Estimating the Impact of Opioid Control Policies

Executive Report

Suzy Anil, Sukhpreet Sahota, Yuanjing Zhu, Xianchi Zhang

12/9/2022

To US Secretary of Health and Human Services (HHS), Dr. Xavier Becerra,

Executive Summary

For this engagement, our team was tasked by yourself and the Health and Human Services (HHS) with measuring and providing a thorough analysis of the opioid drug policies implemented from the late 2000s – early 2010s, in particular the policies implemented by Texas in 2007, Florida in 2010, and Washington in 2012. The purpose of this report is to understand the effectiveness of the various state-wide policy interventions during this time that were created to limit the prescription of opioids in the hopes of decreasing opioid deaths caused by overdoses. In turn, it is our hope this report assists the HHS as you contemplate on national policies and recommendations for other states that may be experiencing increased effects of the ongoing opioid crisis affecting our nation.

When prescription opioids were first introduced in 1990, they were mostly prescribed to treat certain forms of cancer and aid post-surgery recovery. However, by 2007, a rise in advertisements for opioids by major pharmaceutical companies along with the malpractice of over-prescribing pain medication led to patients with chronic illnesses taking opioids over longer periods of time. This increased duration led to higher dosages intakes by patients and increased possibility of opioid addiction as addicted patients looked for alternate ways to curb their urges/compulsions. The rise in opioids also led to an increase in opioid imports, which has correlated to more overdose deaths (caused by prescription opioids, illegally purchased opioids and synthetic opioids).

The three states we examined, Florida, Texas, and Washington, implemented policies to limit the prescription of opioids in the hopes of seeing a decline in opioid abuse and overdose deaths. More and more protocols were put in place to decrease the likelihood of an opioid addiction occurring in patients that required opioid medication for pain relief. Since each of these states established slightly different policies, we needed to examine if any of these policies impacted opioid shipments and opioid deaths within each respective states to see if one set of policies were more effective than the others. To truly understand the impact of these regulations, we employed two strategies to measure policy effectiveness: a pre-post comparison and a difference-in-difference comparison. A pre-post comparison enabled us to inspect the periods before and after

the policies were introduced for each state to see if there was truly a difference in observations that can be contributed to the respective policies. A difference-in-difference comparison complements the pre-post comparison by providing a broader, nationwide perspective of the changes in opioid shipments and overdose deaths. For each of the three states, we have picked six reference states respectively (three states for examining the nationwide trend of opioid deaths and three states for examining the nationwide trend of opioid shipments) that did not implement any opioid regulation practices. These reference states act as control states had our selected states not implemented any policy changes as they are demographically, geographically, and/or politically similar.

Through our analysis, we found that Florida's policies were the most effective as both opioid shipments and opioid deaths experienced declines in the years following its implementation in the state. Texas's mortality rate declined because of its policy changes but had no substantial impact on opioid imports into the state. Washington, on the contrary to its counterparts of Florida and Texas, witnessed no impacts on opioid shipments and opioid deaths from the policies it put in place. Therefore, as the HHS designs new policies and recommendations for other states within the union, Florida's policies and enforcement should be the model that is followed and built upon. It is worth noting that while we believe our analysis is complete, further research into each respective set of reference states is required to ensure they are truly representative of the selected state they act as controls for.

Data

To conduct our analysis, we utilized three different datasets that provided us information on the import of opioids, mortality, and population for all of the selected and reference states we are examining.

1. Opioid Shipments: We retrieved data regarding opioid shipments from the *Washington Post*, specifically the quantity of opioids prescribed over every month from 2006 to 2012
2. Opioid Mortality: The *US Vital Statistics* provided public access to information on overdose deaths separated by county for each respective state
3. Population: To accurately compare mortality to the entire population, we used population data from the *National Historical Geographic Information System*, which had census population data separated by county for each respective state
4. FIPS code: To ensure consistency across all three datasets, we also captured the associated FIPS codes to act as a universal identifier for state-county.

Analysis/Interpretation

Florida

Shipment Rate

Reference States: Arizona, Louisiana, South Carolina

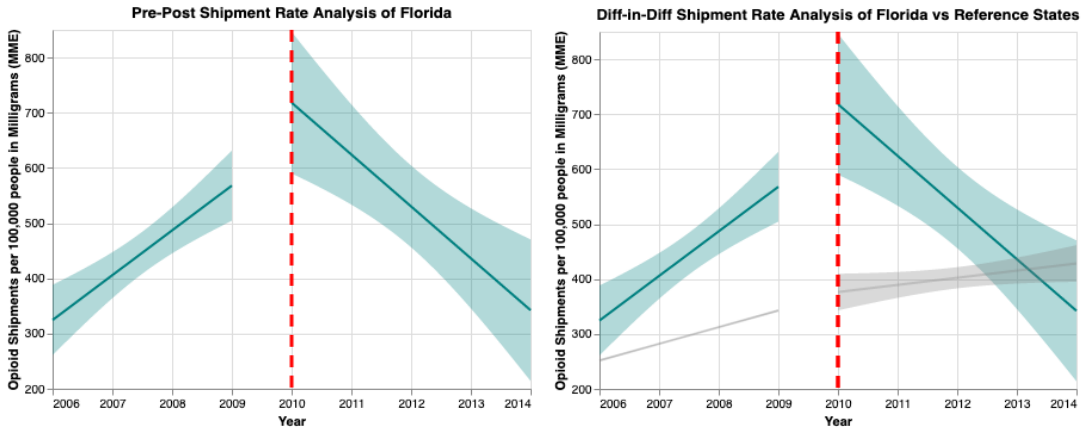

Figure 1 Caption: The graph on the left shows the trend of opioid shipments for Florida segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Florida's opioid shipments against control states that did not implement any policies (AZ, LA, SC). The lines are OLS fits and 95% confidence intervals.

