A California Toolkit to Transform Maternity Care

Improving Health Care Response to Cardiovascular Disease in Pregnancy and Postpartum

November 2017

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Improving Health Care Response to Cardiovascular Disease in Pregnancy and Postpartum

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TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

Cardiovascular disease (CVD) has emerged as the leading cause of maternal mortality in California and the United States. In particular, pregnancy-related death encompasses a spectrum of cardiac conditions with a preponderance of cardiomyopathy. In-depth review of maternal mortality in California between 2002-2006 indicated that only a small fraction of the women had a known diagnosis of CVD prior to death.[2] However, most women who died had presented to care with symptoms either during pregnancy or shortly after childbirth. One-fourth of the deaths were judged preventable if heart disease had been included in the differential diagnosis and timely diagnosis and treatment occurred.[2-4]

Most pregnancies occur in young healthy women and there is an overlap between signs and symptoms women may experience in a normal pregnancy and those they may experience due to cardiac disease, specifically shortness of breath, fatigue and swelling. Health care providers must familiarize themselves with risk factors, warning signs and physical findings that suggest an underlying cardiac problem requiring further evaluation. Prompt diagnosis is critical because a high proportion of women sustain short- and long-term morbidity due to undiagnosed or delayed diagnosis of CVD.

The CMQCC Cardiovascular Disease in Pregnancy and Postpartum Task Force was charged by the California Department of Public Health with developing a toolkit that includes an overview of clinical assessment and management strategies for CVD based on risk factors and presenting signs and symptoms. The Improving Health Care Response to Cardiovascular Disease in Pregnancy and Postpartum Toolkit is a resource for all health care providers who interact with women during the prenatal, intrapartum and postpartum periods. **The key components of the Toolkit include:**

- Algorithm to guide stratification and initial evaluation of symptomatic or high-risk pregnant or postpartum women
- Sections on clinician and facility level resources when caring for women with congenital or other CVD, contraception counseling, and appropriate cardiovascular medications during pregnancy and while breastfeeding
- Information and infographics for women diagnosed with, or at risk of, CVD
- Signs and symptoms of CVD, future CVD risk and long-term health issues, contraceptive options and planning a pregnancy with known CVD
- Discussion on racial and ethnic disparities in CVD prevention and diagnosis

Teaching Slide Set: This Toolkit includes a comprehensive slide set that outlines key components of the Toolkit. Providers, clinical staff, educators, hospitals and healthcare organizations can use the Toolkit for guidance in the development of strategies to improve early recognition and response to cardiovascular disease in pregnancy and postpartum.

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INTRODUCTION TO THE IMPROVING HEALTH CARE RESPONSE TO CARDIOVASCULAR DISEASE IN PREGNANCY AND POSTPARTUM TOOLKIT

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Cardiovascular disease has emerged as the leading cause of maternal mortality in the United States, accounting for over one-third of all pregnancy-related deaths.[2] Data from the U.S. Centers for Disease Control and Prevention indicate that the cardiovascular mortality rate from 2006-2010 is 4.23 deaths per 100,000 live births.[2] As a comparison, the United Kingdom reported a rate of 2.25 maternal deaths per 100,000 live births from 2010-2012.[3,4] Cardiovascular disease in pregnancy accounted for 25% of maternal deaths in the deaths reviewed by the California Pregnancy-Associated Mortality Review (CA-PAMR) from 2002-2006, with a rate of 2.4 maternal deaths per 100,000 live births.[1] Only a small fraction of these women had a known diagnosis of cardiovascular disease prior to death even though most women who died had presented with symptoms either during pregnancy or postpartum. Data from CA-PAMR suggest that one-fourth of these deaths may have been prevented if heart disease was diagnosed earlier; this was especially true for the cardiomyopathy deaths.[1] These findings present an important quality improvement opportunity as timely diagnosis and treatment could have prevented these devastating outcomes. As well, a significantly higher proportion of women sustain short- and long-term morbidity due to undiagnosed or delayed diagnosis of cardiovascular disease (CVD) as evidenced by the fact that one of every three intensive care admissions in pregnancy and postpartum period are related to cardiac disease.[5,6]

> Data from a review of pregnancy-related deaths in California suggests that 25% of deaths attributed to cardiovascular disease may have been prevented if the woman's heart disease had been diagnosed earlier.[1]

Most pregnancies occur in young healthy women and there is a significant overlap between signs and symptoms of cardiac disease and those of normal pregnancy, i.e., shortness of breath, fatigue, limitation of exercise capacity and swelling.[7] Therefore, health care providers must familiarize themselves with risk factors, warning signs and certain physical examination findings that are suggestive of an underlying cardiac condition. Global cardiovascular risk assessment should be obtained in all pregnant women who present with or without cardiac symptoms at their first encounter with an obstetrics provider.[8]

Additional evaluations should occur in each trimester and the postpartum period for women who have been identified as high risk of CVD at their initial encounter during pregnancy and/or postpartum period. Health care providers should maintain a high

index of suspicion for these women and have a low threshold of initiating cardiac work up if these women present with signs or symptoms suggestive of CVD during pregnancy or after delivery. A pregnancy specific tool is available for women to distinguish between common signs and symptoms of heart failure from those related to normal term pregnancy, and may help facilitate earlier recognition of peripartum cardiomyopathy.[9]

The CMQCC Cardiovascular Disease in Pregnancy and Postpartum Task Force was charged by the California Department of Public Health with developing a toolkit that includes an overview of clinical assessment and management strategies based on risk factors and presenting signs and symptoms. The Improving Health Care Response to Cardiovascular Disease in Pregnancy and Postpartum Toolkit serves as a resource for obstetrics, primary care and emergency medicine providers who interact with women during the prenatal, intrapartum and postpartum periods. The key components of the Toolkit include an algorithm developed to guide stratification and initial evaluation of symptomatic or high-risk pregnant or postpartum women. The Toolkit includes brief sections on clinician and facility-level resources when caring for women with congenital or other CVD, contraception counseling, and the appropriate choice of cardiovascular medications during pregnancy and while breastfeeding. Information and infographics are geared directly for women diagnosed with, or at risk of, cardiovascular disease. The information provided covers signs and symptoms of CVD, future CVD risk and long-term health issues, patient education on contraceptive options and planning a pregnancy with known CVD. In addition, the Toolkit includes a discussion on racial and ethnic disparities in CVD prevention and diagnosis.

Clinical pearls presented in this document are derived from the quality improvement opportunity data identified in the CA-PAMR, experience of the authors, literature and expert opinion. The level of evidence for current literature on cardiovascular disease in pregnancy is primarily consensus of expert opinion, case control studies, observational or retrospective studies and registries (Code C).[10]

CLINICAL PEARLS

- Global cardiovascular risk assessment should be obtained in all pregnant women, with or without symptoms.[8]
- The first presentation of cardiovascular disease may be during pregnancy or in the early postpartum period.
- The highest risk period for a preexisting cardiac condition to manifest is generally in the late second trimester, i.e., 24-28 weeks, or in the postpartum period.
- Pregnant or postpartum women presenting with symptoms of shortness of breath, cough or excessive fatigue should be evaluated in the context of risk factors, vital sign abnormalities and abnormal physical examination findings.
- Persistent respiratory symptoms and “new-onset asthma” may be a presentation of heart failure.
- Bilateral infiltrates on chest X-ray may be due to heart failure rather than pneumonia, thus clinical correlation is advised.

- Pregnant or postpartum women with significant cardiovascular risk factors should be counseled regarding their future cardiovascular risk. Early involvement of their primary care provider is crucial in ensuring a smooth transition postpartum.
- Patient education to improve awareness of risk factors, sign and symptoms of cardiac disease, and compliance with follow-up care should be emphasized.
- Women with known cardiovascular disease should receive preconception and interconception counseling by a perinatologist and cardiologist experienced in high-risk pregnancy. This care should occur in a center with access to cardiovascular care.
- Contraception choices should be tailored to the type of CVD present.
- Provider and patient education is essential.
- A high index of suspicion and early diagnosis, along with appropriate referrals and follow-up, are key elements to a successful outcome.

Strength-of-Recommendation Taxonomy (SORT) [10]	
Code	Definition
A	Consistent, good-quality patient-oriented evidence
B	Inconsistent or limited-quality patient-oriented evidence
C	Consensus, disease-oriented evidence, usual practice, expert opinion, or case series for studies of diagnosis, treatment, prevention, or screening

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CARDIOVASCULAR DISEASE ASSESSMENT IN PREGNANT AND POSTPARTUM WOMEN

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Development of the Algorithm: The CMQCC Cardiovascular Disease in Pregnancy and Postpartum Task Force was charged with developing a toolkit that includes an overview of clinical assessment and management strategies based on risk factors and presenting signs and symptoms. The key components of the Toolkit include an algorithm developed to guide stratification and initial evaluation of symptomatic or high-risk pregnant or postpartum women.

The goal of the algorithm is to assist providers in distinguishing between signs and symptoms of cardiac disease and those of normal pregnancy and to guide clinicians in the triage of further cardiac evaluation, appropriate referrals and follow-up of pregnant and postpartum women who may have cardiovascular disease. Drawing from the literature and analysis of cardiovascular deaths reviewed in the California Pregnancy-Associated Mortality Review (CA-PAMR), the authors created this algorithm based on risk factors, symptoms, vital sign abnormalities, and physical examination findings commonly identified in women who die of various types of cardiovascular disease.

The most severe symptoms and vital sign abnormalities are labeled as “Red Flags” and include shortness of breath at rest, severe orthopnea necessitating four or more pillows, resting heart rate ≥120 beats per minute, resting systolic blood pressure ≥160 mm Hg, resting respiratory rate of ≥30 breaths per minute and an oxygen saturation ≤94%. The presence of Red Flags or a personal history of cardiovascular disease in pregnant or postpartum women should lead clinicians to conduct a prompt evaluation and seek consultations with specialists in maternal fetal medicine and primary care or cardiology. If other less severe symptoms and vital sign abnormalities are identified, then risk factors and physical examination findings may need to be combined to stratify the women who require further work-up or routine follow-up.

Sample Case Presentation

A 25-year-old obese (Body Mass Index (BMI) 38) African-American G2P2 underwent an uncomplicated vaginal delivery 10 days ago. She presents to the urgent care clinic with complaints of fatigue and persistent cough since delivery. She is afebrile with blood pressure of 110/80 mm Hg, heart rate 110 bpm and respiratory rate of 28/minute. Chest X-ray reveals bilateral infiltrates. Oxygen saturation is 94% on room air. The patient is diagnosed with a respiratory infection. Fatigue is attributed to the lack of sleep due to care of the newborn. She is prescribed an antibiotic and sent home. One week later, she presents again with continued symptoms. Antibiotics are switched at this time, and beta agonists are added due to presumptive diagnosis of "new-onset asthma" as evidenced by physical examination findings. Two days later, the patient experiences cardiac arrest at home. Resuscitation attempts are unsuccessful. Autopsy findings were indicative of cardiomyopathy.

This case is representative of similar deaths attributed to cardiovascular disease reviewed by CA-PAMR. Maternal mortality due to cardiac disease primarily revolved around the lack of awareness of CVD at both patient and provider levels, coupled with delays in diagnosis. In most cases, diagnosis was made in the perimortem period or at the time of autopsy.

Further testing should include electrocardiogram (EKG) and B-type natriuretic peptide (BNP). Arrhythmia monitor, echocardiogram, chest X-ray, complete blood count, comprehensive metabolic panel, arterial blood gas, assessment of thyroid function, and drug screen may also be considered. BNP is a readily available test that may help identify asymptomatic women with left ventricular dysfunction and assist in triaging pregnant or postpartum women who present with symptoms. BNP is a neurohormone secreted predominantly by the cardiac ventricles in response to volume or pressure overload. A BNP level of <100 pg/mL is considered normal and the half-life is 20 minutes. Its use has been validated in the diagnosis of systolic and diastolic heart failure.[1,2] BNP levels in pregnancy remain within normal range despite significant volume overload in pregnancy, and the levels are higher in pathologic conditions. An elevated BNP level should trigger an echocardiogram to evaluate cardiac function. Serial measurements of BNP in pregnant women with dilated cardiomyopathy are shown to be predictive of adverse cardiovascular outcomes.[3.] BNP is described in detail on page 13 of the Toolkit.

The TSH screen is essential for the high risk pregnancy by history or with cardiovascular (CV) symptoms; however, because of the cardiovascular risk with

subclinical hypothyroidism and hyperthyroidism and the fact that even high-normal thyroid function may cause cardiovascular problems – all pregnant women with CV problems should get full thyroid function testing.[4] When deciding to conduct thyroid screening (TSH) on all pregnant women and advancing to potentially full diagnostic testing (T3 and T4), one is especially looking for subclinical disease that might need treatment.[4]

Validation of the Algorithm: Pregnant and postpartum women who die from cardiovascular disease represent the most extreme consequence of missed or delayed recognition of cardiovascular disease. Accordingly, any triage algorithm should be able to detect the most serious cases and not return a 'false negative' assessment of cardiovascular disease. To assess how well the triage algorithm would have identified pregnant and postpartum women with the most need of further work-up, we compared the 64 cardiovascular disease deaths identified by CA-PAMR for 2002-2006, using the seven critical risks and abnormalities, including heart rate, systolic blood pressure, respiration rate, oxygen saturation, tachypnea, cough and wheezing. We found that the use of algorithm would have identified 56 out of 64 (88%) cases of CVD. The proportion of women identified increased to 93% when we restricted comparison to the 60 cases of women who were symptomatic or had sufficient documentation with which to compare to the algorithm.[5]

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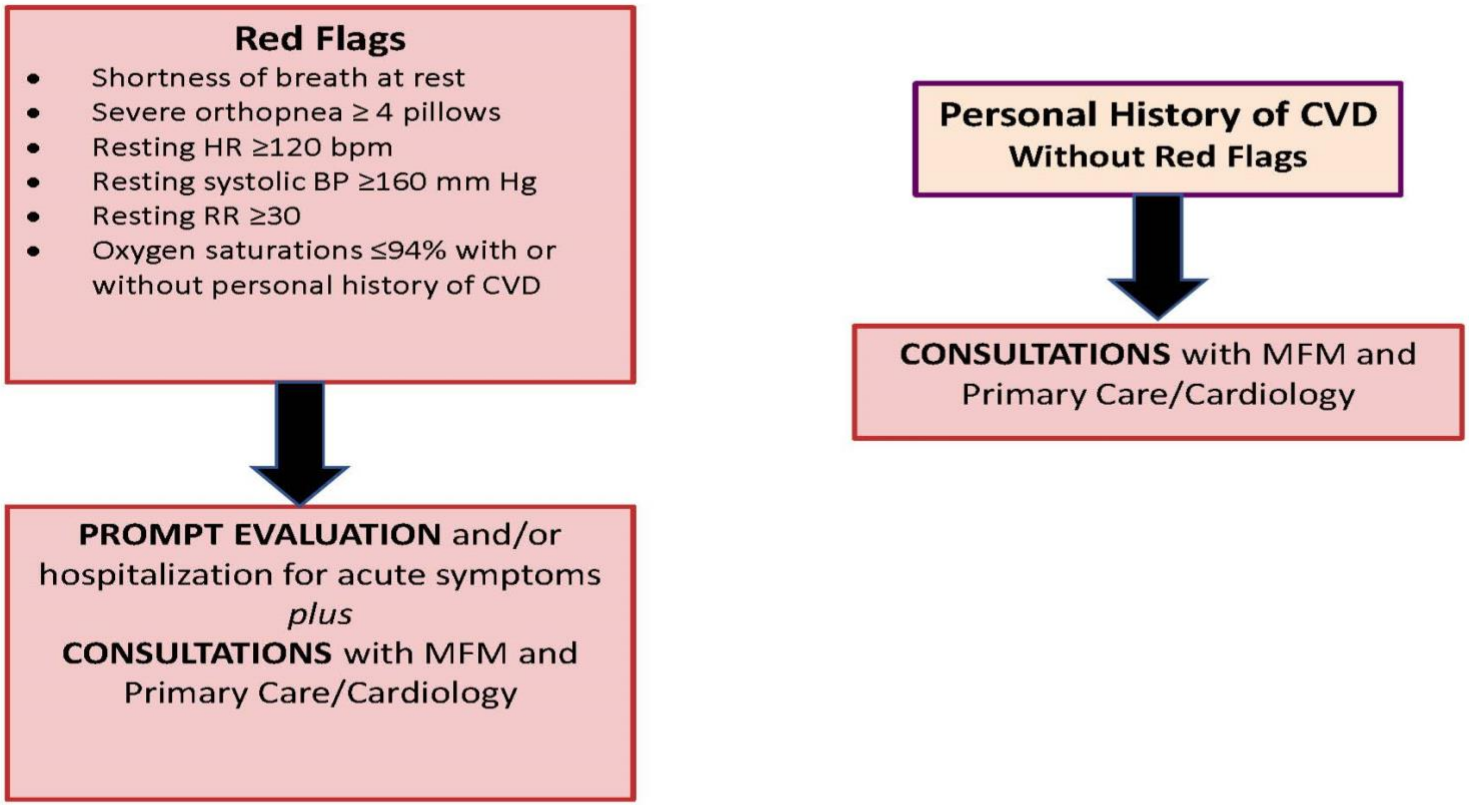
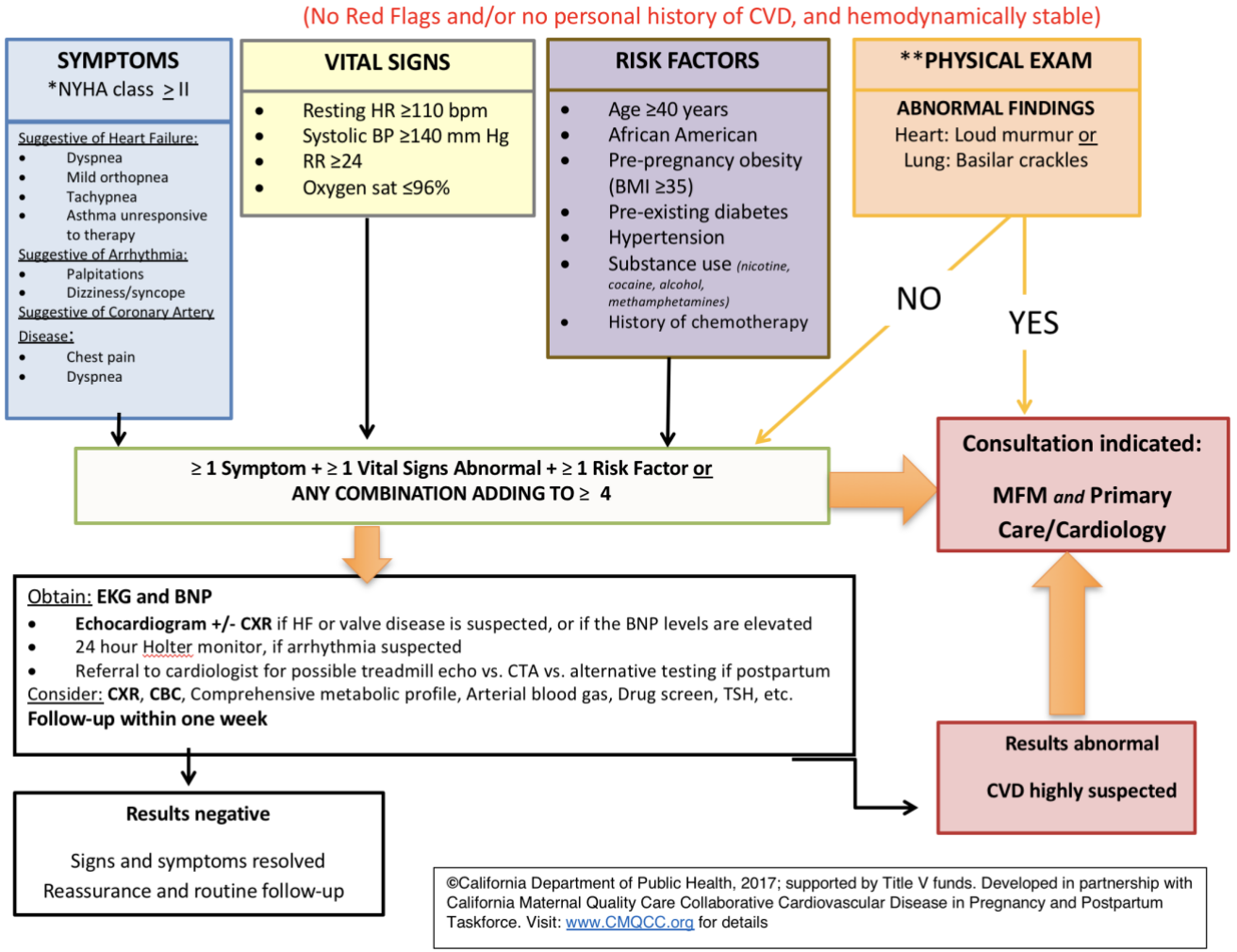
CVD ASSESSMENT ALGORITHM FOR PREGNANT and POSTPARTUM WOMEN



CARDIOVASCULAR DISEASE ASSESSMENT IN PREGNANT and POSTPARTUM WOMEN



*New York Hospital Association Functional Classification (shown on algorithm)

Class	Descriptors
I	Asymptomatic, no limitation of physical activity
II	Asymptomatic at rest, symptoms with exertion and heavy physical activity
III	Asymptomatic at rest, symptoms with normal physical activity
IV	Symptomatic at rest, limitation to physical activity

Reference: Used with permission from American Heart Association, Inc. NYHA Functional Classification, American Heart Association, Inc. http://www.heart.org/HEARTORG/Conditions/HeartFailure/AboutHeartFailure/Classes-of-Heart-Failure_UCM_306328_Article.jsp Accessed May 1, 2015

**Physical Examination (shown on algorithm)

Lungs (presence of)	Heart (presence of)
• Adventitious breath sounds, particularly crackles	• Diastolic murmur
• Jugular vein distention	• Loud systolic murmur (III/IV intensity or higher) ○ Functional murmurs generally are of lesser intensity
• Cyanosis (peripheral)	
• Clubbing of extremities	

Reference: Easterling TR and Stout K. *Heart disease in pregnancy, Chapter 37 in Obstetrics: Normal and Problem Pregnancies*, 7th Ed. Eds: Gabbe SG, Niebyl JR, Simpson JL et al. 2017. Elsevier: Philadelphia.

