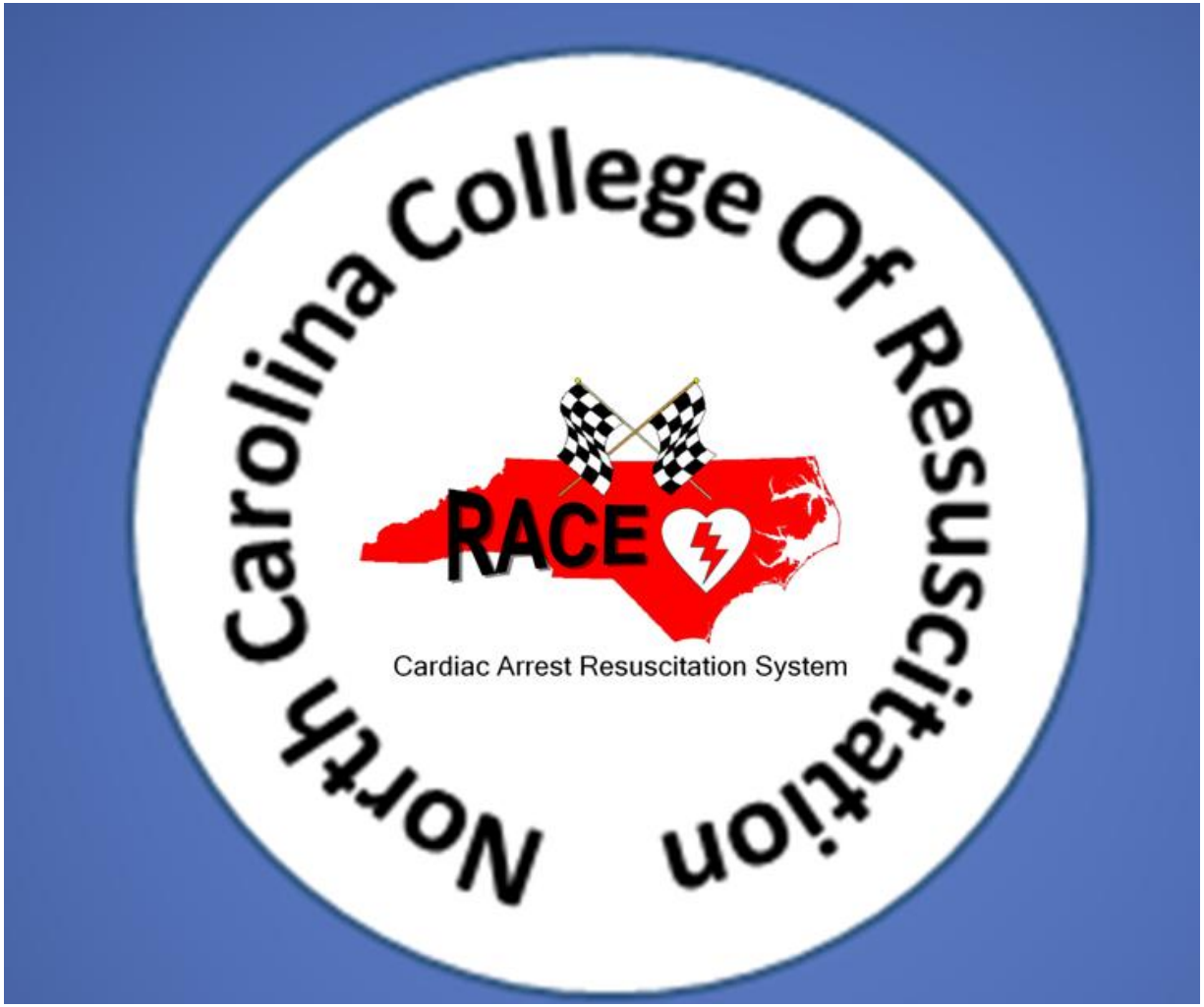
MODULE 4

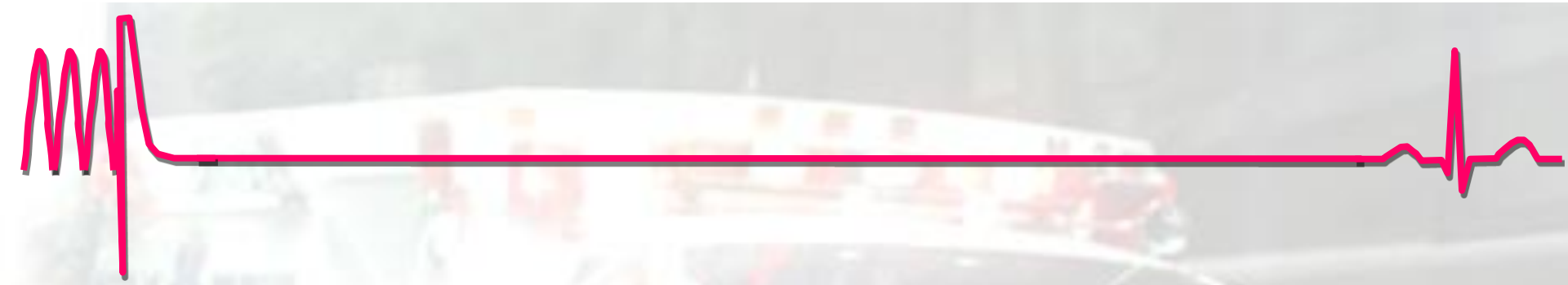

North Carolina College Of Resuscitation
RACE
Cardiac Arrest Resuscitation System

EMS Providers

Claire Corbett, MMS, NREMT-P

Objectives:

- Discuss the “Team Approach” to resuscitation care
- Discuss the importance of High Quality CPR
- Review quality improvement options for improving cardiac arrest care



