



# Heroin overdose prediction for Mesa

APP designed for Naloxone Distribution

# Opioid Overdose Background

01

Opioid-involved overdose claimed the lives of 90 Americans per day in 2015, rising to a staggering 137 per day in 2019

02

Due to the difficulty of monitoring the continually evolving illicit drug supply and rapidly changing overdose risk environment, proactive interventions focused at the community level.

03

These including naloxone distribution, street outreach, expansion of opioid use disorder (OUD) treatment services, and provision of mobile and low-threshold OUD treatment, have become more important than ever



# Naloxone



Naloxone is a medicine that rapidly reverses an opioid overdose.



Families with loved ones who struggle with opioid addiction should have naloxone nearby; ask their family member to carry it; and let friends know where it is. People should still call 911 immediately in the event of an overdose.



Naloxone is being used more by police officers, emergency medical technicians, and non-emergency first responders than before. In most states, people who are at risk or who know someone at risk for an opioid overdose can be trained on how to give naloxone.

# APP: Naloxone Distribution Project (NDP) Helper

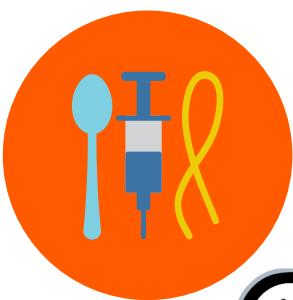


## Public Health Officials

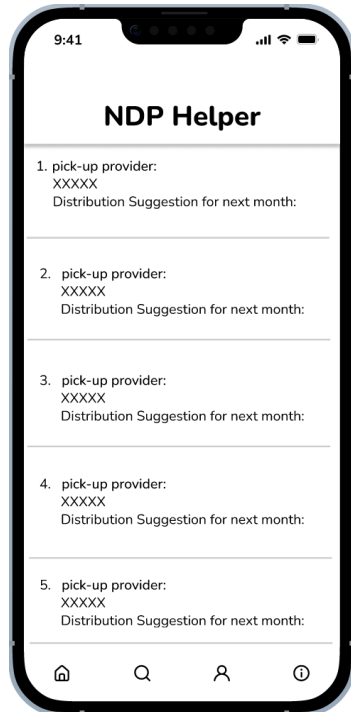
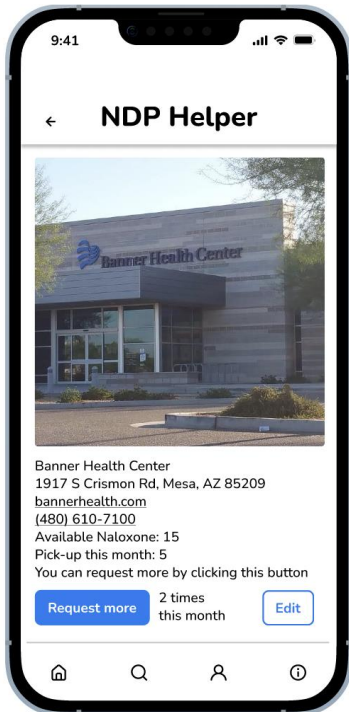
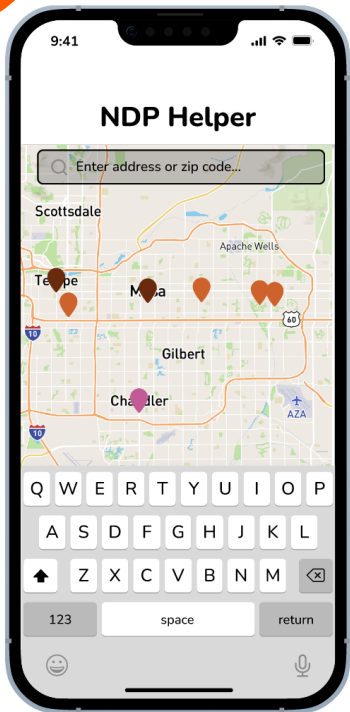
- notice the possibility of a shortage of naloxone as a prevention resource for each provider (based on the prediction).
- They could edit the page for each provider for offering more details.

