

# 2020 Tennessee Maternal Mortality Annual Report

Data in this report reflect deaths occurring in calendar years  
2017 and 2018



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## **DEDICATION**

The Tennessee Department of Health expresses its gratitude to the countless advocates and partners who have championed the purpose of the Maternal Mortality Review Committee (MMRC) to generate quality data to prevent maternal mortality. We extend our gratitude to all those already implementing the recommendations of this report. Thank you also to the state MMRC for reviewing every one of the deaths and developing recommendations that can save lives. It is with deepest sympathy and respect that we dedicate this report to the memory of those 82 women, and to their loved ones, who died while pregnant or within one year of pregnancy in 2018. Those are 82 deaths too many. We know our efforts to further understand the causes and contributing factors of maternal mortality in Tennessee will prevent future deaths.

## **ACKNOWLEDGMENTS 2018**

### **Chair**

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\*Special thanks to the late Dr. Julia Goodin for serving on the Maternal Mortality Review team for the last two years. The impact of her efforts to champion the needs of Tennessee's mothers will be felt for years to come.

## EXECUTIVE SUMMARY

The Tennessee Maternal Mortality Review Act of 2016 established the TN MMRC (T.C.A. § 63-3-2). An interdisciplinary team from across the state reviews every death and contributes to the annual recommendations of this report. 2017 was the first year of deaths reviewed and established a baseline of data. This year's report includes 2018 deaths and a compilation of 2017 and 2018 death data where appropriate. This report describes maternal deaths in Tennessee and the demographic characteristics of women who died while pregnant or within one year of pregnancy. This report also summarizes causes of death and contributing factors. Through a comprehensive review of deaths by the MMRC, this report identifies specific opportunities for prevention of maternal mortality and promotion of women's health. Below are the key findings and recommendations:

### Key Findings from 2018 Cases

- A total of 82 deaths occurred in 2018 compared to 78 in 2017.
- Seventy-seven percent of all deaths were determined to be preventable, with 33% having a 'good chance' of being prevented.
- Twenty-seven percent of all deaths were pregnancy-related deaths while 65% were pregnancy-associated, but not related deaths.
- Approximately 1 in 3 deaths had substance use disorder as a contributing factor, and acute overdose was the leading cause of pregnancy-associated, but not related death.
- Cardiovascular and coronary conditions were the leading cause of pregnancy-related deaths.

### Key Findings from 2017 and 2018 combined data

- The Committee found 81% of all deaths were preventable, with 37% having a 'good chance' of being prevented and 44% having 'some chance' of being prevented.
- The leading cause of pregnancy-related death in 2017 and 2018 was cardiovascular and coronary conditions.
- Substance use contributed to the largest number of deaths and primarily occurred in the pregnancy-associated, but not related deaths.
  - Overdose has been the leading cause of death for 2 years. There were 29 overdoses during 2017 and 2018.
  - During 2017 and 2018, the leading substance seen in acute overdoses was fentanyl (16).
  - Over half of all deaths with substance use disorder had a co-occurring mental health diagnosis as a contributing factor to death (54%).
- Mental health was determined as a contributing factor in 23% of all deaths. These deaths mostly occurred in non-Hispanic White women (76%).

- Among all deaths, non-Hispanic Black women were 1.4 times as likely to die within a year of pregnancy compared to non-Hispanic White women. The disparity is much greater among pregnancy-related causes of death, where Non-Hispanic Black women are 3 times as likely to die from pregnancy-related causes.
- Pregnancy is a primary eligibility category for TennCare coverage. Women with lower socioeconomic resources can often face complex medical and mental health needs. These needs may be associated with a higher burden of pregnancy-associated deaths.
- Fifteen percent of all deaths were classified as intentional violent death (i.e. homicide or suicide). Firearms were involved in 67% of violent deaths.
- Obesity contributed to 27% (n=12) of the pregnancy-related deaths. The leading cause of death of which obesity was a factor was preeclampsia.
- A majority of pregnancy-associated, but not related deaths (75%) occurred between 43-365 days postpartum.
- Nearly one-third (32%) of pregnancy-related deaths occurred at 7-42 days postpartum, and 30% occurred at 43-365 days postpartum.
- Over half (53%) of all deaths occurred in women less than 30 years of age.
- The highest risk age group was women in their forties. This group was nearly 5 times as likely to die within one year of pregnancy compared to women less than 30.

## **SUMMARY OF 2020 RECOMMENDATIONS**

### **Community and Statewide Agencies**

- Extend insurance coverage for pregnant women to one year postpartum to address mental health and medical needs of mother
- Increase number of facilities treating substance use disorder during pregnancy
- Increase availability of autopsies statewide to inform data
- Increase statewide access, education and affordability of intranasal naloxone
- Increase identification and support for those affected by interpersonal violence (IPV)

### **Clinics and Hospital Systems**

- Implement education for all providers on signs and symptoms of preeclampsia
- Implement Alliance for Innovation on Maternal Health (AIM) Bundles on postpartum hemorrhage
- Develop protocols for treatment and education of cardiac conditions, substance use disorder, and mental health disorders throughout pregnancy and the postpartum period
- Develop multipronged strategies for addressing interpersonal violence (IPV)
- Implement implicit bias training for all staff

### **Healthcare Providers**

- Provide education to women on signs and symptoms of preeclampsia
- Increase awareness on when to seek consultation and transfer of high risk obstetric patients
- Consistently screen all high risk pregnant women for preeclampsia, cardiac disease and substance use disorder
- Provide preconception counseling and family planning choices for women
- Implement interpersonal violence screening and support for women
- Counsel gun owners on safe firearm practices and storage

### **Women and their Friends and Families**

- Seek care, support and resources for signs and symptoms of depression
- Establish pregnancy diagnosis as soon as possible and seek care
- When applicable, engage in routine gun safety courses
- Seek treatment for substance abuse and mental health conditions
- Seek support for interpersonal violence (IPV)



## MATERNAL MORTALITY OVERVIEW

### Objective

The objective of this report is to describe the state of maternal mortality in Tennessee in 2018. This report describes the demographic characteristics of maternal deaths as well as summarizes the causes and contributing factors of these deaths. Through a comprehensive review of these deaths by the Tennessee MMRC, this report identifies opportunities for prevention of maternal mortality and promotion of women's health with specific recommendations at the individual/family, community, provider, facility, and systems levels. This report is a requirement of the Tennessee Maternal Mortality Review and Prevention Act of 2016.

### Background

The death of a woman during pregnancy, childbirth, or within the first year postpartum has immediate adverse impacts on a woman's family and community. Nationally, it is estimated that each year approximately 700 women in the United States die from pregnancy or pregnancy-related complications.<sup>1</sup> Racial disparities persist in these statistics as non-Hispanic Black women are three to four times more likely to die from a pregnancy-related complication than non-Hispanic White women.<sup>2</sup> Reducing maternal mortality and improving maternal health are national priorities.<sup>3 4</sup>

### Maternal Mortality in Tennessee Prior to 2017

Prior to the implementation of the MMR Program in Tennessee, the state relied on vital statistics alone to identify all deaths among pregnant women or within one year of pregnancy. In 2012, Tennessee introduced a pregnancy checkbox on the death certificate to aid in identifying maternal deaths. Therefore, data prior to 2012 are not comparable due to different case identification methodologies. Based solely on data from vital statistics, on average, 74 Tennessean women died during or within one year of pregnancy each year during 2012-2016. The pregnancy-associated mortality ratio, or the number of pregnancy-associated deaths per 100,000 live births, was 91.6 in 2016, using vital statistics data alone. These data are not comparable to MMRC data, which is the current gold standard.

There are limitations in using only vital statistics data to measure and understand maternal mortality. With the noted changes in case identification on the death certificate through the pregnancy checkbox, it is difficult to determine whether changes seen in maternal mortality statistics reflect better ascertainment or actual changes in risk of death.<sup>5</sup> There have been errors in reported pregnancy status documented in the literature, which have potentially led to an overestimation of pregnancy-related deaths.<sup>6</sup> Prior to the MMR Program in Tennessee, there was no procedure to confirm these identified cases. In addition, vital statistics data are unable to capture information on whether these deaths were preventable or recommendations that could help eliminate preventable maternal deaths.

The Tennessee MMR Program provides an opportunity to address the limitations in measurement of maternal deaths. With its establishment in 2017, each maternal death identified

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<sup>1</sup> Building U.S. Capacity to Review and Prevent Maternal Deaths. (2018). Report from nine maternal mortality review committees. Retrieved from [http://reviewtoaction.org/Report\\_from\\_Nine\\_MMRCs](http://reviewtoaction.org/Report_from_Nine_MMRCs)

<sup>2</sup> Pregnancy Mortality Surveillance System. Centers for Disease Control and Prevention. Available at: <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html>

<sup>3</sup> Healthy People 2020 [Internet]. Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion [cited [015 January 2020]]. Available from: [https://www.healthypeople.gov/node/4897/data\\_details](https://www.healthypeople.gov/node/4897/data_details).

<sup>4</sup> Kogan MD, Dykton C, Hirai AH, et al. A new performance measurement system for maternal and child health in the United States. *Matern Child Health J.* 2015;19(5):945-57.

<sup>5</sup> Creanga AA, Callaghan WM. Recent increases in the U.S. maternal mortality rate: disentangling trends from measurement issues [letter]. *Obstet Gynecol* 2017;129:206-7

<sup>6</sup> Baeva S, Saxton DL, Ruggiero K, Kormondy ML, Hollier LM, Hellerstedt J, Hall M, Archer NP. Identifying maternal deaths in Texas using an enhanced method, 2012. *Obstet Gynecol.* 2018;131(5),762-769.

through vital statistics data was verified with a comprehensive, standardized process. Additionally, the review of each death by the MMRC enabled further data collection on cause of death, contributing factors, preventability, and recommendations. Since 2017, the MMR program has reviewed 160 maternal mortality cases.

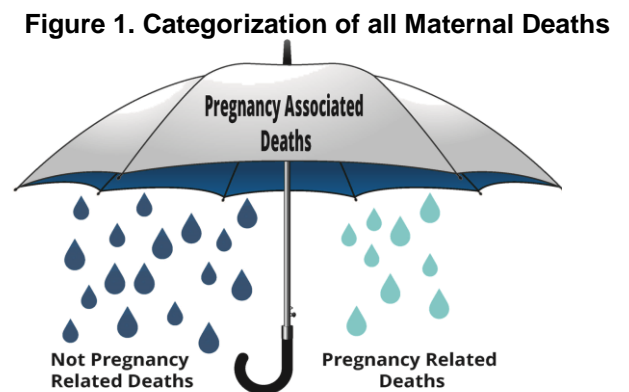
### The Maternal Mortality Review and Prevention Act

Tennessee established the Maternal Mortality Review (MMR) Program on January 1, 2017 upon the effective date of the Maternal Mortality Review and Prevention Act of 2016 (T.C.A. § 63-3-2). The legislation further created the MMR Committee to review maternal deaths and make determinations regarding the preventability of maternal deaths. Set forth in legislation, the purpose of the MMR Program is to: Identify and address the factors contributing to poor pregnancy outcomes for women and facilitate state systems changes to improve the health of women before, during and after pregnancy. The MMR Committee is a multidisciplinary expert panel, with representation from public health, obstetrics-gynecology, maternal and fetal medicine, anesthesiology, neonatology, pediatrics, nurse-midwifery, nursing, mental and behavioral health, domestic violence, Hospital Patient Safety, TennCare/Medicaid, District Attorney's office, the Department of Mental Health and Substance Abuse Services, the Tennessee Senate and House of Representatives, and the State Chief Medical Examiner. The Committee is tasked to review maternal deaths and report recommendations for changes to any law, rule, and policy that would promote the safety and well-being of women and prevention of maternal deaths.

### Definitions

Categorizations of maternal mortality further specify timing and cause of death. A breakdown of the categories can be seen in **Figure 1**. While some organizations define maternal mortality as only occurring during or within 42 days of pregnancy, the Tennessee Maternal Mortality Review and Prevention Act of 2016 uses the following definitions, which are aligned with the Centers for Disease Control and Prevention (CDC)'s definition:

- **Pregnancy-associated deaths:** The death of a woman during pregnancy or within one year of the end of pregnancy from any cause. This encompasses all qualifying deaths the MMRC reviews. Pregnancy-associated deaths can further be classified into **pregnancy-related deaths** or **pregnancy-associated but not related deaths**.
  - **Pregnancy-related deaths:** The death of a woman during pregnancy or within one year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy.
  - **Pregnancy-associated, but not related deaths:** The death of a woman during pregnancy or within one year of the end of pregnancy from a cause that is not related to pregnancy.



## MATERNAL MORTALITY REVIEW PROGRAM PROCESS

The MMR Program process in TN involves four components: case identification, case verification, case abstraction, and case review. This section describes each of these components in detail.

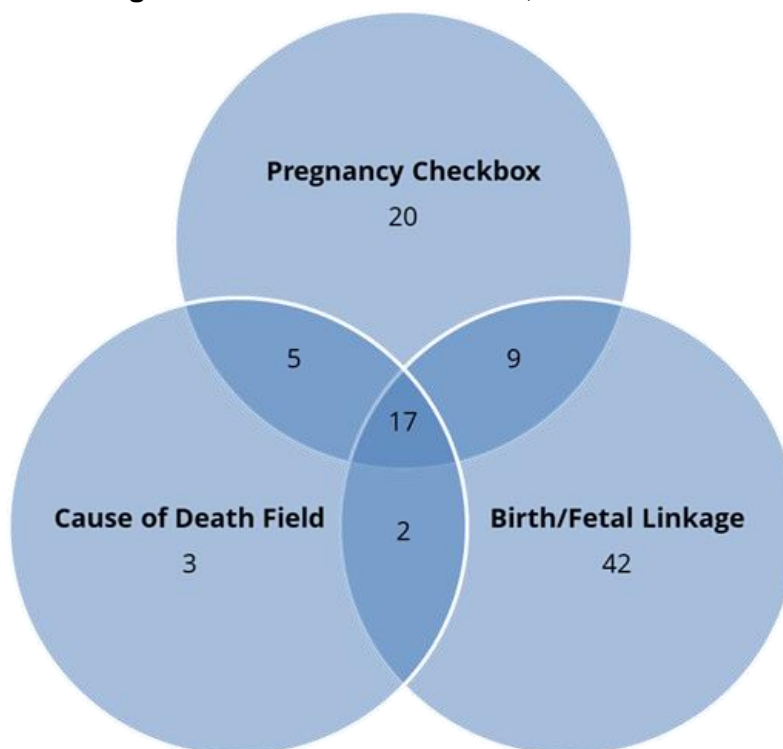
### Case Identification

The MMR Program coordinates with the TDH Office of Vital Records and Statistics to identify pregnancy-associated deaths. All deaths of female Tennessee residents aged 10-55 years were screened and considered potential cases if they met any of the following criteria:

1. Presence of an *International Classification of Diseases* (ICD-10) underlying cause of death code that is indicative of pregnancy or childbirth (A34, O00-O99)
2. Linkage with a live birth or a fetal death record that occurred within one year of the woman's death
3. Checkbox response in the death record that indicates the decedent was either: 1) pregnant at time of death, 2) not pregnant, but pregnant within 42 days of death, or 3) not pregnant, but pregnant 43 days to 365 days before death

In 2018, 98 potential pregnancy-associated deaths were flagged through this case identification methodology. See **Figure 2** for the case identification sources for these 98 cases that met the initial criteria described above and were sent on for further verification. Sixty-five cases met only one of the three criteria listed above while the remaining third had multiple sources of identification. The most common source of identification was a linkage of a woman's death with a live birth or fetal death record.

