The Contemporary Challenge of Maternal Mortality in the U.S.

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Boston University School of Public Health
April, 2023

www.birthbythenumbers.org
Outline of the Presentation

1. Clarifying Definitions
2. Historical Context
3. The Strange Case of the Pregnancy Checkbox
4. The Pregnancy Mortality Surveillance System
5. Comparing the U.S. to the Rest of the World
6. The Persistence of Racial Disparities
7. Update on 2021-22 Data Release
   7. Timing and Maternal Mortality a Public Health Problem
8. The Issue is Broader than Maternal Mortality
9. The Way Forward
1. Definitions – the multiple measures of maternal death
First a quick side trip into the terms rate and ratio. If you don’t find that discussion enthralling, you:

(a) are a normal human being; and

(b) can skip to slide 11 and wonder what you missed.
Is Maternal Mortality a Ratio or a Rate?

• WHO reports maternal mortality as a ratio, while the U.S. National Vital Statistics System reports maternal mortality as a rate. What’s the difference?

• Maternal Mortality Ratio:
  
  Deaths during pregnancy up to 42 days ppm
  Live Births

It is a ratio because all the cases in the numerator (e.g. death during early pregnancy) are not necessarily included in the denominator.

www.birthbythenumbers.org
DOI: https://dx.doi.org/10.15620/cdc:124678
Maternal mortality ratio (MMR) estimates, by country, 2020

Is Maternal Mortality a Ratio or a Rate?

- **Rate**: \# of events / total persons at risk in the population (usually % or number per 1,000/100,000)

- **Ratio**: \# of events (or persons) / some comparable cohort of people or events
Is Maternal Mortality a Ratio or a Rate?

• **RATE**: The frequency of an event in a population. All the cases in the numerator are included in the denominator.

Example:  
Births to women 15-19

*Teen Birth Rate*  
All women 15-19

• **RATIO**: simply divides one number by another – all the cases in the numerator are not included in the denominator.

Example:  
Maternal Deaths

*Maternal Mortality Ratio*  
Live Births

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So, why do we use maternal mortality ratios internationally?

Because most countries don’t have clear measurement of the total number of pregnancies, but do have some record of total births.

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The three widely used definitions of maternal mortality:

1. Pregnancy associated death
2. Pregnancy related death
3. Maternal mortality
Three Definitions (in the U.S.)

• **Pregnancy Associated Death** – The death of a woman while pregnant or **within one year** of termination of pregnancy, **irrespective of cause**. *(WHO calls these “pregnancy related”)*. **Starting point for analyses.**

• **Pregnancy Related Death** – the death of a woman during pregnancy or **within one year** of the end of pregnancy **from a pregnancy complication, a chain of events initiated by pregnancy**, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. **Used by CDC for U.S. trends.**

• **Maternal Mortality Ratio** – the death of a woman **while pregnant or within 42 days of termination of pregnancy**, irrespective of the duration and site of the pregnancy, from any cause **related to or aggravated by the pregnancy** or its management but not from accidental or incidental causes. Typically reported as a ratio per 100,000 births. **Used in international comparisons.**

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Pregnancy Associated Mortality (1 year)

Pregnancy Associated Mortality: All Deaths women of reprod. age pregnancy to 1 year ppm

www.birthbythenumbers.org
Pregnancy Related Mortality:
All Deaths women of reprod. age pregnancy to 1 year ppm Related to the pregnancy

Pregnancy Associated Mortality (1 year)

Pregnancy Related Mortality (1 year)
Maternal Mortality: All Deaths women of reprod. age pregnancy to **42 days ppm** Related to the pregnancy

Maternal Mortality (42 days)

Pregnancy Related Mortality (1 year)

Pregnancy Associated Mortality (1 year)
Maternal Mortality: Deaths during pregnancy and up to 42 days postpartum & related to the pregnancy

Pregnancy Related Mortality: Deaths during pregnancy and up to 1 year postpartum & related to the pregnancy

Pregnancy Associated Mortality: Deaths during pregnancy and up to 1 year postpartum
Timeline of Maternal Mortality Definitions

- **Pregnancy**
- **Birth**
- **Week after Birth**
- **42 days PPM**
- **42 days PPM to 1 year**

**WHO Definition of Maternal Death**

- WHO Maternal Mortality
- CDC Pregnancy Related
- Pregnancy Associated

PPM – postpartum – period after the birth

[www.birthbythenumbers.org](http://www.birthbythenumbers.org)
Timing of Maternal Deaths (2017-19)


www.birthbythenumbers.org
Different Sources & Different Measures


• **CDC Pregnancy Related Mortality System** – Pregnancy Related Mortality

• **State Maternal Mortality Review Committees** – Pregnancy Associated, Pregnancy Related & Maternal Mortality depending on states, but primarily Pregnancy Related Mortality

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# US Maternal Mortality Surveillance

<table>
<thead>
<tr>
<th>Data Source</th>
<th>CDC – National Vital Statistics System (NVSS)</th>
<th>CDC – Pregnancy Mortality Surveillance System (PMSS)</th>
<th>State and Local Maternal Mortality Review Committees (MMRCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Death certificates</td>
<td>Death certificates linked to fetal death and birth certificates</td>
<td>Death certificates linked to fetal death certificates, medical records, social service records, autopsy, informant interviews, etc.</td>
</tr>
<tr>
<td>Time Frame</td>
<td>During pregnancy – 42 days</td>
<td>During pregnancy – 365 days</td>
<td>During pregnancy – 365 days</td>
</tr>
<tr>
<td>Source of Classification</td>
<td>ICD-10 codes</td>
<td>Medical epidemiologists</td>
<td>Multidisciplinary committees</td>
</tr>
<tr>
<td>Measure</td>
<td>Maternal Mortality Rate - # of Maternal Deaths per 100,000 live births</td>
<td>Pregnancy Related Mortality Ratio - # of Pregnancy Related Deaths per 100,000 live births</td>
<td>Pregnancy Related Mortality Ratio - # of Pregnancy Related Deaths per 100,000 live births</td>
</tr>
<tr>
<td>Purpose</td>
<td>Show national trends and provide a basis for international comparison</td>
<td>Analyze clinical factors associated with deaths, publish information that may lead to prevention strategies</td>
<td>Understand medical and non-medical contributors to deaths, prioritize interventions that effectively reduce maternal deaths</td>
</tr>
</tbody>
</table>

Illustrating the Differences in Measures of Maternal Death: Same State; Same Years; 4 different results.

NOTE: NVSS Data on Tenn. Maternal Mortality for 2017-2019: 75 Deaths; 242,217 births Rate – 31.0/100,000

Tennessee Mortality Rates from the Tenn. Maternal Mortality Review Committee per 100,000 live births, 2017-19

- Maternal Mortality (42 days): 18.6
- Pregnancy Associated Mortality (1 year): 91.7
- Pregnancy Related Mortality (1 year): 27.8
2. The Historical Trend in U.S. Maternal Mortality
Declaring Premature Victory

“An examination of the rates for the different states indicates areas in which further improvement can be expected, but it is clear that maternal mortality is no longer a nationwide problem……Childbearing has been made quite safe.”