From the pre-post analysis graph, we observed that opioid shipments per capita rise steadily until the policy was executed in 2010. After regulating the shipment of opioids, we see an immediate decline in prescriptions per capita. When comparing these effects to our control states, there is a difference in trends between the two, which let us equate the change seen in Florida to the restrictions put in place. The control states continue to increase in opioid shipments by comparison which implies that the policy limited the amount of opioids shipped into Florida.

Mortality Rate

Reference States: Colorado, Louisiana, Nevada

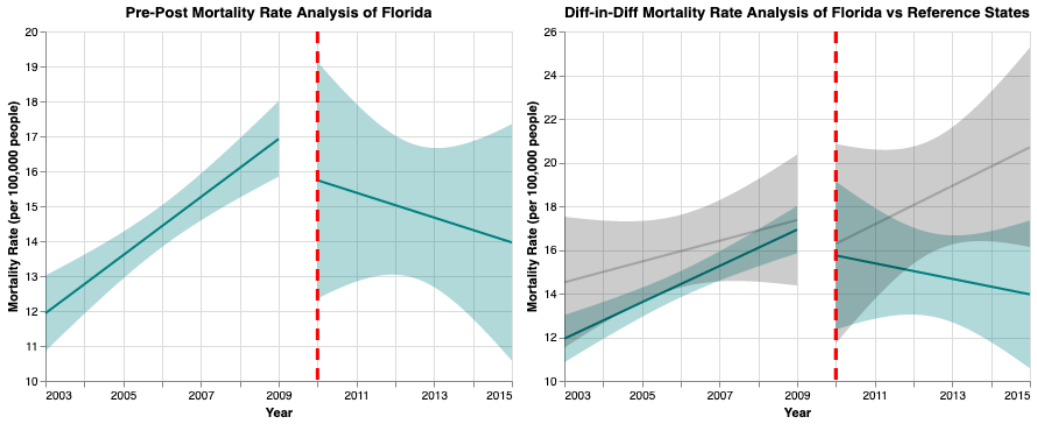

Figure 2 Caption: The graph on the left shows the trend of mortality rate for Florida segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Florida's mortality rate against states that did not implement any policies (CO, LA, NV). The lines are OLS fits and 95% confidence intervals.

Starting with the graph on the left, there is continued growth for mortality rate rising from 12 to 17 per 100,000 people prior to the adoption of the policy. The mortality declines immediately after the implementation of Florida's policy in 2010. However, in order to determine if this was a causal effect due to the regulations advocated by state legislature, we compared the observed trend against the control states'. Looking at the difference-in-difference analysis, the control states exhibit an increase in mortality rate after 2010. This suggests that the regulations placed on opioid prescriptions also had a positive impact on Florida in limiting overdose deaths.

Washington

Shipment Rate

Reference States: Arizona, Colorado, New York

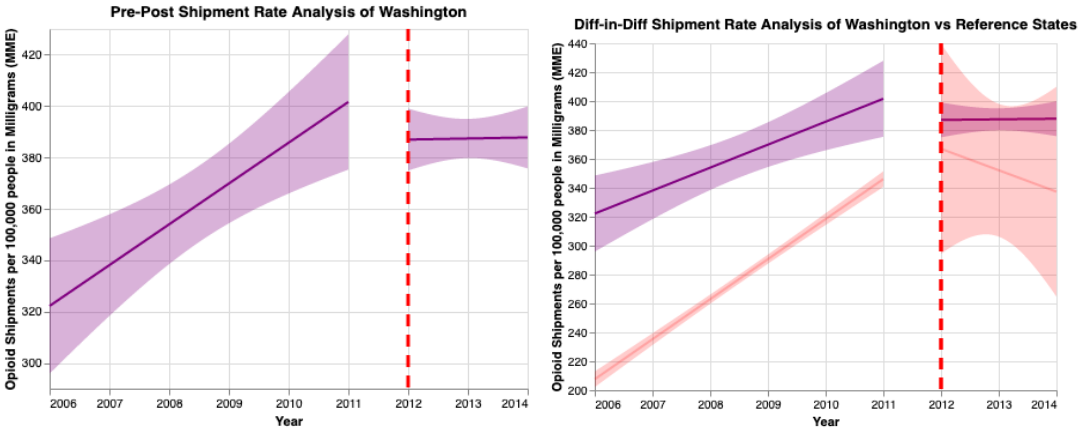

Figure 3 Caption: The graph on the left shows the trend of opioid shipments for Washington segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Washington opioid shipments against states that did not implement any policies (AZ, CO, NY). The lines are OLS fits and 95% confidence intervals.

Looking at the pre-post analysis on opioid prescriptions per capita rate, we noticed the rising tendency in opioid shipments per capita from 320 to 400 mg. This incline is met with a constant trend, with no indication of an increase or decrease in rate after the policy administration in 2012. Regardless of how this presents, we require the results of the difference in difference analysis to check if the treatment versus the control group differ from point of enactment. The results from the control states indicate that they experienced a decline in shipments per capita. This indicates that we cannot relate the change in opioid shipments per capita to Washington's own implementation of opioid prescription regulations.

