developed through the alignment of study components. The research problem leads to the research purpose, and the purpose is operationalized through the research questions. The variables and dataset

identified both aligned with the research questions. The data themselves are all drawn from inherently quantified measures and thus have full validity. The main threat to validity derives from the potential for inaccurate data in the Project DAWN dataset. This risk is deemed to be low as the data are governmental in nature.

The proposed study draws data from the state of Ohio. All 88 counties in Ohio are included in the data, so the data should generalize to the state of Ohio. However, it is unclear how well the results may generalize outside Ohio, given the state's positionality as the epicenter of the opioid epidemic. Otherwise, external validity is expected to be good given the sample size of over 5000 datapoints if monthly data are used, or 352 datapoints if annual data are instead used.

Summary

In summary, the purpose of the proposed quantitative historical study is to examine what relationship, if any, exists between community factors (at the county level) such as socioeconomic status, urban/rural status, race, and healthcare availability and the outcome of successful naloxone overdose reduction per population in Ohio. This section addressed the research methods for the study. The research will be quantitative in nature, with a nonexperimental historical correlational research design. Though the population of interest is individual users, the study will be conducted at the county level. Data at the county level are available through Project DAWN, while data regarding county demographics are available through the US Census. The independent variables will be socioeconomic status, population density, race/ethnicity composition, and number of hospitals per capita, while the dependent variable will be successful overdose reversals

using naloxone. The moderating variable will be the amount of naloxone distributed in a county. These variables will be operationalized using publicly available data. The data will be analyzed using descriptive statistics, multiple linear regression, and hierarchical multiple linear regression. Threats to validity are relatively minimal. Next, in Section 3, the results of the data analysis will be presented.

Section 3: Presentation of the Results and Findings

The purpose of this quantitative historical study was to examine what relationship, if any, exists between community factors (at the county level) such as SES, urban/rural status, race, and health care availability and the outcome of successful naloxone overdose reduction per population in Ohio. Secondary data were collected to measure the variables of SES, population density, race/ethnicity composition, number of hospitals per capita, successful overdose reversals using Naloxone, and amount of Naloxone distributed in a county. Data were analyzed using statistical analyses to answer the research questions in the study. This section provides a discussion of the steps employed to access secondary data. This section also provides the results of the descriptive analysis and the inferential tests. This section ends with a summary of the data analysis results.

Accessing the Data Set for Secondary Analysis

Secondary data were utilized for this study. The data set for this quantitative study was Ohio's Project DAWN data set (DataOhio, 2025). Project DAWN is a naloxone distribution program enacted by the state of Ohio to distribute naloxone and train individuals regarding overdose prevention and reversal. Project DAWN data included distributions of naloxone and overdoses reversed from 2019 to 2024. These data are available at the county level on a monthly basis. As such, the period 2019-2024 in Ohio's 88 counties represented a total set of 5,280 possible data points. The original data for Project DAWN were collected by the project staff at the county level, including the amount of naloxone distributed per county and the number of overdose reversals that were reported to the program by local health authorities.

For the community-level factors at the county level, the U.S. Census data for 2020 were utilized to gather data for SES, urban/rural status, race, and health care availability. SES was measured using the median household income for each county. The urban/rural status of the county was measured using the population density. Race was measured as the percentage of each racial group in each county. Health care availability was measured as the number of hospitals per capita. County level data were inputted in an Excel spreadsheet and transferred to SPSS Version 29.0 for data analyses.

Initially, the plan was to utilize all of the available data from the Project DAWN data set for the analyses. However, only data for 2020 were included in the analyses. Based on the data gathered from Project DAWN, a total of 88 counties in Ohio were included. To ensure independence of observations, I considered each county was considered as an independent case. Data for year 2020 were included in the analyses to align the data collection year for Project DAWN and the U.S. Census data. In the analyses, each county was treated as an individual case. The amount of naloxone distributed and the total number of reversals were summed for the months in 2020. There were no missing data in the data set. From the 88 counties in Ohio, a total of 63 counties were included in the analyses. The counties included in the analyses were counties which has Project DAWN data for the year 2020. Year 2020 was selected to match the available data for the US Census which was used to gather the community factors data.

Descriptive statistics were utilized to determine the mean population, land area of the counties, and mean population density for the counties of Ohio. Descriptive statistics were also utilized to present the mean household income and the race percentages in each

of the counties. Based on the descriptive statistics, the highest percentage of race was for Caucasians. Data were analyzed using multiple linear regression analyses and hierarchical regression analyses to consider the moderating effect of the amount of naloxone on the relationship of community factors and total number of reversals. The results of the analyses determined that there was a significant relationship between population density and the total number of reversals. The results of the hierarchical regression analysis determined that the Naloxone is a significant moderator for predictors household income, population density, and hospital per capita and the total number of reversals. A significance level of .05 was utilized for all analyses.

Results

The descriptive statistics of the study variables are presented in Table 2. The mean population for the counties of Ohio was 358,158 ($SD = 1,486,402$). The mean land area of the counties in Ohio was 1120.14 ($SD = 5088.54$). The mean population density for the counties was 381.47 ($SD = 548.54$). The mean household income for the counties is 67,281.76 ($SD = 14,803.61$). In terms of race, the highest mean percentage was observed for Caucasians at 21.88% ($SD = 89.02$). The lowest mean score was observed for Native Hawaiian with 0.01% ($SD = 0.05$). The mean total number of kits distributed/placed was 913.02 ($SD = 2203.51$) while the total number of reversals has a mean of 106.02 ($SD = 226.03$). For the hospital availability, the mean hospital per Capita is 1.41 ($SD = 1.26$).

