

# Faculty Disclosure

## **Relationships with commercial interests:**

- Not Applicable

## **Potential for conflict(s) of interest:**

- Not Applicable

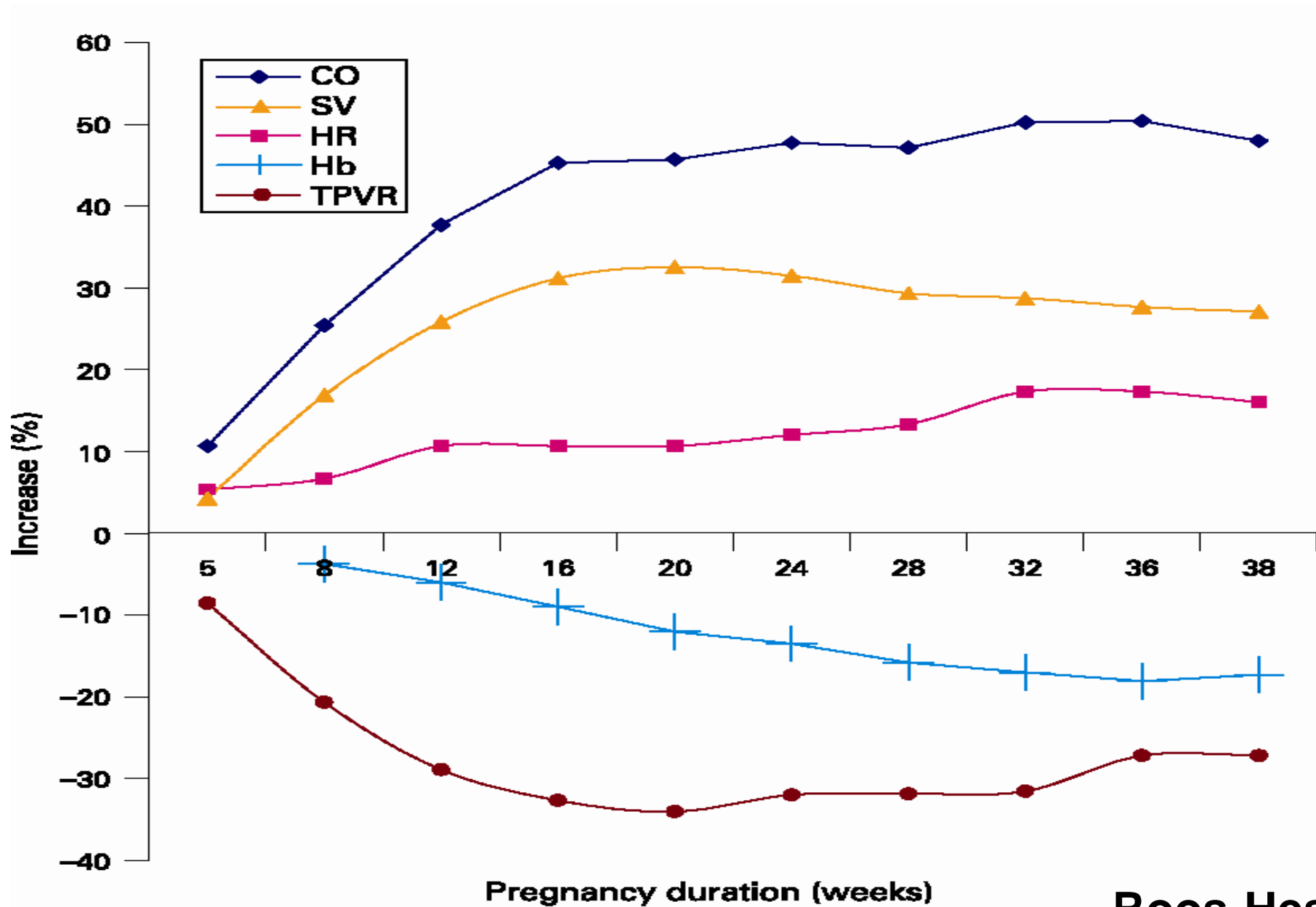
## Mitigating Potential Bias

- All the recommendations involving clinical medicine are based on evidence that is accepted within the profession.
- All scientific research referred to, reported, or used is in the support or justification of patient care.
- Recommendations conform to the generally accepted standards.
- The presentation will mitigate potential bias by ensuring that data and recommendations are presented in a fair and balanced way.

