



A MULTI YEAR LOOK AT
MATERNAL MORTALITY IN
MISSOURI, 2017-2019
PREGNANCY-ASSOCIATED
MORTALITY REVIEW

Annual Report

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Dedication

The Missouri Department of Health and Senior Services (DHSS) and the Pregnancy Associated Mortality Review (PAMR) board would like to convey our deepest sympathies to the children, partners, parents, and all those who love and miss the 185 women who died while pregnant, or within one year of pregnancy from 2017-2019. This report is dedicated to their memory, with the hope that we may bring meaning to what can often seem a senseless death, as our continued efforts to understand the causes and contributing factors of maternal mortality in the state of Missouri will prevent others from experiencing such a loss.



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Executive Summary

Maternal mortality events, those where a mother dies during or shortly after pregnancy, are internationally viewed as an indicator that may be used to judge the overall health of a country, state, or community. This report describes the state of maternal mortality in Missouri based on deaths that occurred from 2017-2019.

While it is vital to analyze these deaths on a yearly basis, the goal of this multi-year report is to provide a more comprehensive representation of maternal mortality in the state. DHSS identified deaths of Missouri residents that occurred when a woman was pregnant or within one-year postpartum and presented information regarding the pregnancy and death to the PAMR board. The PAMR board performed a comprehensive review of these deaths. The board's findings and recommendations are summarized in this report, with the goal to prevent future instances of maternal mortality. Below are key findings and recommendations from the PAMR board.

Key Findings

An average of 61 Missouri women died while pregnant or within one year of pregnancy each year with the highest number recorded in 2018 (68 deaths total).

From 2017-2019:

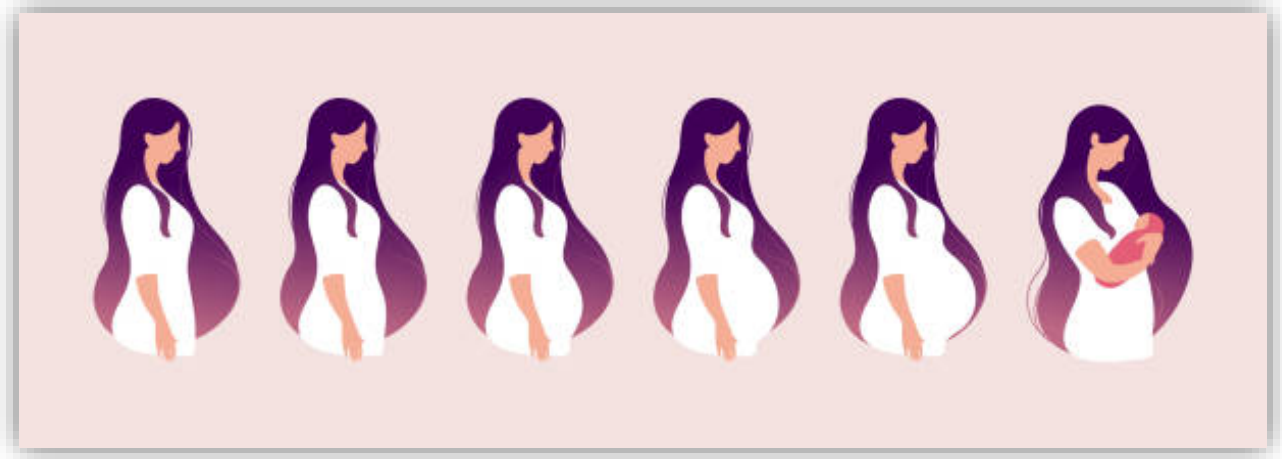
- The pregnancy-related mortality ratio (PRMR) in Missouri was 25.2 deaths per 100,000 live births.
- The PRMR for Black women was more than three times greater than the ratio for White women.
- Seventy-five percent of pregnancy-related deaths were determined to be preventable.
- The greatest proportion of pregnancy-related deaths occurred between 43 days and one year after pregnancy.
- Mental health conditions were the leading underlying cause of pregnancy-related deaths, followed by cardiovascular disease.
- All pregnancy-related deaths due to mental health conditions were determined to be preventable.
- The most common means of fatal injury for pregnancy-related deaths was overdose/poisoning.
- Substance use disorder (SUD) contributed to 32.7% of pregnancy-related deaths.
- Seventy percent of deaths were pregnancy-associated, but not related for a ratio of 59.5 per 100,000 live births.
- The ratio of pregnancy-associated, not related deaths for women on Medicaid was more than 8 times greater than the ratio for those with private insurance.

Key Recommendations

Recommendations for pregnancy-associated deaths developed by the board are summarized below with additional discussion throughout the body of this report.

- The Missouri Legislature should:
 - Provide funding for a statewide Perinatal Quality Collaborative (PQC) by 2023.
 - Establish and fund a statewide Perinatal Psychiatry Access Program to aid health care providers in providing evidence-based mental health care including SUD treatment to Missouri women.
 - Extend Medicaid coverage to one year postpartum for all conditions (including medical, mental health and SUD), even if the woman did not start treatment prior to delivery, to aid women whose condition is exacerbated in the postpartum period.
 - Fund Medicaid expansion by 2023.
- All providers should be further educated regarding screening, referral, and treatment of:
 - Mental health conditions during and after pregnancy.
 - SUD during and after pregnancy.
 - Cardiovascular disorders associated with pregnancy (i.e. peripartum cardiomyopathy, hypertensive disorders of pregnancy, etc.)
- It is necessary that all providers:
 - Perform a full assessment for depression and anxiety utilizing a standardized, validated tool at least once during the perinatal period and at least once during the comprehensive postpartum visit, adding additional screenings as indicated.
 - Perform universal screening for SUD utilizing a standardized, validated tool on every patient at least once during the perinatal period and at least once during the comprehensive postpartum visit, adding additional screenings as indicated.
 - Make referrals to mental health professionals, social workers, community health workers, and SUD treatment programs as appropriate.
- All health care workers (physicians, nurses, doulas, etc.) should:
 - Complete trainings on trauma-informed care, at least annually.
 - Complete implicit bias training, at least annually.
- All birthing facilities should standardize practices and procedures across the health care system through utilization of quality improvement practices such as AIM bundles.
- Community-based organizations should:
 - Reduce stigma surrounding maternal mental health and SUD and provide assistance to resources for these conditions.
 - Educate their community on domestic violence (DV) and intimate partner violence (IPV) and provide resources and assistance for women affected by DV or IPV.
 - Empower pregnant and postpartum women to engage in health care through utilization methods such as doula services, home visitors, and/or community health workers.

- It is necessary that all Medical Death Certifiers ensure an autopsy and toxicology is completed on a woman who has been pregnant within the last year.
- The state should increase public awareness of the importance of seat belt safety during the perinatal period.



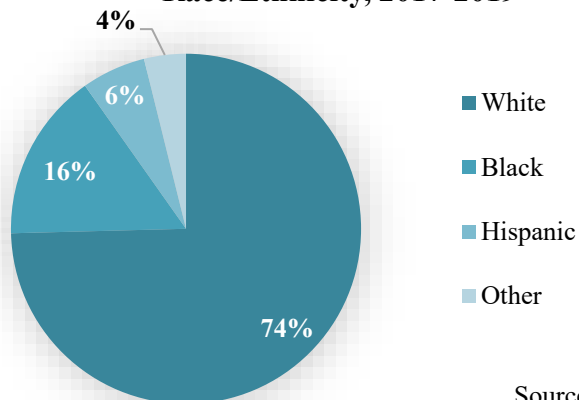
Maternal Health

A woman's health influences the well-being of her children, family and communities. For the purposes of this report, maternal health is defined as the health of a woman from the time she becomes pregnant until one year postpartum. Preconception health, or health prior to becoming pregnant, is vitally important and can dramatically impact health outcomes throughout pregnancy and postpartum. However, during the perinatal period, women often become more engaged with the health care system. For this reason, pregnancy provides an opportunity to identify and manage underlying chronic diseases, such as obesity, hypertension, diabetes and asthma. The death of a woman during pregnancy, childbirth, or within the first year postpartum is a tragic occurrence that has an immediate and lasting impact on her family and communities. These deaths also act as an early warning system for a society's health, reflecting upon a variety of health determinants ranging from individualized factors to more systemic issues.

Birthing Demographics in Missouri

Missouri is a demographically and socially diverse state with a total population of 6,137,428 including 2,001,751 women of reproductive age (defined as 10-60 years old) based on 2019 estimates.¹ From 2017-2019, Missouri women had an average of 72,800 live births per year.²

Figure 1: Percent of MO Live Births by Race/Ethnicity, 2017-2019



Source:
DHSS-MOPHIMS-Birth MICA

Non-Hispanic White women represented 74.6% of these births, while Non-Hispanic Black women represented 15.6% of live births. Hispanic women of any race represented 5.9% of live births. Women, who did not fall into any of the above categories, including Asian, American Indian, Pacific Islander, and other groups, represented 3.9% of live births (Fig. 1). Compared with the population of women of childbearing age in Missouri at this time, a greater percentage of live births were to Black and Hispanic women.

Statewide Challenges

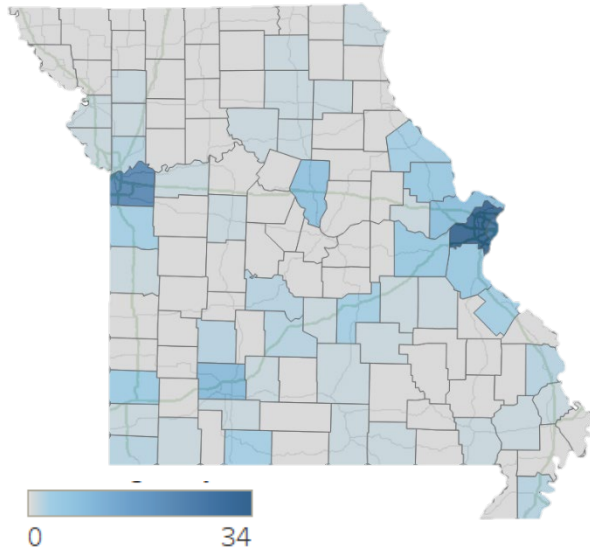
There are a number of challenges likely to influence maternal morbidity and mortality trends in Missouri. One known challenge is a low rate of timely initiation of prenatal care. Between 2017 and 2019, more than half of new mothers reported having had a health care visit in the twelve months prior to becoming pregnant (65%)³, while 28% of expecting Missouri mothers did not begin prenatal care in the first trimester.⁴ Among Black women, these rates are significantly higher as more than half (57%) experienced late entry into prenatal care. Prenatal care utilization provides medical professionals with an opportunity for early identification and potential intervention regarding risk factors that affect maternal mortality.

Data concerning the statewide challenges is limited regarding prenatal care. During 2017-2019, for 14.5% of pregnancy-related deaths, the trimester of first prenatal care visit was unknown. For those cases where the first prenatal care visit was known, 44.7% did not receive prenatal care during the first trimester. While currently limited by low population size, as additional data is gathered further investigation into this challenge may be possible.

Maternal health experiences also differ between rural and urban counties. The percentage of low birth weight infants and premature births was significantly lower in rural counties than in urban counties from 2009-2019. Although it should be noted that Black women in rural areas experienced low birth weight and preterm births at a rate higher than either White women in

rural/urban areas or Black women in urban areas.⁵ However, regardless of race, from 2017-2019, women residing in rural Missouri counties are nearly twice as likely to smoke while pregnant (19.8% vs 10.4%) which is a risk factor for low birth weight infants.

Figure 2: Map of All Pregnancy-Associated Deaths by Residence, 2017-2019



Obtaining risk-appropriate care for complex or high-risk births remains a challenge for rural residents. Risk-appropriate care is a system to ensure pregnant women and infants at high risk of complications receive care at a facility that is prepared to meet their health needs. A regional center (Level IV) is capable of caring for the most complex conditions. From 2015-2019, 69% of high-risk births to rural-county residents were at Level III facilities compared with 89% of high risk births to urban-county residents.⁶ Rural White mothers (69%) were more likely than rural Black mothers (58%) to receive risk-appropriate care. However, as shown in Figure 2, pregnancy-associated

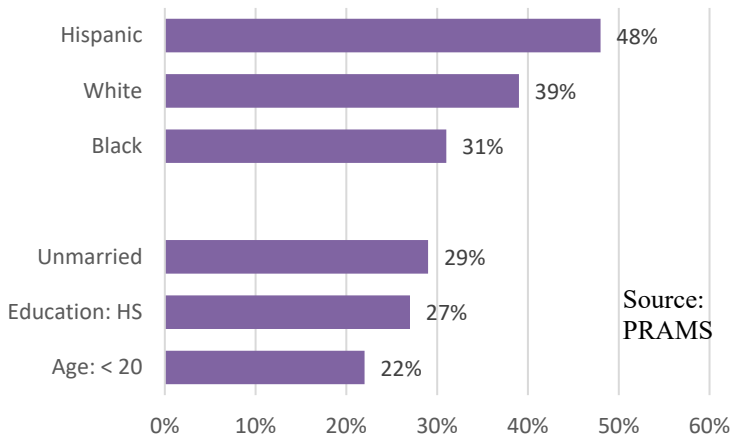
deaths most frequently occurred in metropolitan counties. This finding runs counter to the expectation that the challenges in obtaining risk-appropriate care would negatively impact pregnancy-associated deaths due to lack of providers and lack of public transportation options. As such, further investigation is warranted to understand the relationship between access to care and pregnancy-associated death overall. For pregnancy-related deaths, roughly 51% of all cases gave birth in a (self-designated) Level III or higher facility.

Pregnancy and Chronic Health Conditions

Diet and Exercise

A number of factors can play a role in a healthy woman, healthy pregnancy and a healthy baby. Many of the chronic diseases that are associated with negative health outcomes during pregnancy may be improved by diet and exercise. However, while it may be simple to say this phrase, there are factors that are systemic in nature which act to restrict diet and exercise. Realities like food deserts and financial restrictions to obtain healthy foods, for example, may contribute to problems such as obesity and anemia. Exercise may be inhibited by a lack of safe neighborhoods and well-maintained parks or recreational facilities that would allow physical activity. A full assessment of how these systemic issues influence diet and exercise is beyond the scope of this report, particularly as PAMR does not collect data on these activities.

Figure 3: Women Exercising 3+ Days Weekly Prior to Pregnancy, 2017-2019



Source: PRAMS

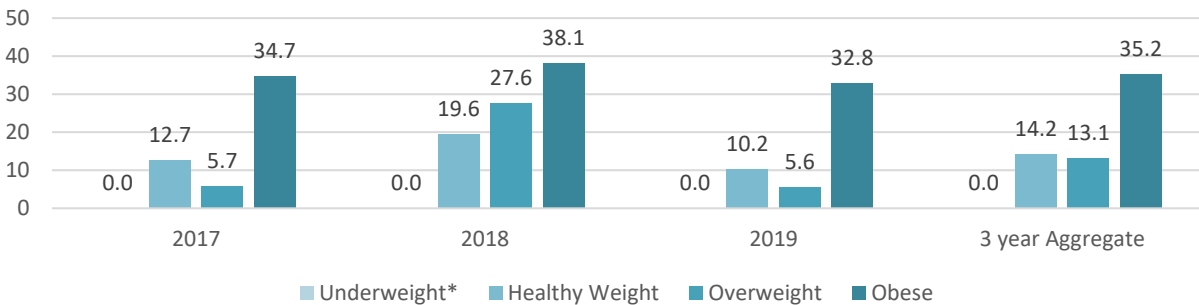
However, the Missouri Pregnancy Risk Assessment Monitoring System (PRAMS) does collect such data, and we are able to briefly offer some insight regarding diet and exercise from this data. Data reported here are from surveys of new Missouri mothers from 2017-2019. Based on these surveys, 29.2% of Missouri mothers reported that they were dieting to lose weight prior to becoming pregnant. More mothers reported they were exercising three or more days per week for fitness prior

to becoming pregnant (38%).⁷ Compared with married women (43%), only 29% of unmarried women were exercising this often. As education increases, so does the percentage who are exercising from a low of 27% with those graduating high school or with a GED to a high of 59% with those holding a graduate degree. Similarly, as age increases, the percentage of those who exercise 3 or more days per week also increases, from a low of 22% for those less than 20 years old to a high of 41% for those over 34 years old (Fig. 3).