Table 2

Descriptive Statistics of Study Variables (N = 63)

Variable	N	Min	Max	M	SD
Population	63	12,800.00	11,799,448.00	358,158.10	1,486,402.59
Land area	63	228.21	40,860.69	1,120.14	5,088.54
Density	63	30.91	2,758.66	381.47	548.54
Median household income	63	46,701.00	126,513.00	67,281.76	14,803.61
% White	63	.97	707.94	21.88	89.02
% Black	63	0.00	115.21	3.67	15.20
% American Indian	63	0.00	1.50	0.06	0.19
% Asian	63	0.00	23.45	0.74	3.05
% Native Hawaiian	63	0.00	.36	0.01	0.05
Total number of kits distributed/placed	63	0.00	15,436.00	913.02	2203.51
Total # reversals	63	0.00	1,450.00	106.02	226.03
Hospital per capita x10,000	63	0.00	4.89	1.41	1.26

RQ1: What relationship, if any, exists between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio?

H_01 : There is no significant relationship between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

H_a1 : There is a statistically significant relationship between the predictor of socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

To address the first research question, the median household income was considered as the predictor variable while the total number of reversals was considered as the criterion variable. The assumptions of the linear regression analysis were tested. The predictor and criterion variables were continuous in nature. The samples were independent of each other because each county is independent of the other counties. The histogram presented in Figure 3 shows the normality of residuals. The histogram showed that the residuals were not normally distributed. Therefore, the violation on the assumption of normality was considered as a limitation of the study's results. Figure 4 shows the scatterplot of residuals vs predicted values showing that there is a linear relationship and no pattern is formed. Thus, the assumptions on linearity and homoscedasticity are met.

Figure 3

Histogram of Regression Standardized Residuals Using Median Household Income as Predictor and Total Number of Reversals as Dependent Variable

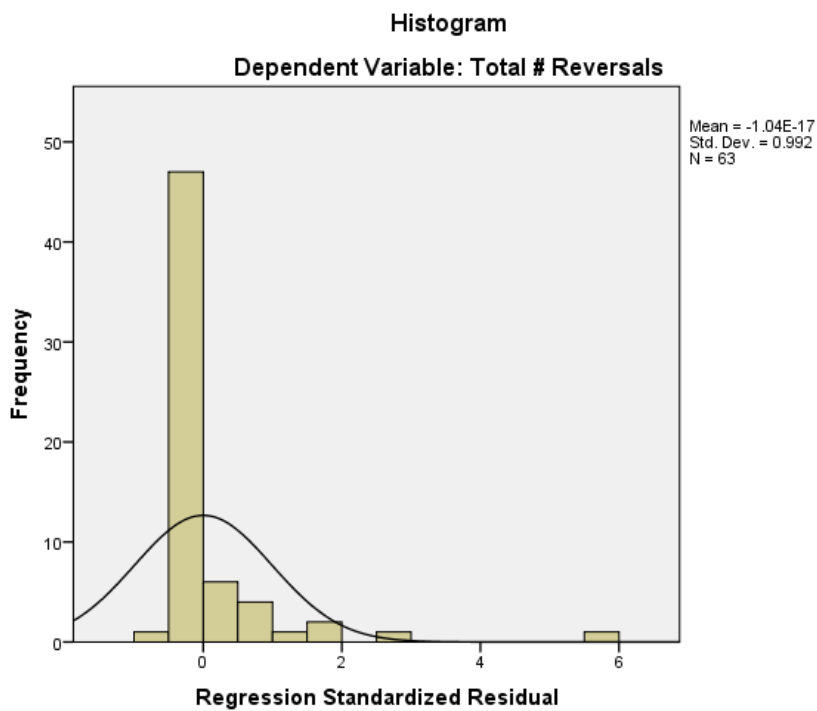
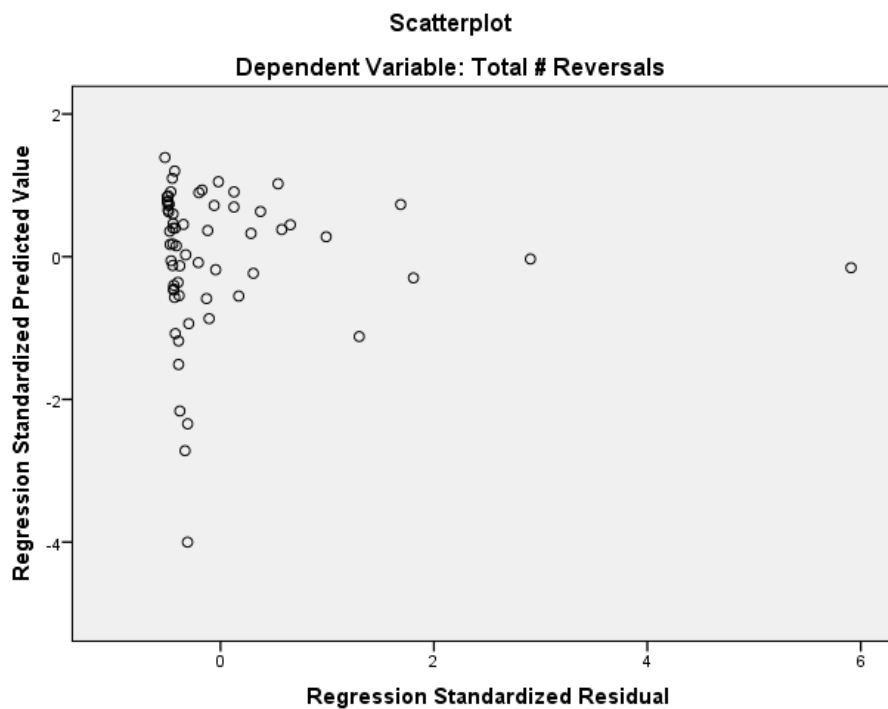


