

RENAU



RESUVal
RESEAU DES URGENCES DE LA VALLEE DU RHONE

REULIAN

CRAU

Printemps 2015 de la médecine d'urgence

Lyon, mardi 12 mai 2015

Quelle réanimation pour l'arrêt cardiaque supposé d'origine coronaire?

Alain Cariou

Intensive Care Unit – Cochin University Hospital

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Inserm
Institut national
de la santé et de la recherche médicale



Presenter Disclosure Information

- *Alain Cariou*
- *RESUVAL 2015*
- *Quelle réanimation pour l'arrêt cardiaque supposé d'origine coronaire?*

FINANCIAL DISCLOSURE:

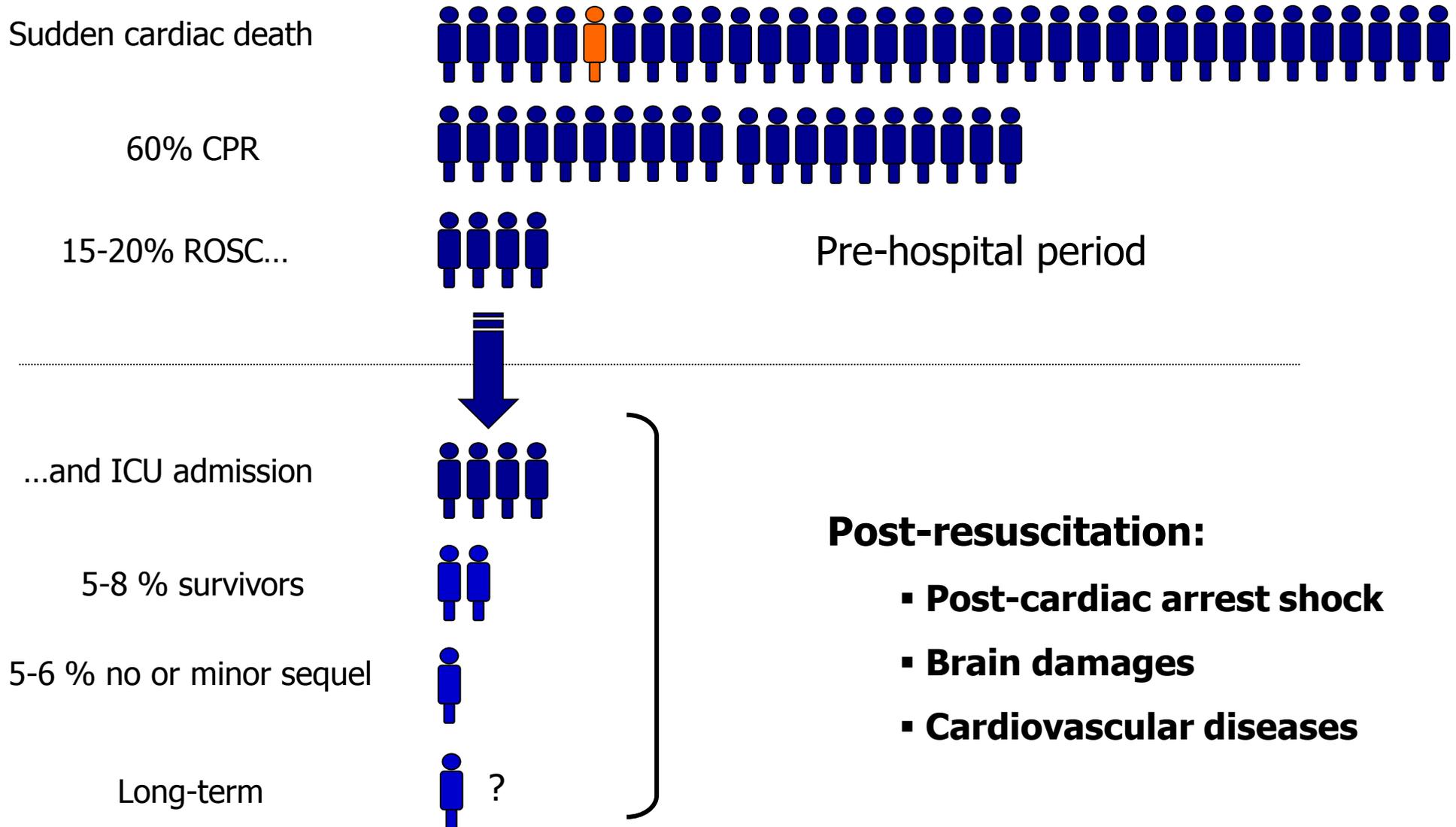
Edwards LifeSciences (honoraria)

Bard France (honoraria)

Pulsion France (honoraria)

UNLABELED/UNAPPROVED USES DISCLOSURE: none

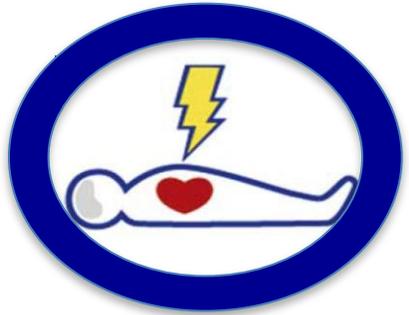
Outcome of sudden cardiac arrest (SCA) victims





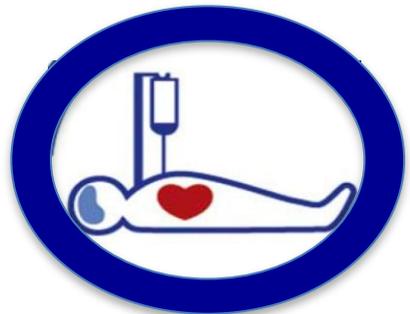
**Bystander
CPR**

**Early
defibrillation**



**CPR
efficiency**

**Post-
resuscitation
care**



2015

2010

2015

2010

2015

2010

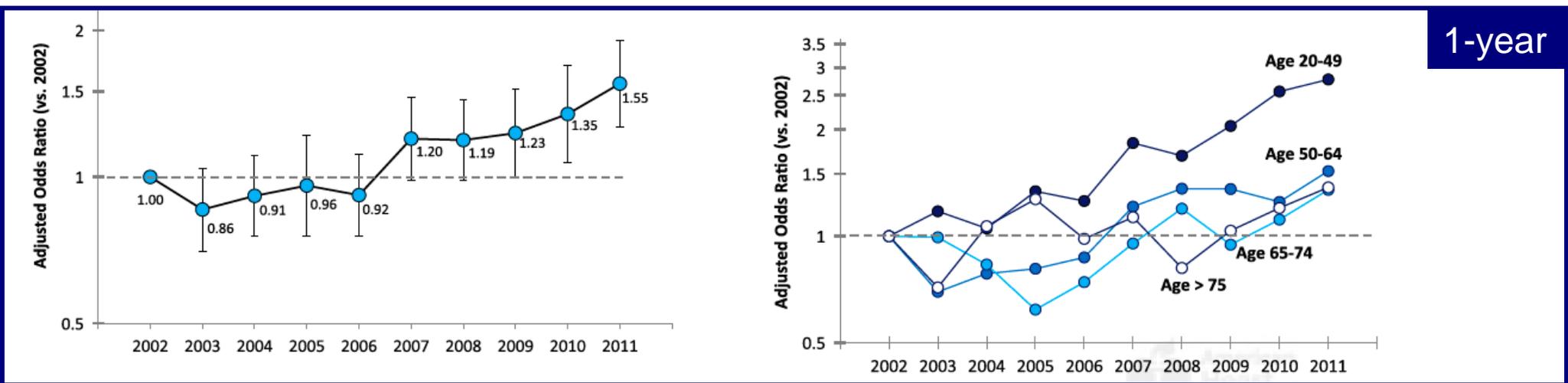
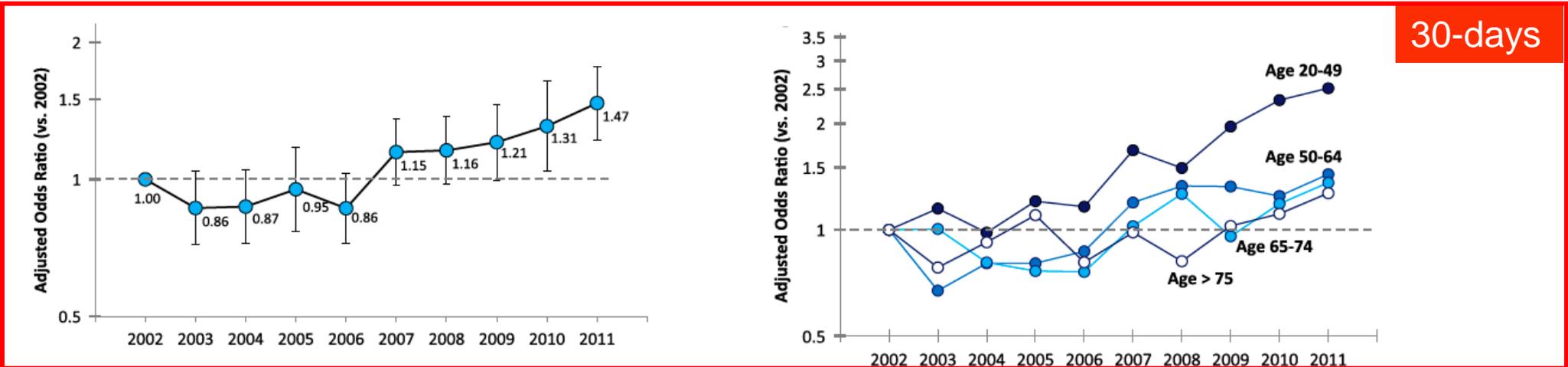
2015

2010

2015

Trends in Short- and Long-Term Survival Among OHCA Patients Alive at Hospital Arrival

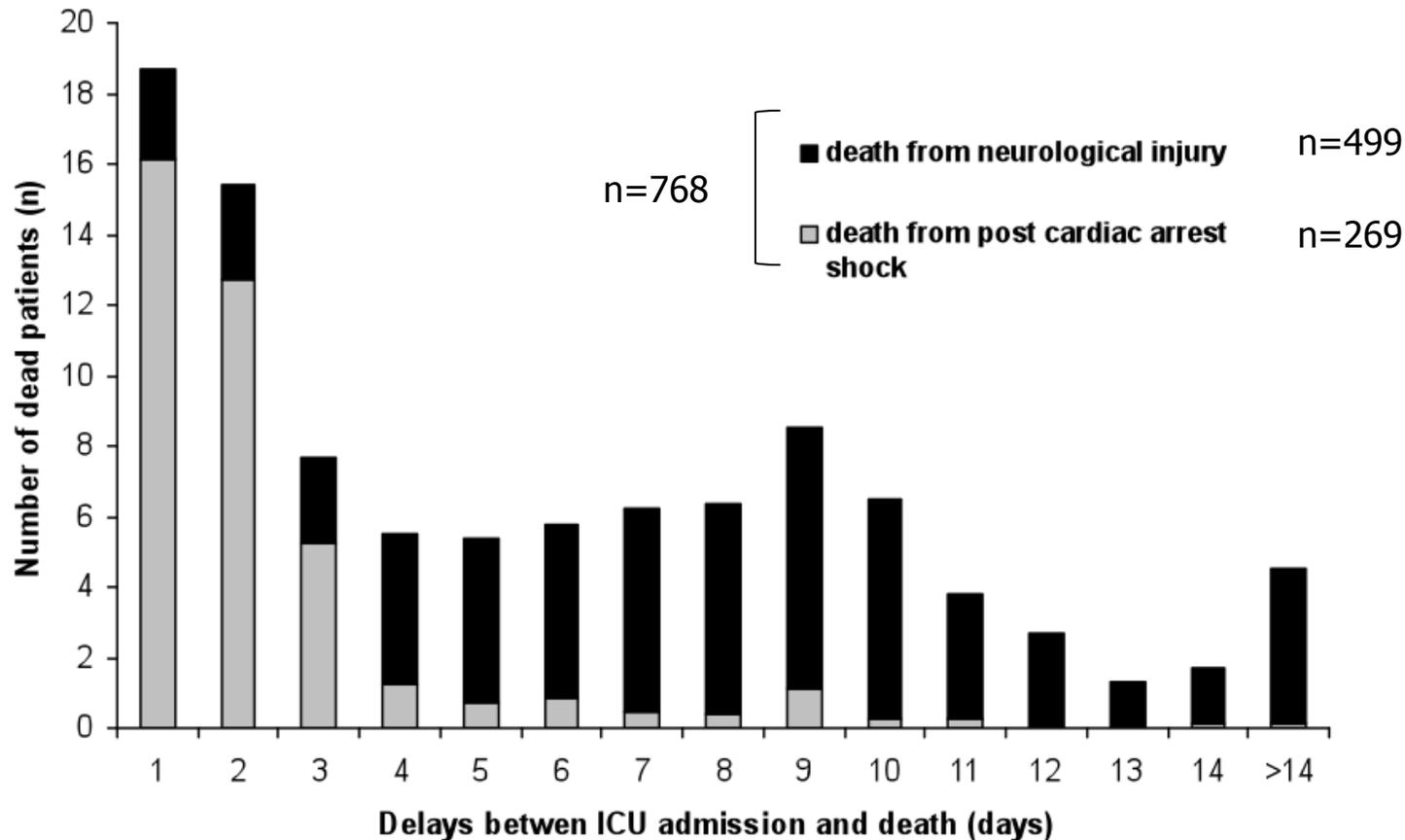
Wong MKY et al. Circulation 2014



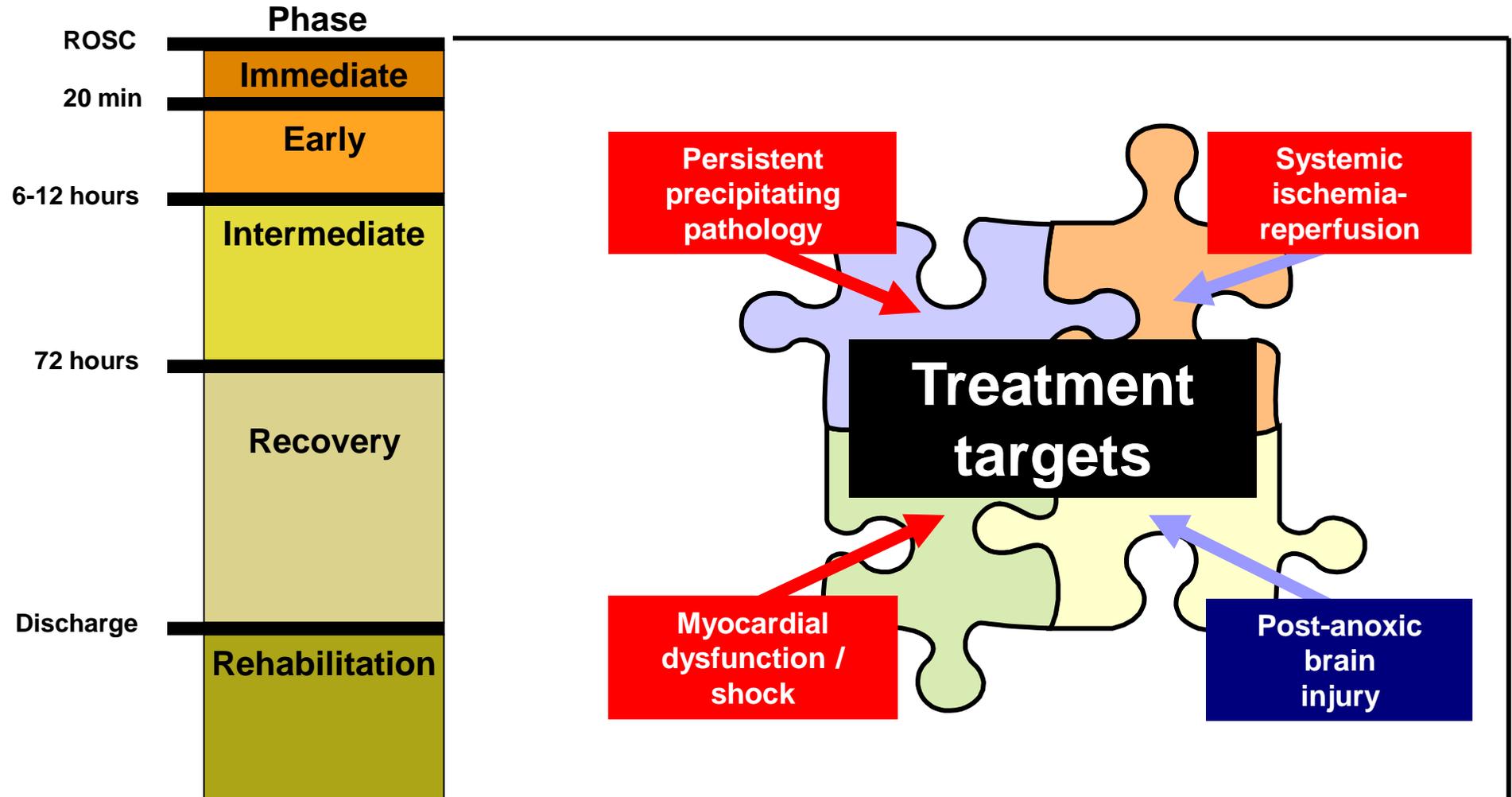
ICU mortality after cardiac arrest: the relative contribution of shock and brain injury in a large cohort

