Regional Approach to Cardiovascular Emergencies
Cardiac Arrest Resuscitation System

RACE CARS

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Forsyth Medical Center  Emergency Department
Medical Director, Stokes County EMS

April, 2012
Objectives:

• Discuss the Medtronic Foundation HeartRescue Project
• Review Current North Carolina Statistics for Cardiac Arrest
• Discuss Improvement Strategies
• Discuss the Implementation of the CARES Registry
**RACE Successes:**

- Shortfalls in MI and HF survival, process measures seen at small US rural hospitals (HARVARD)
  - She pointed to the RACE program as "a model for the type of system-wide thinking that would have to be in place to be able to help small rural hospitals to succeed."
  - As reported last week by heartwire, the RACE program's implementation of specific system care processes in emergency medical services and hospitals in North Carolina significantly reduced door-in-to-door-out times for patients with ST-segment-elevation MI who required transfer for percutaneous coronary interventions (PCI).

- North Carolina's RACE program cuts door-in-to-door-out times for STEMI patients
  - RACE program is an example of a successful coordinated regional ST-elevation-MI care system that could serve as a model for other areas trying to increase the speed of acute-MI care [1].
Statistics:

- Out-of-hospital cardiac arrest (OOHCA)
  - 236,000 - 325,000 people in the US each year
  - 3rd leading cause of death
Variation in survival VF arrest
Resuscitations Outcomes Consortium

Survival to discharge

- Vancouver: 25.0%
- Toronto: 15.7%
- Seattle: 39.9%
- Portland: 22.5%
- Pittsburgh: 21.5%
- Ottawa: 14.8%
- Milwaukee: 26.0%
- Iowa: 22.7%
- Dallas: 9.5%
- Alabama: 7.7%

Nichol JAMA. 2008;300(12):1423-1431
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: 1,845 (35%)
- Arrived at Emergency Department Alive: 1,034 (20%)
- Admitted to Hospital Alive: 589 (11%)
- Discharge from Hospital Alive: not available… likely under 5%
Cardiac arrest in North Carolina

From the CARES Registry:

- Bystander CPR: 23%
- AED Use: 1.3%
- Public CPR training: 3% / year
- 32% Survival Rate

Currently - there are 3 NC CARES sites in NC
Working on baseline data:

2011 REPORTS ARE COMING IN APRIL

<table>
<thead>
<tr>
<th>Overall Survival to Hospital Discharge</th>
<th>EMT Treated Bystander Witnessed VF</th>
<th>% Bystander CPR Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall Survival to Hospital Discharge</strong></td>
<td><strong>Number of Cases included in Overall Survival Statistics</strong></td>
<td><strong>Number of Cases included in VF Survival Statistics</strong></td>
</tr>
<tr>
<td>CARES Utstein Report</td>
<td>1270</td>
<td>CARES 2010 report</td>
</tr>
</tbody>
</table>

10.6%  
16.5%

1270
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.
ACLS: De-emphasis of Devices, Drugs and other Distracters

- Focus on high-quality CPR and defibrillation
- Atropine no longer recommended for routine use in
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 from OOHCA:
  - Early, continuous compressions and early defibrillation
  - Don’t interrupt chest compression for inserting airway
    - Adult takes 10 – 15 minutes to de-saturate below 80%
Ventilation

- 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 intra-thoracic pressure
    and
    → impedes venous return to heart, affecting BP
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

Increased chest compression fraction is independently predictive of better survival
Perishock Pause: Independent Predictor of Survival

Study showed that odds of survival were significantly lower for patients with:
1. Pre-shock pause > 20 seconds
2. Peri-shock pause > 40 seconds

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

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

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.

