

Resuscitation Quality Improvement

Training and Reinforcement

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The Emergency Resuscitation Center

University of Chicago Medical Center, Chicago, IL

Resuscitation Officer Program

September 9, 2016





NO RELEVANT CONFLICTS

Research Grants:

NIH: Cardiac Arrest (THAPCA/PECARN/CPCCRN), Glucose Control
AHRQ Airway Registry/ R18 INSPIRE-Simulation

Canadian Institute of Healthcare Research (CPR/EWS)

Laerdal Medical (Simulation, CPR, Global)

RBaby Foundation (INSPIRE/ImPACTS: Simulation)

Zoll Medical (CPR learning lab)

Nihon-Kohden (Exhaled CO2 detection)

Science Advisory Board (Volunteer)

Citizen CPR Foundation

International Liaison Committee on Resuscitation (ILCOR)

AHA Get with the Guidelines-Resuscitation/National Registry

Pediatric Acute Lung Injury and Sepsis Investigators (PALISI)

Society of Critical Care Medicine Council (SCCM)



Center for Resuscitation Science



Rigorous
Evidence
Evaluation

PRACTICE!

LOOK
AT
OURSELVES!

What
We
Know

**Guidelines
and
Medical
Standards**

What we
teach,
learn and
remember

**What
we
Do**

Patient Outcome



= **20%**

Fact!

95%

x

75%

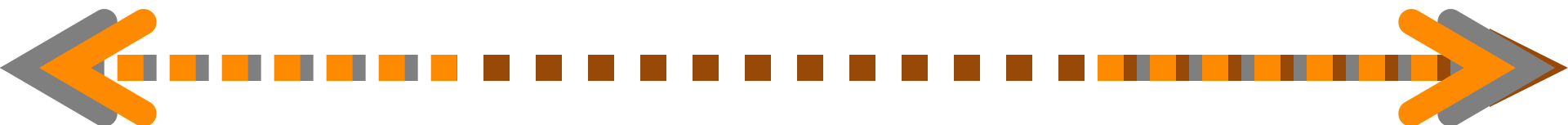
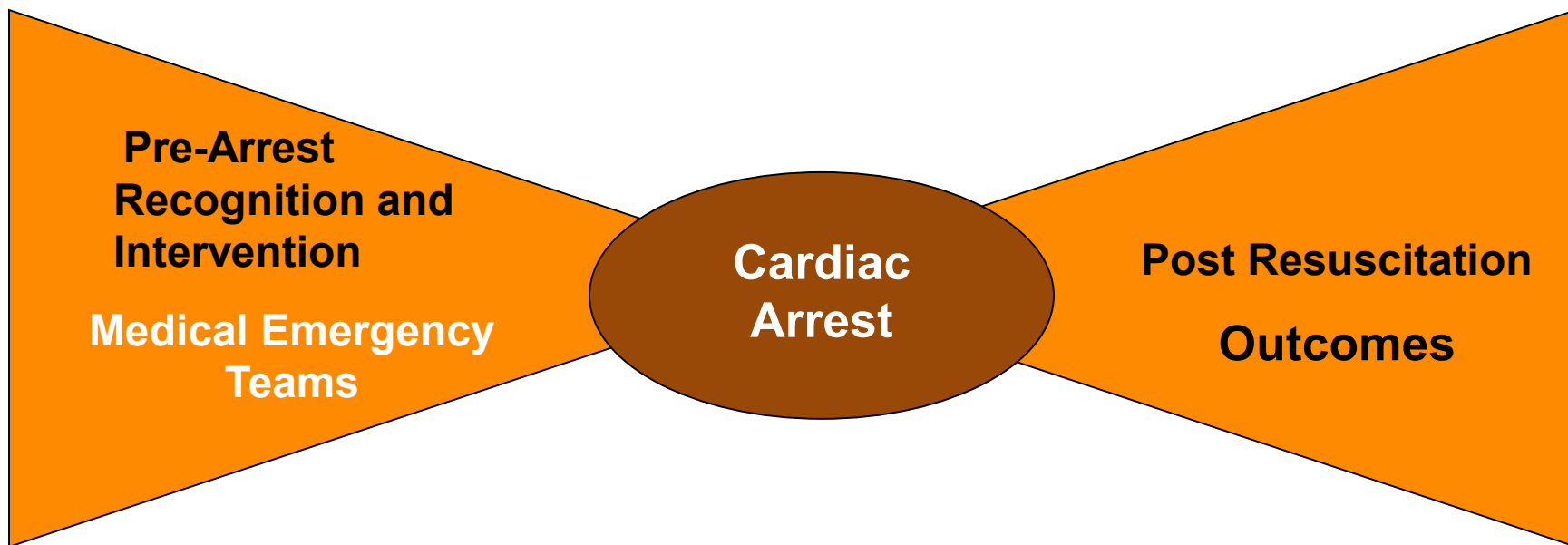
x

75%

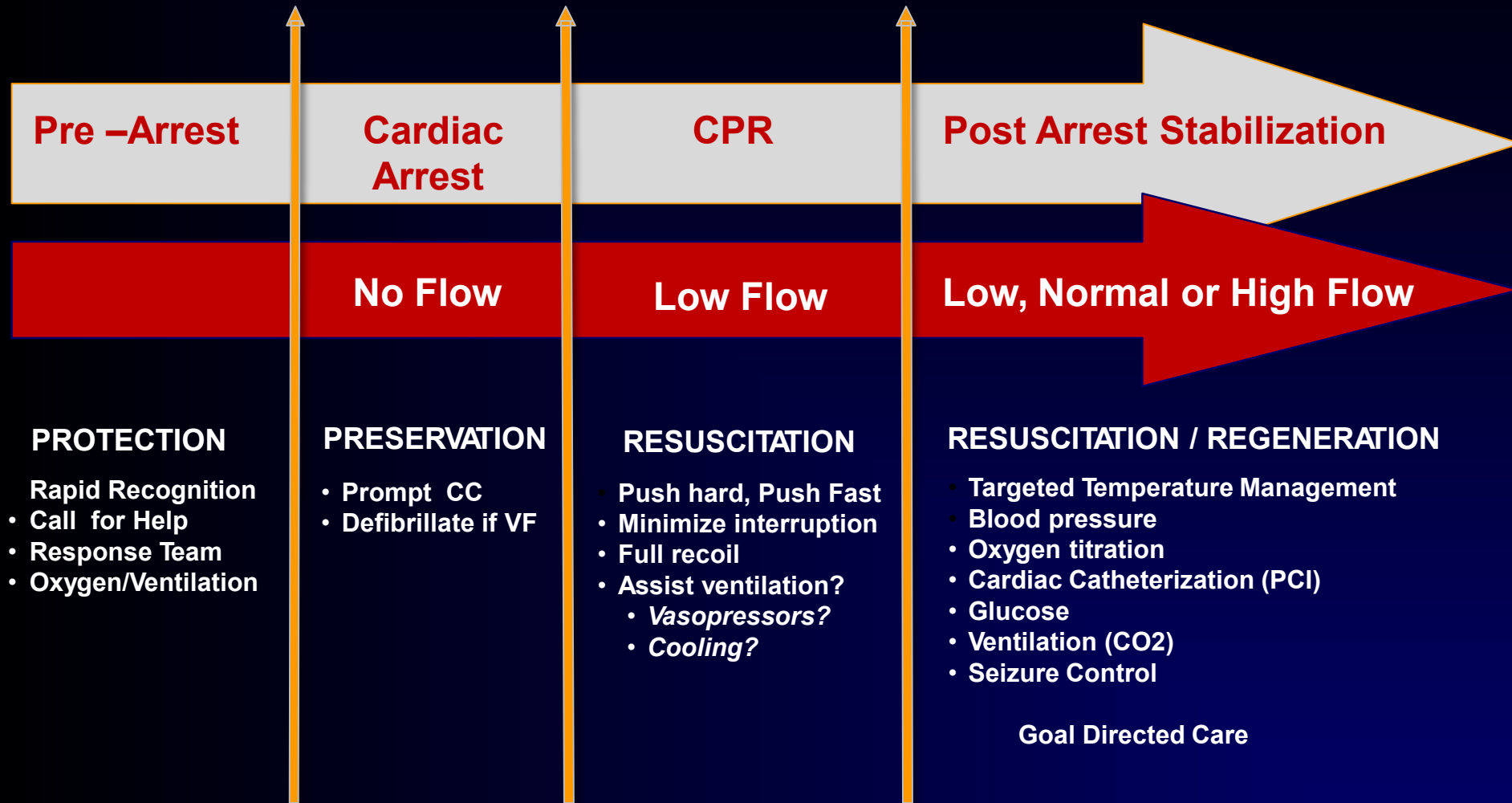
= 54%

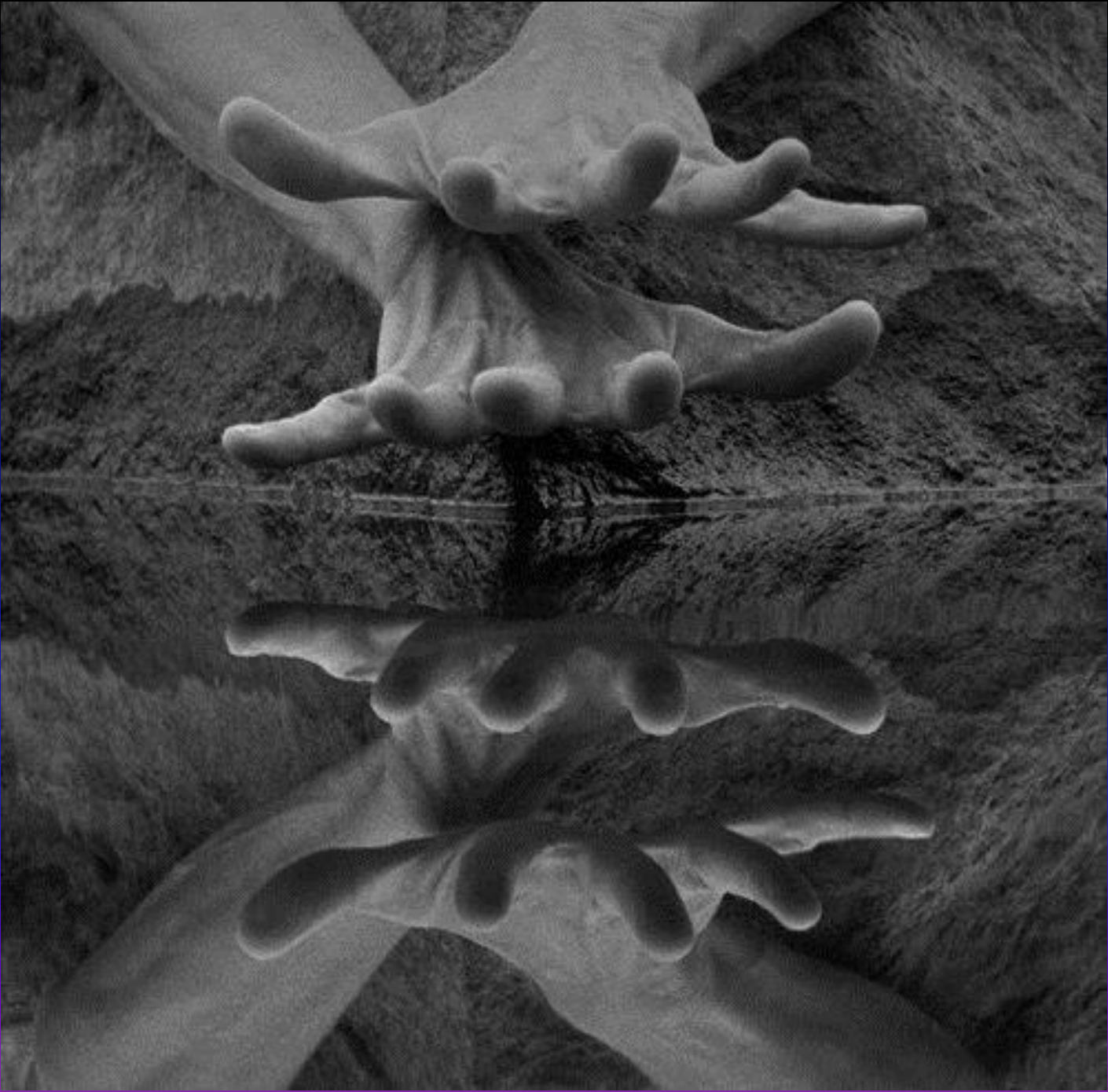
Transmit more of what we know to the care at the bedside!

“Bow Tie” of Resuscitation



High Quality Resuscitation!







heart.org/resuscitation



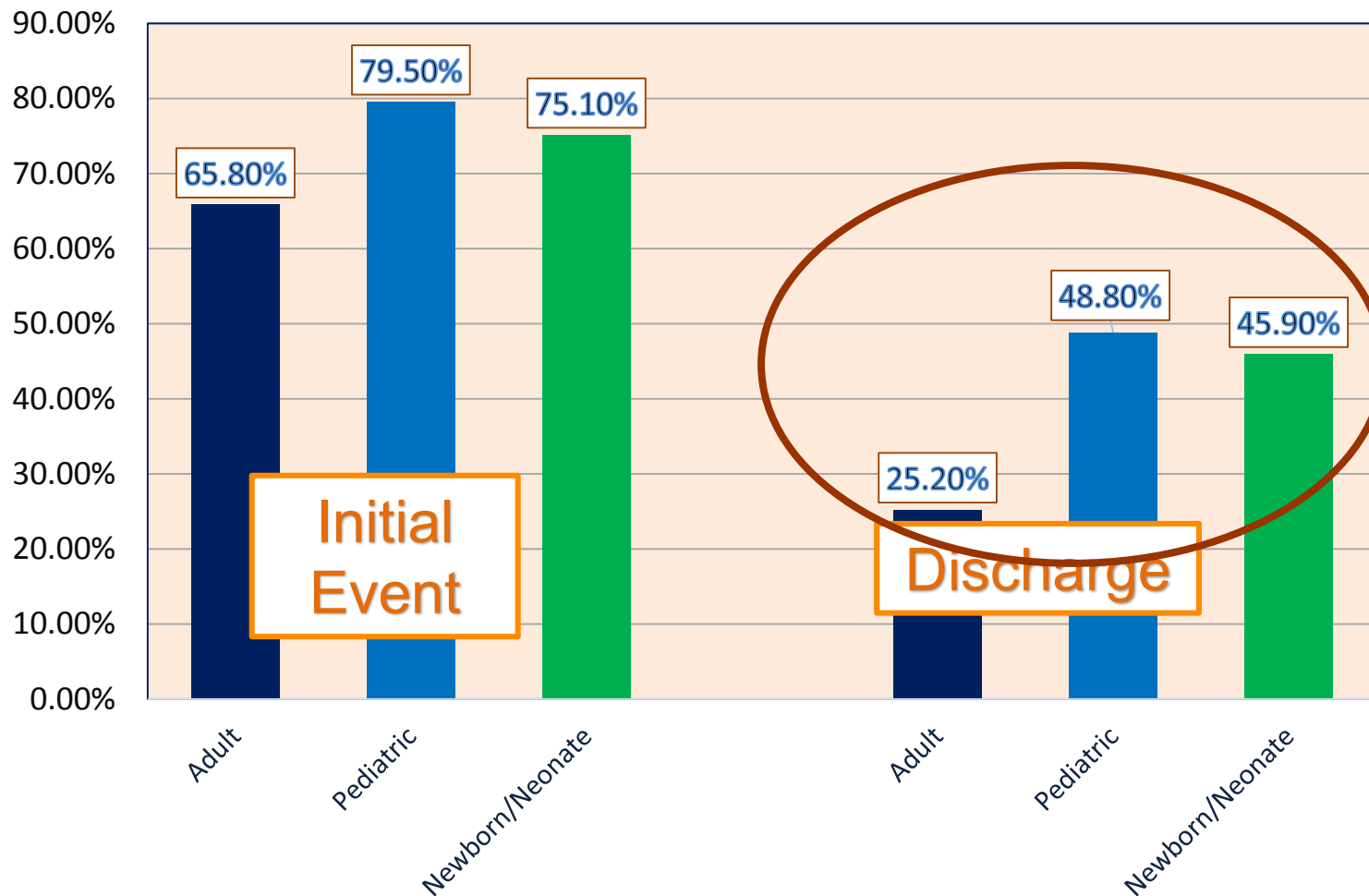
American Heart Association | American Stroke Association
Learn and Live.



