

What the Data Show

In Are We #StayingHome to Flatten the Curve?

First version April 2020, this version August, 2020

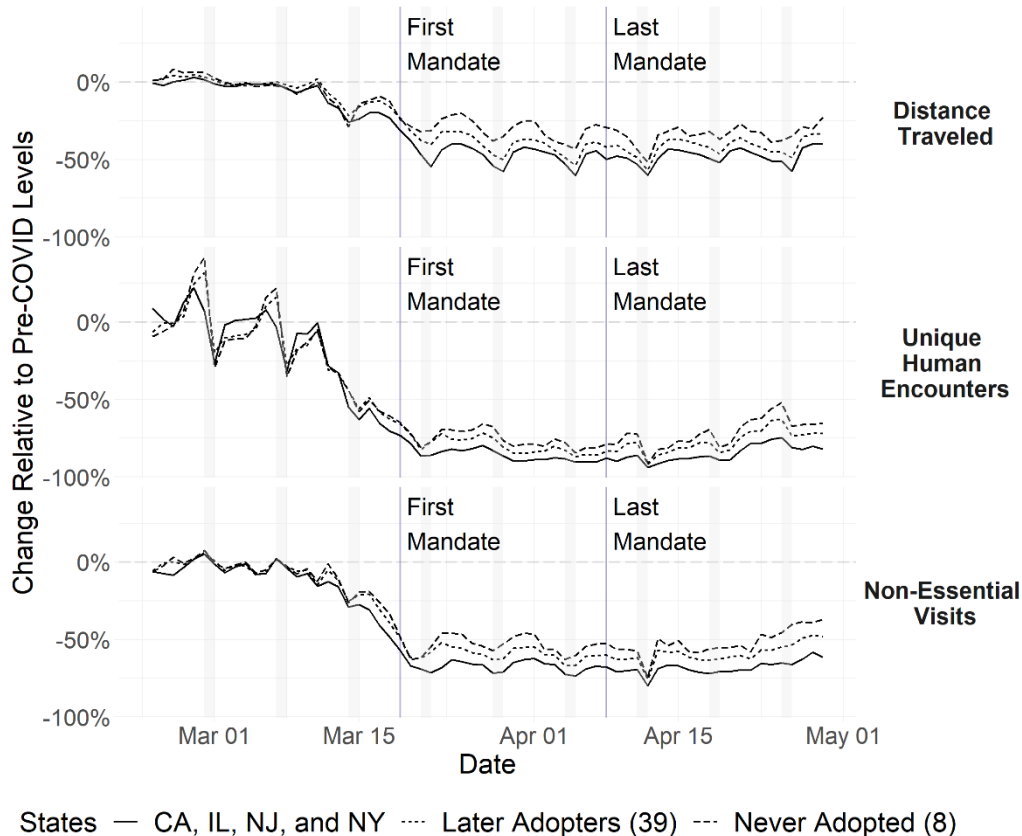
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Abstract:

The recent spread of COVID-19 across the U.S. led to concerted efforts by states to “flatten the curve” through the adoption of stay-at-home mandates that encourage individuals to reduce travel and maintain social distance. Combining data on changes in travel activity with COVID-19 health outcomes and state policy adoption timing, we characterize nationwide changes in mobility patterns and isolate the portion attributable to statewide mandates. We find evidence of dramatic nationwide declines in mobility prior to adoption of any statewide mandates. Once states adopt a mandate, we estimate further mandate-induced declines between 2.1 and 7.0 percentage points across methods that account for states' differences in travel behavior prior to policy adoption. In addition, we investigate the effects of stay-at-home mandates on changes in COVID-19 health outcomes while controlling for pre-trends and observed pre-treatment mobility patterns. We estimate mandate-induced declines between 0.13 and 0.17 in deaths (5.6 to 6.0 in hospitalizations) per 100 thousand across methods. Across 43 adopting states, this represents 23,366-30,144 fewer deaths (and roughly one million averted hospitalizations) for the months of March and April - which indicates that death rates could have been 42-54% higher had states not adopted statewide policies. We further find evidence that changes in mobility patterns prior to adoption of statewide policies also played a role in reducing COVID-19 mortality and morbidity. Adding in averted deaths due to pre-mandate social distancing behavior, we estimate a total of 48-71,000 averted deaths from COVID-19 for the two-month period. Given that the actual COVID-19 death toll for March and April was 55,922, our estimates suggest that deaths would have been 1.9-2.3 times what they were absent any stay-at-home mandates during this period. These estimates represent a lower bound on the health impacts of stay-at-home policies, as they do not account for spillovers or undercounting of COVID-19 mortality. Our findings indicate that early behavior changes and later statewide policies reduced death rates and helped attenuate the negative consequences of COVID-19. Further, our findings of substantial reductions in mobility prior to state-level policies convey important policy implications for re-opening.

