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2 the First Year of the Pandemic.

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11 **Discussion Points:**

- 12 • Would the implemented safety protocols remain effective in the event of additional lockdowns?  
13 • How does the availability of the COVID-19 vaccine effect the results observed from social distancing?  
14 • Among the six study states, Texas experienced the greatest difference in results.  
15 • How effective would these safety protocols be against the delta variant?  
16 • Is it more effective to determine phase transitions state-wide or by county?

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40

1 **ABSTRACT.**

2

3 **Background**

4 SARS-CoV-2, the coronavirus strain responsible for the COVID-19 pandemic, can lead to respiratory diseases  
5 ranging in severity. In the early stages, each U.S. state implemented a transition or “phasing” policy that included  
6 varying degrees of safety protocols. This allowed the states to slowly reopen while controlling transmission. The  
7 initial lockdown was observed to help suppress the pandemic, and our study aimed to determine if there was a  
8 correlation between fatality rates and the phase transitions across the states.

9

10 **Methods**

11 Six states from regions with different caseloads were chosen for this study: Florida, California, New York,  
12 Washington, Kansas, and Texas. Incidence and mortality rate of COVID-19 were obtained from their respective  
13 government websites, allowing case fatality rates to be calculated and compared using Bayesian logistic mixed  
14 models.

15

16 **Results**

17 When examining the fatality rates across phases grouped by state, there was a downward trend with each  
18 transition except in Texas. However, when the states were combined the overall downward trend was clear,  
19 with a median fatality rate of 0.039 in phase 0 dropping to 0.010 by phase 4.

20

21 **Conclusion**

22 Implemented safety protocols and phase transitions were shown to assist in controlling the spread of COVID-  
23 19 as the states re-opened. Differences in fatality rates throughout the U.S. can likely be explained by how  
24 disciplined each state was with quarantine requirements and social distancing policies. This allowed certain  
25 states to control the infectious spread more efficiently than others, thus allowing the states to progress through  
26 the phase transitions at different rates.

27

28 **Key Words:** COVID-19; phase transition; New York; Washington; Kansas; Texas; California; Florida (Source:  
29 MeSH-NLM).

30

## 1 INTRODUCTION.

2

3 Coronaviruses (CoV) are positive-sense, single-stranded RNA viruses surrounded by an envelope made of  
4 glycoprotein. They are one of many types of viruses that can cause acute, mild upper respiratory tract  
5 infections. Transmission is generally via airborne droplets on the nasal mucosa where they replicate in the local  
6 ciliated epithelium, resulting in cell damage and inflammation.<sup>1</sup> Following an outbreak of pneumonia from an  
7 unknown cause in Wuhan, China in December 2019, a novel coronavirus was isolated and dubbed COVID-19  
8 by the World Health Organization in February 2020.<sup>2</sup> It was initially designated as 2019-nCoV, and later changed  
9 to severe acute respiratory syndrome disease (SARS-CoV-2). Over the next few months, the virus spread to  
10 different countries across the world resulting in the COVID-19 pandemic.<sup>3</sup>

11

12 In an effort to control the spread within the U.S., every state in the nation implemented masking and social  
13 distancing protocols. Additional states also initiated a state-wide lockdown to slow the infection rate, which was  
14 followed by four “phases” of reopening where each transition between phases resulted in progressively fewer  
15 restrictions implemented on the public as the state re-opened all its businesses. This process was to effectively  
16 reduce the incidence while slowly returning to a state of normalcy. At the same time several research  
17 companies, such as Pfizer,<sup>4</sup> Moderna,<sup>5</sup> and Johnson & Johnson,<sup>6</sup> worked to develop a COVID-19 vaccine to  
18 protect individuals against the virus, however during their development individuals had to depend on themselves  
19 to stay safe. Each state experienced varying success implementing the protocols as phase transitions occurred  
20 by state instead of nationwide, which increased the risk for a state to reopen prematurely and allow a resurgence  
21 in incidence rates.

22

23 Each phase transition varied between the states, but there were similarities in terms of what reopened and what  
24 remained closed. The phase 1 transition typically resulted in reopening of outdoor activities, including state  
25 parks and outdoor spots. In addition, retail stores were required to have curbside pick-up for their customers.<sup>7,8</sup>  
26 Phase 2 saw reopening of restaurants with outdoor dining, as well as some indoor dining that was typically  
27 reduced to 25-50% capacity. In-store shopping was also opened at reduced capacity, as well as salons,  
28 barbershops, and offices.<sup>8,9</sup> Phase 3 allowed a continued increase in indoor dining, and reopening of nail salons,  
29 massage parlours, and many theme parks, including Disney World and Universal Studios.<sup>8,10</sup> Phase 4 was the  
30 final phase transition across the states, however it still included some limitations to aid in preventing the spread  
31 of the still-present virus while the pharmaceutical companies finished development of the vaccines. Entering  
32 this phase allowed the reopening of low-risk outdoor and indoor arts and entertainment, including zoos,  
33 botanical gardens, museums, and aquariums, as well as fitness centers, bowling alleys, and casinos.<sup>8</sup>

34

35 Initial evidence during the early months of the pandemic suggested the implemented lockdown would suppress  
36 the spread of the virus.<sup>11</sup> However, creation of the re-opening phases introduced the possibility of resurgence.  
37 This study aims to examine the effectiveness of these safety protocols after the initial lockdown on case fatalities  
38 across the states, and whether there were any correlations between the rate of case fatalities (number of deaths  
39 / number of infections) and the transition between phases as the states re-opened.

