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Introduction

The Regional Approach to Cardiovascular Emergencies (RACE) project is a North Carolina statewide system for providing rapid coordinated care of cardiovascular emergencies. Established in 2003, the RACE system incorporates quality improvement efforts of over 119 hospitals, 540 emergency medical agencies and thousands of health care providers working in a coordinated manner to provide timely and lifesaving care. Initially, the RACE system was developed to treat acute myocardial infarction. With an eventual goal to rapidly coordinate the treatment of all cardiovascular emergencies, our current phase called RACE CARS (Cardiac Arrest Resuscitation System) is focusing on out of hospital cardiac arrest.

As the third leading cause of death, cardiac arrest claims 300,000 Americans lives each year. If witnessed, recognized and treated with cardiopulmonary resuscitation (CPR), external defibrillation, and hospital post-arrest care, almost half of victims can survive and return to functional lives. Unfortunately, we currently fall well short of this goal in North Carolina, with only 1 in 5 victims receiving bystander CPR, and only 1 in 20 surviving to hospital discharge. Supported by the Medtronic Foundation HeartRescue Project, and hospitals and emergency medical systems throughout the state, we hope to double survival from cardiac arrest within 5 years.

Our approach includes three components

1) **community response** – mass education in compression only CPR and automatic external defibrillator (AED) use;

2) **pre-hospital response** – rapid dispatch of first responders and defibrillators; dispatcher assisted CPR to increase by-stander CPR rates; high quality CPR and team based resuscitation.

3) **hospital response** – coordinated post-cardiac arrest intensive care including hypothermia protocols.

The key elements of our system include regional organization and coordination, institution of the single best plan for treatment at every point of care, ongoing measurement and prompt feedback, and the establishment of teams of health professionals that span all aspects of cardiovascular emergency care.

In order to assess our progress in the project, we will use data from the North Carolina Office of Emergency Medical Services (NCOEMS). The Prehospital Medical Information System involves emergency medical service records from local agencies submitted to NCOEMS according to state statute and state and national standards including the National EMS Information System (NEMSIS) and the Center for Disease Control Cardiac Arrest Registry to Enhance Survival (CARES). These data elements specify details of the cardiac arrest episode of care including patient identifiers, dispatch time, bystander chest compressions, type of arrest, AED use, outcome of resuscitation, hospital destination, and hospital application of hypothermia, and neurologic outcome.

See CARES Data Collection form, page 37 and 38.

We will rely on these records to measure our impact on bystander CPR, application of cardiac arrest care, and patient outcomes. As the data are often incomplete, we will work with the NCOEMS and submitting providers to ensure data completeness and accuracy. Once NCOEMS identifies a cardiac arrest from periodic data review, we will check all data fields required for CARES reporting, and assist local EMS agencies in completing the data. In addition, we will have a comparison and quality check of data of cardiac arrest patients compared to other patients entered into the CARES registry.

This operations manual represents a state-wide consensus regarding the approaches to cardiac arrest treatment. The recommendations are based upon medical evidence, national guidelines, and the knowledge and experience of numerous professionals specializing in cardiac arrest care. These recommendations are designed to serve as a focal point for system development. To the extent possible, we describe the least complex approaches, allowing participating institutions to adapt these recommendations to local resources, practice patterns, and medical leadership. This manual is designed to work in concert with existing state and local protocols with particular attention to the North Carolina Office of Emergency Medical Services.
Optimal System Specification By Point Of Care

The following basic and advanced recommendations represent features of systems of cardiac arrest care likely to Increase the timeliness of treatment for cardiovascular emergencies.

Community:

Basic recommendations

- Assess current facilities and plans for cardiac arrest care including training, emergency response, and automatic external defibrillator deployment.

- Support the implementation of two regulations.
  - House Bill 837
    - requires high school students to learn CPR
    - pass a test showing proficiency in order to graduate
    - Effective with the Class of 2015
  - House Bill 914
    - requires at least one AED in every state building
    - state workers must be trained to use them

- AED in every public location occupied by more than 250 adults over age 50 for 16 hours a day.

Advanced recommendations

- Organize community events involving civic organizations and churches to train adults in recognition of cardiovascular emergencies: cardiac arrest, myocardial infarction, stroke. These events should teach appropriate 911 dispatch and compression only CPR, and may include activities to obtain and place AEDs in the community.

- Locate all AED’s in the community and report the location to the local dispatch center.

See community training document, page 32.

EMS: Dispatch

Basic recommendations

- Emergency Medical Dispatch (EMD)
- Dispatcher queries regarding whether victim is conscious (awake and alert) and breathing normally.
- Dispatch of first responders equipped and trained in AED use.
- Dispatch and wheels rolling time according to NCOEMS standards.
- Dispatcher trained to recognize cardiac arrest and instruct in continuous chest compression only CPR and AED use.
- Review every cardiac arrest call received for the purpose of process improvement.

Advanced recommendations

- NCCEP Policy 13- Dispatch time according to NCOEMS standards, 90 seconds, 90% of the time for all EMD calls. Cardiac Arrest recommendations is 60 seconds or less.

EMS: First Responder

Basic recommendations

- Use high quality CPR.
- Use team approach to manage resuscitation.
- Apply AED.
- Assign personnel to monitor chest compressions including, rate, depth, full recoil, and pauses.
- Limit pauses in chest compressions to extent possible including minimal pause for defibrillation.
- Breathing and airway management after 2nd shock / 2 rounds of 2 minute compressions.
Communicate with paramedics whether cardiac arrest was witnessed, estimated duration of arrest, and if the patient received bystander CPR.

Participate in community education efforts.

**Advanced recommendations**

- Implement quality improvement effort to improve care.

- NCCEP Policy 14 – First Responders and EMS should have wheels rolling or Turn Out time in 90 seconds, 90% of the time.

EMS: Initial Contact

EMT: Basic, Intermediate, or Paramedic

**Basic recommendations**

- Use high quality CPR.

- Use Team approach to manage resuscitation.

- Apply AED or monitor / defibrillator as appropriate.

- Assign personnel to monitor chest compressions including, rate, depth, full recoil, and pauses.

- Limit pauses in chest compressions to extent possible including minimal pause for defibrillation.

- Breathing and airway management after 2nd shock / 2 rounds of 2 minute compressions.

- For patients transported to the hospital: communicate with hospital regarding scene arrival time, estimated time of arrest, preceding symptoms, bystander witnessed, bystander CPR, bystander AED use, EMS resuscitation sequence, initial rhythm (VT, VF, PEA, asystole), time to return of spontaneous circulation, copy of ECG and interpretation, neurological exam after resuscitation (does the patient follow commands), and whether hypothermia was initiated. Standard EMS run sheets containing the above information are suitable.

- Obtain 12-lead ECG on all patients with return of spontaneous circulation. Institute a coronary artery reperfusion plan for all patients with a definite ST-elevation myocardial infarction by ECG.

- Consider taking selected patients without STEMI for acute angiography, such as cardiac arrest patients with VF/VT and suspicion of acute MI based on history and preceding symptoms.

- Establish and follow a pre-specified plan of care for patients with return of spontaneous circulation.

- Notify the receiving hospital during transport.

- Participate in community education efforts.

- Participate in the CARES registry.

- Provide outcome data to dispatch and first responders.

- Review every cardiac arrest call received for the purpose of process improvement.

**Advanced recommendations**

- Initiate a hypothermia protocol designed to rapidly cool a patient to 32 to 34 degrees Celsius for those patients who remain comatose following resuscitation (does not follow commands).

- Divert to a post cardiac arrest care hospital if logistically and clinically feasible.

- NCCEP Policy 14 – First Responders and EMS should have wheels rolling or Turn Out time in 90 seconds, 90% of the time.

EMS: Interfacility Transfer

EMT: Basic, Intermediate, or Paramedic

**Basic recommendations**

- Transfer patients with ST-elevation myocardial infarction and cardiac arrest with same priority as 911 call and trauma.

- Transfer patients with or without (STEMI) using mode of transfer capable of maintaining level of post-cardiac arrest care including hypothermia, mechanical ventilation, and intensive care regimen.

- Send initial EMS records and hospital records with patient, or fax to receiving hospital.

*See Emergency response plan, page 8.*
Hospital

**Basic recommendations**

- Demonstrate senior management commitment to best cardiovascular emergency care by providing adequate resources to establish an optimal system.

- Establish a cardiovascular emergency team composed of emergency department, physician leaders, EMS, emergency transport, communications, quality assurance, and senior management involved in cardiovascular emergency care. Periodic meetings of team to review and revise system.

