Out-of-Hospital Cardiac Arrest In North Carolina

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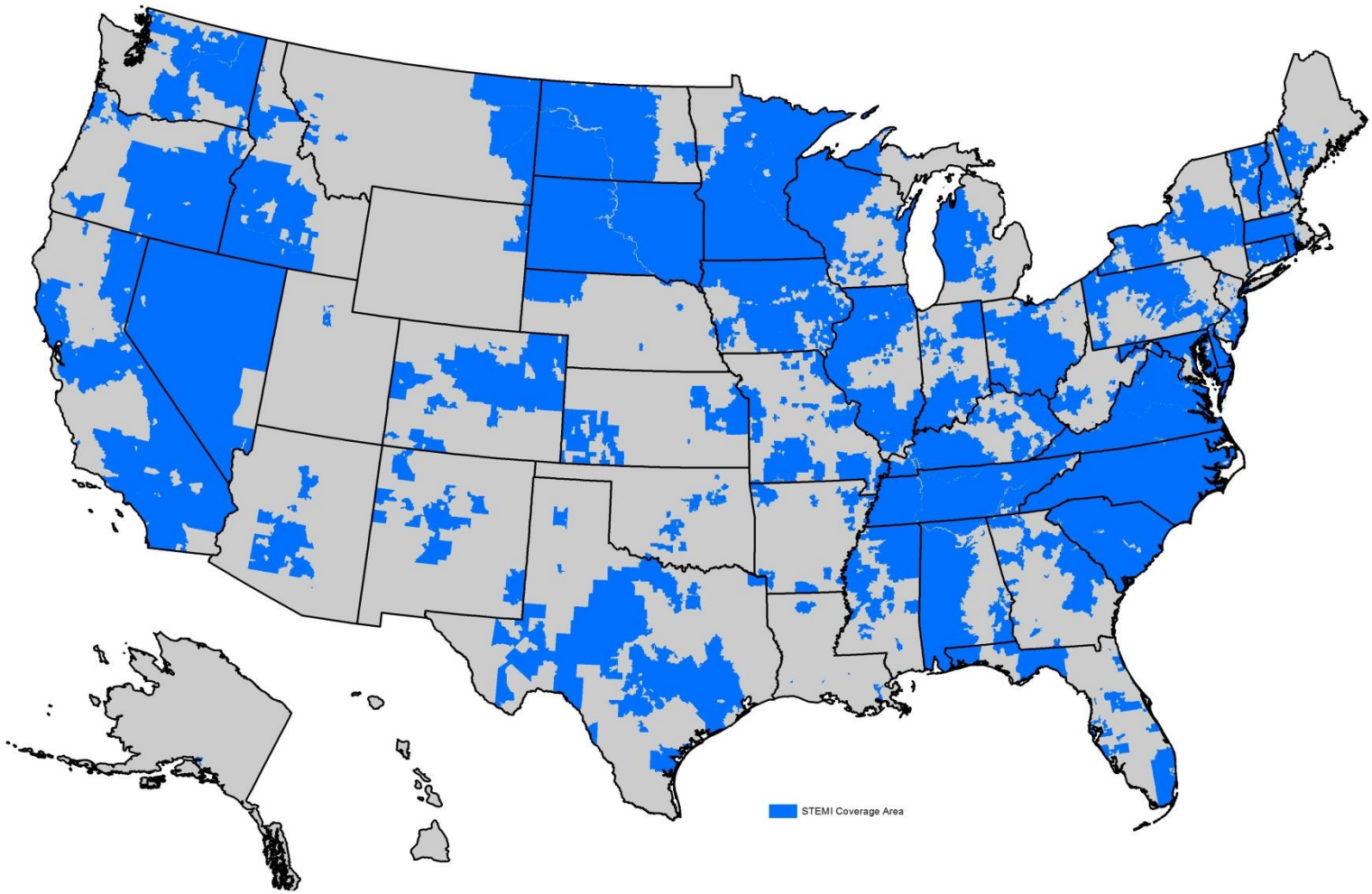
Director, Duke CCU

Disclosure

- Research contracts: AstraZeneca, Novartis, GSK, Sanofi-Aventis, BMS, The Medicines Company, Astellas, and Boehringer Ingelheim
- Consulting/Honoraria: AstraZeneca, GSK, BMS, Lilly, Novartis, Roche, Boehringer Ingelheim, The Medicines Company, Fibrex, and Sanofi-Aventis
- For full listing see w*ww.dcri.duke.edu/research/coi.jsp*

STEMI Systems Coverage

As of 6/21/2012 (630 Systems; 62.7% Population Coverage)

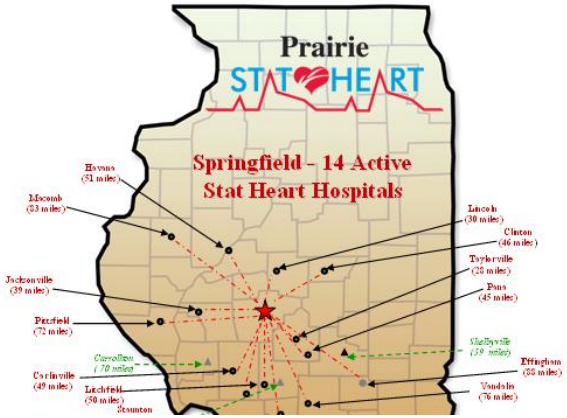


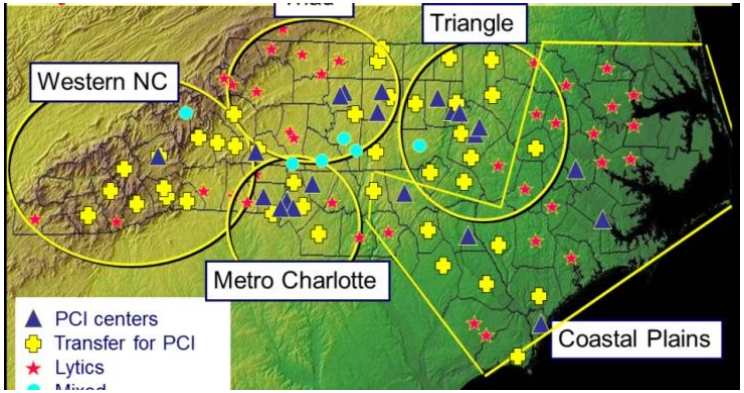
STEMI Accelerator

Individual hospital

Hub and spoke model

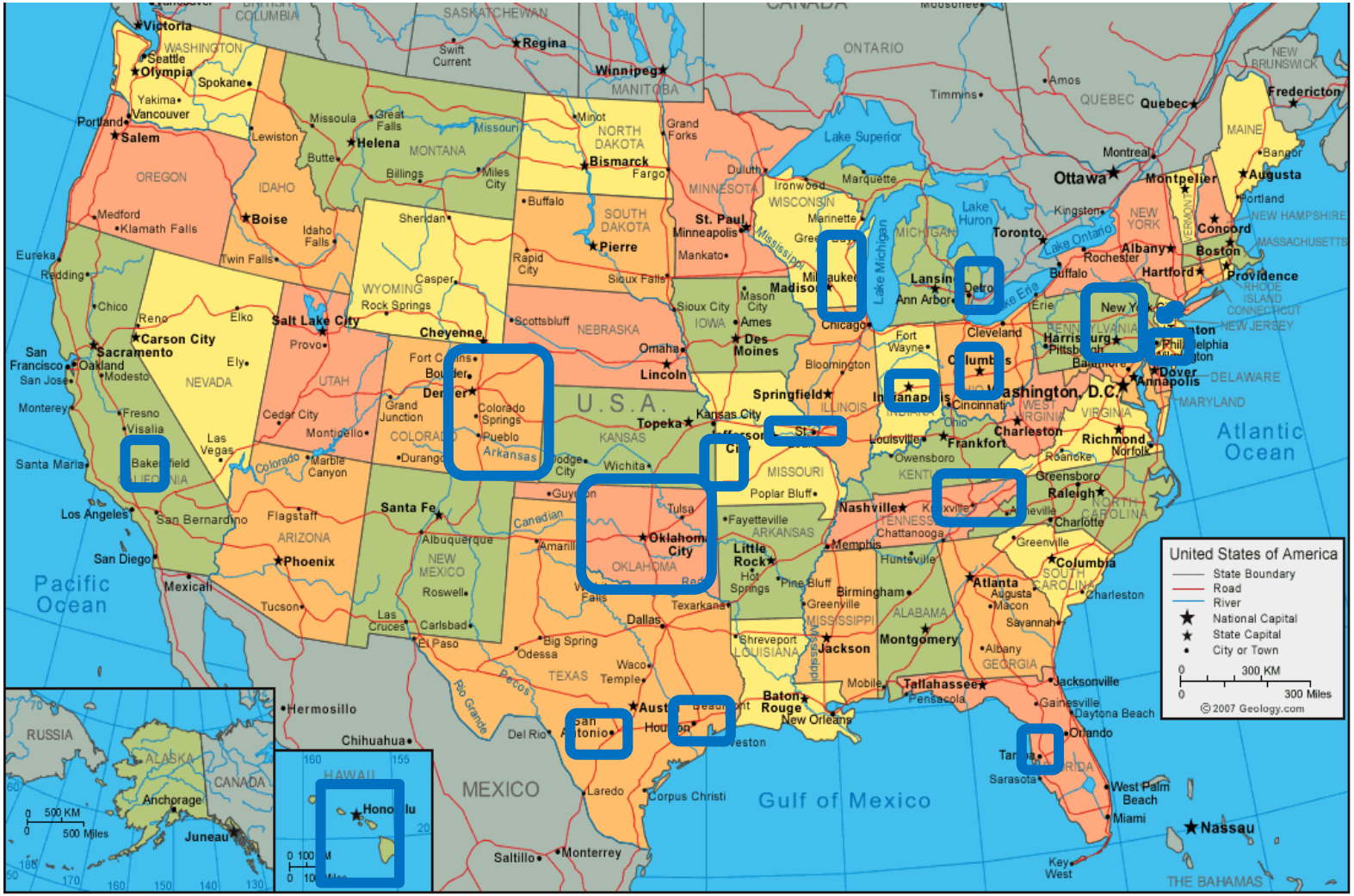
Regional system





Journal of Invasive Cardiology 2011; 23 A:8-12

STEMI Accelerator

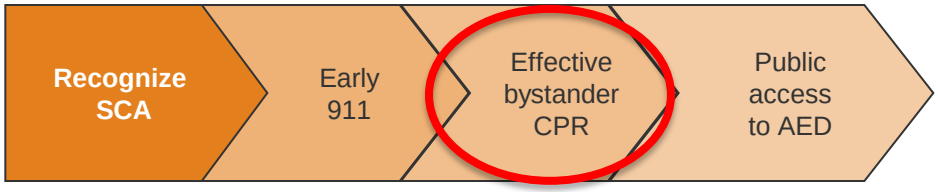


STEMI Accelerator Sites

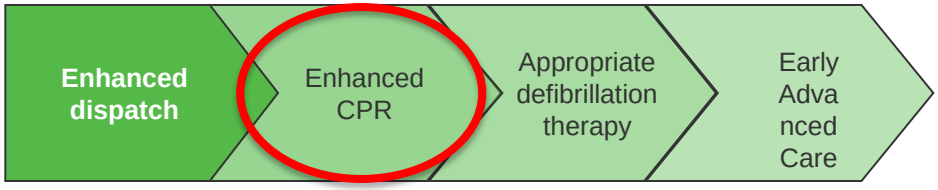
HeartRescue PROJECT

Improving SCA Survival by 50% in 5 years in North Carolina

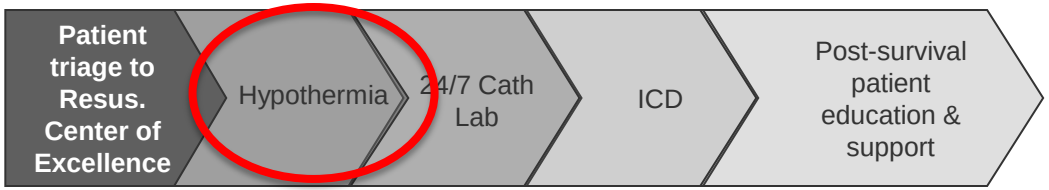
1: Bystander Response

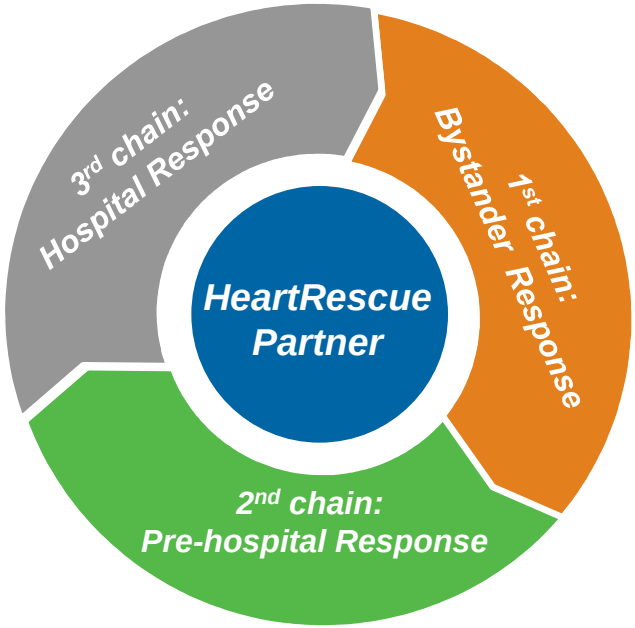


2: Pre-hospital Response



3: Hospital Response





Medtronic FOUNDATION

American Heart Association. | MISSION: LIFELINE®

STEMI & CARDIAC RESUSCITATION

IDEAL SYSTEM

Cardiac Arrest

- Unresponsive
- Not breathing normally

Community

- Hands Only CPR | Bystander CPR
- Early activation of 911
- Apply AED before EMS arrival

