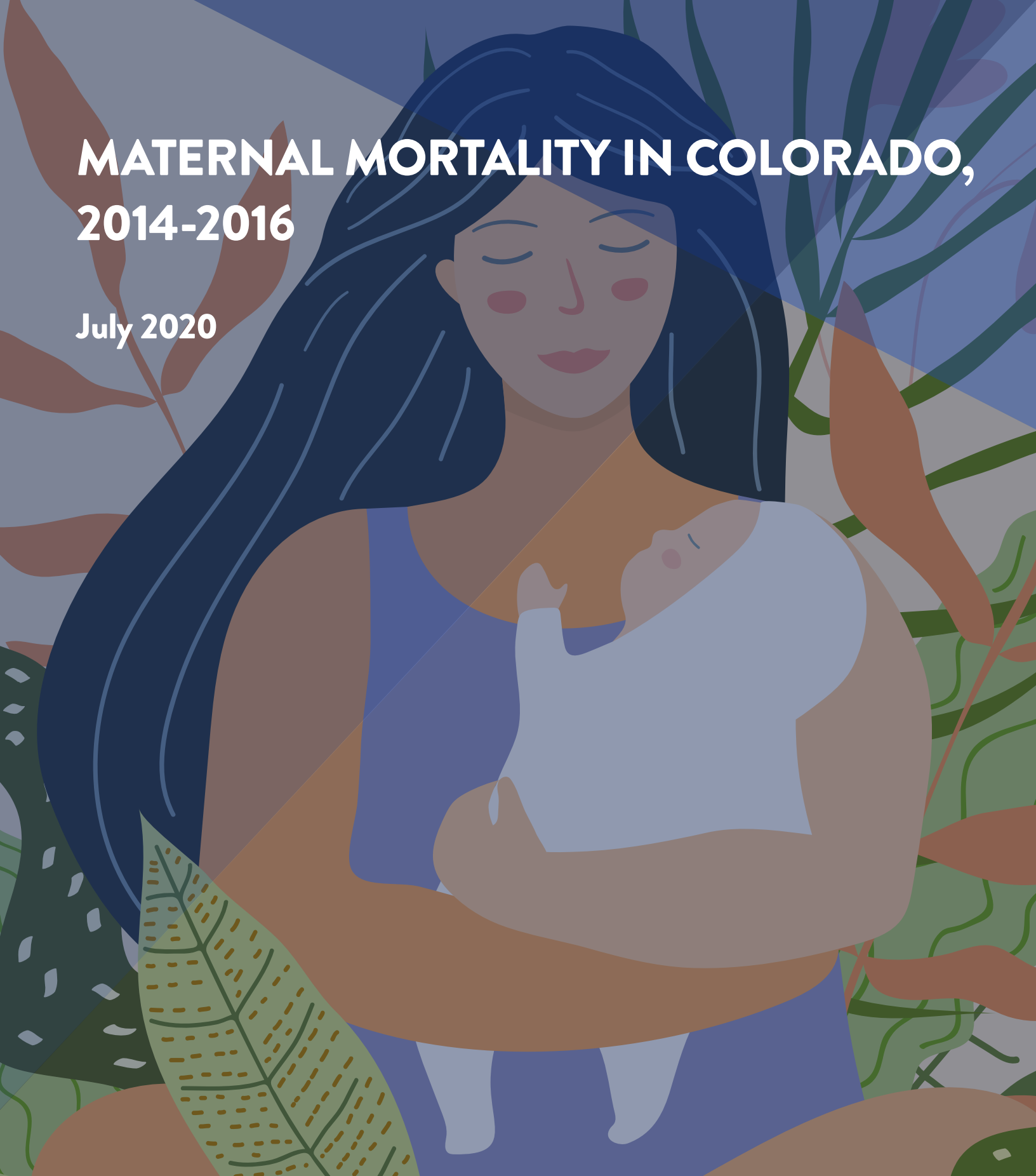


MATERNAL MORTALITY IN COLORADO, 2014-2016

July 2020



COLORADO
Department of Public
Health & Environment

As required in statute, this report recommends strategies to achieve equity in maternal health outcomes and ways to reduce the incidence of preventable maternal mortality and morbidity; identifies maternal mortality causes that have the greatest impact on pregnant and postpartum Coloradans and are most preventable; recommends clinical quality improvement approaches that could reduce the incidence of pregnancy-related mortality or morbidity in clinical settings; and offers ways to disseminate best practice guidelines.

Statute: The Maternal Mortality Prevention Act ([HB19-1122](#))

Date: July 1, 2020

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DEDICATION

The Maternal Mortality Review Committee (MMRC) dedicates this report to Dr. Stuart Gottesfeld, who recently passed away after a truly incredible career as an obstetrician-gynecologist in Colorado. Dr. Gottesfeld is remembered as an excellent clinician, brilliant surgeon and dedicated educator. One of the many manifestations of Dr. Gottesfeld's dedication was his role as a founding member of the MMRC long before its current incarnation. He attended and actively contributed to these meetings until just a few months before his death. This report is fondly dedicated to the memory of his service.

Stuart Gottesfeld passed away on June 14, 2020, at the age of 85. He was born in Denver and went to East High School, attended Amherst College, and graduated from the University of Colorado School of Medicine. After his residency training at Mt. Sinai Hospital in New York, he served as a physician in the Army for two years, before returning to Denver. He established a private practice associated with Rose Hospital, which grew to include his two younger brothers and eventually his oldest son. He served on numerous boards, including the Colorado State Board of Medical Examiners and the Colorado Health Foundation, and served as President of the Medical Staff and Vice Chair of the Department of Obstetrics and Gynecology at Rose Hospital.

Dr. Gottesfeld retired from clinical practice after nearly four decades and thousands of babies delivered. Until earlier this year, he continued his passion for advocating for reproductive health and teaching residents at the University of Colorado. Generations of obstetricians and gynecologists have fond memories of reviewing patient histories and scientific literature under his guidance, learning not just clinical judgment and scientific principles but also integrity and compassion from his example. On the MMRC, he made it his mission to derive learning points from each tragic loss in order to benefit the birthing population of Colorado and improve health for all pregnant and postpartum people and their families.

Above all, the Colorado Department of Public Health and Environment would like to acknowledge the 94 pregnant and postpartum people who died between 2014 and 2016. CDPHE honors and grieves alongside their families and communities, as well as the provider communities who cared for them. CDPHE would like to acknowledge the many people who have given their time and expertise to reviewing maternal deaths, identifying recommendations, and writing this report.

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*Dr. Stuart Gottesfeld was a dedicated member of the committee for nearly three decades, until his death in June 2020. We are deeply grateful for his unwavering commitment and support.

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Statement on Structural Inequity:

The Colorado Department of Public Health and Environment acknowledges that generations-long social, economic and environmental inequities result in adverse health outcomes. They affect communities differently and have a greater influence on health outcomes than either individual choices or one's ability to access health care. Reducing health disparities through policies, practices and organizational systems can help improve opportunities for all Coloradans.

Maternal mortality is the death of a person while pregnant or up to one year postpartum, from any cause. It is an important indicator of the health and health equity of a community and health care system. Each case is a tragedy that is often preventable. The circumstances and causes vary and may be located at any level of the system: patient, provider, facility, systems, or community factors.

Maternal Mortality Review

The Colorado Maternal Mortality Review Committee is responsible for reviewing each individual maternal death in the state. The maternal mortality review process is an ethical, standardized system of continuous quality improvement. It is not a method for finding blame but for reflecting on how events unfolded in order to prevent future maternal deaths.

CDPHE identifies cases through the pregnancy checkbox or cause of death codes on death certificates, or by matching birth and death certificates during a year. For these deaths, CDPHE gathers a range of records, including health records, autopsy records, police records, social media, online obituaries, and other information. After an internal review to ensure as complete a story as possible given available information, the de-identified case narrative is reviewed by the full review committee.

The committee assesses each case using the Centers for Disease Control and Prevention's (CDC) standardized committee decision form to determine the cause of death, whether it was pregnancy-related, if it was preventable, and the contributing factors that led to it. Additionally, the committee makes recommendations for addressing these contributing factors and improving public health systems for maternal health care.

Key Findings

For this report, *maternal mortality* is defined as any death during pregnancy and up to 365 days postpartum. When such a death is from any cause, it is considered a *pregnancy-associated death*. A subset of these deaths are *pregnancy-related deaths*; these are caused by a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. In 2014-2016, there were 94 pregnancy-associated deaths in Colorado. The committee determined that 38 of the 94 maternal deaths were related to pregnancy. For 10 of the 94 deaths, the committee was unable to determine whether the death was related to pregnancy.

Demographics

The mean age at the time of death was 29.1 years (SD \pm 6.2), which is similar to the mean age of the general population of people giving birth within the same period. Similarly, there was no difference in maternal mortality in urban and rural settings. People who died during pregnancy or within a year of the end of the pregnancy were 1.6 times more likely to have a high school education or less than others who gave birth during the same time period.

There was not a significantly different percentage of pregnancy-associated deaths occurring among Black, white, Asian, and Hispanic Coloradans. There was, however, a significantly higher percentage of pregnancy-associated deaths occurring among Native American people compared to the percent of all Native American

people giving birth in the same time period. People of Native American descent were 4.8 times more likely to die than non-Native people who gave birth in the same period.

Timing

The highest ratio of deaths per day was in the first six weeks postpartum (0.41). The second highest ratio was during the six weeks to one year period (0.17) and the third highest was during pregnancy (0.08). People died at a higher rate in the first six weeks after having a baby than during pregnancy or from six weeks to 365 days postpartum.

Causes

During 2014-2016, the top five singular causes of all maternal deaths were:

- Suicide.
- Drug overdose.
- Injury (including motor vehicle crashes).
- Homicide.
- Cardiac conditions.

The most common single cause of death was suicide, with 16 deaths. Despite this high number, there is not a statistically significant difference between the percent of maternal deaths due to suicide (17.0%) and the percent of deaths due to suicide in the general population of women of childbearing age (12.9%).

The second most common singular cause of death was unintentional drug overdose, with 13 deaths, and the third most common singular cause of death was injury, with 10 deaths. There was not a statistically significant difference in the rate of overdose deaths between the maternal mortality cohort and the general population of childbearing age.

Homicide accounted for eight of the deaths, and more than half of these were committed by an intimate partner. There is a statistically significant difference in the percentage of maternal deaths due to homicide (8.5%) and the percentage of deaths due to homicide in the general population of women of childbearing age (3.7%).

Of the pregnancy-related deaths, 25 were caused by medical conditions, such as infection, hypertensive disorders of pregnancy, cerebrovascular accident, cardiac conditions, amniotic fluid embolism, thrombotic pulmonary embolism, and ruptured ectopic pregnancy. Thirteen of the pregnancy-related deaths had non-medical causes, including suicide, homicide, and drug overdose. Based upon the definition of pregnancy-related, the committee determined that seven of the 16 suicide deaths were related to the pregnancy. For example, if a person experienced depression for the first time during pregnancy or their mental health significantly deteriorated during the pregnancy, the committee may determine that the death is pregnancy-related.

Of all 94 maternal deaths, the committee determined that either mental health or substance use contributed to nearly six out of ten deaths. Substance use contributed to almost a third of both pregnancy-associated deaths (30 deaths) and pregnancy-related deaths (12 deaths). Overall, mental health conditions contributed to nearly one in four deaths.

Preventability

A death is considered preventable if the committee determines 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 levels. Guided by that definition, the committee determined that 72 of the 94 maternal deaths during 2014-2016 (76.6%) were preventable. Of the 38 deaths related directly to pregnancy, 26 (68.4%) were determined to be preventable.

The committee's results showed that maternal death was disproportionately high for Native American people during 2014-2016. It did not show disparities for any other racial group. However, because the number of maternal deaths is low (only 94 in a three-year period), just one or two prevented deaths can change the apparent disparity outcomes. The national maternal mortality data indicate that Black pregnant and postpartum people are at a higher risk for maternal death; therefore, Colorado must remain vigilant about the possibility of such a disparity even if it did not emerge during this time period. The committee's findings indicate that opportunities to ensure equity exist at every level of preventability.

Committee Recommendations

The review committee developed the following recommendations as a result of their review of maternal deaths, the causes, and contributing factors:

1. Eliminate structural and interpersonal bias and discrimination in the delivery of services and supports needed by pregnant and postpartum people.
2. Integrate universal screening and connection to treatment for mental health conditions into maternity care.
3. Integrate universal screening and connection to treatment for substance use disorders into maternity care.
4. Improve opioid prescribing practices.
5. Improve evidence-based screening and counseling methods for psychosocial risk factors, including intimate partner violence.
6. Improve care coordination for maternity care.
7. Improve electronic medical records.
8. Improve coordination and efficiency among public health, social services, and health care systems.
9. Improve access to care during preconception, pregnancy, and postpartum.
10. Improve quality and standardization of clinical care for medical and obstetric complications.
11. Redesign postpartum care to include an extended timeframe, dyad care, and family-friendly employment policies.
12. Implement trauma-informed maternity care.
13. Improve family planning care.

Next Steps

The Maternal Mortality Prevention Program (MMPP) has created a strategic work plan to reduce maternal mortality and improve maternal health through a trifecta of solutions:

- **Community-led solutions.** Solutions work best when they draw on the wisdom, strengths, resilience, and the deep knowledge of the issues that exist within communities. The MMPP is working together with communities to identify strategies that, with adequate funding and support, could improve the trajectory of health for a pregnant or postpartum individual through community-level initiatives. Groups such as the Maternal and Child Health Community Advisory Board (MCH-CAB) and grassroots community-based perinatal and birth providers and activists all play a unique and necessary role and will be part of community-led solutions.
- **Clinical quality improvement.** The MMPP partners with the Colorado Perinatal Care Quality Collaborative (CPCQC) to improve patient safety in clinical settings as part of the national Alliance for Innovation on Maternal Health (AIM) project. The project uses continuous quality improvement and implementation of national safety bundles to address both chronic and emergent complications of pregnancy.
- **Public health programs.** The MMPP uses federal funding from the CDC and the Title V Maternal and Child Health program for statewide public health programming to build systems and provide education and outreach for maternal health, especially related to mental health and substance use. This work will expand to address the social and structural determinants of health as well, including a healthy and safe built environment, economic mobility, and the reduction of racial inequities.

