COVID-19 IN THE UNITED STATES

Lockdown Math: Why Timing Makes All The Difference When Dealing With the Coronavirus

An insightful look into what made some US states more effective than others in slowing down the rate of infection and spread of the virus

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Image of people in masks. Source: Freepik.

S econd-guessing government decision-making surrounding the coronavirus has become part of our new normal. As people all over the US adjust to a nation grappling with social and economic changes, we can't help but wonder whether the past few months of social distancing, shutdowns, and sweeping restrictions have been worth it.

Did we do enough? Could we have done more? Earlier? Later? Did what we do matter? Or was it all too much?

Understanding the implications and effects of the lockdown and stay-at-home orders can be quite difficult, especially since we're still in the thick of the pandemic.

Between political debates and personal opinions, there's just too much information for us to objectively come to a conclusion *unless we look to the numbers to inform our answers*.

So, we decided to dig into the data to **help you understand whether the timing and duration of statewide shutdowns were meaningful in reducing or stymieing infection rates.**

See the live dashboard to view all visualizations related to this post.

THE DATA

Since the first reported case of coronavirus in Washington on Jan. 21, 2020, The New York Times has been aggregating time-series data on **new cases each day** from state agencies, local governments, and health departments and making it available to the public (Smith et al., 2020).

The newspaper provides detailed background on its data in the interest of transparency, but it is worth calling out that the data is limited by:

- National virus testing shortages, which may undercount infections;

- Counts that include 'probable' cases from agencies that report them (some do not);

- Overcapacity health systems, which sometimes hinders the speed, accuracy and consistency of case reporting; and,

- Potential bias introduced by various journalists interpreting information and contributing to the database.

On our end, we supplemented The New York Times data with state-by-state information on stay-at-home orders compiled by NPR and NYT journalists (Mervosh et al., 2020; Treisman, 2020), along with population data from the federal government (US Census Bureau, n.d.) to augment our analysis.

Here is the final data file we used for our analysis, in case you wanted to explore the raw data yourself.

WHAT WE DID

We began by first standardizing the data to account for varying states' populations by scaling the raw count to a *case rate per 100,000 people.*

From that, we took an average of the daily new cases in the 14 days directly preceding the state's shutdown date, reopening date, and most recent date (June 23) to come up with three parameters that we could use to quantify each state's daily new case count over time. For the purposes of this analysis, we defined "shutdown" as the start of a state's stay-at-home order and "reopening" as the date when the state eased its restrictions.

Our reasoning behind averaging the data was to even out day-to-day inconsistencies in data reporting from government agencies and avoid unrepresentative daily 'spikes' caused by case reporting methods such as 'data dumps' on certain days. Looking at the data in terms of new cases per day allowed the team to best understand how quickly the virus is spreading.

We then ran exploratory data analysis to identify trends in shutdown duration, timeliness, and effectiveness across 50 US states and the District of Columbia, more specifically, to answer the following two questions:

1. Does the length of a state's shutdown period correlate with a reduction in the current new daily case count?

2. Does the timeliness of a state's shutdown (earlier rather than later) affect the effectiveness of a lockdown?

Finally, based on our analysis, we divided the states into two groups — **'successful' states**, which showed a decline in daily new cases from reopening to June 23, 2020, and **'unsuccessful' states**, which showed an increase in their daily case count *per 100,000 people* since easing restrictions.

Eight states did not have concrete shut down dates, and were eliminated from our consideration.

UNDERSTANDING THE LOCKDOWN

States with Stay At Home Orders

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No. Days of Lockdown

0.00   80.00
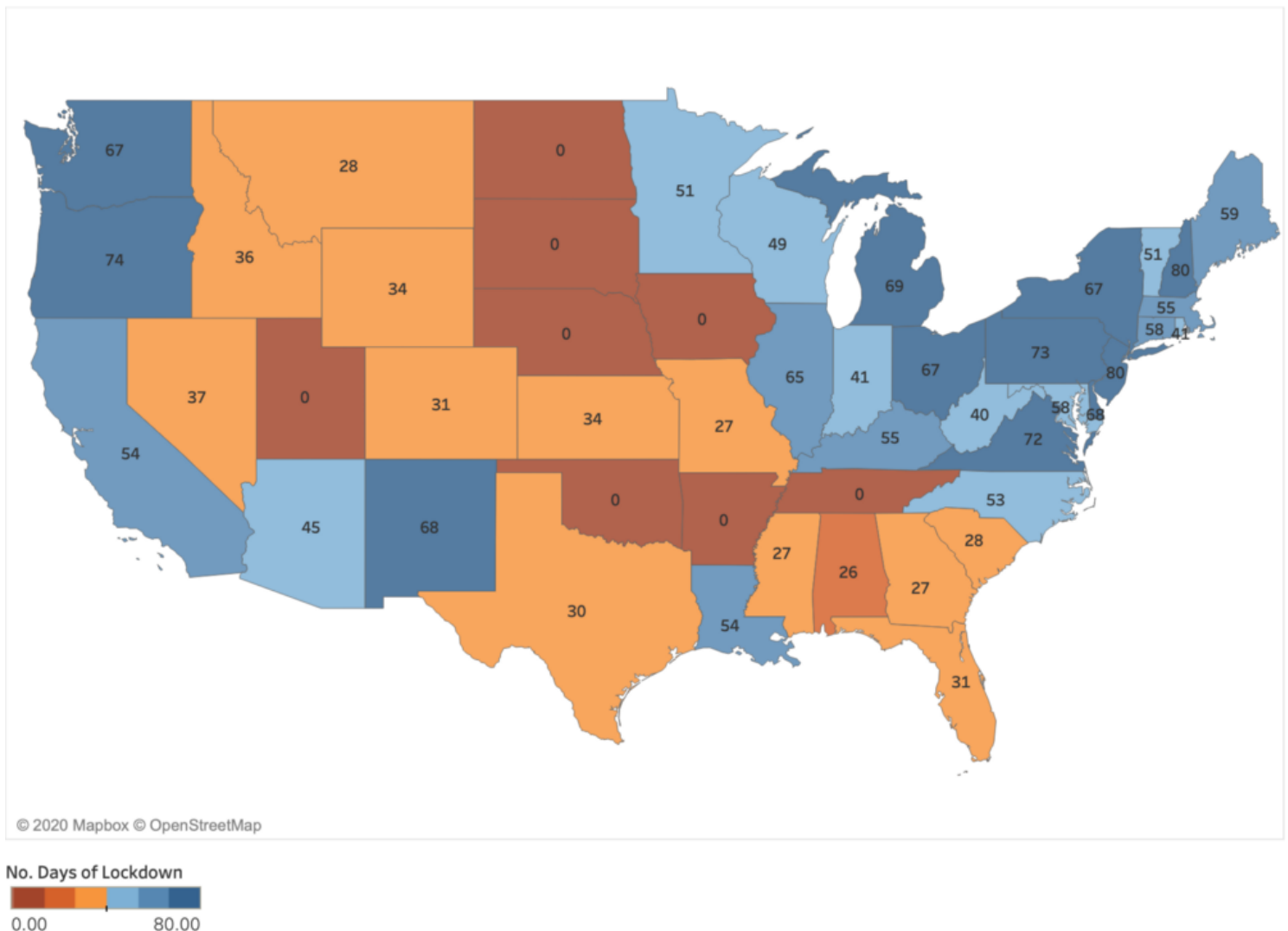
Map of the United States showing each state's lockdown duration. Numbers range from zero (for the eight states that didn't have any statewide stay-at-home orders) to a maximum of 80 days (for New Jersey and New Hampshire).