40

## 1 METHODS

2

### 3 *Data Sources*

4 COVID-19 case rates varied across the U.S., as some states observed higher rates of infection than others.

5 The CDC separated the states into six categories to monitor their progression.<sup>12</sup> Currently, these categories

6 were separated in the following way:

7 1. 14.0 – 17.8k cases per 100,000

8 2. 18.3k – 23.1k cases per 100,000

9 3. 23.5k – 25.5k cases per 100,000

10 4. 25.5k – 26.7k cases per 100,000

11 5. 26.9k – 28.9k cases per 100,000

12 6. 29.2k – 34.7k per 100,000

13

14 To account for the variation in case rates across the U.S., one state from each category were chosen for this

15 study: Florida (3), California (6), New York (5), Washington (1), and Kansas (2), and Texas (4). Data obtained

16 for the study concerning new cases and deaths from each state was publicly available on their local government

17 websites.<sup>13-18</sup> The data was grouped weekly, starting from the first week of March 2020 as Week 1 until the

18 second week of April 2021 as Week 58 for each state. It was further divided to indicate when each new phase

19 was implemented in each state. Certain states, including Florida, New York, and Washington, did not initiate

20 each phase transition statewide and instead did it by region or county. This necessitated further division into

21 half phase transitions to indicate when groups of smaller regions or counties had transitioned between phases

22 (i.e., phase 0.5, 1.5, etc.), as it was usually weeks before the larger areas (i.e., NYC, Miami, etc.) had

23 transitioned. Some of these grouped areas transitioned at different dates, therefore the latest date was used to

24 indicate the group's phase transition. Whole phase transitions indicate when the entire state had transitioned to

25 the next phase. **Table 1** depicts which areas of each state transitioned to the next phase and when the transition

26 occurred.

27

### 28 *Statistical Methods*

29 Statistical analysis was performed using the Goodrich, B. *et al* (2020)<sup>19</sup> rstanarm R package, with Gaussian

30 distributions as uninformative priors. The rstanarm R package emulates other R model-fitting functions, but uses

31 "Stan", a platform for statistical modeling, for back-end estimation. Bayesian logistic mixed models (estimated

32 using MCMC sampling with 4 chains of 2000 iteration and a warmup of 1000) were used, which are the Bayesian

33 analogous of a logistic mixed model. They are best suited for predicting the fatality rate with phases from the

34 ratio of deaths/infections when data is clustered (i.e., states), first considering all phases and then across each

35 phase transition. The model included the states as random effects, which are parameters that vary at more than

36 one level. Each state had its own regression equation, defined as  $y_{ij} = ax_{ij} + b + c_j$  where  $i$  is the individual case

37 and  $j$  is the state. The equations differed only by the constant term as each slope is assumed to remain fixed

38 for all states. The fatality rate odds are used for the random intercept models due to the assumption that the

39 dependent variable can take any value.

40

1 After using the Sequential Effect eXistence and significance Testing (SEXIT) framework, the median of the  
 2 posterior distribution and its 95% CI (Highest Density Interval) along the probability of direction (pd), the  
 3 probability of significance, and the probability of being large were reported. The thresholds beyond which the  
 4 effect is considered significant and large are |0.09| and |0.54|. The Bayesian sampling was assessed using  $\hat{R}$   
 5 (the vector  $r$  divided by the magnitude of  $r$ ), which should be below 1.01, and the Effective Sample Size (ESS;  
 6 an estimate of the sample size required to achieve the same level of precision if that sample was a simple  
 7 random sample), which should be greater than 1000, to determine convergence and stability.<sup>20-22</sup>

8  
 9 Prior distribution for the parameters were set as normal, with the SD varying depending on whether it covered  
 10 all phases or individual phase transitions. The parameters used in each model are as follows:

11 **All Phases:** Normal distributions (mean = 0.00, SD = 2.04) were set. The model's intercept, corresponding to  
 12 phase = 0, is at -2.98 (95% CI [-3.22, -2.75]). The effect of phase (Median = -0.41, 95% CI [-0.41, -0.40]) has a  
 13 100.00% probability of being negative (< 0), 100.00% of being significant (< -0.09), and 0.00% of being large (<  
 14 -0.54). The estimation successfully converged ( $\hat{R}$  = 0.999) and the indices are reliable (ESS = 3528).

15 **Phase 0 to 1/1.5:** Normal distributions (mean = 0.00, SD = 3.95) were set. The effect of phase (Median = -0.51,  
 16 95% CI [-0.53, -0.47]) has a 100.00% probability of being negative (< 0), 100.00% of being significant (< -0.09),  
 17 and 0.35% of being large (< -0.54). The estimation successfully converged ( $\hat{R}$  = 1.001) and the indices are  
 18 reliable (ESS = 3363).

19 **Phase 1.5 to 2:** Normal distributions (mean = 0.00, SD = 10.34) were set. The effect of phase (Median = 1.39,  
 20 95% CI [1.24, 1.56]) has a 100.00% probability of being positive (> 0), 100.00% of being significant (> 0.09),  
 21 and 100.00% of being large (> 0.54). The estimation successfully converged ( $\hat{R}$  = 1.000) and the indices are  
 22 reliable (ESS = 2647).

23 **Phase 2 to 3:** Normal distributions (mean = 0.00, SD = 9.09) were set. The effect of phase (Median = -0.59,  
 24 95% CI [-0.63, -0.55]) has a 100.00% probability of being negative (< 0), 100.00% of being significant (< -0.09),  
 25 and 98.08% of being large (< -0.54). The estimation successfully converged ( $\hat{R}$  = 1.000) and the indices are  
 26 reliable (ESS = 3934).

27 **Phase 3 to 4:** Normal distributions (mean = 0.00, SD = 6.07) were set. The effect of phase (Median = 0.68,  
 28 95% CI [0.65, 0.70]) has a 100.00% probability of being positive (> 0), 100.00% of being significant (> 0.09),  
 29 and 100.00% of being large (> 0.54). The estimation successfully converged ( $\hat{R}$  = 1.001) and the indices are  
 30 reliable (ESS = 3144).

31 The STROBE checklist was used as an instrument of evaluation for the study.<sup>23</sup>

32

## 1 RESULTS.

### 3 *Fatality Rates*

4 When grouped by state across all phases, New York was found to have to lowest median fatality rate (median  
5 [IQR]; 0.011 [0.007, 0.017]), followed by Washington (0.014 [0.011, 0.020]), Kansas (0.014 [0.009, 0.021],  
6 Texas (0.018 [0.013, 0.028]), California (0.021 [0.011, 0.037]), and Florida (0.022 [0.011, 0.034]) (**Figure 1**).  
7 Examining across phases when combing the states, there is a clear downward trend in fatality rate. At the  
8 beginning of the lockdown in phase 0 the median [IQR] is initially 0.039 [0.019, 0.067], and after an increase  
9 across phase 0.5 (0.052 [0.050, 0.054]), the trend decreases across phase 1 (0.040 [0.025, 0.048]), phase 1.5  
10 (0.023 [0.011, 0.033]), phase 2 (0.023 [0.018, 0.026]), and phase 2.5 (0.013 [0.011, 0.015]). There is another  
11 slight increase across phase 3 (0.015 [0.009, 0.025]) and phase 3.5 (0.015 [0.014, 0.016]), and then finishing  
12 with a greater decrease across phase 4 (0.010 [0.007, 0.013]) (**Figure 2**). This downward trend is also evident  
13 across phases when grouped by state. It can be observed in all states except Texas, with the pattern being  
14 most evident for New York and Washington (**Figure 3**). The variation in fatality rate in all six states over the first  
15 58 weeks of the pandemic is displayed in a linear graph in **Figure 4**, with the overall downward trend over time  
16 included over top.