## Learning Objectives

By the end of this session, participants will

- Understand how cardiovascular changes of pregnancy affect women with heart disease
- Understand approaches to risk stratification of pregnant women with heart disease
- Understand management principles of pregnancy women with heart disease

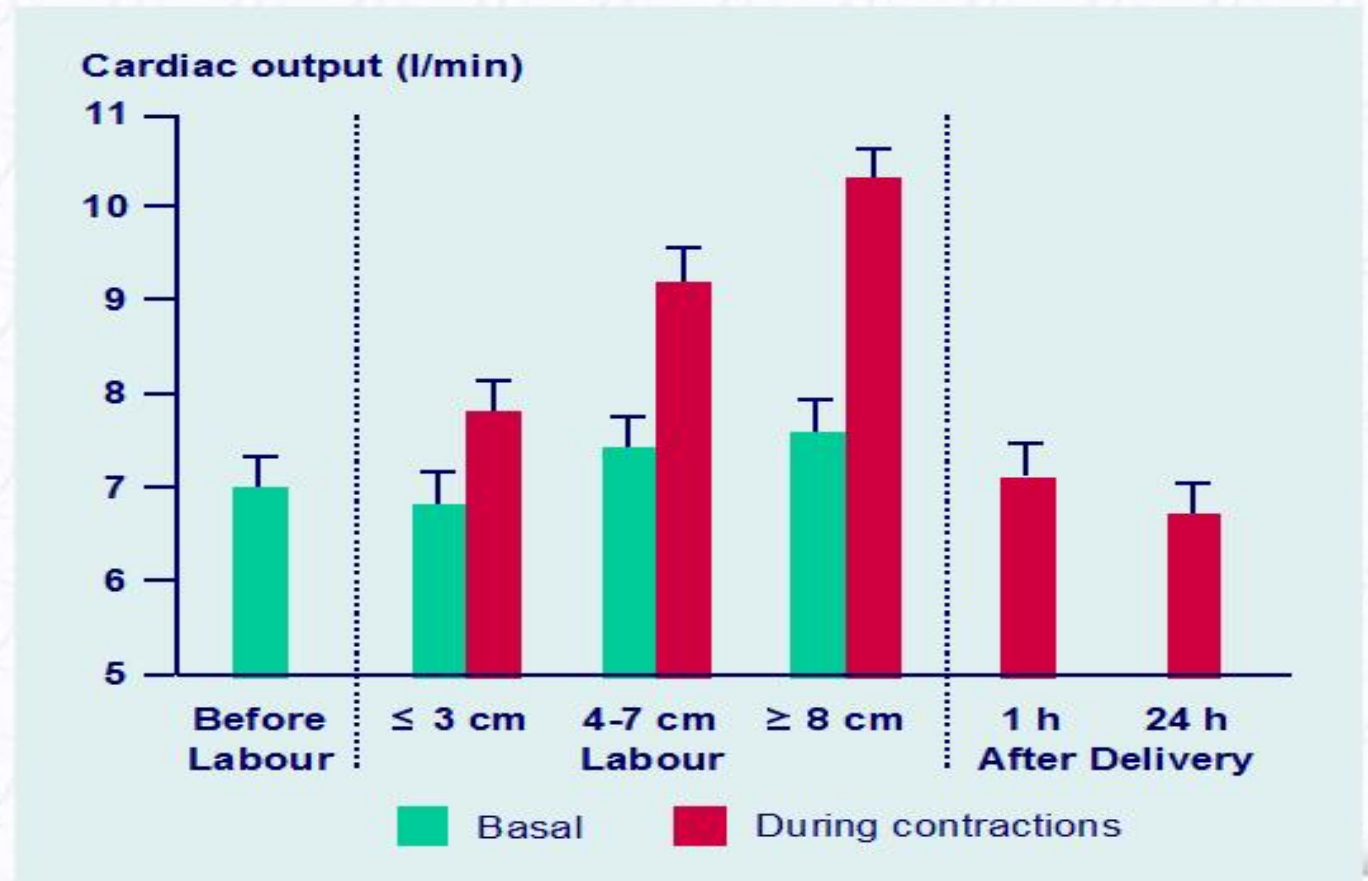


Prothrombotic  
 Proarrhythmic  
 Metabolic  
 Inflammation

Roos-Hesselink, Heart 2009

# Haemodynamic Changes During Delivery

- Labour:
  - ↑ O<sub>2</sub> consumption,
  - ↑ baseline cardiac output,
  - ↑ cardiac output and blood pressure during uterine contractions, depending on modalities of delivery (epidural analgesia, Cesarean section)
- Post-partum:
  - ↑ blood shift from placenta,
  - ↑ preload and cardiac output.