EMS ON-SCENE

- Minimize interuptions of CPR
- Encourage 12-lead ECG after ROSC
- Consider Destination Protocol

EMS Triage Plan

Receiving Hospital (PCI-capable)

- Initiate hypothermia <6 hrs from onset of arrest
- Consider early PCI
- Defer Prognosis assessment for 3 days
- Consider need for ICD before discharge

Interhospital transfer

Referral Hospital (non PCI-capable)

- Initiate hypothermia <6 hrs from onset of arrest
- Consider trasfer to resuscitation receiving center if unconscious and hemodynamically stable

- 50 yo man felt ill on Aug 5 2012
- He was hugging wife, who felt him become heavy and then collapse in her arms
- She worked in home health and had learned CPR at work one month earlier
- Started CPR, called 9-1-1
- Paramedics applied 6 shocks for VFib
- ECG obtained

HR 107
PR 148
QRSD 132
QT 372
QTc 497

-- AXIS --
P 51
QRS 120
T 27

- STMT - * SINUS TACHYCARDIA (Now Present)
- STMT - * (Now Absent) ATRIAL FIBRILLATION
- STMT - * RBBB AND LPFB (Remains)
- STMT - * INFEROLATERAL ST ELEVATION, SUBEPICARDIAL INJURY (Remains)
[SST] * Suggest serial tracings, if clinically indicated
- REMK - * 2807817 tp

PREVIOUS:05-Aug-2012 19:57:25 - No Severity Confirmed

ACCOUNT:0000ss13

operator id:CHEST PAIN
stat:ECG (STANDARD)(ECG)

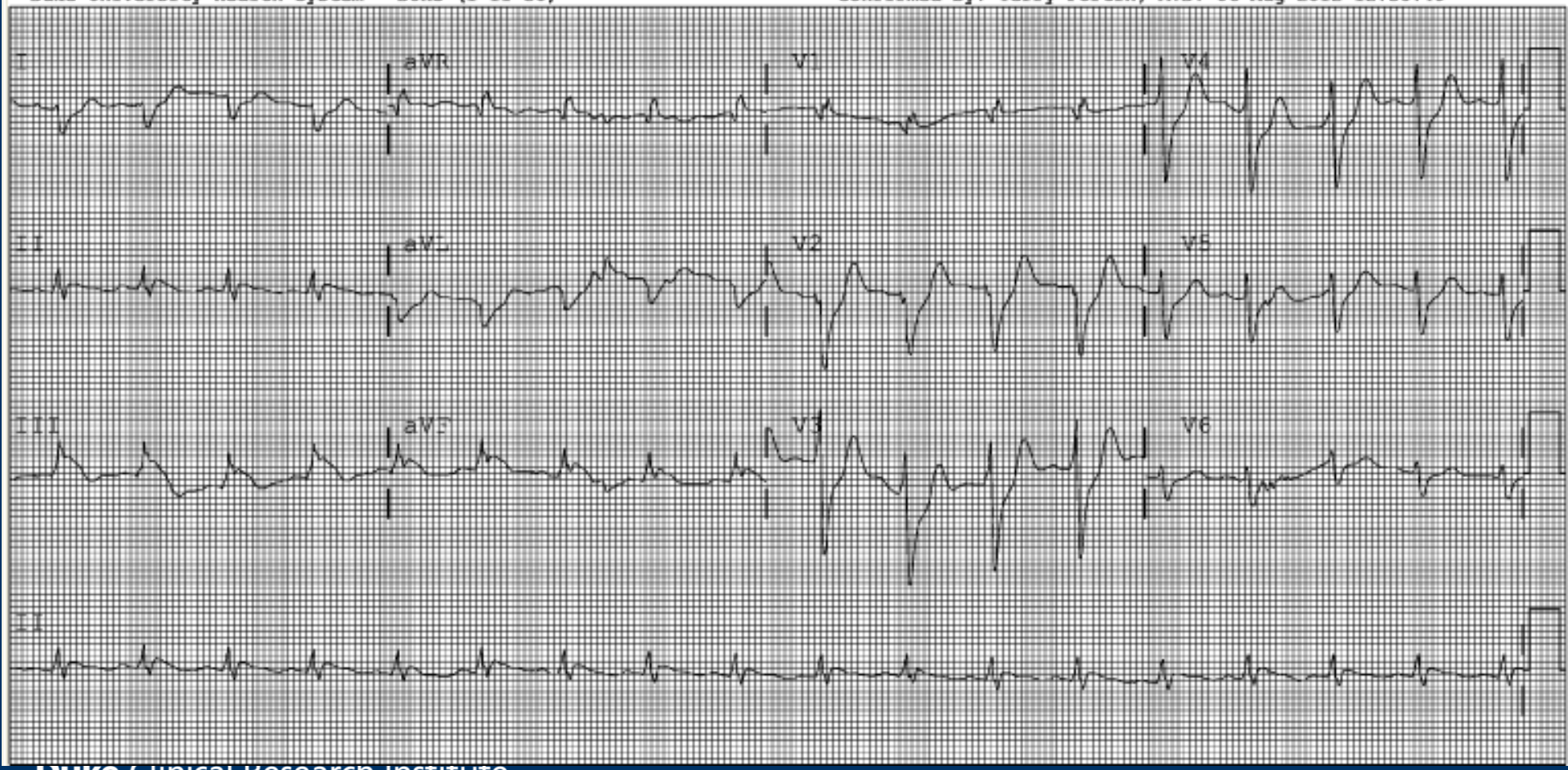
Order #: 666CH10012001

Reason: CHEST PAIN
Standard 12
Requested By: SERRA,RICHARD K

Edited

Duke University Health System - DUHS (1-11-50)

Confirmed by: Terry Fortin, M.D. 06-Aug-2012 12:50:49



- Taken immediately to cath lab, where 95% RCA found to have slow distal flow
- BMS placed; CK-MB 75; LV EF .35
- Prognosis declared grim since no corneal reflex on arrival to CCU
- Therapeutic hypothermia X 24 hours

Woke up on his 51st birthday (3 days after arrest)

We know what to do!

- Recognize arrest
- 9-1-1 with good dispatch
- Bystander CPR (high quality)
- Rapid EMS response (high quality CPR)
- Going to right hospital
- Primary PCI (for ST elevation)
- Therapeutic hypothermia
- Goal-directed intensive care
- Rehab and ICD

"Humanity's greatest advances are not in its discoveries – but in how those discoveries are applied ..."

Bill Gates, June 7, 2007
Harvard Commencement Address

AHA Policy Statement

Regional Systems of Care for Out-of-Hospital Cardiac Arrest

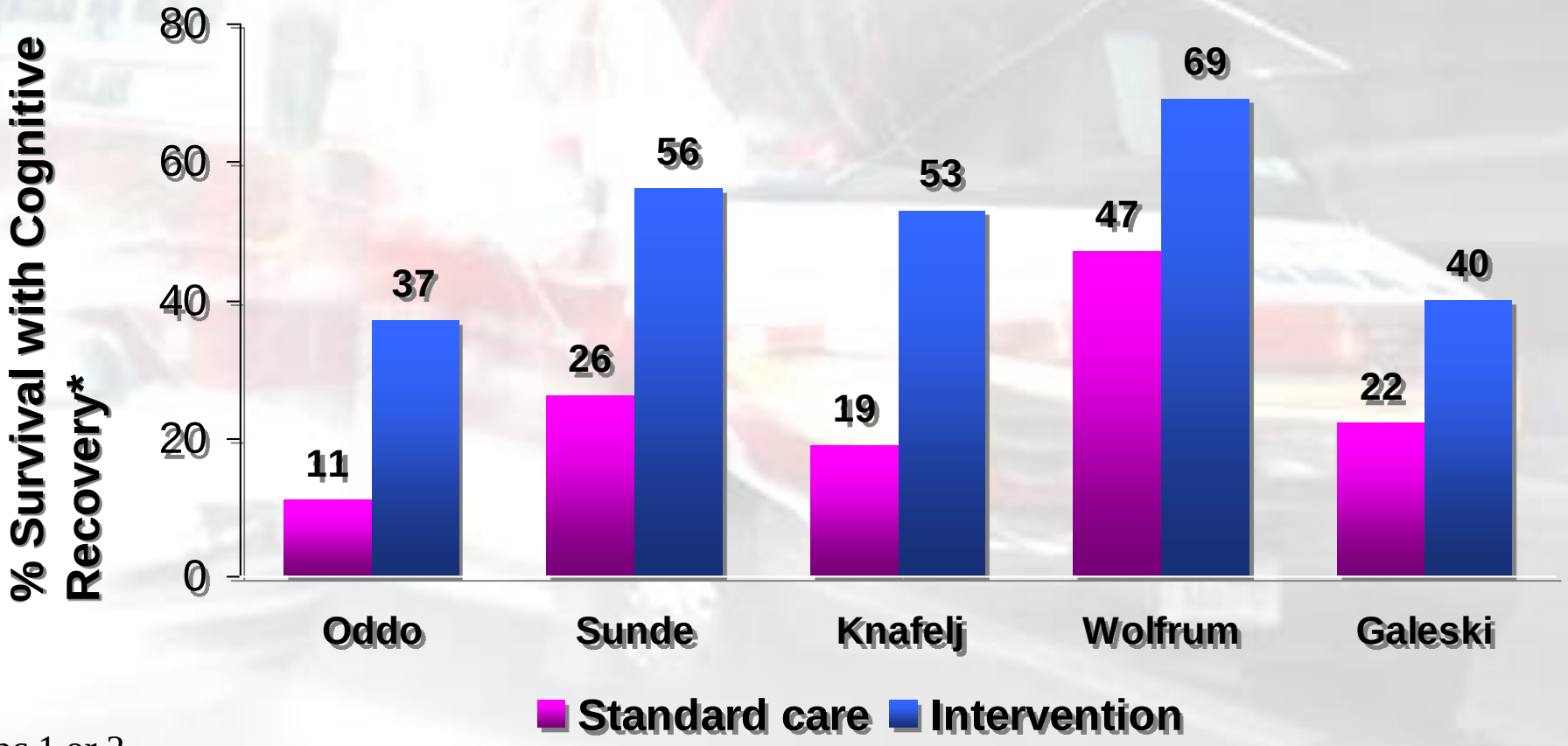
A Policy Statement From the American Heart Association

Graham Nichol, MD, MPH, FAHA, Chair; Tom P. Aufderheide, MD, FAHA; Brian Eigel, PhD; Robert W. Neumar, MD, PhD; Keith G. Lurie, MD; Vincent J. Bufalino, MD, FAHA; Clifton W. Callaway, MD, PhD; Venugopal Menon, MD, FAHA; Robert R. Bass, MD;

"Many more people could survive cardiac arrest if regional systems of care were implemented"

***Circulation*. 2010;121:00-00.**

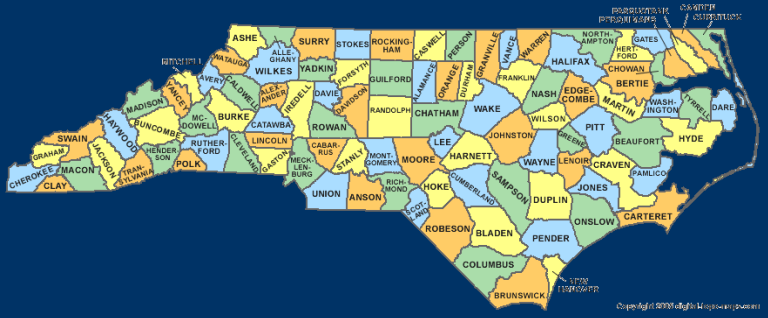
Multifaceted Post-Cardiac Arrest Interventions (Including PPCI, hypothermia, intensive care)



