



Timeliness of Infant Death Data for Infant Mortality Surveillance and Quarterly Provisional Estimates

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Abstract

Objective—This report evaluates the timeliness of infant death data for the National Center for Health Statistics' (NCHS) mortality surveillance program. The lag time between when the infant death occurred and when information on the death certificate became available for analysis is evaluated.

Methods—Provisional mortality data for deaths occurring from January 2015 through December 2016 were used to calculate the percentage of death records available for analysis at various lag times after the deaths occurred. The deaths were aggregated by month and year of death, age at death, cause of death, and jurisdiction of occurrence for each weekly provisional data set and compared with counts generated using final historical data files. Since preliminary analyses showed that lag times are longer for infant deaths occurring in the beginning of the year, analyses of timeliness by age at death, cause of death, and jurisdiction of occurrence were limited to deaths occurring in the first quarter of each year.

Results—Lag times were longer for deaths occurring earlier in the year and shorter for infant deaths occurring later in the year. Lag times were similar for neonatal and postneonatal deaths. Timeliness of provisional data varied by cause of death, with longer lag times for sudden infant death syndrome (SIDS) and unintentional injury. Timeliness also varied by

jurisdiction of occurrence. For infant deaths occurring in the first quarters of 2015 and 2016, 11 and 8 states, respectively, had complete provisional data within 13 weeks, while provisional data were not complete until 52 weeks or more for 17 states in 2015 and 2016.

Conclusion—Quarterly provisional estimates of infant mortality are released with a 9-month lag. While the timeliness of infant death data differs by various factors, completeness at 9 months was more than 90% by month, age, and cause of death.

Keywords: infant mortality rates • maternal and infant health • National Vital Statistics System

Introduction

The National Center for Health Statistics (NCHS) collects and disseminates the nation's official vital statistics through the National Vital Statistics System (NVSS). Through NVSS, jurisdictions (including the 50 states, New York City, the District of Columbia, and 5 U.S. territories) send birth and death data to NCHS. The NVSS surveillance program was initiated by NCHS to provide more timely access to vital statistics data for the purposes of conducting public health surveillance of key indicators from the birth and death data (1–3).

A recent report described the timeliness of mortality data by cause of death, finding that lag times between when the death occurred

and when the data were available for analysis in the NVSS surveillance database were longer for deaths due to injuries, suicide, and drug overdose and shorter for other causes such as heart disease (4,5). That report did not examine infant deaths separately.

Infant deaths are often subject to lengthy death scene investigations and autopsy, including many ancillary tests (e.g., toxicology and genetic testing) (6,7). Additionally, the length of time required for processing death data and coding cause-of-death information varies depending upon whether the record can be automatically processed or whether it requires manual coding by trained nosologists. While approximately 75% of all death records are coded using automated processes, 25% of deaths require manual coding of cause of death. For infant deaths occurring in 2015 and 2016, approximately one-half of records required manual coding, with percentages ranging from 30% to 88% depending on reporting jurisdiction.

The length of the lag time—from when the infant death occurs to when NCHS completes data coding and processing—is important to understand when conducting time-sensitive research and surveillance of infant mortality. Currently, quarterly provisional estimates of infant mortality rates are generated based on a 9-month lag (3). Even with this lag, quarterly provisional estimates of infant mortality due to certain causes of death may be underestimated relative to final data (3).

This report evaluates the timeliness of infant death data for deaths occurring from January 2015 through December 2016. The timeliness of the infant death data is evaluated by month and year of death, age at death, cause of death, and reporting jurisdiction (the 50 states, New York City, and the District of Columbia).

Methods

In late 2014, NCHS began capturing weekly provisional data on all of the death records available in the NVSS surveillance database, including information on the underlying causes of death, dates of death, and select demographic information for all death records received from state vital records offices. Using weekly provisional data, this report describes the timeliness of 2015 and 2016 infant death certificate records where timeliness (i.e., lag time) is defined as the length of time between when the death occurred and the week that the information on the certificate was available for analysis by NCHS. Lag times are presented for infant deaths occurring from January 2015 through December 2016, by month and year of death, age at death (i.e., neonatal deaths of infants aged 0–27 days and postneonatal deaths of infants aged 28 days through 11 months), and jurisdiction of occurrence.

Timeliness is also presented for the five leading causes of infant death, based on the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD–10) code for the underlying cause of death (8):

1. Congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99)
2. Disorders related to short gestation and low birth weight, not elsewhere classified (P07)
3. Newborn affected by maternal complications of pregnancy (P01)
4. Sudden infant death syndrome (SIDS, R95)
5. Unintentional injuries (V01–X59)

Additionally, results are presented for the category of “unknown cause of death” (i.e., “other ill-defined and unspecified causes of mortality,” R99). This group is included because up to one-third of infant death records are initially submitted with the cause coded as unknown. These deaths are of public health interest as they are part of the overall Sudden Unexpected Infant Death (SUID) category, which also includes SIDS (R95) and accidental strangulation and suffocation in bed (ASSB, W75).

