

MHIF FEATURED STUDY:

# WARRIOR – Women’s Ischemia Trial

<p><b>CONDITION:</b> Non-Obstructive CAD in Women</p>	<p><b>PI:</b> Retu Saxena, MD</p>	<p><b>RESEARCH CONTACT:</b> Steph Ebnet <a href="mailto:Stephanie.ebnet@allina.com">Stephanie.ebnet@allina.com</a>   612-863-6286</p>	<p><b>SPONSOR:</b> University of FL Funded by the Department of Defense</p>
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## DESCRIPTION:

The purpose of WARRIOR (Women’s Ischemia Trial to Reduce Events in Non-Obstructive CAD) is to evaluate if intensive medical therapy (IMT) (**potent statin plus ACE-I or ARB**) is better than usual care in women who have s/s of suspected ischemia but no obstructive CAD (defined as <50 stenosis). The hypothesis is that IMT will reduce MACE 20% vs. usual care.

## CRITERIA LIST/ QUALIFICATIONS:

### Inclusion

- Signs and symptoms of suspected ischemia prompting referral for further evaluation by coronary angiography or coronary CT angiogram within previous 3 years
- Non-obstructive CAD defined as 0-50% diameter reduction of a major epicardial vessel

### Exclusion

- Hx NIHCM
- ACS within 30 days
- LVEF< 40% NYHA HF class III-IV
- Prior intolerance to ACE/ARB
- ESRD on dialysis
- Severe valvular disease requiring TVAR within 3 years
- Stroke within 180 days

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## Minneapolis Heart Institute Foundation® Cardiovascular Grand Rounds

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**Title:** Overview of the Cardiopregnancy Program ANW Hospital: A Multidisciplinary Program for the management of Congenital and Acquired Heart Disease in Pregnancy

**Speakers:** William Wagner, MD

Co-Director OB Critical Care Program, Department of Critical Care Medicine,  
Abbott Northwestern Hospital

Co-Lead, Cardiopregnancy Program

**Retu Saxena, MD**

Cardiologist, Minneapolis Heart Institute® at Abbott Northwestern Hospital

**Karol Mudy, MD**

Thoracic Surgeon, Cardiologist, Minneapolis Heart Institute® at Abbott Northwestern Hospital

**Date:** January 6, 2020

**Time:** 7:00 - 8:00 AM

**Location:** Minneapolis Heart Institute Building, Suite 100, Learning Center

### OBJECTIVES

At the completion of this activity, the participants should be able to:

1. Recognize the "Why" for the Cardiopregnancy Program: Historical to the present.
2. Comprehend the important adaptive changes and impact on the hemodynamics of pregnancy both in congenital and acquired heart disease.
3. Interpret how the multidisciplinary approach to the patient improves quality of outcome for both mother and fetus.

### DISCLOSURE POLICY & STATEMENTS

Allina Health, Learning & Development intends to provide balance, independence, objectivity and scientific rigor in all of its sponsored educational activities. All speakers and planning committee members participating in sponsored activities and their spouse/partner are required to disclose to the activity audience any real or apparent conflict(s) of interest related to the content of this conference.

The ACCME defines a commercial interest as "any entity" producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients. The ACCME does not consider providers of clinical service directly to patients to be commercial interests - unless the provider of clinical service is owned, or controlled by, an ACCME-defined commercial interest.

### Moderator(s)/Speaker(s)

Drs. William Wagner, Retu Saxena and Karol Mudy have disclosed that they DO NOT have any real or apparent conflicts with any commercial interest as it relates to presenting the content in this activity/course.

### Planning Committee

Dr. Alex Campbell, Jake Cohen, Jane Fox, Dr. Kevin Harris, Dr. Kasia Hryniewicz, Rebecca Lindberg, Amy McMeans, Dr. Michael Miedema, Dr. JoEllyn Moore, Pamela Morley, Dr. Scott Sharkey, Maia Hendel and Jolene Bell Makowsky have disclosed that they DO NOT have any real or apparent conflicts with any commercial interest as it relates to the planning of this activity/course. Dr. Mario Gössl has disclosed the following relationships -Grant/Research Support: Edwards Life Sciences; Consultant: Abbott Vascular, Caisson; Speaker's Bureau: Edwards Lifesciences. Dr. David Hurrell has disclosed the following relationship -Chair, Clinical Events Committee: Boston Scientific. Dr. João Cavalcante has disclosed the following relationships -Grant/Research Support: Boston Scientific, Medtronic, Abbott Vascular, Circle Cardiovascular Imaging, Siemens Healthineers; Consultant: Boston Scientific, Medtronic; Speaker's Bureau: Medtronic, Siemens Healthineers; Honoraria: Medtronic, Siemens Healthineers.

### COMMERCIAL SUPPORT

We would like to thank the following company for their generous support of our activity.

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A reminder for Allina employees and staff, the Allina Policy on Ethical Relationship with Industry prohibits taking back to your place of work, any items received at this activity with branded and or product information from our exhibitors.

# Severe AI

## 29 weeks pregnant

Karol Mudy, MD

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## JG- 36 yo, 29 weeks pregnant

- History of miscarriage
- 4/29/19- routine dental work
- 4/30/19- intermittent fevers and shaking chills
- 5/5/19- admitted to hospital
- 5/6/19- 5/9/19- blood cultures positive for Gemella species

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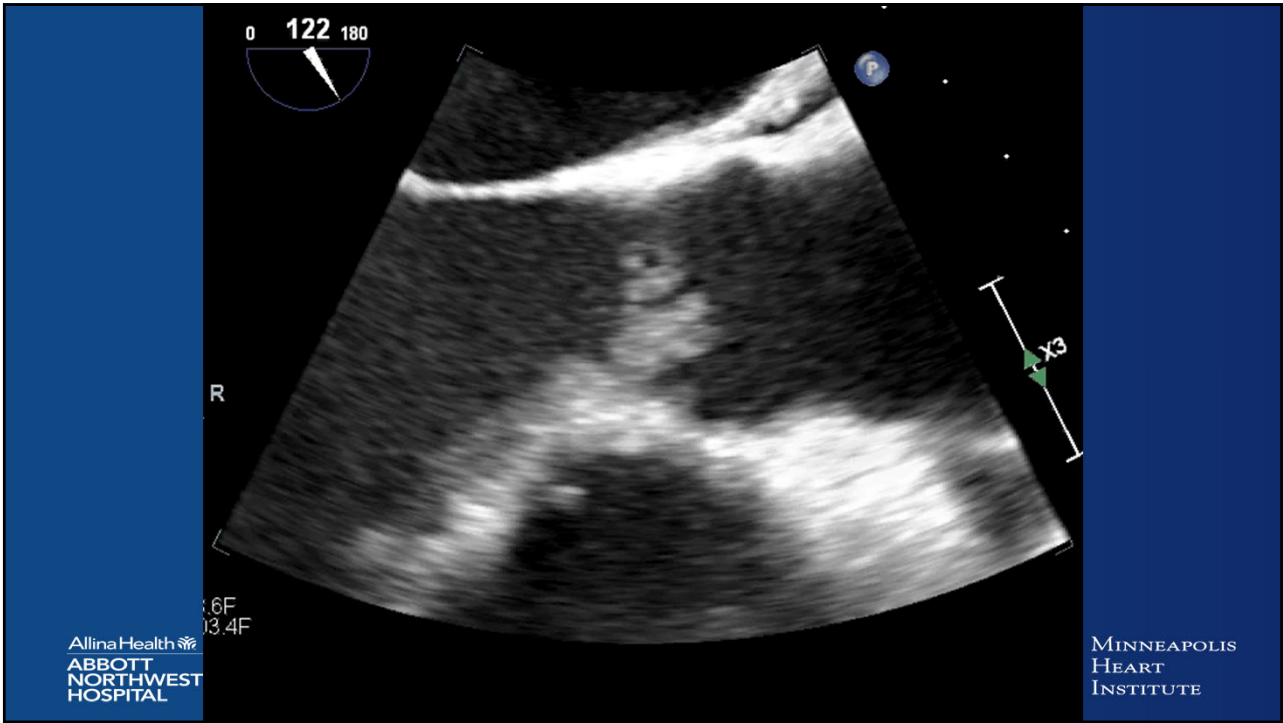
# JG- 36 yo

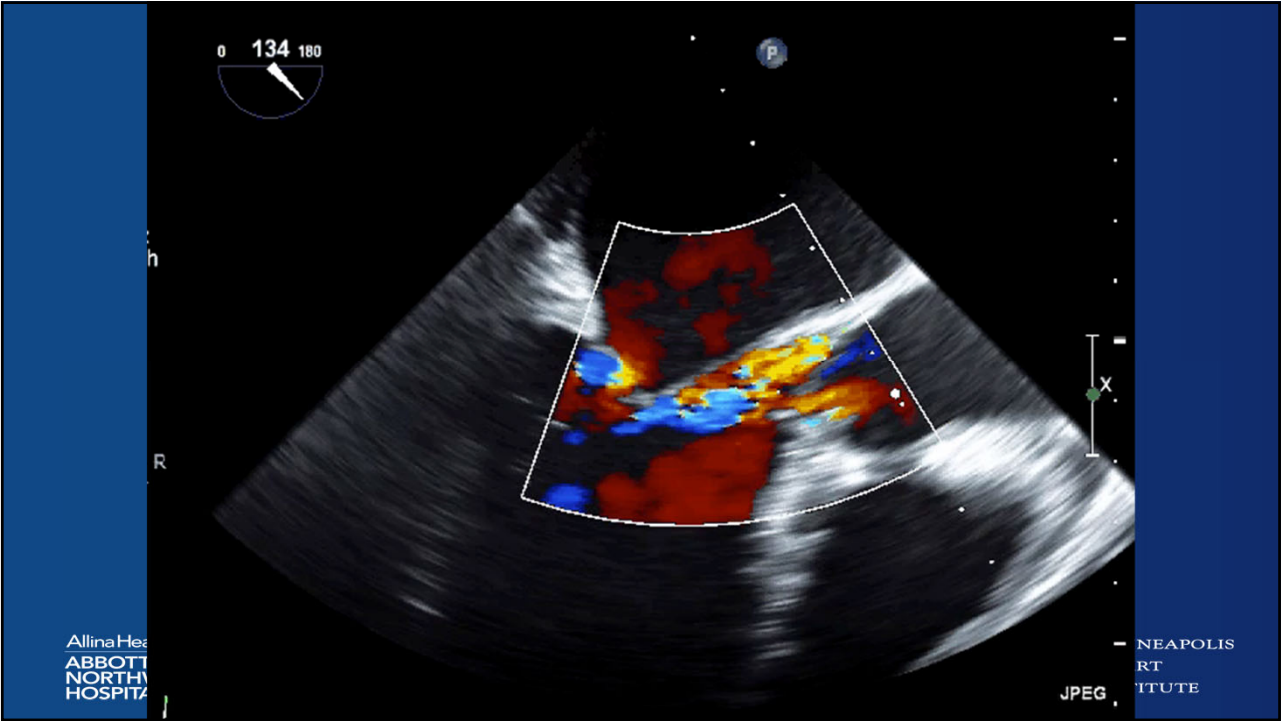
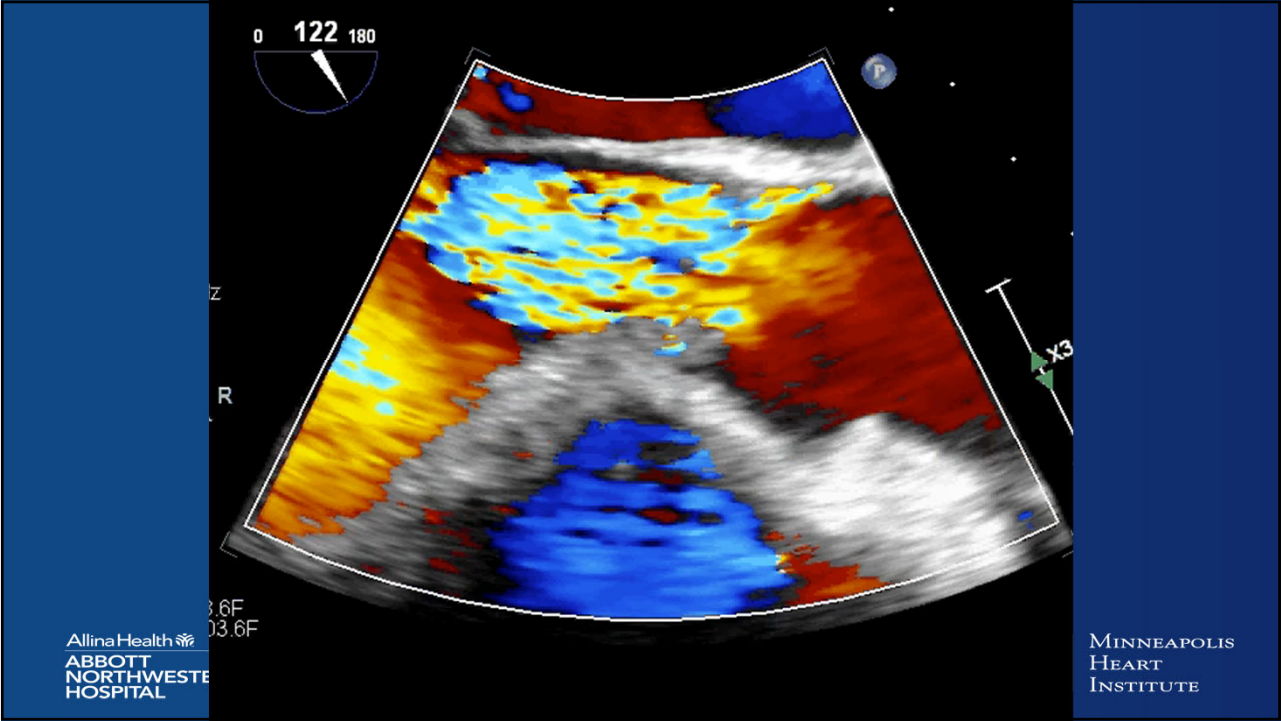
- Echo: -severe AI and dilated ascending aorta
- LVEF: 60-65%
- Hemodynamically “stable”

