Addiction Risk Mapping in Montana: Do bar, brewery, liquor store, pharmacy, or coffee shop locations indicate risk for illicit drug use?

By Robin Silverstein, May 2019

Introduction

Substance use disorders are a significant problem in the United States. In 2017, 70,237 drug overdose deaths occurred in the United States[1]. Opioids were involved in about two-thirds of those deaths. West Virginia lead all states with 57.8 deaths from drug overdose per 100,000 people. Montana had the sixth lowest rate among the fifty states, with 11.7 deaths from drug overdose per 100,000 people in 2017[1]. Nevertheless, substance use disorders are a major public health concern in Montana. Montana has higher alcohol consumption rates of current drinking (58.0%), binge drinking (19.8%), and heavy drinking (7.7%) than the US (53.6%, 16.3%, and 5.9%, respectively)[2]. The Montana Department of Justice reported Drug violations in Montana were led by marijuana (57%), methamphetamine (31%), and other narcotics (7%) in 2015[2]. Forty percent of all adult convictions in Montana were for possession or distribution of drugs or felony DUI, demonstrating the importance of substance use disorders[2].

To better understand the problem of substance use disorders in Montana, there is a need to understand addiction and the spatial association of where it occurs. Addiction occurs with many substances, including two legal ones, caffeine and alcohol. Can the spatial use of these substances provide information that could inform public health officials on the risk of overdose for illicit substances, such as opioids in the form of prescription pills, heroin, or fentanyl? This investigation develops addiction risk maps for caffeine, alcohol, and prescription drugs in Montana as a first step to examining the relationship between the occurrence of coffee shops, bars, breweries, liquor stores, and pharmacies, and the risk of drug use and potential overdose. The second phase would combine the risk maps developed here to associate with illicit drug use and overdose danger that could potentially be used as a prediction tool or to inform where to focus the attention of health promotion. For example, a high-risk association of bars with illicit drug use would call for a program of providing bartenders with naloxone and the training to use it to save the lives of potential overdose victims. By the same token, if the association was stronger between coffee shops and illicit drug use, the naloxone program would be better focused in these venues. Either way, developing a legal addiction risk map would be the first step into understanding the relationship between the different addictions.

This research project is important to public health workers, law enforcement officers, social workers, and anyone else who has in interest in understanding the place of addiction in our society. Using available data sets to help inform addiction dynamics will be an initial step in help guide treatment, education, and awareness among high risk populations. It is important to individuals who may be at risk of addiction as well as those that need treatment in their addictive behavior.

Data

The data for this project will consist of spatial data from Foursquare. Foursquare is a technology provider of location data based on user input from actual places they visit. This project will focus on

Montana cities. Montana is a mostly rural state with only seven larger urban areas with over 20,000 people. The largest metropolitan areas of Billings and Missoula will be the primary focus of the project. The initial analysis will examine foursquare data for occurrences of coffee shops, bars, breweries, liquor stores, and pharmacies in the cities analyzed. Coffee shops will be selected for addiction to caffeine, the world's most popular drug. Bars, breweries, and liquor stores will suggest addiction to alcohol. Pharmacies will represent addiction to drugs, in this case prescribed drugs. Location data on illicit drugs would be more difficult to get. Prescription drugs taken by someone who the prescription was not for are considered illicit because they are illegal too.   Locations of these five vendor categories will be studied in each city and an addiction risk map will be created. The number and location of these different venues will be used to create a predictive map for overall addiction risk.

A search was conducted to locate information on drug use in the two cities of Billings and Missoula. Billings has publicly available data on crimes in the city[3]. Information on drugs and alcohol violations will be used to estimate alcohol and illicit drug use in the city. This data set will be used to evaluate the predictive map. Since there was limited data available for Missoula, the crime comparison with vendors will only be done in Billings.

