DELIVERY ROOM OF THE FUTURE
Congenital Heart Disease

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~10% of newborns need assistance to transition to *ex utero* life

~1% need intensive measures such as CPR

I BELIEVE THAT THE CARE WE PROVIDE IN THE DELIVERY ROOM IS A CRITICAL TIME FOR OUR NEWBORNS AND THEIR FAMILIES

Welcome

The Neonatal Resuscitation Program® (NRP®) course conveys an evidence-based approach to care of the newborn at birth and facilitates effective team-based care for healthcare professionals who care for newborns at the time of delivery. NRP utilizes a blended learning approach, which includes online testing and hands-on case-based simulation/debriefing that focus on critical leadership, communication, and team-work skills.

Mission: To develop and disseminate evidence-based neonatal resuscitation education

Vision: To improve neonatal health by having an expert provider at every birth and an expert team at every resuscitation

https://www.**aap**.org/en/pedialink/neonatal-resuscitation-program/

NRP Textbook

Special Considerations

What you will learn

- When to suspect a pneumothorax or a pleural effusion
- How to manage a life-threatening pneumothorax or pleural effusion
- How to manage a newborn with an airway obstruction
- How to manage congenital lung abnormalities that may complicate resuscitation
- How to manage the newborn with complications from maternal opiate or anesthetic exposure
- How to manage a newborn with myelomeningocele
- How to manage a newborn with an abdominal wall defect

NRP textbook 8th Ed, 2021

Congenital malformations were the leading cause of infant mortality in the United States in 2021

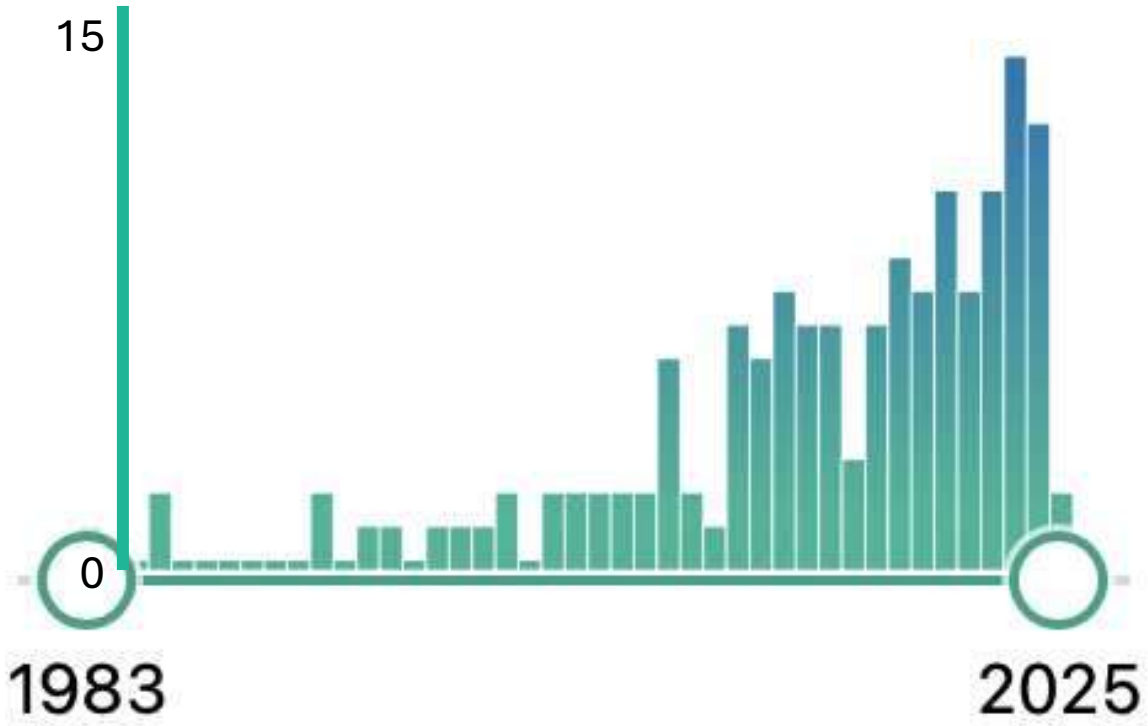
National Vital Statistics Reports, Vol 23, 2023.

All Newborns	Newborns with Congenital Heart Disease
10% DR resuscitation	24% DR resuscitation
Transitional physiology defined	Transitional physiology unknown
Evidence-based DR resuscitation	No evidence base for DR resuscitation
Neonatal Resuscitation Program (NRP) guides training and care	Not included in NRP Expert-based care
Low risk mortality and morbidity	High risk mortality and morbidity

Challenges with the Delivery Room of Today
(for newborns with congenital heart disease)

- Scientific evidence base is limited
- Technology is suboptimal
- Impact of human factors underappreciated
- Precision medicine non-existent

Scientific evidence base is limited



Pubmed search: Delivery room and congenital heart disease

The Role of the Neonatologist in Fetuses Diagnosed with Congenital Heart Disease

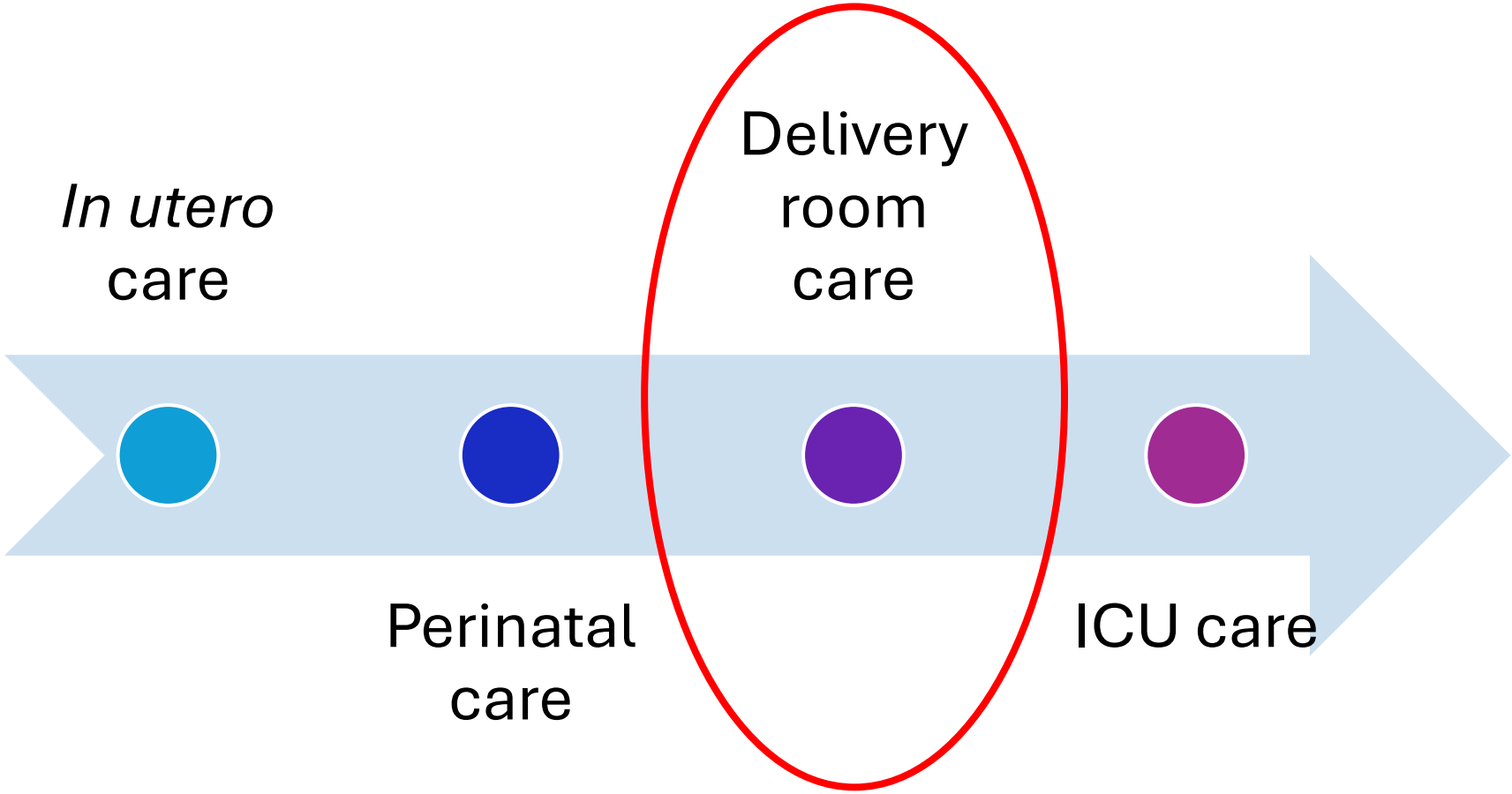
Adverse Obstetric Outcomes in Pregnancies With Major Fetal Congenital Heart Defects

