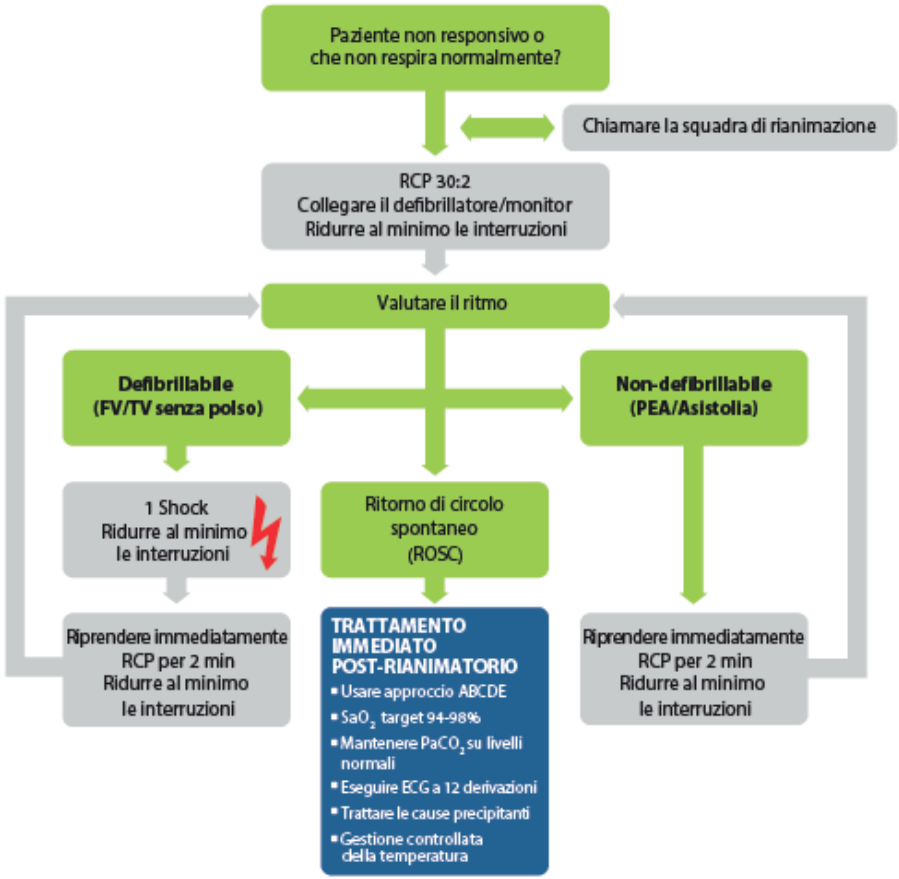
L'ECMO A-V nell'arresto cardiaco refrattario

Maurizio Migliari

m.migliari@asst-monza.it

Supporto avanzato delle funzioni vitali - ALS



DURANTE LA RCP

- Garantire compressioni toraciche di elevata qualità
- Ridurre al minimo le interruzioni
- Somministrare ossigeno
- Utilizzare la capnografia a forma d'onda
- Effettuare compressioni toraciche continue se si sta ventilando attraverso vie aeree avanzate
- Accesso vascolare (via endovenosa o intraossea)
- Somministrare adrenalina ogni 3-5 min
- Somministrare amiodarone dopo 3 shock

TRATTARE LE CAUSE REVERSIBILI

Ipossia	Trombosi – coronarica o polmonare
Ipovolemia	PneumoTorace iperTeso
Ipo-/Iperkalaemia/Metaboliche	Tamponamento cardiaco
Ipotermia/Ipertermia	Tossici

PRENDERE IN CONSIDERAZIONE

- Uso dell'ecografia
- Uso di dispositivi meccanici per compressioni toraciche per facilitare il trasferimento/trattamento del paziente
- Angiografia ed eventuale angioplastica coronarica percutanea
- RCP extracorporea (ERCP)

Resuscitation 95 (2015) 100–147

Contents lists available at ScienceDirect

Resuscitation

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

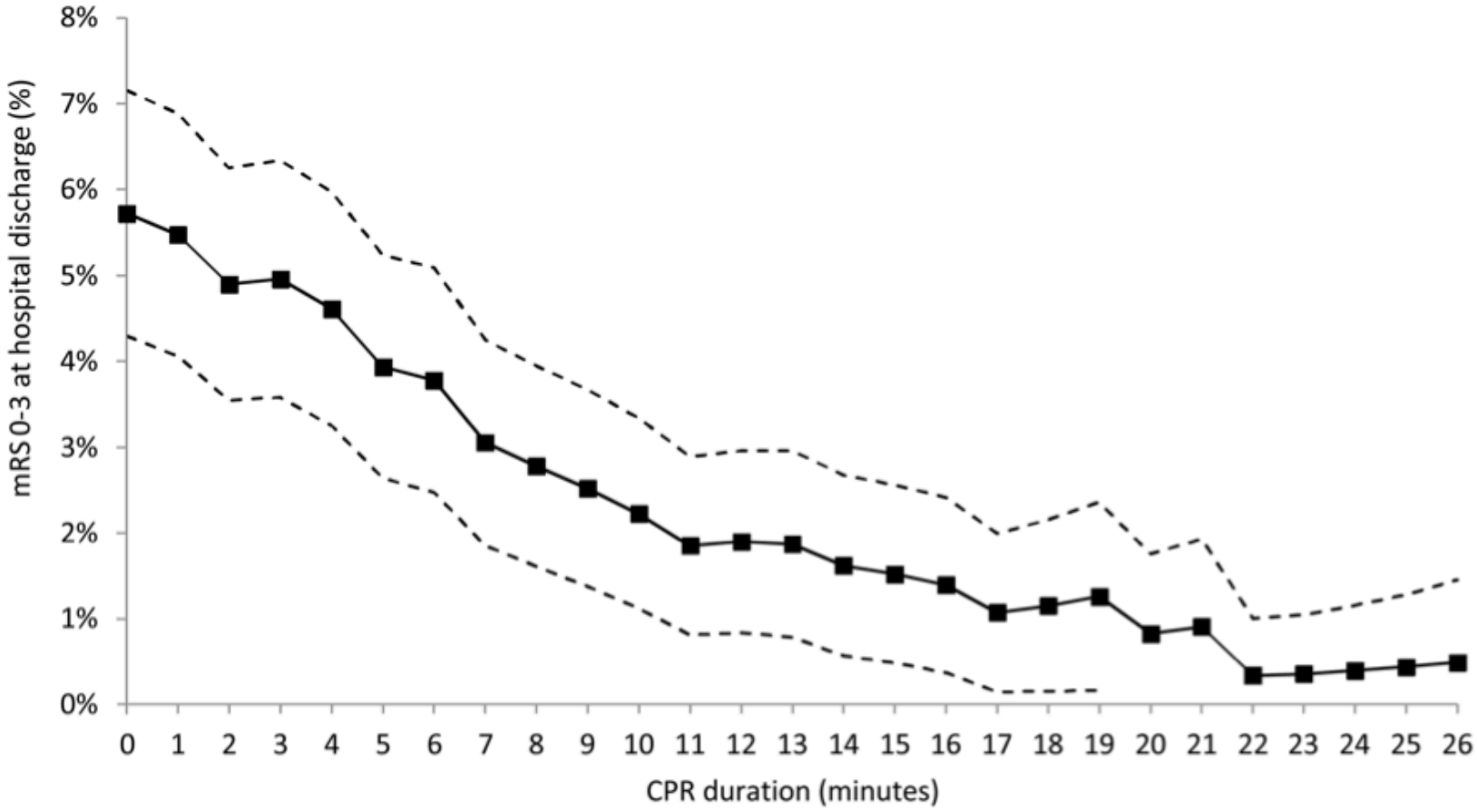
European Resuscitation Council Guidelines for Resuscitation 2015 Section 3. Adult advanced life support

Jasmeet Soar[a,*], Jerry P. Nolan[b,c], Bernd W. Böttiger[d], Gavin D. Perkins[e,f], Carsten Lott[g], Pierre Carli[h], Tommaso Pellis[i], Claudio Sandroni[j], Markus B. Skrifvars[k], Gary B. Smith[l], Kjetil Sunde[m,n], Charles D. Deakin[o], on behalf of the Adult advanced life support section Collaborators[1]

PRENDERE IN CONSIDERAZIONE

- Uso dell'ecografia
- Uso di dispositivi meccanici per compressioni toraciche per facilitare il trasferimento/trattamento del paziente
- Angiografia ed eventuale angioplastica coronarica percutanea
- RCP extracorporea (ERCP)

Dopo quanto tempo l’ ACC è refrattario?



