The Science of CPR
Update from AHA 2010

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Conflicts of Interest

- Sadly, I have no financial or industrial conflicts of interest to disclose.
- Off label discussion: Induced Hypothermia

CPR

EASY TO BE PESSIMISTIC

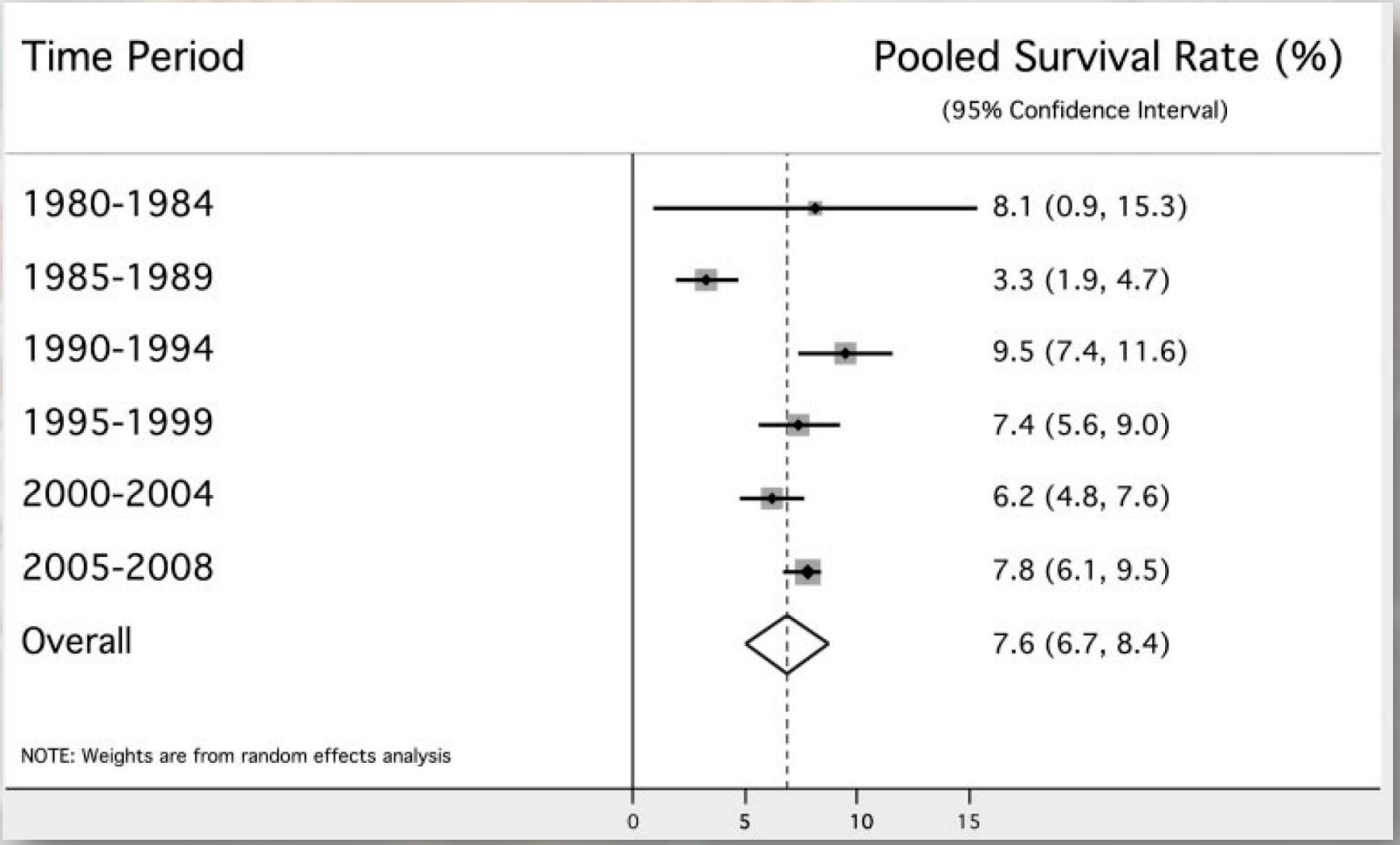
"CPR portrayals are two to five times more successful than real-life situations."

FRAMING THE DISCUSSION

NO ONE SURVIVES CARDIAC ARREST, EXCEPT ON TV

OHCA survival to hospital discharge by 5-year time periods n = 141,581

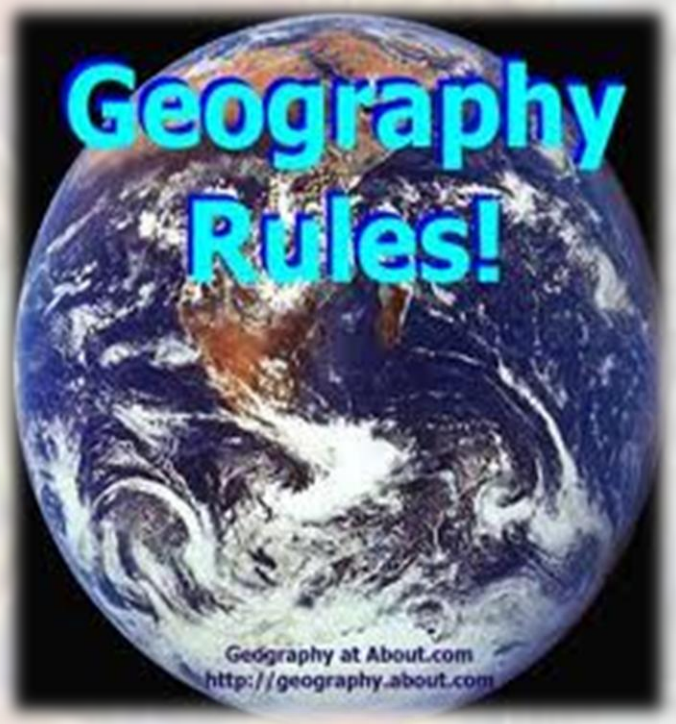
Overall 7.6%



Circ Cardiovasc Qual Outcomes. 2010;3:63-81

Geography

WHAT GIVES YOU THE BEST CHANCE OF SURVIVAL?


