Excess Deaths Associated with COVID-19

Provisional Death Counts for Coronavirus Disease (COVID-19)

Updated July 15, 2020

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Estimates of excess deaths can provide information about the burden of mortality potentially related to the COVID-19 pandemic, including deaths that are directly or indirectly attributed to COVID-19. Excess deaths are typically defined as the difference between the observed numbers of deaths in specific groups during specified periods of time and expected numbers of deaths. This visualization includes weekly estimates of excess deaths by the jurisdiction in which the death occurred. Weekly counts of deaths are compared with historical patterns to determine whether the number of deaths is significantly higher than expected.

On This Page

Counts of deaths from all causes of death, including COVID-19, are presented. As some deaths due to COVID-19 may be assigned to other causes of death (for example, if COVID-19 was not diagnosed or not listed on the death certificate), including cause-of-death mortality can provide information about whether an excess number of deaths is observed, even when COVID-19 mortality may be underestimated. Although COVID-19 is expected to cause a large number of deaths in the United States, it may also be associated with – excess deaths are sometimes referred to as "indirect" deaths – or provide insight into how other causes of deaths are impacted due to COVID-19, and how many excess deaths are reported as due to other causes of death. These deaths could represent reasonable COVID-19 mortality, or potentially could be indirectly related to COVID-19. For example, deaths may result from other causes occurring in the context of health care shortages or overburdened health care systems).

As of June 6, 2020, additional weekly estimates of deaths from all causes by state are available in a separate table. Similar to all causes of death, these weekly counts can be compared to values from the same weeks in prior years to determine if an excess number of deaths is observed. Comparisons of weekly counts of deaths from all causes to prior years may be useful for assessing the impact of the coronavirus pandemic on mortality, including whether an excess number of deaths was noted at a cause of death (see https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm#AllCauseDeath). Cause of death counts are based on the International Classification of Diseases, Tenth Revision (ICD-10) Underlying Cause of Death, which includes Alzheimer disease and dementia. Deaths due to external causes (i.e. accidents, violence, poisoning, and suicide) are not included in these data, but these causes of death may be associated with changes in mortality.

Dashboard

Estimates of excess deaths can be calculated in a variety of ways, and will vary depending on the methodology and assumptions about how expected numbers of deaths are calculated. Different approaches to calculating excess deaths were calculated using Farrington surveillance algorithms (1), A range of values for the number of excess deaths are presented, including the difference between observed count and one of two thresholds for expected deaths: the upper bound of the expected count, or the upper bound of the Farrington algorithm, where the observed count is higher than the threshold, and are reported as:

- **Percent excess:** The percent excess was defined as the number of excess deaths divided by the threshold.
- **Standard deviations:** The number of standard deviations the observed count is above the threshold, calculated by subtracting the excess deaths in each week, from February 1, 2020 to present. Similarly, the total number of standard deviations is calculated by subtracting the total number of prediction-specific excess deaths, from the total negative values set to zero, and not directly estimated using the Farrington surveillance algorithms.

Select a dashboard from the drop-down menu to view the following visualizations for each state or jurisdiction of interest:

- The first dashboard shows the weekly predicted counts of deaths from all causes, and the threshold for the expected number of deaths for the jurisdiction from the drop-down menu to show when an excess is observed.
- The second dashboard shows the weekly predicted counts of deaths from all causes and the weekly count of deaths from all causes reported to date. It takes a prediction interval into account when fitting a model to the data.
- The third dashboard shows the weekly counts of deaths from all causes. Predicted counts (weighted) are shown along with expected boundaries of the data to show the impact of underreporting. Select a jurisdiction from the drop-down menu to show data for that jurisdiction.
- The fourth dashboard shows the weekly percent excess deaths since early February, 2020, jurisdictions with one or more excess deaths are shown. Use the radio button to select all cause mortality, or all cause excluding COVID-19. Use the drop-down menu to select certain jurisdictions.
- The fifth dashboard shows the percent by which the observed counts exceed the threshold (i.e. percent excess) for each week, for jurisdictions with one or more excess deaths. Use the radio button to select all cause or all cause excluding COVID-19. Use the drop-down menu to select certain jurisdictions.
- The sixth dashboard shows the number of deaths by age group. Use the drop-down menu to select certain jurisdictions.
- The seventh dashboard shows weekly counts of death due to select cause of death groups (Respiratory diseases, Influenza and pneumonia, Coronavirus disease 2019, Cardiovascular diseases). Use the drop-down menu to select a jurisdiction.
- The eighth dashboard shows weekly counts of death for more detailed causes of death within three of the larger groups: Respiratory diseases and Circulatory diseases. Use the drop-down menu to select causes of death and a jurisdiction of interest.
- The ninth dashboard shows the weekly counts of deaths from all causes in 2020 relative to 2015-2019, by cause of death. Use the drop-down menu to select certain jurisdictions.
- The eleventh dashboard shows the total number of deaths above the average count since early February, 2020, by jurisdiction and cause of death. Use the drop-down menu to select certain jurisdictions.

