



Maternal Mortality in Tennessee 2017-2020

2022 Report to the Tennessee General Assembly

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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 from this report. Thank you also to the committee for reviewing every one of the deaths and developing the recommendations that can save lives. It is with deepest sympathy and respect that we dedicate this report to the memory of those 98 women, and to their loved ones who died while pregnant within one year of pregnancy in 2020. Those are 98 deaths too many. We know our efforts to further understand the causes and contributing factors of maternal mortality in Tennessee will prevent future deaths.

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Executive Summary

The Tennessee Maternal Mortality Review Act of 2016 established the TN Maternal Mortality Review Committee (MMRC) (T.C.A. § 63-3-601). An interdisciplinary team across Tennessee reviews every death and contributes to the annual recommendations of this report. The first set of reviewed deaths were 2017 maternal deaths, and they represent a baseline data of reviewed maternal deaths. This report includes 2020 deaths and a compilation of 2017 to 2020 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 a summary of the recommendations.

Key Findings: 2020

In 2020, **98 women in Tennessee died** during pregnancy or within year after the end of their pregnancy. **Almost half (47%) of all 2020 deaths deemed pregnancy related** while 43% of all deaths were determined to be pregnancy-associated, but not related. The pregnancy-related mortality ratio in 2020 was 58.5 deaths per 100,000 live births representing a 51% increase from 2017-2019. This is due to the increase of deaths in 2020 and the utilization of the Utah Criteria¹ during MMRC reviews. More than **3 out of 4 deaths** were deemed to be **preventable**, with 22% having a 'good chance' of being prevented and 55% of having 'some chance' of being prevented. The MMRC noted several contributing factors to deaths including substance use disorder (43%), mental health conditions (33%), discrimination (23%), and obesity (15%).

Number of Deaths and Pregnancy-Associated Mortality Ratio

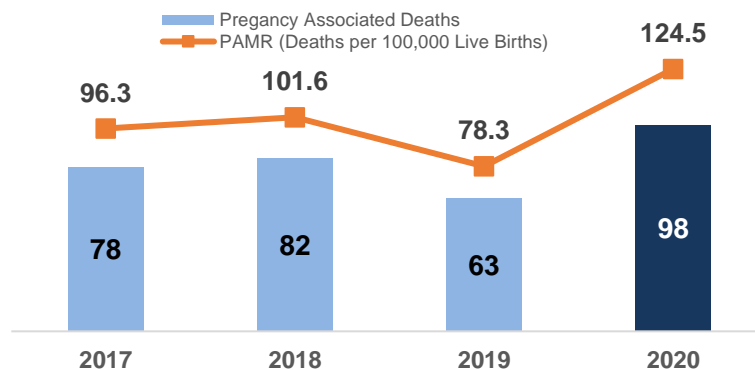


Figure 1.



In 2020 discrimination contributed to **1 in 3 (33%)** of pregnancy-related deaths.



There were **four** covid-19 infections among pregnancy-related deaths in 2020².



The pregnancy-related mortality ratio (PRMR) increased in non-Hispanic white women in 2020. With 46 pregnancy-related deaths overall.

¹ Smid MC, Maeda J, Stone NM, Sylvester H, Baksh L, Debbink MP, Varner MW, Metz TD. Standardized Criteria for Review of Perinatal Suicides and Accidental Drug-Related Deaths. *Obstet Gynecol.* 2020 Oct;136(4):645-653. doi: 10.1097/AOG.0000000000003988. PMID: 32925616; PMCID: PMC8086704.

² As of March 2022, at the time of this publication, 38 cases of women with a positive SARS-COV-19 infection have died within a year of pregnancy.

Executive Summary: 2017-2020

Pregnancy-related deaths: 2017-2020

Deaths within one year of pregnancy where pregnancy was the aggravating factor

Between 2017 and 2020, 113 women in Tennessee died from pregnancy related causes. The burden of pregnancy-related death is higher among non-Hispanic Black women, individuals with more than high school diploma, women covered by TennCare, and those residing in Middle Tennessee.



Non-Hispanic Black women were **2.5 x** more likely to die than white women.



Most (**89%**) of pregnancy-related deaths were deemed preventable with **24%** having a good chance of being prevented.



Obesity contributed to almost **1 in 4 (24%)** of pregnancy-related deaths.



Mental health contributed to **27%** of all pregnancy-related deaths.



The **3** leading causes of death were **cardiovascular and coronary disease, hemorrhage, and mental health conditions.**



Substance use disorder was a contributing factor to over **1 in 4 (26%)** pregnancy-related deaths

Pregnancy-Associated but NOT related deaths: 2017-2020

Deaths within one year of pregnancy where pregnancy was NOT the aggravating factor

From 2017 to 2020, 177 women in Tennessee died from pregnancy-associated, but not related causes. A higher burden of deaths occurred in those younger than 30 years, non-Hispanic White, or covered by TennCare.



Over **3 in 4 (77%)** of pregnancy-associated, but not related deaths were deemed preventable with 42% having a good chance of being prevented.



Substance Use Disorder was a contributing factor to over **46%** of pregnancy-associated, but not related deaths.



Mental health contributed to **23%** of pregnancy-associated, but not related deaths.



Acute overdose (**34%**) was the leading cause of death for pregnancy-associated, but not related deaths.

Violent Pregnancy-Associated deaths: 2017-2020

All homicide/suicide deaths within one year of pregnancy



There were 38 (12%) homicide deaths between 2017 and 2020 and almost half resided in west TN



Suicide was the cause of death in 18 (6%) of all pregnancy-associated deaths.

2022 MMRC Recommendations

*These recommendations are from 2020 deaths reviewed in 2021

Pregnancy-related Recommendations

Community and Statewide Agencies



1. Agencies should reach out to communities and educate them on the resources related to mental health and addiction. This should address stigma, risks, and treatment options available to all pregnant and postpartum women.
2. The State should continue to improve access to and availability of mental health providers for outpatient and in-patient treatment of substance use and mental health disorders.

Clinics and Hospital Systems



1. Facilities should support social work and case management services for pregnant and postpartum women in rural settings.
2. Facilities should increase education on perinatal mental health to patients and providers.
3. Facilities should ensure training, education, and implementation of protocols for all healthcare providers on the management of pregnancy and postpartum complications (up to a year postpartum) in all inpatient and emergency department settings.

Healthcare Providers



1. Providers should ensure appropriate inpatient care of patients with mental health and substance use disorders by avoiding the prescription of addictive substances and ensuring follow up, referrals and support are arranged before discharge.
2. Providers should ensure appropriate treatment and management of patients with or at high risk for pre-eclampsia following [ACOG](#)³ guidelines during and after pregnancy. High blood pressures should be treated aggressively, and those at high risk should receive 81mg aspirin daily. Critical illness should be observed with surveillance for life threatening complications.

Women and their Friends and Families



1. Families and pregnant women should communicate all conditions—including any mental health or substance use conditions—with their medical providers regardless of visit reason, to facilitate treatment and referrals.
2. Family should ensure that safety measures are taken to minimize access to firearms specifically when there is a history of major depression or previous suicide attempt.

³ Gestational Hypertension and Preeclampsia, *Obstetrics & Gynecology*: June 2020 - Volume 135 - Issue 6 - p e237-e260 doi: 10.1097/AOG.0000000000003891

Pregnancy-associated, but not related Recommendations

Community and Statewide Agencies



1. Communities and state organizations should educate individuals on domestic violence, sexual abuse, and identifying and seeking assistance while reducing stigma through all phases of life.
2. Organizations and public places (hotels, rest stops, and restaurants) within the community should increase human trafficking awareness through initiatives such as the [RedSand](#) project and general education and awareness regarding the dynamics of human trafficking throughout Tennessee.
3. State and community agencies should address communities with increased occurrences of violence by implementing support for pregnant and postpartum women such as shelters and safe havens.

Clinics and Hospital Systems



1. Hospitals should educate staff annually on mental health and substance use screening. Screenings should be incorporated into care for all patients.
2. Hospitals should educate patients on seatbelt extenders for obese patients.

Healthcare Providers



1. Providers should utilize trauma informed practices and screen for domestic violence at every visit throughout a woman's reproductive years. If domestic violence is suspected or disclosed, a social work consult should be initiated to provide support, education and referral to community-based services.
2. Emergency and obstetric providers should utilize substance use screenings utilizing [SBIRT](#) during pregnancy and postpartum periods and refer to specialists as indicated per the [ACOG](#) guidelines.