Geography
Rules!
Geography at About.com
http://geography.about.com

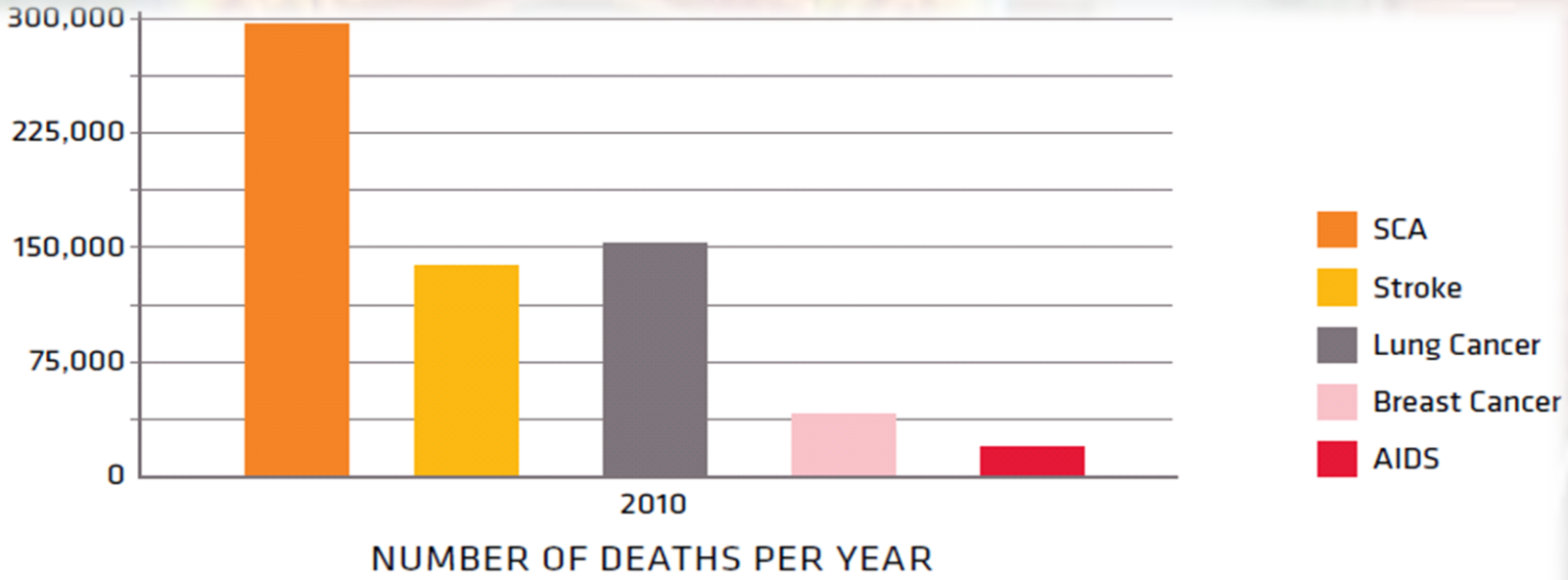
Si's First Rule of Resuscitation

Live Where You Have a Better Chance of Survival

Out-of-Hospital-Cardiac Arrest

SCOPE OF THE CPR PROBLEM

Sudden Cardiac Arrest



1. American Heart Association. Heart Disease and Stroke Statistics—2010 Update.
2. Jemal A, Siegel R, Xu J, et al. Cancer statistics, 2010. CA Cancer J Clin. 2010 Jul 7. [Epub ahead of print]
3. Centers for Disease Control. HIV prevalence estimates—United States, 2006. MMWR 57(39), 3 October 2008.

Out-of-Hospital-Cardiac Arrest

WHY ARE WE FAILING?

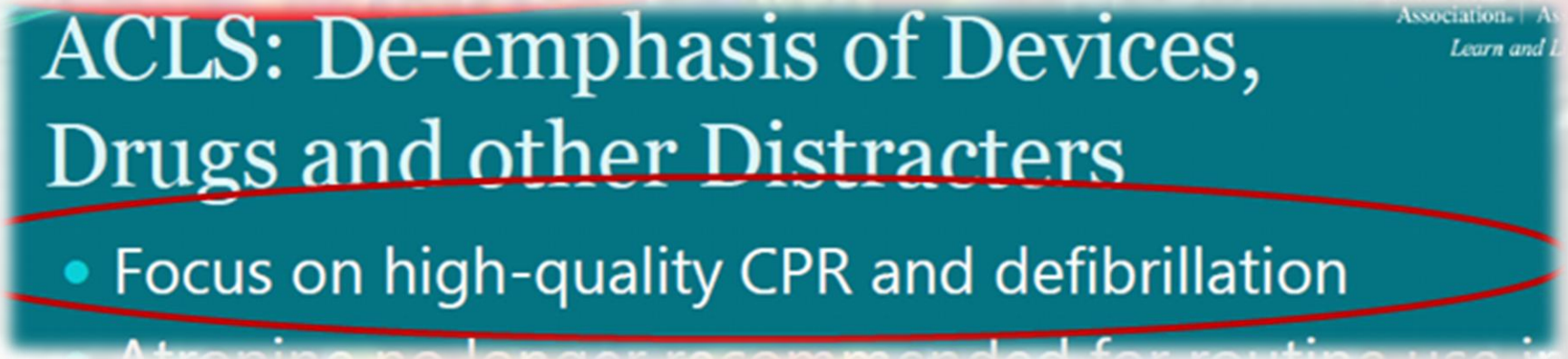
Why are we failing?

- Airway
- Breathing
- Circulation
- Technology
- Transport

Out-of-Hospital-Cardiac Arrest

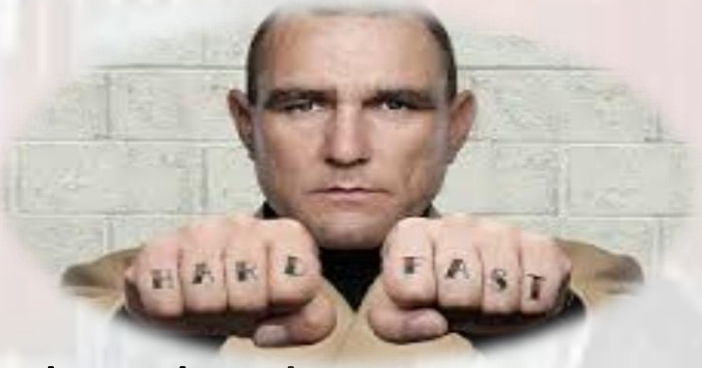
SCIENCE BEHIND CPR

HIGH QUALITY CPR



PREHOSPITAL HIGH QUALITY CPR

- Goal: High quality means continuous chest compressions with *<u>limited</u> interruptions*
  - Rate: 100 – 120/min
  - Depth: 2 inches
  - Allow for complete chest recoil
  - Change every 2 minutes with pulse check
    - not to exceed 5 seconds
  - Address airway 2 cycles unless indicated earlier