Dashboard Data for Current Dashboard

Dashboard datasets in CSV format by clicking on the link for the desired dashboard under "CSV Format" link. Additional file formats are available for download for each dataset at Data.CDC.gov.

Technical Notes

Several changes were made to this visualization, effective as of June 3, 2020. More detail can be found in the Technical Notes. Future refinements to the methodology or other changes will be documented in the Technical Notes.

1. Weekly counts of deaths by age group are presented. Trends are shown for 2015-2019 and 2020.
2. Weekly counts of deaths due to select causes of death are presented. Trends are shown for 2015-2019 and 2020.
3. Total numbers of deaths above average levels since 2/1/2020 are shown for select causes of death.

Options

Select a dashboard:

- Weekly Excess Deaths
- Excess deaths with and without COVID-19
- Excess deaths with and without Pneumonia

Update Dashboard

- Number of Excess Deaths
- Percent Excess Deaths
- Weekly Number of Deaths by Cause Group
- Weekly Number of Deaths by Cause Group
- Weekly Number of Deaths by Jurisdiction
- Change in the Number of Deaths by Cause
- Total number above average by cause
- Total number above average by jurisdiction/cause

Download Data:

CSV Format:

- National and State Estimates of Excess Deaths
- Weekly Deaths by State and Age
- Weekly Deaths by State and Cause
- Weekly Deaths by State and Cause of Death

Data CDC.gov/API:

- National and State Estimates of Excess Deaths
- Weekly Deaths by State and Age
- Weekly Deaths by State and Cause of Death

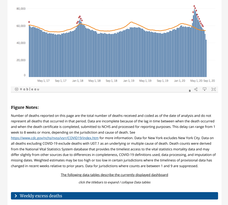

Figure Notes:

Number of deaths reported on this page are the total number of deaths received and coded as of the date of analysis and do not represent all deaths that occurred in that period. Data are incomplete because of the lag in receipt of death certificates and because death certificates in process, submitted to NCHS and processed for reporting purposes. This lag can range from one week to 8 weeks or more, depending on the jurisdiction and cause of death. 1/

Weekly counts of deaths are presented by week of death, based on the date of death for New York excludes New York City. Data on deaths occurring in jurisdictions other than the 50 states and DC are included in the totals for the United States. Data are based on a subset of deaths reported to NCHS from the National Vital Statistics System database that provides the timeliest access to the vital statistics mortality data and may differ slightly from more final data for jurisdictions and for national estimates. COVID-19 definitions and data are provided for informational purposes only. Weighted estimates may be too high or too low in certain jurisdictions where the timeliness of provisional data has changed in recent weeks relative to prior weeks. Data for jurisdictions with weighted estimates that are 50 percent or more of the expected

The following lines update the previous chart the currently displayed dashboard
click the ribbon to expand / collapse View tables

Weekly excess deaths

Technical Notes

Methods

Counts of deaths in the most recent weeks were compared with historical trends (from 2015 to present) to determine whether an excess number of deaths was observed. Different approaches to calculating expected deaths and excess deaths were calculated using algorithms (1). The surveillance package in R (2) was used to implement the Farrington algorithms, which use overdispersed transformed generalized linear models with a quasi-Poisson distribution to model expected deaths and seasonality. For each jurisdiction, a model is used to generate a set of expected counts, and the upper bound of the 95% prediction interval of the model is used to calculate the threshold for excess deaths. Although the Farrington surveillance algorithm is intended to be applied to provisional counts of deaths as they are reported, it has been adapted to retrospectively identify excess deaths in a jurisdiction's mortality data. The number of excess deaths estimate range is generated by comparing the observed counts to the upper bound of the 95% CI of the expected number, and a higher end of the excess death estimate range is generated by comparing the observed count to the average expected number of deaths. Reported counts were weighted to account for the expected completeness of death certificates.

This method is useful in detecting when jurisdictions may have higher than expected numbers of deaths, but cannot be used to determine whether excess deaths are due to COVID-19 or other causes. Because the most recent provisional death counts are incomplete, and the degree of completeness varies by jurisdiction, the most recent weeks of data are withheld from analysis until a sufficient proportion of deaths are received. Thus, the number of recent deaths – the number of deaths falling above the threshold – may be underestimated. Whole reported counts are weighted to account for potential underreporting in the most recent weeks, the true (weighted) number of deaths may be higher than the threshold, indicating that the number of deaths is underestimate the true number of deaths in a given jurisdiction.

