A Report on Pregnancy-Associated Deaths in Ohio 2008-2016

The Ohio Department of Health 2019

Ohio | Department of Health

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Executive Summary

"PREGNANCY-ASSOCIATED MORTALITY REVIEW (PAMR) EXISTS TO COMPREHENSIVELY ASSESS THE CAUSES AND FACTORS THAT CONTRIBUTE TO MATERNAL DEATHS SO RECOMMENDATIONS CAN BE MADE TO PREVENT FUTURE DEATHS."

— PAMR REVIEW COMMITTEE MEMBER

Executive Summary

Maternal death marks a tragedy for families and communities and is associated with poor outcomes for infants and children, including a higher risk of infant mortality. While maternal deaths in the United States plummeted during the twentieth century, they began to rise again in the late 1990s. In response, the Ohio Department of Health (ODH) established a maternal mortality review committee called the Ohio Pregnancy-Associated Mortality Review (PAMR) in 2010. **PAMR exists to comprehensively assess the causes and factors that contribute to maternal deaths so that recommendations can be made to prevent future deaths.**

The PAMR process has three main steps. **First,** the ODH Bureau of Vital Statistics identifies deaths to Ohio women that occurred either during pregnancy or within a year of the end of a pregnancy (collectively known as *pregnancy-associated* deaths). **Second,** ODH PAMR staff seek clinical and social service records from various entities and create a de-identified case summary. **Finally,** the PAMR multidisciplinary committee of experts meets to review the deaths and determines whether the deaths were pregnancy-related (if pregnancy contributed to her death), if there was some chance to alter the outcome (if the death was preventable), contributing factors (steps along the way that, if altered, may have prevented her death), and opportunities and recommendations for preventing future deaths. **These determinations highlight the unique and critical role of PAMR: preventability, contributing factors, and recommendations for improvement.**

This report summarizes the findings from 610 pregnancy-associated deaths to Ohio women that occurred during 2008 through 2016.

Key Findings: Pregnancy-Related Deaths

- Of 610 pregnancy-associated deaths, **186 (31 percent)** were pregnancy-related, meaning the cause of death was related to or aggravated by the pregnancy or its management.
- Women died from pregnancy-related causes in Ohio at a ratio of **14.7 per 100,000** live births from 2008 through 2016.
- The rate of deaths related to pregnancy **did not change significantly over that time**.
- The leading causes of death related to pregnancy were **cardiovascular and coronary conditions, followed by infections, hemorrhage, pre-eclampsia and eclampsia, and cardiomyopathy.**
- **Black women died at a rate more than two and a half times that of white women.**
- Over **half of deaths (57 percent) were thought to be preventable** (among deaths occurring from 2012 through 2016).
- Preventability was highest among pre-eclampsia and eclampsia deaths, with 85 percent determined preventable.
- For every pregnancy-related death, on average four factors were identified that contributed to the death. These factors were at the *provider, system of care or facility,* and *patient or family levels*.
    - Factors at the *provider level* (32 percent) and *system of care* or *facility level* (22 percent), together, comprised more than half of the factors identified that contributed to pregnancy-related deaths.
    - *Provider-level* factors included failure to adequately screen or assess risk, misdiagnosis, use of ineffective treatment, delays in diagnosis, treatment, or follow-up, failure to refer or seek consultation, lack of communication between providers, lack of continuity of care, and inadequate patient education.

- *Systems or facility level* factors included lack of continuity of care from a system perspective; lack of or insufficient case coordination or management; systems barriers to accessing care (e.g., insurance, provider shortage, transportation); unavailable facilities; inadequate, unavailable, or inadequately trained personnel; inadequate follow-up by personnel; lack of or poor communication (e.g., between providers); lack of standardized policies or procedures; and inadequate or unavailable equipment / technology.
- Factors at the *patient or family level* that contributed to death accounted for the remaining 46 percent identified. While these factors operate at the patient or family level, the individual does not necessarily have control over these factors. For example, a woman may have a chronic condition that she was born with, be a victim of domestic violence, or have limited access to resources such as transportation or paid time off from work for appointments. Individual factors may also interact with factors at the provider or systems levels. Common factors included existence of chronic disease, lack of knowledge, non-adherence to medical advice, substance use disorder (including alcohol, prescription or illicit substances, and tobacco), and existence of mental health conditions.

Key Findings: Pregnancy-Associated, but not Related Deaths

- These deaths occurred during pregnancy or within a year after the end of pregnancy, but were not due to a pregnancy-related cause.
- They occurred at a ratio of 29.1 per 100,000 live births from 2008 through 2016 but experienced a rapid increase during 2015 and 2016 due to an increase in unintentional overdoses.
- There was no racial disparity in these deaths.
- The leading causes of these deaths were unintentional injury (e.g., overdose), homicide, and malignancies (i.e., cancers).
- Half (48 percent) of these deaths were considered preventable (among deaths occurring from 2012 through 2014).

What is Ohio Doing

Initiating and sustaining a robust maternal mortality review committee is key to improving surveillance of maternal deaths by understanding trends, causes, contributing factors, and preventive steps for maternal mortality. At its inception in 2010, ODH's PAMR sought guidance from the few existing state review committees and built much from the ground up. As U.S. capacity has grown, Ohio has been an early adopter of strategies being advocated at the national level while also serving as a resource for other states as they set up their own maternal mortality review committees.

Over the past nine years, the ODH PAMR has worked to improve review operations around three important tasks that are outlined in Metz (2018): **collect data in a standardized fashion; assess preventability of maternal deaths by consensus from experts on a multidisciplinary committee representing individuals from across the state; and create recommendations based on maternal death reviews.** Advancements in these areas include improved timely identification of pregnancy-associated deaths, expanded sources of data to facilitate comprehensive reviews, adoption of a standardized and secure data management system, standardized reviewer training, and expanded base of volunteer reviewer expertise. A PAMR website was developed to share the work and disseminate findings (https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/pregnancy-associated-mortality-review/welcome/); PAMR also shares resources through the national maternal mortality review committee website http://www.reviewtoaction.org/.

To prevent maternal deaths, PAMR's first major activity was providing simulation training to low resource hospitals to prepare for obstetric emergencies. Simulation is a technique that imitates a real-world process or system to practice management of a medical condition or event. The emergency scenarios were selected based on PAMR findings and included hypertensive emergency (eclampsia), hemorrhage, maternal cardiac arrest and opiate overdose. Trainings occurred in three parts from 2014 through 2017 through both 1) direct trainings at local host facilities, and 2) train-the-trainer courses for nurse educators and managers to provide them with the tools to independently and effectively train local staff via simulation to respond to obstetric emergencies. After these trainings, participants demonstrated increased knowledge about obstetric emergencies and increased self-efficacy in their ability to respond. Train-the-trainer participants were found to have shared information from the trainings and conducted more simulation exercises in their facilities.

In 2019, ODH was awarded $2,250,000 over 5 years from CDC (9/30/19 – 9/29/24) for the Enhancing Reviews and Surveillance to Eliminate Maternal Mortality (ERASE MM) Program (www.cdc.gov/ERASEMM). ODH is one of 24 awardees of this funding to directly support agencies and organizations that coordinate and manage Maternal Mortality Review Committees to identify, review, and characterize maternal deaths; and identify prevention opportunities.

Also in 2019, Ohio was invited to join 6 other state maternal mortality review committees in a CDC Foundation funded opportunity called Rapid Maternal Overdose Response (RMOR). Activities are based on four, specific strategies: 1) the comprehensive review of all pregnancy-associated overdose deaths; 2) the timely and effective use of maternal mortality review committee overdose death findings; 3) enhancing and expanding maternal mortality review committee partnerships and networks with CDC, stakeholders and other jurisdiction-based maternal mortality review committees; and 4) improving the understanding of opiate use and misuse during pregnancy. Funding is expected through 9/29/20.

Recommendations and Next Steps

Recommendations Specific to the ODH PAMR Program

ODH intends to continue to support, expand, and sustain a vigorous PAMR process. State efforts will continue enhancing data completeness through internal data quality and review processes. Recommendations for ODH include a future convening of a group of stakeholders representing individuals and entities from across the state to identify:

(a) additional recommendations beyond those listed below

(b) areas of collaboration between ODH, state partners, and local entities to implement recommendations

(c) funding opportunities to support implementation of recommendations.

Recommendations that Address Contributing Factors to Prevent Deaths

As part of the review of each death, the committee identifies recommendations for each case (including strategies and action steps) that may address factors which contributed to the death. Those case-level recommendations were grouped into themes. This report outlines potential strategies within each recommendation to prevent future deaths. Strategies are grouped by local or state level. ODH encourages local entities to operationalize these recommendations within the context of their own needs, resources, and capacity. These recommendations fell into 11 themes, which are listed below.

Themes for Recommendations that Address Contributing Factors to Prevent Deaths
Optimize the care of patients with chronic medical conditions prior to pregnancy
Optimize the care of patients with chronic medical conditions during pregnancy
Educate providers and patients on recognition, treatment, and prevention of obstetric complications including: 1. Postpartum hemorrhage 2. Hypertensive disorders 3. Sepsis 4. Thrombo-embolism 5. Cardiovascular conditions including cardiomyopathy
Work to recognize disparities at both the personal and systems level
Optimize vaccinations for pregnant women
Work to increase fire safety in communities
Build capacity for Emergency Medical Services (EMS)
Optimize screening and dissemination of resources for pregnant and postpartum women for intimate partner violence
Ensure mental health screening for all pregnant women and treatment for those with a positive screen
Optimize the treatment of pregnant and postpartum women with substance abuse disorder, including alcohol
Improve identification of cause(s) of maternal deaths and underlying causes

Key Definitions
Background
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"THE OHIO PAMR TAKES A TRULY MULTIDISCIPLINARY APPROACH TO SOLVING PREGNANCY-ASSOCIATED MORTALITY IN OUR OWN COMMUNITY. I HOPE THAT BY SHARING OUR SUCCESSES AND LEARNING FROM OUR FAILURES, WE CAN END PREVENTABLE MATERNAL DEATHS IN OHIO."

— PAMR REVIEW COMMITTEE MEMBER

I. Key Definitions

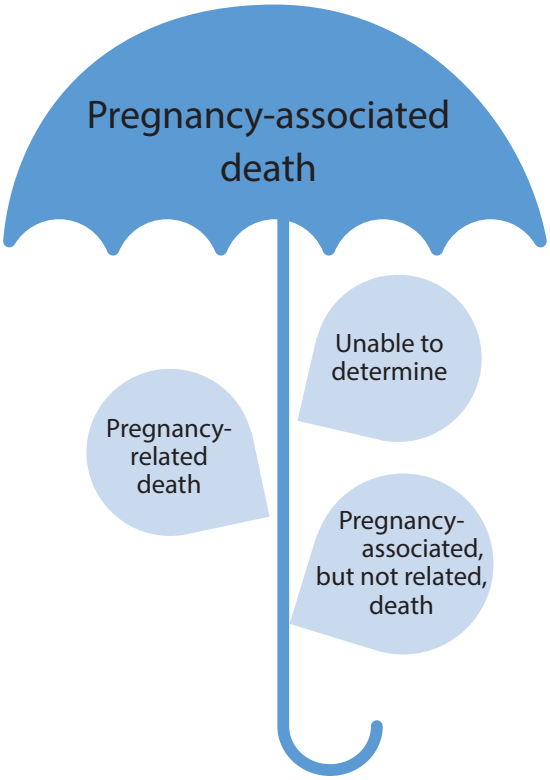
The following definitions are used throughout this report. Additional terms are defined in the Glossary in Appendix A.

Pregnancy-associated death. The death of a woman while pregnant or anytime within one year of pregnancy regardless of cause.

Pregnancy-related death. The death of a woman while pregnant or within one year of the end of pregnancy, regardless of duration and site of pregnancy, from any cause related to or aggravated by her pregnancy or its management (e.g., from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy).

Pregnancy-associated, but not related, death. The death of a woman while pregnant or within one year of the end of pregnancy, due to a cause unrelated to pregnancy.

Pregnancy-associated, but unable to determine pregnancy-relatedness. The death of a woman while pregnant or within one year of pregnancy, due to a cause that could not be determined to be pregnancy-related or not pregnancy-related.



Pregnancy-associated mortality ratio (PMR). The number of pregnancy-associated deaths per 100,000 live births.

Pregnancy-related mortality ratio (PRMR). The number of pregnancy-related deaths per 100,000 live births.

Pregnancy-associated, but not related, mortality ratio. The number of pregnancy-associated deaths, that were not pregnancy-related, per 100,000 live births.

Chance to Alter Outcome. The review committee determination if there was no chance, some chance, or a good chance "of the death being averted by one or more reasonable changes to patient, family, community, provider, and / or systems factors."

Preventability. A death was considered preventable if the committee determines that there was at least some chance of the death being averted.

Contributing Factor. Factors identified by the review committee that contributed to the death. These are steps along the way that, if altered, may have prevented the woman's death. The factors may be related to the patient, health care providers, facilities / hospitals where the woman sought care, or to the systems that influence the lifestyle, care, and health services for the woman.

II. Background

Maternal death marks a tragedy for families and communities and is associated with poor outcomes for infants and children, including a higher risk of infant mortality. Patterns of disparity known within infant mortality and other health outcomes also plague maternal mortality; maternal deaths are more prevalent among black women compared to white women. Further, maternal deaths share similar underlying factors with other poor outcomes; these factors include poverty and other social determinants, chronic illness, provider delay or misdiagnosis, and poor continuity of care. Factors that affect the health of the entire population can also affect mortality among pregnant and postpartum women.

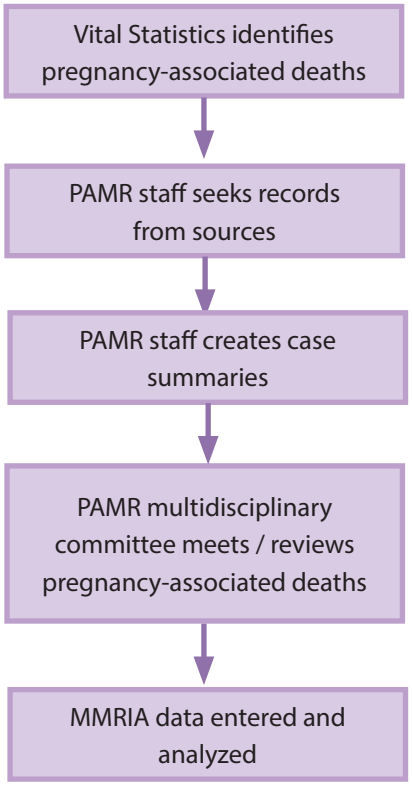
While maternal deaths plummeted during the twentieth century, decreases plateaued around the early 1980s, and then began to rise again in the late 1990s (CDC, 2003; Creeanga, 2017). As part of a resurgence in national response to maternal mortality concerns, the Ohio Department of Health (ODH) established the Ohio Pregnancy-Associated Mortality Review (PAMR) in 2010 (St Pierre, 2018; Goodman, 2013). Like other state-based maternal mortality review committees (MMRCs), ODH's PAMR exists to comprehensively assess the causes and factors that contribute to maternal deaths so that recommendations can be made to prevent future deaths. Committee review data supplements existing vital statistics (death and birth certificate data) to provide detailed and reliable information about underlying factors that offer insight into why preventable maternal deaths occur. According to the Centers for Disease Control and Prevention (CDC), all states in the US now have a maternal mortality review process, such as PAMR (https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-relatedmortality.htm).

The work of PAMR aligns with Ohio's health improvement priorities. Maternal and infant health, explicitly including maternal mortality, is one of three priority topics in Ohio's 2017-2019 State Health Improvement Plan (SHIP) (ODH, 2017). Further, the SHIP seeks to achieve equity in health outcomes and identifies cross-cutting outcomes (e.g., increased preconception planning) that can improve health outcomes across multiple areas.

III. Methods Overview

Ohio's PAMR identifies and reviews pregnancy-associated deaths with the goal of making recommendations to reduce maternal mortality, particularly for pregnancy-related deaths. Briefly, the process is as follows.

- Pregnancy-associated deaths are identified by the ODH Bureau of Vital Statistics using the pregnancy checkbox on maternal death certificates, ICD-10 obstetric cause of death codes, and linking death certificates to live birth or fetal death certificates.
- ODH PAMR staff seeks records from various sources then abstracts the information received to create a de-identified case summary, including a narrative, for review. Data sources typically used include the following:
  - Death Certificate
  - Autopsy Report
  - Birth Certificate or Fetal Death Certificate
  - Prenatal records including office visits
  - Mental health records
  - Hospital records
  - Emergency Department visits
  - Medical transport records (paramedics, emergency medical technicians)
  - Law enforcement records
- A PAMR multidisciplinary committee of experts from across Ohio meets several times a year to review pregnancy-associated deaths. For each case, the committee makes a determination of whether the deaths were pregnancy-related, if there was some chance to alter the outcome, contributing factors (steps along the way that, if altered, may have prevented the woman's death), and opportunities and recommendations for preventing future deaths.



PAMR Makes These Key Decisions for Each Death Reviewed:

1. Was the death pregnancy-related?
2. What was the underlying cause of death?
3. Was the death potentially preventable?
4. What were the factors that contributed to the death?
5. What are the recommendations and actions that address those contributing factors?

While all questions are essential, the last three questions highlight the unique and critical role of PAMR: preventability, contributing factors, and recommendations for improvement.

- A record is created in the Maternal Mortality Review Information Application (MMRIA) that includes data from the sources listed above, along with the case narrative, and committee decisions. These information are then extracted and analyzed using Excel, SAS and Joinpoint software.

See Appendices C through F for details of Ohio's PAMR methods.

IV. Findings

A. All Pregnancy-Associated Deaths

ODH identified **610** deaths to Ohio resident women who died in Ohio from 2008 through 2016, whose deaths were temporally related to pregnancy. These deaths occurred while a woman was pregnant or within one year following the end of pregnancy and were all considered *pregnancy-associated.*

PAMR determined **186 (31 percent)** of these deaths to be pregnancy-related. An additional **368 (60 percent)** were pregnancy-associated but not related. For the remaining **56 (9 percent)**, PAMR was unable to make a determination.

