

# **Are we #staying home to flatten the curve?**

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## Motivation

Many U.S. counties and states have incurred considerable economic and social costs by implementing shelter-in-place mandates

Proponents of the mandates argue that it will "flatten the curve" and reduce future costs and medical system strain, but the magnitude of benefits is largely uncertain



## 3 Research Objectives

In this paper, we provide among the first empirical estimates of the

1. Effect of the severity of the COVID 19 pandemic on individuals' mobility behavior
2. Effect of shelter- in-place mandates on actual behavior by affected individuals and show that these policies are effective at inducing additional social distancing
3. Health effects of changes in mobility weeks prior



# Mobility and Social Distancing Data

Measures of Mobility and Social Distancing by state by day

- Average Change in Distance Traveled relative to pre COVID 19 baseline
- Change Non-Essential Visits (NEV) relative to baseline
- Change in Unique Human Encounter Rate relative to baseline

February 24 to April 29, 2020

Source: Data Sharing agreement between U C Berkeley and Unacast

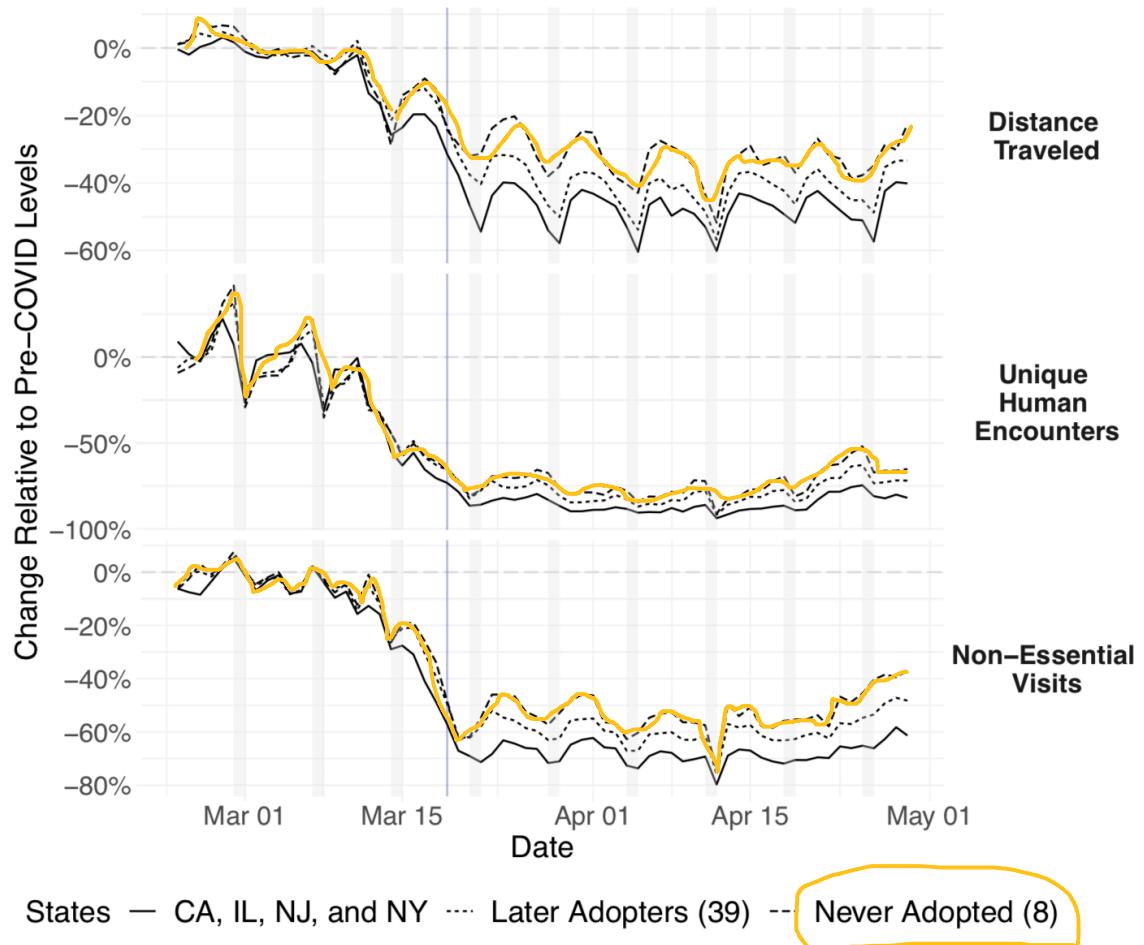
Unacast uses cellular location data for 15-17 million identifiers per day to construct these three measures.



