Evaluation of the Pregnancy Status Checkbox on the Identification of Maternal Deaths

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Abstract

Objectives—This report quantifies the impact of the inclusion of a pregnancy status checkbox item on the U.S. Standard Certificate of Death on the number of deaths classified as maternal. Maternal mortality rates calculated with and without using the checkbox information for deaths in 2015 and 2016 are presented.

Methods—This report is based on cause-of-death information from 2015 and 2016 death certificates collected through the National Vital Statistics System. Records originally assigned to a specified range of ICD–10 codes (i.e., A34, O00–O99) when using information from the checkbox item were recoded without using the checkbox item. Ratios of deaths assigned as maternal deaths using checkbox item information to deaths assigned without checkbox item information were calculated to quantify the impact of the pregnancy status checkbox item on the classification of maternal deaths for 47 states and the District of Columbia. Maternal mortality rates for all jurisdictions calculated using cause-of-death information entered on the certificate with and without the checkbox were compared overall and by characteristics of the decedent.

Results—Use of information from the checkbox, along with information from the cause-of-death section of the certificate, identified 1,527 deaths as maternal compared with 498 without the checkbox in 2015 and 2016 (ratio = 3.07), with the impact varying by characteristics of the decedent such as age at death. The ratio for women under age 25 was 2.15 (204 compared with 95 deaths) but was 14.14 (523 compared with 37 deaths) for women aged 40–54. Without the adoption of the checkbox item, maternal mortality rates in both 2015 and 2016 would have been reported as 8.7 deaths per 100,000 live births compared with 8.9 in 2002. With the checkbox, the maternal mortality rate would be reported as 20.9 and 21.8 deaths per 100,000 live births in 2015 and 2016.

Keywords: maternal mortality • death certificate • National Vital Statistics System

Introduction

Maternal mortality has historically been used as a key indicator of the health of a population. Currently, it is one of a limited number of health indicators included in the Sustainable Development Goals that address countries' success in improving human wellbeing without harming the environment (1). In the United States, the U.S. National Vital Statistics System (NVSS) at the National Center for Health Statistics (NCHS) generates the official mortality statistics, including maternal mortality rates, that are used within the United States and internationally. NVSS identifies deaths of pregnant or recently pregnant women using information reported on the women's death certificates.

NVSS follows guidance from the World Health Organization's (WHO) *International Classification of Diseases, 10th Revision* (ICD–10) and uses ICD terminology when identifying maternal deaths (Figure 1) (2,3). The WHO definition of maternal deaths does not include late maternal deaths, which are defined as deaths with a pregnancy occurring 43 days to 1 year before the death.

Adoption of pregnancy status checkbox item

Research before 2003 (4–7) noted that NVSS underestimated maternal mortality when compared with other data sources and that identification of these deaths could be improved with additional effort. One approach some states took to improve identification of maternal deaths was to add pregnancy status indicators to their death certificates. However, these indicators were not standardized or consistent across the states that adopted them. McKay et al. (4), using early 1990s death certificate data from 16 states, found that 29% of deaths among females occurring within 1 year of pregnancy could be identified

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics
National Vital Statistics System

CDC

NCHS reports can be downloaded from: https://www.cdc.gov/nchs/products/index.htm.

Maternal deaths are defined by the World Health Organization as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. Accidents, homicides, and suicides are all excluded.

Maternal deaths can be divided into two groups:

- Direct obstetric deaths are those resulting from obstetric complications of the pregnancy state (pregnancy, labor and the puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above.
- Indirect obstetric deaths are those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiologic effects of pregnancy.

Late maternal deaths are defined as the death of a woman from direct or indirect obstetric causes more than 42 days but less than 1 year after termination of pregnancy.

SOURCE: World Health Organization

Figure 1. Definition of maternal death and late maternal death

solely through information reported by a checkbox indicating pregnancy status. These study authors proposed that broader use of a checkbox would be a straightforward solution leading to comprehensively identifying maternal deaths.

States were urged to adopt a common pregnancy status checkbox item when they revised their death certificates to reflect the revised 2003 U.S. Standard Certificate of Death. The 2003 revision of the U.S. Standard Certificate of Death included the following pregnancy question in the form of a checkbox item:

36. IF FEMALE:
- ☐ Not pregnant within past year
- ☐ Pregnant at time of death
- ☐ Not pregnant, but pregnant within 42 days of death
- ☐ Not pregnant, but pregnant 43 days to 1 year before death
- ☐ Unknown if pregnant within the past year

The question's response categories align with the concepts and codes in the ICD–10. Including a question also adheres to the ICD–10 recommendation to incorporate questions regarding pregnancy status within the year preceding death to enhance the identification of maternal deaths. However, it should be noted that pregnancy within 42 days of death is not in itself an indication of maternal death. The pregnancy must be related to the death and not incidental or accidental.

States adopted the revised certificate and standard pregnancy checkbox item incrementally over the subsequent 14 years. As states revised their death certificates over this time period, most incorporated the standard checkbox item so that gradually there was wider adoption and greater standardization across the country. Yet, it was midyear 2017 before the last state adopted a separate checkbox item and, at that time, one state still had an item inconsistent with the standard. See Technical Notes for a listing of states and their implementation of pregnancy status questions. Due to the protracted time it has taken states to adopt the standard checkbox item, a national maternal mortality rate from NVSS has not been published by NCHS since 2007.

Cause-of-death coding related to maternal causes of death

Coding of cause-of-death information is a standardized and ordered process restricted to information reported on a death certificate (Figure 2). Causes of death are reported in Part I and Part II of the death certificate (cause-of-death statement). A separate pregnancy checkbox item (item 36 in Figure 2) is on the certificate to report pregnancy in the past year. All of the information needed to code a death as a maternal or late maternal death could be reported in Parts I and II. However, there is no guidance on the death certificate itself specifying the information that is needed to facilitate identification of maternal deaths, and information on pregnancy status in the past year is not always reported in the cause-of-death statement. This results in the under identification of maternal deaths. The checkbox item was intended to provide information about a current pregnancy or a pregnancy in the past year if this was missing from the cause-of-death statement.

The information reported on death certificates is processed through an automated system with the same coding rules a manual coder would use embedded in it. An individual record may be coded by the automated system, fully by a manual coder, or by the automated system with manual intervention. Manual coders typically get involved with more complex records. All maternal deaths are also reviewed manually before the data file is released as a final check of the coding.

If there is no checkbox response, the coding instructions are to assign a maternal ICD–10 code (or O-code, referring to a group of codes beginning with the letter O) to all medical conditions reported on the death certificate if there is any mention of pregnancy on a death certificate. This scenario would occur under the following situations: a) the death certificate includes causes specific to pregnancy, delivery or the puerperium (e.g., eclampsia) in Part I and Part II of the certificate, or b) the death certificate includes causes involving other medical conditions (e.g., diabetes) with a mention of pregnancy in Parts I or II of the certificate.

If there is a checkbox response indicating pregnancy and information in Part I or Part II of the death certificate regarding pregnancy (causes specific to pregnancy, delivery, or the puerperium or causes involving other medical conditions with

CAUSE OF DEATH (See instructions and examples)

32. **PART I.** Enter the chain of events--diseases, injuries, or complications--that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.

Approximate interval: Onset to death

IMMEDIATE CAUSE (Final disease or condition ---------> resulting in death)   a._____

Due to (or as a consequence of):

Sequentially list conditions, if any, leading to the cause listed on line a. Enter the **UNDERLYING CAUSE** (disease or injury that initiated the events resulting in death) **LAST**

b._____

Due to (or as a consequence of):

c._____

Due to (or as a consequence of):

d._____

PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I

33. WAS AN AUTOPSY PERFORMED?
  □ Yes   □ No
34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? □ Yes □ No

To Be Completed By: MEDICAL CERTIFIER

35. DID TOBACCO USE CONTRIBUTE TO DEATH?

  □ Yes □ Probably

  □ No □ Unknown

36. IF FEMALE:
  □ Not pregnant within past year

  □ Pregnant at time of death

  □ Not pregnant, but pregnant within 42 days of death

  □ Not pregnant, but pregnant 43 days to 1 year before death

  □ Unknown if pregnant within the past year

37. MANNER OF DEATH

  □ Natural   □ Homicide

  □ Accident   □ Pending Investigation

  □ Suicide   □ Could not be determined

SOURCE: NCHS, National Vtal Statistics System

Figure 2. Cause-of-death statement on death certificate

a mention of pregnancy), the coding instructions are to assign an O-code, to all medical conditions reported on the death certificate.

