The Shock Team: Necessary or Nonsense?

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Disclosure Statement of Financial Interest

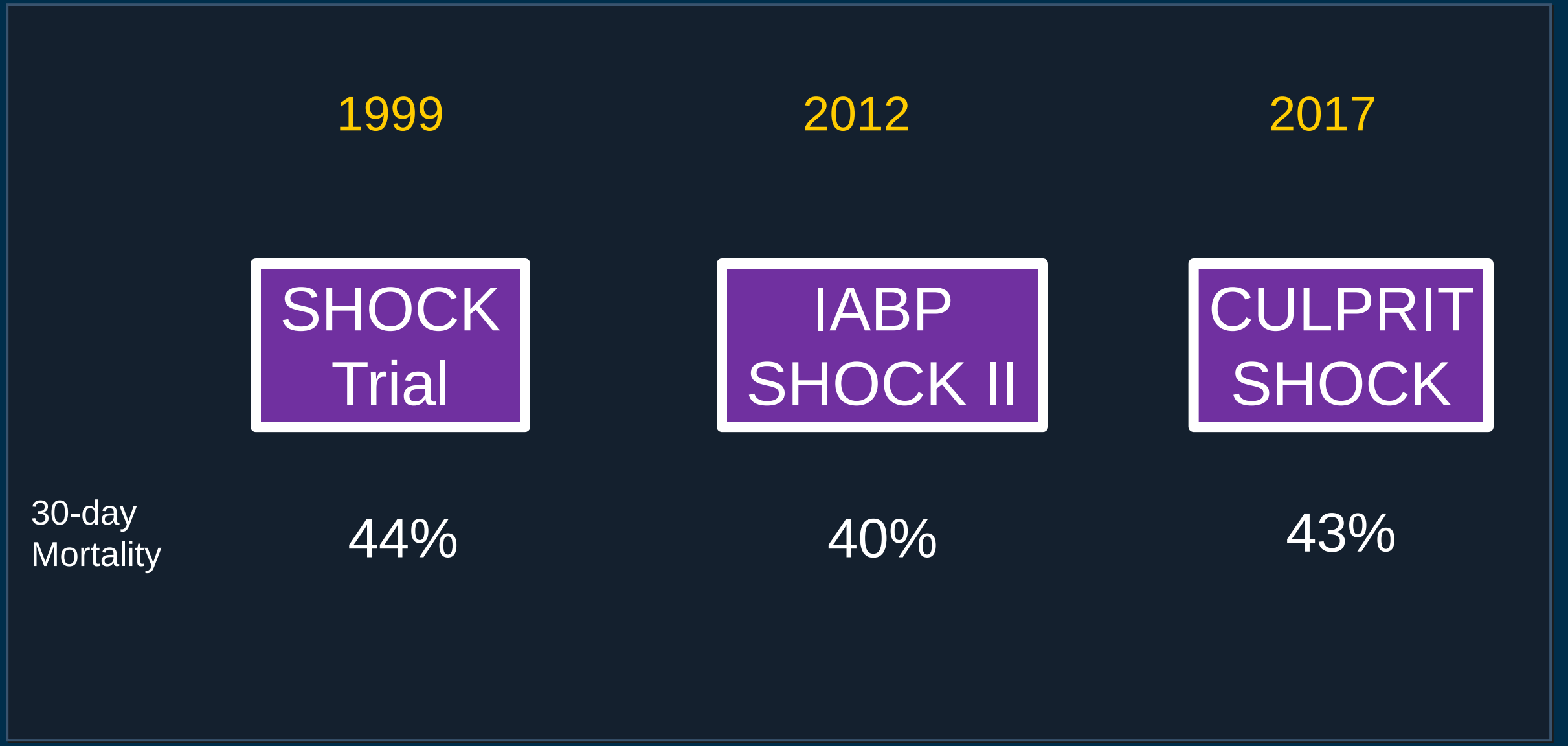
None

The Shock Team: Necessary or Nonsense?

- Rationale of shock teams “THE WHY”
- Members of the shock team “THE WHO”
- Shock Protocols “THE WHAT”
- Shock Centers and Shock Networks “THE WHERE”

The “WHY”

Mortality in Cardiogenic Shock Remains Elevated

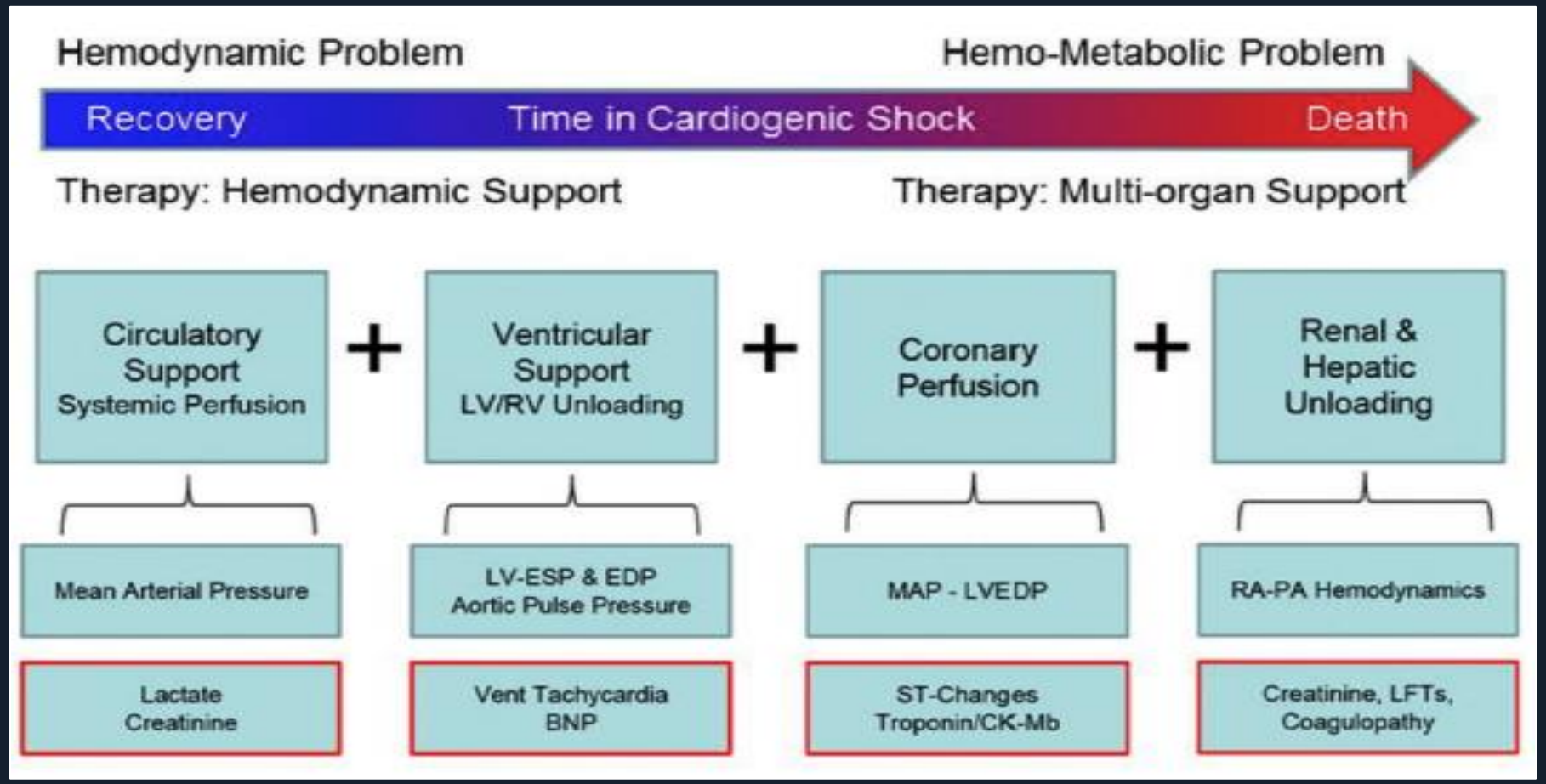


Hochman J et al. NEJM 1999. White H et al Circulation 2005
Thiele H et al. NEJM 2012. Thiele H et al. NEJM 2017

Cardiogenic Shock: Not a single organ condition!

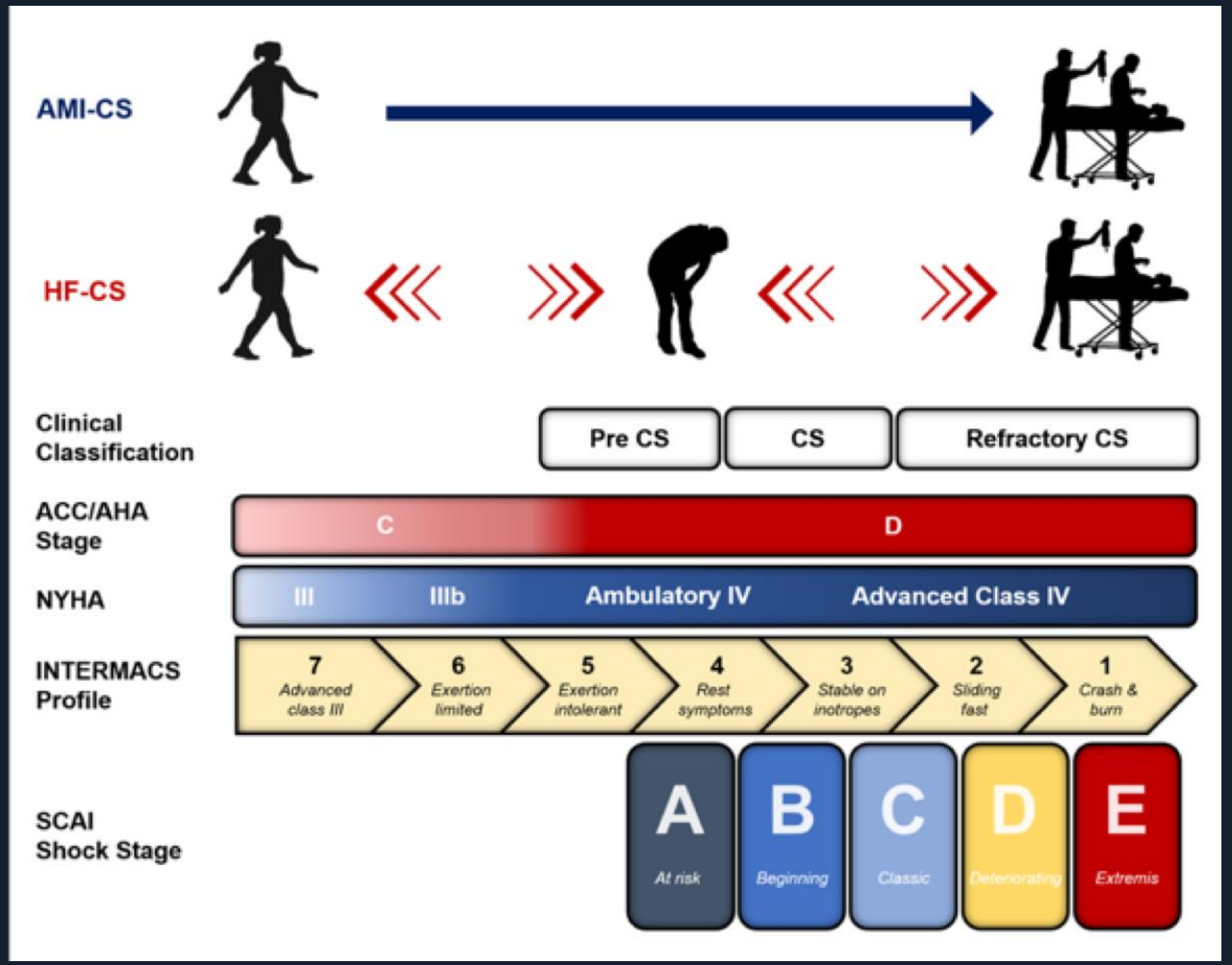
Delirium, Pain | Resp Failure | ID Issues