Maternal mortality is the death of a person while pregnant or up to one year postpartum, from any cause. It is an important indicator of the health equity and wellbeing of a community. Each case is a tragedy that is often preventable.

The circumstances and causes of maternal death vary. Some causes involve individual factors such as health behaviors and access to health care from health care facilities and personnel that offer good quality, culturally appropriate, and respectful care to pregnant and postpartum people. Many causes are connected to social, environmental, and systemic factors that go far beyond the confines of a person's home, clinic, or hospital.

The intent of reviewing each individual maternal death that occurs in Colorado is to translate the experience of an individual to the system level and embed lessons learned into public health and health care systems to make them more equitable.

Maternal mortality has been increasing in the United States, which is an unacceptable situation.¹ It is crucial to remain vigilant and active in preventing maternal mortality. Most cases of maternal death are *preventable*, defined by the Centers for Disease Control and Prevention as having at least some chance of the death being averted by one or more reasonable changes to the patient, community, provider, facility, or systems factors.

Inequity in Maternal Health in the U.S.

In addition to being preventable, maternal death is not experienced evenly across the population. Throughout the U.S., the burden of maternal death is disproportionately and unfairly borne by individuals of color, those with low socioeconomic status, and those living in communities where systemic inequality has persisted and is perpetuated.² Black and Native American people are at the highest risk for pregnancy-related death in the U.S. due to those structural determinants.³

The conditions in which people grow, work, learn, and build a life have a demonstrable effect on health outcomes of all kinds, including maternal health. The quality of air, water, and food affects people's physical and mental health, as do opportunities for school and employment and the daily experience of discrimination and violence. These conditions affect a person's experience of pregnancy, childbirth, and postpartum—a vulnerable time in a person's life. These factors also lead to inequities in chronic health conditions like diabetes and hypertension, which increase the risk of poor maternal health outcomes. As this document demonstrates, Colorado is no exception: structural racism and other inequities drive maternal health outcomes here as they do in the rest of the country.

Racial inequities in maternal health are not rooted in biological differences, nor are they primarily a problem of overt interpersonal bias, which is what typically comes to mind when people think of racism. Instead, this is an institutional and structural problem, a systematic difference in availability of resources and opportunities by race or other social factors. Systemic factors and implicit bias come together, so that some people experience prejudice from their providers based on their race that affects the quality of care they receive. A lifetime of

1 Pregnancy Mortality Surveillance System. Centers for Disease Control and Prevention. <<https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm>>

2 Howell EA. Reducing Disparities in Severe Maternal Morbidity and Mortality. *Clin Obstet Gynecol.* 2018;61(2):387-399.

3 Kuehn B. Disparities in Maternal Mortality. *JAMA.* 2019;322(16):1545.

chronic stress associated with racism also leads to worse health outcomes on multiple levels, commonly known as “weathering.”⁴

Maternal Health in Colorado

During the period of this report (2014-2016) there were 201,594 births in Colorado, an average of 183.9 births per day. The majority of these births occurred in urban settings (87.5%) and in hospitals (97.4%), and approximately three out of four people (74%) gave birth vaginally. People who gave birth in Colorado during this period identified predominantly as white, non-Hispanic (61.1%), with 21.8% identifying as Hispanic. People most commonly gave birth between the ages of 30 to 34 years. Over a third (38.8%) of people were insured by Medicaid when they gave birth. See Table 1 for additional demographic and outcome characteristics of births between 2014 and 2016.

Table 1. Birth Demographics and Outcome Characteristics in Colorado, 2014-2016.

		Number	Percent
Total Live Births 2014-2016 ⁵		201,594	100.0%
Region	Urban	176,485	87.5%
	Rural	18,589	9.2%
	Frontier	3,900	1.9%
	Unknown	2,620	1.3%
Insurer	Medicaid	78,115	38.8%
	Other insurer	123,467	61.3%
	Unknown	12	0.0%
Race	Non-Hispanic, White	123,199	61.1%
	Hispanic	43,906	21.8%
	Non-Hispanic, Black	11,479	5.7%
	Non-Hispanic, Asian	9,148	4.5%
	Non-Hispanic, Native American	2,330	1.2%
	Unknown	11,532	5.7%
Maternal Age	<25 years	47,944	23.8%
	25-29 years	56,757	28.2%
	30-34 years	60,077	29.8%
	35-39 years	30,021	14.9%
	40+ years	6,695	3.3%
	Unknown	100	0.1%
Maternal Education	High school education or less	64,418	32.0%
	More than high school education	135,103	67.0%
	Unknown	2,073	1.0%

4 Geronimus AT, Hicken M, Keene D, Bound J. “Weathering” and age patterns of allostatic load scores among blacks and whites in the United States. *Am J Public Health.* 2006;96(5):826-833.

5 These represent all births that occurred in Colorado, including residents and non-residents. These numbers were used in the analysis of the maternal mortality data because the committee reviewed maternal deaths of anyone who died in the state regardless of residency status. Race and ethnicity are self-reported and do not allow for reporting of multiple racial identities.

		Number	Percent
Birth Setting	Hospital	196,300	97.4%
	Freestanding birth center	1,377	0.7%
	Residence/home	3,035	1.5%
	Other	868	0.4%
	Not classifiable	9	0.0%
Method	Vaginal	149,083	74.0%
	Cesarean section	52,483	26.0%
Gestational Age	Term (≥ 37 weeks)	183,532	91.0%
	Preterm (< 37 weeks)	17,941	8.9%
Provider Type	Physician (MD/DO)	167,891	83.3%
	Certified nurse midwife	28,940	14.4%
	Registered/direct-entry midwife	2,301	1.1%
	Other	1,703	0.9%
	Unknown/missing	759	0.4%

Maternal Mortality Prevention Program

One important way to improve maternal health in Colorado is to understand what happens when a pregnant or postpartum person dies. To better understand those deaths and prevent future ones, the Colorado Department of Public Health and Environment (CDPHE) leads the [Maternal Mortality Prevention Program \(MMPP\)](#). This program supports the Maternal Mortality Review Committee (MMRC), a multidisciplinary committee that reviews maternal deaths, and works to prevent maternal death and support maternal wellness through community-led solutions, clinical quality improvement, and public health programs.

Maternal Mortality Review Committee

Colorado's Maternal Mortality Review Committee (MMRC) was officially founded in 1993, but records show that maternal deaths were reviewed in Colorado as early as the 1950s. The MMRC has grown in scope since the 1990s to review all maternal deaths in Colorado. It is one of 46 multidisciplinary review committees that identify, review, and characterize deaths in order to prevent maternal deaths. The review of a maternal death examines a pregnant or postpartum person's clinical care as well as their social environment, access to care, and lived experience. Resources for the MMPP and MMRC work are provided through a combination of state and federal funds.

Opening Doors with the Maternal Mortality Prevention Act

Colorado's commitment to reviewing maternal mortality was put in statute in May 2019 when Gov. Jared Polis signed the bipartisan [Maternal Mortality Prevention Act](#) to formalize and fund the Maternal Mortality Review Committee.

With the passage of this law, the MMRC became a statutory body that is required to submit recommendations to the legislature to reduce and prevent deaths in pregnant and postpartum individuals.

As a requirement of the new law, the committee's membership expanded to include additional representation from diverse communities and a variety of disciplines. Colorado's MMRC now includes representatives from

addiction medicine, anesthesiology, behavioral health, epidemiology, family medicine, forensic nursing, forensic pathology, health systems, home visiting, labor and delivery nursing, maternal fetal medicine, midwifery, neurology, obstetrics and gynecology, patient advocacy, public health, psychology, rural health, social work, and violence prevention.

The legislation enabled Colorado to apply for and receive grant funding from the Centers for Disease Control and Prevention's [ERASE Maternal Mortality](#) grant program, which began in October 2019. The CDC grant allows the state to expand its three-pronged strategy of community-led solutions, clinical quality improvement, and public health programs. With funds from this program and the state, Colorado can collect better data, analyze and publish data more frequently, and implement recommendations to prevent deaths and improve maternal health equity.

Maternal Mortality Review Process

The maternal mortality review process is an ethical, standardized system of continuous quality improvement that allows the committee to be reflective in order to improve the health and safety of pregnant and postpartum individuals. A comprehensive maternal mortality review process allows Colorado to identify underlying causes of death and make evidence-based recommendations to inform public health and clinical interventions that will reduce deaths and improve systems of care.

CDPHE identifies maternal deaths through three methods: 1) matching birth and death certificates to identify the roster of deaths that have happened in a year through the Colorado Center for Health and Environmental Data Vital Statistics Program, 2) the cause of death code on a death certificate, and 3) the pregnancy checkbox on the death certificate completed by the coroner. All identified cases are reviewed by two certified nurse-midwives to determine whether the death occurred during pregnancy or within 365 days of the end of pregnancy and, therefore, meet criteria for a maternal death. In contrast, the frequently cited National Center for Health Statistics (NCHS) uses a single data source, the death certificate.

For deaths determined to be maternal deaths, CDPHE requests health records, autopsy records, police records, prenatal care records, prescription drug monitoring program records, emergency department and hospital records, social media, online obituaries, and other information to construct a case narrative—a picture of what the person’s life and death looked like. Many hours go into building this case narrative.

After an internal review to ensure as complete a story as possible given available information, the de-identified case narrative is reviewed by the full MMRC. The committee assesses each case using the CDC’s standardized committee decision form to determine the following information:

- What was the cause of death?
- Was the death related to the pregnancy?
- Was the death preventable?
- What were the critical contributing factors to the death?
- What are the recommendations and actions that address those contributing factors?

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

Determining the factors that contributed to a death is another important task for the committee. The committee identifies factors across the five levels, such as violence, delays in care, unstable housing, and lack of care coordination. Examining preventable factors such as these not only helps to prevent maternal death, but also helps to prevent morbidity and promote health and wellbeing among pregnant and postpartum people in Colorado.

To protect confidentiality and because of resources required to conduct this extensive review process, the committee has historically reviewed maternal deaths on a delay. That is why this report is a review of deaths from 2014-2016. With the subpoena protection and funding from the Maternal Mortality Prevention Act and the ERASE Maternal Mortality grant program, the committee has been working to close the delay between an occurrence of maternal death and its review. The committee will continue to close this delay in the years to come, ensuring more timely maternal death data will be available.

Ethic of the Review

The ethic of the maternal mortality review is one of reflection, respect, grief, and improvement. The review process is an opportunity to grieve those who have died and to recognize and honor the trauma experienced by their children, families, provider care teams, and larger communities.

The focus of the maternal mortality review process is on continuous quality improvement, to identify underlying causes of death and make evidence-based recommendations for both public health and clinical interventions. It is not a process designed to assign blame to pregnant people, their communities, or anyone involved in the care of pregnant and postpartum people. Instead, the goal is to reflect on how Colorado can do better, not only to prevent deaths but to keep pregnant and postpartum people healthy and thriving.

When there is a maternal death, everyone involved in that story holds the trauma of it—not only the family and loved ones of the person who died, but their provider care team and anyone else involved in their care and support. The moment of silence at the beginning of review committee meetings prompts the committee to honor the losses and grief, and to proceed with clear eyes and compassion through the review process.

Understanding Maternal Mortality Data

To make sense of maternal mortality data, it is important to understand the different ways it is measured and discussed. For this report, maternal mortality is defined as any death during pregnancy and up to 365 days postpartum. The following terms are helpful for interpreting the data:

- **Pregnancy-related death:** Death 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 death:** An umbrella term that includes pregnancy-related death but also includes deaths from any other cause. To specify a death from a non-obstetric cause, the term pregnancy-associated but not related is used.

A mortality ratio is defined as the number of deaths divided by the number of births multiplied by 100,000. A pregnancy-related mortality ratio includes only deaths directly due to pregnancy and will always be much lower than a pregnancy-associated mortality ratio, which includes maternal death from any cause.

Definitions vary among national data sources. For a comparison, see Appendix A.

Analysis Methods

For the 2014 to 2016 maternal deaths, the MMPP conducted an analysis of aggregated data from birth certificates, death certificates, reviewed records, and committee decisions to understand demographics, causes of death, and contributing factors. The information available to the committee were compared to population level birth data to determine inequities. Finally, the MMPP conducted a qualitative analysis of the MMRC's recommendations to prevent maternal deaths. These prioritized recommendations appear in this report.

Limitations of Data Analysis

To protect the identities of the people who died, any category of analysis with fewer than five cases is not reported. Instead, these cases are aggregated to make a group large enough to maintain confidentiality. As a result, there are potential disparities that cannot be highlighted. This is particularly true of groups that comprise a smaller proportion of Colorado's population.