• At the time the maternal mortality rate was 100 per 100,000
U.S. Maternal Mortality (per 100,000 births), 1915-2021


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<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Year</th>
<th>State</th>
<th>Year</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New Jersey.</td>
<td></td>
<td>Wisconsin.</td>
<td></td>
<td>Mississippi.</td>
</tr>
<tr>
<td></td>
<td>District of Columbia.¹</td>
<td>1909</td>
<td>Ohio.</td>
<td>1920</td>
<td>Nebraska.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1910</td>
<td>Minnesota.</td>
<td>1922</td>
<td>Georgia.³</td>
</tr>
<tr>
<td></td>
<td>Delaware.²</td>
<td></td>
<td>Utah.</td>
<td></td>
<td>Wyoming.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Kentucky.</td>
<td></td>
<td>Iowa.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Missouri.</td>
<td>1923</td>
<td>North Dakota.</td>
</tr>
<tr>
<td>1900</td>
<td>New Hampshire.</td>
<td>1913</td>
<td>Virginia.</td>
<td>1924</td>
<td>North Dakota.</td>
</tr>
<tr>
<td></td>
<td>Rhode Island.</td>
<td>1914</td>
<td></td>
<td></td>
<td>West Virginia.</td>
</tr>
<tr>
<td>1900</td>
<td>Vermont.</td>
<td>1916</td>
<td>South Carolina.</td>
<td>1926</td>
<td>Arizona.</td>
</tr>
<tr>
<td></td>
<td>Maine.</td>
<td>1917</td>
<td>North Carolina.</td>
<td>1927</td>
<td>Arkansas.</td>
</tr>
<tr>
<td></td>
<td>Indiana.</td>
<td></td>
<td>Illinois.</td>
<td>1929</td>
<td>Nevada.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Louisiana.</td>
<td>1933</td>
<td>New Mexico.</td>
</tr>
<tr>
<td></td>
<td>California.</td>
<td>1918</td>
<td>Oregon.</td>
<td></td>
<td>Texas.</td>
</tr>
<tr>
<td>1906</td>
<td>Colorado.</td>
<td></td>
<td></td>
<td>1959</td>
<td>Alaska.</td>
</tr>
<tr>
<td></td>
<td>Maryland.</td>
<td></td>
<td></td>
<td>1960</td>
<td>Hawaii.</td>
</tr>
<tr>
<td></td>
<td>Pennsylvania.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>South Dakota.³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Included as a State.
² Dropped from the registration system in 1900; readmitted in 1919.
³ Dropped from the registration system in 1910; readmitted in 1930.
⁴ Included only municipalities with populations of 1,000 or more in 1900 (about 16 percent of the total population); the remainder of the State was added to the system in 1916.
⁵ Dropped from the registration system in 1925; readmitted in 1928.
Number of U.S. Hospital Beds and Maternal Mortality, 1918-1950

U.S. Maternal Mortality (per 100,000 live births), 1951-2007

1951-1982
89% decline (75.0 to 7.9)

Source: NCHS. Deaths: Final Data. Annual Reports.

www.birthbythenumbers.org
U.S. Maternal Mortality (per 100,000 live births), 1951-2007

Source: NCHS. Deaths: Final Data. Annual Reports.

www.birthbythenumbers.org
U.S. Maternal Mortality (per 100,000 live births), 1951-2007

1997-2007
78% increase (7.1 to 12.7)

Source: NCHS. Deaths: Final Data. Annual Reports.

www.birthbythenumbers.org
Why did reporting of an official maternal mortality ratio for U.S. stop in 2007?
Last reporting (2007) of a maternal mortality rate by NCHS before 2018
How did the U.S. get to the point where they stopped publishing a maternal mortality rate?

Efforts to avoid poor case ascertainment led to over-ascertainment

www.birthbythenumbers.org
“This difficulty [in measuring maternal mortality] would be solved easily if universal birth and stillbirth registration was practiced and if death certificates required a statement as to the association of the puerperal state.”
3. The Case of the Pregnancy Checkbox

“This difficulty [in measuring maternal mortality] would be solved easily if universal birth and stillbirth registration was practiced and if death certificates required a statement as to the association of the puerperal state.”

Quick note on the federal reporting system of births and deaths.

• There is no centralized “national” reporting system in the U.S.

• Birth and death data is collected at the local level, compiled at the state level, and then selected items are sent to the National Vital Statistics System (NVSS).

• The states and the NVSS periodically negotiate an agreement (seen in the U.S. Standard Certificate of Death) on the specific items from state data collection used in the national file. These revisions were last made in 1975, 1989, and 2003.

• The failure to officially report U.S. maternal deaths from 2008-18 was a direct result of the 2003 revisions that attempted to improve reporting.
The Check Box

Determining Pregnancy Status to Improve Maternal Mortality Surveillance


Andrea P. MacKay, MSPH, Roger Rochat, MD, Jack C. Smith, MS, Cynthia J. B.

Objective: More than half of pregnancy-related deaths are not identified through methods. The purpose of this study was to evaluate the effectiveness of check boxes on death certificates in ascertaining pregnancy-related deaths.

Methods: Data derived from the Centers for Disease Control and Prevention Maternal Mortality Surveillance System were used to identify states that included a pregnancy-related death certificate in 1991 and 1992. Death certificates from those states were examined to determine the number and proportion of pregnancy-related death check boxes. Characteristics of death were also examined.

Results: Sixteen states and New York City included a check box or question specifically asking about pregnancy of the decedent. Of the 425 pregnancy-related deaths identified in the 17 reporting areas, 124 (29%) were determined to be pregnancy-related deaths only because of the pregnancy status information provided in the check box. The proportion of deaths identified only by a marked check box ranged from less than 5% for four states to 40% or more for seven states.

16 States already had a pregnancy checkbox on death certificates as far back as 1991-1992, but with different wording.

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<table>
<thead>
<tr>
<th>State</th>
<th>Wording</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Was there a pregnancy in last 42 days? (Specify Yes, No, or dk.)</td>
</tr>
<tr>
<td>California</td>
<td>If female, pregnant in last year? □ Yes □ No □ UNK</td>
</tr>
<tr>
<td>Florida</td>
<td>If female, was there a pregnancy in the past 3 months?  Yes  No</td>
</tr>
<tr>
<td>Idaho</td>
<td>If female aged 0–54: □ not preg win past yr □ preg at time of death □ not pregnant, but preg within 42 days of death □ not pregnant but preg 43 days to 1 yr before death □ unknown if preg w/in the past yr</td>
</tr>
<tr>
<td>Illinois</td>
<td>If female, was there a pregnancy in the past 12 months? (Specify yes or no)</td>
</tr>
<tr>
<td>Indiana</td>
<td>Was decedent pregnant or 90 days postpartum? (Yes or no)</td>
</tr>
<tr>
<td>Iowa</td>
<td>If female, was there a pregnancy in the past 12 months? (Specify yes or no)</td>
</tr>
<tr>
<td>Kentucky</td>
<td>If female, was there a pregnancy in the past 12 months? □ Yes □ No</td>
</tr>
<tr>
<td>Louisiana</td>
<td>If deceased was female 10–49, was she pregnant in the last 90 days? □ Yes □ No □ Unk</td>
</tr>
<tr>
<td>Maryland</td>
<td>If female: Was decedent pregnant in the past 12 months? □ Yes □ No □ Unknown Separate field on dates of death and delivery support capability to compute the other categories in the standard.</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Was female pregnant: At death? yes no In last 12 months? yes no unknown</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Had decedent been pregnant within 90 days prior to death? □ Yes □ No</td>
</tr>
<tr>
<td>Missouri</td>
<td>If deceased was female 10–49, was she pregnant in the last 90 days? □ Yes □ No □ Un</td>
</tr>
<tr>
<td>Montana</td>
<td>If female: □ not preg within past year □ not preg but preg within 42 days of death □ not preg but pregnant 43 days to 1 year before death □ pregnant at time of death □ unknown if preg within past year</td>
</tr>
<tr>
<td>New Jersey</td>
<td>If female, was she pregnant at death, or any time 90 days prior to death □ Yes □ No</td>
</tr>
<tr>
<td>New Mexico</td>
<td>Was deceased pregnant within 6 weeks? □ Yes □ No</td>
</tr>
<tr>
<td>North Dakota</td>
<td>Was deceased pregnant within 18 months of death? □ Yes □ No</td>
</tr>
<tr>
<td>Nebraska</td>
<td>If female, was there a pregnancy in the past 3 months?  Yes □ No □</td>
</tr>
<tr>
<td>Texas</td>
<td>Was decedent pregnant at time of death □ yes □ no □ UNK within last 12 MO □ yes □ no □ UN</td>
</tr>
<tr>
<td>Virginia</td>
<td>If female, was there a pregnancy in past 3 months?  Yes □ No □  Unknown □</td>
</tr>
</tbody>
</table>


### PART II (Other significant conditions)
- Enter all diseases or conditions contributing to death that were not reported in the chain of events in Part I and that did not result in the underlying cause of death. See attached examples.
- If two or more possible sequences resulted in death, or if two conditions seem to have added together, report in Part I the one that, in your opinion, most directly caused death. Report in Part II the other conditions or diseases.

