Cardiac Arrest Update
Systems of Care
2014

Charles Lick MD
Allina Health EMS
How CPR Causes Forward Blood Flow

Compression Phase

Cardiac Pump Theory
- Heart is squeezed between sternum & spine.

Thoracic Pump Theory
- Chest acts as a bellows: compression causes a positive pressure that forces blood out of the heart (cardiac output).
Decompression Phase

- A small, but important, vacuum (negative pressure) forms in the chest relative to atmospheric pressure, drawing blood back into the chest and heart.
- The more blood that returns to the heart (preload), the more that is circulated forward (cardiac output) on the next compression.
- Conventional CPR is inherently inefficient because the vacuum is quickly equalized through an open airway.
Thoracic Pump

Greater venous return (preload) and coronary blood flow, which leads to...

Greater cardiac output on the next compression, which leads to...

Improved blood flow to vital organs.

Interaction between Intrathoracic Pressure and Intracranial Pressure

ITD on

ITD off
Cerebral Blood Flow

↑ Cerebral Perfusion =

↓ Arterial Blood Pressure

minus

↓↓ Cerebral Blood Pressure
Inefficiencies of Conventional Standard CPR (S-CPR)
Inefficiency #1

• **Filling of the heart (preload) is dependent upon the chest wall’s ability to recoil during decompression phase.**

• **Chest wall recoil may be compromised by:**
  - Stiff chest
  - Broken ribs
  - Just doing it wrong
Complete Chest Wall Recoil

- Results in reduced preload

Incomplete Chest Wall Recoil
ACD-CPR Optimizes Chest Wall Recoil

S-CPR

ACD-CPR
Standard vs. ACD CPR: Survival


Standard or ACD CPR during ACLS only

Odds ratios shown above bars

* Statistically significant difference

** Discharge without neurologic impairment
Standard vs. ACD CPR:
Survival


Human Study

Standard or ACD CPR during BLS and ACLS

<table>
<thead>
<tr>
<th>Time</th>
<th>Survivors (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROSC</td>
<td>55</td>
</tr>
<tr>
<td>1 hr</td>
<td>50</td>
</tr>
<tr>
<td>ICU admission</td>
<td>45</td>
</tr>
<tr>
<td>24 hr</td>
<td>40</td>
</tr>
<tr>
<td>Discharge*</td>
<td>30</td>
</tr>
<tr>
<td>1 yr</td>
<td>25</td>
</tr>
</tbody>
</table>

* Discharge without neurologic impairment

N -

standard CPR (n=99)
ACD CPR (n=120)
Metro Twin Cities

• > 200 LUCAS Devices
  – EMS + Hospital
• Pit Crew CPR
• ITD
Heart attack victim survives after nearly three hours of CPR

Among longest time on record made possible by automated CPR

ST. PAUL, MN. – Oct. 17, 2013 – A 56-year-old man who had a heart attack survived and is recovering at home after receiving two hours and forty five minutes of cardiopulmonary resuscitation (CPR). The length of CPR time is believed to be among the longest on record and was made possible because of a mechanical chest compression machine called the LUCAS device.
Inefficiency #2

- Air rushes in through an open airway and wipes out the vacuum we’re relying on to fill the heart.
- Heart stops filling as soon as vacuum is equalized.
The Solution

• The Impedence Threshold Device (ITD)
The Impedance Threshold Device (ITD) selectively prevents unnecessary air from entering the chest during the decompression phase of CPR:
Effect of Inspiratory Impedance

Greater vacuum (negative pressure) in the chest during chest wall recoil phase
“Cardiopulmonary resuscitation with augmentation of negative intrathoracic pressure should be considered as an alternative to standard CPR to increase long-term survival after cardiac arrest.”

See Articles page 301
Methods

• S-CPR (Control)

• ITD + ACD-CPR (Intervention)
Results:

Primary Endpoint

ALLINA MEDICAL TRANSPORTATION

Survival to Hospital Discharge with Favorable Neurologic Outcome

*53% improvement

P = 0.019

OR 1.58

CI (1.07, 2.36)
## Results:

### One-year Survival

<table>
<thead>
<tr>
<th></th>
<th>Control (N = 813)</th>
<th>Intervention (N = 840)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One-Year Survival</strong></td>
<td>48 (5.9%)</td>
<td>74 (8.8%)</td>
<td>0.030</td>
</tr>
<tr>
<td><strong>Emotional:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beck Depression Inventory (BDI) (Score range: 0 – 63)</td>
<td>5.2 ± 6.3</td>
<td>5.5 ± 5.9</td>
<td>0.862</td>
</tr>
<tr>
<td><strong>Functional:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disability Rating Score (DRS) (Score range: 0 – 29)</td>
<td>1.4 ± 3.1</td>
<td>2.2 ± 5.7</td>
<td>0.358</td>
</tr>
<tr>
<td><strong>Cognitive:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Abilities Screening Instrument (CASI) (Score range: 0 – 100)</td>
<td>92.9 ± 12.0</td>
<td>94.5 ± 4.5</td>
<td>0.473</td>
</tr>
</tbody>
</table>
Results

• **Overall results in sham vs active ITD were similar (≈6%)**

• **No safety concerns with ITD**
Survival in ROC PRIMED Study +/- CPR at Incorrect and Correct Compression Rates

Data from the ROC PRIMED Study: Aufderheide et al, NEJM 2011
2004
CDC- Emory University
Connects prehospital data with hospital outcome data
>45 US communities
Hennepin Co joined CARES mid 2009
Then to Now – Allina EMS

18% Improvement

100% Improvement
LUCAS & ResQPOD vs Manual CPR

Patients Presenting in Shockable Rhythm

<table>
<thead>
<tr>
<th></th>
<th>Manual CPR (n=100)</th>
<th>LUCAS + ResQPOD (n=209)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROSC</td>
<td>17</td>
<td>43</td>
</tr>
<tr>
<td>Surv to Hosp Adm</td>
<td>16</td>
<td>43</td>
</tr>
<tr>
<td>Surv to Hosp Disch</td>
<td>14</td>
<td>25</td>
</tr>
</tbody>
</table>

Source: 2011/2012 CARES Data
Multi-Level Focus and Translational Effort (Critical Care Medicine 2010)

- Widespread CPR Training (e.g. CPR Anytime)
- AEDs
- Public Education

- Lay Public
- First Responder
- Hospital
- EMS

Survival

- Rapid Response
- Start CPR immediately
- Rapid AED application
- High Quality CPR
- ITD (ResQPOD)

Resuscitation Centers of Excellence
- Hypothermia
- 24/7 Revascularization
- ICDs

- High Quality CPR
- IO drug delivery prn
- ITD (e.g. ResQPOD)
- Automated CPR Devices (LUCAS)
Take Heart St. Cloud and Anoka Outcomes (Critical Care Medicine 2010)

- From 2006-2007 in the two MN sites
  - >12,000 people were trained in CPR,
  - bystander CPR rates increased by ~5%,
  - all CPR interventions and the ResQPOD deployed,
  - three Level One Cardiac Arrest Centers were established.
- **Survival Improved 8.5% to 19%**
HeartRescue Partners

- University of Washington
- UW Medicine
- King County
- American Medical Response
- AMR
- Arizona
- Save Hearts in Arizona Registry & Education
- Illinois Heart Rescue
- Duke University
- Wake County
- University of Pennsylvania
- Penn Emergency Medicine
- Center for Resuscitation Science
Quality of CPR Matters
Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis.

Sasson C, Rogers MA, Dahl J, Kellermann AL.

Source
Departments of Emergency Medicine and Internal Medicine, University of Michigan, Ann Arbor, MI, USA. comilla@umich.edu

• Survival Odds Ratio Bystander CPR

• 2.44
Chest Compression Rates by Survival

Mean rate, ROSC group
90 ± 17 *

Mean rate, no ROSC group
79 ± 18 *

*p=0.003

Abella et al - 2005
Survival to Hospital Discharge by Compression Rate

N = 6188

Survival to Discharge (%)

Chest Compression Rate (CC/min)

Sham ITD
Active ITD

p = 0.21

Idris et al - Circulation 2012
Analysis of ROC PRIMED Study: Impact of Active ITD when Quality CPR is Delivered