**GET WITH THE
GUIDELINES.**
RESUSCITATION

Formerly NRCPR® (The National Registry
of Cardiopulmonary Resuscitation)

In-Hospital Arrest Outcomes



Events Entered into GWTG-Resuscitation

Pre-Event Care Medical Emergency Teams



Medical Emergency Team Activation (MET)

Patient condition is deteriorating – team response needed to intervene for the crisis

Pre- Cardiac Arrest Care Acute Respiratory Compromise



Acute Respiratory Compromise (ARC)

Patient requires emergency assisted ventilation

Managing the Cardiac Arrest



Cardio-Pulmonary Arrest (CPA)

Patient requires chest compressions or shock by a defibrillator.

Post Cardiac Arrest Care



Post Cardiac Arrest Care (PCAC)

Care of patient with in-hospital or out of hospital event

Effect of Resuscitation Errors

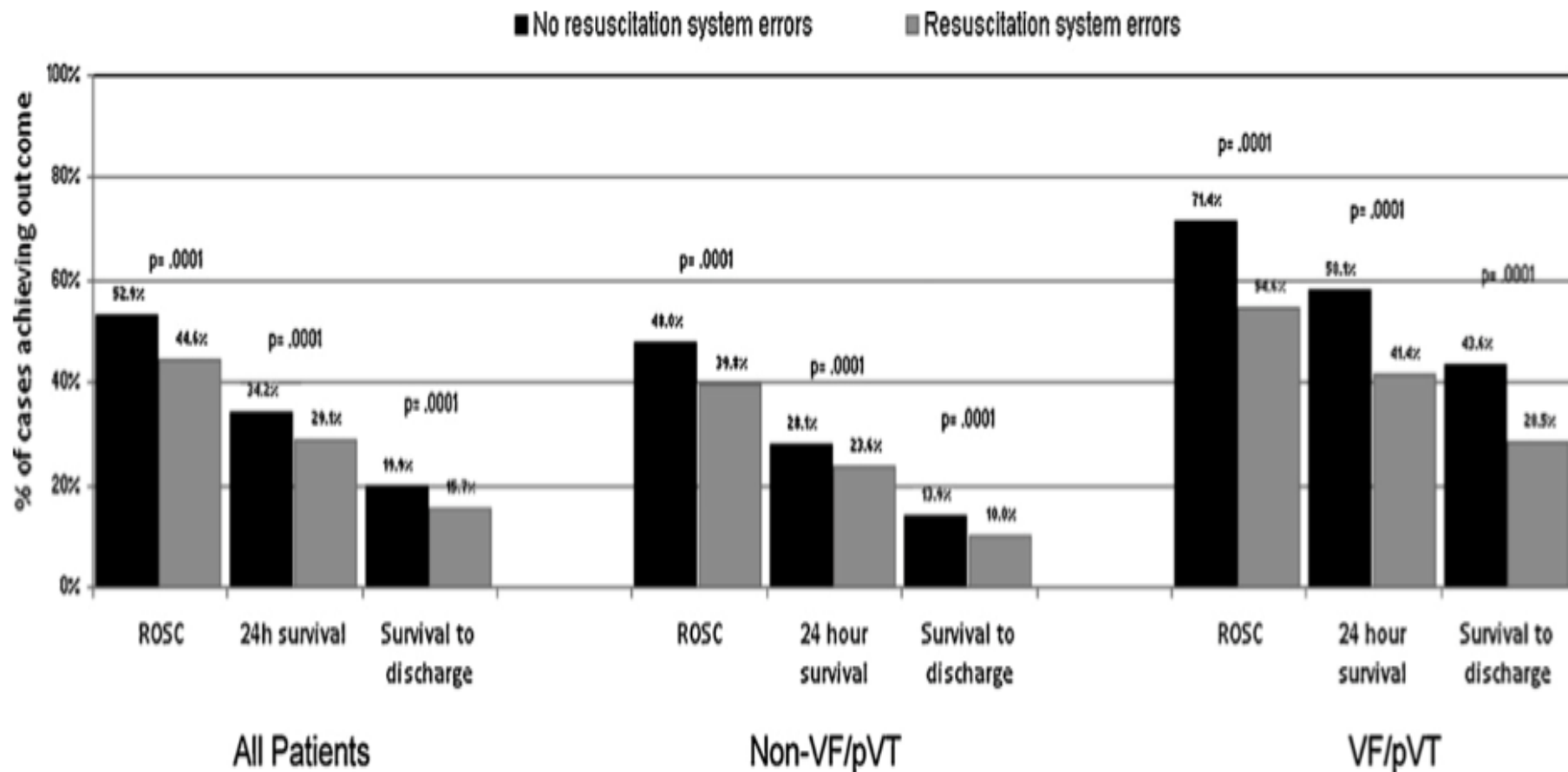


Fig. 1. Effect of any resuscitation system errors on an IHCA event and the rate of ROSC, survival for 24 h, and survival to hospital discharge for all patients and those with an initial documented IHCA rhythm of non-VF/pVT and VF/pVT.

Moving Hospitals Toward A Performance Improvement Approach For In-Hospital Cardiac Arrest

Five Key Metrics Based On Data Of What Matters

1. Increase Survival to Discharge
2. Decrease Time to Defibrillation
3. Decrease Unmonitored/Unwitnessed Arrests
4. Decrease Time to Chest Compressions
5. Confirmation of Endotracheal Tube Placement

Embedding Training into Practice and Measuring of Outcomes

High Risk Screening for Just-in-Time Training



Real-Time Feedback



Performance Debriefing



Focused Efforts to Improve Skills

Low Intensity
High Frequency

Environment

Team

Individual



Performance
Debriefing

Performance
Feedback





High-Q Resuscitation Program

Pre-arrest

Identification

High Risk

Clinical Indicators

Parshuram 2009
Bonafide 2011

"Rolling Refreshers"

Hands-on practice
with defibrillator,
chest
compressions and
ventilations



Niles 2009, Sutton 2011a,
Sutton 2011b

Intra-arrest

Real-time CPR Feedback

- Commercially available
Audio + visual feedback
- ETCO₂
- Arterial BP



Abella 2007, Niles 2008, Sutton 2008,
Sutton 2009, Niles 2009, Edelson 2011



Post-Resuscitation Care

Temperature control, Blood pressure/Hemodynamics, Oxygen, CO₂,
PCA, ECMO, Glucose, pH, electrolytes, Fluid management

Sunde 2007, Sunde 2008, Sunde 2009

0

Day 1

Day 2-3

Day 4 →

Post-Resuscitation "Dress Rehearsals"

Anticipate Challenges; Rehearse Interventions;
Review Protocols; Clarify Communication;
Document Competence

Scholtz 2011



Review and Debriefings

Immediate and Scheduled:

Provide feedback for multidisciplinary provider and resuscitation teams

Immediate

Brief Team Reflection

Quick discussion:
Latent and obvious errors,
clinical issues, barriers
to process
and examples of excellence

Edelson 2008; Dine 2008

Weekly/Monthly

Educational Debriefings

(Audio/Video) Extended
team discussion of
selected events:
Resuscitation
process, provider skills,
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Edelson 2008; Dine 2008; Wolfe 2014



Primary Outcome:
Return of Spontaneous Circulation

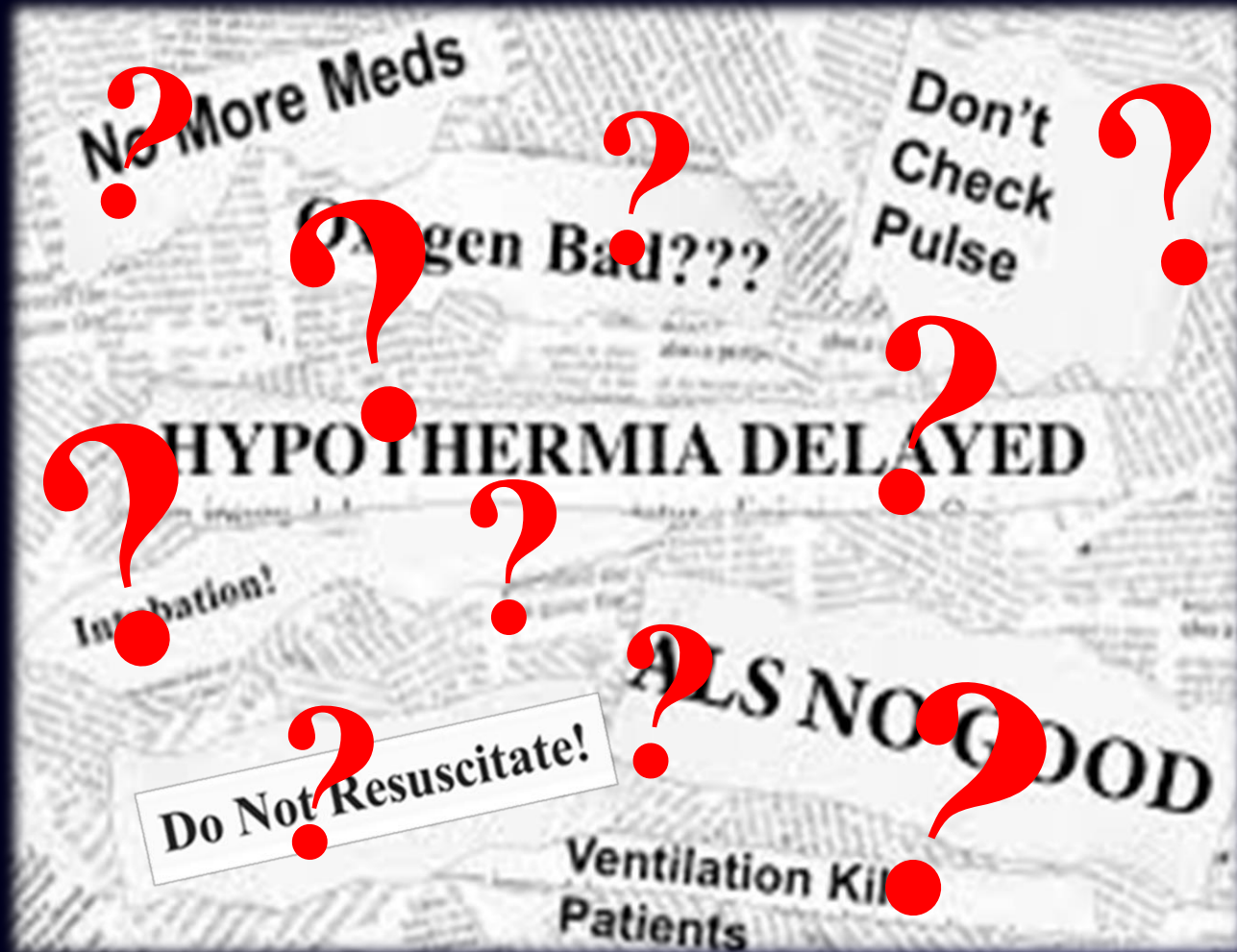
Primary Outcome: Survival to discharge
Secondary Outcome: Survival to One Year



We've come a long way, Baby....



But we still have lots of work to do!