Women and their Friends and Families



1. Individuals and families should seek education on non-violent conflict resolution strategies in childhood and throughout adulthood.
2. Motor vehicle drivers and passengers should always use seat belts in moving vehicles.

Maternal Mortality Overview

Through a comprehensive review of these deaths by the Tennessee Maternal **Mortality Review Committee (MMRC)**, this report identifies opportunities for the prevention of maternal mortality and promotion of women’s health with specific recommendations at the individual/family, community, provider, facility, and systems perspectives.

Definitions

Categorizations of maternal mortality further specify timing and cause of death. A breakdown of the categories can be seen in **Figure 2**. While some organizations define maternal mortality as only occurring during or within 42 days of pregnancy, **the Tennessee Maternal Mortality Review program is aligned with the Centers for Disease Control and Prevention’s (CDC) 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.

Records are collected from the sources and relevant information is abstracted into the CDC’s Maternal Mortality Review Information Application (MMRIA). These sources include:

- Death Certificate
- Fetal Birth or death certificate
- Autopsy Reports
- Hospitals
- Clinics
- Legal History
- Department of Child Services
- Substance Use Clinics

Multidisciplinary MMRC

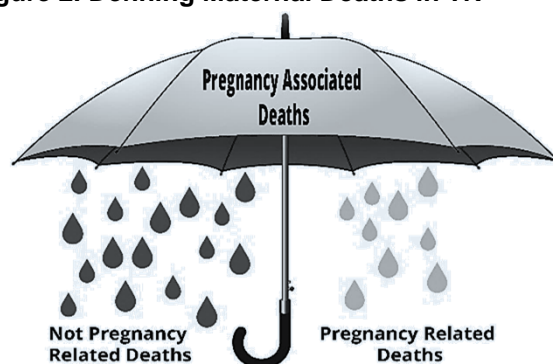
- Anesthesiology
- District Attorney
- Domestic Violence
- Family Practice
- Medical Examiner
- Obstetric nurses and physicians
- Public Health
- TennCare/Medicaid
- Title V Maternal and Child Health Director
- TN Hospital Association
- Certified Nurse Midwife
- Child Protective Services
- March of Dimes
- Maternal Fetal Medicine
- Mental Health
- Neonatology
- TN Justice Center

Decision Process:

Key Questions to Answer

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

Figure 2. Defining Maternal Deaths in TN



Pregnancy-Related Deaths

Deaths that occurred within one year of pregnancy and determined that the pregnancy was the aggravating factor

Between 2017 and 2020, **113 Tennessee women died during pregnancy or within a year of pregnancy from causes related or aggravated by pregnancy.** Pregnancy-related deaths accounted for 35% of all deaths. The proportion of pregnancy-related death has increased over the past four years of maternal death review, from 28% in 2017 to 47% in 2020.



Non-Hispanic Black women are **2.5x** as likely to die than non-Hispanic White women

Women aged **30 to 39 years** were **over 2x** as likely to die than younger women.

Women without a college degree were more likely to die from pregnancy than women with a college degree.

Women in **West Tennessee** had a higher ratio of pregnancy-related deaths than women in other grand divisions.

The pregnancy related mortality ratio (PRMR) increased from 28.6 in 2019 to 58.5 in 2020. This increase may have occurred due to the increase of overall deaths in 2020 and the implementation of the Utah Criteria⁴ when determining the pregnancy relatedness of overdose deaths.

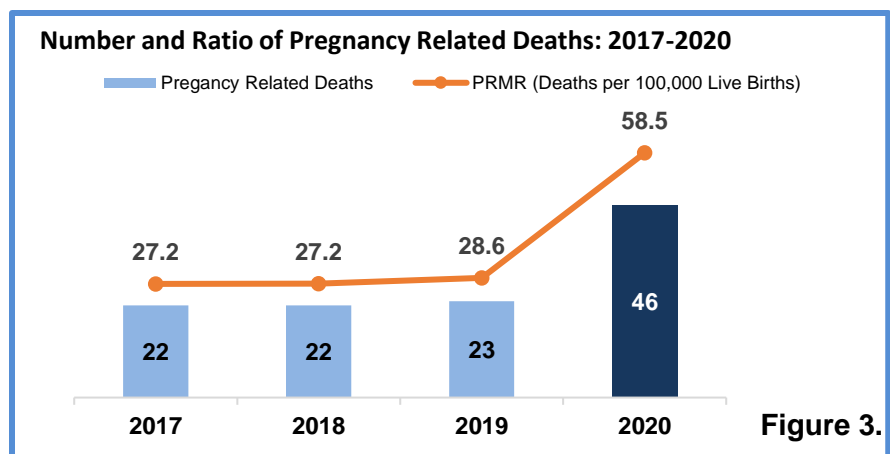


Figure 3.

Location of Death: 2017-2020



Over 1 in 2 (53%) of the pregnancy-related deaths occurred while pregnant or postpartum women were admitted to the hospital. The top causes of death were:

- ➡ Hemorrhage
- ➡ Pre-eclampsia and eclampsia
- ➡ Thrombotic embolism and infection



Almost **1 in 5 (19%)** of the pregnancy-related deaths occurred in an emergency department. The top causes of death were:

- ➡ Cardiovascular Disease (including cardiomyopathy)
- ➡ Thrombotic embolism
- ➡ Pre-eclampsia and eclampsia



Most of the remaining deaths occurred at home (**18%**) with two-thirds of them having mental health conditions as a cause of death.

⁴ Smid MC, Maeda J, Stone NM, Sylvester H, Baksh L, Debbink MP, Varner MW, Metz TD. Standardized Criteria for Review of Perinatal Suicides and Accidental Drug-Related Deaths. *Obstet Gynecol.* 2020 Oct;136(4):645-653. doi: 10.1097/AOG.0000000000003988. PMID: 32925616; PMCID: PMC8086704.

Pregnancy-Related Deaths

Deaths that occurred within one year of pregnancy and determined that the pregnancy was the aggravating factor

Pregnancy-Related Deaths				2017-2020 Pregnancy-Related Mortality Ratio (Deaths per 100,000 live births, PRMR) ³
Characteristics	2019	2020	2017-2020	
Age at death				
Less than 30 years	6 (26%)	20 (43%)	44 (39%)	22.3
30-39 years	17 (74%)	24 (52%)	61 (54%)	52.4
40+ years	0 (0%)	2 (4%)	8 (7%)	111.6
Race/Ethnicity				
Non-Hispanic White	6 (26%)	30 (65%)	58 (51%)	27.8
Non-Hispanic Black	14 (61%)	10 (22%)	43 (38%)	68.4
Other	3 (13%)	6 (13%)	12 (11%)	25.2
Education				
Less than high school	4 (17%)	11 (24%)	23 (23%)	55.5
High school diploma/GED	7 (30%)	15 (33%)	36 (32%)	39.8
More than high school	12 (52%)	20 (43%)	54 (48%)	28.9
Not specified	0 (0%)	0 (0%)	0 (0%)	—
Insurance at Delivery¹				
TennCare	12 (52%)	23 (50%)	55 (49%)	35.6
Private	4 (17%)	6 (13%)	26 (23%)	18.9
Other	1 (4%)	1 (2%)	3 (3%)	—
None	1 (4%)	1 (2%)	2 (2%)	—
Unknown	0 (0%)	0 (0%)	1 (1%)	—
Area of Residence²				
Metropolitan county	16 (70%)	20 (43%)	57 (50%)	40.8
Rural county	7 (30%)	26 (57%)	56 (50%)	30.9
Grand Division				
West TN	9 (39%)	17 (24%)	37 (33%)	46.9
Middle TN	12 (52%)	17 (37%)	45 (40%)	32.0
East TN	2 (9%)	18 (39%)	31 (27%)	30.6
Overall	23	46	113	35.2

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.

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

Percentages may not add to 100 due to rounding.

3. PRMR: Pregnancy-Related Deaths per 100,000 live births

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, 2017-2020. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.

