Refractory cardiac arrest: shall we decide to cannulate ?

Dr Lionel BERTHOMIEU

Hôpital des Enfants

CHU TOULOUSE

Conflicts of interest

Nothing to declare

What are we talking about?

Terme	Définition
Arrêt cardiaque	Perte de conscience avec arrêt respiratoire et abolition des pouls ou nécessité d'un massage cardiaque externe pendant plus d'une minute
Arrêt respiratoire	Absence de respiration ou respiration inefficace nécessitant le recours à ventilation artificielle
Restauration d'une circulation spontanée (RCS)	Restauration d'une circulation spontanée pendant au moins 20 minutes
Survie à l'admission	Enfant vivant à l'arrivée en réanimation
Survie à la sortie de l'hôpital	Enfant quittant l'hôpital vivant
Pediatric cerebral performance category	1 (normal)
	2 (séquelles mineures sans conséquences sur la vie de l'enfant)
Catégorie de performance cérébrale pédiatrique	3 (séquelles modérées ou moyenne)
	4 (séquelles importantes lourdement handicapante)
	5 (état végétatif)
	6 (mort cérébrale)
Pediatric overrall performance category	1 (normal)
	2 (séquelles mineures)
Catégorie de performance pédiatrique globale	3 (séquelles modérées ou moyenne responsables d'un retard de développement et de difficultés scolaires)
	4 (séquelles importantes avec perte de l'indépendance de l'enfant)
	5 (état végétatif)
	6 (mort cérébrale)

Labenne M, Paut O: Arrêt cardiaque chez l'enfant: définition, épidémiologie, prise en charge et pronostic. Journal européen des urgences et de réanimation (2014) 26, 154-172

IHCA for Intra Hospital Cardiac Arrest
→ Survival rate 40-49%

OHCA for Out Hospital Cardiac Arrest
→ Survival rate 10%

CPR Cardiac pulmonary resuscitation

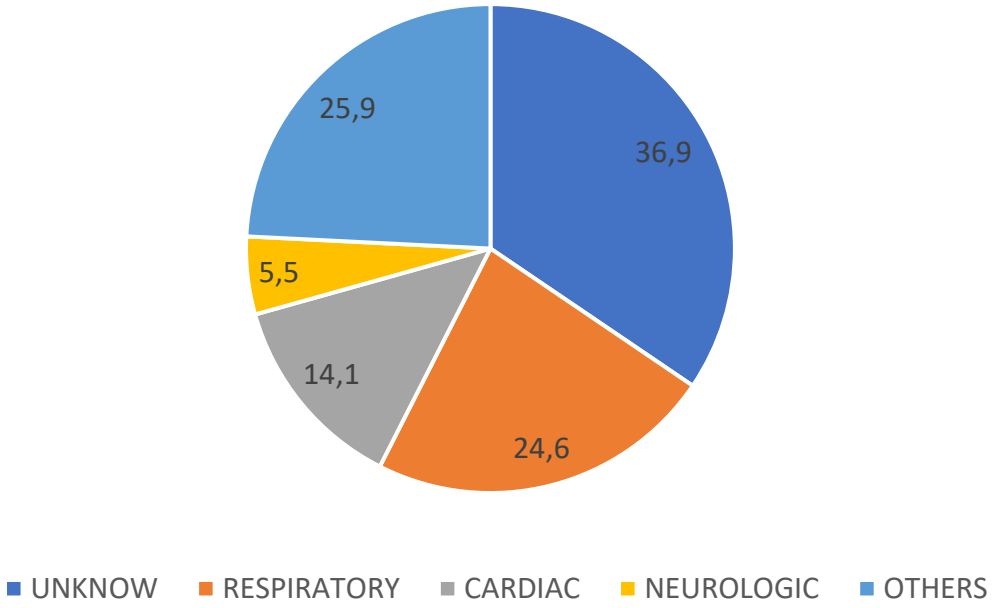
E-CPR Extracorporeal CPR

Tsao CW et al. Heart disease and stroke statistics-−2022 update: a report from the American heart association. Circulation. (2022)

Taylor Olson1 et al. Extracorporeal cardiopulmonary resuscitation in adults and children: A review of literature, published guidelines and pediatric single-center program building experience Frontiers (2022)

Epidemiology: How much and Where?