Figure 1. Pregnancy-Associated Deaths (n=610) by Pregnancy-Relatedness, Ohio 2008-2016.

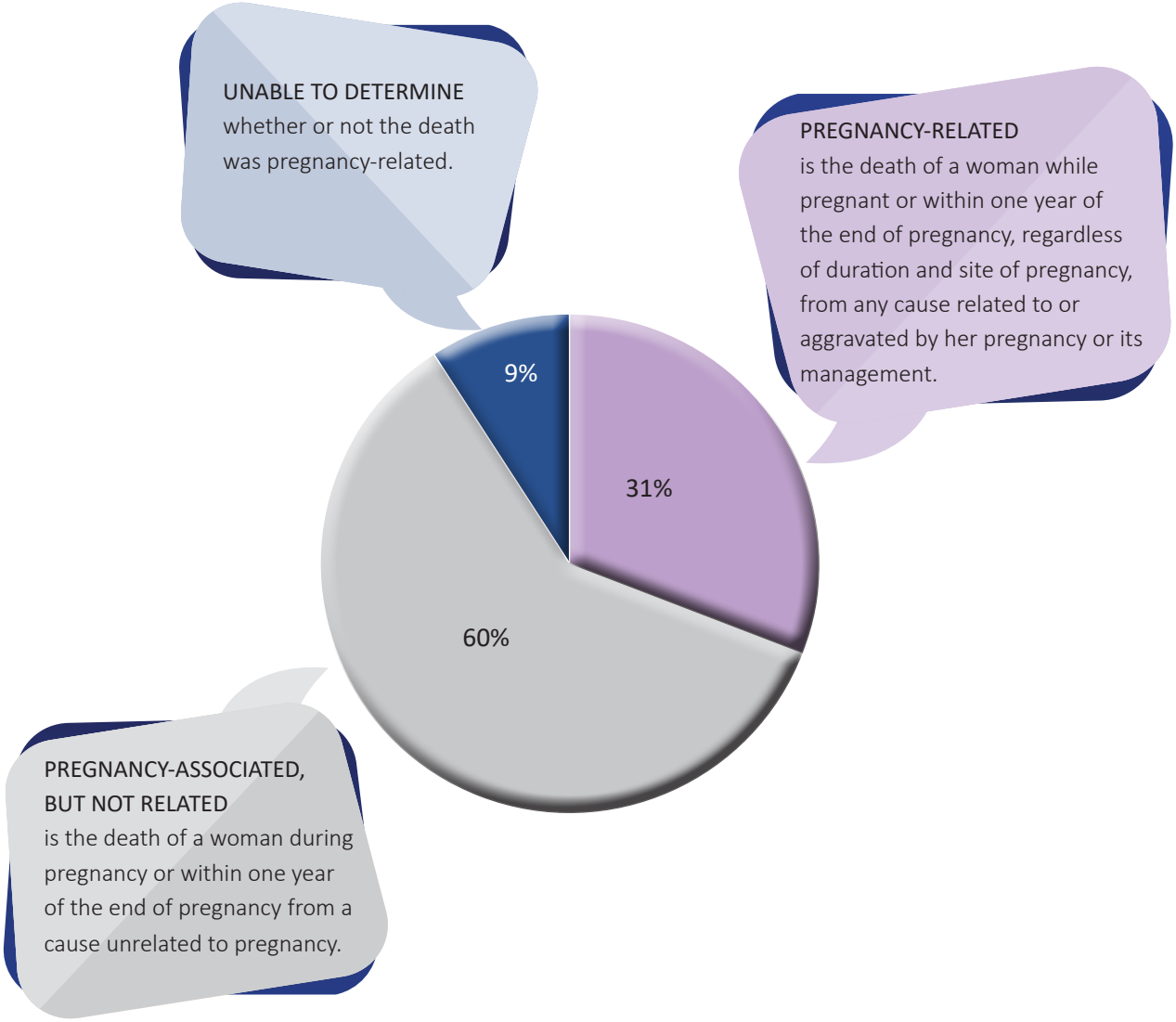


Table 1 describes the demographic characteristics of these women. Most deaths occurred among women aged 20-34, with a high school diploma (or equivalent), who were non-Hispanic white, were never married, and who lived in metropolitan counties.

Table 1. Pregnancy-Associated Deaths Identified by the Ohio Pregnancy-Associated Mortality Review (PAMR), by Demographics, 2008-2016

Demographics of Deceased Women	Count	Percent of all Deaths	Pregnancy-Associated Mortality Ratio
Age in Years at Time of Death			
<20	43	7.1	40.4
20-24	151	24.8	47.7
25-29	172	28.2	45.5
30-34	138	22.6	44.9
35-39	82	13.4	63.9
≥40	24	3.9	89.0
Education			
8th Grade or Less*	12	2.0	28.4
9th-12th Grade, No Diploma	111	18.2	74.3
High School Graduate or Equivalent	285	46.7	89.1
Some College, No Degree	94	15.4	33.6
Associate Degree	36	5.9	32.6
Bachelor's Degree	41	6.7	18.6
Graduate or Professional Degree	29	4.8	21.9
Unknown*	2	<1	--
Race and Ethnicity			
Hispanic	21	3.4	34.6
Non-Hispanic Black	134	22.0	62.7
Non-Hispanic White	421	69.0	44.5
Non-Hispanic, Other Races	34	5.6	77.1
Health Insurance			
Uninsured or Self-Pay*	5	0.8	--
Insured, Medicaid	424	69.5	86.3
Insured, Private	126	20.7	20.5
Insured, Other	54	8.9	81.5
Unknown*	1	<1	--

Table 1 (continued)

Demographics of Deceased Women	Count	Percent of all Deaths	Pregnancy-Associated Mortality Ratio
Marital Status			
Married	205	33.6	28.8
Unmarried	404	66.2	73.7
Unknown*	1	<1	--
Medicare and Medicaid County Type			
Large Metro	176	28.9	43.7
Metro	349	57.2	49.1
Micro	78	12.8	56.4
Rural*	7	1.1	--
ODH County Type			
Metropolitan	341	55.9	48.3
Suburban	74	12.1	39.0
Rural	71	11.6	43.4
Appalachian	124	20.3	60.4
Total	610	100	48.2

Due to rounding, some totals may not correspond with the sum of the separate figures.
**Ratios based on fewer than 20 deaths should be interpreted with caution. Ratios based on fewer than ten deaths are not displayed.*

Data interpretation example: *The row for women aged 20-24 means that 151 pregnancy-associated deaths occurred among Ohio women aged 20 through 24 years from 2008 through 2016. These deaths represented 24.8 percent of all the pregnancy-associated deaths that occurred over that period. Women aged 20-24 in Ohio experienced pregnancy-associated deaths at a ratio of 47.7 deaths per 100,000 live births.*

B. Pregnancy-Related Mortality

Pregnancy-related deaths have typically been the focus of maternal mortality review committees. Of 610 pregnancy-associated deaths, PAMR determined **186 (31 percent)** to be *pregnancy-related* from 2008 through 2016. The pregnancy-related mortality ratio, or PRMR, from 2008 through 2016 was therefore **14.7** deaths per 100,000 live births. PRMR is a measure of the risk of death once a woman has become pregnant.

TRENDS

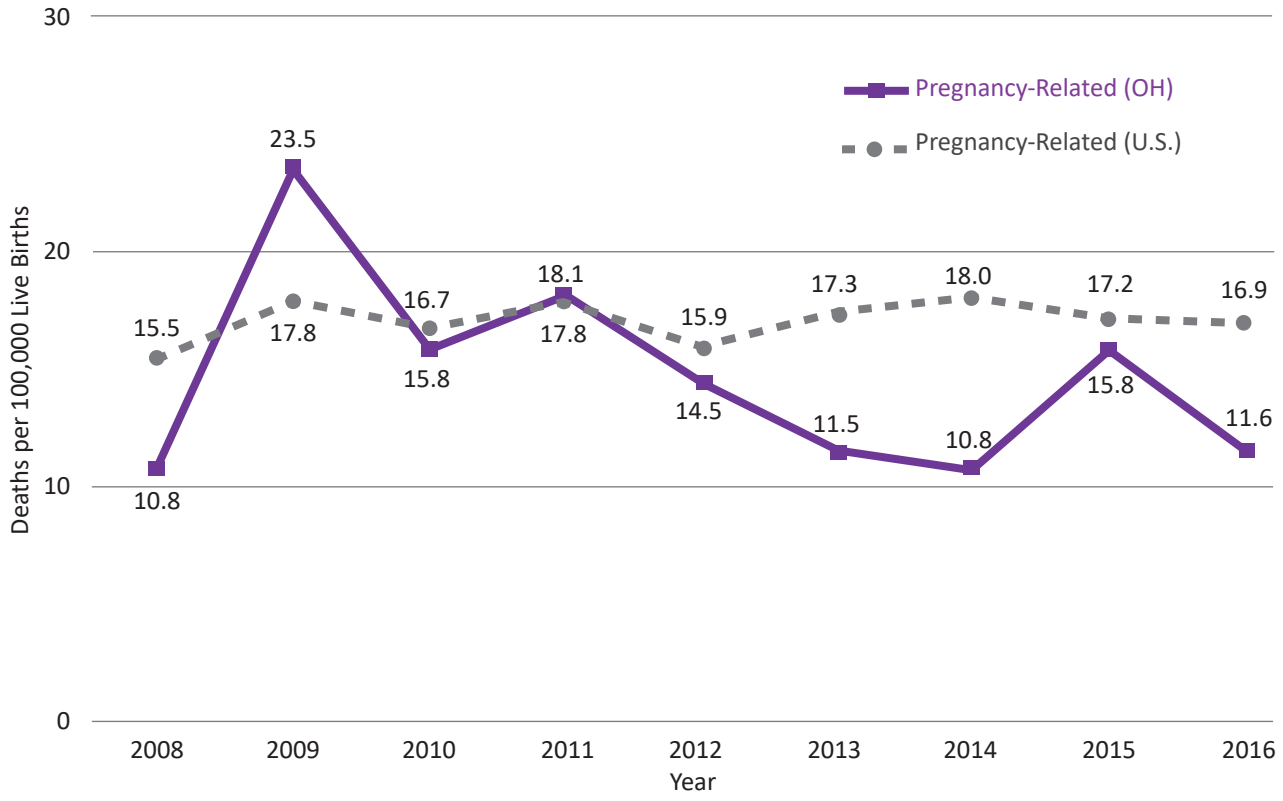
Table 2 shows the number of pregnancy-related deaths by year.

Table 2. Number of Pregnancy-Related Deaths by Year, Ohio 2008-2016

Year	Pregnancy-Related Deaths (Number)
2008	16
2009	34
2010	22
2011	25
2012	20
2013	16
2014	15
2015	22
2016	16
Total	186

Figure 2 shows trends in pregnancy-related mortality ratios (the number of pregnancy-related deaths per 100,000 live births) in Ohio from 2008 through 2016. Over this time, there was no statistically significant change in Ohio's pregnancy-related mortality ratio. Also shown is the United States pregnancy-related mortality ratio from 2008 through 2016. Caution should be used in comparing U.S. and Ohio ratios as surveillance methods differ.

Figure 2. Ohio and U.S. Pregnancy-Related Mortality Ratios, 2008-2016

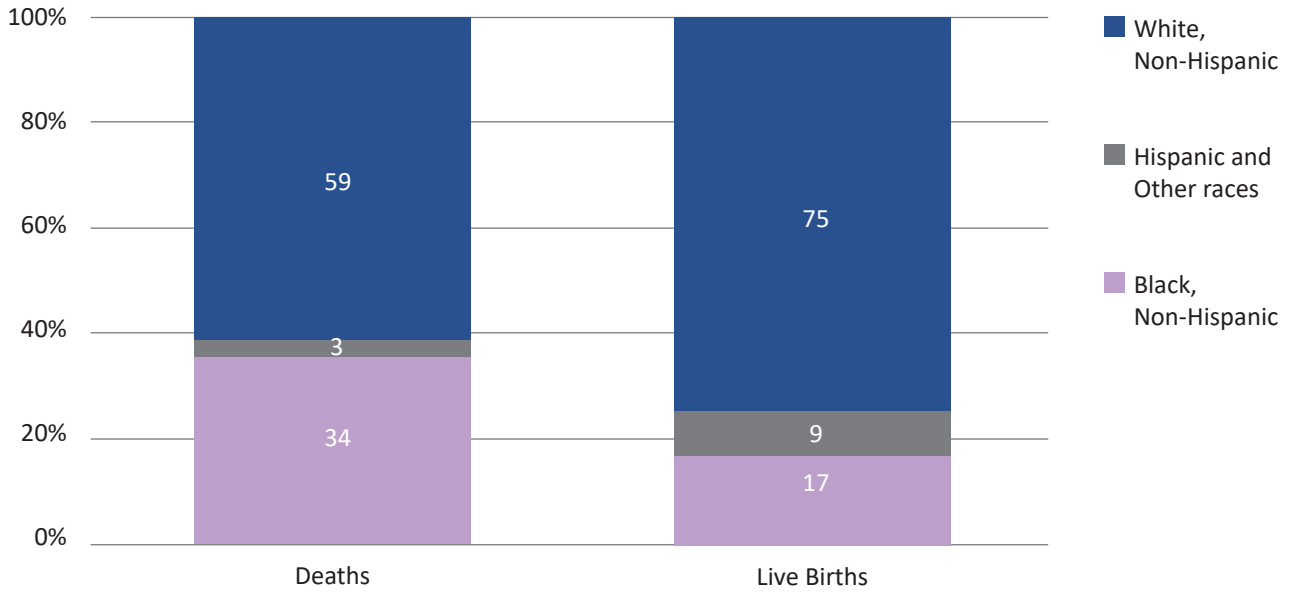


Note: U.S. and Ohio surveillance methods differ. Both include women who died during pregnancy or within one year of pregnancy. However, in contrast to the Ohio PAMR process, the U.S. process is based entirely on vital statistics data submitted to the CDC by states; medically trained epidemiologists determine the cause and time of death related to the pregnancy. More information on the U.S. system can be found at https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html.

DISPARITIES

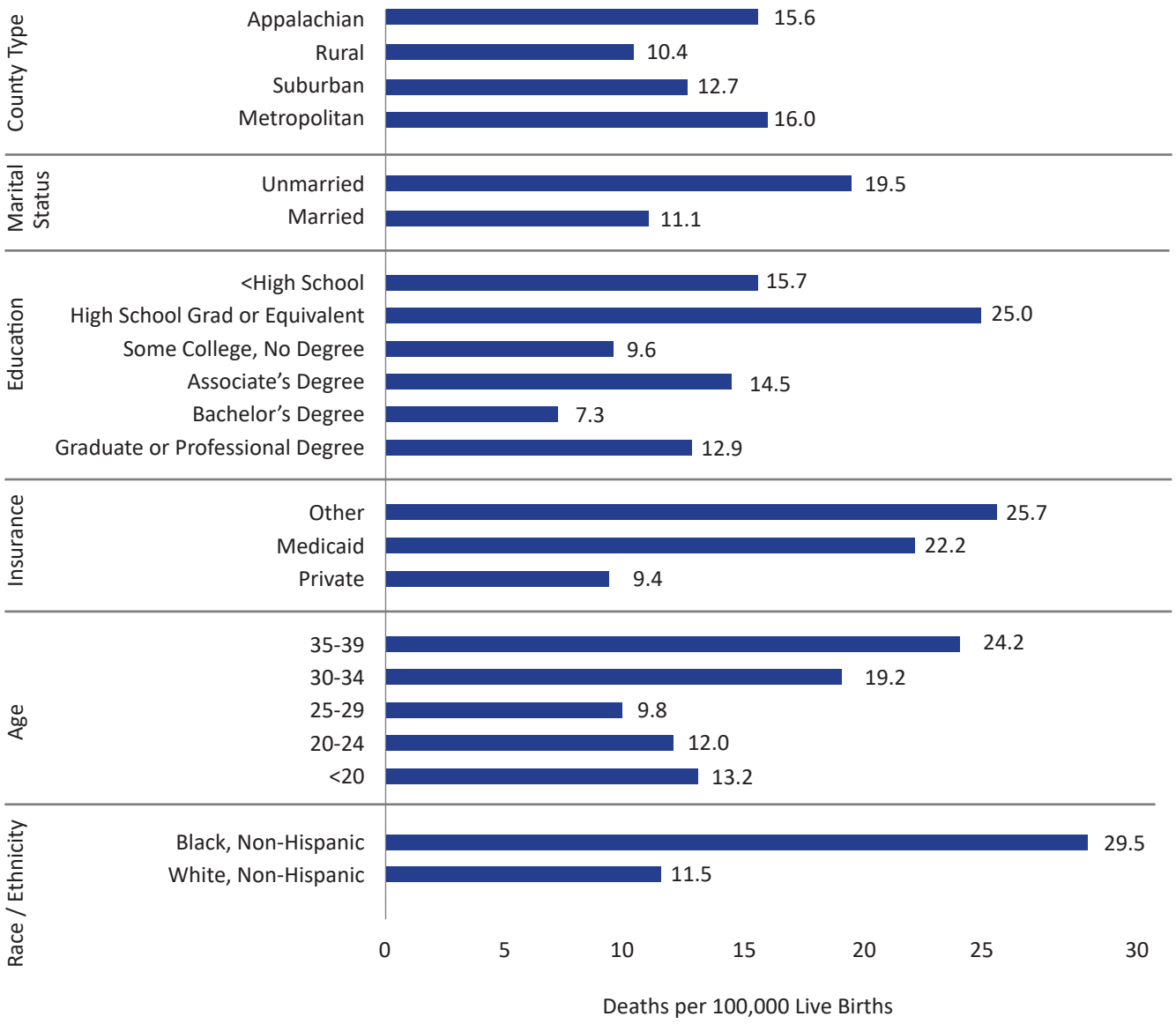
From 2008 through 2016, **109 (59 percent)** pregnancy-related deaths occurred to white women, **63 (34 percent)** to black women, **6 (3 percent)** to Hispanic women, and **8 (4 percent)** to women of other races. Figure 3 shows that the proportion of deaths that occurred among black women (34 percent) far exceeded their representation among the population of women giving birth (17 percent) in Ohio.

