

Estimating the Impact of Opioid Control Policies

Policy Maker Version

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Introduction

In the past 10 years, opiate abuse has become a leading health epidemic in the United States, killing more people every year since 1999. This is representative of the current healthcare system in the United States, that emphasizes quick and simplistic answers to complex physical and mental health needs. This in turn is apart of what has led to mass overprescription of opioids. Due to the addictive nature of opioids, this overprescription can lead to an increase in overdose deaths. Patients may overdose on these legally sourced opiates or may switch to non-prescription opioids such as heroin and fentanyl to feed their addiction. This issue that arises is that likelihood of overdosing on these illegal opioids is far higher than prescribed prescription drugs, due to their higher strength. By analyzing mortality and opioid shipment data to states where policy changes were and were not enacted, this paper provides suggests that within a state, restrictive policy changes are effective in reducing drug-related deaths.

1. Motivation of this Study

The motivation of this study is to evaluate the effectiveness of different policy changes intended to limit the overprescription of opioids and the mortality of drug related overdoses. The theory is that by limiting the access of opioids, the possibility that patients will become addicted decreases. This in turn, leads to a reduction in those who overdose on legal opioids and those who turn to illegally sourced opioids, which are much easier to overdose on, due to their variation in strength. A reduction in those overdosing will hopefully decrease mortality rates of future patients. In this paper, different opioids have been converted to morphine milligram equivalents in order to compare opiates of different strengths under a single unit.

To begin with, a pre-post comparison, measurements are taken before and after the treatment. In this situation, mortality rates before and after the policy change in Florida will be measured to see if the policy change resulted in a decline in opioid shipments and mortality. Although simple to produce and interpret, it is not without its problems. The issue that arises is that if there was some unknown external factors that contributed to the decline of mortality that was not related to policy change, then one could misattribute the policy change as the driver of the decreased mortality rather than the external factor.

To remedy this, a difference-in-difference approach is used. This is a statistical technique that is commonly used in economics and in the social sciences that mimics an experimental research design where the regression calculates the effect of a treatment on an outcome by comparing the average change over time for the treatment group compared to the control group. This statistical approach reduces the concern of extraneous factors. For example, one extraneous factor that one might overlook could be DEA raids that limit the overall supply illicit substances. If a pre-post comparison was used, one could misattribute the decline of opioids to the policy change, rather than the DEA raids.

2. Overview of Data

There datasets were used:

1. *US Vital Statistics* records, to count deaths caused by drugs in different counties (2003-2015)
2. *DEA Automation of Reports and Consolidated Order System* (ARCOS), to track opioid* shipments to counties (2006-2012)
3. *Census*, to normalize deaths by population in a given state (2003 - 2018)

*ARCOS only has information on shipments of oxycodone and hydrocodone which equate to 75% of all opioids sent to pharmacies at the county level for all 50 states.

3. Summary of Policy Changes

Florida (February, 2010)

- Pre-policy change, Florida had become known for its pain clinics prescribing large quantities of opioids with no justification.
 - All but 2 of the top oxycodone dispensing physicians were located in Florida.
- Pain clinics were forced to register under the state (January, 2010)
- Policy change helped crack down on “Pill Mills,” which are rogue pain clinics that would sell pain pills for cash (February, 2010)
 - Arrests, seizures, pain clinic closures

- Legislature changed, prohibiting physician dispensing opioids from their offices (July, 2010)
- Mandatory dispenser reporting to established drug monitoring program (Sept 2011)

Texas (January, 2007)

- Patient must be evaluated before prescribing opiates
 - Periodic review and patient history
- Informed consent from patient is required

Washington (January, 2012)

- Patients on 40 MED/day or less must have annual reviews
- Mandatory consultation for those prescribed 120 MED /day
 - This consultation must be with a pain management specialist
- Advised physicians not to prescribe over 120 MED/day without showing reasonable improvement in patient function.