If the checkbox response is the only indication of a pregnancy in the past year (checkbox-only records), the coding instructions, used from 2003 through 2017, are to assign an O-code, to all medical conditions reported on the death certificate. This would occur when the death certificate includes causes involving other medical conditions with a marked pregnancy checkbox item indicating that a woman was pregnant at the time of death or in the previous year for females aged 10–54 years. Female decedents aged 9 years and under do not get coded as maternal deaths. For the checkbox-only records in women aged 55 and over, the coding instructions are to not rely solely on the checkbox item for coding cause-of-death information. For these records to be coded as maternal deaths, information in the cause-of-death statement has to relate to pregnancy or obstetric causes. Otherwise, the checkbox information is disregarded, and they are not coded as maternal deaths.

To illustrate the assignment of maternal mortality codes, consider how terms such as embolism reported in the cause-of-death statement would be handled when the checkbox response is used to code cause of death. The cause of death would be assigned to I26, Pulmonary embolism, in the ICD–10 circulatory chapter in the absence of mention of pregnancy in the past year in the cause-of-death section and no indication of pregnancy in the checkbox. If, however, the checkbox did indicate pregnancy at the time of death or within 42 days of death, pulmonary embolism would be assigned to a maternal cause-of-death code O88, Obstetric embolism. When pregnancy is reported as being between 43 days and 1 year before death in the checkbox, the pulmonary embolism is assigned to a late maternal code (Death from any obstetric cause occurring more than 42 days but less than one year after delivery, O96).

Deaths consistent with the maternal death definition (Figure 1) are assigned to underlying cause ICD–10 codes A34, O00–O95, or O98–O99 (Obstetrical tetanus and Pregnancy, childbirth and the puerperium), late maternal deaths to ICD–10 code O96, Death from any obstetric cause occurring more than 42 days but less than one year after delivery, and those more than 1 year after pregnancy to ICD–10 code O97, Death from sequelae of obstetric causes. The codes A34, O00–O95, and O98–O99 are comprised of different levels of specificity. Some retain specific information about the conditions included within the code title (e.g., A34, Obstetrical tetanus or O11, Pre-eclampsia superimposed on chronic hypertension), while others have vague titles and include a variety of conditions (e.g., O26.8, Other specified pregnancy-related conditions and O99.8, Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium).

Both the maternal death and late maternal death categories include direct and indirect maternal deaths. As described in Figure 1, direct maternal deaths refer to deaths from conditions that a woman would only experience if pregnant (e.g., amniotic fluid embolism), while indirect maternal deaths refer to deaths from a comorbid condition (either pre-existing or developing during pregnancy) that may be exacerbated by or be more problematic in the context of a pregnancy. For example, a condition such as mitral valve stenosis may be exacerbated in a pregnant woman since the heart has to work harder when pregnant. This may put the woman at greater risk for further complications such as pulmonary edema. For maternal deaths, indirect deaths are assigned to ICD–10 codes O98–O99 and direct deaths to the remaining codes (A34, O00–O95).

The maternal death definition excludes accidental and incidental deaths (3). This includes deaths caused by injuries and the external causes of the injuries (i.e., accidents, suicides, and homicides) among pregnant or recently pregnant women. These exclusions also include maternal deaths due to conditions that are not caused by nor complicated by the pregnancy.

Because coders are instructed to assign a maternal code to all certificates with a mention of pregnancy, including just a checkbox indicating pregnancy in the past year, it is possible that some deaths are assigned a maternal code when the medical conditions reported on the death certificate are incidental (e.g., neither caused nor complicated by pregnancy) to the pregnancy. However, there is typically not enough information on the death certificate to determine whether the reported conditions were incidental to pregnancy, and no standard list of medical conditions that are incidental to pregnancy exists for coders (or the automated system) to use. As a result, coders would assume that there is a relationship between pregnancy and the medical condition and assign a maternal code.

This report is one of three in a series on maternal mortality data from NVSS (8,9) being produced as NCHS plans to resume publishing maternal mortality statistics routinely starting with 2018 mortality data. Given the issues described regarding the implementation of the checkbox item and coding rules, the focus of this report is to evaluate changes in cause-of-death classification of maternal deaths based on whether or not the checkbox is used. This will be done by calculating ratios of deaths assigned to a maternal code using checkbox item information to deaths assigned without checkbox item information. A second report (8), which is complementary to this report, examines the impact of the staggered implementation of the pregnancy checkbox on maternal mortality trends for 1999 through 2017 using a regression discontinuity modeling approach, and considers the potential impact of misclassification of maternal deaths based on the checkbox on the trends. A third report (9) explains the changes in how NCHS will process and release maternal mortality data and will present recoded maternal mortality rates and plans for re-release of maternal mortality data for previous years.

Data and Methods

This analysis is based on 2,029 deaths occurring in the United States in 2015 and 2016, that had an underlying cause code assigned A34 or within the range of O00–O99 (1,527 assigned to O00–O95 and O98–O99; 502 assigned to O96) and a checkbox indicating a pregnancy within 1 year. Pregnancy was only mentioned in the checkbox and not in the cause-of-death statement in about 75% of all records assigned any maternal code, including late maternal codes, and this varied by age (66% for under 25, 67% for 25–39, 94% for 40–54, and 100% for 45–54); pregnancy was mentioned in both the checkbox and cause-of-death statement for 25% of all records. Because the analysis was assessing the impact of the checkbox on code assignment, records with pregnancy only mentioned in the cause-of-death statement (53 in 2015 and 48 in 2016) were not included in the ratio analysis. Data years 2015 and 2016 were

selected because most states had implemented a checkbox and the information from this study could be used to inform any changes in processing the data for subsequent years. Three states were excluded from the ratio calculations. Alabama was excluded because it did not implement the checkbox item from the standard certificate until 2016 and West Virginia because it did not implement the checkbox item either year. California was excluded as it has a nonstandard item asking about pregnancy within the year of death without any of the detail on timing that is included on the standard certificate, which has implications for coding of maternal deaths.

To evaluate changes in the identification of deaths associated with the use of the checkbox, all 2,029 records for these 2 years were coded twice: once using the checkbox item information, as it was reported on the death record received by NCHS, and once without using the checkbox information, as was done before 2003. The numbers of deaths classified as maternal deaths from these two coding approaches for 2015 and 2016 combined were compared using ratios calculated as the number of maternal deaths assigned using the checkbox item in the numerator and the number of maternal deaths assigned without using the checkbox item in the denominator.

Ratios were also calculated by age, race and Hispanic origin, and cause of death. Ratios greater than 1.00 indicate that use of the checkbox identified more maternal deaths compared with cause-of-death coding without using the checkbox for a given characteristic. Recent studies on maternal mortality found an association between older age and errors in classification of maternal deaths with the use of information from the checkbox item (10,11). There are longstanding differences in maternal mortality by race and Hispanic origin, so the impact of the checkbox on the identification of maternal deaths was also examined by race and Hispanic origin (2,8). There might be a variable impact of the checkbox on certificates that also have words or phrases directly connected to pregnancy (e.g., amniotic fluid embolism or postpartum hemorrhage) in the cause-of-death section. These deaths would have likely been assigned a maternal code with or without a checkbox, whereas certificates with no indication of pregnancy in the cause-of-death section (specific causes in these categories) would have been assigned to other ICD–10 codes. Therefore, results are stratified by maternal age, race and Hispanic origin, and cause of death.

