Regional **A**pproach to **C**ardiovascular **E**mergencies

*C**ardiac** A**rrest** R**esuscitation** S**ystem*

A Regional Approach:

Developing Continuity From Scene to CCU

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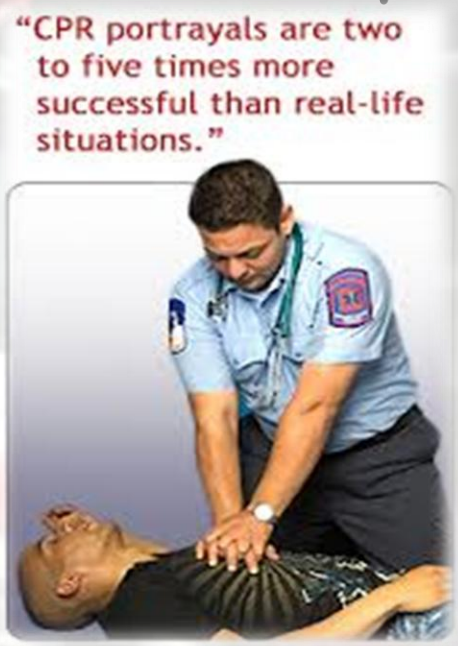
2013

Objectives

- Discuss paradigm of care regionalization
- Highlight importance of protocols to success
- Discuss example of regionalization in NC
- Elements of success / strategies to regionalize care in your community



FRAMING THE DISCUSSION

NO ONE SURVIVES CARDIAC ARREST, EXCEPT ON TV

SURVIVAL AFTER ADMISSION

- 40 Years of EMS and no improvement
- Those resuscitated in field show large survival variability after admission
  - Controlled for patient characteristics
    - ROC study

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

CIRCLE OF REGIONALIZATION

1: Community Response

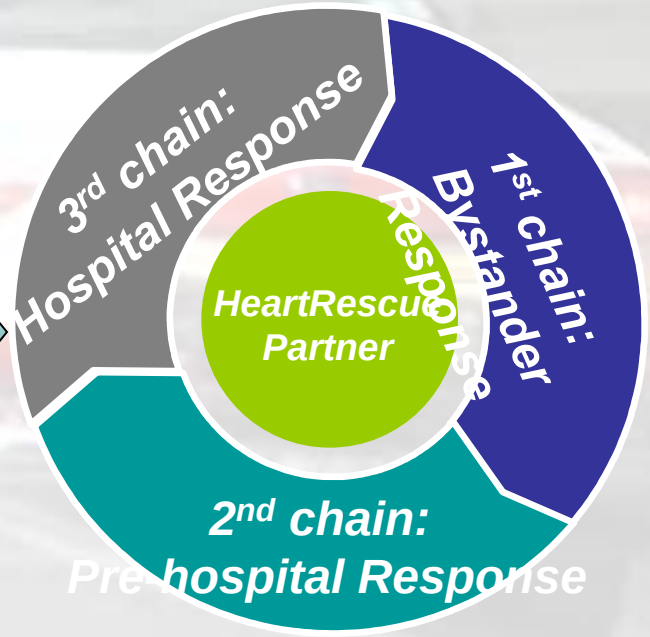
- **Recognize SCA**
- Early 911
- Effective bystander CPR
- Public access to AED

2: Pre-hospital Response

- **Enhanced dispatch**
- Enhanced CPR
- Appropriate defibrillation therapy
- Early Advanced Care

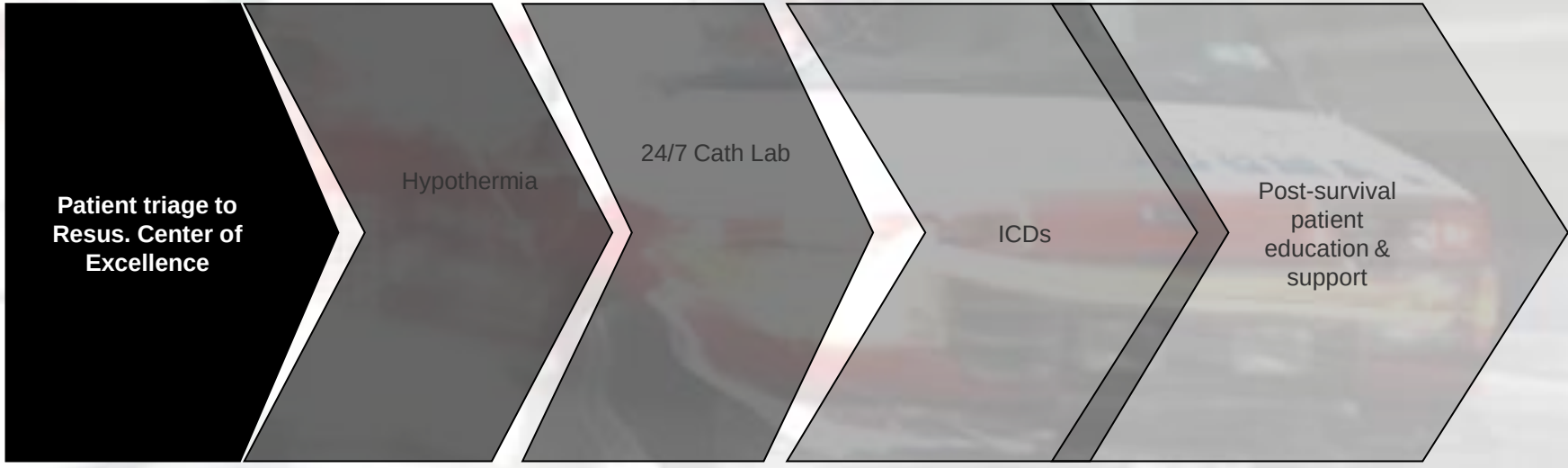
3: Hospital Response

- **Patient triage to Resus. Center of Excellence**
- Hypothermia
- 24/7 Cath Lab
- ICDs
- Post-survival patient education & support



