



# 2016-2020 Pregnancy-Related Maternal Mortality in Arizona Report

November 2025



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## Dedication

Dedicated to all who have been lost during pregnancy, delivery, or postpartum, this report stands as a testament of our commitment to understanding and preventing maternal mortality, and to improving maternal health for all Arizonans.

## Acknowledgments

The Arizona Department of Health Services (ADHS) would like to acknowledge Dr. Sarah Kellerhals and Kim Moore-Salas for their commitment and leadership as current co-chairs of the MMRC. ADHS would also like to acknowledge the 87 members of the Arizona Maternal Mortality Review Committee (MMRC) who completed the 100 case reviews included in this report. Despite evolving guidelines and processes, the focus and dedication of the MMRC has resulted in thorough case reviews and well-crafted recommendations to prevent future maternal morbidities and fatalities in Arizona. A full list of MMRC members can be found in [Appendix A](#). Lastly, the MMRC acknowledges the twenty-two Native Nations in Arizona who have stewarded this Land since time immemorial, and recognizes their People, culture, and history.

## Suggested Citation

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Patricia Tarango, MS, Bureau Chief, Bureau of Women's and Children's Health (*Former*)  
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## Intended Audience

This technical report analyzes the incidence and causes of maternal mortality in Arizona from 2016 to 2020. This report is intended primarily for those engaged in the care and advancement of maternal health, including healthcare providers, community-based organizations, researchers, policymakers, and other stakeholders. While the report is publicly accessible, it is not written for the general public. Individuals without a background in maternal health or clinical knowledge of pregnancy, labor, and delivery complications should use caution when interpreting these findings and recommendations.

## How to Use This Report

This report describes the incidence of maternal deaths in Arizona and highlights various risk factors contributing to these mortalities in Arizona. The key findings are intended to help with identifying future targets for intervention and support the development of effective, evidence-based strategies to reduce adverse maternal health outcomes.

## Disclaimers

### Use of the Term: Maternal Mortality

In this report, the term “Maternal Mortality” (MM) is used interchangeably with “pregnancy-related deaths” which may differ from other organizations, such as the World Health Organization. Please refer to the Glossary in [Appendix B](#) for more detailed definitions.

### Definition of Race

Racial and ethnic designations used in this report are based on information recorded on birth and death certificates as provided by ADHS’s Office of Vital Records. Race or ethnicity for maternal deaths was taken from maternal death certificates. If a woman identified as both Hispanic and any other race, she was classified as Hispanic. For data involving live births, the mother’s race or ethnicity was based on what was recorded on the live birth certificates. Racial and ethnic designations used in this report are White non-Hispanic, Hispanic, Black or African American, American Indian or Alaska Native (including Aleut and Eskimo), and Asian or Pacific Islander (including Hawaiian).

### Data Suppression

To protect confidentiality and ensure accurate reporting, ADHS suppresses numbers less than six but greater than 0. This applies to case numbers, ratios, and percentages. Case counts between six and 10 must be interpreted with caution due to the small sample size.

### Previous ADHS Reports on Maternal Mortality

The methods used to report findings on maternal mortality were derived from the [Review to Action](#) approach, adopted by ADHS in 2018. Three previous reports align with these methods: the [Maternal Mental Health- and Substance Use- Related Deaths in Arizona report \(2016-2018\)](#), the [Maternal Mortalities \(2016-2017\) and Severe Maternal Morbidity in Arizona report \(2016-2019\)](#), and the [Maternal Mortality in Arizona report \(2018-2019\)](#). The first [Arizona Maternal Mortality Review Program report \(2012-2015\)](#) was published before the Review to Action methods were adopted. Therefore, maternal mortality findings between 2016-2020 should not be compared to those reported for 2012-2015.

## **Arizona Health Status and Vital Statistics Annual Reports**

ADHS's Bureau of Public Health Statistics (BPHS) publishes the [Arizona Health Status and Vital Statistics Annual Reports](#), which include maternal and infant health outcomes. Data reported here may differ from previously published data based on additional descriptive context and data obtained during the maternal mortality review process. Population-level data for all Arizona births are available in the Arizona Health Status and Vital Statistics Annual Report.

## **Prevention Recommendations**

The prevention recommendations in this report were developed by the Maternal Mortality Review Committee (MMRC) and informed by a literature review conducted by the Maternal Mortality Review Program (MMRP). Thus, these recommendations do not necessarily reflect the official views of ADHS or the State of Arizona.

## **Publication Information**

Contact the Maternal Mortality Review Program at [maternalhealth@azdhs.gov](mailto:maternalhealth@azdhs.gov) or 602-354-1430 if you would like this report in an alternative format.

Permission to quote from or reproduce materials from this publication is granted when acknowledgment is made. This publication was supported by a Cooperative Agreement Number: 6 NU58DP007788-01-02 funded by the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention or the Arizona Department of Health Services.

## Letter from Committee Co-Chairs

Dear Colleagues, Partners, and Community Members,

It is with a deep sense of purpose and reflection that we present this year's annual report from the Maternal Mortality Review Committee (MMRC). Each year, we undertake the critical task of reviewing the tragic and often preventable deaths of women during pregnancy, childbirth, and the postpartum period. Behind every data point is a person, a family, and a community forever changed.

Over the past year, our committee has continued its work with unwavering commitment—identifying causes, contributing factors, and systemic challenges that lead to maternal deaths. We recognize that maternal mortality is not just a clinical issue, but a complex public health crisis influenced by community factors.

Our analysis revealed persistent themes: lack of access to quality care, gaps in postpartum follow-up, mental health and substance use concerns, and systemic barriers disproportionately affecting Black, Indigenous, and rural mothers. We are particularly troubled by the continuing racial and socioeconomic disparities in maternal outcomes, which call for urgent, coordinated, and culturally informed responses.

Despite these challenges, there is hope. We see encouraging signs of progress through increased collaboration across health systems, community organizations, and public health agencies. Several of our past recommendations have begun to take root—from expanded Medicaid coverage for postpartum care to enhanced provider training and community outreach programs.

Our goal remains clear: to ensure that every pregnancy is a safe, supported experience and that no life is lost to preventable causes. We are grateful to the families who allowed us to learn from their stories, to our committee members for their diligence and compassion, and to our partners who are helping us translate findings into action.

As we move forward, we renew our commitment to data-driven advocacy, evidence-based policies that promote optimal health, and a future where maternal health is a priority for all.

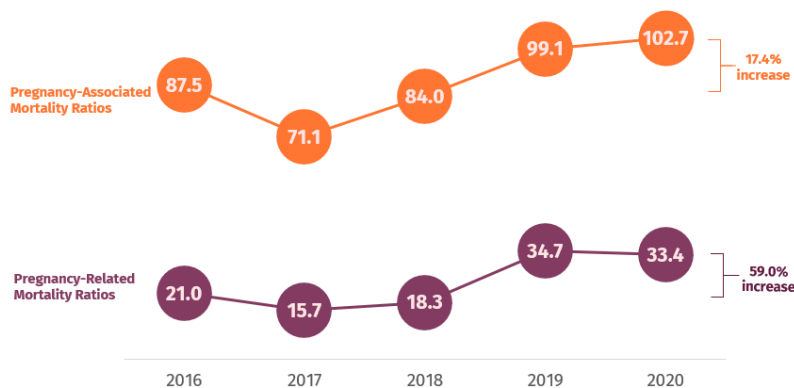
With respect and determination,

*Dr. Sarah Kellerhals*                      &                      *Kim Moore-Salas*

# Executive Summary

## Key Findings on Pregnancy-Related Mortality: 2016-2020

**Maternal Mortality (MM) Ratio:** Maternal mortality, as measured by the pregnancy-related and pregnancy-associated mortality ratios, increased from 2016 to 2020. The pregnancy-associated mortality ratio increased by 17.4% (87.5 to 102.7 maternal deaths per 100,000 live births), and the pregnancy-related mortality ratio increased by 59.0% (21.0 to 33.4 maternal deaths per 100,000 live births). See **Figure 3**.



**Figure 3.** Maternal Mortality in Arizona: 2016-2020 Mortality Ratios per 100,000 live births (15-49 years of age)

**Pregnancy Relatedness:** Between 2016 and 2020, out of the 363 pregnancy-associated deaths, 100 (27.5%) were determined to be pregnancy-related, 200 (55.1%) were pregnancy-associated but not related to the pregnancy, and in 63 cases (17.4%) the MMRC was unable to determine whether the death was pregnancy-related.

**Preventability and Timing of Death:** The MMRC determined that 85.0% of the 100 pregnancy-related deaths were preventable. Of these deaths, the majority occurred in the postpartum period (63.7%), with 37.4% occurring within 42 days of delivery and 26.3% between 43 and 365 days after delivery.

**Manner and Conditions of the Death:** Natural deaths accounted for the highest proportion of pregnancy-related deaths (59.6%), followed by suicides (17.2%), and accidents (16.2%).

**Underlying Cause of Death:** The most common underlying cause of pregnancy-related deaths was mental health conditions (29.0%), followed by other causes (18.0%), infection (16.0%), and hemorrhage (10.0%). Additional causes of death are listed in [Appendix F](#).

**Underlying Cause of Death by Race or ethnicity:** The primary underlying cause of death varied by race or ethnicity. Among American Indian or Alaska Native women and White women, mental health conditions were the most common underlying primary cause of death. For Black or African American women, cardiovascular conditions were the most common, while for Hispanic women, hemorrhage was the leading cause.

**Maternal Race or ethnicity:** American Indian or Alaska Native women had the highest Pregnancy-Related Mortality Ratio (PRMR) at 60.1 deaths per 100,000 live births, followed by

Black or African American women at 52.8 deaths per 100,000 live births. Asian or Pacific Islander women had the lowest PRMR of 18.5 deaths per 100,000 live births.

**Maternal Age:** Women aged between 35 to 44 years of age had the highest PRMR at 45.0 deaths per 100,000 live births, followed by women 25-34 years of age (21.4 deaths per 100,000). Case identification included women 10-60 years of age; however, no cases were identified between the ages of 10-14 years nor 50-60 years. Due to these findings, all calculations in this report were limited to women ages 15-49 years of age.

**Maternal Education:** Maternal health outcomes differed based on women's highest educational attainment. The highest PRMR was observed among those who completed High School or GED (31.5 deaths per 100,000 live births), followed by those who attended High School but did not receive a diploma (28.7 per 100,000). Those who attended some college but did not receive a degree had a PRMR of 22.5 per 100,000. The lowest PRMR was observed among those who attained a bachelor's degree or higher (20.4 per 100,000).

**Maternal Residence:** Women living in rural counties had a higher PRMR (30.4 deaths per 100,000 live births) than those living in urban counties (24.3 per 100,000). The highest PRMR was observed in Central Arizona (26.7 deaths per 100,000 live births), followed by Northern Arizona (25.3 deaths per 100,000 live births), and Southeastern Arizona (21.3 deaths per 100,000 live births).

**Payor:** The highest PRMR was observed among the Self-Pay group (34.6 deaths per 100,000 live births), followed by Medicaid (29.1 per 100,000). The group with the lowest PRMR was the Private Insurance group (16.7 deaths per 100,000 live births).

**Contributing Factors:** Mental health conditions were identified as contributing to the death in 39.0% of cases, followed by Substance Use Disorders (SUD) (33.0%), obesity (26.0%), and discrimination (37.1%).

## Top 5 Recommendations

From 2016 to 2020, the MMRC identified over 500 strategies to prevent maternal mortality. [Section 3](#) of this report provides a comprehensive list of these recommendations, organized by level of implementation (e.g., system, facility, provider). Below are abbreviated versions of the five most frequently recommended strategies across the 100 pregnancy-related deaths.

1. All Providers should improve prenatal and postpartum care by **following evidence-based guidelines/protocols and engaging with continuing education** to: identify, manage and treat perinatal conditions; respond to perinatal emergencies; deliver comprehensive, patient-centered and respectful care; prioritize timely follow-ups for at-risk individuals; conduct effective handoffs between providers; and expand access through alternative appointment options to ensure no gaps in care.
2. Ensure all facilities that serve pregnant women have adequate infrastructure, protocols, and procedures for addressing obstetric emergencies, including **prevention, readiness, recognition and response** as well as the expedition of coordination of care with multidisciplinary team of appropriate healthcare providers, which may include but is not limited to emergency department providers, obstetricians, mental health providers, and hospital unit professionals in oncology, urology, and anesthesiology.
3. The healthcare system, including facilities, **should improve continuity of care** for pregnant and postpartum women, especially those with complex needs by employing culturally congruent staff, integrating and training perinatal medical and behavioral health service providers with collaborating services that are well equipped, and offering flexible treatment options including harm reduction programs to meet patients where they are, as well as patient advocates to support shared decision making and discharge planning.
4. ADHS **should increase public awareness** about important pregnancy and postpartum topics (e.g. reproductive care, postpartum warning signs, perinatal mental health, etc.) by strengthening partnerships with community organizations and leveraging federal and foundation-based grants to provide culturally informed, evidence-based education and resources for professionals, families and communities to understand important information.
5. Healthcare, behavioral health, and correctional systems should adopt **trauma-informed, patient-centered care models** to reduce stigma around perinatal mental health and substance use disorders.

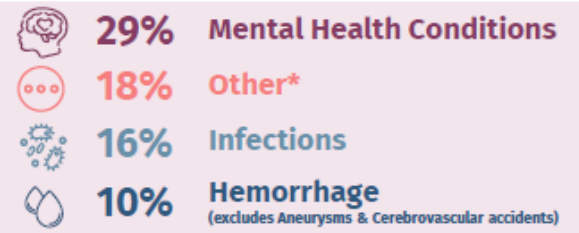
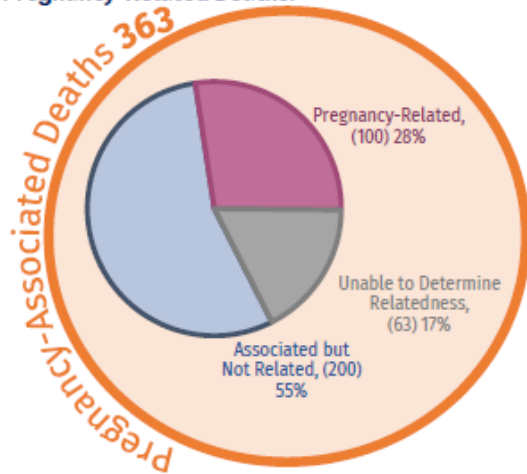
# Maternal Mortality in Arizona, 2016-2020



MMRC Reviewed Deaths in Arizona of Women 15-49 Years of Age with a Pregnancy in the Previous 365 Days

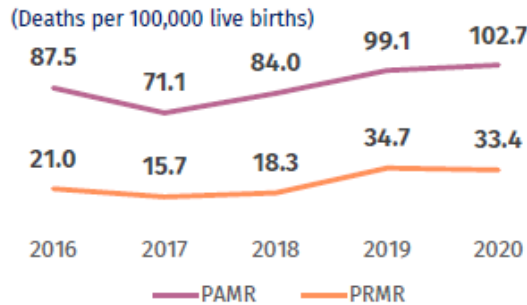
Almost three (3) out of every 10 deaths of women within 365 days of pregnancy were determined to be Pregnancy-Related Deaths.

The most common primary underlying cause of death among Pregnancy-Related cases was mental health conditions.



\*Includes Embolism - Thrombotic (Non-Cerebral), Cardiomyopathy, Metabolic/Endocrine, Neurologic/ Neurovascular Conditions (Excluding CVA), Collagen Vascular/ Autoimmune Diseases, Conditions Unique to Pregnancy, Hematologic Pulmonary Conditions (Excludes AIDS), Renal Diseases, and Unknown Cause of Death

The PRMR and PAMR in Arizona increased between 2016-2020.



\*Data includes maternal deaths ages 15-49 years.

**85%** of Pregnancy-Related deaths were considered **PREVENTABLE**

## Definitions

### Preventability:

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

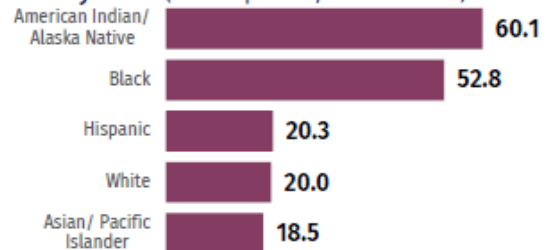
### Pregnancy-Associated:

The death of a woman during pregnancy or within one year of the end of pregnancy, regardless of the cause.