Reynolds JC et al., Circulation 2013;128(23):2488-2494

Contents lists available at ScienceDirect

Best Practice & Research Clinical Anaesthesiology

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

9

Post-cardiac arrest extracorporeal life support

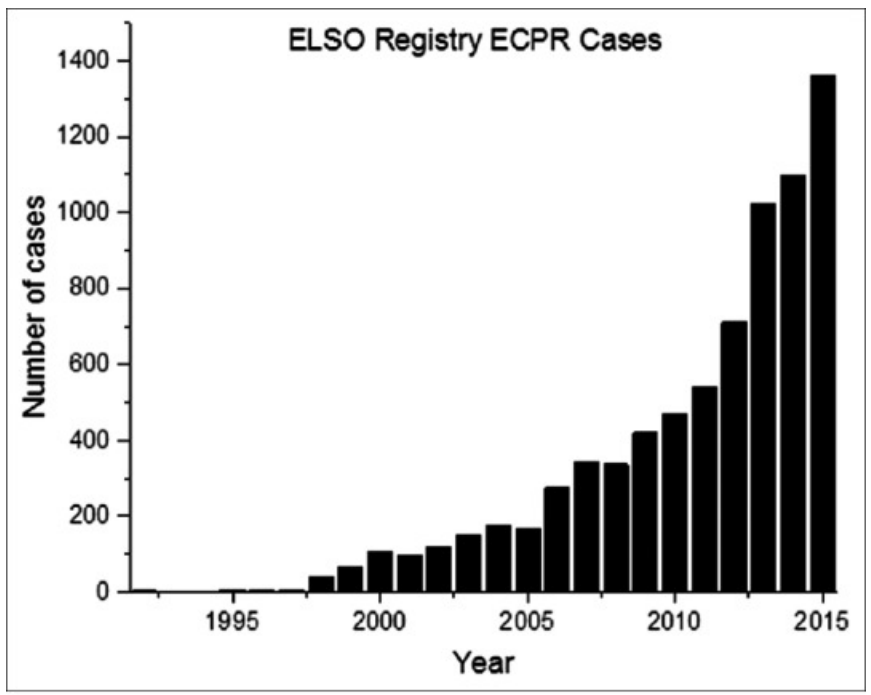
Nicolò Patroniti, MD, Assistant Professor of Anesthesiology, Staff Anesthesiologist [a, b, *],
Fabio Sangalli, MD, Staff Anesthesiologist [b],
Leonello Avalli, MD, Staff Anesthesiologist [b]

[a] Department of Health Science, University of Milano-Bicocca, via Cadore 48, 20048, Monza, MB, Italy
[b] Department of Emergency Medicine and Intensive Care, San Gerardo Hospital, via Pergolesi 33, 20900, Monza, MB, Italy

However, both in-hospital CA (IHCA) and out-of-hospital cardiac arrest (OHCA) survival rate continues to be very low. Good functional recovery from CA can be achieved in >75% of patients with return of spontaneous circulation (ROSC) within 15 min from collapse. This is the time window where conventional resuscitative manoeuvres have the highest chance to be effective [15]. For CA times above 15 min, the probability of good functional recovery among all attempted resuscitations falls to around 2%.

Se invece li connetto ad ECMO cosa succede?

- Non esistono studi randomizzati
- Numerosi studi ossevazionali
- Metanalisi


ELSO Registry ECPR Cases
Number of cases
0
200
400
600
800
1000
1200
1400
1995
2000
2005
2010
2015
Year

ECLS Registry Report

International Summary

January, 2017

Extracorporeal Life Support Organization
2800 Plymouth Road
Building 300, Room 303
Ann Arbor, MI 48109

Overall Outcomes

	Total Runs	*Survived ECLS*		*Survived to DC or Transfer*	
Neonatal					
Pulmonary	29,942	25,205	84%	21,948	73%
Cardiac	7,169	4,643	64%	2,938	40%
ECPR	1,532	1,028	67%	627	40%
Pediatric					
Pulmonary	8,070	5,424	67%	4,632	57%
Cardiac	9,362	6,404	68%	4,758	50%
ECPR	3,399	1,958	57%	1,414	41%
Adult					
Pulmonary	12,346	8,242	66%	7,157	57%
Cardiac	10,982	6,251	56%	4,466	40%
ECPR	3,485	1,382	39%	993	28%
Total	86,287	60,537	70%	48,933	56%

IHCA

Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis

Lancet 2008; 372: 554–61

Yih-Sharng Chen*, Jou-Wei Lin*, Hsi-Yu Yu, Wen-Je Ko, Jih-Shuin Jerng, Wei-Tien Chang, Wen-Jone Chen, Shu-Chien Huang, Nai-Hsin Chi, Chih-Hsien Wang, Li-Chin Chen, Pi-Ru Tsai, Sheoi-Shen Wang, Juey-Jen Hwang, Fang-Yue Lin

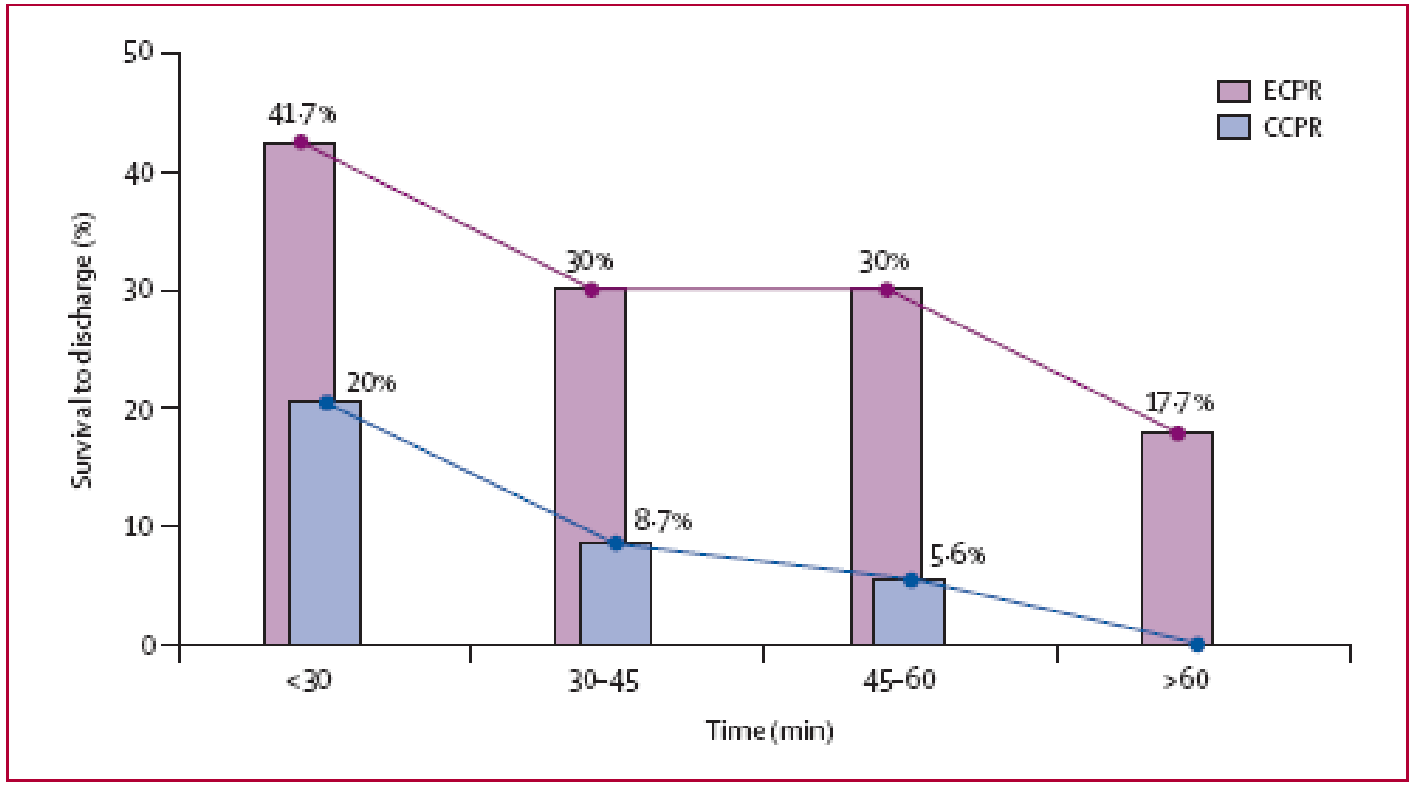


Figure 1: Relation between CPR duration and the survival rate to discharge
ECPR=extracorporeal CPR. CCPR=conventional CPR.

