Covid-19 Open-Readiness Assessment

Utah

Report Date: 08/17/20

Assessment Model Version 1.22

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Moderate social distancing recommended. Protect vulnerable residents. Wear masks in public. No large group gatherings. Establish more robust testing and contact tracing.

Key Indicator	Rating					Metric
Contagious Cases		✓				3.1 per 1000 residents
Contagiousness Trend			✓			37% of peak
Trend Steadiness				✓		42 days since peak
Test Completeness	✓					9.9% positive tests
Population Density			✓			39 per sq mile
14-Day Fatality Forecast				✓		35% decrease in 14-day fatality rate
Disease Control	✓					Infections 450% of day of first death
Population Resistance	✓					7% residents with antibodies
Population Vulnerability					✓	IFR is 0.70x North American

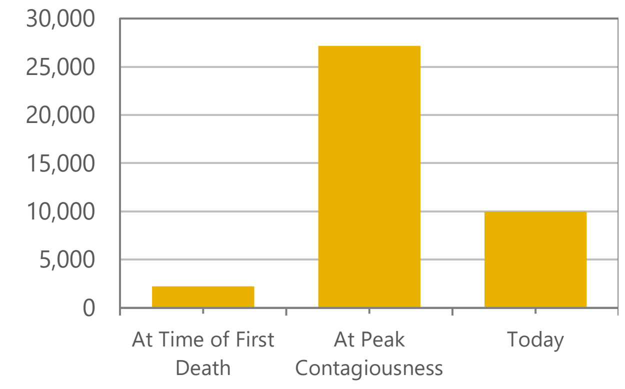
Positive Factors

42 days since peak contagiousness; Estimated 35% decrease in 14-day fatality rate (major factor); Younger population than average (minor factor).

Negative Factors

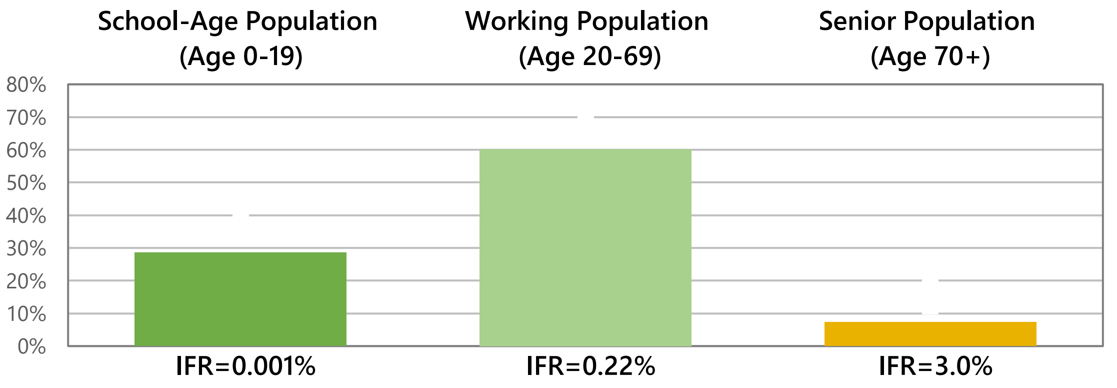
Too many contagious cases remaining (3.1/1000 residents) (major factor); High positive testing percent (9.9%) (major factor); 350% more contagious cases now than on the day of the first death; Not enough residents with antibodies (7%).

