Post-Resuscitation Care

Prof. Wilhelm Behringer

Germany

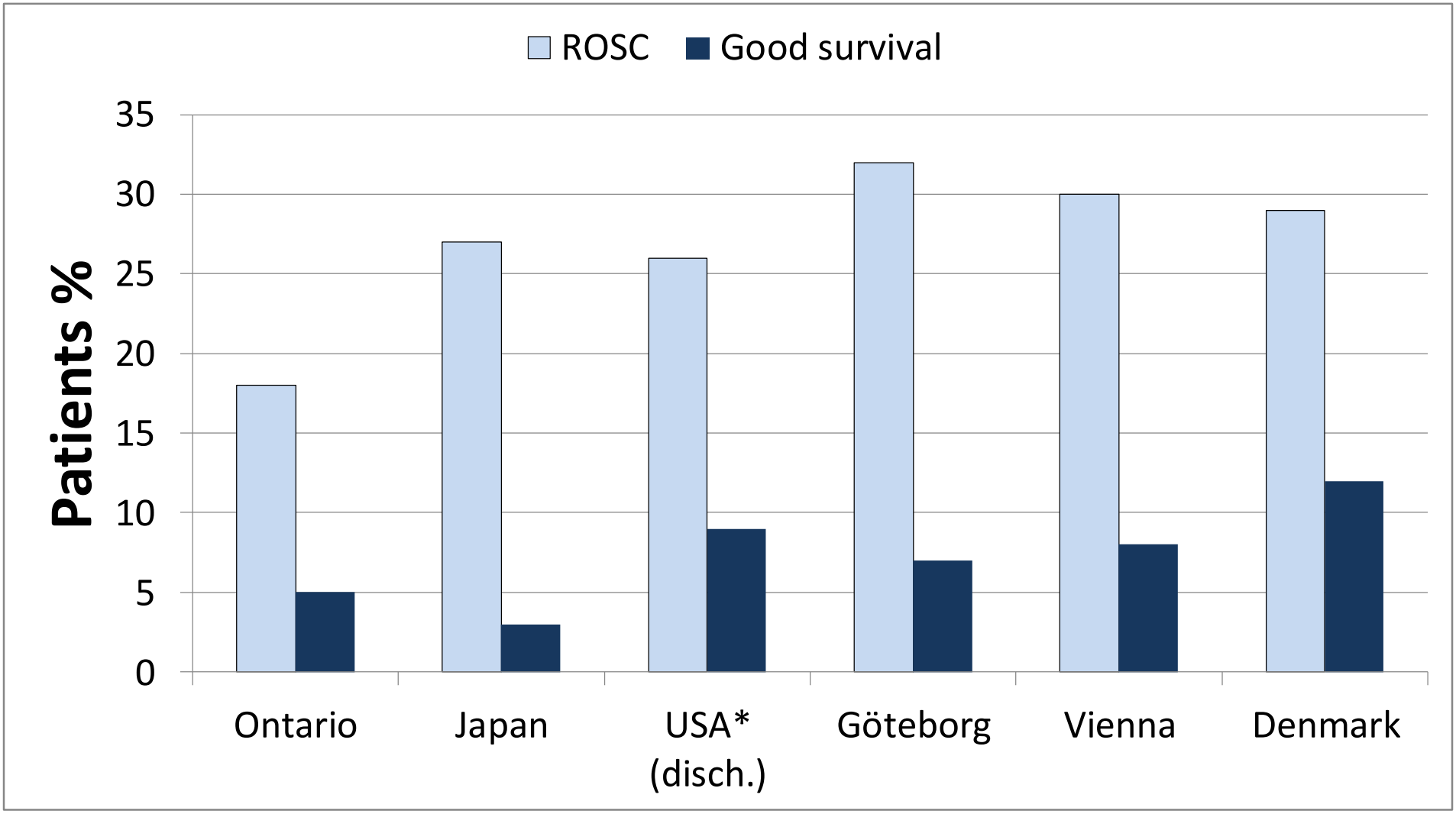
Conflict of interest

Emcools: Shareholder and founder, honoraria

Zoll: honoraria

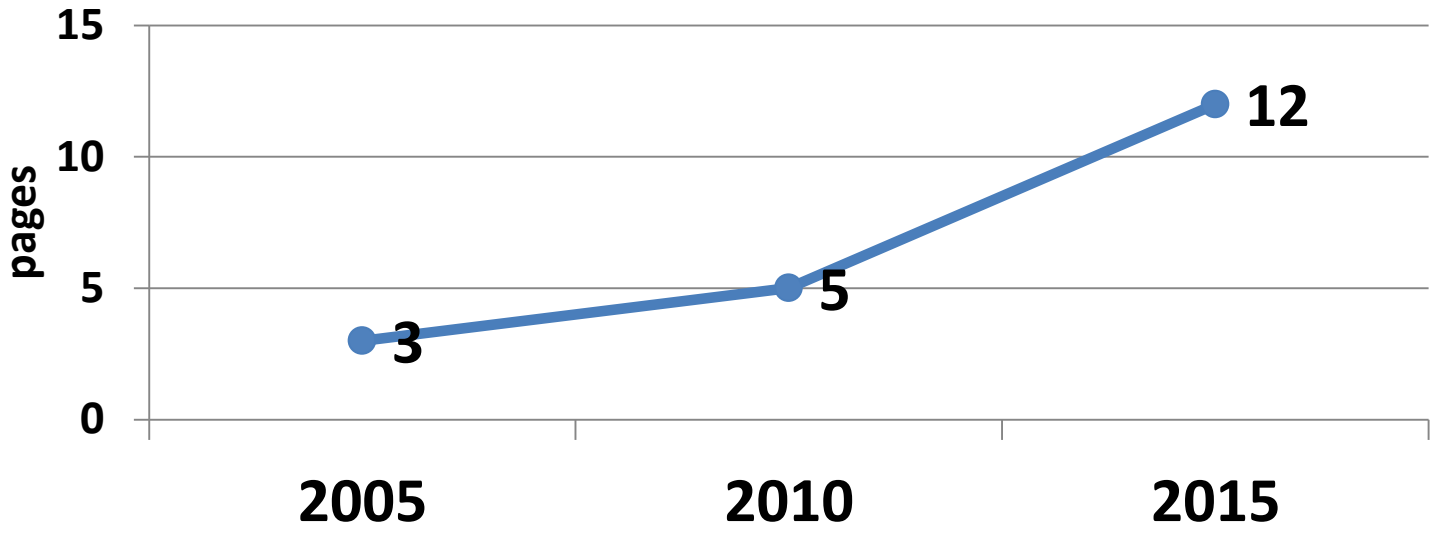
Bard: honoraria, my nephew works for Bard

What happens after ROSC?



Stiell, NEJM 2004; Ong, Resuscitation 2015; Chan, Circulation 2014; Fairbanks, Resuscitation 2007; Nürnberger, Resuscitation 2012; Tanberg, Eur H J 2017

ERC post-resuscitation care guidelines



Resuscitation 2015; 95: 202-222

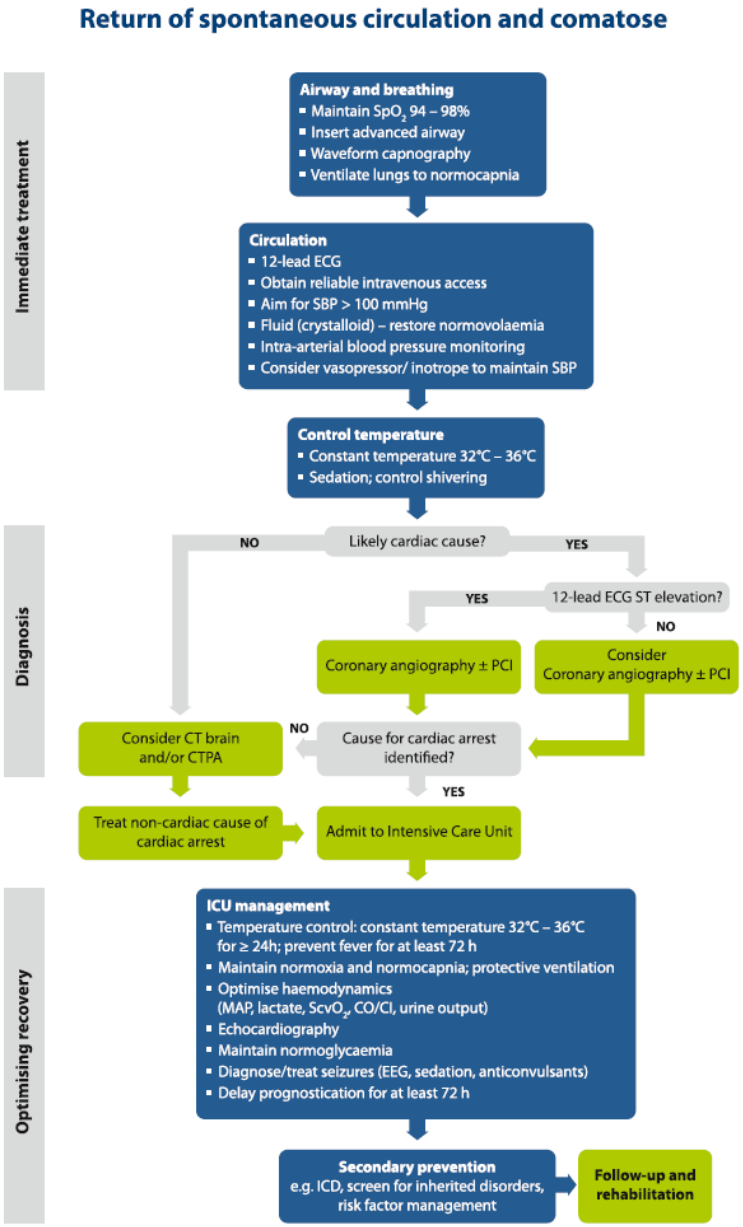
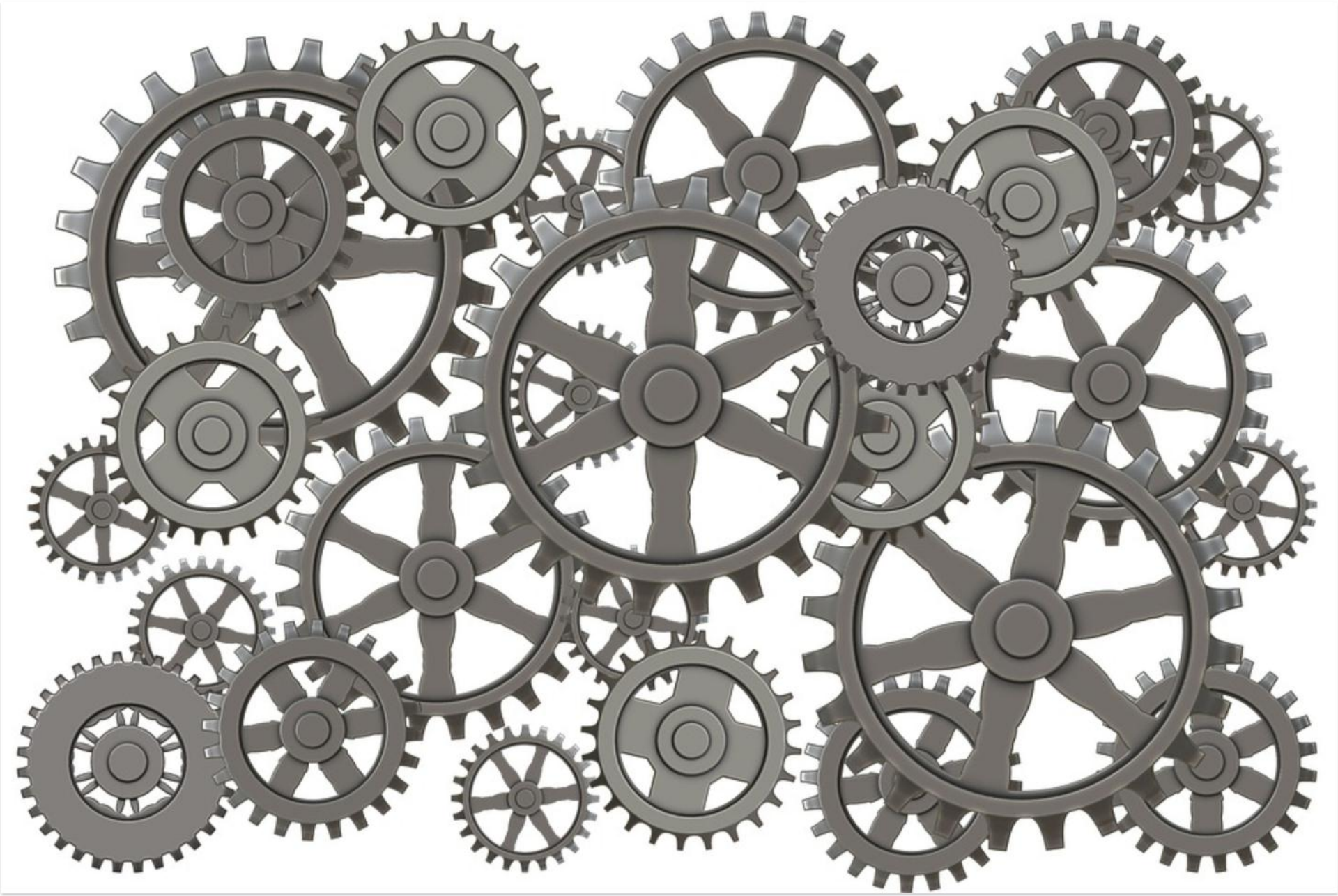
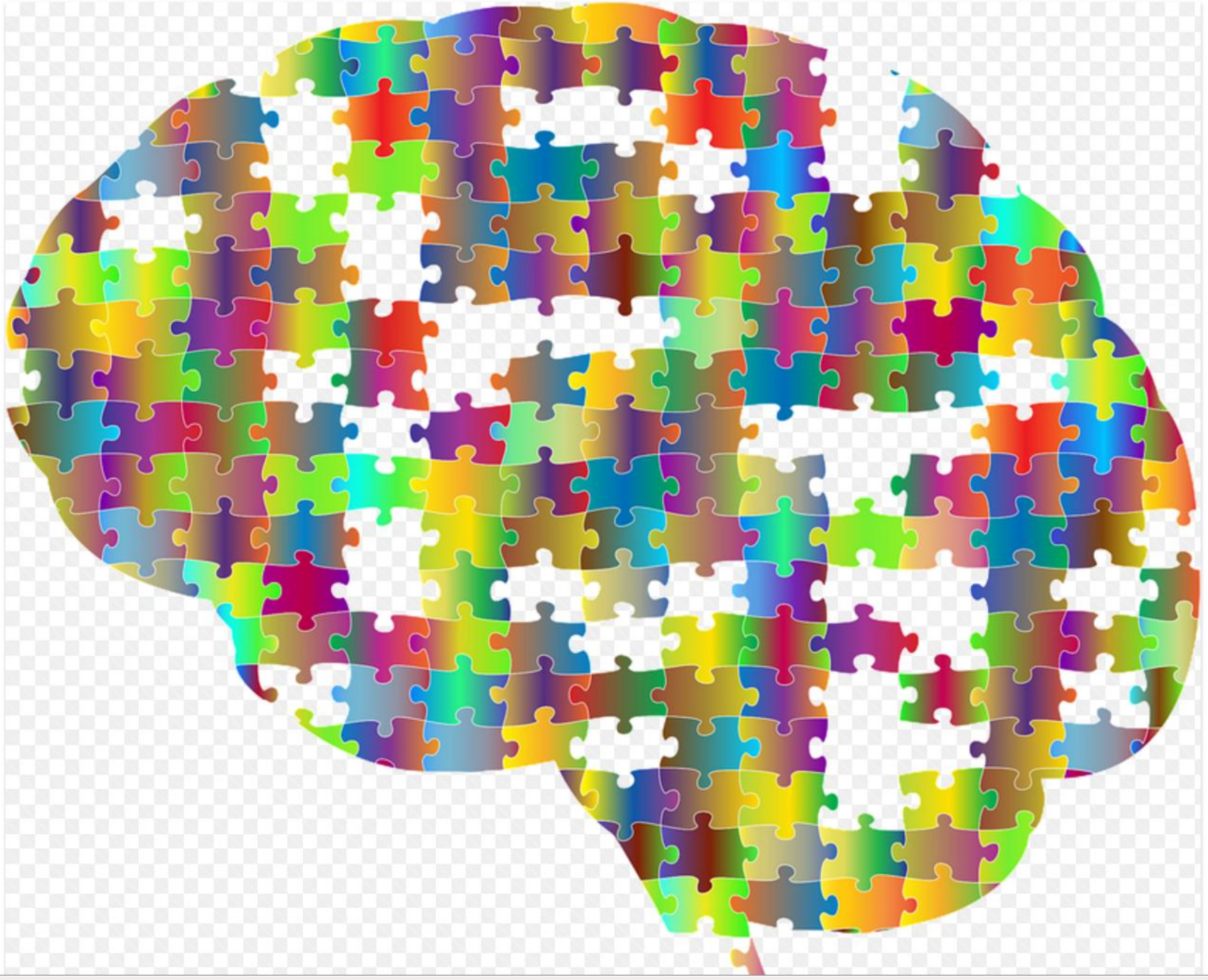