Mortality Rate

Reference States: Hawaii, Oklahoma, Oregon

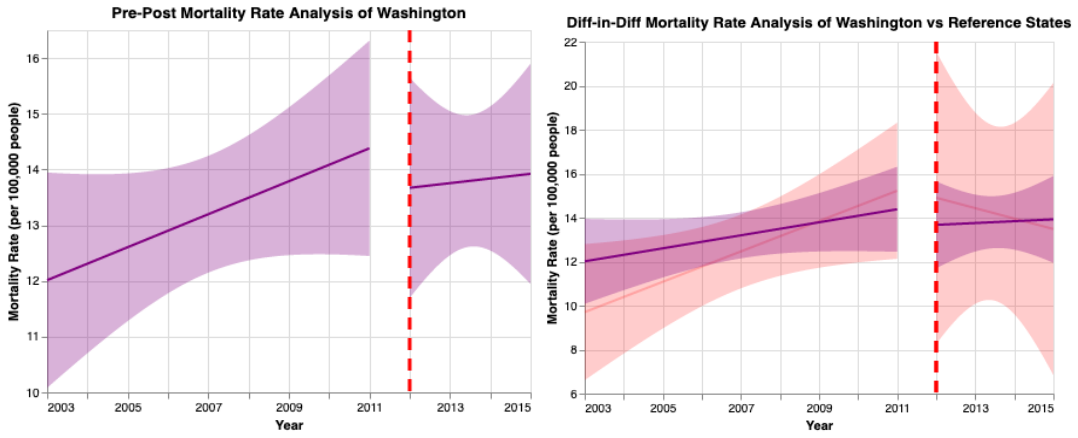

Figure 4 Caption: The graph on the left shows an overview of mortality rate for Washington segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Washington's mortality rate against states that did not implement any policies (HI, OK, OR). The lines are OLS fits and 95% confidence intervals.

Pertaining to the effect of opioid regulations on the mortality rate in Washington, we started with the pre-post analysis on the left, which exhibited a continuing increase in mortality after the policy was enacted. Without considering outside factors, it seems the policy did not manifest as expected. But this cannot be confirmed before examining the difference-in-difference analysis which revealed a differing pattern in the control states. As witnessed by both forms of the analysis, we can conclude that the policy had no effect on overdose deaths experienced in the state.

Texas

Shipment Rate

Reference States: Illinois, New York, Oregon

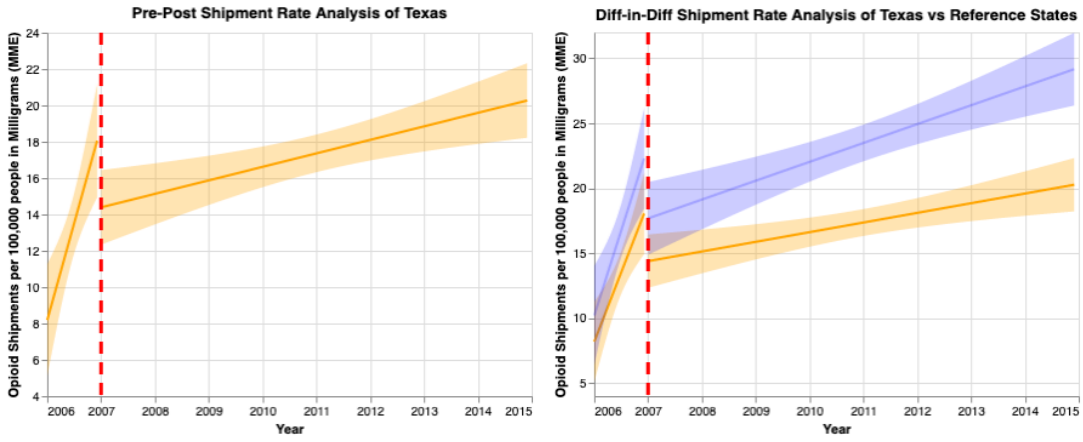

Figure 5 Caption: The graph on the left shows an overview of opioid shipments for Texas segmented by before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares

Texas's opioid shipments against control states that did not implement any policies (IL, NY, OR). The lines are OLS fits and 95% confidence intervals.

Looking at the pre-post analysis on opioid prescriptions per capita rate, we take notice of the rising tendency in opioid shipments per capita per month from 8 to 18 mg. This incline is met with a continued trend after 2007. However, it is key to point out that the increase is not as steep. Analyzing the results of the difference in difference analysis to check if the treatment versus control group differ from point of enactment shows similar results within the control states. This indicates that Texas's regulation did not impact the amount of opioids entering the state (which makes sense as the regulations were oriented to patients rather than importation).

Mortality Rate

Reference States: New York, Oregon, Wisconsin

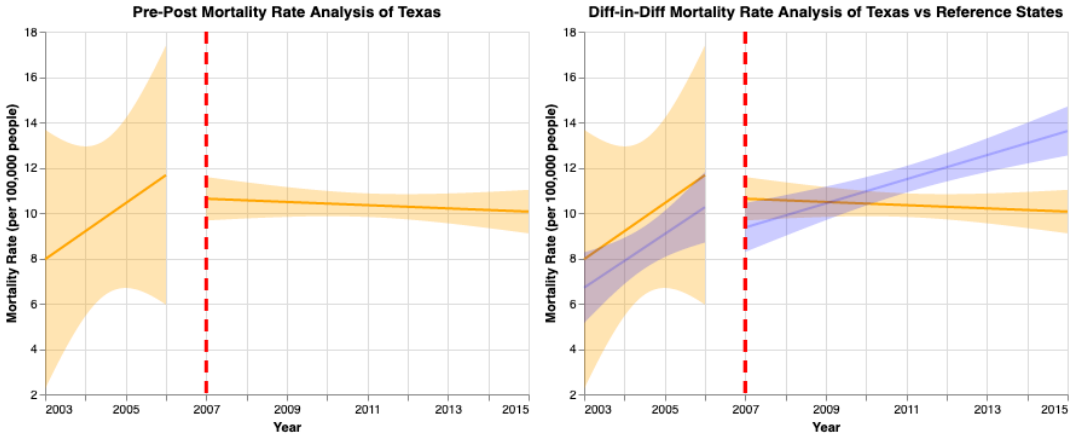

Figure 6 Caption: The graph on the left shows an overview of mortality rate for Texas segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Texas's mortality rate against states that did not implement any policies (WI, NY, OR). The lines are OLS fits and 95% confidence intervals.

