Changing Landscape of Stroke Systems

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Disclosures

Investigator on several NIH sponsored studies:
- Blood biomarkers in Intracranial Stenosis
- Blood biomarkers in traumatic brain injury
- Georgia StrokeNet
- Neurological Emergencies Treatment Trials Network

Investigator on CDC projects:
- Georgia Coverdell Acute Sroke Registry

Industry Funding:
- **None**

Outline

- Acute stroke
- Stroke System of Care challenges and solutions
- GA Coverdell Acute Stroke Registry
- Improving pre-hospital triage

Grady Hospital

1896

Dedicated to those who need it most

Grady Hospital

Today

Dedicated to those who need it most

Atlanta skyline from helipad at Grady

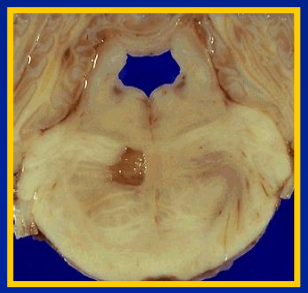
What is a stroke?

Cerebrovascular Disease: Pathogenesis

Ischemic Stroke (80%)

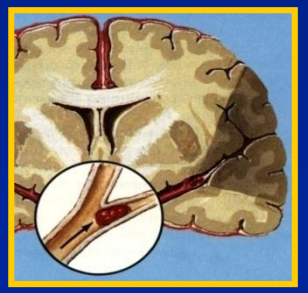
Atherothrombotic Cerebrovascular Disease (20%)

Lacunar (25%)
(small vessel disease)



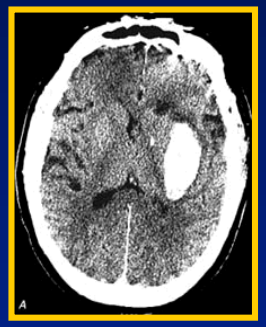
Cryptogenic (30%)

Cardioembolic (20%)

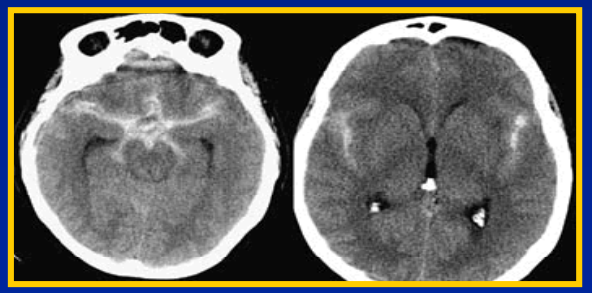


Hemorrhagic Stroke (20%)

Intracerebral Hemorrhage (70%)



Subarachnoid Hemorrhage (30%)



Albers GW, et al. *Chest*. 2001;119:300S-320S.
Albers GW. Personal communication. February 27, 2003.
Rosamond WD, et al. *Stroke*. 1999;30:736-743.

Timeline for Acute Ischemic Stroke

1995
- Landmark clinical trial (NINDS rt-PA Stroke Study) provides definitive proof of benefit (Level 1A evidence)

1996
- FDA approves rt-PA for acute ischemic stroke

2001
- CDC funds Coverdell Acute Stroke Registries in 4 states
- AHA's Get With Guidelines-Stroke begins

2004
- Joint Commission begins Stroke Center Certification process

2015
- 5 trials prove thrombectomy is beneficial (Level 1A evidence)
- Mission Lifeline-Stroke established by AHA

Tissue Plasminogen Activator

- Serine protease
- Endothelial and other cells
- Fibrinolytic, ie, cleaves the protein fibrin
  - Fibrin is the backbone of a blood clot (thrombus)
  - AKA thrombolytic
- Recombinant t-PA used in stroke
  - Activase
- **Randomized clinical trials in stroke**
  - **NINDS Part I and II --- FDA approval 1996**
  - **ECASS I, II and III**

TIME

IS

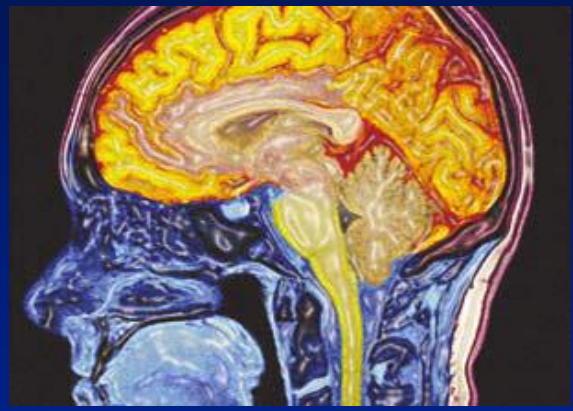
BRAIN

Practice Gap

- Institute of Medicine (IOM)
  - Between the care we have and the care we could have lies not just a gap but a chasm

Bridging the Gap
Stroke Centers

- Primary Stroke Centers
- Comprehensive Stroke Centers
- Remote Treatment Stroke Centers



The Practice Gap remains

- Why?
  - Fragmentation of care
    - Lack of integration of facilities, agencies and professionals
      - Inhibits collaboration
- How do we integrate the components?

American Stroke Association

- Task Force for Stroke Systems of Care[1]
  - Describe the current fragmentation of stroke care
  - Describe components of a stroke system
  - Recommend methods for encouraging the implementation of stroke systems

- System = Network

[1] Schwamm LH, Pancioli A, Acker JE 3rd, Goldstein LB, Zorowitz RD, Shephard TJ, Moyer P, Gorman M, Johnston SC, Duncan PW, Gorelick P, Frank J, Stranne SK, Smith R, Federspiel W, Horton KB, Magnis E, Adams RJ; American Stroke Association's Task Force on the Development of Stroke Systems. Circulation. 2005 Mar 1;111(8):1078-91.

- The Goal:
  - Develop an effective integrated system for stroke prevention, acute treatment, and rehabilitation
- The Challenge:
  - Although individual components of a stroke system may be well developed, these components often operate in isolation.
  - The problem of access to coordinated stroke care may be exacerbated in rural or neurologically underserved (inadequate access to neurological expertise) areas.

Trauma as a model for stroke systems of care

- Enhanced communication among hospitals and emergency medical services (EMS)
- Clear transport protocols to ensure that patients are taken only to facilities with appropriate resources
- Strategies for treating and transporting patients who live in rural and remote areas
- Use of evidence-based treatment protocols
- Local and regional trauma systems are effective in decreasing trauma-related morbidity and mortality

3 Critical Functions of a Stroke System

- Ensure effective interaction and collaboration among the agencies and services involved in a locality or region.
- Promote the use of an organized, standardized approach in each facility and component of the system.
- Identify performance measures (both process and outcomes measures) and include a mechanism for evaluating effectiveness through which the entire system and its individual components continue to evolve and improve.

