Maternal Mortality in Arizona, 2018-2019

January 2024

ARIZONA DEPARTMENT OF HEALTH SERVICES

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Dedication

Dedicated to all the people that have been lost during pregnancy, delivery, or postpartum; this report stands as a testament to our commitment to understanding and preventing maternal mortality.

Acknowledgements

The Arizona Department of Health Services (ADHS) would like to acknowledge the Maternal Mortality Review Committee (MMRC) co-chairs throughout the review of these maternal deaths, including Dr. Kendra Gray, Dr. Andrew Rubenstein, and Dr. Sarah Kellerhals.

ADHS would also like to acknowledge the 57 members of the Arizona MMRC who completed the 149 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 deaths 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.

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Intended Audience

This is a technical report on the analysis of the incidence and causes of Maternal Mortality in Arizona during 2018 and 2019. This report is aimed primarily at those actively involved in the care of and improvements to maternal health, including healthcare providers, community service providers, researchers, policymakers, and other stakeholders. While publicly available, the intended audience of this report is not the general public, and extra care in the use or interpretation of this report should be taken by those with limited background or subject-matter expertise in the areas of maternal health and complications of labor and delivery.

How to Use This Report

This report describes the incidence of maternal deaths in Arizona, as well as a variety of risk factors contributing to these mortalities among birthing persons in Arizona. The key findings presented in this report should assist in the identification of future targets for intervention and guide effective and evidence-based efforts towards the reduction of adverse maternal health outcomes.

Disclaimers

Use of Term: Maternal Mortality

The use of the term “Maternal Mortality” (MM) in this report may differ from use by other organizations, such as the World Health Organization. In this context it is used interchangeably with “Pregnancy-Associated Deaths”. More definitions can be found in the Glossary.

Use of Gender-Neutral Language

This report aims to provide a comprehensive analysis of pregnancy-associated deaths, acknowledging the diverse range of individuals affected by such tragic outcomes, regardless of their gender identity. Throughout this report, references to 'birthing people' or other gender-neutral terms are used to be inclusive of all individuals who can become pregnant. In some areas, the term ‘women’ is used intentionally when ‘female’ is specifically identified within the data sources.

Definition of Race

Racial and ethnic designations used in this topical report are based on Arizona Department of Health Services’ Office of Vital Records certificate information. Race/ethnicity for maternal deaths was based on race and ethnicity identified in the maternal death certificates, where women who identified as both Hispanic and any other race were identified as Hispanic. For data indicators in this report that include live births, race/ethnicity of the mother was indicated based on maternal race/ethnicity reports in the live birth certificates.

Data Suppression

ADHS follows specific guidelines related to suppressing numbers less than six but greater than 0 to protect confidentiality of rare cases and to eliminate bias or room for error in reporting numbers, percentages, or ratios. Therefore, findings in this report with less than six cases are suppressed along with any corresponding calculations.

Previous ADHS Reports on Maternal Mortality

The findings in this report related to maternal mortality were derived from the Review to Action methods, which the Arizona Department of Health Services adopted in 2018. There have been two previous reports published that align with these methods: the Maternal Mental Health- and Substance Use- Related Deaths in Arizona report (2016-2018) and the Maternal Mortalities (2016-2017) and Severe Maternal Morbidity in Arizona report (2016-2019). The first Arizona Maternal Mortality Review Program report (2012-2015) was created before these methods were adopted. For this reason, maternal mortality findings between 2016-2019 should not be compared to findings reported for 2012-2015.

Arizona Health Status and Vital Statistics Annual Reports

The Bureau of Public Health Statistics (BPHS) in Arizona Department of Health Services publishes the Arizona Health Status and Vital Statistics Annual Reports, which includes maternal and infant health outcomes. Data in this topical report may differ from previously published data based on additional descriptive context and data obtained during the maternal mortality review process. Population-level data for births of all Arizona residents can be found in the Arizona Health Status and Vital Statistics Annual Report.

Prevention Recommendations

The prevention recommendations included in this report are developed by the MMRC and do not necessarily reflect the official views of the Arizona Department of Health Services (ADHS) or the State of Arizona. The MMRC recommendations and a literature review conducted by the Maternal Mortality Review Program make up the recommendations that are included in this report.

Publication Information

This publication can be made available in alternative formats. Contact the Maternal Mortality Review Program by emailing maternalhealth@azdhs.gov or calling 602-354-1430.

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: 5 NU58DP006678 funded by the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent official views of the Centers for Disease Control and Prevention or the Department of Health and Human Services.

Letter from the Chairs of the MMRC

Dear Colleagues,

We are writing to you as the Co-Chairs of the Arizona Maternal Mortality Review Committee (MMRC), tasked with overseeing the comprehensive examination of maternal deaths in our state. This correspondence serves as an introduction to our report on maternal deaths in Arizona between 2018-2019.

The Arizona MMRC, under the guidance and in collaboration with the staff of the ADHS, has undertaken the responsibility of scrutinizing all maternal deaths occurring in our state. The overarching goal of this report is to illuminate statewide trends in maternal mortality, with the ultimate aim of providing actionable recommendations to prevent adverse outcomes and enhance the overall health of Arizona families.

The recommendations contained within this report are strategically categorized into four primary areas: providers, facilities, systems, and the community. Each set of recommendations addresses specific concerns based on the committee's findings, proposing tangible actions expected to reduce maternal mortalities when implemented.

In expressing our deepest gratitude, we would like to extend thanks to the exceptional staff at the ADHS and our dedicated team of volunteer Committee Members. The commitment to reviewing these cases in meticulous detail often goes unnoticed and unappreciated. The team's unwavering dedication to this cause has been instrumental in the production of this report.

Additionally, as we present this report, it is with heavy hearts that we take a moment to recognize and honor the individuals whose lives were tragically lost during the period under review. To their families and friends who bear the weight of this loss, we extend our deepest sympathy and unwavering support. In the face of these heart-wrenching circumstances, we want you to know that our thoughts are with you. It is our sincere hope that the findings and recommendations outlined in this report not only pay homage to those we have lost but also contribute to a future where no life is sacrificed without affording an opportunity to shape a better, safer, and more compassionate maternal healthcare system for all. May their memories inspire the necessary changes to prevent such tragedies in the future.

In conclusion, we believe that the insights and recommendations provided in this report will serve as a valuable resource for all stakeholders involved in maternal healthcare. We appreciate your attention to this critical matter and look forward to ongoing collaboration to implement the recommended measures.

Sincerely,

Kendra Gray, DO *Sarah Kellerhals, MD* *Andrew Rubenstein, MD*

Glossary

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

Birthing person: Typically refers to those who are biologically female; however, the term is used to promote inclusivity by encompassing anyone capable of becoming pregnant.

Maternal Mortality: Deaths occurring 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): CDC developed database to collect/abstract clinical and non-clinical information pertaining to the maternal death. Committee Decisions MMRIA Form standardizes review by guiding committee determinations about pregnancy relatedness, manner of death, cause of death and preventability for each case.

Natural Death: A death occurring in the course of nature and from natural causes, such as age or disease.

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.[1]

Pregnancy-Associated, but Not Related: A death during or within one year of pregnancy, from a cause that is not related to pregnancy.[1]

Pregnancy-Associated Mortality Ratio (PAMR): An estimate of the number of pregnancy-associated deaths for every 100,000 live births.

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. In addition to having a temporal relationship to pregnancy, these deaths are causally related to pregnancy or its management.[1]

Pregnancy-Related Mortality Ratio: 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 *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 (MMRC reviewed deaths) or birth certificate at the time of delivery (analysis of Severe Maternal Morbidities). This is not an indication of citizenship or legal residence in Arizona.

Serious Mental Illness: Someone over the age of 18 who has (or had within the past year) a diagnosable mental, behavioral, or emotional disorder that causes serious functional impairment that substantially interferes with or limits or more major life activities. Serious mental illness includes schizophrenia; severe, major depression; severe bipolar disorder; and a few other disorders.[2]

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 which 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

Executive Summary

In Arizona, approximately 71 pregnant or birthing persons died within 365 days of pregnancy each year, of which, 87% per year were preventable on average. National rates of Maternal Mortality (MM) have steadily increased over the last decade, indicating a need for national, state, and local efforts to improve maternal health outcomes.[3] These outcomes can be attributed to a range of factors, including social determinants of health such as financial, housing, transportation, and food security, which have a direct impact on the accessibility of affordable, high quality, and coordinated maternal health care.[4]

Arizona has a unique geographic location as a frontier state with Mexico; is home to 22 federally recognized tribes; and has a combination of vast rural areas and some of the fastest growing urban areas in the United States. Arizona Vital Records reports that between 2018-2019, 41.6% of live births are to Latina persons, 5.8% of live births are to American Indian persons, and 5.9% are to Black persons.[5,6] Arizona's diverse demographic characteristics indicate the need for innovative and targeted strategies that reduce maternal mortality through a multi-faceted approach.

In response to this growing maternal health crisis, Arizona has implemented several initiatives to improve maternal health outcomes. In 2019, the Governor's Goal Council designated MM as a Breakthrough Project, leading to the development of a Maternal Mortality Action Plan. The state established the Advisory Committee on Maternal Fatalities and Morbidity, generating 26 recommendations to enhance data collection for Maternal Mortality and Severe Maternal Morbidity. The ADHS was one of 24 states awarded the Preventing Maternal Deaths: Supporting Maternal Mortality Reviews Grant (i.e., ERASE MM grant) in the Fall of 2019 to strengthen Arizona's MMRC processes and fund associated prevention efforts. Arizona also received an award from the US Department of Health and Human Services Health Resources and Services Administration's State Maternal Health Innovation Program to support the initiatives as defined in the Maternal Mortality Action Plan. Finally, Arizona participates in the Pregnancy Risk Assessment Monitoring System (PRAMS), which is a joint research project between ADHS and CDC to understand experiences before, during, and after pregnancy.

This report focuses on maternal deaths that occurred between 2018 and 2019, presenting descriptive statistics on incidence, causes, contributing factors, and demographics of the 149 cases reviewed. The MMRC has identified 44 data-driven recommendations to inform all maternal health partners and advocates in the collective effort to improve the health and well-being of birthing persons and their families in Arizona.

Key Findings for Maternal Mortality, 2018-2019

Below is a summary of the key findings. For more information, see **Section 2**.

MM Comparison 2016-2017 vs. 2018-2019: From 2016-2017 to 2018-2019, we observed an increase in both Pregnancy-Associated mortality ratios (79.1 to 91.2 maternal deaths per 100,000 live births) and Pregnancy-Related mortality ratios (18.3 to 26.3 maternal deaths per 100,000 live births) by 15.3% and 43.7%, respectively

MM by Pregnancy Relatedness: In 2018-2019, of 149 Pregnancy-Associated deaths, 43 (28.9%) were determined to be Pregnancy-Related, 72 (48.3%) were determined to be Pregnancy-Associated but not related, and 34 (22.8%) pregnancy-relatedness was unable to be determined.

MM by Preventability and Timing of Death: Of the 149 Pregnancy-Associated deaths, 33 (23.1%) transpired during pregnancy, and 100% of those deaths were determined to be preventable by the MMRC. There were 6 deaths (4.5%) on the day of delivery, with 85.7% preventability. Within the period from birth to 42 days post-pregnancy, 21 deaths (13.4%) occurred, 85.7% of which were preventable. Postpartum deaths, occurring between 43 days and one year post-pregnancy, accounted for 89 cases (59.0%), with an 88.8% preventability rate. 90.7% (n=39) of the Pregnancy-Related deaths were preventable with 41.0% (n=16) of the deaths had a "Good Chance" of alternative outcome and 51.3% (n=20) held "Some Chance."

MM by Manner and Conditions of the Death: Accidents accounted for the highest proportion of Pregnancy-Associated deaths (46.3%, n=69), followed by natural deaths (30.2%, n=45), homicide (12.1%, n=18), and suicide (8.1%, n=12). The leading manner of death for Pregnancy-Related deaths was Natural (41.9%, n=18), followed by Accident (27.9%, n=12) and suicide (14.0%, n=6). Homicides constituted a suppressible number (<6 deaths) among pregnancy-related deaths. There were suppressible numbers (6 or less deaths) of pregnancy-related deaths where the manner of death is “Pending Investigation” or “Could Not Be Determined” in 2018-2019.

MM by Primary Underlying Cause of Death: The most common underlying cause of Pregnancy-Related deaths was mental health conditions (32.6%, n=14), followed by cardiovascular conditions (20.9%, n=9), hemorrhage (16.3%, n=7), and infection (16.3%, n=7).

MM by Maternal Race and Ethnicity: More than a third (37.6%, n=56) of the Pregnancy-Associated deaths were of White, non-Hispanic persons and made up 42.7% of live births. Hispanic or Latina persons accounted for 32.9% (n=49) of Pregnancy-Associated deaths and 41.6% of live births. American Indian or Alaska Native persons accounted for 14.8% (n=22) of Pregnancy-Associated deaths, but only 5.8% of the live birth population, showing a large disparity in Pregnancy-Associated deaths. Black or African American persons accounted for 10.7% (n=16) of Pregnancy-Associated deaths and 5.9% of live births, also indicating a disparity. Asian or Pacific Islander persons accounted for a suppressible number (<6 deaths) of Pregnancy-Associated deaths. Among the Pregnancy-Related deaths, 33.3% (n=14) were White, non-Hispanic persons. Hispanic or Latina persons accounted for 38.1% (n=16) of Pregnancy-Related deaths. Black or African American persons accounted for 14.3% (n=6) of Pregnancy-Related deaths. Lastly, American Indian or Alaska

Native persons and Asian or Pacific Islander persons accounted for a suppressible number (less than 6 deaths) of Pregnancy-Related deaths.

American Indian or Alaska Native persons had the highest Pregnancy-Associated Mortality Ratio (PAMR) at 233.9 deaths per 100,000 live births, followed by Black or African American persons at 166.8 deaths per 100,000 live births.

MM by Maternal Age: Disparities were present among three age groups where the Pregnancy-Associated deaths exceeded that of the percent of live births for that age group. This is the case for ages 30-39 (43.0% [n=64] of Pregnancy-Associated deaths, despite accounting for 39.3% of live births), 40-49 (5.4% [n=8] of Pregnancy-Associated deaths, despite accounting for 3.1% of live births), and 10-19 (6.7% [n=10] of Pregnancy-Associated deaths, despite accounting for 5.6% of live births). Persons 40-49 years old had the highest Pregnancy-Associated Mortality Ratio (PAMR) at 156.3 deaths per 100,000 live births, followed by persons 10-19 years old (109.3).

MM by Maternal Education: A disparity exists among persons with a high school or GED education with 39.5% (n=58) of Pregnancy-Associated deaths and 26.6% of live births. A disparity was also observed among persons who attained 9th-12th grade education with no diploma (21.8% [n=32] of Pregnancy-Associated deaths and 13.3% of live births). These educational disparities may suggest that education plays a role in influencing maternal health. Comparatively, those who attained a Bachelor's degree or more accounted for 10.9% (n=16) of Pregnancy-Associated deaths and 25.6% of live births.

MM by Maternal Residence: During 2016-2019, Arizona's maternal health data from the Bureau of Public Health Statistics showed consistent live birth rates across both urban and rural counties. However, urban counties experienced a slight decline in Pregnancy-Associated deaths from 82.1% in 2016-2017 to 77.9% in 2018-2019. Conversely, rural areas experienced an increase from 15.7% in 2016-2017 to 17.4% in 2018-2019. This indicates steady live birth trends but emerging disparities in maternal deaths between urban and rural areas, highlighting potential rural maternal health challenges.

MM by Insurance Type: Pregnancy-associated deaths were disproportionately represented among cases where Medicaid was the primary insurance type. While 49% of live births in Arizona had Medicaid as the primary payor, 72% (n=105) of Pregnancy-Associated deaths had Medicaid listed as the primary insurance type. Private insurance was listed for 41% of live births, and 18% (n=27) of Pregnancy-Associated deaths had private insurance listed as the primary payor. Of the live births in Arizona, 5% were listed as a self-pay for insurance type, and 7% (n=10) of all Pregnancy-Associated deaths had self-pay listed as their insurance type.

MM by Contributing Factors: Substance Use Disorder was identified as a contributing factor to almost half (47.7%, n=71) of Pregnancy-Associated deaths and 41.9% (n=18) of Pregnancy-Related deaths. Mental health conditions contributed to 38.3% (n=57) of Pregnancy-Associated deaths and 39.5% (n=17) of Pregnancy-Related deaths. Obesity contributed to 12.1% (n=18) of Pregnancy-Associated deaths and 20.9% (n=9) of Pregnancy-Related deaths.

Top Recommendations to Prevent Maternal Deaths in Arizona

In response to the MM rates described above, the Arizona MMRC has identified several recommendations to improve maternal health outcomes within the state. Those listed below are the 10 most frequently recommended strategies to address the contributing factors present in 2018-2019 deaths. For a more detailed list of recommendations, see **Section 3**.

→ **Establish continuity of care to ensure timely care coordination between appropriate healthcare providers** (on or offsite) and wraparound services for the family to address social determinants of health and barriers to care by utilizing community-based personnel, following existing guidelines, and obtaining grant funding as needed, especially at specific opportunities for those with increased risk factors. Community-based personnel that could potentially facilitate continuity of care includes, but is not limited to, case managers, patient navigators, social workers, and community-based birth workers. These personnel should follow existing guidelines outlined by the Agency for Healthcare Research and Quality (AHRQ), Centers for Medicare & Medicaid Services (CMS), Health Resources and Services Administration (HRSA), and Institute for Healthcare Improvement (IHI).

→ **Increase adoption of trauma- and culturally-informed practices for providers** by partnering with universities or organizations to adapt curriculum for providers to be trained in providing patient-centered care, which includes the appropriate level of support, navigation, counseling and dialogue with patients and their families about pertinent healthcare topics while ensuring messaging meets language preferences (i.e. interpreters and translators available in-person, by phone, or by video) and reduces stigma, while empowering families to make informed decisions, advocate for themselves, and improve health literacy and health-seeking behavior.

→ **Increase access to high quality mental and behavioral health services** and resources that are affordable, trauma-informed, and supportive of the family unit. Delivering high-quality mental and behavioral health services should look like evidence-based, standardized processes for referral, intake, and care coordination across all settings including but not limited to inpatient care, standard and intensive outpatient care, maternal- and youth-specific care, tribal health clinics, long-term group homes, and clinics offering Medication for Opioid Use Disorder (MOUD). These services should also involve coordination of resources through social work, case management, or peer support services. These services should be prioritized for those who are pregnant or postpartum and facing additional challenges like lack of transportation, unstable housing, rurality, Serious Mental Illness or other mental health conditions, Substance Use Disorder, or those who are managing chronic health conditions, utilizing adoption or foster services, or at an increased risk of suicide.

→ **Expand insurance coverage to provide adequate, timely, and value-based reimbursement mechanisms for the range of maternal health services beyond one year postpartum** and other necessary health services for providers or organizations serving pregnant and postpartum individuals (i.e. regardless of pregnancy outcome) by advancing birth equity and removing barriers, particularly for indigenous peoples, those in the foster care system, and those moving between states or otherwise experiencing a gap in coverage. This recommendation pertains to

payers of health services like the Arizona Health Care Cost Containment System (AHCCCS), Indian Health Services (IHS), Federal Emergency Services, and private payers.

→ **Ensure providers in all settings are screening pregnant persons and their partners** before, during, and after pregnancy or adoption (e.g. prior to discharge) for domestic violence, mental illness (e.g., Perinatal Mood and Anxiety Disorders, Serious Mental Illness), Substance Use Disorder, and Adverse Childhood Experiences. Settings that interact with pregnant persons and their partners include but are not limited to hospitals, schools, correctional facilities, obstetric and pediatric clinics. One strategy to ensure providers are screening is to establish a state universal screening mandate.

→ **Increase provider education about the perinatal period** including signs and symptoms, risk factors, routine screenings, diagnostic criteria, reporting requirements, response protocols, evidence-based medication guidelines, treatment guidelines, and alternative treatment options by securing funding for and requiring or incentivizing participation in continuing education classes. Providers that would benefit from education regarding the perinatal period include but are not limited to first responders, general providers, obstetric and non-obstetric providers, emergency department providers, physician assistants, mental and behavioral health providers, cardiologists, prescribers, pharmacists, and prenatal massage therapists.

→ **Improve access to the full range of reproductive health services** including contraceptives, especially prior to discharge from the birthing facility, and ongoing gynecological care by integrating health services and addressing barriers and social determinants of health by consistently using standardized decision aids when discussing all contraceptive options to avoid coercion.

→ **Ensure facilities have adequate infrastructure, protocols, and procedures to improve readiness, prevention, recognition and response to obstetric emergencies** and expedite coordination of care with a 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.

→ **Address access to care barriers such as for pregnant and postpartum individuals related to income insecurity** while prioritizing assistance to those with children, experiencing domestic violence, using substances, and/or lack a support system.

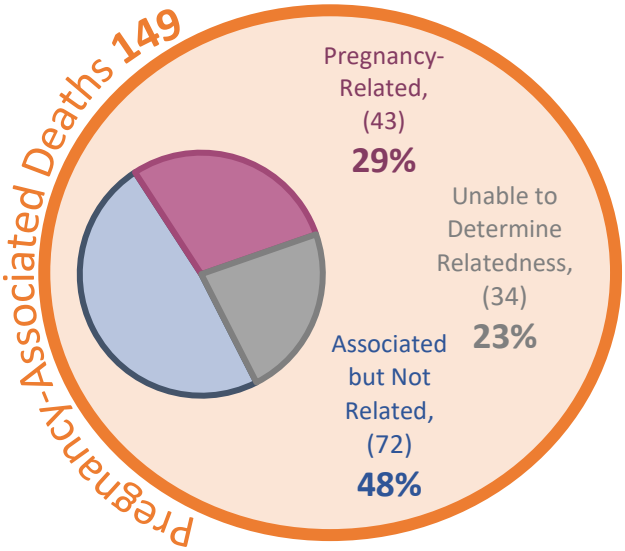
→ **Increase patient education about substance use and misuse** including overdose education, harm reduction strategies, and where to access treatment services. The education is most important for patients and families with a history of substance use as well as community members living in high-risk areas.