Based on the policy change summaries above, it is clear that Florida's series of policy changes, and crackdown on "Pill Mills" is the most extreme. Florida's policy changes are clearly geared towards preventing illegal sale of opioids by rogue pain clinics. Texas and Washington have policy changes that are focused on ensuring that over prescription is addressed and people are informed.

4. Analysis

4.1 Pre-Post Analysis

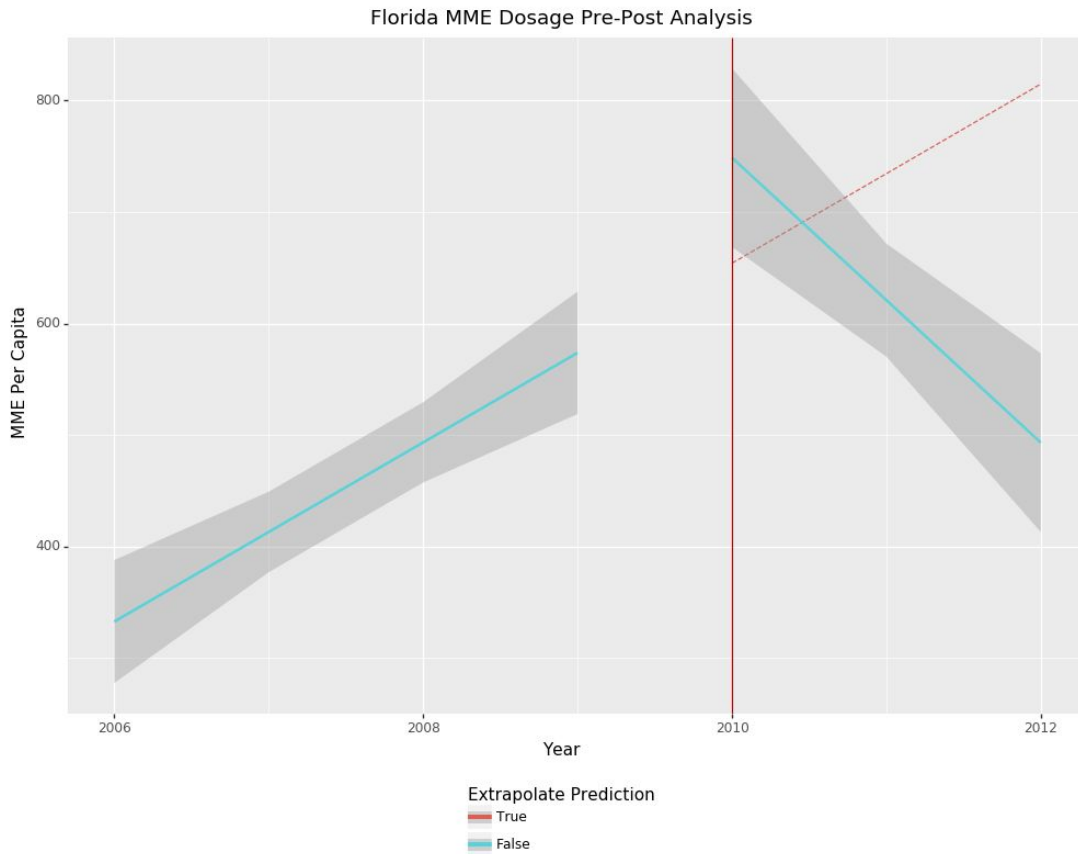


Figure 4.1: Pre-Post Florida MME

(95% Confidence Intervals)

Analyzing Florida MME (morphine milligram equivalent) per capita, we see that after the policy change was enacted, indicated by the red line, the amount of MME that was shipped into Florida dropped year over year. In 2012, the amount of MME being shipped into Florida was actually more than was actually less than what was seen in 2009, based on the Pre-Post regressions.