Figure 3. Proportion of Pregnancy-Related Deaths and Live Births by Race / Ethnicity, Ohio 2008-2016



The PRMRs for different subgroups of women are displayed in Figure 4. Black women were two and a half times as likely to die from a pregnancy-related death than white women. From 2008 through 2016, the pregnancy-related mortality ratio was 11.5 for white women and 29.5 for black women. Other groups with higher mortalty ratios include women with only a high school education, women living in metropolitan counties or Appalachian counties, unmarried women, and women aged 30-34 years.

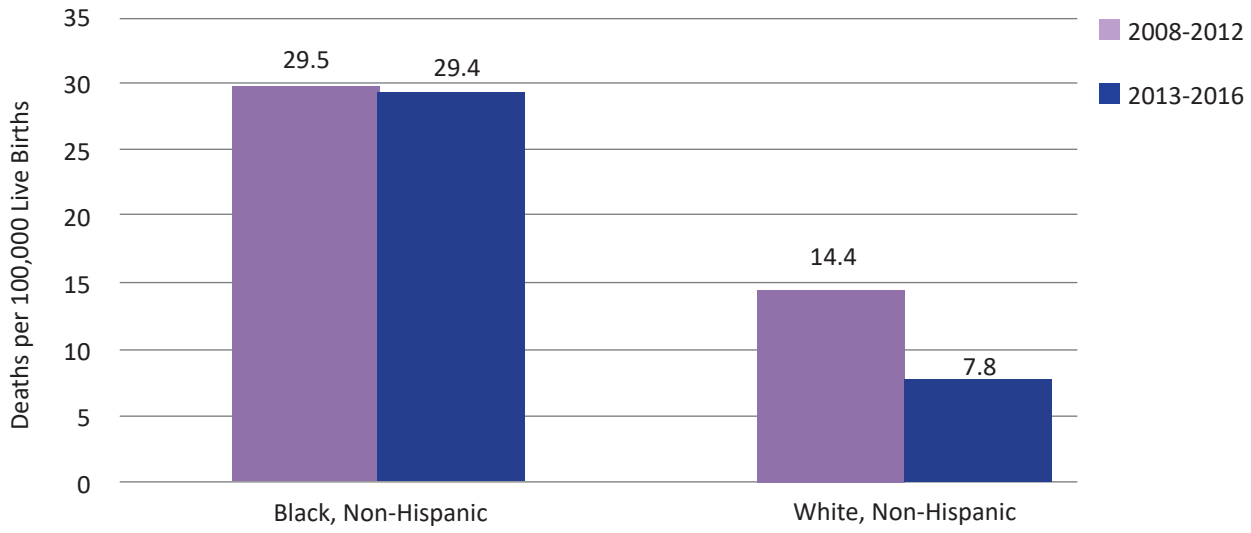
Figure 4. Pregnancy-Related Mortality Ratios, by Maternal Demographics, Ohio 2008-2016



**Ratios based on fewer than ten deaths (e.g., Hispanic) are not displayed.*

Data interpretation example: *The bar on the chart referring to Appalachia means that during 2008 through 2016, women living in an Appalachian county of Ohio experienced pregnancy-related deaths at a ratio of 15.6 per 100,000 live births.*

Figure 5. Pregnancy-Related Mortality Ratios, by Race and Year, Ohio 2008-2012 and 2013-2016



From 2008 through 2012, the PRMR for black women was 29.5 and it was essentially unchanged, at 29.4, during 2013 through 2016. For the same years, the PRMR for white women was 14.4 and 7.8, respectively. However, the apparent decrease among white women did not reflect a statistically significant trend.

MANNER OF DEATH

The manner of death refers to the mechanism or circumstances that result in death, which are designated either natural or unnatural. Unnatural deaths are classified as accidents, homicides, suicides, or undetermined.

Table 3 shows the manners of death, as reported on the death certificate, for all 186 pregnancy-related deaths. The vast majority of pregnancy-related deaths **(89 percent)** were of a natural manner.

Table 3. Manner of Death Among Pregnancy-Related Deaths, Ohio 2008-2016

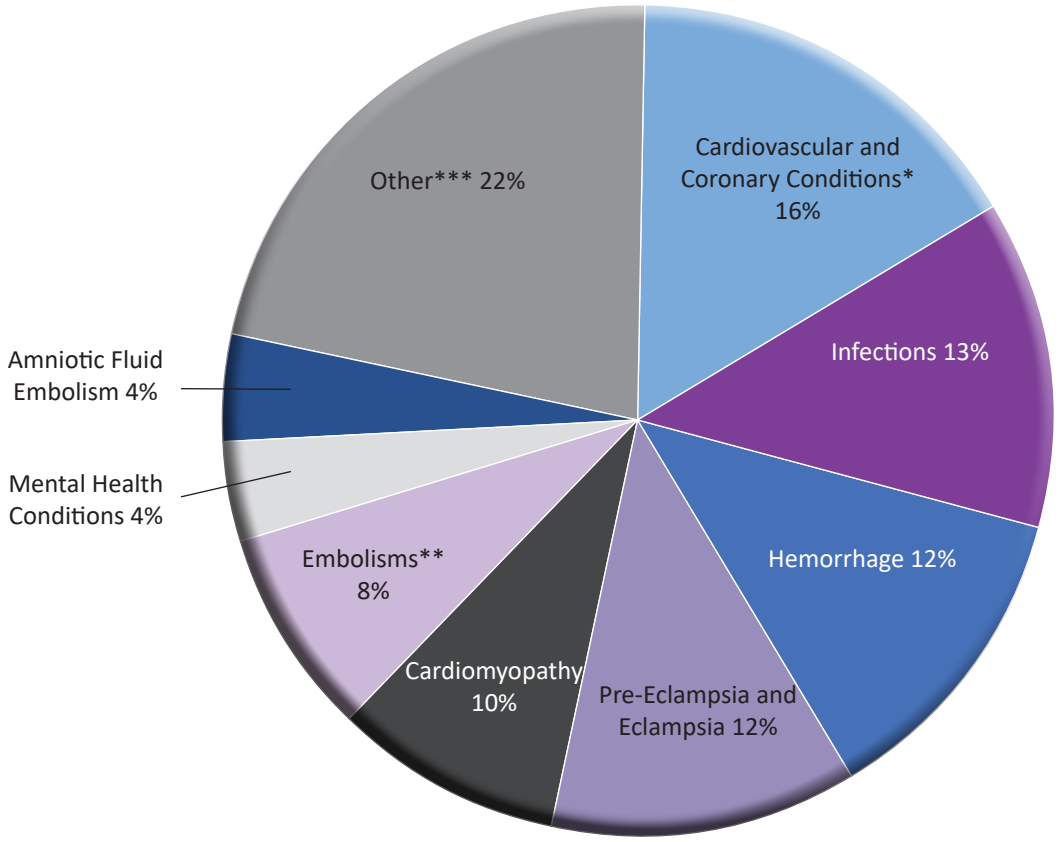
Manner	Number	Percent
Natural	165	88.7
Suicide	9	4.8
Accident	6	3.2
Homicide	5	2.7
Could not be determined	1	0.5
Total	186	100

Due to rounding, percent totals may not equal 100.

CAUSE OF DEATH

Figure 6 displays the underlying causes of pregnancy-related deaths. The most common cause of death was *cardiovascular and coronary conditions* (n=30) followed by *infections* (n=25), *hemorrhage* (n=22), *pre-eclampsia and eclampsia* (n=22), *cardiomyopathy* (n=18), *embolism (not amniotic fluid)* (n=15), *mental health conditions* (n=8), and *amniotic fluid embolism* (n=7). Other causes made up the remainder of deaths and include *cerebrovascular accident* (3 percent), *homicide* (3 percent), and others. A description of cause of death groups can be found in Appendix F. Note that cardiomyopathy is a condition specific to the heart muscle and is separated from other cardiovascular and coronary conditions. Mental health conditions may be identified as the underlying cause for deaths by suicide, deaths by accidental overdose, or others.

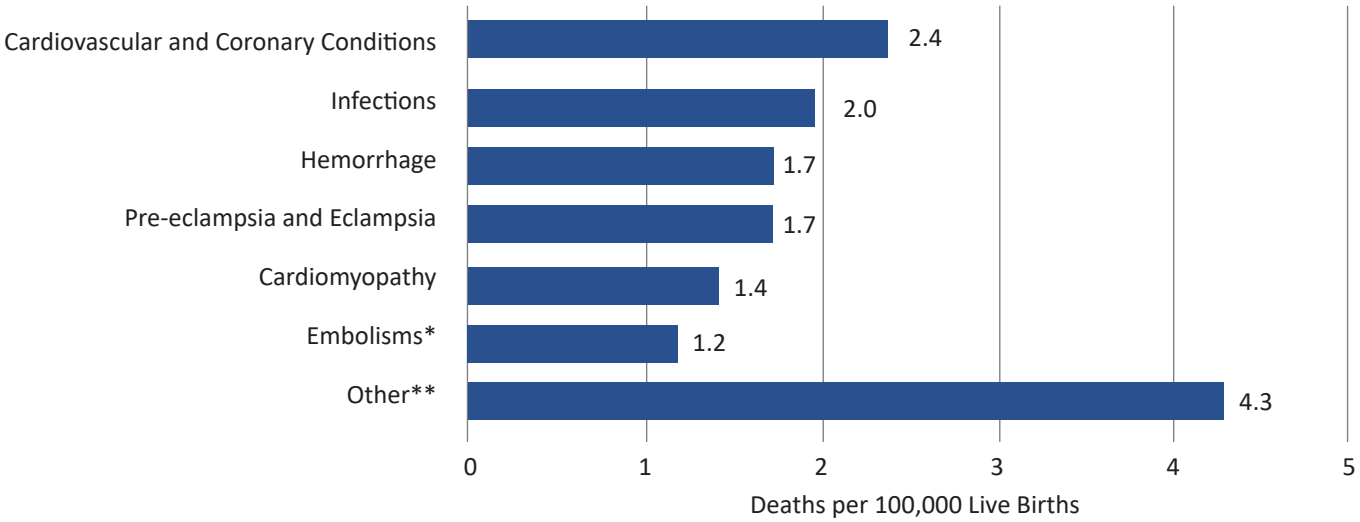
Figure 6. Underlying Causes of Pregnancy-Related Deaths by Leading Causes, Ohio 2008-2016



**Not including cardiomyopathy*
***Not including amniotic fluid embolism*
****Includes cerebrovascular accident, homicide and others*

The cause-specific pregnancy-related mortality ratio for every cause with at least ten pregnancy-related deaths during 2008 through 2016 is displayed in Figure 7. No cause changed significantly over this period.

Figure 7. Mortality Ratios for Leading Underlying Causes of Pregnancy-Related Deaths, Ohio 2008-2016



** Ratios based on fewer than 20 deaths should be interpreted with caution. The embolism category does not include amniotic fluid embolisms.*
***Other includes all causes with fewer than ten deaths (e.g., mental health conditions, amniotic fluid embolism, cerebrovascular accident, homicide).*

Data interpretation example: *The bar for embolisms means that during 2008 through 2016, Ohio women experienced pregnancy-related deaths due to embolisms (not including amniotic fluid embolisms) at a ratio of 1.2 deaths per 100,000 live births*.

The distribution of causes of death by race varied little, however low numbers prevent strong conclusions. Notably there were four homicides related to pregnancy among black women but none among white women. Conversely, there were eight pregnancy-related deaths due to mental health conditions among white women and none among black women.

Table 4. Distribution of Leading* Underlying Causes of Pregnancy-Related Death, by Non-Hispanic Black and White Race, Ohio 2008-2016

Cause of Death	Non-Hispanic Black		Non-Hispanic White	
	Number	Percent	Number	Percent
Cardiovascular and Coronary Conditions	10	15.9	18	16.5
Hemorrhage	8	12.7	13	11.9
Pre-eclampsia and Eclampsia	8	12.7	11	10.1
Infections	7	11.1	17	15.6
Cardiomyopathy	5	7.9	12	11.0
Embolisms (not amniotic fluid)	5	7.9	9	8.3
Homicide	4	6.4	0	--
Mental Health Conditions	0	--	8	7.3
Amniotic Fluid Embolism	3	4.8	4	3.7
All Other	13	20.6	17	15.6
TOTAL	63	100	109	100

**Causes of death with at least four deaths in either racial group are displayed.*

PLACE OF DEATH

The 186 pregnancy-related deaths occurred primarily in hospitals as inpatient or outpatient, or at hospice. Note that these deaths may have occurred anytime during pregnancy through one year after pregnancy.

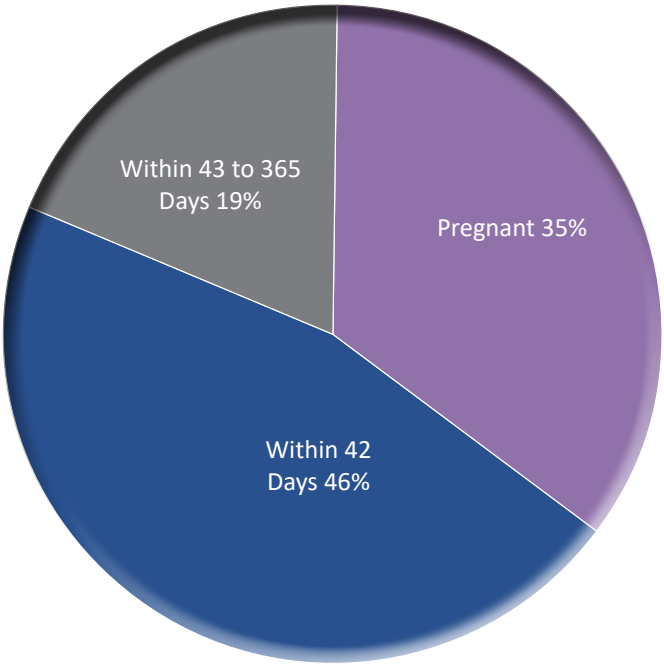
Table 5. Location of Death Among Pregnancy-Related Deaths, Ohio 2008-2016

Place	Number	Percent
Hospital – dead on arrival	3	2
Hospital – inpatient	97	52
Hospital – emergency room or outpatient	43	23
Hospice	36	19
Home	2	1
Other	5	3
Total	186	100

TIMING OF DEATH IN RELATION TO PREGNANCY

Among 186 pregnancy-related deaths, **65 (35 percent)** were pregnant at the time of death (including deaths that occurred the day of delivery), **86 (46 percent)** had been pregnant within 42 days of death, and **35 (19 percent)** had been pregnant within 43 to 365 days of death.

Figure 8. Timing of Pregnancy-Related Death in Relation to Pregnancy, Ohio 2008-2016



Timing of pregnancy-related deaths varied somewhat by cause (Table 6). *Infections* were most likely to occur within 42 days of pregnancy as were deaths due to *pre-eclampsia* or *eclampsia*. At least half of deaths due to *hemorrhage* or *cardiovascular* and *coronary conditions* occurred during pregnancy. At least half of deaths due to *embolism* occurred within 43 to 365 days after the end of pregnancy.

Table 6. Timing of Death in Relation to Pregnancy, by Leading Causes of Death, Ohio 2008-2016

Underlying Cause of Death	Timing of Death in Relation to Pregnancy Number (%)		
	Pregnant	Within 42 Days	Within 43 to 365 Days
Cardiovascular and Coronary Conditions	15 (50)	13 (43)	2 (7)
Infection	4 (16)	19 (76)	2 (8)
Hemorrhage	12 (55)	10 (45)	0
Pre-eclampsia and Eclampsia	6 (27)	15 (68)	1 (5)
Cardiomyopathy	3 (17)	8 (44)	7 (39)
Embolisms (not amniotic fluid)	4 (27)	3 (20)	8 (53)

Data interpretation example: *The row referring to Cardiovascular and Coronary Conditions means that* ***15****, or half* ***(50 percent),*** *of all pregnancy-related deaths due to cardiovascular or coronary condition occurred during pregnancy. A further* ***13 (43 percent)*** *occurred within 42 days of pregnancy and* **2** ***(7 percent)*** *occurred within 43 to 365 days after the end of pregnancy.*

For both black and white women, the largest proportion of pregnancy-related deaths occurred within 42 days of pregnancy followed by deaths during pregnancy then deaths within 43 to 365 days after the end of pregnancy. However, a larger proportion of black vs white women died during pregnancy, while a larger proportion of deaths to white women occurred within 43 to 365 days after the end of pregnancy.

