MEASURING COMMUNITY IMPACTS OF THE OPIOID EPIDEMIC

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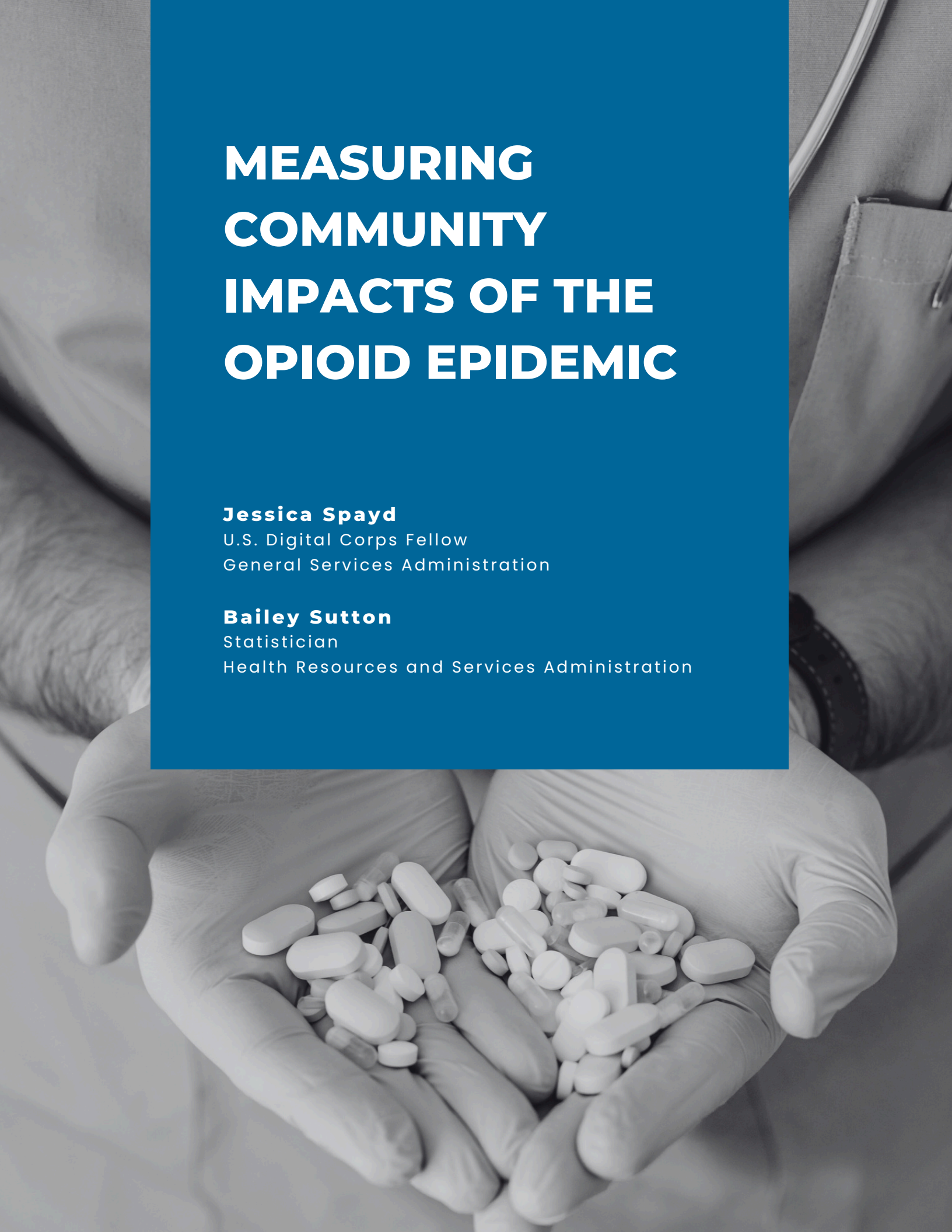

Measuring Community Impacts of the Opioid Epidemic

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Abstract

Over the last decade, the opioid epidemic has ravaged communities across the United States, leading to significant public safety and public health concerns. Despite the widespread devastation of this epidemic, models seeking to measure its causes and effects have primarily been limited to individual-level metrics, like usage and death rates. Our project identifies an alternate measure, the NFLIS-Drug state labs positive reports for opioids, to better assess the impact at the community-level. We use variables from FQHCs to model the impacts on communities rather than individuals. Our models find that the total reports positive for opioids measure may be more effective than death rate at evaluating the impact of the opioid epidemic, and that FQHCs play a vital role at minimizing the negative consequences of opioid addiction.

