HHS Public Access

Author manuscript

*Obstet Gynecol*. Author manuscript; available in PMC 2024 August 01.

Published in final edited form as:

*Obstet Gynecol*. 2024 August 01; 144(2): 252–255. doi:10.1097/AOG.0000000000005628.

# Pregnancy-Related Deaths Due to Hemorrhage: Pregnancy Mortality Surveillance System, 2012–2019

**Lisa M. Hollier, MD, MPH**,
**Ashley Busacker, PhD**,
**Fanny Njie, MPH**,
**Carla Syverson, CNM, MPH**,
**David A. Goodman, PhD**

Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, and the CDC Foundation, Atlanta, Georgia; and Tanaq Support Services, LLC, St. George Island, Alaska.

## Abstract

Hemorrhage has been a leading cause of pregnancy-related death in the Centers for Disease Control and Prevention Pregnancy Mortality Surveillance System since 1987 when reporting began. Pregnancy Mortality Surveillance System data from 2012 to 2019 were analyzed to describe pregnancy-related deaths from hemorrhage. Pregnancy-related mortality ratios were estimated for hemorrhage overall and by hemorrhage subclassifications. Specific subclassifications of hemorrhage-related deaths were analyzed by sociodemographic characteristics. Overall, there were 606 deaths due to hemorrhage. The pregnancy-related mortality ratio for hemorrhage overall was 1.94 per 100,000 live births. Ruptured ectopic pregnancy was the most frequent subclassification (22.9%) of pregnancy-related hemorrhage deaths, followed by postpartum hemorrhage (21.2%). There were no significant trends in the pregnancy-related mortality ratio, overall or among any subclassification of hemorrhage deaths, from 2012 to 2019. Reporting subclassifications of pregnancy-related hemorrhage deaths could improve the ability to focus interventions and assess progress over time.

Hemorrhage has been identified as one of the most frequent Pregnancy Mortality Surveillance System–identified underlying causes of death since reporting began in 1987,[1] accounting for 12.1% of deaths from 2017 to 2019.[2] Most pregnancy-related deaths with hemorrhage as an underlying cause of death are preventable.[3] The objective of this project was to provide additional details on pregnancy-related deaths for which hemorrhage was the Pregnancy Mortality Surveillance System–identified underlying cause of death in the United States from 2012 to 2019.

Corresponding author: Lisa M. Hollier, MD, MPH, Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, GA; ijh8@cdc.gov.

*Each author has confirmed compliance with the journal's requirements for authorship.*

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC) or the CDC Foundation.

Financial Disclosure

The authors did not report any potential conflicts of interest.

## METHODS

All cases of pregnancy-related death with an underlying cause of hemorrhage were identified in the Pregnancy Mortality Surveillance System. This study did not involve human subjects as defined in 45CFR 46.102(e) and thus did not require IRB review. Pregnancy Mortality Surveillance System methodology has been described previously.[1] Briefly, the Centers for Disease Control and Prevention Division of Reproductive Health requests that all states, the District of Columbia, and New York City voluntarily send death records, linked live birth or fetal death records if applicable, and additional data when available on deaths that occurred during pregnancy or within 1 year after the end of pregnancy. Information on individual deaths is reviewed by medically trained epidemiologists to determine pregnancy relatedness and cause.[1] A death is determined to be pregnancy related if the death was caused by a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. Underlying cause of death is classified into 10 mutually exclusive classifications, including hemorrhage.[2] A more specific subclassification of the underlying cause of death, within the 10 higher-level classifications, is then assigned to each death. Race and ethnicity data are collected in the Pregnancy Mortality Surveillance System to describe known differences. These data are from matched live birth or fetal death record or, if those records were unavailable, from death records.

We aggregated Pregnancy Mortality Surveillance System data for the years 2012–2019. Pregnancy-related mortality ratios (number of pregnancy-related deaths per 100,000 live births) with 95% CIs were calculated overall and for each hemorrhage subclassification (ectopic pregnancy, postpartum hemorrhage, placenta accreta spectrum, abruption, previa, uterine rupture, other, unknown) over the 8-year study period in 2-year intervals. The number of live births was obtained from U.S. natality files from the National Vital Statistics System. SAS 9.4 was used for all analyses.