Figure 4

Scatterplot of Residuals vs Predicted Values Using Median Household Income as Predictor and Total Number of Reversals as Dependent Variable



The results of the regression analysis are presented in Tables 3 and 4. The ANOVA test results determined that the regression model was insignificant in predicting the total number of reversals in each county ($F(1,62) = .095, p = .759$). The regression coefficients presented in Table 4 show that the median household income did not significantly predict the total number of reversals in the counties ($B = -.001, p = .759$). Based on the R-squared value, the predictor only explains .2% of the variance in the total number of reversals. Therefore, the household income does not significantly relate to the total number of referrals. There is insufficient evidence to reject the null hypothesis which stated that there is no significant relationship between the predictor of

socioeconomic status and the outcome of overdoses reversed using naloxone at the county level in Ohio.

Table 3

ANOVA Test Result for Median Household Income as Predictor

Model	Sum of squares	df	Mean square	f	p
1 Regression	4,939.279	1	4939.279	.095	.759 ^b
Residual	3,162,743.705	61	51,848.257		
Total	3,167,682.984	62			

Table 4

Regression Results for Median Household Income as Predictor

Model	Unstandardized coefficient		Standardized coefficient	t	p
	B	SE	Beta		
1 (Constant)	146.582	134.526		1.090	.280
Median Household Income	-.001	.002	-.039	-.309	.759

To address the second research question, the percentages for each racial category were considered as the predictor variables while the total number of reversals was considered as the criterion variable. The assumptions of the linear regression analysis were tested. The predictor and criterion variables were continuous in nature. The samples were independent of each other because each county is independent of the other counties. The histogram presented in Figure 5 shows the normality of residuals. The histogram showed that the residuals were not normally distributed. Therefore, the violation on the assumption of normality was considered as a limitation of the study's results. Figure 6

shows the scatterplot of residuals vs predicted values showing that there is a linear relationship and no pattern is formed. Thus, the assumptions on linearity and homoscedasticity are met.

Figure 5

Histogram of Regression Standardized Residuals Using Racial Categories as Predictor and Total Number of Reversals as Dependent Variable

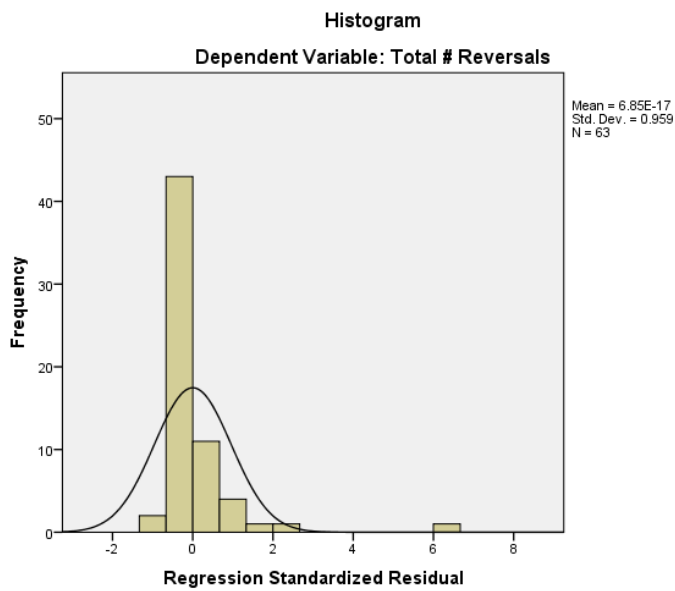
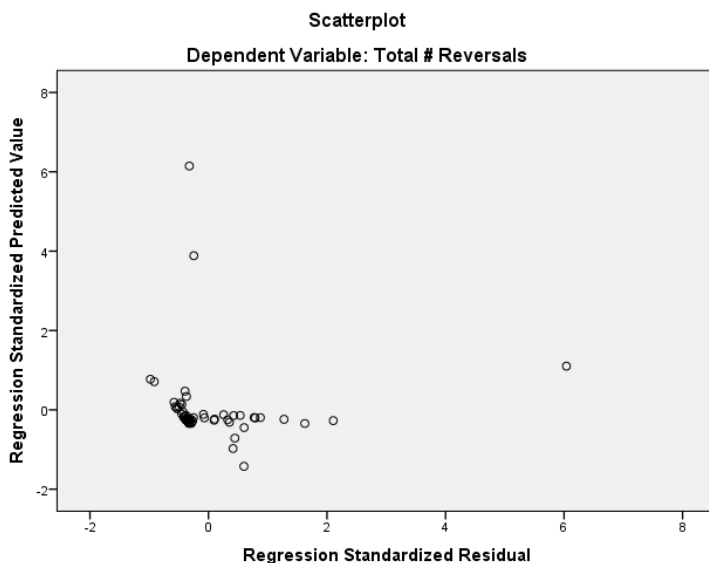


