Missouri Hospital Association
and the Cuff Kit Project

Maternal Cardiovascular Disease

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I have no conflicts or disclosure

Missouri PQC Cuff Kit
Lecture Series

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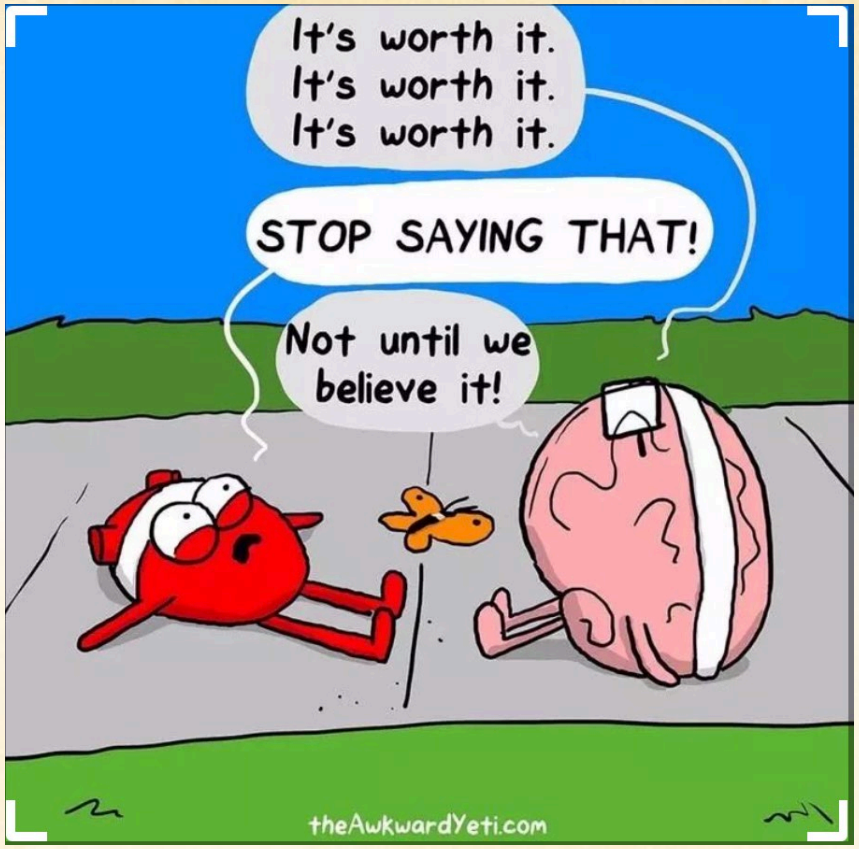
OUTLINE

- Review of maternal cardiovascular disease
  - Physiology
  - Risk factors
  - Outcomes
- CVD AIM bundle
  - Components and metrics
  - Implementation
- Opportunities for community integration of CCOC bundle

Cardiac Output

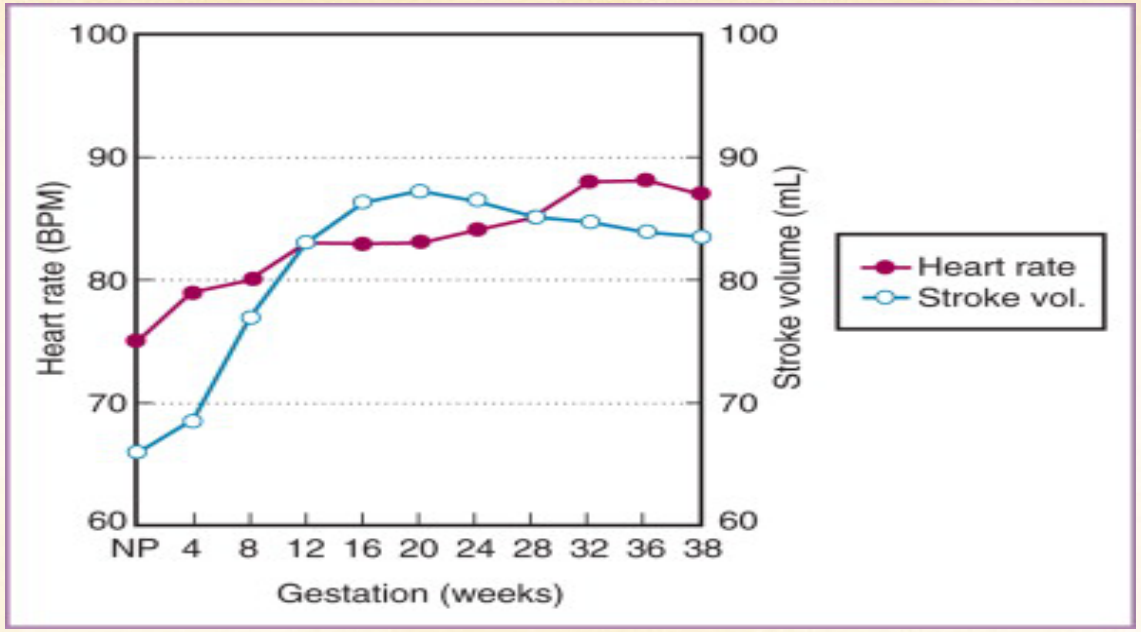
- Different from non-pregnant
  - ***5.5-7.5 L/min***

- What are the determinants of cardiac output?
  - Preload
  - Afterload
  - Contractility
  - Heart rate



Cardiac Output

- **Cardiac output (SV x HR)**
  - Increased by 30-50%
    - Occurs by 8 weeks
    - Parous women have higher rise in SV (as well as lower BP)
  - Significantly affected by maternal posture
    - Supine = drop in CO by as much as 30%
  - *Labor = increase by 30-40%*
- **Uterine blood flow**
  - Increases by 10-fold (500-800 mL/min)
  - Shift from 2% to 17% at term of CO from heart

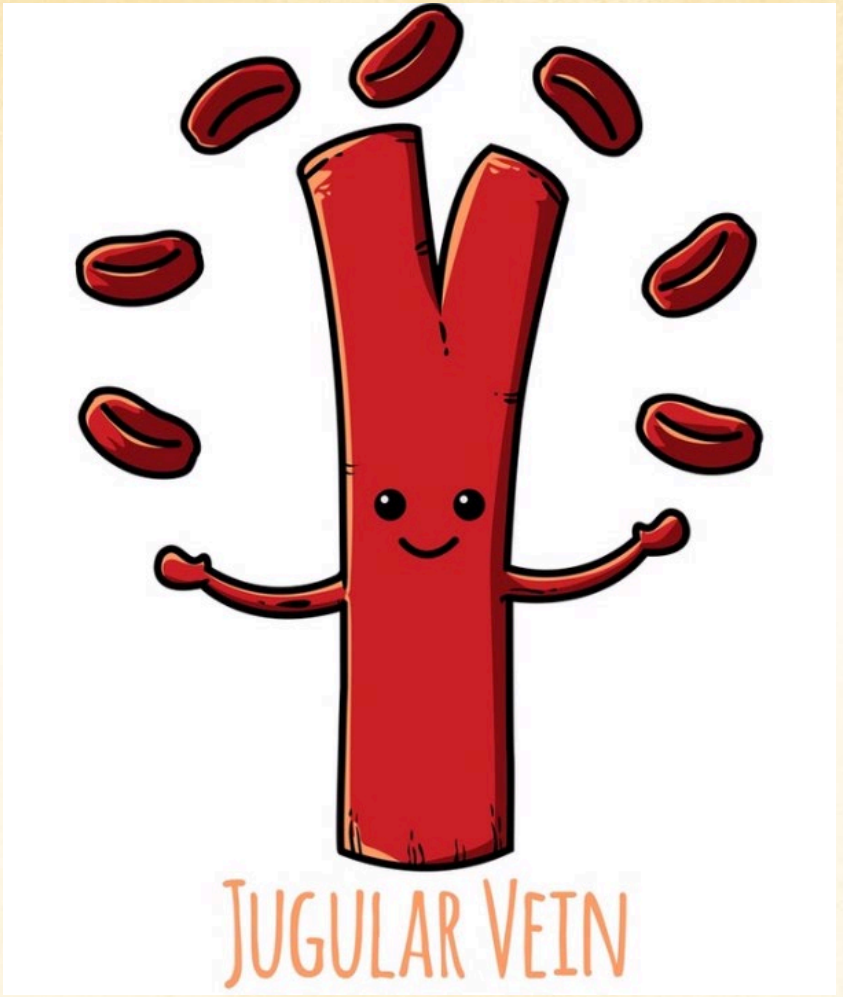


Creasy, Robert K., eds. *Creasy And Resnik's Maternal-fetal Medicine: Principles And Practice*. Philadelphia, PA : Saunders/Elsevier, 2009. Print

Determinants of CO - Preload

- MCFP (mean circulating filling pressure)
  - System at equilibrium
  - Determined by *venous smooth muscle* activation (tone/compliance) and changes in *blood volume*

1. ***Venous distensibility*** (compliance) increases during pregnancy
   - Increases progressively during pregnancy
   - Results in decrease in flow velocity and leads to stasis
   - *Mechanism:* **progesterone**



Determinants of CO - Preload

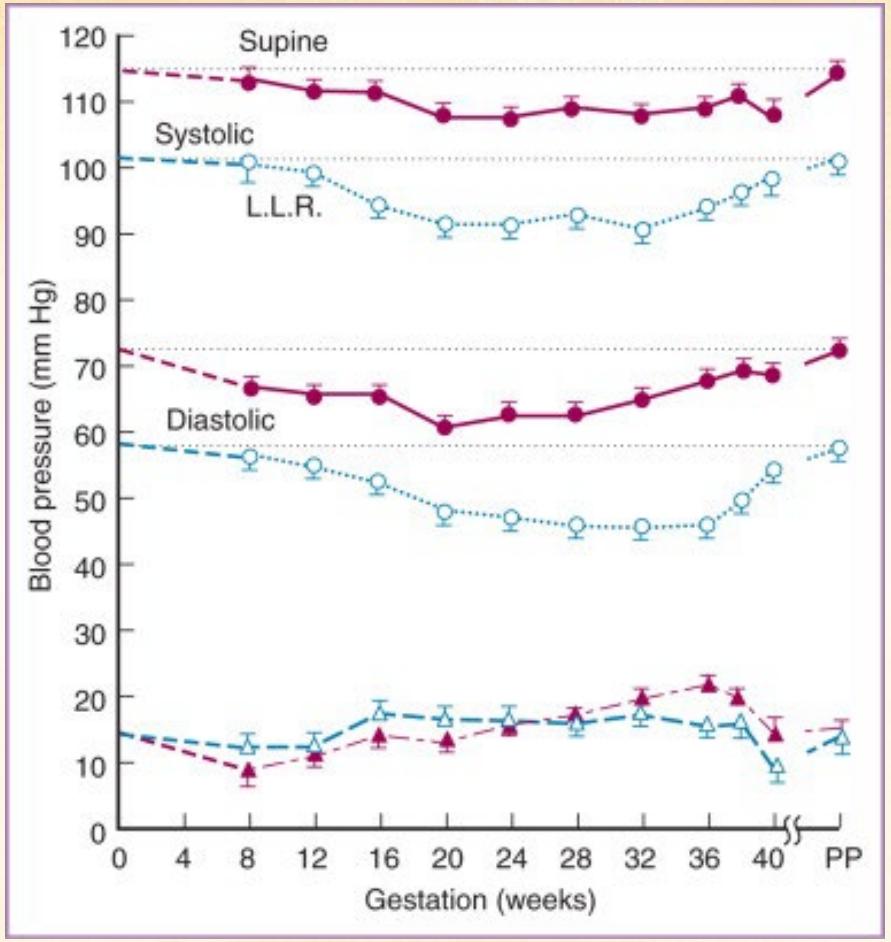
2. **Blood volume**
   - Increase begins at 8 weeks
     - Maximal volume at 28-32 weeks (4700-5200mL)
     - *Mechanism*: NO-related vasodilation which induces RAAS and stimulates Na+ and H_20 retention
   - RBC mass increases by 20-30%
     - Increase in 2,3-DPG which lowers the affinity of maternal hemoglobin for O2
     - *Mechanism*: placental chorionic somatomammotropin, **progesterone** and prolactin

Determinants of CO - Preload

- Right preload = CVP 4-10 mmHg
  - How do you increase preload in the pregnant patient??
    - IV fluids
    - Colloid or blood administration
    - *Left lateral decubitus position*
  - How do you decrease preload in the pregnant patient??
    - Diuretics*
    - Hemorrhage
    - Sitting position/lying flat

Determinants of CO – Afterload

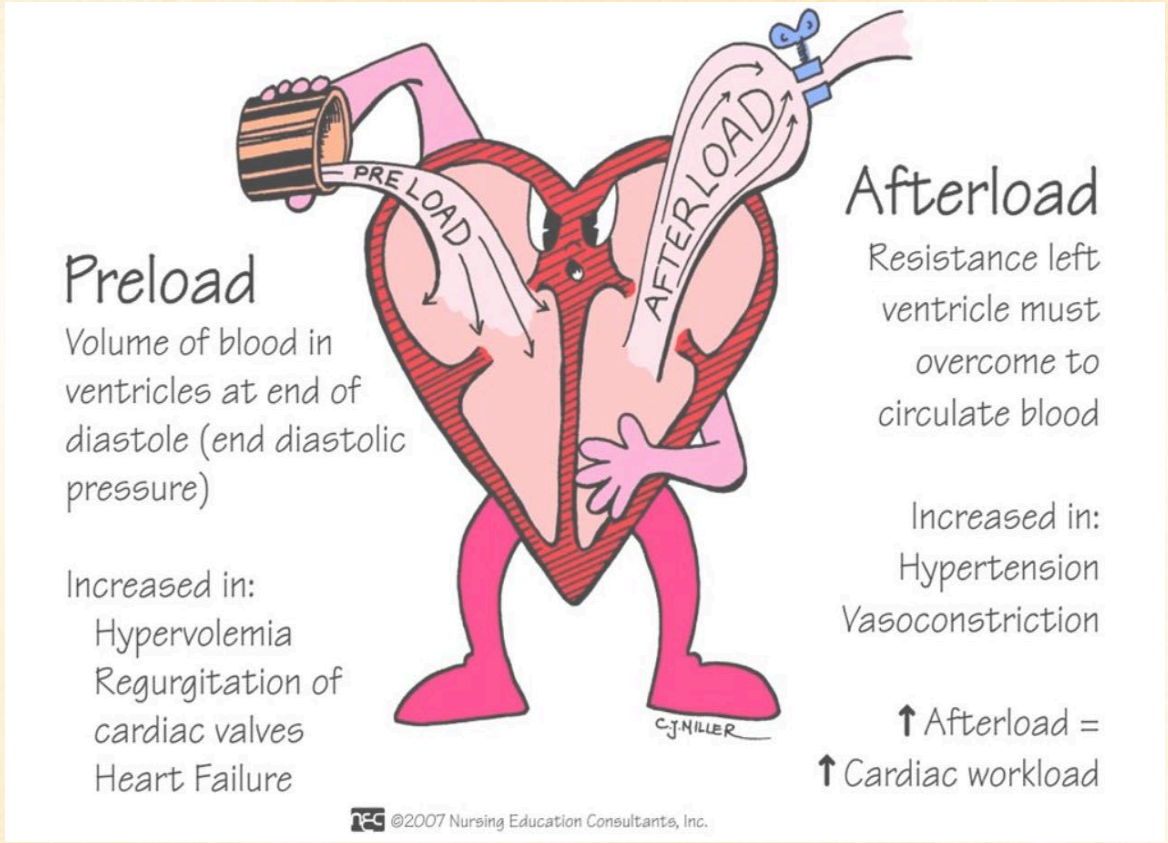
- Blood pressure
  - Decrease can be seen as early as 7 weeks
  - Systolic remains relatively stable while diastolic can decrease by a max of 10mmHg at 28 weeks
  - Increase pulse pressure
  - Marked circadian variation
    - Nadir of both in the early morning and a peak in the late afternoon and evening



Creasy, Robert K., eds. *Creasy And Resnik's Maternal-fetal Medicine: Principles And Practice*. Philadelphia, PA : Saunders/Elsevier, 2009. Print

Determinants of CO – Afterload

- Right-sided afterload
  - Pulmonary vascular resistance during pregnancy
- Left-sided afterload
  - Systemic vascular resistance
- How do you increase afterload in pregnancy?
  - Increase preload, administer vasopressors
- How do you decrease afterload in pregnancy?
  - Anti-hypertensives