Actively Contagious Cases in Utah

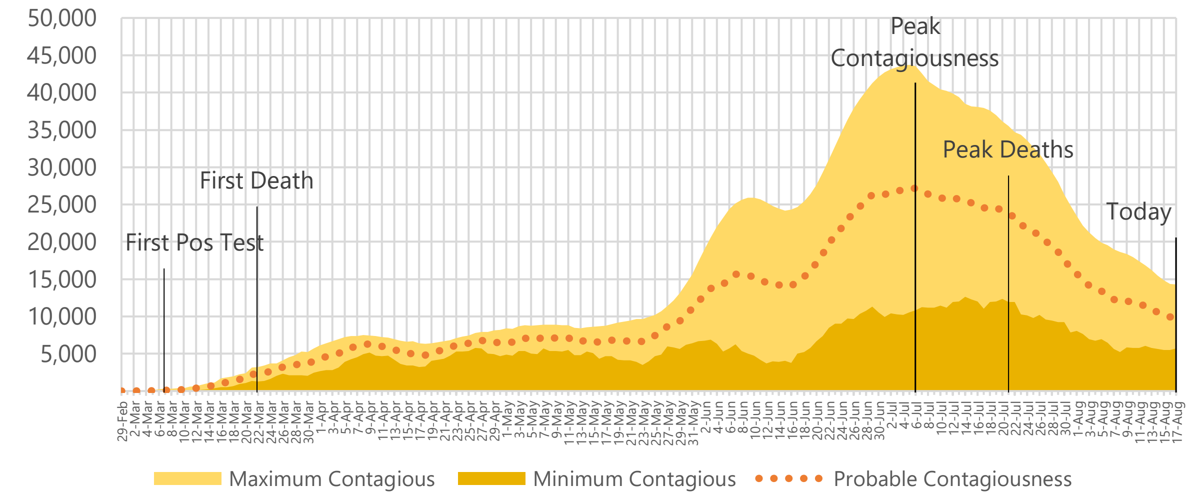


Active cases	
At first death	2,250
At peak	27,500
Today	10,000

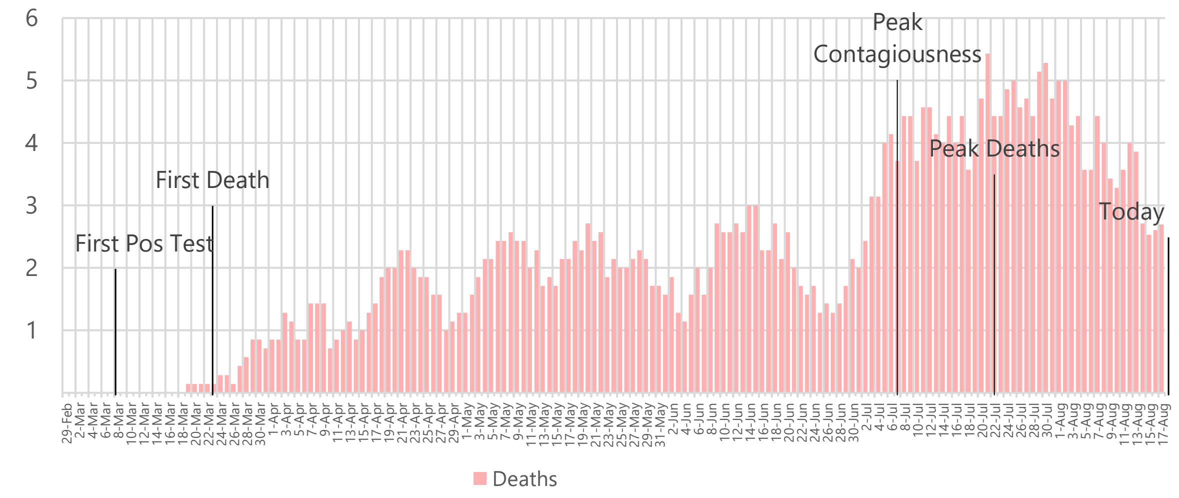
Risk to Different Population Groups



Contagiousness	Minimum	Probable	Possible
Contagious cases today	5,500	10,000	14,000
Per 1,000 residents	1.8	3.1	4.5
Contagious residents, ratio	One in 600	One in 300	One in 225
Peak number of contagious cases (7/6/20)		27,500	



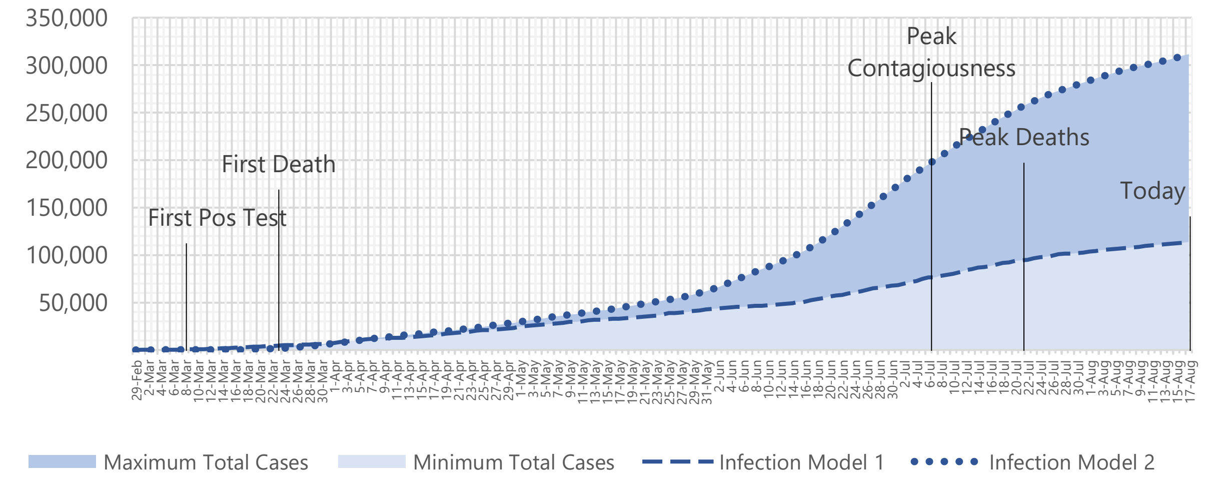
Fatalities	Last 7 Days	Last 14 Days	All Time
Days since first death (3/22/20)			148
Smoothed number of deaths	20	49	365
Per 1,000 residents	0.01	0.02	0.11
Ratio, per resident	One in 155,000	One in 65,000	One in 9,000