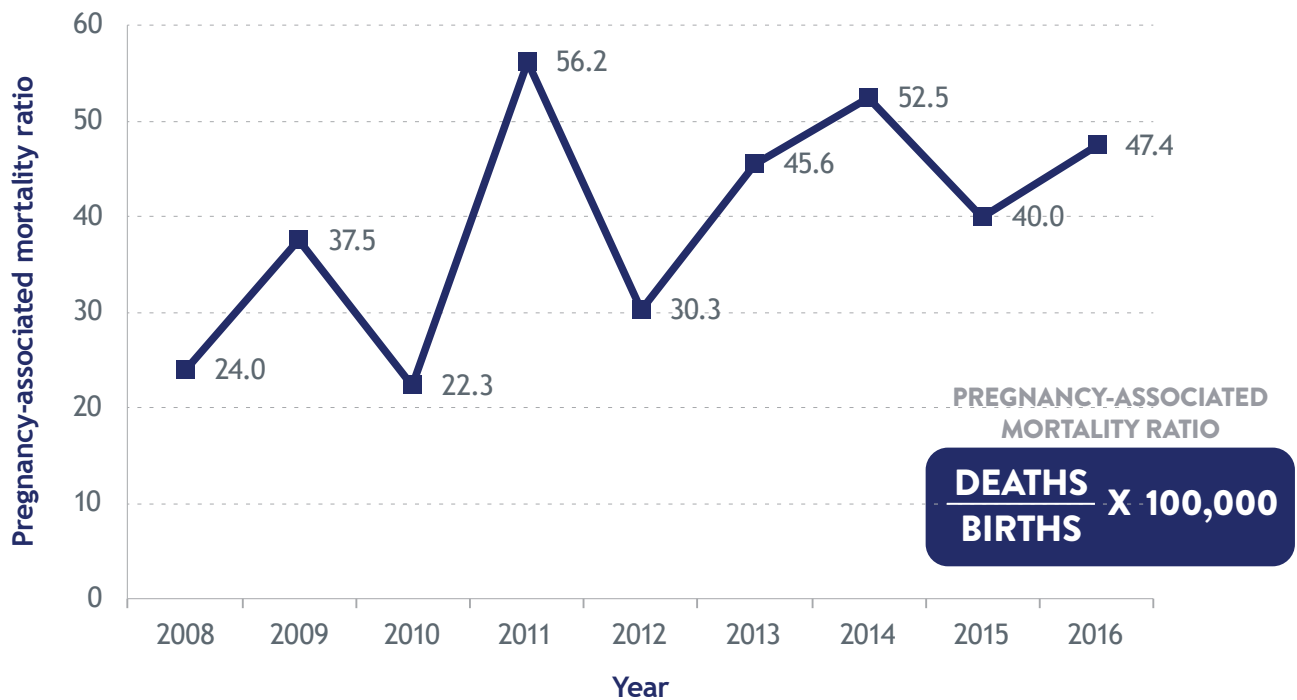
The information available to the committee and reported in this document are collected through institutions distinct from the Maternal Mortality Prevention Program, such as hospital systems and vital statistics reporting systems. Availability and quality of the data are therefore dependent on those institutions. Demographic data are drawn from birth certificate data when available and death certificate data when birth certificate data are not available. Race and ethnicity are self-reported for the birth certificate and determined by the coroner

based on available information for death certificates. The vital statistics reporting systems and the restrictions on data suppression of demographic characteristics for which there are fewer than five cases do not account for the identities of combined races and ethnicities in this report.

Findings

In 2014-2016, there were 94 pregnancy-associated deaths in Colorado. The pregnancy-associated mortality ratio⁶ for all three years is 46.6 per 100,000 live births. For 2016, the most recent year for which there is data, the pregnancy-associated mortality ratio was 47.4 per 100,000 live births. The sections below explain the demographics, timing, causes of death, and contributing factors for maternal deaths that occurred from 2014-2016.

Figure 1. Trend of Pregnancy-Associated Mortality Ratio (PAMR), Colorado, 2008-2016.



Demographics

The mean age at the time of death was 29.1 years (SD ±6.2). There was no difference in the mean age of maternal mortality cases and the mean age of the general population of people giving birth within the same period.⁷ Similarly, the place of residence of those who died were distributed between urban and rural settings⁸ in the same proportion as others who gave birth during the same period.

People who died during pregnancy or within a year of the end of pregnancy had significantly lower education levels.⁹ People who died during pregnancy or within a year of the end of pregnancy were 1.6 times more likely to have a high school education or less than others who gave birth during the same period.

⁶ The mortality ratio is calculated by dividing the number of deaths by the total number of births, then multiplying by 100,000.

⁷ The comparison dataset for all demographic data was the birth certificate data for all Colorado births during the same time period (2014-2016).

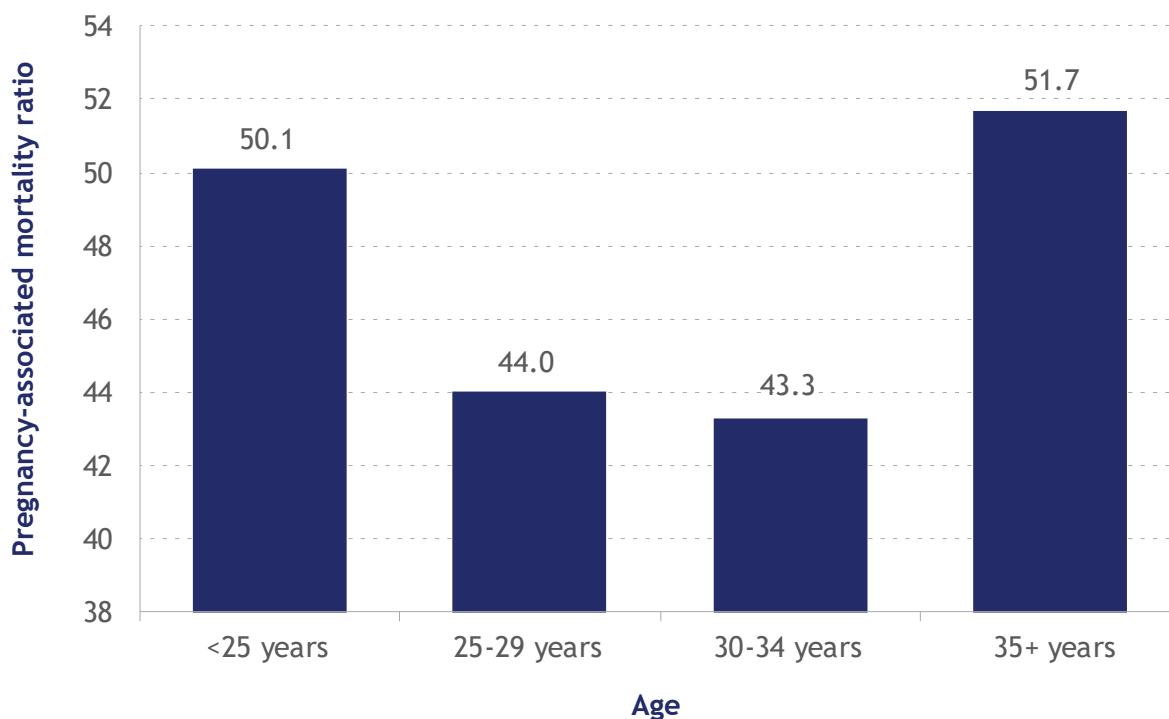
⁸ Rurality based on zip code of residence.

⁹ $p < .05$

In 2014-2016, there was not a significantly different percentage of pregnancy-associated deaths occurring among white, Hispanic, Black, and Asian Coloradans compared to the respective percent of all people giving birth in the same time period.¹⁰ There was, however, a significantly higher percentage of pregnancy-associated deaths occurring among Native American people compared to the percent of all Native American people giving birth in the same time period.¹¹ People of Native American descent were 4.8 times more likely to die than non-Native people who gave birth in the same period.

The demographic characteristics of the maternal mortality cohort are described in the below graphs as pregnancy associated mortality ratios. The pregnancy-associated mortality ratio (PAMR) is the number of deaths in that group divided by the number of births in that same group multiplied by 100,000.

Figure 2. Pregnancy-Associated Mortality Ratio (PAMR) by Age, Colorado, 2014-2016.



10 p >.05

11 p <.001

Figure 3. Pregnancy-Associated Mortality Ratio (PAMR) by Education, Colorado, 2014-2016.

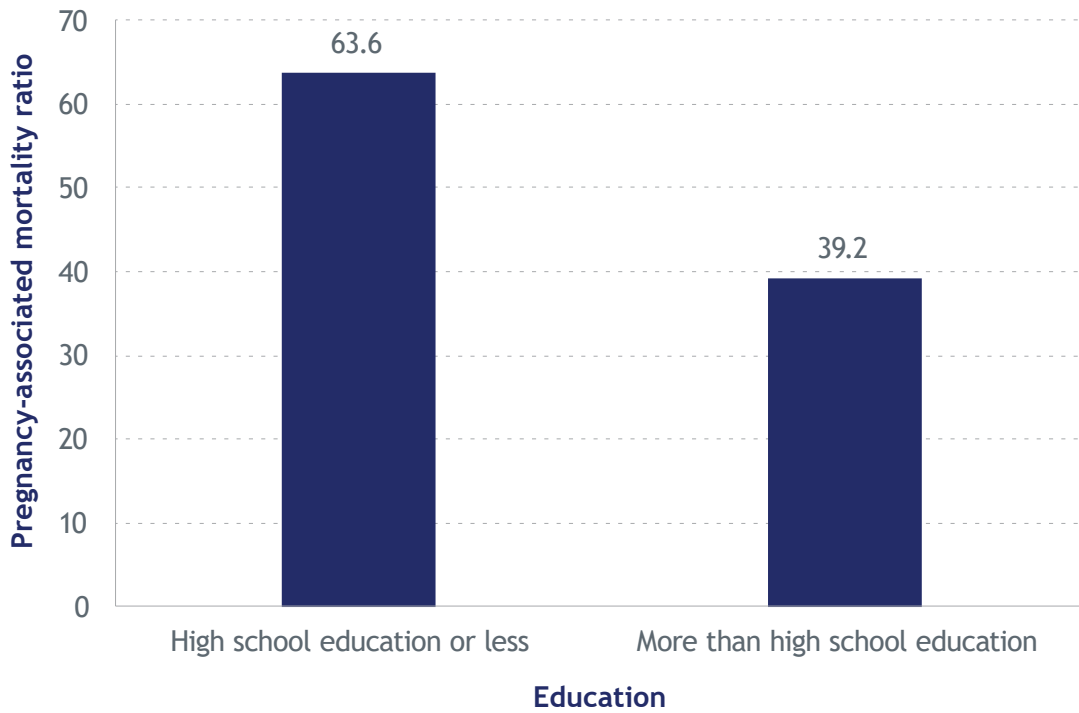


Figure 4. Pregnancy-Associated Mortality Ratio (PAMR) by Region, Colorado, 2014-2016.

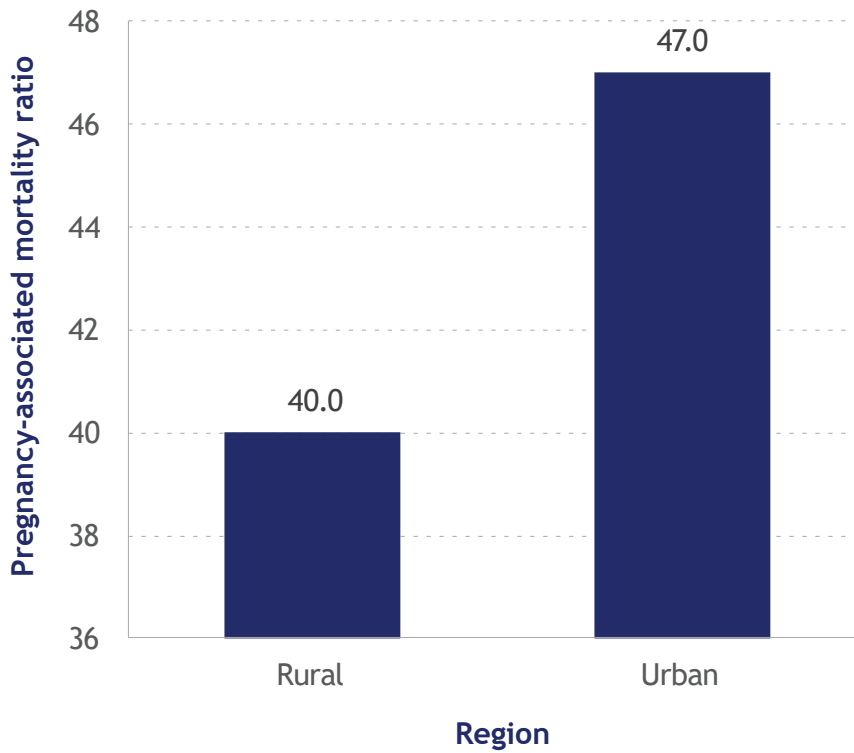


Figure 5. Pregnancy-Associated Mortality Ratio (PAMR) by Type of Insurance, Colorado, 2014-2016.