Predicting High-Risk Fetal Cardiac Disease Anticipated to Need Immediate Postnatal Stabilization and Intervention with Planned Pediatric Cardiac Operating Room Delivery

Impact of Mode of Delivery on Markers of Perinatal Hemodynamics in Infants with Hypoplastic Left Heart Syndrome

Early versus delayed umbilical cord clamping in infants with congenital heart disease: a pilot, randomized, controlled trial

Perinatal and Delivery Management of Infants with Congenital Heart Disease


In utero care
Perinatal care
Delivery room care
ICU care

Neonatal and maternal outcomes of pregnancies with a fetal diagnosis of congenital heart disease using a standardized delivery room management protocol

Journal of Perinatology (2020) 40:316–323
https://doi.org/10.1038/s41372-019-0528-1

Structured pre-delivery huddles enhance confidence in managing newborns with critical congenital heart disease in the delivery room

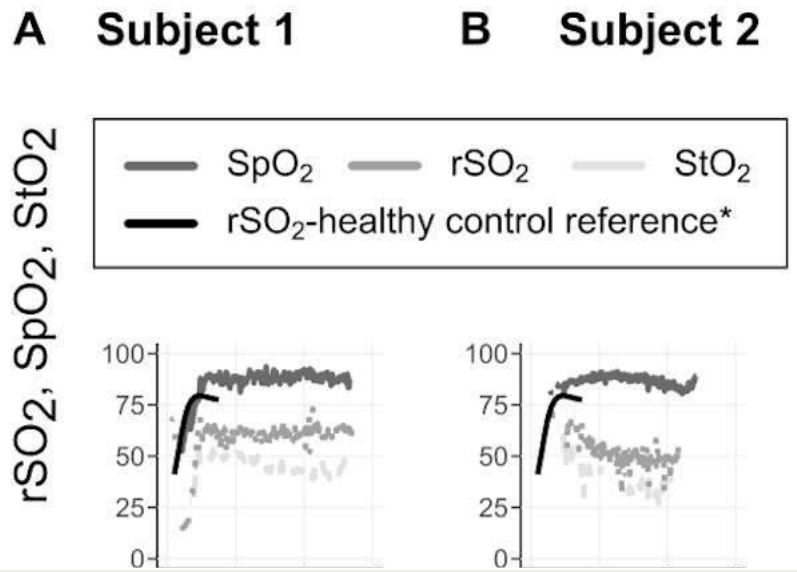
Journal of Perinatology; https://doi.org/10.1038/s41372-024-02196-8

Delivery room oxygen physiology and respiratory interventions for newborns with cyanotic congenital heart disease

Journal of Perinatology (2021) 41:2309–2316
https://doi.org/10.1038/s41372-021-01029-2

Technology is suboptimal

0:00	2:51	3:11
Time of Birth	EKG signal	Pulse Ox signal



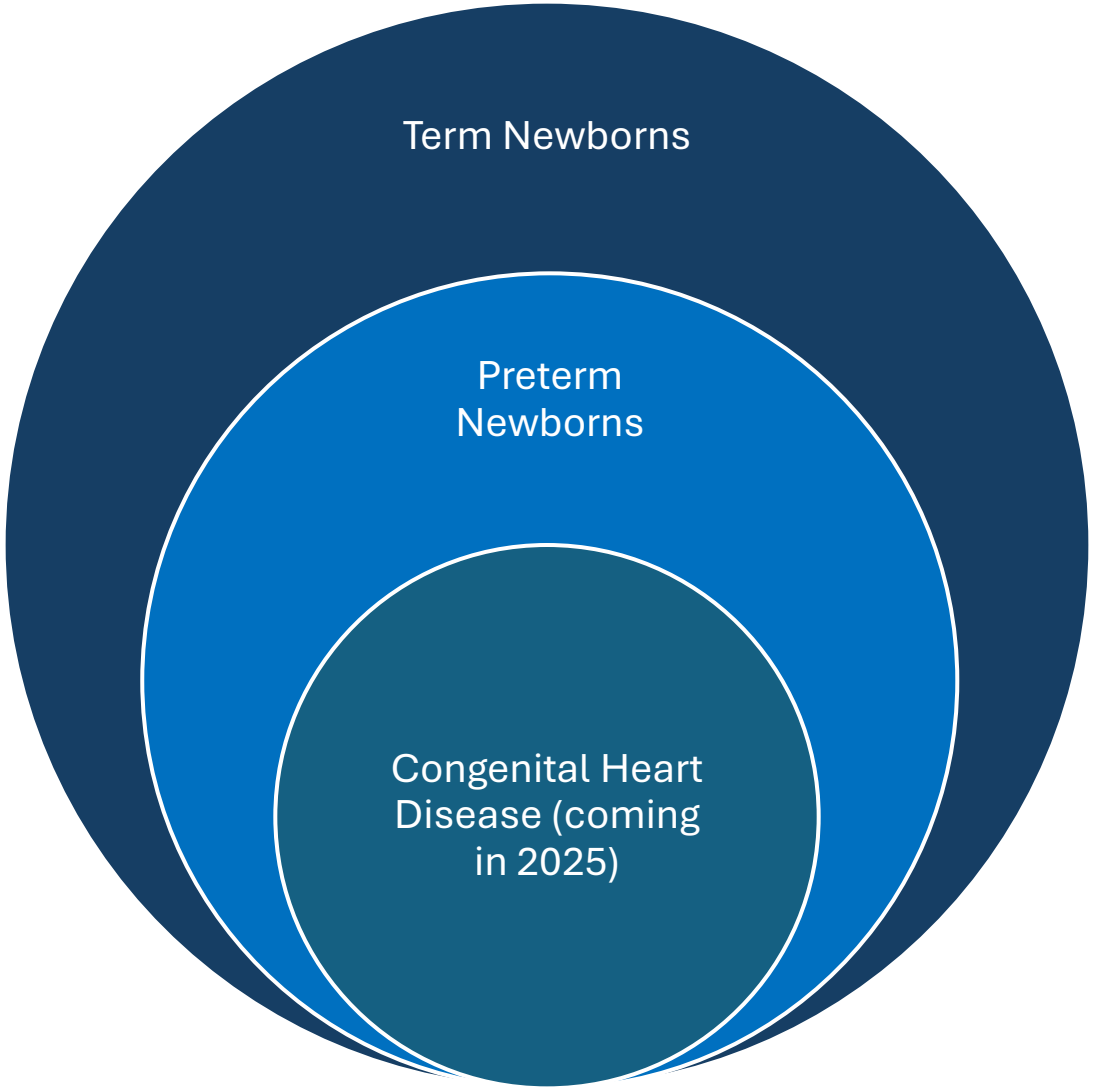
Documentation	Code narrator	Vitals didn't cross over
Equipment	Bed battery	Bed died about 5 min after being unplugged
Equipment	NIRS	NIRS sensor fell off while prioritizing airway
Protocol	NIRS	Did not remember to press start on NIRS monitor

