

Special Topics Report on Pregnancy-Related Deaths
Due to Cardiovascular and Coronary
Conditions and Cardiomyopathy in Ohio, 2008-2016

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Overview

The Ohio Department of Health (ODH) established the Ohio Pregnancy-Associated Mortality Review (PAMR) to identify and review pregnancy-associated deaths with the goal of developing interventions to reduce maternal mortality, particularly for pregnancy-related deaths.

A pregnancy-related death is the death of a woman while pregnant or within one year of pregnancy from any cause related to or aggravated by the pregnancy or management, excluding accidental or incidental causes. A pregnancy-associated death is the broader category and includes the death of a woman while pregnant or anytime within one year of pregnancy regardless of cause.

The purpose of this PAMR special topics data brief is to supplement the comprehensive report, [A Report on Pregnancy-Associated Deaths in Ohio 2008-2016](#), with additional information on leading causes of pregnancy-related deaths.

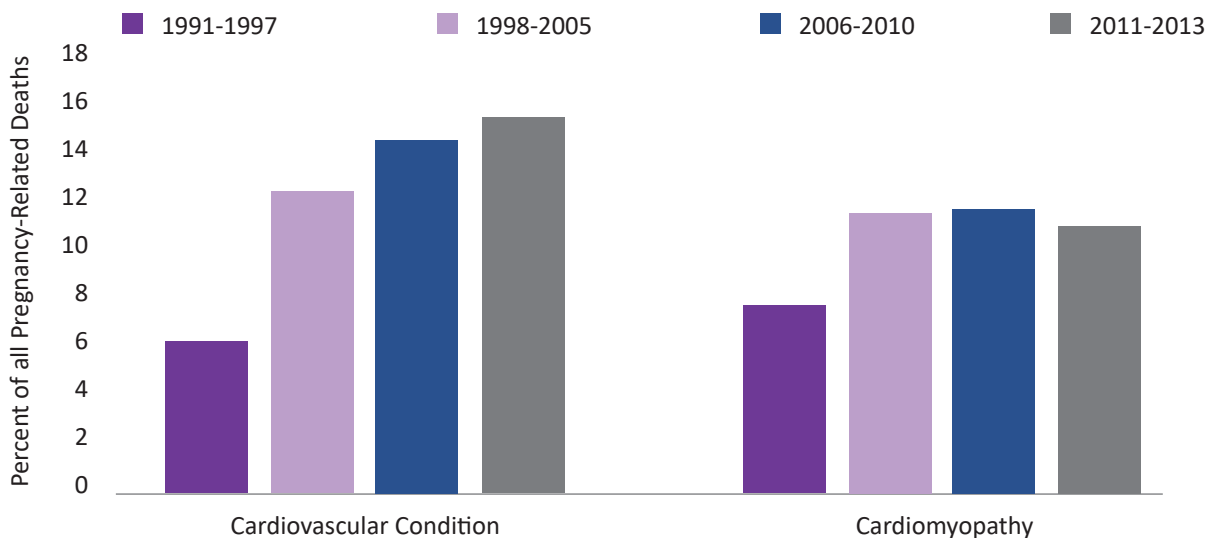
Background on Cardiovascular Disease in Women and Pregnancy-Related Mortality

Cardiovascular disease is the leading cause of death among women in the United States today (Garcia 2016) accounting for one in three deaths to women. Overall cardiovascular mortality, in both men and women, has declined in recent years except among women under the age of 55 years. The reasons are not completely understood though generally, women are less likely (1) to be offered the full range of preventive strategies, (2) to have aggressive treatment once a problem is identified, and (3) to undergo cardiac rehabilitation after a cardiac event, compared to men with equivalent age and risk factors.

Cardiovascular disease encompasses a diverse group of diseases with the most common categories being congenital heart disease (66%), valvular heart disease (25%), cardiomyopathy (7%) and ischemic heart disease (2%) (Roos-Hesselink 2012). Note that cardiomyopathy is a condition specific to the heart muscle that makes it harder for the heart to pump blood, and is separated from other cardiovascular and coronary conditions.

Nationally, the proportion of maternal deaths due to cardiovascular conditions was higher during 2011 through 2013 than prior to 2006 (Figure 1); concurrent decreases were noted in deaths due to hemorrhage, hypertensive disorders, and anesthesia (Creeanga 2017). Recently, a report with data from nine states found that cardiovascular and coronary conditions were a leading cause of pregnancy-related death overall and 68.2% were deemed preventable (Building U.S. Capacity to Review and Prevent Maternal Deaths, 2018).