Methodology

The first step of this project involved abstracting Foursquare data for the five venue types in both Billings and Missoula. As can be seen in the python notebook, the procedure involved several steps adapted from the Foursquare API lab in week 2 of the Applied Data Science Capstone course. First, the requests, pandas, numpy, and random libraries were imported. Nominatim was imported to convert an address to latitudes and longitudes and libraries for displaying images were imported. Json_normalize was imported to transform json files to pandas dataframes. The next step involved logging in with Foursquare credentials and setting the limit to 100 (although a limit of 50 venues per search seemed to be imposed). For Billings, Montana, the address Lucky's Market at 1603 Grand Ave was used as a centralized point. For Missoula, Montana, the address of Big Dipper's Ice Cream Parlor at 631 S Higgins was used as a centralized point. The next step identified the search-query as either "Coffee Shop", "Bar", "Brewery", "Pharmacy", or "Liquor Store". A categoryId for each vendor type was also used to limit the search to that type of vendor in order to avoid results that weren't desired, such as Barnes and Nobles showing up in the Bar search. Next the url was defined, the results requested, the relevant part of JSON assigned to venues, and the venues transformed into a dataframe. Next the data was filtered to capture the important vendor information for each search in a clean tabular format. Finally a map was created with the vendor locations for each type of search. This process was repeated for each of the five categories in both Billings and Missoula.

The crime mapping website contained information on crimes in Billings, submitted by law enforcement agencies to allow citizens to understand where crimes are occurring[3]. This data was used to evaluate the prediction risk map. On the online mapping tool, an area surrounding downtown Billings was selected (Figure 1). The Drugs/alcohol violations category was chosen for the analysis. The separate category of DUI wasn't selected since that would have a bias of occurring along roads that might occur away from vendors. There were 319 records. It was difficult to obtain the latitudes and longitudes from the website, but addresses were available and converted to coordinates using an online conversion platform. Addresses that failed to convert were located individually using google maps and

added to the database. All locations shown on the map were included in the analysis. The drug/alcohol violations included four subtypes: drug investigation, drunk, motivated addictions alternative program, and tobacco/liquor law violations. This information was also used in the analysis. The Billings crime data was analyzed with the foursquare vendor data using a GIS platform. A 500 meter buffer around each vendor was created and all crimes that occurred within these buffers were attributed to a vendor. This was done by converting the crime point shapefile to a 1 meter buffer to utilize the union tool. The vendor buffer and the crime buffer were unioned, resulting in a table that showed the number of crimes occurring at each vendor. Access and Excel were then used to calculate the average number of drug crimes by vendor type.
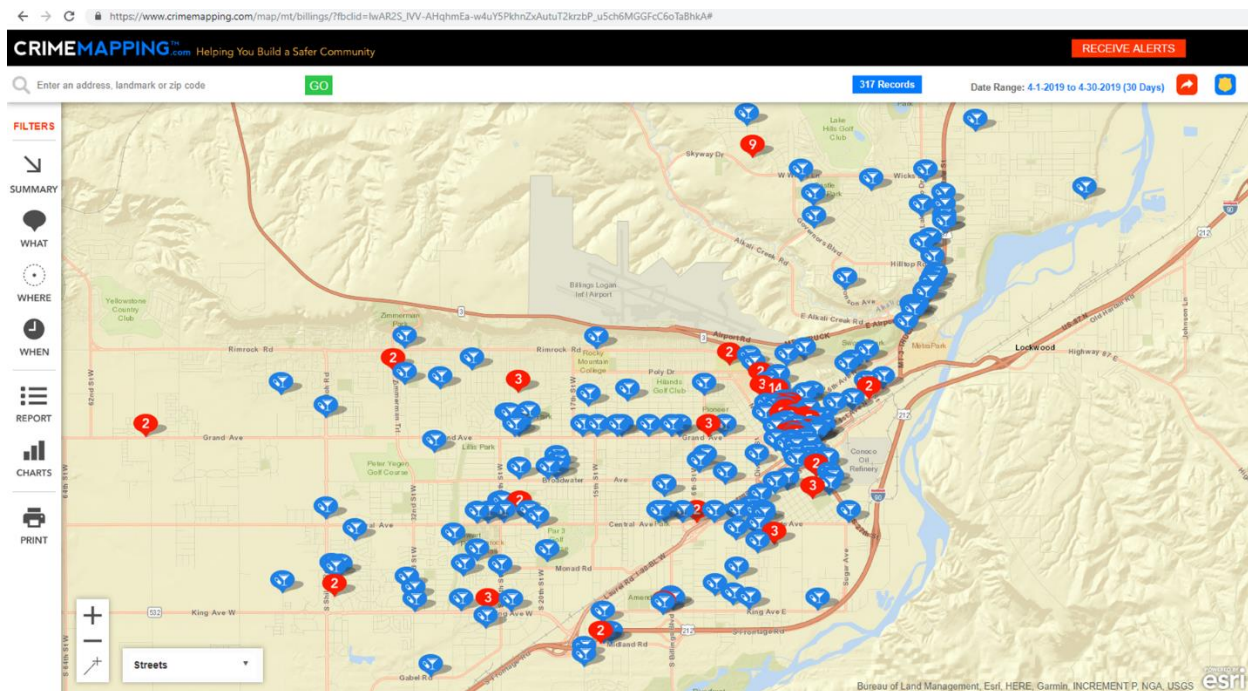