- Lack of data on children
- Lack of data in France (RéaC)



- Witness 53,5%
- Bystander CPR 56,4%

- Arrival of SAMU 17’
- No Flow median 8’
- Low Flow median 34’

- ROCS 25%
- Rate survival on day 0 27,1%

Survival rate
8,4% on day 30

M.Reicher Data from Daily Register on June 2023

Epidemiology: How much and Where?

Extracorporeal cardiopulmonary resuscitation in adults and children: A review of literature published Guidelines and pediatric single-center program building experience

Olson et al, Frontiers in medicine November 2022

- 154000 ECMO
  - → 12% ECPR
- 18000 ECPR
  - → 12% neonates
  - → 31% paediatric
  - → 57% adult

- Children received ECPR

→ 5680 IHCA with survival 42%

→ 70% for cardiac disease

On different register cardiac disease is the main indication with the best outcome

- Littles strong data for OHCA

HELP TO DECIDE: which patient ?

Children with cardiac disease is the best indication to improve survival?

What are the recommendations?

Children	
IHCA	**OHCA**
Cardiac: "ECPR may be considered for pediatric patients with cardiac diagnoses who have IHCA in settings with existing ECMO protocols, expertise, and equipment." (107) Class of recommendation: 2b Weak Level of evidence: Limited Data (C-LD)	"There is insufficient evidence to suggest for or against the use of ECPR for pediatric patients experiencing OHCA..." (107)
Non-cardiac: "There is insufficient evidence to suggest for or against the use of ECPR for….pediatric patients with noncardiac disease experiencing IHCA refractory to conventional CPR." (107)	
"…We advise considering eCPR for children with ED-or IHCA with a presumed or confirmed reversible cause where conventional ALS does not promptly lead to ROSC (weak recommendation, very low certainty evidence). An essential precondition is the organizational setting i.e., with a strong institution-based commitment to sustaining a resuscitation system that includes eCPR with appropriate quality improvement systems. To make a realistic choice about the use of eCPR, systems should also consider the evidence on cost-efficiency…" "Should ECPR be considered as a rescue therapy for septic IHCA the ECMO team must be activated early after initiation of PALS based on institution-specific protocols" (109)	"Given the high resources needed and the fact that outcome is related to time to initiation and quality of CPR before initiation, the indications for eCPR in OHCA are very limited." (109) Appendix RR 33.3 expands, "the writing group would consider E-CPR for OHCA in case (1) it concerns a deep hypothermic arrest …and/or (2) cannulation can be done prehospitally by a highly trained team, within a dedicated healthcare system that accounts for this (provided the no flow + low flow time is known and limited and the cause truly reversible)." (109)
"…ECPR may be considered as an intervention for selected infants and children (eg, pediatric cardiac populations) with IHCA refractory to conventional CPR in settings where resuscitation systems allow ECPR to be well performed and implemented (weak recommendation, very low-quality evidence)" (111–113)	"There is insufficient evidence in pediatric OHCA to formulate a treatment recommendation for the use of ECPR." (111–113)
"We suggest that institutions establish local protocols that guide their use of conventional CPR with or without ECPR. If institutions opt to deploy protocols that involve ECPR, one of the early steps of this protocol must include decision making by a senior clinician based on physiologic principles. Combining high-quality ECPR with high-quality conventional CPR may be considered if the cardiopulmonary arrest is witnessed and is associated with a reversible condition. Unwitnessed events in all settings have a poor prognosis and should be considered a relative contraindication for ECPR." (115)	"In children, there are insufficient data to support the recommendation for the use of ECPR for out-of-hospital cardiopulmonary arrest events, either applied in the field (e.g., trauma or remote retrievals of avalanche or drowning victims) or in the hospital after ongoing conventional CPR during transport." (115)

Olson et al, Frontiers in medicine November 2022

Extracorporeal Cardiopulmonary Resuscitation for Pediatric Cardiac Patients

Michael J. Wolf, MD, Kirk R. Kanter, MD, Paul M. Kirshbom, MD, Brian E. Kogon, MD, and Scott F. Wagoner, RRT