Figure 6

Scatterplot of Residuals vs Predicted Values Using Racial Categories as Predictor and Total Number of Reversals as Dependent Variable



The results of the regression analysis are presented in Tables 5 and 6. The ANOVA test results determined that the regression model was significant in predicting the total number of reversals in each county ($F(5,62) = 4.284, p = .002$). The regression coefficients presented in Table 6 show that none of the percentages of racial groups significantly predicted the total number of reversals in the counties ($p > .05$). Based on the R^2 value, the predictor explains 27.3% of the variance in the total number of reversals. The percentages of racial groups do not significantly relate to the total number of referrals. There is insufficient evidence to reject the null hypothesis which stated that there is no significant relationship between the predictor of race/ethnicity and the outcome of overdoses reversed using naloxone at the county level in Ohio.

Table 5*ANOVA Test Result for Percentages of Racial Groups as Predictor*

Model	Sum of squares	<i>df</i>	Mean square	<i>f</i>	<i>p</i>
1 Regression	865,226.890	5	173,045.378	4.284	.002 ^b
Residual	2,302,456.094	57	40,393.967		
Total	3,167,682.984	62			

Table 6*Regression Results for Percentages of Racial Groups as Predictors*

Model	Unstandardized coefficient		Standardized coefficients		
	<i>B</i>	<i>SE</i>	Beta	<i>t</i>	<i>p</i>
1 (Constant)	64.960	33.410		1.944	.057
% White	.926	1.701	.365	.545	.588
% Black	-9.201	13.397	-.619	-.687	.495
% American Indian	607.122	1,473.627	.521	.412	.682
% Asian	126.507	73.651	1.707	1.718	.091
% Native Hawaiian	-7,515.813	4,751.647	-1.530	-1.582	.119

To address the third research question, the population density was considered as the predictor variable while the total number of reversals was considered as the criterion variable. The assumptions of the linear regression analysis were tested. The predictor and criterion variables were continuous in nature. The samples were independent of each other because each county is independent of the other counties. The histogram presented in Figure 7 shows the normality of residuals. The histogram showed that the residuals were not normally distributed. Therefore, the violation on the assumption of normality was considered as a limitation of this study. Figure 8 shows the scatterplot of residuals vs

predicted values showing that there is a linear relationship and no pattern is formed.

Thus, the assumptions on linearity and homoscedasticity are met.

Figure 7

Histograms of Standardized Residuals Using Population Density as Predictor and Total Number of Reversals as Dependent Variable

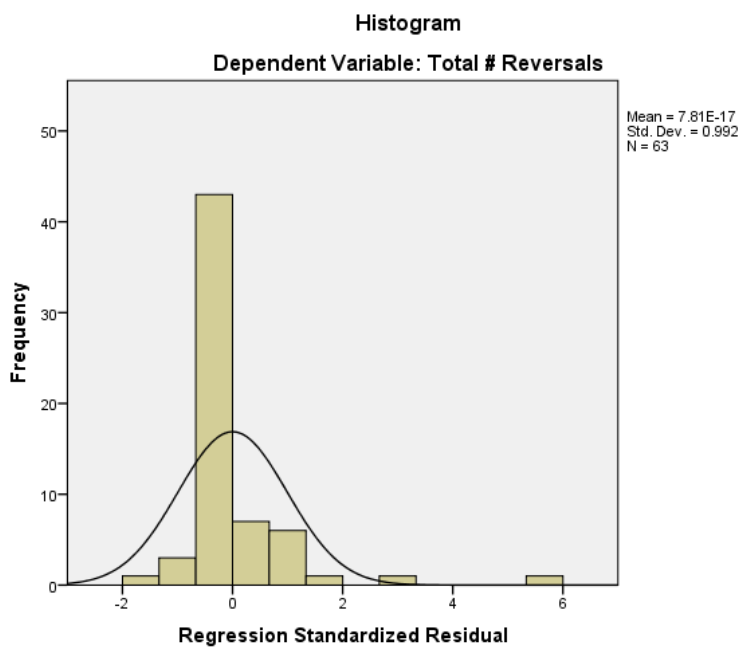
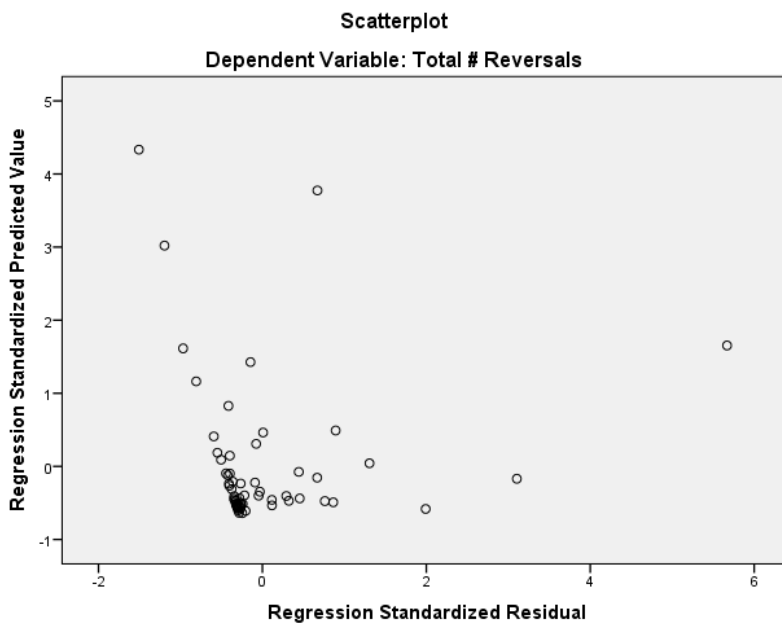