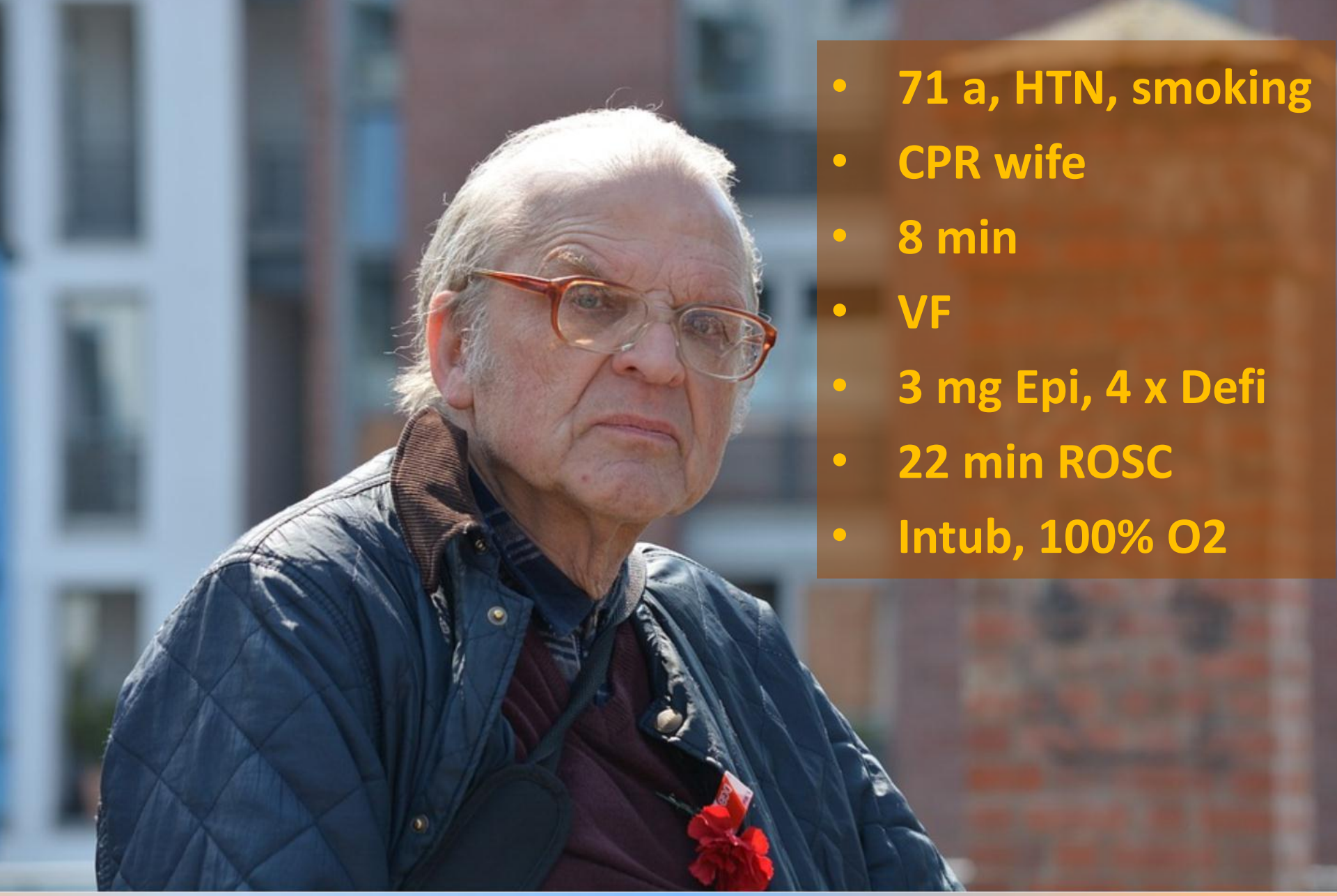
Fig. 5.1. Post-resuscitation care algorithm. SBP: systolic blood pressure; PCI: percutaneous coronary intervention; CTPA: computed tomography pulmonary angiogram; ICU: intensive care unit; MAP: mean arterial pressure; $ScvO_2$: central venous oxygenation; CO/CI: cardiac output/cardiac index; EEG: electroencephalography; ICD: implanted cardioverter defibrillator.





Overview

- Ventilation/oxygenation
- Blood pressure
- PCI
- Glucose
- Targeted temperature management
- Cardiac arrest center
- Conclusions and recommendations

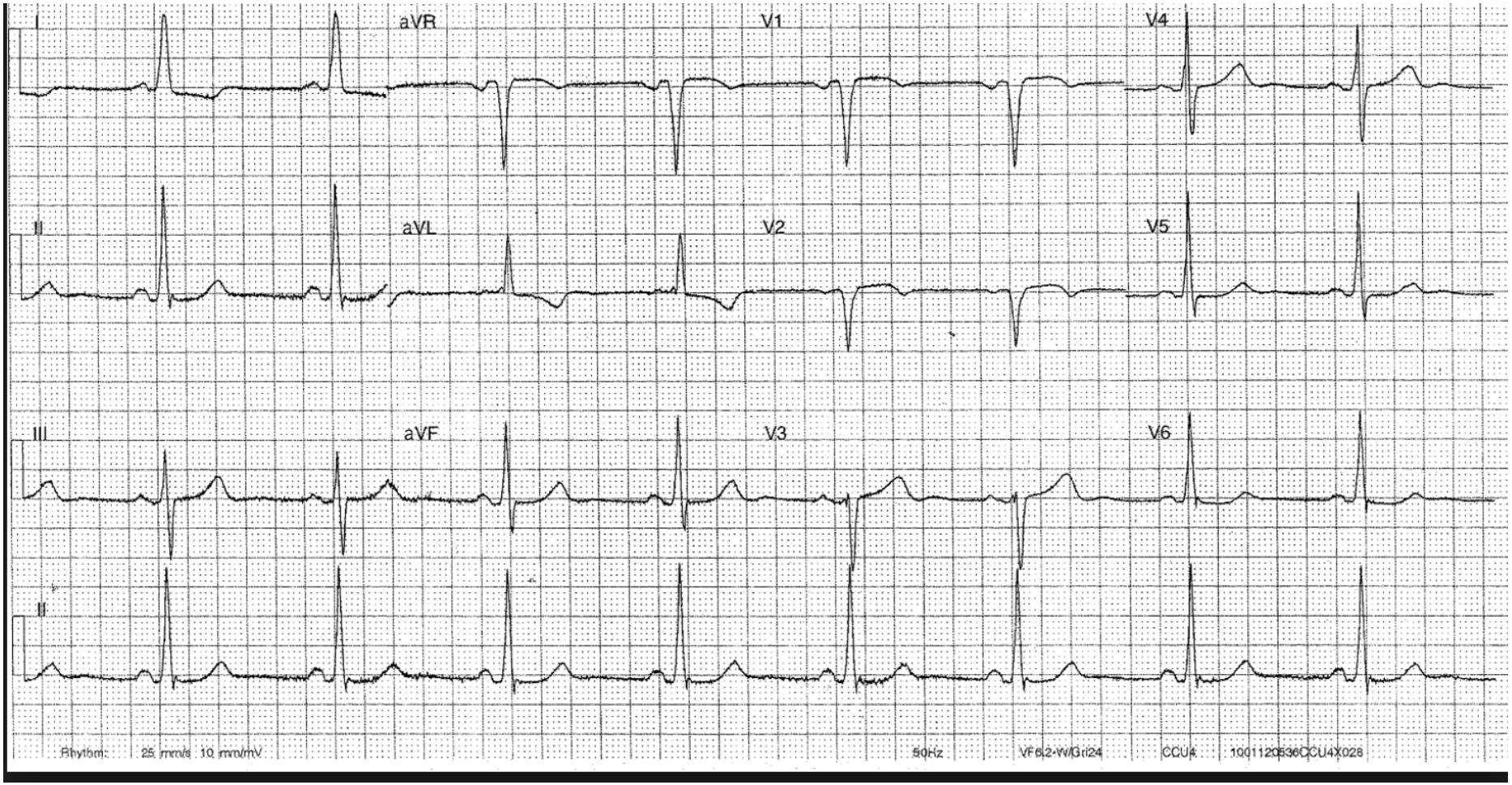


- 71 a, HTN, smoking
- CPR wife
- 8 min
- VF
- 3 mg Epi, 4 x Defi
- 22 min ROSC
- Intub, 100% O2

