# Cardiac arrest: more than just defibrillation?

**Benjamin S. Abella, MD, MPhil, FACEP**

CRS
Center for Resuscitation Science

**Clinical Research Director**
**Center for Resuscitation Science**
**Department of Emergency Medicine**
**University of Pennsylvania**

***ACEP Scientific Assembly***
***Las Vegas – September 2010***

# Speaker disclosures

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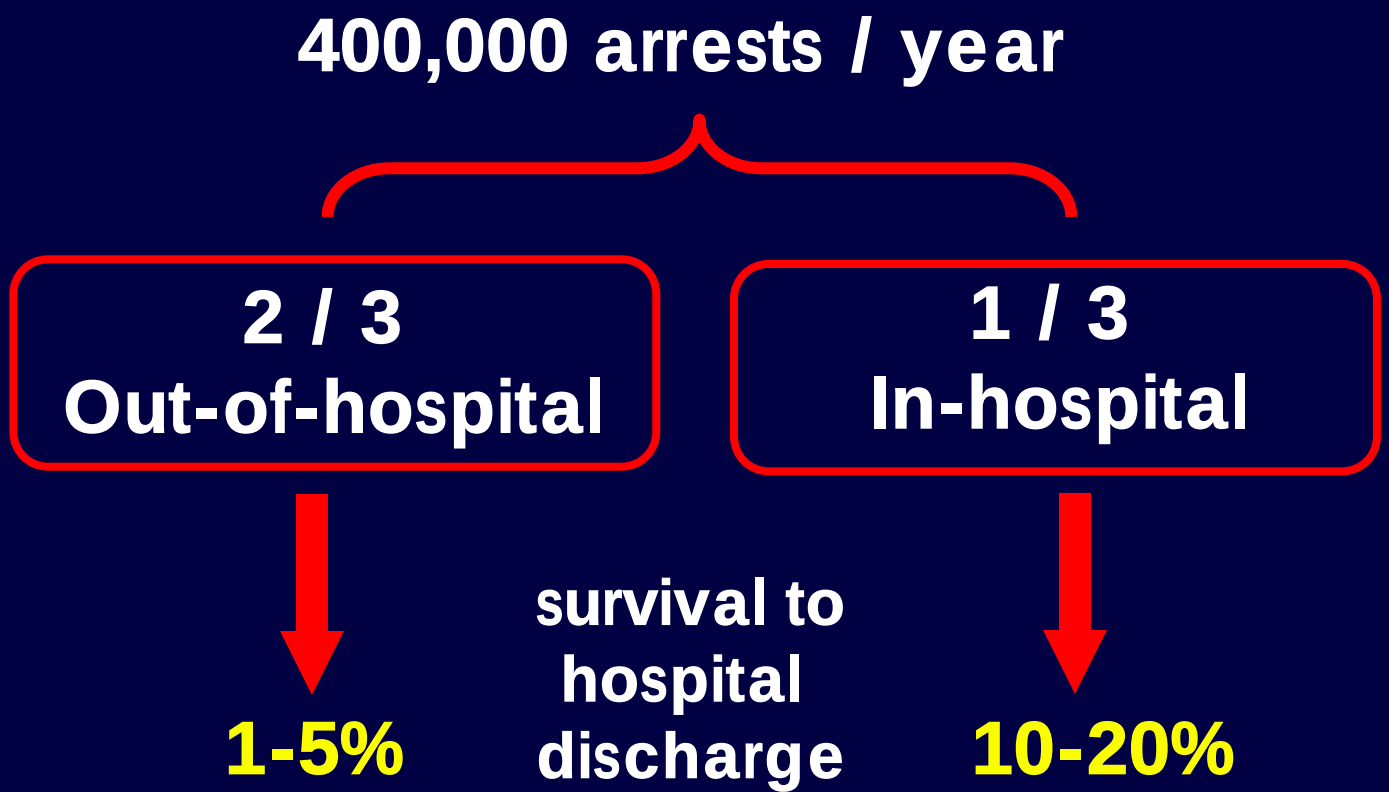
| | Medivance Corporation |

No equity, intellectual property or advisory board conflicts

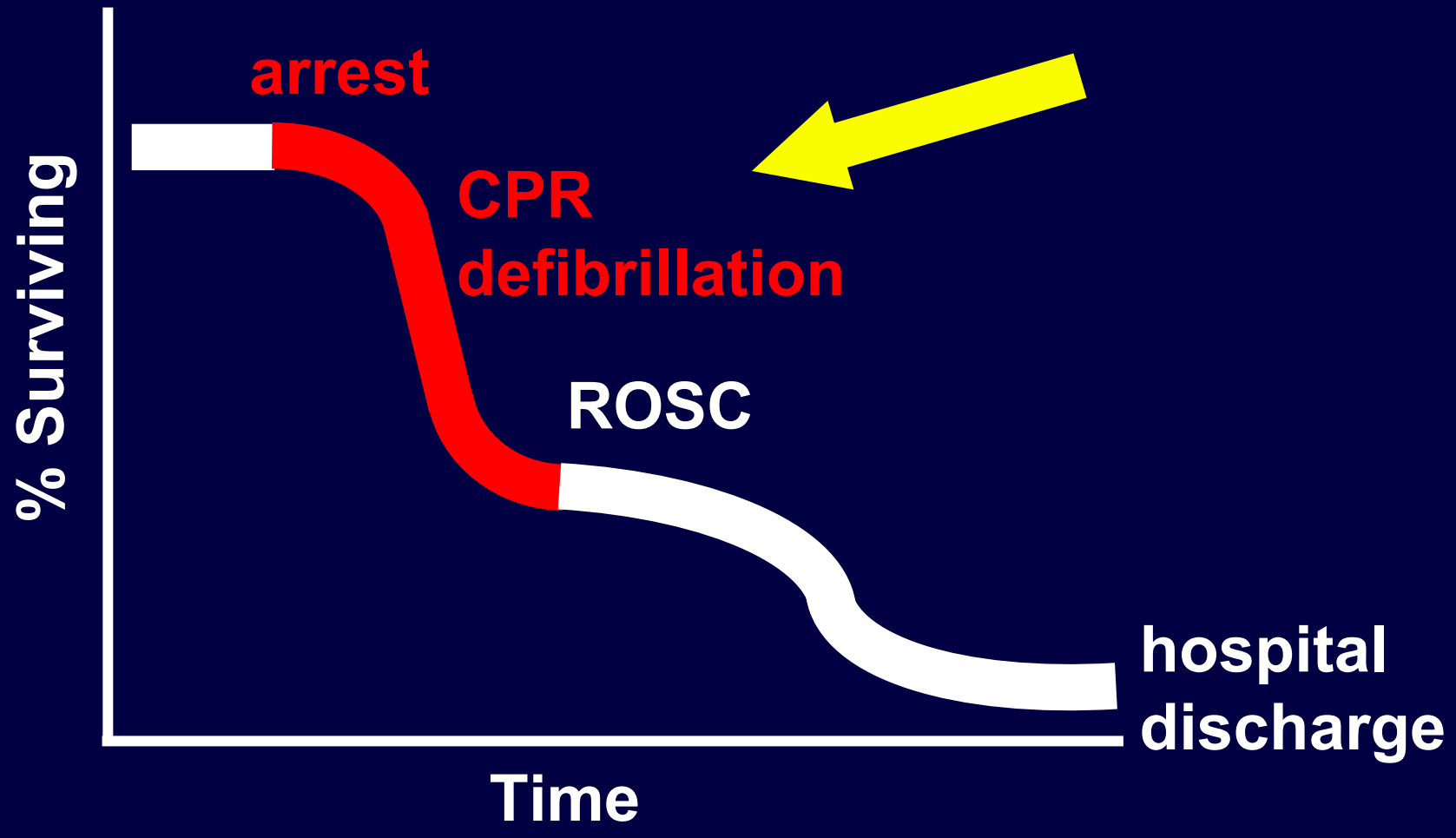
# Cardiac arrest: introduction

# Cardiac arrest epidemiology in the US

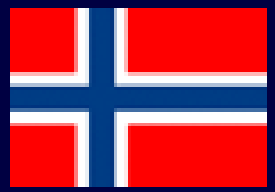



**Seattle: 10-20%!**

# Mortality from cardiac arrest



1961



PROGRAMME

*Symposium on*

# EMERGENCY RESUSCITATION

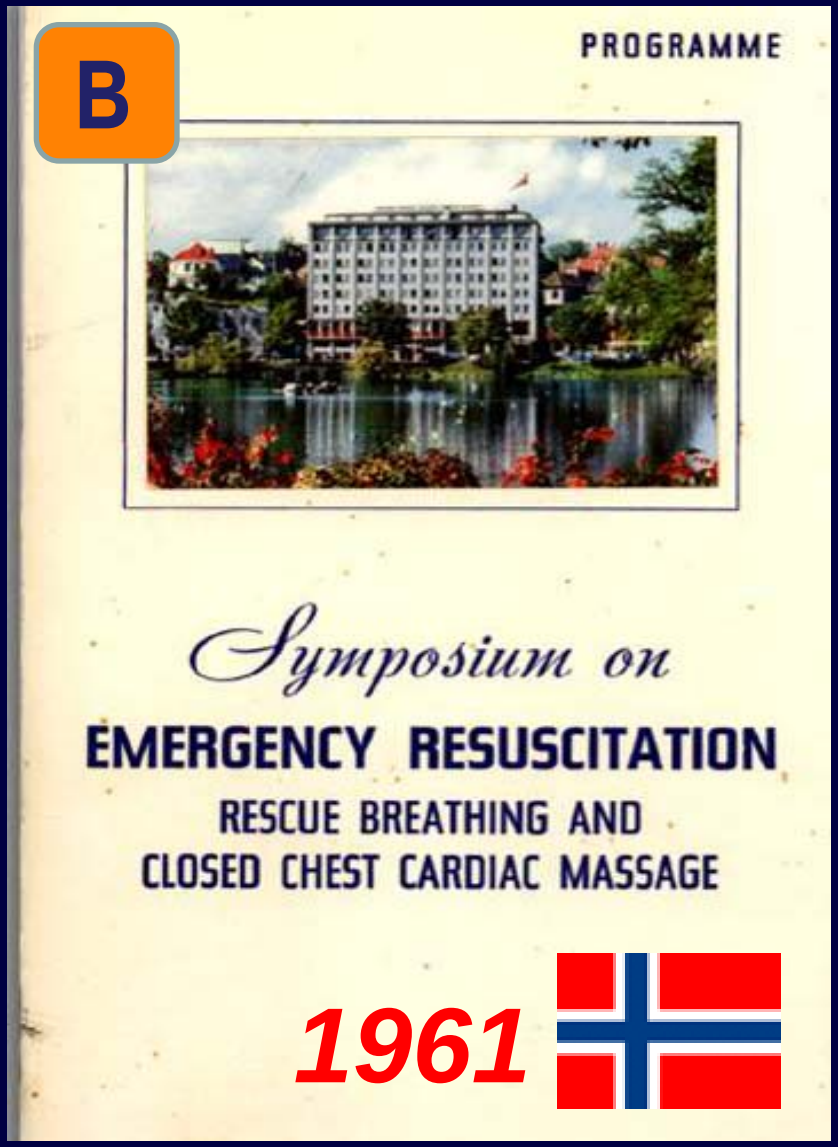
## RESCUE BREATHING AND CLOSED CHEST CARDIAC MASSAGE

AUGUST 21-25 1961

STAVANGER

NORWAY

# Approaching 50 years of modern CPR

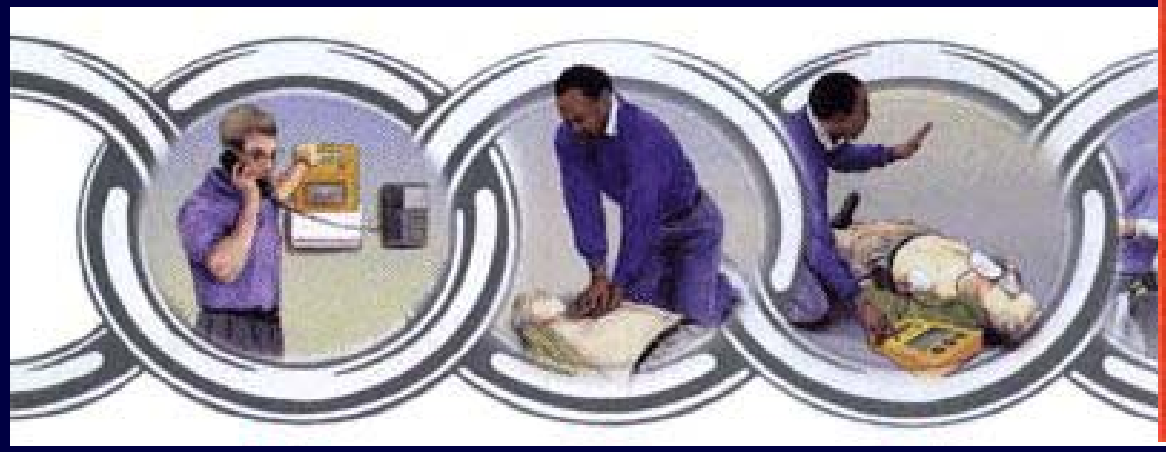



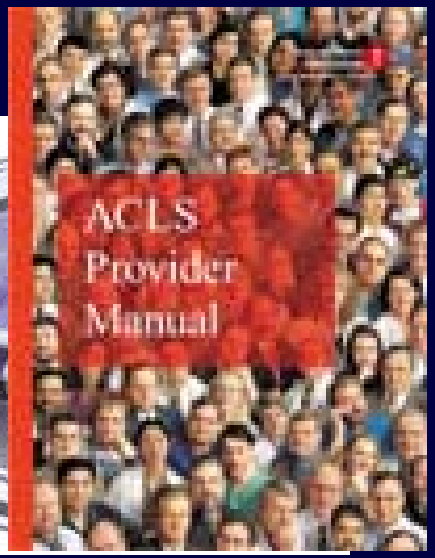

***A. Peter Safar, 1950s***

***B. Early symposium on CPR***

# Cardiac arrest: fundamentals of therapy

**“Chain of Survival”**






**Prompt Access** **Early CPR** **Early Defib** **ACLS Care**

**ACLS Provider Manual (American Heart Association)**

# Chest compression alone CPR

**Bystander contacted 9-1-1**

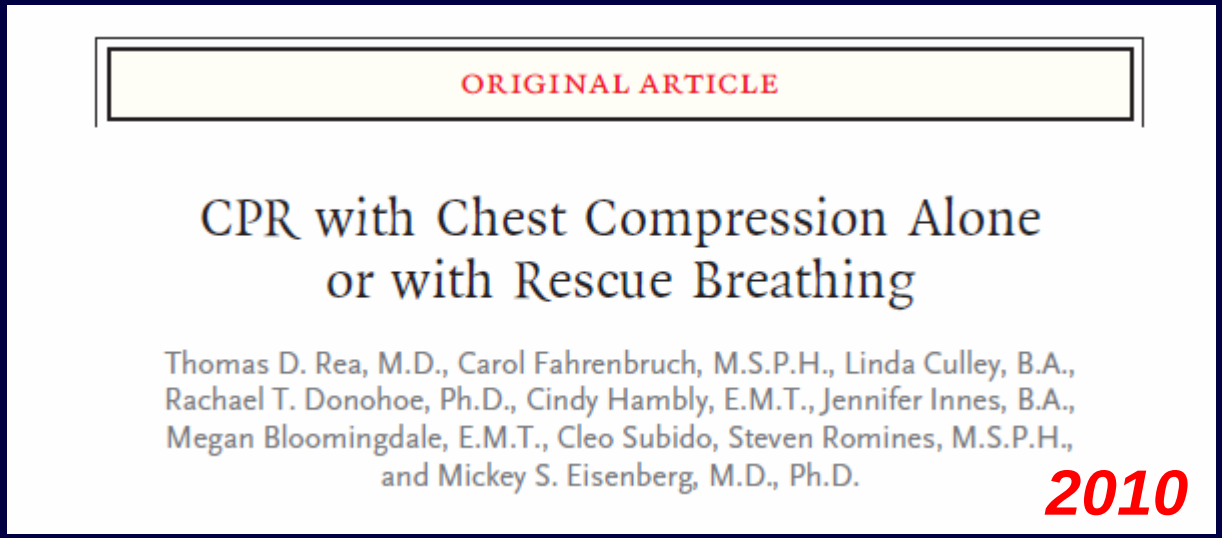
| standard CPR (n=279) | chest compression alone (n=241) |
|---|---|
| **29/279 (10.4%)** | **35/241 (14.6%)** |