## Residents

- check the provider near them by navigating the map to their area.
- They could then contact the provider directly by phone to arrange a free naloxone pick-up.
- They could request more Naloxone on the app.

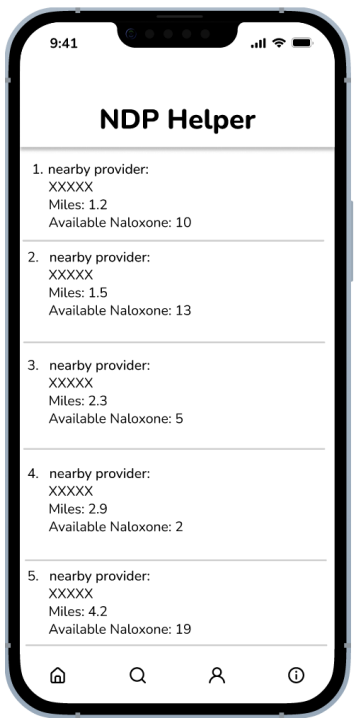
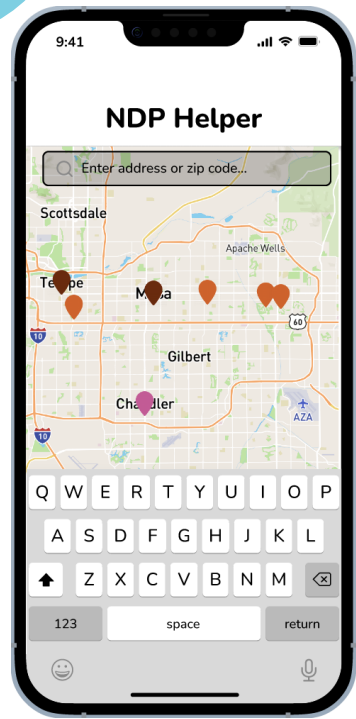