Absent any sweeping federal lockdown mandates, our data shows that states combatted the Coronavirus pandemic on different timelines, with varying lockdown starts, ends, and intensities, in an attempt to stifle the alarming spread of the virus.

Overall, 41 states and the District of Columbia implemented stay-at-home orders, shelter-in-place directives, and other statewide measures to shutter almost all businesses and curb travelling, interacting, and congregating.
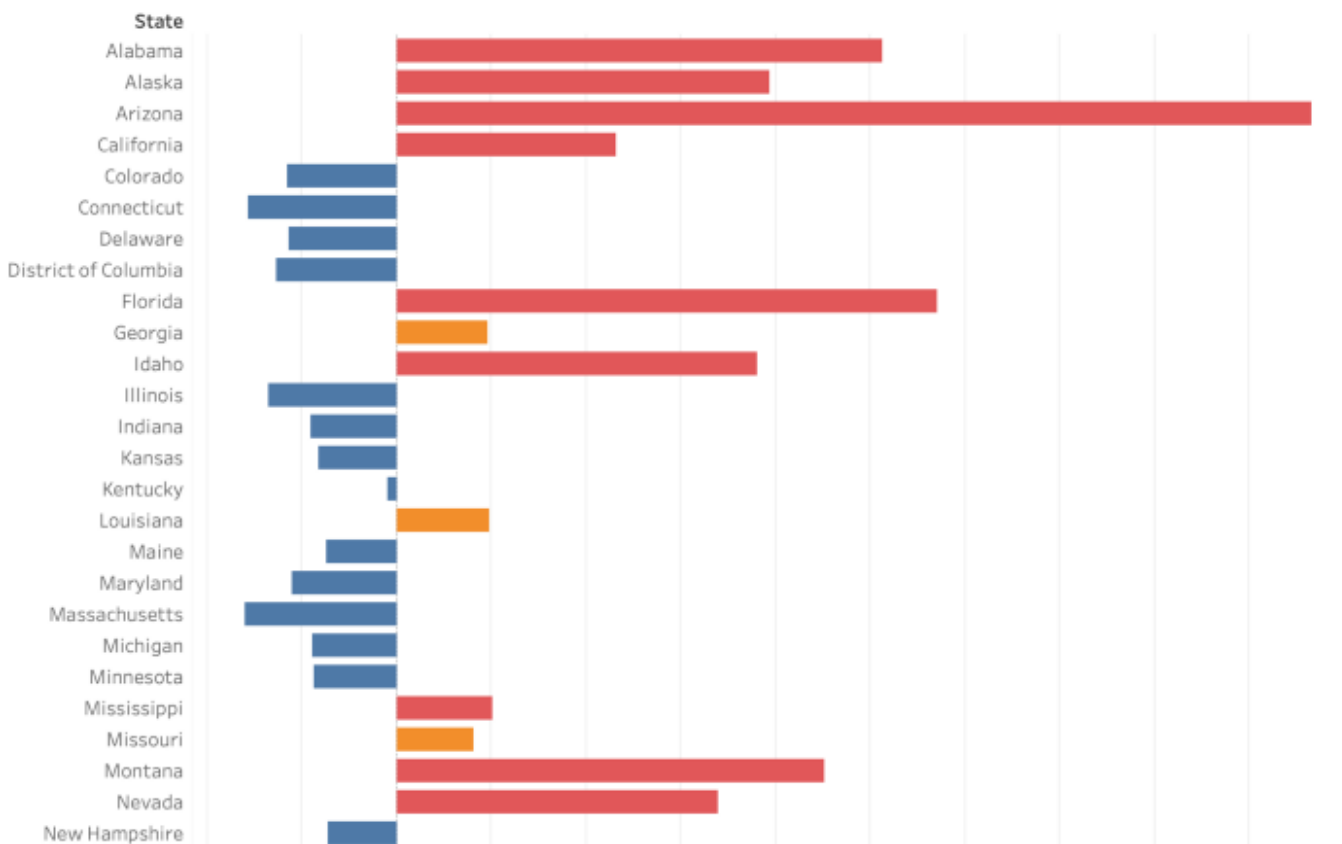
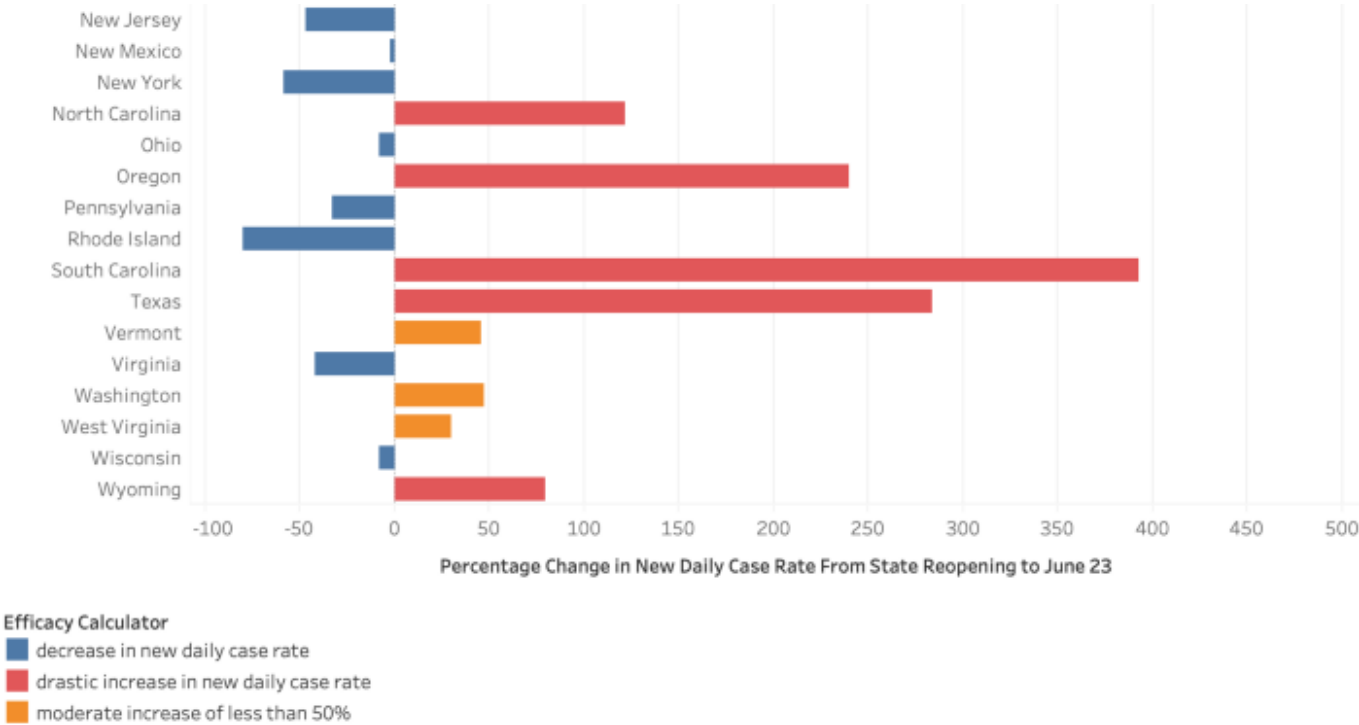## Interactive: Watch the Cases Spread Over Time

In the remaining eight largely rural states — Arkansas, Iowa, Nebraska, North Dakota and South Dakota, Tennessee, Oklahoma, and Utah — governors favored county-specific restrictions over strict statewide lockdowns, enacting social distancing measures and limiting the size of public gatherings while leaving certain non-essential business and services partially open.

DOES DURATION MATTER?

In one word, yes.

Percentage Change in Daily New Case Rate from State Reopening to Now

Efficacy Calculator
- decrease in new daily case rate
- drastic increase in new daily case rate
- moderate increase of less than 50%

Bar chart showing the percentage increase or decrease of individual states' daily new case count from the point of reopening to June 23, 2020. We excluded Hawaii from this set because its percentage increase was skewing the graph's scale. The state had a very low case count of 0.05 per 100,000 people when it came out of lockdown and saw an incremental real-life increase to 0.69 cases in the latest 14-day average. However, because of the way percentages work, this showed up as an 1145% increase in case count, which completely threw off the bar chart, forcing us to eliminate it from this specific visualization.

States that shut down for longer fared better overall in reducing their daily new case rates, with most seeing between a **30% to 80% decrease** since reopening.

