

# CARDIOLOGY 2023

26<sup>th</sup> Annual Update on Pediatric and  
Congenital Cardiovascular Disease

## Learning as we went: Applying time-honored principles

Nancy Ghanayem, MD MS  
Professor of Pediatrics  
Chief, Pediatric Critical Care



AT THE FOREFRONT OF **KIDS' MEDICINE**  
**UChicago Medicine**  
**Comer Children's**

Chicagoland Children's Health Alliance



Nothing to disclose

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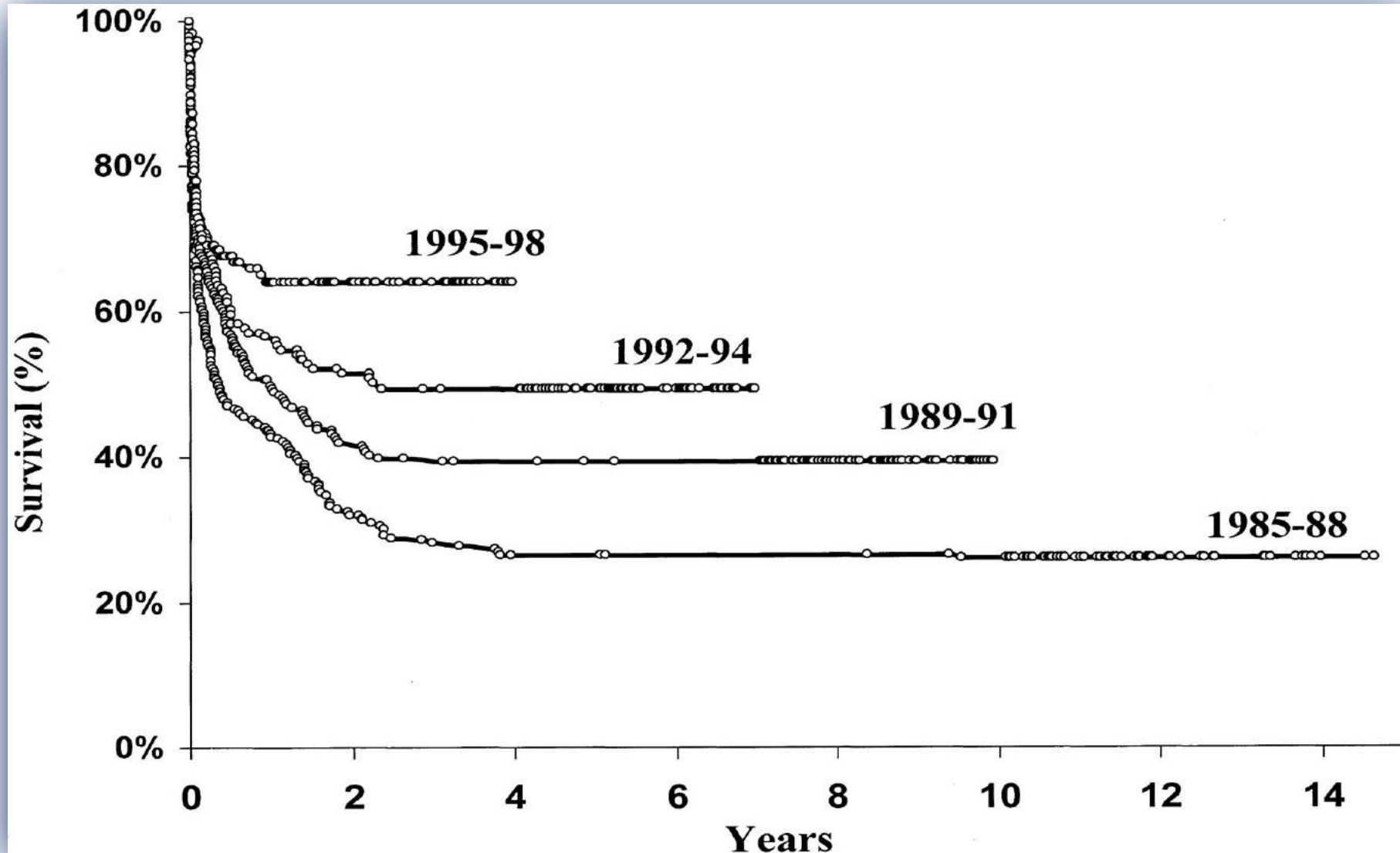
Jack Downes, MD