Trends in Testing	Last 7 Days	Last 14 Days	All Time
Days since first positive test (3/7/20)			163
Smoothed number of positive tests	2,538	5,417	46,953
Per 1,000 residents	0.79	1.69	14.65
Ratio, per resident	One in 1,300	One in 600	One in 70
Trend	-342 (-12%)	-1,657 (-23%)	-

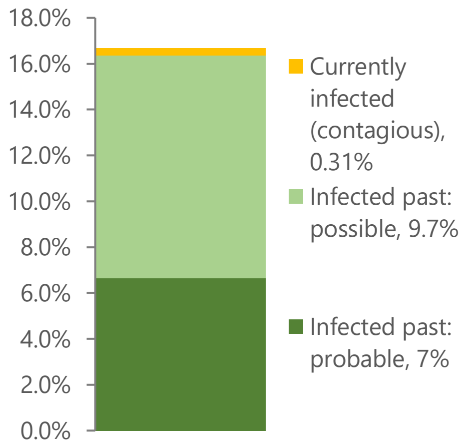
Trends in Fatality	Last 7 Days	Last 14 Days	All Time
Trend, Past	-8 (-28%)	-19 (-28%)	-
	Minimum	**Probable**	**Possible**
Predicted Deaths, Next 14 Days	30	30	35
Per 1,000 residents	0.01	0.01	0.01
Overall Trend, Next 14 Days	35% decrease in 14-day fatality rate		

Infections	Minimum	Probable	Possible
Infections-to-date, % of residents	3.6%	6.6%	9.7%