Maternal mortality rates for the entire United States (including the three states and the cause-of-death statement-only records excluded from the impact of the checkbox assessment) were calculated when including and not including checkbox information in assigning maternal codes. Maternal mortality rates (maternal deaths per 100,000 live births) are calculated using the number of maternal deaths assigned in the numerator and the number of live births in the denominator. The numerator used to calculate the rate as if there was no checkbox is the combination of the data recoded without using the checkbox for those states including the checkbox and the original codes for the states without a checkbox. Calculation of rates using the checkbox was not as straightforward since West Virginia (both years) and Alabama (2015) did not have a checkbox and California (both years) had a different checkbox. Because checkbox information

is not available for these states, rates were calculated without the checkbox for West Virginia and California for both years and Alabama for 2015. Thus, the rates calculated are likely to be underestimates compared with rates obtained if those states had the standard checkbox item. The states without a checkbox are included in the estimates using the checkbox in coding to provide a rate for the United States overall. The ratio analysis excludes the states without a checkbox to more directly estimate the impact of the checkbox. The main purpose of calculating rates was to compare recent data without using the checkbox information with rates before 2003 when incremental adoption of the standard checkbox item began (see Technical Notes for information on statistical testing of differences in rates).

This report focuses on maternal deaths (deaths within 42 days of pregnancy). However, limited information is also presented primarily in tables for late maternal deaths (deaths occurring between 43 days to 1 year of pregnancy). Although not included in the official maternal mortality rates, late maternal deaths have typically been included in NCHS tables about maternal deaths since ICD–10 added the term for the benefit of those interested in events occurring between 43 days and 1 year of death. Since these deaths have been included historically in NCHS tables and reports, inclusion of late maternal deaths in the ratio analysis provides supplemental information on the effect of the checkbox item for the deaths that have been provided in NCHS tables.

Results

Using coding specifications adopted with the 2003 revised death certificate, the ratio comparing the classification of maternal deaths using the checkbox compared with not using the checkbox information was 3.07 (Tables 1 and A) (1,527 maternal deaths [checkbox] compared with 498 [no checkbox].

Use of the checkbox was associated with ratios well above 1.00 for each of the race and Hispanic-origin groups. The ratio was 2.98 for non-Hispanic black women, 3.00 for Hispanic women, and 4.24 for non-Hispanic white women (Table A).

Ratios based on detailed cause of death ranged from 0.60 for Cardiomyopathy in the puerperium (O90.3) to 9.21 for Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium (O99.8). The ratios were close to 1.00 for the categories that include conditions that are explicitly obstetric in nature, (i.e., where the connection with pregnancy is clear), as the information would need to be included in the cause-of-death section to assign these codes. Some examples include Pregnancy with abortive outcome (O00–O07) (ratio of 0.92), Eclampsia and pre-eclampsia (O11, O14–O15) (ratio of 0.98) and Complications of labor and delivery (O60–O75) (ratio of 1.20). For some of these conditions, when the ratio is less than 1.00, (e.g., Pregnancy with abortive outcome [O00–O07] or Cardiomyopathy in the puerperium [O90.3], the checkbox item added information regarding the timing of death (e.g., 43 days to

Table A. Deaths and ratios of deaths classified using pregnancy status checkbox to those classified without using the checkbox for selected characteristics: 47 states and the District of Columbia, 2015–2016

Characteristic	Number classified using checkbox item	Number classified without using checkbox item	Ratio of deaths assigned using checkbox item to those without using checkbox item
Total	1,527	498	3.07
Age (years)			
Under 25	204	95	2.15
25–39	799	366	2.18
40–54	523	37	14.14
40–44	108	35	3.09
45–54	415	2	*
Race and Hispanic origin			
Non-Hispanic black	497	167	2.98
Non-Hispanic white	738	174	4.24
Hispanic	210	70	3.00
Cause of death			
Cardiomyopathy in the puerperium ....(O90.3)	30	50	0.60
Complications of the puerperium, not elsewhere classified .... (O90)	43	51	0.84
Pregnancy with abortive outcome ....(O00–O07)	34	37	0.92
Eclampsia and pre-eclampsia ....(O11, O14–O15)	54	55	0.98
Complications of labor and delivery ....(O60–O75)	60	50	1.20
Obstetric embolism .... (O88)	81	45	1.80
Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium ....(O99.4)	148	38	3.89
Other specified pregnancy-related conditions ....(O26.8)	446	84	5.31
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium ....(O99.8)	267	29	9.21

*Ratio does not meet NCHS standards of reliability.

NOTES: Total includes all maternal causes (A34, O00–O95, O98–O99). Cause-of-death categories shown are not exclusive of one another.

SOURCE: NCHS, National Vital Statistics System.

1 year); without the checkbox item, these cases would be coded as maternal deaths, but some were assigned as late maternal deaths in the presence of the checkbox, thereby excluding them from the count of maternal deaths based on the WHO definition.

More often, the ratio was much greater than 1.00. The checkbox item increased the number of deaths identified from categories such as Obstetric embolism (O88) (ratio of 1.80), Diseases of the circulatory system complicating pregnancy, childbirth, and the puerperium (O99.4) (ratio of 3.89), Other specified pregnancy-related conditions (O26.8) (ratio of 5.31), and Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium (O99.8) (ratio of 9.21). The higher ratios are from non-specific phrases such as embolism or other conditions such as stroke or breast cancer, not explicitly specified as obstetric or due to the pregnancy or conditions assigned to these O-code categories when there is an indication of pregnancy in a checkbox only (i.e., these deaths would have been coded to non-O-code codes if there had been no indication of a pregnancy in the past year on the certificate).

The impact of the checkbox also varied by maternal age. The ratio for all maternal deaths was similar for women women under age 25 and 25–39, (2.15 and 2.18, respectively), but was substantially higher for women 40–54 (14.14). Due to small numbers, ratios for women under 25 and 40–54 could not be calculated for most of the detailed groupings of cause of death (Table 1). For Other direct obstetric causes, the only group where the ratio could be calculated, the ratio for the 40–54 year age group was 11.17 compared with 1.85 and 1.83, respectively, for the two younger age groups. For women under 25 and 25–39 year age groups, the ratios were similar for the two age groups for the total, all maternal causes, and Other direct obstetric causes. The Ratio for Complications predominantly related to the puerperium was 1.09 for women under age 25 and 1.28 for women aged 25–39, which was not statistically different. The ratio was greater for women 25–39 than for women under 25 for Other obstetric conditions, not elsewhere classified, O94–O95 and O98–O99 (4.63 and 3.29, respectively).

With many of the above ratios diverging from 1.00, records would be coded to different codes if the checkbox was used. Figure 3 shows the codes that would have been assigned with and without the use of the checkbox for all deaths and by age of the decedent. Overall, for the records assigned as maternal deaths using the checkbox, 31% continued to be coded to an O-code without the checkbox. Heart conditions accounted for 22% and cancer for 15% of the deaths when not using the checkbox. By age, O-codes accounted for approximately 39%, 42%, and 7% of all deaths without the checkbox among decedents under age 25, 25–39, and 40–54, respectively. Heart conditions and cancer combined accounted for about 24% and 30% of records when not using the checkbox for women under age 25 and 25–39. This increased to 52% among women aged 40–54 (Figure 3).

For the more detailed maternal categories with ratios much greater than 1.00 such as Other specified pregnancy-related conditions (O26.8) and Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium (O99.8), heart conditions and cancer accounted for the largest share coded differently depending on the use of the checkbox item (data

not shown). For Other specified pregnancy-related conditions (O26.8), heart conditions accounted for 21% and cancer 18% of deaths when not using the checkbox. For Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium (O99.8), cancer accounted for the most deaths (48%), followed by heart conditions (18%), when not using the checkbox.

Maternal mortality rates

Tables 2 and B show maternal mortality rates for: (a) 2000 through 2002, before adoption of the standard checkbox item; (b) 2015 and 2016, recoded without using the checkbox item; and (c) 2015 and 2016, using the checkbox item in assigning maternal deaths. When the checkbox item was not used in coding, as before 2003, the maternal mortality rate was 8.7 deaths per 100,000 live births in both 2015 and 2016 and was not statistically different from the earlier years (9.8, 9.9, and 8.9 in 2000, 2001, and 2002). Using the checkbox, the maternal mortality rate was 20.9 and 21.8 deaths per 100,000 live births in 2015 and 2016, respectively.