Impact of human factors underappreciated

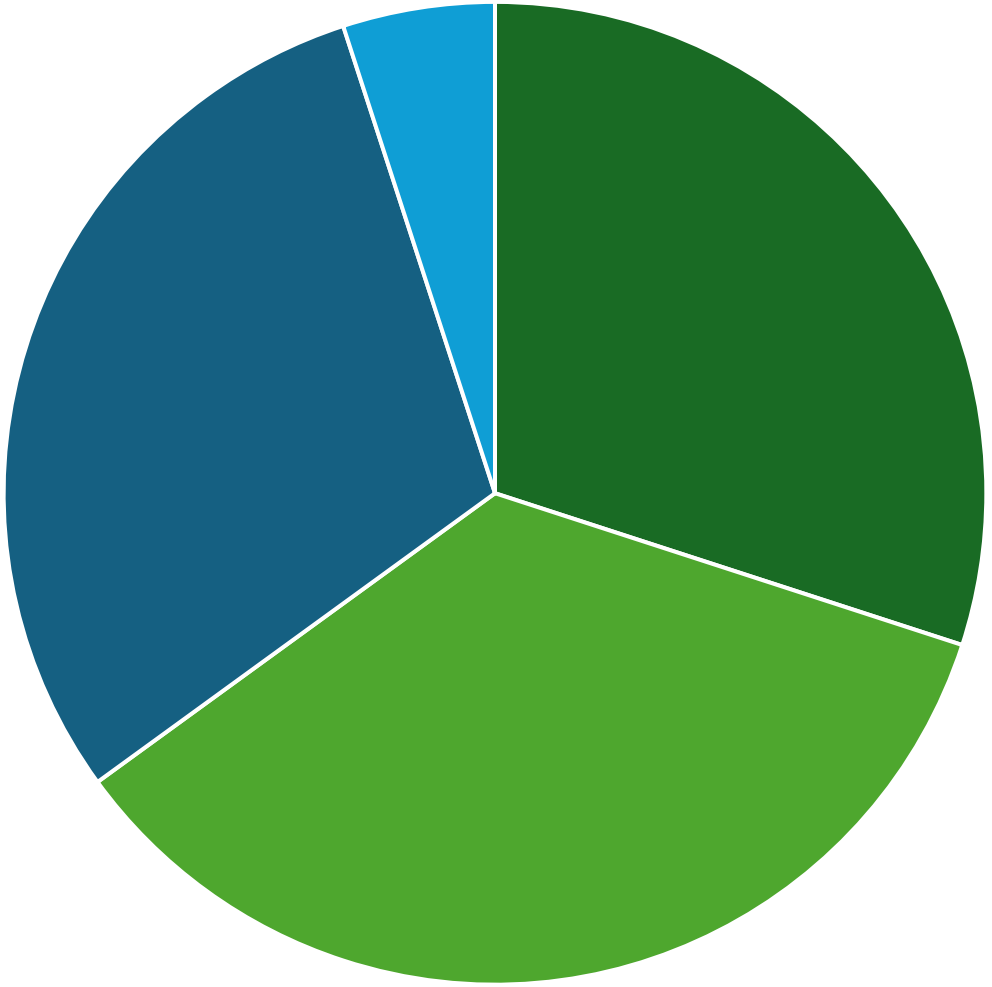
Case number	Order of Huddle Elements										
1	Introductions	Patient (baby) information	Resuscitation plan	Alternative plan							
2	Introductions	Patient (baby) information	Mom information	Resuscitation plan	Alternative plan	Special considerations					
3	Date	Mom information	Patient (baby) information	Resuscitation plan	Introductions						
4	Date	Introductions	Mom information	Patient (baby) information	Alternative plan	Resuscitation plan	Questions/ Concerns	Alternative plan	Knowledge screens	Door duty	Recording
5	Recording	Introductions	Patient (baby) information	Resuscitation plan	Mom information	Other teams	Family wishes				
6	Introductions	Mom information	Patient (baby) information	Knowledge screens	Resuscitation plan	Alternative plan					
7	Timeout lead	Recording	Introductions	Mom information	Patient (baby) information	Resuscitation plan					
8	Introductions	Patient (baby) information	Resuscitation plan	Questions/Concerns	Alternative plan						
9	Patient (baby) information	Resuscitation plan	Introductions	Questions/Concerns	Alternative plan	Grab baby					
10	Patient (baby) information	Resuscitation plan	Grab baby								

