

# Visualizing the relationship between prescription costs and drug overdoses

Group project by Alexander Rusthoven, Jacob Perez, Kenneth Mills

## Introduction

For this group project, we merged a prescription data set with a dataset that had the average number of deaths from overdoses and population counts from five states in the Midwest (Illinois, Indiana, Iowa, Michigan and Ohio). From this data, we wanted to determine if there was a link between the prescription data and overdoses. For example, do states that have lower prescription costs have a higher number of overdoses per state population?

The first data set was on prescription patterns by state. The data provided information on coverage (HMO, PPO, Medicare), prescription costs (ingredient cost), prescription date, and drug name. If we see a potential link between prescribing practices and overdoses we could further look into specific opiate medications and see if there are a higher number of opiate prescriptions in states that have a higher number of overdoses in the population to determine if we can attribute prescription practices to the overdose related deaths.

The second data set we used contained overdose related information for the United states, with numbers from each state. Since overdoses are a rising trend in the United States which has led to many deaths of teens and early adults, we also sought to find a potential link between prescription practices across various coverage types and overdoses.

By combining these data sources, we are seeking to find a potential link between drug cost and overdose related deaths and even how the varying drug cost by differing coverages may lead to overdoses in the Midwest. From our data we have hypothesized that states that have a lower cost for prescriptions have a lower rate of overdoses than states with higher prescription costs.

## Exploratory data analysis

The next step was to process the data in Microsoft Excel to prepare our prescription data set to pull in the State information where the prescription was derived from, along with pulling in the processed date for which month the script was written in. To combine the data sets we used the merge function in Tableau where the state population and number of overdoses were pulled into the report based on the state the script was written in. This allowed us to find data that answered our hypothesis, i.e. if there was any link between prescribing data cost and number of deaths by overdoses in the Midwest states.

We started with our data sets using an exploratory factor analysis that looked at average ingredient cost for prescription medications compared to the average number of deaths from overdoses in the five Midwest states of interest. There appeared to be some link between the average ingredient cost and the average number of deaths (from overdose – Figure 1). The data showed the average number of deaths by overdose per state compared to the state population, while also comparing the average prescription cost in each state.

The percentage of overdoses by state were as follows: Illinois – 0.013%, Indiana – 0.017%, Iowa – 0.0085%, Michigan – 0.017% and Ohio – 0.023%.

The average prescription cost in the states were as follows: Illinois - \$129.91, Indiana - \$120.94, Iowa - \$98.65, Michigan - \$118.85 and Ohio - \$125.94.

From this exploratory factor analysis, it appeared there was a relationship between prescription cost (average ingredient cost) and the number of deaths by overdose. Iowa seems to match our hypothesis – where there is a lower average prescription cost we will see a lower number of deaths by overdose. This could indicate a potential link between patients filling prescriptions due to the cheaper price, compared to patients seeking alternative methods of treatment for pain due to the high cost of the prescription medication.

## **Goodness-of-fit test**

To further demonstrate that there is a relationship between prescription drug cost and overdose related deaths, we performed a goodness-of-fit test to see how well the data fit our model (Figure 2). The data produced an R squared value of 0.65, indicating a strong positive relationship between the number of overdose related deaths to the prescription drug cost. Iowa had the strongest relationship in our model, and in the state of Iowa we have shown that they had a lower percentage of the population die from an overdose while having the lowest prescription drug cost among our midwestern states. This indicates that drug cost is playing a potential role in therapy patients seeking to alleviate symptoms. Where states have a higher prescription drug cost for therapies, there tends to be more overdose related deaths which could indicate that these members may not be filling medications and instead are seeking cheaper alternatives (i.e. drugs that can lead to overdoses).

## **Potential Solution**

Since we were able to show a positive correlation between prescription drug cost and overdose related deaths, we wanted to determine which coverage plans offer the cheapest price for comparative medications (Figure 3) to potentially reduce the number of drug overdoses in the future.

Our graph showed that the PPO (\$95.50) coverage option offered the lowest prescription pricing options compared to the HMO (\$141.46) and Medicare (\$120.50) alternatives. The lowest prescription cost is for members that have PPO coverage.

## **Conclusion**

Since there is a link between prescription drug cost and overdose related deaths we suggest that PPO coverage plans should be more readily available in the Midwest to help reduce the number of overdose related deaths. With more patients with PPO coverage, they may be more likely to fill medications to treat their symptoms as opposed to seeking alternative therapy

options that could lead to overdose as they are using without pharmaceutical or physician direction.

