CPR

The Science and Your Role In Improving Outcomes

Program Outline

1. **Overview**
2. **The Science of CPR**
3. **Guidelines 2005: CPR Revisited**
4. **The Challenges of CPR**
5. **Measuring CPR Quality**
6. **Improving Quality**
7. **Mechanical CPR – Does It Have A Place In Hospitals?**
   - **LDB CPR**
   - **Body of Evidence**
8. **Summary**

Full Disclosure

The presenter is an employee or representative of ZOLL Medical Corporation which develops and markets devices for resuscitation including defibrillators, CPR feedback devices, load distributing band resuscitators and code documentation software.

Overview

This program covers the following:

- The science of CPR, the role of CPR in cardiac resuscitation with an emphasis on AHA Guidelines 2005.
- Key research on the quality of CPR performed and the importance of high quality CPR on outcomes.
- Tools to improve manual CPR quality
- Review of Mechanical CPR

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Objectives

- Following completion of this course participants should be able to:

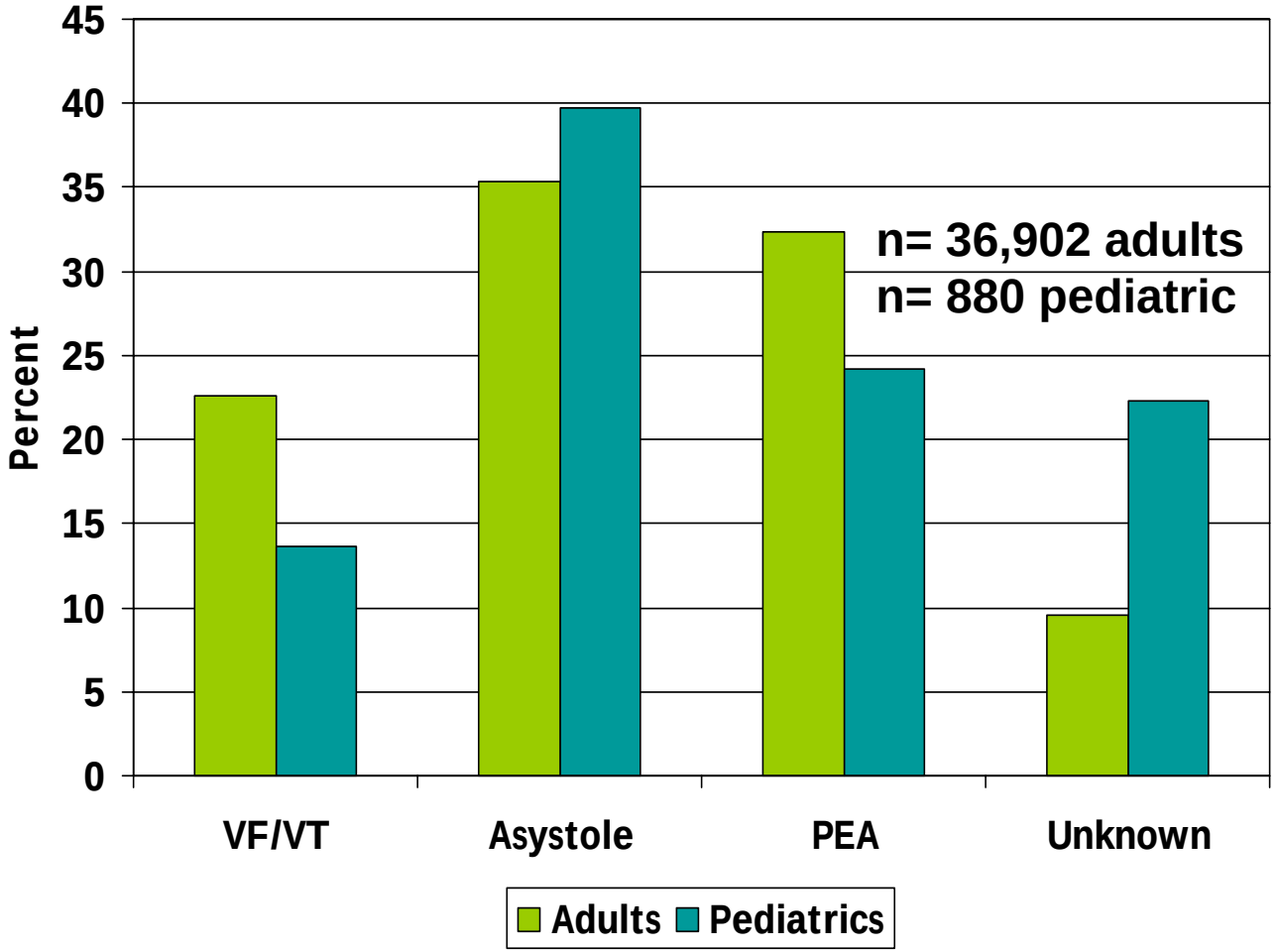
  - Articulate the importance of CPR in resuscitation,
  - Understand the critical components of good CPR
  - Discuss ways to improve CPR quality in hospitals

Overview of In-hospital Cardiac Arrest

- **Incidence:**
  - **0.175 arrests/bed per year**
  - **1-5 arrests/ year per 1000 admissions**
- **ROSC:**
  - **44% Overall**
  - **58% VF**
  - **35% PEA/ Asystole**
- **Survival to Discharge:**
  - **Overall Survival to Discharge: ~17% (0 - 42%)**
  - **With VF/VT – 34%**
  - **With Asystole/PEA: 10 %**

Sandroni, C et al, Intensive Care Medicine, Sept 2006 Online Pub.
Peberdy et al, Resuscitation 58(2003) 297-308

In-hospital Cardiac Arrest in the USA



Nadkarni et al JAMA, Jan 4, 2006 Vol 295, No1
Parish et al Resuscitation 58(2003) 31-35

Why the Change?

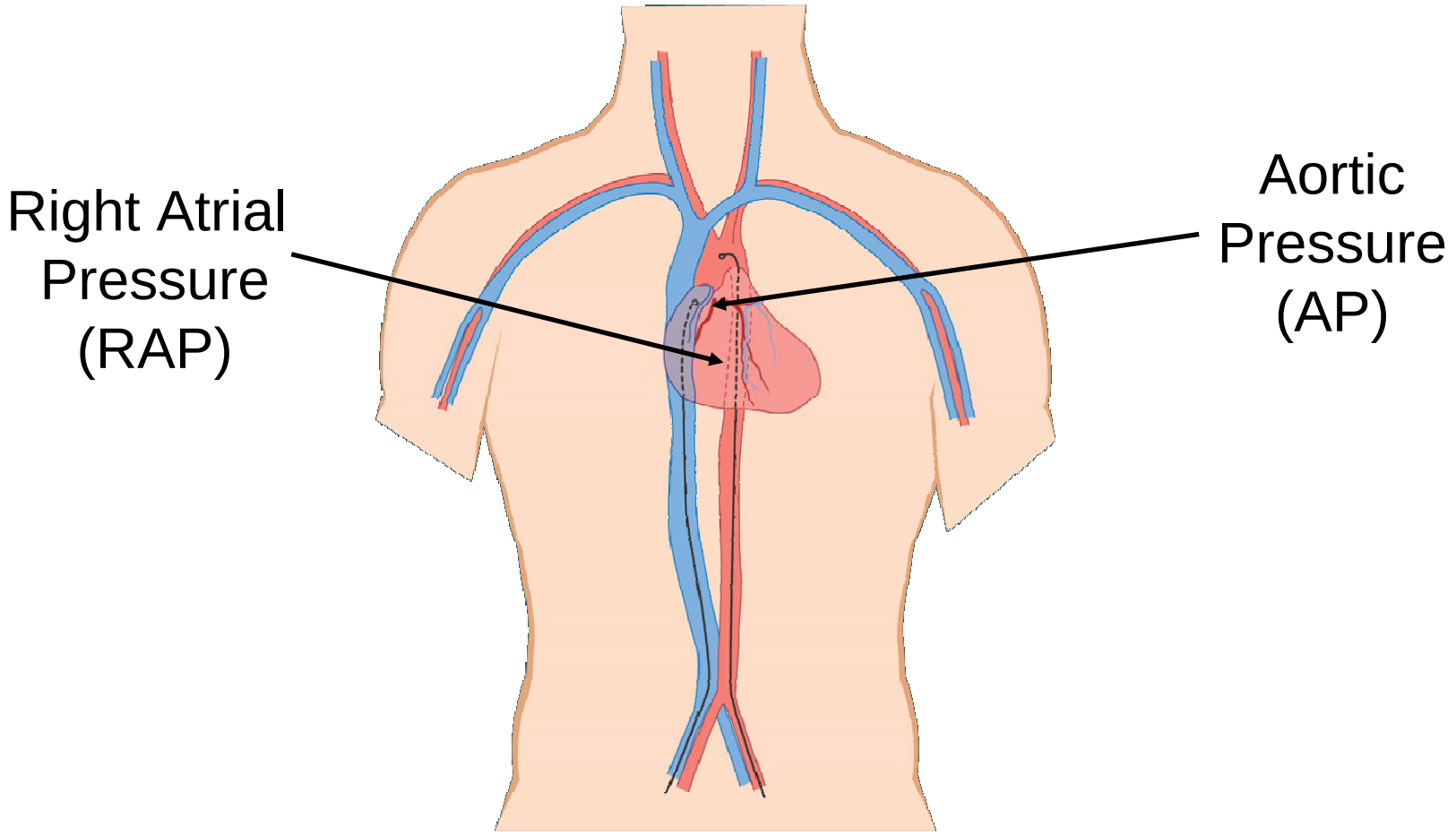
- Thought to be due to widespread use of primary and secondary prevention strategies- calcium channel blockers and beta blockade.
- Also impacted by ICD’s and anti arrhythmic agents
- Increase in arrests due to respiratory failure in non cardiac patients in hospital

The Science of CPR

Re-establishing blood flow to the vital organs is the single most important factor for successful resuscitation when the duration of cardiac arrest is prolonged (> 4 min).

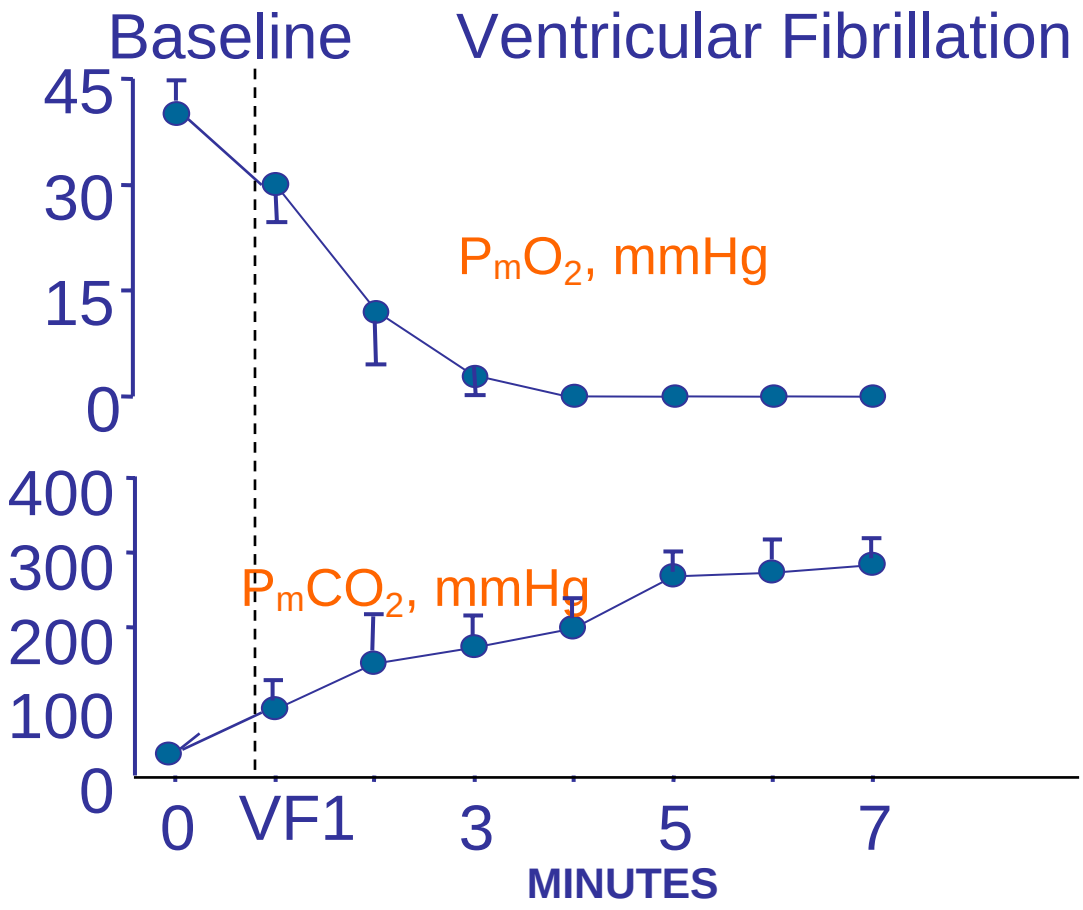
Tang W. Proceedings of ERC Symposium May 2006, Medcom.

