

Understanding the Association between Social Determinants of Health (SDoH) and Health Service Resources with Heroin Overdose

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Introduction

Opioid use has increasingly become a major health issue, affecting approximately 2.1 million people in 2016 and 91 deaths per day nationally, according to the Centers for Disease Control and Prevention (CDC) [1, 2]. Ohio had the fifth highest rate of drug overdose deaths in 2016, and more policy efforts are needed to address the limited resources in medication-assisted treatment which has proven to be the most clinically and cost-effective method to reduce opioid dependency, abuse and overdose deaths [3, 4, 5].

Using a multivariate logistic regression approach, our aim was to examine the correlation between Social Determinants of Health (SDoH), social infrastructure factors and health service resources with high incidences of heroin overdose responses in the urban area of Cincinnati, Ohio in order to explore potential levers for intervention and guide public policy on where to best allocate resources

Methods

The outcome data was extracted from the Cincinnati Fire Incidents EMS response data and filtered for heroin overdoses. Dates of responses were restricted to include incidents from January 1, 2017 to April 29, 2018. The latitude, longitude coordinates were mapped to corresponding census tracts using the Federal Communications Commission (FCC)'s census block API.

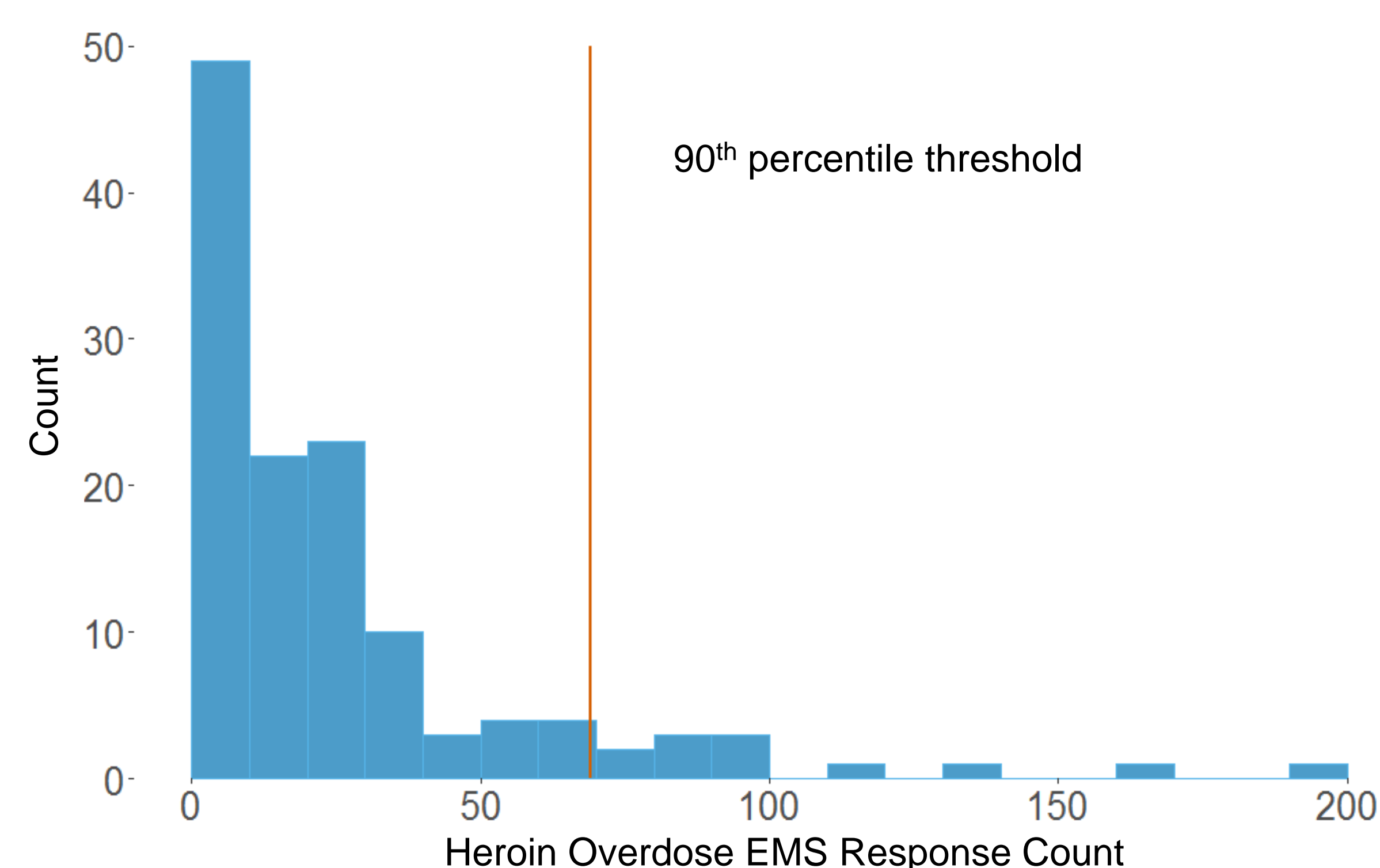
Data was obtained from publicly available sources as summarized in Table 1 below and aggregated and merged on the census tract level.

