On the Strange Case of the *Case Fatality Rate*

Solly Angel,[1] Research Note, July 2, 2020

States in the U.S. report on the number of confirmed Covid-19 cases, deaths, and tests on a daily basis. This allows us to calculate and track the case fatality rate (CFR), the ratio of the number of deaths and the number of cases reported on a given date. We cannot and should not assume that this ratio is fixed or bounded within a narrow band. There is an enormous variation in the CFR among states, and for a given state it also varies over time. We also know that this rate is not the true mortality rate among those infected with Covid-19 because many of those infected are not identified or counted. For most places, excluding possibly Iceland,[2] that true rate remains unknown.

Indeed, there is still no consensus among experts regarding the actual mortality rate from Covid-19, the infection fatality rate (IFR). The CDC estimated the IFR for the U.S. in May 2020 to be 0.26%: "The range of estimates put the fatality rate for those showing symptoms between 0.2%–1%, with a 'best estimate' of 0.4%. It also places the number of asymptomatic cases between 20%–50%, with a 'best estimate' of 35%. By combining the two estimates, the estimated overall fatality rate of those infected with the virus—with and without symptoms—would be 0.26%." Other experts put the rate at 0.5%, while still others claim it can vary between 0.2% and 1.5%.[3] For the sake of our discussion here we note that no expert puts this number above 1.5%. We assume that the reporting of deaths from Covid-19 is more comprehensive and more accurate than the reporting of confirmed cases and, hence, that the CFR should be higher than the IFR.

In this short research note, I illustrate how the CFR from Covid-19 varies over time as well as among states. I look at the 14-day average for cases, deaths, tests, and CFR for March 1 through June 29 in: (1) the U.S., New York State, and the U.S. without New York State; (2) three Northeastern states—Pennsylvania, New Jersey, and Massachusetts—where confirmed cases have been on a general decline since mid-April; and (3) three Southern and

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Western states—Florida, Texas, and California—where cases are on the rise and where more than 5,000 new cases were reported on June 29.

The graph on the left of Figure 1 shows the 14-day running average of the number of new reported cases in the first group between these dates. As the figure shows, the number of reported new cases in New York State peaked in early April 2020 and declined since. The number of new reported cases in the U.S. peaked around that same time, declined until mid-May, remained relatively stable, and then started to increase in mid-June, surpassing its mid-April peak. Cases in the U.S. without New York State did not peak in mid-April but reached a plateau and have been relatively flat, starting to register an uptick in mid-June.
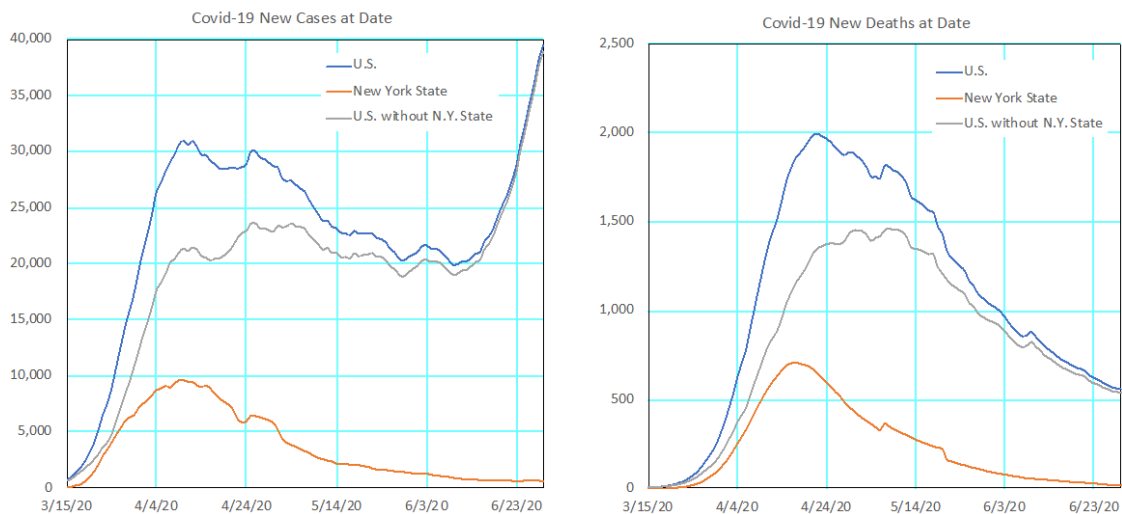

Figure 1: The 14-day running average of reported Covid-19 new cases and deaths in the U.S., in New York State, and in the U.S. without New York State for the March 1–June 29, 2020, period.