IHCA

ASAIO Journal 2009

Clinical Cardiovascular

Use of Extracorporeal Membrane Oxygenation for Adults in Cardiac Arrest (E-CPR): A Meta-Analysis of Observational Studies

Marcelo G. Cardarelli,* Andrew J. Young,† and Bartley Griffith*

Table 1. Diagnosis and Survival

Cause of Cardiac Arrest	Number of Patients	Survival to Discharge (95% Confidence Interval)
Myocardial infarction	46	36.9% (22.1–49.8)
Postcardiotomy arrest	24	50% (30–70)
Pulmonary embolus	21	57% (35.8–78.1)
Viral cardiomyopathy	7	0
Trauma	6	50% (9.9–90)
Acute heart transplant rejection	5	0
Left ventricular rupture	4	25% (sample too small)
Adult respiratory distress syndrome, Werner granulomatosis, Hanta virus	6	33% (sample too small)
Arrhythmias	3	0

SOPRAVVIVENZA 40%

OHCA

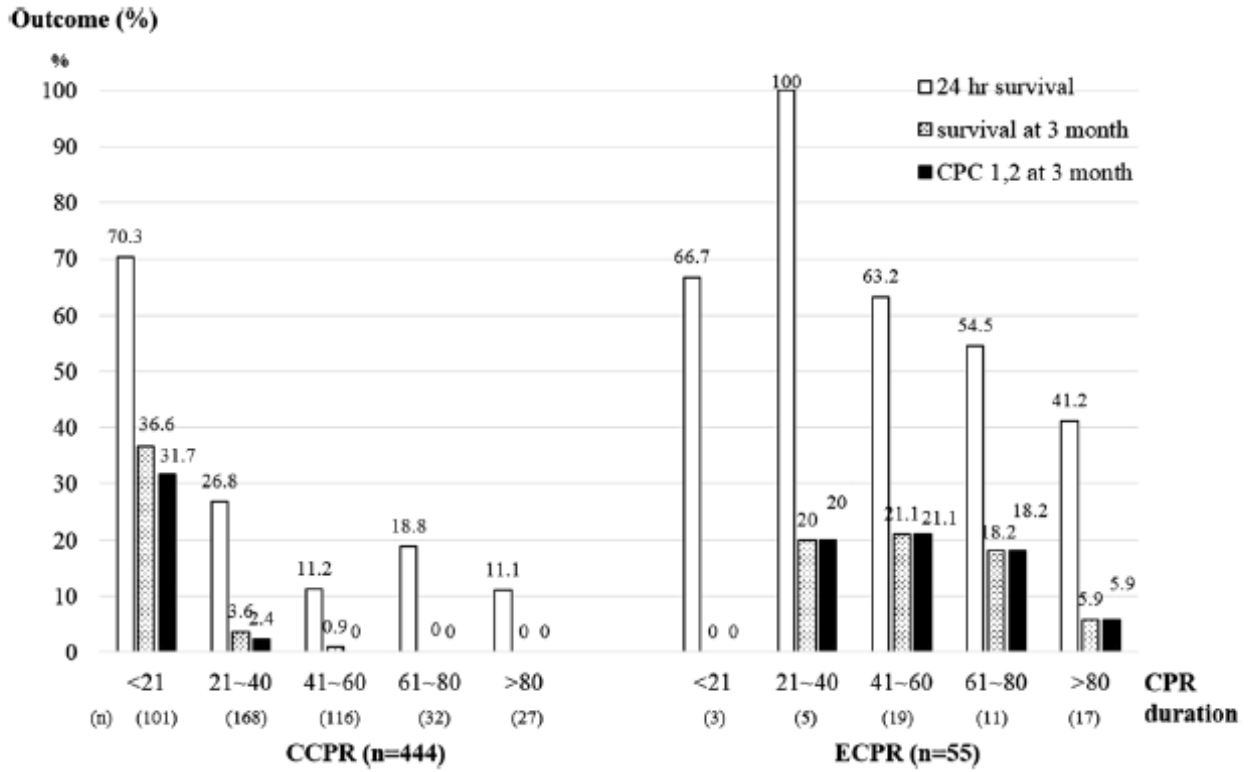


Figure 2 Trends of outcomes in the conventional cardiopulmonary resuscitation (CCPR) and extracorporeal cardiopulmonary resuscitation (ECPR) groups according to the cardiopulmonary resuscitation (CPR) duration. In the ECPR group, the longest CPR duration with a good neurologic outcome was 120 minutes. CPC, cerebral performance category.

Kim *et al. Critical Care* 2014, **18**:535

Resuscitation 101 (2016) 12–20

Contents lists available at ScienceDirect

Resuscitation

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

Review article

Extracorporeal resuscitation for refractory out-of-hospital cardiac arrest in adults: A systematic review of international practices and outcomes☆

Iván Ortega-Deballon[a,b,c,d,e,*], Laura Hornby[f,g], Sam D. Shemie[g,h,i], Farhan Bhanji[h,i,j], Elena Guadagno[k]

Outcomes

This systematic review identified a cumulative total of 833 patients in 20 studies. While there was some variability in time points of reported outcomes, the overall reported survival rate was 22%, including 13% having a good neurological recovery (CPC 1–2 or GOS 4–5, see Table 1). In addition to these short-term results,

Selezione del Paziente: criteri

Resuscitation 101 (2016) 12–20

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Extracorporeal resuscitation for refractory out-of-hospital cardiac arrest in adults: A systematic review of international practices and outcomes☆

Iván Ortega-Deballon[a,b,c,d,e,*], Laura Hornby[f,g], Sam D. Shemie[g,h,i], Farhan Bhanji[h,i,j], Elena Guadagno[k]

Table 2
Commonly cited ECPR inclusion and exclusion criteria and bundle treatments performed.

Inclusion criteria
- Age cutoffs, usually <75 years (low end: 10 years; high end: no upper age)
- Rhythm at the time of CPR (when included, specified as favorable to ventricular arrhythmias or "shockable" rhythms)
- Time interval from collapse to initiation of resuscitation (no flow), generally ≤5 mins (up to <15 mins)
- Witnessed cardiac arrest
- Etiology of arrest, to be of "presumed", "assumed", or "suspected" cardiac etiology
- No ROSC despite optimal CPR, usually by 30 mins (as low as 10 mins) – refractory cardiac arrest definition

Exclusion criteria
- Do not resuscitate order
- Severe activities-of-daily-living disability
- Non-cardiac causes of arrest such as severe trauma, uncontrollable bleeding, irreversible brain damage, drug overdose, poisoning, submersion, etc.
- Severe comorbidities (e.g. Often specify as those that would preclude admission to ICU, i.e. terminal illnesses, malignancies, etc.)
- Hypothermia

Bundle treatment options used during ECPR
- Catheter Lab (e.g. PCI, CABG, etc.) ONLY: 2 studies[23,30]
- Catheter Lab + TTM: 8 studies[12,21,22,24,25,28,29,31]
- Catheter Lab + IABP: 1 study[17]
- Catheter Lab + IABP + TTM: 9 studies[13–16,18–20,26,27]

CPR, cardiopulmonary resuscitation; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; TTM, targeted temperature management, also known as therapeutic mild hypothermia; IABP, intra-aortic balloon pump.

Resuscitation 112 (2017) 1–10

Contents lists available at ScienceDirect

Resuscitation

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

Review article

Prognostic factors for extracorporeal cardiopulmonary resuscitation recipients following out-of-hospital refractory cardiac arrest. A systematic review and meta-analysis☆

Guillaume Debaty[a,b,*], Valentin Babaz[b], Michel Durand[c], Lucie Gaide-Chevronnay[c], Emmanuel Fournel[c], Marc Blancher[b], Hélène Bouvaist[d], Olivier Chavanon[e,f], Maxime Maignan[b,f], Pierre Bouzat[c,g], Pierre Albaladejo[a,c], José Labarère[a,h]

Conclusion: Observational evidence from published primary studies indicates that shorter low-flow duration, shockable cardiac rhythm, higher arterial pH value and lower serum lactate concentration on hospital admission are associated with better outcomes for ECPR recipients after OHCA.

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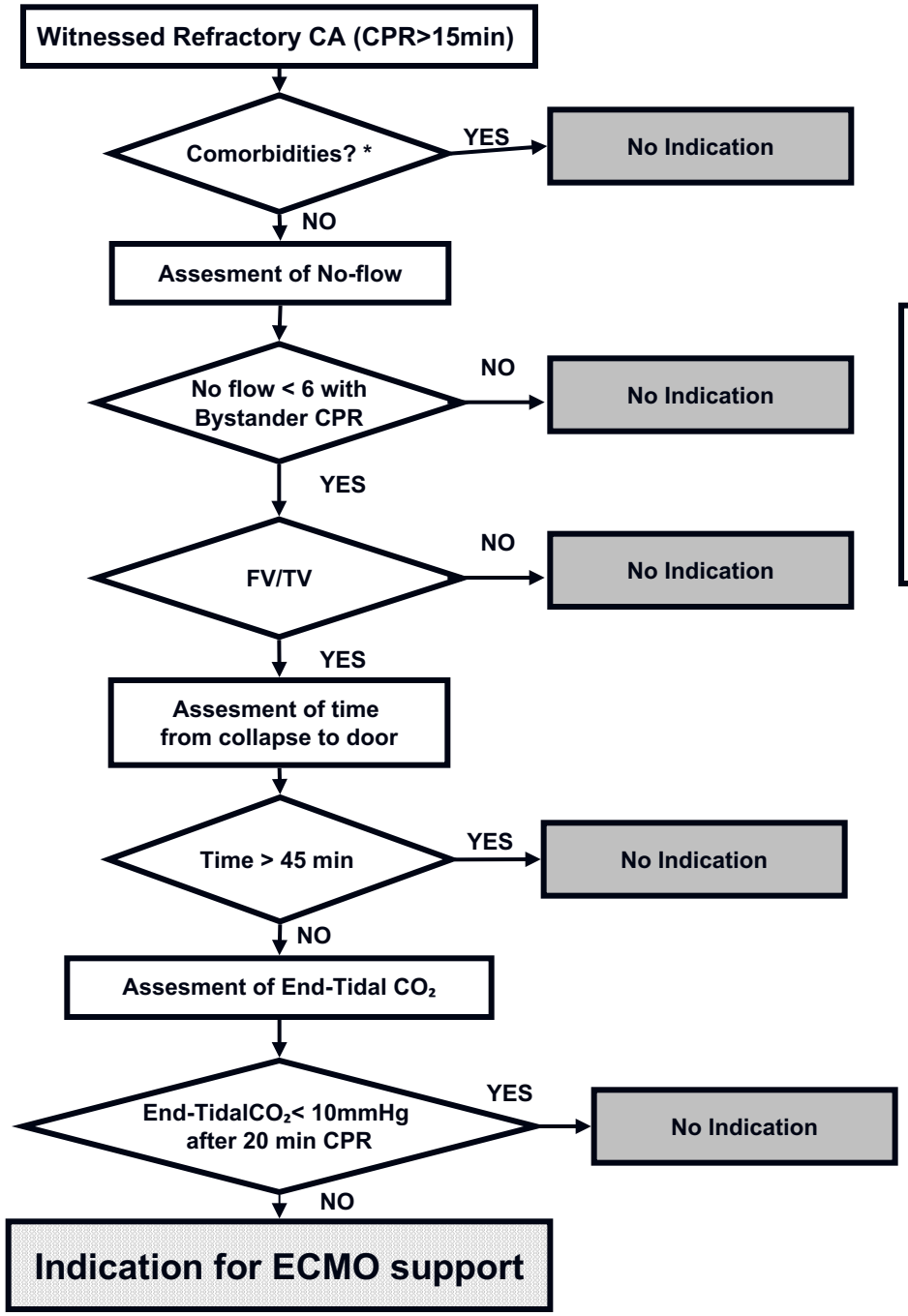