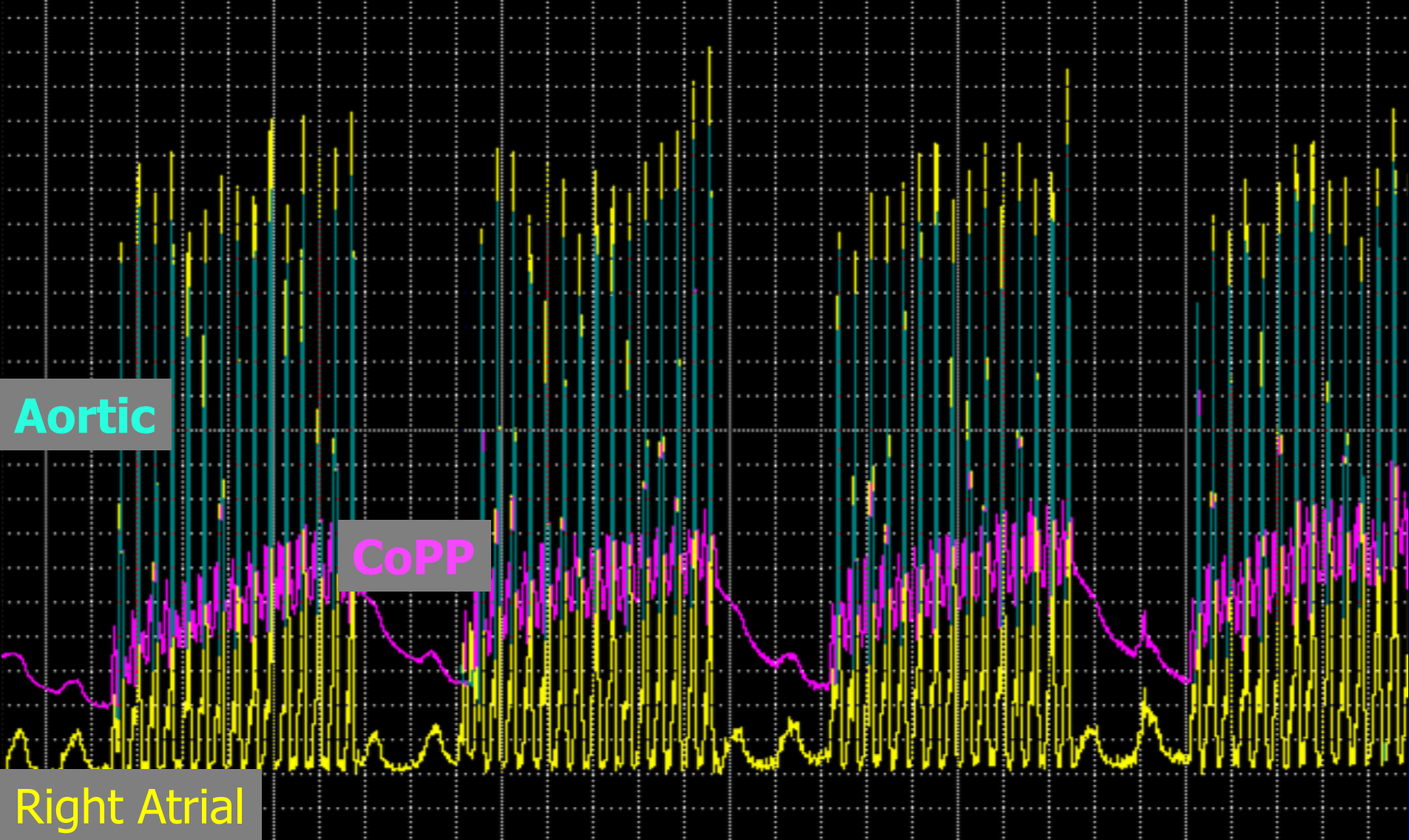


Current CPR Quality: Summary

Studies of CPR quality have found common deficits in performance:

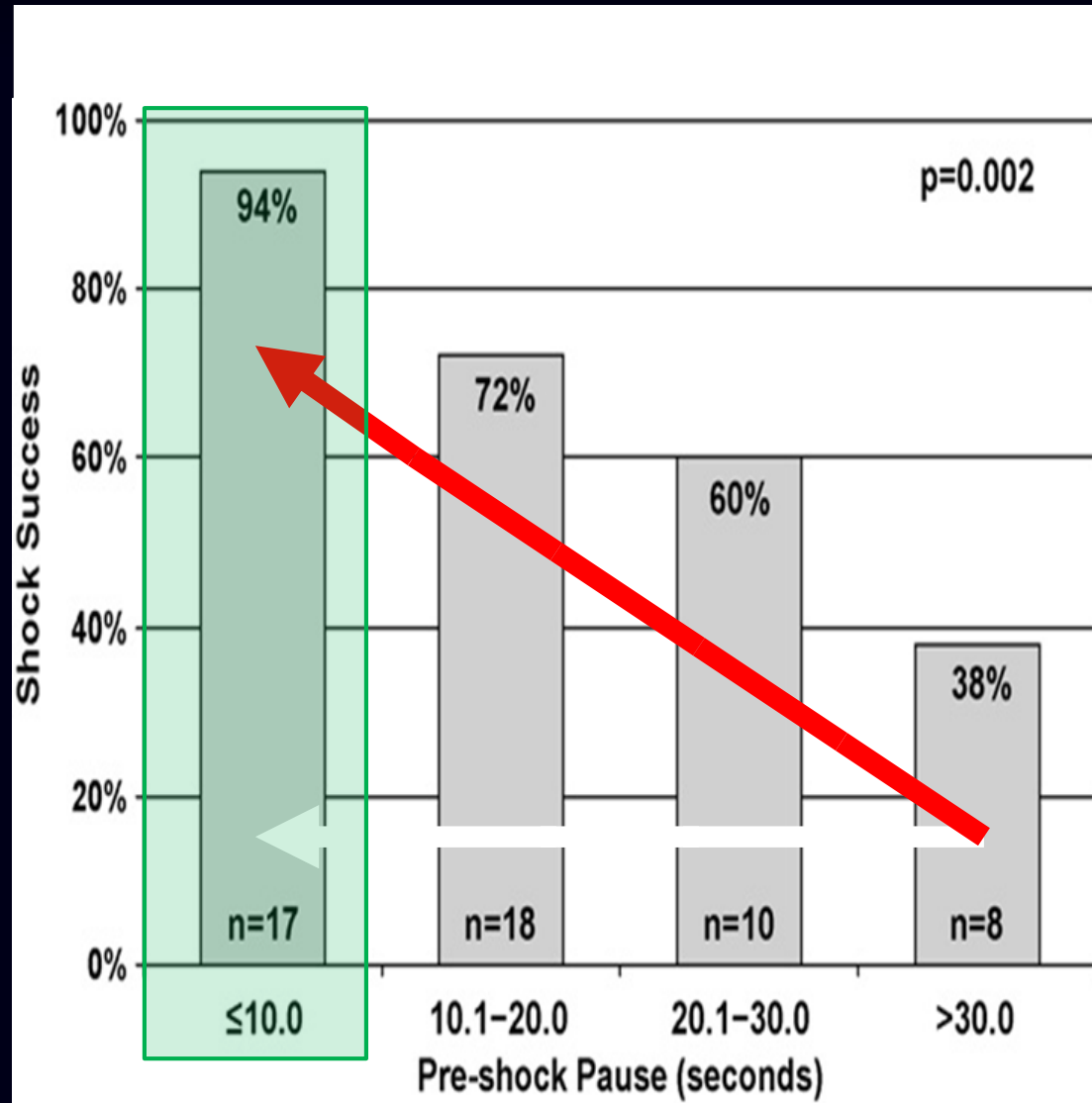


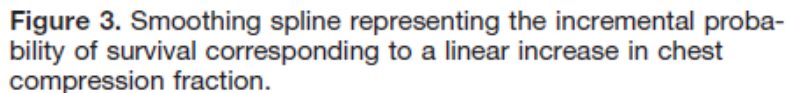
- 1. Shallow compressions**
- 2. Slow or Fast compression rates**
- 3. Frequent and lengthy pauses**
- 4. Hyperventilation**



Coronary Perfusion Pressure during 15:2 CPR
(Ao diastolic - RA diastolic) Berg, Circulation 2001

Terminate lethal rhythms!

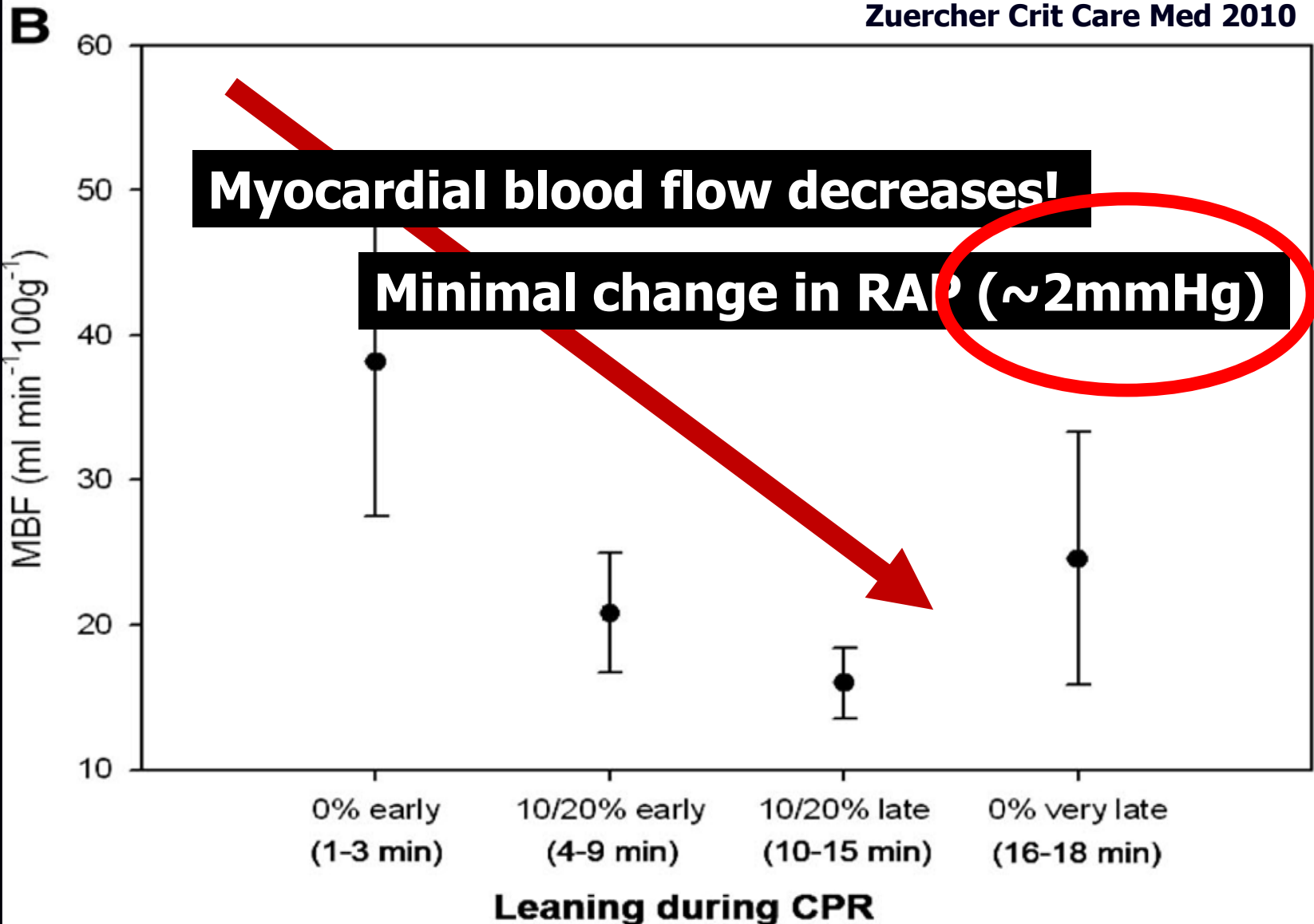




CPR Quality Conference 2013

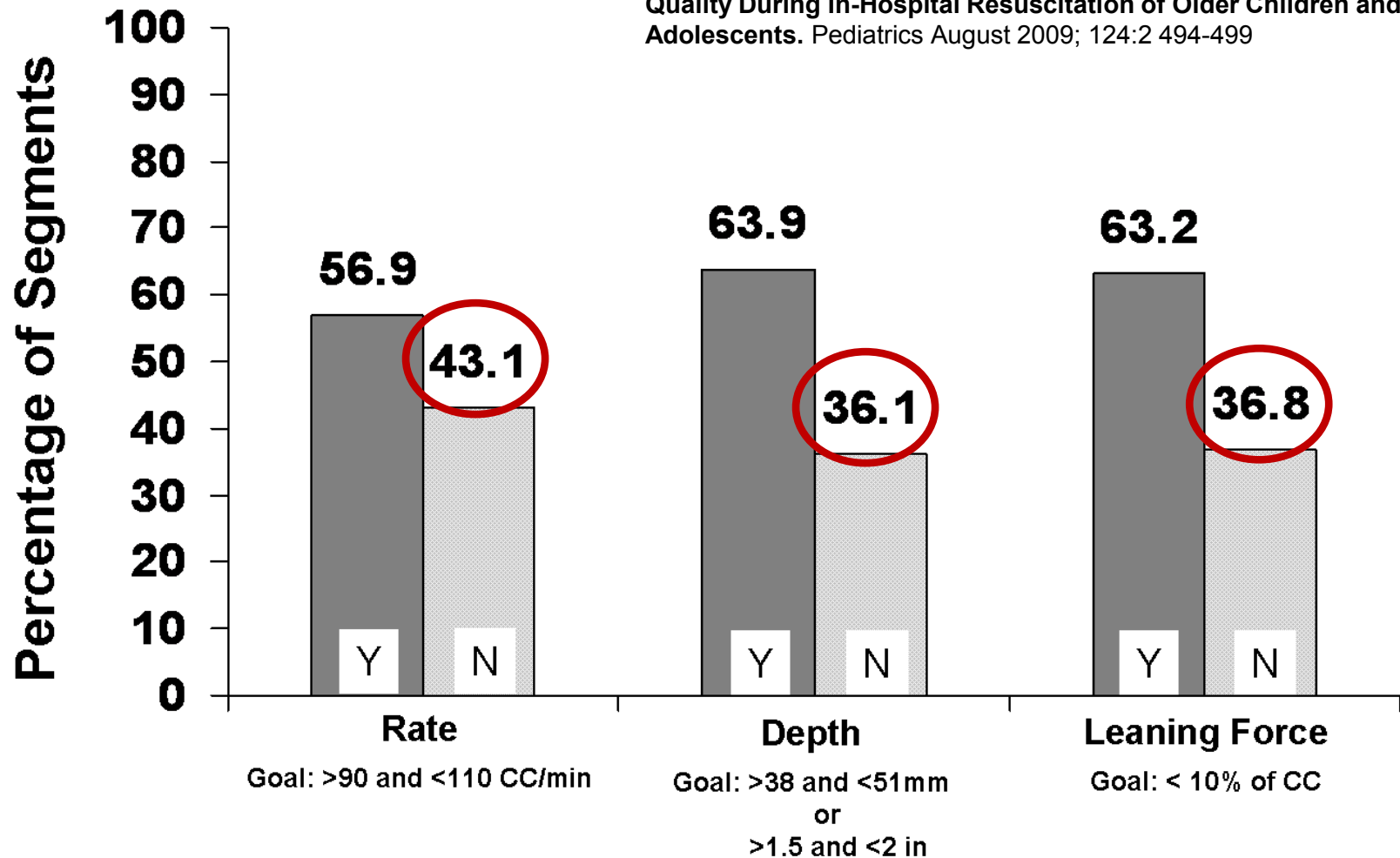
Leaning Matters

Zuercher Crit Care Med 2010



Not as good as we thought...