Introduction

The opioid epidemic has affected communities across the United States for the past several decades. In 2017, the Department of Health and Human Services (HHS) declared it to be a public health emergency.[1] While the individual impacts of this crisis are significant, the community-level impacts are even greater. However, these impacts are understudied despite significant investments into community-based programs.

As recent as March 2024, HHS has committed millions of dollars into opioid treatment and recovery initiatives through grants to community health centers.[2] The Health Center Program is made up of over 1,400 federally qualified health centers (FQHC) in underserved communities across the United States and its territories.[3] These health centers are vital for addressing health crises such as the opioid epidemic.

Existing research on policy interventions to address the opioid epidemic generally focus on individual-level outcomes such as rates of opioid use, overdoses attributed to opioids, or death following an opioid-related overdose.[4] While these metrics are useful for understanding the micro-level effects of an intervention, they fail to assess macro-level effects. Further, there are often significant challenges when measuring these variables, leading to questions regarding the accuracy of study results.[4]

Methodology

This project seeks to examine methods of measuring the opioid epidemic at the community-level. We have doubts that deaths attributed to opioid use is the best way to measure the macro-level effects of the opioid epidemic and seek to identify alternate measures that will be more sensitive to local, rather than individual, factors.

Specifically, this project compares the drug overdose death rate, via the National Center for Health Statistics' (NCHS) Underlying Cause of Death dataset,[5,6] and the total state laboratory reports that were positive for opioids, via the National Forensic Laboratory Information Systems (NFLIS) Public Data,[7] to assess whether the latter is as or more representative of community-level opioid use rates than the former. We believe that the total reports positive for opioids has the potential to gauge persistent, habitual opioid use more accurately within communities than deaths.

Our key independent variable operationalizes community-based treatment of opioid use disorder. We assessed several potential metrics: the number of patients with a diagnosed substance use disorder, the number of visits associated with a substance use diagnosis, the number of patients receiving medication-assisted treatment (MAT) for opioid use disorder, and opioid treatment and recovery services spending at FQHCs by state, via the Health Resources and Services Administration's (HRSA) Uniform Data System (UDS).[8] However, UDS opioid treatment and recovery services spending data was sparse, and ultimately

did not appear to have a statistically significant impact on either drug overdose death rates or total lab reports positive for opioids. Therefore, we chose not to include spending data in our final analysis.

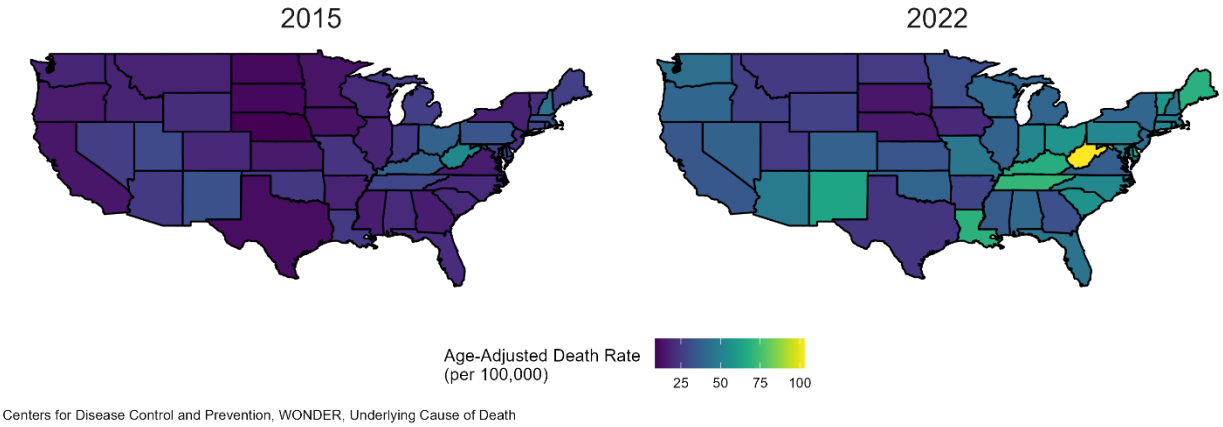
Our research consists of two fixed effects models with data from 2015-2022, one with the drug overdose death rate by state as the outcome variable and the other with the total state laboratory reports that were positive for opioids. Because data collection for our MAT variable began in 2016, models with that variable include data from 2016-2022. Control variables from the U.S. Census Bureau's American Community Survey (ACS)[9] are included to mitigate potential confounding factors and fixed effects account for temporal and state-based variations in the data.