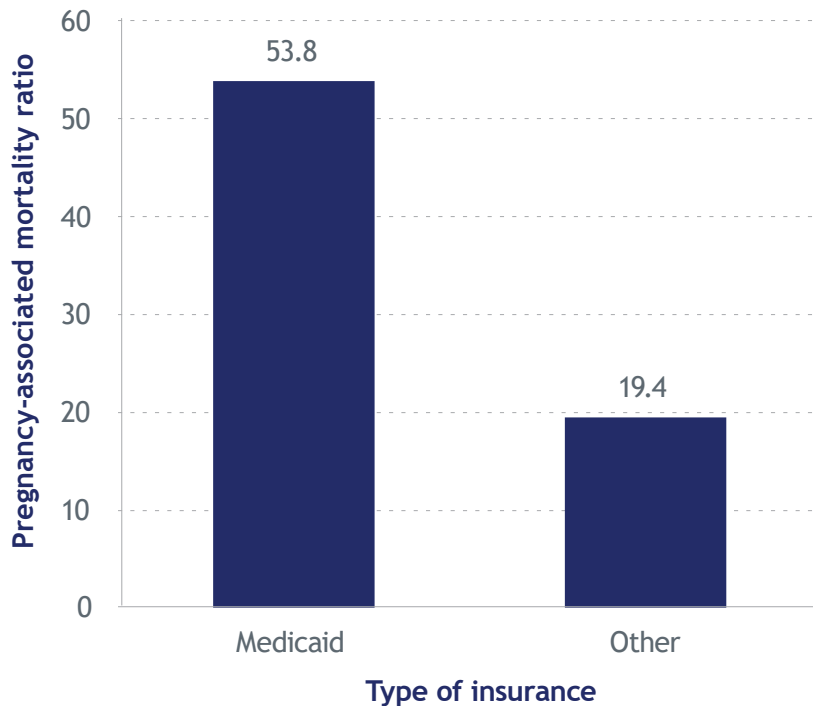
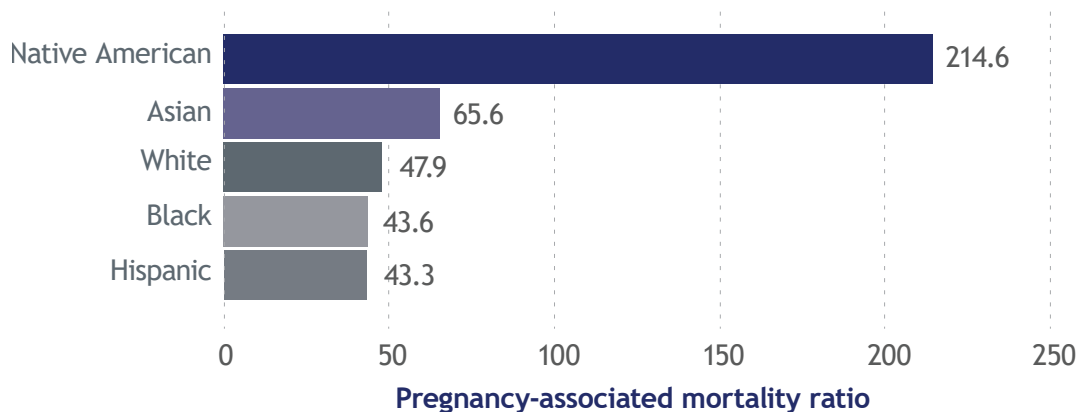


Figure 6. Pregnancy-Associated Mortality Ratio (PAMR) by Race/Ethnicity, Colorado, 2014-2016.



Timing of Death

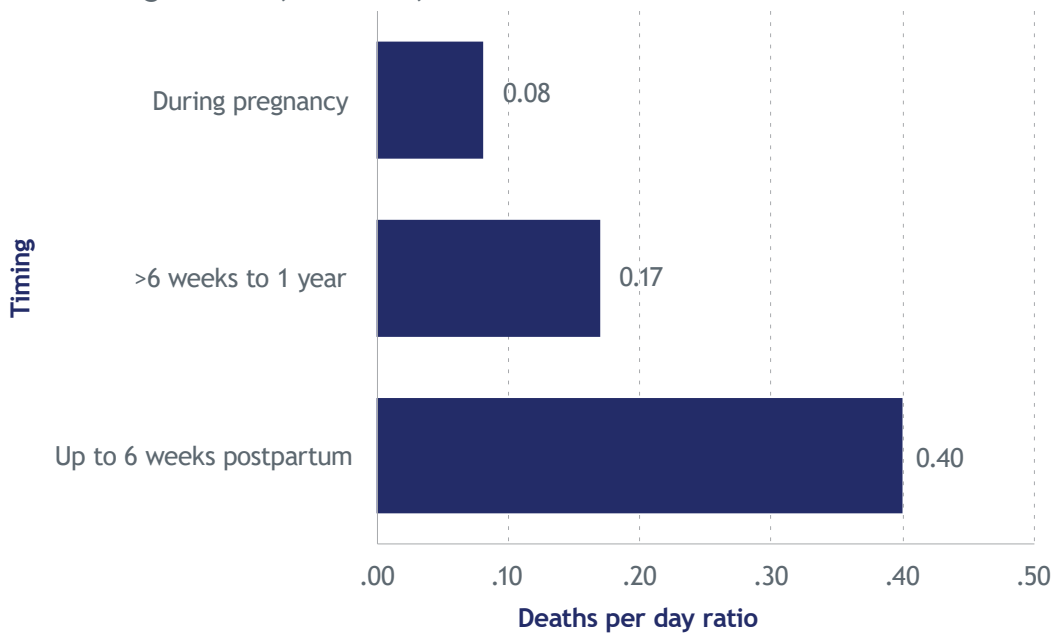
The timing of death is divided into three periods:

- During pregnancy.
- In the first six weeks (42 days) postpartum.
- Beyond six weeks (43 days) postpartum until one year (365 days) after the date the pregnancy ended.

The highest number of deaths occurred during the period from six weeks postpartum to one year postpartum (56 deaths), followed by deaths during pregnancy (21 deaths) and, lastly, the first six weeks postpartum (17 deaths). However, because these periods are not of equal length, it is important to look at the ratio of deaths per day. The highest ratio of deaths per day is in the first six weeks postpartum (0.41). The second highest ratio is during the six-week to one-year period (0.17) and the third highest is during pregnancy (0.08). People

died at a higher rate in the first six weeks after having a baby than during pregnancy or the 323 days after the immediate postpartum period.

Figure 7. Timing of Death, Colorado, 2014-2016.



Causes of All Pregnancy-Associated Deaths

During 2014-2016, the causes of pregnancy-associated deaths (deaths due to any cause during pregnancy and up to one year postpartum) fell into these ten categories:

- Suicide.
- Homicide.
- Drug overdose.
- Sepsis/infection.
- Injury (including motor vehicle crashes).
- Cerebrovascular accidents (stroke).
- Cardiac conditions.
- Thrombotic pulmonary embolism.
- Other obstetric complications, which includes amniotic fluid embolism, hypertensive disorder of pregnancy, ruptured ectopic pregnancy, and uterine rupture.¹² Notably, no deaths were caused by postpartum hemorrhage/bleeding.
- All other medical non-obstetric conditions, including cancer, autoimmune disorders, respiratory conditions, and others.

¹² The “all other obstetric complications” category was created due to suppression of any cause of death with fewer than five cases to protect individual identities.

The most common single cause of death was suicide, with 16 deaths. Despite this high number of suicide deaths, there was not a statistically significant difference between the percentage of suicide deaths in the maternal mortality cohort (17.0%)¹³ and the percentage of suicide deaths in the general population of women of childbearing age¹⁴ (12.9%).

The second most common singular cause of death was unintentional drug overdose, with 13 deaths, and the third most common singular cause of death was injury, with 10 deaths. Suicides by drug overdose were counted as suicide deaths, not drug overdose deaths. There was not a statistically significant difference in the rate of overdose deaths between the maternal mortality cohort (13.8%) and the general population of childbearing age (19.7%).¹⁵

Homicide accounted for eight of the deaths. More than half (five deaths) were committed by an intimate partner. There is a statistically significant difference between the percentage of homicides among the general population of women of childbearing age (3.7%) and maternal deaths (8.5%).¹⁶

Table 2. Causes of Pregnancy-Associated Deaths.

Cause of death	Number of pregnancy-associated deaths	Percentage of pregnancy-associated deaths
Suicide	16	17.0%
Drug overdose	13	13.8%
Injury (including motor vehicle crash)	10	10.6%
Homicide	8	8.5%
Cardiac conditions	7	7.4%
All other obstetric complications (hypertensive disorders of pregnancy, ruptured ectopic pregnancy, uterine rupture, amniotic fluid embolism)	7	7.4%
Sepsis/infection	6	6.4%
Cerebrovascular accident (stroke)	5	5.3%
Thrombotic pulmonary embolism	5	5.3%
All other non-obstetric medical causes of death (e.g. cancer, respiratory conditions)	17	18.1%

Pregnancy-Related Deaths

A death is determined to be pregnancy-related if it is the result of a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. Pregnancy-related deaths comprise a subset of all pregnancy-associated deaths.

The committee determined that 38 of the 94 maternal deaths (40.4%) that occurred between 2014 and 2016 were related to pregnancy. For 10 of the 94 deaths, the committee was unable to determine whether the death was related to pregnancy.

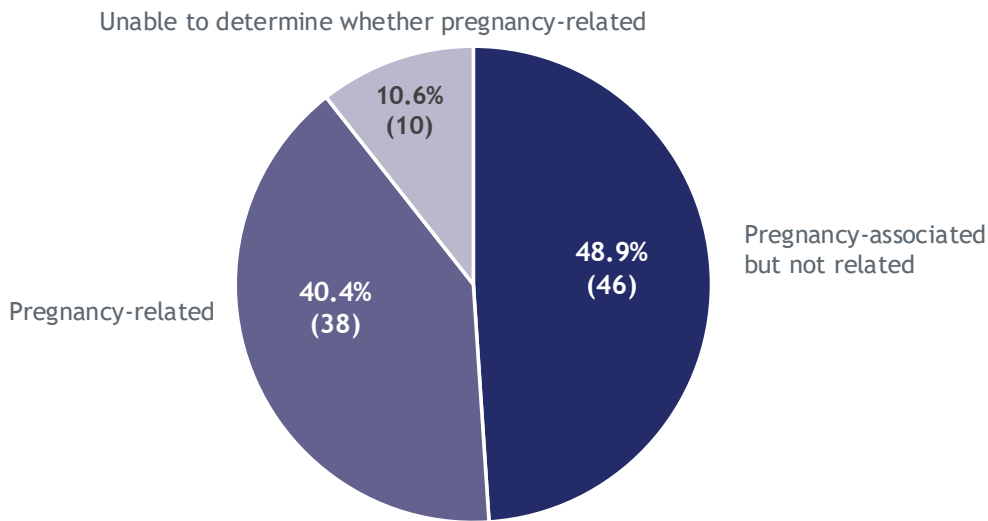
13 p >.05

14 In this report, childbearing age includes ages 15-44 years.

15 p >.05

16 p <.05

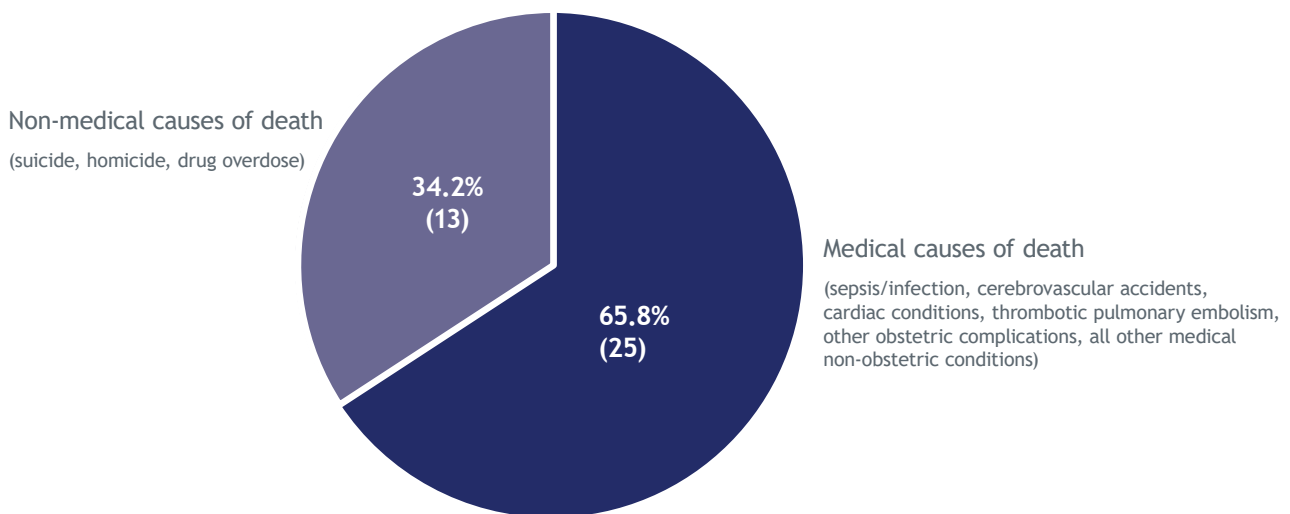
Figure 8. Pregnancy-Associated Deaths, Colorado, 2014-2016.



Because the 38 pregnancy-related deaths comprise a subset of all deaths, numbers have been suppressed for the rural deaths and deaths by race/ethnicity. The pregnancy-related mortality ratios (PRMR) per 100,000 births by demographic are listed in Appendix B.

Of the pregnancy-related deaths, 25 (65.8%) were caused by medical conditions and 13 (34.2%) had non-medical causes, including suicide, homicide, and drug overdose. Based upon the definition of pregnancy-related, the committee determined that seven of the 16 suicide deaths (43.8%) were related to the pregnancy. For example, if a person experienced depression for the first time during pregnancy or their mental health significantly deteriorated during the pregnancy, the committee may determine that the death is pregnancy-related.

Figure 9. Causes of Pregnancy-Related Deaths, Colorado, 2014-2016.



Contributing Factors

Based upon the available records, the committee determines whether substance use, mental health, and obesity contributed to the deaths. Of the 94 pregnancy-associated maternal deaths due to any cause from 2014

to 2016, the committee determined that either mental health or substance use¹⁷ contributed to nearly six out of ten deaths (58.5%). Mental health conditions contributed to 22 pregnancy-associated deaths, 10 of which were pregnancy-related. Substance use contributed to almost a third of both pregnancy-associated deaths (30 deaths) and pregnancy-related deaths (12 deaths). Overall, mental health conditions contributed to nearly one in four deaths. At seven deaths, obesity was a contributing factor in 7.5% of all pregnancy-associated deaths.