# John “Jack” Downes, MD



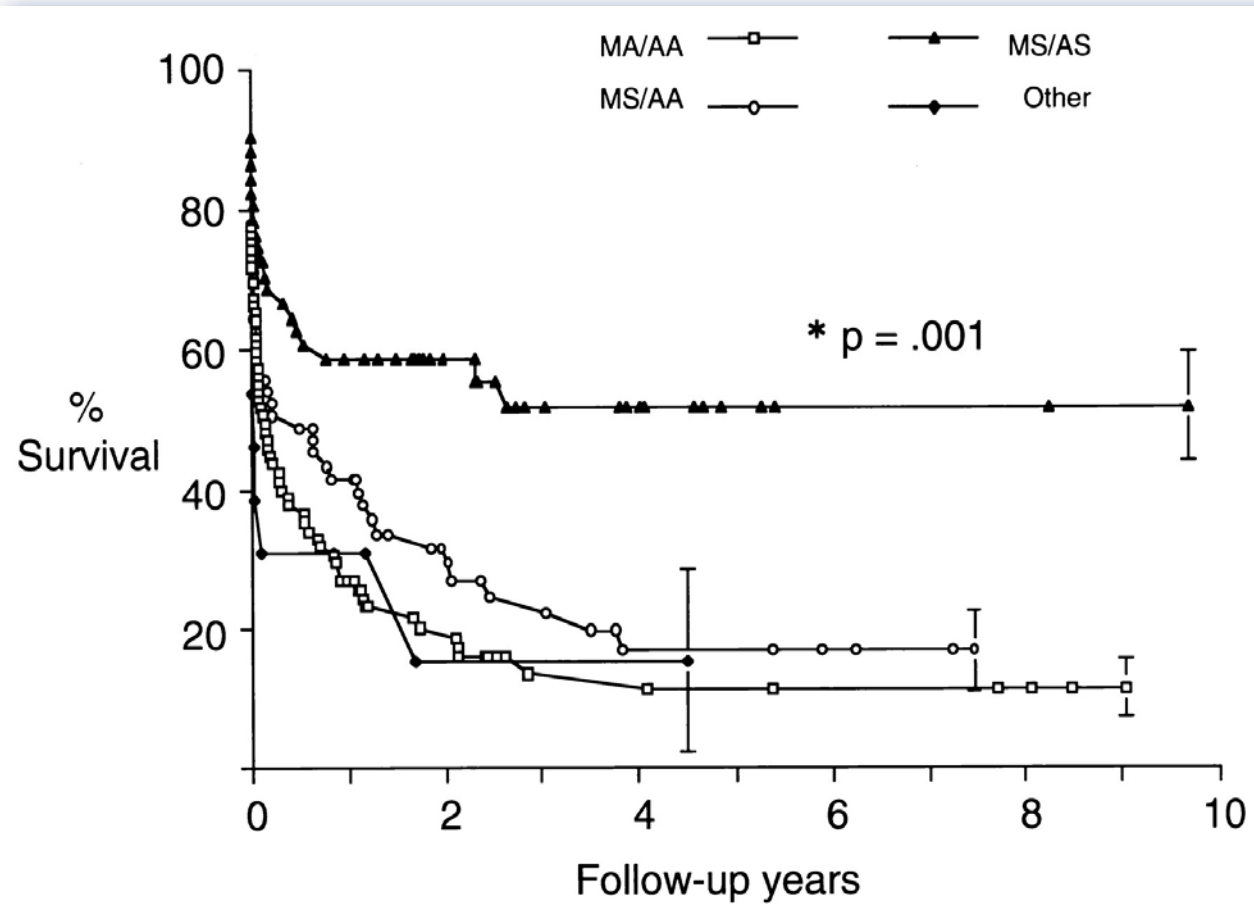
- Anesthesiologist-in-chief and Director of Anesthesiology and Critical Care Medicine (CHOP, 1972 - 1996)
- First PICU in USA (CHOP) – 1967
  - Developed a multidisciplinary care for seriously ill hospitalized children
  - Applied devices and data to expose physiology we could treat
- Pioneered a home care program for the care of disabled children in the 1970s