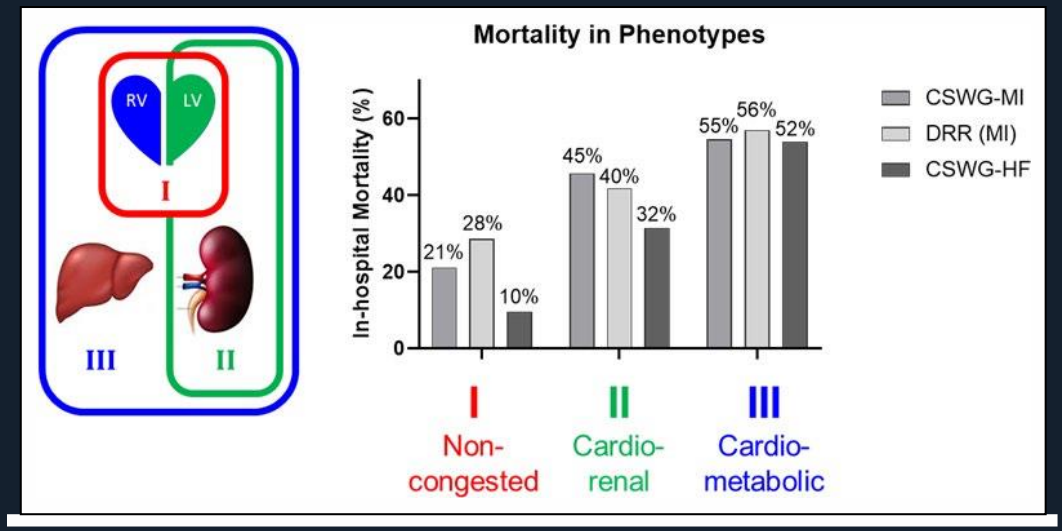
Renal Failure | Palliative care | GI Issues



Esposito M, Kapur N. F1000 Research 2017

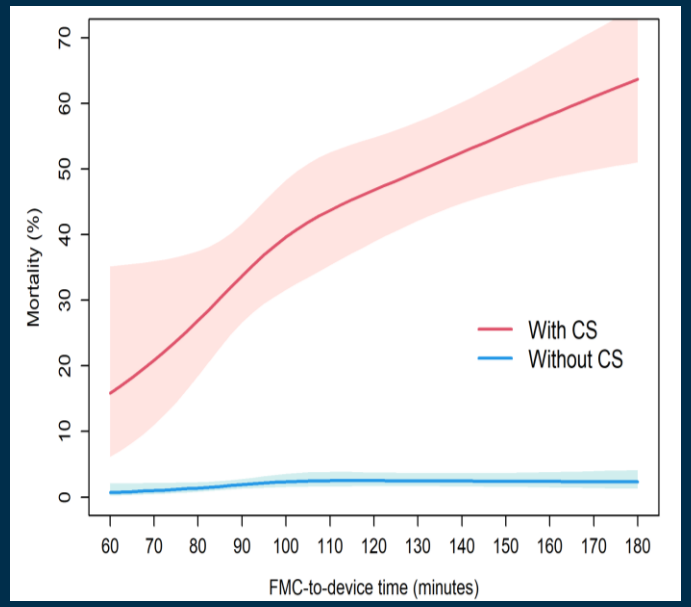
Cardiogenic Shock Phenotypes + Comorbidities Call for a Multidisciplinary Approach



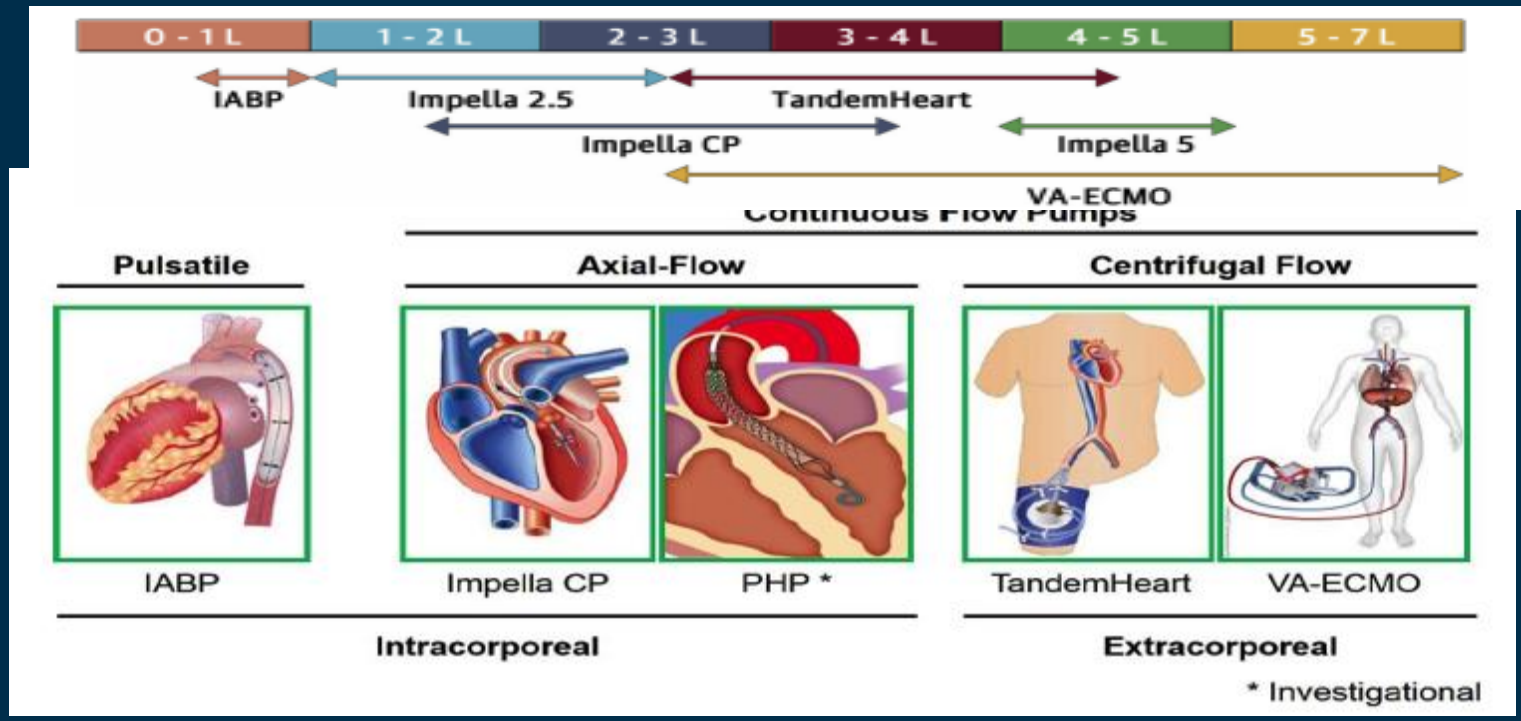


Zweck E. J Am Heart Assoc. 2021;10:e020085. DOI: 10.1161; Esposito M, Kapur N. F1000 Research 2017

Timely and Appropriate Therapies



Delays in reperfusion for AMICS associated with increased mortality



Kochan AF…Alviar CL…Fordyce CB. Under review

The “Who”: the Shock Team

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EDITORIAL COMMENT

Cardiogenic Shock Management Should Be a Team Sport*

Perwaiz M. Meraj, MD,[a] William W. O'Neill, MD[b]

Members of the Cardiogenic Shock Team

Element	On-call physician representative	Responsibilities	Necessary components
1) Intensive care unit	Coordinating physician (intensivist or cardiologist)	-Diagnosis -Triage -Activation of additional team members -Medical management -Invasive hemodynamic monitoring -Maintenance of hemodynamic support devices	-24-hour on-site physician -24-hour nursing support for vasopressor and inotrope infusions, PA catheters and hemodynamic support devices
2) Cardiac catheterization laboratory	Interventional cardiologist	-Revascularization for AMI -Percutaneous hemodynamic support device placement	-On call nurse and technician team -24-hour cath lab availability
3) Cardiothoracic surgery	Cardiothoracic surgeon	-ECMO placement -Temporary VAD placement -Heart transplantation	-On-call OR staff -On-call perfusionist team -24-hour operating room availability
4) Advanced heart failure	Advanced heart failure cardiologist	-Coordinate medical evaluation and listing for heart transplantation and durable VAD -Identify treatment options for patients with decompensated CHF	-Participation in United Network for Organ Sharing (UNOS) -Mature VAD program

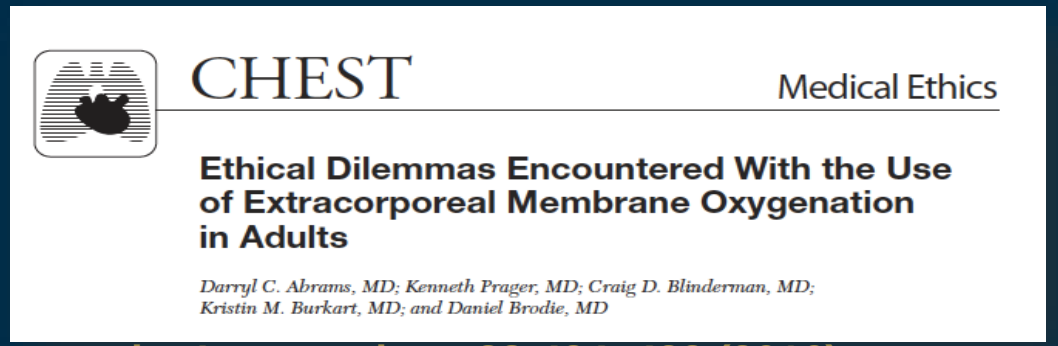
Other CS members:

- Pharmacists
- Palliative Care
- Psychiatry/Psychologist
- Social work
- PT/OT
- Respiratory therapist
- Geriatrician
- Bioethicist
- Primary physician


ORIGINAL RESEARCH

Ethics Committee Consultation and Extracorporeal Membrane Oxygenation

Andrew M. Courtwright[1,2], Ellen M. Robinson[1,3], Katelyn Feins[4], Jennifer Carr-Loveland[4], Vivian Donahue[5,6], Nathalie Roy[7], and Jessica McCannon[8]

