Errata: This documentation was revised on February 10, 2026, after errors were found. Formula “U(R') = 684.8 (GAMMA.INV (0.975, 1998.6, 0.328095) = 684.8” on page 17 was revised to delete the unit increment (+ 1). Changes were made on pages 15, 17, and the last page of the document.

Implementation of New Data Presentation Standards for Rates and Counts for Mortality

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This report presents the new National Center for Health Statistics (NCHS) data presentation standards for rates and counts for mortality data (including updated statistical tests) to be implemented beginning with 2023 final data. This report is divided into three sections that explain how rates are calculated and describe the old and new standards used for presenting death rates and counts. The first section presents the methods used to produce death rates and their standard errors. The second section presents the standards used for the presentation of rates and counts for data years 2022 and earlier (1). The third section presents the new standards for the presentation of rates and counts implemented beginning with data year 2023 (2).

SECTION 1: Computing rates

Mortality data presented in published reports are not subject to sampling error. Mortality data, even based on complete counts, may be affected by random variation; that is, the number of deaths that actually occurred may be considered as one of a large series of possible results that could have arisen under the same circumstances (3,4). When the number of deaths is small, perhaps fewer than 100, random variation tends to be relatively large. Therefore, considerable caution must be observed in interpreting statistics based on small numbers of deaths.

Measuring random variability—To quantify the random variation associated with mortality statistics, an assumption must be made regarding the appropriate underlying distribution. Deaths, as infrequent events, can be viewed as deriving from a Poisson probability distribution. The Poisson distribution is simple conceptually and computationally, and provides reasonable, conservative variance estimates for mortality statistics when the probability of dying is relatively low (3). Using the properties of the Poisson distribution, the standard error (SE) associated with the number of deaths (D) is

$$\mathrm{SE}(D)=\sqrt{\mathrm{var}(D)}=\sqrt{D} \qquad [1]$$

where var(D) denotes the variance of D.

SE associated with crude and age-specific death rates (R) assumes that the population denominator (P) is a constant and is

$$\mathrm{SE}(R)=\sqrt{\mathrm{var}\left(\frac{D}{P^2}\right)}=\sqrt{\frac{1}{P^2}\,\mathrm{var}(D)}=\sqrt{\frac{D}{P^2}}=\frac{R}{\sqrt{D}} \qquad [2]$$

The coefficient of variation or relative standard error (RSE) is a useful measure of relative variation. RSE is calculated by dividing the statistic (such as number of deaths or death rate) into its SE and multiplying by 100. For the number of deaths,

$$\mathrm{RSE}(D)=100\frac{\mathrm{SE}(D)}{D}=100\frac{\sqrt{D}}{D}=100\sqrt{\frac{1}{D}}$$

For crude and age-specific death rates,

$$\mathrm{RSE}(R) = 100\frac{\mathrm{SE}(R)}{R} = 100\frac{R/\sqrt{D}}{R} = 100\sqrt{\frac{1}{D}}$$

Thus,

$$\mathrm{RSE}(D) = \mathrm{RSE}(R) = 100\sqrt{\frac{1}{D}} \qquad [3]$$

SE of the age-adjusted death rate (*R'*) is

$$\mathrm{SE}(R') = \sqrt{\sum_i \left(\frac{P_{si}}{P_s}\right)^2 \mathrm{var}(R_i)} = \sqrt{\sum_i \left\{\left(\frac{P_{si}}{P_s}\right)^2 \left(\frac{R_i^2}{D_i}\right)\right\}} \qquad [4]$$

where:

- R_i is the age-specific rate for the *i*th age group.
- P_{si} is the age-specific standard population for the *i*th age group from the U.S. standard population age distribution (1).
- P_s is the total U.S. standard population (all ages combined).
- D_i is the number of deaths for the *i*th age group.

RSE for the age-adjusted rate, RSE(R'), is calculated by dividing SE(R') from Formula 4 by the age-adjusted death rate, R', and multiplying by 100, as in

$$\mathrm{RSE}(R') = 100\frac{\mathrm{SE}(R')}{R'}$$

For tables showing infant and maternal mortality rates based on live births (*B*) in the denominator, calculation of SE assumes random variability in both the numerator and denominator. SE for IMR is:

$$\mathrm{SE}(IMR) = IMR \bullet \sqrt{\frac{var(D)}{E(D)^2} + \frac{var(B)}{E(B)^2}} = IMR \bullet \sqrt{\frac{1}{D} + \frac{1}{B}} \qquad [5]$$

where the number of births, *B*, is also assumed to be distributed according to a Poisson distribution, and E*(B)* is the expectation of *B*.