Immunity

UT Residents Infected to Date

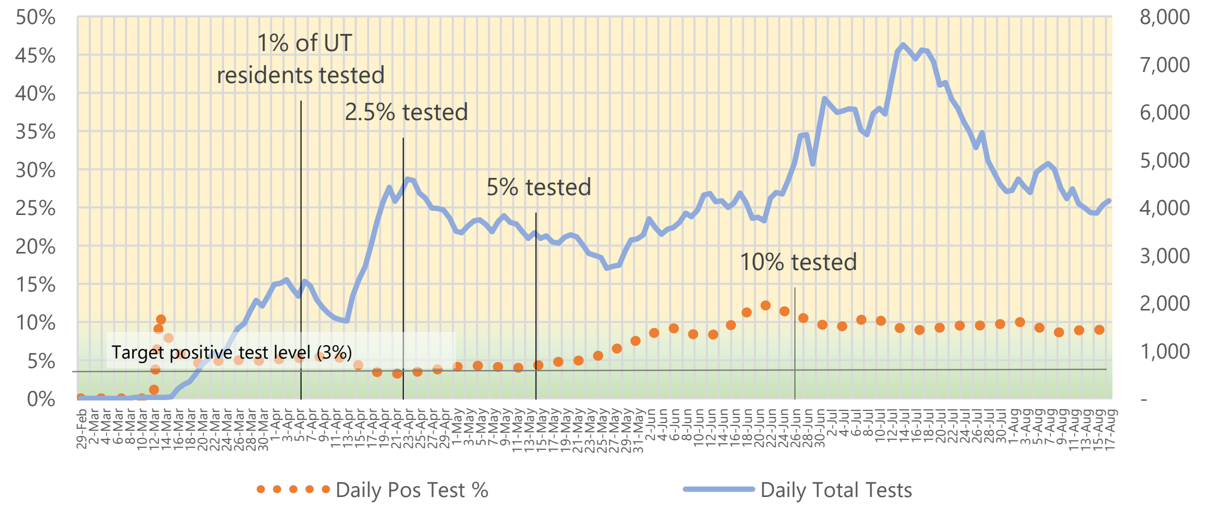


Time Needed to Reach Herd Immunity

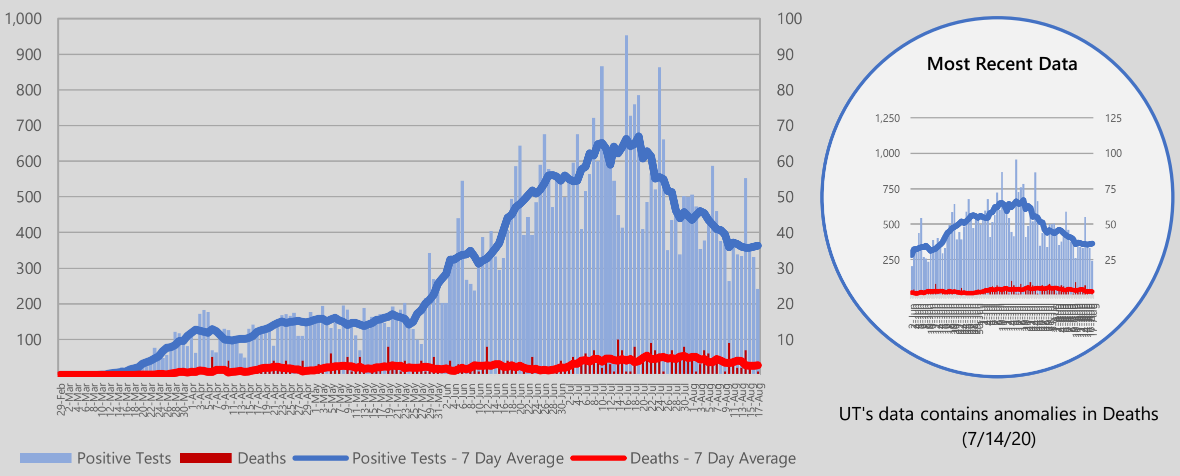
Time needed for 80% of residents to be infected with the virus:

Based on the infection rate since the beginning of the pandemic:	3+ Years
Based on the infection rate of the last 30 days:	4+ Years

Positive Test Percentage	Last 7 Days	Last 14 Days	All Time
Positive tests as % of all tests	11.2%	9.9%	7.8%



Utah Raw Data



UT's data contains anomalies in Deaths (7/14/20)

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Notes

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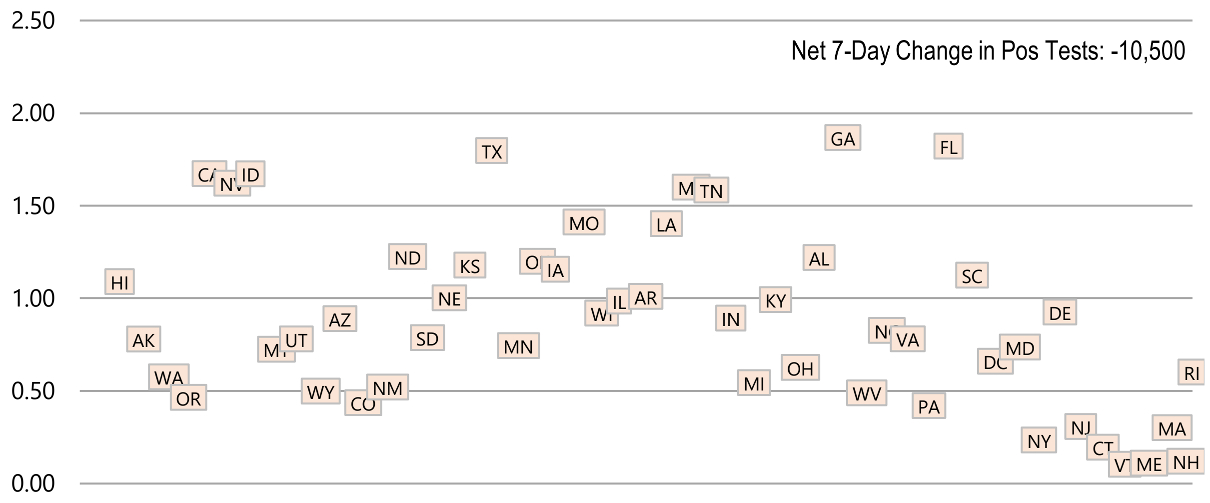
Data Sources. State level data for the daily numbers and total numbers of positive tests, negative tests, total tests, and deaths has been retrieved from the Covid Tracking Project. The Covid Tracking Project data comes from individual state websites. Selected data has been retrieved directly from individual state websites, especially data for the state of New York. Demographic data has been retrieved from the US Census Bureau. Geographic data has been retrieved from Wikipedia. Canadian data is from the Government of Canada.