Pregnancy-Related Deaths

Deaths that occurred within one year of pregnancy and determined that the pregnancy was the aggravating factor

Cardiovascular Disease is the leading underlying causes of Pregnancy-Related Deaths, Tennessee, 2017-2020

Cardiovascular disease is the leading underlying cause of pregnancy-related death for 2017-2020. Of all cardiovascular deaths, pregnant persons were most likely to die of **preeclampsia and eclampsia**. The occurrence of pregnancy-related overdose deaths increased in 2020 with the inclusion of the Utah Criteria⁵ within the MMRC reviews.

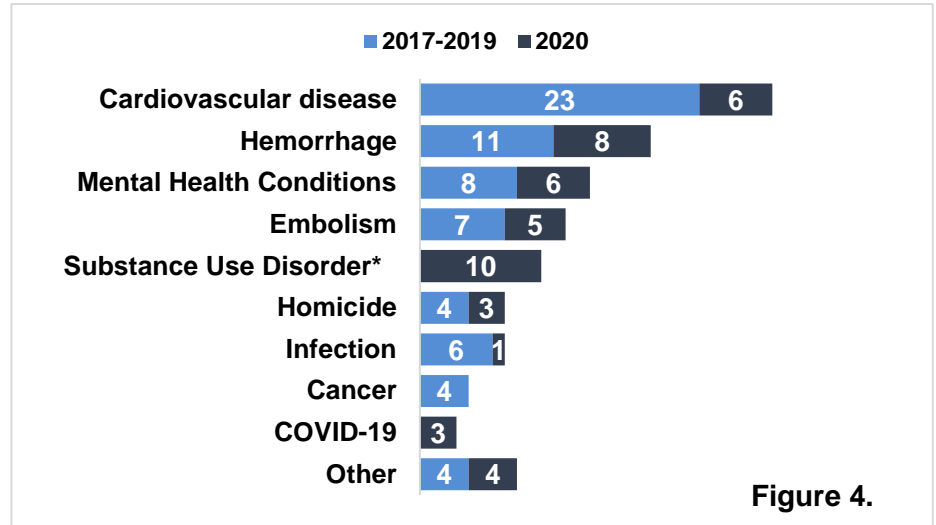


Figure 4.

Other: asthma, neurological disease, CVA, obesity, anesthesia complications, hematologic conditions, systemic lupus.
 * Utah Criteria² implemented in 2020 review process

Leading Causes of Cardiovascular deaths in 2017-2020, N=29

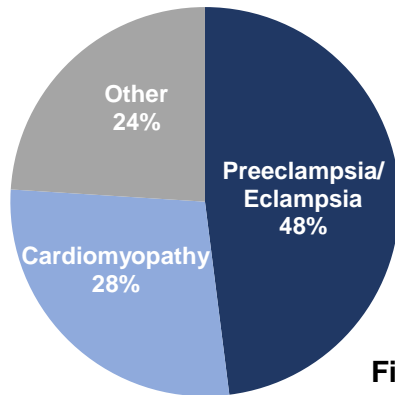


Figure 5.

Other cardiovascular diseases included CHF, Cardiomegaly, Cardiac Hypertrophy, Cardiac Fibrosis, Non-Acute Myocarditis or not otherwise specified (NOS).

Almost half (48%) of the cardiovascular deaths were due to preeclampsia and eclampsia, followed by cardiomyopathy and other causes of cardiovascular death. Alternate causes of cardiovascular deaths were conduction defects/arrhythmias, valvular heart disease and hypertensive cardiovascular disease. The highest risk group was non-Hispanic black women between 30 and 39 years.

Preventability: 2017-2020

90% of all pregnancy-related deaths were determined to be preventable.

10% of pregnancy-related deaths were determined to be not preventable

Almost 1 in 3 preventable pregnancy-related deaths were determined to have a **good chance** of being prevented.

⁵ Smid MC, Maeda J, Stone NM, Sylvester H, Baksh L, Debbink MP, Varner MW, Metz TD. Standardized Criteria for Review of Perinatal Suicides and Accidental Drug-Related Deaths. *Obstet Gynecol.* 2020 Oct;136(4):645-653. doi: 10.1097/AOG.0000000000003988. PMID: 32925616; PMCID: PMC8086704.

Pregnancy-Related Deaths

Deaths that occurred within one year of pregnancy and determined that the pregnancy was the aggravating factor

Timing: 2017-2020

1 in 3 (33%) of pregnancy-related deaths occurred after 43 days postpartum. The **top causes** of death that occurred at 43-365 days include **homicide, suicide, overdose, and cancer.**

Timing of Pregnancy-Related Deaths 2017-2020

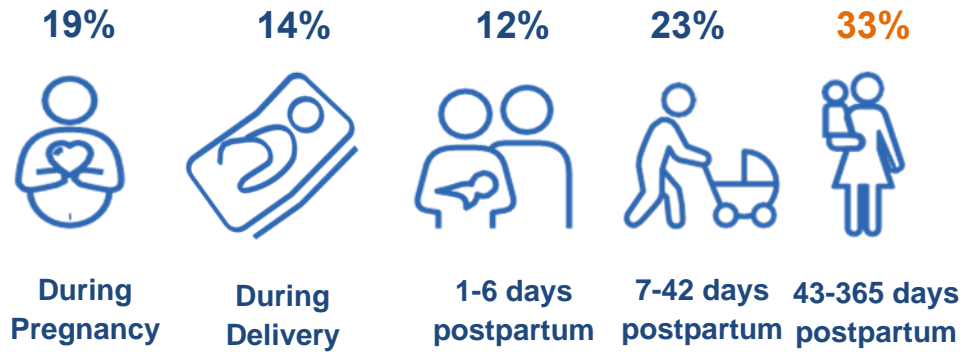


Figure 6.

Circumstances Surrounding Pregnancy-Related Deaths: 2017-2020



Substance Use Disorder

Of the **29 (26%)** cases where substance use disorder contributed to the death, approximately **3 out of 4 (76%)** pregnancy-related deaths had co-occurring mental and substance use disorder.



Mental Health Conditions contributed to just over **1 in 4 (27%)** of pregnancy-related deaths. **Seven** of the **31** cases were confirmed suicide deaths with four probable suicide deaths.



Obesity contributed to almost **1 in 4 (24%)** of pregnancy-related deaths. **Eight** of these cases had preeclampsia or eclampsia as an underlying cause of death, making **obesity a risk factor for preeclampsia or eclampsia related deaths.**

Pregnancy-Related Deaths

Deaths that occurred within one year of pregnancy and determined that the pregnancy **was** the aggravated cause

Contributing Factors by Leading Underlying Causes of Death: 2017-2020*



Preeclampsia/Eclampsia

- Failure to identify complications of severe preeclampsia and not addressing elevated blood pressures in the postpartum period.
- Despite vital signs, lab values, and physical exam evidence of critical illness, no escalation of care was implemented. ICU transfer was not considered before woman's respiratory and cardiac arrest.
- Provider failing to educate patient and families on the signs and symptoms of preeclampsia/eclampsia and the need to monitor, return to care, follow up and medication regimen.
- Lack of provider adherence to ACOG practice guidelines for preeclampsia.



Cardiomyopathy

- Patient left against medical advice.
- Failure to screen for cardiovascular disease risk in pregnancy with inadequate assessment of risks.
- Racial bias, unequal treatment and bias clinical decision making.



Other Cardiovascular Diseases

- Provider delay in diagnosis with insufficient assessment and treatment especially when individual needed much more aggressive care and treatment.
- Judgmental chart entries, delays in diagnosis, and protocols not followed.
- Poor communication between hospitals regarding the follow up of tertiary care and home hospital.



Hemorrhage

- Lack of knowledge of emergency department physician of diagnosis. Poor recognition and management of pregnancy complications.
- Inadequate assessment and incomplete evaluation of postpartum hemorrhage and management of suspected accrete.
- Delayed prenatal care and lack of providers in rural areas.



Mental Health Conditions

- Patient involved in domestic dispute with father of the baby with possible depression over long period of time.
- Lack of domestic violence screening or lack of documentation in records.
- Inadequate or no prenatal care.
- Failure to follow up on Edinburgh Postpartum Depression Scale while patient was inpatient.