Figure 8

Scatterplot of Residuals vs Predicted Values Using Population Density as Predictor and Total Number of Reversals as Dependent Variable



The results of the regression analysis are presented in Tables 7 and 8. The ANOVA test results determined that the regression model was significant in predicting the total number of reversals in each county ($F(1,62) = 6.434, p = .014$). The regression coefficients presented in Table 8 show that the population density significantly predicted the total number of reversals in the counties ($B = .127, p = .014$). Based on the R^2 value, the predictor only explains 9.5% of the variance in the total number of reversals. Therefore, the population density significantly relates to the total number of referrals. There is sufficient evidence to reject the null hypothesis which stated that there is no

significant relationship between the predictor of population density and the outcome of overdoses reversed using naloxone at the county level in Ohio.

Table 7

ANOVA Test Result for Population Density as Predictor

Model	Sum of squares	<i>df</i>	Mean square	<i>f</i>	<i>p</i>
1 Regression	302,240.382	1	302,240.382	6.434	.014 ^b
Residual	2,865,442.602	61	46974.469		
Total	3,167,682.984	62			

Table 8

Regression Results for Population Density as Predictor

Model	Unstandardized coefficient		Standardized coefficients		<i>t</i>	<i>p</i>
	<i>B</i>	<i>SE</i>	Beta			
1 (Constant)	57.461	33.347			1.723	.090
Density	.127	.050	.309		2.537	.014

To address the fourth research question, the hospital per capita was considered as the predictor variable while the total number of reversals was considered as the criterion variable. The assumptions of the linear regression analysis were tested. The predictor and criterion variables were continuous in nature. The samples were independent of each other because each county is independent of the other counties. The histogram presented in Figure 9 shows the normality of residuals. The histogram showed that the residuals were not normally distributed. The violation of the assumption in normality of residuals was considered as a limitation of this study. Figure 10 shows the scatterplot of residuals

vs predicted values showing that there is a linear relationship and no pattern is formed.

Thus, the assumptions on linearity and homoscedasticity are met.

Figure 9

Histogram of Standardized Residuals Using Hospital per Capita as Predictor and Total Number of Reversals as Dependent Variable

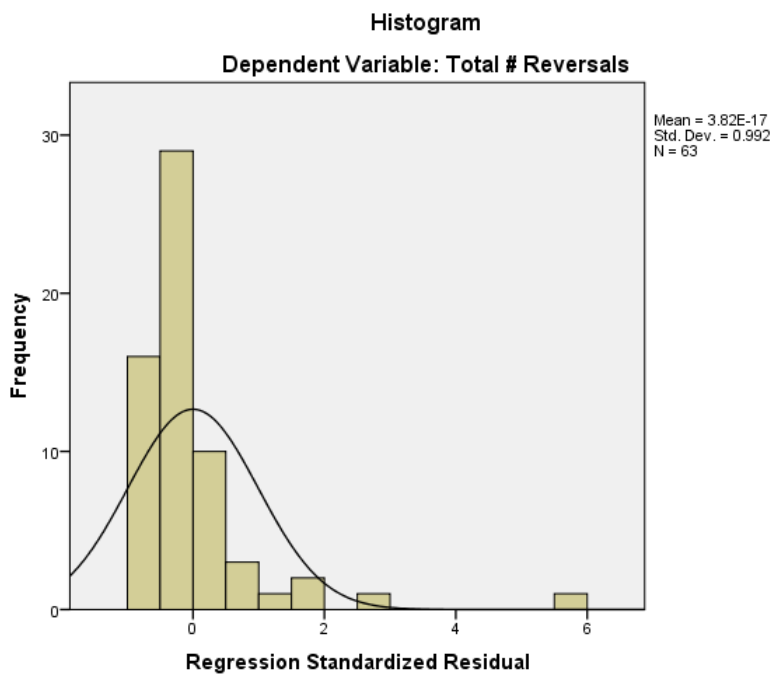
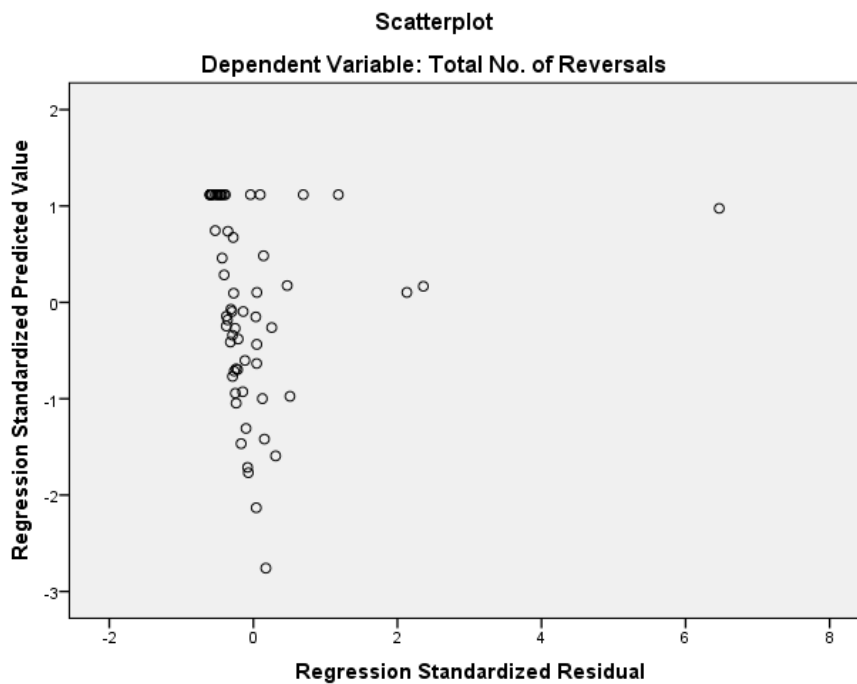