## Norwood Operation: 15-year experience , 840 pts



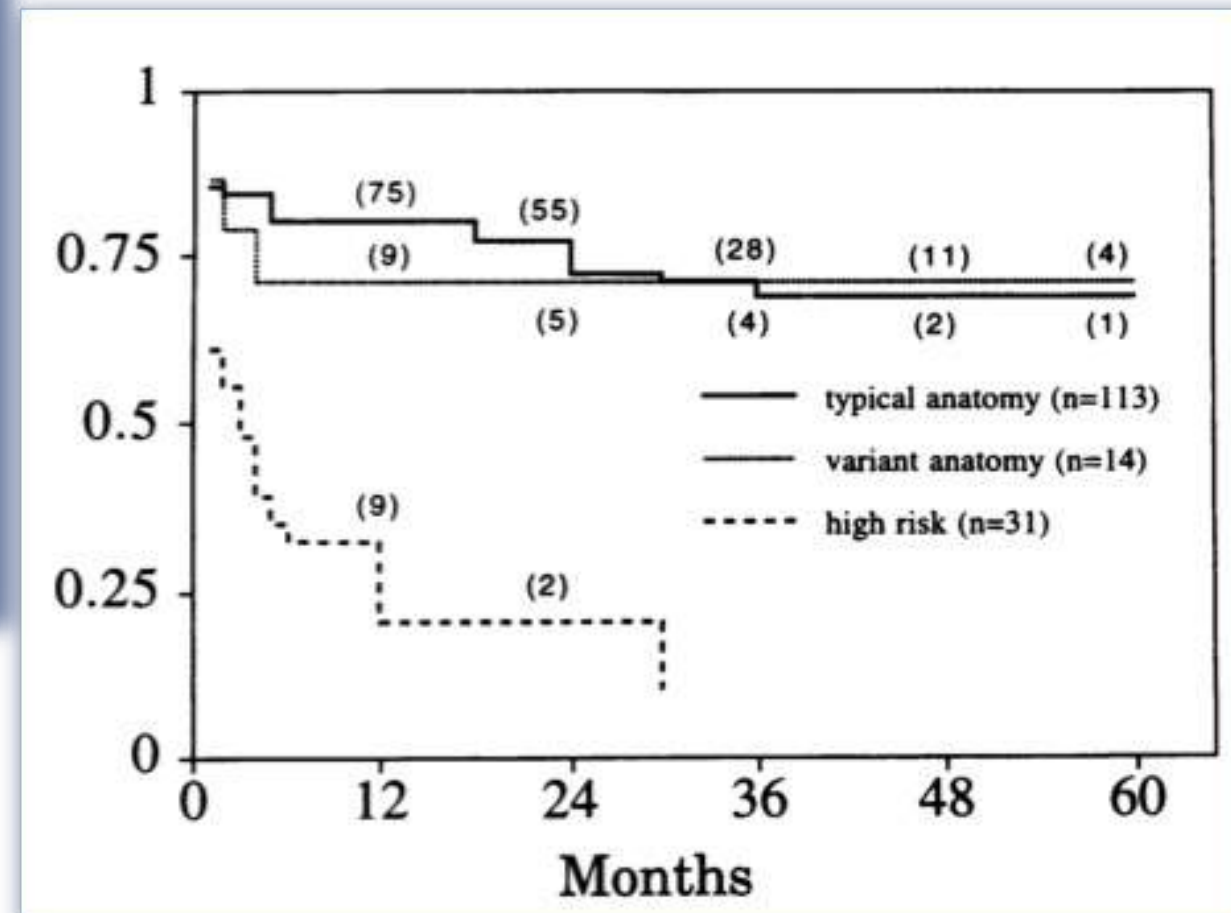


1983-1993, 210 pts



Forbes JM et al, Circulation 1995

1990-1995, 158 pts



Bove EL and Lloyd TR, Annals of Surgery 1996

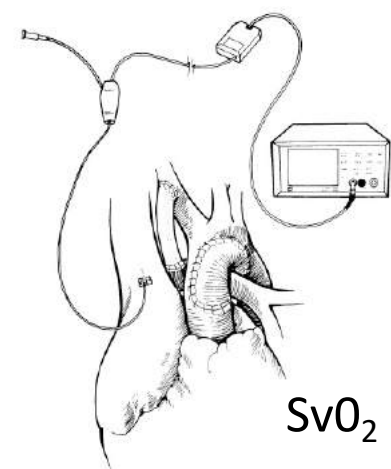
# Postoperative targets for HLHS - early experience

- Predominant focus on Qp:Qs as determined by pulse oximetry alone
  - Derived mostly from mathematical models and animal studies and assumed constant cardiac output
  - Control of PVR through medical gas, ventilator management (hypoxia and hypoventilation)

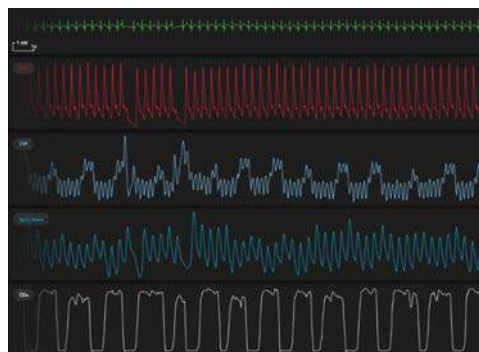
Targeted SpO<sub>2</sub> = balanced circulation & good oxygen delivery **only if**...

- right size systemic to pulmonary artery shunt
- optimal atrial level communication
- normal lung function
- fixed oxygen delivery (DO<sub>2</sub>) and consumption (VO<sub>2</sub>)

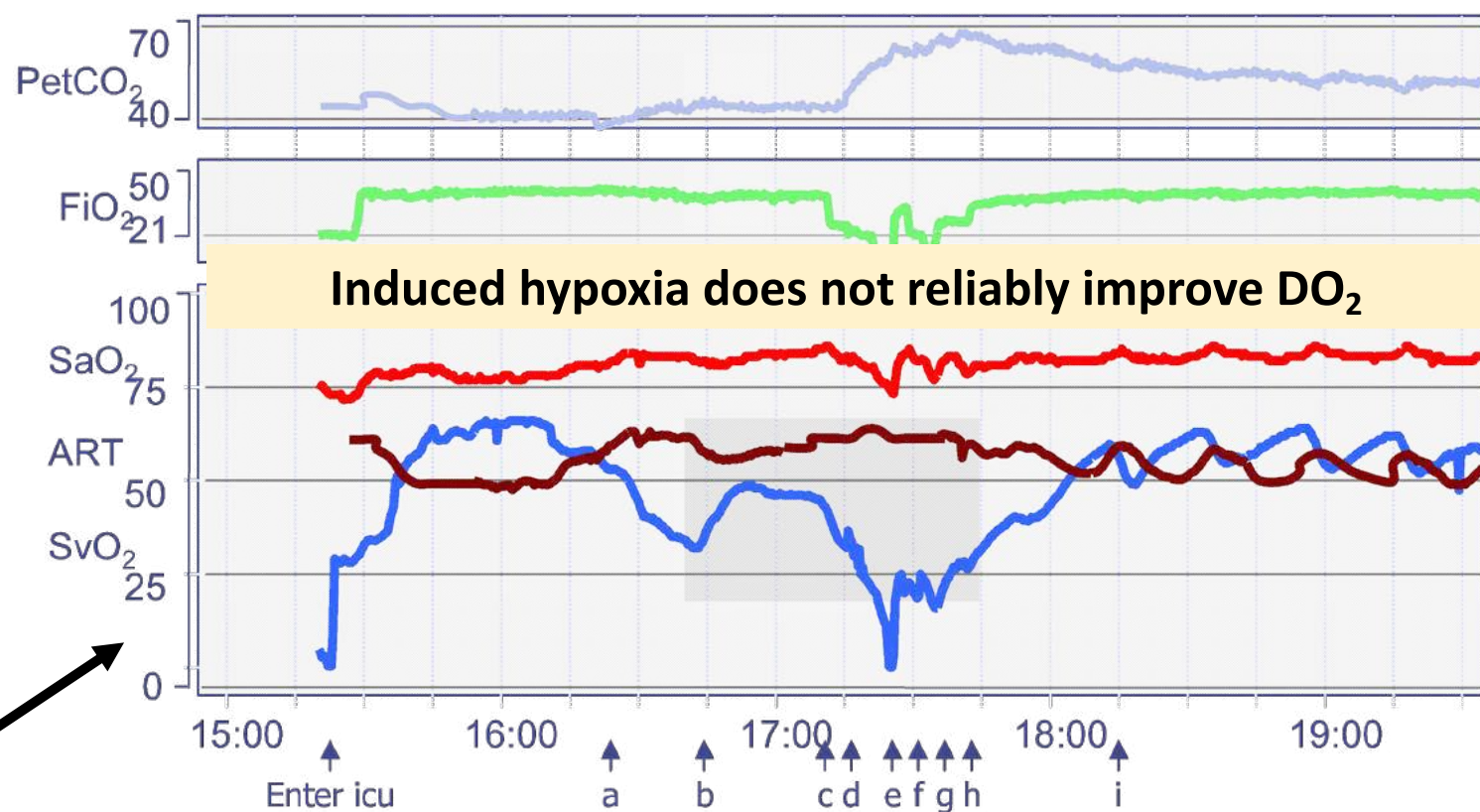
# The journey begins...