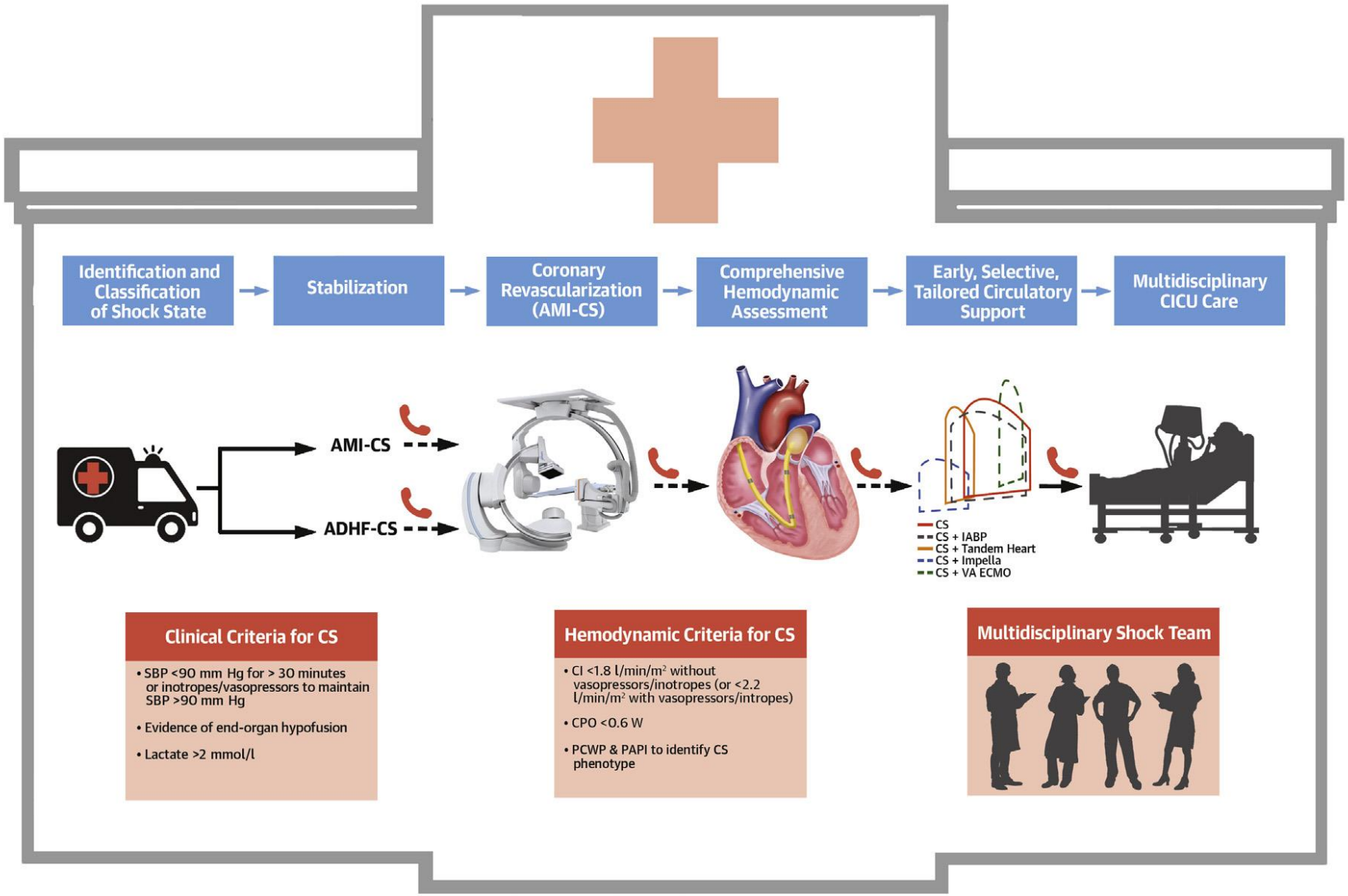

CHEST Medical Ethics

Ethical Dilemmas Encountered With the Use of Extracorporeal Membrane Oxygenation in Adults

Darryl C. Abrams, MD; Kenneth Prager, MD; Craig D. Blinderman, MD; Kristin M. Burkart, MD; and Daniel Brodie, MD

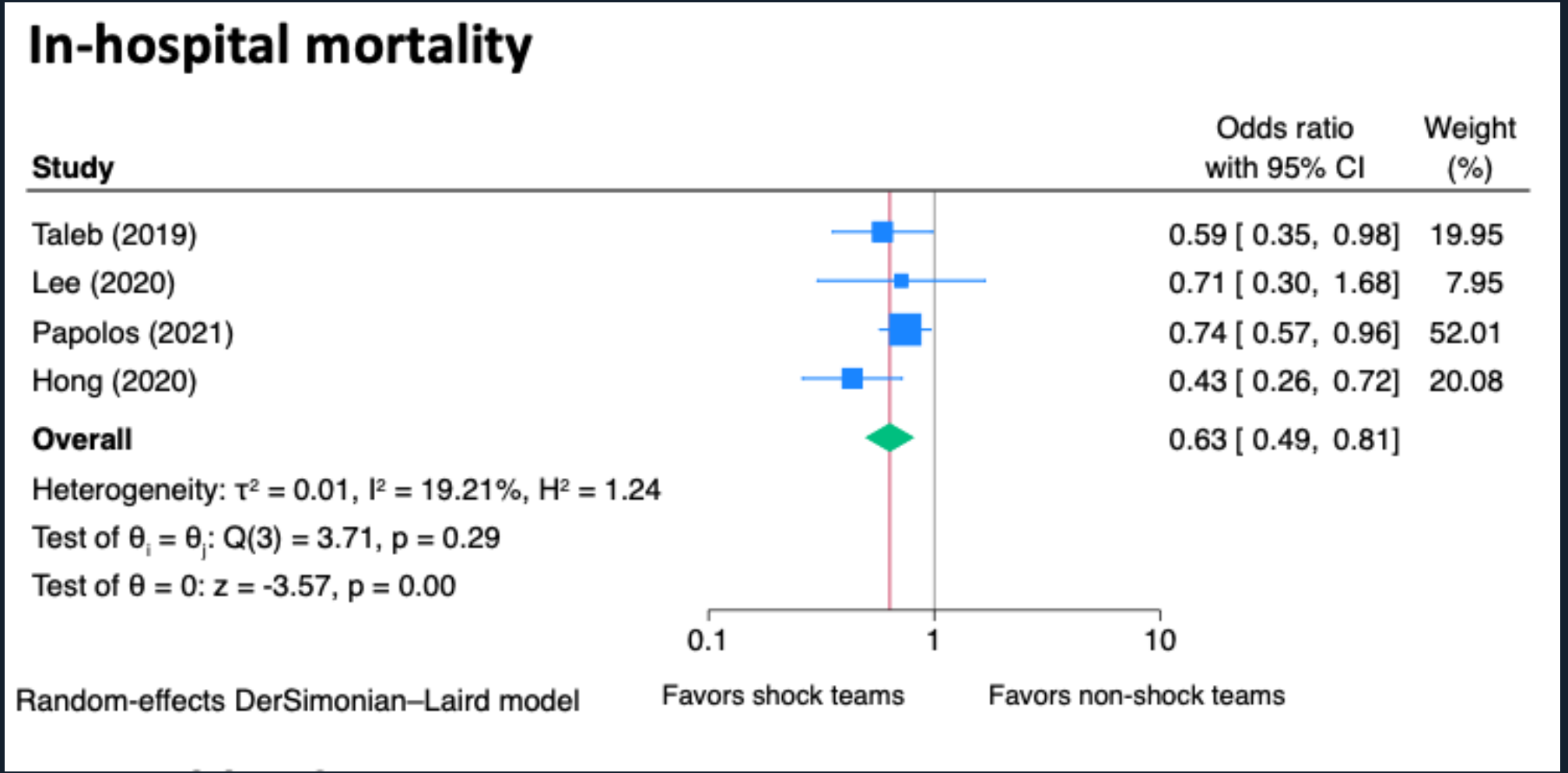
Doll JA. Catheterization and Cardiovascular Interventions 88:424–433 (2016)

The Shock Team in Action



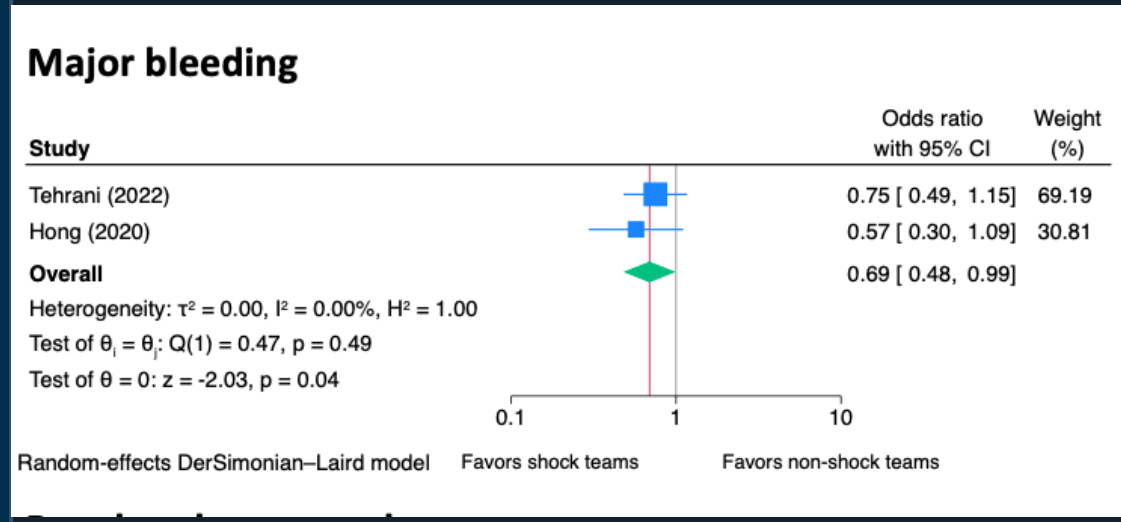
Tehrani, B.N. et al. J Am Coll Cardiol HF. 2020;8(11):879–91.