### Pregnancy-Associated Mortality Ratio (PAMR):

The number of pregnancy-associated deaths per 100,000 live births. It is a ratio, rather than a rate, because the denominator contains only live births and not all pregnant women who are at risk of maternal death.

American Indian/Alaska Native and Black women experienced the highest Pregnancy-Related Mortality Ratio. (Deaths per 100,000 live births)



(Misclassification bias may be present for cases &/or live births with multiple racial/ethnic identities. Please interpret data with caution.)

The Pregnancy-Related Mortality Ratio in the Central Region of Arizona was the highest in the state. (Deaths per 100,000 live births)



\*PRMR for Western Region is suppressed (count < 6)

### Pregnancy-Related:

The death of a woman during pregnancy or within one year of the end of pregnancy, from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy.

### Pregnancy-Related Mortality Ratio (PRMR):

The number of pregnancy-related deaths per 100,000 live births. It is a ratio, rather than a rate, because the denominator contains only live births and not all pregnant women who are at risk of maternal death.



For additional information, email [maternalhealth@azdhs.gov](mailto:maternalhealth@azdhs.gov)

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## Section 1: Overview of Maternal Mortality

Causes of MM extend beyond natural causes of death (e.g., hypertensive disorders, infections, cardiac conditions). Conditions related to maternal mental health (e.g., suicide), drug use (e.g., overdose), domestic violence (e.g., homicide), and other causes of death can also be related to and/or aggravated by pregnancy and can result in a maternal death. To this end, thorough and standardized case reviews conducted by the Arizona MMRC are critical in determining whether deaths among Arizona women within 365 days of pregnancy are pregnancy-related.

For the purposes of this report, Arizona uses an inclusive definition of **maternal mortality, which includes** any death that occurs during or within one year of pregnancy, regardless of the outcome, duration, or site of the pregnancy.

**Pregnancy-associated:** A death that occurs during or within one year of pregnancy, regardless of the cause. These deaths make up the universe of maternal mortality; within that universe are pregnancy-related deaths and pregnancy-associated, but not related deaths.<sup>1</sup>

**Pregnancy-related:** A death that occurs during or within one year of pregnancy, from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy.<sup>2</sup>

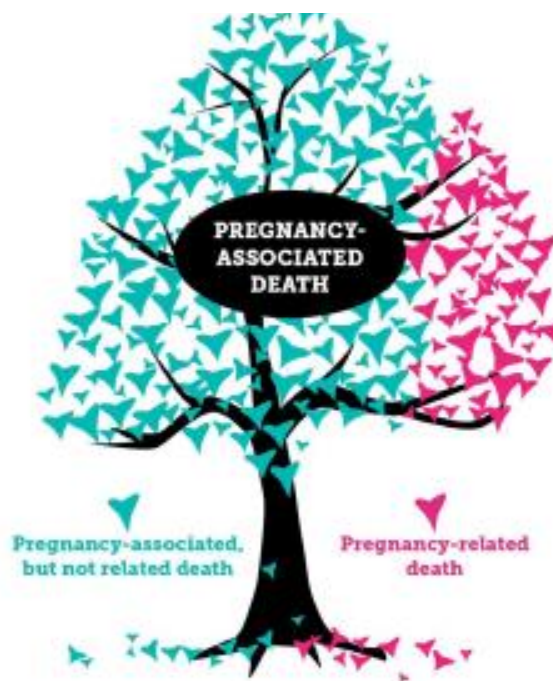
**Pregnancy-associated, but not related:** A death during or within one year of pregnancy, from a cause that is not related to pregnancy.<sup>2</sup>

**Figure 1** demonstrates that while all deaths (shown as leaves on the tree) occurring within one year of pregnancy are considered pregnancy-associated, only a smaller portion are pregnancy-related.

Maternal health outcomes occur on a broad spectrum, ranging from uncomplicated pregnancies to life-threatening events. Refer to pages 22-23 of the 2020 report on [Maternal Mortalities and Severe Maternal Morbidity in Arizona](#) for a more detailed explanation of maternal outcomes. In addition, pages 26-27 of the same report describe the many factors influencing maternal health outcomes before, during, and after pregnancy.

**Figure 1.** Pregnancy-Associated Deaths

Source: Centers for Disease Control and Prevention. "Pregnancy-Associated Deaths".



## Statewide Efforts to Improve Maternal Health Outcomes

ADHS is committed to improving the health and wellness of all Arizonans. As part of this commitment, ADHS released its [2025–2029 Strategic Map](#), which outlines statewide goals to advance health outcomes. Key priorities in maternal health include reducing the number of Health Professional Shortage Areas (HPSAs) by 10% and lowering both infant and pregnancy-related mortality rates to 5.2 infant deaths per 1,000 live births and 22.4 pregnancy-related deaths per 100,000 live births. These targets underscore Arizona’s dedication to addressing maternal health challenges and ensuring healthier outcomes for families across the state.

In 2019, ADHS’s [Maternal Mortality Review Program](#) (MMRP) was one of 24 states awarded the Preventing Maternal Deaths: Supporting Maternal Mortality Reviews Grant (also ERASE MM grant) from the CDC. In 2024, ADHS received renewed funding through a second 5-year award. The funding supports efforts to better understand and prevent pregnancy-related deaths by gathering detailed data on causes and circumstances of maternal deaths and developing recommendations for prevention. Additionally, the MMRP established an American Indian or Alaska Native (AI/AN) Subcommittee to conduct AI/AN specific case reviews ensuring appropriate representation, expertise, and dedicated time for deeper discussion to address maternal mortality disparities within this population.

In 2023, ADHS’s [Maternal Health Innovation Program](#) (MHIP) was also re-awarded funding through the US Department of Health and Human Services Health Resources and Services Administration's (HRSA) State Maternal Health Innovation Program. The program advances maternal health through strategic, data-driven initiatives to reduce disparities. With continued funding, Arizona will continue to strengthen its maternal health system by leading a statewide Maternal Health Task Force (MHTF), enhancing maternal health data infrastructure, and expanding targeted service delivery for pregnant and postpartum women. This grant also supports the implementation of the Alliance for Innovation on Maternal Health (AIM) patient safety bundles. The MHI will continue to support the Arizona Psychiatric Access Line (APAL), a provider support resource serving all of Arizona with 87% of Arizona counties already engaging. Over half of calls support AHCCCS or uninsured patients.

The [Maternal Health Task Force](#) (MHTF) is central to MHIP work, and guides implementation through subcommittees on Maternal Mental Health, Tribal Maternal Health, and the Arizona Alliance for Innovation on Maternal Health (AIM) Steering Committee. These groups meet regularly to identify system gaps, amplify individuals’ experience, and advance coordinated strategies using and following the newly developed Maternal Health Action Plan (2025) which outlines six priority areas: 1) Increase Awareness and Knowledge of Maternal Health and Well-Being; 2) Improve Access to Quality Care; 3) Support Workforce & Workforce Capacity; 4) Improve Collection, Analysis, and Application of Maternal Health Data; 5) Support Systems of Care; and 6) Foster Respectful Community Collaborations.

In synchronization with the MHTF, **The Perinatal and Infant Health Task Force** (PIHT) was founded in 2024 to address the growing needs of the perinatal period including maternal and infant health. This taskforce includes partners from state agencies, local governments, non-profit organizations, hospitals, medical clinics, women and child-serving organizations, and family advisors to address the goals outlined in the [Stillbirth and Infant Mortality Action Plan](#). The goals of the SIMAP are based on the top areas of fetal-infant mortality needs: 1) Reduce prematurity/preterm births; 2) Prevent birth defects; 3) Strengthen systems of care for mothers and infants; 4) Strengthen the workforce; 5) Improve surveillance of fetal-infant morbidities and deaths; and 6) Promote optimal fetal-infant health.

The [Arizona Alliance for Innovation on Maternal Health](#) (AIM) Collaborative in partnership with the Arizona Hospital and Healthcare Association (AzHHA) implements patient safety bundles. In 2026, the AIM Collaborative will focus on continuing the implementation of the Obstetric Hemorrhage bundle and will begin to introduce a new bundle on Perinatal Mental Health and Substance Use Disorders.

The [Pregnancy Risk Assessment Monitoring System](#) (PRAMS) is a joint research project between ADHS and the CDC to better understand mothers' experiences before, during, and after pregnancy. Each month, Arizona PRAMS surveys 1 in 30 new mothers in the state via mail and phone. The survey collects data on prenatal care, health insurance coverage, mental health and/or substance use during pregnancy, preconception and interconception care, and infant health. This data collection helps guide future ADHS efforts to improve maternal and infant health outcomes statewide.

The [High Risk Perinatal Program](#) (HRPP) is a comprehensive, statewide system of services dedicated to reducing maternal and infant mortality and morbidity strategies, including: early identification of women and children at high risk for mortality and morbidity; education for health professionals, families and communities; linkage of infants, toddlers and pregnant women to risk-appropriate services; and establishment of standards of care.

The [Arizona Health Start Program](#) is a statewide initiative that provides comprehensive support to pregnant women, new mothers, and their families, particularly those facing socioeconomic challenges or at risk of poor health outcomes. This program focuses on providing comprehensive services to improve maternal and infant health outcomes.

For more information about how ADHS is working to improve maternal health outcomes, visit <http://azdhs.gov/maternalhealth>.

## Section 2: Maternal Mortality in Arizona, 2016-2020

### Overview of the ADHS Maternal Mortality Review Program

#### Authorization

The A.R.S. 36-3501 was amended in April 2011 to establish the Arizona MMRC as a subcommittee of the Child Fatality Review (CFR) Program. Since its establishment in July 2011, the subcommittee convened by the Arizona Maternal Mortality Review Program (MMRP) has reviewed all identified maternal deaths in the state.

In 2025, Governor Katie Hobbs signed [Senate Bill 1316](#) into law. This legislation formally establishes the MMRP to coordinate and facilitate the review of pregnancy-associated deaths and to assess their incidence, causes and preventability through the MMRC. This bill also establishes committee appointments and mandates the submission of a biannual report due on May 15th of each even-numbered year. The full statute can be found in [Appendix C](#).

#### Structure & Committee Membership

The MMRP is implemented and coordinated by ADHS staff within the Bureau of Assessment and Evaluation (BAE). The team includes an office chief, a program manager, nurse abstractors, epidemiologists, and administrative staff. ADHS staff are responsible for identifying maternal mortalities, requesting records, developing case narratives, supporting MMRC case review meetings, and reporting maternal mortality data.

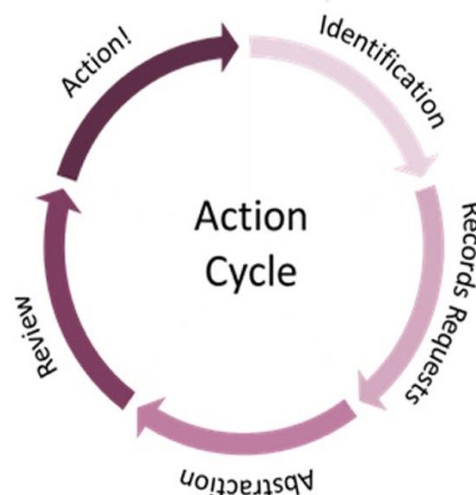
Currently, 67 external members have served on Arizona's MMRC (all volunteers), representing a range of clinical and nonclinical disciplines, including those who served within the past year. This membership includes obstetric providers (obstetricians, midwives, nurse practitioners, and maternal fetal medicine specialists); advocacy organizations; academic institutions; public health professionals and social workers; registered nurses; community-based organizations; health insurance providers; mental health and substance use treatment professionals; case managers, community health workers, home visitors, doulas, and other outreach personnel; domestic violence, sexual assault, and human trafficking specialists; lactation consultants; state, county, and tribal agency representatives; individuals with lived experience, tribal maternal health community advocates, and peer support specialists; forensic pathologists and toxicologists; and emergency medical services and law enforcement personnel. [Appendix A](#) shows the full list of MMRC members involved in case reviews and recommendations developed for this report.

## Methodology for Reviewing Maternal Deaths

### Review to Action

To maintain consistency in MM reviews, the Arizona MMRP applies the same methodologies to each review, from identification to the dissemination of findings, as demonstrated in **Figure 2**. This process, formerly referred to as Review to Action, is adapted from [Berg, CJ \(2012\)](#), and is used by the CDC and other ERASE-MM-funded states.<sup>4,5</sup> As shown in **Figure 2**, the Review to Action methodology is considered to be cyclical: as the number of cases reviewed using this protocol increases, so does the consistency and reliability of the data and resulting recommendations. Ultimately, this process presents a comprehensive overview of the risks and barriers faced by pregnant and postpartum women that can lead to maternal mortality, and highlights areas of opportunity to improve outcomes. For a full description and detailed flow chart of the Review to Action steps, please refer to the previous [Maternal Mortality and Morbidity in Arizona](#) report.

**Figure 2.** Review to Action



Source: Adapted from Berg, C.J. (2012). From identification and review to action—maternal mortality review in the United States. *Seminars in Perinatology*, 36(1), 7-13.

Though the primary components of the Review to Action methodology have remained consistent, some features evolved during the Arizona MMRP’s review of 2016-2020 deaths, resulting in a few instances of missing or incomplete data. Data completeness is indicated with the “n=” for each data metric. Missing data in this report was denoted using techniques used for maternal mortality reporting by the CDC. For additional details, please see [Appendix I](#) “Missing Data.”

### Analytical Methods

Mortality ratios were calculated by estimating the number of pregnancy-related deaths per 100,000 live births based on data from the Arizona Vital Records Office. Ratios were calculated for all pregnancy-associated deaths, for the subset of pregnancy-related deaths, and for select sociodemographic characteristics.

Case identification included all deaths among individuals aged 10-60; however, no deaths were identified outside the 15-49 years age range. Therefore, the mortality ratios and percentage distributions presented in this report are based on the population aged 15-49 (see [Appendix I](#) for details).

Percentage proportions were calculated to describe characteristics of maternal deaths, which were primarily identified by the MMRC. No statistical testing was performed.

Race or ethnicity were categorized using mutually exclusive groups, following the methodology established in the Arizona Health Status and Vital Statistics Annual Reports.<sup>6-10</sup> Additional methodological details can be found in [Appendix I](#).

## Findings for Maternal Deaths in Arizona, 2016-2020

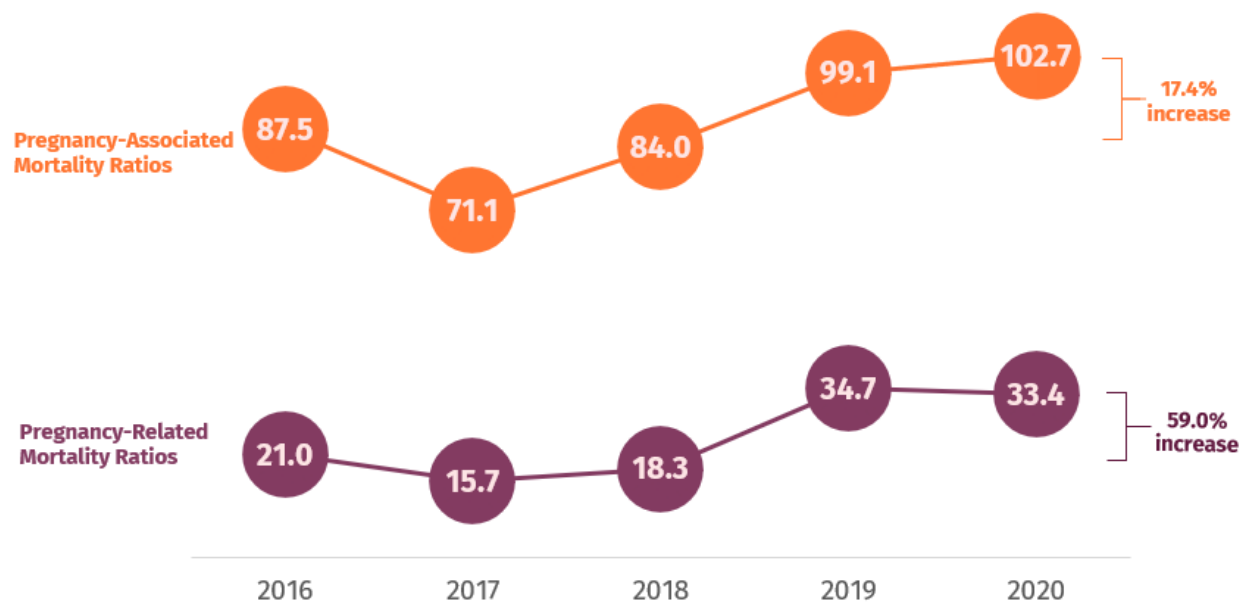
### Maternal Mortality by Year, 2016-2020

Pregnancy-associated mortality ratios (PAMR) for 2016-2020 can be seen in **Figure 3**. PAMR data for 2016 shows a ratio of 87.5 pregnancy-associated deaths per 100,000 live births, dropped slightly in 2017 to 71.1 per 100,000 live births, but overall increased to 102.7 per 100,000 live births in 2020. This resulted in a 17.4% increase in the PAMR over 5 years.