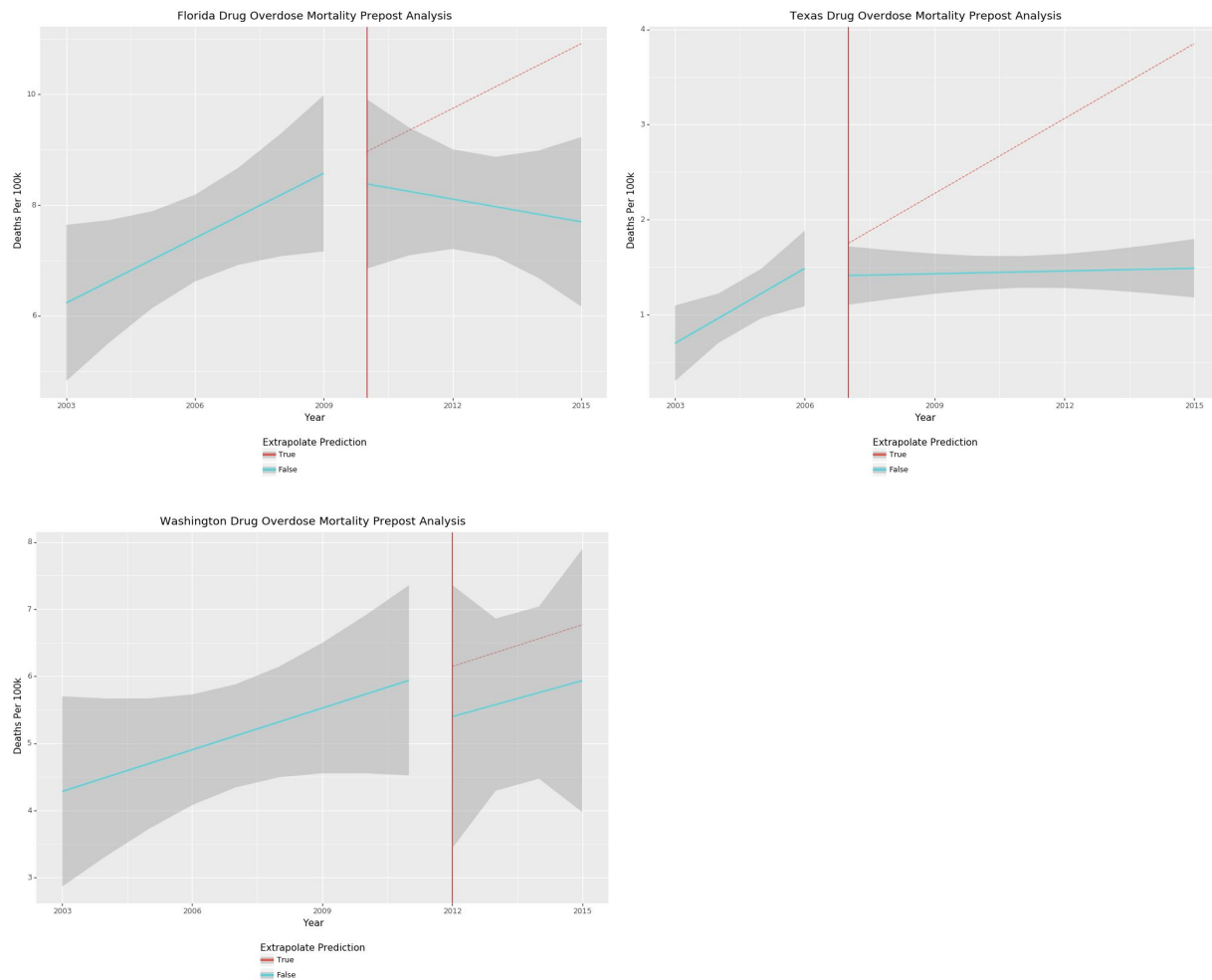


Figure 4.2: Pre-Post Analysis - Mortality

(95% Confidence Intervals)