*Contributing factors represent key themes from all pregnancy-related cases

Pregnancy-Associated, but NOT related

Deaths that occurred within one year of pregnancy and determined that the pregnancy was **not** related

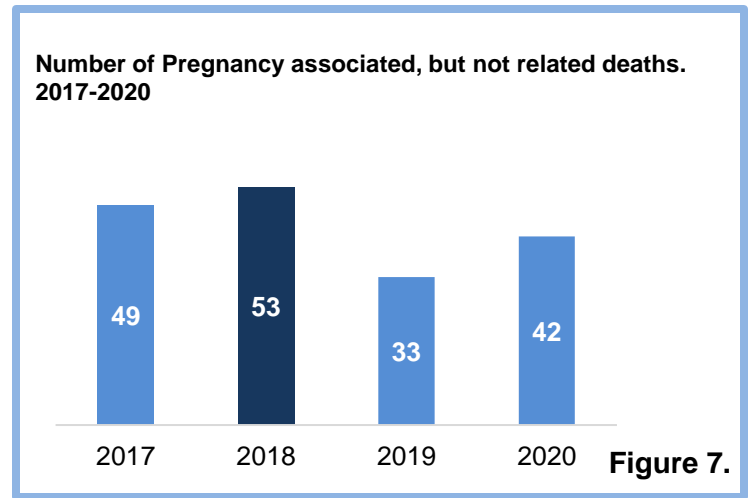
From 2017-2020, 177 individuals died from pregnancy-associated, but not related causes. These deaths accounted for 55% of all deaths. Most (76%) of pregnancy-associated, but not related deaths occurred at 43-365 days postpartum.



Non-Hispanic White women had a higher burden of pregnancy-associated but not related deaths than non-Hispanic Black women.

Women less than 30 years are more represented in pregnancy-associated, but not related deaths than older women.

Women without a college degree had a higher burden of pregnancy-associated, but not related deaths than women with a college degree.



Location of Death Pregnancy-Associated, but not related deaths: 2017-2020



23% of the pregnancy-associated, but not related deaths occurred while admitted to the hospital. The top causes of death were:

- Violent Death
- Traffic-related (motor vehicle, ATV, or motorcycle) deaths



1 in 5 (19%) of the pregnancy-associated, but not related deaths happened in the emergency department. The top causes of death were:

- Acute Overdose
- Traffic-related (motor vehicle, ATV, or motorcycle) deaths
- Influenced by substance use disorder diagnosis



1 in 5 (21%) deaths occurred in home settings. The top causes of death were:

- Acute Overdose
- Homicide
- Influenced by substance use disorder diagnosis



1 in 10 (11%) of all pregnancy-associated, but not related deaths happened on roadways.

Pregnancy-Associated, but NOT related

Deaths that occurred within one year of pregnancy and determined that the pregnancy was not related

Timing of Death Pregnancy-Associated, but not related deaths: 2017-2020

Most (76%) pregnancy-associated, but not related deaths occurred within the 43-365 days postpartum period. The top causes of death that occurred at 43-365 days include acute overdose, motor vehicle crash, homicide, and suicide.

Timing of Pregnancy-Associated, but not Related Deaths 2017-2020

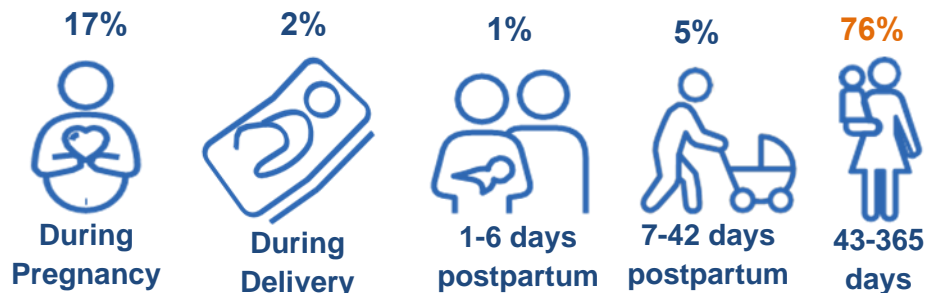


Figure 8.

Contributing Factors by the 3 leading causes of Death: 2017-2020



Substance Use Disorder

- Of the 81 cases where substance use disorder contributed to pregnancy-associated, but not related death, 36 had mental health conditions which also contributed to the death.



Mental Health Conditions

- Mental health conditions contributed to 23% (n=41) of pregnancy-associated, but not related deaths. Four of the 41 cases were confirmed deaths by suicide.



Overdose Deaths include:

- Risk Factors such as childhood sexual abuse, childhood involvement with Children's Services, human trafficking, domestic violence, and rape.
- Contributing factors like lack of referrals, no social work or case management intervention, lack of medical home, and no prenatal care.
- Other contributing factors such as failure of providers to screen for substance use disorder through questions or urine drug screens throughout prenatal care.



Contributing factors in Motor Vehicle Crashes (MVC) include:

- No seatbelt used at time of the crash contributed to death
- Alcohol intoxication with an above the legal limit blood alcohol level contributed to death



Contributing factors in Violent (suicide/homicide) deaths include:

- Intimate partner violence resulting in homicide by partner
- Limited or no prenatal care
- Lack of screening for domestic or intimate partner violence
- No screening for depression or anxiety during hospital admission for delivery

Pregnancy-Associated, but NOT related

Deaths that occurred within one year of pregnancy and determined that the pregnancy was not related

Pregnancy-Associated, Not Related Deaths			
Characteristics	2019	2020	2017-2020
Age at death			
Less than 30 years	16 (48%)	18 (43%)	94 (53%)
30-39 years	17 (52%)	23 (55%)	76 (43%)
40+ years	0 (0%)	1 (2%)	7(4%)
Race/Ethnicity			
Non-Hispanic White	29(88%)	21 (50%)	124 (70%)
Non-Hispanic Black	3 (9%)	18 (43%)	44 (25%)
Other	1 (3%)	3(7%)	9 (5%)
Education			
Less than high school	8 (24%)	6 (14%)	41 (23%)
High school diploma/GED	12 (36%)	23 (55%)	77 (44%)
More than high school	13 (39%)	13 (31%)	58 (33%)
Not specified	0 (0%)	0 (0%)	0 (0%)
Insurance at Delivery¹			
TennCare	22 (67%)	23 (55%)	103 (58%)
Private	4 (12%)	6 (14%)	25 (14%)
Other	0 (0%)	0 (0%)	3 (2%)
None	3 (9%)	2 (5%)	11 (6%)
Unknown	4 (12%)	11 (26%)	35 (20%)
Area of Residence²			
Metropolitan county	13 (39%)	23 (55%)	80 (45%)
Rural county	20 (61%)	19 (45%)	97 (55%)
Grand Division			
West TN	7 (21%)	18 (43%)	56 (32%)
Middle TN	15 (45%)	14 (33%)	58 (33%)
East TN	11(33%)	10 (24%)	62 (35%)
Overall	33	42	177

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.

2. Metropolitan county includes: Davidson, Hamilton, Knox, Madison, Shelby, and Sullivan Counties. Percentages may not add to 100 due to rounding.

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, 2017-2019. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.

Pregnancy-Associated, but NOT related

Deaths that occurred within one year of pregnancy and determined that the pregnancy was not related

Leading causes of Pregnancy-Associated, but not related deaths: 2017-2020

The **leading cause** of pregnancy-associated, but not related death was **acute overdose** (n=61) followed by motor vehicle crash (n=45); homicide/suicide (n=31).

Discrimination contributed to 14% (n=6) of pregnancy-associated, but not related deaths in 2020. **Overdose was the leading cause of death where discrimination was noted.** Fear of legal consequences, lack of referral, and delay in diagnosis and treatment were noted as contributing factors in the six cases of discrimination.