According to the graph on the left, the average mortality rate from drug overdose increases and reaches a peak of roughly 12 per 100,000 people until the policy was executed in 2010. After the implementation of the policy, the death rate declines and maintains a slowly decreasing trend, which might not have been the case had the policy not been put into effect. The difference-in-difference analysis reveals that average death rates of the reference states (NY, OR, WI) continue to rise both before and after 2007. This shows that Texas's mortality rate was decreased because of the opioid regulations that put patients in the forefront.

Conclusion

Through our analysis, we found the following:

1. Florida faced the greatest incline in opioid shipments prior to policies being put into place regulating the quantity of opioids that could be prescribed

2. Florida state legislature implemented the most restrictive regulations out of the three selected states we observed based on the analysis we conducted, as both opioid shipment and mortality experienced a downward trend due to the policy
3. Results of a similar effect were seen from Texas in mortality; however, the regulations had no apparent impact on the number of opioid shipments. We can conclude this decrease in overdose deaths and over-consumption of opioids were limited as direct impacts of the policies put in place
4. When analyzing the policies put in place by the state of Washington, we did not see such an obvious turnout for neither opioid shipments nor opioid mortality as the state hoped/intended. There were no effects from the policy on either measure

One consideration that should be outlined is whether the control states were appropriately picked to be compared against our three selected states of Florida, Texas, and Washington. In particular, the control states of Oregon, Oklahoma, and Hawaii for Washington were selected based on population, geography, and politically; however, from our research, it is difficult to infer whether these control states truly hadn't implemented their own opioid regulation policies. If, in fact, we were correct on both terms, we can conclude that Washington's policy had no impact. However, if we garner evidence in the future that differs from our assumption of no regulation policies being implemented within these control states prior to 2012, which resulted in the stability of mortality rate within these control states, we would need to reexamine the impact by picking new control states (for not only Washington but potentially for Florida and Texas). This would enable us to further validate the conclusion from this analysis.

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Estimating the Impact of Opioid Control Policies

Technical Report

Suzy Anil, Sukhpreet Sahota, Yuanjing Zhu, Xianchi Zhang

12/9/2022

To CDO for the US Department of Health & Human Services (HHS), Dr. Nick Eubank,

Abstract

For this engagement, our team was tasked by yourself and US Secretary of Health and Human Services (HHS) Dr. Xavier Becerra with measuring and providing a thorough analysis of the opioid drug policies implemented from the late 2000s – early 2010s, in particular the policies implemented by Texas in 2007, Florida in 2010, and Washington in 2012. The purpose of this report is to understand the effectiveness of the various state-wide policy interventions during this time that were created to limit the prescription of opioids in the hopes of decreasing opioid deaths caused by overdoses. In turn, it is our hope this report assists the HHS as you contemplate on national policies and recommendations for other states that may be experiencing increased effects of the ongoing opioid crisis affecting our nation.

Purpose and Motivation

When prescription opioids were first introduced in 1990, they were mostly prescribed to treat certain forms of cancer and aid post-surgery recovery. However, by 2007, mere 17 years later, a rise in advertisements for opioids by major pharmaceutical companies along with the malpractice of over-prescribing pain medication led to patients with chronic illnesses taking opioids over longer periods of time. This increased duration also led to higher tolerance levels as patients took the opioids in higher dosages. This ultimately led to a raised potential in opioid addiction as addicted patients looked for alternate ways to curb their urges/compulsions. The rise in prescription opioids also led to an increase in opioid imports, which has correlated to more prescription overdose deaths. Deaths caused by alternative forms of opioids, such as illegally purchased prescription drugs and synthetic opioids, like heroin and fentanyl, have also surged. Synthetic opioids are significantly more potent and lethal than monitored drugs, making it much easier to overdose if taken without supervision and in improper dosages.

In acknowledging this trend and the associated societal effects/concerns, Florida, Texas, and Washington implemented policies to limit the prescription of opioids in the hopes of seeing a decline in opioid abuse and overdose deaths. More protocols were put in place to decrease the likelihood of an opioid addiction occurring in patients that required opioid medication for pain relief. For example, in 2007, Texas outlined regulations regarding pain treatments with

controlled substances, with the guidelines specifically putting the patients in the forefront. At the same time, Florida took a very different phased approach by initially closing pain and health clinics across the state that abused their power and prescribed large quantities of opioids. When Florida government officials saw a major spike and continuing trend in prescriptions in 2010, they enforced registration and increased oversight on remaining pain clinics and conducted statewide raids aimed at closing pain clinics illegally dispensing Schedule I and II drugs. The state implemented guidelines that required patient evaluations before prescriptions and conducting periodic reviews to monitor patient tolerances. This culminated into Florida's state legislature assembling a task force to regulate wholesale drug distributors in 2012. During this same year, Washington enacted similar oversight practices on clinics by introducing regulations focused on dosage intake by administering prescription thresholds of 120 mg. Since each state established slightly different policies, we examined if any of these policies impacted opioid shipments and deaths due to opioid overdoses within each respective states to see if one set of policies were more effective than the others.

Methods

With this backdrop, it is crucial to truly understand the impact of these regulations (if any) by measuring the effect of each states' policy intervention on opioid imports and overdose deaths. To do this, we employed two strategies to gauge policy effectiveness: a pre-post comparison and a difference-in-difference comparison.