Table 7. Timing of Death in Relation to Pregnancy, by Non-Hispanic Black and White Race, Ohio 2008-2016

Race / Ethnicity	Timing of Death in Relation to Pregnancy Number (%)		
	Pregnant	Within 42 Days	Within 43 to 365 Days
Non-Hispanic Black	25 (40)	30 (48)	8 (13)
Non-Hispanic White	36 (33)	49 (45)	24 (22)

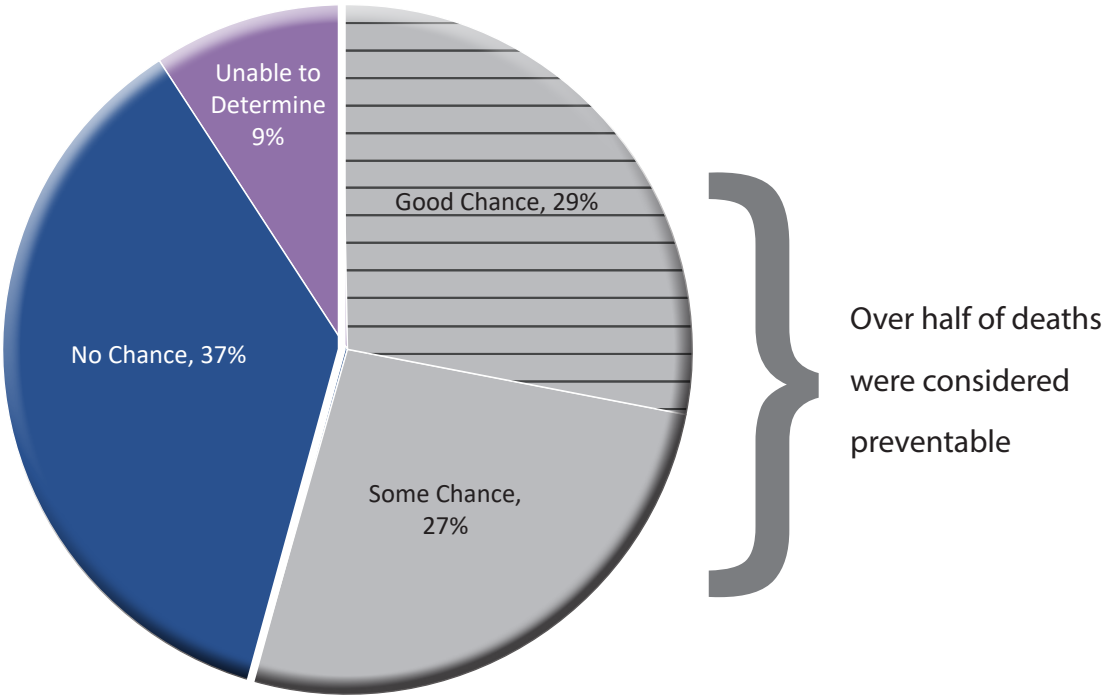
Due to rounding, some totals may not correspond with the sum of the separate figures.

CHANCE TO ALTER OUTCOME

Among 89 pregnancy-related deaths that occurred from 2012 to 2016, the committee determined whether there was a chance to alter the outcome. Prior to 2012, the review process did not consistently determine chance to alter outcome.

The committee determined that there was a good chance to alter the outcome in **26 (29 percent)** deaths and some chance in **24 (27 percent)** deaths. Combining these two categories, over half of pregnancy-related deaths were thought to be preventable.

Figure 9. Chance to Alter Outcome Among Pregnancy-Related Deaths (n=86), Ohio 2012-2016



Preventability varied across underlying causes of death. The cause with the highest degree of preventability was *pre-eclampsia* or *eclampsia* where 85 percent of deaths were considered preventable; conversely only one of five (20 percent) of deaths due to *amniotic fluid embolism* was considered preventable.

Table 8. Pregnancy-Related Deaths Determined Preventable, by Underlying Cause of Death (n=89), Ohio 2012-2016

Underlying Cause of Death	Preventable	Total
	Number (%)	Number
Cardiovascular and Coronary Conditions	4 (29)	14
Pre-eclampsia and Eclampsia	11 (85)	13
Hemorrhage	7 (64)	11
Infections	7 (64)	11
Embolisms (not amniotic fluid)	5 (56)	9
Cardiomyopathy	6 (75)	8
Amniotic Fluid Embolism	1 (20)	5
Cerebrovascular Accidents	1 (25)	4
Mental Health Conditions	3 (100)	3
Other		11
Total	50 (56)	89

CONTRIBUTING FACTORS

For each death, the review committee identifies factors that contributed to the death. These factors include steps along the way that, if altered, may have prevented the woman's death. The committee considers factors that operate at any of these levels:

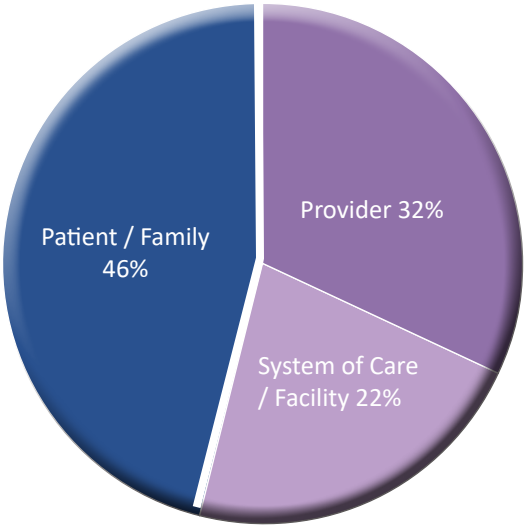
- Patient / family
- Health care provider
- Facilities / hospitals where the woman sought care
- Systems that influence the lifestyle, care, and health services for the woman

Overall

The committee identified 793 unique contributing factors among 186 pregnancy-related deaths. On average, four contributing factors were identified for every pregnancy-related death. For 30 deaths, no factors were identified.

Factors at the provider level (32 percent) and system of care or facility level (22 percent) together comprised more than half of the factors identified that contributed to pregnancy-related deaths. Factors at the patient or family level accounted for the remaining 46 percent of identified factors. While these factors operate at the patient or family level, the individual does not necessarily have control over factors at that level. For example, a woman may have a chronic condition that she was born with, be a victim of domestic violence, or have limited access to resources such as transportation or paid time off from work for appointments.

Figure 10. Distribution of Levels of Contributing Factors Among Pregnancy-Related Deaths, Ohio 2008-2016



We gain greater understanding of how contributors operate when we consider classes of contributing factors within each level. For each factor level, a summary of the most common factor classes and when possible, the dominant themes that emerged from the factor descriptions, is displayed on pages 29-31.

Provider

Among the 255 provider-level factors identified for 186 pregnancy-related deaths, the most common classes of factors are presented in Table 9 along with themes representing each class.

Table 9. Contributing Factors to Pregnancy-Related Deaths (n=186) that Operate at the Provider-Level, by Class, Ohio 2008-2016

Class of Provider-Level Factor	Count (%)	Representative Themes
Delay	53 (21)	Delay in or lack of diagnosis, treatment, or follow-up; delay in securing airway; delay in managing hemorrhage
Assessment	49 (19)	Failure to screen, inadequate assessment of risk, misdiagnosis, use of ineffective treatment
Referral or Consultation	32 (13)	Failure to refer or seek consultation (e.g., maternal fetal medicine or cardiology)
Clinical Skill / Quality of Care	31 (12)	Inadequate preconception counseling, misdiagnosis, use of ineffective treatment
Knowledge	27 (11)	Delay in or lack of diagnosis, treatment, or follow-up; misdiagnosis; use of ineffective treatment; failure to screen or inadequate assessment of risk
Communication	22 (9)	Lack of communication between providers, inadequate patient education
Continuity of Care / Care Coordination	18 (7)	Lack of continuity of care
Other		Non-optimal transfusion ratio (for AFE), early discharge, lack of transfer to better care

Data interpretation example: *The row for delay means that some type of provider delay that contributed to the death of a woman was identified 53 times among the 186 pregnancy-related deaths to Ohio women from 2008 through 2016. These delays included ones described as delay in or lack of a diagnosis, treatment, or follow-up. Specific delays noted in the committee reviews included delays in securing the airway and delays in managing hemorrhage.*

System of Care or Facility

Among the 177 system-of-care or facility-level factors identified for 186 pregnancy-related deaths, the most common classes of factors are presented along with themes representing each class.

Table 10. Contributing Factors to Pregnancy-Related Deaths (n=186) that Operate at the System-of-Care or Facility-Level, by Class, Ohio 2008-2016

Class of System-of-Care or Facility-Level Factor	Count (%)	Representative Themes
Continuity of Care / Care Coordination	48 (62)	Lack of continuity of care from a system perspective; lack of or insufficient case coordination or management (e.g., after discharge or mental health); 10-day gap in care
Access / Financial	27 (15)	Systems barriers to accessing care (e.g., insurance, provider shortage, transportation), unavailable facilities (e.g., need for a 2nd facility), inability to transfer to a higher level of care
Personnel	23 (13)	Inadequate, unavailable, or inadequately trained personnel, inadequate follow-up by personnel, inadequate training of translation services, inadequate EMS response
Communication	19 (10)	Lack of or poor communication (e.g., between providers)
Policies / Procedures	16 (9)	Lack of policies or procedures (e.g., H1N1); lack of standardized policies or procedures (e.g., massive transfusion protocol, hemorrhage checklist, response to high blood pressure)
Clinical Skill / Quality of Care	13 (7)	Inadequately trained or unavailable personnel
Equipment / Technology	9 (5)	Inadequate or unavailable equipment / technology
Other		Failure to refer or seek consultation (e.g., social work consult needed from emergency department); 911 failed to instruct partner to begin CPR; lack of education regarding obesity and symptoms of cardiomegaly

Due to rounding some totals may not correspond with the sum of the separate figures.

Patient / Family

Among the 361 factors identified that operate at the patient / family-level for 186 pregnancy-related deaths, the most common classes of factors are presented along with themes representing each class.

Table 11. Contributing Factors to Pregnancy-Related Deaths (n=186) that Operate at the Patient / Family-Level, by Class, Ohio 2008-2016

Class of Patient / Family-Level Factor	Count (%)	Representative Themes
Chronic Disease	109 (30)	Obesity, chronic medical condition, chronic back pain
Knowledge	54 (15)	Lack of knowledge regarding importance of event, lack of knowledge regarding treatment or follow up, delay or failure to seek care
Adherence	37 (10)	Nonadherence with medical recommendation, nonadherence due to lack of resources or transportation
Mental Health Conditions	23 (6)	Depression, anxiety
Delay	32 (9)	Delay or failure to seek care
Substance Use Disorder – Alcohol, Illicit / Prescription Drugs	20 (6)	Alcohol, illicit drugs, or prescription abuse
Tobacco	19 (5)	Tobacco use
Violence	13 (4)	Intimate partner violence, prior assault
Social Support / Isolation	13 (4)	Lack of family / friend support system
Access / Financial	14 (4)	Lack of financial resources / poverty, unstable housing, transportation
Other		

Due to rounding some totals may not correspond with the sum of the separate figures.

C. Pregnancy-Associated, but not Related, Mortality

Among the 610 pregnancy-associated deaths in Ohio from 2008 through 2016, **368 (60 percent**) deaths were determined **NOT** to be pregnancy-related. While pregnancy was not found to have contributed to their deaths, studying them is still important to understand the experiences of and threats to a vulnerable population of women and their families. Furthermore, pregnancy and postpartum include occasions when a woman may have more contact with medical and social services and thus more opportunity for identification of issues and connection to treatment or support services.

TRENDS

Table 12 shows the number and mortality ratio for pregnancy-associated, but not related, deaths by year. In 2015 and 2016, the number and ratio of deaths increased over prior years. This change in trend was statistically significant.

Table 12. Number and Mortality Ratio of Pregnancy-Associated but not Related Deaths, by Year, Ohio 2008-2016

Year	Pregnancy-Associated, not Related Deaths (number)	Pregnancy- Associated, not Related Deaths (Ratio per 100,000 Live Births)
2008	26	17.5
2009	37	25.6
2010	37	26.6
2011	26	18.8
2012	33	23.9
2013	24	17.3
2014	33	23.7
2015	54	38.8
2016	98	70.9
2008-2016	368	29.1

Table 13 displays the demographic characteristics of women whose deaths were pregnancy-associated, but not related. Both the number of women who died within each demographic group, and the mortality ratios are displayed. The number of deaths was greatest among women 25-29, but the mortality ratio was highest among women 35-39. Mortality ratios were also higher among women with a high school education or lower, women not of white or black race, unmarried women, and women living in an Appalachian county. Note that in contrast to pregnancy-related deaths, there was no racial disparity in deaths that were pregnancy-associated, but not related to pregnancy.

Table 13. Number and Mortality Ratio of Pregnancy-Associated, but not Related Deaths, by Sociodemographic Characteristics, Ohio 2008-2016

Characteristic	Number	Percent of Deaths	Mortality Ratio per 100,000 Live Births
Age in Years at Time of Death			
<20	27	7.3	25.4
20-24	97	26.4	30.7
25-29	115	31.3	30.4
30-34	69	18.8	22.5
35-39	47	12.8	36.6
≥40*	13	3.5	48.2
Education			
8th Grade or Less*	8	2.2	--
9th-12th Grade, No Diploma	74	20.1	49.5
High School Graduate or Equivalent	176	47.8	55.0
Some College, No Degree	58	15.8	20.7
Associate Degree*	17	4.6	15.4
Bachelor's Degree	22	6.0	10.0
Graduate or Professional Degree*	11	3.0	8.0
Unknown*	2	0.5	--
Race and Ethnicity			
Hispanic*	11	3.0	18.1
Non-Hispanic Black	61	16.6	28.5
Non-Hispanic White	274	74.5	29.0
Non-Hispanic, Other Races	22	6.0	49.9
Health Insurance Status and Type			
Uninsured or Self-Pay*	3	0.8	--
Insured, Medicaid	273	74.2	55.6
Insured, Private	60	16.3	9.8
Insured, Other	31	8.4	46.8
Insurance Status Unknown*	1	0.3	--
Marital Status			
Married	109	29.6	15.3
Not Married	259	70.4	47.3
Unknown	0		

Table 13 (continued)

Characteristic	Number	Percent of Deaths	Mortality Ratio per 100,000 Live Births
Medicaid and Medicare County Type			
Large Metro	94	25.5	23.4
Metro	217	58.9	30.5
Micro	53	14.4	38.3
Rural*	4	1.1	--
ODH County Type (DC)			
Metropolitan	192	52.2	27.2
Suburban	47	12.8	24.8
Rural	47	12.8	28.7
Appalachian	82	22.3	40.0
Total	368	100	29.1

** Ratios based on fewer than 20 deaths should be interpreted with caution. Ratios based on fewer than 10 deaths are not displayed.*

Data interpretation example: *The row referring to age <20 means that of the 368 deaths that occurred during 2008 through 2016 that were pregnancy- associated but not related, 27 of them occurred to a woman who was less than 20 years of age. The mortality ratio among women less than 20 years of age was 25.4 per 100,000 live births to women of the same age.*

MANNER OF DEATH

The manner of death refers to the mechanism or circumstances that result in death, which are designated as either natural or unnatural. Unnatural deaths are classified as accidents, homicides, suicides, or undetermined.

The most common manner of death as reported on the death certificate for deaths that were pregnancy-associated, but not related, was accident **(53 percent)** followed by natural **(27 percent)** and homicide **(14 percent)**. This pattern contrasts with the manners of death among pregnancy-related deaths, where **(89 percent)** were natural.

Table 14. Manner of Death Among Pregnancy-Associated but not Related Deaths, Ohio 2008-2016

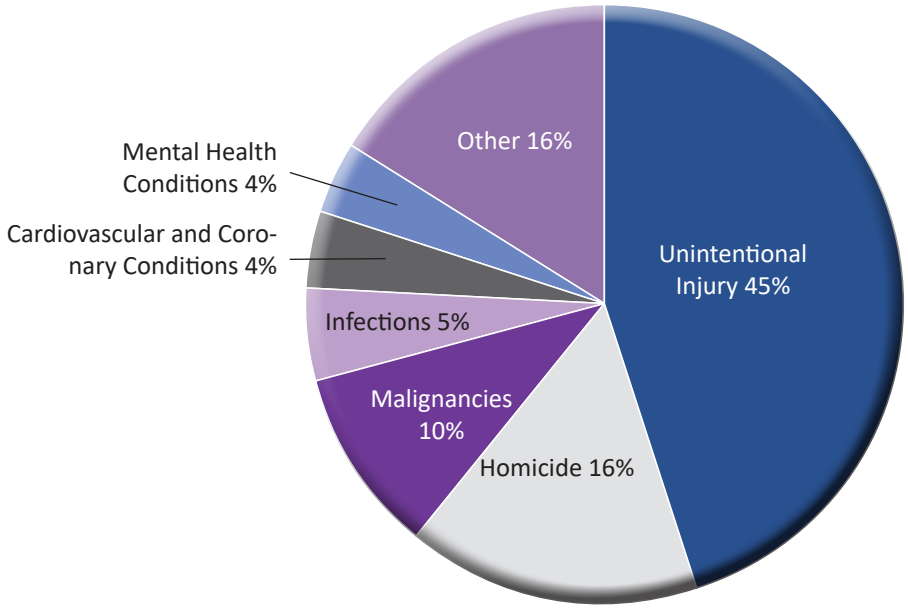
Manner	2008 - 2016	
	Number	Percent
Accident	194	53
Natural	97	27
Homicide	50	14
Suicide	17	5
Could not be Determined / Pending	7	2
Total	365	100

Due to rounding, some totals may not correspond with the sum of the separate figures. Three cases were missing a manner of death.

CAUSE OF DEATH

From 2008 to 2014, all pregnancy-associated deaths were reviewed. For deaths that occurred during 2015-2016, not all were fully reviewed because of the high volume of deaths to be reviewed in a single year (see Appendix C for details). The distribution of causes of death for all 216 pregnancy-associated, but not related deaths prior to 2015 are shown in Figure 11. Among deaths, **45 percent (97)** were due to unintentional injury, while **16 percent (34)** were due to homicide and **10 percent (21)** were due to malignancies. Other causes made up 16 percent of deaths and included seizure disorders (3 percent) and pulmonary conditions (2 percent). In contrast, among pregnancy-related deaths the leading causes of death were medically related.