SvO<sub>2</sub>

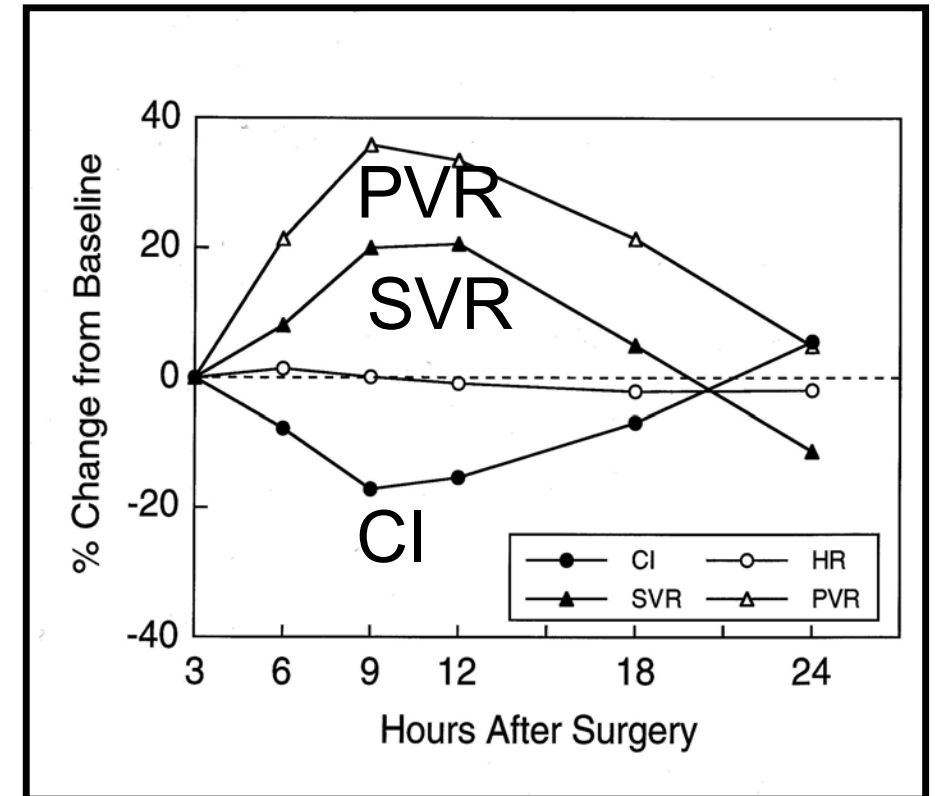
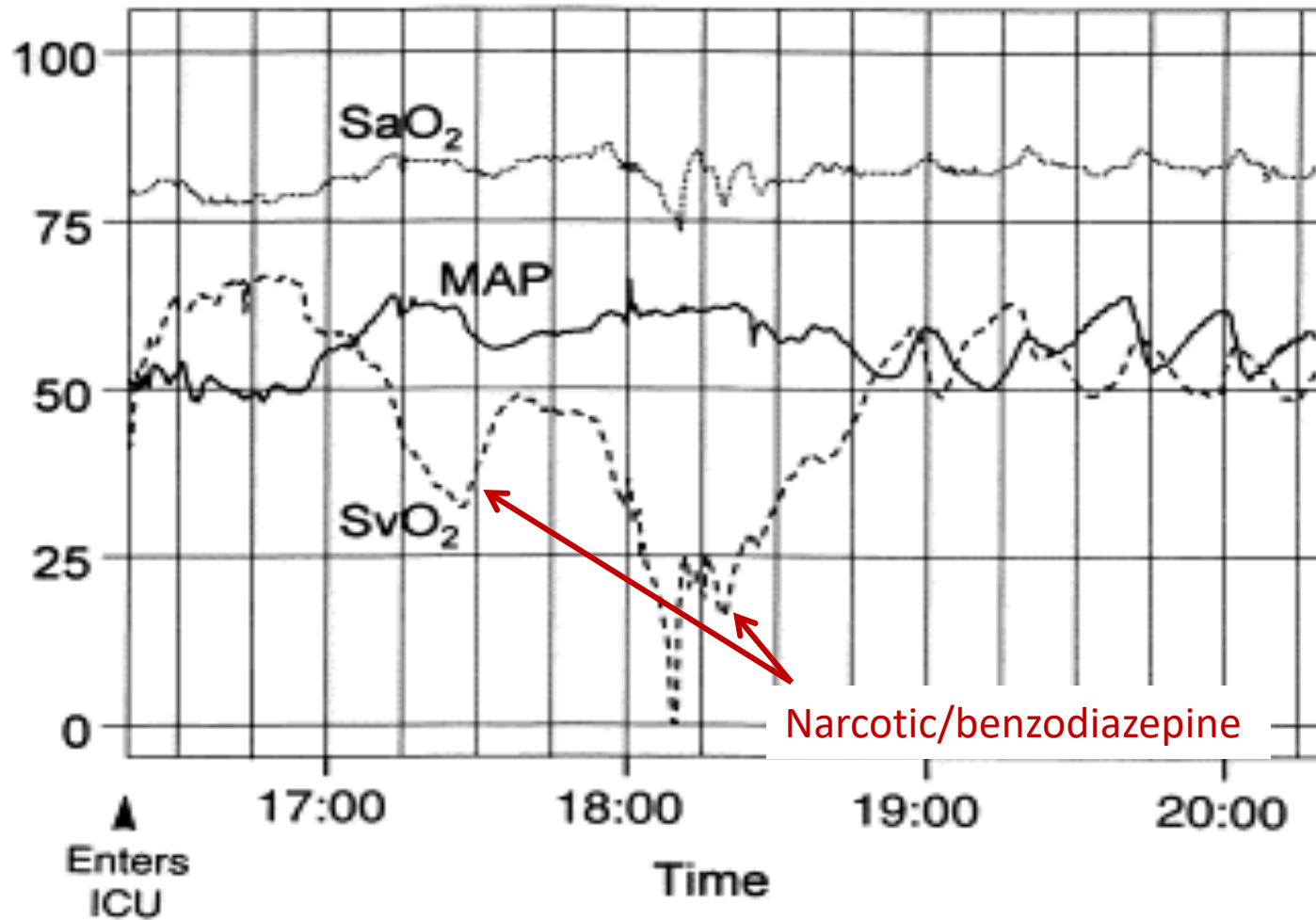


