Article

Criminal Justice Policy Review
1–26

DOI: 10.1177/0887403420911415
journals.sagepub.com/home/cjp
SAGE

Opioids, Race, and Drug Enforcement: Exploring Local Relationships Between Neighborhood Context and Black–White Opioid-Related Possession Arrests

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Abstract

Opioid abuse has redefined drug problems in communities and shifted police activities to redress substance use. Changing neighborhood context around opioid issues may affect arrests and racial disparities in their imposition. This study presents a spatial analysis of arrests involving Blacks and Whites for possession of heroin, synthetic narcotics, and opium offenses. We identify the ecological conditions associated with opioid-related arrests using geographically weighted regression (GWR) methods that illuminate local patterns by allowing coefficients to vary across space. GWR models reveal spatial and racial differences in opioid-related possession arrest rates. Calls for police service for overdoses increase White arrests in more advantaged, rural communities. Economic disadvantage and racial diversity in neighborhoods more strongly elevate possession arrest rates among Blacks relative to Whites. Overdose calls predict Black arrests in poorer urban areas. Findings underscore police responsiveness to opioid problems and Black–White differences in how opioid users interact with the criminal justice system.

Keywords

drug enforcement, race, spatial analysis, policy mapping, opioids

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Drug enforcement has long been marked by problems of racial disparity (Alexander, 2010; Lynch, 2012; Mauer, 1999; Tonry, 1994). Since the beginning of the War on Drugs, Blacks and Latinos disproportionately face arrests for drug possession and dealing offenses relative to their representation in the general population (Provine, 2011). Despite declining crime and incarceration rates (Kaeble & Cowhig, 2018), disparities continue in criminal processing for drug crimes. About a quarter of all drug arrests (Federal Bureau of Investigation, 2018) and almost a third of defendants sentenced to prison for drug possession alone involve Blacks (Carson, 2018). Because arrests loosely correspond with drug involvement among individuals (Johnston et al., 2018; Mitchell & Caudy, 2015), scholarship looks for ecological patterns of arrests and contributors to disparities within neighborhoods (Beckett et al., 2006; Gaston, 2019; Omori, 2017).

Opioid abuse in the past decade has transformed drug interdiction efforts and priorities in addressing substance abuse within communities (K. D. Wagner et al., 2015), giving scholars a reason to reexamine racial disparities among drug arrests. Police departments increasingly serve as first responders to overdose incidents (Davis et al., 2015; Pearlman, 2016) and use their powers to divert people struggling with opioid addiction into treatment (Green et al., 2013; Purviance et al., 2017). Opioid users arguably differ from other drug users in the past, as heroin and prescription opioid users are older, more female, and more White as well as live in more rural areas (Jalal et al., 2018; Keyes et al., 2014; Lankenau et al., 2012). By implication, police officers may be coming into contact with drug users residing in different communities than those historically policed for drug offenses. Hence, we seek to provide a diagnostic of emerging opioid-related arrest patterns and their potential sources under these different conditions of opioid abuse, rather than test for changes in policing practices themselves.

Research has not yet examined the ecological conditions that shape opioid-related possession arrests and racial disparities in their imposition. Scholars have traditionally identified economic disadvantage and racial discrimination as the main drivers of disparate drug arrest patterns. Economic disadvantage can create disparities, as limited means and resources encourage the sale or use of illegal substances in the most deprived communities (Sampson & Wilson, 1995). Due to a close relationship between socioeconomic inequality and segregation (Peterson & Krivo, 2010), racial differences in arrests thus reflect the disparate impact of socioeconomic stratification on communities of color (Engel et al., 2012). Conversely, prejudice, bias, and perceptions of threat among Whites cause oversurveillance and overpolicing of non-Whites (Unnever & Gabbidon, 2011). Disparities then emerge from discriminatory drug enforcement rather than racial differences in drug involvement or the presence of drug market activities in communities (Tonry & Melewski, 2008). Studies of drug arrests in major U.S. cities provide empirical support for the roles of economic disadvantage (Parker & Maggard, 2005) and racial discrimination (Beckett et al., 2005, 2006; Gaston, 2019; Omori, 2017) in shaping arrest disparities.

The purpose of this study is to identify the social conditions contributing to race-specific opioid-related possession arrest rates in communities across the State of

Delaware. We define opioid-related arrests as those involving the illegal possession of heroin, synthetic narcotics, and other opium derivatives. We evaluate local differences in the contextual drivers of opioid-related possession arrests between Whites and Blacks through a spatial analysis of block groups. We focus on the roles of economic disadvantage and racial composition of communities in forging arrest patterns. We also examine the relationship between calls for police service for overdoses and drug arrests to analyze how drug enforcement responds to drug problems within communities.

Our study detects spatial patterns in opioid-related possession arrests by relying on a statistical method called geographically weighted regression (GWR). The approach allows us to test whether opioid-related arrest patterns are equally distributed across neighborhoods and, more importantly, whether the relationships between environmental conditions and arrests vary by race and space. In turn, GWR yields a more nuanced understanding of the sources of Black–White differences in arrest trends across a larger, heterogeneous geographic area (i.e., the entire State of Delaware). We contribute to scholarship by then (a) evaluating traditional environmental sources in contributing to opioid-related arrest patterns, (b) examining local drug arrest outcomes in and outside of urban centers, and (c) illuminating emerging disparities in the law enforcement of opioid-related possession offenses. Our study concludes with directions for policing in response to opioid problems.

The Opioid Crisis and Policing Responses in Communities

In recent years, opioid abuse has transformed the context of drug enforcement. Since 1999, prescriptions for opioid painkillers (e.g., natural, semisynthetic opioids, methadone, and other synthetic opioids) have grown fourfold (Rudd et al., 2016). On a given day, approximately 2.1 million Americans suffer from opioid abuse disorders (Volkow, 2014). Heroin use is also rising (National Institute on Drug Abuse, 2018), as more than two thirds of heroin users report using prescription opioids as their first substance of abuse (Cicero et al., 2014).

The demographic profiles of heroin and opioid users have likewise changed during this period (Lankenau et al., 2012). More than 90% of persons using heroin within the last decade are White compared with about 50% of heroin users in the 1970s (Cicero et al., 2014). More women and older people are likely to abuse opioids and fatally overdose (Jalal et al., 2018). Opioid-related problems are not restricted to urban centers, as rural communities also face some of the greatest overdose death rates in the country (Keyes et al., 2014).