Averaging at roughly 58.5 days of closure *(see graphs below for details)*, these 22 states, including densely populated ones like Massachusetts, Illinois, New Jersey, Pennsylvania, and, surprisingly, New York, all saw a reduction in daily new cases after stay-at-home orders had been lifted, despite having some of the largest total numbers of cases per state in the country.
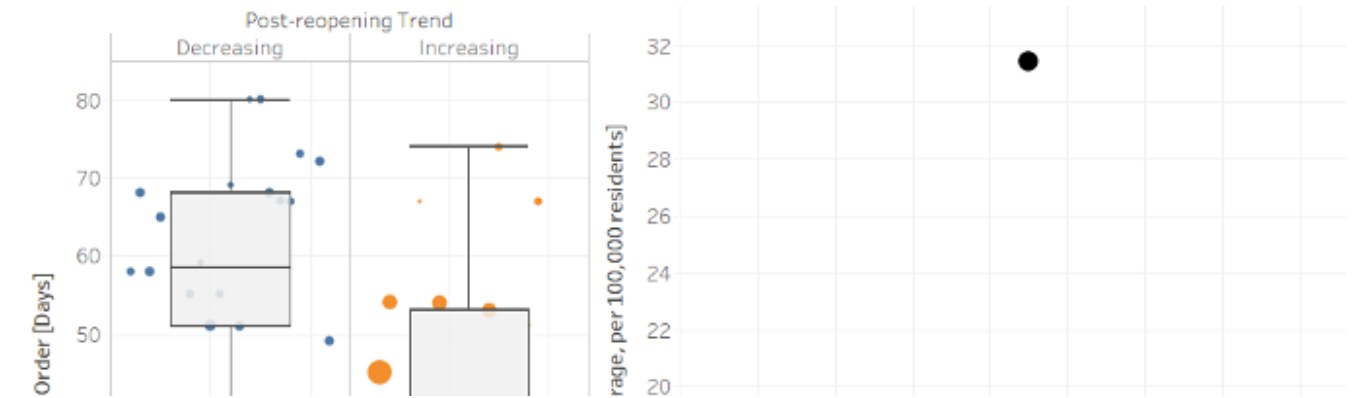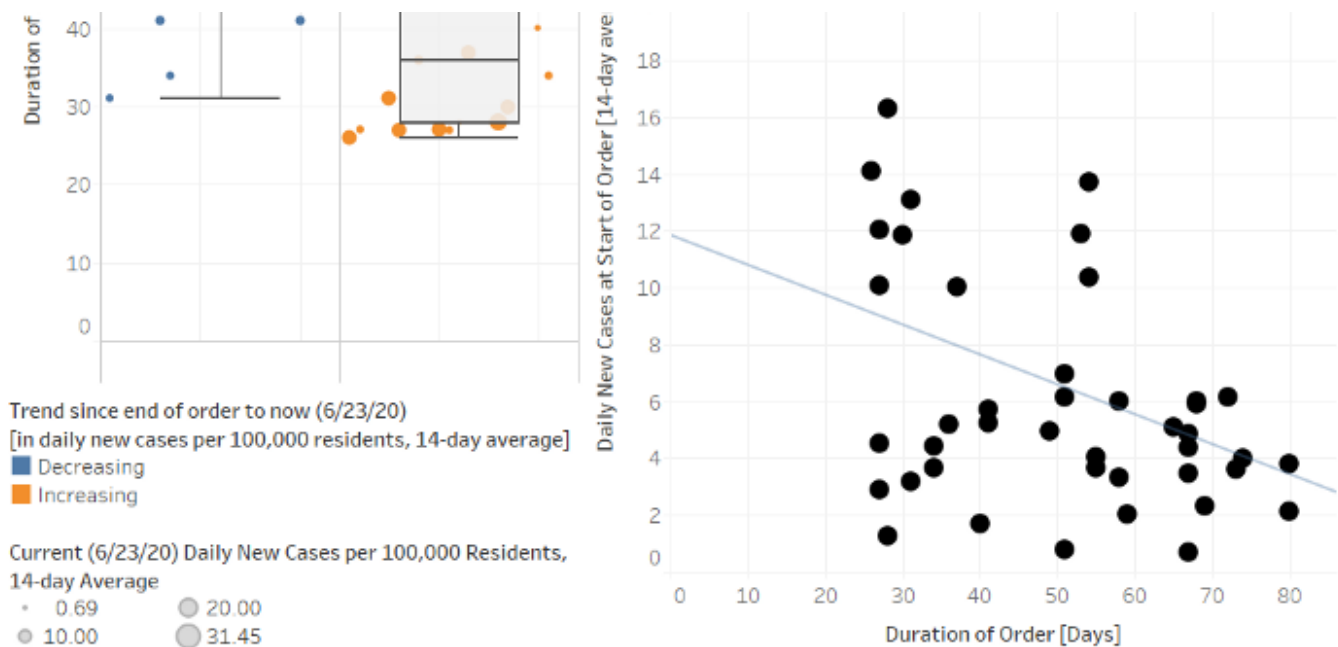
Boxplot (left) shows the minimum, first quartile, median, third quartile, and maximum shut down durations (in days) for successful and unsuccessful states. Dot Plot (right) charts the daily new case rate per 100,000 people of states at the start of their shut down order vs. the duration of their lockdowns.

As with any data set, there were a few anomalies.

Some successful states like Colorado and Kansas had drastically shorter stay-at-home orders of less than 35 days, though they were the exception rather than the norm. Others like New Hampshire and New Jersey erred on the side of caution and didn't ease restrictions for close to 3 months.

On the other hand, states that have seen an *increase* in their daily case count since easing restrictions averaged a mere 36 days of lockdown. In fact, 18 states — the majority of the unsuccessful group — shut down for fewer than 55 days and saw increases of up to 483% over what their daily new case rate was at the point of reopening.

Given this wide range of data, it's hard to pinpoint a magic number that determines an 'optimum' duration of lockdown length. But, based on the data from the successful group, we have evidence that longer shutdowns — ranging from 51 to 68 days — are much more effective than shorter ones in reducing the rate of infection and impeding the spread of the virus.

A CAVEAT ON THE NUMBERS

While percentages make it easy to contextualize large numbers of data and put them on the same scale, they also run the risk of triggering some misleading conclusions.

For example, you might look at New York — which has seen a modest 59% reduction in new daily cases — and try to compare it to South Carolina — which has seen an exorbitant increase of 393%.