B-TYPE NATRIURETIC PEPTIDE (BNP)

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INTRODUCTION

This chapter describes B-type Natriuretic Peptide (BNP) and its use as a tool to help clinicians identify asymptomatic individuals with left ventricular dysfunction or assist in triaging patients presenting with symptoms for further diagnostic testing.

ABOUT BNP

BNP is a neurohormone secreted predominantly by the cardiac ventricles in response to volume expansion or pressure overload. BNP acts as the body's defense against volume overload by virtue of its vasodilatory and renin-angiotensin-aldosterone system inhibitory properties that lead to natriuresis and diuresis.

Normal levels: BNP level of <100 pg/mL is considered normal and the half-life is 20 minutes.

Variations in BNP levels: Women tend to have higher level of BNP when compared to men and levels are also elevated in patients with renal insufficiency/failure. However, obesity is associated with lower plasma BNP in comparison to non-obese population.[1]

CLINICAL USES

Diagnosis of Heart Failure (HF):
BNP levels are used routinely in the emergency room for the diagnosis of HF and play a key role in establishing etiology of dyspnea (cardiac vs. pulmonary) in patients presenting with acute shortness of breath.[2,3] In the Breathing Not Properly trial, plasma BNP was markedly elevated in patients with clinically diagnosed HF compared to those without HF (mean 675 pg/mL vs. 110 pg/mL).[4] In general, a BNP value of $\geq$ 100 pg/mL is diagnostic of HF with a sensitivity and specificity of 90% and 76% respectively. In contrast, a BNP level of < 50 pg/mL has a negative predictive value of 96% in excluding heart failure. BNP has a higher predictive value than other diagnostic tests, i.e., cardiomegaly on chest x-ray, or clinical evaluation including history of HF and rales on physical examination. In a prospective randomized controlled trial, 452 subjects who presented to the emergency room with acute shortness of breath were either assigned BNP bedside assay or received standard clinical assessment. The use of BNP reduced the need for hospitalization, intensive care admission, and time to discharge along with the total cost of in-hospital treatment.[2,5] The American College of Cardiology/American Heart Association guidelines recommend that BNP or NT-proBNP (N-terminal pro-BNP) levels can be useful in the evaluation and risk stratification of patients presenting with symptoms in whom the clinical diagnosis of heart failure is uncertain.[6]

Asymptomatic Left Ventricular Dysfunction:
BNP has been shown to detect asymptomatic left ventricular dysfunction with sensitivity of 88% and specificity of 67% when BNP level of 50 pg/mL is used as a cutoff; it may be used as an initial low-cost modality to identify asymptomatic high risk individuals who would need further diagnostic testing.[7]

Predictor of Adverse Cardiovascular Outcomes:
BNP (>50 pg/mL) has been shown to be the strongest predictor of serious adverse cardiovascular outcomes in older individuals with preserved left ventricular systolic function. BNP level is generally increased in diastolic left ventricular dysfunction and correlates directly with left ventricular hypertrophy.[8,9]

Pregnancy:
Pregnancy is a state of physiologic volume overload. Despite an increase in the left ventricular wall mass and end-diastolic dimensions during normal pregnancy, BNP levels remain stable throughout the gestation and postpartum period. In a longitudinal study of plasma BNP levels during pregnancy, when compared to non-pregnant, age-matched controls, the median level of BNP was noted to be 19 pg/mL during pregnancy vs. 10 pg/mL in the non-pregnant state.[10] BNP levels stay well within normal range during an uncomplicated pregnancy; however, significant elevations are seen in patients with hypertensive disorders including preeclampsia.[11]

- *Preexisting heart disease:* In pregnant women with preexisting dilated cardiomyopathy, serial measurements of NT-proBNP (N-terminal pro-BNP) are shown to be predictive of adverse cardiovascular outcomes.[12] In another study of 66 women with cardiac symptoms, all women who remained event free during pregnancy had BNP < 100 pg/mL.[13]

- *Pregnant women with cardiac symptoms:* BNP may play an important role in evaluation of pregnant women presenting with shortness of breath to determine both systolic and diastolic left ventricular dysfunction. BNP levels correlate with elevated left ventricular filling pressures in symptomatic pregnant women.[14]

SUMMARY

BNP is a simple, readily available, relatively inexpensive test that may assist clinicians in triaging patients who present with symptoms for further diagnostic testing. This test can be of particular value for obstetricians as most women exhibit some degree of fatigue, shortness of breath, palpitation and/or swelling during pregnancy. Adding BNP to routine evaluation of cases with symptoms out of proportion to pregnancy or to those patients presenting with symptoms suggestive of cardiac disease may reduce potential morbidity.

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CLINICAL GUIDANCE FOR POSTPARTUM PRESENTATIONS TO THE EMERGENCY DEPARTMENT, PRIMARY CARE PROVIDER OR OBSTETRIC PROVIDER

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INTRODUCTION

This chapter is intended for clinicians who evaluate women presenting for care in the postpartum period who complain of symptoms of shortness of breath, chest pain, unresolved cough or swelling. Symptoms of cardiovascular disease can occur up to five months postpartum. Women of childbearing age should be questioned about recent pregnancies, in addition to their last menstrual period (LMP). Recommendations are based on the quality improvement opportunity data identified through the California Pregnancy-Associated Mortality Review (CA-PAMR), research literature and expert opinion.

Clinical pearls presented in this document are derived from the quality improvement opportunity data identified in the CA-PAMR, experience of the authors, literature and expert opinion. The level of evidence for current literature on cardiovascular disease in pregnancy is primarily consensus of expert opinion, case control studies, observational or retrospective studies and registries (Code C).[1]

CLINICAL PEARLS

- During pregnancy, symptoms of cardiac disease may be falsely attributed to the common symptoms in a normal pregnancy (i.e., shortness of breath, fatigue. swelling).
- Preexisting cardiovascular disease and/or new-onset peripartum cardiomyopathy may initially present during pregnancy or in the postpartum period.
  - Physiologic changes associated with pregnancy gradually return to baseline by two weeks postpartum[2]
  - Peripartum cardiomyopathy most frequently presents in the first postpartum week, with 75% presenting in first month[3]
  - Pregnant or postpartum women with CVD frequently present with shortness of breath or a new-onset cough.[4]
  - Emergency Department (ED) providers, Primary Care Providers, and Obstetricians should maintain a high index of suspicion for underlying cardiovascular disease when a woman presents with symptoms, signs, and risk factors concerning for heart disease for as long five months postpartum.

HISTORY

When a woman presents in the postpartum period with complaints of shortness of breath, ask if she has experienced:

- Worsened level of exercise tolerance
- Difficulty performing activities of daily living
- Symptoms that are deteriorating
- Chest pain, palpitations, or dizziness
- New-onset cough or wheezing
- Pedal or lower extremity edema and if it is improving or deteriorating
- Unexpected fatigue, i.e., needing to stop frequently when walking
- Inability to lie flat due to shortness of breath, and if this is a change, how many pillows does she use
- Failure to lose weight or unusual weight gain, and how much
- A history of cardiac or pulmonary conditions
- A history of substance use and/or tobacco use
- Has been seen by other providers or in other Emergency Departments since giving birth.

KEY POINTS

- Symptoms related to physiologic changes of pregnancy should be improving in the postpartum period.
- Visits to Emergency Department for dyspnea should raise suspicion for cardiovascular disease.
- Women of childbearing age should be questioned about recent pregnancies, in addition to their last menstrual period (LMP).
- Postpartum dyspnea or new-onset cough is concerning for cardiovascular disease.

PHYSICAL EXAMINATION

Conduct a thorough physical examination, paying particular attention to:

- The vital signs: HR ≥120 bpm, BP ≥160 mm Hg, RR ≥30, and oxygen saturation ≤ 94%
    - Look for the underlying cause of abnormal vital signs
- Lung exam: crackles, wheezing
- Cardiac exam: loud murmur, jugular venous distention
- Extremities: edema, taut shiny skin.

DIFFERENTIAL DIAGNOSIS FOR POSTPARTUM DYSPNEA

- Congestive Heart Failure
- Myocarditis
- Endocarditis
- Pulmonary Embolism
- Pulmonary Hypertension
- Asthma
- Infection
-

WORKUP FOR POSTPARTUM DYSPNEA

- Chest radiograph – *frequently normal in asthma*
- EKG – *may be normal in cardiomyopathy, except for sinus tachycardia*
- CBC, Basic Metabolic Panel, Thyroid Function Test (TSH)
- BNP – *an elevated BNP should raise suspicion for CHF*
- D-dimer – *may normally be elevated in pregnancy, however, may be considered for negative predictive value*
- Toxicology screen - *Substance use (e.g., methamphetamine, cocaine) is a strong risk factor for pregnancy-related cardiovascular disease*
- Echocardiogram: this should be obtained on an emergency basis if the patient has abnormal vital signs or is very symptomatic - *Normal LV ejection fraction does not exclude heart failure, normal RV function does not exclude pulmonary embolism*
- Venous Doppler Ultrasound and/or CT pulmonary angiogram for pulmonary embolism
- Cardiology consultation as needed.

KEY POINTS

- New-onset asthma is rare in adults.
- Bilateral crackles on lung examination are most likely associated with Congestive Heart Failure (CHF).
- Improvement of dyspnea with bronchodilators does not confirm the diagnosis of asthma, as CHF may also improve with bronchodilators. Response to bronchodilators should prompt the consideration of a diagnosis other than asthma.

DISPOSITION

- If considering discharge:
  - Repeat vital signs to ensure they are persistently normal, the symptoms have improved, and the patient is stable for discharge
  - Arrange for early follow-up with primary provider or cardiologist as indicated.
- Admission and cardiology consultation may be indicated for:
  - Persistent symptoms or abnormal vital signs, in particular, HR $\geq$ 120 bpm, BP $\geq$ 160 mm Hg, RR $\geq$ 30, and oxygen saturation $\leq$ 94%
  - Lack of response to treatment
  - Newly-diagnosed cardiomyopathy or pulmonary hypertension.

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RACIAL DISPARITIES IN CARDIOVASCULAR DISEASE: CLINICAL IMPLICATIONS

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INTRODUCTION

This chapter provides an overview of health disparities in cardiovascular disease among African-American women and offers suggestions to providers who provide care to pregnant and postpartum women on how to retain a high index of suspicion when cardiovascular disease (CVD) risk factors are present.

CVD MORTALITY AND MORBIDITY PREVALENCE AND RACIAL DISPARITIES

Maternal and Pregnancy-Related Mortality

- The widest and most persistent racial/ethnic disparity (inequality) in all of U.S. public health occurs in maternal and pregnancy-related mortality.[1]
- African-American women have a three-to-four-fold greater risk of maternal mortality than women of other racial/ethnic groups.[1]
- The CVD pregnancy-related mortality rate for African-American women in California is more than eight times higher than that for White women.[2]

CVD Incidence and Comorbidities

- African-American women have higher rates of pre-existing CVD.[3]
- Comorbid conditions, such as hypertensive disorders of pregnancy, are more prevalent among African-American women.[4]
- Hypertensive disorders are correlated with all types of CVD.
- African-American women have been reported to have lower frequency of prenatal care visits and seek care later in pregnancy than women of other racial/ethnic groups.[5]

Peripartum Cardiomyopathy (PPCM) Prevalence

- African-American women have an increased incidence of CVD in general and peripartum cardiomyopathy (PPCM) compared to white women.[3,6]
- PPCM is highly correlated with all forms of hypertensive disease in pregnancy.[7]
    - Women with gestational hypertension, chronic hypertension, and mild preeclampsia had two-to-five-fold increases in odds of PPCM.[6]
    - Women with severe preeclampsia and eclampsia had 17- and 25-fold increases in odds of PPCM respectively.[6]
- African-American women with PPCM were typically younger, more frequently presented with severe symptoms, and were more likely to be diagnosed postpartum than white women.[8]

FACTORS AFFECTING RACIAL DISPARITIES IN CVD-RELATED DIAGNOSES

- Racial and ethnic disparities in both maternal mortality and morbidity likely stem from social, medical, clinical care, and health system factors.[4]
- African-American women have a higher incidence of hypertension/preeclampsia during pregnancy, yet are less likely to be hospitalized for treatment.[9]
- Chronic stress and experiences of racism over the life course contribute to the higher rates of low birth weight infants and infant mortality experienced by African-American women, likely impacting maternal health outcomes.[10-14]
- African-American women are subject to high levels of stressors (allostatic load) both before and after pregnancy, which are known factors in birth outcomes.[15] Such "embodied inequality" is multi-factorial, and arises from environmental, social and genetic factors.
- Maternal exposures to factors such as malnutrition, toxic substances, intimate partner violence, smoking, infections, racial discrimination, inadequate medical and dental care are socially patterned and highly correlated with low socioeconomic status.[16] African-American women who live in underserved areas often lack necessary resources to maintain a healthy lifestyle, further compounding the negative cycle of poor reproductive and maternal health outcomes.
- For African-American women, higher socioeconomic status and education does not necessarily resolve or provide a protective effect against poor maternal and infant outcomes.[12]

PROVIDER and INSTITUTIONAL BIAS

- Racial and gender bias (conscious or not) and social ideas about race and class shape doctor–patient interactions and influence treatment disparities.[17,18]
- In research examining physicians' implicit racial attitudes, African-American doctors show no preference toward caring for White or African-American patients (gender not specified); women physicians showed less implicit bias than their male counterparts. White male physicians demonstrated significant implicit preference for White compared to non-White patients.[19]
- Multiple studies show that African-American patients are less likely to receive cardiovascular therapies of proven benefit, and have worse outcomes after such procedures. African Americans also more frequently receive medical and surgical care from lower quality health care providers and facilities and experience higher mortality.[20]

CLINICAL IMPLICATIONS

- Patient complaints should be taken seriously, and clinicians should maintain a high index of suspicion for CVD, especially in African-American women who are pregnant or postpartum.
- African-American women with chronic or gestational hypertension, high pre-

pregnancy BMI (≥35) who present with symptoms suggestive of CVD (extreme shortness of breath especially when lying down, persistent cough unrelieved with treatment, significant fatigue, palpitations, swelling or chest pain) or abnormal vital signs as indicated in the CVD Assessment Algorithm should be evaluated carefully and thoroughly for potential CVD.[21,22]

- A key systems-level opportunity for reducing disparities in diagnosing and treating cardiovascular disease is implementing standardized protocols, such as the assessment algorithm in this Toolkit.[20]
- Patient-level interventions, such as education on signs and symptoms is critical, as is examining the *process* and content of educational interventions.[23]

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Clinicians and Facilities:

RESOURCES WHEN CARING FOR WOMEN WITH ADULT CONGENITAL HEART DISEASE OR OTHER FORMS OF CARDIOVASCULAR DISEASE

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INTRODUCTION

This chapter includes a summary of guidelines published by the American College of Cardiology and the American Heart Association in conjunction with other professional groups that manage adult cardiovascular disease.[1,2] These guidelines are based on scientific evidence reviewed by experts in their field of practice. The purpose of the guidelines is to give clinicians the most current evidence upon which to base management of adults with specific cardiac disease. This synopsis is intended to provide information to clinicians who care for women with cardiac disease about current resources and management strategies. Key components of comprehensive, evidence-based care include resources consisting of diagnostic testing, imaging and experienced multidisciplinary staff. Recommendations for appropriate resources when providing care for adults with cardiac disease are also included.[3]

OB PROVIDERS: ADULT CONGENITAL HEART DISEASE (ACHD) GUIDELINES.[1,2]

- Estrogen-containing oral contraceptives are not recommended for patients with Adult Congenital Heart Disease (ACHD) at risk of thromboembolism such as those with cyanosis, intra-cardiac shunt, severe pulmonary arterial hypertension (PAH) or Fontan repair.
- Patients with ACHD should consult with an ACHD expert before pregnancy to develop a plan for management of labor and the postpartum period.
- Preconception counseling is recommended for women receiving chronic anticoagulation with warfarin.
- Patients with intra-cardiac right to left shunt should have fastidious care of IV lines to avoid air embolus.
- Fetal echocardiography is recommended between 18 and 20 weeks in women with personal history of congenital heart disease.

Table 1, on the next page, is an overview and does not replace evaluation and management by an ACHD physician, which should be pursued in all ACHD patients.[1-3]

Table 1: Adult Congenital Cardiac Lesions: Management and Expected Outcomes in Pregnancy

Lesion	Overview *Note: This does not supplant evaluation and management by an ACHD physician, which should be performed in all ACHD patients.[1-3]
Shunt lesions	
Atrial Septal Defect (ASD)	• Well tolerated in the absence of pulmonary arterial hypertension (PAH). • Repair should be considered in patients with large ASDs prior to pregnancy in the absence of PAH. • Pregnancy is not recommended in patients with ASD and severe PAH or Eisenmenger syndrome due to excessive maternal and fetal mortality.
Ventricular Septal Defect (VSD)	• Small VSDs without PAH and no associated lesions do not have increased CV risk and pregnancy is usually well tolerated. • Prior to pregnancy, repair should be considered in patients with large VSDs in the absence of PAH. • Pregnancy is not recommended in patients with VSD and severe PAH or Eisenmenger syndrome due to excessive maternal and fetal mortality.
Atrioventricular Septal Defects (AVSD)	• Usually well-tolerated post repair in the absence of PAH. • Pregnancy is not recommended in patients with AVSD (repaired or unrepaired) and severe PAH or Eisenmenger syndrome due to excessive maternal and fetal mortality.
Left-sided obstruction	
Aortic Stenosis (AS)	• Mild or moderate stenosis is usually well tolerated in pregnancy. • Vaginal delivery is preferred except in critical AS or if associated with aortic disease (dissection or aneurysm).
Supravalvular or Subvalvular AS	• Those with significant obstruction, coronary involvement or aortic disease should be counseled against pregnancy.
Coarctation of Aorta	• Patients with severe obstruction or aortic aneurysm should have hemodynamic assessment and treatment prior to getting pregnant.
Right-sided obstruction	
Pulmonic Stenosis and Right Ventricular Outflow Tract Obstruction	• Mild to moderate obstruction is well tolerated. • Severe obstruction should be treated prior to pregnancy.
Tetralogy of Fallot (TOF)	• TOF should be repaired prior to pregnancy. In patients with repaired TOF and a competent pulmonary valve, pregnancy is well tolerated in those with good functional capacity and without residual lesions. • Severe symptomatic pulmonary regurgitation should be treated prior to pregnancy in the presence of severe right ventricle (RV) dilatation. Patients should be screened for arrhythmias prior to pregnancy.
Other lesions	
Single Ventricle Lesions Post Fontan Repair	• Successful pregnancy is reported after Fontan repair but arrhythmias, ventricular dysfunction, thrombotic complications and edema have been reported. • Increased risk for spontaneous abortion or premature birth.
Ebstein's Anomaly	• Generally well tolerated in the absence of severe tricuspid regurgitation, arrhythmias and cyanosis; however, there is an increased risk of low birth weight, and fetal loss if significant cyanosis is present. The risk of CHD in offspring is approximately 6%.