The rates without the checkbox for non-Hispanic white women, non-Hispanic black women, and Hispanic women in 2016 were 6.2, 21.4, and 7.0 deaths per 100,000 live births, respectively. None of these rates were significantly different statistically from the corresponding rates of 5.6, 24.9, and 7.1 in 2002. In 2016, the maternal mortality rates with the checkbox were 19.4 for non-Hispanic white women, 48.6 for non-Hispanic black women, and 14.3 deaths per 100,000 live births for Hispanic women. Maternal mortality rates for non-Hispanic black women were consistently higher than rates for non-Hispanic white women in 2002 and 2016. Rates for Hispanic women historically (without checkbox) were generally similar to the rates among non-Hispanic white women but were less stable from year to year (e.g., 9.9 in 2000, 7.1 in 2002, 5.5 in 2015, and 7.0 in 2016). Using the checkbox, the maternal mortality rates for non-Hispanic white women were higher than for Hispanic women (e.g., 19.4 compared with 14.3 in 2016).

Maternal mortality rates generally increased with increasing maternal age but unlike the non-Hispanic black and Hispanic-origin differential, the size of the difference varied widely according to use of the checkbox. Using the checkbox in assigning maternal deaths, the rates for women aged 40–54 were about 20 times greater than those for women under 25 (e.g., 230.0 compared with 11.8 in 2016). When the checkbox item was not used in assigning maternal deaths, the rates for women aged 40–54 were five to six times greater than those for women under 25 (e.g., 31.1 compared with 6.3 in 2016).

In general, the maternal mortality rate (Table B) was greater for direct maternal causes than indirect maternal causes (e.g., 15.2 compared with 6.6 with checkbox and 7.4 compared with 1.3 without using the checkbox in 2016). The differential was smaller using the checkbox than when not using the checkbox. The subcategories under direct maternal causes called out in Table A had variable ratios, and the rates show a similar difference (e.g., rates for Pregnancy with abortive outcome and Eclampsia and pre-eclampsia are similar with and without using the checkbox, whereas the rates for Other specified pregnancy-
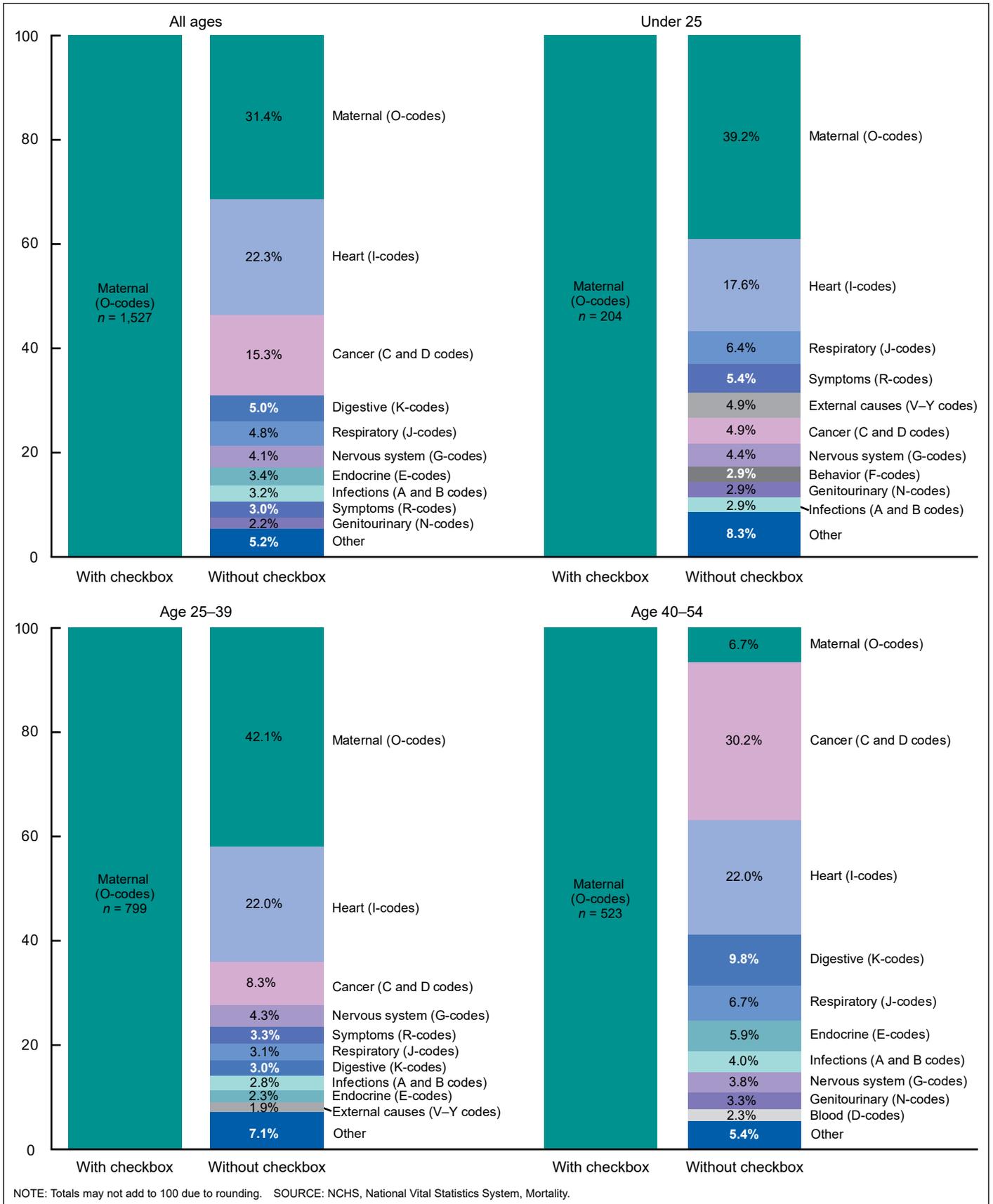
Figure 3. Percent distribution of categories assigned when not using the checkbox information among deaths identified as maternal deaths when using the checkbox, by maternal age: 47 states and the District of Columbia, 2015–2016

Table B. Maternal mortality rates with and without use of the checkbox item, by selected characteristics: United States, selected years

[Maternal deaths (A34, O00–O95, O98–O99) occur while pregnant or within 42 days of being pregnant. All states and the District of Columbia are included]

| | Maternal deaths (A34, O00–O95, O98–O99) | | | | | | |
| | Without checkbox | | | | | With checkbox | |
Characteristic	2000	2001	2002	2015	2016	2015	2016
All	9.8	9.9	8.9	8.7	8.7	20.9	21.8
Age (years)							
Under 25..	6.2	7.5	6.1	6.5	6.3	10.8	11.8
25–39	10.7	10.3	9.7	8.6	8.7	15.6	16.4
40–54	40.2	37.8	28.6	30.6	31.1	232.7	230.0
40–44...	36.7	34.5	24.0	25.0	25.6	76.0	80.4
45–54...	*	*	*	*	*	2,196.1	2,101.1
Race and Hispanic origin							
Non-Hispanic white..	6.8	6.5	5.6	5.7	6.2	18.8	19.4
Non-Hispanic black	22.3	24.7	24.9	23.3	21.4	47.5	48.6
Hispanic	9.9	9.5	7.1	5.5	7.0	11.0	14.3
Cause of death							
Maternal causes........................(A34, O00–O95, O98–O99)	9.8	9.9	8.9	8.7	8.7	20.9	21.8
Direct obstetric causes...................(A34, O00–O95)	8.4	8.6	7.7	7.8	7.4	14.2	15.2
Pregnancy with abortive outcome.............(O00–O07)	0.9	0.9	0.6	0.6	0.6	*	0.6
Eclampsia and pre-eclampsia .... (O11, O14–O15)	1.5	1.5	1.1	0.8	1.0	0.7	0.9
Other specified pregnancy-related conditions.......(O26.8)	*	0.4	1.0	1.3	1.6	5.9	6.1
Complications of labor and delivery .... (O60–O75)	1.6	1.5	1.4	1.2	0.7	1.0	1.1
Obstetric embolism............................ (O88)	1.4	1.7	1.2	0.9	0.6	1.1	1.1
Complications of the puerperium, not elsewhere classified.....................................(O90)	0.7	0.6	0.7	1.0	1.3	1.0	1.0
Cardiomyopathy in the puerperium ....(O90.3)	0.7	0.6	0.7	1.0	1.2	0.8	0.9
Indirect obstetric causes ....(O98–O99)	1.4	1.3	1.1	0.9	1.3	6.7	6.6
Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium.........(O99.4)	*	0.8	0.5	0.5	0.6	2.0	2.0
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium........(O99.8)	0.6	0.3	0.4	*	0.6	3.6	3.4

* Rate does not meet NCHS standards of reliability.