"Lisa"





# SVR management may reduce LCOS



# Patients at Risk for Low Systemic Oxygen Delivery After the Norwood Procedure

James S. Tweddell, MD, George M. Hoffman, MD, Raymond T. Fedderly, MD, Nancy S. Ghanayem, MD, John M. Kampine, MD, Stuart Berger, MD, Kathleen A. Mussatto, RN, and S. Bert Litwin, MD

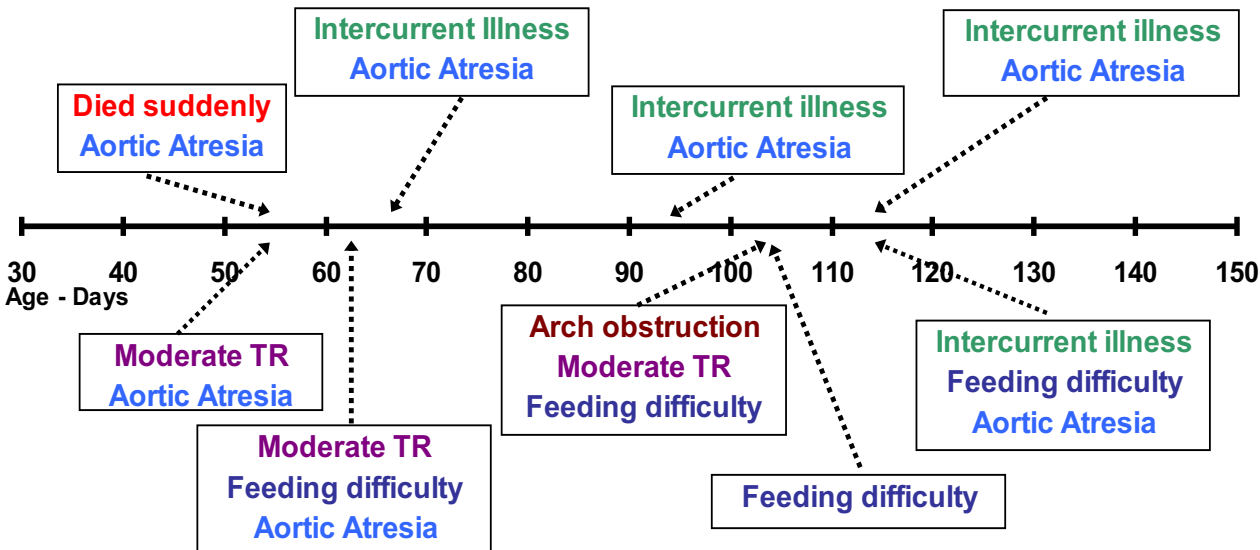
Departments of Surgery (Cardiothoracic Surgery), Anesthesia, and Pediatrics (Divisions of Cardiology and Critical Care), Children's Hospital of Wisconsin, Medical College of Wisconsin, Milwaukee, Wisconsin

- Continuous postoperative monitoring of oxygen delivery with SvO<sub>2</sub> & better SVR management ( $\alpha$ -blockade) reduced postop LCOS
- Associated with improved operative survival over 17 years
  - 93% in initial series of 8 pts – NP w/ mBTTs only (*Ann Thorac Surg* 1999)
  - 93% in follow-up series of 115 pts – NP w/mBTTs only (*Ann Thorac Surg* 2007)
  - 86% to S2P in 45 high-risk pts (*J Thorac Cardiovasc Surg* 2010)
  - 92% in follow-up series of 329 pts (*Ann Thorac Surg* 2017)