Case

- MAP = 70 mmHg
- HR = 110/min
- SaO_2 = 100%
- Temp = 36,8°C
- pO_2 = 320 mmHg (42 kPa)
- pCO_2 = 32 mmHg (4,3 kPa)
- pH = 7,12
- Lactate = 13 mmol/L
- Glucose = 280 mg/dL (15,5 mmol/L)
- K = 3,6 mmol/L
- Na = 136 mmol/L

Case


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Rhythm
25 mm/s 10 mm/mV
50Hz
VF612-W/Gri24
CCU4
1001120536CCU4X028

Overview

- **Ventilation/oxygenation**
- Blood pressure
- PCI
- Glucose
- Antibiotic therapy
- Targeted temperature management
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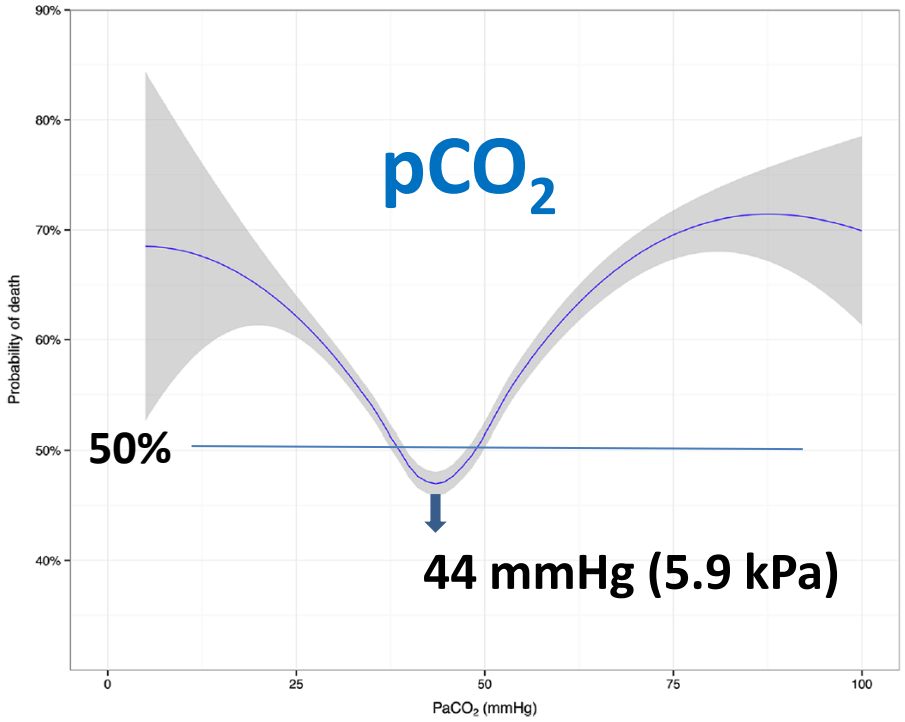
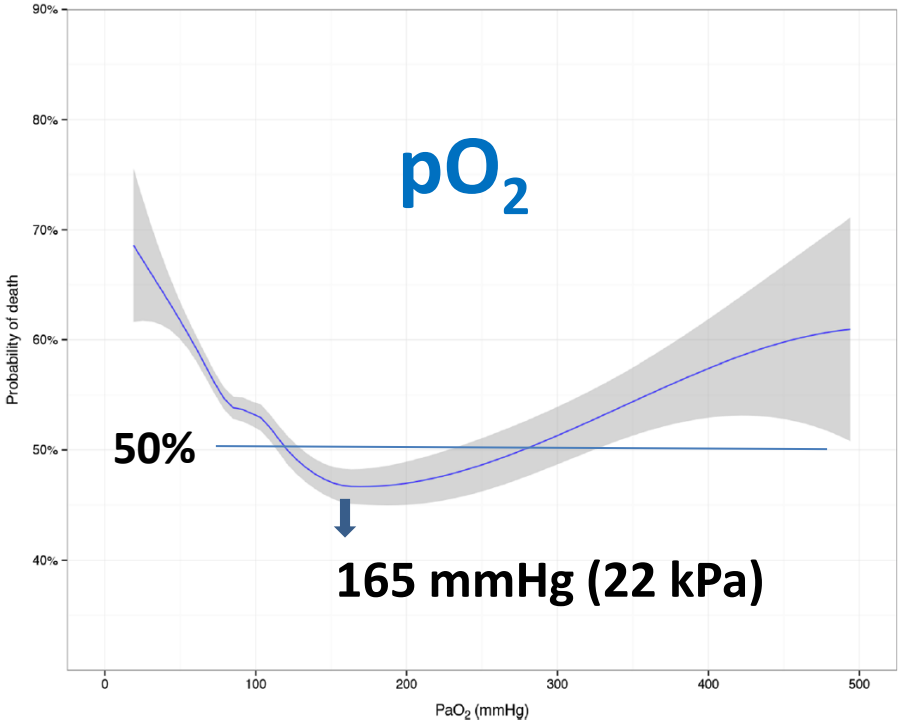
5,258 cardiac arrest patients admitted to 82 ICUs in the Netherlands

y = probabilty of death

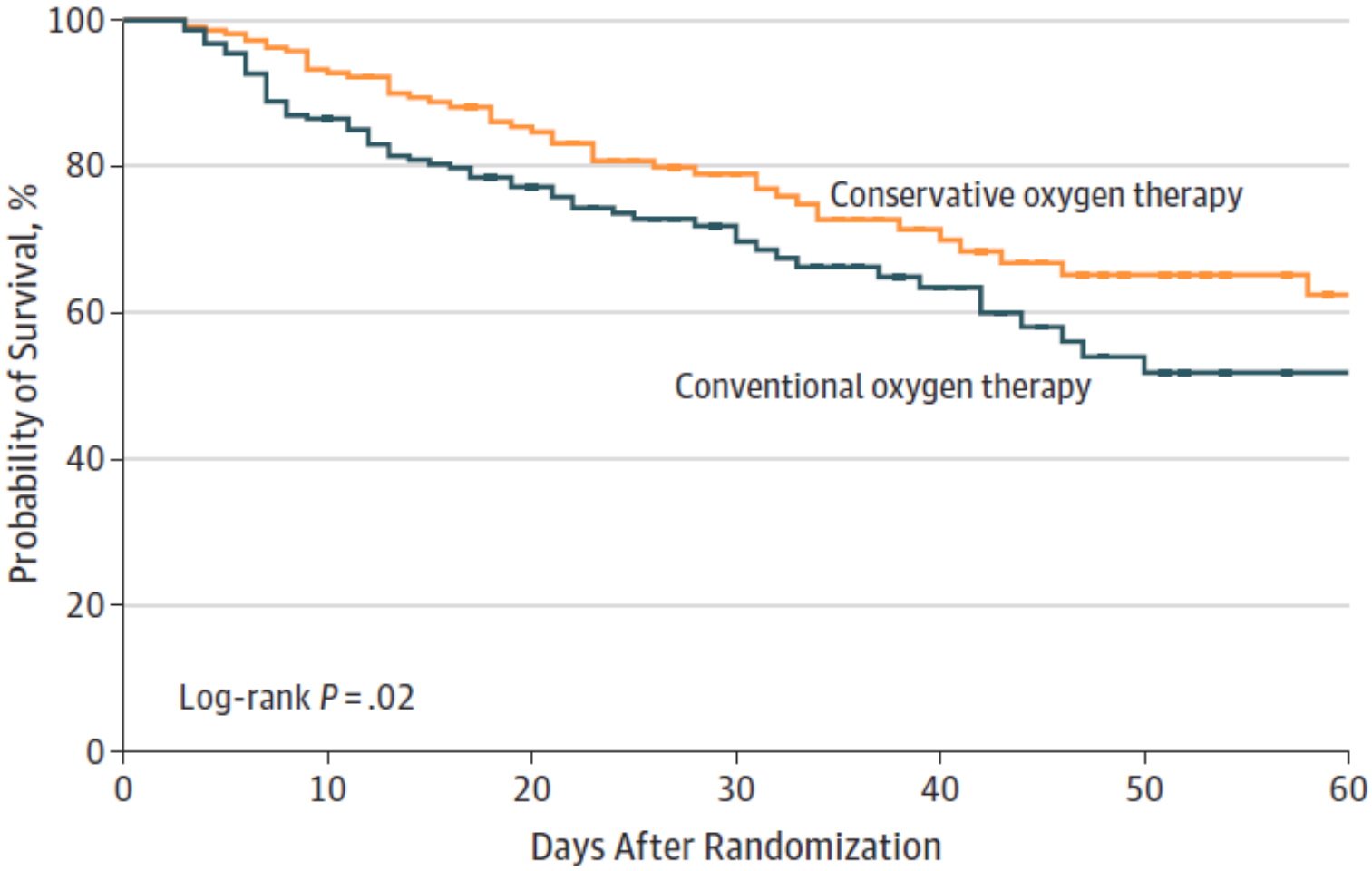




Helmerhorst Crit Care 2015

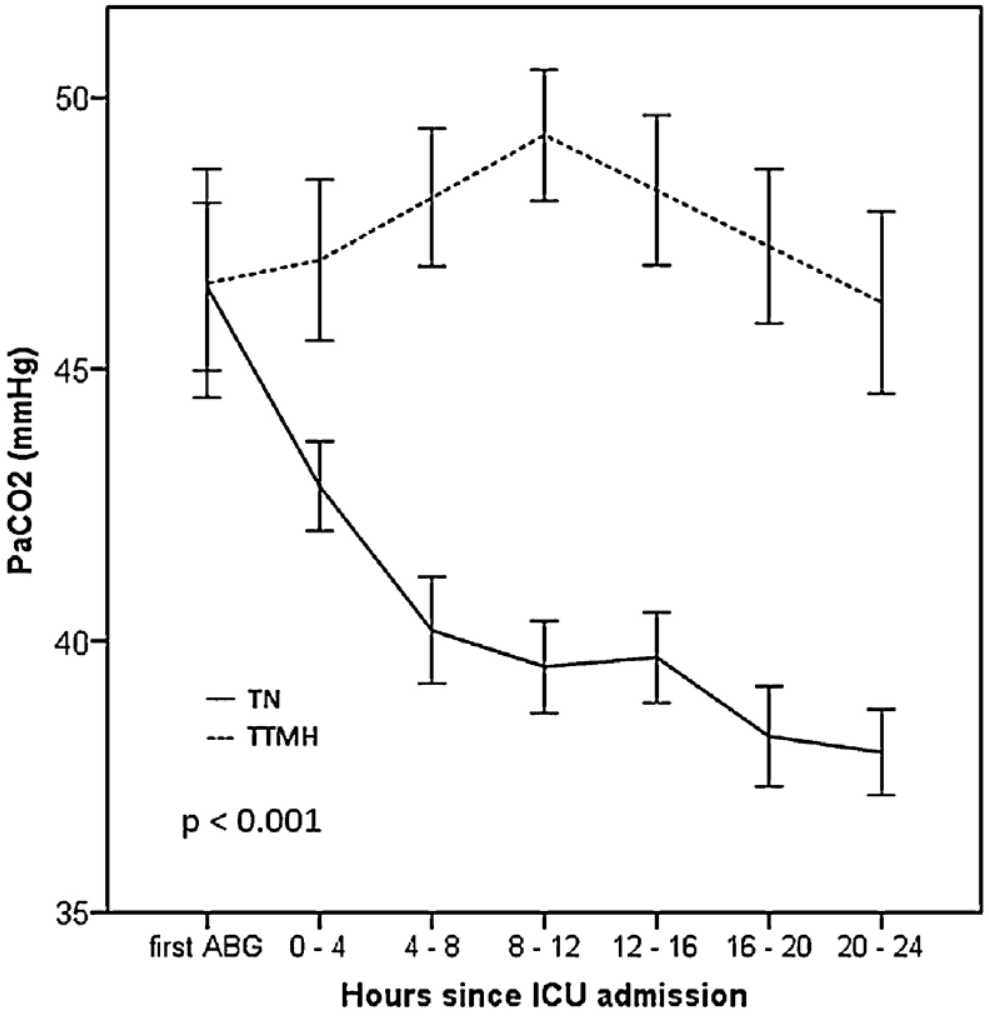
	PaO2 (mmHg)	SpO2 (%)	n
conservative	70-100	94-98	236
conventional	up to 150	97-100	244

All ICU patients



Girardis JAMA 2016

	PaCO2 (mmHg)	n
Targeted normocapnia	35-45	41
Targeted therapeutic mild hypercania	50-55	42