NOTE: Cause-of-death categories shown are not exclusive of one another.

SOURCE: NCHS, National Vital Statistics System.

related conditions are substantially greater when using the checkbox). The subcategories under indirect maternal causes discussed earlier all had ratios that diverged from 1.00 and the rates were greater when using the checkbox (Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium was 0.6 without the checkbox and 2.0 deaths per 100,000 live births with the checkbox in 2016). The numbers were only large enough to calculate late maternal mortality rates when using the checkbox.

Discussion

This report demonstrates that the use of the standard pregnancy status checkbox item to classify deaths as maternal has an impact on maternal mortality measures in the United States by increasing the number of deaths identified as maternal. Use of the checkbox resulted in the tripling of the number of deaths identified as maternal in the 47 states and the District of Columbia that were using the standard checkbox item in 2015 and 2016. The slow and staggered adoption of the checkbox

item across the country obscured the scale and nature of the effect of the checkbox on national data. If the checkbox item had an effect, implementation in a single year could be expected to create a disjuncture in statistics, but when implementation occurs incrementally, any effect is spread out over time as states transition. This delay in national implementation affects assessment of the effect of the checkbox item, and it impacts evaluation of trends. A companion report explores the impact of this staggered implementation in more detail (8).

Calculating maternal mortality rates in 2015 and 2016 in a consistent manner for the entire United States without using the standard checkbox item yielded rates similar to the maternal mortality rates calculated from vital statistics before the standard checkbox item was introduced. Maternal mortality rates were also calculated for the entire United States using the checkbox item for 2015 and 2016. This may be an underestimate of the national rate since Alabama, California, and West Virginia did not have the standard checkbox item for 2015 and California and West Virginia did not have the standard item in 2016, so the checkbox was not used to identify maternal deaths in these

states (California and West Virginia in both years and Alabama in 2015).

While the checkbox item resulted in the identification of a substantially larger number of deaths as maternal deaths, the present study does not address the extent to which the increase in deaths identified as maternal reflects improved identification or more reporting errors. Previous research indicates that improvements in identifying maternal deaths were seen with the addition of the checkbox item (10,12–14). However, other literature has called into question the accuracy of the information reported in the checkbox item (10,15). The pregnancy checkbox item has been implicated as both a source of errors resulting in overestimation of maternal deaths as well as a source of improvement in appropriately identifying maternal deaths (13,16). In particular, the accuracy of the checkbox item has been questioned for women aged 40 and over (10). Based on data from four states, Catalano et al. (11) found that of those where a death potentially occurred within 1 year of a pregnancy (identified by linking death certificates with birth or fetal death certificates or by pregnancy checkbox status), 72% of records were confirmed as having a pregnancy within 1 year, 21% were not pregnant within 1 year, and 7% could not be confirmed as being pregnant within 1 year. Catalano et al.'s findings (11) more specifically indicate that the checkbox item is more likely to be incorrect for women aged 45 and over.

In this analysis, the effect of the checkbox item was greatest for the 40–54 age group. In addition, the causes among the checkbox-only maternal deaths were more consistent with the causes of deaths of women of this age in the general population compared with the causes for checkbox-only maternal deaths among younger women. Heart conditions and cancer, while accounting for approximately 22% and 15% of deaths, respectively, overall and 30% of deaths combined for women aged 25–39, accounted for 52% of checkbox-only cases among women aged 40–54. This analysis quantifies the number of maternal deaths that are identified using the pregnancy checkbox compared with coding information only in the cause-of-death section of the certificate. More deaths are classified as maternal deaths when cause-of-death coding uses information from a checkbox item on pregnancy in the past year, especially for older women. An additional report explores the potential misclassification associated with the staggered implementation of the pregnancy checkbox by states over time (8). Another report will explain the changes in how NCHS will process and release maternal mortality data, starting with 2018 data, and will present recoded maternal mortality rates for previous years (9).

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List of Detailed Tables

Table 1. Ratios of maternal death measures using pregnancy status checkbox to those identified without checkbox information for selected causes, by age: 47 states and the District of Columbia, 2015–2016

[Maternal causes are those assigned to categories in the *International Classification of Diseases, 10th Revision*. Maternal deaths (A34, O00–O95, O98–O99) occur while pregnant or within 42 days of being pregnant. Rates are per 100,000 live births]

Cause of death (based on the *International Classification of Diseases, 10th Revision*)	Total	Under 25	25–39	40–54 Total	40–44	45–54
Ratio of deaths assigned using checkbox to those without using checkbox						
Maternal causes . . . (A34, O00–O95, O98–O99)	3.07	2.15	2.18	14.14	3.09	*
Pregnancy with abortive outcome . . . (O00–O07)	0.92	*	0.93	*	*	*
Other direct obstetric causes . . . (A34, O10–O92)	2.58	1.85	1.83	11.17	3.71	*
Edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium . . . (O10–O16)	1.71	*	1.44	*	*	*
Eclampsia and pre-eclampsia . . . (O11, O14–O15)	0.98	*	0.97	*	*	*
All other edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium . . . (O10, O12–O13, O16)	3.32	*	*	*	*	*
Other maternal disorders predominantly related to pregnancy . . . (O20–O29)	5.44	*	2.94	*	*	*
Other specified pregnancy-related conditions . . . (O26.8)	5.31	*	3.13	*	*	*
All other maternal disorders predominantly related to pregnancy . . . (O20–O26.7, O26.9–O29)	5.88	*	2.33	*	*	*
Maternal care related to the fetus and amniotic cavity and possible delivery problems . . . (O30–O48)	1.37	*	1.33	*	*	*
Complications of labor and delivery . . . (O60–O75)	1.20	*	1.20	*	*	*
Postpartum hemorrhage . . . (O72)	*	*	*	*	*	*
Other complications of labor and delivery, not elsewhere classified . . . (O60–O71, O73–O75)	1.24	*	1.33	*	*	*
Complications predominantly related to the puerperium . . . (O85–O92)	1.34	1.09	1.28	*	*	*
Puerperal sepsis and other puerperal infections . . . (O85–O86)	*	*	*	*	*	*
Obstetric embolism . . . (O88)	1.80	*	1.69	*	*	*
Complications of the puerperium, not elsewhere classified . . . (O90)	0.84	*	0.81	*	*	*
Cardiomyopathy in the puerperium . . . (O90.3)	0.60	*	0.63	*	*	*
All other complications of the puerperium, not elsewhere classified . . . (O90.0–O90.2, O90.4–O90.9)	*	*	*	*	*	*
Other complications predominantly related to the puerperium . . . (O87, O89, O91–O92)	*	*	*	*	*	*
Obstetrical tetanus . . . (A34)	*	*	*	*	*	*
Other obstetric conditions, not elsewhere classified . . . (O94–O95, O98–O99)	6.15	3.29	4.63	*	*	*
Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium . . . (O99.4)	3.89	*	3.88	*	*	*
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium . . . (O99.8)	9.21	*	5.10	*	*	*
All other maternal diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium . . . (O94–O95, O98, O99.0–O99.3, O99.5–O99.7)	*	*	*	*	*	*
Death from any obstetric cause occurring more than 42 days but less than one year after delivery . . . (O96)[1]	*	*	*	*	*	*

See footnotes at end of table.

Table 1. Ratios of maternal death measures using pregnancy status checkbox to those identified without checkbox information for selected causes, by age: 47 states and the District of Columbia, 2015–2016—Con.