Determinants of CO – Contractility

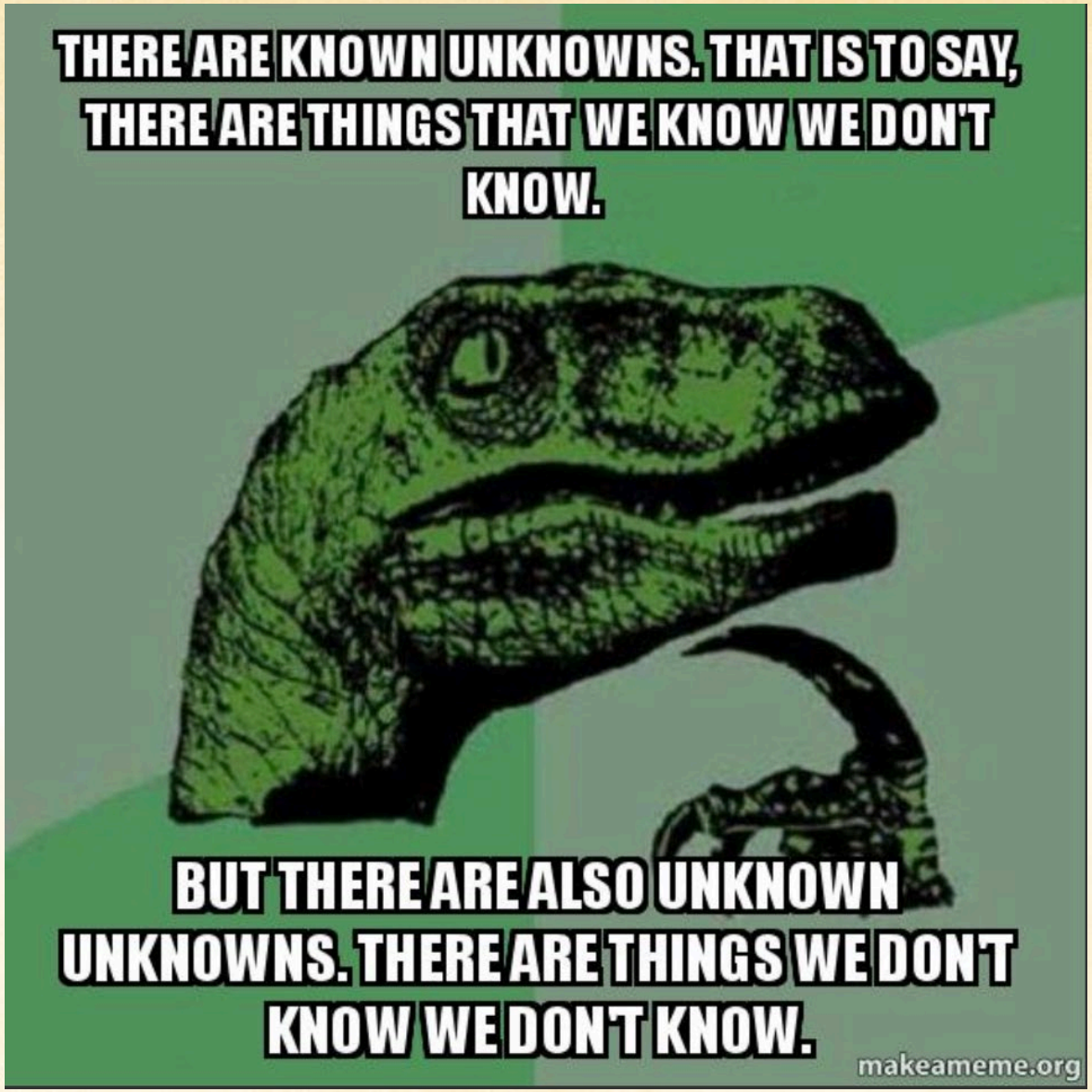
- **Anatomic Changes**
  - Ventricular wall muscle mass (1st trimester) and end-diastolic volume (2nd and 3rd trimester) increases
    - This increases cardiac compliance from softening of collagen without a reduction in EF
  - Myocardial contractility increases
  - Remodeling of the intimal lining
  - Internal dimensions of all cardiac chambers are increased
  - Slight regurgitation through the four valves is frequently observed
  - Increase in cross-sectional area of the left ventricular outflow tract measured at aortic annulus

Review of Maternal Cardiac Physiology

- **Intrapartum dynamics**
  - ***1st stage*** = 30% rise in cardiac output
  - ***2nd stage*** = 50% rise in cardiac output
  - Laboring with epidural decreases this increase
  - Contractions result in a 300-500 mL increase in blood to circulation
  - Blood pressure increases

Review of Maternal Cardiac Physiology

- **<u>Postpartum dynamics</u>**
  - Immediate puerperium is associated with ***80%*** increase in cardiac output
  - Release of venacaval obstruction → autotransfusion
  - Increased venous return to the heart
  - CO returns to pre-labor values 1 hr post delivery

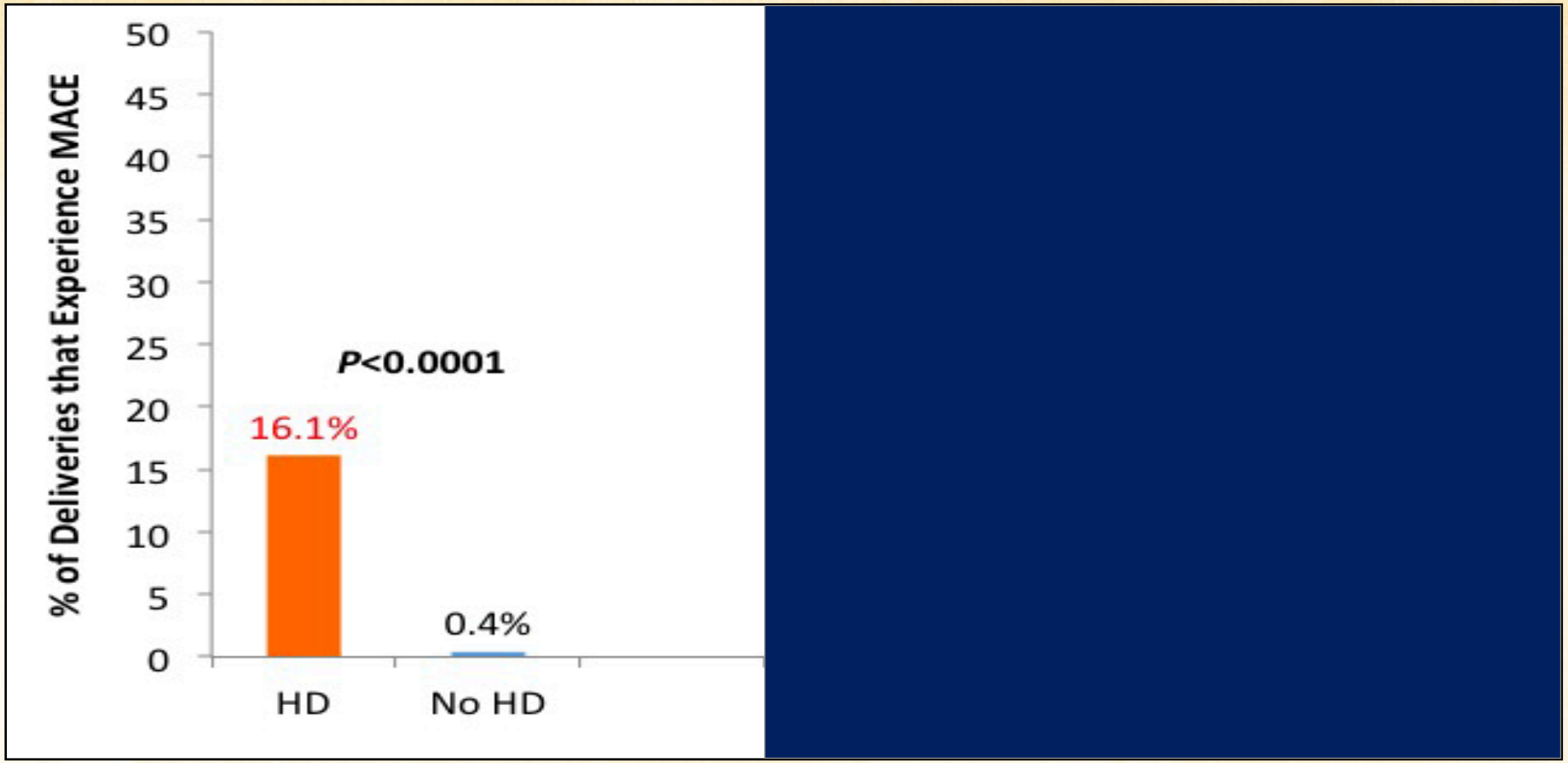

THERE ARE KNOWN UNKNOWNS. THAT IS TO SAY, THERE ARE THINGS THAT WE KNOW WE DON'T KNOW.
BUT THERE ARE ALSO UNKNOWN UNKNOWNS. THERE ARE THINGS WE DON'T KNOW WE DON'T KNOW.
makeameme.org

Outcomes for women with HD

- **APO**
  - Pre-eclampsia, preterm delivery, gestational diabetes, polyhydramnios, placental insufficiency, PPROM, PPH
- **MACE**
  - Heart failure, arrhythmia, need for cardiac intervention, cardiac arrest, cerebrovascular event, pulmonary embolism, cardiorespiratory failure, dissection of the aorta or other artery
- **NACE**
  - Stillbirth, neonatal death, SGA, IUGR, RDS, IVH, CHD

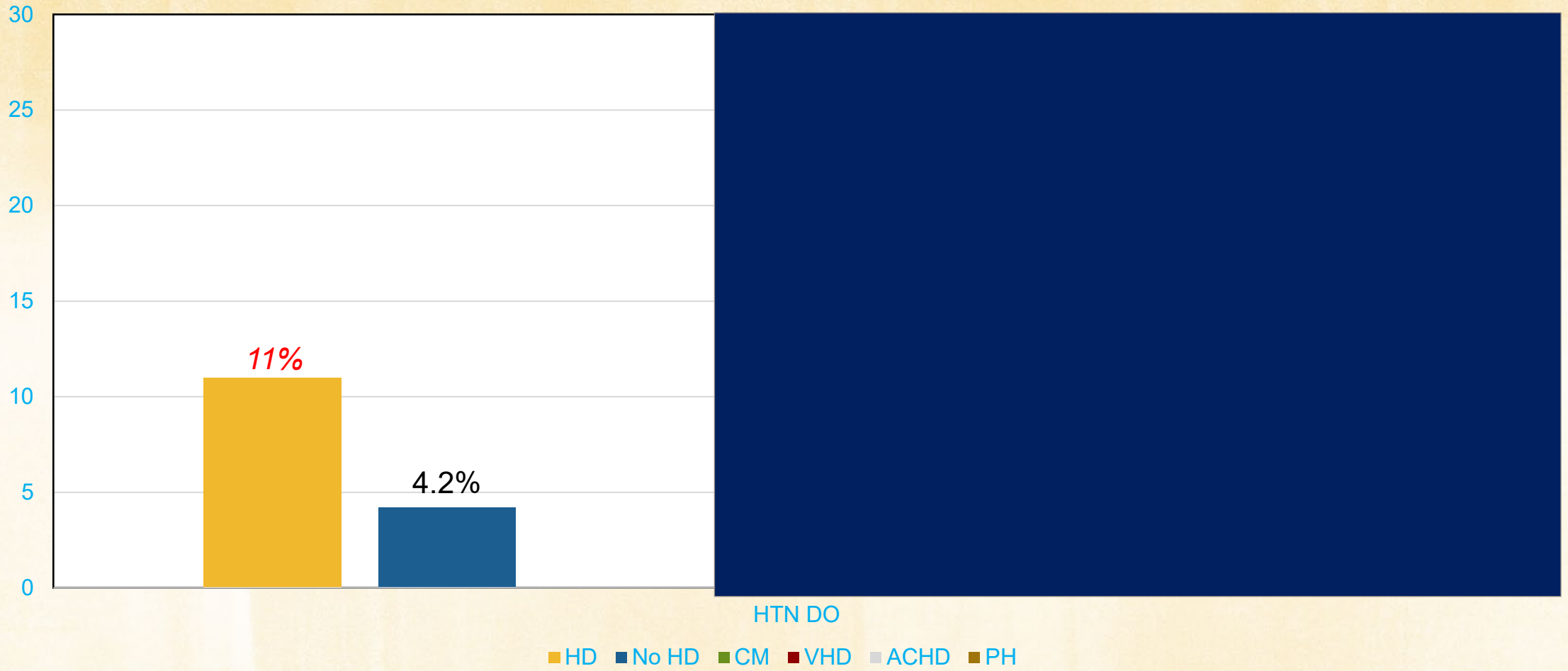
Owens A et al. Neonatal and maternal outcomes in pregnant women with cardiac disease. JAHA. 2018; 7 (21): 1-11.

Maternal Adverse Cardiac Events



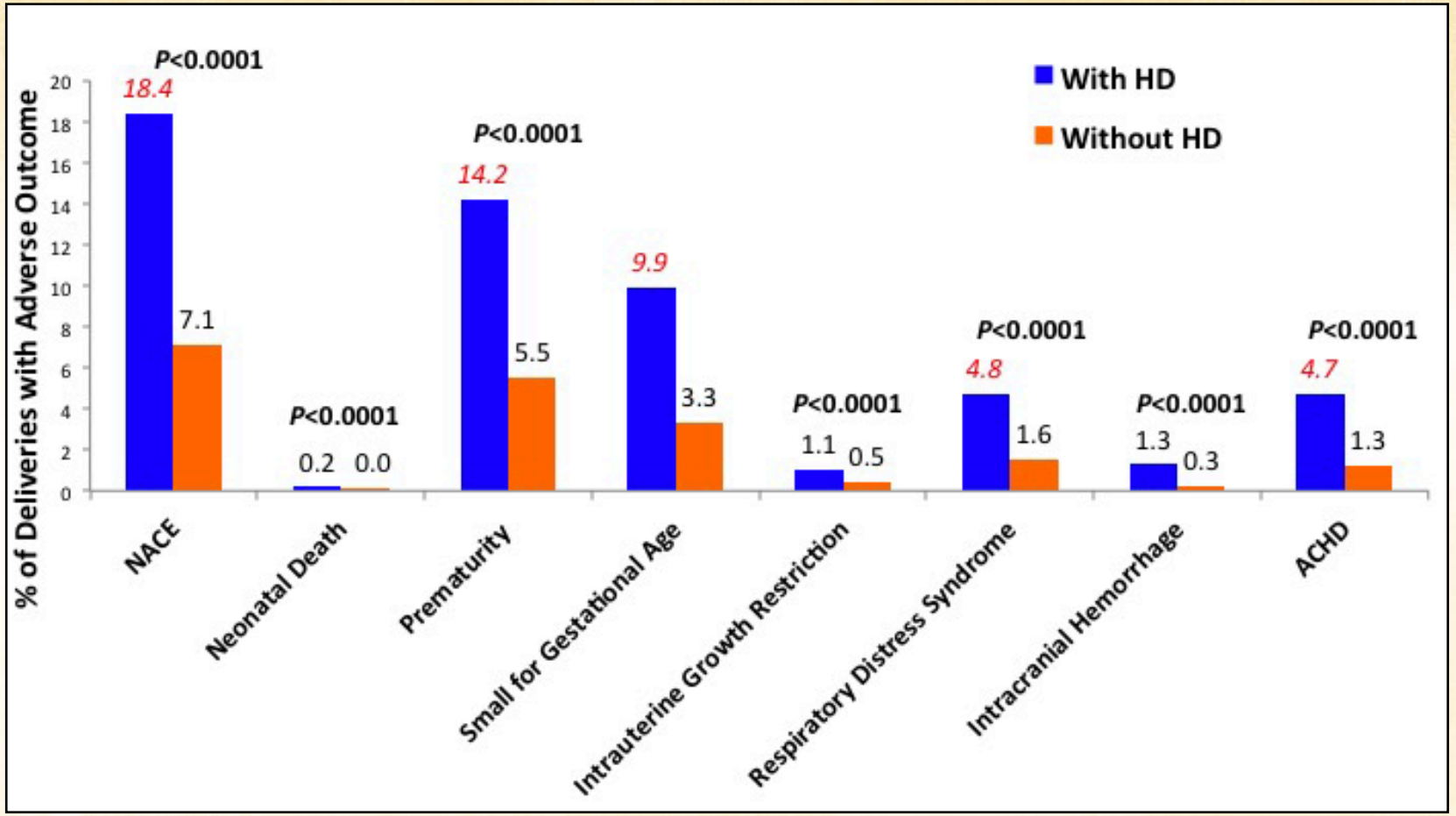
Owens A et al. Neonatal and maternal outcomes in pregnant women with cardiac disease. JAHA. 2018; 7 (21): 1-11.