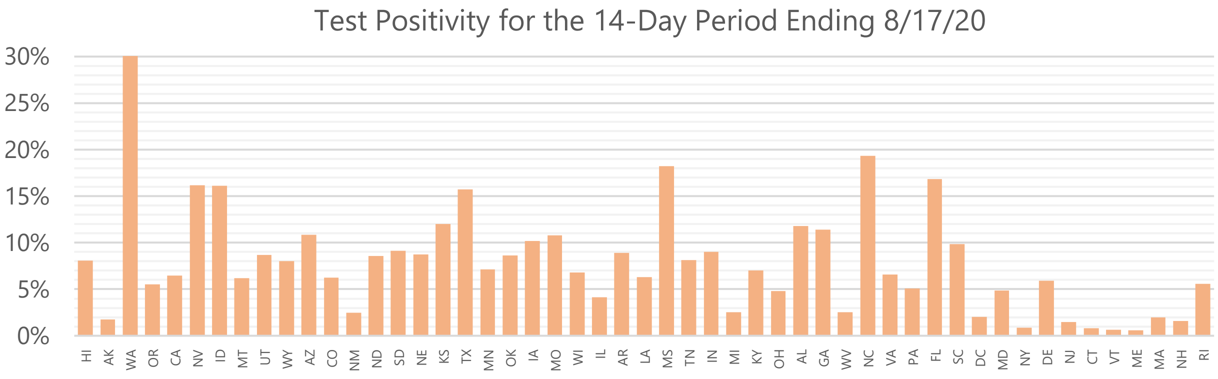
Common Issues with State-Level Data. Many states' raw data contains irregularities, including individual days with spikes in the number of deaths, positive tests, or negative tests; days in which less than zero results are reported (i.e., correcting earlier over-reporting by reporting negative numbers on a single day); and days in which data is missing completely. Some states in May 2020 mingled antibody testing data with virus testing data, and then later corrected the data by making large adjustments on one day. Data for states with low numbers of deaths or relatively small populations will appear more irregular than larger states.

Data Smoothing. Many states do not report results daily. Many states show weekly cycles of under-reporting on certain days and over-reporting on other days. Consequently, test data and fatality data is smoothed to include a 7-day cycle. Smoothing periods shorter than 7 days or longer than 7 days risk disproportionately weighting the days on which results are underreported or overreported.

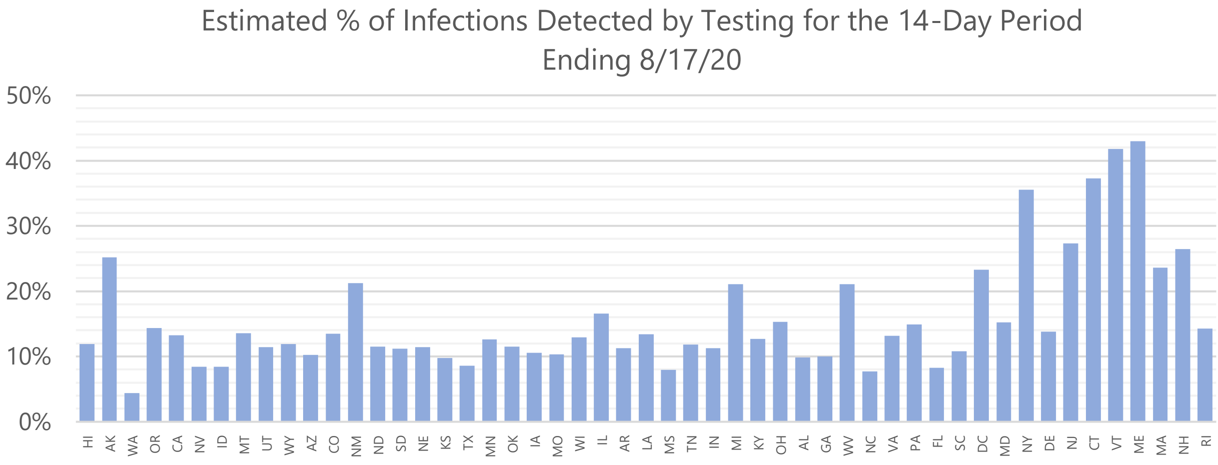
Test Cases. Positive test cases are used as a basis for calculating the total number of infections, as well as for trending the number of infections. The graph below shows the number of positive test per 1,000 residents in each state. States are arranged from west-to-east to help show regional trends.