Obstetric Providers:

RESOURCES WHEN CARING FOR ADULTS WITH CONGENITAL HEART DISEASE

FOR ADOLESCENTS:

- Adolescents with congenital heart disease (CHD) should have a coordinated, collaborative and comprehensive healthcare transition to adult cardiac specialists with services similar to the level of care they received as children.

FOR ADULTS:

- Each provider of adult congenital heart disease (ACHD) care and each facility where ACHD patients receive care should be in contact with a regional ACHD center of excellence.
- Regional ACHD centers are responsible for the organization of ACHD healthcare including:
    - Staff with expertise in cardiology: physicians, nurses, advanced care providers, anesthesiologists
    - Diagnostic testing and imaging
    - Interdisciplinary care teams for special patient populations including obstetrics and neonatology
    - Mechanisms for consultations, referrals, review of policies and protocols, quality assessment
- Patients with ACHD should possess documents that describe their condition including how to access local healthcare and the regional center.
- Each patient with ACHD should have a primary health care provider who has her current medical records and a consultation arrangement with local and regional ACHD experts.
- Patients with moderate or complex ACHD should be followed by a provider with expertise in that level of ACHD, or their primary provider should be in frequent consultation with an expert in CHD. Plans for referral to a higher level of expert care should be in place in the event the patient's condition becomes unstable.
- Adults with moderate or complex CHD should have the following procedures or evaluations in the regional center of excellence:
    - Diagnostic and interventional procedures
    - Surgery that necessitates conscious sedation or general anesthesia
    - Sudden onset or emergent cardiac or non-cardiac conditions.

Obstetric Providers:

ADULT VALVULAR DISEASE GUIDELINES

PRECONCEPTION EVALUATION AND INTRAPARTUM MONITORING:

- Prior to pregnancy, all patients with known or suspected valve disease should be evaluated by a cardiologist with expertise in managing patients with valvular heart disease during pregnancy who can provide preconception counseling.
- Transthoracic echo (TTE) is recommended in the evaluation of all women with known or suspected valvular heart disease as part of preconception counseling and assessment.
- Exercise tolerance testing should be considered prior to pregnancy in patients with severe valve disease.
- Symptomatic severe valve disease should be treated prior to pregnancy and treatment might be indicated in selected asymptomatic patients.
- Asymptomatic valve disease should be monitored by a cardiologist and may require additional testing during pregnancy.
- Pregnant patients with severe valve stenosis or regurgitation should be monitored in a tertiary care center with a dedicated heart team consisting of cardiologists, anesthesiologists and obstetricians with expertise in the management of high-risk cardiac patients during pregnancy. A cardiothoracic surgeon should be part of the team in select cases.
- Use of angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers is contraindicated in pregnant and breastfeeding patients (yet, due to increased risk of angioedema, caution and monitoring of ACE inhibitor use in pregnant African-American women is appropriate); however, the use of beta-blockers and diuretics may be reasonable for symptomatic relief.

RHEUMATIC FEVER / ENDOCARDITIS PROPHYLAXIS:

- Secondary prevention of rheumatic fever with antibiotics is indicated in patients with rheumatic heart disease.
- Patients with prosthetic heart valves, previous endocarditis, cardiac transplant recipients with valve regurgitation, congenital heart disease repaired with foreign material within six months of repair, and unrepaired cyanotic heart disease are at highest risk for infective endocarditis; therefore, antibiotic prophylaxis is indicated.

ANTICOAGULATION / PROSTHETIC VALVES:

- Certain valve lesions will require anticoagulation and should be monitored by a cardiologist at a center with expertise in anticoagulation.
- All pregnant patients with prosthetic valves should undergo clinical evaluation and a baseline TTE evaluation by a cardiologist experienced in valvular heart disease. Pregnancy should be monitored at a tertiary care center with a dedicated heart team.
- Anticoagulation should be given to all pregnant patients with mitral stenosis and atrial fibrillation unless contraindicated.
- All pregnant patients with mechanical valves should ideally be maintained on warfarin in therapeutic range in the second and third trimester. Warfarin crosses placenta and therefore should be discontinued close to the delivery time. Specifically, the current recommendation is to stop warfarin no later than 36 weeks' gestation and start therapeutic doses of unfractionated heparin (UFH) prior to planned vaginal delivery. In the first trimester, it may be reasonable to utilize warfarin if the dose is less than 5 mg. Warfarin may be teratogenic at high doses but birth defects are rare at low doses. Other options include UFH or low molecular weight heparin (LMWH). Due to the unpredictable response and side effect profile of prolonged use of UFH, LMWH is preferred. However, LMWH should not be given unless LMWH levels are frequently monitored 4 hours post-dose to consistently maintain target anti Factor X-a level of 0.8 U/mL to 1.2 U/mL (LMWH level).
- All pregnant patients with mechanical and bioprosthetic valves should additionally be maintained on a daily low dose aspirin 75-100 mg in the second and third trimesters.

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MATERNAL RISKS FOR UNDERLYING CARDIOVASCULAR DISEASE: KEY CONSENSUS TABLES

Two recent review articles are excellent reference materials for clinicians caring for pregnant or postpartum women with cardiovascular disease.[1,2] The four tables reproduced below from their source publications are meant to serve as a reference guide for clinicians to quickly review expert opinions on outcomes for a broad range of cardiovascular disease. The tables represent national and international consensus documents, and typical of such expert views, may contain slight variations between them. The tables are reprinted here with permission from the publishers.

Please also see Table 1: Adult Congenital Cardiac Lesions: Management and Expected Outcomes in Pregnancy in the Toolkit chapter: *Clinician and Facility Resources for Caring for Women with Congenital or Other Cardiovascular Disease* on page 26 for additional reference.

Table 2: Modified World Health Organization (WHO) Classification of Maternal Cardiovascular Risk: Application

WHO Pregnancy Risk Classification (Risk of pregnancy by medical condition)	**Cardiovascular Conditions by WHO Risk Class**

WHO Risk Class I
No detectable increased risk of maternal mortality and no or mild increase in morbidity.
	• Uncomplicated, small or mild
	  ○ Pulmonary stenosis
	  ○ Patient ductus arteriosus
	  ○ Mitral valve prolapse
	• Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage).
	• Atrial or ventricular ectopic beats, isolated

WHO Risk Class II (If otherwise well and uncomplicated) *Small increased risk of maternal mortality or moderate increase in morbidity.*	• Unoperated atrial or ventricular septal defect • Repaired tetralogy of Fallot • Most arrhythmias
WHO Risk Class II or III (Depending on individual) *Risk as indicated in Class II (above) or Class III (below).*	• Mild left ventricular impairment • Hypertrophic cardiomyopathy • Native or tissue valvular heart disease not considered WHO I or IV • Marfan syndrome without aortic dilatation • Aorta <45 mm in aortic disease associated with bicuspid aortic valve • Repaired Coarctation
WHO Risk Class III *Significantly increased risk of maternal mortality or severe morbidity. Expert counseling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth and the puerperium.*	• Mechanical valve • Systemic right ventricle • Fontan circulation • Cyanotic heart disease (unrepaired) • Other complex congenital heart disease • Aortic dilatation 40-45 mm in Marfan Syndrome • Aortic dilatation 45-50 mm in aortic disease associated with bicuspid aortic valve
WHO Risk Class IV (Pregnancy contraindicated) *Extremely high risk of maternal mortality or severe morbidity; pregnancy contraindicated. If pregnancy occurs termination should be discussed. If pregnancy continues, care as for class III.*	• Pulmonary arterial hypertension of any cause • Severe systemic ventricular dysfunction (LVEF <30%, NYHA III-IV)* • Previous peripartum cardiomyopathy with any residual impairment of left ventricular function • Severe symptomatic mitral or aortic stenosis • Marfan syndrome with aorta dilated >45 mm • Aortic dilation >50 mm in aortic disease associated with bicuspid aortic valve • Native severe Coarctation

*LVEF = left ventricular ejection fraction; NYHA = New York Heart Association

Table 2 reprinted here with permission from Regitz-Zagrosek V, Blomstrom Lundqvist C, Borghi C, et al. ESC Guidelines on the management of cardiovascular diseases during pregnancy: The task force on the management of cardiovascular diseases during pregnancy of the European Society of Cardiology (ESC). *European Heart Journal.* 2011;32(24):3147-3197.

Table 3: Predictors of Major Cardiac Event in Pregnant Patients with Heart Disease*

Predictor	Odds Ratio	95% Confidence Interval	*P value*
Prior cardiac event or arrhythmia • Heart failure • Transient ischemic attack • Stroke before pregnancy	6	(3-14)	< .001
New York Heart Association class greater than II or cyanosis	6	(2-22)	.009
Left heart obstruction • Mitral valve area less than 2 cm^2 • Aortic valve area less than 1.5 cm^2 • Peak left vertical outflow tract gradient greater than 30 mm Hg by echocardiography	6	(3-14)	< .001
Systemic ventricular dysfunction • Ejection fraction less than 40%	11	(4-34)	< .001

*Major cardiac event=pulmonary edema, arrhythmia requiring treatment, stroke, cardiac arrest, cardiac death; 0 predictor = 5% risk; one predictor = 27% risk; two or more predictors = 75% risk.

Table 3 reprinted here with permission from: Simpson LL. Maternal cardiac disease: Update for the clinician. *Obstetrics and Gynecology.* 2012;119(2 Pt 1):345-359. Data originally from Sui SC, Sermer M, Colman JM, Alvarez AN, Mercier LA, Morton BC, et al. Prospective multicenter study of pregnancy outcomes in women with heart disease. *Circulation* 2001; 104:515-21. Please contact Wolters Kluwer to re-use this content (http://journals.lww.com/greenjournal/Abstract/2012/02000/Maternal_Cardiac_Disease__Update_for_the_Clinician.21.aspx)

Table 4: Risk of Dissection or Rupture Based on Aortic Root Size among Patients with Marfan Syndrome*

Aortic Root Diameter (cm)	Risk of Dissection or Rupture
Less than 4	1% during pregnancy
4 or more	10% during pregnancy
4.0-4.9	2% yearly rate
5.0-5.9	3% yearly rate
6 or more	7% yearly rate

*Data is extrapolated primarily from non-pregnant population.

Table 4 reprinted here with permission from: Simpson LL. Maternal cardiac disease: Update for the clinician. *Obstetrics and Gynecology.* 2012;119(2 Pt 1):345-359. Data originally from Elefteriades JA. Indications for aortic replacement. *Journal of Thoracic and Cardiovascular Surgery* 2010; 140 (suppl):S5-9; discussion S45-51.

Table 5: Outcome of Subsequent Pregnancies after Peripartum Cardiomyopathy

History of Peripartum Cardiomyopathy	N	Congestive Heart Failure	Maternal Mortality	Preterm Delivery
Normalization of left ventricle function	28	21%	0	11%
Non-normalization of left ventricle function	16	44%	19%	37%

Table 5 reprinted here with permission from: Simpson LL. Maternal cardiac disease: Update for the clinician. *Obstetrics and Gynecology.* 2012;119(2 Pt 1):345-359. Data originally from Elkayam U, Tummala PP, Rao K, Akhter MW, Karaalp IS, Wani OR, et al. Maternal and fetal outcomes of subsequent pregnancies in women with peripartum cardiomyopathy. *New England Journal of Medicine* 2001: 344:1567-71.

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GUIDE TO CARDIOVASCULAR DISEASE MEDICATIONS FOR PREGNANT AND BREASTFEEDING WOMEN

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INTRODUCTION

As with any medication in pregnancy, a careful assessment of fetal risk to maternal benefit should be undertaken in regard to cardiovascular medications. Table 6 contains a short review of the hemodynamic physiology and its effects on drug concentration, kinetics and dosage of cardiovascular medications in pregnancy.[1] Tables 7 and 8 are summaries of cardiovascular drugs that may cause adverse events or are contraindicated in pregnant or breastfeeding women [2-6]

Table 6: Factors Affecting Drug Metabolism in Pregnancy

Maternal physiologic change	Effect on drug concentration and kinetics	Effect on drug dosage
Progressive increase in plasma volume by 50%	Hemodilution	Higher loading doses needed Steady state concentrations do not change
Decrease in plasma protein levels	Decreased protein-bound drug and total drug concentration over non-pregnant state, higher free unbound drug concentration	Potentially increased toxicity at beginning of dosing interval due to fluctuation in unbound drug concentration May need more frequent dosing without change in total daily dose
Increased renal blood flow and clearance, possible activation of cytochrome P450 system	Increased drug clearance, sub-therapeutic concentrations	May need increased dosages

Table 7: Cardiovascular Drugs and Adverse Effects in Pregnancy

Drug	Use	Risk Category*	Side Effects	Breastfeeding
Adenosine	Maternal and fetal arrhythmias	C	No reported side effects, limited first trimester data	Limited data, Unlikely passage into milk due to short half life and acute use
Amiodarone	Maternal arrhythmias	D	IUGR, congenital goiter, hypo-or hyper-thyroidism, prolonged QT in the newborn	Not Recommended
Beta blockers	Maternal hypertension, maternal arrhythmias, mitral stenosis, cardiomyopathy, hyperthyroidism, Marfan syndrome	Labetalol: C Metoprolol: C Propranolol: C Carvedilol: C Atenolol: D	IUGR, low placental weight, fetal bradycardia	Compatible, consider monitoring newborn heart rate (esp. atenolol)
Digoxin	Maternal and fetal arrhythmias, heart failure	C	No fetal side effects	Compatible
Diuretics (Furosemide, hydro-chlorothiazide)	Hypertension, congestive heart failure	C	Growth restriction, hyponatremia and hypokalemia, thiazides can inhibit labor and suppress lactation	Compatible
Flecanide	Maternal and fetal arrhythmias	C	Limited data, case reports of fetal SVT	Limited data, probably Compatible
Hydralazine	Hypertension	C	None reported	Limited data, probably Compatible
Nifedipine	Hypertension, tocolysis	C	Hypotension	Compatible
Nitrates	Myocardial infarction, ischemia, hypertension, pulmonary edema, tocolysis	C	Limited data, fetal distress	Limited data, Unlikely passage into milk due to acute use
Procainamide	Maternal and Fetal arrhythmia	C	Limited data, no reported fetal effects	Compatible

Table 7 continued: Cardiovascular Drugs and Adverse Effects in Pregnancy

Drug	Use	Risk Category*	Side Effects	Breastfeeding
Quinidine	Maternal and Fetal arrhythmia	C	Preterm labor, miscarriage, transient fetal thrombocytopenia and damage to eight nerve	Compatible
Sodium nitroprusside	Hypertension, aortic dissection	C	Limited data, possible thiocynate fetal toxicity	No data, possible toxicity
Sotalol	Maternal arrhythmias, hypertension, fetal tachycardia	B	Limited data, reported cases of fetal death, neurologic morbidity, newborn bradycardia	Compatible
Verapamil	Maternal and fetal arrhythmias, hypertension, tocolysis	C	Limited data, no adverse fetal or newborn effects reported	Compatible

*Risk category from: U.S. Food and Drug Administration Pharmaceutical Pregnancy Categories.

Table 7 adapted and used with permission from: Blanchard DG, Daniels LB. Cardiac Diseases CH 52. In: Creasy R, Resnick R, Iams J, Lockwood C, Moore T, eds. *Creasy and Resnik's maternal-fetal medicine: Principles and practice, 7th ed.* Philadelphia: Saunders; 2013:855-6.

*FDA Pharmaceutical Pregnancy Risk Categories	
Category A	Adequate and well controlled human studies demonstrate no risk.
Category B	Animal studies demonstrate no risk, but no human studies have been performed. OR Animal studies demonstrate a risk, but human studies have demonstrated no risk.
Category C	Animal studies demonstrate a risk, but no human studies have been performed. Potential benefits may outweigh the risks.
Category D	Human studies demonstrate a risk. Potential benefits may outweigh the risks.
Category X	Animal or human studies demonstrate a risk. The risks outweigh the potential benefits.

Reference: U.S. Food and Drug Administration classification of drug risk. From: Office on Women's Health in the U.S. Department of Health and Human Services, Pregnancy and medicines fact sheet: http://womenshealth.gov/publications/our-publications/fact-sheet/pregnancy-medicines.html, accessed May 1, 2015.

Table 8: Drugs Usually Contraindicated in Pregnancy

Drug	Use	Risk Category*	Side Effects	Breastfeeding
ACE inhibitors and Angiotensin Receptor blockers	Maternal hypertension	X	Oligohydramnios, IUGR, prematurity, neonatal hypotension, renal failure, anemia, death, skull ossification defect, limb contractures, patent ductus arteriosus	Compatible
Warfarin (Coumadin)	Anticoagulation	X	Crosses placental barrier, fetal hemorrhage in utero, embryopathy, CNS abnormalities May be used if benefits outweigh risks (for example, history of prosthetic valves)	Compatible
HMG-CoA reductase inhibitors (statins)	Antilipemic agent	X	Possible increase in congenital central nervous system and limb abnormalities if used in the first trimester	Limited data Breastfeeding is discouraged

*Risk category from: U.S. Food and Drug Administration classification of drug risk. From: http://womenshealth.gov/publications/our-publications/fact-sheet/pregnancy-medicines.html, accessed May 1, 2015.

Table 8 adapted and used with permission from: Blanchard DG, Daniels LB. Cardiac Diseases CH 52. In: Creasy R, Resnick R, Iams J, Lockwood C, Moore T, eds. *Creasy and Resnik's maternal-fetal medicine: Principles and practice, 7th ed.* Philadelphia: Saunders; 2013:855-6.

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GUIDE TO CONTRACEPTION INFORMATION FOR WOMEN WITH CARDIOVASCULAR DISEASE

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INTRODUCTION

Hypertension and cardiac disease in pregnancy are the leading causes of maternal morbidity and mortality. Pregnancy can affect the course of cardiovascular disease and potentially endanger the health of the mother. In return, cardiac disease in women can affect fetal well-being and overall health of the pregnancy. Patients with cardiovascular disease including hypertension, congenital heart defects, arrhythmia and heart failure should be educated about contraceptive choices to improve overall health and to successfully achieve their reproductive plan, which may include preventing unwanted pregnancy.[1-4]

INCREASED RISKS DUE TO PREGNANCY IN PATIENTS WITH CARDIOVASCULAR DISEASE INCLUDE:

- Worsening hypertension
- Prolonged hospitalization
- Preeclampsia
- Fetal growth restriction
- Premature delivery
- Myocardial infarction
- Stroke
- Heart failure
- Death

METHODS OF CONTRACEPTION

Non-hormonal methods are the preferred contraception in patients with cardiovascular disease, given the minimal risk of thromboembolism with their use.

- Barrier methods
- Copper IUD
- Tubal ligation
- Trans-cervical tubal occlusion
- Partner vasectomy.

Hormonal methods containing estrogen products and depot medroxy-progesterone acetate injection should be used with caution in patients who have multiple risk factors or a history of cardiovascular disease.[5] Table 9 shares current guidelines for suggested contraception in patients with CVD.