Lemiale V, Dumas F, Mongardon N, Giovanetti O, Charpentier J, Chiche JD, Carli P, Mira JP, Nolan JP, Cariou A

Intensive Care Med 2013



Post-cardiac arrest disease ILCOR Consensus Statement



European Resuscitation Council Guidelines
for Resuscitation 2010

Section 4. Adult advanced life support

Deakin CD, Nolan JP, Soar J, Sunde K, Kostere RW,
Smith GB, Perkins GD
Resuscitation 2010

Advanced Life Support

Unresponsive?
Not breathing or only occasional gasps

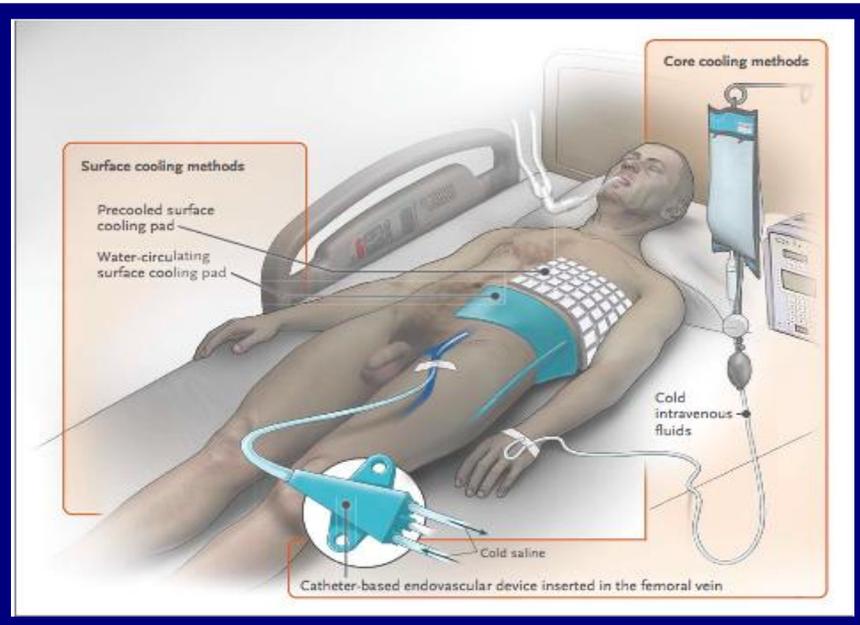
Call
Resuscitation Team

CPR 30:2

Attach defibrillator/monitor

IMMEDIATE POST CARDIAC ARREST TREATMENT

- Use ABCDE approach
- Controlled oxygenation and ventilation
- 12-lead ECG
- Treat precipitating cause
- Temperature control / Therapeutic hypothermia



Immediate coronary angiography in survivors of out-of-hospital cardiac arrest



Variables

LVEF – %

33.9 ± 10.5

LV end diastolic pressure - mmHg

25.3 ± 9.5

Normal coronary arteries – no. (%)

17 (20)

Clinically insignificant CAD – no. (%)

7 (8)

Clinically significant CAD – no. (%)

60 (71)

Recent coronary occlusion – no. (%)

40 (48)

- **Hospital survival rate: 38%**
- **Successful PTCA is protective (OR:5.2, CI 1.1-24.5; p=0.04)**

Mild therapeutic hypothermia in patients after out-of-hospital cardiac arrest due to acute ST-segment elevation myocardial infarction undergoing immediate percutaneous coronary intervention*

Crit Care Med 2008 Vol. 36, No. 6

Sebastian Wolfrum, MD; Christian Pierau; Peter W. Radke, MD; Heribert Schunkert, MD; Volkhard Kurowski, MD

Acute Ischemic Heart Disease

(Am Heart J 2009;157:312-8.)

Acute coronary angiographic findings in survivors of out-of-hospital cardiac arrest

Zacharias Alexandros Anyfantakis, MD,^{a,b} Gabriel Baron, MSc,^c Pierre Aubry, MD,^a Dominique Himbert, MD,^a Laurent J. Feldman, MD, PhD,^a Jean-Michel Juliard, MD,^a Agnès Ricard-Hibon, MD,^d Alexis Burnod, MD,^d Dennis V. Cokkinos, MD,^b and Philippe Gabriel Steg, MD^a *Paris and Clichy, France; and Athens, Greece*

Circulation March 20, 2007

Six-Month Outcome of Emergency Percutaneous Coronary Intervention in Resuscitated Patients After Cardiac Arrest Complicating ST-Elevation Myocardial Infarction

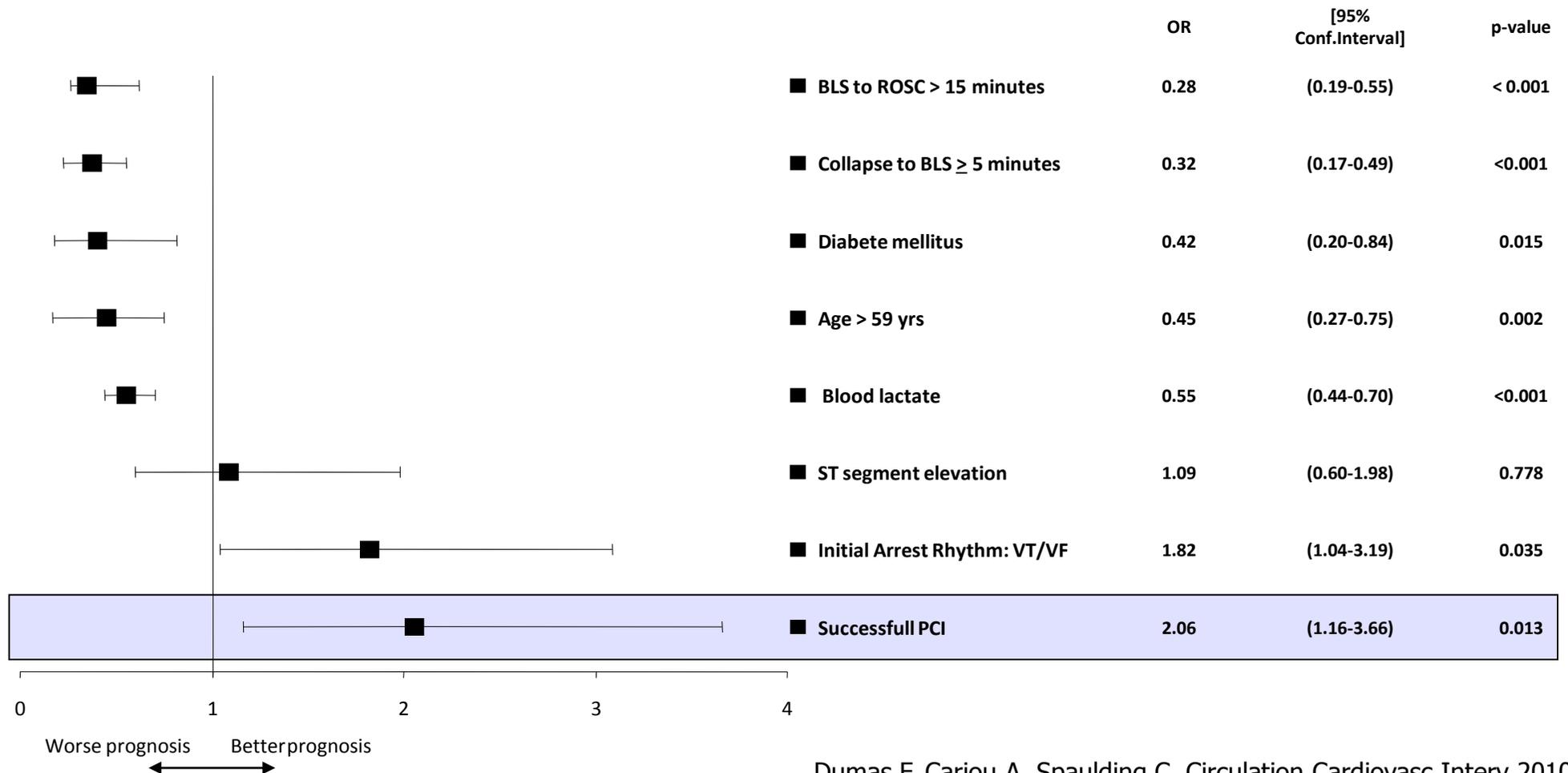
Philippe Garot, MD; Thierry Lefevre, MD; Hélène Eltchaninoff, MD, PhD; Marie-Claude Morice, MD; Fabienne Tamion, MD; Bernard Abry, MD; Pierre-François Lesault, MD; Jean-Yves Le Tarnec, MD; Claude Pougès, MD; Alain Margenet, MD; Mehran Monchi, MD; Ivan Laurent, MD; Pierre Dumas, MD; Jérôme Garot, MD, PhD; Yves Louvard, MD

Emergency percutaneous coronary intervention in patients with ST-elevation myocardial infarction complicated by out-of-hospital cardiac arrest: Early and medium-term outcome (Am Heart J 2009;157:569-575.e1.)

Corrado Lettieri, MD,^a Stefano Savonitto, MD,^b Stefano De Servi, MD,^c Giulio Guagliumi, MD,^d Guido Belli, MD,^c Alessandra Repetto, MD,^f Emanuela Piccaluga, MD,^g Alessandro Politi, MD,^h Federica Etori, MD,ⁱ Battistina Castiglioni, MD,^j Franco Fabbiocchi, MD,^k Nicoletta De Cesare, MD,^l Giuseppe Sangiorgi, MD,^m Giuseppe Musumeci, MD,^d Marco Onofri, MD,ⁿ Maurizio D'Urbano, MD,^c Salvatore Pirelli, MD,^p Roberto Zanini, MD,^a and Silvio Klugmann, MD^b, on behalf of the LombardIMA Study Group *Mantova, Milano,*

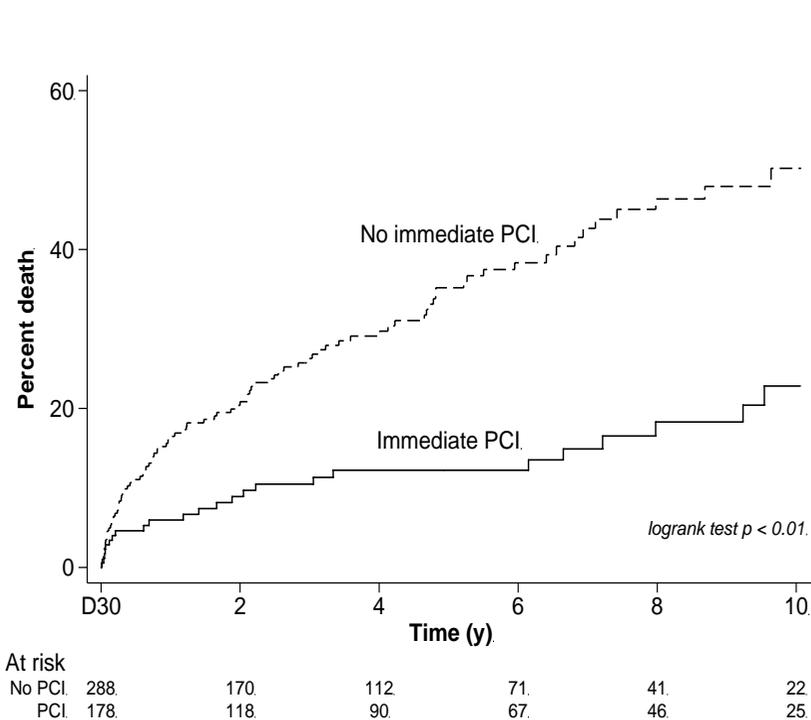
Should We Perform an Immediate Coronary Angiogram in All Survivors of OHCA With No Obvious Extra-Cardiac Cause? Insights from the PROCAT registry

Multivariate analysis of early predictors of survival in OHCA pts without obvious extra-cardiac etiology



Immediate percutaneous coronary intervention is associated with improved short and long-term outcome after out-of-hospital cardiac arrest