Maternal Mortality in Arizona, 2018-2019

ARIZONA DEPARTMENT OF HEALTH SERVICES

MMRC Reviewed Deaths in Arizona of Women 10-60 Years of Age with a Pregnancy in the Previous 365 Days

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

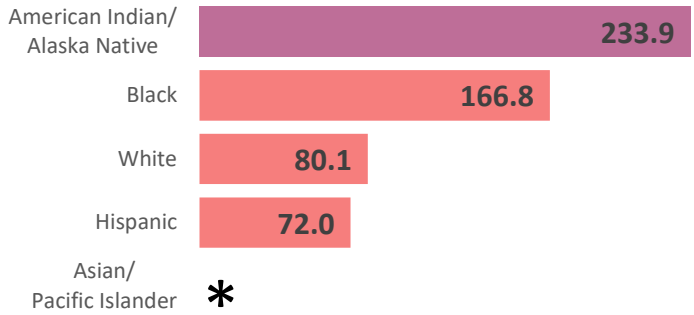


The most common primary underlying cause of death among Pregnancy-Related cases was mental health

- **32.6%** Mental Health Conditions
- **20.9%** Cardiovascular Conditions*
- **16.3%** Hemorrhage (excludes Aneurysms & Cerebrovascular accidents)
- **16.3%** Infections

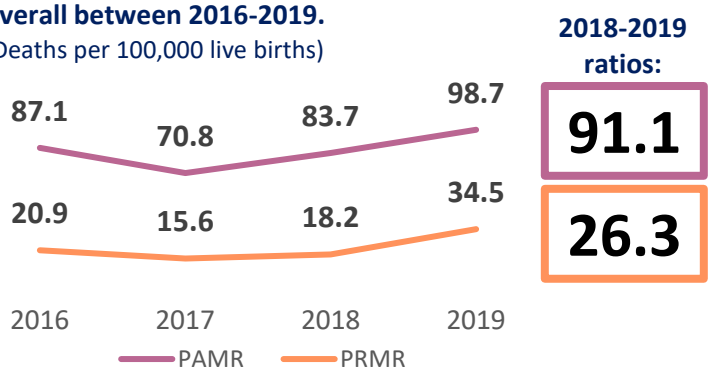
**Includes Amniotic Fluid Embolism, Cardiomyopathy, Embolism- Thrombotic (Non-Cerebral), Hypertensive Disorders of Pregnancy, and Other Cardiovascular Conditions*

American Indian/Alaska Native women exprienced the highest Pregnancy-Associated Mortality Ratio.
(Deaths per 100,000 live births)



**Suppressed due to figures less than 6.*
(Misclassification bias may be present for cases &/or live births with multiple racial/ethinic identities. Please interpret data with caution.)

The PRMR and PAMR in Arizona slightly increased overall between 2016-2019.
(Deaths per 100,000 live births)



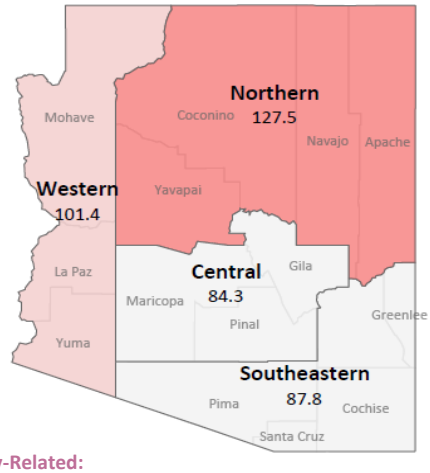
2018-2019 ratios:

91.1

26.3

**2016-2017 data includes maternal deaths ages 15-49 years; 2018-2019 data includes maternal deaths ages 10-60 years.*

The Pregnancy-Associated Mortality Ratio in the Northern and Western Region of Arizona were the highest in the state. (Deaths per 100,000 live births)



90% of Pregnancy-Associated 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.

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 (PAMR):
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

January 2024

Section 1: Overview of Maternal Health

For a better understanding of the spectrum of maternal health outcomes that occur 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. There are many factors influencing maternal health outcomes before, during, and after pregnancy, some of which are described on pages 26-27 of the same report.

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

Figure 1 demonstrates that while all deaths (shown as leaves on the tree) within 1 year are considered Pregnancy-Associated, only a smaller portion are Pregnancy-Related.

Figure 1. Pregnancy-Associated Deaths

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.[1]

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.[1]

Pregnancy-Associated, but Not Related: A death during or within one year of pregnancy, from a cause that is not related to pregnancy.[1]

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 essential to determining the pregnancy-relatedness of deaths occurring among Arizona birthing persons within 365 days of a pregnancy.

In 2019, ADHS's Maternal Mortality Review Program (MMRP) was one of 24 states awarded the Preventing Maternal Deaths: Supporting Maternal Mortality Reviews Grant (i.e., ERASE MM grant) from the CDC. The aim of this funding is to better understand and prevent pregnancy-related deaths by gathering detailed data on causes and circumstances surrounding maternal deaths and developing recommendations for prevention.

In 2019, ADHS's Maternal Health Innovation Program (MHIP) was also awarded funding through the US Department of Health and Human Services Health Resources and Services Administration's State Maternal Health Innovation Program to support several initiatives that aim to improve maternal health outcomes in Arizona, including the implementation of the Alliance for Innovation on Maternal Health patient safety bundles.[7]

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a joint research project between ADHS and CDC to understand mothers' experiences before, during, and after pregnancy. Each month, Arizona PRAMS conducts questionnaires (both phone and mailed surveys) with 1 in 30 new mothers in the state about prenatal care, health insurance coverage, mental health and/or substance use during pregnancy, pre- and inter-conception care, and infant health. The purpose of this data collection is to inform future ADHS efforts to improve health outcomes for mothers and their babies in Arizona.

ADHS' High Risk Perinatal Program (HRPP) is a comprehensive, statewide system of services dedicated to reducing maternal and infant mortality and morbidity through the following strategies: 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.

Arizona Health Start Program is a statewide initiative aimed at supporting pregnant women, new mothers, and their families. This program focuses on providing comprehensive services to improve maternal and infant health outcomes, especially for those individuals facing socioeconomic challenges or at risk of poor health outcomes.

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

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 to the CFR Program. Since its establishment in July 2011, the subcommittee convened by the Arizona MMRP has been reviewing all identified maternal deaths in the state. The Arizona Statute Language can also be found in Appendix B.

Structure and Membership

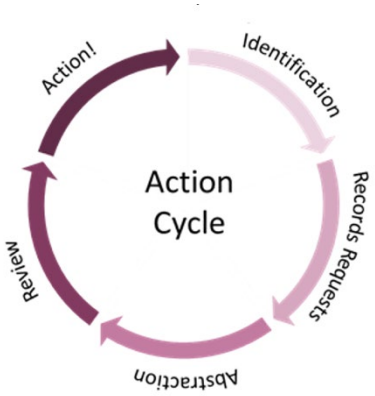
The MMRP is implemented and coordinated by ADHS staff in the Bureau of Assessment and Evaluation (BAE) including an office chief, program manager, nurse abstractors, epidemiologists, and administrative staff. ADHS staff are responsible for identifying maternal mortalities, requesting records and developing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

During the time of these reviews, the MMRC consisted of 57 external clinical and non-clinical members who represent a range of maternal health practitioners (e.g., obstetricians, Maternal Fetal Medicine specialists, midwifery, registered nurses, community-based birth workers, home visitors), mental and behavioral health specialists, domestic violence service providers, community-based organizations, peer support and advocacy groups, academic institutions, forensic experts, state and local public health professionals, and Indian Health Services. A list of MMRC members can be found in Appendix A.

Methodology for Reviewing Maternal Mortalities

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 is derived from Review to Action which is used by CDC and other ERASE MM funded states. As shown, the Review to Action methodology is considered to be cyclical in that as the number of cases reviewed using this protocol increases, the consistency, and reliability of the data and recommendations being put forth increases as well. Ultimately, this process leads to a comprehensive snapshot of the risks and barriers birthing persons face that sometimes result in maternal mortality, and areas of opportunity to improve those outcomes. For a full description of the Review to Action guidelines, please see the previous report, Maternal Mortality and Morbidity in Arizona.

Figure 2. Review to Action Cycle



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 the same, some features evolved throughout the Arizona MMRP's review of 2018-2019 deaths, resulting in a few instances of missing or incomplete data. A detailed flow chart of steps included in the Review to Action Process is included in Appendix C.

For more detailed information about this methodology, see pages 31-33 of the 2020 report on Maternal Mortalities and Severe Maternal Morbidity in Arizona.

Analytical Methods: Mortality ratios were calculated by estimating the number of pregnancy-associated deaths for every 100,000 live births identified in Arizona through the Arizona Vital Records Office. Mortality ratios were calculated for all pregnancy-associated deaths, for the subset of pregnancy-related deaths, and for select sociodemographic characteristics. Percentage proportions were calculated for descriptive characteristics of maternal deaths. These characteristics were primarily identified by the Maternal Mortality Review Committee. Maternal death proportional differences were then compared to percent proportional differences of live births identified in Arizona. No statistical testing was performed. We followed methodology for race/ethnicity established in the vital statistics report.[5,6] Race/ethnicity are mutually exclusive categories.

Section 2: Findings for Maternal Mortalities in Arizona, 2018-2019

This section presents findings from various sources, including death certificates and committee decisions made during maternal mortality reviews. ADHS adheres to guidelines, suppressing numbers under six for confidentiality and unbiased reporting. The analysis focuses on Pregnancy-Associated deaths, with Pregnancy-Related deaths included when numbers exceed six. Percent proportions summarize the findings, without statistical tests for significant differences. Recommendations from all cases, including suppressed findings, are included in **Section 3**.

MM Comparison 2016-2017 vs. 2018-2019

Pregnancy-Associated Mortality Ratios (PAMR) for 2016-2017 and 2018-2019 can be seen in **Figure 3**. PAMR data for 2016-2017 show a ratio of 79.1 per 100,000 live births, and show a 15.3% increase in 2018-2019 to 91.2 Pregnancy-Associated deaths for every 100,000 live births.

Pregnancy-Related Mortality Ratio (PRMR) data for 2016-2017 show that for every 100,000 live births, there were 18.3 maternal deaths. The 2018-2019 data show a 43.7% increase, where for every 100,000 live births, there were 26.3 maternal deaths.

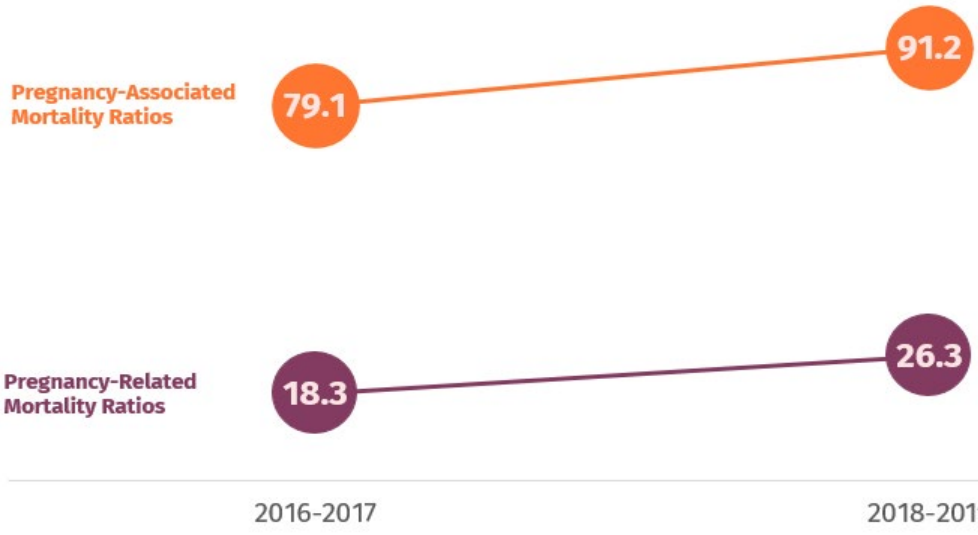


Figure 3. Maternal Mortality in Arizona: 2016-2019, 2-year Mortality Ratios per 100,000 live births (15-49 years of age)

Disclaimer: In 2018-2019, per CDC guidelines, the age criteria for Pregnancy-Associated and -related deaths expanded from 15-49 years to 10-60 years. In the figure above, all mortality ratios include 15-49 years. We also observed an increase in maternal deaths at the national level.[3] *See Appendix F for more information.*

MM by Pregnancy Relatedness

The MMRC reviewed a total of 149 deaths that occurred between 2018-2019. The majority of deaths were determined to be Pregnancy-Associated (48%, n=72) but not related to pregnancy, 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 these, 29% were Pregnancy-Related deaths (n=43), 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."

Additionally, 23% were deaths where the MMRC was unable to determine the relatedness of pregnancy to the death (n=34).

In contrast, to previous years, between 2016 and 2017, Arizona observed 203 deaths, but within the age range of 15-49. A closer look at this data revealed that 22.6% were pregnancy-related (n=46), and 67.6% were associated but not caused by pregnancy (n=138). In this period, the cases where the relation to pregnancy was undetermined were relatively lower, at 9.8% (n=19).

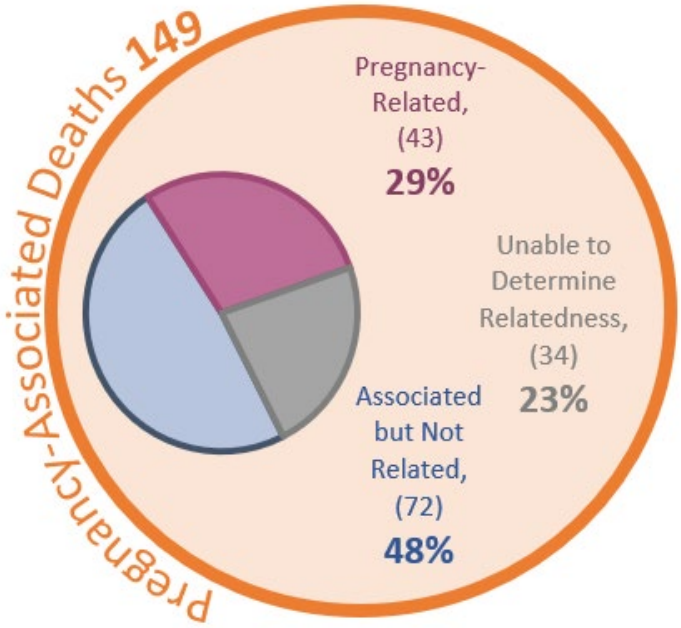


Figure 4. Pregnancy-Relatedness among 2018-2019 Arizona MMRC Reviewed Pregnancy-Associated Deaths

MM by Preventability and Timing of Death

In their assessment, the MMRC identified a death as preventable when there was a possibility that the death could have been avoided through one or more reasonable changes to patient care, family support, medical provider actions, facility standards, systemic processes, or broader community initiatives. Once a death was categorized as preventable, the MMRC further analyzed the likelihood that changes could have led to a different outcome categorizing by the chance to alter outcome as Good Chance, Some Chance or No Chance.

The MMRC found that a significant 89.9% (n=134) of the Pregnancy-Associated deaths were preventable with 39.6% (n=53) of the deaths had a "Good Chance" of alternative outcome and 53% (n=71) held "Some Chance", as highlighted in **Figure 5A**. The remaining were categorized as “No Chance” or “Unable to Determine,” and were suppressed due to low count.

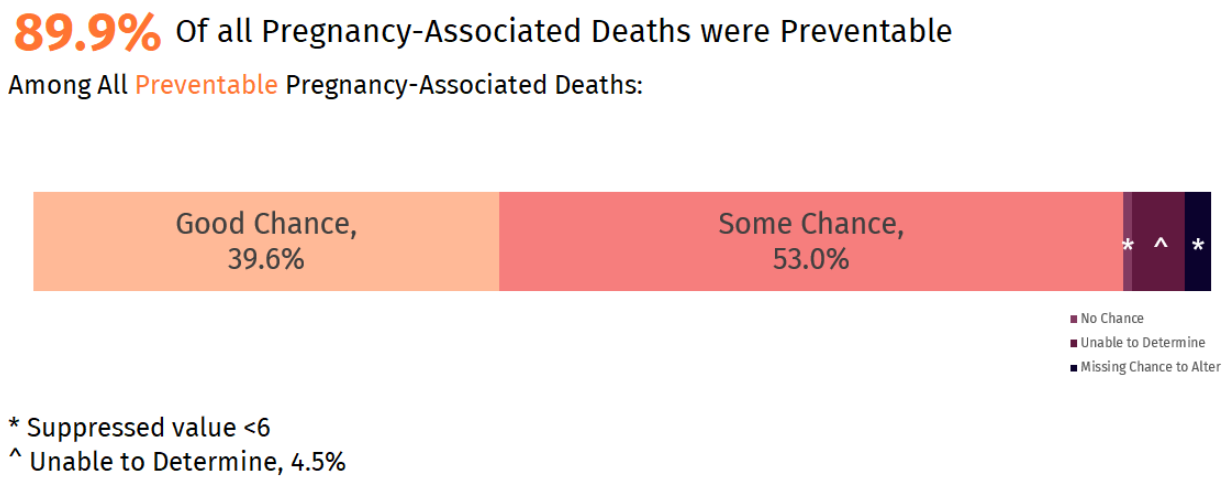
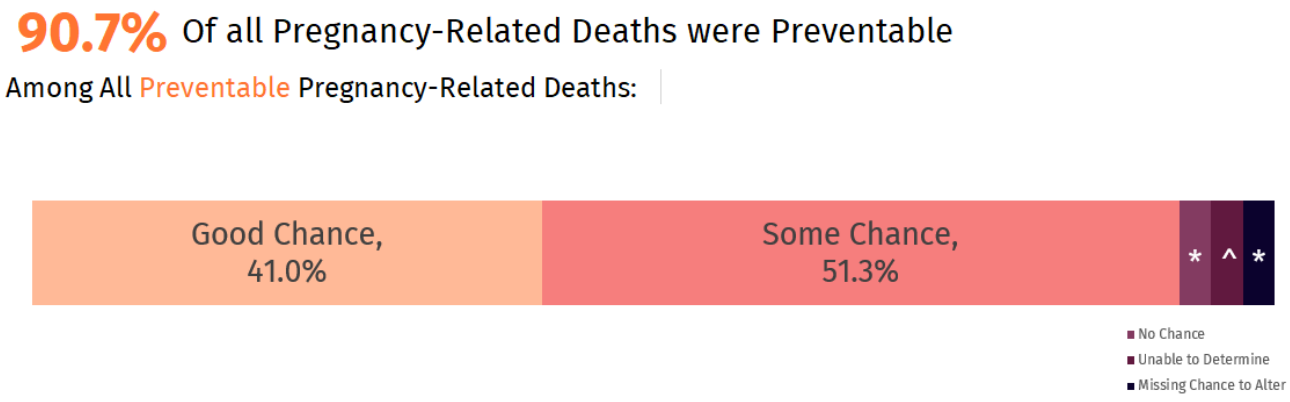


Figure 5A. Preventability and Chance to Alter Outcome of Pregnancy-Associated Deaths Among MMRC Reviewed Pregnancy-Associated Deaths in Arizona of Persons 10-60 Years Old, 2018-2019 (n=149).

The MMRC found that 90.7% (n=39) of the Pregnancy-Related deaths were preventable with 41.0% (n=16) of the deaths had a "Good Chance" of alternative outcome and 51.3% (n=20) held "Some Chance", as highlighted in **Figure 5B**. The remaining were categorized as “No Chance” or “Unable to Determine,” and were suppressed due to low count.



* Suppressed value <6
^ Unable to Determine, 4.5%

Figure 5B. Preventability and Chance to Alter Outcome of Pregnancy-Related Deaths Among MMRC Reviewed Pregnancy-Related Deaths in Arizona of Persons 10-60 Years Old, 2018-2019 (n=43).

In the years 2018-2019, **Figure 6A** illustrates the timing of Pregnancy-Associated deaths relative to different phases of pregnancy. The majority (59.0%, n=89) of deaths occurred between 43 to 365 days following the end of the pregnancy, with 93.9% (n=33) considered preventable. From the end of pregnancy to 42 days, 13.4% of deaths (n=18) occurred with 100% of cases determined to be preventable. During pregnancy, 23.1% (n=33) occurred. On the day of delivery, 4.5% (n=6) of the total Pregnancy-Associated deaths occurred, of which 85.7% were deemed preventable.

Compared to 2016-2017, 50.0% (n=67) of Pregnancy-Associated deaths transpired between 43 to 365 days after the end of the pregnancy, with 85% (n=57) being identified as preventable. Following the end of pregnancy, up to the 42-day mark, 31.3% (n=42) deaths were recorded, and of those, 76% (n=32) were deemed preventable. 16.4% (n=22) of deaths took place during pregnancy, with this interval having the highest preventability rate of 91% (n=20).