Figure 10

Scatterplot of Residuals vs Predicted Values Using Hospital per Capita as Predictor and Total Number of Reversals as Dependent Variable



The results of the regression analysis are presented in Table 9 and 10. The ANOVA test results determined that the regression model was insignificant in predicting the total number of reversals in each county ($F(1,62) = 1.063, p = .307$). The regression coefficients presented in Table 10 show that the hospital per capita did not significantly predict the total number of reversals in the counties ($B = -23.445, p = .307$). Based on the R^2 value, the predictor only explains 1.7% of the variance in the total number of reversals. Therefore, the hospital per capita does not significantly relate to the total number of referrals. There is insufficient evidence to reject the null hypothesis which stated that there is no significant relationship between the predictor of healthcare

availability and the outcome of overdoses reversed using naloxone at the county level in Ohio.

Table 9

ANOVA Test Result for Hospital per Capita as Predictor

Model	Sum of squares	<i>df</i>	Mean square	<i>f</i>	<i>p</i>
1 Regression	54,256.119	1	54,256.119	1.063	.307
Residual	3,113,426.865	61	51,039.785		
Total	3,167,682.984	62			

Table 10

Regression Results for Hospital per Capita as Predictor

Model	Unstandardized coefficient		Standardized coefficient		<i>t</i>	<i>p</i>
	<i>B</i>	<i>SE</i>	Beta			
1 (Constant)	139.074	42.874			3.244	.002
Hospital per capita	-23.445	22.740	-.131		-1.031	.307

To address the fifth research question, a hierarchical regression analysis was conducted to determine whether the amount of Naloxone significantly moderates the relationship of the predictors and the total number of reversals in the counties in Ohio. The interaction of the amount of Naloxone with each of the predictors were calculated and inputted as a predictor in the second model. The results of the hierarchical regression analysis are presented in Tables 10 and 11. As observed, the ANOVA test results determined that the regression model significantly predicts the dependent variable ($F(13, 62) = 14.704, p < .01$). Based on the regression coefficient results, the amount of

Naloxone significantly moderates the relationship between household income and total reversals, population density and total reversals, and hospital per capita and total reversals. The R-squared value of .796 determined that the predictors explain 79.6% of the variance in the total number of reversals. Therefore, there is sufficient evidence to reject the null hypothesis which stated that there is no significant moderation effect for any of RQ1-4.

Table 11

ANOVA Test Result for the Amount of Naloxone as the Moderating Variable

Model		Sum of squares	<i>df</i>	Mean square	<i>f</i>	Sig.
1	Regression	1,377,439.810	8	172,179.976	5.194	.000
	Residual	1,790,243.174	54	33,152.651		
	Total	3,167,682.984	62			
2	Regression	2,521,355.719	13	193,950.440	14.704	.000
	Residual	646,327.265	49	13,190.352		
	Total	3,167,682.984	62			

Table 12*Regression Results for the Amount of Naloxone as the Moderating Variable*

Model	Unstandardized coefficient		Standardized coefficient		Sig.
	<i>B</i>	<i>SE</i>	Beta	<i>t</i>	
1 (Constant)	377.081	145.158		2.598	.012
Density	.277	.077	.672	3.591	.001
Median household income	-.005	.002	-.355	-2.686	.010
% White	4.049	1.906	1.594	2.124	.038
% Black	-34.994	14.073	-2.353	-2.487	.016
% American Indian	-2,144.345	1,510.278	-1.839	-1.420	.161
% Asian	261.179	80.328	3.525	3.251	.002
% Native Hawaiian	-2,998.610	4,479.897	-.610	-.669	.506
Hospital per capita	-5.518	19.086	-.031	-.289	.774
2 (Constant)	134.652	103.292		1.304	.198
Density	.202	.127	.489	1.582	.120
Median household income	-.003	.002	-.199	-1.942	.058
% White	1.830	1.511	.721	1.211	.232
% Black	-6.803	13.494	-.457	-.504	.616
% American Indian	-2284.133	1,192.790	-1.958	-1.915	.061
% Asian	111.518	107.393	1.505	1.038	.304
% Native Hawaiian	-2,795.560	5,405.918	-.569	-.517	.607
Hospital per capita	21.469	15.083	.120	1.423	.161
Income naloxone	4.612E-06	.000	3.064	8.968	.000
Density naloxone	-9.611E-05	.000	-1.046	-5.061	.000
Hospital naloxone	-.048	.021	-.319	-2.287	.027
Asian naloxone	.022	.021	4.536	1.065	.292
Haloxon	-1.855	1.178	-5.747	-1.575	.122