Figure 10. Percent of Pregnancy-Associated Mortality by Mental Health Contribution, Colorado, 2014-2016.

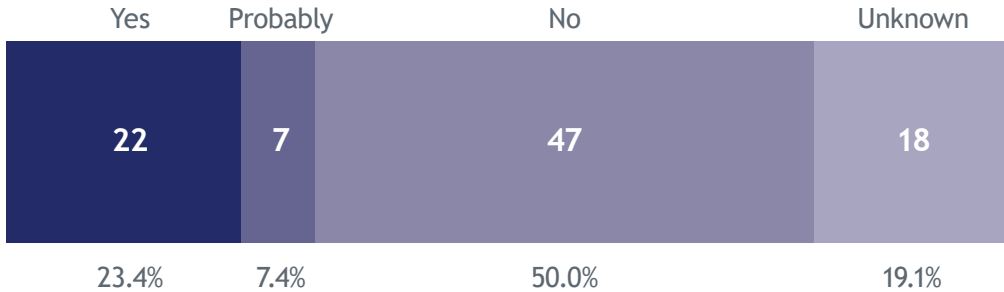


Figure 11. Percent of Pregnancy-Related Mortality by Mental Health Contribution, Colorado, 2014-2016.

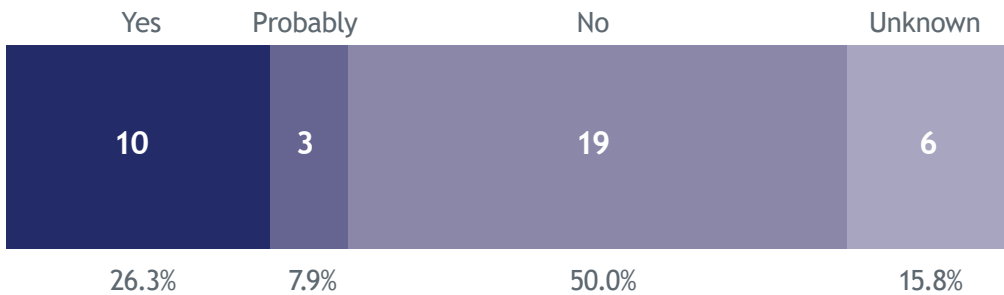


Figure 12. Percent of Pregnancy-Associated Mortality by Substance Use Contribution, Colorado, 2014-2016.

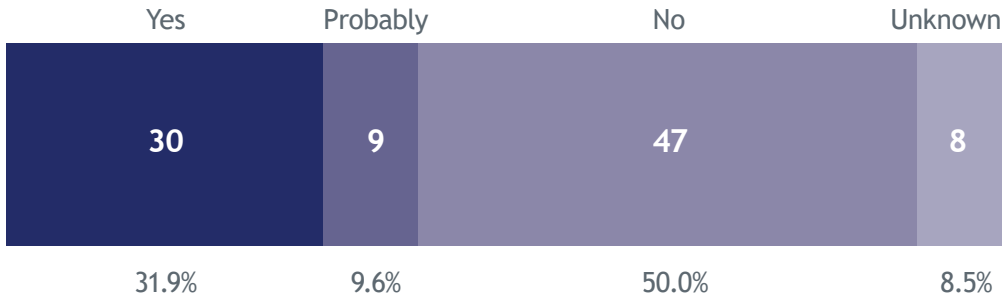
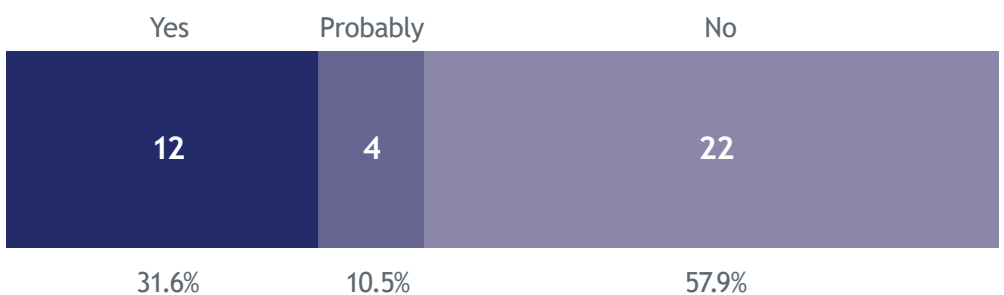


Figure 13. Percent of Pregnancy-Related Mortality by Substance Use Contribution, Colorado, 2014-2016.



¹⁷ This refers to substance use by the person who died. For example, substance use would not be considered a contributing factor to a maternal death caused by a motor vehicle crash in which someone else was intoxicated.

Figure 14. Pregnancy-Associated Mortality Ratio by Obesity Contribution, Colorado, 2014-2016.

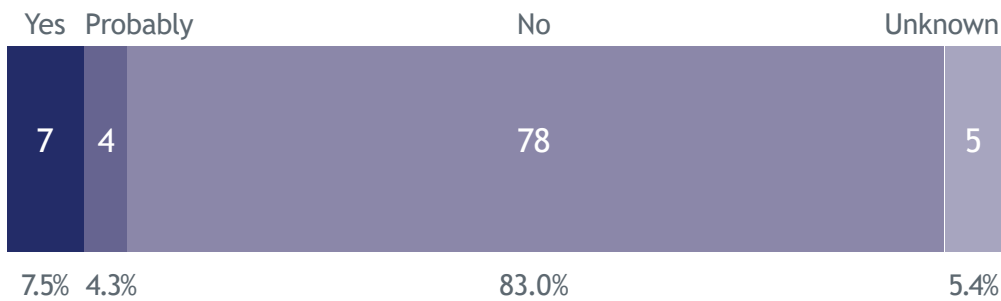
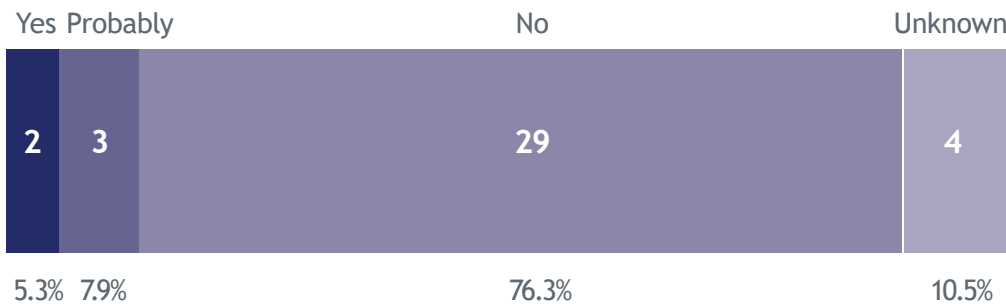


Figure 15. Pregnancy-Related Mortality Ratio by Obesity Contribution, Colorado, 2014-2016.



Additionally, the committee also determined factors on the levels of the patient/family, provider/care team, facility/facility system, public health system, and community. Below are the factors that contributed to the most common causes of maternal death.

The most frequent contributing factors for overdose deaths were:

- Poor continuity of care and care coordination. Care was fragmented among and between healthcare facilities or units within the same facility due to poor communication or lack of access to complete records.
- Lack of knowledge regarding importance of event or of treatment or follow-up by the patient or the provider.
- Inadequate community outreach/resources and lack of coordination between the healthcare system and other outside agencies/organizations for substance use treatment.

The most frequent contributing factors for suicide deaths were:

- Poor continuity of care and care coordination. Care was fragmented among and between healthcare facilities or units within the same facility due to poor communication or lack of access to complete records.
- Absent, inadequate, or unhealthy social support from family, partner, friends, or others.
- Factors placing the person at risk for a poor outcome were not recognized or acted upon.

The most frequent contributing factors for pregnancy-related medical deaths were:

- Poor continuity of care and care coordination. Care was fragmented among and between healthcare facilities or units within the same facility due to poor communication or lack of access to complete records.
- Lack of knowledge regarding importance of event or of treatment or follow-up by the patient or the provider.
- Clinical care providers were not appropriately skilled for the situation or did not exercise clinical judgment consistent with current standards of care.
- Provider delay in referring patients to care, treatment, or follow-up care, or patient delay in accessing such care.

The most frequent contributing factors for homicide deaths were:

- Physical or emotional abuse/violence perpetrated by current or former intimate partner, family member, or stranger.
- Absent, inadequate, or unhealthy social support from family, partner, friends, or others.
- Legal considerations that impacted the outcome, such as involvement in the criminal justice system.

Preventability

A death is considered preventable if the committee determines there was at least some chance of the death being averted by one or more reasonable changes at the patient, provider, facility, systems, or community levels. Guided by that definition, the committee determined that 72 (76.6%) of the 94 pregnancy-associated deaths were preventable. Of the 38 deaths related directly to pregnancy, 26 (68.4%) were determined to be preventable.

Figure 16. Preventability of Pregnancy-Associated Death, Colorado, 2014-2016.

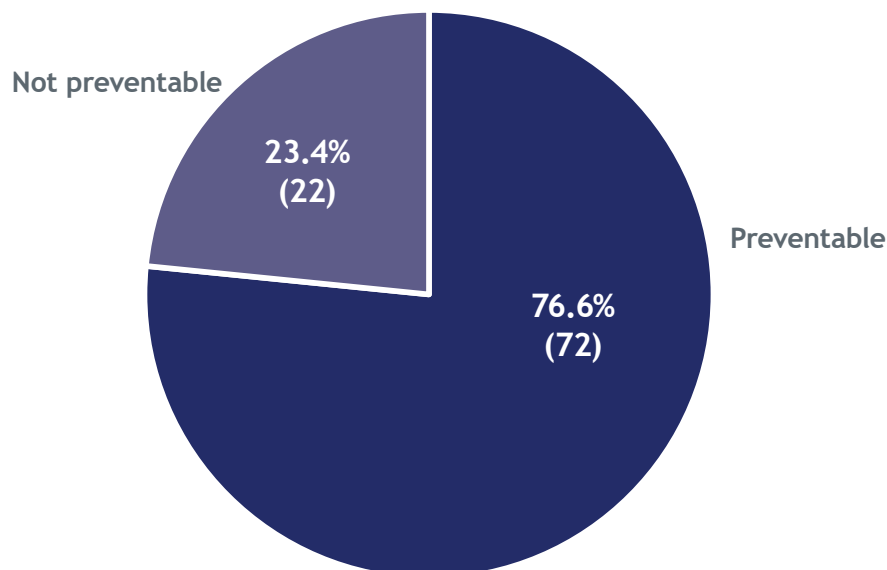
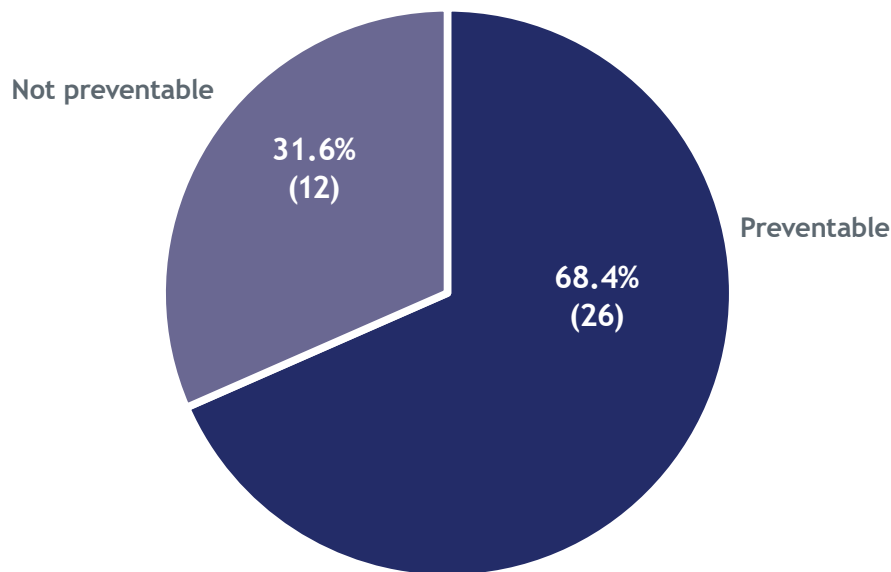


Figure 17. Preventability of Pregnancy-Related Death, Colorado, 2014-2016.



Stories Behind the Numbers

The following stories are composites of multiple pregnant and postpartum people who died in Colorado during this time period. All potentially identifying details have been changed to protect the privacy of those who have died and their families. They are representative of common themes across many people's lives and deaths as observed by the MMRC. These examples are brief vignettes extracted from full cases and include key points but do not represent the full complexities of people's lives.

Case #1

"Catherine" was an Asian woman in her late twenties in her second pregnancy. She had one previous pregnancy that ended in an early miscarriage prior to the current pregnancy. She lived with her husband in a suburban setting and worked in an office-based job. She had moved to Colorado recently and her family lived in another state. She had a few work friends, but was generally socially isolated. During her routine prenatal care when she was six months pregnant, she expressed anxiety, depression, and job-related stress. Prior to this pregnancy, she had not had any history of depression or other mental illness. Her obstetrician referred her to a therapist whom she saw twice. She declined medication treatment or further follow up for mental health during the pregnancy. She had an uncomplicated full-term vaginal birth. At her visit with her provider six weeks postpartum there was no documentation of screening for depression or other mood concerns and the provider's note in her medical records stated that she was "doing fine." Four months later, she called her obstetrician with concern that her depression was worsening. The obstetrician's office gave her an appointment in two weeks. Several days before that appointment, her neighbor found her in the garage with a lethal self-inflicted gunshot wound and a suicide note.