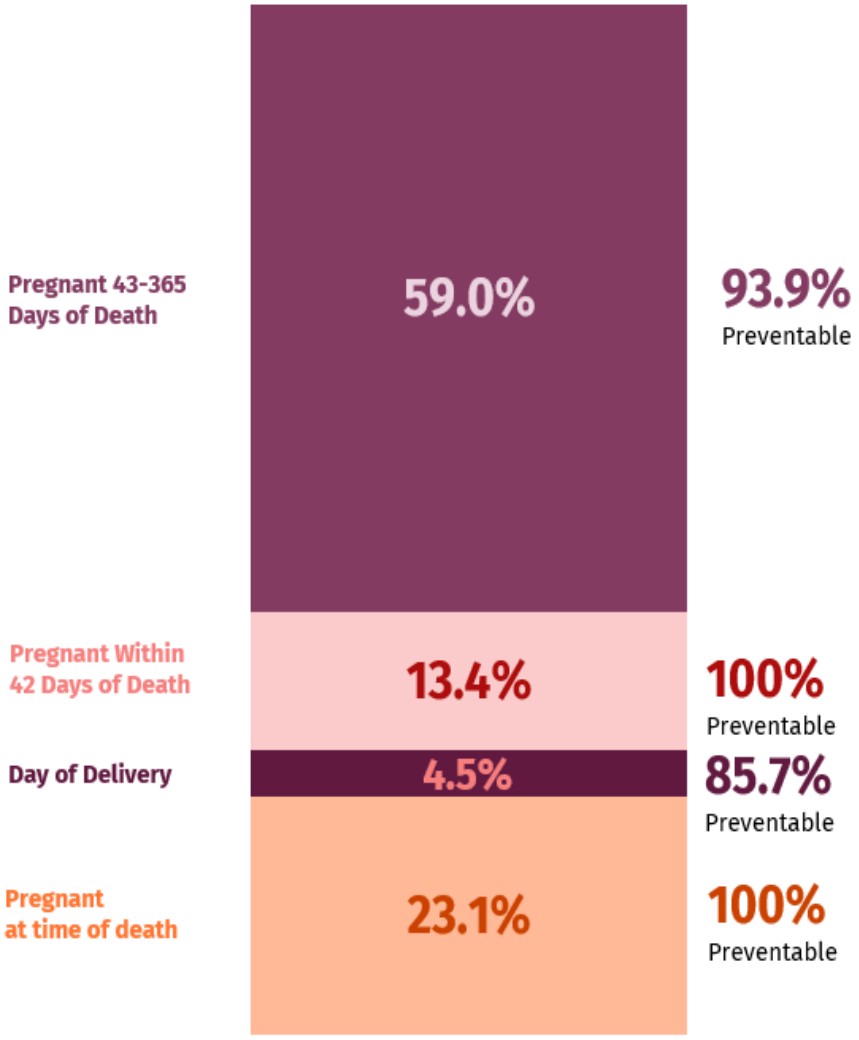


Figure 6A. Timing and Preventability of Pregnancy-Associated Deaths Among MMRC Reviewed Pregnancy-Associated Deaths in Arizona of Women 10-60 Years Old, 2018-2019 (n=149)

In the years 2018-2019, **Figure 6B** illustrates the timing of Pregnancy-Related deaths relative to different phases of pregnancy. A third (33.3%, n=13) of deaths occurred between 43 to 365 days following the end of the pregnancy, with 100% (n=13) considered preventable. From the end of pregnancy to 42 days, 25.6% of deaths (n=12) occurred with 83.3% (n=10) of cases determined to be preventable. During pregnancy, 28.2% (n=13) occurred, with 84.6% considered preventable. On the day of delivery, a suppressible number of the total Pregnancy-Related deaths occurred, of which 100% were deemed preventable.

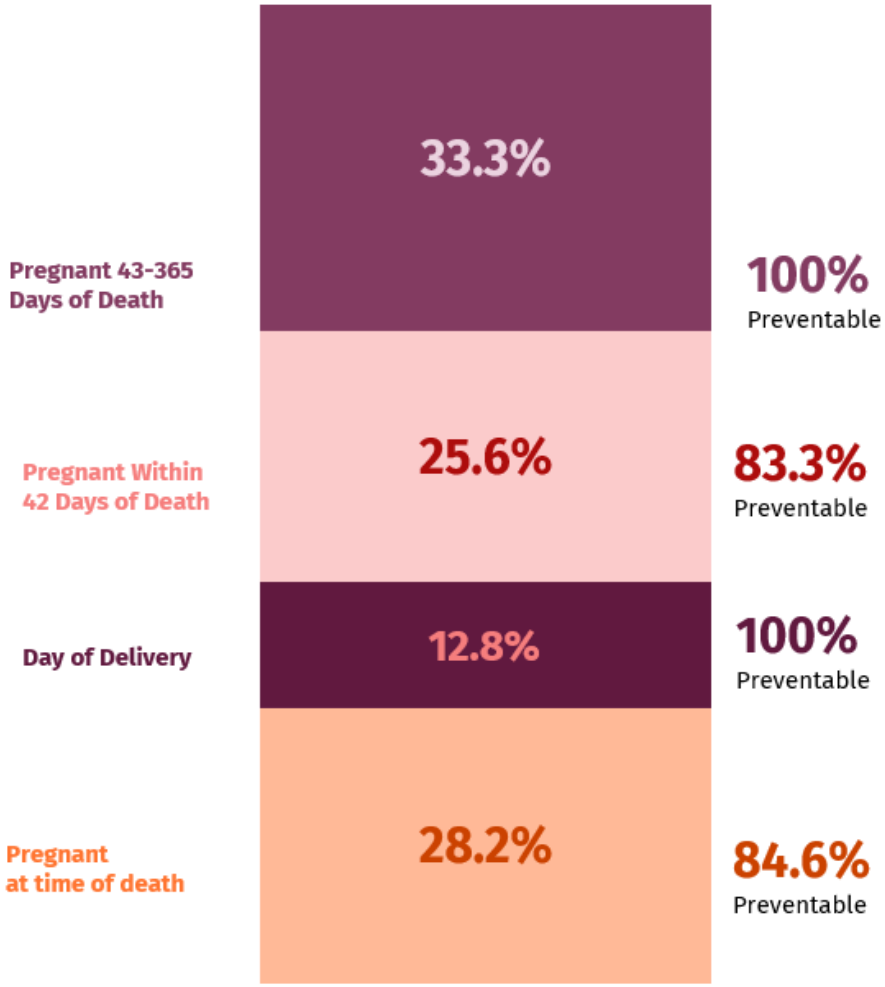


Figure 6B. Timing and Preventability of Pregnancy-Related Deaths Among MMRC Reviewed Pregnancy-Related Deaths in Arizona of Women 10-60 Years Old, 2018-2019 (n=43)

MM by Manner and Conditions of the Death

A distribution of Pregnancy-Associated deaths by the manner of death, as listed on the death certificate, can be seen in **Figure 7**. Accidents, which can include a variety of unintentional injuries such as motor vehicle accidents and unintended drug overdoses, accounted for 46.3% (n=69) of all Pregnancy-Associated deaths in 2018-2019, followed by natural deaths (30.2%, n=45), such as those occurring in the course of nature and from natural causes (as disease). Less common are intentional injuries such as homicide (12.1%, n=18) and suicide (8.1%, n=12). There were suppressible numbers (6 or less deaths) of pregnancy-associated deaths where the manner of death is "Pending Investigation" or "Could Not Be Determined" in 2018-2019.

A distribution of Pregnancy-Related deaths by the manner of death, as listed on the death certificate, can also be seen in **Figure 7**. Natural deaths accounted for 41.9% (n=18) of all Pregnancy-Associated deaths in 2018-2019, followed by Accidents (27.9%, n=12). Less common are intentional injuries such as homicide (n<6) and suicide (14.0%, n=6). There were suppressible numbers (6 or less deaths) of pregnancy-related deaths where the manner of death is "Pending Investigation" or "Could Not Be Determined" in 2018-2019.

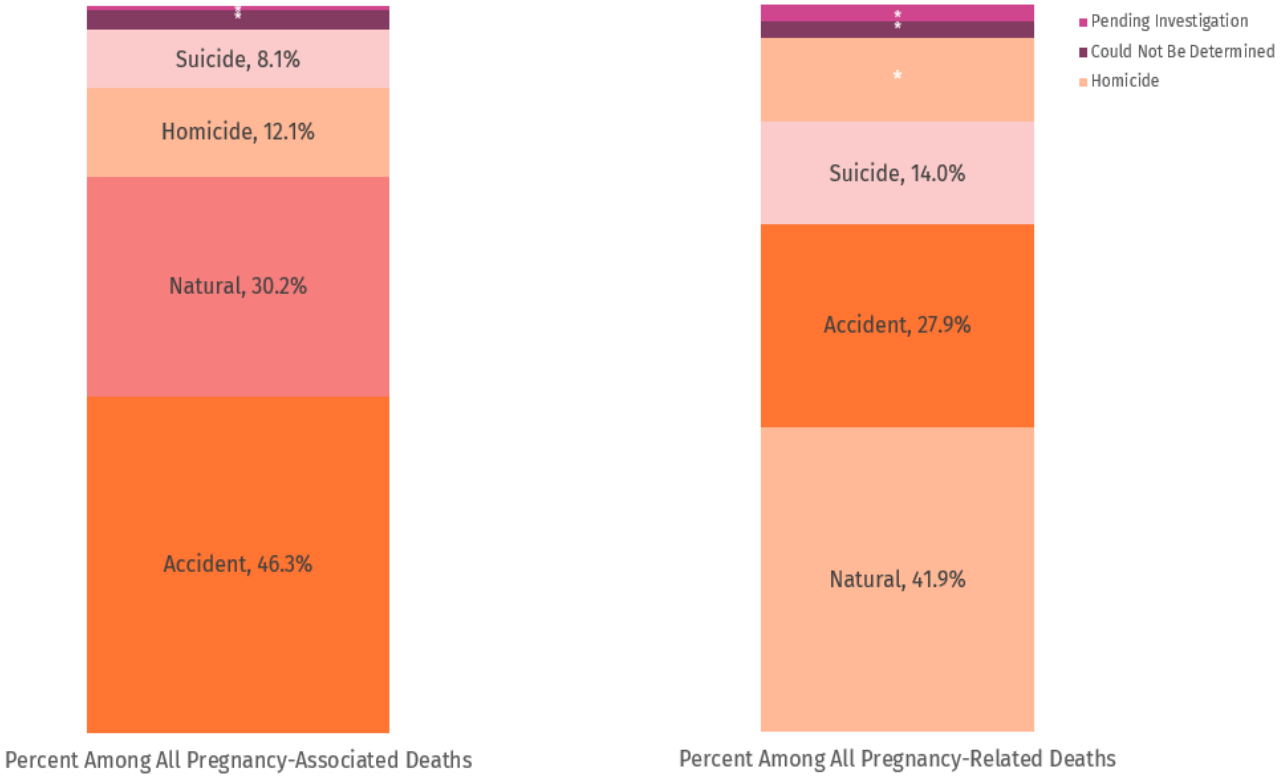


Figure 7. Manner of Death for All Pregnancy-Associated and Pregnancy-Related Deaths, Based on Death Certificates, 2018-2019

A distribution of Pregnancy-Associated and Pregnancy-Related deaths by the suicide and homicide can be seen in **Figure 8**. For 2018-2019, among all Pregnancy-Associated deaths, 12.1% (n=18) were identified as homicide or probable homicide, and 8.7% (n=13) suicide or probable suicide. The trends observed here are similar to percentages observed for 2016-2017 deaths with 12.7% (n=17) homicide and 9.7% (n=13) suicide. Of the Pregnancy-Related deaths in 2018-2019, 14.0% (n=6) were identified as suicide or probable suicide, which is a decrease from 2016-2017 (19.4% suicides). There were a suppressible number (6 or less deaths) of Pregnancy-Related homicides in 2018-2019.

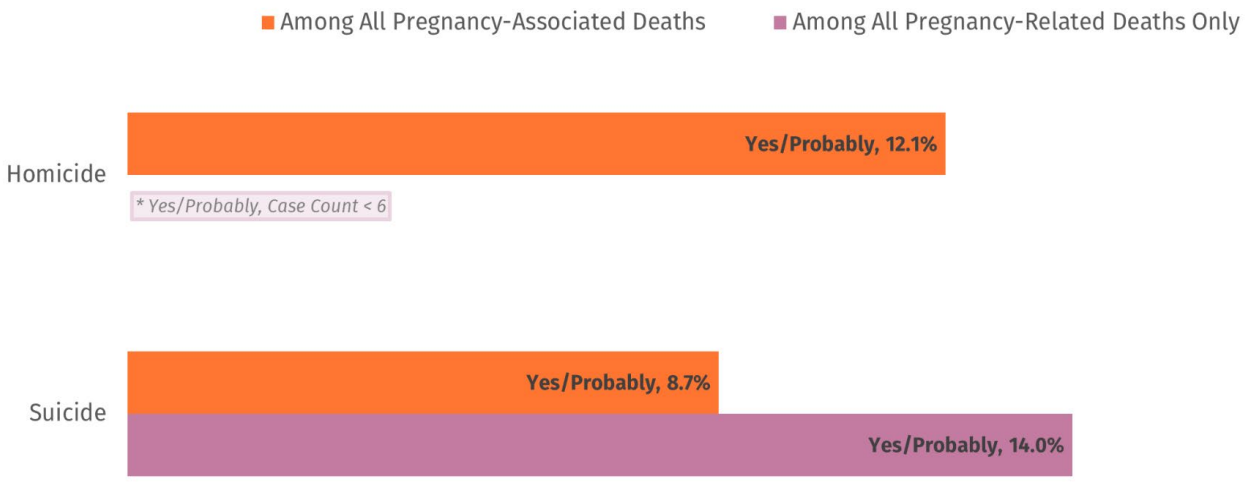


Figure 8. Suicide and Homicide among All Pregnancy-Associated and Pregnancy-Related Deaths, Based on MMRC Decisions, 2018-2019

MM 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. A distribution of Pregnancy-Related deaths by the primary underlying cause of death can be seen in **Figure 9**.

Among Pregnancy-Related deaths, the most common primary underlying cause of death was mental health conditions (32.6%, n=14), followed by cardiovascular conditions (20.9%, n=9), hemorrhage (16.3%, n=7) and infection (16.3%, n=7). The remaining cases had either injury or a neurologic/neurovascular condition (excluding CVA) listed as the primary underlying cause of death. The proportions for the causes listed in the "Other" category are omitted due to small sample sizes.

A similar trend was seen in a CDC analysis of 36 states with MMRCs where mental health was the top underlying cause of death (22.7%).[8]

Although all Pregnancy-Related deaths had a main (primary) underlying cause of death documented, the MMRC found that in 10 of these cases, there was also a secondary, underlying cause of death observed. This resulted in a total of 53 identified underlying causes of death for the 43 cases. Additional underlying cause of death information for both primary and secondary is available in Appendix J.

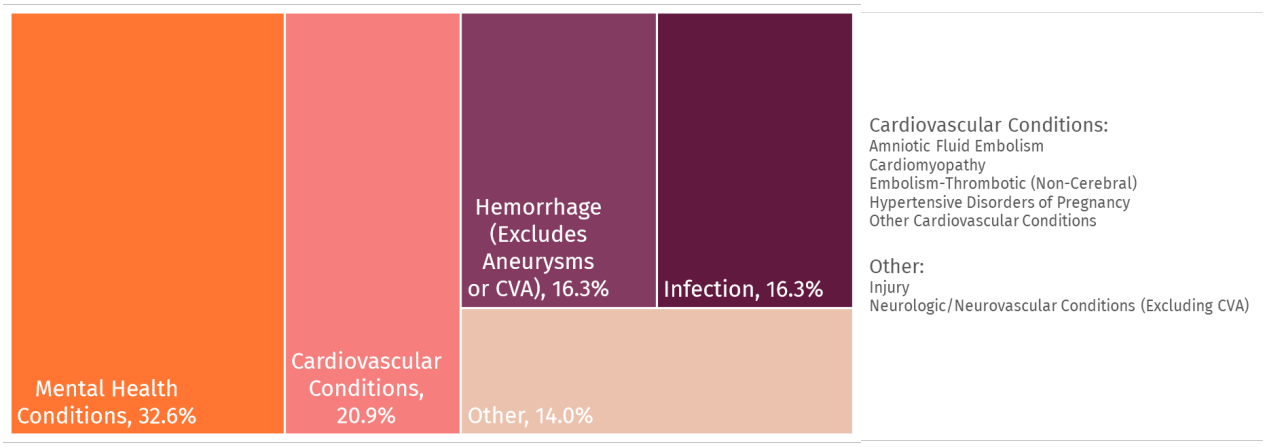


Figure 9. Underlying Primary Cause of Death among Pregnancy-Related Deaths, 2018-2019
Cardiovascular Conditions: Amniotic Fluid Embolism, Cardiomyopathy, Embolism - Thrombotic (Non-Cerebral), Hypertensive Disorders of Pregnancy, other cardiovascular conditions.
Other: Injury, and Neurologic/Neurovascular Conditions (Excluding CVA).

MM by Maternal Race and Ethnicity

A distribution of Pregnancy-Associated and Pregnancy-Related deaths and live births by race and ethnicity can be seen in **Figure 10**. Among the Pregnancy-Associated deaths, 38.4% (n=56) were White, non-Hispanic persons, who made up 42.7% of live births among ages 10-60 years in Arizona in 2018-2019. Hispanic or Latina persons accounted for 33.6% (n=49) of Pregnancy-Associated deaths and 41.6% of live births, while American Indian or Alaska Native persons accounted for 15.1% (n=22) of Pregnancy-Associated deaths and only 5.8% of live births, indicating a disparity. Black or African American persons accounted for 11.0% (n=16) of Pregnancy-Associated deaths and 5.9% of live births, also indicating a disparity. At the national level, rates among both of these racial/ethnic groups are also higher, although it is difficult to cross compare because of differences with racial/ethnic makeup, how racial/ethnic data is grouped together, and overall data availability for this time period.[9] While Asian or Pacific Islander persons accounted for a suppressible number (less than 6 deaths) of Pregnancy-Associated deaths, they accounted for 4.0% of live births. Similar proportions were observed among Pregnancy-Related deaths. Among the Pregnancy-Related deaths, 33.3% (n=14) were White, non-Hispanic persons. Hispanic or Latina persons accounted for 38.1% (n=16) of Pregnancy-Related deaths. Black or African American persons accounted for 14.3% (n=6) of Pregnancy-Related deaths. Lastly, American Indian or Alaska Native persons and Asian or Pacific Islander persons accounted for a suppressible number (less than 6 deaths) of Pregnancy-Related deaths.

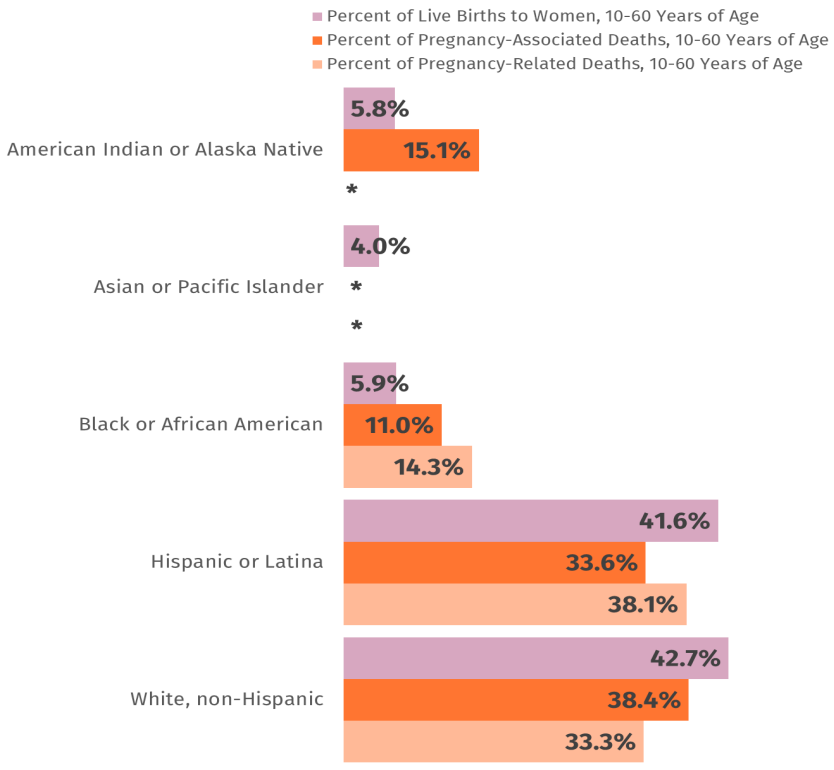


Figure 10. Live Births, Pregnancy-Associated, and Pregnancy-Related Deaths by Race and Ethnicity, 2018-2019

MM by Maternal Age

A distribution of Pregnancy-Associated deaths and live births by age at death can be seen in **Figure 11**. Disparities are observed where the Pregnancy-Associated deaths exceed that of the percent of live births for that age group. Persons 10-19 years old represented 5.6% of live births and 6.7% (n=10) of Pregnancy-Associated deaths. While 52.0% of live births were to persons 10-29 years old, only 45.0% (n=67) of Pregnancy-Associated deaths were to this age group. Conversely, persons 30-39 had 39.3% of live births but 43.0% (n=64) of Pregnancy-Associated deaths, and persons 40-49 had 3.1% of live births but 5.4% (n=8) of Pregnancy-Associated deaths. There were no live births or pregnancy-associated deaths for people who are 50-60 years old.