17  
18 For each phase transition model, there was a big gap between marginal and conditional  $R^2$  that suggested most  
19 of the variation in the fatality rate is explained by the variance within each state. The model for all phases had  
20 a small gap between marginal and conditional  $R^2$ , suggesting that most of the variation is explained by the  
21 variance between each state. When analyzing all phases together, each progression to the next phase had a  
22 decrease in fatality rate by about 33.4% (with a 95% probability of falling in the 33.1% - 33.7% range). The  
23 intraclass correlation coefficient (ICC) value of 0.03 indicates that 3% of the observed variance in fatality rate is  
24 due to systematic between-state differences compared to the total variance. The phase transition from 0 to 1/1.5  
25 had a decrease by roughly 39.7% (with a 95% probability of falling in the 37.8% - 41.4% range). The ICC value  
26 of 0.08 indicates that 8% of the observed variance in fatality rate is due to systematic between-state differences  
27 compared to the total variance. The phase transition from 1.5 to 2 had an increase by roughly 303% (with a  
28 95% probability of falling in the 244.7% - 370.2% range). The ICC value of 0.17 indicates that 17% of the  
29 observed variance in fatality rate is due to systematic between-state differences compared to the total variance.  
30 The phase transition from 2 to 3 had a decrease in fatality rate odds by roughly 44.7% (with a 95% probability  
31 of falling in the 42.4% - 46.8% range). The ICC value of 0.04 indicates that 4% of the observed variance in  
32 fatality rate is due to systematic between-state differences compared to the total variance. The phase transition  
33 from 3 to 4 had an increase in fatality rate odds by roughly 96.5% (with a 95% probability of falling in the 90.9%  
34 - 102.1% range). The ICC value of 0.15 indicates that 15% of the observed variance in fatality rate is due to  
35 systematic between-state differences compared to the total variance.

### 37 *Random Intercepts*

38 Distribution of random intercept across the phases are shown in **Figures 5-9**. When analyzing all phases  
39 together, Washington has a significant and negative intercept, corresponding to good management of the  
40 COVID-19 cases across the phases. On the other hand, New York has a positive and significant intercept,  
41 indicating poor management of the cases. From phase 0 to 1/1.5, Kansas and Texas have significant and



1 negative intercepts, corresponding to good management of the COVID-19 cases through this phase transition.  
2 On the other hand, California and New York have positive and significant intercepts, indicating poor  
3 management of the cases. From phase 1.5 to 2, Kansas has a significant and negative intercept, corresponding  
4 to good management of the COVID-19 cases through this phase transition. On the other hand, New York has  
5 a positive and significant intercept, indicating poor management of the cases. From phase 2 to 3, Washington  
6 has a significant and negative intercept, corresponding to good management of the COVID-19 cases through  
7 this phase transition. From phase 3 to 4, Washington and New York have significant and negative intercepts,  
8 corresponding to good management of the COVID-19 cases through this phase transition.  
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## 1 DISCUSSION.

### 4 *Differences amongst the States*

5 Based on the statistical models, the implementation of phase systems for reopening is significantly correlated  
6 with a decreased fatality rate of COVID-19 when examined across all the states included in this study. It is  
7 observed that overall phase progression shows a significant case fatality odds reduction. The case fatality  
8 reduction is accompanied by a general reduction in the margin of error from phase 1 through phase 4.

9  
10 The states selected for this study allowed for the evaluation of different management styles throughout the  
11 phase transitions. For instance, Washington is the only state whose management across all phases could be  
12 considered effective, even though there was a decrease in fatality rate across all states. Other states also  
13 performed well in individual transitions, such as when New York joined Washington in having statistically the  
14 best management in transition from phase 3 to phase 4. This occurred despite New York's overall management,  
15 which was the poorest from our pool, as it is the only state consistently outside the margin of error in the positive  
16 direction. Texas as an individual state did not show the same trend as other states in the study. There is a  
17 myriad of potential reasons as to why Texas failed to follow the trend that could warrant an independent study.  
18 The trendline for new cases in Texas resembled that of Washington or Kansas, and Texas's population  
19 distribution is not significantly different from other study states such as Kansas, however the fatality rate is  
20 radically dissimilar. This might be a product of the culture of these states overall or the product of the  
21 populations' cultures within the states, and as such show areas where sociological or anthropological studies  
22 might be indicated.

### 24 *Detection and Treatment*

25 It should be noted that the reduction of fatalities in the early stages is likely a secondary effect to the quarantine  
26 and could be argued that it is a more direct result of reducing total infection COVID-19 in the overall population.  
27 Coupled with the lack of detection means, the early information on the reduction in mortalities is matched against  
28 projections and early case fatality estimates. As detection methods became readily available and other  
29 advances in treatment emerged our study could have encountered confounders. Ease of testing and high  
30 specificity tests entering the market create the possibility that we incorrectly identified the fatality rate initially.  
31 The initial available testing modalities had a sensitivity ranging only from 72-77% in symptomatic patients, with  
32 even lower sensitivity in asymptomatic patients, leading to a significant number of false negatives that could  
33 impact the data.<sup>24-26</sup> Additionally, lockdown measures could have acted as a stopgap allowing evolution of  
34 treatments that have led to a reduction in fatality. An example of radical treatment transformations can be seen  
35 in California, where greater than 40% of treatment courses for hospitalized cases consisted of antimicrobials  
36 azithromycin and hydroxychloroquine in March, but by June of 2020 there was a significant reduction in this  
37 modality. A decrease from greater than 40% patients to less than 5% of patients receiving hydroxychloroquine  
38 was observed.<sup>27</sup> This timetable also correlates with other studies that show a reduction in mortality with  
39 increased use of dexamethasone and remdesivir.<sup>28</sup> Another existing possibility is that the most susceptible were  
40 killed early in the pandemic. By the same token those same individuals are largely the easiest people to keep  
41 isolated in lockdown protocols, including those over the age of 80 who had the highest fatality rate.<sup>29</sup>