**Figure 2: Case Identification Source for 98 Potential Pregnancy-Associated Cases Sent to MMR Program for Further Verification, Tennessee 2018**



**Data sources:** Tennessee Department of Health, Office of Vital Records and Health Statistics, Death Statistical File (2018), Birth Statistical File (2017-2018), Fetal Death Statistical File (2017-2018).

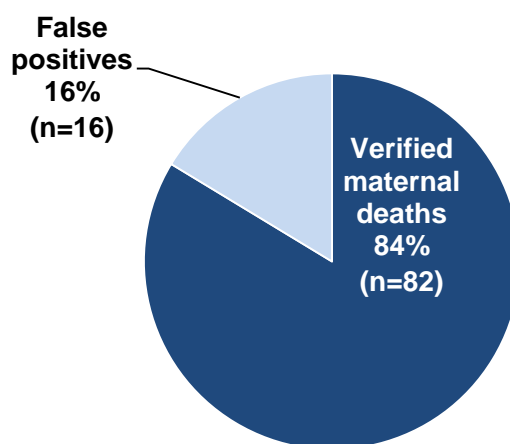
### Case Verification

For a case to be considered eligible for review by the Maternal Mortality Review Committee, it first needed to pass through an in-depth verification process to ensure that the woman in question actually was pregnant within a year of her death. As permitted by the state legislation, upon receipt of the initial list of identified cases, the Maternal Mortality Nurse Abstractor requested medical records for all of the decedents. When appropriate, social media, obituaries, news reports and other data sources were investigated. For example, if a case were a homicide, the nurse abstractor would request any police reports and/or social services records in addition to the usual hospital records, autopsy report, and prenatal care and delivery records. Cases were verified as pregnancy-associated deaths, and therefore eligible for review, if records confirmed that the woman was in fact pregnant within one year of death.

If the records obtained demonstrated either 1) a clear contraindication with pregnancy or recent pregnancy (for example, a stated hysterectomy more than one year prior to death in a medical record) or 2) no indication of pregnancy within one year in any record collected, the Maternal Mortality Nurse Abstractor determined that the death was **not verified** as a pregnancy-associated death and classified as a **false positive**. False positive cases did not move forward to the case abstraction or review process. Once a case was determined to be a false positive, the Maternal Mortality Nurse Consultant notified the Office of Vital Records and Health Statistics. The Office of Vital Records and Health Statistics then contacted the death certifier to further investigate and confirm the error (e.g. a death mistakenly being marked pregnant when in actuality there was no evidence of pregnancy). If a mistake could be confirmed, the amendment process was initiated to correct the erroneous information in the death record that led to the case be falsely identified. In 2018, there were 16 false positives identified and 6 of these cases were amended to reflect that the woman in question was not pregnant within a year of her death.

Of the 98 cases identified as potential pregnancy-associated deaths, 82 (84%) were verified **maternal deaths** of women while pregnant or within one year of pregnancy; the remaining 16 (16%) were false positives (**Figure 3**). These 82 confirmed cases were abstracted and reviewed by the Maternal Mortality Review Committee.

**Figure 3: Pregnancy-Associated Death Case Verification, Tennessee 2018**

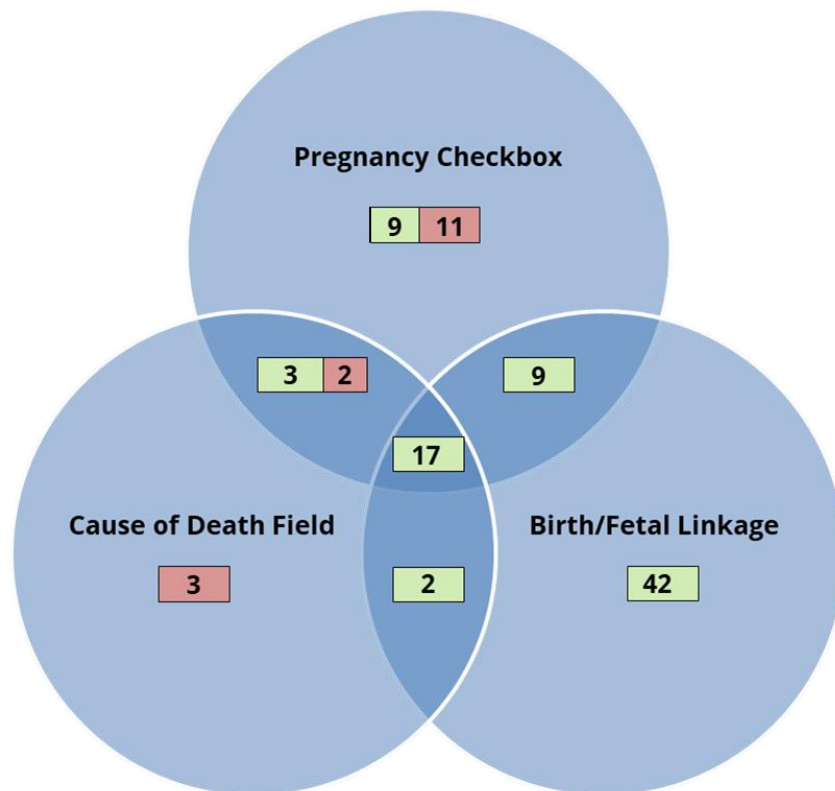


**Data sources:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

As demonstrated in **Figure 4**, the various identification sources differed in terms of the likelihood of producing false positives. For 2018 cases, 100% of cases linked to a live birth or fetal death within a year of death were confirmed as true cases. The identification source producing the most false positives for 2018 was the pregnancy checkbox on the death certificate: of the 51

cases with a response to the pregnancy checkbox indicating pregnancy within a year of death, 38 (75%) were confirmed as true cases. Eleven of the 20 cases that had the pregnancy checkbox as the only source of identification were found to be false positives.

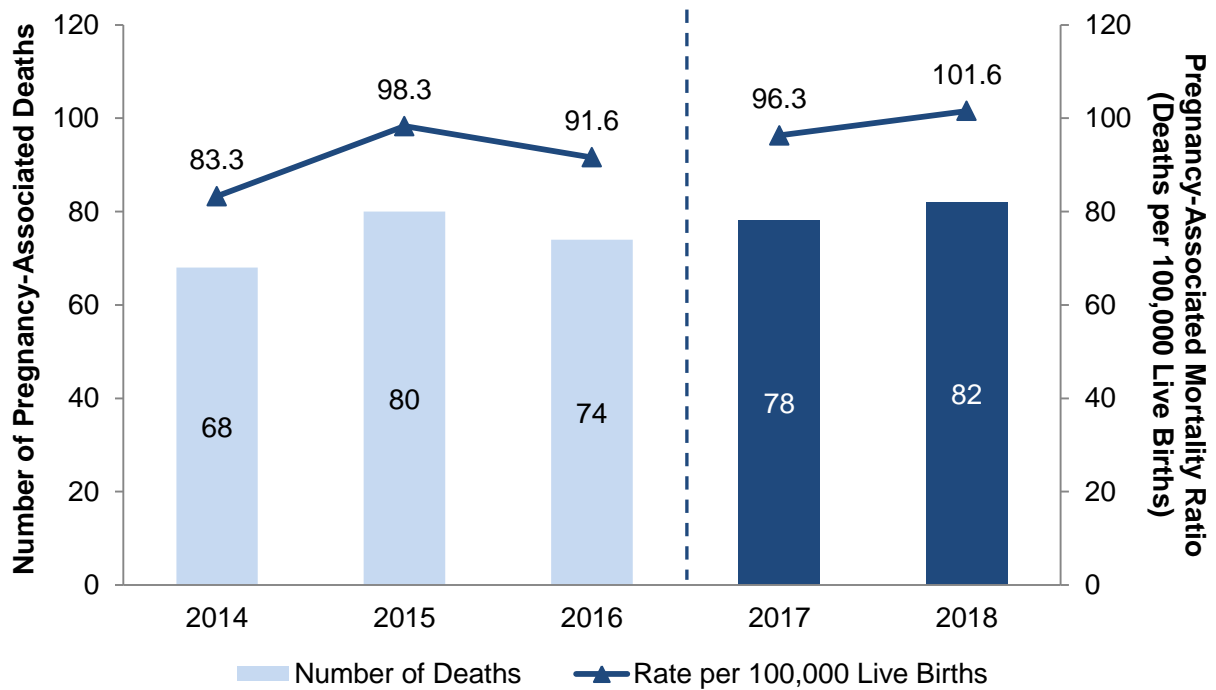
**Figure 4: Number of false positive cases by identification source, Tennessee, 2018**



**Data sources:** Tennessee Department of Health, Office of Vital Records and Health Statistics, Death Statistical File (2018), Birth Statistical File (2017-2018), Fetal Death Statistical File (2017-2018).

Because each potential case is verified to ensure a true pregnancy within a year of death, the MMR Program data is the optimal data source to calculate the pregnancy-associated mortality ratio (PAMR) for Tennessee. In 2018, the Tennessee PAMR was 101.6 per 100,000 live births compared to 96.3 per 100,000 live births in 2017 (**Figure 5**), a difference that is not statistically significant. It is important to note that this is not comparable to estimates for 2014-2016, as data for these years was obtained before the MMR process was in place. These deaths did not go through the verification process and the vital records count is likely to include some proportion of false positives. The effect this verification process has on the overall estimate of the burden of pregnancy-associated mortality is substantial. If the MMR Program did not verify the deaths identified using vital statistics data in 2018, the PAMR would have been 19% higher (101.6 vs. 121.4 per 100,000 live births).

**Figure 5: Pregnancy-Associated Mortality, Tennessee 2014-2016, 2017-2018**



**Note:** The 2017-2018 number of pregnancy-associated deaths and the 2017-2018 pregnancy-associated ratio are not comparable to estimates from 2014-2016; the 2017-2018 data source is the MMR Program while the 2014-2016 data source is Vital Statistics.

**Data sources:** Tennessee Department of Health, Office of Vital Records and Health Statistics, Death Statistical File. Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.

### Case Abstraction

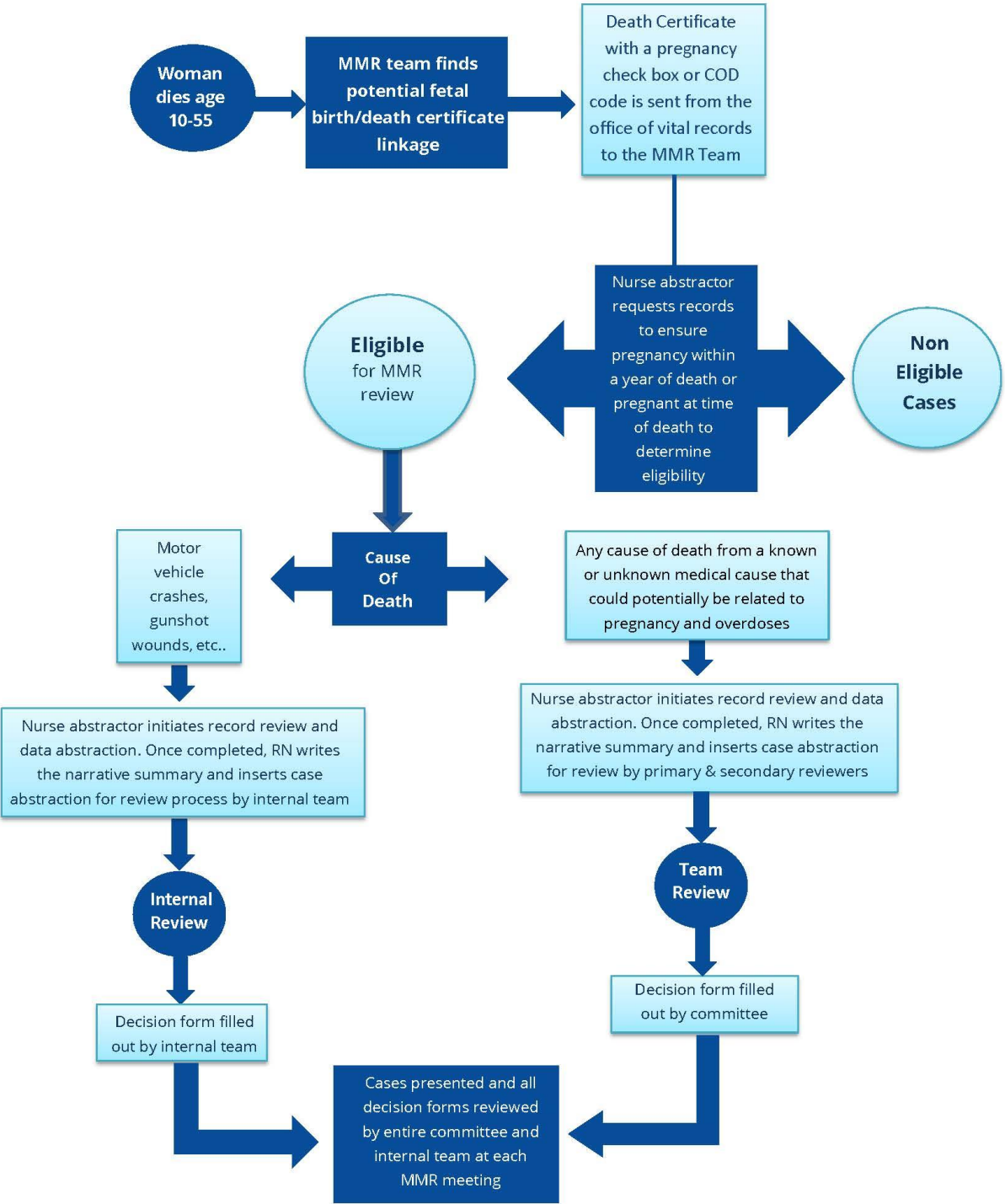
One key aspect of the Tennessee MMR Program is the record collection and abstraction process. Once a death is verified, the Maternal Mortality Nurse Consultant identifies the multiple disciplinary aspects of the decedent's care, which enables a thorough case review. To align with national recommendations, Tennessee utilizes the Maternal Mortality Review Information Application (MMRIA) database from the CDC to capture critical aspects of each case in a standardized format prior to review by the MMR Committee. Documentation in MMRIA represents a wide variety of data sources, and contains multiple forms including: the death certificate, autopsy report, birth certificate, prenatal care record, social and environmental profile, mental health profile, case narrative, and committee decisions. After each death is fully abstracted, the team utilizes the CDC's decision form to ensure case review standardization for every verified pregnancy-associated death. This decision form provides guidance on key decisions required for each case, including:

- Was the death pregnancy-related?
- What was the underlying cause of death?
- Was the death preventable?
- What factors contributed to the death?
- What recommendations may help prevent future deaths?