Precision medicine non-existent

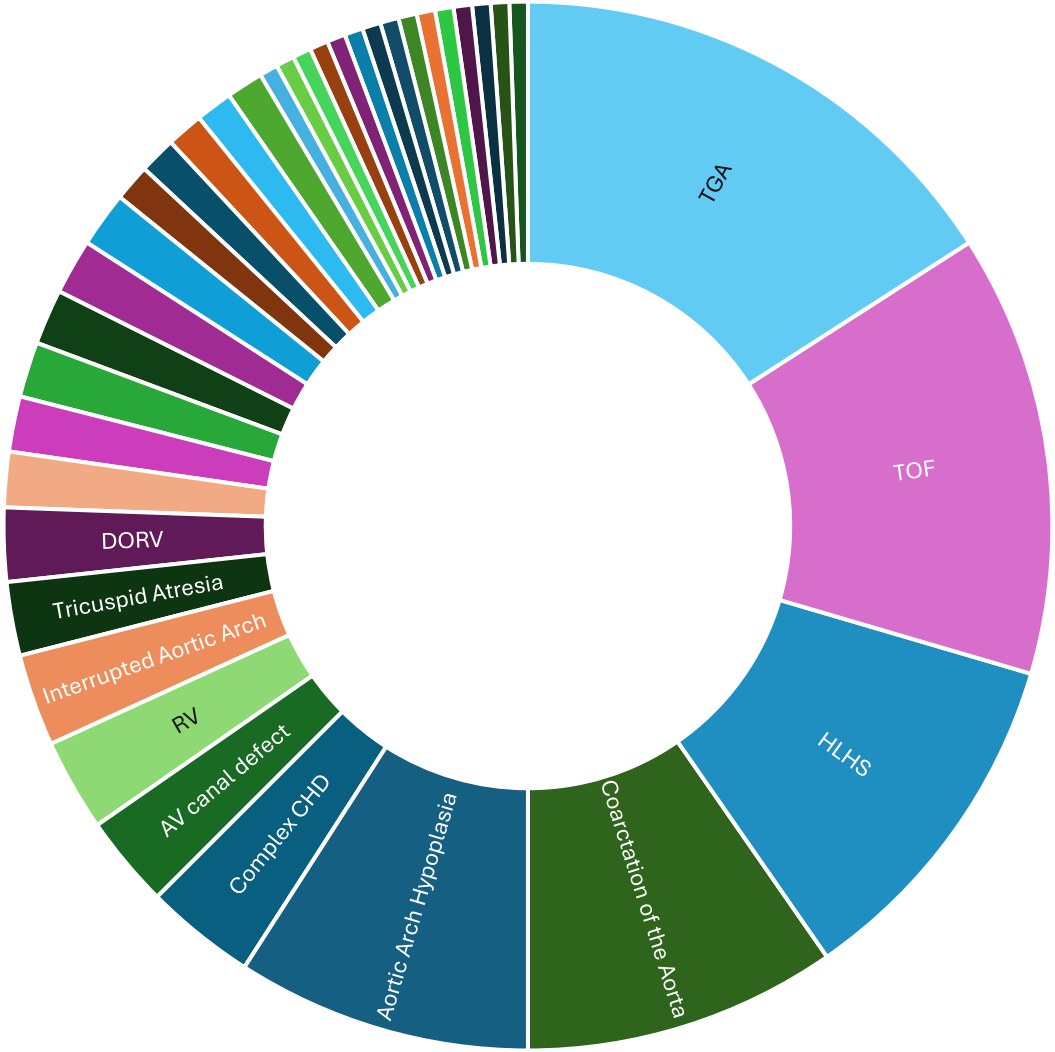
Neonatal Resuscitation Program



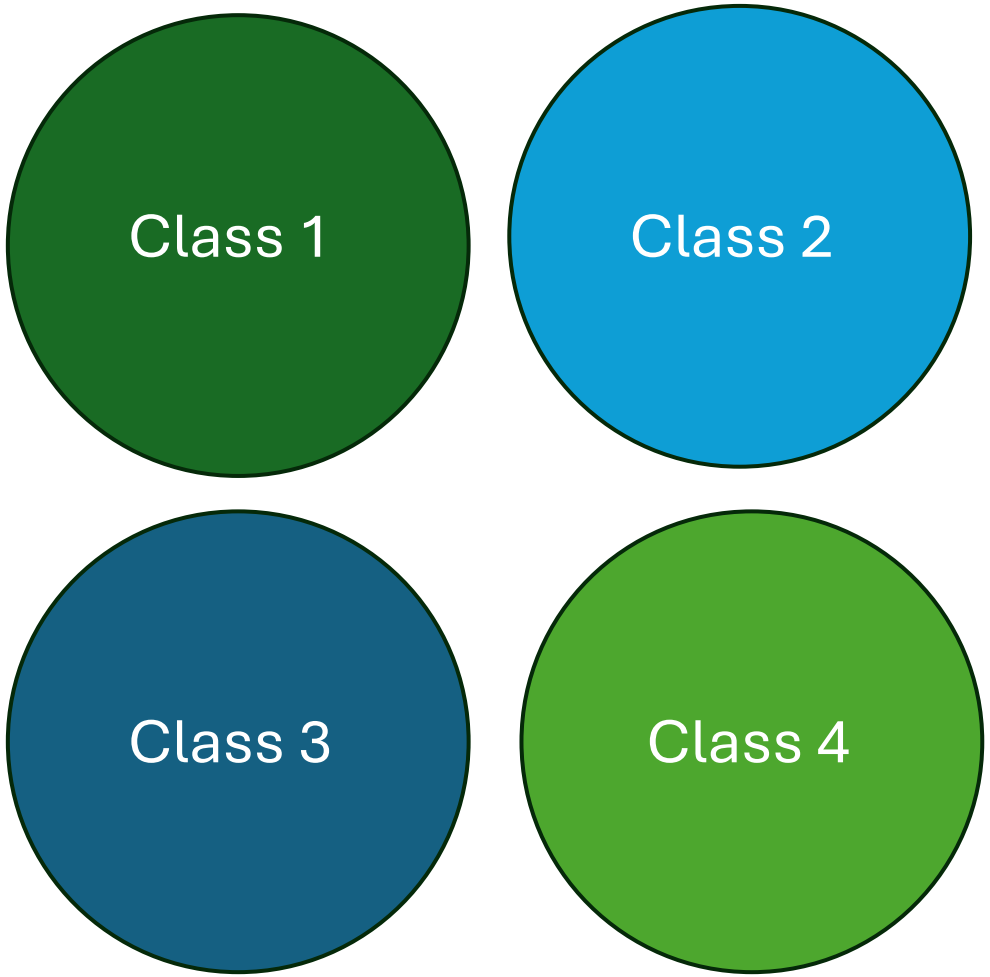
CHD classifications for DR management

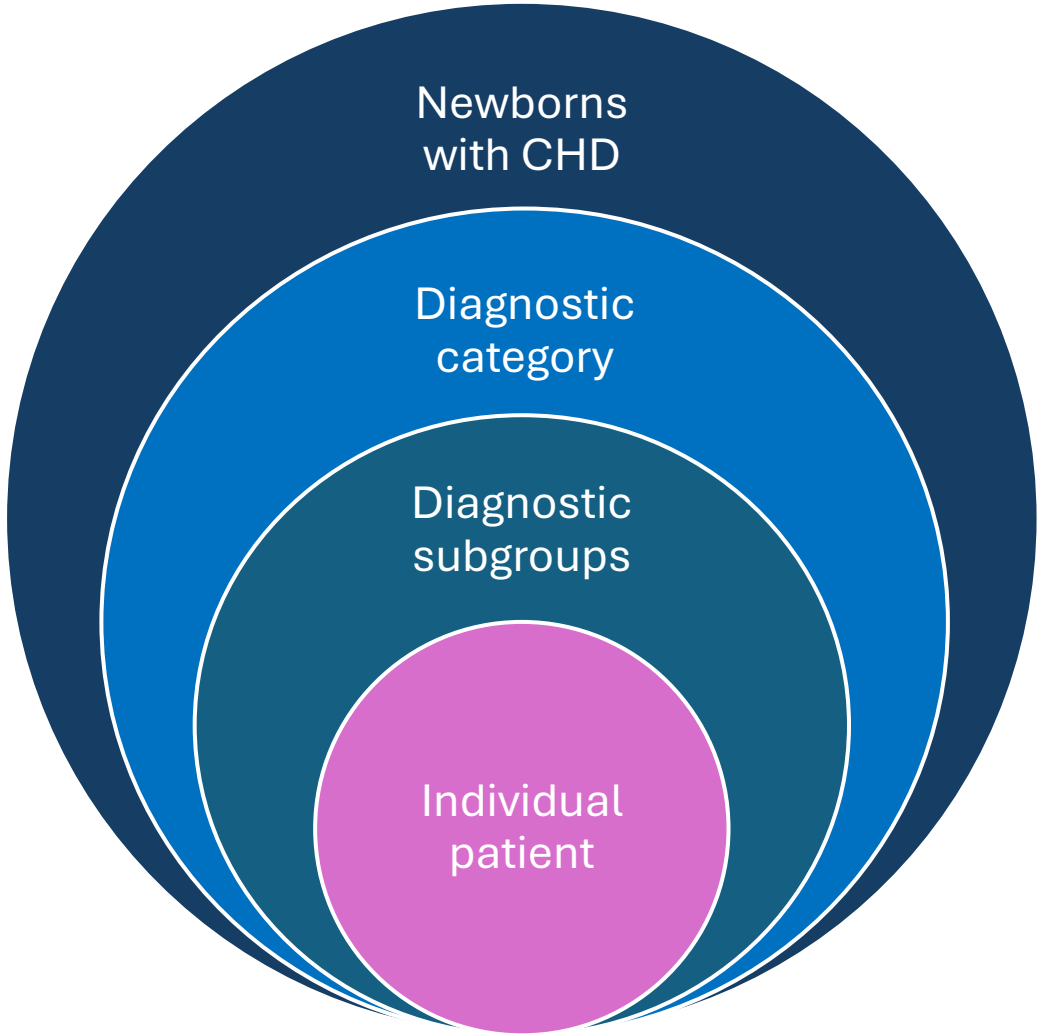


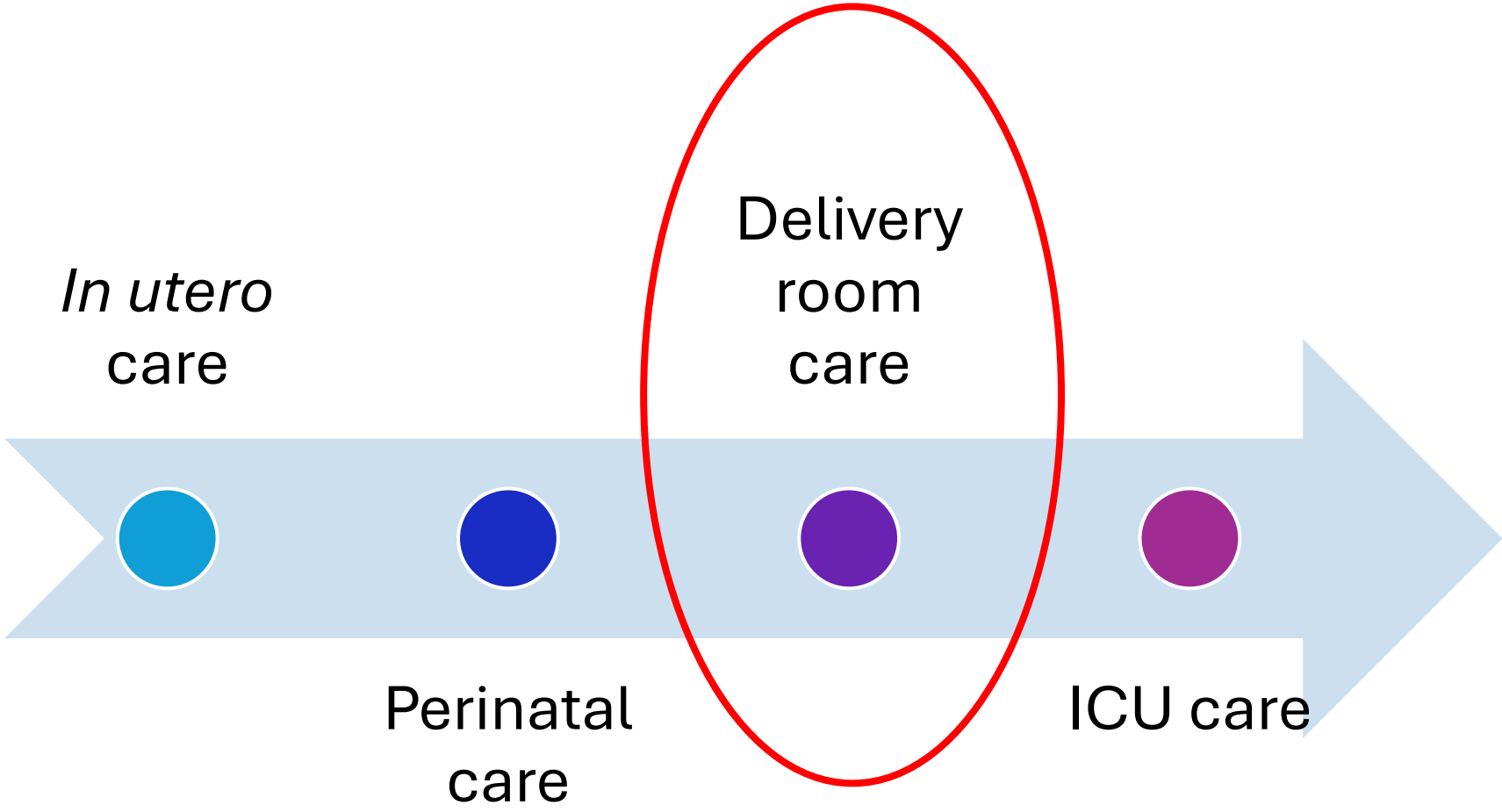
Fetal cardiac diagnoses



Delivery Room of the Future






In utero care
Perinatal care
Delivery room care
ICU care

Mission: Improve Golden Hour Care for all Babies in the SDU

Golden Hour management is an <u>essential</u> and <u>underexamined</u> aspect of clinical care for patients with congenital anomalies