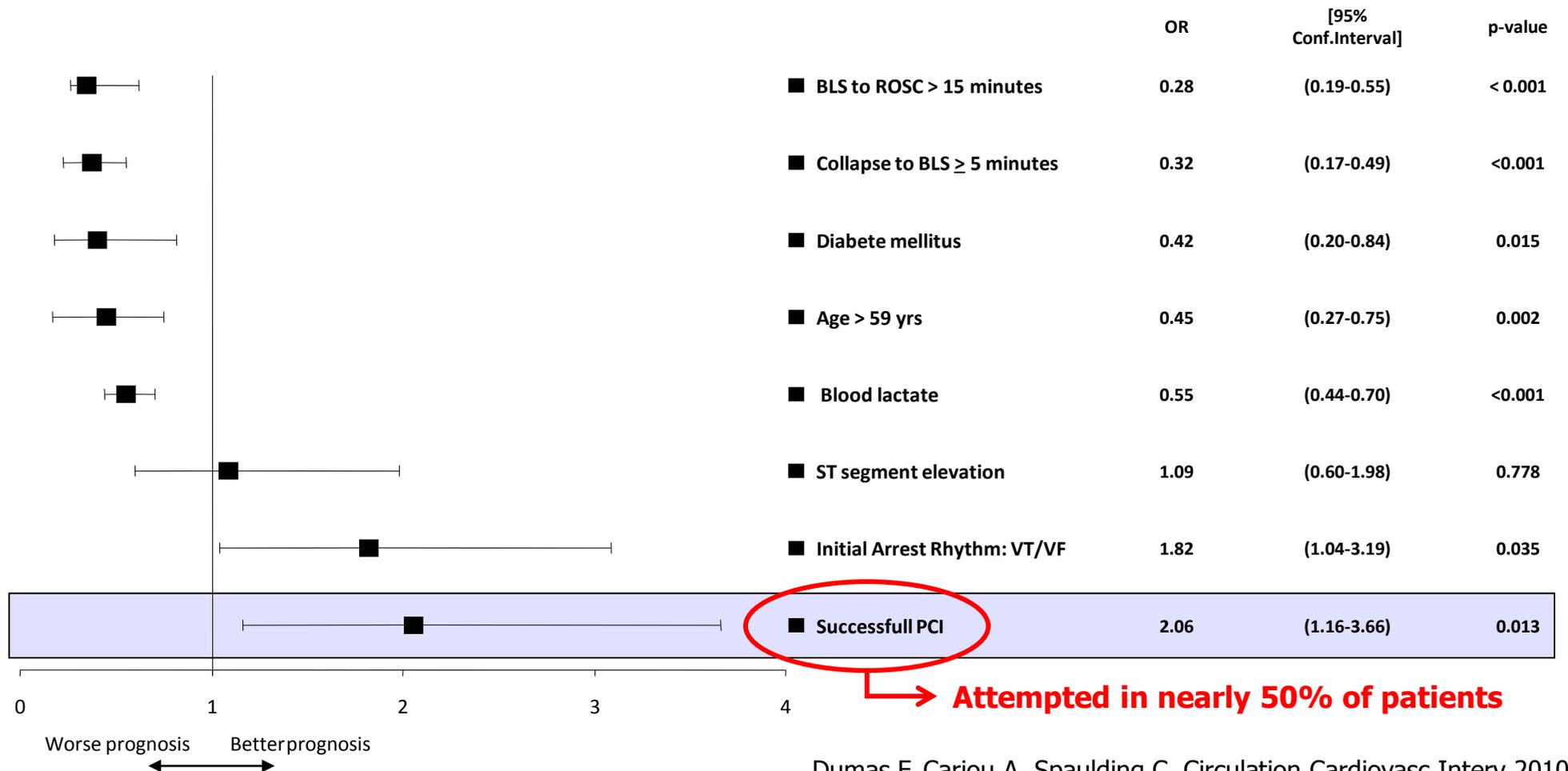
Gerri G, Dumas F, Bougouin W, Varenne O, Daviaud F, Pène F, Lamhaut L, Chiche JD, Spaulding C, Mira JP, Empana JP, Cariou A (ESICM 2014 - submitted)



	No of patients alive at follow-up, n(%)		Odds ratio	
	No PCI	PCI		
Short-term outcome				
Unadjusted unpaired analysis	901/1243 (72.5)	273/479 (57.0)	0.50 [0.40,0.63]	
Adjusted unpaired analysis	706/989 (71.4)	182/415 (43.9)	0.71 [0.53,0.94]	
Adjusted paired analysis	80/184 (43.5)	104/184 (56.5)	0.64 [0.38,1.08]	
Long-term outcome				
Unadjusted unpaired analysis	197/288 (68.4)	154/178 (86.5)	0.35 [0.23,0.56]	
Adjusted unpaired analysis	166/240 (69.2)	137/157 (87.3)	0.41 [0.25,0.68]	
Adjusted paired analysis	99/135 (73.3)	137/157 (87.3)	0.39 [0.22,0.70]	

Should We Perform an Immediate Coronary Angiogram in All Survivors of OHCA With No Obvious Extra-Cardiac Cause? Insights from the PROCAT registry

Multivariate analysis of early predictors of survival in OHCA pts without obvious extra-cardiac etiology

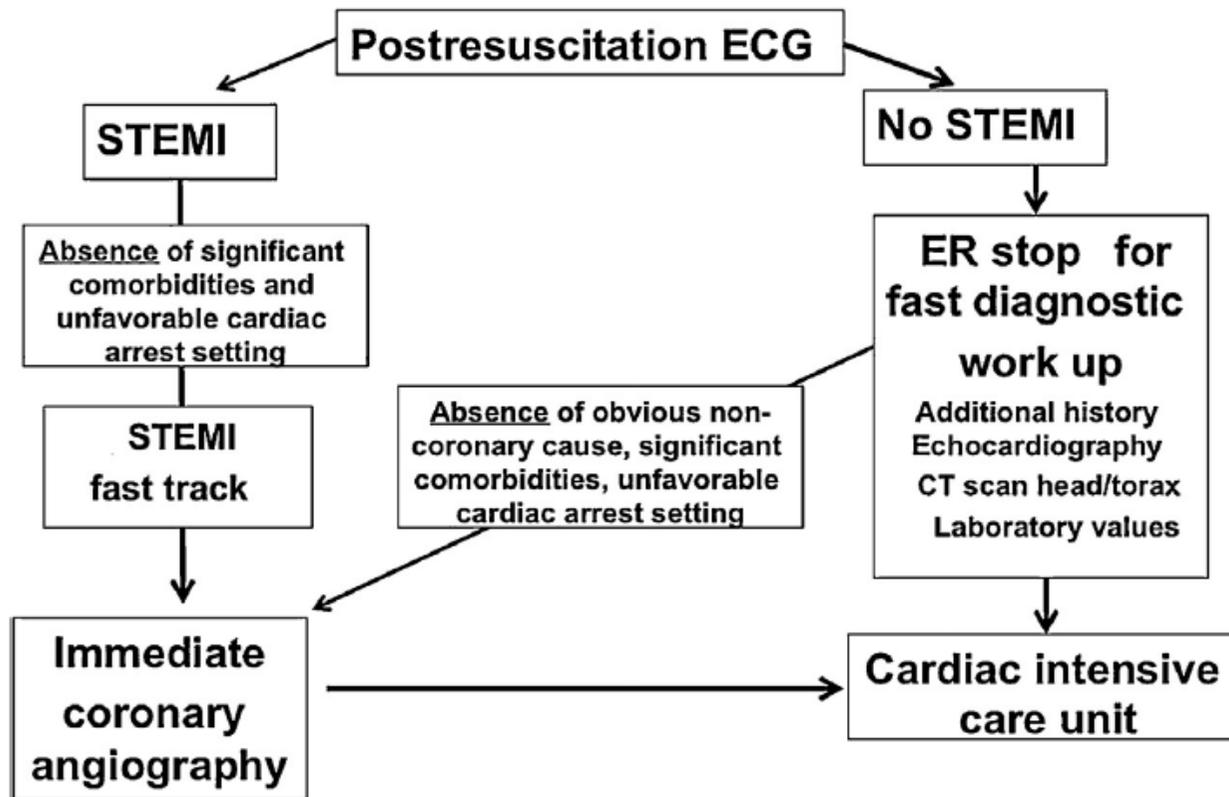


Can we improve the selection of the best candidates for an early reperfusion strategy?



- **ECG?**
- **Echocardiography?**
- **Biomarkers?**

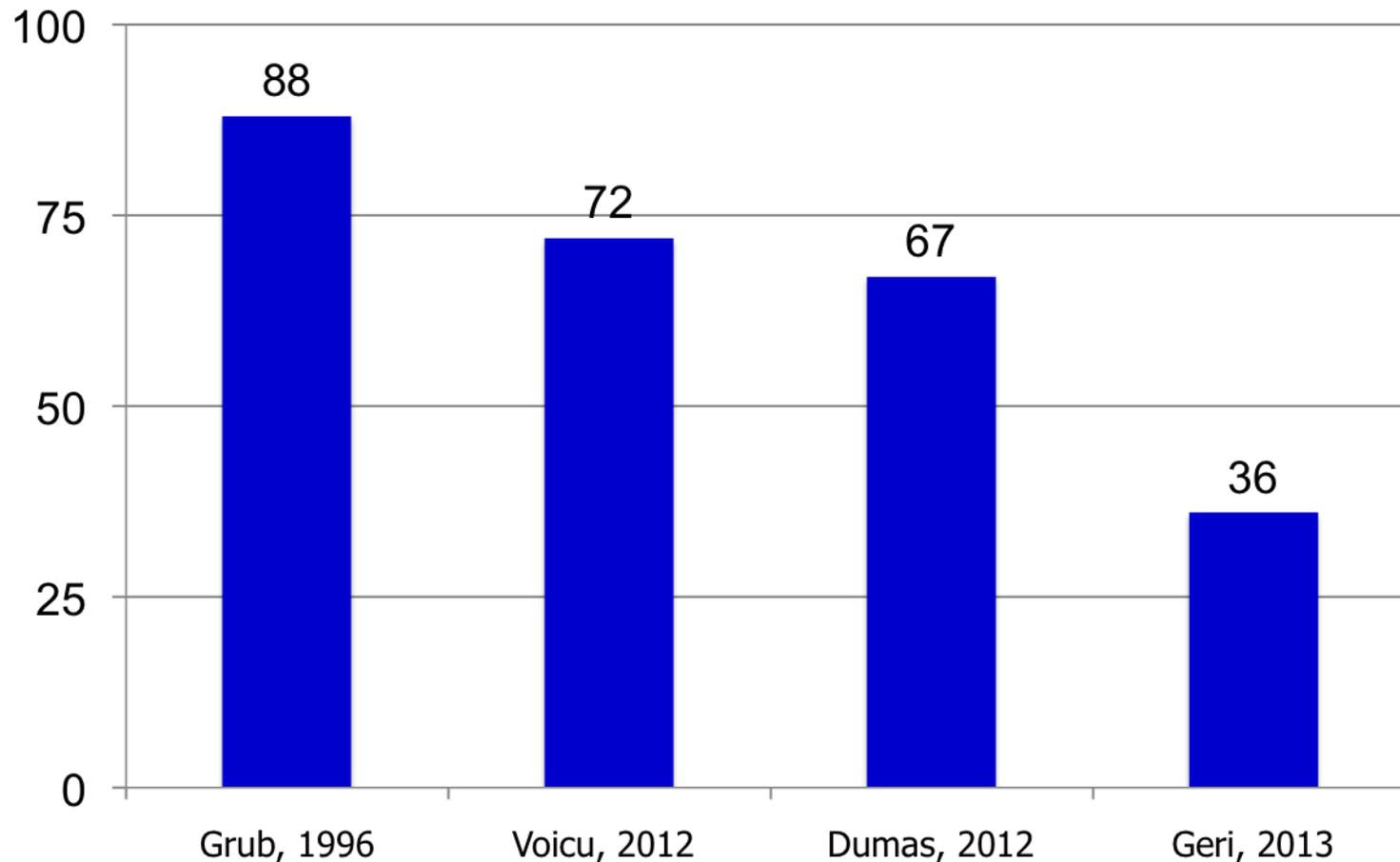
Is later PCI equivalent to immediate PCI?



Should we perform a coronary angiography to all cardiac arrest survivors?

Gerri G, Dumas F, Cariou A. Current Opinion Crit Care 2014

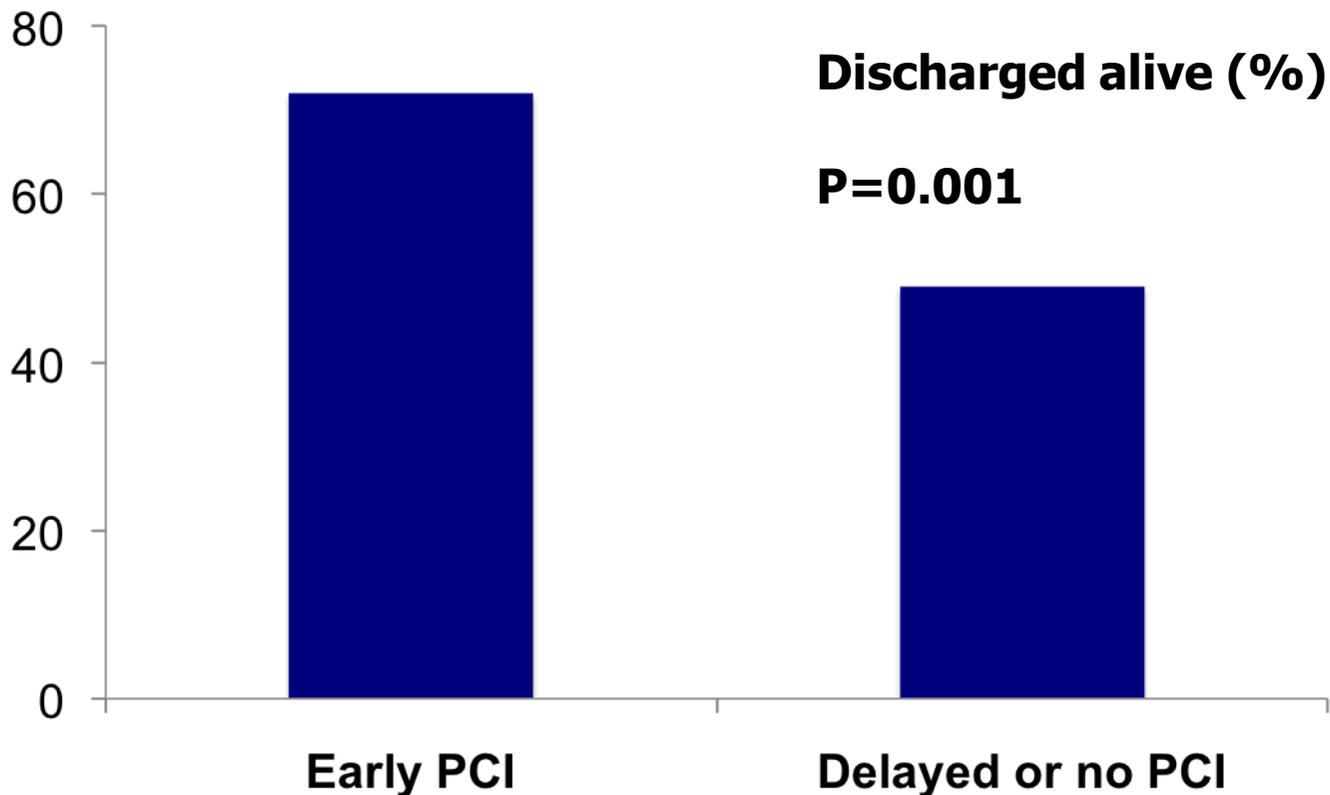
Early troponin sensitivity (%) for prediction of PCI requirement



Comparison of Role of Early (Less Than Six Hours) to Later (More Than Six Hours) or No Cardiac Catheterization After Resuscitation From Out-of-Hospital Cardiac Arrest

Justin A. Strote, MD^a, Charles Maynard, PhD^b, Michele Olsufka, RN^a, Graham Nichol, MD^a, Michael K. Copass, MD^a, Leonard A. Cobb, MD^a, and Francis Kim, MD^{a,*}

Eur. Heart J. Acute Cardiovasc. Care 2012, 1:291–301



Mrs C, 44y

- No past medical history
- Cardiac arrest during sport activity 1 hour ago
- Prodrome: headache
- Post-ROSC:
 - ECG: negative T-waves V3-V6
 - Pupillary reactivity: none
- **If early imaging, which one?**



"I think you should have perform a CT-scan, don't you?"