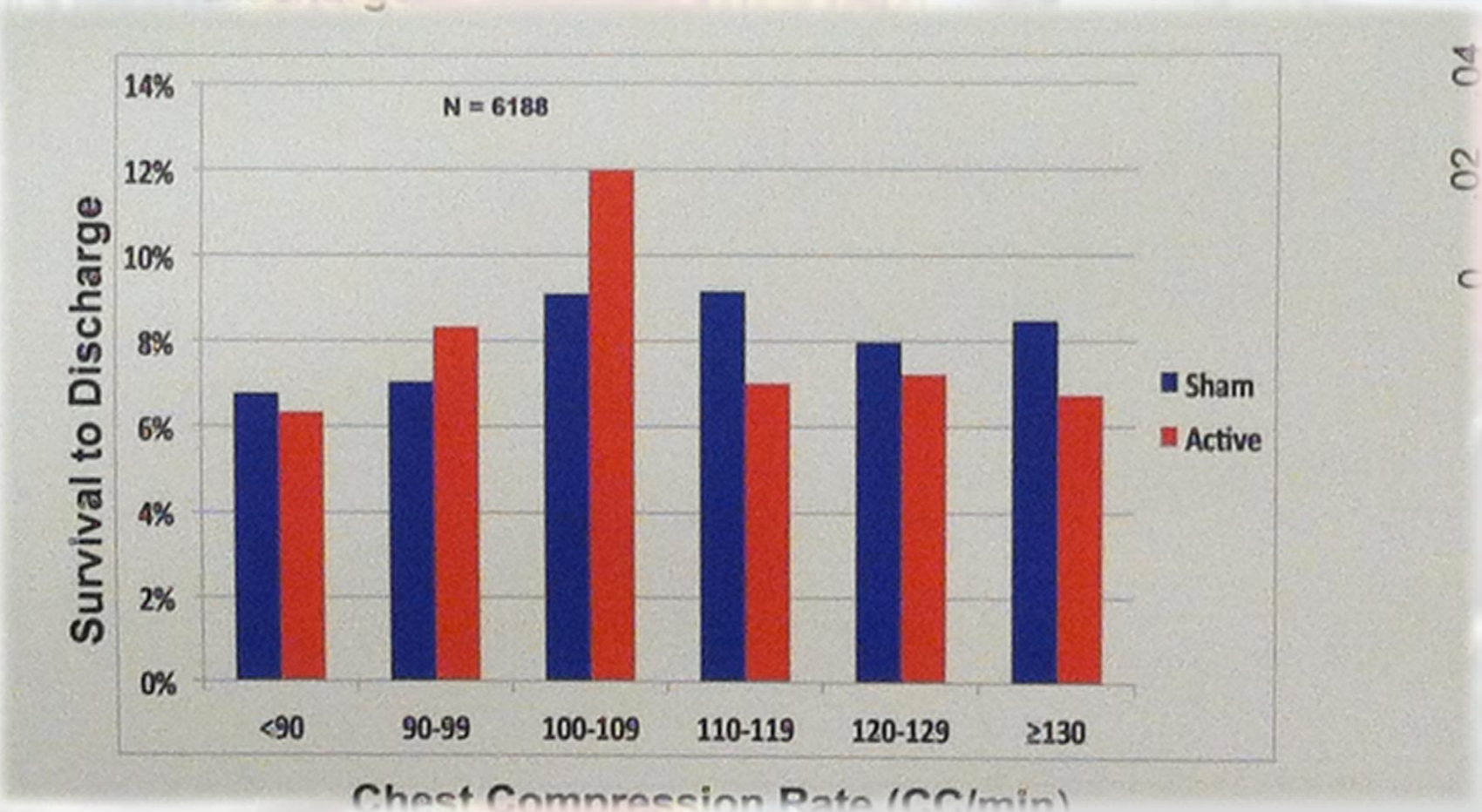


Why 100 – 120 Rate?

- Study measured rates from 2005 – 2007
- 3098 patients enrolled
- Mean compression rate 112
- ROSC peaked at 120
- ROSC declined markedly < 75
  - In this study ROSC not associated with hospital discharge

Idris AH et al. Relationship between chest compression rates and outcomes from cardiac arrest. Circulation 2012 Jun 19; 125:3004.

Why 100 – 120 Rate?



Chest Compression Fraction & Survival

Graph shows survival as it relates to chest compression fraction:

- Move from lower levels of CCF to intermediate has significant benefit
- Supports evidence that increasing pre-shock coronary and cerebral blood flow can improve outcomes

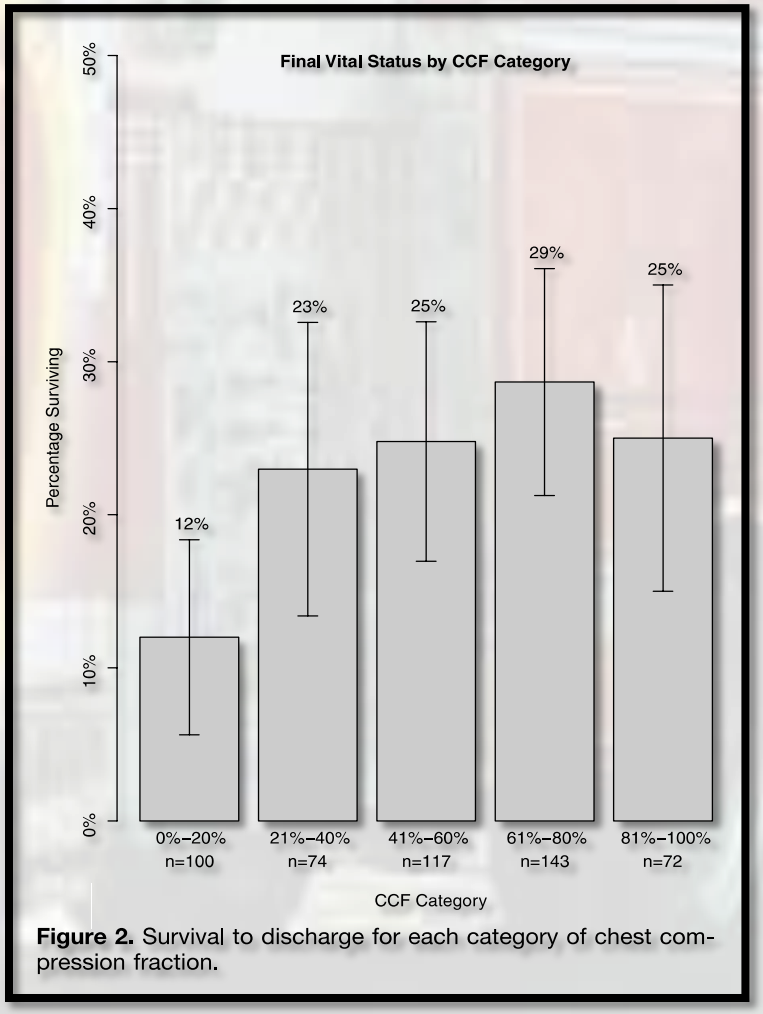


Figure 2. Survival to discharge for each category of chest compression fraction.