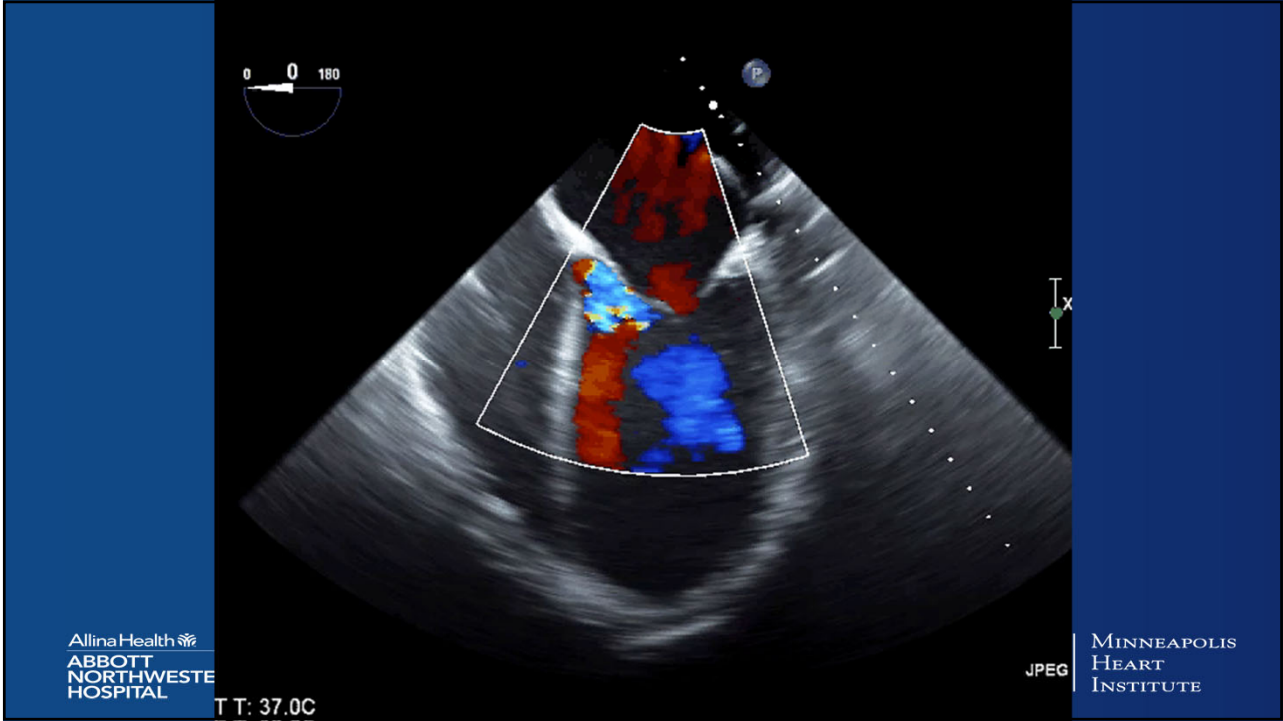
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# Interdisciplinary Decision

- Emergent cesarean section, followed by aortic root surgery

## Interdisciplinary Decision

- Awake percutaneous access:
    - right CFV
    - left CFA
- ▶ US guidance, micro-puncture

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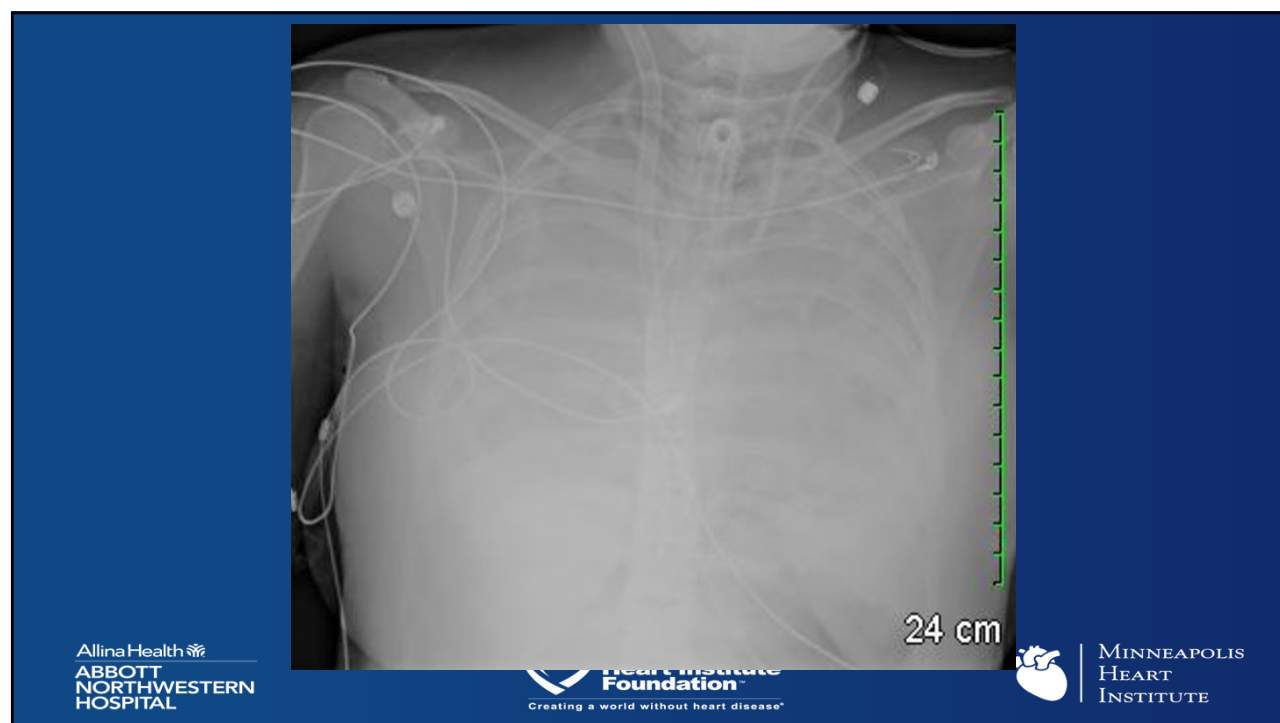
## Interdisciplinary Decision

- Emergency: no temporary MCS options in case of hemodynamic decompensation- severe AI- “relative” contraindication to ECMO

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## Cesarean Section

- C-Section, primary
- Type of Uterine Incision: Low Transverse; Single layer closure
- Additional Procedures: None
- Abdomen packed to close following cardiac surgery completion

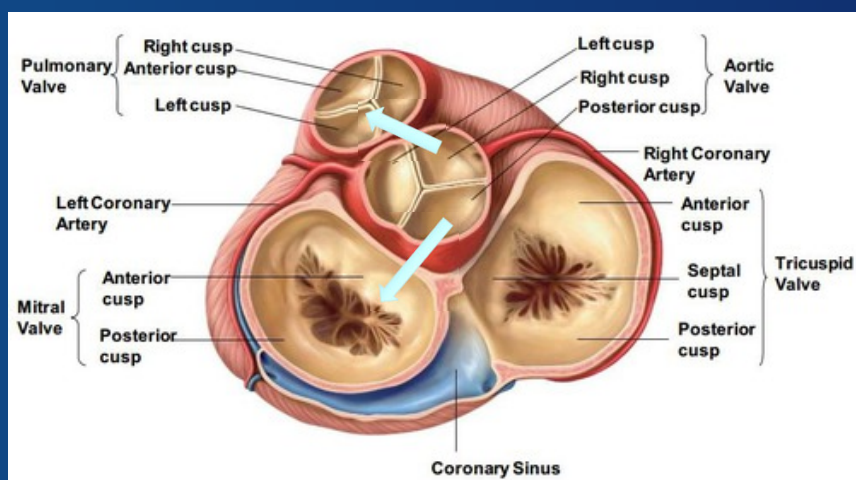
## Cardiac Procedure

1. Destroyed aortic valve cusps with vegetations all over the leaflets.
2. Aortic root abscesses, one extending from right coronary sinus towards the main PA, second root abscess extending almost through-and-through non-coronary sinus over the roof of the left atrium.
3. Moderate/ severe mitral regurgitation with restricted motion of the posterior mitral leaflet.

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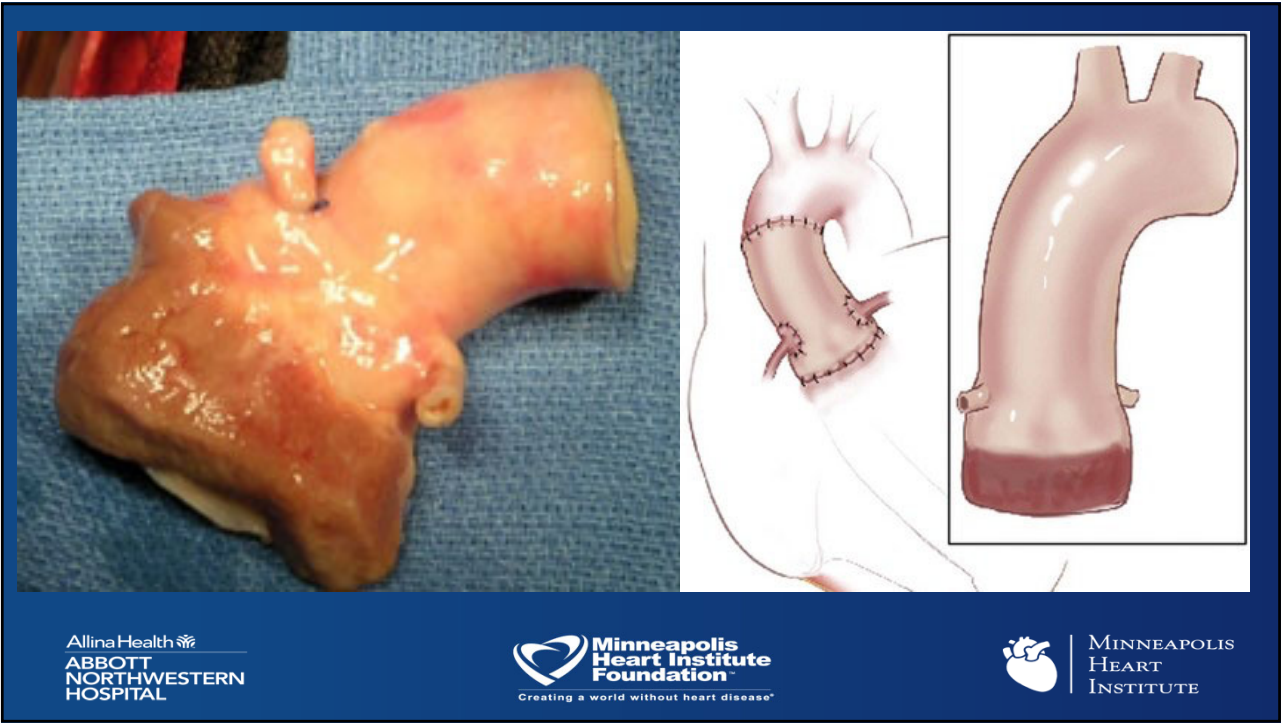
## Cardiac Procedure

- Goal of surgical repair in acute bacterial endocarditis: complete surgical debridement of any infected and devitalized tissue
- Biological repair preferred

## Cardiac Procedure

1. Mitral valve repair with 30 mm Memo 4D ring
2. Aortic root replacement with 21 mm cryopreserved aortic homograft
3. Coronary re-implantation...  
...”The left coronary button (was) kept relatively big for future reoperation”...