Sudden death from brain cause: clinical features and outcome in a multicenter cohort

Arnaout M, Mongardon N, Deye N, Legriel S, Dumas F, Sauneuf B, Charpentier J, Pène F, Baud F, Chiche JD, Mira JP, Cariou A

Crit Care Med 2015

Objective:

While sudden cardiac death has been broadly studied, little is known on cerebrovascular events revealed by out-of-hospital cardiac arrest (OHCA). We aimed to describe clinical features and prognosis of these patients, and to identify characteristics that could suggest a cerebrovascular aetiology of the OHCA.

Methods:

Retrospective review (1999-2012) of databases of three ICUs. Patients admitted for management of successfully resuscitated OHCA were considered if subarachnoid haemorrhage, intracranial haemorrhage, ischemic stroke, sub/epidural hematoma, cerebral thrombophlebitis was the primary cause of OHCA, excluding traumatic or infectious causes. Included patients were compared with a group of OHCA of non-neurological origin.



3710 OHCA

Sudden death from brain cause: clinical features and outcome in a multicenter cohort

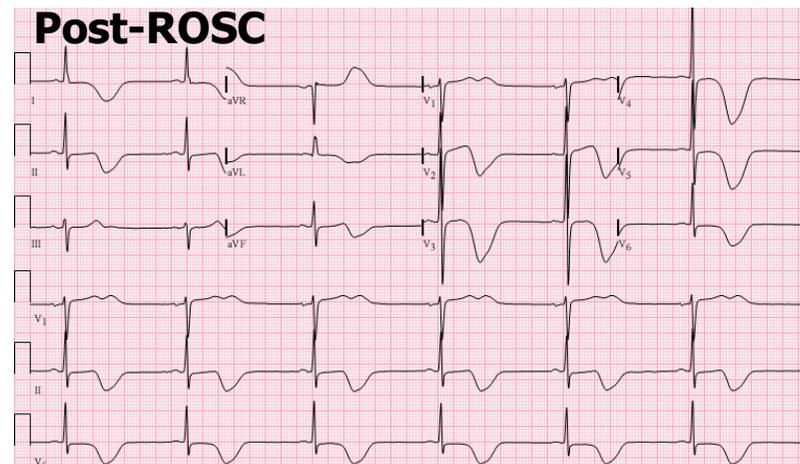
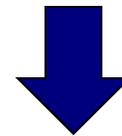
Arnaout M, Mongardon N, Deye N, Legriel S, Dumas F, Sauneuf B, Charpentier J, Pène F, Baud F, Chiche JD, Mira JP, Cariou A

Crit Care Med 2015

Young healthy woman



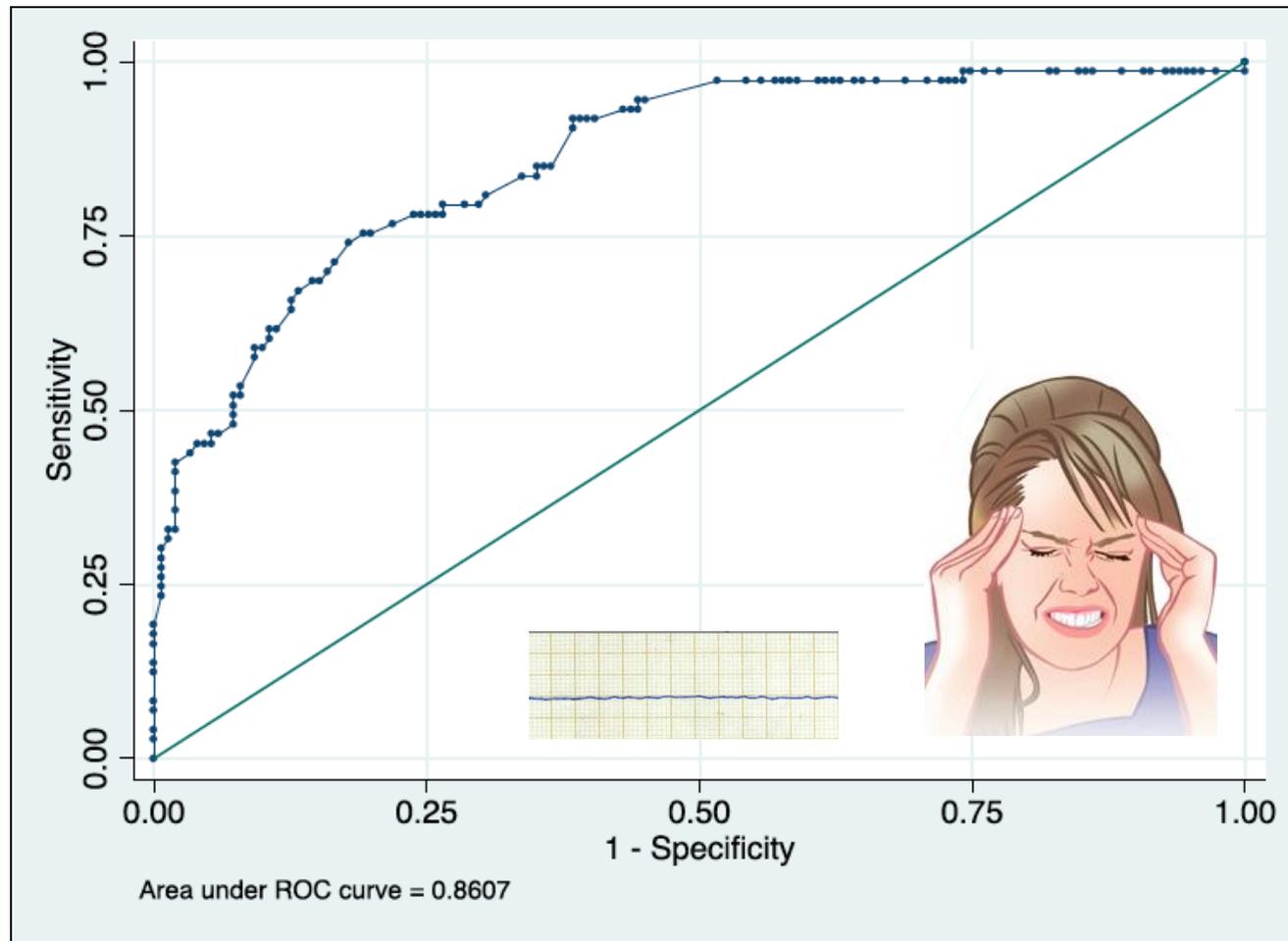
Phenotype



Sudden death from brain cause: clinical features and outcome in a multicenter cohort

Arnaout M, Mongardon N, Deye N, Legriél S, Dumas F, Sauneuf B, Charpentier J, Pène F, Baud F, Chiche JD, Mira JP, Cariou A

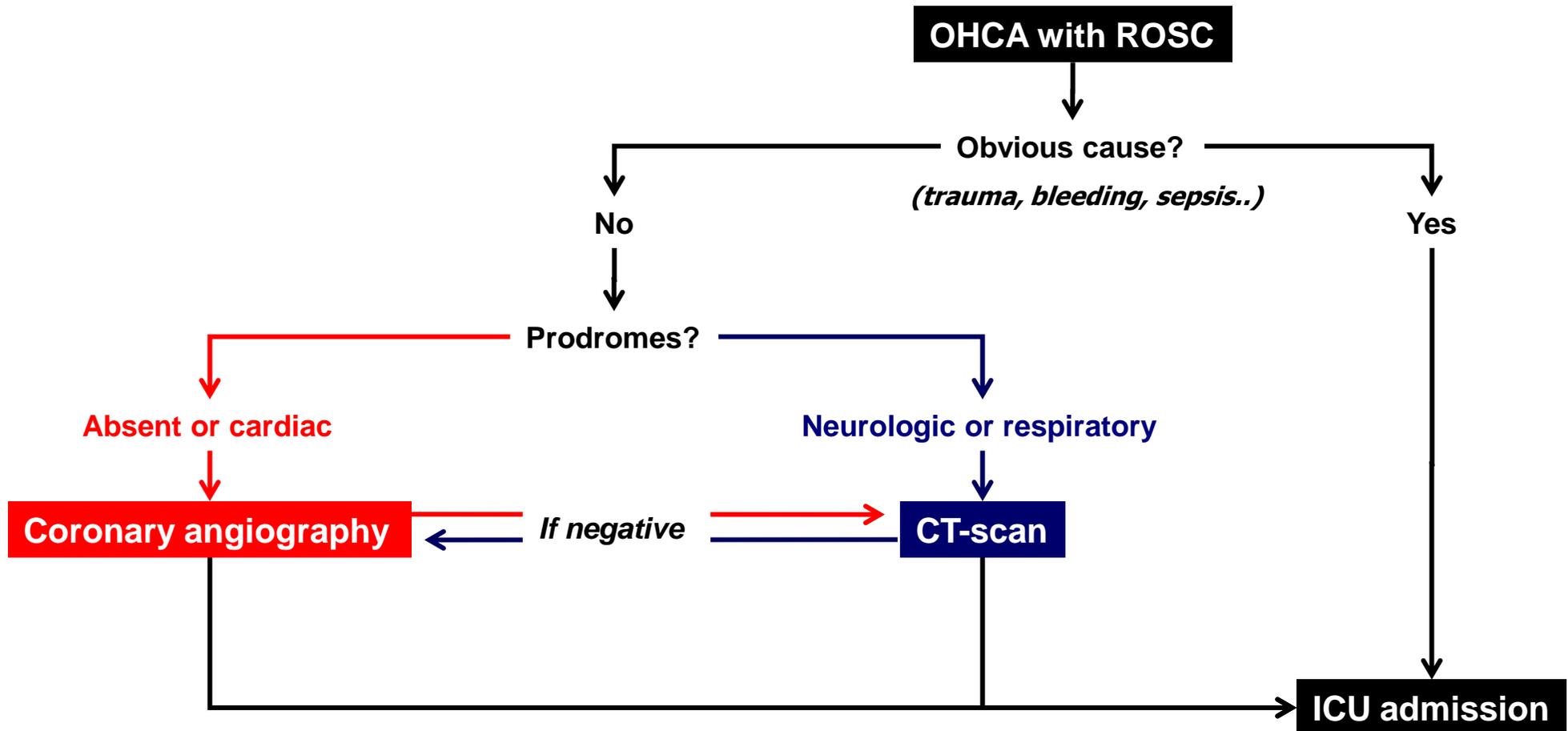
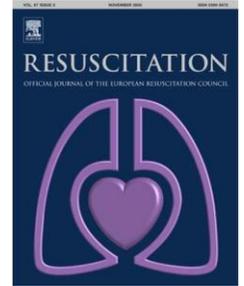
Crit Care Med 2015



Benefit of an early and systematic imaging procedure after cardiac arrest: insights from the PROCAT (Parisian Region Out of Hospital Cardiac Arrest) registry.

J CHELLY, N MONGARDON, F DUMAS, O VARENNE, C SPAULDING, O VIGNAUX, P CARLI, J CHARPENTIER, F PENE, JD CHICHE, JP MIRA, A CARIOU

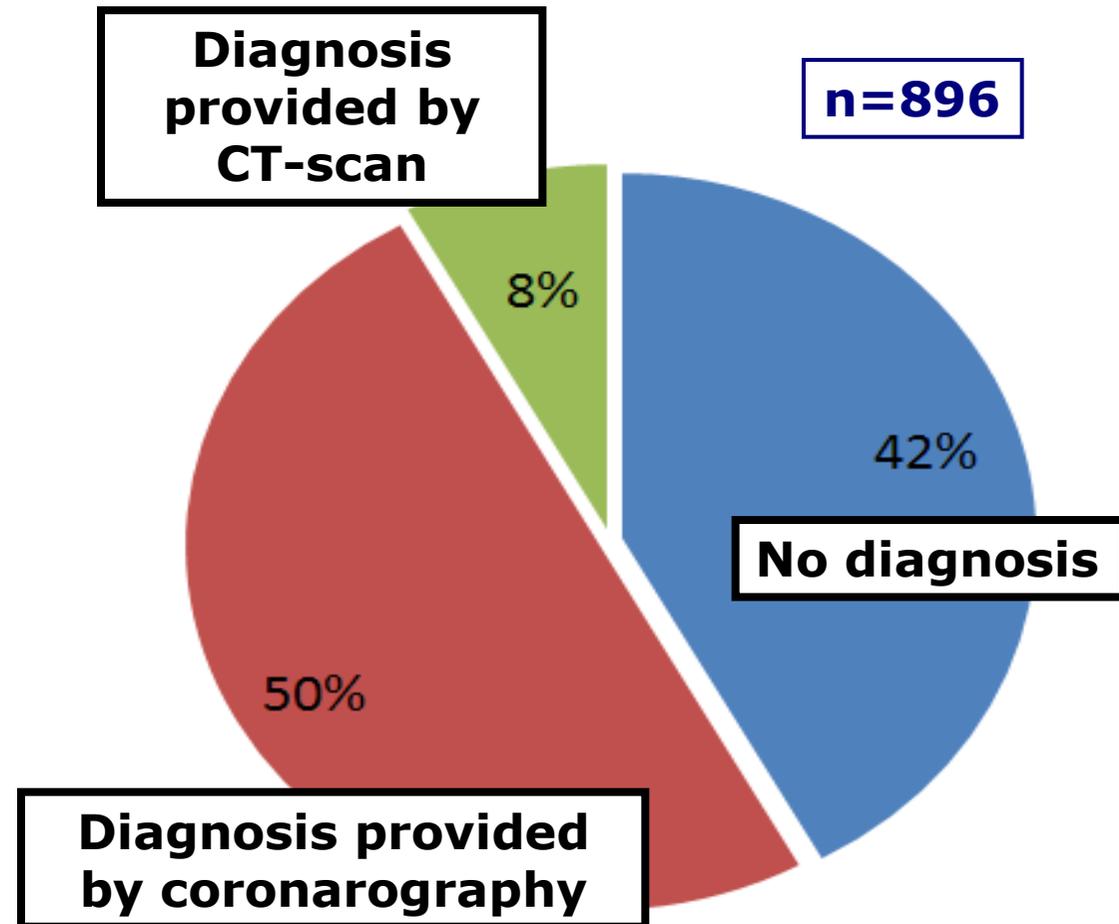
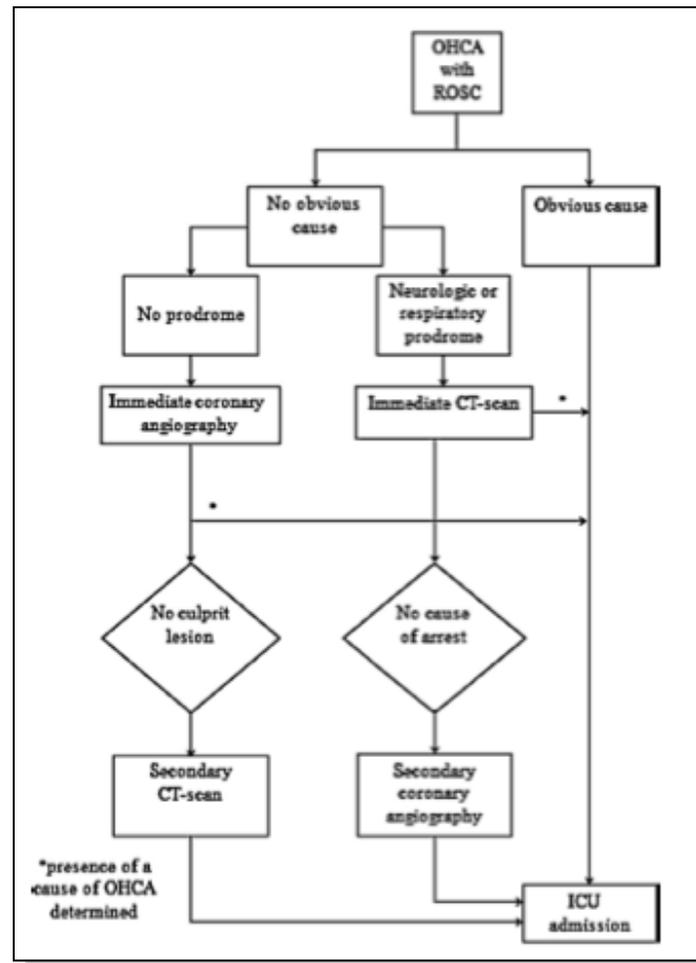
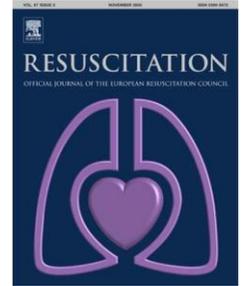
Resuscitation 2009