CARDIAC ARREST OVERVIEW

Cardiac Arrest in North Carolina

5000-8000 per year

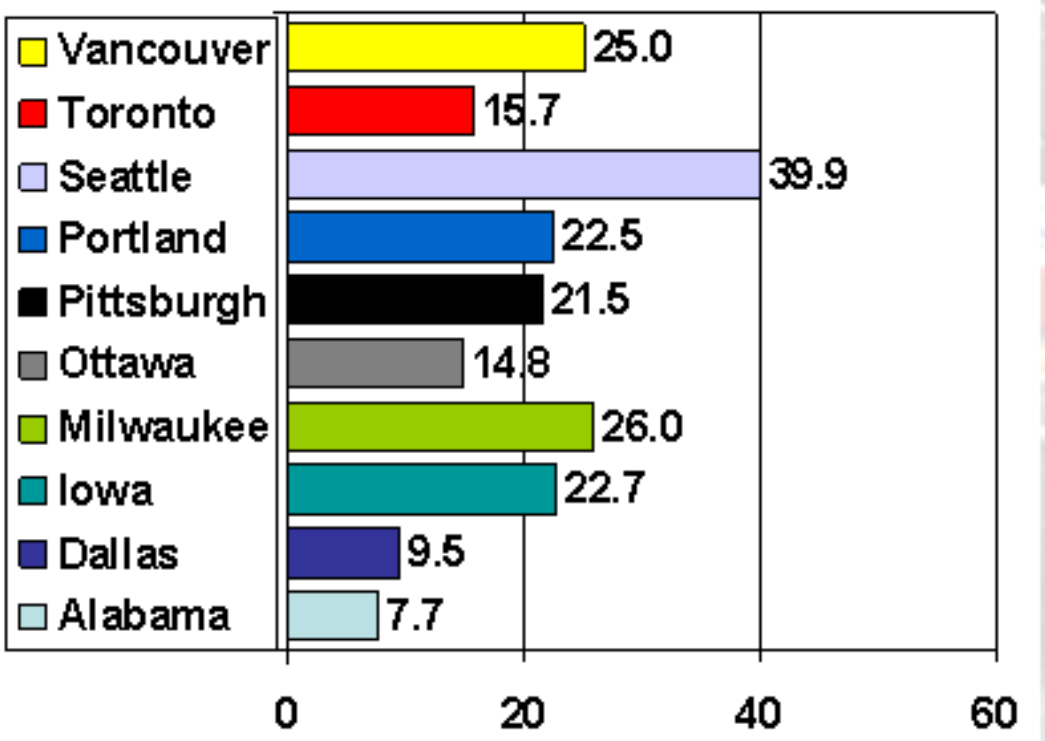
(ED vs. EMS records)

NC Office of EMS Preliminary data

• Statewide Cardiac Arrests:		5,213
• EMS Return of Spontaneous Circulation:	35%	1,845
• Arrived at Emergency Department Alive:	20%	1,034
• Admitted to Hospital Alive:	11%	589
• D/C from Hospital Alive :not available…	likely under 5%	

Variation in Survival VF Arrest
Resuscitations Outcomes Consortium:

Survival to discharge



There were significant and important regional difference in OOHCA incidence and outcomes

Nichol JAMA. 2008;300(12):1423-1431

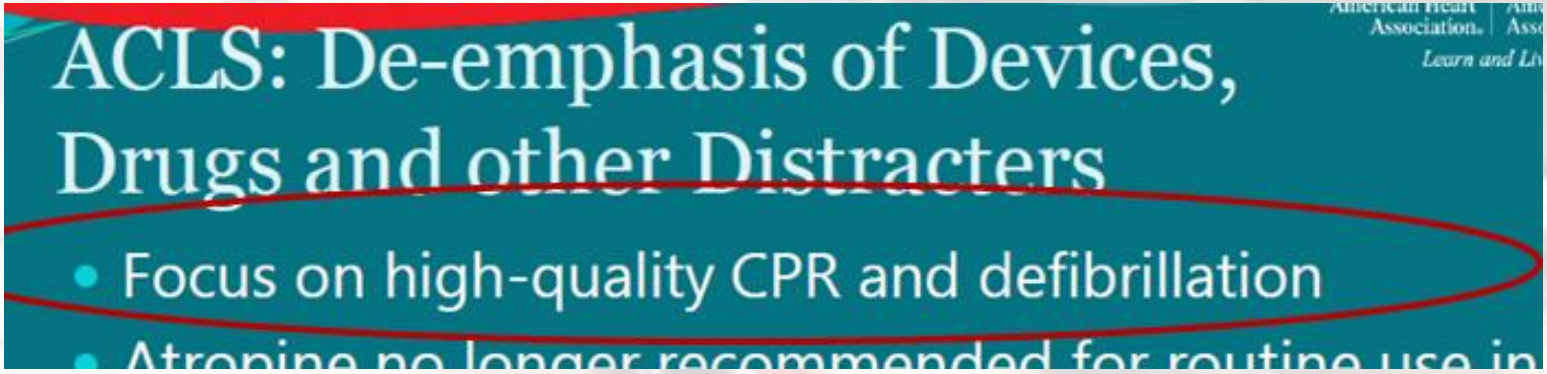
American Heart Association. | American Stroke Association.

Learn and Live.

Summary of 2010 Guidelines

- Many resuscitation systems and communities have documented improved survival from cardiac arrest.
- Too few victims of cardiac arrest receive bystander CPR.
- CPR quality must be high.
- Victims require excellent post–cardiac arrest care by organized, integrated teams.
- Education and frequent refresher training key to improving resuscitation performance.
- We must rededicate ourselves to improving the frequency of bystander CPR, the quality of all CPR and the quality of post–cardiac arrest care.