Eastwood Resuscitation 2016

	PaCO2 (mmHg)	n
Targeted normocapnia	35-45	41
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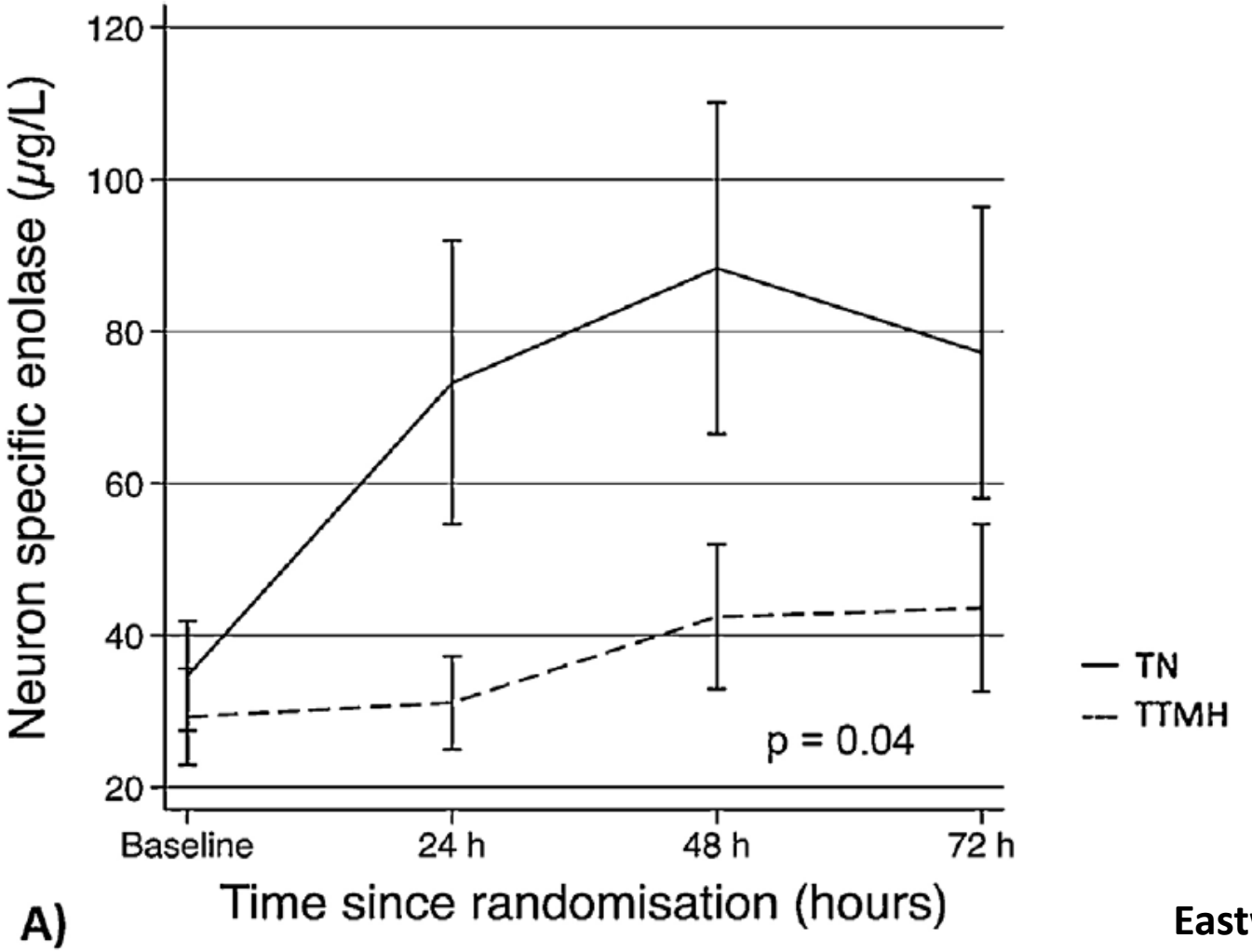
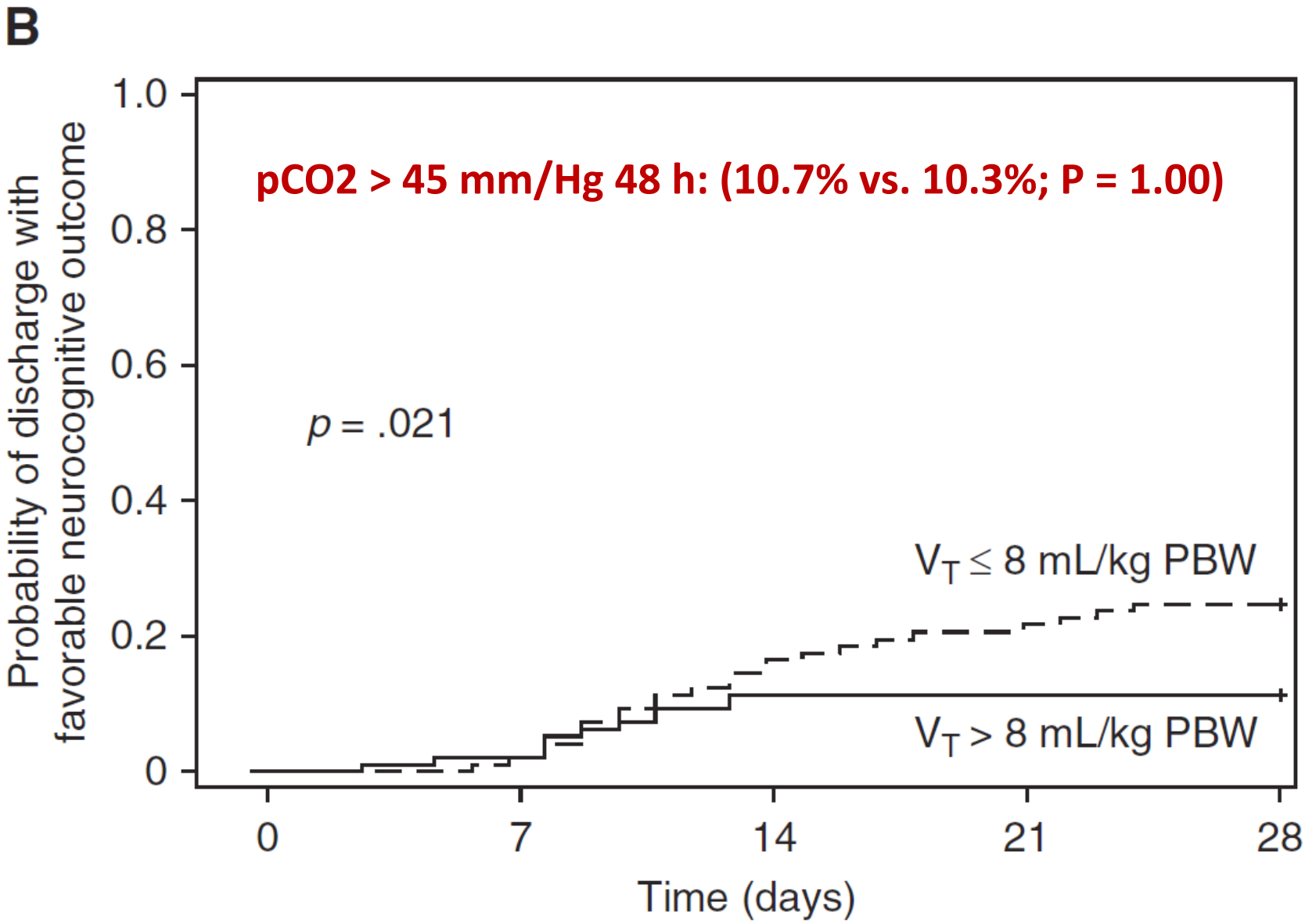


A)

Eastwood Resuscitation 2016


EVERLAST
ORTIZ



Beitler Am J Resp Crit Care 2017

Case

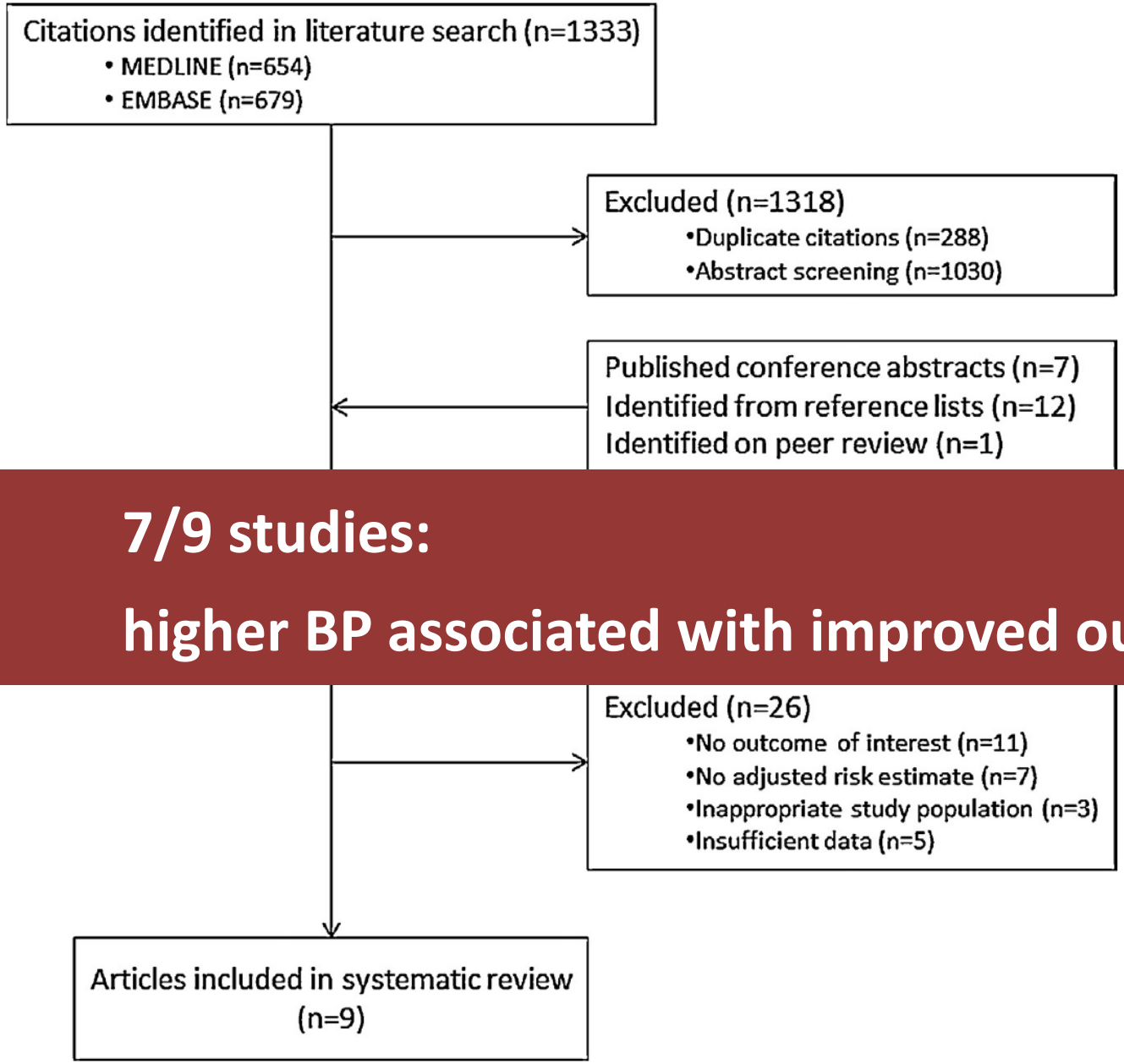
- pO_2 = 320 mmHg (42 kPa)
- pCO_2 = 32 mmHg (4,3 kPa)

- **Reduce FiO_2**
- **Decrease TV/RR**

- 5,5 mmol/L)
- K = 3,6 mmol/L
- Na = 136 mmol/L

Overview

- Ventilation/oxygenation
- **Blood pressure**
- PCI
- Glucose
- Targeted temperature management
- Cardiac arrest center
- Conclusions and recommendations

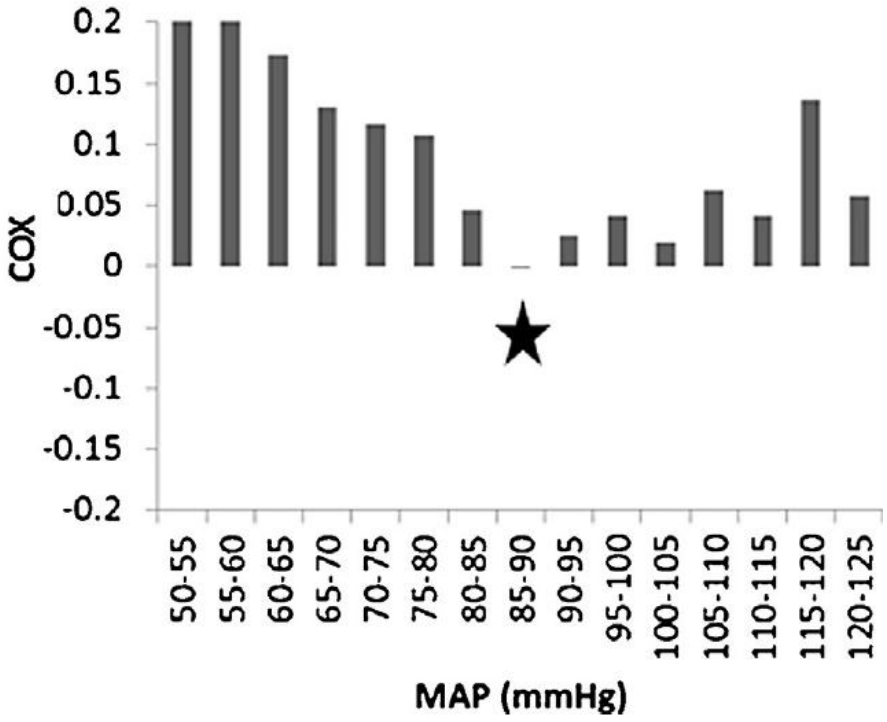


7/9 studies:

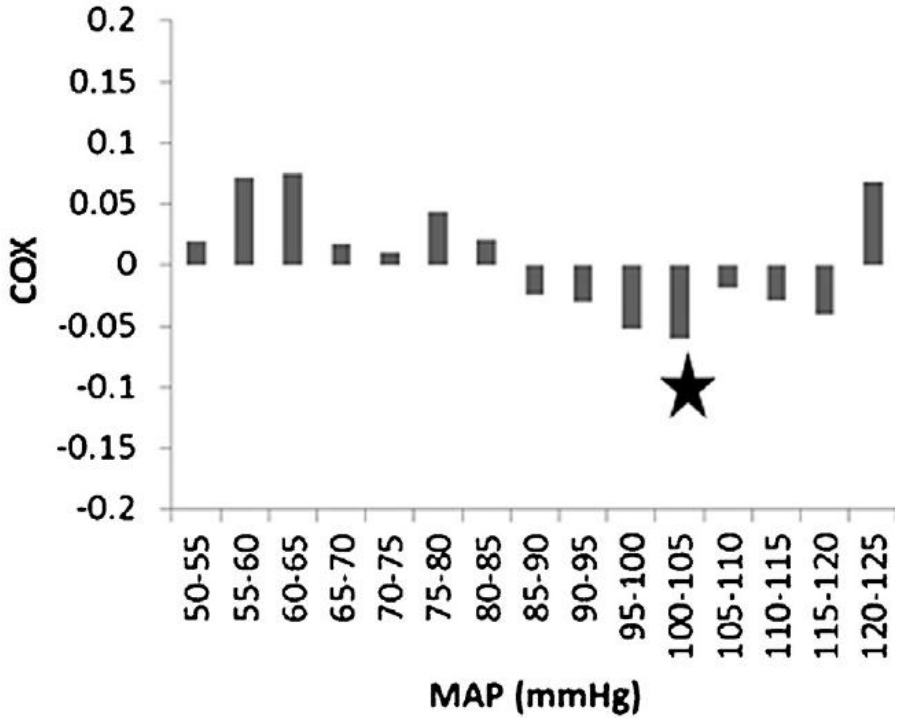
higher BP associated with improved outcomes

Fig. 1. Study selection flowchart.

Bhate Resuscitation 2015



Preserved autoregulation



Disturbed autoregulation

Ameloot Resuscitation 2015

Am Heart J 2017

Mean arterial pressure of 65 mm Hg versus 85-100 mm Hg in comatose survivors after cardiac arrest: Rationale and study design of the Neuroprotect post–cardiac arrest trial

Koen Ameloot [a,b] Cathy De Deyne [c,d] Bert Ferdinande [a] Matthias Dupont [a] Pieter-Jan Palmers [a] Thibault Petit [a] Ward Eertmans [c,d] Clara Moonen [b] Ann Belmans [b] Robin Lemmens [e] Joseph Dens [a,d] and Stefan Janssens [b] *Genk, Leuven, and Diepenbeek, Belgium*

Case

- MAP = 70 mmHg

- **Give fluids**
- **Give vasopressors**
- **Aim MAP 80-100 mmHg**

Overview

- Ventilation/oxygenation
- Blood pressure
- **PCI**
- Glucose
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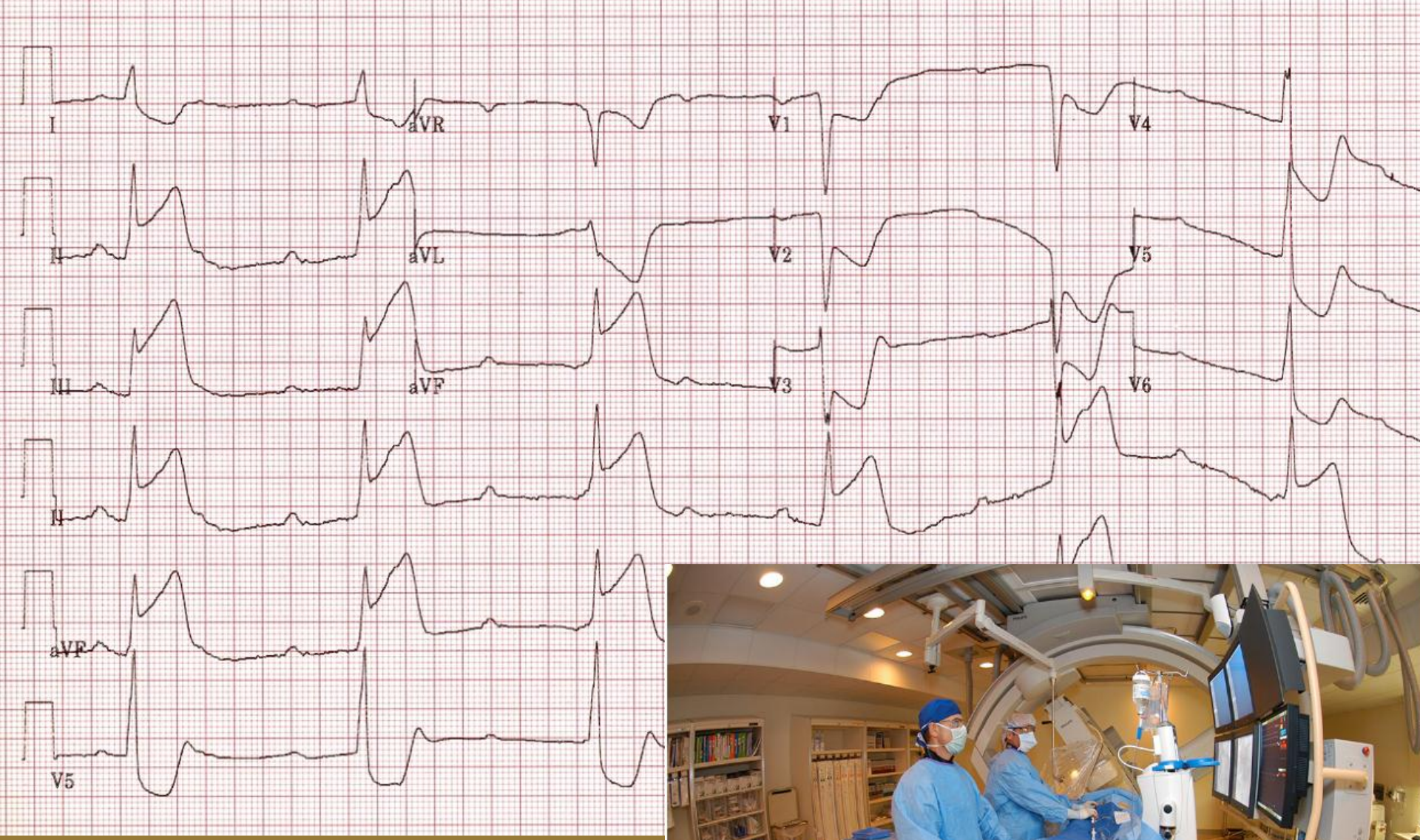

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
aVF
V5

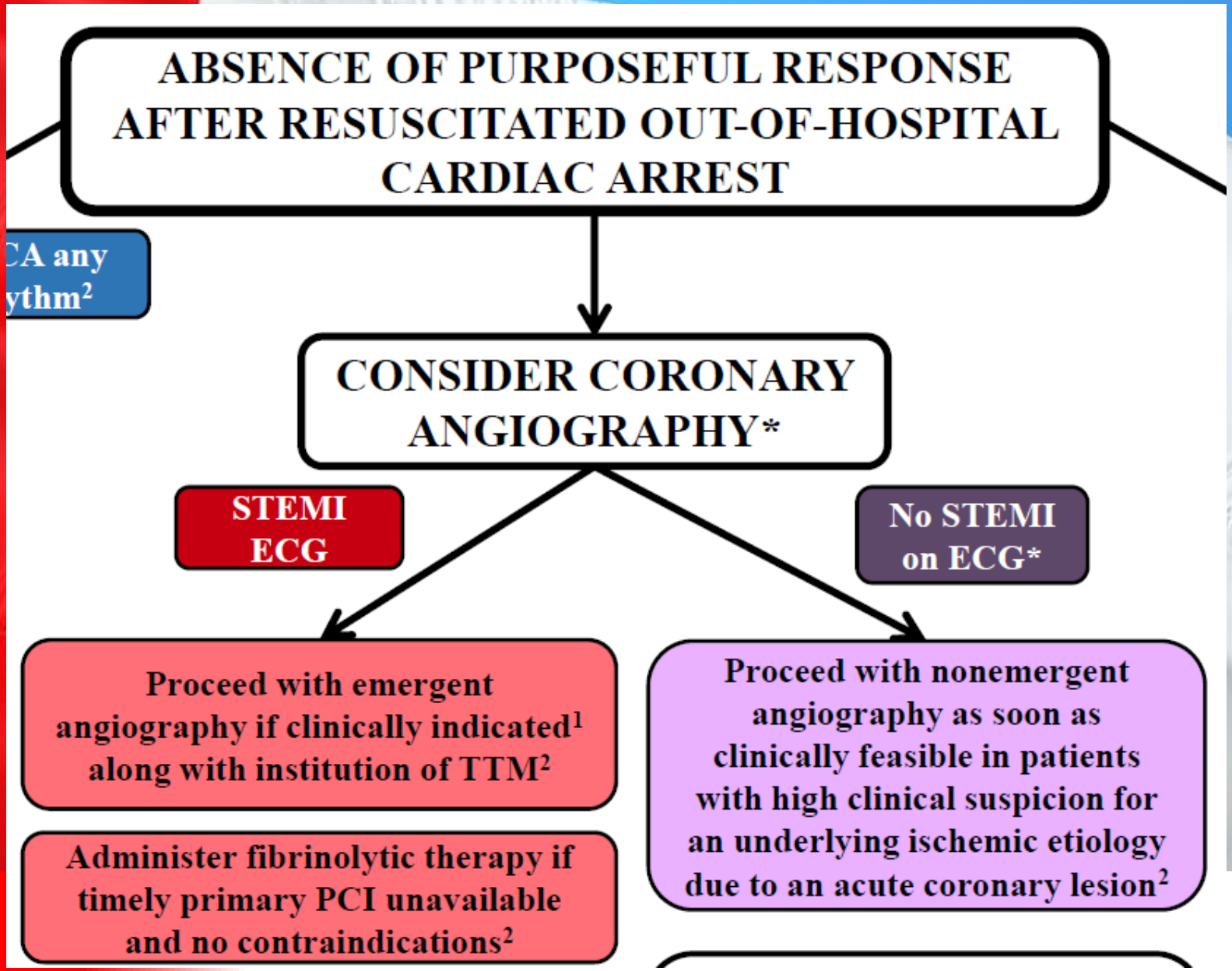
TABLE 2 Angiographic Findings in Patients With Cardiac Arrest and No ST-Segment Elevation on ECG

First Author, Year (Ref. #)	Acute Occlusion	Culprit Lesion*	Significant CAD†
Merchant et al., 2008 (55)	6/17 (35)	–	10/17 (55)
Reynolds et al., 2009 (14)	–	–	31/54 (57)
Anyfantakis et al., 2009 (56)	–	–	27/44 (61)
Radsel et al., 2011 (31)	4/54 (7)	13/54 (24)	32/54 (59)
Bro-Jeppesen et al., 2012 (30)	–	–	43/82 (52)
Dumas et al., 2010 (3)	–	–	176/301 (58)
Hollenbeck et al., 2014 (25)	44/163 (27)	–	–
Kern et al., 2015 (52)	23	33	
Total (%)	23	29	58

Values are n/N (%) or %. *Defined as acute occlusion or irregular plaque morphology with or without thrombus. †Defined according to the definition used in each study.

CAD = coronary artery disease; ECG = electrocardiogram.