Positive Test Percentage/State Testing Effectiveness. The percentage of virus tests that show positive results ("positivity") is an indicator of what percentage of the total infections is being identified through testing. The higher the positivity is, the lower the percentage of overall infections being detected is. Most states started with high positivity (in some cases 30-40%) and are now down to 2.5-10% positivity. The graph below shows the positivity of each state's tests over the past 14 days.


Test Positivity for the 14-Day Period Ending 8/17/20

The level of positivity implies that the actual number of infections in each state is 7-10 times as high as the number of positive tests. The graph below shows the percentage of infections that each state's tests have identified over the past 14 days.

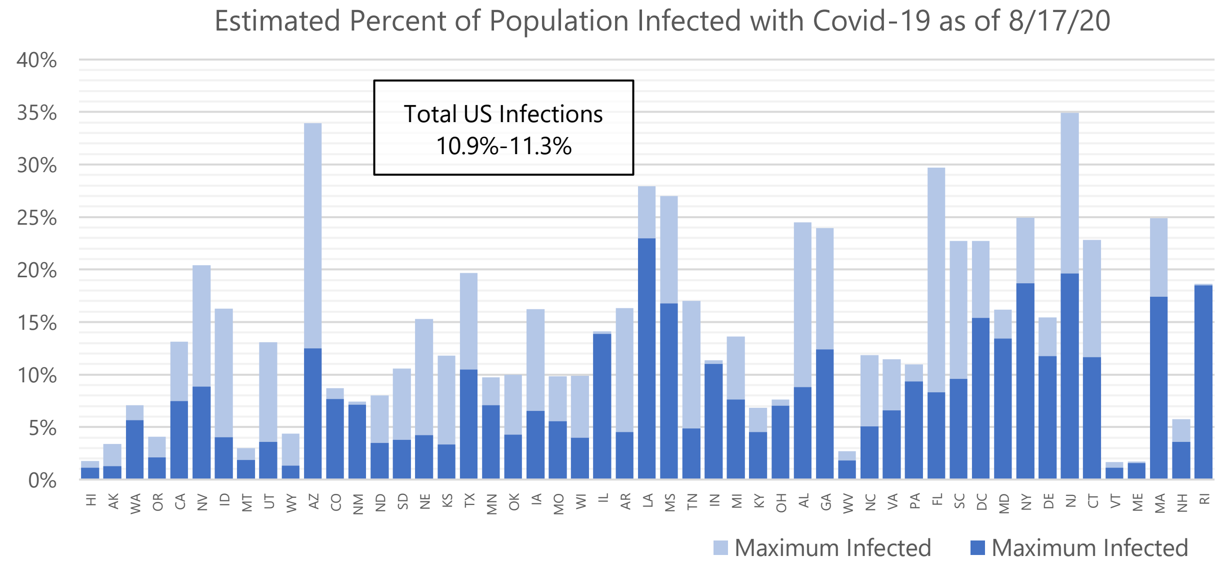

Estimated % of Infections Detected by Testing for the 14-Day Period Ending 8/17/20

Total number of infections. Test cases account for only a fraction of total infections, due to many people being asymptomatic and not seeking testing, limited test availability early in the pandemic, state strategies of testing only high risk individuals, and other factors. Total infections are estimated in two ways.

Infection Model 1 estimates infections based on the number of deaths 14 days after the date of the infection report (the day most test results are reported that later result in those deaths). Infections are calculated as the number of people who would have needed to be infected as of that particular test date to produce the number of actual deaths 14 days later.

Infection Model 2 estimates infections based on the percentage of test results that are positive in each state combined with average age being tested nationall. This calculation is based on a curve-fitted model derived both from longitudinal state-level data and from daily test and death data, using the 14 day lag between tests and deaths.