RSE for IMR is

$$\text{RSE}(IMR) = 100\frac{\text{SE}(IMR)}{IMR} = 100\sqrt{\frac{1}{D}+\frac{1}{B}} \quad [6]$$

For maternal mortality rates, Formulas 5 and 6 may be used to calculate SE and RSE by replacing the IMR with the maternal mortality rate.

Formulas 1–6 may be used for tables that use Census populations for calculating death rates, but not for death rates which are calculated using population estimates that are subject to sampling error, like the American Community Survey (ACS) populations.

SE associated with age-specific death rates adjusted for Hispanic origin and race misclassification ($\acute{R}_i$) on death certificates assumes the population denominator (P_i) is a constant and is

$$\text{SE}(\acute{R}_i) = \sqrt{[(CR_i^2\ \text{SE}(D_i)^2) + (D_i^2\ \text{SE}\,(CR_i)^2)] / P_i^2} \quad [7]$$

SE of the age-adjusted death rate adjusted for Hispanic origin and race misclassification ($\acute{R}'$) is

$$\text{SE}(\acute{R}') = \sqrt{\sum_i \left(\frac{P_{si}}{P_s}\right)^2 \text{SE}(\acute{R}_i)^2} \quad [8]$$

Classification quality has been evaluated for both race and a combination of Hispanic origin and race. For example, there are ratios for “White” regardless of Hispanic origin and for “White non-Hispanic” where:

- $\acute{R}_i$ is the age-specific rate adjusted for Hispanic origin and race misclassification on death certificates for the *i*th age group.
- P_i is the age-specific population for the *i*th age group.
- D_i is the age-specific number of deaths for the *i*th age group.
- CR_i is the age-specific classification ratio for the *i*th age group (see Table III in *Deaths: Final data for 2022* (1)).
- P_{si} is the age-specific standard population for the *i*th age group from the U.S. standard age distribution (1).
- P_s is the total U.S. standard population (all ages combined).

Death rates for Central American, Cuban, Dominican, Mexican, Puerto Rican, South American, and Other Hispanic populations, and death rates by marital status, and by educational attainment, are based on population estimates derived from the ACS and adjusted to resident population control totals (5). As a result, the rates are subject to sampling variability in the denominator as well as random variability in the numerator.

For crude and age-specific death rates (R), the SE is calculated as

$$\mathrm{SE}(R) = R \bullet \sqrt{\frac{1}{D} + \left(\frac{\mathrm{SE}(P)}{P}\right)^2} \qquad [9]$$

For age-adjusted death rates (R')

$$\mathrm{SE}(R') = \sqrt{\sum_i \left\{ \left(\frac{P_{si}}{P_s}\right)^2 \bullet R_i^2 \left[\frac{1}{D_i} + \left(\frac{\mathrm{SE}(P_i)}{P_i}\right)^2\right]\right\}} \qquad [10]$$

where SE*(P)* in Formulas 9 and 10 represents the SEs of ACS population estimates.

SECTION 2: Presentation standards for death rates and counts for data years 2022 and earlier

Suppression of unreliable rates—Beginning with 1989 data, an asterisk is shown in place of a crude or age-specific death rate based on fewer than 20 deaths, the equivalent of an RSE of 23% or more. The limit of 20 deaths is a convenient, if somewhat arbitrary, benchmark, below which rates are considered to be too statistically unreliable for presentation. For infant and maternal mortality rates, the same threshold of fewer than 20 deaths is used to determine whether an asterisk is presented in place of the rate. For age-adjusted death rates, the suppression criterion is based on the sum of age-specific deaths; that is, if the sum of the age-specific deaths is less than 20, an asterisk replaces the rate.

Sampling variability in population denominators based on ACS data had a substantial impact on the overall variability in death rates. Therefore, the number of deaths in the numerator was not used as the sole suppression factor. RSEs for affected rates are derived from Formulas 9 and 10 by dividing the result of Formula 9 by the crude and age specific rate, and the result of Formula 10 by the age-adjusted rate and then multiplying by 100. Rates are replaced by asterisks if the calculated RSE is 23% or more.