Resuscitation Science

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

Sheldon Cheskes, MD; Robert H. Schmickler, 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 Olufka, 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
Advanced Airway Placement

Interruptions in CCC

- 100 cases reviewed
- Median 2 intubation attempts /pt

- 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)
TEAM APPROACH TO RESUSCITATION
Pit Crew Approach to Resuscitation

• Focus on:
  – Leadership, team approach, skills & competencies, communication & teamwork, best practices, and rehearsal

• Emphasis on:
  – Minimally interrupted CPR
  – Controlled ventilations
  – Defibrillation
  – 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

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
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

• Re-tasked the first 5 minutes of cardiac arrest management to:
  – Maximize hands on compression time

Goal: Maximize coronary & 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
<table>
<thead>
<tr>
<th>Problem</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay in initiating CCC</td>
<td>Rapid ABC assessment and initiation of CCC; one rescuer CCC while monitor placed</td>
</tr>
<tr>
<td>Pauses of CCC for rhythm analysis and defibrillation</td>
<td>Brief pause for rhythm analysis; continue CPR until ready for shock, clear and then resume CCC immediately</td>
</tr>
<tr>
<td>Pauses of CCC for advanced airway placement</td>
<td>Defer until later in the arrest unless clinically indicated to do earlier or placement with interruption of CCC</td>
</tr>
</tbody>
</table>
• 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.
Stories:

- Pregnant Woman – Charlotte
- Legislator-Raleigh
- School Teacher-Charlotte
- Baseball Coach-Winston-Salem
- Former Girlscout performs CPR-Durham
Elements of success:

- Witnessed
- Recognition, 911
- Medical dispatch
- Bystander CPR
- 1st responder AED
- Hypothermia protocol
Wake County

Figure 3. Overall survival to hospital discharge and neurologic status* of survivors of out-of-hospital cardiac arrest between baseline (N=425) and full implementation (N=410) of 2005 AHA guidelines (phase 3).
RACE Cardiac Arrest Resuscitation System

- Goal - increase overall out-of-hospital cardiac arrest survival rates by 50% over five years
- Support community to state-wide initiatives that focus on a “systems-based” approach to out-of-hospital cardiac arrest
RACE Cardiac Arrest Resuscitation System

1) Develop leadership, funding, data structure

2) Establish REGIONAL CARDIAC ARREST CENTERS

3a) HOSPITAL by hospital establishment of cardiac arrest plan (review, consensus, training)

3b) EMS by EMS establishment of cardiac arrest plan (review, consensus, training)

3c) Community by community cardiac arrest training/AED placement

4) Improve system

Measurement & Feedback
HeartRescue Flagship Premier Partner Program:

1st Chain: Community Response
i. Early SCA Recognition
ii. Early 911
iii. Early and effective bystander CPR or CCC
iv. Early Public Access to AED

2nd Chain: Pre-Hospital Response
i. Enhanced dispatch
ii. Enhanced/high performance CPR or CCC
iii. Defibrillation care (e.g. one shock therapy for VF patients)
iv. Pre-hospital hypothermia
v. Drug delivery (e.g. Intra-osseous drug delivery)

3rd Chain: Hospital Response
i. Patient triage to Resuscitation Center of Excellence
ii. Hypothermia as indicated by local protocol
iii. 24/7 Cath Lab
iv. Patient indicated therapies provided (e.g. ICD, PTCA, stent, CABG)
v. Post survival patient and family education and support
"Is it just me or is it a bad idea to eat at a place that prints CPR instructions on their placemats?"
Strategies for improving survival

• Medical leadership
• Community
  – Bystander CPR
  – Public access defibrillation
• 911 dispatch
  – Rapid first response
  – Dispatch assisted CPR
• EMS
  – High quality CPR
  – Early defibrillation

• Hospital
  – Specialized centers for treating post–cardiac arrest patients
  – Multidisciplinary post–cardiac arrest care treatment plan
  – Early PCI
  – Therapeutic hypothermia
  – Early hemodynamic optimization
  – AICD placement

Circulation. 2011;123:2898-2910
Essential Elements

• Training
• QI
• Feedback

• Performance Standards
  – Time to recognize cardiac arrest
  – Time to start chest compressions
  – Percent of cardiac arrests that receive telephone CPR
Adult Chain of Survival

1. Immediate recognition of cardiac arrest and activation of the emergency response system
2. Early CPR with an emphasis on chest compressions
3. Rapid defibrillation
4. Effective advanced life support
5. Integrated post–cardiac arrest care
POST-CARDIAC ARREST PROTOCOL

THERAPEUTIC HYPOTHERMIA

After cardiac arrest due to ventricular tachycardia or ventricular fibrillation, all intubated patients should receive therapeutic hypothermia unless:

1. The patient can follow verbal commands.
2. More than 8 hours have elapsed since ROSC (flexible).
3. There is life-threatening bleeding or infection.
4. Cardiopulmonary collapse is imminent, despite vasopressor support.
5. Refractory hemodynamically significant arrhythmias.
6. Aggressive care not warranted.

