Estimate the Impact of Opioid Control Policies (for policymakers)

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Motivation

For this project, we are trying to address the problem of rising opioid usage and its connection with death by drugs in the United States. We have two specific questions: What effect did the opioid policies in Texas, Washington, and Florida have on the number of opioid deaths and overall drug deaths in those states? In other words, how do opioid deaths and overall drug deaths differ in Texas, Washington, and Florida from our chosen control states? We will mention how we decide the control states in the OverView of the Data part.

To change if the policy intervention is effective is vital for the policymakers to improve on the past enactment of the policies on opioid usage. There are many papers concerning the drug overdose problem since opioid is prescribed as a medication for chronic pain. By the neurological property of opioids, the neurotransmitters acetylcholine and dopamine are released, which controls people's Central Nervous System (CNS) and Peripheral Nervous System(PNS) and makes people feel happy accordingly (Janice C. Froehlich). On the other hand, an overdose can lead to a lot of severe problems, including death. Thus, to minimize the possibility of overdose, we try to answer the two questions mentioned above.

Overview of the Data

Upon choosing the control states, we aim to select the states with similar social-demographic characteristics. The following factors are considered: state population, education ranking, average income, and drug-related death rate, as well as the state's policy response to the opioid crisis. We choose the individual treatment state as the baseline. For example, when calculating the state's average income based on that of Florida, we divide the individual state's population by Florida's population. A percentage close to 100% means the state's population is similar to Florida's.

After calculating the similarity for these five indicators (state population, education ranking, average income, rate of drug-related death, and state's policy response to opioid crisis), the States are chosen by a combined weighted metric. Percentages are summed and divided by 4. The population is over-impacting the combined metric for Texas, so it is excluded. Our control states are decided based on if they are in the interval (80%, 120%). Also, due to the county designations confusion in Alaska in 2010, we have excluded Alaska from our control states.

The list of our treatment states and accompanying control states:

Treatment State	Control States
Texas	Arkansas, California, Georgia, Missouri, New York, Wyoming
Washington	Hawaii, Iowa, Kansas, Maine, Massachusetts, Minnesota, Montana, Nebraska, North Dakot
Florida	California, Nevada, New York

The source of our data are:

1. Opioids Prescription/Shipment data (Washington Post):

   In this dataset, it holds all the information of the opioids prescription across the years in all states in the United States. This dataset is about 100Gb and we select the three states and their controlled states to preprocess. The unit of observation for this dataset is at the county level. We sum all the data of all counties in a state and take that into our analyses.

2. Mortality Rate data (CDC Wonder):

   In this dataset, we have state, county, year, opioid-related cause of death and the number of deaths per county and state. The unit of observation for this data is at the county level.

3. Population data (CDC Wonder):

   CDC is a reliable system for holding public health data and information across the United States.

For the shipment & prescription question, we are excluding Texas as we do not have an adequate sample of data.

Analysis

Our methodology for this project is pre-post and difference-in-difference analysis.

Hypothesis:

We hypothesize that there is a causal effect between policy change in opioid use and the case of overdose deaths in Florida, Washington, and Texas State. We also hypothesize that while opioid prescriptions decrease, drug-related deaths as

a whole increase or remain stable. We suggest this result as there is evidence to suggest that removing a drug from an addict does not necessarily imply that the addict will recover. In some cases, the addict will switch to a new drug of choice. In other cases, the opioid addict will be in recovery and later overdose once they're able to find an opioid. This is a well known phenomena as addicts may forget that their tolerance for the opioid decreases during times of recovery and then try to use the same opioid dose as they were using active addiction. In turn, the addict will accidentally overdose. We also suppose that opioid prescriptions decrease in Texas, Washington, and Florida.