Weekly provisional mortality data captured from January 9, 2015 through October 15, 2017 (following the closure of the final historical mortality file for the 2016 data year in September 2017) were used to calculate the number of death records available for analysis in the NVSS surveillance database. Deaths occurring in 2015 and 2016 were aggregated by month and year of death, age at death, cause of death, and jurisdiction of occurrence. These weekly provisional counts were compared with counts generated using final historical data files (9,10) to determine the percentage of infant death records available in the surveillance database at 3, 6, 9, and 12 months after the death occurred and when completeness levels approached 100% relative to final annual data files.

Results

Timeliness of infant death records, by month and year of death

Figure 1 shows the percentage of infant death records available in weekly provisional data, by month and year of death. For infant deaths occurring in January 2015, provisional data were 78% complete with a 3-month lag (13 weeks), 94% complete with a 6-month lag (26 weeks), and 98% complete with a 9-month lag (39 weeks). Completeness reached 100% approximately 12 months (53 weeks) following the month of occurrence. Lag times were shorter for infant deaths occurring later in the year.

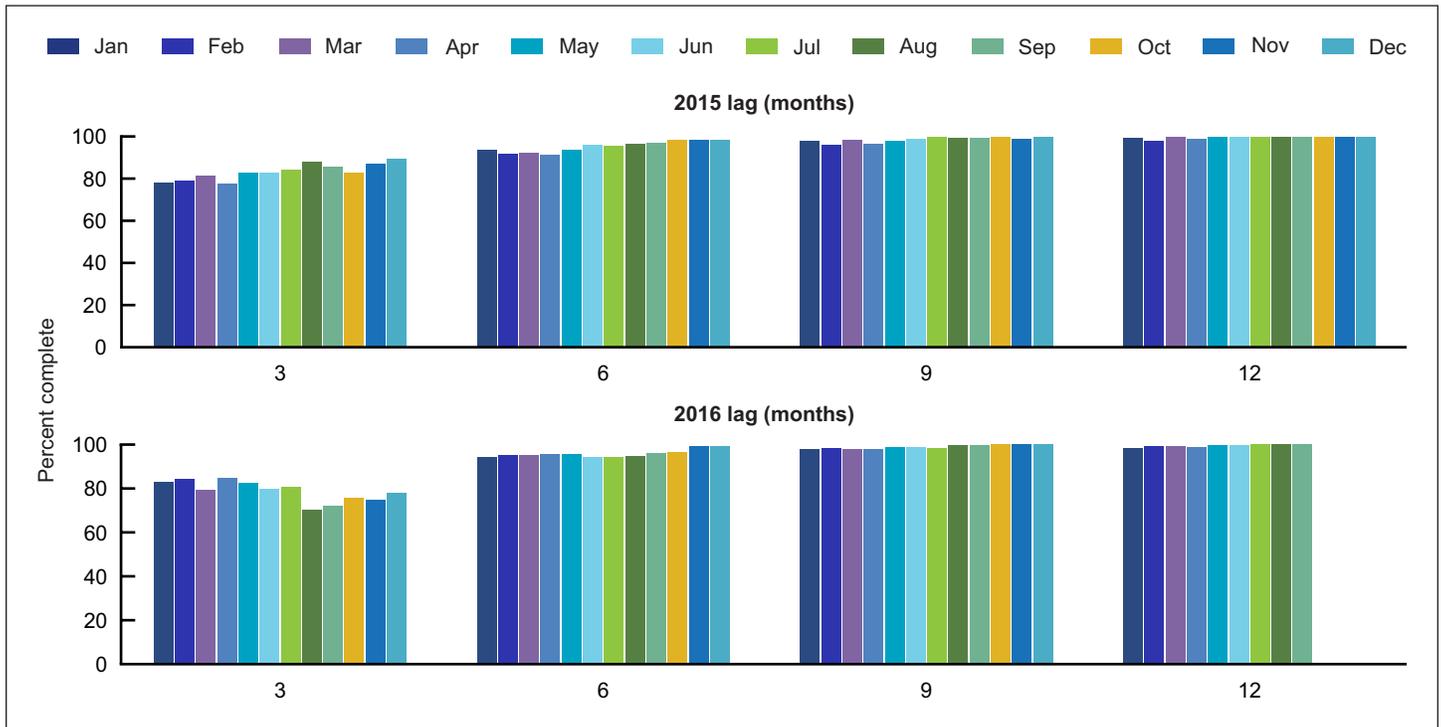
For deaths occurring in December 2015, provisional data were 90% complete within 3 months, 98% complete within 6 months, and 100% complete within 9 months (37 weeks). The pattern was generally similar for infant deaths occurring in 2016. For infant deaths occurring in January 2016, provisional data were 83% complete after 3 months, 94% complete after 6 months, and 98% complete after 9 months, reaching 100% complete after approximately 15 months (66 weeks), compared with about 6 months (27 weeks) for infant deaths occurring in December 2016. For infant deaths occurring in December 2016, completeness was lower after 3 months (78%) compared with deaths occurring in December 2015 (90%).

