Excess Deaths Associated with COVID-19

Provisional Death Counts for Coronavirus Disease (COVID-19)

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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 specified time periods and expected numbers of deaths for the same time periods. This visualization provides weekly estimates of excess deaths by the jurisdiction of residence for the United States and for 47 jurisdictions with sufficient historical mortality data to determine whether mortality in 2020 was higher than expected.

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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 mentioned on the death certificate), tracking all cause mortality can provide information about whether an excess number of deaths is observed, even when COVID-19 mortality may be underestimated. Additionally, deaths from all causes excluding COVID-19 were also estimated. Comparing these two sets of estimates – excess deaths with and without COVID-19 – can provide insight into how many excess deaths are identified as due to COVID-19, and how many excess deaths are reported as due to other causes of death. These deaths could represent misclassified COVID-19 deaths, or potentially could be indirectly related to COVID-19. For example, deaths among persons with underlying conditions may be impacted by the context of the COVID-19 pandemic.

As of June 9, 2020, additional information on weekly counts of deaths by cause of death has been added to this release. Similar to all causes of death, these weekly counts can be compared to values from the same weeks in prior years to determine whether recent increases have been higher than expected given the historical patterns. Weekly counts of deaths from all causes and the weekly counts of deaths from all causes excluding reported or death certificates where COVID-19 was listed as a cause of death are available in the Provisional Mortality Statistics, 2020 through Last Week: https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm#AllCause#AllCause. Cause of death counts are based on the underlying cause of death, and presented for the United States, Census Regions and Divisions, Michigan's metropolitan, and Hispanic ethnicity. Additional information about due to external causes (i.e. injuries) or unknown causes are excluded. For more detail, see the Technical Notes section. Weekly counts of deaths were also added for Puerto Rico.

Estimates of excess deaths can be calculated in a variety of ways, and will vary depending on the methodology and assumptions about how many deaths are expected to occur. Estimates of excess deaths in this report are based on the difference between observed and expected deaths in jurisdictions (47). A range of values for the number of excess deaths was calculated as the difference between the observed count and one of two thresholds from the upper prediction bound of a 95% prediction interval (PI) for the COVID-19 pandemic (2020) period.

Provisional death counts are weighted to account for incomplete data. However, data for the most recent week(s) are still likely to be incomplete, and the number of deaths from all causes and from COVID-19 may be underestimated. Death counts for the most recent week(s) may increase in the days and weeks following the week ending date, as more death certificates are filed and processed by jurisdictions. For more information about the accuracy of the weighted estimates is obtained, further references to the weights may be made, which will impact the estimates, this change is the result of updating the weights and will be explained in the Technical Notes when they occur. More detail about the methods, weighting, data, and limitations can be found in the Technical Notes.

This visualization includes the following:

- **Number of excess deaths:** A range of estimates for the number of excess deaths was calculated as the difference between the observed count and one of two thresholds (either the average expected count or the upper bound threshold), by week and jurisdiction. Negative values, where the observed count is lower than the expected count, are set to zero.
- **Percent excess:** The percent excess was defined as the number of excess deaths divided by the threshold.
- **Number of deaths by Race/Ethnicity:** Estimates of the number of deaths by Race/Ethnicity were calculated by summing the excess deaths in each week from February 1, 2020 to present. Similarly, the total number of deaths for each Race/Ethnicity were calculated as a sum of jurisdiction-specific counts of excess deaths and deaths with negative values set to zero, and not directly estimated using the Farrington surveillance algorithm.

Select a dashboard from the menu, then click on "Update Dashboard" to navigate through the different graphs.