- Establish a predetermined, institution-specific written protocol for cardiac arrest care (see Post-Cardiac Arrest Care Protocol) agreed upon by all physician leaders and staff that includes:
  
  - Standard post-cardiac arrest care plans according to cardiac arrest type and mental status. For patients who require intensive care support, continued hypothermia, and/or urgent coronary angiography, these plans may include transfer to a regional cardiac arrest center.
  
  - Emergency department protocol for cardiac arrest.
  
  - Emergency physician directs care without the need for specialty consultation.
  
  - Documentation of presentation neurological status, if possible.
  
  - Continuation of EMS induced hypothermia for appropriate patients.
  
  - Arrangements for urgent coronary angiography for patients with suspected ST-elevation myocardial infarction according to history and ECG.

- Provide selected patient process and outcome data to the CARES registry and referring institution.

- Provide cardiac arrest training (not certification) to the families of all patients hospitalized with cardiovascular disease. Such training should include recognition of heart attack, stroke, cardiac arrest, activation of EMS, chest compression only CPR, and AED use.

- Provide cardiac arrest training (not certification) to all hospital employees regardless of job. Such training should include recognition of heart attack, stroke, cardiac arrest, activation of the EMS, chest compression only CPR, and AED use.

- Participate with EMS to review every cardiac arrest patient transported to the facility.

- Support efforts to broadly train the community in cardiovascular emergency recognition, response, and resuscitation.

Cardiac Arrest Center

**Basic recommendations**

- Demonstrate senior management commitment to best cardiovascular emergency care by providing adequate resources to establish an optimal system.

- Establish a cardiovascular emergency team composed of emergency department, physician leaders, emergency transport, communications, quality assurance, and senior management involved in cardiovascular emergency care care. Periodic meetings of team to review and revise system.

- Establish a predetermined, institution-specific written protocol for cardiac arrest care (see Post-Cardiac Arrest Care Protocol) agreed upon by all physician leaders and staff that includes:
  
  - Standard post-cardiac arrest care plans according to cardiac arrest type and mental status.
  
  - Emergency department protocol for cardiac arrest.
  
  - Emergency physician directs care without the need for specialty consultation.
  
  - Documentation of admission neurological status.
  
  - Continuation of EMS induced hypothermia for appropriate patients.
  
  - Arrangements for urgent coronary angiography for patients with suspected ST-elevation myocardial infarction according to history and ECG.

- Provide selected patient process and outcome data to the CARES registry and referring institution or emergency medical service.
INTENSIVE CARE UNIT

- Designate physician leadership of post cardiac arrest care. Such leadership may be identified from emergency medicine, critical care medicine, hospital medicine, neurology, and/or cardiology.

- Post cardiac arrest care according to Post-Cardiac Arrest Protocol (pages 28–29).

- Perform neurologic assessment according to institutional expertise and standards when normothermia is achieved and sedating drugs have cleared from the circulation.

CATHETERIZATION LABORATORY

- Perform coronary arteriography and intervention according to national benchmark times for patients with suspected ST-segment elevation myocardial infarction according to history and ECG.

- Follow hypothermia protocol for appropriate patients:
  - Maintain hypothermia for those patients induced prior to catheterization laboratory arrival during the procedure.
  - Induce hypothermia at the earliest time possible for all other appropriate patients.

ELECTROPHYSIOLOGY

- Evaluate all neurologically intact survivors of out-of-hospital cardiac arrest by cardiology or electrophysiology for implantable cardioverter defibrillator (ICD) placement according to established national guidelines. According to these guidelines, survivors of sudden cardiac arrest due to ventricular fibrillation have a Class IA indication for ICD implantation after evaluation to define the cause of the event and to exclude any transient or reversible cause. For patients awaiting reassessment for ICD 40 to 90 days post discharge, consider wearable defibrillator.

HOSPITAL

- Provide cardiac arrest training (not certification) to the families of all patients hospitalized with cardiovascular disease. Such training should include recognition of heart attack, stroke, cardiac arrest, activation of EMS, chest compression only CPR, and AED use.

- Provide cardiac arrest training (not certification) to all hospital employees regardless of job function. Such training should include recognition of heart attack, stroke, cardiac arrest, activation of EMS, chest compression only CPR, and AED use.

- Support efforts to broadly train the community in cardiovascular emergency recognition, response, and resuscitation. Such efforts may include conducting cardiovascular resuscitation classes to community trainers and providing hospital training facilities to community groups.

Advanced recommendations

- Consider advanced data collection such as the INTCAR data registry (see page 39)

Law Enforcement

Providing law enforcement officers with basic cardiopulmonary resuscitation (CPR) skills and training in the use of an AED can potentially increase survival rates from cardiac arrest. Experience from a handful of communities – most notably Rochester MN – has provided strong impetus for a beneficial role of police defibrillation. In many areas, police have the ability to reach a victim of sudden cardiac arrest more quickly than EMS personnel. The chances of survival decrease by about 5% for every additional minute delay in resuscitation efforts.

Advanced recommendations

- Engage Law Enforcement agencies to participate in cardiac arrest response and defibrillation.
Government: Local (including EMS providers)

Basic recommendations

- Make EMS run sheets immediately available to receiving hospitals. Approaches include providing adequate time for EMS crews to complete run sheets before hospital departure and provide paper or electronic format that is readily accessible to hospital personnel. Essential run sheet data should include EMS unit identification, dispatch time, scene arrival time, estimated time of arrest, preceding symptoms, bystander witnessed, bystander CPR, bystander AED use, EMS resuscitation sequence, initial rhythm, time to return of spontaneous circulation, copy of ECG and interpretation, neurological exam after resuscitation, and whether hypothermia was initiated.

- Transfer patients across county lines to the nearest facility for post-cardiac arrest care or primary angioplasty if these services are not available in the incident county.

- If vehicle transfer to remote counties is not feasible, consider developing transfer agreements with regional medical centers.

- Helicopter transport protocols should include EMS and ED protocols capable of launching helicopters to medical scenes and establishment of helicopter landing zones (LZ). Patients transported to LZs adjacent to hospitals should not require medical evaluation by that hospital unless deemed necessary by the EMS crew.

- Support continuing education programs in basic and advanced cardiac life support.

Advanced recommendations

- Provide all first responders with AEDs.

- Support efforts to broadly train the community in cardiovascular emergency recognition, response, and resuscitation.

Government: State and Federal

State

Basic recommendations

- Support linkage of EMS, hospital and vital status data to inform providers of emergency cardiovascular care.


Advanced recommendations

- Fund existing educational standards.

Federal

Basic recommendations

- Remove out-of-hospital cardiac arrest patients from publically reported hospital mortality figures so as not to discourage institutions from providing care to these patients.

Advanced recommendations

- Establish and support universal standards of care for all cardiac emergencies.
Pre-Hospital
# Emergency Response Plan

**Goal:** To improve survival from cardiac arrest by 50%

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<th>9-1-1</th>
<th>First Responders:</th>
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<td>- 9-1-1 Dispatches asks: is the patient able to talk and are they breathing normally (gaspig is not normal)</td>
<td>- Assess victim for decision to attempt resuscitation or not attempt resuscitation</td>
<td>- If first on scene: assess victim for decision to attempt resuscitation or not attempt resuscitation</td>
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<tr>
<td>- Dispatcher recognizes cardiac arrest</td>
<td>- Initiate High Quality CPR with focus on: 1. rate 2. depth 3. recoil 4. limiting time off of chest 5. Switch compressors every 2 minutes</td>
<td>- If taking over or make decision to attempt resuscitation: Initiate high quality CPR with focus on: 1. rate 2. depth 3. recoil 4. limiting time off of chest 5. Switch compressors every 2 minutes</td>
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<tr>
<td>- Dispatcher sends appropriate units to scene</td>
<td>- Attach AED: follow instructions</td>
<td>- Attach defibrillator</td>
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<td>- 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</td>
<td>- Consider compressions while AED is charging or resume CPR if no shock is recommended</td>
<td>- Consider compressions while defibrillator is charging or resume CPR if no shock is needed</td>
</tr>
<tr>
<td>- Attach AED if available, follow instructions</td>
<td>- Add breathing and airway management after 2nd shock and 2 rounds of 2 min CPR</td>
<td>- Standard and well executed ACLS protocols including adding breathing and airway management after 2nd shock and 2 rounds of 2 min CPR</td>
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<tr>
<td>- Dispatcher stays on phone until responders arrive</td>
<td>- If ROSC, follow standard and well executed protocols</td>
<td>- Continue efforts until ROSC or until resuscitation is stopped</td>
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<td></td>
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<td>- If ROSC, evaluate victim for hypothermia protocol</td>
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<td>- Transport to appropriate Resuscitation Capable Hospital or Cardiac Arrest Center</td>
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Characteristics of High Quality CPR