Coronary Perfusion Pressure



CPP = AP minus RAP

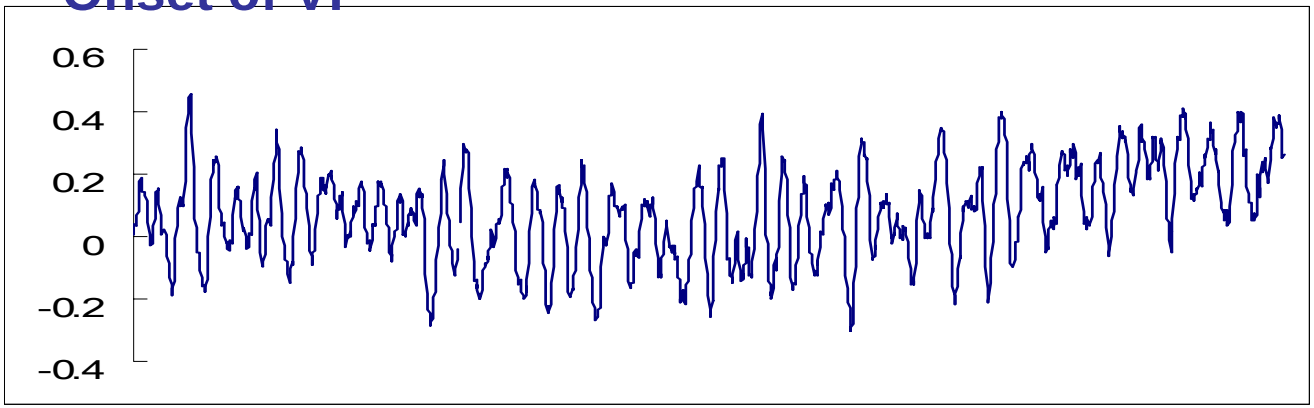
Oxygen and VF



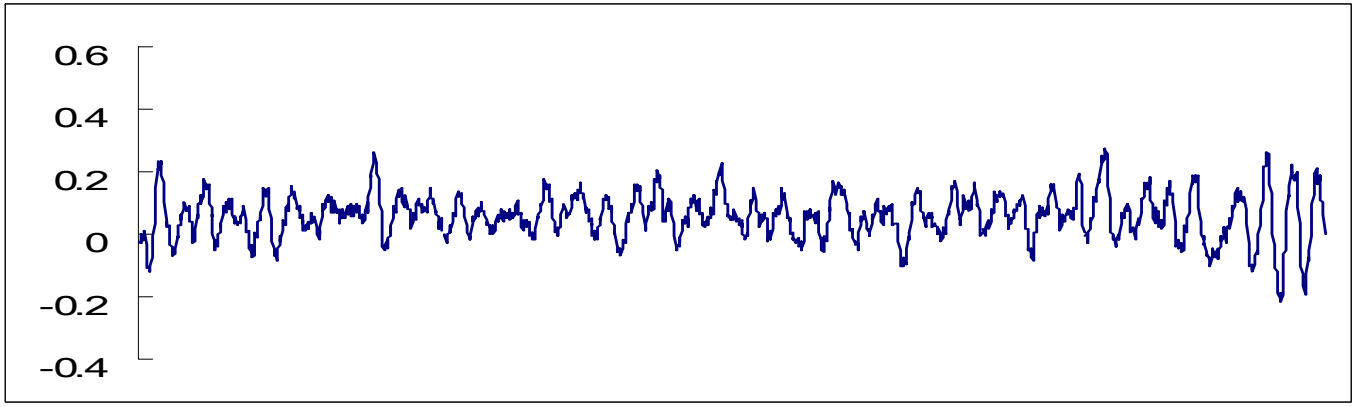
Tang W: Proceedings of ERC Symposia: Squeezing High Performance Out of CPR Medcom 2006

VF Changes Over Time

Onset of VF

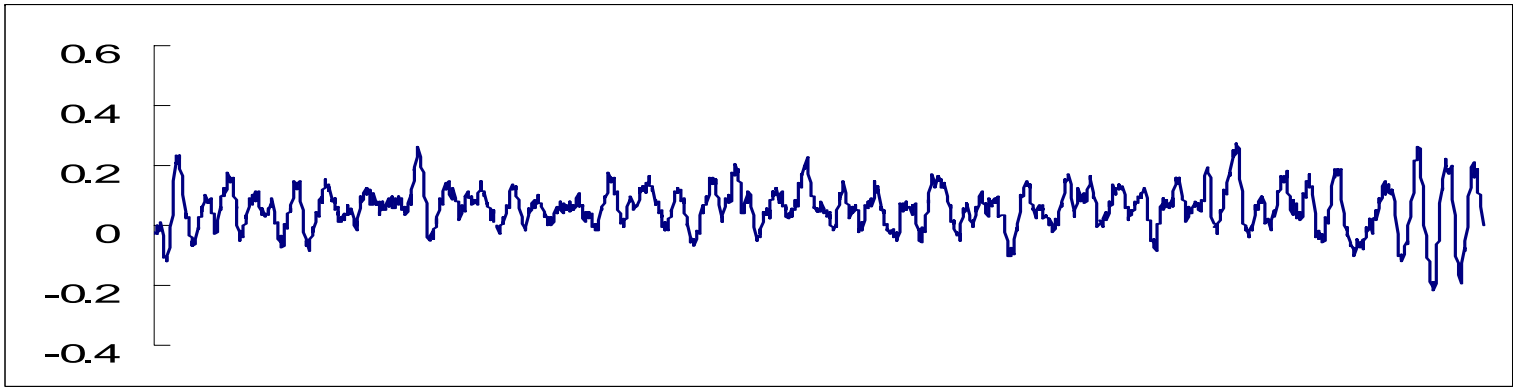


5 Minutes VF

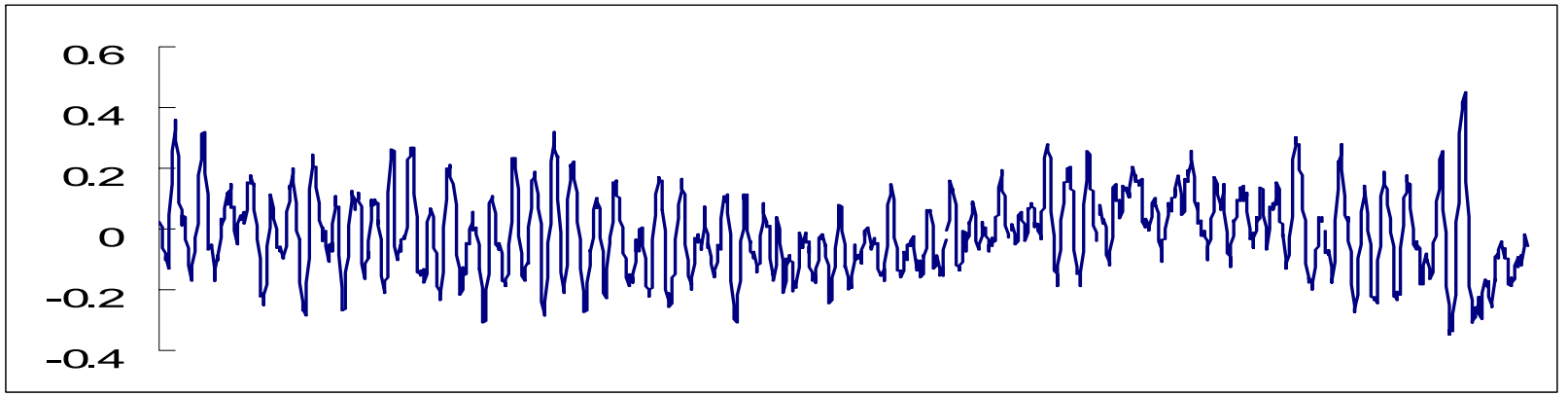


CPR and VF

5 Minutes of VF



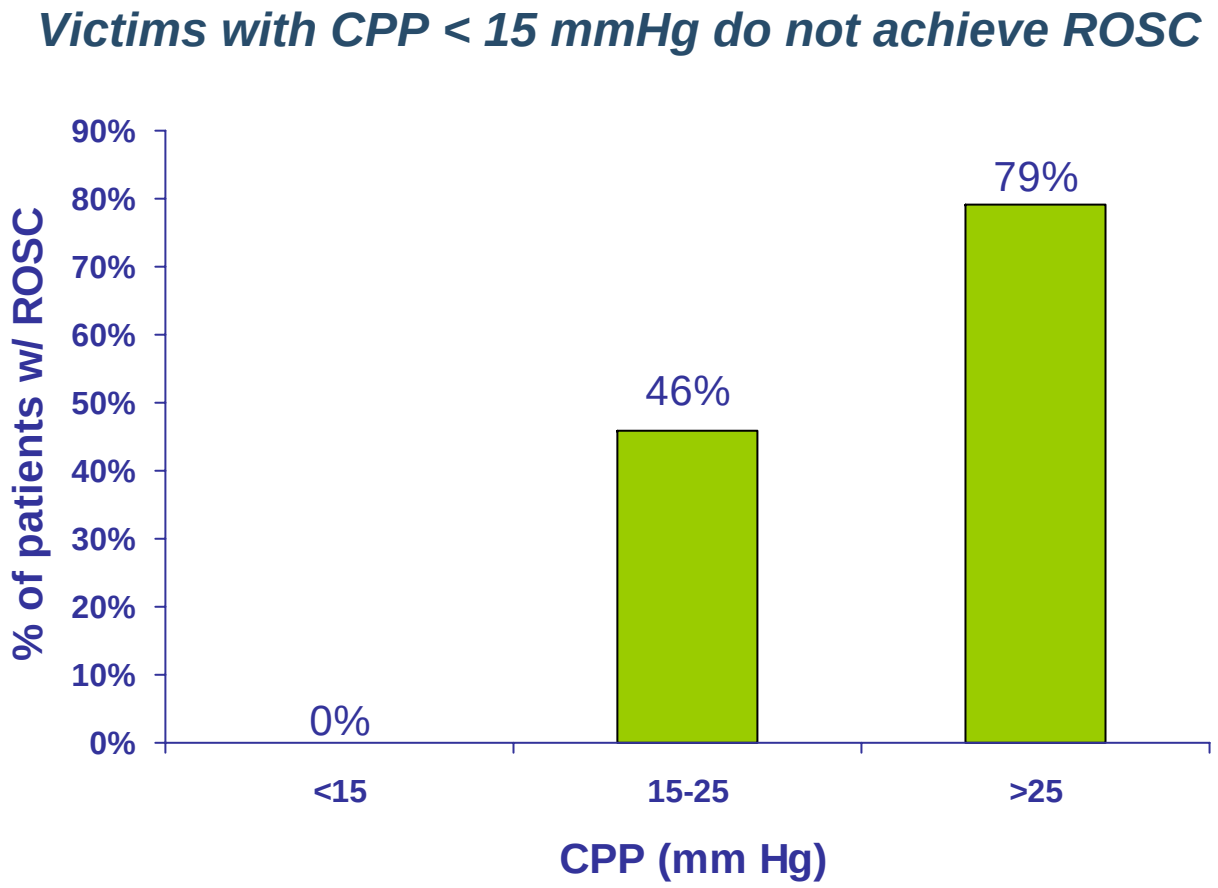
After 3 Minutes of Effective CPR



Eftestol et al Circulation 2004;110;10-15

CPR

ROSC Requires >15mmHg



Paradis NA et al. *JAMA*. 1990;263:1106-1113.