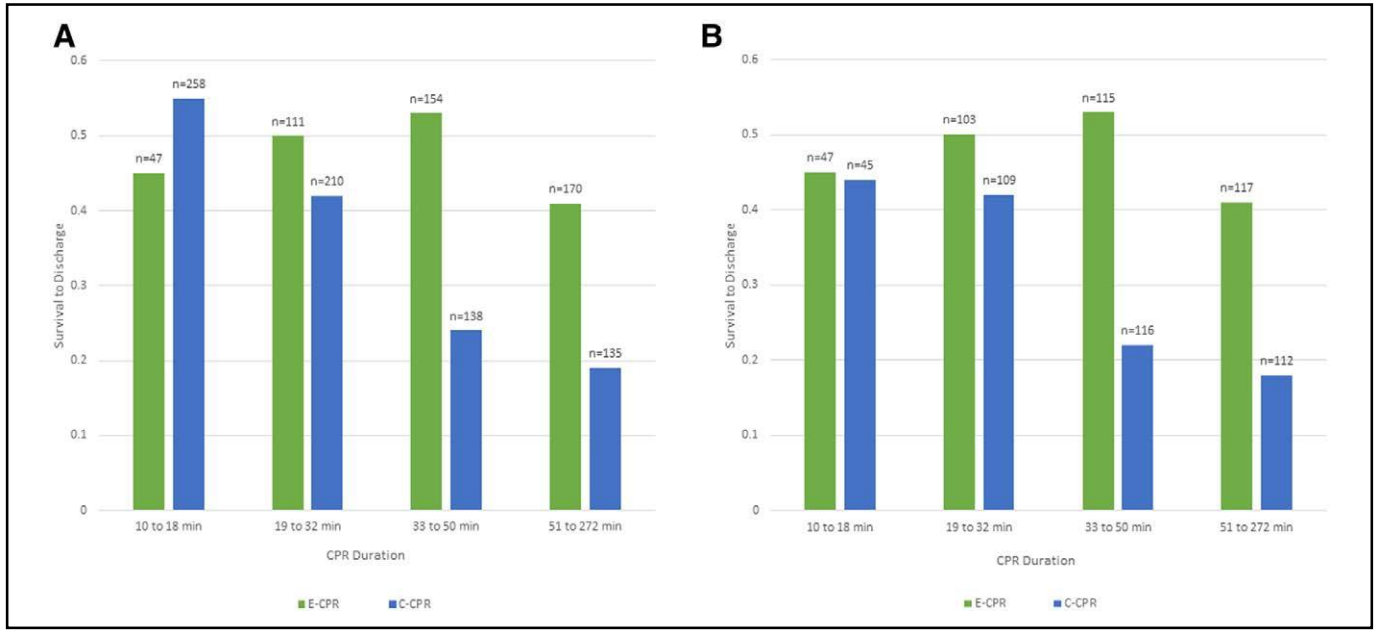
Division of Pediatric Cardiology, Department of Pediatrics, and Pediatric Cardiothoracic Surgery, Department of Surgery, Emory University School of Medicine; and Department of ECMO and Advanced Technologies, Children's Healthcare of Atlanta, Atlanta, Georgia

→ Survival rate 56%
→ Survival rate attempt 89% for CMD- myocarditis
→ 78% without transplantation

HELP TO DECIDE

Higher Survival With the Use of Extracorporeal Cardiopulmonary Resuscitation Compared With Conventional Cardiopulmonary Resuscitation in Children Following Cardiac Surgery: Results of an Analysis of the Get With The Guidelines-Resuscitation Registry*

Kobayashi et al , Critical Care Medicine ,April 2024



No difference for the quartile 10-18'

After survival increased with ECPR

→ *ANTICIPATION*

HELP TO DECIDE :

Goto *et al. Critical Care* 2014, **18**:R133
http://ccforum.com/content/18/3/R133

CRITICAL CARE

RESEARCH Open Access

Decision tree model for predicting long-term outcomes in children with out-of-hospital cardiac arrest: a nationwide, population-based observational study

Yoshikazu Goto[1*], Tetsuo Maeda[1] and Yumiko Nakatsu-Goto[2]