On the surface, it looks like South Carolina is doing six times worse than New York when the reality is far from it. Since reopening, South Carolina has seen a jump of 648 new cases per day (from 164.9 to 813.2 now), while New York has seen a much more significant decrease of 979.5 daily cases (from 1163.5 to 683.9 now).

In attempting to standardize our data by using percentages, unfortunately, as is in this case, the nuance of the real numbers gets lost.

Actual Change in Daily New Case Count from State Reopening to Now
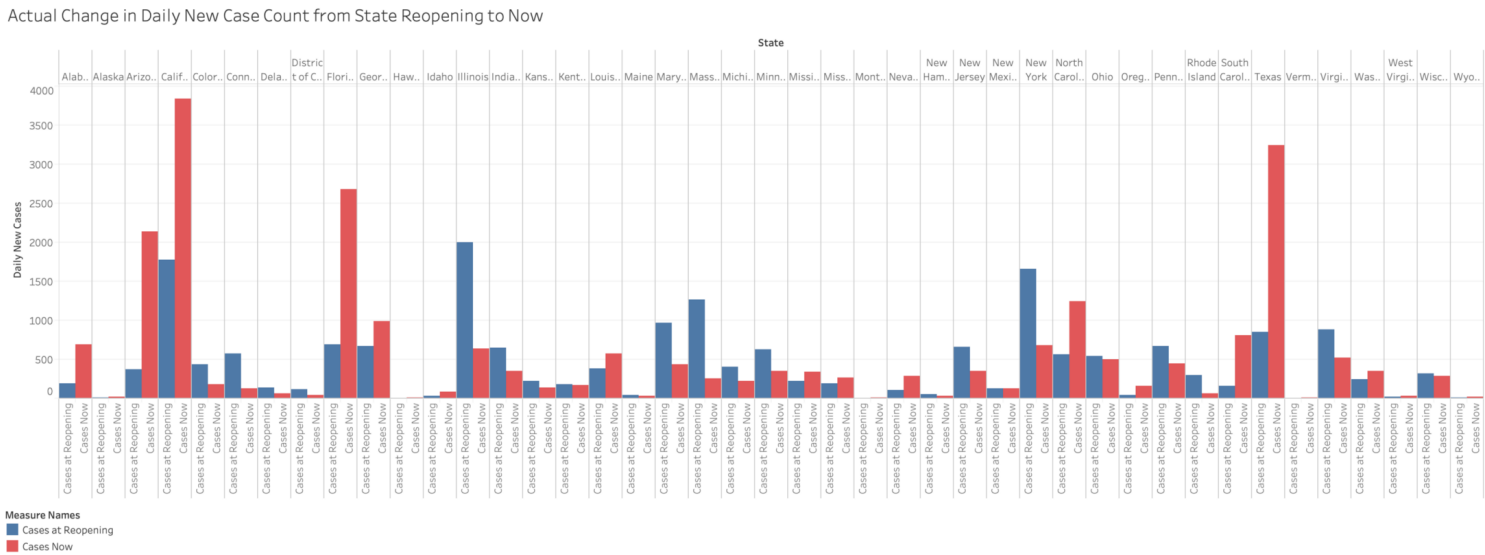
Graph showing the actual number of daily new cases in 41 states and the District of Columbia. Data taken from the day the state reopened (in blue) vs. June 23, 2020 (in red). Hawaii excluded to appropriately scale this visualization. Eight states without statewide stay-at-home orders also excluded.

DOES TIMELINESS MATTER?

States that reacted quicker and locked down sooner, and with *lower infection rates* were 1.52 times (or 52%) more likely to see significant reductions in the number of current daily new cases.

