311 service requests as indicators of neighborhood distress and opioid use disorder

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Abstract

Opioid use disorder and overdose deaths is a public health crisis in the United States, and there is increasing recognition that its etiology is rooted in part by social determinants such as poverty, isolation and social upheaval. Limiting research and policy interventions is the low temporal and spatial resolution of publicly available administrative data such as census data. We explore the use of municipal service requests (also known as "311" requests) as high resolution spatial and temporal indicators of neighborhood social distress and opioid misuse. We analyze the spatial associations between georeferenced opioid overdose event (OOE) data from emergency medical service responders and 311 service request data from the City of Columbus, OH, USA for the time period 2008–2017. We find 10 out of 21 types of 311 requests spatially associate with OOEs and also characterize neighborhoods with lower socio-economic status in the city, both consistently over time. We also demonstrate that the 311 indicators are capable of predicting OOE hotspots at the neighborhood- level: our results show code violation, public health, and street lighting were the top three accurate predictors with predictive accuracy as 0.92, 0.89 and 0.83, respectively. Since 311 requests are publicly available with high spatial and temporal resolution, they can be effective as opioid overdose surveillance indicators for basic research and applied policy.

Workflow

We examine the use of 311 service requests as indicators of neighborhood distress and opioid overdose incidents. We identify 311 request types that can serve as robust surveillance indicators for opioid use disorder based on three criteria: (1) spatial association with individual-level opioid overdose events (OOEs); (2) characterize neighborhoods with apparent conditions of socioeconomic distress, and; (3) stability of these relationships with respect to time. We also demonstrate their use in predicting OOE hotspots at the neighborhood level.

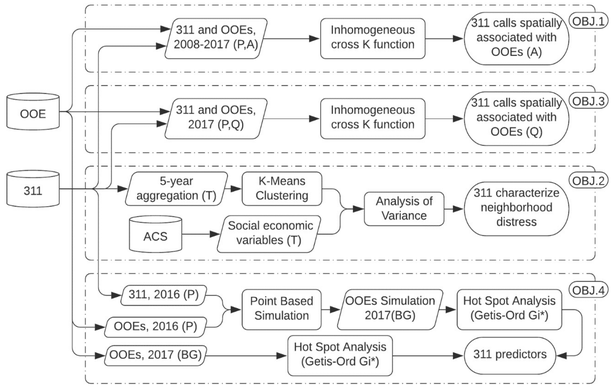


Figure 1. Analytic workflow. P=point; T=census tract; BG=census block group; A=Annually; Q=Quarterly

Objective 1: discover the spatial association between OOEs and 311 service requests types.

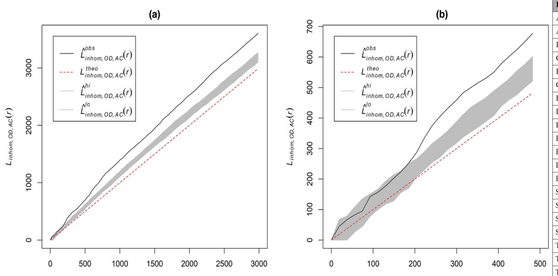
Objective 2: identify types of 311 requests that characterize neighborhoods with socioeconomic distress.

Objective 3: assess the stability of the spatial associations between 311 requests and OOEs.

Objective 4: evaluate the performance of the robust 311 indicators in predicting overdose hotspots.

Results

Spatial associations between OOEs and 311 service calls



Full name	Abbr	Year (20–) 08	09	10	11	12	13	14	15	16	17
Abandoned vehicles	AV	C**	C**	C**	C**	C**	C**	C**	C**	C**	C**
Animal complains	AC	C*	C*	C*	C*	C**	C*	C*	C**	C**	C**
Bike related items	BRI	R	R	N/A	R	R	D	R	R	R	R
Code violation	CV	N/A	C**	C**	C*	C**	C**	C**	C**	C**	C**
Fire hydrant	FH	N/A	N/A	N/A	R	R	R	R	R	R	C*
Graffiti	GRA	C*	C*	C*	C*	R	R	R	R	R	R
Homeless advocacy	HA	N/A	N/A	R	R	R	R	R	R	C**	C**
Law enforcement	LE	C**	C**	C**	C**	C**	C**	C**	C**	C**	C**
Parking	PAR	R	R	D	R	C*	C*	C**	R	C**	C**
Public health	PH	C*	C**	C**	C**	C**	C**	C**	C**	C**	C**
Recreation and parks	RP	R	R	R	R	R	R	R	R	R	R
Recycling yard waste	RYW	C**	R	C*	C*	C**	C**	C**	C**	C**	C**
Refuse trash litter	RTL	C**	C**	C**	C**	C**	C**	C**	C**	C**	C**
Sidewalk curbs ramps	SCR	C*	C*	C**	C*	C*	C*	C*	C**	C**	C**
Snow ice removal	SIR	C*	C*	C**	C**	C*	C*	C**	C*	R	R
Street lighting	SL	C**	C**	C**	C**	C**	C**	C**	C**	C**	C**
Street maintenance	SM	C**	C**	C**	C**	C**	C**	C**	C**	C**	C**
Traffic signals	TS	R	R	C*	C*	C**	C**	C**	C**	C**	C**
Traffic signs	TS2	C**	C**	C**	C**	C*	C**	C**	C**	C**	C**
Trees	TREES	R	R	C*	C*	C**	C*	C**	C*	C**	C**
Water sewers drains	WSD	C*	C*	C**	C**	C**	C*	C**	C*	C**	C**