Aim 1

Establish a longitudinal multimodal registry for all infants born in SDU to:

1. <u>Inform</u> advancements in clinical care
2. <u>Support</u> transitional physiology research

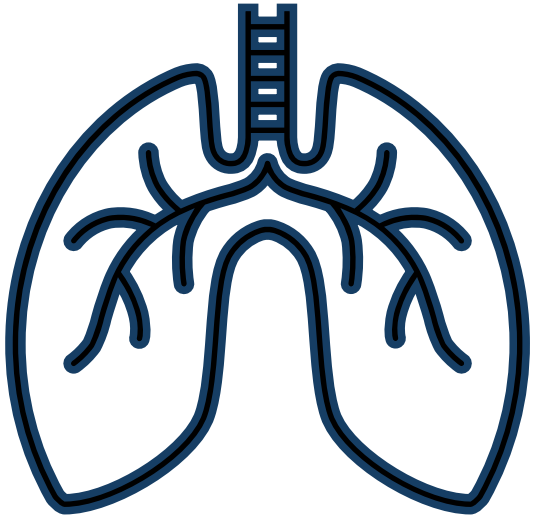
Aim 2

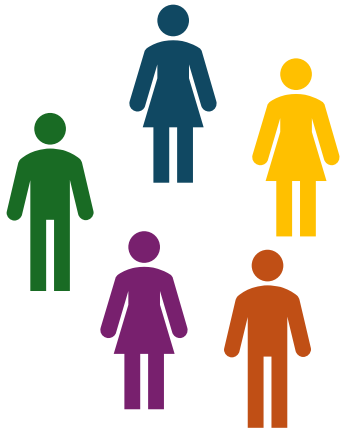
Apply a Human Factors Engineering Science approach to optimize clinician performance during resuscitation

Aim 3

Develop existing cognitive aid into a novel data-driven Digital Coach to support real-time provider performance during DR resuscitation