Acute Overdose is the leading cause of death of Pregnancy-Associated, but not related deaths, Tennessee, 2017-2020

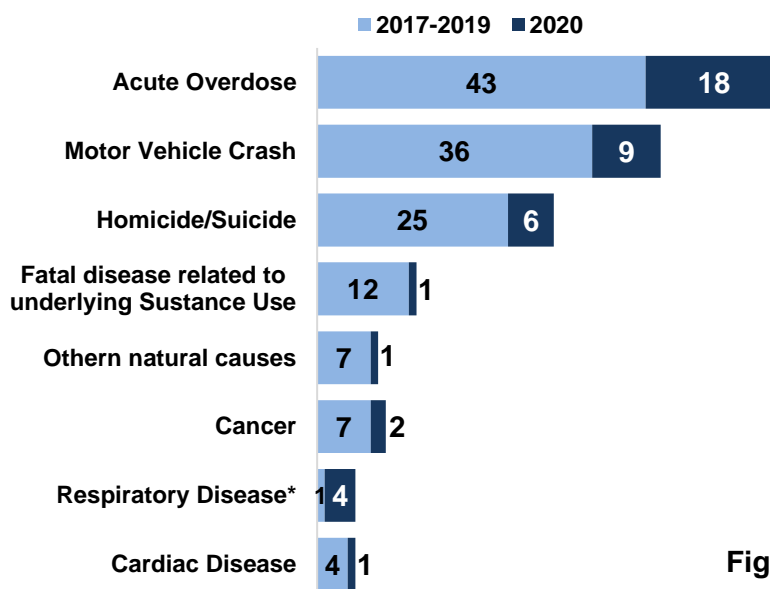


Figure 9.

*Respiratory disease in 2020 had no positive SARS-CoV-2 testing or infection

Preventability of Pregnancy-Associated, but not related deaths: 2017-2020

Over 3 in 4 (77%) of all pregnancy-associated, but not related deaths were preventable with **42%** of the deaths having a **good chance** of being prevented. **Preventability is multifactorial and falls under a category classification system of community, facility, patient/family, system, and provider.** The preventability for each case and classification is determined by the MMRC.

Recommendations for preventable pregnancy-associated, but not related deaths include:

1. **Transportation-Related Deaths:** Education on seatbelts and helmet use, cautions against speeding, and refraining from driving while intoxicated
2. **Substance User Disorder:** improved screening, referral, and coordination of care for treatment of substance use disorder from prenatal through postpartum periods
3. **Homicide:** screening for intimate partner violence, referrals for victims of violence, firearm safety

Pregnancy-Associated Deaths

ALL deaths that occurred within one year of pregnancy

From 2017 to 2020, **321** Tennessee women died during pregnancy or within a year of pregnancy.

Pregnancy-Associated Deaths				2017-2020 Pregnancy-Associated Mortality Ratio (Deaths per 100,000 live births, PAMR) ³
Characteristics	2019	2020	2017-2020	
Age at death				
Less than 30 years	26(41%)	44 (45%)	154 (48%)	78.1
30-39 years	36(57%)	51 (52%)	150 (47%)	128.8
40+ years	1 (2%)	3 (3%)	17 (5%)	237.2
Race/Ethnicity				
Non-Hispanic White	38(60%)	58 (59%)	202 (63%)	96.9
Non-Hispanic Black	21(33%)	31 (32%)	98 (31%)	155.8
Other	4 (7%)	9 (9%)	21 (7%)	44.2
Education				
Less than high school	13 (21%)	20 (20%)	70 (22%)	169
High school diploma/GED	24 (38%)	41 (42%)	130 (40%)	143.5
More than high school	26 (41%)	37 (38%)	119 (37%)	63.7
Not specified	0 (0%)	0 (0%)	2 (1%)	—
Insurance at Delivery¹				
TennCare	39 (62%)	51 (52%)	175 (71%)	113.3
Private	9 (14%)	12 (12%)	53 (21%)	38.4
Other	1 (2%)	1 (1%)	6 (2%)	47.7
None	4 (6%)	3 (3%)	13 (5%)	196.4
Unknown	0 (0%)	0 (0%)	1 (0%)	—
Area of Residence²				
Metropolitan county	34 (54%)	50 (51%)	155 (48%)	110.9
Rural county	29 (46%)	48 (49%)	166 (52%)	91.7
Grand Division				
West TN	21 (33%)	31 (32%)	106 (33%)	141.5
Middle TN	28 (44%)	36 (37%)	112 (35%)	79.7
East TN	14 (22%)	31 (32%)	102 (32%)	100.6
Overall	63	98	321	100

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.

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

Percentages may not add to 100 due to rounding.

3. PAMR: Pregnancy-Associated Deaths per 100,000 live births

With the identification of new deaths, the MMRC can review additional cases and provide updated evidence. Therefore, the count and rate of deaths reported in prior publications may differ from data in this report.

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, 2017-2020. Population estimates based on interpolated data from the U.S. Census's Annual Estimates of the Resident Population.

Pregnancy-Associated Deaths

ALL deaths that occurred within one year of pregnancy

Maternal Mortality by Pregnancy-Relatedness, Tennessee, 2017-2020

N=321

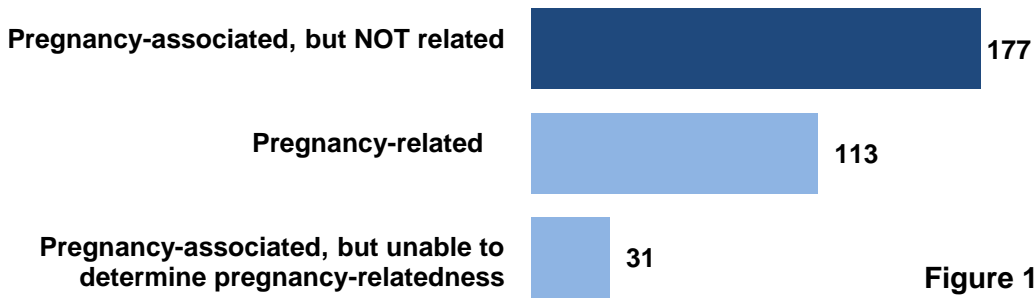


Figure 10.

Timing of Deaths: 2017-2020

Most deaths occurred in the late postpartum period, Tennessee 2017-2020

(N=321)

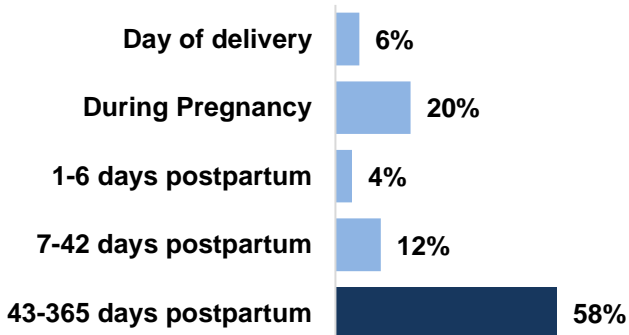


Figure 11.

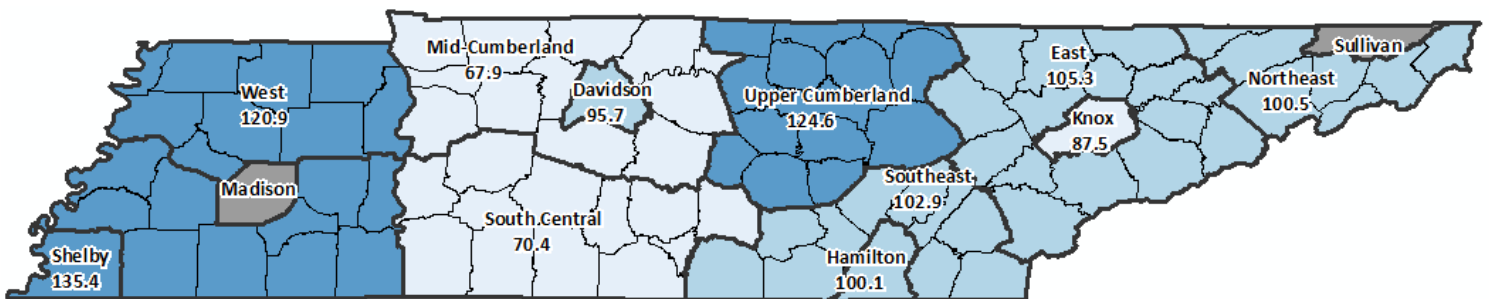
Most pregnancy-associated deaths occurred between **43-365 days postpartum**. Among all pregnancy-associated deaths, a combined **81% could have been prevented** with the appropriate resources and/or interventions.

Obesity contributed to **12%** of all pregnancy-associated deaths.

Mental health conditions contributed to **25%** of all pregnancy-associated deaths, and **63** of the **79** mothers with mental health conditions were suffering from a **substance use disorder**.

Substance use disorders contributed to **36%** of all pregnancy-associated deaths.