**Figure 6** highlights the full maternal mortality review program process.



**Figure 6: Flow Chart MMR Program Process**



## **PREGNANCY-ASSOCIATED DEATHS**

Pregnancy-associated death is the death of a woman during pregnancy or within one year of the end of pregnancy from any cause. From 2017 to 2018, 160 Tennessean women died within one year of pregnancy. Table 1 provides a description of these women by age, race/ethnicity, educational level, insurance type, and geographic location of residence. The table also includes the pregnancy-associated mortality ratio which is the number of pregnancy-associated deaths per 100,000 live births. The PAMR was not calculated for pregnancy-associated death counts less than 11, as estimates based on numbers below this threshold are unreliable.

### **Demographic Highlights**

The burden of maternal mortality is not equal across Tennessee. Several demographic groups were found to have greater risk of dying while pregnant or within a year of pregnancy.

- Women less than 30 years old had the lowest PAMR. The highest risk group was women in their forties, who were nearly 5 times as likely to die within one year of pregnancy compared to women less than 30.
- Non-Hispanic Black women were approximately 1.4 times as likely to die within one year of pregnancy compared to non-Hispanic White women.
- Women with less than a high school education (i.e. no high school diploma or GED) were approximately 3 times as likely to die within one year of pregnancy compared to women who had more than a high school education (i.e. at least some college).
- Across the state of Tennessee, the PAMR was similar for women living in metro and rural counties. By grand division, rates were variable year to year. The highest PAMR was seen for women living in West Tennessee. Although West demonstrated a decline in deaths from 2017 to 2018, the two year PAMR is highest in West which is reflective of the fewer number of live births in West Tennessee.



**Table 1. Demographic Characteristics of All Pregnancy-Associated Deaths, Tennessee, 2017-2018**

| Characteristics                          | Pregnancy-Associated Deaths |           |            | Pregnancy-Associated Mortality Ratio (PAMR) <sup>1</sup> |
|--|-----------------------------|-----------|------------|--|
|  | 2017                        | 2018      | Total      |  |
| <b>Age at Death</b>                      |                             |           |            |  |
| Less than 30 years                       | 43 (55%)                    | 41 (50%)  | 84 (53%)   | 83.3   |
| 30-39 years                              | 29 (37%)                    | 34 (41%)  | 63 (39%)   | 109.6  |
| 40+ years                                | 6 (8%)                      | 7 (9%)    | 13 (8%)    | 378.0  |
| <b>Race/Ethnicity</b>                    |                             |           |            |  |
| Non-Hispanic White                       | 55 (71%)                    | 51 (62%)  | 106 (66%)  | 98.9   |
| Non-Hispanic Black                       | 18 (23%)                    | 28 (34%)  | 46 (29%)   | 139.9  |
| Other                                    | 5 (6%)                      | 3 (4%)    | 8 (5%)     | —  |
| <b>Education</b>                         |                             |           |            |  |
| Less than high school                    | 15 (19%)                    | 22 (27%)  | 37 (23%)   | 177.0  |
| High school diploma/GED                  | 37 (47%)                    | 34 (41%)  | 71 (44%)   | 156.0  |
| More than high school                    | 25 (32%)                    | 24 (29%)  | 49 (31%)   | 52.0   |
| Not specified                            | 1 (1%)                      | 2 (2%)    | 3 (2%)     | —  |
| <b>Insurance at Delivery<sup>2</sup></b> |                             |           |            |  |
| TennCare                                 | 40 (69%)                    | 43 (61%)  | 83 (65%)   | 107.7  |
| Private                                  | 16 (28%)                    | 16 (23%)  | 32 (25%)   | 48.1   |
| Other                                    | 0 (0%)                      | 3 (4%)    | 3 (2%)     | —  |
| None                                     | 0 (0%)                      | 5 (7%)    | 5 (4%)     | —  |
| Unknown                                  | 2 (3%)                      | 3 (4%)    | 5 (4%)     | —  |
| <b>Area of Residence<sup>3</sup></b>     |                             |           |            |  |
| Metropolitan county                      | 34 (44%)                    | 35 (43%)  | 69 (43%)   | 97.6   |
| Rural county                             | 44 (56%)                    | 47 (57%)  | 91 (57%)   | 99.9   |
| <b>Grand Division</b>                    |                             |           |            |  |
| West TN                                  | 32 (41%)                    | 25 (30%)  | 57 (36%)   | 142.6  |
| Middle TN                                | 23 (29%)                    | 26 (32%)  | 49 (30%)   | 69.5   |
| East TN                                  | 23 (29%)                    | 31 (38%)  | 54 (34%)   | 105.4  |
| <b>Overall</b>                           | <b>78</b>                   | <b>82</b> | <b>160</b> | <b>98.9</b>  |

1. PAMR calculated from 2017 and 2018 combined count.

2. Insurance status defined for women with a live birth. This variable excludes insurance status for women without a live birth, i.e. women who died during pregnancy, following a miscarriage, or after a fetal death.

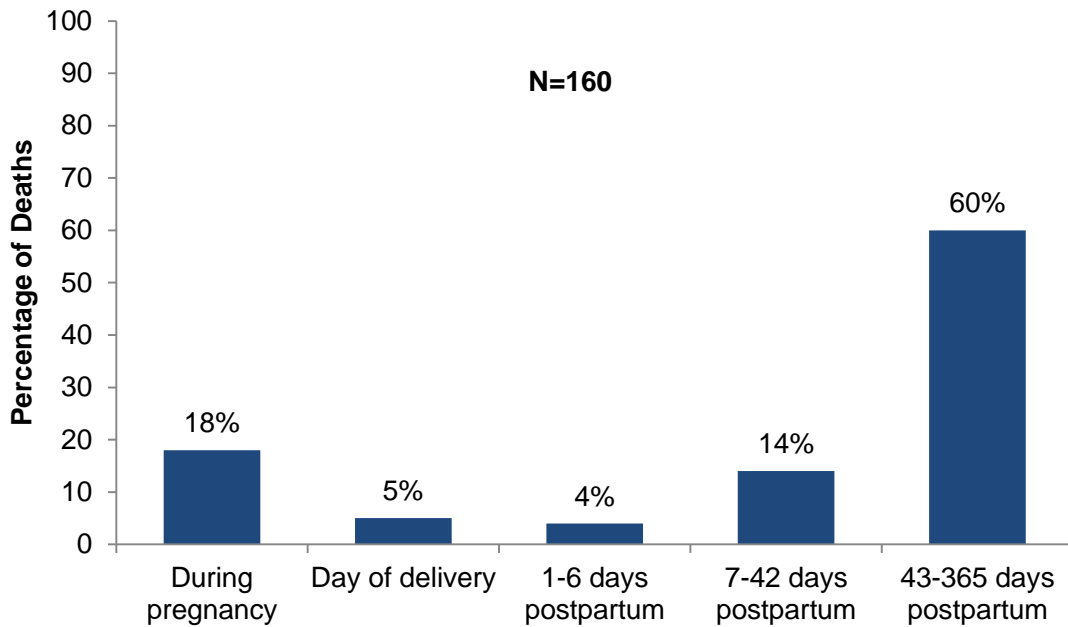
3. Metropolitan county includes: Davidson, Hamilton, Knox, Madison, Shelby, and Sullivan Counties.

**Data sources:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program. Tennessee Department of Health, Office of Vital Records and Health Statistics, Birth Statistical File, 2017. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.

### Timing of Pregnancy-Associated Deaths in Relation to Pregnancy

The majority of pregnancy-associated deaths (60%) occurred 43 days to one year after pregnancy. Eighteen percent of deaths happened when women were pregnant, while 14% of deaths occurred within 7-42 days postpartum. There was a similar representation of maternal deaths on the day of delivery (5%) and within the first six days postpartum (4%) (**Figure 7**).

**Figure 7. Timing of All Pregnancy-Associated Deaths in Relation to Pregnancy, Tennessee, 2017-2018**



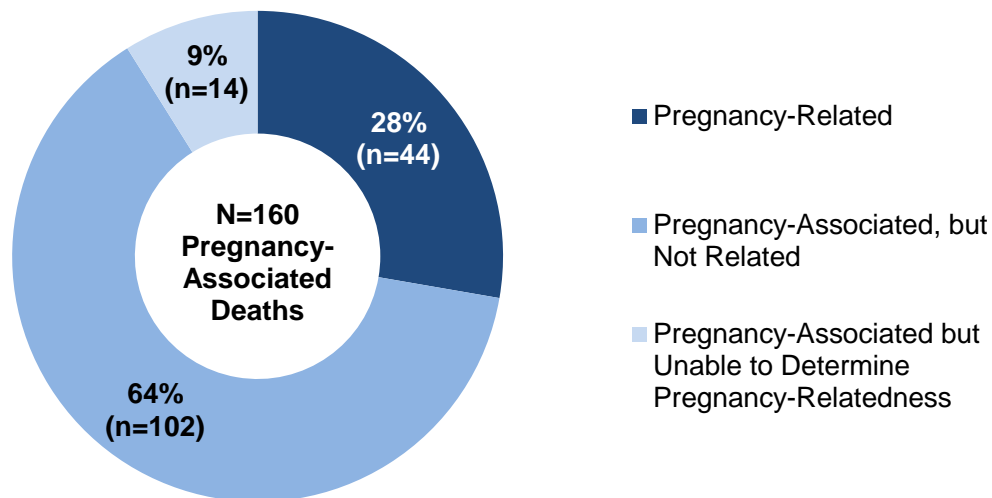
**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

## Committee Decisions for All Pregnancy-Associated Deaths

### Pregnancy-Relatedness

Of the 160 pregnancy-associated deaths, 28% of deaths (n=44) were determined to be pregnancy-related and 64% (n=102) were classified as not pregnancy-related by the Committee, meaning these deaths were not a result of the woman's pregnancy. The Committee was unable to determine pregnancy-relatedness in 9% (n=14) of all cases (**Figure 8**).

**Figure 8. Committee Determination of Pregnancy-Relatedness, Pregnancy-Associated Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

As there were significant differences in pregnancy-related vs. pregnancy-associated, but not related deaths, the next sections throughout the report will further describe details of the committee decisions regarding these two types of deaths.

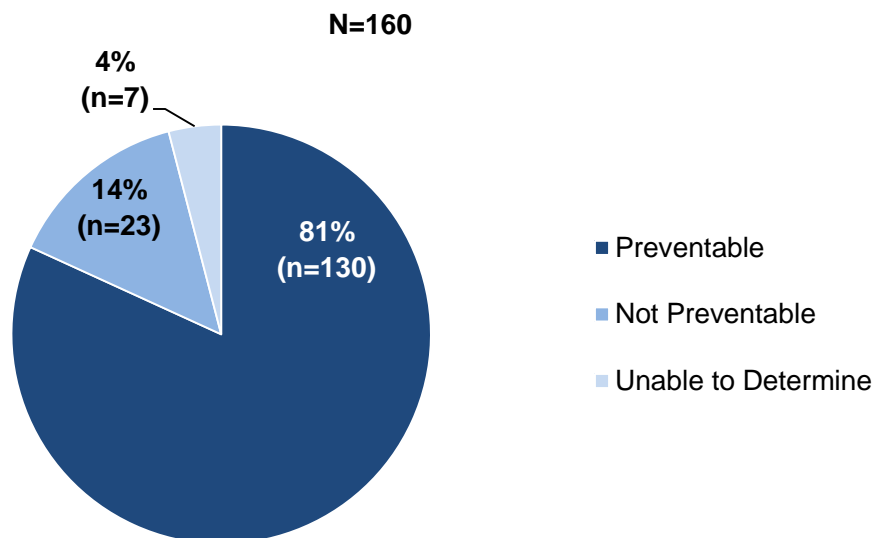
### Preventability

Deaths were considered preventable if there was at least some chance of the death being averted by one or more reasonable changes at the patient, community, provider, facility, and/or systems factor levels.<sup>7</sup> These are levels in which contributing factors are organized. Many times these cases are multifactorial in the preventability and involve the communities, systems, facilities, providers and patients and their families to prevent these deaths. The committee found that 81% of all pregnancy-associated deaths were preventable, 14% were not preventable and 4% were unable to determine preventability (**Figure 9**).

**Health conditions** contributing to most pregnancy-associated deaths are determined by cases where substance use disorder (SUD), mental health condition, and obesity contributed to the death. Deaths where mental health, SUD and obesity were determined to be a factor in a death were determined to be mostly preventable (92%) by the Committee.

<sup>7</sup> Building U.S. Capacity to Review and Prevent Maternal Deaths. (2018). Report from Nine Maternal Mortality Review Committees. [http://reviewtoaction.org/Report\\_from\\_Nine\\_MMRCs](http://reviewtoaction.org/Report_from_Nine_MMRCs)

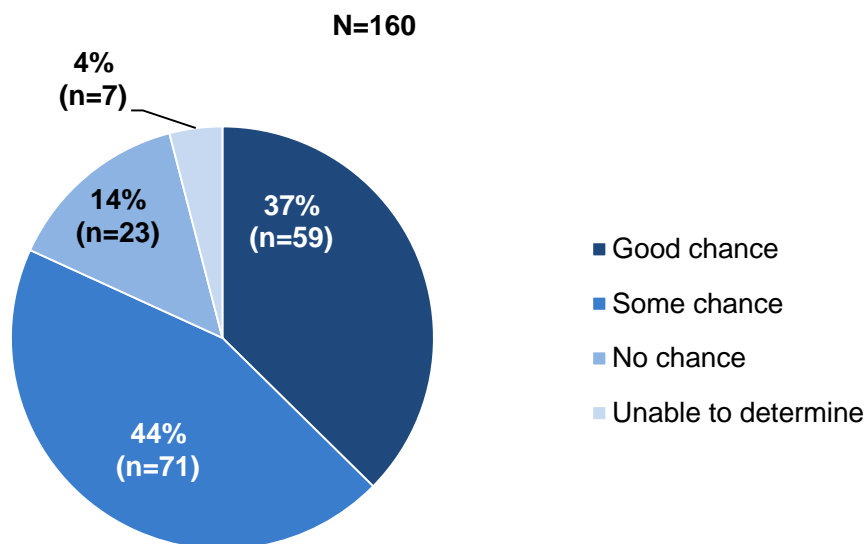
**Figure 9. Preventability of All Pregnancy-Associated Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

After a death is determined to be preventable, the committee determines the chance the outcome could have been altered. This outcome is determined as ‘good’, ‘some’, ‘no’ chance or ‘unable to determine’. Of the cases analyzed, 37% were determined to have a ‘good chance’ and 44% of them had ‘some chance’ to alter the outcome (**Figure 10**).

**Figure 10: Committee’s Determination on Chance to Alter Outcome, Pregnancy-Associated Deaths, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

**Health and Social Conditions Contributing to Maternal Death**

The MMR Committee was asked to determine whether substance use disorder (SUD), mental health conditions or obesity contributed to each death occurring during pregnancy or within one year of pregnancy. **Figure 11** provides the percentage of deaths in which these factors contributed.