Timeliness by age at death

Figure 2 shows the percentage of neonatal and postneonatal deaths that were available in weekly provisional data, limited to deaths occurring in the first quarter of 2015 and 2016 (the numbers of neonatal deaths in 2015 and 2016 were 3,852 and 3,800, respectively; the numbers of postneonatal deaths in 2015 and 2016 were 2,058 and 2,055, respectively). Given that lag times are longer for infant deaths occurring in the beginning of the year, these estimates for neonatal and postneonatal deaths represent a lower-bound for timeliness. Lag times were similar for neonatal and postneonatal deaths for both 2015 and 2016. For infant deaths occurring in the first quarter of 2015, provisional data were 84% complete at 3 months, 93% at 6 months, and 97% at 9 months for neonatal deaths. For postneonatal deaths, provisional data were 88% complete at 3 months, 97% at 6 months, and 100% at 9 months. Patterns were similar for infant deaths occurring in the first quarter of 2016. Provisional data were 88%, 96%, and 98% complete for neonatal deaths at 3, 6, and 9 months, respectively. For postneonatal deaths, provisional data were 89%, 98%, and 99% complete for the same time periods.

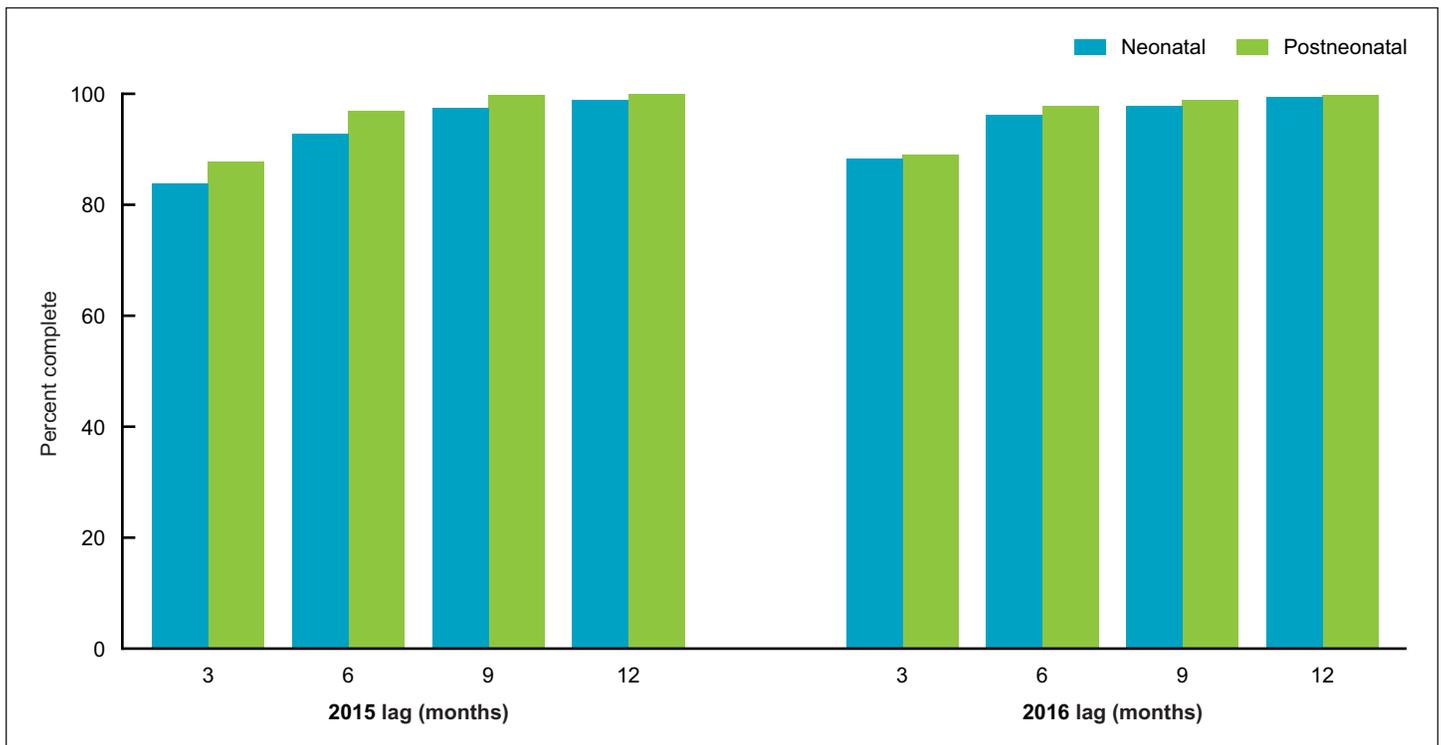
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Figure 1. Mean percentage of infant death certificate records available for analysis after various lag times, by month and year of occurrence: United States, January 2015–December 2016