Increased chest compression fraction is independently predictive of better survival

Depth and Speed Matter

- ROC Study
- 1029 Adult patients including 58 EMS agencies
- Median compression rate is 106
- Median compression depth is 37.5 mm
- 53 % with compression depth < 38 mm
- 92 % with compression depth < 50 mm
  - Faster compression rate = less depth
- Survival improved with depth > 38 mm

Stiell IG et al. What is the role of chest compression depth during out-of-hospital cardiac arrest resuscitation? Crit Care Med 2012 Jan 5

Why 2 Minutes?

- 45 Providers, single rescuer CPR – 10 minutes
- Child and Adult manikins with AV feedback
- Mean compression rate remained > 100
- Adequate compressions
  - Fell from 85 % to < 40 % over 10 minutes
  - < 70 % after 90 seconds in child
  - < 70 % after 120 seconds in adult
- Self reported fatigue low by 2 minutes

Badaki-Makun O et al. Chest compression quality over time in pediatric resuscitations. Pediatrics 2013 Mar; 131:e797.

Si's First Rule of Resuscitation

Pump Hard and Fast Jack

See things in a new way so you can

GET (RE)STOKED

Dogma

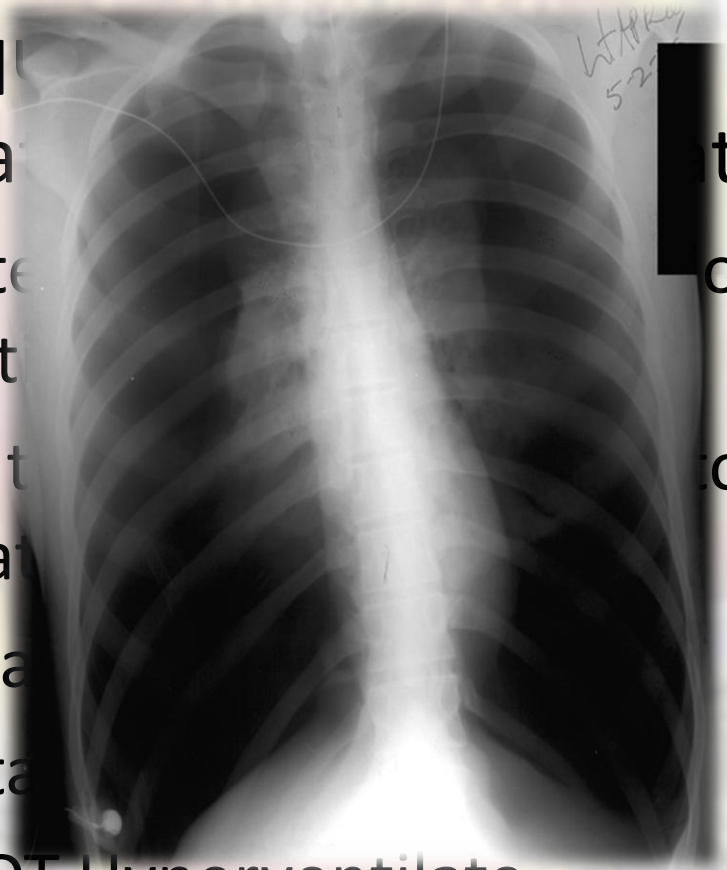
WHY CAN'T WE LET GO OF THE AIRWAY

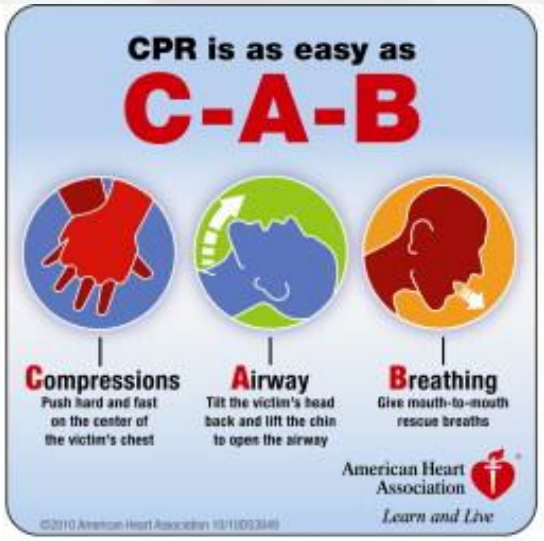

One, two three, BREATHE
He's dead, Jim

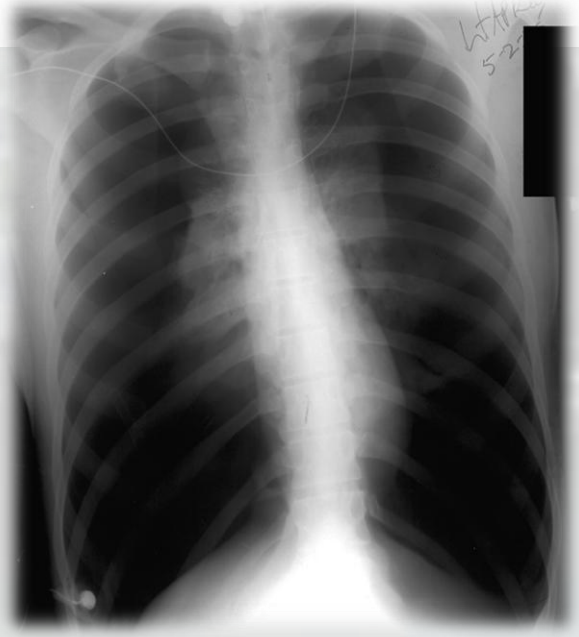
PREHOSPITAL HIGH QUALITY VENTILATIONS

Goal: High q… hyperventila…tion

- Don't inte…on for insert…
  - Adult t…o de-satura…
  - Ventila…
  - Mainta…
  - Do NOT Hyperventilate