[Maternal causes are those assigned to categories in the *International Classification of Diseases, 10th Revision*. Maternal deaths (A34, O00–O95, O98–O99) occur while pregnant or within 42 days of being pregnant. Rates are per 100,000 live births]

				Age		
					40–54	
Cause of death (based on the *International Classification of Diseases, 10th Revision*)	Total	Under 25	25–39	Total	40–44	45–54
Numbers allocated when checkbox used						
Maternal causes . . . . (A34, O00–O95, O98–O99)	1,527	204	799	523	108	415
Pregnancy with abortive outcome . . . . (O00–O07)	34	3	28	3	–	–
Other direct obstetric causes . . . . (A34, O10–O92)	970	122	512	335	104	231
Edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium . . . . (O10–O16)	137	17	79	41	14	27
Eclampsia and pre-eclampsia . . . . (O11, O14–O15)	54	14	35	5	5	–
All other edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium . . . . (O10, O12–O13, O16)	83	3	44	36	9	27
Other maternal disorders predominantly related to pregnancy . . . . (O20–O29)	587	64	259	263	70	193
Other specified pregnancy-related conditions . . . . (O26.8)	446	56	210	179	50	129
All other maternal disorders predominantly related to pregnancy . . . . (O20–O26.7, O26.9–O29)	141	8	49	84	20	64
Maternal care related to the fetus and amniotic cavity and possible delivery problems . . . . (O30–O48)	48	8	36	4	2	2
Complications of labor and delivery . . . . (O60–O75)	60	9	42	9	9	–
Postpartum hemorrhage . . . . (O72)	18	2	10	6	6	–
Other complications of labor and delivery, not elsewhere classified . . . . (O60–O71, O73–O75)	42	7	32	3	3	–
Complications predominantly related to the puerperium . . . . (O85–O92)	138	24	96	18	9	9
Puerperal sepsis and other puerperal infections . . . . (O85–O86)	11	2	6	3	–	3
Obstetric embolism . . . . (O88)	81	12	59	10	7	3
Complications of the puerperium, not elsewhere classified . . . . (O90)	43	9	29	5	2	3
Cardiomyopathy in the puerperium . . . . (O90.3)	30	7	22	1	1	–
All other complications of the puerperium, not elsewhere classified . . . . (O90.0–O90.2, O90.4–O90.9)	13	2	7	4	1	3
Other complications predominantly related to the puerperium . . . . (O87, O89, O91–O92)	3	1	2	–	–	–
Obstetrical tetanus . . . . (A34)	–	–	–	–	–	–
Other obstetric conditions, not elsewhere classifed . . . . (O94–O95, O98–O99)	523	79	259	185	49	136
Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium . . . . (O99.4)	148	22	93	33	14	19
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium . . . . (O99.8)	267	34	107	126	25	101
All other maternal diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium . . . . (O94–O95, O98, O99.0–O99.3, O99.5–O99.7)	108	23	59	26	10	16
Death from any obstetric cause occurring more than 42 days but less than one year after delivery . . . . (O96)[1]	502	89	326	87	38	49

See footnotes at end of table.

Table 1. Ratios of maternal death measures using pregnancy status checkbox to those identified without checkbox information for selected causes, by age: 47 states and the District of Columbia, 2015–2016—Con.

[Maternal causes are those assigned to categories in the *International Classification of Diseases, 10th Revision*. Maternal deaths (A34, O00–O95, O98–O99) occur while pregnant or within 42 days of being pregnant. Rates are per 100,000 live births]

				Age		
					40–54	
Cause of death (based on the *International Classification of Diseases, 10th Revision*)	Total	Under 25	25–39	Total	40–44	45–54
Numbers allocated without the checkbox						
Maternal causes . . . . . (A34, O00–O95, O98–O99)	498	95	366	37	35	2
Pregnancy with abortive outcome . . . . . (O00–O07)	37	5	30	2	2	–
Other direct obstetric causes . . . . . (A34, O10–O92)	376	66	280	30	28	2
Edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium . . . . . (O10–O16)	80	16	55	9	8	1
Eclampsia and pre-eclampsia . . . . . (O11, O14–O15)	55	13	36	6	6	–
All other edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium . . . . . (O10, O12–O13, O16)	25	3	19	3	2	1
Other maternal disorders predominantly related to pregnancy . . . . . (O20–O29)	108	12	88	8	8	–
Other specified pregnancy-related conditions . . . . . (O26.8)	84	10	67	7	7	–
All other maternal disorders predominantly related to pregnancy . . . . . (O20–O26.7, O26.9–O29)	24	2	21	1	1	–
Maternal care related to the fetus and amniotic cavity and possible delivery problems . . . . . (O30–O48)	35	6	27	2	2	–
Complications of labor and delivery . . . . . (O60–O75)	50	10	35	5	4	1
Postpartum hemorrhage . . . . . (O72)	16	2	11	3	3	–
Other complications of labor and delivery, not elsewhere classified . . . . . (O60–O71, O73–O75)	34	8	24	2	1	1
Complications predominantly related to the puerperium . . . . . (O85–O92)	103	22	75	6	6	–
Puerperal sepsis and other puerperal infections . . . . . (O85–O86)	7	3	4	–	–	–
Obstetric embolism . . . . . (O88)	45	6	35	4	4	–
Complications of the puerperium, not elsewhere classified . . . . . (O90)	51	13	36	2	2	–
Cardiomyopathy in the puerperium . . . . . (O90.3)	50	13	35	2	2	–
All other complications of the puerperium, not elsewhere classified . . . . . (O90.0–O90.2, O90.4–O90.9)	1	–	1	–	–	–
Other complications predominantly related to the puerperium . . . . . (O87, O89, O91–O92)	–	–	–	–	–	–
Obstetrical tetanus . . . . . (A34)	–	–	–	–	–	–
Other obstetric conditions, not elsewhere classifed . . . . . (O94–O95, O98–O99)	85	24	56	5	5	–
Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium . . . . . (O99.4)	38	12	24	2	2	–
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium . . . . . (O99.8)	29	6	21	2	2	–
All other maternal diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium . . . . . (O94–O95, O98, O99.0–O99.3, O99.5–O99.7)	18	6	11	1	1	–
Death from any obstetric cause occurring more than 42 days but less than one year after delivery . . . . . (O96)[1]	5	3	2	–	–	–

* Ratio does not meet NCHS standards of reliability.

– Quantity zero.

[1]Late maternal deaths.

NOTE: Table excludes data from Alabama, California, and West Virginia.

SOURCE: NCHS, National Vital Statistics System.

Table 2. Maternal deaths and maternal mortality rates, by race and Hispanic origin and age: United States, selected years, 2000–2016

[Maternal causes are those assigned to categories in the *International Classification of Diseases, 10th Revision*. Maternal deaths (A34, O00–O95, O98–O99) occur while pregnant or within 42 days of being pregnant. Rates are per 100,000 live births]