Police departments have since taken action to reduce opioid problems (Biehl, 2018). Police officers often serve as first responders to overdose incidents (Rando et al., 2015), especially in rural areas where emergency services may be more remote (Davis et al., 2015). Increasingly, police officers receive training for responding to possible overdoses and administering naloxone to reverse the deadly effects of blocked opioid receptors (Green et al., 2013). The Police Assisted Addiction and Recovery Initiatives (PAARI, 2019) have swept the country, involving nearly 400

police departments in 32 different states. These initiatives feature nonarrest treatment options for select persons or diversionary programs once an opioid user has been arrested (Police Executive Research Forum, 2017). The public has likewise accepted a greater role of law enforcement in addressing opioid-related problems. K. D. Wagner et al. (2015) report drug users called on police 50% of the time when an overdose was occurring, and expressed a greater inclination to call for help from law enforcement if they previously experienced an overdose (K. D. Wagner et al., 2015). Still, other police-led approaches to opioid abuse have been criticized for their disproportionate focus on predominantly White communities (Cole et al., 2018). To illustrate, the "Arlington Model" of providing outreach to known opioid users through a police department clinician was first created in Gloucester, Massachusetts with a 95% White population (Pearlman, 2016). In summary, new awareness of opioid-related programs and law enforcement agencies' responses toward opioid abuse encourage scholars to examine patterns of opioid-related arrests, in particular those related to possession.

Traditional Explanations of Arrest Disparities in Neighborhoods

Prior literature on drug arrest disparities asserts neighborhood context shapes patterns of contact with the criminal justice system due to its effects on individual behavior and police responses (Peterson & Krivo, 2010). Effectively, arrest rates vary across geographic space and such variation may be explained by social conditions, such as unemployment or residential mobility (Boggess & Hipp, 2010; Graif et al., 2014; Sampson, 2012). Scholarship has advanced two leading ecological causes of racial disparities in drug arrests: economic disadvantage and racial discrimination.

Economic disadvantage may first shape drug arrest disparities. Relative deprivation in an area leads to structural and cultural changes and, consequently, creates an environment conducive to crime (Sampson et al., 2018). Economic deprivation reduces residents' resources to solve local problems and may diminish collective efficacy or trust in others (Sampson et al., 1997). Crime may increase due to the growing prevalence of illegal activities and the absence of legitimate opportunities (Agnew, 2015; Akers & Jensen, 2006). As informal social controls discouraging crime decline, neighborhoods may become increasingly surveyed and subject to formal social controls such as police patrols (Meares & Fagan, 2008). Hence, arrests increase. The impacts of deprivation are assumed to be "racially invariant," meaning any group facing these circumstances would respond in similar ways (Sampson & Wilson, 1995). Because economic disadvantage is more concentrated in predominantly non-White communities, racial disparities in arrests should then emerge from broader socioeconomic inequalities in society (Hernandez et al., 2018; McNulty, 2001).

Racial discrimination based on the composition of communities offers an alternative source of arrest disparities. Discrimination and prejudice fuel the surveillance, arrest, and sanctioning of people of color beyond any potential underlying differences in criminal involvement. Racial threat influences the responses of criminal justice

actors, who can use their authority to preserve discriminatory practices and institutions (Omi & Winant, 1986; Unnever & Gabbidon, 2011). Drug arrests cannot be explained by differential involvement of racial/ethnic minorities in illicit drug use (Mitchell & Caudy, 2015). Implicit biases may also shape police deployments. For example, differences in urban/nonurban space lead Blacks to engage in drug activities in more visible and public spaces than Whites (Tonry & Melewski, 2008). Arrest disparities will increase as police officers target outdoor drug activities while ignoring more private transactions (Mauer, 1999).

Empirical studies attribute racial disparities in drug arrests to both economic disadvantage and racial discrimination within communities. Parker and Maggard (2005), for instance, find urban disadvantage directly increased in drug arrests between 1980 and 1990 for Blacks, but not for Whites. This race-specific effect could be explained by the decline of the manufacturing sector in American cities, which disparately impacted labor-market opportunities for Blacks. Looking at drug arrests in Seattle, Engel and colleagues (2012) similarly conclude increased police presence in disadvantaged areas "produces disproportionate minority drug arrests, even in the absence of racial bias of officers" (p. 629). Other studies conclude "racialized" drug enforcement may contribute to arrest disparities after adjusting for neighborhood disadvantage. Beckett and colleagues (2005, 2006) show Seattle police officers focused their interdiction efforts in more racially diverse areas. Likewise, Omori (2017) demonstrates drug case filings and sentencing are more prevalent in poorer and more ethnoracially heterogeneous neighborhoods in Sacramento. To note, all these studies have focused on drug enforcement in major U.S. cities. Whether the opioid problems in a community influence arrest patterns and racial disparities in arrest outcomes also remains a pressing question for policy. Our study attempts to bridge these gaps by exploring race-specific opioid-related possession arrests across the entire State of Delaware.

Present Study

The current study analyzes the ecological conditions associated with opioid-related possession arrests among Blacks and Whites in Delaware. Despite the small size of Delaware, it is a densely populated state along the mid-Atlantic coast. It has a population estimate of 973,764 people and demographically breaks down to a 69.5% White, 23% Black, and 7.5% Other population (U.S. Census Bureau, 2019). There are three counties within Delaware, with the northernmost county urbanized and the two southern counties being largely rural (Center for Drug and Health Studies, 2019). The largest city is Wilmington, located in the urban county of New Castle. Although it has recently increased its residential and business developments, Wilmington has notably high rates of gun violence and drug use (Jones, 2014). This is in stark comparison with the southern counties of Delaware (i.e., Kent and Sussex Counties). Kent County includes the state capital of Dover and the Dover Air Force Base. Sussex includes smaller cities such as Georgetown and beach resort towns along the coast. Following patterns of residential segregation across the United States (Peterson & Krivo, 2010),

more Black Delawareans live in urban centers, such as Dover and Wilmington, whereas more White Delawareans reside in suburban and rural areas (Boyer & Ratledge, 2013).

Policing in Delaware has several remarkable traits. As with all states in the United States, Delaware has both local and state police agencies. Delaware has 36 local police departments, one of the fewest in the country (Bureau of Justice Statistics, 2008), and eight state police troops (Delaware State Police Annual Report, 2018). Due to population density as well as crime activity, there is a larger police presence in the northern part of the state when compared with the more rural districts of southern Delaware. All criminal incident and arrest records from all agencies are shared in a central database known as the Delaware Criminal Justice Information System (DELJIS).