Figure 11. Causes of Death Among Pregnancy-Associated but not Related Deaths, Ohio 2008-2014



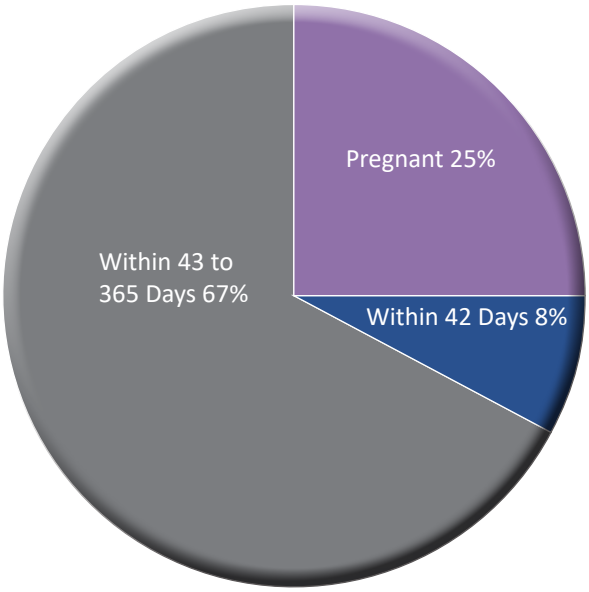
Note: *Other includes seizure disorders, pulmonary conditions, and others, and four deaths where the PAMR committee could not determine a cause of death.*

Among the 48 of 152 reviewed pregnancy-associated, but not pregnancy-related deaths that occurred during 2015 and 2016, the leading causes of deaths as assigned by the committee were *unintentional injury* (n=26), *cerebrovascular accidents* (n=4), *cardiovascular and coronary conditions* (n=3), *homicide* (n=3), *infections* (n=3), and *mental health conditions* (n=3).

TIMING OF DEATH IN RELATION TO PREGNANCY

The majority **(67 percent)** of pregnancy-associated, but not related deaths, occurred from 43 to 365 days after pregnancy. About a quarter occurred during pregnancy and the remaining **8 percent** occurred within 42 days of pregnancy. In contrast, among pregnancy-related deaths, **46 percent** occurred within 42 days after the end of pregnancy (see page 24).

Figure 12. Timing of Death in Relation to Pregnancy Among Pregnancy-Associated, but not Related Deaths, Ohio 2008-2016



CHANCE TO ALTER OUTCOME

The committee's determination of chance to alter outcome is displayed in Table 15 for pregnancy-associated, but not related deaths occurring during 2012-2014 (all deaths) and during 2015-2016 (excluding not fully reviewed deaths). Approximately half **(48 percent)** of these deaths were found to be preventable (either some chance or good chance to alter outcome) during 2012-2014 and about a third of reviewed deaths were found to be preventable during 2015-2016. Prior to 2012, the committee did not consistently determine preventability.

Table 15. Preventability Among Reviewed Pregnancy-Associated but not Related Deaths, Ohio 2012-2016

Chance to Alter Outcome	2012-2014		2015-2016*		
	Number	Percent	Number	Percent	Unreviewed
Good Chance	10	11	4	8	
Some Chance	33	37	13	27	
No Chance	39	44	28	58	
Unable to Determine	7	8	3	6	
Total	89	100	48	100	104

**Deaths that were not pregnancy-related were not all reviewed in 2015 and 2016 (See Appendix C for additional explanation). These data only represent reviewed deaths. One death from 2012-2014 was missing preventability.*

Due to rounding, some totals may not correspond with the sum of the separate figures. Three cases were missing a manner of death.

For 2012 through 2016, determination of chance to alter outcome is shown in Table 16 by manner and underlying cause of death for leading causes among pregnancy-associated, but not related deaths. About half of deaths by a manner of natural cause or homicide were considered preventable (some or good chance to alter outcome), while just over a third of deaths by accident or suicide were determined preventable. By cause of death, approximately one third of unintentional injuries and about one half of homicides were considered preventable.

Table 16. Preventability Among Reviewed Pregnancy-Associated but not Related Deaths, by Manner and Leading Underlying Causes of Death, Ohio 2012-2016

	Chance to Alter Outcome Number (%)				
	Good Chance	Some Chance	No Chance	Unable to Determine	Total
Manner of Death					
Accident	6 (10)	17 (27)	37 (59)	3 (5)	63
Natural	5 (12)	16 (39)	15 (37)	5 (12)	41
Homicide	1 (5)	9 (43)	9 (43)	2 (10)	21
Suicide	0	3 (38)	5 (63)	0	8
Cause of Death					
Unintentional Injury	5 (8)	17 (27)	38 (60)	3 (5)	63
Homicide	1 (5)	9 (43)	9 (43)	2 (10)	21
Malignancies	1 (13)	3 (38)	3 (38)	1 (13)	8
Cerebrovascular Accidents	0	4 (57)	3 (43)	0	7

CONTRIBUTING FACTORS

For each manner of death, the following tables present the most common classes of contributing factors, by level, along with themes representing each class.

Among pregnancy-associated, but not related deaths,

- Almost one in four deaths due to an **accidental** manner were found to have substance use disorder as a contributing factor at the patient / family level (Table 17);
- Almost one in four deaths due to a **natural** manner were found to have chronic disease as a contributing factor at the patient / family level (Table 18); and
- One in four deaths due to **homicide** were found to have violence as a contributing factor at the patient / family level (Table 19).

Table 17. Contributing Factors Among 62 Reviewed Pregnancy-Associated, but not Related Deaths with **Accident** as the Manner of Death, Ohio 2008-2016

Factor Class	Count (%)	Representative Themes
Patient / Family Factor Level		
Substance Use Disorder	74 (23)	Substance abuse directly compromised woman's health status, illicit drugs, alcohol, multiple medications
Mental Health Conditions	39 (12)	Anxiety, depression
Adherence	28 (9)	Non-adherence with medical recommendations, no adherence due to unstable housing, lack of seatbelt use
Environmental	20 (6)	Factors related to weather or terrain, fire or stove alarms, poor weather, icy roads, fire hazards
Violence	12 (4)	Intimate partner violence, abused by brother, other history of violence
Delay	11 (3)	
Chronic Disease	11 (3)	Asthma, chronic pain, epilepsy
Knowledge	8 (3)	Lack of knowledge of treatment or follow-up, lack of knowledge leading to delayed care, lack of knowledge about seatbelt use
Childhood Abuse / Trauma	8 (3)	Childhood sexual abuse
Social Support / Isolation	7 (2)	Lack of family or friend support system
Unstable Housing	5 (2)	
SUBTOTAL	247 (76)	
Provider Factor Level		
Assessment	6 (2)	Failure to screen, inadequate assessment of risk, lack of toxicity screen
Continuity of Care / Care Coordination	5 (2)	Lack of continuity of care
Referral	5 (2)	Failure to refer or seek consultation
SUBTOTAL	27 (8)	
System / Facility		
Continuity of Care / Care Coordination	14 (4)	Lack of continuity of care, lack of or poor quality case coordination or management, lack of coordination resulting in continued access to prescription medications
Access / Financial	12 (4)	Lack of insurance, lack of transportation creating a barrier to accessing care, lack of providers, lack of facilities, difficulty getting an appointment
Outreach	7 (2)	Inadequate community outreach, inadequate resources for community outreach
Communication	6 (2)	Inadequate connection to mental health system for referral and follow-up, poor communication between providers
Policies / Procedures	5 (2)	Lack of standardized policies or procedures (e.g., no policy for provider to reach out to psych when patient presents with intense mental health issues; no procedure to check women for toxicity at birth and during prenatal care)
SUBTOTAL	53 (16)	
Total	327 (100)	

Due to rounding, some totals may not correspond with the sum of the separate figures.

Table 18. Contributing Factors Among 39 Reviewed Pregnancy-Associated, but not Related Deaths with a **Natural** Manner of Death, Ohio 2008-2016

Factor Class	Count (%)	Representative Themes
Patient / Family Factor Level		
Chronic Disease	52 (22)	Obesity, cancer, diabetes, hypertension, epilepsy, HIV
Knowledge	23 (10)	Lack of knowledge regarding importance of event, lack of knowledge of treatment or follow-up
Delay	20 (9)	Delay or failure to seek care
Adherence	16 (7)	Lack of adherence to medical recommendations, lack of prenatal care, ran out of medication, gaps in taking medication
Substance Use Disorder	10 (4)	
Mental Health Conditions	7 (3)	Depression
Tobacco Use	6 (3)	
Access / Financial	6 (3)	Lack of insurance, lack of financial resources,
Social Support / Isolation	5 (2)	Lack of family or friend support system, isolation
Cultural / Religious	5 (2)	
SUBTOTAL	161 (69)	
Provider Family Factor Level		
Clinical Skill / Quality of Care	9 (4)	Misdiagnosis, use of ineffective treatment, inadequate preconception counseling
Delay	7 (3)	Delay in or lack of diagnosis, treatment or follow-up
Referral or Consultation	5 (2)	Failure to refer or seek consultation
SUBTOTAL	40 (17)	
System / Facility		
Access / Financial	11 (5)	Insurance barriers to accessing care, provider shortage a barrier to accessing care, transportation barriers to accessing care
Continuity of Care / Care Coordination	8 (3)	Lack of case coordination or management, lack of continuity of care
SUBTOTAL	29 (13)	
TOTAL	232 (100)	

Due to rounding, some totals may not correspond with the sum of the separate figures.

Table 19. Contributing Factors Among 21 Reviewed Pregnancy-Associated, but not Related Deaths with **Homicide** as the Manner of Death, Ohio 2008-2016

Factor Class	Count (%)	Representative Themes
Patient / Family Factor Level		
Violence	27 (26)	Intimate partner violence, other history of violence
Social Support / Isolation	7 (7)	Lack of family or friend support system, lack of social support
Mental Health Condition	5 (5)	
Substance Use Disorder	5 (5)	
Access / Financial	5 (5)	Lack of financial resources, uninsured
SUBTOTAL	71 (68)	
System / Facility Factor Level		
Continuity of Care / Care Coordination	8 (8)	Case coordination or management was lacking and may have helped, lack of continuity of care, no follow up with women's clinic
Access / Financial	5 (5)	Barriers to accessing care including transportation, provider shortage, and insurance
SUBTOTAL	22 (21)	
TOTAL	104 (100)	

Due to rounding, some totals may not correspond with the sum of the separate figures.

Among 17 reviewed pregnancy-associated, but not related deaths with **suicide** as the manner of death from 2008 through 2016, 53 contributing factors were identified by the review committee.

RECOMMENDATIONS

"MATERNAL DEATH IS SUCH A HORRIBLE EVENT. THANKFULLY RARE, IT MEANS FINDING A ROOT CAUSE CAN BE DIFFICULT. BY COMING TOGETHER AND RESEARCHING THE CAUSES ACROSS THE STATE, WE HOPE TO FIND TRENDS THAT CAN HELP A NEW MOTHER STAY ALIVE IN THE FUTURE SO THAT SHE CAN BE THERE TO RAISE HER CHILD."

— PAMR REVIEW COMMITTEE MEMBER

V. Recommendations

A. Recommendations Specific to the PAMR Program at the Ohio Department of Health

ODH intends to continue to support, expand, and sustain a vigorous PAMR process. State efforts will also continue to focus on enhancing data completeness through internal data quality and review processes:

1. Provide timely, accurate, and standardized information available about deaths to women during pregnancy and the year after the end of pregnancy, including opportunities for prevention,
2. Increase awareness of existence and recommendations of PAMR among the public, clinician and policy makers, and
3. Inform the development of data driven recommendations.

Recommendations for ODH include convening a Maternal Health Task Force, comprised of stakeholders representing individuals and from across the state in order to:

1. Identify Ohio-specific gaps and assist in the development of an Ohio-focused strategic plan informed by PAMR data,
2. Employ tools for effective implementation including prioritization of evidence-based interventions,
3. Manage the deployment of interventions through topic-specific Implementation Teams,
4. Identify additional areas of collaboration between ODH, state partners, and local entities, and
5. Identify and pursue funding opportunities to support implementation of recommendations.

B. Recommendations that Address Contributing Factors to Prevent Deaths

As part of the review of each death, the committee identifies recommendations (including strategies and action steps) that may address factors that contributed to the death. Those recommendations for prevention were grouped into themes and expanded upon by the committee. Below, each theme is described along with strategies and examples of how to implement the strategies. The strategies are further grouped according to the appropriate implementation vehicle: local or state.

Regarding the local strategies, ODH encourages local entities to operationalize these recommendations within the context of their own needs, resources, and capacity.

Preventability Theme	Strategies for Local Efforts	Strategies for ODH
Optimize the care of patients with chronic medical conditions **prior** to pregnancy	1. Counsel women with chronic diseases about pregnancy risks in the preconception and interconception period and early in pregnancy. *For example: Connect patients with primary care providers and medical sub-specialists to coordinate care and determine if telemedicine is an available option to facilitate care.* 2. Improve access to effective contraception for patients. *For example: (a) Partner with community initiatives to increase same day access to the full range of contraceptives to prevent unintended pregnancy and improve birth outcomes; (b) Educate patients about reproductive life planning and optimal birth spacing by promoting community outreach on this topic.* 3. Increase wellness visits, screening, prevention, and treatment for chronic conditions among women of reproductive age. *For example: Partner with primary care to improve screening and treatment for chronic conditions among reproductive aged women.*	1. Promote preconception health and prevention of chronic conditions during reproductive aged years. *For example: (a) Develop and disseminate public health messages via social media to reach women regarding the importance of wellness visits and the importance of identifying risk factors for chronic disease; and (b) Implement interconception care models that support women when they accompany their children to well-child visits, to enhance access to a health care provider especially for women who may not otherwise seek care.*

Preventability Theme	Strategies for Local Efforts	Strategies for ODH
Optimize the care of patients with chronic medical conditions **during** pregnancy	1. Minimize or remove barriers to health care access — including prenatal and sub-specialty care (e.g., financial, language, fear of deportation). *For example: (a) Engage medical sub-specialists and / or maternal fetal medicine specialists in the care of patients and determine if telemedicine is an available option to facilitate care; and (b)* Explore increased access to telehealth services through expanded reimbursement policies. 2. Improve care coordination during pregnancy and postpartum period, particularly during the "4th trimester". *For example: (a) Promote the increased use of case management for these patients; (b) Consider the use of healthcare navigators with particular attention on cultural issues.*	1. Support the implementation of maternal levels of care and the care of women with complex health needs at a facility with the ability to provide a higher level of care. *For example: (a) Present Ohio PAMR findings and recommendations to Ohio Maternal Newborn Advisory Council (MNAC) and maternity licensure at ODH, Ohio chapter of American College of Obstetricians and Gynecologists (ACOG), Ohio Hospital Association, Ohio Department of Medicaid and Managed Care Plans, and the Ohio Equity Institute; and (b) Implement CDC Levels of Care Assessment tool (LOCATe) to obtain a current snapshot of Ohio birth facilities' capacities, identify gaps, and assess the relationship between capabilities and outcomes.*

Preventability Theme	Strategies for Local Efforts	Strategies for ODH
Educate providers and patients on recognition, treatment, and prevention of obstetric complications including: 1. Hypertensive disorders 2. Cardiovascular conditions including cardiomyopathy 3. Sepsis 4. Postpartum hemorrhage 5. Thrombo-embolism	1. Encourage the use of known standards of care at the hospital / clinic level (e.g., ACOG). 2. Encourage the adoption of the corresponding patient safety bundles through the Patient Safety Council on Women's Healthcare, the Alliance for Innovation on Maternal Health [AIM], Association of Women's Health, Obstetric and Neonatal Nurses [AWHONN], and the California Maternal Quality Care Collaborative. *For example: All maternity units in the state should adopt specific (includes OR / Recovery Room / Postpartum / ED) management plan for each condition that includes:* *a. Readiness — Checklists, Drills, Huddles, and post event debriefings* *b Recognition of at-risk patients and institution of prevention strategies* *c. Escalation of care, if needed, and* *d. Monitoring of outcomes* 3. Ensure proper care coordination / case management to assist patient with access to resources. *For example: Ensure transition to primary care or medical sub-specialists is in place for patients during the postpartum period and beyond.* 4. Maternity units should partner with their emergency departments to ensure recognition and standardized management of common postpartum complications. 5. Ensure availability of uterotonic agents for emergency departments, particularly those without maternity services. 6. Partner with the OHA Sepsis Network for prevention and management strategies. 7. Consider use of the (AWHONN) patient discharge materials regarding warning signs in the postpartum period. *For example: Educate patients as to their clinical complication and how to monitor; use teach back method with patients to assure understanding prior to discharge.*	1. Partner with internal partners (e.g., maternity licensure) and external agencies (e.g., Ohio ACOG, Ohio Hospital Association, Ohio Department of Medicaid, etc.) to identify areas for support and collaboration on implementing listed local efforts. 2. Implement simulation training with emergency medicine providers for obstetric emergencies.

Preventability Theme	Strategies for Local Efforts	Strategies for ODH
Work to recognize disparities at both the personal and systems level (Howell 2018)	1. Provide staff education on peripartum racial and ethnic disparities and their root causes. *For example: Embed training on implicit bias in graduate medical education (Talati 2018) and / or within existing trainings at the unit, and /or hospital level to bring about awareness of personal behaviors that could impact health disparities.* 2. Health systems should consider establishing a mechanism for patients, families, and staff to report inequitable care and episodes of miscommunication or disrespect. This mechanism should include a plan to ensure a timely and tailored response to each report of inequity or disrespect.	1. Provide staff education on racial and ethnic disparities and their root causes. *For example: Conduct training on implicit bias for public health employees.* 2. Focus implementation of strategies aimed at addressing disparities on populations experiencing the greatest disparities. *For example: (a) Identify high-risk geographic areas within communities served by the hospital; (b) prioritize facilities that serve a high proportion of women from vulnerable populations when implementing strategies; and (c) develop a dashboard on women's health including year, race, ethnicity, payor source, and geography to monitor trends.*
Optimize vaccinations for pregnant women	1. Encourage the use of known standards of care to screen and treat influenza in pregnancy.	1. Increase the utilization of influenza vaccinations in pregnancy in Ohio. *For example: (a) Increase campaigning for universal flu vaccinations; (b) Monitor influenza vaccines in pregnant women.*
Work to increase fire safety in communities	1. Increase access to smoke detectors, fire extinguishers, and fire safety education. *For example: Partner with local fire departments to develop programs to provide / give away fire extinguishers / smoke detectors.* 2. Implement community education and outreach regarding fire safety education. *For example: (a) Include fire safety checks / education in Home Visiting Programs; (b) Encourage primary care / obstetric / pediatric providers to screen for working smoke detectors.* 3. Promote development of policies for landlords to have working alarms at the community level.	