12-75 aa
NO
TRAUMA

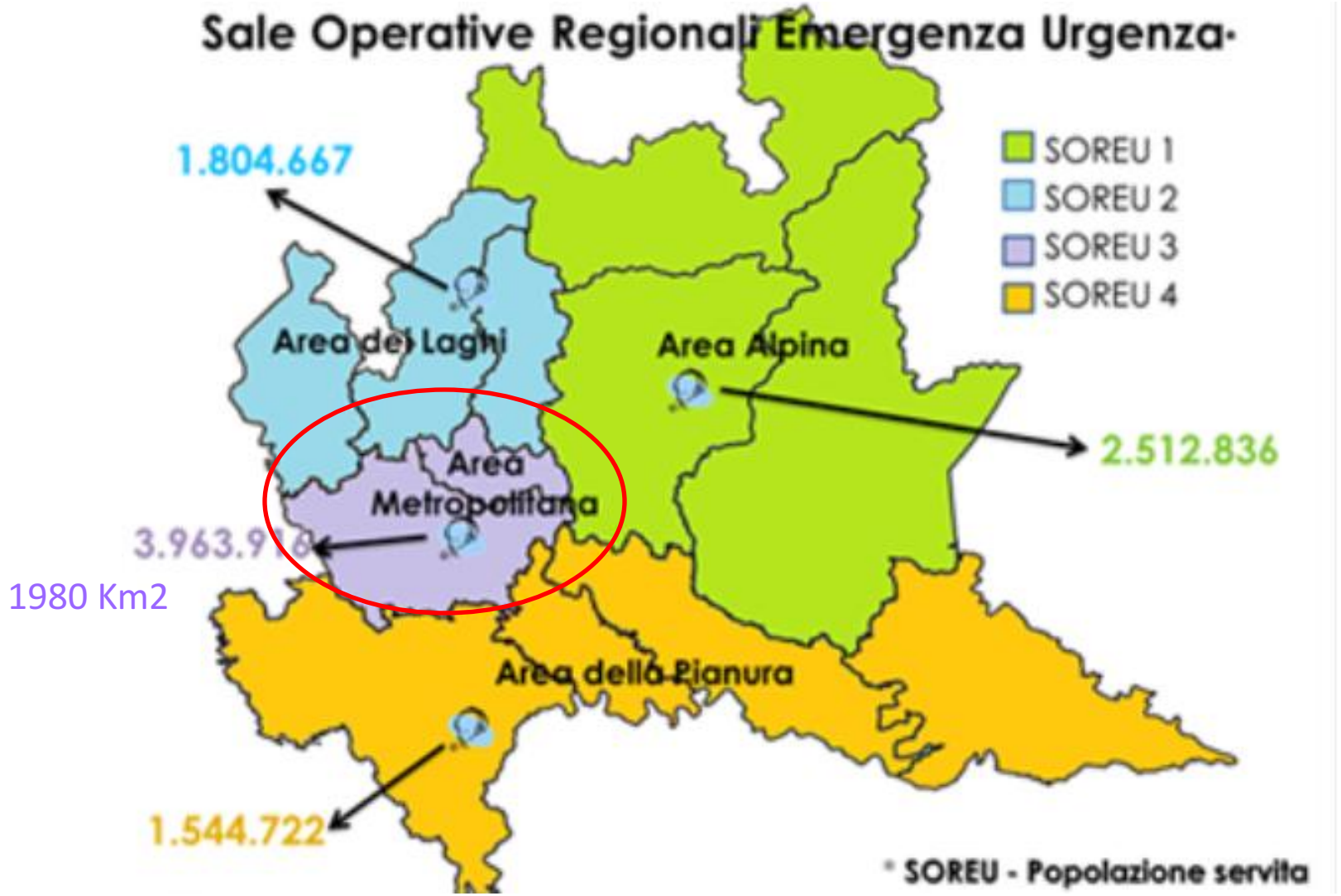
* Comorbidities:
- terminal malignancy
- aortic dissection
- severe peripheral arteriopathy
- severe cardiac failure without transplant indication
- severe aortic valve failure.

PZ < 50 aa: ECMO TEAM valuta se trattare il pz anche se fuori protocollo

2006-2014
ECPR OHCA

Terapia intensiva cardiochirurgica
Perfusionista h24
Cardiochirurgia
Emodinamica h24

COEU 118 MB
Estensione 405 Km2
850.000 abitanti
3.200 ab./Km2

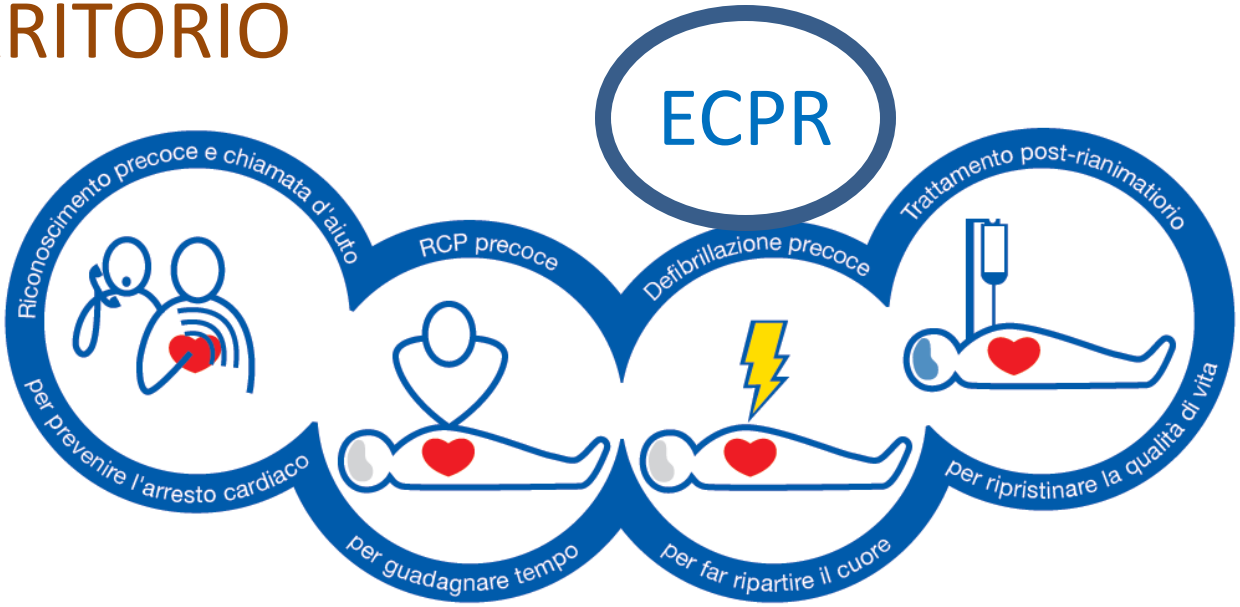

Sale Operative Regionali Emergenza Urgenza
1.804.667
SOREU 1
SOREU 2
SOREU 3
SOREU 4
Area dei Laghi
Area Alpina
2.512.836
Area Metropolitana
3.963.918
1980 Km2
Area della Pianura
1.544.722
* SOREU - Popolazione servita