Summary

A total of 63 counties in Ohio were included in the analyses. The 63 counties were the counties with 2020 data in Project DAWN. The year 2020 was selected because the US Census data utilized in the study were also collected in the year 2020. Through the assumptions testing, the assumption on normality of residuals was violated in the linear regression analysis. Therefore, this was considered as a limitation in drawing conclusions for the study. The results of the analysis determined that there is no significant relationship between median household income and the total number of reversals. There is also no significant relationship between racial groups and the total number of reversals as well as the hospital per capita and the total number of reversals. A significant relationship was determined between population density and the total number of reversals. The results determined that only population density was significantly related to the total number of reversals. Based on the regression analysis, a unit increase in population density results to 0.127 increase in the total number of reversals. The results of the hierarchical regression analysis determined that the Naloxone is a significant moderator for predictors household income, population density, and hospital per capita and the total number of reversals. A significance level of .05 was utilized for all analyses. Section 4 includes a detailed discussion of the interpretation of findings, limitations, and recommendations for future practice and research, and conclusions of the study.

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

The purpose of this quantitative historical correlational study was to examine the relationship between community-level factors—SES, race/ethnicity, population density, and health care availability—and the successful reversal of opioid overdoses using naloxone in Ohio counties, while considering the moderating role of naloxone distribution. The study was conducted to address gaps in understanding how these community determinants influence naloxone distribution and opioid overdose outcomes, with the goal of informing more effective public health interventions.

Key Findings

Population density was the only community factor significantly associated with the number of naloxone overdose reversals at the county level. The amount of naloxone distributed significantly moderated the relationships between household income, population density, hospital per capita, and overdose reversals, explaining a substantial portion of the variance in outcomes.

Interpretation of Findings

This study's findings support and extend previous research linking naloxone access and opioid overdose prevention to structural and demographic determinants to naloxone access and use. Consistent with Pérez-Figueroa et al. (2023), counties with lower SES had lower reversal rates, highlighting persistent inequities. The significant association between population density and overdose reversals aligns with research indicating that urban areas, with higher population densities, tend to have better access to health care resources and emergency services, leading to more effective overdose

interventions (Chatterjee et al., 2022). Similarly, rural counties, often characterized by low population density, experienced lower rates of successful reversals, affirming research by Nesoff et al. (2022) and Yi et al. (2022). The lack of a significant direct relationship between SES and overdose reversals contrasts with prior studies that found lower SES to be a barrier to naloxone access. However, the current study's finding is consistent with more recent research suggesting that other factors, such as targeted distribution and community outreach, may mitigate SES disparities in certain contexts (Pérez-Figueroa et al., 2023).

The absence of a significant effect for race/ethnicity and hospital per capita is notable because previous studies documented disparities in naloxone access among racial/ethnic minorities and in areas with fewer health care facilities. This suggests that, at least in Ohio in 2020, these disparities may have been less pronounced or offset by statewide initiatives such as Project DAWN (Van Arsdale et al., 2025). Although race/ethnicity was expected to play a significant role, results were mixed and appeared to interact with other factors such as SES and healthcare infrastructure. This finding adds nuance to research by Khan et al. (2023) and Takemoto et al. (2022), who found racial disparities in naloxone access and education. The moderating effect of naloxone distribution confirmed that supply alone is insufficient; systemic barriers must also be addressed (Smart et al., 2024). It also emphasizes the importance of widespread naloxone availability in improving overdose outcomes, regardless of baseline community characteristics.

Findings and Theoretical Framework

The study is grounded in and aligns with the tenets of the social-ecological perspective (Bronfenbrenner, 2000), which posits that individuals exist within interconnected systems - microsystems, mesosystems, exosystems, macrosystems, and chronosystems where health outcomes are shaped by interactions across multiple layers of influence, from individual to societal. The finding that population density is a significant predictor supports the framework's emphasis on environmental and community-level determinants of health (Nolen et al., 2022). The moderating role of naloxone distribution highlights the importance of structural interventions (macrosystem/exosystem levels) in shaping health outcomes, reinforcing the value of policies that ensure broad access to life-saving medications (Freiermuth et al., 2023).

This framework was instrumental in interpreting the interplay between SES (exosystem), population density (mesosystem), race/ethnicity (microsystem), and healthcare infrastructure (macrosystem). The lack of significant direct effects for SES, race/ethnicity, and hospital per capita suggests that, within the context of a robust statewide program, some traditional disparities may be mitigated - an insight that extends the application of the social-ecological model to real-world public health interventions (Lemen et al., 2024). The significant interaction between naloxone distribution and these factors reflects the chronosystem level, indicating that the effects of public health interventions are mediated by time and context. The findings reinforce the value of the social-ecological perspective for understanding and addressing community-level health disparities in opioid overdose outcomes (Bayly et al., 2025; Hawk et al., 2021).

Findings and Knowledge Extension

This study contributes to public health by providing empirical evidence that community-level variables significantly influence naloxone effectiveness. By quantifying these associations using a large secondary dataset, the research fills a critical gap identified by Chatterjee et al. (2022) and Vadiiei et al. (2024). It demonstrates that population density remains a key determinant of naloxone effectiveness, underscoring the need for tailored interventions in rural versus urban settings (Paul et al., 2024). It also highlights the need for place-based naloxone distribution strategies that go beyond quantity to address accessibility barriers. These findings support the development of data-driven interventions targeted at high-need communities and may guide future programming at state and local health departments (Newman et al., 2025).