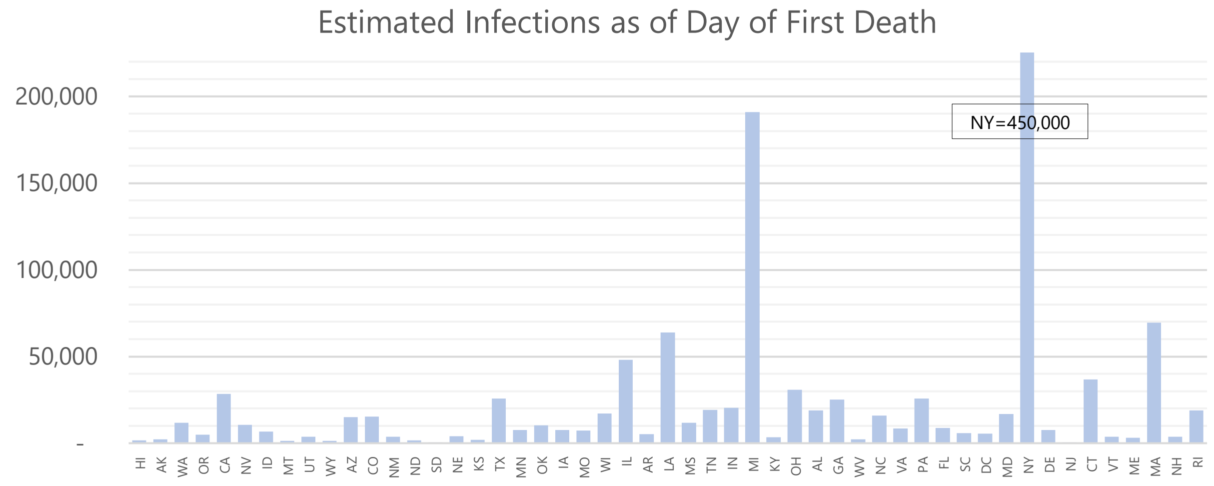
Total Population Infected Over Time. These infection models can be used to estimate the total number of people in each state that have been infected since the beginning of the pandemic. The graph below shows an estimate of the estimated percentage of people in each state who have been infected.


Estimated Percent of Population Infected with Covid-19 as of 8/17/20

Cases as of Day of First Death. Many states had extensive infections as of the day of the first Covid-19 death in the state. Comparing the current level of contagiousness to the level on the day of the first death allows for comparison of justification for social distancing then and now.

The graph below shows the approximate number of infections in each state on the day of the first death. This is calculated based on the number of infections needed on the day of the first death to produce the number of deaths actually observed 18 days later.

The number of infections varies significantly. New York had about a half million infections as of the day of the first death that it needed to address. California, with twice the population of New York, had only a tiny fraction of that number to address.

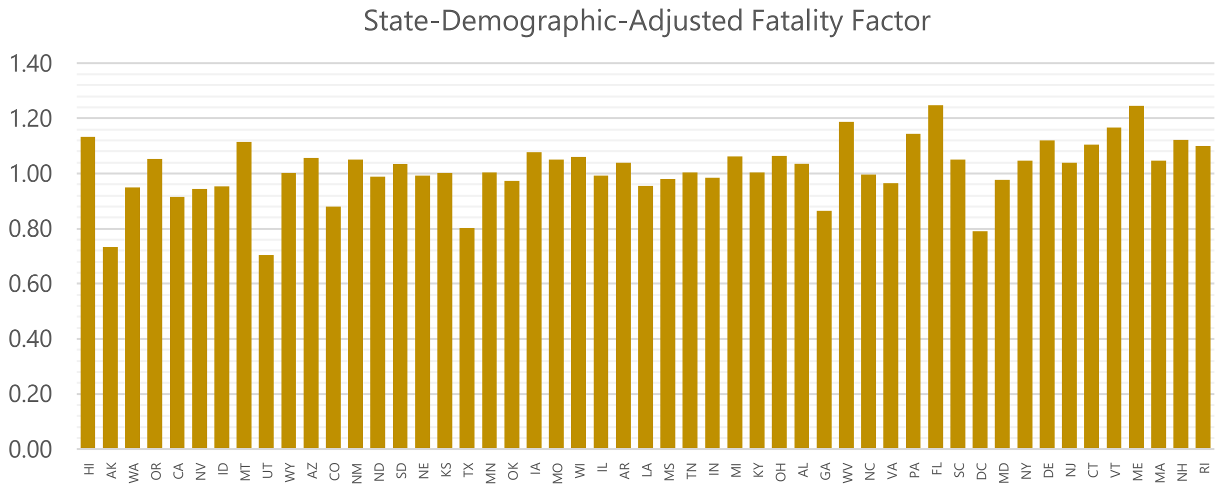

Estimated Infections as of Day of First Death

Contagiousness period. The contagious period is treated as the 9-day period from 2 days before a positive test result to 6 days after.

Actively Contagious Cases. Current contagiousness is compared to peak contagiousness and contagiousness as of the day of first death. Comparison to peak contagiousness indicates the degree to which the state has controlled covid-19.