High Quality CPR:

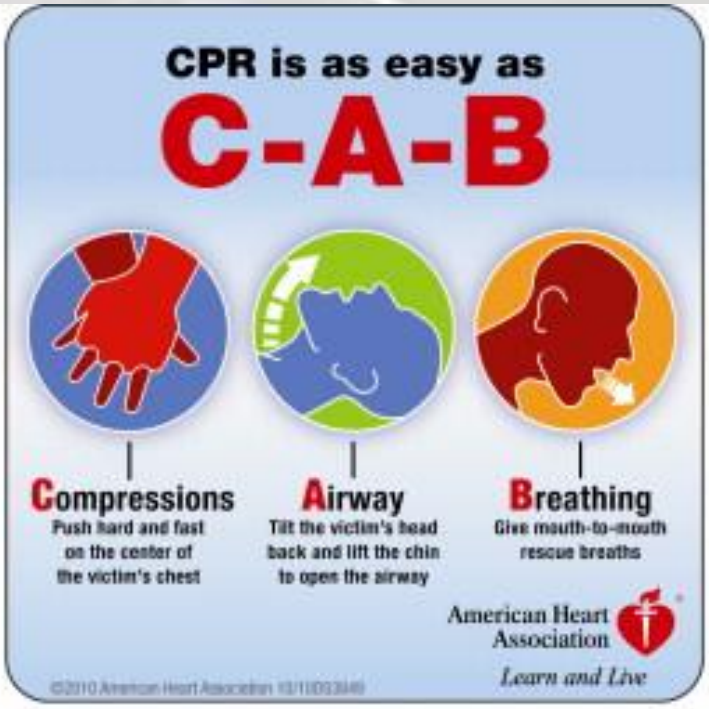


High Quality CPR:

- Goal: high quality and continuous chest compressions with *limited 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 after unless indicated earlier

High Quality CPR:

- Best chance for survival
  - Early, continuous compressions and early defibrillation
  - Don't interrupt chest compression for inserting airway
    - Adult takes 10 – 15 minutes to desaturate below 80%



Ventilations:

- Recommended rate: 8 – 10/min
- Maintain SpO2 > 95%
- Avoid Hyperventilation
  - Worsens brain ischemia by inducing cerebral vasoconstriction as PaCO2 falls
  - Hyperinflation of the chest

    → increased intrathoracic pressure

    and

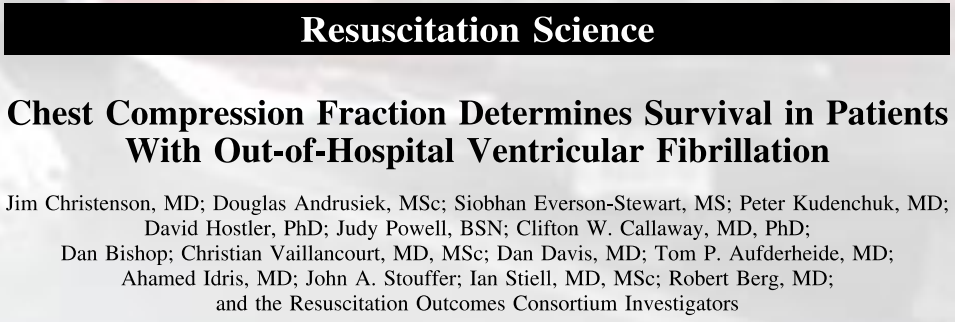
    → impedes venous return to heart, affecting BP

Chest Compression Fraction:

Study evaluated the impact of CCF prior to defibrillation on survival.

Chest Compression Fraction (CCF): Proportion of time spent delivering chest compressions during CPR.

- 506 patients with VF / VT
- Not defib. before EMS arrival
- Electronically recorded cardiopulmonary resuscitation before the first shock
- Age 64, 80% male
- 51% bystander CPR
- 6 minutes call to scene
- 11 minutes call to first shock
- ROSC 72%
- Survived to discharge 23%



Resuscitation Science

Chest Compression Fraction Determines Survival in Patients With Out-of-Hospital Ventricular Fibrillation

Jim Christenson, MD; Douglas Andrusiek, MSc; Siobhan Everson-Stewart, MS; Peter Kudenchuk, MD; David Hostler, PhD; Judy Powell, BSN; Clifton W. Callaway, MD, PhD; Dan Bishop; Christian Vaillancourt, MD, MSc; Dan Davis, MD; Tom P. Aufderheide, MD; Ahamed Idris, MD; John A. Stouffer; Ian Stiell, MD, MSc; Robert Berg, MD; and the Resuscitation Outcomes Consortium Investigators

Chest Compression Fraction and 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

Increased chest compression fraction is independently predictive of better survival

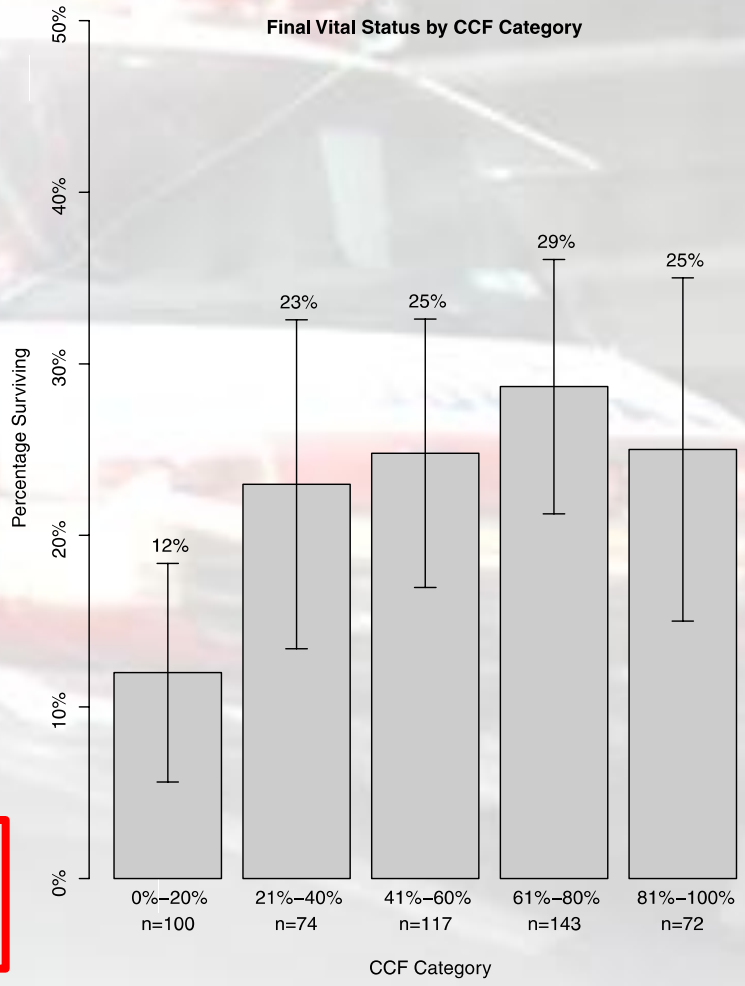


Figure 2. Survival to discharge for each category of chest compression fraction.