- The first dashboard shows the weekly predicted counts of deaths from all causes, and the threshold for the expected number of deaths. Select a jurisdiction from the drop-down menu to select certain jurisdictions.
- The second dashboard shows the weekly predicted counts of deaths from all causes and the weekly count of deaths from all causes excluding COVID-19 deaths. Select a jurisdiction from the drop-down menu to select certain jurisdictions.
- The third dashboard shows the weekly counts of deaths from all causes. Predicted counts (weighted) are shown, along with reported counts (unweighted). Select a jurisdiction from the drop-down menu to select certain jurisdictions. Select a cause of death to view jurisdictions.
- The fourth dashboard shows the total number of excess deaths since early February, 2020. Jurisdictions with one or more excess deaths are plotted. Use the radio buttons and select one measure of excess deaths (number or percent) to view the map and select certain jurisdictions.
- The fifth dashboard shows the percent by which the observed counts exceed the threshold (i.e. percent excess) by week and jurisdiction. 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 sixth dashboard shows weekly counts of death by age group. Use the drop-down menu to select certain jurisdictions.
- The seventh dashboard shows weekly counts of death by sex and jurisdiction. Use the drop-down menu to select certain jurisdictions and mortality outcomes (e.g., all-cause mortality, all-cause excluding COVID-19, and COVID-19 deaths).
- The eighth dashboard shows the change in the weekly number of deaths in 2020 relative to 2015-2019, by race and Hispanic origin. Use the drop-down menu to select certain jurisdictions.
- The ninth dashboard shows the number of deaths by select cause of death groups (Respiratory diseases, Circulatory diseases, Malignant neoplasms, and Alzheimer disease and dementia). Use the drop-down menu to select a jurisdiction.
- The tenth dashboard shows the total number of deaths since early February, 2020, jurisdictions with one or more excess deaths are plotted. Use the radio buttons and select one measure of excess deaths (number or percent) to view the map and select certain jurisdictions.
- The eleventh dashboard shows the percent by which the observed counts exceed the threshold (i.e. percent excess) by week and jurisdiction. 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 twelfth dashboard shows weekly counts of death by age group. Use the drop-down menu to select certain jurisdictions.
- The thirteenth dashboard shows weekly counts of death by sex and jurisdiction. Use the drop-down menu to select certain jurisdictions and mortality outcomes (e.g., all-cause mortality, all-cause excluding COVID-19, and COVID-19 deaths).

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

Changes to the weighting methodology were made to this visualization, effective as of September 9, 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. Weights for several jurisdictions were adjusted downward to account for incomplete reporting of the timeliness of vital records data for deaths occurring in April through May of 2020. These analyses have suggested that timeliness has improved with shorter lags in reporting for these jurisdictions. New for this update are Florida, New Jersey, Pennsylvania, South Carolina, Texas, Vermont, Virginia, West Virginia, and Puerto Rico. Weights for these jurisdictions were adjusted according to improve the accuracy of the predicted counts in these jurisdictions.

Options

Select a dashboard:

- Weekly Excess Deaths

Excess deaths with and without COVID-19

Excess deaths with and without weighting

Number of Excess Deaths

Update Dashboard

- Percent Excess Deaths
- Weekly Number of Deaths by Age
- Number of Deaths by Race/Ethnicity
- Change in Number of Deaths by Race/Ethnicity
- Weekly Number of Deaths by Sex
- Weekly Number of Deaths by Cause of Death Group
- Weekly Number of Deaths by Subgroup
- 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 of Death
- Weekly Deaths by State and Ethnicity

Data CDC.gov®:

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

Select a jurisdiction

United States

Includes observed count above threshold
Predicted number of deaths from all causes
Predicted number of deaths

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 a week. Death counts are incomplete for the most recent week(s) and will increase as more death certificates are received and processed, estimated to NCHS and processed for reporting purposes. This delay can range from 1 week to 8 weeks or more, depending on the jurisdiction and cause of death. See https://www.cdc.gov/nchs/nvss/vsrr/COVID19/index.htm for more information. Data for New York includes New York City. Data on all deaths including COVID-19 include deaths with U07.1 as an underlying or multiple cause of death. Death counts were derived from the National Vital Statistics System database that provides the timeliest access to the vital statistics mortality data and may differ slightly from other sources due to differences in completeness. Predicted counts were calculated using a Farrington algorithm, which adjusts for reporting delays in the number of deaths relative to two different thresholds. The lower end of the excess death estimate range is generated by comparing the observed counts to the upper bound threshold, and a higher value for the excess death estimate range is generated by comparing the observed counts to the average expected number of deaths. Reported counts were weighted to account for potential underreporting in the most recent weeks.

This method is adapted from the Farrington algorithm for detecting outbreaks in surveillance data. The method has been used to determine whether a given jurisdiction has fewer deaths than expected given that the data are provisional. Provisional counts of deaths are known to be incomplete, and the number of deaths reported in recent weeks for a jurisdiction are likely to be lower than previous weeks' counts as further data are collected. In observed counts below the threshold, thus, the estimates of excess deaths – the numbers of deaths falling above the threshold – may be underestimated. Additional information about the Farrington algorithm for detecting unusual increases in mortality, and the adjustments for underreporting in recent weeks, is available at Vital Statistics Rapid Release report, No. 10 (https://stacks.cdc.gov/view/cdc/58828). Weights were applied to the counts to account for incomplete reporting in recent weeks.