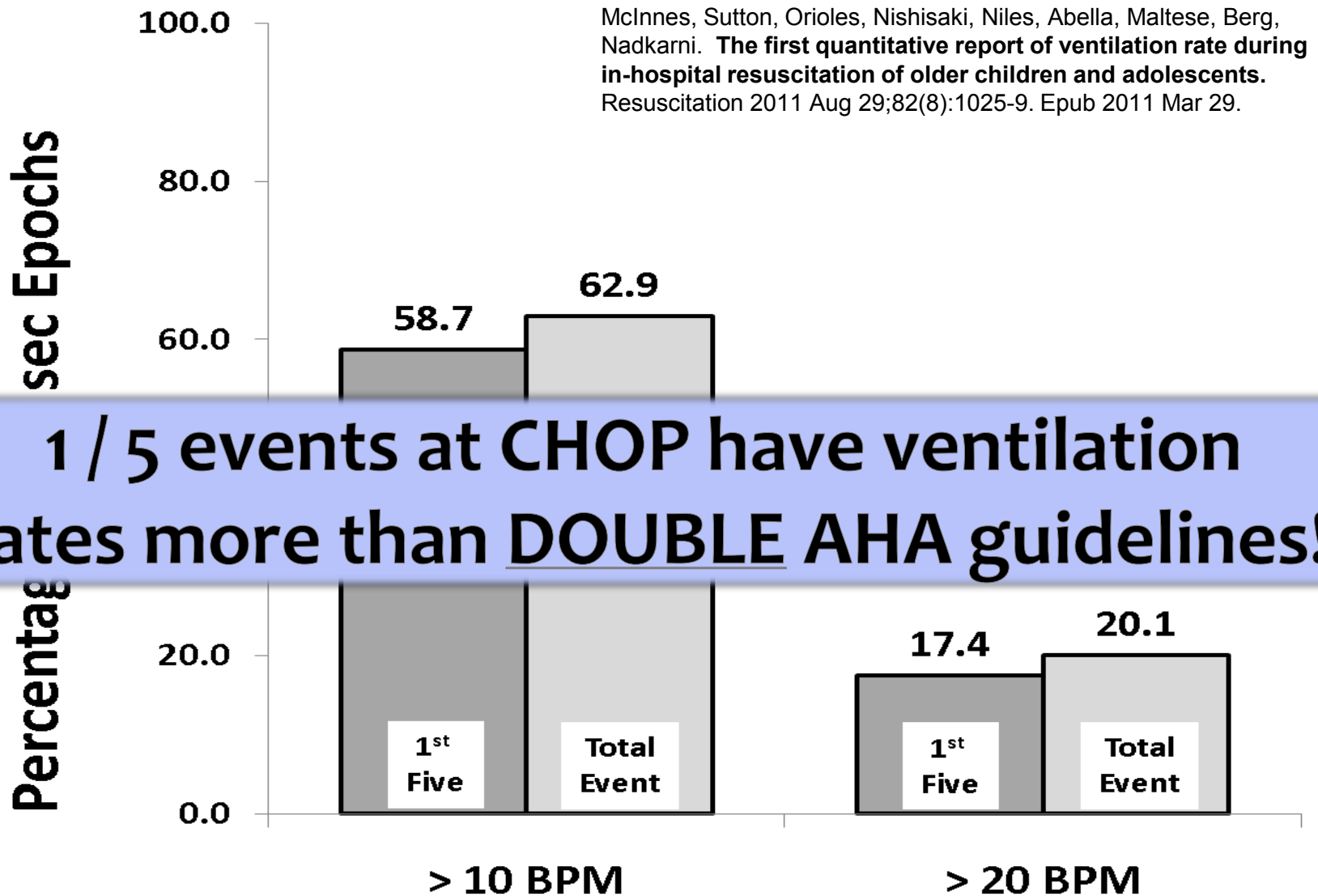
Sutton, Niles, Nysaether, Abella, Arbogast, Nishisaki, Maltese, Donoghue, Bishnoi, Helfaer, Myklebust, Nadkarni. **Quantitative Analysis of CPR Quality During In-Hospital Resuscitation of Older Children and Adolescents.** Pediatrics August 2009; 124:2 494-499



CPR Quality Targets

We Ventilate a lot!

McInnes, Sutton, Orioles, Nishisaki, Niles, Abella, Maltese, Berg, Nadkarni. **The first quantitative report of ventilation rate during in-hospital resuscitation of older children and adolescents.** Resuscitation 2011 Aug 29;82(8):1025-9. Epub 2011 Mar 29.



And we still have work to do...

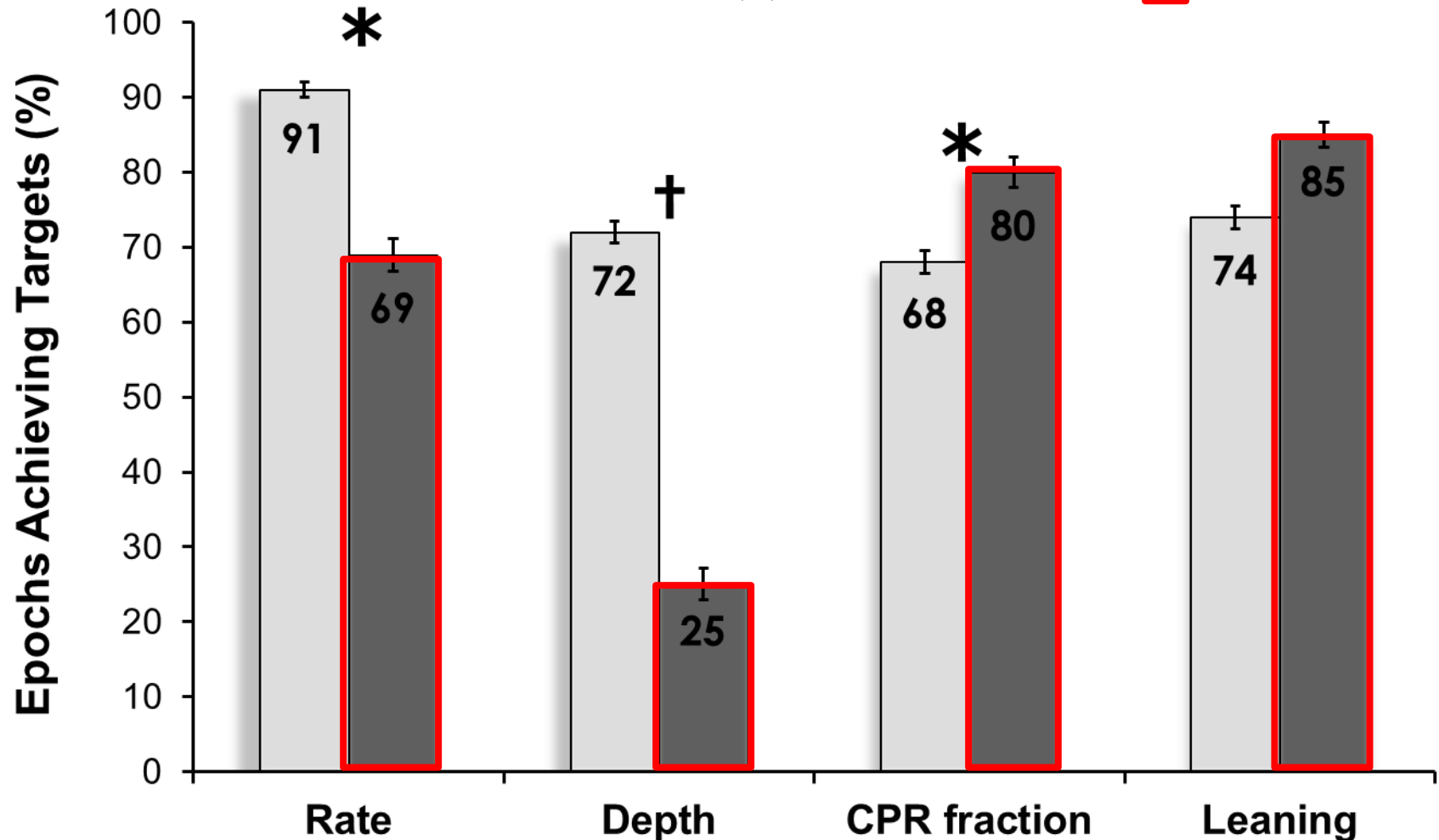
Pushing harder, pushing faster, minimizing interruptions... But falling short of 2010 cardiopulmonary resuscitation targets during in-hospital pediatric and adolescent resuscitation[☆]

Robert M. Sutton^{a,b,*}, Heather Wolfe^a, Akira Nishisaki^{a,b}, Jessica Leffelman^{a,b}, Dana Niles^{a,b}, Peter A. Meaney^{a,b}, Aaron Donoghue^{a,b}, Matthew R. Maltese^a, Robert A. Berg^a, Vinay M. Nadkarni^{a,b}

Resuscitation 2013 Dec29;84(12)1680-4

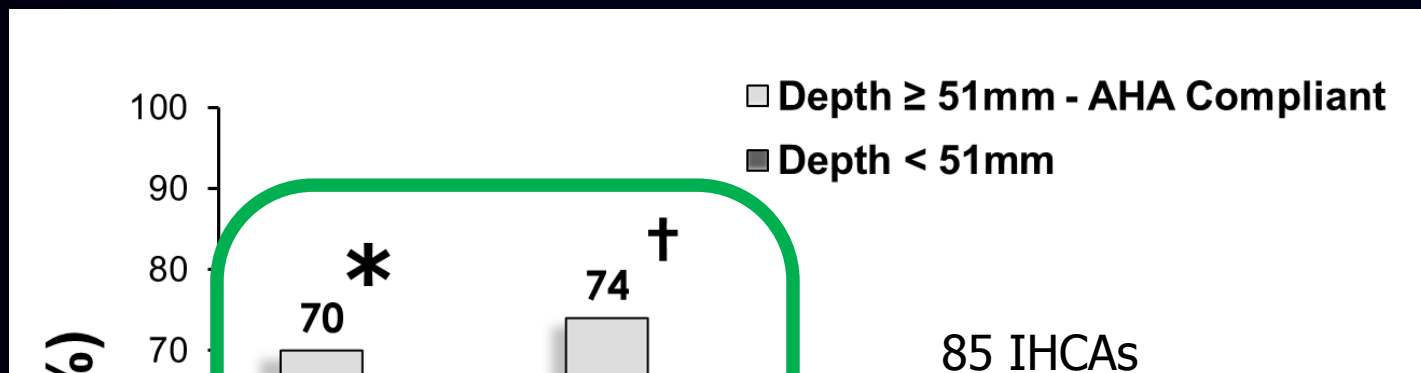
2005

2010

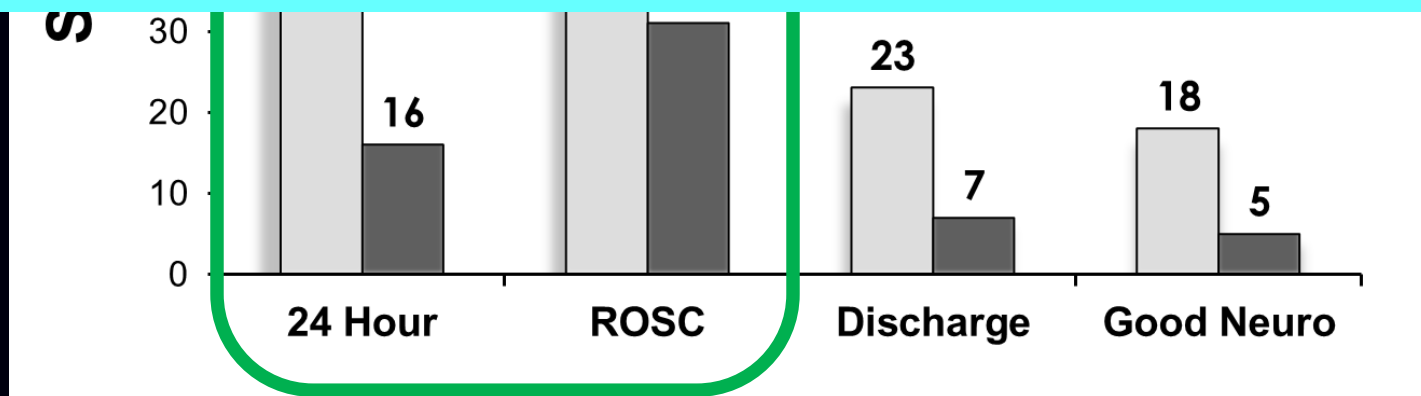


High Quality CPR Associated with Survival

Sutton, Resuscitation 2014



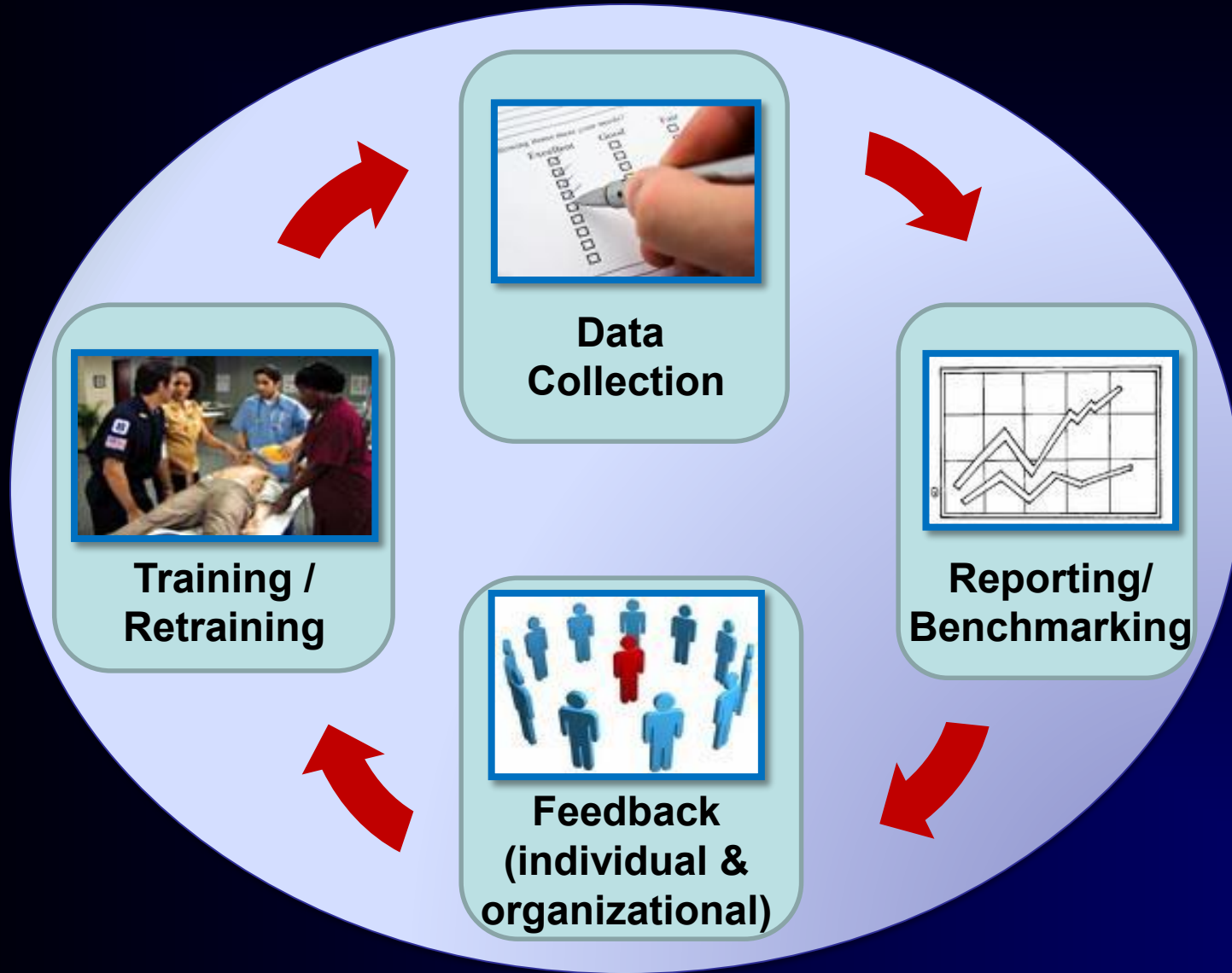
More kids survive (> 4x more!)
when you perform AHA Compliant CPR



* aOR 10.3, CI95: 2.75 – 38.8, $p < 0.01$

† aOR 4.21, CI95: 1.34 – 13.2, $p = 0.014$

Elements of a High-Q(uality) Resuscitation Program





High-Q Resuscitation Program

Pre-arrest

Identification

High Risk

Clinical Indicators

Parshuram 2009
Bonafide 2011

"Rolling Refreshers"

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with defibrillator,
chest
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Abella 2007, Niles 2008, Sutton 2008,
Sutton 2009, Niles 2009, Edelson 2011



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PCA, ECMO, Glucose, pH, electrolytes, Fluid management

Sunde 2007, Sunde 2008, Sunde 2009

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Edelson 2008; Dine 2008

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Resuscitation
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system process, etc.