Obesity

A number of conditions can result in health complications during pregnancy for both the mother and the child. One key condition is obesity, which is a chronic disease that disproportionately affects Black women (37%, compared to 28% among White women).⁸ Obesity is associated with an increased risk for nearly all pregnancy complications, and with a higher incidence of congenital defects.⁹ In addition to increased complications during pregnancy, the ratio of pregnancy-related death for obese women is significantly higher than for any other weight group (Fig. 4).

Figure 4: Pregnancy-Related Mortality Ratio per 100,000 Live Births by BMI



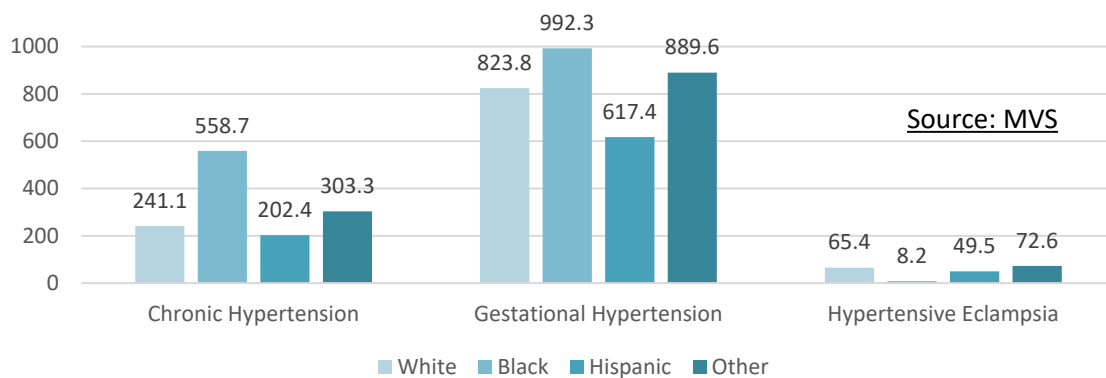
Body Mass Index (BMI) was calculated based on a woman’s pre-pregnancy height and weight. The pregnancy-related mortality ratio was highest among women who were obese with 35.2 deaths per 100,000 live births. This ratio was more than 2.5 times the ratio of overweight women and more than double the ratio for women of healthy weight. This disparity was found to be statistically significant.* While timely prenatal care cannot change BMI, providers are able to help with guidance and recommendations on diet and exercise to decrease the risk of complications associated with obesity.

Hypertension

Blood pressure issues are highly correlated with obesity, and hypertensive disorders occur in 12-22 percent of pregnancies.¹⁰ They are estimated to also be responsible for 17 percent of maternal mortality events nationwide. Hypertensive disorders of pregnancy (HDP) may be subdivided into: chronic hypertension, preeclampsia/eclampsia, preeclampsia superimposed on chronic hypertension, and gestational hypertension. If not managed, all of these could potentially become medical emergencies.

From 2017-2019 in Missouri, there were 1,395 instances of hypertensive eclampsia, 6,270 instances of chronic hypertension in pregnancy, and 18,066 instances of gestational hypertension.¹¹ Black mothers had the highest rates of chronic and gestational hypertension, while those classified as Other Race had the highest rate of hypertensive eclampsia (Fig. 5). Those who most commonly had any form of hypertension were obese. Chronic hypertension in pregnancy and hypertensive eclampsia was most frequent among those age 30-39 years old. Gestational hypertension most frequently occurred in women between 20-29 years old.

**Figure 5: Hypertension During Pregnancy by Race
Ratio per 10,000 2017-2019**



From 2017-2019, approximately 16% of pregnancy-related deaths had some form of hypertension diagnosis during the perinatal period. This data is pulled from birth and fetal death

* Statistical significance was determined at the ($p \leq 0.05$) level using Chi-Square testing.

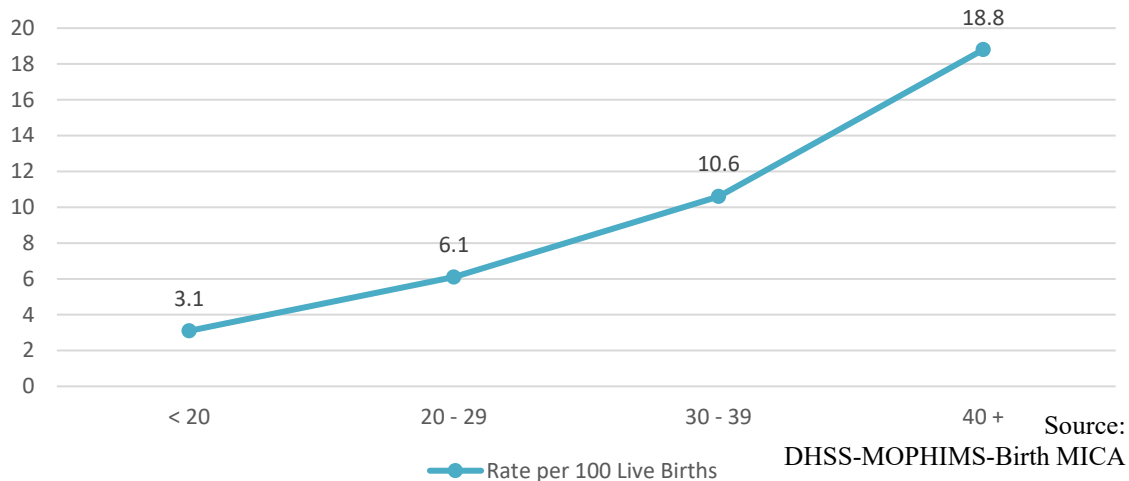
certificates and may be an underestimate of the true prevalence. Further investigation is warranted.

Diabetes

Diabetes is an often overlooked disease, with some studies indicating that it could actually be the third leading cause of death in the United States.¹² During pregnancy, any form of diabetes may negatively impact the health of women and their babies. To alleviate these risks, preconception care is a vital component to ensuring a healthy mother and baby. The primary means of managing diabetes during pregnancy include dietary recommendations for gestational diabetes, as well as physical activity and if necessary medication. Doctors can help monitor blood sugar and make recommendations specific to each case for how to best manage this condition.

From 2017-2019, diabetes affected 8.6% of live births in Missouri. Diabetes affected White mothers (7.7%) more often than it affected Black mothers (6.9%). Diabetes during pregnancy was highest for those who were obese pre-pregnancy (52%). This was more than twice the rate for any other BMI category. Gestational diabetes affected 9% of women who had a pregnancy-related death during this time. As shown in Figure 6, as age increases, so does the rate of diabetes.¹³

Figure 6: Rate of Diabetes by Age, 2017-2019

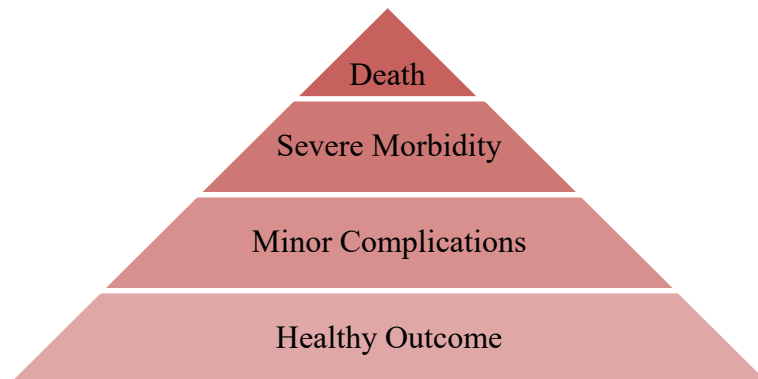


Maternal Morbidity and Mortality

There is a continuum of birth outcomes experienced by women and their families and it's important to highlight those events that can lead to maternal mortality. The most common experience is a healthy outcome, a birth with minor or no complications.

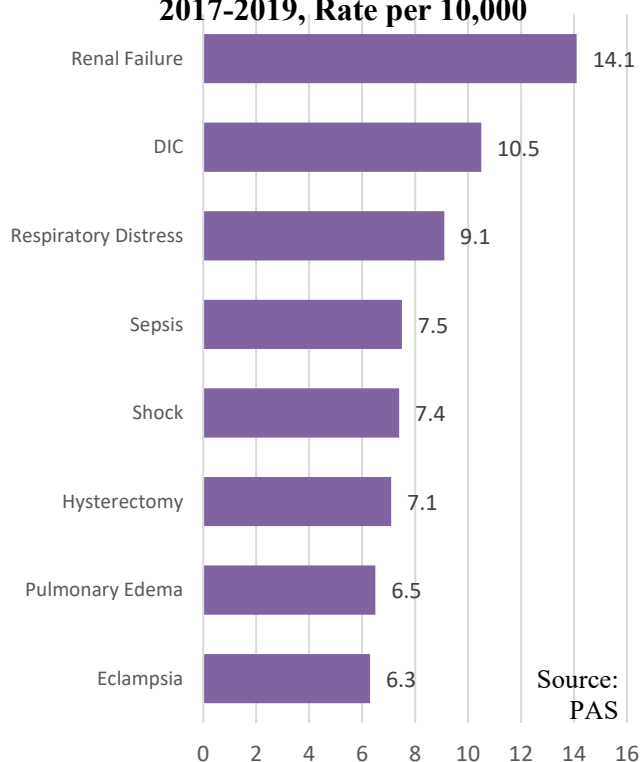
In general, the more severe the outcome, the less frequently it occurs (Fig. 7). Maternal morbidity, including Severe Maternal Morbidity (SMM) is an overarching term for unexpected outcomes of labor and delivery. These acute conditions may directly cause maternal deaths and/or have a significant impact on a woman's short- or long-term health, and may include blood transfusions, renal failures, and hysterectomies.¹⁴

Figure 7: Maternal Health Outcome Continuum



Those most at risk for SMM are women of advanced maternal age, were carrying multiples,¹⁵ had other coexisting medical conditions,¹⁶ or had a prior cesarean delivery.¹⁷ From 2017-2019

Figure 8: Additional Indicators of Severe Maternal Morbidity, 2017-2019, Rate per 10,000



there were 2,445 instances of SMM in the state of Missouri for an overall rate of 118 per 10,000 live births.[†] The most common indicator for SMM is a transfusion. Transfusions occur at a rate of 70.2 per 10,000 live births. Blood transfusions during pregnancy are often necessitated by severe anemia or by hemorrhaging. The rate of transfusions for Black women was 138 per 10,000 live births. This is more than double the rate for White women (57). Figure 8 provides the rates for other indicators of SMM.

Renal failure was the second most common indicator of SMM with a rate of 14.1 per 10,000 live births. However, the top five most common indicators after transfusions vary by race. For White mothers, renal failure (9.3), followed by Disseminated

[†] This data is based on the 25 Indicators metric, recalculated for severity using the Callaghan 2012 methodology for Missouri residents only.

Intravascular Coagulation (DIC) with a rate of 9.3 per 10,000 live births. This was followed by respiratory distress (7.5), sepsis (6.4), and shock (5.4). For Black mothers, the second highest rate after transfusion was also renal failure with a rate of 35.9 per 10,000 live births, followed by respiratory distress (16.5), DIC (13.1), eclampsia (12.5), and shock (12.2).

The most severe outcome is death during or after pregnancy. This report is focused on these extreme outcomes and seeks to emphasize opportunities to improve maternal health and health care. While maternal mortality continues to decline globally, the ratio of maternal mortality in the United States is three to four times higher than in other developed nations. It is estimated that approximately 700 women in the United States die because of pregnancy or pregnancy-related complications annually.¹⁸

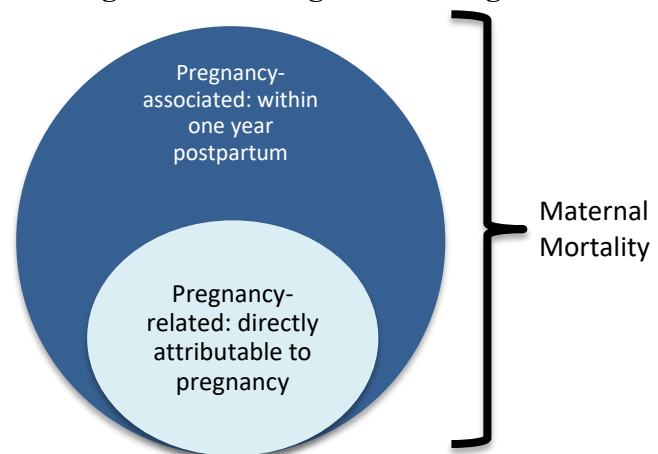
Surveillance of Maternal Mortality

The increasing ratio of maternal mortality, and the disparities in those ratios, has led to an increased interest in these topics. Reducing maternal mortality and improving maternal health are both state and national priorities. To this end, in 2019 the state of Missouri was awarded the Enhancing Reviews and Surveillance to Eliminate Maternal Mortality (ERASE-MM) grant from the Centers for Disease Control and Prevention (CDC). This five-year grant supports the PAMR program by facilitating timely identification of deaths, the formation of prevention strategies, and dissemination of strategies to reduce maternal deaths and associated disparities.

There are a number of operational definitions for maternal mortality. Missouri PAMR utilizes the following definitions:

- *Pregnancy-associated death*: When a Missouri resident dies while pregnant, during delivery or within one year postpartum regardless of the cause. Pregnancy-associated deaths can further be placed into one of three categories:
 - *Pregnancy-related death*: A subset of pregnancy-associated deaths where the death of a woman occurred 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 physiological effects of pregnancy (See Fig. 9).
 - *Pregnancy-associated, but not related death (PANR)*: The death of a woman during or within one year of pregnancy, from a cause that is not related to pregnancy.
 - *Pregnancy-associated but unable to determine relatedness*: This is a third category for those instances where the board was unable to determine if a death was pregnancy-related or PANR. In previous reports, this category was counted as a PANR death due to small

Figure 9: Defining Death Categories

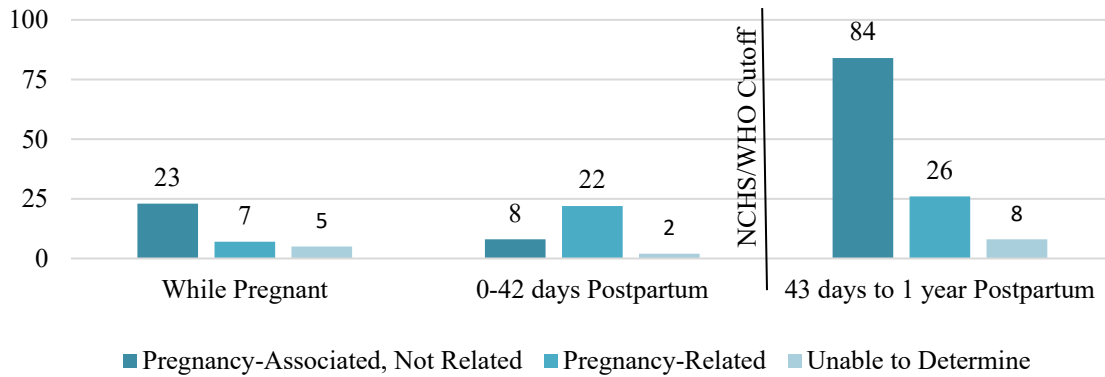


population size. For the sake of brevity, this is referred to as *Unable to Determine* in the charts and figures below.