Adverse Pregnancy Outcomes



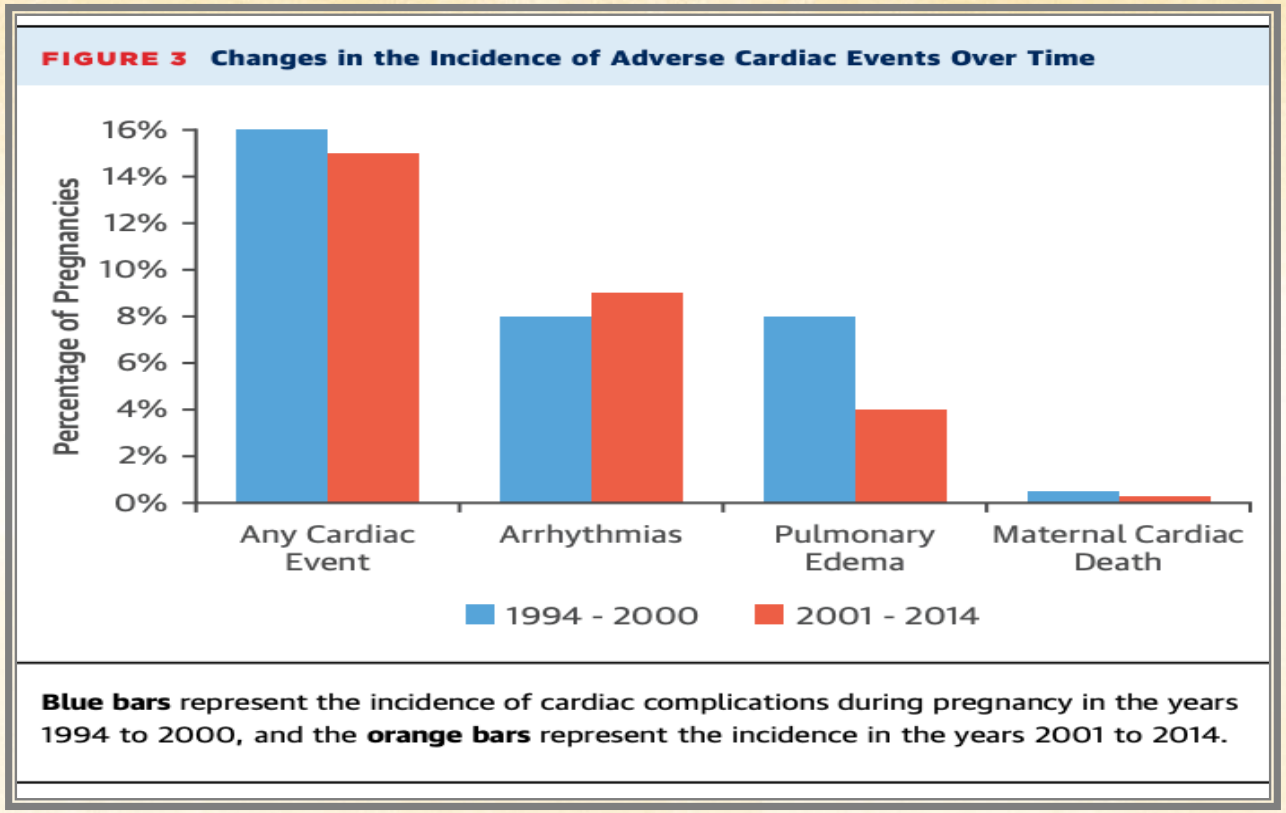
Owens A et al. Neonatal and maternal outcomes in pregnant women with cardiac disease. JAHA. 2018; 7 (21): 1-11.

Neonatal Adverse Outcomes



Owens A et al. Neonatal and maternal outcomes in pregnant women with cardiac disease. JAHA. 2018; 7 (21): 1-11.

Risk Stratification and Outcomes: CARPREG II



Silversides CK, Grewal J, Mason J, et al. Pregnancy Outcomes in Women With Heart Disease: The CARPREG II Study. *J Am Coll Cardiol*. 2018;71(21):2419-2430. doi:10.1016/j.jacc.2018.02.076

Risk Stratification and Outcomes: CARPREG II

- 73% of all pregnancies with cardiac disease had at least one cardiac event (223/307)

  Most common lesions:
  - arrhythmias (9.3%)
  - heart failure (6.2%)

TABLE 2 Incidence of Adverse Cardiac Event Rates During Pregnancy (N = 1,938)

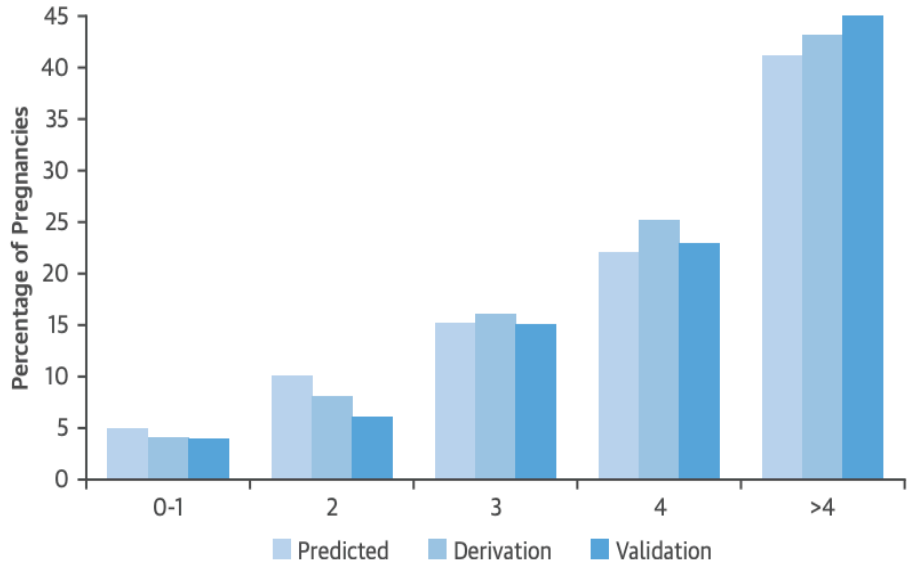
Any maternal cardiac events	307 (15.8)
Maternal cardiac death	6 (0.3)
Maternal cardiac arrest	8 (0.4)
Arrhythmias	181 (9.3)
Any left- or right-sided HF	120 (6.2)
Left-sided HF	106 (5.5)
Right-sided HF	19 (1.0)
Stroke	13 (0.7)
Myocardial infarction	8 (0.4)
Dissection	7 (0.4)
Cardiac thromboembolism	6 (0.3)

Values are n (%). Events are not mutually exclusive.
HF = heart failure.

Silversides CK, Grewal J, Mason J, et al. Pregnancy Outcomes in Women With Heart Disease: The CARPREG II Study. *J Am Coll Cardiol*. 2018;71(21):2419-2430. doi:10.1016/j.jacc.2018.02.076

Risk Stratification and Outcomes: CARPREG II

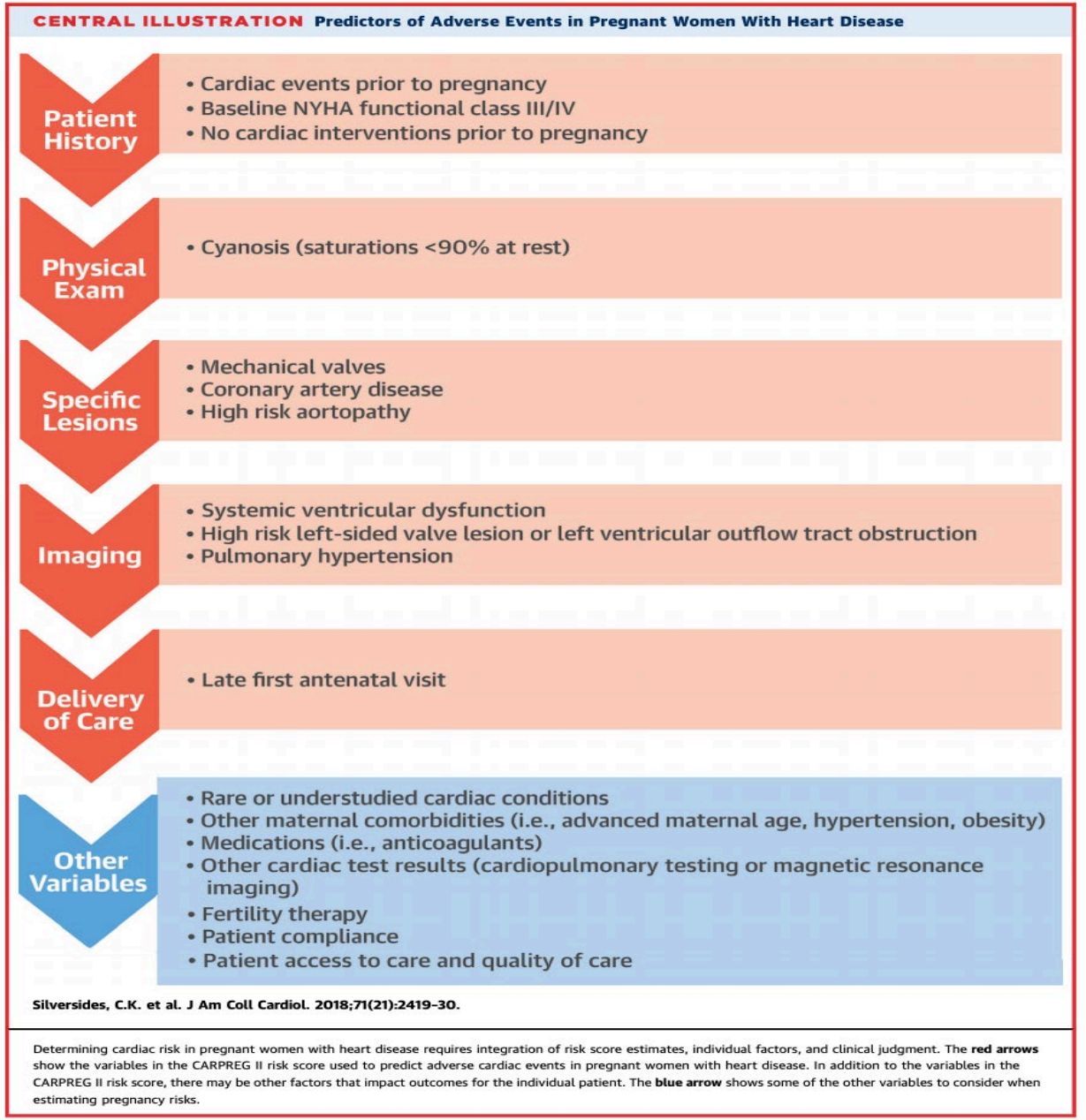
FIGURE 4 CARPREG II Risk Prediction Index: Incidence of Adverse Cardiac Events Stratified According to CARPREG II Risk Scores

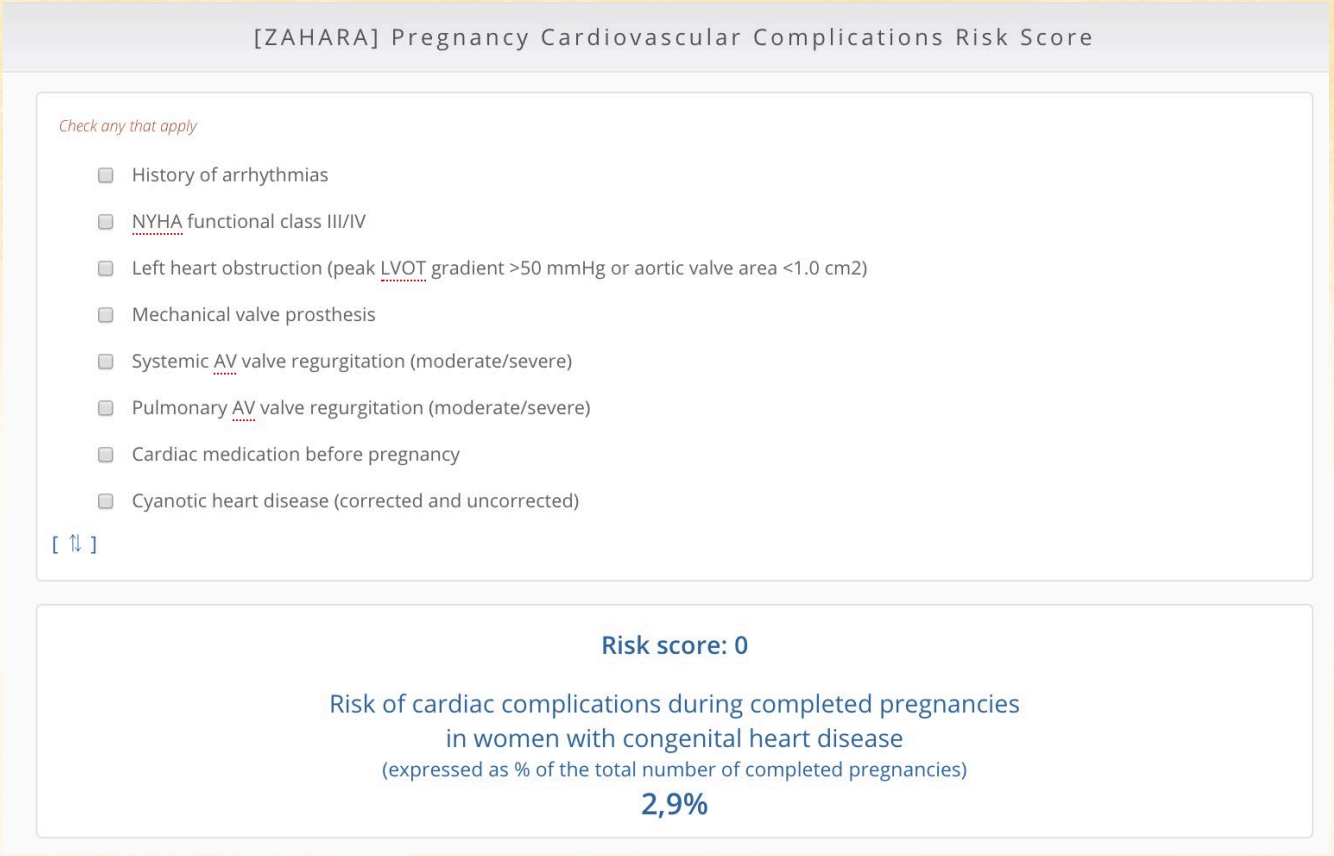


PREDICTOR	POINTS
Prior cardiac events or arrhythmias	3
Baseline NYHA III-IV or cyanosis	3
Mechanical valve	3
Ventricular dysfunction	2
High risk left-sided valve disease/ left ventricular outflow tract obstruction	2
Pulmonary hypertension	2
Coronary artery disease	2
High risk aortopathy	2
No prior cardiac intervention	1
Late pregnancy assessment	1

The CARPREG (Cardiac Disease in Pregnancy Study) II risk score is based on 10 predictors, shown in the **box.** Each predictor is assigned a weighted point score. The sum of points represents the risk score. Risk scores are categorized into the 5 groups (x-axis). The predicted **(light blue)** and the observed frequency of primary cardiac events in the derivation **(medium blue)** and validation **(dark blue)** groups are shown on the y axis. NYHA = New York Heart Association.

