Socioeconomic Impact on Opioid Use: Who be poppin pills?

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by
Austin White,
Rylan Hunter,
Mayank Jaggi

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Section 1: Investigative Report

Introduction

This paper sought to investigate the impact that the opioid crisis has had on different populations based on socio-economic factors. In particular, we were interested in how an area's median income and population density (i.e. if an area is more rural vs urban) correlate with opioid prescription use. To do so, we used data pulled from the ARCOS opioid database, as well as US census data taken within the same timeframe (the year 2010). We found that there was not a strong correlation, but we still did find useful data from our investigation.

Results

Figure 1.1 shows scatter plots of the amount of each opioid type (in milligrams, mg) per capita vs population density, where each individual dot represents an individual zip code. There are clearly a lot more rural zip codes with high amounts of opioid usage, however there are also more zip codes overall with lower population density. More investigation into this was needed, which is talked about later in this report.

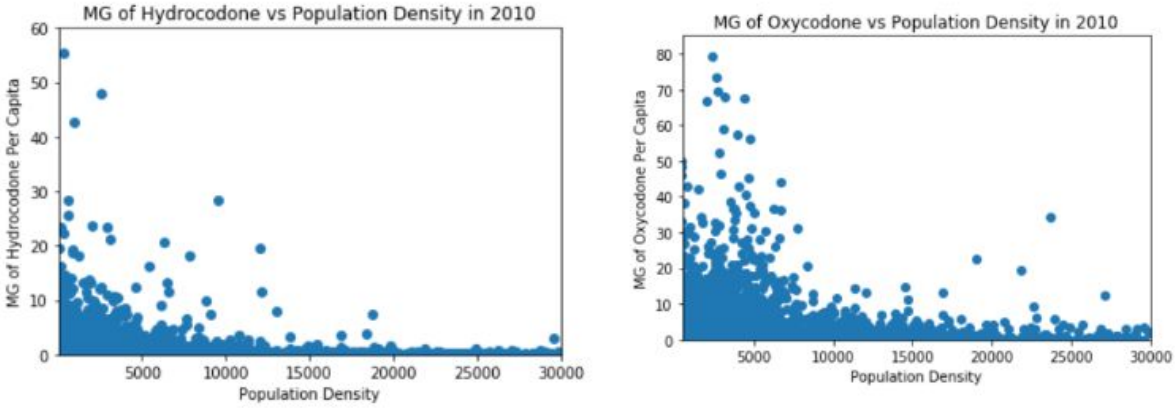

Figure 1.1: MG of Opioids Per Capita vs Population Density

Figure 1.2 shows scatter plots of each opioid type (in mg) per capita vs median household income. This data appears to show significantly more opioid usage in areas where the median income is between $40,000-$80,000, however this is also the range that the majority of zip codes are found in and therefore more investigation was needed here as well, which is also discussed in this report.

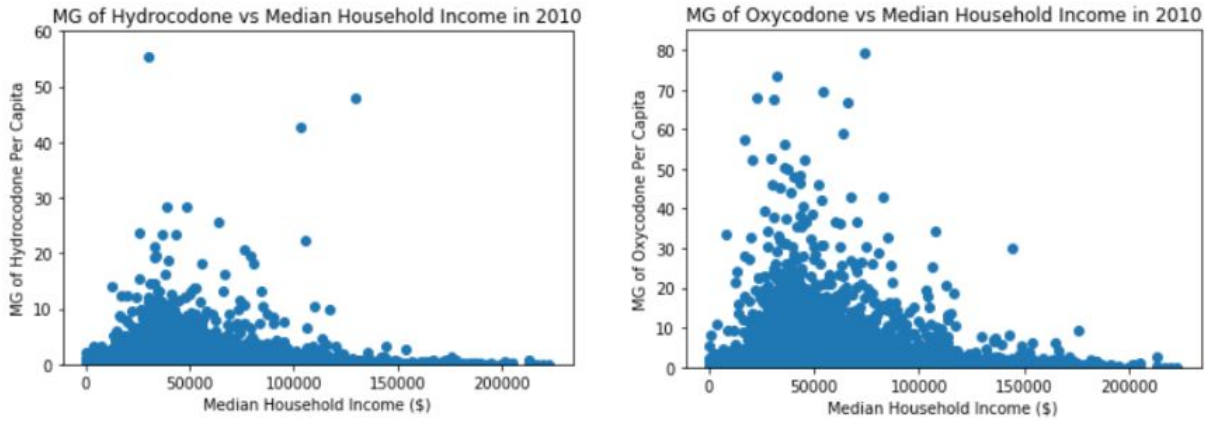

Figure 1.2: MG of Opioids Per Capita vs Median Household Income

In order to get a better look at how socio-economic status is correlated to the opioid crisis, we separated median household income and population density into relevant ranges, and found the average MG/Capita of opioid use for each range. This is shown in Figure 1.3 below.