# User: Public Health Officials





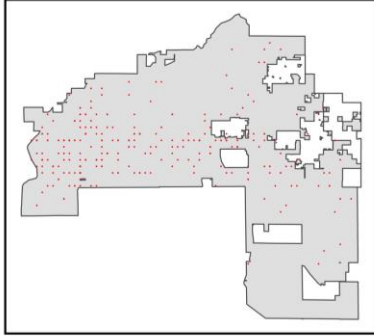
# User: Residents



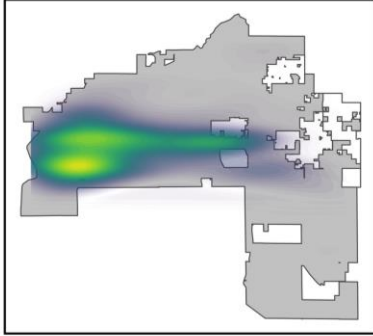
# Data Exploration

## 01 Overdose in Mesa 2020

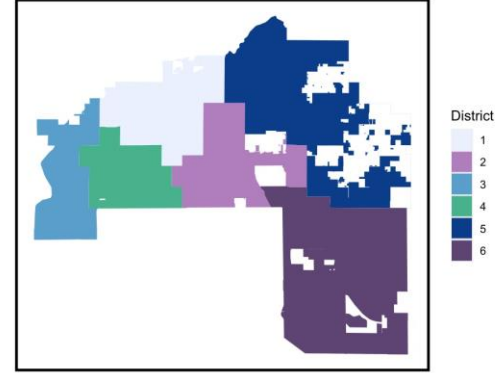
Opioid Overdose, Mesa - 2020



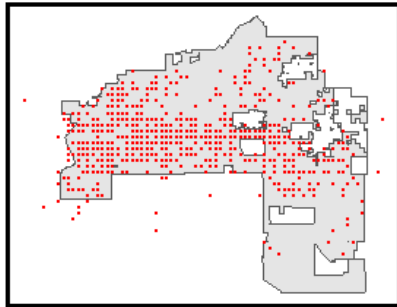
Density of Opioid Overdose



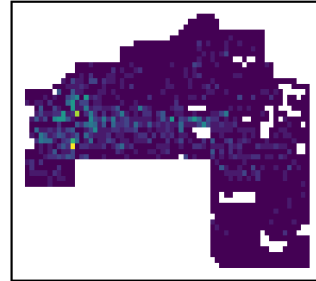
Council District



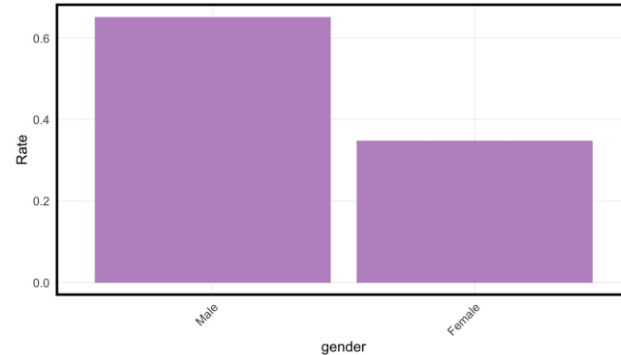
## 02 Overdose data & count map - all



Count of Crimes for the fishnet



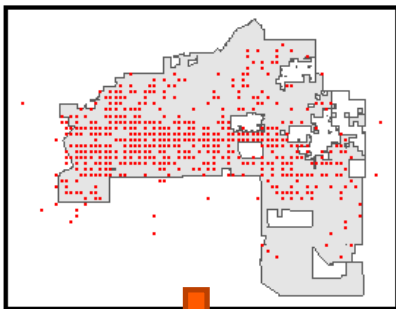
opioid overdose



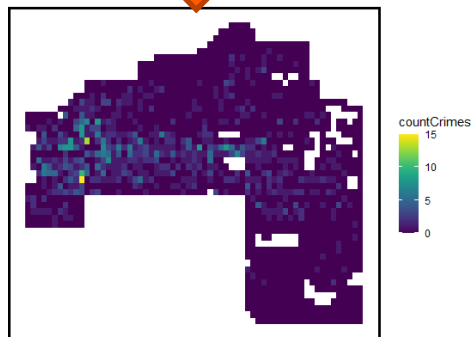
# Data Exploration

## 01 Dependent Variable

Heroin Overdose in 2020



Fishnet



## 02 Independent Variable

### Risk Factors:

Un\_Sheltered", "Trans\_graffiti", "Plc\_incidence", "Plc\_dispatch",  
"Code\_violation"

### Amenities:

"Park", "Light", "Rail\_station"

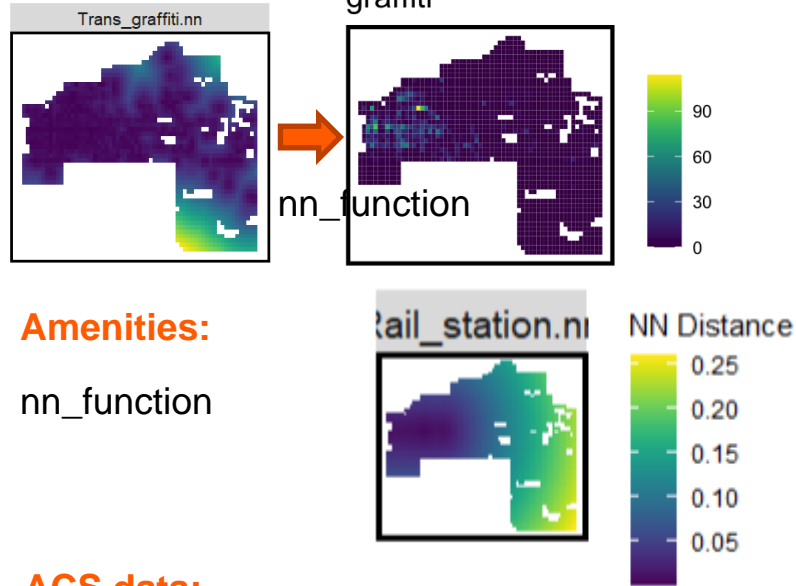
### ACS data:

"pctWhite", "pctBachelors", "pctPoverty", "MedHHInc", "MedRent",  
"Familyincome"



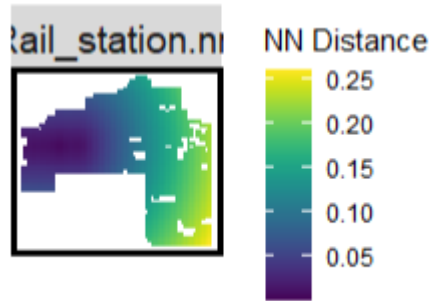
# Engineering Features

## Risk Factors:



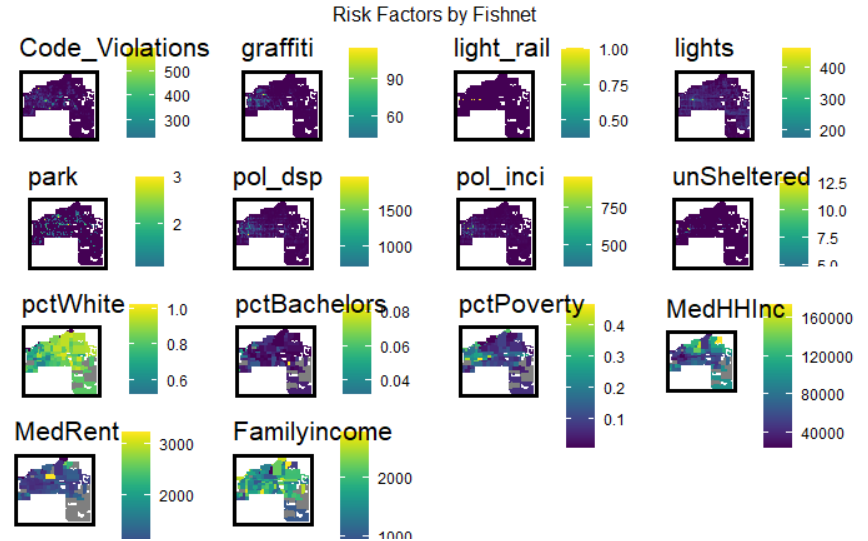
## Amenities:

nn\_function

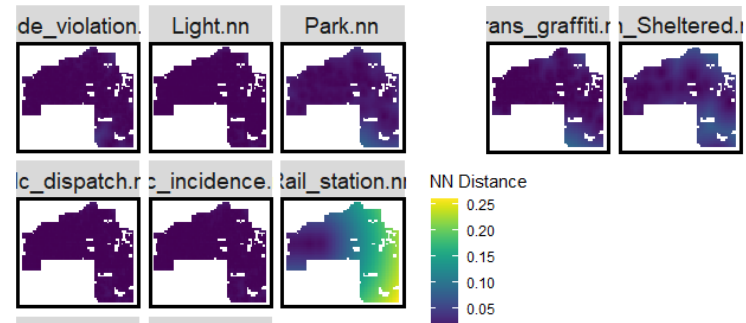


## ACS data:

Connect to Fishnet



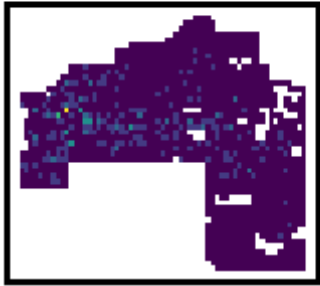
Visualize the NN feature



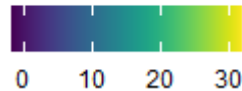
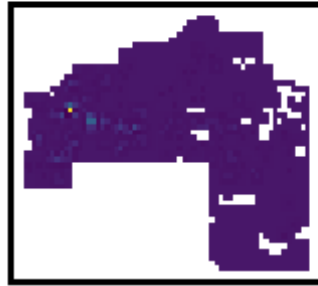
# Spatial Process