Pregnancy-related mortality ratio (PRMR) data for 2016 show that for every 100,000 live births, there were approximately 21.0 maternal deaths. We observed an overall slight increase in the PRMR in 2020, with approximately 33.4 maternal deaths per 100,000 live births, resulting in a 59.0% increase over five years.

The count of pregnancy-related deaths ranged from 13 deaths per year in 2017 to 28 deaths per year in 2019. For death counts for all years, please see [Appendix D](#).

**Figure 3.** Maternal Mortality in Arizona: 2016-2020 Mortality Ratios of Women 15-49 Years of Age (per 100,000 live births)



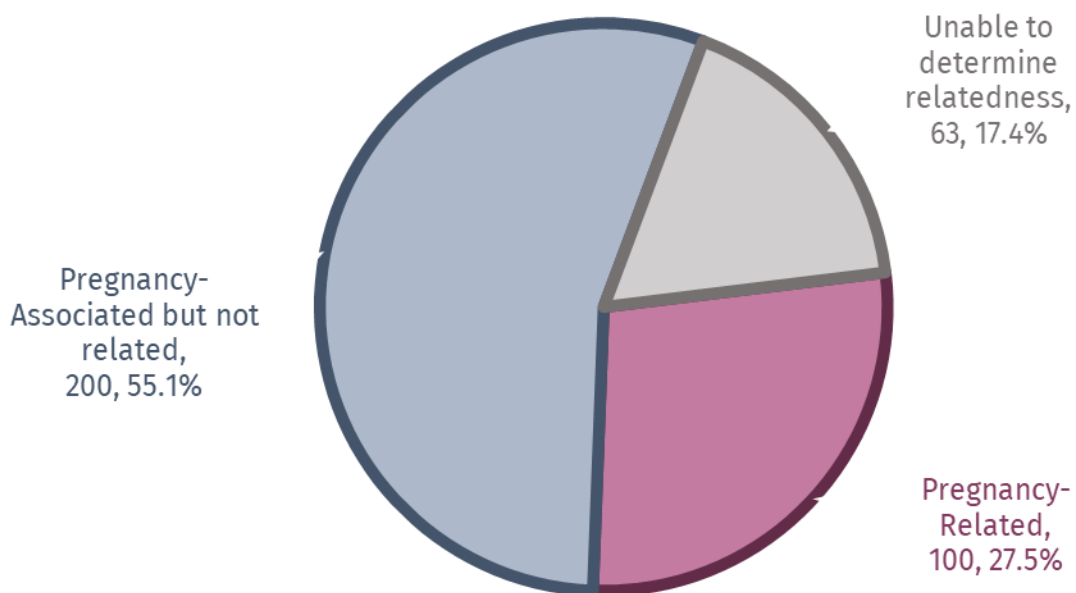
Disclaimer: In 2018, per CDC guidelines, the age criteria for pregnancy-associated and -related deaths expanded from 15-49 years to 10-60 years. Although the age inclusion criteria were expanded for the case identification of deaths occurring in 2018 onward, no deaths were identified outside of the 15-49 year age range. With these findings in mind, all calculations were limited to the 15-49 years of age range in this report. Regardless of the changes in maternal age inclusion criteria, an overall increase between these two time periods was seen when assessing annual ratios. A similar increase was observed in maternal deaths at the national level,<sup>11</sup> see [Appendix E](#) for more information.

## Maternal Mortality by Pregnancy Relatedness

From 2016-2020, there were 363 total maternal deaths, which are categorized as pregnancy-associated deaths. The majority of those deaths in this time frame were determined to be pregnancy-associated but not related to pregnancy (55.1%, n=200), or “deaths during pregnancy or within one year of the end of pregnancy from a cause that is not related to pregnancy” (**Figure 4**).

Of the 363 identified pregnancy-associated deaths, 100 (27.5%) were pregnancy-related deaths, or “a death during pregnancy or within one year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy.” These pregnancy-related deaths serve as the primary focus for the remainder of this report. Additionally, 63 (17.4%) were deaths where the MMRC was unable to determine the relatedness of pregnancy to the death.

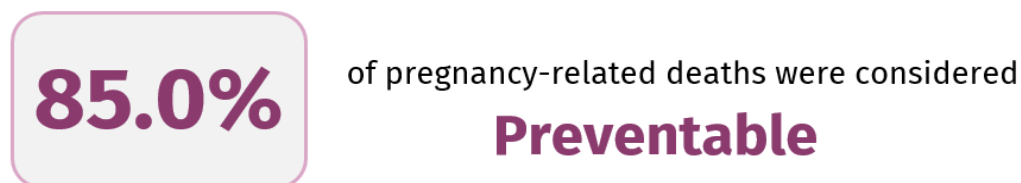
**Figure 4.** Pregnancy-Relatedness among 2016-2020 MMRC Reviewed Deaths (Percentage and Frequency), 2016-2020 Deaths in Arizona of Women 15-49 Years of Age with a Pregnancy in the Previous 365 Days (n=363)



## Maternal Mortality by Preventability and Timing of Death

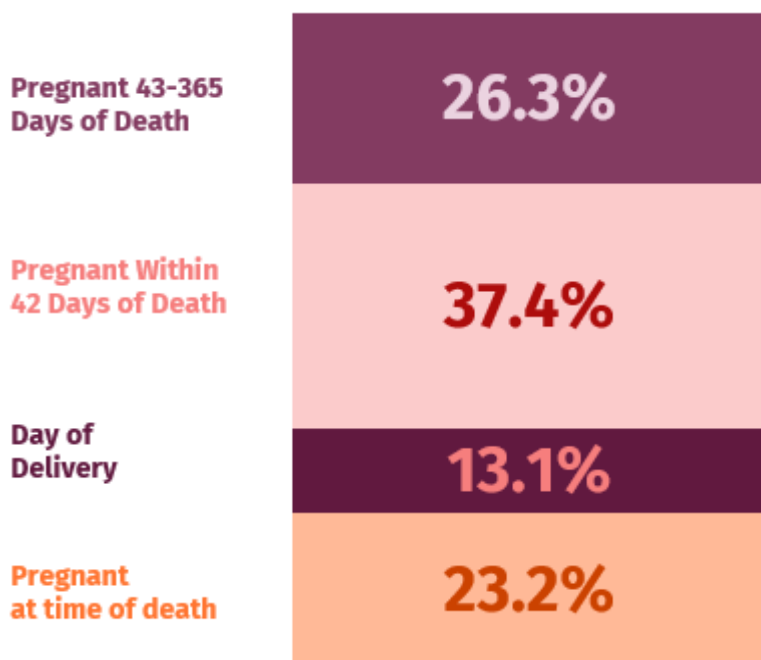
The MMRC determined that 85.0% (n=85) of pregnancy-related deaths were preventable (see **Figure 5**). The MMRC classified a death as preventable if it could have been avoided through one or more reasonable changes in patient care, family support, medical provider actions, facility standards, systemic processes, or community-level initiatives.

**Figure 5.** Preventability of Pregnancy-Related Deaths Among MMRC Reviewed Pregnancy-Associated Deaths in Arizona of Women 15-49 Years of Age (Percentage), 2016-2020 (n=100)



**Figure 6** illustrates the timing of pregnancy-related deaths from 2016 to 2020 relative to different phases of the pregnancy and postpartum period. Most pregnancy-related deaths occurred in the postpartum period (63.7%, n=63), with the majority (37.4%, n = 37) occurring within 42 days and 26.3% (n = 26) occurring between 43 and 365 days postpartum. Additionally, 23.2% of pregnancy-related deaths (n = 23) occurred during pregnancy, and 13.1% (n = 13) occurred on the day of delivery. Similar trends were observed at a national level.<sup>12</sup>

**Figure 6.** Timing of Pregnancy-Related Deaths Among MMRC Reviewed Pregnancy-Associated Deaths in Arizona of Women 15-49 Years of Age (Percentage), 2016-2020 (n=99)



The [Arizona Perinatal Trust](#) (APT) facilitates the Voluntary Certification Program (VCP), which assigns a certification level to participating facilities based on the services and level of care they provide to mothers and infants during and after labor and delivery. APT level designation is correlated with the facility's ability to serve high-risk patients. Of

the 13 deaths that occurred on the day of delivery, 46.2% occurred at a facility with an APT certification level of IIE or higher (**Figure 6A**). Deliveries at facilities with higher APT levels are more likely to be indicative of high-risk pregnancies or deliveries needing more intensive care services. For additional information on APT level designation criteria, please visit <https://azperinatal.org/certification/>.

**Figure 6A.** Arizona Perinatal Trust (APT) Level of the Birth Facility Among Pregnancy-Related Deaths in Arizona that Occurred on the Day of Delivery, 2016-2020 (n=13)

APT Level	Count	Percent
Non-APT	*	*
Lower than IIE	*	*
IIE or higher	6	46.2

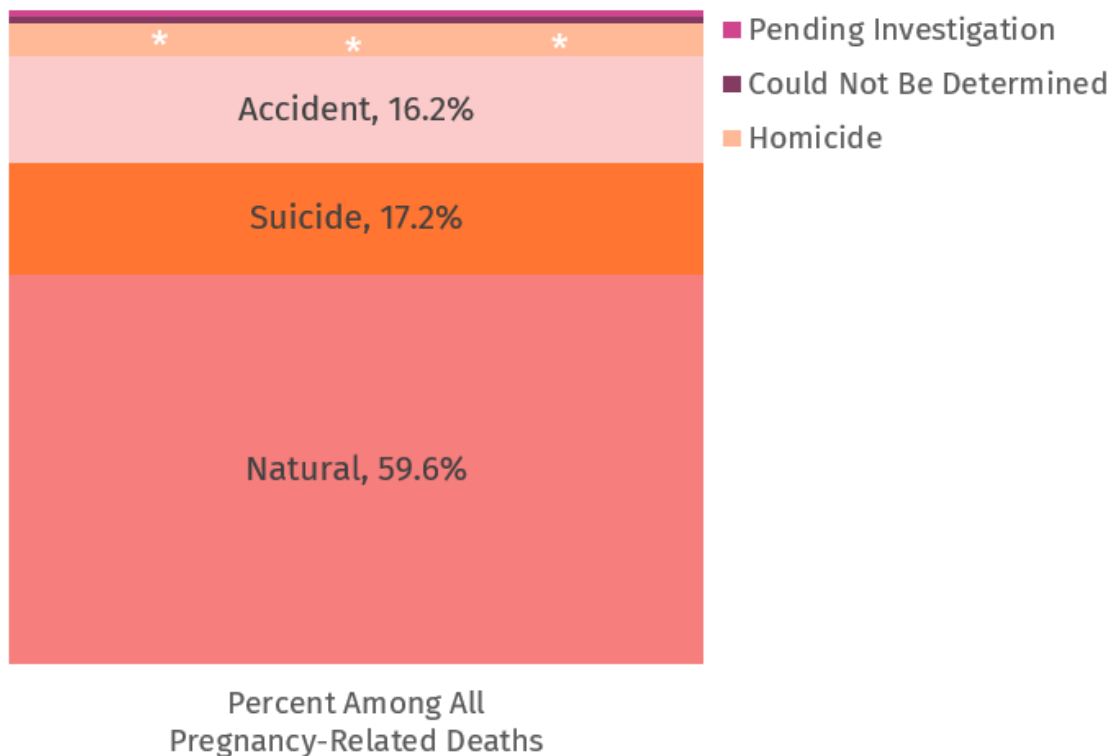
\*Cells with a case count less than 6 but greater than 0 have been suppressed. Cells with percentages that were calculated with a suppressed case count are also suppressed.

APT Level: The APT Level of the birth facility was used, except in the case(s) where a birth facility was unavailable, then the facility where the death occurred was used. APT Levels for each facility may change annually. For this analysis, the APT Level used was the level assigned to that facility for the year that the death occurred. For more information, please visit the [Arizona Perinatal Trust Website](#).

## Maternal Mortality by Manner and Conditions of the Death

Figure 7 shows the distribution of pregnancy-related deaths by manner of death, as recorded on the death certificate. From 2016 to 2020, natural deaths, such as those occurring in the course of nature and from natural causes (such as age or disease), accounted for 59.6% of pregnancy-related deaths. Suicide accounted for 17.2%, while accidental deaths—including unintentional injuries such as motor vehicle accidents and unintended drug overdoses—accounted for 16.2% of pregnancy-related deaths. Death counts for homicide, cases pending investigation, and deaths where causes were undetermined were suppressed due to small numbers (fewer than 6 cases).

**Figure 7.** Manner of Death for Pregnancy-Related Deaths of Women 15-49 Years of Age (Percentage), Based on Death Certificates, 2016-2020 (n=99)



\*Homicide, pending investigation, and could not be determined are suppressed due to counts less than 6

**Figure 8** shows the percentage of *MMRC-determined* pregnancy-related deaths by suicide and homicide. Between 2016 and 2020, 18.0% of pregnancy-related deaths were identified by the MMRC as suicide or probable suicide, which is nearly twice the national percentage of 9.3% as reported by the MMRC.<sup>12</sup> Pregnancy-related homicide data were suppressed due to low sample sizes (6 or fewer cases). Nationally, 3.0% of pregnancy-related deaths were homicide or probable homicide.<sup>12</sup> Among all pregnancy-related deaths that were either identified as suicide, probable suicide, homicide, or probable homicide, 43.5% indicated firearm use as the means of fatal injury (not shown).

**Figure 8.** Suicide and Homicide among Pregnancy-Related Deaths of Women 15-49 Years of Age (Percentage), Based on MMRC Decisions, 2016-2020 (n=100)



\*Homicide is suppressed due to count less than 6

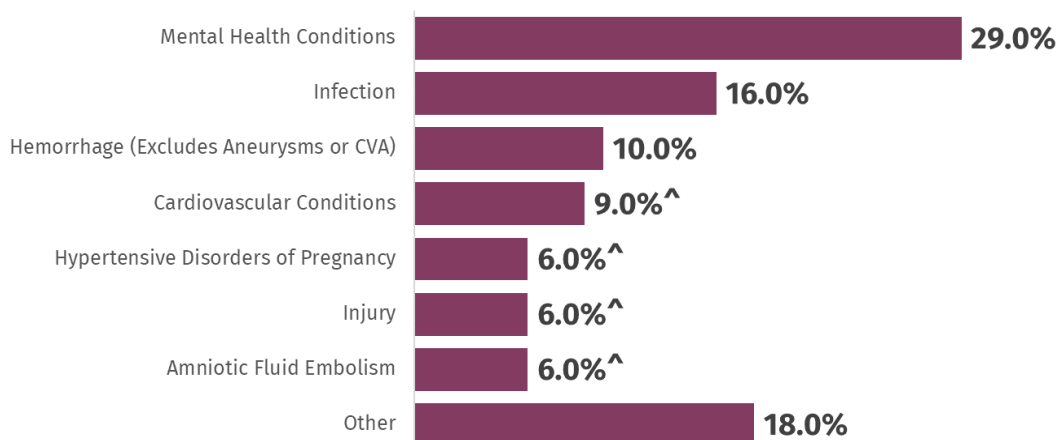
## Maternal Mortality by Primary Underlying Cause of Death

For pregnancy-related deaths, the MMRC assigned an underlying cause of death, or the disease or injury that initiated the chain of events leading to death or the circumstances of the accident or violence which produced the fatal injury. **Figure 9** shows pregnancy-related deaths by primary underlying cause.