We focus on Delaware due to its existing opioid and racial justice issues. Delaware currently ranks sixth among states with the highest rates of age-adjusted drug overdose deaths occurring from 2013 to 2017 (Scholl et al., 2019). The overdose mortality rate is higher than those of motor vehicle and gun-related fatalities (Center for Drug and Health Studies, 2017) and continues to climb (Ciolino, 2019). Delaware further exceeds the national averages in the number of babies diagnosed with neonatal abstinence syndrome (Hussaini, 2017) and adults receiving methadone in treatment programs (Substance Abuse and Mental Health Services Administration, 2017). The state began to develop formal institutional responses to its opioid abuse issues in late 2016 and started to implement opioid-specific response initiatives, such as the Hero Help and the ANGEL programs, that help bridge the gap between drug treatment and enforcement in select communities from 2017 onward (Streisel et al., 2019).

Geographic variation also characterizes opioid problems in Delaware. Analyzing prescription rates across the entire state, Anderson and colleagues (2019) find that communities with high rates of Medicare/Medicaid coverage have more prescription opioids. Prescriptions for opiates are also more common in predominantly White areas with lower home values and large veteran populations, concluding these areas may be at risk for opioid abuse (Anderson et al., 2019). J. Wagner et al. (2019) further highlight Delaware communities can have 13-fold differences in overdose death rates. Fatal overdose rates do not necessarily follow socioeconomic lines, but instead depend on the racial composition, urbanicity, and family organization within a community (J. Wagner et al., 2019).

Delaware has also shown issues of disparities in its criminal justice system (Delaware Statistical Analysis Center, 2011). Although representing less than one quarter of Delaware's adult population, Blacks are overrepresented among the state's arrestee (41%) and incarcerated populations (57%; MacDonald & Donnelly, 2019). Policy makers have cited drug offenses as a driver of racial disparities at different criminal processing stages (Eichler, 2000). Criminal sentencing decisions also significantly vary in courts across the state (MacDonald & Donnelly, 2016). No previous study of opioids or criminal justice practices in Delaware, however, has examined state and local patterns of racial differences in possession arrests involving opioid-related substances.

This study makes three contributions to the literature on drug and racial disparities in arrests. It first evaluates whether traditional sources of drug arrest disparities can

explain patterns of arrests for opioid-related possession offenses during the opioid crisis. Revisiting the causes of arrest disparities is crucial as the model opioid user does not entirely fit the historic profile of drug users. Although we do not directly test for changes in policing efforts prior to and during the opioid epidemic, this study examines current arrest patterns since the rise of new law enforcement responses to opioid abuse noted in previous empirical work (Biehl, 2018; Green et al., 2013; Rando et al., 2015). Second, it illuminates patterns of opioid-related arrest disparities across urban and nonurban spaces. Most studies of arrest disparities only examine neighborhoods in a single city (Beckett et al., 2005; Gaston, 2019; Omori, 2017). Third, this study examines global and local variations in opioid-related possession arrests, allowing scholars to make better conclusions about drivers of arrest patterns in different types of communities.

Data

This study examines adult arrest patterns for opioid-related possession offenses in 569 block groups in Delaware between 2015 and 2017. Geolocated arrest data were requested from DELJIS for all criminal offenses involving adults (i.e., persons aged 18 years and above). We classify an incident as an opioid-related arrest if at least one arrest charge involves possession of heroin, synthetic narcotics, or opium derivatives. We assign an arrest to a block group by plotting the latitude and longitude of the most serious opioid-related offense per arrest into ArcGIS and overlaying a Census 2010 shapefile of block groups onto these data points. We then aggregate the number of arrests by race and year for each block group.

We then add in socioeconomic, demographic, and criminal incident information to our block group data file. We gather census data at the block group level from the 5-year estimates of the American Community Survey (2012–2017). We also introduce information about calls for police service and crime incidents occurring between 2015 and 2017 from DELJIS. We apply the same mapping procedure above to get a total number of service calls or criminal incidents by block group and year. Our data set features 569 block groups out of a possible 571 block groups.

Outcomes

This study examines the race-specific average annual number of opioid-related possession arrests per 100,000 population in a block group between 2015 and 2017. We construct the opioid-related possession arrest rate for Whites and the rate for Blacks separately. We take the average of this 3-year period to smooth any temporal variation in arrest patterns.[1]

Explanatory Variables

To explain variation in Black–White opioid-related possession arrest rates, we focus on three key factors. First, we examine the *call for service for overdoses rate*[2] based

on the 3-year average number of calls for police service for potential overdose incidents per 100,000 population in a block group. Police officers in Delaware are recommended to respond with emergency services to 911 calls involving overdoses ("Delaware Breaks State Record for Overdose Deaths," 2018). We use this calls for service measure as a proxy for opioid abuse problems within a block group. Approximately four out of five overdose deaths in the state involve fentanyl, heroin, or other opioids (J. Wagner et al., 2019).

Next, we measure the relative economic affluence/deprivation of a block group using an *economic disadvantage index*. We measure economic deprivation using a regression-based index of four conditions in a block group: percent of the population living below the poverty line, percent of the population using public assistance, percent of the civilian labor force aged 18 to 65 years that is unemployed, and percent of households with children below the age of 18 and with a single female head. Like a *Z*-score in statistics, the index has a mean of 0 and a standard deviation of 1 (DiStefano et al., 2009). Positive index values suggest more economic disadvantage, whereas negative index values suggest there is more economic affluence. We then consider the racial composition of a community. *Percent White* measures the percent of the general population that identifies as non-Hispanic/Latino, White.

Control Variables

We then control for other environmental factors with possible influences on opioid-related possession arrests. Two variables adjust for residential instability in communities, as turnover among residents may weaken social bonds and diminish a community's willingness to address problems (Boggess & Hipp, 2010). *Percent renter* measures the percentage of households occupied by renters in the block group. *Percent moved in last year* measures the percent of the population that relocated in the last calendar year.

Our analysis also considers the demographic characteristics of a block group's general population. We adjust for age structure in a block group by including the percent of the population below the age of 25 (*percent young*). We account for gender composition by measuring the percent of the population identifying as male (*percent male*). *Percent rural* measures the percent of the population living in rural areas within the block group.

Finally, we adjust for underlying crime or police activity levels within block groups. *Violent crime rate* is calculated as the average number of violent criminal incidents per 100,000 population in a block group between 2015 and 2017. We define a violent incident as any offense involving aggravated assault, forcible rape, robbery, and murder or nonnegligent manslaughter regardless of whether it is cleared by an arrest.