The graph on the right of Figure 1 indicates that, while the number of reported new cases in the U.S., with or without New York, has been rather flat and recently increasing as well, the number of new reported deaths has been declining steadily, in the U.S. since late April and in the U.S. without New York State since mid-May. This important finding is conveniently passed over or left for the fine print by most media reporting—including the *New York Times*—reporting that chooses to focus on the bad news, the uptick in confirmed cases, rather than on the good news (if deaths in any number can be called "good news"): the steady decline in confirmed deaths. This is true nationwide and, as we shall see below, it is especially true in states experiencing a rapid increase in reported new cases.

The difference in the curves on the left and the right of figure 1 suggests that the CFR has been changing over time, a rather surprising observation but one that makes complete sense. Initially, when there was little testing and fewer cases were reported, the CFR was predictably high. As more cases are reported, it should decline, eventually stabilizing at 1–2%. Figure 2 below shows the change in the 14-day average CFR during the March 1 to June 29 period in

the first group. For the U.S., it increased steadily to a peak of 7.4% in early May and has been in steady decline since, reaching 1.4% by the end of the reporting period. It was similar in the U.S. without New York State. This makes some sense. As testing increased, the number of reported cases increased, and the CFR declined, eventually approaching the IFR which, as mentioned earlier is of the order of 0.25–1.5%.
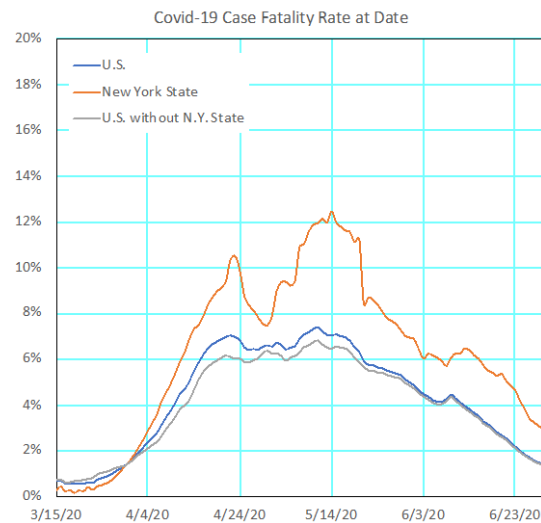

Figure 2: The 14-day running average of the Case Fatality Rate for the March 1–June 29, 2020, period in the U.S., in New York State, and in the U.S. without New York State.

I next compare two groups of states to further illustrate this finding in greater detail: three states in the Northeast—Pennsylvania, New Jersey, and Massachusetts—where the reporting of new cases has been in general decline since the end of April, and three states in the South and West—Florida, Texas, and California—where reported cases are on the increase and where more than 5,000 new cases have been reported daily in late June.

The graph on the left of Figure 3 shows the rise and fall of new cases in the first group. In this first group, new cases peaked before the end of April. By June 29, the 14-day average of new reported cases reached 543 in Pennsylvania, 265 in New Jersey, and 223 in Massachusetts. The graph on the right of Figure 3 shows that the 14-day average of new reported cases reached an early peak in both Florida and California in early April, remained flat, and then started to increase rapidly in early June, reaching 6,589 and 5,499, respectively, by June 29. It has been increasing steadily in Texas, reaching 5,447 by June 29. On the face of it, assuming that the CFR is similar everywhere, one would predict many more recent deaths in the second group of states.
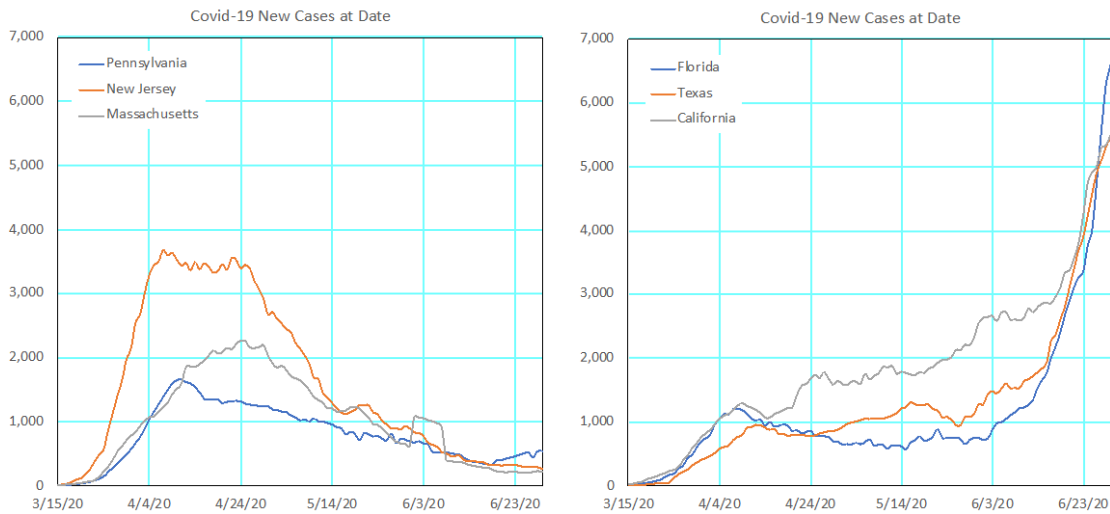
Figure 3: The 14-day running average of reported Covid-19 new cases in two groups of states—Pennsylvania, New Jersey, and Massachusetts on the left and Florida, Texas, and California on the right—for the March1–June 29, 2020, period.