The most common primary underlying cause of pregnancy-related deaths was mental health conditions (29.0%), followed by other causes (18.0%), infection (16.0%), and hemorrhage (10.0%). The remaining causes had one of the following conditions listed as the primary cause: cardiovascular conditions, injury, hypertensive disorders of pregnancy, and amniotic fluid embolism. Of the 29 cases that were identified to have mental health conditions as the primary underlying cause of death, 15 (51.7%) had substance use disorder indicated as either the primary or secondary underlying cause of death.

Similar trends were seen in a CDC analysis of MMRC data from 36 states, where mental health conditions were also the leading cause (22.7%), followed by hemorrhage (13.7%), cardiac and coronary conditions (12.8%), and infection (9.2%).<sup>12</sup> Notably, the Arizona percentage of deaths with infection as the primary underlying cause of death was 1.7 times higher than that of the national percentage of deaths due to infection. Of the 100 pregnancy-related deaths, 43 cases also had a secondary underlying cause of death. However, including the secondary underlying causes of death did not change the observed trends, so they are not discussed further in the report.

**Figure 9.** Underlying Primary Cause of Death among Pregnancy-Related Deaths of Women 15-49 Years of Age (Percentage), 2016-2020 (n=100)



Other: Embolism - Thrombotic (Non-Cerebral), Cardiomyopathy, Metabolic/Endocrine, Neurologic/ Neurovascular Conditions (Excluding CVA), Collagen Vascular/ Autoimmune Diseases, Conditions Unique to Pregnancy, Hematologic Pulmonary Conditions (Excludes ARDS), Renal Diseases, and Unknown COD

^ Percentage is based on a case count greater than or equal to 6 but less than 10, therefore should be interpreted with caution.

### Maternal Mortality by Primary Underlying Cause of Death by Race or Ethnicity

**Figure 10** shows the primary underlying cause of pregnancy-related deaths by race or ethnicity. For the 14 deaths among American Indian or Alaska Native women, mental health conditions were the most common underlying primary cause of death. For the 112 deaths among Black or African American women, the leading cause was cardiovascular conditions, and for the 34 Hispanic women, it was hemorrhage. Among the 36 White, Non-Hispanic women, the most common cause was mental health conditions. Due to small numbers (six or fewer deaths), data for Asian or Pacific Islander women were suppressed.

National data reflect similar trends for some groups.<sup>12</sup> Nationally, mental health conditions were the leading primary underlying cause of death among White non-Hispanic women (34.8%), while cardiac and coronary conditions (15.9%) were the leading cause for Black or African American women. However, national data showed that mental health conditions (24.1%) were the leading cause of death for Hispanic women, followed by hemorrhage (21.3%). Among Asian women nationally, the leading causes were hemorrhage (31.3%), cardiac and coronary conditions (21.9%), and amniotic fluid embolism (21.9%). National data for American Indian or Alaska Native women were not reported due to small sample sizes.

**Figure 10.** Primary Underlying Cause of Death among Pregnancy-Related Deaths of Women 15-49 Years of Age by Race or Ethnicity, 2016-2020 (n=100)

<b>American Indian or Alaska Native</b>	<b>Mental Health Conditions</b>
<b>Asian or Pacific Islander</b>	*
<b>Black or African American</b>	<b>Cardiovascular Conditions</b>
<b>Hispanic</b>	<b>Hemorrhage</b>
<b>White Non-Hispanic</b>	<b>Mental Health Conditions</b>

\*Asian or Pacific Islander is suppressed due to count less than 6

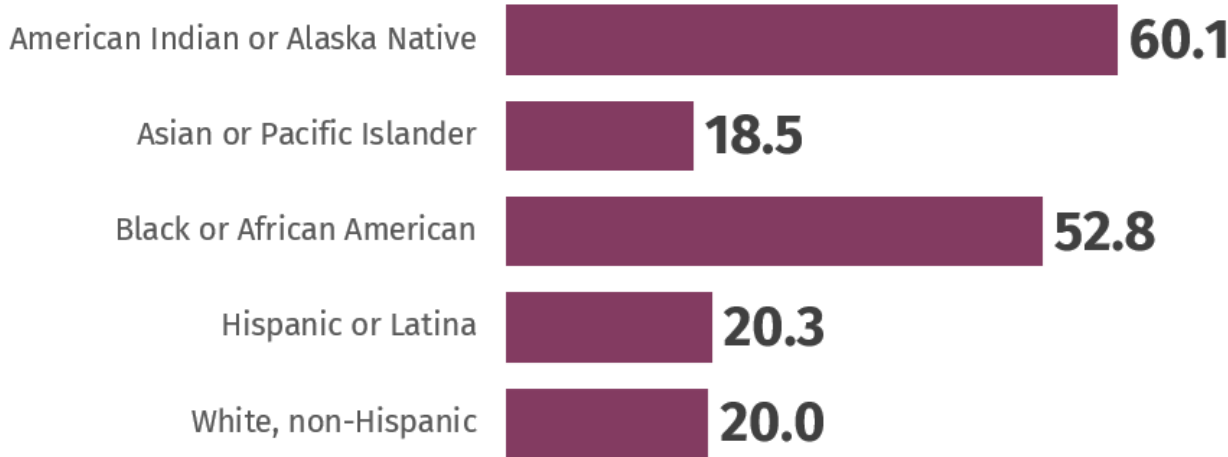
### Maternal Mortality by Maternal Race or Ethnicity

**Figure 11** shows mortality ratios for pregnancy-related deaths by maternal race or ethnicity. The highest PRMR was observed among American Indian or Alaska Native women (60.1 deaths per 100,000 live births), which was about 3 times higher than the PRMR among White, non-

Hispanic women (20.0 per 100,000 live births). Black or African American women had the next highest PRMR (52.8 per 100,000 live births), which was more than 2.5 times the PRMR for White, non-Hispanic women. Hispanic or Latina women had a similar PRMR to White, non-Hispanic women (20.3 vs. 20.0 per 100,000). The lowest PRMR was observed among Asian or Pacific Islander women (18.5 per 100,000 live births).

At the national level, rates among Black or African American and American Indian or Alaska Native women are also higher, although it is difficult to cross-compare because of differences in racial/ethnic makeup, how racial/ethnic data are grouped together, and overall data availability for that time period.<sup>13</sup>

**Figure 11.** Pregnancy-Related Mortality Ratios by Race or ethnicity Among Arizona Women 15-49 Years of Age (per 100,000 live births), 2016-2020 (n=99)

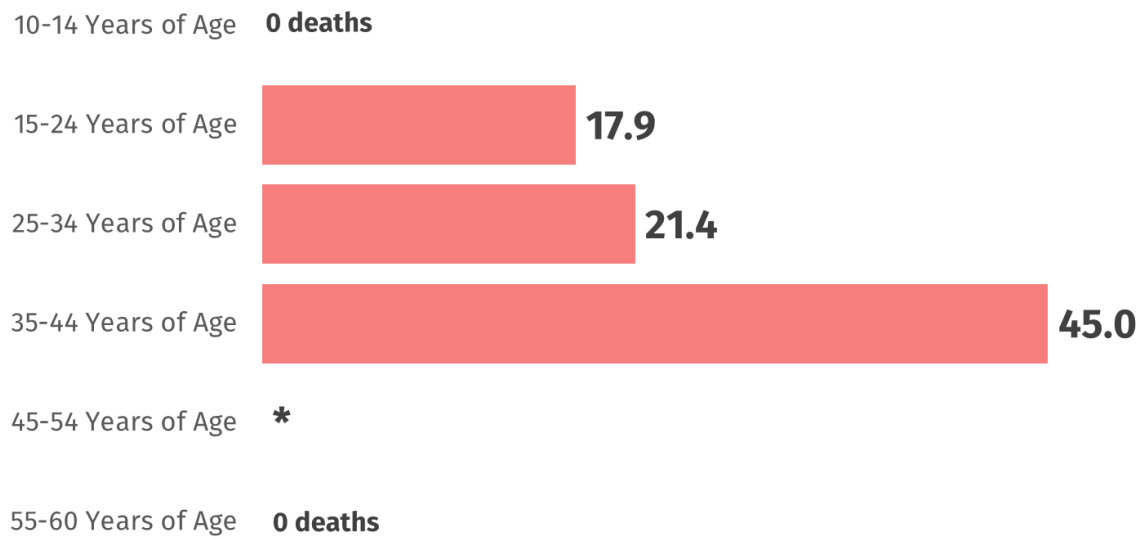


**Maternal Mortality by Age**

Generally, the risk for maternal mortality increases with advanced maternal age, which is typically identified as 35 years of age and above.<sup>14</sup> **Figure 12** shows mortality ratios for pregnancy-related deaths by maternal age in Arizona. Although case identification included women aged 10-60, no cases were identified between the ages of 10-14 or 50-60 years. Thus, all pregnancy-related calculations in this report are limited to women aged 15-49.

Between 2016 and 2020, the highest PRMR was observed among women aged 35-44 years (45.0 deaths per 100,000 live births), followed by women aged 25-34 (21.4 per 100,000 live births), and those aged 15-24 years old (17.9 per 100,000 live births). No pregnancy related deaths occurred among women aged 10-14 or 50-60 during this period. Case counts for pregnancy-related deaths were suppressed for women aged 45-54 due to low sample size (fewer than 6).

**Figure 12.** Pregnancy-Related Mortality Ratios by Age Among Arizona Women 15-49 Years of Age (per 100,000 live births), 2016-2020 (n=100)



\*45-54 Years of Age is suppressed due to count less than 6

## Maternal Mortality by Maternal Education

The highest PRMR was observed among women who completed high school or earned a GED (31.5 deaths per 100,000 live births), followed by those who attended high school but did not receive a diploma (28.7 per 100,000), and those who attended some college but did not receive a degree (22.5 per 100,000). The lowest PRMR was observed in women with a bachelor's degree or higher (20.4 per 100,000). Mortality ratios for women with an 8<sup>th</sup>-grade education or less, as well as those with an associate's degree, were suppressed due to small sample sizes (fewer than 6 cases). Mortality ratios for pregnancy-related deaths by the woman's highest educational attainment can be seen in **Figure 13**.

**Figure 13.** Pregnancy-Related Mortality Ratios Among Arizona Women 15-49 Years of Age by Education (per 100,000 live births), 2016-2020 (n=100)



\*Mortality ratios for 8th Grade or Less and Associate's Degree are suppressed due to counts less than 6

## Maternal Mortality by Maternal Residence

Women living in rural counties had a higher PRMR (30.4 deaths per 100,000 live births) than those living in urban counties (24.3 per 100,000). Mortality ratios for pregnancy-related deaths by the county type of residence (urban vs. rural) can be seen in **Figure 14**.

**Figure 14.** Pregnancy-Related Mortality Ratios Among Arizona Women 15-49 Years of Age by County Type of Residence (per 100,000 live births), 2016-2020 (n=100)



Rural: Residing in Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Santa Cruz, or Yavapai Counties

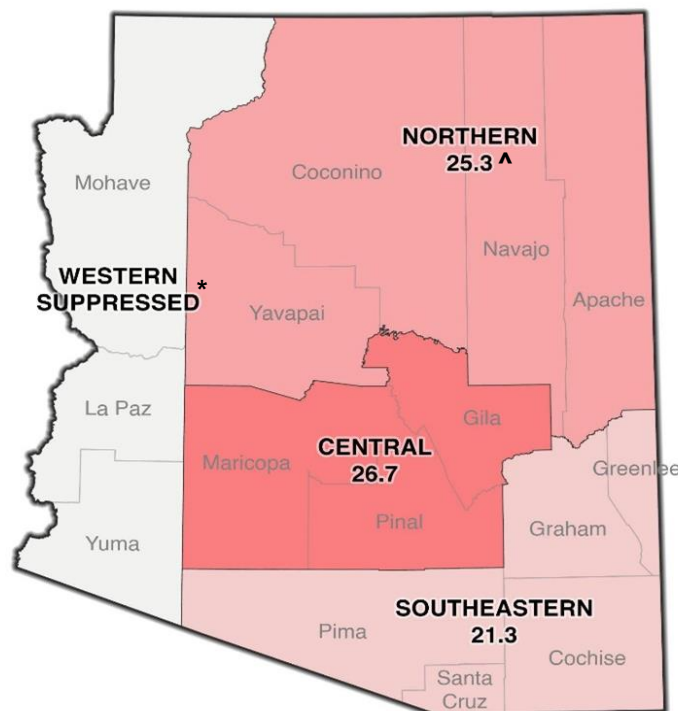
Urban: Residing in Maricopa, Pima, Pinal, or Yuma Counties

Mortality ratios for pregnancy-related deaths by the county region of residence (Central, Northern, Southeastern, and Western) can be seen in **Figure 15**. Central Arizona (Gila, Maricopa, and Pinal Counties) had the highest PRMR, at 26.7 deaths per 100,000 live births, followed by Northern Arizona (Apache, Coconino, Navajo, and Yavapai Counties) with 25.3 deaths per 100,000 live births, and Southeastern Arizona (Cochise, Graham, Greenlee, Pima, and Santa Cruz Counties) with 21.3 deaths per 100,000 live births. Mortality ratios were suppressed for the Western Arizona region (La Paz, Mohave, and Yuma Counties) due to low sample sizes (6 or fewer cases).

**Figure 15.** Pregnancy-Related Mortality Ratios Arizona Women 15-49 Years of Age by County Region of Residence (per 100,000 live births), 2016-2020 (n=100)

\*Western Region is suppressed due to count less than 6

^ Ratio is based on a case count greater than or equal to 6 but less than 10; therefore, it should be interpreted with caution.

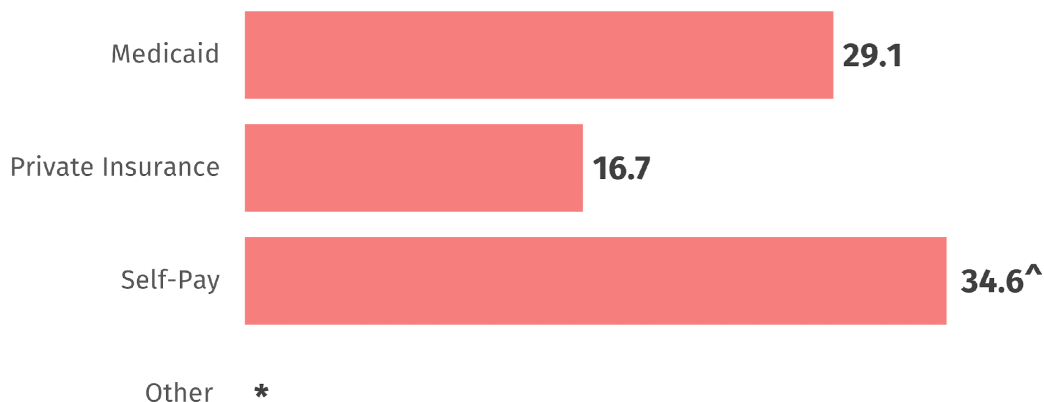


## Maternal Mortality by Payor

**Figure 16** displays PRMRs by payor type, which is the principal source of payment for the delivery. The highest PRMR was observed among the Self-Pay group (34.6 deaths per 100,000 live births), followed by Medicaid (29.1 per 100,000). The lowest PRMR was observed among those in the Private Insurance group, at 16.7 per 100,000 live births. PRMRs were suppressed for the Other payor group, which includes the Indian Health Service (IHS), TriCare/CHAMPUS, and other types, due to low sample sizes (6 or fewer cases).

While the Self-Pay group had the highest mortality ratio, the majority of pregnancy-related deaths occurred among Medicaid recipients, who accounted for 60.2% of deaths. In comparison, 28.6% of deaths occurred among those with Private Insurance, and 7.1% were Self-Pay (see [Appendix D](#) for more information on the distribution of pregnancy-related deaths and live births by payor type).