2005 AHA Guidelines - What Changed?

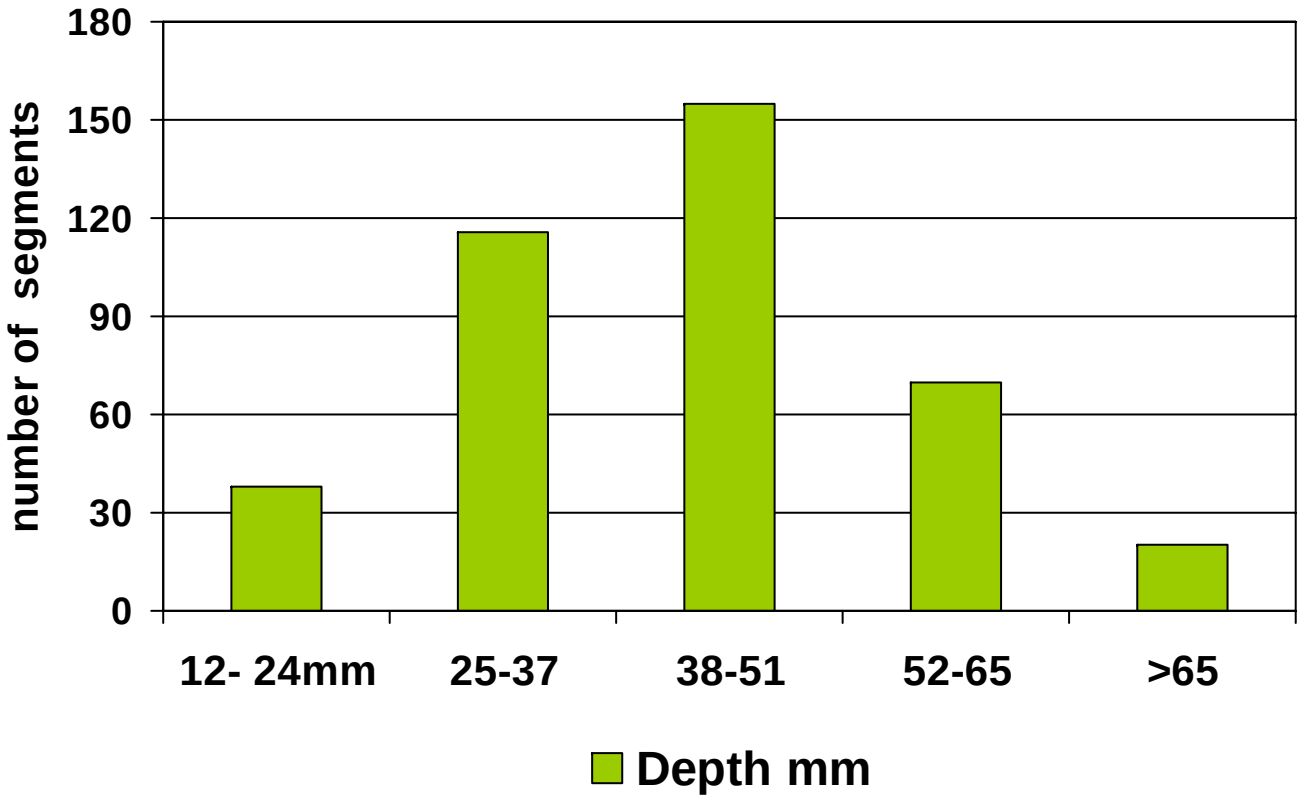
- 1 cycle of CPR 30 compressions and 2 breaths
- 2 minutes of CPR between shocks
- No stacked shocks, 1 shock then 2 minutes of CPR
- Unwitnessed arrest start with CPR
- Reduce Ventilations to 8-12/minute

Quality of CPR
Evidence and Effects

The Challenges

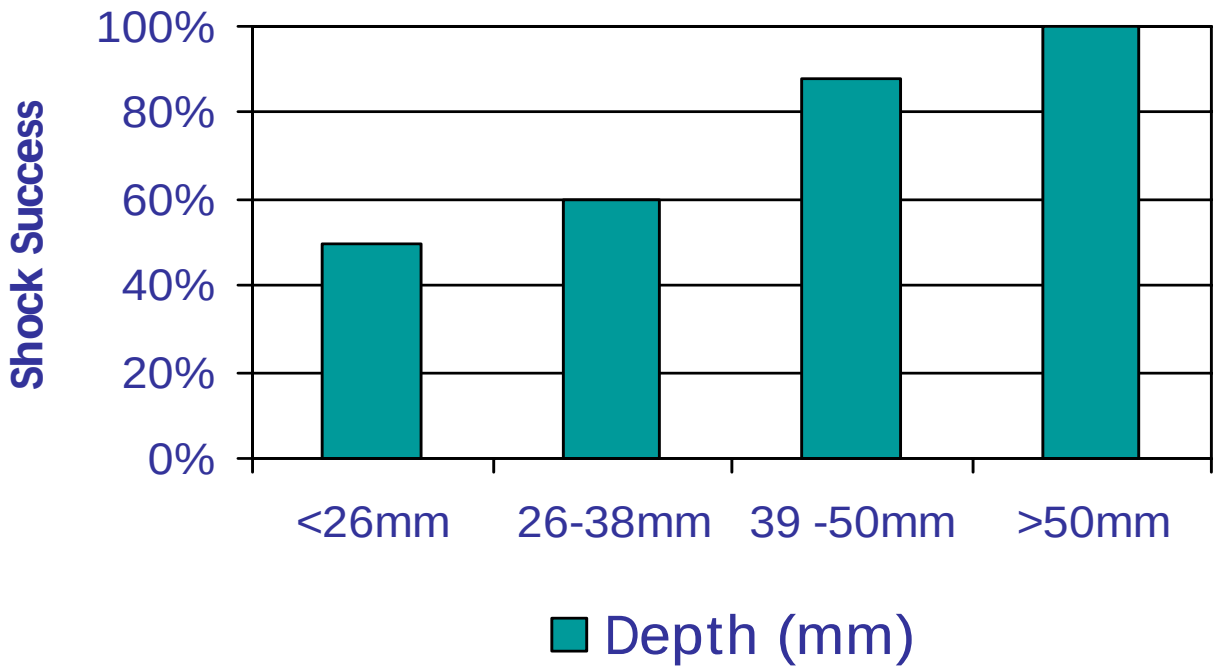
- Poor quality
  - Inconsistent depth and rate and duty cycle
- Harmful interruptions
- Inadequate cerebral and cardiac perfusion
- Inadequate support for defibrillation

Compression Depth
How Well Do We Do?



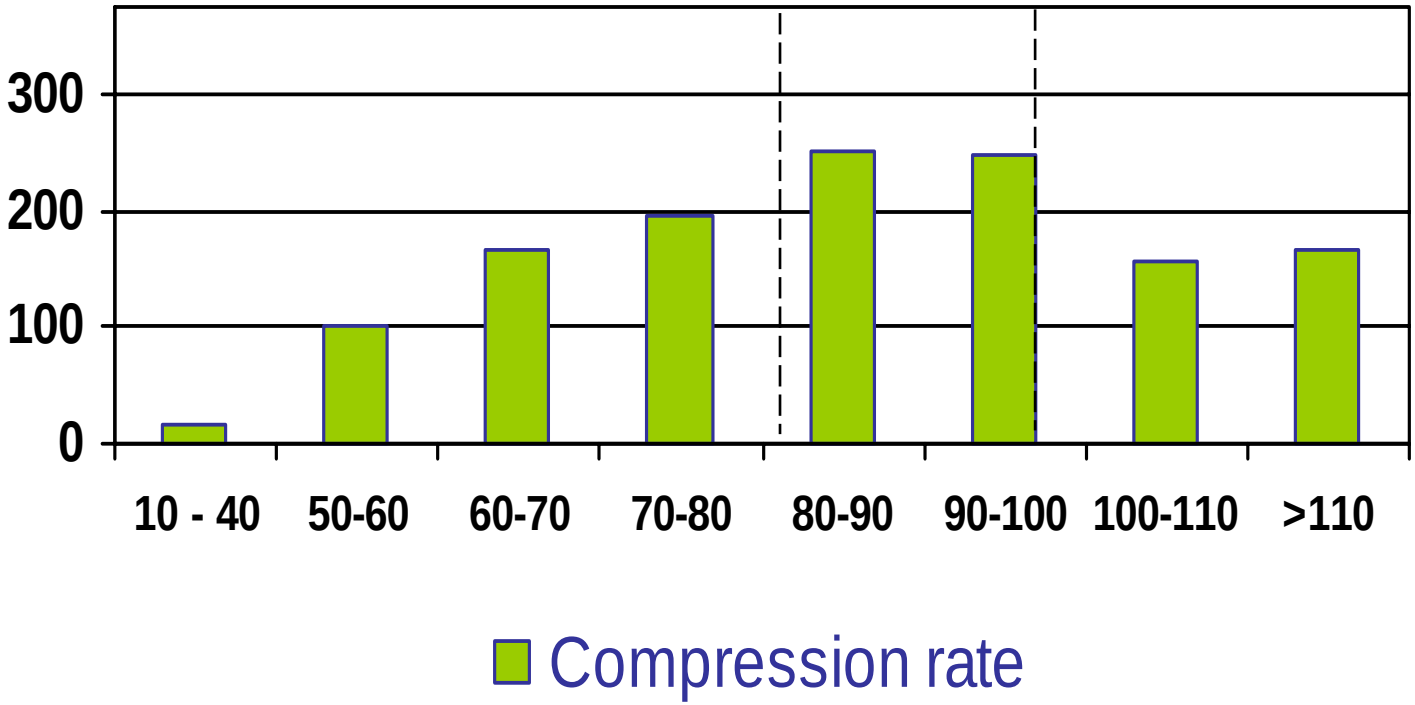
Abella BS, CPR Symposia ERC 2006

Compression Depth
How Much Does It Matter?



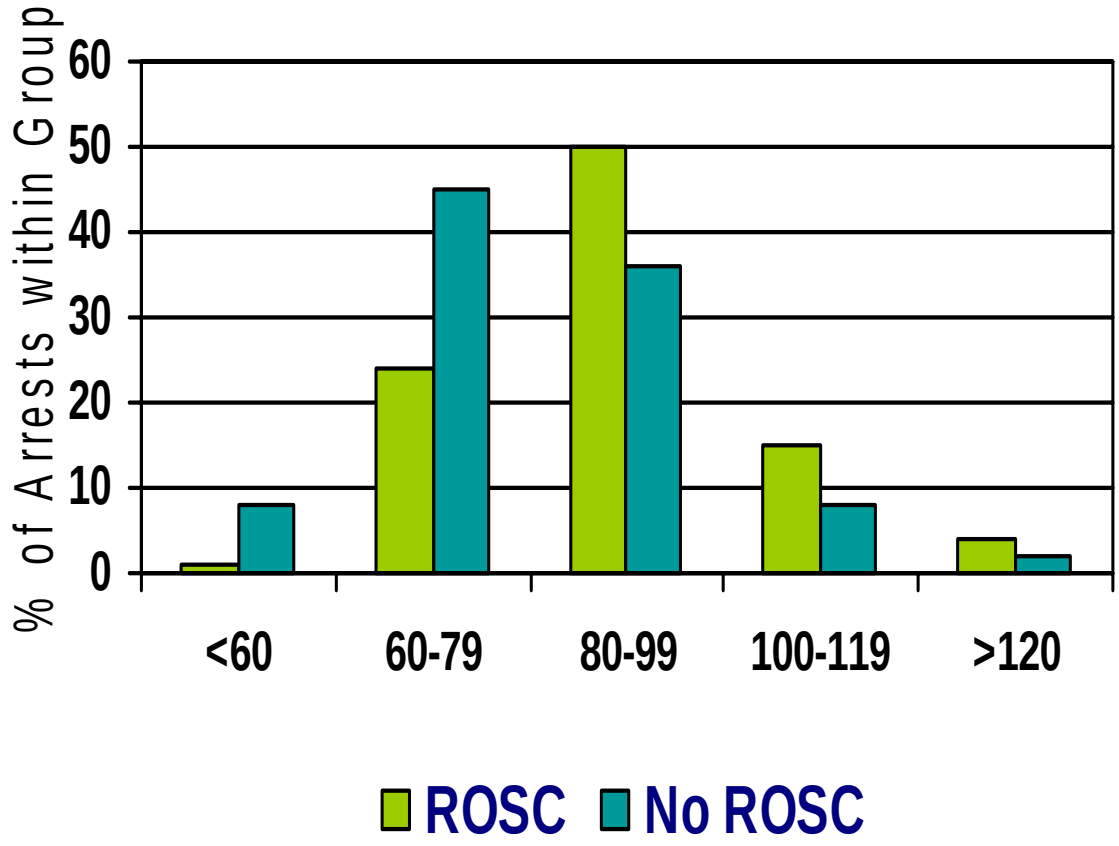
Edelson DP et al, Resuscitation (2006) 71, 137-145

Rate: How Do We Do?