Confidence intervals and statistical tests based on 100 deaths or more—When the number of deaths is large, a normal approximation may be used in calculating confidence intervals and statistical tests. What is considered to be large, in terms of number of deaths, is to some extent subjective. In general, for crude and age-specific death rates and for infant and maternal mortality rates, the normal approximation performs well when the number of deaths is 100 or more. For age-adjusted rates, the criterion for use of the normal approximation is somewhat more complicated (4,6). Formula 11 is used to calculate 95% confidence limits for the death rate when the normal approximation is appropriate:

$$L(R) = R - 1.96(SE(R)) \text{ and } U(R) = R + 1.96(\mathrm{SE}(R)) \qquad [11]$$

where L*(R)* and U*(R)* are the lower and upper limits of the confidence interval, respectively. The resulting 95% confidence interval can be interpreted to mean that the chances are 95 in 100 that the "true" death rate falls between L*(R)* and U*(R)*. For example, suppose that the crude death rate for Malignant neoplasms is 186.0 per 100,000 population based on 565,469 deaths. Lower and upper 95% confidence limits using Formula 11 are calculated as

$$L(186.0) = 186.0 - 1.96\ (0.25) = 185.5$$

and

$$U(186.0) = 186.0 + 1.96\ (0.25) = 186.5$$

Thus, the chances are 95 in 100 that the true death rate for Malignant neoplasms is between 185.5 and 186.5. Formula 11 can also be used to calculate 95% confidence intervals for the number of deaths, age-adjusted death rates, IMRs, and other mortality statistics when the normal approximation is appropriate, by replacing R with D, R', IMR, or other estimates.

When testing the difference between two rates, R_1 and R_2 (each based on 100 or more deaths), the normal approximation may be used to calculate a test statistic, z, such that

$$z = \frac{R_1 - R_2}{\sqrt{\mathrm{SE}(R_1)^2 + \mathrm{SE}(R_2)^2}} \qquad [12]$$

If $|z| \geq 1.96$, then the difference between the rates is statistically significant at the 0.05 level. If $|z| < 1.96$, then the difference is not statistically significant. Formula 12 can also be used to perform tests for other mortality statistics when the normal approximation is appropriate (when both statistics being compared meet the normal criteria) by replacing R_1 and R_2 with D_1 and D_2, R'_1 and R'_2, or other estimates. For example, suppose that the male age-adjusted death rate for Malignant neoplasms of trachea, bronchus and lung (lung cancer) is 65.1 per 100,000 U.S. standard population in the previous data year (R_1) and 63.6 per 100,000 U.S. standard population in the current data year (R_2). SE for each of these figures, $\mathrm{SE}(R_1)$ and $\mathrm{SE}(R_2)$, is calculated using Formula 4. A test using Formula 12 can determine if the decrease in the age-adjusted rate is statistically significant:

$$z = \frac{65.1 - 63.6}{\sqrt{(0.222)^2 + (0.217)^2}} = 4.83$$

Because $z = 4.83 > 1.96$, the decrease from the previous data year to the current data year in the male age-adjusted death rate for lung cancer is statistically significant.

Confidence intervals and statistical tests based on fewer than 100 deaths—When the number of deaths is not large (fewer than 100), the Poisson distribution cannot be approximated by the normal distribution. The normal distribution is symmetrical, with a range from $-\infty$ to $+\infty$. As a result, confidence intervals based on the normal distribution also have this range. The number of deaths or the death rate, however, cannot be less than zero. When the number of deaths is very small, approximating confidence intervals for deaths and death rates using the normal distribution will sometimes produce lower confidence limits that are negative. The Poisson distribution, in contrast, is an asymmetric distribution with zero as a lower bound—confidence limits based on this distribution will never be less than zero. A simple method based on the more general family of gamma distributions, of which the Poisson is a member, can be used to approximate confidence intervals for deaths and death rates when the number of deaths is small (4,7). For more information regarding how the gamma method is derived, see "Derivation of gamma method" at the end of this section.