*cpc 1 or 2

Nichols *Circulation 2010;121;709-729*

US Emergency Healthcare is Fragmented



21 primary PCI centers

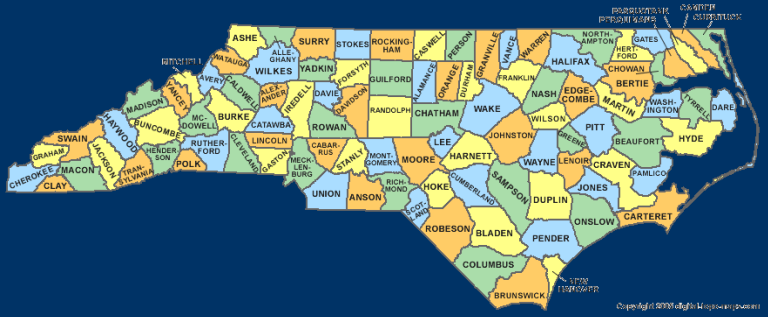
540 EMS systems

5,240 paramedics

18,000 EMTs

118 emergency departments

Duke Clinical Research Institute


ASHE
SURRY
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CASWELL
PERSON
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NORTH-AMPTON
GATES
HERT-FORD
ALLE-GHANY
WILKES
YADKIN
FORSYTH
GUILFORD
ALAMANCE
ORANGE
DURHAM
FRANKLIN
HALIFAX
CHOWAN
BERTIE
AVERY
CALDWELL
ALEX-ANDER
IREDELL
DAVIE
DAVIDSON
RANDOLPH
CHATHAM
WAKE
NASH
EDGE-COMBE
MARTIN
WASH-INGTON
TYRRELL
DARE
MADISON
BURKE
MC-DOWELL
ROWAN
WILSON
PITT
BEAUFORT
HYDE
SWAIN
BUNCOMBE
CATAWBA
LINCOLN
CABAR-RUS
LEE
JOHNSTON
GREENE
GRAHAM
HENDER-SON
RUTHER-FORD
CLEVELAND
GASTON
MECK-LEN-BURG
STANLY
MONT-GOMERY
MOORE
HARNETT
WAYNE
LENOIR
CRAVEN
PAMLICO
CHEROKEE
MACON
JACKSON
HAYWOOD
TRAN-SYLVANIA
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UNION
ANSON
RICH-MOND
HOKE
CUMBERLAND
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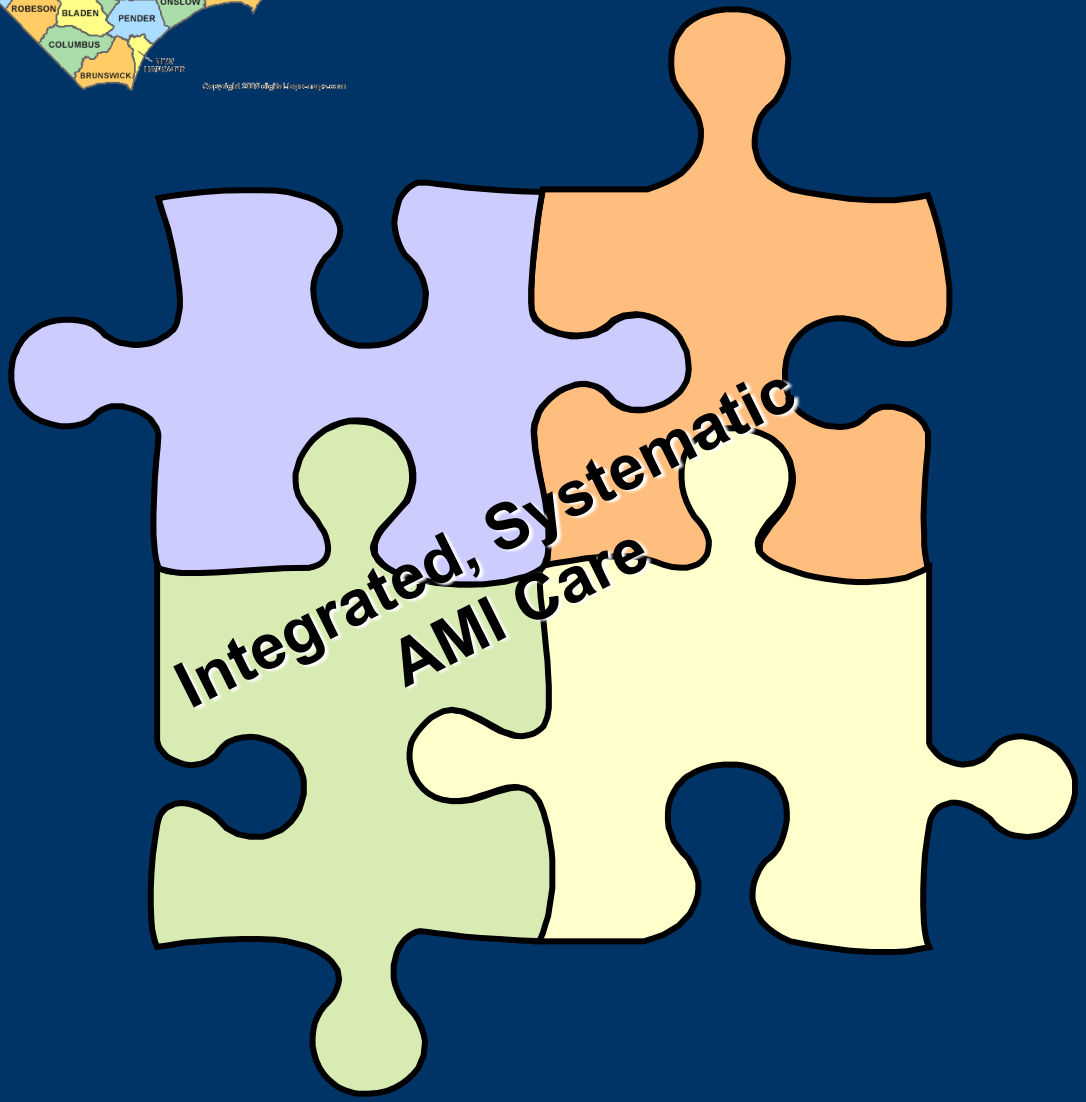

Integrated, Systematic
AMI Care

INSIDE THIS WEEK: A 14-PAGE SPECIAL REPORT ON AGEING

The Economist

JUNE 27TH–JULY 3RD 2009 Economist.com

Iran's agony

The mystery of Mrs Merkel

Asia's consumers to the rescue?

The Greeks and those marbles

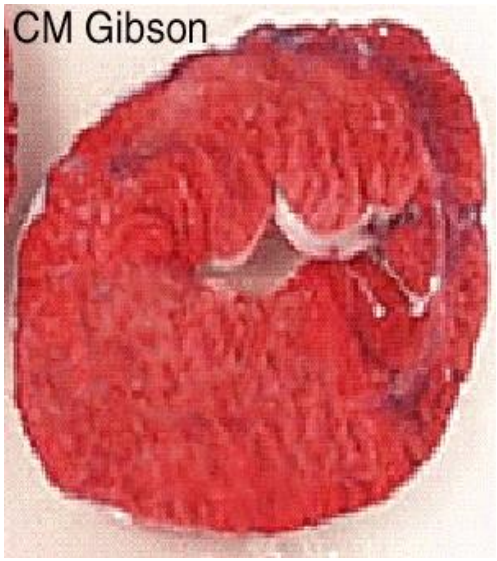
Evolution and depression

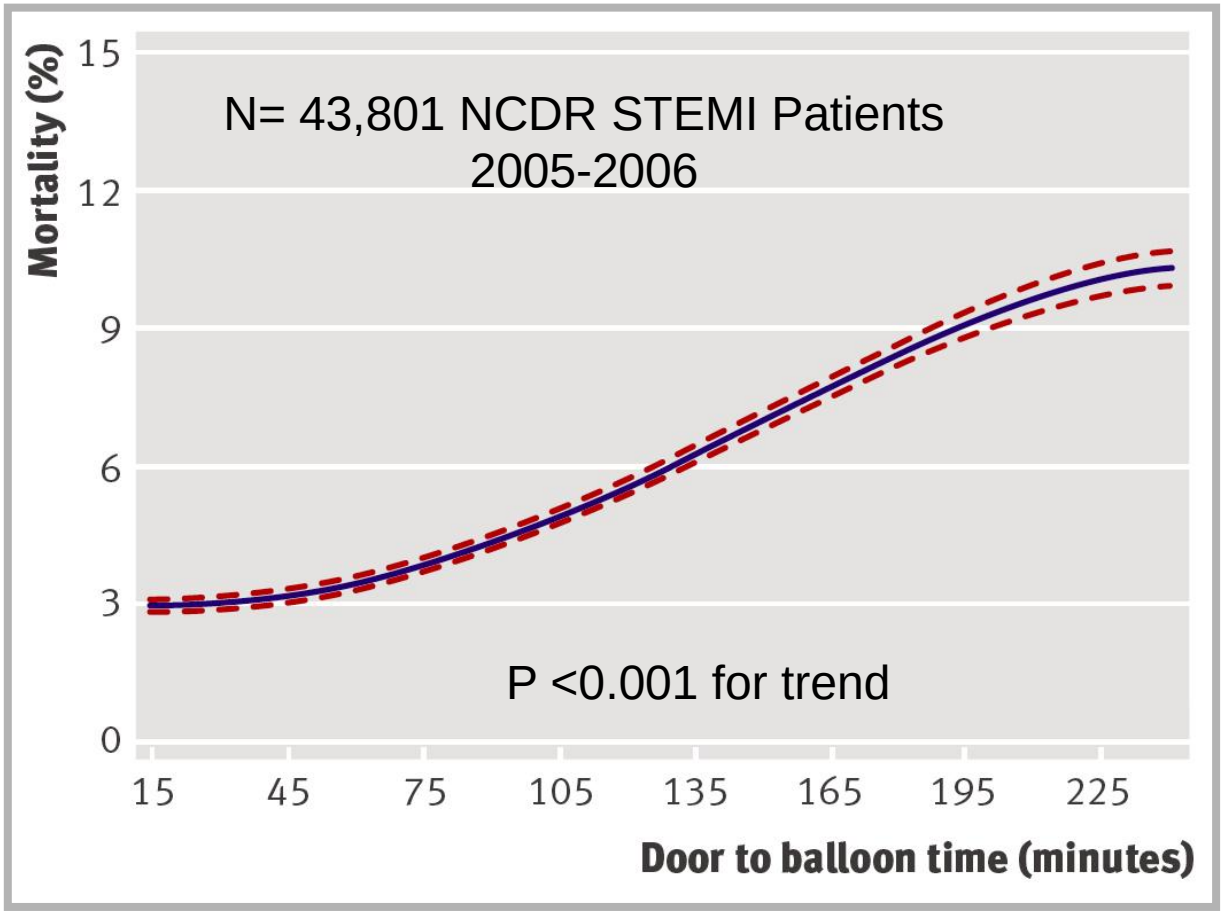
Reforming health care

This is going to hurt

Cardiovascular emergencies for which treatment benefit is time dependent

- **STEMI**
- **Stroke**
- **Cardiac Arrest**





Reimer. Circulation 1977;56:786-794.

Rathore BMJ 2009;338:1807

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

Duke

Cardiac arrest

Recommendations	Class[a]	Level[b]
All medical and paramedical personnel caring for a patient with suspected myocardial infarction must have access to defibrillation equipment and be trained in cardiac life support.	I	C
It is recommended to initiate ECG monitoring at the point of FMC in all patients with suspected myocardial infarction.	I	C
Therapeutic hypothermia is indicated early after resuscitation of cardiac arrest patients who are comatose or in deep sedation.	I	B
Immediate angiography with a view to primary PCI is recommended in patients with resuscitated cardiac arrest whose ECG shows STEMI.	I	B
Immediate angiography with a view to primary PCI should be considered in survivors of cardiac arrest without diagnostic ECG ST-segment elevation but with a high suspicion of ongoing infarction.	IIa	B

ECG = electrocardiogram; FMC = first medical contact; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.

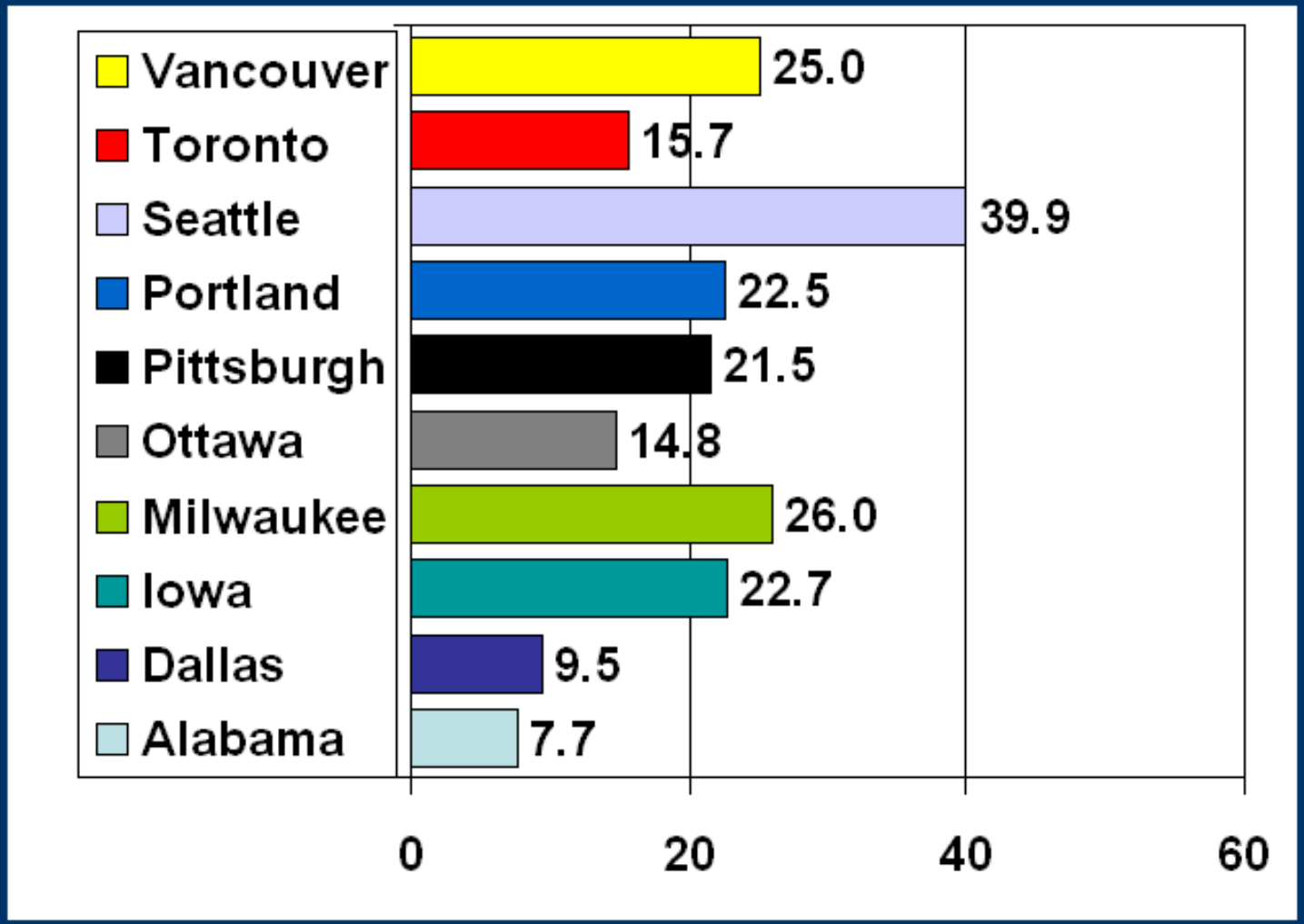
European Heart Journal 2012 - doi:10.1093/eurheartj/ehs215

