

Jeremy Selkirk

11/5/20

COSC 5610

Over the past couple of years, the concern about prescription drugs has greatly increased. The most talked about category of drug out of all these prescription drugs is opioids. Out of the opioids, one of the most prescribed, according to the National Institute on Drug Abuse, is oxycodone. However, there is an alternative to taking an opioid and that is the drug Ibuprofen. According to the University of Michigan Health Library, a similar pain killer to Ibuprofen is oxycodone. Oxycodone has two manufactures in the dataset so by combining them it causes a class imbalance between the total number of oxycodone prescription claims, 16,287,595, and the number of ibuprofen prescription claims, 4,965,918. This is a class imbalance ratio of 1:3.28. However, oxycodone was prescribed by less than 2 times the number of doctors than ibuprofen which shows that either doctors prefer to prescribe an opioid or, since ibuprofen does not always require a prescription, there is inefficiencies and inaccuracies in the data collection. Since there is still data on the prescription ibuprofen neither scenario can be determined as the only correct factor. The next question from there was determining the relevance that living in a particular state gave a person a higher chance of receiving one prescription drug over the other. The following figure shows the relationship between the total number of prescription claims of both Ibuprofen and Oxycodone in each state:

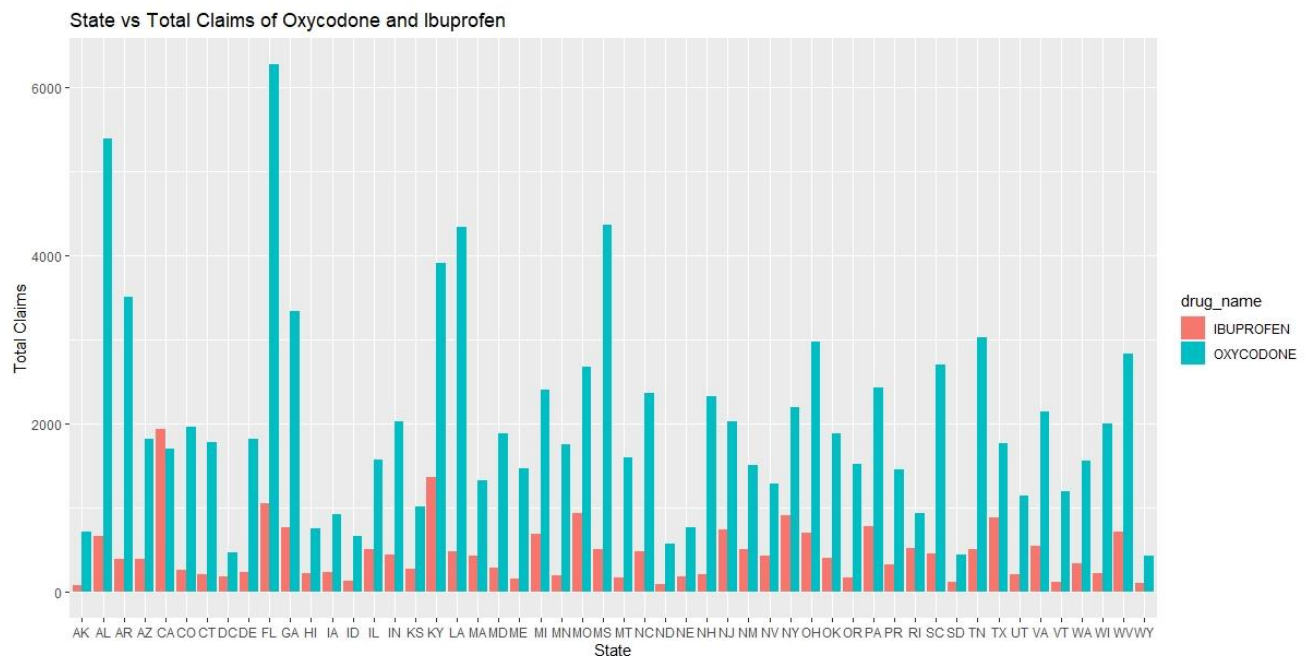


Figure 1: This figure shows the total number of claims of each drug, Ibuprofen and Oxycodone, in each state including Puerto Rico and Washington DC

In Figure 1, there appears to be a significant number of claims of Oxycodone compared to the number of claims of Ibuprofen. The only state that has fewer total claims of Oxycodone is California. However, it appears that there are a handful of states that where the number of prescribe Oxycodone far outnumbers the number of prescribed Ibuprofen where Alaska, Florida, Georgia, Kentucky, Louisiana, Mississippi, and Arkansas have the greatest number of claims. This figure happens to match up closely with opioid prescribing rates per state released by the CDC where Arkansas, Tennessee, and Mississippi have the highest rate of prescription per 100 people. The figure is backed up by the t-value and the p-value which are 4.635 and  $1.52 \times 10^{-5}$ . With a p-value of less than 0.05 and a t-value greater than 1.96 the null hypothesis, of no relationship between total prescription claims and the state where it is prescribed, can be rejected.