Hunter et al. *Br Med J* 1992;68:540-3

# Normal Pregnancy

## Symptoms

- Dyspnea
- Syncope
- Palpitations
- Orthopnea
- Edema

## Exam

- Prominent JVP
- Displaced LV apex
- Systolic murmur

# Normal Pregnancy

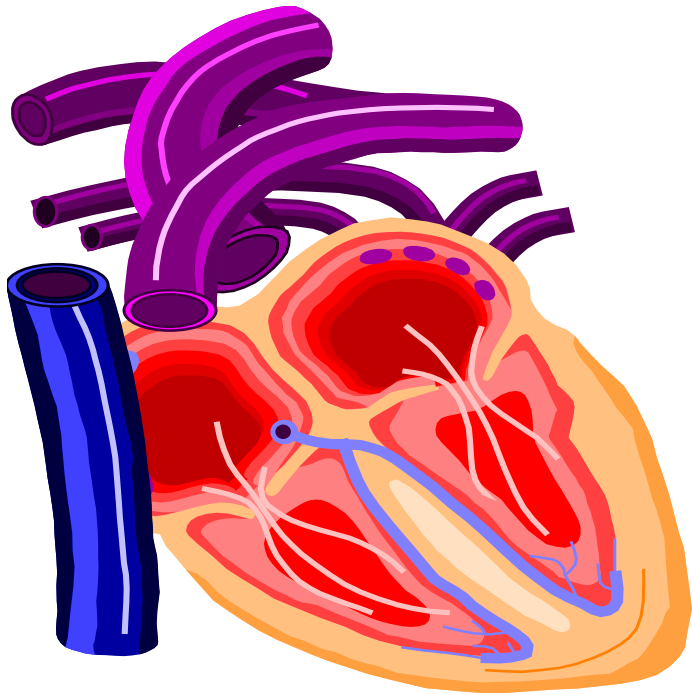
## ECG

- QRS axis deviation
- ST-T wave changes
- Sinus tachycardia
- PACs, VPBs, non sustained arrhythmias

## CXR

- Straightening of the left upper cardiac border
- Horizontal position of the heart
- Increased lung marking
- Small pleural effusion early postpartum

## Echo Findings During Normal Pregnancy



- Slight increase systolic & diastolic LV dimensions
- Unchanged or slightly increase in LVEF
- Slight enlargement of LA size
- Small pericardial effusion
- Functional tricuspid regurgitation (RVE & TV annulus enlargement)



## Take Away Point 1

Normal pregnancy is a reversible physiologic hyperdynamic state accompanied by changes in cardiac evaluation that can mimic heart disease

# Management Approach to the Pregnant Woman with Heart Disease

- Risk to her
- Risk to the fetus
- Recurrence risk of Congenital Heart Defect
- Antepartum and peripartum management
- Long term risk

## Predicting Maternal Cardiac Risk

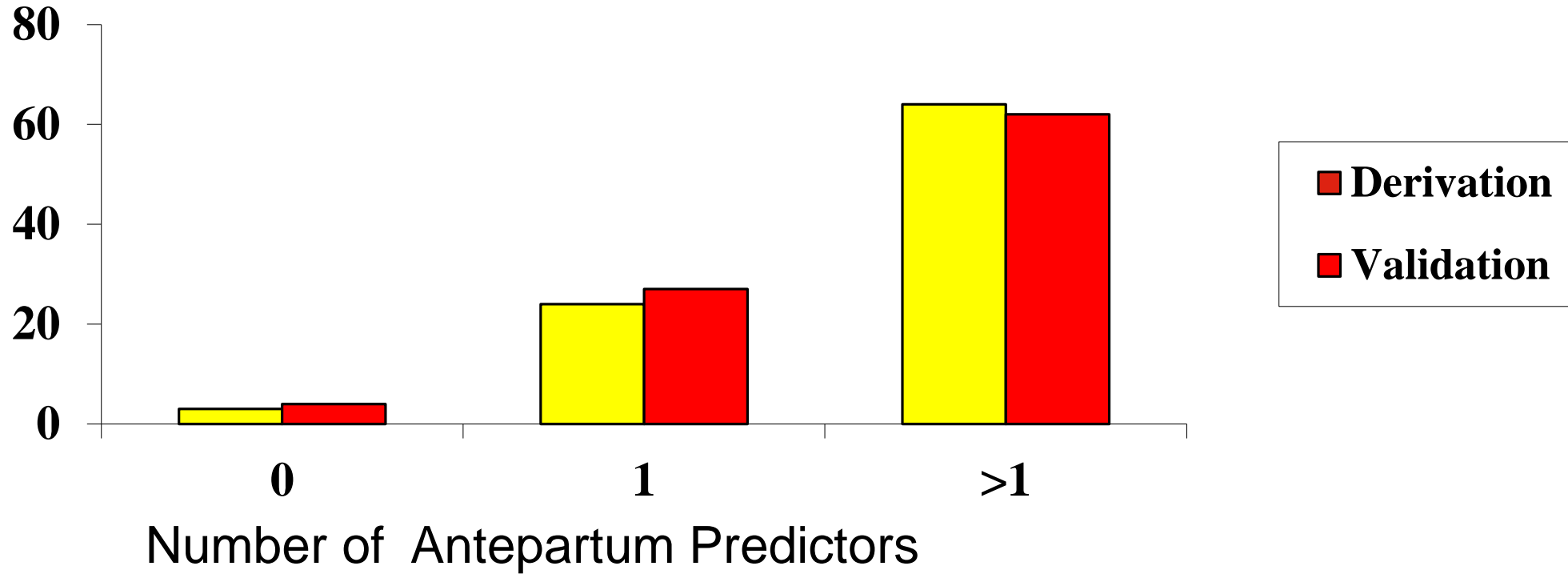
- Lesion specific
  - Risk index
  - Combination of Lesion specific and Risk index
- *History, physical exam, finger oximetry, 12 lead ECG, transthoracic echo*
  - *Preconception exercise testing in some*
  - *Other imaging modalities in some*