Perishock Pause: Independent Predictor of Survival

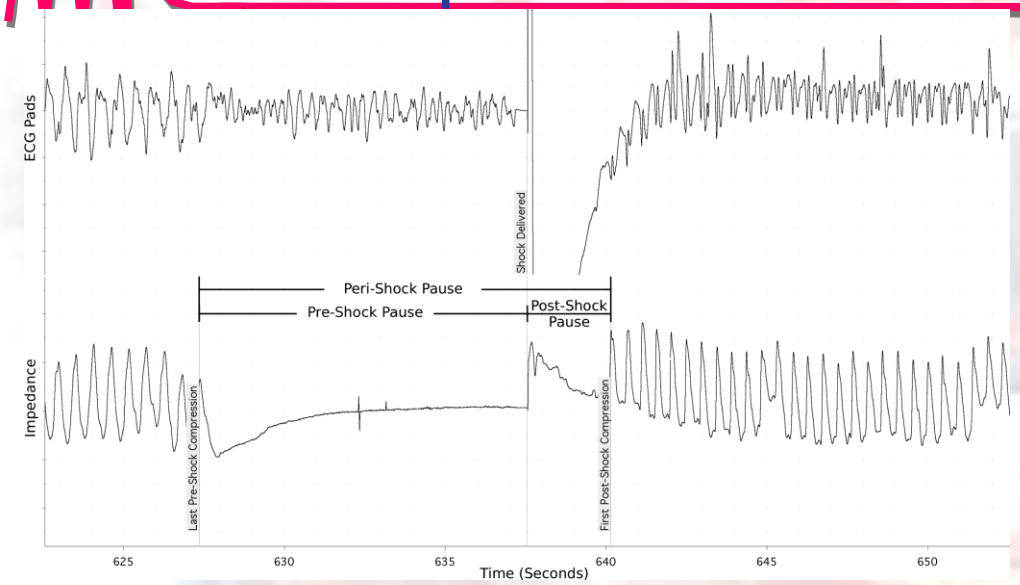


Figure 1. Diagram of preshock, postshock, and perishock pause. Preshock pause of 10 seconds, postshock pause of 2.3 seconds, and perishock pause of 12.3 seconds depicted in the impedance channel of the cardiopulmonary resuscitation process file.

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

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

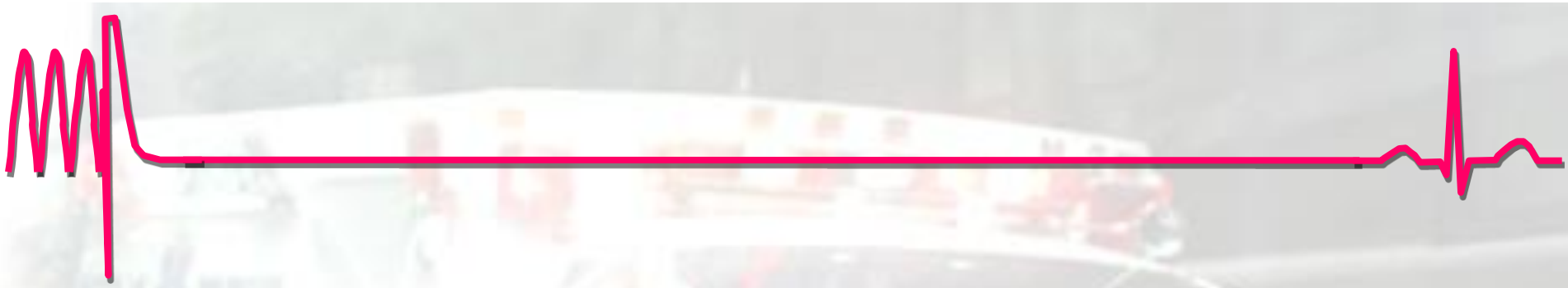
1. Pre-shock pause > 20 seconds
2. Peri-shock pause > 40 seconds

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

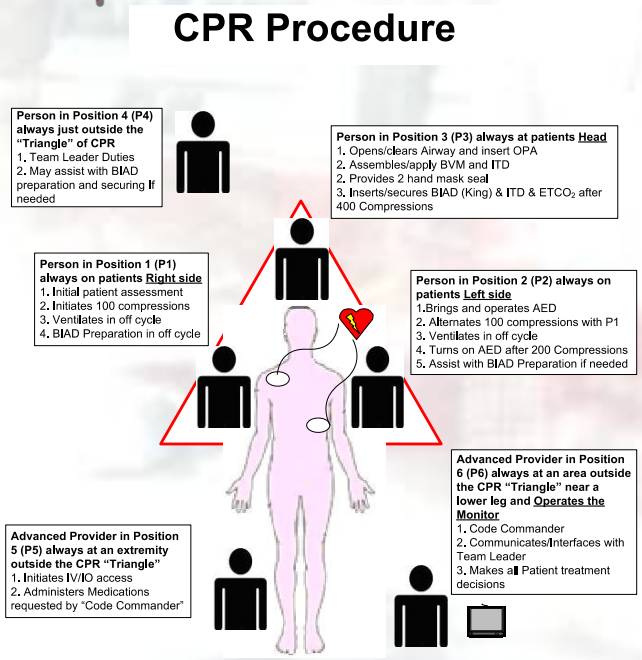


TEAM APPROACH TO RESUSCITATION

Pit Crew Approach to Resuscitation:

- Focus on
  - Leadership, team approach, skills & competencies, teamwork & communication, best practices, and rehearsal
- Emphasis on
  - Minimally interrupted CPR, controlled ventilations, defibrillation, and appropriate timing of interventions

Pit Crew Approach:



- Each person has assigned role
  - Providers focus on their assigned job expertly and efficiently
  - Practice in each role
  - Helps minimize interruptions in compressions

Pit Crew Approach:

Pre-assigned Roles

1. Pit Crew Leader
2. Airway Leader
3. IV/IO & Medications
4. CPR Chief
5. CPR Duty Chief
6. Variable Player

Variations to this model exist for:

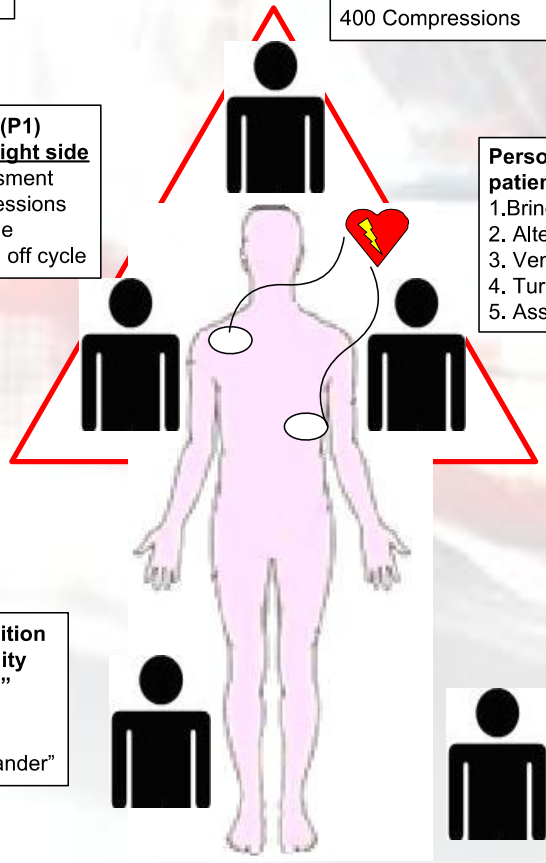
3 Rescuers
4 Rescuers
5 Rescuers
6 Rescuers

CPR Procedure

Person in Position 4 (P4) always just outside the "Triangle" of CPR
1. Team Leader Duties
2. May assist with BIAD preparation and securing If needed

Person in Position 3 (P3) always at patients Head
1. Opens/clears Airway and insert OPA
2. Assembles/apply BVM and ITD
2. Provides 2 hand mask seal
3. Inserts/secures BIAD (King) & ITD & $ETCO_2$ after 400 Compressions

Person in Position 1 (P1) always on patients Right side
1. Initial patient assessment
2. Initiates 100 compressions
3. Ventilates in off cycle
4. BIAD Preparation in off cycle



Person in Position 2 (P2) always on patients Left side
1.Brings and operates AED
2. Alternates 100 compressions with P1
3. Ventilates in off cycle
4. Turns on AED after 200 Compressions
5. Assist with BIAD Preparation if needed

Advanced Provider in Position 6 (P6) always at an area outside the CPR "Triangle" near a lower leg and Operates the Monitor
1. Code Commander
2. Communicates/Interfaces with Team Leader
3. Makes all Patient treatment decisions

Advanced Provider in Position 5 (P5) always at an extremity outside the CPR "Triangle"
1. Initiates IV/IO access
2. Administers Medications requested by "Code Commander"

Henderson EMS, Nevada

- Created Team Based Method
- Developed 4 Roles with specific responsibilities
  1. Compression Tech
  2. Monitor Tech
  3. Ventilation Tech
  4. Medication Tech

Identified which roles would be filled in what order as providers arrived to scene

Henderson EMS, Nevada

- Focused on training
  - Team based
  - Developed competencies to evaluate knowledge of each role
  - Used monitor feedback to evaluate quality of compressions
    - Found crews often pushed too fast with compressions and didn't allow chest recoil

Pittsburg EMS, PA

- Developed the 375E5 Program

375 Compressions & Epinephrine in 5 minutes

- Retasked the first 5 minutes of cardiac arrest management to:
  - Maximize hands on compression time

  Goal: Maximize coronary and cerebral perfusion pressures

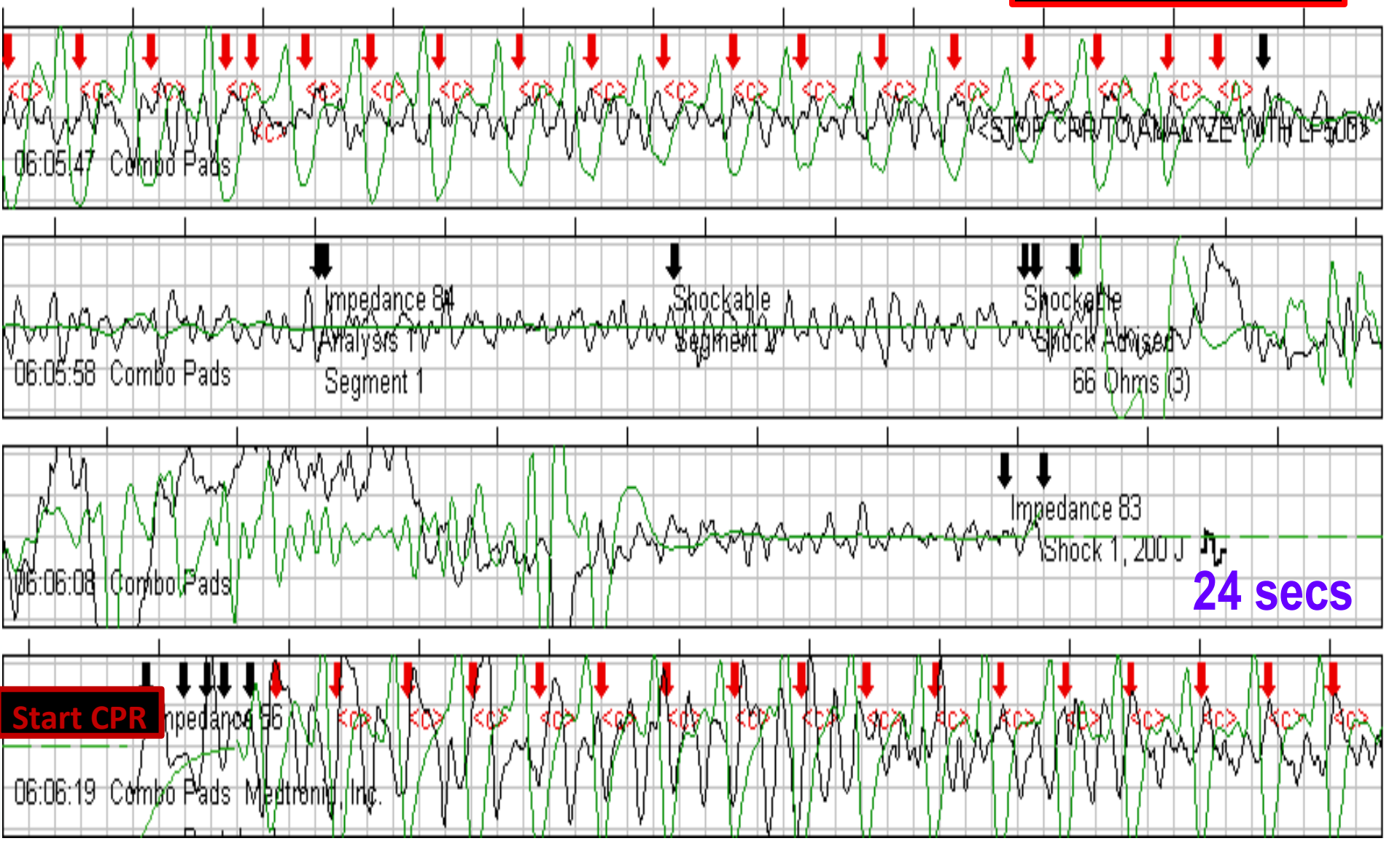
375E5 Cardiac Arrest Program:

- Maximize hands on compression time and CPR %
  - Defer advanced airway management unless clinically indicated to do earlier
- Early IV Access
- Early IV Epinephrine
- Developed team based approach & created scenarios to evaluate processes and performance

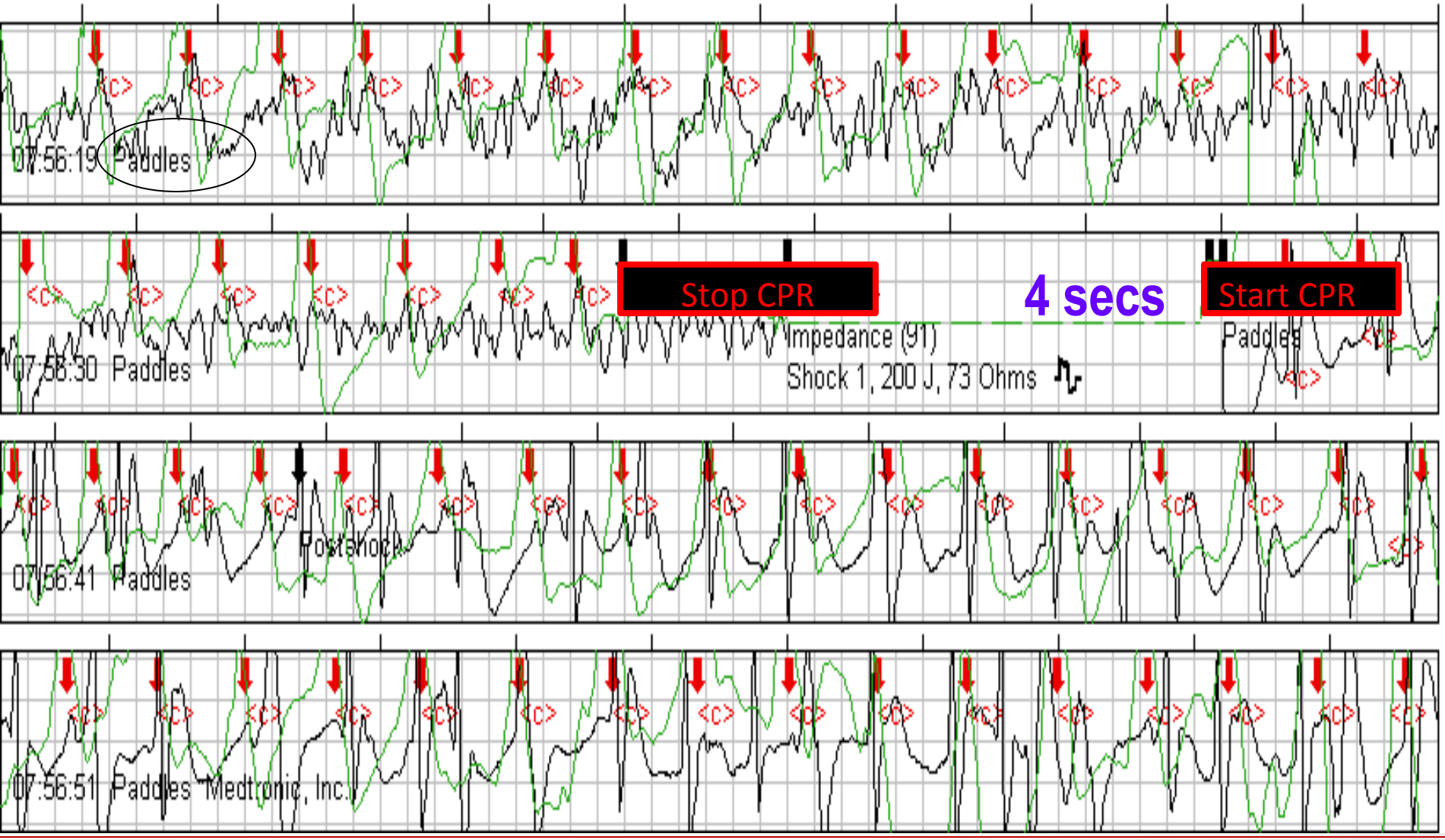
375E5 Program: Training

- Scenarios for 2 and 4 providers for 5 minutes
  - Pretest scenario
  - Performance Feedback
  - Post test scenario
- Measured CPR Fraction and pause times

