

# Who Dunnit? US Opioid Epidemic

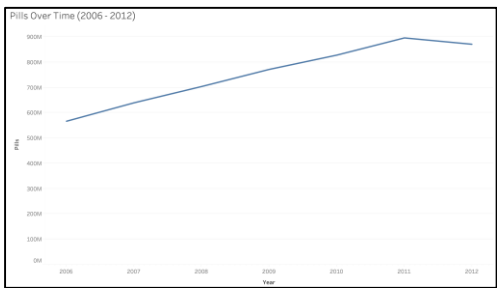
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## Executive summary

In recent years, there has been a steady increase in opioids purchased across the United States. The trend of drug-related deaths has been similar. In this work, we propose an approach to identify pharmacies and practitioners that overprescribe opioids through clustering. To this end, we leverage publicly available Drug Enforcement Agency (DEA) data that records all transactions between suppliers and buyers over the period 2006 – 2012. We develop strategies to flag pharmacies that oversell and quantify their level of overselling relative to ‘peer’ pharmacies. This ensures that efforts are targeted towards specific pharmacies and hotbeds of opioid crisis in need of intervention.

## Problem

- Steady increase in number of opioids sold over time
- Large number of pharmacies oversell opioids, identifying them can be crucial
- States of Kentucky, Tennessee, and West Virginia are hotbeds of opioid crisis



## Key questions



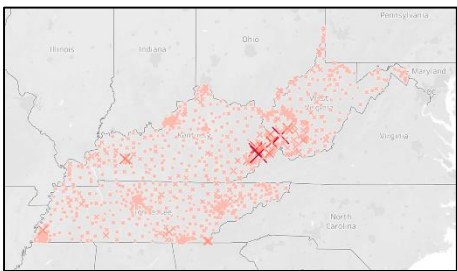
## Data

- DEA data – contains every opioid transaction from supplier to buyer (pharmacy/practitioner) between 2006 and 2012.
- County health rankings (demographics, health indicators & economic status)
- Census on population and income at the zip code level

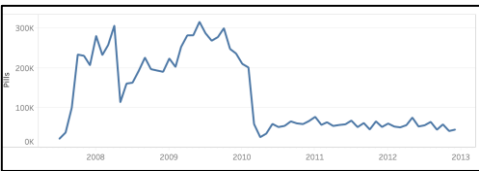
Pharmacy type	Population (ZIP code)	Average income (in \$10k)	Number of pharmacies (ZIP code)		Total number of pills sold in 2012
...	...	...	...	...	...
Practitioner	2439	52.00	11	...	52
Chain	18103	46.46	5	...	188250
Retail	7406	37.70	2	...	68500
...	...	...	...	...	...

## Exploratory Analysis

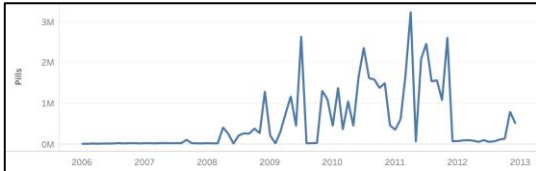
### Visualizing Pills per Capita Sold by Pharmacy



### Temporal Plots by Pharmacy



Tug Valley Pharmacy



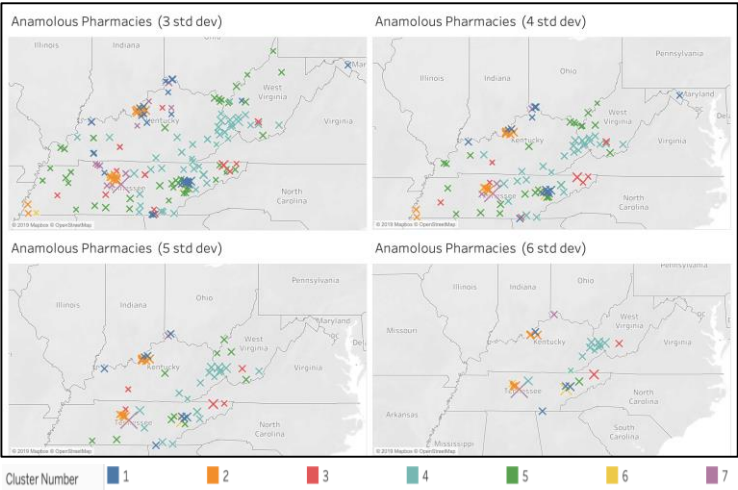
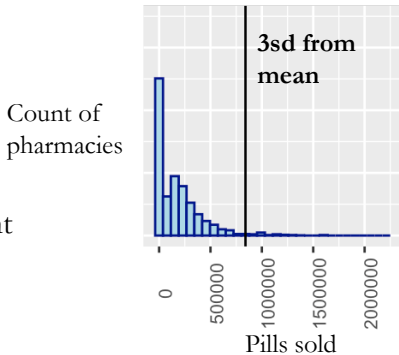
Reeves-Sain Extended Pharmacy

## Results

The main analysis identified ‘peer pharmacies’, i.e. pharmacies that likely sell a similar number of drugs. These were identified by clustering pharmacies on pharmacy type (chain vs retail), population, income, number of nearby pharmacies, number of nearby doctors, % insured, and % over 65 years.

For each cluster, we identified pharmacies that bought more pills than X standard deviations from the mean of its cluster for each year between 2006 – 2012.

### Pills sold by Cluster 4 Pharmacies in 2012



## Takeaways

### Who Dunnit? Many players to consider



### Recommendations (Collaboration between all major players)

- Provide **support services** to opioid addicts in areas such as West Virginia-Kentucky border and Nashville, TN which have many pharmacies exhibiting anomalous opioid purchasing patterns
- Depending on the level of suspicion (standard deviations from mean of cluster) as well as resources available, the following measures can be taken:
  - Targeted **notifications** warning pharmacies and nearby doctors that authorities have noticed high level of opioid sales
  - Conduct **audits** of suspect pharmacies and nearby doctors
- Drug Enforcement Agency (DEA) to develop an anomaly **detection system** which proactively leverages their data to flag suspect purchases made by pharmacies
- In the longer term, impose **regulations** on drug manufacturers to limit total quota of opioids produced and imported

## Concluding Remarks & Next Steps

Studying which pharmacies oversold opioids is a proxy for understanding which areas are suffering the most from opioid abuse, thus enabling us to make appropriate interventions in collaboration with local authorities in these regions. This is crucial to informing policy and taking decisive action against offending parties to tackle the opioid epidemic.

### Future Scope:

- Clusters may not be robust to the introduction of new pharmacies; we look to developing a robust prediction model for the number of pills sold based on our current findings.
- Model demand for pills at the pharmacy level in order to impose a quota on the number of opioids produced.
- Expand scope of our investigation to pharmacies nationwide.