
# Emergency Department eCPR: An Exploratory Observational Study of Human Factors

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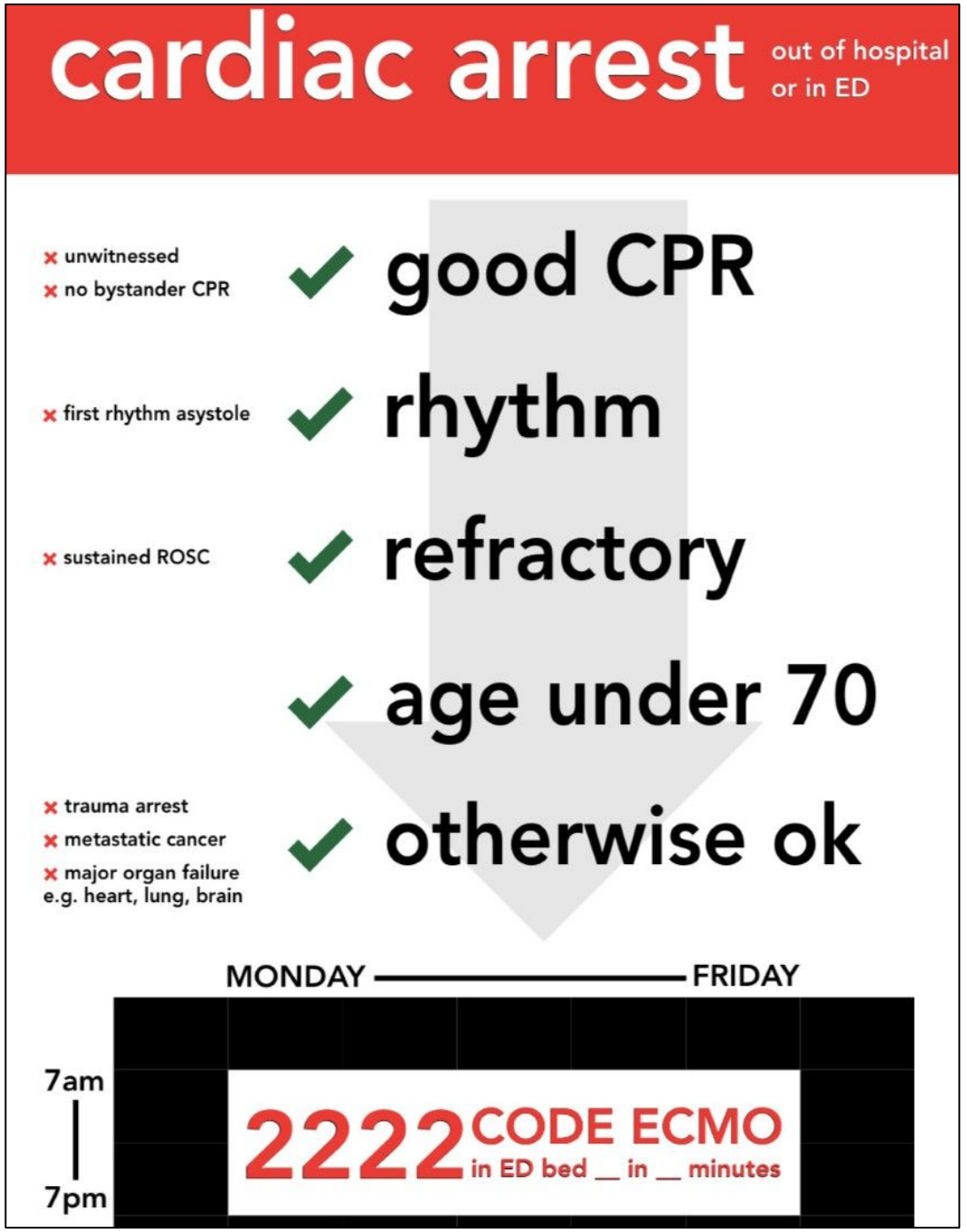
## Overview