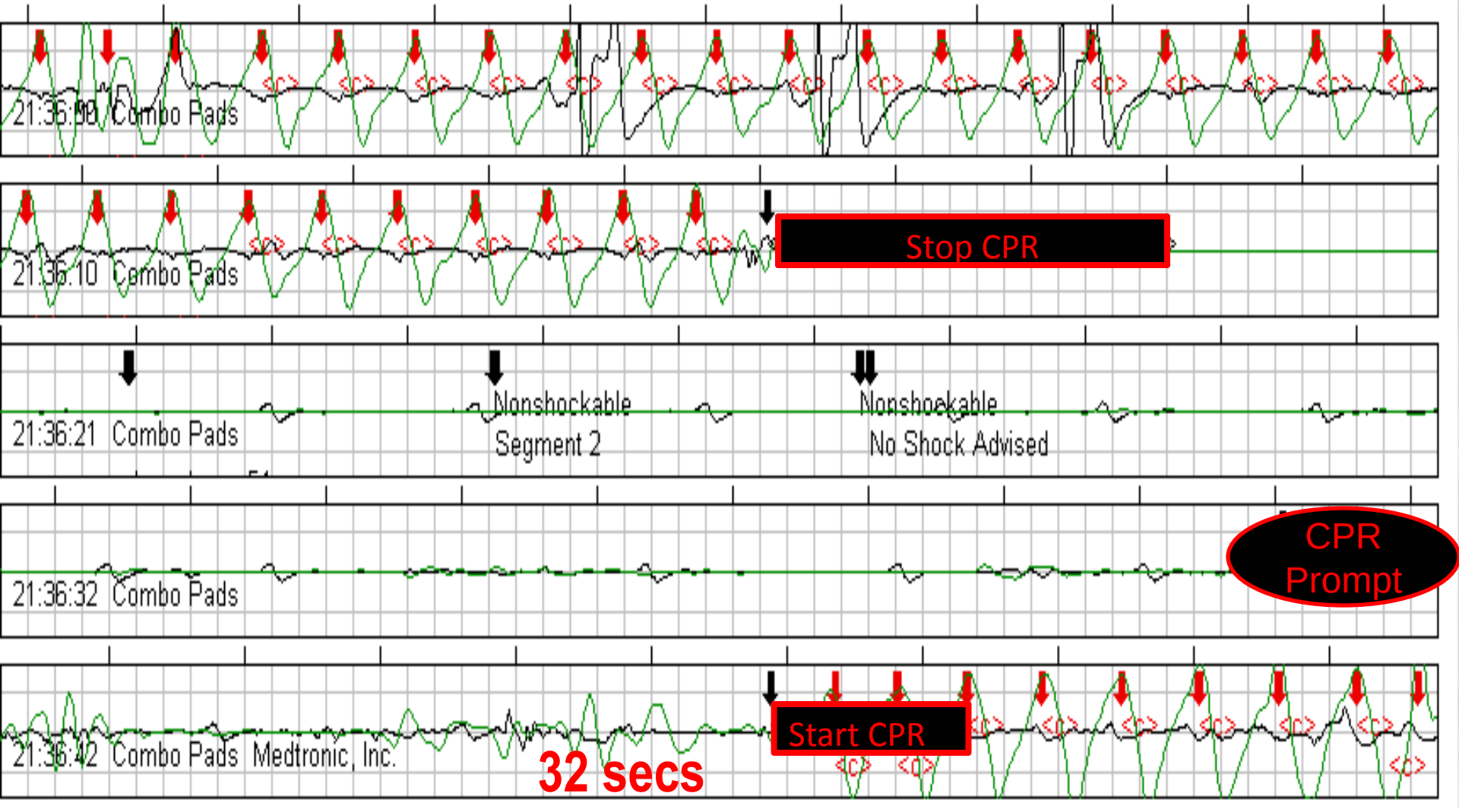
Training CPR Feedback:
ECG Voice Impedence



Training CPR Feedback:
ECG Voice Impedence



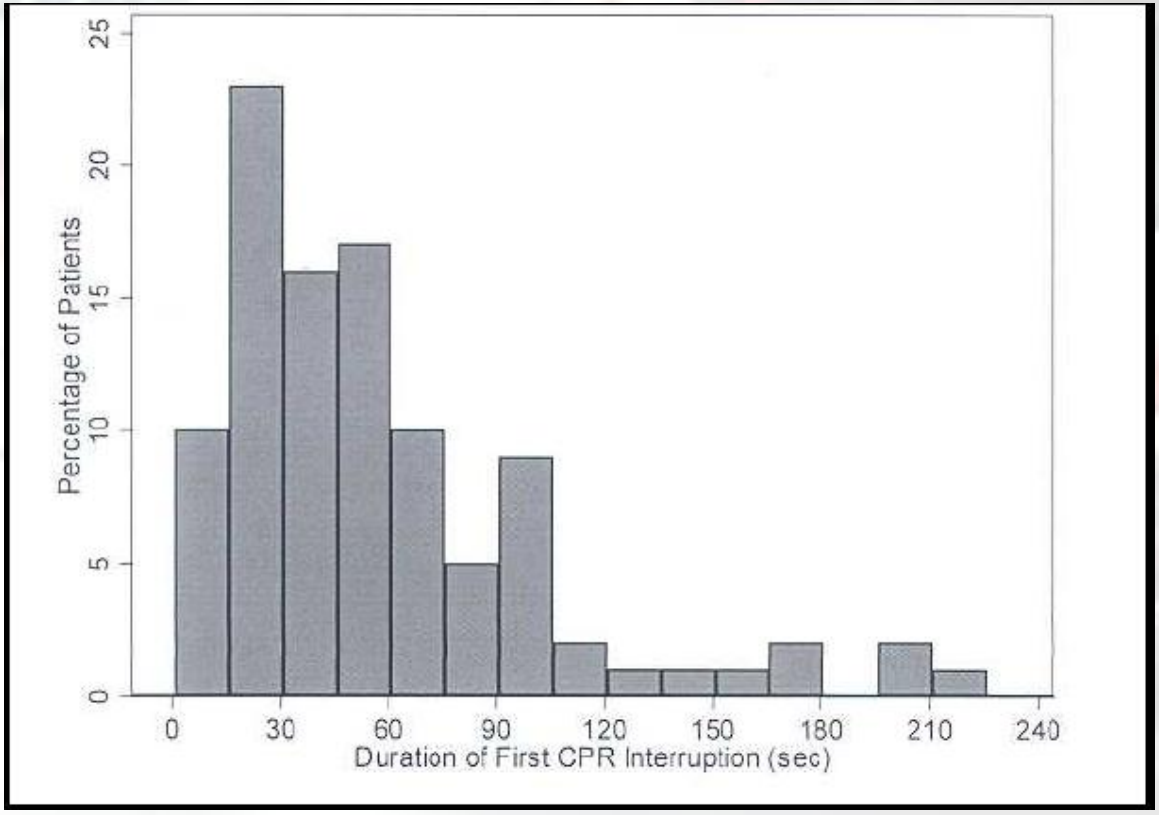
Training CPR Feedback:
ECG Voice Impedence