Ospedali della Rete ACC-ECMO Metropolitana

1. Humanitas
2. San Gerardo
3. San Raffaele
4. Sacco
5. Niguarda
6. Policlinico di Milano

ATTORI RETE ECMO

- CENTRI ECMO
- MEZZI DI SOCCORSO 118
- CENTRALE OPERATIVA 118
- POPOLAZIONE-TERRITORIO



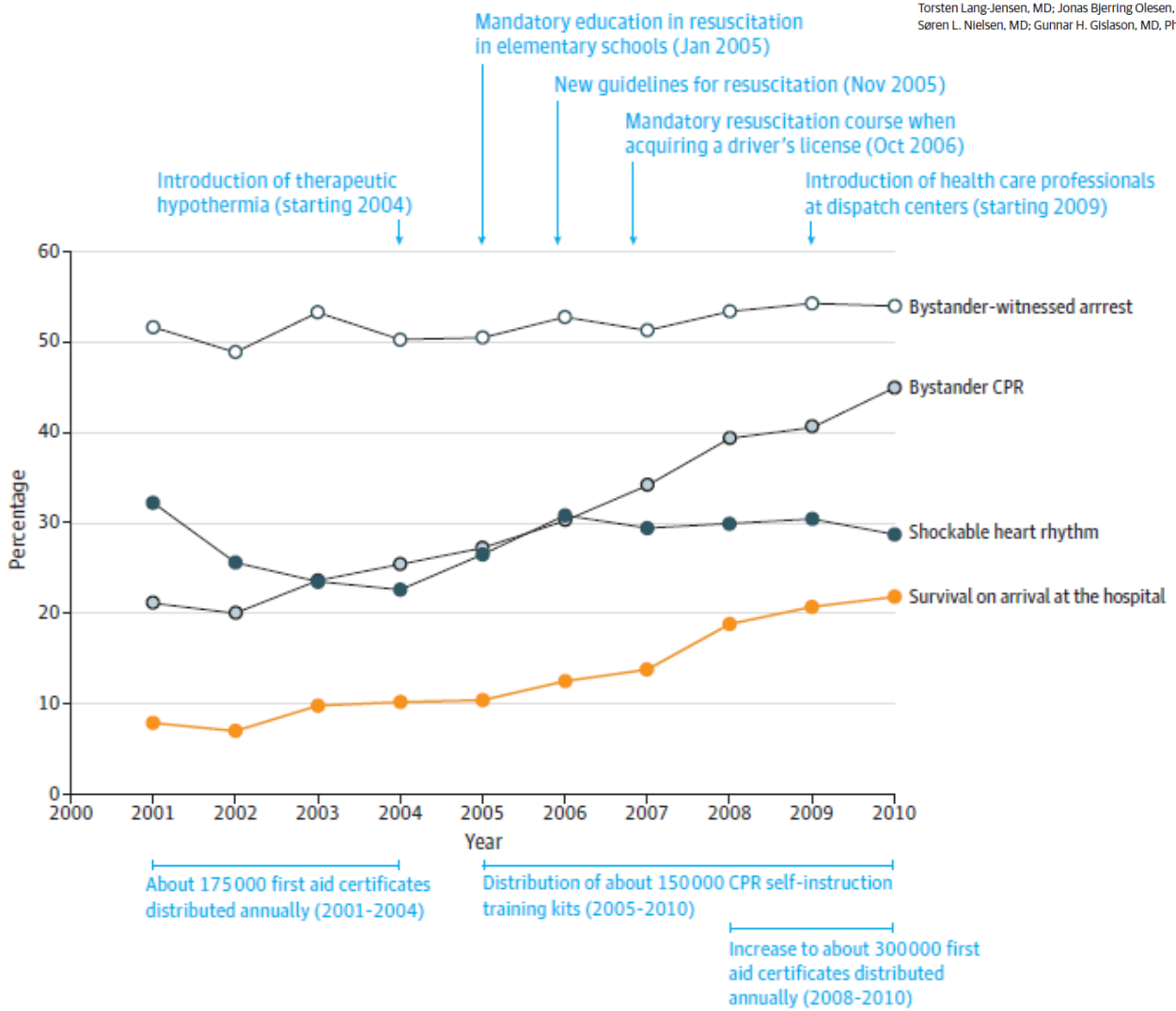
POPOLAZIONE

Research

Original Investigation

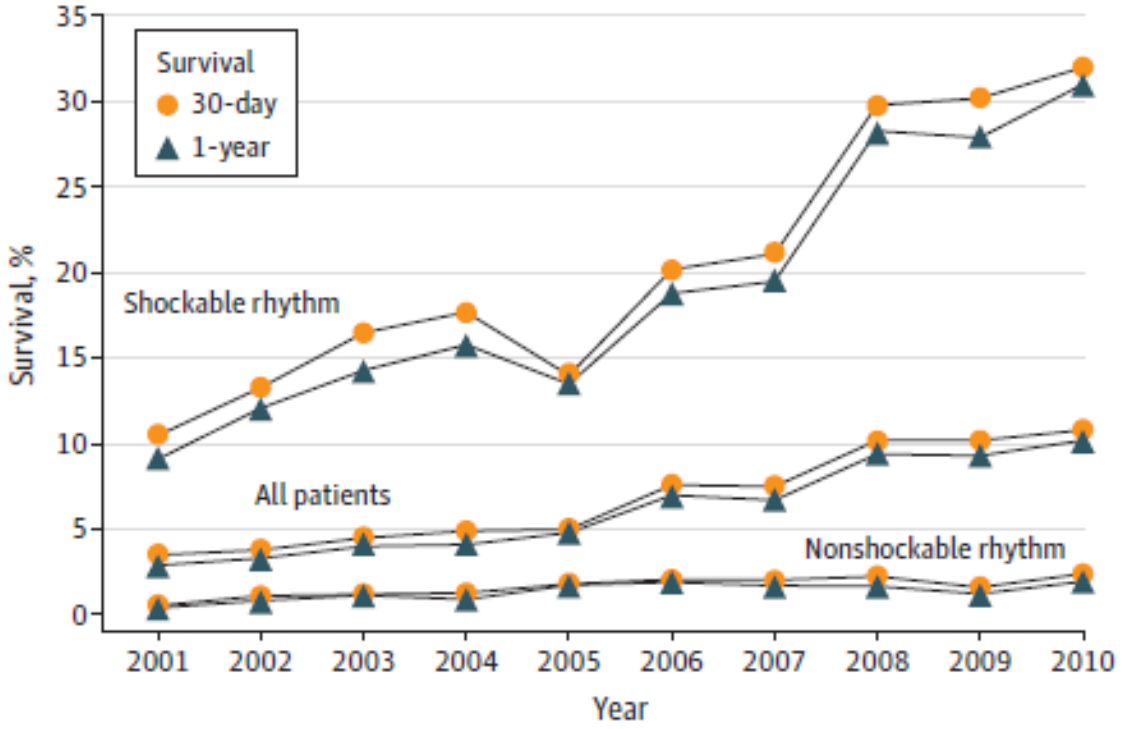
Association of National Initiatives to Improve Cardiac Arrest Management With Rates of Bystander Intervention and Patient Survival After Out-of-Hospital Cardiac Arrest

Mads Wissenberg, MD; Freddy K. Lippert, MD; Fredrik Folke, MD, PhD; Peter Weeke, MD; Carolina Malta Hansen, MD; Erika Frischknecht Christensen, MD; Henning Jans, MD; Poul Anders Hansen, MD; Torsten Lang-Jensen, MD; Jonas Bjerring Olesen, MD; Jesper Lindhardsen, MD; Emil L. Fosbol, MD, PhD; Søren L. Nielsen, MD; Gunnar H. Gislason, MD, PhD; Lars Kober, MD, DSc; Christian Torp-Pedersen, MD, DSc



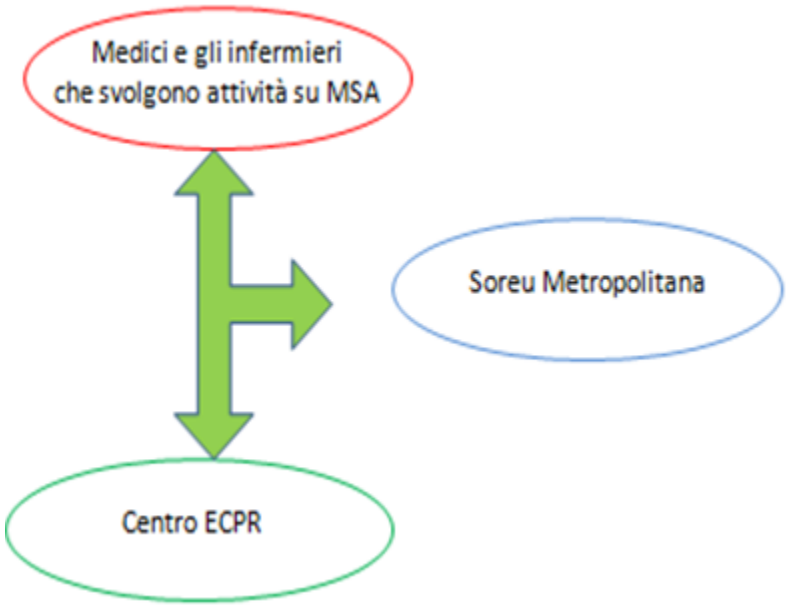
POPOLAZIONE

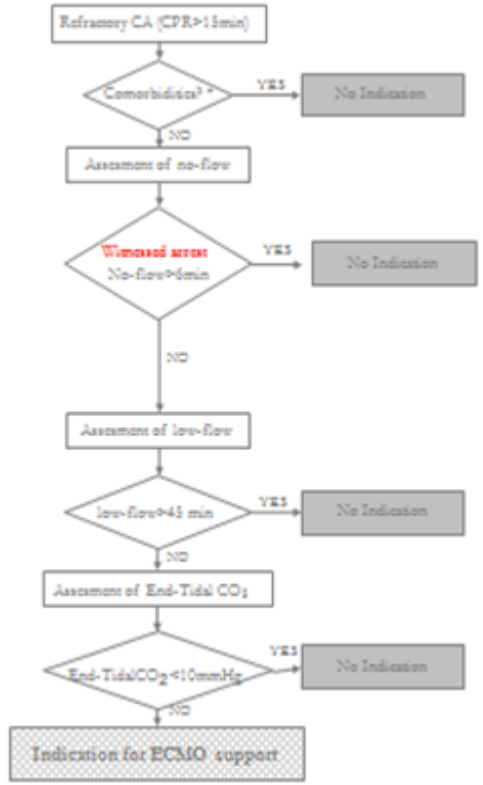
Figure 3. Survival Following Out-of-Hospital Cardiac Arrest, 2001–2010