Figure 1. Billings drug crimes locations in April 2019, as shown on crimemapping.com website.

Results

The results of the searches of vendors came up with 50 coffee shops in both Billings and Missoula, suggesting the availability of caffeine in both towns as the legal drug of choice. For alcohol availability, Billings had 15 bars, 12 liquor stores, and 3 breweries, or thirty choices. Missoula, on the other hand, had 40 bars, 13 liquor stores, and 8 breweries for 61 choices, doubling Billings even with a lower population size! Billings had more pharmacies at 25 compared to Missoula with 15. The location of most of the facilities is shown in the maps in figure 2 and figure 3. In both Billings and Missoula, the bars, coffee shops, and breweries are clustered around the downtown area, whereas the pharmacies and liquor stores are more spread out.
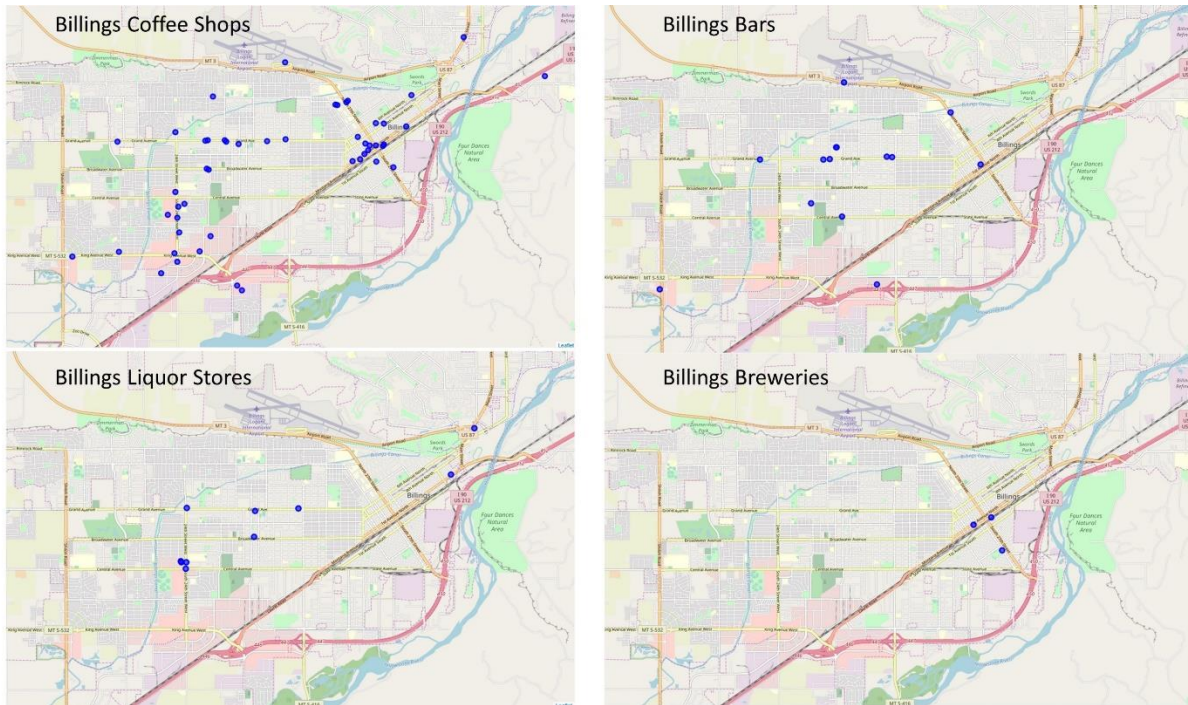
Figure 2: Foursquare locations of downtown Billings Coffee shops, Bars, Liquor Stores, and Breweries indicated with blue dots.
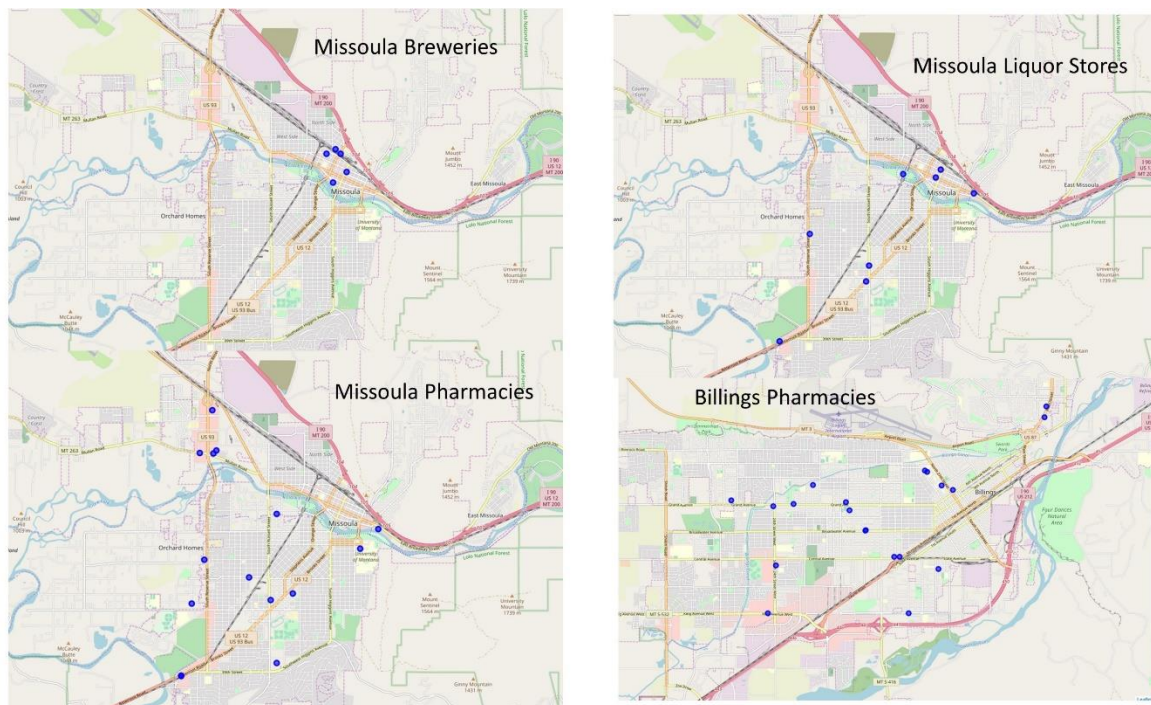