Days from 1st Case to Start of Stay-at-home Order

Change Now Reope..
·   -0.80
○   2.00
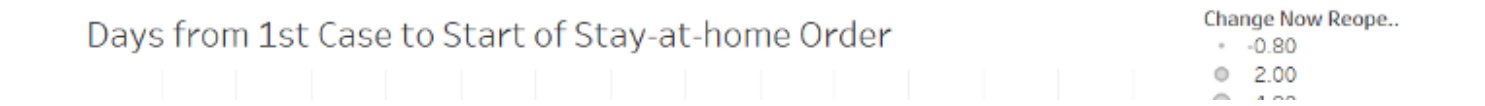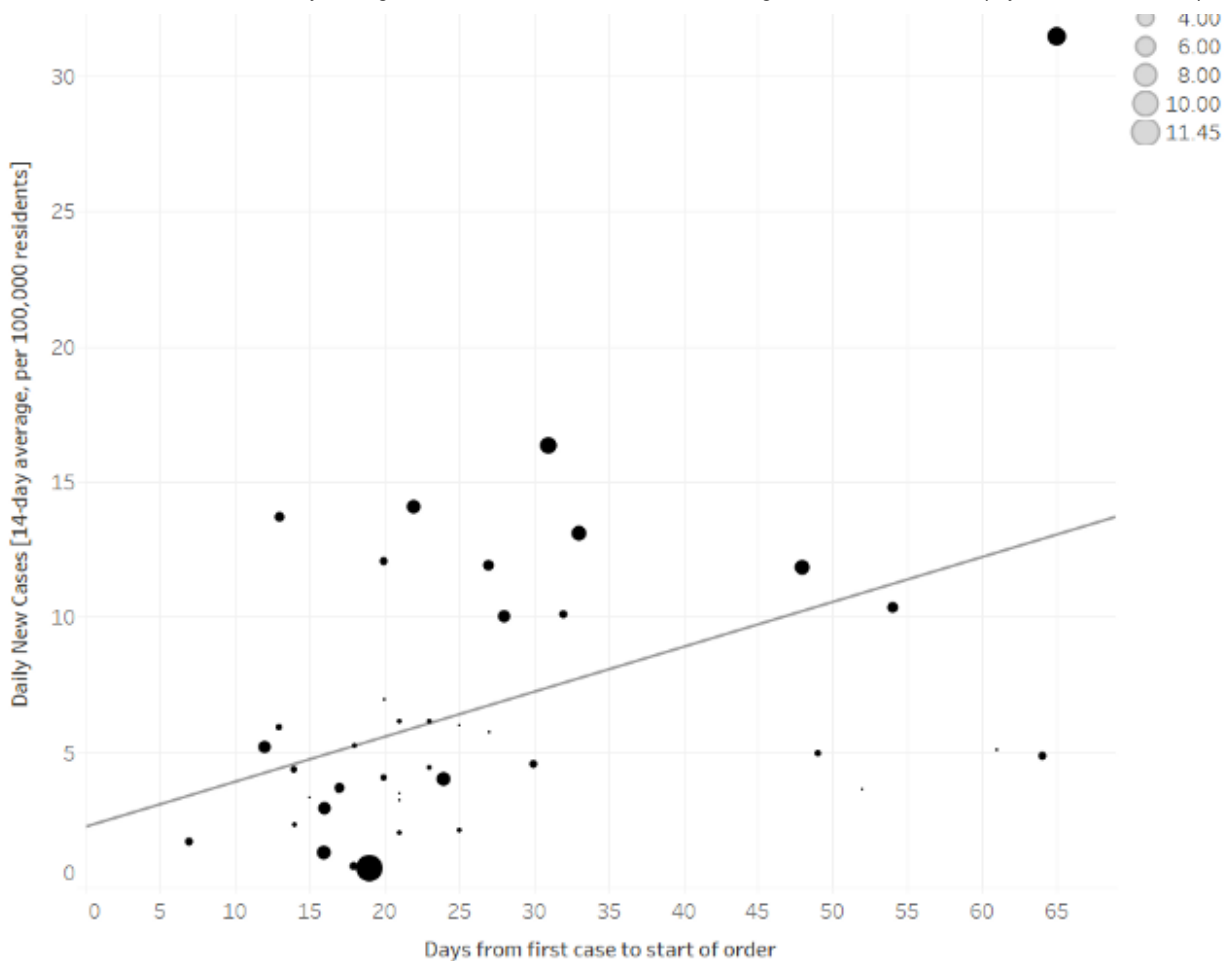
Dot plot showing the relationship between the number of days states waited before they shut down, the number of current new daily cases, and the change in case rate per 100,000 people from the date of reopening to June 23, 2020.

While most successful states closed within 21 days of their first recorded case, most unsuccessful ones waited an extra 3 days to follow suit. In fact, the four worst-performing states — which saw increases of between 240% and 483% — waited between 31 to 65 days before finally shutting things down.