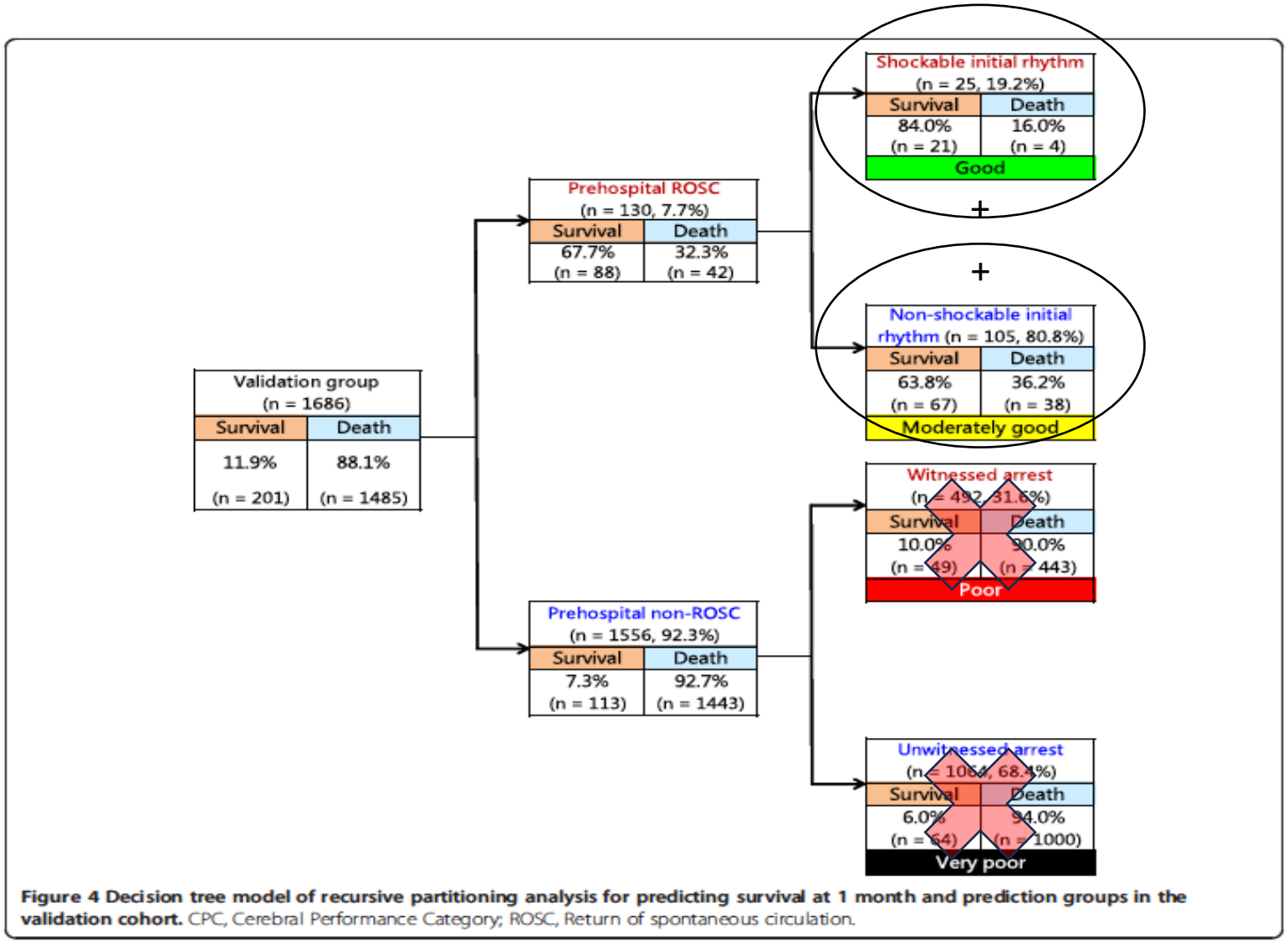


Figure 4 Decision tree model of recursive partitioning analysis for predicting survival at 1 month and prediction groups in the validation cohort. CPC, Cerebral Performance Category; ROSC, Return of spontaneous circulation.

Decision support in whether or not to continue treatment
Place of ECPR on admission or post-arrest ECMO

Patient selection: ETCO2 help to decide??