By utilizing a pre-post comparison, it enabled us to inspect the periods before and after the policies were introduced for each state to see if there was truly a difference in observations that can be contributed to the respective policies. For example, we fitted the trend before and after Florida's policy was put in place in 2010. If the policy had an effect, there would be a downward trend in opioid shipments and overdose mortality after policy emplacement; however, if there was no effect, we would see the trend in shipments and mortality unaffected and continue accordingly.

However, there is a major flaw with solely basing our conclusion off this method as it could falsely attribute declines in opioid shipment and overdose deaths to the introduction and effectiveness of each respective policy when other contributing factors were the real causes behind the change in trend. For example, in 2010, the US Customs Service started regulating the importation of fentanyl into the United States. A comparison of the amount of overdose deaths for Florida in 2009 to Florida in 2011 revealed a decline that was actually occurring nationwide because of this regulation and not just a trend that was unique to Florida (or by association, as a result of its drug policies). To account for this, it is important to compare changes within our three selected states to other states that did not implement any policies.

Our second form of analysis, a difference-in-difference comparison, provides that perspective by enabling us to have a broader, nationwide view of changes in opioid shipments and overdose deaths. For each of the three states, we have picked up to six unique reference states respectively (up to three unique states for examining opioid deaths and up to three unique states for examining opioid shipments) that did not implement any opioid regulation practices. These reference states act as control states had our selected states not implemented any policy changes as they are demographically, geographically, and/or politically similar. If the reference states continue to show a trend for either opioid shipments or overdose deaths (or both) that differs in comparison from our selected states, we can assume and correlate the implementation of the policy to the changes in trend within each selected states for each measure (shipment and deaths). As a descriptive example, if we see an upward trend in opioid deaths in Texas and its reference states of New York, Oregon, and Wisconsin before 2007 and a downward trend for only Texas after the policy is put in place, while the reference states continue to experience an upward trend, it is safe to assume that the policy was the direct influence and there were no additional outside factors.

Data

To conduct our analysis, we utilized three different datasets that provided us information on the import of opioids, mortality, and population for all the selected and reference states we are examining.

5. Opioid Shipments: We retrieved data regarding opioid shipments from the *Washington Post*, specifically the quantity of opioids prescribed over every month from 2006 to 2012
6. Opioid Mortality: The *US Vital Statistics* provides public access to information on overdose deaths separated by county for each respective state
7. Population: Lastly, to accurately compare mortality to the entire population, we used population data from the *National Historical Geographic Information System*, which had census population data separated by county for each respective state
8. To standardize, ensure consistency, and merge our datasets accordingly based on county, we added FIPS codes to all datasets as we discovered discrepancies in the combination of state-county names across the three datasets highlighted above

Summary Statistics

Shipment						
States	Florida	Reference States (AZ, LA, SC)	Washington	Reference States (AZ, CO, NY)	Texas (By month)	Reference States (IL, NY, OR) (By Month)
Count	600	1120	351	1219	24042	21214
Mean	1.72E+08	5.53E+07	61484989.38	73096665.97	1945605.54	3837451.12
Standard Deviation	3.46E+08	1.72E+08	1.14E+08	1.851588e+08	7160816.91	8730708.23
Minimum	628449.83	2185.88	761058.52	242.16	60.54	18.16
25th Q	9807154.29	4985211.97	7347821.67	5070708.75	99853.25	285781.36
Median	54206960.7	14981229.21	20319301.58	16678279.11	310666.88	971152.28
75th Q	1.67E+08	4.35E+07	51758630.42	55783699.52	1179114.07	2690345.39
Maximum	3.03E+09	2.11E+09	6.47E+08	2.11E+09	1.19E+08	8.55E+07

Overdose Death						
	Florida	Reference States (CO, LA, NV)	Washington	Reference States (HI, OK, OR)	Texas	Reference States (NY, OR, WI)
Count	871	1885	507	1534	3302	2210
Mean	0.0146	0.0157	0.0134	0.016	0.0102	0.0106
Standard Deviation	0.0046	0.0049	0.0034	0.0056	0.0022	0.0032
Minimum	0.0038	0.0034	0.0043	0.0034	0.0015	0.0008
25th Q	0.0125	0.0127	0.012	0.0114	0.0093	0.0084
Median	0.0146	0.0149	0.0137	0.0155	0.0099	0.0108
75th Q	0.0165	0.019	0.0143	0.0199	0.0107	0.0129
Maximum	0.0408	0.0783	0.0314	0.0401	0.0416	0.0376

As we began to analyze the aforementioned datasets, we realized discrepancies within the opioid mortality and opioid shipment datasets that needed to be resolved before we could actually conduct our pre-post and difference-in-difference analysis. To start, we found missing values in the mortality data. We determined this to be a result of how the data was collected and inputted for counties with less than ten deaths. Rather than ignoring these missing counties, we decided to employ mean imputation to fill in missing values for mortality rate. Specifically, we imputed any missing values with the mean mortality rate for that year and state. Based on the non-missing mortality rates, we found that the series randomly fluctuates around a particular level so by imputing with the mean value, we were able to preserve the mean mortality rate for that state.

From the opioid shipment data, we found there were many mismatches with county names when merging with the population data. There were two differentiations that occurred: 1) some counties were labeled as “parishes” and 2) some counties were labeled as “SAINT” within the shipment dataset, while within the population dataset, the same counties were abbreviated to “ST.” In order to merge these two datasets, we changed those irregular county names present in the population data to match the shipment data. The summary statistics were procured after cleaning and the imputation of missing values.