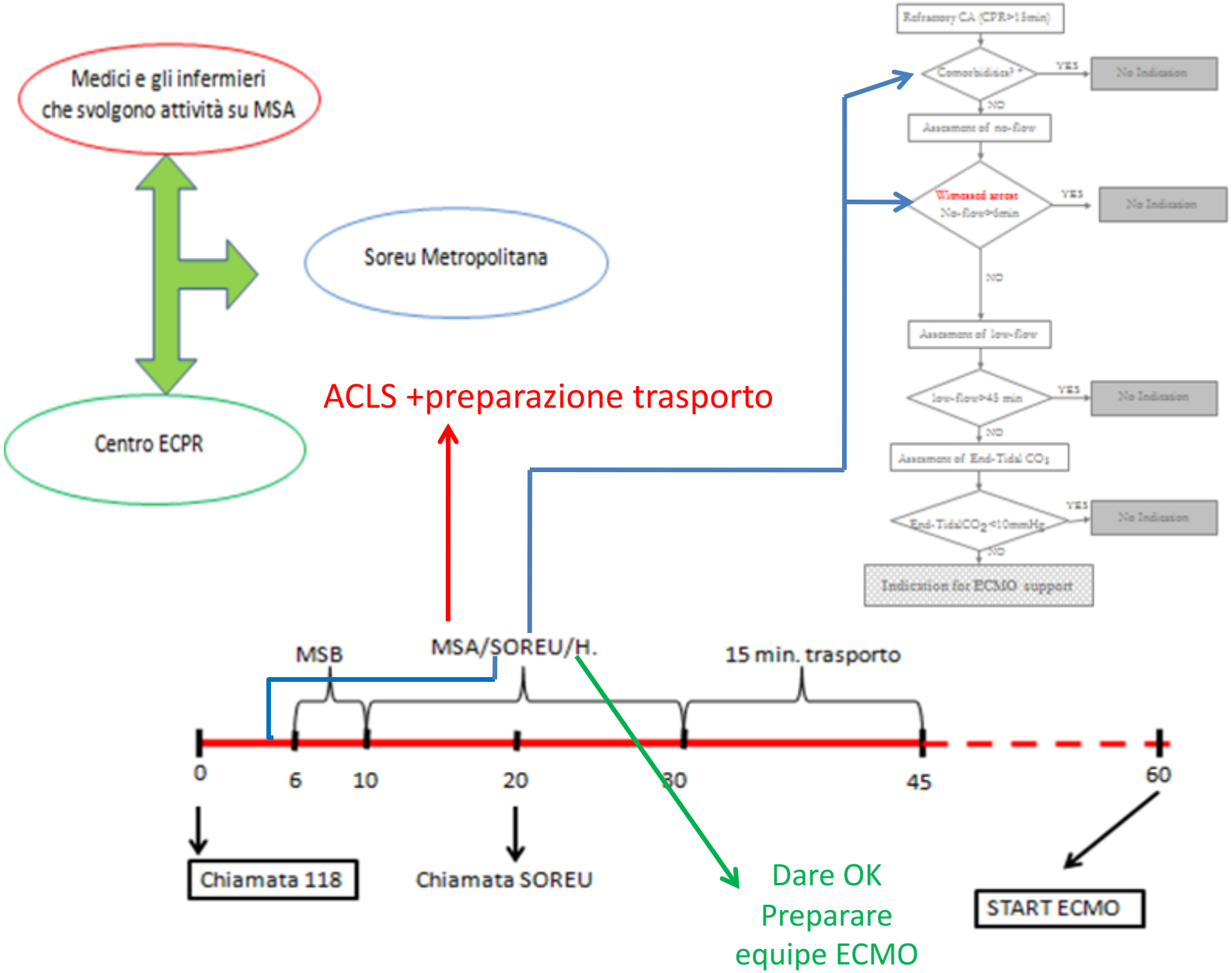
POPOLAZIONE

Variable	CPR Started after Arrival of EMS (N=14,869)	CPR Started before Arrival of EMS (N=15,512)
Median age (10th to 90th percentile) — yr	74 (54–86)	69 (46–84)
Female sex — %	30.2	26.8
Cardiac cause of cardiac arrest — %	73.4	72.4
Collapse at home — %	73.2	55.5
VF or VT as initial ECG rhythm — %	30.7	41.3
Median intervals (10th to 90th percentile) — min		
Collapse to call for EMS	4 (0–11)	3 (0–10)
Call for EMS to arrival of EMS	6 (3–15)	8 (3–20)
Collapse to start of CPR	11 (5–23)	4 (0–17)
Patients in VF or VT — no.	4194	5900
Median time from collapse to defibrillation (10th to 90th percentile) — min	11 (6–21)	13 (7–24)

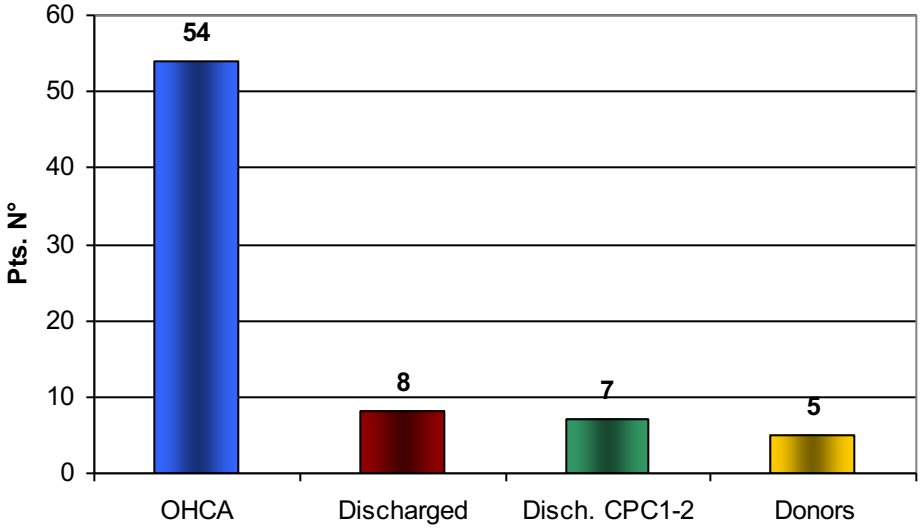

Medici e gli infermieri
che svolgono attività su MSA
Soreu Metropolitana
Centro ECPR


Refractory CA (CPR>15min)
Comorbidities? *
YES
No Indication
NO
Assessment of no-flow
Witnessed arrest
No-flow>4min
YES
No Indication
NO
Assessment of low-flow
low-flow>45 min
YES
No Indication
NO
Assessment of End-Tidal CO_2
End-TidalCO_2<10mmHg
YES
No Indication
NO
Indication for ECMO support

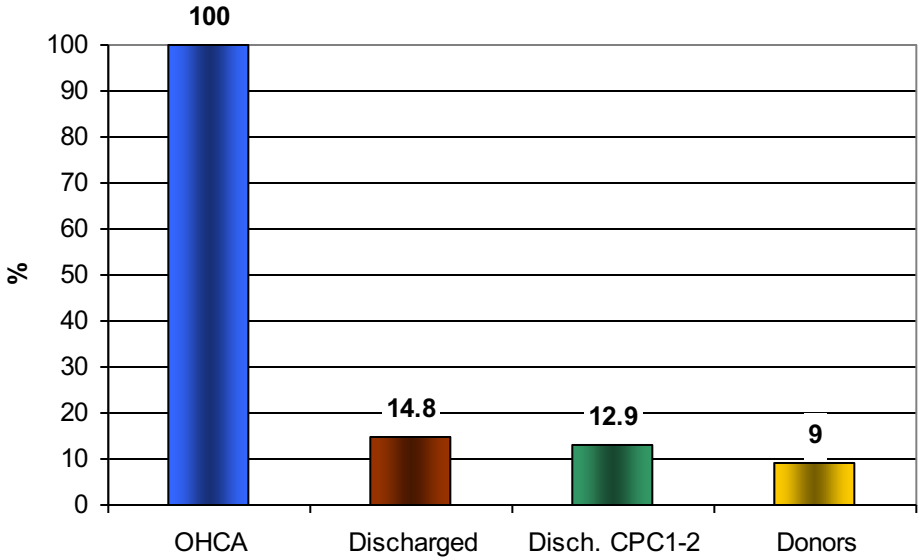
MSB
MSA/SOREU/H.
15 min. trasporto
0
6
10
20
30
45
60
Chiamata 118
Chiamata SOREU
START ECMO