Analytic Strategy

Our study of environmental factors and opioid-related possession arrests in block groups proceeds in two steps. First, we examine the relationships between social conditions and arrest rates using two sets of regression models: ordinary least squares

(OLS) and geographically weighted regression (GWR). We use OLS models to examine what ecological conditions influence opioid-related arrest rates *across all* block groups. We introduce GWR models to examine any spatial variation in relationships between predictors and outcomes in *local areas* of block groups. GWR adjusts for such nonstationarity in relationships by running a series of local regressions for each location (Bivand, 2019).

GWR departs from OLS that provides one coefficient estimate for an entire sample. Instead, GWR coefficients for predictors are calculated for the block groups falling within a specified local area (Brunsdon et al., 1996). Coefficients for predictors may then vary in direction and magnitude across a large geographic space. The coefficients also account for spatial autocorrelation within the data. GWR calculations give more weight to observations in closer areas and less weight to observations in farther areas (Fotheringham et al., 2003). After completing runs of all local regressions, GWR results can be displayed in two ways. First, GWR tables can present the median, upper, and lower quantiles of coefficients estimated from the local regression models for each variable. These tables can show whether coefficients have short or long ranges. Second, local coefficients from these models may be mapped to indicate areas where a factor has more or less strength, thus allowing for the interpretation of effects with respect to geography (Brunsdon et al., 1996).

To conduct our OLS and GWR analyses, we use R statistical software. The OLS model is estimated by running a linear model (i.e., "lm" command) to predict race-specific opioid-related possession arrest rates as a function of our key explanatory and control variables. The GWR model is estimated using the "spgwr" package developed by Bivand (2019). The package allows us to specify a bandwidth around the centroids of block groups to define local areas and create a distance-based weighting matrix for our coefficients.[3] We then fit a linear GWR model of opioid-related arrest rates. We highlight the lower/upper quartiles and median values of local coefficients for each predictor to show their spatial variation.

Second, because our global estimates of the predicted impact of social conditions from OLS models may not hold for opioid-related arrest rates across the entire state, we consider whether local patterns in arrests are associated with *specific types* of block groups (Cahill & Mulligan, 2007). We thus distinguish clusters of block groups with similar sociodemographic characteristics. We complete a hierarchical cluster analysis using R's "hclust" function. We identify an appropriate number of clusters by using Ward's method that minimizes the total variance within a cluster as clusters are being formed. We then run GWR models within our clusters to illuminate spatial relationships within similar types of block groups. This cluster–GWR analysis then strikes a balance between GWR models that allow coefficients to vary within local areas containing different types of block groups and OLS models that require estimates to be fixed for the entire state.

Results

Table 1 presents descriptive statistics for opioid-related arrests and sociodemographic conditions in of block groups for 2015 to 2017. The table shows approximately 232

Table 1. Summary Statistics of Block Groups (2015–2017).

Variable	*M*	*SD*	Minimum	Maximum
White opioid-related possession arrest rate	137.29	136.49	0	1,104.71
Black opioid-related possession arrest rate	95.37	162.03	0	984.53
Calls for service for overdoses rate	27.52	67.30	0.00	930.75
Economic disadvantage	−0.00	1.00	−1.38	6.33
Percent White	72.23	25.21	0.00	100.00
Percent renter	22.74	20.39	0.00	97.73
Percent mobile	7.86	16.66	0.00	100.00
Percent male	48.44	6.38	16.83	99.21
Percent young	30.78	11.98	0.00	94.26
Violent crime incident rate	3,823.96	3,649.96	0.00	37,145.97
Percent rural	14.69	29.86	0.00	100.00
N	569	—	—	—

opioid-related possession arrests per 100,000 occur in a block group during this time period. The arrest rate for possessing heroin, synthetic narcotics, and opium derivatives is higher among Whites (137.29 per 100,000) than Blacks (95.27 per 100,000). This Black–White difference in arrest rates is not statistically significant (difference of means t-statistic = 0.20; $p > .05$). Each block group in Delaware has an average of 28 calls for service related to overdoses and almost 3,800 violent crime incidents per 100,000 population. Block groups are predominantly White (72%) with sizable male (48%) and young (31%) populations.

Global and Local Regression Model Estimates

To identify the drivers of opioid-related possession arrest rates, we compare regression estimates from OLS and GWR models. Table 2 displays global estimates from OLS models and local estimates from GWR models. The results reveal two patterns. First, opioid-related arrest rates for Whites and Blacks are associated with different sets of environmental conditions based on the OLS results. For Whites and Blacks, overdose call rates do not appear to influence global arrest rates. White possession arrest rates grow in more rural block groups and block groups with higher violent crime rates. Arrests among Whites also marginally increase in areas with more economically deprived, more mobile, more male, and more White populations.

Black opioid-related possession arrest rates occur in a different context. Arrests involving Blacks are more likely to take place in areas of economic disadvantage, increased violent crime rates, and less White populations. According to the OLS model, economic disadvantage (Z-score coefficient of comparison = 2.66, $p < .01$) and racial composition of neighborhoods (Z-score coefficient of comparison = 5.32, $p < .01$) more strongly predict Black opioid-related possession arrests rates relative to those involving Whites (Paternoster et al., 1998).

Table 2. OLS and GWR Estimates of Opioid-Related Possession Arrest Rates by Race.

	White opioid-related possession arrest rate					Black opioid-related possession arrest rate				
	Global (OLS) estimates		Local (GWR) estimates			Global (OLS) estimates		Local (GWR) estimates		
Variable	Coefficient	*SE*	Lower quantile	Median	Upper quantile	Coefficient	*SE*	Lower quantile	Median	Upper quantile
Calls for service for overdoses rate	−0.03	0.09	−0.07	0.58	1.49	0.05	0.07	−0.15	0.07	0.63
Economic disadvantage	17.42*	8.57	−20.26	2.34	30.05	46.78**	6.92	1.57	25.47	47.38
Percent White	0.83*	0.33	−0.64	0.71	1.56	−3.10**	0.27	−3.32	−1.73	−0.35
Percent renter	0.06	0.36	−0.83	0.16	1.31	−0.43	0.29	−0.60	0.18	1.04
Percent mobile	0.81*	0.37	−1.33	0.72	2.77	−0.20	0.30	−1.78	−0.41	0.28
Percent male	1.87*	0.88	−1.47	1.37	4.07	−0.49	0.71	−2.67	−0.36	0.96
Percent young	0.65	0.55	−1.61	−0.34	0.95	−0.85	0.44	−1.94	−0.06	1.14
Violent crime incident rate	0.01**	0.00	0.00	0.01	0.02	0.01**	0.00	0.00	0.01	0.02
Percent rural	0.77**	0.20	−4.35	−0.74	0.25	0.28	0.17	−0.71	0.01	0.98
Intercept	−73.06	55.54	−158.53	18.50	184.40	342.95	44.85	34.37	202.14	374.44
Adjusted R^2	0.09	—	0.75	—	—	0.58	—	0.89	—	—
N	569	—	569	—	—	569	—	569	—	—

Note. OLS = ordinary least squares; GWR = geographically weighted regression; *SE* = standard error.
*$p < .05$. **$p < .01$.