Rab JACC 2015



Can J Card 2017

Case

Overview

- Ventilation/oxygenation
- Blood pressure
- PCI
- **Glucose**
- Targeted temperature management
- Cardiac arrest center
- Conclusions and recommendations

Resuscitation 80 (2009) 624–630

Contents lists available at ScienceDirect

Resuscitation

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

Clinical paper

Derangements in blood glucose following initial resuscitation from in-hospital cardiac arrest: A report from the national registry of cardiopulmonary resuscitation☆

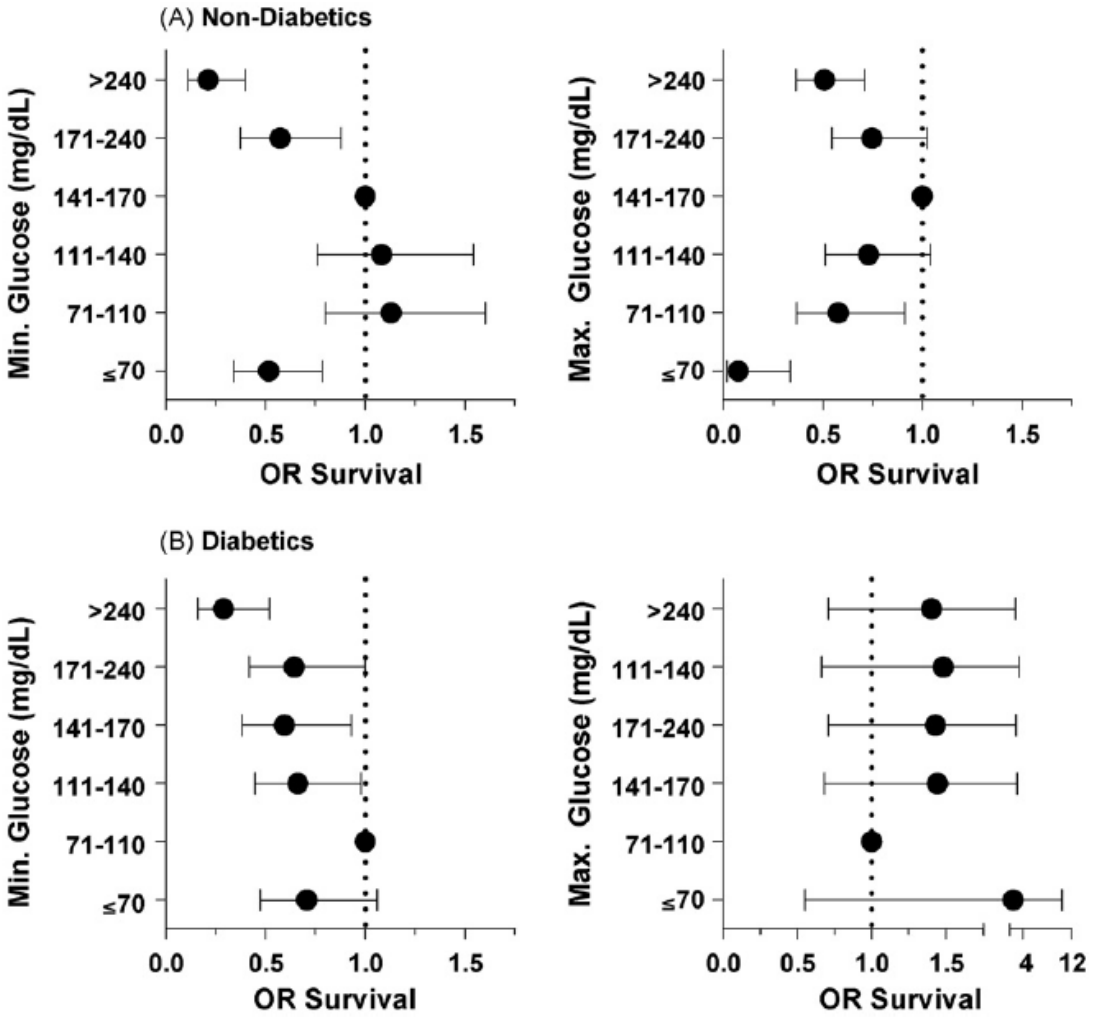
David G. Beiser[a,*,d], Gordon E. Carr[b,d], Dana P. Edelson[b,d], Mary Ann Peberdy[c,d], Terry L. Vanden Hoek[a,d]

[a] Section of Emergency Medicine, Department of Medicine, University of Chicago, Chicago, IL 60637, USA
[b] Section of Pulmonary and Critical Care Medicine, Department of Medicine, University of Chicago, Chicago, IL 60637, USA
[c] Division of Cardiology, Virginia Commonwealth University, Richmond, VA 23298, USA

17.800 adult IHCA

Odds ratio of survival

after CA



Glucagon-Like Peptide-1 Analog Exenatide

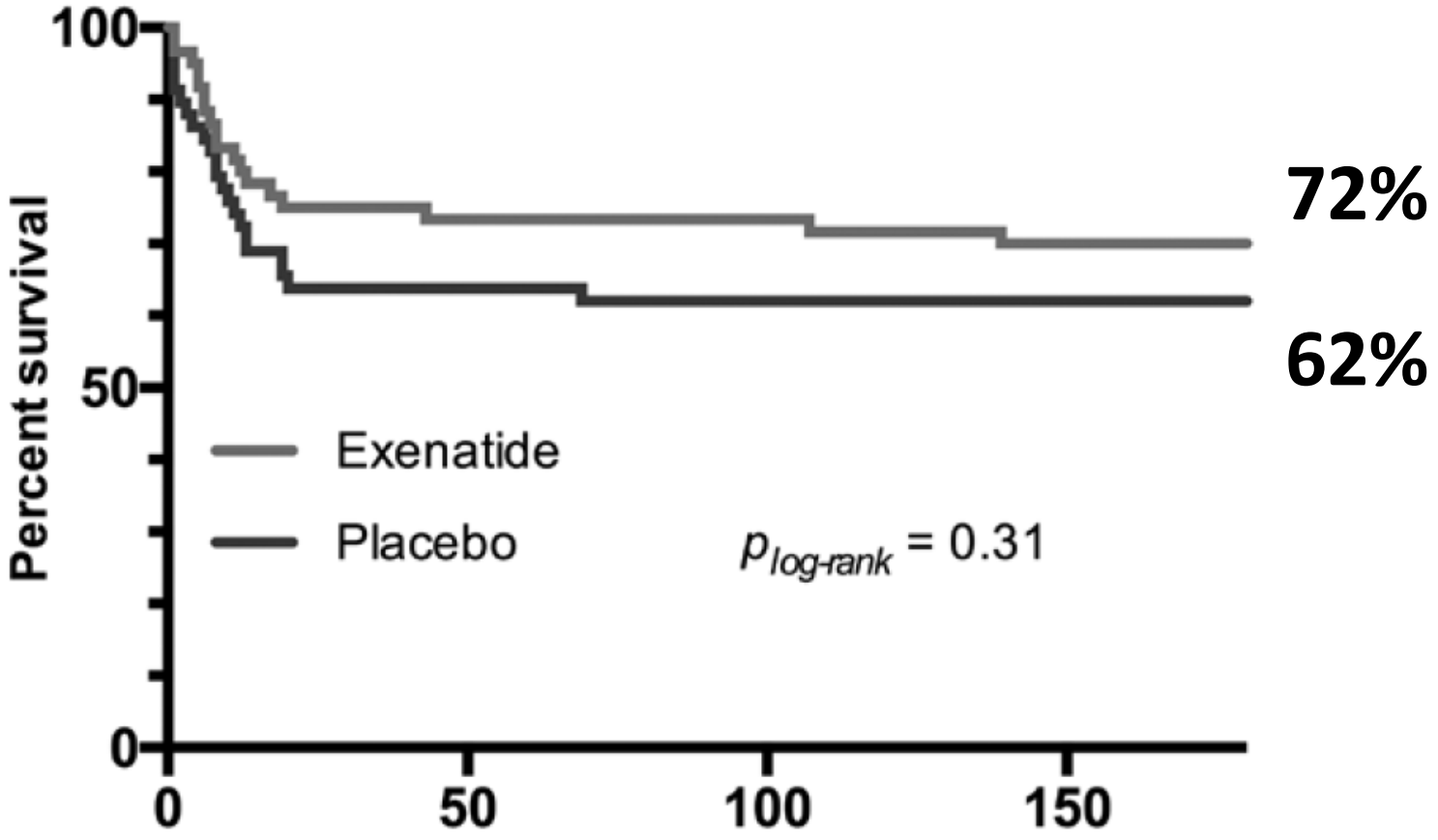
Median (IQR) blood glucose at 8 h:

	mmol/l	mg/dl
Exenatide	5.8 (5.2–6.7)	104 (94-121)
Placebo	7.3 (6.2–8.7)	132 (112-157)

($p < 0.0001$)

Wiberg Circulation 2016

Glucagon-Like Peptide-1 Analog Exenatide

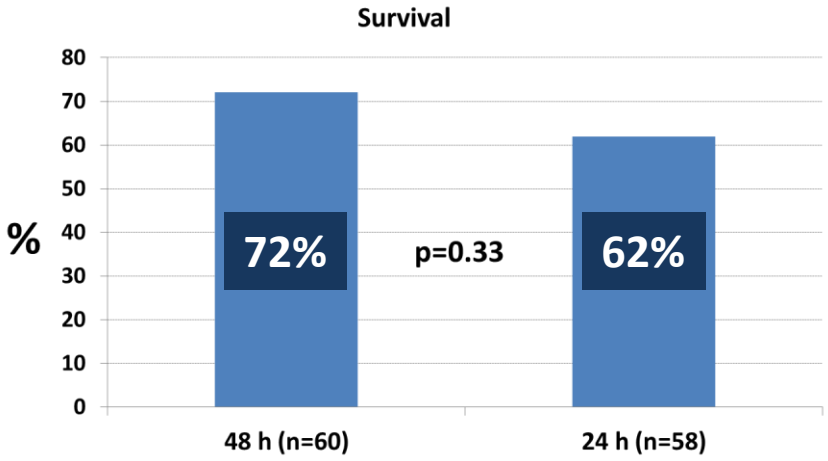


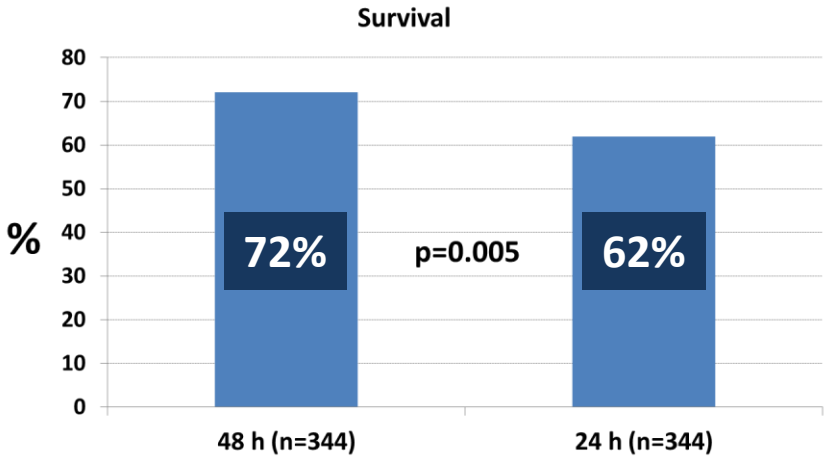
No. at risk				
Exenatide	60	44	44	42
Placebo	58	37	36	36

Wiberg Circulation 2016


346 patients
per group

It is all about power!