## RESULTS

Overall, 5,309 pregnancy-related deaths were identified. Among these, 606 (11.4%) were determined to have hemorrhage as an underlying cause. The overall pregnancy-related mortality ratio for the period was 17.0, and the pregnancy-related mortality ratio for hemorrhage deaths was 1.94 per 100,000 live births (Table 1). Ruptured ectopic pregnancy was the most frequent cause of hemorrhage-related mortality (22.9%), followed by postpartum hemorrhage (21.2%) and placenta accreta spectrum (12.7%). The most frequent hemorrhage subclassification varied by race and ethnicity. Placenta accreta spectrum was the most frequent (20.6%) among Hispanic deaths, postpartum hemorrhage among non-Hispanic Asian deaths (37.8%), and ruptured ectopic pregnancy among non-Hispanic Black (32.6%) and non-Hispanic White deaths (23.4%).

Pregnancy-related mortality ratios by hemorrhage subclassifications are shown in Figure 1. There were no significant trends in the annual pregnancy-related mortality ratios for any subclassifications of hemorrhage deaths.

## DISCUSSION

Pregnancy-related deaths with an underlying cause of hemorrhage remain frequent, with a pregnancy-related mortality ratio of 1.9 per 100,000 live births. Ruptured ectopic pregnancy and postpartum hemorrhage were the most common subclassifications of pregnancy-related hemorrhage deaths. The most frequent subclassifications of pregnancy-related hemorrhage deaths varied by race and ethnicity.

Birth facilities across the country, often with support of state Perinatal Quality Collaboratives, have implemented tools like those from the Alliance for Innovation on Maternal Health to reduce morbidity and mortality from postpartum hemorrhage.[4–6] Addressing hemorrhage deaths from ruptured ectopic pregnancies will require additional interventions. Most cases of tubal ectopic pregnancy that are detected early can be treated successfully with minimally invasive surgery or with medical management. Early diagnosis is aided by a high index of suspicion. Women with clinical signs and physical symptoms of ruptured ectopic pregnancy should be evaluated and treated urgently.[7] Special education programs and early access to care should be targeted for groups of women known to be at higher risk, including those with prior ectopic pregnancy, with damage to fallopian tubes, who smoke, or who are more than 35 years of age.[7]

The Pregnancy Mortality Surveillance System provides detailed national information about the causes and characteristics of pregnancy-related mortality. Pregnancy Mortality Surveillance System data allow reporting of both proportionate mortality and pregnancy-related mortality ratios among Pregnancy Mortality Surveillance System–identified underlying causes of death useful for monitoring changes over time. There were no significant changes in pregnancy-related mortality ratio attributable to hemorrhage overall or by subclassification in our study.

There are limitations of this analysis. Aggregated data may mask changes in the distribution of characteristics over time. Data are limited by the completeness and accuracy of original records, potentially leading to misclassification of pregnancy-related deaths; however, Pregnancy Mortality Surveillance System processes minimize misclassification. Strengths include the collection of data from across the United States with the ability to evaluate subclassifications of causes of death.

Ruptured ectopic pregnancy and postpartum hemorrhage persist as significant contributors to pregnancy-related mortality due to hemorrhage. Subclassifications of hemorrhage deaths have different causes and different prevention opportunities. Reporting subclassifications of pregnancy-related hemorrhage deaths could improve the ability to focus interventions and identify progress over time.

## REFERENCES

1. Creanga AA, Syverson C, Seed K, Callaghan WM. Pregnancy-related mortality in the United States, 2011–2013. Obstet Gynecol 2017;130:366–73. doi: 10.1097/AOG.0000000000002114. [PubMed: 28697109]

2. Centers for Disease Control and Prevention. Pregnancy mortality surveillance system. Accessed December 2, 2022. https://cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm

3. Building U.S. capacity to review and prevent maternal deaths. (2018). Report from nine maternal mortality review committees. Accessed June 24, 2023. https://cdcfoundation.org/sites/default/files/files/ReportfromNineMMRCs.pdf

4. Main EK, Goffman D, Scavone BM, Low LK, Bingham D, Fontaine PL, et al. National Partnership for Maternal Safety: consensus bundle on obstetric hemorrhage [published errata appear in Obstet Gynecol 2015;126:1111; and Obstet Gynecol 2019;133: 1288]. Obstet Gynecol 2015;126:155–62. doi: 10.1097/AOG.0000000000000869 [PubMed: 26241269]

5. Alliance for Innovation on Maternal Health. AIM revised obstetric hemorrhage implementation webinar. Accessed August 11, 2023. https://vimeo.com/711718789

6. Agency for Healthcare Research and Quality. Toolkit for improving perinatal safety. Accessed December 26, 2023. https://www.ahrq.gov/patient-safety/settings/labor-delivery/perinatal-care/index.html