Also consider therapeutic hypothermia following cardiac arrest due to pulseless electrical activity or asystole.

Start cooling as early as possible for maximum effectiveness. Initiate therapy in the ED when possible and continue treatment in the cath lab and ICU.

INDUCTION

1) Activate hypothermia protocol rapid response team. Members may include intensivist, critical care nursing, neurology, cardiology, pharmacy, and/or pastoral care.
Community Response

- NC Standard Course of Study and Grade Level Competencies
  - CPR and AED training by 8th grade
- Heart patients on discharge
- All hospital employees
- Regional plans to address community training
- Hire community coordinators

Recognize cardiac arrest, MI, stroke; CPR; AED
Pre Hospital

- Rapid dispatch
  - Medical dispatcher
  - Dispatcher CPR instruction

- Effective resuscitation
  - Uninterrupted chest compression
  - ACLS team approach

- In the field cooling

- CARES Registry
## Pre-hospital Response Dispatch:

<table>
<thead>
<tr>
<th>9-1-1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9-1-1 Dispatches asks: is the patient is able to talk and are they are breathing normally (gasp is not normal)</td>
<td></td>
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<tr>
<td>Dispatcher recognizes cardiac arrest</td>
<td></td>
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<tr>
<td>Dispatcher sends appropriate units to scene</td>
<td></td>
</tr>
</tbody>
</table>
| Dispatcher gives bystander instructions for hands only chest compressions and to get an AED if available:  
  1. Place heel of hand in center of chest, over breast bone  
  2. Place other hand on top of that first hand  
  3. Push hard  
  4. Push fast  
  *If AED location is known by dispatcher, can send bystander/s to get AED |  |
| Attach AED if available, follow instructions |  |
| Dispatcher stays on phone until responders arrive |  |
2-Question Approach

- Is the patient responsive/conscious?
  - Yes: Consider alternate conditions
  - No: Is the patient breathing normally?
    - Yes: Consider alternate conditions
    - No: Possible Cardiac Arrest
      START CPR
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
Chest compression only CPR:

- Bystanders more willing to initiate
- Arterial blood is adequately oxygenated at onset of primary cardiac arrest
- Less likely to cause regurgitation of stomach contents
- Rescue breathing interrupts critical chest compressions
- Easier to teach
- Observational evidence of improved survival

Public-Access Defibrillation and Survival after Out-of-Hospital Cardiac Arrest:

• AED’s combined with trained volunteer response save lives,
  – Particularly in public places with more than 250 adults over age 50

### First Responders:

<table>
<thead>
<tr>
<th></th>
<th>Assess victim for decision to attempt resuscitation or not attempt resuscitation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Initiate hands only High Quality CPR with focus on:</td>
</tr>
<tr>
<td></td>
<td>1. rate</td>
</tr>
<tr>
<td></td>
<td>2. depth</td>
</tr>
<tr>
<td></td>
<td>3. recoil</td>
</tr>
<tr>
<td></td>
<td>4. and limiting time off of chest</td>
</tr>
<tr>
<td></td>
<td>5. Switch compressors every 2 minutes</td>
</tr>
<tr>
<td></td>
<td>Attach AED: follow instructions</td>
</tr>
<tr>
<td></td>
<td>Consider compressions while AED is charging or resume CPR if no shock is</td>
</tr>
<tr>
<td></td>
<td>recommended</td>
</tr>
<tr>
<td></td>
<td>Add breathing and airway management after 2nd shock and 2 rounds of 2 min CPR</td>
</tr>
<tr>
<td></td>
<td>If ROSC, follow Standard and well executed Protocols</td>
</tr>
</tbody>
</table>
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