#### CHANGES TO CAUSE OF DEATH
Should additional medical information or autopsy findings become available that would change the cause of death originally reported, the original death certificate should be amended by the certifying physician by immediately reporting the revised cause of death to the State Vital Records Office.

### ITEMS 33-34 - AUTOPSY
- 33 - Enter “Yes” if either a partial or full autopsy was performed. Otherwise enter “No.”
- 34 - Enter “Yes” if autopsy findings were available to complete the cause of death; otherwise enter “No.” Leave item blank if no autopsy was performed.

### ITEM 35 - DID TOBACCO USE CONTRIBUTE TO DEATH?
Check “yes” if, in your opinion, the use of tobacco contributed to the death. Tobacco use may contribute to deaths due to a wide variety of diseases; for example, tobacco use contributes to many deaths due to emphysema or lung cancer and some heart disease and cancers of the head and neck. Check “no” if, in your clinical judgment, tobacco use did not contribute to this particular death.

### ITEM 36 - IF FEMALE, WAS DECEDENT PREGNANT AT TIME OF DEATH OR WITHIN PAST YEAR?
This information is important in determining pregnancy-related mortality.

### ITEM 37 - MANNER OF DEATH
- Always check Manner of Death, which is important: 1) in determining accurate causes of death; 2) in processing insurance claims; and 3) in statistical studies of injuries and death.
- Indicate “Pending Investigation” if the manner of death cannot be determined whether due to an accident, suicide, or homicide within the statutory time limit for filing the death certificate. This should be changed later to one of the other terms.
- Indicate “Could not be Determined” ONLY when it is impossible to determine the manner of death.

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To improve case identification:


Checkbox format:

- 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

Meant to solve 2 problems:

(1) Most states had no such question; and

(2) Different questions used in different states that did ask about pregnancy status.

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<table>
<thead>
<tr>
<th>Year</th>
<th>New Adopters*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2004</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>2005</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>2006</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>2007</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>2008</td>
<td>7</td>
<td>31</td>
</tr>
<tr>
<td>2009</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>2010</td>
<td>4</td>
<td>35</td>
</tr>
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<td>2011</td>
<td>2</td>
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<td>2012</td>
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<td>2013</td>
<td>1</td>
<td>42</td>
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<td>2014</td>
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<td>2015</td>
<td>2</td>
<td>49</td>
</tr>
<tr>
<td>2016</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>2017</td>
<td>1</td>
<td>51</td>
</tr>
</tbody>
</table>

* Note: Some states adopted change in the middle of the calendar year.

### Delays in Adoption of the U.S. Standard Pregnancy Question among States

<table>
<thead>
<tr>
<th>State</th>
<th>Year Adopted</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA, ID, MT, NY</td>
<td>2003</td>
</tr>
<tr>
<td>New Jersey</td>
<td>2004</td>
</tr>
<tr>
<td>Florida</td>
<td>2005</td>
</tr>
<tr>
<td>Texas</td>
<td>2006</td>
</tr>
<tr>
<td>Ohio</td>
<td>2007</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>9/2014</td>
</tr>
<tr>
<td>Alabama</td>
<td>2016</td>
</tr>
<tr>
<td>W. VA</td>
<td>2017</td>
</tr>
</tbody>
</table>

www.birthbythenumbers.org
Staggered adoption of 2003 revisions by states (2003-17)

*Until August 2021, California used a non-standard pregnancy checkbox (only captured within 1 year)
Maternal Mortality Rates (per 100,000) in States with & without a checkbox, 1996-2003

So adopting the checkbox will solve the problem of under ascertainment & we can report a more accurate national rate after 2003?

Original Research

Recent Increases in the U.S. Maternal Mortality Rate
Disentangling Trends From Measurement Issues

Marian F. MacDorman, PhD, Eugene Declercq, PhD, Howard Cabral, PhD, and Christine Morton, PhD

RESULTS: The estimated maternal mortality rate (per 100,000 live births) for 48 states and Washington, DC (excluding California and Texas, analyzed separately) increased by 26.6%, from 18.8 in 2000 to 23.8 in 2014. California showed a declining trend, whereas Texas had a sudden increase in 2011–2012. Analysis of the measurement change suggests that U.S. rates in the early 2000s were higher than previously reported.
Correcting for Impact of Adding Pregnancy Box

Correction factor = \[
\frac{\text{Sum of the number of maternal deaths in each state for 2 years following the revision date}}{\text{Sum of the number of maternal deaths in each state for the 2 years preceding the revision date}}
\]

Also did tests involving 1 year and 3 year periods with little change
Note: Includes 24 states that did not have a pregnancy question on their unrevised death certificate and which adopted the U.S. standard question upon revision: Arkansas, Arizona, Connecticut, Delaware, Georgia, Idaho, Kansas, Maine, Michigan, Montana, New Hampshire, Nevada, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Washington, and Wyoming.

Impact of adding the pregnancy checkbox was to approximately double a state’s maternal mortality ratio

Correction Factor: 1.93
NVSS analyses of the impact of the pregnancy checkbox

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

by Donna L. Hoyert, Ph.D., Division of Vital Statistics, Sayeeda F.G. Uddin, M.D., M.P.H., Office of the Director, and Arialdi M. Minino, M.P.H., Division of Vital Statistics

Maternal Mortality in the United States: Changes in Coding, Publication, and Data Release, 2018

by Donna L. Hoyert, Ph.D., and Arialdi M. Minino, M.P.H., Division of Vital Statistics

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Statistical Analysis

• **Objective 1:** Quantify the impact of the staggered implementation of the pregnancy checkbox on Maternal Mortality Rates (MMRs)

• **Objective 2:** Estimate trends in MMRs from 1999 through 2017, accounting for the checkbox

• **Objective 3:** Examine the impact of potential misclassification of pregnancy status on the death certificate on MMR trends from 1999 through 2017
NCHS Analysis of the Impact of Checkbox

Figure 1. Average change in maternal mortality rates associated with the pregnancy checkbox implementation: United States, 2003–2017


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<table>
<thead>
<tr>
<th>State</th>
<th>Change in maternal mortality rate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>29.0 (18.4 – 39.7)</td>
</tr>
<tr>
<td>Alaska</td>
<td>4.0 (–8.7 – 16.7)</td>
</tr>
<tr>
<td>Arizona</td>
<td>10.2 (2.2 – 18.1)</td>
</tr>
<tr>
<td>Arkansas</td>
<td>15.7 (1.0 – 30.4)</td>
</tr>
<tr>
<td>California</td>
<td>9.9 (5.2 – 14.7)</td>
</tr>
<tr>
<td>Colorado</td>
<td>2.0 (–4.8 – 8.8)</td>
</tr>
<tr>
<td>Connecticut</td>
<td>5.7 (–0.6 – 12.0)</td>
</tr>
<tr>
<td>Delaware</td>
<td>19.0 (–15.5 – 53.5)</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>2.3 (–9.9 – 14.6)</td>
</tr>
<tr>
<td>Florida</td>
<td>9.3 (4.8 – 13.7)</td>
</tr>
<tr>
<td>Georgia</td>
<td>3.2 (–2.4 – 8.7)</td>
</tr>
<tr>
<td>Hawaii</td>
<td>–6.4 (–22.3 – 9.5)</td>
</tr>
<tr>
<td>Idaho</td>
<td>23.9 (4.7 – 43.2)</td>
</tr>
<tr>
<td>Illinois</td>
<td>17.9 (10.6 – 25.1)</td>
</tr>
<tr>
<td>Indiana</td>
<td>20.4 (14.3 – 26.5)</td>
</tr>
<tr>
<td>Iowa</td>
<td>9.5 (–1.7 – 20.7)</td>
</tr>
<tr>
<td>Kansas</td>
<td>14.0 (4.3 – 23.8)</td>
</tr>
<tr>
<td>Kentucky</td>
<td>11.6 (0.6 – 22.7)</td>
</tr>
<tr>
<td>Louisiana</td>
<td>38.2 (28.4 – 48.0)</td>
</tr>
<tr>
<td>Maine</td>
<td>6.9 (–13.5 – 27.3)</td>
</tr>
<tr>
<td>Maryland</td>
<td>–7.8 (–13.3 – 2.4)</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2.4 (–1.6 – 6.5)</td>
</tr>
<tr>
<td>Michigan</td>
<td>29.9 (20.4 – 39.3)</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1.5 (–6.2 – 9.2)</td>
</tr>
<tr>
<td>Mississippi</td>
<td>–10.0 (–21.4 – 1.5)</td>
</tr>
<tr>
<td>Missouri</td>
<td>6.5 (–3.9 – 16.9)</td>
</tr>
<tr>
<td>Montana</td>
<td>0.4 (–24.2 – 25.0)</td>
</tr>
<tr>
<td>Nebraska</td>
<td>–2.6 (–16.8 – 11.7)</td>
</tr>
<tr>
<td>Nevada</td>
<td>–1.3 (–12.7 – 10.0)</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>5.3 (–12.9 – 23.4)</td>
</tr>
</tbody>
</table>