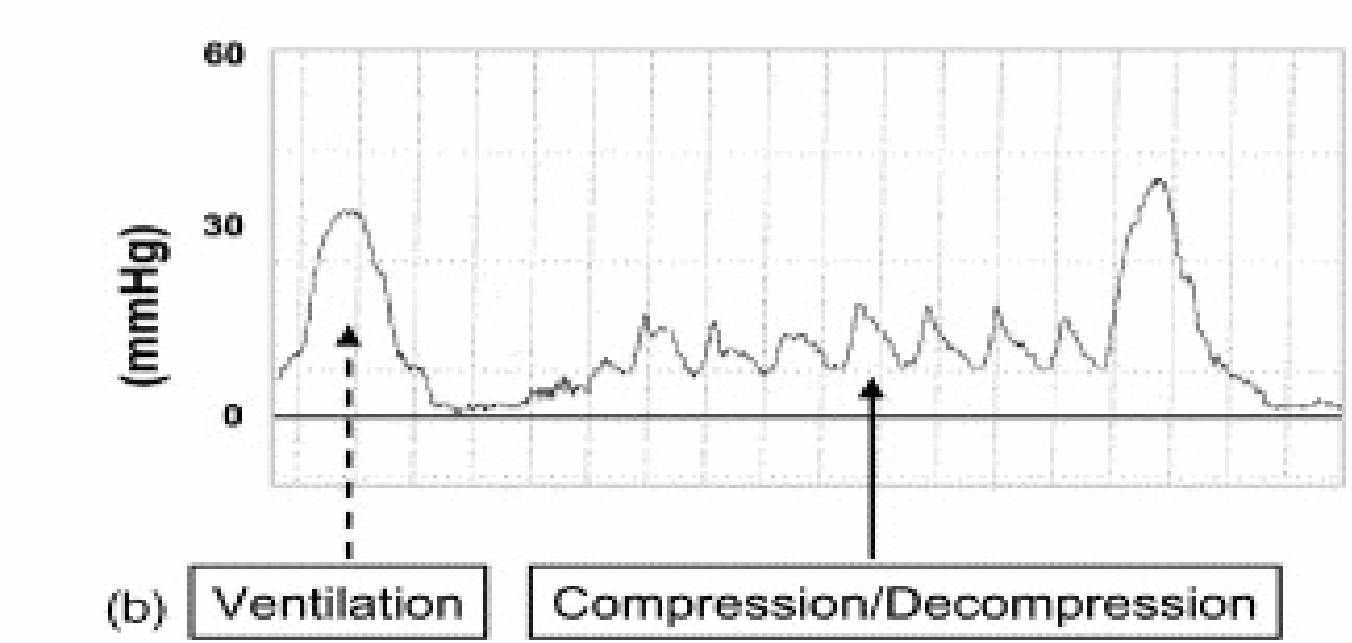
Abella BS et al Circulation 2005;111;428-434

Rate - How Much Does It Matter?



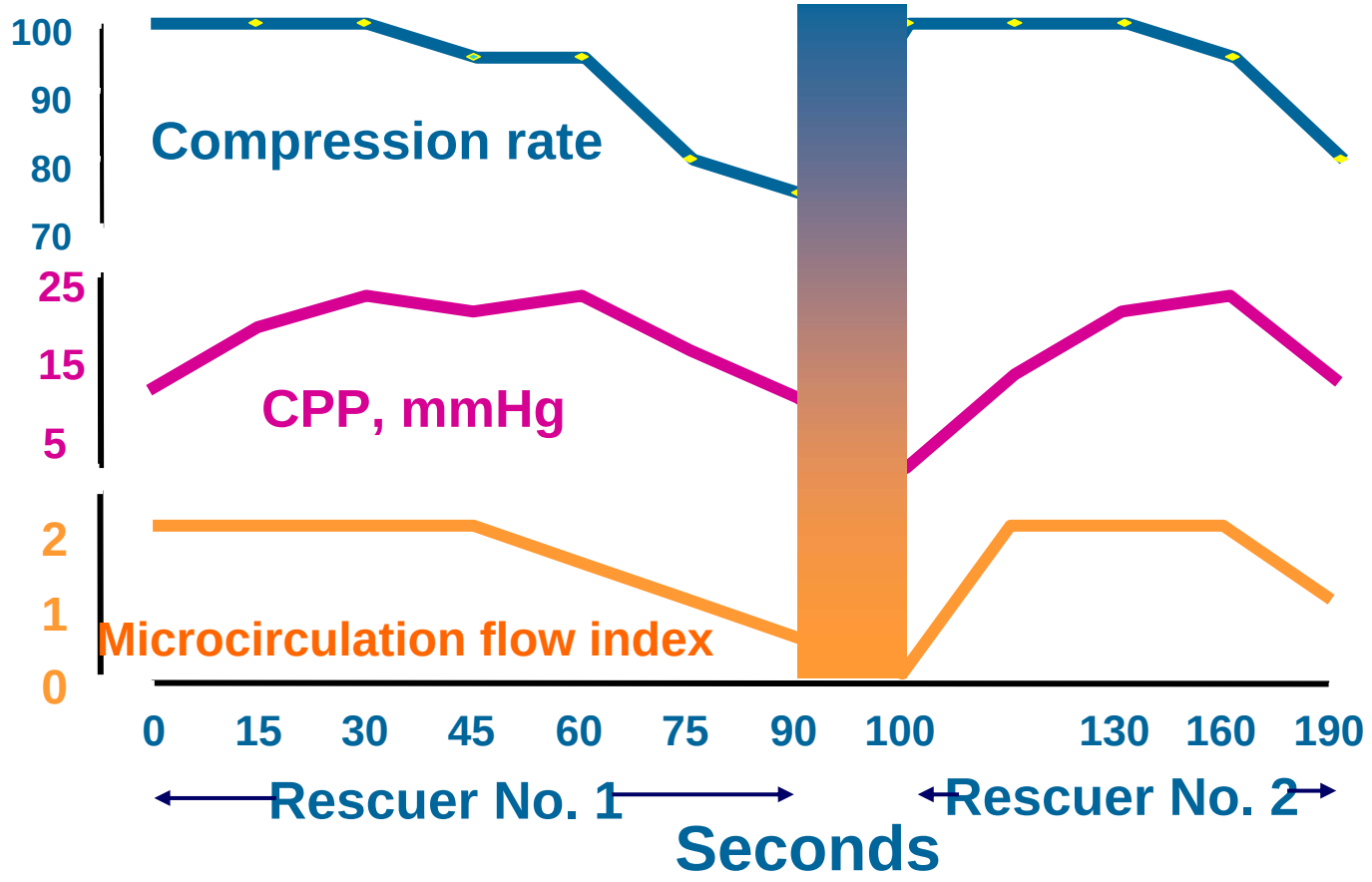
Abella BS et al Circulation 2005;111;428-434

Duty Cycle- Does It Matter?



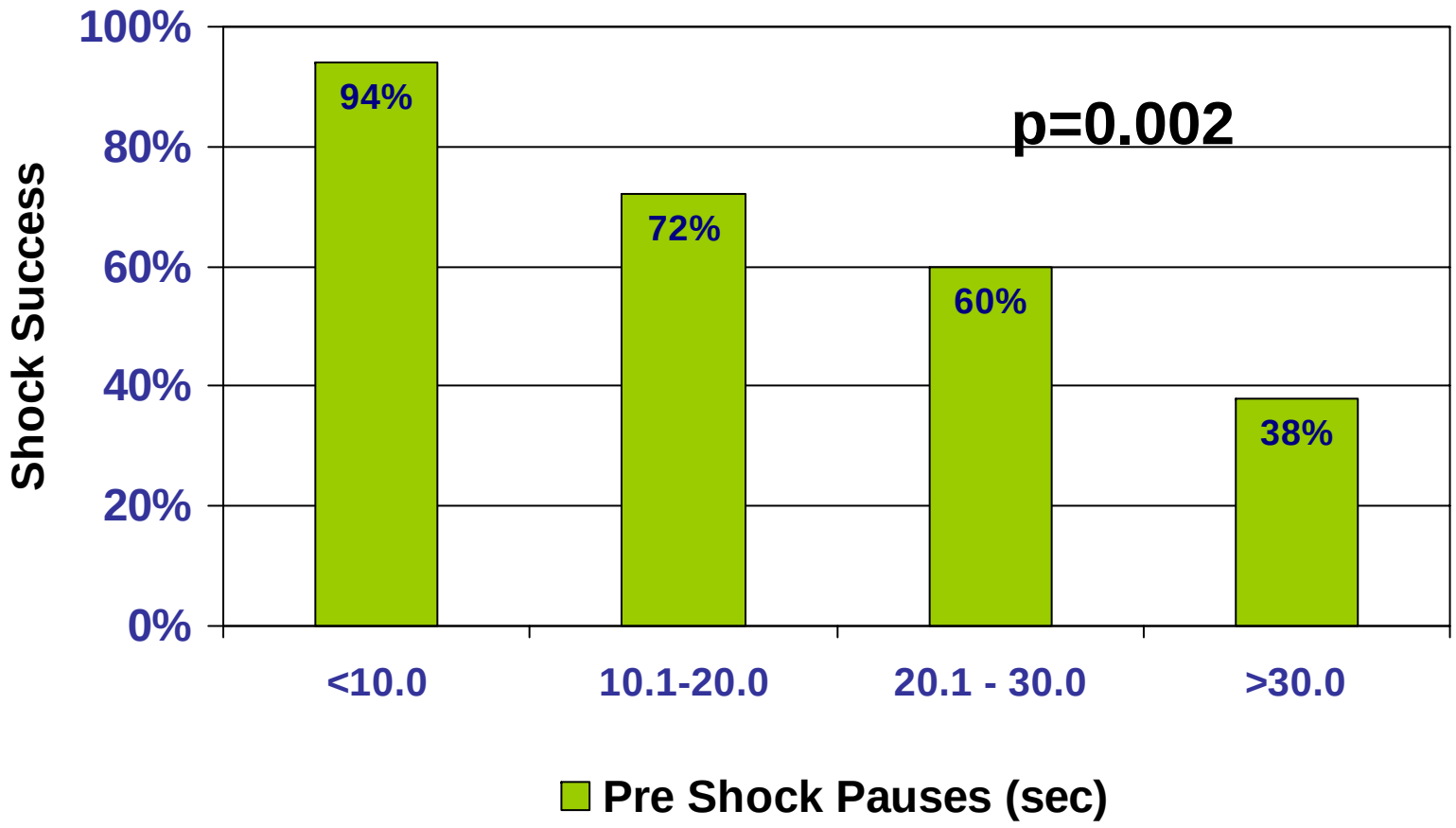
Aufderheide et al, Resuscitation 64(2005) 353-362

Interruptions
How Much Do They Matter?