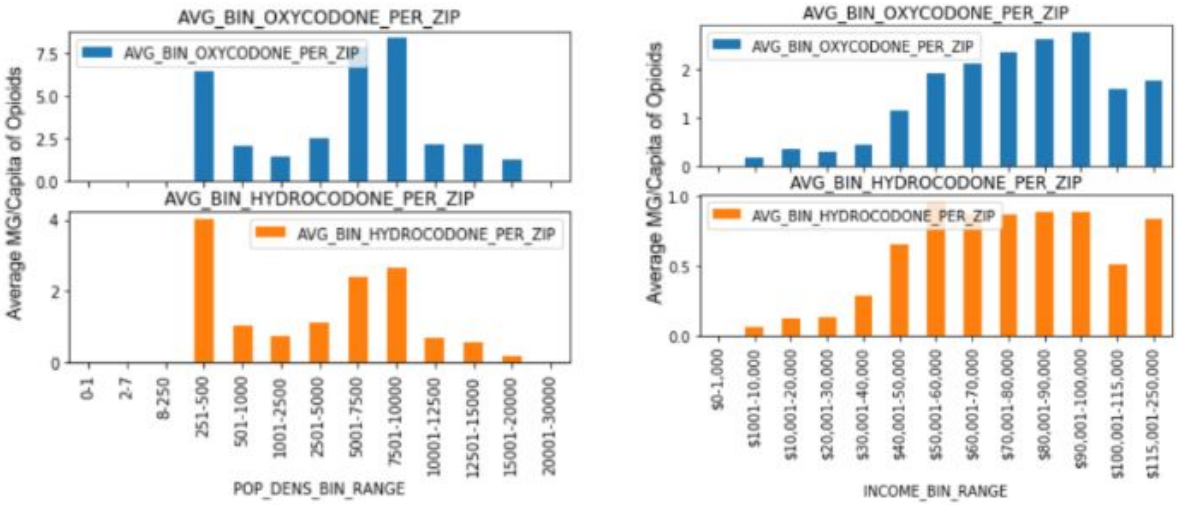

Figure 1.3: Average MG of Opioids Per Capita vs Population Density

There does appear to be a significant increase in opioid usage in very rural areas with a population density between 250-500 people per square mile, and there also appears to be increased opioid usage in urban areas with a population density between 5,000-10,000 people per square mile. There also appears to be significantly less opioid usage in very poor areas where the median household income is less than $40,000 per year.

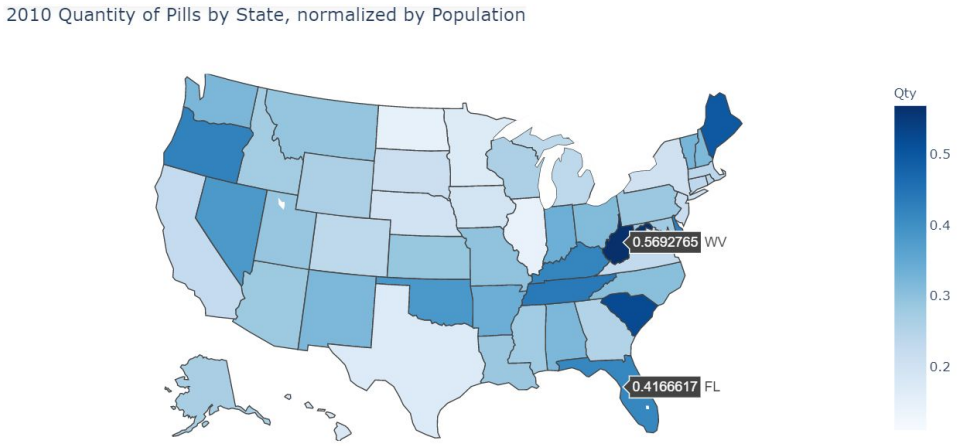

Figure 1.4: Total Opioid Pill Count by State (normalized by population)

Despite the correlation between certain population density ranges and opioid usage, looking at the heat map in Figure 1.4 of opioid usage across the United States, it appears that population density and income are not the most significant factors in the opioid crisis. It seems that rather that state laws, an area's access to doctors, as well as major airports/highways, are a better correlation. Urban areas will naturally have better access to these, hence the correlation. It is also possible that the very rural areas have a higher occurrence of injuries that would lead to a prescription for opioids (do to more blue collar work/physical labor), and the lower population would lead to any of these occurrences heavily skewing the results.