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### *Enforcement of Protocols*

While efforts were made to keep the public safe, there is the possibility that the study states were not entirely adherent to the protocols. Anecdotal stories and a cursory glance across news sites and police reports indicate that Florida often experienced widespread violation of phase protocols in Miami-Dade, Palm Beach, and Broward counties during the first year of the pandemic. This could account for the spikes in Florida from week 14 onward, as these counties account for nearly 30% of the population and have the among the highest population density within Florida. Given the dynamics of the business model for Southern Florida as not only a tourist destination but also as a primarily service-based economy, limiting interactions would place many businesses in situations where violating protocol would be tempting. While this is truly speculative, this possibility is granted further viability by the fact that these counties were the only counties that were delayed in transitioning to phase 2 with the rest of the state. This same spike is mirrored in New York where NYC and Long Island account for more than 50% of the state population and the same narrative of violations exist during the lag time between other New York regions reopening and NYC resuming services.

### *Future Studies*

As previously mentioned, this study involved the first year of the pandemic, which was when the first variant of COVID-19, "alpha", was the primary strain in the U.S. This was followed by the "delta" variant, which appeared towards the end of 2020 in India before also spreading worldwide (the "beta" variant, found in South Africa towards the end of 2020, was not commonly seen in the U.S). As each new COVID-19 strain appears, contagiousness for the virus increased leading to a higher incidence rate. However, severity of the associated illness potentially decreased with each new variant.<sup>30</sup> Due to the ever-evolving virus, it is possible that the lockdown protocols and gradual reopening of the states might not have been as effective in controlling fatality rates with the newer variants. Another confounding factor is the introduction of COVID-19 vaccines in late 2020, which slowly became available to all age groups (excluding 0-4 years) by the end of 2021.<sup>31</sup> Certain safety protocols, such as wearing masks and limiting group sizes, continue to change between mandatory to optional across the states. It would be interesting to determine if there is a correlation between the shift in these safety protocols and the fatality rates, considering the newer variants and the availability of the COVID-19 vaccines and boosters, which have different levels of effectiveness against newer strains.

### *Study Limitations*

There are a few potential limitations associated with this study. The first is regarding how the data was originally compiled. As metrics such as incidence and mortality rate of COVID-19 from each state were obtained from their respective government websites, and not a central agency, it is possible that different biases may have influenced how each state classified a "COVID-19-related death" and also how truthful they were when releasing the data. For example, in New York it was discovered that then Governor Andrew Cuomo had significantly understated the extent of COVID-19 related deaths in nursing homes.<sup>32</sup> This led to a vast overestimation of how successful the state of New York was in controlling the spread of infection in the early stages. Unfortunately, COVID-19 had been politicized by both the Democratic and Republican parties, and with the looming 2020 presidential election it is not inconceivable that politics played a role in the perception and tracking of COVID-19 across various states. The second limitation observed concerns the sample size. Only 6 U.S. states out of

1 50 were chosen and acted as surrogates for their respective case rate categories, which could be viewed as  
2 too small for an adequate sample size. Various regional and geographic factors of these surrogates could also  
3 impact the overall data. For instance, populations of certain states may experience a differing prevalence of  
4 illnesses than others, such as cardiomyopathies, coronary heart disease, heart failure, hypertension, obesity,  
5 sickle cell anemia, diabetes, etc., all of which have a significant comorbidity with COVID-19. This would result  
6 in these states also seeing a higher COVID-19 case fatality rate, causing them to potentially misrepresent their  
7 case rate category. Finally, as mentioned previously it is difficult to gauge the extent to how well enforced the  
8 protocols actually were. Recommendations of the CDC and local and state agencies were not uniformly  
9 embraced by the American people, making it difficult to properly gauge the effectiveness of the safety protocols  
10 across different states.

11

### 12 *Conclusion*

13 This study has shown the effectiveness of the implemented safety protocols and phase transitions in controlling  
14 the spread of COVID-19 as the states reopened during the first year of the pandemic. Adherence to the protocols  
15 likely played a large role in reducing fatality rates, resulting in different reopening schedules across the states.  
16 This could be due to certain counties being more disciplined than others, maintaining better control of the  
17 infectious spread than other parts of the state and thus progressing through the phase transitions quicker. As  
18 global efforts continue to fight the COVID-19 pandemic, it may be the case that repeat studies are indicated in  
19 the event of additional lockdowns with the added variables of vaccination rates and variant detection causing  
20 new spikes in infection rates.

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## 1 SUMMARY - ACCELERATING TRANSLATION

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3 The COVID-19 pandemic changed virtually everyone's way of life. Out of the nearly 6.52 million deaths  
4 worldwide, the U.S. contributed significantly to that count with roughly 1.05 million fatalities to date. While  
5 countries such as Australia and New Zealand maintained strict, strenuous COVID restrictions countrywide, in  
6 the U.S. each state tackled the crisis independently. After the lockdown was initiated across the country, each  
7 U.S. state implemented their own safety protocols or "phase transitions" as businesses were reopened, based  
8 on regional data and recommendations from the Center for Disease Control and Prevention (CDC) on how to  
9 keep the citizens safe. The plan was that as COVID-19 fatality rates were controlled, states would allow more  
10 businesses to reopen with fewer restrictions on group sizes, social distancing, etc. Due to each state acting  
11 independently, this created unique reopening schedules with certain states maintaining stricter guidelines for  
12 longer than others. Americans, in general, were opposed to strict authoritative quarantining mandates, such  
13 as those imposed in China, and state governors often made decisions based on their political party.  
14 Accounting for all these variables, this begs the question, how effective were the states in curbing the effects  
15 of COVID-19, and was there a correlation between the fatality rates and phase transitions as the states  
16 reopened their economy?

17

18 This study addresses these points by comparing fatality rates across multiple U.S. states in 2020 to early  
19 2021, each with their own implemented phase transitions as businesses reopened. The CDC separated the  
20 states into six categories based on infection rates, and to account for this variation a surrogate state from  
21 each category was chosen for the study: California, Florida, Kansas, New York, Texas, and Washington. Each  
22 state has its own unique culture, geography, and distinctive political preferences. Data regarding new cases  
23 and new deaths related to COVID-19 was obtained from the respective local government websites, as a  
24 centralized database does not exist.