Figure 3: Foursquare locations of downtown Missoula Breweries, Liquor Stores, and Pharmacies, and downtown Billings Pharmacies indicated with blue dots. Note: Missoula bars and coffee shops not shown due to trouble with the map displaying.

Of the 319 drug/alcohol violations occurring in Billings in April, 2019, 120 were for being drunk, 110 were drug investigation, 54 were assigned to the Motivated Addictions Alternative Program, and 35 were tobacco/liquor law violations. The results of the analysis of crimes within 500 meters of vendors was surprising (Figure 4). The bars and liquor stores had lower levels of crime, whereas the breweries had the highest and coffee shops next. Drug investigations and drunk crimes were highest at the breweries. However, the very small sample size of three breweries likely was the cause of these high levels. Since all three breweries occurred in the same area, it was likely a location that had high crime rates. It is worth noting that the information is still valuable for understanding the risks of alcohol and drug use. Social venues like coffee shops and breweries may be locations were drug transactions occur.
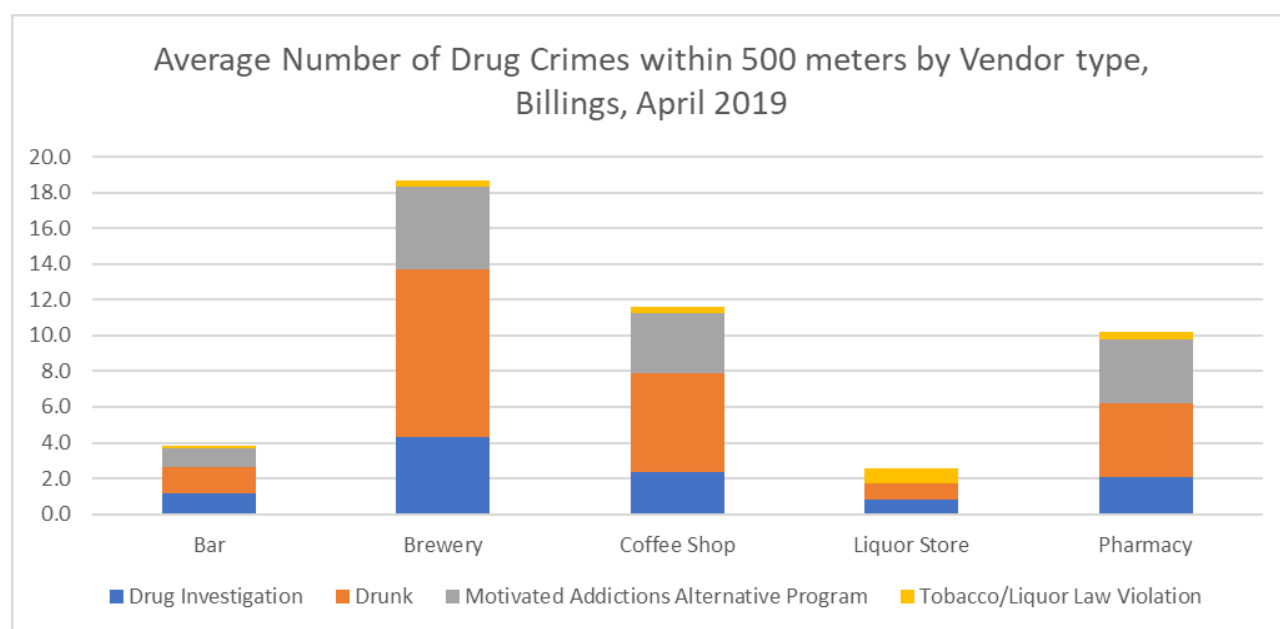

Figure 4. Average number of drug/alcohol violations from crimemapping.com data within 500 meters of foursquare vendor type locations.

Discussion

The current opioid epidemic in the United States has reached historic levels. Understanding where people may become addicted is an import step in the prevention of future victims of substance use disorder. This analysis considers the location of forms of legal addictive substances – caffeine, alcohol, and prescription drugs – as a potential tool to guide public health efforts to reduce the occurrence of drug addiction. The first step involved using foursquare data to find locations of five vendor types associated with addiction – coffee shops, bars, liquor stores, breweries, and pharmacies. The two largest Montana cities – Missoula and Billings were examined. Maps were produced to show the pattern of occurrence of the different vendor types. The next step in the analysis involved a preliminary look at how the location information could be used, by comparing crime data from Billings with the vendor locations. This showed that there was a surprising pattern of breweries and then coffee shops having higher average drug crimes within 500 meters than bars or liquor stores. Pharmacies also

tended to have more crimes within that range. There were many explanations that could be driving this pattern. The crime data examined was only one month, April, 2019, which may not have been enough to represent true patterns in crime over the course of the year. Breweries stood out but this might be because breweries were located in a busy part of downtown where most crime would tend to occur. There were only three breweries on foursquare, although Billings seems to have more from a simple google search. This data limitation could make a difference in the accuracy of the analysis.

The next steps for research of this type would be to create an addiction risk map where public health and law enforcement officials could predict the spatial properties of drug use. This would help to deter drug use and help get the needed treatment and medication to current users. It could be useful in harm reduction efforts, such as to guide the placement of needle exchange programs. The opioid epidemic is a pressing problem and needs to be addressed in multiple ways. Predicting where addiction could occur is be an import step in helping to prevent future substance use disorders.

Conclusion

This capstone project utilized some of the skills learned over the course of nine Data Science courses. It focused on an area of interest, opioid overdose prevention, by examining addiction of other legal substances from a spatial perspective using foursquare data. Although this work is preliminary it has the potential for a longer term project that could help allocate resources spatially where they are needed most. Understanding addiction is an important step to solving the opioid crisis and using data on other forms of addiction from the public's behavior is a novel approach that was tested here. Data science has the potential to address important problems in society as this project hopefully demonstrated.

References

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