## High Risk Heart Lesions

- Marfan syndrome with aortopathy ? aortopathies
- Eisenmenger syndrome
- Mechanical valve
- Peripartum cardiomyopathy with residual LV dysfunction
- Acute coronary syndrome during pregnancy

# Canadian Multi-Centre Prospective Study (CARPREG n=617)

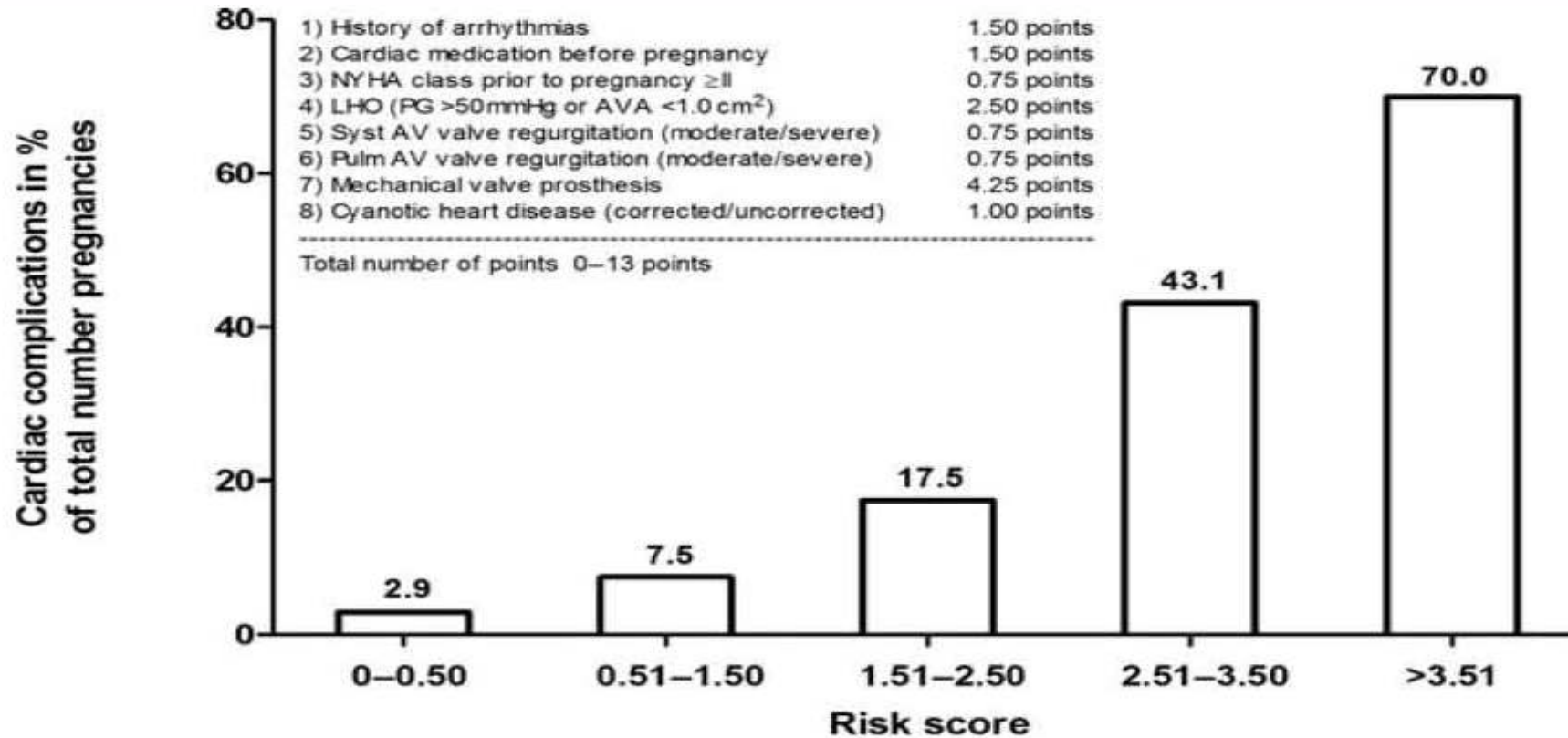
% Pregnancies with CHF,  
Arrhythmia, CVA, or Death