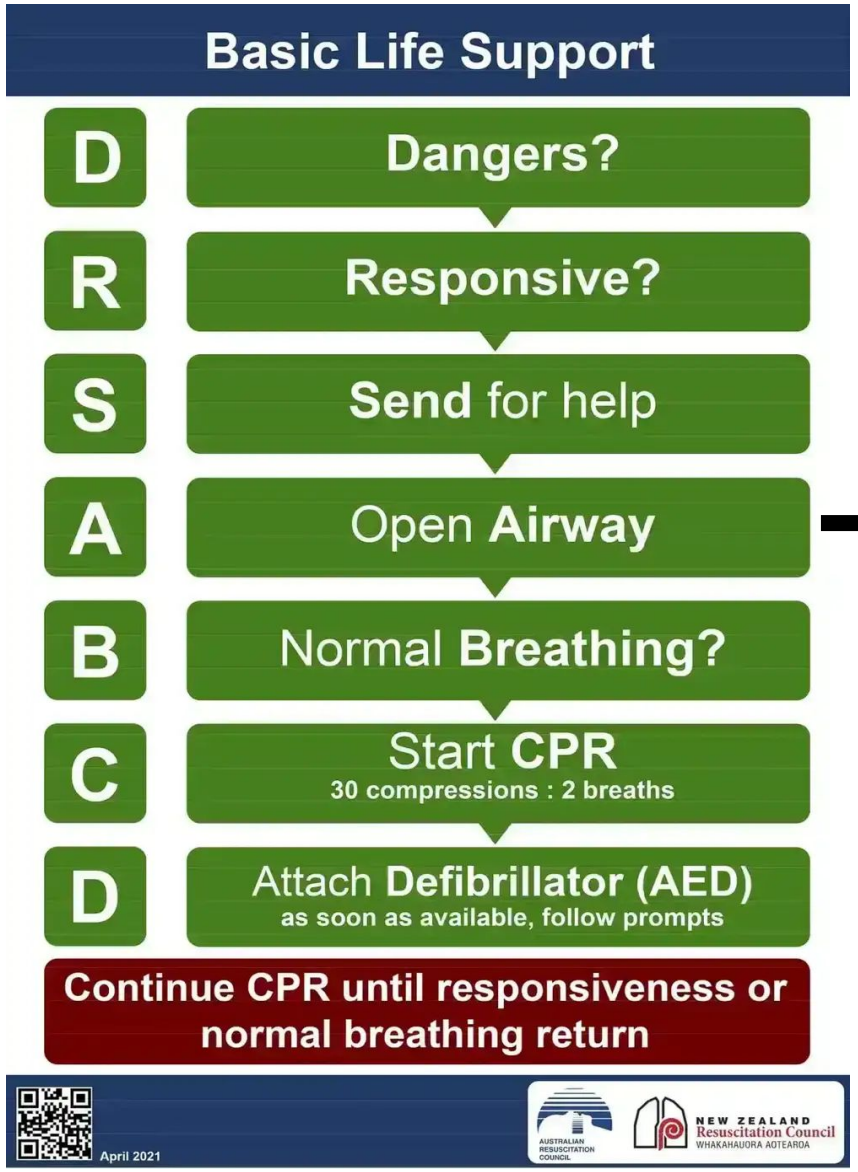
ECMO = extracorporeal membrane oxygenation