<table>
<thead>
<tr>
<th>CR 90-109/min</th>
<th>Sham</th>
<th>Active</th>
<th>p-value</th>
<th>Odds ratio</th>
<th>CI lower</th>
<th>CI upper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MRS≤3 Total %</td>
<td>MRS≤3 Total %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>MRS≤3 81/1418 5.71%</td>
<td>MRS≤3 106/1394 7.60%</td>
<td>0.049</td>
<td>1.4</td>
<td>1.01</td>
<td>1.83</td>
</tr>
<tr>
<td>Shockable rhythm</td>
<td>62/354 17.51%</td>
<td>88/355 24.79%</td>
<td>0.021</td>
<td>1.6</td>
<td>1.08</td>
<td>2.24</td>
</tr>
<tr>
<td>Witnessed VF, bystander CPR</td>
<td>30/138 21.74%</td>
<td>52/139 37.41%</td>
<td>0.006</td>
<td>2.2</td>
<td>1.27</td>
<td>3.66</td>
</tr>
<tr>
<td>CR 90-109, Depth 4-6, CF≥50</td>
<td>MRS≤3 25/588 4.25%</td>
<td>MRS≤3 46/572 8.04%</td>
<td>0.010</td>
<td>2.0</td>
<td>1.19</td>
<td>3.25</td>
</tr>
<tr>
<td>All patients</td>
<td>22/164 13.41%</td>
<td>40/161 24.84%</td>
<td>0.011</td>
<td>2.1</td>
<td>1.202</td>
<td>3.79</td>
</tr>
<tr>
<td>Shockable rhythm</td>
<td>10/70 14.29%</td>
<td>24/59 40.68%</td>
<td>0.001</td>
<td>4.1</td>
<td>1.76</td>
<td>9.60</td>
</tr>
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<td>Witnessed VF, bystander CPR</td>
<td>22/164 13.41%</td>
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<td>0.011</td>
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<td>1.202</td>
<td>3.79</td>
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Code Stat
HEART SAFE COMMUNITIES
A Program of Allina Hospitals & Clinics Medical Transportation
Heart Safe Communities
> 2500 AEDs

- 2001 Start
  - >35,000 trained in CPR
  - AED Package
    - AED, Cabinet, CPR/AED Training
  - Churches
  - Businesses
  - Schools
From the Animal Laboratory to Clinical Practice
Translational Research to Out-of-Hospital Cardiac Arrest

Aufderheide et al
Crit Care Med
2008

From laboratory science to six emergency medical services systems: New understanding of the physiology of cardiopulmonary resuscitation increases survival rates after cardiac arrest

Tom P. Aufderheide, MD; Carly Alexander, BS; Charles Lick, MD; Brent Myers, MD; Laurie Romig, MD; Levon Vartanian, MD; Joseph Stothert, MD, PhD; Scott Mcknitle, BS; Tim Matsuura, BA; Demetris Yannopoulos, MD; Keith Lurie, MD

Objective: The purpose of this study is to: 1) describe a newly discovered mechanism of blood flow to the brain during cardiopulmonary resuscitation using the impedance threshold device in a piglet model of cardiac arrest, and 2) describe the survival benefits in humans of applying all of the highly recommended changes in the 2005 guidelines related to increasing circulation during cardiopulmonary resuscitation, including use of the impedance threshold device, from six emergency medical services systems in the United States.

Design: A multi-center, prospective trial with each piglet serving as its own control. Historical controls were used for the human studies.


Interventions: Piglets (10–12 kg) were treated with an active (n = 9) or sham (n = 9) impedance threshold device after 10 mins of ventricular fibrillation. Humans were treated with cardiopulmonary resuscitation per the American Heart Association 2005 guidelines and the impedance threshold device.

Measurements and Main Results: Animals: The primary endpoint in the piglet study was cerebral blood flow which increased from 59 mL/min without an impedance threshold device to 91 mL/min (p = 0.017) with impedance threshold device use. Airway pressures during the chest recoil phase decreased from ~ 0.46 mm Hg to ~ 2.29 mm Hg (p = 0.0006) with the active impedance threshold device. Intracranial pressure decreased more rapidly and to a greater degree during the decompression phase of cardiopulmonary resuscitation with the active impedance threshold device. Humans: Conglomerate quality assurance data were analyzed from six emergency medical services systems in the United States serving a population of ~3 million people. There were 920 patients treated for cardiac arrest after implementation of the 2005 American Heart Association guidelines, including Impedance threshold device use, and 1,750 patients in the control group during the year before implementation. Demographics were similar between the two groups. Survival to hospital discharge was 9.3% in the control group versus 13.6% in the intervention group. The odds ratio, 95% confidence interval, and p value were 1.54 (1.19–1.96) and p = 0.009, respectively. This survival advantage was conferred to patients with a presenting cardiac arrest rhythm of ventricular fibrillation (28.2% vs. 19.0%, p = 0.006).