- **Stroke systems should be customized for each state, region, or locality**
  - **Certain universal elements are encouraged to help ensure optimal prevention and the timely identification, transport, and treatment of stroke patients.**

Notification and Response of EMS for Stroke

- Rapid EMS response
  - 911 and E911
  - Develop and monitor goals
- Diagnostic algorithms
  - Same time limits/goals as in MI, Trauma
  - Education materials (e.g., stroke cards, apps)
- Promote frequent and meaningful dialogue
  - Prehospital providers, ED directors, Stroke Center directors
  - Discuss operational issues and collaborative educational efforts
  - Define and deliver continuing education

Transport to nearest stroke-ready hospital

- All available EMS transportation resources, including ground and air transport, should be considered to minimize transport time to the appropriate hospital.
- Bypass procedures

EMS assessment/screening

- All potential stroke patients should be scored/screened for:
  - Stroke signs and symptoms
  - Time of onset
- Completion of forms or other methods (as agreed on by the local stroke community in collaboration with EMS) to provide written or transmitted data to the receiving hospital.
- Obtaining information should not delay patient transport.
- The scoring and screening tools should be part of a comprehensive quality improvement program and be improved and refined as needed.

Acute Treatment for Stroke

- A stroke system should determine the acute stroke treatment capabilities and limitations of all hospitals and make these available to primary care providers, EMS, and the public.

CQI initiatives

- A stroke system should strive to optimize the overall effectiveness of the system and each of its individual components.
- Identify performance measures (process and outcome)
  - For components (e.g., hospitals, EMS)
  - System function as a whole (e.g., aggregate data, connectivity)
- Employ CQI strategies in collaboration with key stakeholders

CQI initiatives

- Evaluations of the system should examine overall patient outcomes, linkages among key stroke system components and linkages to other systems and entities, and obstacles to care and potential gaps.

Summary: Stroke Systems of Care

- Building stroke systems throughout the United States is the critical next step in improving patient outcomes
- The current fragmented approach to stroke care in most regions of the United States provides inadequate linkages and coordination among the fundamental components of stroke care.
- Providers and policymakers at the local, state, and national levels can make significant contributions to reducing the devastating effects of stroke by working to promote coordinated systems that improve patient care.

Georgia Coverdell Acute Stroke Registry

Purpose

- Monitor and improve quality of care of acute stroke patients in Georgia
- Addresses all phases of hospital care
  - Rapid Diagnosis
  - Treatment
  - Prophylaxis measures
  - Discharge planning
  - Prevention of recurrent stroke

Georgia Coverdell Acute Stroke Registry

Georgia Partners

- GA Division of Public Health (includes EMS)
  - Overall Program Oversight
- Emory University
- American Heart Association (AHA)
- Georgia Hospital Assocation (GHA)
- Georgia Medical Care Foundation (EMCF)
- Georgia Hospitals

Georgia Coverdell Acute Stroke Registry

Georgia Partners

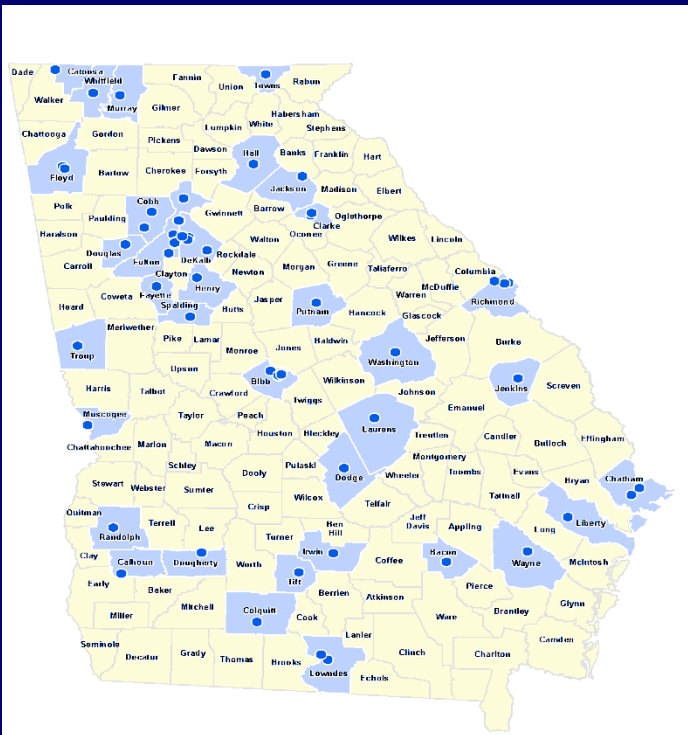
- Hospitals
  - Abstract medical records year round
  - Improve quality of care for stroke patients
    - Monitor progress in achieving quality indicators
    - Implement quality improvement strategies
  - Partner with the steering committee
  - Partner with each other