Edelson 2008; Dine 2008; Wolfe 2014



Primary Outcome:
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Primary Outcome: Survival to discharge
Secondary Outcome: Survival to One Year



Pre-Identification

Improve ability to ID patients at risk of requiring CPR

Over the course of a month trial:

- 1,185 PICU admissions
 - 67 (6%) patients identified as high-risk
 - 12 (18%) of these were CCs

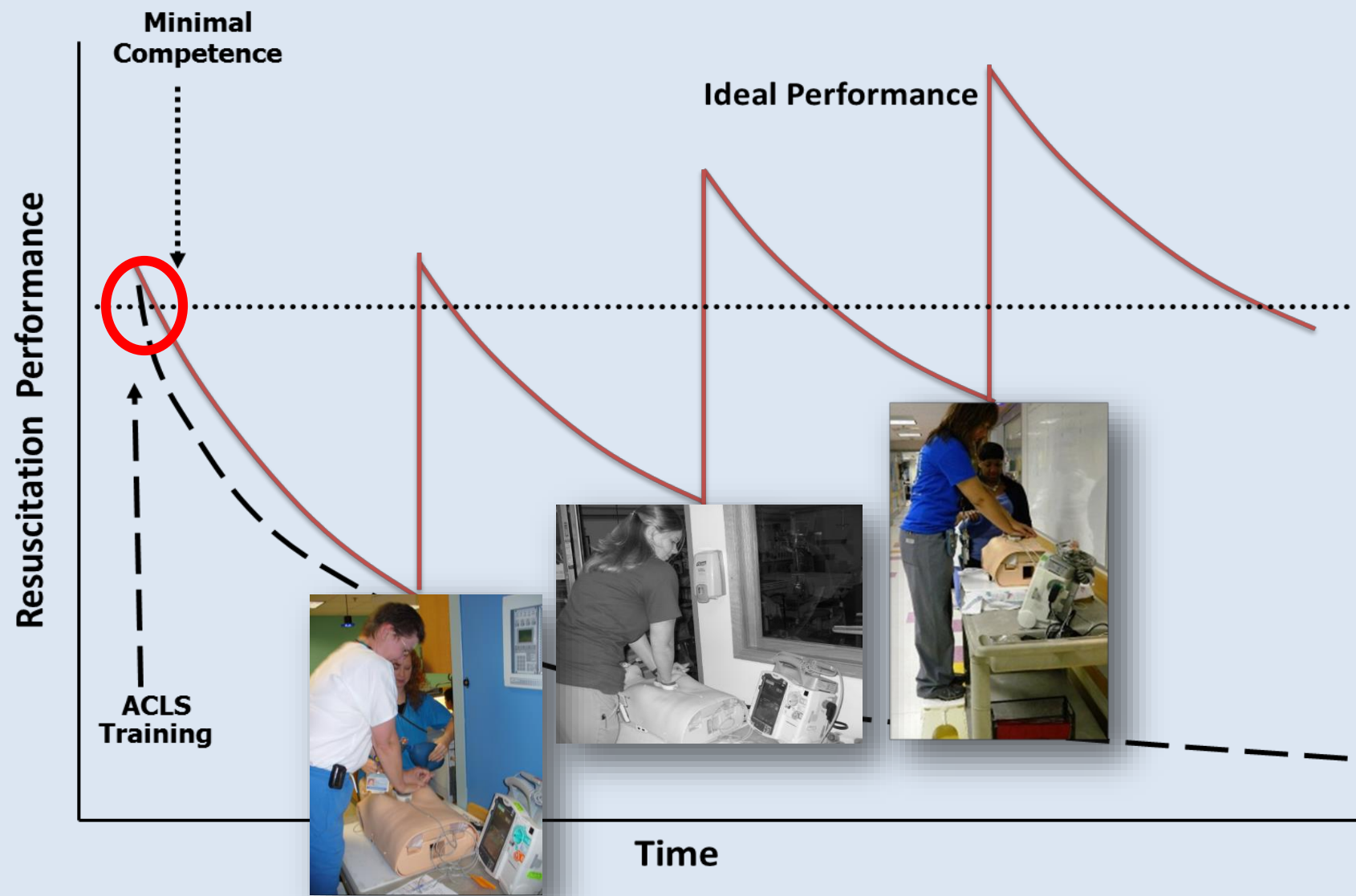
**All children that had Code
Team Activation or
CC were pre-identified
(...our criteria worked!)**

High Risk Clinical Indicators Checklist (check all that apply)*	
Respiratory	<input type="checkbox"/> MAP > 20 <input type="checkbox"/> Nitric oxide therapy > 5 ppm <input type="checkbox"/> ECMO
Circulatory	<input type="checkbox"/> Recent cardiac arrest (< 24 hrs) <input type="checkbox"/> Use of 2 vasoactive medications (dopamine > 5 min) or single drug with dopamine > 10; epinephrine > 0.25 <input type="checkbox"/> Recent life threatening event requiring code team activation (e.g., BPD spell, pulmonary hypertension, ALTE) <input type="checkbox"/> Stage I repair < 24 hours
Neurologic	<input type="checkbox"/> Traumatic brain injury elevated intracranial pressure sustained > 20 with need for blood pressure augmentation to support cerebral perfusion pressure
Metabolic	<input type="checkbox"/> PICU initiated Renal Replacement Therapy <input type="checkbox"/> Potassium > 7.0 <input type="checkbox"/> pH < 7.15 <input type="checkbox"/> Lactate > 10
High Risk Procedure	<input type="checkbox"/> Intubation / extubation of known difficult airway <input type="checkbox"/> Intubation of known diagnosis of myocarditis
Other	<input type="checkbox"/> Provider Intuition (e.g., patient too unstable for daily care) <input type="checkbox"/>

*Any one or combination of risks may indicate that patient is at high risk for cardiac arrest. Other criteria may apply and confirmation should be made with patients' clinical management team.

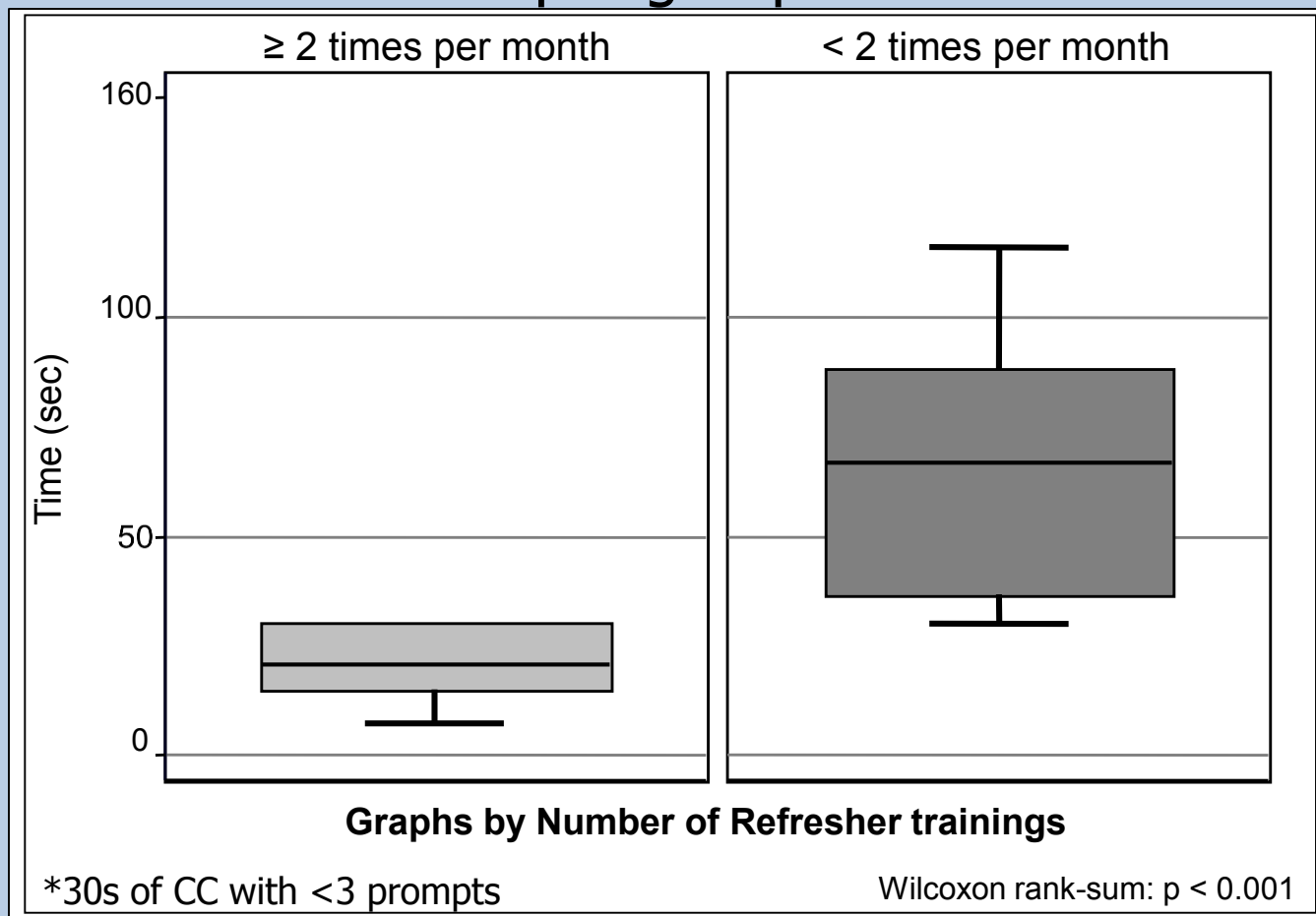
v.14 Feb 2011

A Remedy for Skills Deterioration?

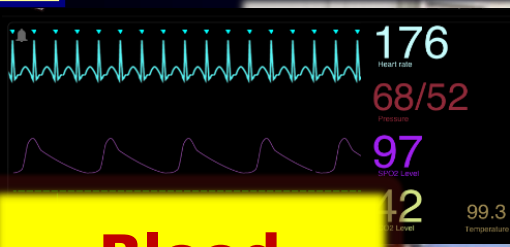


Time to Excellence Improved

Time to achieve chest compression skill success*
per group

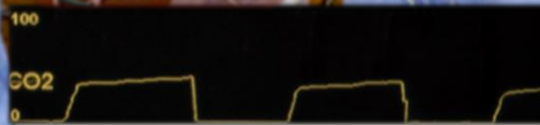


Monitor Quality of CPR!



**Blood
Pressures**

ETCO₂



**Real-time
Audiovisual
CC Feedback**



Monitor Quality of CPR!

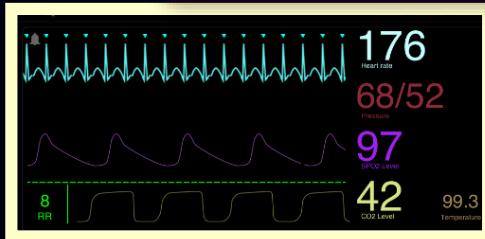
CPR Feedback lets us know if our CCs are Guideline Compliant....

**Real-time
Audiovisual
CC Feedback**



Monitor Quality of CPR!

But what does the Patient tell you...??!



Blood Pressures!

ETCO₂!