Multimodal registry



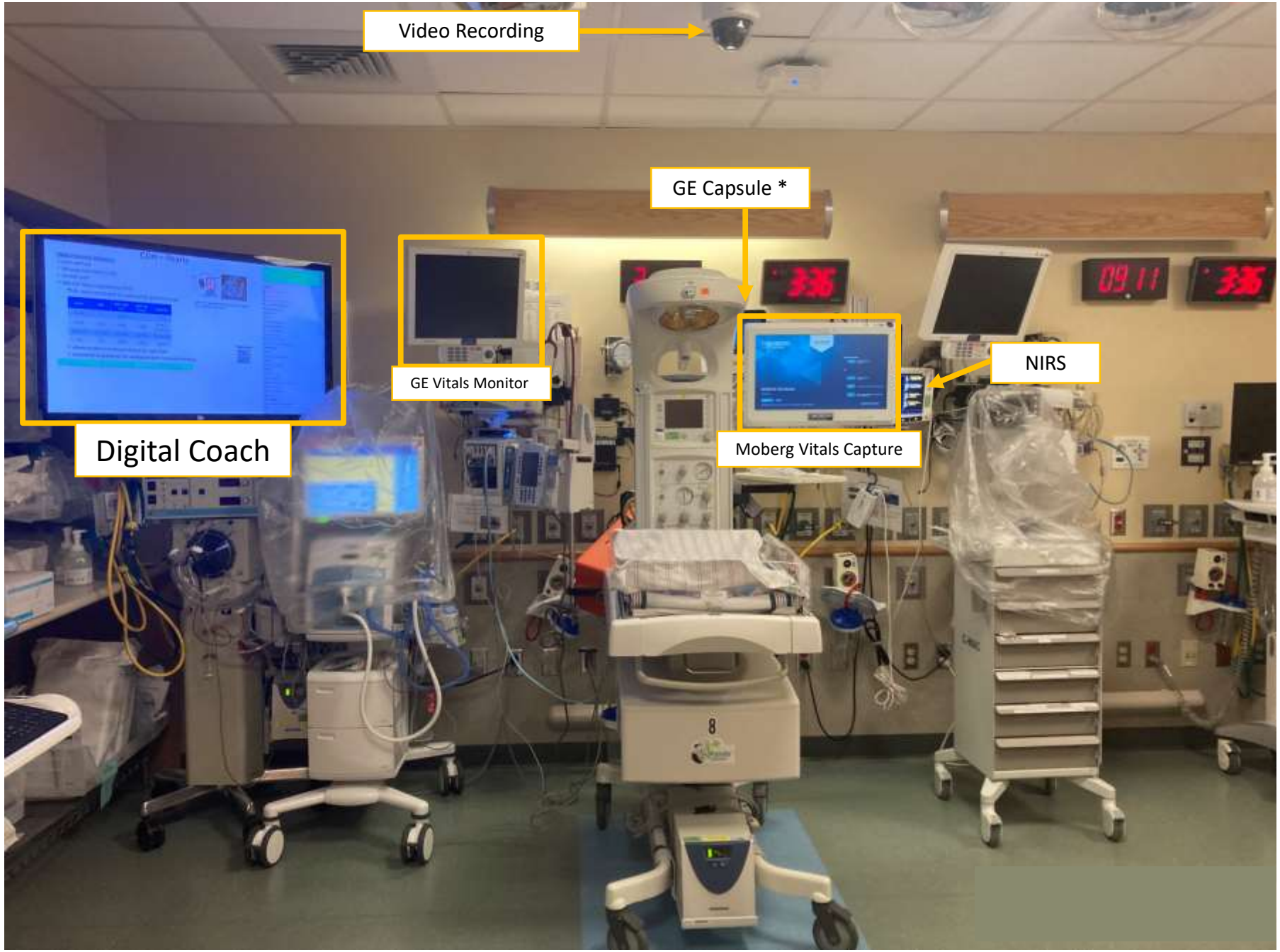


Clinical Outcomes Data Archive

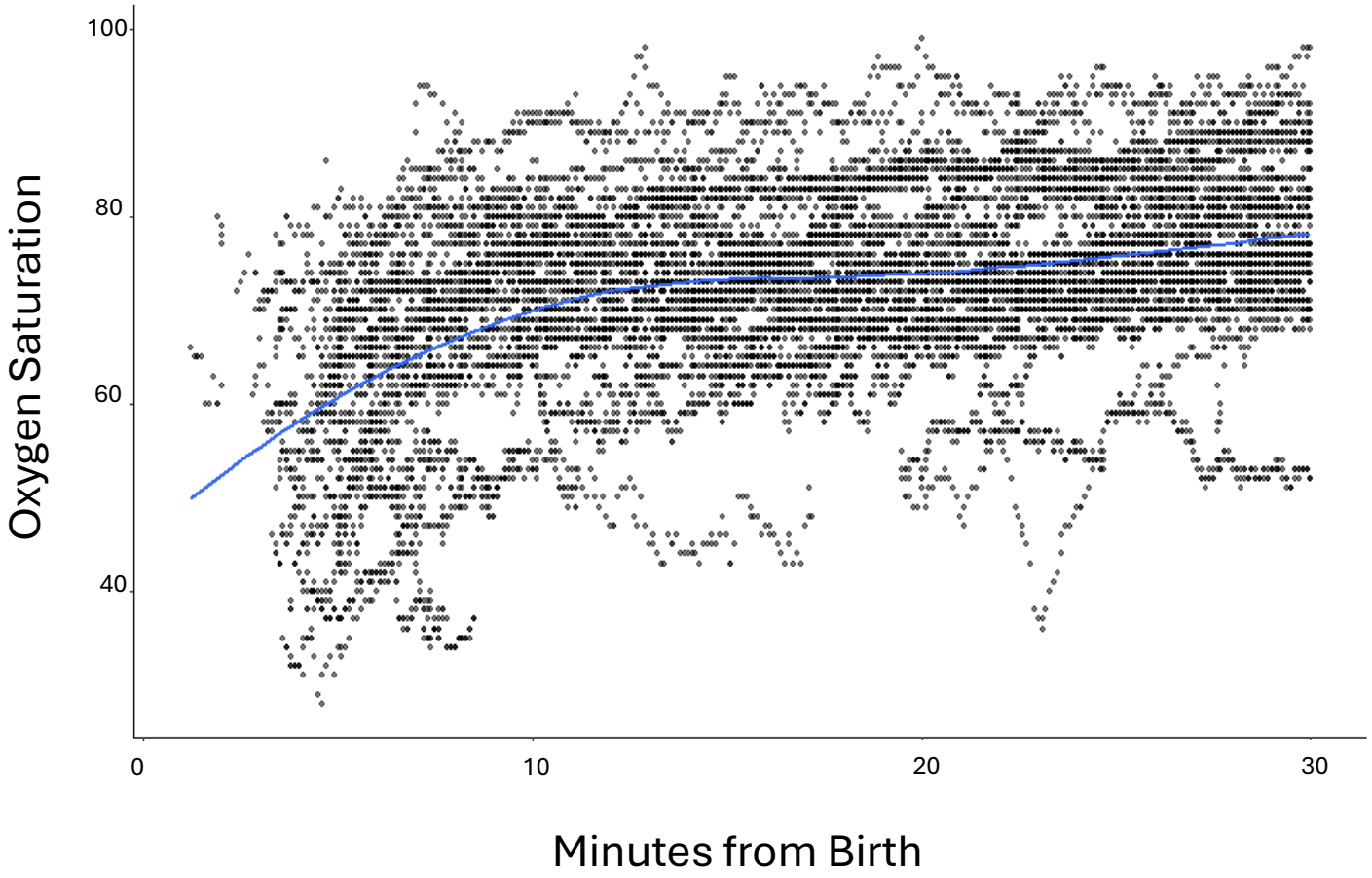
Epic

Code Narrator

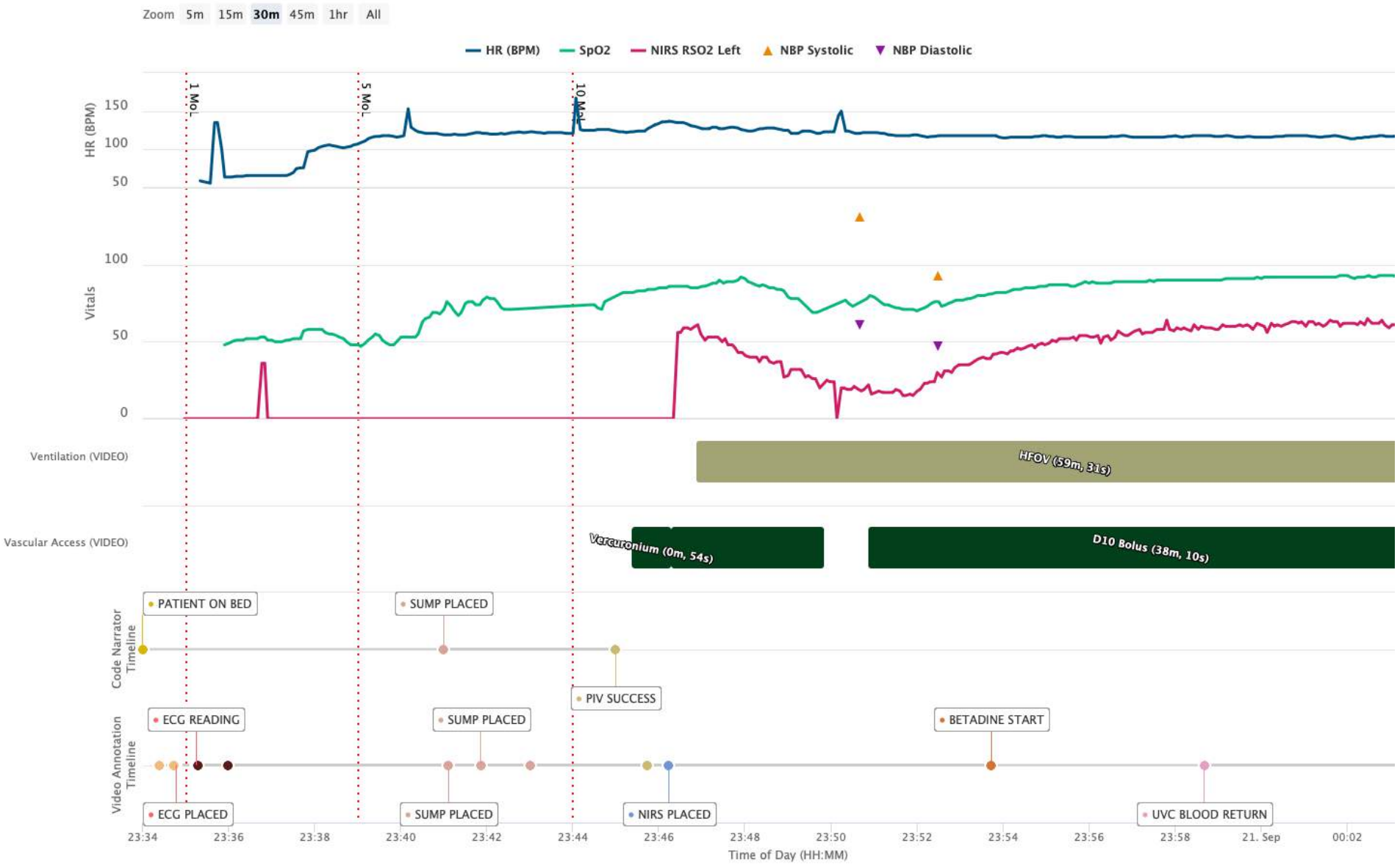
Since 2023


Video Recording
GE Capsule *
Digital Coach
GE Vitals Monitor
NIRS
Moberg Vitals Capture

Single continuous data stream

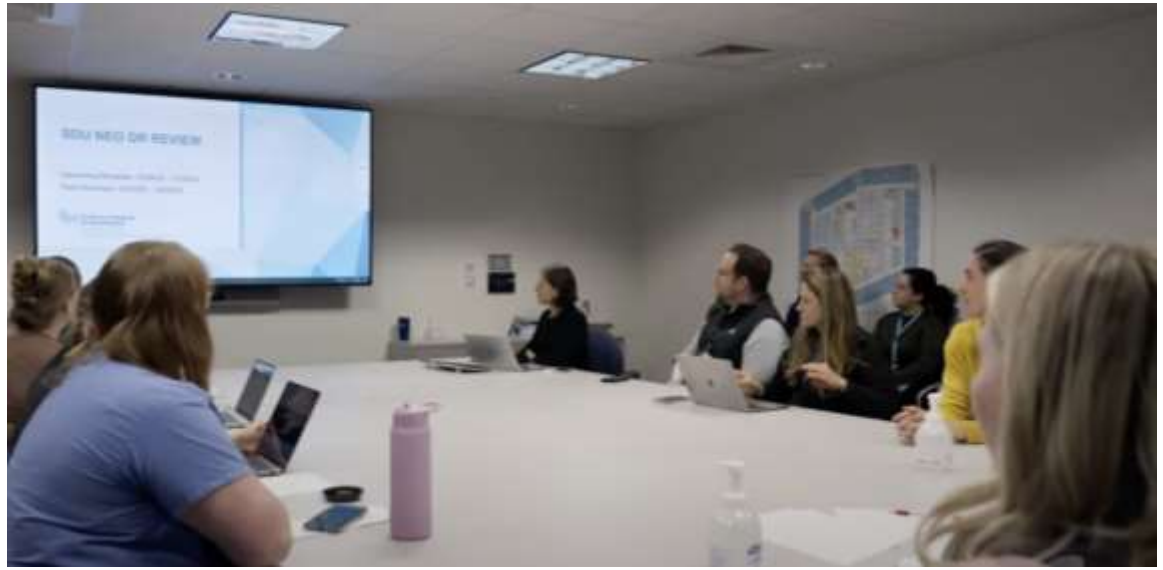


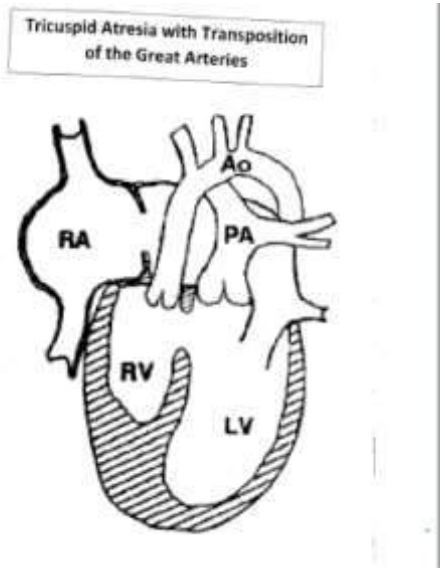
Multimodal data stream



WE VALUE

Speaking up
Everyone’s ideas
Group think
All team members
Your expertise
Reflection