Georgia Coverdell Acute Stroke Registry

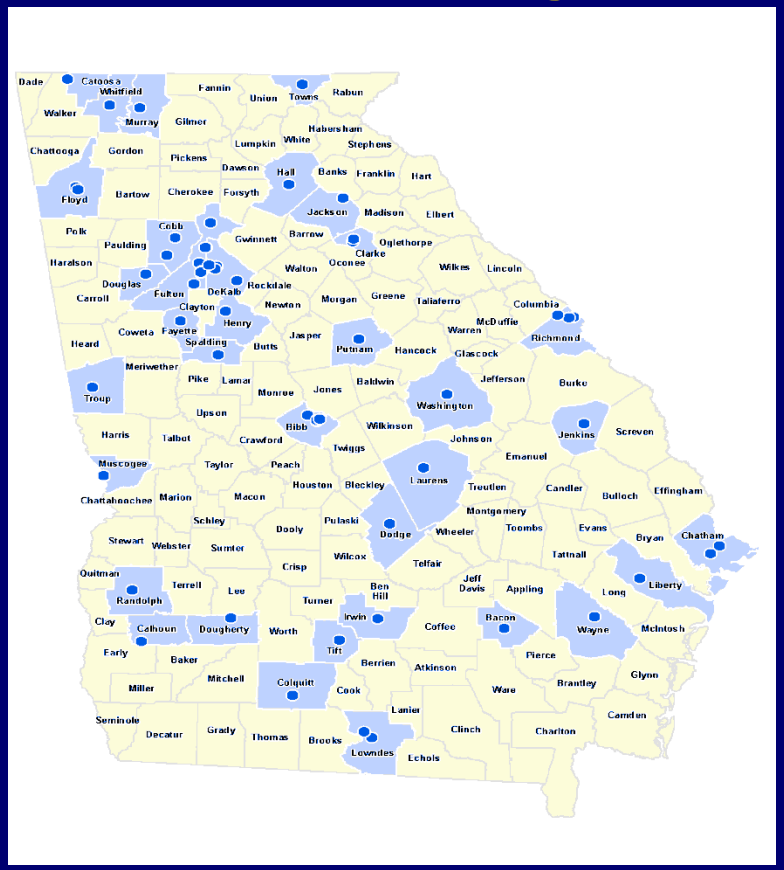
Hospital Enrollment

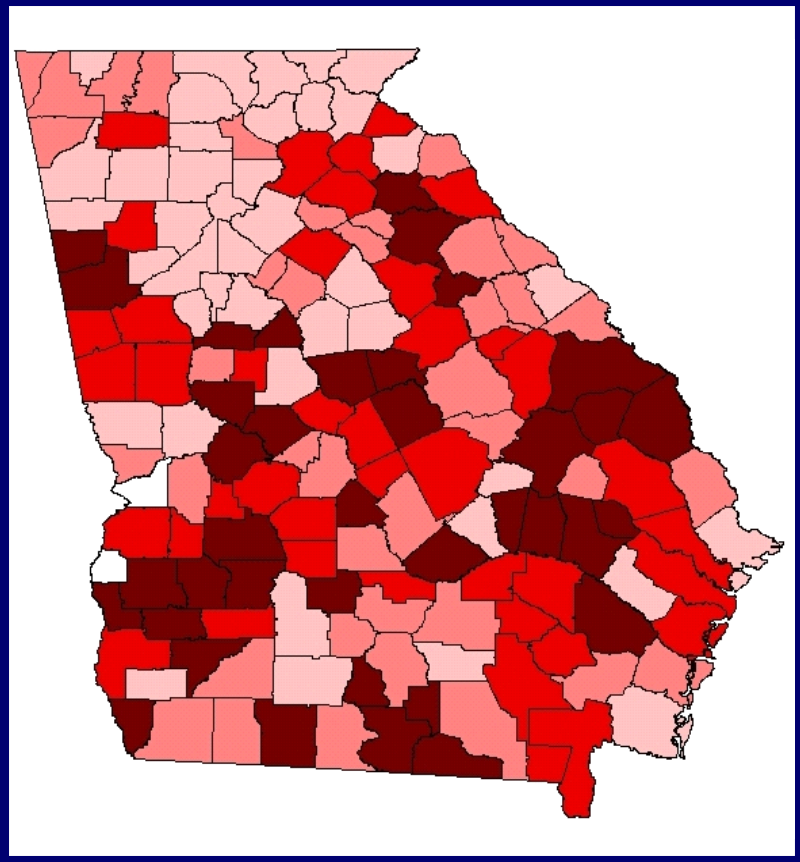
- 2001: 46 hospitals (first cohort)
- 2004: 32 actively participating hospitals
- 2005-2011: Four additional hospital cohorts recruited sequentially
- 2014: 68 hospitals

Approximately…
- 1/3rd of GA's hospitals
- More than 80% of patients admitted with acute stroke



Age-adjusted Stroke Death Rates by County, Georgia, 2000-2004





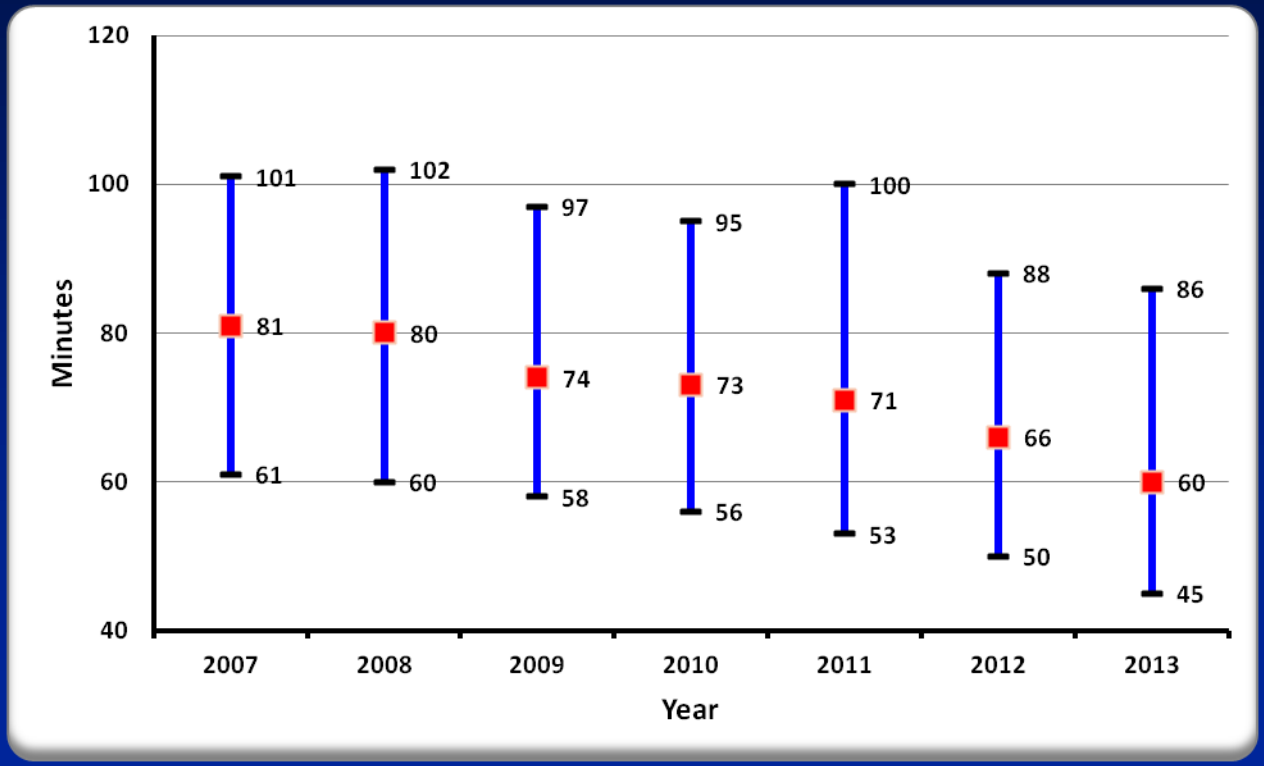
(Q=quartile)

- Rate N/A
- Q1 (41.6 - 62.0 deaths per 100,000 population)
- Q2 (62.1 - 70.1 deaths per 100,000 population)
- Q3 (70.2 - 81.3 deaths per 100,000 population)
- Q4 (81.4 - 145.0 deaths per 100,000 population)

Coverdell Stroke Care Quality Indicators

- t-PA administration
- Dysphagia screening
- Antithrombotic by end of hospital day 2
- DVT Prophylaxis
- Stroke education
- Smoking cessation advice/counseling
- Assessed for rehabilitation
- Discharged on antithrombotic therapy
- Anticoagulation for Atrial Fibrillation
- Discharged on cholesterol reducing medication

Trend in median door-to-needle time among patients included in the analysis, Georgia Coverdell Acute Stroke Registry, 2007-2013 (n=3,218)