Figure 1. Proportionate Pregnancy-Related Mortality for Cardiovascular Conditions and Cardiomyopathy—United States, 1991–2013*



*From Creeanga. *Pregnancy-Related Mortality in the United States*. *Obstet Gynecol* 2017

Cardiovascular Changes Related to Pregnancy

During pregnancy and the postpartum period, physiologic changes occur (Thompson 2015) that impact women's cardiovascular health. During pregnancy the heart rate increases which leads to an increase in the amount of blood pumped per cycle as well as an increase in blood volume overall and the ability of the heart to pump. Normally these changes are tolerated well by pregnant women, but women with a history of congenital heart disease or other underlying cardiac disease are at higher risk of morbidity and mortality usually due to the development of heart failure (Ruys 2014). This is particularly true if there are other pre-existing medical conditions present such as chronic hypertension, diabetes, autoimmune diseases, or chronic renal failure.

Peripartum or postpartum cardiomyopathy is a type of heart failure that occurs either in the late third trimester or within five months of the end of pregnancy and affects 1,000 to 1,300 women in the United States annually. The underlying cause is unclear but both inflammation and / or genetics may play a role in some cases. The condition occurs across all age groups and risk factors include obesity, history of prior cardiac disorders, alcoholism, and multi-fetal gestation.

Best Practices

A history of any type of cardiac problem in a pregnant woman warrants further clinical investigation. When evaluating women within a year of a delivery, providers must consider cardiac disease. Postpartum care should extend beyond the customary 6-week visit and every effort should be made to provide targeted inter-conception care to optimize maternal health prior to a next pregnancy. There is a need for education both for health care providers and for young women and prospective new mothers for them to be able to identify risk factors, concerning symptoms and resources to seek timely medical attention. California has recently released a toolkit (CMQCC 2017) for providers regarding management of pregnant and postpartum women with cardiovascular disease and symptoms. This resource can be used by individual providers and across different departments in facilities.