NOTE: Deaths occurring in October through December of 2016 are not shown with a 12-month lag (bottom right) because weekly provisional mortality data were captured through October 15, 2017, less than 12 months following the month that the deaths occurred.
SOURCE: NCHS, National Vital Statistics System, January 9, 2015–October 15, 2017.

Figure 2. Mean percentage of infant death certificate records available for analysis after various lag times, by age at death: United States, infant deaths occurring in 2015 Quarter 1 and 2016 Quarter 1



NOTE: Weekly provisional data are shown beginning 3 months (13 weeks) following the end of the first quarter of 2015 (left) or the first quarter of 2016 (right).
SOURCE: NCHS, National Vital Statistics System, January 9, 2015–October 15, 2017.

Timeliness by cause of death

Figure 3 shows the percentage of infant deaths available in provisional data at 3, 6, 9, and 12 months by cause of death, for deaths occurring in the first quarter of 2015 and 2016. Lag times were shortest for congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99). Lag times were longest for SIDS (R95) and unintentional injuries (V01–X59).

1. *Congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99)*: For infant deaths occurring in the first quarter of 2015 ($n = 1,214$), provisional data were 88% complete after 3 months, 96% complete after 6 months, and 98% complete after 9 months. Patterns were similar for infant deaths occurring in the first quarter of 2016 ($n = 1,224$).
2. *Disorders related to short gestation and low birth weight, not elsewhere classified (P07)*: For infant deaths occurring in the first quarter of 2015

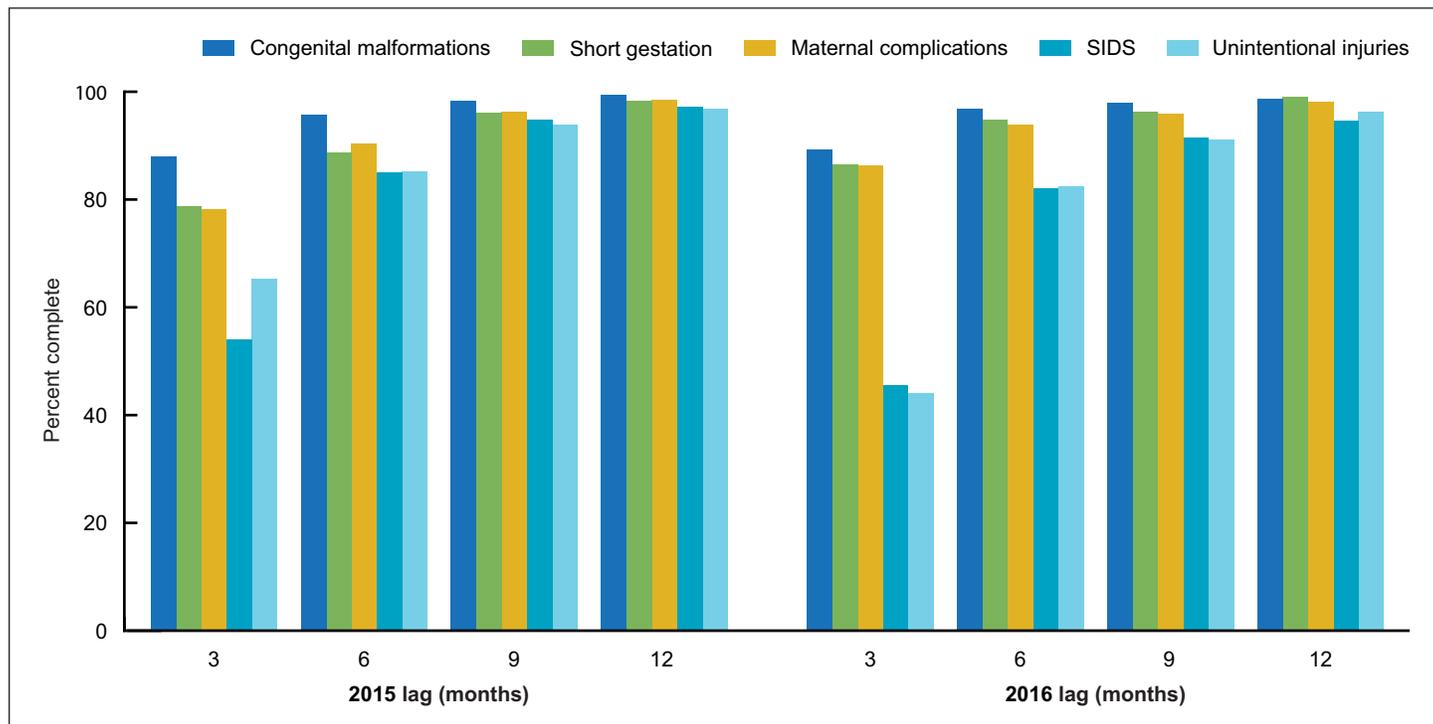
($n = 1,015$), provisional data were 79% complete after 3 months, 89% complete after 6 months, and 96% complete after 9 months. Lag times were slightly shorter for deaths occurring in the first quarter of 2016 ($n = 1,015$), with provisional data 86%, 95%, and 96% complete after 3, 6, and 9 months, respectively.