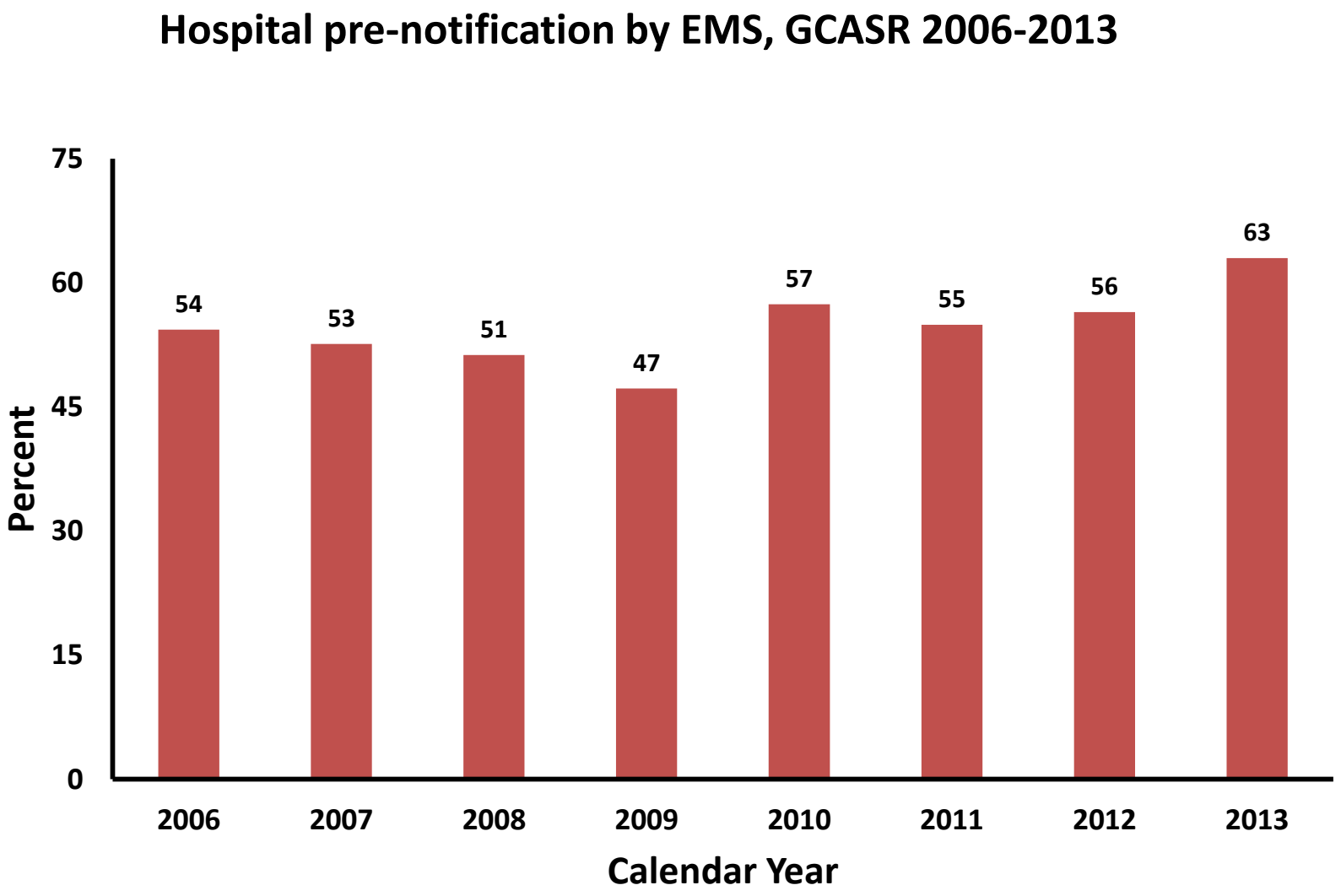


Less disability and lower mortality with earlier treatment

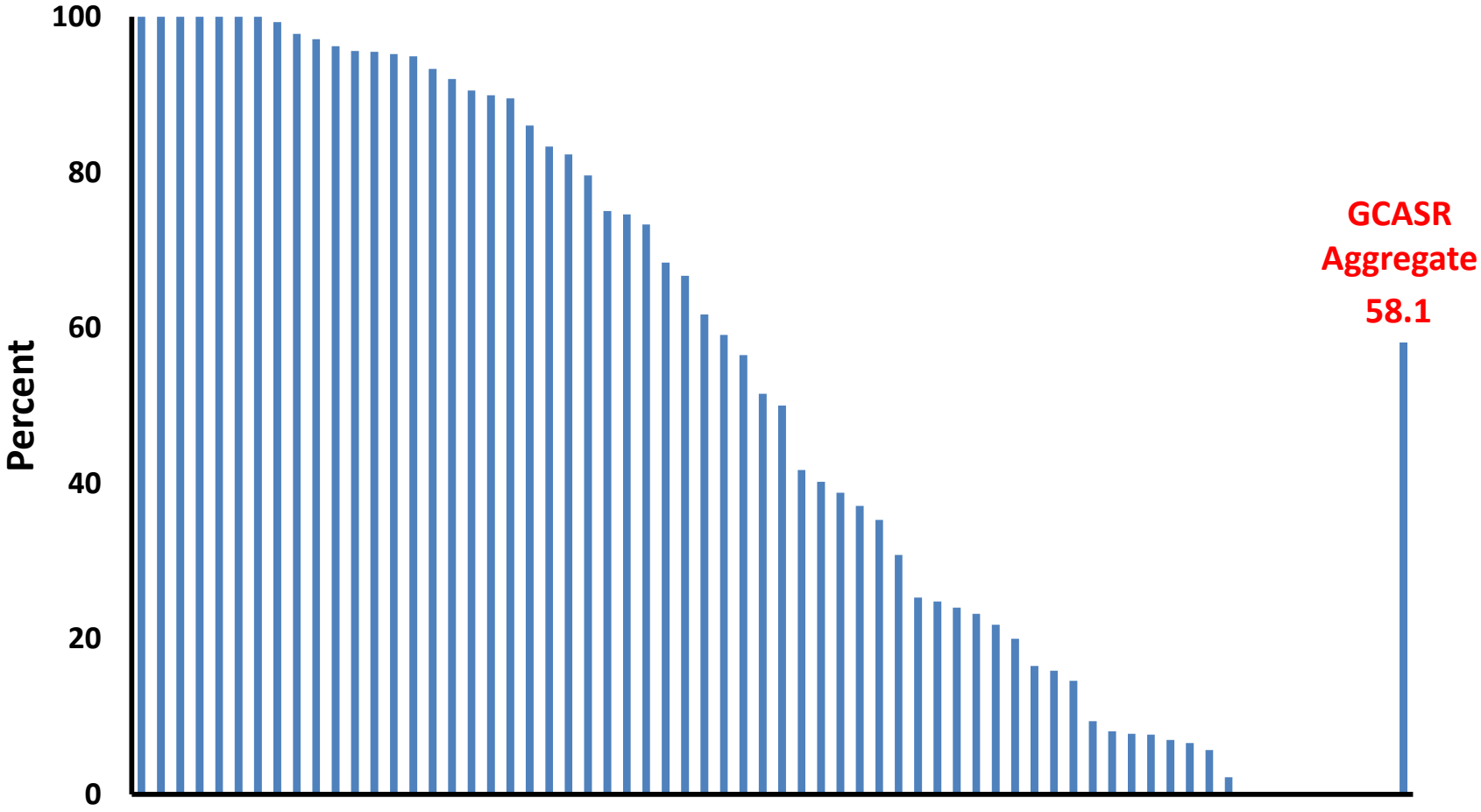
EMS Pre-notification

- Data from Georgia
- Why it’s important
- How we can improve

Georgia Coverdell Acute Stroke Registry (GCASR)