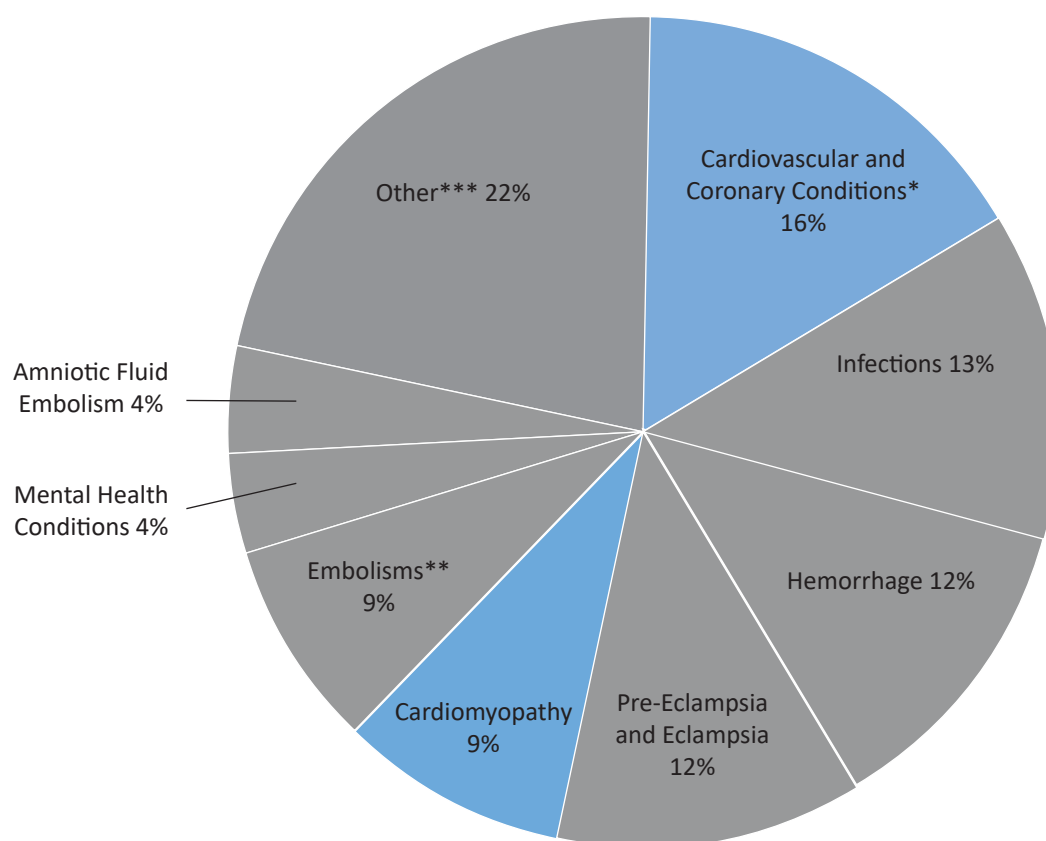
PAMR Findings

During 2008 through 2016, **67** pregnancy-associated deaths due to *cardiomyopathy* or *cardiovascular and coronary conditions* were identified and reviewed by PAMR. Of these, **48 (72%)** deaths were found to be related to pregnancy, **15 (22%)** were determined not be related to pregnancy and the committee was unable to make a determination for the remaining four deaths. The data presented below are restricted to the 48 deaths due to *cardiomyopathy* (18) or *cardiovascular and coronary conditions* (30) determined to be related to pregnancy.

Cause of Death

Figure 2 displays the underlying causes of 2008-2016 pregnancy-related deaths. Cardiovascular and coronary conditions comprised 16% of pregnancy-related deaths, and cardiomyopathy comprised 9% of pregnancy-related deaths.

Figure 2: Underlying Causes of Pregnancy-Related Deaths by Leading Causes, Ohio 2008-2016



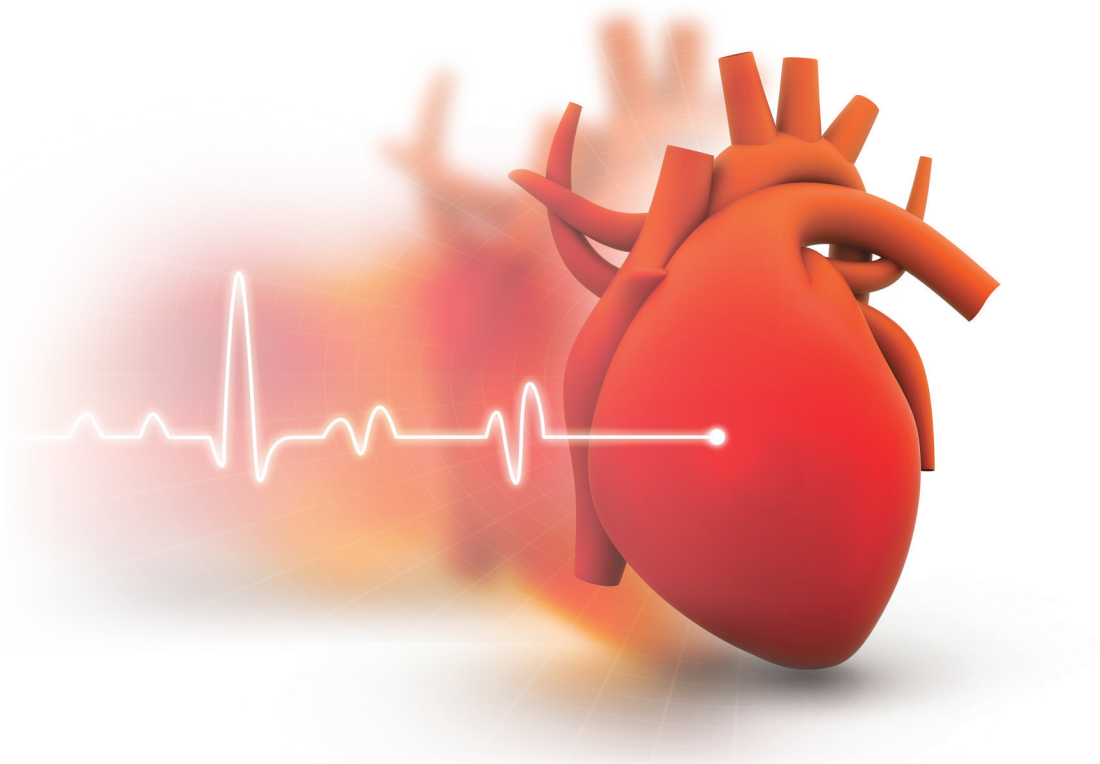
*Not including cardiomyopathy

**Not including amniotic fluid embolism

***Includes cerebrovascular accident, homicide and others

Table 1. Pregnancy-Related Deaths Due to Cardiomyopathy and Cardiovascular Conditions, by Specific Pregnancy Mortality Surveillance System (PMSS) Cause of Death, Ohio 2008-2016