While opioid use appears to be consistent across the majority of income brackets, it is apparent that areas with a median household income below $40,000 have not been impacted by opioid usage nearly as much. This is an interesting result, as it shows that the opioid crisis has primarily impacted the middle and upper classes. The lack of opioids in the lower income areas is likely related to access to healthcare, as people without extra income or good health insurance are less likely to go to the doctor for illnesses and injuries.

While our findings do not show that socio-economic status is significantly related to the opioid crisis, it is still useful data. Our data can be used to show that other external factors are at play in this crisis, as they do not correlate with the same populations that are more likely to abuse hard/illegal drugs.

Section 2: In-depth Analysis and Methodology

Databases

The ARCOS database contained information on all oxycodone and hydrocodone pills sold from the years 2006 to 2012. With each record, we had quite a bit of information, including number of pills prescribed, dosage strength of pills, date sold, and buyer's zip, city, state. We paired this dataset down and organized the quantity sold by zip code, and cross-correlated this data with the census data. Since the census is only taken every 10 years, we choose to look at any ARCOS record from 2010.

The US 2010 Census was also sortable by zip code, and included average income, median income, total population, and population density. We chose to use median income, since the average can be quite skewed by outliers, and the median offers a better statistical value.

Methodology

We looked at population density and median household income on a zip code level from the 2010 census for our investigative analysis of the opioid crisis. We felt that these are a good representation of the socio-economic status of an area, which allowed us to determine this was a primary factor into how the opioid crisis has impacted the United States. We compared this data to the amount of opioids in each zip code in 2010, which we pulled from the ARCOS database.

We looked at median income over average income, as it is less skewed by outlier data (which is especially important in lower population areas). This allowed us to get a more accurate look into a population's economic status. What we found was that areas with a median household income below $40,000 had significantly less opioid use than other areas (where as areas with household incomes above $40,000 had relatively consistent opioid usage). We believe that this is related to a populations access to healthcare, as people with low income and bad/no health insurance tend to not go to the doctor as much for non-severe issues. This would lead to less prescription drugs to this population.

We did find that certain population densities (discussed in section 1) had higher opioid usage, but as we will look into in this report, it appears that opioid usage is more correlated with major highways/airports and access to doctors (can be seen in Figure 2.2). The highly rural areas are likely to be skewed by individuals with opioid prescriptions, of which there may be a higher need for due to a higher amount of blue collar work and physical labor in these communities. Areas

with a population density between 5,000-10,000 did also have more opioid usage, which is an interesting correlation.

We chose our income and population density brackets so that the sample sizes were spread out enough for outliers to not impact the data too much, while also taking into consideration relevant definitions for income brackets and rurality.

Further Analysis into Opioid Crisis

We created heat maps of opioid usage across the United States, which showed that there is likely another factor that is more strongly correlated with the opioid crisis than socio-economic status. Below in Figure 2.1 is a heat map showing prescription Oxycodone usage across the country, where it is clear that the amount of opioids vary with different geographic regions, even when comparing states with similar socio-economics. Also see Figure 2.2, which looks at prescription dosage of Hydrocodone.