Level of EMS pre-notification at each participating hospital, GCASR 2011-2013



EMS Pre-notification Improves Care

- Faster Door to CT time
  - Approx 15 min faster
- Faster Door to Needle time
  - Approx 10 min faster
- Better adherence to quality indicators
  - 15% greater likelihood of defect free care

EMS Pre-notification

- Meet with local EMS providers
- Develop plan for pre-notification
- Implement plan
- Track adherence levels
- Provide feedback to EMS providers

Measuring Success in the Georgia Coverdell Acute Stroke Registry

- Defect Free Care
- Door-to-needle (DTN) time
- Stroke Center Certification
- Remote Treatment Stroke Center designation
- Interfacility transfer guideline (“drip/ship”
- GA Stroke Professionals Alliance (GA-SPA)

Defect-free Care

- Defined as patient receiving care meeting all of the 10 indicators for which the patient qualifies
- Considers overall quality of care

Coverdell Stroke Care Quality Indicators

- t-PA administration
- Dysphagia screening
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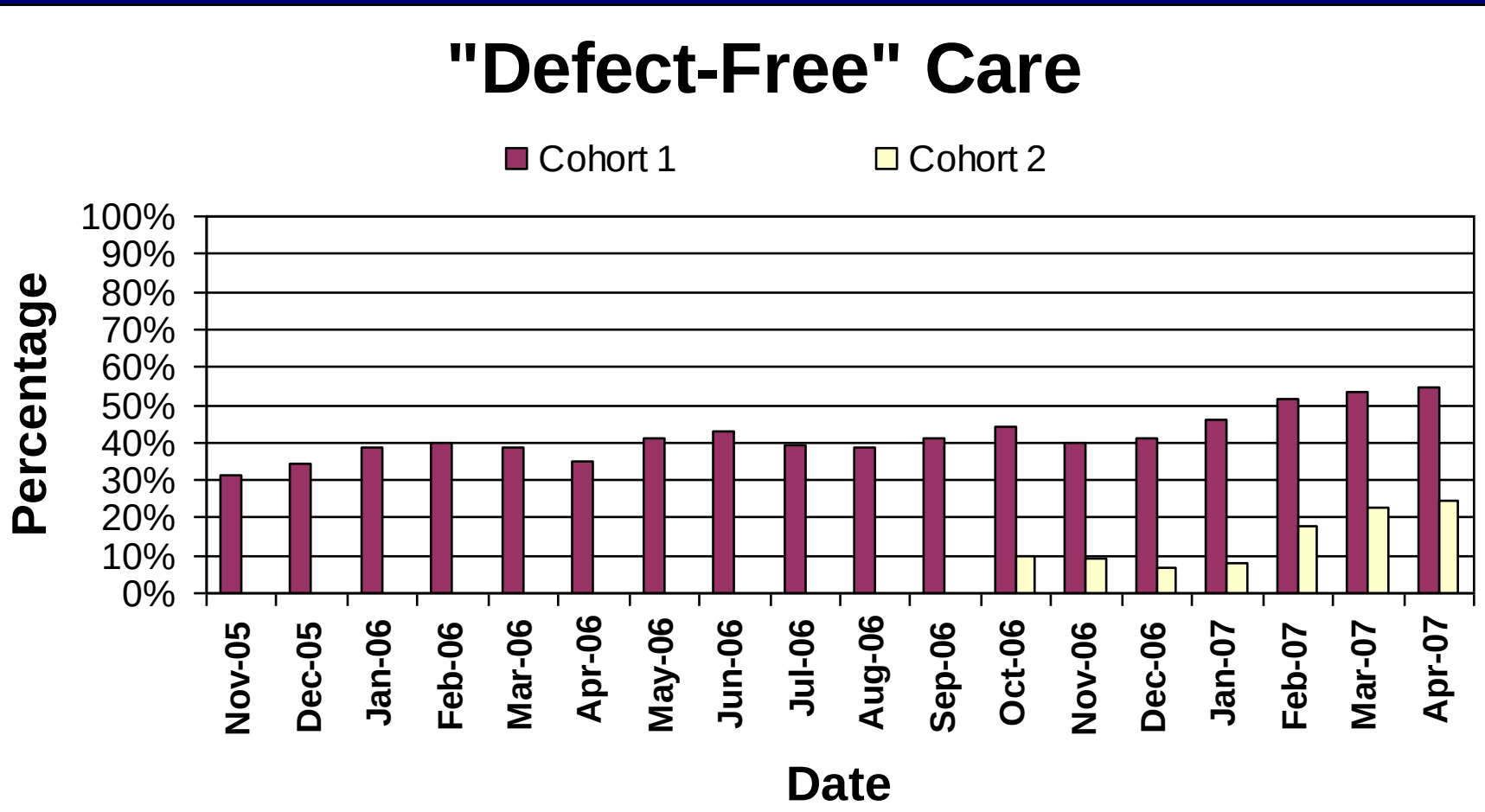
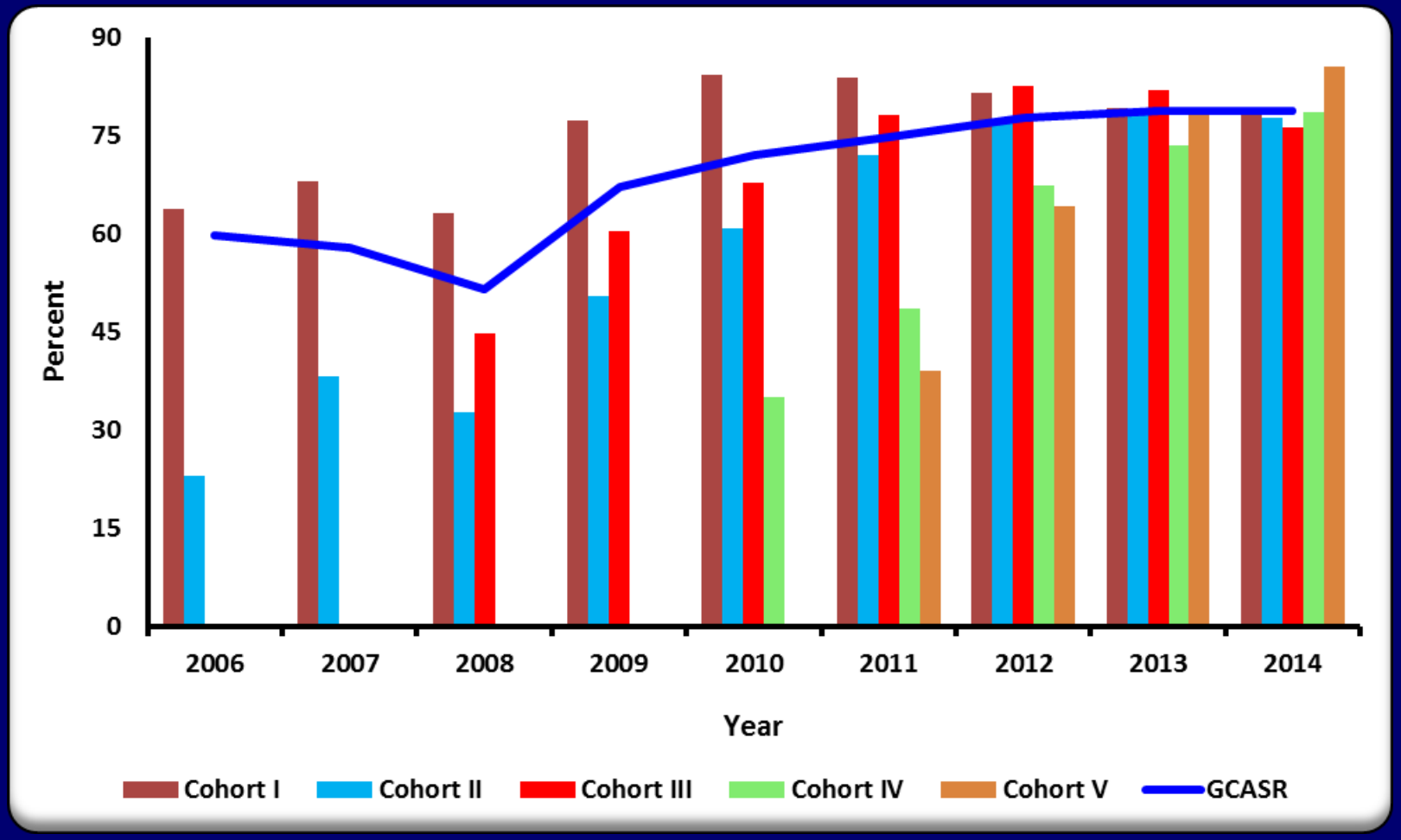
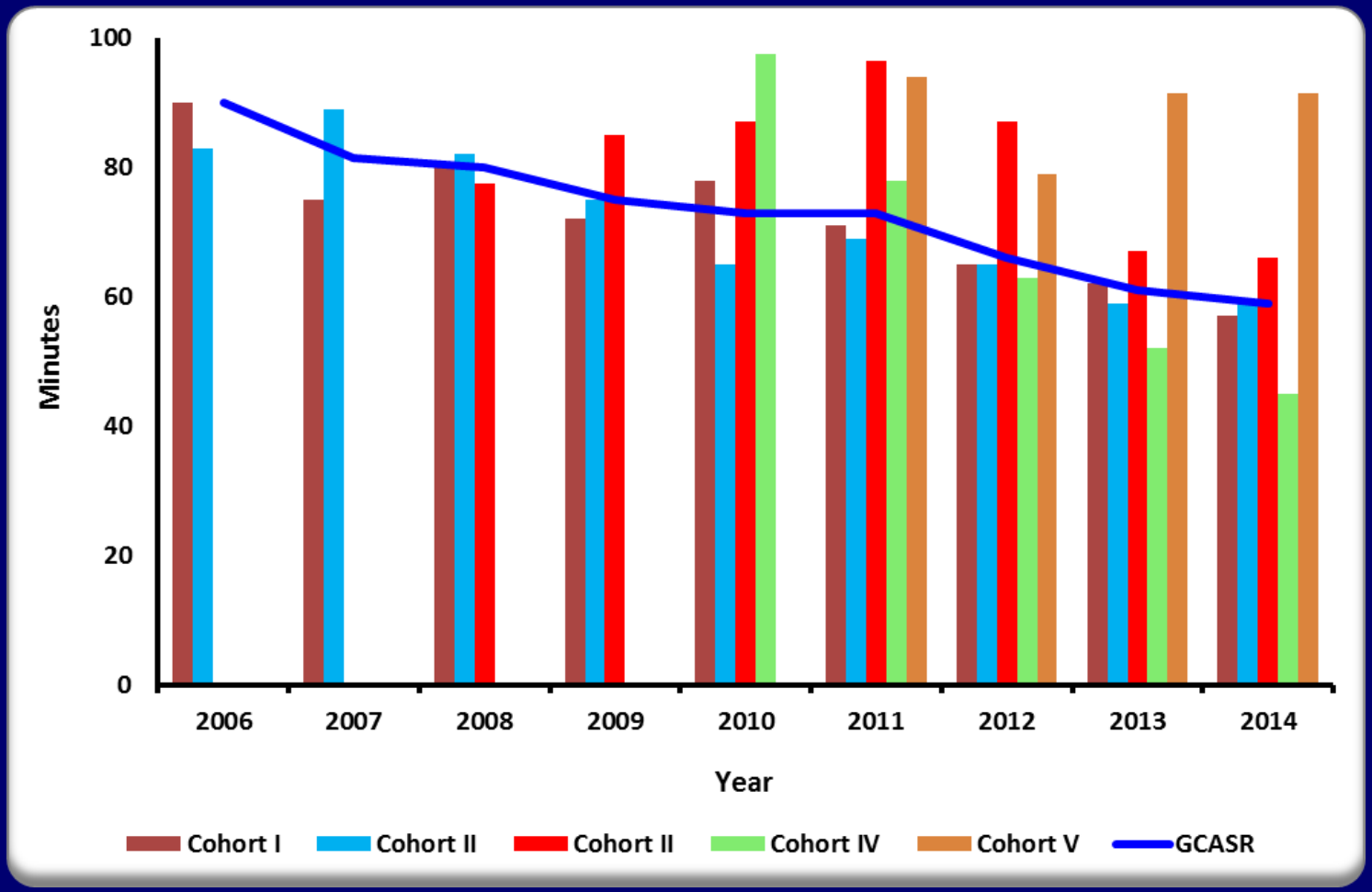

"Defect-Free" Care
Cohort 1
Cohort 2
Percentage
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nov-05
Dec-05
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
Date