Silversides CK, Grewal J, Mason J, et al. Pregnancy Outcomes in Women With Heart Disease: The CARPREG II Study. *J Am Coll Cardiol*. 2018;71(21):2419-2430. doi:10.1016/j.jacc.2018.02.076





http://www.pmidcalc.org/?sid=20584777&newtest=Y

Risk Stratification Models: ZAHARA

- 1802 women with 1300 pregnancies
- All with CHD
- Maternal cardiac outcomes, neonatal outcomes and obstetric outcomes

Table 3. Modified World Health Organization Pregnancy Risk Classification for Women With Preexisting Cardiovascular Disease

Modified WHO Pregnancy Risk Classification (Risk of Pregnancy by medical condition) Suggested follow-up*	Specific Cardiac Lesions	Pregnancy Care Delivery Location
mWHO Risk Class I No detectable increased risk of maternal mortality and no or mild increase in morbidity (2–5% risk of maternal cardiac event rate) Follow-up: Cardiology evaluation once or twice during pregnancy	• 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	• Prepregnancy/pregnancy counseling • Care at local hospital • Delivery at local hospital*
mWHO Risk Class II Small increased risk of maternal mortality or moderate increase in morbidity (6–10% maternal cardiac event rate) Follow-up: Cardiology, every trimester	• Unoperated atrial or ventricular septal defect • Repaired Tetralogy of Fallot or aortic coarctation • Most arrhythmias (supraventricular arrhythmias) • Turner syndrome without congenital cardiac disease	• Prepregnancy/pregnancy counseling • Pregnancy Heart Team* consultation/ counseling • Care at local hospital • Delivery at local hospital*
mWHO Risk Classes II and III Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity (11–19% maternal cardiac event rate) Follow-up: Cardiology, every trimester	• Mild left ventricular impairment (EF >45%) • Hypertrophic cardiomyopathy • Native or bioprosthetic valve disease not considered mWHO Risk Class I or IV (mild mitral stenosis, moderate aortic stenosis) • Marfan or other HTAD syndrome without aortic dilation • Aorta <45 mm in bicuspid aortic valve pathology • Repaired coarctation without residua (non-Turner) • Atrioventricular septal defect	• Prepregnancy/pregnancy counseling • Pregnancy heart team* consultation/ counseling • Care at an appropriate level hospital (critical members of the Pregnancy Heart Team* available depending on cardiac disease) • Delivery at an appropriate level hospital*†
Pre-mWHO Risk Class III Significantly increased risk of maternal mortality or severe morbidity (20–27% maternal cardiac event rate) Follow-up: Cardiology, every 1–2 months	• Moderate left ventricular impairment (EF 30–45%) • Previous peripartum cardiomyopathy without any residual left ventricular impairment • Mechanical valve • Systemic right ventricle with good or mildly decreased ventricular function • Uncomplicated Fontan circulation, • Unrepaired cyanotic heart disease • Other complex heart disease • Moderate mitral stenosis • Severe asymptomatic aortic stenosis • Moderate aortic dilation (40–45 mm in Marfan syndrome or other HTAD; 45–50 mm in bicuspid aortic valve; Turner syndrome ASI 20–25 mm/m²; Tetralogy of Fallot <50 mm) • Ventricular tachycardia	• Prepregnancy/pregnancy counseling • Pregnancy Heart Team* consultation/ counseling • Care at an appropriate level hospital† • Delivery at an appropriate level hospital*†

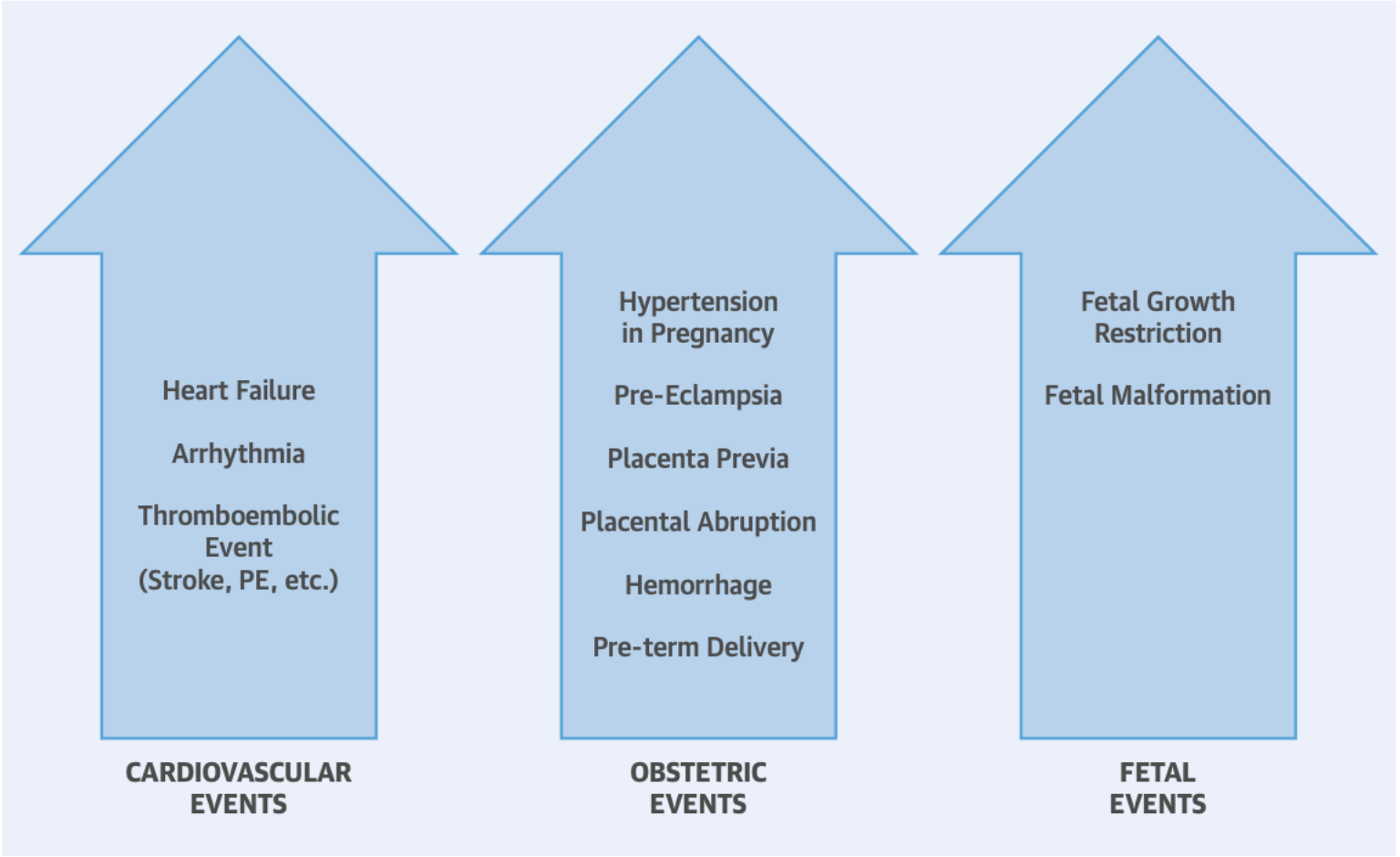
Table 3. Modified World Health Organization Pregnancy Risk Classification for Women With Preexisting Cardiovascular Disease (*continued*)

Modified WHO Pregnancy Risk Classification (Risk of Pregnancy by medical condition) Suggested follow-up*	Specific Cardiac Lesions	Pregnancy Care Delivery Location
mWHO Risk Class IV Pregnancy contraindicated Discuss induced abortion Extremely high risk of maternal mortality or severe morbidity (>27% maternal cardiac event rate) Follow-up: Cardiology follow-up every month (minimum)	• Pulmonary arterial hypertension • Severe systemic ventricular dysfunction (EF <30%, NYHA III-IV) • Previous peripartum cardiomyopathy with any residual left ventricular dysfunction • Severe mitral stenosis • Severe symptomatic aortic stenosis • Systemic right ventricle with moderate to severely decreased ventricular function • Severe aortic dilation (>45 mm in Marfan syndrome or other HTAD; >50 mm in bicuspid aortic valve; Turner syndrome ASI >25 mm/m²; Tetralogy of Fallot >50 mm) • Vascular Ehlers-Danlos • Severe (re)coarctation • Fontan circulation with any complication	• Pregnancy Heart Team* consultation/ counseling • Care at an appropriate level hospital‡ (critical members of the Pregnancy Heart Team* available depending on cardiac disease) • Delivery at an appropriate level hospital*‡

Moussa HN, Rajapreyar I. ACOG Practice Bulletin No. 212: Pregnancy and Heart Disease. *Obstet Gynecol*. 2019;134(4):881-882. doi:10.1097/AOG.0000000000003497

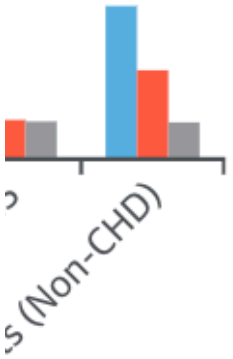
FIGURE 1

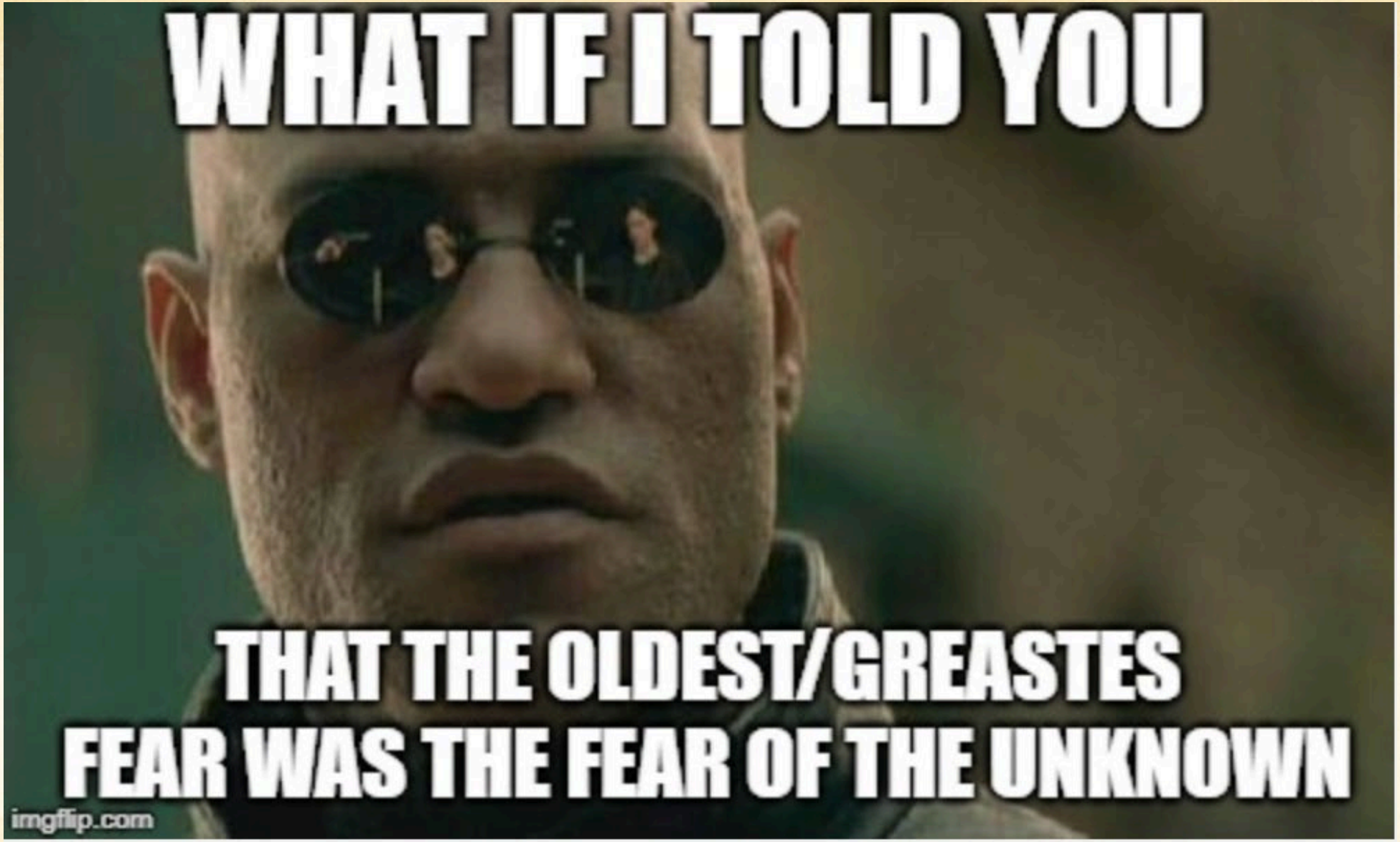
CENTRAL ILLUSTRATION Increased Risk for Adverse Cardiovascular, Obstetric, and Fetal Events in Women With Congenital Heart Defects



Schlichting, L.E. et al. J Am Coll Cardiol. 2019;73(17):2181-91.

This figure shows the cardiovascular, obstetric, and fetal adverse events more common in women with CHDs. CHD = congenital heart defect; PE = pulmonary embolism.




WHAT IF I TOLD YOU
THAT THE OLDEST/GREASTES
FEAR WAS THE FEAR OF THE UNKNOWN
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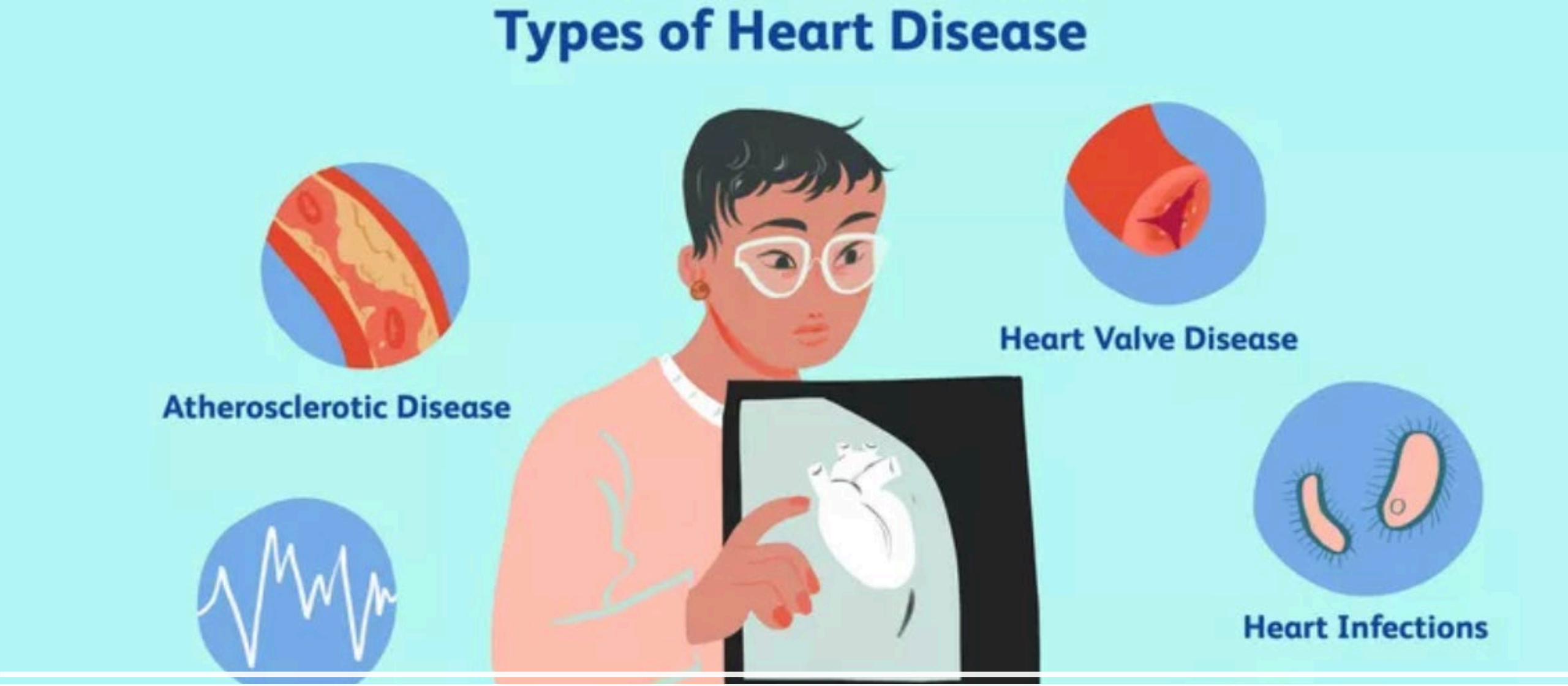
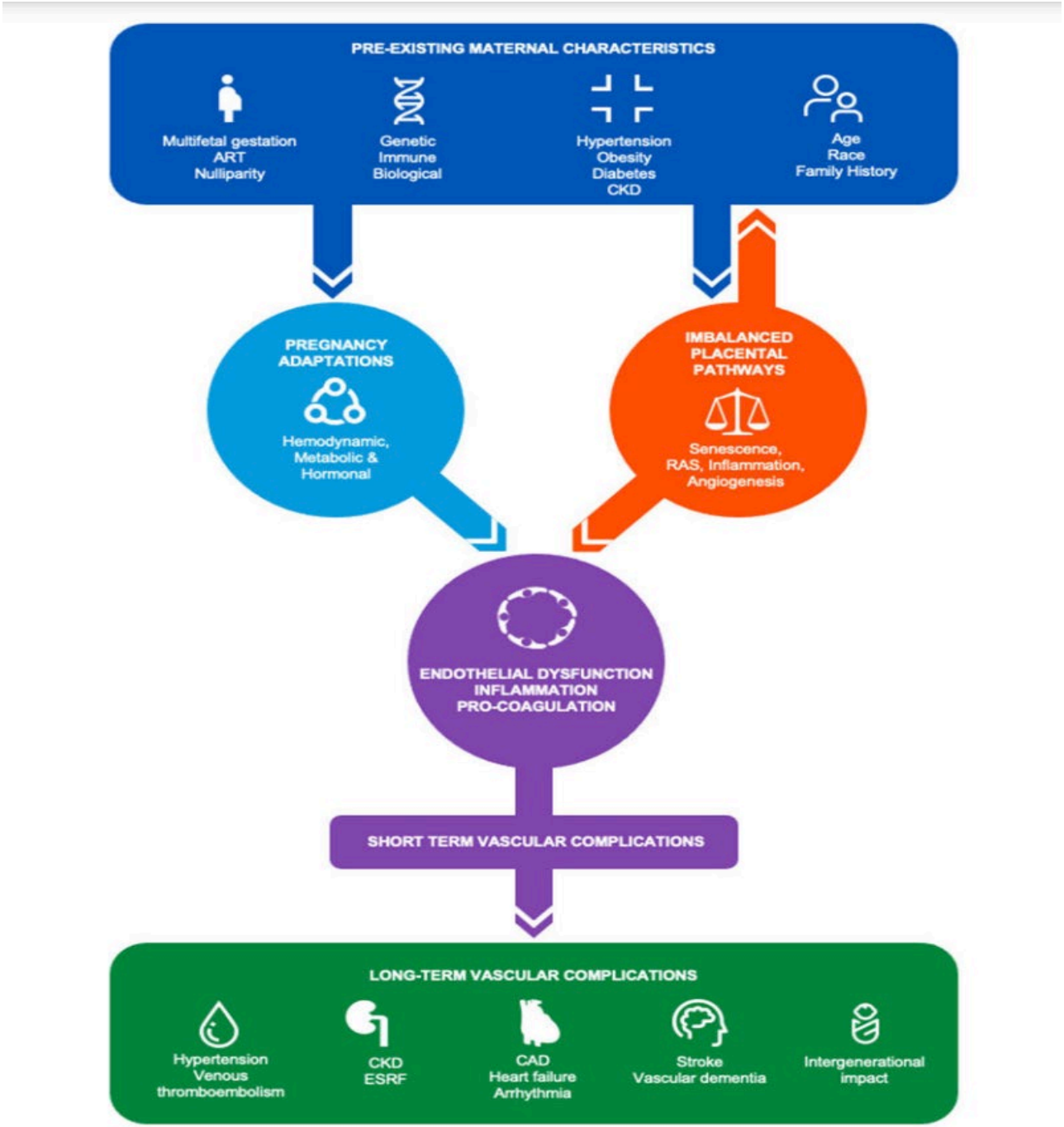