Another factor that needs to be considered is the specialty of the doctor who is prescribing the pain killer. The specialty of the doctor can help to understand the reason and type of problem that a prescription pain killer is being used for which can potentially help to determine if prescribing an opioid is necessary. According to the CDC, primary care accounted for nearly half of opioid prescriptions followed by surgery and physical medicine and rehabilitation. Figure 2 shows the ten specialties that prescribe the most oxycodone compared to the amount they prescribe of ibuprofen:

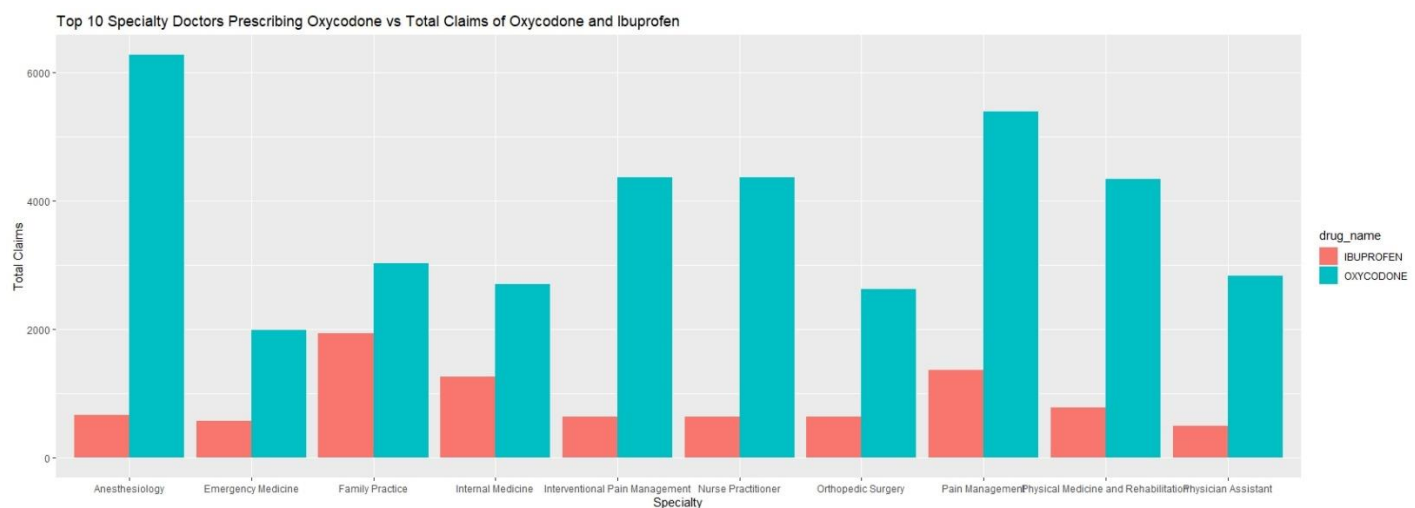


Figure 2: This shows the specialty of doctors who prescribe the most oxycodone to their patients with Anesthesiologists, Pain Management, Physical Medicine and Rehabilitation, and Nurse Practitioners prescribing the most

A lot of the top specialties that the CDC found prescribing opioids matches with the top specialties prescribing opioids including anesthesiologists, Physical Medicine and Rehabilitation, and Pain Management. This compares relatively closely with specialties prescribing the most ibuprofen as shown in Figure 3:

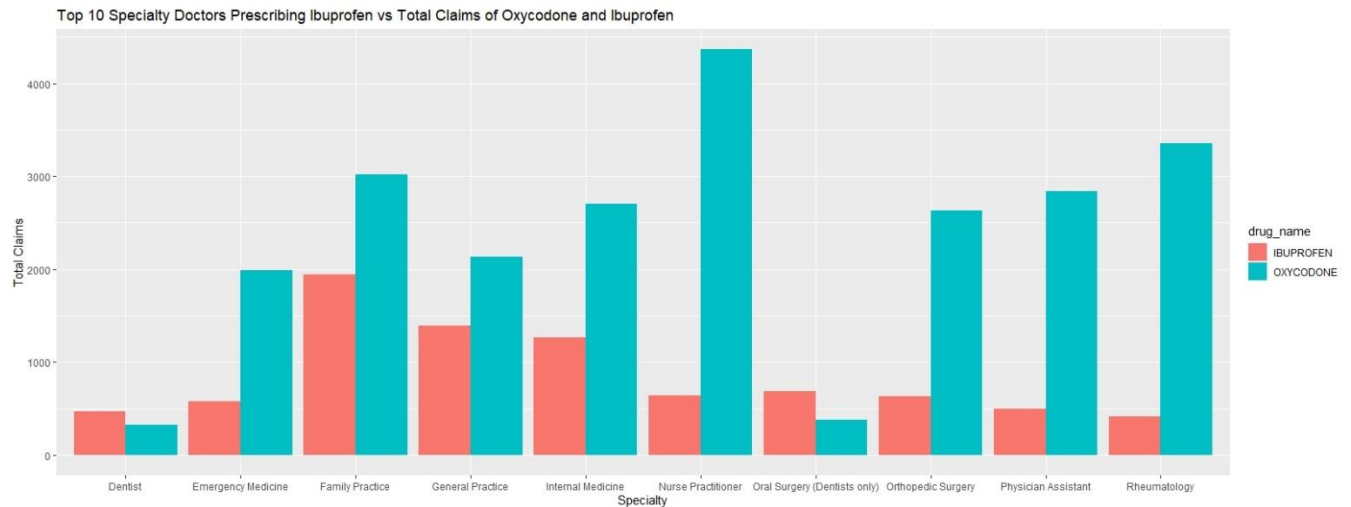


Figure 3: This shows the specialty of doctors who are prescribing the most ibuprofen to their patients compared to how much oxycodone they are prescribing them. Family Practice, General Practice, and Internal Medicine are prescribing the most with Dentists and Oral Surgeons prescribing more ibuprofen than oxycodone.

As shown in Figure 3, General Practitioners and Family Practitioners are prescribing the most ibuprofen, but they still are not prescribing it as much as oxycodone. The only top pain killing prescribing specialties that are prescribing more ibuprofen than oxycodone are Dentists and Oral Surgeons. There are also specialties that are in both figures that are prescribing a large number of painkillers. Nurse Practitioners, Orthopedic Surgeons, Family Practitioners, Physicians Assistants, and Emergency Medicine are prescribing a large number of painkillers. Figure 2 and 3 have some similarities and differences and those are shown in the p-value and t-value. The relationship between specialty and total prescription count had a p-value of 0.05087 and a t-value of 1.9677 which show the similarities and differences in the two graphs. Even though the p-value is slightly above 0.05, there could have been a slight calculation error in the amount of data points available to make to calculation and the t-value has a value greater than 1.96 which can allows the Null Hypothesis, which states that there is no relationship between specialty and total prescription count, to be rejected. These numbers again get backed up by the CDC in their study of which practitioners were prescribing opioids.

The final factor to consider in the dataset is the average cost of each prescription by state. The price of a drug could determine whether a doctor prescribes a certain drug or if a patient decides to receive the prescribed drug. Figure 4 and 5 show the average price of each drug by state:

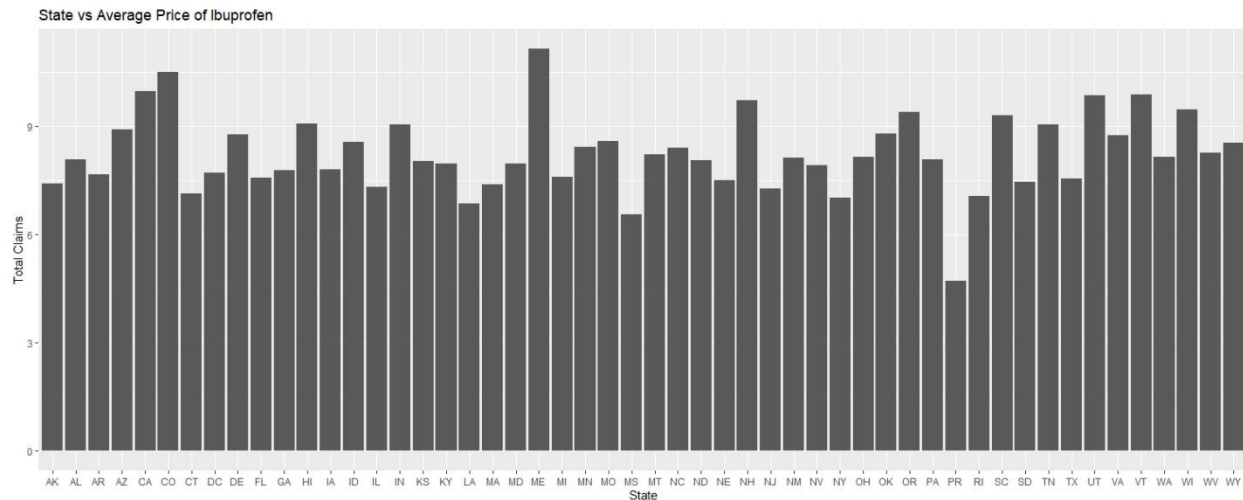


Figure 4: This shows the average cost of ibuprofen in each state

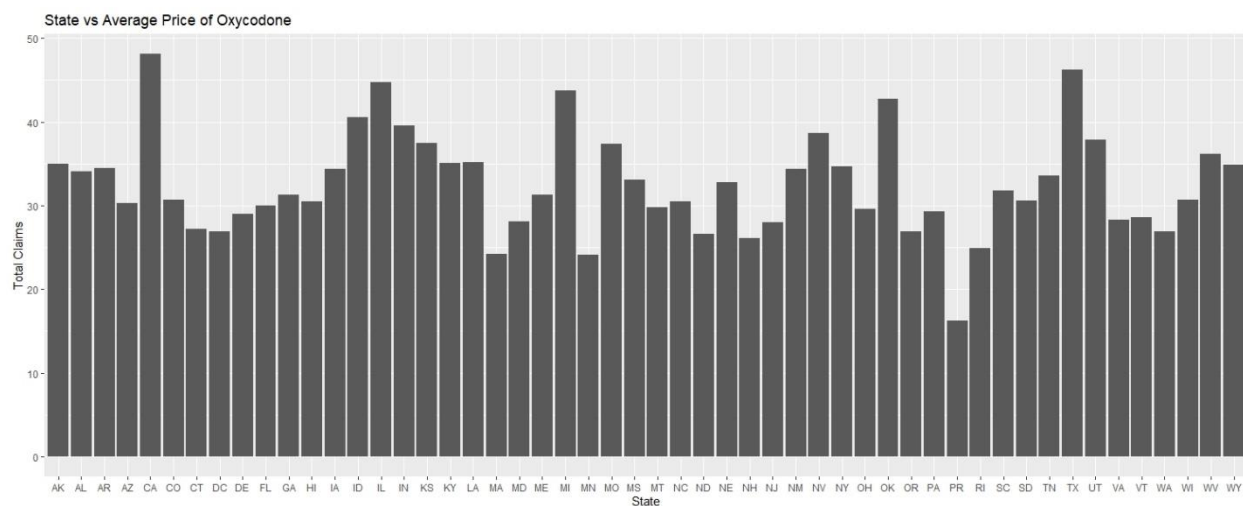


Figure 5: This shows the average cost of oxycodone in each state

Figure 4 shows that ibuprofen has a steady average cost around \$9 while figure 5 shows oxycodone's price fluctuates depending on the state with some well over \$40 and the majority between \$25 and \$35. According to a study out of the National Institute of Health, doctors are usually unaware of drug prices when prescribing certain drugs and have a "tendency to underestimate the price of expensive drugs and overestimate the price of inexpensive ones". This is backed up in the calculation of the p-value when it had a value of 0.2383 meaning that the null hypothesis, which states that there is no relationship between the average cost per state and the prescription rate, cannot be rejected.

Benjamin Levy, Leonard Paulozzi, Karin A. Mack, and Christopher M. Jones. 2015. Trends in Opioid Analgesic–Prescribing Rates by Specialty, U.S., 2007–2012. *American Journal of Preventive Medicine* 49, 3 (2015), 409–413.  
DOI:<http://dx.doi.org/10.1016/j.amepre.2015.02.020>

CDC. 2017. U.S. State Prescribing Rates, 2016. (July 2017). Retrieved November 6, 2020 from <https://www.cdc.gov/drugoverdose/maps/rxstate2016.html>

G.Michael Allan, Joel Lexchin, and Natasha Wiebe. 2007. Physician Awareness of Drug Cost: A Systematic Review. *PLoS Medicine* 4, 9 (2007).  
DOI:<http://dx.doi.org/10.1371/journal.pmed.0040283>

National Institute on Drug Abuse. 2020. Prescription Opioids DrugFacts. (July 2020).  
<https://www.drugabuse.gov/publications/drugfacts/prescription-opioids>

University of Michigan. 2019. ibuprofen and oxycodone. (November 2019). Retrieved November 6, 2020 from <https://www.uofmhealth.org/health-library/d05415a1>