Center Hub of Regionalization

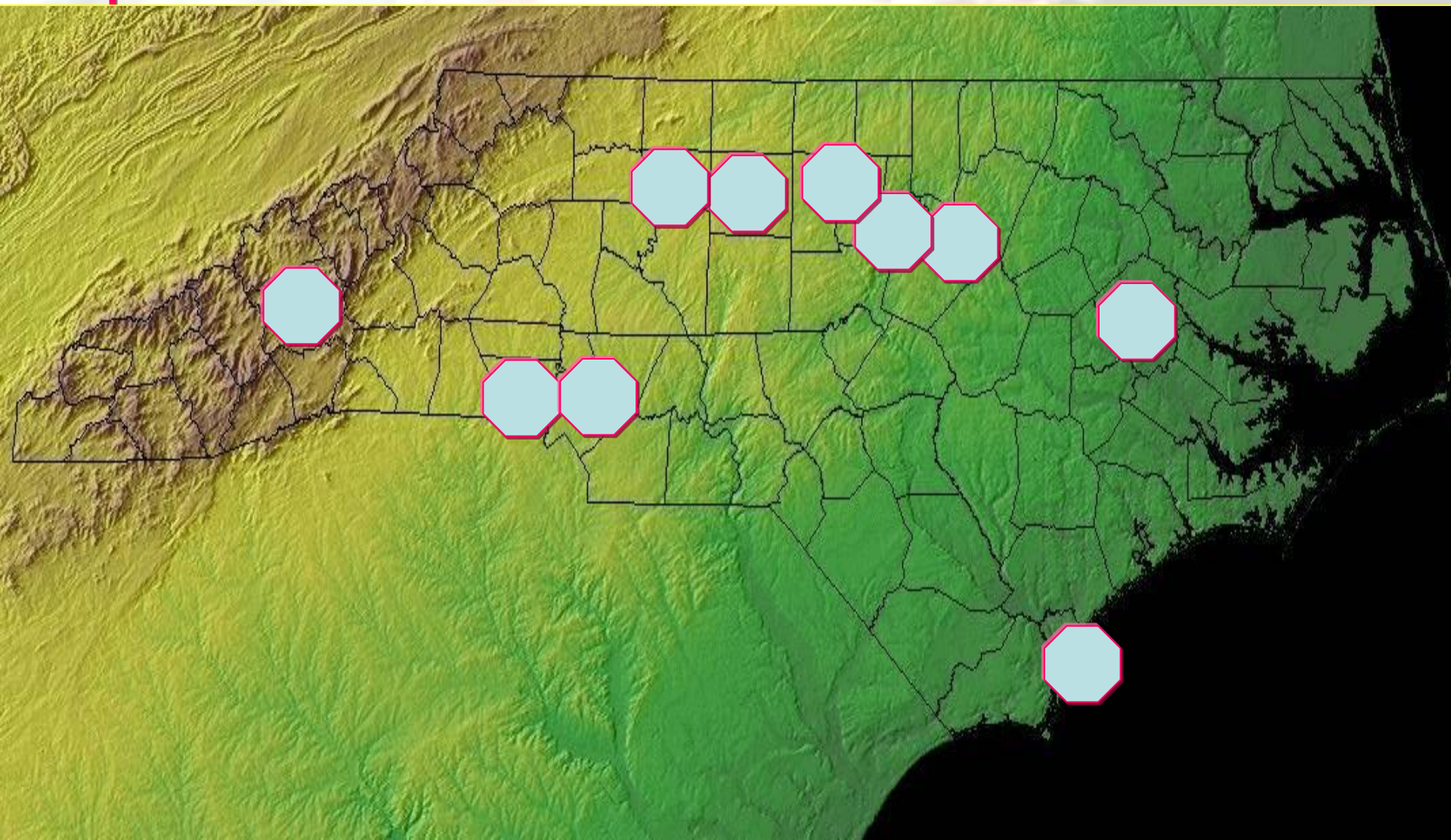
Post-ROSC Integrated Care Facility



Time Dependent Conditions

- 1. Respiratory distress
- 2. STEMI
- 3. Stroke
- 4. Trauma
- 5. Out-of-Hospital-Cardiac Arrest

Hospital / EMS cardiac arrest programs 2010



AHA Policy Statement 2010

- PROBLEMS

- OHCH Public Health
- Regional variation
- EMS / Hospital variation
- Barriers
  - Lack of knowledge
  - Experience
  - Personnel
  - Resources
  - Infrastructure