25

26 Statistical analysis of the data when assessed by individual states demonstrated a downward trend with each  
27 transition, with Texas as a notable exception. Thus, most states maintained an overall decrease in fatality rate  
28 as restrictions were lifted, presumably due to better social distancing, mask compliance, and quarantine  
29 protocols. Because Texas did not exhibit such a trend, it suggests that perhaps this state transitioned too  
30 quickly between phases or did not follow the quarantining guidelines properly. There are numerous  
31 possibilities as to why fatality rates in Texas fluctuated so widely across the phase transitions, and future  
32 studies are warranted. However, when combining the states for the analysis there is an observed decrease in  
33 fatality rate from 0.039 [0.019, 0.067] in phase 0 to 0.010 [0.007, 0.013] in phase 4. Thus, this decrease  
34 supports an overall effectiveness of the implemented safety protocols in controlling COVID-19 transmission as  
35 the states reopened.

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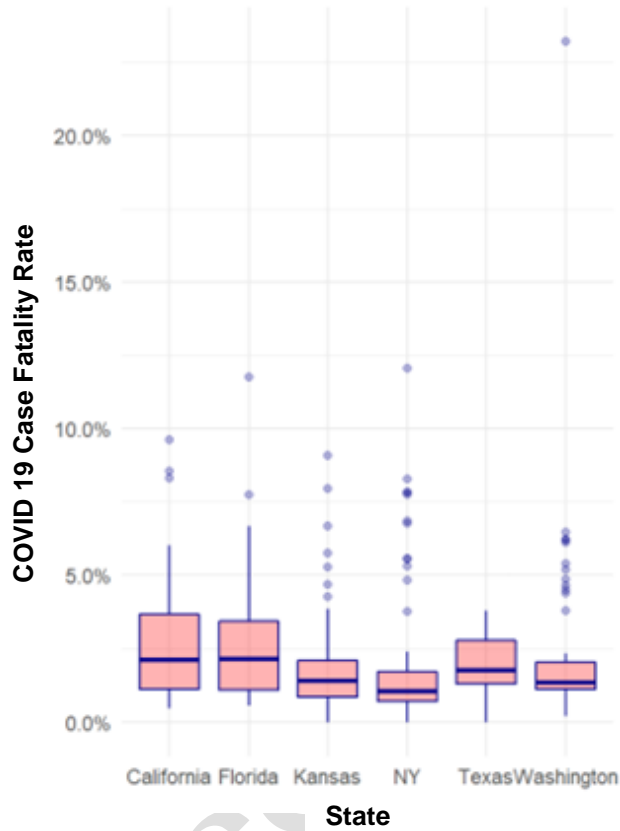
37 Based on this study's results the initiated phase transitions did exhibit success in controlling the spread as the  
38 economy reopened, as demonstrated by decreasing fatality rates across the U.S. Future studies that account  
39 for the introduction of COVID-19 vaccines and new emerging COVID-19 variants, and their impact on the  
40 fatality rates may prove beneficial in determining the next steps in combatting the pandemic.

41

1 **FIGURES AND TABLES.**

2

3 **Figure 1.** Distribution of fatality rate over the first 58 weeks of the pandemic in the U.S. by state. New York was  
4 found to have to lowest median fatality rate.



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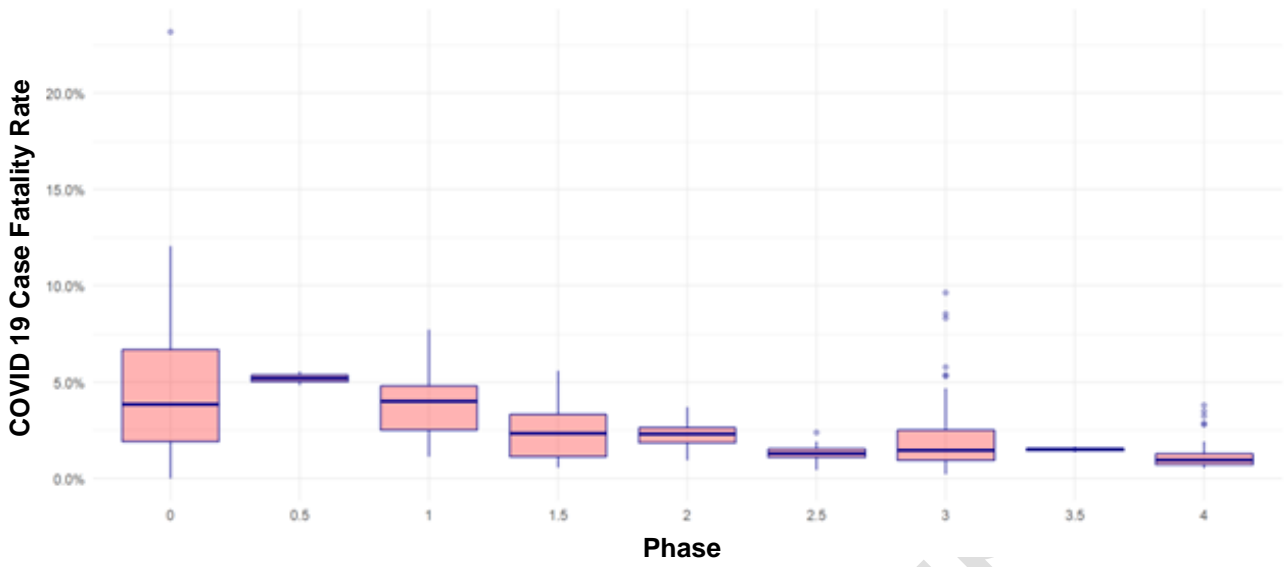
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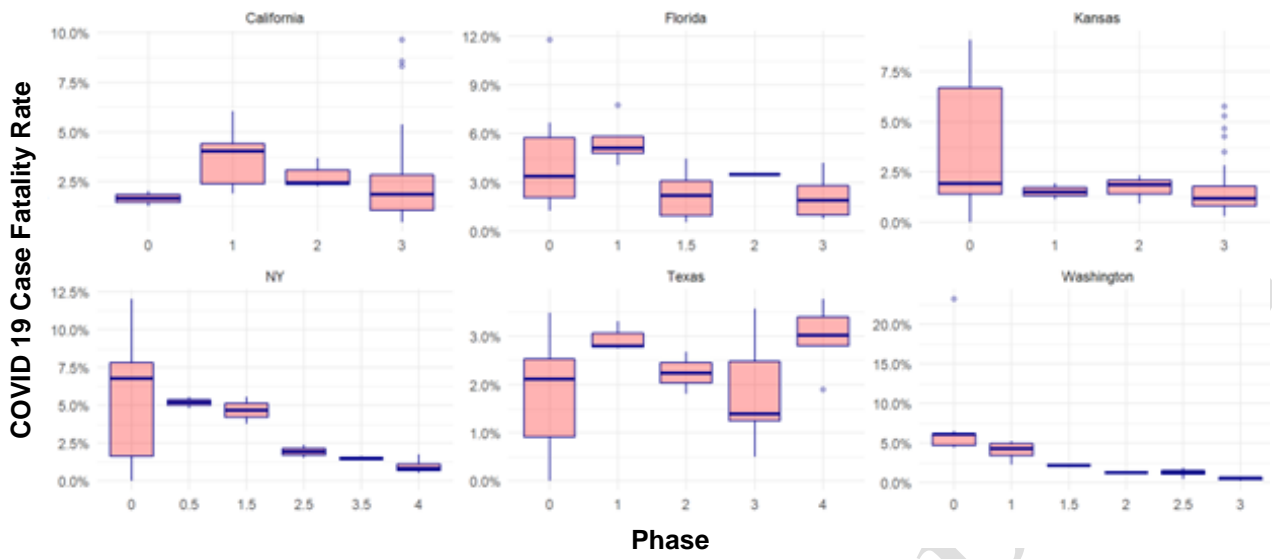
- 1 **Figure 2.** Distribution of fatality rate over the first 58 weeks of the pandemic in the U.S. across phases, when  
2 combining the study states. The median fatality rate shows a downward trend.