Person in Position 3 (P3) always at patients Head
1. Opens/clears Airway and insert OPA
2. Assembles/apply BVM and ITD
3. Provides 2 hand mask seal
4. Inserts/secsures BIAD (King) & ITD & ETCO₂ after 400 Compressions

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
Pre-hospital Response EMS:

- NCOEMS / North Carolina College of Emergency Physicians Cardiac Arrest protocol update 2011
- Commit to implement new protocols, training director, courses, plans, data
- Work with regional EMS and hospitals
- Commit to community education
**Pre-hospital Response EMS:**

**EMS Personnel:**

- **If first on scene:** Assess victim for decision to attempt resuscitation or not attempt resuscitation.
- **If taking over or make decision to attempt resuscitation:**
  - Initiate hands High Quality CPR with focus on:
    1. rate
    2. depth
    3. recoil
    4. and limiting time off of chest
  - Switch compressors every 2 minutes
- **Attach defibrillator**
- **Consider compressions while defibrillator is charging or resume CPR if no shock is needed**
- **Standard and well executed ACLS Protocols including adding breathing and airway management after 2nd shock and 2 rounds of 2 min CPR**
- **Continue efforts until ROSC or until resuscitation is stopped**
- **If ROSC, evaluate victim for hypothermia protocol**
- **Transport to appropriate Resuscitation Capable Hospital or Cardiac Arrest Center**
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
3. Provides 2 hand mask seal
4. Inserts/secures BIAD (King) & ITD & ETCO2 after 400 Compressions

Person in Position 1 (P1) always on patients’ Right side
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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 5 (P5) always at an extremity 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 6 (P6) always at an area outside the CPR “Triangle” near a lower leg and Operates the Monitor
Cardio-cerebral Resuscitation

- EMS arrival
- CC Only
- 200 chest compressions
- BVM or Passive Insuflation 100% FIO2 Begin IV
- Analysis
- Single shock without pulse Check or rhythm analysis
- 200 chest compressions
- Administer 1 mg IV Epinephrine
- Analysis
- Single shock if Indicated without pulse check or rhythm analysis
- 200 chest compressions
- Resume Standard ACLS
- Consider Endotracheal Intubation
- Analysis
- Single shock if Indicated without pulse check or rhythm analysis

• If adequate bystander chest compressions are provided, EMS providers perform immediate rhythm analysis
Hospital

- Post cardiac arrest care
  - Strong physician leader
  - Cardiac arrest team / coordinator
  - ICU / hypothermia / cath. / neurology protocols
  - Limited data measurement and feedback
- EP evaluation / Implantable defibrillators
- Community support / training
Cardiac Arrest Centers:

<table>
<thead>
<tr>
<th>Cardiac Arrest Center</th>
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</thead>
<tbody>
<tr>
<td>Goal: To improve the survival from cardiac arrest by 50%</td>
</tr>
<tr>
<td>- Standard and well executed ACLS Protocols</td>
</tr>
<tr>
<td>- Baseline Neurologic examination</td>
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<td>- 2 large bore IV</td>
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<tr>
<td>- ECG: If new LBB or STEMI to Cath Lab</td>
</tr>
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<td>- Optimize BP to MAP &gt; 80mmHg</td>
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<td>- Titrate EtCO2 for 35-40</td>
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<td>- CT of Brain</td>
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<tr>
<td>- Pressure infuse 2L of cold saline if candidate for hypothermia</td>
</tr>
<tr>
<td>- Sedation and possibly paralysis</td>
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<tr>
<td>- On-going Neurological Assessment and Care</td>
</tr>
<tr>
<td>- Early Coronary Angiography if not a STEMI</td>
</tr>
<tr>
<td>- ICD Evaluation</td>
</tr>
<tr>
<td>- 24/7 Cath Lab availability for STEMI</td>
</tr>
<tr>
<td>- Rehabilitation Plan</td>
</tr>
<tr>
<td>- Family and Staff Support</td>
</tr>
<tr>
<td>- Data measurement and feedback</td>
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</tbody>
</table>
## Resuscitation Capable Centers:

<table>
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<th>Resuscitation Capable Hospital</th>
<th>Goal: To improve survival from cardiac arrest by 50%</th>
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<tbody>
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</tr>
<tr>
<td>- 2 large bore IV</td>
<td></td>
</tr>
<tr>
<td>- ECG: If new LBB or STEMI: Activate STEMI Plan</td>
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<tr>
<td>- Early notification of the receiving hospital</td>
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<tr>
<td>- Early activation of the transport plan</td>
<td></td>
</tr>
<tr>
<td>- Implement Treatment protocols for STEMI and Cardiac Arrest</td>
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<tr>
<td>- Send medical records including EMS information, ECG, record of treatment with times, and EMTALA form (can fax records if need time to complete, EMTALA forms must go with patient)</td>
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<td>- Optimize BP to MAP &gt; 80 mmHg</td>
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<td>- Data measurement and feedback</td>
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</table>
All Hospitals:

- Lead community education efforts
- Train all employees in some level of CPR based on job classification
  - Orientation and ongoing yearly training
- Train patient and families on recognition and compression only CPR on discharge
Therapeutic Hypothermia

Post Cardiac Arrest Care
Why treat with TH?

- With TH, cell metabolic rate decreases 6 – 7 % for every 1°C lowered temp
- ↓ cell metabolism leads to ↓ O$_2$ consumption
  - TH slows neuroexcitatory processes
    - Leads to ↓ in disruptions in blood brain barrier and prevents premature cell death
  - TH ↓ many chemical rxns, including free radical production
  - TH ↓ inflammatory response (by decreasing activity of neutrophils and macrophages)
## Trial Outcomes

### Alive at hospital discharge with favorable neurological recovery

<table>
<thead>
<tr>
<th></th>
<th>Hypothermia</th>
<th>Normothermia</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HACA</td>
<td>53%</td>
<td>36%</td>
<td>.006</td>
</tr>
<tr>
<td>Bernard</td>
<td>49%</td>
<td>26%</td>
<td>.052</td>
</tr>
</tbody>
</table>

### Alive at 6 months with favorable neurological recovery

<table>
<thead>
<tr>
<th></th>
<th>Hypothermia</th>
<th>Normothermia</th>
<th>P Value</th>
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<tr>
<td>HACA</td>
<td>52%</td>
<td>36%</td>
<td>.009</td>
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</table>
Switzerland Trial

From evidence to clinical practice: Effective implementation of therapeutic hypothermia to improve patient outcome after cardiac arrest*

Mauro Oddo, MD; Marie-Denise Schaller, MD; François Feihl, MD; Vincent Ribordy, MD; Lucas Liaudet, MD

2006

- Retrospective study at one hospital in Switzerland
- Out-of-hospital arrests with any rhythm
- Cooling initially with ice bags then a cooling mattress
- Target temp 33 degrees for 24 hours
- STEMIs went to the cath lab
## Outcomes VF Arrest

### Outcome at discharge for out-of-hospital VF arrest

<table>
<thead>
<tr>
<th></th>
<th>CPC5</th>
<th>CPC3</th>
<th>CPC2</th>
<th>CPC1</th>
</tr>
</thead>
<tbody>
<tr>
<td>baseline</td>
<td>56%</td>
<td>19%</td>
<td>12%</td>
<td>14%</td>
</tr>
<tr>
<td>cooling</td>
<td>40%</td>
<td>5%</td>
<td>14%</td>
<td>42%</td>
</tr>
</tbody>
</table>

CPC: Cerebral Perfusion Category (1-5)
Outcomes Asystole Arrest

Outcome at discharge for out-of-hospital asystole arrest

<table>
<thead>
<tr>
<th>Baseline</th>
<th>CPC5: 89%</th>
<th>CPC3: 11%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling</td>
<td>CPC5: 83%</td>
<td>CPC1: 17%</td>
</tr>
</tbody>
</table>

CPC: Cerebral Perfusion Category (1-5)
Who to Cool?