- Prior cardiac event or arrhythmia
- Poor functional class (NYHA 3 or 4) or cyanosis
- Systemic ventricular systolic dysfunction (EF < 40%)
- Left heart obstruction
  - Aortic valve area < 1.5 cm<sup>2</sup>
  - Peak LVOT gradient > 30 mmHg
  - Mitral valve area < 2.0 cm<sup>2</sup>

**Siu, Circ 2001**

# Zahara 1: Multi-Centre Retrospective Study of 1302 ACHD Pregnancies



Number of pregnancies at risk	828	280	126	58	10
Percentage of total population	63.6	28.1	6.1	1.4	0.8

Drenthen W et al. European Heart J 2010

# Modified WHO Classification: ESC 2011 Guidelines (Expert)

**Table 6** Modified WHO classification of maternal cardiovascular risk: principles

Risk class	Risk of pregnancy by medical condition
I	No detectable increased risk of maternal mortality and no/mild increase in morbidity.
II	Small increased risk of maternal mortality or moderate increase in morbidity.
III	Significantly increased risk of maternal mortality or severe morbidity. Expert counselling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth, and the puerperium.
IV	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.

Modified from Thorne *et al.*<sup>72</sup>

WHO = World Health Organization

# Modified WHO Classification: ESC 2011 Guidelines

Conditions in which pregnancy risk is WHO I
<ul style="list-style-type: none"><li>• Uncomplicated, small or mild<ul style="list-style-type: none"><li>- pulmonary stenosis</li><li>- patent ductus arteriosus</li><li>- mitral valve prolapse</li></ul></li></ul>
<ul style="list-style-type: none"><li>• Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage).</li></ul>
<ul style="list-style-type: none"><li>• Atrial or ventricular ectopic beats, isolated</li></ul>

Regitz-Zagrosek, EHJ 2011



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Regitz-Zagrosek, EHJ 2011

## Modified WHO Classification: ESC 2011 Guidelines

### **WHO II** (if otherwise well and uncomplicated)

- Unoperated atrial or ventricular septal defect
- Repaired tetralogy of Fallot
- Most arrhythmias