**Real-time
Audiovisual
CC Feedback**



Learning from Racing: The “Pit-stop”

Pulse Check

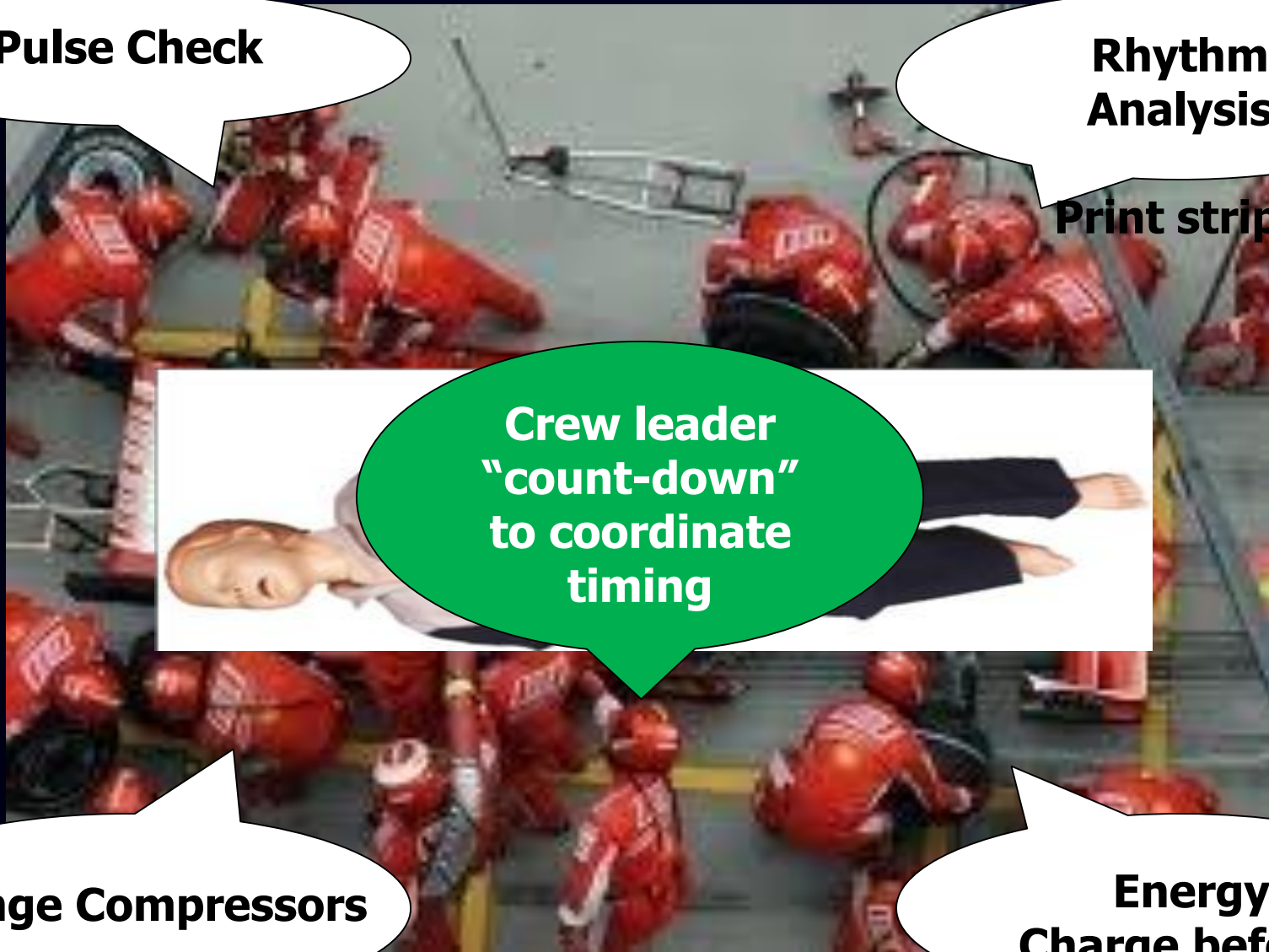
**Rhythm
Analysis**

Print strip?

**Crew leader
“count-down”
to coordinate
timing**

Change Compressors

**Energy
Charge before?**



Team Reflection (Hot Debrief)

Brief and focused discussion with participating Resuscitation Team and providers “immediately” post event

Immediate Review of:

- CPR “Report Card”
(if readily available)
- Latent and obvious errors
- Examples of excellence
- Clinical issues
- System issues
- Team performance



Post-analysis Q-CPR Report Card			
Case ID:	Sample_MRx_v900	Patient ID:	
Case date:	10/9/2007	First name:	
Device:	HeartStart MRx: U500206643	Last name:	
Code Summary:			
Code start time			10/9/2007 7:00:59 PM
Length of episode			00:02:59.1
Number of shocks			1
Device on			10/9/2007 7:00:59 PM
Device off			10/9/2007 7:07:17 PM
Time excluded from statistical calculations			00:00:00.0
Compression Data:			
Number of compressions			169
Compressions with adequate depth			165
Compressions with insufficient depth			4
Compressions with incomplete release			0
Average compression rate [/min] [90-120]			114
Average compression depth [mm] [38-51]			44
Adequate depth [%]			97.6
Average compression counts [/min]			57
Ventilation Data:			
Total number of ventilations			10
Total time before intubation			00:02:59.1
Total time after intubation			00:00:00.0

Post Resuscitation Dress Rehearsals... Building Competence to Excellence...

“Just-in-Time....Just-in-Place”



Educational (Cold) Debriefings

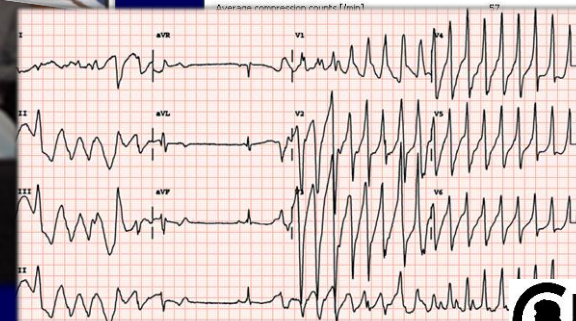
Regularly scheduled education and discussion of resuscitation event(s) open to multidisciplinary providers

- Audio-video review
- Patient history and diagnosis
- Quantitative review of CPR Quality (CC and hemodynamic data, ETCO₂)
- Latent and obvious errors
- Examples of excellence
- Clinical issues
- System issues
- Team performance



Post-analysis Q-CPR Report Card

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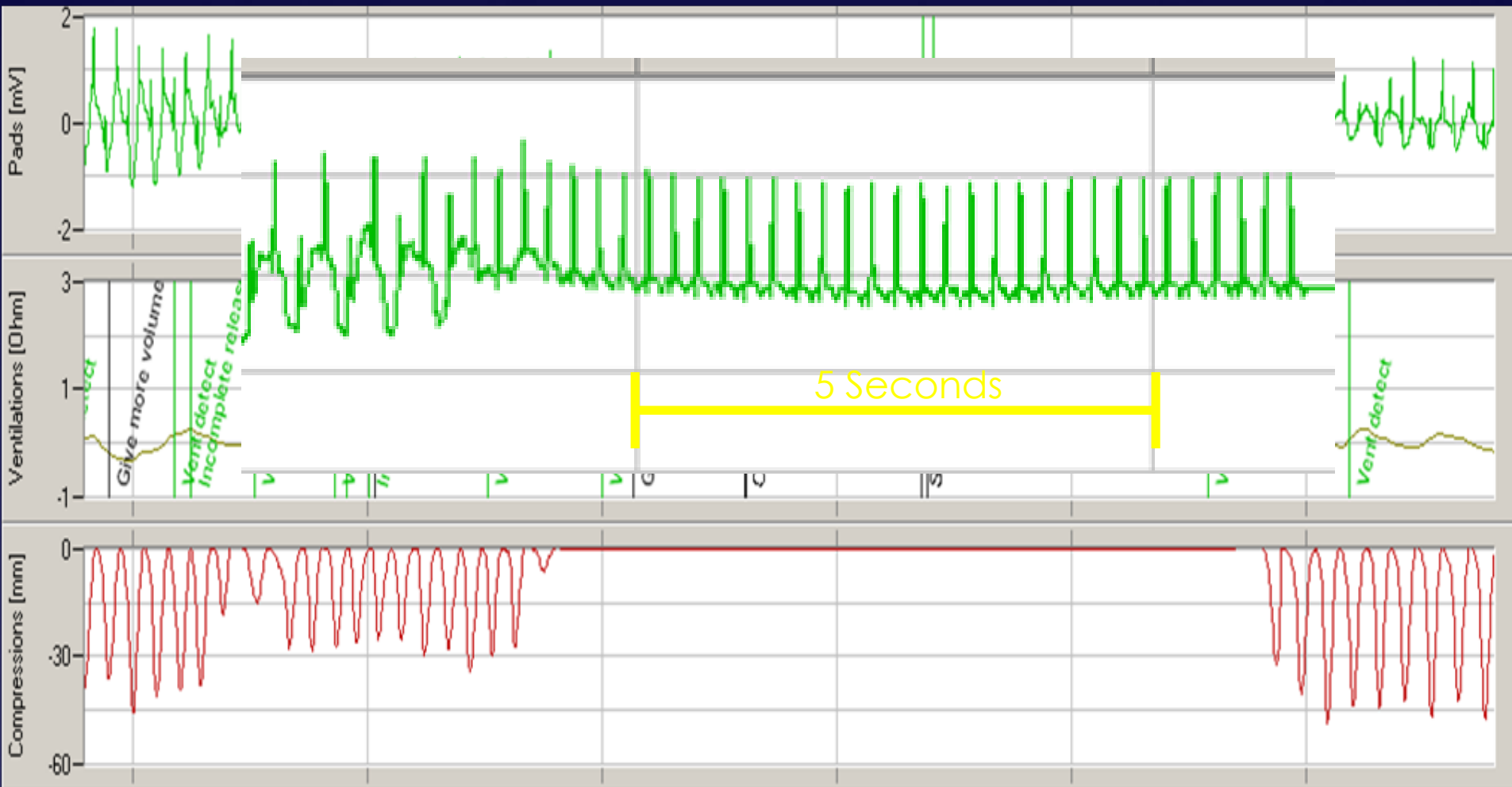
What is debriefing?

- * **Carefully reviewing upon completion**
- * **Facilitator-led participant discussion of events, reflection, and assimilation of activities**

Eight Content Areas

- * No flow time**
- * Chest compression quality (rate and depth)**
- * End tidal CO2 use to guide CC quality**
- * Defibrillation (time to, success)**
- * Communication/teamwork**
- * Rhythm recognition**
- * Medications**
- * Pediatric cardiac arrest physiology**