Interpretation of the Analysis (Strengths and Limitations)

Florida

Effects of Regulations on Opioid Shipments

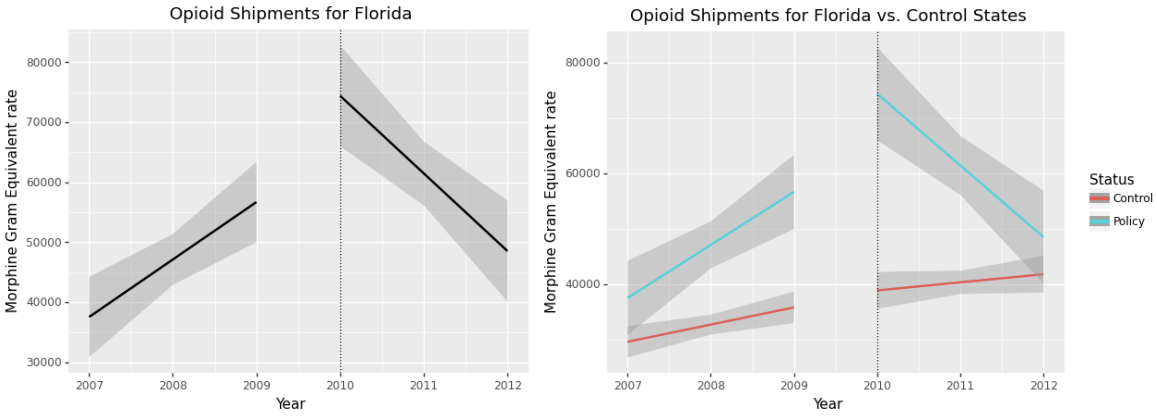

Figure 1. *Pre-Post and Diff-in-Diff Model for Opioid Shipments in Florida and All Control States*

When we looked at the opioid prescription rate, it is obvious that Figure 1 shows an upward trend before 2010, when the policy was implemented. After its implementation in the year 2010, however, the prescription per capita dropped significantly. We also compare it with the control states: California, Nevada, and New York. We observe that the prescription rate continues to increase after 2010, which is the same as our assumption. This difference-in-difference analysis suggests that the opioid policy in Florida is successful.

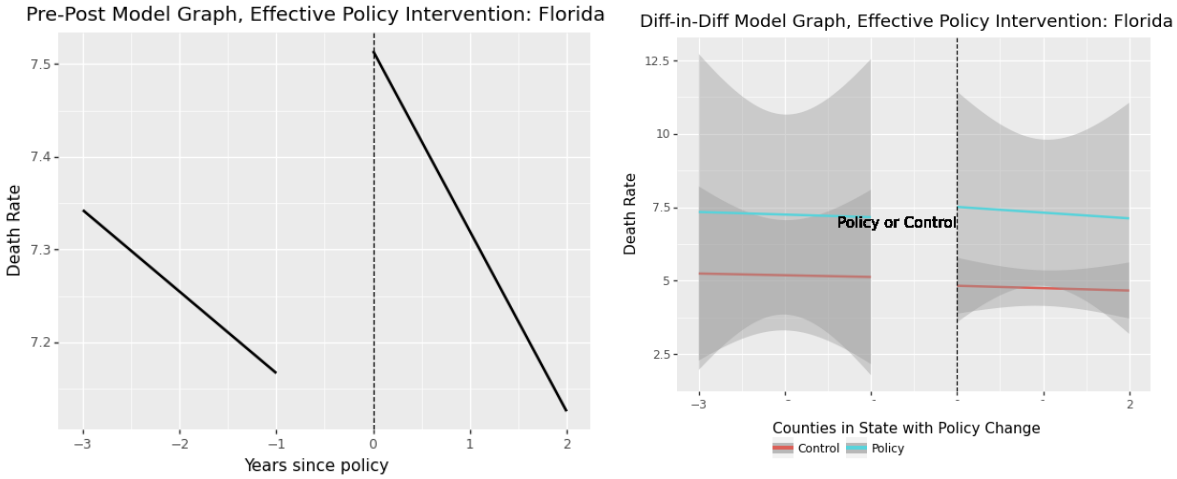

Figure 2. *Pre-Post and Diff-in-Diff Model for Mortality Rate in Florida and All Control States*

Figure 2 shows the pre-post death rate related to drug use per 100,000 people in Florida and the difference-in-difference graph for control states (California, Nevada, and New York). Florida showed a downward trend in the death rate before 2010, when the opioid policy was implemented. The pre-post graph showed that the death rate tren line dropped even steeper after implementing the policy. Meanwhile, the difference-in-difference analysis showed that the death rate in the control states decreased slightly. This decreasing graph for Florida hints that the opioid policy had a positive impact on decreasing drug-related death in Florida.