Tang W. Proceedings of the ERC symposium: Squeezing High performance out of CPR. Medcom 2006

Pre Shock Pauses in CPR Impact Ability to Defibrillate Successfully

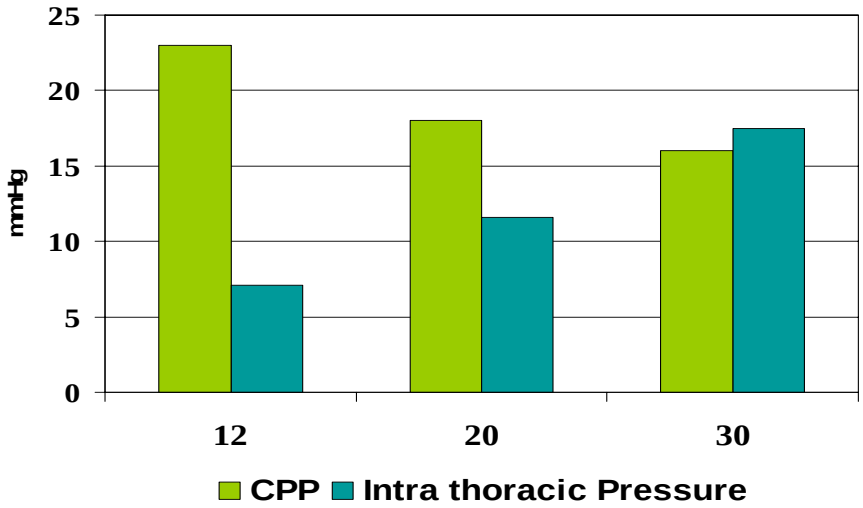


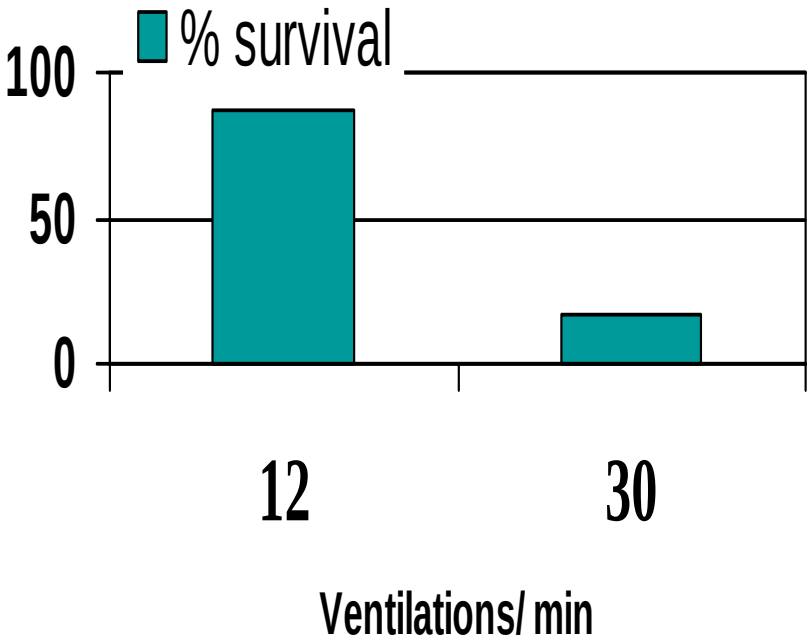
Edelson et al, Resuscitation (2006) 71, 137-145

Ventilation
How Do We Do?

Aufderheide et al. Circulation 2004; 109;1960-1965
Abella et al JAMA 2005;293,3 305-310

Ventilation Does It Matter?

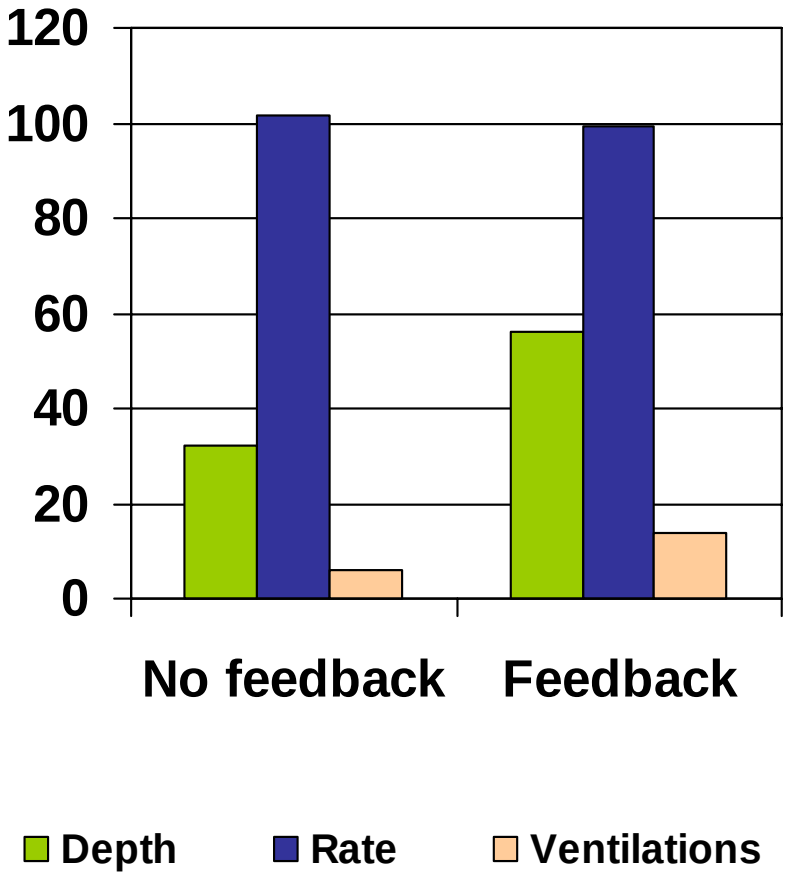


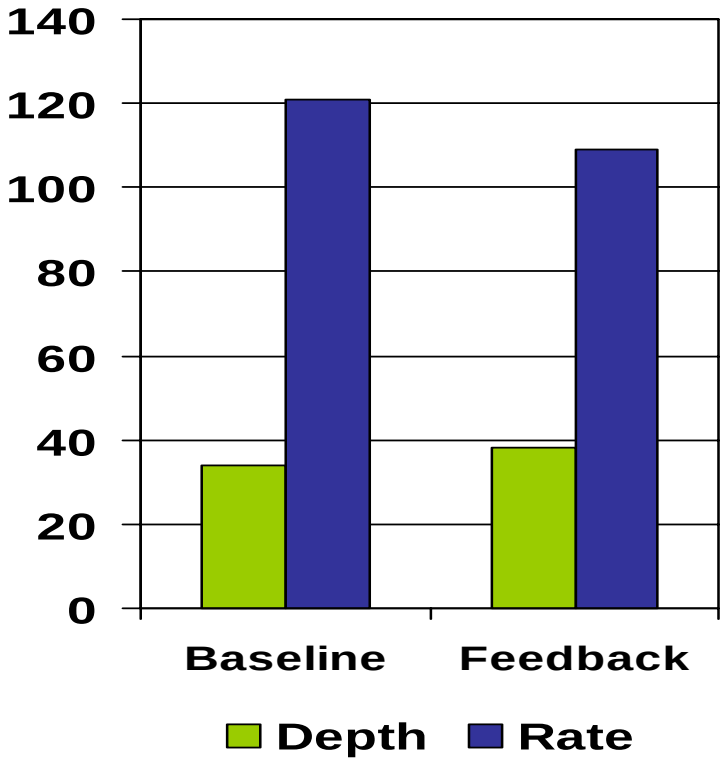


Aufderheide et al Circulation 2004;109;1960-1965

Improving CPR Quality is Not a Question of Training

Does CPR Feedback Help?





Handly AJ et al , Resuscitation. 2003 Apr;57(1):57-62.

Kramer-Johansen J et al Resuscitation (2006) 71,283-292

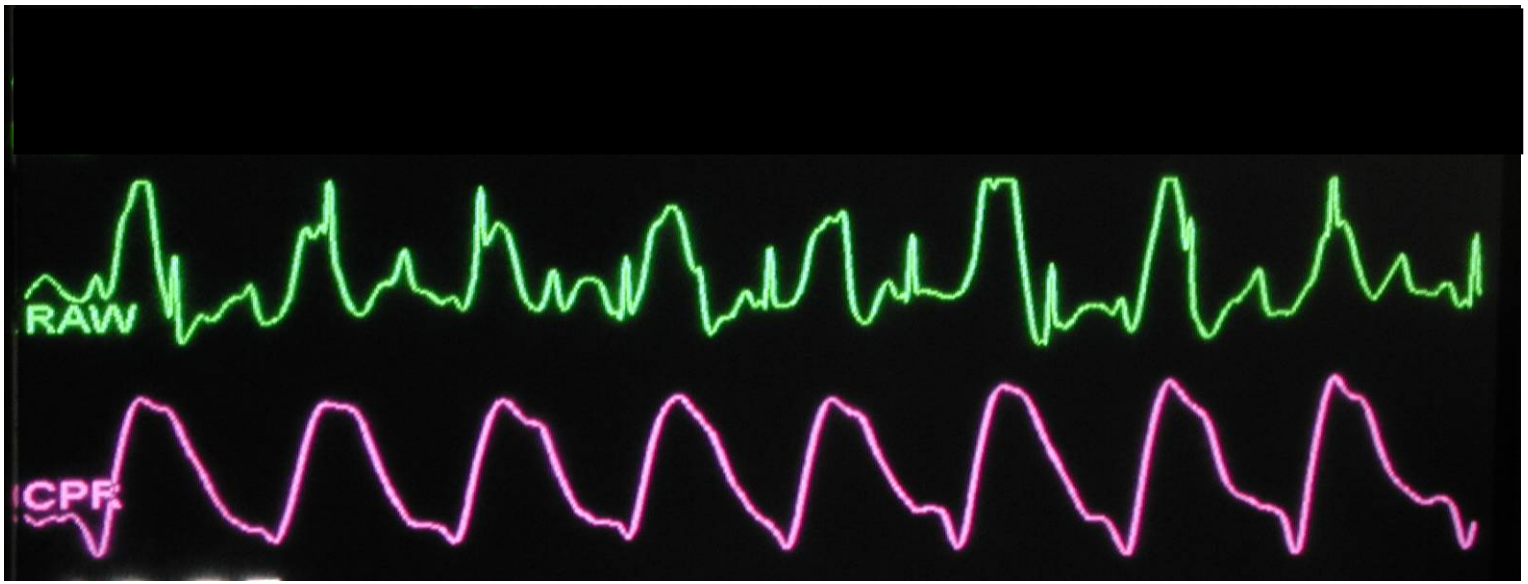
Tools to Improve Manual CPR

Feedback Mechanisms

- Metronomes to pace and coach rate
- Coaching for depth of compressions
- Visual displays of depth and rate
- Indicators of idle time
- Filtering CPR compressions from the ECG
- Data analysis to assess effectiveness and aid in training.