Conclusions: Use of the impedance threshold device in piglets increased cerebral blood flow and coronary and cerebral perfusion pressures and reduced intracranial pressure during the decompression phase of cardiopulmonary resuscitation at a faster rate than controls, resulting in a longer duration of time when intracranial pressures are at their nadir. Patients in six emergency medical services systems treated with the impedance threshold device together with the renewed emphasis on more compressions, fewer ventilations, and simplified chest wall recoil had a nearly 50% increase in survival rates after out-of-hospital cardiac arrest compared with historical controls. (Crit Care Med 2008; 36[Suppl]:S397-S404)

Key Words: cardiac arrest; sudden death; impedance threshold device; cerebral perfusion pressure; intracranial pressure; CPR
## Outcome Results

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Intervention</th>
<th>P-value</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROSC</strong></td>
<td>30.4% (535/1757)</td>
<td>34.1% (586/1719)</td>
<td>0.022</td>
<td>1.18 (1.022, 1.366)</td>
</tr>
<tr>
<td><strong>Hospital Discharge</strong></td>
<td>9.7% (170/1757)</td>
<td>12.6% (216/1719)</td>
<td>0.007</td>
<td>1.34 (1.078, 1.671)</td>
</tr>
<tr>
<td><strong>HD (VF)</strong></td>
<td>19.0% (85/447)</td>
<td>31.1% (128/412)</td>
<td>&lt;0.001</td>
<td>1.91 (1.384, 2.667)</td>
</tr>
<tr>
<td><strong>CPC 1 or 2</strong></td>
<td>31.4% (11/35)</td>
<td>55.2% (32/58)</td>
<td>0.033</td>
<td>2.68 (1.027, 7.213)</td>
</tr>
</tbody>
</table>
Implementing the 2005 American Heart Association Guidelines and Use of the Impedance Threshold Device Improves Hospital Discharge Rates after In-hospital Cardiac Arrest

**Hospital Discharge Rates Based on Initial Heart Rhythm**

<table>
<thead>
<tr>
<th>HD</th>
<th>Control Phase</th>
<th>Intervention Phase</th>
<th>p-value: O.R. [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF</td>
<td>18/57 (31.6%)</td>
<td>21/48 (43.8%)</td>
<td>0.228: 1.68 [0.70, 4.04]</td>
</tr>
<tr>
<td>PEA</td>
<td>14/97 (14.4%)</td>
<td>27/91 (29.7%)</td>
<td>0.014: 2.50 [1.15, 5.58]</td>
</tr>
<tr>
<td>Asystole</td>
<td>10/87 (11.5%)</td>
<td>23/110 (20.9%)</td>
<td>0.087: 2.04 [0.86, 5.09]</td>
</tr>
<tr>
<td>Overall</td>
<td>42/241 (17.4%)</td>
<td>71/249 (35.3%)</td>
<td>&lt;0.001: 2.59 [1.63, 4.13]</td>
</tr>
</tbody>
</table>
Level 1 Cardiac Arrest Centers

• 24/7 team of specialized critical care decision-makers:
  – Cardiac catheterization
  – Thrombolytics
  – Therapeutic Hypothermia
  – Prevention of 2° injury by inflammatory processes
  – Optimal pressor & antiarrhythmic agents
  – Ventilation management
  – Electrophysiology and ICD implantation
  – Nutrition
  – Report outcomes

THE USE OF HYPOTHERMIA AFTER CARDIAC ARREST

DONALD W. BENSON, M.D.
G. RAINIE WILLIAMS, JR., M.D.
FRANK C. SPENCER, M.D.
ADOLPH J. YATES, M.D.