Regional Systems of Care for Out-of-Hospital Cardiac Arrest, Circ. 2010; 121 709

AHA Policy Statement 2010

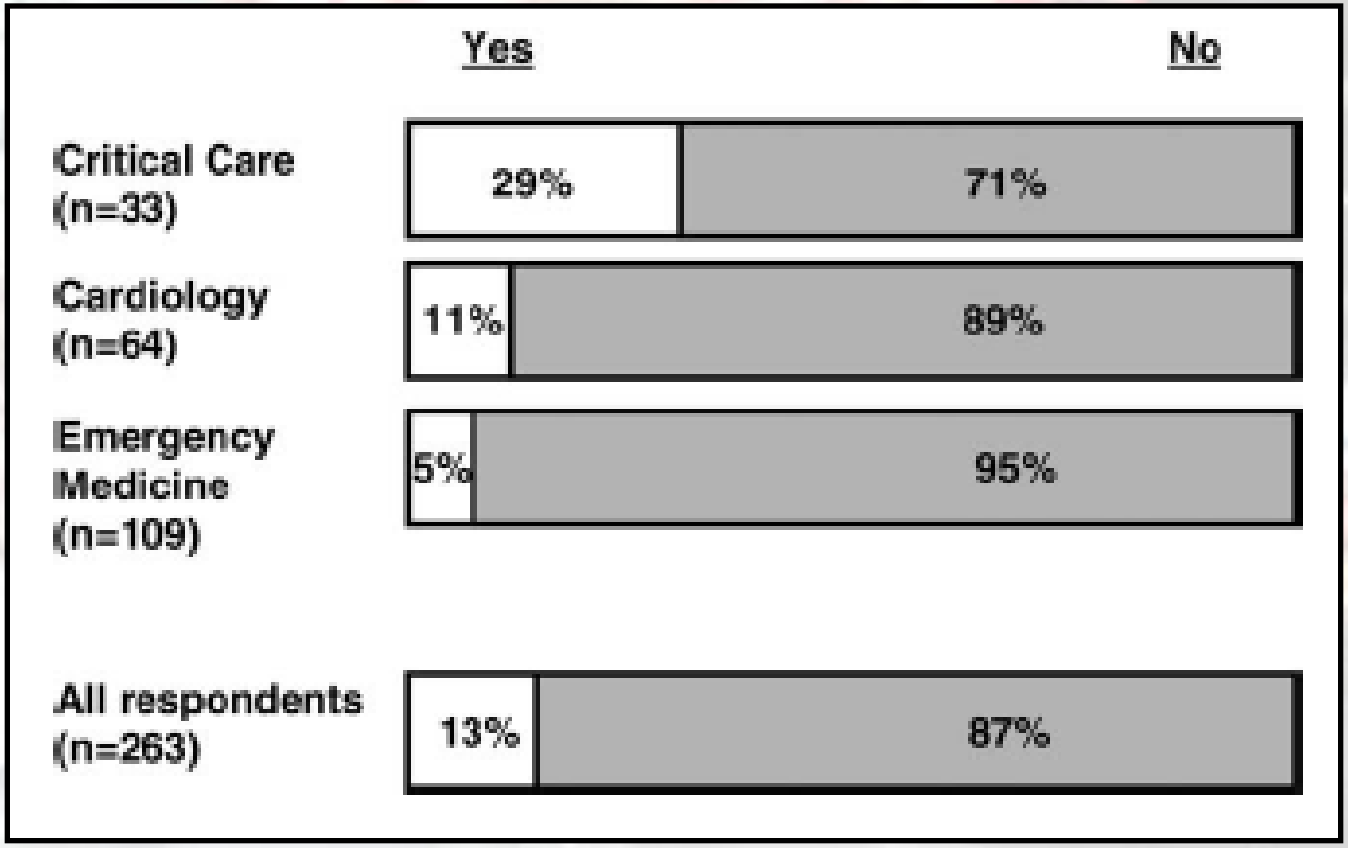
- SOLUTIONS
- Time-dependent conditions
- Increased Volumes
  - Providers / Hospitals
  - Better outcomes
- Regional Systems
  - Improved STEMI
  - Trauma

Regional Systems of Care for Out-of-Hospital Cardiac Arrest, Circ. 2010; 121 709

DO THIS TOMORROW

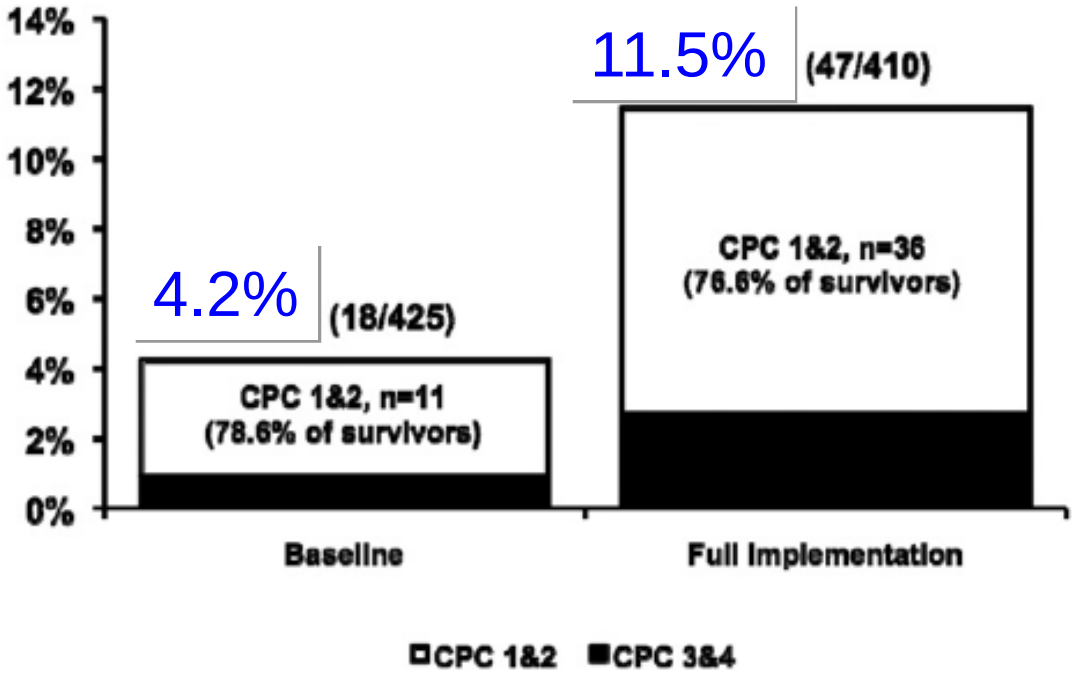
- Teach every person to preform CPR
- Public Access Defibrillation
- 911 Recognizes Cardiac Arrest
- 911 Provides PAI
- First Responders
  - AED
- EMS
  - ACLS
  - Therapeutic Hypothermia
- Tertiary Medical Center
  - Therapeutic Hypothermia
  - Cardiology, Pulmonologist, Neurologist
  - PTCI / ICD

US Implementation 2005



Abella B, et al. *Resuscitation* 2005.
Merchant RM, et al. *Crit Care Med* 2006.
Laver SR, et al. *Anaesthesia* 2006.
Bigham BL, et al. *Resuscitation* 2009.
Toma A, et al. *Crit Care Med* 2010.