New Jersey: 16.1 (11.0 – 21.1)  
New Mexico: 15.7 (–5.9 – 37.2)  
New York City: 9.3 (2.7 – 15.9)  
New York State: 6.6 (1.8 – 11.3)  
North Carolina: 9.5 (5.0 – 14.1)  
North Dakota: 25.3 (–14.3 – 64.9)  
Ohio: 19.6 (12.7 – 26.4)  
Oklahoma: 29.9 (16.0 – 43.8)  
Oregon: 5.1 (–3.7 – 13.9)  
Pennsylvania: –2.4 (–8.4 – 3.6)  
Rhode Island: –0.8 (–13.5 – 11.8)  
South Carolina: 18.3 (9.8 – 26.7)  
South Dakota: 14.8 (–7.1 – 36.7)  
Tennessee: 18.8 (11.2 – 26.3)  
Texas: 12.5 (8.8 – 16.1)  
Utah: 10.9 (0.1 – 21.5)  
Vermont: 4.4 (–16.6 – 25.4)  
Virginia: 7.4 (2.5 – 12.3)  
Washington: 3.7 (–2.3 – 9.6)  
West Virginia: 4.6 (–17.4 – 26.6)  
Wisconsin: –4.8 (–12.9 – 3.2)  
Wyoming: 84.4 (–22.5 – 191.3)

Observed and predicted maternal mortality ratios: United States, 1999–2017


www.birthbythenumbers.org
Ratio of pregnancy associated deaths assigned using the checkbox item to maternal deaths assigned without using the checkbox item for maternal deaths: Selected states, 2015–2016

<table>
<thead>
<tr>
<th>State</th>
<th>Assigned by checkbox</th>
<th>Assigned w/out checkbox</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 States &amp; D.C.*</td>
<td>1,527</td>
<td>498</td>
<td>3.07</td>
</tr>
<tr>
<td>Florida</td>
<td>78</td>
<td>37</td>
<td>2.11</td>
</tr>
<tr>
<td>Georgia</td>
<td>134</td>
<td>28</td>
<td>4.79</td>
</tr>
<tr>
<td>Illinois</td>
<td>40</td>
<td>21</td>
<td>1.90</td>
</tr>
<tr>
<td>New York</td>
<td>72</td>
<td>41</td>
<td>1.76</td>
</tr>
<tr>
<td>Ohio</td>
<td>53</td>
<td>24</td>
<td>2.21</td>
</tr>
<tr>
<td>Texas</td>
<td>264</td>
<td>58</td>
<td>4.55</td>
</tr>
</tbody>
</table>

* Excludes Alabama, California, & W. Virginia


www.birthbythenumbers.org
Two key problems raised by the checkbox

1. Over ascertainment

2. Loss of precision in identifying causes of maternal death – the rise of “other” causes.
The problem with “other”

Original Research

Trends in Maternal Mortality by Sociodemographic Characteristics and Cause of Death in 27 States and the District of Columbia

Marian F. MacDorman, PhD, Eugene Declercq, PhD, and Marie E. Thoma, PhD

Obstet Gynecol 2017;129:811–8
Underlying cause of death

Total maternal deaths (during pregnancy or within 42 days after the end of pregnancy) (A34, O00-O95, O98-O99)

Total direct obstetric causes (A34, O00-O92)
- Pregnancy with abortive outcome (O00-O07)
  - Ectopic pregnancy (O00)
- Hypertensive disorders (O10-O16)
  - Pre-existing hypertension (O10)
  - Eclampsia and pre-eclampsia (O11, O13-O16)
- Obstetric Hemorrhage (O20, O43.2, O44-O46, O67, O71.0-O71.1, O71.3-O71.4, O71.7, O72)
- Pregnancy-related infection (O23, O41.1, O75.3, O85, O86, O91)
  - Puerperal sepsis (O85)
- Other obstetric complications (O21-O22, O24-O28, O30-O41.0, O41.8-O43.1, O43.8-O43.9, O47--O66, O68-O70, O71.2, O71.5, O71.6, O71.8, O71.9, O73, O75.0-O75.2, O75.4-O75.9, O87-O90, O92)
  - Diabetes mellitus in pregnancy (O24)
  - Liver disorders in pregnancy (O26.6)
- Other specified pregnancy-related conditions (O26.8)
  - Obstetric embolism (O88)
  - Cardiomyopathy in the puerperium (O90.3)
- Anesthesia-related complications (O29, O74, O89)

Total indirect causes (O98-O99)
- Mental disorders and diseases of the nervous system (O99.3)
- Diseases of the circulatory system (O99.4)
- Diseases of the respiratory system (O99.5)
- Other specified diseases and conditions (O99.8)
- Obstetric death of unspecified cause (O95)

Late maternal causes (43 days-1 year after the end of pregnancy) (O96-O97)

Source: MacDorman M. OBGYN. 2017;129:811

Maternal Death ICD-10 Codes

www.birthbythenumbers.org
Over Ascertainment??

• Research into the cause of death category finds much of the increase is coming from less specific ICD-10 codes:
  - Other specified pregnancy-related conditions (O26.8)
  - Other obstetric complications (O21–O22, O24–O41.0, O41.8–O43.1, O43.8–O43.9, O47–O66, O68–O70, O71.2, O71.5, O71.6, O71.8, O71.9, O73–O75.2, O75.4–O75.9, O87–O90, O92)
  - Other specified diseases and conditions (O99.8)
  - Obstetric death of unspecified cause (O95)

Source: MacDormanM. OBGYN. 2017;129:811

www.birthbythenumbers.org
## Impact of ill-defined causes on maternal deaths by cause of death, 27 states & DC, 2008-2009 to 2013-2014

<table>
<thead>
<tr>
<th>Underlying Cause of Death</th>
<th>2008/09 Rate</th>
<th>2013/14 Rate</th>
<th>% Change 2008/2009-2013/2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Maternal</strong></td>
<td>20.6</td>
<td>25.4</td>
<td>23.3</td>
</tr>
<tr>
<td>Ill-defined &quot;other&quot; causes</td>
<td>7.0</td>
<td>10.4</td>
<td>47.9</td>
</tr>
<tr>
<td><strong>Total maternal minus ill defined</strong></td>
<td>13.5</td>
<td>15.0</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Total Direct Obstetric</strong></td>
<td>13.9</td>
<td>16.6</td>
<td>19.7</td>
</tr>
<tr>
<td>Other spec. pregnancy related cond.</td>
<td>3.4</td>
<td>5.9</td>
<td>73.0</td>
</tr>
<tr>
<td><strong>Total direct obstetric minus ill defined</strong></td>
<td>10.5</td>
<td>10.7</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Total indirect causes</strong></td>
<td>5.3</td>
<td>8.2</td>
<td>54.4</td>
</tr>
<tr>
<td>Other specified dis. &amp; conditions</td>
<td>2.2</td>
<td>3.9</td>
<td>75.9</td>
</tr>
<tr>
<td><strong>Total indirect minus ill defined</strong></td>
<td>3.1</td>
<td>4.3</td>
<td>38.7</td>
</tr>
</tbody>
</table>