***p=0.18***

**Improvement due to:**
**? less time to train**
**? better CPR strategy**

***Hallstrom et al, 2000***

# Chest compression alone CPR: revisited



ORIGINAL ARTICLE

CPR with Chest Compression Alone or with Rescue Breathing

Thomas D. Rea, M.D., Carol Fahrenbruch, M.S.P.H., Linda Culley, B.A., Rachael T. Donohoe, Ph.D., Cindy Hambly, E.M.T., Jennifer Innes, B.A., Megan Bloomingdale, E.M.T., Cleo Subido, Steven Romines, M.S.P.H., and Mickey S. Eisenberg, M.D., Ph.D.

*2010*

**Bystander contacted 9-1-1**

**standard CPR (n=960)**

**chest compression alone (n=981)**

**11.5%**

**14.4%**

**(OR 2.9)**

**Survival to DC**

# Chest compression alone CPR: revisited

## Dispatcher-Assisted Cardiopulmonary Resuscitation

### Risks for Patients Not in Cardiac Arrest

Lindsay White, MPH; Joseph Rogers, MS; Megan Bloomingdale; Carol Fahrenbruch, MSPH; Linda Culley, BA; Cleo Subido, RPL; Mickey Eisenberg, MD, PhD; Thomas Rea, MD, MPH

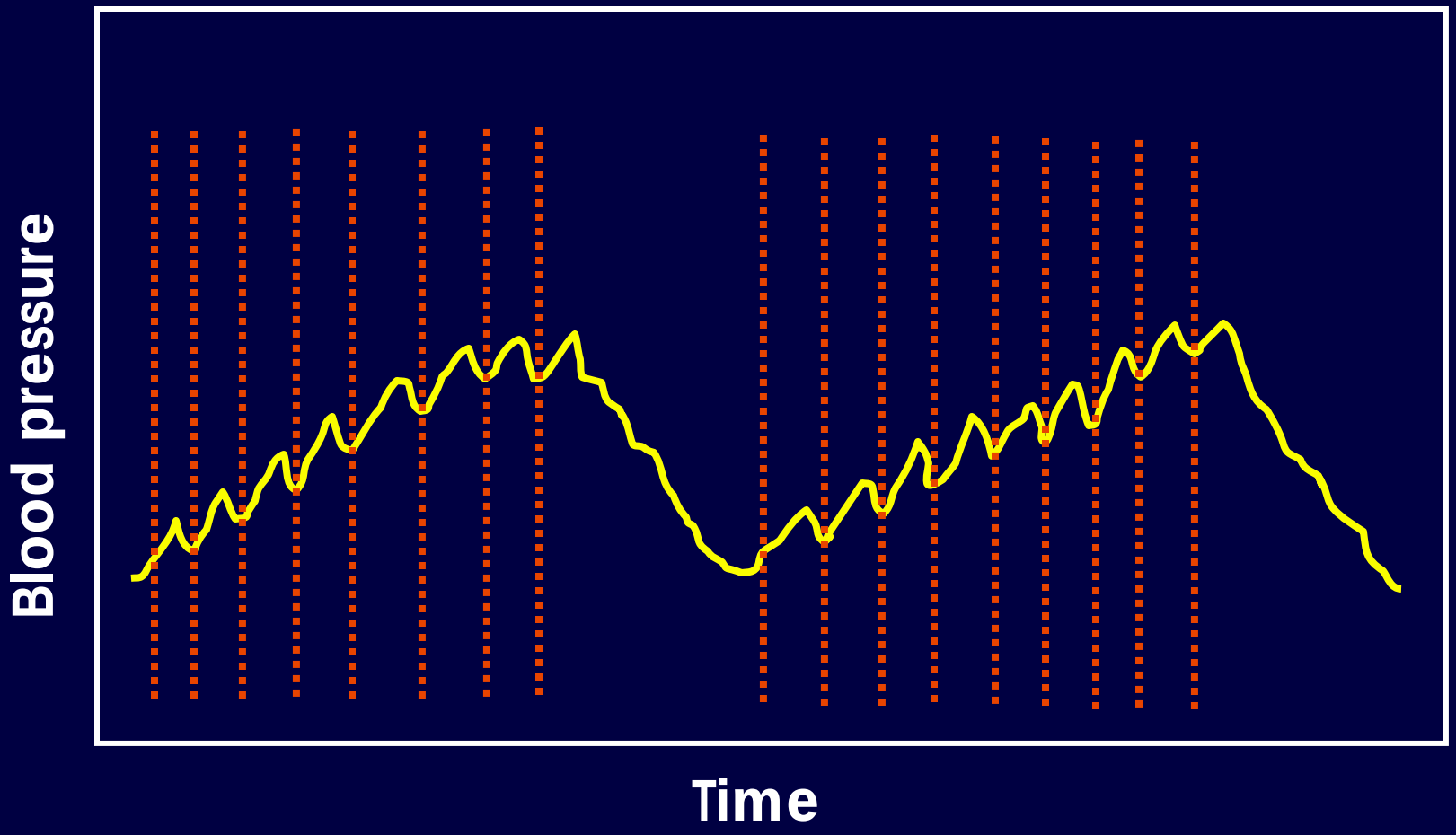
***2010***

**CPR has very little risk to patients:**

**247 patients given CPR erroneously**

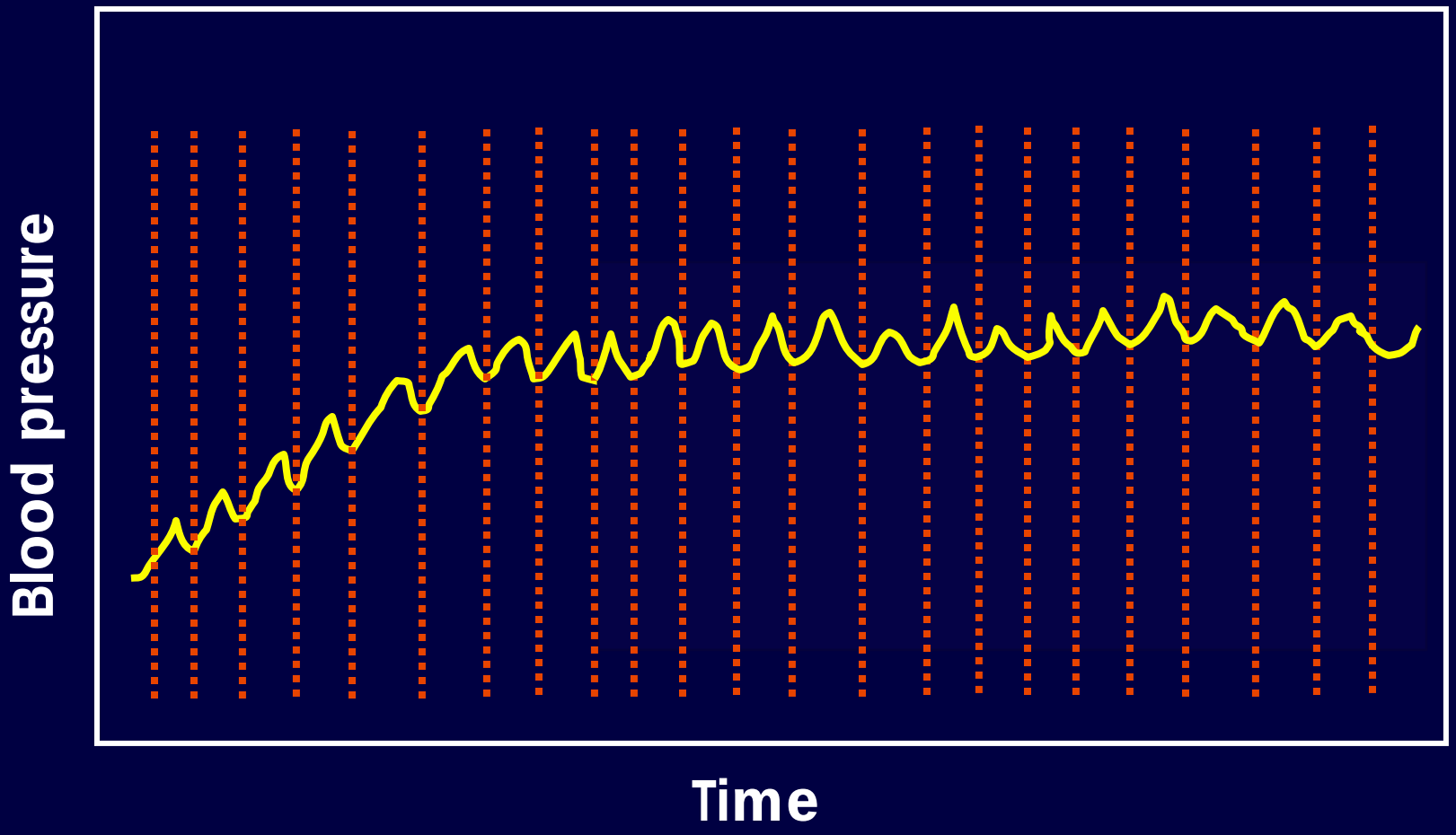
**12% reported discomfort**
**2% had fracture – none with visceral organ damage**