Wake County



*Neurologic status is represented by Cerebral Performance Category (CPC); 1&2 denote "good" and "moderate" cerebral performance; 3&4 denote "poor" and "vegetative" cerebral performance; 5 denotes "brain death" and thus is not represented in this survivor to hospital discharge bar chart. ** Survivors in baseline phase where CPC score available = 14.

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).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DAYS IN HOSPITAL BED
SPEED LIMIT
25
SLOWER IS BETTER


AMERICA'S
50 BEST
HOSPITALS
2013
healthgrades

Regionalization Rationale

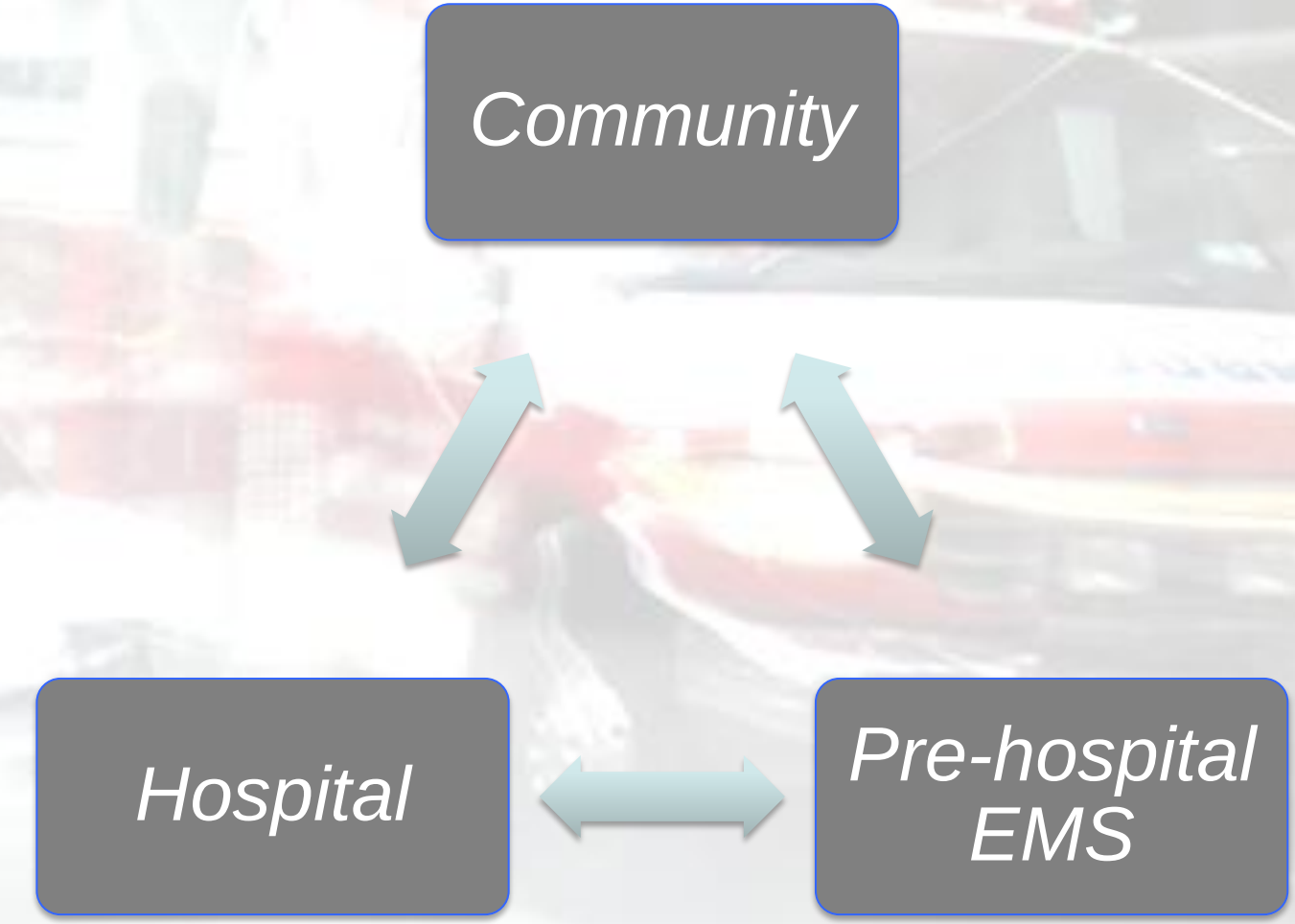
- IOM 2006 & AHA 2010 endorse regionalized systems of care
- Increase utilization of proven, complex interventions
- Specialized resources and expertise at certain centers
- Correlation between case volume and patient outcome

et al. *Circulation*. 2011.

WHERE DO WE START?

REGIONALIZATION BEGINS?