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% prediction interval of the expected number of deaths. Estimates, where the observed count falls below the thresholds, were set to zero. The percent excess was defined as the number of excess deaths divided by the threshold. The total number of excess deaths in each state was calculated by summing the excess deaths in each week from February 1, 2020 to present. Similarly, the total number of excess deaths for each Race/Ethnicity were calculated by summing the total numbers of excess deaths across the jurisdictions.

Estimates of excess deaths for the US overall were calculated by a sum of jurisdiction-specific numbers of excess deaths (with negative values set to zero), and not directly estimated using the Farrington surveillance algorithm. Summation rather than estimation was chosen because the Farrington algorithm could not converge for the US data, and because the US overall is composed of the 50 jurisdictions, so the US overall excess deaths represent the sum of jurisdiction-specific excess deaths. Confidence intervals around the US overall excess deaths were not calculated because the jurisdictions are not independent of one another, and correlation between the jurisdictions would need to be accounted for in the calculation of the confidence intervals. Therefore, weighted estimates of the true number of deaths in the US when estimated directly compared with the sum of 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 the observed counts and the upper bound threshold of the prediction interval, results in lower estimates of excess deaths. The upper bound more readily identifies areas experiencing statistically significant higher than normal mortality. Using the expected count, by contrast, would indicate which areas are experiencing high overall mortality, which could be partly attributable to normal variation in the number of deaths expected. Excess deaths relative to different thresholds.

Finally, the estimates of excess deaths reported here may not be due to COVID-19, either directly or indirectly. The pandemic may have changed mortality patterns for other causes of death. Upward trends in other causes of death (e.g., suicide, drug overdose, heart disease) may contribute to excess deaths. Further analyses by the cause of cause-specific excess deaths will provide more information about these patterns.

As more information about the accuracy of the weighted estimates is obtained, further references 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 September 9, 2020. Generally, these updates resulted in estimates of the total number of excess deaths that were slightly smaller than in previous releases, however, for some jurisdictions with improved timeliness were reduced. While these adjustments likely reduce potential overestimation for those jurisdictions with improved timeliness, it remains the most recent data, for the US overall and many jurisdictions, that a larger number of deaths than previous releases. Some jurisdictions have little to no provisional data available in the most recent week(s) (CT, NC, NYC together, these jurisdictions combined account for less than 1% of the total number of provisional deaths in the US). Estimates for these and other certain jurisdictions with low or no provisional data in recent weeks may be unstable and should be interpreted with caution. Overall, the updated weighting methods mitigate the impact of the previous overestimation for some jurisdictions with improved timeliness but provide additional adjustments for underestimation in a lack of recent provisional data in other jurisdictions. We expect these health estimates for the US overall are expected to result in a larger degree of underestimation than in previous releases.

To account for potential underreporting in recent weeks, the Farrington algorithm has been updated and weights for some jurisdictions with improved timeliness were reduced. Using provisional data from 2018-2019, weekly provisional counts were compared to final data (with final data for 2019 approximately 90% complete) and a set of weights were created for each week, by jurisdiction, for lags 0 (the current week), 1 (one week prior), 2 (two weeks), 3 (three weeks) reporting jurisdictions. Complete weights by week, lag, and jurisdiction were modeled using zero-inflated binomial hierarchical models with random effects for jurisdiction and a cubic B-spline for the effect of lag, stratified by week of the year. These weights were applied to provisional counts, with the exception of September 5 weights for recent weeks that were adjusted to account for the impact of COVID-19 on reporting patterns, where counts in a given time period depend on the value for the prior time period, plus an error term. These models were implemented using R-INLA (https://www.r-inla.org/) and posterior medians were used to adjust the provisional counts. Prediction intervals for the counts by age, sex, and race/ethnicity for 2019 were averaged to provide the most recent possible estimates of completeness by jurisdiction, at given lag times. The proportion of deaths expected to be reported for the most recent week, by jurisdiction, was then estimated by dividing the 2019 weekly average proportion of provisional reporting across all lags by the proportion reported in the most recent week. Finally, the weekly proportions were cumulated from the most recent week to the first week of the pandemic, to obtain the cumulative proportion of deaths, then the weights for that jurisdiction would be 2 for data presented with a 1 week lag and 1.5 for data presented with a 2 week lag. Of note, these estimated completeness differ from the estimated proportion of death certificates expected to be received (NCVS), which only rely on the current counts of deaths relative to the expected number (i.e., percent over expected).