### Substance Use Disorder (SUD)

About one in three (34%; n=54) pregnancy-associated deaths from 2017-2018 had SUD as a contributing factor (**Figure 11**). There was a similar representation of women with SUD who resided in metropolitan areas (48%) and rural areas (52%). Deaths to women with SUD did not occur in isolation; over half of all deaths with SUD as a contributing factor also had a co-occurring mental health diagnosis as a contributing factor (54%).

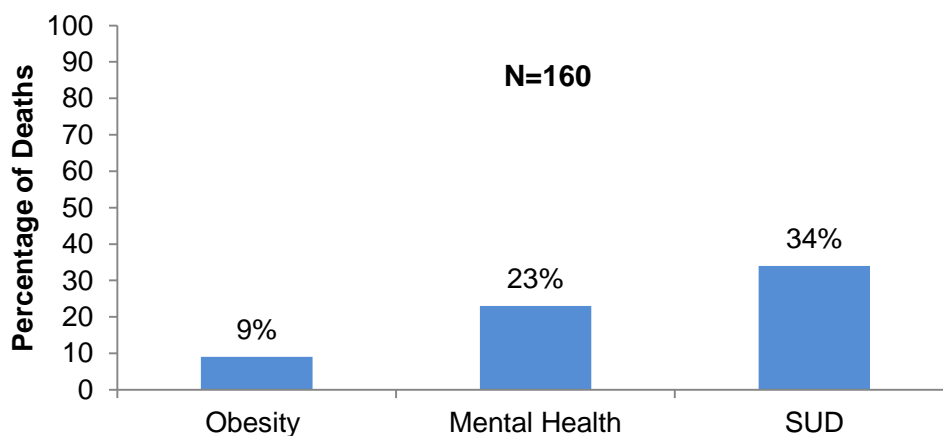
### Mental Health Conditions

The Committee determined that a mental health condition was a contributing factor in 23% (n=37) of all pregnancy-associated deaths (**Figure 11**). The leading cause of death for all pregnancy-associated deaths with a mental health condition contributing to the death was overdose. These deaths mostly occurred among non-Hispanic White women (76%) with similar representation of women living in metropolitan areas (46%) and (54%) living in rural areas.

### Obesity

Nine percent (n=15) of all pregnancy-associated deaths reviewed were determined to have obesity as a contributing factor (**Figure 11**). The leading cause of death for pregnancy-associated cases with obesity as a contributing factor was preeclampsia/eclampsia. All maternal deaths with the underlying cause of death with preeclampsia or eclampsia were determined to be pregnancy-related. More than half of these deaths were to non-Hispanic Black women (53%). The majority of these deaths occurred to women who resided in metropolitan areas (67%).

**Figure 11: Health Conditions Contributing for All Pregnancy-Associated Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

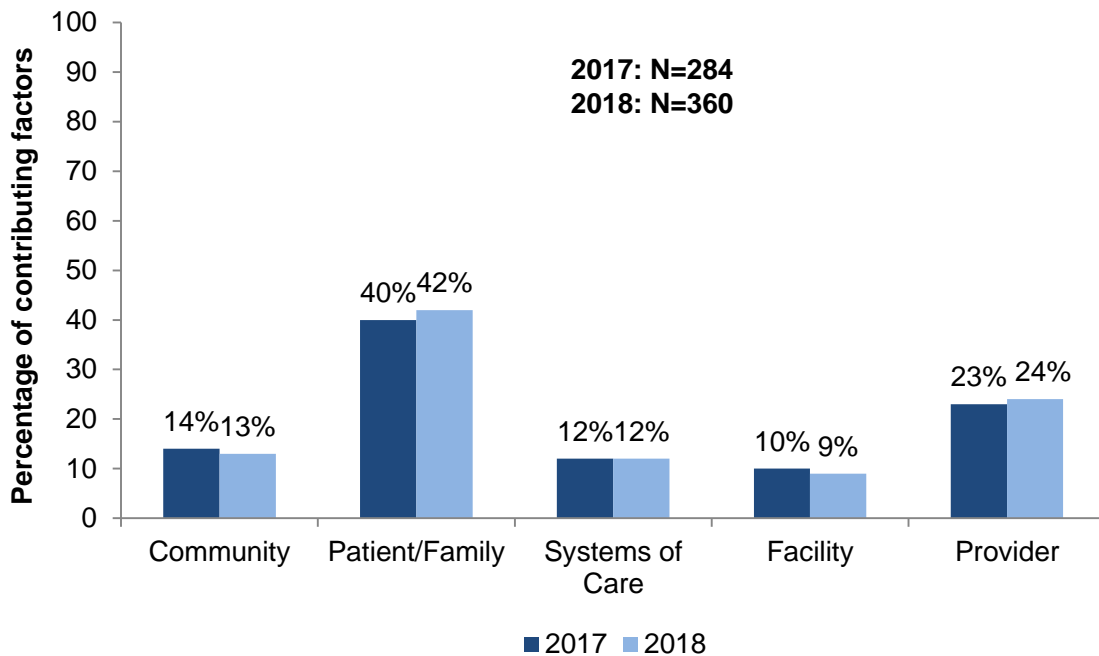
### Violent Deaths

Of the 160 pregnancy-associated deaths reviewed, there were **24** intentional violent deaths: **18** cases of homicide and **6** cases of suicide. Nine of the homicides were a result of intimate partner violence. About half (54%) of violent deaths occurred among non-Hispanic white women. Also, the majority of violent deaths (**70%**) occurred between 43 days and 365 days postpartum. All suicide deaths were determined to be preventable by the Committee while about half (78%) of homicide deaths were determined to be preventable. Firearms were involved in **67%** of violent deaths.

### Contributing Factor Categories in Pregnancy-Associated Deaths

The Committee identified contributing factors and categorized them into one of five factor categories in which change in the outcome could have occurred. These five factor categories were patient/family, provider, facility, systems of care, and community. There were a total of 360 critical factors identified for 2018 pregnancy-associated deaths. The contributing factor levels helped guide discussion for the Committee's recommendations to eliminate maternal death. On average, the Committee identified 4.9 contributing factors per pregnancy-associated death in Tennessee in 2018. **Figure 12** provides the percentage of these contributing factors by level. Major themes have been identified from the review of 2018 deaths. These themes that contributed to the 2018 maternal deaths can be seen on page 38.

**Figure 12. Contributing Factor Categories for Pregnancy-Associated Deaths, Tennessee, 2017 vs. 2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

## PREGNANCY-RELATED DEATHS

### Demographics of Pregnancy-Related Deaths

Pregnancy-related deaths are deaths to women 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.

Between 2017 and 2018, a total of 44 deaths were classified as pregnancy-related by the committee, representing 28% of all pregnancy-associated deaths. The pregnancy-related mortality ratio (PRMR), or number of pregnancy-related deaths per 100,000 live births, for the two years combined was 27.2. **Table 2** describes the demographic characteristics of the pregnancy-related cases for 2017 and 2018, including the cases' age, race/ethnicity, educational level, insurance type, and geographic location of residence. The table also includes the PRMR estimates for the subgroups shown, based on the combined data for 2017 and 2018. The PRMR is suppressed (i.e., marked with a dash) when the combined 2017-2018 count was less than eleven, as estimates based on counts below this threshold are unreliable.

Pregnancy-related mortality was not experienced equally by all groups of women. From 2017-2018, there were substantial differences in the PRMR for women based on their race/ethnicity, age, education level, insurance type, and location of residence.

- Non-Hispanic Black women were about three times as likely to die from a pregnancy-related cause compared to Non-Hispanic White women.
- Women aged 30 to 39 were about twice as likely to die from a pregnancy-related cause compared to women less than 20. The number of cases amongst women 40 and older was too low to allow for a reliable comparison, but future reports with additional years of data will address the increased risk seen nationally for this group.
- Women with a high school education or less were more likely to die from a pregnancy-related cause compared to women who had more than a high school education.
- Across the state of Tennessee, women who lived in the West Grand Division were the most likely to die from a pregnancy-related cause. Women in West Tennessee were approximately two times as likely to die from a pregnancy-related cause compared to women in Middle or East Tennessee. As was seen in pregnancy-associated death, this was variable year to year and additional data in the coming years will be helpful in looking at this. Although there were similar number of deaths in Middle and West Tennessee, West Tennessee had fewer numbers of live births.

### Location of Death

The location of deaths can vary by clinical setting (in-patient vs. outpatient, or nursing home), decedent's home, or other settings (e.g. road, in motor vehicle crashes). The location of death varied among the 44 cases of pregnancy-related deaths in 2017 and 2018. Specifically, these deaths took place in:

1. Inpatient clinical settings: 59% percent (n=26) of pregnancy-related deaths occurred in inpatient clinics/hospitals. In this category, the primary cause of death includes blood clots, cardiovascular disease, sepsis, cancer and hemorrhage.
2. Outpatient settings/emergency room: Almost 1 in 5 (18%, n=8) pregnancy-related deaths happened in outpatient clinical settings or the emergency room. The main cause of these deaths includes eclampsia, cardiomyopathy, and blood clots.
3. The remaining proportion occurred at decedent's home, nursing home/long-term care facility, or other location, or pronounced dead on arrival.

**Table 2. Demographic Characteristics of Pregnancy-Related Deaths, Tennessee, 2017-2018**

| Characteristics                          | Pregnancy-Related Deaths |           |           | Pregnancy-Related Mortality Ratio (PRMR) <sup>1</sup> |
|--|--------------------------|-----------|-----------|---|
|  | 2017                     | 2018      | Total     |   |
| <b>Age at Death</b>                      |                          |           |           |   |
| Less than 30 years                       | 10 (45%)                 | 8 (36%)   | 18 (41%)  | 17.9  |
| 30-39 years                              | 9 (41%)                  | 11 (50%)  | 20 (45%)  | 34.8  |
| 40+ years                                | 3 (14%)                  | 3 (14%)   | 6 (14%)   | —   |
| <b>Race/Ethnicity</b>                    |                          |           |           |   |
| Non-Hispanic White                       | 12 (55%)                 | 10 (45%)  | 22 (50%)  | 20.5  |
| Non-Hispanic Black                       | 8 (36%)                  | 11 (50%)  | 19 (43%)  | 57.8  |
| Other                                    | 2 (9%)                   | 1 (5%)    | 3 (7%)    | —   |
| <b>Education</b>                         |                          |           |           |   |
| High school education or less            | 10 (45%)                 | 12 (55%)  | 22 (50%)  | 33.1  |
| More than high school                    | 12 (55%)                 | 10 (45%)  | 22 (50%)  | 23.4  |
| <b>Insurance at Delivery<sup>2</sup></b> |                          |           |           |   |
| TennCare                                 | 8 (53%)                  | 10 (48%)  | 18 (50%)  | 23.4  |
| Private                                  | 7 (47%)                  | 9 (43%)   | 16 (44%)  | 24.0  |
| Other                                    | 0 (0%)                   | 1 (5%)    | 1 (3%)    | —   |
| Unknown                                  | 0 (0%)                   | 1 (5%)    | 1 (3%)    | —   |
| <b>Area of Residence</b>                 |                          |           |           |   |
| Metropolitan county                      | 11 (50%)                 | 10 (45%)  | 21 (48%)  | 29.7  |
| Rural county                             | 11 (50%)                 | 12 (55%)  | 23 (52%)  | 25.2  |
| <b>Grand Division</b>                    |                          |           |           |   |
| West TN                                  | 6 (27%)                  | 11 (50%)  | 17 (39%)  | 42.5  |
| Middle TN                                | 10 (45%)                 | 6 (27%)   | 16 (36%)  | 22.7  |
| East TN                                  | 6 (27%)                  | 5 (23%)   | 11 (25%)  | 21.5  |
| <b>Overall</b>                           | <b>22</b>                | <b>22</b> | <b>44</b> | <b>27.2</b>   |

1. PRMR calculated from 2017 and 2018 combined count.

2. Insurance status defined for women with a live birth. This variable excludes insurance status for women without a live birth, i.e. women who died during pregnancy, following a miscarriage, or after a fetal death.

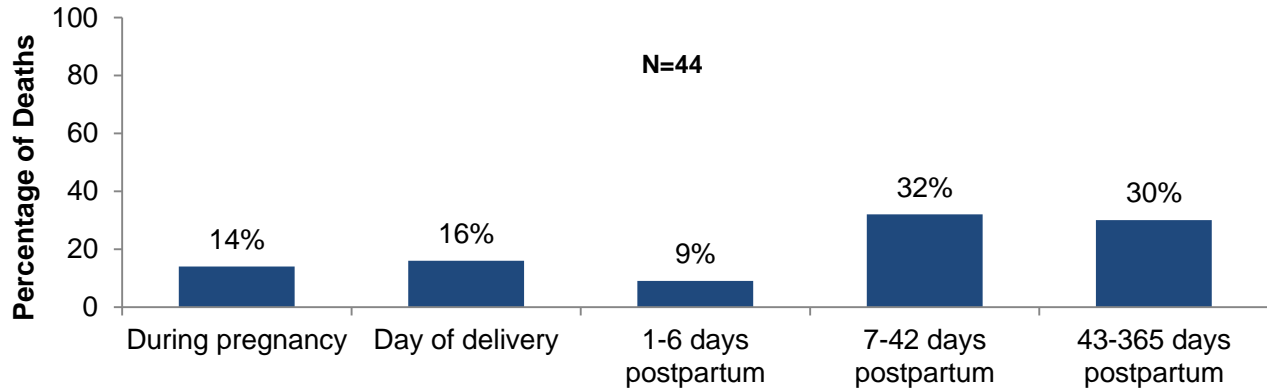
**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.



### Timing of Death of Pregnancy-Related Deaths

Of the pregnancy-related deaths during 2017 and 2018, 14% occurred during pregnancy, 16% occurred on the day of delivery, 9% occurred 1 to 6 days postpartum, 32% occurred 7 to 42 days postpartum, and 30% occurred 43 to 365 days postpartum (**Figure 13**).

**Figure 13: Timing of Pregnancy-Related Deaths, Tennessee, 2017-2018**

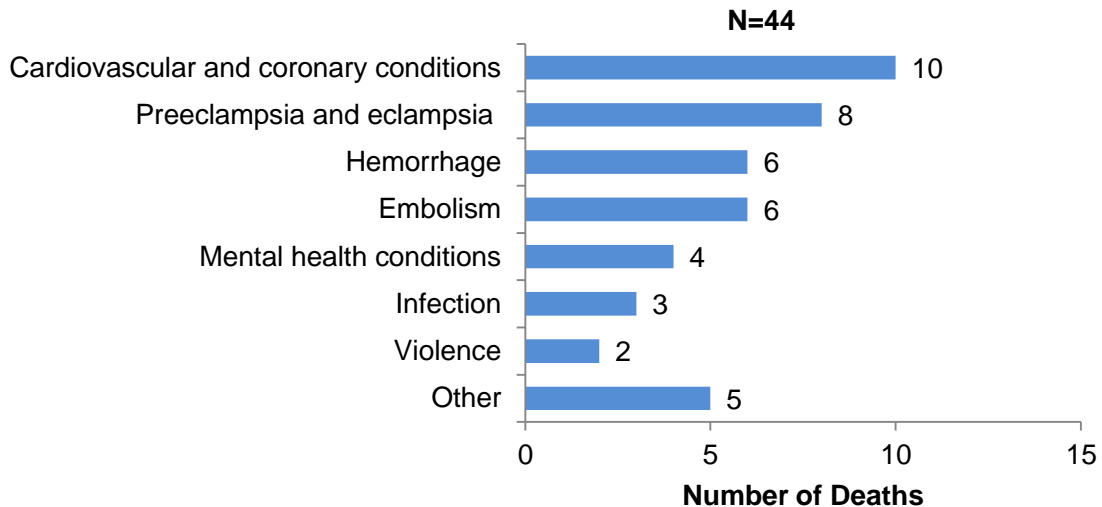


**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Underlying Causes of Pregnancy-Related Deaths

Underlying causes of pregnancy-related deaths were grouped into eight categories, based on classification from Building U.S. Capacity to Review and Prevent Maternal Deaths.<sup>8</sup> **Figure 14** provides the number of pregnancy-related deaths by underlying cause of death category. The most common cause of pregnancy-related death was cardiovascular and coronary conditions, followed by preeclampsia and eclampsia. For the categorization of the underlying causes of death please see **Appendix 1**.

