

State-level mortality associated with indicators of high COVID-19 community levels defined by the Centers for Disease Control and Prevention

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Background

In February 2022, the Centers for Disease Control and Prevention (CDC) released a new framework for community metrics to inform COVID-19 prevention strategies, based on explicit goals of avoiding severe illness and healthcare strain [1]. Indicators and thresholds for defining low, medium and high “COVID-19 community levels” were chosen to maximize performance in predicting severe disease and mortality three weeks later [2], and CDC recommends that high levels trigger public health measures including community masking. However, the range of mortality corresponding to the COVID-19 community levels has not been reported. In this study, we estimate mortality rates in US states linked to periods of high COVID-19 community levels during the delta and omicron waves.

Methods

We used data reported to the U.S. Department of Health and Human Services Unified Hospital Data Surveillance System on new admissions and inpatient bed utilization by COVID-19 patients [3], and aggregated counts of COVID-19 cases and deaths reported by state and local health agencies [4]. Over the study duration (June 1, 2021 to March 8, 2022), we identified periods in which each state would have been categorized as having a high COVID-19 community level according to new CDC metrics:

1. If <200 cases per 100,000 in the past 7 days: either new COVID-19 admissions ≥ 20 per 100,000 population (7d total), or $\geq 15\%$ of staffed inpatient beds occupied by confirmed COVID-19 patients (7d average).
2. If ≥ 200 cases per 100,000: new COVID-19 admissions ≥ 10 per 100,000 or COVID-19 bed occupancy $\geq 10\%$

To match the recommended weekly updating of community levels, we analyzed indicator and outcome variables reported at the midpoint of each week. We defined distinct episodes of high COVID-19 community levels that began with each week a state transitioned to the high category (and remained high for at least 1 additional week) following ≥ 1 week at low or medium.

We examined 7d average mortality rates at 21d lags after high episodes. We benchmarked mortality against a previously proposed threshold of 0.9 deaths per 100,000 population per week, defined in reference to peak weekly mortality from influenza and respiratory syncytial virus during a high-intensity season [5].

To summarize the relationship between case rates and mortality outcomes over time, we also examined ratios of 21d lagged mortality to case reports ('case-fatality ratios', CFR).

Results

Across the 50 states and District of Columbia, there were 81 distinct episodes of high COVID-19 community levels between June 2021 and March 2022 (Table S1). Episodes of high community levels were mapped to levels of mortality 21d later (Figure 1). With a 21d lag, mean and median mortality rates per 100,000 at episode onset were 2.7 and 2.5 across all episodes (interquartile range [IQR] 1.8-3.2), 2.7 and 2.6 (IQR 1.8-3.2) for episodes beginning June to October, and 2.8 and 2.5 (IQR 1.8-3.3) for episodes beginning November to January. In 78/81 episodes (96%), weekly mortality 21d after onset exceeded the reference level of 0.9 per 100,000. In 52/81 episodes (64%), lagged weekly mortality at onset exceeded 2.1 per 100,000. Mortality rose in most states over high episodes, with the IQR of peak weekly mortality spanning 4.7 to 9.3 per 100,000 over episodes beginning May-October, and 5.4 to 8.8 over episodes beginning November-January.

The 21d lagged CFR varied substantially over time (Figure 2). During the omicron wave, national CFR declined from 1.6% on November 30 to 0.32% on January 16, then rose to 1.04% by February 15, the latter corresponding to 2.1 deaths per 100,000 at a weekly case rate of 200 per 100,000.

Discussion

We retrospectively analyzed state-level mortality associated with periods during the delta and omicron waves that would be characterized as high COVID-19 community levels according to current CDC guidance. Between June 2021 and March 2022, the onset of most episodes marked by high community case and hospitalization levels was followed by average mortality rates 21d days later exceeding 2.1 deaths per 100,000 per week, a rate corresponding to approximately 1,000 deaths per day in the national population. Although future mortality will depend on the virulence of new variants and uptake of vaccination and antiviral therapies, the current CFR near 1% and rising suggests that similar relationships between cases and deaths may persist even with future surges comparable to the omicron wave.

Because mortality lags case diagnosis and hospitalization, there is limited scope for changes in individual behavior and public health measures to reduce mortality over the three weeks after communities reach the high COVID-19 category. During delta and omicron waves, mortality over that interval typically surpassed reference levels based on peak mortality in a severe flu season

and continued to rise. Earlier indicators may be needed to prompt preventive measures in time to avert substantial mortality in future COVID-19 surges.