# Standard CPR vs CC alone



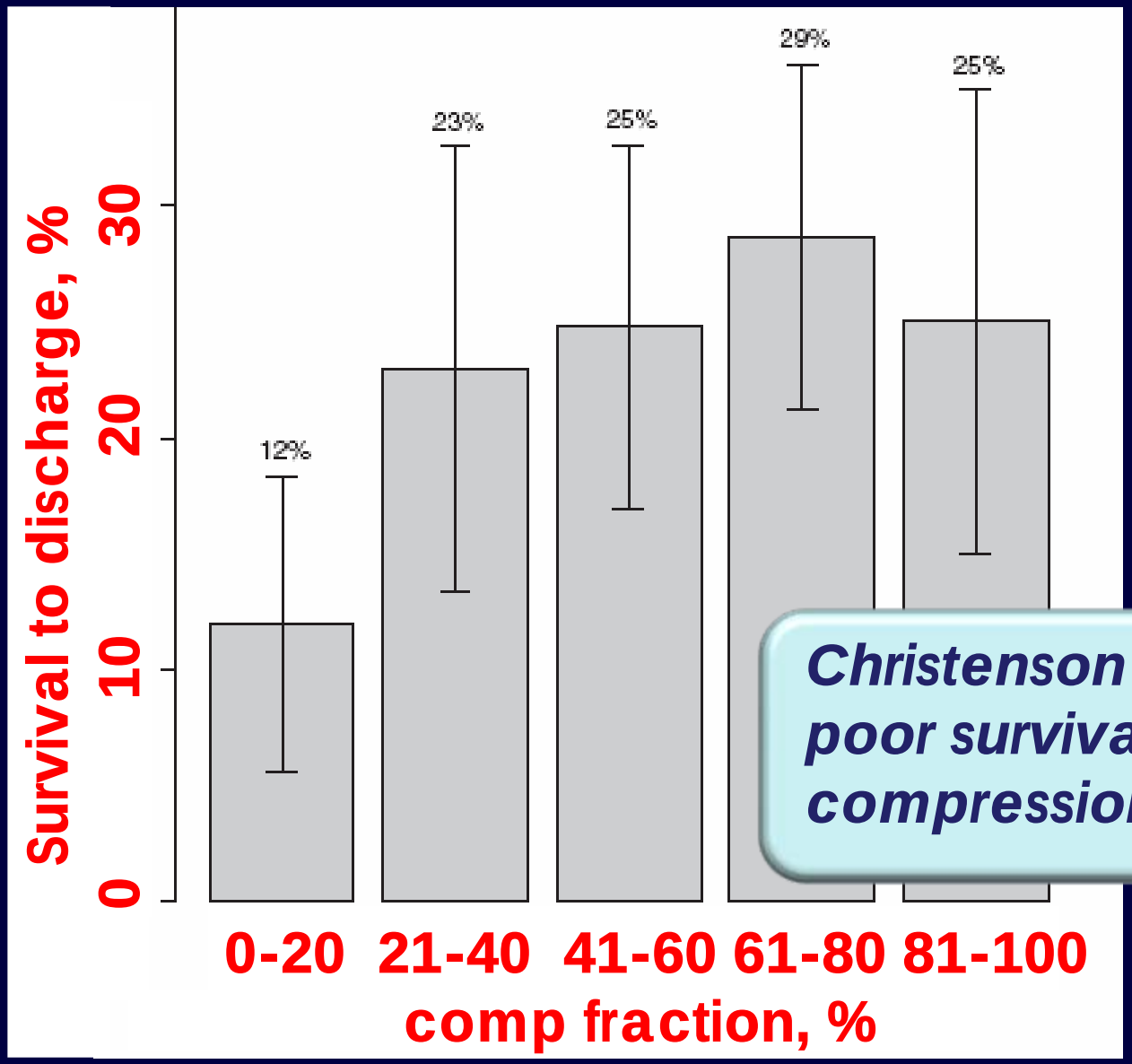

*Berg et al, 2001*

# Standard CPR vs CC alone



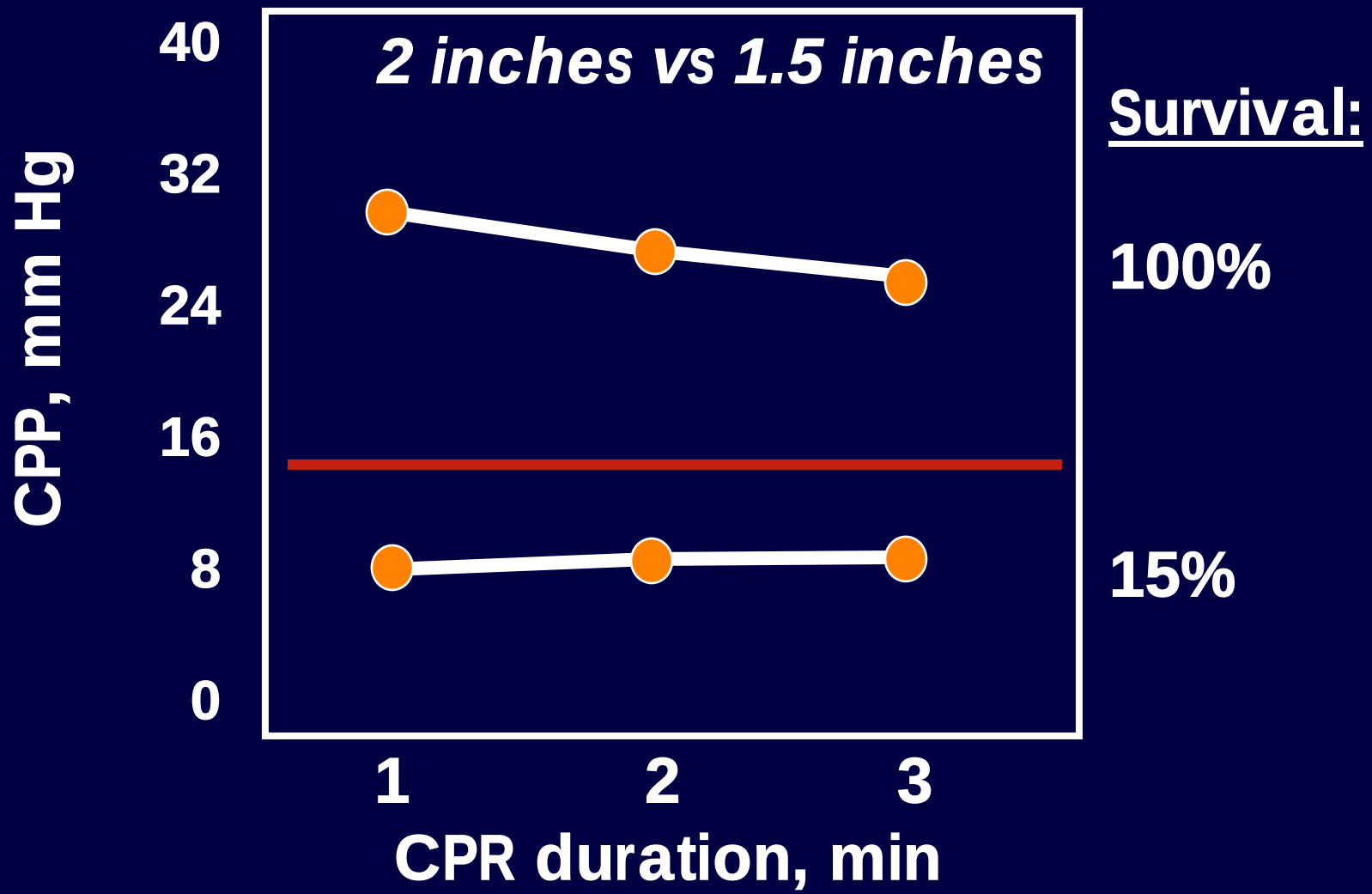

*Berg et al, 2001*

# “No flow” / compression fraction




***Christenson J et al, Circ 2009 poor survival with lowest compression fraction in OHCA***

# Chest compression depth




*ICCM, 2005*

# CPR first may improve survival

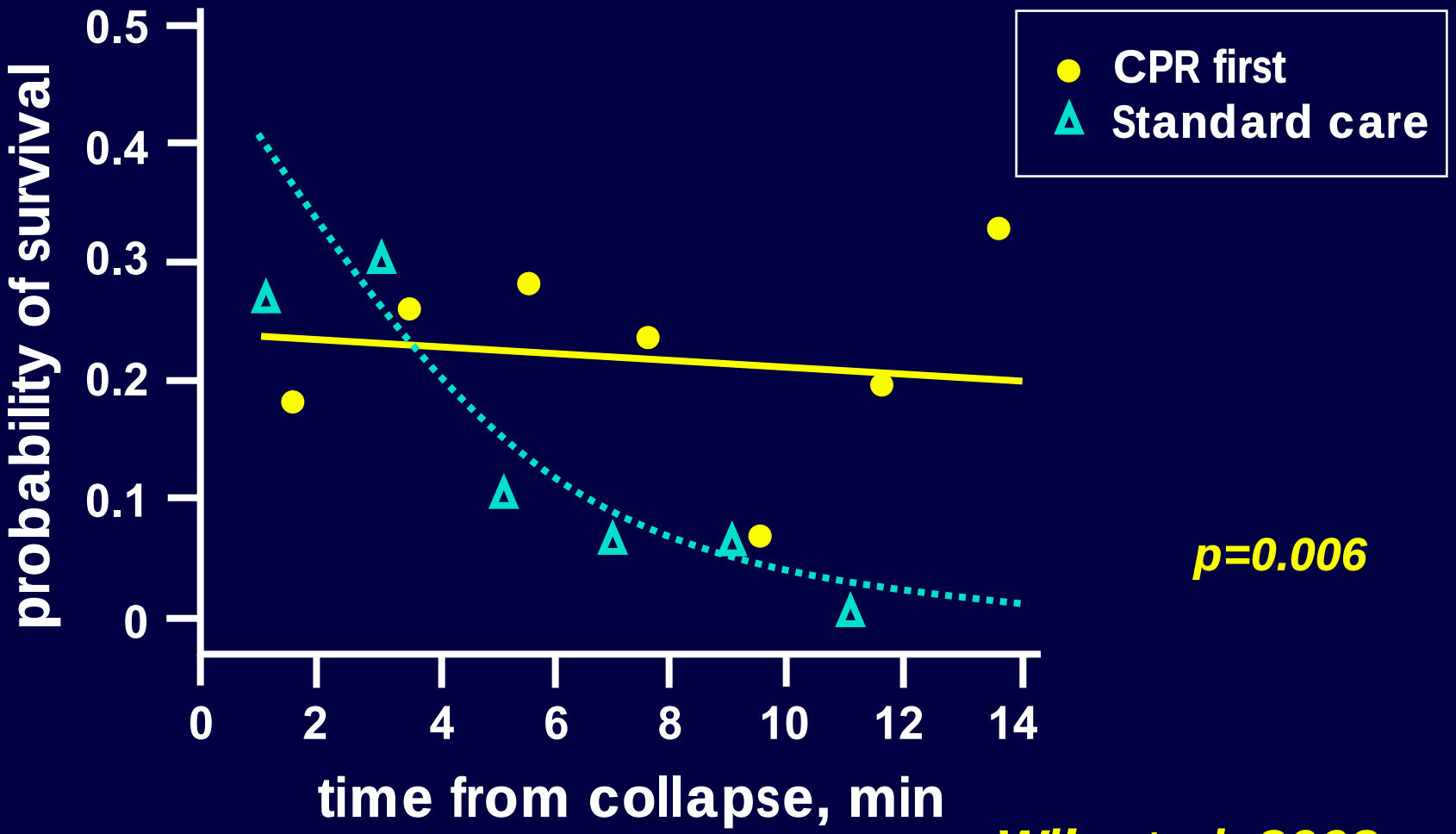
**Influence of cardiopulmonary resuscitation prior to defibrillation in patients with out-of-hospital ventricular fibrillation**

24% (155/639) 30% (142/478) *p=0.04*


**42 months** **36 months**

***Cobb et al, 1999***

# CPR first may improve survival: RCT




*Wik et al, 2003*

# CPR sensing and recording defibrillator


Similar defibrillators now made by both Philips and Zoll

# Using CPR feedback to improve quality

**Quality of out-of-hospital cardiopulmonary resuscitation with real time automated feedback: A prospective interventional study**☆

Jo Kramer-Johansen[a,b,c,*], Helge Myklebust[d], Lars Wik[a,c,e], Bob Fellows[f], Leif Svensson[g], Hallstein Sørebø[c], Petter Andreas Steen[a,h]

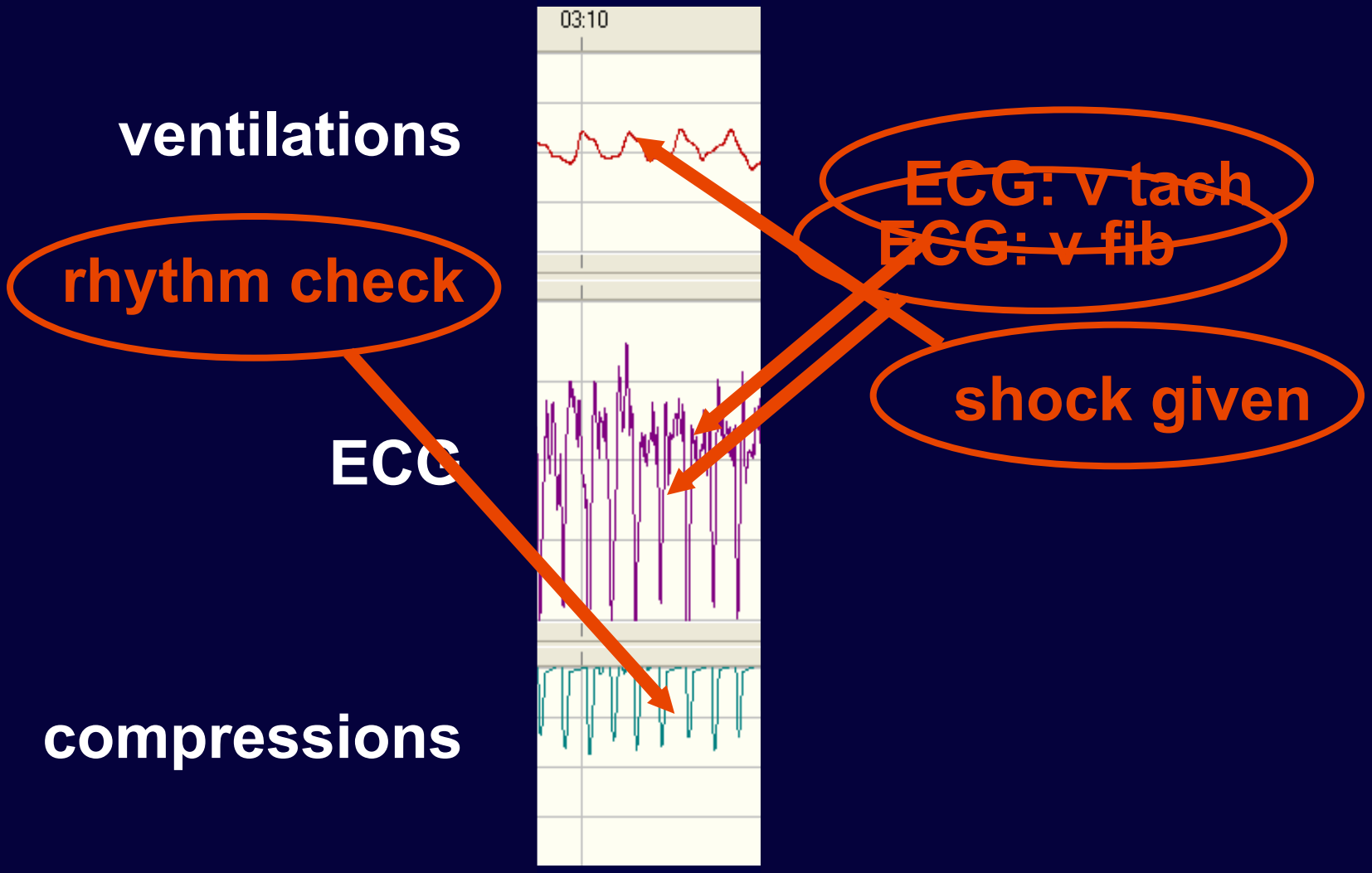
***Kramer Johansen, 2006***

**CPR quality improvement during in-hospital cardiac arrest using a real-time audiovisual feedback system**☆

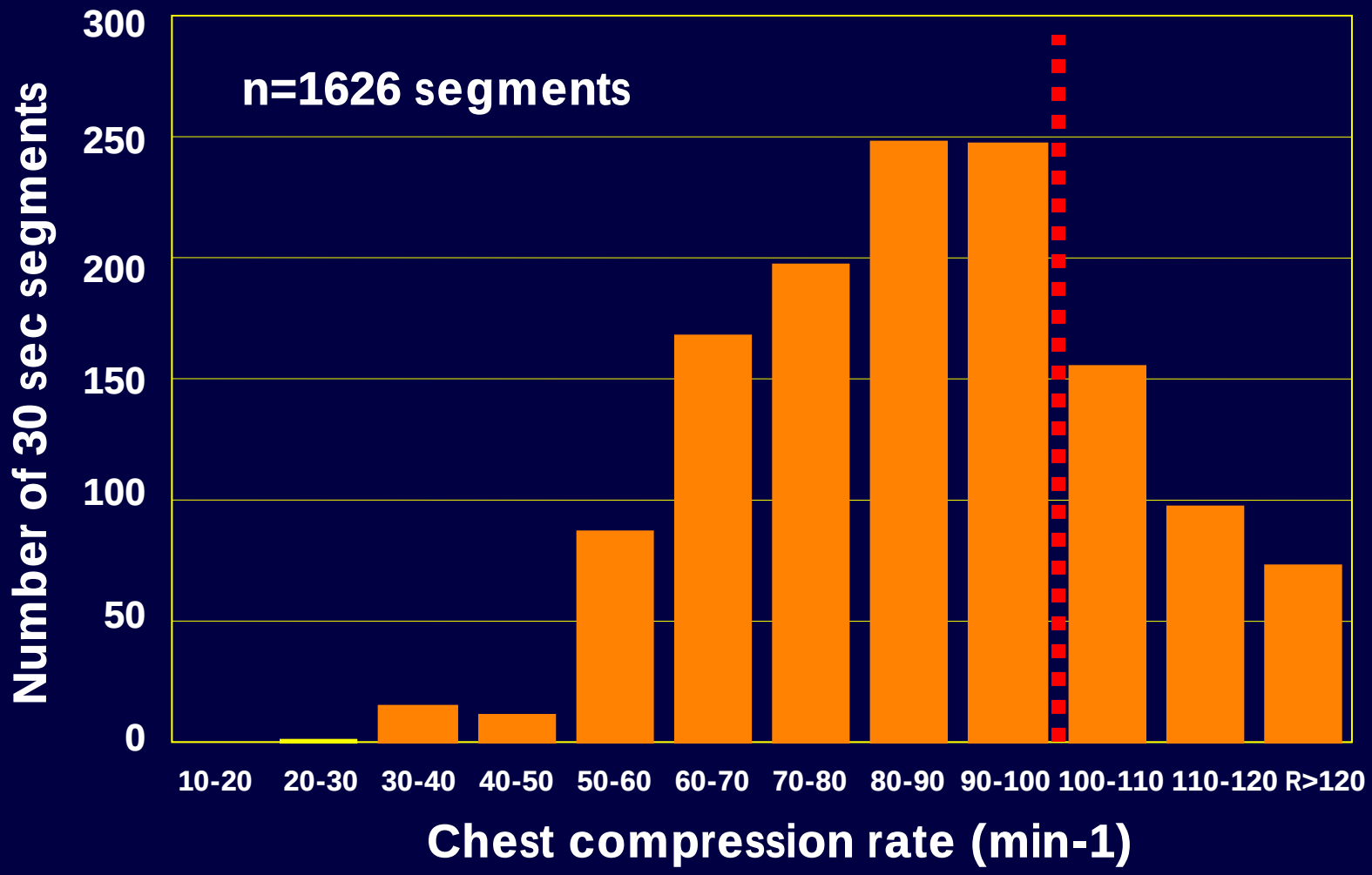
Benjamin S. Abella[a,*], Dana P. Edelson[b], Salem Kim[a], Elizabeth Retzer[c], Helge Myklebust[d], Anne M. Barry[c], Nicholas O'Hearn[e], Terry L. Vanden Hoek[c], Lance B. Becker[a]