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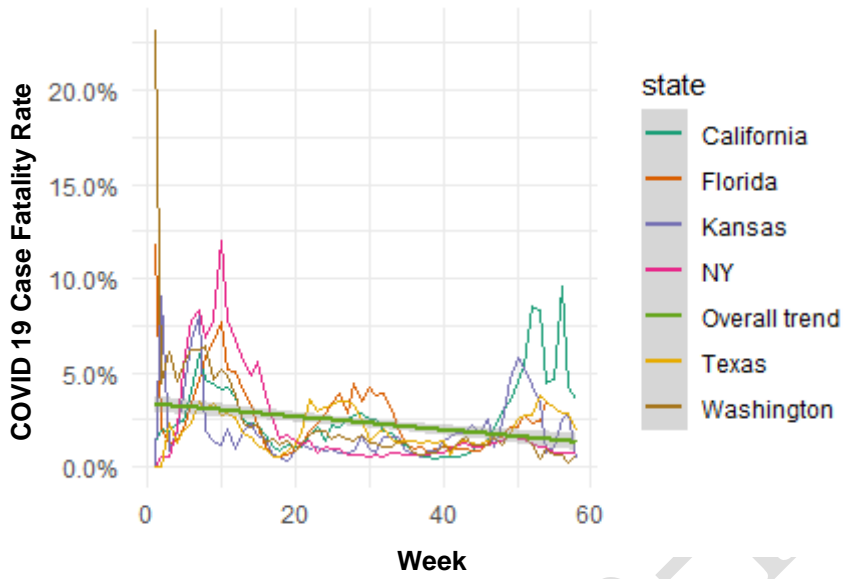
1 **Figure 3.** Distribution of fatality rate over the first 58 weeks of the pandemic in the U.S. across phases,  
2 grouped by state. There is a downward trend for all states except Texas.



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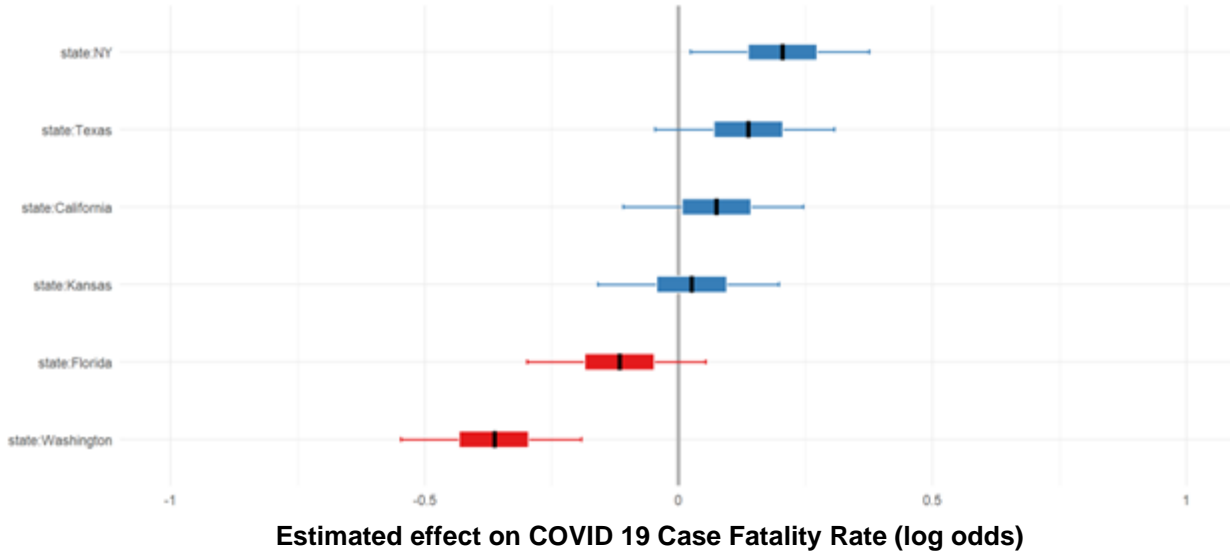
1 **Figure 4.** Fatality rate of the six study states in the U.S. over the first 58 weeks of the pandemic. There is an  
 2 overall downward trend over time.  
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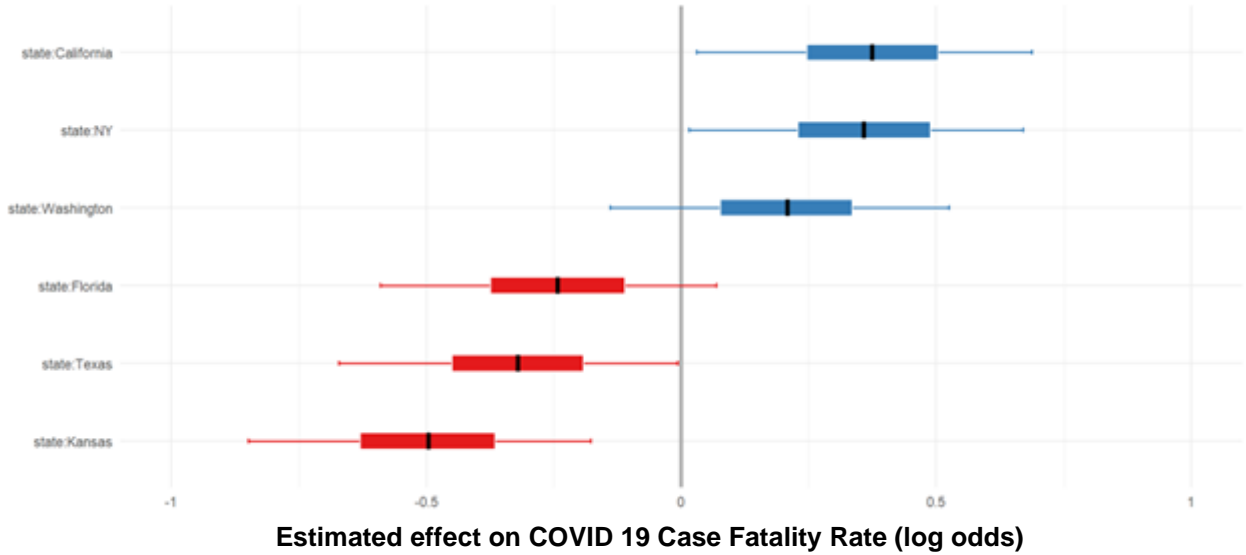
1 **Figure 5.** Distribution of the random intercepts over the first 58 weeks of the pandemic in the U.S. for each  
 2 study state across all phases. Washington has a significant and negative intercept, corresponding to good  
 3 management of the COVID-19 cases while New York has a positive and significant intercept, indicating poor  
 4 management of the cases.