Weights in the first two weeks of data for each cause of death were adjusted and variable by cause and jurisdiction with relatively small numbers of deaths and where completeness of provisional data is typically very low (0-2 weeks in the first few weeks following the date of death. These jurisdictions: District of Columbia, Alaska, Connecticut, Hawaii, North Carolina, Oregon, Rhode Island, and West Virginia. To avoid highly inflated estimates in these jurisdictions, weights were trimmed at the 90th percentile for weeks reported with shorter lag times (e.g., 0-2 weeks additional) and the 95th percentile for weeks reported with longer lag times (3 weeks additional). These adjustments improved the timeliness of provisional data for deaths occurring in April through May of 2020. These analyses have suggested that timeliness has improved for these jurisdictions, with the exceptions of Florida, New Jersey, Pennsylvania, South Carolina, Texas, Vermont, Virginia, West Virginia, and Puerto Rico. Weights for these jurisdictions were adjusted according to improve the accuracy of the predicted counts.

Unweighted estimates are shown in line of the dashboards so that readers can examine the impact of weighting on estimates of excess deaths. For some jurisdictions, improvements in timeliness in 2020 relative to prior years will lead to weighted estimates that are too large, for other jurisdictions, the weighting may be insufficient to account for reporting delays. Weighted estimates are rounded to the nearest ten and within 6-4 weeks. As an additional step to guard against underreporting, the weighted counts of deaths by week and jurisdiction were compared with counts from the same week in previous years to obtain the percent by which the observed counts exceed the threshold (i.e. percent excess) by week and jurisdiction. If the number of excess deaths was calculated as the difference between the observed count and one of two thresholds from the upper bound of a 95% prediction interval (PI) for the COVID-19 pandemic (2020) period, by week and jurisdiction, the weighted values were compared with the control count. The weighted count for a jurisdiction was set to zero if the weighted count was less than the control count for that same jurisdiction and week and was 80%, this indicates that the weights are not fully accounting for incomplete data. In this case, the value of the COVID-19 pandemic period was replaced with the average of the two previous years' values for that jurisdiction and week.

Some jurisdiction where counts are between 1 and 9 are suppressed. Additionally, data for weeks where the counts are less than 50% of the expected number are also suppressed, as these provisional counts are highly incomplete and potentially misleading. This change resulted in showing estimates for fewer weeks in the most recent months. For example, in the US, for most causes of death, 2020 Week 17 ending April 25, Puerto Rico, lag two greater. Declines in the observed numbers of deaths in recent weeks should not be interpreted to mean that the number of deaths from all causes is lower than expected, but rather that deaths from some causes may not be reported in the most recent weeks. While the weighting method is intended to account for the impact of incomplete reporting in recent weeks, it may underestimate the problem of underreporting entirely. Therefore, it is not yet possible to determine whether decreases in the number of deaths are due to underreporting or to a reduction until more complete data is obtained.

Mortality Outcomes

Weekly counts of deaths from all causes were estimated, including deaths due to COVID-19. As many deaths due to COVID-19 may be assigned to other causes of death (for example, if COVID-19 was not diagnosed or not mentioned on the death certificate), tracking all-cause mortality can provide information about whether an excess number of deaths is observed, even when COVID-19 mortality may be underestimated. Deaths from all causes are presented by week and jurisdiction of residence. Weekly counts of deaths from all causes excluding COVID-19 deaths are also presented. These counts exclude deaths with U07.1 as an underlying or multiple cause, as this indicates a death attributed to COVID-19. Additionally, deaths from all causes **excluding COVID-19** were also estimated. These counts exclude deaths with U07.1 as an underlying or multiple cause, as this indicates a death attributed to COVID-19.

Comparing these two sets of estimates – excess deaths with and without COVID-19 – can provide insight about how many excess deaths are identified as due 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 are often initially completed without a cause of death, and are updated later with more information. For example, in the case that some excess deaths that are not attributed directly to COVID-19 will be updated in coming weeks with cause of death information that includes COVID-19. These updates will be updated periodically, and the numbers presented will change as more data are received.