Medici e gli infermieri che svolgono attività su MSA
Soreu Metropolitana
Centro ECPR
ACLS +preparazione trasporto
Refractory CA (CPR>15min)
Comorbidities? *
YES
No Indication
NO
Assessment of no-flow
Witnessed arrest
No-flow>4min
YES
No Indication
NO
Assessment of low-flow
low-flow>45 min
YES
No Indication
NO
Assessment of End-Tidal CO_2
End-TidalCO_2<10mmHg
YES
No Indication
NO
Indication for ECMO support
MSB
MSA/SOREU/H.
15 min. trasporto
0
6
10
20
30
45
60
Chiamata 118
Chiamata SOREU
Dare OK
Preparare
equipe ECMO
START ECMO

Results 2015



OHCA 2015 Milano-Brianza Network



2016 Monza

- 17 pazienti arruolati
- 5 sopravvissuti CPC 1-2 a 3 mesi (29%)
- 1 donatore

Resuscitation 86 (2015) 88–94

Contents lists available at ScienceDirect

Resuscitation

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

Clinical Paper

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)☆

Dion Stub[c,f,g], Stephen Bernard[a,b,d,*], Vincent Pellegrino[a], Karen Smith[b,d,e], Tony Walker[d], Jayne Sheldrake[a], Lisen Hockings[a], James Shaw[a,b,c], Stephen J. Duffy[a,b,c], Aidan Burrell[a,b], Peter Cameron[a,b], De Villiers Smit[a], David M. Kaye[a,b,c]

Selezione del paziente IHCA

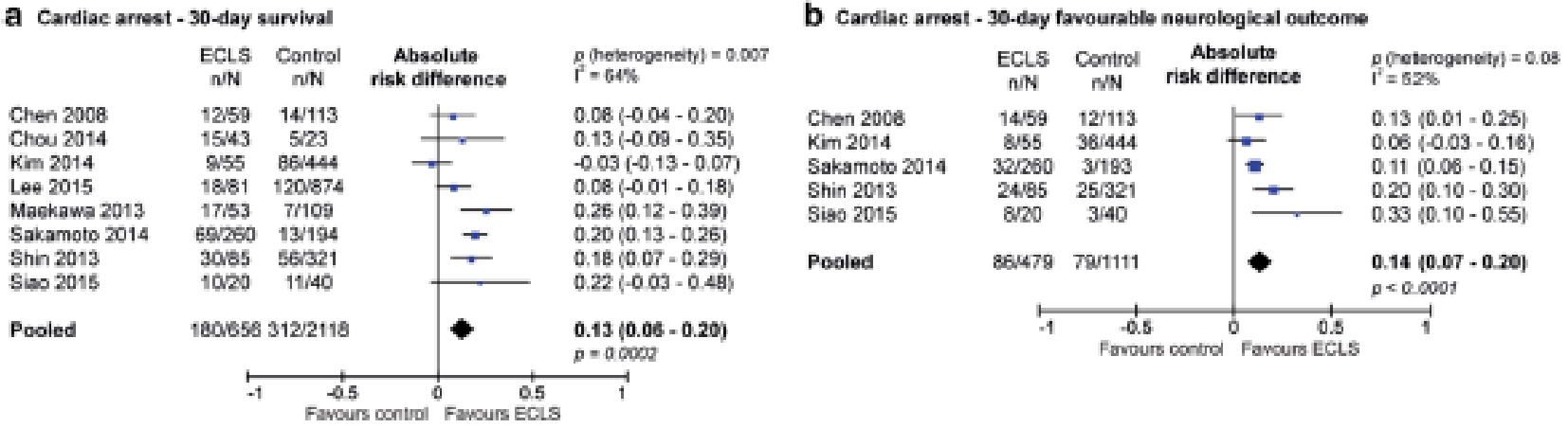
Patients with IHCA were eligible for E-CPR at the discretion of the attending critical care physician when it was considered likely that the cardiac arrest would be reversible if veno-arterial ECMO and definitive treatment could be provided immediately. Patients with IHCA were excluded if they were known to have known significant pre-existing neurological disability, non-cardiac co-morbidities that cause limitations in activities of daily living such as severe chronic airways disease, cirrhosis of the liver, renal failure on dialysis and terminal illness due to malignancy.

Intensive Care Med (2016) 42:1922–1934
DOI 10.1007/s00134-016-4536-8

SYSTEMATIC REVIEW

Extracorporeal life support during cardiac arrest and cardiogenic shock: a systematic review and meta-analysis

Dagmar M. Ouweneel[1], Jasper V. Schotborgh[1], Jacqueline Limpens[2], Krischan D. Sjauw[1], A. E. Engström[1], Wim K. Lagrand[3], Thomas G. V. Cherpanath[3], Antoine H. G. Driessen[1], Bas A. J. M. de Mol[1] and José P. S. Henriques[1*]



Cardiological outcome post CA

ECMO vs no ECMO (62 paz 2011-2015)

	ROSC *(48 paz)*	ECMO *(14 paz)*	P-value
LVEF first day	**35,7**	**20**	<0,001
US parameters at 2 months			
FEVS	**49,2**	**46,0**	0,37
TAPSE	**2,19**	**2,25**	0,76
VTDVS	**107,2**	**95,8**	0,32
VTSVS	**56,7**	**51,0**	0,55
DTDVS	**5,1**	**5,2**	0,50
DTSVS	**3,7**	**3,8**	0,78

Cardiological outcome post CA

ECMO vs no ECMO (62 paz 2011-2015)

	ROSC *(48 paz)*	*ECMO (14 paz)*	P-value
US parameters 3-12 months			
FEVS	**46,1**	**42,13**	0,50
TAPSE	**2,07**	**1,75**	0,11
VTDVS	**128,4**	**115,8**	0,44
VTSVS	**72,8**	**70,5**	0,88
DTDVS	**5,4**	**5,4**	0,94
DTSVS	**3,8**	**4,2**	0,38

Resuscitation 86 (2015) 88–94

Contents lists available at ScienceDirect

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

Clinical Paper

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11 Pz OHCA
15 Pz IHCA
Sopravvivenza alla dimissione con CPC 1 **54%**

Conclusione

- ECPR da considerare in caso di ACC di durata > 15 min
- Attenta selezione dei pazienti candidabili (OHCA Vs IHCA)
- Precisa organizzazione del sistema con un attento coinvolgimento di tutti gli attori.
- Donazione organi.

GRAZIE

Table 2
Cardiac arrest and treatment details.

Arrest characteristics	All $N = 26$	Survivors $N = 14$	Non-survivors $N = 12$	P value
ECMO inserted, n (%)	24 (92)	12 (86)	12 (100)	0.41
Median time from ECPR team arrival to initiation of ECMO, min (IQR)	20 (15–30)	16 (15–19)	30 (24–35)	0.01
Median time from collapse to initiation ECMO, min (IQR)	56 (40–85)	40 (27–57)	78 (48–101)	0.02
Location of ECMO ($n = 24$)				
Emergency Department, n (%)	13 (50)	6 (43)	7 (58)	
Intensive Care Unit, n (%)	7 (27)	3 (21)	4 (33)	0.40
Coronary catheterization laboratory, n (%)	3 (12)	2 (14)	1 (8)	
Hospital ward, n (%)	1 (4)	1 (7)	0 (0)	
ST elevation on initial ECG, n (%)	9 (35)	5 (36)	4 (33)	0.75
Initial post arrest laboratory values				
pH	6.9 (6.7–7.1)	7.0 (6.8–7.1)	6.8 (6.7–7.0)	0.02
PCO_2 mmHg	57 (43–85)	52 (32–69)	77 (48–91)	0.23
PO_2 mmHg	112 (83–211)	114 (101–159)	97 (68–350)	0.51
HCO_3 mEq/L	10 (6–16)	15 (8–16)	8 (6–13)	0.23
Lactate mEq/L	10 (7–14)	8 (6–12)	13 (9–14)	0.18
INR	1.3 (1.2–1.4)	1.3 (1.1–1.4)	1.3 (1.2–3.1)	0.40
Troponin μgm/mL	1.5 (0.12–19)	0.16 (0.07–5.8)	3.5 (1.4–39)	0.02
Creatinine μmol/L	119 (107–132)	114 (97–123)	127 (110–146)	0.24
Subsequent intervention				
Coronary angiogram, n (%)	21 (81)	13 (93)	4 (33)	0.61
PCI, n (%)	11 (42)	6 (43)	5 (42)	
Pulmonary thrombectomy, n (%)	1 (4)	1 (7)	0 (0)	
AICD, n (%)	5 (19)	5 (36)	0 (0)	0.02
Extent of coronary disease				
No significant disease, n (%)	6 (23)	6 (43)	0 (0)	0.07
Single vessel disease, n (%)	6 (23)	3 (21)	3 (25)	
Multivessel disease, n (%)	9 (70)	4 (29)	5 (42)	
LMCA involvement, n (%)	2 (16)	0 (0)	2 (17)	
Culprit vessel				
Left anterior descending, n (%)	4 (15)	2 (14)	2 (17)	0.71
Left circumflex, n (%)	4 (25)	2 (14)	2 (17)	
Right coronary artery, n (%)	3 (8)	2 (14)	1 (8)	