Data Sources

The variable for the drug overdose death rate was drawn from the NCHS's Underlying Cause of Death dataset. The bridged-race categories dataset was used for the 2015-2017[5] data and the single-race categories dataset was used for 2018-2022[6]. The death rate by state is based on death records received and processed by the National Center for Health Statistics (NCHS) using cause-of-death ICD-10 codes and is limited to individuals aged 15 and older. It is adjusted to account for the underlying age distribution within the state population at the time. The ICD-10 codes used for our analysis are in line with CDC publications on drug overdose deaths using this data.[10]

Deaths as a result of drug overdoses are a concern across the country. Between 2015 and 2022, the drug overdose death rate nearly doubled from 22.6 deaths per 100,000 to 43.8. Figure 1 shows the age-adjusted death rate by state for these years.

Figure 1: Deaths Due to Drug Overdose



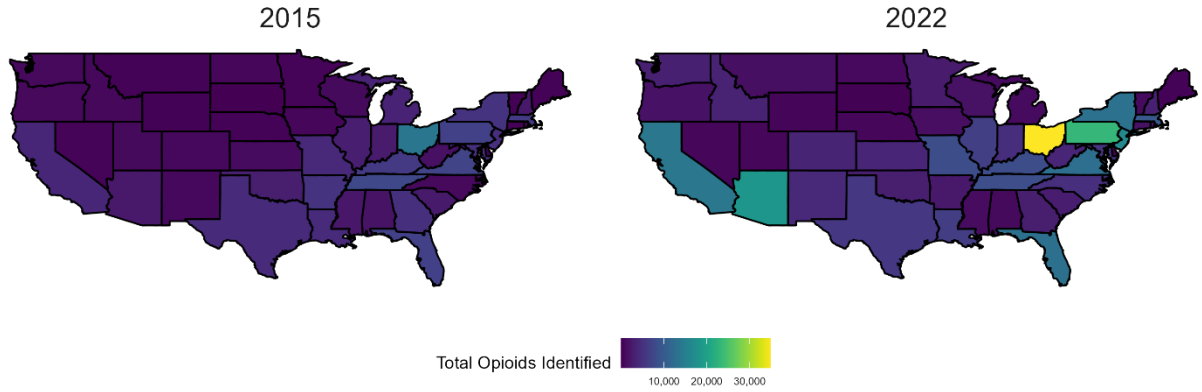
Centers for Disease Control and Prevention, WONDER, Underlying Cause of Death

The total opioid-positive laboratory results were drawn from the Drug Enforcement Administration's (DEA) NFLIS-Drug public dataset.[7] This data tracks drugs identified by federal, state, and local forensic laboratory reports following law enforcement operations. Our dependent variable is the total count of substances containing narcotic analgesics, which include opioids, for a given year as listed in the NFLIS-Drug Annual Report. However, the public dataset only includes the 60 most frequently reported substances each year, therefore the drugs included vary year to year. A full table of the included opioids for each year is included in Appendix A.

Like the drug overdose death rate, the total reports for substances testing positive for opioids increased dramatically between 2015 and 2022. In 2015, the total reports averaged at about 2,500 across the fifty states and DC, while in 2022 this number ballooned to just over 5,200. Figure 2 captures this data by state

across the two years. The similar rate of increase to the drug overdose death rate makes it good candidate for an alternate measure of the opioid epidemic.

Figure 2: Total Opioids Identified by NFLIS-Drug Laboratories



U.S. Department of Justice, Drug Enforcement Agency, NFLIS-Drug Public Data

Our three independent variables, the total number of substance use disorder patients, substance use disorder visits, and MAT patients at FQHCs were drawn from HRSA's Health Center Program UDS data.[8] This annual dataset collects information regarding the patients served by and services rendered at FQHCs. Because the number of MAT patients was not included in UDS collection until 2016, models including this variable include data from only 2016-2022.