***Abella, 2007***

# Actual arrest transcript: U of C, 2004

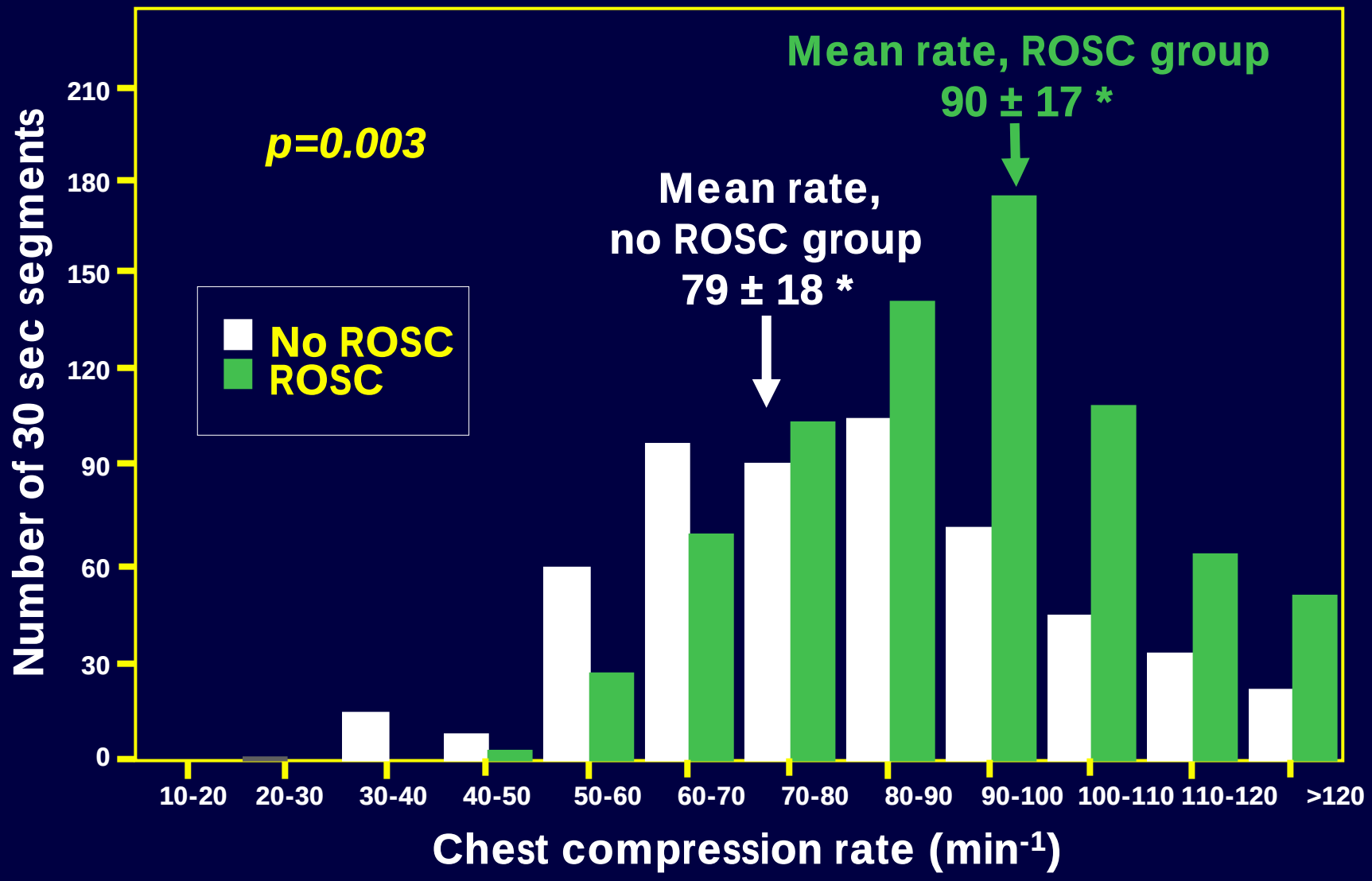


# Chest compression rates



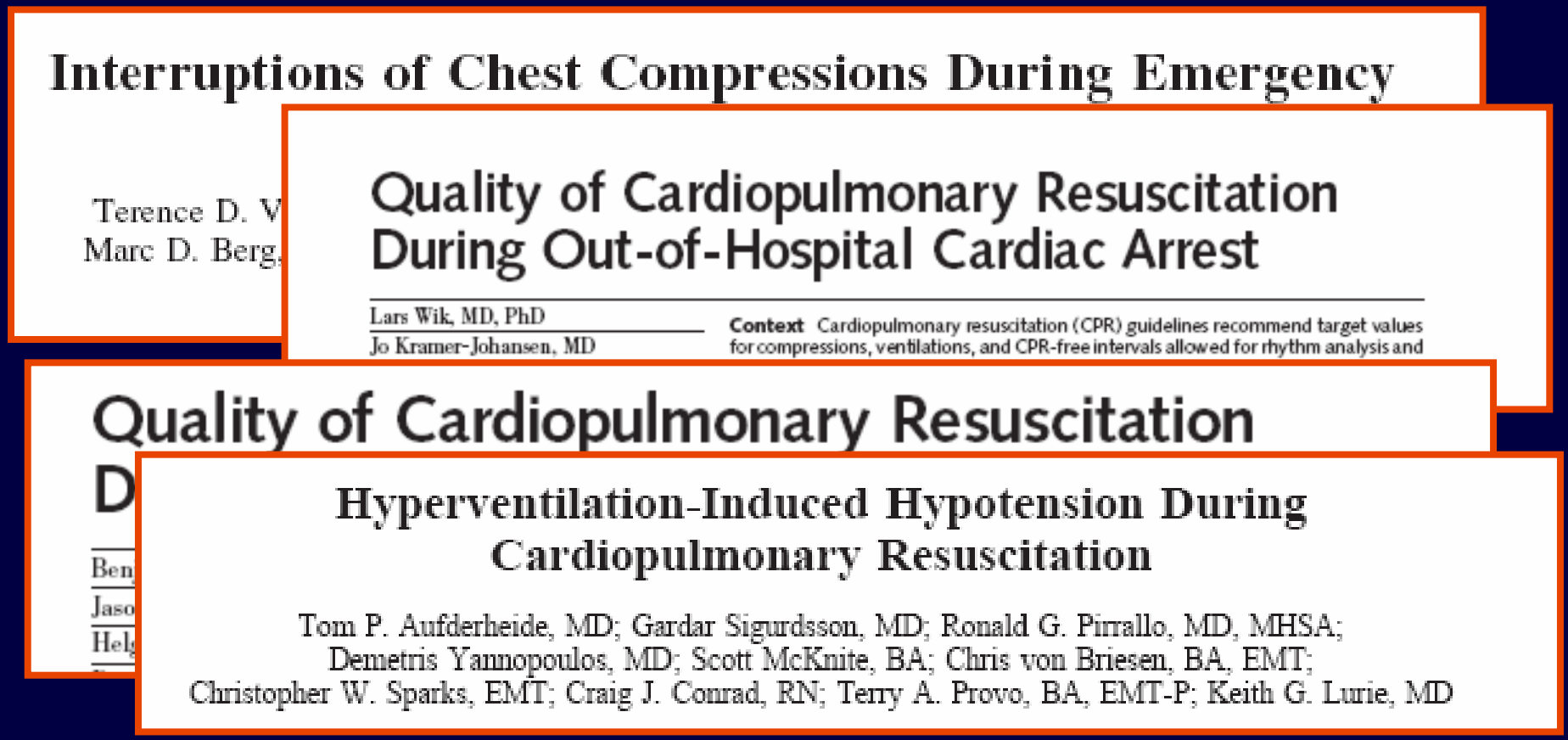

***Abella et al, 2005***

# Chest compression rates by survival



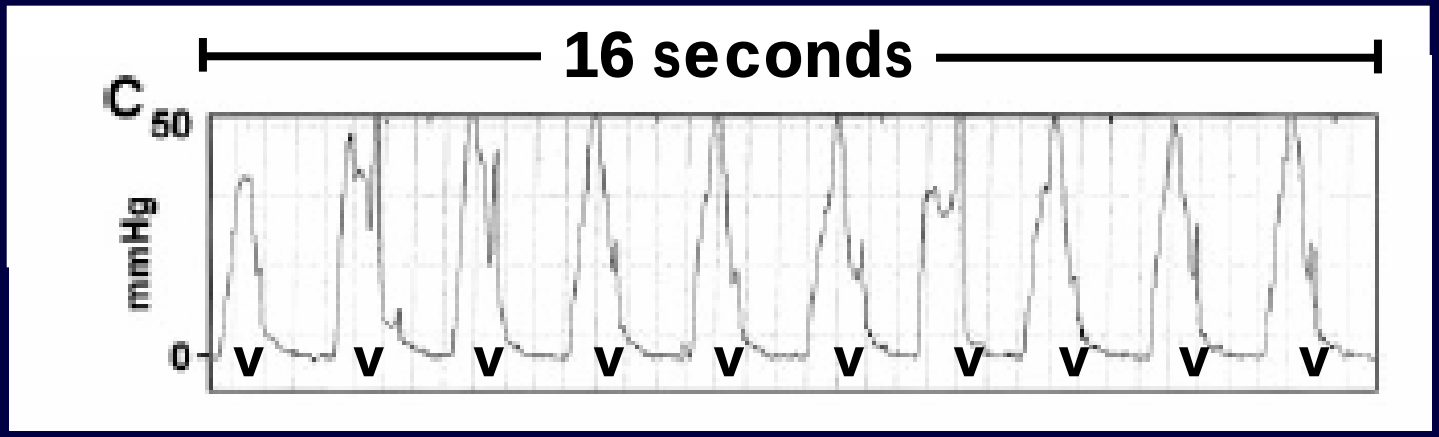

*Abella et al, 2005*

# CPR renaissance: measuring CPR




***Valenzuela et al, Circ 2005***
***Wik et al, JAMA 2005***
***Abella et al, JAMA 2005***
***Aufderheide et al,Circ 2004***

