Mortality and Morbidity
The Measure of a Pandemic

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By late May 2020, more than 100 000 individuals in the US died of coronavirus disease 2019 (COVID-19).[1] News reports lamented the number, comparing it to the capacity of a large football stadium or a small town and noting its similarity to the number of US soldiers killed in World War I or in the Korean and Vietnam wars combined.[2]

Death seems like it should be an accurate measure of the pandemic's evolution and effects—the worst outcome, an unequivocal outcome. However, the number of deaths attributed to COVID-19 in official reports is likely an underestimate of deaths caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In addition, the statistic does not incorporate deaths indirectly attributable to the virus and the measures used to contain it.

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Early in the pandemic, people who died of COVID-19 may not have been recognized due to inadequate knowledge of the infection or lack of testing availability, and their deaths may have been attributed to another respiratory disease, such as influenza.[3] Individuals who died at home or in nursing homes may not have been tested for or diagnosed with COVID-19, and those deaths would not be counted in mortality related to the pandemic.

In addition, other deaths not from COVID-19 may have resulted from the pandemic, particularly related to concerns about exposure to SARS-CoV-2 and social distancing measures. One study showed that hospitalizations at Veterans Affairs facilities for 6 emergency and potentially life-threatening conditions, such as myocardial infarction and stroke, declined by 41.9% during the first weeks of the pandemic (from 77 624 admissions in weeks 5-10 of 2020 to 45 155 admissions in weeks 11-16).[4] People may have ignored symptoms as they obeyed stay-at-home orders or were concerned about going to a hospital where they might contract the virus. Data on whether avoidance of care has translated into additional deaths are not yet available.

In contrast, quarantine measures also may have led to a decline in deaths from other causes, such as vehicular crashes because fewer people were driving on the roads. A study from California found that traffic crashes, injuries, and fatalities decreased by half in the month after the state's stay-at-home mandate.[5] In addition, social distancing measures have been shown to decrease the incidence of influenza[6] and other respiratory viruses, presumably decreasing deaths from these causes.

How then is it possible to estimate the true effect of this pandemic, accounting for these different factors? One way is to estimate excess deaths (ie, deaths beyond what would be expected). In this issue of *JAMA*, Woolf and colleagues[7] compared the number of excess deaths in the US between March 1, 2020, and April 25, 2020, with the preceding 6 years. Based on data from 2014 to 2019, the authors expected 419 058 deaths but observed 505 059, an excess of 87 001 deaths. They estimated that 65% were attributable to COVID-19, leaving 35% of the excess deaths unexplained. Some of these deaths may be due to inaccuracies in the data (eg, misclassified deaths, incomplete reports) or to avoidance of care. If the same pattern continued through the end of May, there would be, as reported, 100 000 deaths attributable to COVID-19, but an estimated 135 000 total deaths attributable to the pandemic. Woolf et al[7] also provide state-by-state estimates of excess deaths and a more detailed account of the 5 states most affected by COVID-19.

Estimating excess deaths is not a new approach. Similar calculations have been done to assess the effect of common and uncommon causes of mortality. For example, a study used this calculation to analyze the obesity epidemic and found excess deaths attributable to obesity vs normal weight.[8] After Hurricane Maria in Puerto Rico, estimated counts of excess deaths ranged from 1139 to 4645, compared with an official death toll of 64.[9]

However, focusing only on death as a measure of the effect of the pandemic overlooks morbidity. Just as with mortality, there are direct and indirect effects, many of which cannot yet be fully appreciated. Hospitalizations from COVID-19 may be a valuable direct measure to help assess morbidity. Some morbidities are still being evaluated. For example, reports of children developing a multisystem inflammatory syndrome after COVID-19, with potential cardiac damage, have emerged.[10] It is too soon to know whether the severe pulmonary damage observed in some adults who recovered from severe COVID-19 will have long-term respiratory implications.

In addition, although the mitigation efforts (eg, stay-at-home orders, school closures) have been successful in decreasing the rate of spread of the virus, they have had indirect effects. For example, reports of domestic violence have increased.[11] Social isolation has been associated with psychological distress. In a national survey from April 2020 that involved 1468 respondents, 13.6% of adults reported serious psychological distress, compared with 3.9% in 2018, at levels that predict serious mental illness.[12] School closures, especially if they continue in the fall, may harm children, especially those at social risk. Not only could educational progress

be affected, but children who rely on school breakfast and lunch may be going hungry. Children who rely on school-based health centers might not receive some health services.[13] Closures of businesses, whether temporary or permanent, may have health effects. With the unemployment rate reaching 13.3% in May 2020,[14] many individuals may have to choose between paying the rent and seeing a physician or refilling a prescription.

The COVID-19 pandemic and the social distancing measures used to contain the spread of the virus have altered everyday life in the US and produced excess mortality and morbidity. It is important to have an accurate count of the number of deaths that have resulted from this pandemic either directly or indirectly. Woolf et al[7] have provided an early count of these numbers by estimating excess deaths from COVID-19 and other causes. The goal is to update these counts in the fall of 2020 so that an accurate measure of the status of the pandemic and of efforts to mitigate the related morbidity and mortality are available to be debated prior to the presidential election.

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