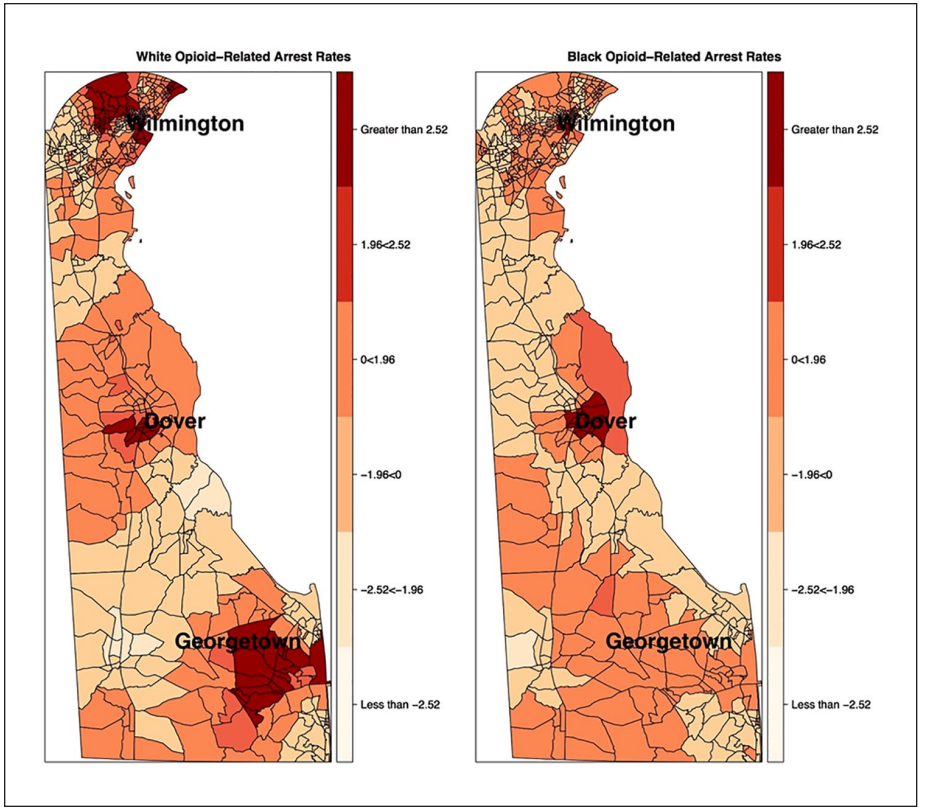

Figure 1. *T* statistics of calls for service for overdoses rates on opioid-related possession arrest rates by race.

Second, there is tremendous spatial variation in the relationships between social conditions and opioid-related arrests. The GWR models explain a greater share of the variation in opioid-related possession arrest rates than the OLS models as evidenced by higher adjusted R^2 values. For instance, although the OLS model only accounted for 9% of the variation for White arrest rates, the GWR models explained 75% of the variation in these rates. The GWR models also highlight racial differences in opioid-related possession arrests. Economic disadvantage has a consistently positive effect and percent White has a negative effect on Black opioid-related possession arrests. All social conditions have less consistent impacts on opioid-related arrests among Whites. More importantly, calls for police service for overdose rates may have stronger, positive associations with White arrests relative to Black arrests in certain block groups.

To visually demonstrate how geography influences the context of arrests, Figure 1 maps the *t*-statistic values associated with the GWR models' local coefficients of calls for service for overdoses rates on White and Black opioid-related possession arrest

rates by block group. The *t*-statistic values correspond with recognized levels of statistical significance (i.e., below −1.96 or above 1.96 indicates significance at the 0.05 level and below −2.52 or above 2.52 indicates statistical significance at the 0.01 level). Lighter colors represent negative *t*-statistic values and darker colors identify positive *t*-statistic values for the relationship between overdose call rates on opioid-related arrest rates by race. Although not produced here, these figures could be generated for other social conditions in the GWR model.

Figure 1 illuminates racial differences in the spatial relationships between rates of calls for service for overdoses and arrests, as estimated by the GWR model. On the right panel, overdose call rates are strongly predictive of Black arrest rates in block groups near urban centers, such as Wilmington in the upper left and Dover in the center of the state. These calls generally have a positive, but statistically insignificant, impact on Black opioid-related arrests across the state. On the left side of the panel, local White arrest rates appear more closely tied to calls for service for overdoses. Overdose call rates are linked to more arrests *outside* of cities. Overdose call rates increase White opioid-related arrests in suburban areas bordering Wilmington, semirural areas surrounding Dover, and more rural, poor communities in the South. In short, this visualization reveals different relationships between opioid abuse and law enforcement response over geographic space.

GWR Estimates Within Clusters

Our previous analysis suggests there is considerable local variation in opioid-related possession arrests involving Blacks and Whites and environmental sources for these patterns. We then consider whether we can identify racial differences in these arrest patterns across similar types of communities within the state. In this section, we identify clusters of similar block groups based on their sociodemographic attributes and then explore arrest patterns within these clusters. A hierarchical cluster analysis based on Ward's method distinguished five clusters of block groups as the optimal choice.[4] This set of five clusters features three medium clusters ($n = 72$–119), one small cluster ($n = 39$), and one large ($n = 264$) cluster. We describe the five clusters, their arrest outcomes, and demographic conditions in Table 3. We then show the geographic distribution of these clusters in Figure 2.