1. EMTs own CPR [CPR is a BLS skill that should be the responsibility of BLS / first responders.]
2. Minimize interruptions in CPR at all times. Goal is compression fraction > 95%
3. Ensure proper depth of compressions ( >2 inches)
4. Ensure full chest recoil / decompression
5. Ensure proper chest compression rate (100-120/ minute)
6. Rotate compressors every 2 minutes
7. Minimize peri-shock pause by:
   a. Hovering hands over the chest during shock administration
   b. Charging defibrillator while compressions continue
   c. Resume compression immediately after shock delivered
8. Intubate or place advanced airway with ongoing CPR
9. Place IV or IO with ongoing CPR
10. Coordination and teamwork between EMTs and paramedics.
    (This list is based upon the High Performance CPR Toolkit by The Resuscitation Academy)

Definitions:

1. **Peri-Shock Pause**
   Interruption in chest compressions before and after defibrillatory shock
   Optimal pre-shock Pause: < 5 seconds, max of 10 seconds

2. **Compression fraction:**
   The percentage of time that chest compressions are performed during resuscitation.
   Computed using the formula: \[ \frac{\text{Resuscitation Time - Pauses}}{\text{Resuscitation Time}} \]
   **Typically time is measured in seconds**
   Example: during an arrest with a time to ROSC of 8 minute 30 seconds and a total amount of pauses = 69 seconds 510–69 / 510 = 86%
Pit Crew Resuscitation

AHA 2010 Guideline recommend a team approach during resuscitations. Resuscitation interventions are performed simultaneously, and rescuers must be able to work collaboratively to minimize interruptions in chest compressions. The “Pit Crew” methodology is designed to meet this objective.

Objective: to maximize the effectiveness of available resuscitation resources and though the use of predefined roles.

Key Principles:
1. The generation of high quality CPR is key to resuscitation effectiveness and the primary task of the resuscitation Pit Crew.
2. Unless safety or physical space issues exist, resuscitations are most effectively performed at the location the patient is initially found.
3. The quality of compressions is the responsibility of every member of the team.
4. Rhythm assessment every two minutes with defibrillation as indicated with a maximum of a 10 second pause in compressions.
5. The ALS component builds upon a strong BLS component maintaining an emphasis on minimum interruptions of compression.
6. The use of a resuscitation checklist is highly desirable as a means to ensure completeness and repeatability of resuscitation tasks.
7. The model is meant to be flexible and each agency should tailor the roles to the resources that they have available.
8. Team work requires practice. Agencies wishing to implement Pit Crew resuscitations must commit to realistic practice involving first responders, transport resources and ALS providers. Practice should include feedback to the participants on the rate and depth of compressions, duration of pauses and include a calculation of compression fraction.

Example Checklist:
- Pit Crew Positions Identified
- Continuous compression being performed
- Rhythm check every 2 minutes
  - Charge defibrillator at 1 minute 45 seconds
- Compressor rotated every two minutes or 200 compressions
- BVM is attached to oxygen and flowing
- ITD (impedance threshold device) in place w/light activated (if applicable)
- Monitor visible and in paddles mode
- Code Commander is identified and positioned at the monitor
- Advanced airway inserted without interruption of compressions
- IV/IO access obtained
- ETCO2 waveform present and monitored
- Gastric distention considered / addressed
- Family is receiving care and included in resuscitation process
- Consider Hs and Ts
  - Hypovolemic
  - Hypoxia
  - Hydrogen Ions (acidosis)
  - Hypothermia
  - Hyper/hypokalemia
  - Hypoglycemia
  - Tablets / Toxins
  - Tamponade
  - Tension Pneumothorax
  - Thrombosis (MI)
  - Thrombosis (PE)
  - Trauma
Team Approach

AHA 2010 Guideline recommend a team approach during resuscitations. Resuscitation interventions are performed simultaneously, and rescuers must be able to work collaboratively to minimize interruptions in chest compressions. Below are examples of team roles during resuscitation.

4-Person Resuscitation

**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**
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 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/secure BIAD (King) & ITD & ETCO₂ 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 5 (P5) always at an extremity outside the CPR “Triangle”
1. Initiates IV/IO access
2. Administers medications requested by “Code Commander”

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
EMS Protocols
Team focused CPR

Criteria for Death / No Resuscitation
Review DNR / MOST Form

NO

Begin Continuous CPR Compressions
Push Hard (2 inches) Push Fast (≥ 100 / min)
Change Compressors every 2 minutes
(Limit changes / pulses checks ≤ 10 seconds)

First Arriving BLS / ALS Responder
Initiate Compressions Only CPR
Initiate Defibrillation Automated Procedure if available
Call for additional resources

Second Arriving BLS / ALS Responder
Assume Compressions or
Initiate Defibrillation Automated / Manual Procedure
Place BIAD
DO NOT Interrupt Compressions
Ventilate at 6 to 8 breaths per minute

Utilize this Protocol with
Cardiac Arrest Protocol

AT ANY TIME
Return of Spontaneous Circulation
Go to Post Resuscitation Protocol

BLS

Third Arriving Responder
BLS or ALS

ALS

Establish Team Leader
(Hierarchy)
Fire Department or Squad Officer
EMT-B
First Arriving Responder

Rotate with Compressor
To prevent fatigue and effect high quality compressions
Take direction from Team Leader

Fourth / Subsequent Arriving Responders
Take direction from Team Leader

Continue Cardiac Arrest Protocol

Team Leader
ALS Personnel
Responsible for patient care
Responsible for briefing / counseling family

Incident Commander
Fire Department / First Responder Officer
Team Leader until ALS arrival
Marages Scene / Bystanders
Ensures high-quality compressions
Ensures frequent compressor change
Responsible for briefing family prior to ALS arrival

Establish Team Leader
(Hierarchy)
EMS ALS Personnel
Fire Department or Squad Officer
EMT-B
First Arriving Responder

Initiate Defibrillation Automated Procedure
Establish IV / IO
Administer Appropriate Medications
Establish Airway with BiAD if not in place

Initiate Defibrillation Manual Procedure
Continuous Cardiac Monitoring
Establish IV / IO
Administer Appropriate Medications
Establish Airway with BiAD if not in place

Continue Cardiac Arrest Protocol

Protocol 21
Any local EMS System changes to this document must follow the RC-EMS Protocol Change Policy and be approved by OEMS

2012
VF pulseless VT

Cardiac Arrest Protocol

Defibrillate 200 J

Begin Continuous CPR Compressions
- Push Hard (≥ 2 inches) Push Fast (≥ 100 / min)
- Change Compressors every 2 minutes
  (Limit changes / pulses checks ≤ 10 seconds)

IV Procedure
- Epinephrine (1:10,000) 1 mg IV / IO
  Repeat every 3 to 5 minutes
  Or
  Vasoopressin 40 units IV / IO
  May replace first or second dose of epinephrine

Defibrillate 200 J

Begin Continuous CPR Compressions
- Push Hard (≥ 2 inches) Push Fast (≥ 100 / min)
- Change Compressors every 2 minutes
  (Limit changes / pulses checks ≤ 10 seconds)

If Rhythm Refractory
- Continue CPR and give Agency specific Anti-arrhythmics / Epinephrine / Vasoopressin during compressions.
- Continue CPR up to point where you are ready
to defibrillate with device charged.
- Repeat pattern during resuscitation.