Part 9: Post–Cardiac Arrest Care
2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

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Class I, LOE B  All comatose patients with ROSC after out-of-hospital VF cardiac arrest should be cooled to 32 – 34° C for 12 – 24 hours.

Class IIb, LOE B Induced hypothermia also may be considered for comatose adult patients with ROSC after in-hospital cardiac arrest of any rhythm or after out-of-hospital cardiac arrest with an initial rhythm of pulseless electrical activity or asystole.
Who to Cool?

RACE Ops Manual Recommendations

- After cardiac arrest due to VF, all intubated pts should receive TH unless:
  - The pt can follow verbal commands
  - > 8 hours have since ROSC
  - Life threatening bleeding or infection
  - Cardiopulmonary collapse is imminent, despite vasopressor support
  - Refractory hemodynamically significant arrhythmias
  - Aggressive care not warranted

- Also consider TH following cardiac arrest due to PEA or asystole
Who to Cool?

NCOEMS Protocol

• Criteria for TH:
  – Any presenting rhythm is eligible
  – Advanced airway (including BIAD) in place with no purposeful response to verbal commands
  – Initial temp > 34°C
  – Non traumatic or hemorrhage arrest

• Relative contraindications:
  – Pregnancy
  – Sepsis
1. Induction

2. Maintenance

3. Rewarming
How to Cool

1. Induction
   - Infuse cool saline (4°C) over 30 mins
     • 30 cc/kg (~2 L)
   - Initiate water circulating blanket (Artic Sun)
     • Insert temp probe
     • Set machine to 33°C (32 – 34°C)
   - Sedation
     • Per system protocol (midazolam, fentanyl, propofol)
   - Shivering control
     • Per system protocol (vecuronium, pancuronium)
   - Monitoring
     • MAP > 65 mmHg or systolic pressure > 90
       - Per system protocol (fluids, norepi, dopamine)
2. Maintenance

- Achieve goal temperature, 33°C, maintain for 24 hours
- Keep MAP > 65 mmHG or Systolic > 90
- Ventilator Support: target O₂ saturation > 90 %
  - Avoid hyperoxia
- Potassium: check every 4 hrs
  - Treat if needed during cooling (may have hypokalemia)
- Seizures: monitor for seizures
3. Rewarming

- Controlled rewarming
  
  • Set device to reach goal of 36.5°C over 12 hours (.25 - .35°C/hr)

- Monitor for hypotension and hyperkalemia

- Maintain sedation until 35°C
When to Cool

Best time to initiate TH and the optimal duration of cooling is not well defined

Overall thought:
- Reasonable to initiate cooling as soon as possible to maximize benefits
  - Injury to the brain starts within minutes
  - Benefits of cooling have been shown with delayed initiation
When to Cool

2011 Mayo Clinic Study – looked at time to target temp on patient outcomes

Time to Target (TTT) = Witnessed arrest to temp 34°C

“Early TH” = TTT < 6 hrs
“Late TH” = TTT > 6 hrs

<table>
<thead>
<tr>
<th></th>
<th>Early TH</th>
<th>Late TH</th>
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<tbody>
<tr>
<td>Good Outcome</td>
<td>80%</td>
<td>24%</td>
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<tr>
<td>CPC 1-2</td>
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<td></td>
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<tr>
<td>Poor Outcome</td>
<td>20%</td>
<td>76%</td>
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<tr>
<td>CPC 3-5</td>
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</tbody>
</table>

Earlier Hypothermia Attainment is Associated with Improved Outcomes after Cardiac Arrest
Side Effects of TH

- ↓ heart rate (usually hemo-dynamically stable brady-cardia)
- ↑ systemic vascular resistance, maintaining MAP
- Bleeding, sepsis, renal insufficiency, pancreatitis seen in pts with TH
  - However, these are also seen in post arrest pts with normo-thermia
- Arrhythmias are seen below 32°C, not seen during mild TH
- Decrease in metabolic rate → prolongs the ½ life of drugs, delaying clearance from system
EMS and TH