**Figure 14: Leading Underlying Causes of Pregnancy-Related Deaths, Tennessee, 2017-2018**



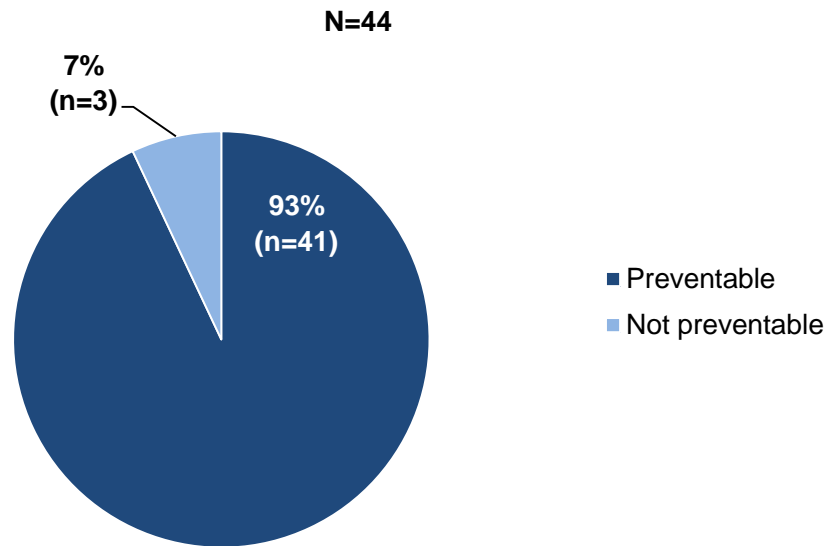
**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program

<sup>8</sup> Building U.S. Capacity to Review and Prevent Maternal Deaths. (2018). Report from nine maternal mortality review committees. Retrieved from [http://reviewtoaction.org/Report\\_from\\_Nine\\_MMRCs](http://reviewtoaction.org/Report_from_Nine_MMRCs)

### Preventability of Pregnancy-Related Deaths

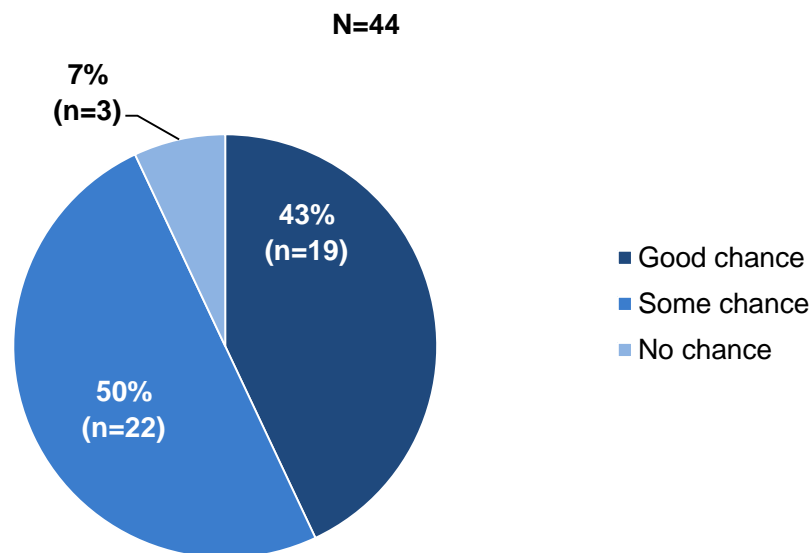
The committee determined that 93% (n=41) of the pregnancy-related deaths for 2017 and 2018 were potentially preventable (Figure 15). Of these 41 preventable deaths, the committee determined that there was a 'good chance' the death could have been averted for 19 cases and 'some chance' for the remaining 22 cases (Figure 16).

**Figure 15. Preventability of Pregnancy-Related Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

**Figure 16. Committee's Determination on Chance to Alter Outcome for Pregnancy-Related Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Substance Use Disorder

The committee determined that substance use disorder contributed to 18% (n=8) of the pregnancy-related deaths between 2017 and 2018 (Figure 17). Of the 8 cases with substance use disorder as a contributing factor, just one involved an acute overdose. Most cases succumbed to chronic health conditions complicated or aggravated by substance use. Five of the 8 cases also had mental health conditions as a contributing factor to their death.

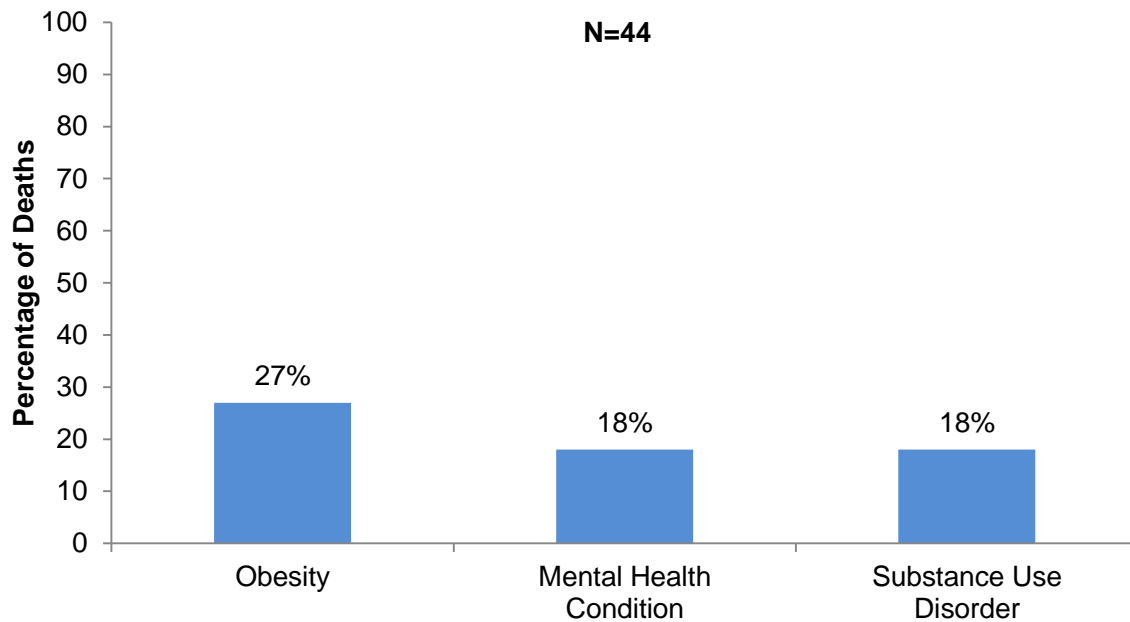
### Mental Health Conditions

Mental health conditions contributed to 18% (n=8) of the pregnancy-related deaths (Figure 17). Three of these 8 cases were suicide deaths and one was an overdose of unknown intent. The committee determined suicide deaths to be pregnancy-related if the pregnancy was demonstrated to be an aggravating factor to the woman's mental health or to have initiated a chain of events culminating in her suicide.

### Obesity

Obesity contributed to 27% (n=12) of the pregnancy-related deaths (Figure 17). Half of these cases (n=6) had preeclampsia or eclampsia as the underlying cause of death.

**Figure 17. Health Conditions for Pregnancy-Related Deaths, Tennessee, 2017-2018**



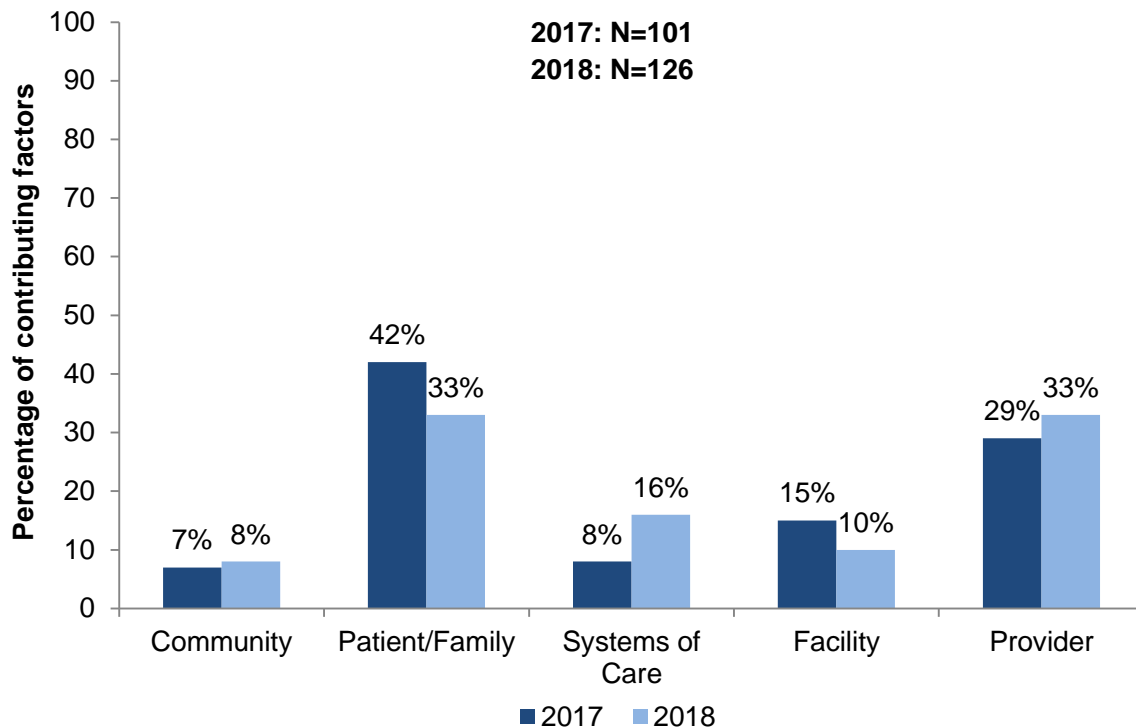
**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Contributing Factors of Pregnancy-Related Deaths

For each pregnancy-related case, the committee identified specific factors that had contributed to the woman's death. Contributing factors were identified in five categories: patient/family, provider, facility, system of care and community. Among the 22 pregnancy-related deaths in 2018, the committee described a total of 126 contributing factors. On average, the committee identified 5 contributing factors for each pregnancy-related death during 2018.

The distribution of contributing factors by category among pregnancy-related deaths is shown in **Figure 18**. In 2018, most contributing factors amongst pregnancy-related deaths were in the patient/family and provider categories, each of which accounted for 33% of the total factors for this year. The smallest proportion of contributing factors were identified at the community level, consistent with the trend from 2017. Examining contributing factors among each pregnancy-related case fosters the committee's discussion on prevention recommendations. Major themes have been identified over the course of the review of 2018 deaths. These themes that contributed to the 2018 maternal deaths can be seen on page 38.

**Figure 18: Contributing Factor Categories for Pregnancy-Related Deaths, Tennessee, 2017 vs. 2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

## PREGNANCY-ASSOCIATED, BUT NOT RELATED DEATHS

### Demographics

Pregnancy-associated, but not related death is defined as a death of woman during pregnancy or within one year after pregnancy from causes not related to pregnancy (e.g., motor vehicle crash). From 2017 and 2018, 102 of 160 (**64%**) deaths were classified as pregnancy-associated, **but not related** deaths by the committee. **Table 3** provides a description of the women who died by age, race/ethnicity, educational level, insurance type, and place of residence.

- The majority of pregnancy-associated, but not related deaths occurred among women under 30 years old (59%) and who were non-Hispanic White (73%). This differed from the distribution seen amongst pregnancy-related deaths, where non-Hispanic White women made up only 50% of cases.
- One-fourth (25%) of pregnancy-associated, but not related cases had more than a high school education (i.e. at least some college) while the remaining cases had less than a high school education (27%) or high school as their highest level of education (45%).
- More pregnancy-associated, but not related deaths occurred amongst women residing in rural counties (59%). There was not a pronounced difference in the distribution of pregnancy-associated, but not related deaths across the three Grand Divisions in Tennessee: West (30%), Middle (29%), and East (40%).

**Table 3: Demographic Characteristics of Pregnancy-Associated, but Not Related Death, Tennessee, 2017-2018**

| Characteristics                          | Pregnancy-Associated, but Not Related Deaths |           |            |
|--|--|-----------|------------|
|  | 2017   | 2018      | Total      |
| <b>Age at Death</b>                      |  |           |            |
| Less than 30 years                       | 29 (59%)                                     | 31 (58%)  | 60 (59%)   |
| 30-39 years                              | 17 (35%)                                     | 19 (36%)  | 36 (35%)   |
| 40+ years                                | 3 (6%)                                       | 3 (6%)    | 6 (6%)     |
| <b>Race/Ethnicity</b>                    |  |           |            |
| Non-Hispanic White                       | 36 (73%)                                     | 38 (72%)  | 74 (73%)   |
| Non-Hispanic Black                       | 10 (20%)                                     | 13 (25%)  | 23 (23%)   |
| Other                                    | 3 (6%)                                       | 2 (4%)    | 5 (5%)     |
| <b>Education</b>                         |  |           |            |
| Less than high school                    | 11 (22%)                                     | 17 (32%)  | 28 (27%)   |
| High school or GED                       | 24 (49%)                                     | 22 (42%)  | 46 (45%)   |
| More than high school                    | 13 (27%)                                     | 13 (25%)  | 26 (25%)   |
| Not Specified                            | 1 (2%)                                       | 1 (2%)    | 2 (2%)     |
| <b>Insurance at Delivery<sup>1</sup></b> |  |           |            |
| TennCare                                 | 27 (71%)                                     | 31 (67%)  | 58 (69%)   |
| Private                                  | 9 (24%)                                      | 6 (13%)   | 15 (18%)   |
| Other                                    | 0 (0%)                                       | 2 (4%)    | 2 (2%)     |
| None                                     | 0 (0%)                                       | 5 (11%)   | 5 (6%)     |
| Unknown                                  | 2 (5%)                                       | 2 (4%)    | 4 (5%)     |
| <b>Area of Residence</b>                 |  |           |            |
| Metropolitan County                      | 22 (45%)                                     | 20 (38%)  | 42 (41%)   |
| Rural County                             | 27 (55%)                                     | 33 (62%)  | 60 (59%)   |
| <b>Grand Division</b>                    |  |           |            |
| West TN                                  | 15 (31%)                                     | 16 (30%)  | 31 (30%)   |
| Middle TN                                | 12 (24%)                                     | 18 (34%)  | 30 (29%)   |
| East TN                                  | 22 (45%)                                     | 19 (36%)  | 41 (40%)   |
| <b>Overall</b>                           | <b>49</b>                                    | <b>53</b> | <b>102</b> |

1. Insurance status defined for women with a live birth. This variable excludes insurance status for women without a live birth, i.e. women who died during pregnancy, following a miscarriage, or after a fetal death.