Amiodarone 1 mg/min IV / IO
- May repeat at 150 mg IV / IO
  if no response

Defibrillate 200 J

Amiodarone 300 mg IV / IO
- May repeat if rhythm converts

Defibrillate 200 J

Lidocaine 1.5 mg/kg IV / IO
- May repeat initial dose in no response

Defibrillate 200 J

Consider Discontinuation of Resuscitation Policy

Return of Spontaneous Circulation

Notify Destination or Contact Medical Control

Any local EMS System changes to this document must follow the NC OEMS Protocol Change Policy and be approved by OEMS

2012
Adult Asystole/Pulseless Electrical Activity

**Cardiac Arrest Resuscitation System**

**History**
- First medical history
- Medications
- Events leading to arrest
- End stage renal disease
- Estimated downtime
- Suspected hypothermia
- Suspected overdose
  - Tricyclic
  - Digitalis
  - Beta blockers
  - Calcium channel blockers
  - DNR, MOST, or Living Will

**Signs and Symptoms**
- Pulseless
- Apneic
- No electrical activity on ECG
- No heart tones on auscultation

**Differential**
- Hypovolemia (Trauma, AAA, other)
- Cardiac tamponade
- Hypothermia
- Drug overdose (Tricyclic, Digitalis, Beta blockers, Calcium channel blockers)
- Massive myocardial infarction
- Hypoxia
- Tension pneumothorax
- Pulmonary embolus
- Acidosis
- Hyperkalemia

---

**Cardiac Arrest Protocol**

- Central venous pressure

**Criteria for Death / No Resuscitation**
- Review DNR / MOST Form
- Cardiac Monitor

**AT ANY TIME**
- Return of Spontaneous Circulation
  - Go to Post Resuscitation Protocol

---

**Reversible Causes**
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypothermia
- Hypo / Hyperkalemia
- Hypoglycemia
- Tension pneumothorax
- Tamponade; cardiac Toxins
- Thrombosis; pulmonary (PE)
- Thrombosis; coronary (MI)

**Procedures**

- Search for reversible causes
- IV Procedure
- IO Procedure
- Consider Normal Saline Bolus 500 mL IV / IO
- Consider Chest Decompression Procedure

**Epinephrine (1:10,000) 1 mg IV / IO**
- Repeat every 3 to 5 minutes
- Or Vasopressin 40 units IV / IO

**Criteria for Discontinuation**

**Notify Destination or Contact Medical Control**

---

Protocol 11

Any local EMS System changes to this document must follow the NC OEMS Protocol Change Policy and be approved by OEIRs
Cardiac Arrest; Adult

Criteria for Death / No Resuscitation
Review DNR / MOST Form

Begin Continuous CPR Compressions
Push Hard (≥ 2 inches) Push Fast (≥ 100 / min)
Change Compressors every 2 minutes
(Limit changes / pulses checks ≤ 10 seconds)

AED Procedure if available

AT ANY TIME
Return of Spontaneous Circulation

Go to Post Resuscitation Protocol

ALS Available

Cardiac Monitor

Shockable Rhythm

NO

YES

Shockable Rhythm

NO

YES

Continue CPR
2 Minutes
Repeat and reassess
Airway Protocol(s)

Shock Delivery
Continue CPR
2 Minutes
Repeat and reassess
Airway Protocol(s)

Follow Asystole / PEA
Airway Protocol(s) as indicated

Follow VF / VT
Tachycardia
Airway Protocol(s) as indicated

Notify Destination or
Contact Medical Control

History
- Events leading to arrest
- Estimated downtime
- Past medical history
- Medications
- Existence of terminal illness

Signs and Symptoms
- Unresponsive
- Apneic
- Pulseless

Differential
- Medical vs. Trauma
- VF vs. Pulseless VT
- Asystole
- PEA
- Primary Cardiac event vs. Respiratory arrest or Drug Overdose

Decomposition
Rigor mortis
Dependent lividity
Blunt force trauma
Injury incompatible with life
Extended downtime with asystole
Do not begin resuscitation
Follow Deceased Subjects Policy
Post Resuscitation

<table>
<thead>
<tr>
<th>History</th>
<th>Signs/Symptoms</th>
<th>Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory arrest</td>
<td>Return of pulse</td>
<td>Continue to address specific differentials associated with the original dysrhythmia</td>
</tr>
</tbody>
</table>

**Repeat Primary Assessment**

- **Optimize Ventilation and Oxygenation**
  - Maintain SpO2 ≥ 94%
  - Advanced airway *if indicated*
  - ETCO2 ideally 35 – 45 mm Hg
  - Respiratory Rate 6 – 12 / minute
  - Remove Impedance Threshold Device
  - **DO NOT HYPERVENTILATE**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Action</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Procedure</td>
<td>P</td>
<td>Monitor Vital Signs / Reassess</td>
</tr>
<tr>
<td>IO Procedure</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>12 Lead ECG Procedure</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Cardiac Monitor</td>
<td></td>
</tr>
</tbody>
</table>

**Normal Saline Bolus 500 mL IV / IO**
May repeat as needed if lungs remain clear
Maximum 2 L

**Dopamine**
2 – 20 mcg/kg/min IV / IO
Titrate to SBP ≥ 90

**Arrhythmias are common and usually self-limiting after ROSC**

- If Arrhythmia Persists follow Rhythm Appropriate Protocol

**B**

<table>
<thead>
<tr>
<th>Hypotension</th>
<th>SYSTOLIC BP &lt; 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Follows Commands</td>
</tr>
</tbody>
</table>

**YES**

- Induced Hypothermia Protocol *if available*

- **STEMI / Suspicion of MI**

**YES**

- Chest Pain and STEMI Protocol
  - STEMI EMS Triage and Destination Plan

**NO**

**Symptomatic Bradycardia**

**YES**

**NO**

**ROSC with Antiarrhythmic given**

**YES**

- Consider Sedation / Paralysis
  - Use only with definitive airway in place
  - **Versed 2.5 mg IV / IO**
    - May repeat in 5 minutes if needed
    - And / Or
    - **Fentanyl 50 – 75 mcg IV / IO bolus**
      - May repeat 25 mcg every 20 minutes
      - As needed
      - Maximum 200 mcg

**NO**

- **Vecuronium 10 mg IV / IO**
  - If needed

**Notify Destination or Contact Medical Control**

**Protocol 19**

Any local ERS System changes to this document must follow the HC/QRS Protocol Change Policy and be approved by QEMS
Induced Hypothermia (Optional)

**History**
- Non-traumatic cardiac arrests (drownings and hanging/asphyxiation are permissible in this protocol.)
- All presenting rhythms are permissible in this protocol.
- Age 18 or greater

**Signs and Symptoms**
- Cardiac arrest
- Return of Spontaneous Circulation post-cardiac arrest

**Differential**
- Continue to address specific differentials associated with the arrhythmia

---

**Exit to Post Resuscitation Protocol**

**Criteria for Induced Hypothermia**
- Initial rectal temperature ≥ 93.2°F (34°C)

---

**Advanced Airway** (includes BLAD) in place with ETCO₂ > 20 mmHg
- Perform Neurological Assessment
- Expose and apply ice packs to axilla and groin areas

**Cold Normal Saline Bolus**
- 30 mL/kg IV / IO
- Maximum 2 L

**Dopamine 2 – 20 mcg/kg/min IV / IO**
- Titrated to SBP ≥ 90

---

- **Reassess Rectal Temperature**
  - Target: 91.4°F (33°C)
  - Range: 89.6°F to 93.3°F
  - Range: 32°C to 34°C

- **Shivering noted**
  - **NO**
  - **YES**

---

**Etomide 10 – 20 mg IV / IO**

---

**Versed 2.5 mg IV / IO**
- May repeat in 5 minutes if needed
- And/or
- **Fentanyl 50 – 73 mcg IV / IO bolus**
- May repeat 25 mcg every 20 minutes as needed
- **Maximum 200 mcg**

---

**Notify Destination or Contact Medical Control**

---

**Vecuronium 10 mg IV / IO**
- If needed
  - x1 dose
Chest Pain and STEMI

**History**
- Age
- Necedations (Viagra / sildenafil, Levitra / vardenafil, Cialis / tadalaftil)
- Past medical history (MI, Argina, Diabetes, post menopausal)
- Allergies
- Recent physical exertion
- Palliation / Provocation
- Quality (crumpy, constant, sharp, dull, etc.)
- Region / Radiation / Referred
- Severity (1-10)
- Time (onset / duration / repetition)

**Signs and Symptoms**
- CP (pain, pressure, aching, vice-like tightness)
- Location (subternal, epigastric, arm, jaw, neck, shoulder)
- Radiation of pain
- Pale, diaphoreisis
- Shortness of breath
- Nausea, vomiting, dizziness
- Time of Onset

**Differential**
- Trauma vs. Medical
- Angina vs. Myocardial infarction
- Pericarditis
- Pulmonary embolism
- Asthma / COPD
- Pneumothorax
- Aortic dissection or aneurysm
- GE reflux or Hiatal hernia
- Esophageal spasm
- Chest wall injury or pain
- Pleural pain
- Overdose (Cocaine) or Methamphetamine

**Transport based on:**
- STEMI
- EMS Triage and Destination Plan
- Immediate Notification of Facility
- Immediate Transmission of ECG
- If capable
- Keep Scene Time to ≤ 10 Minutes
- If transporting to Non PCI Center
- Reparfusion Checklist