Providing evidence that broad distribution of naloxone can serve as an equalizer, significantly enhancing overdose reversal rates even in communities with varying SES, racial composition, or healthcare infrastructure (Chatterjee et al., 2022). The study highlights the potential for statewide programs to reduce traditional disparities in access and outcomes, supporting calls for policy-level solutions to the opioid epidemic (Smart et al., 2024). In addition, this research reinforces the necessity of integrating community-level equity indicators into overdose prevention efforts. There is also a need to further compare the outcome of these studies with other existing ones.

Limitations of the Study

This study is subject to several limitations. First, reliance on the Project DAWN dataset limited control over data collection processes and potential inconsistencies in

reporting. The use of a correlational design prohibits causal inference. Although statistical associations were found, the results do not confirm that community characteristics cause naloxone overdose reversals. Using county-level data may obscure intra-county disparities. For example, urban counties often contain high-resource and low-resource neighborhoods. Secondary data analysis relied on existing datasets, which may have limitations in data accuracy, completeness, and variable operationalization (Freiermuth et al., 2023). Blocks of single-year analysis limit the ability to assess trends over time or the impact of evolving policies and practices (Lemen et al., 2024). County-level aggregation of data may obscure important within-county variations and does not capture individual-level determinants (Paul et al., 2024). Some regression analyses violated the assumption of normality, which may affect the robustness of statistical inferences (Nolen et al., 2022). Finally, generalizability is limited to the state of Ohio and may not apply to other geographic contexts with different policies or demographic characteristics.

Recommendations for Future Research

Based on the findings and limitations, several recommendations for future research are warranted. Future research should examine multi-year data to assess trends and the long-term impact of naloxone distribution programs through longitudinal studies (Van Arsdale et al., 2025). Studies at the neighborhood or census tract level may uncover disparities masked by county-level analysis by employing finer geographic granularity (Pérez-Figueroa et al., 2023). Qualitative research could incorporate methods to provide deeper insight into barriers and facilitators of naloxone access in specific communities

(Chatterjee et al., 2022). Comparative studies of different state or regional naloxone distribution models would help identify the best practices for reducing opioid overdose deaths (Smart et al., 2024).

Public Health Practice and Field-Based Products

This research supports the development of field-based products for public health use. Health departments should implement geospatial mapping tools that layer SES, race/ethnicity, and healthcare access to guide naloxone distribution strategies. Localized training and education efforts should prioritize areas where overdose reversal rates are lowest, despite high naloxone distribution. Additionally, partnerships with community-based organizations, mobile health clinics, and pharmacies in low-resource settings should be strengthened to enhance naloxone reach and utilization.

Public health agencies should continue to expand naloxone distribution, especially in areas with lower population density and limited healthcare infrastructure (Lemen et al., 2024). Programs should be adapted to address the unique needs of rural and urban communities to ensure equitable access to overdose reversal resources (Paul et al., 2024). Regular evaluation of naloxone distribution programs is essential to identify gaps and optimize allocation strategies through continuous monitoring (Freiermuth et al., 2023).

Professional Practice and Social Change Implications

The findings offer several implications for professional public health practice and broader social change. First, they underscore the importance of integrating social determinants of health into overdose prevention planning. Public health professionals must go beyond distribution volume and examine who is being reached, who is left out,

and why. Promoting equity by implementing policies that prioritize equitable access to naloxone, particularly through publicly funded initiatives, would be helpful (Van Arsdale et al., 2025). Empowering communities through training and educating them on naloxone distribution to maximize community capacity for overdose response could be invaluable (Pérez-Figueroa et al., 2023). Findings can guide policymakers in designing interventions that address both structural and community-level determinants of opioid overdose outcomes (Chatterjee et al., 2022). Finally, this study highlights the need for structural equity approaches in naloxone programming, including anti-racist health practices, community empowerment, and targeted funding allocations. These efforts can lead to more equitable health outcomes and reduce mortality in the most vulnerable populations.

Conclusion

This study was conducted using an appropriate and rigorous methodology. A historical, correlational quantitative design with secondary data from Project DAWN provided a reliable foundation for exploring the influence of community-level factors on naloxone overdose reversal outcomes in Ohio. The methods and procedures were executed appropriately, and the results were clearly aligned with the research purpose and questions. Conclusions, limitations, and recommendations are well-integrated with the current state of knowledge and are relevant to improving health practice outcomes (Smart et al., 2024). The methods aligned with the research questions and hypotheses, and the data analysis yielded statistically valid results. The conclusions drawn are consistent with the literature and within the scope of the data.

The findings are ready for dissemination to the broader public health community and are amenable to peer review. The implications for social change are clear: equitable naloxone access can save lives, and targeting interventions based on structural determinants is critical to reducing opioid-related mortality. Expanding naloxone access through state programs, and possibly, nationwide, can reduce opioid overdose deaths and promote health equity (Nolen et al., 2022). This research has the potential to influence public health practice and policy, contributing to the ongoing effort to address the opioid epidemic and improve population health outcomes. Moreover, it contributes to the growing body of knowledge around health equity in opioid overdose prevention. This dissertation contributes to a timely, evidence-based resource for stakeholders invested in transforming opioid overdose prevention strategies and enhancing public health outcomes (Paul et al., 2024).

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