Unknown or Undiagnosed Cardiovascular Disease

Risk Factors for Cardiovascular Disease



O'Kelly AC, Michos ED, Shufelt CL, et al. Pregnancy and Reproductive Risk Factors for Cardiovascular Disease in Women. *Circ Res*. 2022;130(4):652-672. doi:10.1161/CIRCRESAHA.121.319895

CARDIOMYOPATHY

Peripartum Cardiomyopathy: Definition

- **Historically**
  - HF within 1 mon delivery or 5 mon PP
  - Absence of determinable etiology
  - Absence of HF before last month of pregnancy

- **ESC**
  - "an idiopathic cardiomyopathy presenting with HF secondary to LV systolic dysfunction toward the end of pregnancy where no other cause of HF is found"
  - LV dysfunction
    - LVEF < 45%
    - Fractional shortening of < 30%
    - Both

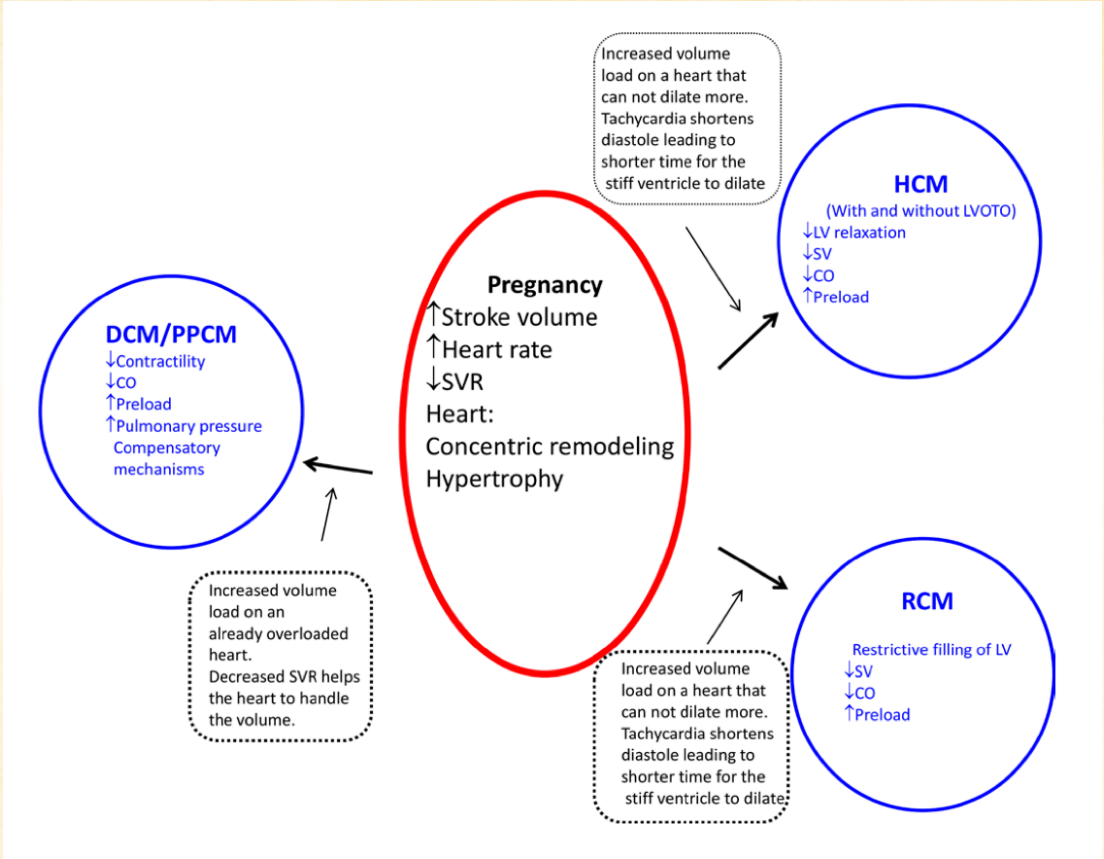


Table 3. Temporal Trends in Peripartum Cardiomyopathy Incidence Rate/10 000 Live Births Stratified According to Race/Ethnicity

	n	Overall	2004	2005	2006	2007	2008	2009	2010	2011	P_{trend}
Complete case analysis											
Caucasian	11 561	6.4	5.2	5.8	5.3	5.8	6.4	7.2	8.3	7.6	<0.001
African–American	10 948	22.8	15.9	13.7	15.9	19.9	21.5	28.3	32.5	35.2	<0.001
Hispanic	2813	3.6	2.9	3.8	3.2	3.6	3.3	3.4	4.3	3.9	<0.001
Asian/Pacific Islander	664	3.6	3.6	2.9	2.6	3.3	2.9	4.5	5.5	3.1	0.156
Native American	165	5.0	0.0	1.2	5.9	4.4	5.0	5.8	6.0	12.0	0.001
Other	750	—	—	—	—	—	—	—	—	—	—
Unknown/missing	7318	—	—	—	—	—	—	—	—	—	—

Peripartum Cardiomyopathy: Incidence

- **Incidence**
- Different by geographic location
- United States = 1 in 1000 to 1 in 4000
- Haiti = as high as 1% of all pregnancies

Table 1 | Worldwide variation in incidence of peripartum cardiomyopathy

Country/ Region	Incidence (per live births)	Reference	Data source
Nigeria	1/102	Isezuo et al[18]	Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria
Haiti	≈1/300	Fett et al[19]	Hospital Albert Schweitzer PPCM Registry
China	1/346	Huang et al[20]	Liaocheng People's Hospital, Shandong Province, China
United States	1/968	Kolte et al[12]	US Nationwide Inpatient Sample
South Africa	1/1000	Desai et al[21]	King Edward VIII Hospital, Durban, South Africa
California, US	1/2066	Gunderson et al[11]	Kaiser Permanente Northern California hospitals
Malaysia	1/2941	Chee et al[22]	University Malaya Medical Centre
Sweden	1/5719*	Barasa et al[23]	National Inpatient, Cause of Death, and Medical Birth Registries
Denmark	1/10 149	Ersbøll et al[24]	Danish National Birth and Patient Registers
Japan	≈1 in 20 000	Kamiya et al[25]	Japanese Nationwide Survey of Peripartum Cardiomyopathy

*Heart failure in late pregnancy and the postpartum period.

Honigberg MC, Givertz MM. Peripartum Cardiomyopathy. BMJ. 2019; 364: k5287

Peripartum Cardiomyopathy: Risk Factors

Age

- Known independent risk factor with OR 1.7-1.8
- IPAC study with mean age 30
- US sample
  - 20-29: 1 in 1200
  - 30-39: 1 in 790
  - 40-54: 1 in 270

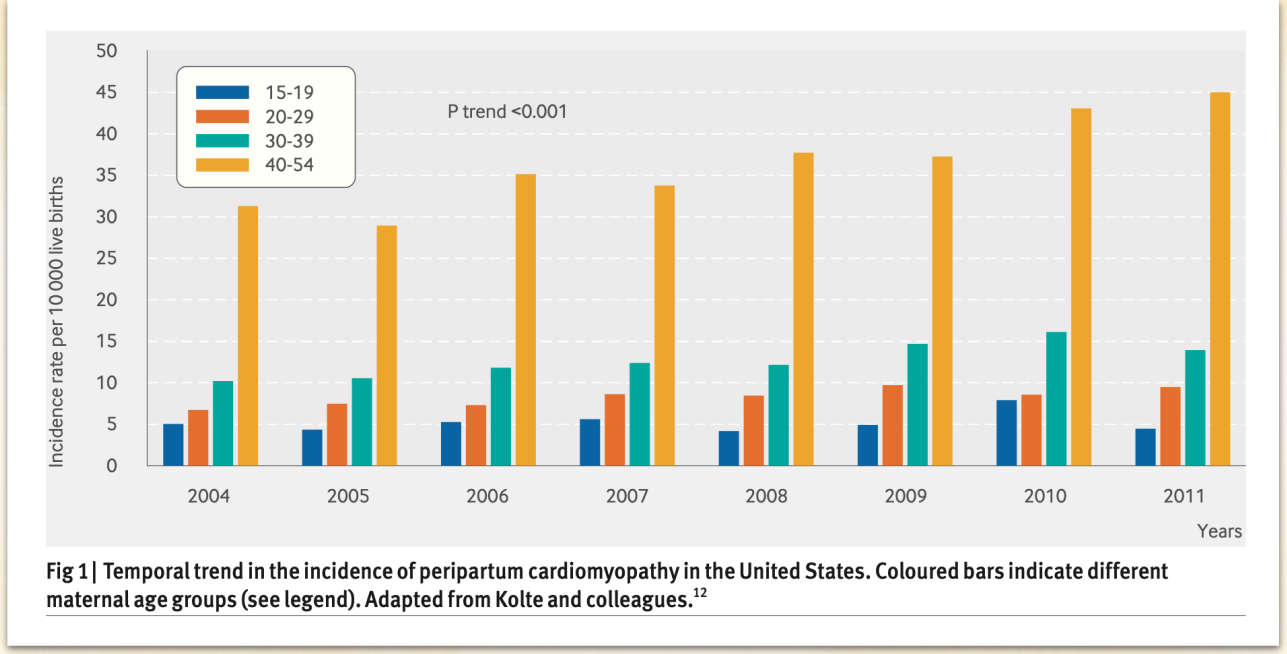
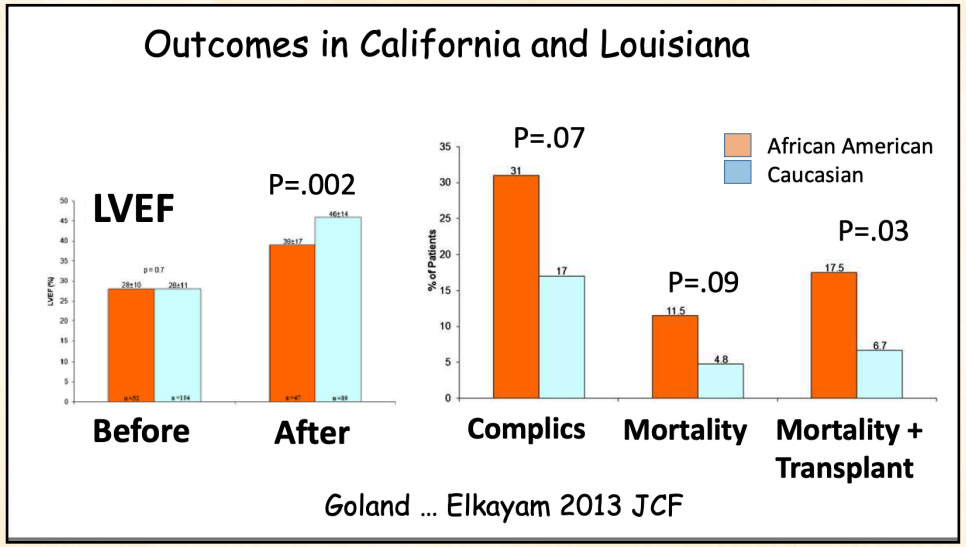


Fig 1 | Temporal trend in the incidence of peripartum cardiomyopathy in the United States. Coloured bars indicate different maternal age groups (see legend). Adapted from Kolte and colleagues.[12]

Honigberg MC, Givertz MM. Peripartum Cardiomyopathy. BMJ. 2019; 364: k5287

Peripartum Cardiomyopathy: Risk Factors

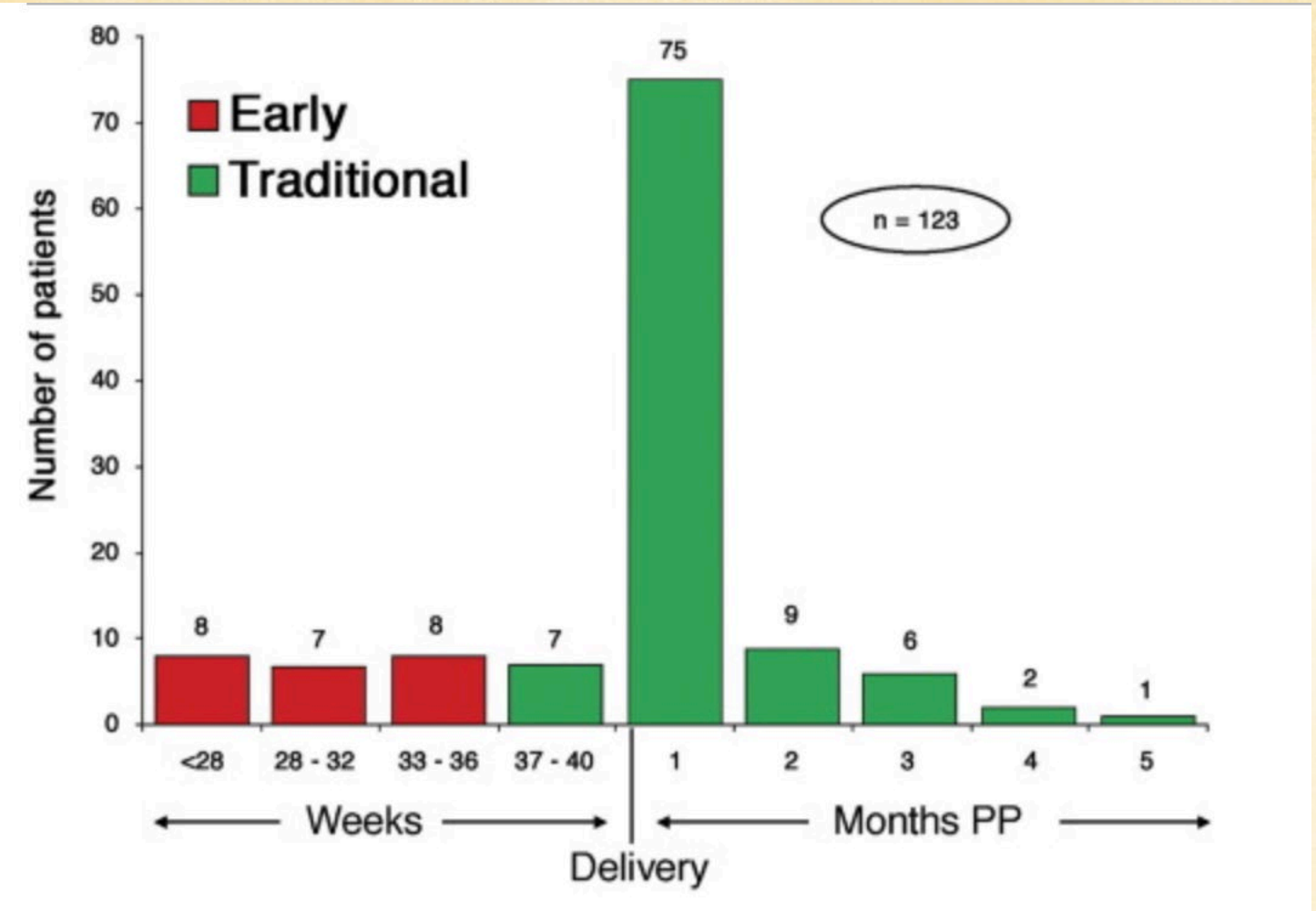
- **Race**
  - 16-fold higher in Black women
    - Accounted for half of all PPCM but only 15% of all births (US studies – *Krishnamoorthi et al, 2016*)
  - Five-fold higher mortality rates *(Harper et al, 2012)*
  - Typically younger, have higher rates of PEC, lower rates of LVEF recovery and worse outcomes *(Goland et al, 2013)*