Two of the five clusters feature rural areas with large White populations. Cluster 1 (*rural, disadvantaged*) and Cluster 3 (*rural, more advantaged*) characterize block groups in the central and southern parts of the state. Cluster 1 is marked by more economic disadvantage relative to Cluster 3 and has the highest White opioid-related arrest rate among all clusters. Urban block groups in Wilmington, Dover, and other larger towns constitute Cluster 4. Cluster 4 (*urban, disadvantaged*) features more economic disadvantage, predominantly non-White populations, and greater Black opioid-related arrest rates. The remaining clusters identify two types of communities bordering urban centers. Cluster 5 (*urban outskirts*) refers to block groups lying directly outside of cities. These areas have moderate levels of economic disadvantage, greater levels of residential instability due to renting and population mobility, and more racially diverse

Table 3. Summary Statistics of Block Group Clusters.

	Cluster 1: Rural, economically disadvantaged, predominantly White areas		Cluster 2: Suburban, economically affluent, predominantly White areas		Cluster 3: Rural, more economically advantaged, predominantly White areas		Cluster 4: Urban, economically disadvantaged, predominantly non-White areas		Cluster 5: Urban outskirts, economically disadvantaged, racially mixed areas	
Variables	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
White opioid-related possession arrest rate	198.00	156.99	104.03	115.85	155.02	112.76	138.74	153.53	165.93	174.72
Black opioid-related possession arrest rate	114.49	148.44	25.13	50.98	70.89	95.38	340.07	261.57	240.93	227.12
Calls for service for overdoses rate	41.20	56.55	17.66	50.17	29.08	48.21	44.25	90.32	37.76	120.53
Economic disadvantage	0.27	0.97	−0.50	0.51	0.01	0.64	1.39	1.69	0.78	1.06
Percent White	70.64	22.80	83.32	14.49	72.28	22.33	37.25	31.24	52.08	29.44
Percent renter	24.59	16.10	15.81	16.89	22.78	19.72	42.56	23.64	35.43	22.17
Percent mobile	15.00	22.77	5.06	12.62	13.16	20.85	2.14	6.49	5.02	13.72
Percent male	49.67	5.34	48.88	6.42	48.77	5.29	45.67	7.70	46.50	7.37
Percent young	32.27	11.12	28.06	10.97	31.24	11.12	34.99	15.55	36.17	13.03
Violent crime Incident rate	4,896.20	420.63	1,392.00	654.91	3,317.35	459.30	13,657.58	5,369.17	7,135.01	1,074.25
Percent rural	20.84	32.98	14.46	29.55	19.80	33.90	0.25	1.30	8.48	24.80
N	75	—	264	—	119	—	39	—	72	—

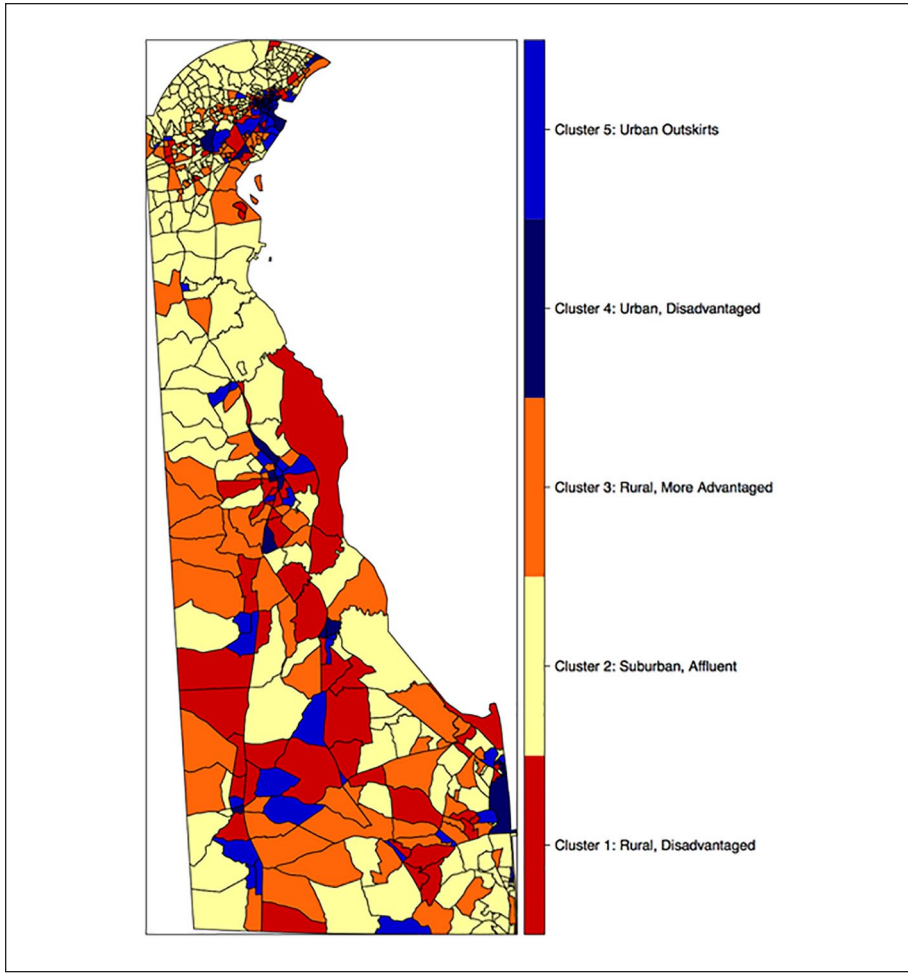

Figure 2. Block group clusters in Delaware.

populations. Suburban block groups make up Cluster 2 (*suburban, affluent*) defined by economic affluence and low levels of crime. Both Cluster 5's and Cluster 2's block groups are scattered throughout the state.

We then explore the various relationships between sociodemographic characteristics of communities and arrests in the five block group clusters. Table 4 presents the median values of coefficients from GWR models predicting White and Black opioid-related possession arrest rates within each cluster.[5] The table shows overdose call rates are positively related to arrests in more rural (Cluster 1 and Cluster 3) and urban poor clusters (Cluster 4). Specifically, calls for service for overdoses most strongly predict White arrests in more advantaged, rural areas. Overdoses calls are predictive of Black

Table 4. Geographically Weighted Regression Block Group Cluster Estimates of Opioid-Related Possession Arrest Rates by Race.