Complete Interdependency

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COMMUNITY

Community Training

Objective: To improve the rate of bystander CPR

Education

- **Identify leaders and interested community members**
- **Survey the community (what exists now)**
- **Seek funding from local businesses, partnerships or grants**
- **Use RACE CARS material and/or AHA materials**

COMMUNITY

Community Training

Objective: To improve the rate of bystander CPR Education

Train the Trainer

- **Participate in existing offerings**
- **Advertise:** send emails, ask to post signs, talk to local TV/radio stations, be creative
- **Count how many are trained** at each event:
  - send event name
  - location-city and county
  - and how many trained
- We will be tracking bystander CPR rates and survival rates in every community across NC

COMMUNITY

Community Training

Objective: To improve the rate of bystander CPR Education

Public Access Defibrillation Program

- **Identify leaders and interested community members**
- **Survey the community to identify locations of AED's**
- **Obtain contact information for the responsible party for each AED**
- **Work with local EMS to input AED locations into CAD**
- **Seek funding from local businesses partnerships or**
  - AED's for locations with >250 people

American Heart Association and American Red Cross CPR Training

o Identify AHA and ARC classes for communities

PREHOSPITAL / EMD

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

How to drive behavior and ensure consistency

PROTOCOLS

Team Focused CPR (Optional)

Criteria for Death / No Resuscitation
Review DNR / MOST Form

YES

Decomposition
Rigor mortis
Dependent lividity
Blunt force trauma
Injury incompatible with life
Extended downtime with asystole

Do not begin resuscitation

Follow Deceased Subjects Policy

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

Third or Fourth Arriving Responder
BLS or ALS

BLS

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

ALS

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

I

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

P

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

Utilize this Protocol with

Cardiac Arrest Protocol

AT ANY TIME

Return of Spontaneous Circulation

Go to Post Resuscitation 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
Manages Scene / Bystanders
Ensures high-quality compressions
Ensures frequent compressor change
Responsible for briefing family prior to ALS arrival

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

Return of Spontaneous Circulation ROSC

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

NO → Exit to Post Resuscitation Protocol

YES

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Airway Protocol(s) *as indicated*

NO

B	**Advanced Airway (includes BIAD) in place with EtCO2 > 20 mmHg**
	Perform Neurological Assessment
	Expose and apply ice packs to axilla and groin areas
I	**Cold NS Bolus 30 mL / kg IV / IO Maximum 2 liters**
P	**Dopamine infusion 5 – 20 mcg/kg/min IV / IO To effect SBP ≥ 90**

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

≤ 91.4 F (33 C) → Stop cooling measures Until temperature increases

Reassess temperature every 10 minutes

Continue Post Resuscitation Care

≥ 92 F (33.3 C) → Continue Cooling

Exit to Post Resuscitation Protocol

Shivering noted

NO

YES

P **Midazolam 2 - 2.5 mg IV / IO / IN May repeat Maximum 10 mg**

Continued Shivering

YES

NO

P **Fentanyl 50 – 75 mcg IV / IO May repeat 25 mcg every 20 minutes as needed Maximum 200 mcg**

P **Only with BIAD / ETT**

Consider Vecuronium 10 mg IV / IO

Notify Destination or Contact Medical Control

Agencies utilizing cerebral cooling devices are unlikely to see a change in rectal temperature during transport.

Continued temperature assessment not warranted with these devices. Document initial temperature

Adult Cardiac Section Protocols

HOSPITAL

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>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
❑	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

HOSPITAL

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 $PaCO_2$ of 38 – 42mmHg)
  - Avoid hyperoxia (rapidly decrease FiO_2 to maintain SpO_2>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

HOSPITAL

Cardiac Arrest Center

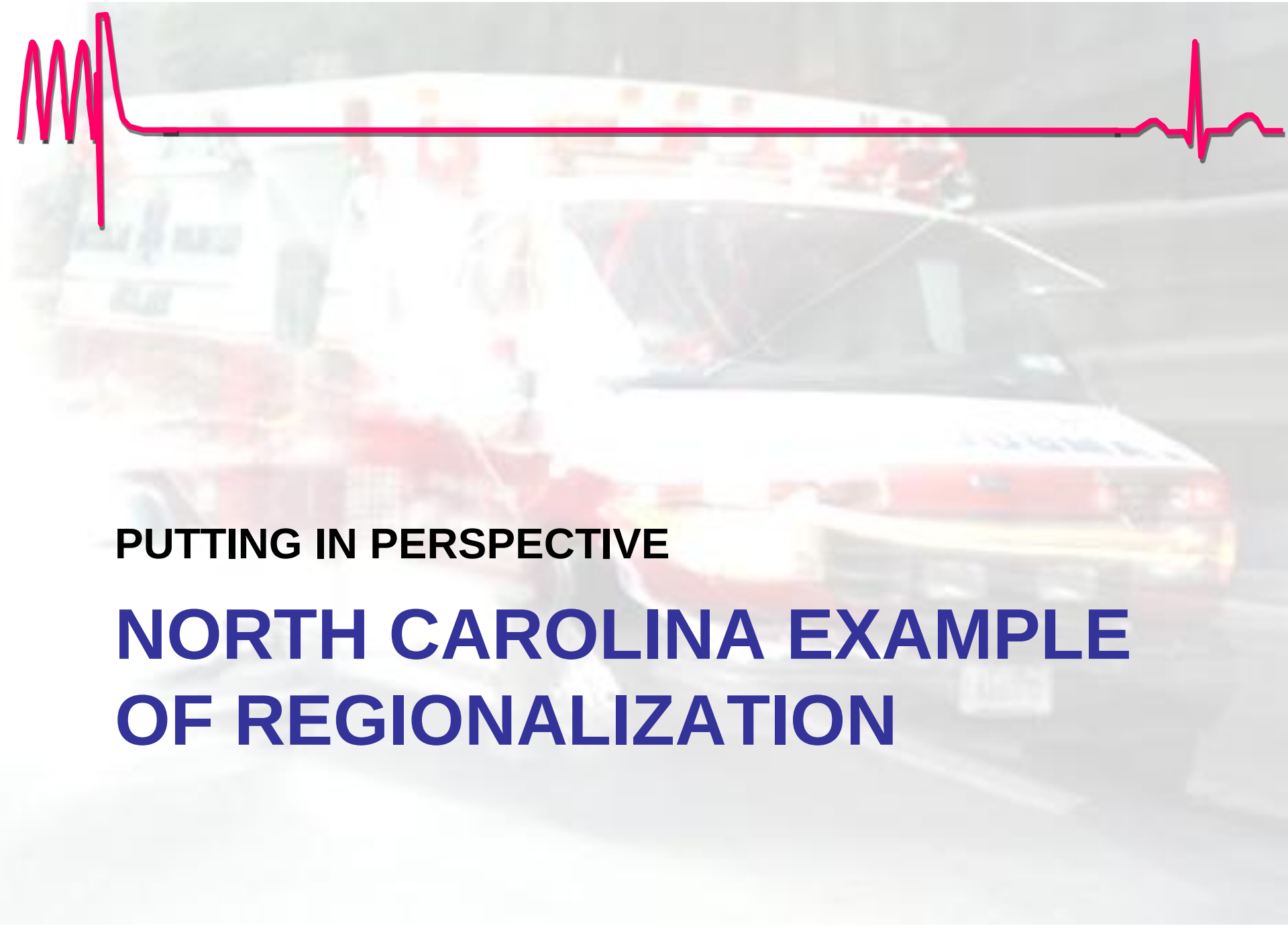
Goal: To improve the survival from cardiac arrest by 50%