**Acute MI / STEMI**
(STEMI = 1 mm ST Segment Elevation ≥ 2 Contiguous Leads)
New LBBB

- 12 Lead ECG Procedure
  - Aspirin 81 mg x 4 PO (chewed)
  - Or 325 mg PO
  - Nitroglycerin 0.3 / 0.4 mg Sublingual
  - Repeat every 5 minutes x 3
  - if prescribed to patient
  - and (BP ≤ 100)

- Nitroglycerin 0.3 / 0.4 mg SL
  - Repeat every 5 minutes as needed

- Nitroglycerin Paste
  - SBP > 100
  - 1 inch
  - SBP > 150 1.5 inch
  - SBP > 200 2 inch

- Morphine 2 – 4 mg (0.1 mg/kg) IV / IO
  - Repeat every 5 minutes as needed
  - Maximum 10 mg
  - Or
  - Fentanyl 50 – 75 mcg IV / IO
  - Repeat 25 mcg every 20 minutes as needed
  - Maximum 200 mcg

- Cardiac Monitor

- IV Procedure
- IO Procedure

- Systolic BP ≥ 100

- Exit to Adult CHF / Pulmonary Edema

- Notify Destination or Contact Medical Control

**Normal Saline Bolus 500 mL**
Repeat as needed
Maximum 2 L

**Agency Specific Medications**
- Thrombolyic
- Heparin Agents
- Flavix

**Exit to Appropriate Protocol**

**Exit to Adult Cardiac Section Protocols**

Any local EMS System changes to this document must follow the NC OEMS Protocol Change Policy and be approved by OEMS 2012
Hospital
Cardiac Arrest Center

**Goal: To improve the survival from cardiac arrest by 50%**

- Standard and well executed ACLS protocols
- Baseline neurologic examination
- 2 large bore IV’s
- ECG: STEMI to cath lab
- Optimize BP to MAP>65mmHg
- Titrate EtCO2 for 35–40
- Consider CT of brain, do not delay cooling for scan or extensive testing before transfer unless clinically indicated
- Pressure infuse 2L of cold saline if candidate for hypothermia (If EMS started cooling do not stop)-continue cooling in transport
- Continue therapeutic hypothermia for 24 hours
- Sedation and possibly paralysis
- On-going neurological assessment and care
- 24/7 Cath lab availability for STEMI
- Early coronary angiography if not a STEMI
- ICD Evaluation
- Rehabilitation plan
- Train family in recognition of cardiac emergency and compression only CPR prior to patient discharge
- Family and staff support
- Data measurement and feedback
Resuscitation Capable Hospital

**Goal: To improve survival from cardiac arrest by 50%**

- Standard and well executed ACLS protocols
- Baseline neurologic examination
- 2 large bore IV’s
- ECG: If new LBBB or STEMI: Activate STEMI Plan
- Early notification of the receiving hospital
- Early activation of the transport plan
- Implement treatment protocols for STEMI and cardiac arrest
- 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)
- Optimize BP to MAP > 65 mmHG
- Titrate EtCO2 for 35–40
- Consider CT of brain, do not delay cooling for scan or extensive testing before transfer unless clinically indicated
- Pressure infuse 2L of cold saline if candidate for hypothermia (If EMS started cooling do not stop)-continue cooling in transport
- Sedation and possibly paralysis
- Train family in recognition of cardiac emergency and compression only CPR prior to patient discharge
- Family and staff support
- Data measurement and feedback
# CARES Post Cardiac Arrest Hypothermia Order Set

## Pre-Cooling
- Inclusion and Exclusion Criteria Reviewed
- Code Status Documented
- Neurologic Exam Performed and Documented
- Consider pre-hypothermia CT head to exclude intra-cranial abnormalities if clinically appropriate
- Activate hypothermia protocol response team. (Members may include ICU, critical care nursing, neurology, cardiology, pharmacy, and/or pastoral care)

## Cooling (if core temperature >34°C)
- Infuse 30cc/kg cold saline (4°C) saline over 30 minutes if no evidence of heart failure
- Place ice packs in patients axilla, groin, side of neck
- Disrobe patient
- Apply external cooling pads/system
- For Institutions with Intravascular Cooling Catheters. Insert catheter and set temperature at 33°C
- Lower room temperature (if possible)

## Sedation (Use routine sedation for a mechanically ventilated patient according to hospital protocols and manufacturers recommendations).
- Sedation target ______________________________. (Suggest Richmond Assessment Scale -4)
- Midazolam loading dose ____________mg IV (Usual 0.01 - 0.1 mg/kg) q 5min prn until sedation target reached then start maintenance ____________ mg/kg/hr IV (Usual 0.03 - 0.25 mg/kg/h).
- Fentanyl loading dose ____________mcg IV (Usual 1 - 2 mcg/kg) q 5min prn until sedation target reached then start maintenance ____________ mcg/kg/hr IV (Usual 0.5 -5.0 mcg/kg/h).
- Dexmedetomidine loading dose ____________mcg IV (Usual 1 mcg/kg) then start maintenance ____________ mcg/kg/hr IV (Usual 0.2 -1.0 mcg/kg/h).
- Propofol _________________________ mg/kg/hr (Usual 1.0-5.0 mg/kg/hr)
- Other:
## CARES Post Cardiac Arrest Hypothermia Order Set

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Orders (check all appropriate boxes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shivering Control</strong> (Use paralytic agents according to hospital protocols and manufacturers recommendations)</td>
<td></td>
</tr>
</tbody>
</table>
- Pancuronium _________________ (0.06-0.1 mg/kg q 1-3 h prn). Avoid if renal insufficiency.  
- Other Paralytic Agent* best used during induction phase, but rarely necessary during maintenance.  
- Monitor level of paralysis with nerve stimulator (ie., Train of Four). Target 1 of 4. |
| **Monitoring** |  
- Baseline CBC, Cr, BUN, electrolytes, glucose, Mg, ionized calcium, ABG, Lactate, troponin, CK, AST, ALT, ALP, bilirubin, INR, PTT, Chest XR, ECG  
  - Repeat above daily  
- Electrolytes, Glucose, Lactate q 4h  
  - Target K 4.0-5.0 and target Glucose range _____________mg/dl  
- Repeat troponin, CK, ECG in 6 hours  
- ABG q4h + prn  
- Toxicology Screen (if clinically appropriate)  
- Insert arterial line.  
  - Continuous arterial blood pressure monitoring  
- Insert internal jugular or subclavian central venous catheter.  
  - CVP monitoring q ________ hours  
- Insert esophageal, bladder or rectal temperature probe.  
  - Continuous temperature monitoring  
- Continuous EEG monitoring (if available and if clinically appropriate)  
| **Maintenance** |  
- Maintain core body temperature 32-34°C for 24 hours. Once target temperate achieved, remove ice packs  
- NPO  
- NG/OG to low suction  
- Target MAP _____________mmHg (Usual range 65–80mmHg)  
- For fluid refractory (CVP>8) hypotension:  
  - Consider Norepinephrine 0.01–0.2 mcg/kg/min Dopamine 2.5–20 mcg/kg/min  
- For Hypertension: These medications are rarely necessary, as long as MAP < 100. Avoid antihypertensive drugs during cooling.  
- IV Fluid: |
## CARES Post Cardiac Arrest Hypothermia Order Set

### Date/Time

### Orders (check all appropriate boxes)

### Ventilator Management and Pneumonia Prevention
- Target SaO2 > 94% with minimal FIO2 achievable. Avoid hypoxia & hyperoxia
- Target pH 7.35-7.45
- Head of bed >30°
- Attach endotracheal tube to suction
- Chlorhexidine mouthwash BID

### Rewarming
- Begin rewarming 24 hours after hypothermia target temperature achieved
- For cooling devices (blanket or intravascular) – set device to rewarm to target temperature 36.5°C (0.25-0.35°C/hr)
- Re-set room temperature and re-cloth patient as appropriate
- Do not discontinue sedation until body temperature > 35°C and train of four (for paralyzed patients) 4 of 4
- Continue to monitor electrolytes and glucose q 4 h

### Medications
- Stress Ulcer Prophylaxis:
- DVT prophylaxis:
- Anti-arrhythmic:
- Anti-seizure:
- ASA: _____ mg ng/og/po/pr (circle one) daily
- 
- 
- 
- 
- 