References

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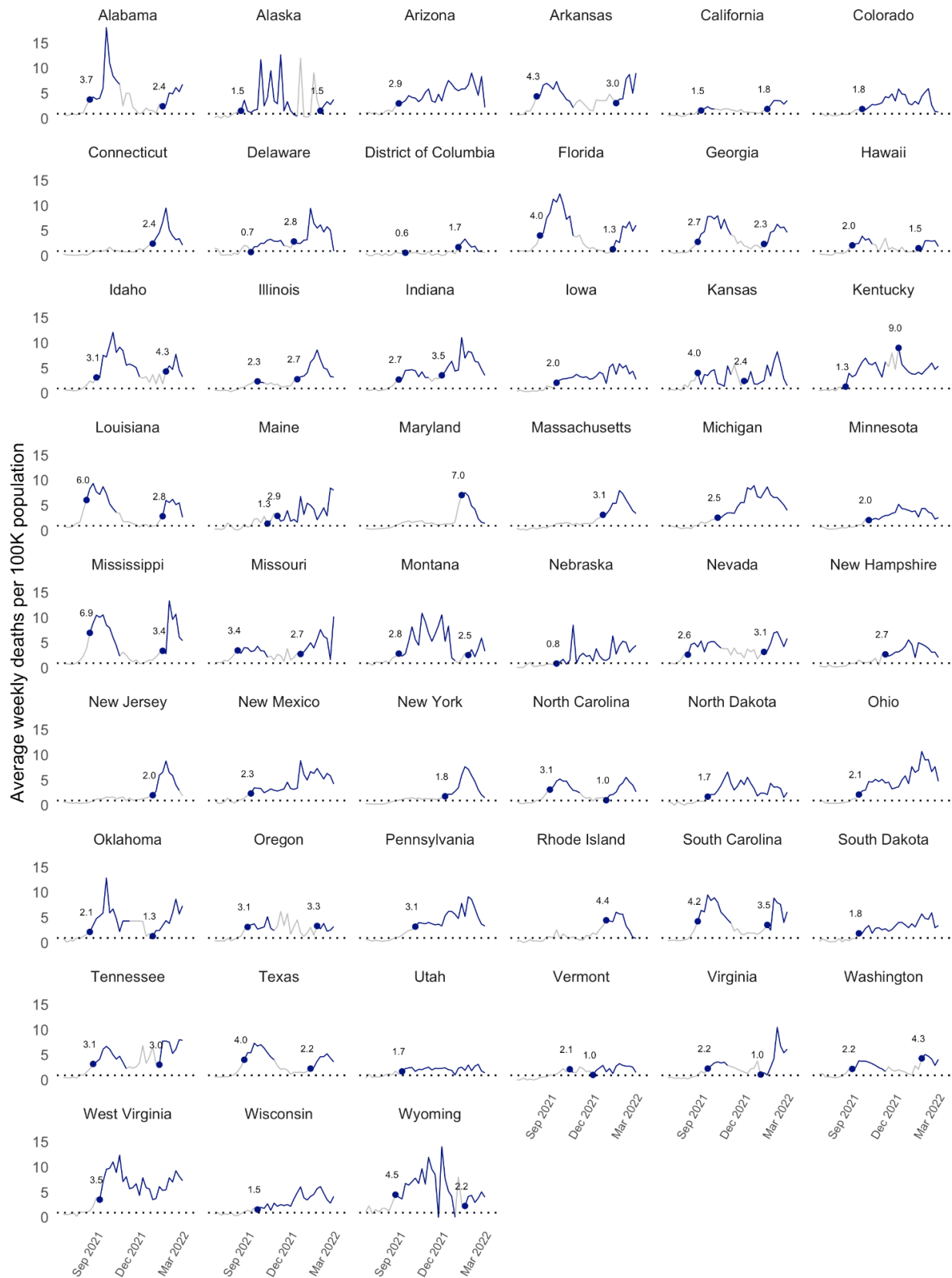


Figure 1. Average weekly deaths per 100,000 by state, June 22, 2021 through March 8, 2022. Segments marked in blue show death rates lagging 21d after periods that would meet CDC criteria for high COVID-19 community levels, while gray segments show lagging death rates after periods meeting criteria for low or medium COVID-19 community levels. The dotted horizontal line marks a reference level of 0.9 deaths per 100,000 per week [5]. Labeled dots report the mortality rate at 21d after the beginning of each distinct episode of high COVID-19 community levels.