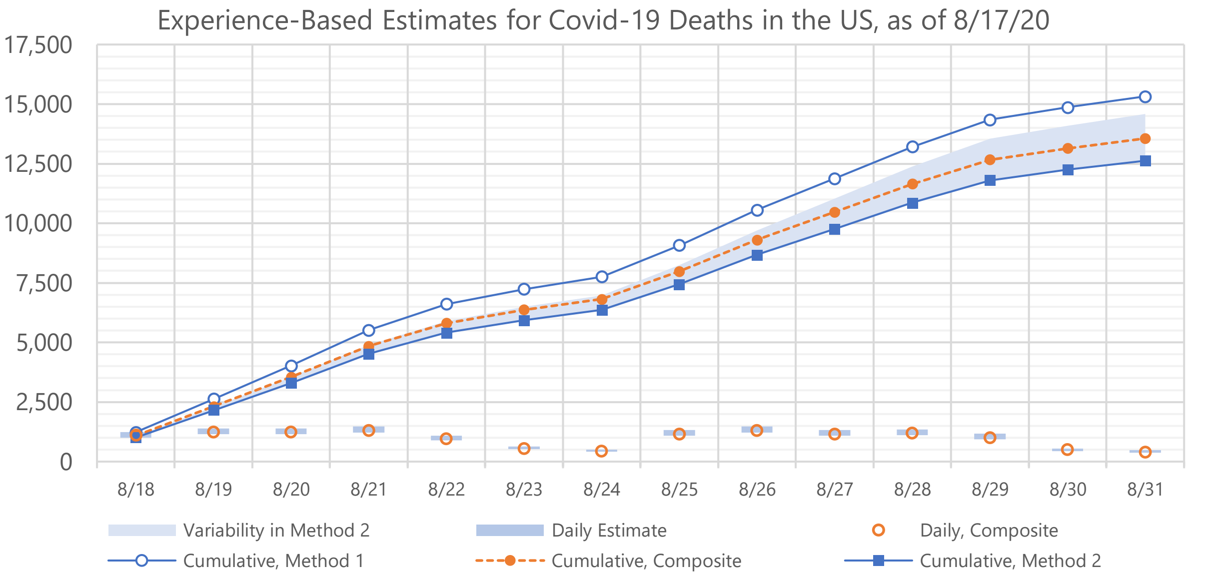
IFR baseline. A baseline Infection Fatality Rate (IFR) is calculated using New York state's antibody study. Based on antibody tests conducted the weekend of April 18-19, 2.71 million residents in New York were determined to have been infected. Two timing considerations were included: (1) After 21 days 95% of infected patients test positive for antibodies; (2) Average time from infection to death is 18 days. Using total deaths from April 16 yields a New York-specific IFR of 0.500%. The New York-specific IFR was divided by a demographic adjustment factor of 0.984 to produce a Baseline IFR for the US of 0.508%. Details can be found here.

State-Level IFRs. Each state is assigned a state-level IFR based on specific age distribution of its population. The ratios of the states' IFRs to the US-average IFR are shown in the graph below.


State-Demographic-Adjusted Fatality Factor

Scoring Criteria. Scoring is a combination of weighted factors and rules-based scoring. Criteria are weighted as follows: contagious cases (30%), test completeness (20%), fatality forecast (15%), contagiousness trend (10%), trend steadiness (10%), population density (7.5%), long-term change (2.5%), population resistance (2.5%), population vulnerability (2.5%). Very high contagiousness and/or significant irregularities in state-reported data limit the maximum score a state can receive; very low contagiousness can further improve a state's score.

Estimated Deaths. Deaths for the 14-day period following testing can be estimated fairly accurately using the number of positive test cases, recent CFR (rather than IFR), and positive test percentage. Using this approach, this is the estimate for total deaths in the US over the next 14 days.


Experience-Based Estimates for Covid-19 Deaths in the US, as of 8/17/20

About the Author

Steve McConnell has been a leading expert in software estimation, software measurement, and software engineering practices for more than 20 years. In this assessment, Steve has used his expertise in data analysis, measurement, and forecasting to analyze and forecast Covid-19 data. Steve is best known as the author of the software industry classics *Code Complete* and *Software Estimation: Demystifying the Black Art*.

Steve's company, Construx Software, provides training for high potential software development teams and consulting support for companies committed to being world-class software organizations. The performance measurement system used in this assessment is similar to performance management systems that Construx staff have implement in leading companies worldwide. Steve welcomes your contact through the channels below.

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