- Early Cardiac Arrest Hemodynamics, End-Tidal Co2, and Outcome in Pediatric Extracorporeal Cardiopulmonary Resuscitation: Secondary Analysis of the ICU-RESUScitation Project Dataset (2016–2021)*

Yates et al , Pediatric Critical Care Medicine April 2024 • Volume 25 • Number 4

Survival with favorable neurologic outcome occurred in 41% of ECPR patients with high-quality CPR in the initial 10 minutes of resuscitation.

Candidates for ECPR with end-tidal Co_2 less than 10 mm Hg may survive with favorable neurologic outcome.

We did not demonstrate an association between the hemodynamics achieved by high-quality CPR and survival to hospital discharge with favorable neurologic outcome.

HOW TO IMPROVE RESULTS / OUTCOMES and ENCOURAGE ECPR

Resuscitation 83 (2012) 710–714

Contents lists available at SciVerse ScienceDirect

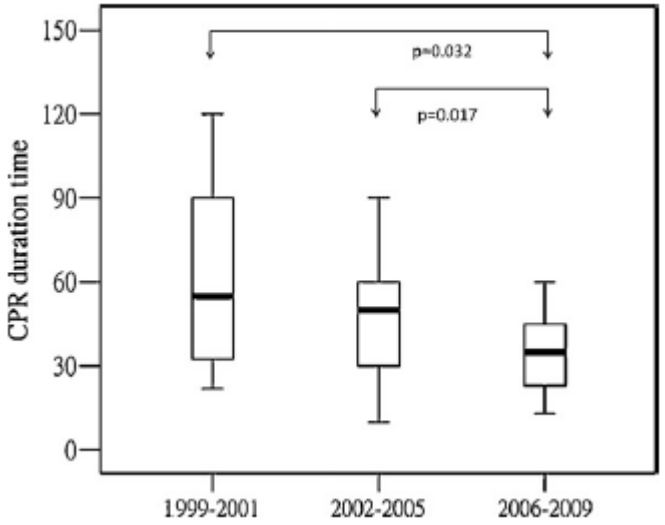
Resuscitation

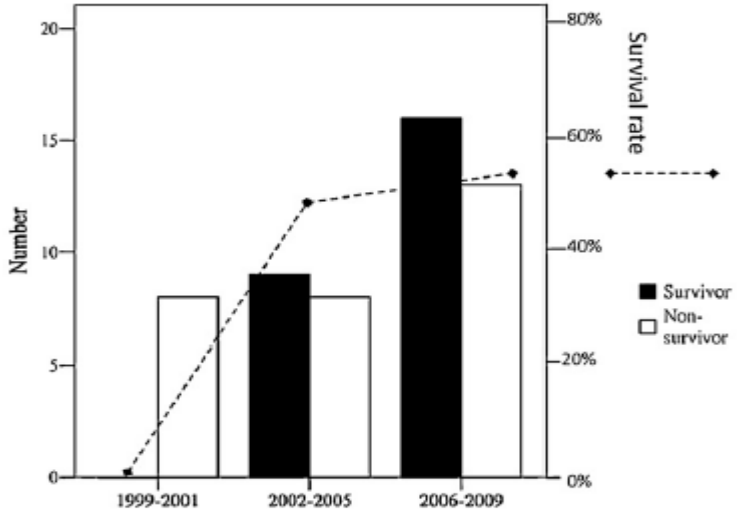
journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Eleven years of experience with extracorporeal cardiopulmonary resuscitation for paediatric patients with in-hospital cardiac arrest☆

Shu-Chien Huang[a], En-Ting Wu[b], Ching-Chia Wang[b], Yih-Sharng Chen[a], Chung-I. Chang[a], Ing-Sh Chiu[a], Wen-Je Ko[a], Shoei-Shen Wang[a,*]