**Figure 16.** Pregnancy-Related Mortality Ratios Arizona Women 15-49 Years of Age by Payor (per 100,000 live births), 2016-2020 (n=98)



Self-Pay: No source of payment was identified at the time of admission

Other: Indian Health Service (IHS), TriCare/CHAMPUS, and other types

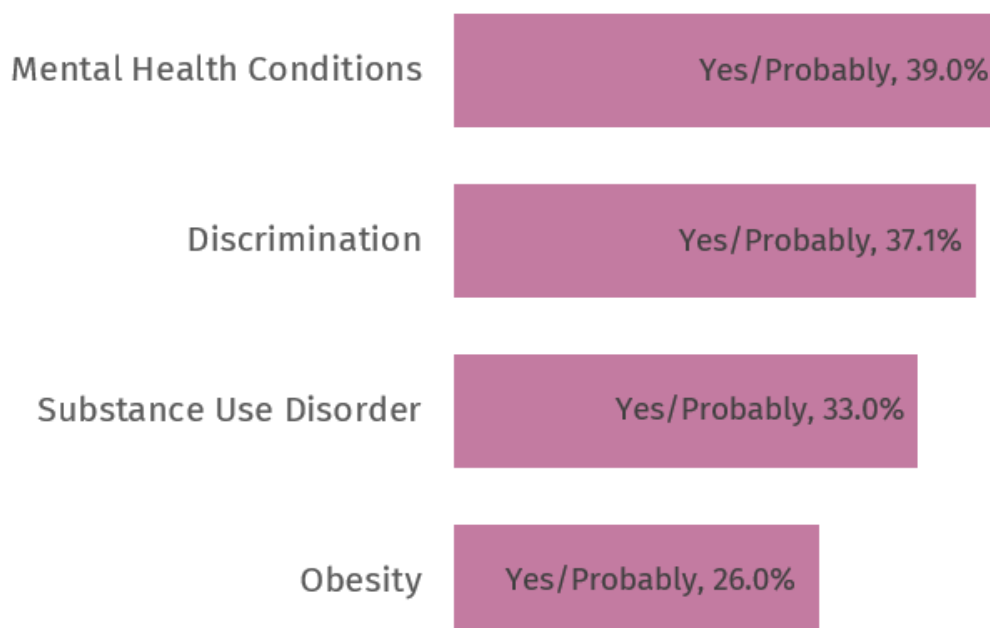
<sup>^</sup> Ratio is based on a case count greater than or equal to 6 but less than 10, therefore should be interpreted with caution.

## Maternal Mortality by Contributing Factor

Following the determination of both pregnancy-relatedness and preventability, the MMRC also determines if obesity, discrimination, mental health conditions, or substance use disorder (SUD) contributed to the death. Discrimination as a contributing factor includes committee concerns around interpersonal racism, structural racism, and/or any indication that the decedent was being treated differently based on a group that they belong too. Additional details about contributing factors can be found on the [MMRIA Committee Decisions Form](#).

Among pregnancy-related deaths, mental health conditions were identified as contributing factors in 39.0% of cases, followed by SUD (33.0%), obesity (26.0%), and discrimination (37.1%) (**Figure 17**). For the pregnancy-related deaths that had substance use disorder indicated as a contributing factor, the MMRP received toxicology records where a positive result was noted with at least one substance identified for 22 individuals. Among the 22 cases, the most commonly identified substance was methamphetamine or amphetamines (11 or 50.0%), followed by fentanyl (8 or 36.4%). Half of the 22 cases had two or more substances identified through their toxicology results (11 or 50.0%). Toxicology results detailed here exclude substances that were either administered by a health care provider or available through over-the-counter purchases.

**Figure 17.** Contributing Factors Among Pregnancy-Related Deaths of Women 15-49 Years of Age (Percentage), 2016-2020



## Section 3: Recommendations for Preventing Maternal Mortality in Arizona

Given the MM outcomes presented in Section 2, the Arizona MMRC identified the following recommendations to improve maternal health outcomes in the future. These were initially derived from the recommendations made during MM case reviews and were collected using the [MMRIA Committee Decisions Form](#). MMRP staff completed qualitative analysis on all recommendations made for 2016-2020 deaths and categorized them into levels of who might be responsible for enacting them, though some recommendations specify partners and strategies more than others. Over 500 recommendations were reviewed and categorized into 23 actionable recommendations that take place between 3 system levels (system, facility, provider); however, some could have multiple levels. Recommendations were structured in a who will do what by when format as prescribed by the CDC.

The intent of these committee recommendations is that, through widespread dissemination, partners and key stakeholders across the state will consider them for implementation. In some cases, the recommendations may currently be in practice given that the timeframe of these deaths occurred between 2016-2020.

The main takeaway from this section is each reader has an opportunity to collaborate on the implementation of data-driven actions that aim to improve maternal health outcomes in Arizona. Recommendations may include subtext that specifies specific items, strategies or persons that were identified in the review process.

### System

- **The healthcare system, including facilities, should improve continuity of care for pregnant and postpartum women, especially those with complex needs by:**
  - **Integrating and training perinatal medical and behavioral health service providers with collaborating services that are well-equipped<sup>24</sup>**
  - **Employ culturally congruent staff, including peer support specialists, navigators, doulas, and patient advocates<sup>25, 26, 27</sup>**
  - **Offer flexible treatment options including harm reduction programs to meet patients where they are, as well as patient advocates to support shared decision making and discharge planning<sup>28</sup>**

The healthcare system includes payor health plans managed care organizations. Complex needs include co-occurring mental health and substance use disorders, housing, food and/or transportation instability. The MMRC recommended integrating services such as integrating psychology, psychiatry, substance use treatment with reproductive care, mother and infant support with collaborating services such as peer support programs, mobile health clinics, home visiting programs, community health workers, birth to five navigation programs, group prenatal care, housing programs and shelters, etc. It was recommended that those services should be well equipped, ensuring that case managers have a manageable caseload, there is an available workforce that is culturally congruent, and there are appropriate resources. The MMRC recommended flexible treatment options

including harm reduction, traditional healing, and outpatient Medically Assisted Treatment and discharge planning should include an effective hand off and care coordination.

- **ADHS should increase public awareness about important pregnancy and postpartum topics (e.g., reproductive health care, prenatal care, postpartum warning signs, etc.) by partnering with community organizations and leveraging grants to provide culturally informed, evidence-based education and resources for professionals, families, and communities.**

The MMRC recommended that educational content for a public awareness campaign should include information on reproductive health care, prenatal care, and recognizing postpartum warning signs. It could also address perinatal mental health, substance use disorders, and harm reduction strategies such as the use of fentanyl test strips, naloxone rescue kits, and campaigns like Hope Heals. Additional topics may include trauma-informed care, domestic violence awareness (including legal rights and safety planning) and suicide prevention. Any campaign should also promote available support resources, including helplines and hotlines such as the Postpartum Support International (PSI) Helpline, the National Maternal Mental Health Hotline, the 988 Suicide & Crisis Lifeline, and the Opioid Assistance and Referral Line (OARLine).

- **Healthcare, behavioral health, and correctional systems should adopt trauma-informed, patient-centered care models to reduce stigma<sup>29</sup> around perinatal mental health and substance use disorders.<sup>30,31,32</sup> This should be done by:**
  - **Expanding and educating care team providers on trauma-informed care and implicit bias**
  - **Implementing perinatal risk reduction protocols and screenings to understand experiences that may impact health care management**
  - **Treating or conducting a warm handoff that care team and patients are comfortable with**
  - **Hospitals integrating the AIM Perinatal Mental Health and Substance Use Patient Safety Bundle<sup>33,34</sup>**

Providers include but are not limited to physicians, case managers, doulas, home visitors, midwives, nurse practitioners, massage therapists, etc. A strategy to improve patient-centered care around substance use disorder that was recommended by the MMRC is for hospitals to require consent for diagnostic tests such as urine drug screens.

- **The healthcare system should expand, promote and utilize real-time consultation services to support providers in managing high-risk and complex pregnant and postpartum patients by:**
  - **Ensuring OBs, EMS, and other healthcare professionals can easily consult with Maternal-Fetal Medicine (MFM) specialists and other relevant providers**
  - **Educating providers on recognizing early warning signs and the importance of timely consultation**
  - **Increasing awareness and capacity of the HRPP consultation line for provider consultation**
  - **Ensuring all perinatal consultation lines accept NPs, PAs, and CNMs as referring providers**

- To improve health outcomes for pregnant and postpartum women in rural areas<sup>35,36</sup>, the healthcare system should:
- Enhance continuity of care by expanding transportation options such as ride share or medical helicopter services
  - Identify solutions to accessing needed medications by increasing the availability of pharmacies (such as integrating them into health facilities), expanding reliable mail order prescription options, or exploring other delivery models
  - Coordinate with the [Arizona Perinatal Trust](#) guidelines for appropriate maternal and neonatal transfers and understanding levels of care
  - Integrate telehealth and remote monitoring
  - Ensure access and address barriers to attending prenatal and postpartum care visits (such as affordable childcare, transportation)
  - All payors should implement care models similar to the AHCCCS rural high-risk pregnancy coordinators to navigate care for rural women
  - Utilize clinic rotations to increase access to multidisciplinary providers (e.g., family medicine providers, obstetricians, nurse practitioners, midwives)
  - Consider geographic challenges when developing care plans, such as admitting patients for induction rather than requiring outpatient management.
- Arizona should improve the investigation of the incidence and causes of maternal deaths by:
- Hospitals should conduct root cause analysis following every maternal sentinel event to understand gaps in care and enable pathology residents to perform hospital autopsies with next of kin consent<sup>37</sup>.
  - ADHS should collaborate with the MMRC to develop a list of practitioners in order to disseminate data to applicable providers
  - The state should increase funding for maternal death investigations in order to support medical examiners with the necessary resources and agreements to conduct autopsy on every maternal death regardless of cause of death<sup>38</sup>

## Payors

- Payors, including AHCCCS, should ensure women have access to comprehensive pregnancy and postpartum care and support by:
- Providing proactive outreach and case management to all members, safe housing resources, reliable transportation, and childcare through partnerships with community organizations
  - Increasing the number of reimbursable support providers and services for mother that align with infant care schedules, especially for members with mental health conditions, Substance Use Disorder, chronic conditions, or histories of domestic violence, pregnancy loss, or other trauma<sup>39</sup>
  - Tracking access to referred, received and completed resources for members

Strategies that were recommended by the MMRC for proactive outreach for insurance plan members include assigning and connecting members to a primary care provider and following up on missed appointments. Support providers that should be reimbursable include, but are not limited to, SUD treatment providers, certified perinatal peer support specialist, case management, home visiting, doulas, mobile health clinics, etc.

- **Payors should remove barriers to perinatal care and treatment, especially behavioral health care by:**
  - **Reimbursing multiple methods of substance use treatment (not just inpatient), patient navigation, community health worker, and peer support models to connect individuals to mental health and substance use resources<sup>40, 41,</sup>**
  - **Ensuring ongoing navigation support (especially those with cognitive or physical disabilities, or who have experienced domestic violence, pregnancy loss, or other traumatic event) beyond initial pregnancy and postpartum care**
  - **Prioritizing patient care and improving health outcomes over cost savings**
  
- **Payors should expand access to contraceptives for women of childbearing age by:**
  - **Ensuring same-day placement of requested intrauterine device (IUDs), including after dilation and curettage (D&C) procedures**
  - **Eliminating prior authorization restrictions and prescription requirements**
  - **Incentivizing providers to include contraceptives and preconception care in routine wellness visits**

## **Law Enforcement**

- **The state and law enforcement should allocate funding to establish crisis teams that are deployed when responding to calls involving domestic violence, mental health, substance use, unstable housing, or financial instability, and partner with community organizations to ensure individuals receive appropriate social services and behavioral health support. <sup>42,43, 44, 45, 46</sup>**

## **Other Systems or Policies**

- **Arizonans should strengthen policies that support family planning, child care taking and maternal well-being such as:**
  - **Paid Family Leave<sup>47, 48, 49</sup>**
  - **Child tax credits**
  - **Tax credits for employers who hire individuals with a history of incarceration<sup>50</sup>**
  - **Expanding health care and prescription coverage**
  - **Statewide access to full range of contraception without prescription**
  - **Comprehensive support for people in the 4th trimester that requires that they are automatically enrolled and receive support services (e.g., child care, financial, housing, etc.) to support postpartum recovery**
  - **Participate in a national task force to advocate for quality of care for pregnant and postpartum women in Arizona**

- **Given that there were multiple preventable pregnancy-related firearm deaths, Arizonans should consider firearm safety regulations (e.g. mental health screening, offering surrender of weapons in unsafe situations, etc.)<sup>51</sup>. Additionally, ADHS, local law enforcement, policymakers, and communities should collaborate to:**
  - **Launch public campaigns, health communications and events that emphasize firearm safety and mental health, focusing on reaching pregnant and postpartum women with high firearm ownership**
  - **Provide training on safe storage practices**
  - **Encourage healthcare providers to review firearm access and share resources with patients.**
  
- **Policymakers should expand funding for mental health and substance use treatment to include inpatient SUD treatment and post-NICU housing/care that allows pregnant and postpartum women to stay with their infants and children, following models like Hushabye Nursery and Jacob's Hope while also increasing funding and opportunity for culturally congruent certified perinatal and mental health providers and other support such as peer support, case management and doulas<sup>52</sup>**

A strategy that was recommended for increasing the availability of mental health and substance use treatment was creating fellowships.

- **The state should support schools expanding culturally competent health education, ensuring all middle and high school students learn about comprehensive sex education, healthy relationships, boundaries, substance use and mental health, and how social media impacts health.<sup>53,54</sup>**

## Facility

**Ensure all facilities that serve pregnant women have adequate infrastructure protocols and procedures for addressing obstetric emergencies, this includes:**

- **Prevention<sup>55</sup>**
- **Readiness<sup>56</sup>**
- **Recognition and response<sup>57,58,59</sup>**
- **Expedition of coordination of care with multidisciplinary team of appropriate healthcare providers, which may include but is not limited to emergency department providers, obstetricians, mental health providers, and hospital unit professionals in oncology, urology, and anesthesiology**

The MMRC recommended several strategies to improve facility protocols, procedures, readiness, and response<sup>60, 61,62,63</sup>. One example of adequate infrastructure was the implementation of electronic medical records with trigger alerts for conditions like sepsis. The committee emphasized the importance of protocols that include sepsis screening, blood transfusion procedures, transfer protocols, and regular drills for emergency codes, including coordination with specialists. Recommended readiness strategies included conducting simulation exercises,

ensuring access to blood products, maintaining up-to-date provider training, having equipment such as sequential compression devices readily available and participating in the implementation of Alliance for Innovation on Maternal Health (AIM) safety bundles. To strengthen response efforts, the committee advised having providers present during critical events or codes, as well as responding promptly to postpartum warning signs and emergencies such as chest pain, shock, cervical ripening complications, placenta accreta, hemorrhage, hypertension, and seizures related to epilepsy.

- **Facilities and Community Organizations should coordinate with home visitation programs to provide social services (e.g. transportation, childcare) and a warm hand-off to services for all pregnant and postpartum women, especially those transported from rural settings, lack social support or with a history of mental health conditions.**<sup>64</sup>
- **Healthcare facilities should develop standardized documentation of medical records and leverage health information exchange (HIE) and databases (e.g. Contexture, Controlled Substances Prescription Monitoring Program) to facilitate the coordination of perinatal, behavioral health (especially alerts for prescribed medications), and case management records across all involved providers, even across state lines.**

The MMRC recommended that medical records should include documenting family medical history, current and historical medications, vaccinations, and code events and should also include capturing pertinent adoption and surrogacy information.

- **NICU facilities<sup>65</sup> should employ dedicated staff for postpartum care coordination and secure insurance reimbursement for comprehensive support services such as:**
  - **Lactation consultations**
  - **Family and peer-to-peer support groups**
  - **Maternal mental health programs**
  - **Loss of custody support services**

## Provider

- **All providers should improve prenatal and postpartum care by following evidence-based guidelines/protocols and engaging with continuing education**<sup>66, 67, 68, 69</sup> **to:**
  - **Identify, manage and treat perinatal conditions**
  - **Respond to perinatal emergencies**
  - **Deliver comprehensive, patient-centered care**
  - **Prioritize earlier and more frequent follow-ups for individuals facing vulnerable situations**
  - **Conduct effective handoffs between providers**
  - **Expand access through alternative appointment options to ensure no gaps in care**

The MMRC recommended that providers follow evidence-based guidelines from organizations such as ACOG, AIM, The Joint Commission, ACNM, AWHONN, the International Confederation of Midwives, and the American Association of Birth Centers. To deliver comprehensive, patient-centered prenatal and postpartum care, strategies included offering culturally congruent peer support and wrap-around services, empowering patients through advocacy and shared decision-making, and ensuring continuity of care by avoiding discharges or care transitions

before treatment comprehension is confirmed. The committee also recommended the use of alternative treatment options when appropriate and increasing flexibility in care delivery through off-hour visits, telehealth, group prenatal care, and aligning maternal visits with pediatric appointments for the infant.