Table 1: Summary of External Data Sources

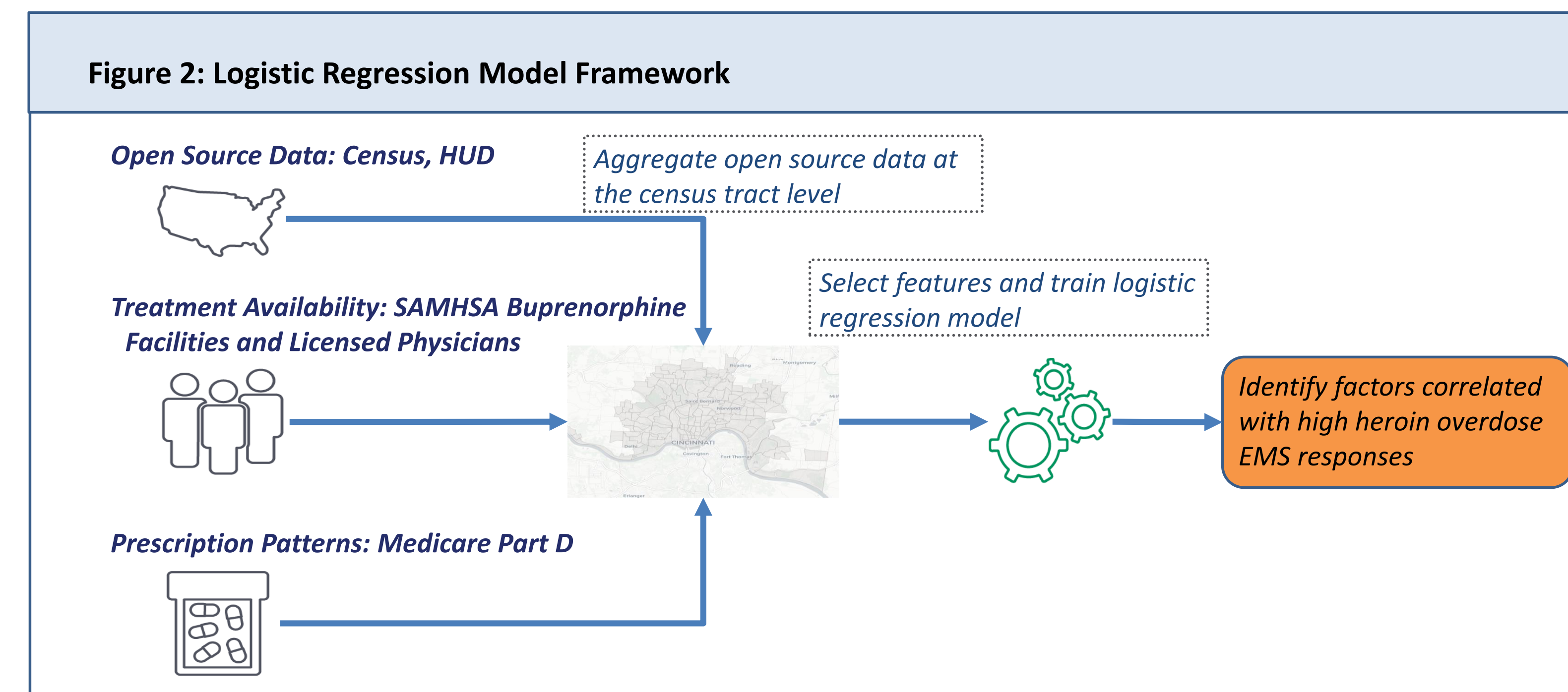
Data Domain	Source
Social Determinants of Health	Center for Disease Control (CDC) Social Vulnerability Index 2014 (SVI)
	US Department of Agriculture Food Access Research Atlas
	US Census American Community Survey (ACS) 2016
	US Department of Housing and Urban Development
Prescription Pattern	CMS Part D Prescriber Data 2015
Treatment Resource	Substance Abuse and Mental Health Services Administration (SAMHSA)