Annals of Cardiac Anaesthesia

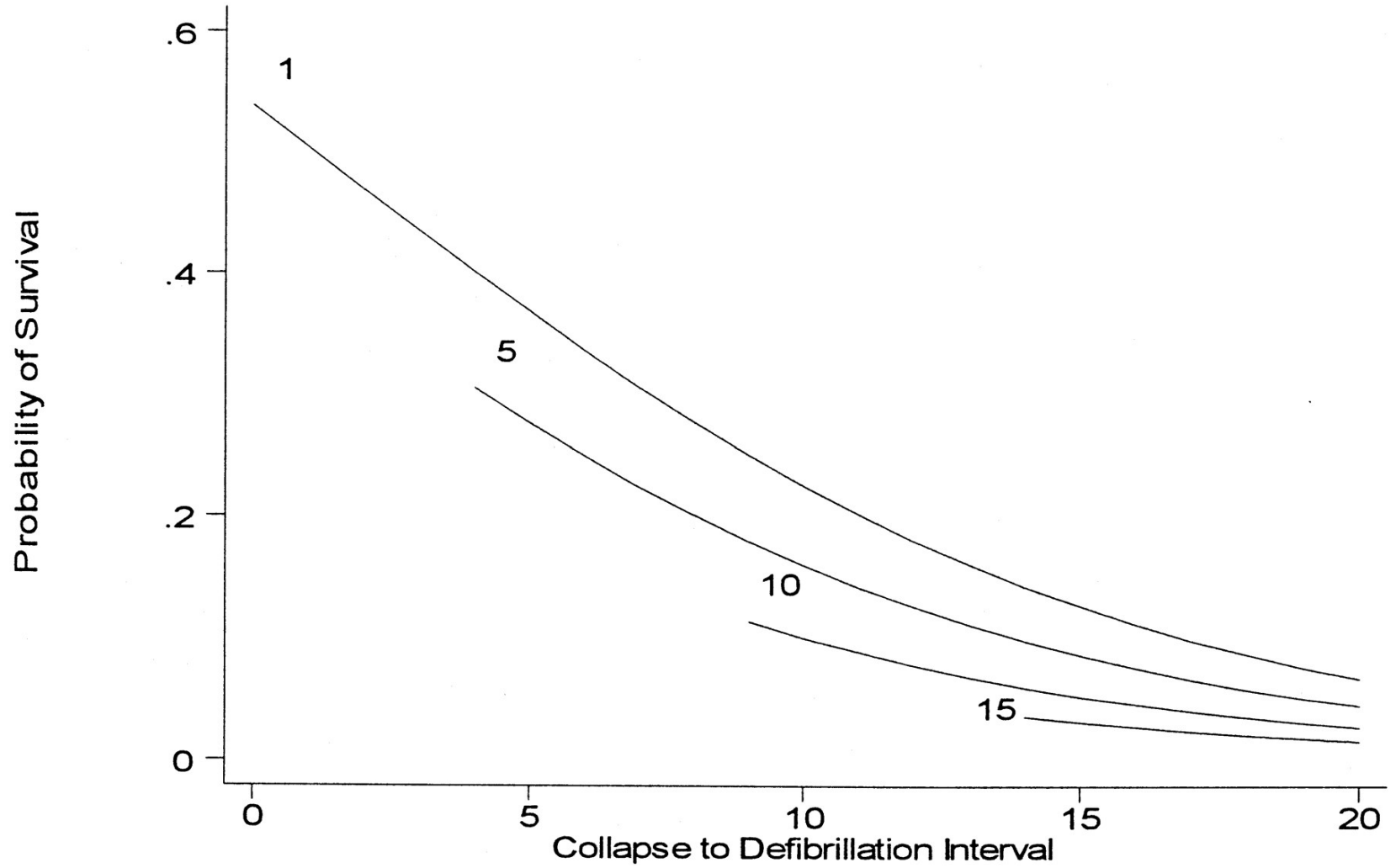
Extracorporeal Membrane Oxygenation for Refractory Cardiac Arrest

Ann Card Anaesth. 2017 Jan; 20(Suppl 1): S4–S10.

Rationale for Extracorporeal Cardiopulmonary Resuscitation

Survival is low for both in-hospital and out-of-hospital cardiac arrest managed with conventional CPR, on the order of 10% for out-of-hospital and 15%–20% for in-hospital.[11,12,13,14,15] Conventional CPR even when optimally performed provides only a fraction of normal cardiac output, in particular cerebral and myocardial blood

Relation of collapse to CPR and defibrillation to survival: simplified model.



Valenzuela T D et al. Circulation. 1997;96:3308-3313

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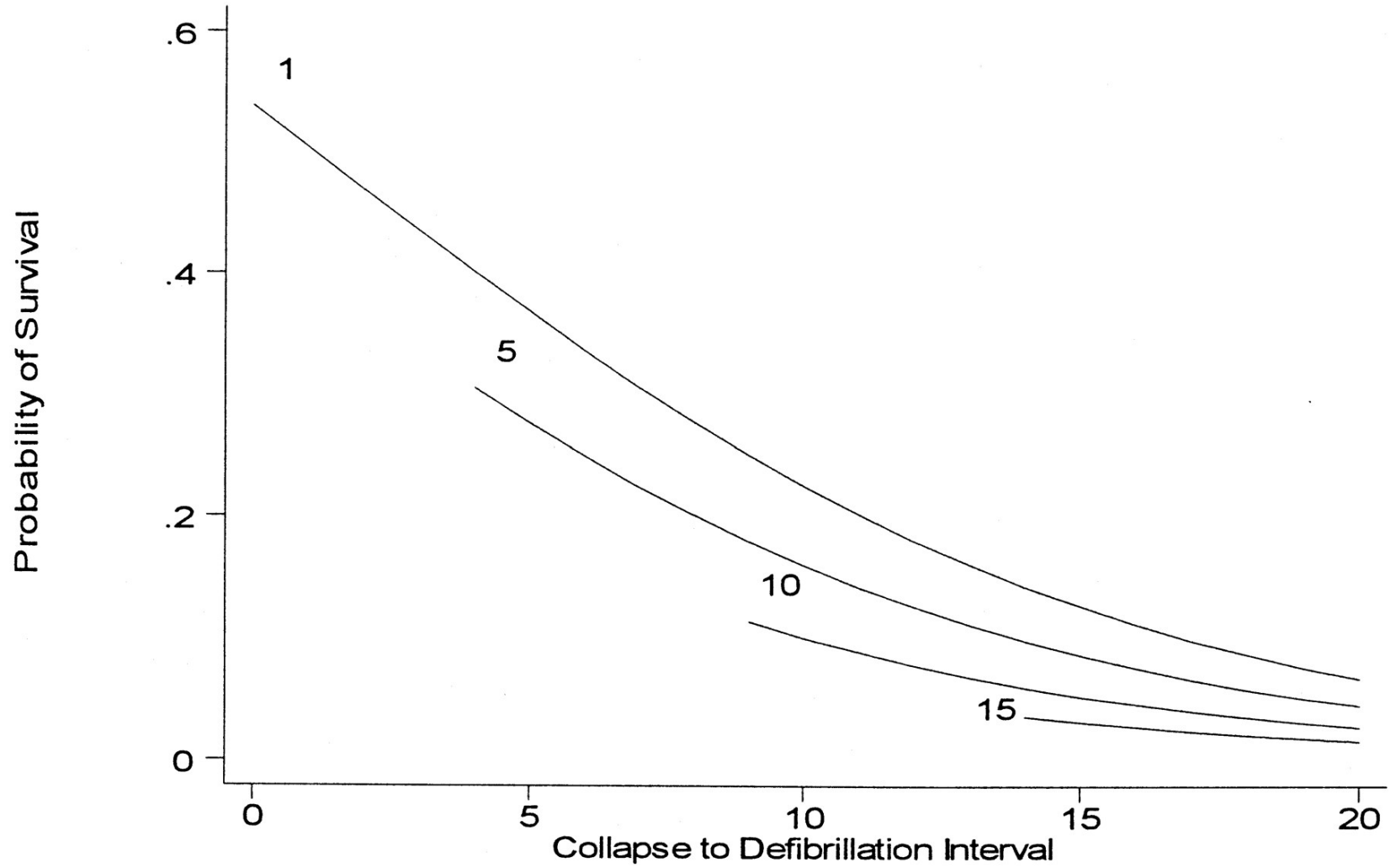
Relation of collapse to CPR and defibrillation to survival: simplified model.



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