Source: MacDorman M. *OBGYN.* 2017;129:811

[www.birthbythenumbers.org](http://www.birthbythenumbers.org)
Ratios of deaths classified using pregnancy status checkbox to those classified without using the checkbox by Cause of Death, 47 states & D.C., 2015–2016

- Other spec. dis. & condit. complic. preg, cb, puer. (O99.8): 9.21
- Other specified pregnancy-related conditions (O26.8): 5.31
- Diseases circul. syst. Complic. preg., cb, puerper. (O99.4): 3.89
- Obstetric embolism (O88): 1.80
- Complications of labor and delivery (O60–O75): 1.20
- Eclampsia and pre-eclampsia(O11, O14–O15): 0.98
- Pregnancy with abortive outcome (O00–O07): 0.92
- Complications of the puerp., not elsewhere class. (O90): 0.82
- Cardiomyopathy in the puerperium (O90.3): 0.60

## Number of births and deaths with positive pregnancy responses in the checkbox: United States, 2013

<table>
<thead>
<tr>
<th>Age</th>
<th>Births</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-44</td>
<td>134,540</td>
<td>145</td>
</tr>
<tr>
<td>45-49</td>
<td>10,329</td>
<td>89</td>
</tr>
<tr>
<td>50-54</td>
<td>780</td>
<td>148</td>
</tr>
<tr>
<td>55-59</td>
<td>74</td>
<td>33</td>
</tr>
<tr>
<td>60-64</td>
<td>7</td>
<td>51</td>
</tr>
<tr>
<td>65-69</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>70-74</td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>75-79</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>80-84</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>85+</td>
<td></td>
<td>147</td>
</tr>
</tbody>
</table>

NOTE: Alabama, Alaska, Colorado, Hawaii, Massachusetts, North Carolina, Virginia, and West Virginia did not have the standard checkbox in 2013.

Over-ascertainment: Results of a 4 state study (Georgia, Louisiana, Michigan, and Ohio)

In 28% of cases with pregnancy checkbox checked, reviewers were not certain the woman was pregnant.

False Positives on the Pregnancy Checkbox by Age

Source: Adapted from Catalano A. Validity of the Pregnancy Checkbox. AJOG.2019.online.

www.birthbythenumbers.org
It’s Never Simple: Impact of the Checkbox – Worse and Better Ascertainment

• While the checkbox contributed to errors, a Four MMRC Committee study showed that the checkbox also improved identification of pregnancy-related deaths. Without the pregnancy checkbox, states would have missed approximately:

• 50% of pregnancy-related deaths that occurred during pregnancy

• 11% of pregnancy-related deaths that occurred within 42 days of the end of pregnancy, and

• 8% of pregnancy-related deaths that occurred within 43 days to 1 year of the end of pregnancy

Source: CDC. Report from MMRCs: a view into their critical role.

www.birthbythenumbers.org
How can there be so much misclassification?  

Who completes death certificates?

• *Death certificates can be signed by* a medical examiner, a primary physician, an attending physician, a non-attending physician, a nurse practitioner, a forensic pathologist or a coroner, but it varies according to state law. In Texas, for example, a justice of the peace can sign. Typically, deaths have to be recorded with local health departments within 72 hours of the death, and to the state within five to seven days.

• *Only about 8% of death certifications involve an autopsy*

PBS. Frontline. PostMortem.(2/1/2011)  
How can there be so much misclassification?
Definitions of terminology involved in certifying death.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pronouncement of Death</td>
<td>Date and time an individual was found to be legally dead. May be pronounced by a physician, medical examiner, or coroner.</td>
</tr>
<tr>
<td>Date and Time of Death</td>
<td>Date and time an individual is thought to have really died: may be actual or estimated by a physician, medical examiner, or coroner.</td>
</tr>
<tr>
<td>Cause of Death</td>
<td>Causal chain of events (disease or injury) that directly led to the death.</td>
</tr>
<tr>
<td>Immediate Cause of Death</td>
<td>Final event in the causal sequence that occurred closest to the time of death. Filled in as top line diagnosis on death certificate.</td>
</tr>
<tr>
<td>Underlying Cause of Death</td>
<td>Initiating event in the causal sequence that occurred most remote from the time of death. Filled in as bottom line diagnosis on death certificate.</td>
</tr>
<tr>
<td>Manner of Death</td>
<td>Classification of death based on circumstances surrounding it, i.e. suicide, homicide, accident, natural, or undetermined.</td>
</tr>
<tr>
<td>Medical Certifier of Death</td>
<td>Individual completing the medical portion of the death certificate including time, cause, and manner of death.</td>
</tr>
</tbody>
</table>

Source: Clinical Medicine & Research 2015; 13(2):74-82.
Errors and grades of errors on 601 randomly selected death certificates completed by non–Medical Examiners (physicians, advance practice registered nurses, and physician assistants), Vermont, 7/1/15-1/31/16.

<table>
<thead>
<tr>
<th>Error</th>
<th>#</th>
<th>% (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any error</td>
<td>319</td>
<td>53 (49-57)</td>
</tr>
<tr>
<td>Major error</td>
<td>305</td>
<td>51 (47-55)</td>
</tr>
<tr>
<td>Minor Error</td>
<td>59</td>
<td>10 (7-12)</td>
</tr>
<tr>
<td>Major comorbidities error</td>
<td>232</td>
<td>39 (35-42)</td>
</tr>
<tr>
<td>UCoD not on last line</td>
<td>174</td>
<td>29 (25-33)</td>
</tr>
<tr>
<td>Correct UCoD not in Part I</td>
<td>158</td>
<td>26 (23-30)</td>
</tr>
<tr>
<td>Wrong UCoD on certificate</td>
<td>107</td>
<td>18 (15-21)</td>
</tr>
</tbody>
</table>

* UCoD-Underlying Cause of Death

Factors that can introduce error in death certificates

Restrictive Form
• “They want it to be a cascade of events, which isn’t necessarily the way these health issues happen. Often, they are happening all at the same time.”

Lack of Training or Feedback
• “I don’t recall having any training in medical school or in my residency. The first time I completed death certificates was in practice.”
• “I don’t think I’ve ever had it returned to me. Or no one has ever queried me on it.”

Financial or personal impact on next of kin
• “Certain causes of death like end stage liver disease with a main cause of alcohol abuse can be contentious...I have had families come back and want to have it changed.”

Challenges to clinical certainty
• Unexpected deaths & deaths following a prolonged period without medical care.

Strategies Resulting from these Limits

Use the most general cause of death

• “I always use respiratory failure if I don’t know” & “If I don’t know the cause of death I would...fill out the most general term.”

Use admission diagnosis

• “I’ll default to their admissions diagnosis. If somebody comes in for sepsis, then other badness happens...I will put acute hypoxic respiratory failure secondary to sepsis.”

Most likely cause based on expectations or epidemiology

• “The most common cause of death for a patient with dementia would be aspiration pneumonia. If the story fits, that’s what we sign it out as.”

Obtain more information

• “I would fill in the history. You could do a chart review and talk to the family.”

### Transitioning Local reporting into National Rates

- The National Vital Statistics System must take the locally generated death certificates and translate them into national maternal mortality rates. Study examined the literal causes of death written on the certificate to ascertain if the coding of them is accurate.

- "US coding practices specify that if the pregnancy checkbox indicates the death occurred during or within 1 year of pregnancy, and the death is due to natural causes (i.e. excluding accidents, homicide and suicide) then the cause of death is automatically coded as a maternal or late maternal death, regardless of whether the condition was related to or exacerbated by the pregnancy."