Duration aside, successful states also had an overall lower case density at the start of their stay-at-home orders.
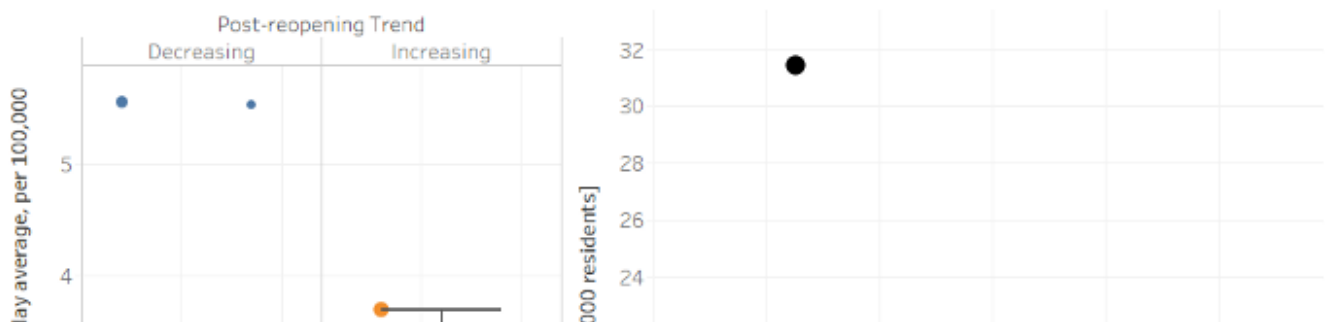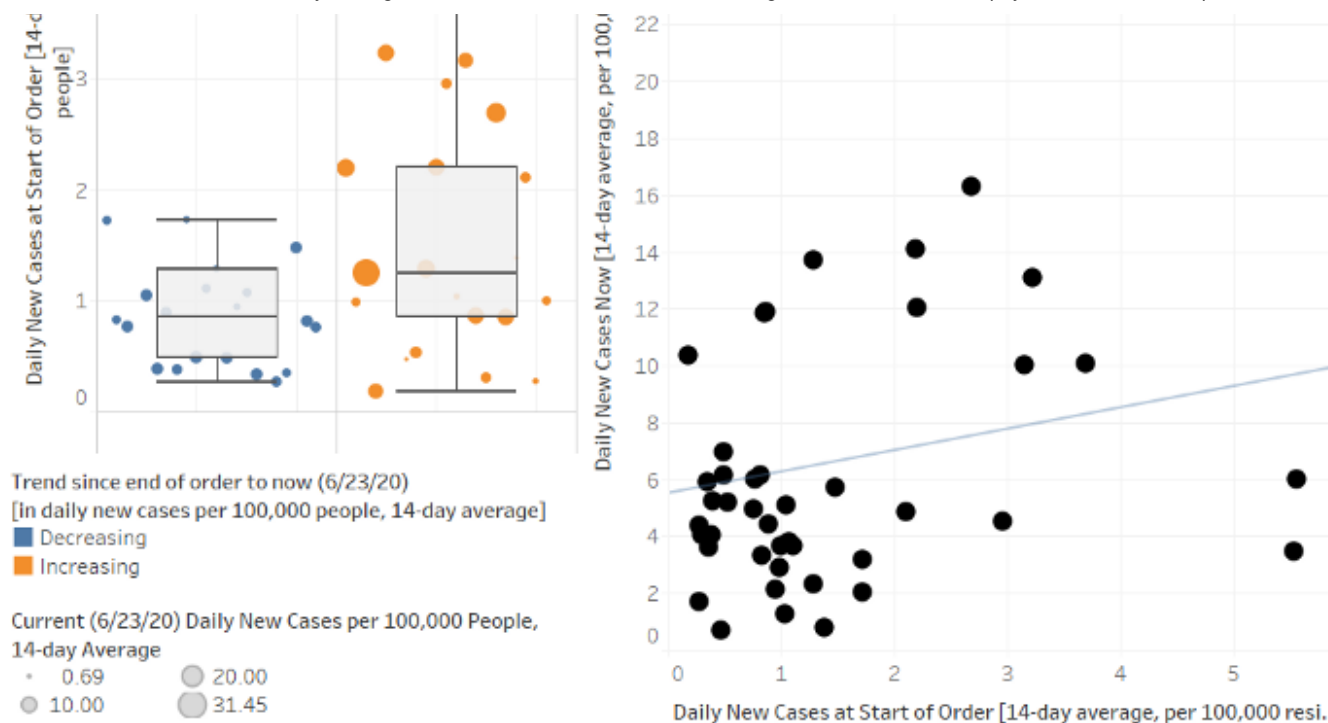
Boxplot (left) shows the minimum, first quartile, median, third quartile, and maximum range of daily new cases per 100,000 at the point of shutting down for successful and unsuccessful states. Dot Plot (right) charts the daily new case rate per 100,000 people of states at the start of their shut down order vs. their June 23, 2020 daily new case rate