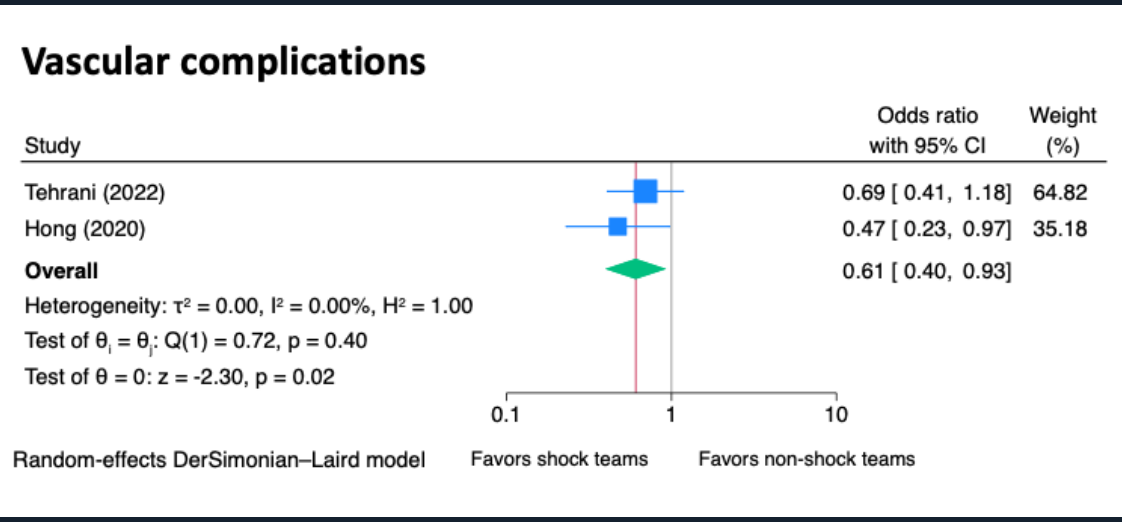
Shock Team Improves Survival



Haisum…..Bangalore…Alviar et al. AHA 2023 (Submitted)

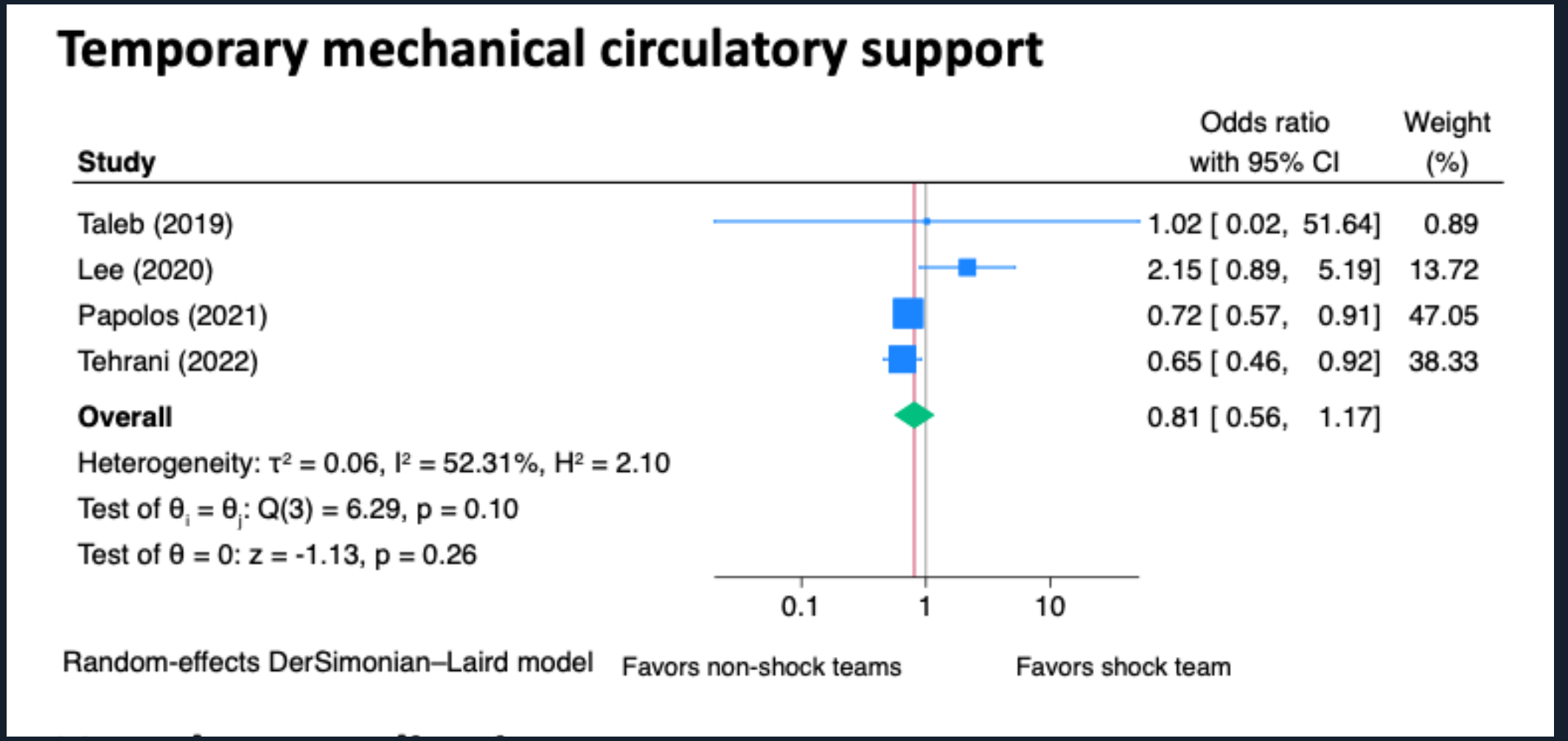
Shock Team Decreases Complications





Haisum…..Bangalore…Alviar et al. AHA 2023 (Submitted)

Shock Team: No increase in MCS



Haisum…..Bangalore…Alviar et al. AHA 2023 (Submitted)

In this meta-analysis, CS team implementation was associated with lower in-hospital mortality, major bleeding, and vascular complications, but no difference in tMCS use. These findings argue for larger, prospective, and even randomized investigations to further clarify the impact of CS teams for improving CS outcomes

Haisum…..Bangalore…Alviar et al. AHA 2023 (Submitted)

The “What”: The Shock Protocol

CS Protocols

CICU Management of Cardiogenic Shock

Serial Assessment

- Lactate
- Fick + thermodilution CO/CI
- CPO and PAPi

and if MCS

- Serial echocardiograms
- Assess for hemolysis
- Neurovascular assessments

*Criteria for Refractory Shock

- CPO <0.6W
- CI <2.2 l/min/m²
- ↑ Lactate

Contraindications To MCS

- Anoxic brain injury
- Irreversible end organ failure
- Prohibitive vascular access
- DNR

CPO = MAP x CO/451
PAPi = (sPAP-dPAP)/RA

Treatment Objectives

- Wean vasopressors/inotropes
- Early escalation for refractory shock
- Heart recovery

Refractory Shock*

No

CPO >0.6W
PAPi >1.0
RA <15 mm Hg
PCWP <15 mm Hg

→ Wean vasopressors/ inotropes and assess for heart recovery

Yes

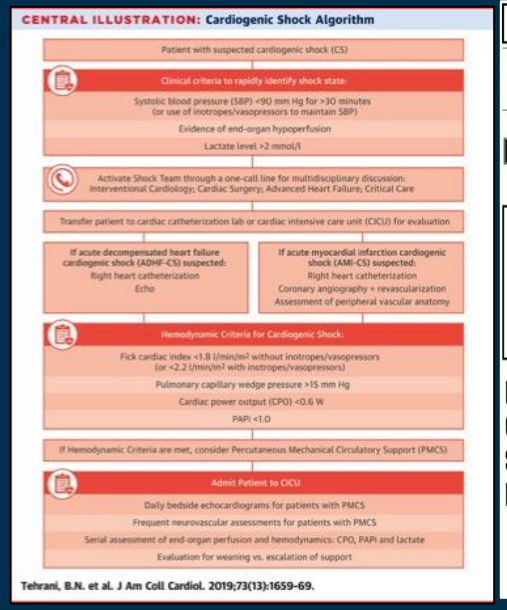
Bi-V CS	LV-dominant CS	RV-dominant CS
CPO <0.6W	CPO <0.6W	CPO < 0.6W
PAPi <1.0	PAPi >1.0	PAPi <1.0
RA >15 mm Hg	RA <15 mm Hg	RA >15 mm Hg
PCWP >15 mm Hg	PCWP >15 mm Hg	PCWP <15 mm Hg

Multidisciplinary Shock Team Consultation

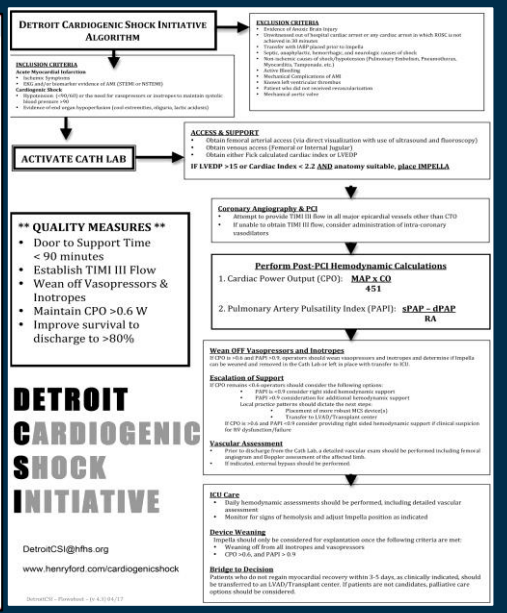
Assess Candidacy for Temporizing MCS

Hypoxemia	Hypoxemia	Hypoxemia
Yes: R + L pVAD with Oxygenator or VA-ECMO +/- LV Vent	Yes: L pVAD with Oxygenator or VA-ECMO +/- LV Vent	Yes: R pVAD with Oxygenator or VA-ECMO +/- LV Vent
No: R + L pVAD	No: L pVAD	No: R pVAD

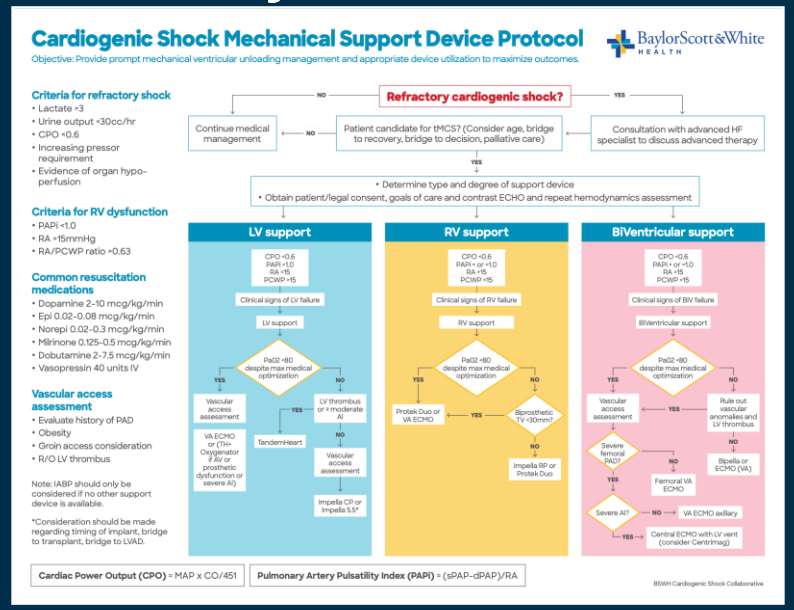
Innova HVI



Detroit SI

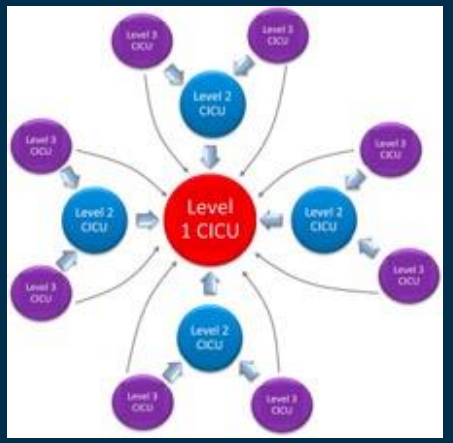


Baylor Scott&White



The “WHERE”