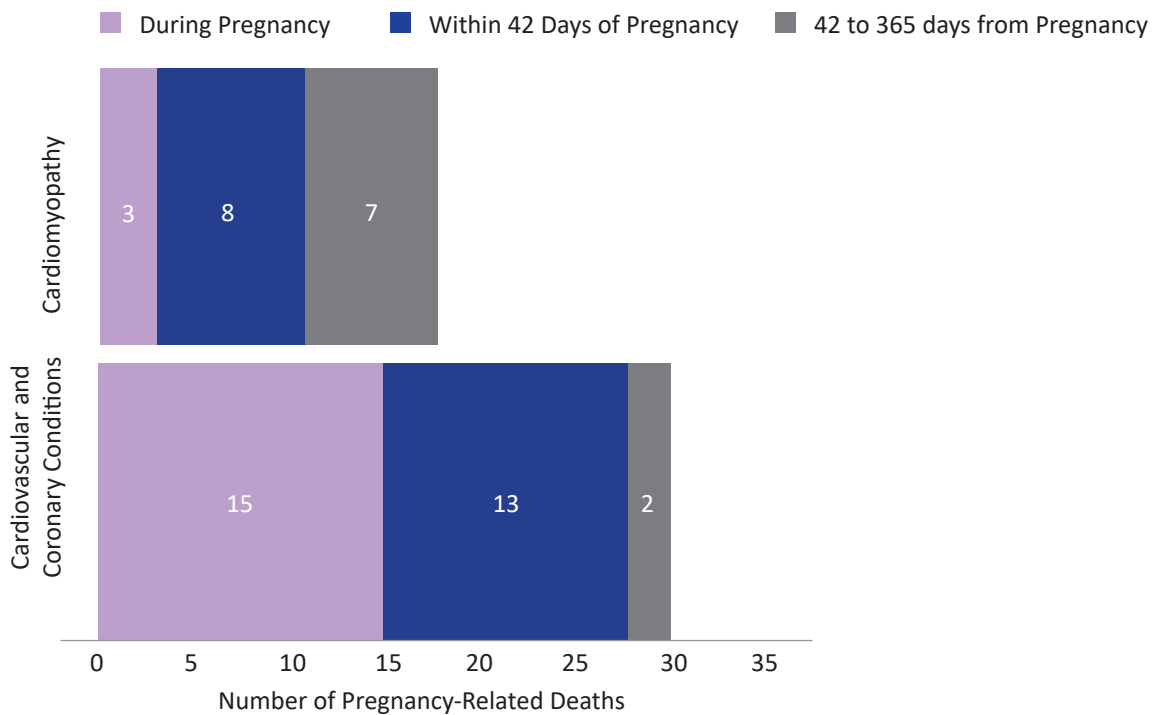
Cause of Death	Number	Percent
Post-partum / peripartum cardiomyopathy	11	
Other cardiomyopathy	3	
Cardiomyopathy not specified	4	
Cardiomyopathy Subtotal	18	38
Coronary artery disease / myocardial infarction / atherosclerotic cardiovascular disease	6	
Pulmonary hypertension	3	
Vascular aneurysm / dissection (non-cerebral)	6	
Hypertensive cardiovascular disease	3	
Conduction defects / arrhythmias	5	
Other cardiovascular disease / NOS	7	
Cardiovascular and Coronary Conditions Subtotal	30	62
Total	48	100



TIMING OF DEATH

The timing of these deaths in relation to pregnancy have different patterns by cause. Among deaths due to *cardiomyopathy*, few occur during pregnancy while 44% occurred within 42 days of pregnancy and 39% occurred from 43-365 days after pregnancy. Among deaths due to *cardiovascular and coronary conditions* however, half occurred during pregnancy, while 43% occurred during 42 days after the end of pregnancy and very few occurred between 43 and 365 days after pregnancy.