- **Providers should increase early recognition and response to Perinatal Mood and Anxiety Disorders (PMADs) and Substance Use Disorder (SUD) <sup>70,71,72,73</sup> by:**
  - **Screening all pregnant and postpartum patients and their partners at every visit**
  - **Addressing self-medication as a symptom of depression**
  - **Supporting patients with infants in NICU or through withdrawal to prevent leaving Against Medical Advice (AMA)**
  - **Educating patients and families about risk factors and warning signs**
  - **Establishing group prenatal care programs to encourage peer support**
  - **Facilitating referrals to perinatal mental health specialists and transitions to treatment, counseling services, peer support, and community resources**
  
- **Providers should educate patients and their friends/families on signs and symptoms that require medical attention during pregnancy or postpartum (e.g. as postpartum warning signs) and disease processes (e.g. obesity, diabetes, epilepsy, etc.) in a non-stigmatizing, culturally informed way, encouraging understanding about risks and emphasizing the importance of continued treatment.**

The MMRC recommended that providers use educational tools such as “How to Help Me/What to Look For” magnets and infographics to inform patients about topics like epilepsy, proper wound care for individuals with diabetes, non-opioid pain management, and the importance of taking medications only as prescribed.

- **Providers, prescribers, and pharmacists should be trained in evidence-based recommendations and resources regarding the safety of medications and best prescribing practices during pregnancy and breastfeeding by utilizing resources such as MotherToBaby, Medications and Mother's Milk, and the Infant Risk Center.<sup>74</sup>**

The MMRC recommended resources to support prescribing practices including Postpartum Support International (PSI) medication management consultations, approved MOUD medication list and dosing, and the Arizona Perinatal Access Line (APAL). The MMRC recommended considering best practices around prescribing MAT, mental health medications, pain management medications, multi-month prescriptions, and history of heart conditions when prescribing.

- **Providers should ensure screening for domestic violence (DV)/intimate partner violence (IPV) and human trafficking is done with all women of reproductive age to assess safety concerns and connect them to DV shelters (that allow children) and other services (e.g. financial support, evidence based DV counseling, etc.) as needed.<sup>75,76</sup>**

## Section 4: Limitations

Several limitations should be considered when reviewing the data included in this report. The following section highlights key limitations in the reporting of maternal mortality in Arizona.

Misclassification of maternal mortality cases by race may occur, resulting in underestimation, especially for American Indian or Alaska Native women.<sup>15, 16</sup> American Indian or Alaska Native (AI/AN) communities face persistent disparities in health status, including lower life expectancy and a disproportionate burden of disease. These disparities are often linked to broader community health factors such as inadequate education, disproportionate poverty, discrimination in the delivery of health services, healthcare delivery, and cultural differences.<sup>17</sup> Additionally, AI/AN women represent a small proportion of the population – only 1.1% nationally (2020)<sup>18</sup> and 5.7% of live births in Arizona (2016-2020)<sup>19</sup> – leading to their frequent exclusion from analyses, national reports, and resource allocation, despite the higher rates of health challenges faced. These include lower life expectancy, higher poverty rates, and increased rates of certain health issues like type 2 diabetes-related deaths, suicides, and alcohol-related deaths when compared to White, non-Hispanic populations. The underreporting and misclassification of data and the increased disease burden within AI/AN communities further highlight the importance of racial misclassification, emphasizing the critical need for inclusion and recognition of these populations in health reporting and resource allocation efforts.<sup>20</sup>

Another major limitation is the inconsistency and incompleteness of available records for review. The MMRC determined that only 71% of case narratives included records that were “complete” or “mostly complete.” Records are particularly difficult to obtain when the decedent’s provider is unknown, or when the case involves case management, social work, and mental or behavioral health services. The MMRP also honors the sovereignty of Arizona’s tribal nations, including the confidentiality of healthcare and other sensitive data. As a result, records from healthcare providers, law enforcement, EMS, and other services related to incidents on tribal lands are often unavailable. This limitation is routinely acknowledged by the MMRC during case reviews. MMRP staff make concerted efforts to identify and request all relevant records from available sources and continue to seek new opportunities, new partnerships, and collaboration to improve data access.

There are also limitations related to the committee’s identification and interpretation of prevention recommendations. One significant challenge is the unintentional representation of recommendations due to reliance on literal content documented during committee meetings, which may not fully capture the intended context. Additionally, assigning themes to each recommendation can introduce bias, especially as themes are altered over the course of the analysis period, potentially impacting consistency in categorization.

Lastly, while the MMRP uses a standard outline to develop all case narratives, the content is identified and abstracted by clinical nurse abstractors using their best judgment based on available information. Social factors that may have contributed to a decedent's death are difficult to assess, especially when detailed case management notes or interviews with family members or friends (most often found in police records or medical examiner Preliminary Investigative Reports) are absent. Additionally, MMRC membership has changed over time, and attendance varies slightly from meeting to meeting. As a result, there is potential for bias or inconsistency during the abstraction and review process depending on the context provided and the perspectives of professionals present during each review. In addition, although ADHS adopted the Review to Action Guidelines in 2018, these standards continue to evolve over time, resulting in gaps or inconsistencies in committee decisions over time. MMRP accounted for these factors when analyzing and reporting data that may be affected by these inconsistencies.

## Section 5: Discussion

In Arizona, deaths occurring within one year of pregnancy increased from 87.5 per 100,000 live births in 2016 to 102.7 per 100,000 live births in 2020. Pregnancy-related deaths increased from 21.0 to 33.4 deaths per 100,000 live births. The leading cause of pregnancy-related deaths was mental health conditions (29.0%), followed by 'Other' causes (18.0%) and infections (16.0%). The manner of death varied from 2016 to 2020, with natural causes being the most common (59.6%), followed by suicide (17.2%) and accidents (16.2%). To address these concerns, the MMRC issued several recommendations focused on addressing mental health care at the System, Facility and Provider levels. These included expanding funding for mental health and substance use treatment, adopting trauma-informed care practices at facilities, and increasing early recognition and response to Perinatal Mood and Anxiety Disorders (PMADs) and Substance Use Disorder (SUD) by providers. Additional mental health and SUD recommendations can be found in [Section 3](#).

Understanding when pregnancy-related deaths occur is pivotal to improving prevention and care practices. The highest proportion of deaths occurred in the postpartum period (63.7%), with most occurring within 42 days of delivery (37.45%), followed by those occurring between 43 to 365 days postpartum (26.3%). Some recommendations address the coordination and continuity of care to close the gap in care for people in Arizona.

Through detailed individual case reviews, the Arizona MMRC found that 85.0% of the 100 deaths reviewed in the 2016-2020 period were preventable. Nationally, the CDC reported that 80% of pregnancy-related deaths in 36 states from 2017 to 2019 were preventable.<sup>12</sup> While Arizona's mortality ratios are not directly comparable to national data due to differences in methodology and inclusion criteria, these findings indicate the need for improved health care strategies and systemic change, particularly in addressing persistent health disparities.

Between 2016 and 2020, American Indian or Alaska Native women (60.1 deaths per 100,000 live births) had the highest Pregnancy Related Mortality Ratio in Arizona, which was 3 times higher than the rate for White, non-Hispanic women (20.0 deaths per 100,000 live births). Black or African American women had the next highest PRMR (52.8 deaths per 100,000 live births), which was 2.5 times higher than the White, non-Hispanic rate. A national report on pregnancy-related deaths (2018-2022) reported that American Indian or Alaska Native women and Black or African American women faced the highest burden of maternal mortality compared to other races.<sup>21</sup> These disparities underscore the need for a comprehensive approach that addresses the needs of the population and promotes optimal maternal health.

In June 2022, the White House released a report that outlines the state of maternal health in the U.S. and strategized on how to address maternal health outcomes.<sup>22</sup> In July 2024, the White House provided an update on the progress made to address the maternal health crisis since the release of the [Blueprint for Addressing the Maternal Health Crisis](#).<sup>23</sup> The update outlined several initiatives to enhance healthcare accessibility and quality, including

Medicaid expansion and expansion of resources for underserved communities like Veterans. There was a focus on workforce expansion, which involved provider trainings on maternal mental health and substance misuse, and implementation of the Pregnant Workers Fairness Act (PWFA) and the Providing Urgent Maternal Protections (PUMP) for Nursing Mothers Act, which provide protection for pregnant workers and nursing women on the job. Resources were also allocated for research, data initiatives, and the dissemination of information about maternal health outcomes, like in the HEAR Her campaign. Efforts are ongoing at the federal, state, and local, non-profit, community, and grassroots levels to continue to alleviate disparities and improve overall maternal health outcomes, including the continuation of MMRC programming. At the time of release of this report, MMRC programming is funded by ERASE-MM. Many of the recommendations developed by the MMRC members in [Section 3](#) are supported by similar actions in the report.<sup>22, 23</sup>

Moreover, to collectively address the preventable losses and work towards optimal maternal health, all partners are called to take steps toward the implementation of the recommendations detailed in [Section 3](#).

In summary, the top 5 recommendations are:

1. All providers should improve prenatal and postpartum care by adhering to evidence-based guidelines, pursuing continuing education, and ensuring timely, patient-centered, and coordinated care that addresses both routine and emergency perinatal needs.
2. All facilities serving pregnant women should maintain adequate infrastructure, protocols, and procedures to effectively prevent, recognize, and respond to obstetric emergencies, ensuring readiness and timely coordination of care.
3. The healthcare system should improve continuity of care by integrating behavioral and medical health services, particularly for pregnant and postpartum women with complex needs.
4. ADHS should increase public awareness of the perinatal period by partnering with community organizations and leveraging grants to provide culturally informed, evidence-based education and resources for professionals, families, and communities.
5. Healthcare, behavioral health, and correctional systems should adopt trauma-informed, patient-centered care to reduce stigma around perinatal mental health and substance use by educating providers and implementing evidence-based risk reduction and care coordination practices.

The primary purpose of the Maternal Mortality Review Program is to gather detailed data on the causes and circumstances surrounding maternal deaths in order to develop recommendations for prevention. This work is made possible by the ERASE MM grant. One of

the objectives of the grant is to improve the availability of timely, accurate, and standardized information on maternal deaths. The Arizona Maternal Mortality Review Program is actively enhancing the efficiency of its review process, aiming for real-time analysis. This shift ensures that the MMRC's prevention recommendations remain pertinent in the dynamic landscape of maternal health in Arizona. Emphasizing the intricate interplay of community health factors and their impact on maternal outcomes is crucial. The disparities revealed in this report, especially among Black, Indigenous, and People of Color (BIPOC) and those in rural areas, highlight the pressing need for in-depth analysis supporting calls for systemic change. Contributing to the expanding knowledge on critical gaps and potential solutions holds the promise of advancing maternal health on a broad scale.

## Section 6: Appendices

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Thank you to the following Arizona MMRC Members who participated in the review of and creation of recommendations for 2016-2020 cases.

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## Appendix B. Glossary

### Definitions for Common Terminology in Maternal Mortality

The following are definitions for common terminology found in this report.

- **Discrimination:** Encompasses the following
  - Treating someone less or more favorably based on the group, class, or category they belong to, resulting from biases, prejudices, and stereotyping. It can manifest as differences in care, clinical communication and shared decision-making.
  - Discriminatory interactions between individuals based on differential assumptions about the abilities, motives, and intentions of others and resulting in differential actions toward others based on their race. It can be conscious as well as unconscious, and it includes acts of commission and acts of omission. It manifests as lack of respect, suspicion, devaluation, scapegoating, and dehumanization.
  - The systems of power based on historical injustices and contemporary social factors that systematically disadvantage people of color and advantage white people through inequities in housing, education, employment, earnings, benefits, credit, media, health care, criminal justice, etc.
- **Natural Death:** A death occurring in the course of nature and from natural causes, such as age or disease.
- **Maternal Mortality (MM):** The death of a woman while pregnant or within 1 year of the end of a pregnancy – regardless of the outcome, duration, or site of the pregnancy – from any cause related to or aggravated by the pregnancy or its management. Though the CDC definition excludes accidental and incidental causes from maternal mortality reporting, the Arizona MMRP reviews and reports on all maternal mortalities occurring in Arizona regardless of the manner of death.
- **Maternal Mortality Review Information Application (MMRIA):** A CDC-developed database that collects/abstracts clinical and non-clinical information pertaining to maternal deaths. Committee Decisions MMRIA Form standardizes review by guiding committee determinations about pregnancy relatedness, manner of death, cause of death, and preventability for each case.
- **Pregnancy-Associated:** The death of a woman during pregnancy or within one year of the end of pregnancy, regardless of the cause. All deaths that have a temporal relationship to pregnancy are included.

- **Pregnancy-Associated Mortality Ratio (PAMR):** An estimate of the number of pregnancy-associated deaths for every 100,000 live births.
- **Pregnancy-Related:** The death of a woman during pregnancy or within one year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. In addition to having a temporal relationship to pregnancy, these deaths are causally related to pregnancy or its management.
- **Pregnancy-Related Mortality Ratio (PRMR):** An estimate of the number of pregnancy-related deaths for every 100,000 live births. This ratio is often used as an indicator to measure the nation's health.
- **Preventability:** A death is considered preventable if the committee determines that there was at least some chance of the death being averted by one or more reasonable changes to patient, community, provider, facility, and/or systems factors. MMRIA allows MMRCs to document preventability decisions in two ways: 1) determining preventability as a "yes" or "no" and/or 2) determining the chance to alter the outcome using a scale that indicates "no chance," "some chance," or "good chance." Any death with a "yes" response or a response that there was "some chance" or a "good chance" to alter the outcome was considered "preventable"; deaths with a "no" response or "no chance" were considered "not preventable."
- **Resident:** Arizona residency was determined by the county of residence as listed on the death certificate. This is not an indication of citizenship or legal residence in Arizona.
- **Underlying Cause of Death:** The disease or injury that initiated the chain of events leading to death or the circumstances of the accident or violence that produced the fatal injury. In addition to the listed causes of death from the death certificate, the MMRC assigns an underlying cause of death code for Pregnancy-Related cases.

## Appendix C. AZ Statute Language

On May 2, 2025, Governor Katie Hobbs signed into law [SB 1316](#). This law establishes the Maternal Mortality Review Program to coordinate and facilitate the review of pregnancy-associated deaths to understand the incidences, causes and preventability by the Maternal Mortality Review Committee. This bill establishes appointees to the committee and requires a biannual report due May 15th of even years.