# ‘LOW FLOW’ TIME 25 MINUTES
# “PLEASE TREAT THIS 55 YEAR OLD PATIENT WITH REFRACTORY VF ARREST”

# When do we activate the team?

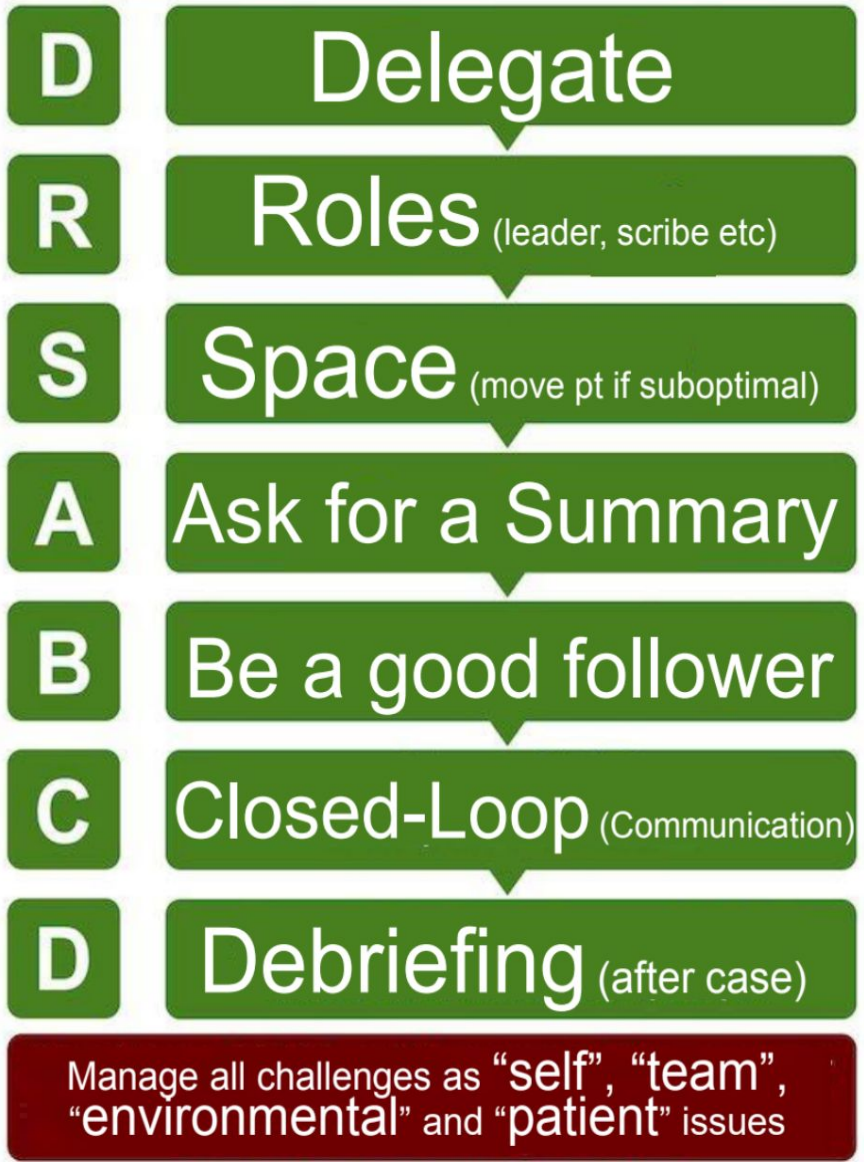


# Technical

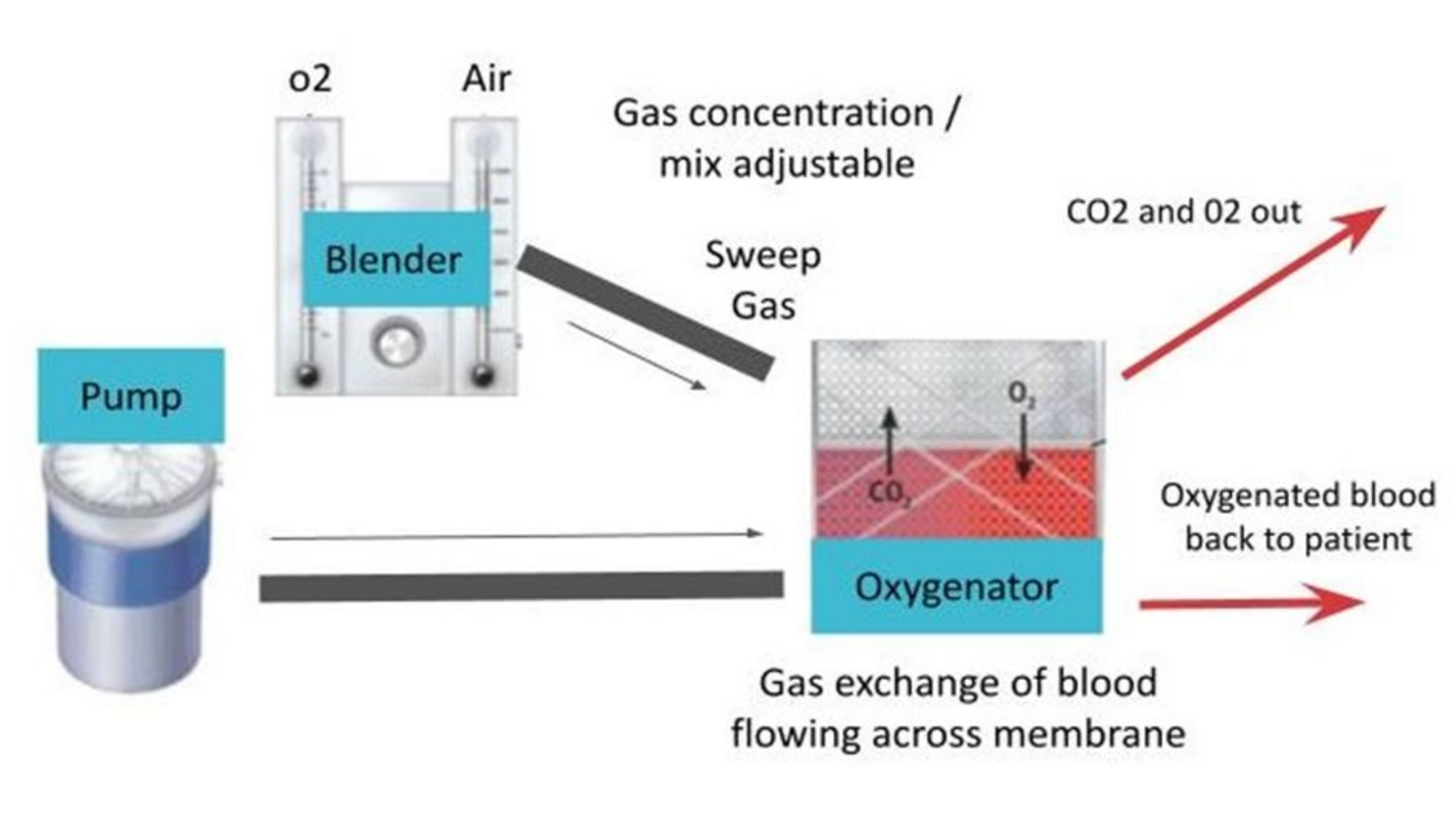



~~MAFS~~

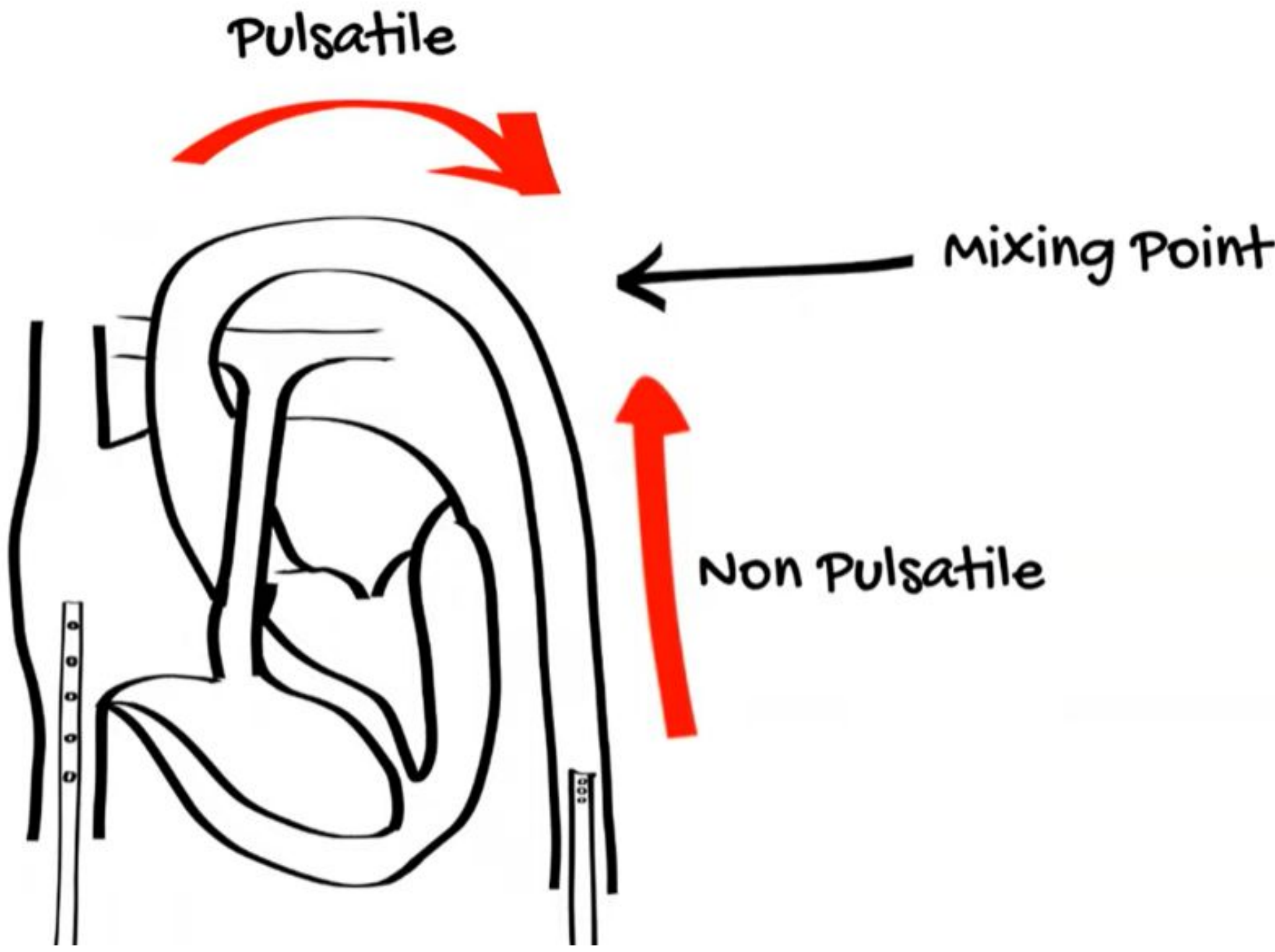
# Non-Technical



# What does it look like?


o2
Air
Gas concentration /
mix adjustable
Blender
Sweep
Gas
CO2 and 02 out
Pump
$O_2$
$CO_2$
Oxygenated blood
back to patient
Oxygenator
Gas exchange of blood
flowing across membrane

# Venous-Arterial (VA) ECMO



# Slides and References

iPhone / iPad (iOS)

Android / Google Play

Slides available at: www.emergencypedia.com/ECMO

**This study was supported by SIMULATION in several ways:**

a) to *design* the eCPR system;
b) to *rehearse* and refine a *research* protocol before real clinical events (Fatovich et al)
c) to identify *targets* for improvement and *support* improvement (TALK/STOP-5)


# eCPR

- High acuity
- Low occurrence
- High coordination burden
- High environmental load