Surveillance Timing

Timing of death influences whether a case is identified as a possible instance of maternal mortality. The CDC National Center for Health Statistics (NCHS) and the World Health Organization (WHO) identify deaths that occur during pregnancy, or within 42 days postpartum, as possible cases of maternal death. This differs in terminology, as the PAMR program utilizes the term pregnancy-associated as defined above for case identification, and in duration, as the PAMR program continues beyond 42 days postpartum to one year. Had the NCHS/WHO standard been used, 26 pregnancy-related cases would not have been identified (Fig. 10).

Figure 10: Timing of Death by Relationship to Pregnancy, 2017-2019



PAMR Board Determinations

The PAMR board collaboratively reviewed the case summaries provided by the abstractor. While some states divide the caseload by the cause of death, the entire PAMR board evaluated all pregnancy-associated cases. They worked to determine pregnancy-relatedness, evaluated the cause and contributing factors of death, and provided recommendations for improved outcomes.

Figure 11 shows the board determinations regarding relatedness by year.

- In 2019, 12 cases were determined to be related to pregnancy.
- Forty-one cases were found to be PANR.
- A further four cases were determined to be pregnancy-associated but the board was unable to determine relatedness.

Figure 11: Number of Deaths, Missouri 2017-2019

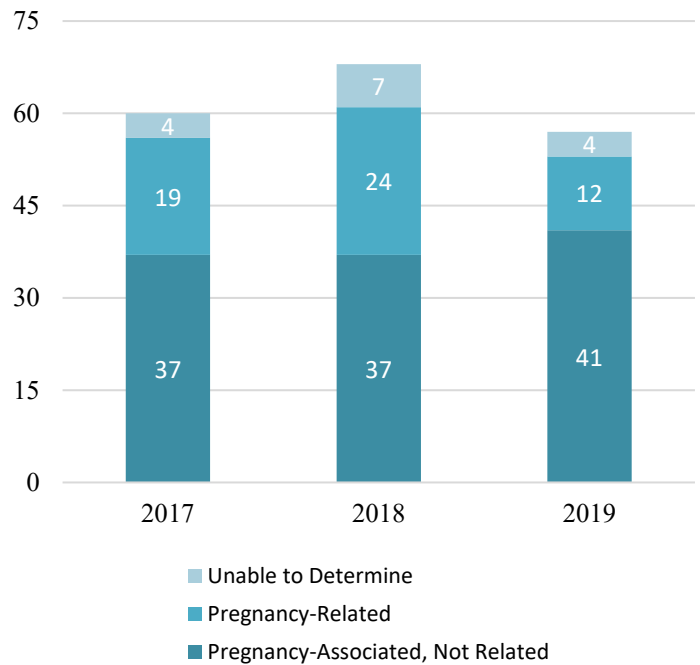
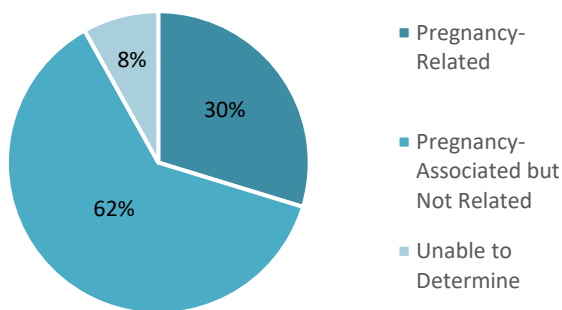


Figure 12: Committee Determination of Pregnancy-Related Deaths, 2017-2019

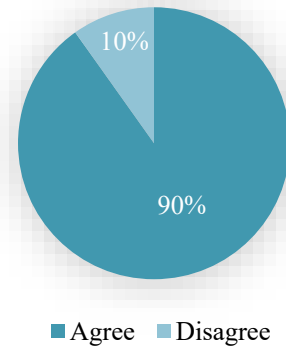


Between 2017-2019, 30% of cases were found to be pregnancy-related. Meanwhile, the majority of cases (62%) were found to be PANR. A further 8% of cases evaluated were found to be unable to determine relatedness (Fig. 12). In these instances, the board often would point out the need for additional data that simply did not exist (e.g. toxicology reports, autopsy).

Data Evaluation

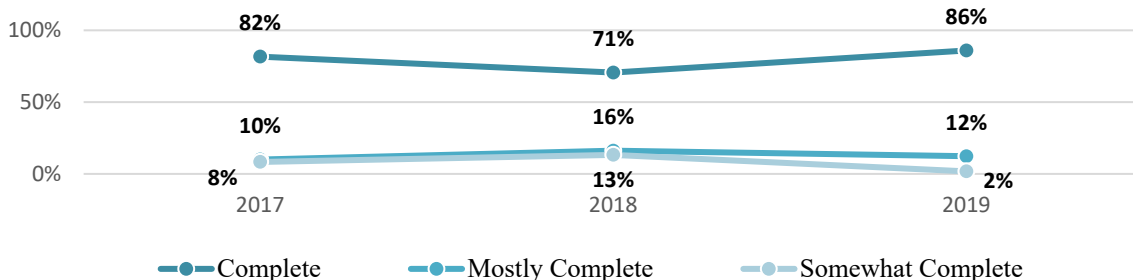
The PAMR board agreed with the underlying cause of death listed on the death certificate for the majority of cases during 2017-2019 (90%, Fig. 13). The PAMR board disagreed with the cause of death only when there was sufficient evidence to justify disputing the information found on the death certificate. There were 18 cases where the PAMR board disagreed with the cause of death on the death certificate and only 33.33% of these cases had an autopsy. Of the 18 cases, 61% were determined by the board to be pregnancy-related. Of the pregnancy-related cases, 81.8% were determined to have a medical underlyingly cause of death, 72.7% were determined to have died as a result of a cardiovascular disease, and 45.5% died between 43 days to one year postpartum. The decisions of the PAMR board were dependent upon the quality of information they received, and their abilities were also limited by that same restriction. For this reason, the PAMR board evaluated every case for completeness, to ensure they were being given sufficient data to make their determinations. Case completeness was established based on the provision of available records.

Figure 13: Committee Agreement with Underlying Cause of Death Listed on Death Certificate, 2017-2019



Regarding 2019 cases, the PAMR board found that 86% were complete or mostly complete, and 12% were somewhat complete. This represents a three year high, with the low point being 71% complete in 2018 and then 82% complete in 2017 (Fig. 14). In order to assure the best data quality possible, the PAMR program did attempt to obtain more specific information if the board requested. Every attempt was made to obtain records from health care providers and facilities, as well as coroners and medical examiners. However, toxicology screenings and autopsies were not always performed, and additional information from the health care system was not always obtainable. As such, the PAMR program occasionally did find itself desiring information that simply did not exist. This shortcoming specifically led the board to make recommendations that autopsies be performed on women of childbearing age who are pregnant or were pregnant within

Figure 14: Case Completeness - All Cases, 2017-2019



the last year who die in a suspicious, unusual, or unnatural way. They additionally recommended that toxicology be performed on all suspected overdose cases.

Case completeness was also complicated because not all relevant information was documented or known. For instance, a woman could have sought medical treatment from a provider in another location, but details such as the name of the provider and/or clinic were not documented in medical records (e.g. the patient was seen by a neurologist for headaches). Such concerns helped to drive the board's recommendations regarding continuity of care and adoption of a centralized medical record system.

Additionally, the PAMR program began utilizing linkages with the Patient Abstract System (PAS) in 2021. The PAS reports patient procedure and discharge codes for health care interactions across inpatient and outpatient records. Records were evaluated for the year of death and the year preceding death. This linkage permitted previously unreported case interactions with the health care system that occurred within the state to be identified, and provided the opportunity to more fully explore case medical histories.



Pregnancy-Related Demographic Disparities

After cases are reviewed by the PAMR board, the data gathered is broken down based on demographic factors, including age, race, and educational attainment. It is further evaluated by place of residence, health care insurance coverage, and Body Mass Index (BMI). While the maxim that correlation is not causation must be kept in mind, comparing these ratios helps us

determine the degree of disparity in health outcomes

between each group. Pregnancy-related mortality ratios are reported as number of deaths per 100,000 live births.

- The ratio of pregnancy-related deaths was nearly two times higher for those who were more than 40 years old compared to those who were between 20 and 29.
- The ratio of pregnancy-related deaths for Black women was more than three times higher than the ratio of deaths for White women.
- The ratio of deaths was lowest for those who had obtained more than a high school diploma or GED compared with those who had a high school diploma or GED or less.

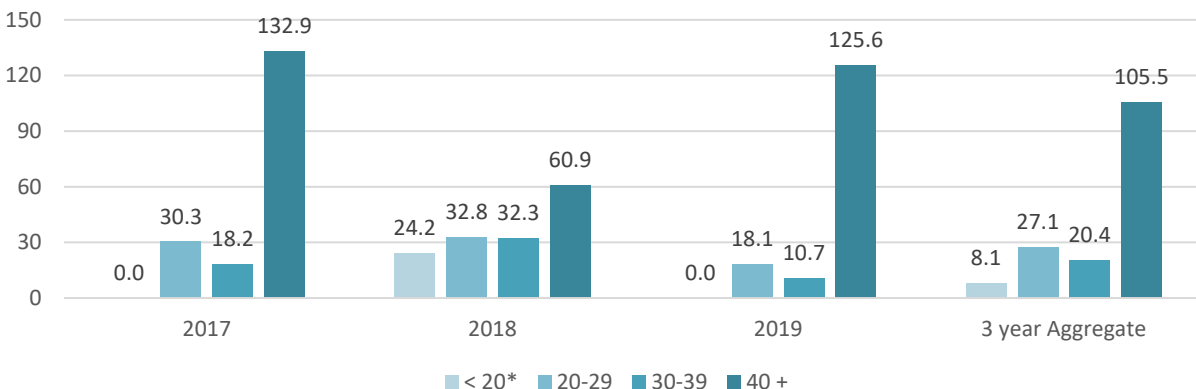
A Word of Caution

Instances of pregnancy-associated death, and in particular pregnancy-related instances, are rare events. As such, even when aggregating three years of data, the population size for this analysis is small and the results should be used with caution. The problem of having a small population size is there is an increased likelihood of the results being skewed; meaning some effects may be exaggerated, while others may remain hidden. This skewness may be increased when data is missing. Working with small population sizes also prevents more complex statistical analysis to be completed. A more complex analysis would provide additional insights and help reveal causes and not just correlations. The PAMR board makes their recommendations with this in mind, seeking to not only lower ratios of maternal mortality, but to improve the reproductive health outcomes of women overall.

While the three-year aggregate ratio reported here generally represents a much more stable ratio for evaluation than in prior years, unless indicated otherwise by an asterisk or in the text, it should still be used with caution as these numbers remain small. In this section of analysis, we are focused only on the ratios of pregnancy-related mortality. Demographics relating to pregnancy-associated, but not related deaths are discussed in a later section. Each figure provides the annual ratios between 2017-2019 and the aggregate three-year ratio. The highest aggregate ratios are among those 40 years old or older, Black women, those with a high school diploma or GED, those in urban areas, those who are obese, and those who are unmarried. Regarding insurance type, the highest ratio was among those who were self-pay. However, this ratio is unstable due to low population size; the ratio for those with Medicaid is the highest stable ratio.

Demographics and Disparities

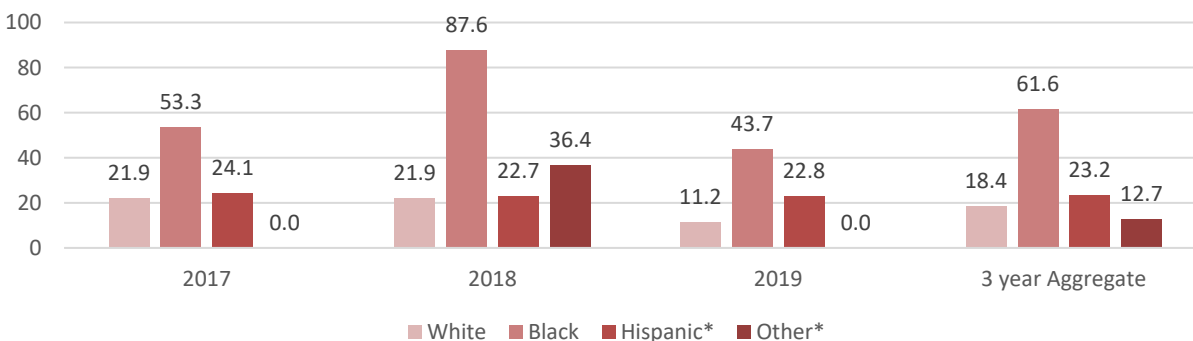
Figure 15: Pregnancy-Related Mortality Ratio per 100,000 Live Births by Age



From Figure 15 above, we see that the ratio for pregnancy-related mortality is highest in women 40 years old or older, with a ratio of 105.5 deaths per 100,000 live births. The largest group of women who gave birth in the state of Missouri from 2017-2019 were aged 20 to 29 years old.

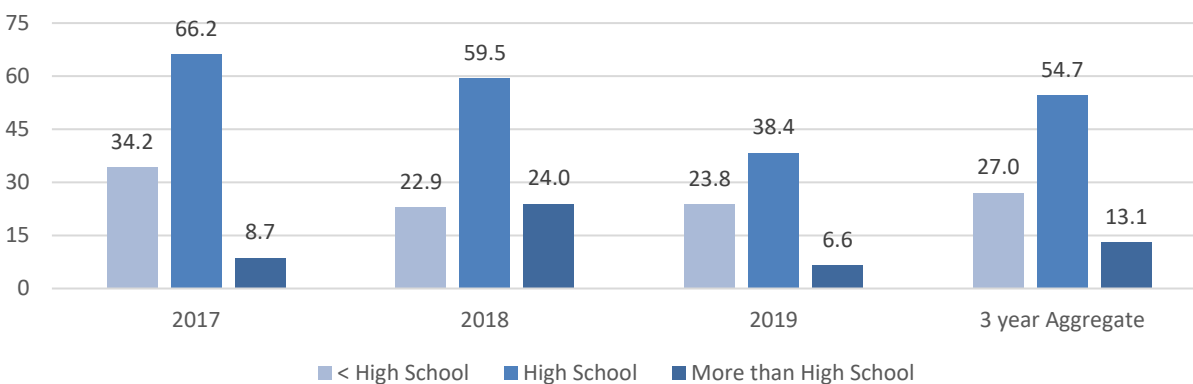
The ratio for this group was nearly four times lower than the ratio for women 40 years old or older. The ratio for women between 30 and 39 years old was more than five times lower than the ratio for women 40 years or older. Due to low population sizes, the aggregate ratios calculated are considered unstable for ages < 20, and further analysis was not deemed feasible at this time. The disparity in outcomes based on age was statistically significant.