As we began our analysis, we conducted an initial exploratory data analysis to better understand each measure contributing to the opioid crisis: opioid shipments and opioid deaths. In the opioid shipment dataset highlighted above, to compare the effects that took place in Florida, we used Arizona, Louisiana, and South Carolina as the respective reference states. In our initial comparison between these similar states, we observed higher yearly averages for opioid dosage after 2010 for our reference states. As we examined the opioid shipments within Washington, we decided to use Arizona, Colorado, and New York as reference states and found that all states show a higher yearly mean of opioid shipments after 2012. Lastly, as we assessed opioid shipments within Texas, we picked the states of Illinois, New York, and Oregon as the respective

reference states and found that the average number of opioid shipments in the reference states were nearly twice as many as Texas. However, it is important to note that unlike the observations made for Florida and Washington, this computation was on a monthly basis (as the opioid shipment dataset from the *Washington Post* contains data for only one year prior to Texas implementing its drug policy).

To compare against Florida's mortality data, we picked Colorado, Louisiana, and Nevada as control states. We found that the top three counties with the highest death rate for each state for each respective year also have the highest mean opioid dosage use. For the Washington mortality rate analysis, we chose Hawaii, Oklahoma, and Oregon as the respective reference states. We analyzed that all states presented an uptrend of death rate after 2012. Among the statistics, the change of mean values in Oklahoma shows this apparent incline. Lastly, to compare mortality rates within Texas, we designated New York, Oregon, and Wisconsin as the appropriate reference states. We found that except for Texas, the reference states show an increased rate of deaths, although all of them don't show big differences of mean values before and after the policy implementation.

From the overview of summary statistics, we found that the opioid death rate and shipments are quite different for each respective selected state. This further validated that our two methods of pre-post and difference-in-difference are required to understand more.

Analysis/Interpretation

Florida

Shipment Rate

Reference States: Arizona, Louisiana, South Carolina

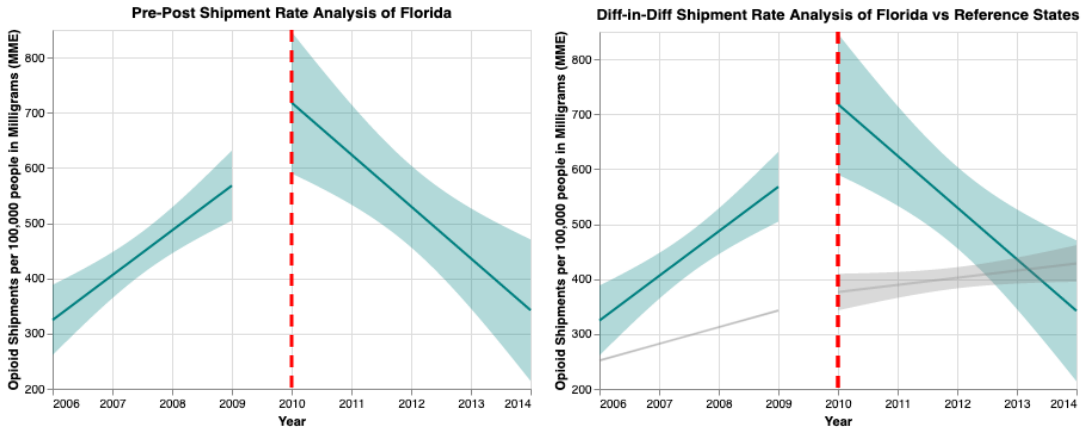

Figure 1 Caption: The graph on the left shows the trend of opioid shipments for Florida segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Florida's opioid shipments against control states that did not implement any policies (AZ, LA, SC). The lines are OLS fits and 95% confidence intervals.

From the pre-post analysis graph, we observed that opioid shipments per capita rise steadily until the policy was executed in 2010. After regulating the shipment of opioids, we see an immediate decline in prescriptions per capita. When comparing these effects to our control states, there is a difference in trends between the two, which let us equate the change seen in Florida to the restrictions put in place. The control states continue to increase in opioid shipments by comparison which implies that the policy limited the quantity of opioids shipped into Florida.

Mortality Rate

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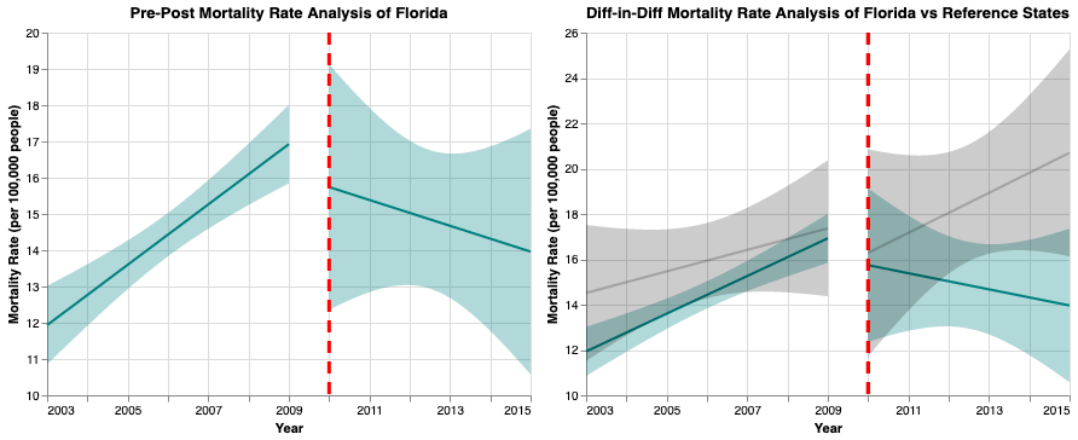

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Starting with the graph on the left, there is continued growth for mortality rate rising from 12 to 17 per 100,000 people prior to the adoption of the policy. The mortality declines immediately after the implementation of Florida's policy in 2010. However, in order to determine if this was a causal effect due to the regulations advocated by state legislature, we compared the observed trend against the control states'. Looking at the difference-in-difference analysis, the control states exhibit an increase in mortality rate after 2010. This suggests that the regulations placed on opioid prescriptions also had a positive impact on Florida in limiting overdose deaths.