A range of estimates of excess deaths is provided based on comparing the observed numbers of deaths to two different thresholds, by week and jurisdiction: 1) the average expected number of deaths, and 2) the upper bound of the 95% CI of the expected number of deaths. The difference between observed counts and the average expected number will be lower, the percent excess and standard deviations calculated using this threshold will be lower, and the total number of excess deaths in each week was calculated by summing the excess deaths in each week, from February 1, 2020 to present. Because the upper bound of the Farrington algorithm is used as a threshold, the total number of excess deaths across the jurisdictions.

Estimates of excess deaths in the most recent weeks are compared as a sum of jurisdiction-specific numbers of excess deaths (with negative values set to zero), and not directly estimated using the Farrington surveillance algorithms. Estimates of excess deaths by state are presented for all causes of death, and for deaths due to COVID-19 and other cause-based subgroups. Estimates of excess deaths are provided based on the observed number of deaths reported to date, and positive values will cannot sector offer our when estimating excess deaths for the US directly using the Farrington algorithms was approximately 15% lower than the number of excess deaths estimated by summing the jurisdiction-specific estimates. This difference is likely due to several jurisdictions reporting lower than expected numbers of deaths – which could be a function of underreporting of deaths, or a shift in the timeliness of death reporting that is different than what has been observed in the retrospective data used to model expected seasonal patterns of mortality – and the Farrington algorithm applied to the jurisdiction-specific estimates could be related to different estimated thresholds for the expected number of deaths in the US and across the jurisdictions.

Different definitions of excess deaths result in different estimates. For example, defining excess deaths as the difference between observed and the expected number of deaths in the upper bound of the 95% CI, results in larger estimates of excess deaths. The upper bound of the 95% CI more readily identifies areas experiencing statistically significantly higher than expected deaths. The expected number, by contrast, would include areas that are experiencing higher than average mortality. Expected counts are now provided so that users can evaluate excess deaths relative to both thresholds.

Finally, the estimates of excess deaths reported here may not be due to COVID-19, either directly or indirectly. The excess deaths may be due to other causes of death, including but not limited to other infectious diseases, such as influenza. Or, e.g. nonfatal, drug overdoses, may contribute to excess deaths in some jurisdictions. Future analyses of cause-specific excess mortality may provide additional information about these patterns.

As more information is available, and more complete data are received to obtain estimates, these refinements may be made and changes to the weighting methods will impact the estimates. Any changes to the methods or weighting algorithm will be noted in the Technical Notes when they occur.

Completeness

Methods to address reporting lags (i.e. underreporting) were updated as of May 12, 2020. Generally, these updates resulted in estimates that are further in the past being slightly lower, and further than the previous estimates, the impact of extreme weights in some jurisdictions was reduced.

Accounts for potential incomplete reporting of deaths in recent weeks. Counts were weighted by the inverse of completeness. Completeness was estimated as follows. Using provisional death files 2018-2019, weekly provisional counts were compared to final counts. For each week, the proportion of deaths reported in each week was calculated at various lag times (e.g., 1 week following the death, 2 weeks, 3 weeks, up to 26 weeks) by reporting jurisdiction. Median values were used to estimate completeness. Ratios were then averaged across the 52 weeks in 2018-2019 to generate 'final' weights for each week, by jurisdiction. Weekly counts of deaths were included for deaths in the most recent provisional counts, and the lag or reporting delay. These random effects were specified using a type1 random walk distribution, where a random effect for each jurisdiction depended on the value for the prior time period, plus an error term. These models were implemented using R INLA (3). Posterior predicted median values of completeness by jurisdiction and week were used to weight the observed counts. Weighted counts of deaths from all causes were used to fit models to estimate expected counts and prediction intervals for excess deaths, which can be found in a separate file. The number of deaths were applied as weights to adjust for incomplete reporting of provisional mortality data. For example, if provisional mortality data for a jurisdiction indicated that 50% of deaths were reported in a week, the death counts would be complete within 2 weeks of death, then the weights for that jurisdiction would be 2 for data presented with a 1 week lag. Data are provisional and subject to change. Death counts are based on provisional death certificate data and may not be complete. Weekly provisional death counts are based on partial data and may not be complete. Decline in the observed numbers of deaths in recent weeks should not be interpreted to mean that the numbers of deaths are decreasing. An increase in observed deaths compared with prior weeks may reflect a lag in death certificates complete in recent weeks. While the weighting method is intended to mitigate the impact of underreporting, it may not be sufficient to overcome the impact of incomplete reporting. Therefore, it is not given that an increase in observed weather decreases in the number of deaths is due to underreporting or to true declines and more complete data is received.