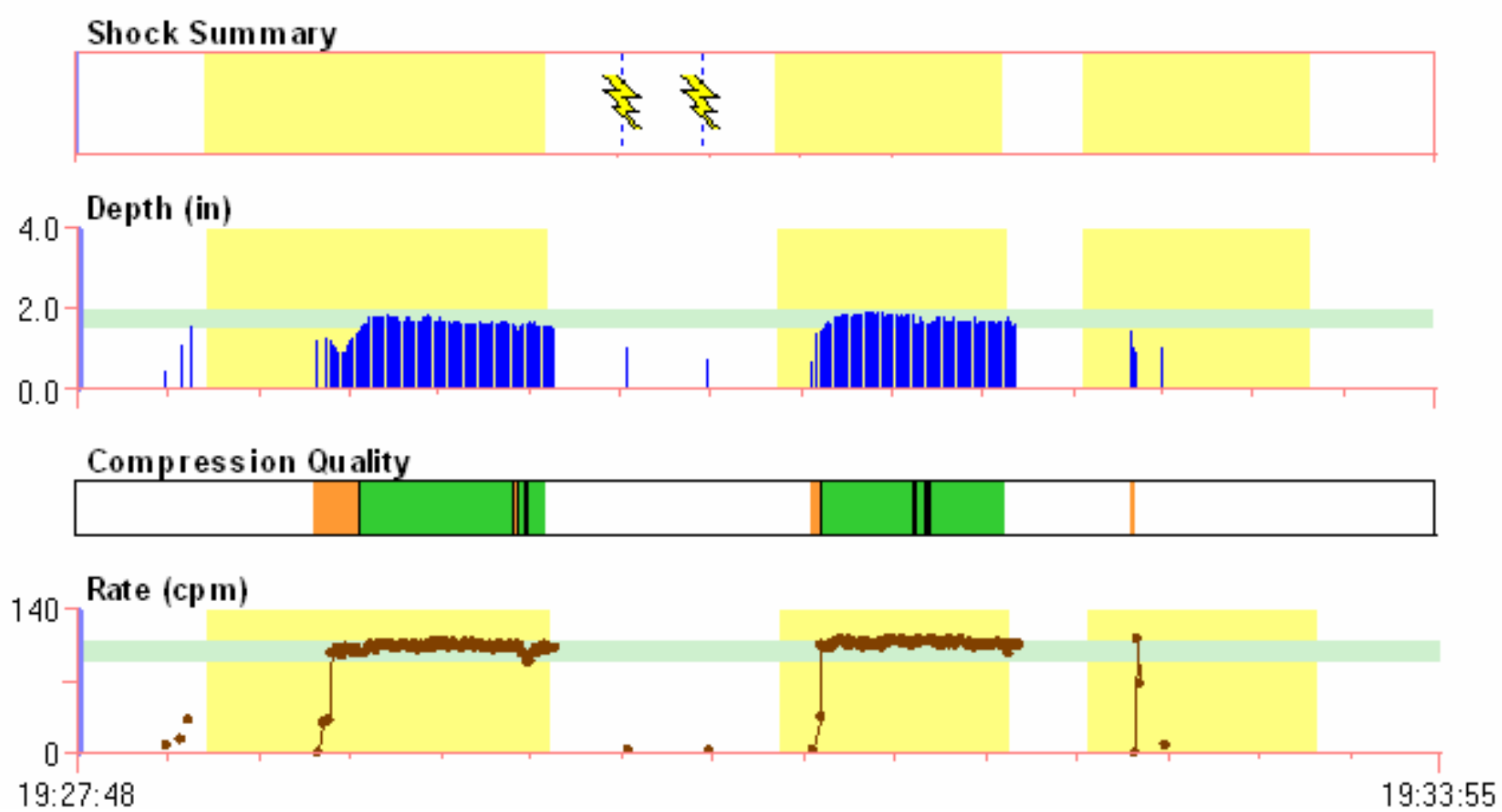
Visual Indicator on Defibrillator

Filtering the ECG Can Minimize Interruptions



CPR artifact is filtered so clinicians can discern the presence of organized rhythms ***while performing*** chest compressions

Graphical Performance Data



Summary

Key indicators

Time to first compression:	00:01:04
Average time to shock after compressions stopped:	00:00:32
Average time to compressions after shock delivered:	00:00:40
Mean compression depth:	1.67 in
Mean compression rate:	100.76 cpm

Entire case

Case duration:	00:06:07	
Time in CPR:	00:03:36	(58.86 %)
Time not in CPR:	00:02:31	(41.14 %)

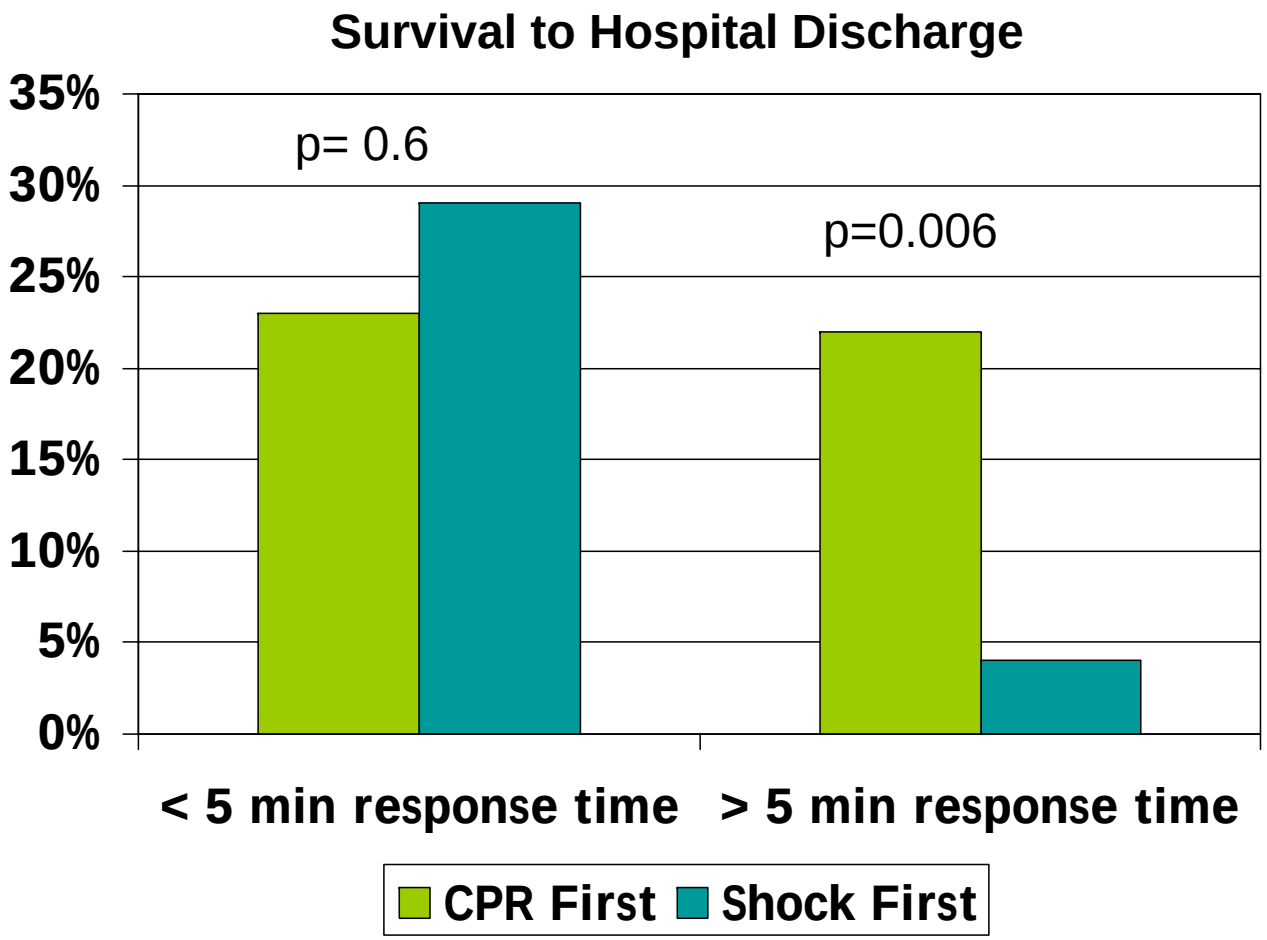
CPR periods

Time in compressions:	00:01:57	(54.17 %)
Time not in compressions:	00:01:39	(45.83 %)
Compressions in target:	84.92 %	

Depth:			Rate:		
Standard deviation:	0.21 in		Standard deviation:	17.08 cpm	
Above target zone:	0	(0.00 %)	Above target zone:	4	(2.01 %)
In target zone:	174	(87.44 %)	In target zone:	185	(92.96 %)
Below target zone:	25	(12.56 %)	Below target zone:	10	(5.03 %)

Can CPR Quality Change Outcomes In-hospital?

One Result Out of Hospital…



Wik et al. JAMA 2003;289:1389-95

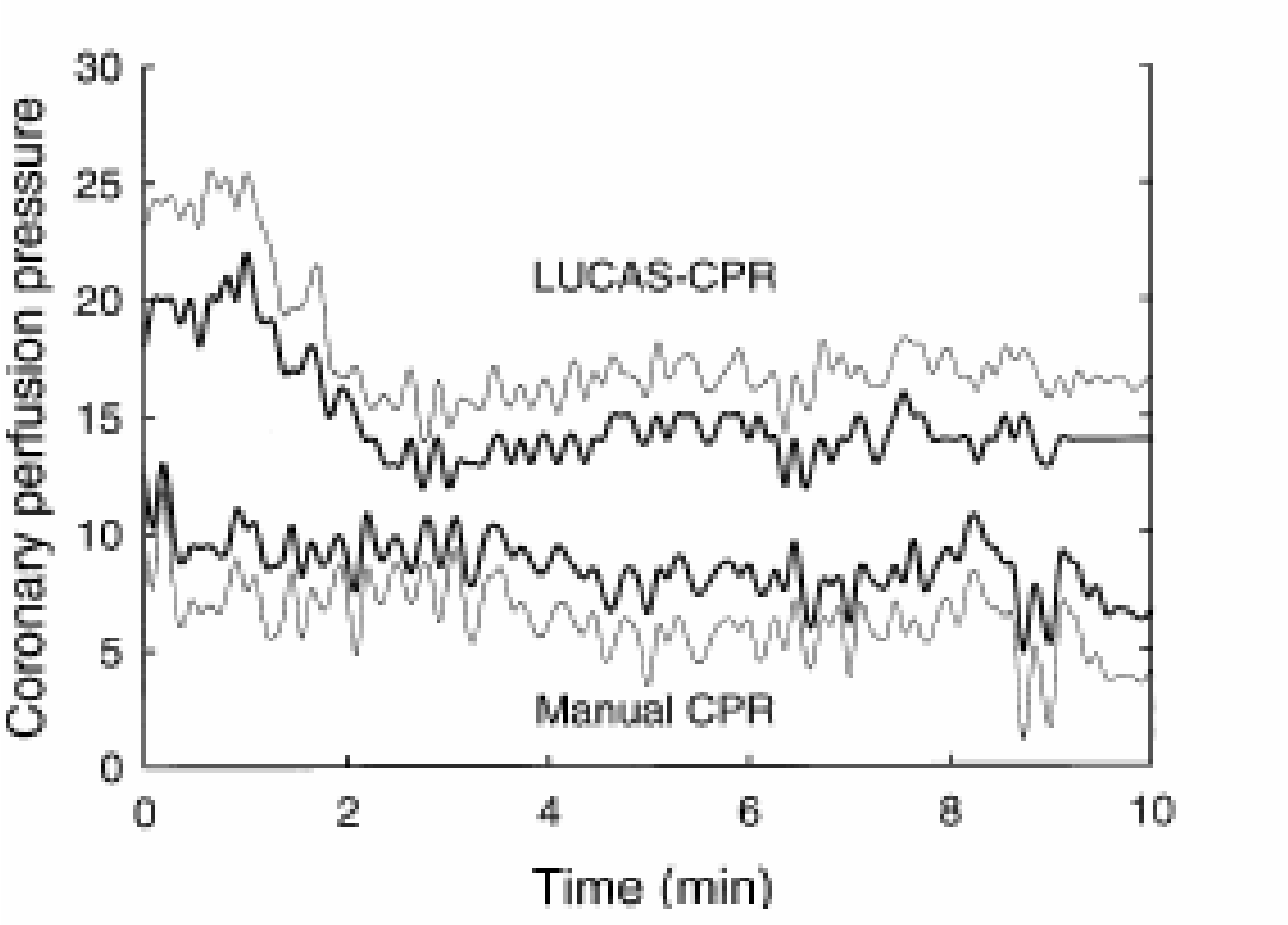
Mechanical CPR

Mechanical Piston Devices

Compression is created by depressing the sternum with a pneumatically powered plunger mounted on a backboard