TEAMWORK MAKES THE DREAMWORK

Maternal Demographics:
YO G P
EDD:
Home city:
Maternal Diagnoses: GDM
Maternal Beta:
RSV vaccine:
GBS: Negative

Neo Consult:
Other:

Infant Name:

Maternal MRN:

***** Needs Spanish interpreter *****

Research Studies: **Cord CHD ORANGE envelope**,

Maternal Name

Delivery Plan: IOL on XX/XX/25
Cardiac Diagnosis: Class II – Tricuspid atresia with d-TGA, mod posterior malalignment type VSD, dilated L atrium, hypoplastic RV, diffuse hypoplasia of AA with further isthmus narrowing
Fetal:
- **GA:** 38w2d (02/10/25)
- **EFW:** 3200 g; 34% (02/05/25)
- **Prenatal genetic testing:** Negative amnio/microarray
- **Fetal Airway Concern:** No
- **Expected care area for baby:** CICU
- **Candidate for Delayed Cord Clamping:** **Cord CHD**
- **Candidate for SDU Couplet Care:** No

Anticipated DR needs: Targeted pre-ductal SpO2: 75-85
- **PGE:** Yes
- **Airway/Respiratory:** Routine
- **Vascular access:** UAC/UVC
- **Advanced Resuscitation Team:** No
- **Special Considerations:** No

Class II Cardiac

38w4d

3.2 kg (just now)

FULL TEAM HUDDLE

PREVIEW MODE

Huddle Start

Push video recording button ON to capture huddle

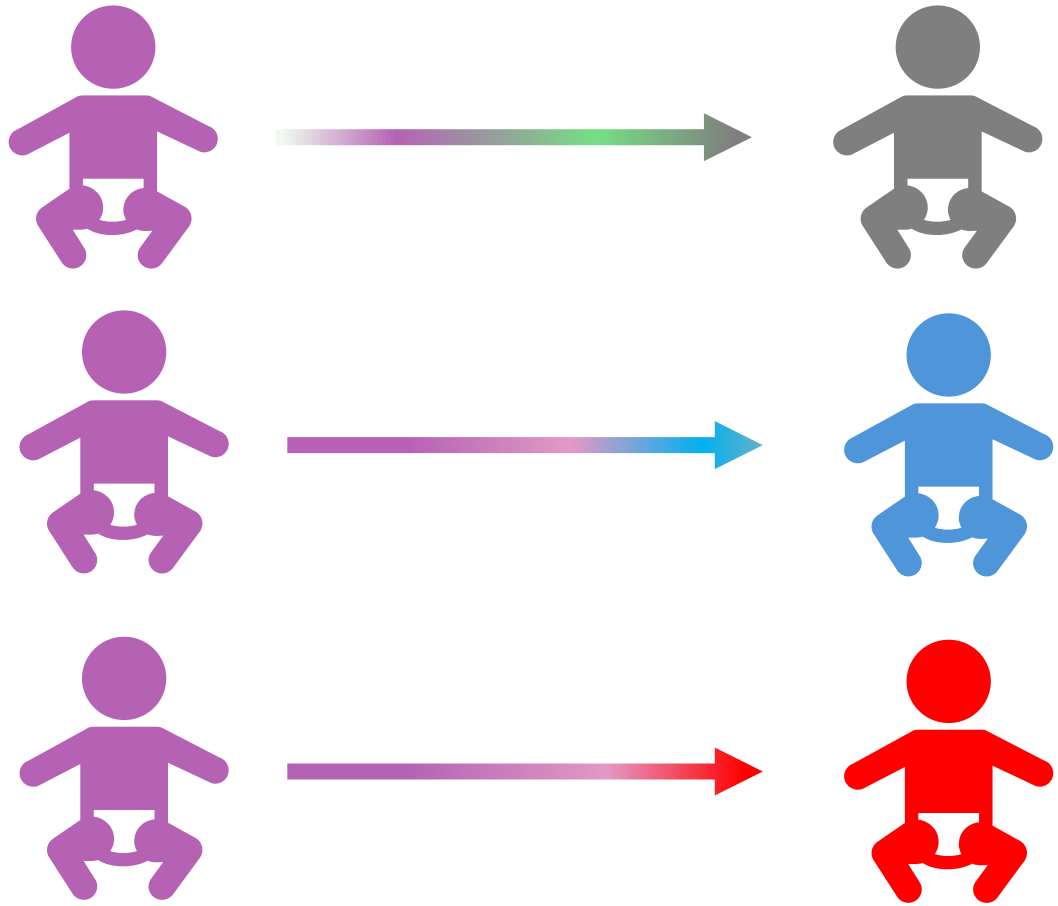
Turn on warmer bed and suction

Turn on Moberg and NIRS

Introduce team members by name

Next

Patients with the same anomaly have different trajectories

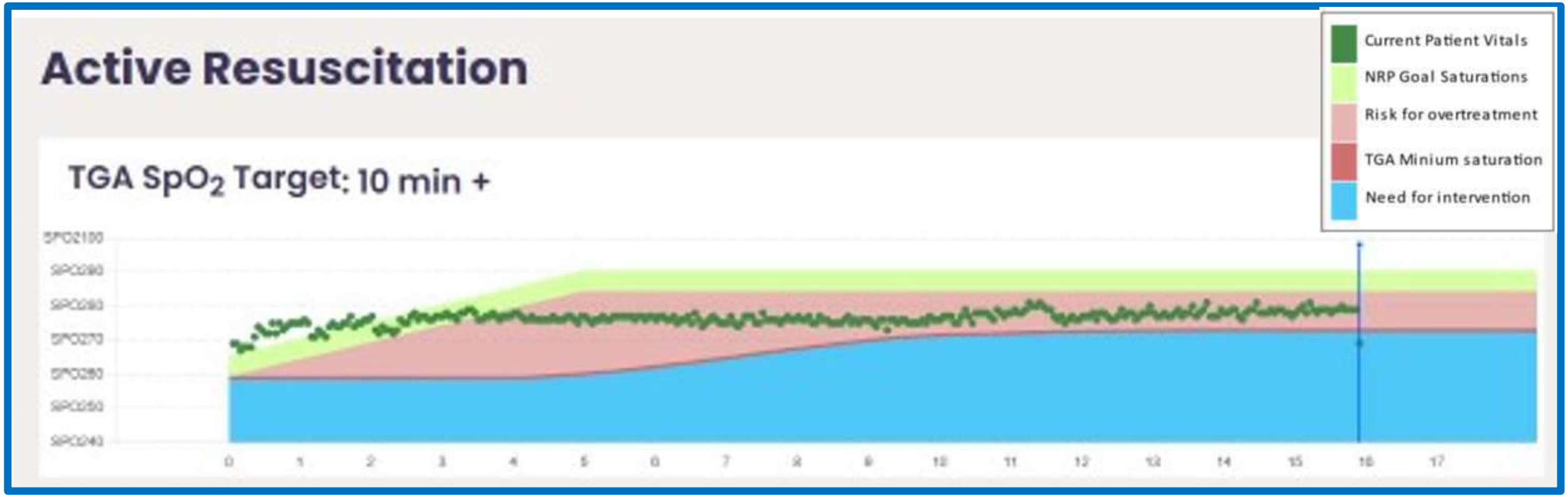


Intubation and Lower Saturation in the Delivery Room are Associated with Balloon Atrial Septostomy in Neonates with Transposition of the Great Arteries