#### CAUSE OF DEATH (See instructions and examples)

<table>
<thead>
<tr>
<th>IMMEDIATE CAUSE (Final disease or condition resulting in death)</th>
<th>Approximate Interval: Onset to death</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. <strong>twin pregnancy</strong></td>
<td></td>
</tr>
<tr>
<td>Due to (or as a consequence of):</td>
<td></td>
</tr>
<tr>
<td>b. <strong>placenta previa</strong></td>
<td></td>
</tr>
<tr>
<td>Due to (or as a consequence of):</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>Due to (or as a consequence of):</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>Due to (or as a consequence of):</td>
<td></td>
</tr>
</tbody>
</table>

**In this example, the underlying cause of death based on NCHS rules was twin pregnancy, but researchers recoded to placenta previa.**

Solving the problem with “other” causes of death by studying the “literals” on death certificates

Among the 1691 records originally coded as maternal deaths, 735 (43.5%) were originally coded to ill-defined or non-specific causes (O26.8, O95, O99.8). We were able to recode 694 (94.4%) of these cases to more specific causes of death as more specific information was available from the cause-of-death literals. Thus, only 41 records (5.6%) retained a non-specific cause code (O26.8, O95, O99.8, or R99) in our recoding.

Summary

• The introduction of the pregnancy checkbox served its stated purpose – it identified cases that would have been otherwise missed.

• Unfortunately, it also led to a significant overcounting of women’s death as maternal deaths.

• Misclassification in maternal deaths is only part of a larger problem in death reporting.

• Even if you take a more conservative approach to determining the maternal mortality ratio, the U.S. data suggests we are not doing well.
4. The Pregnancy Related Mortality Surveillance System
Pregnancy Mortality Surveillance System

When did CDC start conducting national surveillance of pregnancy-related deaths?

CDC initiated national surveillance of pregnancy-related deaths in 1986 because more clinical information was needed to fill data gaps about causes of maternal death.

How does CDC define pregnancy-related deaths?

For reporting purposes, a pregnancy-related death is defined as the death of a woman while pregnant or within 1 year of pregnancy termination—regardless of the duration or site of the pregnancy—from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

How are the data collected and coded?

Each year, CDC requests the 52 reporting areas (50 states, New York City, and Washington, DC) to voluntarily send copies of death certificates for all women who died during pregnancy or within 1 year of pregnancy, and copies of the matching birth or fetal death certificates, if they have the ability to perform such record linkage. All of the information obtained is summarized, and medically trained epidemiologists determine the cause and time of death related to the pregnancy. Causes of death are coded by using a system established in 1986 by the American College of Obstetricians and Gynecologists and the Centers for Disease Control and Prevention Maternal Mortality Study Group.

How are the data used?

Data are analyzed by CDC scientists. Information about causes of pregnancy-related deaths and risk factors associated with these deaths is released periodically through peer-reviewed literature, CDC’s Morbidity and Mortality Weekly Report, and the CDC website. This information helps clinicians and public health professionals to better understand circumstances surrounding pregnancy-related deaths and to take appropriate actions to prevent them.
Data for CDCs Pregnancy Related Mortality System

Each year, CDC requests the 52 reporting areas (50 states, New York City, and Washington DC) to **voluntarily send copies of death certificates for all women who died during pregnancy or within 1 year of pregnancy, and copies of the matching birth or fetal death certificates,** if they have the ability to perform such record links. All of the information obtained is summarized, and medically trained epidemiologists determine the cause and time of death related to the pregnancy. Causes of death are coded by using a system established in 1986 by the American College of Obstetricians and Gynecologists and the Centers for Disease Control and Prevention Maternal Mortality Study Group.
Our best existing measure


www.birthbythenumbers.org
Timing of Maternal Deaths (2017-19)


www.birthbythenumbers.org
Pregnancy-related mortality ratio by urban-rural classifications: 2017-2019

Source: CDC Website.

www.birthbythenumbers.org
Causes of pregnancy-related death in the U. S.: 2017-19

Source: CDC Website.
Pregnancy Related Mortality Ratios by Race, U.S., 2017-2019


www.birthbythenumbers.org
Pregnancy-related mortality ratios (per 100,000 live births) by race/ethnicity, U.S. 2007-2016


www.birthbythenumbers.org
Pregnancy-related mortality ratios (per 100,000 live births) by race/ethnicity, U.S. 2007-2016

Moving from the CDC Pregnancy Related Mortality Surveillance to the National Vital Statistic System Data
Maternal Mortality Rates in the United States, 2021

by Donna L. Hoyert, Ph.D., Division of Vital Statistics

This report presents maternal mortality rates for 2021 based on data from the National Vital Statistics System. A maternal death is 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 (1).” Maternal mortality rates, which are the number of maternal deaths per 100,000 live births, are shown in this report by age group and race and Hispanic origin.
Maternal Mortality Ratios (per 100,000 live births), U.S. 1987-2022 (2022 is provisional)*

- Official NVSS Rate
- Estimated from PMSS

# 1987-2007 & 2018-21 based on official NVSS reported ratio; 2008-2016 estimated based on Pregnancy-Related Mortality Ratio limited to 42 days postpartum.


NVSS – National Vital Statistics System; CDC – Pregnancy Mortality Surveillance System
Summary

• The Pregnancy Related Maternal Mortality System provides a reasonable alternative to the National Vital Statistics Syst. & it documented a steady increase in maternal deaths, 1987 to 2005.

• It has also shown a plateauing of the ratio from 2008-2019, though the difference between the two ratios in 2018-2019 has increased.

• The question is whether that plateauing is at an acceptable level and for that we need to place the U.S. in a comparative context.

• The resumption of the official reporting shows a rapid increase from 2018-2021, partially the result of the COVID pandemic.
5. Comparing the U.S. to the Rest of the World
## U.S. in a Comparative Context, 1910, 1927, 2020

<table>
<thead>
<tr>
<th></th>
<th>1901-1910&lt;sup&gt;1&lt;/sup&gt;</th>
<th>1927&lt;sup&gt;2&lt;/sup&gt;</th>
<th>2020&lt;sup&gt;3&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>per 100K births</td>
<td>per 100K births</td>
<td>per 100K births</td>
</tr>
<tr>
<td>Norway</td>
<td>290</td>
<td>245</td>
<td>2</td>
</tr>
<tr>
<td>Australia</td>
<td>530</td>
<td>592</td>
<td>3</td>
</tr>
<tr>
<td>Italy</td>
<td>270</td>
<td>264</td>
<td>5</td>
</tr>
<tr>
<td>Sweden</td>
<td>230</td>
<td>278</td>
<td>5</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>550</td>
<td>480</td>
<td>5</td>
</tr>
<tr>
<td>New Zealand</td>
<td>460</td>
<td>491</td>
<td>7</td>
</tr>
<tr>
<td>France</td>
<td>520</td>
<td>287</td>
<td>8</td>
</tr>
<tr>
<td>England &amp; Wales&lt;sup&gt;4&lt;/sup&gt;</td>
<td>410</td>
<td>411</td>
<td>10</td>
</tr>
<tr>
<td>United States&lt;sup&gt;5&lt;/sup&gt;</td>
<td>650</td>
<td>647</td>
<td>24</td>
</tr>
</tbody>
</table>

**Sources & Notes:**
Countries in green have fewer than 100,000 births. Let’s do a more reasonable comparison.

U.S. Maternal Mortality Ratio (per 100,000 births) Compared to Industrialized Countries with 300,000+ births, 2020


www.birthbythenumbers.org
U.S. Maternal Mortality Ratio (per 100,000 births) Compared to Industrialized Countries with 300,000+ births, 2020


www.birthbythenumbers.org
Maternal Mortality Ratio (per 100K births), 2000-2021, U.S. & Comparable Countries*

*Countries with 300,000+ births (2017): Australia, Canada, France, Germany, Italy, Japan, S. Korea, Spain, United Kingdom

Sources: OECD Health Data 2021; & U.S. Estimated from NVSS & Pregnancy Mortality Surveillance System
Summary

• No matter how you structure a comparison, the U.S. fares poorly in cross-national comparisons.