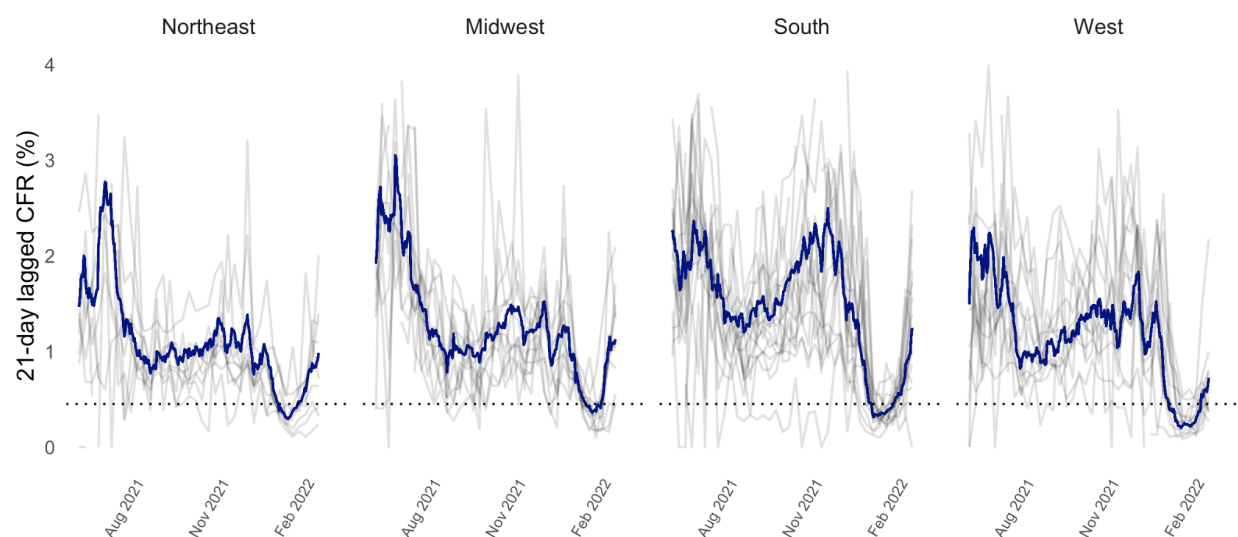


Figure 2. COVID-19 case fatality ratio (weekly averages with 21d lagged mortality) by U.S. Census region, June 1, 2021 through February 15, 2022. Each state is represented by a gray line, with overall regional averages in blue. The dotted horizontal line marks a CFR of 0.45%, which corresponds to the ratio between the reference mortality level of 0.9 deaths per 100,000 per week [5] and a case rate of 200 cases per 100,000 per week, which is a threshold used in defining high COVID-19 community levels in the CDC guidance.

Table S1 – Indicators and lagged mortality outcomes by episode.

Start date	State	Duration of 'high' episode (weeks)	Values at start of episode			Weekly deaths per 100K 21 days after start
			Weekly cases per 100K	Weekly hospital admissions per 100K	Percentage of inpatient beds occupied by COVID-19 patients	
2021-07-28	Alabama	10	276	30.8	9.0	3.7
2021-12-29	Alabama	8	392	14.5	6.5	2.4
2021-07-28	Alaska	18	209	12.9	9.2	1.5
2022-01-12	Alaska	6	1382	15.6	7.6	1.5
2021-08-11	Arizona	29	236	17.0	12.7	2.9
2021-07-14	Arkansas	12	237	24.7	8.9	4.3
2021-12-29	Arkansas	9	385	19.5	10.1	3.0
2021-08-11	California	5	214	15.1	13.0	1.6
2021-12-29	California	8	398	11.5	9.8	1.8
2021-09-01	Colorado	25	201	16.8	10.8	1.8
2021-12-08	Connecticut	10	300	16.2	8.4	2.4
2021-08-18	Delaware	11	204	15.2	6.5	0.7
2021-11-17	Delaware	14	225	12.3	6.4	2.8
2021-08-25	District of Columbia	2	163	28.9	5.6	0.6
2021-12-15	District of Columbia	8	227	16.0	5.4	1.7
2021-07-21	Florida	11	264	27.9	10.6	4.0
2021-12-22	Florida	9	351	10.9	3.9	1.3
2021-08-04	Georgia	11	257	28.7	15.4	2.7
2021-12-22	Georgia	9	250	14.2	8.9	2.3
2021-08-11	Hawaii	7	267	19.4	12.3	2.0
2021-12-29	Hawaii	8	761	10.1	6.0	1.5
2021-08-11	Idaho	14	216	14.7	11.6	3.1
2022-01-05	Idaho	9	309	12.7	11.8	4.3
2021-09-01	Illinois	3	229	15.7	10.1	2.3
2021-11-24	Illinois	13	257	13.0	8.5	2.7
2021-08-11	Indiana	10	201	17.1	9.5	2.7
2021-11-10	Indiana	15	208	15.0	10.2	3.5
2021-08-25	Iowa	26	225	17.6	10.5	2.0
2021-08-04	Kansas	11	217	17.7	9.4	4.0
2021-11-10	Kansas	15	234	16.3	8.3	2.4
2021-07-28	Kentucky	13	157	20.8	6.3	1.3
2021-11-17	Kentucky	16	213	18.0	9.2	9.0
2021-07-21	Louisiana	10	302	22.5	7.1	6.0