If you don’t measure it, you can’t improve it

Variation in Survival for Cardiac Arrest

Resuscitations Outcomes Consortium

Survival to Discharge for VF Arrest



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

Cardiac Arrest Registry

Part A : Non - HealthEMS™ Users start here, otherwise skip to part B

1 - Street Address (Where Arrest Occurred)

1 - City | 1 - State | 1 - Zip Code

2 - First Name | 3 - Last Name

4 - Age ☐ Days ☐ Months ☐ Years | 5 - Date of Birth | 6 - Gender ☐ Male ☐ Female | 28 - Race/Ethnicity ☐ American-Indian/Alaska ☐ Asian ☐ Black/African-American ☐ Hispanic/Latino ☐ Native Hawaiian/Pacific Islander ☐ White ☐ Unknown

Part B : To be completed by all Users

7 - EMS Agency ID | 8 - Date of Arrest / / | 9 - Call # | 10 - Booklet ID (HealthEMS™ Users Only)

First Responding Agency | **Hospital Destination** | **Dispatch Times**

11 - Fire/First Responder | 12 - Destination Hospital | 13 - EMS Notified : : | 13 - EMS Arrived at Scene : :

Arrest Information

14 - Location Type
- ☐ Home/ Residence
- ☐ Public Building
- ☐ Street/Hwy
- ☐ Nursing Home
- ☐ Residence/Institution
- ☐ Physician Office/Clinic
- ☐ Educational Inst.
- ☐ Hospital
- ☐ Recreation/Sport
- ☐ Industrial Place
- ☐ Farm
- ☐ Mine / Quarry
- ☐ Jail
- ☐ Airport
- ☐ Other

15 - Arrest Witnessed
- ☐ Witnessed Arrest
- ☐ Unwitnessed Arrest

16 - Arrest After Arrival of EMS
- ☐ Yes
- ☐ No

17 - Presumed Cardiac Arrest Etiology
- ☐ Presumed Cardiac Etiology
- ☐ Trauma
- ☐ Respiratory
- ☐ Drowning
- ☐ Electrocution
- ☐ Other

Resuscitation Information

13 - Time of 1st CPR : | 13 - ROSC Time : | 13 - CPR Stopped/Termination Time : | 13 - Time of 1st Defibrillation :

18 - Resuscitation Attempted by EMS
- ☐ Yes
- ☐ No

20 - Who Initiated CPR
- ☐ Bystander
- ☐ Bystander Family Member
- ☐ First Responder Fire/Police
- ☐ Responding EMS Personnel
- ☐ Medical Provider
- ☐ Other

21 - Was an AED Used During Resuscitation
- ☐ Yes
- ☐ No
- ☐ AED Present but not Used
- ☐ AED Malfunctioned

0f AED Shocks

0f Manual Shocks

22 - Who First Applied Monitor/Defibrillator, AED
- ☐ Not Applicable
- ☐ Bystander
- ☐ Bystander Family Member
- ☐ First Responder Fire/Police AED
- ☐ EMS AED or Monitor/Defibrillator
- ☐ ALS First Responder Monitor/Defibrillator

First Cardiac Arrest Rhythm of Patient and ROSC Information

23 - First Arrest Rhythm of Patient
- ☐ Ventricular Fibrillation
- ☐ Ventricular Tachycardia
- ☐ Asystole
- ☐ Idioventricular/PEA
- ☐ Unknown Shockable Rhythm
- ☐ Unknown Unshockable Rhythm

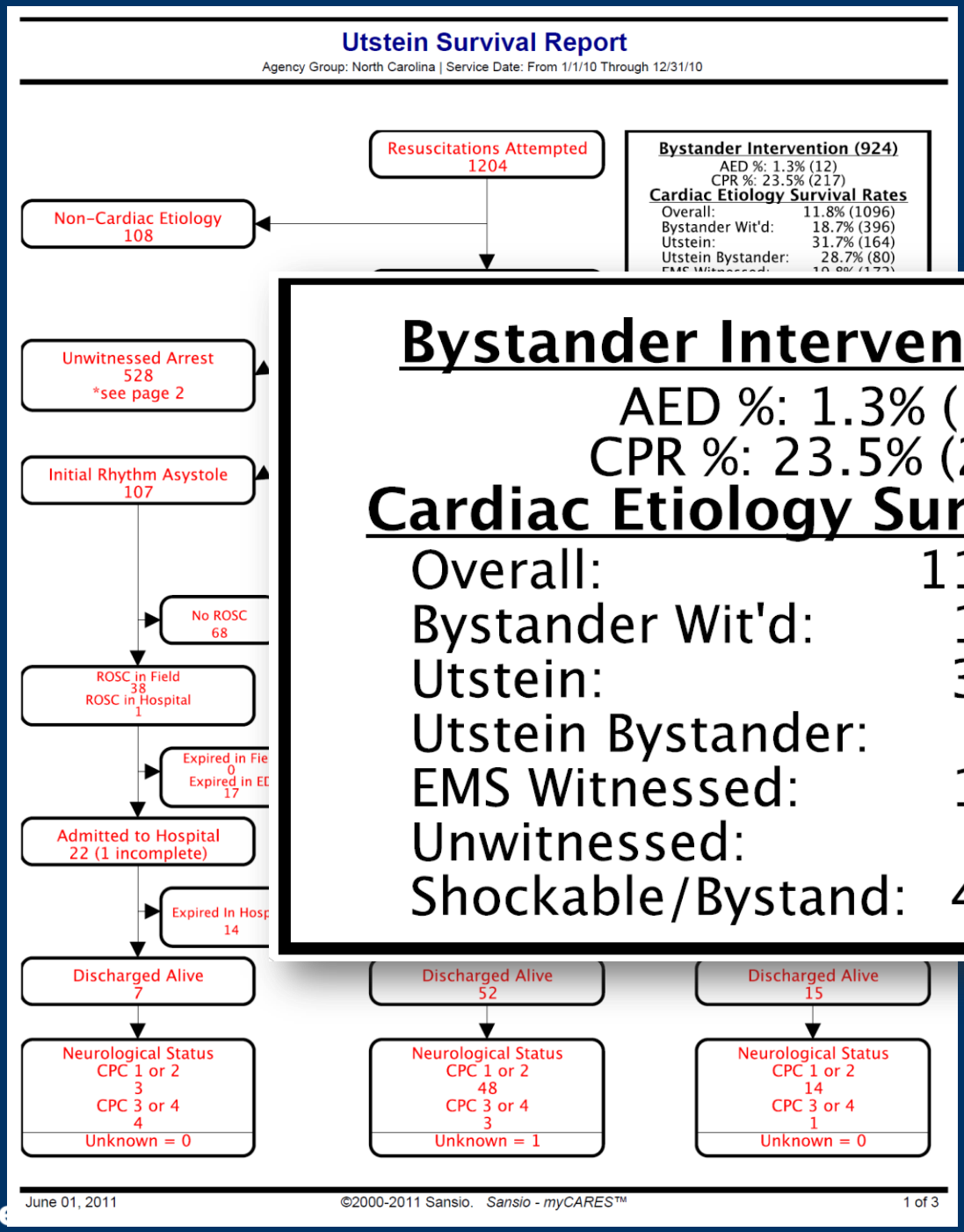
24 - ROSC
- ☐ Yes
- ☐ No

25 - Sustained ROSC
- ☐ Yes
- ☐ No

26 - Out of Hospital Disposition
- ☐ Resuscitation not initiated at scene due to obvious signs of death, DNR, resuscitation considered futile, or resuscitation is not required
- ☐ Resuscitation terminated at scene due to medical control order, protocol/policy requirements completed
- ☐ Transported to Hospital with or without ROSC

27 - End of the Event
- ☐ Dead in Field
- ☐ Pronounced Dead in ED
- ☐ Ongoing Resuscitation in ED

First Cardiac Arrest Rhythm Strip (Apply with ScotchTape on Top and Sides)



Bystander Intervention (924)

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

Cardiac Etiology Survival Rates

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

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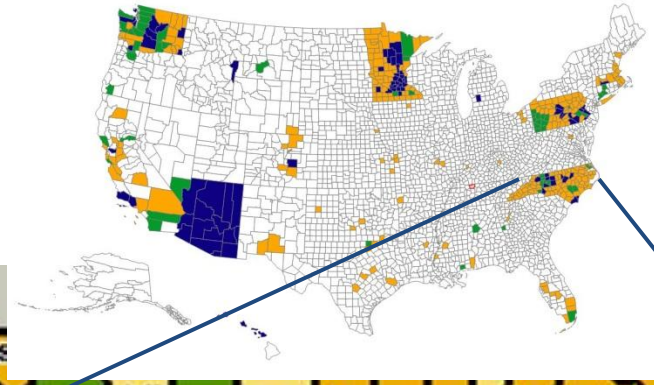
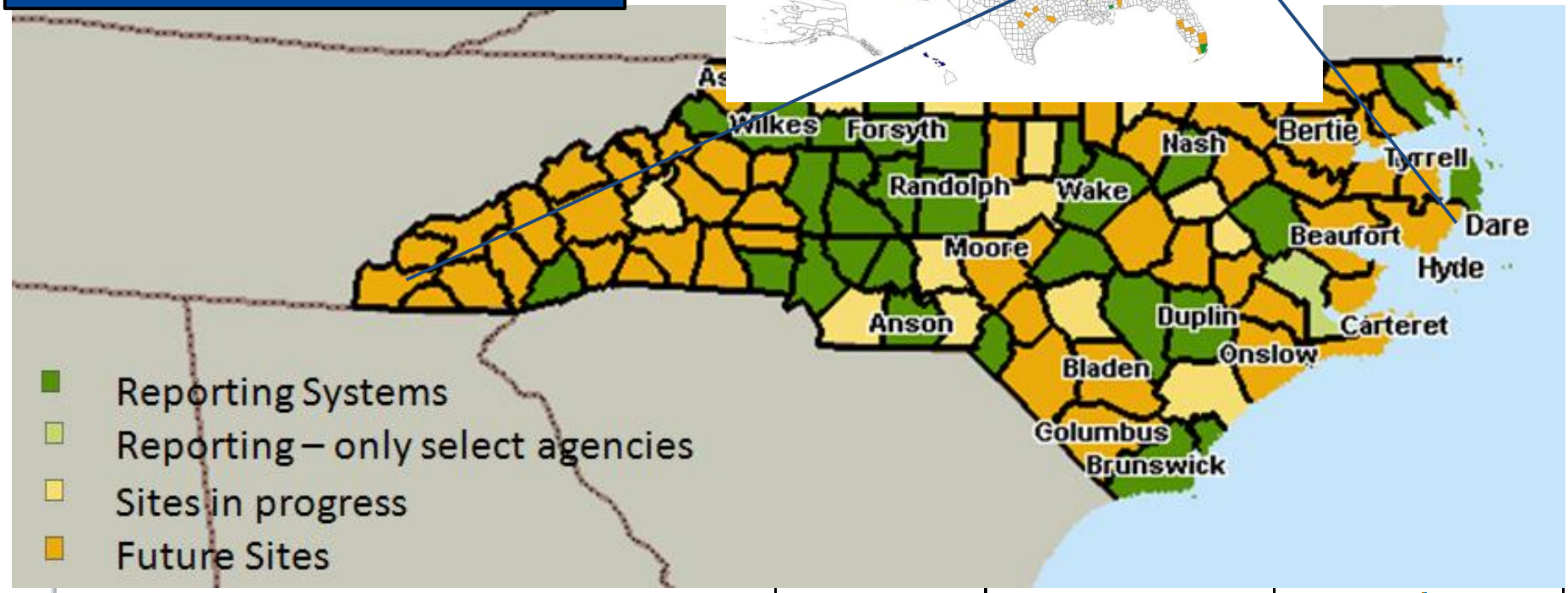




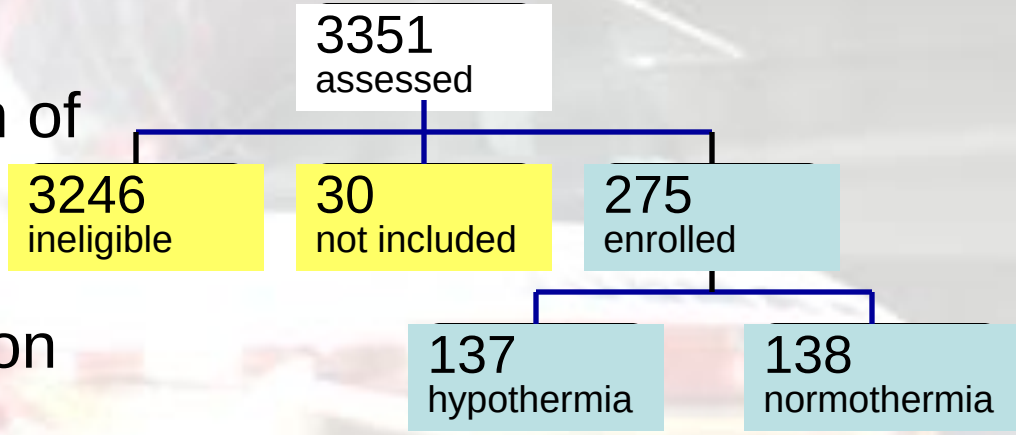
	Number	% Population	Cumulative Population
EMS Systems in NC	100	100%	
EMS Systems reporting into CARES	**31**	**55.28%**	55.28%
EMS Systems in Progress	14	12.94%	68.22%
Future EMS Systems	57	31.78%	100