7. Tubal ectopic pregnancy. ACOG Practice Bulletin No. 193. American College of Obstetricians and Gynecologists. Obstet Gynecol 2018;131:e91–103. doi: 10.1097/AOG.0000000000002560 [PubMed: 29470343]

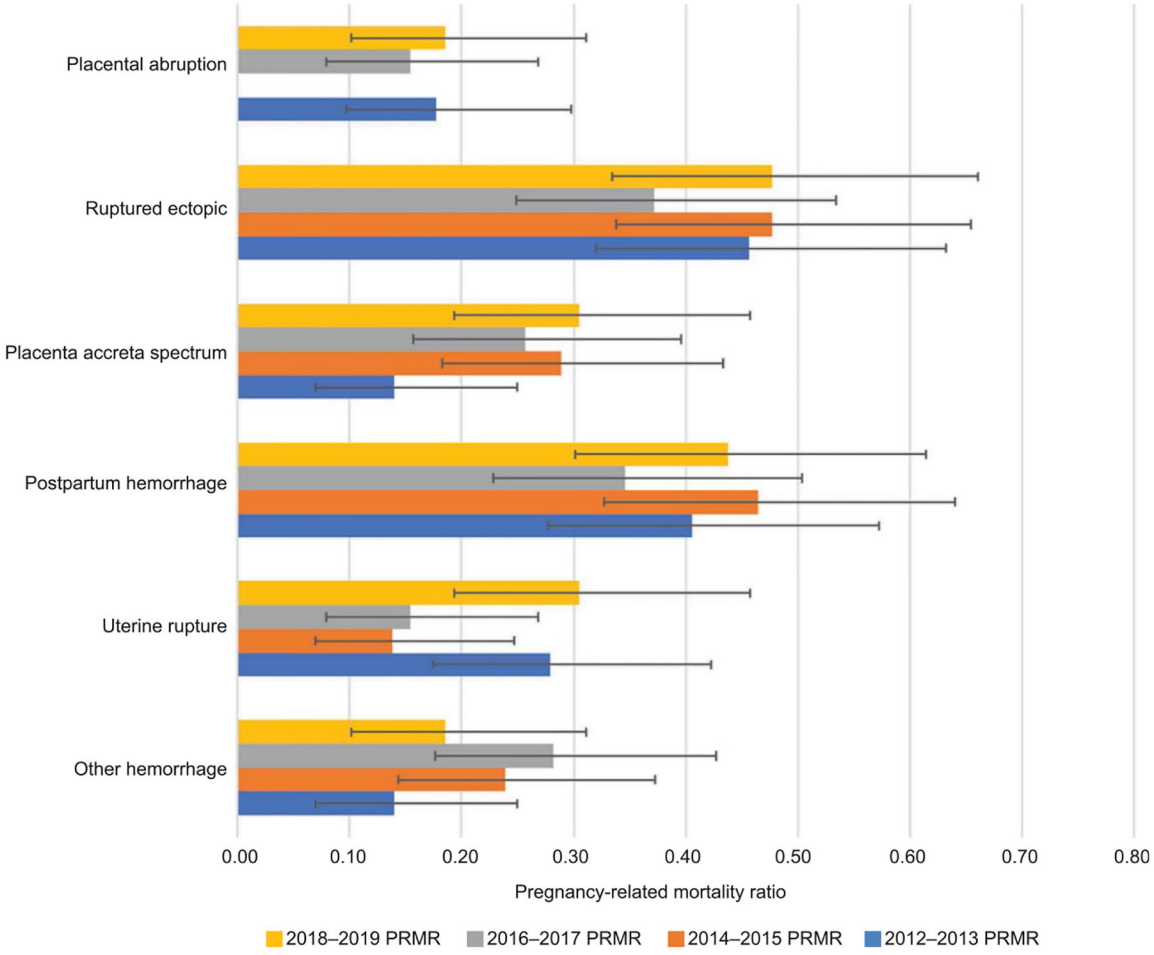


**Fig. 1.**

Cause-specific pregnancy-related mortality ratios and 95% CIs for deaths with underlying cause of hemorrhage,* Pregnancy Mortality Surveillance System, 2012–2019. *Figure excludes pregnancy-related deaths attributable to unknown hemorrhage subclassification. Pregnancy-related mortality ratios were not calculated for placenta previa for all year groupings and for placental abruption for 2014–2015 because PRMRs based on <8 deaths are considered not reliable for reporting. PRMR, pregnancy-related mortality ratio.