Local Morans I statistics, Crimes

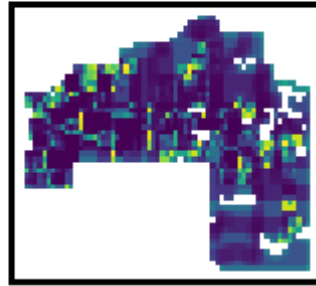
crime\_count



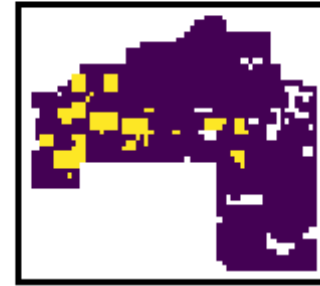
Local\_Morans\_I



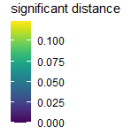
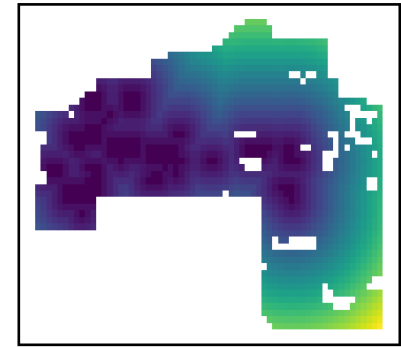
P\_Value



Sig\_Hotspots



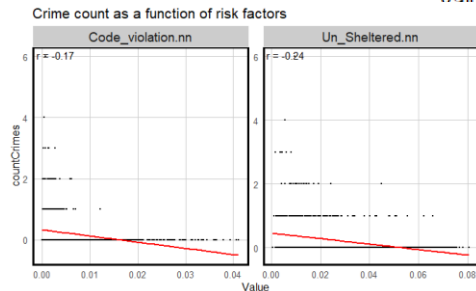
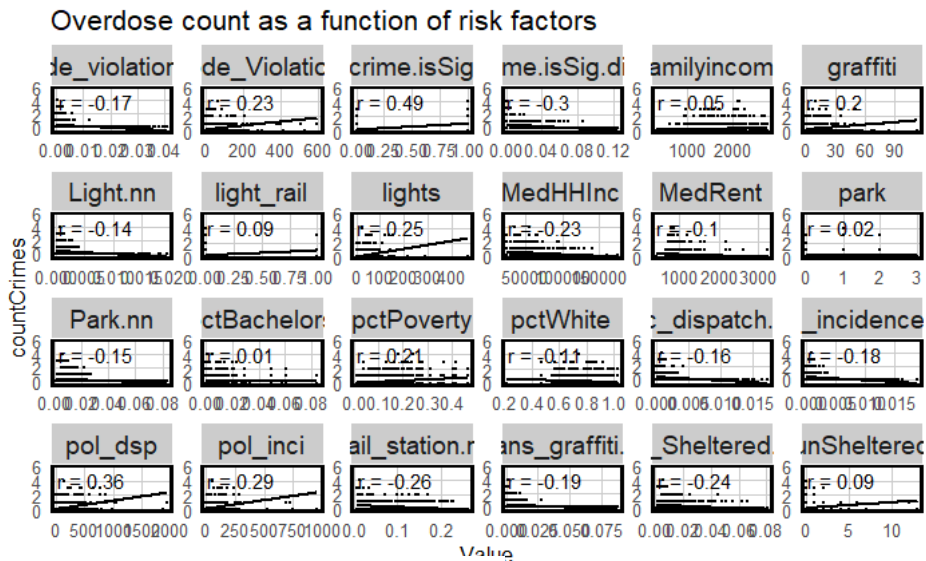
distance to highly significant hot pot



# Geospatial risk modeling

We will use geospatial risk model which is a regression model, Predictions from these models are interpreted as ‘the **FORECAST RISK** /opportunity of that event occurring here’.