**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program

### Location of death

Of the 102 pregnancy-associated but not-related deaths between 2017 and 2018, 93 of them had information on the location of death. These deaths occurred in:

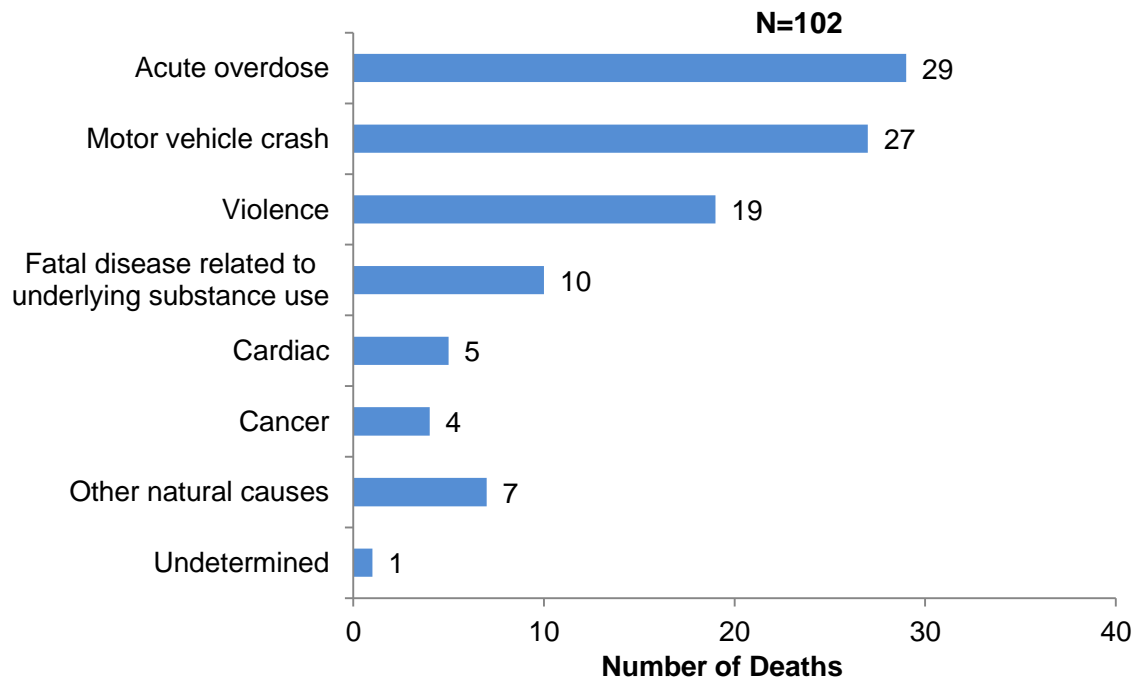
1. Inpatient settings: Thirty percent (n=28) of pregnancy-associated, but not related deaths occurred in inpatient clinic or hospitals.
2. Outpatient settings/ emergency room: Twenty-three percent (n=21) pregnancy associated but not related deaths took place in the outpatient clinical settings.
3. Home: Eighteen percent (n=17) of pregnancy-associated not related deaths happened in a home.

The remaining proportion of pregnancy-associated, but not related deaths happened at hospice (n=2) or other location (n=15). The other pregnancy-associated deaths were declared dead *on arrival* (n=7) or not specified (n=3).

### Underlying Causes of Pregnancy-Associated, but Not Related Deaths

Pregnancy-associated, but not related deaths are deaths to women during pregnancy or within one year of pregnancy from a cause that is not related to pregnancy. Underlying causes of pregnancy-associated, but not related deaths were grouped into eight categories, which are defined in **Appendix 2**. **Figure 19** provides the number of deaths by each of the categories. The three leading causes of pregnancy-associated, but not related deaths were acute overdose (n=29), motor vehicle crashes (n=27), and violence (n=19). Violent deaths include homicides, suicides, and accidental firearm deaths.

**Figure 19. Leading Underlying Causes of Pregnancy-Associated, but Not Related Deaths, Tennessee, 2017-2018**

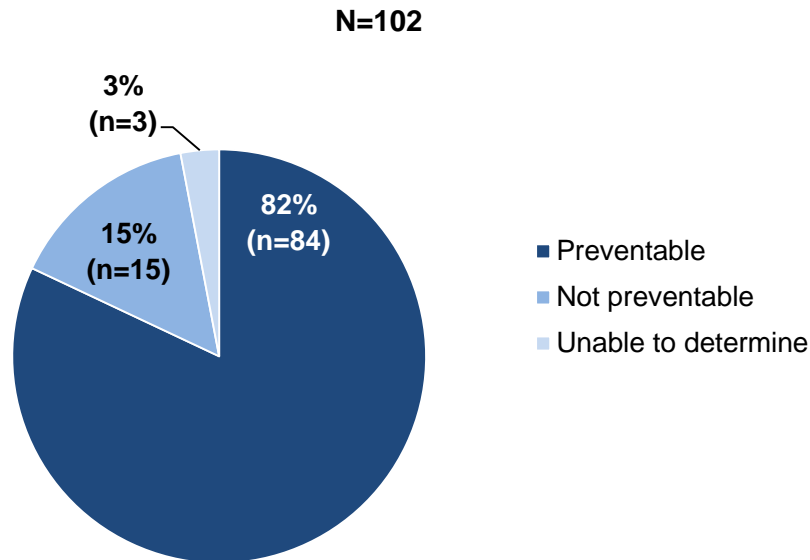


**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Preventability of Pregnancy-Associated, but Not Related Deaths

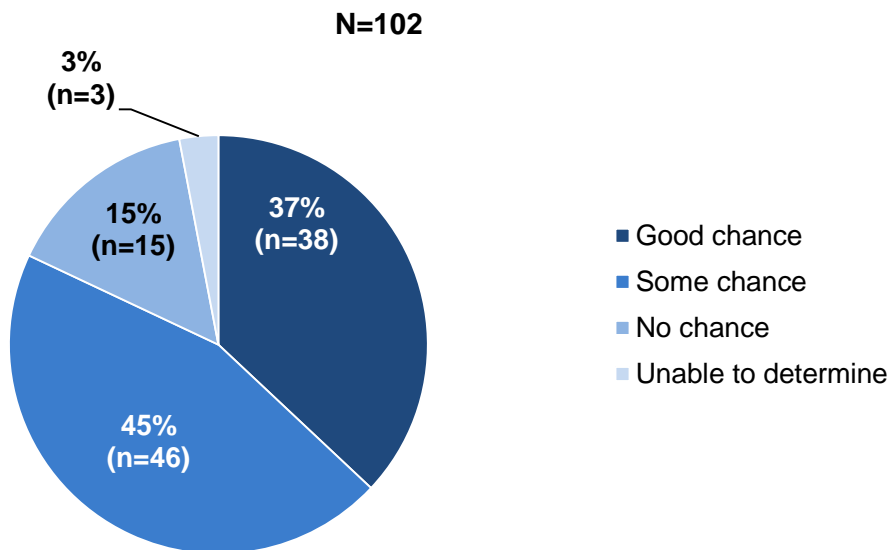
The committee determined that 82% (n=84) of the pregnancy-associated but not related deaths for 2017 and 2018 were potentially preventable (Figure 20). Of the 84 preventable deaths, the committee determined that there was a 'good chance' the death could have been averted for 38 cases and some chance for the remaining 46 cases (Figure 21).

**Figure 20. Preventability of All Pregnancy-Associated, but Not Related Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

**Figure 21. Committee's Determination on Chance to Alter Outcome for Pregnancy-Associated, but Not Related Deaths, Tennessee, 2017-2018**

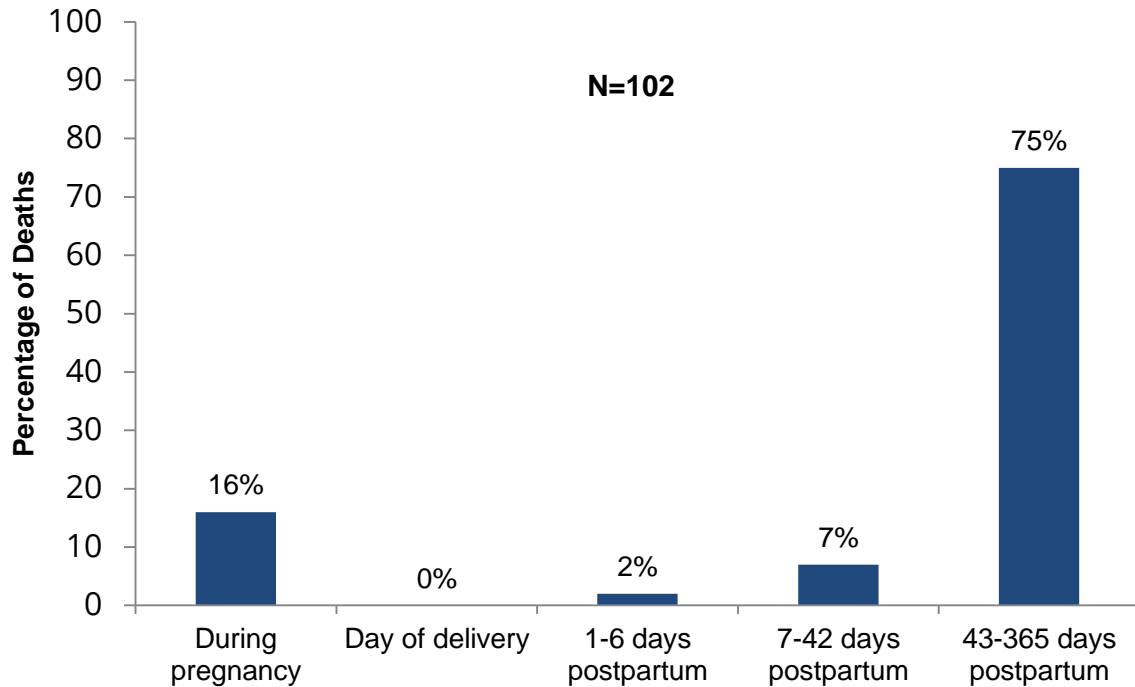


**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Timing of Death of Pregnancy-Associated, but Not Related Deaths

From 2017 to 2018, a vast majority of pregnancy-associated, but not related deaths occurred after 42 days postpartum. Three-fourths (75%) of deaths took place between 43 and 365 days postpartum, compared to just 16% during pregnancy, 2% between one and six days postpartum, and 7% from seven to 42 days postpartum (**Figure 22**).

**Figure 22. Timing of Pregnancy-Associated, but Not Related Deaths, Tennessee, 2017-2018**



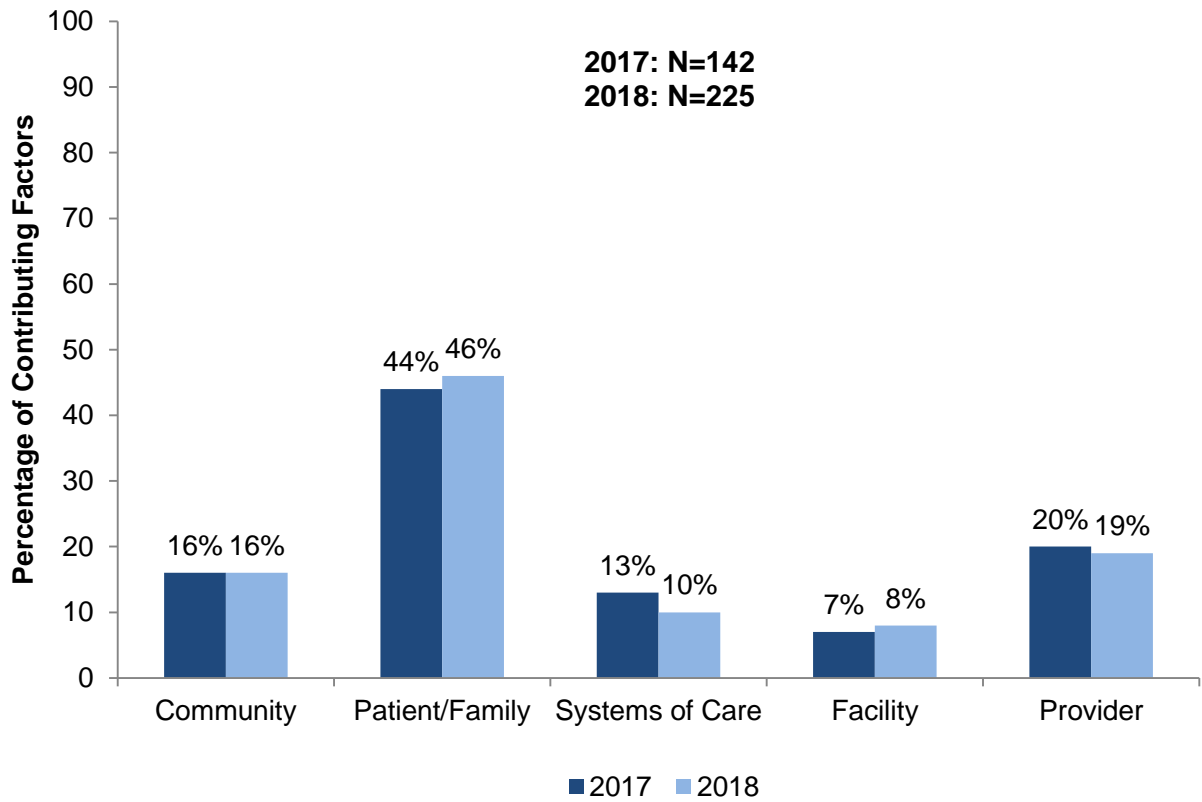
**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Contributing Factors of Pregnancy-Associated, but not Related Deaths

The Committee identified contributing factors among the pregnancy-associated, but not related deaths. Similar to pregnancy-related deaths, these cases were also multi-factorial events, with contributing factors occurring in multiple categories. These categories are individual/family, provider, facility, community, systems of care. In 2018, the Committee identified 225 contributing factors among pregnancy-associated but not related deaths. On average, the Committee found 4.8 factors that contributed to each pregnancy-associated, but not related death in Tennessee. The distribution of contributing factors by category among preventable pregnancy-associated, but not related deaths is shown in **Figure 23**. The largest proportion of contributing factors among preventable pregnancy-associated, but not related deaths were in the patient/family category (46%), followed by the provider category (19%); the systems of care and facility categories had the smallest proportions of factors identified. Compared to pregnancy-related deaths, pregnancy-associated but not related deaths had higher proportions of contributing factors in the patient/family and community categories, and smaller proportions in the provider and systems of care categories. The contributing factors identified for 2018 pregnancy-associated, but not related cases had multiple consistent themes. These themes of contributing factors that played a major role across the 2018 maternal deaths can be seen on page 38.