3. *Newborn affected by maternal complications of pregnancy (P01)*: For infant deaths occurring in the first quarter of 2015 ($n = 390$), provisional data were 78% complete after 3 months, 90% complete after 6 months, and 96% complete after 9 months. Lag times were slightly shorter for deaths occurring in the first quarter of 2016 ($n = 362$), with provisional data 86%, 94%, and 96% complete after 3, 6, and 9 months, respectively.
4. *Sudden infant death syndrome (SIDS, R95)*: For infant deaths occurring in the first quarter of 2015 ($n = 449$), provisional data were 54% complete after 3 months,

85% complete after 6 months, and 95% complete after 9 months. Lag times were slightly longer for deaths occurring in the first quarter of 2016 ($n = 389$), with provisional data 46%, 82%, and 92% complete after 3, 6, and 9 months, respectively.

5. *Unintentional injuries (V01–X59)*: For infant deaths occurring in the first quarter of 2015 ($n = 336$), provisional data were 65% complete after 3 months, 85% complete after 6 months, and 94% complete after 9 months. Lag times were slightly longer for deaths occurring in the first quarter of 2016 ($n = 300$), with provisional data 44%, 82%, and 91% complete after 3, 6, and 9 months, respectively.
6. *Unknown or undetermined cause (R99)*: For deaths coded as unknown cause (R99), completeness relative to the final data is in excess of 100% because many infant death records initially are submitted with an unknown cause of death (Figure 4). Thus, 3 months after

Figure 3. Mean percentage of infant death certificate records available for analysis, by cause of death and various lag times: United States, infant deaths occurring in 2015 Quarter 1 and 2016 Quarter 1



NOTES: Weekly provisional data are shown beginning 3 months (13 weeks) following the end of the first quarter of 2015 (left) or the first quarter of 2016 (right). SIDS is sudden infant death syndrome.
SOURCE: NCHS, National Vital Statistics System, January 9, 2015–October 15, 2017.

the quarter in which the deaths occurred (first quarter of 2015 and 2016), there were more than twice as many R99s in the provisional data as there would eventually be in the final data (215% and 260% for 2015 and 2016, respectively). After 15–18 months, the number of infant deaths coded as R99 in the provisional data began to approach the number observed in the final data (278 and 268 in the first quarter of 2015 and 2016, respectively).

Timeliness by jurisdiction of occurrence

There was variability by jurisdiction of occurrence (i.e., the 50 states, New York City, and the District of Columbia) in the length of time between when infant deaths occurred and when provisional data were complete (Figure 5). There was also considerable variability within jurisdictions between 2015 and 2016 (Figure 5).

For infant deaths occurring in the first quarter of 2015, provisional data were 100% complete within 10 weeks of the close of the quarter for Arizona, Florida, Idaho, Maine, Montana, New Hampshire, New York City, Utah, Vermont, and Wyoming (Figure 5). States with the longest lags before provisional infant death data were 100% complete (greater than 12 months) were Alabama, Arkansas, Georgia, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Jersey, New York (excluding New York City), Nebraska, Oregon, and Pennsylvania. Lags for these states were all 52 weeks or more.