- Combined Hormonal Contraceptives (CHC): Pill, Patch or Ring
- Progestin only form: Pill, Injection, Implant, or IUD

Table 9: Current Guidelines for Suggested Contraception in Patients with Cardiovascular Disorders

	Peripartum Cardio-myopathy	Valvular Disease on no anticoagulation	Valvular Disease on anticoagulation	Congenital Cardiac Defect
Combined Hormonal Contraceptives: Pill, Patch, Ring **Risks include** thromboembolism, stroke, myocardial infarction, lipid abnormalities **Risk of unintended pregnancy:** User dependent up to 9/100	Based on individual patient profile in consultation with cardiologist	Based on individual patient profile in consultation with cardiologist	AVOID	Based on individual patient profile in consultation with cardiologist
Progestin only **Risk of unintended pregnancy:** User dependent up to 9/100	Recommended	Recommended	Recommended	Based on individual patient profile in consultation with cardiologist
Progestin Injection **Risks include** fluid overload **Risk of unintended pregnancy:** 6/100	Recommended	Recommended	Recommended	Based on individual patient profile in consultation with cardiologist
Progestin Implant **Risk of unintended pregnancy:** Less than 1/100	Recommended	Recommended If mechanical valve, antibiotic prophylaxis	Recommended If mechanical valve, antibiotic prophylaxis	Based on individual patient profile in consultation with cardiologist
Copper IUD **Contraindicated in:** Allergy to copper; Wilson's disease **Risk of unintended pregnancy:** Less than 1/100	Recommended	Recommended	Recommended If mechanical valve, antibiotic prophylaxis	Based on individual patient profile in consultation with cardiologist
Levonorgestrel IUD **Risk of unintended pregnancy:** Less than 1/100	Recommended	Recommended	Recommended If mechanical valve, antibiotic prophylaxis	Based on individual patient profile in consultation with cardiologist

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LIFETIME RISKS OF HEART DISEASE AFTER PREGNANCY COMPLICATIONS AND SYMPTOMS OF HEART DISEASE

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BACKGROUND

Recent research demonstrates a higher lifetime likelihood of cardiovascular disease (CVD) when women experience complications during pregnancy or postpartum.[1] These complications include gestational diabetes, gestational hypertension, preeclampsia and HELLP (hemolysis, elevated liver enzyme levels, and low platelet levels) syndrome and preterm birth. Hypertensive disorders occur in 5-10% of all pregnant women.[1] Gestational diabetes is diagnosed in up to 14% of all pregnancies.[2]

Many women who have had pregnancy complications are unaware of the long term cardiovascular health impacts. As well, women who develop symptoms of heart disease are unaware of their implication or have difficulties obtaining appropriate assessment. To address these information gaps, two infographics were developed by the CVD Task Force (see Patient Resources section). The first one outlines pregnancy complications and future risk of cardiovascular disease and aims to increase awareness on how women can potentially modify their risk of CVD through lifestyle changes. The second infographic focuses on the signs and symptoms of heart disease in pregnancy and postpartum. Both infographics are available in English and Spanish in .jpg and .pdf formats on the CMQCC website (www.cmqcc.org). The infographics are designed to be posted or displayed in medical clinic offices and/or exam rooms for patients to observe, read and review. They may also be incorporated into digital communications, such as social media or embedded in emails.

HYPERTENSION IN PREGNANCY

Women can enter pregnancy with chronic hypertension or develop hypertension during their pregnancy. New-onset hypertension in pregnancy can further be diagnosed as gestational hypertension, preeclampsia, or preeclampsia with HELLP syndrome.

Gestational Hypertension: Gestational hypertension is diagnosed when a pregnant woman presents with hypertension in the absence of proteinuria after the 20th week of pregnancy.[3] The incidence of gestational hypertension is 6%.[4] Gestational hypertension is managed similarly to preeclampsia and has similar impact on future development of hypertension, but there is not as strong an association with other cardiovascular diseases.[5,6]

Preeclampsia: The American Congress of Obstetricians and Gynecologists (ACOG) have published comprehensive definitions and guidelines on diagnosis and

management of hypertension in pregnancy.[3] Women diagnosed with preeclampsia have double the risk of stroke, cardiac ischemia or venous thromboembolism for up to 20 years after pregnancy.[1] The risk for the development of hypertension is four-fold among women with preeclampsia.[1] For women who develop preeclampsia prior to 34 weeks' gestation (early-onset preeclampsia), the risk of developing these complications is 8-10 times higher than among women who develop preeclampsia after 34 weeks' gestation.[1]

OTHER CONDITIONS

Gestational Diabetes: Gestational diabetes mellitus (GDM) is a complication of pregnancy and is associated with an increased risk of developing CVD.[7-9] The most common risk factors associated with GDM include advanced maternal age, obesity, and excess weight gain during pregnancy, family history of diabetes, previous pregnancy with GDM and hypertension.[2] Women with GDM have a higher risk of developing CVD earlier in their lives.[5,10] Among women diagnosed with GDM, there is a 48% incidence among Hispanic women, 35% among White women, 12% among Asian women and 5.5% among African-American women.[11,12]

Preterm Birth: Preterm birth is defined as birth occurring at less than 37 weeks gestation. In 2012,11.5% of all U.S. births were preterm.[13] A number of preterm births can be attributed to hypertension in pregnancy.[14] Women who experience preterm birth AND preeclampsia have 8-10 times higher CVD mortality in their lifetimes compared to women with normal pregnancies.[1]

RECOMMENDATIONS FOR WOMEN TO DECREASE CVD RISK AFTER PREGNANCY COMPLICATIONS

Women who have had pregnancy complications and are monitored throughout their lifetime can improve their cardiovascular health outcomes and overall health. All women should share their pregnancy and postpartum information with their current and future healthcare providers and ensure their medical records are shared as they receive care throughout their lives. In addition, all providers should ensure women are informed of and understand their pregnancy complications, and stress the importance of the six-week postpartum visit. The postpartum visit occurs on or between 21 and 56 days following the birth and is important for all postpartum women.[15] Women who experienced gestational diabetes should be re-screened for diabetes. Obstetric providers should provide a referral for a 3- or 6-month follow-up visit with a primary care provider to assess future CVD risk.

Postpartum Period: All healthcare providers should educate women with regard to serious signs or symptoms that may be associated with preeclampsia or cardiovascular disease in the first few days or weeks following birth. These include:

- Severe headache
- Shortness of breath – especially when lying down
- Chest pain
- Persistent cough
- Extreme swelling
- Extreme fatigue

Postpartum women (up to five months following birth) should notify their pregnancy provider and/or seek care from the provider or an Emergency Department when experiencing symptoms listed above. Women should be empowered to listen to their body and trust their instincts. It is crucial that women who seek care from an Emergency Department notify providers of their recent birth experience.

Throughout Their Lifetime: At three to six months postpartum, and annually thereafter, women who had any hypertension, preterm birth, preeclampsia, or gestational diabetes should consider a physical examination with their pregnancy provider or primary care provider for assessment of future CVD risk. This visit should include:[1]

- Vital signs – blood pressure, heart rate, respiratory rate, oxygen saturation, weight and BMI
- Consider laboratory studies – fasting blood glucose levels with or without a Hemoglobin A1C, lipid profile to check total/HDL/LDL cholesterol, and triglyceride levels.

Healthcare providers should share this information with women and discuss what these results mean for their health. Women should be encouraged to know their own health-related numbers and how they relate to healthy heart values from the American Heart Association (2017) referenced below:[16]

Health Indicator	Healthy Values (less than)
Blood pressure	< 120/80 mm Hg
Total cholesterol	< 200 mg/dL
HDL cholesterol	< 50 mg/dL
LDL cholesterol	< 100 mg/dL
Triglyceride	< 100 mg/dL
Fasting blood glucose	< 100 mg/dL
BMI	< 25 kg/m^2

Lifestyle Modifications: Lifestyle changes may decrease the incidence or development of cardiovascular disease.[17] As many CVD diagnoses are associated with an increased BMI and waist circumference, steps to maintain a healthy weight are important.[5] Women should be encouraged to have a healthy diet and regular exercise as recommended by their healthcare provider. When compared to women who remained obese, women who

lost weight lowered their incidence of the following conditions in future pregnancies: gestational hypertension from 23.5% to 9.6% and preeclampsia from 20.8% to 12%.[18]

Breastfeeding has added benefits for maternal health. Women whose cumulative lifetime duration of breastfeeding is six-to-twelve months were 10% less likely to develop cardiovascular disease.[19] Breastfeeding has been theorized to decrease the incidence of hypertension through changes that occur to the maternal vasculature and maternal lipid and hormonal values.[20] It also enhances postpartum weight loss.

COMMON MISCONCEPTIONS

A common misconception among providers and the public is that pregnancy-related hypertension and gestational diabetes complications resolve after the baby is born. In fact, women with a history of preeclampsia have twice the risk of stroke, cardiac ischemia or blood clots, and four times the risk of developing chronic hypertension.[21] Of women diagnosed with gestational diabetes, up to 50% may develop Type II diabetes within five years after giving birth.[8,10,11]

KEY POINTS

Women who have experienced preeclampsia are often unaware of their increased lifetime risk for cardiovascular health concerns but are enthusiastic to learn of the association and how they can improve their health.[21]

- Hypertension and diabetes in pregnancy represent a wake-up call for women and those who care for them.
- Healthy lifestyle changes will likely reduce future cardiovascular disease risk by 4-13%.[17]

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Patient Handout:

PREPARING FOR PREGNANCY IF YOU HAVE A HISTORY OF HEART PROBLEMS OR CARDIOVASCULAR DISEASE

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Do you have a history of heart disease (preexisting heart disease discovered during childhood or adulthood) and are thinking about having a baby?

Planning for a healthy pregnancy
More women who were born with a heart problem are able to get pregnant and have a healthy baby. In most cases, if you were born with a heart problem, you can have a healthy and safe pregnancy and childbirth. However, because of your heart disease, if you get pregnant, you will be considered high-risk.

The first step is to talk to your doctor BEFORE you get pregnant. Your doctor should refer you to a cardiologist and/or a maternal fetal medicine specialist for a preconception counseling appointment. If you had surgery for heart disease as a child, it is important that you see a cardiologist who is an expert in congenital heart disease. In the meantime, it is important to keep using birth control until you have made a plan for pregnancy with your doctor and other specialists.

Preparing for your visit before you become pregnant (preconception)
The preconception counseling appointment is an important visit. You can discuss how your heart disease will affect your pregnancy and how your pregnancy will affect your heart disease. At this visit, the specialist will go over your medical history and help you decide whether pregnancy is right for you. The doctor will also talk to you about what you can do to improve your chances of a safe pregnancy and a healthy baby.

The doctor will ask you about your current and past symptoms, such as chest pain, fast heart beat (palpitations) or if you have a hard time breathing. It may help to keep a diary of your symptoms to show your doctor. You and your doctor can talk about how these symptoms may change when you are pregnant and after you have a baby.

You should bring all of your medical records with you to this visit so the doctor can review your health history. Bring records from any childhood surgeries that you have had. All of this information will help the doctor understand your risks in pregnancy. The information will help you decide whether it is safe for you to get pregnant.

Evaluation of heart disease before you get pregnant
It is very likely that you will be asked to have some tests done before you get pregnant to see if your heart is ready for pregnancy. You may have had tests of your heart in the past, such as an EKG or an echocardiogram, a special ultrasound of the heart. Your doctor will use these tests to help you decide if and when you are ready for pregnancy. If the doctor does not order these tests, it is very reasonable to ask for them especially if they have not been performed in more than one year or if you've experienced new symptoms.

Heart disease medications and pregnancy
Your doctor may want you to change some medications that you currently take to different medications that are safe to take when you are pregnant. There are some medications that are unsafe in pregnancy. Your doctor may switch you off these medications to safer ones even before you become pregnant.

Congratulations on taking the first steps in planning for a healthy pregnancy!

Websites for more information:
Adult Congenital Heart Association: www.achaheart.org
American Heart Association: www.americanheart.org

Patient Handout:

CONTRACEPTION INFORMATION FOR WOMEN WITH CARDIOVASCULAR DISEASE

Maryam Tarsa, MD, MAS – University of California, San Diego School of Medicine

Why is birth control important?
When you are pregnant and have heart disease, it can be dangerous for both mother and baby. If you have known heart disease, including high blood pressure, heart defects, and heart failure, you should avoid pregnancy until you see a heart doctor (cardiologist) for full evaluation and treatment. Then, your heart doctor and prenatal provider can advise you when it is safe to become pregnant. In the meantime, it is important for women with heart problems to use safe and effective birth control.[1,2]

These factors put you at higher risk for heart problems in pregnancy:

- High blood pressure
- Born with a heart defect (with or without history of surgery)
- Heart failure
- Previous heart attack or stroke
- Previous abnormal blood clot
- Previous or current obesity or diabetes
- Previous or current substance use including alcohol, cocaine, amphetamine, methamphetamine and heroin.

If you are pregnant and have heart disease, you may be at risk for:

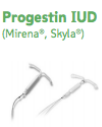
- Worsening high blood pressure
- Preeclampsia or eclampsia (severe blood pressure and seizures)
- Heart attack
- Heart failure
- Stroke
- Death.

If you are pregnant and have heart disease, your baby may be at risk for:

- Being born too early (premature)
- Poor or slow growth
- Death.

Methods of birth control

Birth control methods are divided into those that include hormones and those that do not. Some women with heart disease should avoid birth control containing hormones.

NON-HORMONAL BIRTH CONTROL METHODS		
Barrier methods, such as condoms, diaphragms		
Copper intrauterine device (IUD)		
Tubal ligation (female sterilization)	<no image available>	
Transcervical tubal occlusion, an incision-free, minimally invasive approach to sterilization	<no image available>	
Partner vasectomy (male sterilization)	<no image available>	
HORMONAL BIRTH CONTROL METHODS		
Combined Hormonal Contraceptives Pill | Patch | Ring		
		
Progestin only Pill | Injection | IUD | Implant		
		
		

Images used with permission from http://www.reproductiveaccess.org.

Questions to Ask Your Health Care Practitioner

What are the risks to my health if I am pregnant?
Will it ever be safe for me to have a baby?
What is the best type of birth control for me?
When can I start to use birth control?
How can I improve my health so I can have a safe pregnancy?
What lifestyle changes should I consider?

REFERENCES

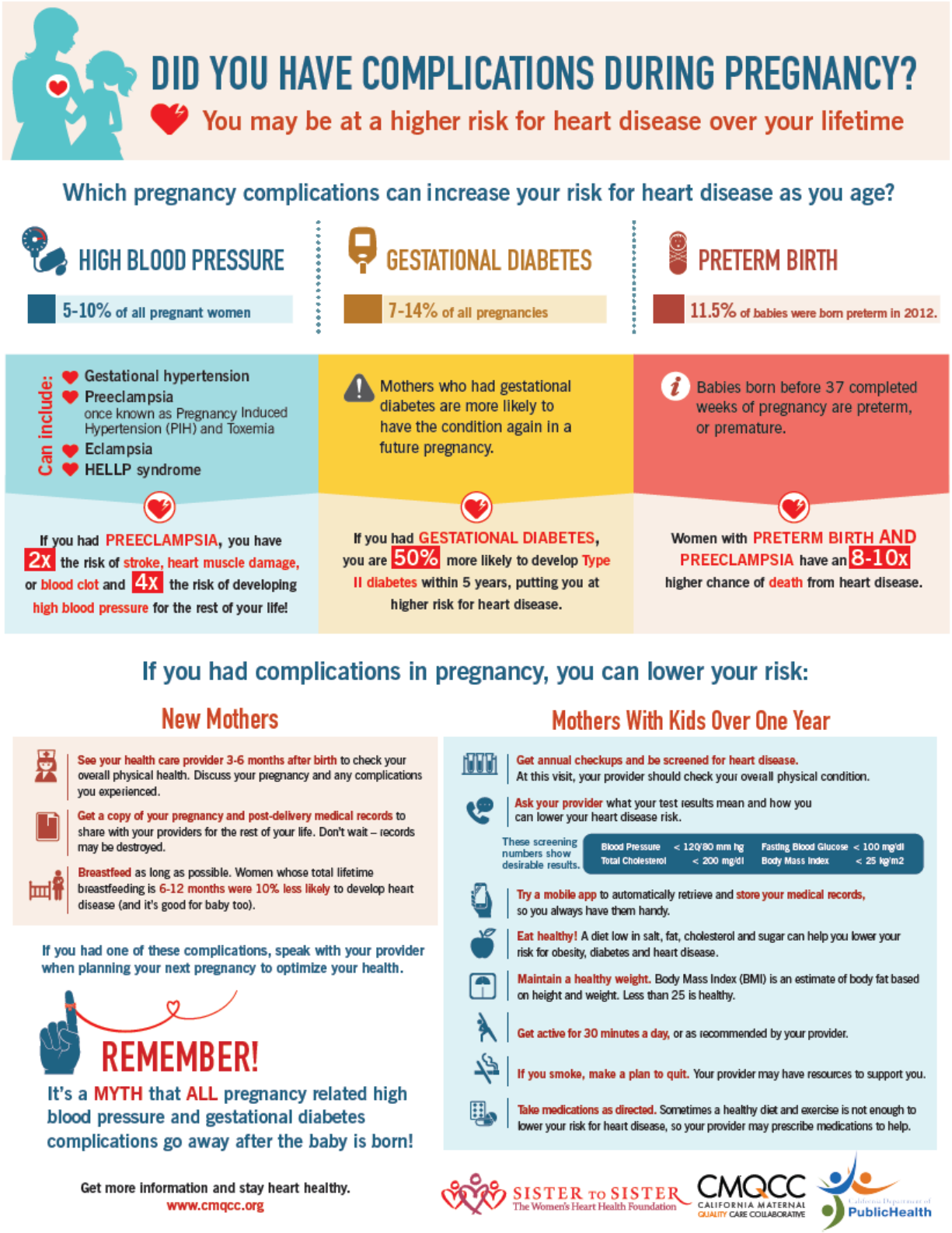
1. Chor J, Oswald L, Briller J, Cowett A, Peacock N, Harwood B. Reproductive health experiences of women with cardiovascular disease. *Contraception.* 2012;86(5):464-469.
2. Silversides CK, Sermer M, Siu SC. Choosing the best contraceptive method for the adult with congenital heart disease. *Curr Cardiol Rep.* 2009;11(4):298-305.

INFOGRAPHIC #1: LIFETIME RISKS OF HEART DISEASE AFTER PREGNANCY COMPLICATIONS

This infographic is available in .pdf and .jpg formats in English and Spanish. All versions are available to download, share via social media and reproduce for distribution or posting in clinics and public spaces. For optimal resolution of these graphics, download them directly at https://www.cmqcc.org/.

Infographic Goal: To increase women's awareness that having certain complications in pregnancy or postpartum (after having a baby) can increase their lifetime risk of CVD. Women can lower their risk by engaging in healthy activities and making sure to get regular checkups with a health care provider who knows their history.

This infographic was developed as part of the Cardiovascular Disease in Pregnancy and Postpartum Task Force in partnership with Sister to Sister: The Women's Heart Health Foundation, which ceased existence in October 2014. Design by IQ Solutions (www.iqsolutions.com).