Calculations using the gamma method can be made using commonly available spreadsheet programs or statistical software (such as Excel or SAS) that include an inverse gamma function. In Excel, the function "gammainv (probability, alpha, beta)" returns values associated with the inverse gamma function for a given probability between zero and one. For 95% confidence limits, the probability associated with the lower limit is $0.05/2 = 0.025$, and with the upper limit, $1 - (0.05/2) = 0.975$. Alpha and beta are parameters associated with the gamma distribution. For the number of deaths and crude and age-specific death rates, alpha = D (the number of deaths) and beta = 1. In

Excel, the following formulas can be used to calculate lower and upper 95% confidence limits for the number of deaths and crude and age-specific death rates:

$$\text{L}(D) = \text{GAMMAINV}(0.025, \text{D}, 1)$$

and

$$\text{U}(D) = \text{GAMMAINV}(0.975, \text{D} + 1, 1)$$

Confidence limits for the death rate are then calculated by dividing L*(D)* and U*(D)* by the population (*P*) at risk of dying (see Formula 19).

Alternatively, 95% confidence limits can be estimated using the lower and upper confidence limit factors shown in Table XI in *Deaths: Final Data for 2022* (1). For the number of deaths, *D*, and the death rate, *R*,

$$\text{L}(D) = L \bullet D \text{ and } \text{U}(D) = U \bullet D \qquad [13]$$

and

$$\text{L}(R) = L \bullet R \text{ and } \text{U}(R) = U \bullet R \qquad [14]$$

where *L* and *U* in both formulas are the lower and upper confidence limit factors that correspond to the appropriate number of deaths, *D*, in *Deaths: Final Data for 2022* (1). For example, suppose that the death rate for American Indian and Alaska Native non-Hispanic females ages 1–4 is 39.5 per 100,000 and based on 50 deaths. Applying Formula 14, values for *L* and *U* from Table XI *Deaths: Final Data for 2022* (1) for 50 deaths are multiplied by the death rate, 39.5, such that

$$\text{L}(R) = \text{L}(39.5) = 0.742219 \bullet 39.5 = 29.3$$

and

$$\text{U}(R) = \text{U}(39.5) = 1.318375 \bullet 39.5 = 52.1$$

These confidence limits indicate that the chances are 95 in 100 that the actual death rate for American Indian and Alaska Native non-Hispanic females ages 1–4 is between 29.3 and 52.1 per 100,000.

Although the calculations are similar, confidence intervals based on small numbers for age-adjusted death rates, infant and maternal mortality rates, and rates that are subject to sampling variability in the denominator are somewhat more complicated (4).

Refer to the last published version of the Mortality Technical Appendix for further detail: https://www.cdc.gov/nchs/data/statab/techap95.pdf (6).

When comparing the difference between two rates (R_1 and R_2), where one or both of the rates are based on fewer than 100 deaths, a comparison of 95% confidence intervals may be used as a statistical test. If the 95% confidence intervals do not overlap, then the difference is considered to be statistically significant at the 0.05 level. A simple rule of thumb is: If $R_1 > R_2$, then test if $L(R_1) > U(R_2)$, or if $R_2 > R_1$, then test if $L(R_2) > U(R_1)$. Positive tests denote statistical significance at the 0.05 level. For example, suppose that American Indian and Alaska Native non-Hispanic females ages 1–4 have a death rate (R_1) of 39.5 based on 50 deaths, and Asian non-Hispanic females ages 1–4 have a death rate (R_2) of 20.1 per 100,000 based on 86 deaths. The 95% confidence limits for R_1 and R_2 calculated using Formula 14 would be

$$L(R_1) = L(39.5) = 0.742219 \bullet 39.5 = 29.3$$

and

$$U(R_1) = U(39.5) = 1.318375 \bullet 39.5 = 52.1$$

$$L(R_2) = L(20.1) = 0.799871 \bullet 20.1 = 16.1$$

and

$$U(R_2) = U(20.1) = 1.234992 \bullet 20.1 = 24.8$$

Because $R_1 > R_2$ and $L(R_1) > U(R_2)$, it can be concluded that the difference between the death rates for American Indian and Alaska Native non-Hispanic females ages 1–4 and Asian non-Hispanic females of the same age is statistically significant at the 0.05 level. That is, accounting for random variability, Asian non-Hispanic females ages 1–4 have a death rate significantly lower than that for American Indian and Alaska Native non-Hispanic females of the same age.

This test may also be used for other statistics when the normal approximation is not appropriate for one or both of the statistics being compared, by replacing R_1 and R_2 with D_1 and D_2, R'_1 and R'_2, or other estimates.