Preventability Theme	Strategies for Local Efforts	Strategies for ODH
Build capacity for Emergency Medical Services (EMS)	1. Educate first responders and emergency medicine providers about ACOG algorithm for perimortem Cesarean section. 2. Increase the opportunities for CPR trainings to increase bystander intervention. 3. Disseminate information regarding "Seatbelt Safety" for pregnant women. 4. Develop policies for EMS transport whereby pregnant women are not taken to facilities without obstetric care capability.	1. Promote joint simulation training with maternity units, emergency departments, and local EMS for obstetric emergencies.
Optimize screening and dissemination of resources for pregnant and postpartum women at risk for sexual violence, intimate partner violence, and human trafficking	1. Standardize screening, documentation and referral for intimate partner violence. *For example: standardize the development of a safety plan once risks are identified.* 2. Ensure that medical professionals and first responders are trained regarding signs of these risks.	
Ensure mental health screening for all pregnant women and treatment for those with a positive screen	1. Optimize treatment for pregnant and postpartum women with mental health issues. 2. Ensure that anyone with mental health concerns (e.g., history of suicide attempt) have an evaluation during pregnancy, prior to discharge at any hospital admissions and the postpartum period. 3. Optimize case management for mental health particularly between the pregnant and postpartum periods. 4. Implement training on suicide risk assessment / depression screening.	1. Partner with ODH Injury Prevention and the Ohio Department of Mental Health and Addiction Services regarding development of resources for patients, families, and healthcare providers, including those for dual diagnosis (substance abuse / mental health) and promote dissemination of mental health resources at the local community level.

Preventability Theme	Strategies for Local Efforts	Strategies for ODH
Optimize the treatment of pregnant and postpartum women with substance abuse disorder, including alcohol	1. Promote the institution of more comprehensive resources and treatment programs for reproductive aged women who are drug and / or alcohol dependent. 2. Improve coordination of medical care and substance abuse / mental health treatment. 3. Offer prenatal and postpartum education about substance abuse to health care providers. *For example: Disseminate and implement the national AIM Opioid Use in Pregnancy Collaborative and disseminate materials.*	1. Partner with ODH, WIC, and the Ohio Department of Mental Health and Addiction Services regarding WIC's brief intervention model to evaluate alcohol use in pregnancy and making referrals. 2. Develop a statewide surveillance system of perinatal substance abuse. 3. Perform a environmental scan for care coordination and transition (from prenatal to postpartum) care in resource poor regions.
Improve identification of cause(s) of maternal deaths and underlying causes	1. Promote local level review of severe maternal morbidity cases.	1. Improve the rates of autopsy for maternal deaths. *For example: Engage the Ohio Coroners' Association in developing strategies.* 2. Improve data quality by implementing quality assurance system for conducting data checks for completeness and accuracy of data within PAMR's MMRIA system.

COUNTY-LEVEL DATA

"THE PROFESSIONAL COLLABORATION, ATTENTION TO DETAIL, AND SHARING LESSONS LEARNED TRULY HELPS TO ENHANCE THE PRACTICE OF OUR CAREGIVERS, WHICH HELPS TO IMPROVE OBSTETRIC PATIENT SAFETY AND QUALITY ACROSS OUR HOSPITAL SYSTEMS AND THROUGHOUT THE STATE."

— PAMR REVIEW COMMITTEE MEMBER

VI. County-Level Data

Table 20 displays the number of pregnancy-associated deaths (deaths that occurred during pregnancy or within one year after the end of pregnancy) for each county, along with the number of deaths that were determined to be pregnancy-related. Pregnancy-associated mortality ratios are displayed when there were at least ten deaths.

Table 20. Pregnancy-Associated Deaths and Pregnancy-Related Deaths, by Ohio County of Residence, 2008-2016

County of Residence	Pregnancy-Associated (Number)	Pregnancy-Associated Mortality Ratio (Deaths per 100,000 Live Births)	Pregnancy-Related (Number)
Adams	0	*	0
Allen	6	*	1
Ashland	2	*	1
Ashtabula	3	*	0
Athens	6	*	2
Auglaize	2	*	0
Belmont	1	*	0
Brown	3	*	0
Butler	24	57.5	6
Carroll	1	*	1
Champaign	1	*	1
Clark	13	**88.3	3
Clermont	7	*	3
Clinton	7	*	1
Columbiana	7	*	3
Coshocton	3	*	1
Crawford	0	*	0
Cuyahoga	65	47.7	24
Darke	5	*	3
Defiance	1	*	0
Delaware	9	*	8
Erie	2	*	0
Fairfield	7	*	2
Fayette	3	*	0
Franklin	68	40.8	27
Fulton	5	*	1

Table 20 (continued)

County of Residence	Pregnancy-Associated (Number)	Pregnancy-Associated Mortality Ratio (Deaths per 100,000 Live Births)	Pregnancy-Related (Number)
Gallia	0	*	0
Geauga	2	*	0
Greene	3	*	1
Guernsey	4	*	0
Hamilton	43	43.2	14
Hancock	2	*	1
Hardin	3	*	1
Harrison	0	*	0
Henry	0	*	0
Highland	5	*	1
Hocking	0	*	0
Holmes	2	*	1
Huron	3	*	0
Jackson	2	*	0
Jefferson	5	*	1
Knox	6	*	1
Lake	6	*	1
Lawrence	2	*	1
Licking	8	*	4
Logan	5	*	1
Lorain	16	**52.0	6
Lucas	24	46.2	8
Madison	1	*	0
Mahoning	17	**77.7	4
Marion	5	*	0
Medina	2	*	0
Meigs	2	*	0
Mercer	2	*	0
Miami	3	*	1
Monroe	1	*	0
Montgomery	48	78.7	12
Morgan	4	*	1
Morrow	2	*	2
Muskingum	8	*	4
Noble	0	*	0
Ottawa	0	*	0

Table 20 (continued)

County of Residence	Pregnancy-Associated (Number)	Pregnancy-Associated Mortality Ratio (Deaths per 100,000 Live Births)	Pregnancy-Related (Number)
Paulding	0	*	0
Perry	1	*	0
Pickaway	2	*	1
Pike	7	*	1
Portage	7	*	1
Preble	1	*	0
Putnam	3	*	0
Richland	3	*	2
Ross	7	*	0
Sandusky	3	*	0
Scioto	5	*	1
Seneca	3	*	0
Shelby	1	*	1
Stark	15	**39.6	5
Summit	29	52.4	8
Trumbull	15	**77.6	5
Tuscarawas	2	*	1
Union	0	*	0
Van Wert	0	*	0
Vinton	2	*	0
Warren	1	*	1
Washington	2	*	1
Wayne	6	*	2
Williams	3	*	1
Wood	4	*	1
Wyandot	1	*	0
Total Ohio***	610	48.2	186

** Ratios based on fewer than 10 deaths are considered unreliable and not reported.*
*** Ratios based on fewer than 20 deaths should be interpreted with caution.*
**** The total for Ohio includes 124 deaths where the last county of residence was unknown.*

Data interpretation example: *The row for Butler County means that 24 pregnancy-associated deaths occurred among Ohio women who lived in Butler County from 2008 through 2016. Considering the number of births that occurred in Butler County over those years, those 24 deaths represent a pregnancy-associated mortality ratio of 57.5 deaths per 100,000 live births over that period. The corresponding pregnancy-associated ratio for all of Ohio was 48.2. Six (6) of the 24 deaths were considered pregnancy-related. Because that number is fewer than ten it is not appropriate to calculate a PRMR.*

Four counties experienced at least ten deaths determined to be pregnancy-related and for which we calculated a nine-year pregnancy-related mortality ratio (deaths per 100,000 live births): Cuyahoga (17.6), Franklin (16.2), Hamilton (14.0), and Montgomery (19.7).

Table 21 displays pregnancy-associated and pregnancy-related deaths by ODH county type. Pregnancy-associated mortality was highest in Appalachian counties (PMR: 60.4). Pregnancy-related mortality was highest in metropolitan (PRMR: 16.0) closely followed by Appalachian (PRMR: 15.6) counties.

Table 21. Pregnancy-Associated Deaths and Pregnancy-Related Deaths, by County Type of Residence, Ohio 2008-2016

ODH County Type	Pregnancy-Associated (Number)	Pregnancy-Associated Mortality Ratio (Deaths per 100,000 Live Births)	Pregnancy-Related (Number)	Pregnancy-Related Mortality Ratio (Deaths per 100,000 Live Births)
Metropolitan	341	48.3	113	16.0
Suburban	74	39.0	24	12.7
Rural	71	43.4	17	*10.4
Appalachian	124	60.4	32	15.6
Total OHIO **	610	48.2	186	14.7

** Ratios based on fewer than 20 deaths should be interpreted with caution.*
*** The total for Ohio includes 124 deaths where the last county of residence was unknown.*

WHAT IS OHIO DOING TO ADDRESS MATERNAL MORTALITY?

"OHIO'S PAMR IS DEVELOPING AND PROVIDING EDUCATION AND TRAINING FOR HOSPITALS AND PRACTITIONERS AS A RESULT OF THEIR FINDINGS, AND I BELIEVE AS A COMMITTEE MEMBER THAT OUR WORK PLAYS A KEY ROLE IN HELPING TO IMPROVE MATERNAL MORTALITY IN OHIO."

— PAMR REVIEW COMMITTEE MEMBER

VII. What is Ohio Doing to Address Maternal Mortality?

Initiating and sustaining a robust maternal mortality review committee is the key to improving surveillance of maternal deaths by understanding trends, causes, contributing factors, and preventive steps for maternal mortality. When the Ohio PAMR began meeting in 2010, little guidance or resources existed to assist teams in how to conduct maternal case reviews. Although other state review teams were contacted and provided information about their own processes, gaps remained, and much time was spent in developing tools and protocols to expedite the process of review. Subsequently, national capacity has been built due to the guidance from CDC and the Association of Maternal Child Health Programs (AMCHP), among others. Ohio has both benefited from these activities and contributed to the development of national resources. Ohio has been an early adopter of strategies currently being advocated at the national level. In an example of paying things forward, Ohio has served as a resource for several states as they set up their own maternal mortality review committees.

Below, the collective work of PAMR to date is framed by the capacity of PAMR to do three important tasks as outlined in Metz (2018):

A. Collect data in a standardized fashion

B. Assess preventability of maternal deaths by consensus from experts on a multidisciplinary committee representing individuals from across the state

C. Create recommendations based on maternal death reviews

A. Collect Data in a Standardized Fashion

1. Identification of Maternal Deaths/Quality Improvement for Vital Statistics

Identification of maternal deaths and accurately counting maternal deaths is the first step of the review process.

a. Ohio was one of four states invited to participate in a quality improvement collaborative by the CDC designed to identify solutions for improving accuracy of the pregnancy checkbox on death certificates. Monthly, the ODH Bureau of Vital Statistics staff performed a linkage between 2016 death certificates for women who died with a positive maternal checkbox and any live birth certificate or fetal death certificate issued within 365 days of each woman's death.

   Women with a positive maternal checkbox should have a linkage and if so, would be a considered confirmed maternal death. If no linkage was identified, vital statistics staff queried local certifiers to either confirm (true positives) or disconfirm (false positives) pregnancy. If not confirmed, local certifiers were then asked to file an amended death certificate to correct any errors. Significantly more false negatives than false positives were identified. These certificates were successfully corrected.

   This on-going process leads to accurate state statistics for reporting maternal deaths to stakeholders and to national agencies and databases. From a PAMR standpoint, identification of false positives saves time for staff as they will not receive false positive records and spend unnecessary time requesting records for these cases. In addition, the pregnancy-associated death ratio and number of cases for review will be available at least a year earlier.

b. A second quality improvement project, centering on assessment of cause of death, looked at the level of agreement on cause of death between committee findings and death certificates from 2008-2011. PAMR data was the gold standard for comparison. PAMR-determined cause of death had 83.9 percent agreement with the death certificate cause of death. In addition, PAMR disqualified 103 (36.5 percent) of these cases as false positives and ascertained 55 additional cases, leading to a positive predictive value for pregnancy-associated deaths identified from death certificates of 63.5 percent and a sensitivity of 76.5 percent. While comprehensive review systems, such as PAMR, are considered the gold standard for surveillance of pregnancy-associated death, more rapid data for monitoring and response is needed. Additionally, improvements are needed in both certifier and physician reporting.

2. PAMR has established data use agreements with internal and external partners to share records and improve completeness of the data abstractions/case summaries:

a. **Medicaid Claims Data** – Prenatal and postpartum claims data are provided by Medicaid. Specifically, for women who are on Medicaid or another managed care plan, we receive the name of the provider, the date of the visit, and the diagnosis or procedure.

b. **ODH National Violent Death Reporting System** – Although many of the data collected for this system overlap with the records requested for PAMR (https://www.cdc.gov/violenceprevention/nvdrs/index.html), this internal ODH program provides PAMR with a narrative note regarding the circumstances of the death. This narrative often provides additional information beyond what is available in records requested for PAMR (e.g., medications prescribed to the patient).

c. **The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)** – The type of information shared includes (but is not limited to): annual income, household size, public assistance, smoking or alcohol use, and risk codes such as low iron, slow weight gain, limited diet, unhealthy diet habits, etc. Although much of this data is found in medical records, some of the data is different.

3. Data Management

One of the key needs of mortality review is the ability to analyze the data obtained. Ohio partnered with CDC in developing a national database for maternal deaths by serving as a beta testing site during 2014-2016, and sharing review tools and process.

a. The Maternal Mortality Review Information Application (MMRIA) provides a system for case abstraction and logging committee decisions as well as providing data in a format ready for analysis. The national system gives a common language for maternal mortality review committees like PAMR across the country, allowing for comparisons among states and aggregation of data. Following beta-testing from 2014-2016, Ohio fully adopted this system in 2017.

b. A module for pregnancy associated mortality has been added to Ohio's Public Health Information (Data) Warehouse (online resource for selected population health indicators) and is updated after every PAMR meeting. Not all variables elicited during the review process are entered here; only a select number. The idea is not to duplicate the function of MMRIA but to provide data for internal researchers and policy makers in a timely manner.

4. Improving the Review Process

At its heart, case review is a peer-driven process. The process has evolved and improved since its inception. Members gain better understanding of how to conduct a review with experience. The challenge is to achieve consistency in review from meeting to meeting. The following steps have been taken to improve and achieve consistency in reviews:

a. In 2017, the Ohio PAMR eliminated the two-year lag from occurrence to review to facilitate real time data availability. Two years of cases, 2015 and 2016, were reviewed during mid-2017 to mid-2018. Going forward cases will begin the abstraction and review process within six months of the availability of a death certificate from vital statistics.

b. Development of a member training webinar occurred in 2014 to orient new participants to the review process and review expectations.

c. Ohio PAMR, with guidance from CDC, has provided additional guidance for members to be more consistent when classifying overdose deaths.

B. Assess preventability of maternal deaths by consensus from experts on a multidisciplinary committee representing individuals from across the state

1. Composition of PAMR

Members of the Ohio PAMR are volunteers. Professional organizations representing relevant areas of expertise in Ohio were contacted and asked to provide representation. The board aims to include representation from Ohio's geographic regions, both urban and rural, and multidisciplinary expertise including, but not limited to:

- Anesthesiology (Cardiac/ICU/Obstetric)
- Emergency medicine
- Family medicine
- Forensic pathology
- Maternal-fetal medicine
- Obstetrics/gynecology
- Pediatrics
- Alcohol and substance abuse/addiction
- Coroner
- Child Fatality Review
- Epidemiology
- Legal services including risk management
- Mental Health
- Public Health, particularly maternal child health
- Home visiting
- Quality Improvement
- Legal services
- Midwifery
- Sexual violence, intimate partner violence, and human trafficking

It is best to have a large group of members, both for expertise and because a review should not be dependent on one person or a small group of people. The board started with a small core of individuals who recruited other members to provide specific expertise; this includes both medical expertise and social determinants of health. Given the varied nature of causes of death and risk factors, it is important to have several areas of expertise represented to effectively review all types of cases. Additionally, members represent stakeholder organizations to disseminate recommendations.

Maintaining member engagement is facilitated by using the data for improvements; tangible evidence of the work of the review may be discussed, disseminated, and used to develop interventions. The committee works best using consensus on major decisions and a ground up rather than top down organization. Also, it is important to meet team needs; be flexible and even creative in the timing and format of meetings. Most of the time, the members are volunteers who travel a distance to meetings and take the time from their jobs for this important work. We have used strategies such as convening extra meetings focused on similar types of deaths and utilizing subcommittees for data to action initiatives such as the simulation project.

2. **Determining Preventability**

Determining preventability is a critical role of PAMR (Building US Capacity, 2018). By determining preventability, potential opportunities and recommendations for prevention of future maternal deaths can be identified. However, preventability is challenging to determine due to the wide range of individual interpretations of the definition.

When PAMR began in 2010, the committee experienced tremendous difficulty in consistently reaching consensus, and for a short time, actually stopped determining preventability. Ultimately, after CDC provided guidance on defining preventability, PAMR resumed its determination. The definition from CDC is: a death is considered preventable if the committee determines that there was at least some chance of death being averted by one or more reasonable changes to the patient, community, provider, facility, and/or systems factors. The MMRIA data system allows committees to document a decision using two approaches (CDC, 9 state report):

a. Determining preventability as a “yes” or “no”, and/or

b. Determining the chance to alter outcomes using a scale that indicates “no chance”, “some chance”, or “good chance”.

Determining preventability is now a priority for PAMR in order to inform and prioritize potential actions.