Case #2

“Jane” was a white woman in her twenties in her first pregnancy. After a sports injury three years earlier, she was prescribed Percocet several times a day to manage her back and hip pain as a consequence of her injuries. She attended five prenatal visits at three different facilities around her rural part of the state. During her pregnancy she received 12 prescriptions for Percocet from five different healthcare providers and three different pharmacies. Two providers consulted the Prescription Drug Monitoring Program before writing her a prescription. There was no note of her providers discussing or prescribing Narcan.

She had a full-term vaginal birth without complications. Following birth, the newborn was admitted to the neonatal intensive care unit for substance exposure due to her opiate use during pregnancy. After assessment of her opioid use, the hospital social worker referred her to an outpatient treatment program. Jane contacted the treatment program, but they would not allow her to bring her baby and she did not have childcare, so she did not pursue care.

After discharge from the hospital, she received six more opiate prescriptions and three prescriptions for benzodiazepines during the seven weeks following the birth from urgent care clinics, her primary provider, and the emergency department of the tertiary care hospital where she delivered her baby. There was no record of her attending a postpartum visit with her primary midwife.

Eight weeks after giving birth, she was found by her boyfriend unresponsive in their bed when he arrived home from work in the morning. He attempted CPR while awaiting 911 responders. Upon arrival, EMTs continued his efforts and administered Narcan, but were unable to revive her. He reported that when he left for work the previous night, she was having a glass of wine with dinner and caring for their infant. He knew she was struggling with pain from her injury, but was unaware of her opioid use. Her death was attributed to an unintentional overdose of opiates, benzodiazepines, alcohol, and acetaminophen (Tylenol).

Case #3

“Sandra” was a Hispanic Latina woman in her late thirties who had just had her fifth baby at the time of death. She lived with her children and her spouse and was a stay-at-home parent. She spoke Spanish and limited English.

Her first two babies were born in Mexico and for the last three she received care at a federally qualified health clinic and delivered at a local hospital, which was unaffiliated with the clinic. All five of the infants were born by cesarean section, and during three of the pregnancies she was diagnosed with gestational diabetes requiring insulin. Her pregnancies were also considered high risk because of her weight. At the time of her fourth birth, she requested a tubal ligation

or IUD but she was unable to get them because she did not have insurance and could not pay for them out-of-pocket.

In her fifth pregnancy, she was admitted to the hospital at 34 weeks gestation for uncontrolled diabetes. After two weeks in the hospital for diabetes control, her baby boy was born via cesarean section at 36 weeks gestation. After the cesarean birth, she had an uncomplicated postpartum course and was discharged from the hospital three days after the birth. In her discharge note, the physician noted she was at increased risk for a deep vein thrombosis due to her age, number of pregnancies, gestational diabetes, cesarean section, and her weight, and therefore required anticoagulant injections. The discharge orders did not show that she received a prescription for the injections, and there was no evidence that she received discharge instructions about the anticoagulant. There was no record of anyone reviewing all of her medications together.

Eight days after being discharged from the hospital her husband brought her to the emergency department unconscious. He reported that she had been complaining of pain in her right leg for a couple of days and that evening she had difficulty breathing and chest pain, then became unresponsive. She was diagnosed with a pulmonary embolism resulting from a deep vein thrombosis. She was put on a ventilator in the intensive care unit and did not regain consciousness. After five days, the physicians and hospital chaplain discussed with the family that there was no brain activity on testing and that she would not recover. The family decided to withdraw life support and she died within two hours.

Case #4

“Shelley” was a Black woman in her thirties with a history of infertility, obesity, and mild chronic hypertension who was pregnant for the first time at the time of her death. She initiated prenatal care early in pregnancy and attended visits regularly. At several prenatal visits her blood pressure was mildly elevated, although not requiring medication. Laboratory tests for preeclampsia were normal 12 days prior to her death. At a routine prenatal visit one week before her death, her obstetrician noted she had swelling in both ankles that was attributed to normal changes of pregnancy. She called her provider three days before her death with a complaint of feeling poorly and changes in her vision and was told to monitor symptoms at home. At 32 weeks gestation she was found unresponsive in bed by her husband. She had no cardiac or respiratory function and her death was pronounced on the scene. He reported that she had texted him that she had a headache before she went to bed. Autopsy found the cause of death to be complications of eclampsia (high blood pressure and seizure caused by pregnancy).

Case #5

“Nicole” was a white woman in her late twenties who presented several times during her pregnancy to several local emergency departments for injuries. At the first visit, she told the intake coordinator that she had fallen. At two different emergency departments she reported to the healthcare team that the injuries were the result of fights with her husband when they were using methamphetamine. It was unclear from the medical record whether law enforcement was contacted about the altercations. The last time she went to the emergency department during pregnancy included documentation of strangulation marks on her neck. Law enforcement was contacted and a restraining order was placed on her husband.

Throughout her pregnancy, Nicole was receiving regular prenatal care at a private obstetrician’s office. There was no record of screening for intimate partner violence in her prenatal care, delivery, or postpartum medical records. The obstetrician did not have access to the electronic emergency department records because the local emergency department was in a different hospital than where she gave birth.

Nicole was found deceased in her home by her mother three months postpartum. According to the coroner’s report, her cause of death was multiple severe contusions consistent with intentional physical assault. Her husband was charged for her murder.

Case #6

“Jennifer” was a Native American woman in her thirties who was five weeks pregnant at the time of her death. She was the driver and only occupant of a car that was hit by an oncoming vehicle at an intersection. She was wearing a seatbelt. Information about her death was primarily from autopsy and police reports. A toxicology screen was performed on autopsy, which was positive for nicotine, indeterminate for cannabis, and negative for alcohol and other recreational substances. Traffic safety officials later determined that the intersection was unsafe and updated signage around the intersection.

Recommendations from the Committee

After analyzing the cases and the contributing factors, the committee identifies recommendations for preventing deaths, ensuring good maternal health, and improving the health care and public health systems to better meet the needs of pregnant and postpartum Coloradans.

In their review of 94 cases of maternal death from 2014-2016, the committee identified 484 recommendations. An adapted grounded theory qualitative analysis was then conducted of all 484 recommendations to determine the prevalence of causes and how preventable they were. With the grounded theory method, researchers generate themes and theories based on patterns in the qualitative data. The result of this analysis was 13 prioritized recommendations that were presented to community members for feedback and input. These are discussed in detail in the next section of this report.

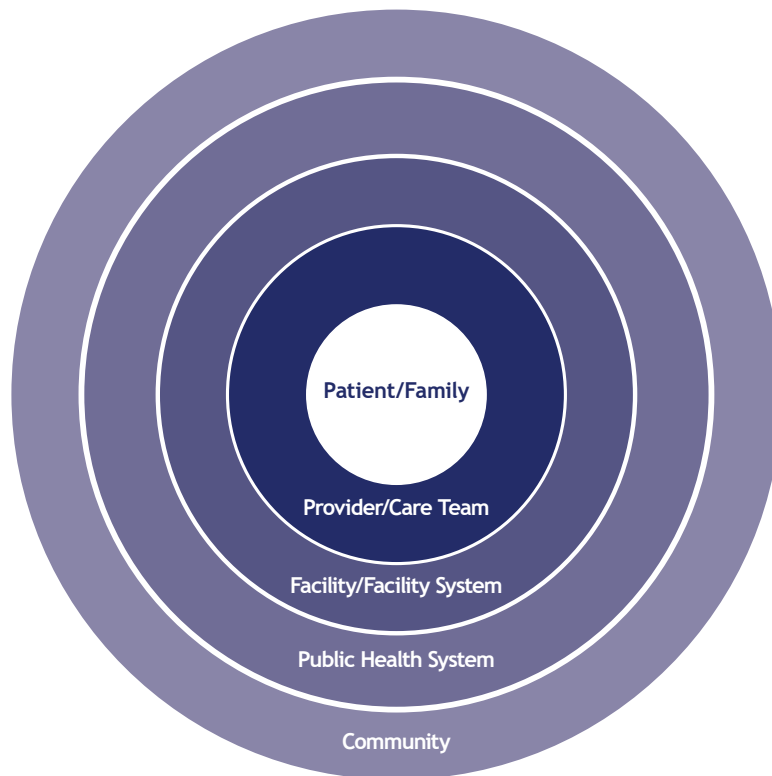
DISCUSSION AND RECOMMENDATIONS

The committee’s analysis and review of maternal mortality in Colorado from 2014 to 2016 has yielded insights about the causative factors that lead to maternal death. This section explores those factors in greater detail and describes steps that could be taken to improve maternal health across the state.

Preventability

Determining whether a maternal death was preventable is one of the committee’s most important tasks. While it is important to understand the prevalence of factors that lead to maternal death, it is difficult to take informed action without knowing if and how these deaths could have been prevented. The committee looks beyond a simple “yes” and “no” to the question of preventability to assess the degree to which these factors are preventable. This assessment is reflected in the recommendations they make.

A death is considered preventable if the committee determines there was at least some chance of the death being averted by one or more reasonable changes to factors at patient, provider, facility, systems, or community levels. Guided by that definition, the committee determined that approximately three out of every four pregnancy-associated deaths and approximately two out of three deaths related directly to pregnancy were preventable on at least one of these levels.



The stories from the previous section illustrate changes that could have been made at multiple levels to prevent the death in each case. Below are examples of how their deaths could have been prevented at just one of these levels.

- Patient/family level: “Nicole’s” family life was not safe and, ultimately, she was killed by her partner. Intimate partner violence has many opportunities for prevention, including better access to trauma-informed care and protective and supportive services.

- Provider/care team level: “Shelley” died from complications of eclampsia (high blood pressure and seizure due to pregnancy) because best practices for screening and monitoring for eclampsia—or providing patient education about it—were either not in place or not followed.
- Facility/facility system level: “Sandra” died from a blood clot that a hospital provider knew was a risk, but she did not receive the necessary medication and education due to a lack of facility-level protocols.
- Public health system level: “Jane” did not have access to substance use treatment that enabled her to continue to care for and bond with her infant.
- Community level: “Jennifer” died in an intersection with traffic safety issues that were not addressed until after her death.

Suicide, Substance Use, and Homicide Are Leading Causes of Maternal Death

As the most common single cause of maternal death during 2014-2016, suicide is a key issue to address to prevent future maternal deaths. While the rate of suicide among pregnant and postpartum people was a bit higher than that of the general population of women of reproductive age, the difference was not statistically significant. Still, given how frequently pregnant and postpartum people interact with the health care system and see providers, mental health issues and suicide risk should be more likely to be identified and addressed for pregnant and postpartum people. Other data sources, such as the Pregnancy Risk Assessment Monitoring System (PRAMS), suggest that postpartum depression is one of the most common complications of pregnancy. In Colorado during 2014-2016, 10.4% of women of reproductive age reported experiencing postpartum depression,¹⁸ and there is evidence that this problem persists. Colorado’s Health eMoms survey data from 2018 show that nearly 1 in 3 people who responded to the survey noted symptoms of a possible anxiety disorder in the postpartum period, demonstrating an ongoing need to address mental health concerns. The committee identified care coordination, timely referral to mental health services, and access to such services as important steps to take to prevent future maternal deaths by suicide. In addition, the committee pointed to social isolation as a risk factor for depression and suicide.

Similarly, unintentional drug overdose is a leading cause of maternal death. While pregnant and postpartum people did not have a higher rate of death from drug overdose than the general childbearing population, pregnant and postpartum people should have more touch points with the health care system that provide additional opportunities for intervention. The committee’s findings show that evidence-based therapies, including medication-assisted therapy, remain difficult to access for many people. Providers should also use tools like the Prescription Drug Monitoring Program to identify risk for drug overdose and modify their prescribing to take the risk of overdose into greater consideration. By strengthening screening and treatment of substance use disorders, supporting care focused on both mother and infant, and strengthening the postpartum transition from obstetric care to primary care, Colorado can reduce the risk of maternal death.

The rate of homicide for pregnant and postpartum people was over double that of the general childbearing population. Both quantitative and qualitative data from the 2014-2016 review indicate that pregnant and postpartum people are at a higher risk for injury and death from intimate partner violence: more than half of the homicides were committed by a partner. The committee found that opportunities for prevention lie in

¹⁸ Pregnancy Risk Assessment Monitoring System (PRAMS). Colorado Department of Public Health and Environment. 2014-2016.

improved screening for psychosocial factors, better and more consistent assessment of injuries, and better systems of follow-up and support for people experiencing intimate partner violence.

Inequity in Maternal Health Persists

The results of the committee's analysis indicate that Colorado has inequities in maternal health that must be addressed. These inequities are threaded throughout all levels of preventable factors and exacerbate the challenges presented by these factors.

Racial Inequity

For 2014-2016, the committee's results revealed that Native American people have a higher rate of maternal death than other racial or ethnic groups in Colorado. People of Native American descent were 4.8 times more likely to die than non-Native people who gave birth in the same period. This finding indicates not only that there is work to do to support maternal health for Native Americans giving birth in Colorado, but also that there are racial inequities in Colorado that require attention. Anytime racial disparities emerge from health data, it is a cause for concern, reflection, and action. Any disparity observed in a population based on race or other social factors is unacceptable and must be investigated and addressed—in this case, for Native Americans but also for any other group that has historically experienced bias and inequity. Although data from this period do not suggest a higher maternal mortality rate for Black pregnant and postpartum people, this does not necessarily indicate a trend. The current data do not have the strength to imply that this gap has been closed, or that the Black community experiences health outcomes equivalent to those of white or Hispanic people in Colorado. Because the number of maternal deaths is low (only 94 in a three-year period), just one or two deaths can change the apparent disparity outcomes. The national maternal mortality data indicate that Black pregnant and postpartum people are at a higher risk for maternal death; therefore, Colorado must remain vigilant about the possibility of such a disparity even if it did not emerge during this time period.