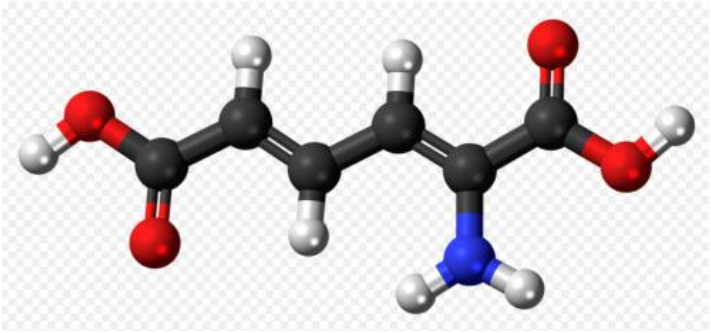




Case

- MAP = 70 mm
- HR = 110/mi
- SaO_2 = 100%

- **Consider insulin**
- **Avoid hypoglycemia**



- Lactate = 13 mmol/L
- **Glucose = 280 mg/dL (15,5 mmol/L)**
- K = 3,6 mmol/L
- Na = 136 mmol/L

Overview

- Ventilation/oxygenation
- Blood pressure
- PCI
- Glucose
- **Targeted temperature management**
- Cardiac arrest center
- Conclusions and recommendations

Resuscitation 95 (2015) 202–222

Contents lists available at ScienceDirect

Resuscitation

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

2015 ERC Recommendations

European Resuscitation Council and European Society of Intensive Care Medicine Guidelines for Post-resuscitation Care 2015
Section 5 of the European Resuscitation Council Guidelines for Resuscitation 2015☆

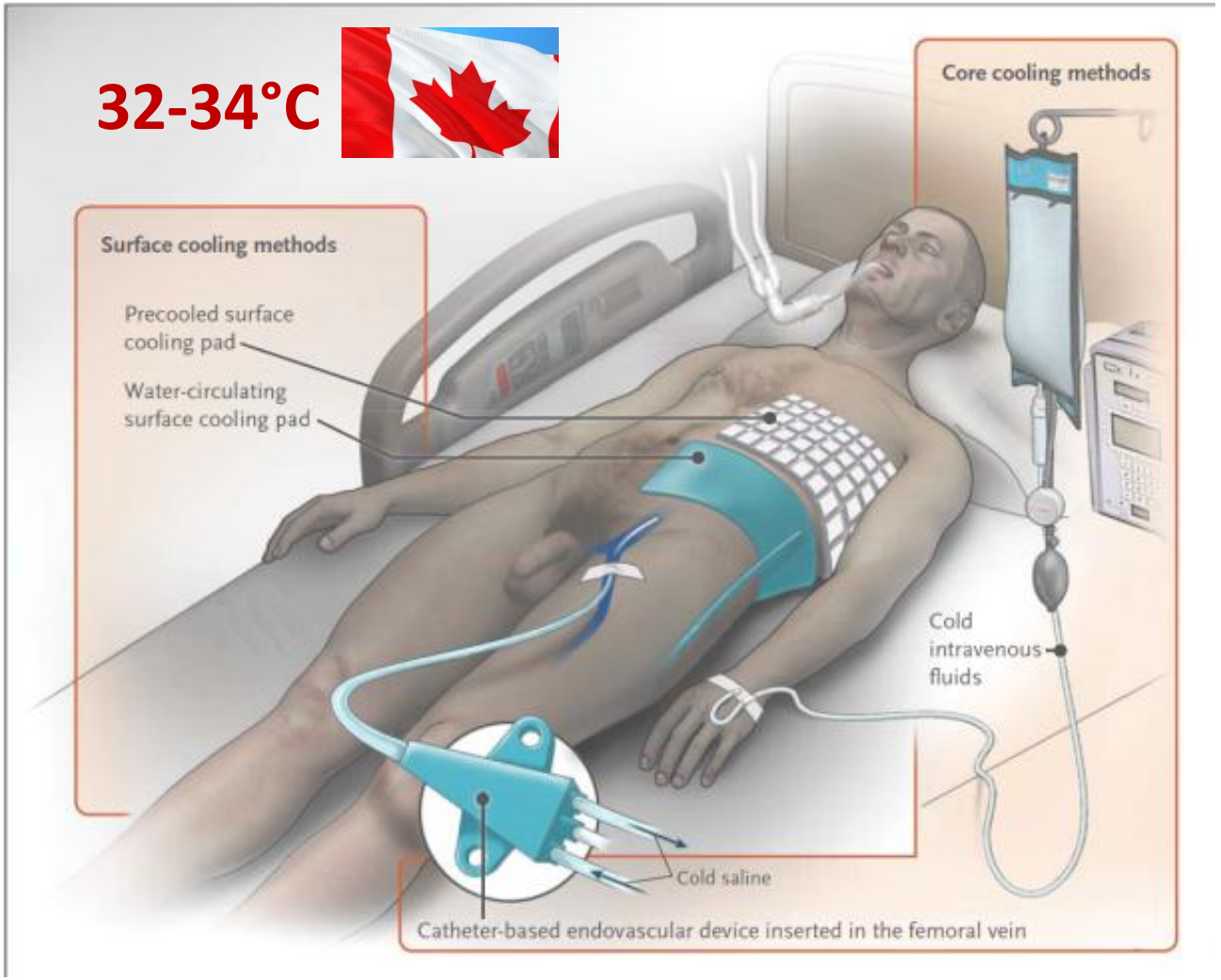
Jerry P. Nolan[a,b,*], Jasmeet Soar[c], Alain Cariou[d], Tobias Cronberg[e], Véronique R.M. Moulaert[f], Charles D. Deakin[g], Bernd W. Bottiger[h], Hans Friberg[i], Kjetil Sunde[j], Claudio Sandroni[k]

- **TTM 32°C and 36°C OHCA**
- **TTM recommended: VF**
- **TTM suggested:**
  - **Non-VF OHCA**
  - **IHCA with any initial rhythm**
- **If TTM is used: duration at least 24**


• TTM 32°-34°
• As rapidly as possibly
• 24 h

Case

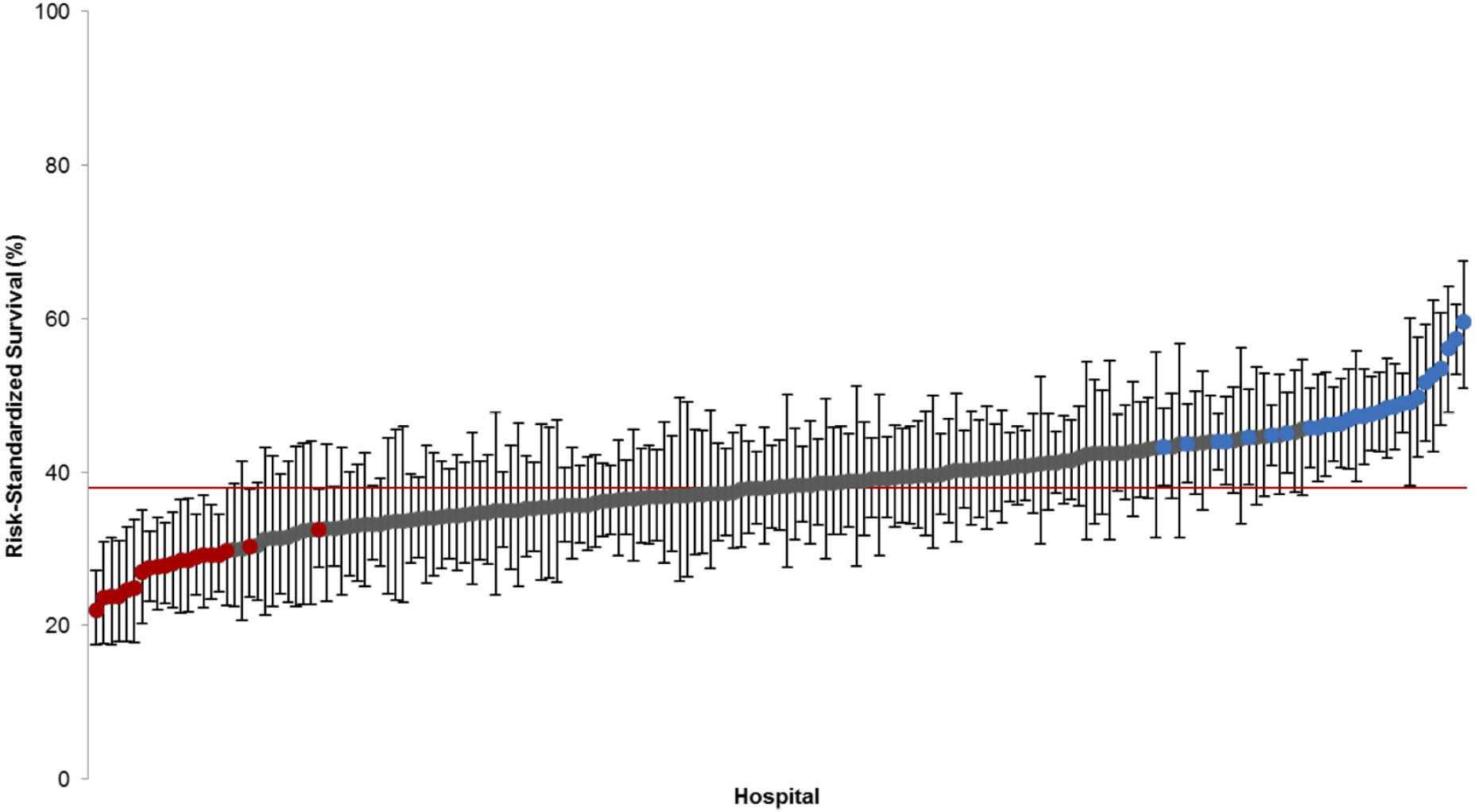
- MAP = 70 mmHg
- HR = 110/min
- SaO_2 = 100%
- **Temp = 36,8°C**



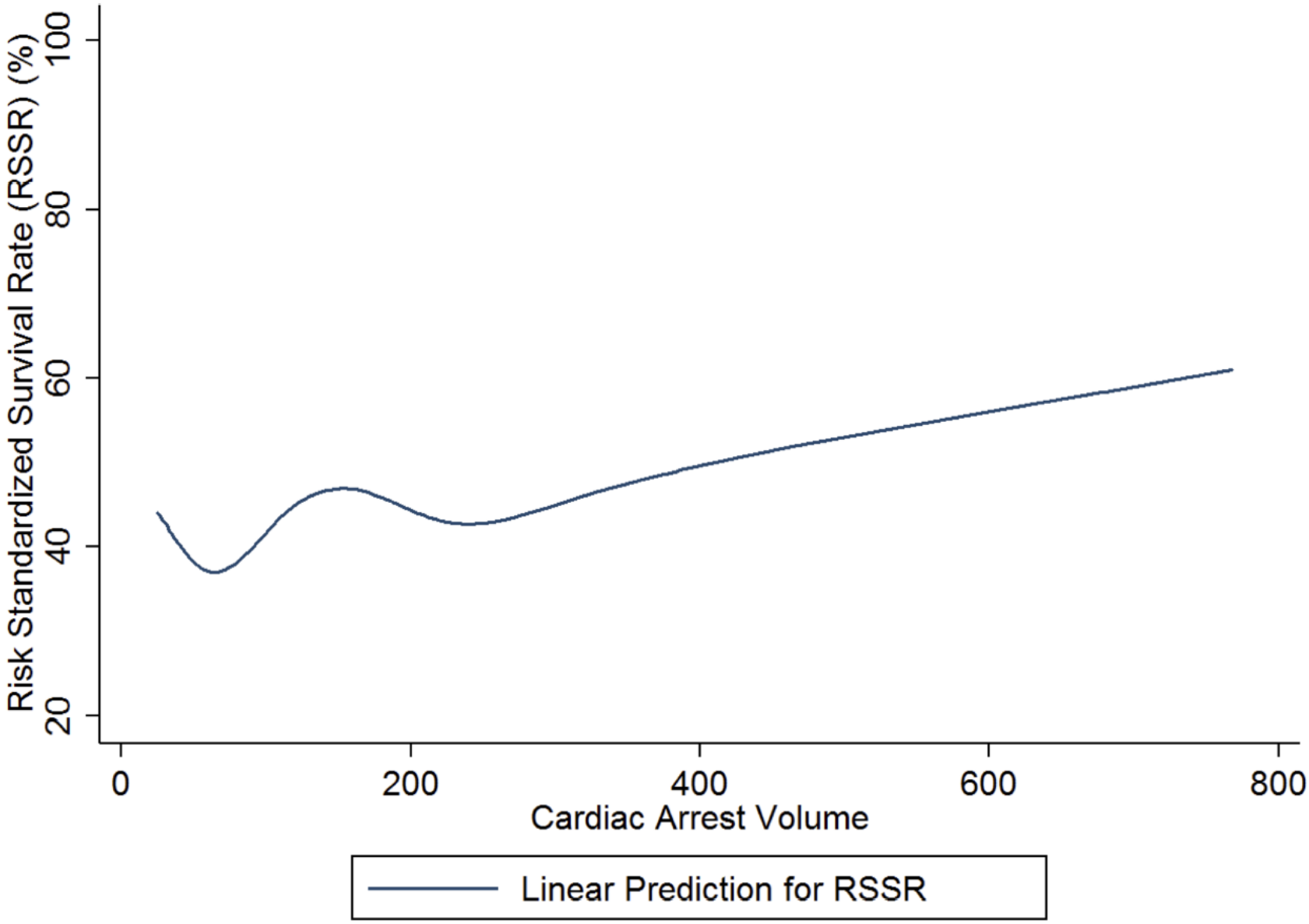
Overview

- Ventilation/oxygenation
- Blood pressure
- PCI
- Glucose
- Antibiotic therapy
- Targeted temperature management
- **Cardiac arrest center**
- Conclusions and recommendations