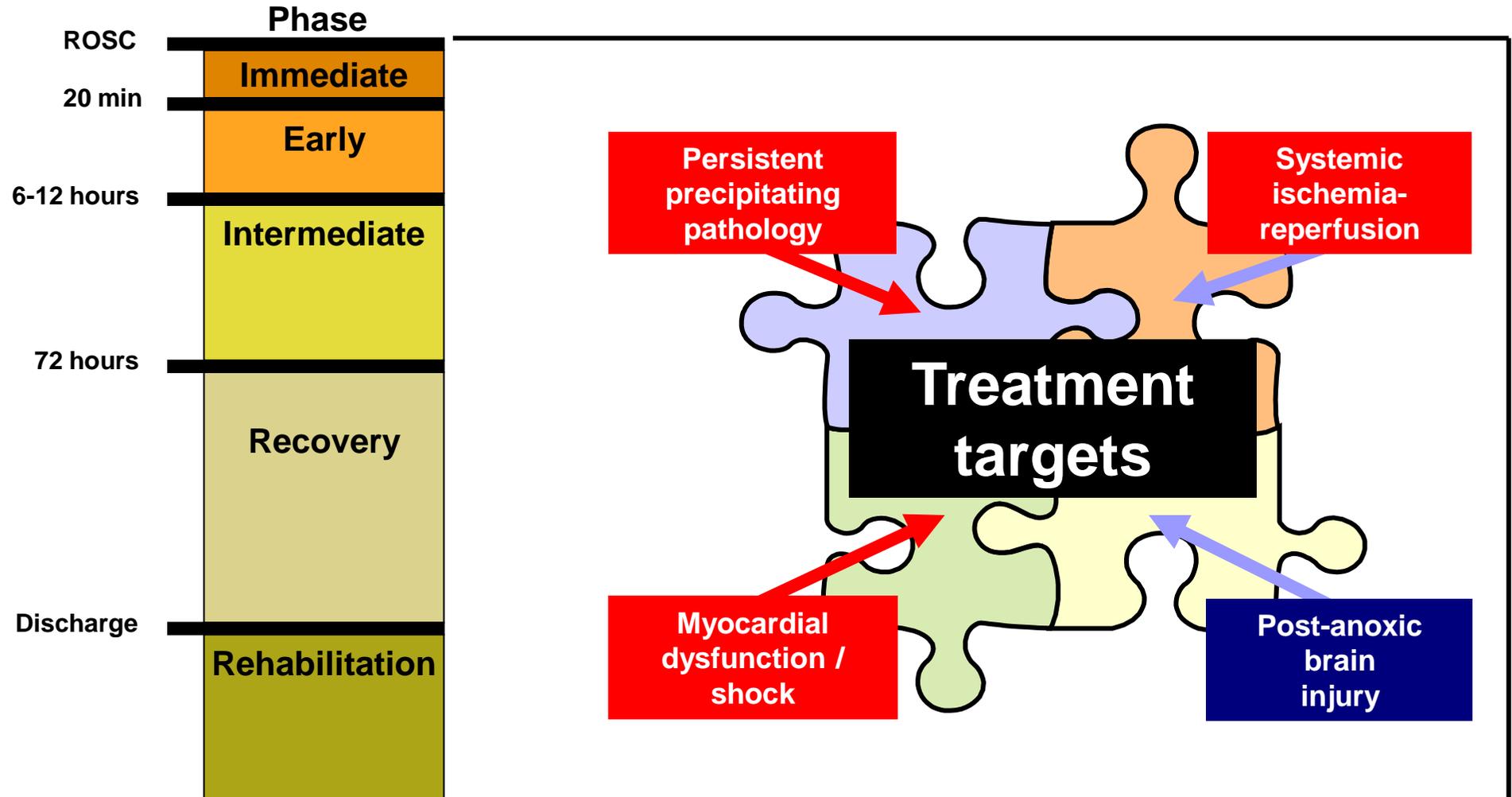
Benefit of an early and systematic imaging procedure after cardiac arrest: insights from the PROCAT (Parisian Region Out of Hospital Cardiac Arrest) registry

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Resuscitation 2009

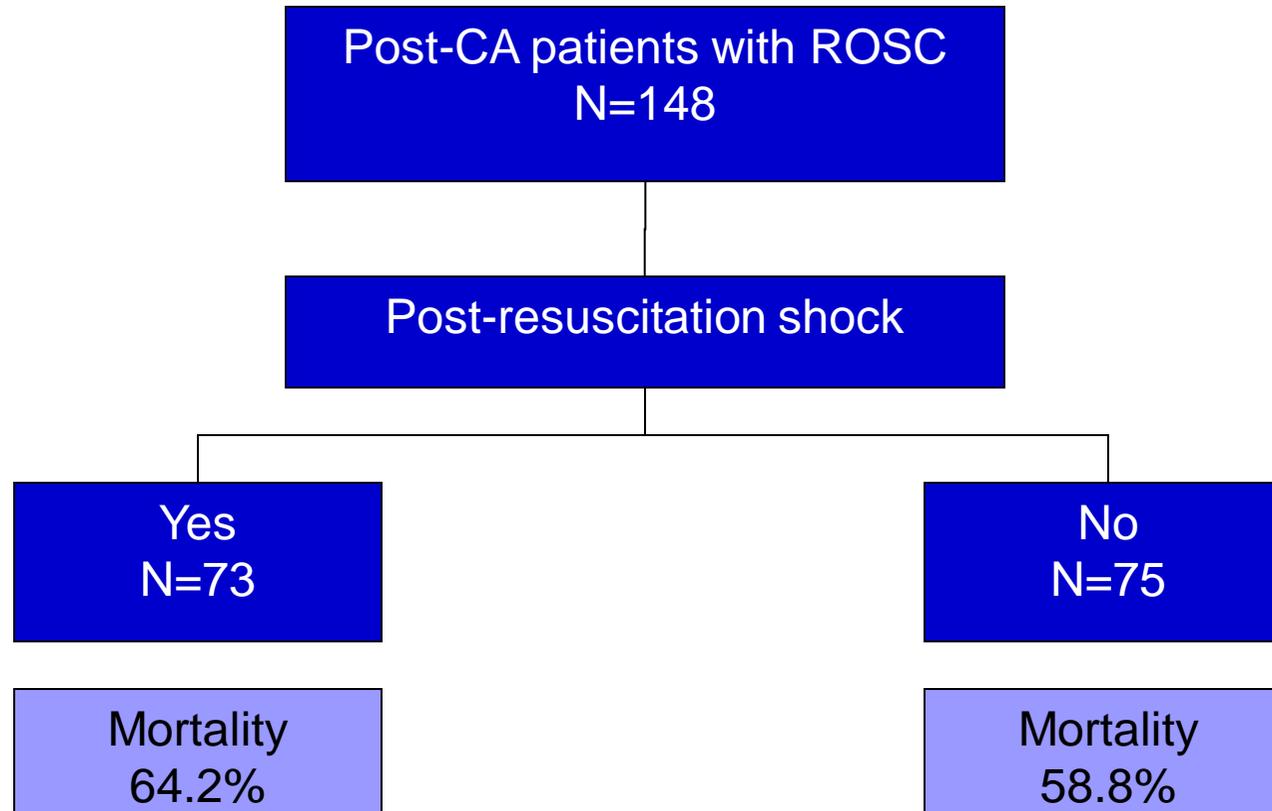


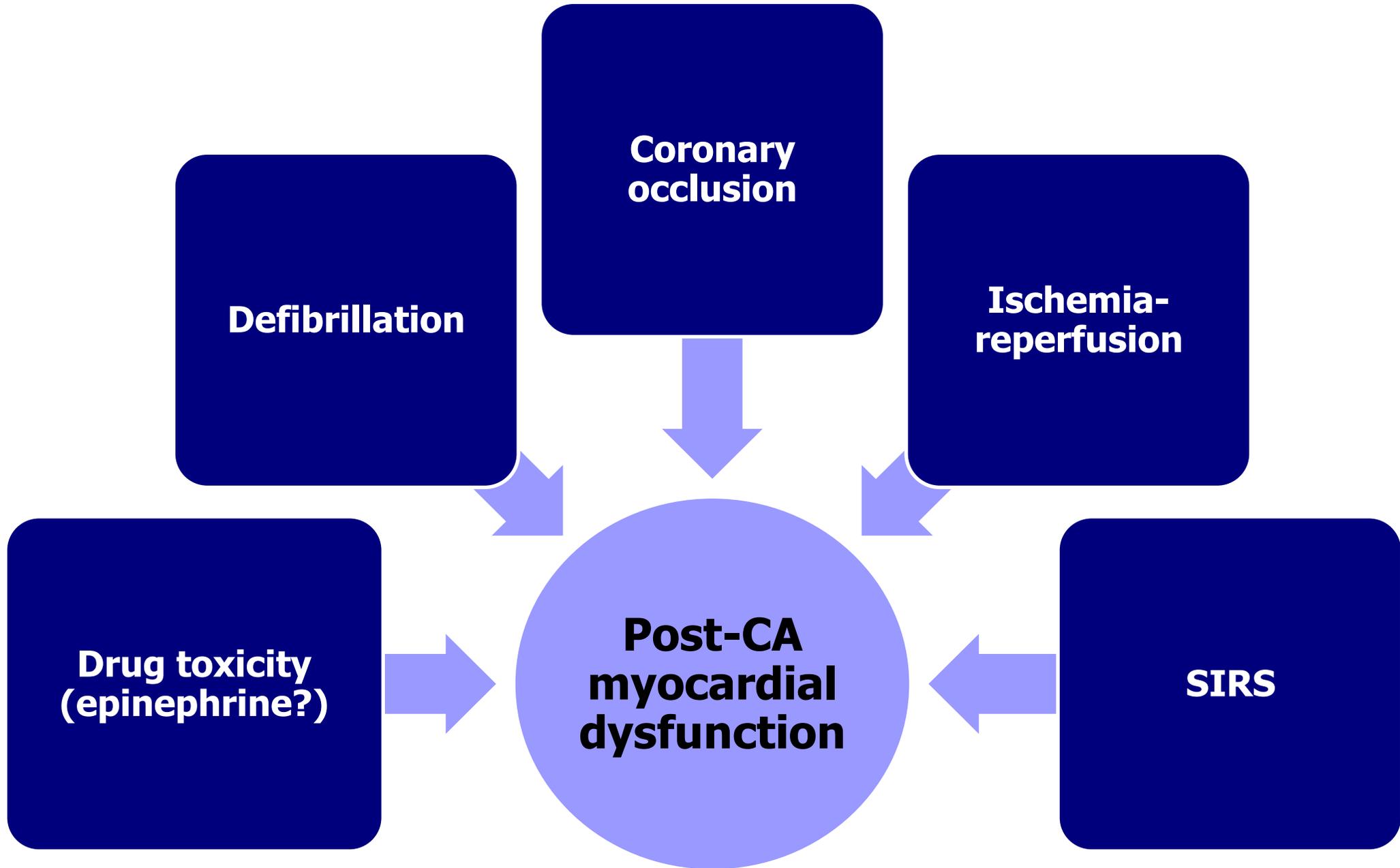
Post-cardiac arrest disease ILCOR Consensus Statement



Reversible Myocardial Dysfunction in Survivors of Out-of-Hospital Cardiac Arrest

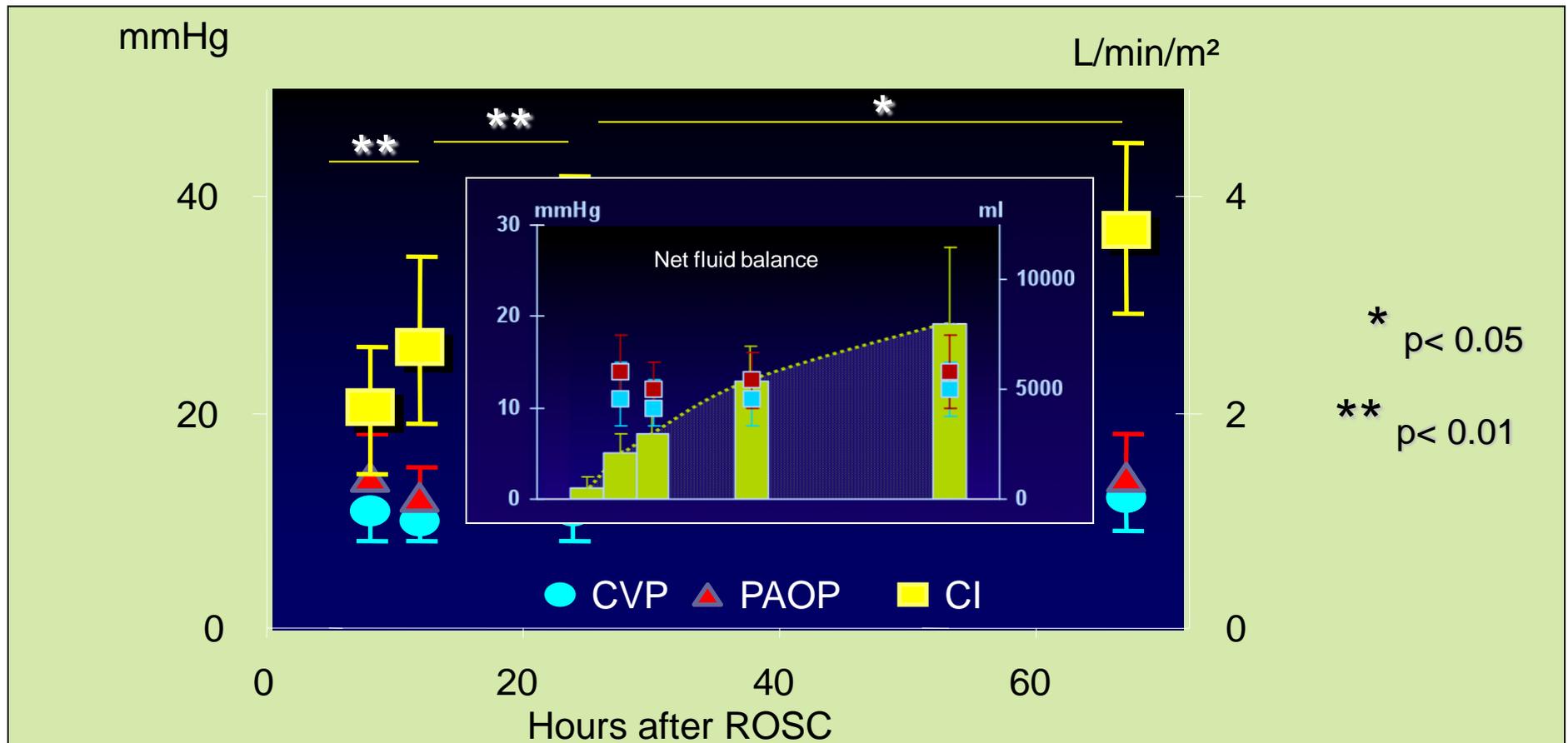
Laurent I, Monchi M, Chiche JD, Joly LM, Spaulding C, Bourgeois B, Cariou A, Rozenberg A, Carli P, Weber S, Dhainaut JF.
J Am Coll Cardiol 2002





Reversible Myocardial Dysfunction in Survivors of Out-of-Hospital Cardiac Arrest

Laurent I, Monchi M, Chiche JD, Joly LM, Spaulding C, Bourgeois B, Cariou A, Rozenberg A, Carli P, Weber S, Dhainaut JF.
J Am Coll Cardiol 2002



High-Volume Hemofiltration after Out-of-Hospital Cardiac Arrest. A randomized study.