Table S1 – Indicators and lagged mortality outcomes by episode. *(continued)*

Start date	State	Duration of 'high' episode (weeks)	Values at start of episode			Weekly deaths per 100K 21 days after start
			Weekly cases per 100K	Weekly hospital admissions per 100K	Percentage of inpatient beds occupied by COVID-19 patients	
2021-12-29	Louisiana	8	617	20.7	5.3	2.8
2021-09-22	Maine	2	238	15.4	9.8	1.3
2021-10-13	Maine	20	258	10.3	7.4	2.9
2021-12-22	Maryland ¹	8	299	22.3	16.6	7.0
2021-12-01	Massachusetts	11	290	11.5	5.4	3.1
2021-09-15	Michigan	23	217	12.8	8.1	2.5
2021-09-15	Minnesota	23	235	10.4	10.0	2.0
2021-07-28	Mississippi	10	312	21.8	12.3	6.9
2021-12-29	Mississippi	8	449	15.6	8.3	3.4
2021-07-21	Missouri	10	251	19.9	11.5	3.4
2021-12-01	Missouri	12	239	17.0	11.0	2.7
2021-08-11	Montana	18	168	21.2	7.9	2.8
2022-01-05	Montana	9	332	23.8	7.4	2.5
2021-08-25	Nebraska	26	224	13.8	10.8	0.8
2021-07-14	Nevada	11	154	21.0	10.4	2.6
2021-12-22	Nevada	9	212	17.5	10.7	3.2
2021-10-20	New Hampshire	18	283	13.6	7.7	2.7
2021-12-08	New Jersey	9	316	15.4	7.8	2.0
2021-08-18	New Mexico	28	261	17.4	11.6	2.3
2021-11-17	New York	13	208	10.3	6.1	1.8
2021-08-11	North Carolina	10	313	17.1	10.9	3.1
2021-12-08	North Carolina	12	205	10.5	8.0	1.0
2021-08-25	North Dakota	26	229	15.0	7.4	1.7
2021-08-25	Ohio	25	208	17.4	10.0	2.1
2021-07-28	Oklahoma	13	219	23.6	9.4	2.1
2021-12-08	Oklahoma	12	237	24.3	9.3	1.3
2021-08-11	Oregon	9	233	13.4	12.7	3.1
2022-01-05	Oregon	8	553	10.1	10.8	3.3
2021-09-15	Pennsylvania	22	236	15.5	10.5	3.2
2021-12-08	Rhode Island	10	565	14.5	9.3	4.4
2021-08-04	South Carolina	11	295	18.4	9.2	4.2

Table S1 – Indicators and lagged mortality outcomes by episode. (continued)

Start date	State	Duration of 'high' episode (weeks)	Values at start of episode			Weekly deaths per 100K 21 days after start
			Weekly cases per 100K	Weekly hospital admissions per 100K	Percentage of inpatient beds occupied by COVID-19 patients	
2021-12-29	South Carolina	9	346	16.2	8.9	3.5
2021-08-25	South Dakota	26	245	20.0	8.3	1.8
2021-08-04	Tennessee	11	256	18.6	10.2	3.2
2021-12-22	Tennessee	10	242	12.9	8.9	3.0
2021-08-04	Texas	10	271	28.3	15.0	4.0
2021-12-22	Texas	9	202	11.3	7.8	2.2
2021-08-18	Utah	27	254	13.5	10.6	1.7
2021-09-22	Vermont	2	240	10.9	5.7	2.1
2021-11-10	Vermont	16	350	11.1	5.9	1.0
2021-08-25	Virginia	7	224	13.3	10.6	2.2
2021-12-15	Virginia	10	212	12.6	10.2	1.1
2021-08-11	Washington	11	225	9.5	10.5	2.2
2022-01-05	Washington	7	747	16.7	13.5	4.3
2021-08-18	West Virginia	29	248	22.2	8.6	3.5
2021-09-01	Wisconsin	25	238	21.3	10.9	1.6
2021-08-04	Wyoming	19	201	17.8	9.4	4.5
2021-12-29	Wyoming	8	204	11.2	10.4	2.2

¹ Maryland did not report case data from December 5, 2021 through December 19, 2021, and values in the New York Times dataset were filled by repeating the December 4 value over the entire missing interval. For our purposes, we replaced those repeated values in our analytic dataset with backfilled Maryland case data for December 5 to December 19 obtained directly from the Maryland Department of Health, available at <https://coronavirus.maryland.gov/datasets/mdcovid19-casesper100kpopulationstatewide/explore> ('MDCOVID19 CasesPer100KpopulationStatewide').