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# Who Should Care for IE Patients?

## 1. Who should care for and operate on patients with IE?

Patients with suspected IE should ideally be cared for at centers with access to a complete team, including cardiology, infectious disease, cardiac surgery, and other services needed to handle IE complications	I	B	4,5,7,89
Surgeons operating on patients with IE should be well-trained, experienced valve surgeons who are well versed in the different reconstruction techniques needed by patients with advanced disease	I	C	4,5,31,89

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# Prosthesis Choice

## 5. Native aortic valve IE

For patients with native aortic valve IE and infection limited to the valve cusps, repair may occasionally be possible. Choice of replacement valve—mechanical or tissue prosthesis—should be based on usual criteria

For invasive and destructive native aortic valve IE requiring root reconstruction and replacement, using an allograft may be beneficial, but a prosthetic biroot or prosthetic valved conduit with a mechanical or bioprosthetic valve are acceptable alternatives, with choice guided by surgeon training and experience

I	B	4-6,43,83,197-201
Ila	B	6,8,44,81,82,199,200, 204-208

## Are homografts superior to conventional prosthetic valves in the setting of infective endocarditis involving the aortic valve?

Joon Bum Kim, MD, PhD,<sup>a,b</sup> Julius I. Ejiofor, MD,<sup>c</sup> Maroun Yammine, MD,<sup>c</sup> Janice M. Camuso, RN,<sup>a</sup> Conor W. Walsh, BA,<sup>d</sup> Masahiko Ando, MD, PhD,<sup>a</sup> Serguei I. Melnitchouk, MD,<sup>a</sup> James D. Rawn, MD,<sup>c</sup> Marzia Leacche, MD,<sup>c</sup> Thomas E. MacGillivray, MD,<sup>a</sup> Lawrence H. Cohn, MD,<sup>c</sup> John G. Byrne, MD,<sup>c</sup> and Thoralf M. Sundt, MD<sup>a</sup>

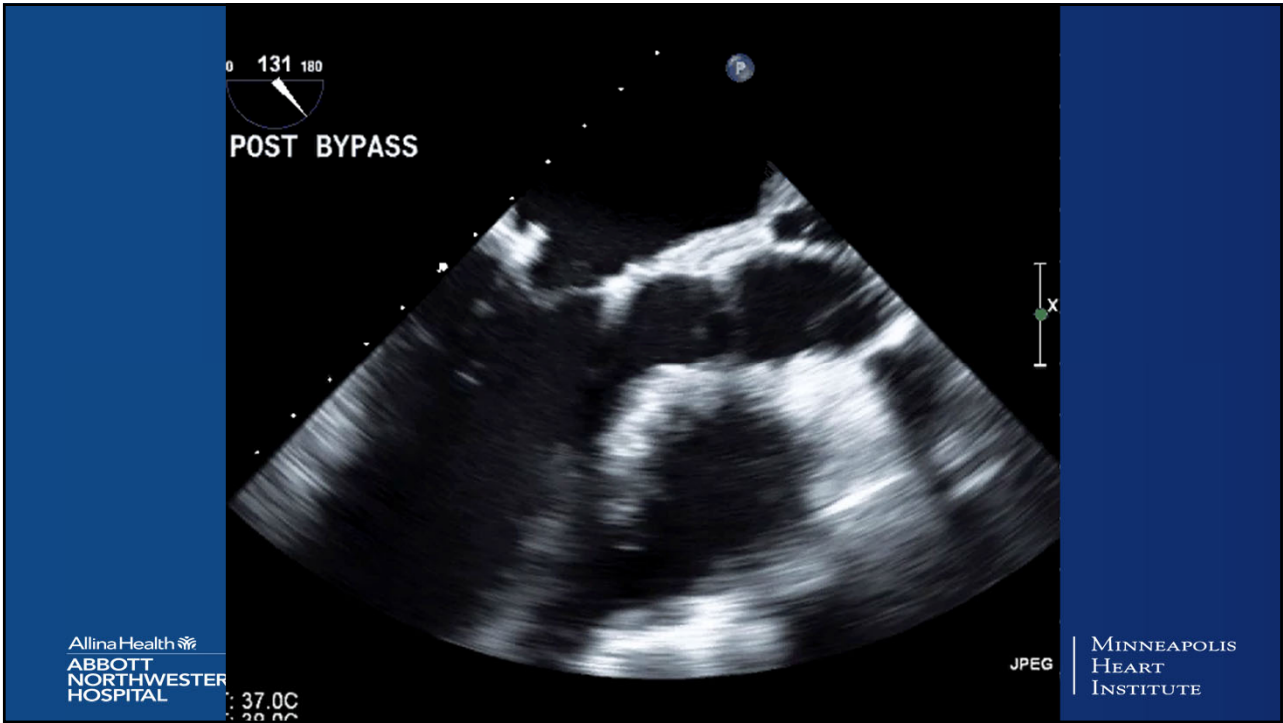
**Methods:** From the prospective databases of 2 tertiary academic centers, we identified 304 consecutive adult patients (age  $\geq 17$  years) who underwent surgery for active IE involving the aortic valve (AV), in the period 2002 to 2014. Short- and long-term outcomes were evaluated using propensity scores and inverse-probability weighting to adjust for selection bias.

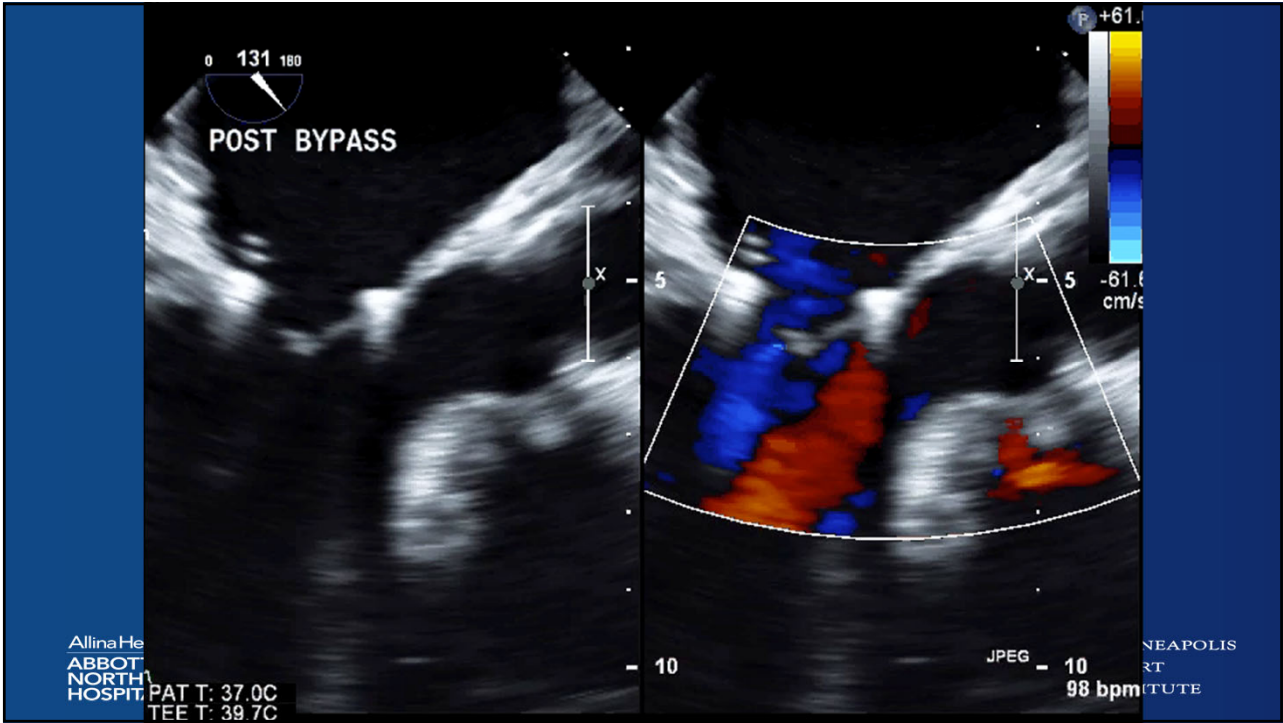
**Conclusions:** No significant benefit to use of homografts was demonstrable with regard to resistance to reinfection in the setting of IE. The choice among prosthetic options should be based on technical and patient-specific factors. Lack of availability of homografts should not impede appropriate surgical intervention. (J Thorac Cardiovasc Surg 2016;151:1239-48)

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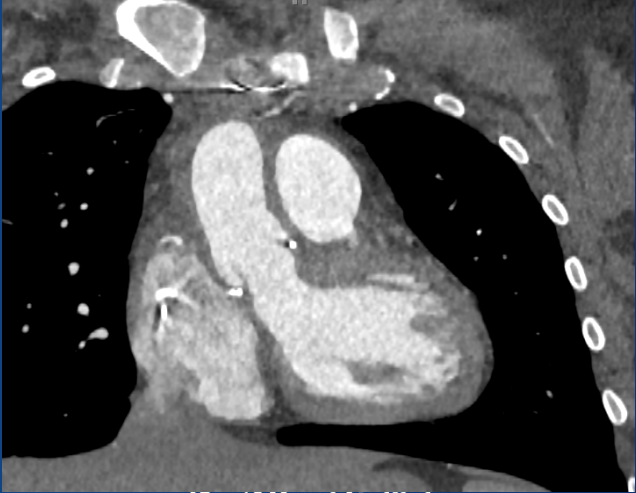
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# Cardiac Procedure


- No AI on the homograft
- Mean gradient through mitral valve- 4 mm Hg
- Mean gradient through aortic valve- 7 mm Hg