The goal is to borrow the experience from places where crime is **OBSERVED** and test whether that experience generalizes to places that **MAY BE AT RISK**, even if few events are reported.

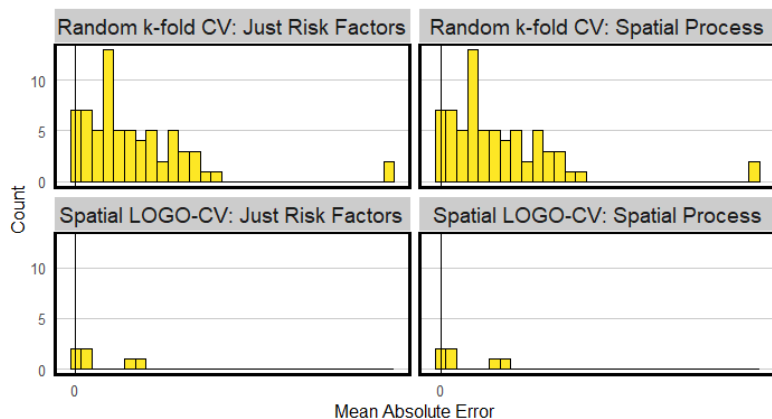


# CV: Accuracy & Generalizability

## Accuracy

### Distribution of MAE

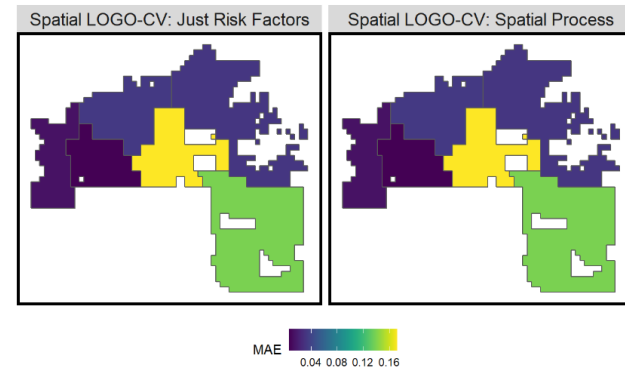
*k*-fold cross validation vs. LOGO-CV



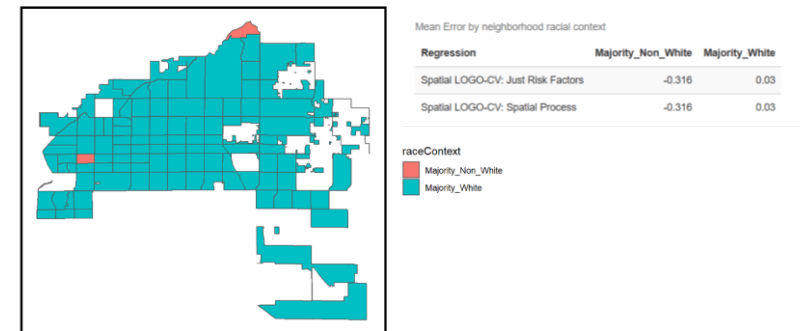
Regression	Mean_MAE	SD_MAE
Random k-fold CV: Just Risk Factors	0.16	0.23
Random k-fold CV: Spatial Process	0.16	0.23
Spatial LOGO-CV: Just Risk Factors	0.07	0.07
Spatial LOGO-CV: Spatial Process	0.07	0.07