What we are targeting... one example



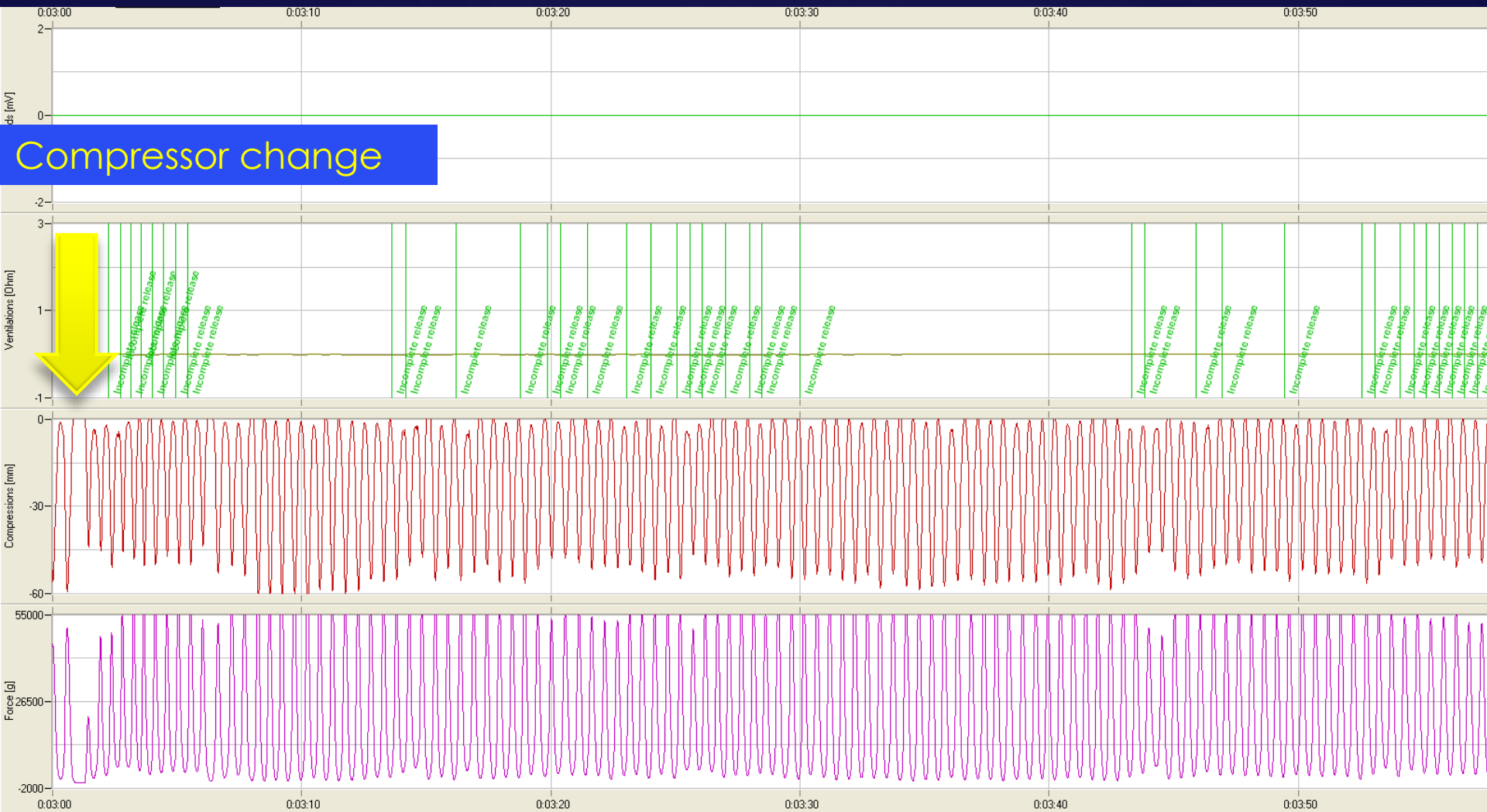
Defibrillation



Provider switch

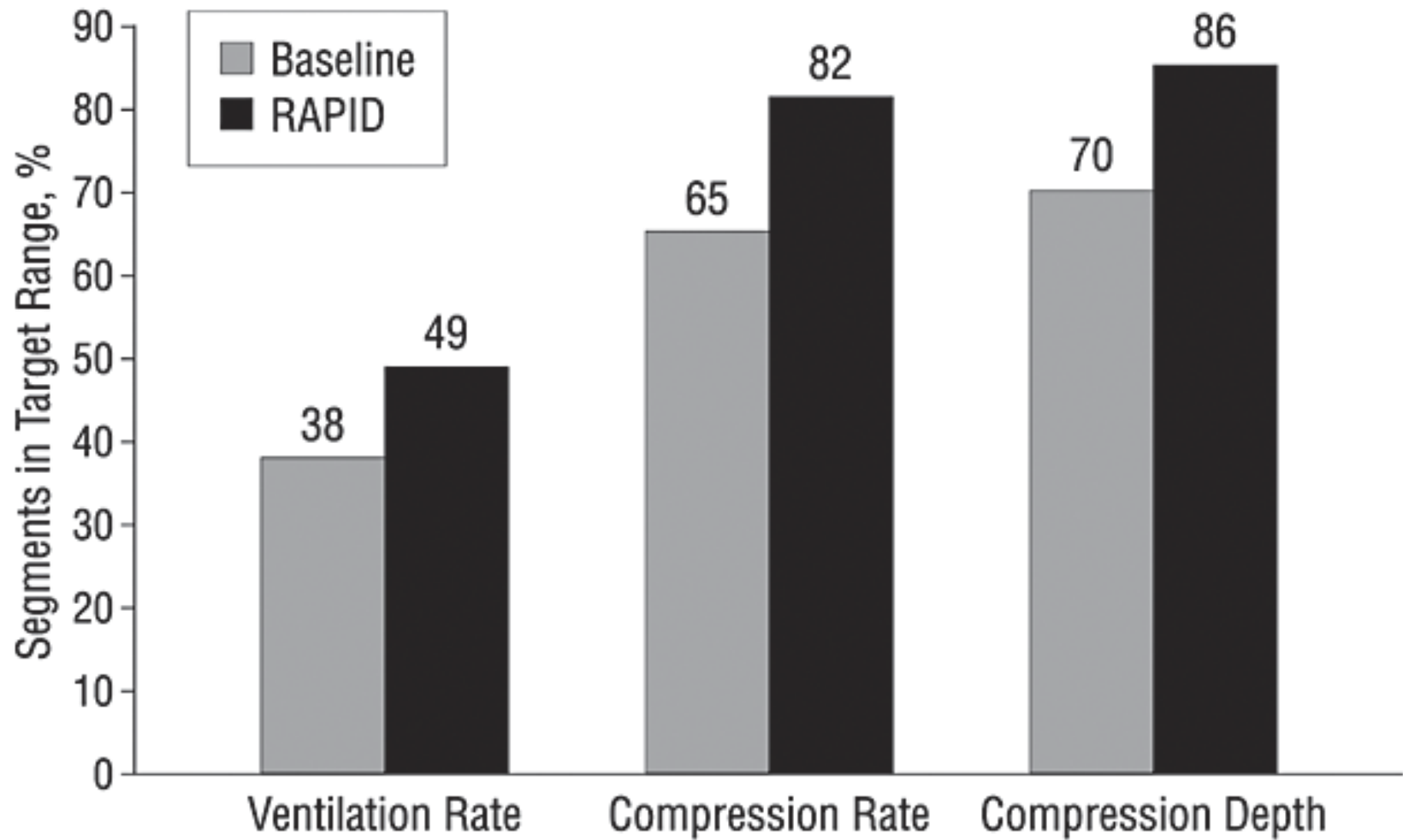


Provider switch



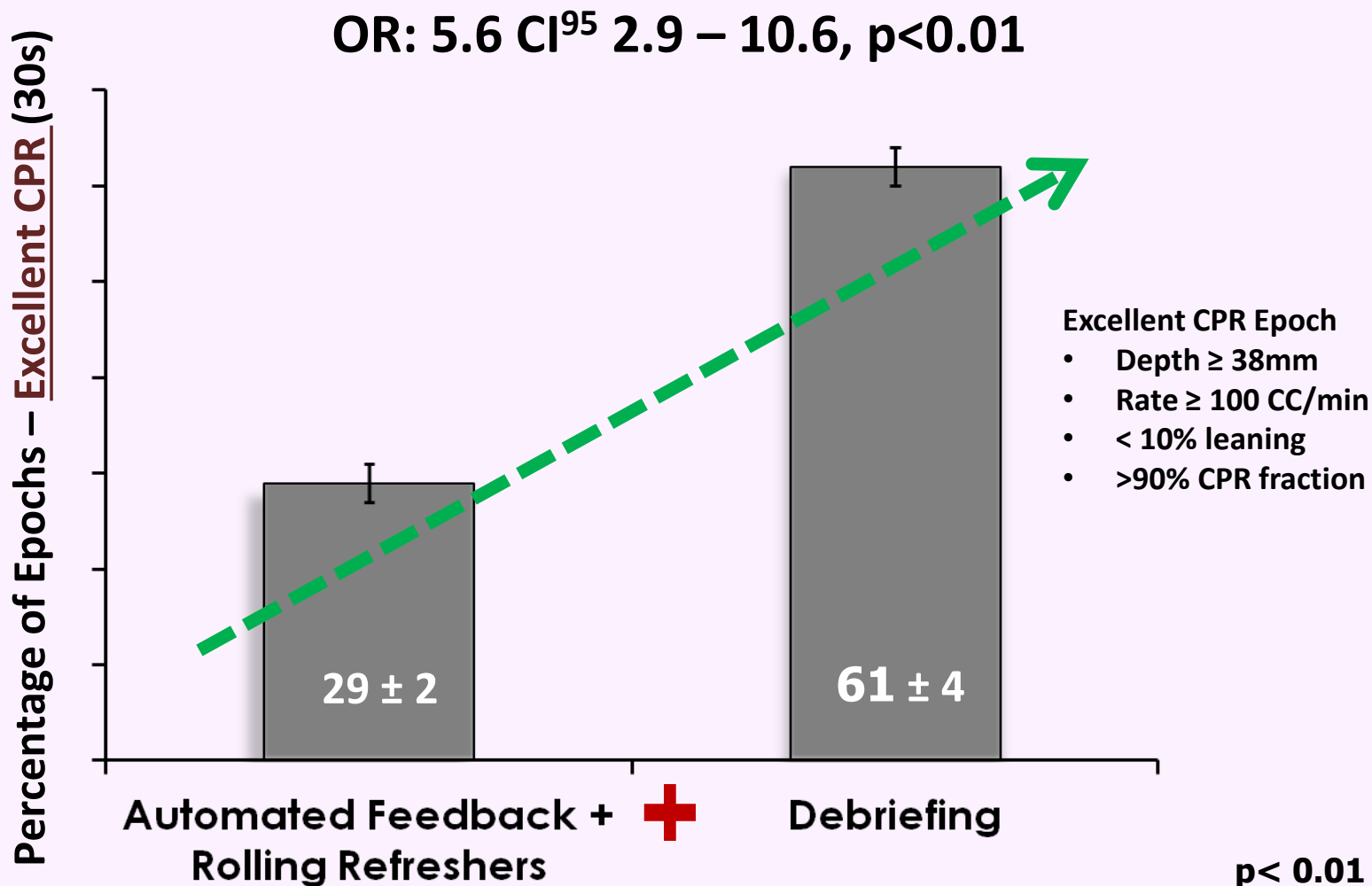
Debriefing Improves CPR

Edelson Archives of Internal Medicine 2008



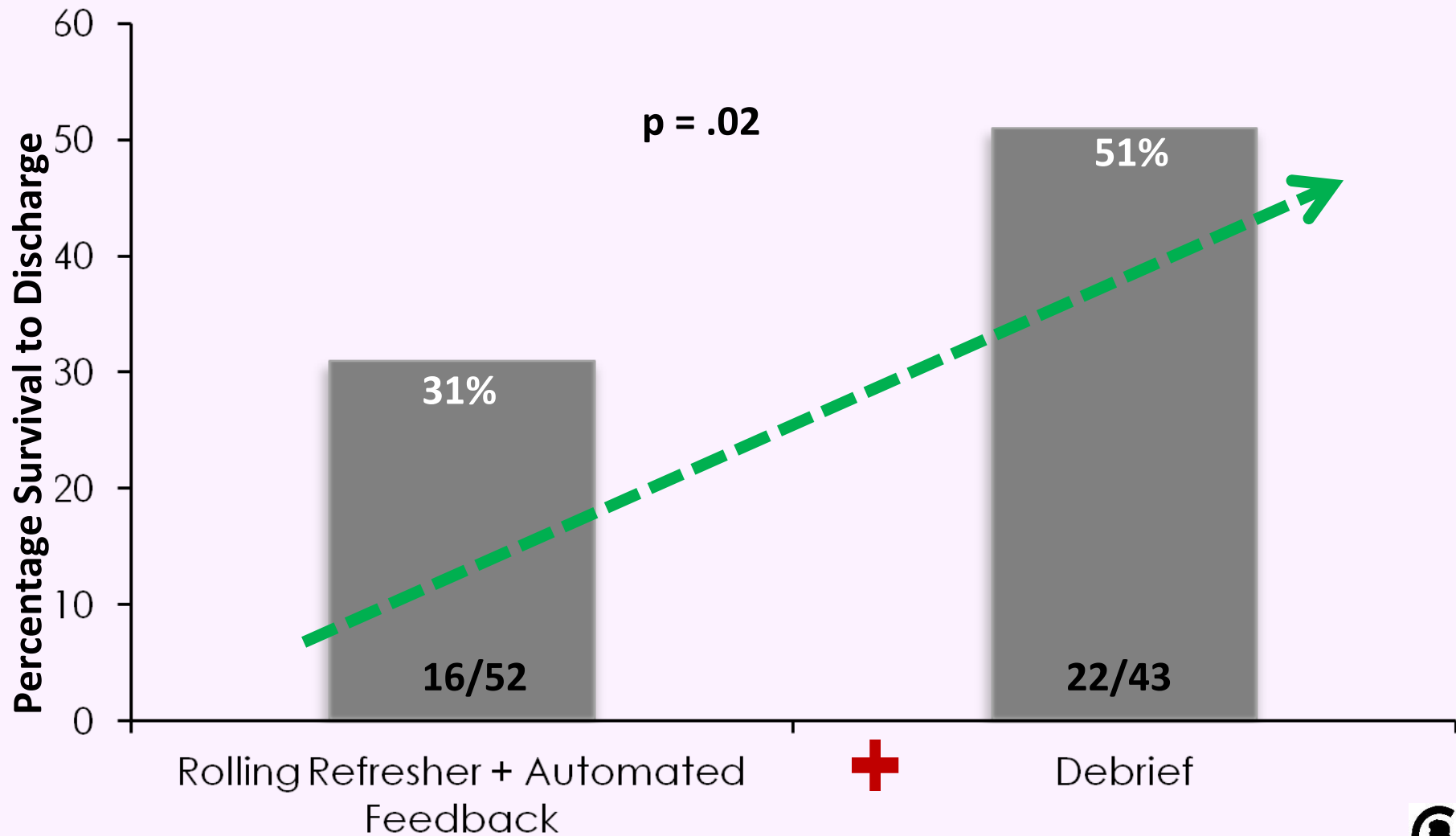
Rolling Refreshers + Debriefing

Primary Outcome: Excellent CPR



Rolling Refreshers + Debriefing

Secondary Outcomes: Survival to Discharge



The *Pediatric* Quality of Resuscitation Program



Bridging the Gap between “Training” and “Actual Performance”

Vinay Nadkarni MD, MS

President-Elect, Citizen CPR Foundation

December 10, 2015

Rigorous
Evidence
Evaluation

PRACTICE!

LOOK
AT
OURSELVES!

What
We
Know

**Guidelines
and
Medical
Standards**

What we
teach,
learn and
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**What
we
Do**

Patient Outcome



= **20%**

Fact!

95%

x

75%

x

75%

= 54%

Transmit more of what we know to the care at the bedside!

Desired Implementation resulting from Education

Self-efficacy

(improvement in learner's self-confidence)

Competence

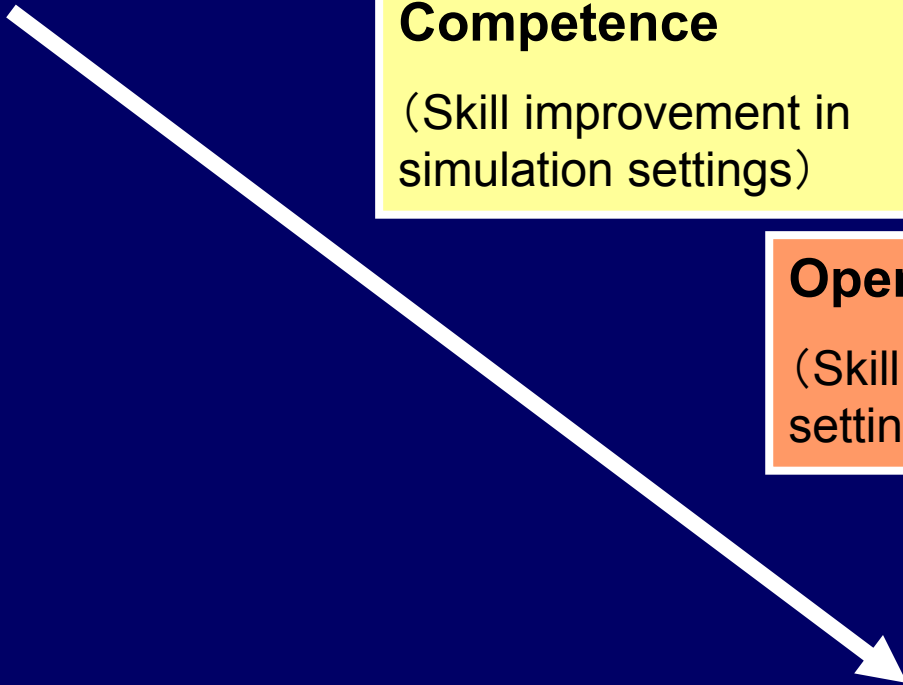
(Skill improvement in simulation settings)

Operational Performance

(Skill improvement in clinical settings)

Improved Outcome

(Improvement in patient outcome)



The Children's Hospital of Philadelphia



40% ICU Beds (200/540)