Figure 16: Pregnancy-Related Mortality Ratio per 100,000 Live Births by Race



Pregnancy-related mortality is highest among Black women with a ratio of 61.6 deaths per 100,000 live births (Fig. 16). While the extent of this disparity varies from year to year, this disparity has persisted across all three years. The aggregate mortality ratio for Black women was more than three times the ratio of White women, who made up the largest group of birthing women from 2017-2019. The ratio for Hispanic women and other minorities is unstable and should be interpreted with caution due to extremely low population size. The disparity in racial outcomes was statistically significant.

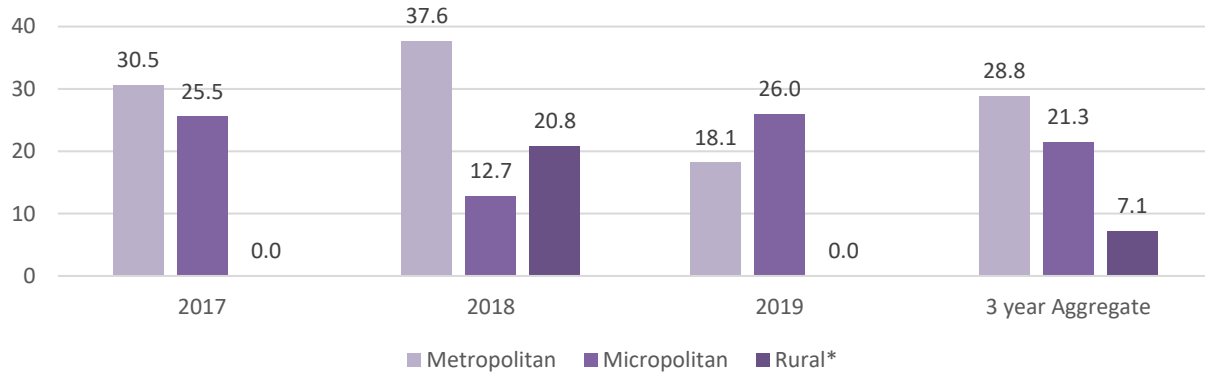
Figure 17: Pregnancy-Related Mortality Ratio per 100,000 Live Births by Education Level



Pregnancy-related mortality is highest for women who completed high school or a GED but did not pursue secondary education with a ratio of 54.7 deaths per 100,000 live births. This ratio was more than four times the ratio of women who had more than a high school diploma or GED, the largest education group for the target population in Missouri. Figure 17 and Figure 18 illustrate some of the problems of relying upon a single year for the examination of disparities and why

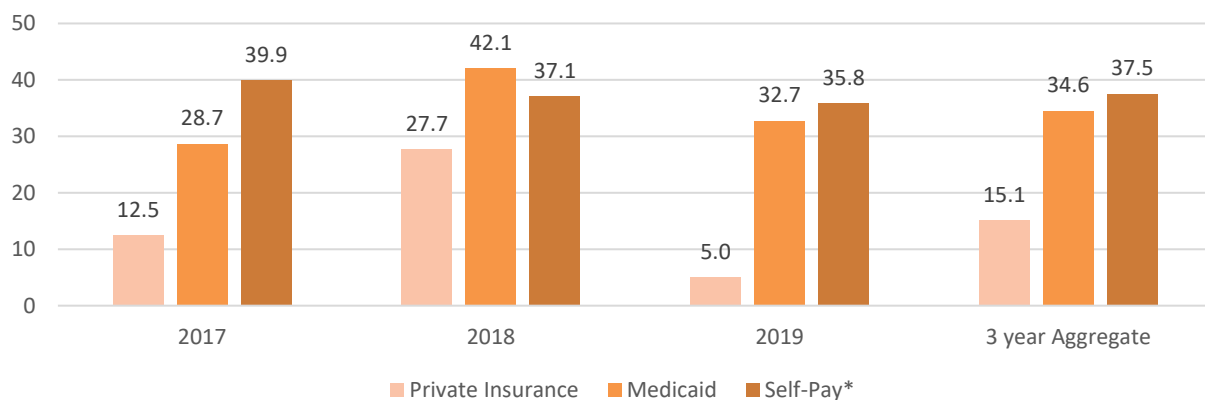
the emphasis is placed on the aggregate ratio in this report. The differences between education levels were statistically significant.

Figure 18: Pregnancy-Related Mortality Ratio per 100,000 Live Births by Urban Status



The largest group of births occurred to women in metropolitan counties from 2017-2019. Ratios of pregnancy-related mortality were also highest among women from a metropolitan area, with 28.8 deaths per 100,000 live births. The ratio for rural women was unstable and should be treated with caution due to extremely low population sizes. This finding is interesting given the prevalence of birthing facilities, especially with higher levels of care, in metropolitan areas, compared with settings that are more rural and warrants further investigation. Despite the low population size for rural women, the disparities based on urban status were statistically significant.

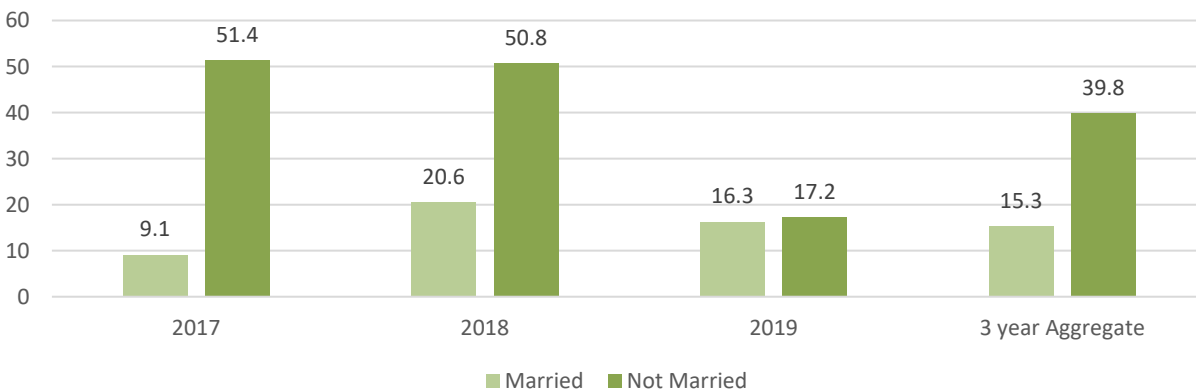
Figure 19: Pregnancy-Related Mortality Ratio per 100,000 Live Births by Payment Type



The pregnancy-related mortality ratio was highest among those who had self-pay status at 37.5 deaths per 100,000 live births (Fig. 19). This ratio was slightly more than twice the ratio of those with private insurance, who made up the greatest percentage of live births in Missouri from 2017-2019. It should be noted that those with a Medicaid covered birth made up the largest percentage of pregnancy-related deaths (52.7%). Insurance information is obtained from the birth certificate and supplemented by the prenatal record as well as other medical documentation.

Those with an unknown insurance status are excluded, as this information is not always available from the birth certificate, prenatal care records, or other medical records and sources. The difference between groups for pregnancy-related deaths was found to be statistically significant.

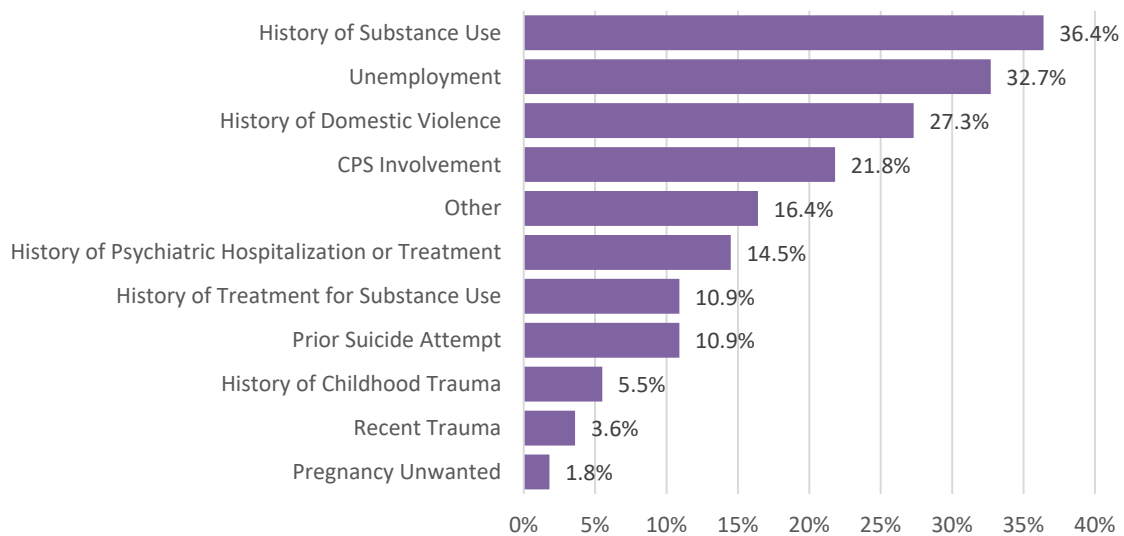
Figure 20: Pregnancy-Related Mortality Ratio per 100,000 Live Births by Marital Status



The pregnancy-related mortality ratio was highest among women who were not married with a ratio of 39.8 deaths per 100,000 live births (Fig. 20). This finding persisted across all three years, though the extent of this disparity fluctuated. The aggregate ratio is more than double the ratio for married women, who made up the greatest percentage of live births in Missouri from 2017-2019. For this report, women who were married, but separated at time of death were treated as married. This ratio was recalculated from prior years, which had utilized a composite variable favoring the birth certificate data to determine if the woman had ever been married and to eliminate unknown responses. However, a data quality review determined that reliance on the death certificate data alone was sufficient, as there were no unknowns for pregnancy-related deaths and as this captured the mother’s marital status at time of death. This disparity was found to be statistically significant.

The PAMR program employed a life course perspective to help better understand the context around a pregnancy-associated death. Beyond the demographic analyses reported above, it was determined that women whose deaths were pregnancy-related showed evidence of undergoing social and emotional distress (Fig. 21). The most commonly indicated stressor was a history of substance use, impacting 36.4% of these women whereas only 10.9% had a history of treatment for substance use. More than 1 in 4 pregnancy-related deaths had a history of DV or unemployment. More than 1 in 5 pregnancy-related deaths had been involved with Child Protective Services (CPS).

Figure 21: Pregnancy-Related Social and Emotional Stressors, 2017-2019





Cause and Context

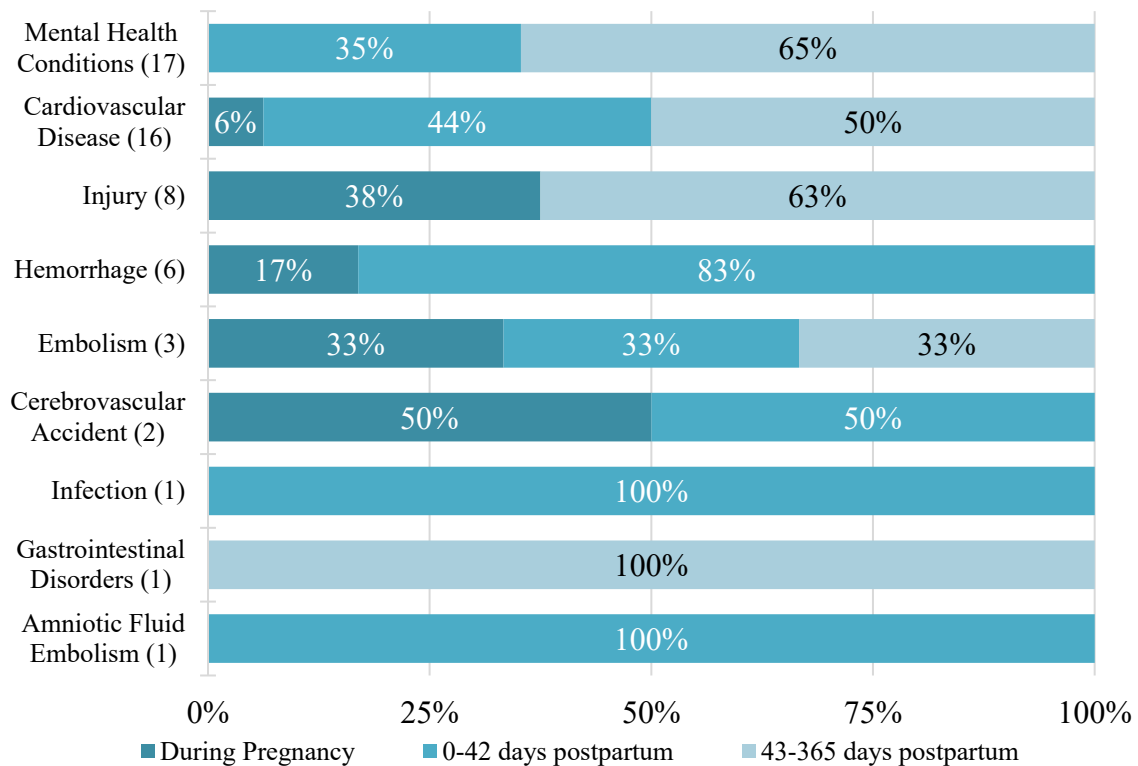
Upon reviewing the information obtained, and determining pregnancy-relatedness, the PAMR board worked to establish a consensus between board members regarding the underlying cause of death and evaluate the circumstances surrounding pregnancy-related deaths. The leading underlying cause of pregnancy-related deaths from 2017-2019 was determined to be mental health conditions, inclusive of SUD. Among injury-related deaths, the most frequent means of fatal injury was overdoses/poisonings, followed by firearms.

Pregnancy-Related Causes of Death

Overall, mental health conditions was the most common underlying cause of death for pregnancy-related cases. This was the leading cause of death for mothers between 43 days and one year postpartum. For this analysis, mental health conditions was a composite of depressive disorder (41.2%) and SUD (58.8%). During pregnancy, the most frequent cause of death was injury.