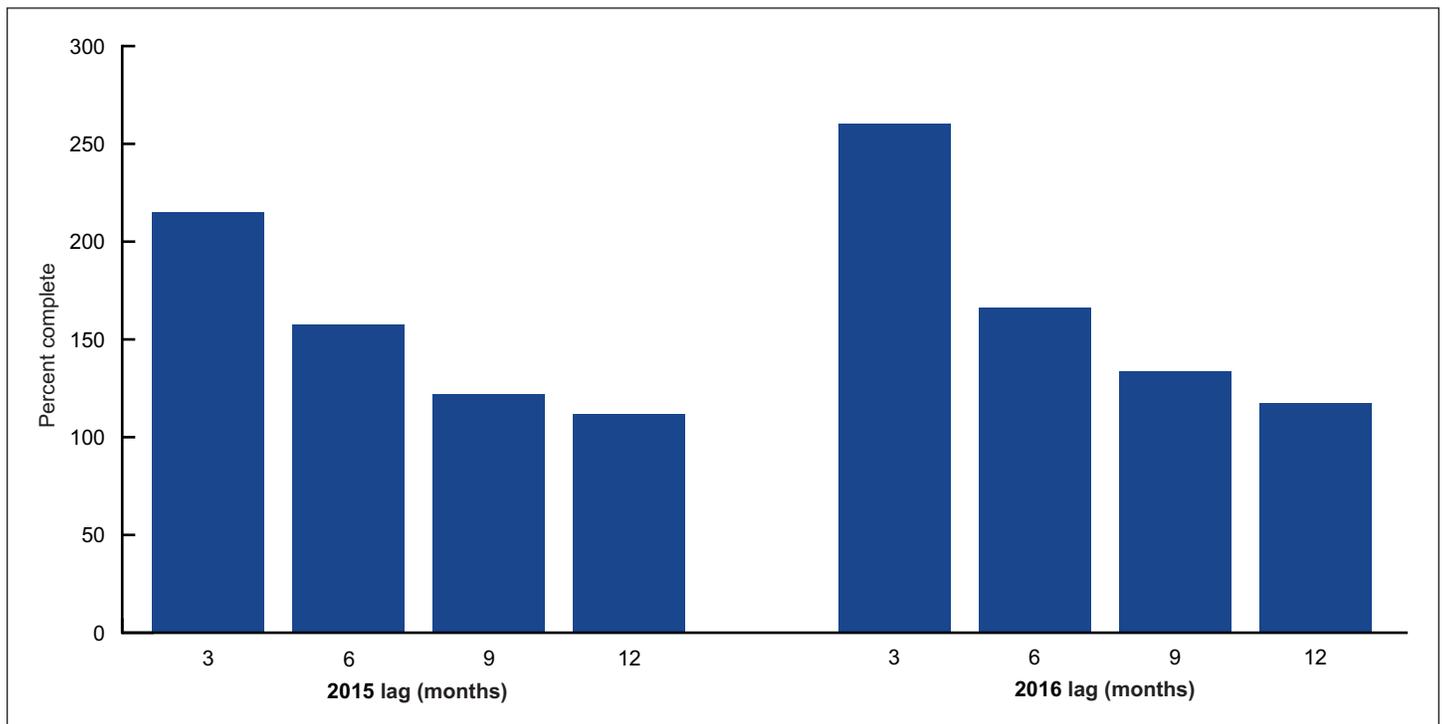
For infant deaths occurring in the first quarter of 2016, provisional data were 100% complete within 10 weeks for Alaska, Idaho, New Hampshire, South Dakota, and Vermont. (Idaho, New Hampshire, and Vermont were also in this group in 2015.) Provisional data were 100% complete after 52 weeks or more for the following states: Georgia, Illinois, Indiana,

Iowa, Kentucky, Maryland, Michigan, Mississippi, Nebraska, New Jersey, New Mexico, New York (excluding New York City), North Carolina, Oklahoma, Oregon, Tennessee, and West Virginia. (Georgia, Indiana, Kentucky, Michigan, Mississippi, Nebraska, New Jersey, New York, and Oregon were also in this group in 2015.) Twenty jurisdictions improved their lag time by 4 weeks or more from 2015 to 2016, while 28 jurisdictions had lag times that were at least 4 weeks longer in 2016 than in 2015.

Discussion

The timeliness of the submission, processing, and coding of infant death records varies by when and where the death occurred as well as by the cause of death. The timeliness of infant death data is an important factor to consider when producing and interpreting quarterly provisional estimates of infant mortality (3). While quarterly provisional estimates of infant mortality are produced based on a 9-month lag