Figure 4 below shows that this is clearly not the case. New reported deaths in the first group, shown in the graph on the left, peaked between late April and mid-May—150 and more deaths per day—and declined steadily thereafter, reaching lows of 27, 34, and 32 by June 29.[4] New reported deaths in the second group, shown on the right, show a radically different pattern. Their peak rates were much lower, never exceeding 80 reported new deaths per day. And even though cases have been increasing in all three states since mid-May, the numbers of death reported daily have been remarkably stable. In fact, daily reported deaths in Texas and California on June 29 were of a similar order to those in the first group, 30 and 37, respectively, even though reported cases there were more than 10 times higher on that date. The difference must be attributed to the differences in the CFR between these two groups of states, differences that are illustrated in figure 5 below.

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[4]   New Jersey revised its death toll and reported 1,877 new Covid-19 deaths on June 25, 2020. These deaths were not single-day new deaths and they have been eliminated from the present calculations.
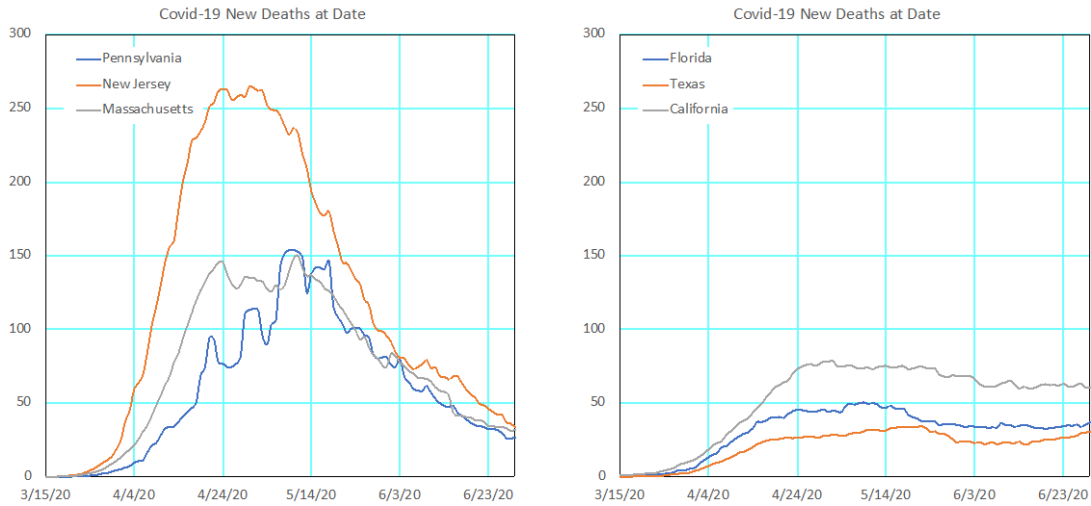
Figure 4: The 14-day running average of reported Covid-19 new deaths in two groups of states—Pennsylvania, New Jersey, and Massachusetts on the left and Florida, Texas, and California on the right—for the March 1–June 29, 2020, period.