---

**Cardiac Arrest Resuscitation System**
# CARES Post-Cardiac Arrest Hypothermia Initiation

## Orders for Transferring Hospitals

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Orders (check all appropriate boxes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Cooling</strong></td>
<td></td>
</tr>
<tr>
<td>- Inclusion and Exclusion Criteria Reviewed</td>
<td></td>
</tr>
<tr>
<td>- ECG Performed</td>
<td></td>
</tr>
<tr>
<td>- Neurologic Exam Performed and Documented (GCS, corneal/pupillary/gag reflexes, tone, reflexes)</td>
<td></td>
</tr>
<tr>
<td><strong>Cooling (if core temperature &gt;34°C)</strong></td>
<td></td>
</tr>
<tr>
<td>- Infuse 30cc/kg cold saline (4°C) saline over 30 minutes if no evidence of heart failure</td>
<td></td>
</tr>
<tr>
<td>- Place ice packs in patients axilla, groin, side of neck</td>
<td></td>
</tr>
<tr>
<td>- Disrobe patient and open ambulance windows during transfer</td>
<td></td>
</tr>
<tr>
<td><strong>Sedation</strong></td>
<td></td>
</tr>
<tr>
<td>- Midazolam loading dose _____________mg IV (Usual 0.01–0.1 mg/kg) q 5min prn.</td>
<td></td>
</tr>
<tr>
<td>- Fentanyl loading dose _____________mcg IV (Usual 1–2 mcg/kg) q 5min prn</td>
<td></td>
</tr>
<tr>
<td><strong>Investigations</strong></td>
<td></td>
</tr>
<tr>
<td>- Baseline CBC, Cr, BUN, electrolytes, glucose, Mg, ionized calcium, ABG, Lactate, troponin, CK, AST, ALT, ALP, bilirubin, INR, PTT, CXR</td>
<td></td>
</tr>
<tr>
<td>- Consider pre-hypothermia CT head to exclude intra-cranial abnormalities if clinically appropriate</td>
<td></td>
</tr>
</tbody>
</table>
Post-Cardiac Arrest Protocol

THERAPEUTIC HYPOTHERMIA

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

i. The patient can follow verbal commands.
ii. More than 8 hours have elapsed since ROSC (flexible).
iii. There is life-threatening bleeding or infection.
iv. Cardiopulmonary collapse is imminent, despite vasopressor support.
v. Refractory hemodynamically significant arrhythmias.
v. 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.
2) Physician performs and documents the neurologic exam. If seizure activity is suspected, treat seizure activity and consider neurology consultation.
3) If core temperature is greater than 34°C, infuse refrigerated (4°C) normal saline over 30 minutes (approximately 30 cc / kg: 2 liters < 60kg, 3 liters 60-95 kg, 4 liters >95 kg).
4) Institutions with water circulating blankets (Arctic Sun, Cincinnati Sub Zero, Polar Air) Place external defibrillation pads. Insert esophageal temperature probe and initiate cooling with device set to 33°C. A bladder probe may be substituted if urine output > 30cc/hr. A bladder probe may be substituted. New bladder probes measure bladder wall temperature and are not reliant on urine output.
5) Institutions with intravascular cooling catheters (Coolgard, Innercool) Insert intravascular catheter and initiate cooling with device set to 33°C.
6) Sedation

Use routine sedation for a mechanically ventilated patient according to hospital protocols and manufacturers recommendations.

Possible agents include:

<table>
<thead>
<tr>
<th></th>
<th>Loading dose</th>
<th>Maintenance dose</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>0.01–0.1 mg/kg</td>
<td>0.03–0.25 mg/kg/h</td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td>1–2 mcg/kg</td>
<td>0.5–2 mcg/kg/h</td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td>0.5–2.0 mg/kg</td>
<td>1.0–5.0 mg/kg/h</td>
<td></td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>1 mcg/kg</td>
<td>0.2–1.0 mcg/kg/h</td>
<td></td>
</tr>
</tbody>
</table>

7) Shivering control

Adequately sedate patient and set ventilator to a back-up rate.

Shivering may stop when patient reaches target temperature.

Use paralytic agents according to hospital protocols and manufacturers recommendations.

Possible agents include:

<table>
<thead>
<tr>
<th></th>
<th>Loading dose</th>
<th>Intermittent dose</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vecuronium</td>
<td>0.1 mg/kg every hour</td>
<td>PRN shivering</td>
<td></td>
</tr>
<tr>
<td>Pancuronium</td>
<td>0.06 to 0.1 mg/kg every 1 to 3 hours PRN shivering</td>
<td>Avoid with renal insufficiency</td>
<td></td>
</tr>
<tr>
<td>Cisatracurium</td>
<td>0.15–0.2 mg/kg</td>
<td>0.03 mg/kg IV every 20 to 30 minutes PRN shivering</td>
<td>Alternative option: continuous infusion 0.5 to 3 mcg/kg/min</td>
</tr>
</tbody>
</table>

*Paralytics are best used during the induction phase but rarely are necessary during the maintenance phase.*
Post-Cardiac Arrest Protocol

8) Monitoring
Arterial lines and central venous lines should be placed per intensive care unit protocols.

Maintain mean arterial pressure above 65 mmHg or systolic pressure above 90.
- Maintenance fluids.
- Norepinephrine 5 mcg / minute, titrate as needed.
- Other pressors including Dopamine may also be considered.
- Consider echocardiography in patients with hemodynamic instability.

MAINTENANCE
1) Achieve goal temperature of 33°C and maintain for 24 hours.
2) Maintain mean arterial pressure above 65 mmHg or systolic pressure above 90.
   Treat cardiogenic or septic shock if suspected.
3) Ventilator support
   - Target oxygen saturation greater than 94%, pH 7.4, and PCO2 35-45.
   - Avoid hyperoxia.
4) Electrolytes
   - Hypothermia commonly causes hypokalemia. When patients are rewarmed hyperkalemia may occur.
   - Check electrolytes including potassium every 4 hours. Potassium values below 3.5 mEq/L should be treated while the patient is being cooled. Potassium administration should be stopped once rewarming begins.
5) Aspiration pneumonia
   - Aspiration commonly occurs during cardiac arrest resuscitation.
   - Possible aspiration should be documented in the medical record.
   - Treat suspected aspiration pneumonia as appropriate.
6) Seizures
   - Monitor and treat for seizures.
   - Consider electroencephalogram monitoring.
   - Consider neurology consultation.

REWARMING
1) Controlled rewarming – set device to reach a goal of 36.5°C over 12 hours (0.25 to 0.35°C per hour).
2) Monitor patient for hypotension and hyperkalemia induced by rewarming.
3) Maintain sedation until 35°C.
4) Formal neurologic assessment should be performed when normothermia is achieved and sedating drugs have cleared from the circulation. Accurate neurological prognostication may be delayed after therapeutic hypothermia beyond 72 hours from arrest.

URGENT CORONARY ANGIOGRAPHY
After cardiac arrest due to ventricular tachycardia or ventricular fibrillation, patients with preceding symptoms or ECG suggestive of acute myocardial infarction should undergo urgent coronary angiography. Coronary angiography should not delay induction of hypothermia.

Consider urgent coronary angiography for all ventricular tachycardia or ventricular fibrillation cardiac arrest patients.

- Patients whose primary PCI is delayed longer than 90 minutes post hospital arrival due to required need for CPR, are excluded from the Centers for Medicare & Medicaid Services / The Joint Commission measure of “primary PCI received within 90 minutes of hospital arrival.”

- For Centers for Medicare & Medicaid Services 30-Day AMI Mortality, only patients with acute myocardial infarction (ICD-9 code 410.x0 and 410.x1) as a principal discharge diagnosis are included. Principal diagnosis is defined as that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care.