Mortality Outcomes

Weekly counts of deaths from all causes, including those not attributed to COVID-19, may provide data to monitor the impact of COVID-19 on other causes of death. For example, if COVID-19 was not mentioned on the death certificate as a suspected or confirmed cause of death, all-cause mortality can provide information on whether an excess number of deaths is observed, even when COVID-19 mortality may be undercounted. These estimates can also provide information on whether COVID-19 may be indirectly related to COVID-19. For example, if deaths from other causes may increase as a result of health care shortages due to COVID-19. Additionally, deaths from all causes during the COVID-19 pandemic can be compared to historical data to assess how COVID-19 may be affecting other causes of death.

Comparing these two sets of estimates – excess deaths with and without COVID-19 – can provide insight about how many excess deaths are attributed to COVID-19, and how many excess deaths are due to other causes of death. These deaths could represent misclassified COVID-19 deaths, or potentially could be indirectly related to COVID-19. Additionally, death certificates may not be completed within the same timeline for all causes of death, when cause of death information becomes available. It may be the case that some excess deaths that are not attributed to COVID-19 may be due to other causes of death that have been reported on death certificates during 1918, COVID-19. These analyses will be updated periodically, and the numbers presented will change as more data are received.

Cause of Death

As of June 3, 2020, weekly counts of deaths due to select causes of death are presented. These causes were selected based on analyses of unmatched conditions reported on death certificates where COVID-19 was listed as a cause of death (see https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm#VitalStatistics). Some causes with insufficient numbers of deaths by week and jurisdiction were combined with other categories, and can cause was added to the Underlying cause disease and dementia (ICD-10 codes G30-G31). These estimates are based on the underlying cause of death, and include Respiratory diseases, Circulatory diseases, Malignant neoplasms, and Alzheimer disease and dementia (ICD-10 codes were used to classify deaths according to the following causes:

- Respiratory diseases
  - Influenza and pneumonia (J09-J18)
  - Chronic lower respiratory diseases (J40-J47)
  - Other diseases of the respiratory system (J00-J06, J20-J39, J60-J70, J80-J86, J90-J94, J95-J99, R09.2, U04)
- Circulatory diseases
  - Hypertensive diseases (I10-I15)
  - Ischemic heart disease (I20-I25)
  - Heart failure (I50)
  - Cerebrovascular diseases (I60-I69)
  - Other disease of the circulatory system (I00-I09, I26-I49, I51-I52, I70-I99)
- Malignant neoplasms (C00-C97)
- Alzheimer disease and dementia (G30, G31, F01, F03)
- Other select causes of death
  - Diabetes (E10-E14)
  - Renal failure (N17-N19)
  - Sepsis (A40-A41)

Weekly counts of deaths for these and other causes of death could represent misclassified COVID-19 deaths, or potentially could be indirectly related to COVID-19 e.g., deaths from other causes occurring in the context of health care shortages or overburdened health care systems). Additionally, death certificates may not be completed within the same timeline for all causes of death, when cause of death information becomes available. It may be the case that some excess deaths that are not attributed to COVID-19 may be due to other causes of death that have been reported on death certificates during 1918, COVID-19. These analyses will be updated periodically, and the numbers presented will change as more data are received.

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Limitations

These estimates are based on provisional data, which are incomplete. The weighting method applied may not fully account for reporting lags in the most recent weeks and may not present the most accurate estimates. Incomplete reporting lags are currently much longer than they have been in past years, and death counts for 2020 are therefore underestimated. Although the weighting method is intended to account for differences in reporting patterns in delay timeliness in certain jurisdictions, Unweighted estimates are provided, so that users can see the impact of weighting on the estimates. Weighted estimates are intended to account for differences in reporting patterns in delay timeliness, but may underestimate the true counts of deaths in recent weeks in some jurisdictions, and may be higher than estimates when using weighted estimates, but not the unweighted. The estimates presented may be an early indication of excess mortality related to COVID-19, but should be interpreted with caution, until more data are available. In some cases, small numbers of deaths, and/or a possible true recent improvements in the timeliness of data could also contribute to the observed increase in estimated excess deaths. Estimates based on small numbers of deaths are unweighted. Coverage, lag, and completeness of death count data reported to NCHS vary by state. For example, in some states (e.g., Connecticut, North Carolina) either due to the lack of provisional data or insufficient weighting to address incomplete data.

The completeness of provisional data varies by cause of death and by age group. However, the weights applied do not account for this variability. Estimates of excess deaths among persons aged 85 years and older are very high for some cause of deaths. For example, provisional data on deaths among younger age groups is typically less complete than data on deaths among persons aged 85 years and older. The weighting method does not fully account for this, and the estimates of excess deaths among persons aged 85 years and older are very high for some cause of deaths. For example, for some causes of death and likely too low, as reporting lags are typically larger for specific causes of death than for all cause mortality. To minimize the degree of underreporting, cause-specific estimates are presented with a two-week lag.

References

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Weekly Updates by...

Technical Notes