Upper-left:Florida; **Upper-right:**Texas

Lower-left:Washington

When observing the pre/post analysis for Florida (Fig 4.1), it appears that the policy change was effective in reducing MME/capita and drug overdose/capita. The downward gradient line indicates that the mortality after 2010 has decreased year over year. Texas was somewhat successful at reducing deaths. After the Texas policy change in 2007, the rate of deaths flatlines, indicating that mortality stays consistent throughout the years. However, Washington policy change did not have a similar level of success in terms of deaths. This is due to the downshifted post-treatment line that has a similar slope as the pre-treatment line, indicating that the rate of deaths is still the same. Upon

further investigation, we see that the Washington Department of Health had more relaxed policy changes on the prescription of opioids for pain treatment compared to other states with policy changes. For example, it was recommended that a practitioner not prescribe more than an average of 120 mg morphine equivalents per day (MED) without either the patient demonstrating improvement in function or without first obtaining a consultation from a pain management expert. 120 MED is already an extremely high dosage, and at this dosage, risk of overdose and addiction substantially increases (CDC 2019). For addicts, it would be easy to feign discomfort/pain in order to have the practitioner sign off for pain medication.

4.3 Difference-in-Difference Analysis

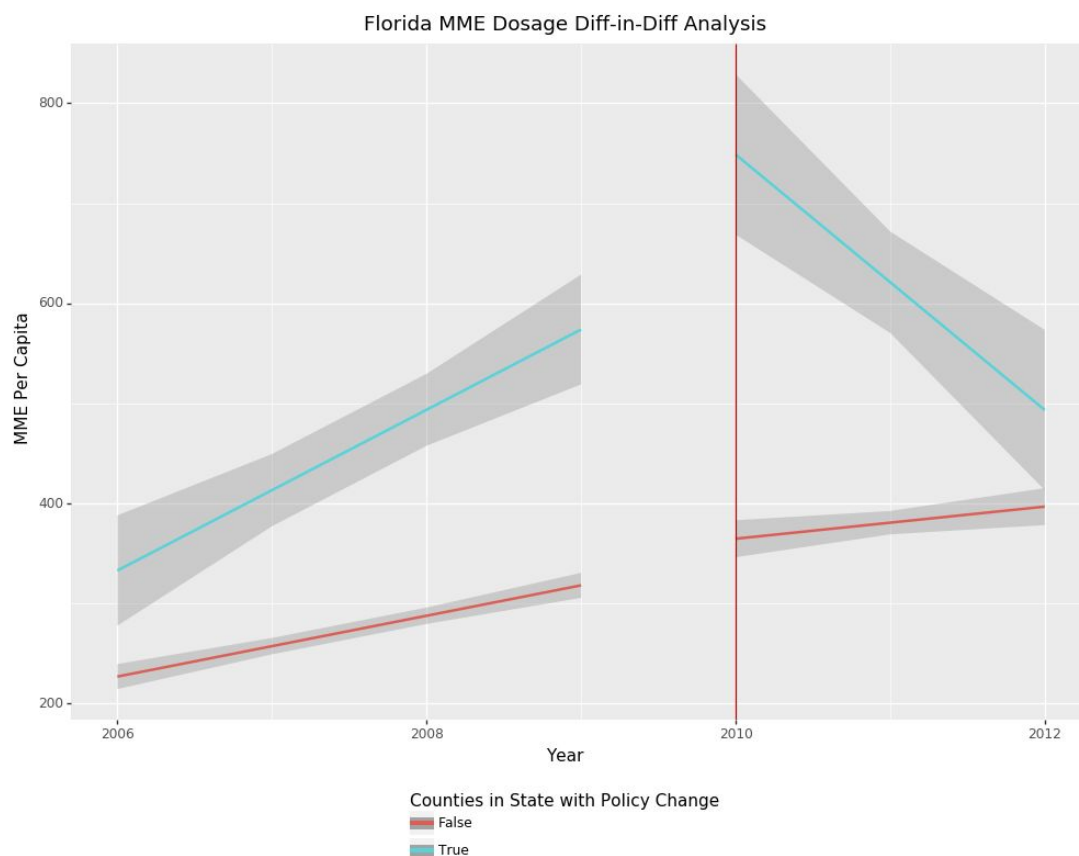


Figure 4.3: Diff in Diff - Florida MME

(95% Confidence Intervals)

Evaluating the MME Dosage Difference-in-Difference comparing Florida to the control states, we see that that enacting a policy change did indeed have a controlled effect on the amount of opioids that were brought in. Initially, Florida, on average had a much higher MME per capita compared to the control states. However, after the policy implementation, MME per capita dropped significantly compared to the steady increase of MME per capita for the control states.