American Heart Association CICU levels



Increasing complexity

Level 3

Diagnosis
- AMI
- Acute heart failure
- Uncomplicated arrhythmia
- Post-procedure monitoring

Coverage
- Cardiologist
- +/- CCM consult available

Monitoring/Devices
- Telemetry
- Mechanical ventilation
- Non-invasive monitoring

Level 2

Diagnosis
- AMI + complications
- Early shock
- Acute heart failure
- Complicated arrhythmia
- Refractory VT

Coverage
- Cardiologist
- +/- CCM consult available

Monitoring/Devices
- IABP +/- pLVAD
- Invasive hemodynamics

Level 1

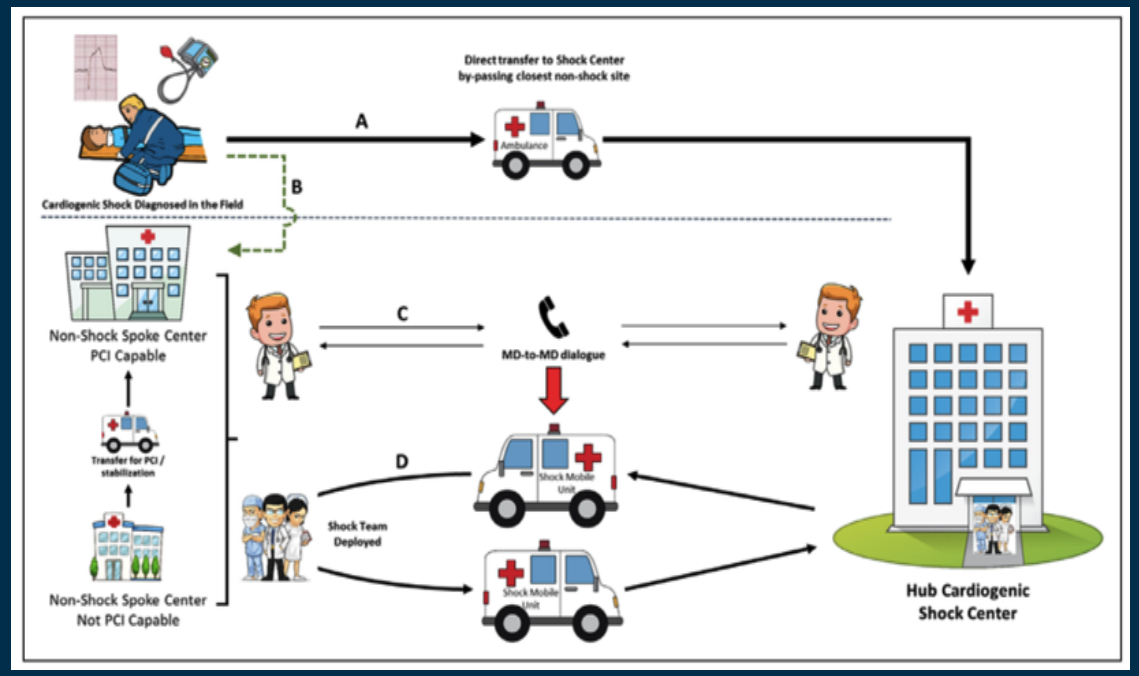
Diagnosis
- Refractory shock
- Complex congenital HD
- RV failure pHTN
- Mixed shock
- VT storm

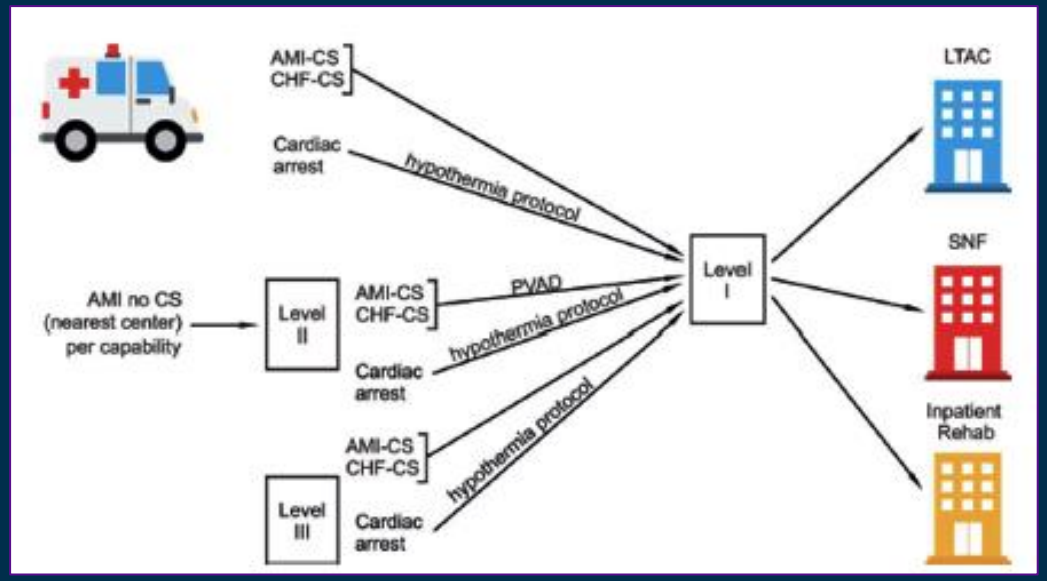
Coverage
- Critical care cardiologist or
- Cardiologist + CCM

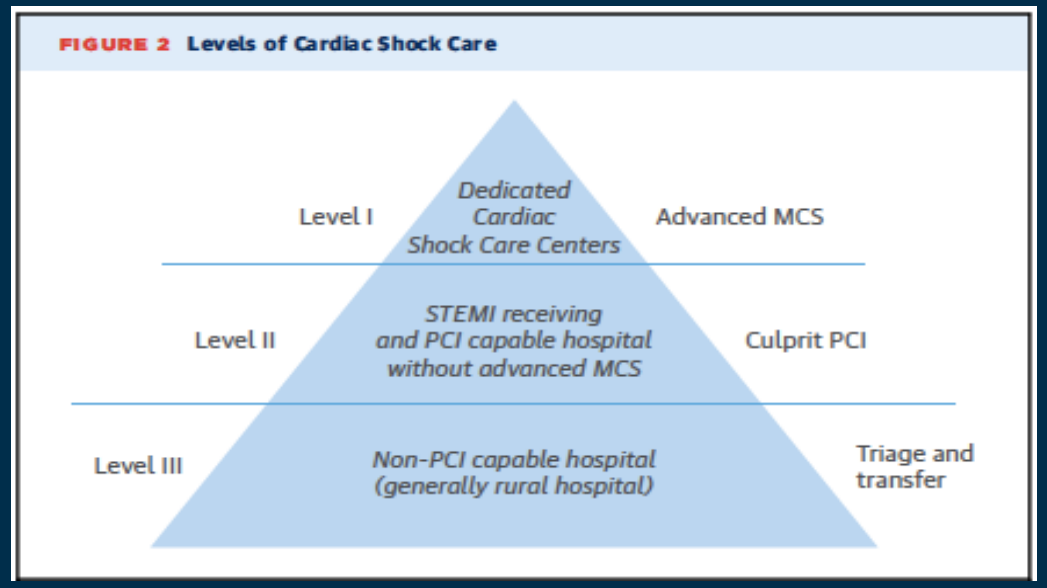
Monitoring/Devices
- MCS (including ECMO)
- Advance ventilator support

Morrow DA. Circulation. 2012;126:1408-1428
van Diepen S. Circulation 2019; 140(4): 267-269
Le May M.. Can J of Cardiology 32 (2016) 1204-13

Shock Centers







Patarroyo M, Manrique C. DeBakey Heart J. 2020

JACC: HEART FAILURE
VOL. 10, NO. 10, 2022

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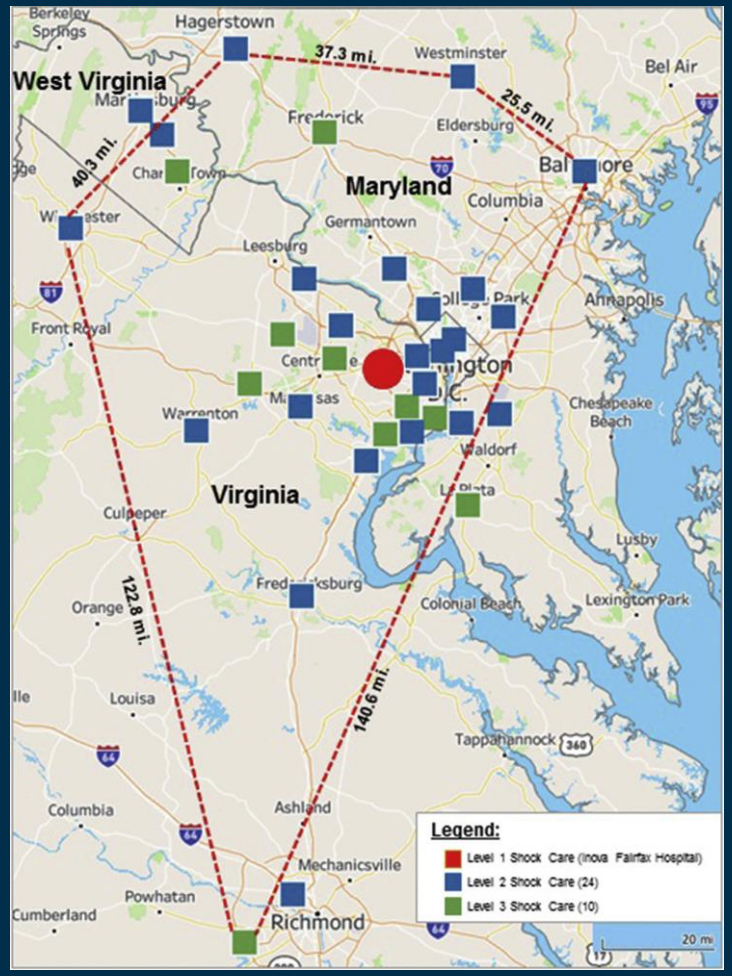
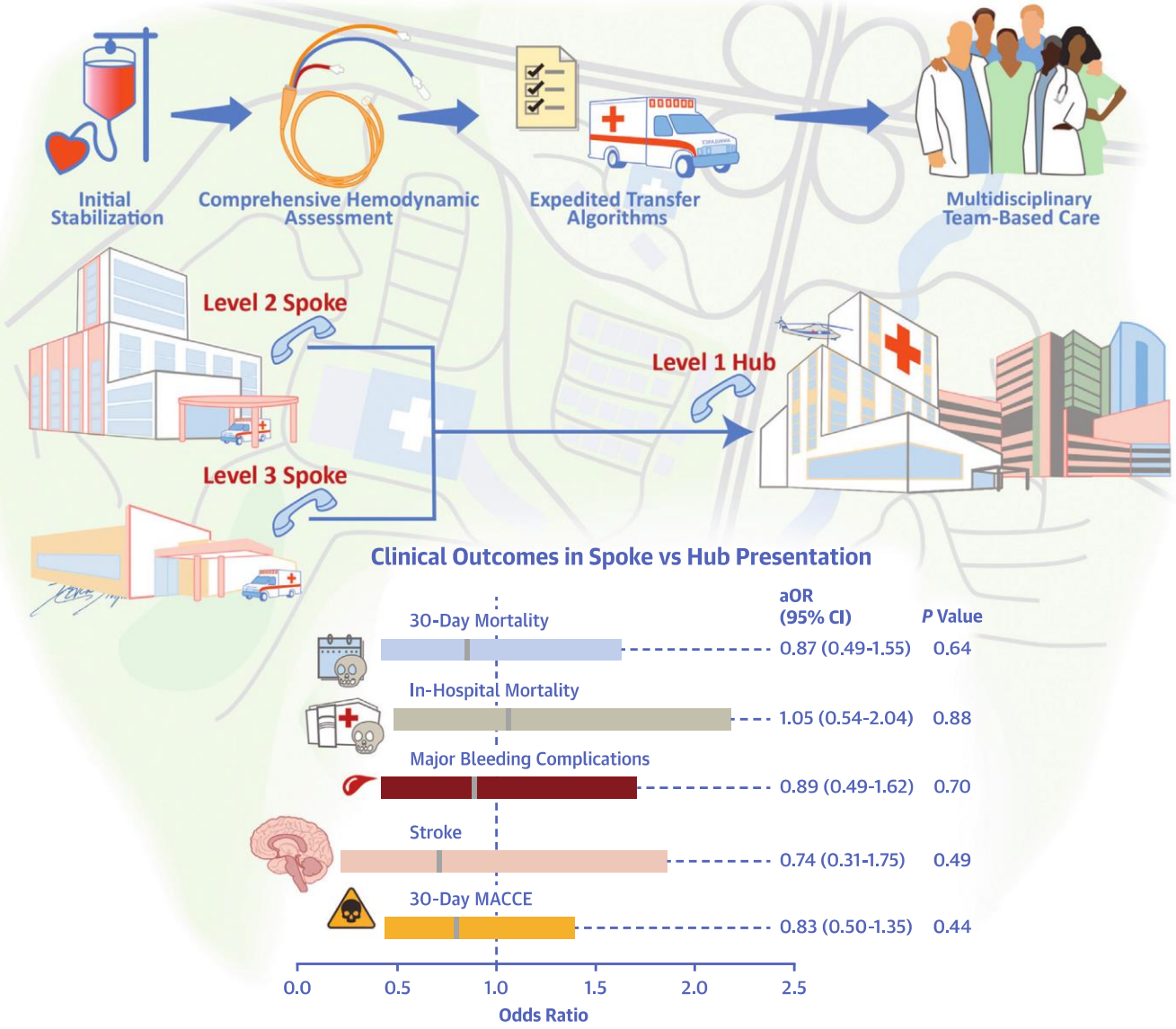
A Standardized and Regionalized Network of Care for Cardiogenic Shock