# Methods

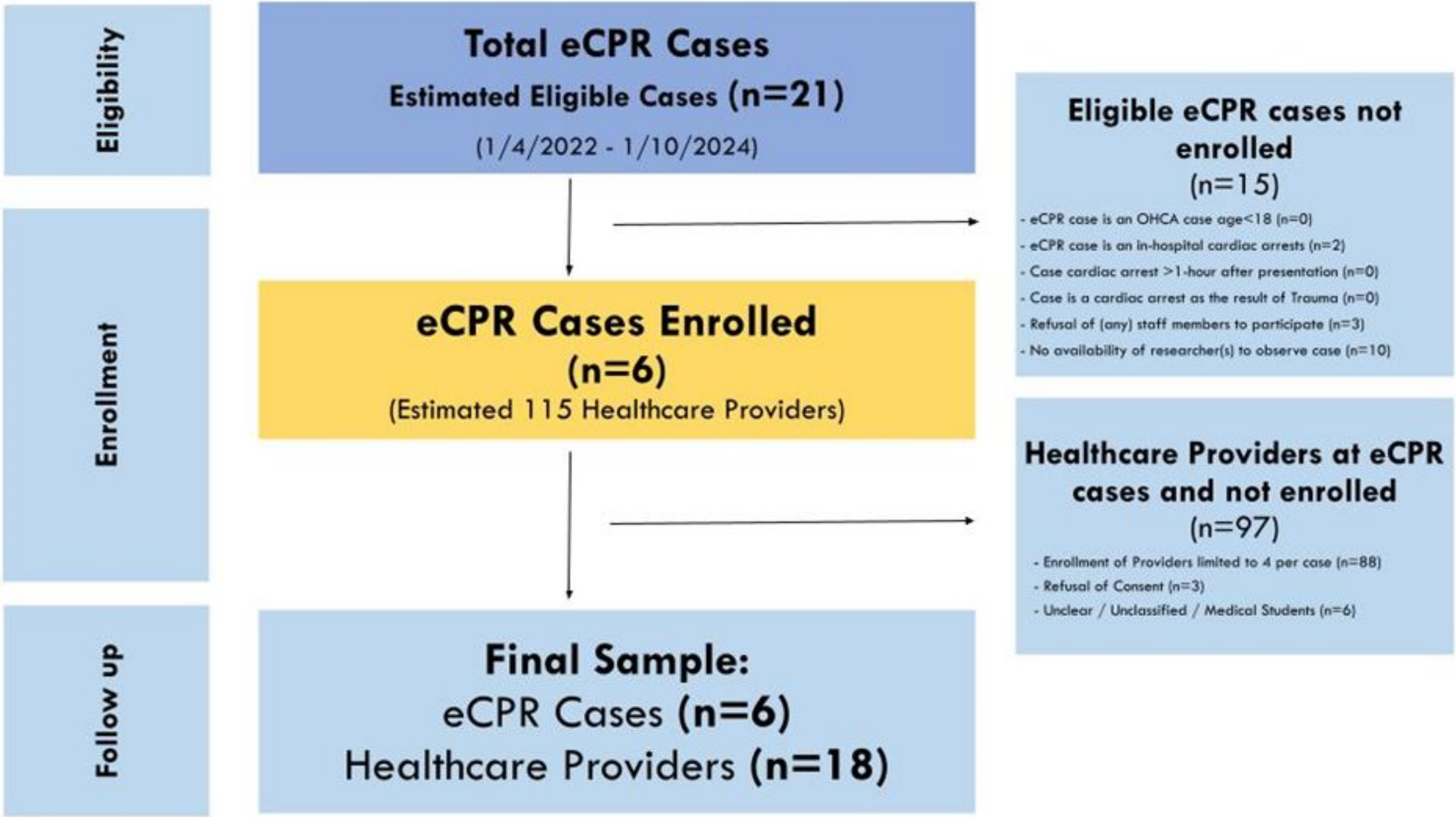
EXPLORATORY OBSERVATIONAL DESIGN

HUMAN FACTORS FOCUS

- Exploratory two-phases
  - Simulation
  - Cases
- 2 eCPR hospital sites over 32 months,

- Reid's Domains Observed

- Aligned Outcomes ----------


Eligibility
Enrollment
Follow up
Total eCPR Cases
Estimated Eligible Cases (n=21)
(1/4/2022 - 1/10/2024)
eCPR Cases Enrolled
(n=6)
(Estimated 115 Healthcare Providers)
Final Sample:
eCPR Cases (n=6)
Healthcare Providers (n=18)
Eligible eCPR cases not enrolled
(n=15)
- eCPR case is an OHCA case age<18 (n=0)
- eCPR case is an in-hospital cardiac arrests (n=2)
- Case cardiac arrest >1-hour after presentation (n=0)
- Case is a cardiac arrest as the result of Trauma (n=0)
- Refusal of (any) staff members to participate (n=3)
- No availability of researcher(s) to observe case (n=10)
Healthcare Providers at eCPR cases and not enrolled
(n=97)
- Enrollment of Providers limited to 4 per case (n=88)
- Refusal of Consent (n=3)
- Unclear / Unclassified / Medical Students (n=6)

# Outcomes

## PATIENT OUTCOMES

- Utstein measures
- eCPR timings

## PROVIDER OUTCOMES

- Mobile heart rate monitoring

- Salivary cortisol

- Validated psychometric measures

## TEAMWORK

- Mayo High-Performance Teamwork Score (MHPTS)

## ENVIRONMENT

- Ambient noise levels

- Team headcounts

- Observed eCPR workflow

# Dropped or Kept after Simulation Testing?

***SIM PILOT***

Video tracking
Pedometers
Physiological monitoring
Noise
Teamwork scoring
Environmental observations
Follow-up cortisol

***POST PILOT***

Keep noise measurement
Keep MHPTS/teamwork observation
Keep selected stress measures
Drop video tracking
Drop pedometers
Simplify observer workflow
Prepare follow-up pathways

# Results


6
eCPR cases
18
observed
providers
155
minutes
observable
teamwork


S
SELF
High stress signal
Elevated heart rate and cortisol
High cognitive load
Reported mental effort during cases
Variable stress responses
Across roles and timepoints
T
TEAM
Moderate–high teamwork scores
(All MHPTS Scores >10/15)
Strengths in leadership, coordination, communication, mutual support
E
ENVIRONMENT
Median headcount: 20
IQR 16–24
Noisy environment
Median 78 dBA (IQR 72–86)
Crowded, dynamic setting
High activity and interruptions
P
PATIENT
Six cases observed
3 survived to hospital discharge
50% survival to hospital discharge
155 minutes of observable teamwork
Across six eCPR cases


## PATIENT

**Six cases observed**

**3 survived to hospital discharge**
50% survival to hospital discharge

**155 minutes of observable teamwork**
Across six eCPR cases

“That was my last memory until I woke up in Westmead Hospital two weeks later.”

Simeon is alive today thanks to ECMO at Westmead Hospital

On the day he collapsed, Simeon’s heart kept going into a lethal arrhythmia and was effectively in cardiac arrest. He was defibrillated multiple times before he was placed on a form of life support known as extracorporeal membrane oxygenation – or ECMO.