	Cluster 1: Rural, economically disadvantaged, predominantly White areas		Cluster 2: Suburban, economically affluent, predominantly White areas		Cluster 3: Rural, more economically advantaged predominantly White areas		Cluster 4: Urban, economically disadvantaged, predominantly non-White areas		Cluster 5: Urban outskirts, economically disadvantaged, racially mixed areas	
Variable	Median (White opioid-related arrest rates)	Median (Black opioid-related arrest rates)	Median (White opioid-related arrest rates)	Median (Black opioid-related arrest rates)	Median (White opioid-related arrest rates)	Median (Black opioid-related arrest rates)	Median (White opioid-related arrest rates)	Median (Black opioid-related arrest rates)	Median (White opioid-related arrest rates)	Median (Black opioid-related arrest rates)
Calls for service for overdoses rate	0.03	0.54	−0.09	0.01	0.70	0.17	0.43	1.00	0.06	−0.19
Economic disadvantage	−10.05	29.39	36.36	20.35	−17.80	3.45	−16.45	10.44	−20.42	78.15
Percent White	0.80	−4.97	0.73	−1.61	0.14	2.58	−1.11	−3.00	1.48	−2.48
Percent renter	−0.11	−1.12	0.10	−0.14	0.37	0.46	1.25	−0.56	−1.37	0.65
Percent mobile	0.06	−0.28	−0.71	−0.36	−0.19	0.34	11.79	−9.35	1.97	3.63
Percent male	12.59	4.34	−0.15	−0.85	2.46	0.87	0.58	3.46	0.33	0.84
Percent young	0.03	−3.54	0.48	−0.35	1.28	1.45	−0.61	3.13	−2.38	0.44
Violent crime incident rate	−0.06	−0.01	0.02	0.01	0.02	0.04	0.01	0.01	0.00	0.02
Percent rural	0.07	0.46	−0.78	0.13	−0.65	0.19	4.85	33.13	0.07	−0.74
Intercept	−238.23	419.75	−55.18	209.92	−130.93	7.17	18.45	41.45	230.00	91.71
N	75	—	264	—	119	—	39	—	72	—

arrests in poor urban areas. Economic disadvantage is more strongly associated with increased arrest rates among Blacks than Whites across all clusters. With the exception of the suburban, economically advantaged, predominantly White cluster (Cluster 2), economic disadvantage is negatively associated with White opioid-related arrest rates. In other words, only Cluster 2 demonstrates a positive association between economic disadvantage and White opioid-related arrest rates. Percent White tends to increase White arrest rates in rural and suburban clusters and it tends to decrease Black arrest rates. Across most clusters, increases in violent crime rates lead to higher opioid-related arrest rates across race. The cluster—GWR analysis largely affirms findings in the initial GWR model of all block groups.

Discussion

Differential drug enforcement has led to disproportionate minority contact with the criminal justice system (Alexander, 2010; Mauer, 1999; Tonry, 1994). The opioid crisis may be changing the "typical" profile of drug offenders, as opioid abuse is found among more advantaged, nonurban, older, female, and White populations (Cole et al., 2018; Jalal et al., 2018; Keyes et al., 2014). As police agencies increasingly respond to opioid problems (Green et al., 2013; Pearlman, 2016; Purviance et al., 2017; K. D. Wagner et al., 2015), scholarship must examine opioid-related arrest patterns and disparities in how opioid users come into contact with the criminal justice system.

This study analyzes the relationships among social conditions and local race-specific opioid-related possession arrest rates. A GWR analysis reveals two sets of findings concerning arrest patterns and disparities in their imposition. First, looking at the entire State of Delaware, we observe considerable spatial variation in the environmental factors that predict opioid-related possession arrests. We find calls for service for overdoses are significantly predictive of arrest rates in some local areas compared with others. OLS regression models minimize these associations between opioid abuse and arrests because it provides a fixed, global estimate of this relationship for block groups across the state. At the same time, we see global differences in the drivers of opioid-related possession arrests involving Whites and Blacks. Calls for service for overdoses are more strongly predictive of White versus Black opioid-related arrest patterns. Likewise, economic disadvantage and racial composition of communities matter more in shaping Black arrest rates across the state.

Second, we demonstrate that spatial patterns in opioid-related possession arrests exist within particular types of communities. Using a cluster analysis, we separate Delaware's block groups into five types of areas: disadvantaged rural, advantaged rural, poor urban, affluent suburban, and disadvantaged urban outskirts. Our results show racial differences in the association between calls for service for overdoses and arrest rates in communities. For Whites, overdose call rates strongly increase possession arrests in rural areas with more economic advantage. Conversely, overdose call rates are associated with Black arrest rates in poorer and predominantly non-White communities, especially in urban areas. Across all clusters, more economic disadvantage is more positively associated with opioid-related arrest rates for Blacks relative to

Whites. These findings suggest the effects of structural disadvantage on arrests are significantly different across racial groups.

These two sets of findings point to a couple of implications for policy and practice. On one hand, arrests for opioid-related possession offenses appear to increase in some of the same places as calls for service for overdoses. This pattern suggests law enforcement may be assuming a more "problem-oriented" stance toward opioid abuse, meaning arrest serves as one way by which police departments can intervene in the lives of opioid users and reduce or deter opioid abuse. We emphasize that this association between overdose calls and opioid-related possession arrests holds after adjusting for other sociodemographic factors in localities, strengthening this conclusion of police officers making arrest decisions in light of other known opioid problems within certain communities. Given its diagnostic nature, our study cannot tell us whether arrest is an effective or valid response in these high overdose calls for service/high opioid-related possession arrest rate areas. An ever-growing number of efforts by police officers and prosecutors have sought to develop alternatives to connect individuals struggling with substance abuse to drug treatment, mental health, and rehabilitation programs (Police Executive Research Forum, 2017). It is also an open empirical question in Delaware whether opioid-related possession arrestees are subsequently diverted out of the courts or face formal criminal sanctions. Gathering sentencing data can inform how the criminal justice system reacts and how to improve its responses to local problems of opioid abuse. Nevertheless, identifying areas of high overdose calls and/or high rates of arrest for opioid possession may present an opportunity to introduce new diversionary or treatment programs linked to law enforcement agencies.

On the other hand, in distinguishing the drivers of opioid-related arrest rates, our study raises some concerns for racial justice. Space impacts arrest rates differently for Black and White opioid users. Although evidence from GWR models demonstrates local arrest patterns for Whites are closely tied to opioid abuse problems in block groups *outside of cities*, overdose call rates are predictive of Black arrest rates in block groups in *urban centers*. Standing alone, this finding reveals that broad patterns of segregation in the residences and daily lives of Black and White Delawareans (Boyer & Ratledge, 2013) also help to define how opioid users interact with law enforcement. Still, the rate of overdose calls for service is a stronger driver of White arrests rates relative to Black arrests. This connection might reflect growing rates of heroin and opioid abuse among Whites (Cicero et al., 2014) and law enforcement's willingness to address opioid problems within primarily White and often privileged communities (Pearlman, 2016). Moreover, economic disadvantage and percent White population more strongly influence Black relative to White arrest rates, regardless of community type. Strong associations between a community's sociodemographic character and Black opioid-related arrest rates underscore continuing expressions of discriminatory drug enforcement in the poorest communities. Traditional explanations of drug arrest disparities thus remain valuable in explaining racial differences in the drivers of opioid-related arrest patterns. Although our analysis does not formally test whether economic disadvantage *or* racial bias related to the racial/ethnic makeup of communities is the stronger predictor of Black opioid-related arrest rates (see Hernandez et al.,

2018, for a similar study), we encourage future researchers to take care in disentangling the relationships among arrests, poverty and related forms of deprivation, and opioid use/abuse problems at the individual or community levels.