Pregnancy-Associated Mortality Ratio by Region, Tennessee: 2017-2020



Pregnancy-associated mortality varies by region in Tennessee. **Mid Cumberland** has the **lowest** ratio (**67.9** per 100,000 live births) of pregnancy-associated deaths while **Shelby** has the **highest** ratio (**135.4** per 100,000 live births) of pregnancy-associated deaths.

Pregnancy-Associated Mortality Ratio

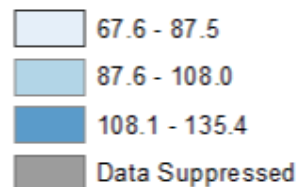


Figure 12.

Pregnancy-Associated COVID Deaths 2020

ALL deaths that occurred within one year of pregnancy

Pregnancy-Associated COVID Deaths: 2020



Five of the 98 cases reviewed by the MMRC had a positive SARS-CoV-2 test within a year of pregnancy. In four of these cases, the death was determined to be pregnancy-related in which pregnancy was an aggravating factor contributing to the death. Out of the five cases, **SARS-CoV-2 was a leading underlying cause of death in three of the five cases** and was a contributing factor in two of the cases.



100% of cases with a leading cause of death of SARS-COVID-19 were determined to be preventable at **patients/family, physician, hospital, community, or system levels.**

Contributing Factors in Pregnancy-Associated COVID Deaths: 2020

- Delay of care to patients such as drawing labs and initiating CPR due to providers having to wear personal protective equipment (PPE) before entering a patient's room.
- Lack of education surrounding reasons to seek care in the instance of COVID-19 diagnosis along with limited discharge education and postpartum follow up
- Providers not following ACOG recommendations for delivery at 37 weeks gestation for gestational hypertension
- Lack of universal screening for COVID-19

Recommendations for COVID Deaths: 2020

- Providers should promote COVID-19 vaccination for pregnant women and eligible family members. *
- Facilities should take all precautions to minimize the spread of COVID-19 infection to patients, healthcare workers, and other essential workers using standard infection control policies and personal protective equipment.
- Facilities and providers should improve clinical care for pregnant and postpartum women during the COVID-19 pandemic by considering implementing pre-admission/procedure COVID-19 testing, timely labs for positive critically ill patients, and following the joint COVID 19 protocol established by [ACOG](https://www.acog.org) and [SMFM](https://www.smfm.org) for management of pregnant and postpartum women.
- Facilities should provide increased post postpartum follow up with all COVID-19 positive patients such as postpartum discharge packet, increased follow up visits, or home visits.

**Vaccination was not available during 2020 therefore this recommendation wasn't specific to those deaths reviewed in 2020. However this recommendation has been added to prevent future COVID-19 deaths based on best practices at time of publication. For current COVID-19 data, go to <https://www.tn.gov/health/cedep/ncov/data/special-populations.html> or <https://www.tn.gov/content/tn/health/cedep/ncov/data.html>*

Health Disparities in Pregnancy-Associated Deaths

ALL deaths that occurred during pregnancy or within one year of pregnancy

Pregnancy-Related vs Not Related: 2017-2020

Black women are at increased risk at dying within one year of pregnancy. That risk drastically increases for pregnancy-related causes. **Non-Hispanic Black women are 2.5x as likely as non-Hispanic White women to die from pregnancy-related causes.** The leading underlying cause of death for black women was cardiovascular and coronary conditions.

Obesity contributed to almost 1 in 4 (24%) of all pregnancy-related deaths.

Discrimination in 2020 Pregnancy-Associated Deaths

In 2020, the CDC's Committee Decision's Form was updated to determine if discrimination contributed to the death. Discrimination contributed to **23%** (n=23) of all pregnancy-associated deaths in 2020. To determine if discrimination contributed to the death, the committee looks at interpersonal racism, structural racism, and discrimination. In these cases, the committee noted lack of prenatal care, patients' leaving against medical advice without appropriate consultation, and a delay or lack of screening, diagnosis, treatment, referral, or medical transportation as other factors contributing to death.

Almost two in three (65%; n=15) of deaths with discrimination were pregnancy related and had substance use disorder and mental health conditions as other contributing factors.

Education: 2017-2020

The distribution of educational level of women who died from pregnancy-associated causes varied by pregnancy relatedness (Figure 16).

Women with more than a high school diploma accounted for the major proportion (48%) of pregnancy-related deaths. On the contrary, **women with high school diploma (44%) had the largest burden of pregnancy-associated, but not related deaths.**

Highest Educational Level of Decedents by Pregnancy Relatedness

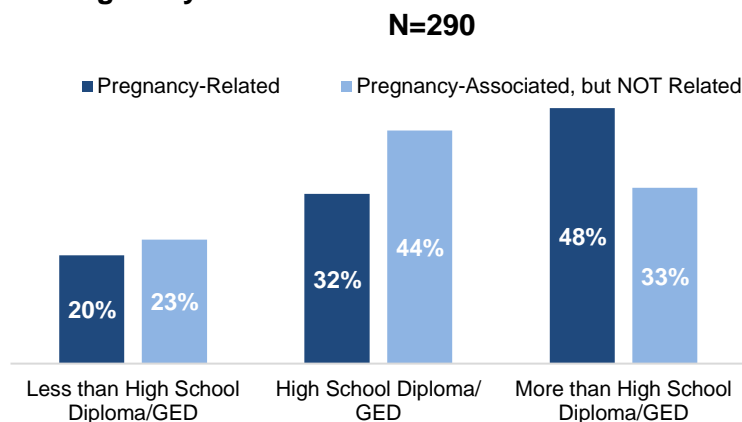


Figure 13.

Insurance at delivery: 2017-2020

Women with lower socioeconomic status often face complex health, medical, and mental health needs and may be at high risk for poor pregnancy outcomes. **Most pregnancy-associated deaths (71%) occurred in women who had TennCare/Medicaid at delivery.** Also, **almost half (49%) of women who died from pregnancy-related causes had TennCare at delivery.** TennCare, Tennessee's Medicaid program, provides health services to certain residents or legal aliens with low-income/very low-income status, including pregnant women.

Pregnancy-Associated Deaths Substance Use & Mental Health

ALL deaths that occurred within one year of pregnancy

Substance use disorder (SUD) and mental health conditions contributed to **41%** of pregnancy-associated deaths from 2017 to 2020. These two conditions can co-occur in both pregnancy-related and pregnancy-associated, but not related deaths.

Between 2017 to 2020, the MMRC substance use disorder listed in 26% of (n=29) pregnancy related deaths and 46% of pregnancy-associated, but not related deaths. **Mental Health conditions coexisted with substance use disorder more in pregnancy-related (77%) than pregnancy-associated, but not related deaths (44%).**

Between 2017 and 2020, **61 individuals died of an acute overdose** among pregnancy-associated, but not related cases. **Figure 19** depicts the substances involved in these 61 cases. All but seven of these incidents involved multiple substances. Thus, the total number of substances shown in **Figure 19** is greater than the number of overdose deaths.

Fentanyl was the single most common substance, present in 45 of the 61 (65%) overdose deaths.

Opiates falling into the 'Other Opioid' category include oxycodone, oxymorphone, morphine, hydrocodone, hydromorphone, buprenorphine, and U-47700. These substances were involved in 35 total overdose deaths.

In Tennessee women who died from acute overdose within a year of pregnancy:

- **Four in five (80%)** of them died at **43 days or more postpartum**
- **Most (85%)** were preventable
- **Half (51%)** had mental health conditions contributing to their deaths
- **29-years-old** was the average age of acute overdose

Mental health Conditions and SUD: Co-occurring Contributing Factors, 2017-2020

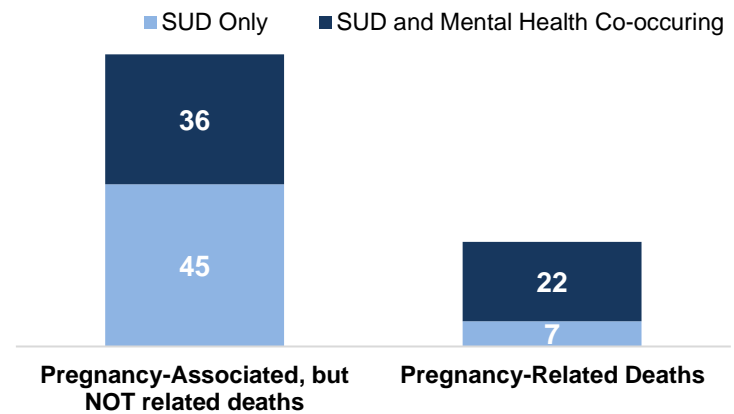


Figure 14.