We further support the recommendation to offer PPO options by comparing the cost of the prescription drugs by coverage options in our five states (Figure 4). Iowa offered the lowest drug cost for members that have PPO coverage and Iowa was also the state with the lowest overdose rate when looking at the population. This indicates that patients are more willing to fill their medication than seek alternative therapy due to the lower cost. This data shows that overdoses by state may be dependent on the prescription drug cost. Further research will have to be performed as to what is driving this relationship: lack of prescription fill due to cost or some other phenomena, but as our data suggest there is a strong relationship between drug cost and overdose related deaths.

## **Discussion**

In our data we hypothesized that the lower the cost of prescription drugs there will be a lower number of overdose related deaths. Oftentimes overdoses are the result of opiate alternative therapies to alleviate pain related symptoms. The cost of prescription medication is so high that many patients may not be able to afford the medication they need to treat their symptoms. Because of this, many patients seek alternative options to alleviate pain and suffering which can lead to death with the lack of physician supervision of the chosen therapy.

Our data sets have shown that there is a link between prescription drug cost and overdose related deaths. We are suggesting from the data that states should offer their citizens more PPO related coverage options as PPO plans have the lowest cost of prescriptions compared to the HMO and Medicare alternatives. Iowa had both the lowest average cost of prescriptions for their PPO plans and the lowest percentage of overdose related deaths. Further research should be performed to determine a link between medication class cost and overdose related deaths to determine if the cost of painkillers (opiates) is driving patients to lower cost alternatives. Also, further research should be performed to determine why the cost of prescriptions varies so much across states. This data should be used to urge lawmakers, pharmaceutical manufacturers

and insurance carriers to offer lower cost plans to members and lower the cost of prescription drug therapies so that alternative therapies will be avoided.

## Appendix

Figure 1:

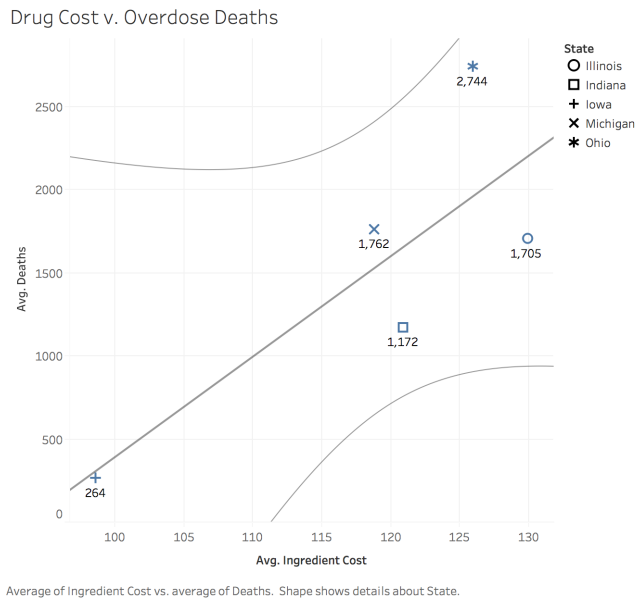
Exploratory Analysis



Average of Deaths, average of Ingredient Cost and average of Population for each State (overdoses.csv). Color shows details about State.

In this figure we did an exploratory factor analysis of our merged data sets to find a potential relationship between prescription drug cost and overdose related deaths in the Midwest. Here is our exploratory analysis of the merged data sets looking into average ingredient cost for prescription medications compared to average number of deaths from overdose in our Midwest states. In the data, there appears to be something going on between Avg. Ingredient Cost and Avg. Deaths (from overdose), with Iowa being the example of a trend.

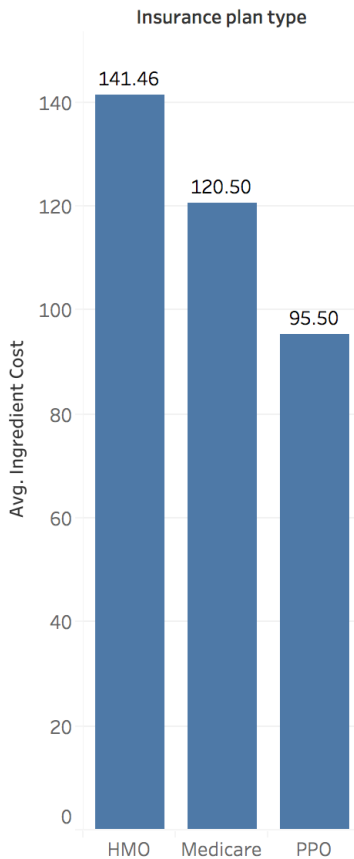
**Figure 2:**



Following the results of the exploratory factor analysis, we looked at the correlation between prescription drug cost and average number of deaths. From the data we saw an R squared value of 0.65, indicating that there is a strong correlation between the cost of prescription medications and the number of overdose related deaths.