Behnam N. Tehrani, MD,[a] Matthew W. Sherwood, MD, MHS,[a] Carolyn Rosner, MSN, NP-C, MBA,[a] Alexander G. Truesdell, MD,[a,b] Seiyon Ben Lee, PhD,[c] Abdulla A. Damluji, MD, PhD,[a] Mehul Desai, MD,[a] Shashank Desai, MD, MBA,[a] Kelly C. Epps, MD,[a] Michael C. Flanagan, MD,[a] Edward Howard, MD,[a,b]

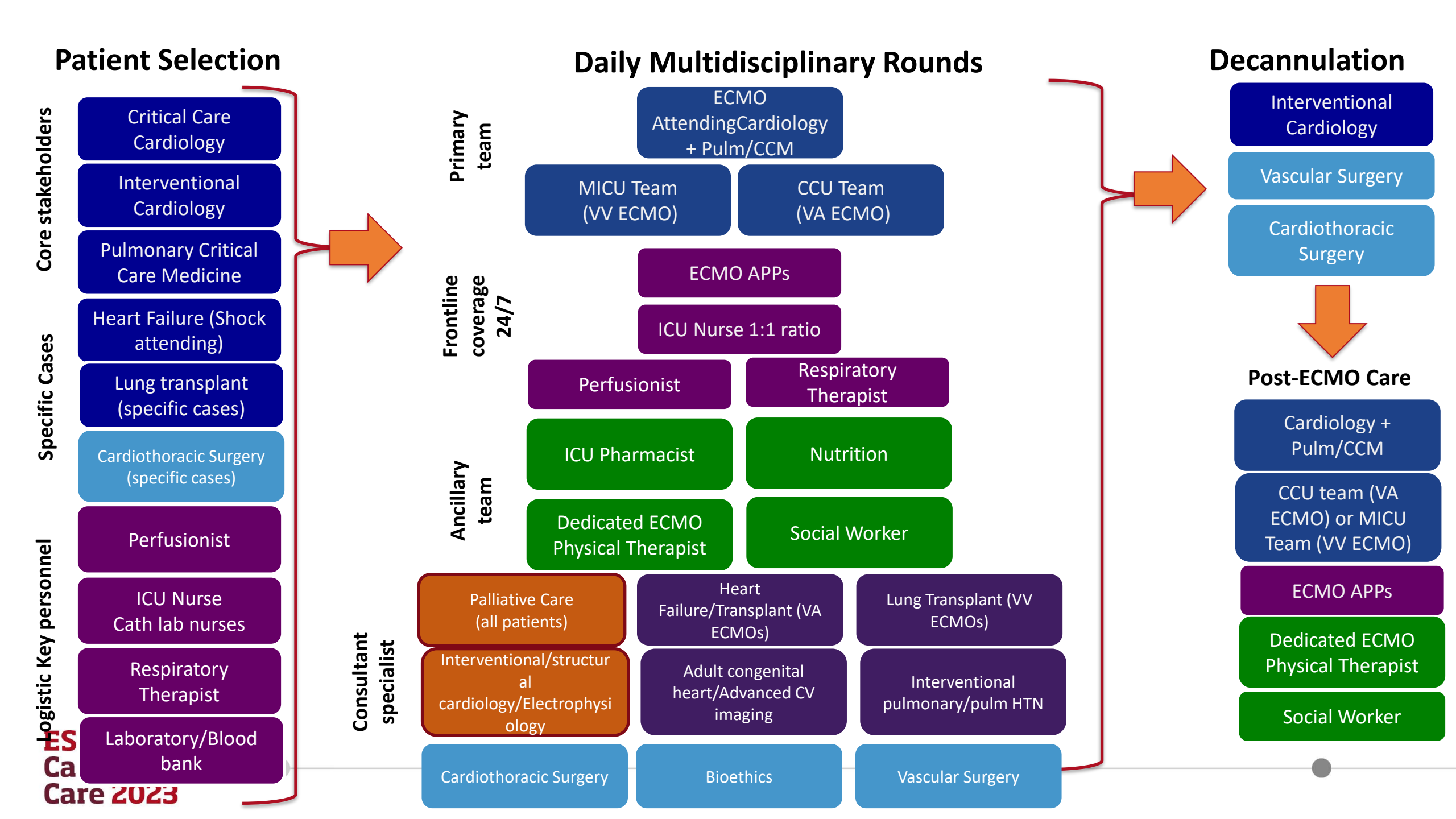


CENTRAL ILLUSTRATION Standardized Systems of Care Network for Cardiogenic Shock



Tehrani BN, et al. J Am Coll Cardiol HF. 2022;10(10):768–781.

The NYC Health and Hospital Network


Patient Selection
Core stakeholders
Critical Care Cardiology
Interventional Cardiology
Pulmonary Critical Care Medicine
Specific Cases
Heart Failure (Shock attending)
Lung transplant (specific cases)
Cardiothoracic Surgery (specific cases)
Logistic Key personnel
Perfusionist
ICU Nurse
Cath lab nurses
Respiratory Therapist
Laboratory/Blood bank
Daily Multidisciplinary Rounds
Primary team
ECMO AttendingCardiology + Pulm/CCM
MICU Team (VV ECMO)
CCU Team (VA ECMO)
Frontline coverage 24/7
ECMO APPs
ICU Nurse 1:1 ratio
Perfusionist
Respiratory Therapist
Ancillary team
ICU Pharmacist
Nutrition
Dedicated ECMO Physical Therapist
Social Worker
Consultant specialist
Palliative Care (all patients)
Heart Failure/Transplant (VA ECMOs)
Lung Transplant (VV ECMOs)
Interventional/structural cardiology/Electrophysiology
Adult congenital heart/Advanced CV imaging
Interventional pulmonary/pulm HTN
Cardiothoracic Surgery
Bioethics
Vascular Surgery
Decannulation
Interventional Cardiology
Vascular Surgery
Cardiothoracic Surgery
Post-ECMO Care
Cardiology + Pulm/CCM
CCU team (VA ECMO) or MICU Team (VV ECMO)
ECMO APPs
Dedicated ECMO Physical Therapist
Social Worker

ORIGINAL RESEARCH

American Heart Association | American Stroke Association

Effect of Cardiogenic Shock Hospital Volume on Mortality in Patients With Cardiogenic Shock

Shahzad Shaefi, MD; Brian O'Gara, MD; Robb D. Kociol, MD; Karen Joynt, MD, MPH; Ariel Mueller, MA; Junaid Nizamuddin, MD; Eitezaz Mahmood, BS; Daniel Talmor, MD, MPH; Sajid Shahul, MD, MPH

Hospitals with > 100 cases of CS/ year had lower mortality than centers with < 30 cases/ year (37% vs 42%).

Table 4. Association Between Hospital Volume and Risk-Adjusted Mortality

	Annual Hospital Volume of Cardiogenic Shock			
	≤27 Cases	28 to 58 Cases	59 to 106 Cases	≥107 Cases
No. of hospitals, %	2046 (76.49)	366 (13.68)	177 (6.62)	86 (3.21)
Odds ratio, 95% CI				
Unadjusted model	1.58 (1.45 to 1.73)	1.29 (1.17 to 1.41)	1.17 (1.06 to 1.29)	1.00 [Reference]
Multivariate model*	1.27 (1.15 to 1.40)	1.20 (1.08 to 1.32)	1.12 (1.01 to 1.24)	1.00 [Reference]
Mortality incidence, 95% CI				
Unadjusted model	45.32 (44.53 to 46.11)	40.27 (39.25 to 41.29)	37.96 (36.66 to 39.28)	34.40 (32.53 to 36.32)
Multivariate model*	41.97 (40.87 to 43.08)	40.72 (39.52 to 41.93)	39.31 (37.91 to 40.72)	37.01 (35.11 to 38.96)

MI indicates myocardial infarction.

*Adjusted for age group, sex, race, acute MI, early revascularization, hemodialysis, teaching status of the hospital, hospital region, median household income for the patient's ZIP code, mechanical ventilation, valvular disease, pulmonary circulation disease, peripheral vascular disease, hypertension, paralysis, neurological disorders, chronic pulmonary disease, diabetes with and without chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer disease, AIDS, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, deficiency anemias, alcohol abuse, drug abuse, psychoses, depression.