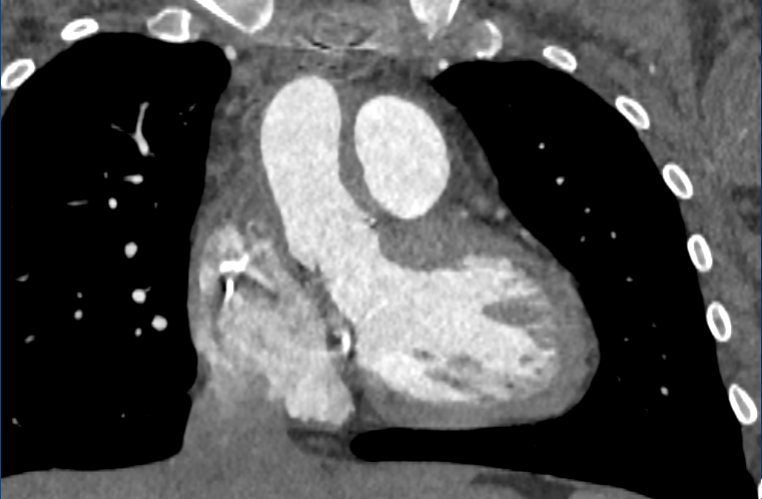
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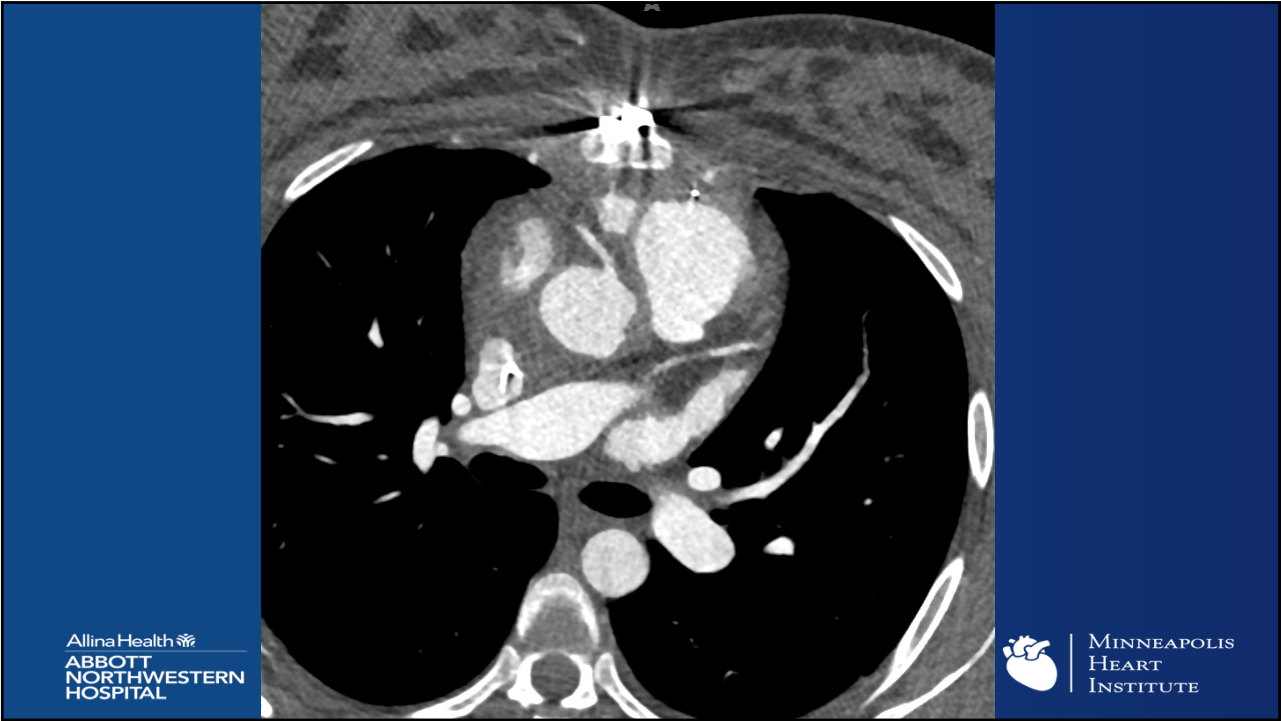
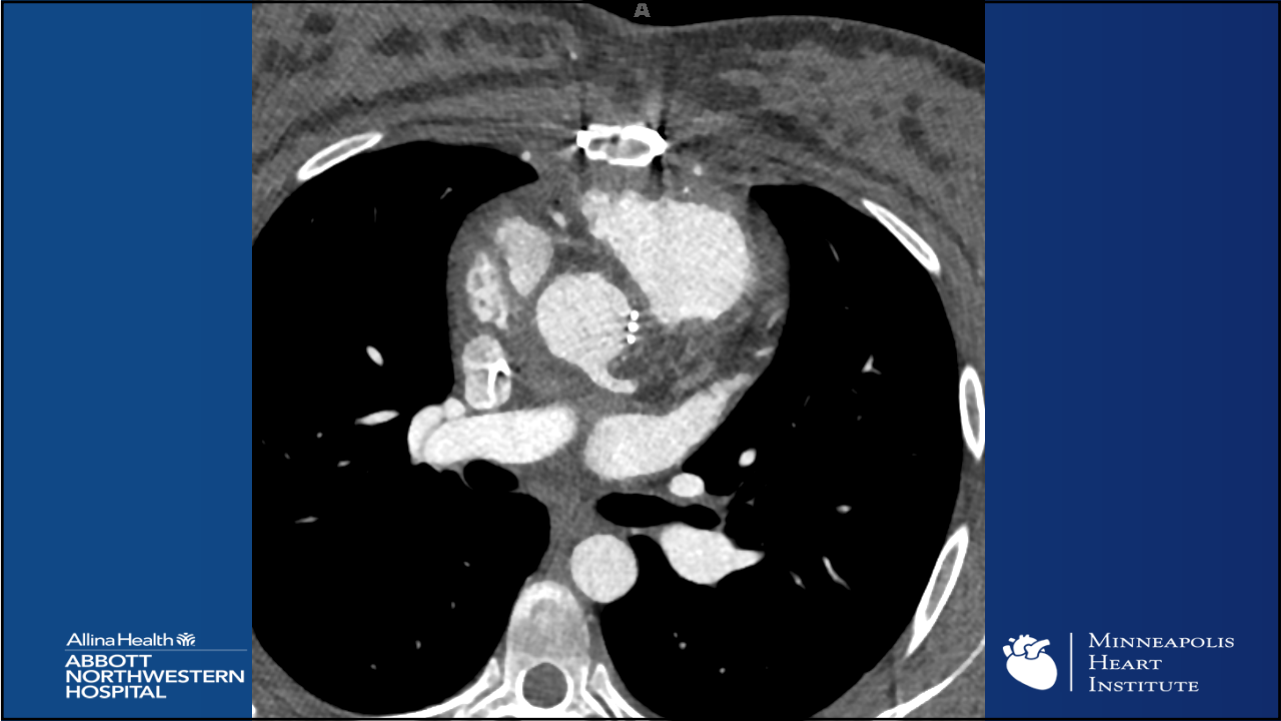
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## Future

- Follow up echoes
- Reoperation for homograft degeneration with a mechanical Bentall





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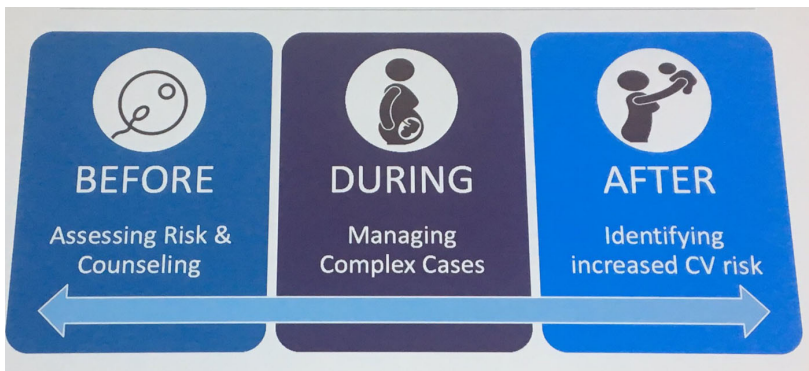
# Grand Rounds

## Retu Saxena, MD

January 6, 2020




## Pregnancy and Cardiovascular Disease




**BEFORE**  
Assessing Risk & Counseling

**DURING**  
Managing Complex Cases

**AFTER**  
Identifying increased CV risk



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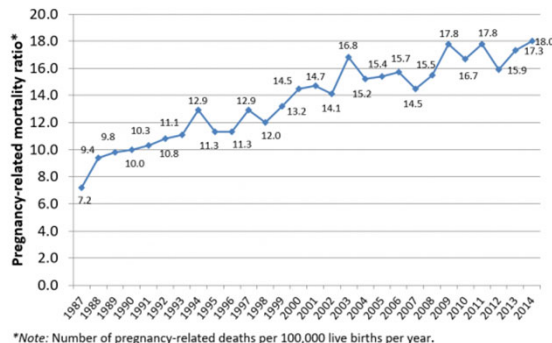


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## Pregnancy and Mortality

Trends in pregnancy-related mortality in the United States: 1987–2014



Maternal mortality rate was 26.4 per 100 000 live births in 2015.

All developed countries did better:  
4.4/100000 Sweden,  
9.2 in the United Kingdom  
7.3 in Canada.

According to international groups, mortality rates dropped by an estimated 44% worldwide from 1990 to 2015—a decline of 48% for industrialized countries.

Based on US statistics, pregnancy-related deaths rose by about 27% from 2000 to 2014.

For every maternal death, there are 84 women who suffer from a severe complication

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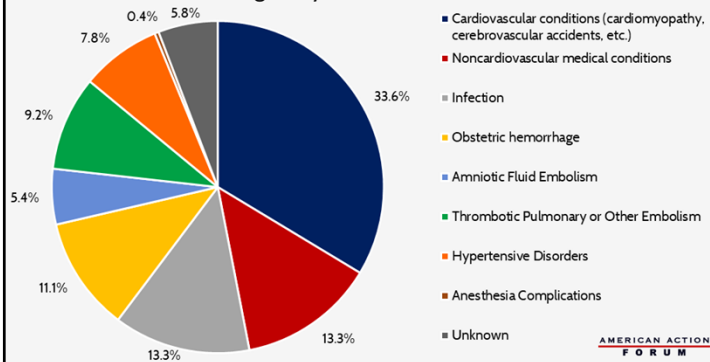


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## Maternal Mortality

Cause of Pregnancy-Related Deaths, 2007–2016



♥ the most common causes of pregnancy-related deaths were cardiovascular conditions:

- ♥ congenital heart disease,
- ♥ ischemic heart disease
- ♥ cardiac valvular disease
- ♥ hypertensive heart disease,
- ♥ congestive heart failure

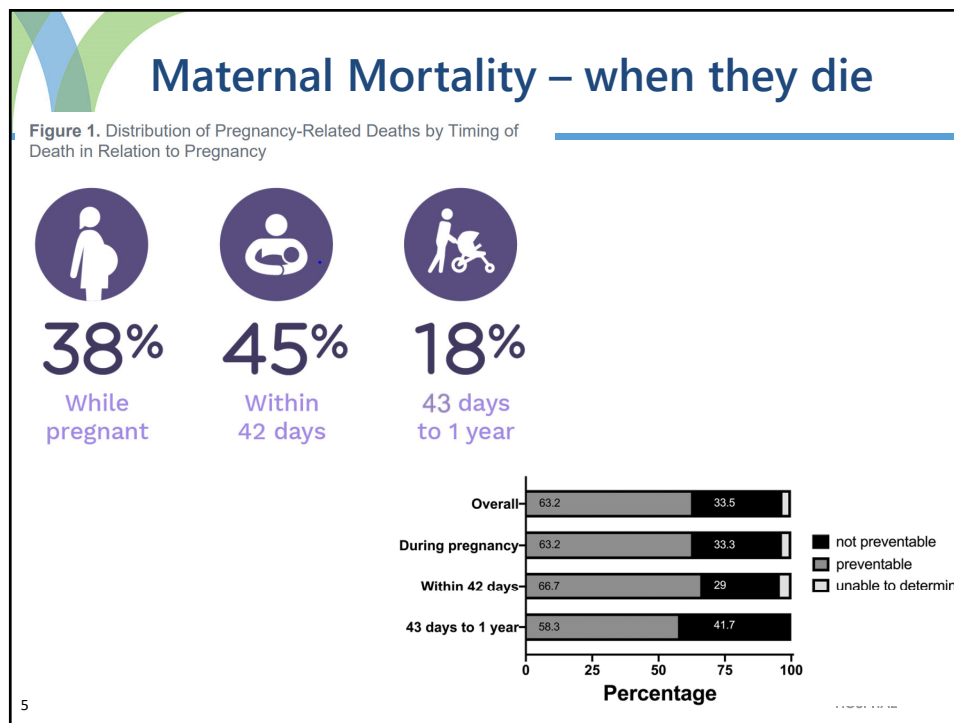
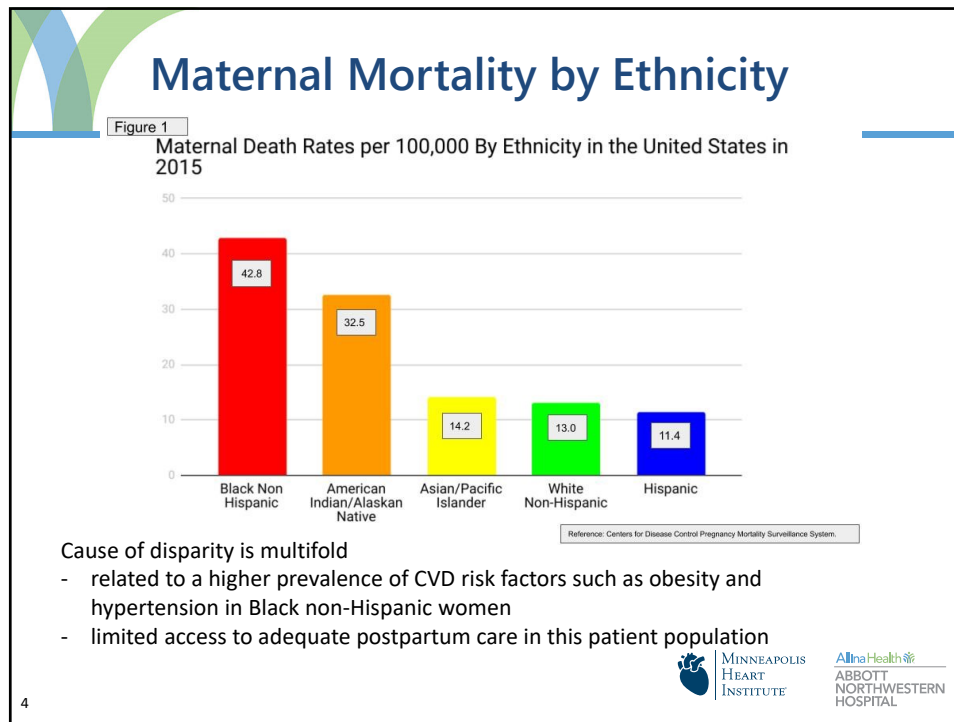
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## Role for Cardiology