Take Away:

Our study uses cellphone mobility data to measure changes in distances traveled, rates of unique human encounters, and counts of visits to non-essential businesses relative to the beginning of the year before the spread of COVID-19 in the United States which we use to look at the effects of state-level stay-at-home mandates. In the first part of our paper, we conduct analysis focusing on describing these changes in mobility patterns; what we find is striking evidence of very large reductions in all measures of travel activity even before state mandates came into effect.



The above figure plots changes in the three mobility measures over time, with average changes relative to pre-COVID-19 levels reported for each of three groups of states: the solid line for the first four to implement statewide mandates (CA, IL, NJ, and NY), dotted for later adopters of statewide policies, and dashed for the eight states that never adopted statewide policies. The vertical line marks March 19, the date the first statewide policy came into effect in California.

The data show that across the country people were staying home and avoiding unnecessary trips to retailers well in advance of their statewide mandates. In fact, visits to non-essential businesses had already reached close to its floor by the time the first state policy came into effect. Given that people were avoiding local businesses en-masse before state mandates, these policies shouldn't be blamed for all the economic decline. The historic pandemic rightfully deserves some of this blame for lost business and resulting unemployment.

After discussing trends in the data, we employ more advanced statistical techniques to identify the causal impact of statewide stay-at-home policies on behavioral changes in mobility. Once states adopt a mandate, we estimate further mandate-induced declines between 2.1 and 7.0 percentage points across methods that account for states' differences in travel behavior prior to policy adoption. Critically, these reductions came *after* mobility had already been reduced by more than half of normal levels. As a result, any effect of mandates that we measure is conditional on prior behavioral changes - our estimates are clearly an understatement of the effect these policies would have had if they had been rolled out earlier in the pandemic, before individuals had already modified their behavior so extensively. Our results indicate that even in

this complicated world, states' stay-at-home policies had their intended effect and were able to reach a group of people who had not previously responded to local policies or internalized the risk of pandemic. Further, we only measure the direct impact of state policies on residents of that state. We do not take into account any spillovers (i.e. residents of other states deciding to stay home after learning about California's mandate) or earlier local policies or changes to school or work scenarios, and therefore further understate the true effect of how individuals responded to the full set of COVID-19 policies.

Finally, we provide initial evidence of the link between stay-at-home mandates and attenuated health impacts from COVID-19. Our findings suggest that stay-at-home mandates likely decreased daily deaths by 0.13-0.16 and daily hospitalizations by 5.6-6 per 100,000 population in the average mandate state. Further, we observe that changes to mobility patterns prior to the adoption of statewide mandates played a similar magnitude role in averting COVID-19 deaths. Projecting these findings to stay-at-home mandates spanning March and April in all adopting states, this corresponds with 23-30,000 averted deaths due to mandate-induced behavioral responses and 48-71,000 averted deaths across all behavior changes for mandate states in these two months. Our estimates indicate that, absent these policies, U.S. deaths from COVID-19 could have been 1.86-2.27 times higher than they actually were during March and April.

The resulting economic benefits of 48-71,000 averted deaths amount between \$480-\$710 billion for observed behavioral changes in March and April, using the value of \$10 million corresponding to the United States Environmental Protection Agency's central VSL estimate, recommended for benefit calculation use ``regardless of the age, income, or other population characteristics of the affected population.