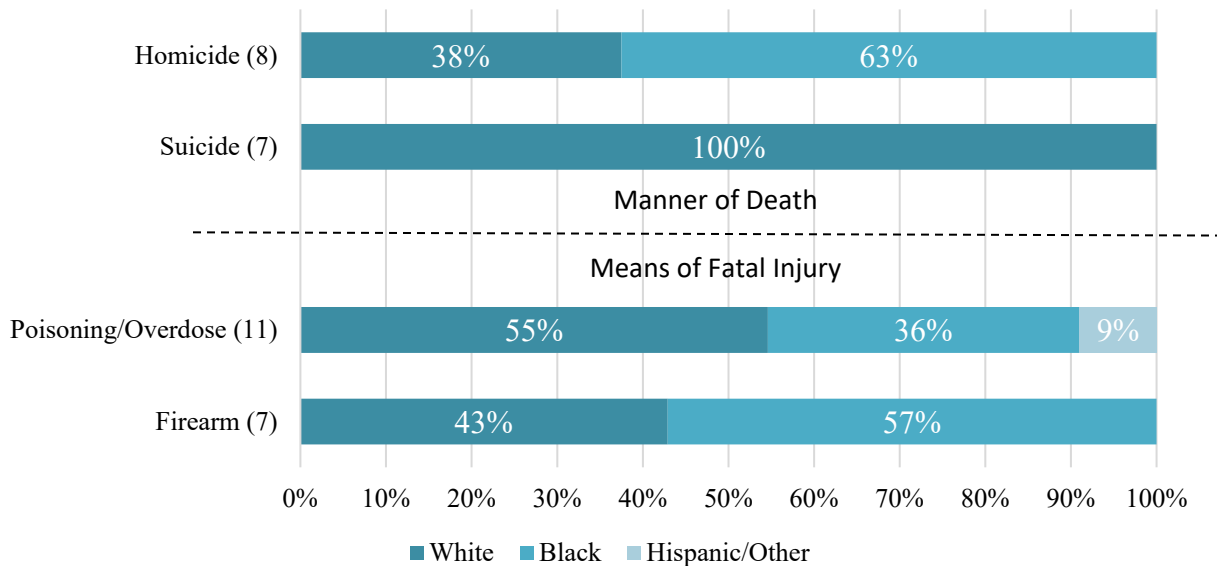
Figure 22 shows when, during the perinatal period, different causes resulted in a pregnancy-related death. Cardiovascular disease is the second leading cause of pregnancy-related death. Previously, these were separated out in this analysis due to the underlying physiologic etiology between hypertensive disorders (4), cardiomyopathy (6) and other cardiovascular conditions (6) such as myocardial infarction or arrhythmias. While this was the leading cause of death between 0 and 42 days postpartum, the data indicates that these deaths predominantly occur after the traditional six-week postpartum follow up period. This finding supports PAMR board recommendations for improvements to the assessment and identification of these conditions. It also supports the conclusions that follow up care beyond the initial six-week period is necessary and bolsters the recommendations for the removal of financial and access barriers to care through the extension of Medicaid coverage through one year postpartum.

Figure 22: Timing of Leading Underlying Causes of Pregnancy-Related Deaths, 2017-2019



The PAMR board indicated a secondary underlying cause of death for 23 of the 55 pregnancy-related cases. Cardiovascular disease was the most common secondary cause of death (30.4%). Depressive/anxiety disorders and other mental health conditions (not counting SUD) made up the bulk of these secondary causes (21.7%).

Figure 23: Pregnancy-Related Fatal Injury Death by Race, 2017-2019



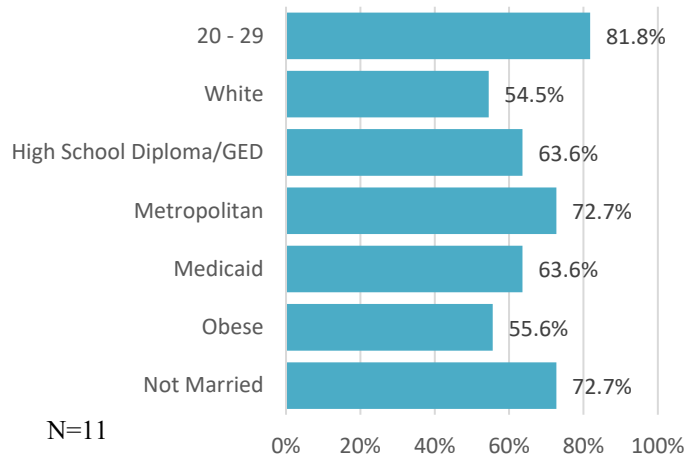
Pregnancy-related deaths that the board determined were homicides comprised 14.5% of all pregnancy-related deaths. The most common means of fatal injury in these homicide cases was the use of a firearm (62.5%). In half of these cases, the records provided to the PAMR program indicated a history of DV. In each of these homicides, the perpetrator was a current or former partner. In a quarter of these cases (25%), the couple was currently married, and all homicides occurred in metropolitan areas. The majority (62.5%) had a high school Diploma or GED. In 62.5% of these instances there was also a history of substance use indicated in the records. One in four of these homicide cases also had been involved with CPS. The majority (63%) of pregnancy-related homicide deaths were to Black women (Fig. 23). The majority of homicides (75%) occurred between 43 days and one year postpartum.

Cases that the PAMR board determined were “probably” suicide were classified as suicide for this report. Those that the board were “unable to determine” were treated as not suicides. Suicides comprised 12.7% of pregnancy-related cases. Examination regarding the means of fatal injury for suicide cases are unable to be published in accordance with best practices of statistical reporting and regarding messaging and suicide.¹⁹ The majority of these suicide cases (71.4%) occurred in metropolitan areas. All pregnancy-related suicides were to White women. Due to the low population size of cases that were determined to be suicides by the PAMR board, further demographic analysis of these instances was not reportable. The numbers regarding social and

environmental data for suicide cases were also below the reporting threshold. The majority of suicides (71.4%) occurred 43 days to one year postpartum.

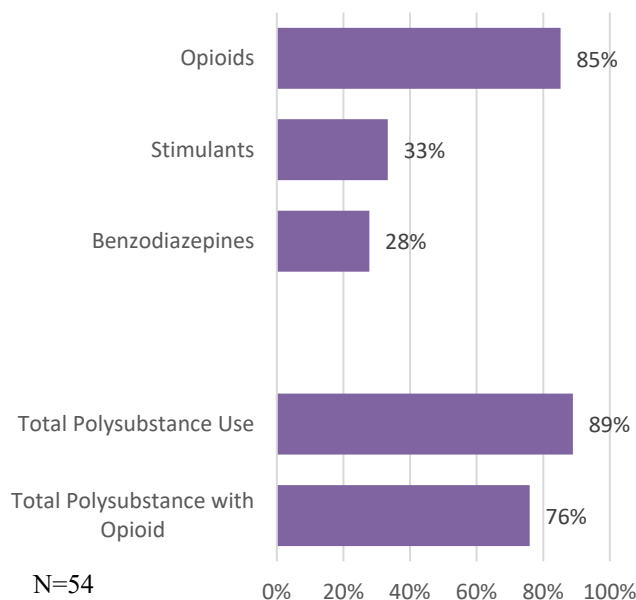
The most common means of fatal injury for pregnancy-related deaths was overdose/poisoning. The majority (72.7%) of these instances had opioids (excluding buprenorphine/methadone) in their toxicology results. In 27.3% of these deaths, amphetamines were found. For more than half (54.5%) of these cases there was also evidence of some substances with other chemical classifications.

Figure 24: Most Frequent Groups of Pregnancy-Related Overdose Deaths, 2017-2019



The majority (72.7%) of deaths due to overdoses appeared to be accidental, meaning the PAMR board did not consider them homicides or suicides. The majority of these cases also had a history of prior substance use (72.7%). The records provided indicated a history of DV for 45.5% of these cases and 54.5% had been involved with CPS. Figure 24 shows the demographic make up the greatest percentages of pregnancy-related overdose deaths.

Figure 25: Substances found in Pregnancy-Associated Overdose/Poisoning Deaths, 2017-2019



Evaluating all pregnancy-associated deaths provided information regarding the types of substances used in overdose deaths. The most common drug class identified in toxicology screens was opioids (85%). This comprised a variety of drugs including fentanyl, morphine, oxycodone and others. The second most frequent class of drug was stimulants (33%), specifically amphetamines and methamphetamines. Benzodiazepines appeared in 28% of deaths. The third most common class was actually anti-histamines 31%, however, these are not considered controlled substances and so were not included in Figure 25. The majority of these deaths

(89%) involved polysubstance use, with 76% of poisoning/overdose deaths involving multiple substances including opioids.

Firearms were the second most frequent means of fatal injury for pregnancy-related deaths. All pregnancy-related firearm deaths occurred in metropolitan areas. Numbers were too small for additional demographic or social/environmental analysis.

Figure 26: Timing of Pregnancy-Related Fatal Injury, 2017-2019

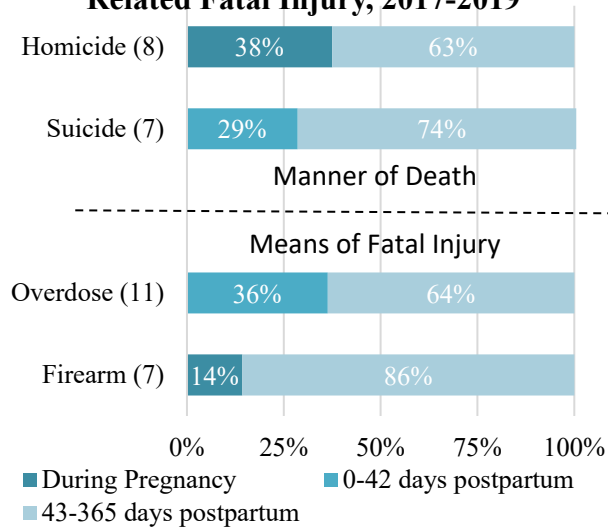


Figure 26 provides a graphic representation of when a given type of pregnancy-related injury death occurred in relation to a pregnancy. The majority of overdose deaths (64%) were found to occur between 43 days and one year postpartum, while 36% occurred during pregnancy. Overdoses made up 20% of all pregnancy-related deaths. The majority of firearm deaths (86%) occurred between 43 days and one year postpartum. Firearms were the means of fatal injury for 12.7% of all pregnancy-related deaths.



Circumstances Surrounding Death

In accordance with CDC best practice standards, the PAMR board evaluates circumstances leading to an instance of pregnancy-related death. Four specific circumstances are highlighted to determine whether they contributed to a death with every case. The first is mental health conditions other than SUD. Although SUD is recognized as a mental health condition, it is important to capture data on mental health conditions that do not include SUD such as postpartum depression. While instances of postpartum psychosis are extremely rare, postpartum depression affects 1 in 7 mothers.²⁰ Mental Health conditions was found to have contributed to 32.7% of pregnancy-related deaths.

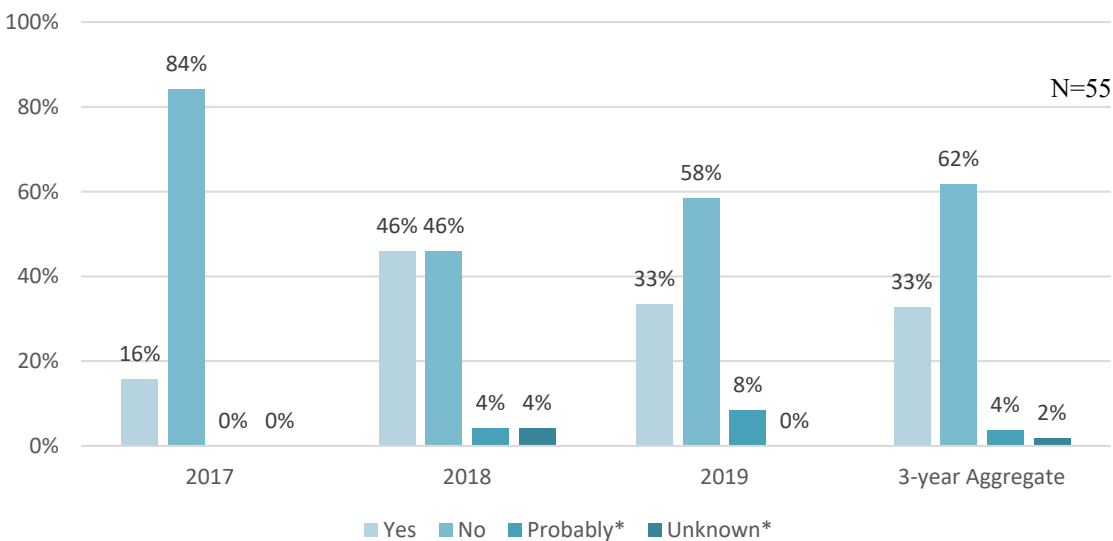
SUD is the second circumstance evaluated. As previously mentioned, SUD is a recognized mental health disorder, and therefore a subset of mental health conditions. Given the increase in overdose-related deaths in Missouri, this remains an area of public health concern.²¹ SUD was found to have contributed to 32.7% of pregnancy-related deaths. The board similarly evaluates obesity, which continues to be a problem across the country and is a high risk factor for both maternal mortality and SMM. Obesity was only found to have played a direct role in 12.75% of pregnancy-related cases. While not evaluated until 2019, the role of discrimination is also examined. However, this was not an influence connected to any pregnancy-related cases.

Mental Health Conditions

Overall, mental health conditions other than SUD contributed to roughly 1 in 3 pregnancy-related deaths during the aggregate period (Fig. 27). This is slightly higher than the rate of one in five pregnant women who are affected by depression, anxiety and other mental health conditions.²² Over 14,000 Missouri families are annually impacted by maternal mental health conditions, with an estimated cost of \$467 million if untreated.^{23, 24}

- Prior to their most recent pregnancy for women who experienced a pregnancy-related death:
 - 16% had been treated for an anxiety disorder.
 - During pregnancy this number increased to 18%
 - After pregnancy this number decreased to 11%
 - 27% had been treated for depression.
 - During pregnancy this number decreased to 20%
 - After pregnancy this number decreased to 16%
- In 61% of deaths where a mental health condition other than SUD was determined to be a contributing factor to their pregnancy-related death, the records also indicated that the decedent had a history of substance use.
- Additionally, for nearly 2 in 5 pregnancy-related deaths where mental health conditions were a contributing factor, the decedent:
 - had a history of DV.
 - had a history of psychiatric hospitalizations or treatment.
 - had experienced unemployment.
 - had been involved with CPS.

Figure 27: Pregnancy-Related Deaths and Mental Health Conditions, 2017-2019



Substance Use Disorder

State of Missouri

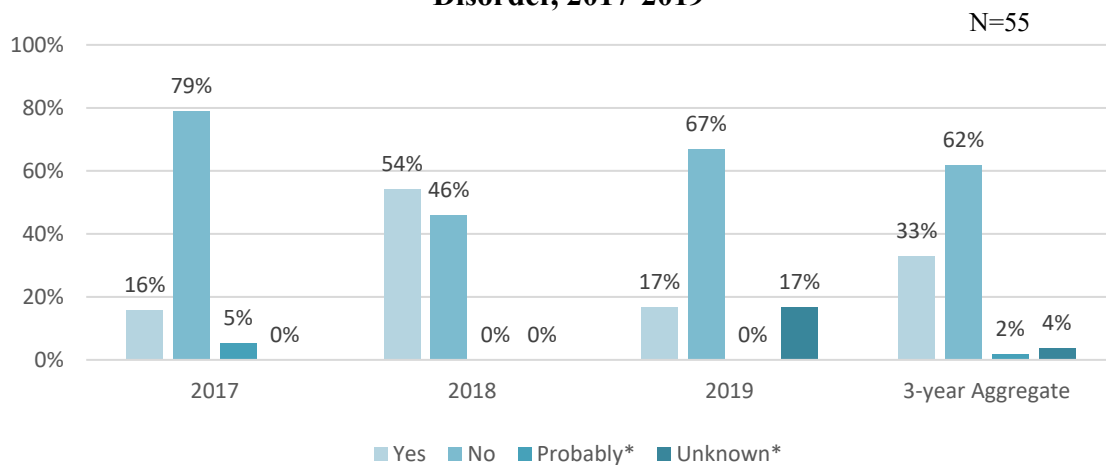
In 2017, the estimated cost of fatal opioid overdoses in Missouri was determined to be \$10,993,800,000.²⁵ From 2017-2019 there were 3,177 opioid overdose deaths in Missouri. Women of childbearing age (10-60 years old) represented 29.2% of these deaths (929).²⁶

- White women represented 77% of these deaths.
- Black women represented 21% of these deaths.
- An average of 76.9% per year had a non-alcohol substance abuse problem.[‡]
- An average of 14.7% per year had a prior overdose.