# Hyperventilation during EMS resuscitation

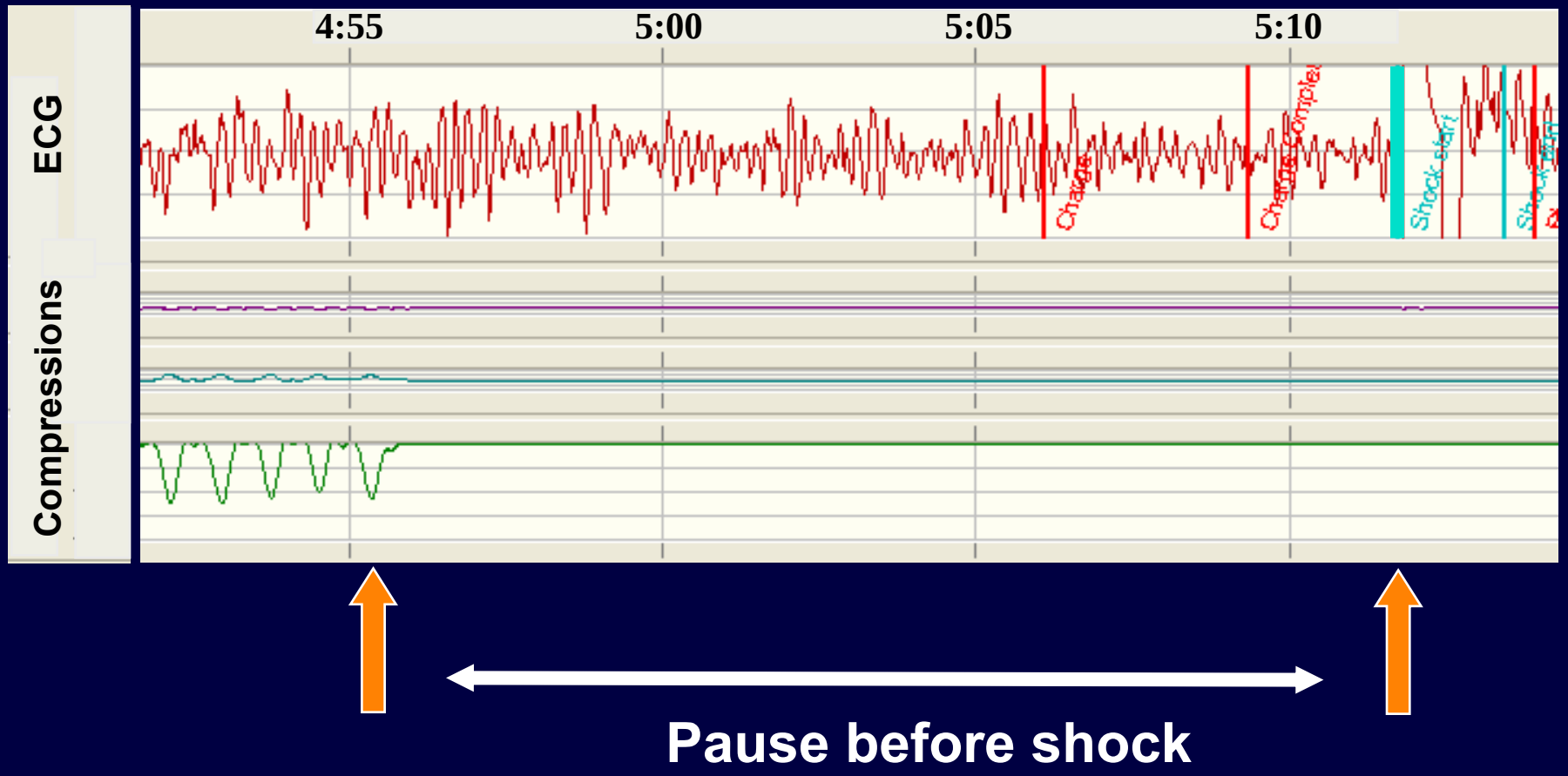



**mean ventilation rate: 30 ± 3.2**

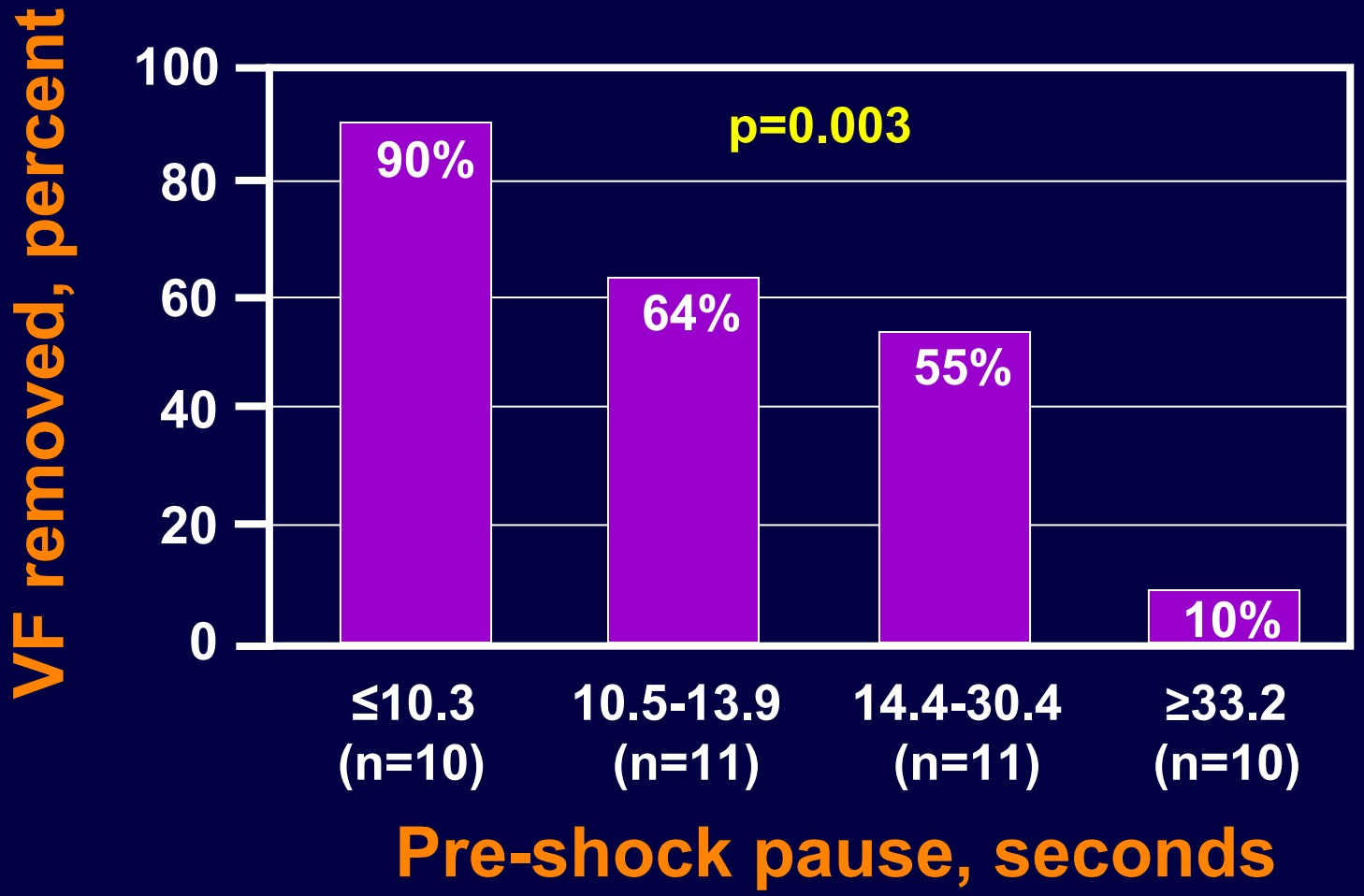
**first group: 37 ± 4** → **after retraining: 22 ± 3**