Variables from the ACS[9] were included to control for social, economic, and demographic characteristics. The selected variables in this study are the estimated counts of individuals 15 years or older and/or households for the following characteristics: age, sex, race, ethnicity, disability status, veteran status, educational level, employment status, health insurance coverage, household income, poverty, SNAP benefits receipt, and total population. The estimates are only conducted for geographies with a population of 65,000 or more. Furthermore, 2020 ACS data are experimental estimates to address nonresponse bias during the COVID-19 pandemic.

All data is defined at the state-year level for all fifty U.S. states and the District of Columbia.

Results

The primary objective of our analysis is to evaluate whether the total positive reports for opioids by state is an effective metric to measure the opioid epidemic compared to the typical drug overdose death rate.

Table 1 contains the results of our base models with the age-adjusted drug overdose death rate as the dependent variable. The only statistically significant variable across all models was MAT patients. As the total number of patients that received medication-assisted treatment at FQHCs increased by one, on average there was an increase in the drug overdose death rate of 0.001 when controlling for demographic factors. This result was statistically significant at the 10% level and the same in our multi-variate fixed effects model.

Table 1. Time-Entity Fixed Effects Regression Results

	Dependent variable:			
	Age-Adjusted Drug Overdose Death Rate			
	(1)	(2)	(3)	(4)
SUD Visits	-0.00004 (0.00003)			0.00002 (0.00002)
SUD Patients	0.0003 (0.0003)		0.0003 (0.0002)	
MAT Patients	0.001* (0.0004)	0.001* (0.0004)		
Observations	357	357	408	408
R^2	0.245	0.240	0.172	0.168
Adjusted R^2	-0.050	-0.048	-0.094	-0.100

*p<0.1; **p<0.05; ***p<0.01

Table 2 includes the results of our comparison models that used the total number of reports indicating a positive test for opioids as the dependent variable. Nearly all the models tested had statistically significant key independent variables of interest.

As the total number of patients that received MAT at FQHCs increased by one, on average there were 0.202 fewer positive reports for opioids to the NFLIS, when controlling for demographic factors, substance use disorder visits and substance use disorder patients. This result was statistically significant at the 5% level.

As the total number of substance use disorder patients at FQHCs increased by one, on average there were 0.388 more positive reports for opioids, when controlling for demographic factors. This result was statistically significant at the 1% level. In the multi-variate model, this association drops by approximately one-third while maintaining significance, but at the 10% level.

As the total number of substance use disorder visits at FQHCs increased by one, on average there were 0.050 more positive reports for opioids, when controlling for demographic factors. This result was statistically significant at the 1% level. Like the total substance use disorder patients variable, this relationship also decreases in magnitude, although not as extremely, in the multi-variate model while still being statistically significant at the 1% level.

Table 2. Time-Entity Fixed Effects Regression Results

	Dependent variable:			
	NFLIS Opioid-Positive Substance Reports			
	(1)	(2)	(3)	(4)
SUD Visits	0.032*** (0.008)			0.050*** (0.005)
SUD Patients	0.132* (0.071)		0.388*** (0.045)	
MAT Patients	-0.202** (0.095)	0.025 (0.100)		
Observations	357	357	408	408
R^2	0.536	0.423	0.530	0.551
Adjusted R^2	0.354	0.203	0.379	0.406

*p<0.1; **p<0.05; ***p<0.01

Discussion

Our models demonstrate the importance of identifying alternate methods of measuring the opioid epidemic. The drug overdose death rate is by and large the most common way of measuring this, but it only captures the most extreme outcome of opioid addiction. The opioid epidemic has far-greater consequences than just death. By instead using the number of NFLIS-Drug positive reports for opioids, our models were more sensitive to changes in the presence of opioids within communities. This is further underscored by the fact that we could not determine a statistically significant relationship between either the number of substance use disorder patients at FQHCs or the number of substance use disorder visits and the drug overdose death rate, but we were able to identify relationships for both variables and the number of positive reports for opioids. This indicates that changes in the number of patients seeking care for substance use disorders do not have a relationship with the drug overdose death rate, but they do with the presence of opioids in a community.

Further, our models underscore how vital community-based care is for treating this epidemic. Our measure of the total patients receiving MAT from FQHCs had an inverse relationship to the total positive reports for opioids. This implies that a greater presence of opioids in communities is not necessarily spillover from patients receiving MAT. The inverse is also true; patients receiving MAT at FQHCs is related to fewer opioids found in confiscated substances in that state. Further, the number of patients receiving MAT seems to have a reducing effect on the number of patients and visits for substance abuse disorder, with both of those variables seeing a reduction in magnitude when included with the MAT variable. This is a significant conclusion and worth greater analysis as MAT continues to be a widely used method of treating opioid addiction at FQHCs.