DID YOU HAVE COMPLICATIONS DURING PREGNANCY?
You may be at a higher risk for heart disease over your lifetime
Which pregnancy complications can increase your risk for heart disease as you age?
HIGH BLOOD PRESSURE
5-10% of all pregnant women
GESTATIONAL DIABETES
7-14% of all pregnancies
PRETERM BIRTH
11.5% of babies were born preterm in 2012.
Can include:
Gestational hypertension
Preeclampsia
once known as Pregnancy Induced Hypertension (PIH) and Toxemia
Eclampsia
HELLP syndrome
If you had PREECLAMPSIA, you have 2x the risk of stroke, heart muscle damage, or blood clot and 4x the risk of developing high blood pressure for the rest of your life!
Mothers who had gestational diabetes are more likely to have the condition again in a future pregnancy.
If you had GESTATIONAL DIABETES, you are 50% more likely to develop Type II diabetes within 5 years, putting you at higher risk for heart disease.
Babies born before 37 completed weeks of pregnancy are preterm, or premature.
Women with PRETERM BIRTH AND PREECLAMPSIA have an 8-10x higher chance of death from heart disease.
If you had complications in pregnancy, you can lower your risk:
New Mothers
See your health care provider 3-6 months after birth to check your overall physical health. Discuss your pregnancy and any complications you experienced.
Get a copy of your pregnancy and post-delivery medical records to share with your providers for the rest of your life. Don't wait – records may be destroyed.
Breastfeed as long as possible. Women whose total lifetime breastfeeding is 6-12 months were 10% less likely to develop heart disease (and it's good for baby too).
If you had one of these complications, speak with your provider when planning your next pregnancy to optimize your health.
REMEMBER!
It's a MYTH that ALL pregnancy related high blood pressure and gestational diabetes complications go away after the baby is born!
Get more information and stay heart healthy.
www.cmqcc.org
Mothers With Kids Over One Year
Get annual checkups and be screened for heart disease.
At this visit, your provider should check your overall physical condition.
Ask your provider what your test results mean and how you can lower your heart disease risk.
These screening numbers show desirable results.
Blood Pressure < 120/80 mm hg
Total Cholesterol < 200 mg/dl
Fasting Blood Glucose < 100 mg/dl
Body Mass Index < 25 kg/m2
Try a mobile app to automatically retrieve and store your medical records, so you always have them handy.
Eat healthy! A diet low in salt, fat, cholesterol and sugar can help you lower your risk for obesity, diabetes and heart disease.
Maintain a healthy weight. Body Mass Index (BMI) is an estimate of body fat based on height and weight. Less than 25 is healthy.
Get active for 30 minutes a day, or as recommended by your provider.
If you smoke, make a plan to quit. Your provider may have resources to support you.
Take medications as directed. Sometimes a healthy diet and exercise is not enough to lower your risk for heart disease, so your provider may prescribe medications to help.
SISTER TO SISTER The Women's Heart Health Foundation
CMQCC CALIFORNIA MATERNAL QUALITY CARE COLLABORATIVE
California Department of PublicHealth


¿TUVO COMPLICACIONES DURANTE SU EMBARAZO?
Usted puede correr mayor riesgo de enfermedades del corazón por el resto de su vida
¿Cuáles son las complicaciones del embarazo que pueden aumentar el riesgo de enfermedades del corazón con el paso de los años?
PRESIÓN ARTERIAL ALTA
5-10% de todas las mujeres embarazadas
DIABETES GESTACIONAL
7-14% de todos los embarazos
NACIMIENTO PREMATURO
11.5% de todos los bebés nacieron prematuros en el 2012
Puede incluir:
Hipertensión gestacional
Preeclampsia, anteriormente conocida como hipertensión inducida por el embarazo o toxemia
Eclampsia
Síndrome HELLP (por sus siglas en inglés) que incluye hemólisis, enzimas hepáticas elevadas y un conteo bajo de plaquetas.
Las madres que tuvieron diabetes gestacional tienen más probabilidad de volver a tenerla en un futuro embarazo.
Los bebés que nacen antes de las 37 semanas completas de embarazo son prematuros.
Si tuvo PREECLAMPSIA, tiene 2 veces más riesgo de tener un ataque al cerebro, daño en los músculos del corazón o un coágulo de sangre, y 4 veces más riesgo de desarrollar presión arterial alta por el resto de su vida.
Si usted tuvo DIABETES GESTACIONAL, tiene 50% más probabilidad de desarrollar diabetes tipo II dentro de 5 años, lo que aumenta su riesgo de enfermedades del corazón.
Las mujeres con PARTO PREMATURO Y PREECLAMPSIA tienen de 8-10 veces más probabilidad de morir por enfermedades del corazón.
Si tuvo alguna complicación en su embarazo, usted puede disminuir su riesgo:
Nuevas mamás
Consulte con su proveedor de atención médica de 3 a 6 meses después del parto para que le evalúa su salud física general. Cuéntele sobre su embarazo y cualquier complicación que haya tenido.
Obtenga una copia de los registros médicos de su embarazo y posparto para poder compartir con sus proveedores el resto de su vida. No espere para hacerlo, ya que pueden destruir los registros.
Amamante el mayor tiempo posible. Las mujeres que han amamantado por un total de 6 a 12 meses de toda su vida tienen 10% menos probabilidad de desarrollar enfermedades del corazón (y también es bueno para el bebé).
Si usted tuvo una de estas complicaciones, consulte con su proveedor de atención médica al planear su siguiente embarazo para mantenerse lo más saludable posible.
¡RECUERDE!
Es un MITO que TODA presión arterial alta relacionada con el embarazo y TODAS las complicaciones de la diabetes gestacional desaparecen después de que nace el bebé.
Obtenga más información y mantenga su corazón sano.
www.cmqcc.org (en inglés)
Mamás con niños mayores de un año
Hágase un chequeo anual y pruebas de detección para las enfermedades del corazón. En su visita anual, su proveedor debe evaluarle su condición física en general.
Pregúntele a su proveedor qué significan los resultados de sus pruebas y cómo puede reducir su riesgo de las enfermedades del corazón.
Estos son los resultados deseables de las pruebas de detección:
Presión arterial < 120/80 mm hg
Glucosa en la sangre, en ayunas < 100 mg/dl
Colesterol total < 200 mg/dl
Índice de masa corporal < 25 kg/m²
Pruebe una aplicación móvil que pueda automáticamente recuperar y almacenar sus registros médicos para que siempre los tenga a la mano.
¡Coma sano! Una dieta baja en sal, grasa, colesterol y azúcar puede ayudar a reducir el riesgo de obesidad, diabetes y enfermedades del corazón.
Mantenga un peso saludable. El índice de masa corporal (IMC) es un cálculo de la grasa corporal que se basa en la estatura y el peso. Lo saludable es tener un índice menor de 25.
Manténgase activa por 30 minutos al día o lo que le recomiende su proveedor.
Si fuma, haga un plan para dejar de fumar. Su proveedor puede tener recursos para ayudarle.
Tome los medicamentos siguiendo las indicaciones. A veces, no es suficiente seguir una dieta saludable y hacer ejercicio para reducir el riesgo de las enfermedades del corazón. Por eso, quizás su proveedor le recete medicamentos que le pueden ayudar.
SISTER TO SISTER The Women's Heart Health Foundation
CMQCC CALIFORNIA MATERNAL QUALITY CARE COLLABORATIVE
PublicHealth

INFOGRAPHIC #2: SIGNS AND SYMPTOMS OF HEART DISEASE DURING PREGNANCY AND POSTPARTUM

This infographic is available in .pdf and .jpg formats in English and Spanish. All versions are available to download, share via social media and reproduce for distribution or posting in clinics and public spaces. For optimal resolution of these graphics, download them directly at https://www.cmqcc.org.

Infographic Goal: To increase women's awareness of the signs and symptoms of CVD in pregnancy or postpartum (up to five months after having a baby). Heart disease is the leading cause of death among pregnant and postpartum women. If extreme symptoms do not go away with over-the-counter or prescription medication, women should see a healthcare provider.

This infographic was developed as part of the Cardiovascular Disease in Pregnancy and Postpartum Task Force. Design by IQ Solutions (www.iqsolutions.com).

Signs & Symptoms of Heart Disease

During Pregnancy and Postpartum

Heart disease is the leading cause of death among women in the U.S. who are pregnant or gave birth in the last 5 months (postpartum).

Symptoms to watch for in late pregnancy and up to five months postpartum:

- Extreme swelling or weight gain
- Extreme fatigue
- Fainting
- Persistent cough
- Chest pain or fast heart beat
- Severe shortness of breath (especially when lying down)

NOTE: While some of these symptoms are common in late pregnancy, they may be a sign of heart disease especially if they are severe and do not go away after treatment.

If you have any of these symptoms and they don't go away:

- Contact your OB, midwife, family medicine doctor, or your primary care provider
- Describe your symptoms clearly and explain how sick you feel
- If your symptoms arise postpartum, be sure to tell the provider that you recently had a baby
- If your provider says your symptoms are normal, ask what symptoms should cause you to call or come back

Go to the Emergency Department

If you have persistent chest pain or severe shortness of breath, or otherwise feel extremely sick. If possible, take someone with you.

Any woman can develop heart disease in pregnancy or postpartum, but you are at higher risk if you:

- Have prior heart disease
- Are over 40 years old
- Have preeclampsia or high blood pressure (hypertension)
- Are African-American (4X greater risk and 8-10X more likely to die of heart disease)
- Are obese

Bottom line

- Trust your instincts when you feel something is wrong
- When you see a healthcare provider, bring your partner, friend or family member who can support you and help explain these symptoms are not normal for you
- Seek a second opinion if you don't feel listened to or your symptoms are not taken seriously

Get online support and information: www.myheartsisters.com | www.womenheart.org

CMQCC CALIFORNIA MATERNAL QUALITY CARE COLLABORATIVE
www.cmqcc.org

Funding for the development of this Infographic was provided by Federal Title V MCH block grant funding from the California Department of Public Health; Maternal Child Adolescent Health Division, and Stanford University.

Señales & Síntomas de enfermedades del corazón *durante el embarazo y posparto*

En los Estados Unidos, las enfermedades del corazón son la principal causa de muerte en las mujeres que están embarazadas o que han dado a luz en los últimos 5 meses (posparto).

Esté atenta a los siguientes síntomas hacia el final de su embarazo y hasta 5 meses después de dar a luz:

- Tos persistente
- Fatiga extrema
- Desmayos
- Hinchazón extrema o aumento de peso
- Dolor en el pecho o latido rápido del corazón
- Mucha dificultad para respirar (especialmente cuando está acostada)

NOTA: Aunque algunos de estos síntomas son comunes al final del embarazo, también pueden ser una señal de una enfermedad del corazón, especialmente si son graves y no desaparecen después de tener un tratamiento.

Si usted tiene cualquiera de los síntomas anteriores y éstos no desaparecen:

- Comuníquese con su obstetra, partera, médico general o proveedor de atención médica principal.
- Descríbale claramente sus síntomas y dígale lo mal que se siente.
- Si sus síntomas aparecen después del parto, asegúrese de que su médico sepa que usted dio a luz hace poco.
- Si su médico u otro proveedor de atención médica le dice que sus síntomas son normales, pregúntele cuáles síntomas requieren que usted le llame de nuevo o vuelva a su consultorio.

Vaya a la sala de emergencias si usted tiene un dolor de pecho persistente, mucha dificultad para respirar, o se siente extremadamente enferma por alguna otra razón. De ser posible, trate de que alguien le acompañe.

Cualquier mujer puede desarrollar una enfermedad del corazón durante el embarazo o el posparto, pero usted corre un riesgo más alto si:

- Ya tenía una enfermedad del corazón
- Tiene más de 40 años
- Es afroamericana (4 veces más riesgo y 8 a 10 veces más probabilidad de morir de una enfermedad del corazón)
- Tiene preeclampsia o presión arterial alta (hipertensión)
- Es obesa

Conclusión

- Confíe en sus instintos si siente que algo anda mal.
- Cuando consulte a su proveedor de atención médica, vaya con su pareja, amigo o amiga o algún familiar que le pueda apoyar y ayudarle a explicar a su médico que estos síntomas no son normales para usted.
- Busque una segunda opinión si siente que su proveedor de atención médica no le escucha o que no toma en serio sus síntomas.

Obtenga apoyo e información en el internet: www.myheartsisters.com | www.womenheart.org | www.womenheart.org/espanol

CMQCC California Maternal Quality Care Collaborative www.cmqcc.org

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SLIDESET FOR PROFESSIONAL EDUCATION

[SEE NEXT PAGE FOR PDF OF TEACHING SLIDES]

Instructions

- This slide set is for you to use in your professional capacity to help improve the healthcare response to cardiovascular disease in pregnancy.
- You can use all or some of the slides, but please do not change the slides.
- However, if you feel you must modify one of our slides, please remove the CDPH and CMQCC logos.
- If you want to add one of your own slides, please use a "generic" slide template, but do not add CDPH or CMQCC logos.
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CMQCC
California Maternal
Quality Care Collaborative

Improving Health Care Response to Cardiovascular Disease in Pregnancy and Postpartum: A California Quality Improvement Toolkit

The CVD Toolkit was developed by CMQCC at Stanford University under contract with CDPH with funding from federal Title V MCH Block grant

California Department of PublicHealth

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Disclaimer

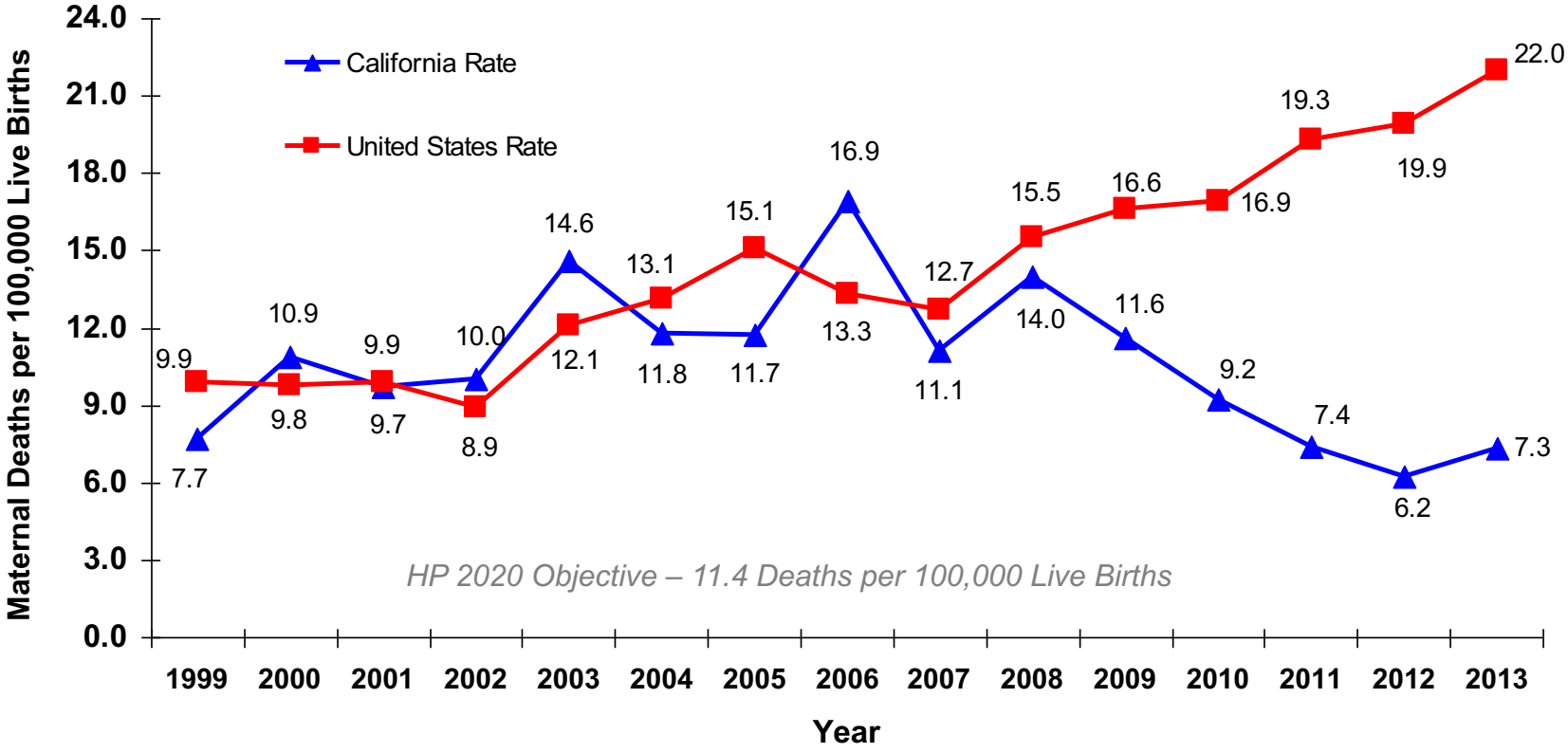
The CVD Toolkit is considered a resource and does not define the standard of care in California. Users are advised to adapt the guidelines and the resources based on their local facility's level of care and patient population and to not rely solely on the guidelines presented.

Presentation Topics

- California Pregnancy Associated Mortality Review (CA-PAMR): Summary Findings
- CA-PAMR: Cardiovascular disease (CVD) Findings
- Introduction to CVD Toolkit
- Proposed CVD Evaluation with Algorithms, B-Type Natriuretic Peptide (BNP) and Clinical Pearls
- Postpartum Presentations (Emergency Department [ED], Primary Care Provider [PCP], or Obstetric [OB] Setting)
- Racial Disparities in CVD
- Guidelines for Adults with Heart Disease

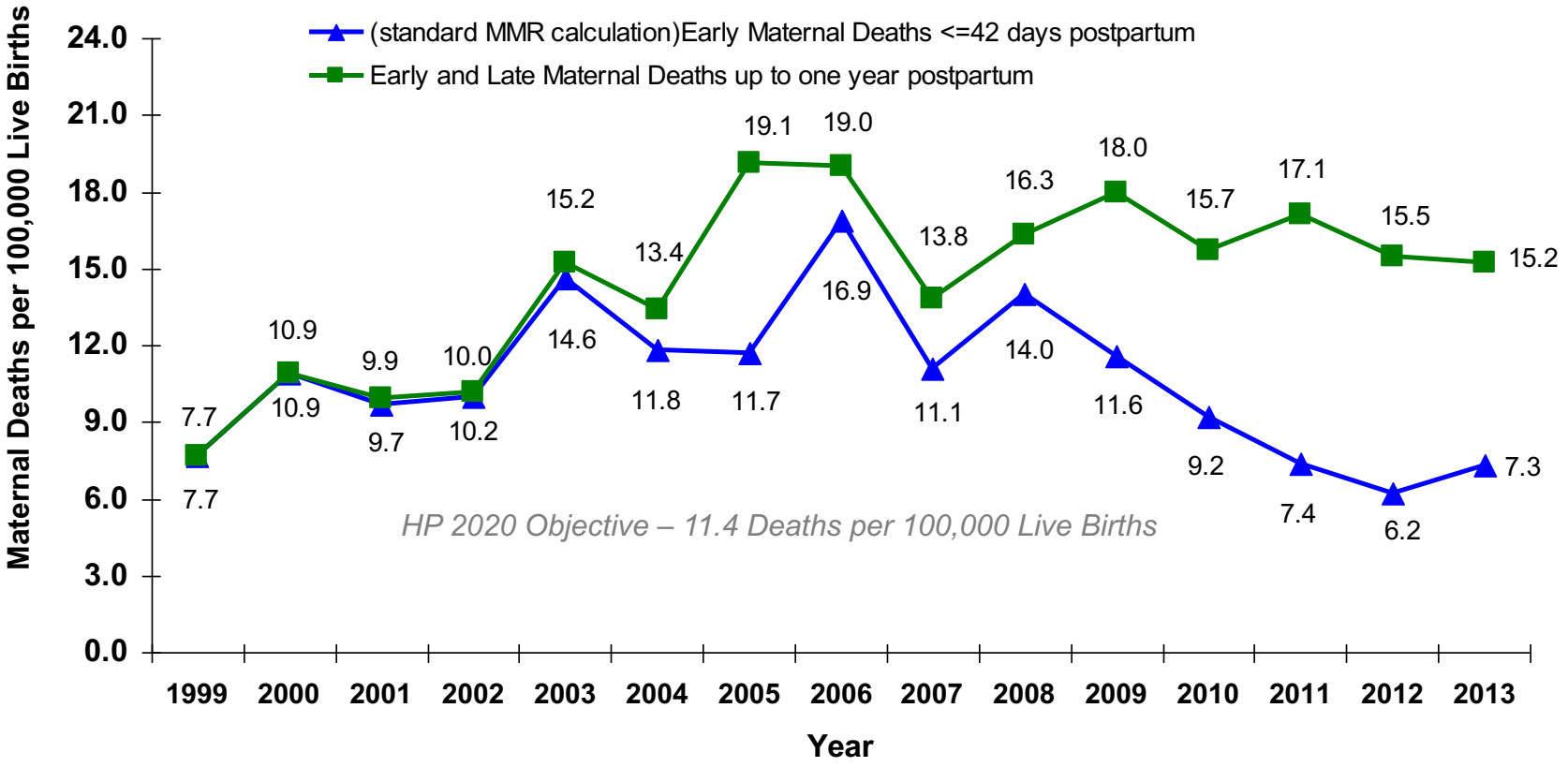
California Pregnancy Associated Mortality Review (CA-PAMR) Summary of Findings

Maternal Mortality Rate
California and United States- 1999-2013



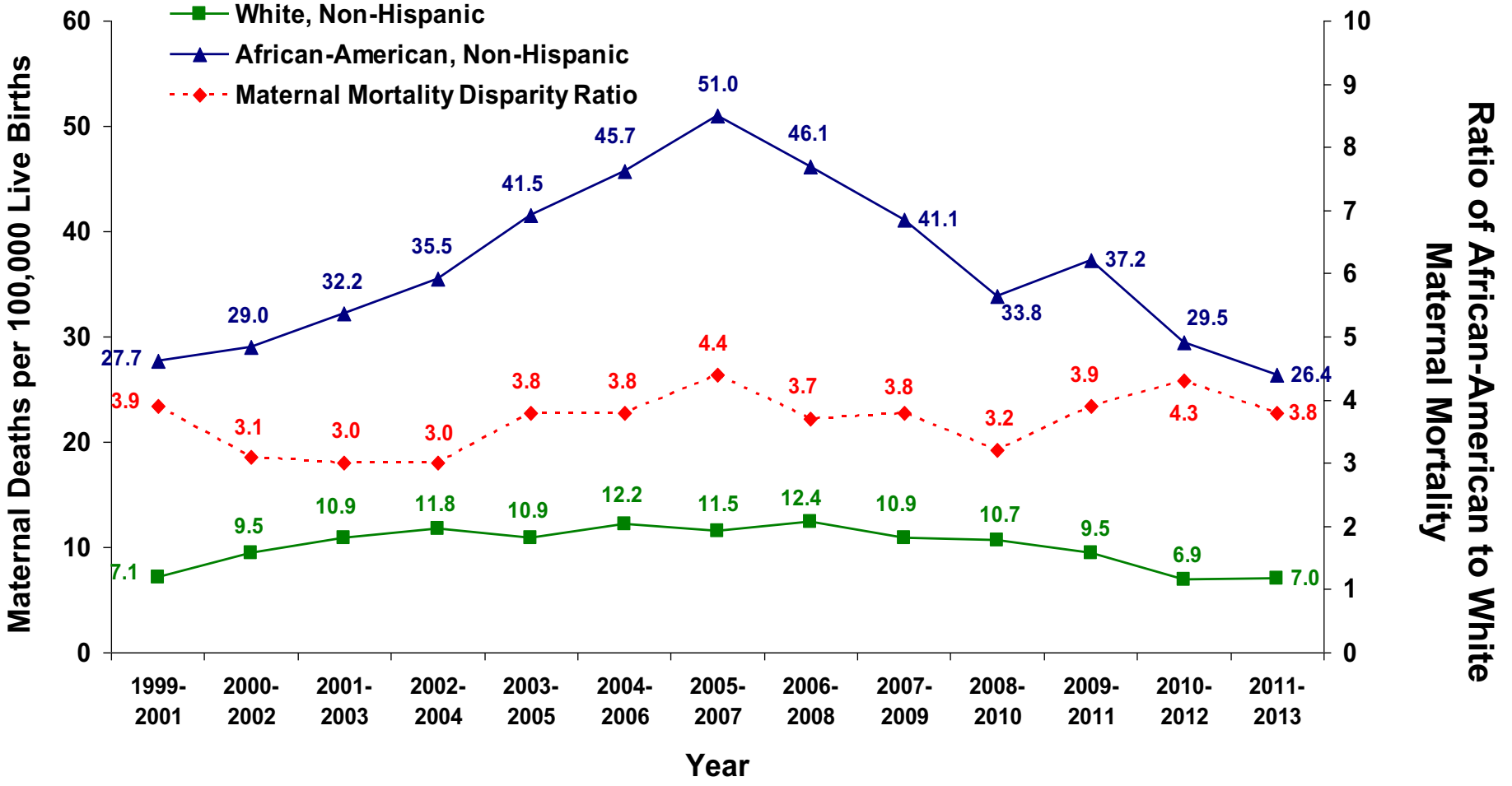
SOURCE: State of California, Department of Public Health, California Birth and Death Statistical Master Files, 1999-2013. Maternal mortality for California (deaths ≤ 42 days postpartum) was calculated using ICD-10 cause of death classification (codes A34, O00-O95,O98-O99). United States data and HP2020 Objective use the same codes. U.S. maternal mortality data is published by the National Center for Health Statistics (NCHS) through 2007 only. U.S. maternal mortality rates from 2008 through 2013 were calculated using CDC Wonder Online Database, accessed at Center for Disease Control March 11, 2015. Produced by California Department of Public Health, Center for Family Health, Maternal, Child and Adolescent Health Division, March, 2015.