### **WHO II-III** (depending on individual)

- 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 III**

- 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

**Regitz-Zagrosek, EHJ 2011**

## Modified WHO Classification: ESC 2011 Guidelines

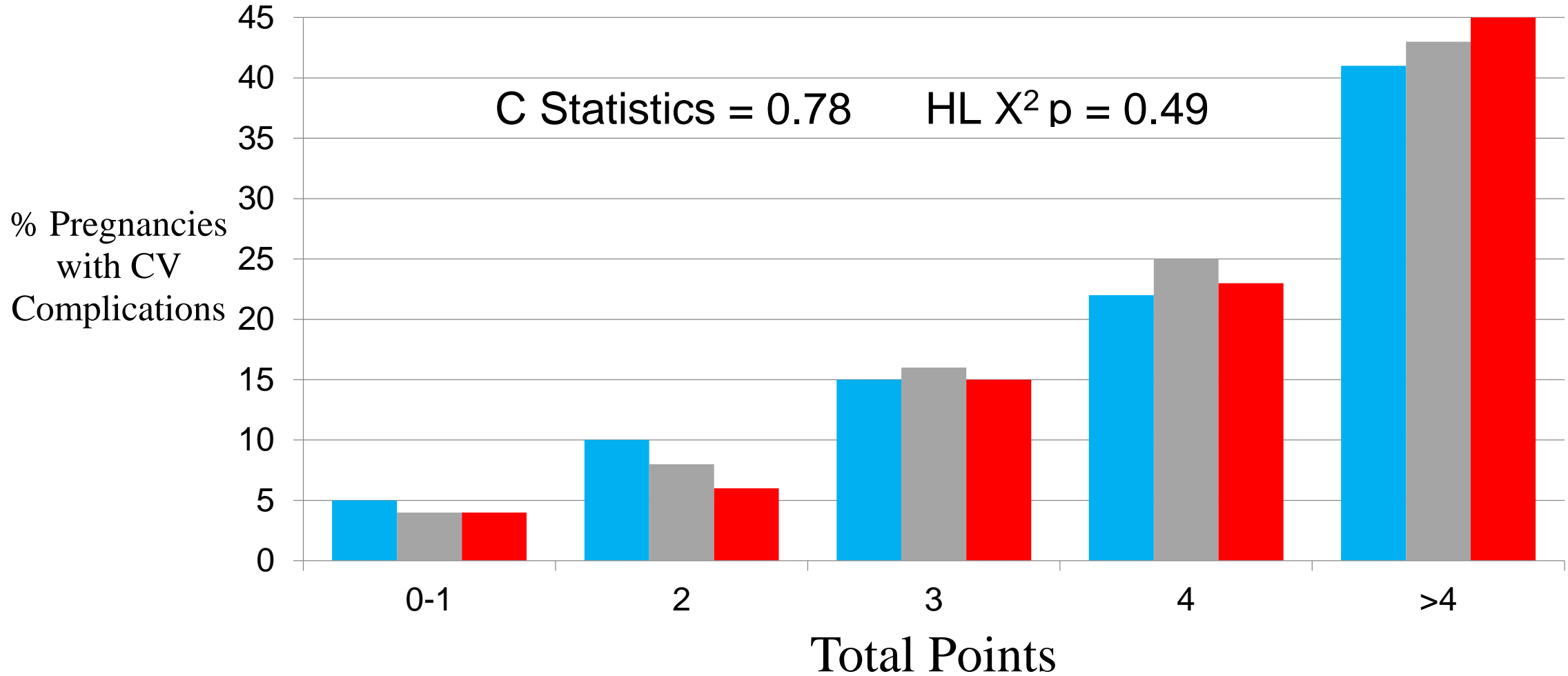
### Conditions in which pregnancy risk is WHO IV (pregnancy contraindicated)

- 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 mitral stenosis, severe symptomatic aortic stenosis
- Marfan syndrome with aorta dilated >45 mm
- Aortic dilatation >50 mm in aortic disease associated with bicuspid aortic valve
- Native severe coarctation

Regitz-Zagrosek, EHJ 2011

# CARPREG II Risk Score (n = 1938)

■ Predicted ■ Derivation ■ Validation



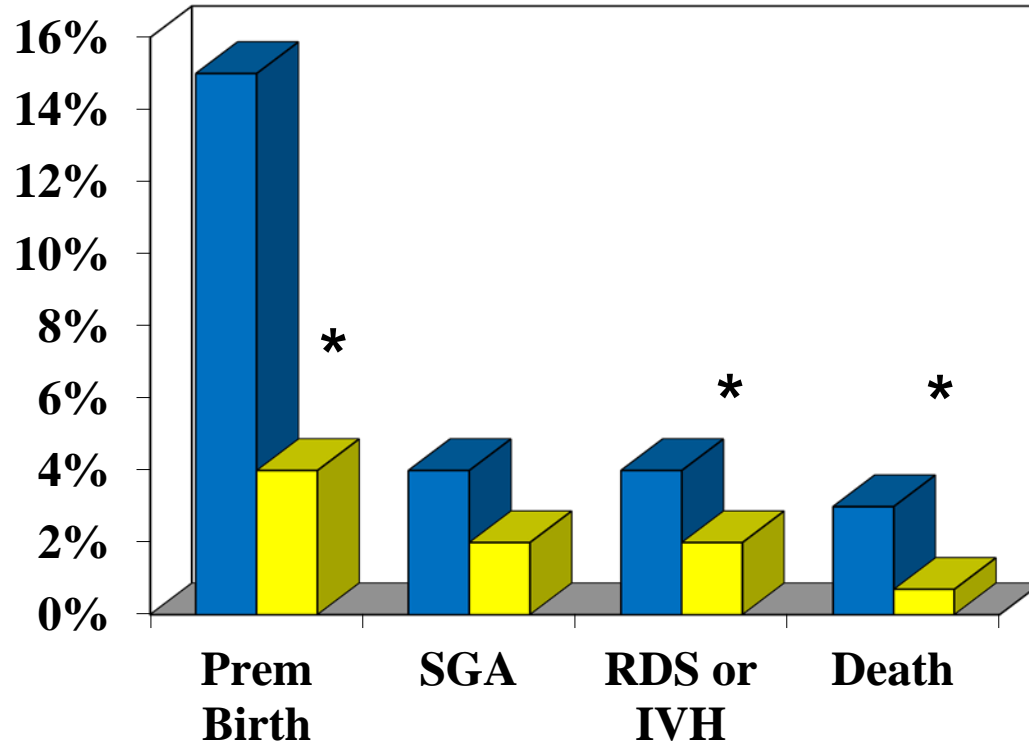
**Siu, Grewal,...Silversides. AHA 2017**