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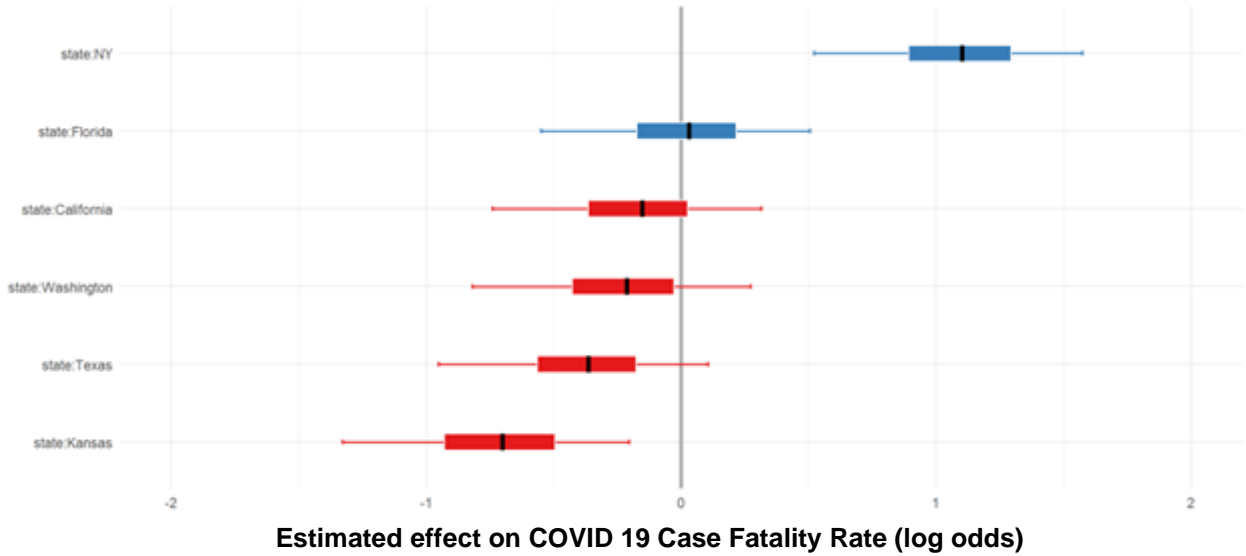
1 **Figure 6.** Distribution of the random intercepts over the first 58 weeks of the pandemic in the U.S. for each  
 2 study state across the phase 0 to phase 1/1.5 transition. Kansas and Texas have significant and negative  
 3 intercepts, corresponding to good management of the COVID-19 cases while California and New York have  
 4 positive and significant intercepts, indicating poor management of the cases.



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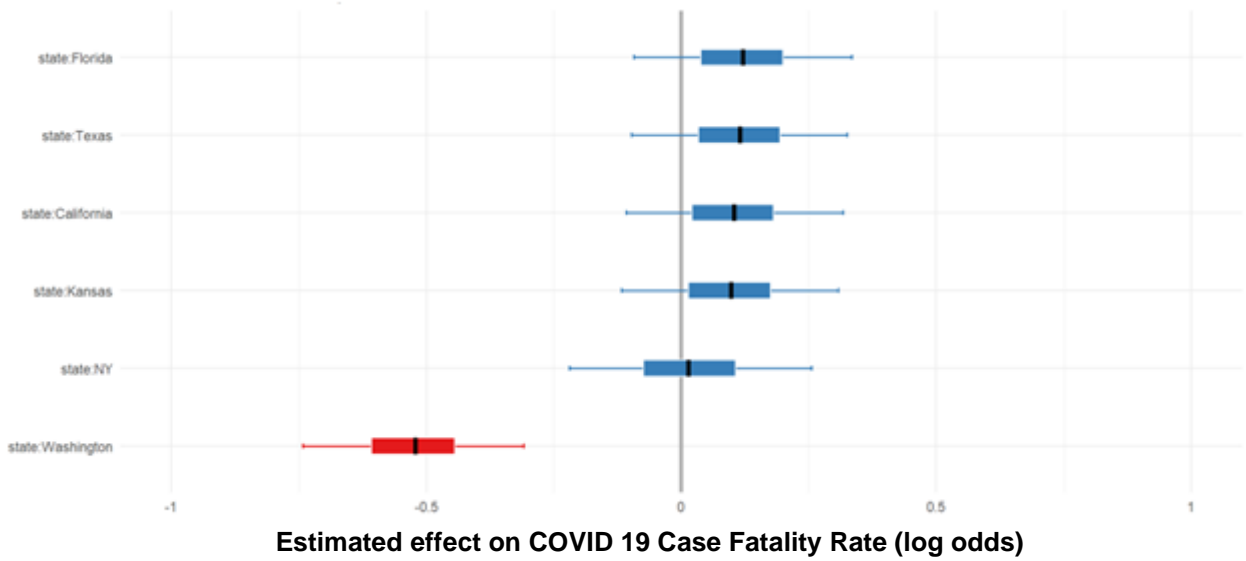
1 **Figure 7.** Distribution of the random intercepts over the first 58 weeks of the pandemic in the U.S. for each  
 2 study state across the phase 1.5 to phase 2 transition. Kansas has a significant and negative intercept,  
 3 corresponding to good management of the COVID-19 cases while New York has a positive and significant  
 4 intercept, indicating poor management of the cases.