- important to recognize these patients when they present to us for the first time for care
- in the antepartum period it is vital for us to be able to **differentiate pathologic cardiovascular signs and symptoms from the physiologic cardiovascular changes related to pregnancy**
- important that if these women present to us in the antepartum or postpartum period that they have an adequate assessment of their cardiovascular risk

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## PrePartum

- Women with known heart disease should see a cardiologist prior to pregnancy and receive pre-pregnancy counseling
- Pre pregnancy risk factors
  - Chronic hypertension
  - Dyslipidemia
  - BMI > 30 (even > 25)
- PrePregnancy **BMI, SBP, DBP, HDL (low), Triglycerides (HIGH)** account for 40% of the difference in rates of postpartum CV risk factors in those who developed a hypertensive disorder of pregnancy

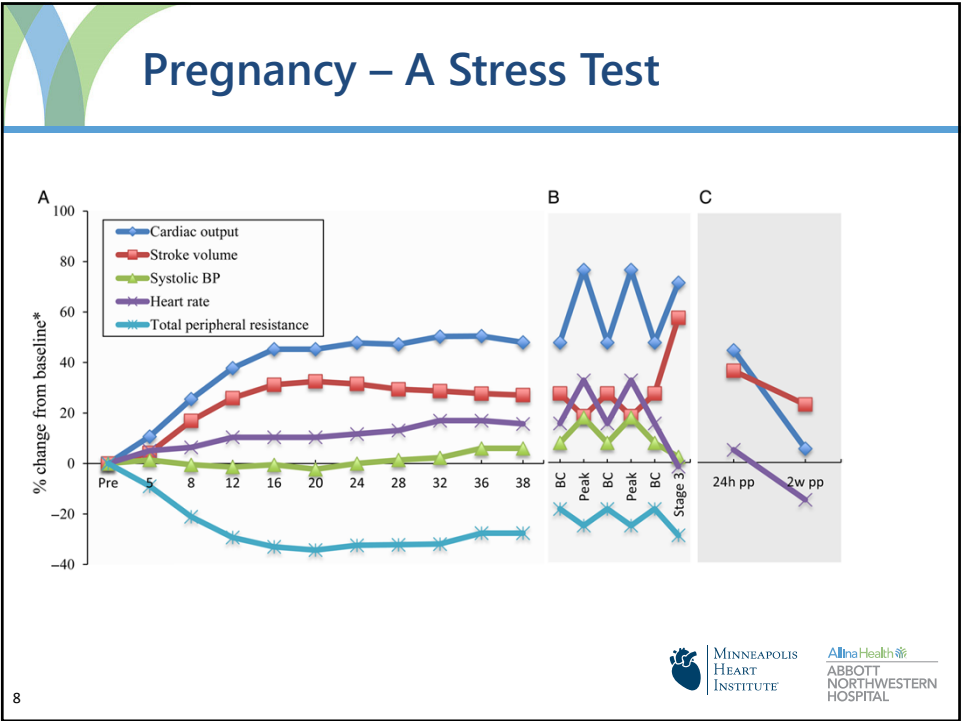
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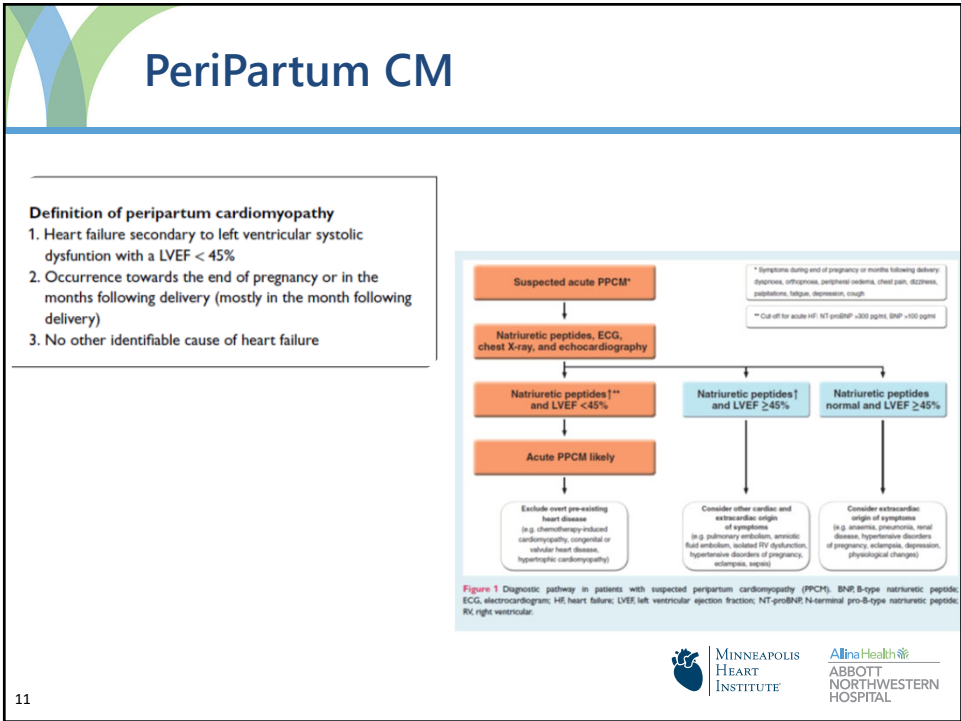
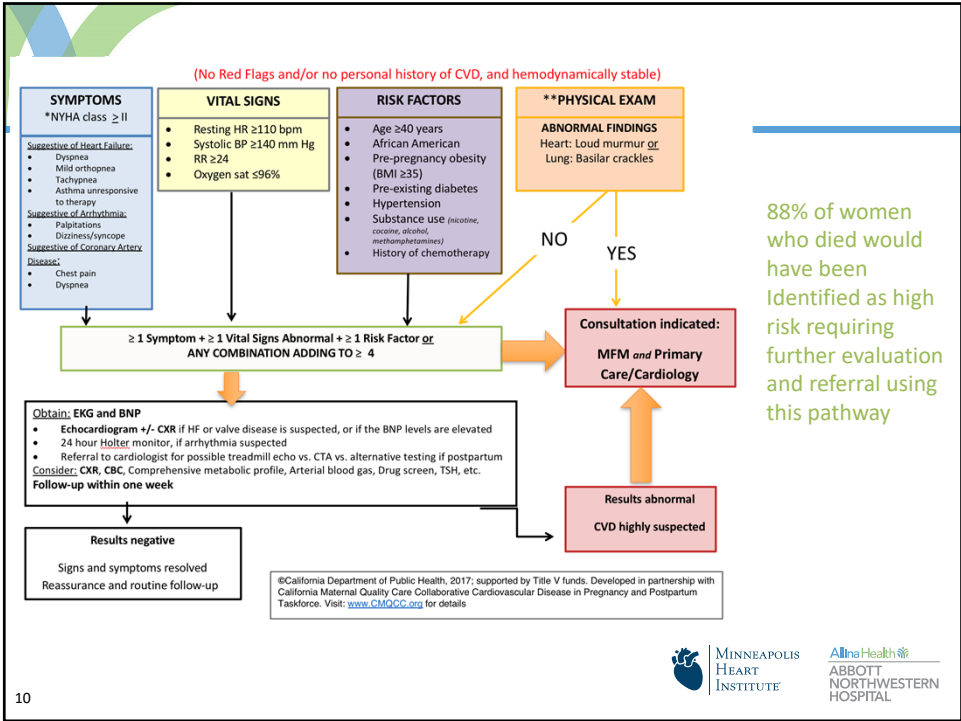
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	ROUTINE CARE	CAUTION*†	STOP†‡	Symptoms During Pregnancy
	Reassurance	Nonemergent Evaluation	Prompt Evaluation Pregnancy Heart Team	
History of CVD	None	None	Yes	ACOG PRACTICE BULLETIN Number 122 September 2019 Pregnancy and Heart Disease
Self-reported 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	ACOG PRACTICE BULLETIN Number 122 September 2019 Pregnancy and Heart Disease
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	ACOG PRACTICE BULLETIN Number 122 September 2019 Pregnancy and Heart Disease
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	ACOG PRACTICE BULLETIN Number 122 September 2019 Pregnancy and Heart Disease
Edema	Mild	Moderate	Marked	

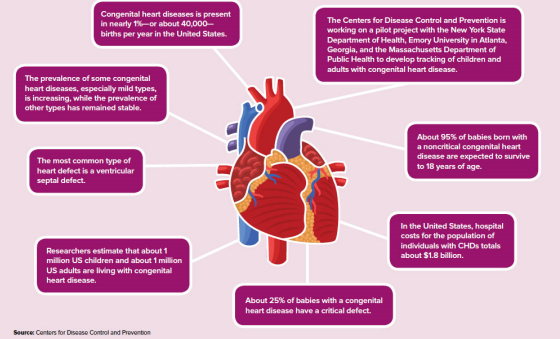
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## Congenital Heart Disease

### Facts & Figures

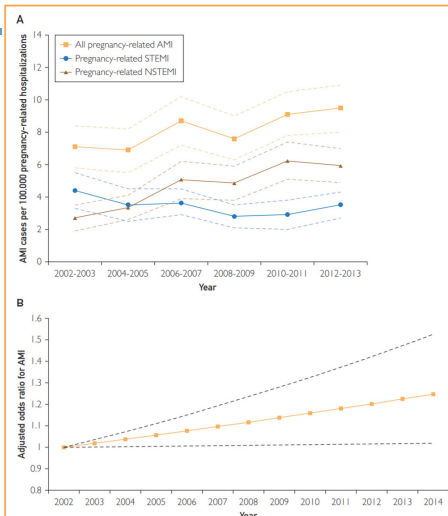


- ♥ Significant Increase Risk In Pregnancy
- ♥ Most women Can Be Managed with multidisciplinary care
- ♥ < 1% of women get recommended PRECONCEPTION care
- ♥ 23% of women get no pregnancy care at all

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## PAMI- Pregnancy associated MI



**FIGURE 2.** A, Trends in the frequency of AMI complicating pregnancy and the puerperium over time,  $P < .001$  for trend. B, Odds ratios for AMI associated with pregnancy over time after adjustment for age and race. Adjusted odds ratios are calculated using 2002 as the reference time period. Bars represent 95% CIs. AMI = acute myocardial infarction; NSTEMI = non-ST-segment elevation myocardial infarction; STEMI = ST-segment elevation myocardial infarction.