Until that law goes into effect, the current maternal mortality review program falls under the [A.R.S. §35-3601](#) C.12. *Evaluate the incidence and causes of maternal fatalities associated with pregnancy in this state. For the purposes of this paragraph, "maternal fatalities associated with pregnancy" means the death of a woman while she is pregnant or within one year after the end of her pregnancy.*

**36-3501.01. Maternal mortality review program; committee; members; reports; compensation; definition**

**A. THE MATERNAL MORTALITY REVIEW PROGRAM IS ESTABLISHED TO EVALUATE THE INCIDENCE, CAUSES AND PREVENTABILITY OF PREGNANCY-ASSOCIATED DEATHS. THE PROGRAM SHALL COORDINATE AND FACILITATE CASE REVIEWS BY THE MATERNAL MORTALITY REVIEW COMMITTEE. IN COLLABORATION WITH THE MATERNAL MORTALITY REVIEW PROGRAM, THE MATERNAL MORTALITY REVIEW COMMITTEE SHALL PRODUCE PREVENTION RECOMMENDATIONS THAT AIM TO ADDRESS THE CONTRIBUTING FACTORS THAT LEAD TO PREVENTABLE PREGNANCY-ASSOCIATED DEATHS.**

**B. THE MATERNAL MORTALITY REVIEW PROGRAM IS COMPOSED OF THE MATERNAL MORTALITY REVIEW COMMITTEE AND THE COMMITTEE'S STAFF. THE DIRECTOR OF THE DEPARTMENT OF HEALTH SERVICES SHALL APPOINT THE MEMBERS OF THE COMMITTEE. THE DIRECTOR OR THE DIRECTOR'S DESIGNEE SHALL SERVE AS COCHAIRPERSON OF THE COMMITTEE. THE COMMITTEE SHALL ELECT A SECOND COCHAIRPERSON FROM THE COMMITTEE'S MEMBERSHIP.**

**C. THE DIRECTOR OF THE DEPARTMENT OF HEALTH SERVICES SHALL APPOINT AT LEAST THE FOLLOWING MEMBERS OF THE MATERNAL MORTALITY REVIEW COMMITTEE, ONE OF WHOM IS FROM A COUNTY WITH A POPULATION OF LESS THAN FIVE HUNDRED THOUSAND PERSONS:**

**1. TWO OBSTETRICIANS WHO ARE LICENSED PURSUANT TO TITLE 32, CHAPTER 13 OR 17, AT LEAST ONE OF WHOM IS A MATERNAL FETAL MEDICINE SPECIALIST.**

**2. A CERTIFIED NURSE MIDWIFE WHO IS LICENSED PURSUANT TO TITLE 32, CHAPTER 15.**

**3. A REPRESENTATIVE OF A NONPROFIT ORGANIZATION THAT PROVIDES EDUCATION, SERVICES OR RESEARCH RELATED TO MATERNAL AND CHILD HEALTH.**

**4. A REPRESENTATIVE OF AN ORGANIZATION THAT REPRESENTS HOSPITALS IN THIS STATE.**

**5. A BEHAVIORAL HEALTH PROFESSIONAL.**

**6. A DOMESTIC OR INTERPERSONAL VIOLENCE SPECIALIST.**

**7. A FORENSIC PATHOLOGIST OR TOXICOLOGIST.**

**8. AN INDIVIDUAL WITH PERSONAL OR COMMUNITY-LEVEL EXPERIENCE IN MATERNAL HEALTH ISSUES.**

**9. A REPRESENTATIVE FROM THE ARIZONA HEALTH CARE COST CONTAINMENT SYSTEM.**

**10. A REPRESENTATIVE FROM THE DEPARTMENT OF CHILD SAFETY.**

**11. A REPRESENTATIVE FROM THE ARIZONA PERINATAL TRUST.**

**12. A REPRESENTATIVE OF INDIAN HEALTH SERVICES.**

**D. THE MATERNAL MORALITY REVIEW PROGRAM SHALL:**

**1. DEVELOP A DATA COLLECTION SYSTEM FOR MATERNAL FATALITIES.**

**2. PROVIDE TRAINING TO COOPERATING AGENCIES AND INDIVIDUALS ON IDENTIFICATION, REVIEW AND DISSEMINATION PROCESSES.**

**3. ON OR BEFORE MAY 15 OF EACH EVEN-NUMBERED YEAR, PRODUCE A STATISTICAL REPORT ON THE INCIDENCE AND CAUSES OF PREGNANCY-RELATED DEATHS IN THIS STATE AND SUBMIT A COPY OF THIS REPORT, INCLUDING THE COMMITTEE'S RECOMMENDATIONS FOR PREVENTING MATERNAL FATALITIES, TO THE GOVERNOR, THE PRESIDENT OF THE SENATE, THE SPEAKER OF THE HOUSE OF REPRESENTATIVES AND THE CHAIRPERSONS OF THE HEALTH AND HUMAN SERVICES COMMITTEES OF THE HOUSE OF REPRESENTATIVES AND THE SENATE, OR THEIR SUCCESSOR COMMITTEES.**

**4. STUDY THE ADEQUACY OF STATUTES, ORDINANCES, RULES, TRAINING AND SERVICES TO DETERMINE THE CHANGES THAT ARE NEEDED TO DECREASE THE INCIDENCE OF PREVENTABLE MATERNAL FATALITIES.**

**E. COMMITTEE MEMBERS ARE NOT ELIGIBLE TO RECEIVE COMPENSATION, BUT MEMBERS APPOINTED PURSUANT TO SUBSECTION C OF THIS SECTION ARE ELIGIBLE FOR REIMBURSEMENT OF EXPENSES PURSUANT TO TITLE 38, CHAPTER 4, ARTICLE 2.**

**F. FOR THE PURPOSES OF THIS SECTION, "PREGNANCY-ASSOCIATED DEATH" MEANS A DEATH THAT OCCURRED DURING PREGNANCY OR WITHIN ONE YEAR AFTER THE END OF PREGNANCY.**

## Appendix D. Supplemental Data Table: Pregnancy-Related Deaths, Sociodemographic Characteristics <sup>^</sup>

Pregnancy-Related Deaths				
	# of Deaths	% of Deaths	Live Births	Ratio (All)
<b>Overall</b>	100	NA	409456	24.4
<b>Year</b>	n=100			
2016	18	18.0%	85700	21.0
2017	13	13.0%	83010	15.7
2018	15	15.0%	82145	18.3
2019	28	28.0%	80692	34.7
2020	26	26.0%	77909	33.4
<b>Sociodemographic Characteristics</b>				
<b>Maternal Race or ethnicity</b>	n=99			
American Indian or Alaska Native	14	14.1%	23279	60.1
Asian or Pacific Islander	*	*	16248	*
Black or African American	12	12.1%	22748	52.8
Hispanic or Latina	34	34.3%	167243	20.3
White, non-Hispanic	36	36.4%	179938	20.0
<b>Maternal Age</b>	n=100			
10-14 Years of Age	0	**	NA	**
15-24 Years of Age	20	20.0%	111472	17.9
25-34 Years of Age	49	49.0%	229415	21.4
35-44 Years of Age	30	30.0%	66644	45.0
45-54 Years of Age	*	*	2759	*
55-60 Years of Age	0	**	NA	**
<b>Maternal Education</b>	n=100			
8th Grade or Less	*	*	11740	*
9th-12th Grade; No Diploma	15	15.0%	52264	28.7
High School Grad or GED Completed	33	33.0%	104773	31.5
Some College Credit, but No Degree	21	21.0%	93242	22.5
Associate's Degree	*	*	34918	*
Bachelor's Degree or More	21	21.0%	103038	20.4
<b>Payor</b>	n=98			
Medicaid	59	60.2%	203052	29.1
Private Insurance	28	28.6%	167646	16.7
Self-Pay	7	7.1%	20204	34.6
Other	*	*	17276	*
<b>Maternal Residence</b>				
<b>Rural vs. Urban</b>	n=100			
Rural	16	16.0%	52573	30.4
Urban	84	84.0%	345675	24.3

Regions	n=100			
Central	75	75.0%	280528	26.7
Northern	7	7.0%	27620	25.3
Southeastern	14	14.0%	65838	21.3
Western	*	*	24262	*

\*Cells with a case count less than 6 but greater than 0 have been suppressed. Cells with percentages or ratios that were calculated with a suppressed case count are also suppressed. \*\* Percentages and ratios with a case count of 0. ^ Case counts greater than or equal to 6 but below 10 and their corresponding calculations should be interpreted with caution.

## Appendix E. Supplemental Data Table: Pregnancy-Related Mortality Ratios by Inclusion Criteria<sup>^</sup>

See [Appendix I](#) for Inclusion Criteria definitions.

	Pregnancy-Related		
	Ratio (All)	Ratio (CDC)	Ratio (AZ)
<b>Overall</b>	24.4	23.6	23.4
<b>Year</b>			
2016	21.0	20.4	21.0
2017	15.7	11.1	15.7
2018	18.3	18.8	17.0
2019	34.7	35.8	32.2
2020	33.4	32.9	32.1
<b>Sociodemographic Characteristics</b>			
<b>Maternal Race or ethnicity</b>			
American Indian or Alaska Native	60.1	52.9	55.8
Asian or Pacific Islander	*	*	*
Black or African American	52.8	53.2	48.4
Hispanic or Latina	20.3	19.8	20.3
White, non-Hispanic	20.0	19.4	18.9
<b>Maternal Age</b>			
10-14 Years of Age	**	**	**
15-24 Years of Age	17.9	17.4	17.9
25-34 Years of Age	21.4	20.6	20.1
35-44 Years of Age	45.0	45.5	43.5
45-54 Years of Age	*	**	*
55-60 Years of Age	**	**	**
<b>Maternal Education</b>			
8th Grade or Less	*	*	*
9th-12th Grade; No Diploma	28.7	25.3	26.8
High School Grad or GED Completed	31.5	31.0	30.5
Some College Credit, but No Degree	22.5	22.8	21.4
Associate's Degree	*	*	*
Bachelor's Degree or More	20.4	18.0	19.4
<b>Payor</b>			
Medicaid	29.1	28.1	33.4
Private Insurance	16.7	16.8	13.3
Self-Pay	34.6	39.2	34.6
Other	*	*	*
<b>Maternal Residence</b>			
<b>Rural vs. Urban</b>			

Rural	30.4	26.6	26.6
Urban	24.3	23.1	23.7
<b>Regions</b>			
Central	26.7	25.3	26.4
Northern	25.3	25.3	21.7
Southeastern	21.3	19.7	19.7
Western	*	*	*
<b>Committee determination of preventability</b>			
<b>Preventable Deaths</b>			
Yes	20.8	19.8	19.8
No	3.7	3.8	3.7
<b>Chance to Alter Outcome (among Preventable Deaths)</b>			
Good Chance	8.5	7.5	8.3
Some Chance	11.5	11.6	10.7
No Chance	*	*	*
Unable to Determine	*	*	*
<b>Timing of Death</b>			
Pregnant at time of death	5.6	5.3	5.6
Day of Delivery	3.2	3.3	2.9
Pregnant within 42 days of death	9.0	8.5	8.8
Pregnant 43-365 days of death	6.3	6.5	5.9
<b>Preventability for each Timing of Death Group</b>			
Pregnant at time of death (Preventable)	5.1	4.8	5.1
Day of Delivery (Preventable)	2.4	2.5	2.2
Pregnant within 42 days of death (Preventable)	7.1	6.5	6.8
Pregnant 43-365 days of death (Preventable)	5.9	6.0	5.4
<b>Committee determinations on circumstances surrounding death</b>			
<b>Did obesity contribute to the death?</b>			
Yes	4.4	4.5	4.2
Probably	2.0	2.0	2.0
No	15.4	14.6	14.9
Unknown	2.7	2.5	2.4
<b>Did discrimination contribute to the death?</b>			
Yes	2.4	2.5	2.4
Probably	3.2	3.3	2.7
No	5.4	5.5	5.1
Unknown	4.2	4.0	3.9
<b>Did mental health conditions contribute to the death?</b>			
Yes	7.8	7.5	7.3
Probably	1.7	1.5	1.7
No	10.7	10.8	10.5
Unknown	4.2	3.8	3.9

<b>Did substance use disorder contribute to the death?</b>			
Yes	7.1	7.0	6.8
Probably	*	*	*
No	13.9	14.1	13.4
Unknown	2.4	1.8	2.4
<b>Manner of Death</b>			
<b>Manner of Death - Summary</b>			
Accident	3.9	4.0	3.7
Homicide	*	*	*
Natural	14.4	14.1	13.9
Suicide	4.2	3.8	3.9
Pending investigation	*	*	*
Could not be determined	*	*	*
<b>Was this death a suicide?</b>			
Yes	4.4	3.8	4.2
Probably	**	**	**
No	17.6	17.3	16.9
Unknown	2.4	2.5	2.4
<b>Was this death a homicide?</b>			
Yes	*	*	*
Probably	**	**	**
No	22.7	21.8	21.7
Unknown	*	*	*
<b>Committee determinations of causes of death</b>			
<b>Underlying cause of death</b>			
Mental Health Conditions	7.1	6.8	6.8
Infection	3.9	4.0	3.9
Hemorrhage (Excludes Aneurysms or CVA)	2.4	2.5	2.4
Cardiovascular Conditions	2.2	2.3	2.2
Amniotic Fluid Embolism	1.5	1.5	*
Hypertensive Disorders of Pregnancy	1.5	1.5	*
Injury	1.5	*	1.5
Embolism - Thrombotic (Non-Cerebral)	*	*	*
Cardiomyopathy	*	*	*
Metabolic/Endocrine	*	*	*
Neurologic/Neurovascular Conditions (Excluding CVA)	*	*	*
Collagen Vascular/Autoimmune Diseases	*	*	*
Conditions Unique to Pregnancy	*	*	*
Hematologic	*	*	*
Pulmonary Conditions (Excludes ARDS)	*	**	*
Renal Diseases	*	*	*
Unknown COD	*	*	*

\*Cells with a case count less than 6 but greater than 0 have been suppressed. Cells with percentages or ratios that were calculated with a suppressed case count are also suppressed. \*\* Percentages and ratios with a case count of 0. ^ Case counts greater than or equal to 6 but below 10 and their corresponding calculations should be interpreted with caution.

## Appendix F. Supplemental Data Table: Maternal Mortality Review Committee Decisions for Pregnancy-Related Deaths<sup>^</sup>

	Pregnancy-Related			
	# of Deaths	% of Deaths	Live Births	Ratio (All)
<b>Overall</b>	100	NA	409456	24.4
<b>Committee determination of preventability</b>				
<b>Preventable Deaths</b>	n=100			
Yes	85	85.0%	409456	20.8
No	15	15.0%	409456	3.7
<b>Chance to Alter Outcome (among Preventable Deaths)</b>				
	n=84 of 85			
Good Chance	35	41.7%	409456	8.5
Some Chance	47	56.0%	409456	11.5
No Chance	*	*	409456	*
Unable to Determine	*	*	409456	*
<b>Timing of Death</b>				
	n=99			
Pregnant at time of death	23	23.2%	409456	5.6
Day of Delivery	13	13.1%	409456	3.2
Pregnant within 42 days of death	37	37.4%	409456	9.0
Pregnant 43-365 days of death	26	26.3%	409456	6.3
<b>Preventability for each Timing of Death Group</b>				
	n=84 of 85			
Pregnant at time of death (Preventable)	21	25.0%	409456	5.1
Day of Delivery (Preventable)	10	11.9%	409456	2.4
Pregnant within 42 days of death (Preventable)	29	34.5%	409456	7.1
Pregnant 43-365 days of death (Preventable)	24	28.6%	409456	5.9
<b>Committee determinations on circumstances surrounding death</b>				
<b>Did obesity contribute to the death?</b>				
	n=100			
Yes	18	18.0%	409456	4.4
Probably	8	8.0%	409456	2.0
No	63	63.0%	409456	15.4
Unknown	11	11.0%	409456	2.7
<b>Did discrimination contribute to the death?</b>				
	n=62			
Yes	10	16.1%	409456	2.4
Probably	13	21.0%	409456	3.2
No	22	35.5%	409456	5.4
Unknown	17	27.4%	409456	4.2
<b>Did mental health conditions contribute to the death?</b>				
	n=100			
Yes	32	32.0%	409456	7.8
Probably	7	7.0%	409456	1.7
No	44	44.0%	409456	10.7
Unknown	17	17.0%	409456	4.2
<b>Did substance use disorder contribute to the death?</b>				
	n=100			
Yes	29	29.0%	409456	7.1

Probably	*	*	409456	*
No	57	57.0%	409456	13.9
Unknown	10	10.0%	409456	2.4
<b>Manner of Death</b>				
<b>Manner of Death - Summary</b> n=99				
Accident	16	16.2%	409456	3.9
Homicide	*	*	409456	*
Natural	59	59.6%	409456	14.4
Suicide	17	17.2%	409456	4.2
Pending investigation	*	*	409456	*
Could not be determined	*	*	409456	*
<b>Was this death a suicide?</b> n=100				
Yes	18	18.0%	409456	4.4
Probably	**	**	409456	**
No	72	72.0%	409456	17.6
Unknown	10	10.0%	409456	2.4
<b>Was this death a homicide?</b> n=100				
Yes	*	*	409456	*
Probably	**	**	409456	**
No	93	93.0%	409456	22.7
Unknown	*	*	409456	*
<b>Committee determinations of causes of death</b>				
<b>Underlying cause of death</b> n=100				
Mental Health Conditions	29	29.0%	409456	7.1
Infection	16	16.0%	409456	3.9
Hemorrhage (Excludes Aneurysms or CVA)	10	10.0%	409456	2.4
Cardiovascular Conditions	9	9.0%	409456	2.2
Amniotic Fluid Embolism	6	6.0%	409456	1.5
Hypertensive Disorders of Pregnancy	6	6.0%	409456	1.5
Injury	6	6.0%	409456	1.5
Embolism - Thrombotic (Non-Cerebral)	*	*	409456	*
Cardiomyopathy	*	*	409456	*
Metabolic/Endocrine	*	*	409456	*
Neurologic/Neurovascular Conditions (Excluding CVA)	*	*	409456	*
Collagen Vascular/Autoimmune Diseases	*	*	409456	*
Conditions Unique to Pregnancy	*	*	409456	*
Hematologic	*	*	409456	*
Pulmonary Conditions (Excludes ARDS)	*	*	409456	*
Renal Diseases	*	*	409456	*
Unknown COD	*	*	409456	*

\*Cells with a case count less than 6 but greater than 0 have been suppressed. Cells with percentages or ratios that were calculated with a suppressed case count are also suppressed. \*\* Percentages and ratios with a case count of 0. ^ Case counts greater than or equal to 6 but below 10 and their corresponding calculations should be interpreted with caution.