PAMR Deaths

SUDs (including opiates, alcohol and other substances) were a contributing factor in 32.7% of pregnancy-related deaths (Fig. 28). Although documentation of an existing diagnosed SUD was lacking in most case medical histories, there was sufficient evidence for the PAMR board to definitively say a SUD was present.

Figure 28: Pregnancy-Related Deaths and Substance Use Disorder, 2017-2019



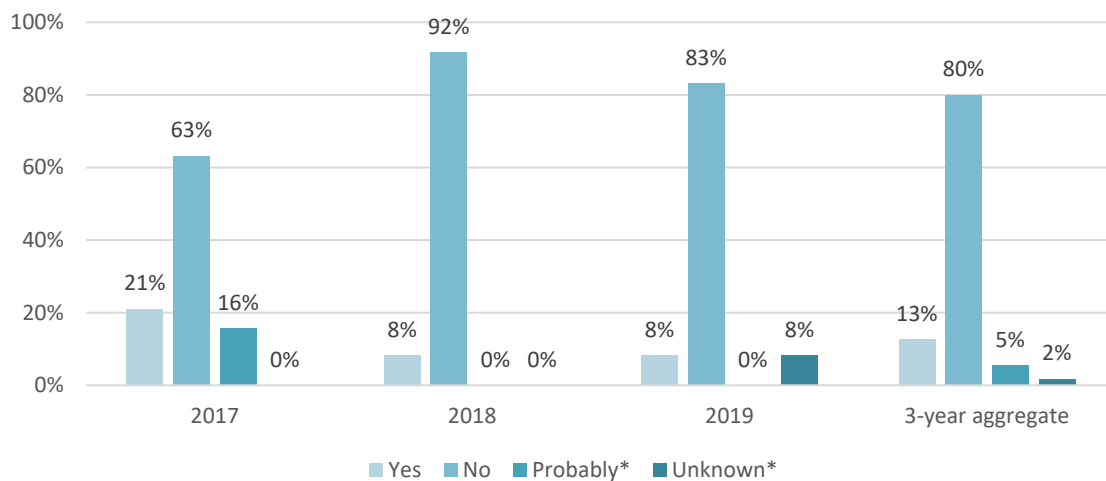
- For two-thirds (67%) of the cases where the board determined that SUD was a contributing factor, mental health conditions other than SUD was also a contributing factor.
- Of those for whom SUD was a contributing factor:
 - 33% had a history of DV.
 - 39% experienced unemployment.
 - 50% had involvement with CPS.
 - 33% had a history of substance use treatment.

[‡] The last two points should be treated as a minimum as the witnesses that State Unintentional Drug Overdose Reporting System (SUDORS) data relies upon may be unable to provide a complete history for the victim.

Obesity

The PAMR board indicated that obesity, here defined as BMI of 30 or above, contributed to 12.7% of pregnancy-related deaths (Fig. 29). The finding that obesity was not a contributing factor for an instance of pregnancy-related death does not mean the decedent was not obese. While 29% of total live births were to obese women from 2017-2019, they comprised 40% of pregnancy-related deaths. This question looks at whether obesity was directly attributable to a death. The board may be unable to determine if other health conditions were exacerbated or triggered as a side effect of obesity in some instances where there was not sufficient documentation.

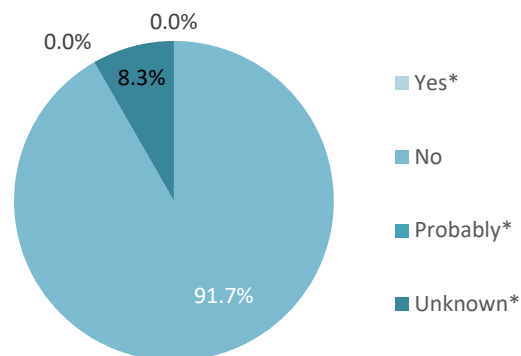
Figure 29: Pregnancy-Related Deaths and Obesity, 2017-2019



Discrimination

Midway through review of 2018 deaths, the CDC added the variables needed for the PAMR board to begin evaluating whether or not discrimination contributed to a death. The board considered discrimination due to race, class, status and other variables. As 2019 is the only full year for which this was considered, aggregate reporting is unavailable. While the board recognizes discrimination within systems that persist today, they determined that no pregnancy-related deaths could be attributed directly to discrimination in 2019. Additional analysis is also unavailable due to small population size and present information should be used with extreme caution (Fig. 30).

Figure 30: Pregnancy-Related Deaths and Discrimination, 2019





Preventability and Recommendations

The PAMR board evaluated whether, or not, a death was preventable and the likelihood of altering the outcome. For preventable deaths, the board made recommendations about the specific and feasible actions that, if taken, might have changed the course of events. The board determined that 75% of pregnancy-related deaths were preventable. The board made recommendations to address the factors which contributed to a pregnancy-related death across five levels: patient/family, provider, facility, community, and system.

The most frequently identified contributing factor for pregnancy-related deaths from 2017-2019 was assessment. The board most commonly recommended secondary tier prevention (56%), seeking to reduce the impact after a contributing factor has occurred. The largest percent of recommendations (37%) were anticipated to have a medium impact, targeting clinical interventions and coordination of care across the continuum of well-woman visits.

Preventability

A pregnancy-related death is considered to have been 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, community, and/or system factors. Among these deaths, the majority (74.5%) were considered preventable, while 25.5% were either non-preventable, or the committee felt that it could not determine preventability (Fig. 31). Looking at the timing of those pregnancy-related deaths, which the board determined were preventable in Figure 32, more than half of them (51%) occurred between 43 days and one year postpartum. Deaths with no chance of preventability were most commonly due to cardiomyopathy (4).

Figure 31: Chance to Alter Outcome of Pregnancy-Related Deaths, 2017-2019

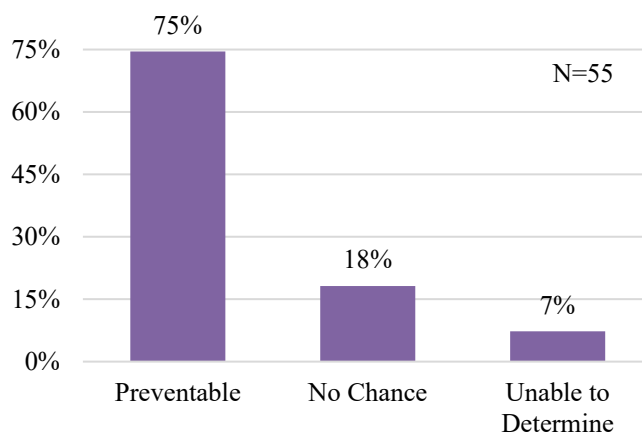
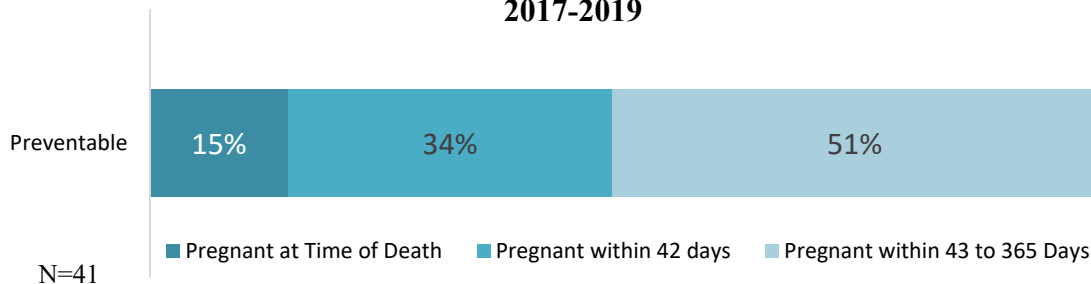


Figure 32: Timing of Preventable Pregnancy-Related Deaths, 2017-2019



Preventable pregnancy-related deaths varied by cause of death. All pregnancy-related deaths due to mental health conditions were determined to be preventable, 64.7% of which occurred between 43 days and one year postpartum. Two-thirds of deaths due to hemorrhage were determined to be preventable, 75% of which occurred within 42 days postpartum while the other 25% occurred during pregnancy. More than half of the deaths due to cardiovascular disease (56.3%) were determined to be preventable, and more than half of those (55.6% occurred between 43 days and one year postpartum.

Looking at where these deaths occur, nearly half (49%) of the pregnancy-related deaths occurred within a hospital. Twenty-two of these deaths (81%) were inpatient and five were outpatient/ER. Of these deaths, 54.6% of inpatient deaths and 100% of outpatient deaths were considered preventable. A further 18 pregnancy-related deaths occurred at the decedents home, 83.3% of

[§] The board exercised their judgment and applied the reasonable person standard in considering whether or not a change was reasonable.

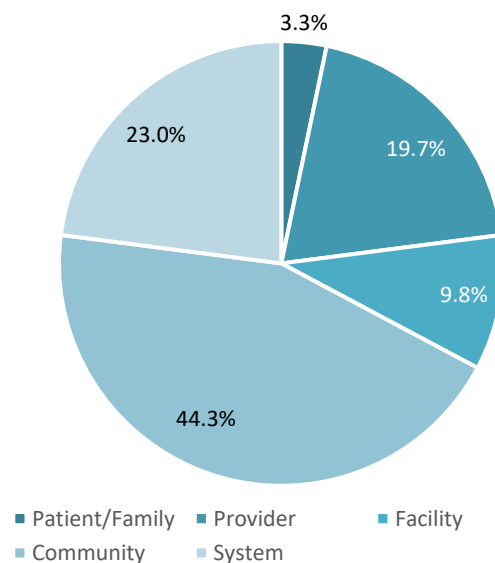
which were determined to be preventable. It should be noted that this is based on where a death occurred. For example, a person had a cardiac event at home but was taken to the ED where they died. While the case may be deemed preventable, that does not necessarily mean that action taken by the ED is what would have prevented the death. Prior encounters with health care, family and self-awareness may have been where chances to alter the outcome could have occurred.

Recommendations for Action

For each pregnancy-related death, the PAMR board determines what factors contributed to the death and then provides the recommendation(s) to prevent future deaths. These contributing factors can occur in one of five levels: patient/family, provider, facility, community, and system. To better understand the discussion going forward, it is important to know that contributing factors, which occur at one level, may have solutions that can be implemented at another level, which is demonstrated in Figure 33.

During 2017-2019, the most common contributing factors for pregnancy-related deaths identified by the PAMR board included assessment, knowledge, access/financial, adherence, continuity of care/care coordination and violence. These contributing factors, associated with the leading causes of pregnancy-related deaths, which were mental health conditions, cardiovascular disease, injury and hemorrhage, are discussed below.

Figure 33: Recommendation Level when the Contributing Factor was Patient/Family Level, 2017-2019



Mental Health Conditions

A leading contributing factor for mental health conditions was *assessment*. To address this, the PAMR board recommended all providers perform a full assessment for depression and anxiety, perform universal screening for SUD, and make referrals to mental health professionals, social workers, community workers, and SUD treatment programs. Specific to SUD, assessment and referral branched out and often focused on providing wraparound services to address the unique social risk factors associated with SUDs.

Another contributing factor identified was *knowledge* when the board found that either the provider and/or patient/family had an inadequate understanding of the significance of a health condition(s) and/or the need for treatment/follow-up. Therefore, the PAMR board recommended that all providers should be further educated on the treatment of mental health conditions and SUD during and after pregnancy. The PAMR board included all providers in this

recommendation because providers other than Obstetricians see pregnant women, especially in the postpartum period.

Furthermore, the PAMR board recommended that the Missouri Legislature establish and fund a statewide Perinatal Psychiatry Access Program to support providers treating perinatal mental health conditions and SUD. During case reviews, it was often noted that individuals who were taking prescribed antidepressants stopped their medication due to becoming pregnant. It is imperative that individuals taking medications for behavioral health conditions speak to their doctor prior to stopping any medications. Additionally, the PAMR board recommended that community-based organizations assist with educating their community on maternal mental health and SUD to help reduce the stigma associated with these conditions.

Cardiovascular Disease

Three leading contributing factors for cardiovascular disease were *access/financial, assessment, and continuity of care/care coordination*. As discussed previously, half of pregnancy-related deaths due to cardiovascular diseases occurred beyond the traditional six-week postpartum follow up period and often after the 60 day Medicaid coverage ends. For that reason, to address access/financial factors the PAMR board recommended that the Missouri Legislature expand Medicaid to one year postpartum for all conditions to aid women whose condition is exacerbated in the postpartum period. Furthermore, the PAMR board recommended that the Missouri Legislature fund the extension of Medicaid to provide insurance coverage for women to optimize their health prior to pregnancy and in-between pregnancies.

The PAMR board addressed assessment by recommending all providers, including Emergency Room providers where women with these conditions may seek care, be further educated regarding screening, referral, and treatment of cardiovascular disorders associated with pregnancy (i.e. cardiomyopathy, hypertension, etc.). Moreover, providers should be asking women if they've been pregnant within the last year to assess their cardiovascular risks. As discussed previously, the PAMR board had sufficient evidence to disagree with the cause of death listed on the death certificate for 20% of pregnancy-related deaths, the majority of which were due to cardiovascular disease. Additionally, there were often times where the PAMR board desired an autopsy that simply was not done, and therefore recommended that all Medical Certifiers ensure an autopsy and toxicology is completed on a woman who has been pregnant within the last year. The PAMR board addressed continuity of care/care coordination by recommending that Obstetric providers refer patients with a reported cardiovascular condition or with a family history of cardiovascular disease to a cardiologist. Women with cardiovascular risk factors can be referred to specialized care to ensure a healthy pregnancy and delivery for both mom and baby.

Injury

The most common contributing factor for pregnancy-related deaths due to injury was *violence*. This classification was used when there was evidence of physical or emotional abuse perpetrated by another individual. The PAMR board recommended community-based organizations help educate their community on signs of DV and IPV and provide resources and assistance for women affected by violence. Additionally, the PAMR board recommended health care workers complete trainings on trauma-informed care and implicit bias to improve patient engagement and health outcomes as well as become innovative with ways to screen women affected by IPV or those at risk of IPV so these women can safely communicate if they are in trouble beyond standard screenings. For example, offering a way to indicate IPV on a urine sample cup. In addition, the PAMR board recommended that families be educated on assessing access to firearms and other means of fatal injury in the household of individuals living with violence.

Hemorrhage

The most common contributing factors for pregnancy-related deaths due to hemorrhage were *policies/procedure* and *assessment*. To standardize care and improve the identification (assessment) and treatment of hemorrhage, the PAMR board recommended that facilities implement the Alliance for Innovation on Maternal Health Hemorrhage bundle. To assist facilities with implementation of quality improvement efforts, the PAMR board recommended the Missouri Legislature to provide funding for a statewide PQC. Additionally, the PAMR board recommended that all delivering facilities have the ability to implement a mass transfusion protocol and perform annual obstetric simulations to prepare for emergencies.