ECMO is action (left) and Simeon with his daughters

Once recovered, he was fitted with an implantable cardioverter defibrillator (ICD). The device constantly monitors his heart rate and can administer shocks to save him in a medical

# SELF

**High stress signal**
Elevated heart rate and cortisol

**High cognitive load**
Reported mental effort during cases

**Variable stress responses**
Across roles and timepoints

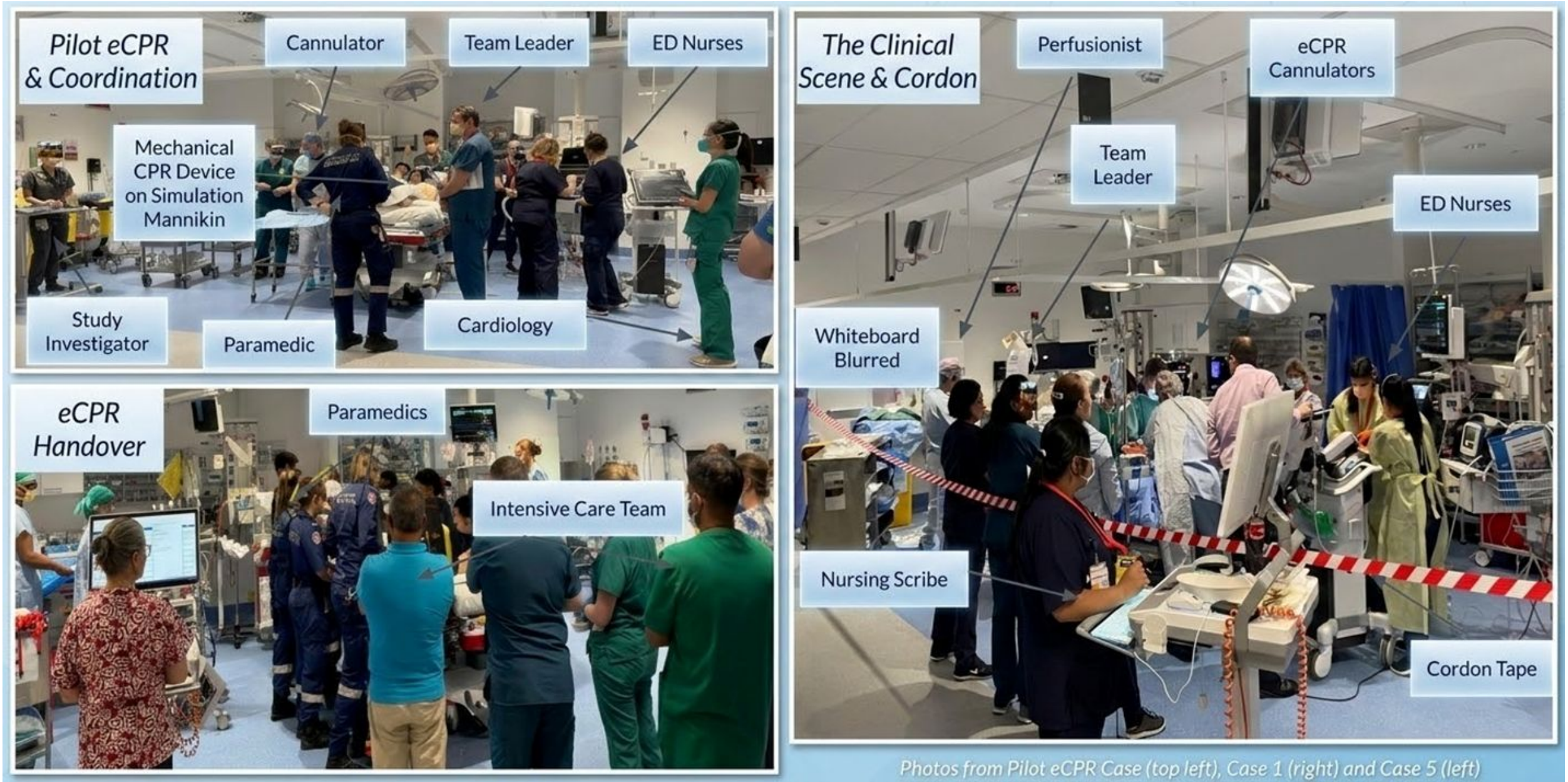
# TEAM

**Moderate–high teamwork scores**

Median MHPTS overall 4.6/5

**Strengths in leadership, coordination, communication, mutual support**

# Results




Photos from Pilot eCPR Case (top left), Case 1 (right) and Case 5 (left)