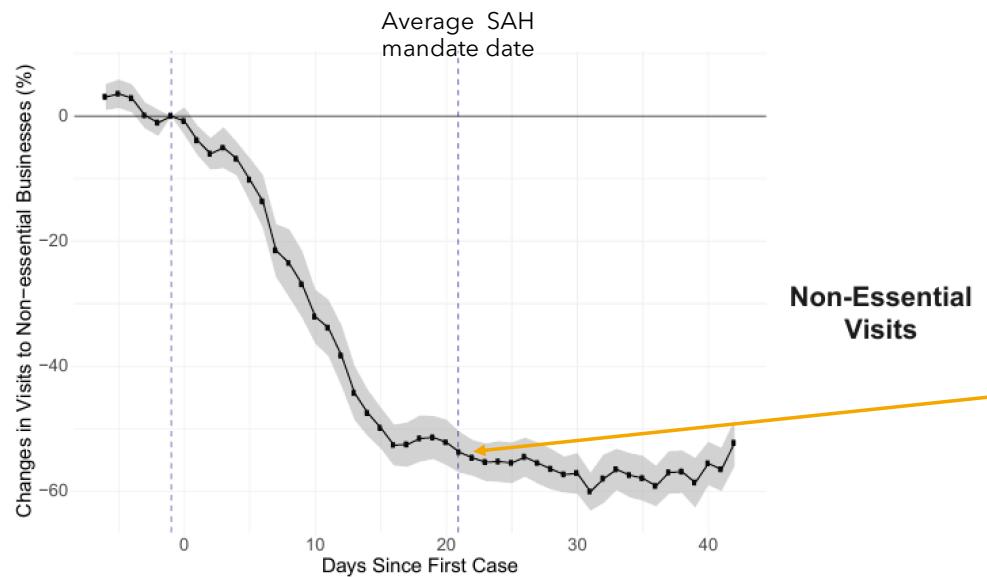
## Changes in Mobility by day for Early, Late and Non Mandate States

By March 18, before the first statewide mandate went into effect:

- The decline in travel distances is between 12 and 23 percentage points,
- between 34 to 49 percentage points fewer non-essential visits.
- Unique human encounters had already fallen between 61 and 71 percentage points relative to pre-COVID-19.,



# Effect of the severity of the COVID 19 pandemic on individuals' mobility behavior



This Figure depicts the changes in travel activity NEV relative to the day prior to the state's first case, merely as a function of being  $k$  days relative to the state's first case, no controls.

Most of the reduction in NEV had already occurred before the average date of mandate implementation.

NEV dropped -52%

Similar for ADT and Encounter Rate

## **Identification of shelter- in-place mandates' effects on actual behavior by affected individuals**

Compare changes in mobility in states with mandates relative to (comparable) states without mandates controlling for

- state specific trends in mobility (due to states being in different paths in pandemic and other state-specific reasons that could affect mobility having nothing to do with mandates) and
- day to day changes in mobility common to all states (due for instance to severity of pandemic overall)



# Mobility and Social Distancing Effects of Early Mandates

Table 4: Effect of Early Stay-at-Home Mandates on Travel Activity and Social Distancing

	<i>ADT</i>		<i>NEV</i>		<i>ENC</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>SAH</i> <sub>it</sub>	-4.454** (2.074)	-4.136*** (1.010)	-6.088*** (1.455)	-5.185*** (1.307)	-6.895*** (1.223)	-4.683*** (1.270)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
State Cubic Trends	No	Yes	No	Yes	No	Yes
N	3,366	3,366	3,366	3,366	3,300	3,300
Adjusted R <sup>2</sup>	0.926	0.961	0.970	0.983	0.968	0.974

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. Standard errors are clustered at the state level. These models estimate the effect of the first four (CA, IL, NJ, and NY) statewide stay-at-home mandates on travel activity and social distancing. The dependent variables measure the change in percentage points for the same day of the week relative to the four weeks before March 8 (pre-COVID-19 time). A coefficient of one indicates a marginal effect of a 1 percentage point increase in travel relative to pre-COVID-19 levels, controlling for time and the average COVID-19 mobility change in the state during the sample period. 'Cub x St' indicates state-specific cubic time trends.