Therapeutic Hypothermia

Hypothermia After Cardiac Arrest Study Group

- 275 patients VT/VF
- 5-15 minutes to initiation of resuscitation
- <60 minutes to restoration
- 24 hour temp 32-34 degrees
- 8 hours to achieve target temp

Cooling blankets, ice packs



N Engl J Med 2002;346:549-56

Hypothermia After Cardiac Arrest Study Group

Survival and Neurologic Outcome at Discharge

	Hypothermia	Normothermia
Survival p=0.02	**64**% 87/137	**50**% 69/138
Favorable neurologic outcome p=0.009	**47**% 64/134	**31**% 42/135

N Engl J Med 2002;346:549-56

Hypothermia

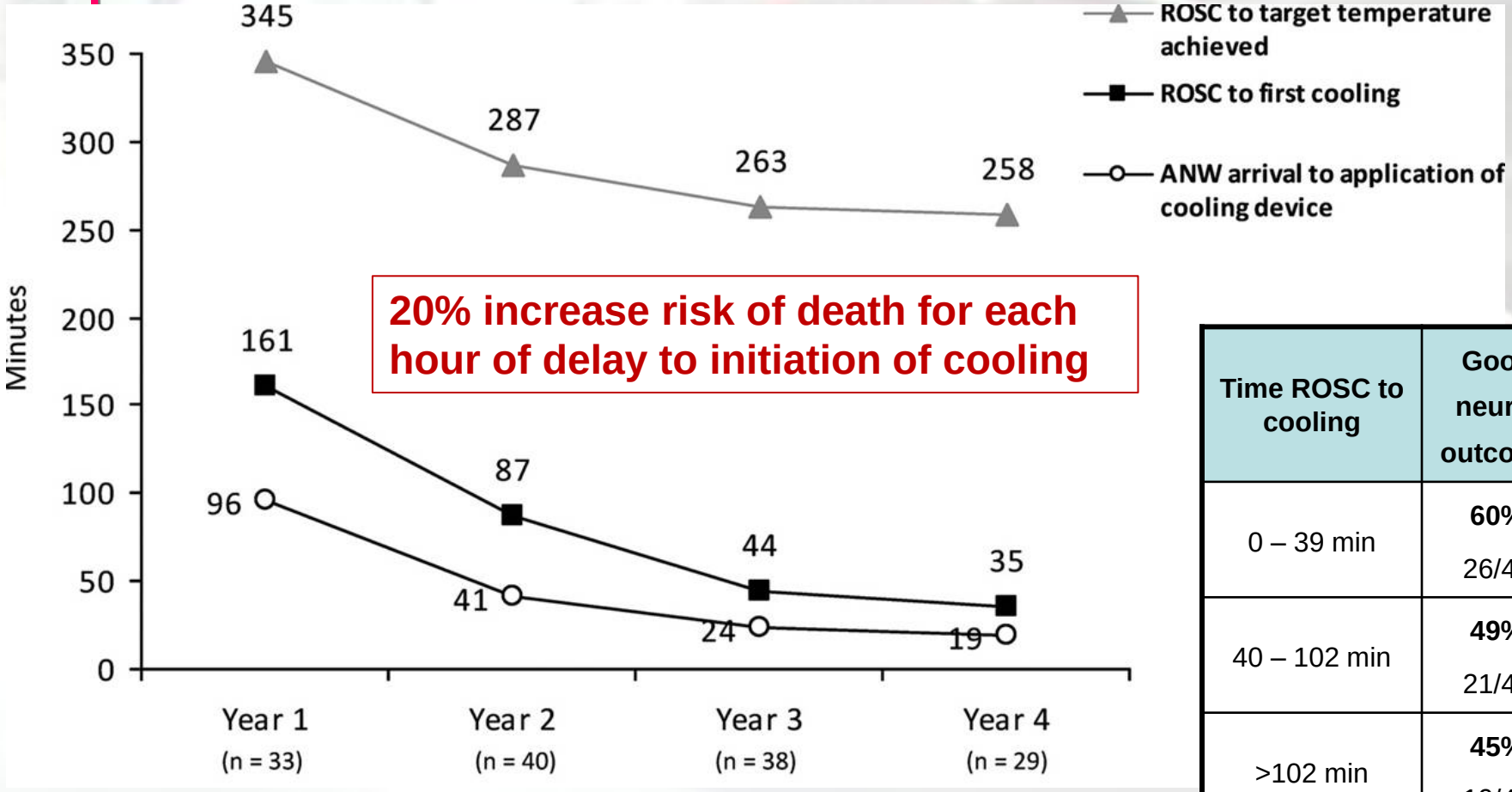
- Hypothermia saves lives
- Candidates
  - Persistent coma (not following commands) following Return of Spontaneous Circulation (ROSC)
  - VT/VF or “shockable rhythm”
  - Possibly asystole / pulseless electrical activity

Hypothermia

- Questions remain
  - Who, how, when to start, for how long
  - Role and value of prehospital hypothermia
  - When to assess neurological recovery

Therapeutic Hypothermia After Out-of-Hospital Cardiac Arrest

Evaluation of a Regional System to Increase Access to Cooling



20% increase risk of death for each hour of delay to initiation of cooling

Time ROSC to cooling	Good neuro. outcome
0 – 39 min	**60%** 26/43
40 – 102 min	**49%** 21/43
>102 min	**45%** 19/42

Mooney M R et al. Circulation 2011;124:206-214

Code Cool

1. Induction

2. Maintenance

3. Rewarming

Carolinas Medical Center (CMC)

Therapeutic Hypothermia Post Cardiac Arrest

CMC Critical Care Committee

Initiate: CMC Therapeutic Hypothermia Post Cardiac Arrest
Verify Allergies:_____

Admit to: ICU under Dr.: _____ **List:** _____
Diagnosis: Cardiac Arrest
Condition: Critical
Notify Paging Operator at 355-2443 to activate Code Cool

Consults

Pulmonary and Critical Care Consultants (PCCC) ; page #3767 immediately, unless previously notified
Sanger Cardiology
Physical Medicine and Rehabilitation - List 66287
Activate Group Page 8760 for family support referral

Treatment Parameters

Refer to: **CMC Therapeutic Hypothermia After Cardiac Arrest Guideline**
Goal Temperature 33° C
Minimize FiO_2 to maintain SpO_2 greater than 95%
Maintain Mean Arterial Pressure (MAP) greater than 65 mmHg
Maintain $PaCO_2$ of 38 - 42 mmHg

Pharmacy/Treatments and Interventions Weight: _____ kg
Hold all orders for Beta Blockers and Antihypertensive medications
Maintenance IV Fluids: _____ at _____ ml per hour
Norepinephrine (Levophed) 5 mcg/min; titrate to maintain MAP greater than 65 mmHg

Induction Phase (if not completed in the ED)
Place Temperature monitoring Foley catheter
Initiate refrigerated (4 ° C) IV NS 30 ml/kg bolus over 1 hour as tolerated
Apply Cooling Device with goal temperature set to 33° C

Pantroprazole (Protonix) 40 mg IV Q24H; first dose upon admission to ICU

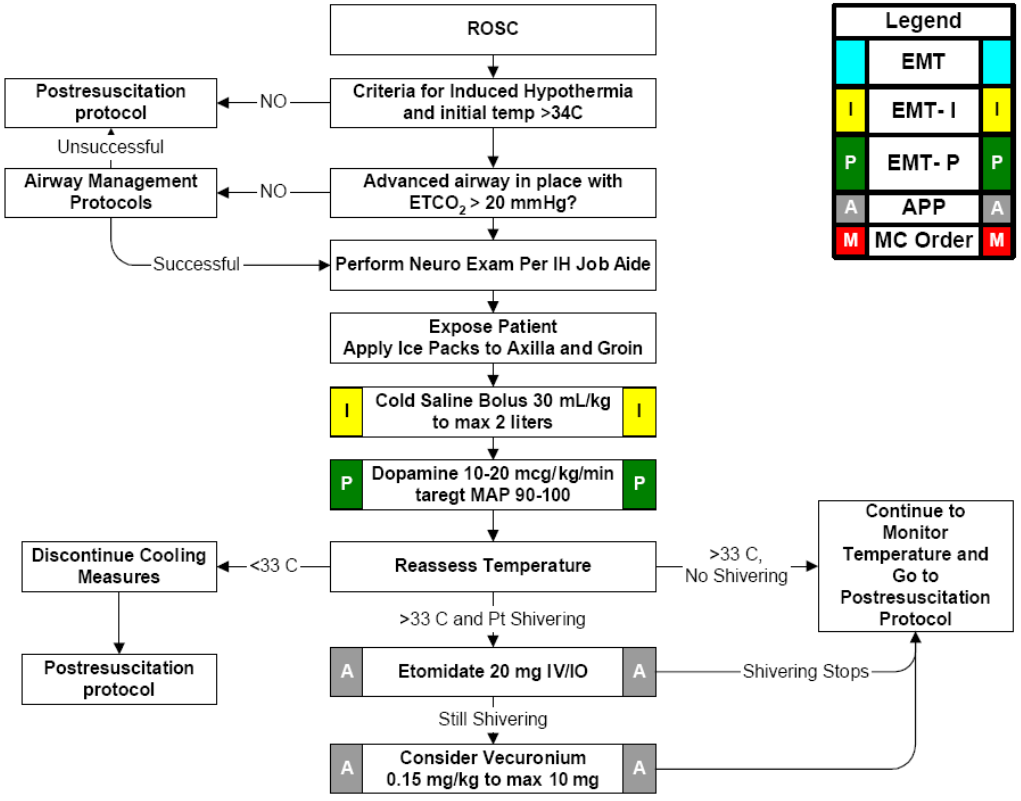
Shivering Protocol
Initiate sedation per **CMC Sedation and Analgesia for the Mechanically Ventilated Non Paralyzed Patient** (MD to initiate)
For refractory shivering: Vecuronium (Norcuron) 0.1 mg/kg IV Push Q1H PRN shivering

Maintenance Phase
Maintain temperature of **33° C for 24 hours** via Cooling Device

Re-warming Phase
Begin controlled re-warming **at less than 0.5° C per hour** to 37° C via Cooling Device
Discontinue sedation once 36° C is achieved
Cooling Device to remain operational with goal temperature of 37° C until order received to discontinue
____ Refer to: **CMCC Subcutaneous Insulin Orders for the Non-Pregnant Patient** (MD to initiate)
Implement: SO CMC Tight Glucose Control for the Adult Patient in MICU SICU TICU DHU CVRU or Neuro ICU (EndoTool®) if 2 consecutive blood glucose checks greater than 150 mg/dL

Induced Hypothermia

History	Signs and Symptoms:	Differential:
• Non-traumatic cardiac arrest (drowning and hanging are permissible in this protocol)	• Return of pulse	• Continue to address specific differentials assoicated with the original dysrhytmia



Pearls:

- Criteria for Induced Hypothermia
  - ROSC not related to blunt/penetrating trauma or hemorrhage
  - Age 12 or older with adult body habitus
  - Temperature after ROSC gretaer than 34 C degrees
  - Advanced airway in place with no purposeful response to pain
- If no advanced airway can be obtained, cooling may only be initiated on order from online medical control
- Take care to protect patient modesty. Undergarments may remain in place during cooling
- Do not delay transport to cool
- Frequently monitor airway, especially after each patient move
- Patients may develop metabolic alkalosis with cooling. Do not hyperventilate

Surface cooling pads


XLTEK
XLTEK

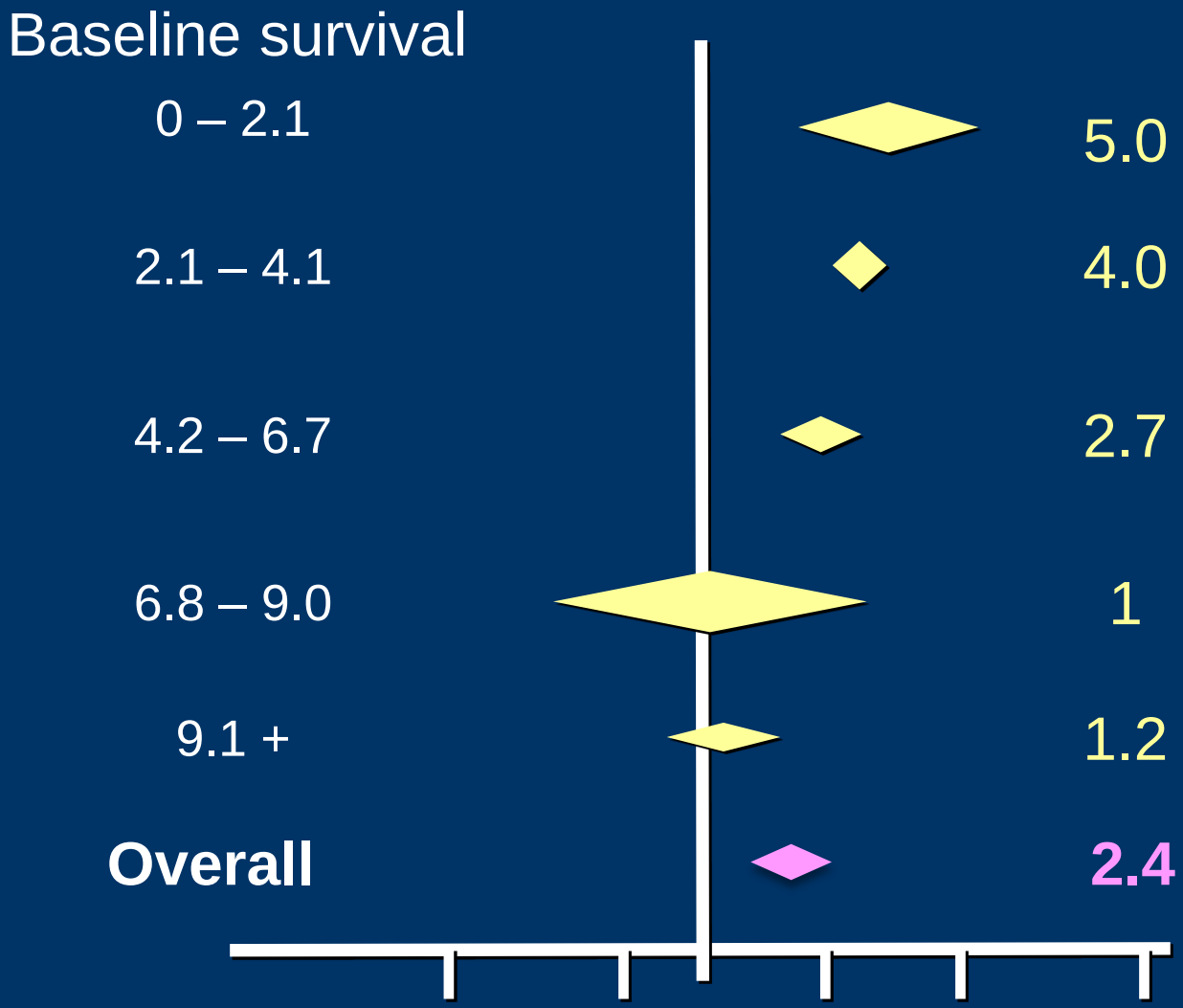
Complications of hypothermia

- Increased pneumonia / sepsis risk
- Hypovolemia
- Bradycardia
- Hyperglycemia
- Decreased drug clearance
- Increased bleeding
- Shivering
- Loss of K, Mg, Phos, Ca.
- Hyperkalemia in rewarming stage