**Figure 3:**

### Drug Cost Per Plan

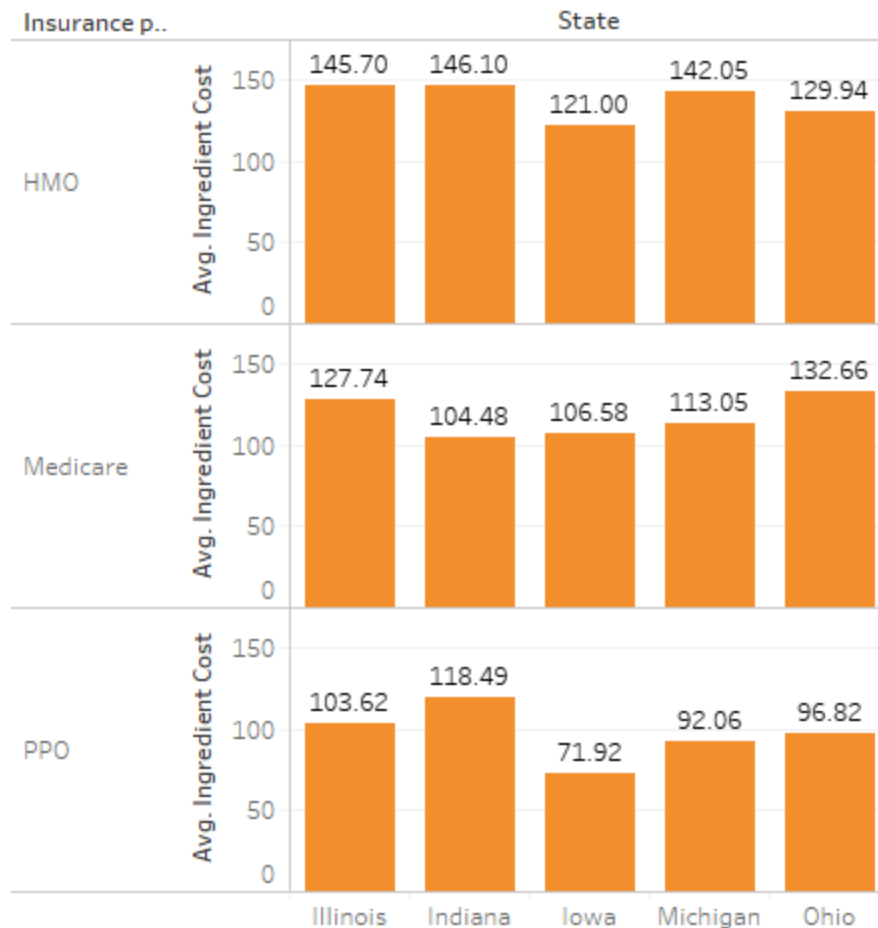


Average of Ingredient Cost for each Insurance plan type.

In this graph, we compared the average ingredient cost between insurance plan providers. The lowest prescription cost is for members that have PPO coverage. Based on this information, more communities should have a wider variety of PPO coverage plans available when selecting insurance plans in order to reduce deaths from overdose. This could also be a recommendation to lawmakers and pharmaceutical manufacturers to lower the cost of drugs as the higher cost of drugs tends to lead people to alternative therapeutic options which can lead to overdose as these are generally not under physician supervision.

**Figure 4:**

## Drug Cost Per Plan by State



Average of Ingredient Cost for each State broken down by Insurance plan type.

To further support our suggestion to recommend PPO plans to lower the number of overdose related deaths, we compared the average prescription prices for the various coverage plans in our Midwest states. The Iowa PPO plan had the lowest prescription price and coincidentally Iowa also had the lowest percentage of Drug related overdose deaths. Perhaps a higher proportion of the state of Iowa has the lower cost PPO plan so seek therapeutic prescriptions instead of alternative therapies which often lead to overdoses.