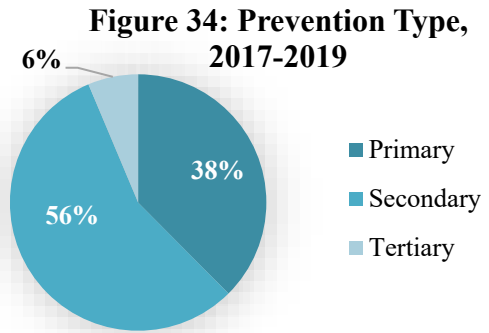
Table 1 provides the number of factors that the board determined contributed to a pregnancy-related death. There can be more than one contributing factor identified per death and the contributing factors can be identified at any of the five levels: patient/family, provider, facility, community or system.

Cause of Death	Total Numbers			Number of Factors by Level				
	Total Factors	Pregnancy-Related Deaths	Factors Per Death	Patient or Family	Provider	Facility	Community	System
Mental Health Conditions	79	17	4.6	23	33	6	5	12
Cardiovascular Disease	70	16	4.4	24	19	2	3	22
Injury	26	8	3.3	11	4	3	3	5
Hemorrhage	19	6	3.2	2	11	5	0	1

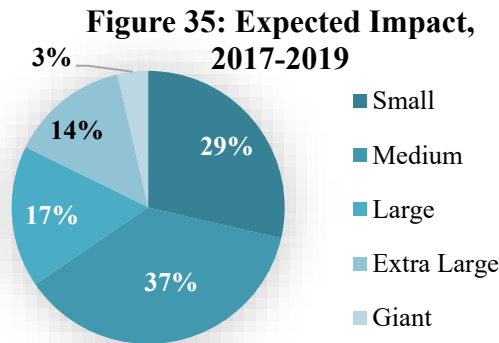
** Table 1 interpretation example: From 2017-2019, there were a total of 79 contributing factors for deaths due to mental health conditions with an average of 4.6 factors per death. There were a total of 33 contributing factors at the provider level, 6 at the facility level, etc.

Recommendations: Prevention and Impact

Recommendations at the primary type of prevention were those that prevent the contributing factor before it ever occurs and comprised 38% of recommendations. The majority of recommendations (56%) were directed at the secondary type of prevention. These were those recommendations targeted at reducing the impact of the contributing factor once it has occurred. Lastly, tertiary prevention comprised six percent of the recommendations (Fig. 34). These were recommendations that would reduce the impact of the progression of what has become an ongoing contributing factor.



The expected impact of a recommendation was ranked from small to giant. Small impacts, those involving education/counseling (community- and/or provider-based health promotion and education activities) were expected from 29% of recommendations. The largest percent of recommendations (37%) were anticipated to have a medium impact. These involved clinical interventions and coordination of care across the continuum of well woman visits (i.e. protocols, prescriptions). Large impacts, those that act as long-lasting protective interventions (i.e. improved readiness, recognition and response to obstetric emergencies, and long-acting reversible contraceptives) were anticipated for 17% of recommendations. Extra-large impacts, those that create a change in context (i.e. promoting environments that support healthy living/ensure available and accessible services) were anticipated for 14% of recommendations (Fig. 35). Giant impacts, those that address social determinants of health (i.e. poverty, inequality, etc.) were expected from three percent of PAMR board recommendations.



After the 2017 report, the PAMR board had resolved to make recommendations that would have a larger impact. In 2018, 34.1% of recommendations were expected to have at least a large impact, compared with 30.6% in 2017. In 2019, this number increased again to 42.5%.



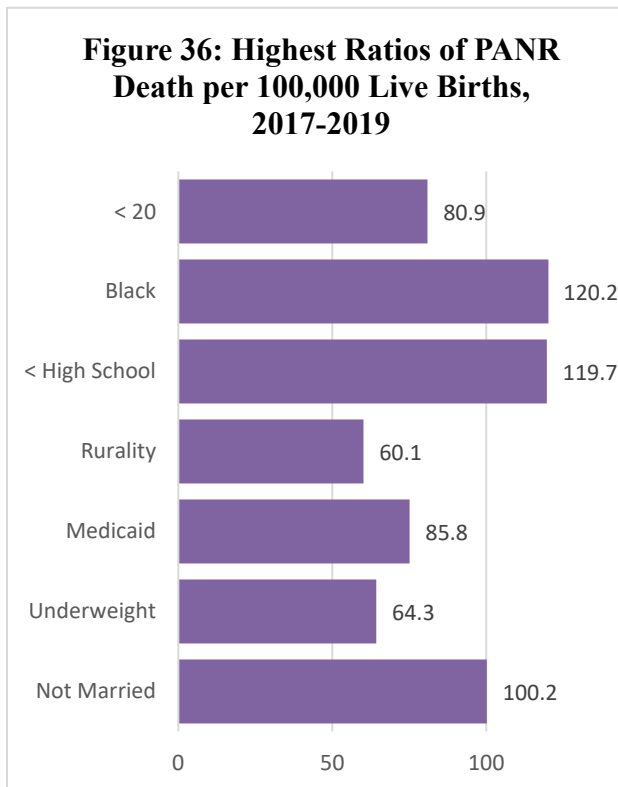
Insights from Pregnancy-Associated, Not Related Deaths

While pregnancy-related death is the primary focus of the PAMR program, there are also excellent insights to be gained from pregnancy-associated deaths. These cases are not assessed for preventability, but the PAMR board does evaluate these deaths for contributing factors and will make recommendations to try and prevent similar deaths in the future. The majority of PANR deaths from 2017-2019 are attributed to poisoning/overdoses (33.9%) followed by Motor Vehicle Collisions (MVC) at 30.4%. From 2017-2019, SUD contributed to 44.4% of PANR deaths.

PANR Disparities

As with pregnancy-related deaths, there are demographic differences in the ratios of PANR deaths. Figure 36 provides a demographic breakdown of those groups with the highest ratio of PANR deaths.

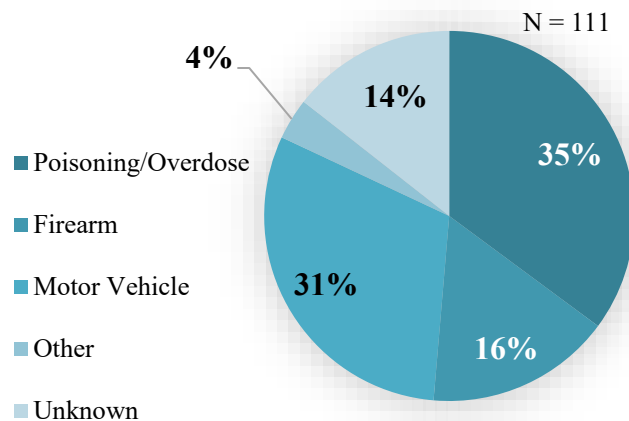
- Those aged < 20 had a ratio nearly 1.5 times that of women 20-29 years old.
- Black women had a ratio more than three times that of White women.



- Those with less than a high school diploma or GED had a ratio that was more than 7 times greater than the ratio for those with more than a high school diploma or GED.
- Rural women had the highest ratio of PANR deaths.
- The ratio for those on Medicaid was more than 8 times the ratio of those with private insurance.
- Those who were underweight had the highest ratio of PANR deaths with a ratio roughly 1.8 times the ratio for those with a healthy BMI. It should be noted that the highest percentage of PANR deaths were to women who were overweight/obese (55%).
- The ratio for those who were not married was more than 5 times the ratio of those who were married.

Figure 37 breaks down the means of fatal injury for PANR deaths. The majority of injury-related deaths (69.7%), such as homicides, suicides, MVCs and overdoses, occurred between 43 days and one year postpartum. However, 29% of PANR deaths due to MVC occurred during pregnancy as did 18% of PANR due to overdoses. As defined by the manner of death on the death certificate, the majority of PANR deaths were due to accidents (64.4%). Of these accidents, 48.7% were overdoses/poisonings while 46% were MVCs.

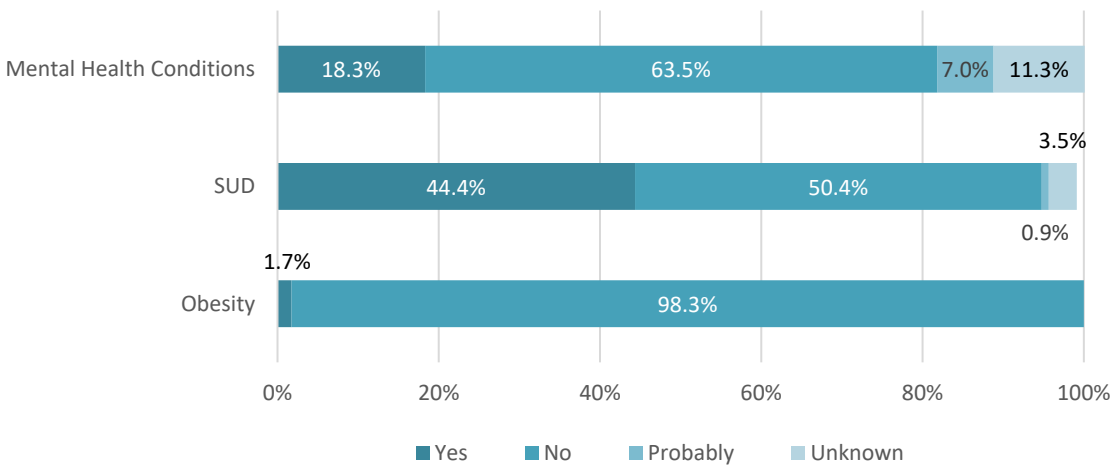
Figure 37: PANR Means of Injury, 2017-2019



As overdoses were the most common form of accidental death, further analysis was warranted. White women represented 59% of these deaths, 62% were between 20 and 29 years old, 54% had a high school diploma or GED, 82% were from metropolitan areas, 59% had a Medicaid covered birth, 43% had a healthy BMI, and 64% were never married. More than 3/4 of these cases (79.5%) had a history of substance use, but only 25.6% had a history of substance use treatment. An additional 23.1% had a history of psychiatric hospitalization or treatment. Involvement with CPS occurred in 41% of cases, and unemployment affected 43.6% of cases.

For PANR homicide deaths, 90% were committed with firearms. The perpetrator was a current or former partner for 20% of PANR homicide cases. Seventy percent of PANR homicide cases were to Black women, 50% had a high school diploma or GED, 95% were from metropolitan areas, and 75% had a Medicaid covered birth.

Figure 38: Factors Contributing to PANR Deaths, 2017-2019



SUD was the leading contributing factor for PANR deaths at 44.4%, followed by mental health conditions (18.3%), then obesity (1.7%) (Fig. 38). For 39.2% of PANR deaths where the board determined that SUD was a contributing factor, mental health conditions were also a contributing factor. Though only available for 2019, discrimination was determined to be a contributing factor for 7.3% of those PANR cases, with an additional 2.4% marked as probably.

Recommendations for Action

Examining the PANR deaths, many of the contributing factors go hand-in-hand. Many of the recommendations for pregnancy-related deaths can also be implemented to address PANR deaths. In addition to the above, the PAMR board recommended the following:

- The state should increase public awareness of the importance of seat belt safety during the perinatal period.
- Schools should offer Driver's Education as part of school curriculum for teenage drivers.
- Community-based organizations should empower pregnant and postpartum women to engage in health care through utilization methods such as doula services, home visitors, and/or community health workers.
- All providers should assess the need to prescribe naloxone for patients who are at risk for opioid overdose.
- Missouri should explore ways to combat gun violence.

From 2017-2019, 78% of PANR deaths due to MVCs, not including crashes involving pedestrians, were unrestrained. During the same time, 2019 had the lowest number of fatalities overall due to MVCs (7). The majority (64%) of PANR recommendations were at the secondary prevention level. Medium level impacts were anticipated from 40.6% of recommendations. Another 35% of recommendations were anticipated to have a small impact.



Implementation and Improvement

As the PAMR program continues to strengthen efforts and timely review of pregnancy-associated deaths, it is important to connect the data to action. Like many programs, the ongoing COVID-19 response impacted PAMR program efforts in 2021. This slowed development of program infrastructure, document development, and development of dissemination networks and strategies. However, despite the restriction to staff time and availability, progress continued to be made throughout the year.

Summary of Major Accomplishments:

- Improved measurement of the actual ratio of maternal mortality in Missouri through determination of pregnancy-relatedness.
- Improved focus on pregnancy-related deaths in annual maternal mortality report using more stable ratios due to aggregating data.
- Continued utilization of provisional vital statistics data to improve timeliness of case reviews (49% increase from baseline).
- Published and disseminated second report on maternal mortality in the state.
- Continued collaboration between internal and external partners on maternal mortality prevention efforts.
- Completed twenty dissemination activities on maternal mortality (an increase from 3 the previous year).
- PAMR data fueled Missouri's AIM work (described below).
- Participated in CDC's national call for Maternal Mortality Review Information Application (MMRIA) data for conducting national maternal mortality aggregate data analysis.
- Participated in CDC's State Vitals and Maternal Mortality Review Information Application (MMRIA) Integration Pilot

The PAMR recommendation to “standardize practices and procedures across the health care system through utilization of evidence-based practices such as AIM bundles” was implemented through Missouri’s AIM collaborative. Through a contract funded by the ERASE-MM grant, the MHA implemented sustainability of the AIM “Severe Hypertension in Pregnancy” bundle”, which saw a 25% improvement in anti-hypertensive medication administration. In the summer of 2021, MHA began recruitment for the “Care for Pregnant and Postpartum People with Substance Use Disorder” collaborative and is currently in the implementation phase. Additional efforts to increase provider collaboration to develop advanced skills related to perinatal best practices was through the Show-Me ECHO (Extension for Community Health care Outcomes). This team uses teleconferencing to connect interdisciplinary teams of experts with primary care providers and other professionals twice a month.



Conclusions

Maternal mortality in the state of Missouri is exceptionally complex. It touches the societal issues of rampant obesity, health inequity, and the ongoing opioid epidemic. Seeking to understand this problem brings to light a variety of other concerns rooted in the systems that are intended to help. Through addressing the issues identified by the PAMR board, the state of Missouri seeks to decrease our ratio of maternal mortality, while simultaneously improving the health of women, particularly during the reproductive years and after.

It is with this goal in mind, the PAMR board developed key recommendations, which if implemented, can reverse the trajectory of maternal mortality in Missouri. Moving forward, the PAMR board will continue to review cases of maternal mortality and provide recommendations to eliminate preventable maternal mortality in the future.

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Appendix A: Behind the PAMR Curtain

Distinguishing PAMR

The CDC oversees multiple programs that seek to monitor maternal mortality. These programs offer valuable information at the national level regarding causes of death and associated risk factors. However, they are not able to evaluate contextual factors that contributed to individual deaths, or determine preventability. These programs are also limited by an inability to provide recommendations that would prevent future instances of maternal mortality.