Polderman KH, Crit Care Med 2009; 37:1101–1120

CPR

Bystander CPR
2.4 times survival to hospital discharge

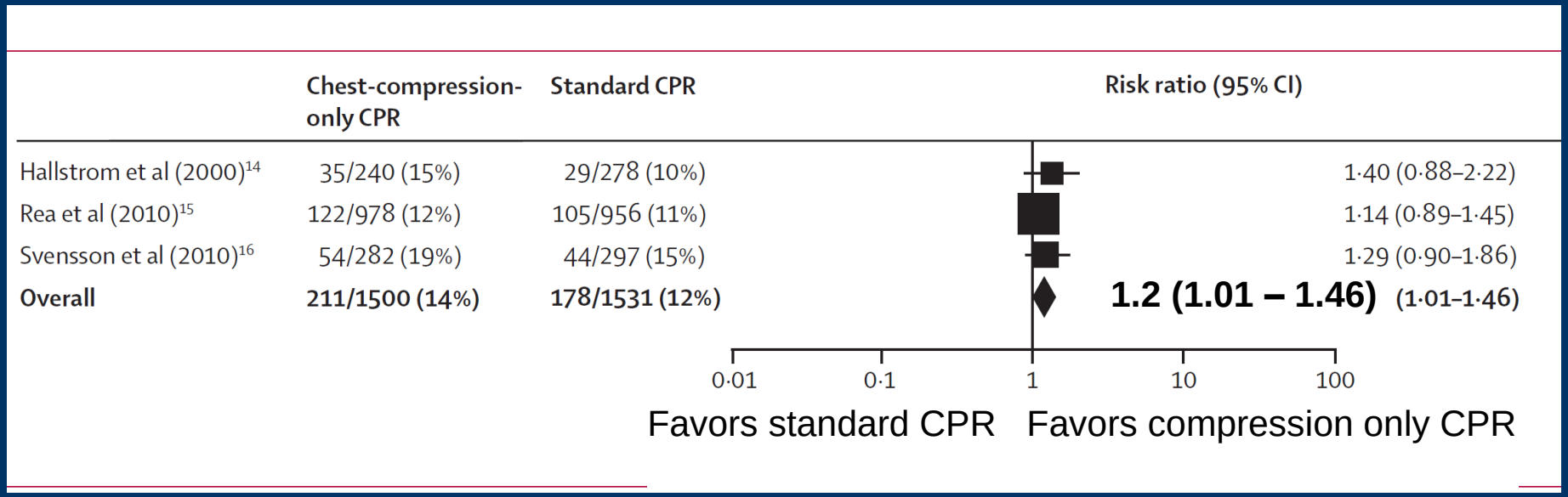


Circ Cardiovasc Qual Outcomes. 2010;3:63-81

Chest-compression-only vs. standard CPR

Meta-analysis of randomized dispatch instruction

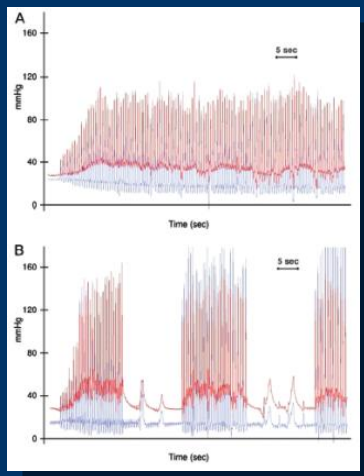
Survival to hospital discharge in 3 trials



P = 0.04

Lancet 2010; 376: 1552–57

Chest compression only CPR



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

Ramaraj R, Ewy GA. Heart 2009;95:1978–1982.

Bystander CPR

HeartRescue PROJECT

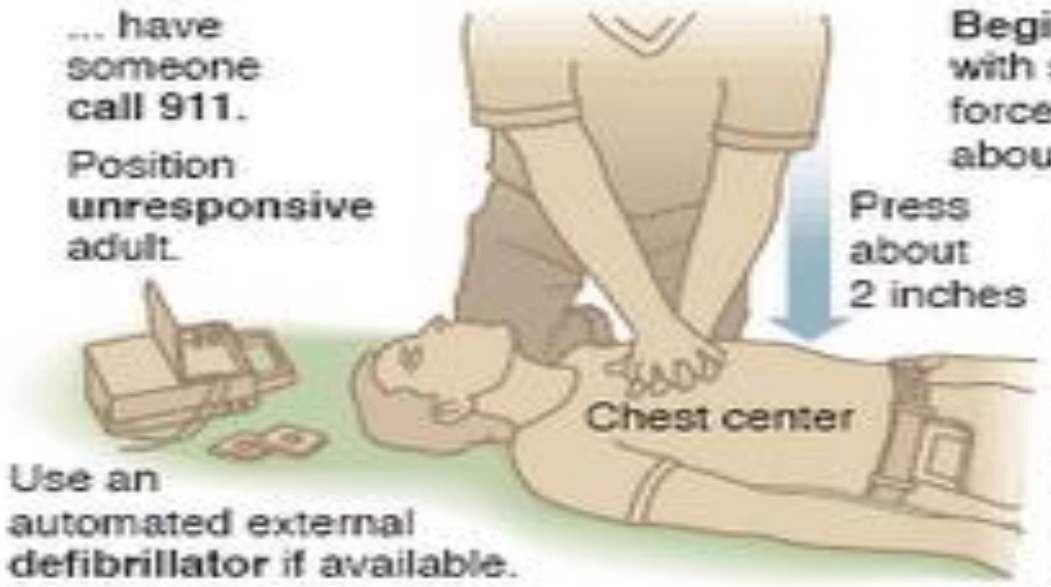
Simplifying to hands-only CPR

Experts now believe an adult who suddenly collapses due to cardiac arrest has enough air in his lungs and blood during CPR and doesn't need mouth-to-mouth breathing.

If you see someone collapse ...

... have someone **call 911.**

Position **unresponsive** adult.



Use an automated external **defibrillator** if available.

Keep CPR interruptions to a minimum.

Begin hands-only CPR with straight arms and forceful compressions at about 100 a minute.

Lift hands slightly after each to allow chest to recoil.

Take turns with a bystander until emergency medical services arrive.

SOURCES: University of Arizona Sarver Heart Center; American Heart Association

AP

Medtronic FOUNDATION

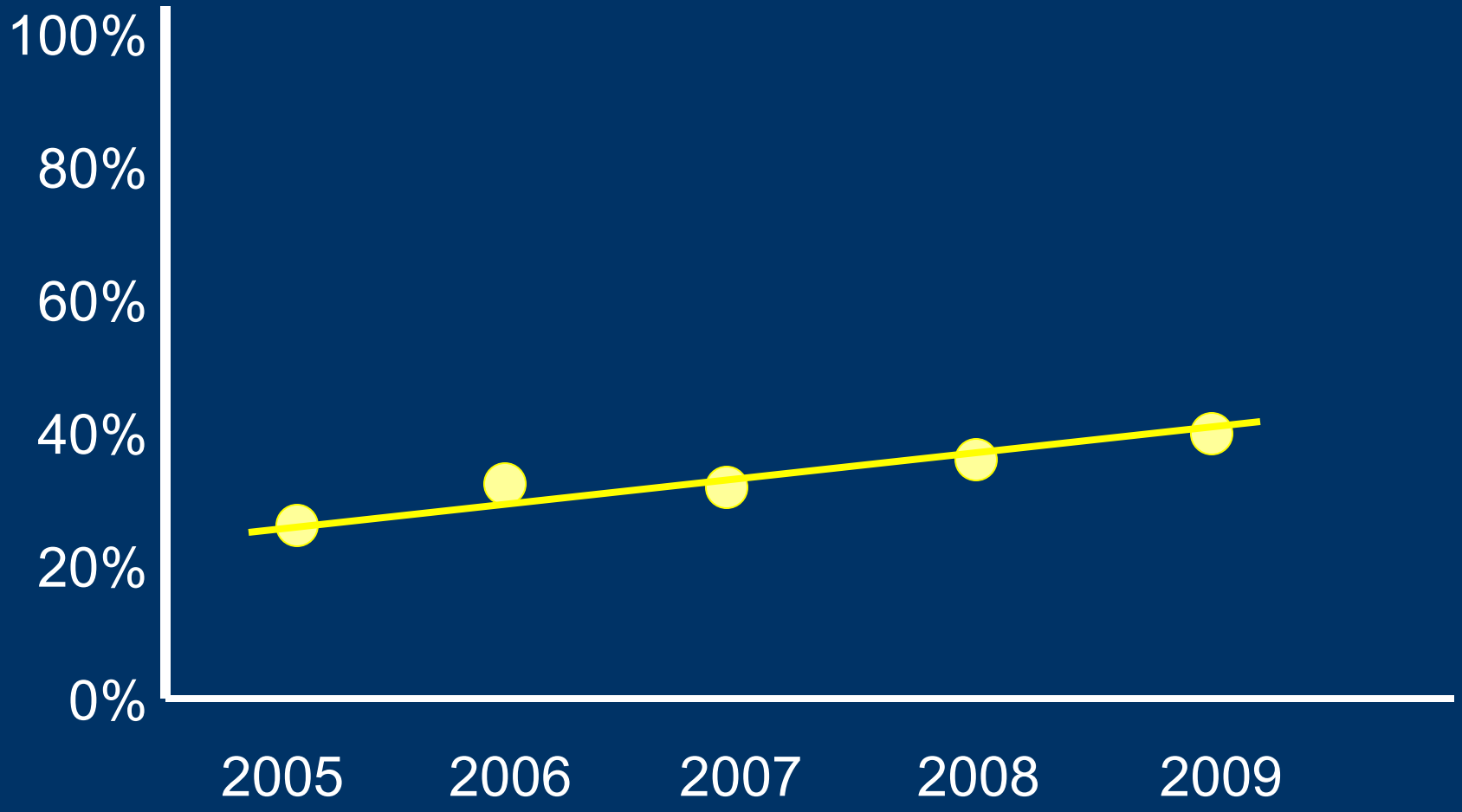
JAMA ORIGIONAL CONTRIBUTION

Chest Compression-Only CPR by Lay Rescuers and Survival From Out-of-Hospital Cardiac Arrest

Bobrow *et al.* JAMA 2010;304:1447-1454

Bystander CPR for OHCA in Arizona (2005 to 2010)