Peripartum Cardiomyopathy: Risk Factors

- **Hypertension/Pre-eclampsia**
  - Effects up to 23% of all PPCM in US (Elkayam et al, 2005; Bello et al, 2013)
  - 37% with any hypertensive disorder (Bello et al, 2013)
  - Having PEC 12-fold increased risk of PPCM
  - ECHO findings PEC
    - LV diastolic dysfunction
    - Cardiac hypertrophy
    - PPCM with PEC only diagnosed with LV systolic dysfunction

Peripartum Cardiomyopathy: Timing of Diagnosis



Elkayam U. Clinical Characteristics of Peripartum Cardiomyopathy in the United States: Diagnosis, Prognosis, and Management. JACC. 2011; 58 (7): 659-670

Peripartum Cardiomyopathy: Risk Factors

- **Multifetal gestation**
  - Up to 10% of cases world-wide
  - Overall incidence of 9% of PPCM cases (compared to twin incidence of 3%)

- **Parity**
  - Silwa et al, world-wide registry reported mean avg parity of 3.6

- **Diabetes**
  - Recently added to list

Genetics of PPCM

- Current thinking favors two hit model with genetic underpinning
  - Vascular insult + underlying predisposition
- First noted familial clusters
- Similar gene variants to women with DCM
  - 172 women with PPCM and compared variants in gene sequencing to women with DCM
  - Of the 43 genes known to DCM sequenced in women with PPCM, discovered 26 variants, of which 65% were in titin gene
  - Identified in 15% of the PPCM cohort, similar to the 17% in reports of DCM
  - Presence also dictated lower EF at 12 months
  - Also found more commonly in Black women (*Ware JS et al, NEJM 2016*)

Pathophysiology of PPCM

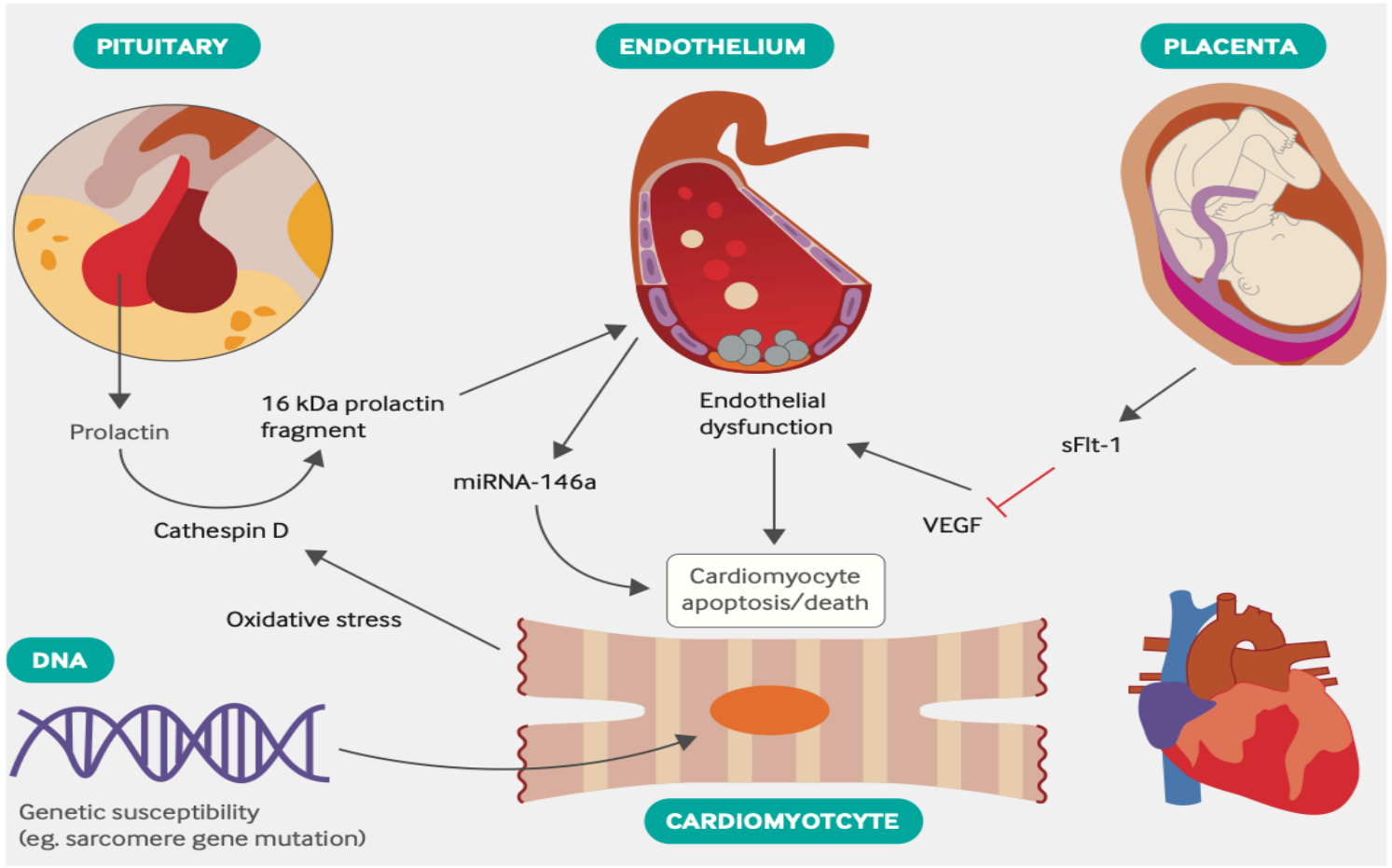


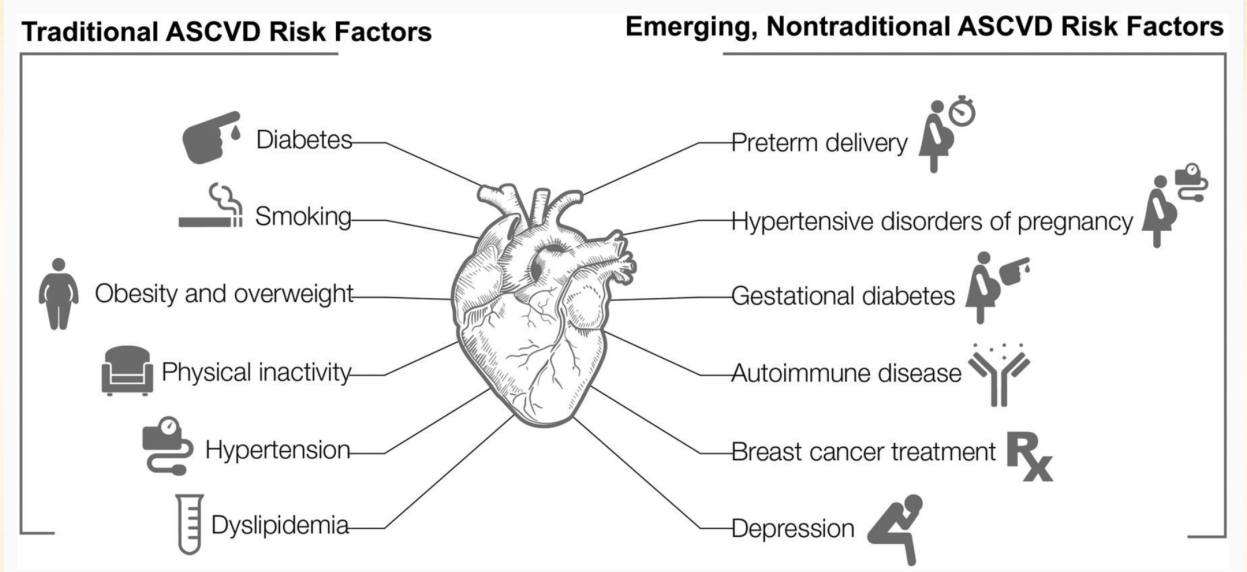
Fig 2| Pathobiology of peripartum cardiomyopathy. Secretion of prolactin by the anterior pituitary gland, upregulation of endothelial microRNA-146a (miRNA-146a), and placental secretion of soluble fms-like tyrosine kinase receptor 1 (sFlt-1) lead to endothelial dysfunction and cardiomyocyte death; genetic susceptibility is also present in some patients. VEGF=vascular endothelial growth factor. See text for details.

Honigberg MC, Givertz MM. Peripartum Cardiomyopathy. BMJ. 2019; 364: k5287

MYOCARDIAL INFARCTION AND SCAD

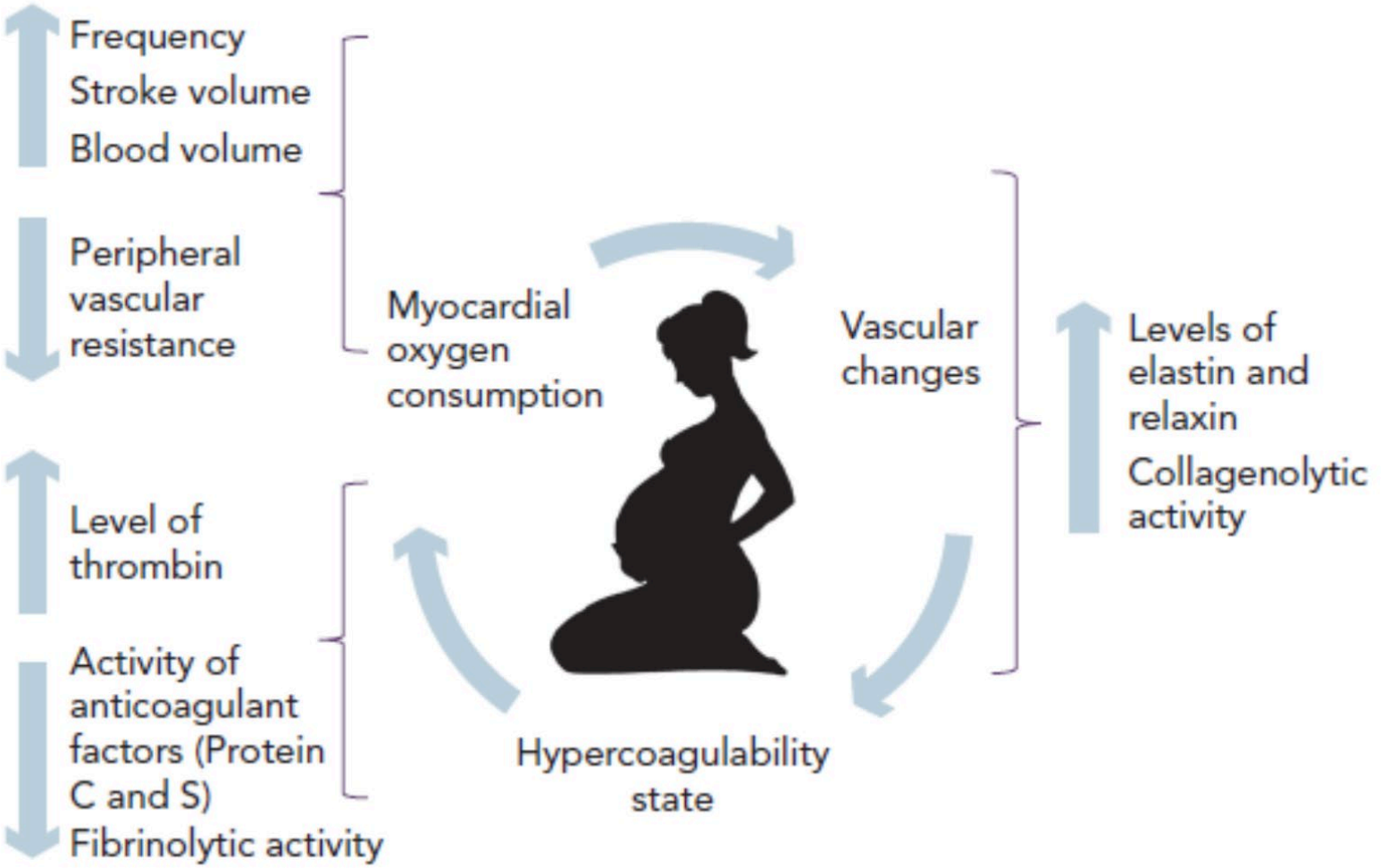
Myocardial Infarction and SCAD

- Pregnancy increases the risk for MI by 2-fold
- Accounts for 1/5 of all pregnancy-related CVD deaths
- Prevalence of 6.2 per 100K pregnancies
  - Atherosclerosis with or without coronary sclerosis = 27-40%
  - SCAD = 27-43%
  - Intracoronary thrombus without sclerosis = 8-17%
  - Coronary artery spasms = 2%
- Risk factors
  - Obesity
  - Diabetes
  - Hypertension
  - Older age
  - Use of fertility medications



- Garcia M, Mulvagh SL, Bairey Merz CN, Buring JE, Manson JE. Cardiovascular Disease in Women: Clinical Perspectives. *Circ Res*. 2016;118(8):1273-1293. doi:10.1161/CIRCRESAHA.116.307547
- Charishma Nallapati, Ki Park. Ischemic Heart Disease in Pregnancy. Cardiology Clinics. Volume 39, Issue 1,2021.Pages 91-108,ISBN 9780323809269, https://doi.org/10.1016/j.ccl.2020.09.006.

Figure 3: Cardiovascular Changes During Pregnancy



Briguori C, Laboratory of Interventional Cardiology, Clinica Mediterranea and 'Vita e Salute' University School of Medicine, San Raffaele Hospital; Director, Catheterisation Laboratory, EMO Centro Cuore Columbus, Colombo A, Laboratory of Interventional Cardiology, Clinica Mediterranea and 'Vita e Salute' University School of Medicine, San Raffaele Hospital; Director, Catheterisation Laboratory, EMO Centro Cuore Columbus. Microvascular Complications and Outcome after Drug-eluting Stent Implantation in Diabetic Patients. *European Cardiology Review*. 2007;3(1):95. doi:10.15420/ecr.2007.0.1.95

AIM

ALLIANCE FOR INNOVATION
ON MATERNAL HEALTH

Cardiac Conditions in Obstetric Care

Cardiac Conditions in Obstetric Care

For the purpose of this Bundle, cardiac conditions refer to disorders of the cardiovascular system which may impact maternal health. Such disorders may include congenital heart disease or acquired heart disease, including but not limited to cardiac valve disorders, cardiomyopathies, arrhythmias, coronary artery disease, pulmonary hypertension and aortic dissection.

Readiness — Every Unit

Train all obstetric care providers to perform a basic Cardiac Conditions Screen.

Establish a protocol for rapid identification of potential pregnancy-related cardiac conditions in all practice settings to which pregnant and postpartum people may present.

Develop a patient education plan based on the pregnant and postpartum person's risk of cardiac conditions.

Establish a multidisciplinary "Pregnancy Heart Team" or consultants appropriate to their facility's designated Maternal Level of Care to design coordinated clinical pathways for people experiencing cardiac conditions in pregnancy and the postpartum period.

Establish coordination of appropriate consultation, co-management and/or transfer to appropriate level of maternal or newborn care.

Develop trauma-informed protocols and training to address health care team member biases to enhance quality of care.