| Characteristic | Maternal mortality (A34, O00–O95, O98–O99) | | | | | | | Late maternal mortality (O96) | | | | | | |
| | Without checkbox | | | | | With checkbox[1] | | Without checkbox | | | | | With checkbox[1] | |
	2000	2001	2002	2015	2016	2015	2016	2000	2001	2002	2015	2016	2015	2016
							Rates							
All ages (years)............	9.8	9.9	8.9	8.7	8.7	20.9	21.8	*	*	*	*	*	7.4	8.8
Under 25..............	6.2	7.5	6.1	6.5	6.3	10.8	11.8	*	*	*	*	*	4.2	6.6
25–39	10.7	10.3	9.7	8.6	8.7	15.6	16.4	*	*	*	*	*	6.6	8.1
40–54	40.2	37.8	28.6	30.6	31.1	232.7	230.0	*	*	*	*	*	56.3	43.4
40–44	36.7	34.5	24.0	25.0	25.6	76.0	80.4	*	*	*	*	*	24.1	21.2
45–54	*	*	*	*	*	2,196.1	2,101.1	*	*	*	*	*	459.4	320.7
Non-Hispanic white........	6.8	6.5	5.6	5.8	6.2	18.8	19.4	*	*	*	*	*	6.4	7.7
Under 25..............	4.5	5.3	3.0	5.7	*	9.8	10.3	*	*	*	*	*	4.1	7.2
25–39	6.9	6.5	5.9	5.3	6.1	12.7	13.0	*	*	*	*	*	5.1	6.5
40–54	*	*	*	*	*	252.9	260.8	*	*	*	*	*	58.6	44.0
40–44	*	*	*	*	*	70.9	82.5	*	*	*	*	*	*	*
45–54	*	*	*	*	*	2,405.0	2,409.4	*	*	*	*	*	536.8	*
Non-Hispanic black........	22.3	24.7	24.9	23.3	21.4	47.5	48.6	*	*	*	*	*	14.9	16.6
Under 25..............	10.7	14.4	15.3	13.7	16.2	21.6	22.4	*	*	*	*	*	*	10.0
25–39	32.2	31.9	34.2	26.5	22.4	40.1	42.5	*	*	*	*	*	16.4	17.9
40–54	*	*	*	*	*	574.8	518.2	*	*	*	*	*	*	*
40–44	*	*	*	*	*	191.9	188.6	*	*	*	*	*	*	*
45–54	*	*	*	*	*	5,080.6	4,102.6	*	*	*	*	*	*	*
Hispanic	9.9	9.5	7.1	5.5	7.0	11.0	14.3	*	*	*	*	*	5.8	6.4
Under 25..............	*	*	*	*	*	*	6.9	*	*	*	*	*	*	*
25–39	12.8	10.5	8.2	6.2	7.7	10.6	13.2	*	*	*	*	*	5.2	7.5
40–54	*	*	*	*	*	87.3	110.3	*	*	*	*	*	*	*
40–44	*	*	*	*	*	*	*	*	*	*	*	*	*	*
45–54	*	*	*	*	*	*	*	*	*	*	*	*	*	*
							Number of deaths							
All ages (years)............	396	399	357	345	345	832	862	2	9	9	7	9	296	348
Under 25..............	93	110	88	70	64	117	120	1	2	2	1	4	46	67
25–39	265	252	240	238	243	432	460	1	6	6	5	4	182	228
40–54	38	37	29	37	38	281	281	–	1	1	1	1	68	53
40–44	33	32	23	28	29	85	91	–	1	1	1	–	27	24
45–54	5	5	6	9	9	196	190	–	–	–	–	1	41	29
Non-Hispanic white........	160	151	128	123	129	400	407	1	3	1	–	4	136	162
Under 25..............	33	38	21	28	16	48	47	–	1	–	–	2	20	33
25–39	108	100	91	84	96	200	206	1	1	1	–	2	81	103
40–54	19	13	16	11	17	151	154	–	1	–	–	–	35	26
40–44	17	11	14	9	12	39	45	–	1	–	–	–	10	10
45–54	2	2	2	2	5	112	109	–	–	–	–	–	25	16
Non-Hispanic black........	135	146	144	137	125	280	284	–	4	6	5	3	88	97
Under 25..............	34	44	45	31	34	49	47	–	1	1	1	1	14	21
25–39	89	87	93	92	80	139	152	–	3	4	3	1	57	64
40–54	12	15	6	14	11	91	84	–	–	1	1	1	17	12
40–44	10	12	4	9	7	28	28	–	–	1	1	–	10	6
45–54	2	3	2	4	4	63	56	–	–	–	–	1	7	6
Hispanic	81	81	62	51	64	102	131	1	1	2	2	1	54	59
Under 25..............	22	27	18	9	12	16	21	1	–	1	–	–	12	9
25–39	54	47	38	36	45	61	77	–	1	1	2	1	30	44
40–54	5	7	6	6	7	25	33	–	–	–	–	–	12	6
40–44	4	7	5	5	6	9	15	–	–	–	–	–	5	4
45–54	1	–	1	1	1	16	18	–	–	–	–	–	7	2

* Rates do not meet NCHS standards of reliability.
– Quantity zero.
[1]Not all areas had a checkbox so data may be underestimated. Alabama, California, and West Virginia did not have the standard checkbox in 2015; California and West Virginia did not have the standard checkbox in 2016.

NOTE: Table includes entire United States (50 states and the District of Columbia).

SOURCE: NCHS, National Vital Statistics System, Mortality.

Technical Notes

Tabulations of cause-of-death statistics in this report are based solely on the underlying cause of death. The underlying cause is defined by the World Health Organization (WHO) as "the disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury." The underlying cause is selected from the conditions entered by the medical certifier in the cause-of-death section of the death certificate. When more than one cause or condition is entered by the medical certifier, the underlying cause is determined by the sequence of conditions on the certificate, provisions of the *International Classification of Diseases* (ICD), and associated selection rules and modifications. Generally, more medical information is reported on death certificates than is directly reflected in the underlying cause of death. This is captured in National Center for Health Statistics (NCHS) multiple cause-of-death statistics.

Coding process

Mortality statistics for 2015 and 2016 are based on information submitted by the states and coded by NCHS through the Vital Statistics Cooperative Program. For 2015 and 2016 data years, all states submitted mortality medical data and demographic data electronically to NCHS.

The mortality statistics were compiled in accordance with WHO regulations, which specify that member countries classify and code causes of death in accordance with the current revision of the ICD. ICD provides the basic guidance used in virtually all countries to code and classify causes of death (17).

Mortality medical data are processed through the Mortality Medical Data System (MMDS). Records that cannot be automatically processed by MMDS are rejected for manual intervention and then fed back into the automated processing system. Records assigned an underlying cause from the ICD chapter for Pregnancy, childbirth and the puerperium (ICD–10 codes O00–O99) are separated out after this for additional manual review.

Beginning in 2011, individual states sent mortality data to NCHS in electronic format with the causes of death sent with the terms reported. Automated systems, NCHS coding specialists, or a combination of automated systems and manual coding specialists then code these causes according to the ICD–10 classification. Before 2011, many states were coding the causes of death before sending the data file to NCHS. This practice was changed because of resource limitations at the state level and as part of efforts to improve the timeliness of mortality data processing.

The coding specialists (coders) in the states formerly and at NCHS currently are trained at NCHS. They are trained on the rules, guidelines, and instruction manuals that document how mortality coding should be done. There are multiple phases in the training. Training starts with multiple cause coding because this is the step in which codes are assigned for the descriptive text used on death certificates. After mastering this step, the next phase focuses on underlying cause, which is where the coder goes through a series of rules to select the underlying cause.

This is a single code from the record that is used most often in research and publications using this data. Together, these two stages provide the basic preparation for coding general mortality data.

Whether fully automated, manual, or automated with manual intervention, the same process is being followed because they are adhering to the same rules. The manual coders are typically getting records that are more complex than the automated system can successfully process. About 46% of maternal deaths and 0% of late maternal deaths are automatically processed, but even when records are automatically processed, all are reviewed manually.

State-specific information

Separate checkbox item

In 2003, Idaho, Maryland, Montana, New York city, and New York state had separate questions that could provide the detail captured in the checkbox item on the 2003 version of the U.S. Standard Certificate (Table I). Alabama, California, Florida, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New Mexico, North Dakota, Texas, and Virginia had separate questions; however, they were not consistent with the detail requested in the 2003 U.S. Standard Certificate checkbox item. Since then, states have gradually adopted revised state death certificates that include the standard checkbox item.

Specific coding procedures

In addition to the general coding guidelines for the standard checkbox item, instructions for the jurisdictions' specific questions were developed and distributed to the states beginning in 2003 (2). Data from the states with nonstandard questions were used to the extent possible. If the state identified any of the specific categories in the standard checkbox item, then the information was used in the same way as the standard to assign codes. If the state collapsed categories, then the information was treated as if the pregnancy occurred for the latter category being collapsed. The collapsed category that has the greatest impact is for states like California that asked if a pregnancy occurred within the year. This category is equivalent to combining the standard checkbox item categories of "pregnant at time of death"; "not pregnant, but pregnant within 42 days of death"; and "not pregnant, but pregnant 43 days to 1 year before death." A positive response to this nonstandard category without further specification of timing in the cause-of-death statement was treated as if the pregnancy occurred between 43 days and 1 year before death. Too many records may be coded to late maternal deaths, for example, instead of as maternal deaths if the only information on the timing of the pregnancy comes from a nonstandard question.

By 2015, California was the only jurisdiction with these nonstandard checkbox item categories. Treating the checkbox item response as equivalent to the latter category being collapsed intentionally results in more deaths allocated to the late maternal death group than when the checkbox item was not being used.

Thus, the ratio measuring the effect of using the checkbox item for maternal deaths would be anticipated to be less than 1.00 for California (ratio for California was 0.35).

Effect of checkbox item by state of occurrence

Only a small number of states have sufficient numbers to calculate the ratios by state (Table II). The ratios range from 1.76 for New York to 4.79 for Georgia. For the 47 states and the District of Columbia overall, the maternal ratio is 3.07 (Table II).