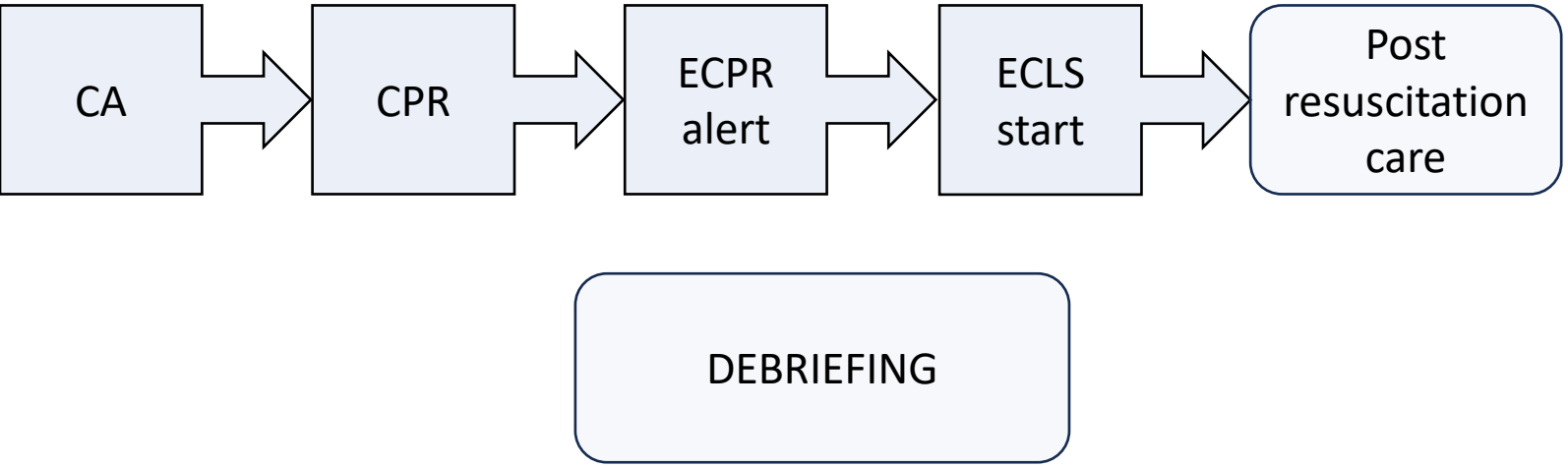
HOW TO IMPROVE RESULTS / OUTCOMES and ENCOURAGE ECPR

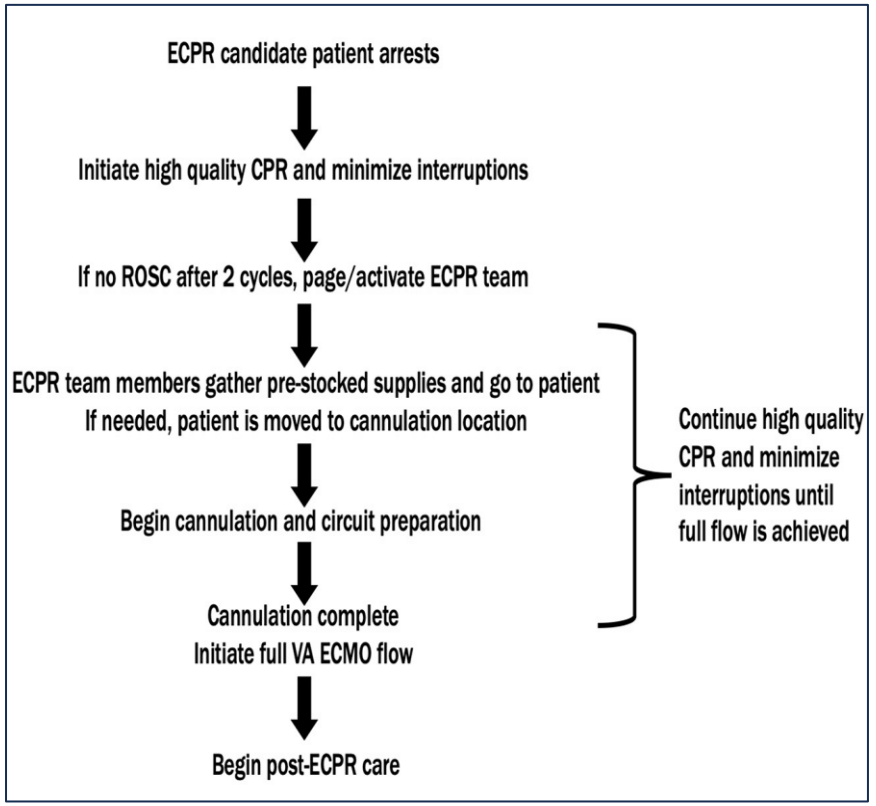
Extracorporeal cardiopulmonary resuscitation in adults and children: A review of literature published Guidelines and pediatric single-center program building experience