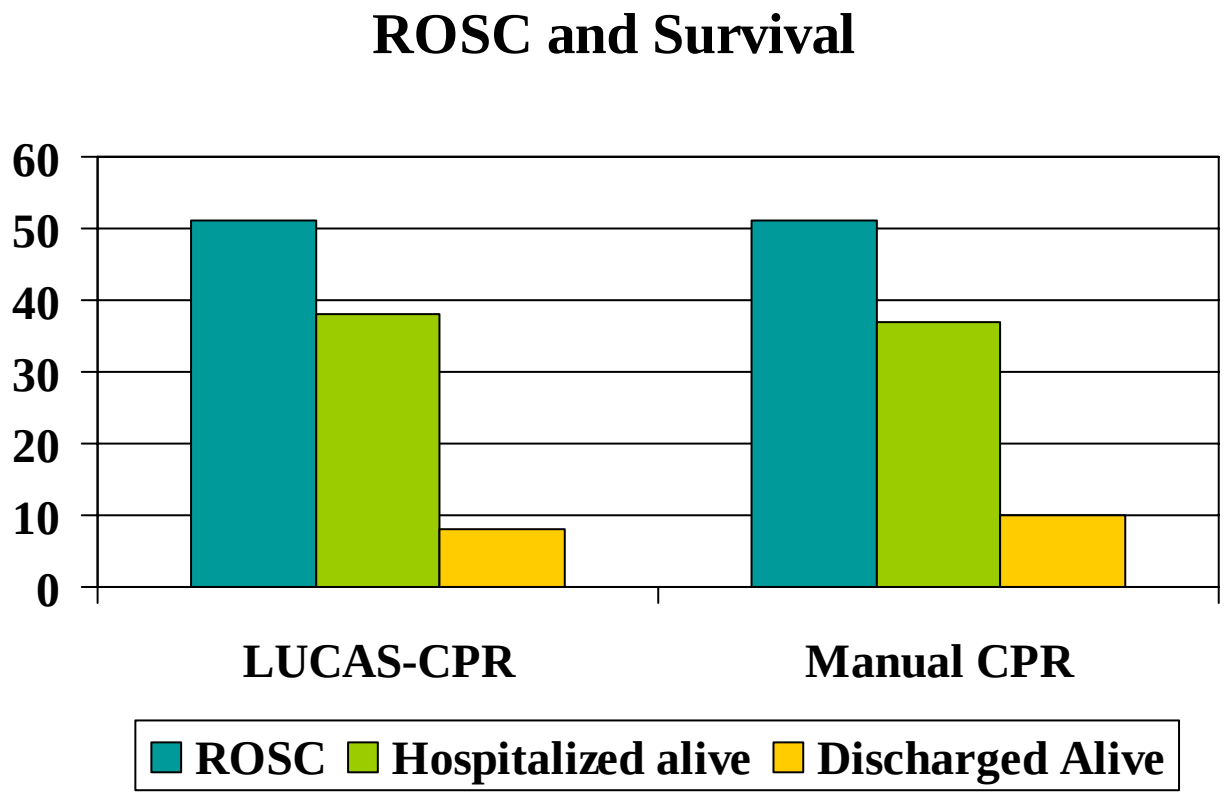
L.U.C.A.S

Comparison to Manual CPR



Steen et al Resuscitation 55(2002) 285-299

Pilot Study EMS

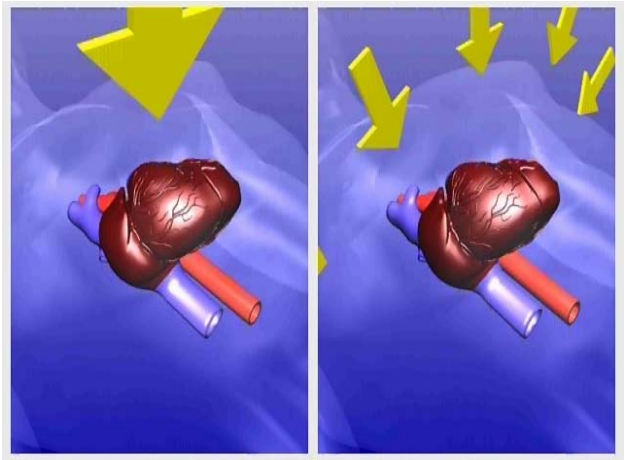


Axelsson C et al Resuscitation (2006) 71,47-55

Load Distributing Band CPR

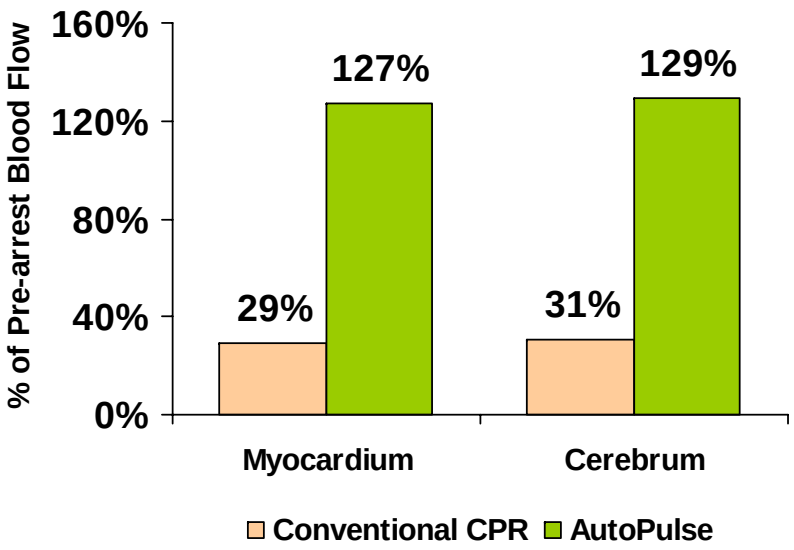
AutoPulse

- Compresses chest circumferentially in a 50/50 duty cycle and rate of 80 CPM

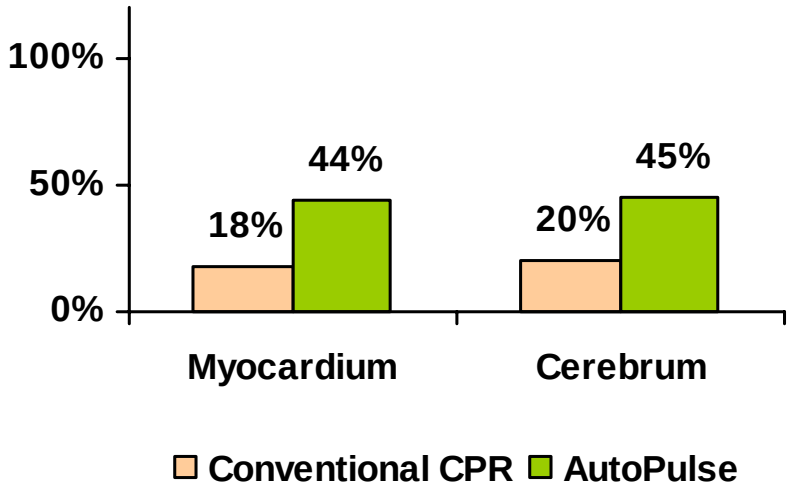


Animal Hemodynamics Study

ACLS Protocol

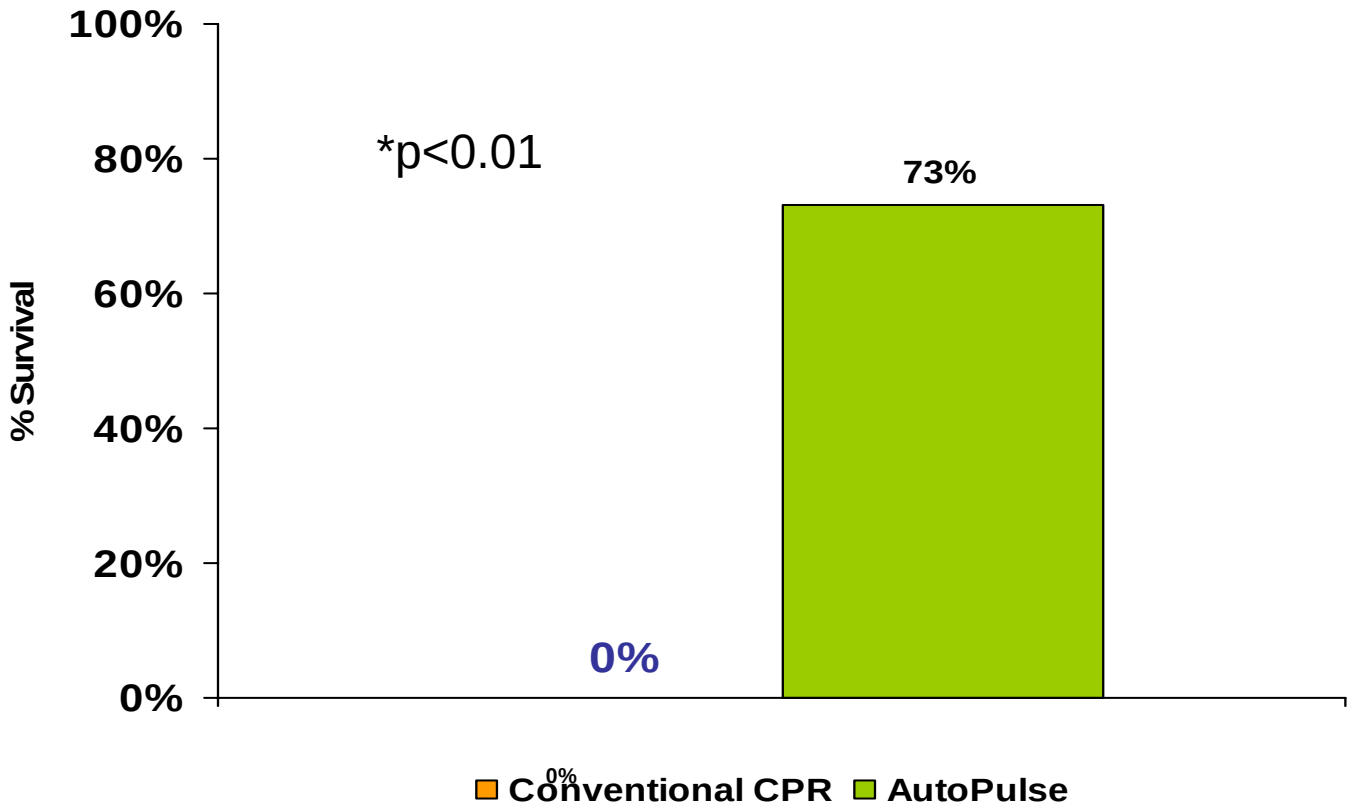


BLS Protocol:



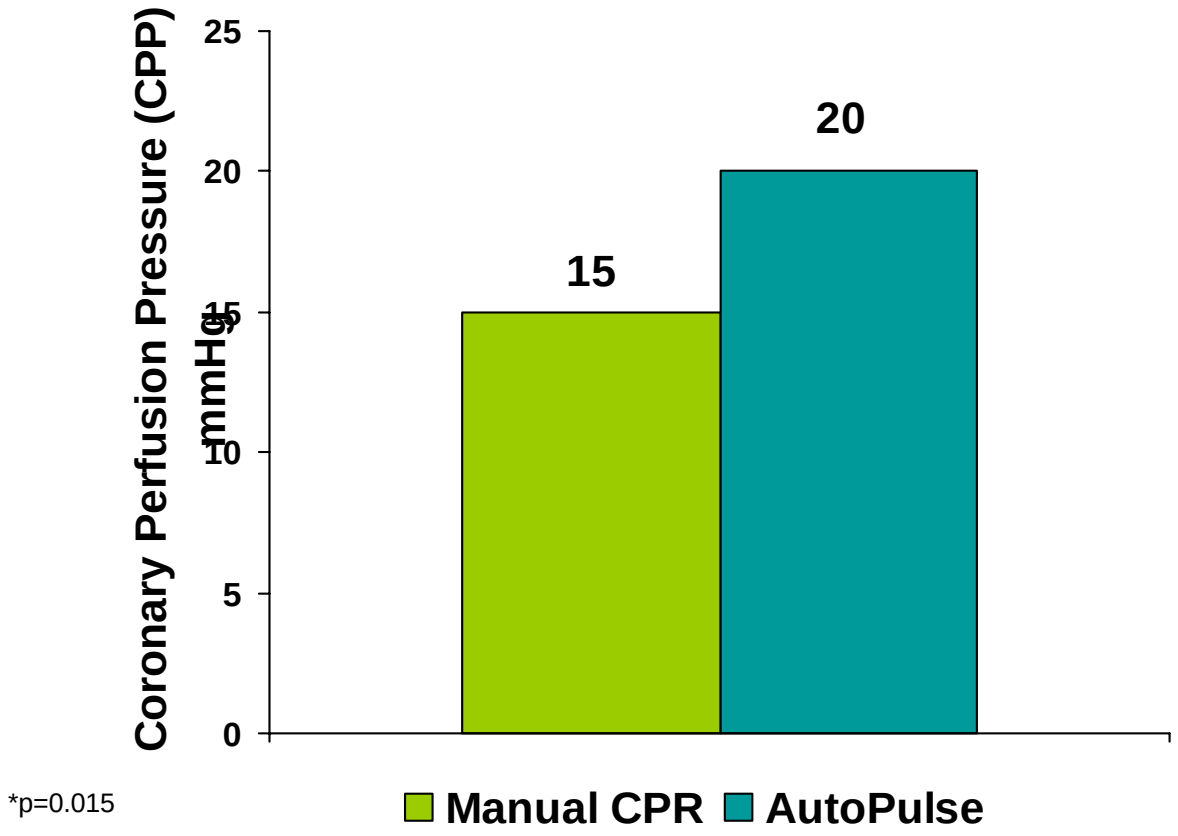
Halperin HR et al. *JACC.* 2004;44(11):2214-20.