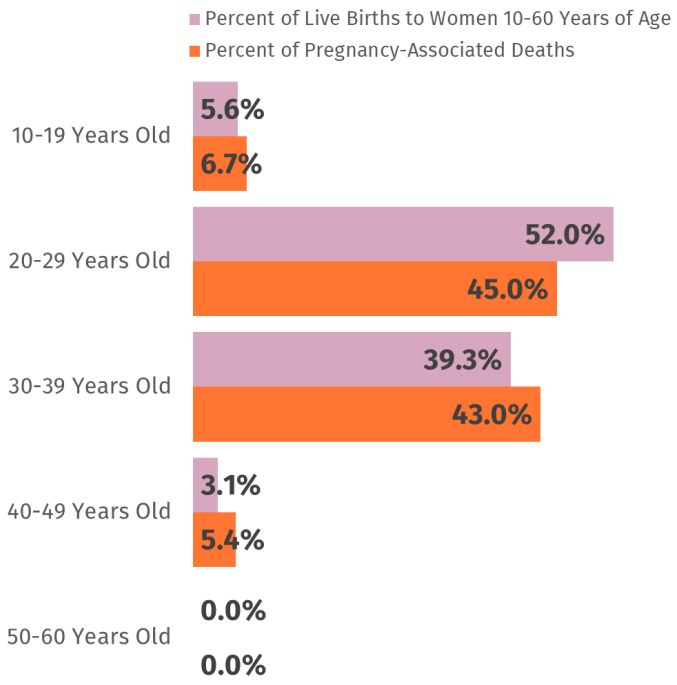


Figure 11. Live Births and Pregnancy-Associated Deaths by Age, 2018-2019

MM by Maternal Education

Figure 12 presents a detailed overview of Pregnancy-Associated deaths and live births by educational level from 2018-2019. Those who obtained a high school diploma or GED represented 39.5% (n=58) of Pregnancy-Associated deaths and 26.6% of live births, indicating a disparity. A disparity was also observed among persons who attained 9th-12th grade education with no diploma (21.8% [n=32] of Pregnancy-Associated deaths and 13.3% live births). These educational disparities may suggest that education has a role in influencing maternal health.

Persons who attained an Associate degree accounted for similar proportions of live births and Pregnancy-associated deaths (8.7% and 8.2% [n=12], respectively).

Persons who attained a Bachelor's degree or higher, or attended some college accounted for a lower proportion of Pregnancy-Associated deaths (10.9% [n=16] and 15.0% [n=22], respectively) than the proportion of live births (25.6% and 23.0%, respectively).

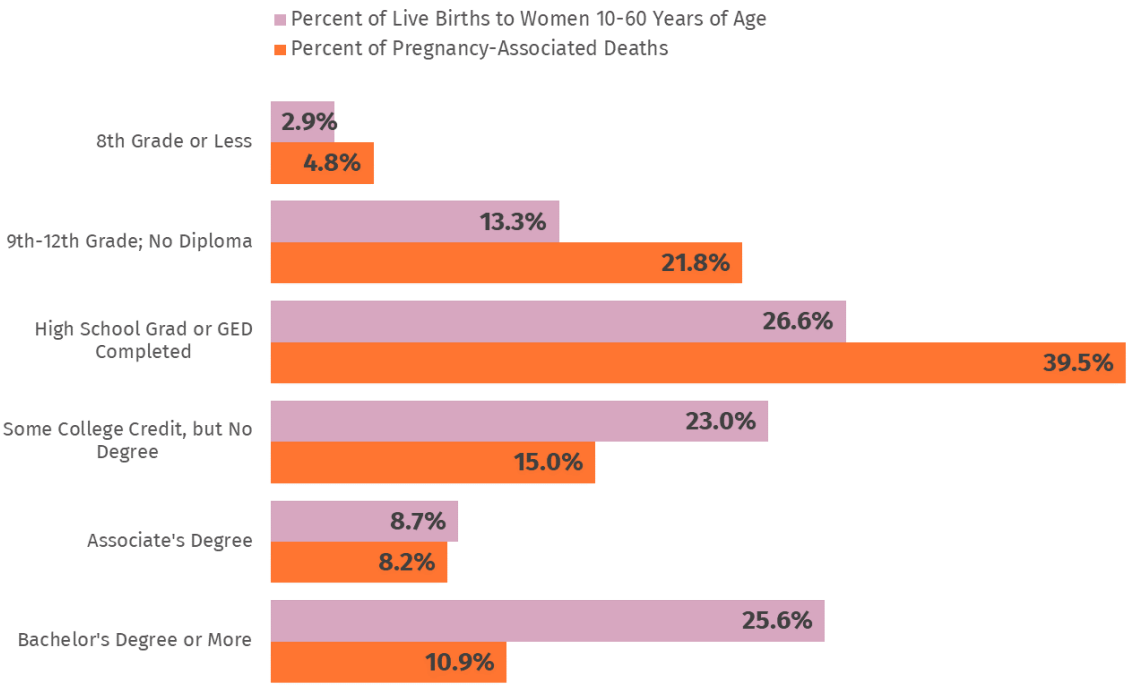


Figure 12. Live Births and Pregnancy-Associated Deaths by Education, 2018-2019

MM by Maternal Residence

In examining maternal health trends in Arizona across two intervals, 2016-2017 and 2018-2019, using data from the Bureau of Public Health Statistics, a combination of consistencies and variations becomes apparent. Urban counties, including Maricopa, Pima, Pinal, and Yuma, had a relatively stable trend in live births from 2016-2017 and 2018-2019 (84.7% to 87.9%) (**Figure 13**). We observed a decrease in Pregnancy-Associated deaths during that period (82.1% [n=110] to 75.8% [n=113]), indicating a reduction of Pregnancy-Associated deaths in urban counties during this time period. Rural counties, including Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Santa Cruz, and Yavapai, had relatively consistent live birth rates of 13.2% in 2016-2017 and 11.3% in 2018-2019. However, Pregnancy-Associated deaths in rural counties increased from 15.7% (n=21) to 16.8% (n=25) during this time period, indicating a disparity.

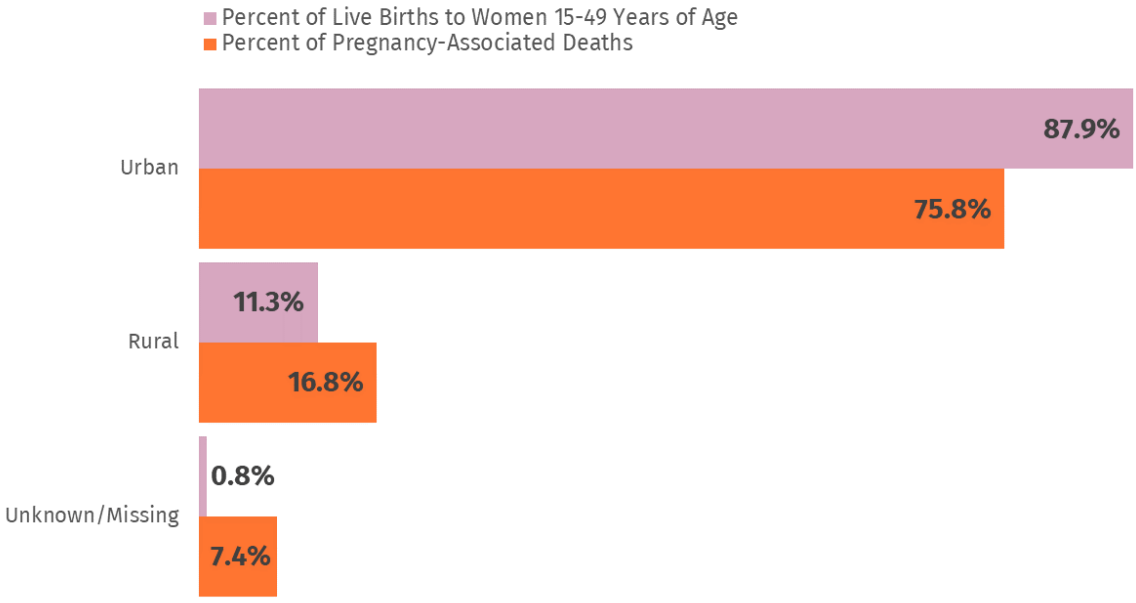


Figure 13. Live Births and Pregnancy-Associated Deaths by County Type of Residence Among Live Births in Arizona to Persons 10-60 Years Old and MMRC Reviewed Pregnancy-Associated Deaths in Arizona of Persons 10-60 Years Old, 2018-2019 (n=149)

MM by Insurance Type

Figure 14 presents an overview of Pregnancy-Associated deaths and live births according to medical insurance type from 2018-2019. Decedents who had private insurance accounted for 18% (n=27) of all Pregnancy-Associated deaths, whereas 41% of all live births had private insurance listed as their insurance type. The opposite trend was found among those who had Medicaid as the primary insurance type; 49% of all live births had Medicaid listed as their insurance yet 72% (n=105) of all Pregnancy-Associated deaths had Medicaid as their insurance.

Persons who were listed as self-pay consisted of a much smaller proportion for both live births and Pregnancy-Associated deaths, yet were slightly higher among decedents (7%, n=10) in comparison to all of live births (5%).

Finally, decedents who had an alternate form of insurance listed (i.e. "Other") accounted for a suppressible proportion of Pregnancy-Associated deaths. This included individuals with insurance identified in the data source as "other" and those identified as "Indian Health Service."

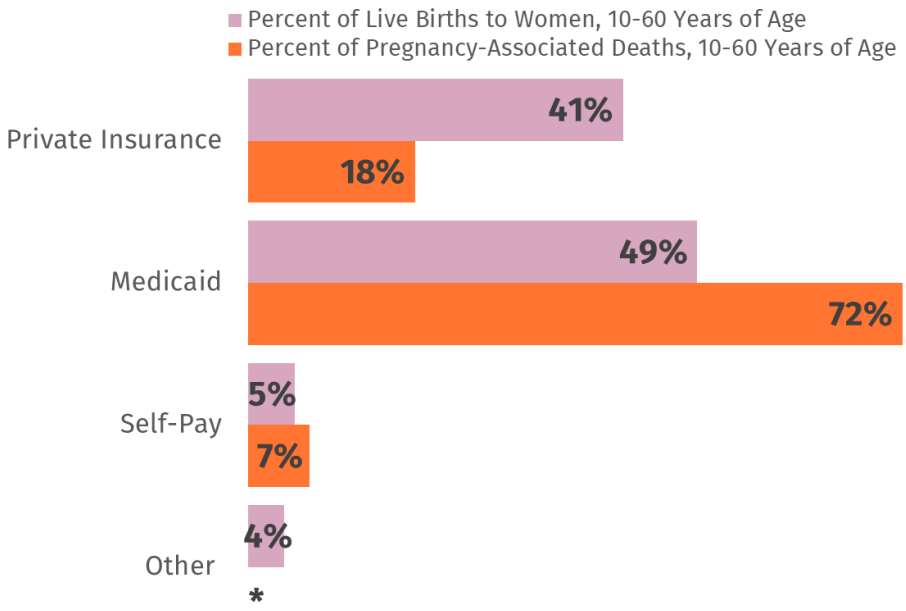


Figure 14. Live Births, and Pregnancy-Associated Deaths by Insurance Type, 2018-2019

Disclaimer: Insurance type for maternal deaths was identified through various information sources. Details regarding case information for insurance type is available in Appendix I.

MM 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. Among all Pregnancy-Associated deaths, SUD was identified as contributing to the death in 47.7% (n=71) of cases, followed by mental health conditions (38.3%, n=57), and obesity (12.1%, n=18) (**Figure 15**). Among Pregnancy-Related deaths, substance use disorders contributed to 41.9% (n=18) of deaths, while mental health conditions contributed to 39.5% (n=17) of deaths, and obesity contributed to 20.9% (n=9).

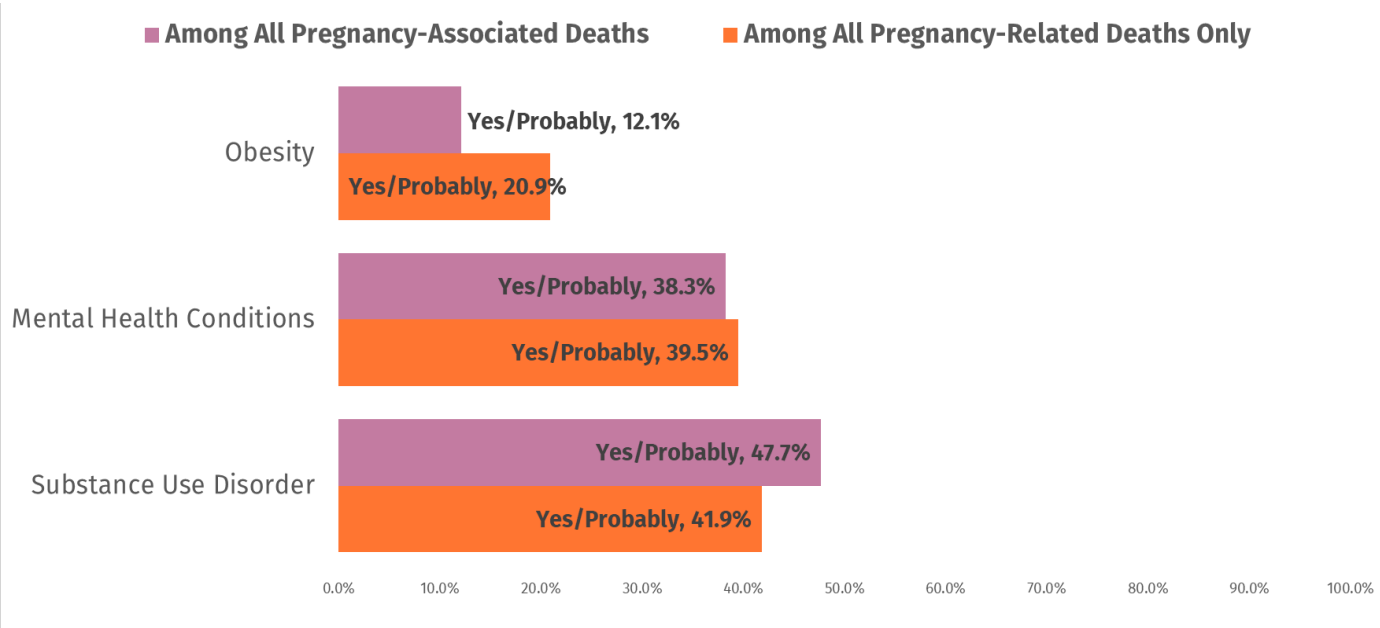


Figure 15. Contributing Factors Among Pregnancy- Associated Deaths and Pregnancy-Related Deaths, 2018-2019

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 (Appendix G). MMRP staff completed qualitative analysis on all recommendations made for 2018-2019 deaths and categorized them into levels of who might be responsible for enacting them, though some recommendations specify partners and strategies more than others. Almost 900 recommendations were reviewed and categorized into 43 actionable recommendations that take place between 4 system levels (system, facility, provider, and community).

The intent of these 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 in 2018 and 2019. 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.

Healthcare System Recommendations

→ Establish continuity of care to ensure timely care coordination between appropriate healthcare providers on or offsite and wraparound services for the family to address social determinants of health and barriers to care by utilizing community-based personnel[10], following existing guidelines, and obtaining grant funding as needed, especially at specific opportunities for those with increased risk factors. Community-based personnel that could potentially facilitate continuity of care includes but is not limited to case managers, patient navigators, social workers, and community-based birth workers. These personnel should follow existing guidelines outlined by the Agency for Healthcare Research and Quality (AHRQ), Centers for Medicare & Medicaid Services (CMS)[11], Health Resources and Services Administration (HRSA), and Institute for Healthcare Improvement (IHI)

Continuity of care is essential, especially for those with increased risk factors:

Mental and Behavioral Health:

- Substance Use Disorder
- Mental health condition(s)
- Postpartum depression
- History of trauma
- History of suicidal ideation or attempts
- History of self-harm

Reproductive Health:

- Pregnancy loss
- Teen pregnancy
- Surrogacy

Social Determinants of Health:

- Chronic health condition(s)
- Unstable housing
- Uninsured or underinsured
- Lack of established healthcare providers
- Loss of custody
- Cognitive or physical disabilities
- Children and Youth with Special Healthcare Needs
- Single-parent household
- Domestic Violence

Continuity of care should be established at specific opportunities:

Mental and Behavioral Healthcare:

- High score on a mental or behavioral health screening
- New mental health diagnosis
- Overdose event
- Suicidal ideation or attempt
- Substance Use Disorder treatment
- Diversion program

Reproductive Health:

- Positive pregnancy test
- Facility or home-based delivery
- Miscarriage or abortion event
- Ongoing postpartum gynecological concerns

Other Healthcare:

- Discharge planning
- Leaving against medical advice
- Admission into the Neonatal Intensive Care Unit
- Post-removal of a breast abscess
- Breakthrough seizures

Continuity of care should include wrap-around services:

Social Determinants of Health:

- Housing and food services
- Transportation services
- Women, Infants, and Children (WIC)
- Community Medical Services

Community Engagement:

- Community-based resources
- Home visitation
- Peer support

Family and Child Wellbeing:

- Parenting and childcare support
- Crisis family centers
- Family Resource Center
- First Things First
- Support for children of individuals with Serious Mental Illness
- Support for children who lose a parent
- Paternity testing

Legal and Social Services:

- Legal support
- Social services
- Department of Child Safety (DCS)

→ Increase adoption of trauma- and culturally-informed practices for providers[12,13] by partnering with universities or organizations to adapt curriculum for providers to be trained in patient-centered care, which includes the appropriate level of support, navigation, counseling and dialogue with patients and their families about pertinent healthcare topics while ensuring messaging meets language preferences (i.e. interpreters and translators available in-person, by phone, or by video) and reduces stigma, while empowering families to make informed decisions, advocate for themselves, and improve health literacy and health-seeking behavior.[14,15]

The strategies listed below are especially important to consider as it pertains to pregnant and postpartum individuals among communities at greater risk for MM like African Americans, Native Americans, refugees, people living with HIV, people arranging adoption, people with Serious Mental Illness, people on court ordered treatment, people with special healthcare needs, and people with a history of trauma including Adverse Childhood Experiences; having children in the foster system; being exposed to racism, violence, or substances; or experiencing teen pregnancy or pregnancy loss.

Strategies to increase adoption of trauma- and culturally-informed practices:

System:

- Become a trauma-informed state[16]
- Focus on social determinants of health
- Build awareness and responsiveness to systemic oppression and intersectionalities

Facility:

- Educate personnel about historical and childhood trauma[17,18]
- Establish grand rounds about birth equity
- Enact risk reduction protocols to reduce patients leaving against medical advice
- Document gender identity and sexual orientation to ensure preferred language is used
- Collect history of discrimination in healthcare settings to better understand barriers to care
- Collect multiple methods of communication
- Track the presence of advanced directives for individuals in delivery and support developing one in a culturally appropriate, patient centered manner in order to provide confidence that individual's care plan is established and followed
- Offer options for childcare that are accessible and affordable
- Offer group prenatal care as an alternative option[19]

Provider:

- Ensure collaborative care plans
- Offer treatment options that consider behavioral and lifestyle factors
- Use gender-affirming language
- Allow patients to complete screenings in private
- Utilize the Child and Adolescent Level of Care Utilization System (CALOCUS) tool[20] to provide whole person care

Providers that would benefit from training in patient-centered care include but are not limited to mental and behavioral healthcare providers, hospital-based personnel, birthing center personnel, first responders, birth and death doulas, community health workers, and peer support specialists. Providers

have the opportunity to engage in supportive dialogue with their patients about pertinent health topics like those listed below.

Providers should engage in supportive dialogue about Pertinent Health Topics:

General Health and Prevention	Reproductive Health:	End-of-Life Care and Decision-Making:	Other Healthcare Considerations:
• Healthy weight • Preventative screenings • Healthy relationships • Increased risk factors	• Safe sex practices • Prenatal Care • Pre-birth and postpartum warning signs	• Terminal or severe diagnoses • Delayed or termination of care • Advanced directives • End of life decisions • Grief counseling	• Infection or disease states • Care plan and medication adherence • Mental health conditions • Substance Use Disorder • Proper HIV management

→ Increase access to high quality mental and behavioral health services and resources that are affordable, trauma-informed, and supportive of the family unit. Delivering high-quality mental and behavioral health services should look like evidence-based, standardized processes for referral, intake, and care coordination across all settings including but not limited to inpatient care, standard and intensive outpatient care, maternal- and youth-specific care, tribal health clinics, long-term group homes, and clinics offering Medication for Opioid Use Disorder (MOUD). These services should also involve coordination of resources through social work, case management, or peer support services. These services should be prioritized for those who are pregnant or postpartum and facing additional challenges like lack of transportation, unstable housing, rurality, Serious Mental Illness or other mental health conditions, Substance Use Disorder, or those who are managing chronic health conditions, utilizing adoption or foster services, or at an increased risk of suicide.

Strategies to increase access to high quality mental and behavioral health services:

Accessible:

- Integrate mental and behavioral health services into perinatal care[21]
    - Revisit laws that prevent healthcare integration
- Improve referral processes
- Ensure timely delivery of services
- Increase funding for perinatal mental and behavioral health services
- Increase the number of perinatal mental and behavioral health providers
    - Conduct a network adequacy study
    - Streamline licensing and oversight
- Implement telehealth, telephone, and online services

Affordable:

- Expand insurance coverage for comprehensive care
- Secure funding for free and low-cost services

    - Prioritize those who are uninsured and underinsured
    - Consider options for non-Arizona residents

Trauma-Informed and Supportive of the Family Unit:

- Establish residential treatment allowing children to stay with their families[22]
- Provide options for childcare
- Support adoptive and foster parents
- Implement innovative models like Hushabye Nursery[23] and the MOMS model[24]

→ Expand insurance coverage to provide adequate, timely, and value-based reimbursement mechanisms for the range of maternal health services beyond one year postpartum[25] and other necessary health services for providers or organizations serving pregnant and postpartum individuals (i.e. regardless of live birth or pregnancy loss) by advancing birth equity[26] and removing barriers, particularly for indigenous peoples, those in foster care system, and those moving between states or otherwise experiencing a gap in coverage. This recommendation pertains to payers of health services like the Arizona Health Care Cost Containment System (AHCCCS), Indian Health Services (IHS), Federal Emergency Services, and private payers.