Figure 2. Characterizing cross point pattern between OOEs and animal complains related 311 calls, 2013. (a) Graph view with 3000m maximum distance; (b) Graph view with 500m maximum distance.

Table 1. Temporal trend of pairwise spatial dependences between OOE and 311 categories, annually. 2008-2017.

C** Clustering at short distance (< 100 m), C* clustering at a long distance (100–500 m), R random pattern, D dispersed pattern.

Neighborhood clusters based on 311 requests and socioeconomic status

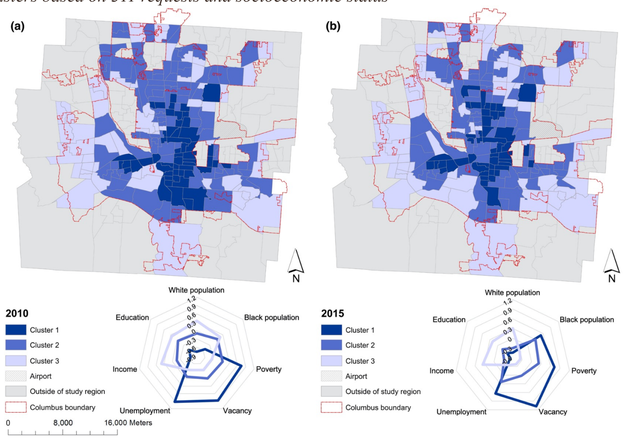


Figure 3. Spatial distribution and the socioeconomic profiles of the 311 clusters, Columbus, OH. (a) 2010; (b) 2015.

The neighborhoods comprising cluster 1 are most likely to be associated with socioeconomic distress, we define robust 311 indicators as those with high relative frequency in distressed neighborhoods and spatially associate with OOE, consistently over time (both conditions met in 2010 and 2015). Based on these criteria, we identify abandoned vehicles, animal complaints, code violation, law enforcement, public health, refuse trash litter, street lighting, street maintenance, traffic signs, and water sewers drains as robust indicators.

Prediction of OOE hotspots

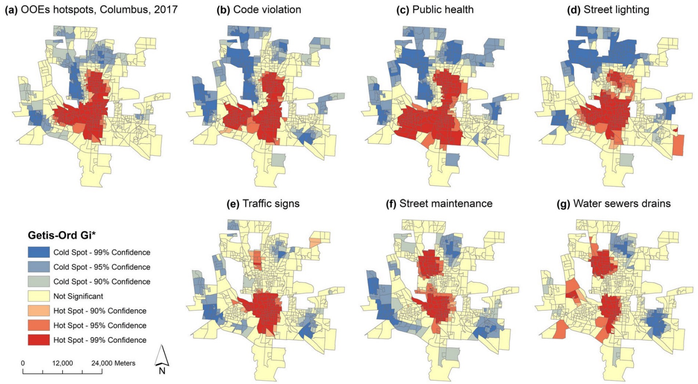


Figure 4. Spatial distribution of OOE hot/cold spots in 2017. (a) actual hot/cold spots; (b) prediction from 'Code violation'; (c) prediction from 'Public health'; (d) prediction from 'Street lighting'; (e) prediction from 'Traffic signs'; (f) prediction from 'Street maintenance'; (g) prediction from 'Water sewers drains'.

We demonstrated that the 311 indicators are capable of predicting OOE hotspots at the neighborhood-level: our results show code violation, public health, and street lighting were the top three accurate predictors with predictive accuracy as 0.92, 0.89 and 0.83, respectively.

Implications

The results from this study support the view that opioid crisis is rooted in social and neighborhood distress. We show such spatial characteristics can be used along with 311 data itself to predict the trends of opioid overdose hotspots when OOEs data is not available. Since 311 requests are publicly available and with high spatial and temporal resolution, they can be effective as opioid overdose surveillance indicators for basic research and applied policy. It is worth mentioning that our research is not a predictive policing tool. An appropriate use is to help think strategically about where to allocate outreach, programs and resources to at-risk individuals and how to alleviate the underlying social and environmental stressors in our city.

Acknowledgement and Contact

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