❑	Standard and well executed ACLS protocols
❑	Baseline neurologic examination
❑	2 large bore IV's
❑	ECG: If new LBBB or 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

AHA 2010: Post-Arrest Guidelines

- Optimize perfusion
- Identify & treat precipitating cause
- Transport to comprehensive post-cardiac arrest treatment system
  - Acute coronary interventions
  - Goal-directed critical care
  - Hypothermia

Peberdy, et al. *Circulation*. 2010.



PUTTING IN PERSPECTIVE

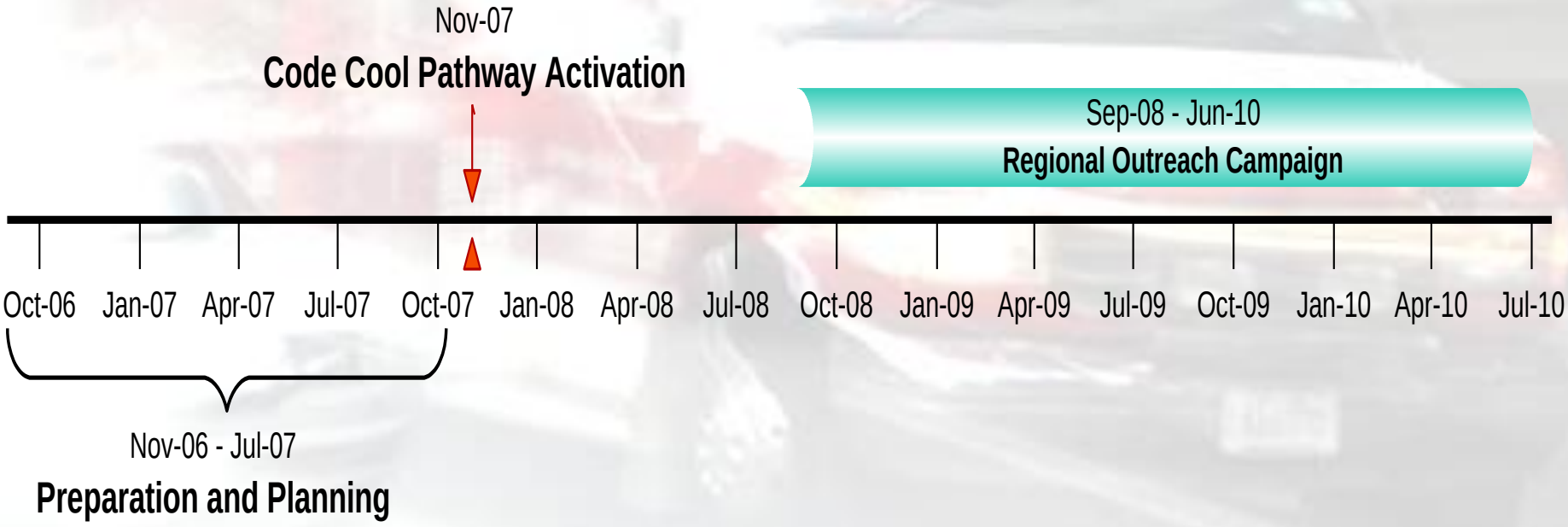
NORTH CAROLINA EXAMPLE OF REGIONALIZATION