} SvO<sub>2</sub> and 2-site NIRS

# High-risk interstage period exposed

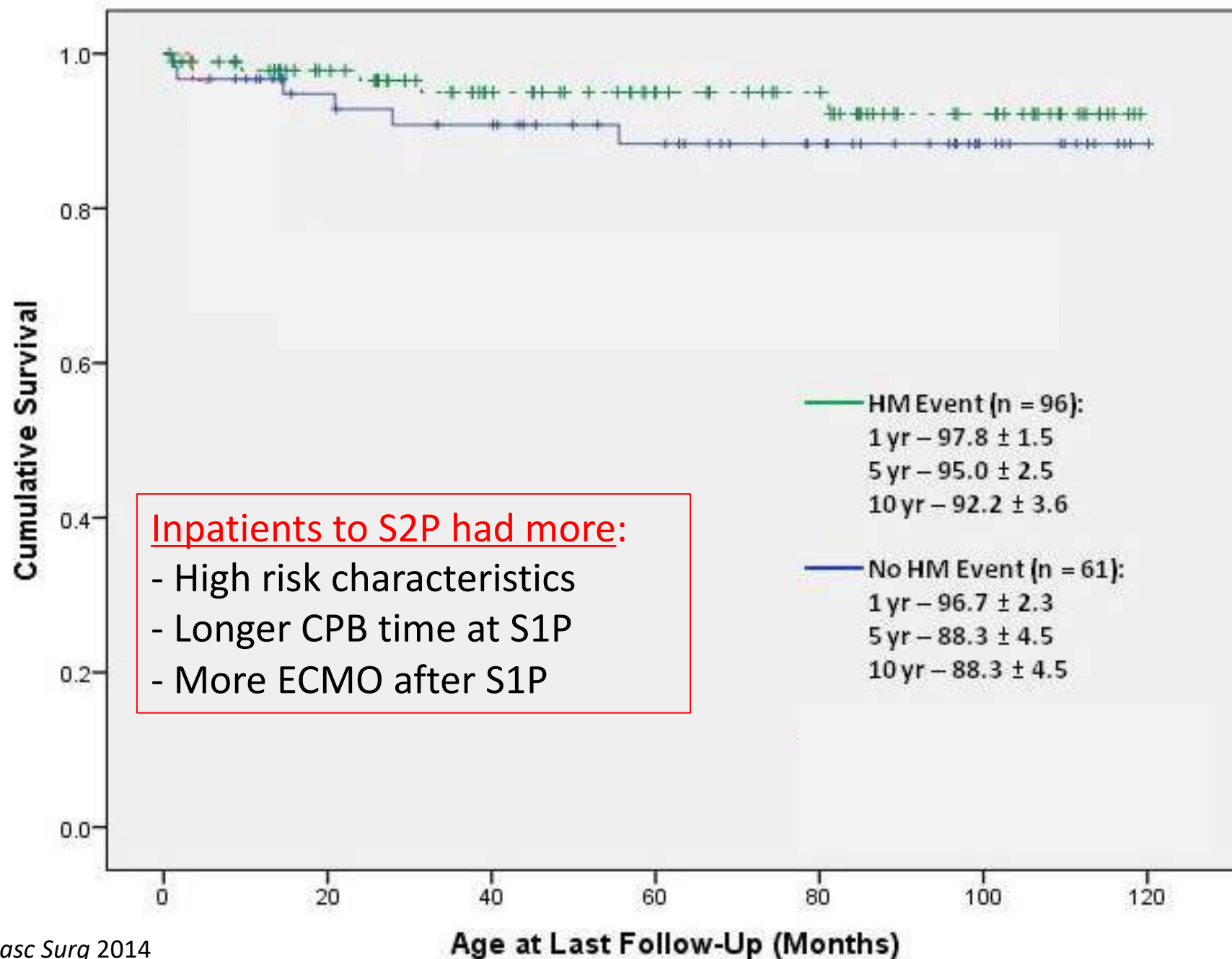
Single Center (S1P w/mBTTs 1996-2000)  
*Operative mortality – 7%*  
**Interstage mortality = 14%**



- Single center reports (2002-2011)
  - Standard-risk patients: 5-14%
  - High-risk patients: 13-48%
- PHN SVR Trial Interstage mortality: 12%
  - mBTTs – 18%; RVPAS – 6%
  - Risk factors:
    - Gestational age
    - Census block
    - Hispanic ethnicity
    - AA/MA
    - Postoperative complications

# Interstage Surveillance Program (2000)

- Home monitoring of SpO<sub>2</sub> and weight for monitoring of :
  - Residual or recurrent lesions
  - Hydration
  - Growth
  - Physiologic alterations related to common infant illness
  - Anemia
- Select inpatient interstage surveillance for high-risk patients