• If you include all countries, the U.S. ranks in the 60s; if you limit it to large wealthy countries, the U.S. ranks 10th...out of 10 countries.

• In terms of comparative trends, the U.S. in 2000 had a maternal mortality rate double the average for the comparison countries and over the next 20 years fell further behind.
6. The Persistence of Racial Disparities
U.S. Maternal Mortality (per 100,000 live births), 1951-2007 by Race

Source: NCHS. Maternal Mortality and Related Concepts. Vital & Health Statistics. Series 33; #3. & annual data reports. 1915-1960 data from NCHS. Vital Statistics Rates In The United States 1940-1960. NOTE: Shifts in measurement (e.g. not all states were part of registration system prior to 1933; infant race was based on race of the child until 1980 & then race of the mother post 1980) accounts for some of the variation over time. 2007-2016 based on 2 year estimates of the pregnancy related mortality rate: Petersen E. MMWR.9/6/19.

www.birthbythenumbers.org
Black to White Ratios, U.S. Maternal Mortality, 1915-2021

Source: NCHS. Maternal Mortality and Related Concepts. Vital & Health Statistics. Series 33; #3. & annual data reports. 1915-1960 data from NCHS. Vital Statistics Rates In The United States 1940-1960. NOTE: Shifts in measurement (e.g. not all states were part of registration system prior to 1933; infant race was based on race of the child until 1980 & then race of the mother post 1980) accounts for some of the variation over time. 2007-2016 based on 2 year estimates of the pregnancy related mortality rate: Petersen E. MMWR.9/6/19.

www.birthbythenumbers.org

Source: NCHS. Maternal Mortality and Related Concepts. Vital & Health Statistics. Series 33; #3. & annual data reports. 1915-1960 data from NCHS. Vital Statistics Rates In The United States 1940-1960. NOTE: Shifts in measurement (e.g. not all states were part of registration system prior to 1933; infant race was based on race of the child until 1980 & then race of the mother post 1980) accounts for some of the variation over time. 2007-2016 based on 2 year estimates of the pregnancy related mortality rate: Petersen E. MMWR.9/6/19.
# U.S. Maternal Mortality, by Race/Ethnicity, 2018-2021

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hisp. White</td>
<td>14.9</td>
<td>17.9</td>
<td>19.1</td>
<td>26.6</td>
</tr>
<tr>
<td>Non-Hisp. Black</td>
<td>37.3</td>
<td>44.0</td>
<td>55.3</td>
<td>69.9</td>
</tr>
<tr>
<td>Hispanic</td>
<td>11.8</td>
<td>12.6</td>
<td>18.2</td>
<td>28.0</td>
</tr>
<tr>
<td>Non-Hisp Asian</td>
<td>13.3</td>
<td>13.8</td>
<td>12.3</td>
<td>24.3</td>
</tr>
<tr>
<td>Non-Hisp. AIAN</td>
<td>*</td>
<td>49.2</td>
<td>48.5</td>
<td>118.7</td>
</tr>
<tr>
<td>All</td>
<td>17.4</td>
<td>20.1</td>
<td>23.8</td>
<td>32.9</td>
</tr>
<tr>
<td>40 years of Age +</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>81.9</td>
<td>75.5</td>
<td>107.9</td>
<td>138.5</td>
</tr>
</tbody>
</table>

Source: NVSS Hoyert. Maternal mortality rates in the United States, 2021. NCHS Health E-Stats. 2023; CDC Wonder; * < 10 deaths
Maternal mortality rates, by race & Hispanic origin and age: United States, 2021

DOI: https://dx.doi.org/10.15620/cdc:124678.
Manifestation of Racial Disparities 2017-2019

Leading Underlying Causes of Pregnancy-Related Deaths, by Race-Ethnicity

Cause-specific pregnancy-related mortality, by race/ethnicity, U.S., 2007-2016 (%)


AIAN – American Indian, Alaskan Native; Asian PI – Asian Pacific Islander

www.birthbythenumbers.org
Maternal Mortality (per 100,000 births) by Race, U.S. (2020) and England (2018-2020)

Summary

• Racial disparities in maternal mortality have existing in the U.S. as long as data has been collected.
• The consistency of the disparity with Black maternal mortality ratios 3 to 4 times that of white maternal mortality for decades reflects the lack of progress made in the U.S.
• Presently, the disparity does not reflect SES differences, with maternal education providing no protection for Black mothers.
• The maternal mortality ratios for American Indian/Alaskan natives were also far higher than those for white and Hispanic mothers.
7. Maternal Mortality during a Pandemic
2018-2022 COVID & Maternal Deaths Update

Total Maternal Deaths

Source: CDC Wonder Mortality File
Maternal Deaths (Preg-42 days ppm) per Month, 2019-2022 (2022 Provisional)
U.S. Maternal Deaths per Month, 2019-2022 (2022 Provisional)

Source: CDC Wonder Mortality File
Pregnancy Related # Death Ratios with & without a COVID Code by Race-Ethnicity, April, 2020 – December, 2021

# Deaths during pregnancy and up to 1 year after delivery;
*AIAN – American Indian Alaskan Native

Source: CDC Wonder
Maternal Mortality Ratio, U.S. States*, 2018-21

* States with < 10 maternal deaths, 2018-2020, are excluded from reporting

Source: CDC Wonder
Pregnancy Related Mortality* by State during the Pandemic (2020Q2-Q4, 2021)

* States with > 10 maternal deaths

Source: CDC Wonder
Pregnancy Related Mortality (per 100,000 births) 2020-2021* and % Female State Legislators 2021

*r = -.46
p < .01

Sources: % Female Legis – Nat’l Conf State Legisl.; Pregnancy Related Mortality – CDC Wonder

State Pregnancy Related Mortality (per 100,000 births) (4/20-12/21) & Vaccination Rates

Maternal Mortality (per 100,000) during Pandemic

Proportion of Population Fully Vaccinated

Sources: Vaccination NYTimes 10/20/22; Mat Mort: CDC Wonder
Average Pregnancy Related Mortality* in Medicaid Expansion and non-Expansion States, 2018-2021

Non-Expansion States:
Summary

• The COVID pandemic contributed more than 50% to the number of maternal deaths in 2021. It appears to have lost its impact in 2022.

• The pandemic exacerbated existing disparities between different groups, with especially high ratios among American Indians/Alaskan Natives and non-Hispanic Blacks.

• State political systems appear to be related to the likelihood of a pregnancy related death.
8. Maternal Mortality as a Public Health Problem: 

Timing & Causes of Death
Timing of Maternal Deaths (2017-19)

Maternal deaths are a public health issue as much as a clinical care issue.


www.birthbythenumbers.org
Maternal Mortality as a Public Health Problem


www.birthbythenumbers.org
Pregnancy-related deaths, by cause of death and timing of death relative to the end of pregnancy, 2011-15

Moving to a Public Health Approach

Underlying Causes of Pregnancy-Related Deaths, by Timing of Death


www.birthbythenumbers.org
Summary

• If only a quarter of maternal deaths occur at the time of birth, solutions have to look beyond the birth hospitalization to improve outcomes.

• We have made considerable strides in improving care at the time of birth. The recent increases have been largely among cardiovascular conditions, many of which only manifest after the birth.

• There are clearly different patterns of causes of death by timing indicating a need for more nuanced approaches.

• Research into the underlying causes of death suggests a need for a greater focus on maternal mental health, particularly in the postpartum period.
9. The Issue is Broader than Maternal Mortality
Not just about maternal mortality

Deaths: Final Data for 2019

by Jiaquan Xu, M.D., Sherry L. Murphy, B.S., Kenneth D. Kochanek, M.A., and Elizabeth Arias, Ph.D.,
Division of Vital Statistics

Maternal deaths represent the canary in the coal mine for women’s health.