The graph on the left of Figure 5 shows the CFR in Pennsylvania rising to a peak of 17.5% in mid-May and then declining to 5% by June 29. At peak, reported deaths were almost one in six reported cases. By June 29, that ratio declined to one in twenty. The CFRs in New Jersey and Massachusetts were still above 15% for most of June. The behavior of the CFR in the second group of states was entirely different, as the graph on the right of Figure 5 shows. It never reached peaks beyond 9% for Florida and 5% for Texas and California, and it has been in decline in all three states since mid-May, reaching 1.1% in Texas and 0.55% in Florida and California by June 29. By that date, the CFR in these three states was already within the range of the IFR (0.25–1.5%). In contrast, in New Jersey and Massachusetts it was still an order of magnitude higher by that date.
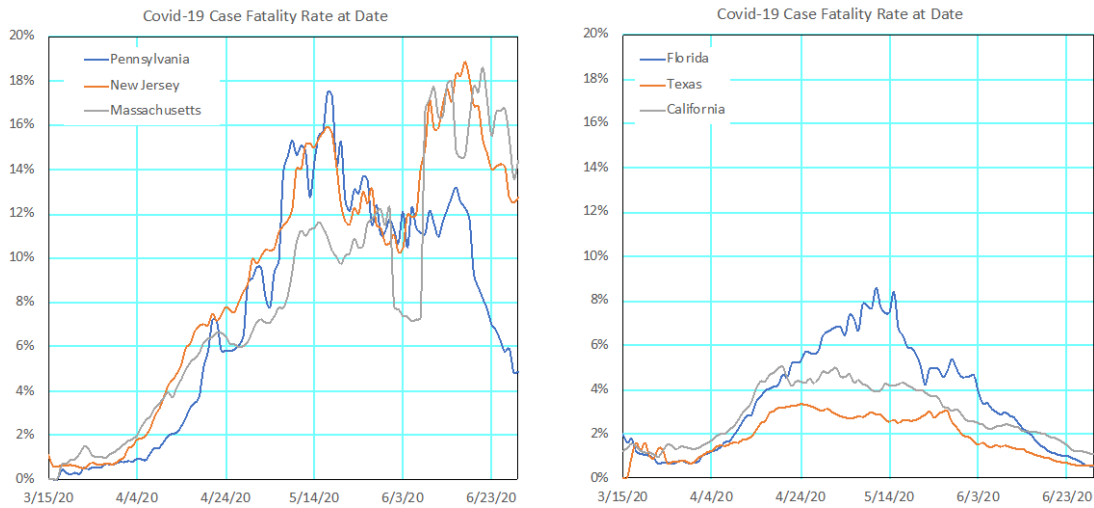
Figure 5: The 14-day running average of reported Covid-19 CFR in two groups of states—Pennsylvania, New Jersey, and Massachusetts on the left and Florida, Texas, and California on the right—for the March 1–June 29, 2020, period.

What accounts for these vast differences in the CFR between these two groups of states? To confess, I am not able to provide a definite answer, far from it. I find it very perplexing indeed.

We can dismiss the contention that they may be due to differences in rates of testing. As Figure 6 below shows, the trends in rates of testing in these two groups of states are remarkably similar. By June 29, they varied betweeen 0.9 and 2.5 tests per 1,000 in all six states.
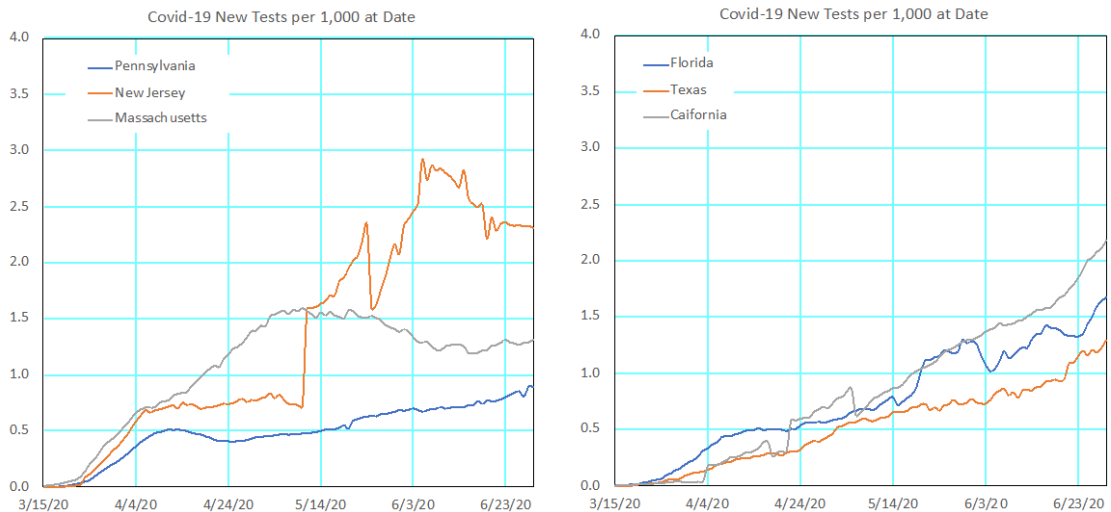
Figure 6: The 14-day running average of Covid-19 tests in two groups of states—Pennsylvania, New Jersey, and Massachusetts on the left and Florida, Texas, and California on the right—for the March 1–June 29, 2020, period.