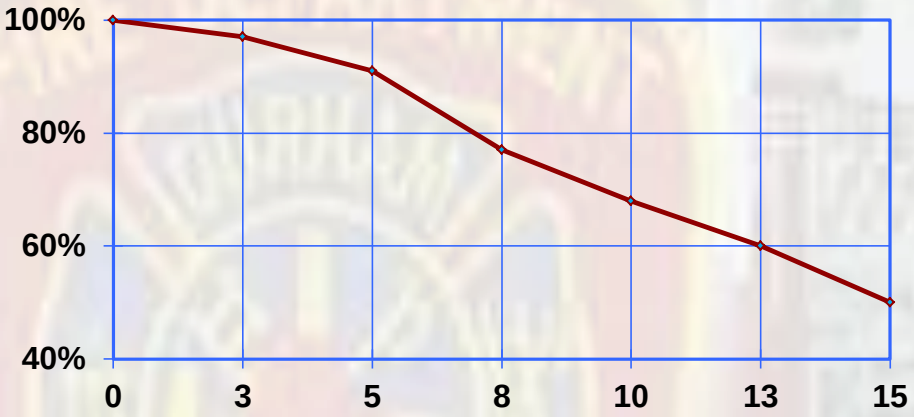




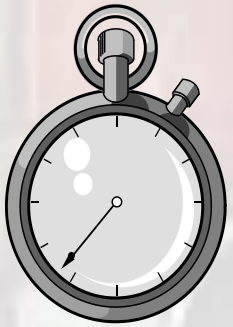


PREHOSPITAL HIGH QUALITY VENTILATIONS

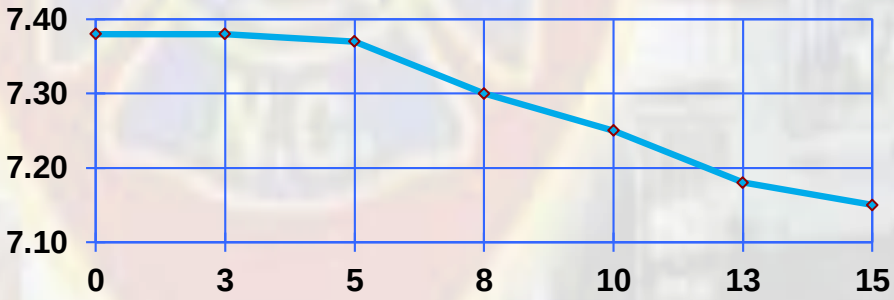
Oxygen Saturation



min



Arterial pH



min

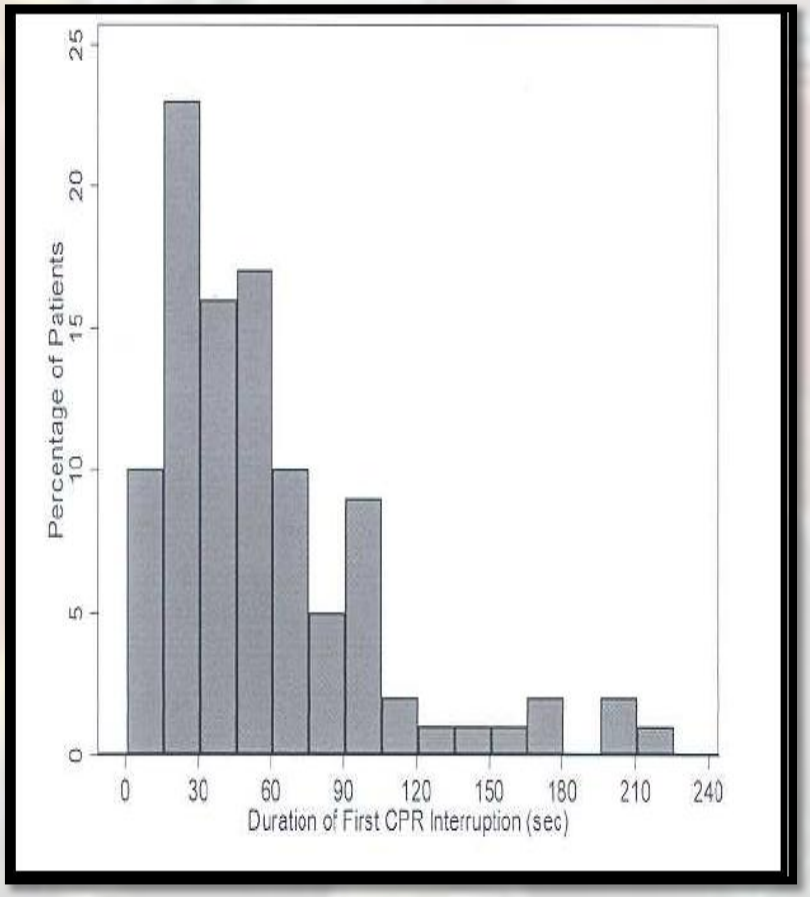
Advanced Airway Placement

Interruptions in CCC

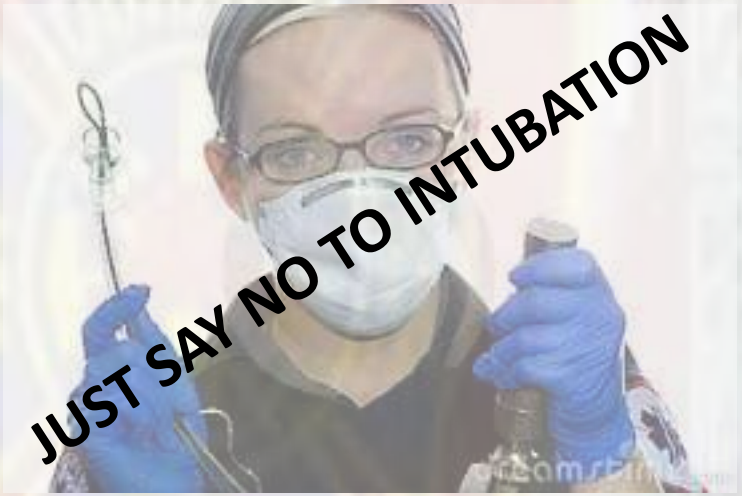
- 100 cases reviewed
- Median 2 intubation attempts

- Median duration of interruption for 1st attempt = **46.5 sec**.

- Median total interruptions for all attempts = **109.5 sec**



Interruptions in Cardiopulmonary Resuscitation From Paramedic Endotracheal Intubation (WANG 2009)


JUST SAY NO TO INTUBATION

Why De-emphasis of Airway?

- Nationwide Japanese Registry 649,654
- ETT or BIAD Good Neurological Outcome 1 %
- BVM Good Neurological Outcome 3 %

Kohei Hasegawa, MD, MPH; Atsushi Hiraide, MD, PhD; Yuchiao Chang, PhD; David F. M. Brown, MD JAMA. 2013;309(3):257-266. doi:10.1001/jama.2012.187612.

Why De-emphasis of Airway?