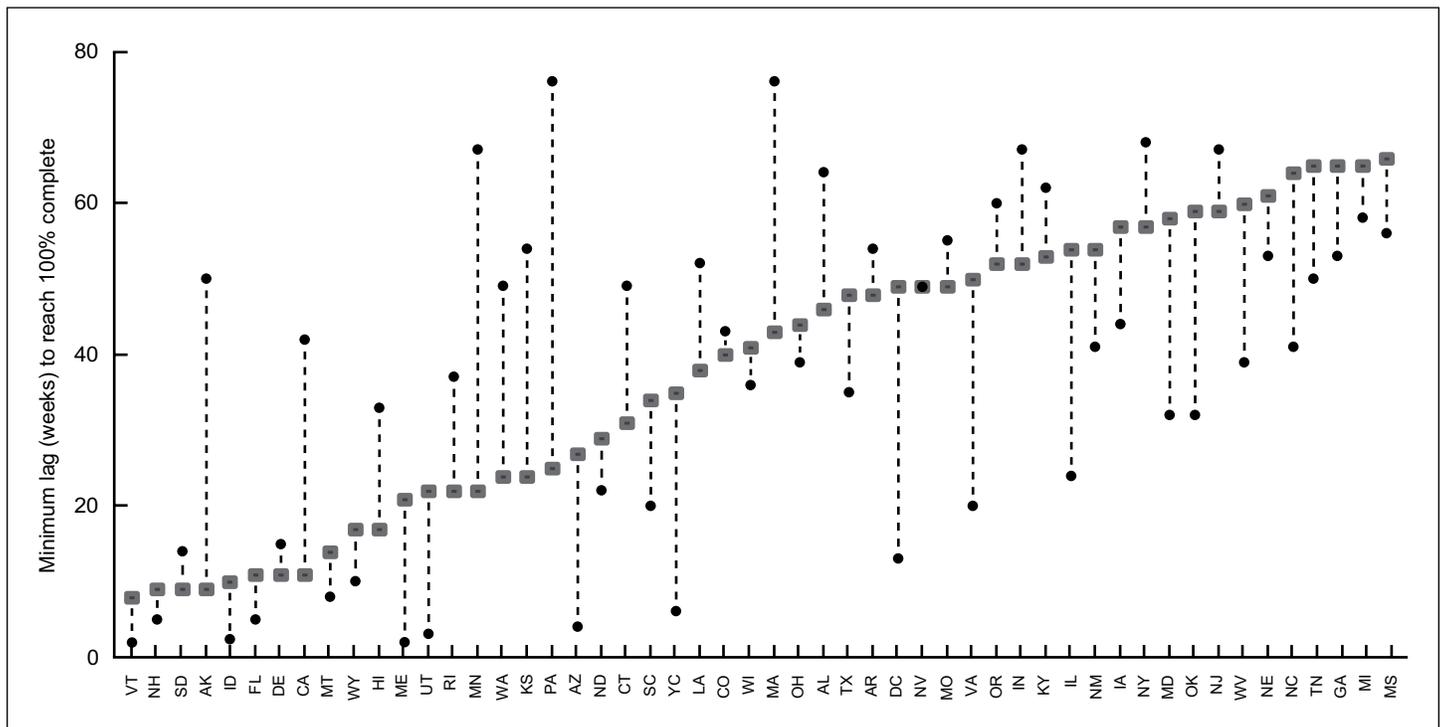
Figure 4. Percentage of infant death certificate records with unknown cause of death in provisional data relative to final data, by various lag times: United States, infant deaths occurring in 2015 Quarter 1 or 2016 Quarter 1



NOTES: The bars show the percent completeness greater than 100% because of the higher number of R99s observed in provisional data relative to final data. Weekly provisional data are shown beginning 3 months (13 weeks) following the end of the first quarter of 2015 (left) or the first quarter of 2016 (right). SOURCE: NCHS, National Vital Statistics System, January 9, 2015–October 15, 2017.

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Figure 5. Number of weeks following the close of Quarter 1, 2015 and Quarter 1, 2016 that 100% of infant death certificate records were available for analysis, by reporting jurisdiction



NOTES: The black dots illustrate the lag in weeks for deaths occurring in the first quarter of 2015. The gray squares represent the lag in weeks for deaths occurring in the first quarter of 2016. The length of the dotted line segments represent the change in the lag between the two years. Jurisdictions are ordered from those with the shortest lag times in 2016 (left) to those with the longest (right). SOURCE: NCHS, National Vital Statistics System, January 9, 2015–October 15, 2017.

after the deaths occurred, in some cases, this lag is insufficient to ensure complete data, and rates based on provisional data may underestimate rates based on final data. For certain causes of death such as SIDS and unintentional injuries, the degree of this underestimation will be greater, since provisional data for these causes are less complete after 9 months than for other causes of infant death. Infant death data are more timely for deaths occurring later in a given data year, likely due to the push to report the data before the national file closure, which typically occurs about 8 months after the end of the data year. For infant deaths occurring earlier in a given data year, it may be up to 18 months before the national file closure. Given these differences in timeliness based on when the death occurred, quarterly provisional estimates of infant mortality will tend to underestimate infant mortality rates to a larger extent for the deaths occurring in the first and second quarters of the year, and to a lesser extent in the third and fourth quarters of the year.