Animal Survival Study



Ikeno F et al. Resuscitation. 2006;68:109-118.

Human Hemodynamics Study

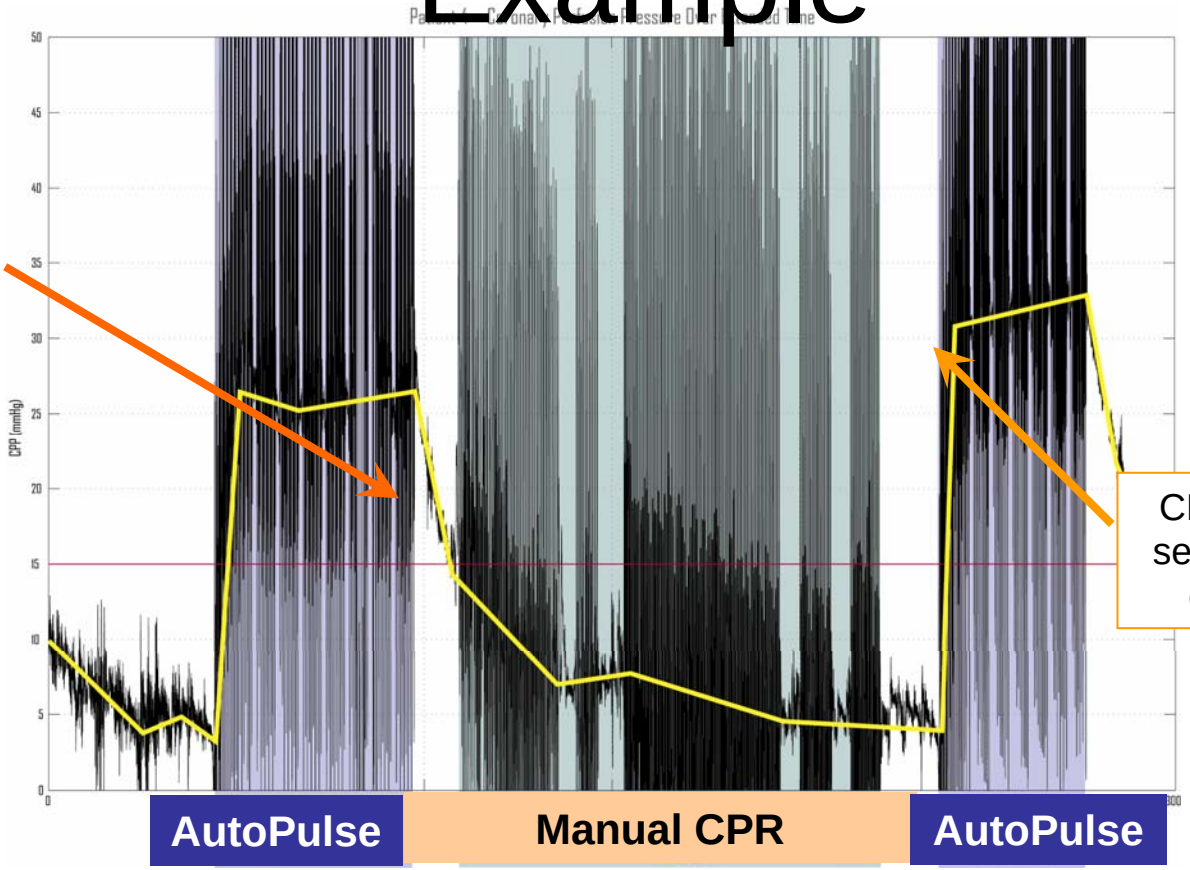


*p=0.015

Timerman S et al. Resuscitation. 2004;61:273-280.

Human Hemodynamics Study Example

CPP drops quickly when AutoPulse compressions stop



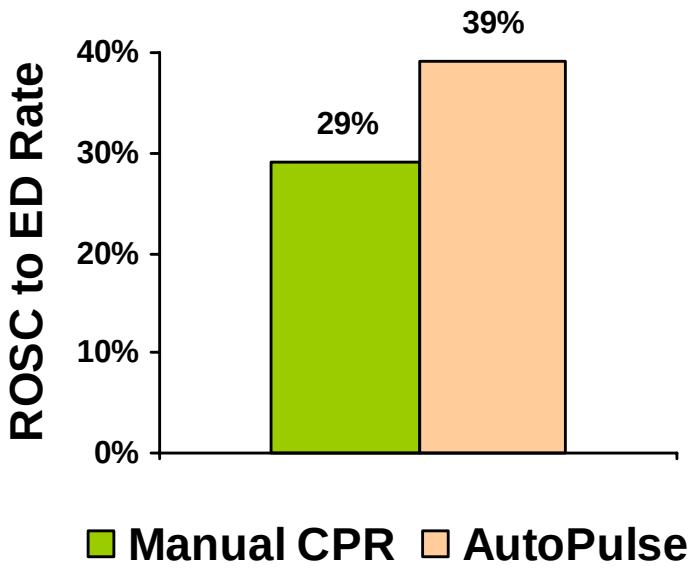
CPP returns after several AutoPulse compressions

Timmerman S et al. *Resuscitation.* 2004;61:273-280.

Human Short-term Survival Studies

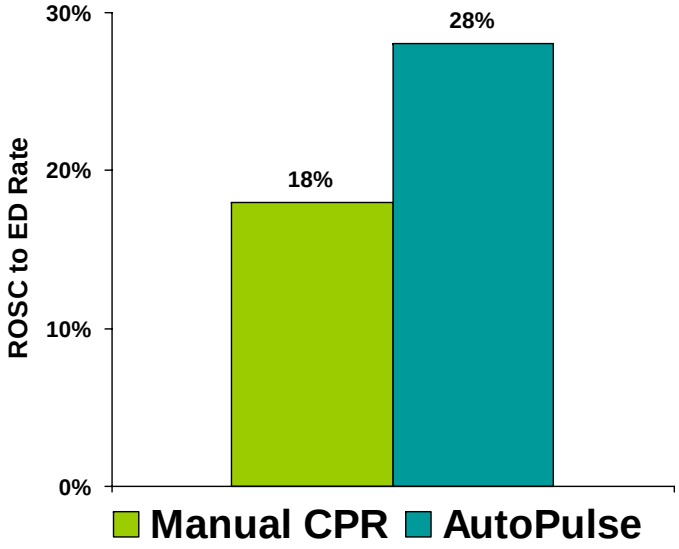
n = 93 n =69

p = 0.02



n =607 n = 269

p = 0.003

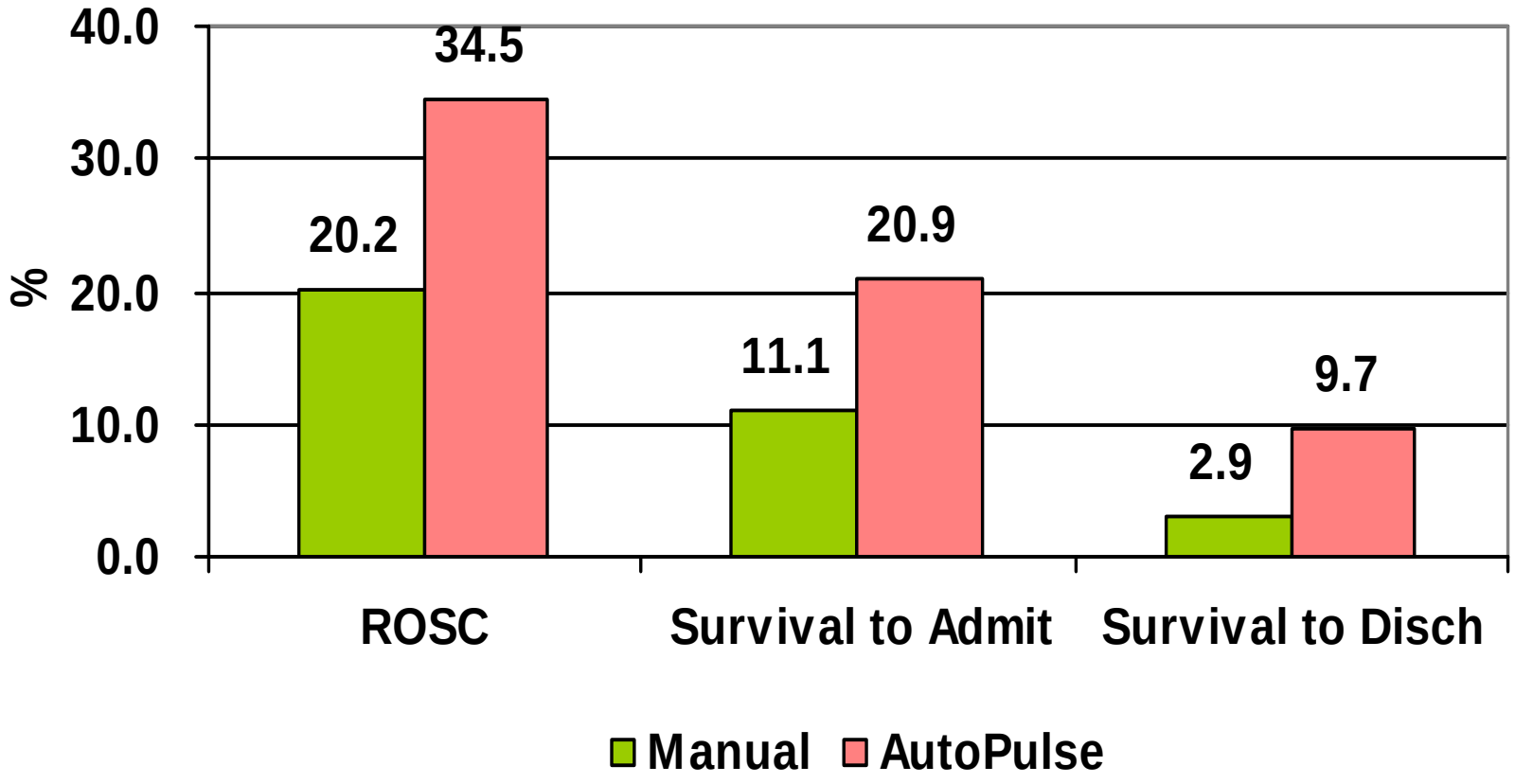


Casner M et al. *Prehospital Emergency Care.* 2005;9(1):61-67.

Swanson M et al. *Circulation*. 2006;114(18):II-554.

Human Long-term Survival Study

p=0.0001 p=0.0002 p=0.0001



Ong ME, Ornato J et al. *JAMA*. 2006;295(22):2629-2637.

Summary

- In hospital arrest is increasingly presenting as asystole and PEA; VF in recent studies represents only 25% of in-hospital arrests.
- Given that these rhythms are generally non shockable, CPR becomes critical for survival.
- Studies demonstrate that the quality of CPR delivered is critical, and that generally the quality of manual CPR is sub optimal.
- Tools to improve CPR include training, feedback and the institution of mechanical CPR in hospitals.