Users of the method of comparing confidence intervals should be aware that this method is a conservative test for statistical significance—the difference between two rates may, in fact, be statistically significant even though confidence intervals for the two rates overlap (8). Caution should be observed when interpreting a nonsignificant difference between two rates, especially when the lower and upper limits being compared overlap only slightly.

Derivation of gamma method—For a random variable X that follows a gamma distribution $\Gamma(y,z)$, where y and z are the parameters that determine the shape of the distribution (8), $E(X) = yz$ and $Var(X) = yz^2$. For the number of deaths, D, $E(D) = D$ and $Var(D) = D$. It follows that $y = D$ and $z = 1$, and thus,

$$D \sim \Gamma(D,1) \quad [15]$$

From Equation 13, it is clear that the shape of the distribution of deaths depends only on the number of deaths.

For the death rate, R, $E(R) = R$ and $Var(R) = D/P^2$. It follows, in this case, that $y = D$ and $z = P^{-1}$, and thus,

$$R \sim \Gamma(D,P^{-1}) \qquad [16]$$

A useful property of the gamma distribution is that for $X \sim \Gamma(y,z)$, X can be divided by z such that $X/z \sim \Gamma(y,1)$. This converts the gamma distribution into a simplified, standard form, dependent only on parameter y. Expressing Formula 14 in its simplified form gives:

$$R/P^{-1} = D \sim \Gamma(D,1) \qquad [17]$$

From Equation 15, it is clear that the shape of the distribution of the death rate is also dependent solely on the number of deaths.

Using the results of Equations 13 and 15, the inverse gamma distribution can be used to calculate upper and lower confidence limits. Lower and upper $100(1 - \alpha)$ percentage confidence limits for the number of deaths, $L(D)$ and $U(D)$, are estimated as

$$L(D) = \Gamma^{-1}{}_{(D,1)}(\alpha / 2) \text{ and } U(D) = \Gamma^{-1}{}_{(D+1,1)}(1 - \alpha /2) \qquad [18]$$

where Γ^{-1} represents the inverse of the gamma distribution and D + 1 in the formula for $U(D)$ reflects a continuity correction, which is necessary because D is a discrete random variable and the gamma distribution is a continuous distribution. For a 95% confidence interval, $\alpha = 0.05$. For the death rate, it can be shown that

$$L(R) = L(D)/P \text{ and } U(R) = U(D)/P \qquad [19]$$

For more detail regarding the derivation of the gamma method and its application to age-adjusted death rates and other mortality statistics, see References (3,9,10).

SECTION 3: Presentation standards for death rates and counts for data years 2023 and later

Beginning with 2023 data, new presentation standards were introduced for death rates and statistical tests (2). This section explains the new statistical tests in determining whether death rates should be presented or suppressed based on statistical reliability.

Measuring precision—The width of a two-sided confidence interval (CI), i.e., the difference between the CI's upper and lower limits, allows the assessment of an estimate's precision. Technical definitions of confidence intervals can be found in standard statistical textbooks (11,12). Briefly, for a 95% confidence interval, the true value of the death rate is expected to be contained in 95% of the calculated intervals in a large series of possible numbers of deaths that could have occurred under the same circumstances. The relative width of the confidence interval, which is calculated as the length of the interval divided by the estimate multiplied by 100, is a useful measure of relative precision.

Confidence intervals—A simple method based on the relationship between the tail probabilities of the Poisson distribution and those of the gamma family of distributions can be used to construct confidence intervals (CI) for deaths and death rates that maintain nominal coverage (e.g., 0.95 or greater probability that a 95% confidence interval covers the true value) (3,4,7).

Calculations of confidence intervals for age-specific death rates using the gamma method have been explained in the previous section.

For the age-adjusted death rate, $R' = \sum_i \frac{P_{si}}{P_s} R_i$, no exact 95% confidence interval limits are known. Instead, the Fay-Feuer modification of the gamma method is used (4). The Fay-Feuer method produces approximate 95% confidence intervals for age-adjusted death rates that maintain the nominal 95% coverage. The SE of the age-adjusted death rate (R') is shown in Formula 4.