Maternal Mortality Rate (early and late deaths) California Residents - 1999-2013



SOURCE: State of California, Department of Public Health, California Birth and Death Statistical Master Files, 1999-2013. Maternal mortality for California (Early maternal deaths ≤ 42 days postpartum) was calculated using ICD-10 cause of death classification (codes A34, O00-O95,O98-O99) and code O96 is also included when calculating Early and Late Maternal Deaths up to one year postpartum. Produced by California Department of Public Health, Center for Family Health, Maternal, Child and Adolescent Health Division, March, 2015.

Disparities in Maternal Mortality by Race/Ethnicity, California Residents; 1999-2013

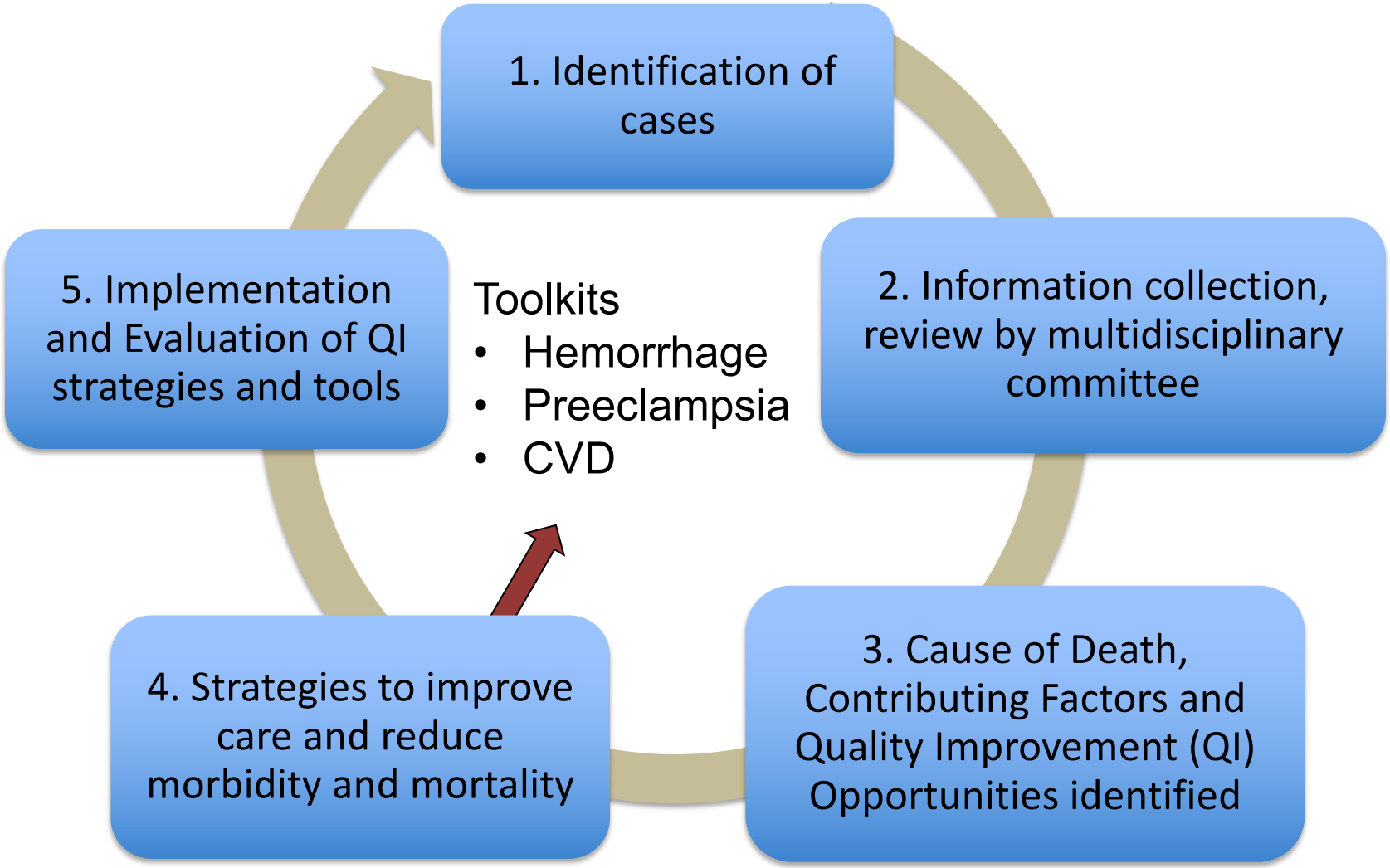


SOURCE: State of California, Department of Public Health, California Birth and Death Statistical Master Files, 1999-2013. Maternal mortality rates for California (deaths ≤ 42 days postpartum) were calculated using ICD-10 cause of death classification (codes A34, O00-O95,O98-O99). Produced by California Department of Public Health, Center for Family Health, Maternal, Child and Adolescent Health Division, May, 2015.

Background

- The **California Pregnancy-Associated Mortality Review** (CA-PAMR) was started in 2006 by the California Department of Public Health in response to rising rates of maternal mortality with the goal of understanding and reducing maternal morbidity and mortality.
- CA-PAMR found **cardiovascular disease (CVD) to be the leading cause** of pregnancy-related death in California.

CA-PAMR Quality Improvement Review Cycle

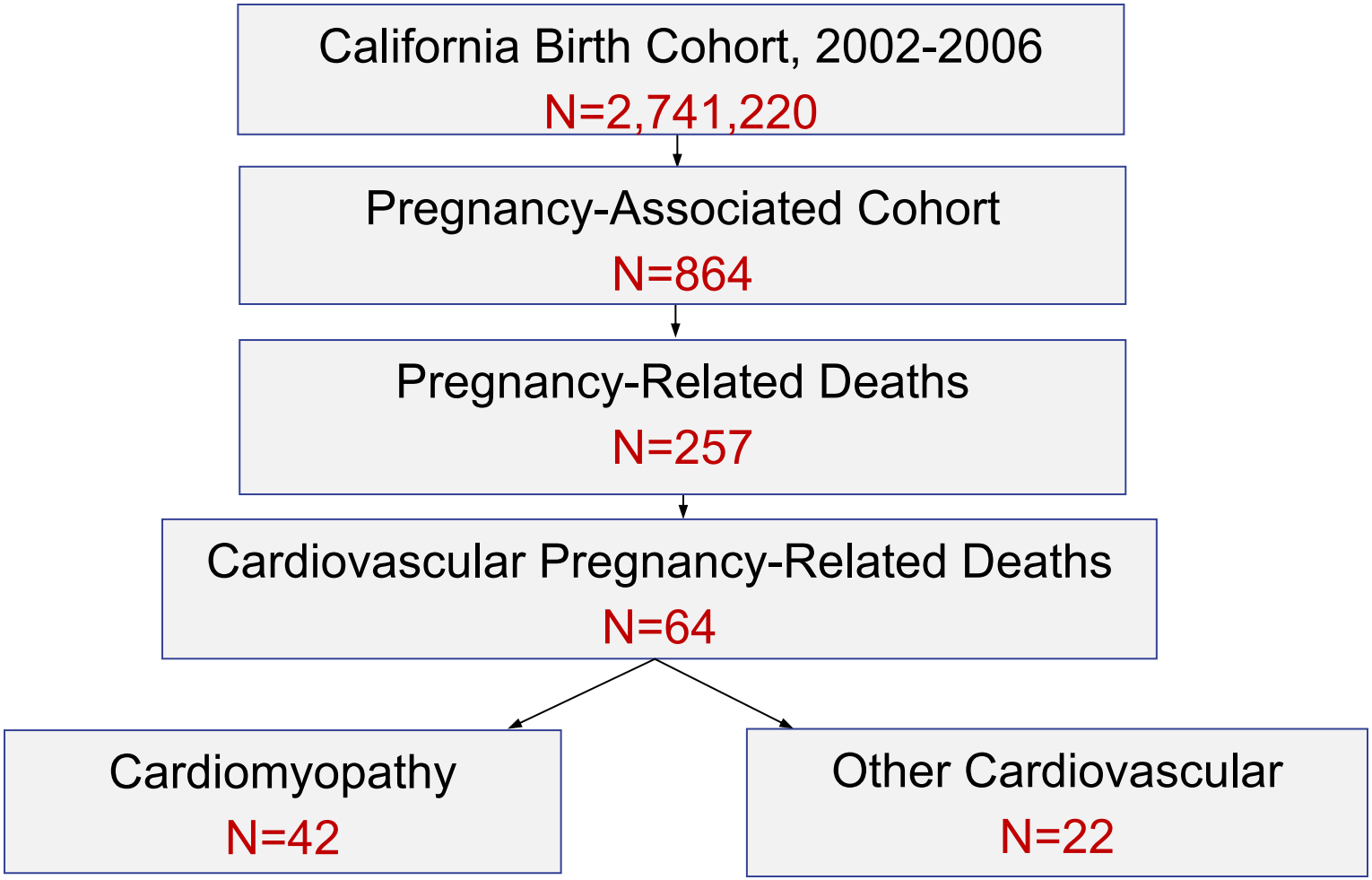


CA-PAMR

Cardiovascular Disease (CVD) Findings

CA-PAMR Findings

Identification and Confirmation of CVD Pregnancy-Related Deaths 2002-2006



Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Top 5 Causes of Death 2002-2006 (N=257)

Grouped Cause of Death, *per CA-PAMR Committee*	Pregnancy-Related Deaths N (%)
Cardiovascular disease	64 (25)
Cardiomyopathy	*42 (16)*
Other cardiovascular	*22 (9)*
Preeclampsia/eclampsia	45 (18)
Obstetric hemorrhage	25 (10)
Sepsis	23 (9)
Venous thromboembolism	22 (9)
TOTAL	**257**

CVD Pregnancy-Related Mortality Rate: 2.4 deaths /100,000 live births

CA-PAMR Pregnancy-Related Deaths
Causes of Death, by Race/Ethnicity
2002-2006 (N=257)

Clinical Cause of Death	White, Non-Hispanic N (%)	African-American, Non-Hispanic N (%)	Hispanic N (%)	Asian N (%)	TOTAL
Cardiovascular Disease	16 (24)	25 (45)	21 (19)	2 (9)	64 (25)
*Cardiomyopathy**	*11 (17)*	*18 (32)*	*11 (10)*	*2 (9)*	*42 (16)*
Other cardiovascular	*5 (8)*	*7 (13)*	*10 (9)*	*0*	*22 (9)*
Preeclampsia/eclampsia*	11 (17)	5 (9)	27 (24)	2 (9)	45 (18)
Obstetric hemorrhage	7 (11)	2 (4)	14 (13)	2 (9)	25 (10)
Venous thromboembolism	6 (9)	7 (13)	9 (8)	0	22 (9)
Sepsis	5 (8)	2 (4)	11 (9)	5 (22)	23 (9)
All other causes	21 (32)	15 (27)	30 (27)	12 (52)	78 (30)
TOTAL	66	56	112	23	257

*p<.05

CA-PAMR Pregnancy-Related Deaths
Chance to Alter Outcome by Grouped Cause of Death
2002-2006 (N=257)

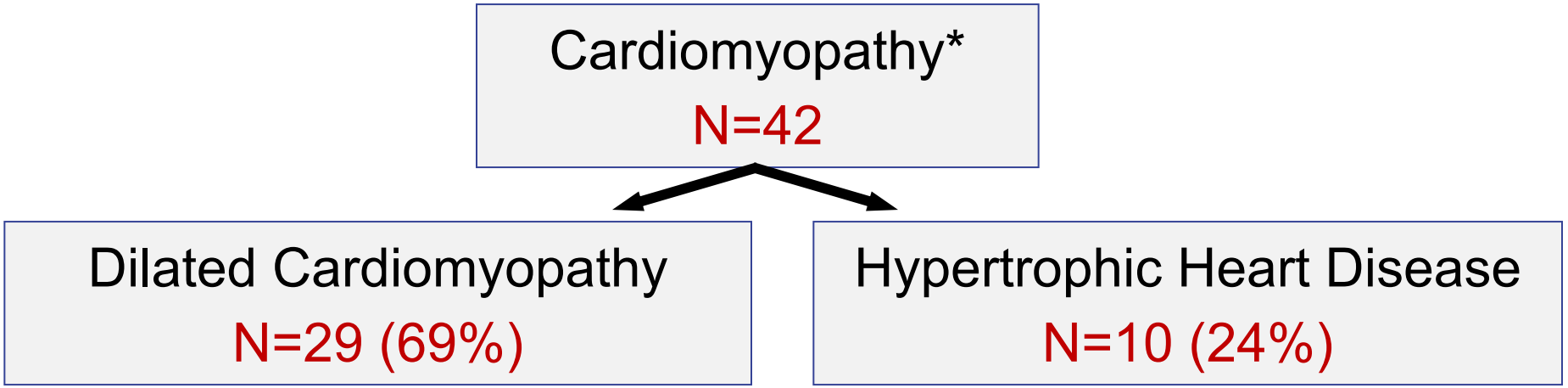
Clinical Cause of Death	Chance to Alter Outcome			
	Strong/Good N (row %)	Some N (row %)	None N (row %)	Total N
Obstetric hemorrhage	18 (72)	6 (24)	1 (4)	25
Sepsis/infection	14 (61)	7 (30)	2 (9)	23
Preeclampsia/eclampsia	27 (61)	16 (36)	1 (2)	44
Venous thromboembolism	11 (50)	10 (46)	1 (5)	22
Cardiomyopathy and other cardiovascular causes	15 (24)	37 (59)	11 (18)	63
Cerebrovascular accident	3 (15)	6 (30)	11 (55)	20
Amniotic fluid embolism	0	16 (84)	3 (16)	19
All other causes of death	16 (41)	19 (49)	4 (10)	39
Total (%)	104 (41%)	117	34	255*

* Two deaths lacked sufficient records to make determination (1 CVD, 1 preeclampsia).

CA-PAMR Findings

Cardiomyopathy Subtypes

2002-2006



*The type of cardiomyopathy (dilated or hypertrophic) could not be determined in 3 (7%) cases.

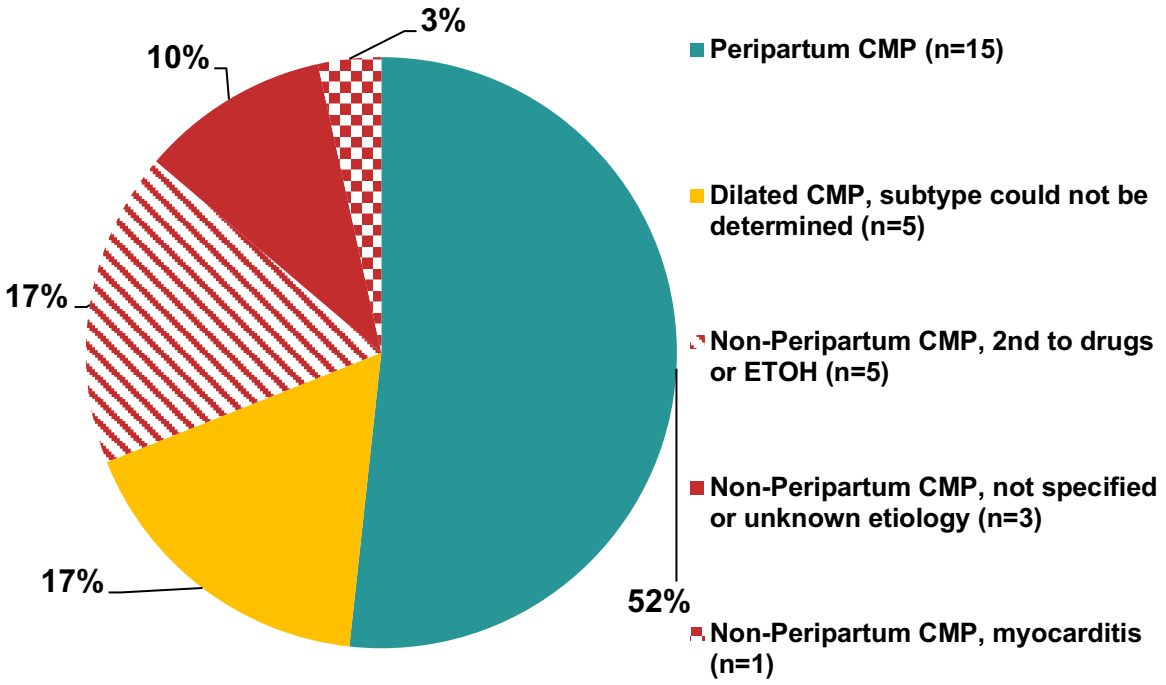
Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings

Cardiomyopathy Subtypes, 2002-2006

Dilated Cardiomyopathy

N=29 (69%)