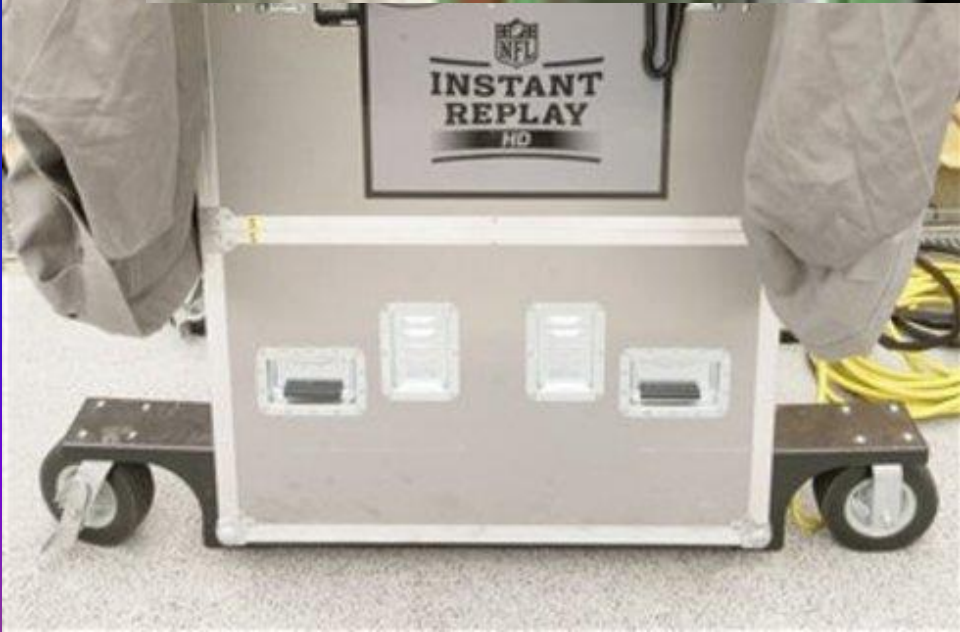
**> 1,000,000
Possible teams**

HOW DO YOU TAKE A
TEAM OF
CHAMPIONSHIP
CHAMPIONS
TEAM !!
AND MAKE
THEM INTO A



Sports

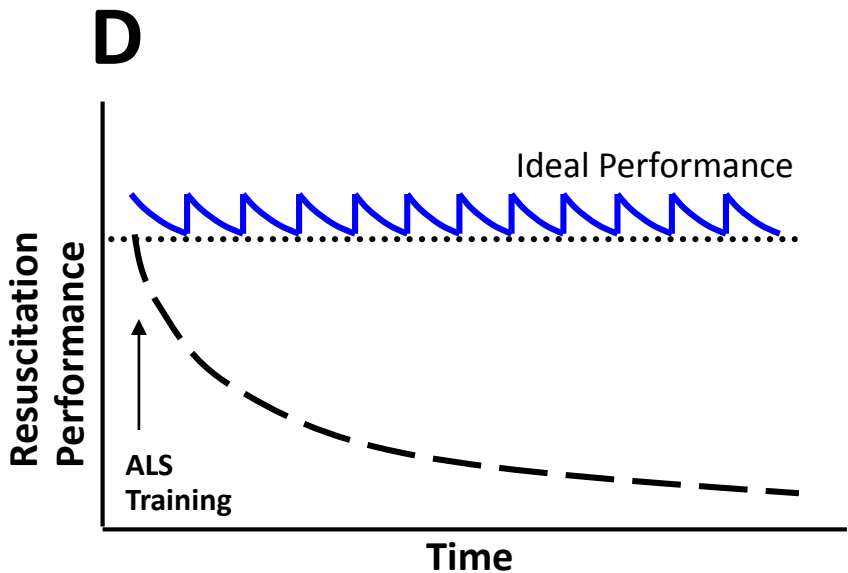
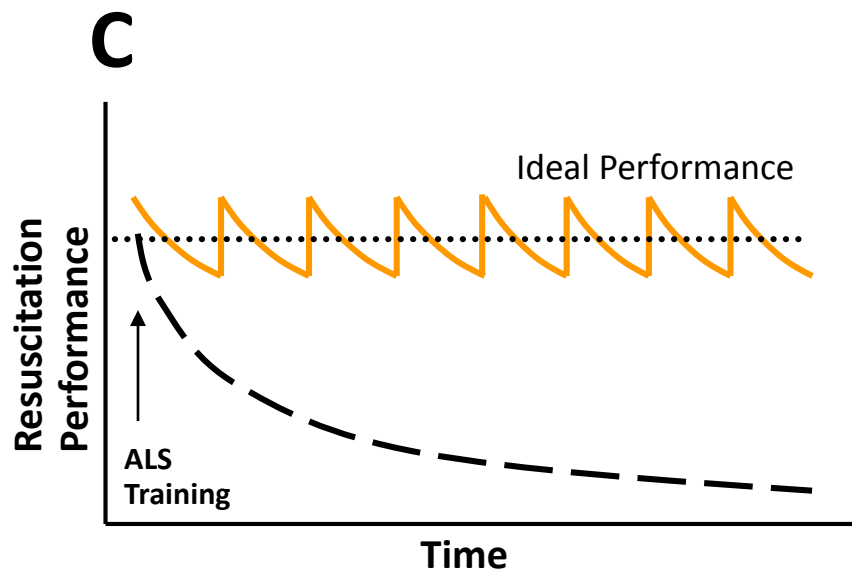
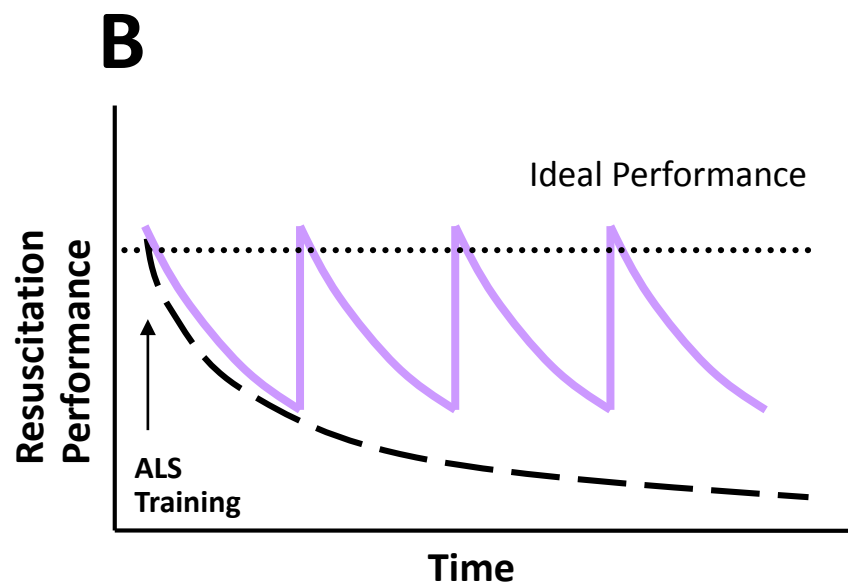
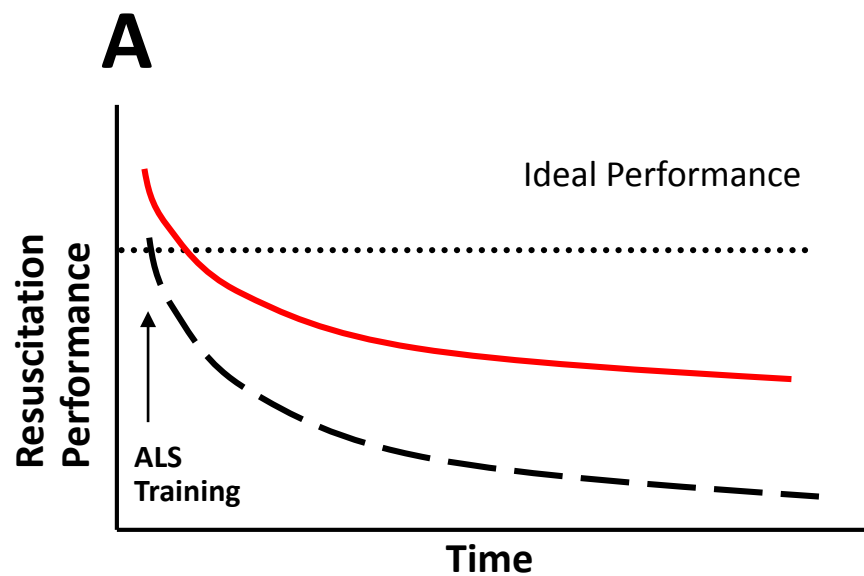




FANTASY FOOTBALL

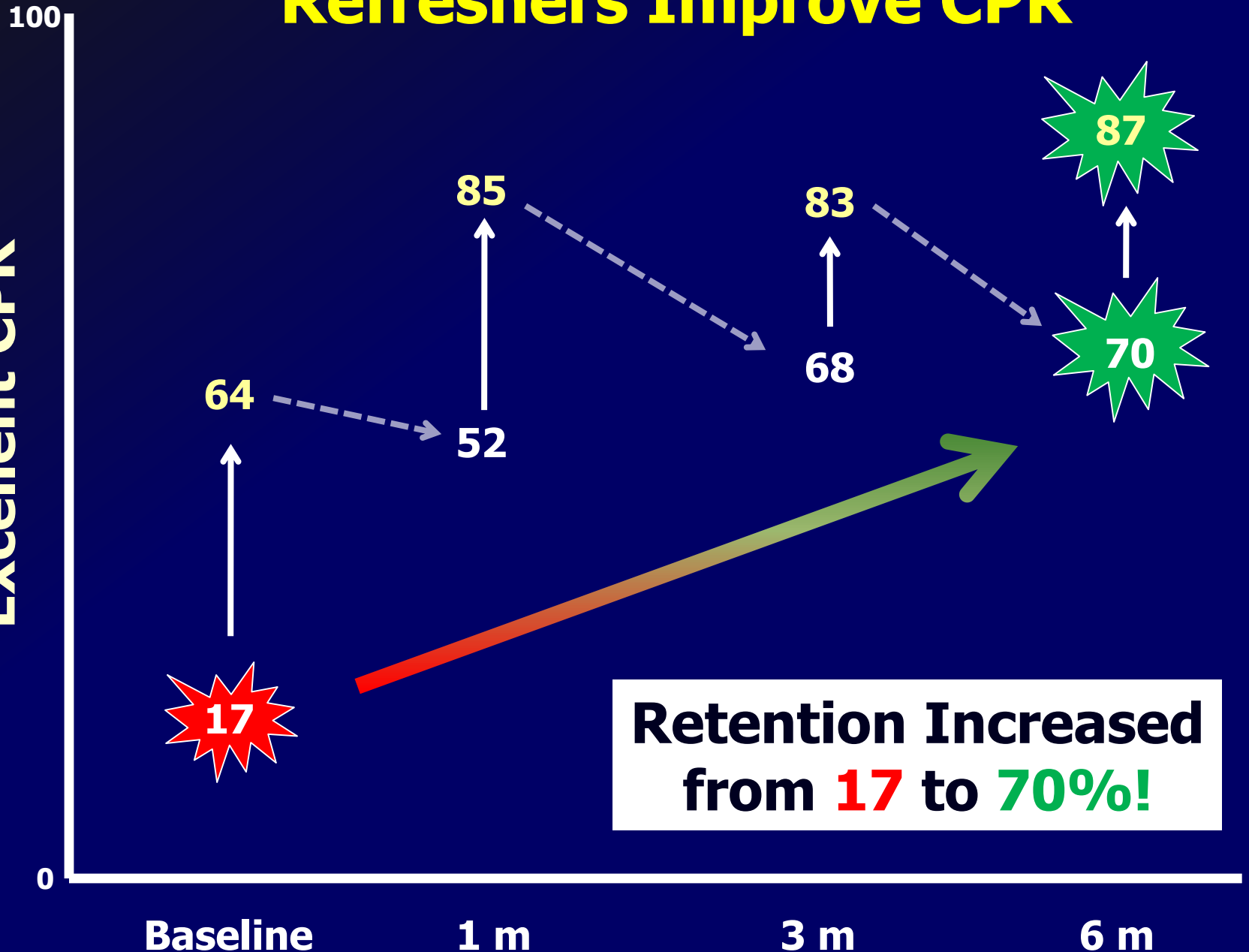


Resuscitation Performance Over Time With Various Training Techniques



Refreshers Improve CPR

Percentage Performing
Excellent CPR



Retention Increased
from **17** to **70%**!



Embedding Training into Practice and Measuring of Outcomes

High Risk Screening for Just-in-Time Training



Real-Time Feedback



Performance Debriefing



Focused Efforts to Improve Skills

Low Intensity
High Frequency

Environment

Team

Individual



Performance
Debriefing

Performance
Feedback



Pit Stop Mentality



NASA Command Center

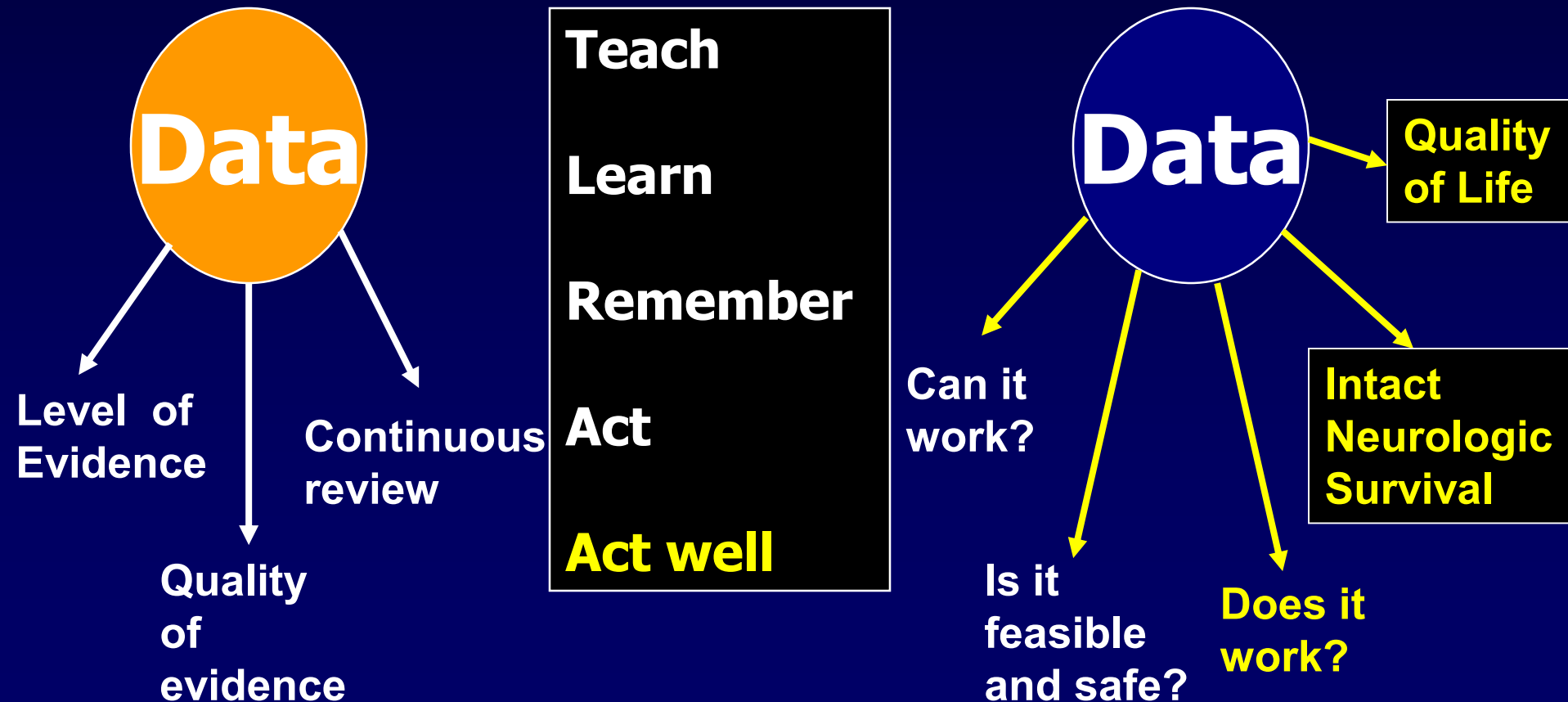




On-Star (Automobile support)

Challenges toward 2020

Knowledge Discovery → **Knowledge Processing** → **Knowledge Transfer**



Quality of Resuscitation Improvement