- 170 Post-arrest patients with hypothermia
- 45 % survived to hospital discharge
- Survivors had lower median PaO2 198 mmHg
  - Nonsurvivors PaO2 254 mmHg
- Good neurological outcome 197 mmHg
  - Poor neurological outcome 247 mmHg
- Increased oxygen in first 24 hours
  - 1.5 times more likely to have poor outcome

Janz DR et al. Hyperoxia is associated with increased mortality in patients treated with mild therapeutic hypothermia after sudden cardiac arrest. *Crit Care Med* 2012 Dec; 40:3135.

Si's First Rule of Resuscitation

Forget about the airway initially…Jack

Easy

DEFIBRILLATION

Perishock Pause

Independent Predictor of Survival

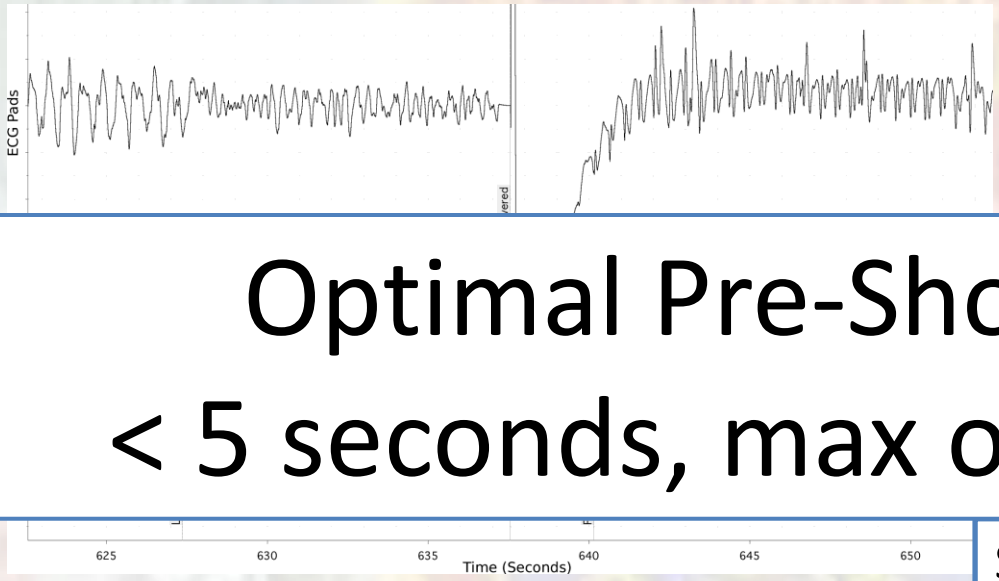


Figure 1. Diagram of preshock, postshock, and perishock pause. Preshock pause of 10 seconds, postshock pause of 2.3 seconds and perishock pause of 12.3 seconds depicted in the impedance channel of the cardiopulmonary resuscitation process file.

Perishock Pause = interruption in chest compressions before and after defibrillatory shock

Optimal Pre-Shock Pause:
< 5 seconds, max of 10 seconds

Resuscitation Science

Perishock Pause

An Independent Predictor of Survival From Out-of-Hospital Shockable Cardiac Arrest

Sheldon Cheskes, MD; Robert H. Schmicker, MS; Jim Christenson, MD; David D. Salcido, MPH; Tom Rea, MD; Judy Powell, RN; Dana P. Edelson, MD; Rebecca Sell, MD; Susanne May, PhD; James J. Menegazzi, PhD; Lois Van Ottingham, RN, BSN; Michele Olsufka, BSN; Sarah Pennington, RN; Jacob Simonini, ACP; Robert A. Berg, MD; Ian Stiell, MD, MSc; Ahamed Idris, MD; Blair Bigham, MSc; Laurie Morrison, MD, MSc; on behalf of the Resuscitation Outcomes Consortium (ROC) Investigators

Study showed that odds of survival were significantly lower for patients with:

1. Pre-shock pause > 20 seconds
2. Peri-shock pause > 40 seconds

PREHOSPITAL

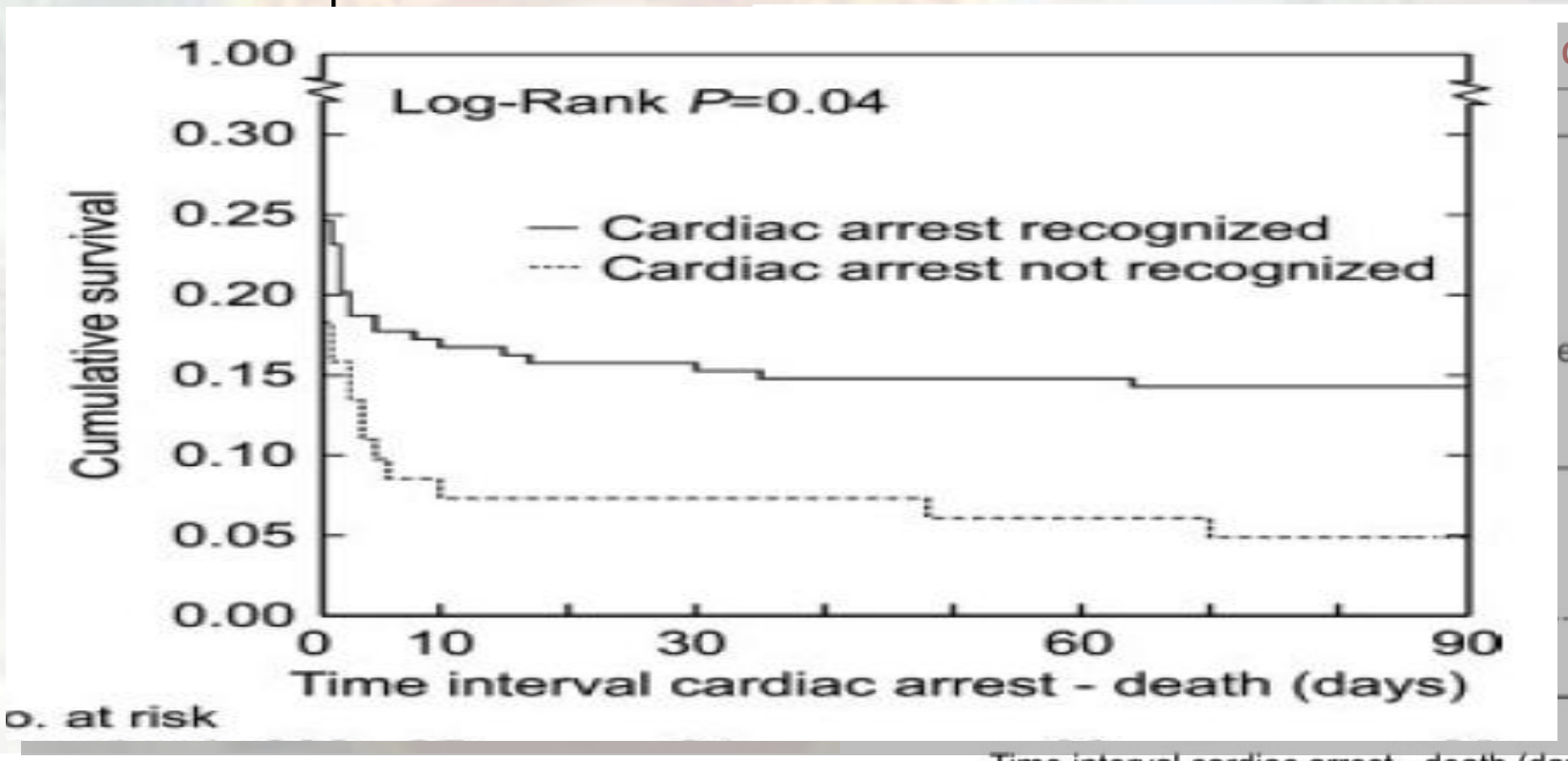
Emergency Medical Dispatch / EMD

EMS NEEDS THE DISPATCHER

TIME IS CRITICAL

Survival decreases by 10% for every minute treatment is delayed

- Amsterdam dispatch
-
-
-



Time interval cardiac arrest - death (days)
o. at risk

Resuscitation Science

Importance of the First Link

Description and Recognition of an Out-of-Hospital Cardiac Arrest in an Emergency Call

Jocelyn Berdowski, MS, MSE; Freerk Beekhuis, RN; Aeilko H. Zwinderman, PhD; Jan G.P. Tijssen, PhD; Rudolph W. Koster, MD, PhD

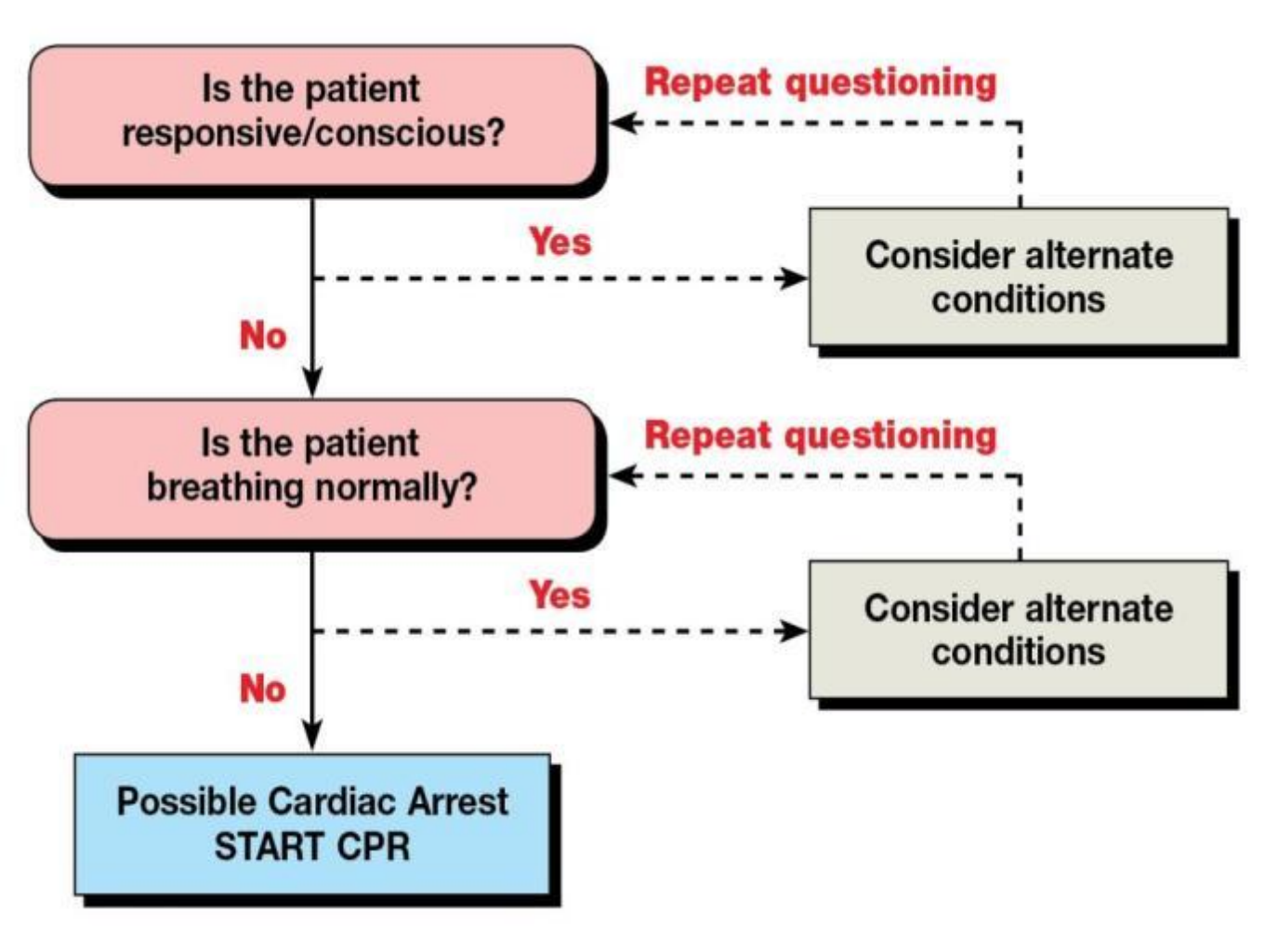
Berdowski, *J. Circulation*. 2009;119:2096-2102

PREHOSPITAL / EMD

Because dispatcher CPR instructions substantially increase the likelihood of bystander CPR performance and improve survival from cardiac arrest, ALL dispatchers should be appropriately trained to provide telephone CPR instructions (Class I, LOE B).

2010 AHA Guidelines for CPR & ECC

PREHOSPITAL / EMD



"*The Agony of Agonal Respirations*"

LAFD dispatchers waste time getting 911 callers to start CPR

September 2012

- Article in LA Times
- "Speed is everything," says the report, which was obtained under the California Public Records Act. "Withholding or delaying [CPR] may result in a potentially preventable death!!"