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## Pami

**Table 1. Potential mechanisms of pregnancy-associated myocardial infarction**

Etiology	Potential contributing factors
Coronary artery dissection	<ul style="list-style-type: none"> <li>Pregnancy-associated vascular remodeling</li> <li>Vessel wall shear stress from increased plasma volume and cardiac output during pregnancy</li> <li>Underlying genetic or acquired vasculopathy</li> <li>Iatrogenic (e.g., catheter trauma during angiography)</li> </ul>
Atherosclerosis	<ul style="list-style-type: none"> <li>Rising prevalence of cardiovascular risk factors (e.g., hypertension, hyperlipidemia, diabetes, and obesity) among reproductive-aged women</li> </ul>
Coronary thrombosis	<ul style="list-style-type: none"> <li>Hypercoagulable state of pregnancy</li> <li>Inherited thrombophilia</li> <li>Right-to-left shunt with paradoxical embolism</li> <li>May-Thurner anatomy</li> </ul>
Vasospasm	<ul style="list-style-type: none"> <li>Enhanced vasoreactivity to angiotensin II</li> <li>Endothelial dysfunction</li> <li>Exposure to ergot alkaloids (for prevention of postpartum hemorrhage)</li> </ul>
Takotsubo cardiomyopathy	<ul style="list-style-type: none"> <li>Pain, Anxiety, Tocolytic Agents</li> </ul>

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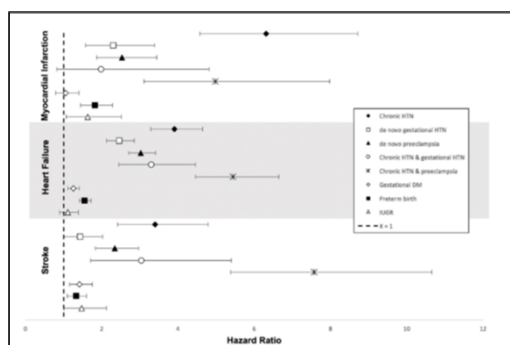
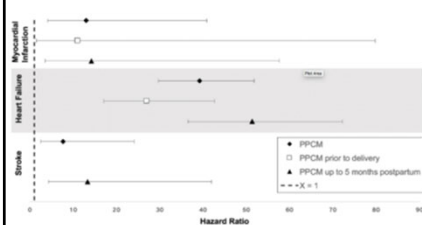


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## Post partum

### APO and CV outcomes

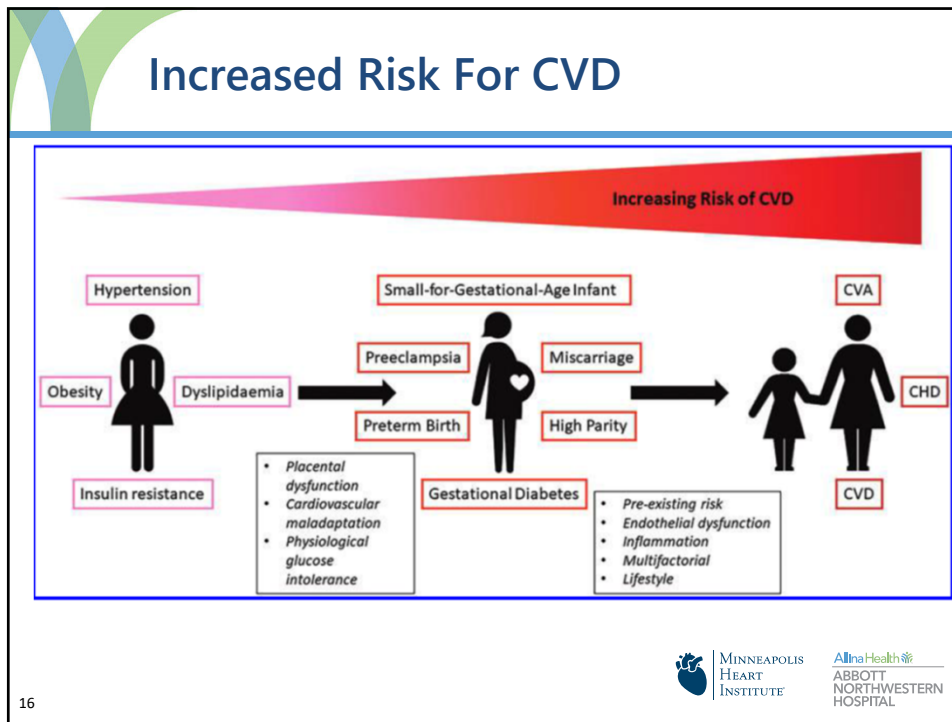


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## Maternal Pregnancy Risk Classification Systems

- ♥ Modified WHO classification: CHD and maternal risk
- ♥ Carpreg : cardiac disease in pregnancy – all cardiac disease
  - ♥ Now carpreg II – published 2018
- ♥ Zahara : CHD specific, also includes fetal outcomes
  
- ♥ ROPAC: Registry of pregnancy and cardiac disease
- ♥ Eventually Hope Registry Data

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## mWHO Pregnancy Classification

- WHO I: no increase in mortality, no/small increase in morbidity
- WHO II: small increased risk of mortality, moderate morbidity
- WHO II-III: moderate risk of mortality and morbidity
- WHO III: Significantly increased maternal mortality or severe morbidity
  - Expert counseling required.
  - intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth, and the puerperium
- WHO IV: Pregnancy Contraindicated. Extremely high risk of mortality/severe morbidity
  - Expert counseling required
  - termination may be considered. If pregnancy continues, care should follow class III recommendations.

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WHO Pregnancy Classification	mWHO I	mWHO II	mWHO II-III	mWHO III	mWHO IV
	Small or mild – pulmonary stenosis – patent 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	Unoperated atrial or ventricular septal defect Repaired to Fallot Most arrhythmia (supraventricular arrhythmia) Turner syndrome without aortic dilatation	Mild left ventricular impairment (EF >45%) Hypertrophic	Moderate left ventricular impairment (EF 30–45%) Previous peripartum cardiac impairment No residual left ventricular impairment Left ventricle with decreased ejection fraction Patient is well conditioned Ischemic heart disease Aortic stenosis Mitral aortic stenosis Aortic dilatation Marfan syndrome HTAD; bicuspid aortic valve Turner syndrome ASI >25 mm/m <sup>2</sup> tetralogy of Fallot >50 mm)	Pulmonary arterial hypertension Severe systemic ventricular dysfunction (EF <30% or NYHA class III–IV) Previous peripartum cardiomyopathy with any residual left ventricular impairment Severe mitral stenosis Severe symptomatic aortic stenosis Systemic right ventricle with moderate or severely decreased ventricular function Severe aortic dilatation (>45 mm in Marfan syndrome or other HTAD, >50 mm in bicuspid aortic valve, Turner syndrome ASI >25 mm/m <sup>2</sup> , tetralogy of Fallot >50 mm) Vascular Ehlers–Danlos Severe (re)coarctation Fontan with any complication

Overall risks

Risk category I = event rate of 9.9%

Risk category II = event rate of 7.7%

Risk category I–III = event rate of 17.7%

Risk category III = event rate of 28.9%

Risk category IV = event rate of 50.3%

Risks for advanced countries

Risk category I = event rate of 4.8%

Risk category II = event rate of 5.6%

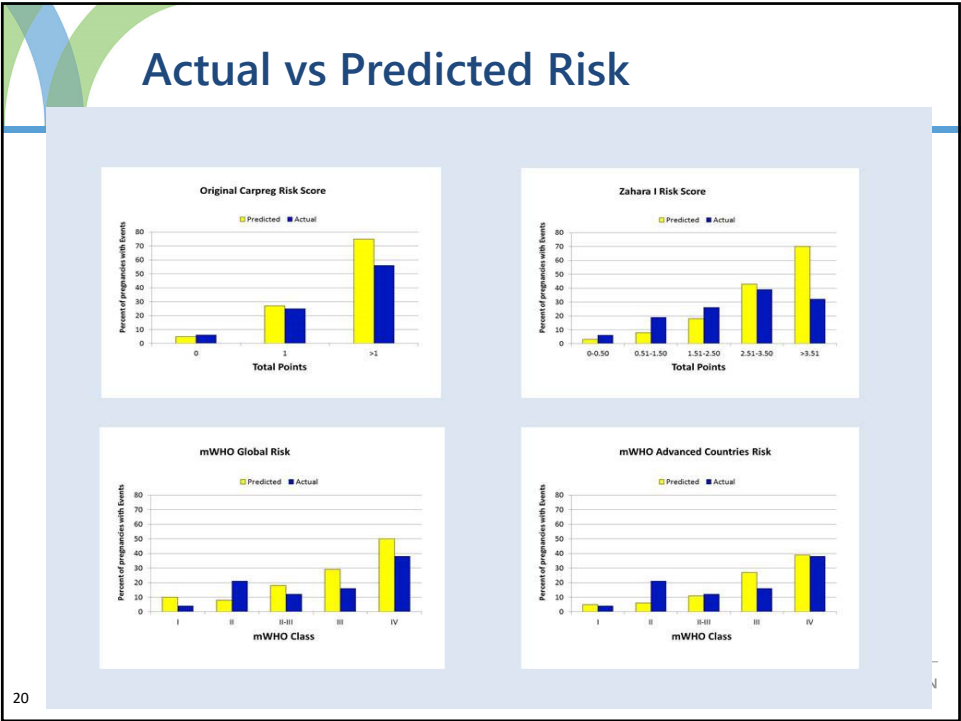
Risk category I–III = event rate of 11.4%

Risk category III = event rate of 27.0%

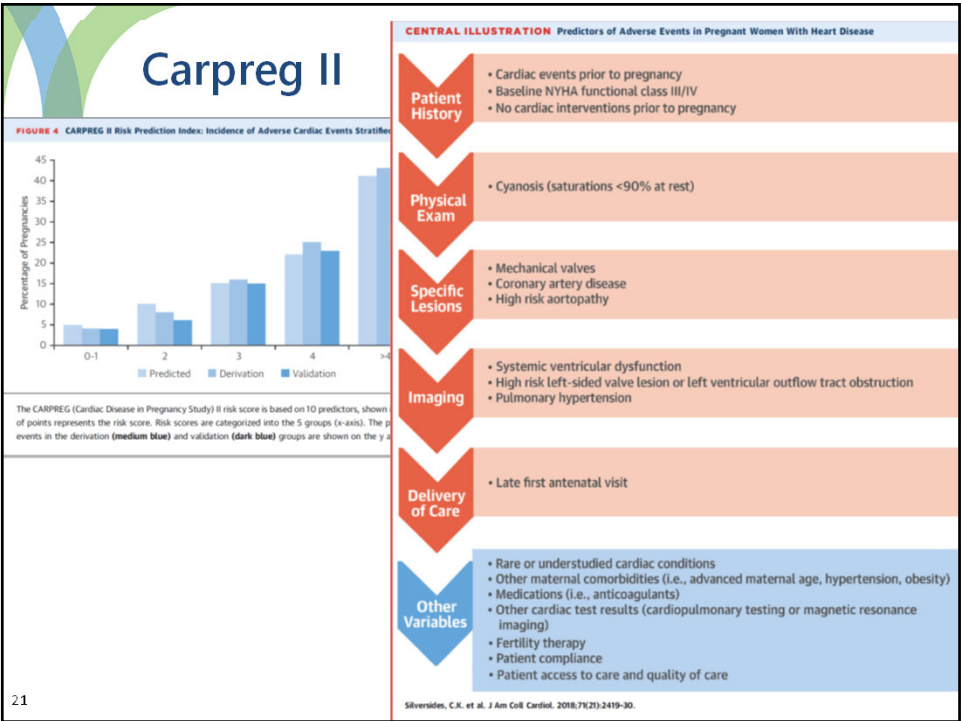
Risk category IV = event rate of 39.3%

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## What we can do -

- Recognition and Management of CVD risk factors prepartum
- Assessment preconception for women with heart disease to determine if pregnancy is contraindicated and if not contraindicated to determine suitable follow up of these women in the ante and postpartum period.
- Appropriate delivery plan should be outlined by a multidisciplinary team
- Adequate cardiovascular follow up during the pregnancy and postpartum period for women with an intermediate or high CVD risk.
- Early postpartum cardiovascular assessment in the first 1-2 weeks post delivery for women with high CVD risk features such as women with placental abruption and stillbirth in addition to hypertensive disorders of pregnancy, gestational diabetes mellitus, and preterm births.
- Women with high CVD risk should have long term cardiovascular care not only in the first year postpartum but these women will likely require long term cardiovascular follow up even beyond a year to improve their lifelong cardiovascular risk.
- Raising awareness of the elevated maternal morbidity and mortality risk predominantly due to CVD is important to improve their outcomes.