Laurent I, Adrie C, Vinsonneau C, Cariou A, Chiche JD, Ohanessian A, Spaulding C, Carli P, Dhainaut JF, Monchi M.
J Am Coll Cardiol 2005



Six-month survival:

- Controls 21%
- HF alone 42% $p=0.28$
- HF + HT 32%

Death by intractable shock (IS):

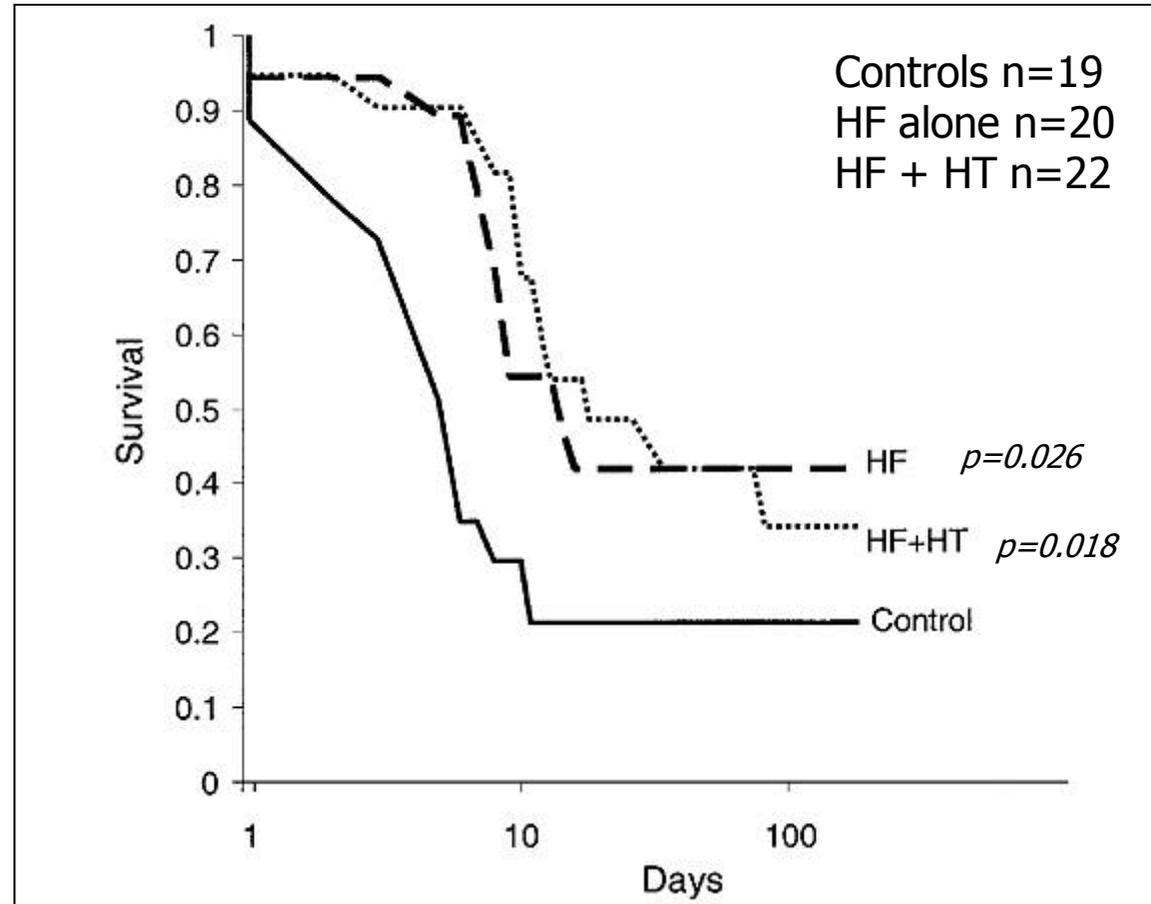
- Controls 42%
- HF alone 10% $p=0.009$
- HF + HT 14%

Relative risk of death by IS:

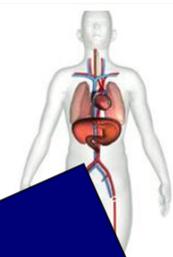
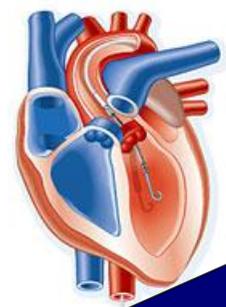
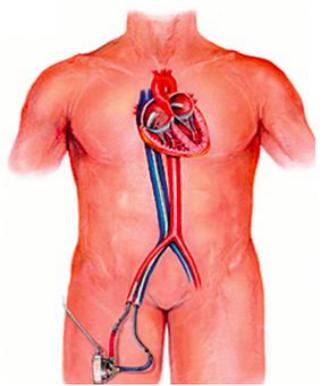
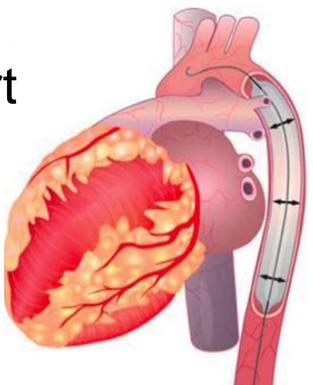
- HF alone 0.21 (95% CI 0.05-0.85)
- HF + HT 0.29 (95% CI 0.09-0.91)

Multivariate analysis:

- HF and six-month death: OR 0.21 (95% CI 0.05-0.85)
- HF and death by IS: OR 0.29 (95% CI 0.09-0.91)



Percutaneous Circulatory Support



	IABP	TandemHeart	Centrifugal Pump	VA-ECMO
Pump mechanism	Pneumatic	Centrifugal	Centrifugal	Centrifugal
Insertion	Retrograde 7–9F balloon catheter into the descending aorta via the femoral artery	21F inflow cannula into left atrium and 21F outflow cannula into the femoral vein	21F inflow cannula into the right atrium and 21F outflow cannula into the femoral vein	15–22F inflow cannula into the right atrium via the femoral vein and 15–22F outflow cannula into the descending aorta via the femoral artery
Difficulty of insertion	++	++	+++	++
Degree of circulatory support (with ideal SVR)	++	++	++ (Increased CO by 2.5 L/min)	++++ (Increased CO to ≥ 4.5 L/min)
Implantation time, min	10–15	10–15	11–25	10–15
Limb ischemia	++	+++	++	+++
Hemolysis	++	++	++++	+++
Bleeding risk	++	+++	++	++++
510k Approval	6	6	6	6
Evidence of efficacy	Increased CO and coronary and peripheral perfusion; decreased afterload	Increased CO, MAP, MvO_2 , and urine output; decreased lactic acid, creatinine, and PCWP	Increased CO and MAP; decreased lactic acid and PCWP	Increased CO, MAP, and oxygenation

SVR indicates systemic vascular resistance; CO, cardiac output; MAP, mean arterial pressure; MvO_2 , mixed venous oxygen saturation; and PCWP, pulmonary capillary wedge pressure.

Bridges to neurological evaluation

European Resuscitation Council Guidelines
for Resuscitation 2010

Section 4. Adult advanced life support

Deakin CD, Nolan JP, Soar J, Sunde K, Kostere RW,
Smith GB, Perkins GD
Resuscitation 2010

Advanced Life Support

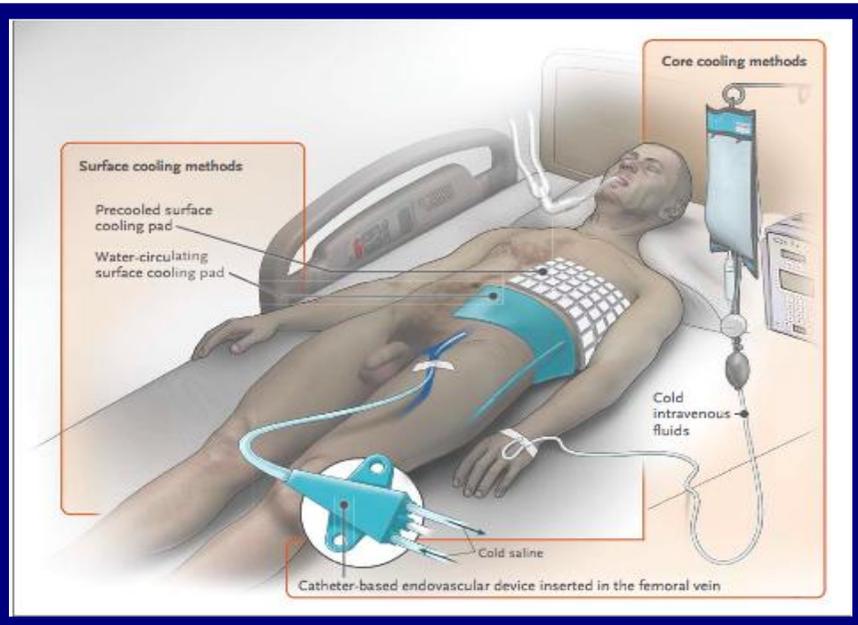
Unresponsive?
Not breathing or only occasional gasps

Call
Resuscitation Team

CPR 30:2
Attach defibrillator/monitor

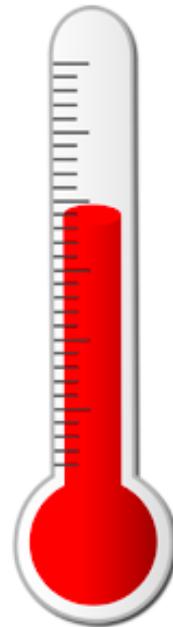
IMMEDIATE POST CARDIAC ARREST TREATMENT

- Use ABCDE approach
- Controlled oxygenation and ventilation
- 12-lead ECG
- Treat precipitating cause
- Temperature control / Therapeutic hypothermia



WHAT LEVEL?

33° C: the dogma





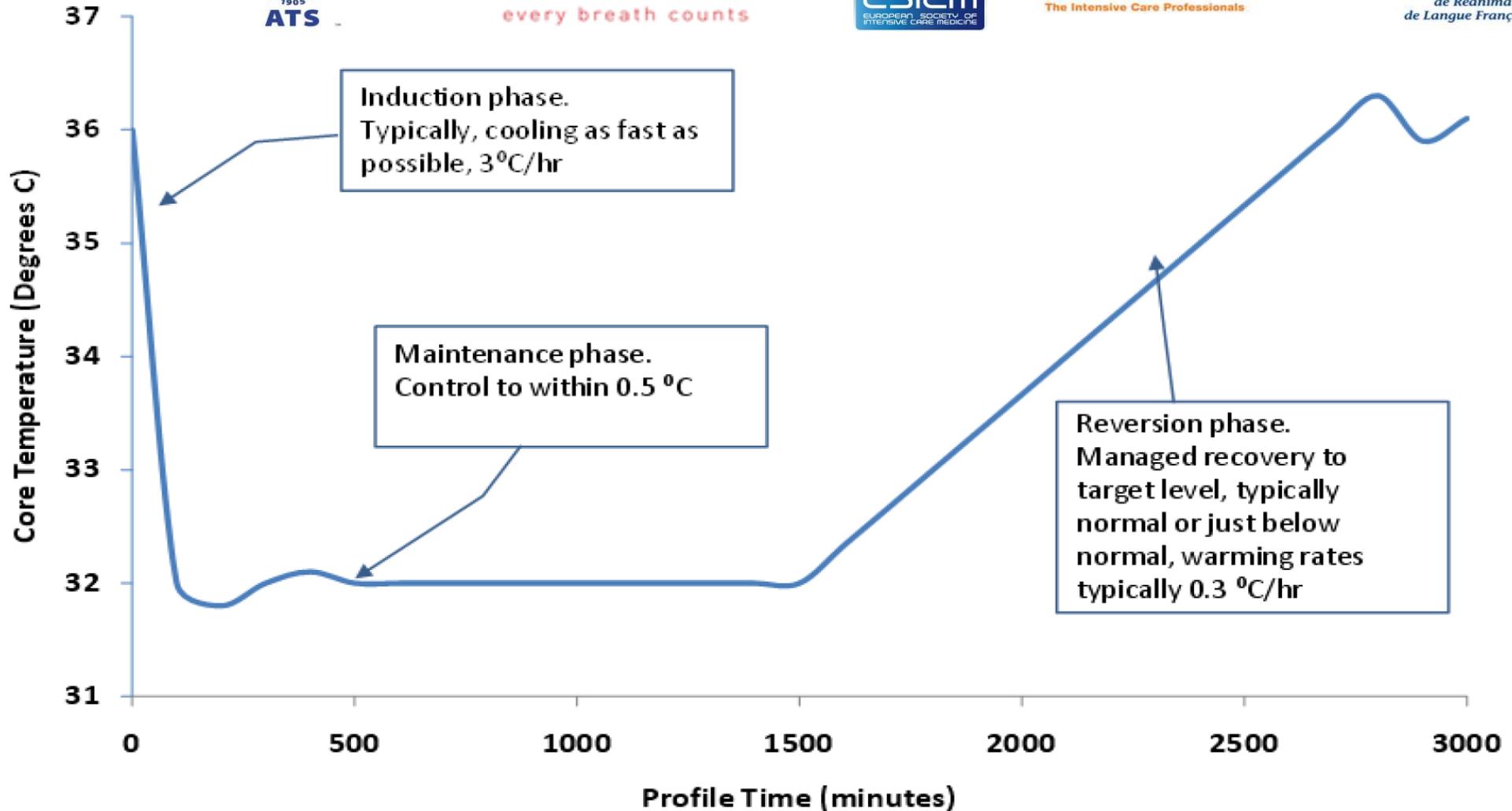
Targeted temperature management in critical care: A report and recommendations from five professional societies*



ERS EUROPEAN RESPIRATORY SOCIETY
every breath counts

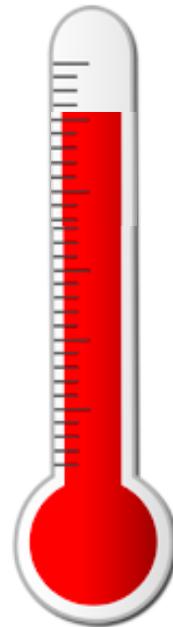


Society of Critical Care Medicine
The Intensive Care Professionals



WHAT LEVEL?