375E5 - 2 Rescuer Scenario:

Problem	Mitigation
Delay in initiating CCC	Rapid ABC assessment and initiation of CCC; one rescuer CCC while monitor placed
Pauses of CCC for rhythm analysis and defibrillation	Brief pause for rhythm analysis; continue CPR until ready for shock, clear and then resume CCC immediately
Pauses of CCC for advanced airway placement	Defer until later in the arrest unless clinically indicated to do earlier or placement with interruption of CCC

Advanced airway placement in cardiac arrest:



Median duration of CCC pause for 1st ETI in cardiac arrest = **46.5 sec**.

Total CCC pause for All ETI attempts = **109.5 sec** (Wang, 2008)

375E5 - 2 Rescuer Scenario

Problem	Mitigation
Delay in initiating IV	One rescuer CPR while second rescuer starts IV; Defer advanced airway
Delay in administering epinephrine	One rescuer CPR while second rescuer administer epinephrine
Number of 1 mg epinephrine administered	2 mg epinephrine IVP first dose then 1 mg q 3 minutes

Epinephrine and Coronary Perfusion Pressure:

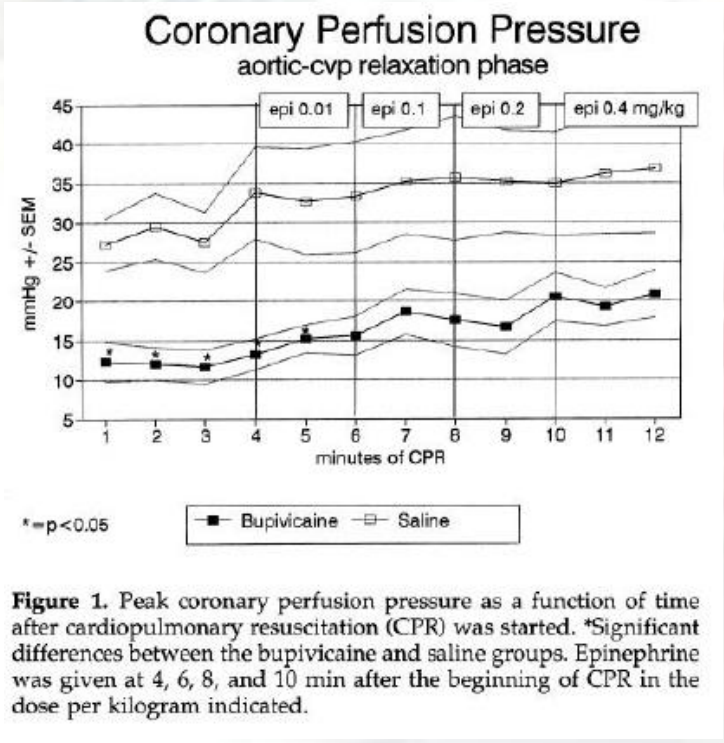


Figure 1. Peak coronary perfusion pressure as a function of time after cardiopulmonary resuscitation (CPR) was started. *Significant differences between the bupivicaine and saline groups. Epinephrine was given at 4, 6, 8, and 10 min after the beginning of CPR in the dose per kilogram indicated.

(Rosenberg, 1996)

375E5:

- Focused on maintaining blood pressure
- Give Epi drip to maintain BP 110 – 140 systolic
- Start early, even if BP is within guideline range
  - Aim to preempt drop in BP as Epi is washed out

375E5 - 4 Rescue Scenario

Problem	Mitigation
Delay in initiating CCC	Rapid ABC assessment and initiation of CCC; CCC while monitor placed
Pauses of CCC for rhythm analysis and defibrillation	Brief pause for rhythm analysis; continue CPR until ready for shock, clear and then resume CCC immediately
Pauses of CCC for advanced airway placement	Defer until later in the arrest unless clinically indicated to do earlier or placement with interruption of CCC

375E5 - 4 Rescuer Scenario

Problem	Mitigation
Delay in initiating IV	Defer advanced airway
Delay in administering epinephrine	Administer as soon as IV
Number of 1 mg epinephrine administered	2 mg epinephrine IVP first dose then 1 mg q 3 minutes

375E5 Summary

- Nothing more important than compressions
- Pulse checks are performed initially and then only when a significant change occurs
- Hyperventilation is fatal and not necessary
- While they have their roles, drugs and devices are secondary to compressions

375E5 Summary

- Through development of scenario based evaluation, training and process improvement, the 375E5 project improved performance parameters in simulated cardiac arrests.
- Resulted in statistically significant improvement in patients who arrived at the ED with a pulse.

SUMMARY

Summary:

- Focus on quality CPR
- Develop team based approach to resuscitation
- Develop process improvement plan
  - Collect data
  - Evaluate performance
  - Implement process improvement steps
- Focus on training

Resources

1. Mark E Pinchalk, MS, EMT-P, Pittsburg EMS "New Approaches for Prehospital Cardiac Arrest Management" 2010 NCEMSF Conference
2. Resuscitation Outcomes Consortium Investigators *Circulation*. 2009;120:1241-1247
3. Sheldon Cheskes, et al. "Perishock Pause: An Independent Predictor of Survival From Out-of-hospital Shockable Cardiac Arrest." *Circulation* 124 (2011): 58-66.
4. Christenson, Jim. "Chest Compression Fraction Determines Survival in Patients with Out-of-Hospital Ventricular Fibrillation." *Circulation* 120 (2009): 1241-247.
5. Vivier, Scott A. "The Quest for High-Quality CPR: A Team-based Approach & Feedback Help the Henderson Fire Department Improve CPR Effectiveness." *Journal of Emergency Medical Services* (2010).
6. Pinchalk, Mark E. "Managing Post Cardiac Arrest Syndrome in the Prehospital Setting." *Journal of Emergency Medical Services* (2010).