# ENVIRONMENT

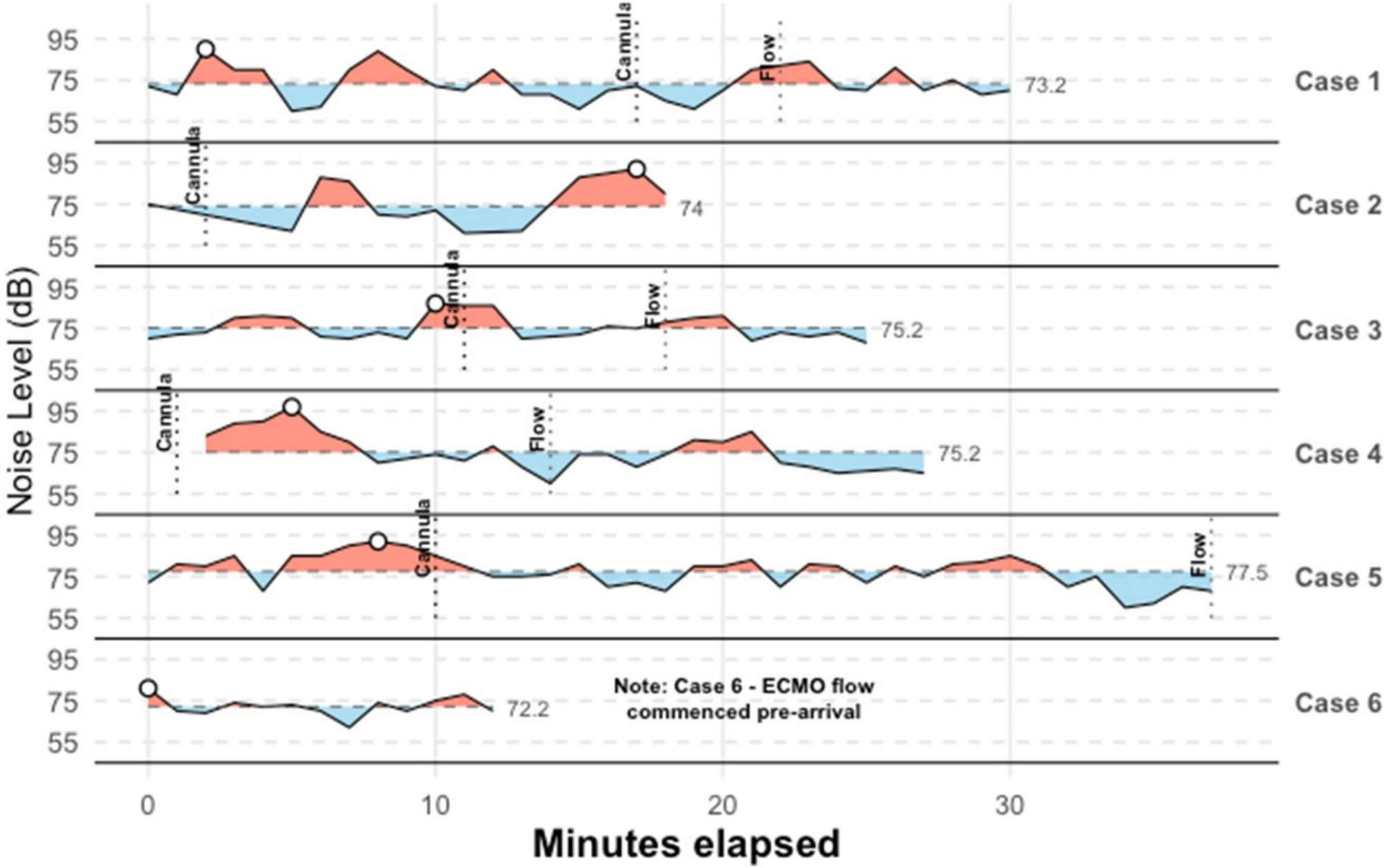
**Median headcount: 20**
IQR 16–24

**Noisy environment**
Median 78 dBA (IQR 72–86)

**Crowded, dynamic setting**
High activity and interruptions


Bed
4

# Results


Noise Level (dB)
95
75
55
Cannula
Flow
73.2
Case 1
74
Case 2
75.2
Case 3
75.2
Case 4
77.5
Case 5
72.2
Case 6
Note: Case 6 - ECMO flow commenced pre-arrival
0
10
20
30
Minutes elapsed

# Quick Reflections:

## What we observed?

## What we learned?

# Team Leader Checklist

## ED TEAM LEADER ECPR CHECKLIST

### PRE-ARRVAL

**DECLUTTER:** Remove unnecessary equipment
**ROLE ALLOCATION:** Assign ED roles – lanyards
**CROWD CONTROL**
**EQUIPMENT:** ECMO trolley foot of bed
TOE: right of patient
Vascular U/S: left of patient
**DRUGS:** ACLS drugs

## ED TEAM

**ED Medical Team leader (ED Senior MO)**

Suggested Tasks:

- Overall in-charge
- Remain Hands off
- Allocate Roles
- Drive Resuscitation in terms of Disposition/Diagnosis
- ANNOUNCE TRANSITION TO ECMO CPR (e-CPR) - Stop shocks/drugs

## ED TEAM

**Airway MO (ED Senior MO or TOE anaesthetics)**

Suggested Tasks:

- PPE 5-point
- Assist RNs with ALS, intubate and tie tube
- Connect EtCO2/ventilator
- Leave room if complete - handover to TOE Doctor

## ED or ICU TEAM

**Circulation MO (ED Senior MO or ICU MO)**

Suggested Tasks:

- Prepare USS, lines
- Stand right side of room
- Large IV line Send VBG
- Left arm Art Line (USS)
- Liaise with ICU - ask for further role(s) if complete

## ED TEAM

**Nursing Team leader**

Suggested Tasks:

- Remain Hands off
- Work with Medical T/L
- Allocate resources
- Drive Resuscitation in terms of logistics
- Keep noise down

## ED TEAM

**Crowd Control Person (Senior RN or MO)**

Suggested Tasks:

- Remain Hands off
- Prevent CHAOS / NOISE
- Assist T/L with logistics
- Prevent Noise from Observers
- Create / Control Cordon

## ED TEAM

**Nursing Scout Nurse / Runner / Scribe**

Suggested Tasks:

- Scribe, record ETCO2 (every 4-5 mins)
- Set up procedure trolleys outside resuscitation room
- Get any other equipment
- Assist Nursing T/L and inside nurses as required