Strategies to expand insurance coverage:

Advance Birth Equity:

- Address social determinants of health
    - Increase provider and treatment availability, especially in underserved areas
    - Address housing instability through collaboration with housing organizations
    - Increase reimbursement for rural area transportation
- Incentivize provider cultural competency training
- Improve transparency and accountability of payers
    - Utilize data dashboards to monitor utilization patterns and outcomes
    - Produce evidence that high-risk patients are receiving available services

Remove Barriers:

- Eliminate same-day restrictions on mental and behavioral healthcare reimbursement
- Establish fee-for-service billing processes for efficiency
- Mitigate ineligibility due to Social Security benefits or other income sources
- Increase enrollment assistance programs

→ Improve access to the full range of reproductive health services including contraceptives, especially prior to discharge from the birthing facility, and ongoing gynecological care by integrating health services and addressing barriers and social determinants of health by consistently using standardized decision aids when discussing all contraceptive options to avoid coercion. [27]

The full range of reproductive health services includes but is not limited to over-the-counter contraceptives, oral contraceptives, long acting reversible contraception, medroxyprogesterone acetate, and sterilization. Ongoing gynecological care includes but is not limited to reproductive health education, contraceptive management, interconception care, as well as miscarriage and abortion support.

Some access to care barriers that should be addressed include but are not limited to a prescription requirement, prior authorization, rules preventing same-day placement of long acting reversible contraception, rules preventing inpatient administration, inadequate insurance coverage, and lack of transportation. This is especially pertinent for those managing critical medical conditions or Serious Mental Illness, caretaking for multiple children, or experiencing recent loss of custody.

→ Improve access to healthcare for people of reproductive age including prenatal and postpartum care, mental and behavioral health care, emergency care, specialty care, and Substance Use Disorder treatment.

Strategies to improve access to healthcare:

- Increase the number of culturally-congruent providers in underserved areas (e.g., midwives, nurse practitioners, and obstetricians)[28–30]
    - Provide free or low-cost workforce development programs
    - Offer full scholarships for continuing education
    - Establish treatment fellowships (e.g., addiction medicine)
- Ensure the affordability and accessibility of prescription medications
    - Prescribe alternative, less expensive medications
    - Discharge from inpatient with at least one week of medication
- Expand options for healthcare delivery (e.g., mobile units, group care, telemedicine/telephone, local birth centers)
- Improve broadband and cell phone coverage across the state (i.e. on and off reservations)
- Address underlying barriers through case management (e.g., transportation, childcare, lack of or inadequate insurance coverage)

→ Improve care coordination by consulting with and escalating care between healthcare providers such as emergency providers, first responders, intensive care unit providers, primary care provider, midwives, obstetricians, maternal-fetal medicine specialists, lactation consultants, mental and behavioral health providers, cardiologists and cardiac rehabilitation providers, neonatologists, pediatricians, nurse practitioners, and physician assistants.

Consultation lines would especially be helpful in the following scenarios:

- Outside of obstetric unit[31]
- Considerations of whether to seek cancer care
- Breastfeeding considerations
- Low white blood cell count
- History of cardiac or hypertensive disorders of pregnancy
- Placenta accreta
- Increased risk for Group A Strep
- High score on mental health screening
- Transportation to higher level of care as needed (e.g., High Risk Perinatal Program)

→ Improve information sharing across providers to better identify the need for services. Providers should be able to collect and share comprehensive information about their patients' previous encounters and diagnoses as well as their social determinants of health. This information should be

documented in neutral language by refraining from stigmatizing words like "non-compliance."[32] **Enhancing the sharing of health information among providers facilitates continuity of care, particularly in services such as case management for individuals transitioning from out-of-state providers or sovereign institutions.**

Strategies to improve information sharing:

Increase funding for healthcare integration strategies

Integrate medical, behavioral, and social health information:

- Establish universal medical records
- Automate Electronic Health Record integration with an "opt-out" model
- Integrate behavioral health records
- Integrate records from Department of Child Safety (e.g. history of adoption)

Expand and require use of Controlled Substances Prescription Monitoring Program

→ Expand postpartum care to proactively provide outreach and follow-up services on the same schedule as infant follow-up care, and ensure services are accessible, especially for individuals experiencing stressors or physical, mental, or behavioral health conditions that require medication management. The postpartum follow-up schedule should be at least 3 days, 2 weeks, 1 month, 2 months, 6 months, 9 months, and 1 year. [33–35]

Strategies to expand postpartum care:

Outreach and follow-up:

- Identification of risk level
- Assessment of parental wellness during pediatric visits

Ensure accessibility:

- Telehealth
- Off-hours visit to accommodate work schedule

Be most proactive with individuals experiencing:

- Barriers to care
- Pregnancy loss
- Loss of custody

→ Improve Electronic Health Records (EHRs) by integrating trigger alerts, protocols like sepsis response[36]**, and risk assessment tools for pregnant and postpartum individuals. EHRs should alert providers to consider prenatal labs, screenings, and vaccinations.**

→ Increase research funding to expand pharmacologic and other treatment options for Methamphetamine Use Disorder.

→ Improve the quality of care for pregnant and postpartum individuals utilizing Indian Health Services[37] **by ensuring adequate funding for wrap-around services, especially when discharged to a facility far from their residence. Wrap-around services should include but not be limited to home**

health, contraceptive services, childcare support, cancer treatment, social work, and tribal-specific support.

→ Improve support for surrogates by enacting legislation safeguarding surrogate and arranged adoption rights, creating a system to identify and monitor surrogates, and devising a comprehensive protocol for healthcare providers and professional associations to educate and support surrogates throughout the perinatal period. Surrogates should be educated about current surrogacy laws and encouraged to seek prenatal care.

Other System Recommendations

→ Address access to care barriers for pregnant and postpartum individuals related to income insecurity by considering the following strategies, while prioritizing assistance to those with children, experiencing domestic violence, using substances, and/or lack a support system.

Healthcare Reform

- Adopt universal healthcare and prescription coverage

Financial Support

- Establish paid sick and family leave[38–40]
- Expand Federal Medical Leave Act policies to up to one year postpartum
- Enact child tax credits
- Assistance applying for financial assistance (e.g. Division of Developmental Disabilities)

Housing Solutions

- Increase facilities that provide permanent and temporary housing
- Provide housing assistance
- Expand government funding for housing
- Expand housing options for AHCCCS members beyond those in Regional Behavior Health Authority and/or Serious Mental Illness designation
- Utilize Substance Abuse Block Grant (SABG)[41] funds for housing

Childcare Initiatives

- Offer in-house childcare at healthcare facilities
- Ensure access to affordable childcare through congressional measures[42]

Community Infrastructure

- Public transportation with air conditioning
- Increase accessible hydration stations
- Offer alternative office hours for providers

→ Improve interactions with the Department of Child Safety (DCS) by considering the following strategies to reduce harm, especially to pregnant or postpartum individuals.[43,44]

Implement family-centric policies:

- Keep families together when possible
    - Reduce mandated reporting requirements
    - Leave children with the non-offending parent
- Educate and support families when separated
    - Reduce exposure to Adverse Childhood Experiences[45]
    - Ensure appropriate visitation rights

Enhance systemic support and safety measures:

- Ensure adequate and culturally-congruent staffing
- Ensure appropriate resources for safe and supportive foster care
- Ensure safe reporting of concerns related to mental health, Substance Use Disorder, and other healthcare needs to prevent underreporting due to fear of retribution
- Reconsider orders of protection to prevent child being removed from parent when situation is safe
- Extend foster care beyond age 17 to better provide resources for aging out children
- Work with families to prioritize court dates

Engage parents in rehabilitative services:

- Mental health treatment
- Substance Use Disorder treatment
- Arizona Families First Program
- Family Treatment Court

Connect families to support services:

- Housing identification and assistance
- Family advocate
- Court-ordered attorney
- Peer support
- Healthy parenting classes
- Family planning
- Infant and early childhood behavioral health supports
- Innovative models like Hushabye Nursery

→ Improve the investigation of the incidence and causes of maternal death.

Strategies to improve maternal death investigations:

System

- Establish an opt-out policy for autopsies of all pregnancy-associated deaths
- Provide federal assistance to tribal law enforcement to support records management
- Increase access to records by amending statute (e.g. 35-3503) to allow access to pediatrician records for the decedent's children, as many intervention and prevention opportunities take place at pediatrician's office during well child visit
- Increase access to records by amending statute (e.g. 35-3503) to allow access to informant interviews with consent, as those who knew the decedent could provide valuable information not included in patient records

Facility

- Require reporting to ADHS and facility tracking of maternal sentinel events for improving processes
- Utilize sentinel events for grand rounds and peer review for education

Law Enforcement

- Strengthen capacity and relationship with tribal law enforcement organizations
- Improve law enforcement investigations in the case of sexual assault (e.g., timely handling of sexual assault kits)

Maternal Mortality Review Program

- Increase the diversity of review committee
- Encourage inclusion of all patient records in record request
- Obtain a list of Federally Qualified Health Centers (FQHCs) with on-site behavioral health providers
- Prioritize issues related to social determinants of health
- Explore opportunities to share findings (e.g., outpatient clinics, other providers, AHCCCS Maternal Mental Health Advisory Committee recommendations[46])

→ Improve justice system interactions before, during, and after incarceration, while integrating healthcare and social service providers as needed, especially for cases involving Substance Use Disorder or domestic violence in the pregnancy or postpartum period.

Strategies to improve justice system interactions before incarceration:

Criminal Justice Reform:

- Change criminal codes for drug offenses to offer treatment as an alternative to incarceration
- Report to social work before law enforcement for individuals with Substance Use Disorder

Family Support and Education:

- Provide affordable, adequate, and reliable legal representation
- Educate on how to obtain, maintain, and remove restraining orders
- Disseminate free to low-cost resources for families
- Support utilization of Community Legal Services[47]

Strategies to improve justice system interactions during incarceration:

Screening and Assessment:

- Expand medical, behavioral, and social history screening
- Reduce fees for court-mandated paternity testing

Behavioral Health Services:

- Full range of mental health and substance use treatment
- Behavioral health counseling to individuals and their families
- Support family communication and reunification

Health Services:

- Group prenatal care

Strategies to improve justice system interactions after incarceration:

Reentry Programs:

- Assess needs of individual upon re-entry in community
- Community reentry program
- Step-down group home
- Transitional housing and programming

Behavioral Health Services:

- Full range of mental health and substance use assessment and treatment
- Behavioral health counseling to individuals and their families
- Support family communication and reunification

Specialized Programs:

- Partner with programs such as Native American Fathers and Families Program to provide support in reunification, communication and other needs

→ Establish and increase awareness of a centralized community resource line to identify, educate, refer, and coordinate health-related services and resources for both providers and community members. This will require identifying sustainable funding mechanisms to ensure consultation services are reimbursable; some strategies are to utilize grant funding and leverage existing navigation resources.

Callers should be connected to services like behavioral health, home visiting, High Risk Perinatal Program, peer support services, coping skills, grief and mourning, and provider to provider treatment consultations via a warmline, hotline, or phone application.

→ Expand access to reliable transportation for all communities to access prenatal and postpartum care, particularly in underserved areas and those across the border. Transportation should be made available for medical, non-medical, after-hours, emergency, and air transport needs by ensuring affordability through insurance benefits, travel stipends, or rideshare vouchers.

Ensure care is coordinated to increase engagement and reduce the number of trips required. Some strategies include admitting for induction rather than outpatient induction and establishing protocols to improve transfer times.

→ Improve civil infrastructure by increasing road and highway lighting, crosswalks, clear roadway indications, intersection cameras, and fixed-wing emergency transportation services, particularly in rural areas, areas that are poorly lit, and areas with frequent pedestrian usage.

Facility Recommendations

→ Ensure facilities have adequate infrastructure, protocols, and procedures to improve readiness, prevention, recognition and response to obstetric emergencies and expedite coordination of care with a multidisciplinary team of appropriate healthcare providers, which may include but is not limited to emergency department providers, obstetricians, perinatal mental health providers, and hospital unit professionals in oncology, urology, and anesthesiology.

Facilities should have protocols and procedures for obstetric emergencies that address:

Readiness

- Having enough beds for inpatient services
- Having blood supply availability
- Conducting emergency simulation[48]

Prevention

- Avoid elective inductions and c-sections when not medically necessary

Recognition and Response

- Estimate blood loss
- Obstetric early warning signs
- Postpartum warning signs[49] (e.g. mental health warning signs, pre-eclampsia, hemorrhage)
- Maternal fetal triage index[50]
- Placenta accreta
- Hemorrhage[51]
- Cervical ripening
- Use of cardiac implant devices
- Sequential Compression Device availability and use
- Amniotic fluid embolism[52]
- Codes with provider participation throughout
- Timely transfer to appropriate level of care (e.g., Arizona Perinatal Trust specialty centers)

→ Increase facility quality improvement efforts by establishing family-driven advisory committees to share their healthcare experiences, appropriately documenting sentinel events, and conducting investigations to identify and act upon areas of improvement.

Provider Recommendations

→ Ensure providers in all settings are screening pregnant persons and their partners before, during, and after pregnancy or adoption (e.g. prior to discharge) for domestic violence, mental illness (e.g., Perinatal Mood and Anxiety Disorders[53], Serious Mental Illness), Substance Use Disorder, and Adverse Childhood Experiences. Settings that interact with pregnant persons and their partners include but are not limited to hospitals, schools, correctional facilities, obstetric and pediatric clinics. One strategy to ensure providers are screening is to establish a state universal screening mandate.

Screening should take place for every patient regardless if they describe symptoms, but especially those with a history of these conditions, those who are first time parents, and those with an infant in the Neonatal Intensive Care Unit. The mental health screening should use a combination of recognized tools such as Edinburgh Postnatal Depression Screening (EPDS), Patient Health Questionnaire-9 (PHQ-9), General Anxiety Disorder-7 (GAD-7), and/or 4Ps Screening Tool. Those administering the screening should provide appropriate instructions for completing the questionnaire and encourage the person being screened to answer honestly.[54]

Providers should ensure they are appropriately reporting results, educating the patient about the results, and coordinating care for high-scoring patients by scheduling a follow-up visit within two weeks of discharge, connecting to mental health and substance use treatment, providing social support services, and providing ongoing assessment of medication effectiveness.[55]

→ Increase provider education about the perinatal period including signs and symptoms, risk factors, routine screenings, diagnostic criteria, reporting requirements, response protocols, evidence-based medication guidelines, treatment guidelines, and alternative treatment options by securing funding for and requiring or incentivizing participation in continuing education classes. Providers that would benefit from education regarding the perinatal period include but are not limited to first responders, general providers, obstetric and non-obstetric providers, emergency department providers, physician assistants, perinatal mental and behavioral health providers, cardiologists, prescribers, pharmacists, and prenatal massage therapists.

Provider education options should cover a range of essential elements, including:

- Understanding signs such as pre-birth warning signs and symptoms related to various conditions.
- Recognizing risk factors and diagnostic criteria, utilizing reputable sources such as American Journal of Obstetrics and Gynecology PubMed Identifier[56,57]
- Knowledge of response protocols, encompassing steps such as ordering and coordinating labs/imaging, initiating medications as needed, following American College of Obstetricians and Gynecologists guidelines[58], and referring/transporting patients to the appropriate level of care using the suitable mode of transportation. This could involve connections with High Risk Perinatal Programs and the Arizona Perinatal Trust specialty providers, mandating admission for monitoring, immediate treatment, and implementing youth mental health first aid strategies.
- Adhering to evidence-based medication guidelines, including proper prescribing practices for medications like Adderall and benzodiazepines, considering breastfeeding implications,

reevaluating and reducing the number of medications, avoiding narcotics, being mindful of potential drug interactions, ensuring appropriate dosage and quantity for chemical restraints, conducting thorough assessments before prescribing medications like Ambien, especially concerning heart risks, considering Medications for Opioid Use Disorder (MOUD), and prescribing low-dose aspirin for those at risk of Deep Vein Thrombosis (DVT), and understanding proper medication tapering protocols.

- Knowledge of treatment guidelines across various domains such as cancer treatment, peer support, therapy options, and pain management strategies; as well as knowledge of alternative treatment options, including when to utilize life vests and cardiac implants, and resources available in cases where prescription refusal occurs

→ Increase patient education about substance use and misuse[59] including overdose education, harm reduction strategies, and where to access treatment services. The education is most important for patients and families with a history of substance use as well as community members living in high-risk areas.

Prescription education should include but is not limited to information about non-medical use of prescriptions, toxic effects of fentanyl with an opioid prescription, sharing medications with others, and obtaining substances without a prescription. Providers should ensure that all pregnant people and their families have access to naloxone to prevent a fatal overdose.

Harm reduction strategies to consider include but are not limited to naloxone administration training, distribution of fentanyl test strips, as well as the establishment of safe use sites, needle exchange sites, and harm reduction vending machines.

→ Increase patient and family education about caring for people of reproductive age, especially those in the perinatal period, regarding the importance of prenatal care, routine screenings, including recognition of risks (e.g., grand multiparity, multiple cesarean sections) and warning signs[60] (e.g., difficulty breathing, upper left quadrant plain), appropriate response (e.g., using naloxone), as well as how and when to seek medical attention or available resources (e.g. emergency AHCCCS coverage) and treatment options. Specific vulnerable populations or circumstances that have been identified frequently were those with specific medical and mental and behavioral health care needs.

Most Notably:

- Persons experiencing hypertension, pyelonephritis, urinary tract infection, pulmonary embolism, hemorrhage, placenta previa/scarring, sepsis, epilepsy and seizure episodes, PICC line administration, post-bariatric surgery, and/or cancer
- Persons experiencing mental and behavioral health needs such as PMADs, depression, suicidal ideation, substance use disorder, pregnancy loss grief
- Persons who are uninsured, underinsured, non-Arizona residents, and non-US citizens

→ Increase service provider education and training in Domestic Violence, Intimate Partner Violence[61], sexual violence, and human trafficking, including how to:

- Recognize physical and non-physical signs
- Use validated screening tools[62]
- Use discrete mechanisms of detection

- Provide education through different forms of media (e.g., handouts, videos in waiting rooms or bathrooms) about topics such as unhealthy relationships and the court order process
- Provide direct support (e.g., safety planning, how to handle risky situations)
- Provide navigation to services and resources such as peer support, ROSE Advocates, temporary housing, case management, and legal support
- Adapt to the needs of pregnant and postpartum individuals, youth, and those who identify as LGBTQIA+

→ Increase the identification of Adverse Childhood Experiences (ACEs) and other stressors, particularly in prenatal care, teen pregnancy prevention, abortion services, and social services.

Increase connection to support services for ACEs and other stressors such as behavioral health, counseling, peer support, youth mentorship, and school-based resources.

Community Recommendations

→ Increase awareness about the importance of pedestrian and motor vehicle safety, especially for those who are pregnant or postpartum or otherwise responsible for children, by creating public safety campaigns to educate or strengthening regulations to require:

- Abiding by traffic laws
    - Proper use of seat belts and car seats for the entire duration of trip
    - Driving the speed limit
    - Not driving under the influence or fatigued
- Limiting distractions (e.g., cell phone use)
- Refraining from having passengers in truck beds
- Safe driving practices in congested areas
- Safe ways to pull over
- Pedestrian safety
- Rideshare companies to provide safe work environments for their drivers
- Car manufacturers to create more driving safety features
- Tailored education to those with Substance Use Disorder

→ Increase access to community-based services by identifying sustainable funding mechanisms, expanding eligibility criteria, increasing availability of services (e.g., without a provider referral), increasing awareness about services (e.g., information on peer-support groups in clinic bathrooms), and increasing the number of programs for pregnant and postpartum individuals.

Community-based services should provide education, screening (e.g., Perinatal Mood and Anxiety Disorders, Substance Use Disorder, common cancers), and connection to needed services like home visiting, case management, peer support and mentoring, community-based birth workers, birth to five navigation programs, Federally Qualified Health Centers (FQHCs), safe and sober living environments, and the Prenatal Family Care Plan. The availability of these services is especially needed for African American and other at-risk communities.

Identifying sustainable funding for community programs is essential to build trust and maintain consistent services. Some potential funding mechanisms include expanding insurance coverage,

leveraging the Comprehensive Addiction and Recovery Act (CARA), reallocating funds from internal Medicaid managed care programs to community initiatives, and tapping into other funding sources independent of payers. With sufficient funding, these programs can retain their staff, reducing turnover and ensuring regular contact with patients through weekly visits for one year postpartum.

Increase the number of programs to address community-specific needs:

- Contraception
- Mental health or Substance Use Disorder treatment for adults and youth
- History of trauma or violence
- Chronic conditions
- High-risk pregnancy
- Increased risk for Perinatal Mood and Anxiety Disorders
- Lack of social support
- History of miscarriages
- Social determinants of health such as housing, food, or transportation

→ Expand culturally-competent health education to include comprehensive sex education[63], teen pregnancy prevention, mental health and coping strategies, substance use prevention and cessation strategies, and healthy relationships[64]. This education should be made available in a variety of settings including K-12 schools, community organizations, prevention programs, foster and adoption agencies, and social media campaigns informed by teens. Staff should be trained to identify trauma and provide connection to low cost services and resources including contraception, treatment, counseling, and support groups as needed.

Education about healthy relationships should include information about social supports, boundaries, communication strategies, warning signs of unhealthy relationships, safety planning, and parenting skills.

→ Dispatch a crisis team on all calls involving domestic violence, substance use, mental health challenges, or social and economic instabilities. These crisis teams should include first responders, law enforcement, behavioral health providers, social workers, translators and interpreters.[65–67]

Crisis team personnel should be trained in a trauma-informed approach, emergency psychiatric care, and safety planning (e.g. imminent escape).

Crisis teams should assist with resource navigation through warm handoffs, referrals, or timely emergency transportation to resources such as domestic violence prevention programs, financial support, peer support, community-based services, and individual counseling for survivors and perpetrators.

→ Expand stigma reduction activities regarding mental health and substance use disorders to encourage pregnant and postpartum individuals to seek treatment.[68]

Strategies to reduce stigma:

System: Implement a statewide stigma reduction campaign, and adapt language to focus on reducing stigma in rural communities and provider-specific communities.