Individual bias, particularly implicit bias, can play a role in these inequities; for example, some people are not heard and believed by their providers due to perceptions and prejudices based on race or other social factors. However, individual bias intersects with, and evolves out of, institutional inequities. While addressing inequity includes addressing interpersonal bias, it primarily means addressing its roots in institutions, structures, and systems. This is why education and training alone do not solve the problem. Instead, the root causes of structural and systemic inequities need to be addressed at the level of policy and practice by redressing differences in the availability of resources and opportunities that are embedded in organizations, systems, and policies. Encountering systemic barriers such as these, particularly on a daily level, not only affects the period of pregnancy and postpartum, but builds during the entire lifetime of a person, often resulting in traumatic or toxic stress and increasing the risk for chronic health conditions, mental health concerns, and substance use.

In addition, Native American people experience daily barriers related to laws and systems that inconsistently honor tribal sovereignty and agreements to fund health care and other services for Native American people. Addressing health inequities requires renewed commitment to intergovernmental relations between state/local governments and sovereign Tribal Nations, as well as proactive collaboration with Urban Indian Health Organizations and community groups.

It is both urgent and possible to address systemic inequities in maternal health based on social structures such as race and socioeconomic status to achieve equity not only in maternal health outcomes but also

more broadly in the health care system and across communities. Camara Jones, MD, MPH, PhD, a family physician, epidemiologist, past president of the American Public Health Association, and health equity expert, summarizes this responsibility succinctly: “Addressing racism—indeed addressing all systems of structured inequity as they all share the same structure—will require valuing individuals and populations equally, recognizing and rectifying historical injustices, and providing resources according to need.”¹⁹

Inequity Based on Socioeconomic Status and Health Insurance Coverage

The review also revealed that people with a lower education level have poorer maternal health outcomes. People who died during pregnancy or within a year of the end of pregnancy were 1.6 times more likely to have a high school education or less than others who gave birth during the same period.

The data also suggest that pregnant and postpartum people who died were more likely to have been publicly insured (covered by Medicaid, Medicare, or Tricare). Based on the data available, people who died during pregnancy or within a year of the end of the pregnancy were 2.8 times more likely to be insured by Medicaid than others who gave birth during the same period. Although the data set is incomplete, this possible relationship should be explored because many births in Colorado are covered by Medicaid—over one-third (38.8%) during 2014-2016. This may present an opportunity for Colorado to understand the barriers Medicaid members are facing and create policy, processes, information, and training to address them. The MMPP has received grant funding from the CDC to improve data collection and tracking and enable integration with the Medicaid data system. These data enhancements will help provide a more accurate and comprehensive picture of the relationship between social factors and maternal deaths.

Addressing the Roots of Inequity in Maternal Health

The committee’s methods lend themselves well to investigating and discovering the sources of inequity found in the structures and systems people interact with during pregnancy and the postpartum period and throughout their lives. By carefully reviewing contributing factors at all levels, the committee can look at the role of the social determinants of health in maternal health outcomes. These social determinants reflect unequal access to resources necessary for good health: housing, access to healthy food, access to health care, clean air and water, education, a strong social support network, and economic opportunities. The committee also seeks to understand the role that the daily experience of bias and racism play in health outcomes and quality of life.

Addressing inequity in maternal mortality is not only about preventing death and serious illness, as important as those goals are. It is about supporting equitable maternal health care systems that lead to good health outcomes for all. Doing this will require working closely and authentically engaging with communities. Community engagement and partnership have been a critical component of success for groups promoting equity. People of color-led disability justice movements and reproductive justice movements offer some of the strongest examples and models of how to approach this work.

¹⁹ Jones CP. Foreword: An APHA Perspective. In: Ford CL, Griffith DM, Bruce MA and Gilbert KL, eds. Racism: Science and Tools for the Public Health Professional. 2019. <https://ajph.aphapublications.org/doi/full/10.2105/9780875533049fm1>

Recommendations

Given the maternal mortality findings for 2014-2016 and the greatest opportunities for prevention of death and promotion of maternal health, the committee has made the recommendations described below. These recommendations are a starting place for discussion among policymakers, maternal health stakeholders, and communities as they decide which actions they will take to prevent maternal mortality and foster greater and more equitable maternal health across the state.

Eliminate structural and interpersonal bias and discrimination in the delivery of services and supports needed by pregnant and postpartum people.

The committee recommends that the state MMPP and other organizations work to eliminate discrimination based on race, cognitive status, disability status, immigration status, gender identity, sexual orientation, or other factors. Bias must be addressed at all levels of the system, including through providers, health facilities, and public health systems. It is important to raise awareness of explicit bias and especially implicit bias, and offer training and other evidence-based strategies to mitigate it. To ensure full access to care, it is important that services be offered in the language an individual speaks. Finally, efforts must also be made to recruit, hire, and retain a diversity of care providers to all roles in health care and social services. As part of this effort, workplaces should take steps to assess that the workplace setting is equitable for diverse staff. The committee recommends that equity be considered and woven throughout the implementation of all subsequent recommendations.

Integrate universal screening and connection to treatment for mental health conditions into maternity care.

The committee recommends that routine pregnancy and postpartum care include universal screening of mental health conditions with screening tools that have been validated cross culturally. Universal screening will help decrease the stigma of mental health conditions. In addition, increased screening and awareness of perinatal mood and anxiety disorders across clinical specialties will increase opportunities for pregnant and postpartum people to get appropriate and timely high-quality treatment of perinatal mood and anxiety disorders. However, screening is only helpful if treatment is available. Colorado must invest in mental health care statewide to ensure that needed care is available from an appropriate mental health provider network.

Integrate universal screening and connection to treatment for substance use disorders into maternity care.

Similarly, the committee recommends that pregnancy and postpartum care include universal screening and referral to treatment for substance use disorders. The committee found that it is essential for screening and treatment to be non-punitive, supportive, family-centered, and culturally relevant. However, the current shortage of substance use treatment providers will not meet the need. Colorado must invest in bolstering this system so that treatment can be provided and coordinated with maternity care providers. Treatment should include medication-assisted treatment as needed.

Improve opioid prescribing practices.

To help prevent substance use disorders or dangerous drug combinations, the committee recommends that providers use evidence-based protocols for prescribing opioids. Providers should consult with pain management specialists or receive continuing education as needed to help with appropriate pain management in pregnant and postpartum people. Providers should also use the Prescription Drug Monitoring Program (PDMP) when prescribing to find out what other medications the person has been prescribed and work with the person to make decisions about medication.

Improve evidence-based screening and counseling methods for psychosocial risk factors, including intimate partner violence.

Screening and counseling, especially for psychosocial risk factors, is fundamental to supporting maternal health. The committee recommends creating more options and locations for screening and counseling, including virtual/online services and locations that serve pregnant and postpartum people, such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Screening and counseling for behavioral health issues (such as mental health and substance use disorders), intimate partner violence, and social determinants of health require community-led solutions that have been shown to work across contexts and in different communities. Evidence-based strategies, such as motivational interviewing, should be explored and used consistently. Screening for psychosocial risk factors should be comprehensive and coordinated because these risk factors are often interconnected.

Improve care coordination for maternity care.

A healthy pregnancy and postpartum period requires services and support from across the health care system, as well as from agencies and organizations outside the health care system. The broken links and poor coordination across these systems are dangerous for the health of all people and certainly for pregnant and postpartum people. In particular, the systems and individuals who provide services during pregnancy are not necessarily the ones who provide postpartum services, and therefore need to be connected. Those who are birthing need to be connected to a place that offers them the right level of care based on their needs and risk factors. Ongoing outreach and assessment of needs is essential not only during pregnancy but in the postpartum period. Coordination among health care providers, social services, behavioral health providers, and community support organizations ensures that pregnant and postpartum people get the care they need to be well during and after pregnancy.

Improve electronic medical records.

An important part of good communication and care coordination is an electronic health record that can be accessed by all providers giving care during pregnancy and postpartum, with all necessary privacy and security measures in place to protect private health information. This is a systems-level recommendation that calls for universal electronic medical record systems that are accessible and interoperable with one another and with tools such as the Prescription Drug Monitoring Program (PDMP). The committee recommends that these records could be family-centered rather than individual-centered, linking the records of the postpartum person and their infant to facilitate dyad care.

Improve coordination and efficiency among public health, social services, and health care systems.

Health care providers are only one piece of the support network accessed by pregnant and postpartum people. The committee recommends that systems be established to connect agencies and organizations that provide care and support to a pregnant or postpartum person. This includes maternal and child health-focused care coordination and home visiting programs, as well as programs and systems that provide food or housing assistance or shelter from domestic violence, and those that address child welfare, law enforcement and criminal justice. It is critical for these organizations and systems to work together to foster supportive connections with parents during the first year of a child's life. The committee recommends establishing a system that would allow these organizations to communicate, make referrals, and learn the outcome of a referral made. In addition, the committee recommends that when feasible, organizations co-locate their services to improve accessibility.

Improve access to care during preconception, pregnancy, and postpartum.

Access to care prior to conception provides opportunity to identify needs, address risk factors and improve health status before entering the critical period of pregnancy. Access to care during pregnancy allows for ongoing management of any chronic health conditions, early identification of emerging pregnancy-related concerns and an opportunity to connect people to services that support their wellbeing before an infant is born. Access to care in the postpartum period ensures appropriate follow-up on medical conditions that have developed or worsened during the pregnancy or in the early postpartum period, creates opportunity to address maternal mental health needs, and supports positive parent-infant connections. The committee recommends expanded access to alternative methods of providing care, including telehealth, and expanded access to the range of services needed, including mental health services and medication-assisted therapy for substance use treatment. By removing barriers to care, people can receive the timely and necessary care needed to manage health conditions appropriately before, during, and after pregnancy.

Improve quality and standardization of clinical care for medical and obstetric complications.

Due to the complexity and range of factors involved in pregnancy and postpartum health, consistent use of best practices and clinical protocols is needed to improve decision making for diagnosis, treatment, and follow-up at every stage. Consistent use of currently available, standardized tools can help clinicians assess which concerns are a normal part of pregnancy and postpartum and which need additional care and attention. Issues that the committee specifically named as requiring better adherence to best-practice protocols and guidelines include:

- Providing prevention and treatment for deep vein thrombosis (blood clots).
- Recognizing and treating sepsis.
- Evaluating new headaches.
- Managing high blood pressure.
- Managing pain with limited and monitored opioid use.
- Counseling patients on obesity and providing treatment.
- Using single embryo transfer for in vitro fertilization (IVF).

To improve quality of care, providers need more time with patients, easier and more consistent referral processes, multidisciplinary care conferences, and continuing education on best clinical practices, as well as interviewing and counseling skills.

Redesign postpartum care to include an extended timeframe, dyad care, and family-friendly employment policies.

The postpartum period, which is considered to be up to a year after giving birth, is a vulnerable time for both parent and child. And yet, care and support for the parent often drops off within the first six weeks after birth and interactions with the health care system occur almost exclusively through pediatric care systems focused on the infant. The committee recommends standard postpartum care be provided to the birthing parent through one year postpartum to monitor their health and mental health status, provide support during this transition period, and ensure access to treatment for any concerns that arise. This includes both extending insurance coverage and benefits to ensure access to care and changing the standard postpartum care protocols to include additional postpartum visits at regular intervals beyond the current single visit at six weeks postpartum. This care should be provided within the context of caring for the infant and include connections to care that support the mother-infant bond, including dyad care, which supports the interconnected physiologic changes that happen to both mother and infant in the hours and days after birth.

Critical to the wellbeing of parents and their infants during the first year postpartum is supportive family-friendly employment policies, including paid family leave. Maternal mental health improves with paid leave, which affords a new parent support in the transition to parenthood and improves bonding with their infant.

Implement trauma-informed maternity care.

The committee recommends that health care and social service providers who work with pregnant and postpartum people practice trauma-informed care. Pregnancy, childbirth, and the postpartum period can bring existing traumas to the surface and create new traumas (such as birth trauma). Trauma-informed care includes screening for adverse childhood events, providing care in a way that demonstrates sensitivity to trauma, and referring people for the mental health care they need for trauma that occurs prior to, during, or after pregnancy.

Improve family planning care.

Family planning, or the ability to choose if and when to have children and in what ways, is essential to the health and wellbeing of people before, during, and after a pregnancy. To help people make these choices, people who could become pregnant should have access to preconceptional counseling, especially if they have chronic conditions. Culturally appropriate family planning care should be covered by insurance and include options for preventing pregnancy and options for building a family. Clinicians should have access to specialist consultation for patients with conditions that may complicate the use of contraception, and should have protocols and training for how to assess pregnancy intendedness.

Improve the maternal mortality review process.

The committee recommended the following improvements to the maternal mortality review process:

- Detailed and standardized scene investigations and death investigations.
- Detailed and standardized perinatal autopsies, including standardized toxicology.
- Shared decision-making with families of a deceased person about performing autopsies.
- Improved access to medical records for death review, including records from law enforcement, child protective services, and the criminal justice system.
- Key informant interviews with families of a deceased person.

Current Work to Support Maternal Health

The state Maternal Mortality Prevention Program (MMPP) uses the committee’s analysis and findings to shape its data collection and maternal health programs to fill gaps and address the preventable causes of maternal death that are within its mission and scope.

Title V Maternal and Child Health Program

The MMPP works closely with the Title V Maternal and Child Health (MCH) program, a federally funded program that works with local public health agencies statewide to improve the health of Coloradans using population-based and infrastructure-building strategies. The Title V MCH program offers an opportunity to improve the health and wellbeing of pregnant and postpartum people and their children by employing primary prevention and early intervention public health strategies. Priorities for the upcoming MCH block grant cycle are to: increase prosocial connection, create safe and connected built environments, improve access to supports, increase social emotional wellbeing, promote positive child and youth development, increase economic mobility, and reduce racial inequities.