By Eugene DeMuro and Neil Malik
August 22, 2018

www.birthbythenumbers.org
The Problem is Bigger than Maternal Mortality

Overall Deaths rates (per 100K), Females 15-44, 1999-2021

Source: CDC Wonder

www.birthbythenumbers.org
The Problem is Bigger than Maternal Mortality

Overall Deaths rates (per 100K), Females 15-44, 2010-2021

Source: CDC Wonder

www.birthbythenumbers.org

All Female Deaths 15-44
2010 -- 47,427; 2021 -- 78,110 (COVID 8,885)
Ratio of Black/White Female Death Rates, Women 15-44, 2000-2021

NHW Rate Increase 2000-2021: 53%
NHB Rate Increase 2000-2021: 26%

Source: CDC Wonder
## Top 10 Causes of Death for Women 15-44 in 2021

<table>
<thead>
<tr>
<th>Cause</th>
<th>2021 Total Deaths</th>
<th>% of total</th>
<th>Rate per 100K</th>
<th>% Change in rate 2010-2021</th>
<th>Proportion of 2010-21 Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>All causes</td>
<td>78,110</td>
<td>100.0</td>
<td>120.0</td>
<td>57.9%</td>
<td>---</td>
</tr>
<tr>
<td>Accidents (unintentional inj.)</td>
<td>23,562</td>
<td>30.2%</td>
<td>36.5</td>
<td>96%</td>
<td>38.9%</td>
</tr>
<tr>
<td>COVID-19</td>
<td>8,885</td>
<td>11.4%</td>
<td>13.8</td>
<td>---</td>
<td>29.0%</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>8,740</td>
<td>11.2%</td>
<td>13.5</td>
<td>-8%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>Diseases of heart</td>
<td>5,694</td>
<td>7.3%</td>
<td>8.8</td>
<td>21%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Intentional self-harm (suicide)</td>
<td>4,549</td>
<td>5.8%</td>
<td>7.0</td>
<td>27%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Assault (homicide)</td>
<td>3,032</td>
<td>3.9%</td>
<td>4.7</td>
<td>57%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Chronic liver disease and cirrhosis</td>
<td>2,858</td>
<td>3.7%</td>
<td>4.4</td>
<td>175%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1,747</td>
<td>2.2%</td>
<td>2.7</td>
<td>59%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Pregnancy, childbirth &amp; puerperium</td>
<td>1,665</td>
<td>2.1%</td>
<td>2.6</td>
<td>117%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Cerebrovascular diseases</td>
<td>1,254</td>
<td>1.6%</td>
<td>1.9</td>
<td>0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>All other causes (residual)</td>
<td>16,124</td>
<td>24.8%</td>
<td>21.2</td>
<td>19.5%</td>
<td>10.1%</td>
</tr>
</tbody>
</table>

Increases in Female Deaths (15-44) 2010-2021: 47% of the non-COVID increase came from 1 cause.

- 2010:
  - Drug-Induced: 7,129
  - COVID-19: 40,298
  - All other: 47,427

- 2021:
  - Drug-Induced: 17,558
  - COVID-19: 51,667
  - All other: 78,110

Increase:
- Drug-Induced: 10,429
- COVID-19: 21,798
- All other: 47,427

Total increase: 78,110
Increase in Drug Induced Deaths, Women 15-44, by Race/Ethnicity, 2010 & 2021


www.birthbythenumbers.org
Summary

• Pick your idiom: tip of the iceberg or canary in the coal mine – the 800 maternal deaths are a warning about a much larger problem in the U.S. -- the rising death rate among women of reproductive age.

• While the pregnancy related mortality rate has remained steady since 2010, the overall death rate for women 15-44 has increased by 13% through 2019 and 59% overall when the pandemic is taken into account.

• The death rate for non-Hispanic White women was rising 2010-2017 at a much faster rate than the rate among non-Hispanic black women, but that has shifted.

• The primary cause of these increases in deaths is substance use.

www.birthbythenumbers.org
10. The Way Forward
Preventability

•**Definition**: A death is considered preventable if the committee determines there was at least some chance of the death being averted by one or more reasonable changes to patient, family, provider, facility, system and/or community factors.


www.birthbythenumbers.org
Maternal Mortality Review Committees (MMRCs) in 50 State and Local Jurisdictions

Updated 02/26/2021
The Challenge of Keeping Women in the Health System: Insurance Coverage
9. The Way Forward

Keeping Women in the System

Percentages of women who gave birth in the period 2005–13, by health insurance type and month before or after delivery

Source: Daw J. Health Affairs 2017; 36:598-606

www.birthbythenumbers.org
Medicaid Eligibility for Parent vs Pregnant Women in 12 Non-Expansion States

*Medicaid eligibility thresholds, Jan., 2023*

Is expanding Medicaid eligibility out to 1 year postpartum the answer?

• Sort of…

• Since a significant proportion (30%) of maternal deaths occur between 42-365 postpartum, keeping women, especially vulnerable women, in the health care system makes sense.

• There is also the matter of how women on Medicaid are treated when they are getting care.

www.birthbythenumbers.org
Survey Results (Adjusted Odds Ratios*) among women on Medicaid compared to private insurance

* Adjusted for maternal age, prenatal provider, race/ethnicity, maternal education, US born, pregnancy complications, and agreement with statement “childbirth shouldn’t be interfered with unless medically necessary.” All ratios significant at p < .05.

Source: Declercq, E. Women’s experience of agency & respect in maternity care by type of insurance in Cal.. PLOS One. 2020; 15(7): e0235262
<table>
<thead>
<tr>
<th>States Implementing* 12 Month Extension of Postpartum Eligibility (as of 6/2/23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
</tr>
<tr>
<td>Arizona</td>
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<tr>
<td>California</td>
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<td>Colorado</td>
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<td>Connecticut</td>
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<td>Delaware</td>
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<td>District of Columbia</td>
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<td>Florida</td>
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<td>Hawaii</td>
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<td>Illinois</td>
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<td>Indiana</td>
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<td>Kansas</td>
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<td>Kentucky</td>
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<td>Louisiana</td>
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<td>Maine</td>
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<td>North Carolina</td>
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<td>North Dakota</td>
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<td>Pennsylvania</td>
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<td>Rhode Island</td>
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<td>Tennessee</td>
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<td>Virginia</td>
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<tr>
<td>Washington</td>
</tr>
<tr>
<td>West Virginia</td>
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</tbody>
</table>

* Only lists states that have implemented the extension. Several more are planning to implement.

Four Policy Recommendations to Reframe Maternal Deaths Review into Women’s Health Campaign

1. Use Maternal Mortality Review Committees to explore pregnancy associated deaths for causes and possible bases for prevention;

2. Use linked datasets to examine women’s health through the lifecourse and identify critical moments (e.g. pregnancy?) where intervention might matter;

3. Fund a systematic process for listening to women tell us about their lives and experiences in pregnancy and beyond to craft sustainable solutions that are meaningful to them.

4. Craft policies that keep women of all ages within the health and social system to prevent problems that lead to pregnancy associated death.
Black Maternal Health Week
April 11 - 17, 2021
BLACK MAMAS MATTER
CLAIMING OUR POWER, RESILIENCE & LIBERATION

Join us April 11-17 for a week of activism and community building for Black Mamas in solidarity with National Minority Health Month and the International Day for Maternal Health and Rights. Black Mamas Matter Alliance founded BMHW to raise awareness, inspire activism, and strengthen organizing for Black maternal health. Join the conversation: #BMHW21 and #BlackMaternalHealthWeek

www.blackmamasmatter.org/bmw

NATIONAL
MATERNAL HEALTH
WEEK
MAY 5th-12th, 2019

#MarchforMoms

#BeyondMothersDay

- Promote State & Federal Legislative Efforts to Improve Maternal Health
- Drive Media Attention on State of Maternal Health
- Seek City, State and National Proclamations
- Organize Visits in DC on Capitol Hill May 10th
- Rally on National DC Mall on May 11th
- Livestream the Rally on Facebook Live
- Curate and Promote Daily Themes Related to Maternal Health

www.birthbythenumbers.org