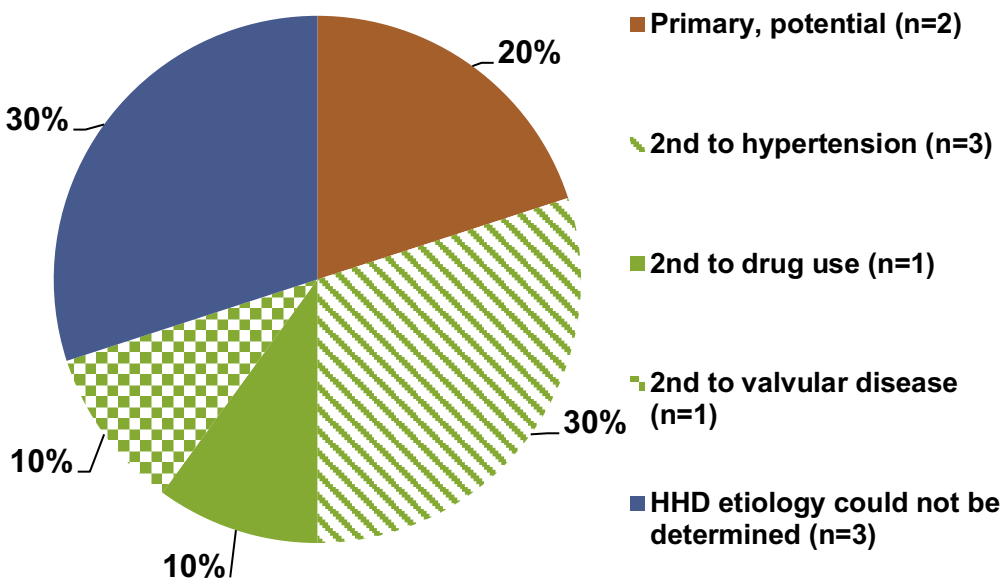
Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings

Cardiomyopathy Subtypes, 2002-2006

Hypertrophic Heart Disease

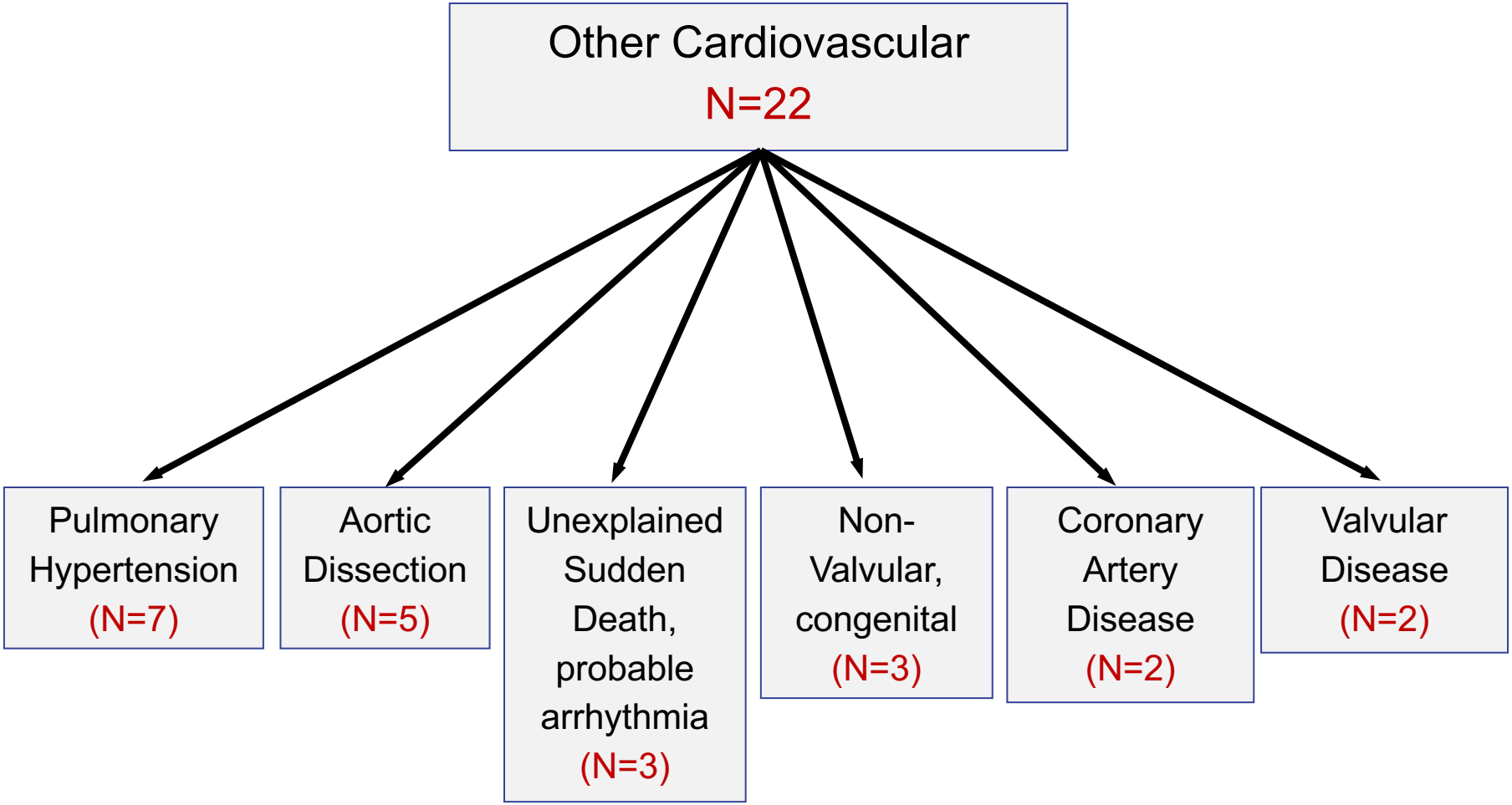
N=10 (24%)



*The type of cardiomyopathy (dilated or hypertrophic) could not be determined in 3 cases.

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Other Cardiovascular Disease Subtypes
2002-2006

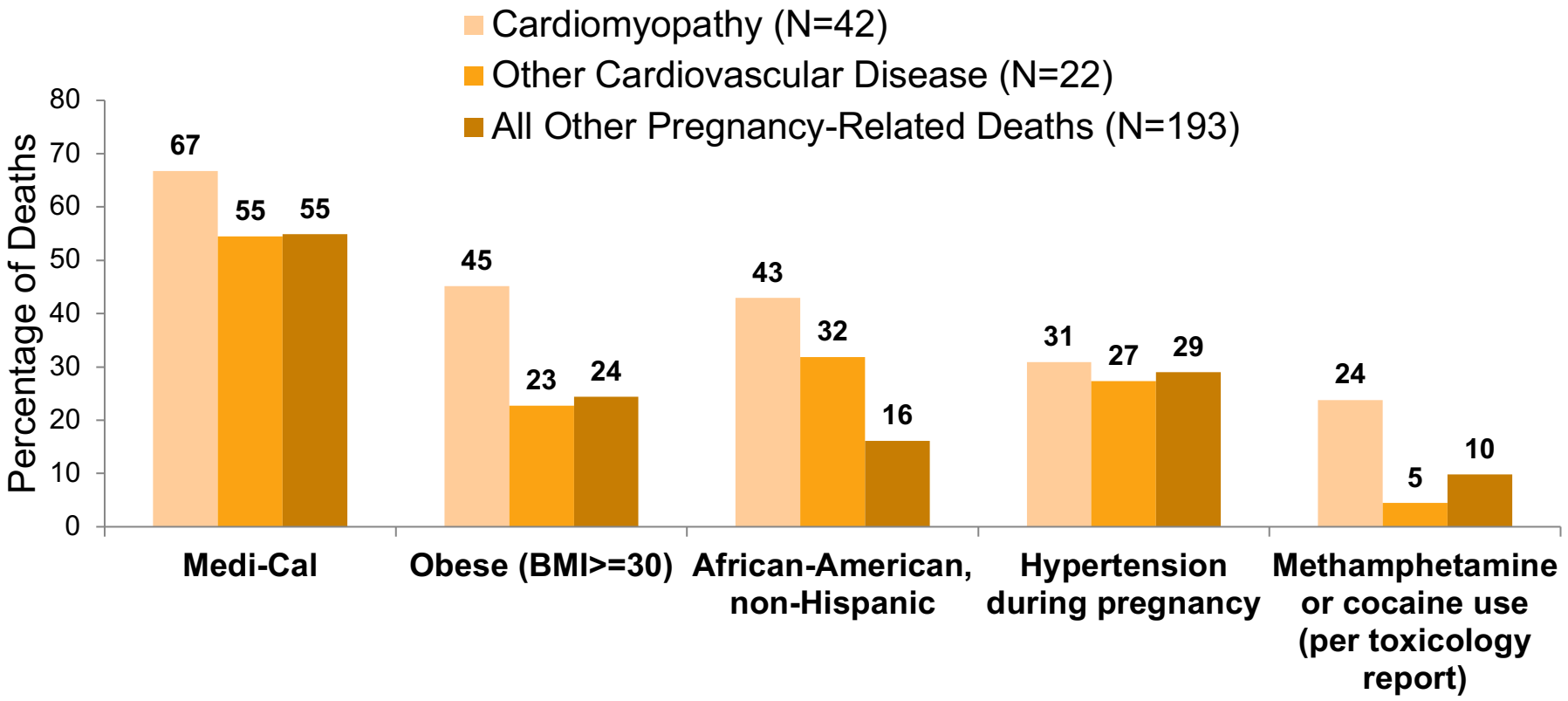


Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings

Characteristics and Risk Factors

2002-2006



Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Presentation of Women with CVD
2002 - 2006

- Only 2 women entered pregnancy with known CVD
- Prevalence of CVD symptoms (SOB, wheezing, palpitations, edema, chest pain, dizziness, or extreme fatigue)
  - Prenatal period: 43%
  - Labor and delivery: 51%
  - Postpartum: 80%

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Presentation of Women with CVD
2002 - 2006

- Abnormal physical exam findings
  - HTN ≥140/90 (64%)
  - HR ≥120 (59%)
  - Crackles, S3 or gallop rhythm etc. (44%)
  - O2 ≤90% (39%)

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Timing of Diagnosis and Death
2002-2006

- Timing of CVD Diagnosis (n=64)

- Preexisting (prior to pregnancy)
- Prenatal period
- At labor and delivery
- Postpartum period
- Postmortem

- Timing of Death
  - 30% of all CVD deaths were >42 days from birth/fetal demise vs. 7.3% of non CVD pregnancy-related deaths
  - Driven by Cardiomyopathy deaths, with 42.9% deaths >42 days

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Contributing Factors & Quality Improvement Opportunities (2002-2006) for CVD

Health Care Provider Related

- Contributing Factors: (69% of all cases)
  - Delayed or inadequate response to clinical warning signs (61%)
  - Ineffective or inappropriate treatment (39%)
  - Misdiagnosis (37.5%)
  - Failure to refer or consult (30%)
- Quality Improvement Opportunities
  - Better recognition of signs and symptoms of CVD in pregnancy
    - Shortness of breath, fatigue
    - Tachycardia, blood pressure change, or low oxygen saturation
    - Improved management of hypertension

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Contributing Factors & Quality Improvement Opportunities (2002-2006) for CVD

Patient Related

- Contributing factors: (70% of all cases)
  - Presence of underlying medical conditions (64%)
  - Obesity (31%)
  - Delays in seeking care (31%)
  - Lack of recognition of CVD symptoms (22%)
- Quality improvement opportunities
  - Education around when to seek care for worrisome symptoms
  - Support for improving modifiable risk factors, such as attaining healthier weight and discontinuing drug use

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Findings
Preventability
2002-2006

24% of ALL CVD pregnancy-related deaths
(and 31% of cardiomyopathy deaths)
were determined to be
potentially preventable

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Conclusions

Cardiovascular disease was the leading cause of pregnancy-related mortality in California (2002-2006).

- Dilated cardiomyopathy was the most common form of CVD, comprising 45% of all deaths
- Peripartum cardiomyopathy accounts for
  - 23% of all CVD pregnancy-related deaths
  - 52% of dilated cardiomyopathy deaths
- Major risk factors for cardiomyopathy were low income, substance abuse, African-American race, obesity, and pregnancy-related hypertension/preeclampsia.

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

CA-PAMR Conclusions

- Signs and symptoms of normal pregnancy / postpartum may mimic cardiac disease, but should be interpreted with caution when severe and occur in the presence of vital sign abnormalities and underlying risk factors.
- Most CVD was not diagnosed until after the women gave birth or had died.
- Increased awareness and index of suspicion for potential cardiovascular disease diagnosis, preconception counseling, and referral to higher level of care may help prevent adverse maternal outcomes.

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

Introduction to the CVD Toolkit

Rationale for Toolkit

Cardiovascular Disease is

- the leading cause of maternal mortality in CA and U.S.
- under-recognized in pregnant or postpartum women
- higher among African-American women

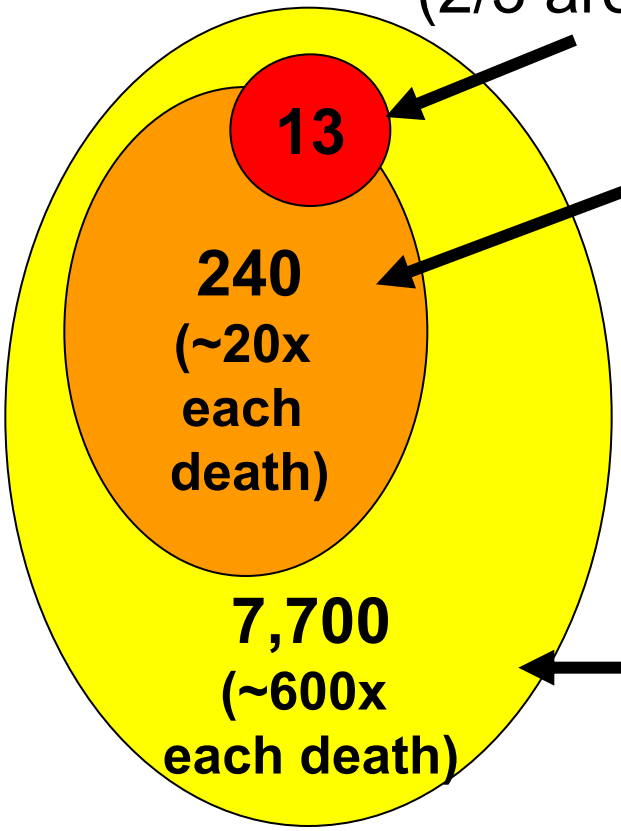
- 25% of deaths attributed to cardiovascular disease may have been prevented if the woman's heart disease had been diagnosed earlier.

- Pregnancy is a period of frequent interaction with health care providers and offers an opportunity to detect and treat heart disease, improve pregnancy outcomes, and affect future cardiovascular health.

Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008

Maternal Morbidity **and** Mortality related to CVD

Among the ~500,000 California women giving birth EVERY year, there are an estimated:



[1]Hameed A, Lawton E, McCain CL, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology* 2015; DOI: 10.1016/j.ajog.2015.05.008
[2]Gunderson EP, Croen LA, Chiang V, Yoshida CK, Walton D and Go AS. Epidemiology of peripartum cardiomyopathy: incidence, predictors, and outcomes. *Obstetrics and Gynecology*. 2011;118:583-91.

CVD Toolkit Goals

Given that CVD is the leading cause of maternal mortality & morbidity in California, the Toolkit aims to:

- Encourage obstetric and other healthcare providers to retain a high index of suspicion for CVD, particularly among women with risk factors who present with symptoms in late pregnancy or early postpartum period

- To serve as resource for generalists who provide maternity care to women, with special emphasis on
  - Prenatal visits
  - Postpartum encounters
  - Emergency room visits

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CVD Toolkit Audience

- Maternity clinicians
  - General OBs, Midwives, Nurses
- Providers of prenatal/postpartum care
  - Family Physicians
  - Emergency Medicine
  - Critical Care Medicine physicians
  - Nurse practitioners
- Pediatric specialists and cardiologists who specialize in care of young adults with congenital heart disease

CVD Toolkit Components (1)

- Cardiac disease assessment
  - Screening and diagnosis algorithm
  - Referral guidelines
  - Diagnostic testing- EKG, BNP, echocardiogram as resource for work up and follow up
- Postpartum visits (to ED, OB, or PCP)
- Racial/ethnic disparities and CVD
- Clinician and Facility resources for treating women with CVD

CVD Toolkit Components (2)

- CVD medications in pregnancy and breastfeeding
  - For women
  - For practitioners
- Contraception considerations for women with CVD
  - For women
  - For practitioners

CVD Toolkit Components (3)

Patient Information

- Preparing for pregnancy with known CVD
- Contraception information for women with CVD

Infographics

- Rationale
- Lifetime risk of heart disease after pregnancy complications
- Signs and symptoms of heart disease during pregnancy and postpartum

Proposed CVD Evaluation with Algorithms,

B-Type Natriuretic Peptide (BNP), and Clinical Pearls

CVD Case Presentation

- 25 year old obese (BMI 38) African-American G2P2 presents 10 days after an uncomplicated vaginal delivery with fatigue and persistent cough since delivery.
- BP 110/80, HR 110, RR 28, afebrile, with O2 sat 94% on room air.
- She gets diagnosed with respiratory infection and is prescribed an antibiotic. Fatigue is attributed to lack of sleep.

CVD Case Presentation (*CONTINUED)*

- One week later, she presents again with continued symptoms. Antibiotics are switched and beta-agonists are added for presumptive “new-onset asthma.”
- Two days later, the patient experiences cardiac arrest at home and resuscitation attempts are unsuccessful.
- Autopsy findings were indicative of cardiomyopathy.

CVD Algorithm Validation

- We applied the algorithm to 64 CVD deaths from 2002-2006 CA-PAMR.
- 56 out of 64 (88%) cases of maternal mortality would have been identified.
- Detection increased to 93% when comparison was restricted to 60 cases that were symptomatic.