Texas

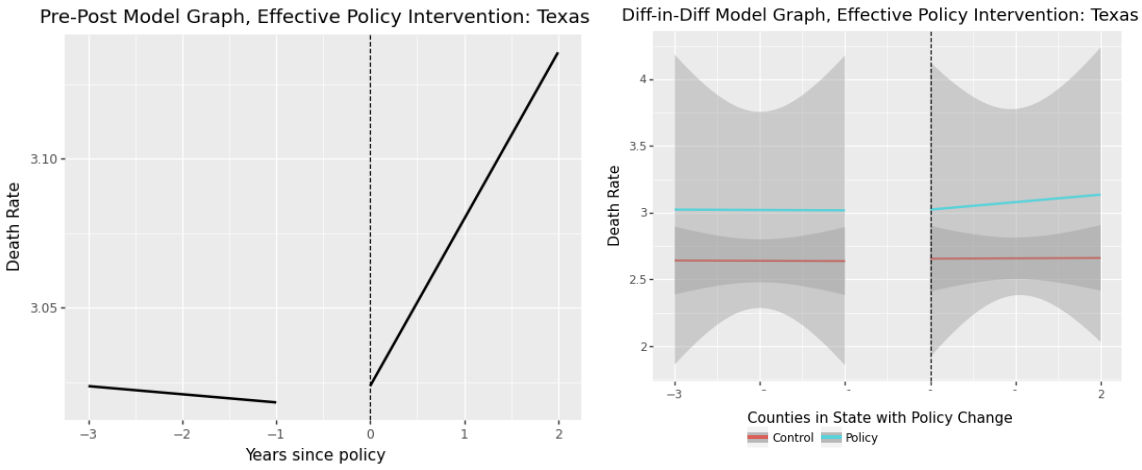

Figure 3. *Pre-Post and Diff-in-Diff Model for Mortality Rate in Texas and All Control States*

Figure 3 shows the pre-post graph for the death rate related to drug use per 100,000 people in Texas and the difference-in-difference graph for control states (Arkansas, California, Georgia, Missouri, New York, and Wyoming). Texas showed a downward trend in the death rate before 2007, when the opioid policy was implemented. The pre-post graph showed that after implementing the policy, the death rate remained upward and even steeper from before. Meanwhile, the difference-in-difference analysis showed that the death rate in the control states stagnated after policy implementation in 2007. This increasing graph for Texas hints that the opioid policy had a negative impact in decreasing drug-related death in Texas.

Washington

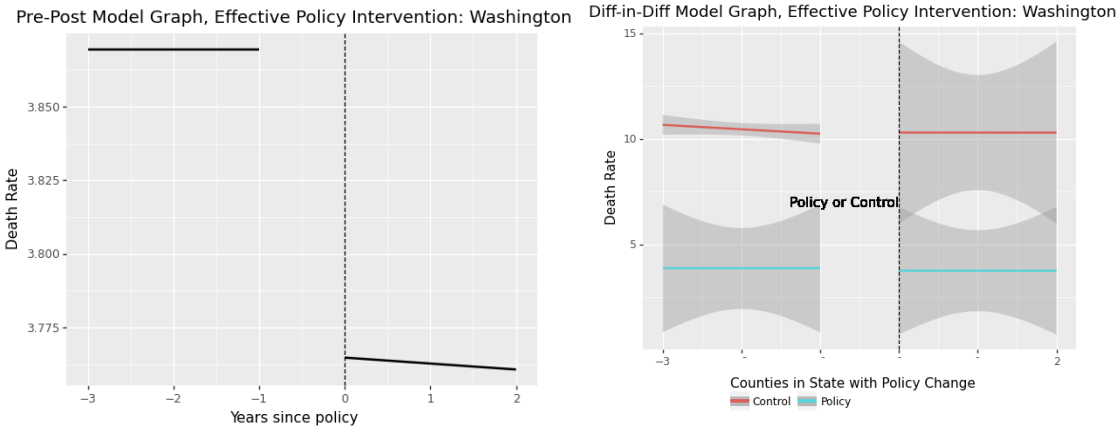

Figure 4. *Pre-Post and Diff-in-Diff Model for Mortality Rate in Washington and All Control States*