These early adopters, including states like New Jersey, New York, and Connecticut, had a median case rate of 0.86 per 100,000 people when their statewide measures went into play. They were part of the first cohort in the US to implement strict shutdowns, and, by and large, had some of the most aggressive social distancing and restriction protocols in the country (Leins, 2020).

Unsuccessful states, on the other hand, had on average almost double the number of cases — 1.25 per 100,000 people — before they shut down.

Our findings bolster those from a recent May 2020 study by researchers at Columbia University which suggests that if the US had only begun locking down *two weeks earlier,* on March 1st, there would have been 54,000 fewer deaths — an 83% decrease in the overall death rate — due to COVID-19 (Pei et al., 2020).

How Earlier Control Measures Could Have Saved Lives

Number of reported deaths by May 3

60,000 deaths

65,307
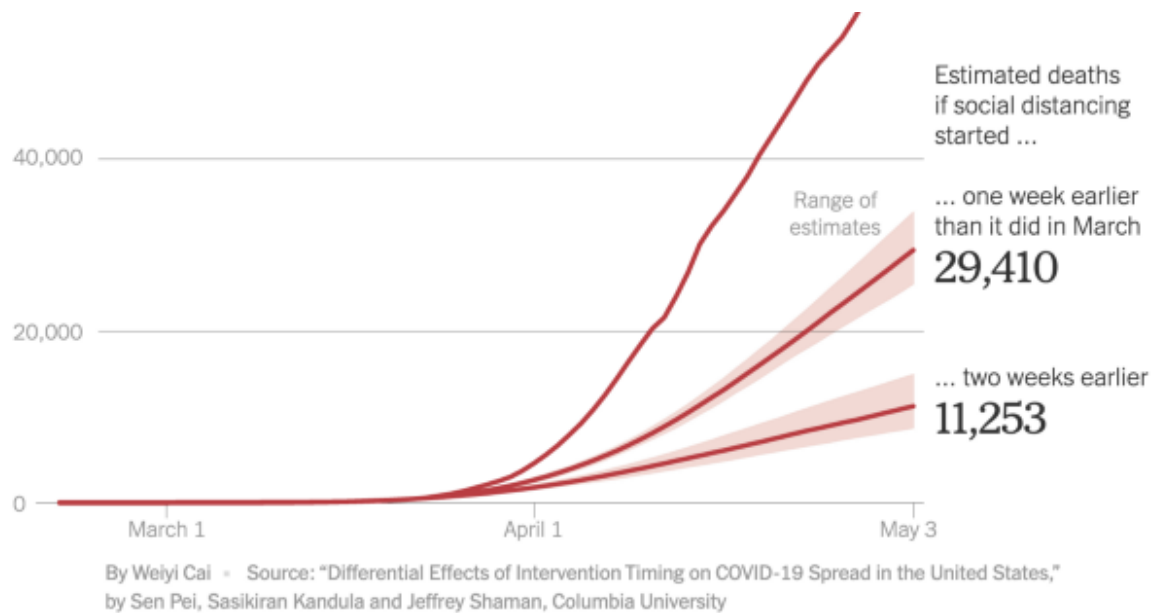
Graph taken from the New York Time's article "Lockdown Delays Cost at Least 36,000 Lives, Data Show"

According to a New York Times article on the same study, "the enormous cost of waiting to take action reflects the unforgiving dynamics of the outbreak…Even small differences in timing would have prevented the worst exponential growth, which by April had subsumed New York City, New Orleans and other major cities" (Glanz & Robertson, 2020).