What does make a difference, of course, are the positive-test rates. As Figure 7 below shows, that rate declined in both groups from early April to early June. It then continued to decline in the first group and started to rise rapidly in the second group. The positive-test rate in Florida and Texas was above 15% on June 29, while in New Jersey and Massachusetts it was below 3%. In short, in Florida, Texas, and California more people tested positive for Covid-19, but of those who tested positive fewer, people died; while in Pennsylvania, New Jersey, and Massachusetts fewer people tested positive, but of those who tested positive, more people died.
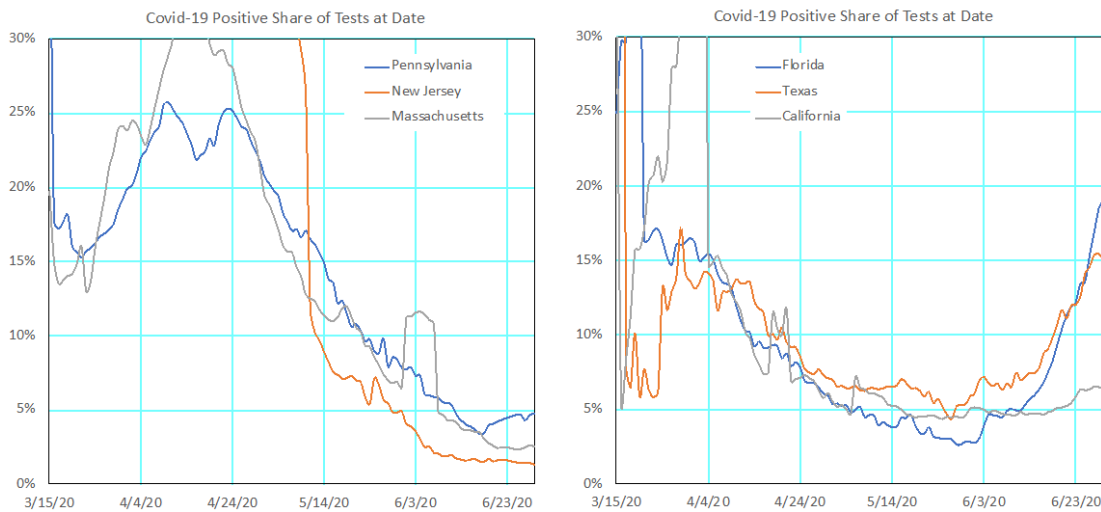

Figure 7: The 14-day running average of the positive share of Covid-19 tests in two groups of states—Pennsylvania, New Jersey, and Massachusetts on the left and Florida, Texas, and California on the right—for the March 1–June 29, 2020, period.

The question is why? One hypothesis is that, in the Northeastern states, stay-at-home, mask, and social-distancing rules worked better with the less vulnerable population than in the rest of the country. As a result, in those three states, the infection rate was higher than average among the vulnerable populations and lower than average among the less vulnerable population. Namely, these states had a lower share of asymptomatic cases with a low viral load, a lower share of cases with mild symptoms, and a higher share of cases with a high viral load and serious symptoms, many of whom died. In contrast, it may well be that in the Southern and Western states, the most vulnerable populations—those in nursing homes and those with pre-existing conditions—are now abiding by stay-at-home, mask, and social-distancing rules, while the less vulnerable population is exposed to low viral loads in asymptomatic people infected with Covid-19, who rarely die from it. Yet another possibility is that the two groups of states are following distinctly different testing regimes, Namely, in the Northeastern states the emphasis is on testing the more vulnerable population. And while most of the vulnerable population is protected, and hence tests negative, those who test positive have a high fatality rate. In contrast, in the Southern and Western states testing is not

focused on the vulnerable population; more people test positive, but fewer of them die. In truth, this remains a conundrum and may remain so for a while.

To conclude, there is too much emphasis—both in the media and in policy circles—on the number of cases, rather than on the number of deaths. The two are not proportional to each other, as I have shown, because the CFR varies over time and across states. Looking at the change in new reported deaths from Covid-19 and following it into the future is more important than looking at those testing positive and declaring it a national crisis. Isolating and protecting vulnerable populations may turn out to be more important than fighting the spread of the virus among the majority of healthy people who have a very small chance of dying from it.

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