Trend in defect-free care by hospital cohort, GACSR 2006-2014



Trend in median door-to-needle time by hospital cohort, GACSR 2006-2014



Georgia Coverdell Acute Stroke Registry
DTN Analysis
Key findings and conclusions

- Participation in quality improvement focused is effective in reducing DTN
- Patients were 50% more likely to receive tPA w/in 60 min of hospital arrival in 2011 compared with the previous 3 years.
- Hospitals treating more patients with tPA are better able to reduce DTN
- Early arrival delays DTN
- Time of day is related to DTN

Creating a Stroke Center

Recommendations for the Establishment of Primary Stroke Centers

Mark J. Alberts, MD
George Hademenos, PhD
Richard E. Latchaw, MD
Andrew Jagoda, MD
John R. Marler, MD
Marc R. Mayberg, MD
Rodman D. Starke, MD
Harold W. Todd
Kenneth M. Viste, MD
Meighan Girgus
Tim Shephard, RN
Marian Emr
Patti Shwayder, MPA
Michael D. Walker, MD
for the Brain Attack Coalition

Objective To develop recommendations for the establishment and operation of primary stroke centers as an approach to improve the medical care of patients with stroke.

Participants Members of the Brain Attack Coalition (BAC), a multidisciplinary group of representatives from major professional organizations involved with delivering stroke care. Supplemental input was obtained from other experts involved in acute stroke care.

Evidence A review of literature published from 1966 to March 2000 was performed using MEDLINE. More than 600 English-language articles that had evidence from randomized clinical trials, meta-analyses, care guidelines, or other appropriate methods supporting specific care recommendations for patients with acute stroke that could be incorporated into a stroke center model were selected.

Consensus Process Articles were reviewed initially by 1 author (M.J.A.). Members of the BAC reviewed each recommendation in the context of current practice parameters, with special attention to improving the delivery of care to patients with acute stroke, cost-effectiveness, and logistical issues related to the establishment of primary stroke centers. Consensus was reached among all BAC participants before an element was added to the list of recommendations.

Conclusions Randomized clinical trials and observational studies suggest that several elements of a stroke center would improve patient care and outcomes. Key elements of primary stroke centers include acute stroke teams, stroke units, written care protocols, and an integrated emergency response system. Important support services include availability and interpretation of computed tomography scans 24 hours everyday and rapid laboratory testing. Administrative support, strong leadership, and continuing education are also important elements for stroke centers. Adoption of these recommendations may increase the use of appropriate diagnostic and therapeutic modalities and reduce peristroke complications. The establishment of primary stroke centers has the potential to improve the care of patients with stroke.

JAMA. 2000;283:3102-3109 www.jama.com

DESPITE SIGNIFICANT ADvances in its diagnosis, treatment, and prevention, stroke remains a common disorder. An estimated 700 000 to 750 000 new and recurrent strokes occur each year in the United States,[1,2] and as the

Multidisciplinary group (AAN, AANS, AANN, ACEP, ASNR, ASA, CDC, NAEMSP, NINDS, NSA, SBC, VA)

Reprinted with permission from Alberts MJ, et al. *JAMA.* 2000;283:3102-3109.

"Stroke Mortality is Related to Hospital Readiness"*

- For uncertain reasons, states in the southeastern US consistently have higher rates of stroke mortality.
- Hospital surveys based on Brain Attack Coalition Guidelines
- CDC Statistics on Stroke Mortality
- **Stroke mortality risk was 20% lower for people living near a stroke ready hospital**
- Non-stroke death was also associated with stroke readiness, but to a lesser degree (9% risk reduction)

*David D. Blaney, Elaine J. Hallisey, Yueqin Zhou, Georgia Division of Public Health, Atlanta, GA; Sara L. Huston, North Carolina Division of Public Health, Raleigh, NC; Michael R Frankel, Emory University School of Medicine, Atlanta, GA. Submitted to International Stroke Conference Feb/2007.

Stroke Center Certification

- 40 Certified Stroke Centers in GA

Coverdell and EMS

- Remote Treatment Stroke Centers in GA
  - Coverdell Murphy Act in 2007
  - Collaborative effort to define criteria
  - State office of EMS in collaboration with GA Coverdell Acute Stroke Registry
  - Partnership and collaboration across hospitals and with state office of EMS
- Interfacility transfer guideline
  - Drip/Ship after initiating IV rt-PA
  - Adopted and endorsed by state office of EMS
  - Disseminated throughout state

Coverdell and EMS

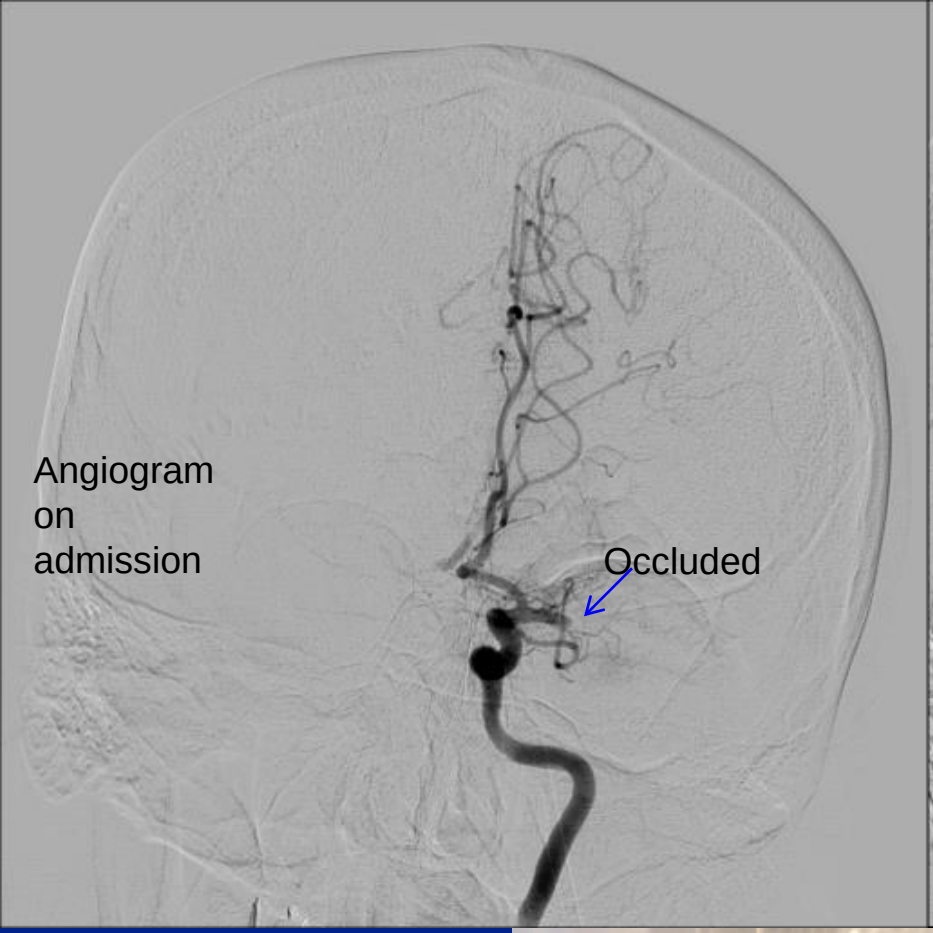
- Multiple agencies working on data linkage
  - Breaking down information silos
  - Focusing on developing key indicators
    - Documentation of Last Known Well
    - Use of stroke assessment tool
    - Prenotification