IMPLANTABLE CARDIOVERTER DEFIBRILLATOR
An implantable cardioverter defibrillator is indicated for all neurologically intact survivors of cardiac arrest due to ventricular fibrillation or hemodynamically unstable sustained VT after evaluation to define the cause of the event and to exclude any completely reversible causes.*

Resuscitation Capable Hospital Pre-Transfer Guidelines

**Inclusion Criteria**
- Adults (age ≥ 18 years)
- Return of Spontaneous Circulation (ROSC) within 60 minutes of arrest
- Persistent Coma: Inability to follow commands and/or GCS < 9

**Exclusion Criteria**
- Severe or terminal illness with anticipated non-aggressive care
- Active hemorrhage
- Systemic infection/sepsis
- Severe refractory shock

**Resuscitation Priorities**
- **Airway:** Intubation
- **Breathing**
  - Avoid hyperventilation (goal PaCO2 of 38 – 42mmHg)
  - Avoid hyperoxia (rapidly decrease FiO2 to maintain SpO2>95%)
- **Circulation**
  - Goal MAP>65
  - Anticipate and avoid hypotension
  - Norepineprine is the preferred vasopressor
  - ECG screen for STEMI

**Cooling Induction**
- Initiate cooling as soon as possible after ROSC
- Refrigerated (4°C) NS 30 cc/kg IV bolus as tolerated
- Ice packs to groin, axilla and neck
- Shivering control with Propofol 10 mcg/kg/min
- Paralyze patient with Vecuronium 0.1mg/kg q1hr

*Courtesy of David Pearson, MD, Carolinas Medical Center Code Cool*
Community
Community Training

**Objective:** To improve the rate of bystander CPR

### Education
- Identify leaders and interested community members to join your team. This should also include local hospitals, EMS agencies, fire, police, and community colleges
- Survey the community to understand what education exists around cardiac emergencies including CPR training, health fairs, hospital offerings, other health agency offerings
- Seek funding from local businesses, find grant opportunities on line, or partner with existing offerings
- Use RACE CARS material and/or AHA materials
- Train the Trainer – identify volunteers who are willing to teach community offerings and train them how to run a community education offering
- Participate in existing offerings or schedule your own – YMCA’s, churches, Rotatory, Kiwanis, sporting events, events at the local stadiums/coliseums, schools – be creative
- Advertise: send emails, ask to post signs, talk to local TV/radio stations, be creative
- Count how many are trained at each event: Use this link to provide your event information:
  - [https://duke.qualtrics.com/SE/?SID=SV_e4FROMWMPQ8DqNC](https://duke.qualtrics.com/SE/?SID=SV_e4FROMWMPQ8DqNC)
  - This information includes: event name, location, numbers trained, and type of training
- We will be tracking bystander CPR rates and survival rates in every community across NC

### Public Access Defibrillation Program
- Identify leaders and interested community members to join your team. This should also include local hospitals, EMS agencies, fire, police, and community colleges
- Survey the community to identify locations of AED’s.
- Obtain contact information for the responsible party for each AED
- Work with local EMS to get the AED locations into their 911 system (ability to track AED info – when pads expire, battery expiration, etc)
- Seek funding from local businesses or find grant opportunities to fund AED’s for locations with >250 people

### American Heart Association and American Red Cross CPR Training
- Identify AHA and ARC classes for communities
Compression Only - “Hands Only” CPR
The 3 “C’s” of seeing when you should call 911

STEPS:

1. CHECK
   • To see if the victim will respond to you
     – this includes moving, speaking, blinking, and answering your questions
   • If they are not responding to you, check to see if their breathing is normal
     – gasping is not normal

2. CALL
   • Emergency Medical Services -911 quickly
     – If someone is there to help you, have them call 911 and get an AED if available
     – If you are alone, you must call yourself and get an AED if available

An AED is a box that has a computer in it that will tell you if the patient needs to be shocked

3. COMPRESSION only CPR – Hands Only
   • If the victim is not responding and does not have normal breathing
     – Make sure the area is safe
     – Place the victim on their back on a hard surface
     – Remove clothing over the chest of victim
     – Place heel of one hand in center of the victim’s chest, place heel of other hand on top of the first hand
     – Push hard –at least 2 inches down
     – Let the chest come back to the normal position after pushing down
     – Push fast – to the beat of the song “Stayin Alive” - If there is someone else there to help you, switch every 2 minutes, move quickly to limit the time off of the chest
     – Continue until help arrives
Cardiovascular Emergencies: Myocardial Infarction

Cardiovascular Emergencies involve problems with the heart and blood vessels that need immediate medical attention. These include myocardial infarction, stroke, and cardiac arrest.

**Definition**
A myocardial infarction is the sudden loss of blood flow to the heart due to blockage of a heart artery. A myocardial infarction is diagnosed by symptoms and an EKG that is not normal.

The blocked coronary artery needs to be opened quickly (ideally within 1 to 2 hours) to allow blood to flow again to that area of the heart. There are two ways to open the artery, using a small balloon to push the blockage back or giving a drug to dissolve the clot.

Other conditions that may resemble myocardial infarction include indigestion and chest, neck or arm pain from other causes.

**Symptoms**
- Chest discomfort (pressure, squeezing, fullness, or pain)
- Discomfort in other areas of the upper body (neck, arm, jaw)
- Shortness of breath
- Sweating
- Nausea
- Light headedness
- Older patients, diabetics, and women are less likely to experience typical symptoms.

**What to do**
Call 911 for Emergency Medical Services immediately.

You may give victims an aspirin if they are not allergic to it. If they have been prescribed nitroglycerin, this may also be administered.

Wait with the victim until EMS personnel arrive. Report information about symptoms so an appropriate treatment may be chosen.

Do **not** drive victim to the hospital as they may go into cardiac arrest and die in your car. Ambulances have trained personnel and equipment to treat cardiac arrest and safely transport patients.
Cardiovascular Emergencies: Stroke

Cardiovascular Emergencies involve problems with the heart and blood vessels that need immediate medical attention. These include myocardial infarction, stroke, and cardiac arrest.

**Definition**
A stroke is the sudden loss of blood flow to the brain due to a blockage of a brain artery or bleeding into the brain. Victims of a stroke develop symptoms of brain damage.

Stroke is diagnosed by a physician exam and a computed tomography (CT) scan. If the stroke is due to a blocked brain artery, opening the artery quickly (ideally within 3 hours) by blood dissolving medications or devices will minimize brain damage.

Other conditions that may resemble stroke include severely low blood sugar.

**Symptoms (FAST)**
- Sudden weakness of the face (F)
  – Ask the person to smile. Does one side of the face droop?
- Sudden numbness of arm (A)
  – Ask the person to raise both arms. Does one arm drift downward?
- Difficult speech (S)
  – Ask the person to repeat a simple phrase. Is their speech slurred or strange?
- Sudden confusion
- Difficulty seeing in one or both eyes
- Sudden trouble walking, dizziness, loss of balance or coordination
- Sudden, severe headache with no known cause

**What to do**
Call 911 for Emergency Medical Services immediately. Time (T) is important.

Wait with the patient until EMS personnel arrive. Report the time that symptoms started so an appropriate treatment may be chosen.
Cardiovascular Emergencies: Cardiac Arrest

Cardiovascular Emergencies involve problems with the heart and blood vessels that need immediate medical attention. These include Heart Attack, Stroke, and Cardiac Arrest.

**What:**
Cardiac arrest is the sudden loss of adequate blood flow to the brain due to a heart rhythm problem. Victims become unresponsive and limp. Other conditions that may resemble cardiac arrest include severely low blood sugar, brain seizures, respiratory arrest, or anaphylactic shock. Cardiac arrest is more common in adults and older children who do not have lung disease.

**Call Emergency Medical Services-911:**

**Symptoms:**
- Unresponsive, limp
- Standing patients may fall to the floor
- Sitting patients may slump over in their chair
- During cardiac arrest, victims may gasp for air

**Treatment:**
Treatment should begin immediately as above includes calling 911, calling for an automatic external defibrillator, applying hands only cardiopulmonary resuscitation, and applying an automatic external defibrillator.

If victims receive immediate bystander chest compressions and early defibrillation (within 9 minutes), they are much more likely to survive.
CARES created the first database to contain integrated information from EMS dispatch to hospital discharge for victims of OOHCA. The information system is driven by EMS agencies entering data into the system regarding dispatch, pre-arrival care, procedures performed and outcome from EMS care.

For those patients that survive to the hospital the receiving facility is asked to input patient procedures and outcome data. In some patient this requires tracking to a tertiary hospital for final outcome information. Using the Utstein style of statistics for OOHCA, CARES is capable of identifying and tracking all cases of cardiac arrest in a defined geographic area.