**Figure 23. Contributing Factor Categories for Pregnancy-Associated, but Not Related Deaths, Tennessee, 2017 vs. 2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program

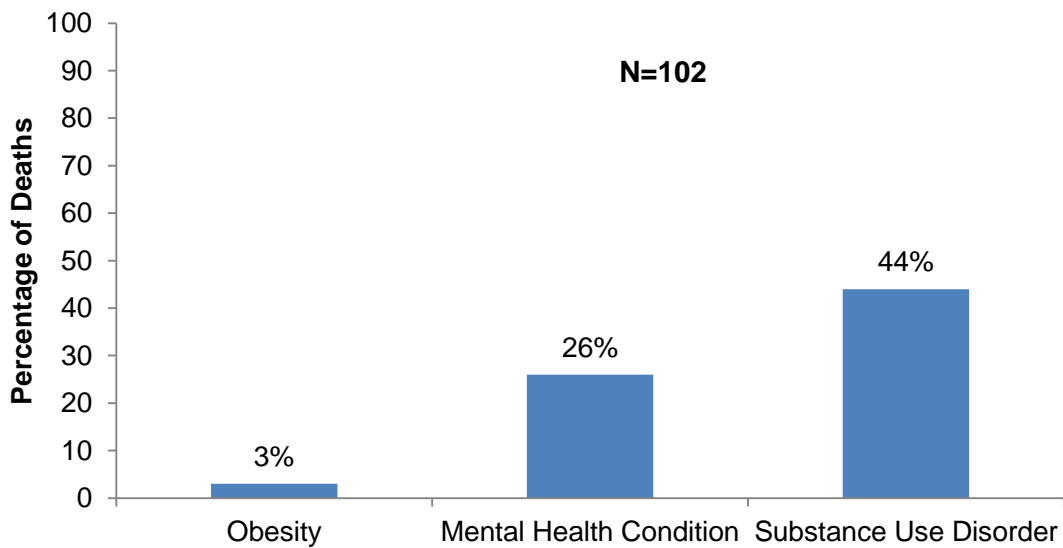
## **SUBSTANCE USE AND MENTAL HEALTH IN PREGNANCY-ASSOCIATED, BUT NOT RELATED DEATHS, 2017-2018**

### **Substance Use and Mental Health**

Substance use disorder (SUD) and mental health conditions contributed to substantial percentages of pregnancy-associated deaths from 2017 to 2018. This contribution was particularly large amongst the pregnancy-associated but not related cases which this section focuses on, though SUD and mental health conditions were also contributing factors in several pregnancy-related cases over this period. The Committee determined that SUD was a contributing factor in 44% of pregnancy-associated, but not related deaths (**Figure 24**). Table 4 provides a detailed description of the demographic characteristics of these 45 cases. Of this group of pregnancy-associated, but not related cases for which substance use disorder was found to be a contributing factor:

- Seventy-six percent were non-Hispanic White women.
- Fifty-eight percent were less than 30 years.
- Sixty percent lived in East Tennessee Grand Division.

**Figure 24. Health Conditions for Pregnancy-Associated, But Not Related Deaths, Tennessee, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

**Table 4: Demographic Characteristics of SUD in Pregnancy-Associated, But Not Related Deaths, Tennessee, 2017-2018**

| Characteristics                          | Pregnancy-Associated, but Not Related Deaths with Substance Use Disorder as Contributing Factor |           |           |
|--|---|-----------|-----------|
|  | 2017  | 2018      | Total     |
| <b>Age at Death</b>                      |   |           |           |
| Less than 30 years                       | 12 (55%)  | 14 (61%)  | 26 (58%)  |
| 30-39 years                              | 9 (41%)   | 9 (39%)   | 18 (40%)  |
| 40+ years                                | 1 (5%)  | 0 (0%)    | 1 (2%)    |
| <b>Race/Ethnicity</b>                    |   |           |           |
| Non-Hispanic White                       | 17 (77%)  | 17 (74%)  | 34 (76%)  |
| Non-Hispanic Black                       | 4 (18%)   | 5 (22%)   | 9 (20%)   |
| Other                                    | 1 (5%)  | 1 (4%)    | 2 (4%)    |
| <b>Education</b>                         |   |           |           |
| Less than high school                    | 3 (14%)   | 11 (48%)  | 14 (31%)  |
| High school or GED                       | 9 (41%)   | 8 (35%)   | 17 (38%)  |
| More than high school                    | 9 (41%)   | 3 (13%)   | 12 (27%)  |
| Not Specified                            | 1 (5%)  | 1 (4%)    | 2 (4%)    |
| <b>Insurance at Delivery<sup>1</sup></b> |   |           |           |
| TennCare                                 | 14 (74%)  | 15 (71%)  | 29 (73%)  |
| Private                                  | 4 (21%)   | 1 (5%)    | 5 (13%)   |
| None                                     | 0 (0%)  | 5 (24%)   | 5 (13%)   |
| Unknown                                  | 1 (5%)  | 0 (0%)    | 1 (3%)    |
| <b>Area of Residence</b>                 |   |           |           |
| Metropolitan County                      | 10 (45%)  | 11 (48%)  | 21 (47%)  |
| Rural County                             | 12 (55%)  | 12 (52%)  | 24 (53%)  |
| <b>Grand Division</b>                    |   |           |           |
| West TN                                  | 6 (27%)   | 5 (22%)   | 11 (24%)  |
| Middle TN                                | 3 (14%)   | 4 (17%)   | 7 (16%)   |
| East TN                                  | 13 (59%)  | 14 (61%)  | 27 (60%)  |
| <b>Overall</b>                           | <b>22</b>   | <b>23</b> | <b>45</b> |

1. Insurance status defined for women with a live birth. This variable excludes insurance status for women without a live birth, i.e. women who died during pregnancy, following a miscarriage, or after a fetal death.

**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.

#### **Mental Health:**

Fifty-one percent (n=23) of the 45 pregnancy-associated, but not related cases with a SUD also had a co-occurring mental illness as a contributing factor to the death. In these cases, the committee noted anxiety, bipolar disorder depression, history of physical and sexual abuse, and suicide attempt as conditions contributing to maternal death.

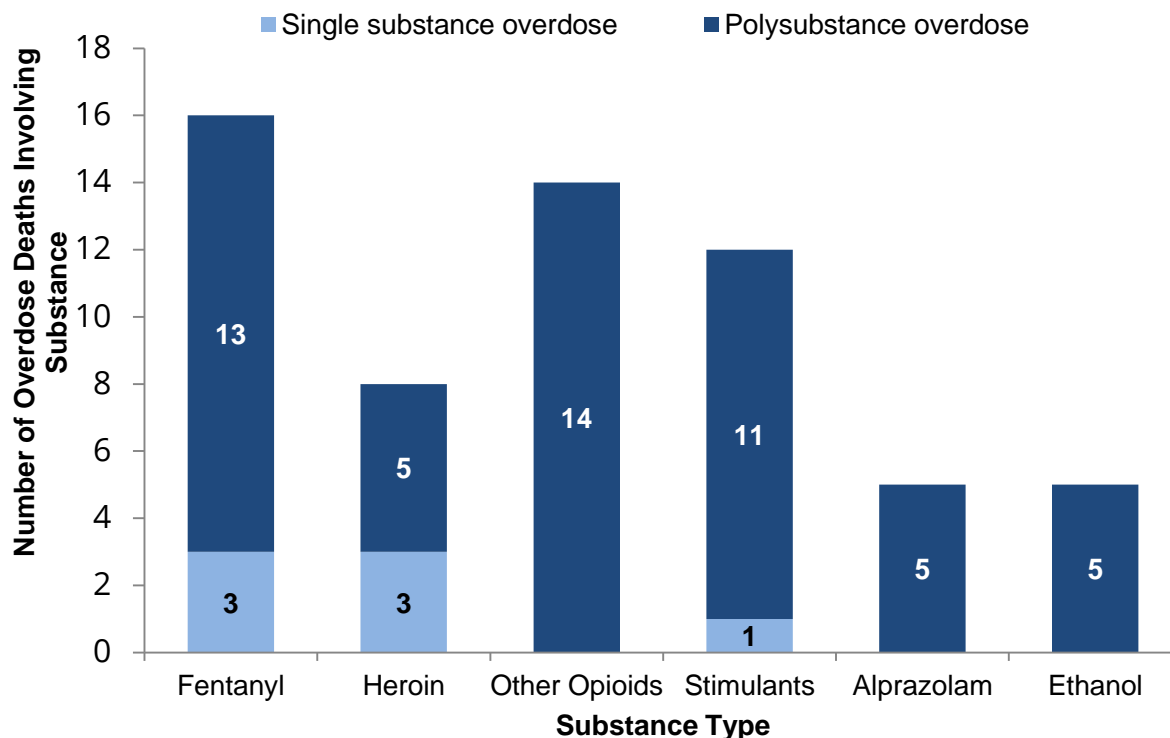
#### **Substances Involved in Overdose Deaths**

Between 2017 and 2018, there were a total of 29 acute overdose deaths among pregnancy-associated, but not related cases. **Figure 25** depicts the substances involved in these 29 cases. All but 7 of these incidents involved multiple substances, meaning that the total number of substances shown in **Figure 25** is greater than the number of overdose deaths.

- Fentanyl was the single most common substance, present in 16 of the 29 total overdose deaths (55%). Of these 16 cases involving fentanyl, it was the only substance present for 3 cases and found in combination with other substances for 13 cases.

- Heroin was the next most common opioid, identified in eight of the 29 overdose deaths (28%), as the single substance for three cases and in combination with other substances for 5 cases.
- Opiates falling into the ‘Other Opioid’ category include oxycodone, oxymorphone, morphine, hydrocodone, hydromorphone, buprenorphine, and U-47700. These substances were involved in 14 total overdose deaths, sometimes in combination with fentanyl or heroin.
- Across the 29 overdose deaths, 22 (76%) involved at least one opiate.
- Cocaine and methamphetamine, grouped together into the ‘Stimulants’ category in Figure 16, were present in 12 of the 29 overdose deaths (41%).
- Alprazolam (brand name Xanax) and ethanol were each present in 5 overdose deaths, always in combination with other substances.

**Figure 25. Type of Substances Involved in Pregnancy-Associated, but Not Related Acute Overdose Deaths, Tennessee, 2017-2018**



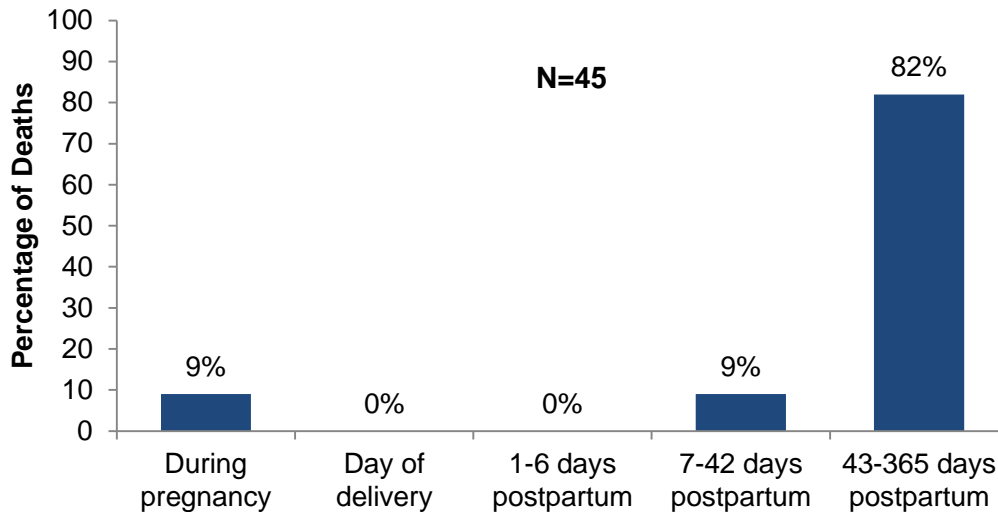
**Notes:** There were a total of 29 acute overdose deaths among pregnancy-associated, but not related cases in 2017 and 2018 combined. Because most of these deaths involved multiple substances, the total number of substances involved in these cases is greater than the number of overdose deaths. Other opioids include oxymorphone, oxycodone, morphine, hydromorphone, hydrocodone, buprenorphine, noroxycodone, and U-47700. Stimulants include methamphetamine (8 polysubstance overdoses) and cocaine (one single substance overdose, 3 polysubstance overdoses).

**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

### Timing of Death in SUD Deaths

The vast majority of pregnancy-associated, but not related deaths with a SUD occurred between 43 and 365 days postpartum (82%) (Figure 26).

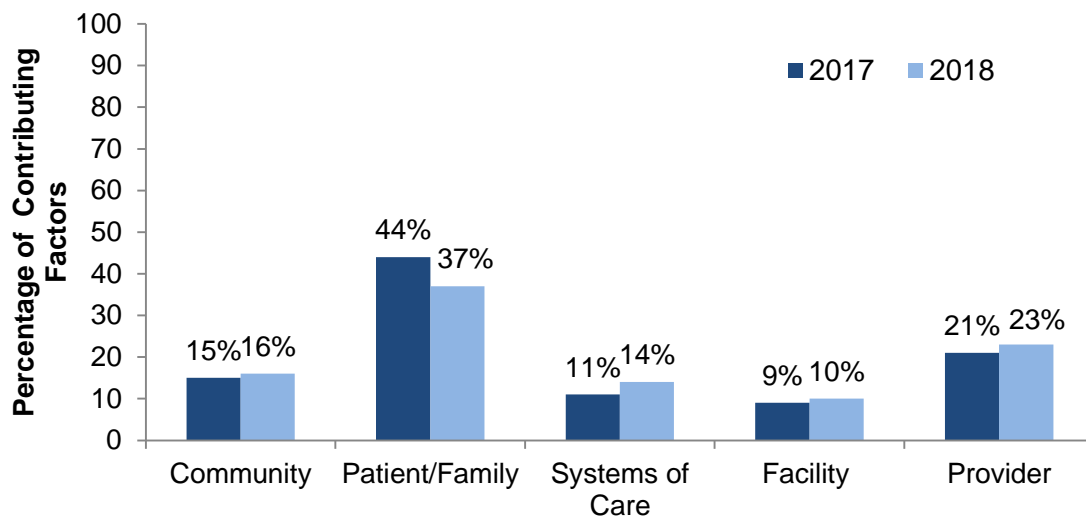
**Figure 26. Timing of Death: SUD in Pregnancy-Associated, Not Related Deaths, 2017-2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program.

Contributing factors were identified at five levels: patient/family, provider, facility, system of care and community. Among pregnancy-associated but not related cases with an SUD, the largest proportion of contributing factors was identified at the patient/family level. Examples of these factors included lack of adherence to treatment for SUD, delay in seeking treatment, lack of social support, and history of depression.