## Generalizability

### Overdose errors by LOGO-CV Regression



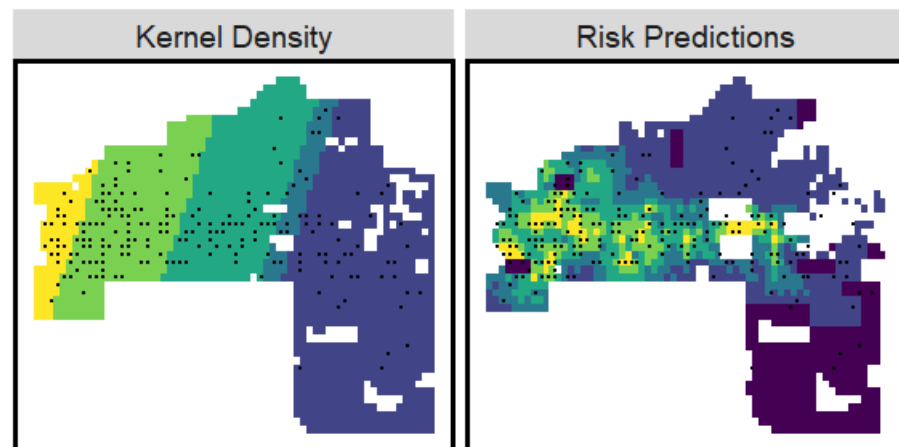
### Race in Mesa



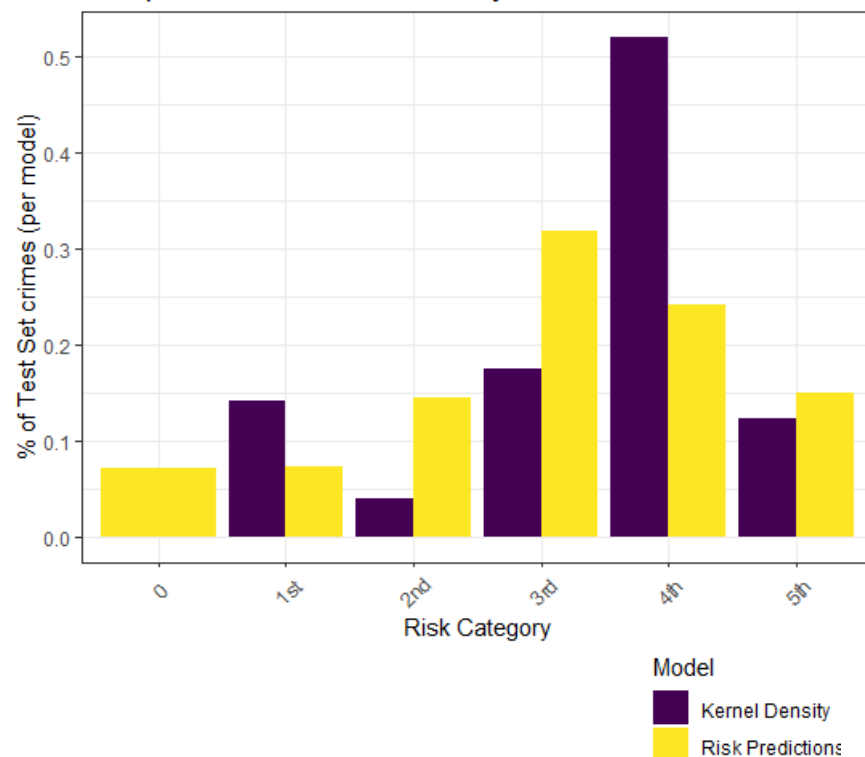
# Results

## Comparison of Kernel Density and Risk Predictions

2020 crime risk predictions; 2021 crimes



## Risk prediction vs. Kernel density, 2021 crimes



# Bias & Conclusion

## Bias:



**Reported Bias:** We used the reported heroin overdose data. However, more crimes are 'reported', and more risk is predicted. Some areas may simply have more reports of heroin overdoses due to more surveillance, rather than a high number of heroin overdoses in the area itself.



**Observation Bias:** heroin overdose are often unobserved because somebody carrying or using heroin is frequently not arrested or sent to hospital - we only observe the event when there is an incident or a police presence.

**Conclusion: Useful but need more improvement.**

## Improvement:

**More factors:**  
such as hospitals and schools

## More overdose services by prediction

We recommend, based on the prediction map, distributing more naloxone to syringe services programs, substance Use Treatment, substance use prevention coalitions, recovery meetings, recovery housing, library, health department, food bank...