Leading Substances Found in Acute Overdose Deaths: 2017-2020

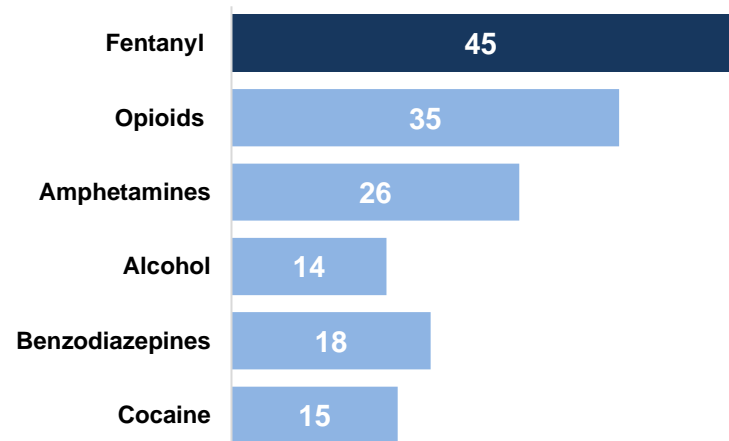


Figure 15.

Pregnancy-Associated Violent Deaths

ALL deaths that occurred within one year of pregnancy

Between 2017 and 2020, there were **56 violent (homicide or suicide) deaths** in Tennessee that occurred during pregnancy or within a year of pregnancy. Most (77%) of the violent deaths were preventable, with 63% of preventable deaths having some chance of preventability.

2017-2020 Pregnancy-Associated Violent deaths in Tennessee		
Characteristics	Homicides	Suicides
Age at death		
Less than 30 years	22	13
30 years or older	16	7
Race/Ethnicity		
Non-Hispanic White	18	13
Non-Hispanic Black	18	5
Means of Homicide		
Firearms	25	5
Overall	38	18

Suicides in Pregnancy-Associated Deaths: 2017-2020

- From 2017 to 2020, **suicide was the cause of death in 18 (6%) of all pregnancy-associated deaths.**
- **Non-Hispanic White women** (n=13) had a higher proportion of suicide than others.
- Women residing in **Middle Tennessee** accounted for **half** (n=9) of the suicides.
- **Mental health conditions accounted for most** (n=16) of **suicide deaths** while substance use disorder (**n=8**) of these deaths.

Homicides in Pregnancy-Associated Deaths: 2017-2020

- Homicide was the cause of death in **38** (12%) of all pregnancy-associated deaths.
- **Women** who are younger, **less than 30 years** (n=22) and with a **High School diploma or less** (n=21) had a **high burden of homicide.**
- **Most** homicide (n=25) were perpetuated by **firearm.**
- Almost half of homicide decedents (47%, n=18) resided in **West Tennessee.**

Pregnancy-Associated, But Unable to Determine Pregnancy Relatedness

ALL deaths that occurred during or within 1 year of pregnancy, but where the committee could not determine its relatedness to pregnancy

Leading Causes of Pregnancy-Associated, but Unable to Determine Pregnancy-Relatedness Deaths, Tennessee, 2017-2020

N=31

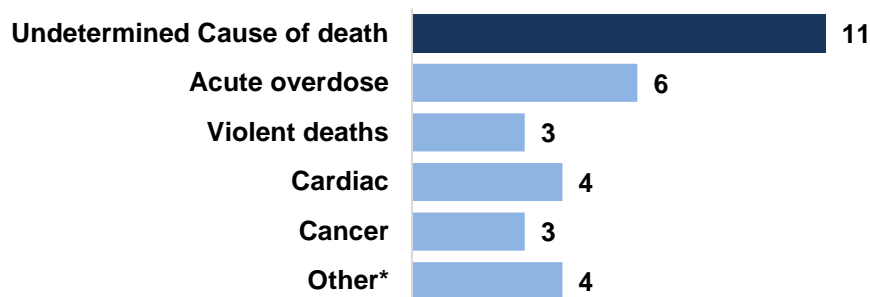


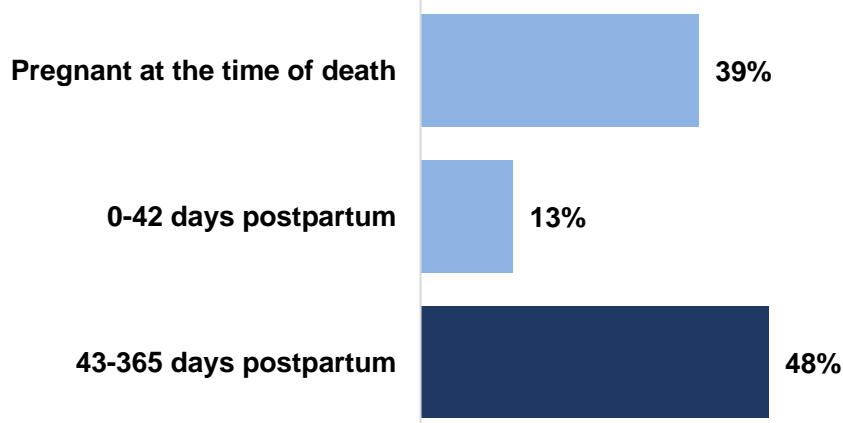
Figure 16.

Other includes deaths from motor vehicle crash, seizure secondary to acute alcohol withdrawal from delirium terms, sudden death in epilepsy, and diabetes mellitus

Timing & Preventability: 2017-2020

Timing of pregnancy-associated, but unable to determine relatedness deaths, 2017-2020

N=31



Most pregnancy-associated, but not able to determine relatedness occurred between **43-365 days postpartum**.

About **half** (52%) of these deaths **were preventable**.

Six of undetermined deaths **were violent deaths**.

Figure 17.

Process Improvement Recommendations

1. In any case that is undetermined cause of death an autopsy should be performed for all pregnant and postpartum women
2. Tennessee legislation should implement a centralized medical examiner system for improved uniform death investigators and quality of care
3. Tennessee should improve educational laws and funding surrounding medical examiners' office and indication for autopsy

Success Stories 2020-2021

Community Grants: 2021

In January of 2021 four community agencies were awarded up to \$20,000 to implement their proposed projects to reduce maternal mortality by implementing the 2021 recommendations.

Vanderbilt University Medical Center (VUMC) OBGYN

Developed a “Train-the Trainer” model for implicit biases within obstetrical care. Facilitation teams identified six hospitals to implement this model across the state. These hospitals included: VUMC, Maury Regional, VUMC Wilson County, VUMC Northcrest, East Tennessee State University Johnson City, University of Tennessee Memphis, and Meharry Medical College. The facilitation team provided three, eight-hour sessions for each hospital and each trainer was given 2-3 hours of individual coaching with the primary VUMC team. Trainings were provided to OBGYN providers and nursing staff. These workshops ensured that the trainers felt proficient in their abilities to educate staff within their respective hospitals on implicit bias in maternal health. Post Test data after these trainings reported 97% of respondents expressed an understanding of racial/ethnic disparities associated with Maternal Mortality in the US.

East Tennessee State University (ETSU)



Proposed to develop and distribute toolkits of information and resources, a novel workbook for mothers, and an educational series for providers aimed at preventing maternal mortality and morbidity. The target population was women receiving services through the ETSU Health Obstetrics and Gynecology, Family Medicine, and Pediatric Clinics, particularly those in the Baby Steps Antenatal Drug Use/Exposure program. The target population also included health and service providers in the region of Northeast Tennessee. Toolkits of information and resources were produced as part of this project to prevent firearm injuries (gun trigger locks and firearm safety educational materials) and drug overdose (medication safety lock boxes and information about safe medication storage, diversion prevention, and naloxone use). ETSU engaged women and distributed these and other resources/education for maternal mortality prevention through in-clinic visits, telephone calls, and community outreach. They reached 800 people with these activities.