In total, 127 census tracts in the Cincinnati region were identified with an EMS response. We converted overdose responses per census tract to a binary outcome by setting a threshold at the 90th percentile of the incidents count, with 1 indicating the census tract with response volume ranked in the top 10th percentile (Figure 1).

Figure 1: Heroin Overdose Count per Census Tract



Feature selection started with literature review on factors associated with overdose. Altogether, a total of 47 variables were created. Feature elimination and selection was further accomplished by 1) analysis of feature correlation and 2) identifying significant features through LASSO regression and recursive feature elimination (RFE). In this way, we reduced the dataset to 12 features which were used to train a logistic regression model with Python's statsmodel package.



Results

Using logistic regression, the estimated total census tract population, % of population that is a minority, % of population that is institutionalized, and the total sum of antipsychotics scripts prescribed by physicians in a census tract were found to have statistically significant correlations with high rates of heroin overdose incidents. Complete results are presented in Table 2 below.

Table 2: Correlation coefficients of logistic regression model

Feature	Coefficient	SE	z	P > z	[95.0 % Conf. Int.]	OR	[95.0 % Conf. Int.]
% Minority	-0.05	0.02	-2.50	0.01*	-0.08 -0.01	0.95	0.92 0.99
Population Estimate	-0.0008	0.00	-2.38	0.02*	0.00 0.00	1.00	1.00 1.00
% Institutionalized	0.06	0.03	2.13	0.03*	0.01 0.12	1.06	1.00 1.13
Sum of Antipsychotics Claims	0.002	0.00	2.00	0.05*	0.00 0.00	1.00	1.00 1.00
Low rate vehicle access	1.62	0.88	1.84	0.07	-0.11 3.35	5.07	0.90 28.62
% Poor English	0.42	0.24	1.75	0.08	-0.05 0.90	1.53	0.95 2.45
Per Capita Income Estimate	-0.00006	0.00	-1.73	0.08	0.00 0.00	1.00	1.00 1.00
% Uninsured & non-institutionalized	0.11	0.07	1.68	0.09	-0.02 0.24	1.12	0.98 1.27
% Mobile Homes	-1.70	1.14	-1.49	0.14	-3.93 0.53	0.18	0.02 1.71
Public housing count	-0.16	0.11	-1.46	0.14	-0.38 0.06	0.85	0.68 1.06
Licensed buprenorphine treatment facility count	-0.60	0.73	-0.82	0.41	-2.04 0.84	0.55	0.13 2.31
% Occupied Housing	0.13	0.17	0.79	0.43	-0.20 0.47	1.14	0.82 1.60