Washington

Shipment Rate

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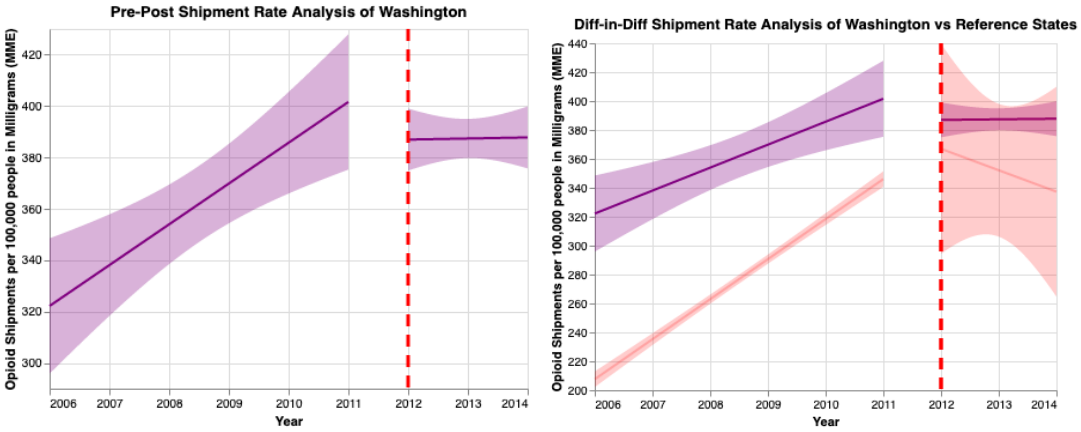
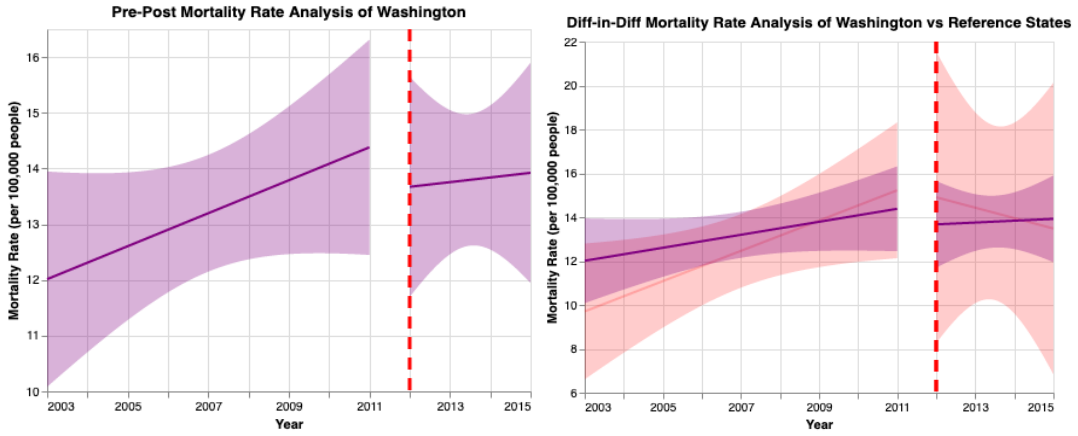


Figure 3 Caption: The graph on the left shows the trend of opioid shipments for Washington segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Washington opioid shipments against states that did not implement any policies (AZ, CO, NY). The lines are OLS fits and 95% confidence intervals.

Looking at the pre-post analysis on opioid prescriptions per capita rate, we noticed the rising tendency in opioid shipments per capita from 320 to 400 mg. This incline is met with a constant trend, with no indication of an increase or decrease in rate after the policy administration in 2012. Regardless of how this presents, we require the results of the difference in difference analysis to check if the treatment versus the control group differ from point of enactment. The results from the control states indicate that they experienced a decline in shipments per capita. This indicates that we cannot relate the change in opioid shipments per capita to Washington's own implementation of opioid prescription regulations.

Mortality Rate

Reference States: Hawaii, Oklahoma, Oregon



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Pertaining to the effect of opioid regulations on the mortality rate in Washington, we started with the pre-post analysis on the left, which exhibited a continuing increase in mortality after the policy was enacted. Without considering outside factors, it seems the policy did not manifest as expected. But this cannot be confirmed before examining the difference-in-difference analysis which revealed a differing pattern in the control states. As witnessed by both forms of the analysis, we can conclude that the policy had no effect on overdose deaths experienced in the state.