## Predictors of Cardiac Complications (16%, 0.3% CV Death)

Independent Predictors of CV Complications	OR (95% CI)	P	Points
Prior cardiac events or arrhythmia	5.9 (4.2 - 8.4 )	<0.001	3
Baseline NYHA class III-IV or cyanosis	4.9 (2.2 -10.8 )	<0.001	3
Mechanical valve	4.2 (1.6 - 10.9)	0.003	3
At least mild systemic ventricular systolic dysfunction	2.3 (1.5 -3.5 )	<0.001	2
High risk left-sided valve disease	2.1 (1.3 - 3.3)	0.001	2
Pulmonary hypertension	3.3 (1.5 - 7.2 )	0.003	2
Coronary artery disease	3.0 (1.1 - 7.6 )	0.025	2
High risk aortopathy	2.7 (1.1 - 7.3)	0.044	2
No prior cardiac intervention	1.6 (1.1 - 2.3 )	0.01	1
<i>Late pregnancy assessment</i>	1.6 (1.1 - 2.3)	0.009	1

Siu, Grewal,...Silversides. AHA 2017

# Neonatal Events in Completed Pregnancies



\*p<0.005 HD vs Controls

Odds Ratio for any neonatal event: HD vs controls  
Propensity Adjusted: 2.6 (1.5-4.6)

**Siu, Circ 2002**

## Take Away Point 2

2a Choices of risk stratification approaches for predicting maternal cardiac complications in women with heart disease

2b Low cardiac risk  $\neq$  No cardiac Risk

2c Elevated fetoneonatal risk

# Management of the Pregnant Woman with Heart Disease

- **General Approach**
- **Specific Issues**



# Who to Refer, When to Refer, and to Whom

- Women with known or suspected heart disease contemplating pregnancy or pregnant should be assessed by *cardiologist* with **expertise** in pregnancy and maternal heart disease
- Pregnant women with heart disease, not in low risk group, should be assessed and followed at a referral centre by a **team** with **expertise** in the care of this population
- **Best to refer before conception**
- **If not possible, refer as early as possible during antepartum period**
- **Maternal Cardiology Clinic**

## Pregnancy Risk in Congenital Heart Disease What Women Are Not Told

<b>MD Rated Current Risk of Maternal CV Complications</b>				
		<b>Low Risk</b>	<b>Intermediate or High Risk</b>	<b>Total</b>
<b>Patient recall being told of increased risk</b>	<b>No</b>	16	<b>27</b>	<b>43</b>
	<b>Yes</b>	<b>20</b>	53	<b>73</b>

**Kovacs, JACC 2008**

## Interventions to Reduce Risk

- Correction of cyanosis
- Treatment of severe obstructive lesion ? Role for preventative therapy of severe AS and MS
- **Smoking cessation**
- Preconception vitamins

# Antepartum Management

- **Multi-disciplinary approach**
  - Medical
  - Nursing
  - Social work
- Serial cardiac assessments
  - Baseline
  - 3<sup>rd</sup> trimester
- Fetal echo
- Genetic screening/consultation
- Cardiac Medications
- Anticoagulation

# Peripartum Management

## Tailored Approach according to Maternal and Fetal Risk Category

- Community hospital vs referral centre
- Induction vs spontaneous delivery
- Cardiac monitoring and/or ICU/CCU admission

# Pulmonary Edema during Pregnancy

## Windows of vulnerability

- Late 2<sup>nd</sup> trimester to 3<sup>rd</sup> trimester (26 weeks until term)
- Early postpartum period

## Identify Substrate and Precipitant

- Ventricular dysfunction
- Valvular dysfunction
- Tachyarrhythmia
- Pulmonary emboli

## Treatment

- Diuretics
- Slow tachyarrhythmia
- Prepare for premature delivery

# TachyArrhythmia during Pregnancy

## Windows of vulnerability

- Entire pregnancy and postpartum period

## Identify Substrate and Precipitant

- Ventricular dysfunction
- Valvular dysfunction
- Pulmonary emboli

## Treatment

- Rate control usually more feasible than rhythm control strategy
- Electrical cardioversion for hemodynamic instability
- Consider anticoagulation especially with structural or post DC version
- Prepare for premature delivery