Random variation

Mortality data are not subject to sampling error but 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 (17) for a more complete discussion of random variation, confidence intervals, and statistical tests for rates). For the ratio of the maternal deaths with and without the checkbox, 95% confidence intervals were calculated to assess precision and divergence from 1.00. To calculate if ratios for subgroups differed, a test statistic, z, was calculated using the same standard error formula used to calculate the confidence intervals (18). The formula is based on multinomial sampling theory and considers the fact that a proportion of the deaths coded to a particular category with and without the checkbox are the same deaths (i.e., the numerator and denominator in the ratio are not independent; see Box two in (18) for exact formula).

Suppression of unreliable rates—An asterisk is shown in place of a mortality rate based on fewer than 20 deaths, or the equivalent of the relative standard error of 23% or more. The limit of 20 deaths is the current standard for NCHS' Division of Vital Statistics, below which rates are too statistically unreliable for presentation.

Table I. Separate questions related to pregnancy on state certificates in 2003 and after

State	Question in 2003	Later question added	Date added
Alaska	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2014
Alabama	Was there a pregnancy in last 42 days? (Specify Yes, No, or Unk.)	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2016
Arkansas	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2008
Arizona	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2010
California	If female, pregnant in last year? □ Yes □ No □ UNK	None.	2003
Colorado	None.	If female: □ not pregnant within last year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2015
Connecticut	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2005
Delaware	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2007
District of Columbia	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	Midyear 2005
Florida	If female, was there a pregnancy in the past 3 months? __ Yes __ No	If female: _ Not pregnant within past year _ Unknown if pregnant within past year Yes, pregnant within past year (Select one below): _ Pregnant at time of death _ Not pregnant at time of death but pregnant within 42 days of death _ Not pregnant at time of death, but pregnant 43 days to 1 year before death	2005

See footnotes at end of table.

Table I. Separate questions related to pregnancy on state certificates in 2003 and after—Con.

State	Question in 2003	Later question added	Date added
Georgia	None.	If female: □ not applicable □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2008
Hawaii	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year □ not pregnant but pregnant within past year (time unknown)	2014
Idaho	If female aged 10–54: □ not pregnant within past year □ pregnant at time of death □ not pregnant, but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ unknown if pregnant within the past year	None.	2003
Illinois	If female, was there a pregnancy in past three months? Yes □ No □	If female: □ not pregnant within past 12 months □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past 12 months	2008
Indiana	Was decedent pregnant or 90 days postpartum? (Yes or no)	If female: □ not pregnant within past 12 months □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2008
Iowa	If female, was there a pregnancy in the past 12 months? (Specify yes or no)	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2011
Kansas	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the last year	2005
Kentucky	If female, was there a pregnancy in the past 12 months? □ Yes □ No	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	Midyear 2010
Louisiana	If deceased was female 10–49, was she pregnant in the last 90 days? □ Yes □ No □ Unk	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year □ not applicable	Midyear 2012

See footnotes at end of table.

Table I. Separate questions related to pregnancy on state certificates in 2003 and after—Con.

State	Question in 2003	Later question added	Date added
Maine	No question but had a prompt	If female: □ not pregnant within one year of death □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to one year before death □ pregnant at time of death □ unknown if pregnant within one year of death	Midyear 2010
Massachusetts	None.	Select Not pregnant within the past year; Pregnant at the time of death; Not pregnant, but pregnant within 42 days of death; Not pregnant, but pregnant 43 days or 1 year before death; Unknown if pregnant within the last year	Midyear 2014
Maryland	If female: Was decedent pregnant in the past 12 months? □ Yes □ No □ Unknown Separate fields on dates of death and delivery support capability to compute the other categories in the standard.	None.	2001
Michigan	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2004
Minnesota	Was female pregnant: At death? __ yes __ no __ unknown In last 12 months? __ yes __ no __ unknown	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	Midyear 2011
Mississippi	Had decedent been pregnant within 90 days prior to death? □ Yes □ No	If female: □ not pregnant within the past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2012
Missouri	If deceased was female 10–49, was she pregnant in the last 90 days? □ Yes □ No □ Unk.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2010
Montana	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	None.	2003
Nevada	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year □ not applicable	2008

See footnotes at end of table.

Table I. Separate questions related to pregnancy on state certificates in 2003 and after—Con.

State	Question in 2003	Later question added	Date added
New Jersey	If female, was she pregnant at death, or any time 90 days prior to death? □ Yes □ No	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2004
New Mexico	Was decedent pregnant within last 6 weeks? □ Yes □ No	If decedent was female, was decedent pregnant within the last year? □ not pregnant within 1 year of death □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within 1 year of death	2006
New York city	If female □ not pregnant within 1 year of death □ pregnant at time of death □ not pregnant at death, but pregnant within 42 days of death □ not pregnant at death, but pregnant 43 days to 1 year before death □ unknown if pregnant within 1 year of death Also have date of outcome, so could compute intervals if needed.	None.	2003
New York state	If female: □ not pregnant within last year □ pregnant at time of death □ not pregnant, but pregnant within 42 days of death □ not pregnant, but pregnant 43 days to 1 year before death □ unknown if pregnant within past year Also have date of delivery, so could compute intervals if needed.	None.	2003
North Carolina	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2014
North Dakota	Was deceased pregnant within 18 months of death? □ Yes □ No	If female, decedent was: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2008
Nebraska	If female, was there a pregnancy in the past 3 months? Yes □ No □	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2005
New Hampshire	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	Midyear 2004
Ohio	None.	If female, pregnancy status: □ not pregnant within last year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown □ not applicable	2007

See footnotes at end of table.

Table I. Separate questions related to pregnancy on state certificates in 2003 and after—Con.

State	Question in 2003	Later question added	Date added
Oklahoma	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2004
Oregon	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2006
Pennsylvania	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2012
Rhode Island	None.	Pregnancy– if female– the decedent was: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2006
South Carolina	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to one year before death □ pregnant at time of death □ unknown if pregnant within the past year	2005
South Dakota	None.	If female, the decedent was: □ not pregnant within the past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2004
Tennessee	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2012

Texas	Was decedent pregnant
	  at time of death □ yes □ no □ UNK
	  within last 12 MO □ yes □ no □ UNK
		If female:
		□ not pregnant within past year □ not pregnant but pregnant within 42 days of death
		□ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death
		□ unknown if pregnant within the past year
			2006

Utah	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2005
Vermont	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	Midyear 2008

See footnotes at end of table.

Table I. Separate questions related to pregnancy on state certificates in 2003 and after—Con.

State	Question in 2003	Later question added	Date added
Virginia	If female, was there a pregnancy in past 3 months? Yes □ No □ Unknown □	If female: Make selection only if the decedent's age is between 5 and 75 years □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	Midyear 2014
Washington	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the past year	2004
Wisconsin	None.	Pregnancy status (statistical use only– will <u>not</u> appear on certificate) □ not pregnant within the past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year prior to death □ pregnant at time before death □ unknown if pregnant within last year	Midyear 2013
West Virginia	None.	If female: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within the last year	Midyear 2017
Wyoming	None.	If female aged 10–54: □ not pregnant within past year □ not pregnant but pregnant within 42 days of death □ not pregnant but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if pregnant within past year	2004

NOTE: Unk. and UNK are Unknown. Table shows the question related to pregnancy on individual state death certificates, if any, in 2003; any subsequent question added related to pregnancy; and the date added.

SOURCE: Official death certificate forms in the 50 states, the District of Columbia, and New York city.

Table II. Ratio of maternal deaths assigned using the checkbox item to maternal deaths assigned without using the checkbox item for maternal deaths: Selected states, 2015–2016

[Maternal deaths (A34, O00–O95, O98–O99) occur while pregnant or within 42 days of being pregnant]

State	Maternal deaths (A34, O00–O95, O98–O99)		
	Number of deaths		
	As assigned using checkbox	As assigned without using checkbox	Ratio
47 states and the District of Columbia.	1,527	498	3.07
Florida	78	37	2.11
Georgia	134	28	4.79
Illinois	40	21	1.90
New York	72	41	1.76
Ohio.	53	24	2.21
Texas	264	58	4.55

NOTE: Table excludes data from Alabama, California, and West Virginia.

SOURCE: NCHS, National Vital Statistics System.

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Abstract

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Series 3, Number 44   January 2020

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