Success Stories 2020-2021

ETSU also created the novel *Caring for Motherhood* Journal using evidence-based information on best practices from the Centers for Disease Control (CDC), American College of Obstetrics and Gynecology (ACOG), American Academy Family Practitioners (AAFP), and others, as well as input from expert regional stakeholders. The journal is organized into three sections: information, resources, and reflection activities; a section of pages for documenting and reflecting on each perinatal visit; and an interactive 12-month calendar with health and wellness-promoting stickers and tear-out lists to use as reminders. The primary focus of the journal is prevention of maternal mortality and morbidity. Information and resources are organized into the following subsections: Caring for Your Health, Caring for Your Finances, Caring for Your Mind, Caring for Your Safety, Caring for Yourself, and Caring for Your Baby.



St. Thomas Medical Center

Implemented the Mitigation Action for Maternal Mortality (MAMM) to mitigate the number of deaths caused by cardiovascular disease that occur during or after pregnancy. The MAMM team developed a Heart Awareness and Cardiovascular Disease flyer for distribution at focus groups, in physician offices, and for multiple audiences at other venues. The Heart Awareness and Cardiovascular Disease flyer, and a flyer about Preeclampsia were both distributed to OB providers and internists to inform and educate about risk factors and prevention strategies. The MAMM team will introduce the Heart Awareness and Cardiovascular Disease flyer to the Tennessee Initiative for Perinatal Quality Care (TIPQC) at its next meeting. MAMM is collaborating with TDH to include some of their messaging on the TDH Maternal Mortality Review website and the Tennessee Initiative for Perinatal Quality Care Resource web site.

The Heart Awareness and Cardiovascular Disease flyer was also released on Facebook with positive reviews from the public. The Tennessee Maternal Fetal Medicine Group and MAMM team members, Dr. Graves and Dr. Davis, developed cardiac screenings with the support of the University of California Irvine with a subrecipient grant award from the Gordon and Betty Moore Foundation. This cardiac screening tool was fully accepted and is in use at all Ascension Saint Thomas Hospitals with OB departments. Ascension Health committed to adopt this Cardiac screening tool for use within its nationwide system of hospitals with OB departments. They screened over 5000 women in a 5-month period as outpatients at Ascension Saint Thomas (Midtown, Rutherford and River Park). Over 800 women have been screened at Tennessee Maternal Fetal Medicine.



Success Stories 2020-2021

Chattanooga Hamilton, Erlanger Medical Center

Proposed to decrease maternal mortality in Hamilton and surrounding counties in Tennessee by reducing existing disparities and ensuring that all staff and patients have access to the information they need to reduce risk factors and improve outcomes. To achieve this, Chattanooga Hamilton trained all of their maternal care staff which included 250 physicians, certified nurse midwives, advanced practice nurse practitioners and registered nurses in the following topics: recognizing and overcoming their own implicit bias, recognizing and addressing signs of pre-eclampsia, recognizing and addressing substance use disorders, and recognizing and addressing mental health disorders.

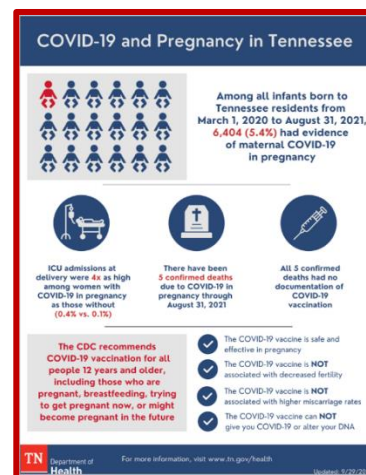
To educate staff on consistent screening and assessments for substance use disorder utilizing the Screening, Brief Intervention, and Referral to Treatment (SBIRT) scale and the 5 P's assessment. These tools were incorporated into all patient intake forms. Additionally, if patients screen positive, staff involve case management and Maternal Fetal Medicine (MFM) for treatment.



COVID-19 Identification and Review

On July 9, 2020, the TN department of health received notification of the first pregnancy-associated COVID-19 death. In partnership with the Chief Medical Examiner's Office, TN Department of Health's Emergency Preparedness Program, and the Viral Hepatitis Program a collaborative effort with the Maternal Mortality Review (MMR) program was put into place to rapidly identify pregnancy-associated COVID-19 deaths. Every COVID-19 death reported to the Chief Medical Examiner's Office where the pregnancy check box was checked the death was immediately reported to the MMR team. Additionally, if the Chief Medical Examiner's office found a pregnancy reported in absence of the check box these deaths were also reported to the MMR team.

Any Tennessee resident who tested positive after a polymerase chain reaction (PCR) test with a positive pregnancy indicator on the Patient Under Investigation (PUI) ID form was observed under this program. In addition to a pregnancy indicator, fetal birth and death certificates are linked to positive PCR tests to verify pregnancy status. The linked positive cases with positive pregnancy indicated is stratified with the MMR list of cases. With this, the MMR team was able to identify further pregnancy-associated deaths with positive COVID-19.



Success Stories 2020-2021

Maternal Death and Violence Grant

In August 2021, the TDH MMR program applied for the Department of Health and Human Services Office of the Assistant Secretary for Health's funding opportunity to reduce maternal deaths due to violence. The MMRC has developed several recommendations addressing violent deaths. TDH was awarded \$300,000 to strengthen TN's review and prevention of homicide and suicide deaths that occur within one year of pregnancy. With this funding TN will start working towards reducing these deaths with the partnership of organizations and stakeholders across the state. The MMR program will implement processes to increase the review, identification and tracking of maternal deaths due to violence by increasing MMR staff, subject matter experts to the MMRC, analysis of data, and development of education materials. The MMR program will also implement education to all the Evidenced-Based Home Visiting (EBHV) staff and CHANT staff on how to identify and address domestic violence in the home. TDH also plans to implement trainings for organizations and stakeholders to screen, identify, and refer individuals with perinatal mood disorders.

Postpartum Support International (PSI) Training



Postpartum Support International (PSI) is an internationally recognized program for healthcare providers and support networks for mothers suffering from perinatal mood disorders. Their mission is to promote awareness, prevention and treatment of mental health issues related to childbearing in every country worldwide.

Cherished Mom a non-profit organization in East Tennessee committed to increasing the number of perinatal mental health providers in the state. As a grantee of the Tennessee Department of Health's Preventing Maternal Deaths: Supporting Maternal Mortality Review Committee's Grant, Cherished Mom facilitated PSI's 2-day Perinatal Mental Health training free of cost to therapists, hospitalists, nurses, midwives and other interested providers who care for the perinatal population. A 3rd day of training was offered in advanced perinatal psychotherapy which enhanced providers' ability to screen, counsel and prescribe appropriate medications for perinatal mood disorders.

Cherished Mom created a public service announcement (PSA) to market the availability of the course offerings which were held virtually due to the Covid-19 pandemic. By completion of the 2 course offerings, Cherished Mom was able to provide a total of 218 scholarships.

Appendix

Appendix: Tables

Table 1. Pregnancy-Related Deaths, Tennessee, 2019-2020

Table 2. Pregnancy-Associated, but Not Related Deaths, 2019-2020

Table 3. 2017-2020 Pregnancy Associated Violent Deaths in Tennessee

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Figure 5. Leading Causes of Cardiovascular deaths in 2017-2020

Figure 6. Timing of Pregnancy-Related Deaths 2017-2020

Figure 7. Number of Pregnancy-associated, but not related deaths. 2017-2020

Figure 8. Timing of Pregnancy-Associated, but not Related Deaths 2017-2020

Figure 9. Acute Overdose is the leading cause of death of Pregnancy-Associated, but not related deaths, Tennessee, 2017-2020

Figure 10. Maternal Mortality by Pregnancy-Relatedness, Tennessee, 2017-2020

Figure 11. Most deaths occurred in the late postpartum period, Tennessee 2017-2020

Figure 12. Pregnancy-Associated Mortality Ratio by Region, Tennessee, 2017-2020

Figure 13. Highest Educational Level of Decedents by Pregnancy Relatedness


Figure 14. Mental Health Conditions and SUD: Co-occurring Contributing Factors, 2017-2020

Figure 15. Leading Substances Found in Overdose Deaths 2017-2020

Figure 16. Leading Causes of Pregnancy-Associated, but Unable to Determine Pregnancy-Relatedness Deaths, Tennessee, 2017-2020

Figure 17. Timing of pregnancy-associated, but unable to determine relatedness deaths, 2017-2020



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