CMC CODE COOL OVERVIEW

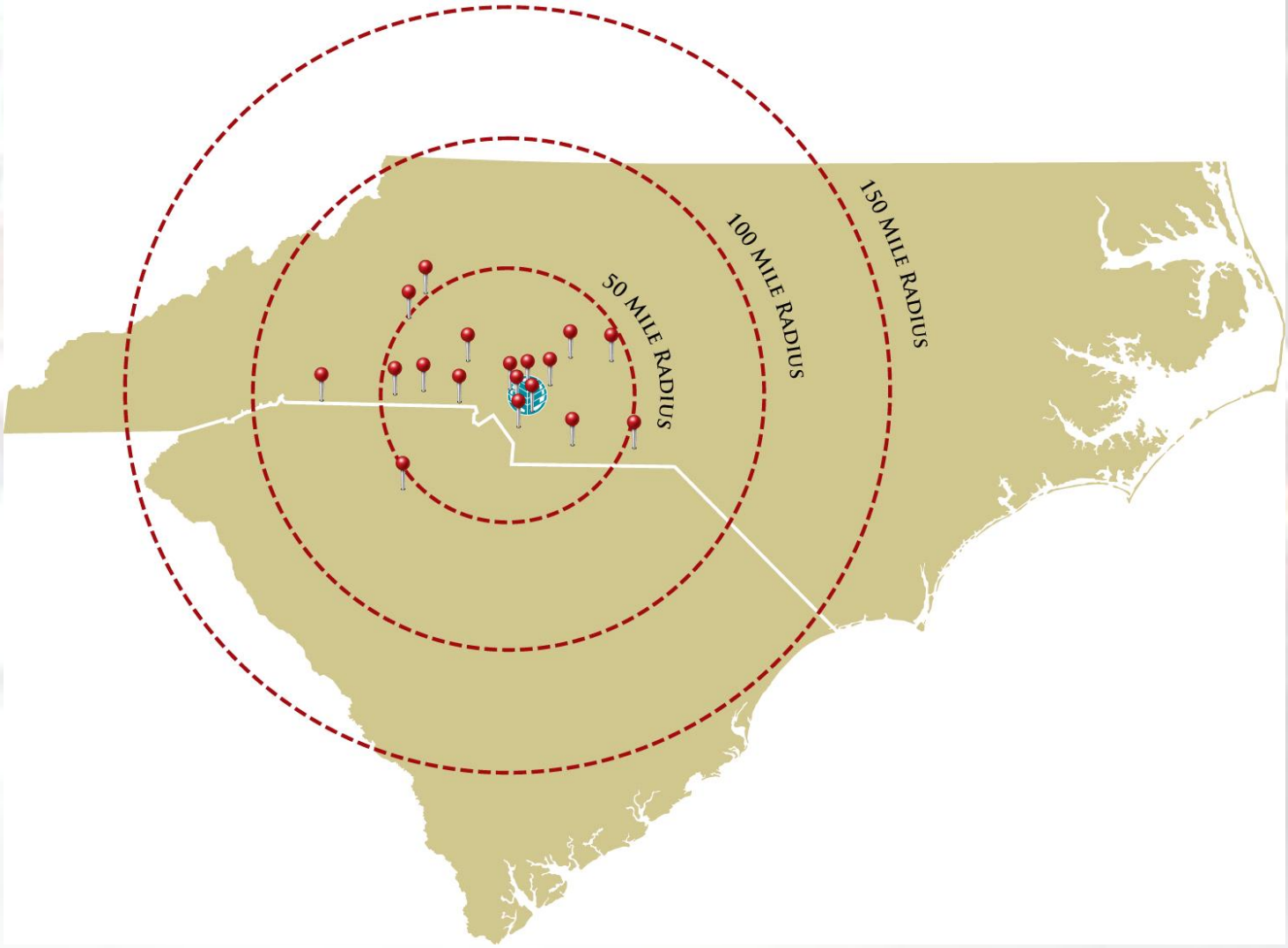
- Started November 2007
- Total patients to date: 228
- Transfers: 41%
- In-hospital arrests: 5%
- STEMIs: 12%

CMC CODE COOL

Code Cool Implementation Timeline



CMC CODE COOL



CMC CODE COOL

Regional System for Therapeutic Hypothermia: Arrest Characteristics

- Witnessed: 82%
- Bystander CPR: 66%
- VT/VF 76%
- PEA / Asystole 24%
- STEMI 49%
- Shock 44%
- Downtime 22 minutes

et al. *Circulation*. 2011.

Regional System for Therapeutic Hypothermia: Outcomes

- 56% survived
- 51% good neurological outcome
- 20% increased risk of death with every hour delay in initiation of cooling
- Time to goal temperature not significantly associated with survival

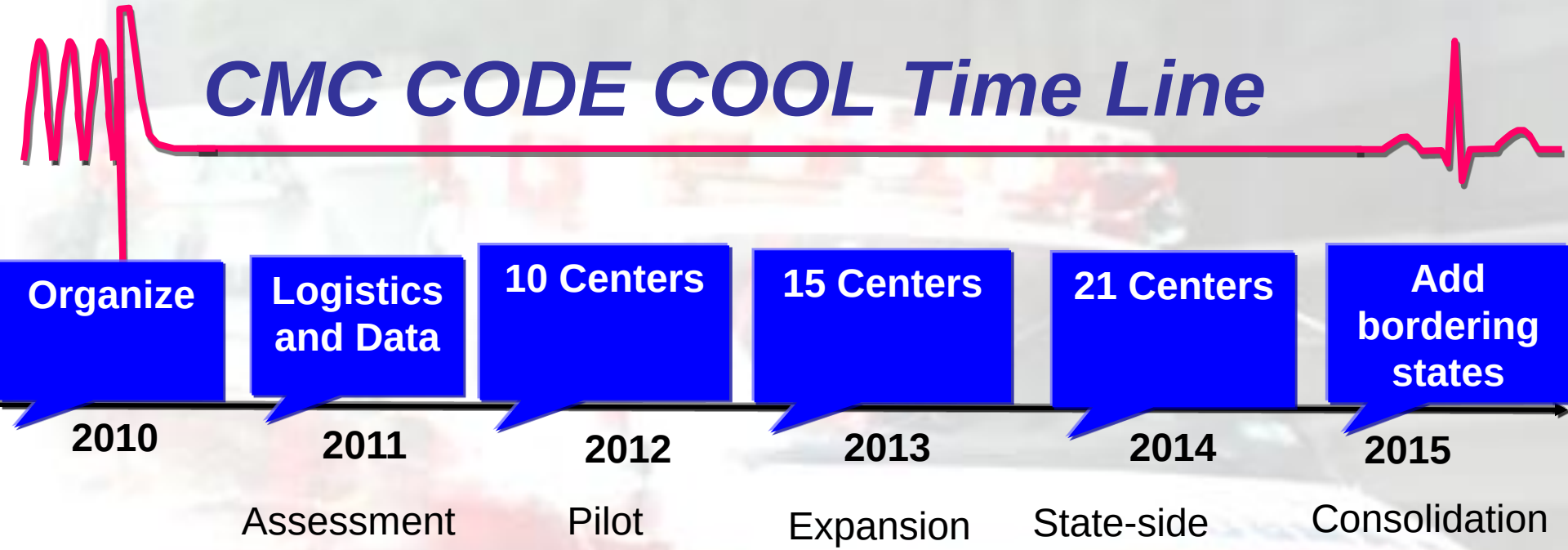
Mooney, et al. *Circulation*. 2011.