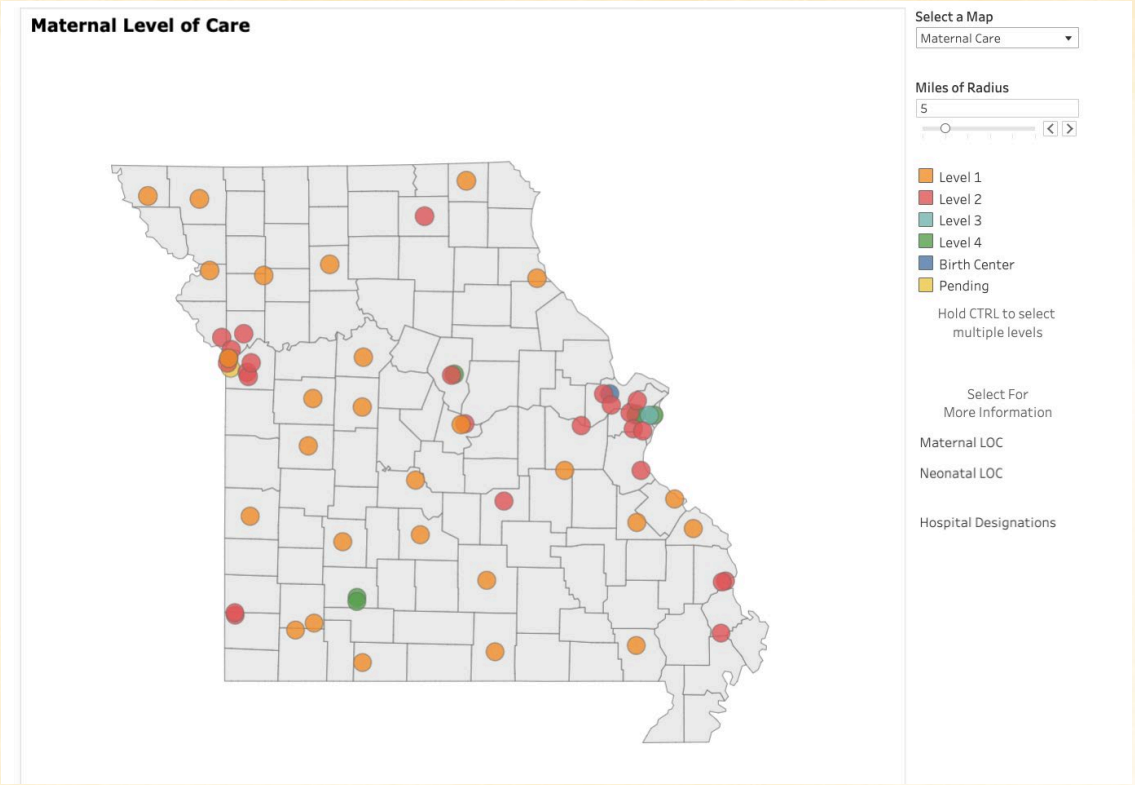
Develop and maintain a set of referral resources and communication pathways between obstetric providers, community-based organizations, and state and public health agencies to enhance quality of care.*

Training Providers in the Care of Cardio-OB Patients

University of Missouri

Establish a Protocol Cardio-OB Patients

- Identification of pregnancy-related complications (toolkits)
- Who to call (cardiology, MFM, anesthesiology, NICU)
- Escalate to higher levels of care (new levels of care in Missouri)



Recognition & Prevention — Every Patient

Obtain a focused pregnancy and cardiac history in all care settings, including emergency department, urgent care, and primary care.

In all care environments assess and document if a patient presenting is pregnant or has been pregnant within the past year.

Assess if escalating warning signs for an imminent cardiac event are present.

Utilize standardized cardiac risk assessment tools to identify and stratify risk.

Conduct a risk-appropriate work-up for cardiac conditions to establish diagnosis and implement the initial management plan.

Screen each person for condition associated risk factors and provide linkage to community services and resources.*

Treatment Recommendations

Rev. 10/21/2019

1st Line Anti-Hypertension Treatment:

IV Labetalol or Hydralazine; if no IV access, give immediate release oral nifedipine

Target BP: 140–150/90–100 mm Hg (BP< 140/90 = decreased fetal perfusion)

IV LABETALOL as Primary

- Administer labetalol 20 mg IV over 2 min
- Repeat BP in 10 min
  - If BP threshold is still exceeded, administer labetalol 40 mg IV
  - If SBP <160 and DBP <110, continue to monitor closely
- Repeat BP in 10 min
  - If BP threshold is still exceeded, administer labetalol 80 mg IV
  - If SBP <160 and DBP <110, continue to monitor closely
- Repeat BP in 10 min
  - If BP threshold is still exceeded, administer hydralazine 10 mg IV over 2 min
  - If SBP <160 and DBP <110, continue to monitor closely
- Repeat BP in 20 min; if BP threshold is still exceeded, obtain emergent consultation from maternal-fetal medicine, internal medicine, anesthesiology, or critical care.
- Once target BP achieved, monitor BP q10 min for 1 hour, q15 min for 2nd hour, q30 min for 3rd hour

IV HYDRALAZINE as Primary

- Administer hydralazine 5 or 10 mg IV
- Repeat BP in 20 min
  - If BP threshold is still exceeded, administer hydralazine 10 mg IV
  - If SBP <160 and DBP <110, continue to monitor closely
- Repeat BP in 20 min
  - If BP threshold is still exceeded, administer labetalol 20 mg IV
  - If SBP <160 and DBP <110, continue to monitor closely
- Repeat BP in10 min
  - If BP threshold is still exceeded, administer labetalol 40 mg IV and obtain emergent consultation from maternal-fetal medicine, internal medicine, anesthesiology, or critical care
  - If SBP <160 and DBP <110, continue to monitor closely
- Once target BP achieved, monitor BP q10 min for 1 hour, q15 min for 2nd hour, q30 min for 3rd hour

PO NIFEDIPINE as Primary

- Administer immediate release nifedipine capsules 10 mg po
- Repeat BP in 20 min
  - If BP threshold is still exceeded, administer immediate release nifedipine capsules 20 mg po
  - If SBP <160 and DBP <110, continue to monitor closely
- Repeat BP in 20 min
  - If BP threshold is still exceede administer immediate release nifedipine capsules 20 mg po
  - If SBP <160 and DBP <110, continue to monitor closely
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  - If SBP <160 and DBP <110, continue to monitor closely
- Once target BP achieved, monito
- BP q10 min for 1 hour, q15 min fo 2nd hour, q30 min for 3rd hour

Magnesium

Initial Treatment in the ED:

- Consult with OB and if ordered, give Magnesium Sulfate 5 grams IM x 2 doses;
- Close observation for signs of toxicity
  - Disappearance of deep tendon reflexes
  - Decreased RR, shallow respirations, shortness of breath
  - Heart block, chest pain
  - Pulmonary edema
- Place Calcium Gluconate at bedside as reversal agent; follow ED anti-seizure protocol; give Ativan stat if patient

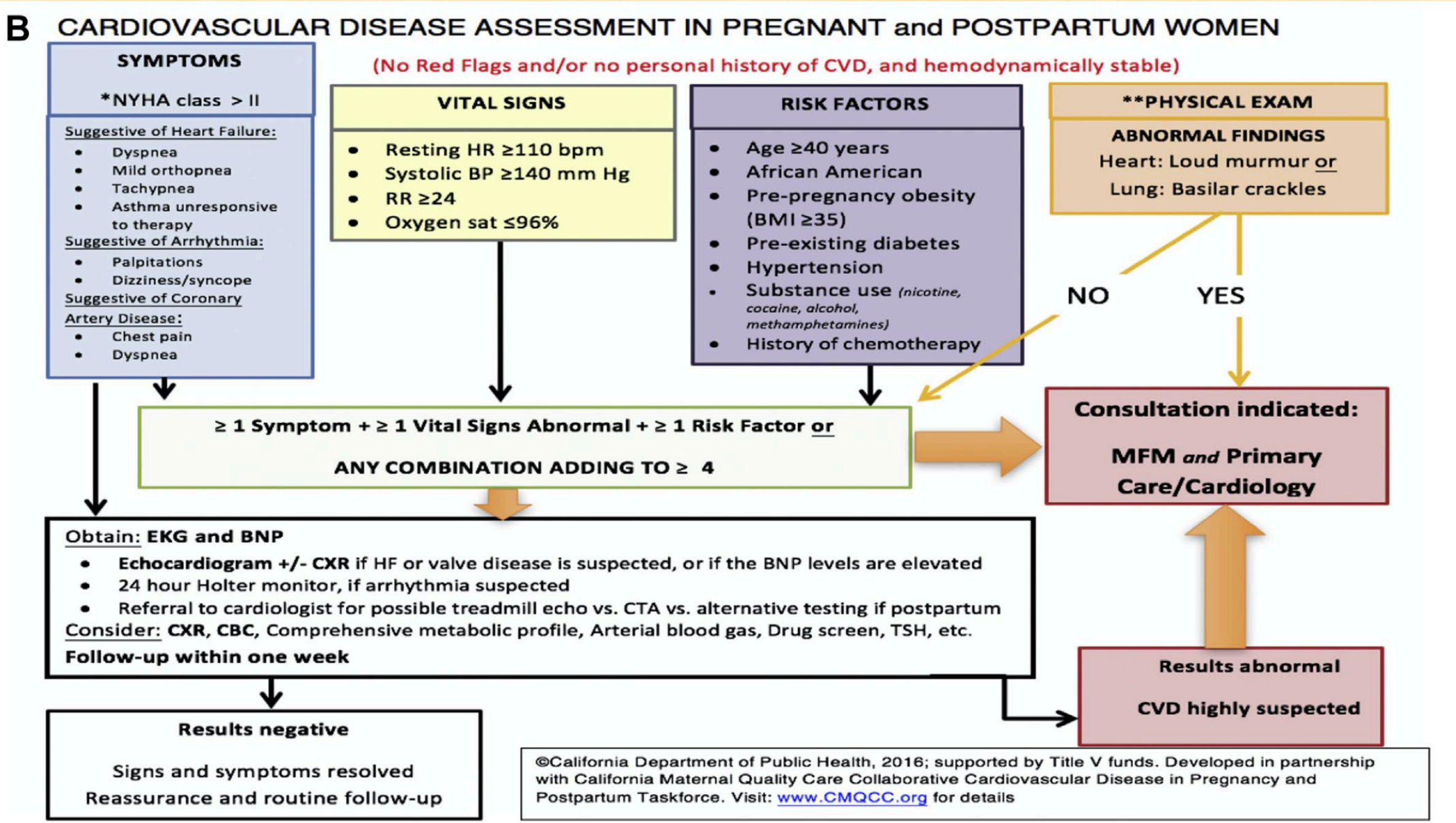
Cardiac S/S: Prompt evaluation by obstetrics and cardiology providers (if currently pregnant or was pregnant within the past year):

- Orthopnea ≥ 3 pillows
- Asthma unresponsive to therapy
- Shortness of breath without activity
- New onset chest pain
- Resting HR ≥ 119
- Systolic blood pressure of ≥ 160 mmHg or diastolic ≥ 110 mmHg
- Resting respiratory rate of ≥ 29
- Oxygen saturations at or below 94%
- Syncope

Recognition of Cardiovascular Symptoms

Table 2. How to Differentiate Common Signs and Symptoms of Normal Pregnancy Versus Those That Are Abnormal and Indicative of Underlying Cardiac Disease

	ROUTINE CARE Reassurance	CAUTION*† Nonemergent Evaluation	STOP†‡ Prompt Evaluation Pregnancy Heart Team
History of CVD	None	None	Yes
Self-reported symptoms	None or mild	Yes	Yes
Shortness of breath	No interference with activities of daily living; with heavy exertion only	With moderate exertion, new-onset asthma, persistent cough, or moderate or severe OSA§	At rest; paroxysmal nocturnal dyspnea or orthopnea; bilateral chest infiltrates on CXR or refractory pneumonia
Chest pain	Reflux related that resolves with treatment	Atypical	At rest or with minimal exertion
Palpitations	Few seconds, self-limited	Brief, self-limited episodes; no lightheadedness or syncope	Associated with near syncope
Syncope	Dizziness only with prolonged standing or dehydration	Vasovagal	Exertional or unprovoked
Fatigue	Mild	Mild or moderate	Extreme
Vital signs	Normal		
HR (beats per minute)	<90	90–119	≥120
Systolic BP (mm Hg)	120–139	140–159	≥160 (or symptomatic low BP)
RR (per minute)	12–15	16–25	≥25
Oxygen saturation	>97%	95–97%	<95% (unless chronic)
Physical examination	Normal		
JVP	Not visible	Not visible	Visible >2 cm above clavicle
Heart	S3, barely audible soft systolic murmur	S3, systolic murmur	Loud systolic murmur, diastolic murmur, S4
Lungs	Clear	Clear	Wheezing, crackles, effusion
Edema	Mild	Moderate	Marked



olfe. The pregnant cardiac patient. Am J Obstet Gynecol 2019.

Cardiac Conditions in Obstetric Care

Response — Every Event

Facility-wide standard protocols with checklists and escalation policies for management of **cardiac symptoms**.

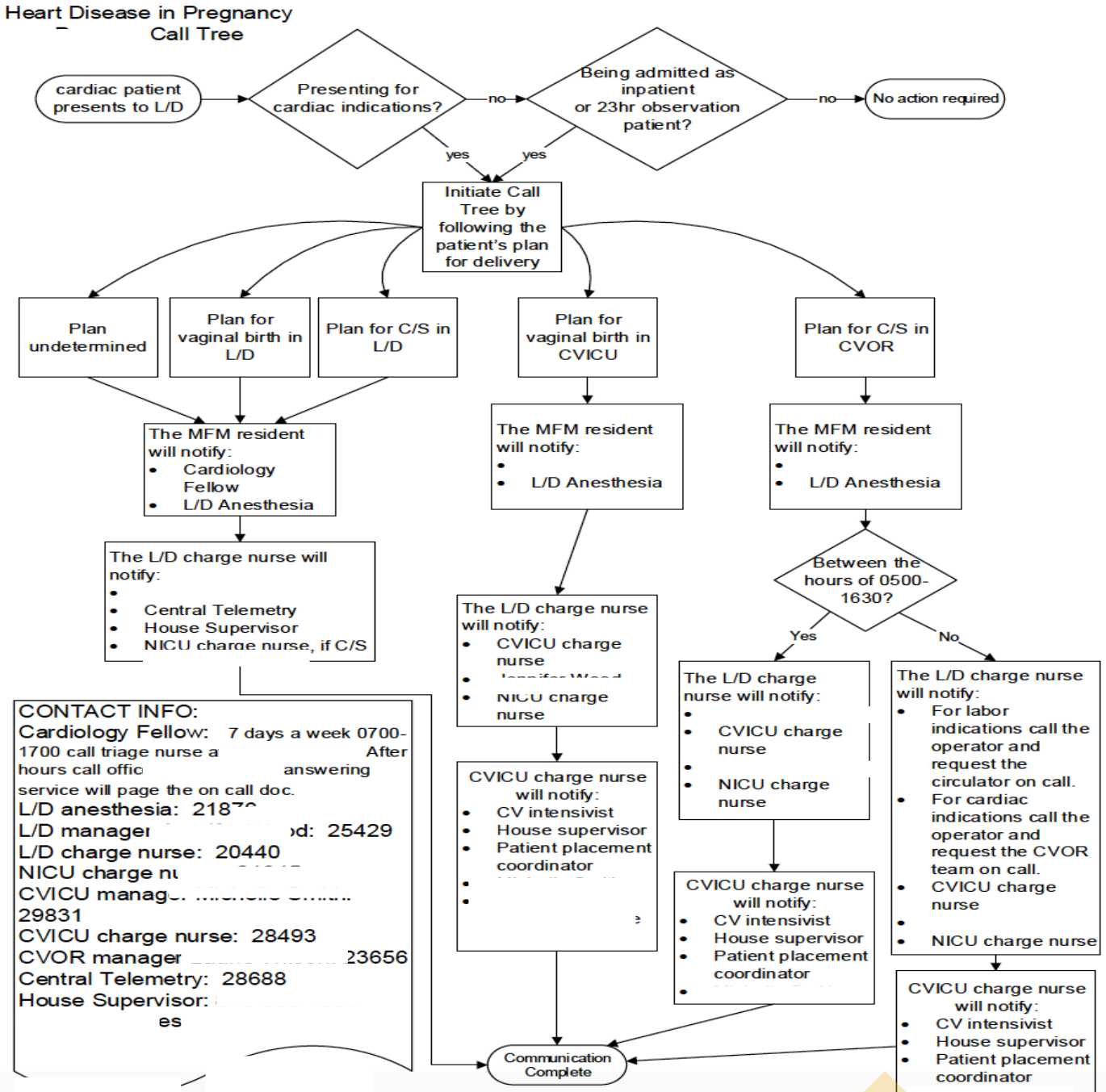
Facility-wide standard protocols with checklists and escalation policies for management of people with **known or suspected cardiac conditions**.

Coordinate transitions of care including the discharge from the birthing facility to home and transition from postpartum care to ongoing primary and specialty care.

Offer reproductive life planning discussions and resources, including access to a full range of contraceptive options in accordance with safe therapeutic regimens. *

Provide patient education focused on general life-threatening postpartum complications and early warning signs, including instructions of who to notify if they have concerns, and time and date of a scheduled postpartum visit.