33° C: the dogma

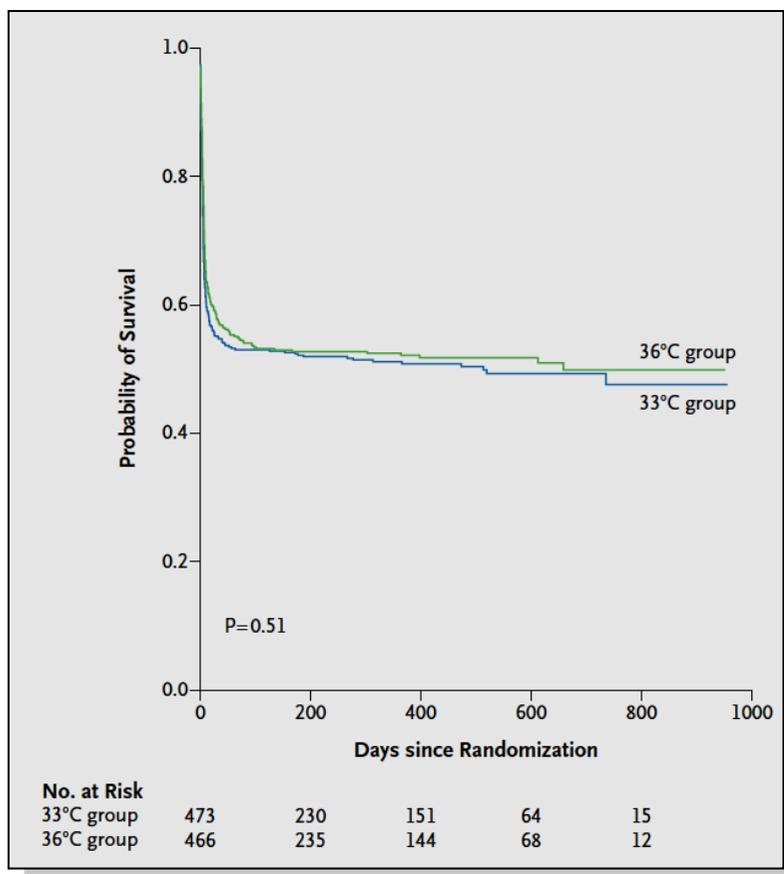


36° C: the future?



Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

Nielsen N. NEJM 2013

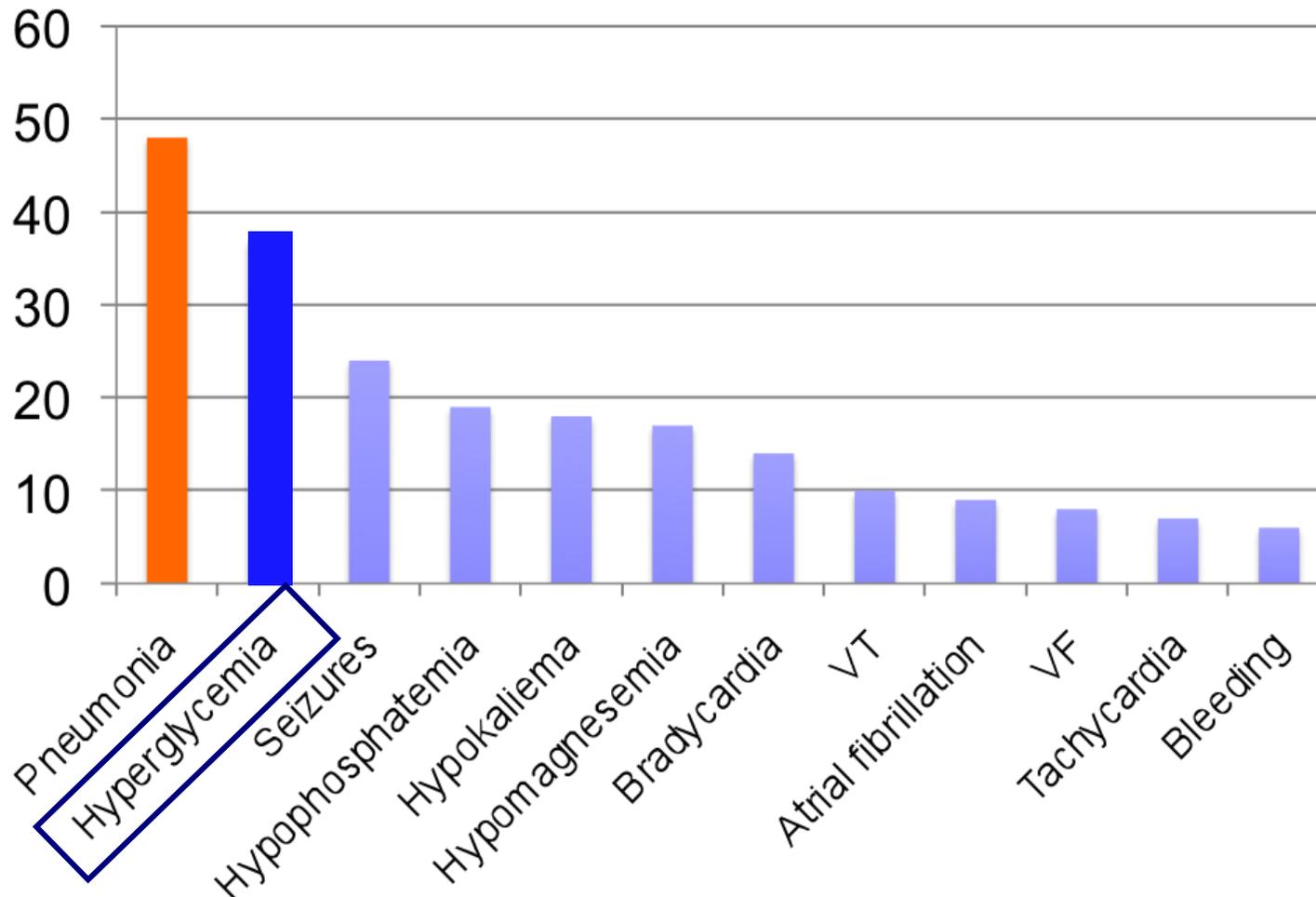


Variable	33°C Group	36°C Group
CPC at follow-up†		
Total no. of patients	469	464
Category — no. (%)		
1	195 (42)	183 (39)
2	23 (5)	39 (8)
3	17 (4)	20 (4)
4	6 (1)	2 (0.5)
5	228 (49)	220 (47)
P value for trend	0.85	

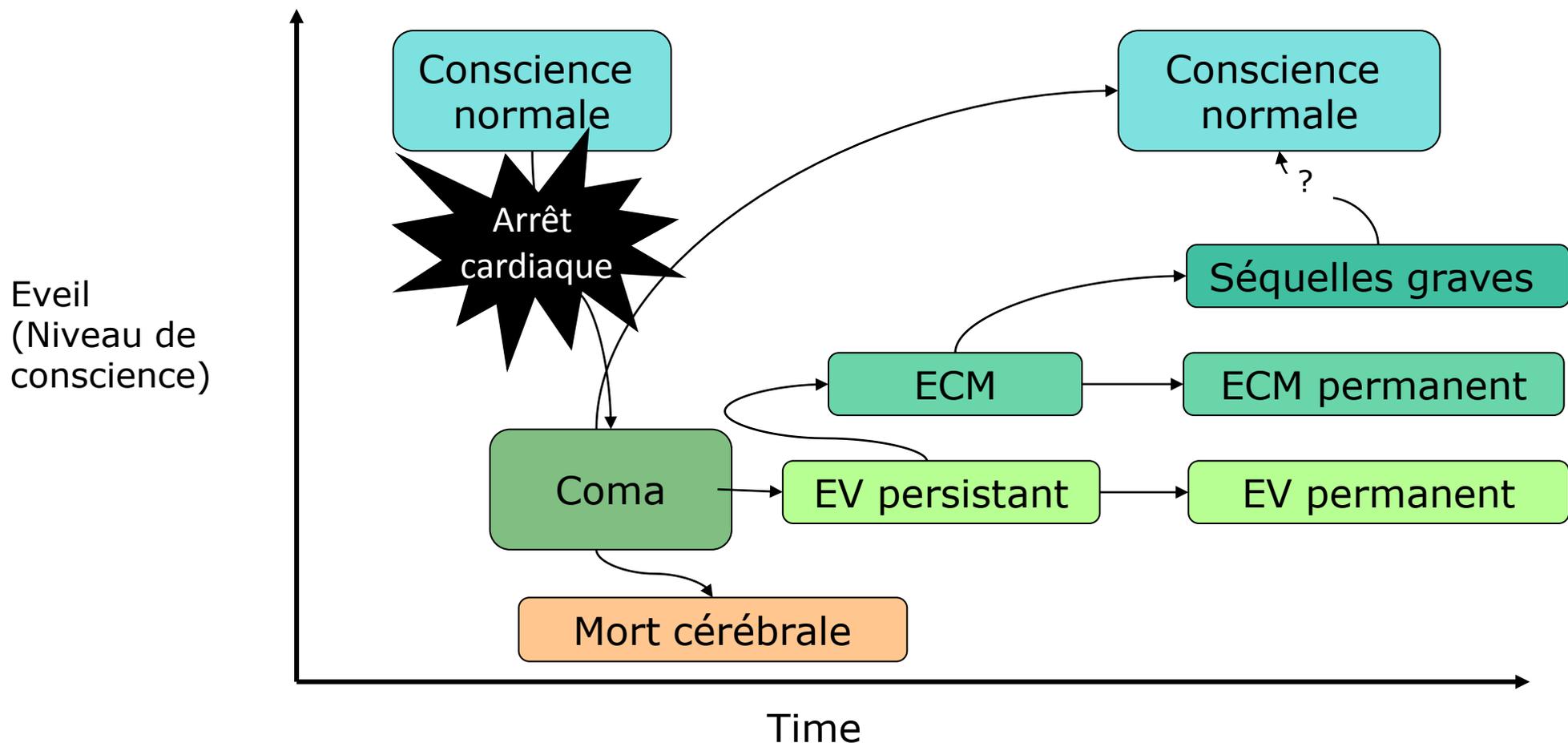
Adverse events and their relation to mortality in out-of-hospital cardiac arrest patients treated with therapeutic hypothermia*

Crit Care Med 2011 Vol. 39, No. 1

Niklas Nielsen, MD, PhD; Kjetil Sunde, MD, PhD; Jan Hovdenes, MD, PhD; Richard R. Riker, MD; Sten Rubertsson, MD, PhD; Pascal Stammet, MD; Fredrik Nilsson, PhD; Hans Friberg, MD, PhD; the Hypothermia Network



Spectre des anomalies de la conscience après arrêt cardiaque



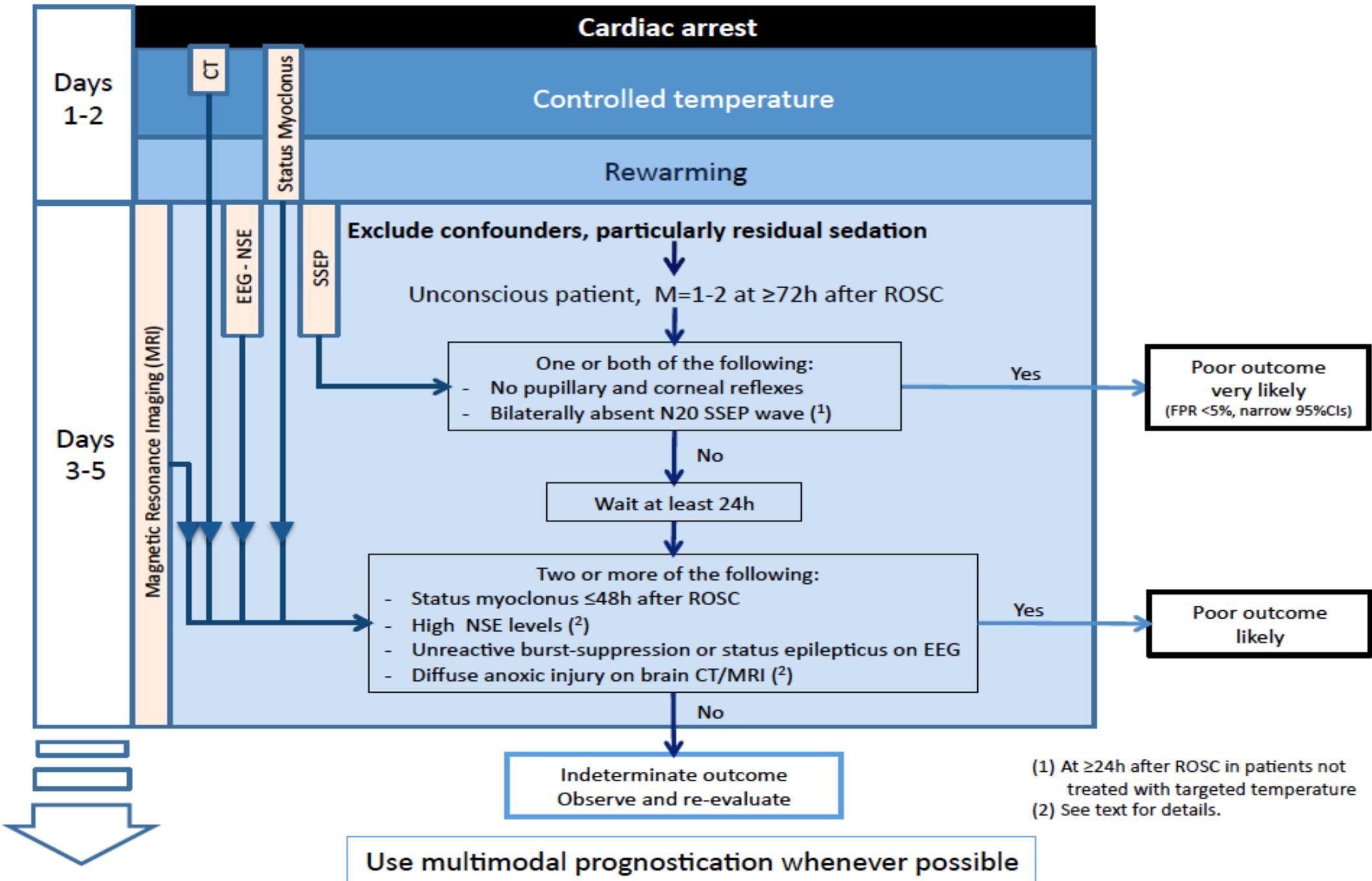
Prognostication in comatose survivors of cardiac arrest: An Advisory Statement from the European Resuscitation Council and the European Society of Intensive Care Medicine

Claudio Sandroni, Alain Cariou, Fabio Cavallaro, Tobias Cronberg, Hans Friberg, Cornelia Hoedemaekers, Janneke Horn, Jerry P. Nolan, Andrea O. Rossetti and Jasmeet Soar

Intensive Care Med 2014

Aims was to:

- **Update and summarize the available evidence on this topic, including that on TH-treated patients;**
- **Provide practical recommendations on the most reliable prognostication strategies, based on a more robust analysis of the evidence, in anticipation of the next ERC Guidelines on Resuscitation to be published in October 2015;**
- **Identify knowledge gaps and suggest directions for future research**



Cardiac arrest

Days 1-2

Controlled temperature

Rewarming

Days 3-5

Exclude confounders, particularly residual sedation

Unconscious patient, M=1-2 at ≥72h after ROSC

One or both of the following:

- No pupillary and corneal reflexes
- Bilaterally absent N20 SSEP wave ⁽¹⁾

Yes

Poor outcome very likely
(FPR <5%, narrow 95% CIs)

No

Wait at least 24h

Two or more of the following:

- Status myoclonus ≤48h after ROSC
- High NSE levels ⁽²⁾
- Unreactive burst-suppression or status epilepticus on EEG
- Diffuse anoxic injury on brain CT/MRI ⁽²⁾

Yes

Poor outcome likely

No

Indeterminate outcome
Observe and re-evaluate

Magnetic Resonance Imaging (MRI)

CT

Status Myoclonus

EEG - NSE

SSEP

Use multimodal prognostication whenever possible

(1) At ≥24h after ROSC in patients not treated with targeted temperature
(2) See text for details.