The ultimate goals of CARES is to help local EMS administrators and medical directors identify who is affected, when and where cardiac arrest events occur, which elements of the system are functioning properly and which elements are not, and how changes can be made to improve cardiac arrest outcomes. There is no cost to join the CARES registry. Data entry time is as quick as 10 minutes for EMS and 5 minutes for hospitals per case once a reviewer becomes familiar with the screens.
### CARES Data Form: page 2

#### Part D: BLS Interventions (check all that apply)

<table>
<thead>
<tr>
<th>38. Mechanical CPR device used:</th>
<th>56. Automated CPR feedback device used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
<td>[ ] No</td>
</tr>
</tbody>
</table>

- **Load Distributing Band (AutoPulse)**
- **Active Compression Decompression (LUCAS Device)**
- **Mechanical Peloton**
- **Other**

<table>
<thead>
<tr>
<th>41. ITO used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
</tbody>
</table>

- **If 'Yes', please specify:**
  - Bag valve mask
  - Endotracheal tube
  - Contribube
  - King Airway
  - LMA
  - Oral Nasal ET
  - Other

<table>
<thead>
<tr>
<th>45. STBI:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
</tbody>
</table>

- **If 'Yes', select drugs given:**
  - Epinephrine
  - Atropine
  - Amodarone
  - Bicarbonate
  - Dextrose
  - Lidocaine
  - Vasopressin
  - Other

<table>
<thead>
<tr>
<th>47. Vascular access:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] No</td>
</tr>
<tr>
<td>[ ] IV</td>
</tr>
<tr>
<td>[ ] IO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>54. 12-Lead:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
</tbody>
</table>

#### Part E: Hospital Section

<table>
<thead>
<tr>
<th>49. Hospital Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Died in the hospital</td>
</tr>
<tr>
<td>[ ] Discharged alive</td>
</tr>
<tr>
<td>[ ] Patient made DNR</td>
</tr>
<tr>
<td>[ ] Transferred to another acute care facility from the ED</td>
</tr>
</tbody>
</table>

- **If 'Yes', please choose one of the following:**
  - Died in the hospital
  - Discharged alive
  - Transferred to another acute care hospital
  - Not yet determined

<table>
<thead>
<tr>
<th>58. Discharge from the Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Home/Residence</td>
</tr>
<tr>
<td>[ ] Rehabilitation Facility</td>
</tr>
<tr>
<td>[ ] Skilled Nursing Facility/Hospice</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>59. Neurological Outcome At Discharge From Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Good Cerebral Performance (CPC 1)</td>
</tr>
<tr>
<td>[ ] Moderate Cerebral Disability (CPC 2)</td>
</tr>
<tr>
<td>[ ] Severe Cerebral Disability (CPC 3)</td>
</tr>
<tr>
<td>[ ] Coma, Vegetative State (CPC 4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>67. Was the final diagnosis acute myocardial infarction:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
</tbody>
</table>

#### Hospital Procedures

<table>
<thead>
<tr>
<th>50. Coronary Angiography Performed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
<tr>
<td>[ ] Unknown</td>
</tr>
</tbody>
</table>

- **If 'Yes', provide date and time:**

<table>
<thead>
<tr>
<th>62. Was a cardiac arrest placed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
<tr>
<td>[ ] Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>63. CABG performed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
<tr>
<td>[ ] Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>64. Was an ICD placed and/or scheduled:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Yes</td>
</tr>
<tr>
<td>[ ] No</td>
</tr>
<tr>
<td>[ ] Unknown</td>
</tr>
</tbody>
</table>

#### Response and Treatment Times

<table>
<thead>
<tr>
<th>67. Time call received at dispatch center</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>68. Time First Responder dispatched</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>69. Time of First Responder on route</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>70. Time Ambulance dispatched</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>71. Time for Ambulance on route</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>72. Time First Responder arrived at scene</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>73. Time Ambulance arrived at scene</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>74. Time EMS arrived at patient side</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>75. Time Ambulance left scene</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>76. Time Ambulance arrived at ED</th>
</tr>
</thead>
</table>

#### General Comments

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**SH3001 (2 of 2), Rev 5.11.13**

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(Page 2)

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**CARES Data Dictionary**

https://mycares.net/cares_info.jsp
INTCAR Data Registry

1

INTCAR:
• International Registry for Cardiac Arrest
• http://www.intcar.org/
• is a joint venture of hospitals, research societies and individuals dedicated to improving post-resuscitation care for cardiac arrest survivors.
• allows members to participate in research groups of their own design and choosing

2

Core Set:
• 108 data elements
• 2 hours to abstract and enter
• Clinical abstractor
• Subset Example:
  – The Cardiology group was developed to evaluate the relationship between cardiac features of cardiac arrest and outcome, and was founded in 2009.

3

Primary Function of the Registry:
• Collect data
  – How and on whom is hypothermia being performed after Cardiac Arrest
  – Characteristics of the patients
  – Utilization of PCI, EEG, MRI, etc
  – Outcomes
• Return reports to member institutions for internal QI purposes, compare outcomes and practices to norms within the registry

4

Secondary Functions:
• Research within the registry
  – Requires approval and cooperation of the steering committees
• “Networking” function to connect centers
  – Research groups
  – Provide support for new sites

5

INTCAR Commitment
• Identify a principle investigator and data coordinator
• Report ALL unconscious patients admitted to your ICU, ICU group, or hospital with a primary diagnosis of cardiac arrest*
  – Even if not treated with hypothermia
• PI should maintain contact with INTCAR administrator, and must take responsibility for high quality data entry

6

Registration
• Go to the INTCAR or the Neurocritical Care Society website and follow registration instructions
• Seek exemption from local IRB to enter fully de-identified patient data
• Administrator will contact you by email, conduct a brief telephone interview, and provide you with a logon and password
• Review the “test patient” field
• Discuss data questions with administrator
• Begin entering patient data for ALL comatose survivors of cardiac arrest admitted to your institution

7

Database Management
• Submit to INTCAR
• Develop a standing database to pull data back locally
• Develop reports to be generated for Quality Improvement
• Research questions addressed by query
• May add fields locally
Glossary of Terms

**Asystole:**
cardiac standstill manifested by a "flat line" ECG rhythm and absence of a pulse.

**Automatic External Defibrillator (AED):**
a device that can be used by anyone with a minimal amount of training to defibrillate someone whose heart has stopped.

**Cardiac Arrest (also known as cardiopulmonary arrest):**
the cessation of normal circulation of the blood due to failure of the heart to contract effectively.

**Cardiac Arrest Registry to Enhance Survival (CARES) Registry:**
a national registry of cardiac arrest care and outcome supported by the Centers for Disease Control and Prevention and maintained at Emory University. http://www.cdc.gov/dhdsp/cares.htm

**Cardiopulmonary Resuscitation (CPR):**
an emergency procedure involving manual compression only of the heart from above the sternum and forced air into the lungs. The most recent guidelines recommend that bystanders perform chest compression alone at a rate of 100 times per minute with at least 2 inches of chest compression.

**Catheterization:**
Inserting a small curved plastic tube into the arterial system for the purpose of injecting an iodine-based fluid and illuminating the arteries by x-ray.

**Coronary angiography:**
X-ray pictures of the vessels that supply blood to the heart. Blockage of the vessels often causes cardiac arrest.

**Electrocardiogram (ECG):**
a recorded tracing of the electrical activity of the heart.

**Emergency Medical Service (EMS):**
a system of health care professionals, facilities and equipment providing pre-hospital emergency care.

**Emergency Medical Technician (EMT):**
an emergency responder trained to provide pre-hospital emergency medical services (EMS) to the critically ill and injured. There are multiple levels of training ranging from basic to intermediate to paramedic.

**First Responder:**
first medically trained responder to arrive on scene including police, fire, or EMS.

**Hypothermia:**
Cooling a patient to 32 – 34 degrees Celsius (90 – 93 degrees Fahrenheit). After cardiac arrest, this process reduces swelling and inflammation and has been shown to improve brain recovery.

**Normothermia:**
Maintaining a patient at normal body temperature, approximately 37.0 degrees Celsius or 98.6 degrees Fahrenheit.

**Myocardial infarction (MI):**
the sudden loss of blood flow to the heart due to blockage of a heart artery.

**Public Safety Answering Point (PSAP):**
is a call center responsible for answering calls to an emergency telephone number for police, fire, and ambulance.

**Percutaneous Coronary Intervention:**
The use of balloon tipped catheter to treat a narrowed or blocked coronary artery.

**Pulseless Electrical Activity (PEA):**
any heart rhythm observed by ECG that should be producing a pulse with the absence of a pulse.

**ST-Elevation Myocardial Infarction (STEMI):**
a myocardial infarction for which the ECG shows ST-segment elevation, usually associated with a recently closed coronary artery. Patients suffering this type of myocardial infarction are more likely to survive if their coronary artery is opened within 12 hours of onset.

**Return of Spontaneous Circulation (ROSC):**
the return of a pulse following resuscitation.

**Stroke:**
the sudden loss of blood flow to the brain due to a blockage of a brain artery or bleeding into the brain.

**Therapeutic or Induced Hypothermia:**
a medical treatment that lowers a patient’s body temperature in order to help reduce the risk of the ischemic injury to tissue following a period of insufficient blood flow.

**Ventricular Fibrillation (VF):**
pulseless, chaotic activity of the heart muscle manifested by a disorganized and erratic ECG rhythm.

**Ventricular Tachycardia (VT):**
depolarization of the heart that originates in the ventricle manifested by a wide and regular ECG rhythm faster than 120 beats per minute.

REFERENCES