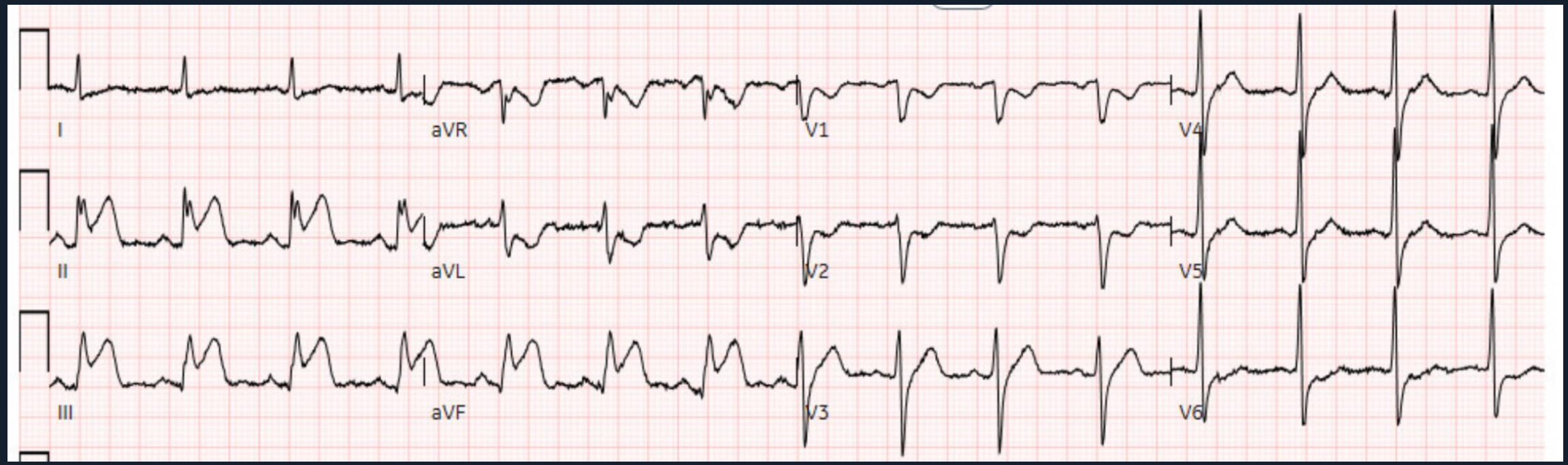
J Am Heart Assoc. 2015;4:e001462

54 y/o M with chest pain

- Hx of HTN, HLD, DM, STEMI s/p DES to RCA in 2019. EF normal
- Not taking any meds for 1 year. Trying herbal supplements and vitamins
- Presents with chest pain 1-2 hours
- EKG with inferior STEMI
- Loaded with ASA, Clopidogrel, Heparin
- While awaiting transfer to cath lab, episode of emesis followed by VT arrest

54 y/o M with chest pain and cardiac arrest

EKG



54 y/o M with chest pain

- Multiple rounds of CPR with transient ROSC
- Shock team activated
- Patient placed on LUCAS and transferred to cath lab
- Ongoing CPR, Amio, Lido, Multiple shocks
- Initial Labs
  - Hb 16.4; Plts 245; Cr 1.1; LFTs WNL
  - Tn HS 24
  - Lactate 3.4

54 y/o M with chest pain

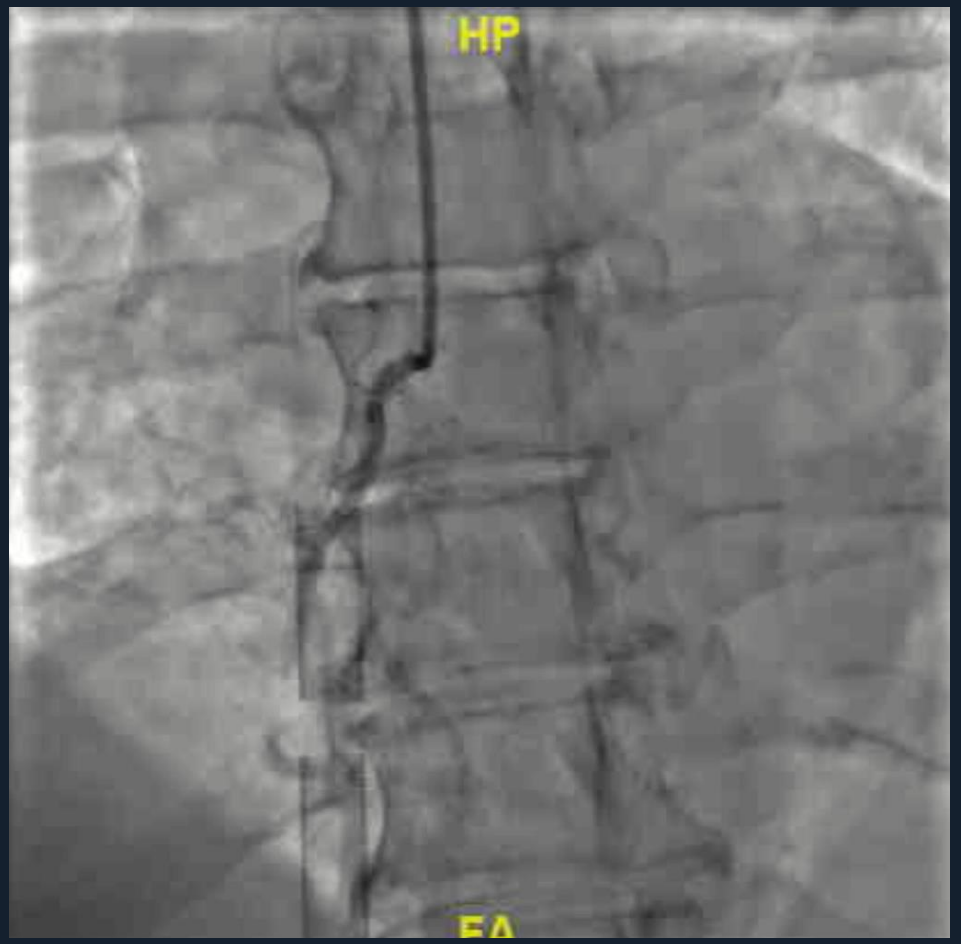
- Ongoing CPR (LUCAS), Amio, Lido, Multiple shocks
- Labs
  - Lactate 12.1
  - Ph 7.26; PO2 104, PCO2 29
- Decision made to cannulate and initiate eCPR
  - 25 F venous in right femoral vein
  - 17 F arterial in left femoral artery (2 perclose)
  - 6 F arrow distal reperfusion
  - Time from CPR to cannulation ~60 mins