Texas

Shipment Rate

Reference States: Illinois, New York, Oregon

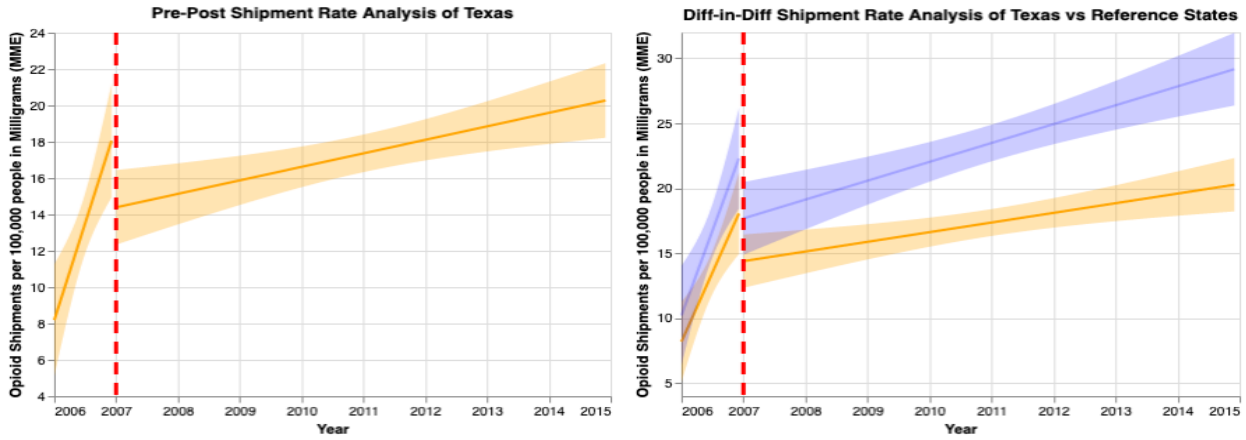

Figure 5 Caption: The graph on the left shows an overview of opioid shipments for Texas segmented by before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares

Texas's opioid shipments against control states that did not implement any policies (IL, NY, OR). The lines are OLS fits and 95% confidence intervals.

Looking at the pre-post analysis on opioid prescriptions per capita rate, we take notice of the rising tendency in opioid shipments per capita per month from 8 to 18 mg. This incline is met with a continued trend after 2007. However, it is key to point out that the increase is not as steep. Analyzing the results of the difference in difference analysis to check if the treatment versus control group differ from point of enactment shows similar results within the control states. This indicates that Texas's regulation did not impact the amount of opioids entering the state (which makes sense as the regulations were oriented to patients rather than importation).

Mortality Rate

Reference States: New York, Oregon, Wisconsin

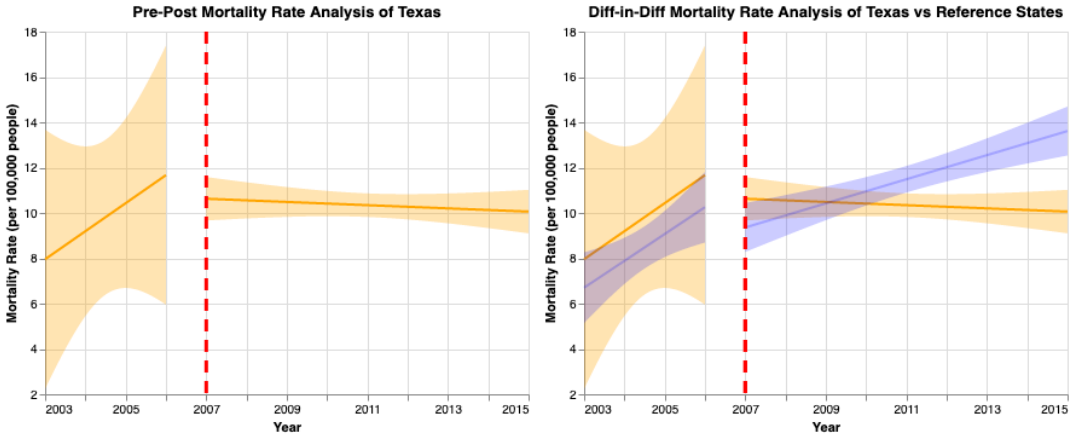

Figure 6 Caption: The graph on the left shows an overview of mortality rate for Texas segmented before and after the state's policy to restrict the prescription of opioids was implemented. The graph on the right compares Texas's mortality rate against states that did not implement any policies (WI, NY, OR). The lines are OLS fits and 95% confidence intervals.

According to the graph on the left, the average mortality rate from drug overdose increases and reaches a peak of roughly 12 per 100,000 people until the policy was executed in 2010. After the implementation of the policy, the death rate declines and maintains a slowly decreasing trend, which might not have been the case had the policy not been put into effect. The difference-in-difference analysis reveals that average death rates of the reference states (NY, OR, WI) continue to rise both before and after 2007. This shows that Texas's mortality rate was decreased because of the opioid regulations that put patients in the forefront.

Conclusion

Through our analysis, we found the following:

5. Florida faced the greatest incline in opioid shipments prior to policies being put into place regulating the quantity of opioids that could be prescribed.

6. Florida state legislature implemented the most restrictive regulations out of the three selected states we observed based on the analysis we conducted, as both opioid shipment and mortality experienced a downward trend due to the policy.
7. Results of a similar effect were seen from Texas in mortality; however, the regulations had no apparent impact on the number of opioid shipments. We can conclude this decrease in overdose deaths and over-consumption of opioids were limited as direct impacts of the policies put in place.
8. When analyzing the policies put in place by the state of Washington, we did not see such an obvious turnout for neither opioid shipments nor opioid mortality as the state hoped/intended. There were no effects from the policy on either measure.

One consideration that should be outlined is whether the control states were appropriately picked to be compared against our three selected states of Florida, Texas, and Washington. In particular, the control states of Oregon, Oklahoma, and Hawaii for Washington were selected based on population, geography, and politically; however, from our research, it is difficult to infer whether these control states truly hadn't implemented their own opioid regulation policies. If, in fact, we were correct on both terms, we can conclude that Washington's policy had no impact. However, if we garner evidence in the future that differs from our assumption of no regulation policies being implemented within these control states prior to 2012, which resulted in the stability of mortality rate within these control states, we would need to reexamine the impact by picking new control states (for not only Washington but potentially for Florida and Texas). This would enable us to further validate the conclusion from this analysis.

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