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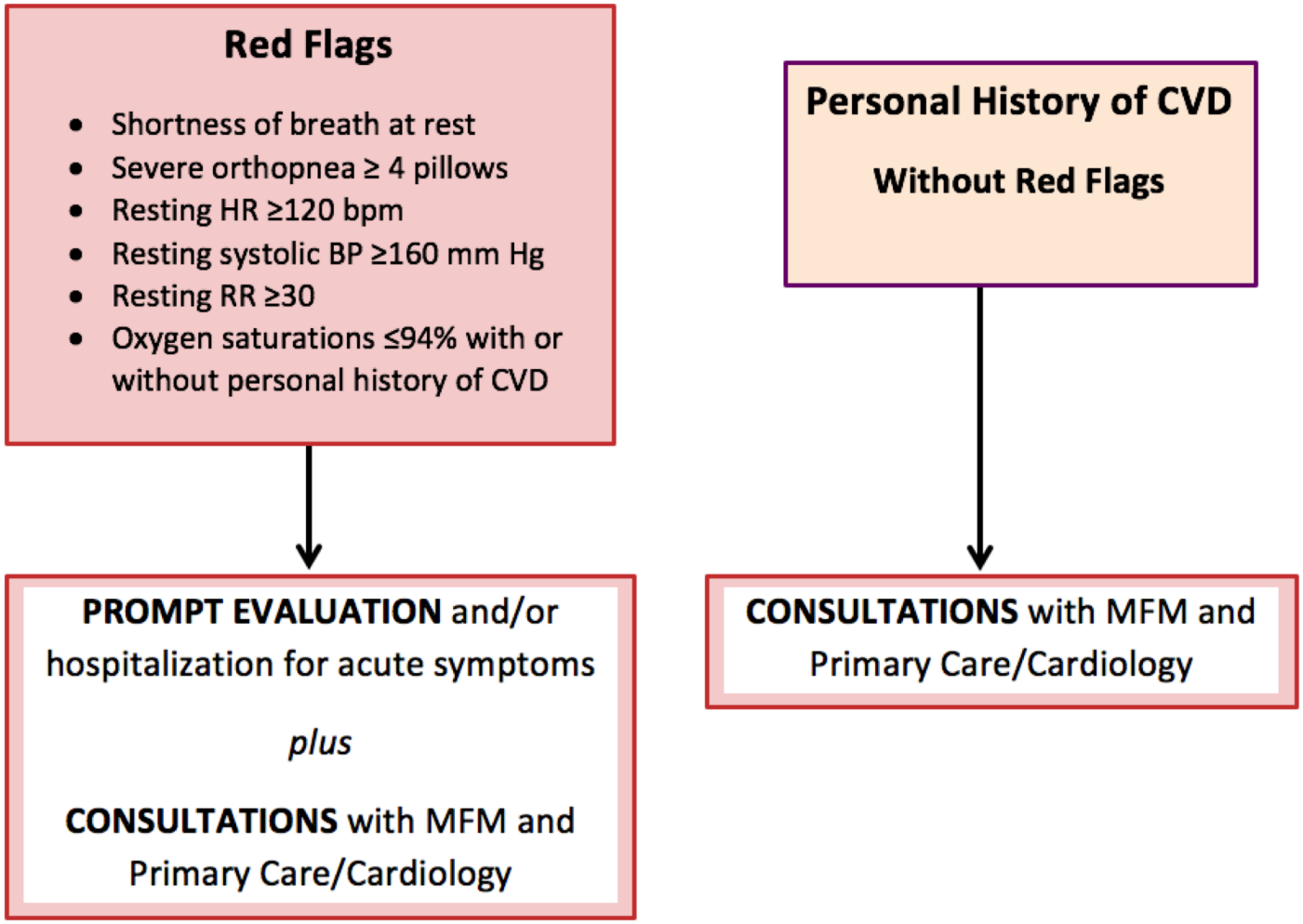
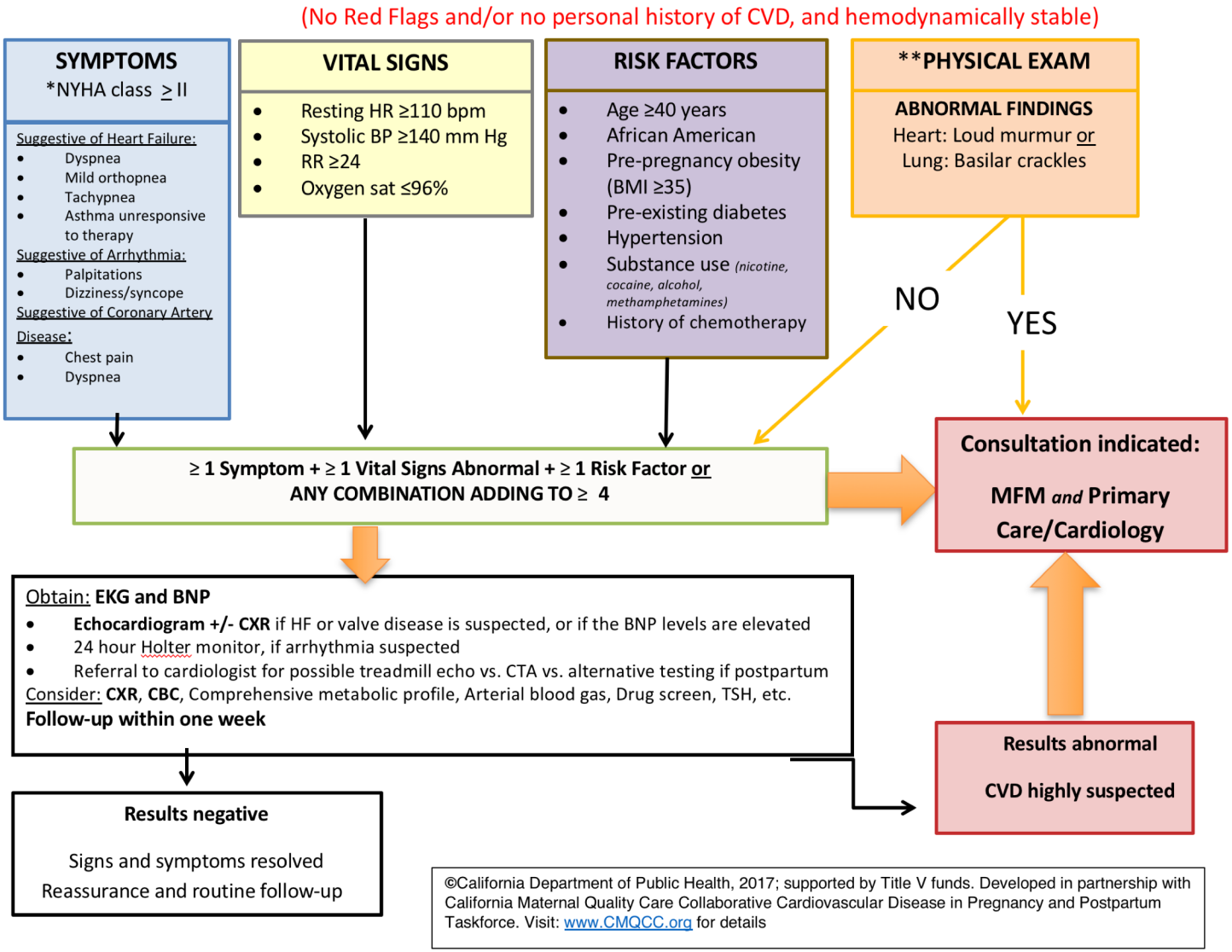
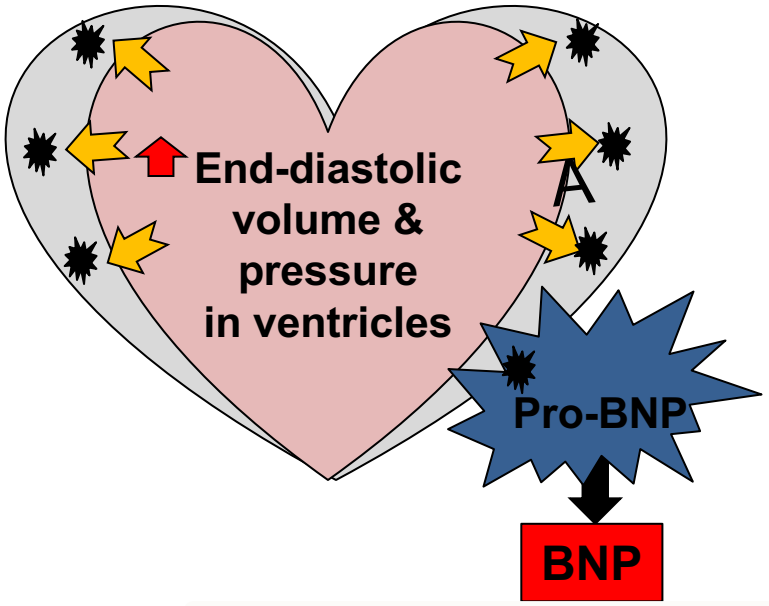
CVD Assessment Algorithm
For Pregnant and Postpartum Women





B Type Natriuretic Peptide (BNP)

Neurohormone secreted by the cardiac ventricles in response to ventricular volume expansion and pressure overload



Relaxes vascular smooth muscle

Inhibits renin-angiotensin-aldosterone system

Increases natriuresis and diuresis

Image Credit: Afshan Hameed, MD. Used with permission

BNP in Pregnancy

- Pregnancy is a state of physiologic volume overload

- LV wall mass and the diastolic dimensions increase

Lev-Sagie A, Bar-Oz B, Salpeter L, Hochner-Celnikier D, Arad I and Nir A. Plasma Concentrations of N-Terminal Pro-B-Type Natriuretic Peptide in Pregnant Women near Labor and during Early Puerperium. *Clinical Chemistry*. October 2005; 51 (10):1909-10.

Katz R, Karliner JS, Resnik R. Effects of a natural volume overload state (pregnancy) on left ventricular performance in normal human subjects. *Circulation*. 1978;58(3 Pt 1):434-41.

BNP Levels in Normal Pregnancy

- Median longitudinal BNP in 72 healthy pregnancies:
  - 1st trimester: 19.5 pg/mL
  - 2nd trimester: 18.0 pg/mL
  - 3rd trimester: 26.5 pg/mL
  - Postpartum: 18.5 pg/mL
- No statistically significant difference was noted in BNP levels throughout pregnancy and postpartum
- There is a statistically significant difference ($p < 0.001$) in BNP levels between non-pregnant 15 ± 9 pg/ml and normal healthy pregnant women 26 ± 21 pg/ml

Hameed AB, Chan K, Ghamsary M, Elkayam U. Longitudinal changes in the B-type natriuretic peptide levels in normal pregnancy and postpartum. *Clinical Cardiology.* Aug 2009;32(8):E60-62.

Clinical Uses of BNP in Pregnancy

- Diagnosis of heart failure
  - In pregnant women with dilated CMP, higher BNP predicts adverse cardiovascular outcomes
- Asymptomatic left ventricular function
  - Useful to evaluate shortness of breath
- Predictor of cardiovascular outcome
  - In pregnant women with congenital heart disease, higher BNP levels are associated with poor outcomes

- Blatt A, Svirski R, Morawsky G, et al. Short and long-term outcome of pregnant women with preexisting dilated cardiomypathy: An NTproBNP and echocardiography-guided study. *The Israel Medical Association journal : IMAJ.* Oct 2010;12(10):613-616.
- Tanous D, Siu SC, Mason J, et al. B-type natriuretic peptide in pregnant women with heart disease. *J Am Coll Cardiol.* Oct 5 2010;56(15):1247-1253.
- Kansal M, Hibbard JU, Briller J. Diastolic function in pregnant patients with cardiac symptoms. *Hypertens Pregnancy.* 2012;31(3):367-374.

Key Clinical Pearls

- First presentation of cardiovascular disease may be during pregnancy or early postpartum.
- The highest risk period for CVD worsening is between 24-28 weeks or postpartum.
- CVD symptoms or vital sign abnormalities should not be ignored in pregnant/postpartum women.
- New onset or persistent asthma may be a sign of heart failure.
- Bilateral infiltrates on chest x-ray may be due to heart failure rather than pneumonia.

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Key Clinical Pearls (continued)

- Pregnancy or postpartum women with significant risk factors should be counseled regarding future CVD risk.
- Women with known CVD should receive pre- & inter-conception counseling by an experienced perinatologist and cardiologist.
- Contraception choices should be tailored to the individual.
- Provider and patient education is essential.
- High index of suspicion, early diagnosis, appropriate referrals and follow up are the key elements to a successful outcome.

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Postpartum Presentations

(Emergency Department [ED], Primary Care Provider [PCP], or Obstetric [OB] Setting)

Postpartum Presentations to the ED, PCP or OB Provider

- Symptoms of cardiac disease may be falsely attributed to the common symptoms in a normal pregnancy (i.e., shortness of breath, fatigue).

- Preexisting cardiovascular disease and/or new onset peripartum cardiomyopathy may initially present during pregnancy or in the post-partum period.

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Postpartum Presentations to the ED, PCP or OB Provider

When a woman presents in the postpartum period with complaints of shortness of breath, ask if she has experienced:

- Worsened level of exercise tolerance
- Difficulty performing activities of daily living; Unexpected fatigue
- Symptoms that are deteriorating, especially chest pain, palpitations, or dizziness
- New onset of cough or wheezing
- Leg edema and if it is improving or deteriorating
- Inability to lay flat; if this is a change; how many pillows she uses to sleep
- Failure to lose weight or unusual weight gain, and how much
- A history of cardiac or pulmonary conditions
- A history of substance abuse and/or cigarette use
- Or has been seen by other providers or in other Emergency Departments since giving birth.

Postpartum Presentations to the ED, PCP or OB Provider

Key Points (1)

- Symptoms related to physiologic changes of pregnancy should be improving in the postpartum period.
- Any visits to Emergency Department for dyspnea should raise suspicion for cardiovascular disease.
- Women of childbearing age should be questioned about recent pregnancies, in addition to their last menstrual period (LMP).
- Postpartum dyspnea or new onset cough is concerning for cardiovascular disease.

Postpartum Presentations to the ED, PCP or OB Provider

Key Points (2)

- New onset asthma is rare in adults.
- Bilateral crackles on lung examination are most likely associated with Congestive Heart Failure (CHF).
- Improvement of dyspnea with bronchodilators does not confirm the diagnosis of asthma, as CHF may also improve with bronchodilators. Likewise, a lack of response to bronchodilators should prompt the entertainment of a diagnosis other than asthma.

Racial Disparities in CVD

Racial Disparities in CVD

Clinical Implications

- Maternal mortality is associated with the widest and most persistent disparity (inequality) in all of U.S. public health.*
- African-American women have a three-to-four fold greater risk of dying than women of other racial-ethnic groups.*
- The CVD-pregnancy-related mortality rate for African-American women was more than eight times higher than the mortality rate for White women.^

*Creanga AA, Berg CJ, Syverson C, Seed K, Bruce FC, Callaghan WM. Pregnancy-related mortality in the United States, 2006-2010. *Obstetrics and Gynecology.* 2015;125:5-12.
^Hameed A, Lawton E, McCain C, et al. Pregnancy-Related Cardiovascular Deaths in California: Beyond Peripartum Cardiomyopathy. *American Journal of Obstetrics and Gynecology.* 2015; DOI: 10.1016/j.ajog.2015.05.008.

Racial Disparities in CVD
Clinical Implications

Comorbidities with CVD

- Hypertensive disorders of pregnancy are more prevalent among African-American women.*^
- Hypertensive disorders are correlated with all types of CVD.*
- African-American women have lower frequency of prenatal care visits and seek care later in pregnancy than non-African-American women.^

*Creanga AA, Bateman BT, Kuklina EV, Callaghan WM. Racial and ethnic disparities in severe maternal morbidity: A multistate analysis, 2008-2010. *American Journal of Obstetrics and Gynecology.* May 2014;210(5):435 e431-438.
^Harper M, Dugan E, Espeland M, Martinez-Borges A, McQuellon C. Why African-American women are at greater risk for pregnancy-related death. *Annals of Epidemiology.* Mar 2007;17(3):180-185

Racial Disparities in CVD
Clinical Implications

- **Listen to women.** Take patient complaints seriously, and maintain a high index of suspicion for CVD especially in ALL African-American women.
- Any co-morbidity should further heighten the clinical index of suspicion.
- African-American women with chronic or gestational hypertension, high BMI (>35) who present with symptoms suggestive of CVD or vital signs indicated in the CVD Assessment Algorithm should be evaluated carefully and thoroughly for potential CVD.

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Guidelines for Adults with Heart Disease

OB Providers
Adult Valvular Disease Guidelines

Preconception Evaluation and Intrapartum Monitoring

- Prior to pregnancy all patients with known or suspected valve disease should be evaluated by a cardiologist with expertise in managing patients with valvular heart disease during pregnancy, who can provide pre-pregnancy counseling.
- Transthoracic echo (TTE) is recommended in the evaluation of all women with known or suspected valvular heart disease as part of pre-pregnancy counseling.
- Exercise testing is reasonable prior to pregnancy in patients with severe valve disease.

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OB Providers
Adult Valvular Disease Guidelines

Preconception Evaluation and Intrapartum Monitoring:

- Symptomatic severe valve disease should be treated prior to pregnancy.
- Asymptomatic valve disease should be monitored by a cardiologist and may require additional testing during pregnancy.
- Pregnant patients with severe valve stenosis or regurgitation should be monitored in a tertiary care center with a dedicated heart team with expertise in the management of high-risk cardiac patients during pregnancy.
- Use of ace inhibitors and angiotensin receptor blockers is contraindicated in pregnant and breastfeeding patients, however the use of beta blockers, diuretics and maybe reasonable for symptomatic relief.

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OB Providers
Adult Congenital Heart Disease Guidelines (ACHD)

- Patients with ACHD should consult with an ACHD expert before pregnancy to develop a plan for management of labor and postpartum.
- Pre-pregnancy counseling is recommended for women receiving chronic anticoagulation with warfarin.
- Estrogen-containing oral contraceptives are not recommended for ACHD patients at risk of thromboembolism.
- Patients with intra-cardiac right to left shunt should have fastidious care of IV lines to avoid air embolus.
- Fetal echocardiography is recommended between 18 and 20 weeks in women with personal history of congenital heart disease.

OB Providers
Adult Congenital Heart Disease
Resources for Care

- Adolescents with congenital heart disease (CHD) should have a coordinated, collaborative and comprehensive healthcare transition to adult cardiac specialists with services similar to the level of care they received as children.

- All adult congenital heart disease (ACHD) care providers and facilities where ACHD patients receive care should be in contact with a regional ACHD center of excellence.

Guide to Cardiovascular Disease Medications for Pregnant and Breastfeeding Women

- As with any medication in pregnancy, a careful assessment of fetal risk to maternal benefit should be undertaken in regards to cardiovascular medications.
- The Toolkit includes a short review of the physiology, indications and possible adverse effects of cardiovascular medications in pregnancy.

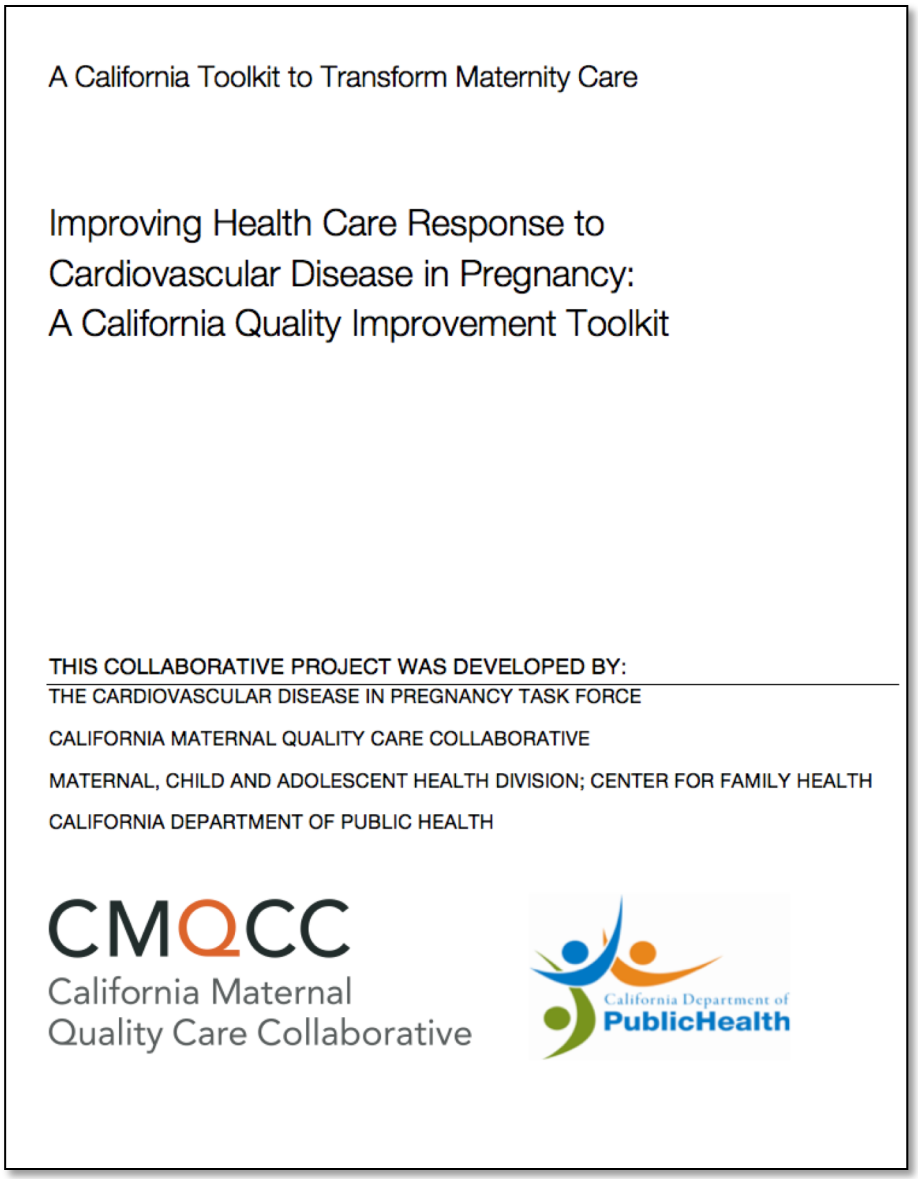
Guide to Contraception Information for Women with Cardiovascular Disease

Patients with cardiovascular disease including hypertension, congenital heart defects, arrhythmia and heart failure should be educated about contraceptive choices to improve overall health and prevent unwanted pregnancy.

- **Non-hormonal methods** are the preferred contraception in patients with cardiovascular disease, given the minimal risk of thromboembolism with their use.
- **Hormonal methods** containing estrogen products and depot medroxy-progesterone acetate injection should be used with caution in patients who have multiple risk factors or a history of cardiovascular disease.

Lifetime Risks of Heart Disease After Pregnancy Complications

- Pregnancy complications increase heart disease (CVD) risk:
  - Gestational hypertension, preeclampsia and HELLP syndrome
  - Gestational diabetes
  - Preterm birth.
- Women are often unaware of their CVD risk but are enthusiastic to learn more.
- Hypertension and diabetes in pregnancy = wake-up call for women and families.
- Future CVD risk can be reduced by 4-13% with healthy lifestyle changes.



For More Information and to Download the Toolkit

- Visit
- www.cmqcc.org
- https://www.cdph.ca.gov
- Contact: info@cmqcc.org

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(in order of presentation - 1)

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- Gunderson EP, Croen LA, Chiang V, Yoshida CK, Walton D and Go AS. Epidemiology of peripartum cardiomyopathy: incidence, predictors, and outcomes. *Obstetrics and Gynecology*. 2011;118:583-91.
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