54 y/o M with chest pain

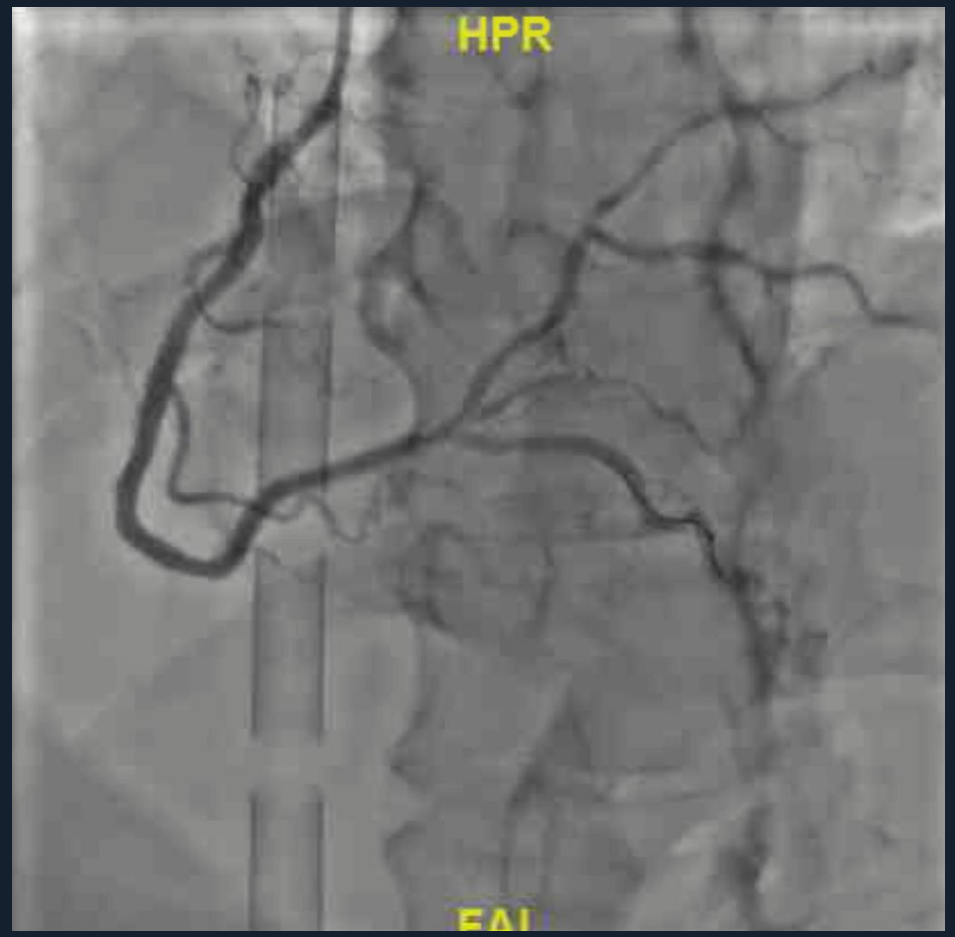
- Immediate return of ROSC

54 y/o M with chest pain and eCPR

Coronary Angiography

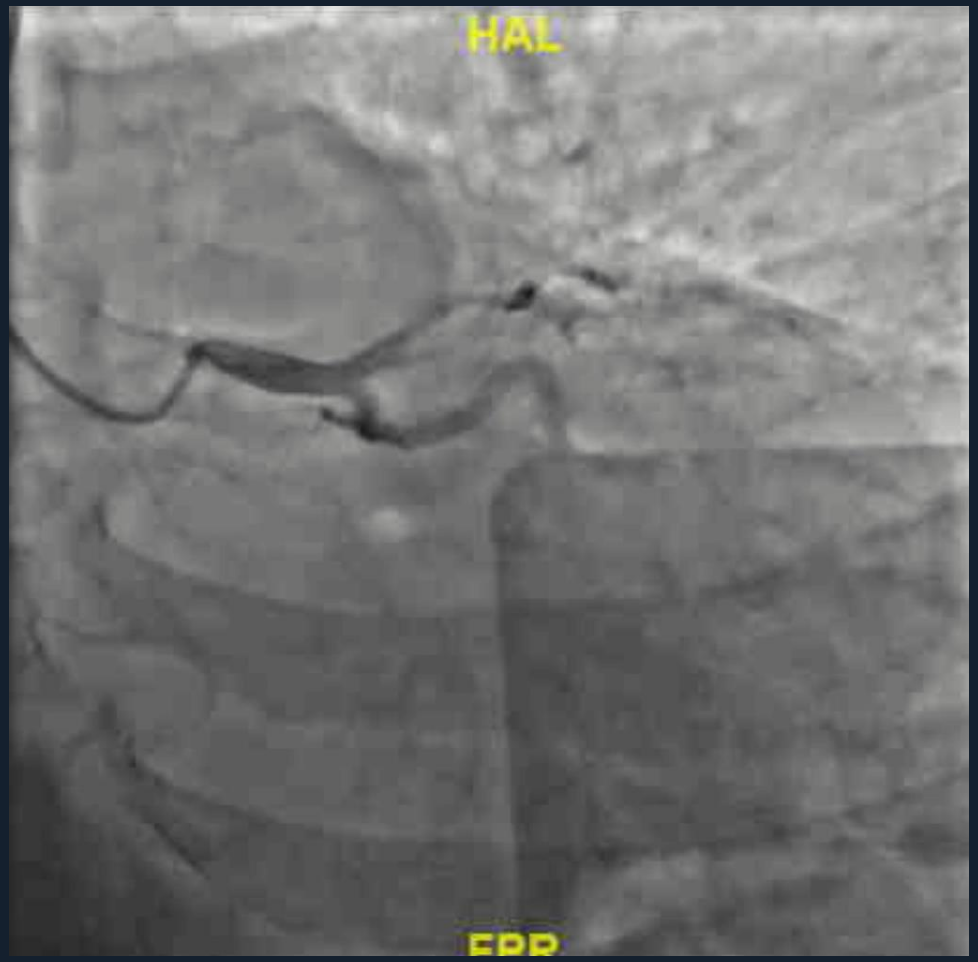


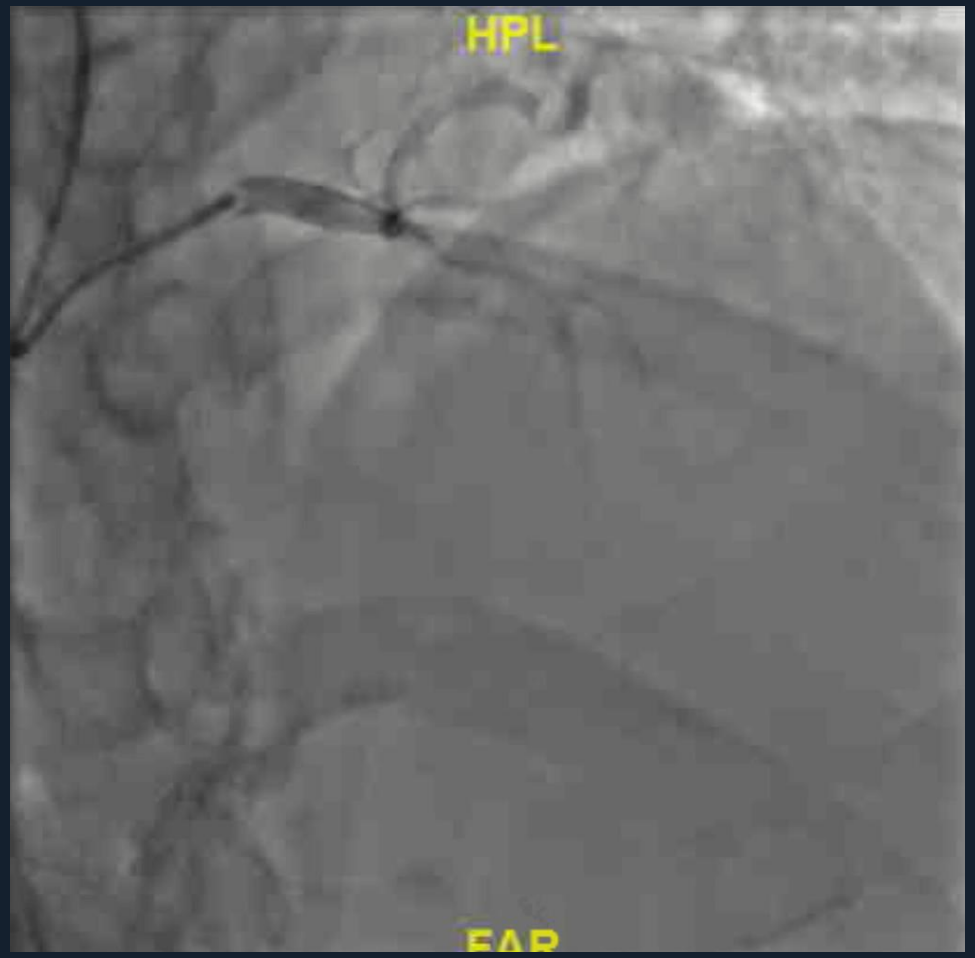
3.0 x 33 mm Xience



54 y/o M with chest pain and eCPR

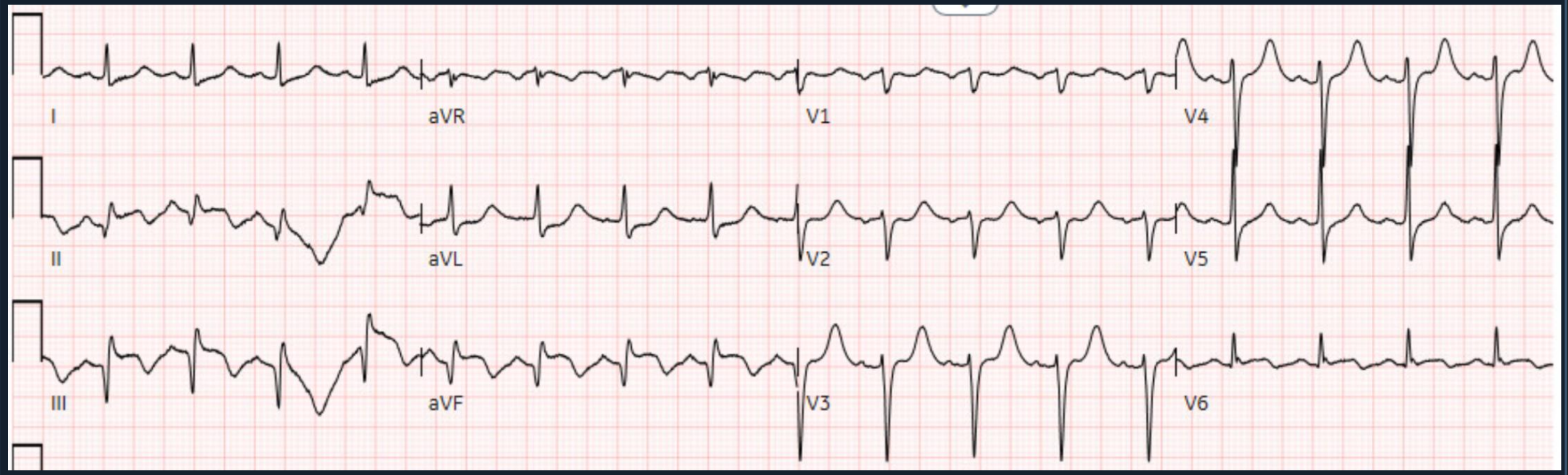
Coronary Angiography





54 y/o M with chest pain and cardiac arrest

EKG Post PCI

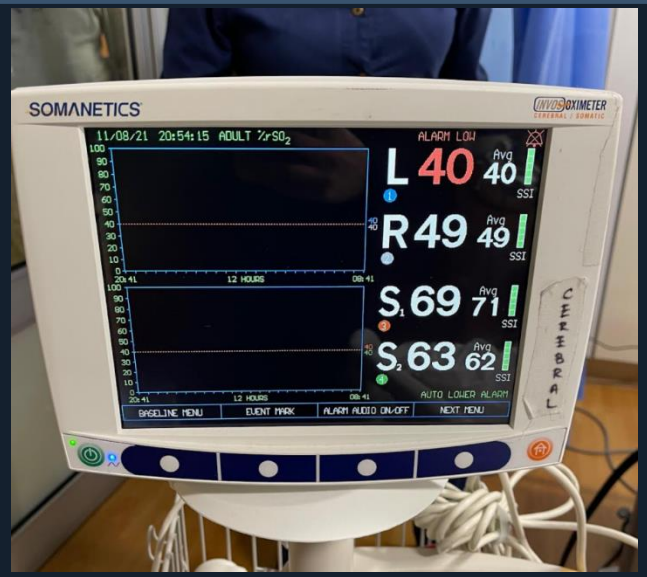


54 y/o M with chest pain and eCPR

ECMO Management

54 y/o M with chest pain and eCPR

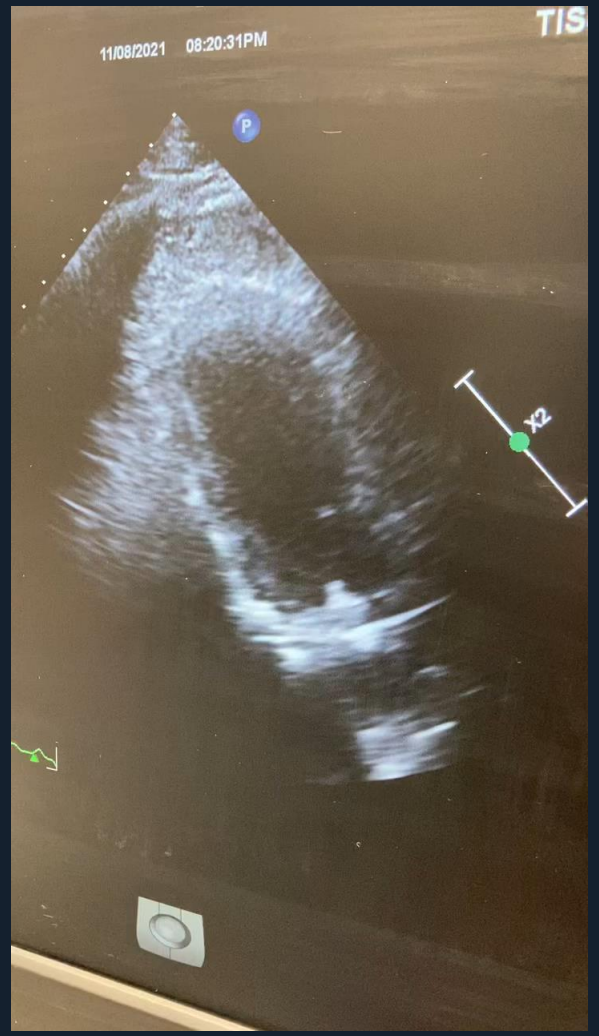
ECMO Management



- RPM 3500; Flow 3.3 L; Sweep 1.0
- Low left extremity NIRS
- Increase flow to 3.7
- Improvement in limb perfusion

54 y/o M with chest pain and eCPR

ECMO Management



- Bedside echo with EF 10%. Global HK concerning for LV ballooning
- Pharm venting with Dobutamine 2.5
- Patient following commands. Cooling deferred
- Lactate 12.1→9.2→7.6→5.9→3.0→2.0→1.3

54 y/o M with chest pain and eCPR

ECMO Weaning

- Next day- ECMO weaning trial
- Dobutamine 2.5 and minimal levo
- Flow reduced to 3.0→2.5→2.0
- Hemodynamics (BP, PA, PCW) stable
- CI stable
- Echo no increase in RV size or change in function

The Shock Team: Necessary or Nonsense?

Summary

- Mortality in cardiogenic shock remains high
- It is rarely a single organ condition
- Shock teams have the potential to improve survival and lower complications