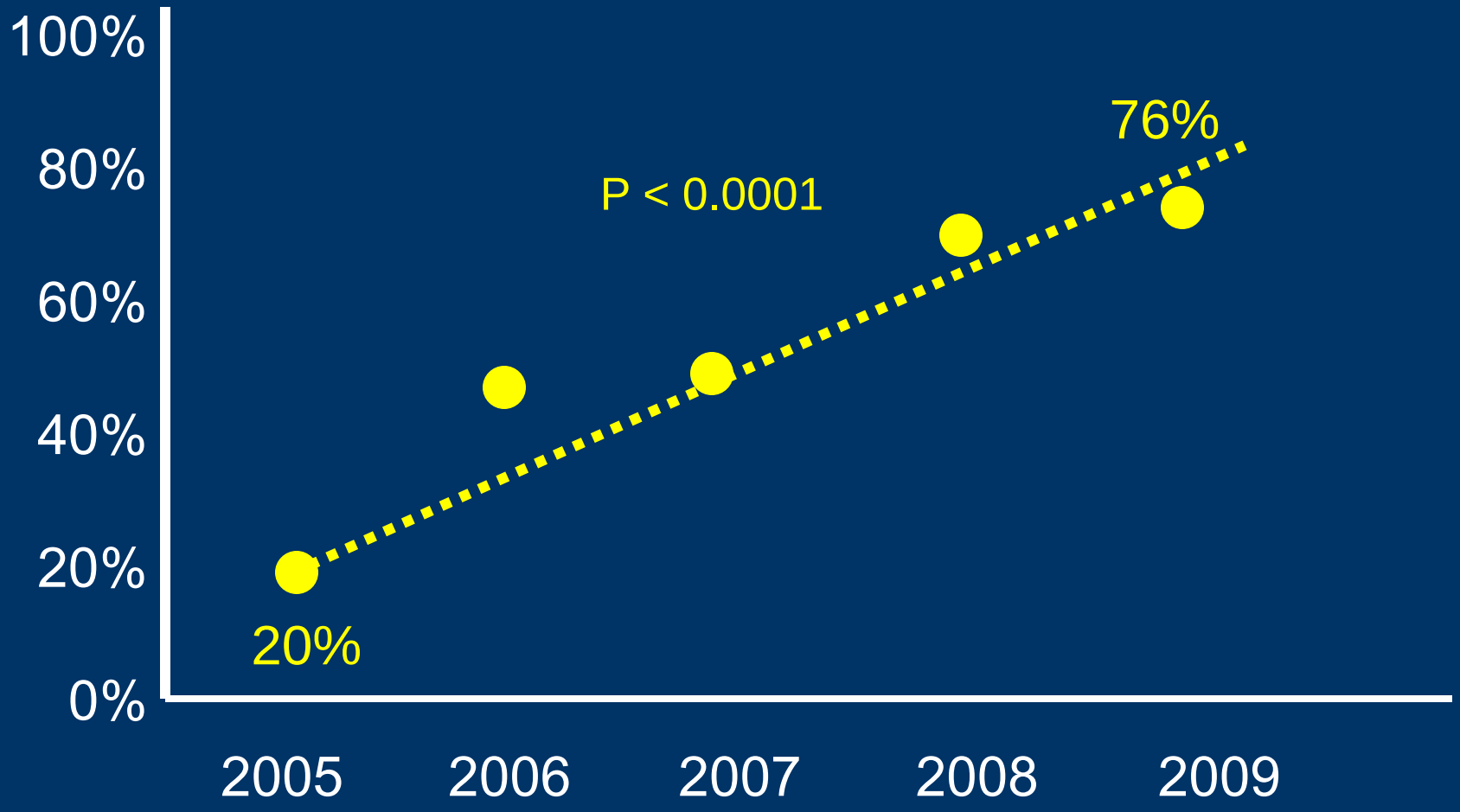
Overall incidence of bystander CPR



Bobrow, et al. JAMA 2010;304:1447-1454

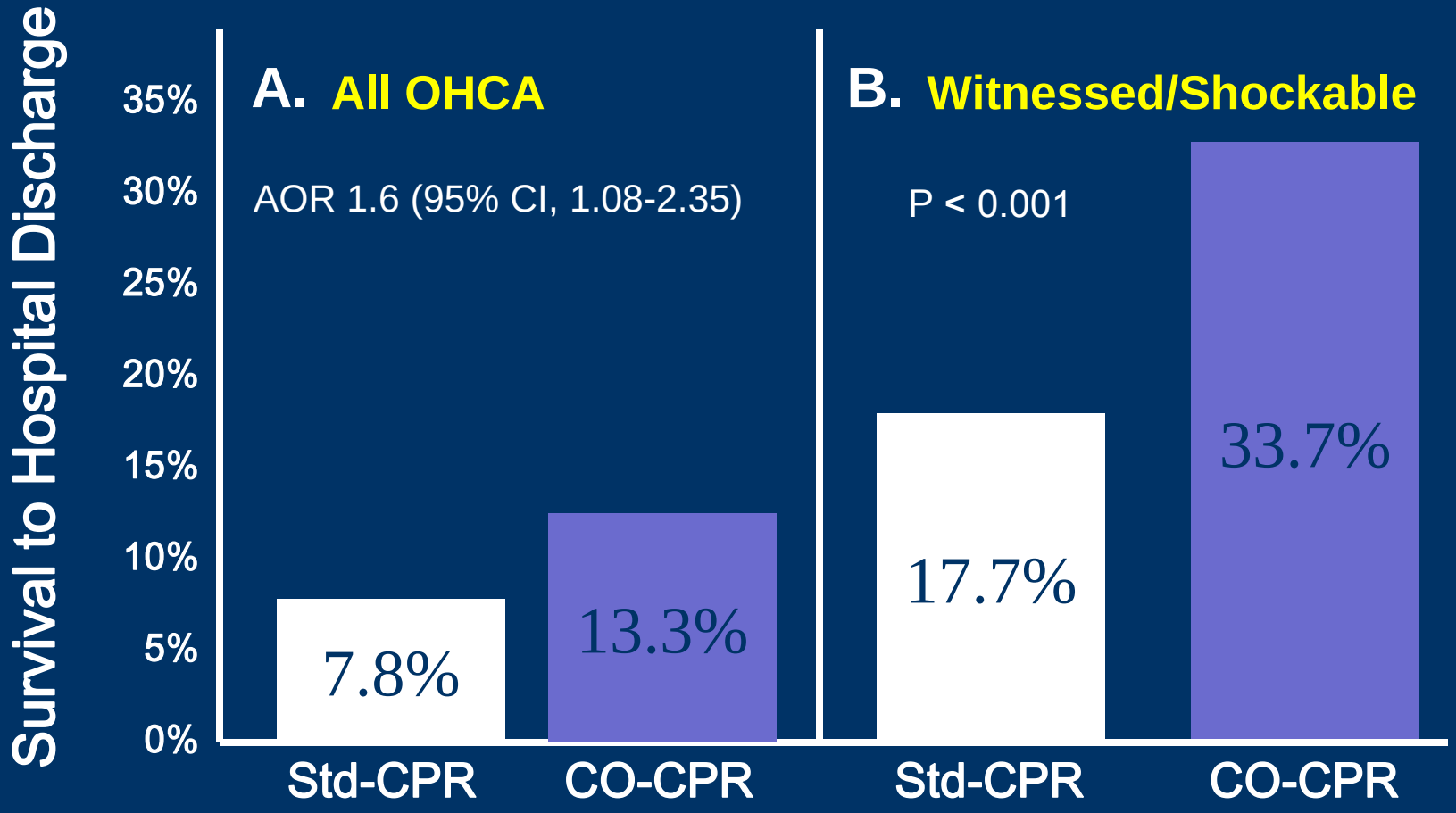
Bystander CPR for OHCA in Arizona (2005 to 2010)

Percent of lay CPR providers who performed CO-CPR



Bobrow, et al. JAMA 2010;304:1447-1454

Chest Compression-Only CPR by Lay Rescuers and Survival From Out-of-Hospital Cardiac Arrest



Bobrow, et al. JAMA 2010;304:1447-1454

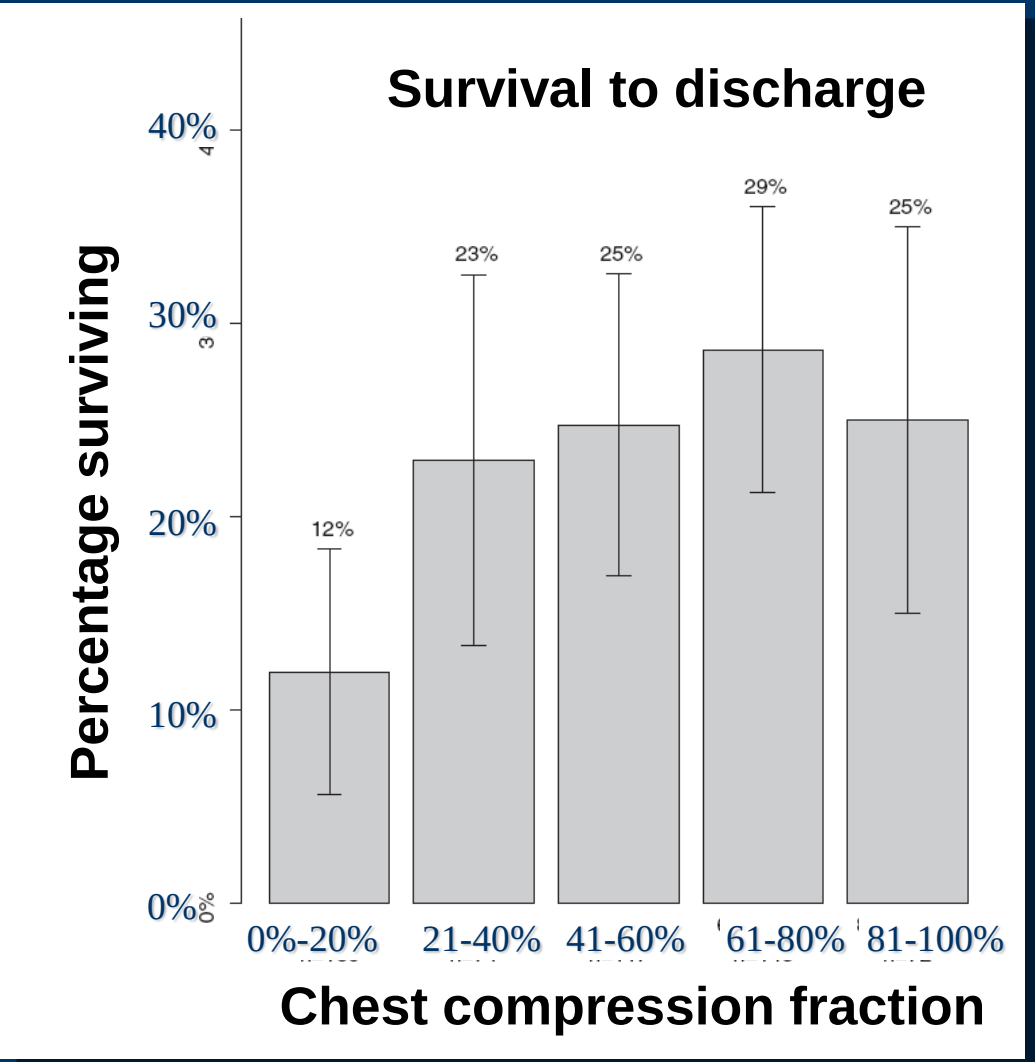
CPR Quality

Standard CPR 15:2

Coronary Perfusion pressure (Ao diastolic- RA diastolic)

Chest compression fraction and survival

- 506 patients with VF / VT and no defib. before EMS arrival.
- Electronically recorded cardiopulmonary resuscitation before the first shock.
- Age 64, 80% male
- 51% bystander CPR
- 6 minutes call to scene
- 11 minutes call to first shock.
- ROSC 72%
- Survived to discharge 23%



ROC Investigators *Circulation*. 2009;120:1241-1247.

Dispatcher Instruction

Resuscitation Science

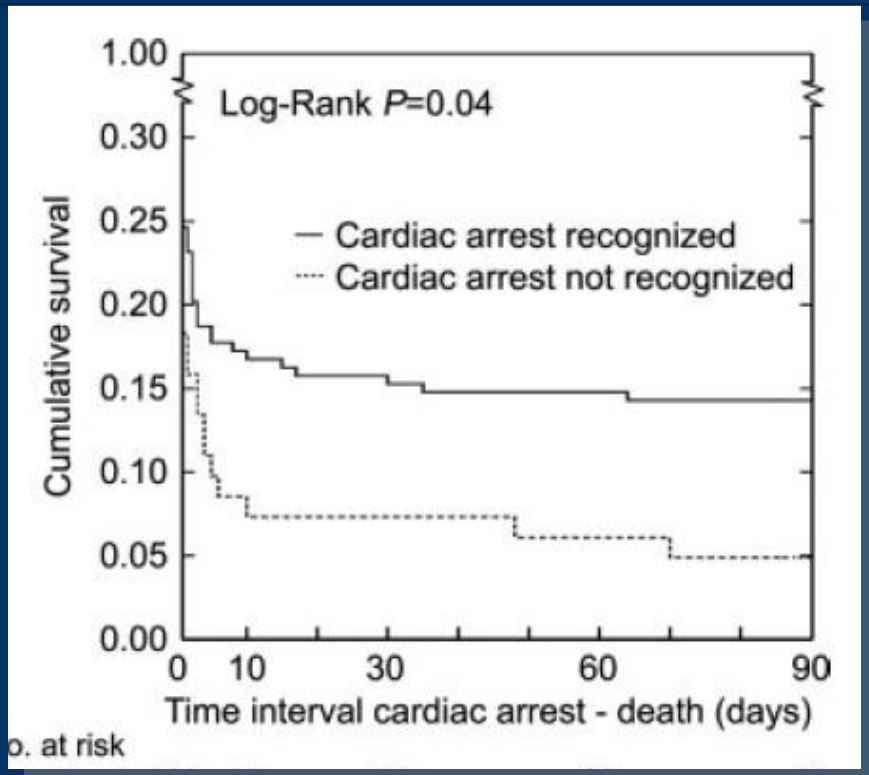
Importance of the First Link

Description and Recognition of an Out-of-Hospital Cardiac Arrest in an Emergency Call

Jocelyn Berdowski, MS, MSE; Freerk Beekhuis, RN; Aeilko H. Zwinderman, PhD; Jan G.P. Tijssen, PhD; Rudolph W. Koster, MD, PhD

- Amsterdam dispatch
- 506 cardiac arrest emergency calls (3%)
- Unrecognized, dispatch 0.9 min later, on scene 1.4 minute later
- Main reason for not recognizing the cardiac arrest was not asking if the patient was breathing (42 of 82) / describe the type of breathing