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1 **Figure 8.** Distribution of the random intercepts over the first 58 weeks of the pandemic in the U.S. for each  
 2 study state across the phase 2 to phase 3 transition. Washington has a significant and negative intercept,  
 3 corresponding to good management of the COVID-19 cases.

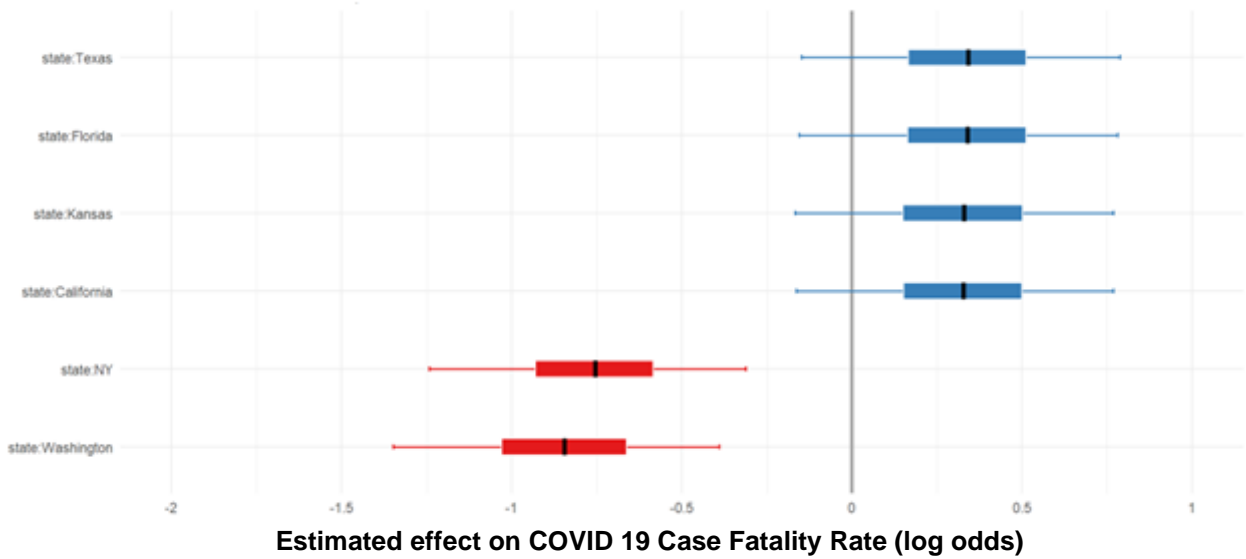


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1 **Figure 9.** Distribution of the random intercepts over the first 58 weeks of the pandemic in the U.S. for each  
 2 study state across the phase 3 to phase 4 transition. Washington and New York have significant and negative  
 3 intercepts, corresponding to good management of the COVID-19 cases.



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1 **Table 1.** Phase transition dates and locations in the states of Florida, California, New York, Washington,  
2 Kansas, and Texas.  
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Phases	Florida	California	New York	Washington	Kansas	Texas
Phase 0.5	Area: -	Area: -	Area: All regions, except NYC	Area: -	Area: -	Area: -
	Date: -	Date: -	Date: May 29, 2020	Date: -	Date: -	Date: -
Phase 1	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide
	Date: May 20, 2020	Date: March 19, 2020	Date: June 8, 2020	Date: May 5, 2020	Date: May 4, 2020	Date: April 27, 2020
Phase 1.5	Area: All counties, except for Broward, Miami-Dade, and Palm Beach	Area: -	Area: All regions, except NYC	Area: All counties, except Clark, Klickitat, Okanagon, Pierce, Skagit, Snohomish, and Whatcom	Area: -	Area: -
	Date: June 5, 2020	Date: -	Date: June 10, 2020	Date: May 28, 2020	Date: -	Date: -
Phase 2	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide
	Date: September 14, 2020	Date: May 26, 2020	Date: June 22, 2020	Date: June 19, 2020	Date: May 22, 2020	Date: May 18, 2020
Phase 2.5	Area: -	Area: -	Area: All regions, except NYC	Area: Asotin, Coubia, Ferry, Garfield, Grays Harbor, Island, Kittitas, Lewis, Lincoln, Mason, Pacific, Pend Oreille, Skamania, Stevens, Thurston, Wahkiakum, and Whitman counties	Area: -	Area: -
	Date: -	Date: -	Date: June 24, 2020	Date: June 24, 2020	Date: -	Date: -
Phase 3	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide	Area: Statewide
	Area: September 25, 2020	Date: June 12, 2020	Date: July 6, 2020	Date: March 22, 2021	Date: June 8, 2020	Date: June 3, 2020
Phase 3.5	Area: -	Area: -	Area: All regions, except NYC	Area: -	Area: -	Area: -
	Date: -	Date: -	Date: July 8, 2020	Date: -	Date: -	Date: -
Phase 4	Area: -	Area: -	Area: Statewide	Area: -	Area: -	Area: Statewide

	<i>Date:</i> -	<i>Date:</i> -	<i>Date:</i> July 20, 2020	<i>Date:</i> -	<i>Date:</i> -	<i>Date:</i> March 2, 2021
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