Facility: Create treatment environments that promote “no shame, no blame” to encourage reporting of mental health or substance use concerns.

→ Improve firearm safety by promoting and enforcing firearm regulations and increasing the number of community-based events that promote firearm safety.[69]

Promote and enforce firearm regulations:

- Limit availability of firearms
- Provide gunlocks and hold community buy-back programs or firearm safety events
- Require surrender in unsafe situations through court order

Promote firearm safety:

- Keep firearm and ammunition in separate locked storage
- Educate about mental health implications
- Educate about considerations for children or guests in the home

→ Increase awareness about mental health conditions in the perinatal period among community members, law enforcement, probation officers, correction officials, and medical providers about warning signs of a mental health crisis, response protocols, treatment referrals, and available resources.[70–72]

One strategy to raise awareness is to implement a public service announcement about mental health conditions in the perinatal period, with mention of the 988-suicide hotline. Warning signs such as suicidal and homicidal ideation or attempt should be met with an appropriate response, for example, immediately restricting access to firearms.

→ Expand access to car seats and installation education, including where to access free car seats and how to install car seats in both private and public transportation.

This education should extend to the whole family, be available in rural areas, be tailored for tribal communities, and include technician certifications.

Other Recommendations

The following recommendations were identified less than five times while reviewing deaths from 2018-2019; nevertheless, steps toward these strategies should be considered to improve maternal health outcomes in Arizona.

→ Establish a public awareness campaign for survivors of domestic violence and intimate partner violence with culturally relevant messaging about:

Legal rights: orders of protection and child separation

Safety planning: preparing children, financial considerations, how to determine imminent danger

Harm reduction: having additional support present when confronting perpetrator

Available resources[73]: Arizona Sexual and Domestic Violence Helpline and National Domestic Violence Hotline

→ Improve legal action for domestic violence offenses by addressing gaps, such as ensuring adequate penalties for first-time offenses, providing options for orders of protection, and ensuring access to lawyers to ensure victims receive notice when charges are dropped.

→ The Federal Drug Administration (FDA) should establish a pilot program for pregnant and postpartum persons to test monitoring devices for epilepsy.

→ The US should regulate social media platforms' role in drug trafficking.

→ Arizona should establish a perinatal quality collaborative.

→ ADHS should provide support to local jurisdictions, community-based organizations, Tribes, and EMS agencies to achieve statewide coordination of effective opioid prevention activities.

→ Manufacturers should design a more comfortable life vest for perinatal patients to improve adherence.

→ Employers should be educated about the importance of supporting night shift workers with getting sufficient sleep.

Section 4: Limitations

Several limitations should be kept in mind when reviewing data included in this report. The following section describe limitations in reporting maternal mortality in Arizona.

Misclassification of maternal mortality cases by race may occur, especially for American Indian/Alaska Native persons, resulting in underestimation.[74,75] American Indian/Alaska Native communities face longstanding disparities in health status, encountering "lower life expectancy and the disproportionate disease burden exist perhaps because of inadequate education, disproportionate poverty, discrimination in the delivery of health services, and cultural differences. These are broad quality of life issues rooted in economic adversity and poor social conditions."[76] Additionally, the small population size of AI/ANs (only 1.7% of the US population, 5.8% of live births in Arizona) often leads to their exclusion from analyses, national reports, and resource allocation, despite documented health disparities, including lower life expectancy, higher poverty rates, and increased rates of certain health issues like type 2 diabetes-related deaths, suicides, and alcohol-related deaths compared to non-Hispanic Whites. The underreporting of disease burden within AI/AN communities due to racial misclassification emphasizes the critical need for inclusion and recognition of these populations in health reports and resource allocation efforts.[77]

One of the most significant limitations in reviewing maternal mortalities is consistency in available records across all decedents. Though MMRP staff work diligently to identify and request records from relevant sources, delays in receiving these records and inconsistencies in details included in records creates gaps in our understanding of the factors contributing to each decedent's death. For example, the MMRC determined that only 68% of maternal mortality case narratives had complete or mostly complete records. Records that are often the most difficult to obtain include primary care records if the provider is unknown, case management or social work notes, and mental health or behavioral health records. The MMRP also respects the sovereignty of data and healthcare records originating from Arizona's tribal nations. To this end, healthcare, police, EMS, and other records from incidents or encounters occurring on a reservation are often unavailable. This is recognized regularly by the MMRC during reviews and Other System Recommendations include a recommendation to implement strategies that would overall improve data collection and reporting for MMRC team.

Additionally, the evaluation of the committee's identified prevention recommendations reveals a few notable limitations. One primary concern lies in the interpretation of recommendations derived from committee meetings, often reliant on the literal content as documented. This may lead to unintentional misrepresentation of the overall recommendation. In an effort to prevent this some cases required further investigation to understand the context of a specific recommendation. Furthermore, potential bias might exist in the assignment of overall themes to each recommendation, as the evolution and alteration of themes over the course of the analysis period may have impacted their categorization.

Lastly, While the MMRP does have a standard outline used to develop all case narratives, content included in the narratives is identified and abstracted by clinical nurse abstractors using their best judgment of the information available to them. Social factors that may or may not have contributed to a decedent's death are difficult to interpret from records, particularly in the absence of detailed case management notes or interviews with family members or friends (most often found in police records or

medical examiner Preliminary Investigative Reports). Additionally, MMRC membership has shifted over time and attendance for reviews varies slightly from meeting to meeting. To this end, there is often a risk of bias or inconsistency during the abstraction and review process based on the available context or the mix of professionals who are reviewing the narrative in any given meeting. Additionally, although ADHS adopted the Review to Action Guidelines in 2018, the guidelines continue to evolve over time, resulting in slight gaps or inconsistencies in committee decisions made for each death. The MMRP staff kept these inconsistencies in mind when analyzing and reporting data that may be affected.

Section 5: Discussion

In Arizona, deaths within one year of pregnancy have increased from 79.1 per 100,000 live births in 2016-2017 to 91.2 per 100,000 live births in 2018-2019, and those that were related to pregnancy increased from 18.3 to 26.3 deaths per 100,000 live births. The leading cause of death for pregnancy-related deaths was mental health condition (32%), followed by hemorrhage (16.3%) and infections (16.3%). Manner of death varied from 2016-2017, with natural deaths occurring less than in 2018-2019 (30.2% compared to 42.5% in 2016-2017); and accidental, homicide and suicide increasing in 2018-2019 (46.3%, 12.1%, and 8.1%, respectively compared to 31.1%, 10.4% and 7.5%, respectively, in 2016-2017) in all pregnancy-associated deaths. Multiple prominent recommendations from the MMRC addressed mental health care including increasing access to high quality mental and behavioral health services and increasing awareness of mental health conditions and warning signs of suicide.

Understanding the pregnancy phase in which the death occurred is pivotal to prevention and care improvement. The majority of deaths (59.0%) occurred between 43 to 365 days post–pregnancy, an increase from 2016-2017 (50.0%). However, the phase at the end of pregnancy to 42 days decreased substantially from 31.3% in 2016-2017 to 13.4% in 2018-2019. Some recommendations address the coordination and continuity of care to close the gap in care for people in Arizona.

Through individual-level case reviews, the Arizona MMRC determined that about 90% of the 149 deaths that occurred between 2018-2019 were preventable. In the CDC's report on Pregnancy-Related Deaths: Data from MMRCs in 36 US States, 2017-2019, it was found that 80% of pregnancy-related deaths in those 36 states were determined to be preventable.[8] Although Arizona's mortality ratios cannot be directly compared to national or other state ratios because of slight differences in samples and inclusion criteria, this data emphasizes the need for improved health care strategies and systemic changes, especially as it pertains to addressing health disparities.

Arizona's 2018-2019 data reveals that just under 6% of live births occurred among American Indian or Alaska Native individuals, yet they represented almost 15% of Pregnancy-Associated deaths in Arizona. Similarly, just under 6% of live births are attributed to Black or African American individuals, yet they accounted for almost 11% of Pregnancy-Associated deaths. In the CDC's report on Pregnancy-Related Deaths Among American Indian or Alaska Native Persons: Data from MMRCs in 36 US States, 2017-2019, it was determined that 93% of Pregnancy-Related deaths to AI/AN persons were preventable.[78] These disparities underscore the need for a comprehensive and culturally sensitive approach to address root causes and equitably improve maternal health outcomes.

In June 2022, the White House detailed a report that strategizes how to address maternal health outcomes.[79] The report primarily focuses on comprehensive measures to enhance healthcare accessibility and quality. This involves expanding maternal health initiatives, especially in underserved rural communities, and implementing vital implicit bias training for healthcare providers. Additionally, the government aims to empower birthing individuals by ensuring their active involvement in decision-making processes within healthcare systems, supported through programs like the Alliance for Innovation on Maternal Health (AIM). Efforts also extend towards bolstering data collection, research, and transparency in maternal health to better understand and address root causes. Moreover, there is a concerted push to diversify and strengthen the perinatal healthcare workforce, acknowledging the urgent need for representation and resources. Finally, the government plans to fortify social and

economic support systems, streamlining access to federal assistance programs, thereby aiming to alleviate disparities and improve overall maternal health outcomes across the nation. Many of the recommendations developed by the MMRC members in **Section 3** are supported by similar actions in the report.

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 10 recommendations are:

1. Establish continuity of care for timely coordination among healthcare providers.
2. Adopt trauma- and culturally-informed practices for healthcare providers.
3. Increase access to high quality mental and behavioral health services.
4. Expand insurance coverage for the range of maternal health services beyond one year postpartum.
5. Screen pregnant individuals and their partners for domestic violence, mental illness, Substance Use Disorder, and Adverse Childhood Experiences.
6. Increase provider education about the perinatal period.
7. Enhance access to the full range of reproductive health services.
8. Ensure facilities are prepared for obstetric emergencies.
9. Address access to care barriers related to income insecurity.
10. Increase patient education about substance use and misuse.

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 social determinants of health 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

Appendix A: Arizona Maternal Mortality Review Committee Membership

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4th Trimester

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Arizona Hospital and Healthcare Association

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Retired Obstetrician and Gynecologist

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Humana

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Appendix B. Arizona Statute Language

Be it enacted by the Legislature of the State of Arizona:

Section 1. Advisory committee on maternal fatalities and morbidity; membership; report; delayed repeal

A. The advisory committee on maternal fatalities and morbidity is established to recommend improvements to information collection concerning the incidence and causes of maternal fatalities and severe maternal morbidity. The director of the department of health services shall appoint the members of the advisory committee. One of the members of the advisory committee shall be from a county with a population of less than five hundred thousand. The director or the director's designee shall serve as chairperson of the committee. The chairperson may not be affiliated with an organization that is otherwise represented on the committee.

B. The advisory committee consists of the following members:

1. A representative of a contractor from each geographic service area designated by the Arizona health care cost containment system.
2. A representative of the Arizona health care cost containment system.
3. A representative of Indian health services.
4. Three obstetricians, of which at least two are maternal fetal medicine specialists, who are licensed pursuant to title 32, chapter 13 or 17, Arizona Revised Statutes.
5. A certified nurse midwife who is certified pursuant to title 32, chapter 15, Arizona Revised Statutes.
6. Two representatives of nonprofit organizations that provide education, services or research related to maternal fatalities and morbidity.
7. A representative of this state's health information organization.
8. A representative of a public health organization.
9. Two representatives of organizations that represent hospitals in this state.

C. The department of health services, in conjunction with the advisory committee, shall hold a public hearing to receive public input regarding the recommended improvements to information collection concerning the incidence and causes of maternal fatalities and severe maternal morbidity.

D. On or before December 31, 2019, the advisory committee shall submit to the chairpersons of the health and human services committees of the house of representatives and the senate, or their successor committees, a report with recommendations concerning improving information collection on the incidence and causes of maternal fatalities and severe maternal morbidity.

E. This section is repealed on July 1, 2020.

Sec. 2. Department of health services; report; delayed repeal

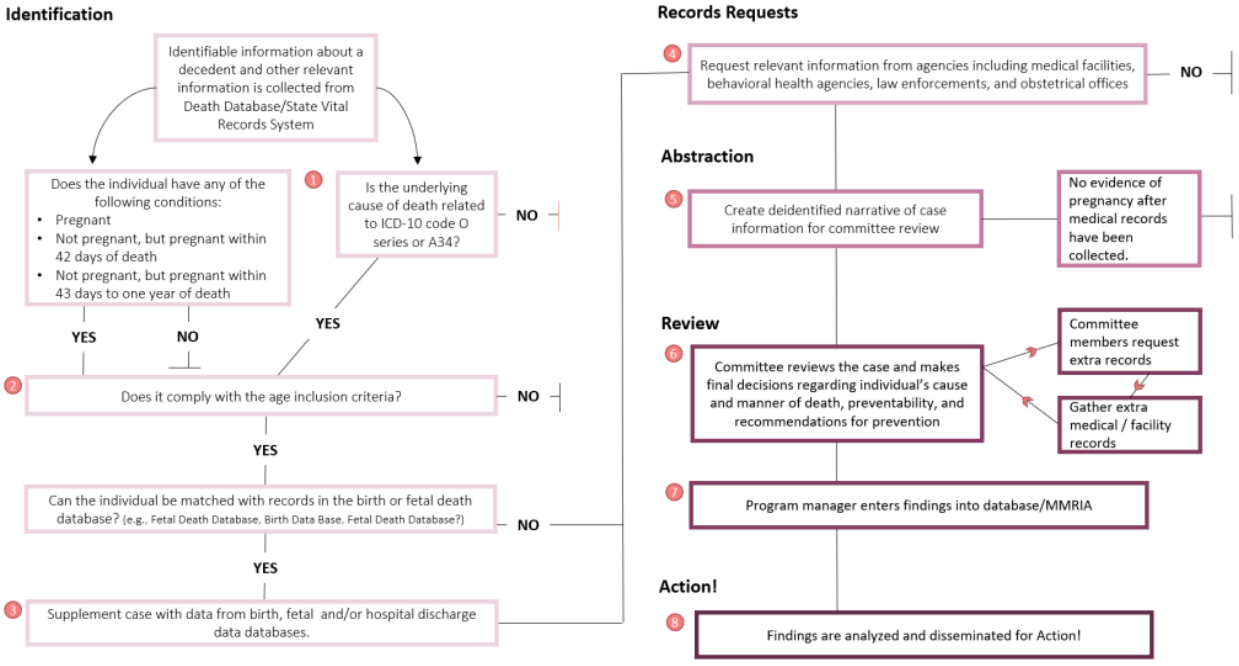
A. On or before December 31, 2020, the department of health services shall submit a report to the governor, the speaker of the house of representatives and the president of the senate, and shall provide a copy to the secretary of state, on the incidence and causes of maternal fatalities and morbidity that includes all readily available data through the end of 2019.

B. This section is repealed on July 1, 2021.

Sec. 3. Emergency

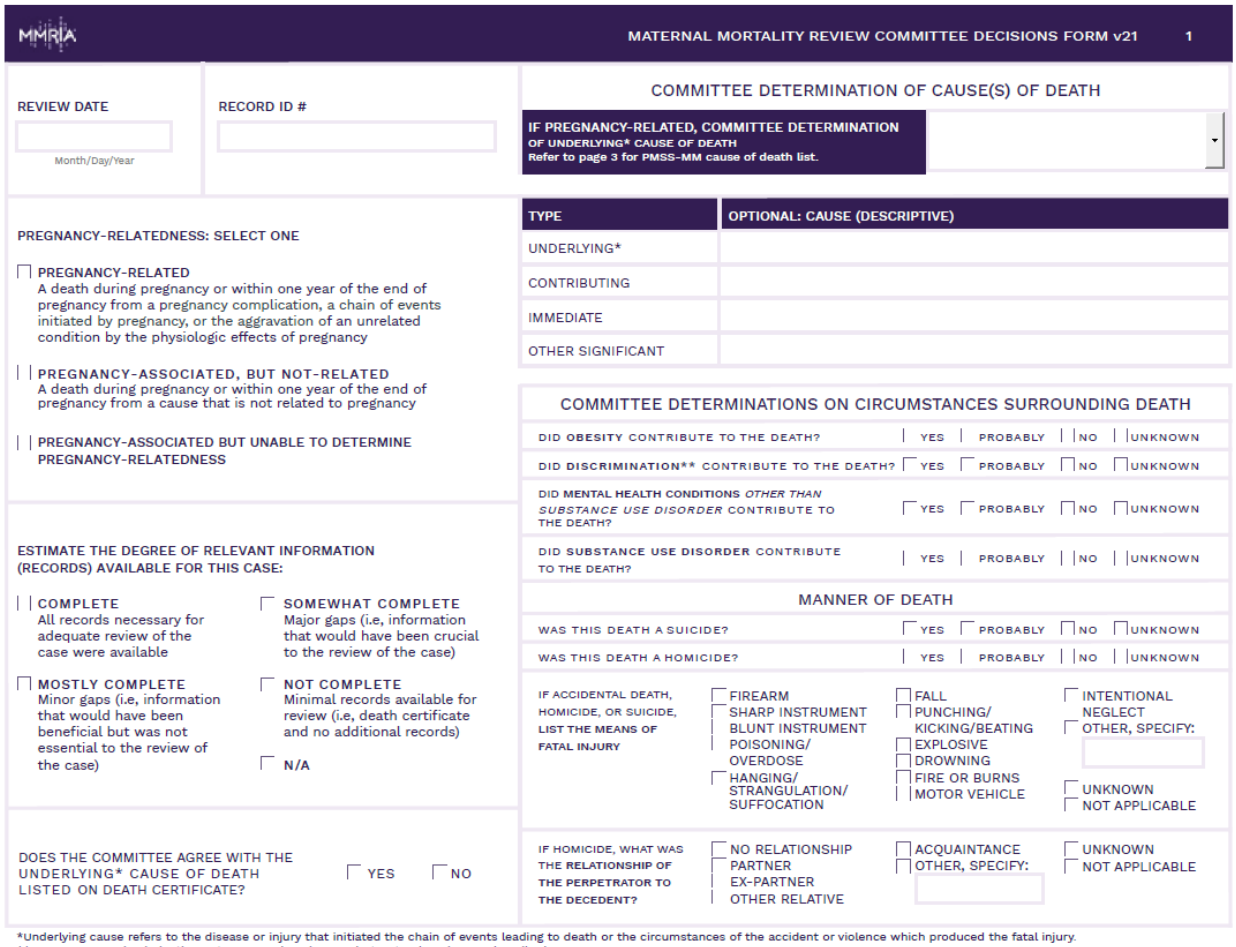
This act is an emergency measure that is necessary to preserve the public peace, health or safety and is operative immediately as provided by law.

Appendix C. Review to Action Flow Chart



Appendix D. MMRIA Committee Decisions Form

The Committee Decision Form displayed here is Version 21 of the form. CDC updates this form periodically, and therefore, several versions of this form (18, 19, 20, and 21) were used to review the 149 maternal mortality cases included in this brief. For more information about the various versions of the form, see ReviewtoAction.org.



MMRIA — MATERNAL MORTALITY REVIEW COMMITTEE DECISIONS FORM v21 1

REVIEW DATE (Month/Day/Year)

RECORD ID #

COMMITTEE DETERMINATION OF CAUSE(S) OF DEATH

IF PREGNANCY-RELATED, COMMITTEE DETERMINATION OF UNDERLYING* CAUSE OF DEATH
Refer to page 3 for PMSS-MM cause of death list.

PREGNANCY-RELATEDNESS: SELECT ONE

- ☐ PREGNANCY-RELATED — 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
- ☐ PREGNANCY-ASSOCIATED, BUT NOT-RELATED — A death during pregnancy or within one year of the end of pregnancy from a cause that is not related to pregnancy
- ☐ PREGNANCY-ASSOCIATED BUT UNABLE TO DETERMINE PREGNANCY-RELATEDNESS

TYPE	OPTIONAL: CAUSE (DESCRIPTIVE)
UNDERLYING*	
CONTRIBUTING	
IMMEDIATE	
OTHER SIGNIFICANT	

ESTIMATE THE DEGREE OF RELEVANT INFORMATION (RECORDS) AVAILABLE FOR THIS CASE:

- ☐ COMPLETE — All records necessary for adequate review of the case were available
- ☐ MOSTLY COMPLETE — Minor gaps (i.e, information that would have been beneficial but was not essential to the review of the case)
- ☐ SOMEWHAT COMPLETE — Major gaps (i.e, information that would have been crucial to the review of the case)
- ☐ NOT COMPLETE — Minimal records available for review (i.e, death certificate and no additional records)
- ☐ N/A

DOES THE COMMITTEE AGREE WITH THE UNDERLYING* CAUSE OF DEATH LISTED ON DEATH CERTIFICATE? ☐ YES ☐ NO

COMMITTEE DETERMINATIONS ON CIRCUMSTANCES SURROUNDING DEATH

	YES	PROBABLY	NO	UNKNOWN
DID OBESITY CONTRIBUTE TO THE DEATH?	☐	☐	☐	☐
DID DISCRIMINATION** CONTRIBUTE TO THE DEATH?	☐	☐	☐	☐
DID MENTAL HEALTH CONDITIONS *OTHER THAN SUBSTANCE USE DISORDER* CONTRIBUTE TO THE DEATH?	☐	☐	☐	☐
DID SUBSTANCE USE DISORDER CONTRIBUTE TO THE DEATH?	☐	☐	☐	☐

MANNER OF DEATH

	YES	PROBABLY	NO	UNKNOWN
WAS THIS DEATH A SUICIDE?	☐	☐	☐	☐
WAS THIS DEATH A HOMICIDE?	☐	☐	☐	☐

IF ACCIDENTAL DEATH, HOMICIDE, OR SUICIDE, LIST THE MEANS OF FATAL INJURY

- ☐ FIREARM
- ☐ SHARP INSTRUMENT
- ☐ BLUNT INSTRUMENT
- ☐ POISONING/ OVERDOSE
- ☐ HANGING/ STRANGULATION/ SUFFOCATION
- ☐ FALL
- ☐ PUNCHING/ KICKING/BEATING
- ☐ EXPLOSIVE
- ☐ DROWNING
- ☐ FIRE OR BURNS
- ☐ MOTOR VEHICLE
- ☐ INTENTIONAL NEGLECT
- ☐ OTHER, SPECIFY:
- ☐ UNKNOWN
- ☐ NOT APPLICABLE

IF HOMICIDE, WHAT WAS THE RELATIONSHIP OF THE PERPETRATOR TO THE DECEDENT?