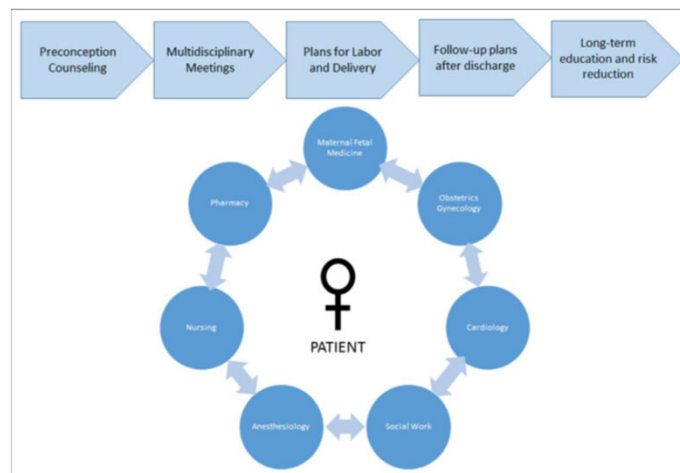
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## CardioPregnancy Team



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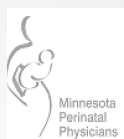
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HOSPITAL

WILLIAM E. WAGNER, MD  
MATERNAL FETAL/CRITICAL CARE MEDICINE  
CO-DIRECTOR OB-ICU PROGRAM/ANW HOSPITAL  
ABBOTT NORTHWESTERN HOSPITAL CRITICAL CARE SERVICES  
DEPARTMENT OF CRITICAL CARE MEDICINE/ABBOTT  
NORTHWESTERN HOSPITAL  
CO-LEAD CARDIOPREGNANCY PROGRAM (MHI/CHILDREN'S  
HOSPITAL/MPP)  
MINNESOTA PERINATAL PHYSICIANS


# Cardiopregnancy Program




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HEART  
INSTITUTE




Minnesota  
Perinatal  
Physicians




Allina Health



Children's  
Hospitals and Clinics  
of Minnesota



The Children's  
Heart Clinic



# Cardiopregnancy Program:

- Children's Heart Clinic
- Abbott Northwestern Hospital
- Minnesota Perinatal Physicians
- Midwest Adult Congenital Cardiac Center (MACC) + Adult Congenital Heart Disease (ACHD) Clinic
- Department of Critical Care Medicine ANW Hospital



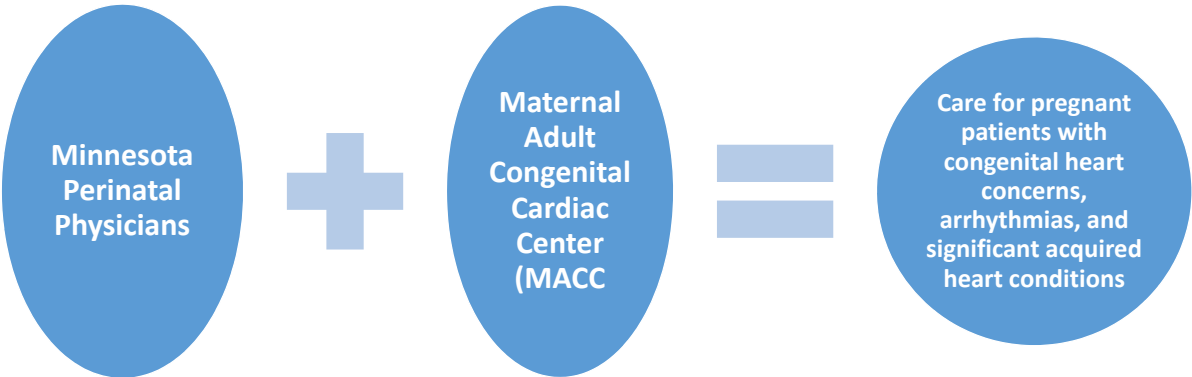
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The Children's  
Heart Clinic



## Cardiopregnancy Program – A Unique Partnership

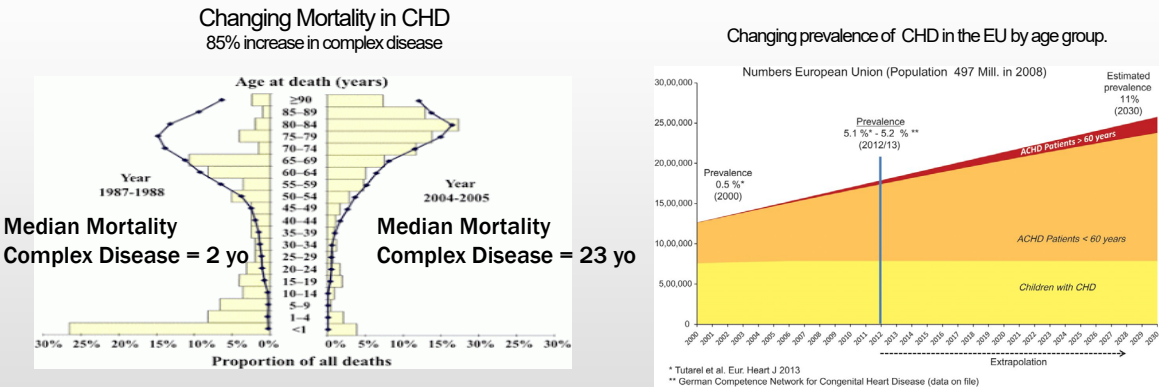


MACC is a partnership of Children’s Minnesota, Children’s Heart Clinic (CHC), and Minneapolis Heart Institute (MHI)

## Why Cardiopregnancy Program?

- To provide a multidisciplinary model of outpatient care to then ensure a seamless inpatient quality of care to those patients whom previously would not have had the opportunity to consider pregnancy given their underlying palliative and/or corrected congenital heart disease (CHD) or acquired heart disease.

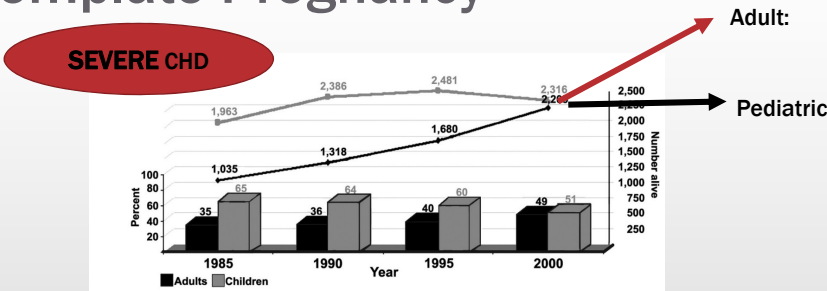
# CHD is a Medical Success Story



- Almost 50% of ACHD admissions are in patients > 60 yo
- Greatest survival trend is in complex CHD
- 2003-2012:
  - 85% increase in valve procedures
  - 57% increase in EP procedures

Marelli, et al. Progress in CV diseases 53 (2011) 239-244  
Marelli et al. Circulation. 2007;115:163-172  
Helmut Baumgartner Eur Heart J 2014;35:683-685  
Khairy et al. JACC 2010; 56:1149-1157  
Agarwal et al. J Am Heart Assoc 2016;5:e002330

# More Women with CHD are able to contemplate Pregnancy



- Greatest survival trend is in severe/complex CHD
- There are now more adults than children with complex CHD
- Complex disease in adulthood increased 85% - 1985-2000  
complex=conduits, TGA (atrial or arterial switch), single V, PA, Truncus, any cyanotic lesion
- Median age of patient with complex disease 2000: 29 yo in

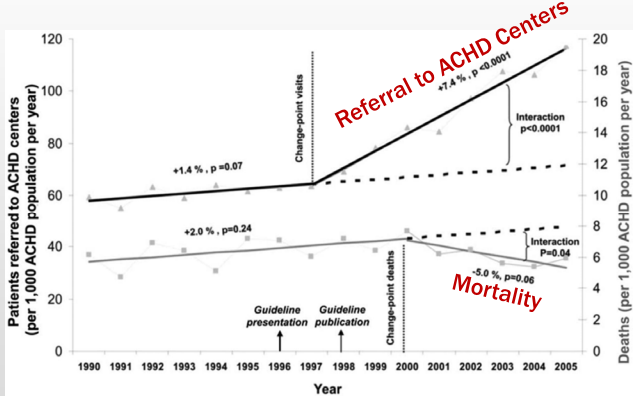


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Marelli, et al. From Numbers to Guidelines. Progress in CV diseases 53 (2011) 239-244  
Marelli et al. Circulation. 2007;115:163-172

# As a Result, Pregnancy and Reproductive Care is Essential to ACHD Programs

Reduced mortality but high morbidity  
Arrhythmia, heart failure, valve disease, pregnancy



## 2017 - 11 centers

ACHA ACHD PROGRAM CRITERIA  
Comprehensive Care Center

- A. ACHD Cardiologist
- B. ACHD Medical Program Director
- C. Advanced Practice Nurse/Physician Assistant
- D. Registered Nurse
- E. Cardiothoracic Surgery and Cardiothoracic Intensive Care Unit
- F. Heart Failure, Heart Transplant, Heart/Lung Transplantation
- G. Interventional Cardiac Catheterization
- H. Interventional Electrophysiology
- I. Inpatient Services
- J. Outpatient Services
- K. Transitional Services
- L. Patient-Centered Care
- M. Echocardiography
- N. Cardiac Magnetic Resonance Imaging
- O. Cardiac Computed Tomography
- P. Pulmonary Arterial Hypertension
- Q. Exercise Testing and Cardiac Rehabilitation
- R. Reproductive Services
- S. Psychology and Social Work



Darren Mylotte et al. Circulation. 2014;129:1804-1812

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## Cardiopregnancy Overview

- The program currently serves the continuum of patient care needs:
- Contraception planning care for cardiac patients who would benefit by a better understanding of risks and benefits of pregnancy and contraception options; GYN care is in conjunction with an identified Allina OBGYN group as possible
- Pre-pregnancy consultations with patients who are interested in becoming pregnant with a variety of heart conditions are conducted with the team approach. The patient is scheduled with MPP physicians and their appropriate cardiology partner (congenital, arrhythmia, or other). The team is working to incorporate cardiology services such as echoes into the clinic as needed.

## Cardiopregnancy Overview

- Pregnant patients receive outpatient care on either a consult or primary OB basis. The focused care team includes the appropriate cardiologist, MPP physicians, APRN teams and care coordinators.
- If the patient does not require the cardiopregnancy team following the consult and care plan development, follow-ups may be conducted in any MPP clinics using the care plan tab as a guide.
- If there is a change in the care plan or patient's condition, that communication will be sent back to the care coordinators for a care plan update and reassessment for future visits. For significant changes in patient status requiring a significant change in the plan of care, provider-to-provider communication will occur.