• Pre-hospital induced hypothermia by infusion 2 L of chilled saline (4°C) over 30 minutes has been shown to be
  – Feasible
  – Safe
  – Effective in lowering temperature
  – Differences in outcomes has not been shown

• New trial currently enrolling pts in Seattle
EMS & TH

- Trial evaluated efficiency and efficacy of pre-hospital TH
- Cooled ROSC patients in the field with 4°C Saline
- Found it safe and feasible
- Effective at lowering temp
  - Expect a ↓ of 1.7 - 2°C with 2L cool saline
  - Pre-hospital cooling **not** associated with adverse consequences in terms of
    - BP, HR, arterial oxygenation, pulmonary edema, or re-arrest
Welcome To:
Cardiac Arrest Registry to Enhance Survival (CARES)

Sponsored by:

CDC
Department of Health and Human Services
Centers for Disease Control and Prevention

EMORY UNIVERSITY SCHOOL OF MEDICINE
American Heart Association

CARES
The Cardiac Arrest Registry to Enhance Survival (CARES) was initiated in October 2004 as a cooperative agreement between the Center for Disease Control and Prevention (CDC) and the Department of Emergency Medicine at Emory University School of Medicine to identify incidents of prehospital cardiac arrest. The CARES Program is designed to consolidate all essential data elements of a prehospital cardiac arrest event in an efficient manner. With this standardized collection system, participants can track ongoing system performance in several, tailored reports. If you have questions about this program, please send an email to...
CARES Registry:

- Created 2004 agreement between CDC and Emory
- Help EMS Identify:
  - When, where, what part of the system is functioning properly, and where there are opportunities to improve
- Consolidates all essential elements
- Quick and easy data collection
- Track ongoing performance
- Create reports for benchmarking
CARES Registry
HIPAA / PHI

- CDC Registry – Federal exempt
- Duke IRB approved
- Business Associate Agreement can be executed.
- Direct identifiers removed
North Carolina:

Entering = 16
In Process = 14

We need to update, we now cover **46%** of NC population
# Cardiac Arrest Registry

**Part A: Demographic Information**

1. Street Address Where Arrest Occurred
2. City
3. State
4. Zip Code
5. First Name
6. Last Name
7. Age
8. Date of Birth
9. Gender
10. Race/Ethnicity
11. Medical History
   - No
   - Unknown
   - Cancer
   - Diabetes
   - Heart Disease
   - Hyperlipidemia
   - Hypertension
   - Renal Disease
   - Respiratory Disease
   - Stroke
   - Other

**Part B: Run Information**

14. Nature of Arrest
15. Incident #

**First Responding Agency**

16. First Responder
17. Destination Hospital

**Part C: Arrest Information**

18. Location Type
   - Home/Residence
   - Public/Commercial Building
   - Place of Recreation
   - Street/Highway
   - Industrial Area
   - Nursing Home
   - Other: Specify

19. Arrest Witnessed
20. Arrest After Arrival of 911 Responders
21. Presumed Cardiac Arrest Etiology
   - Presumed Cardiac Etiology
   - Trauma
   - Respiratory
   - Drowning
   - Electrocution
   - Other

**Resuscitation Information**

22. Resuscitation attempted by 911 Responder
   (or AED shock given prior to EMS arrival)
   - Yes
   - No

23. Who Initiated CPR
   - Not Applicable
   - Lay Person
   - Lay Person Family Member
   - Lay Person Medical Provider
   - First Responder (non-EMS)
   - Responding EMS Personnel

24. Type of Bystander CPR provided
   - Compressions and ventilations
   - Compressions Only
   - Ventilations Only

25. Were Dispatcher CPR instructions provided:
   - Yes
   - No

26. Was an AED applied prior to EMS arrival
   - Yes, with defibrillation
   - Yes, without defibrillation
   - No

27. Who First Applied the AED
   - Lay Person
   - Lay Person Family Member
   - Lay Person Medical Provider
   - First Responder (non-EMS)
   - First Responder (EMS)
   - Refused by patient