C. Create recommendations based on maternal death reviews

1. Recommendations are included in this report on pages 42-49.

Additional Ohio PAMR Activities

1. **Data dissemination**
   There is a need to provide information obtained from the reviews to stakeholders around the state. Ohio PAMR developed an online presence with the addition of a webpage, housed on the ODH website. General information about state data, including topic-specific factsheets, may be obtained here. Two topic-specific fact sheets—Ohio Maternal Mortality and Ohio Severe Maternal Morbidity are available on the website. In addition, fact sheets as well as program tools may be found at the national website, www.reviewtoaction.org.

2. **Collaboration with ODH Maternity Licensure**
   In 2011, Ohio maternity licensure rules underwent major revisions for the first time since 1952. In those revisions, mandatory maternal death reporting began on January 1, 2012. The Ohio PAMR board assisted the ODH Office of Health Assurance and Licensing, Maternity Licensure by developing the reporting format. The information derived from mandatory reporting is helpful to PAMR in two ways. First, it serves as an additional mode of identification of maternal deaths. Second, the submitted information and records serve as another data source to inform the PAMR case summary. Effective October 1, 2019, Ohio's rules were again updated and include four new levels of obstetric care. In accordance with ACOG 2015 standards, these rules require delivery in a facility where a woman's antepartum and postpartum medical needs can be met.

3. **Severe Maternal Morbidity**
   Severe maternal morbidity (SMM) refers to physical and psychological conditions, related directly or indirectly to pregnancy, that negatively impact a woman's health (Callaghan 2008). Each individual condition is relatively rare, but collectively SMM occurs 100 times more frequently than maternal death (Callaghan 2012). Combined with mortality, SMM data inform the development of interventions to improve clinical care and prevent maternal morbidity and mortality. ODH obtains de-identified data on delivery hospitalizations from the Ohio Hospital Association to identify women with SMM and examine trends in the types of morbidities and risk factors. From these data, ODH analyzed SMM rates from 2008-2013 and shared findings in a fact sheet (Conrey 2019).

4. **Obstetric Simulation Training to Manage Obstetric Emergencies**
   PAMR conducted a needs assessment survey of all Ohio birthing facilities in 2014 to identify opportunities to reduce maternal mortality and morbidity and improve patient safety. Support for conducting simulation training was identified as a priority need among birthing facilities with Level I nurseries, which represent about 55 percent of Ohio facilities. In response, PAMR developed a simulation training program with simulation topics selected based on Ohio PAMR and severe maternal morbidity data. The goal was to improve maternity departments' readiness for common obstetric emergencies.

a. Part I targeted low-resource birthing centers, bringing the supplies and personnel needed for **Direct Training** using simulation to sites. It occurred during the Fall of 2014 and Spring of 2015 in collaboration with the Clinical Skills Education and Assessment Center at The Ohio State University with funding from Merck's Every Mother Initiative. Direct training was delivered at three host sites: St. Rita's Medical Center in Lima (Allen County); Union Hospital in Dover (Tuscarawas County); and Fairfield Medical Center in Lancaster (Fairfield County). The 122 participants were mainly obstetrical nurses and represented 14 different birthing facilities (nine from Level I nurseries and five from Level II special care nurseries). To evaluate the trainings, ODH surveyed participants before, immediately following, and one month after the training. Participants were found to have *increased overall knowledge of obstetric complications and improved self-efficacy and confidence for managing emergencies.*

b. Part II was a **Train-the-Trainer** course for nurse educators from Ohio Level I and Level II birthing facilities to provide local educators with the tools to independently and effectively train staff via simulation to respond to obstetric emergencies. The course was held twice during Fall 2015 at the Clinical Skills Education and Assessment Center at The Ohio State University and funded from Ohio's Title V Maternal and Child Health Block Grant. Didactic and skill-building sessions included managing three emergency scenarios: opiate overdose, hemorrhage, and hypertensive crisis (eclampsia). The 47 participants represented 43 facilities with Level I (78 percent) and Level II (22 percent) nurseries.

   To evaluate the trainings, ODH surveyed participants before, immediately following, and both 3- and 11-months following the courses. By 3-months post-training, 75 percent of participants had made changes in how simulation was performed at their facilities. By 11-months post-training the following was reported:

   - 80 percent conducted staff simulation exercises since training
     - vs. 60 percent pre-training
   - 67 percent increased simulation exercise frequency
     - 53 percent to quarterly and 20 percent to bi-annually
   - 47 percent started using simulator (model/task) trainer
   - On a scale of 1-10 with 10 being the highest, average self-rated confidence at conducting simulation-based training =7.37 (Range: 5-9)
   - 80 percent would attend an ***Advanced*** **Train the Trainer** course

c. Part III was delivered in 2017 and built on prior trainings with both didactic and skills-building. The multi-faceted program had three components: **Direct Trainings**, **Train-the-Trainer** courses, and a new **Advanced Train-the-Trainer** course. All were evaluated via participant surveys directly prior to and following the training. Participants in the **Direct** and **Train-the-Trainer** courses also completed a follow-up survey 9-12 months after the training.

   The **Direct Trainings** were offered on four different days and were intentionally located in two host sites within southeastern Ohio to address an underrepresentation of facilities in that region during Parts I and II. The target audience was delivery nurses and obstetric providers. The 64 participants primarily represented Level I facilities (80 percent), 91 percent were from southeast Ohio, and 48 percent had prior simulation training. At follow-up, 83 percent agreed they had *utilized at least one new skill since the training* and 43 percent had *shared resources with other staff.* Confidence levels for 11 obstetric emergency skills (e.g., placing a Bakri balloon) significantly increased pre- to post-training and remained higher at follow-up.

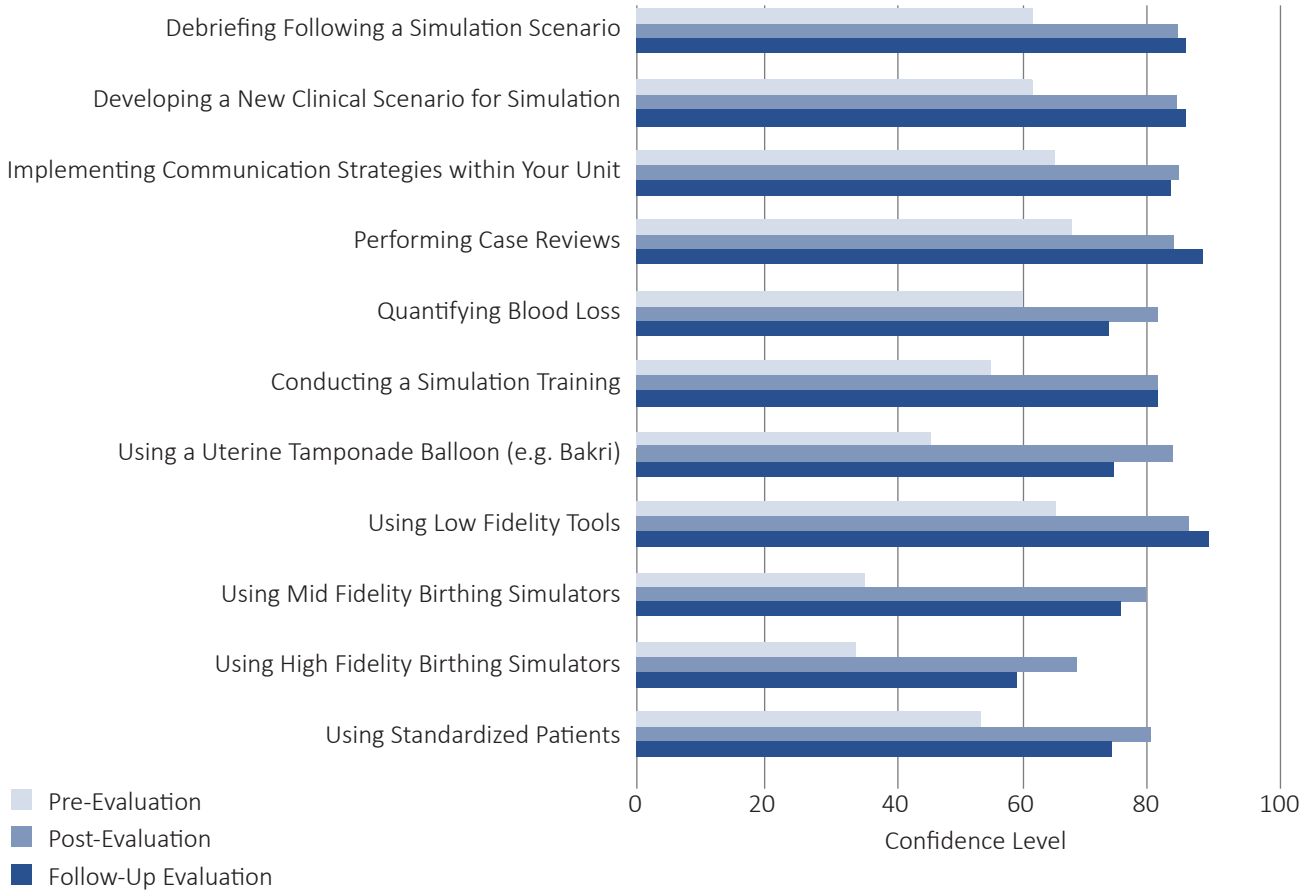
Table 22. Participants in Obstetric Simulation Part III Trainings, Ohio 2017

Participant Characteristics	Direct	Train-the-Trainer	Train-the-Trainer Advanced
Number	64	41	23
Level I Facility	80%	56%	52%
Southeast Ohio	91%	22%	26%
Post-training Evaluation Response Rate	67%	71%	--

Two **Train-the-Trainer** sessions were held at the Clinical Skills Education and Assessment Center at The Ohio State University. Obstetric nurse educators and managers learned to independently deliver simulation training to staff at their own facility. The simulated scenarios were obstetric hemorrhage, hypertensive emergency, and opiate overdose. Participants ran the training scenarios once each as a learner, debriefer, and facilitator. Of the 41 participants, 52 percent represented Level I facilities, 80 percent reported their facility staff participate in simulation, and 64 percent had previously facilitated simulation. Post-training, participants indicated the following intentions: *develop a more formal and scheduled simulation program, increase simulation participation within and across departments, increase the frequency of simulation exercises, integrate simulators into exercises, and improve communication skills.* Nine months post-training, the birthing facilities of 83 percent of participants had conducted a simulation exercise, 86 percent of participants had organized or planned a simulation exercise, 76 percent had conducted or led an exercise, and 69 percent had facilitated a briefing following a simulation. The frequency of simulation trainings increased for 63 percent. Confidence levels for 11 skills (e.g., implementing communication strategies) significantly increased pre- to post-training (Figure 28).

Participant Quote: *"I wanted to thank your team again for putting on [the training]. I have scheduled eight simulations over the next three months in our maternity department. I feel with your classes they have given me the tools to accomplish this successfully."*

Figure 13. 2017 Obstetric Simulation Train-the-Trainer Evaluation Results: Average Confidence with Simulation Tasks Before (Pre), Directly Following (Post), and Nine Months Post (Follow-up) Training, Ohio



Finally, two sessions of a newly developed **Advanced Train-the-Trainer** program were offered for individuals who had completed a prior **Train-the-Trainer** course. In addition to didactic and skills-building sessions, participants worked in small groups and focused on developing simulation scenarios for a clinical problem to increase their capability to independently use simulation to prepare their institutions for emergencies. Half of the 23 participants were from Level I facilities.

6. Patient Safety Webinar Series.

From August through September 2017, a series of five webinars on the management of perinatal emergencies was broadcast. The five webinar topics were identified through feedback from participants in the obstetric simulation trainings. Subject matter experts delivered the following webinars:

- Understanding and Treating the Bleeding Parturient: Strategies for Success
- Would the Real High-Risk Patient Please Stand Up?
- Improving Neonatal Care Through Simulation
- Shoulder Dystocia: Identification and Management
- Pilot to Co-Pilot: Strategies for Improved Communication on Labor and Delivery

The webinars are archived and available on ODH's PAMR website: https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/pregnancy-associated-mortality-review/resources/pamr-webinars.

CONTRIBUTORS AND ACKNOWLEDGEMENTS
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"THIS COMMITTEE IS ONE OF THE KEY WAYS THAT WE IN THE STATE OF OHIO CAN IMPROVE HEALTH FOR ALL OF OUR WOMEN AND MOTHERS."

— PAMR REVIEW COMMITTEE MEMBER

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APPENDICES

"THE OHIO PAMR TAKES A TRULY MULTIDISCIPLINARY APPROACH TO SOLVING PREGNANCY-ASSOCIATED MORTALITY IN OUR OWN COMMUNITY. I HOPE THAT BY SHARING OUR SUCCESSES AND LEARNING FROM OUR FAILURES, WE CAN END PREVENTABLE MATERNAL DEATHS IN OHIO." — PAMR REVIEW COMMITTEE MEMBER

A. Appendix: Glossary of Acronyms

ACOG American Congress of Obstetricians and Gynecologists

BMI Body Mass Index

CDC Centers for Disease Control and Prevention

ICD-9-CM International Statistical Classification of Diseases and Related Health Problems 9th Revision. This ninth edition is a publication from the World Health Organization comprising a set of codes that are used worldwide to classify diseases and injuries.

ICD-10-CM is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD), a medical classification list by the World Health Organization (WHO). The WHO copyrighted ICD-10 in 1990. Since then, countries around the world have adopted it to report mortality and morbidity. The United States began using it in 1999 to report mortality only. It codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases.

MMR Maternal mortality ratio

MMRC Maternal Mortality Review Committee

ODH Ohio Department of Health

PAMR Pregnancy-Associated Mortality Review led by the Ohio Department of Health

PRMR Pregnancy-related mortality ratio

PMSS Pregnancy mortality surveillance system

SHIP State Health Improvement Plan

B. Appendix: History of PAMR

The Ohio Pregnancy-Associated Mortality Review (PAMR) was established in 2010 to identify and review all pregnancy-associated deaths in Ohio with the goal of developing effective interventions to reduce maternal mortality. Prior to 2010, a maternal death review was operated by ODH and the Ohio State Medical Association in the late 1970s and early 1980s. The review ended due to shifting priorities and concerns about malpractice litigation and liability. In 2009, a variety of factors prompted medical and public health professionals to explore re-establishing a statewide PAMR: 1) increasing mortality rates nationally, and in other states, 2) awareness of unacceptable disparities in mortality, 3) reports of promising efforts to reduce maternal mortality in other states, 4) a desire to act, and 5) a negative publication on maternal mortality in the United States by Amnesty International[1]. The key barrier to creating a statewide PAMR was funding.

In 2010, ODH successfully competed for funding from the Agency for Healthcare Research and Quality (AHRQ) for a one-year patient safety planning grant to develop Ohio PAMR, which resulted in the program initiation. The grant required the development of the program and the review of one year of cases within that year, an ambitious goal which was achieved. Funding after the first year came from the Maternal and Child Health Block Grant through ODH. The initial review process framework was adapted from the CDC publication, Strategies to Reduce Pregnancy-Related Deaths, along with technical assistance from CDC's Division of Reproductive Health and states with fully functional PAMR systems[2]. The review process and forms were refined by PAMR staff and members over time, in collaboration with federal partners.

[1]Amnesty International. Deadly delivery: The maternal health care crisis in the USA. London: Amnesty International, 2010.

[2]Berg C, Danel I, Atrash H et al. (Editors). Strategies to reduce pregnancy-related deaths: from Identification and review to action. Atlanta: Centers for Disease Control and Prevention, 2001.

C. Appendix: Identification of Cases and Case Abstraction

Each year, PAMR cases are identified by the Ohio Department of Health, Bureau of Vital Statistics (VS), using the pregnancy checkbox on the death certificate, ICD-9-CM (prior to 2016) or ICD-10 obstetric cause of death codes, and linkage to live birth or fetal death certificates. Deaths must meet the following criteria to be reviewed:

- The death must be pregnancy-associated.
- The decedent must be an Ohio resident.
- The death must have occurred in Ohio.

Deaths are first identified by ODH vital statistics staff from the pregnancy checkbox on the death certificate and/or the use of diagnostic O-codes for the cause of death. Deaths from 2008 through 2015 were identified after a two-year lag, then beginning with 2016 deaths after only a one-year lag. For the first three years, this was the only way deaths were identified. In 2011, linkage was added, identifying about 15 to 20 additional deaths per year. This process was done retrospectively to identify any missed cases from 2008 through 2010 and has been routine since. Through the linkage, the woman's death certificate is matched to a corresponding live birth or fetal death certificate when applicable (fetal deaths are only registered in Ohio at or above 20 weeks gestation). For maternal death certificates that cannot be linked, further investigation occurs to confirm that the pregnancy checkbox on the death certificate was not erroneously marked. For cases where there is concern for a possible error, the certifier is contacted for confirmation. A full list of deaths is usually available to PAMR staff by the spring of the following year.

Relevant records are then requested, via a letter signed by a designee of the state Director of Health, and may include: primary health care provider records; prenatal care records; hospitalizations (labor and delivery and other); emergency medical services records; medical examiner files including autopsy, toxicology, and related investigative reports; social services and mental health records; fire marshal and law enforcement reports. In addition, Ohio PAMR has data sharing agreements with Ohio Medicaid, Ohio Child Fatality Review, the Women, Infants, and Children program (WIC), the Ohio Opiate Death Registry and the Ohio Violent Death Reporting System. Legal authority for data requests is provided by Ohio Revised Code 3701.14 (Special Duties of the Director of Health), which states that "reports of births and deaths shall be subjects of study by the director of health of the state of Ohio." Ohio passed the budget bill in July 2019 (effective October 17, 2019) that addressed maternal death review (HB166, Sec. 3738.03).

The legislation codifies the processes ODH had previously established for PAMR, including:

- Recommending and developing plans for implementing program changes and interventions,
- Preparing a biennial report with aggregate data, trends, patterns,
- Requesting records with additional authority and protections, and
- Providing immunity to any entity providing records to PAMR and to board members.