- ☐ NO RELATIONSHIP
- ☐ PARTNER
- ☐ EX-PARTNER
- ☐ OTHER RELATIVE
- ☐ ACQUAINTANCE
- ☐ OTHER, SPECIFY:
- ☐ UNKNOWN
- ☐ NOT APPLICABLE

*Underlying cause refers to 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.
**Encompasses Discrimination, Interpersonal Racism, and Structural Racism as described on page 4.

COMMITTEE DETERMINATION OF 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, family, provider, facility, system and/or community factors.

WAS THIS DEATH PREVENTABLE?	YES	NO
CHANCE TO ALTER OUTCOME	GOOD CHANCE	SOME CHANCE
	NO CHANCE	UNABLE TO DETERMINE

CONTRIBUTING FACTORS AND RECOMMENDATIONS FOR ACTION (Entries may continue to grid on page 5)

CONTRIBUTING FACTORS WORKSHEET

What were the factors that contributed to this death?
Multiple contributing factors may be present at each level.

RECOMMENDATIONS OF THE COMMITTEE

If there was at least some chance that the death could have been averted, what were the specific and feasible actions that, if implemented or altered, might have changed the course of events?

DESCRIPTION OF ISSUE (enter a description for EACH contributing factor listed)	CONTRIBUTING FACTORS (choose as many as needed below)	LEVEL	COMMITTEE RECOMMENDATIONS [Who?] should [do what?] [when?] Map recommendations to contributing factors.	LEVEL	PREVENTION TYPE (choose below)	EXPECTED IMPACT (choose below)

CONTRIBUTING FACTOR KEY (DESCRIPTIONS ON PAGE 4)

- Access/financial
- Adherence
- Assessment
- Chronic disease
- Clinical skill/ quality of care
- Communication
- Continuity of care/ care coordination
- Cultural/religious
- Delay
- Discrimination
- Environmental
- Equipment/ technology
- Interpersonal racism
- Knowledge
- Law Enforcement
- Legal
- Mental health conditions
- Outreach
- Policies/procedures
- Referral
- Social support/ isolation
- Structural racism
- Substance use disorder - alcohol, illicit/prescription drugs
- Tobacco use
- Trauma
- Unstable housing
- Violence
- Other

DEFINITION OF LEVELS

- **PATIENT/FAMILY:** An individual before, during or after a pregnancy, and their family, internal or external to the household, with influence on the individual
- **PROVIDER:** An individual with training and expertise who provides care, treatment, and/or advice
- **FACILITY:** A physical location where direct care is provided - ranges from small clinics and urgent care centers to hospitals with trauma centers
- **SYSTEM:** Interacting entities that support services before, during, or after a pregnancy - ranges from healthcare systems and payors to public services and programs
- **COMMUNITY:** A grouping based on a shared sense of place or identity - ranges from physical neighborhoods to a community based on common interests and shared circumstances

PREVENTION TYPE

- **PRIMARY:** Prevents the contributing factor before it ever occurs
- **SECONDARY:** Reduces the impact of the contributing factor once it has occurred (i.e, treatment)
- **TERTIARY:** Reduces the impact or progression of what has become an ongoing contributing factor (i.e, management of complications)

EXPECTED IMPACT

- **SMALL:** Education/counseling (community- and/or provider-based health promotion and education activities)
- **MEDIUM:** Clinical intervention and coordination of care across continuum of well-woman visits (protocols, prescriptions)
- **LARGE:** Long-lasting protective intervention (improve readiness, recognition and response to obstetric emergencies/LARC)
- **EXTRA LARGE:** Change in context (promote environments that support healthy living/ensure available and accessible services)
- **GIANT**: Address social determinants of health (poverty, inequality, etc.)

IF PREGNANCY-RELATED, COMMITTEE DETERMINATION OF UNDERLYING CAUSE OF DEATH* PMSS-MM

* PREGNANCY-RELATED DEATH: 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.

Hemorrhage (Excludes Aneurysms or CVA)
10.1 - Hemorrhage – Uterine Rupture
10.2 - Placental Abruption
10.3 - Placenta Previa
10.4 - Ruptured Ectopic Pregnancy
10.5 - Hemorrhage – Uterine Atony/Postpartum Hemorrhage
10.6 - Placenta Accreta/Increta/Percreta
10.7 - Hemorrhage due to Retained Placenta
10.10 - Hemorrhage – Laceration/Intra-Abdominal Bleeding
10.9 - Other Hemorrhage/NOS

Infection
20.1 - Postpartum Genital Tract (e.g,, of the Uterus/ Pelvis/Perineum/Necrotizing Fasciitis)
20.2 - Sepsis/Septic Shock
20.4 - Chorioamnionitis/Antepartum Infection
20.6 - Urinary Tract Infection
20.7 - Influenza
20.8 - COVID-19
20.10 - Pneumonia
20.11 - Other Non-Pelvic Infection (e.g,, TB, Meningitis, HIV)
20.9 - Other Infection/NOS

Embolism - Thrombotic (Non-Cerebral)
30.1 - Embolism – Thrombotic (Non-Cerebral)
30.9 - Other Embolism (Excludes Amniotic Fluid Embolism)/NOS

Amniotic Fluid Embolism
31.1 - Embolism - Amniotic Fluid

Hypertensive Disorders of Pregnancy
40.1 - Preeclampsia
50.1 - Eclampsia
60.1 - Chronic Hypertension with Superimposed Preeclampsia

Anesthesia Complications
70.1 - Anesthesia Complications

Cardiomyopathy
80.1 - Postpartum/Peripartum Cardiomyopathy
80.2 - Hypertrophic Cardiomyopathy
80.9 - Other Cardiomyopathy/NOS

Hematologic
82.1 - Sickle Cell Anemia
82.9 - Other Hematologic Conditions including Thrombophilias/TTP/HUS/NOS

Collagen Vascular/Autoimmune Diseases
83.1 - Systemic Lupus Erythematosus (SLE)
83.9 - Other Collagen Vascular Diseases/NOS

Conditions Unique to Pregnancy
85.1 - Conditions Unique to Pregnancy (e.g, Gestational Diabetes, Hyperemesis, Liver Disease of Pregnancy)

Injury
88.1 - Intentional (Homicide)
88.2 - Unintentional
88.9 - Unknown Intent/NOS

Cancer
89.1 - Gestational Trophoblastic Disease (GTD)
89.3 - Malignant Melanoma
89.9 - Other Malignancy/NOS

Cardiovascular Conditions
90.1 - Coronary Artery Disease/Myocardial Infarction (MI)/Atherosclerotic Cardiovascular Disease
90.2 - Pulmonary Hypertension
90.3 - Valvular Heart Disease Congenital and Acquired
90.4 - Vascular Aneurysm/Dissection (Non-Cerebral)
90.5 - Hypertensive Cardiovascular Disease
90.6 - Marfan Syndrome
90.7 - Conduction Defects/Arrhythmias
90.8 - Vascular Malformations Outside Head and Coronary Arteries
90.9 - Other Cardiovascular Disease, including CHF, Cardiomegaly, Cardiac Hypertrophy, Cardiac Fibrosis, Non-Acute Myocarditis/NOS

Pulmonary Conditions (Excludes ARDS-Adult Respiratory Distress Syndrome)
91.1 - Chronic Lung Disease
91.2 - Cystic Fibrosis
91.3 - Asthma
91.9 - Other Pulmonary Disease/NOS

Neurologic/Neurovascular Conditions (Excluding CVA)
92.1 - Epilepsy/Seizure Disorder
92.9 - Other Neurologic Disease/NOS

Renal Disease
93.1 - Chronic Renal Failure/End-Stage Renal Disease (ESRD)
93.9 - Other Renal Disease/NOS

Cerebrovascular Accident not Secondary to Hypertensive Disorders of Pregnancy
95.1 - Cerebrovascular Accident (Hemorrhage/ Thrombosis/Aneurysm/Malformation) not Secondary to Hypertensive Disorders of Pregnancy

Metabolic/Endocrine
96.2 - Diabetes Mellitus
96.9 - Other Metabolic/Endocrine Disorder/NOS

Gastrointestinal Disorders
97.1 - Crohn's Disease/Ulcerative Colitis
97.2 - Liver Disease/Failure/Transplant
97.9 - Other Gastrointestinal Disease/NOS

Mental Health Conditions
100.1 - Depressive Disorder
100.2 - Anxiety Disorder (including Post-Traumatic Stress Disorder)
100.3 - Bipolar Disorder
100.4 - Psychotic Disorder
100.5 - Substance Use Disorder
100.9 - Other Psychiatric Condition/NOS

Unknown COD
999.1 - Unknown COD

CONTRIBUTING FACTOR DESCRIPTIONS

LACK OF **ACCESS/FINANCIAL** RESOURCES
Systemic barriers, e.g, lack or loss of healthcare insurance or other financial duress, as opposed to noncompliance, impacted their ability to care for themself (e.g, did not seek services because unable to miss work or afford postpartum visits after insurance expired). Other barriers to accessing care: insurance non-eligibility, provider shortage in their geographical area, and lack of public transportation.

ADHERENCE TO MEDICAL RECOMMENDATIONS
The provider or patient did not follow protocol or failed to comply with standard procedures (i.e, non adherence to prescribed medications).

FAILURE TO SCREEN/INADEQUATE **ASSESSMENT** OF RISK
Factors placing the individual at risk for a poor clinical outcome recognized, and they were not transferred/transported to a provider able to give a higher level of care.

CHRONIC DISEASE
Occurrence of one or more significant pre-existing medical conditions (e.g, obesity, cardiovascular disease, or diabetes).

CLINICAL SKILL/QUALITY OF CARE (PROVIDER OR FACILITY PERSPECTIVE)
Personnel were not appropriately skilled for the situation or did not exercise clinical judgment consistent with standards of care (e.g, error in the preparation or administration of medication or unavailability of translation services).

POOR **COMMUNICATION**/LACK OF CASE COORDINATION OR MANAGEMENT/ LACK OF CONTINUITY OF CARE (SYSTEM PERSPECTIVE)
Care was fragmented (i.e, uncoordinated or not comprehensive) among or between healthcare facilities or units, (e.g, records not available between inpatient and outpatient or among units within the hospital, such as Emergency Department and Labor and Delivery).

LACK OF **CONTINUITY OF CARE** (PROVIDER OR FACILITY PERSPECTIVE)
Care providers did not have access to individual's complete records or did not communicate their status sufficiently. Lack of continuity can be between prenatal, labor and delivery, and postpartum providers.

CULTURAL/RELIGIOUS, OR LANGUAGE FACTORS The provider or patient demonstrated that any of these factors was either a barrier to care due to lack of understanding or led to refusal of therapy due to beliefs (or belief systems).

DELAY
The provider or patient was delayed in referring or accessing care, treatment, or follow-up care/action.

DISCRIMINATION
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. (Smedley et al, 2003 and Dr. Rachel Hardeman).

ENVIRONMENTAL FACTORS
Factors related to weather or social environment.

INADEQUATE OR UNAVAILABLE **EQUIPMENT/TECHNOLOGY**
Equipment was missing, unavailable, or not functional, (e.g, absence of blood tubing connector).

INTERPERSONAL RACISM
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. (Jones, CP, 2000 and Dr. Cornelia Graves).

KNOWLEDGE - LACK OF KNOWLEDGE REGARDING IMPORTANCE OF EVENT OR OF TREATMENT OR FOLLOW-UP
The provider or patient did not receive adequate education or lacked knowledge or understanding regarding the significance of a health event (e.g, shortness of breath as a trigger to seek immediate care) or lacked understanding about the need for treatment/follow-up after evaluation for a health event (e.g, needed to keep appointment for psychiatric referral after an ED visit for exacerbation of depression).

INADEQUATE **LAW ENFORCEMENT** RESPONSE
Law enforcement response was not in a timely manner or was not appropriate or thorough in scope.

LEGAL
Legal considerations that impacted outcome.

MENTAL HEALTH CONDITIONS
The patient had a documented diagnosis of a psychiatric disorder. This includes postpartum depression. If a formal diagnosis is not available, refer to your review committee subject matter experts (e.g, psychiatrist, psychologist, licensed counselor) to determine whether the criteria for a diagnosis of substance use disorder or another mental health condition are met based on the available information.

INADEQUATE COMMUNITY **OUTREACH**/RESOURCES
Lack of coordination between healthcare system and other outside agencies/organizations in the geographic/cultural area that work with maternal health issues.

LACK OF STANDARDIZED **POLICIES/PROCEDURES**
The facility lacked basic policies or infrastructure germane to the individual's needs (e.g, response to high blood pressure, or a lack of or outdated policy or protocol).

LACK OF **REFERRAL** OR CONSULTATION
Specialists were not consulted or did not provide care; referrals to specialists were not made.

SOCIAL SUPPORT/ISOLATION - LACK OF FAMILY/ FRIEND OR SUPPORT SYSTEM
Social support from family, partner, or friends was lacking, inadequate, and/or dysfunctional.

STRUCTURAL RACISM
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. (Adapted from Bailey ZD. Lancet. 2017 and Dr. Carla Ortique).

SUBSTANCE USE DISORDER – ALCOHOL, ILLICIT/ PRESCRIPTION DRUGS
Substance use disorder is characterized by recurrent use of alcohol and/or drugs causing clinically and functionally significant impairment, such as health problems or disability. The committee may determine that substance use disorder contributed to the death when the disorder directly compromised their health status (e.g, acute methamphetamine intoxication exacerbated pregnancy- induced hypertension, or they were more vulnerable to infections or medical conditions).

TOBACCO USE
The patient's use of tobacco directly compromised the patient's health status (e.g, long-term smoking led to underlying chronic lung disease).

TRAUMA
The individual experienced trauma: i.e,, loss of child (death or loss of custody), rape, molestation, or one or more of the following: sexual exploitation during childhood plus persuasion, inducement, or coercion of a child to engage in sexually explicit conduct; or other physical or emotional abuse other than that related to sexual abuse during childhood.

UNSTABLE HOUSING
Individual lived "on the street," in a homeless shelter, or in transitional or temporary circumstances with family or friends.

VIOLENCE AND INTIMATE PARTNER VIOLENCE (IPV)
Physical or emotional abuse perpetrated by current or former intimate partner, family member, friend, acquaintance, or stranger.

OTHER
Contributing factor not otherwise mentioned. Please provide description.

Appendix E. Supplemental Data Table: Maternal Mortality Sociodemographic by Pregnancy Relatedness

	All Pregnancy-Associated Deaths			Pregnancy-Associated, but NOT related			Pregnancy-Associated, but relatedness unknown			Pregnancy-Related		
	# of Deaths	% of Deaths	Ratio (All)	# of Deaths	% of Deaths	Ratio (All)	# of Deaths	% of Deaths	Ratio (All)	# of Deaths	% of Deaths	Ratio (All)
Overall	149	NA	91.1	72	48.3	44.0	34	22.9	20.8	43	28.9	26.3
Sociodemographic Characteristics												
Maternal Race and Ethnicity	n=146			n=71			n=33			n=42		
American Indian or Alaska Native	22	15.1	233.9	11	15.5	116.9	6	18.2	63.8	*	*	*
Asian or Pacific Islander	*	*	*	*	*	*	0	**	**	*	*	*
Black or African American	16	11.0	166.8	7	9.9	73.0	*	*	*	6	14.3	62.6
Hispanic or Latina	49	33.6	72.0	23	32.4	33.8	10	30.3	14.7	16	38.1	23.5
White, non-Hispanic	56	38.4	80.1	28	39.4	40.1	14	42.4	20.0	14	33.3	20.0
Maternal Age	n=149			n=72			n=34			n=43		
10-19 Years Old	10	6.7	109.3	7	9.7	76.5	*	*	*	0	**	**
20-29 Years Old	67	45.0	78.9	35	48.6	41.2	16	47.1	18.8	16	37.2	18.8
30-39 Years Old	64	43.0	99.7	25	34.7	38.9	14	41.2	21.8	25	58.1	38.9
40-49 Years Old	8	5.3	156.3	*	*	*	*	*	*	*	*	*
50-60 Years Old	0	**	**	0	**	**	0	**	**	0	**	**
Over 60	0	**	**	0	**	**	0	**	**	0	**	**
Maternal Education	n=149			n=72			n=34			n=43		
8th Grade or Less	8	5.4	167.5	*	*	*	*	*	*	*	*	*
9th-12th Grade; No Diploma	32	21.5	148.2	20	27.8	92.6	7	20.6	32.4	*	*	*
High School Grade or GED Completed	58	39.0	134.7	25	34.7	58.0	17	50.0	39.5	16	37.2	37.2
Some College Credit, but No Degree	23	15.4	61.8	14	19.4	37.6	*	*	*	7	16.3	18.8
Associate's Degree	12	8.1	85.4	*	*	*	*	*	*	*	*	*
Bachelor's Degree or More	16	10.8	38.6	*	*	*	*	*	*	8	18.6	19.3
Maternal Insurance	n=146			n=72			n=32			n=42		
Private Insurance	27	18.5	40.5	12	16.7	18.0	*	*	*	10	23.8	15.0
Medicaid	105	71.9	131.6	55	76.4	68.9	23	71.9	28.8	27	64.3	33.8
Self-Pay	10	6.9	118.2	*	*	*	*	*	*	*	*	*
Other	*	*	*	*	*	*	0	**	**	*	*	*

*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.

Appendix E. Supplemental Data Table: Maternal Mortality Sociodemographic by Pregnancy Relatedness

Table Continued.

	All Pregnancy-Associated Deaths			Pregnancy-Associated, but NOT related			Pregnancy-Associated, but relatedness unknown			Pregnancy-Related		
	# of Deaths	% of Deaths	Ratio (All)	# of Deaths	% of Deaths	Ratio (All)	# of Deaths	% of Deaths	Ratio (All)	# of Deaths	% of Deaths	Ratio (All)
Maternal Residence												
Urban vs. Rural	n=142			n=69			n=30			n=43		
Urban	116	81.7	80.7	56	81.2	39.0	23	76.7	16.0	37	86.1	25.7
Rural	26	18.3	141.1	13	18.8	70.5	7	23.3	38.0	6	14.0	32.6
Regions	n=142			n=69			n=30			n=43		
Central	95	66.9	84.3	45	65.2	39.9	21	70.0	18.6	29	67.4	25.7
Northern	14	9.9	127.5	8	11.6	72.9	*	*	*	*	*	*
Southeastern	23	16.2	87.8	11	15.9	42.0	*	*	*	10	23.3	38.2
Western	10	7.0	101.4	*	*	*	*	*	*	*	*	*

*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.

Appendix F. Supplemental Data Table: Maternal Mortality Rates by Inclusion Criteria

	All Pregnancy-Associated Deaths			Pregnancy-Associated, but NOT related			Pregnancy-Associated, but relatedness unknown			Pregnancy-Related		
	Ratio (All)	Ratio (CDC)	Ratio (AZ)	Ratio (All)	Ratio (CDC)	Ratio (AZ)	Ratio (All)	Ratio (CDC)	Ratio (AZ)	Ratio (All)	Ratio (CDC)	Ratio (AZ)
Overall	91.1	88.3	85.6	44.0	42.6	41.0	20.8	18.8	20.2	26.3	26.9	24.5
Sociodemographic Characteristics												
Maternal Race and Ethnicity												
American Indian or Alaska Native	233.9	239.9	191.4	116.9	120.0	85.1	63.8	65.4	63.8	*	*	*
Asian or Pacific Islander	*	*	*	*	*	*	**	**	**	*	*	*
Black or African American	166.8	157.6	156.4	73.0	63.0	73.0	*	*	*	62.6	63.0	*
Hispanic or Latina	72.0	71.7	69.0	33.8	35.1	32.3	14.7	12.2	13.2	23.5	24.4	23.5
White, non-Hispanic	80.1	75.4	77.3	40.1	36.2	38.6	20.0	18.8	20.0	20.0	20.3	18.6
Maternal Age												
10-19 Years Old	109.3	111.3	87.5	76.5	77.9	*	*	*	*	**	**	**
20-29 Years Old	78.9	76.9	74.1	41.2	42.1	38.8	18.8	15.6	17.7	18.8	19.2	17.7
30-39 Years Old	99.7	95.9	96.5	38.9	35.2	37.4	21.8	20.8	21.8	38.9	39.9	37.4
40-49 Years Old	156.3	143.9	136.7	*	*	*	*	*	*	*	*	*
50-60 Years Old	**	**	**	**	**	**	**	**	**	**	**	**
Over 60	**	**	**	**	**	**	**	**	**	**	**	**
Maternal Education												
8th Grade or Less	167.5	173.4	167.5	*	*	*	*	*	*	*	*	*
9th-12th Grade; No Diploma	148.2	141.3	143.6	92.6	84.8	88.0	32.4	33.0	32.4	*	*	*
High School Grad or GED Completed	134.7	127.4	123.1	58.0	56.6	51.1	39.5	33.0	37.2	37.2	37.7	34.8
Some College Credit, but No Degree	61.8	62.5	56.4	37.6	38.0	34.9	*	*	*	18.8	19.0	16.1
Associate's Degree	85.4	87.8	85.4	*	*	*	*	*	*	*	*	*
Bachelor's Degree or More	38.6	34.9	36.2	*	*	*	*	*	*	19.3	19.9	16.9
Maternal Insurance												
Private Insurance	40.5	39.3	36.0	18.0	18.2	16.5	*	*	*	15.0	15.1	13.5
Medicaid	131.6	125.1	124.1	68.9	65.7	63.9	28.8	25.3	28.8	33.8	34.1	31.3
Self-Pay	118.2	143.1	118.2	*	*	*	*	*	*	*	*	*
Other	*	*	*	*	*	*	**	**	**	*	*	*

*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.