"*The Agony of Agonal Respirations*"

- Percentage of CC started?
  - 31 %
- Average time to begin CC?
  - 4 minutes and 12 seconds
  - Longest 7 minutes and 30 seconds

AHA January 2012 EMD

- **Dispatchers should help 9-1-1 callers identify cardiac arrest victims and coach callers to provide immediate CPR.**
  - *If more dispatchers followed these processes, thousands of lives could be saved every year.*

AHA January 2012 EMD

- **Communities should regularly evaluate 9-1-1 emergency dispatchers' performance and the overall emergency response system**,
  - American Heart Association statement.

AHA January 2012 EMD

- **Dispatchers should confidently give Hands-Only CPR instructions for adults who have had a cardiac arrest *not* caused by asphyxia (as in drowning).**

AHA January 2012 EMD

- **Communities should measure performance of dispatchers and local EMS agencies, including how long it takes until CPR is begun.**

- **Performance measurements should be part of a quality assurance program involving the entire emergency response system including EMS and hospitals.**

Family Presence / TOR

- France: 15 EMS crews
- Randomized
- Questionnaires following
- 90 days later survivor interviewed
- 570 families enrolled / 475 completed
- 76 % witnessed in intervention group
- 43 % witnessed in control group
- PTSD symptoms 1.7 X higher in control

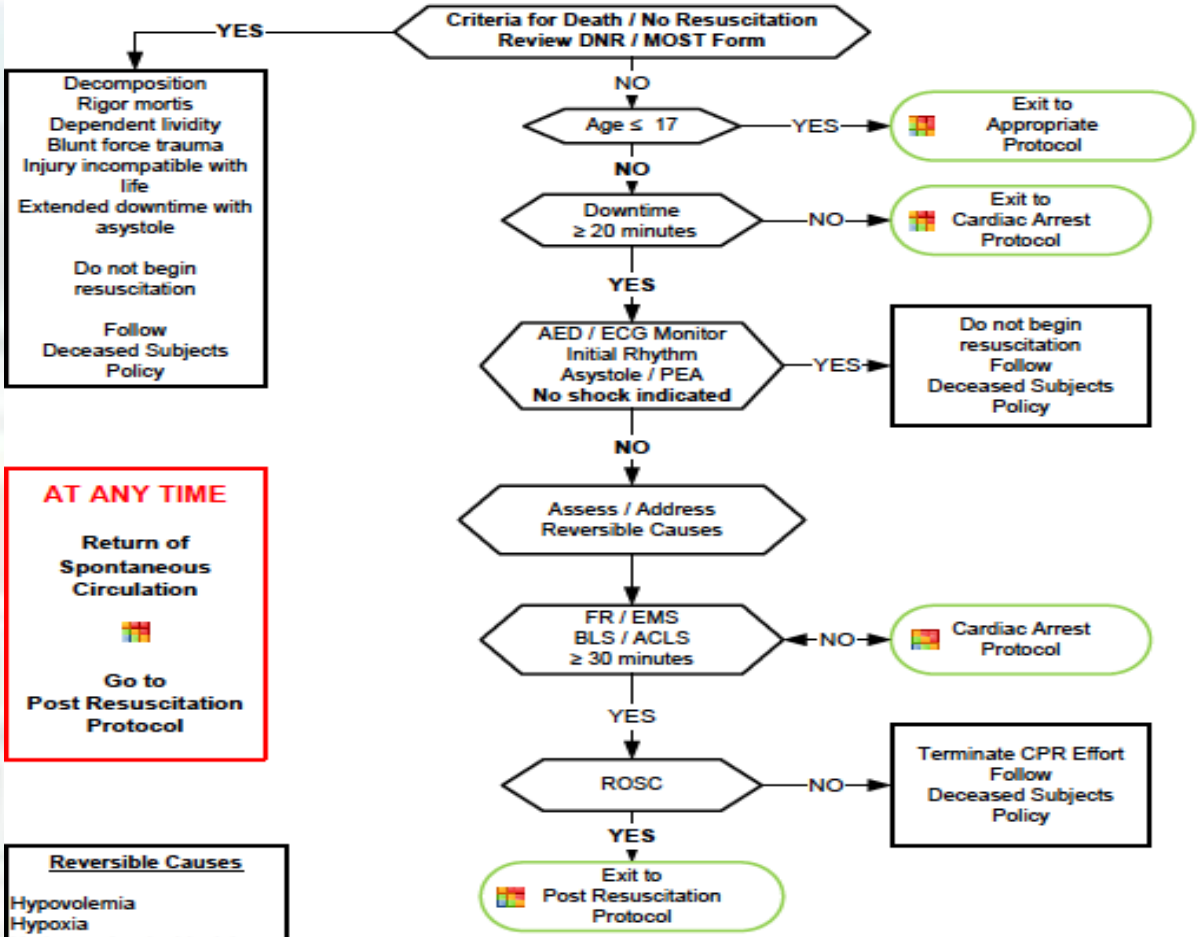
Jabre P et al. Family presence during cardiopulmonary resuscitation. N Engl J Med 2013 Mar 14; 368:1008.

TOR

- 3 Validated TOR Rules currently exist
- 2483 patients with CPR performed 08 – 10
- Survival to discharge is 6.6 %
- Field ROSC 36 %
- Survival 17.2 % with ROSC
- Without ROSC in field survival is 0.7 %
  - By following TOR Rules transports would have decreased by 50 %

Wampler DA et al. Cardiac arrest survival is rare without prehospital return of spontaneous circulation. Prehosp Emerg Care 2012 Jul 26

Termination of CPR



AT ANY TIME

Return of Spontaneous Circulation

Go to Post Resuscitation Protocol

Reversible Causes

Hypovolemia
Hypoxia
Hydrogen ion (acidosis)
Hypothermia
Hypo / Hyperkalemia
Hypoglycemia

Tension pneumothorax
Tamponade; cardiac
Toxins
Thrombosis; pulmonary (PE)
Thrombosis; coronary (MI)

Team Leader
ALS Personnel
Responsible for patient care
Responsible for briefing / counseling family

Incident Commander
Fire Department / First Responder Officer
Team Leader until ALS arrival
Manages Scene / Bystanders
Ensures high-quality compressions
Ensures frequent compressor change
Responsible for briefing family prior to ALS arrival

Therapeutic Hypothermia

- Several studies since 2009
- All agree minimal side effects
- All agree better neurological outcomes
  - Greatest in VF
  - Still present in all other rhythms
- None have determined better outcome by starting in field
- Bottom line: Start if feasible
  - What you start is difficult for hospital to stop

Si's First Rule of Resuscitation

You're not dead until you're cold and dead…Jack

Summary

- 1. Improving resuscitation is multi-faceted
- 2. Starts with bystander
- 3. 911
- 4. First Responder
- 5. EMS
- 6. Integrated hospital approach