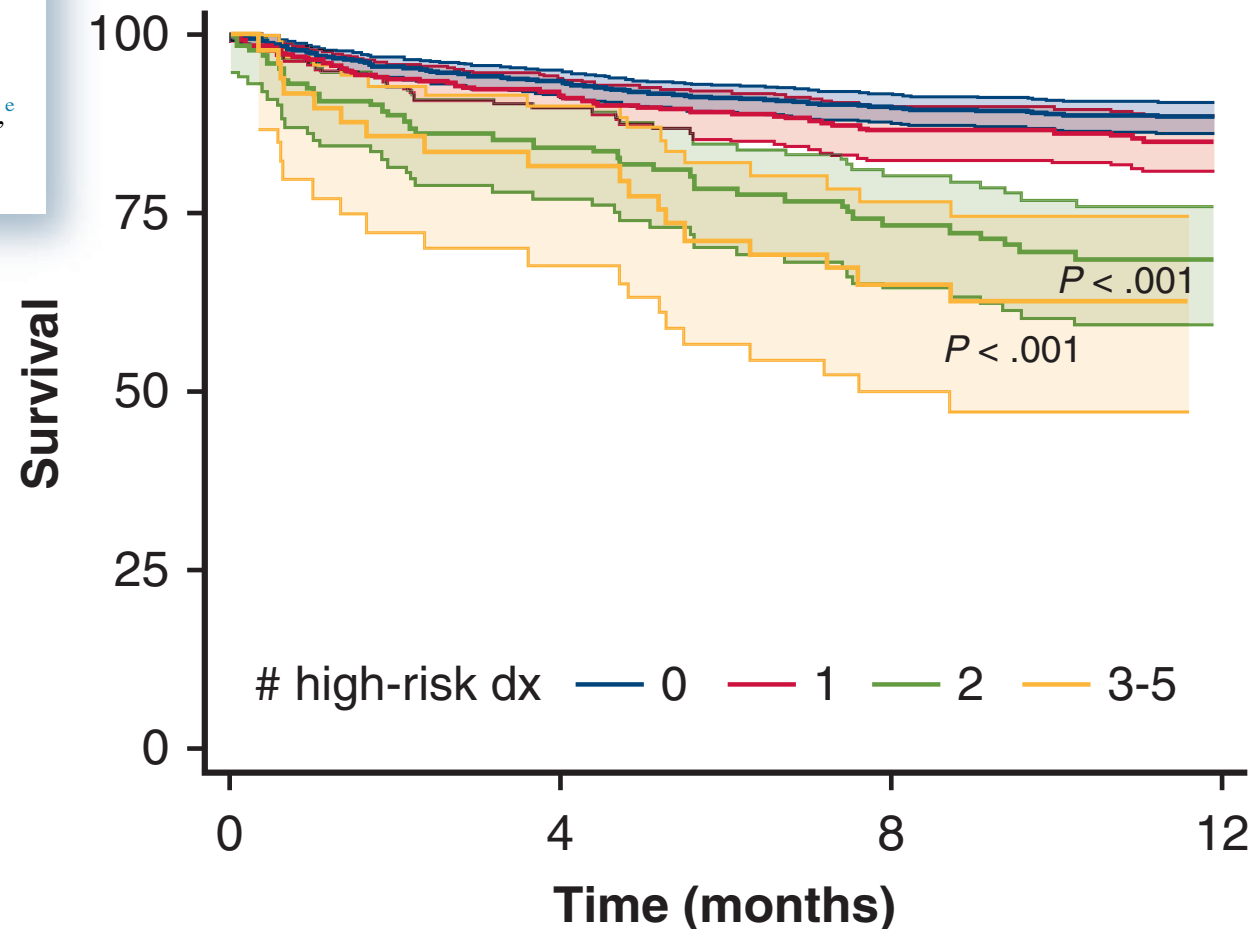
## Cumulative comorbid conditions influence mortality risk after staged palliation for hypoplastic left heart syndrome and variants

Emily R. Backes, MD, MA,<sup>a</sup> Natasha S. Afonso, MD, MPH,<sup>a</sup> Danielle Guffey, MS,<sup>a</sup> James S. Tweddell, MD,<sup>b</sup> Sarah Tabbutt, MD, PhD,<sup>c</sup> Nancy A. Rudd, MS, APNP,<sup>d</sup> Ginny O'Harrow, RT,<sup>c</sup> Silvana Molossi, MD, PhD,<sup>a</sup> George M. Hoffman, MD,<sup>d</sup> Garick Hill, MD,<sup>b</sup> Jeffrey S. Heinle, MD,<sup>a</sup> Priya Bhat, MD, MS,<sup>a</sup> Jeffrey B. Anderson, MD, MPH, MBA,<sup>b</sup> and Nancy S. Ghanayem, MD, MS<sup>e,f</sup>

1421 Participants from 58 centers (2016-20)

**40% at least 1 high-risk dx**

*prematurity, low birth weight,  
secondary cardiac dx,  
extracardiac anomaly and/or genetic  
condition*



Better monitoring to assess oxygen delivery: SvO<sub>2</sub> (1996) followed by 2-site NIRS (2001)

Perioperative care shift from PVR to SVR manipulation (1996)

Interstage home monitoring with selective inpatient care to S2P (2000)

## A sustainable strategy amidst intraoperative changes and growing teams

Variable	Entire Cohort (All Patients) (n = 329)	SvO <sub>2</sub> (n = 301)	NIRS (n = 214)	Comparison Group (SvO <sub>2</sub> +NIRS) (n = 194)
Dates of S1P	5/31/96–12/10/13	5/31/96–12/4/13	9/21/01–12/10/13	9/21/01–12/4/13
Follow-up, years	9.4 (8.1), 1.9–17.3	9.7 (7.7), 2.4–17.2	7.1 (5.0), 1.7–12.2	7.5 (4.8), 1.7–12.2
Survival				
Thirty-day/hospital	303 (92.1)	278 (92.4)	194 (90.7)	177 (91.2)
Cumulative	263 (79.9)	241 (80.1)	178 (83.2)	163 (84.0)



George Hoffman, MD (Anesthesia)



Jim Tweddell, MD  
Cardiac Surgery  
1959-2022



Stuart Berger, MD (Cardiology)



