Challenge 1: Opioids
Understanding social determinants of health (SDoH) and health service resources correlation with opioid overdose

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]. In October 2017, HHS declared the opioid epidemic a public health crisis and the government passed an omnibus bill in March 2018 that added $3.3b in resources to opioid and mental health efforts [2, 3].

Ohio had the fifth highest rate of drug overdose deaths in 2016, despite establishing an Opiate Action Team in 2011 that focused on responsible opioid use, reducing supply, and overdose prevention and harm reduction through naloxone expansion [4]. These efforts did show promising progress in reducing opioid prescriptions by 28.4% from 2012 to 2017 [4, 5], but broad studies indicate more policy efforts are needed especially to address the limited resources in medication-assisted treatment which proves to be the most clinically and cost effective method to reduce opioid dependency, abuse and overdose deaths [9].

Using a multivariate logistic regression approach, our aim is to examine the correlation between health service resources, Social Determinants of Health (SDoH), and social infrastructure factors to high incidences of overdose responses in the urban area of Cincinnati, Ohio as a case study to determine potential levers for intervention applicable to other areas of the United States as well. In this way, we hope to answer the following questions: What are sociodemographic and geographic factors correlated with high incidence areas of heroin overdose? And how can current policies be changed to appropriately address and prevent further exacerbation of the opioid crisis in these areas?

Data Source

The outcome data was extracted from the Cincinnati Fire Incidents EMS response data, which was filtered down to “HEROIN OVERDOSE” response type group. Data covers responses from 2015 to April 29, 2018. The latitude, longitude coordinates were mapped to census tract using the FCC’s census block API (refer to table 1).

The predictors data was obtained from publicly available sources as summarized in Table 2 below. There are three main focused data areas: social determinants of health mainly from census and other public available data, prescribing pattern from Medicare Part D data and substance treatment resources from Substance Abuse and Mental Health Services Administration. When needed, the addresses from the data were mapped to census tract using

the US Census Bureau's geocoder. Those addresses without a match were removed (~20% of data).

Table 1: APIs for geocoding

API Source	Description
Federal Communications Commission (FCC)	Latitude/Longitude to census tract
United States Census Bureau	Address to census tract

Table 2: External data sources

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

Methods

Multivariate logistic regression was used to analyze the associations between a set of social determinants of health and health services variables and opioid overdose incidents.

Both the EMS response data and data fields of interest from other public sources were grouped by census tract ID and then aggregated in order to create features on the census tract level. In total, 128 census tracts were identified with an EMS response.

The EMS overdose incidents count was converted to a binary response outcome by setting a threshold at the 75^{th} percentile. Predictor selection started with literature review on related factors associated with overdose. We created a total of 150 variables across the three main data domains. Feature selection was completed using LASSO regression and a final logistic regression model was trained on the dataset. Predictor examples are included in Table 3.

Table 3: Example predictors for EMS overdose response

Data Domain	Feature

Social Determinants of Health	Median ACS household income for designated tract
Social Determinants of Health	Percentage uninsured in the total civilian noninstitutionalized population estimate
Social Determinants of Health	Percentage of census tract population in ethnic minority
Social Determinants of Health	Percentage of occupied housing units with more people than rooms estimate
Social Determinants of Health	Count of public housing units in census tract
Social Determinants of Health	Percentage with low vehicle access
Social Determinants of Health	Percentage of households with single parent
Prescribing Patterns	Sum of opioids claims count (Medicare Part D)
Prescribing Patterns	Sum of opioids days supply (Medicare Part D)
Treatment Resources	Count of Buprenorphine facilities in census tract
Treatment Resources	Count of Buprenorphine licensed physicians in census tract

Results

Our preliminary results show social determinants of health, prescribing patterns and treatment resources are associated with high incidences of heroin overdose at the census tract level. Final results will be presented in the full abstract submission.

Reference

[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 .Retrieved May 1, 2018 from https://www.hhs.gov/about/news/2017/10/26/hhs-acting-secretary-declares-public-health-emergency-address-national-opioid-crisis.html

[2] Ahrnsbrak R., & Bose J.,& Hedde S. L., & Lipari R. N., & Park-Lee E. (September 2017). Substance Abuse and Mental Health Services Administration. Key Substance Use and Mental Health Indicators in the United States: Results from the 2016 National Survey on Drug Use and Health. Retrieved on April 15th from https://www.samhsa.gov/data/sites/default/files/NSDUH-FFR1-2016/NSDUH-FFR1-2016.pdf

[3] Lopez G. (March 22,2018). Congress's omnibus bill adds $3.3 billion to fight the opioid crisis. It's not enough. Retrieve on April 17th from https://www.vox.com/policy-and-politics/2018/3/22/17150294/congress-omnibus-bill-opioid-epidemic

[4] Penm J.,& MacKinnon N. J., & Boone J. M., & Ciaccia A., & McNamee C., & Winstanley E. L. (January 4, 2017). Strategies and policies to address the opioid epidemic: A case study of Ohio. Journal of the American Pharmacists Association 57 (2017) S148eS153

[5] Schierholt S. W. (2018). OHIO AUTOMATED RX REPORTING SYSTEM 2017 ANNUAL REPORT. Retrieve on May 1st from State of Ohio Board of Pharmacy website: https://www.ohiopmp.gov/documents/Annual%20Report%20(2017).pdf

[6] Center for Disease Control and Prevention. Opioid Prescribing (2017). Retrieve April 20th from https://www.cdc.gov/vitalsigns/opioids/

[7] Stoller K. B., &. Stephens M. C., & Schorr A. (July 13, 2016). American Association for the Treatment of Opioid Dependence. Integrated Service Delivery Models for Opioid Treatment Programs in an Era of Increasing Opioid Addiction, Health Reform, and Parity. Retrieved on April 15th from http://www.aatod.org/wp-content/uploads/2016/07/2nd-Whitepaper-.pdf

[8] Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. Archives of General Psychiatry. 2005;62(6):617–627.

[9] Rembert M., & Betz M., & Feng B., & Partridge M. (October 2017). Swank Program in Urban Policy-Ohio State University. Taking Measure of Ohio's Opioid Crisis. Retrieve on April 21st from https://aede.osu.edu/sites/aede/files/publication_files/Swank%20-%20Taking%20Measure%20of%20Ohios%20Opioid%20Crisis.pdf