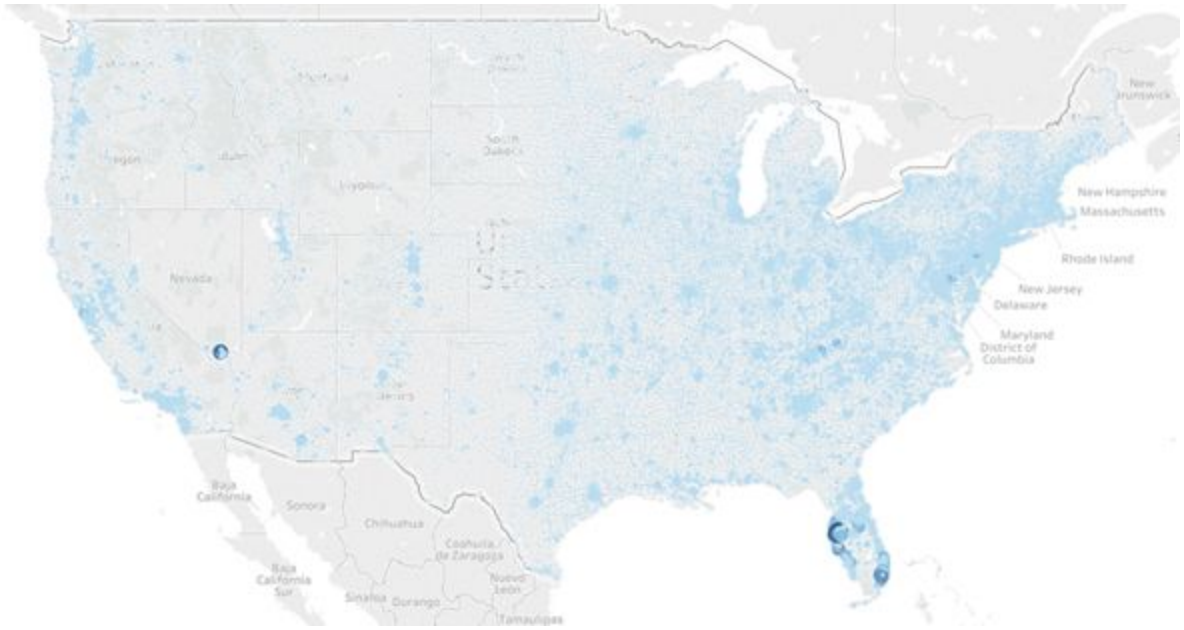

Figure 2.1: Total MG of Oxycodone by Zip Code (across Mainland USA)

Maximum consumption of Oxycodone is in the following cities (size of the circle and color indicates the mg consumed) :

- Las Vegas (NV)
- Tampa (FL)
- Ft Lauderdale (FL)

- Knoxville (TN)
- Hallandale (FL)

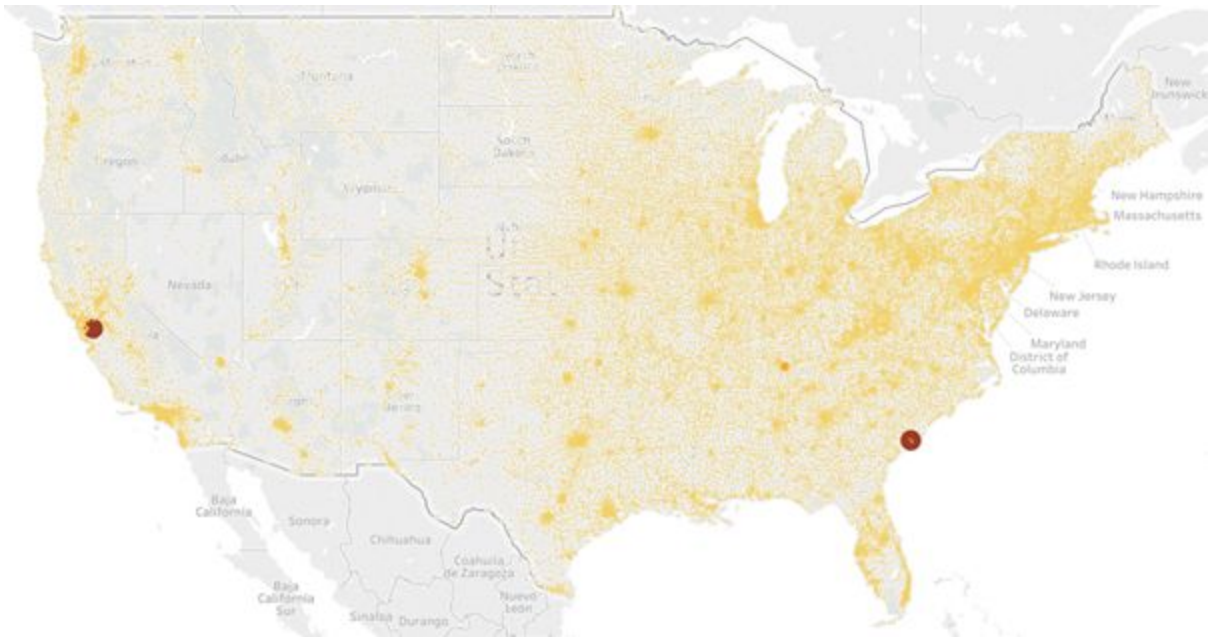

Figure 2.2:Total MG of Hydrocodone by Zip Code (across Mainland USA)

Maximum consumption of Hydrocodone is in the following cities (size of the circle and color indicates the mg consumed):

- Charleston (SC)
- Livermore (CA)
- Murfreesboro (TN)
- Downey (CA)

We can also aggregate quantity by zip code and see the results plotted in Figure 2.3. Larger circles indicate more opioid pills prescribed in that particular zip code.