Delivery Room	No BAS	BAS
Max SpO_2 first 10 minutes	74%	64%
Max SpO_2 first 20 minutes	81%	71%
Max FiO_2	70%	100%
Intubated	33%	87%

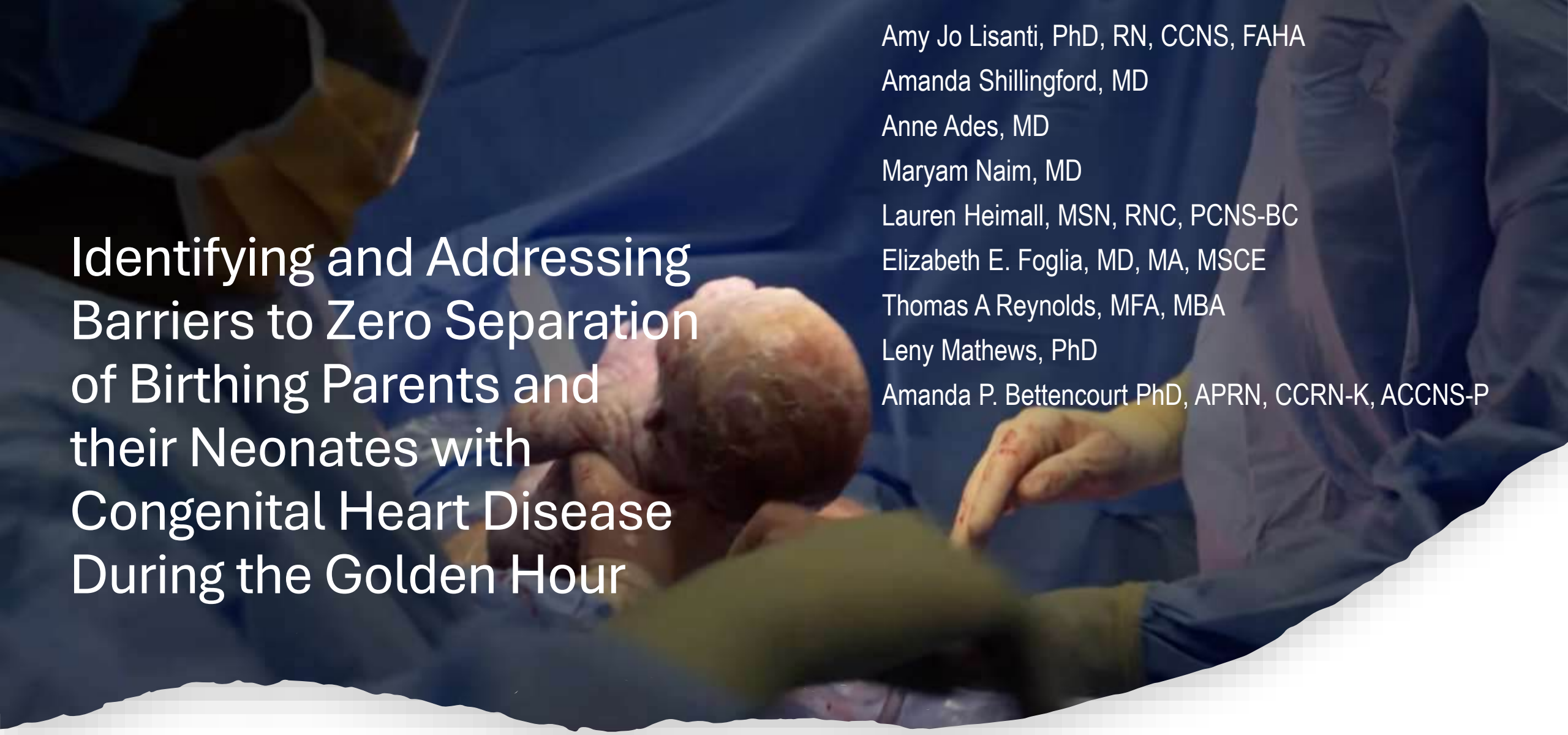
(J Pediatr 2024;275:114222).

Individualize care



Hypothetical proposition

Individualize care



Identifying and Addressing Barriers to Zero Separation of Birthing Parents and their Neonates with Congenital Heart Disease During the Golden Hour

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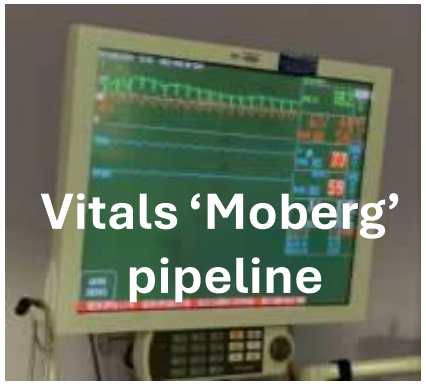
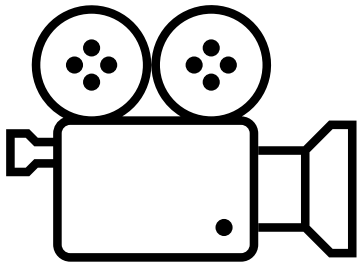
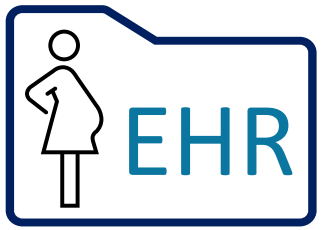






Real-time
Note transmission

CODA Application

CODA
Database

Clinical
Data Extract

Chart
Abstraction

CHOP Data
Warehouse/
Helix

Digital Coach – Critical Knowledge Platform

- Accurate, up-to-date, easily modifiable content
- Critical pearls informed by decades of morbidity and mortality conferences, ACA, and RCA's to ensure *NEVER again* events
- Diagnosis and procedure modules, 350 in total
- Centralized upcoming delivery plans for specific patients
- Can display real-time EPIC documentation and vital sign trajectory
- Large touch screen display at bedside
- Accessible on CHOP network and via mobile
- > 1000 user interactions to date

Transposition of the Great Arteries (d-TGA)

37w0d

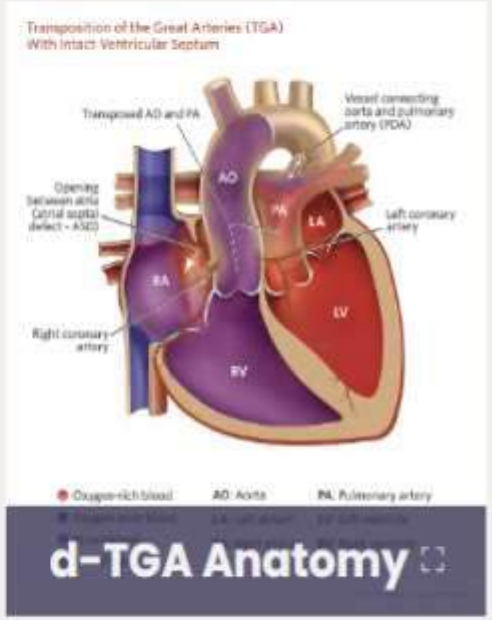
3 kg (just now)

FULL TEAM HUDDLE

d-TGA Resuscitation Review

Anticipated Stabilization Plan

- Routine NRP
- Pulse ox on right hand
- Starting FiO_2 21%
- Pulse oximetry goal: 75-85% after 5 minutes
- PGE1 (Alprostadil) 0.01 mcg/kg/min
- Destination Unit: CICU or Cath Lab



d-TGA Anatomy

Stabilization Specifics - If saturation ≥ 75% and well appearing after 5 min

- Proceed with vascular access
  - UVC- 5.0 Fr DL preferred
  - UAC
- Initiate
  - PGE1 (Alprostadil) 0.01 mcg/kg/min (in smaller lumen)
  - D10W at TFL 80 mL/kg/day (in larger lumen)
- Visit family

CHD Vascular Access

Next →

Time

00:00:19

NRP SpO_2 Target

60-65%

Anticipated Stabilization Plan

- Routine NRP
- Pulse ox on right hand
- Starting FiO_2 21%
- Pulse oximetry goal: 75-85% after 5 minutes
- PGE1 (Alprostadil) 0.01 mcg/kg/min

Acknowledgements

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Tom Reynolds, MFA, MBA

Children's Hospital of Philadelphia®

Frontier Programs

The future of pediatric medicine is here

DELIVERY ROOM OF THE FUTURE