28. Who First Defibrillated the Patient
   - Lay Person
   - Lay Person Family Member
   - Lay Person Medical Provider
   - First Responder (non-EMS)
   - First Responder (EMS)
   - Refused by patient

29. Did 911 Responder perform CPR:
   - Yes
   - No

**First Cardiac Arrest Rhythm of Patient and ROSC Information**

30. First Arrest Rhythm of Patient
   - Ventricular Fibrillation
   - Ventricular Tachycardia
   - Asystole
   - Idioventricular/PEA
   - Unknown Shockable Rhythm
   - Unknown Non-Shockable Rhythm

31. Sustained ROSC (20 consecutive minutes)
32. Was hypothermia care provided in the field
33. End of Event
   - Pronounced in the Field
   - Pronounced in the ED

34. When did ROSC first occur:
   - Never
   - After EMS CPR Only
   - After EMS Defibrillation
   - Unknown

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### Part A: Demographic Information

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<tr>
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<td>2 - 3</td>
<td>City / State</td>
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<tr>
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<tr>
<td>4b</td>
<td>County</td>
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<tr>
<td>5</td>
<td>First Name</td>
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</tr>
<tr>
<td>6</td>
<td>Last Name</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Age</td>
<td>Days, Months, Years</td>
</tr>
<tr>
<td>9</td>
<td>Date of Birth</td>
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<tr>
<td>10</td>
<td>Gender</td>
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<td>Race/Ethnicity</td>
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<td>12</td>
<td>Medical History</td>
<td>No, Unknown, Cancer, Diabetes, Heart Disease, Hyperlipidemia, Hypertension, Renal Disease, Respiratory Disease, Stroke, Other</td>
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### Part B: Run Information

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<td>Fire/First Responder</td>
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<td>17</td>
<td>Destination Hospital</td>
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</table>
Number of Utstein Survivors by Site:

Site A - 10
Site B - 2
Site C - 8
Site D - 13
Site E - 8
Site F - 6
Site G - 7
Site H - 4
Site I - 3
Site J - 5
Site K - 4
Site L - 4
Site M - 16
Site N - 4
Your Site - 3
Bystander Intervention (924)

AED %: 1.3% (12)
CPR %: 23.5% (217)

Cardiac Etiology Survival Rates

Overall: 11.8% (1096)
Bystander Wit'd: 18.7% (396)
Utstein: 31.7% (164)
Utstein Bystander: 28.7% (80)
EMS Witnessed: 19.8% (172)
Unwitnessed: 4.0% (528)
Shockable/Bystand: 41.4% (396)
CARES Summary:

• CARES software integrates EMS, 911, and hospital data

• Survival Reports are ‘real-time’ feedback for the participating agency and larger community

• Allows systems to internally and externally benchmark

• Provides a model national OHCA surveillance registry

• Ultimate Goal is to improve cardiac arrest survival
CARES Process:

- Agree to track cardiac arrest pts
- Contact NC CARES coordinator (LISA)
- Complete short survey
- Demo of data entry
- Complete formal application
  - Identify hospital process to get outcomes
- CARES and coordinator build you screens
- Begin data entry
- Feedback on first 10 pts
Conclusions:

- Cardiac arrest is common and the third leading cause of death.
- Victims of out of hospital cardiac arrest are unlikely to survive.
- There are some regions of the country including Mecklenburg and Wake counties with higher survival rates.
Improving outcomes in cardiac arrest

Conclusions:

Simple interventions in the chain of survival are likely to improve survival including:

- Community
  - Bystander CPR
Improving outcomes in cardiac arrest

Conclusions:

• EMS
  – Dispatch
  – Dispatcher CPR instruction
  – Effective ACLS
  – Initiation of hypothermia in advanced systems
Improving outcomes in cardiac arrest

Conclusions:

• Hospitals
  – Post cardiac arrest care including ICU goal directed care, rapid cath. for appropriate patients, hypothermia, neurology consultation, rehab., ICD placement
Let’s make NC the best place in the country to have a heart attack or a cardiac arrest!