## Cardiac Arrest in the Pregnant Female

- Gravid uterus > umbilicus limits effectiveness of chest compressions: Lateral Uterine Displacement
- Hypoxemia develops more rapidly
  - airway management more difficult
  - no more than 2 intubation attempts
  - may require smaller ET tube (6-7)
- ACLS protocol Epinephrine > Vasopressin
- iv on upper extremities
- **Consider emergency Cesarean delivery if no ROSC by 4 minutes of resuscitation**

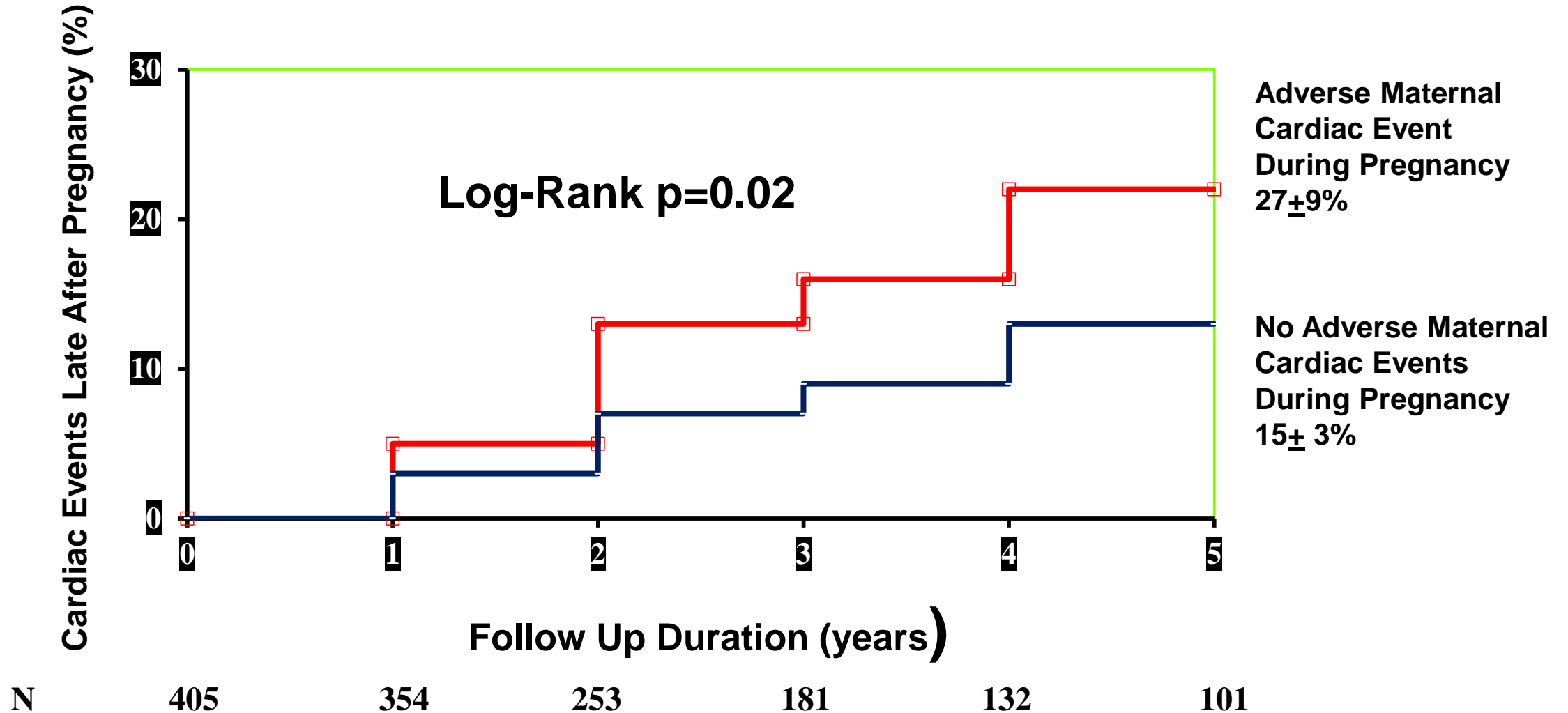
**AHA Guidelines, Circ 2015**



# Management Approach to the Pregnant Woman with Heart Disease

- Risk to her
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- Long term risk

# Stress Test for Life : Pregnancy Complications Predicts Long Term Outcomes In Women with Cong Heart Defects



## Take Away Point 3

3a Obtain a Maternal Cardiology assessment prior to pregnancy or early in pregnancy

3b Team Approach to Management

## Conclusions

1. Hyperdynamic state of normal pregnancy result in cardiac findings that mimics heart disease
2. Choices of risk stratification approaches for predicting maternal cardiac complications. Low CV risk  $\neq$  No CV Risk
3. Early referral to maternal cardiology clinic and team approach to management



**Questions?**