***Aufderheide et al, 2004***

# Chest compression pauses before shocks

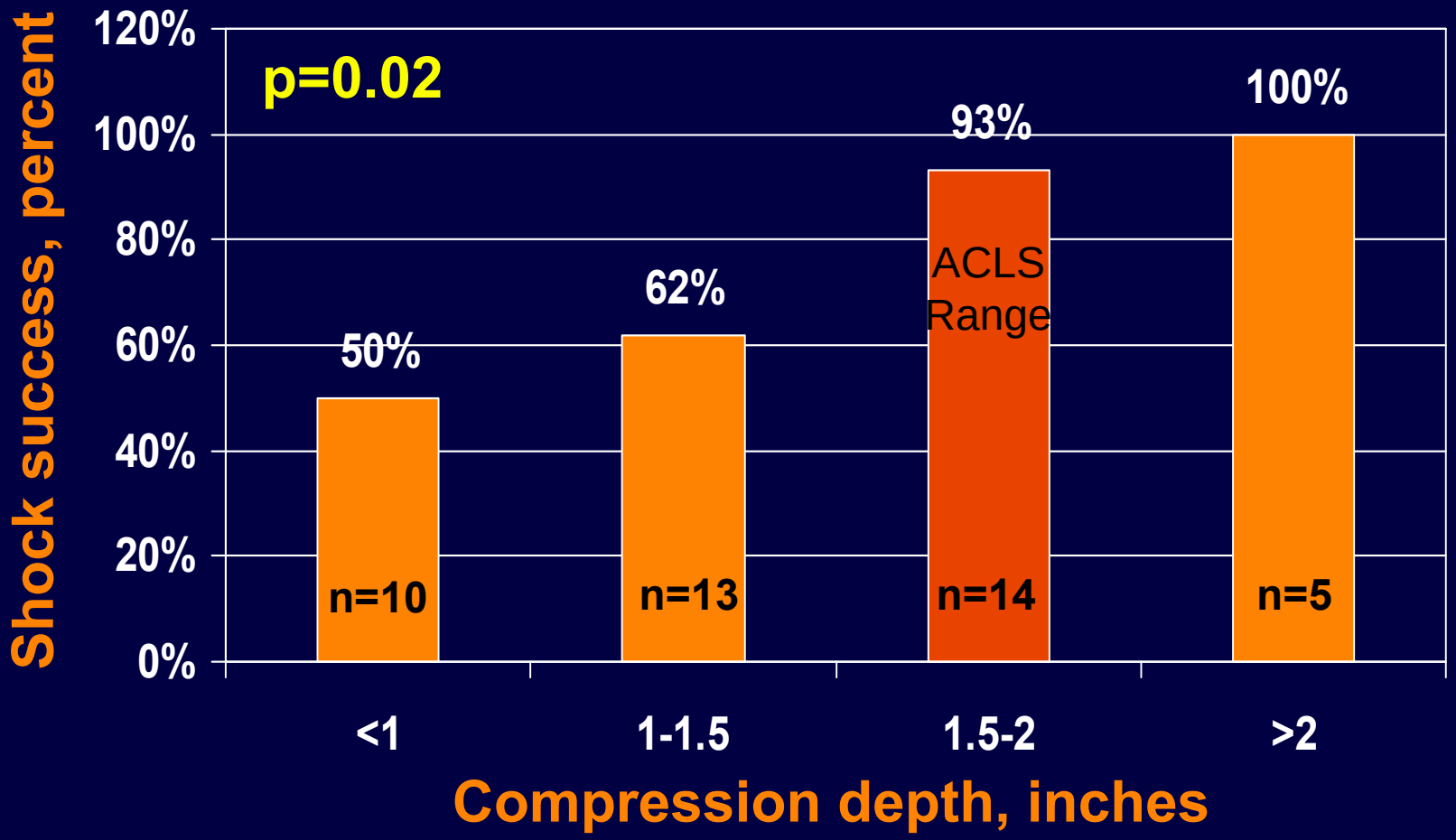


# Dose-effect of pre-shock pauses



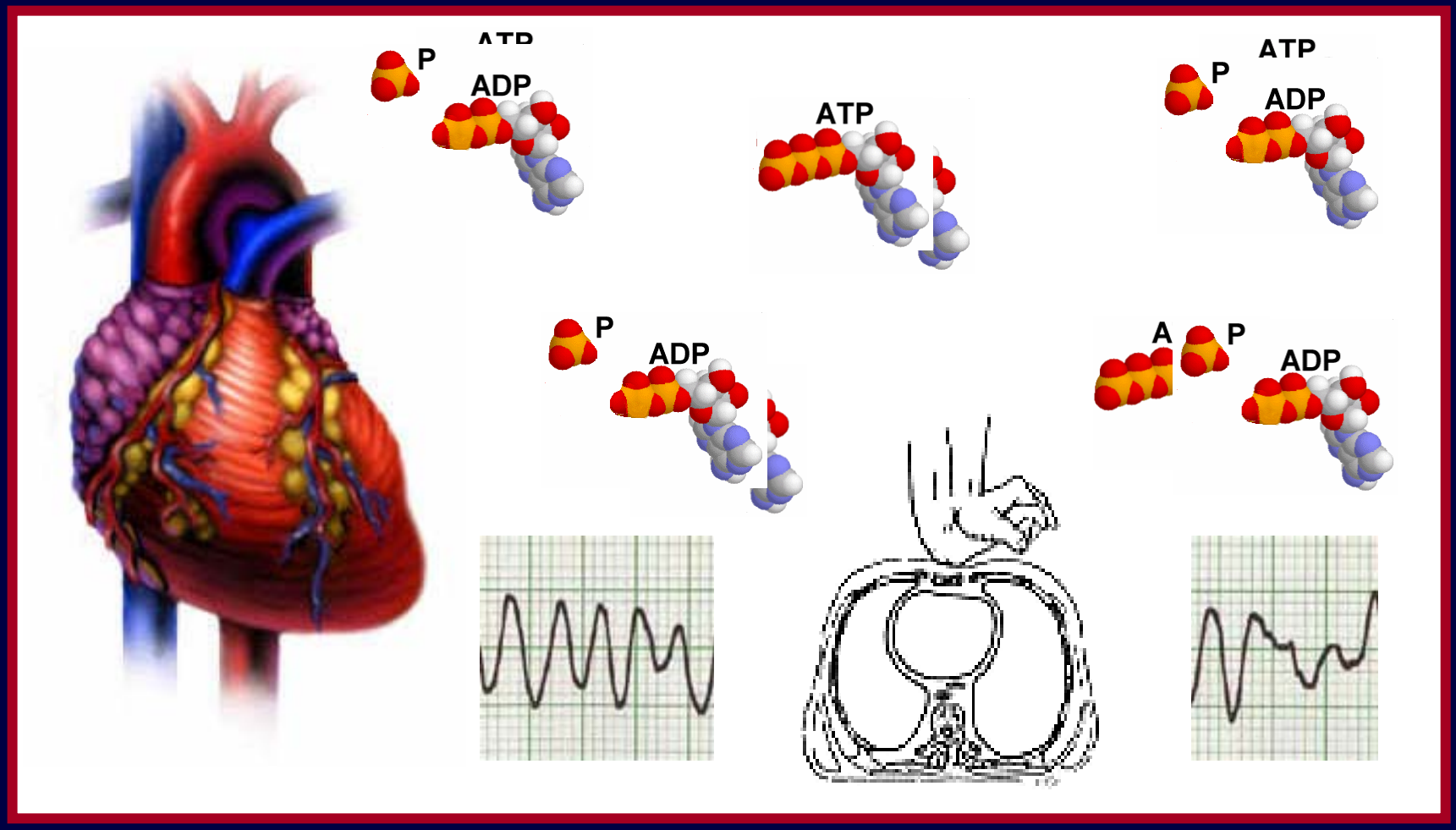

*Edelson et al, 2006*

# Shock success by compression depth




*Edelson et al, 2006*

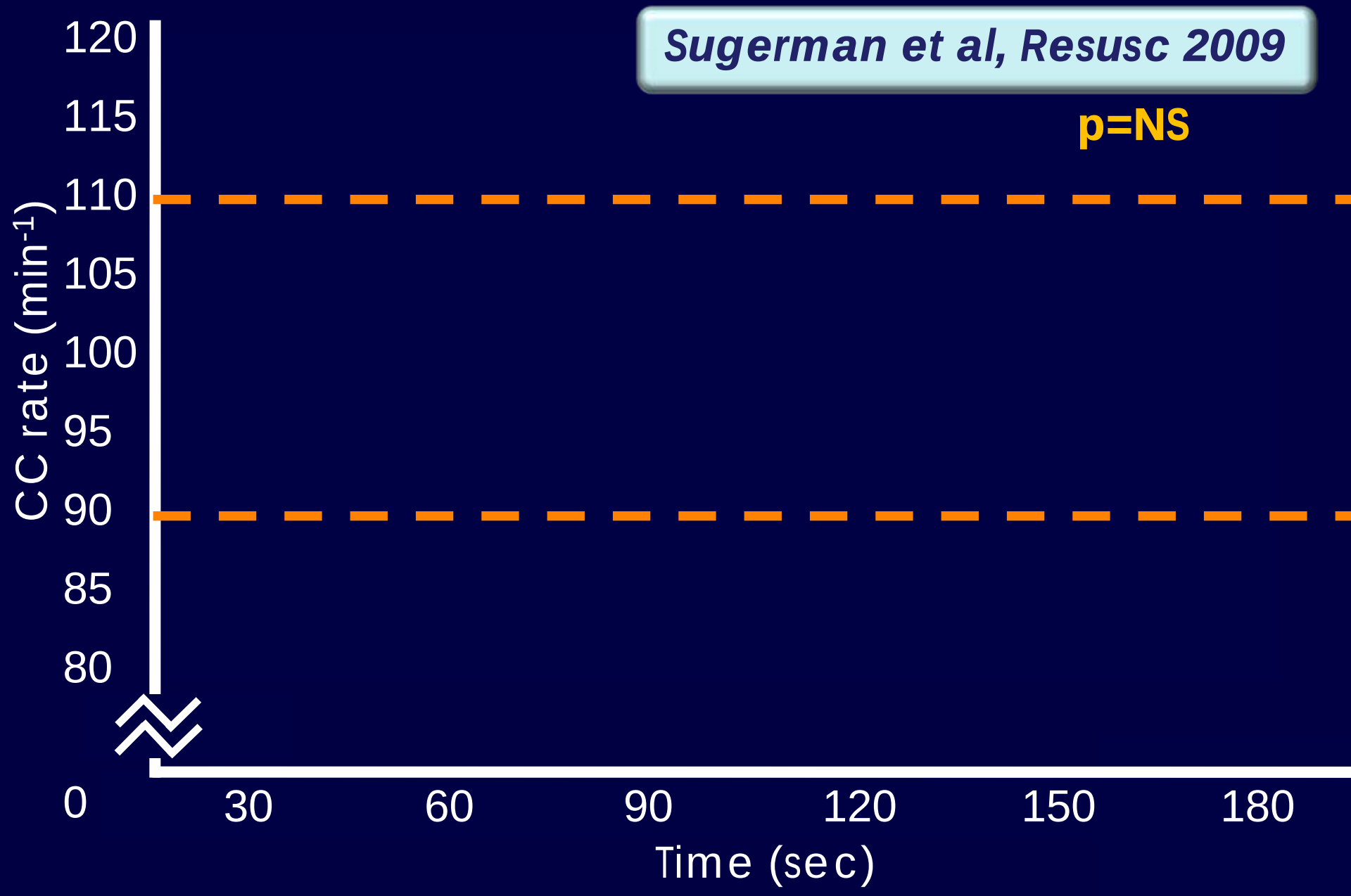
# Possible model underlying these data



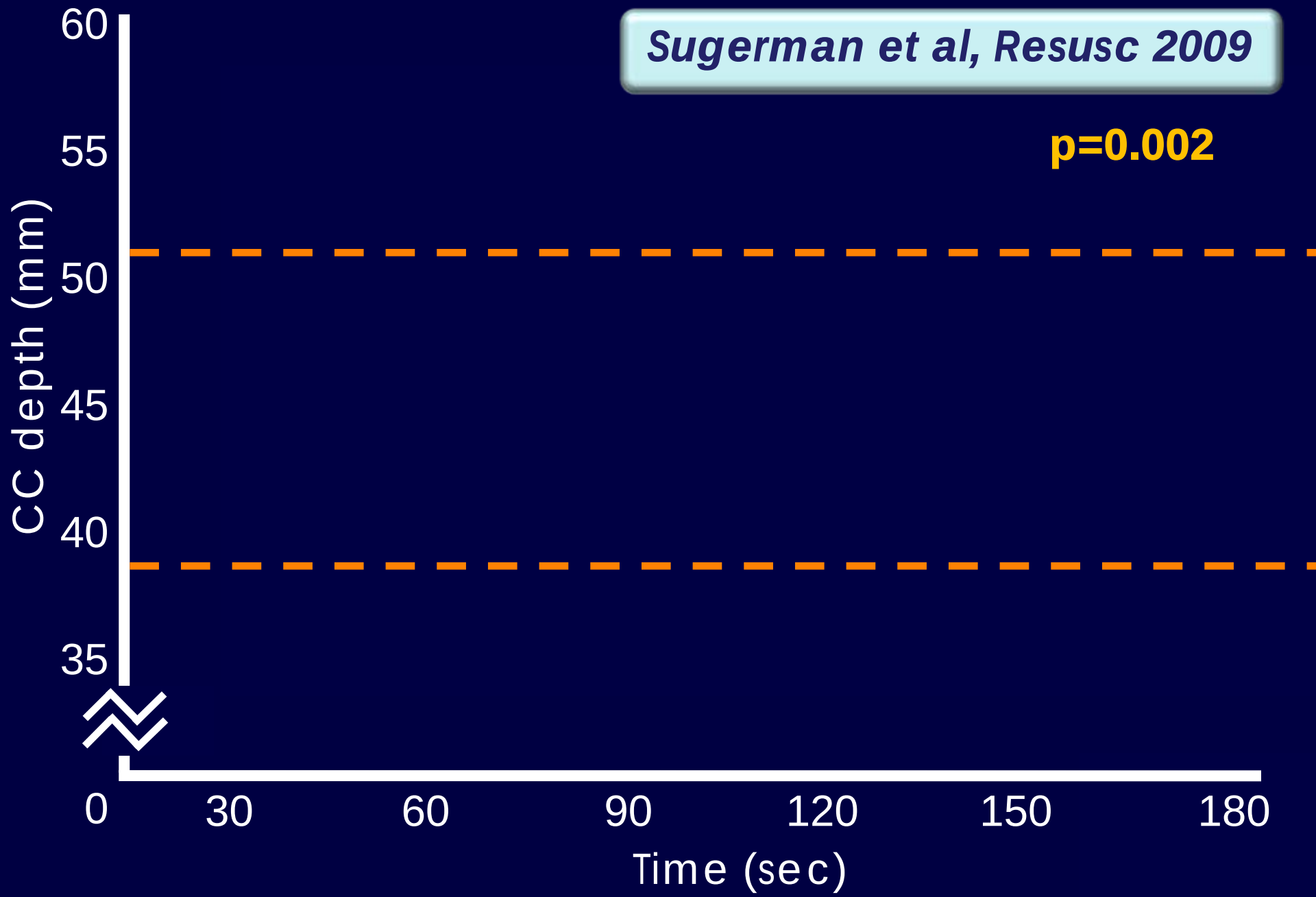
# Additional rescuer factor: fatigue


*May represent fatiguing*

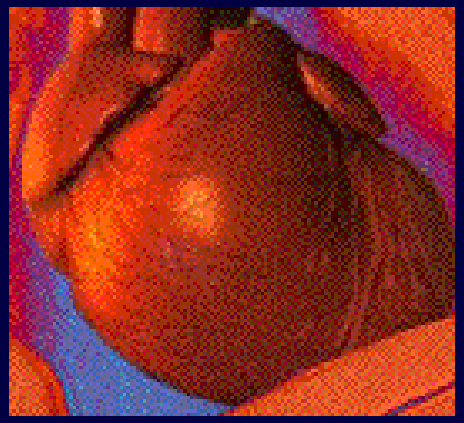
# Mean CC rate over consecutive 30 sec segments



# Mean CC depth over consecutive 30 sec segments



# Current CPR quality: summary



1. **Slow compression rates**
2. **Frequent and lengthy pauses**
3. **Shallow compressions**
4. **Hyperventilation**

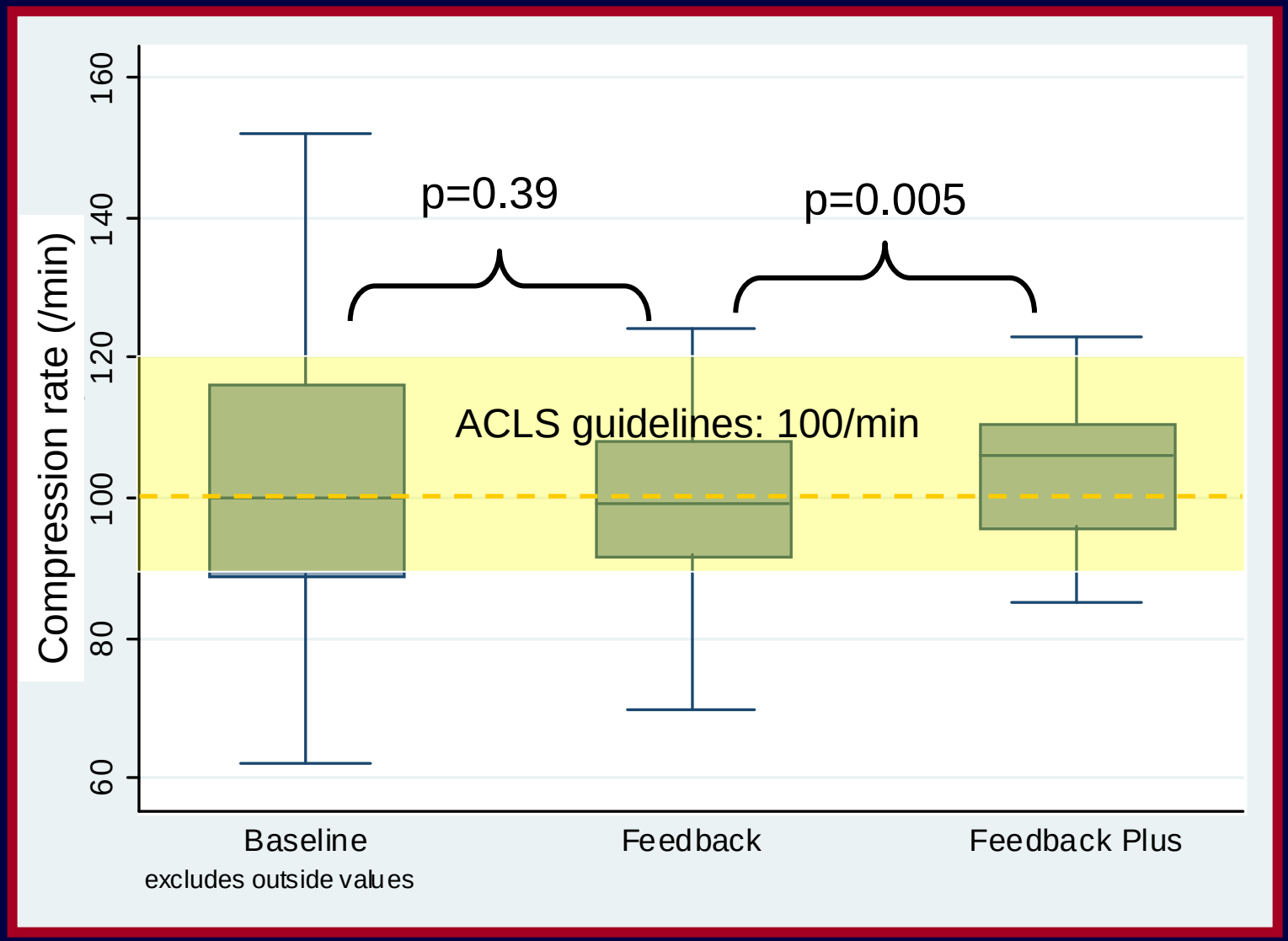
# The problem with cardiac arrest

# The military solution

# Debriefing intervention

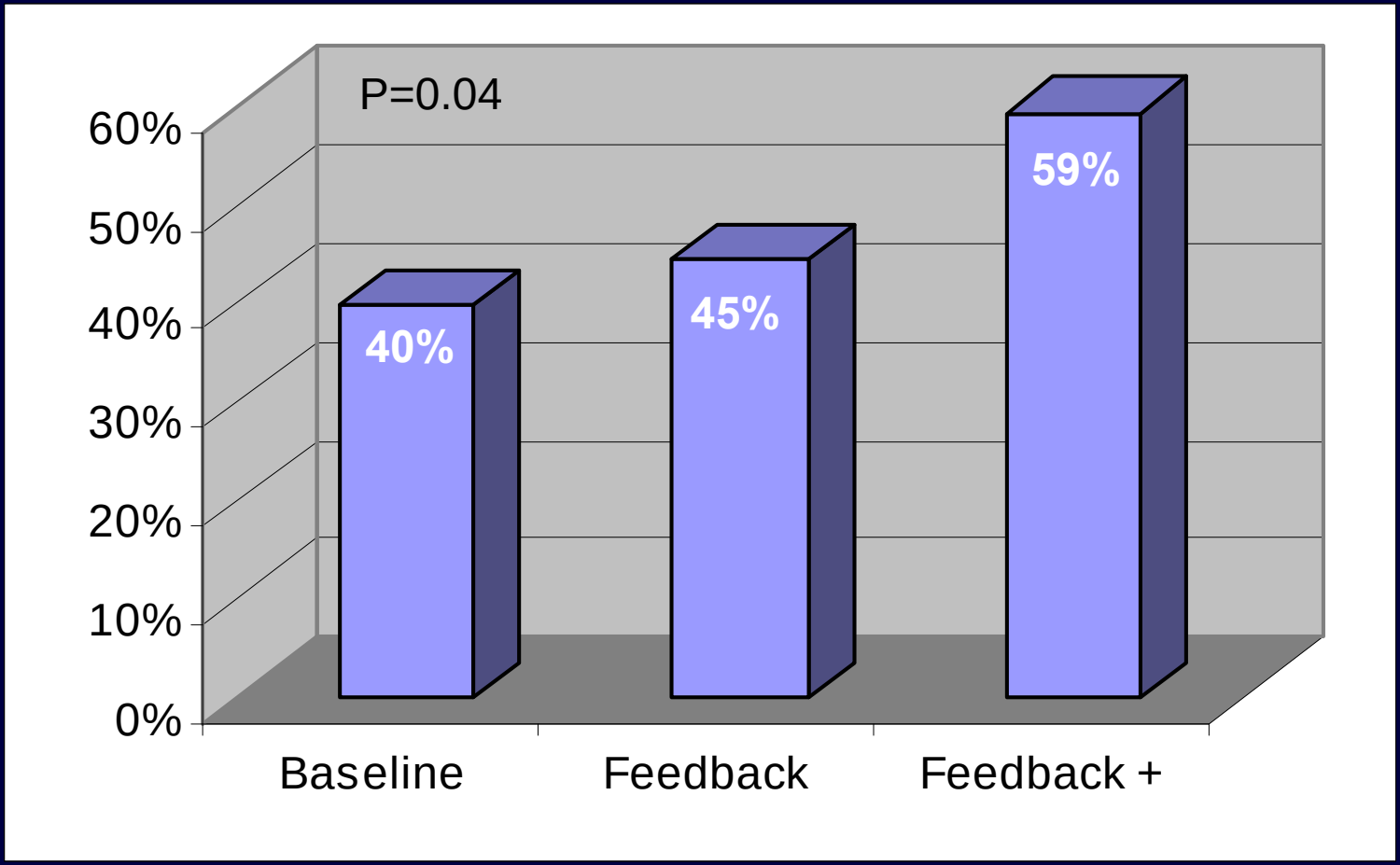
- Code review investigation:
  - All residents and students rotating through resuscitation team roles
  - Debrief teams on their events
  - Weekly 30-45 min resuscitation debriefing/teaching sessions