Bed
4

BLUE = EQUIPMENT

GOLD = THE ED TEAM

RED = THEATRE / EXTERNAL TO THE ED TEAM

**Airway ED Nurse**
(Airway, Drugs)

**Airway ED Doctor**
(Intubate, Tie Tube, Connect to EtCO2)

Defibrillator
Monitor
Ventilator

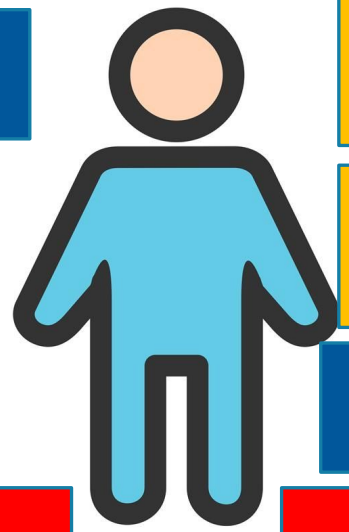
Use the Largest Resus Bay Available

USS TOE

**Defib ED Nurse**
(COACH, Operate LUCAS, Drugs)

**TOE Anaesthetist**

**Circulation ED Doctor**
(Large IV and Art line Radial)



USS 1

Spare USS

ED TEAM IN AND OUT

ECMO TEAM MUSTERING and TROLLEY

**Cannulation Doctor 1**

ECMO GEAR

**Cannulation Doctor 2**

**Scrub Nurse**

**Perfusionist**

EXTERNAL TEAM ENTRY

**Crowd Control ED Leader (ED Senior 2)**

**Medical ED Team leader (ED Senior)**

**Nurse ED Team leader (Senior ED RN)**

ENTRY

EXIT

CORDON OFF - RED LINE (only role allocated members in resuscitation bay)

**Cardiology (Mobile)**

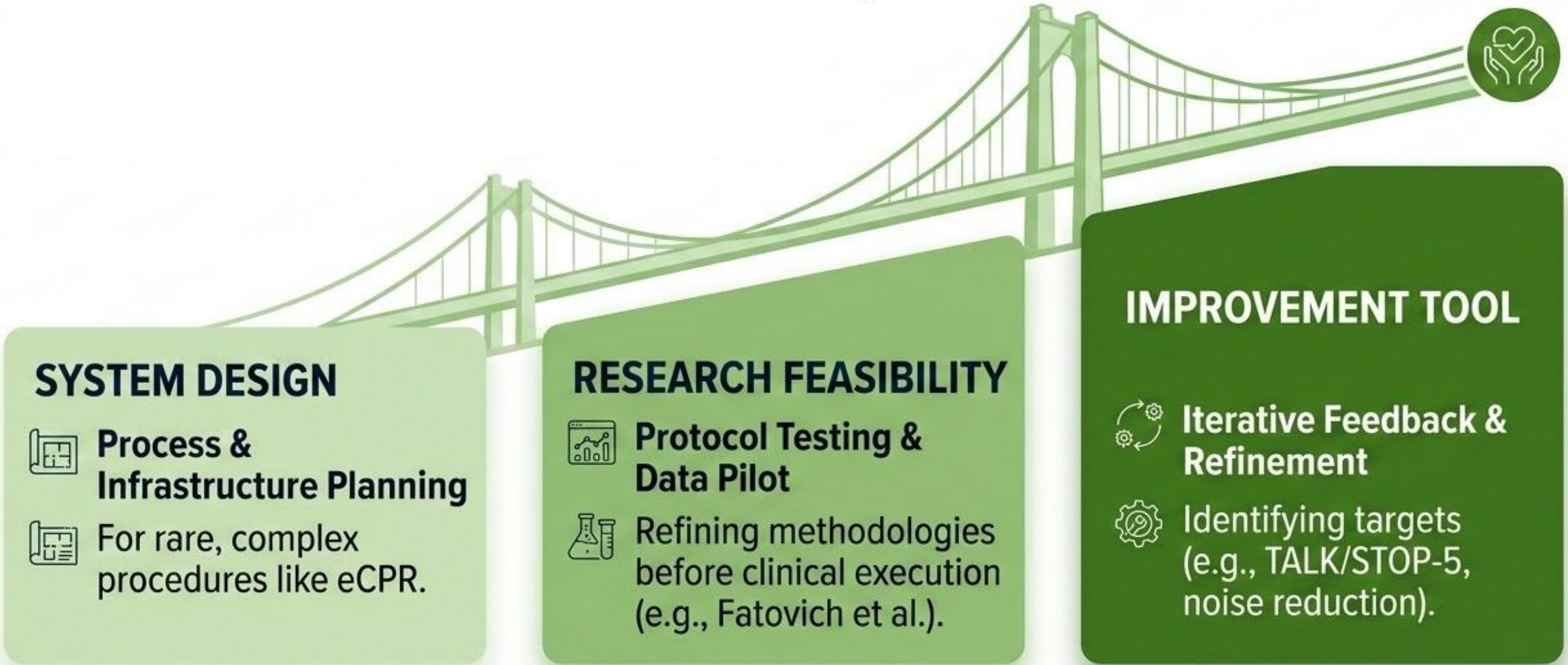
**ICU Doctor**

**Observers**
(remain behind CORDON red line)

**"Scout" ED Nurse (Comms if single room)**
(Set up trolleys, non-ALS drugs)

**Cardiothoracics Team**

# Beyond Training: Simulation as a Strategic Tool



## SYSTEM DESIGN

**Process & Infrastructure Planning**

For rare, complex procedures like eCPR.

## RESEARCH FEASIBILITY

**Protocol Testing & Data Pilot**

Refining methodologies before clinical execution (e.g., Fatovich et al.).

## IMPROVEMENT TOOL

**Iterative Feedback & Refinement**

Identifying targets (e.g., TALK/STOP-5, noise reduction).

# Take Home, Questions, Resources

iPhone / iPad (iOS)

Android / Google Play

Slides available at: **www.emergencypedia.com/ECMO**