Limitations

There are several limitations and concerns with the data included in these models that may influence our results. First, not all the data were able to be limited to opioid use and opioid-related effects. The age-adjusted drug overdose death rate and both substance use disorder variables capture all substances, not just opioids. Therefore, it is not a 1:1 comparison with our opioid-limited variables and a significant barrier to accurate measurements in our models.

Second, the NFLIS-Drug public data is limited to the top 60 most common substances each year. Therefore, our analysis was unable to capture the total opioids reported each year and the types of substances included varies year to year. This limits our ability to compare year-over-year totals and introduces unnecessary bias.

Further, data from the UDS dataset is aggregated at the FQHC-level and does not track individual patient outcomes. Therefore, because multiple years and different variables are included, it cannot be determined if year-to-year the same patient population is represented, or if the same patients are counted more than once across each of the three UDS variables. Additionally, these data are linked to state based on where the FQHC is located, not where the patient resides. Finally, some FQHCs have their totals suppressed either for patient privacy or because the health center's data is confidential. All of these factors may have introduced bias into the models.

Additionally, while we believe the total state laboratory reports that were positive for opioids measure has the potential to capture persistent opioid use that does not lead to death within communities, there are more intermediary steps between individual opioid use and increased positive reports for opioids than individual-level measures, such as death. Therefore, while we saw great outcomes in our positive reports for opioids models, it is likely they contain greater bias than the drug overdose death rate ones.

Finally, while a fixed effects model minimizes bias, it cannot eliminate it in the way that models based on some degree of randomization can. As a result, the findings in this analysis are limited to relationships and correlations rather than causal linkages.

Recommendations

This analysis identifies significant possibilities for innovation in measuring and treating the opioid epidemic. Not only did we demonstrate that drug overdose death rates may not be the most effective way to assess community-level impacts of opioid use, but we also showed that federally-qualified community health centers are at the forefront of treating those suffering from opioid addiction. Both results provide opportunities for further analysis into other potential measures and ways of evaluating opioid addiction treatment and recovery.

Through this project, we also identified several areas for improvement, especially within data collection. Several of our limitations were the result of incomplete public files or a lack of specificity allowing us to narrow in on opioid use rather than substance use overall. We hope that our work shows the importance of providing full and complete datasets to the public related to the opioid epidemic in order to reduce bias and spur continued research and innovation in this area.

Finally, our project shows the importance of partnerships between public safety and public health organizations. The opioid epidemic affects every community in the United States and requires intervention, investment, and innovation across a variety of sectors. We hope that our work will foster a holistic, community-oriented partnership between the public safety and public health sectors in tackling this epidemic.

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Appendix A: Drug Inclusion by Year

	2015	2016	2017	2018	2019	2020	2021	2022
4-Fluoroisobutyryl fentanyl			X	X				
6-Monoacetylmorphine			X	X	X	X		
Acetyl fentanyl	X	X	X	X	X	X	X	X
Acryl fentanyl			X					
Buprenorphine	X	X	X	X	X	X	X	X
Carfentanil		X	X		X	X		
Codeine	X	X	X	X	X	X	X	X
Cyclopropyl fentanyl			X	X				
Fentanyl	X	X	X	X	X	X	X	X
Fluorobutyryl fentanyl (unspecified isomer)								X
Fluorofentanyl							X	X
Fluorofentanyl (unspecified isomer)								X
Fluoroisobutyryl fentanyl				X				
Furanyl fentanyl		X	X					
Hydrocodone	X	X	X	X	X	X	X	X
Hydromorphone	X	X	X	X	X	X		
meta-Fluorofentanyl								X
Methadone	X	X	X	X	X	X	X	X
Methoxyacetyl fentanyl				X				
Metonitazene							X	
Morphine	X	X	X	X	X	X	X	X
ortho-Fluorofentanyl								X
Oxycodone	X	X	X	X	X	X	X	X
Oxymorphone	X	X	X	X				
para-Fluorofentanyl							X	X
Tramadol	X	X	X	X	X	X	X	X
U-47700			X					
Valeryl fentanyl					X			