Figure 4 shows the pre-post graph for the death rate related to drug use per 100,000 people in Washington and the difference-in-difference graph for control states (Hawaii, Iowa, Kansas, Maine, Massachusetts, Minnesota, Montana, Nebraska, North Dakota, Oregon, South Dakota, Virginia, Wyoming). Washington showed a stagnant trend in the death rate before 2012, when the opioid policy was implemented. The pre-post graph showed that after implementing the policy, the death rate decreased and showed a downward trend, but not as steep as before. Meanwhile, the difference-in-difference analysis showed that the death rate in the control states was stagnant after policy implementation in 2012. This slightly decreasing graph for Washington hints that the opioid policy had a positive impact in decreasing drug-related death in Washington.

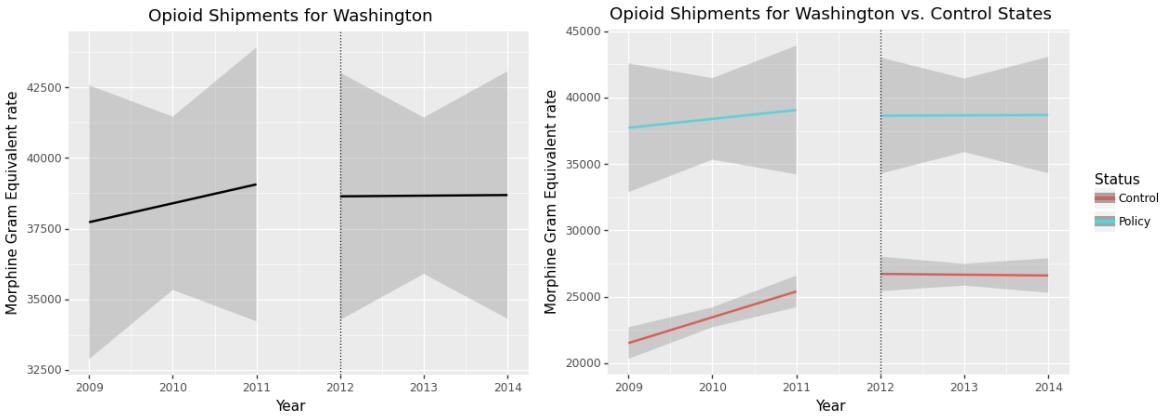

Figure 5. *Pre-Post and Diff-in-Diff Model for Opioid Shipments in Washington and All Control States*

Figure 5 shows the pre-post graph for opioid shipment in Morphine Gram Equivalent in Washington and the difference-in-difference graph for control states (Hawaii, Iowa, Kansas, Maine, Massachusetts, Minnesota, Montana, Nebraska, North Dakota, Oregon, South Dakota, Virginia, Wyoming). Washington showed an upward trend of opioid shipment per 100,000 people before 2012, when the opioid policy was implemented. The pre-post graph also showed the shipment rate in a stagnant trend after implementing the policy. Meanwhile, the difference-in-difference analysis showed that the opioid shipment in the control states also stagnated after policy implementation in 2012. This stagnated graph for Washington hints that the opioid policy had a slightly positive impact on decreasing opioid shipments in Washington.

Conclusion

It is with great importance that you, the policymaker, should take appropriate action when handling the opioid crisis. The greatest positive impact from our analysis comes from Florida. Florida's death rate and prescription & shipment rate had the biggest change. The rate of shipments & prescriptions decreased as well as the rate of death. In conclusion, if you, the policymaker, is seeking a state to model your policy after, Florida is the best state to consider when serving your constituents.

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