Figure 3. Timing of Death in Relation to Pregnancy Among Pregnancy-Related Deaths due to Cardiomyopathy and to Cardiovascular and Coronary Conditions, Ohio 2008-2016 (n=48)



RISK FACTORS / DEMOGRAPHICS

The distribution of demographic characteristics did not appear to differ for cardiomyopathy versus cardiovascular and coronary conditions and are therefore presented together in Table 3.

Table 3. Pregnancy-Related Deaths due to Cardiomyopathy and to Cardiovascular and Coronary Conditions by Demographic Characteristics, Ohio 2008-2016

Characteristic	Number	Percent	Cause-Specific Pregnancy-Related Mortality Ratio per 100,000 live births
Race and Ethnicity			
Non-Hispanic White	30	63	3.2
Non-Hispanic Black	15	31	**7.0
Hispanic and Other	3	6	*
Insurance Payor			
Medicaid	29	60	5.9
Private	12	25	**2.0
Other	7	15	*
Age Group (years)			
<20	4	8	*
20-24	10	21	**3.2
25-29	11	23	**2.9
30-34	14	29	4.6
≥35	9	19	*
Marital Status			
Currently Married	20	42	2.8
Not Married	28	58	5.1
Residence County Type			
Metropolitan	26	54	3.7
Suburban	9	19	*
Appalachian	11	23	5.4
Rural	2	4	*
TOTAL	48	100	3.8

*Ratios based on fewer than 10 deaths are considered unreliable and not reported.

**Rates based on fewer than 20 deaths should be interpreted with caution.

The review committee determined that obesity contributed to **42% (20)** of these deaths.

CHANCE TO ALTER OUTCOME

Among these deaths reviewed during 2012 through 2016, **four** of 14 (**29%**) deaths due to *cardiovascular and coronary conditions* were found to have at least some chance to alter outcome. Among eight deaths due to *cardiomyopathy* during these same years, **six** deaths (**75%**) were found to have at least some chance to alter outcome.

CONTRIBUTING FACTORS

Among the 48 pregnancy-related deaths due to *cardiomyopathy* and to *cardiovascular and coronary conditions*, 200 factors that contributed to the deaths were identified. Half of these operated at the patient or family level and the other half operated at the provider or system level.



Table 4. Contributing Factors Among 48 Reviewed Pregnancy-Related Deaths due to Cardiomyopathy and to Cardiovascular and Coronary Conditions, Ohio 2008-2016

Factor Class	Count (%)	Representative Themes
Provider Factor Level		
Delay	12 (6)	Delay or lack of diagnosis, treatment, or follow up
Assessment	10 (5)	Failure to screen; inadequate assessment of risk; misdiagnosis
Referral	10 (5)	Failure to refer; failure to seek consultation
Continuity of Care / Care Coordination	7 (4)	Lack of continuity of care
Communication	6 (3)	Lack of communication between providers; inadequate education provided to patient
Knowledge	6 (3)	Due to knowledge gap, lack of adequate or timely risk screening or follow-up, misdiagnosis, or use of ineffective treatment
Clinical Skill / Quality of Care	5 (3)	Misdiagnosis; use of ineffective treatment
SUBTOTAL	63 (32)	
System / Facility Factor Level		
Continuity of Care / Care Coordination	13 (7)	Lack of case management or coordination; lack of continuity of care
Communication	6 (3)	Poor communication
Personnel	5 (3)	Inadequate availability of personnel; inadequately trained personnel; inadequate or unavailable services; <i>personnel not trained</i> on issue or patient did not see appropriate specialist
Access / Financial	3 (2)	Barriers to accessing care; inadequate evaluation of patient's insurance status, patient claimed no insurance, but had Medicaid; unable to transfer to higher level of care
Policies / Procedures	3 (2)	Lack of standardized policies or procedures; lack of standardized response to high blood pressure
SUBTOTAL	38 (19)	
Patient / Family Factor Level		
Chronic Disease	42 (21)	Obesity; chronic medical condition; unknown heart or other medical condition
Adherence	14 (7)	Non-adherence with medical recommendations; nonadherence due to lack of insurance, financial resources, or transportation
Knowledge	12 (6)	Lack of knowledge of importance of event; lack of knowledge of treatment or follow-up
Delay	8 (4)	Delay or failure to seek care
Tobacco Use	8 (4)	
Access / Financial	3 (2)	Lack of financial resources; difficulty getting to appointments; poverty
SUBTOTAL	99 (50)	
TOTAL	200 (100)	

Note that totals in each category may be greater than the sum of the specific classes listed because classes with fewer than three factors noted were not listed individually.