Olson et al, Frontiers in medicine November 2022

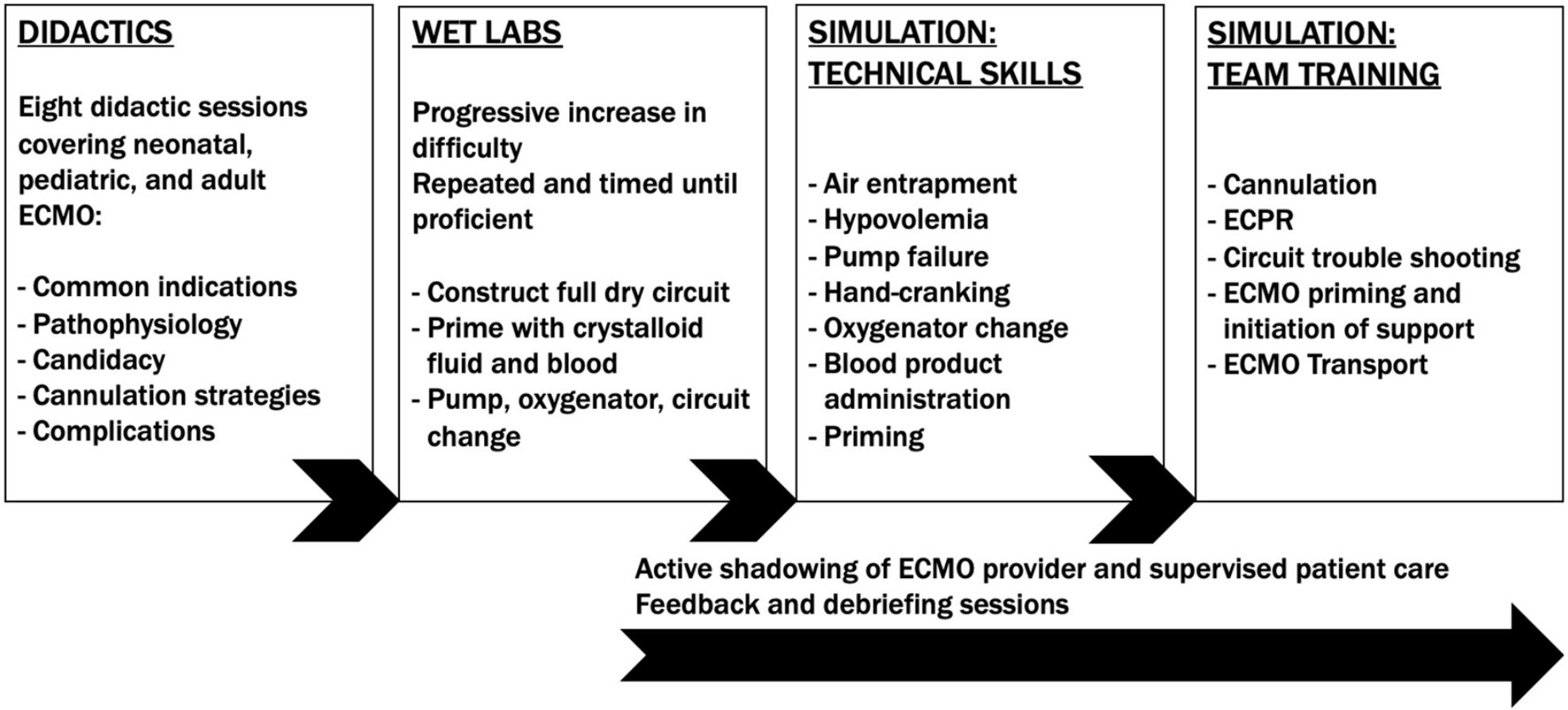
→ Example from Texas Children Hospital

Program begin on 2005 and every ECPR is an opportunity to upgrade practices





HOW TO IMPROVE RESULTS / OUTCOMES and ENCOURAGE ECPR



TAKE HOME MESSAGE

- ECPR improve survival for IHCA on patient with cardiac disease
- ECPR must be integrated into an institutional program
- ECPR must be evaluated by cohort monitoring
- ECPR must be the subject of specific continuing training