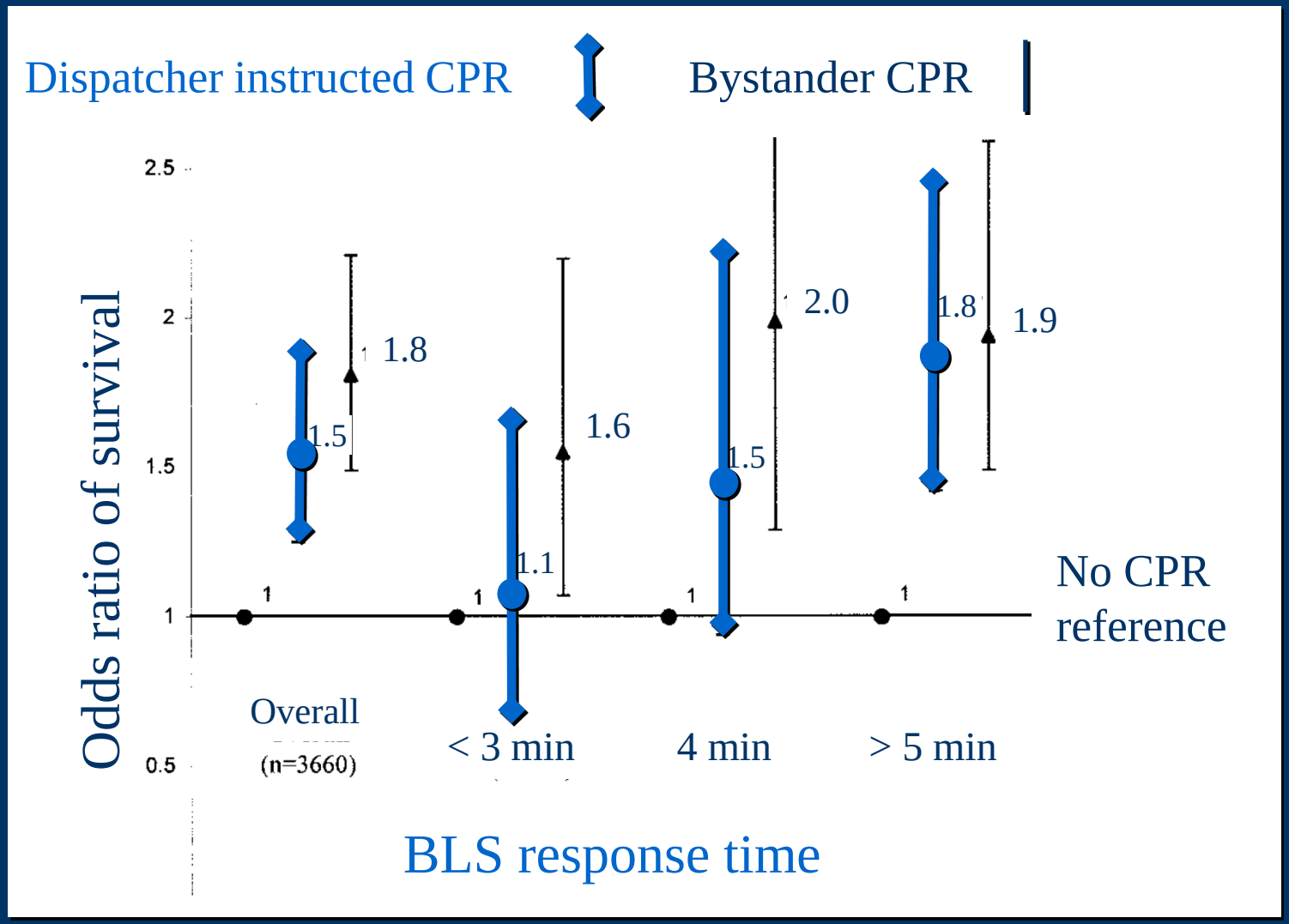
3 month survival by dispatch recognition



Berdowski, J. Circulation. 2009;119:2096-2102

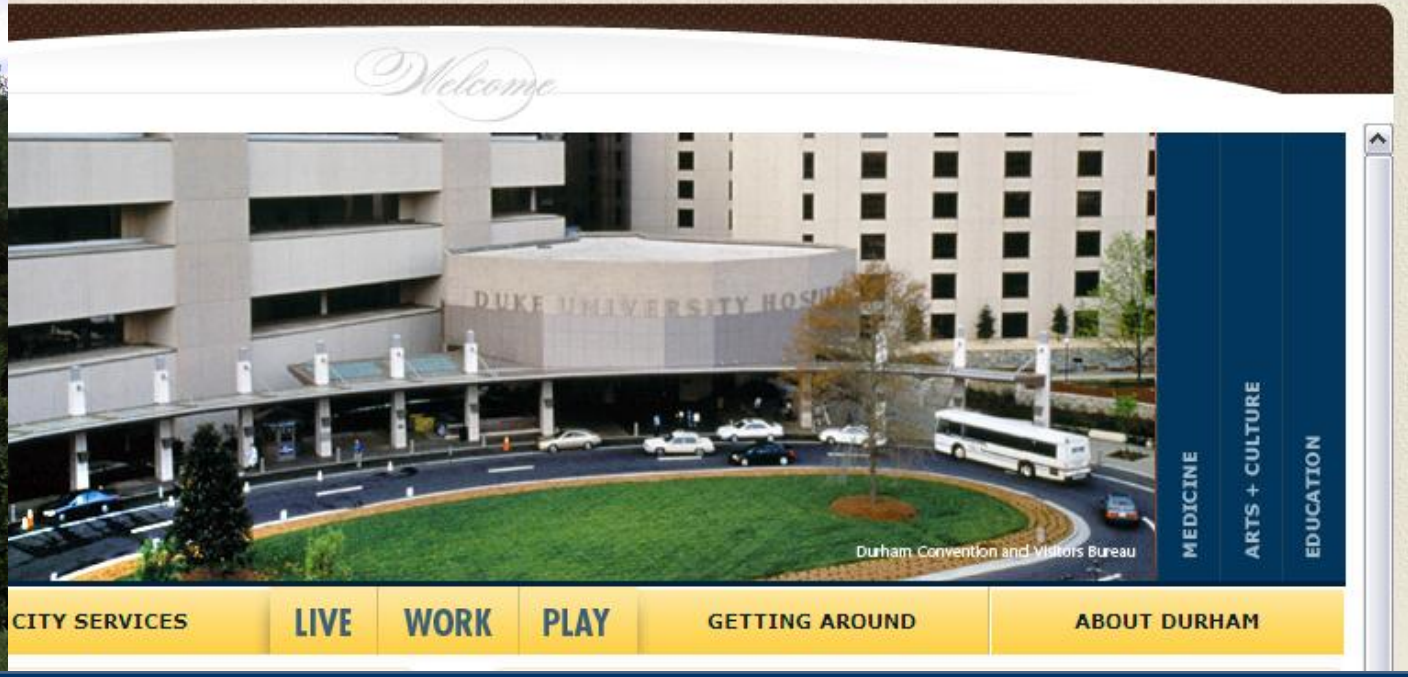
Odds ratio of survival by CPR status and BLS response time

Witnessed cardiac arrest, King County 1983 – 2000, n = 7265



Rea TD *et al. Circulation. 2001;104:* 2513-2516.

Can we improve bystander CPR rates from 18% to 40% in Durham?



Medicine

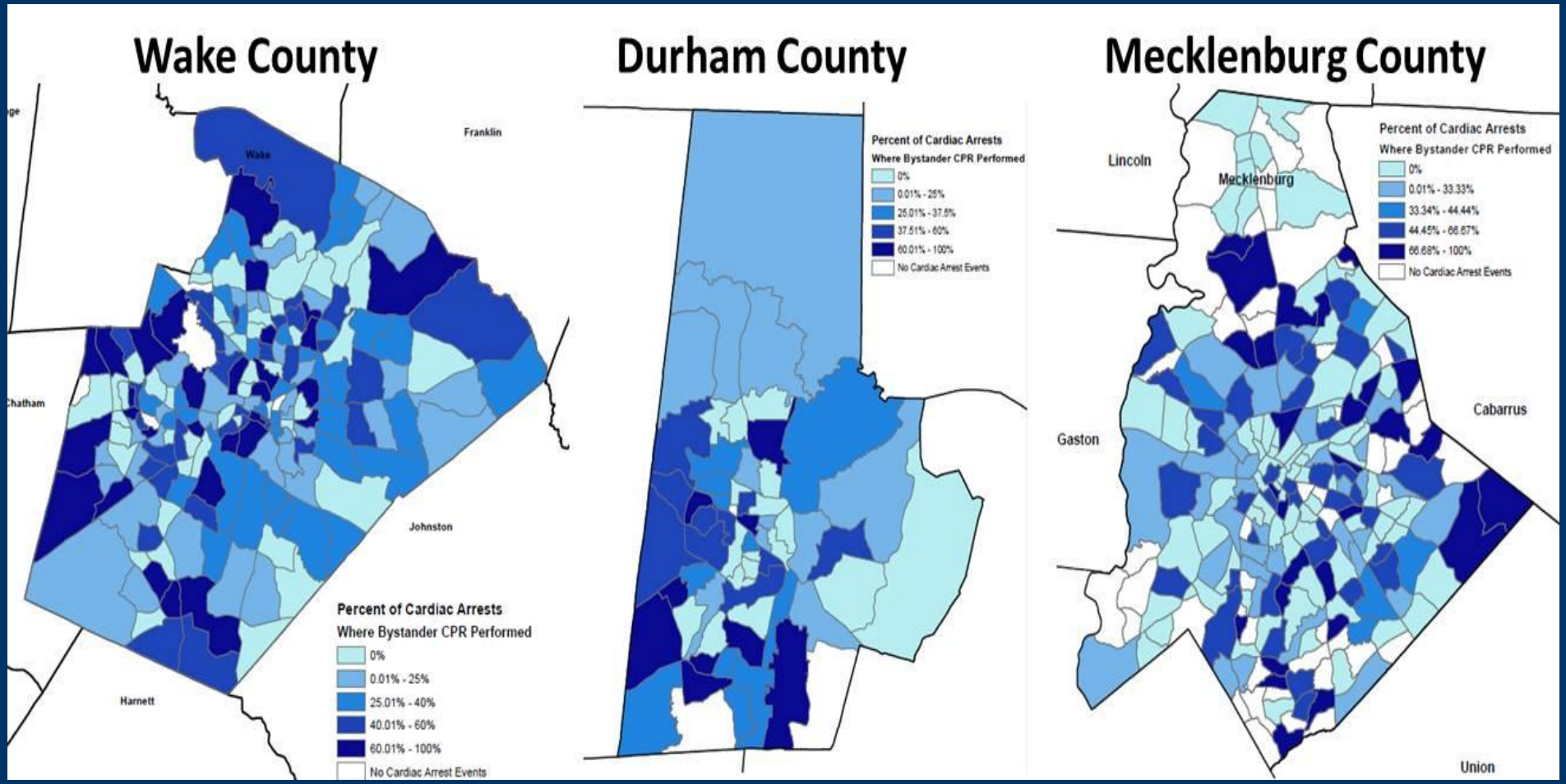
The Durham area has one of the highest per capita concentrations of hospital beds and physicians in the world. With over 2,300 physicians, there is an approximate average of 10.6 physicians per 1000 residents in Durham. Two excellent university teaching hospitals are located in the area -- Duke Medical Center in Durham and UNC Hospitals (state teaching hospital) in Chapel Hill.

Durham as case study in cardiac arrest

- Bystander CPR rate in 2010 was 18% (24% nationally, 40% in Seattle and Arizona)
- Duke is number one employer in Durham
- “Hands-only CPR” can be taught with 5 minute training module
- Program to train all Duke employees to perform CPR

Can we identify patterns of frequency of arrests, bystander CPR rates, time to response at neighborhood level to improve care?

Attempted resuscitations 2009- 2010
Bystander CPR rates by Neighborhood



Fosbol

Duke Football Game
September 1, 2012
>500 people trained in CPR

(8 people, 4 hours = 16 trained per man-hour)

To improve CPR rates in Durham and in NC, where should we start?

NC Health Systems

	Number of Employees
Carolinas HealthCare System	48,120
	44,200
Duke University	33,705
Vidant Health	11,000
Presbyterian Healthcare	9,000
New Hanover Regional Medical Center	5,400

Recognition and activation

Dispatchers should instruct untrained lay rescuers to provide Hands-Only CPR for adults who are unresponsive with no breathing or no normal breathing.

How do we improve application of hypothermia?

Hypothermia for PEA arrest?
Can we predict no chance for recovery within 5 days?

47-year-old woman with a history of atrial fibrillation, recently started on dofetilide, who suffered a witnessed ventricular fibrillation cardiac arrest while a passenger in a car on April 5th 2011 at about 10:30 a.m.

- PEA on ED arrival, 45 min of CPR
- Therapeutic hypothermia begun
- Shock, acute renal failure treated with dialysis, and severe anoxic brain injury.

April 11 (6 days after arrest). No response to commands. GCS 5. Multisystem organ failure.

My note:
“2. Cardiac arrest and anoxic encephalopathy. Her chance of recovery is becoming very small. We discussed her situation with her husband. “

April 13 (8 days after arrest). Still comatose.
“We had a long discussion with her family, including review of her decreasing likelihood of good recovery, and what she would want us to do under that circumstance.

Decision to continue care. Trach/PEG April 15.

- Discharged April 28, still on dialysis, moving around, but not following commands or speaking
- Since has made complete recovery – returned to cardiology clinic January 11
- Had long discussion with her and her husband at Costco last Sunday

Conclusions:

- **Cardiac arrest is common and care and outcomes are heterogeneous.**
- **There are some regions including Rowan, Mecklenburg and Wake counties with higher survival rates.**
- **Simple interventions in the chain of survival improve survival, with focus on bystander CPR, EMS protocols, primary PCI, therapeutic hypothermia.**
- **50% improvement in survival is a bold but realistic goal.**
- **Regional systems will play a key role in improving regional care of cardiovascular emergencies**