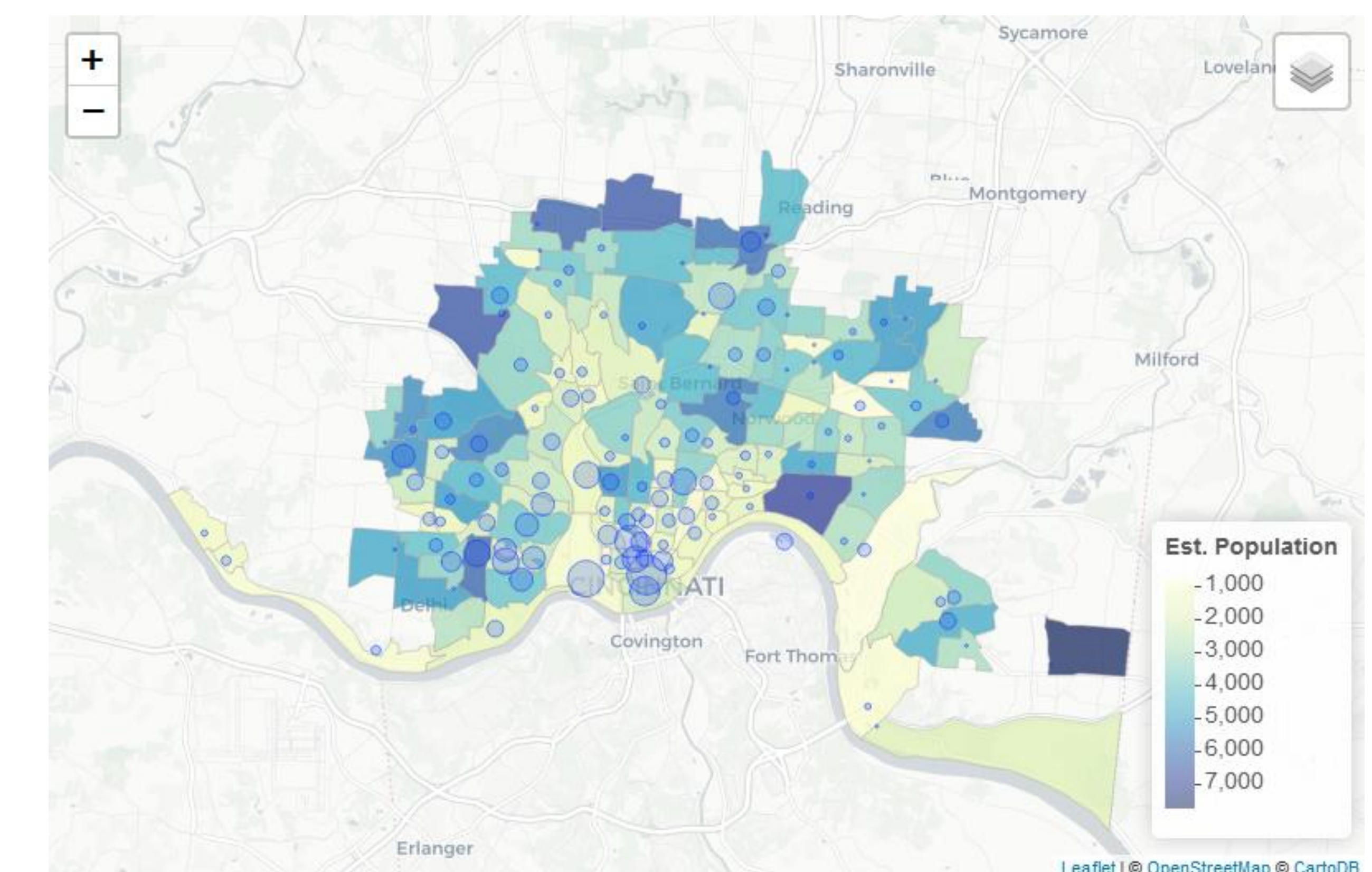
* p < 0.05

The coefficients indicate that an increase in population estimate and % minority population decreased the likelihood of high overdose incidents in a census tract. Our results show that an increase in the institutionalized population by 1% was associated with a 6% increase in odds for a census tract to be an area of high overdose incidents. An increase of 10 antipsychotic claims per census tract was associated with a 2% increase in odds of being a tract of high overdose incidents. Other social determinants variables such as low transportation, per capita income and % uninsured and non-institutionalized are also strongly correlated with the heroin overdose but not statistically significant at the 0.05 level.

Discussion

Through this study, we can gain an understanding of characteristics of areas with higher likelihood of heroin overdose events and dedicate appropriate resources to those areas. By utilizing sociodemographic statistics and historical anti-psychotic prescription data of physicians, public officials can use a combination of these factors to prioritize areas in which to set up resources and enable the greatest impact. A heat map of population size against heroin overdose responses in Figure 3 below illustrate how geographic visualizations like this serve as actionable tools to aid in policy planning.

Figure 3: Heatmap of population compared to heroin overdose count



References

- [1] HHS Press Office (October 26, 2017). HHS Acting Secretary Declared Public Health Emergency to Address National Opioid Crisis. U.S. Department of Health and Human Services.
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