# Median compression rate by group




***Edelson et al, 2008***

# Return of spontaneous circulation




***Edelson et al, 2008***

***Training effect confirmed by Dine et al. 2008***

# Another approach: mock codes

**Simulation of In-Hospital Pediatric Medical Emergencies and Cardiopulmonary Arrests: Highlighting the Importance of the First 5 Minutes**

Elizabeth A. Hunt, MD, MPH[a,b,c,d], Allen R. Walker, MD, MBA[c,d], Donald H. Shaffner, MD[a,d], Marlene R. Miller, MD[c,d], Peter J. Pronovost, MD, PhD[a,d]

***Hunt et al, 2007***

Simulation on steroids → sudden and unannounced

Little experience or literature for this in ED setting or adult in-hospital environment

# CPR quality technologies

## Manual CPR support devices

Zoll AED, R series

Philips MRx

## Mechanical CPR devices


Zoll Autopulse

LUCAS

# Autopulse data

**Ong et al, 2006**

***Out-of-hospital, Richmond, VA (one site)***

| | Manual | Autopulse |
|---|---|---|
| ROSC | 101/499 (20.2%) | 96/278 (34.5%) |
| Admitted | 54/485 (11.1%) | 58/277 (20.9%) |
| D/C | 14/486 (2.9%) | 27/278 (9.7%) |

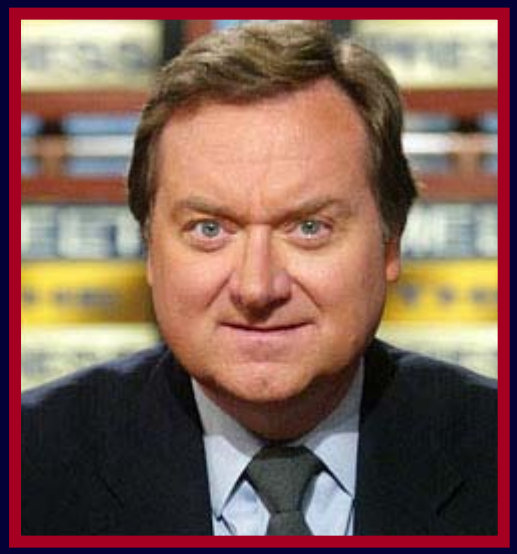
# Autopulse data: RCT

***Hallstrom et al, 2006 (ASPIRE)***

***Out-of-hospital, multicenter RCT – US, Canada***

| | Manual | Autopulse |
|---|---|---|
| ROSC | 92/373 (24.7%) | 104/394 (26.4%) |
| D/C | 37/373 (9.9%) | 23/394 (5.8%) |

# CPR in the workplace



***Friday, June 13, 2008***

**Tim Russert, TV correspondent**

**Known asymptomatic coronary dz**

**Suffered AMI → cardiac arrest**

**Attempted resuscitation (CPR and defibrillation) failed**

**Unknown CPR quality or pre-shock pause time**

# CPR in the home

***Friday, June 25, 2009***

**Michael Jackson died at home**

**Respiratory arrest from drug OD**

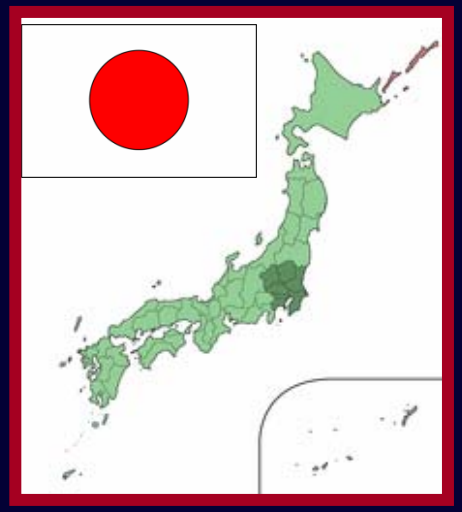
**Attempted resuscitation (CPR and defibrillation) failed**

**CPR performed in the bed – questionable quality, pauses in performance?**

# Full circle: chest compressions alone?

The New York Times

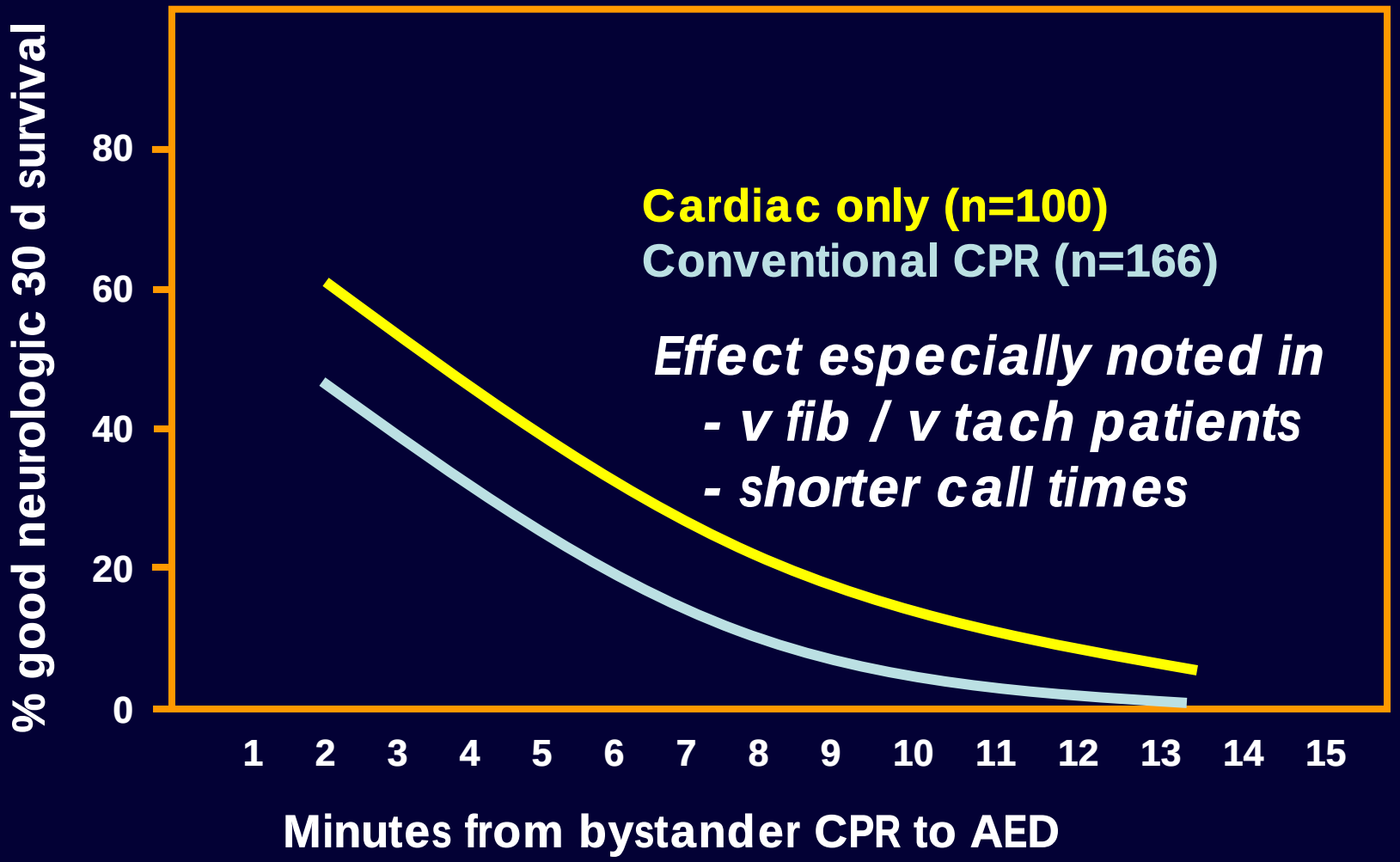
***March 17, 2007***



**Detailed study by Ken Nagao et al (Japan)**
**Evaluated "standard" CPR vs cc alone**

**Important to note:**
- **bystander CPR**
- **done in 2002-2003**
- **not randomized**
- **CPR unmeasured**

# Japanese bystander CPR study




*SOS-KANTO et al, 2007*

# Improving EMS care with "CC only"

## Minimally Interrupted Cardiac Resuscitation by Emergency Medical Services for Out-of-Hospital Cardiac Arrest

Bentley J. Bobrow, MD
Lani L. Clark, BS
Gordon A. Ewy, MD

**Context** Out-of-hospital cardiac arrest is a major public health problem.

**Objective** To investigate whether the survival of patients with out-of-hospital cardiac arrest would improve with minimally interrupted cardiac resuscitation (MICR), an

***Bobrow et al, 2008***

**Interventions:**

1. **Significantly delay intubation**
2. **200 compressions before first shock**
3. **Minimize pre and post shock pauses**

**Tripled survival to hospital discharge (3.8% → 9.1%)**

# Improving EMS care with "CC only"

Confirmation of this finding:

**Improved Patient Survival Using a Modified Resuscitation Protocol for Out-of-Hospital Cardiac Arrest**

Alex G. Garza, MD, MPH; Matthew C. Gratton, MD; Joseph A. Salomone, MD; Daniel Lindholm, EMTP, MICT; James McElroy, EMTP, MICT; Rex Archer, MD, MPH

***2009***

**Table 2. ROSC and Survivors, Witnessed VF Patient Population**

| | Preprotocol Cohort, n (%) | Postprotocol Cohort, n (%) | Unadjusted OR (95% CI) |
|---|---|---|---|
| Witnessed VF | 143 | 57 | NA |
| ROSC | 54 (37.8) | 34 (59.6) | 2.44 (1.24–4.80) |
| Discharge alive | 32 (22.4) | 25 (43.9) | 2.71 (1.34–5.49) |

OR indicates odds ratio; VF, ventricular fibrillation; and ROSC, return of spontaneous circulation.

# The key importance of CPR

Reflected in the poor impact of ACLS meds:

## Intravenous Drug Administration During Out-of-Hospital Cardiac Arrest

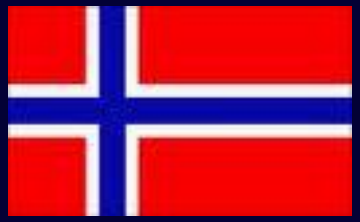
### A Randomized Trial

Theresa M. Olasveengen, MD
Kjetil Sunde, MD, PhD
Cathrine Brunborg, MSc
Jon Thowsen
Petter A. Steen, MD, PhD
Lars Wik, MD, PhD

**Context** Intravenous access and drug administration are included in advanced cardiac life support (ACLS) guidelines despite a lack of evidence for improved outcomes. Epinephrine was an independent predictor of poor outcome in a large epidemiological study, possibly due to toxicity of the drug or cardiopulmonary resuscitation (CPR) interruptions secondary to establishing an intravenous line and drug administration.

**Objective** To determine whether removing intravenous drug administration from an ACLS protocol would improve survival to hospital discharge after out-of-hospital cardiac arrest.

***2009***

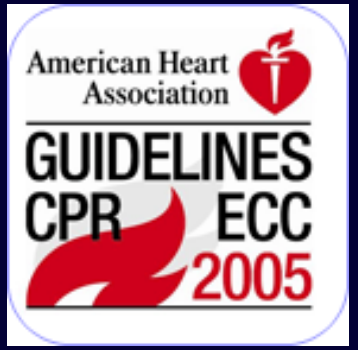


**Randomized trial of epinephrine versus no epinephrine**
**For EMS treated cardiac arrest → NO SURVIVAL BENEFIT!**

# Impact on CPR guidelines in future

**Next guidelines update: 2010**

**What might change:**




1. **Increasing emphasis on compression-only for both bystanders and dispatch-assisted**
2. **Improved techniques for dispatch assisted: video-phone? Simplified protocols?**
3. **Improved mechanical devices for EMS**

# Why this is so relevant

Residents feel unprepared and unsupervised as leaders of cardiac arrest teams in teaching hospitals: A survey of internal medicine residents

Chris W. Hayes, MD, MSc; Augustine Rhee, MD; Michael E. Detsky; Vicki R. Leblanc, PhD; Randy S. Wax, MD, MEd

**Critical Care Medicine, 2007**

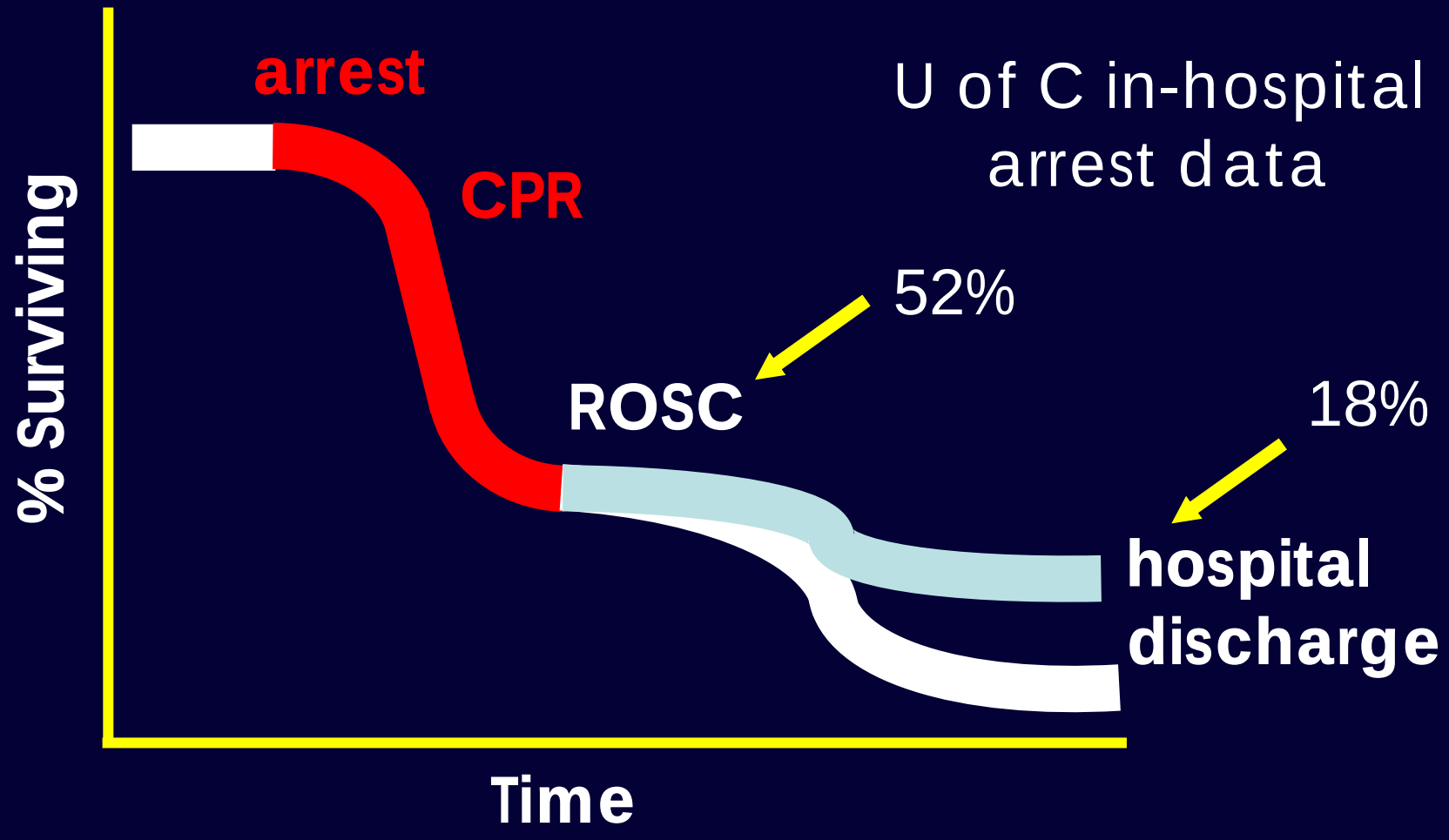
**Solutions --** **debriefing**
**simulation training**
**dedicated teams**