Health eMoms

Since 2018, the MMPP has been leveraging the information and insight from Health eMoms, a series of surveys that captures real experiences from mothers across Colorado to inform how to better support them and their babies. Each year, the program invites 2,400 Coloradans to participate in Health eMoms and share their opinions and experiences during the first few years of their babies’ lives. People who join Health eMoms receive two brief online surveys on a variety of health and social topics each year starting shortly after they give birth and continuing up until their child’s third birthday. Topics on the survey include breastfeeding, vaccinations, maternal mental health, maternal leave, finance and resource insecurities, marijuana and other substance use, and more.

This survey allows CDPHE to collect information to understand nuances of the pregnancy and postpartum experience that might otherwise be overlooked. Maternal deaths are comprehensive case studies that provide rich data for a relatively small number of people. Health eMoms offers the opportunity to gain insight from more Coloradans about how Colorado can support maternal health and wellbeing. For example, the maternal mortality

review process has illuminated the fact that some women do not discuss their depression or anxiety with their providers. Data from the Health eMoms surveys offer insight into why these conversations are not happening.

Colorado Maternal Mental Health Collaborative and Framework

MMPP staff participate in the Colorado Maternal Mental Health Collaborative and Framework, a central source for Coloradans to collaborate and move toward improved mental health and wellness for all pregnant and postpartum people in Colorado. The Collaborative is actively working to build an equitable mental health system that is flexible and responsive to the differing needs and desires of all families. The MMPP is a stakeholder and contributor to the collaborative, primarily sharing data and information.

The findings section of this report describes how often mental health problems and substance use disorders are a factor in maternal deaths. Pregnancy-related depression is the most common complication of pregnancy, with more than one in ten pregnant or postpartum Coloradans affected by it.²⁰ For these reasons, the work of the collaborative is a priority. The collaborative works on a number of levels, connecting individuals with care, providing education, building the mental health workforce, and advocating for system change.

Colorado Perinatal Care Quality Collaborative and Alliance for Innovation on Maternal Health

The MMPP partners with the Colorado Perinatal Care Quality Collaborative (CPCQC), a statewide nonprofit network of hospitals, healthcare facilities, clinicians and public health professionals that improves the health of women and infants through continuous quality improvement. This group focuses on the clinical health care quality issues and interventions that affect maternal health.

In 2019, Colorado joined the national Alliance for Innovation on Maternal Health (AIM). CPCQC is the lead organization of this statewide effort. With funding from the Health Resources and Services Administration, AIM aligns national, state, and hospital level efforts to improve maternal health and safety and provides evidence-based resources for improving care processes and patient outcomes for people with high-risk maternal conditions. These protocols and resources, or “patient safety bundles,” give clinical guidance for assessing and treating specific issues, such as reducing cesarean births. The CPCQC is a key partner for implementing the clinical quality improvements recommended by the Maternal Mortality Review Committee.

²⁰ Pregnancy Risk Assessment Monitoring System (PRAMS). Colorado Department of Public Health and Environment. 2014-2016.

Planned Work to Support Maternal Health

The MMPP has created a strategic work plan that aims to reduce maternal mortality and improve maternal health through a trifecta of solutions:

- **Community-led solutions.** The MMPP is working together with communities to identify strategies that, with adequate funding and support, could improve the trajectory of health for pregnant or postpartum individuals. Solutions work best when they draw on the wisdom, strengths, resilience, and deep knowledge of the issues that exist within communities.

Within the community prong of the work plan, MMPP has identified opportunities to include and involve the perspectives of diverse stakeholders—those who are affected by the issue and those who have the ability to make a difference. Groups such as the Maternal and Child Health Community Advisory Board (MCH-CAB), Tribal governments, and grassroots community-based perinatal and birth providers and activists all play a unique and necessary role. Communities bring the knowledge, experience, and perspectives needed to ensure efforts to reduce and prevent maternal deaths are effective, equitable, relevant, and resonant to those most impacted.

Starting in 2020, MMPP seeks to hold conversations with stakeholders to understand how communities perceive the issue of maternal death and co-develop a process for moving the conversations from “information-giving” to information-sharing and, ultimately, to the co-development of solutions to prevent maternal deaths.

- **Clinical quality improvement.** The MMPP partners with the CPCQC and to improve patient safety in clinical settings as part of the national Alliance for Innovation on Maternal Health (AIM) project. The project uses continuous quality improvement and implementation of national patient safety bundles (structured evidence-based guidance to address a specific maternal health issue) to address both chronic and emergent complications of pregnancy. In response to the issues identified by the Maternal Mortality Review Committee, the CPCQC is rolling out the AIM Opioid Use Disorder Bundle in 2020 at 11 hospitals across Colorado.
- **Public health programs.** The MMPP uses federal funding from the CDC and the Title V Maternal and Child Health program for statewide public health programming to build systems and provide education and outreach for maternal health, especially around the priorities of mental health and substance use. This work will expand to address the social and structural determinants of health as well, including a healthy and safe built environment, economic mobility, and the reduction of racial inequities.

MATERNAL MORTALITY REVIEW COMMITTEE



CONCLUSIONS

Maternal mortality review is a valuable tool for Colorado. The review process reveals the complex factors that came together with a devastating result, allowing us to honor the loss and take steps to prevent it from happening in the future.

Maternal mortality is an indicator of a society's health and a key marker of its health care system. There is much to learn about all of the systems that impact health and wellbeing when we look carefully at the experiences of people during the vulnerable time of pregnancy and postpartum. With the 2019 passage of the Maternal Mortality Prevention Act, Colorado has committed to understanding maternal mortality and, as a result, the health of Coloradans as a whole.

Indeed, the review of 94 maternal deaths from 2014 to 2016 maternal mortality reflect some of the predominant health trends in Colorado, and most of these deaths are preventable. Mental health and substance use issues are a leading cause of maternal morbidity and mortality, and it is still difficult for people to access the treatment and resources they need to heal and recover. Intimate partner violence presents a danger, especially to pregnant and postpartum people. Social and structural determinants of health—access to safe housing, food, education, economic opportunity, racism—have real, quantifiable effects on health. They result in unacceptable health inequities that persist with life-and-death consequences.

The Maternal Mortality Review Committee and CDPHE's Maternal Mortality Prevention Program meet the requirements of the Maternal Mortality Prevention Act, and have addressed the following in this report:

- **Strategies for Addressing the Most Preventable Causes:** The committee has identified many opportunities for prevention, including clinical best practices for screening, management of chronic conditions during pregnancy, and coordinating care across providers. Many maternal deaths were the result of information that was not shared in a timely manner. To address this, the committee has also recommended better information exchange not only within health care organizations but among all agencies and organizations that serve pregnant and postpartum people. This is no small task, but it can gradually become a reality by establishing strong community partnerships across the state. In addition, the committee has recommended better access to all necessary care, including family planning and mental health and substance use treatment, and that this care should be delivered in a family-centered and trauma-informed manner and made available throughout the year-long postpartum period.
- **Clinical Quality Improvement Approaches:** This report has identified a number of clinical approaches to preventing maternal morbidity and mortality, including universal screening for behavioral health and psychosocial risk factors and standardized best-practice protocols for identifying medical and obstetric complications of pregnancy.
- **Best Practices Dissemination:** For clinical best practices, CDPHE actively partners with the CPCQC and the Alliance for Innovation on Maternal Health to establish and disseminate these practices. CDPHE also works with groups such as the Colorado Maternal Mental Health Collaborative and Framework to disseminate information and best practices. Finally, CDPHE is beginning to establish partnerships with community partners across the state, which will become one of the most important avenues for education and dissemination of best practices to individuals and organizations.

- **Strategies for Achieving Equity in Maternal Health:** Many of the recommendations offered in this report, if followed universally and consistently, will help to address disparities in maternal health outcomes. However, it is also important to take steps to address the problem of inequity. The committee has recommended specifically that bias be directly addressed at the provider, health facility, public health system, and community levels. This includes anti-bias training but also trauma-informed care that is responsive to the unique traumas of racism and daily barriers to access for resources of all kinds. It will require strong community partnerships to identify both problems and solutions, and to build a health and social services workforce that understands the unique needs, challenges, and values of all Coloradans.

CDPHE is grateful for the commitment, passion, and technical expertise of the committee members who reviewed the 94 stories of maternal deaths. Most importantly, we want to honor the lives of those who died and those who experienced the devastating loss of these precious lives. We commit to holding you in memory and telling the stories of how you died, so that together we may prevent future tragedies, save other lives, and improve maternal health for all pregnant and postpartum people in Colorado.

APPENDIX A

Different Sources, Different Measures: Making Sense of Maternal Mortality Reports

Data source:	CDC National Center for Health Statistics (NCHS)	CDC Division of Reproductive Health, Pregnancy Mortality Surveillance System (PMSS)	Colorado Maternal Mortality Prevention Program and Review Committee
Time frame for maternal death:	During pregnancy to 42 days postpartum	During pregnancy to 365 days postpartum	
Terms:	<p>Maternal deaths include deaths of women while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.</p> <p>Late maternal deaths include deaths of women from direct or indirect obstetric causes more than 42 days but less than one year after termination of pregnancy</p>	<p>Maternal Death or Pregnancy-associated: The death of a person during pregnancy or within one year of the end of pregnancy from any cause.</p> <p>Pregnancy-related: The death of a person 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.</p> <p>Pregnancy-associated but not related: The death of a person during pregnancy or within one year of the end of pregnancy from a cause that is not related to pregnancy.</p>	
Data source used to identify possible maternal deaths	<p>ICD-10 codes on death certificates</p> <p>Pregnancy checkbox on death certificates</p>	<p>Death certificates linked to fetal death and birth certificates</p> <p>ICD-10 codes on death certificates</p> <p>Pregnancy checkbox on death certificates</p>	<p>Death certificates linked to fetal death and birth certificates</p> <p>ICD-10 codes on death certificates</p> <p>Pregnancy checkbox on death certificates</p> <p>National Violent Death Reporting System (NVDRS) data</p>
Data sources used to confirm and review maternal deaths	n/a - no review conducted	<p>“Maternal death information from vital statistics is linked to birth/fetal death records and is interpreted clinically by medically trained epidemiologists to determine if the death was pregnancy-related.” Source: CDC</p>	<p>Death certificate</p> <p>Birth or fetal death certificate</p> <p>Coroner’s report and autopsy</p> <p>Medical records (e.g. prenatal care, postpartum visits, emergency department visits)</p> <p>Toxicology</p> <p>Prescription Drug Monitoring Program (PDMP)</p> <p>Social Media</p> <p>Any other relevant items</p>

Data source:	CDC National Center for Health Statistics (NCHS)	CDC Division of Reproductive Health, Pregnancy Mortality Surveillance System (PMSS)	Colorado Maternal Mortality Prevention Program and Review Committee
Measure:	Maternal mortality rate: number of maternal deaths per 100,000 live births	Maternal mortality ratio: number of pregnancy-related maternal deaths per 100,000 live births	Pregnancy-associated mortality ratio: number of pregnancy-associated deaths per 100,000 live births. Pregnancy-related mortality ratio: number of pregnancy-related deaths per 100,000 live births. Pregnancy-associated but not related mortality ratio: number of pregnancy-associated but not related per 100,000 live births.
Last published data Year: Rate (jurisdiction)	2018: 17.4 per 100,000 live births (national)	2016: 16.9 pregnancy-related deaths per 100,000 live births (national)	2016: 19.3 pregnancy-related deaths per 100,000 live births 28.2 pregnancy-associated but not related deaths per 100,000 live births 47.4 pregnancy-associated maternal deaths per 100,000 live births (Colorado)

APPENDIX B

Pregnancy-Associated Mortality Ratios by Demographic Characteristics.

Demographic Characteristics	Number of pregnancy-associated deaths 2014-2016 ^a	Total number of births in Colorado 2014-2016 ^b	Pregnancy-associated mortality ratio
Age			
<25 years old	24	47944	50.1
25-29 years old	25	56757	44.1
30-34 years old	26	60077	43.3
35+ years old	19	36716	51.8
Region			
Rural & Frontier	9	22489	40.0
Urban	83	176485	47.0
Insurance provider			
Medicaid	42	78115	53.8
Non-Medicaid	24	123467	19.4
Education			
High school or less	41	64418	63.7
More than high school	53	135103	39.2
Race/Ethnicity			
White	59	123199	47.9
Black	5	11479	43.3
Hispanic	19	43906	43.6
Asian	6	9148	65.6
Native American	5	2330	214.6

Pregnancy-Related Mortality Ratios by Demographic Characteristics.

Demographic Characteristics	Number of pregnancy-related deaths 2014-2016 ^C	Total number of births in Colorado 2014-2016 ^B	Pregnancy-related mortality ratio
Age			
<25 years old	7	47944	14.6
25-29 years old	11	56757	19.4
30-34 years old	10	60077	16.7
35+ years old	10	36716	27.2
Region			
Rural & Frontier	*	22489	*
Urban	33	176485	18.7
Insurance provider			
Medicaid	15	78115	19.2
Non-Medicaid	9	123467	7.3
Education			
High school or less	13	64418	20.2
More than high school	25	135103	18.5
Race/Ethnicity			
White	25	123199	20.3
Black	*	11479	*
Hispanic	5	43906	11.4
Asian	*	9148	*
Native American	*	2330	*

* Any category for which there are fewer than five cases are suppressed to protect the identities of those who have died.

^a Data missing from pregnancy-associated deaths: region = 2; insurance= 28.

^b Data missing from all births: maternal age = 100; region = 2620; insurance = 12; education = 2073; race/ethnicity = 11532.

^c Data missing from pregnancy-related deaths: region = 1; insurance = 14.