CMC Code Cool

Neurologic Outcomes

Patient Group	Good Neurologic Outcomes
Local (n=99)	43%
Referred (n=67)	34%

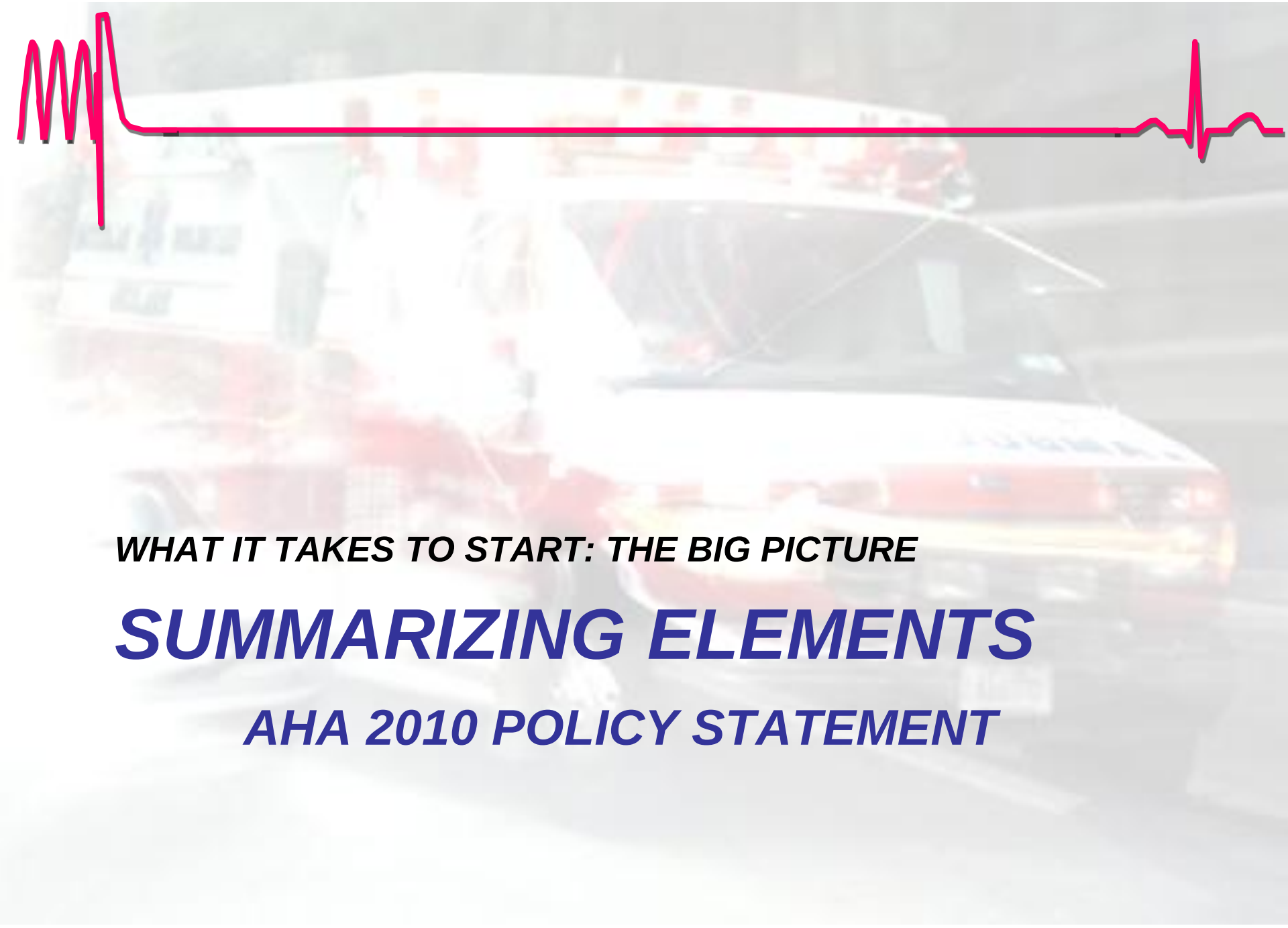
CMC CODE COOL Time Line



CMC CODE COOL Take Home

- Establish protocols
- Establish protocols
- Establish protocols

- Cardiac arrest centers
- Resuscitation center
- Aggressively resuscitate post-arrest patients



WHAT IT TAKES TO START: THE BIG PICTURE

SUMMARIZING ELEMENTS

AHA 2010 POLICY STATEMENT

EMS ESSENTIAL ELEMENTS

- Medical director works with hospitals
- External certification / verification
- Triage of ROSC to Resuscitation Center
- Plan and treat re-arrest
- Therapeutic Hypothermia
- Performance Improvement Initiative

HOSPITAL ESSENTIAL ELEMENTS

- **Resuscitation Capable Center**
  - Works with EMS Medical Director
  - External certification / verification
  - Initiates / continues Hypothermia
  - Early transport to Cardiac Center
  - Plan and treat re-arrest

  - Provide CPR training for lay public
  - Provide BLS and ACLS training for employees
  - Performance Improvement Initiative

HOSPITAL ESSENTIAL ELEMENTS

- **Cardiac Arrest Center**
  - Works with EMS Medical Director
  - External certification / verification
    - Align with STEMI centers
  - Initiates / continues Hypothermia
- Plan and treat re-arrest
- No prognostication before 72 hours

- **Center Characteristics**
  - High volume, 40 arrests per year
  - Meets ACC / AHA STEMI Guidelines for PTCI
  - EP Testing and ICD Implantation

- Provide CPR training for lay public
- Provide BLS and ACLS training for employees
- Performance Improvement Initiative
  - Multidisciplinary


Does Project Planning
Feel Like Herding Cats?


Herding Cats
1
2
3
4
5
6
7
It CAN be done