*Hollier. Pregnancy-Related Deaths due to Hemorrhage. Obstet Gynecol 2024.*

**Table 1.**

Distribution of Pregnancy-Related Deaths With Hemorrhage as Pregnancy Mortality Surveillance System–Identified Underlying Cause of Death and Subclassification Specific Pregnancy-Related Mortality Ratio, Pregnancy Mortality Surveillance System, 2012–2019

| | Hemorrhage Cause of Death Subclassifications | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Placental Abruption [n=47 (7.8)]** | **Ruptured Ectopic Pregnancy [n = 139 (22.9)]** | **Placenta Accreta Spectrum [n = 77 (12.7%)]*** | **Placenta Previa [n=14 (2.3)]** | **Postpartum Hemorrhage [n=129 (21.3)]** | **Uterine Rupture [n=68 (11.2)]** | **Other [n=66 (10.9)]** | **Unknown [n=66 (10.9)]** | **Total (N=606)** |
| PRMR | 0.15 | 0.45 | 0.25 | 0.05 | 0.41 | 0.22 | 0.21 | 0.21 | 1.94 |
| Characteristic | | | | | | | | | |
| Race and ethnicity | | | | | | | | | |
| Hispanic | 6 (12.8) | 23 (16.6) | 29 (37.7) | 5 (35.7) | 26 (20.2) | 15 (22.1) | 20 (30.3) | 17 (25.8) | 141 |
| Non-Hispanic American Indian/Alaska Native | 0 | 3 (2.2) | 2 (2.6) | 0 | 8 (6.2) | 1 (1.5) | 3 (4.6) | 3 (4.6) | 20 |
| Non-Hispanic Asian | 5 (10.6) | 3 (2.2) | 6 (7.8) | 3 (21.4) | 17 (13.2) | 1 (1.5) | 3 (4.6) | 7 (10.6) | 45 |
| Non-Hispanic Black | 14 (29.8) | 56 (40.3) | 10 (13.0) | 1 (7.1) | 35 (27.1) | 18 (26.5) | 22 (33.3) | 16 (24.2) | 172 |
| Non-Hispanic Native Hawaiian and other Pacific Islander | 0 | 0 | 2 (2.6) | 0 | 1 (0.8) | 0 | 1 (1.5) | 0 | 4 |
| NH White | 22 (46.8) | 51 (36.7) | 28 (36.4) | 4 (28.6) | 42 (32.6) | 32 (47.1) | 17 (25.8) | 22 (33.3) | 218 |
| NH multiple races† | 0 | 1 (0.7) | 0 | 1 (7.1) | 0 | 1 (1.5) | 0 | 0 | 3 |
| None of above or missing race | 0 | 2 (1.4) | 0 | 0 | 0 | 0 | 0 | 1 (1.5) | 3 |
| Age group (y) | | | | | | | | | |
| Younger than 20 | 1 (2.1) | 4 (2.9) | 0 | 0 | 4 (3.1) | 3 (4.4) | 1 (1.5) | 0 | 13 |
| 20–29 | 20 (42.6) | 48 (34.5) | 19 (24.7) | 5 (35.7) | 44 (34.1) | 23 (33.8) | 20 (30.3) | 20 (30.3) | 199 |
| 30–39 | 22 (46.8) | 73 (52.5) | 47 (61.0) | 7 (50.0) | 68 (52.7) | 33 (48.5) | 40 (60.6) | 37 (56.1) | 327 |
| 40 or older | 4 (8.5) | 14 (10.1) | 11 (14.3) | 2 (14.3) | 13 (10.1) | 9 (13.2) | 5 (7.6) | 9 (13.6) | 67 |
| Urbanicity | | | | | | | | | |
| Rural | 13 (27.7) | 17 (12.2) | 6 (7.8) | 5 (35.7) | 24 (18.6) | 8 (11.8) | 6 (9.1) | 14 (21.2) | 93 |
| Urban | 33 (70.2) | 119 (85.6) | 67 (87.0) | 8 (57.1) | 99 (76.7) | 58 (85.3) | 57 (86.4) | 48 (72.7) | 489 |
| Missing | 1 (2.1) | 3 (2.2) | 4 (5.2) | 1 (7.1) | 6 (4.7) | 2 (2.9) | 3 (4.6) | 4 (6.1) | 24 |

PRMR, Pregnancy-Related Mortality Ratio (number of pregnancy-related deaths per 100,000 livebirths); NH, non-Hispanic.

Data are n (%) unless otherwise specified.

[*] When both placenta previa and placenta accreta spectrum were recorded on the death record, these deaths were classified as placenta accreta spectrum.

[†] Begins with 2018 data.