Our benefit calculations are by no means a complete estimate of even the total health benefits of these policies. The value we estimate is the health benefit associated only with averted deaths from COVID-19 (accounting for the demographics of those most affected by the pandemic). The numbers we present do not take into account savings due to reduced hospitalizations, lowered strain on the medical system, or improvements to individual welfare due to averted cases. The estimates that we present are only part of the economic benefits due to these policies. Our approach also fails to capture any health and economic costs associated with the mandates.

Our estimates are also assuredly lower bounds even for this narrow source of benefits. Properly identifying COVID-19 deaths is itself a difficult task that relies on adequate testing to determine what deaths are due to the pandemic and which result from unrelated illnesses. As COVID-19 is an underlying and not immediate cause of death, attribution requires medical professionals to correctly note that an individual had the coronavirus prior to death. With errors on [20-30%](#) of death certificates prior to COVID-19, failure to count many at-home deaths without testing, COVID-19's presence in the U.S. [much earlier than previously measured](#), and the ability to detect it likely linked to the strength of a state's outbreak, the official numbers used in our study may reflect an undercount of the pandemic's actual death toll. Given these challenges, it may

never be possible to know the true death count - but the magnitude of our estimates will continue to increase as more deaths are correctly identified.

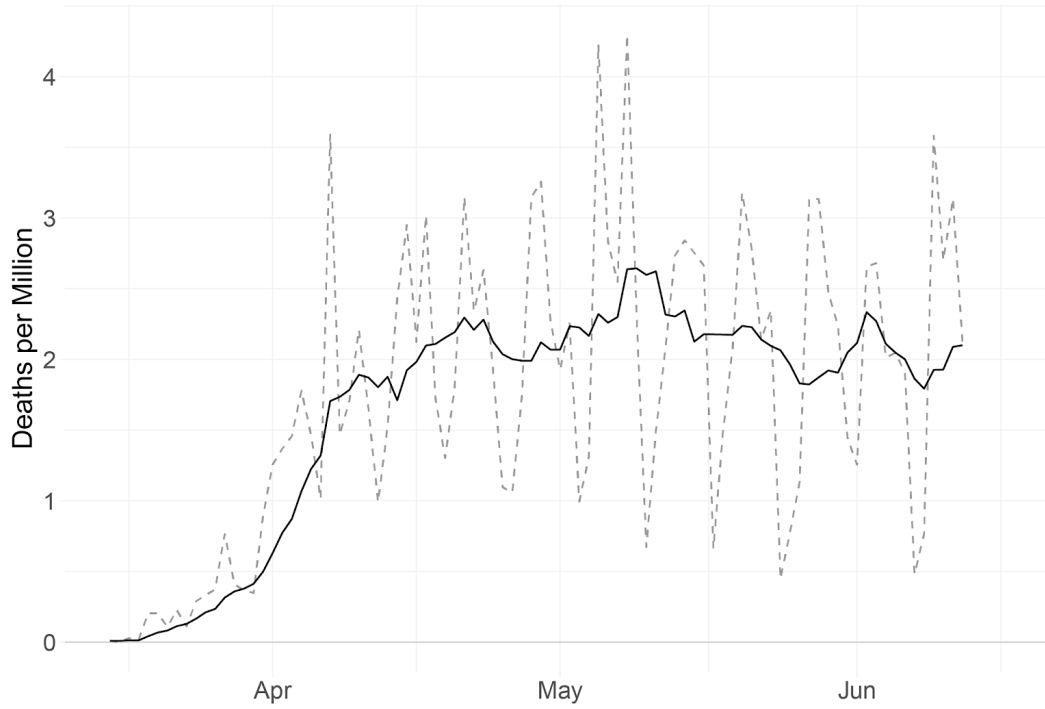
Beyond averted deaths and other health benefits, stay-at-home mandates have led to a wide range of benefits, including [improved air quality](#), reduced [automobile insurance costs](#) and [traffic congestion](#), along with considerable costs associated with [foregone non-COVID-19 healthcare](#) leading to untreated and undiagnosed diseases and a [mental health crisis](#) with the potential for [increases in suicide rates](#). As more data comes in and researchers are able to properly value all the costs and benefits of stay-at-home policies, then we will be able to know whether these policies have resulted in any overall losses or gains.