33.700 cardiac arrest patients in 213 hospitals

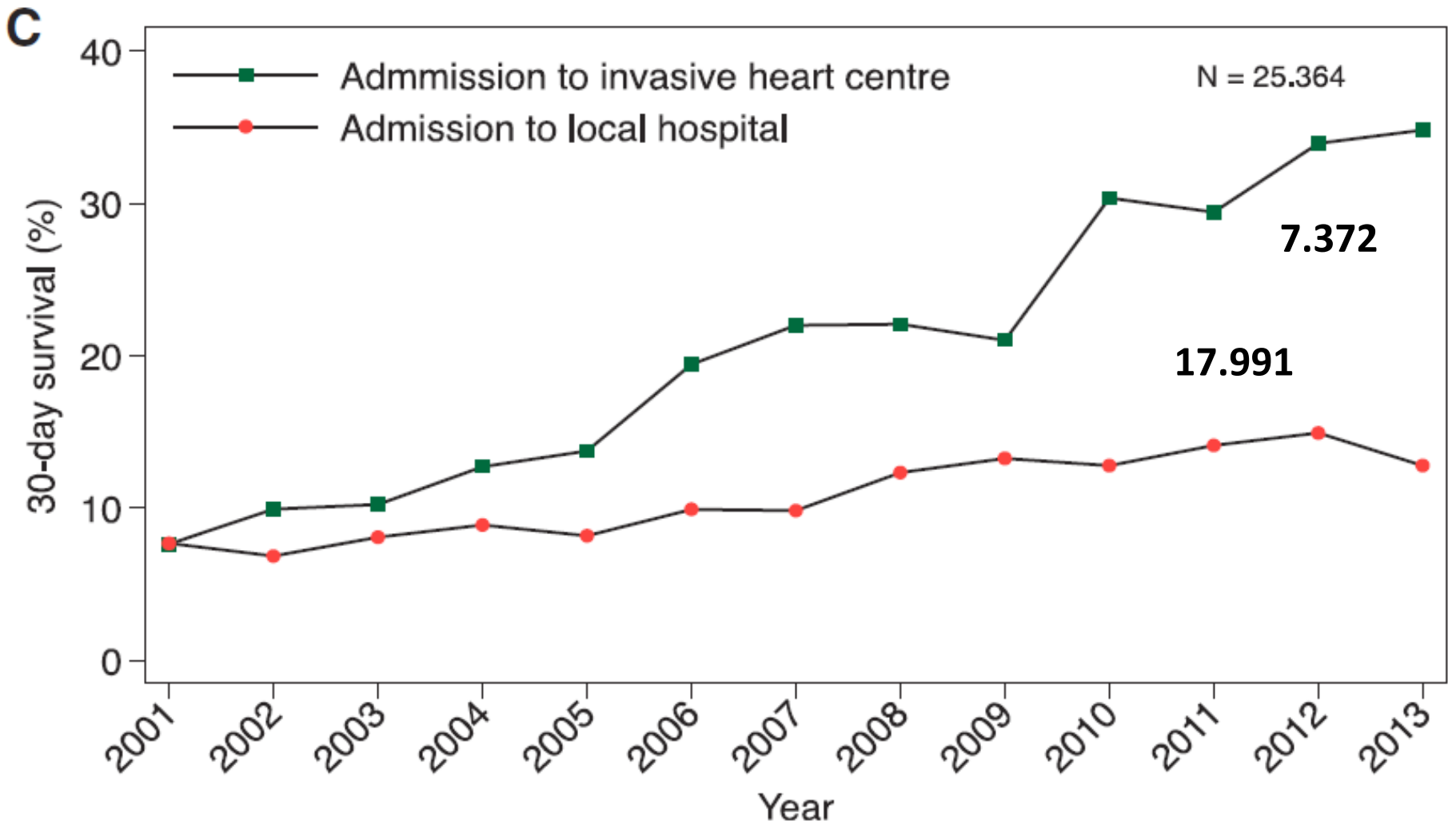


Kurz Plos One 2017

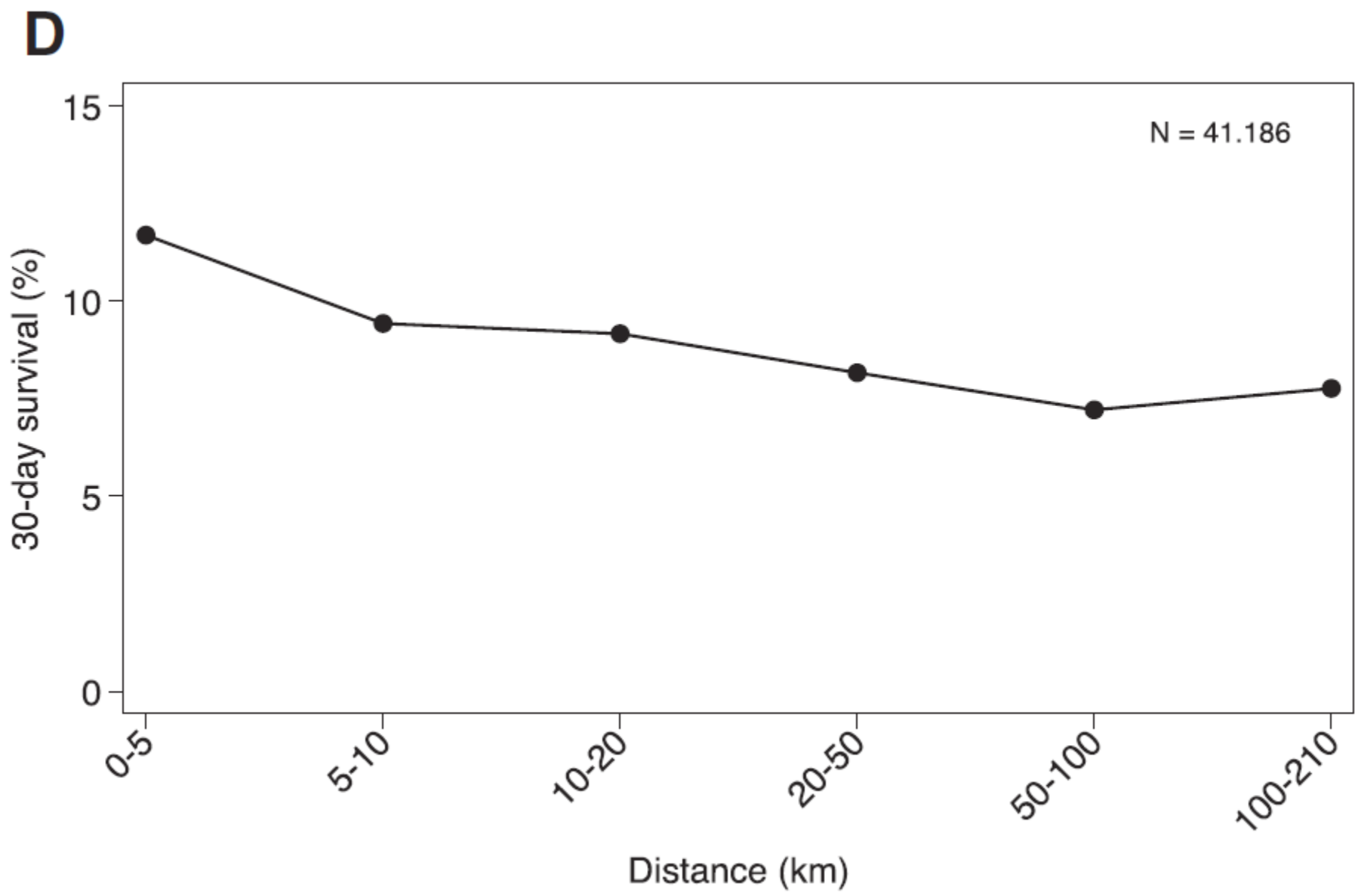


Kurz Plos One 2017

Tranberg Eur Heart J 2017



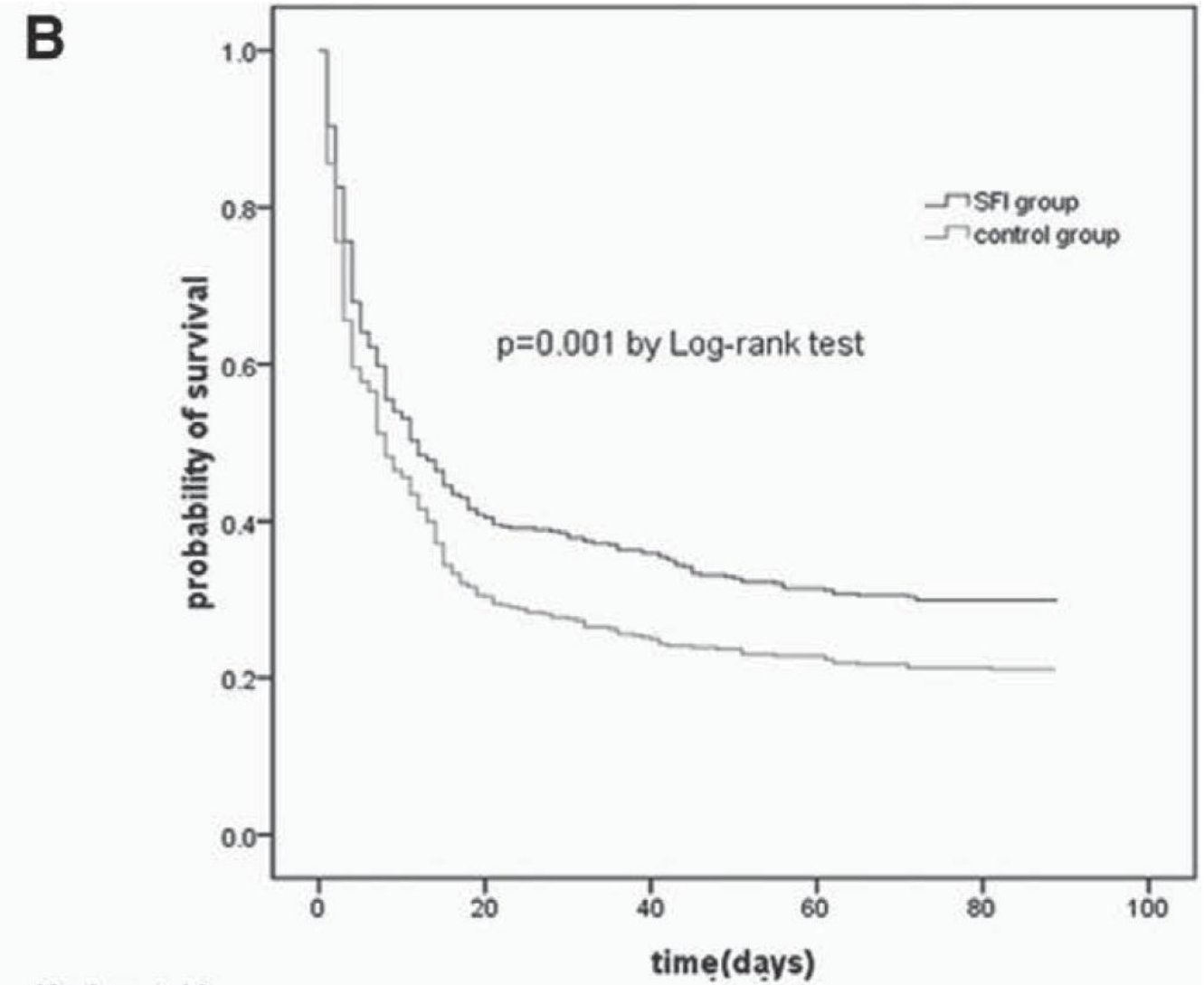
Tranberg Eur Heart J 2017



Tranberg Eur Heart J 2017


CARDIAC ARREST CENTER

Zhang Crit Care Med J 2017



Numbers at risk

Day	0	20	40	60	80	90
SFI group	492	241	207	203	199	195
control group	486	180	167	159	137	126

Zhang Crit Care Med J 2017

Overview

- Ventilation/oxygenation
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- **Conclusions and recommendations**

Conclusion I

- **Ventilation and oxygenation strategies (Guidelines ERC 2015):**
  - **O2 94–98%, avoid hypoxaemia**
  - **Normocarbia**
- **Reperfusion strategies (Guidelines Canada 2017):**
  - **PCI as soon as feasible with high suspicion for coronary cause**
  - **Avoid hypotension**
- **Metabolic control (Guidelines ERC 2015):**
  - **Glucose ≤ 10mmol/L (180mg/dl)**
  - **Hypoglycaemia should be avoided**
- **Mild therapeutic hypothermia 32-34°C (Guidelines Canada 2016)**
  - **VF recommended, non-VF suggested**
  - **As early as feasible**

Conclusion I

- Ventilation and oxygenation strategies (Guidelines ERC 2015):
  - O2 94–98%, void hypoxaemia
  - Normocarbia
- Reperfusion strategies (Guidelines Canada 2017):
  - PCI as soon as feasible with high suspicion for coronary cause
  - Avoid hypotension
- Metabolic control (Guidelines ERC 2015):
  - Glucose ≤ 10mmol/L (180mg/dl)
  - Hypoglycaemia should be avoided

?

limited evidence

- Mild therapeutic hypothermia 32-34°C (Guidelines Canada 2016)
  - VF recommended, non-VF suggested
  - As early as feasible

RCTs!!!!

Conclusion II

Implementation of

cardiac arrest centres!!!!!