Consistent with findings from a previous report on overall mortality, this report illustrates that the lag time for infant death certificate records is longer for infant deaths requiring more extensive investigation (i.e., SIDS and injury-related deaths). Additionally, this report shows a decline in the percentage of infant death records with unknown cause (R99) after longer lag times, confirming previous findings that death records with unknown cause are updated over time with more specific cause-of-death information. However, about 5% of infant death records remain coded as having an “unknown” cause in the final data. The higher percentages of unknown cause of death observed in the provisional data pose a challenge for generating quarterly provisional estimates of SUID, as provisional estimates will overstate SUID rates compared with final data. Conversely, death rates due to SIDS or unintentional injuries will tend to be underestimated using available provisional data, as these deaths have longer lag times

between when the death occurred and when the data are available for analyses. Finally, a better understanding of the variation in timeliness by jurisdiction can inform future expansions of the quarterly provisional estimates of infant mortality to include estimates by state or region of the United States.

This study has some limitations. Until recently, the NVSS surveillance database included a small number of death records that were voided, typically because the record may have been a duplicate or was submitted in error. Although the number of infant death records that are eventually voided is small, their inclusion in the provisional data will tend to overstate the completeness relative to final data. Thus, it is possible that lag times might be slightly longer than presented here. Additionally, provisional data did not include any unique identifiers that would allow for the tracking of individual records for much of the time period under evaluation in this report. This information would be helpful to determine how long it might

take for records initially submitted with an unknown cause of death to eventually be assigned an underlying cause of death. Also, provisional data have not undergone the standard processing, evaluation, imputation, and recoding done in the course of producing a final data file for release. Thus, there may be discrepancies between the provisional counts generated from the NVSS surveillance database and final counts generated annually from NCHS public-use data files that have undergone additional processing, editing, and imputation. Finally, timeliness and completeness may vary over time. Results presented here may not generalize to future years, and patterns may need to be reexamined periodically.

Despite these limitations, this report describes baseline estimations of the timeliness of infant death data in the Vital Statistics Rapid Release program. Timeliness of the data is an important factor to consider when conducting research and public health surveillance activities, such as the provision of quarterly provisional estimates of infant mortality.

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Technical Notes

Definitions

Infant death refers to a death of an infant under 1 year of age.

Neonatal death refers to a death of an infant aged 0–27 days.

Postneonatal death refers to a death of an infant aged 28 days through 11 months.

Five leading causes of infant death are:

1. Congenital malformations, deformations, and chromosomal abnormalities
2. Disorders related to short gestation and low birth weight, not elsewhere classified
3. Newborn affected by maternal complications of pregnancy
4. Sudden infant death syndrome
5. Unintentional injuries

Records with unknown cause of death are assigned the ICD–10 code R99 (other ill-defined and unspecified causes of mortality).

Lag time is the time between when the death occurred and when the death certificate data are available in the provisional data. This length of time varies due to the time it takes for jurisdictions to submit data and for the data to be processed and coded by NCHS.

Nature and source of data

Provisional mortality data—Weekly snapshots

In late 2014, NCHS began taking weekly snapshots of its mortality data, which include death certificate records from the 50 states, New York City, and the District of Columbia. In 2015, the NVSS surveillance system was unable to capture three snapshots that occurred on October 4, October 11, and October 18, 2015. These provisional snapshots are therefore missing from this analysis.

Cause-of-death classification

Mortality statistics are compiled in accordance with World Health Organization (WHO) regulations specifying that WHO member nations classify and code causes of death in accordance with the current revision of the *International Statistical Classification of Diseases and Related Health Problems (ICD)*. ICD provides the basic guidance used in virtually all countries to code and classify causes of death. It provides not only disease, injury, and poisoning categories but also the rules used to select the single underlying cause of death for tabulation from the conditions reported on the death certificate, as well as definitions, tabulation lists, the format of the death certificate, and regulations on use of the classification. Causes of death for data presented in this report were coded according to ICD guidelines described in annual issues of the *NCHS Instruction Manuals* (11).

Data on cause of death are subject to some nonrandom sampling error. This is because the delay in receiving the report of a death depends on the cause of death. Furthermore, for some deaths, the final cause may not be available at the time that the death was reported. In those cases, the cause of death may be reported as unknown or pending investigation and coded to ICD–10 code R99 (other ill-defined and unspecified causes of mortality). In the final data, some of the deaths with unknown cause will be reassigned to specific causes if further, more specific cause-of-death information is provided.

Acknowledgments

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Suggested citation

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