Baltimore, Maryland
Auto Racing

Pit Crew Concept

• Dr Bob Tober – Naples EMS

• Pit Crew CPR
Cardiac Arrests
PIT Crew CPR

ASYSTOLE/PEA PROTOCOL

Use the card on every arrest!
Importance of Following Protocol

N = 989

OR (95\% CI) = 3.1 (2.02, 4.82)
ArrestPAC
Pit Crew Video


• [Charles.lick@allina.com](mailto:Charles.lick@allina.com)

• [mrc@umn.edu](mailto:mrc@umn.edu)
Transformative technologies

CPR Anytime Kit

ITD

Lay Public

First Responder

ICD

Intra-osseous bone injection

Hospital

EMS

Angiography

AED

Therapeutic hypothermia

Automated CPR device
Take Heart America: Phase 1 Results
St. Cloud and Anoka Outcomes

From 2006-2008 in the two MN sites:

- >28,000 people were trained in CPR,
- bystander CPR rates increased from 21% to 29%,
- all CPR interventions including ITD deployed,
- 3 Level One Cardiac Arrest Centers were established.
Take Heart St. Cloud and Anoka Outcomes
(Critical Care Medicine 2010)

- From 2006-2007 in the two MN sites
  - >12,000 people were trained in CPR,
  - bystander CPR rates increased by ~5%,
  - all CPR interventions and the ResQPOD deployed,
  - three Level One Cardiac Arrest Centers were established.

Take Heart America Survival

Series1
Take Heart

Love Minnesota

Sudden Cardiac Arrest Survival Initiative
Town of Colonie (NY)
EMS Experience

• Population 80,000
• EMS shift supervisors respond to all arrests to monitor resuscitation quality
• **2005:** Baseline survival to hospital discharge - 4%
• **2006:**
  – Implemented new CPR guidelines
  – Expanded bystander CPR training (CPR Anytime)
• **2007:**
  – + ITD
  – More rapid deployment of mechanical CPR
• **2008:**
  – Dispatch improvements to reduce response times
  – 2 min CPR prior to defib
  – Delayed advanced airway placement & IV in favor of a period of high quality CPR
• **2009:**
  – Three Level One Cardiac Arrest Centers w/ hypothermia capabilities
• **2010:** Awarded Heart Safe Community Award for efforts
Town of Colonie (NY)
EMS Experience

P=0.307

P=0.001
New Orleans (LA) EMS Experience

- Population 275,000 (post Katrina)
- **Baseline (year prior):** Stable ROSC upon arrival at ED - 21%
- **Intervention Group (Dec 2009):**
  - + ITD to ambulances (first responders rec’d in Mar 2009)
  - + Mechanical CPR in sprint car
  - Meds delivered IV or IO (EZ-IO)
  - Prehospital therapeutic hypothermia (cold packs and chilled saline)
  - Baseline and peak ETCO2 values also assessed
New Orleans (LA) EMS Experience

- ROSC: 75% improvement
- ETCO2
  - Measured in 84 subjects
  - 69% had an increase
  - Increase was > 10 mmHg in 36% of pts
- Prehospital Cooling
  - 38% of ROSC pts cooled
Improved Out-of-Hospital Cardiac Arrest Survival After the Sequential Implementation of 2005 AHA Guidelines for Compressions, Ventilations, and Induced Hypothermia: The Wake County Experience

Paul R. Hinchey, MD, MBA
J. Brent Myers, MD, MPH
Ryan Lewis, MS, EMT-P
Valerie J. De Maio, MD, MSc
Eric Reyer, MSN, ACNP
Daniel Licatese, RN
Joseph Zalkin, BSHS
Graham Snyder, MD
For the Capital County Research Consortium

From WakeMed Health and Hospitals (Hinchey, Myers, De Maio, Reyer, Snyder); the Clinical Research Unit, Emergency Services Institute (Hinchey, De Maio); Wake County EMS (Hinchey, Myers, Lewis, Zalkin); and Rex Healthcare (Licatese), Raleigh, NC.

Study objective: We assess survival from out-of-hospital cardiac arrest after community-wide implementation of 2005 American Heart Association guidelines.

Methods: This was an observational multiphase before-after cohort in an urban/suburban community (population 840,000) with existing advanced life support. Included were all adults treated for cardiac arrest by emergency responders. Excluded were patients younger than 16 years and trauma patients. Intervention phases in months were baseline 16; phase 1, new cardiopulmonary resuscitation 12; phase 2, impedance threshold device 6; and phase 3, full implementation including out-of-hospital-induced hypothermia 12. Primary outcome was survival to discharge. Other survival and neurologic outcomes were compared between study phases, and adjusted odds ratios with 95% confidence intervals (CIs) for survival by phase were determined by multivariate regression.