When SAH mandates implemented in early states, mandate states drop by 5.2 percentage points in non-essential visits (NEV) relative to change in controls



# Mobility and Social Distancing Effects of All Mandates

Table 5: Effect of All State Stay-at-Home Mandates on Travel Activity and Social Distancing

	<i>ADT</i>		<i>NEV</i>		<i>ENC</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>SAH</i> <sub>it</sub>	−5.508*** (1.036)	−2.809*** (0.863)	−5.196*** (0.721)	−4.491*** (0.652)	−4.621*** (0.654)	−3.648*** (0.771)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
State Cubic Trends	No	Yes	No	Yes	No	Yes
<i>N</i>	3,366	3,366	3,366	3,366	3,300	3,300
Adjusted R <sup>2</sup>	0.929	0.961	0.972	0.983	0.968	0.974

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. Standard errors are clustered at the state level. These models estimate the effect of all statewide stay-at-home mandates on travel activity and social distancing. The dependent variables measure the change in percentage points for the same day of the week relative to the four weeks before March 8 (pre-COVID-19 time). A coefficient of one indicates a marginal effect of a 1 percentage point increase in travel relative to pre-COVID-19 levels, controlling for time and the average COVID-19 mobility change in the state during the sample period. 'State Cubic Trends' indicate state-specific cubic time trends.

All states' Mandate effects significant and smaller magnitudes than for early states

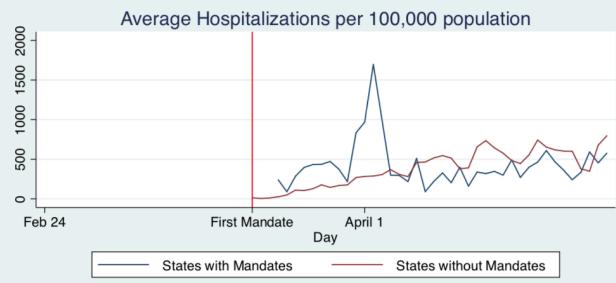
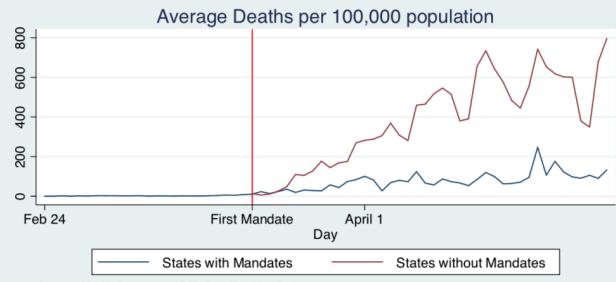


## What we have so far

- Pre mandate we see most of the mobility and social distancing drops in the data
- Early mandate (CA, NY, NJ, IL) effects
  - Drop in average distance traveled of 4.1 %
  - Drop in non-essential visits 5.2%
  - Drop in encounter rates 4.7%
- Mandate effects are significant and smaller when all states considered
  - ADT drops 2.8%, NEV drops 5%, Encounters drop 3.7%