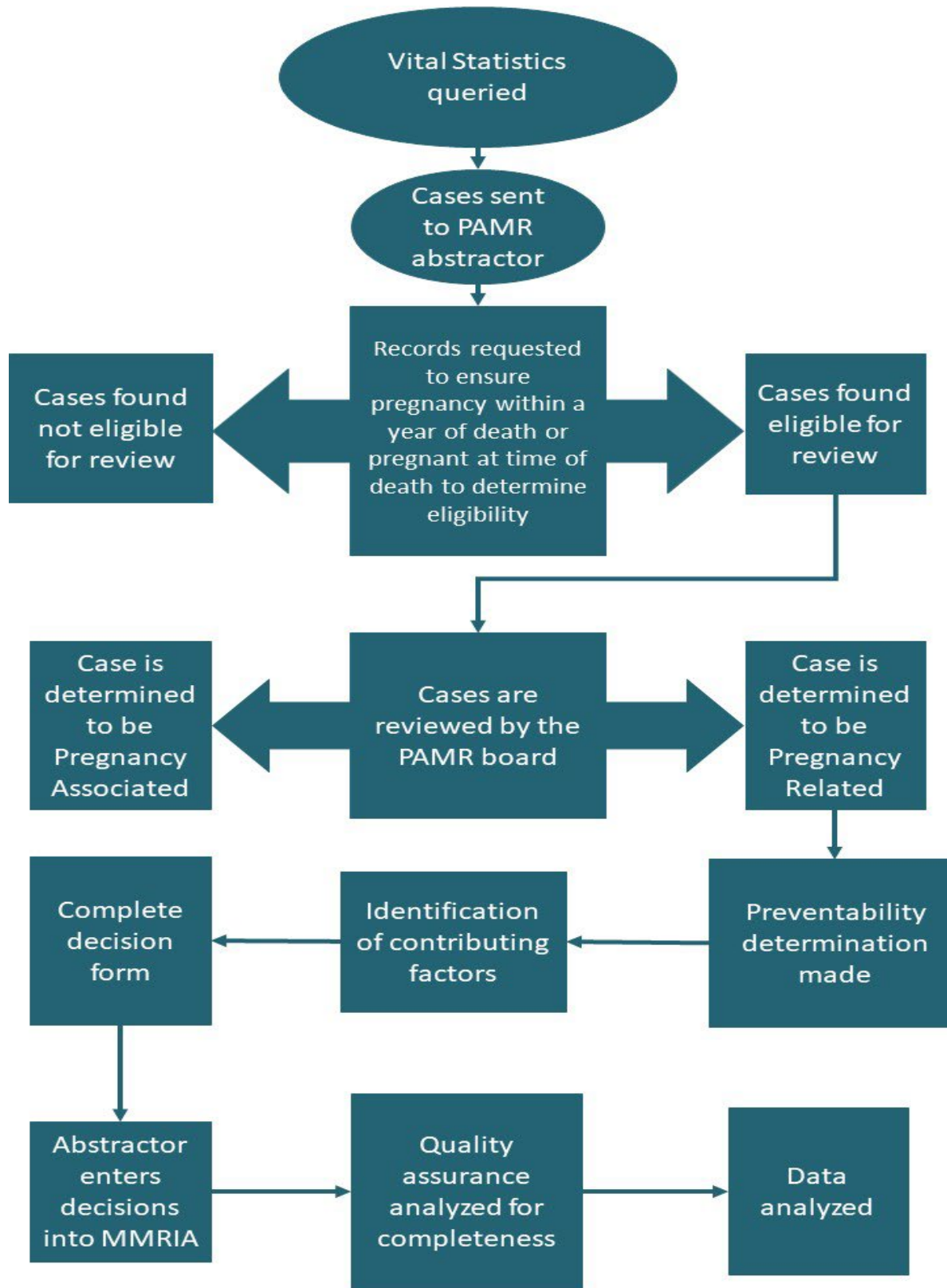
The PAMR program differs from these national programs in that it functions as the states' Maternal Mortality Review Committee (MMRC). MMRCs operate using a standardized and comprehensive system to better understand the context and causes surrounding a woman's death. They are able to determine if a death could have been prevented, and can make recommendations to help similar situations have better outcomes. While focused on the prevention of death, MMRCs also act to improve health and wellness throughout the pregnancy cycle.

PAMR Process

The Office of Epidemiology (OOE) identifies cases of maternal mortality for investigation by the PAMR program. After cases have been identified, they are further scrutinized prior to sending them to the PAMR abstractor. This involves examining the identified certificates to ensure that the data does indeed match. At this stage, those cases, which were linked based on data entry errors, may be detected. For example, if a case matches based on the social security number, but the names, date of birth, and other information does not match, the case is considered unverified, or a false positive.

Once cases undergo this first round of verification, they are forwarded to the PAMR abstractor for further investigation. This includes obtaining medical records, toxicology reports, news articles, social media postings, and other data. The abstractor is able to further determine if a case was a false positive, through the information they obtain, for instance, when a woman's medical records indicate they have had a hysterectomy. The information for deaths that were not deemed false positives is then used to create a summary of the events that led up to and ended in death. The de-identified summary is then given to the multi-disciplinary PAMR board who evaluate the case to determine pregnancy relatedness, as well as the contributing factors and preventability of a death. The PAMR board also makes recommendations in order to help improve the outcome of similar situations in the future. See Figure 42 for a visual overview of the PAMR process.

Figure 39: Flow Chart of PAMR Program Process



Appendix B: Committee Decisions Form

MATERNAL MORTALITY REVIEW COMMITTEE DECISIONS FORM v21 1																																						
REVIEW DATE <input style="width: 100%; height: 20px;" type="text"/> <small>Month/Day/Year</small>	RECORD ID # <input style="width: 100%; height: 20px;" type="text"/>	COMMITTEE DETERMINATION OF CAUSE(S) OF DEATH																																				
IF PREGNANCY-RELATED, COMMITTEE DETERMINATION OF UNDERLYING* CAUSE OF DEATH <small>Refer to page 3 for PMSS-MM cause of death list.</small>		<input style="width: 100%; height: 20px;" type="text"/>																																				
PREGNANCY-RELATEDNESS: SELECT ONE <input type="checkbox"/> PREGNANCY-RELATED <small>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</small> <input type="checkbox"/> PREGNANCY-ASSOCIATED, BUT NOT-RELATED <small>A death during pregnancy or within one year of the end of pregnancy from a cause that is not related to pregnancy</small> <input type="checkbox"/> PREGNANCY-ASSOCIATED BUT UNABLE TO DETERMINE PREGNANCY-RELATEDNESS	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #2c3e50; color: white;"> <th style="text-align: left; padding: 2px;">TYPE</th> <th style="text-align: left; padding: 2px;">OPTIONAL: CAUSE (DESCRIPTIVE)</th> </tr> </thead> <tbody> <tr><td style="padding: 2px;">UNDERLYING*</td><td style="padding: 2px;"><input style="width: 100%;" type="text"/></td></tr> <tr><td style="padding: 2px;">CONTRIBUTING</td><td style="padding: 2px;"><input style="width: 100%;" type="text"/></td></tr> <tr><td style="padding: 2px;">IMMEDIATE</td><td style="padding: 2px;"><input style="width: 100%;" type="text"/></td></tr> <tr><td style="padding: 2px;">OTHER SIGNIFICANT</td><td style="padding: 2px;"><input style="width: 100%;" type="text"/></td></tr> </tbody> </table>	TYPE	OPTIONAL: CAUSE (DESCRIPTIVE)	UNDERLYING*	<input style="width: 100%;" type="text"/>	CONTRIBUTING	<input style="width: 100%;" type="text"/>	IMMEDIATE	<input style="width: 100%;" type="text"/>	OTHER SIGNIFICANT	<input style="width: 100%;" type="text"/>	<table border="1" style="width: 100%; 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UNDERLYING*	<input style="width: 100%;" type="text"/>																																					
CONTRIBUTING	<input style="width: 100%;" type="text"/>																																					
IMMEDIATE	<input style="width: 100%;" type="text"/>																																					
OTHER SIGNIFICANT	<input style="width: 100%;" type="text"/>																																					
COMMITTEE DETERMINATIONS ON CIRCUMSTANCES SURROUNDING DEATH																																						
DID OBESITY CONTRIBUTE TO THE DEATH?	<input type="checkbox"/> YES <input type="checkbox"/> PROBABLY <input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN																																					
DID DISCRIMINATION** CONTRIBUTE TO THE DEATH?	<input type="checkbox"/> YES <input type="checkbox"/> PROBABLY <input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN																																					
DID MENTAL HEALTH CONDITIONS OTHER THAN SUBSTANCE USE DISORDER CONTRIBUTE TO THE DEATH?	<input type="checkbox"/> YES <input type="checkbox"/> PROBABLY <input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN																																					
DID SUBSTANCE USE DISORDER CONTRIBUTE TO THE DEATH?	<input type="checkbox"/> YES <input type="checkbox"/> PROBABLY <input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN																																					
MANNER OF DEATH																																						
WAS THIS DEATH A SUICIDE?	<input type="checkbox"/> YES <input type="checkbox"/> PROBABLY <input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN																																					
WAS THIS DEATH A HOMICIDE?	<input type="checkbox"/> YES <input type="checkbox"/> PROBABLY <input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN																																					
IF ACCIDENTAL DEATH, HOMICIDE, OR SUICIDE, LIST THE MEANS OF FATAL INJURY	<table style="width: 100%; border: none;"> <tr> <td style="width: 25%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> FIREARM <input type="checkbox"/> SHARP INSTRUMENT <input type="checkbox"/> BLUNT INSTRUMENT <input type="checkbox"/> POISONING/ OVERDOSE <input type="checkbox"/> HANGING/ STRANGULATION/ SUFFOCATION </td> <td style="width: 25%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> FALL <input type="checkbox"/> PUNCHING/ KICKING/BEATING <input type="checkbox"/> EXPLOSIVE <input type="checkbox"/> DROWNING <input type="checkbox"/> FIRE OR BURNS <input type="checkbox"/> MOTOR VEHICLE </td> <td style="width: 50%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> INTENTIONAL NEGLECT <input type="checkbox"/> OTHER, SPECIFY: <input style="width: 100%; height: 20px;" type="text"/> <input type="checkbox"/> UNKNOWN <input type="checkbox"/> NOT APPLICABLE </td> </tr> </table>	<input type="checkbox"/> FIREARM <input type="checkbox"/> SHARP INSTRUMENT <input type="checkbox"/> BLUNT INSTRUMENT <input type="checkbox"/> POISONING/ OVERDOSE <input type="checkbox"/> HANGING/ STRANGULATION/ SUFFOCATION	<input type="checkbox"/> FALL <input type="checkbox"/> PUNCHING/ KICKING/BEATING <input type="checkbox"/> EXPLOSIVE <input type="checkbox"/> DROWNING <input type="checkbox"/> FIRE OR BURNS <input type="checkbox"/> MOTOR VEHICLE	<input type="checkbox"/> INTENTIONAL NEGLECT <input type="checkbox"/> OTHER, SPECIFY: <input style="width: 100%; height: 20px;" type="text"/> <input type="checkbox"/> UNKNOWN <input type="checkbox"/> NOT APPLICABLE																																		
<input type="checkbox"/> FIREARM <input type="checkbox"/> SHARP INSTRUMENT <input type="checkbox"/> BLUNT INSTRUMENT <input type="checkbox"/> POISONING/ OVERDOSE <input type="checkbox"/> HANGING/ STRANGULATION/ SUFFOCATION	<input type="checkbox"/> FALL <input type="checkbox"/> PUNCHING/ KICKING/BEATING <input type="checkbox"/> EXPLOSIVE <input type="checkbox"/> DROWNING <input type="checkbox"/> FIRE OR BURNS <input type="checkbox"/> MOTOR VEHICLE	<input type="checkbox"/> INTENTIONAL NEGLECT <input type="checkbox"/> OTHER, SPECIFY: <input style="width: 100%; height: 20px;" type="text"/> <input type="checkbox"/> UNKNOWN <input type="checkbox"/> NOT APPLICABLE																																				
IF HOMICIDE, WHAT WAS THE RELATIONSHIP OF THE PERPETRATOR TO THE DECEDENT?	<table style="width: 100%; border: none;"> <tr> <td style="width: 33%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> NO RELATIONSHIP <input type="checkbox"/> PARTNER <input type="checkbox"/> EX-PARTNER <input type="checkbox"/> OTHER RELATIVE </td> <td style="width: 33%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> ACQUAINTANCE <input type="checkbox"/> OTHER, SPECIFY: <input style="width: 100%; height: 20px;" type="text"/> </td> <td style="width: 34%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> UNKNOWN <input type="checkbox"/> NOT APPLICABLE </td> </tr> </table>	<input type="checkbox"/> NO RELATIONSHIP <input type="checkbox"/> PARTNER <input type="checkbox"/> EX-PARTNER <input type="checkbox"/> OTHER RELATIVE	<input type="checkbox"/> ACQUAINTANCE <input type="checkbox"/> OTHER, SPECIFY: <input style="width: 100%; height: 20px;" type="text"/>	<input type="checkbox"/> UNKNOWN <input type="checkbox"/> NOT APPLICABLE																																		
<input type="checkbox"/> NO RELATIONSHIP <input type="checkbox"/> PARTNER <input type="checkbox"/> EX-PARTNER <input type="checkbox"/> OTHER RELATIVE	<input type="checkbox"/> ACQUAINTANCE <input type="checkbox"/> OTHER, SPECIFY: <input style="width: 100%; height: 20px;" type="text"/>	<input type="checkbox"/> UNKNOWN <input type="checkbox"/> NOT APPLICABLE																																				
ESTIMATE THE DEGREE OF RELEVANT INFORMATION (RECORDS) AVAILABLE FOR THIS CASE: <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; padding: 2px;"><input type="checkbox"/> COMPLETE <small>All records necessary for adequate review of the case were available</small></td> <td style="width: 50%; padding: 2px;"><input type="checkbox"/> SOMEWHAT COMPLETE <small>Major gaps (i.e, information that would have been crucial to the review of the case)</small></td> </tr> <tr> <td style="padding: 2px;"><input type="checkbox"/> MOSTLY COMPLETE <small>Minor gaps (i.e, information that would have been beneficial but was not essential to the review of the case)</small></td> <td style="padding: 2px;"><input type="checkbox"/> NOT COMPLETE <small>Minimal records available for review (i.e, death certificate and no additional records)</small></td> </tr> <tr> <td colspan="2" style="padding: 2px;"><input type="checkbox"/> N/A</td> </tr> </table>		<input type="checkbox"/> COMPLETE <small>All records necessary for adequate review of the case were available</small>	<input type="checkbox"/> SOMEWHAT COMPLETE <small>Major gaps (i.e, information that would have been crucial to the review of the case)</small>	<input type="checkbox"/> MOSTLY COMPLETE <small>Minor gaps (i.e, information that would have been beneficial but was not essential to the review of the case)</small>	<input type="checkbox"/> NOT COMPLETE <small>Minimal records available for review (i.e, death certificate and no additional records)</small>	<input type="checkbox"/> N/A		DOES THE COMMITTEE AGREE WITH THE UNDERLYING* CAUSE OF DEATH LISTED ON DEATH CERTIFICATE? <input type="checkbox"/> YES <input type="checkbox"/> NO																														
<input type="checkbox"/> COMPLETE <small>All records necessary for adequate review of the case were available</small>	<input type="checkbox"/> SOMEWHAT COMPLETE <small>Major gaps (i.e, information that would have been crucial to the review of the case)</small>																																					
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<input type="checkbox"/> N/A																																						

*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.)