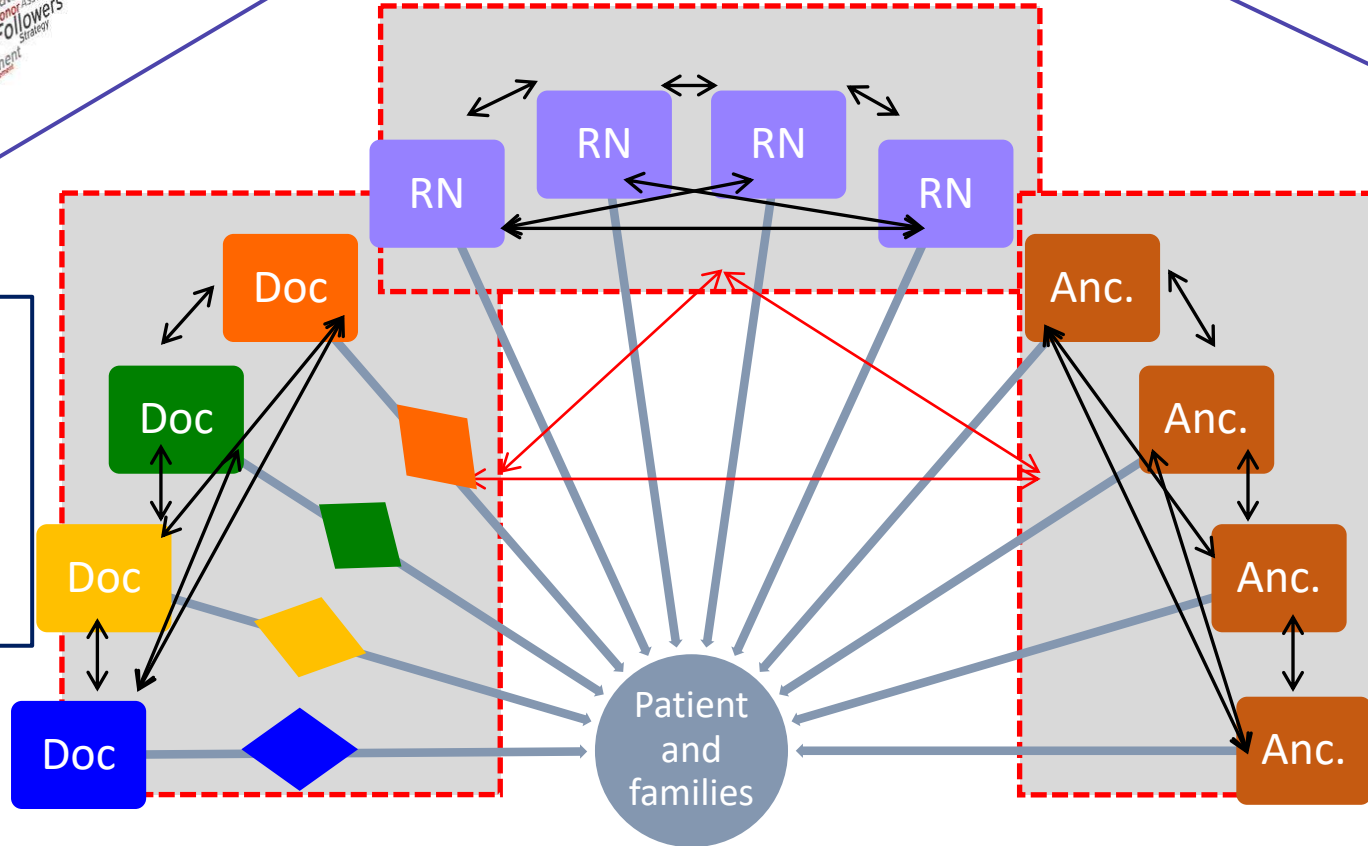
Tom Rice, MD (Critical Care)



- Surgery
- Critical Care
- Cardiology
- Anesthesia
- Neonatology
- Pediatric subspecialties

- Inpatient (ICU, acute care)
- Operating theatre
- Outpatient

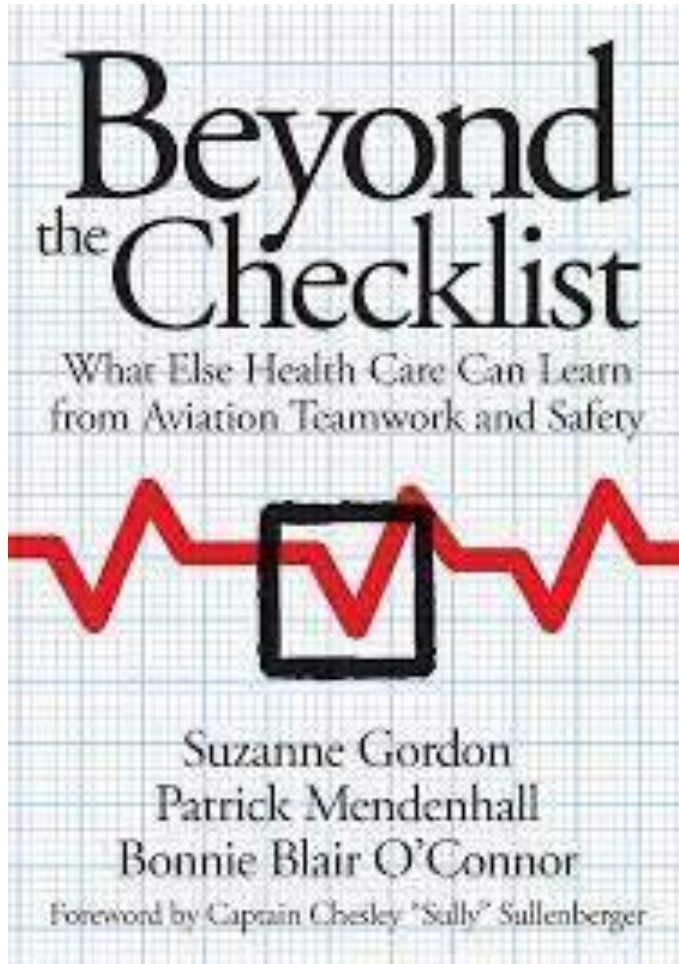
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- Advanced practice providers
- (PAs and NPs)
- Respiratory
- Transport
- Laboratory
- Blood Center
- Pharmacy
- Radiology
- OR Staff
- Therapists
- Dietician
- Environmental services

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# Team Intelligence

Capacity of the individual members of a team to **learn, teach, communicate, reason and think together**, irrespective of hierarchical position, in service of shared goals.

Team members must have:

- ✓ Shared identity to articulate goals
- ✓ Be willing and able to share information
- ✓ Understand one another's roles
- ✓ Have trust and support one another



# Leah Goldberg, MD MHS

- Hypoplastic left heart syndrome
  - Norwood palliation at CHOP (1995)
- Living with a Fontan
  - Partial hepatectomy for HCC (2019)
- Ran a half marathon
- Undergraduate research mentors (CHOP)
  - Drs. Stephanie Fuller & Yuli Kim
  - Presented at AHA
- Medical school at Temple University
- Resident at University of Chicago SOM



— Our Why —