Heart Disease in Pregnancy
Call Tree



Document located N:>SLH>OBGYN Cardiac Patients>Resources Updated 7/17/15 rmg

Curr Treat Options Cardio Med (2020) 22: 68
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Pregnancy and Cardiovascular Disease (N Scott, Section Editor)

Contraception for the Cardiac Patient: a Cardiologist's Primer

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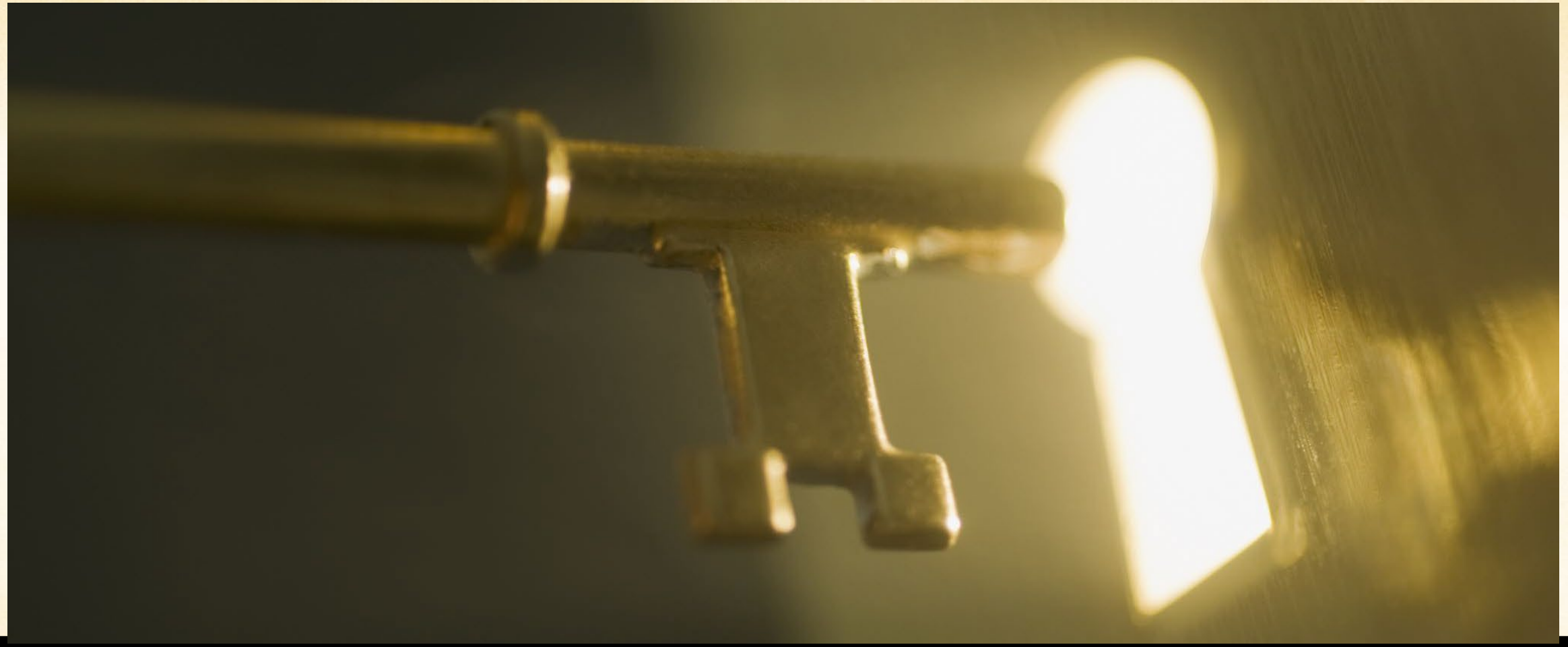
Reporting and Systems Learning — Every Unit

For pregnant and postpartum people at high risk for a cardiac event, establish a culture of multidisciplinary planning, admission huddles and post-event debriefs.

Perform multidisciplinary reviews of serious complications (e.g. ICU admissions for other than observation) to identify systems issues.

Monitor outcomes and process data related to cardiac conditions, with disaggregation by race and ethnicity due to known disparities in rates of cardiac conditions experienced by Black and Indigenous pregnant and postpartum people.

Defining Key Metrics



How To Define Important Metrics?

St Luke's Mid America Heart Instutite and Maternal Fetal Medicine Heart Disease in Pregnancy Center of Excellence Summary							
Year	Total patients	Patients delivered with program	Average Gestational age at Delivery	Vaginal Delivery	ICU Delivery	Average Birthweight	Average Hospital stay
2014	31	29	36.8+/-3.1	31%	13%	2968+/- 685 g	5.3 days
2015	85	74	37.3+/-2.6	41%	7%	3091+/-728 g	4.9 days
2016	101	91	37.7+/-2.2	52%	5%	3105+/-560 g	4.3 days
2017	247	182	37.9+/-2.6	53%	5%	3250+/-560 g	4.1 days

Daming et al. J Matern Fetal Neonatal Med. 2019

Two Outcome Metrics for CCOC

- Implementing the SMART goal mantra

- Two metrics for CCOC Bundle
  - **Cesarean delivery rate**
  - **Preterm birth rate**

How to Interpret Outcome Metrics

- Measured over time course (trend rather than single point in time)
- Comfort level increase in caring for women with cardiac disease
- Discussions in a multidisciplinary fashion

Respectful, Equitable, and Supportive Care — Every Unit/Provider/Team Member

Screen for structural and social drivers of health that might impact clinical recommendations or treatment plans and provide linkage to resources that align with the pregnant or postpartum person's health literacy, cultural needs, and language proficiency.

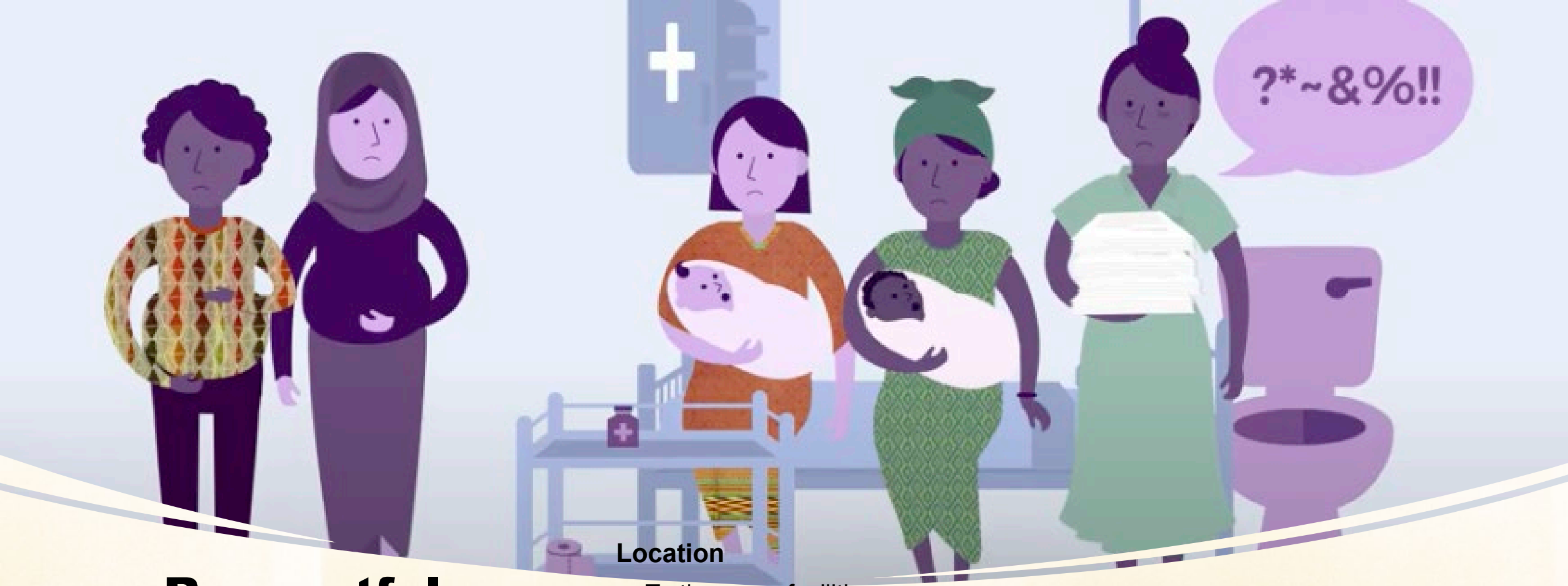
Engage in open, transparent, and empathetic communication with pregnant and postpartum people and their identified support network to understand diagnoses, options, and treatment plans.

Include each pregnant or postpartum person and their identified support network as respected members of and contributors to the multidisciplinary care team.*

What is Respectful Care?

Meeting the patient ***where*** they are, ***when*** they need it, and ***how*** and from ***who***

https://www.aft.org/hc/spring2021/taylor



Respectful Care: Where Can Refer to…

Location

- Tertiary care facilities
  - Access to multiple disciplines
  - Resources
  - Alternative models

Social/Cultural

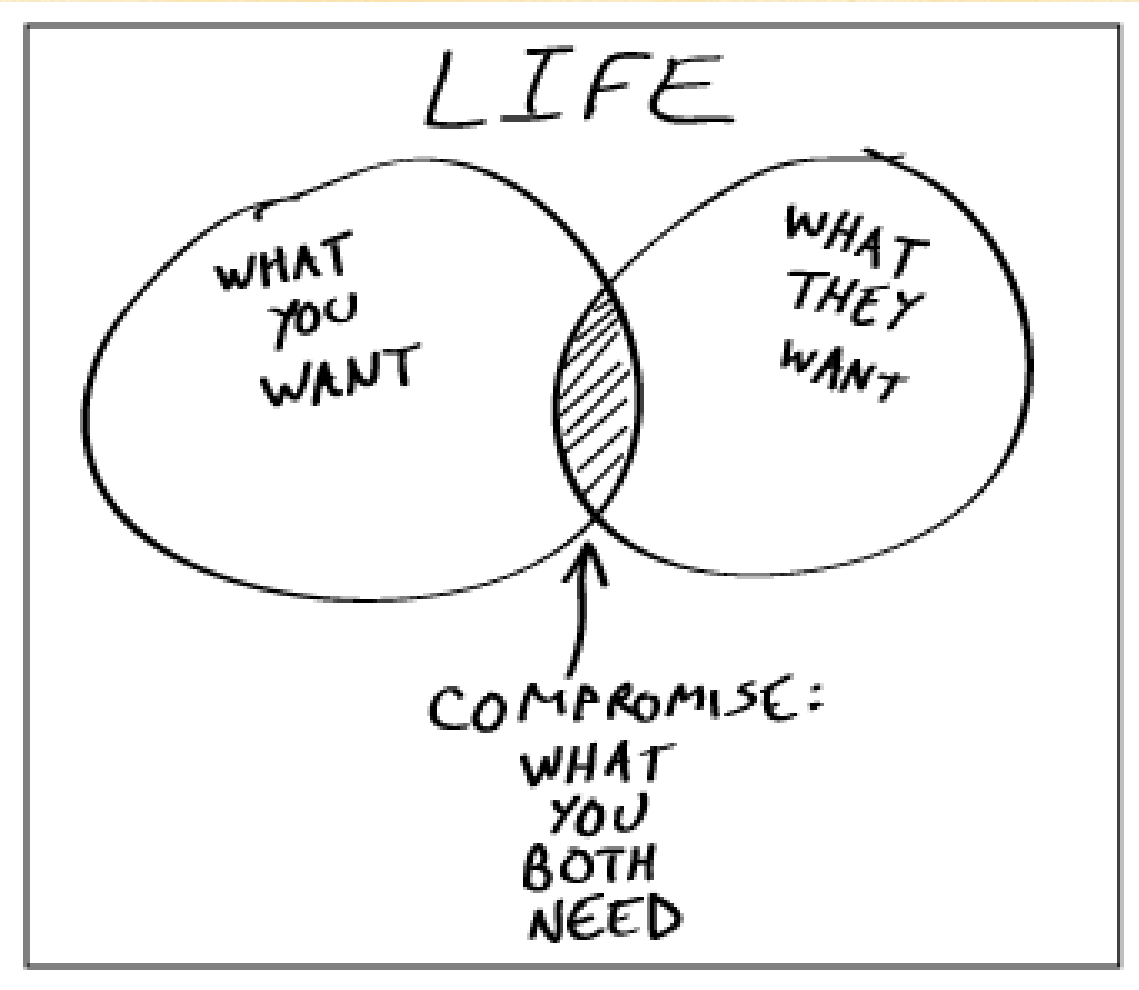
- Provider resources that align with literacy, cultural needs and language

Respectful Care: When Can Refer To…

- Actual timing of visits
- When to engage support structure and family

Respectful Care: How Can Refer To…

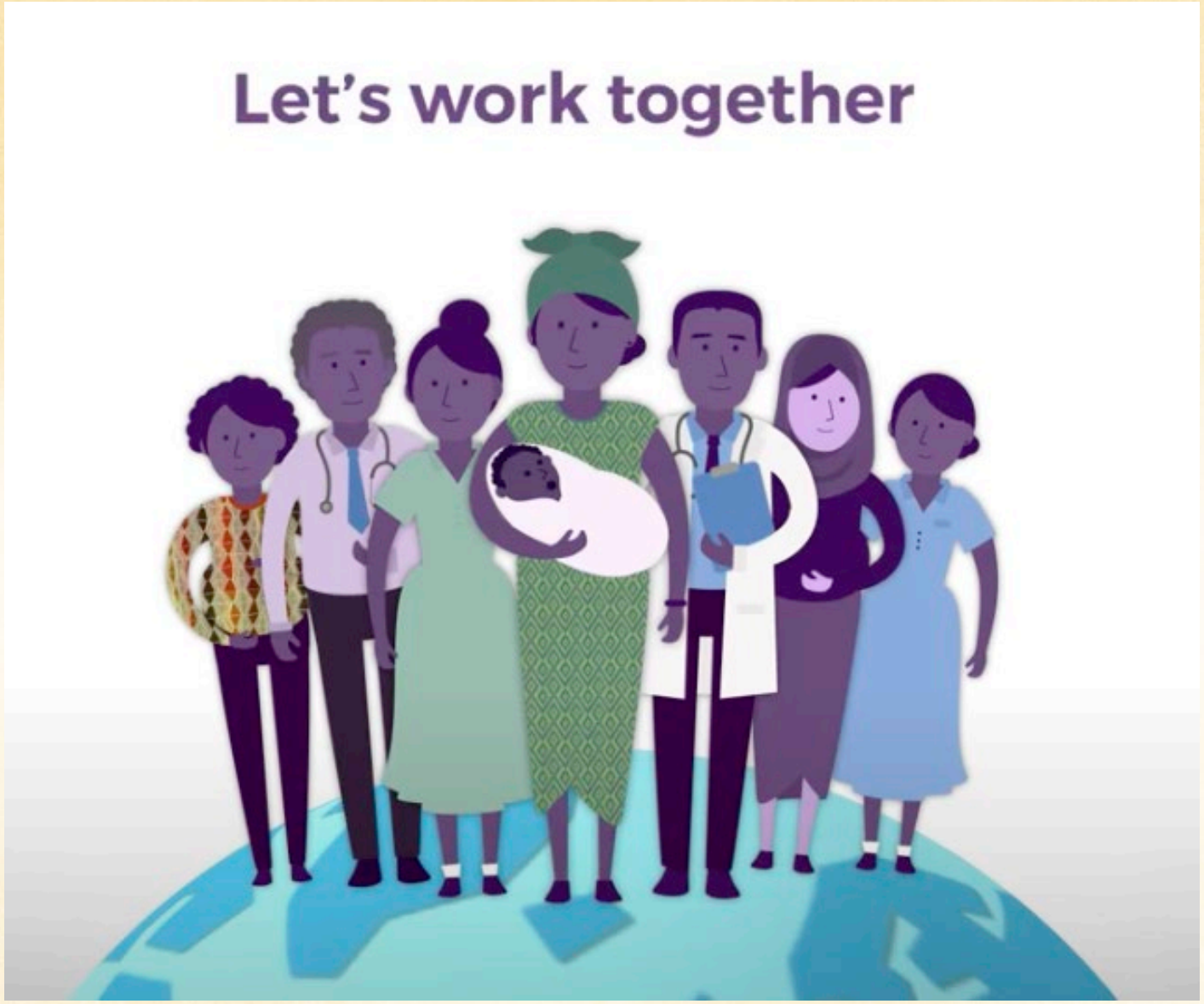
- Screening for social drivers of health
  - Provide linkages to resources that align with patient needs
- Engage in open, transparent and empathetic communication
- Include patients and support network in decision-making

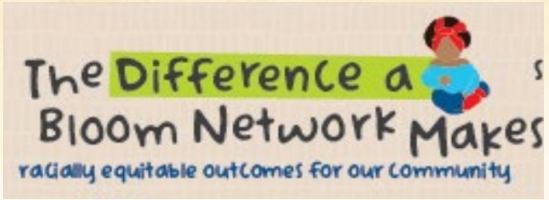


Respectful Care: Who Can Refer To…

- ***ALL*** of the patients' health care team
  - Providers
  - Nursing staff
  - Community health workers
  - Support network

- Alignment of patient/provider





Community Integration

The Strength of Missouri Quality Improvement

+

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THANK YOU!!