Appendix F. Supplemental Data Table: Maternal Mortality Rates by Inclusion Criteria

Table Continued.

	All Pregnancy-Associated Deaths			Pregnancy-Associated, but NOT related			Pregnancy-Associated, but relatedness unknown			Pregnancy-Related		
	Ratio (All)	Ratio (CDC)	Ratio (AZ)	Ratio (All)	Ratio (CDC)	Ratio (AZ)	Ratio (All)	Ratio (CDC)	Ratio (AZ)	Ratio (All)	Ratio (CDC)	Ratio (AZ)
Maternal Residence												
Urban vs. Rural												
Urban	80.7	81.5	78.6	39.0	39.0	37.6	16.0	16.3	16.0	25.7	26.2	25.0
Rural	141.1	149.9	108.5	70.5	74.9	54.3	38.0	40.3	32.6	*	*	*
Regions												
Central	84.3	83.4	82.5	39.9	39.1	38.2	18.6	18.6	18.6	25.7	25.7	25.7
Northern	127.5	127.5	100.2	72.9	72.9	54.6	*	*	*	*	*	*
Southeastern	87.8	87.8	84.0	42.0	42.0	42.0	*	*	*	38.2	38.2	34.4
Western	101.4	101.4	71.0	*	*	*	*	*	*	*	*	*

*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.

Appendix G. Supplemental Data Table: Maternal Mortality Review Committee Decisions by Pregnancy Relatedness

	All Pregnancy-Associated Deaths		Pregnancy-Associated, but NOT related		Pregnancy-Associated, but relatedness unknown		Pregnancy-Related	
	# of Deaths	% of Deaths	# of Deaths	% of Deaths	# of Deaths	% of Deaths	# of Deaths	% of Deaths
Overall	149	NA	72	48.3	34	22.9	43	28.9
Committee determination of preventability								
Preventable Deaths	n=149		n=72		n=34		n=43	
Yes	134	89.9	63	87.5	32	94.1	39	90.7
No	15	10.1	9	12.5	*	*	*	*
Chance to Alter Outcome (among Preventable Deaths)	n=131 of 134		n=61 of 63		n=32 of 32		n=38 of 39	
Good Chance	53	40.0	24	38.1	13	40.6	16	42.0
Some Chance	71	54.0	35	55.6	16	50.0	20	53.0
No Chance	*	*	0	0.0	0	0.0	*	*
Unable to Determine	6	5.0	*	*	*	*	*	*
Timing of Death	n=149		n=72		n=34		n=43	
Pregnant at time of death	33	22.1	10	13.9	10	29.4	13	30.2
Day of Delivery	6	4.0	*	*	0	0	*	*
Pregnant within 42 days of death	21	14.1	6	8.3	*	*	12	27.9
Pregnant 43-365 days of death	89	60.0	55	76.4	21	61.8	13	30.2
Preventability for each Timing of Death Group	n=134 of 134		n=63		n=32		n=39 of 39	
Pregnant at time of death (Preventable)	31	23.0	10	16.0	10	31.0	11	84.6
Day of Delivery (Preventable)	6	4.0	*	*	0	0.0	*	*
Pregnant within 42 days of death (Preventable)	18	13.0	6	10.0	*	*	10	83.0
Pregnant 43-365 days of death (Preventable)	79	59.0	46	73.0	20	63.0	13	100.0
Committee determinations on circumstances surrounding death								
Did obesity contribute to the death?	n=147		n=70		n=34		n=43	
Yes	12	8.2	6	8.6	*	*	*	*
Probably	6	4.1	0	0	*	*	*	*
No	120	81.6	60	85.7	31	91.2	29	67.4
Unknown	9	6.1	*	*	0	0.0	*	*
Did discrimination contribute to the death?	n=116		n=52		n=28		n=36	
Yes	13	11.2	*	*	*	*	6	16.7
Probably	20	17.2	9	17.3	*	*	7	19.4
No	44	37.9	24	46.2	11	39.3	9	25.0
Unknown	39	33.6	16	30.8	9	32.1	14	38.9

Appendix G. Supplemental Data Table: Maternal Mortality Review Committee Decisions by Pregnancy Relatedness

Table Continued.

	All Pregnancy-Associated Deaths		Pregnancy-Associated, but NOT related		Pregnancy-Associated, but relatedness unknown		Pregnancy-Related	
	# of Deaths	% of Deaths	# of Deaths	% of Deaths	# of Deaths	% of Deaths	# of Deaths	% of Deaths
Did mental health conditions contribute to the death?	n=147		n=70		n=34		n=43	
Yes	39	26.5	17	24.3	9	26.5	13	30.2
Probably	18	12.2	6	8.6	8	23.5	*	*
No	53	36.1	28	40.0	9	26.5	16	37.2
Unknown	37	25.2	19	27.1	8	23.5	10	23.3
Did substance use disorder contribute to the death?	n=147		n=70		n=34		n=43	
Yes	65	44.2	32	45.7	16	47.1	17	39.5
Probably	6	4.1	*	*	*	*	*	*
No	68	46.3	31	44.3	14	41.2	23	53.5
Unknown	8	5.4	*	*	*	*	*	*
Manner of Death								
Manner of Death – From Death Certificate	n=149		n=72		n=34		n=43	
Natural	45	30.2	21	29.2	6	17.6	18	41.9
Homicide	18	12.1	11	15.3	*	*	*	*
Accident	69	46.3	37	51.4	20	58.8	12	27.9
Suicide	12	8.1	*	*	*	*	6	14.0
Pending investigation	*	*	0	0	0	0	*	*
Could not be determined	*	*	*	*	*	*	*	*
Was this death a suicide?	n=147		n=70		n=34		n=43	
Yes	12	8.2	*	*	*	*	6	14.0
Probably	*	*	*	*	0	0	0	0.0
No	108	73.5	58	82.9	19	55.9	31	72.1
Unknown	26	17.7	9	12.9	11	32.4	6	14.0
Was this death a homicide?	n=147		n=70		n=34		n=43	
Yes	17	11.6	10	14.3	*	*	*	*
Probably	*	*	*	*	0	0.0	0	0.0
No	126	85.7	59	84.3	30	88.2	37	86.1
Unknown	*	*	0	0	*	*	*	*

*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.

Appendix H. Maternal Mortality Case Identification Process: Additional Details

Case Identification through Arizona Death Certificates

Arizona vital records death certificates are the primary source of identification for 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 both of the following criteria were met:

- The decedent was identified as female in the death certificate
- The decedent was listed as 10-60 years of age at the time of death

The list of decedents that met the sex and age criteria within the death certificates were further queried to identify (or "flag") potential cases with any of the following types of ICD codes:

- Z codes
- O codes
- A34 codes

Decedents were also identified as a potential maternal death case if they were identified as pregnant within the last year prior to death through the pregnancy checkbox field in the death certificate.

Guidance was provided by the ADHS Bureau of Public Health Statistics to create record-level unique identifiers for each data source by using information from the corresponding data source. The 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

The unique identifiers were 13 characters long for the decedent, and consisted of a combination of alphanumeric characters selected from the decedent's first name, last name, date of birth, and sex.

For each of the three linkages conducted using the four data sources listed, each of the record-level matches was assigned a score based on the potential for an accurate match to have occurred. Additionally, matched records were manually reviewed by select members of the MMRP team to ensure selection of only accurately matched records.

Death Record Linkage with Arizona Hospital Discharge Database

Linkage between death records and the hospital discharge database was performed to identify pertinent information that could support a death being identified as a maternal death, and to locate hospital information that would be needed by the MMR team to request medical records for review.

Similar to death certificate records, the HDD was queried to identify patients that did not identify as male and that were between 10-60 years of age during the hospitalization. Patients were flagged if they had any of the ICD codes previously listed in this Appendix.

Maternal death certificates were linked to hospitalization events that occurred in the calendar year of the death and the calendar year prior to the death.

Death Record Linkage with Vital Records Live Birth Certificates

Additionally, and separately, death certificates for potential cases were also linked with Arizona Vital Records Live Birth Certificates. This linkage was performed to identify supporting information that the death was a maternal death that occurred either during or within a year of pregnancy. This linkage was also conducted to obtain key demographic information for epidemiological assessments.

Maternal death certificates were linked to live birth certificates for live births that occurred in either the same calendar year as the maternal death or in the calendar year prior to the maternal death.

Death Record Linkage with Vital Records Fetal Death Certificates

Similar to live birth certificates death records were linked with Arizona Fetal Death Certificates. The linkage was performed to identify supporting information that the death was a maternal death that occurred either during or within a year of pregnancy.

Maternal death certificates were linked to fetal death certificates for fetal deaths that occurred in either the same calendar year as the maternal death or in the calendar year prior to the maternal death.

Appendix I: Maternal Mortality Epidemiological Methods: Additional Details

Missing Data

Missing data in this report was accounted for in similar methods to CDC DRH reports (Trost et al, 2022). Cases that have missing data for a particular stratum (i.e. category) are excluded from any calculations for that stratum. For instance, if a total of 149 cases were identified, yet 9 of them had missing race/ethnicity data, then the 9 cases would be excluded from any calculations (i.e. ratios, proportions, and others) involving the race/ethnicity strata. The sample size (n) for each strata calculation were indicated whenever possible.

All-Inclusive Criteria for Report

Data metrics within the report narratives 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**:** Similarly, when calculating mortality ratios, all live births with an Arizona live birth certificate were included in the mortality ratio calculation, regardless of county of residence or delivery, if the maternal age of the live birth was between 10-60 years of age at time of birth.

$$\frac{\text{Maternal Deaths for Birthing Persons Ages 10-60 years of age}}{\text{Live Births for Arizona for Birthing Persons Ages 10-60 years of age}} \times 100{,}000 = \text{Mortality Ratio}$$

Arizona Inclusion Criteria, per Statute

Numerator: Maternal death cases where the decedent was 10-60 years of age at time of death, and died in Arizona.

Denominator: For maternal mortality ratios, all live births with an Arizona live birth certificate were included in the denominator, regardless of county of delivery, and if the maternal age of the live birth was between 10-60 years of age at the time of birth.

$$\frac{\text{Maternal Deaths for Birthing Persons Ages 10-60 years of age}}{\text{Live Births for Arizona for Birthing Persons Ages 10-60 years of age}} \times 100{,}000 = \text{Mortality Ratio}$$

CDC-Recommended Inclusion Criteria (Appendix F)

Numerator: Maternal death cases where the decedent was 10-60 years of age at time of death, and most recently resided in Arizona.

Denominator: For maternal mortality ratios, all live births with an Arizona live birth certificate were included in the denominator if the maternal residence listed in the live birth certificate was Arizona and if the maternal age of the live birth was between 10-60 years of age at the time of birth.

$$\frac{\text{Maternal Deaths with Arizona Residency, 10-60 years of age}}{\text{Live Births with Arizona Residency for Birthing Persons, 10-60 years of age}} \times 100{,}000 = \text{Mortality Ratio}$$

Final Case Count

Final case count mentioned in this report includes all cases that met the following criteria:

Decedent sex: Persons identified as female in the Arizona death certificate, which was further confirmed in any case records received by the abstraction team

Age at time of death: Persons identified as 10-60 years of age at the time of death in the Arizona death certificate, which was further supported by any case records received by the abstraction team

Pregnancy-Relatedness: Persons identified as any one of the three Pregnancy-Associated categories by the Maternal Mortality Review Committee:

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

Arizona Residency and/or Place of Death: Decedent was either of the following:

- A resident of Arizona immediately prior to death as identified in either the death certificate and/or the corresponding live birth certificate.
- Place of death was listed as Arizona according to the decedent's Arizona death certificate

Maternal death cases were also included in the final case count if the following apply:

The case met the 4 criteria listed above (i.e. sex, age, pregnancy-relatedness, and Arizona as most recent residency and/or place of death)

The case has an identified death certificate number from Arizona

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 data base system.

Mortality Ratios

Ratios are the preferred method to compare trends across stratum due to different sources of data and slight difference in time intervals between the cases (numerator) and the live births (denominator).

The three inclusion criteria standards were implemented for all report stratum (i.e. categories) as needed. All data metrics included in the report narrative used the "All-inclusive" criteria. Appendix F display data taking into account the Arizona and CDC-Recommended inclusion criteria.

All inclusion criteria standards were implemented for both the numerator and denominator when calculating the mortality ratios.

Maternal Race and Ethnicity

Case Counts

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

- High-level of completeness for race/ethnicity information within the maternal 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: All cases were included in the race/ethnicity stratum of this report if they had race/ethnicity information documented as mentioned in the "Case Counts" description for these strata.

Denominator: Similarly, all live births with an Arizona live birth certificate were included for this specific analysis if the live birth certificate had maternal race/ethnicity information documented.

Mortality Ratio for each Race/Ethnicity Stratum =

$$\frac{\text{Race/Ethnicity Category for Maternal Deaths, Ages 10-60 years of age}}{\text{Maternal Race/Ethnicity Category of Live Births, Ages 10-60 years of age}} \times 100{,}000$$

Stratum (i.e. Categories)

- American Indian/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 maternal age at time of death information documented in various fields. However, maternal age information was primarily sourced from Vital Records maternal death certificate decedent years field. This was due to all cases having age at time of death documented from this data source

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 live birth certificate were included for this analysis if the live birth certificate had maternal date of birth and date of live birth information documented so that maternal age could be calculated.

Mortality Ratio for each Age Group Stratum =

$$\frac{\text{Maternal Age Category for Maternal Deaths, Ages 10-60 years of age}}{\text{Maternal Age Category of Live Births,Ages 10-60 years of age}} \text{ x } 100{,}000$$

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, which proved helpful given data missingness for this particular stratum. The availability of this data through different data fields facilitated the implementation of additional data management methods that served to optimize completeness of maternal education information.

Mortality Ratio Formula

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

Denominator: All live births with an Arizona live birth certificate were included for this specific analysis if the live birth certificate had maternal information documented.

Mortality Ratio for each Maternal Education Group Stratum =

$$\frac{\text{Maternal Education Category for Maternal Deaths, Ages 10-60 years of age}}{\text{Maternal Education Category of Live Births,Ages 10-60 years of age}} \text{ x } 100{,}000$$

Stratum (i.e. Categories)

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

Maternal Residence

Overview of Case Data

All maternal mortality cases in this report had maternal residence documented in various fields within various data sources. This facilitated the implementation of additional data management techniques that served to optimize completeness of maternal residence. This was especially important since maternal residency was the basis for two different data metrics (Urban-Rural and Regional) and because it was information needed for a criterion for the CDC-recommend inclusion criteria.

Overview of Maternal Ratio Formula

Maternal residence information for live births is needed to properly calculate the mortality ratios. Maternal residency for live births was primarily based on the live birth certificate data.

Maternal Residence Based on County

Arizona County	Region	Urban-Rural Designation
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	Central	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 were either documented as urban or rural residency if the case had a recent residence within Arizona. Urban-Rural designation were based on Arizona Vital Statistics Report definition.[80] Details regarding where the data was sourced from are explained in the Maternal Residence "Overview of Case Data" section.

Mortality Ratio Formula

Numerator: All cases were included in the urban-rural maternal residence stratum if they had county of maternal residence documented (see Maternal Residence "Overview of Case Data")

Denominator: Live births with an Arizona live birth certificate that met the inclusion criteria were included for this specific analysis if the live birth certificate had county of maternal residence documented.

Mortality Ratio for each Age Group Stratum =

$$\frac{\text{Urban-Rural Maternal Residence Category for Maternal Deaths, Ages 10-60 years of age}}{\text{Urban-Rural Maternal Residence Category of Live Births, Ages 10-60 years of age}} \times 100{,}000$$

Stratum (i.e. Categories)

- Urban
- Rural

Regional Maternal Residence

Case Counts

All maternal mortality cases were documented into one of the four Arizona Regions (see Maternal Residence "Maternal Residence Based on County") if the case had a recent residence within Arizona. Details regarding where the data was sourced from are explained 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 county of maternal residence documented (see Maternal Residence "Overview of Case Data" section).

Denominator: Live births with an Arizona live birth certificate that met the inclusion criteria and if the live birth certificate had county of maternal residence listed.

Mortality Ratio for each Age Group Stratum =

$$\frac{\text{Regional Maternal Residence Category for Maternal Deaths, Ages 10-60 years of age}}{\text{Regional Maternal Residence Category of Live Births,Ages 10-60 years of age}} \times 100{,}000$$

Stratum (i.e. Categories)

- Central
- Northern
- Southeastern
- Western

Maternal Insurance Type

Case Counts

All maternal mortality cases in this report had insurance type information documented in various fields, which proved helpful given data missingness for this particular stratum. Medical insurance information for all decedents was sourced from the MMRIA registry. The primary source of information from the registry was the insurance payor for the obstetric delivery that was originally documented in either the corresponding live birth certificates or fetal death certificates. If information was not available within the registry from this source, then the payor was identified through the program-acquired inpatient hospital records. Finally, if payor information was missing from both of those sources, the insurance coverage within MMRIA that was identified as the payor for prenatal care was selected for this metric. This insured that a minimal amount of cases had missing data for these strata.

Mortality Ratio Formula

Numerator: All cases were included in the insurance type stratum of this report if they had payor information documented as mentioned in the "Case Counts" description for this metric.

Denominator: All live births with an Arizona live birth certificate were included for this analysis if the live birth certificate had payor of the delivery documented.

Mortality Ratio for each Age Group Stratum =

$$\frac{\text{Insurance Type Category for Maternal Deaths, Ages 10-60 years of age}}{\text{Insurance Type Category of Live Births, Ages 10-60 years of age}} \times 100{,}000$$

Stratum (i.e. Categories)

- Private Insurance
- Medicaid
- Self-Pay
- Other (including Indian Health Services)

Appendix J: Underlying Cause of Death: Supplemental Findings

For the 43 pregnancy-related cases identified for this time-frame, a total of 53 underlying causes of death were identified among these cases. For 10 of the 43 pregnancy-related cases, two underlying causes of death were identified by the MMRC. Causes were either noted to be the main (or primary) underlying cause of death, or the secondary underlying cause of death.

The majority of cases that had two underlying causes of death documented were mental health conditions. All of the cases that had a mental health condition listed as the secondary underlying cause of death also had a mental health condition listed as the primary underlying cause of death. For example, this could have occurred when either two specific mental health disorders were identified (such as depression and bipolar) or when a mental health disorder was found in the presence of substance use disorder (e.g. Anxiety/PTSD and substance use disorder). Additional, secondary underlying causes of deaths identified were hypertensive disorders of pregnancy, infection, and hemorrhage. The total 53 underlying causes of death identified are shown in **Figure 16**, below.

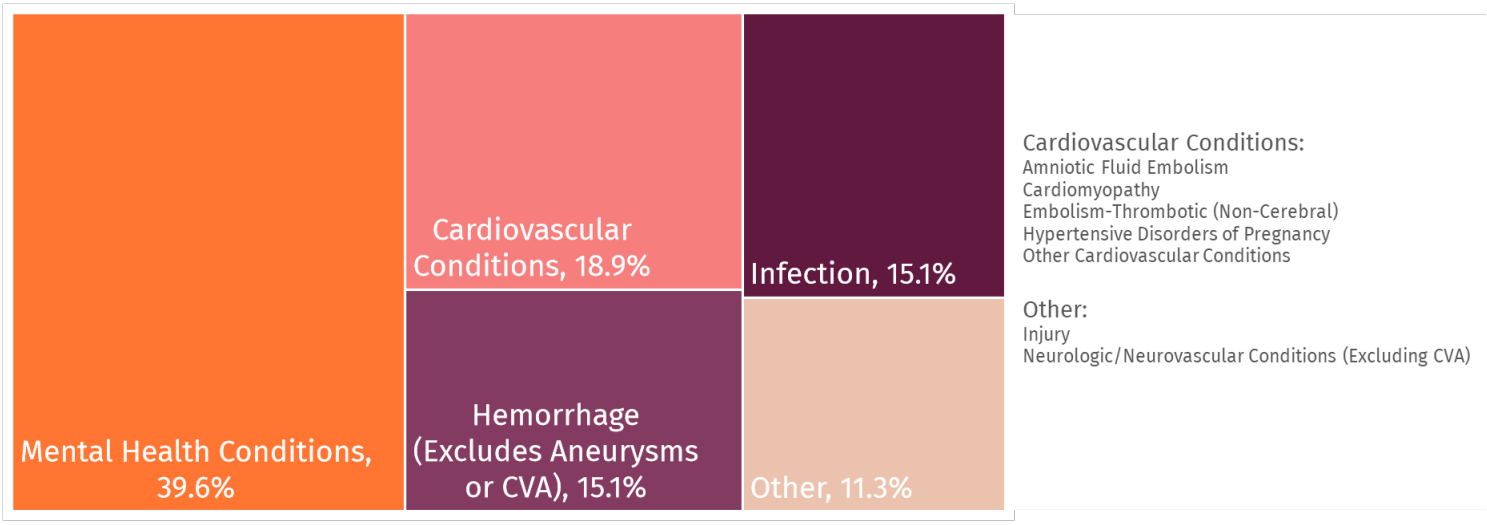


Figure 16. All Underlying Causes of Death among Pregnancy-Related Deaths, 2018-2019
Cardiovascular Conditions: Amniotic Fluid Embolism, Cardiomyopathy, Embolism - Thrombotic (Non-Cerebral), Hypertensive Disorders of Pregnancy, other cardiovascular conditions.
Other: Injury, and Neurologic/Neurovascular Conditions (Excluding CVA).

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