**Dine et al, 2008: similar survey in US, in progress**

# Key “take home” points

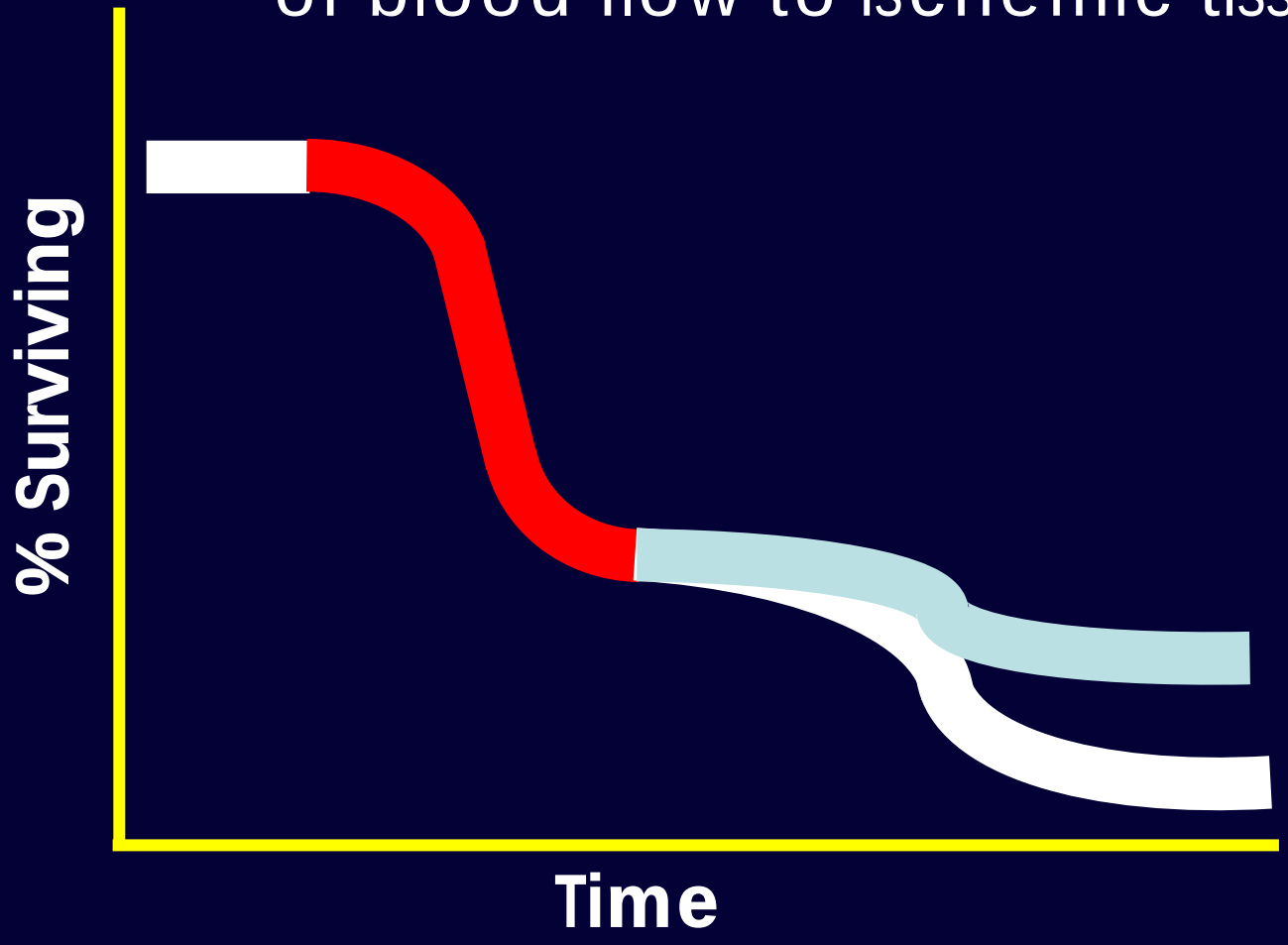
1. **Cardiac arrest is not hopeless!**
2. **CPR quality has big impact**
3. **Minimize ventilations**
4. **Maximize chest compression rate and depth**
5. **Consider CPR feedback tools and code debriefing**
6. **Use hypothermia after cardiac arrest**

# The post-arrest problem



# Reperfusion injury

Damage observed after restoration of blood flow to ischemic tissues



# Modern era of hypothermia use

The New England
Journal of Medicine



VOLUME 346 FEBRUARY 21, 2002 NUMBER 8

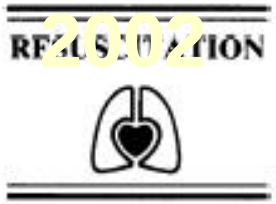
INDUCED HYPOTHERMIA AFTER OUT-OF-HOSPITAL CARDIAC ARREST

HACA, 2002

Bernard, 2002

Resuscitation 51 (2001) 275–281

Mild hypothermia induced by a helmet device: a clinical feasibility study



Said Hachimi-Idrissi *, Luc Corne, Guy Ebinger, Yvette Michotte, Luc Huyghens

*Department of Critical Care Medicine and Cerebral Resuscitation Research Group, AZ-VUB, Free University of Brussels, Laarbeeklaan, 101, B-1090, Brussels, Belgium*

Idrissi, 2001

# Hypothermia trials: outcomes

| | Hypothermia (%) | Normothermia (%) | RR (95% CI) | P value |
|---|---|---|---|---|
| ***Alive at hospital discharge with favourable neurological recovery*** | | | | |
| **HACA** | 72/136 (53%) | 50/137 (36%) | 1.51 (1.14-1.89) | 0.006 |
| **Bernard** | 21/43 (49%) | 9/34 (26%) | 1.75 (0.99-2.43) | 0.052 |
| **Idrissi** | 4/16 (25%) | 1/17 (6%) | 4.25 (0.70-53.83) | 0.16 |
| ***Alive at 6 months with favourable neurological recovery*** | | | | |
| **HACA** | 71/136 (52%) | 50/137 (36%) | 1.44 (1.11-1.76) | 0.009 |

# Real world usage: Switzerland

From evidence to clinical practice: Effective implementation of therapeutic hypothermia to improve patient outcome after cardiac arrest*

**2006**

Mauro Oddo, MD; Marie-Denise Schaller, MD; François Feihl, MD; Vincent Ribordy, MD; Lucas Liaudet, MD

*Oddo M et al, 2006*

Retrospective study at one hospital in Switzerland

Cooling intervention with historical controls

Survivors of out-of-hospital arrest (n=109)

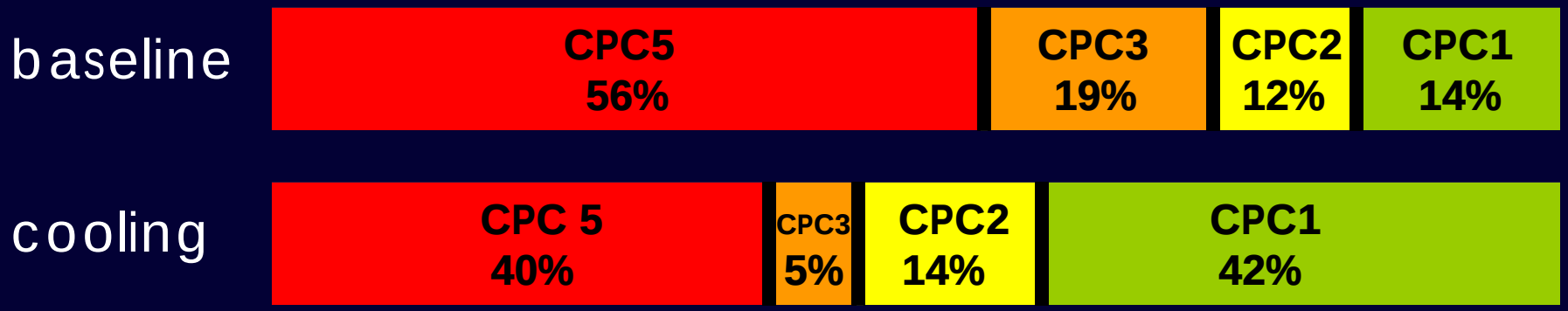
Cooling initially via ice bags, then cooling mattress

Target temperature 33°C, maintained for 24 hrs

All post-arrest ST elevations received cardiac cath

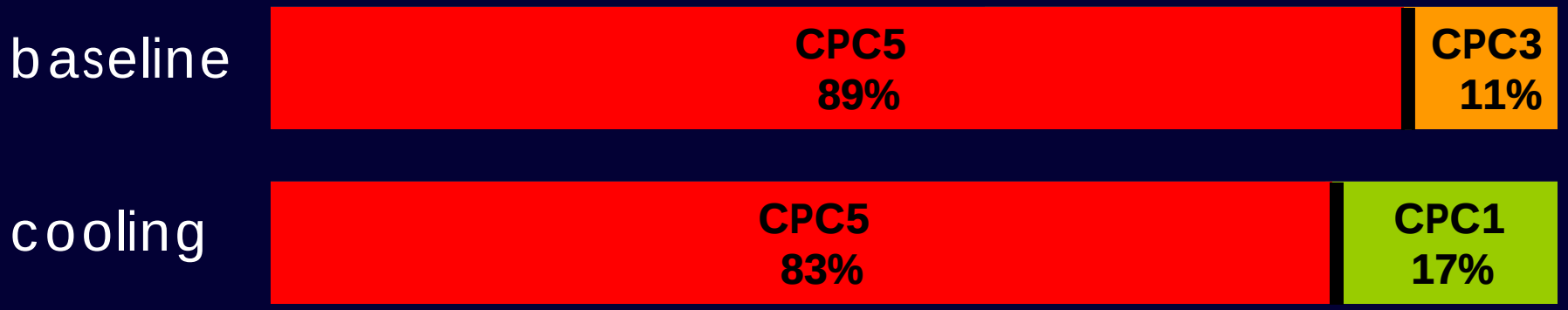
# Real world usage: Switzerland

Outcome at discharge for out-of-hospital VF arrest



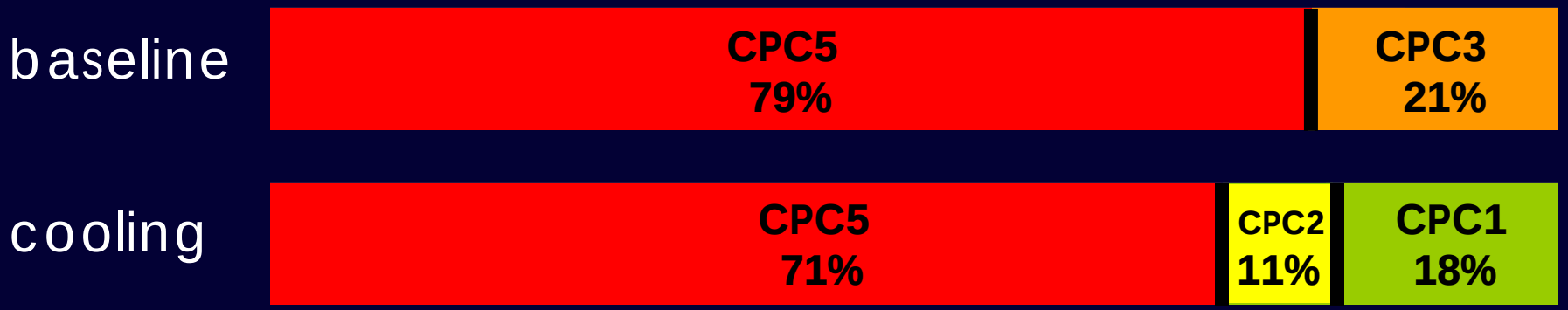
# Real world usage: Switzerland

Outcome at discharge for out-of-hospital asystole arrest



# Real world usage: Switzerland

Outcome at discharge for all rhythms with post-arrest hypotension and shock



# Hypothermia resource website

Penn Medicine

Therapeutic Hypothermia
Center for Resuscitation Science
University of Pennsylvania

Last updated on November 1, 2006

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Hypothermia Discussion Forum

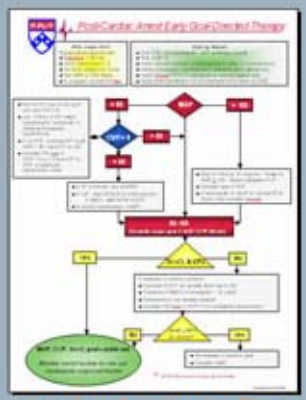
## Welcome

These pages are intended for use by physicians, nurses and other health care professionals who are interested in the care of patients after they are resuscitated from cardiac arrest. While Advanced Cardiopulmonary Life Support (ACLS) guidelines provide consensus information on the recognition and treatment of cardiac arrest in the form of "links" in the "chain of survival", the care of patients after resuscitation remains a "missing link". It is hoped that these pages will contribute towards filling this void.

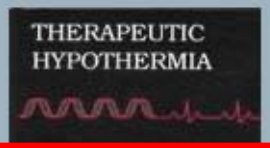
At the present time, the most important specific treatment for a patient surviving cardiac arrest may be the induction of therapeutic hypothermia. A number of animal and clinical studies have supported the use of this treatment, and international guidelines have been published regarding the use of this exciting new modality.

The majority of content on these resource pages focus on therapeutic hypothermia and practical issues of how hospitals can develop protocols for use.

FEATURED THIS WEEK



View hypothermia algorithm>




**www.med.upenn.edu/resuscitation/Hypothermia.htm**

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# Questions?