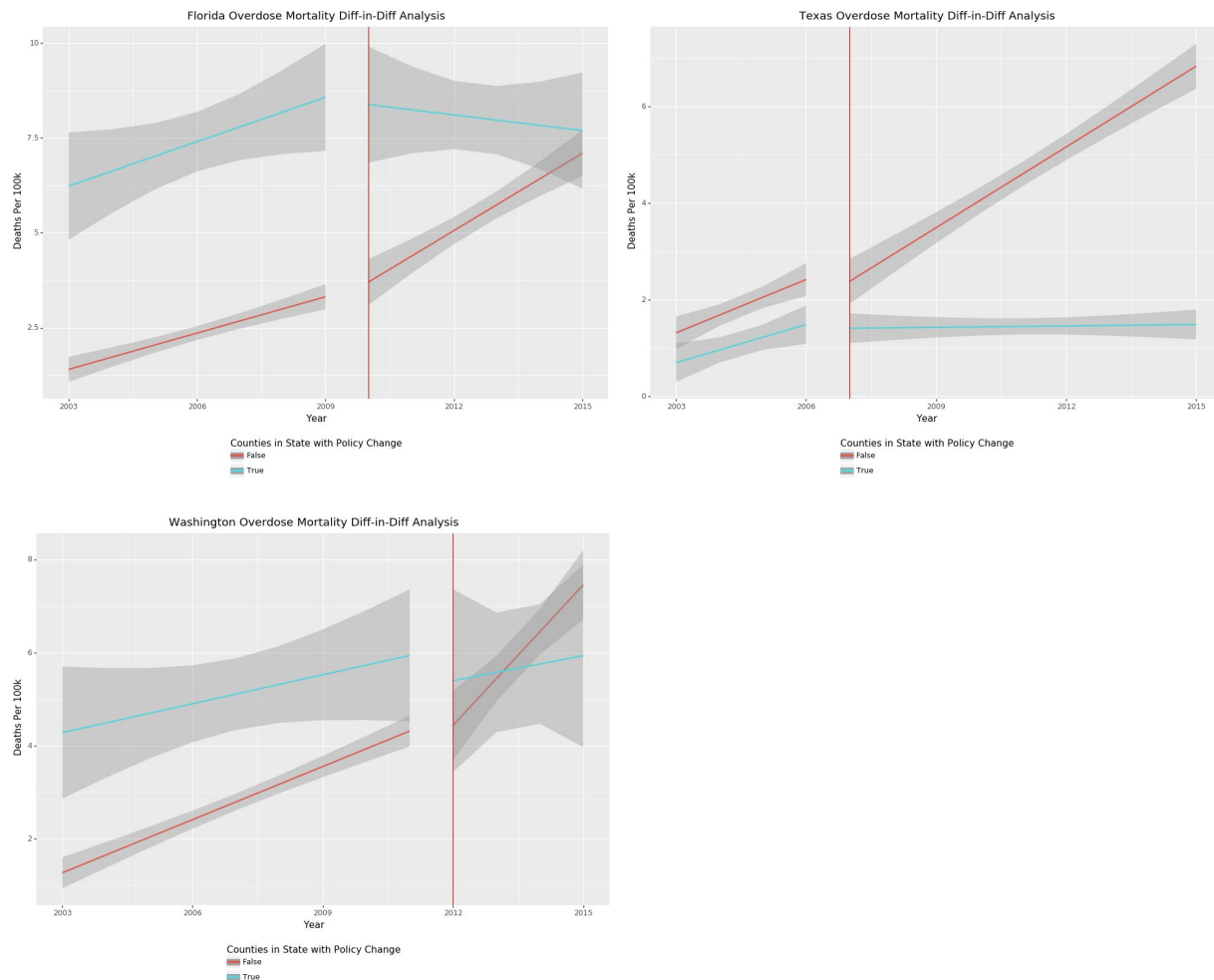


Figure 4.4: Diff-in-Diff - Mortality

(95% Confidence Intervals)