Although the present study provides significant contributions to understanding the drivers and disparities around opioid-related possession arrests, a few limitations must be acknowledged. First, our measure of calls for police service for overdoses potentially underestimates opioid abuse as individuals facing a potential overdose situation may rely on or receive assistance outside of formal channels (i.e., a friend may take someone who is potentially overdosing directly to the hospital rather than call for help). Next, our study may include bias due to police misclassification of substances at the time of arrest. Police officers in Delaware rely on their discretion to classify the illicit substance a person is booked for and this classification stands in DELJIS records until laboratory processing prior to criminal trial. Third, we cannot estimate the number of persons who sought police assistance for an opioid problem, but were not arrested. In Delaware, police-led programs offering treatment for opioid-related addiction, such as the New Castle County–based Hero Help and Dover-based ANGEL programs, were not initiated until late 2016 and only serve a small subset of communities (Horn, 2017). Finally, our records do not distinguish between arrests made by state and local police departments. Arrests may be driven by one type of police agency relative to the other in the same geographic spaces. This study also cannot make comparisons between statewide or local approaches and opioid-related arrests.

In all, our study encourages further research into opioid abuse, law enforcement responses, and arrest disparities. For scholars seeking to understand the relationships between opioid abuse and criminal justice contact, two paths might be taken. First, studies must consider whether drug law enforcement patterns are changing and, if so, for what populations. Research should take opportunities to formally evaluate changes in policing practices after jurisdictions develop policy responses (e.g., through quasi-experimental research designs comparing places with/without opioid abuse programs) and reassess whether traditional perspectives on drug law enforcement (e.g., economic disadvantage vs. racial discrimination arguments) sufficiently explain drug interdiction efforts today. Second, local patterns should be discerned. Ordinary statistical analysis relying on global estimates may underestimate the influence of social conditions on arrest patterns (Fotheringham et al., 2003). This methodological limitation may be especially pronounced when analyzing arrest patterns in a geographically large or diverse space like an entire state. Taking a more localized statistical approach, such as breaking communities into neighborhood types through cluster analysis, may be important to provide a rich portrait of the ecological sources of opioid-related arrests, as estimates of predictors can vary among communities in close proximity to one another and/or with similar dynamics (Cahill & Mulligan, 2007). These local approaches may also help to distinguish whether the factors influencing drug arrests are similar across racial/ethnic, gender, age, and other sociodemographic groups.

Priorities for practitioners should be twofold. State criminal justice and public health officials should continue to recognize and evaluate how law enforcement is currently responding to opioid problems (Davis et al., 2015; Perez et al., 2017;

Purviance et al., 2017; Rando et al., 2015). Responsiveness should be assessed across a range of activities, including law enforcement partnerships with state/local agencies to provide naloxone training; new programs involving outreach, diversion, and treatment-based alternative sanctions for eligible opioid users; and data collection and sharing efforts across bureaucracies (e.g., data from vital statistics, criminal incident and arrest record databases, and prescription drug monitoring programs; Goodison et al., 2019). A second priority corresponds to equity in combating opioid abuse through law enforcement initiatives. Whether Black opioid users are given the same treatment by police officers (e.g., arrest/nonarrest) and receive similar opportunities for rehabilitation as White opioid users once coming into contact with the criminal justice system is a pressing question (Cole et al., 2018). By assessing who is served by these law enforcement–based programs and the placement of these diversionary and treatment-oriented services in different types of communities, policy makers can begin the process of improving fairness in their efforts to reduce and control opioid abuse.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research derives from work on the "Delaware Opioid Metric Intelligence Project" (2017-IJ-CX-0016), funded by the National Institute of Justice, U.S. Department of Justice. Tammy L. Anderson of the Center for Drug and Health Studies is the principal investigator of this funded project.

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Notes

1. The total number of opioid-related arrests was 2,234 in 2015, 2,134 in 2016, and 1,641 in 2017. This decrease may be due to the introduction of diversionary programs in select jurisdictions in Delaware (Streisel et al., 2019). Omitting 2017 arrests from our analysis does not change our conclusions about Black opioid-related arrest rates. When we rerun the regression results with 2015 and 2016 alone, the marginally significant signs for economic disadvantage, percent mobile, and percent male population predicting White opioid-related possession arrest rates become nonsignificant. About 60% (2,950) of these arrests involved Whites and 40% (1,831) involved Blacks. Just less than 90% of our block groups had at least one opioid-related possession arrest. We retain all block groups with zero arrests to ensure continuity in our sample across our models.
2. We were not given demographic information (e.g., race, gender) about the person who was involved with a potential overdose incident that required a response by law enforcement due to concerns for privacy.

3. Optimal bandwidth was determined through a spatially weighted process for minimizing the Akaike information criterion (AIC). We chose calls for service for overdoses as the regression point to calibrate the bandwidth because it represents the closest proxy to opioid-related abuse.
4. When experimenting with the number of clusters, specification of six or more clusters created block group types with less than 10 observations while retaining one large cluster with at least 200 observations. A call for more than five clusters then splits medium and small clusters into smaller groups. Four or fewer clusters lead to large clusters with hundreds of block groups, indicating these groups could be broken down further.
5. We do not report statistical significance tests associated with global (ordinary least squares [OLS]) parameter estimates from regressions within clusters. Formal statistical tests are not appropriate in this section because some samples of block group types are small (i.e., less than 100 observations for three out of five clusters) and thus lack statistical power to detect differences in a variable's effect on arrest rates. Although we present parameter estimates (i.e., median coefficients from geographically weighted regression [GWR] local regressions), this type of local regression analysis should be treated as exploratory. That is, results from local regression models describe rather than predict possible relationships between social conditions and arrest rates among similar types of block groups (see Cahill & Mulligan, 2007).

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