The preparatory work done before the review is laborious. There are many challenges in compiling a useful case summary for review. Records must be requested, sometimes more than once, and the time from request to reception is highly variable. It can be extremely difficult to locate sources of information. In particular, the source of prenatal care provision is not always clear. The delivering provider, as listed on the birth certificate, is not always the prenatal care provider. When pregnancies are only identified at autopsy and there is no birth or fetal death certificate, a delivering provider is not available at all, decreasing the chances of obtaining any prenatal care records. To overcome some of these challenges, an arrangement with Ohio

Medicaid was developed where ODH provides maternal names to Medicaid and in turn, Medicaid provides a list of providers who billed Medicaid for services for these women. In this way, many obstetric providers have been identified, allowing additional, pertinent records to be requested.

Records are abstracted by the PAMR Coordinator, a registered nurse, using a standardized form. Until 2018, the format of the case summary used was adapted by ODH from the Florida PAMR. Beginning in 2018, cases are abstracted directly into a CDC-supported data system (see appendix E). Each abstraction takes two to 10 hours, depending on the complexity of the case and record format (e.g., hand-written, electronic, hybrid of both). Deidentified case summaries are distributed to PAMR members before the meeting.

To respond to calls for more timely and actionable data, in 2017, a decision was made to decrease the time lag from the occurrence of a death and PAMR review of that death. During 2017-2018, deaths during both 2015 and 2016 were reviewed. Due to the number of cases for 2015 and 2016 combined, PAMR was unable to fully review all deaths.

Therefore, the following criteria (see Box 1) were instituted to determine which pregnancy-associated deaths would be fully abstracted and receive a full review.

Box 1. Criteria Used for Deaths That Occurred During 2015-2016 to Determine Which Deaths Would Receive Full Abstraction and PAMR Review

Review all
- Deaths determined by staff review to be potentially pregnancy-related
- Drug overdose deaths during pregnancy
- Suicide deaths during or within six months of the end of pregnancy
- Homicide deaths during pregnancy

Sampling of
- Motor vehicle accident deaths during pregnancy or within one year of pregnancy
- Non-pregnancy-related cancer deaths within one year of the end of pregnancy
- Homicide deaths within one year of the end of pregnancy
- Drug overdose deaths within one year of the end of pregnancy
- Non-pregnancy-related medical causes within one year of the end of pregnancy
- Suicide deaths more than six months after end of pregnancy

For deaths that occurred during 2015 or 2016 for which a full abstraction and review were not conducted, these limited data were abstracted into the data system by PAMR staff:

- PAMR ID
- Birth or Fetal Death Certificate information (e.g. race/ethnicity)
- Death Certificate Information (e.g. race/ethnicity)
- Pregnancy-related: yes/no
- Pregnancy: During, within 1-42 days, within 43 days – 1 year
- If during pregnancy, gestational age at time of death
- Insurance: private, government, Medicaid, unknown

D. Appendix: PAMR Case Review Process

Ohio's case review process was adapted from the CDC publication, Strategies to Reduce Pregnancy-Related Deaths (reference) and from the processes of other concurrently operating state maternal review boards. Ohio's process utilizes both peer review and individual expertise while promoting reviewer engagement. Each member of the PAMR committee receives all case summaries approximately one week before the meeting; however, each case is assigned a primary and secondary reviewer who have specialized expertise in the type of case assigned and review the case in detail.

The PAMR committee meets face-to-face approximately three times per year. Committee members are split into two teams and each team reviews a set of cases. The purpose is to maximize the number of cases reviewed per meeting and facilitate member engagement through smaller team size. During the review meeting, each team follows this format:

1. The primary reviewer reads the narrative from the case summary form, adds pertinent details from the abstraction, and reviews pertinent strengths and gaps in the records available (5 to 7 min)
2. The secondary reviewer provides additional comments, if applicable (2 to 3 min)
3. All team members engage in a discussion, asking questions and providing answers from their specialty or review of the case (5 min)
4. The primary reviewer puts forward an opinion on the following:
    - Determination as pregnancy-related or not
    - Assessment of case record completeness
    - Determination of manner of death and the underlying cause of death (agree with death certificate or propose alternate)
    - The underlying cause of death is then classified per CDC's Pregnancy Mortality Surveillance System codes (see Box 2)
    - Opportunity to alter outcome (i.e., preventability)
    - Determination of suitability as a potential teaching case
    - Identification of contributing factors at the provider, facility or system, and patient/family levels
    - Identification of factors, barriers, gaps, needs, and areas for improvement
5. All team members engage in group discussion and come to consensus
6. All team members contribute recommendations and action steps

A committee decision form is used to document the consensus of the committee in a standardized format for each case. To promote consistency in interpretation of associated factors between the groups, the form incorporates a data dictionary (adapted from the California PAMR). The form has been altered several times to meet the needs of the review. The original form was adapted from the Virginia review committee. In 2016, changes were made to add a health equity lens to the review. In 2017, ODH began using the CDC's Maternal Mortality Review Committee Decision Form.

Each PAMR meeting opens with an overview of the review process, a reminder of definitions and confidentiality statement, and presentation of any updates. Meetings include an invited presentation on a topic of relevance to the PAMR committee. These presentations occur over the lunch hour—the topics alternate between medical and social determinants of health. During each meeting, the committee reviews approximately 20 cases.

Box 2. CDC Pregnancy Mortality Surveillance Survey Underlying Cause of Death Codes

Note: cases may be coded or analyzed with two or three digits

10 Hemorrhage (excludes aneurysms or CVA) 10.1 Hemorrhage – rupture / laceration / intra-abdominal bleeding 10.2 Placental abruption 10.3 Placenta previa 10.4 Ruptured ectopic pregnancy 10.5 Hemorrhage – uterine atony / postpartum hemorrhage 10.6 Placenta acreta / increta / percreta 10.7 Hemorrhage due to retained placenta 10.8 Hemorrhage due to primary DIC 10.9 Other hemorrhage / NOS
20 Infection 20.0 Chorioamnionitis/antepartum infection 20.1 Postpartum genital tract (e.g., of the uterus / pelvis / perineum / necrotizing fasciitis) 20.2 Sepsis/septic shock 20.5 Non-pelvic infections (e.g., pneumonia, tb, meningitis, HIV) 20.6 Urinary tract infection 20.9 Other infections / NOS
30 Embolism- thrombotic (non-cerebral) 30.9 Other embolism / NOS
31 Embolism – amniotic fluid
40 Pre-eclampsia
50 Eclampsia
60 Chronic hypertension with superimposed pre / eclampsia
70 Anesthesia complications
80 Cardiomyopathy 80.1 Postpartum / peripartum cardiomyopathy 80.2 Hypertrophic cardiomyopathy 80.9 Other cardiomyopathy / NOS
82 Hematologic 82.1 Sickle cell anemia 82.9 Other hematologic conditions including thrombophilias/NOS
83 Collagen vascular / auto immune diseases 83.1 Systemic lupus erythematosis (SLE) 83.9 Other collagen vascular disease / NOS
85 Conditions unique to pregnancy (e.g., gestational diabetes, hyperemesis, liver disease of pregnancy
88 Injury 88.1 Intentional 88.2 Unintentional 88.9 Unknown/NOS

Box 2 (continued)

89 Cancer 89.1 Gestational trophoblastic disease (GTN) 89.3 Malignant melanoma 89.9 Other malignancies/NOS
90 Cardiovascular conditions 90.1 Coronary artery disease / myocardial infarction (MI) / atherosclerotic cardiovascular disease 90.2 Pulmonary hypertension 90.3 Valvular heart disease 90.4 Vascular aneurysm / dissection 90.5 Hypertensive cardiovascular disease 90.7 Conduction defects / arrhythmias 90.9 Other cardiovascular disease / NOS
91 Pulmonary conditions (excludes ARDS (Adult respiratory distress syndrome)) 91.1 Chronic lung disease 91.2 Cystic fibrosis 91.3 Asthma 91.9 Other pulmonary disease/NOS
92 Neurologic/neurovascular conditions (excluding CVAs) 92.1 Epilepsy / seizure disorder 92.9 Other neurologic diseases / NOS
93 Renal Disease 93.1 Chronic renal failure / End-stage renal disease (ESRD) 93.9 Other renal disease / NOS
95 Cerebrovascular accident (hemorrhage / thrombosis / aneurysm / malformation) not secondary to hypertensive disease
96 Metabolic/endocrine 96.1 Obesity 96.2 Diabetes mellitus 96.9 Other metabolic / endocrine disorders
97 Gastrointestinal disorders 97.1 Crohn's disease / ulcerative colitis 97.2 Liver disease / failure / transplant 97.9 Other gastrointestinal diseases / NOS
100 Mental health conditions 100.1 Depression / suicide 100.9 Other psychiatric conditions / NOS
999 Unknown COD

E. Appendix: Data Management

ODH enters and stores PAMR data in the Maternal Mortality Review Information Application (MMRIA). MMRIA, pronounced "Maria", is a standardized, custom data system developed by the Centers for Disease Control and Prevention (CDC) and the CDC Foundation. It is available to all state maternal mortality review committees, free of cost, with the goal of facilitating the development of nationally consistent language and data.

MMRIA is housed on a secure server and stores all case record data. Beginning in 2017, cases are abstracted directly into MMRIA, and committee review decision data is entered following committee review meetings. ODH works closely with CDC to implement enhancements to MMRIA as they become available. Cases reviewed prior to 2017 have retrospectively been entered into the MMRIA system for consistency.

F. Appendix: Data Analysis

Data were extracted from the MMRIA system and analyzed using SAS software, with the exception of tests for trends, which were conducted using Joinpoint software with $p<0.05$ used to determine significance. When percentages are presented, some totals may not equal 100 due to rounding.

The following variables were analyzed and used in this report to describe pregnancy-associated deaths.

Year. Year refers to the year of the woman's death

Age at Death. Using information from death certificates, age at death is captured as a continuous variable in the data set. For the purposes of analysis, we grouped age at death into six categories:

- Younger than 20 years,
- 20-24 years,
- 25-29 years,
- 30-34 years,
- 35-44 years, and
- 45 years and older.

Race and Ethnicity. Race and ethnicity were derived from the birth or fetal death certificate (or if unavailable, from the death certificate) where race and ethnicity are captured separately. Ethnicity is captured as Hispanic or non-Hispanic. For analysis, race and ethnicity were combined; available data did not support analysis beyond non-Hispanic black, non-Hispanic white, Hispanic, and Non-Hispanic of other races combined. Unknown ethnicity was combined with non-Hispanic and unknown or mixed race was combined with other races.

Education. Education refers to the woman's education status as documented on the death certificate.

Insurance status. When the decedent can be found in Ohio's Medicaid enrollment data base, Medicaid is always marked as the source of payment. Otherwise, insurance status is preferentially derived from the prenatal care record. In cases when the

prenatal care record is not available, the source of payment from the birth certificate or fetal death certificate is used. Women whose deaths occurred in 2015 or 2016 and did not undergo a full review and were not found in the Medicaid enrollment data base, do not have a recorded insurance status or source of pay. In the analysis, other includes Tricare.

Marital Status. From the death certificate. Re-categorized into currently married, or unmarried, for consistency with information from the birth certificate so that MMRs could be calculated.

County Type. From county of residence as reported on the death certificate. Based on the Centers for Medicaid and Medicare Services (CMS) designations, this report divides counties into large metro, metro, micro or rural county types. Based on ODH designations, this report also divides counties into Metropolitan, Suburban, Rural, and Appalachian types. Note that if a county is defined as Appalachian by the Appalachian Regional Commission, the county is put into that category regardless of whether it would otherwise qualify as rural, suburban, or metropolitan. The designations are as follows.

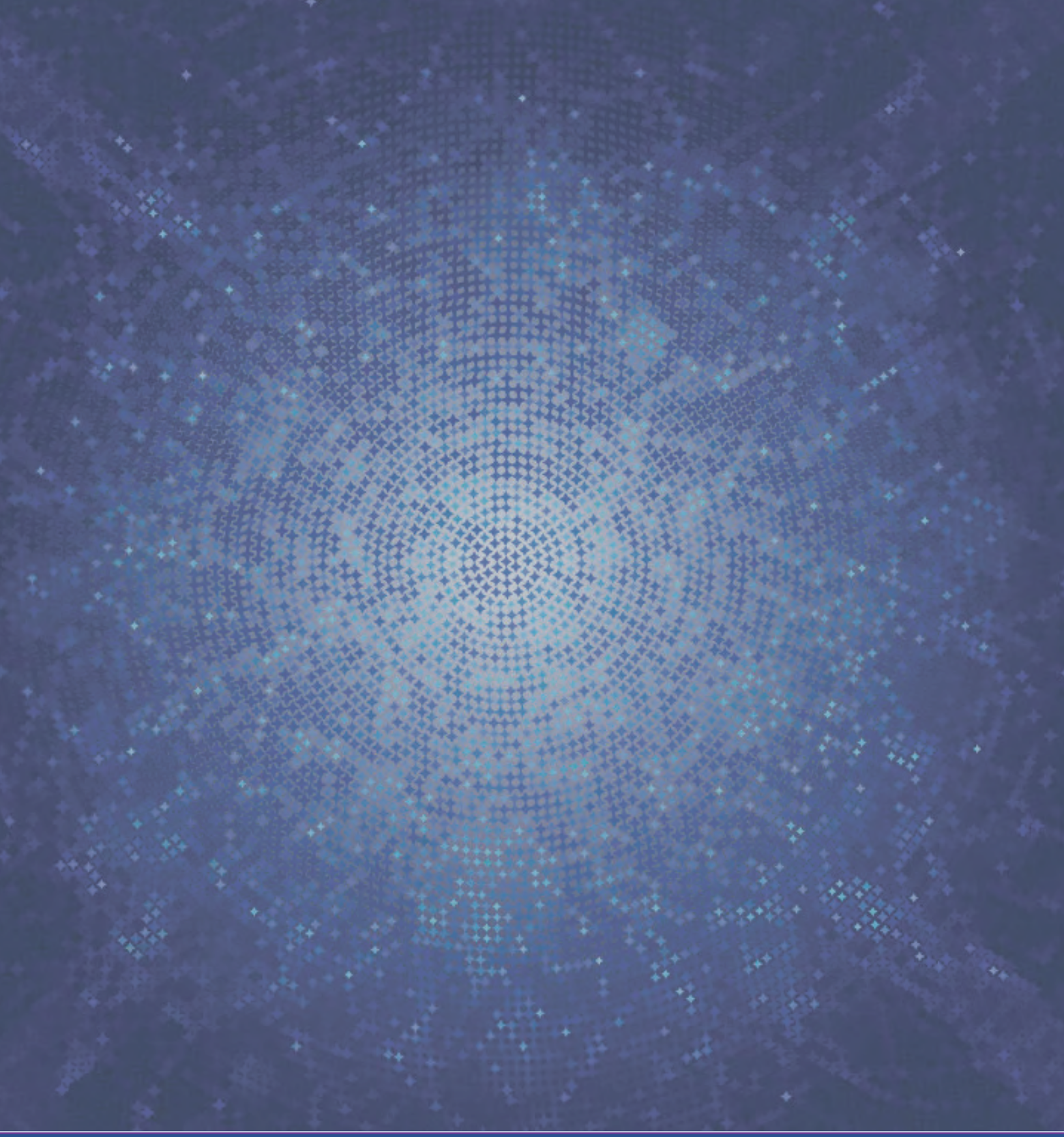
> Metropolitan counties include Allen, Butler, Cuyahoga, Franklin, Hamilton, Lorain, Lucas, Montgomery, Richland, Summit, and Stark.
>
> Appalachian counties include Adams, Ashtabula, Athens, Brown, Belmont, Carroll, Clermont, Columbiana, Coshocton, Gallia, Guernsey, Harrison, Highland, Hocking, Holmes, Jackson, Jefferson, Lawrence, Mahoning, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Ross, Scioto, Trumbull, Tuscarawas, Vinton, and Washington.
>
> Rural counties include Ashland, Champaign, Clinton, Crawford, Darke, Defiance, Erie, Fayette, Hancock, Hardin, Henry, Huron, Knox, Logan, Marion, Mercer, Morrow, Ottaway, Paulding, Preble, Putnam, Sandusky, Seneca, Shelby, Van Wert, Warren, Wayne, Williams, and Wyandot
>
> Suburban Counties include Auglaize, Clark, Delaware, Fairfield, Fulton, Geauga, Greene, Madison, Medina, Miami, Lake, Licking, Pickaway, Portage, Union, and Wood.

Timing of death in relation to pregnancy. When a death certificate links to a birth or fetal record, then the number of days between death and the end of pregnancy is calculated within MMRIA. When this information was missing or unknown, we used timing information on the death certificate checkbox. Following the groupings available on the checkbox, we grouped all deaths into the following categories:

- Pregnant at time of death, including deaths that occurred the day of delivery;
- Not pregnant, but pregnant within 42 days of death; and
- Not pregnant but pregnant 43 days to one year before death.

Cause of Death Groupings

Underlying cause of death is captured two ways by the PAMR committee. First, the committee documents the underlying cause of death using free text fields, including the immediate, underlying, and contributing causes. Second, the committee assigns a code using a system developed for the Centers for Disease Control and Prevention's Pregnancy Mortality Surveillance System (PMSS) as detailed in Box 2 in Appendix D. These codes represent a standard approach for classifying pregnancy-related deaths in a clinically meaningful way. For this report, the codes are regrouped as recommended in the 2018 "Report from Nine Maternal Mortality Review Committees." The one exception is that deaths coded with PMSS 88.9 (injury unknown) were categorized with unintentional injuries in the 2018 report but are categorized by themselves here as "injury unknown." Note that cardiomyopathy is a condition specific to the heart muscle and is separated from other cardiovascular and coronary conditions. The embolism category includes thromboembolism and unspecified embolisms, but excludes amniotic fluid embolism, which has its own category.



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