The Fay-Feuer method assumes that there exists a gamma-distributed random variable Z with mean equal to R' and variance equal to $\mathrm{SE}(R')^2$ such that the tail probabilities of Z and R' are (approximately) equal. As a result, the lower limit $\mathrm{L}(R')$ of a 95% confidence interval is obtained from the 0.025-quantile of a gamma distribution with parameters alpha = $[R'/\mathrm{SE}(R')]^2$ and beta = $\mathrm{SE}(R')^2/R'$. (Note that in the case of crude or age-specific death rates, alpha = $[R/\mathrm{SE}(R)]^2 = D$ and beta = $\mathrm{SE}(R)^2/R = 1/P$; see Formula 2.) For the upper limit $\mathrm{U}(R')$, the number of deaths, D_k, in the age group with the largest value of $P_{si}/(P_s P_i)$ in Formula 3 is incremented by 1, leaving all the other age-specific counts D_i unchanged, and the 0.975-quantile is computed for the gamma distribution with parameters alpha = $(R' + \kappa)^2 / (\mathrm{SE}(R')^2 + \kappa^2$ and beta = $(\mathrm{SE}(R')^{2+} \kappa^2) / (R' + \kappa)$, and $\kappa = \max_i\{P_{si}/(P_s P_i)\}$.

Example calculations for the Native Hawaiian and Other Pacific Islander (NHOPI) non-Hispanic female population are shown in Table I. The columns in the table are described below as follows:

Column 1 shows deaths.

Column 2 shows populations.

Column 3 shows age-specific death rates per 100,000 population. The crude death rate is 638.7 deaths per 100,000 population (bottom of column 3).

Column 4 shows the year 2000 U.S. standard population.

Column 5 shows the weights used in calculating the age-adjusted death rate.

Column 6 shows the Kappa factor used in calculating the confidence intervals (CI) for the age-adjusted death rate.

Column 7 shows the calculation of the age-adjusted death rate by applying the weights in column 5 to the age-specific death rates in column 3. The sum of values in column 7 equals the age-adjusted death rate (655.4 per 100,000 standard population).

Column 8 shows the calculation of the standard error squared (SE^2) of the age-adjusted death rate by summing the values for each age-specific death rate (214.998885 or 215.0).

The bottom of Table I shows a summary of the calculation of the crude death rate.

The bottom of Table I also includes a summary of the values needed to calculate the CI for the age-adjusted death rate. The age-adjusted death rate is 655.4 (bottom of column 7). The standard error of the age-adjusted death rate is the sum of values in column 8 (215.0).

The alpha parameters $R'^2 / \mathrm{SE}(R')^2$ and $(R'+\kappa)^2 / (\mathrm{SE}(R')^2+\kappa^2)$ are calculated as 1,997.7 and 1,998.6, respectively, whereas the beta parameters $\mathrm{SE}(R')^2 / R'$ and $(\mathrm{SE}(R')^2+\kappa^2) / (R'+\kappa)$ are calculated as 0.328062 and 0.328095, respectively. The alpha and beta parameters are used in the calculation of CI for age-adjusted death rates.

The maximum value of the kappa parameter, $P_{si}/(P_s P_i)$ is $\kappa = 0.384372$ per 100,000 (see column 6, 75-84 years).

Using function GAMMA.INV in Excel, the approximate 95% CI intervals are $L(R') = 626.9$ (GAMMA.INV(0.025, 1997.7, 0.328062) = 626.9) and $U(R') = 684.8$ (GAMMA.INV(0.975, 1998.6, 0.328095) = 684.8) per 100,000.

For presenting statistically reliable age-adjusted death rates, the standard is based on the relative width of the 95% two-sided CI. The absolute width of the interval is the difference between the upper CI and the lower CI. The relative width of the CI is the length of the interval divided by the rate multiplied by 100. A relative width of 160% or narrower is needed to present the rate. Using the example presented in the previous paragraph, the relative width is ((684.8 – 626.9) / 655.4) * 100 = 8.8% (2). Since the relative width of the CI is less than 160%, the age-adjusted death rate can be shown with confidence.

For tables showing infant and maternal mortality rates based on live births (*B*) in the denominator, variance calculations assume random variability and independence, of the numerator and denominator. This approach is conservative, as *B* and deaths (*D)* will be positively correlated. Assuming independence and dropping the covariance term will result in a larger variance and confidence interval. The SE for the infant mortality rate (IMR) is shown in Formula 5.

The recommended approximate 95% confidence interval for IMR is

$$\exp\left\{\ln(\text{IMR}) \pm \ t_{0.025,\text{df}}\sqrt{\frac{1}{D}+\frac{1}{B}}\right\} \qquad [20]$$

where the degrees of freedom (df) for the Student-t critical value $t_{0.025,\text{df}}$ are given by df = min(*D*, *B*) – 1 (2).