It should be noted however that there are outliers to our findings, and that an earlier close date cannot be solely attributed to a successful response outcome.

States with lower case densities like Illinois and Massachusetts locked down later — 52 and 61 days after their first recorded case — but still had successful outcomes.

Two other states — District of Columbia and New York — also buck the trend. They started their lockdowns with the highest case rate in the country but were able to get new infections under control and see a continued decrease in daily new cases.

While we can't underscore exactly what factors contributed to these unexpected successes, we do know that these states had some of the most aggressive responses to closures and social distancing measures, which probably helped reduce their daily new case rate. (Leins, 2020).

WRAPPING IT ALL UP

When we do a side-by-side comparison of the top two performing states in terms of percentage reduction — Massachusetts and Rhode Island — against the bottom two — Arizona and South Carolina — we see that:

- In Massachusetts and Rhode Island, shutdown orders were put in place early and weren't lifted until new infection rates started to decline

- In Arizona and South Carolina, shutdown orders were delayed and lifted well before cases started to drop
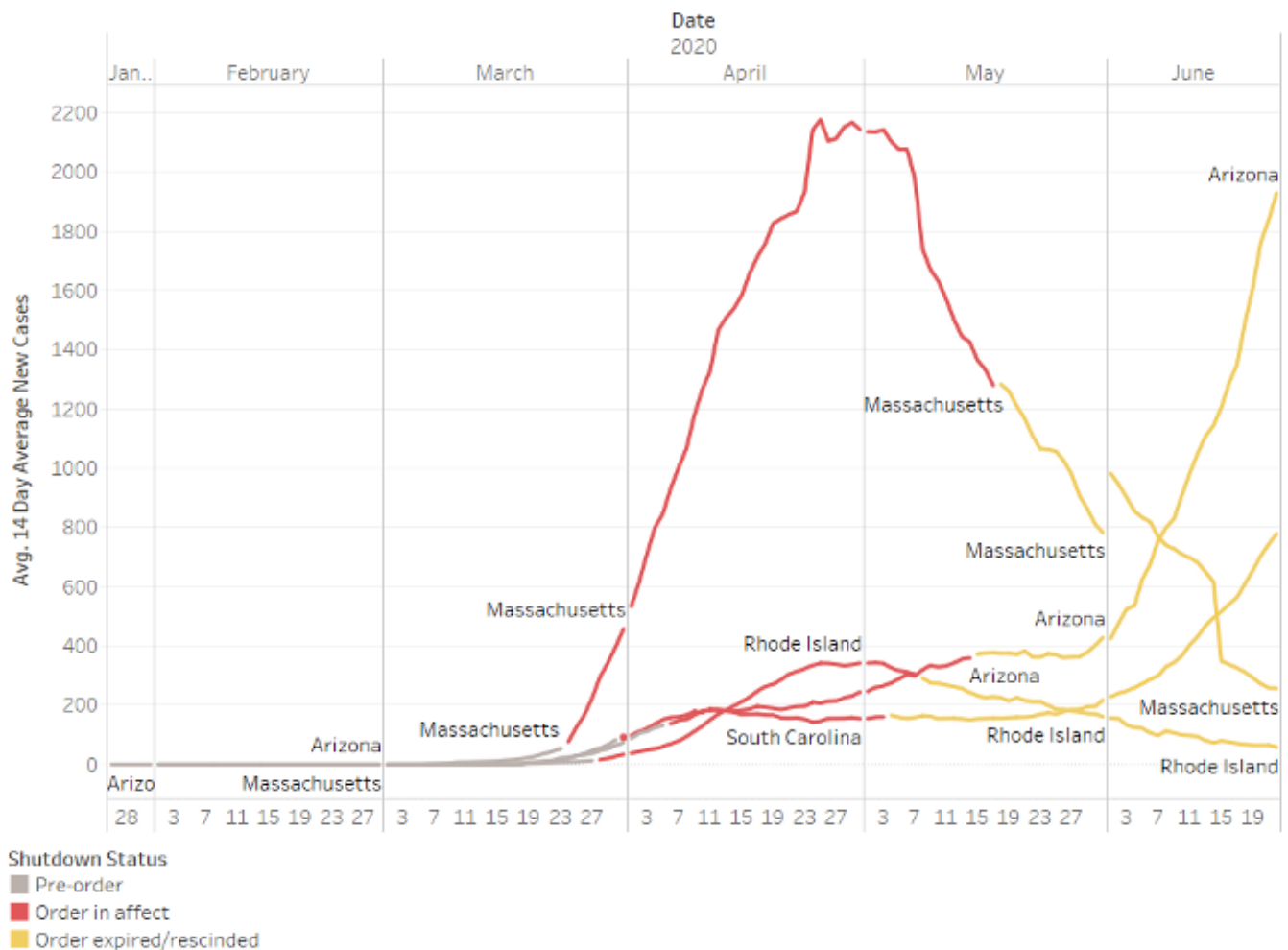
Line graph showing how the average daily new case count in the top two and bottom two performing states compare pre, during, and post lockdowns.

These findings reinforce the CDC's guidelines for reopening (*CDC Activities and Initiatives Supporting the COVID-19 Response and the President's Plan for Opening America Up Again*, 2020, p. 24) and support our analysis that the sooner a state shuts down and

*

the longer they keep it that way, the fewer number of daily cases they'll see going forward.

As the world prepares to confront a predicted second wave of coronavirus, we hope this analysis sheds some light on the efficacy and importance of prompt government response, and why something as simple as *time* can make all the difference.

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