Rosaline's Story - Cardiovascular Disease in Pregnancy

"Rosaline" was a 30-year-old Black Haitian woman who had six pregnancies leading to five children and a miscarriage. She died during the postpartum period, 1.5 months following her sixth pregnancy. Her primary language was French, and she spoke little English. During care, sometimes there was no one to interpret and other times a family member interpreted for her. An official interpreter was not used until her arrival at the tertiary care center where she died.

Prenatal Period: She began prenatal care late at 35 weeks gestation and had four visits with an OB / GYN. Intake records note "Question of a history of congestive heart failure", but no referrals were made.

Delivery Hospitalization: At 38 weeks, Rosaline was induced which resulted in an uncomplicated vaginal delivery. Anesthesia and nursing notes document her history of congestive heart failure. While she complained of shortness of breath, a chest X-ray was normal, and she was discharged two days after delivery without additional evaluation or referral.

Postpartum Period: Rosaline went to the emergency department two weeks after delivery with shortness of breath / chest pain and was diagnosed with asthma and treated. Her symptoms continued so she returned about three weeks after the first visit. She was found to be in congestive heart failure and transferred to a tertiary care center with the ability to do heart transplants. She died there soon after arrival at 1.5 months after delivery.

The cause of death on the death certificate was cardiogenic shock (condition in which the heart suddenly can't pump enough blood to meet the body's needs) due to cardiomyopathy (disease of the heart muscle that makes it harder for the heart to pump blood) with a heart attack. The manner of death was natural. No autopsy was performed.

Additional History Obtained at Transfer to Tertiary Care Center:

1. Family history of cardiomyopathy (19-year-old brother)
2. Peripartum cardiomyopathy in fourth pregnancy which led to a recommendation to terminate her fifth pregnancy
3. Intimate partner violence identified after transfer (she had a restraining order against the father of her baby)

Key Questions Answered by the Review Committee

Was the Death Pregnancy-Related?

Yes. Physiologic changes to the cardiovascular system occur during pregnancy. An overall increase in blood volume leads to increases in the heart rate and the amount of blood that must be pumped. These changes are normally tolerated, but may be dangerous in a woman with underlying cardiac disease and a decreased pumping ability at baseline. Maternal condition can worsen leading to the development of heart failure.

What was the Cause of Death?

Cardiomyopathy.

Was there Some Opportunity to Alter Outcome?

Yes. Although Rosaline presented late to prenatal care, a history of congestive heart failure was identified. Her cardiac status should have been immediately assessed and she should have been followed closely, particularly postpartum. Timelier management could have optimized her condition and altered the outcome.

What were the Factors that Contributed to this Death?	What are the Recommendations and Actions that Address those Contributing Factors?
Chronic medical condition (patient / family level)	Engage medical sub-specialists and / or maternal fetal medicine specialists in care of patients with complex medical problems
Inadequate assessment of medical condition during pregnancy (system level)	Recognition of enhanced care needed for women with cardiac symptoms, especially postpartum
Misdiagnosis (provider level)	Recognition of enhanced care needed for women with cardiac symptoms, especially postpartum
Lack of referral and coordination of care between providers in the health system (system level)	Promote case management / coordination of care for patients with complex medical problems and consider the use of healthcare navigators for women from vulnerable populations
English as a second language with discordance of language between healthcare providers and the patient (individual); lack of appropriate interpreter services (system)	Assure the availability of interpretative services for patients
Intimate partner violence leading to social isolation and contributing to her late entry into prenatal care at 35 weeks gestation	Ensure that medical professionals are trained to screen and document intimate partner violence

Case is fictitious but based on real events



Committee Recommendations

As part of the review of each death, the committee identifies recommendations (including strategies and action steps) that may address factors that contributed to the death.

1. Optimize the care of patients with chronic medical conditions **prior** to pregnancy.
2. Optimize the care of patients with chronic medical conditions **during** pregnancy.
3. Educate providers and patients on recognition, treatment, and prevention of obstetric complications including cardiovascular and coronary conditions and cardiomyopathy.

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