Results: One thousand three hundred sixty-five cardiac arrest patients were eligible for inclusion: baseline n=425, phase 1 n=369, phase 2 n=161, phase 3 n=410. Across phases, patients had similar demographic, clinical, and emergency medical services characteristics. Overall and witnessed ventricular fibrillation and ventricular tachycardia survival improved throughout the study phases: respectively, baseline 4.2% and 13.8%, phase 1 7.3% and 23.9%, phase 2 8.1% and 34.6%, and phase 3 11.5% and 40.8%. The absolute increase for overall survival from baseline to full implementation was 7.3% (95% CI 3.7% to 10.9%); witnessed ventricular fibrillation/ventricular tachycardia survival was 27.0% (95% CI 13.6% to 40.4%), representing an additional 25 lives saved annually in this community.

Conclusion: In the context of a community-wide focus on resuscitation, the sequential implementation of 2005 American Heart Association guidelines for compressions, ventilations, and induced hypothermia significantly improved survival after cardiac arrest. Further study is required to clarify the relative contribution of each intervention to improved survival outcomes. [Ann Emerg Med. 2010;xx:xxx.]
Wake Co.

Neurologically-Intact Survival (%) – Pts in VF/VT

*P<0.05 when compared to baseline
No $$

No Mission

Lick et al Critical Care Medicine  in press 2010
Take Heart America
Financial Analysis
Lick et al Critical Care Medicine 2010

• Initial Hypothesis: Out-of hospital sudden cardiac arrest patients delivered alive to the ED generate significant revenue and margin for the hospital.

• Process: Reviewed hospital billing/cost data for out of hospital SCA patients delivered alive to ED during 19 month period of time.

• N = 69 SCA patients delivered alive to ED.
## Money Mechanics of Resuscitation Center Survival

<table>
<thead>
<tr>
<th></th>
<th>Average Revenue per Pt.</th>
<th>Direct Cost per Pt.</th>
<th>Direct Margin per Pt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharged</td>
<td>$57,783</td>
<td>$37,099</td>
<td>$20,684</td>
</tr>
<tr>
<td>Died</td>
<td>$12,014</td>
<td>$8,686</td>
<td>$3,329</td>
</tr>
</tbody>
</table>
Systems Based Approach

- Bystander CPR
- ITD
- ICD
- Angiography
- Hypothermia
- Automated CPR
- Lay Public Hospital
- EMS First Responder
- Survival
Keeping Families Whole
Systems based approach

- Bystander CPR
- ITD
- Intra-osseous bone injection
- ICD
- Angiography
- AED
- Therapeutic hypothermia
- Automated CPR device
Little Serenity Joy: 15 months old and status post in utero Take Heart CPR
Prehospital

• 56 yo healthy Paramedic on critical case
• VF - Immediate CPR
• Defib, unsuccessful
• LUCAS device (total 20 minutes)
• Unable to be intubated due to teeth clenching, shook head, raised arms
• End tidal CO2 above 25
• Defibs and epis X 4, amiodarone
At Hospital 30 minutes

• Rapid sequence intubation
• LUCAS and Impedance Threshold Device
  – Slow ventilation, guided by ITD
• Epi, CaCl, NaHCO3, Lidocaine, Mg
• VF successful defibrillation
• EKG obtained 37 minutes into arrest
Cath Lab Activated
But VF recurred
Success at 68 minutes

- Lidocaine, defibs, NaHCO3, Vasopressin, Epi
- Esmolol bolus and drip, CaCl, Epi, Atropine, NaHCO3
- Defibrillated successfully
- Poor EF
- Arctic Sun applied and cooling started
- Repeat EKG

Total of 68 minutes chest compressions:
- 10 manual
- 58 on LUCAS device (38 LUCAS plus ITD)
Heparin, aspirin, to cath lab to open proximal LAD.
Wayne Schneider – 68 minutes of high performance CPR
Pit Crew CPR Links

- [http://www.slideshare.net/Hiltz/high-performance-high-density-pit-crew-team-cpr#btnNext](http://www.slideshare.net/Hiltz/high-performance-high-density-pit-crew-team-cpr#btnNext)
- [http://wilco.sharepointsite.com/EMS/FROtraining/Lists/WHATS%20NEW/Attachments/12/Pit%2020Crew%20Model%20FRO%20version.pdf](http://wilco.sharepointsite.com/EMS/FROtraining/Lists/WHATS%20NEW/Attachments/12/Pit%2020Crew%20Model%20FRO%20version.pdf)
- [http://vimeo.com/53478207](http://vimeo.com/53478207)
Celebrate the Saves