Upper-left:Florida; **Upper-right:**Texas

Lower-left:Washington

Similarly above, we compare mortalities through Difference-in-Difference regressions. Starting with Florida, we see similar results before. Prior to the policy implementation, Florida had above average deaths compared to the controls. But after the policy was introduced, the number of deaths decreased noticeably while deaths in non-policy states continued to increase. For Texas we see that the number of deaths has decreased noticeably since the policy introduction in 2007. Similar to the Texas pre/post analysis for mortality, we see that the rate of deaths flatlined after the introduction, but compared to states that did not have a policy change. Lastly for Washington, again the results for the policy change are similar to the pre/post analysis where the line was downshifted and the slope remained the same. But when compared to the control states, it seems that the policy change was successful as the slope is flatter compared to the control states, indicating that the rate of deaths is lower.

5. Interpretation

5.1 Comparison of policy changes effectiveness in three states

Policy changes differ in their actions in the three states that were investigated. As a result, the mortality records in each state and drug shipment volume in Florida appears to be affected after the policy changes were imposed.

To interpret the graphs, we can first look at the trend of values we are interested in for each state, i.e. the pre-post analyses. Florida has a huge change in the trend of MME received, this change is reflected in drug overdoses that have led to deaths. By comparing the trend of the amount of MME shipped into Florida before and after the policy change year to other states which did not have opioid related policy changes, we observed a drastic reduction in mortality related to drug overdoses, as opposed to the increase in mortality as well as opioid shipment in non-policy changed states.

Due to the drug-related policy change in Texas, the yearly rate of death, which had been steadily increasing, due to opioid overdose, has also been curbed. When compared to non-policy changed states, we can see that this reduction in mortality is not a nationwide occurrence and is likely due to the policy change.

However, in Washington state, while policy change has made a difference in deaths related to drug overdose, it has only been effective in the first year after the policy changes were implemented. The increasing mortality trend seen pre-policy change, continues to increase at the same rate, despite the reduction in mortality right after the

change. The policy change leads to a more meaningful result when we compare Washington State to other non-policy states. Though the mortality rate continues to go up, in the last year, the average of drug-related deaths in Washington counties has been controlled below the average of that in non-policy counties. Taking this into consideration, we believe the prescription regulation changes in Washington has led to a control on drug over-prescription to an extent. This, in turn, has led to a control in overdoses.

Therefore, we draw the conclusion that any kind of policy change at all, would be beneficial in saving lives and reducing the amount of opiates prescribed. Those that have had more strict policy changes, such as Florida, do indeed lead to a higher reduction in opioid prescription and in drug-related mortality.

5.2 Limitations of Analysis

5.2.1 Assumptions on missing values

When looking at county death records relating to Drug/Alcohol related deaths, death counts under 10 were not recorded in the data. Since this was the case, we put in zeros for deaths in these counties for those years. This makes our analysis biased as mortality is underestimated.

5.2.2 Assumptions on drug shipment dataset

Hydrocodone and oxycodone make up 75% of the opiates being shipped in the United States. The other 25% is not accounted for in our analysis, which might affect the overall results. Stronger opioids such as oxymorphone and hydromorphone have a morphine milligram equivalent (MME) of 3 and 4, respectively (CDC, 2019). Since these prescribed pills are stronger, they are likely to be more dangerous for users, specifically recreational users, which may not be able to accurately gauge the dose they are taking. In addition, we do not have data for looking at illegal opioids shipped into each state or county. Since illegal opioids are generally stronger and vary in strength more, users are more prone to overdosing. Illegal opioids are also more likely to be injected intravenously by addicts, which increases the bioavailability of the drug, making it stronger, and potentially more dangerous.