## Appendix H. Maternal Mortality Identification Process: Additional Details

### Case Identification through Arizona Death Certificates

Arizona vital records death certificates are the primary source used to identify potential maternal death cases. However, live birth certificates, fetal death certificates, and hospital discharge data are also queried in the case identification process to find supporting information.

A potential maternal death was initially selected if the decedent met the following criteria:

- Identified as female on the death certificate
- Between 10 and 60 years of age at the time of death

Among decedents meeting the sex and age criteria, additional screening was conducted to identify (or “flag”) cases with any of the following types of ICD (International Classification of Diseases) codes:

- Z codes
- codes
- A34 codes

Decedents were also identified as potential maternal death cases if the death certificate indicated pregnancy within the year prior to death (as marked by the pregnancy checkbox).

Maternal deaths occurring between 2018 and 2020 were identified with guidance provided by the ADHS Bureau of Public Health Statistics. For each data source, record-level unique identifiers (13 characters long) were created using a combination of the decedent’s first name, last name, date of birth, and sex. These unique identifiers were used to conduct

the following three linkages:

- Death Certificates with Hospital Discharge Data records
- Death Certificates with Live Birth Certificates
- Death Certificates with Fetal Death Certificates

Each linked record-level match was assigned a probability score indicating the likelihood of an accurate match. All matches were then manually reviewed by selected members of the MMRP team to ensure accuracy.

### Death Record Linkage with Arizona Hospital Discharge Database

Linkage between death records and the hospital discharge database was performed to identify relevant information that could support the classification of a death as a maternal death. This linkage also helped locate hospital information to request medical records for

review by the MMRP team. Similar to death certificate records, the HDD was queried to identify patients who did not identify as male and who were between 10 and 60 years of age at the time of hospitalization. Patients were flagged if they had any of the previously listed ICD codes. Maternal death certificates were linked to hospitalization events that occurred during the calendar year of the death as well as the calendar year preceding the death.

### **Death Record Linkage with Vital Records Live Birth Certificates**

In addition to other data sources, death certificates for potential maternal death cases were linked with Arizona Vital Records Live Birth Certificates. This linkage aimed to identify supporting evidence that the death occurred either during or within one year postpartum and to obtain key demographic information for epidemiological assessments. Maternal death certificates were linked to live birth certificates for live births that occurred either in the same calendar year as the maternal death or in the calendar year preceding the death.

### **Death Record Linkage with Vital Records Fetal Death Certificates**

Similar to live birth certificates, death records were linked with Arizona Fetal Death Certificates. This linkage aimed to gather supporting information that the death occurred either during or within a year of pregnancy. Maternal death certificates were linked to fetal death certificates for fetal deaths that occurred either in the same calendar year as the maternal death or in the year prior.

## Appendix I. Maternal Mortality Epidemiological Methods: Additional Details

### Missing Data

Missing data in this report were addressed using methodologies consistent with those outlined in the CDC's Division of Reproductive Health (DRH) reports.<sup>9</sup> Cases with missing data for a particular stratum (i.e., category) were excluded from calculations pertaining to that stratum. For instance, if 100 cases were identified and one case had missing race or ethnicity data, that case was excluded from any race or ethnicity calculations (i.e., ratios, proportions, and others). The sample size (n) for each strata calculation was indicated whenever possible.

### All-Inclusive Criteria for Report

Data metrics presented in the narrative used live birth counts for the all-inclusive criteria.

**Numerator:** All cases were included in this report in every calculated statistic if they met the case criteria listed in [Appendix H](#).

**Denominator:** For mortality ratio calculations, all live births with an Arizona-issued birth certificate were included, regardless of county of residence or place of delivery, if the maternal age of the live birth was between 15-49 years of age at the time of birth.

$$\frac{\text{Maternal Deaths for Birthing Persons Ages 15-49 years of age}}{\text{Live Births for Arizona for Birthing Persons Ages 15-49 years of age}} \times 100,000 = \text{Mortality Ratio}$$

### Arizona Inclusion Criteria, per Statute ([Appendix H](#))

**Numerator:** Maternal death cases in which the decedent was aged 15-49 years at the time of death, and the death occurred in Arizona.

**Denominator:** All live births with an Arizona-issued birth certificate, regardless of county of delivery, provided maternal age was between 15 and 49 years at the time of birth.

$$\frac{\text{Maternal Deaths for Birthing Persons Ages 15-49 years of age}}{\text{Live Births for Arizona for Birthing Persons Ages 15-49 years of age}} \times 100,000 = \text{Mortality Ratio}$$

### CDC-Recommended Inclusion Criteria ([Appendix H](#))

**Numerator:** Maternal death cases in which the decedent was 15-49 years of age at the time of death, and most recently resided in Arizona.

**Denominator:** For maternal mortality ratio calculations, all live births with an Arizona-issued birth certificate were included, provided the maternal residence listed on the certificate was in Arizona and the maternal age was between 15-49 years at the time of birth.

$$\frac{\text{Maternal Deaths for Birthing Persons Ages 15–49 years of age}}{\text{Live Births for Arizona for Birthing Persons Ages 15–49 years of age}} \times 100,000 = \text{Mortality Ratio}$$

## Final Case Count

The final case count presented in this report includes all cases that met the following criteria:

**Decedent sex:** Persons identified as female in the Arizona death certificate, with confirmation from additional case records received by the abstraction team

**Age at time of death:** Persons aged between 15 and 49 years at the time of death, as indicated on the Arizona death certificate and further supported by cases reviewed by the abstraction team

**Pregnancy-Relatedness:** Persons identified as pregnancy-related by the MMRC. For figures [1](#) & [4](#), pregnancy-associated case counts included any of the following three categories of cases identified by the MMRC:

- Pregnancy-Related,
- Pregnancy-Associated, but Not Related, and
- Pregnancy-Associated, but unable to determine pregnancy-relatedness

**Arizona Residency and/or Place of Death:** The decedent met at least one of the following:

- Most recently resided in Arizona prior to death, as documented on the death certificate and/or the corresponding live birth certificate.
- Died in Arizona, as listed on the Arizona death certificate

Additionally, maternal death cases were included in the final case count if they met all of the following conditions:

- Satisfied all four criteria listed above (i.e., sex, age, pregnancy-relatedness, and Arizona residency and/or place of death)
- Had an identified Arizona death certificate number

The case was not identified through the Arizona MMR internal case identification process, and instead, any of the following scenarios apply:

- The case was identified through the Arizona Infant Mortality Review Program
- The case was identified through a non-Arizona MMR Program through their internal process, but the case either recently resided in Arizona or passed away in Arizona.
- The case was identified through the CDC media release database system.

## Mortality Ratios

Mortality Ratios are the preferred method for comparing trends across strata due to different data sources and slight differences in time intervals between maternal death cases (numerator) and live births (denominator). The three inclusion criteria standards were implemented for all report strata (i.e. categories) as needed. All data metrics included in the report narrative used the “All-inclusive” criteria. [Appendix H](#) displays data taking into account the Arizona and CDC-recommended inclusion criteria. In all cases, the selected inclusion criteria were implemented consistently to both the numerator and denominator when calculating mortality ratios.

## Maternal Race or ethnicity

### Case Counts

All maternal mortality cases in this report had race or ethnicity information documented in various fields. However, race or ethnicity information was primarily sourced from the Vital Records maternal death certificate race or ethnicity field for two main reasons:

- A high level of completeness for race or ethnicity data within the death certificate
- Consistency with Vital Records as the primary source of information for case counts (i.e. numerator for mortality ratios) with the denominator values for this stratum.

### Mortality Ratio Formula

Numerator: Maternal death cases were included in the race or ethnicity stratum, if race or ethnicity information was documented as described in the “Case Counts” section above.

Denominator: All live births with an Arizona-issued birth certificate were included in the denominator if maternal race or ethnicity was documented on the certificate.

Mortality Ratio for each Race or Ethnicity Stratum =

$$\frac{\text{Race or Ethnicity Category for Maternal Deaths, Ages 15–49 years of age}}{\text{Maternal Race or Ethnicity Category of Live Births, Ages 15–49 years of age}} \times 100,000$$

### Stratum (i.e. Categories)

- American Indian or Alaska Native (AI/AN)
- Asian or Pacific Islander (API)
- Black or African American
- Hispanic
- White, Non-Hispanic
- Unknown/Missing

## Maternal Age

### Case Counts

All maternal mortality cases in this report had the maternal age at time of death recorded. The primary source for maternal age information was the decedent's age field on the Vital Records death certificate, which was consistently documented for all cases.

### Mortality Ratio Formula

Numerator: All cases were included in the Maternal Age stratum of this report if they had age information documented as mentioned in the "Case Counts" description for these strata.

Denominator: All live births with an Arizona-issued birth certificate were included if the certificate had the maternal date of birth and date of birth of the child; these fields were used to calculate maternal age.

Mortality Ratio for each Age Group Stratum =

$$\frac{\text{Maternal Age Category for Maternal Deaths, Ages 15-49 years of age}}{\text{Maternal Age Category of Live Births, Ages 15-49 years of age}} \times 100,000$$

### Stratum (i.e. Categories)

- 10-19 years of age
- 20-29 years of age
- 30-39 years of age
- 40-49 years of age
- 50-60 years of age
- Over 60 years of age
- Unknown/Missing

## Maternal Education

### Case Counts

All maternal mortality cases in this report had maternal education information documented in various fields. Leveraging multiple data sources allowed for enhanced data completeness. The availability of maternal education data through multiple data fields in multiple data sources facilitated the use of conditional assignment statements within SAS version 9.4 to account for missing data and optimize the completeness of maternal education information within this report.

### **Mortality Ratio Formula**

Numerator: Maternal death cases were included in the maternal education stratum, if education information was documented, as mentioned in the “Case Counts” section.

Denominator: All live births with an Arizona-issued live birth certificate were included in this analysis if maternal education was documented in the certificate.

Mortality Ratio for each Maternal Education Group Stratum =

$$\frac{\text{Maternal Education Category for Maternal Deaths, Ages 15–49 years of age}}{\text{Maternal Education Category of Live Births, Ages 15–49 years of age}} \times 100,000$$

### **Stratum (i.e. Categories)**

- 8th Grade or Less
- 9th-12th Grade; No Diploma
- High School Graduate or GED Completed
- Some College Credit, but No Degree
- Associate’s Degree
- Bachelor’s Degree or More
- Unknown/Missing

### **Maternal Residence**

#### **Overview for Case Data**

All maternal mortality cases in this report had maternal residence documented across various fields and data sources. This facilitated the implementation of additional data management techniques that served to optimize completeness of maternal residence. This was especially important because maternal residency serves as the foundation for two key metrics in this report -Urban-Rural and Regional) - and was a required element for applying the CDC-recommended inclusion criteria.

#### **Overview of Mortality Ratio Formula**

Maternal residence information for live births are needed to calculate mortality ratios. Maternal residency for live births was primarily sourced from live birth certificate data.

#### **Maternal Residence Based on County**

<b>Arizona County</b>	<b>Region</b>	<b>Urban-Rural Designation</b>
Apache	Northern	Rural
Cochise	Southeastern	Rural

Coconino	Northern	Rural
Gila	Central	Rural
Graham	Southeastern	Rural
Greenlee	Southeastern	Rural
La Paz	Western	Rural
Maricopa	Central	Urban
Mohave	Western	Rural
Navajo	Northern	Rural
Pima	Southeastern	Urban
Pinal	Urban	Urban
Santa Cruz	Southeastern	Rural
Yavapai	Northern	Rural
Yuma	Western	Urban

\*Urban-Rural designation was based on definitions included in the Arizona Vital Statistics Annual Report.

**Urban-Rural Maternal Residence**

**Case Counts**

All maternal mortality cases with a recent residence in Arizona were classified as either Urban or Rural. Urban-Rural classifications were based on definitions outlined in the Arizona Vital Statistics Report.<sup>19</sup> Details on the data source are provided in the Maternal Residence - Overview of Case Data section.

**Mortality Ratio Formula**

Numerator: All maternal mortality cases were included in the urban-rural maternal residence stratum if the county of maternal residence was documented (see Maternal Residence “Overview of Case Data”)

Denominator: All live births with an Arizona-issued live birth certificate were included in the denominator, where the county of maternal residence was documented on the certificate.

Mortality Ratio for each Residence Stratum =

$$\frac{\text{Urban-Rural Maternal Residence Category for Maternal Deaths, Ages 15-49 years of age}}{\text{Urban-Rural Maternal Residence Category of Live Births, Ages 15-49 years of age}} \times 100,000$$

**Stratum (i.e. Categories)**

- Urban
- Rural

**Regional Maternal Residence**

**Case Counts**

All maternal mortality cases with recent residence in Arizona were assigned to one of the four Arizona Regions (see Maternal Residence - Maternal Residence Based on County). Details on data sources are described in the Maternal Residence -Overview of Case Data section.

**Mortality Ratio Formula**

Numerator: All cases were included in the regional maternal residence stratum of this report if they had a county of maternal residence documented (see Maternal Residence “Overview of Case Data” section).

Denominator: Live births with an Arizona-issued live birth certificate that met the inclusion criteria and had the maternal county of residence documented were included.

Mortality Ratio for each Regional Stratum =

$$\frac{\text{Regional Maternal Residence Category for Maternal Deaths, Ages 15-49 years of age}}{\text{Regional Maternal Residence Category of Live Births, Ages 15-49 years of age}} \times 100,000$$

**Stratum (i.e. Categories)**

- Central
- Northern
- Southeastern
- Western

**Maternal Payor Type**

**Case Counts**

All maternal mortality cases in this report had payor type information documented in various fields, which helped mitigate data gaps in this stratum. Medical insurance information for decedents was sourced from the Maternal Mortality Review Information App (MMRIA) registry. The primary source of payor information was the insurance payor listed for the obstetric delivery, as recorded on the corresponding live birth or fetal death certificates. If payor information was unavailable in the registry, then the payor was identified from inpatient

hospital records acquired by the program. In cases where both sources were missing payor information, the payor type recorded in MMRIA was used. This approach ensured minimal missing data for these strata.

### ***Mortality Ratio Formula***

Numerator: Maternal death cases were included in the insurance type stratum of this report if payor information was documented as mentioned in the “Case Counts” description for this metric.

Denominator: All live births with an Arizona-issued live birth certificate were included in the denominator if payer of the delivery was documented on the certificate.

Mortality Ratio for each Payor Type Stratum =

$$\frac{\text{Payor Type Category for Maternal Deaths, Ages 15–49 years of age}}{\text{Payor Type Category of Live Births, Ages 15–49 years of age}} \times 100,000$$

### ***Stratum (i.e. Categories)***

- Private Insurance
- Medicaid
- Self-Pay: indicated when no source of payment was identified at the time of admission. Self-Pay can be due to various complex societal factors (e.g. foreign-born, insurance lapse, pay out-of-pocket, etc.) which is beyond the scope of this report.
- Other: included Indian Health Services and TriCare/CHAMPUS.

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