# Data on Hospitalization and Deaths per state per day per 100 million

Evolution of Death and Hospitalization Rates by Mandate States



Evolution of Death and Hospitalization Rates by NEV drops

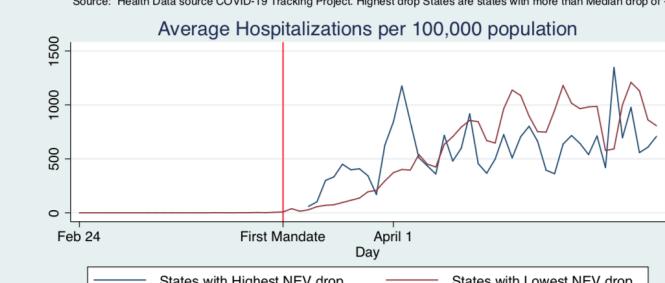
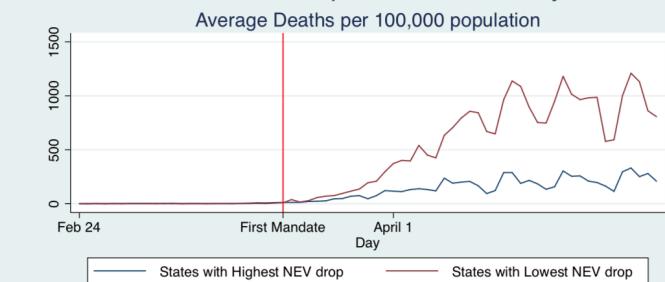


Figure 3: Source: Health Data source COVID-19 Tracking Project. Mandate states

## Health effects of changes in mobility weeks prior

	Deaths- all States	Hosp
NET 1 week prior	-0.068 (2.038)	5.04 (3.904)
NET 2 weeks prior	2.640 (2.001)	2.348 (2.949)
NET 3 weeks prior	6.589*** (1.940)	6.684 (2.756)
Sum of Obs. squared	2193 0.82 15.53	165 0.63 0.88 0.05

	(2) All States	(3) Deaths- Early Mandate States
NET 1 week prior	-5.796 (18.355)	
NET 2 weeks prior	15.543 (17.107)	
NET 3 weeks prior	24.025* (14.395)	
Sum of Obs. squared	156 0.92 9.75	

05, \*\*\* $p < 0.01$ .

the dependent

variables are COVID Death rate (column 1), Hospitalization rate (2),  
death rate for early mandate states (3) by day by state. There are not enough observations for Hosp analysis in early n  
states only. All Columns have state fixed effects, day fixed effects, and state specific cubic daily trend.

- Long Term Impact =

$$-0.068 + 2.64 + 6.6 =$$

9.2 fewer deaths per 100 million if NEV changes by one percentage point three weeks earlier

## **Consistent Patterns emerge from comparable data- Google Mobility Reports**

- Unacast and comparable category google measures 0.9 correlations by state and day
- Early Mandate states exhibit significant drops in mobility for work, parks, retail and recreation categories, and significant increases of mobility in the residential category
- Past changes in google mobility are associated with less future deaths

## Take Away

- At least half of the reduction in mobility and social distancing came before the average date of mandate implementation
- We estimate on average 52% fewer non-essential visits (NEV) 20 days after first case (average SAH mandate date)
- Given that a one percentage drop in NEV in past weeks results in 9.2 fewer deaths per day per 100 million
- From average drop, that would be 478 fewer deaths per day per one hundred million, or 4.78 per million per day



## BENEFITS per 14 days for US from 52% drop NEV even before mandate

US 328 mill \* 14 days \* 52\*0.092 =  
Less deaths 14 days US =21968

	EPA 2020	CEA 2019	Aldy, Viscusi, 2008
<b>VSL in \$ million</b>	<b>10</b>	<b>5.77</b>	<b>3.35</b>
<b>Less US deaths 14 days</b>	<b>21948</b>	<b>21968</b>	<b>21968</b>
<b>in US Dollars</b>	<b>220 billion</b>	<b>127 billion</b>	<b>74 billion</b>



## Take Away

- We estimate on average 5.2% fewer non-essential visits NEV due to mandates
- Given that a one percentage drop in NEV in past weeks results in fewer 9.2 deaths per day per 100 million
- From average drop that would be less 4.8 deaths per day per one hundred million, or 0.48 per million per day



**BENEFITS per 14 days for US  
from 5.2% drop NEV due to  
mandates**

US 328 mill \* 14 days \* 0.092 \* 5.2 =  
Less deaths 14 days US = 2,197

	EPA 2020	CEA 2019	Aldy, Viscusi, 2008
VSL in \$ million	10	5.77	3.35
Less US deaths 14 days	2197	2197	2197
in US Dollars	22 billion	13 billion	7 billion

**Mandate has one tenth of the pre  
mandate 52% drop effect**



## Implications

- It was not the mandates that primarily brought mobility down
- Pre-mandate mobility drops are present and represent most of the variation in drops
- Releasing mandates alone may not result in large uptakes in mobility



**Thank you**