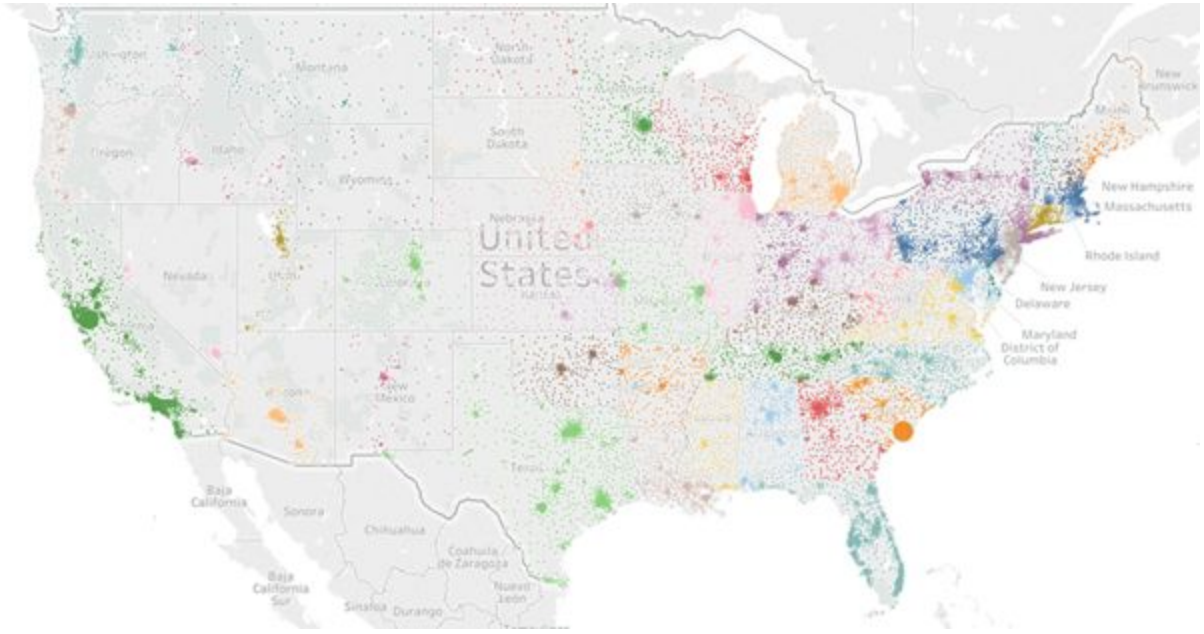

Figure 2.3 : Total Quantity of Pills by Zip Code color coded by State (across Mainland USA)

Maximum pills are consumed in the following cities:

- Charleston (SC)
- Livermore (CA)
- Murfreesboro (TN)
- Downey (CA)
- Torrance(CA)

From these results, it seems as though there is a strong correlation between pills prescribed and geographic proximity to major cities, and major airports/highways. We believe this may be due to increased access to doctors and major hospitals, which is relevant to both the patients being prescribed the pills, and the distribution companies (that likely push their products, such as opioids, more to doctors in major areas that are easy to access).

It appears that the more sparsely populated regions in the west and midwest have the lowest opioid usage rates in the nation overall. Our data shows this is not simply because these regions are rural, as there are plenty of rural areas in the United States that have an opioid problem (such as the southern United States and places like West Virginia, where they are largely rural and yet has a major opioid problem). This supports our theory that geographic proximity to major cities, airports, and highways have a more relevant correlation than simply rurality alone.

References

Links to our data sources below:

ARCOS:
https://www.kaggle.com/paultimothymooney/pain-pills-in-the-usa#arcos_all_washpost.tsv.gz

US 2010 Census Data:
Population Density:
https://blog.splitwise.com/2014/01/06/free-us-population-density-and-unemployment-rate-by-zip-code/

Median Household Income:
https://blog.splitwise.com/2014/01/06/free-us-population-density-and-unemployment-rate-by-zip-code/