The SE and RSE for maternal mortality rates can be calculated using Formulas 5 and 6 by substituting the IMR with the maternal mortality rate.

Suppression of unreliable rates—Beginning with 2023 data, an asterisk is shown in place of a crude or age-specific death rate based on fewer than 10 deaths. The limit of 10 deaths is a minimum benchmark, below which rates are considered to be too statistically unreliable for presentation. It is also consistent with the minimum threshold required for disclosure protection of sub-national vital statistics data at NCHS (9). Additionally, to guard against overly imprecise estimates when the number of deaths upon which they are based is 10 or more, the relative width of the appropriate 95% confidence interval, as described previously, should be less than or equal to 160% for the estimate to be presented. If the relative width is greater than 160%, an asterisk is presented.

For infant and maternal mortality rates, the same initial threshold of fewer than 10 deaths is used to determine whether an asterisk is presented in place of the rate. Furthermore, the relative width of the 95% confidence interval in Formula 5 should be less than or equal to 160% for the rate to be presented.

For age-adjusted death rates, the threshold is based on the sum of age-specific deaths; that is, if the sum of the age-specific deaths is less than 10, an asterisk replaces the rate. Furthermore, even if there are 10 or more underlying deaths, the relative width of the 95% confidence interval derived from Fay-Feuer approximation described previously should be less than or equal to 160% for the age-adjusted rate to be presented.

For death rates subject to sampling variability in the denominators, in addition to the sample size criterion of 10 or more and the relative confidence interval width criterion of 160% or less, the denominator effective sample size and degrees of freedom also need to be examined to determine whether an estimate should be presented.

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Table I. Example calculation of 95% confidence intervals for the age-adjusted death rate using the Fay-Feuer method

Age group (years)	Deaths (D_i) (1)	Population (P_i) (2)	Age-Specific Death Rate (R_i) (1) / (2)*100,000= (3)	2000 U.S. Standard Population (P_{si}) (4)	2000 U.S. Standard Population weights (4) / $\sum P_s$ = (5)	Kappa (k) ((4) / $\sum P_s \cdot$ (2))*100000 = (6)	Calculation of age-adjusted death rate (3) * (5) = (7)	age-adjusted death rate standard error squared (SE^2) $(5)^2 * ((3)^2 / (1))$ = (8)
Younger than 1	37	3,914	945.3	3,794,901	0.01382	0.353042	13.06220	4.611381
1–4	7	16,306	42.9	15,191,619	0.05532	0.339237	2.37305	0.804484
5–14	7	44,372	15.8	39,976,619	0.14556	0.328052	2.29990	0.755650
15–24	34	44,094	77.1	38,076,743	0.13865	0.314432	10.68957	3.360794
25–34	73	48,814	149.5	37,233,437	0.13557	0.277738	20.26845	5.627536
35–44	142	49,968	284.2	44,659,185	0.16261	0.325436	46.21481	15.040903
45–54	240	38,610	621.6	37,030,152	0.13483	0.349222	83.81327	29.269431
55–64	358	35,152	1,018.4	23,961,506	0.08725	0.248205	88.85436	22.053347
65–74	453	25,016	1,810.8	18,135,514	0.06604	0.263972	119.57672	31.564218
75–84	410	11,666	3,514.5	12,314,793	0.04484	0.384372	157.59300	60.574522
85 and older	296	4,150	7,132.5	4,259,173	0.01551	0.373700	110.61482	41.336618
Total	2,057	322,062	638.7	274,633,642	1.00000		655.4	214.998885

Crude Rate Calculations

$\sum D_i$	$\sum P_i$	$\sum D_i / \sum P_i$
2,057	322,062	638.7

Age-adjusted Rate Calculations

R'	$SE(R')^2$	Alpha (L(R')) = $R'^2 / SE(R')^2$	Beta (L(R')) = $SE(R')^2 / R'$	maxKappa (k)
655.4	215.0	1,997.7	0.328062	0.384372

$L(R')$	$U(R')$	Alpha (U(R')) = $(R' + k)^2 / (SE(R')^2 + k^2$	Beta (U(R')) = $(SE(R')^2 + k^2) / (R' + k)$
626.9	684.8	1,998.6	0.328095

Relative width (%) 8.8

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.