Recent State Reopening Evidence:

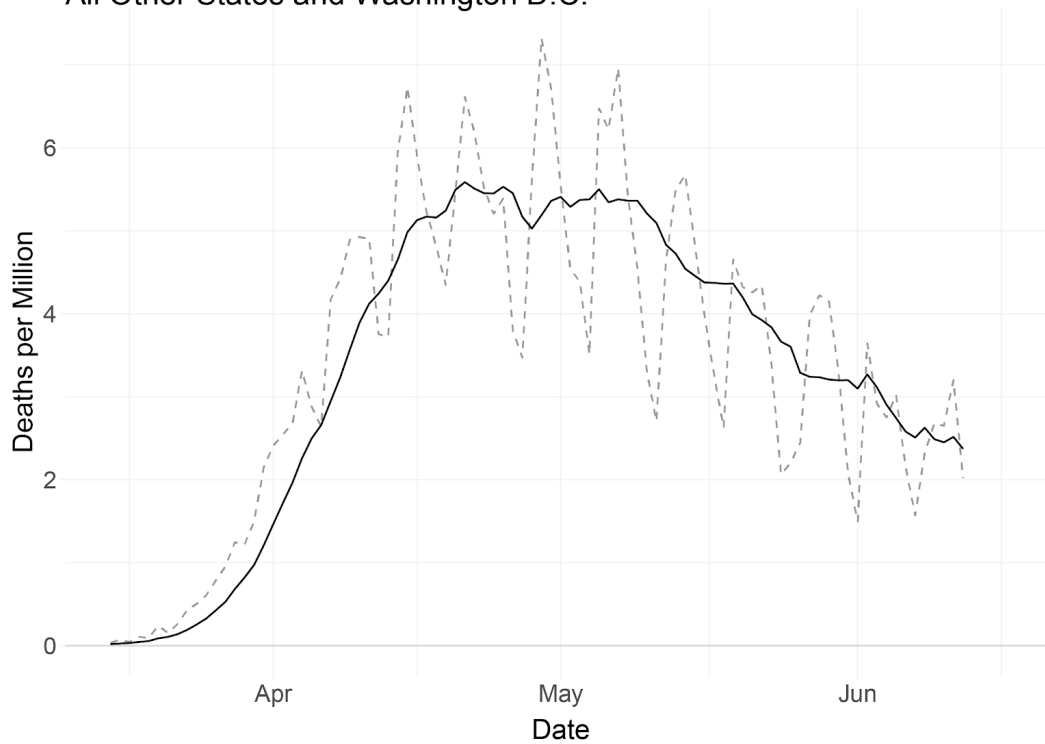
In the short-run, however, decisions to relax COVID-19 restrictions or reopen economies entirely should be motivated and guided by the health data. Looking at these data tells an initial cautionary tale.

COVID-19 Death Rates

Early Reopening States (AZ, FL, GA, TX, and WI)



All Other States and Washington D.C.



-- Death Rate — 1 Week Moving Average

The above figure plots the daily COVID-19 death rates from two groups of states: those that opened more completely at an earlier time (Arizona, Florida, Georgia, Texas, and Wisconsin), and all other states. While many of these other states have also relaxed restrictions since May 1, these five states represent a group that reopened more completely at an earlier time. The data show that the daily death rate reached its peak in both groups in mid-April. While the death rate began a linear decline in early May for all other states, it plateaued near its peak for states that reopened more completely. More advanced statistical analysis confirms that, for these five states, death rates in all days post-reopening are statistically indistinguishable from their peak death rates.

What the data show is that social distancing and stay at home policies have played a significant role in flattening the curve and in attenuating the magnitude of outbreaks across the country. What the most recent data show is that COVID-19 has not been eliminated - especially in areas that have chosen to reopen too soon.