## Cardiopregnancy Overview

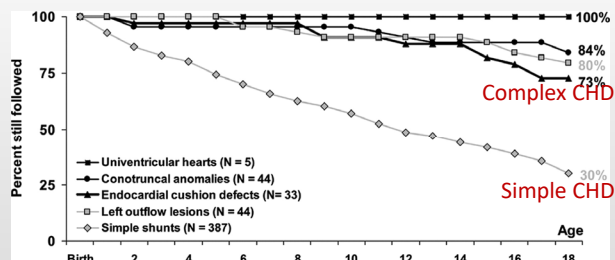
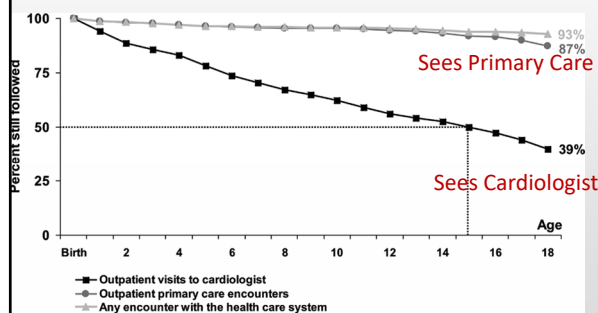
- Pregnant patients who need inpatient care at any point during the pregnancy may be admitted to TMBC – Minneapolis or MHI depending on the current condition and care plan.
  - If the patient has previously been seen in consult, they will be admitted to the appropriate unit according to the care plan that has been established. If they are admitted to the Heart Hospital, the cardiology team or the medicine hospitalist team may admit them. MPP will consult on the patients as needed. Obstetric assessments inform other care team needs such as obstetric nursing. In all cases, there is communication required with TMBC and cardiology teams about these patients.
  - If the Cardiopregnancy team has not previously seen the patient and the team learns about her through a transfer request, the patient will be admitted to TMBC–Minneapolis or MHI as appropriate and seen by the MPP providers with appropriate consultation with cardiology and the Cardiopregnancy team as needed.

# Monthly Cardiopregnancy Multidisciplinary Conference

- Meets 2<sup>nd</sup> Tuesday of each month
- Room ANW E1220: Call in Skype option
- Multidisciplinary round table discussion of all current Cardiopregnancy patients
- Establish consensus to Risk classification in pregnancy, review of imaging (Congenital echo/Cardiac MR/Catheter findings as indicated) and plan ongoing care and future delivery planning
- Entire Cardiopregnancy team attends each meeting
  - MFM including APRN team/ACHD-MACC/MHI imaging
  - Med-Peds Hospitalist
  - Intensivist/Cardiac Surgery/Cardiac anesthesia
  - Care Coordinators from each discipline and administrators

## The proportion of CHD patients in contact with the healthcare system by age and by CHD complexity

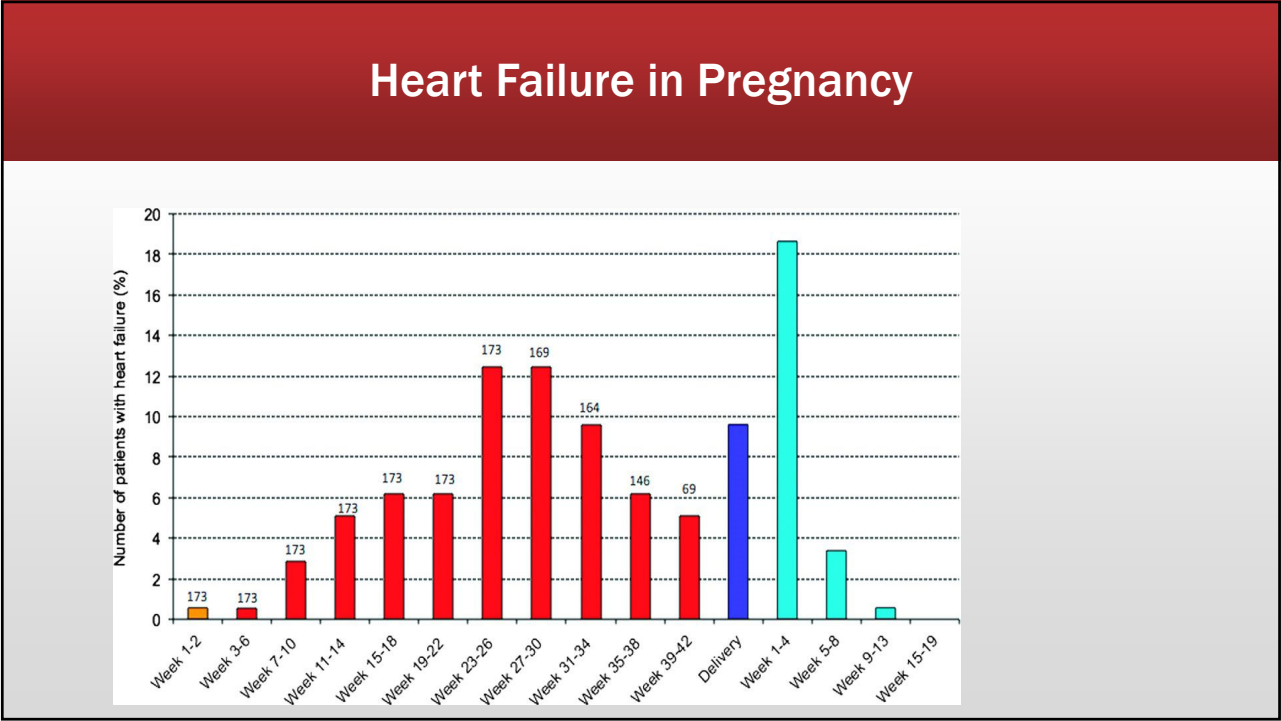
Many patients have not been counseled about contraception or pregnancy risk



Andrew S. Mackie et al. Circulation. 2009;120:302-309

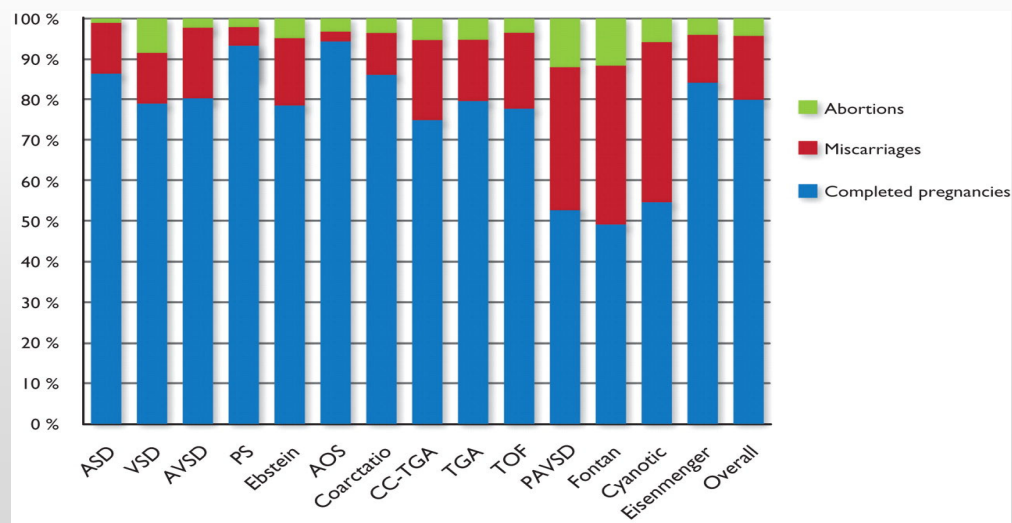
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- ### Risk Factors for Heart Failure (ROPAC data)
- *(heart failure in pregnant women with cardiac disease: data from the ROPAC) Heart 2014;100: 231–238.*
  - Heart Failure is the most common major complication during pregnancy (4.8% mortality vs 0.5%)
  - Median presentation 31 weeks gestation or peripartum
  - Baseline parameters associated with pregnancy CHD:
    - NYHA class 3 or above
    - Clinical signs of heart failure pre-pregnancy
    - WHO category 3 or above
    - Cardiomyopathy or PHN

**Completed Pregnancy by Underlying CHD (does not include SGA/prematurity/CHD in baby)**



**Maternal predictors of neonatal events in women with heart disease (Siu):**

- Baseline NYHA class II or cyanosis
- Maternal left heart obstruction
- Smoking during pregnancy
- Multiple gestation
- Use of oral anticoagulation during pregnancy
- Mechanical Valve prosthesis

## CHD Specific predictors of adverse neonatal and maternal outcomes (Khairy):

- (Maternal cardiac events 19.4%/neonatal adverse events 28% of completed pregnancies)
- Smoking history (OR 27)
- NYHA 2 or above (OR 5.4)
- History of heart failure: (OR 15)
- Decreased subpulmonary EF (OR 7.7)
- Decreased subpulmonary EF and/or severe PI (OR 10)
- Subaortic ventricular outflow tract gradient > 30 mmHg (OR of neonatal adverse event 10)

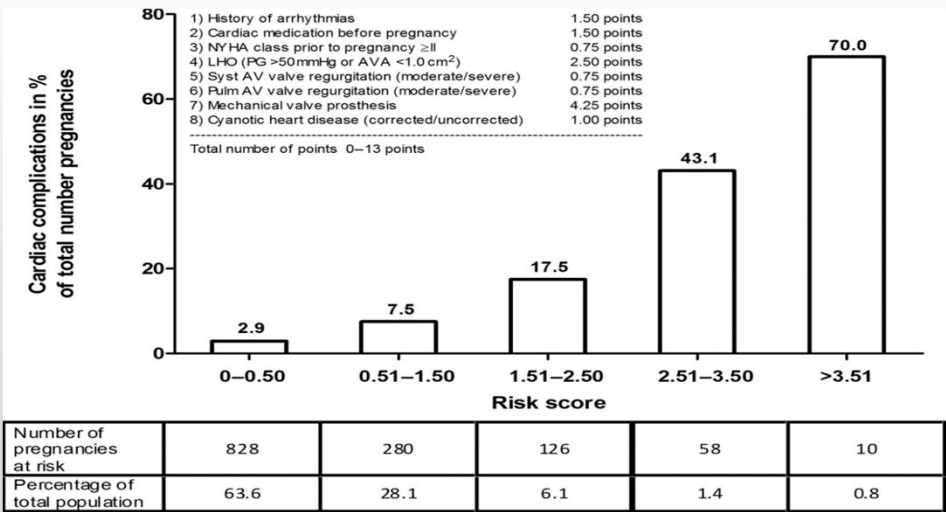
## ACHD AP RISK OF ADVERSE CARDIAC EVENTS

- **A** (NYHA I/no hemodynamic or anatomic sequelae/no arrhythmia/normal exercise capacity/renal/hepatic and pulmonary fxn)
- **B** (NYHA II/mild hemodynamic sequelae, mild valve disease or small shunt, arrhythmia not requiring treatment, abnormal objective cardiac limitation to exercise)
- **C** (NYHA III/significant valve disease or ventricular dysfunction, moderate aortic enlargement, venous or arterial stenosis, mild or moderate hypoxemia, significant shunt, arrhythmia controlled with treatment/PHN/end organ dysfunction responsive to therapy)
- **D** (NYHA IV/severe aortic enlargement, arrhythmia refractory to treatment, severe hypoxemia/cyanosis, severe PHN, refractory end organ dysfunction)

## CARPREG II SCORING

- **CARPREG II SCORING**
- 
- Prior cardiac event (heart failure, stroke, TIA) or arrhythmia = 3.0 points
- Baseline NYHA FC at least III/IV or cyanosis = 3.0
- Mechanical valve = 3.0
- High risk valve disease/left heart obstruction (mitral valve area < 2 cm<sup>2</sup>, aortic valve area < 1.5 cm<sup>2</sup>, or peak LVOT gradient > 30 mmHg) = 2.0
- Systemic ventricular dysfunction = 2.0
- High risk aortopathies = 2.0
- Pulmonary hypertension = 2.0
- Coronary artery disease = 2.0
- No prior cardiac intervention = 1.0
- Late pregnancy assessment = 1.0
- 
- **Risk of complications:**
  - points = 5% risk
- **2 points = 10% risk**
- **3 points = 15% risk**
- **4 points = 22% risk**
- **>4 = 41% risk**

## Zahara risk classification (specific for CHD)



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**William E. Wagner, MD  
Maternal Fetal/Critical Care Medicine  
Co-Director OB-ICU Program/ANW Hospital  
Abbott Northwestern Hospital Critical Care Services  
Department of Critical Care Medicine/Abbott Northwestern  
Hospital  
Co-lead Cardiopregnancy program (MHI/Children's Hospital/MPP)  
Minnesota Perinatal Physicians  
612-863-4502 office  
952-687-1709 Cell/text  
612-654-6270 pager  
612-863-1000 One Call**

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