Cause of Death

As of June 9, 2020, weekly counts of deaths due to select causes of death are presented. These causes were selected based on analyses of controlled conditions based 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#AllCause). Some causes with insufficient numbers of deaths by week and jurisdiction of residence to allow for reliable estimates of excess deaths, such as deaths due to influenza, are not shown in the dashboard (Tab 11). 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, J50-J70, J80-J86, J90-J96, J97-J99, R09.2, U04)
- Circulatory diseases
  - Hypertensive diseases (I10-I15)
  - Ischemic heart diseases (I20-I25)
  - Heart failure (I50)
  - Cerebrovascular diseases (I60-I69)
  - Other disease of the circulatory system (I00-I09, I26-I46, 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)

Estimated numbers of deaths due to these other causes of death could represent misclassified COVID-19 deaths, or potentially could be indirectly related to COVID-19. Deaths from other causes may be impacted by the context of the COVID-19 pandemic, for example, deaths due to systemic Deaths with an underlying cause of death COVID-19 **are not included** in these estimates of deaths due to other causes, but deaths with COVID-19 listed as a cause but not the underlying cause may be included in these estimates. Deaths with COVID-19 as a contributing cause, for example, in some cases COVID-19 may hasten an individual's death by weeks or months, but the individual may ultimately die from a different cause. For the majority of deaths where COVID-19 is reported on the death certificate (approximately 95%), COVID-19 is selected as the underlying cause of death.

Deaths due to all other natural causes were excluded (ICD-10 codes: A00-A39, A42-B99, D00-E07, E15-E88, E95-E99, F00-F02, F04-G26, G32-I49, I60-I69, I95-J09, J19-J96, J98-J99, N20-N98, O00-O99, P00-P96, Q00-Q99). Excess causes of death in recent months may underestimate the total, as the reporting lag is substantially longer for external causes of death (S). Additionally, causes of death where the underlying cause was unknown or ill-specified (R). Excess deaths associated with other causes of death, which is included under the Respiratory diseases category. Counts of deaths with unknown cause are typically substantially higher in provisional data, as many records are initially submitted without a specific cause of death and are updated once more information is available. Additionally, deaths with COVID-19 listed as a cause of death or underlying cause, provisional data are highly unreliable and inaccurate in recent weeks, and it can take six to nine months to ensure sufficiently accurate estimates. Excess deaths associated with other causes of death may be impacted by the context of the pandemic.

Estimates by cause of death and age at death are weighted, using the methods described above. The total counts of deaths above average by cause of death, by age, by sex, and by jurisdiction, are calculated by summing the excess deaths in each week from February 1, 2020 to present. Estimates of excess deaths are set to zero and therefore excluded from these sums. Weighted counts of deaths from all causes and from all causes excluding COVID-19 deaths are presented in the two average expected numbers of deaths are estimated, the total numbers of deaths across all the weeks in the dashboard, by cause of death, age, sex, and jurisdiction, are presented.

Estimates by race and Hispanic origin are weighted using the methods described above. Weekly counts are shown for deaths due to all causes, all cause excluding COVID-19, and COVID-19 deaths. Weighted counts of deaths are presented in the dashboard, however, the weighted counts of deaths due to COVID-19 will not match other data sources. For years 2018 – 2020, race and Hispanic origin categories are based on the 1997 Office of Management and Budget standards, allowing for the presentation of the multiracial decedents. Prior to 2018, race and ethnicity categories were reported in a different manner.

Limitations

These estimates are based on provisional data, which are incomplete. The weighting method applied may not fully account for reporting delays in the most recent week(s) and may underestimate the number of deaths in these weeks. Additional adjustments have been made to account for lags in reporting and death counts for 2020 in some jurisdictions. Unweighted estimates are provided in the dashboard to allow for comparisons with previous releases. Estimates of excess deaths are based on comparisons with historical data, and may differ from other sources due to differences in completeness. Some jurisdictions exhibit recent increases in deaths when using weighted estimates, but not for unweighted estimates because they are in part indicative of a lack of recent data. Weighted estimates for specific causes of death are likely too low, or reporting lags are largest for specific causes of death than for all-cause mortality. To minimize the danger of underreporting, specific estimates are presented with a two-week lag.

References

1. Noufaily A, Enki DG, Farrington P, Garthwaite P, Andrews N, Charlett A. An Improved Algorithm for Outbreak Detection in Multiple Surveillance Systems. Statistics in Medicine 2013;32(7):1206-1222.
2. Salmon M, Schumacher D, Höhle M. Monitoring Count Time Series in R: Aberration Detection in Public Health Surveillance. Journal of Statistical Software 2016;70(10):1-35.
3. Rue H, Martino S, Chopin N. Approximate Bayesian inference for latent Gaussian models using integrated nested Laplace approximations (with discussion). Journal of the Royal Statistical Society. Series B 2009;71(2):319-392.
4. Spencer MR, Anderson T. Timeliness of death certificates for mortality surveillance and provisional estimates. National Center for Health Statistics. 2019. https://www.cdc.gov/nchs/data/vsrr/report002.pdf.

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