**Figure 27. Factor-Level Contributing in SUD and Pregnancy-Associated, Not Related Deaths, 2017 vs. 2018**



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program

## **Contributing Factors to Maternal Death in 2018**

Throughout the maternal mortality review process the MMRC identifies factors that have contributed to each death. Contributing factors are categorized by patient and family, provider, facility, systems, and community. Further discussion occurs by the committee to describe how each factor contributed to the death. Major themes have been identified over the course of the review of 2018 deaths. The themes that contributed to the 2018 maternal deaths include:

### **Pregnancy-Related**

1. Community: Limited workplace and community support resulting in missed appointments
2. Systems: Lack of continuity of care for high risk pregnancies and the need for implementation of effective healthcare management between multidisciplinary teams
3. Facility: Delay in responding and treating preeclampsia, hypertension, cardiac disease, respiratory distress and signs of hemorrhage
4. Provider: Implicit bias resulting in biased clinical decision
5. Patient/Family: Lack of knowledge around symptoms of preeclampsia

### **Pregnancy-Associated, but Not Related**

1. Community: Lack of access to addiction medicine treatment and mental health resources to help patient achieve and maintain sobriety
2. Systems: Lack of case coordination and management between healthcare facilities in regards to referrals and management of care
3. Facility: Limited continuity of care. Patients lost to follow-up for addiction medicine treatment and mental health services
4. Provider: Lack of adequate screening regarding mental health and substance use; implicit bias surrounding substance use
5. Patient/Family: Use of illicit drugs, lack of adherence to substance use treatment and refusal of care

## **TENNESSEE 2018 MATERNAL MORTALITY REVIEW RECOMMENDATIONS**

### **Community and Statewide Agencies**

1. Assure insurance coverage for women of childbearing age to include the first trimester of pregnancy up to one year postpartum at a minimum.
2. Increase funding to expand the number of inpatient and outpatient facilities for treatment of substance use disorder and mental health conditions in pregnant and postpartum women.
3. Expand insurance coverage for addiction medicine treatment and mental health services for those in need of treatment and their families.
4. Evaluate opportunities for expanding access to MAT through OB or mid-level providers while minimizing risks of diversion.
5. Increase outreach to pregnant and postpartum women on the importance of seatbelt use.
6. Increase funding to the Medical Examiner's Office for statewide autopsies and implementation of policy changes and guidance for providers in the understanding of when to request an autopsy.
7. Increase statewide access to easy, affordable intranasal naloxone and education for its use to patients, families and communities affected by substance use.
8. Identify and support people at risk of interpersonal violence (IPV) through the increased use of the lethality assessment. Increase referrals to protective environments, support systems, programs and victim centered services. <https://www.tn.gov/finance/office-of-criminal-justice-programs/ocjp/fa-ocjp-best-practices/fa-ocjp-lap.html>

### **Clinics and Hospital Systems**

1. Implement education for all providers within prenatal clinics, obstetrics departments, intensive care, and emergency departments, on the signs and symptoms of preeclampsia with proper assessment, evaluation and management. Hospitals and providers should refer to ACOG practice bulletin 202 (Gestational hypertension and preeclampsia)<sup>[1]</sup>.
2. Implement the Alliance for Innovation on Maternal Health (AIM) postpartum hemorrhage bundle.
3. Provide physician education on appropriate treatment and evaluation of cardiac conditions along with implementation of a quality measures checklist for providers on specific conditions such as cardiomyopathy from resources such as <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityMeasures/Downloads/Cardiovascular-Measures.pdf>.
4. Develop and implement improved protocols and systems of care for provider screening, and management of patients with substance use and mental health disorders.
5. Implement standardization of practice for women with substance use disorder regarding pain management during the peripartum and postpartum period.
6. Develop multipronged strategies for addressing Interpersonal Violence (IPV) screening, assessment and care coordination using recommendations from the American College of Obstetricians and Gynecologists (ACOG) Committee Opinion 518. <https://www.acog.org/Clinical-Guidance-and-Publications/Committee-Opinions/Committee-on-Health-Care-for-Underserved-Women/Intimate-Partner-Violence>
7. Implement education on implicit bias for all staff.

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<sup>[1]</sup> (2019). ACOG Practice Bulletin No. 202: Gestational Hypertension and Preeclampsia. Obstetrics and gynecology, 133 1, e1-e25 .

## Healthcare Providers

1. Provide education to all pregnant women on the symptoms and risks associated with preeclampsia, when to call a healthcare provider and when to seek immediate help.
2. Ensure consultation and transfer management for patients with high risk obstetric conditions to the appropriate level of maternal obstetric care<sup>9</sup>.  
<https://www.acog.org/Clinical-Guidance-and-Publications/Obstetric-Care-Consensus-Series/Levels-of-Maternal-Care>
3. Implement consistent screening, assessment and treatment for high risk conditions such as preeclampsia, cardiac disease and substance use disorder at each point of care with increased communication of a multidisciplinary team to include obstetrics and gynecology (OBGYN), maternal fetal medicine (MFM), neurology, critical care, cardiology, social work and case management.
4. Increase implementation and documentation of preconception counseling for women with chronic disease, obesity, high order cesareans and high risk pregnancies.
5. Increase screening, identification, support and referral for patients at risk of interpersonal Violence (IPV).
6. Counsel patients and their families who are gun owners on safe firearm storage and handling practices within the home.

## Women and their Friends and Families

1. Seek care with the earliest symptoms of depression and take medication dose schedules as written.
2. Seek positive peer interactions and reach out to trusted individuals to improve interpersonal connectedness and to build resilience.
3. Seek resources or trainings to develop skills related to emotional or anger control, problem solving, conflict resolution and coping skills. TMHSAS Helpline: (855) 274-7471  
<https://www.tn.gov/behavioral-health/mental-health-services/mental-health-services-for-children-and-youth/programs---services/programs-and-services/tmhsas-helpline.html>
4. Establish a pregnancy diagnosis as soon as possible and gain access to prenatal care immediately upon diagnosis.
5. Engage in firearm refresher courses on gun safety for families who own guns within the home.
6. Seek treatment and assistance for substance abuse (TN REDLINE: 1-800-889-9789) and mental health conditions.

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<sup>9</sup> Levels of maternal care. Obstetric Care Consensus No. 9. American College of Obstetricians and Gynecologists. Obstetrics Gynecology 2019 ;134: e41-55.



## TENNESSEE MMR SUCCESS STORIES

### Tennessee MMR Program Receives Additional Funding

Tennessee Department of Health received additional funding in 2019 to improve the Maternal Mortality Review Program. The program received funding through the CDC Foundation Rapid Assessment of Maternal Overdose Review grant and the CDC Enhancing Reviews and Surveillance to Eliminate Maternal Mortality (ERASE MM) grant.

#### Rapid Assessment of Maternal Overdose Review (RMOR)

In Tennessee, acute overdose was the leading cause of pregnancy associated, but not related deaths and substance use disorder contributed to 33% of all pregnancy associated deaths in 2017. In September 2018, the Centers for Disease Control Foundation chose Tennessee, along with 6 other states, to participate in the Rapid Assessment of Maternal Overdose Review funding. This funding expanded capacity for deeper abstraction and full team review of opioid use disorder (OUD) deaths. Previously the OUD deaths were only reviewed by an internal team.

With additional funding the MMR committee established a deeper understanding for overdose deaths Tennessee developed a one page infographic to disseminate information from the report on 2017 OUD deaths and the recommendations surrounding OUD and mental health. This one page infographic has been distributed across all 3 regions of the state. <https://www.tn.gov/content/dam/tn/health/documents/mch/MMR-Infographic.pdf>



#### Enhancing Reviews and Surveillance to Eliminate Maternal Mortality (ERASE MM)

In August 2019, TN was awarded the Centers for Disease Control (CDC) ERASE MM grant <https://www.cdc.gov/reproductivehealth/maternal-mortality/erase-mm/index.html>. Tennessee was one of 24 states awarded this grant. This funding will be utilized to enhance current activities and implement new strategies to better understand and prevent maternal deaths. The funding will improve the state level infrastructure of the Maternal Mortality Review program along with increased support for implementation of the recommendations. This funding will allow Tennessee to better identify maternal deaths and implement activities to prevent those deaths.

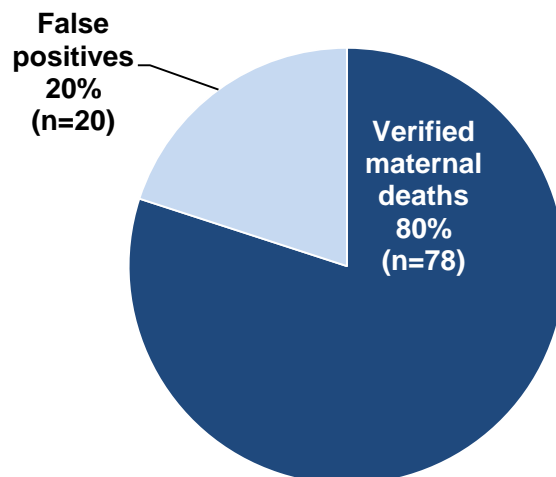
## Improving Data Quality on Death Certificates

The *Review of 2017 Maternal Deaths Report* identified a 20% error rate within the pregnancy checkbox on the death certificates, similar to other states. The checkbox on the death certificates had been inaccurately selected on those 20% of cases. A Plan-Do-Study-Act (PDSA) cycle was implemented to improve accuracy of reporting pregnancy on death certificates. The Office of Vital Statistics and the Maternal Mortality Review (MMR) staff initiated a PDSA cycle to decrease the discordance between reported pregnancy status on decedents identified through the death certificate pregnancy checkbox and the MMR Program data.

When a potential false positive was identified the nurse coordinator would verify the false positive through medical records and document this within the MMR excel files. Once verified, the MMR coordinator emailed the cases to the Office of Vital Statistics Director, who would implement death certifier outreach. For this process the Office of Vital Statistics contacted the death certifier for the false positive to confirm or update the pregnancy status on the death certificate. In cases requiring updates, the Office of Vital Statistics assisted the death Certifier to file an Affidavit and update the file that gets sent to NCHS.

At the start of the PDSA cycle there were 11 false positives identified by the MMR Program and 11 were eligible for correction to the pregnancy checkbox. Of the 11, 2 were amended prior to the start of the PDSA cycle, 4 were amended as a direct result of the PDSA cycle, and in 5 cases, the death certifier was unable to be reached after 3 attempts via email and telephone. Overall, 6/11 (55%) eligible false positives were corrected in the file 2018 death file. With the success of this PDSA cycle the Department of Health has continued to implement this process moving forward for all cases identified as potential false positives.

### Pregnancy-Associated Death Case Verification, MMR Program Data, Tennessee 2017



**Data Source:** Tennessee Department of Health, Division of Family Health and Wellness, Maternal Mortality Review Program

## **Mental Health Provider Training**

Perinatal mood disorders are one of the most common complications of pregnancy and effects one in every 7 women. In the Maternal Mortality Review of 2017 Deaths, mental health contributed to 18% of all deaths and in 2018 deaths there was a 10% increase. In Tennessee, there are some providers trained in perinatal mood disorders. While there are additional providers across the state with the capabilities to prescribe psychotropic medications, they are not given specialized training on prescribing specific medications needed for mood disorders within the perinatal period.

Expansion of mental health services was recommended by the Maternal Mortality Review Committee (MMRC) in 2019. Postpartum Support International and the Rooted Bridge partnered with TriStar Centennial Women's Hospital to host a perinatal mood and anxiety disorder training in Middle Tennessee. PSI specializes in training providers and maternal health care takers to build confidence in providing mental health care in pregnancy and the postpartum period. With this training providers obtain specialized evidence-based training on mental health care in pregnancy and the postpartum period. This training was held January 2020 with 80 participants, including psychiatrists, nurses, physicians, social workers, mental health providers, childbirth professionals, and social support providers.

## APPENDICES

### Appendix 1: Pregnancy-Related Cause of Death Categories

| Category                                      | Specified Cause of Death Indicated on Decision Form  |
|---|--|
| <b>Cardiovascular and Coronary Conditions</b> | Postpartum/peripartum cardiomyopathy, Valvular Heart Disease Congenital and Acquired, Cardiomyopathy, Vascular Aneurysm /Dissection (non-cerebral) |
| <b>Embolism</b>                               | Embolism Thrombotic (non-cerebral)   |
| <b>Hemorrhage</b>                             | Ruptured Ectopic Pregnancy, Hemorrhage-uterine atony/postpartum hemorrhage, hemorrhage due to Primary DIC  |
| <b>Infection</b>                              | Sepsis/Septic Shock  |
| <b>Pre-eclampsia and Eclampsia</b>            | Eclampsia, Preeclampsia, Chronic Hypertension with Superimposed Preeclampsia,  |
| <b>Mental Health</b>                          | Depression, Other Psychiatric Conditions/NOS   |
| <b>Other</b>                                  | Obesity, Cancer  |

## Appendix 2: Pregnancy-Associated but Not Related Cause of Death Categories

| Category   | Specified Cause of Death Indicated on Decision Form  |
|--|--|
| <b>Overdose</b>  | Combined Fentanyl and Alprazolam Intoxication, Fentanyl and Heroin Toxicity, Heroin Overdose, Oxymorphone, Diphenhydramine, and Methamphetamine toxicity, Heroin Overdose, Cocaine Overdose, Acute Combined Drug Overdose (Alprazolam, Hydromorphone, Oxycodone and methamphetamine), Acute Combined Drug Toxicity (Cocaine Methamphetamine, Heroin), Acute Morphine, Fentanyl and Methamphetamine Intoxication, Probable Multi-drug Intoxication (Buprenorphine, Oxycodone, and Ethanol), Acute combined drug toxicity (alprazolam, Fentanyl, and Oxycodone), Acute Fentanyl Toxicity, Combined Fentanyl and Ethanol Intoxication, Combined Drug Overdose |
| <b>Fatal Disease Related to Underlying Substance Use</b> | Endocarditis Staph Aureus, Complications of Bacterial Endocarditis with Mobile Vegetation, Complications of Acute Infectious Endocarditis, Sepsis due to Endocarditis  |
| <b>Violence</b>  | Gunshot Wound to Head, Suicide Attempt by Hanging, Blunt Force injuries to the Head and Sharp Force Injuries, Gunshot wound (homicide), Gunshot Wound of the Neck  |
| <b>Motor Vehicle Accident (MVA)</b>                      | Motor Vehicle Crash, Multiple Blunt Force Injuries, Head Injury, Blunt Force Trauma  |
| <b>Cardiac Related Deaths</b>                            | Cardiac (Dilated Cardiac Hypertrophy ) Fatal arrhythmia  |
| <b>Other Medical Related Diagnosis</b>                   | Sepsis, Sudden Unexpected Death in Epilepsy, Uncal Herniation/Effacement Left lateral Ventricular System, Acute Pancreatitis   |
| <b>Cancer</b>  | Metastatic Adenocarcinoma of the Lung  |
| <b>Undetermined</b>                                      | Extensive Subarachnoid Hemorrhage with Intraventricular Hemorrhage   |

### Appendix 3: Tables

1. Demographic Characteristics of All Pregnancy-Associated Deaths, Tennessee, 2017-2018
2. Demographic Characteristics of Pregnancy-Related Deaths, Tennessee, 2017-2018
3. Demographic Characteristics of Pregnancy-Associated, but Not Related Death, Tennessee, 2017-2018
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