Comatose survivor



Prehospital hypothermia



Transport to CA specialized center



Avoid early prognostication



First 24 hours

Early goal directed therapy



Maintenance blood pressure
Avoid secondary brain insults



TTE – Assess cardiac damage
Guide choice of inotropes if required



➡ *Maintenance hypothermia
32-34° C for 24 hours*

➡ *Controlled oxygenation
(O2 saturation 94-96%)*

➡ *Discuss mechanical
assistance*

Further care

Prognostication after 72 hours
Clinical – SSEP – EEG - Biomarkers

➡ **Follow Up**
*Assessment for ICD
Rehabilitation*

Post Cardiac Arrest Team

Rapid
Emergency Service

Brain Preservation
with Hypothermia

Cardiology

Rehabilitation

Feedback and
System Improvement

Critical Care

An evaluation of post-resuscitation care as a possible explanation of a difference in survival after out-of-hospital cardiac arrest[☆]

J. Hollenberg^{a,*}, J. Lindqvist^b, M. Ringh^a, J. Engdahl^b,
K. Bohm^a, M. Rosenqvist^a, L. Svensson^c *Resuscitation* (2007) 74, 242–252

Is hospital care of major importance for outcome after out-of-hospital cardiac arrest?
Experience acquired from patients with out-of-hospital cardiac arrest resuscitated by the same Emergency Medical Service and admitted to one of two hospitals over a 16-year period in the municipality of Göteborg

Johan Engdahl *, Putte Abrahamsson, Angela Bång, Jonny Lindqvist,
Thomas Karlsson, Johan Herlitz *Resuscitation* 43 (2000) 201–211

Implementation of a standardised treatment protocol for post resuscitation care after out-of-hospital cardiac arrest[☆]

Kjetil Sunde^{a,b,*}, Morten Pytte^{a,b}, Dag Jacobsen^c, Arild Mangschau^d,
Lars Petter Jensen^a, Christian Smedsrud^a,
Tomas Draegni^a, Petter Andreas Steen^a *Resuscitation* (2007) 73, 29–39

Treatment and outcome in post-resuscitation care after out-of-hospital cardiac arrest when a modern therapeutic approach was introduced[☆]

M. Werling, A.-B. Thorén, C. Axelsson, J. Herlitz* *Resuscitation* (2007) 73, 40–45

Implementation Strategies for Improving Survival After Out-of-Hospital Cardiac Arrest in the United States : Consensus Recommendations From the 2009 American Heart Association Cardiac Arrest Survival Summit

Robert W. Neumar, Janice M. Barnhart, Robert A. Berg, Paul S. Chan, Romergryko G. Geocadin, Russell V. Luepker, L. Kristin Newby, Michael R. Sayre and Graham Nichol

- Finally, optimization of post-cardiac arrest care will require the commitment of hospital providers to develop and implement comprehensive multidisciplinary treatment protocols that can be executed 24 hours a day, 7 days a week.
- Optimized post-cardiac arrest care is resource intensive and not feasible in every hospital that receives EMS patients.
- **A solution proposed by the AHA is the development and certification of specialized cardiac resuscitation centers.**

Part 9: Acute Coronary Syndromes: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations

Robert E. O'Connor, Leo Bossaert, Hans-Richard Arntz, Steven C. Brooks, Deborah Diercks, Gilson Feitosa-Filho, Jerry P. Nolan, Terry L. Vanden Hoek, Darren L. Walters, Aaron Wong, Michelle Welsford, Karen Woolfrey and Acute Coronary Syndrome Chapter Collaborators

In adult patients with ROSC after cardiac arrest (out-of- hospital or in-hospital), does the use of comprehensive treatment protocol, as opposed to standard care, improve outcome (eg, survival)?

Treatment Recommendation

- A comprehensive treatment protocol that includes multiple interventions provided in a structured way may improve survival after cardiac arrest.

Knowledge Gaps

- Studies are needed to determine whether a comprehensive treatment protocol after cardiac arrest with a sustained ROSC improves short- and long-term outcomes. Future studies should define what interventions other than hypo- thermia are important inclusions in an effective comprehensive treatment protocol.

« Cardiac arrest center » : les clés du succès ?

Des outils solides...



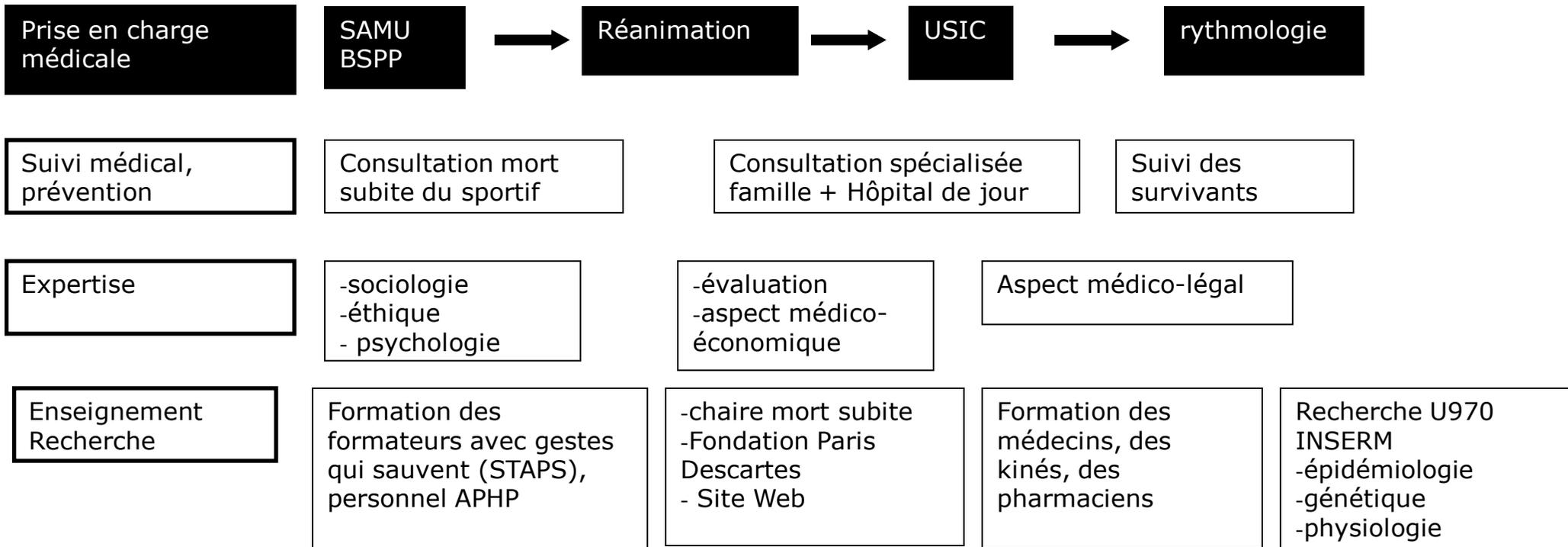
Une organisation sans faille...





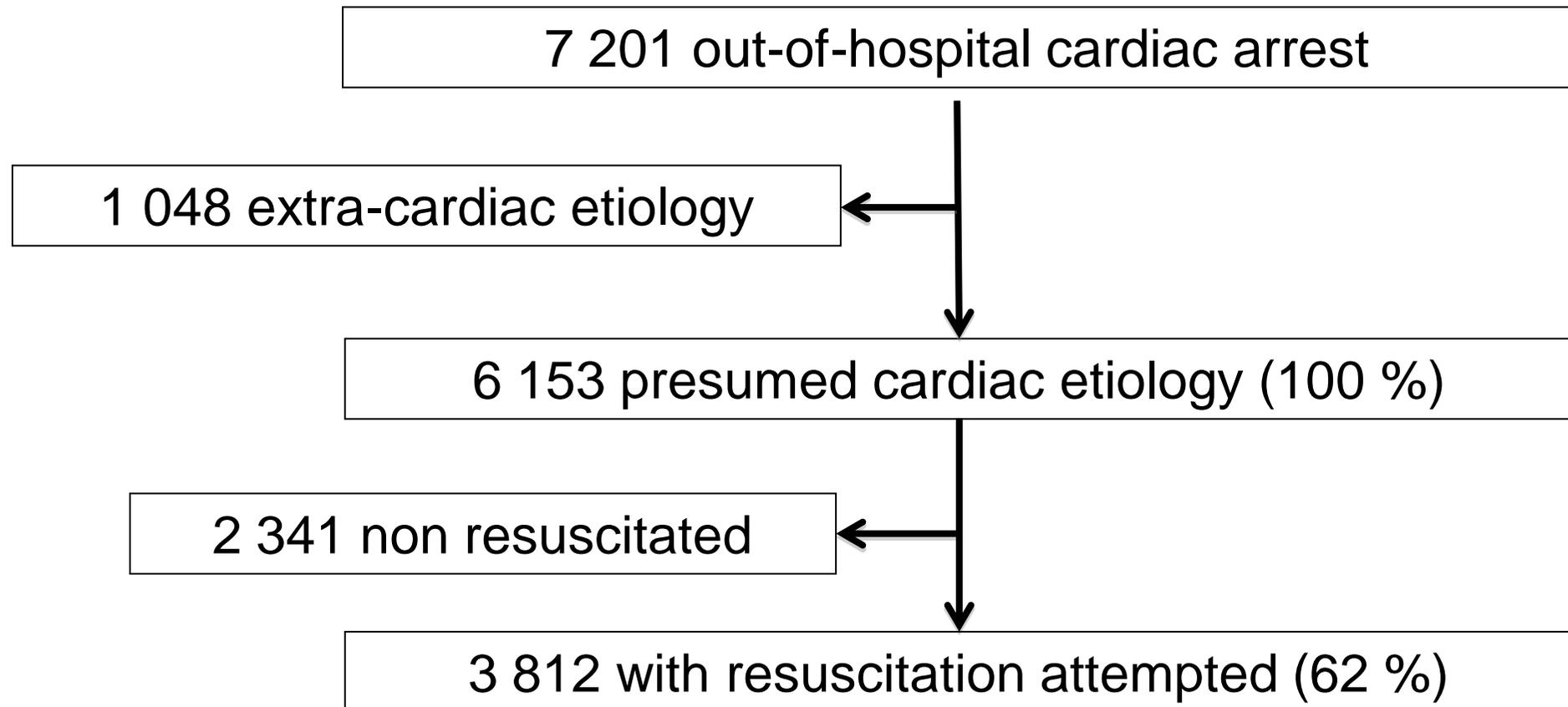
Centre d'expertise mort subite (CEMS)

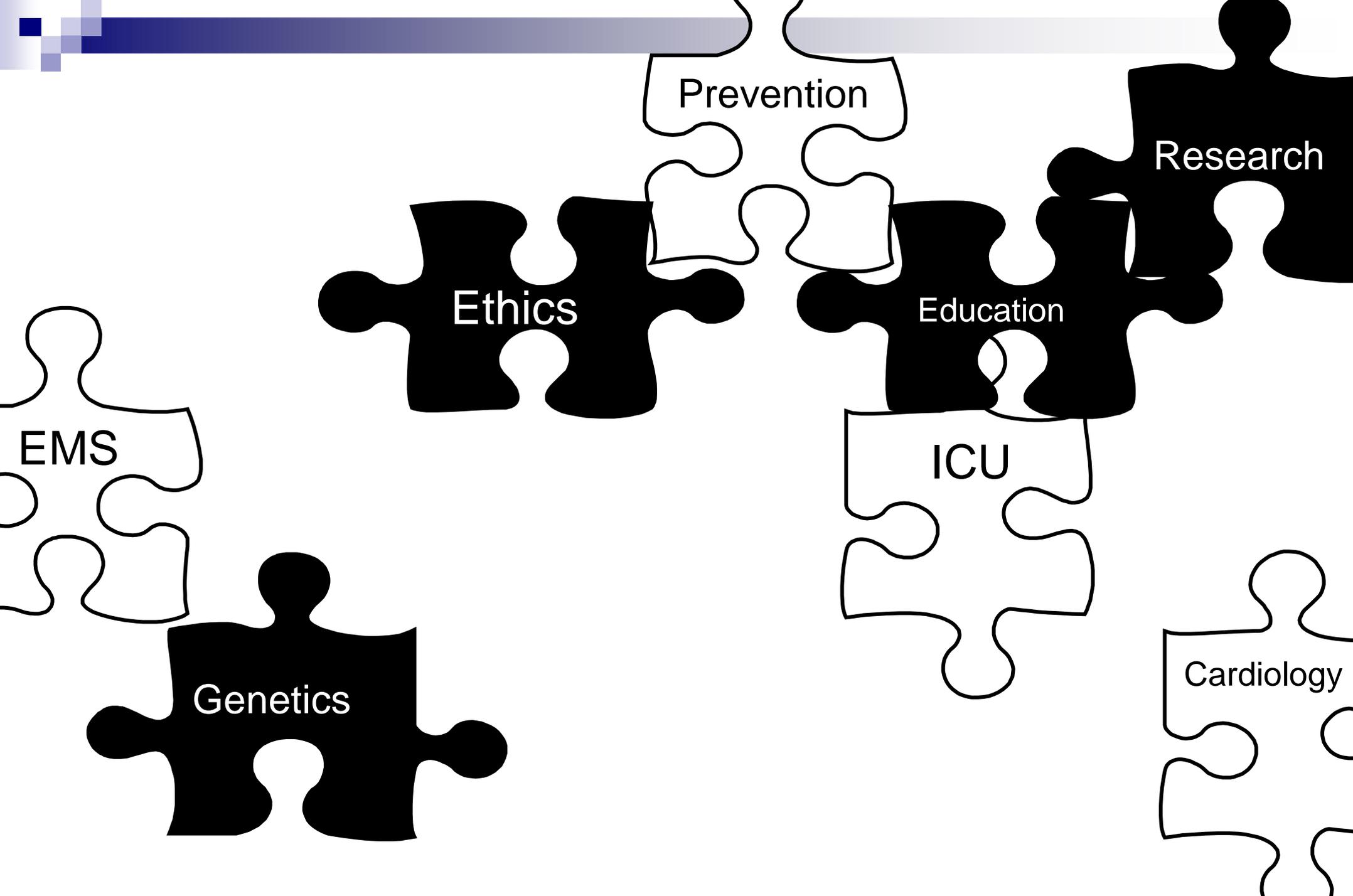
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SDEC Registry

From 15th May 2011 to 15th May 2013





Prevention

Research

Ethics

Education

EMS

ICU

Genetics

Cardiology