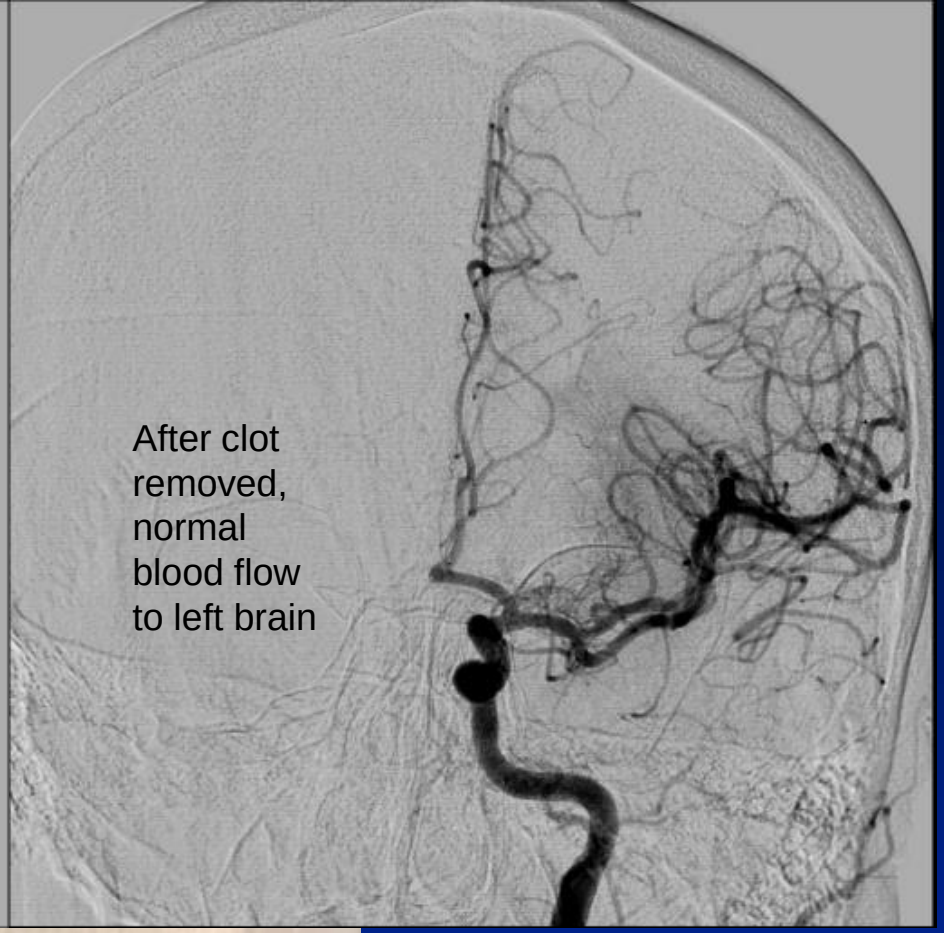
Georgia Stroke Professionals Alliance GA-SPA

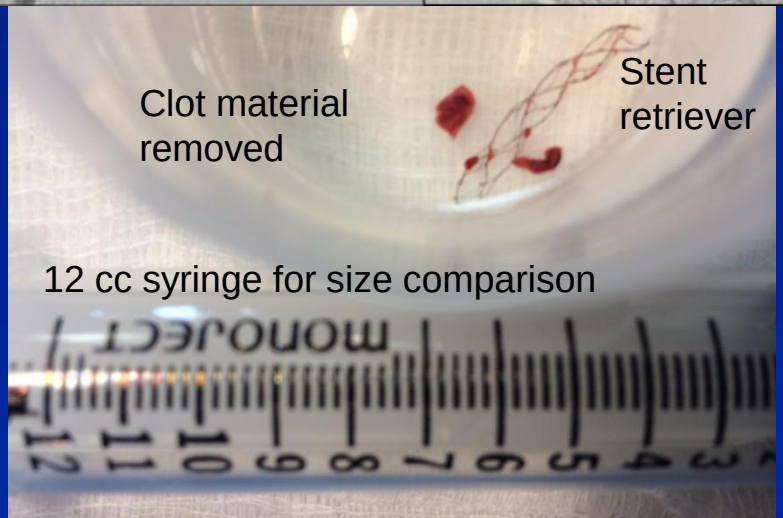
- Mission: To improve stroke prevention and optimize care through professional networking and education.
- Listserve
- Sharing best practices, advice, mentoring, etc.
- Built on longstanding trust established in the Coverdell Registry

2015

- Landmark clinical trials
  - Endovascular thrombectomy beneficial in large artery occlusion in acute ischemic stroke
- Consensus guidelines from AHA
  - Level 1A evidence
- Stroke Systems of Care
  - Mission Lifeline-Stroke (AHA)


Angiogram on admission
Occluded


After clot removed, normal blood flow to left brain


Clot material removed
Stent retriever
12 cc syringe for size comparison

MARCUS STROKE &
NEUROSCIENCE CENTER

Grady

First Neuroendovascular OR inside Neurocritical Care ICU

Current Mission: Lifeline Program

Mission: Lifeline is the American Heart Association/American Stroke Association's national initiative to advance **systems of care** for patients suffering from Acute Myocardial Infarction (AMI), Cardiac Resuscitation, **and Stroke**. The overarching goal of this initiative is to reduce existing barriers to efficient treatment so that death and disability can be reduced**.**

Unique Aspects of Mission: Lifeline that could Benefit Stroke Systems

- Addresses the continuum of care
- Preserves a role for the local referring hospital
- Understands the issues specific to rural communities
- Promotes different solutions/protocols for rural vs. urban/suburban areas
- Recognizes there is no “one-size-fits-all” solution
- Knows the issues of implementing national recommendations on a community level

Focus on Quality

AHA/ASA Acute Stroke Systems of Care Efforts

- Should "connect the various dots" and various parts of the nations current Stroke system
- Should connect regions and states into a unified interstate and national system that puts the needs of Stroke patients first
- Should coordinate and improve acute stroke care at all levels

We can do this, and Mission Lifeline is the obvious template!

Improving pre-hospital triage

- Developing a new tool for pre-hospital stroke assessment in Georgia

- Goal: Improve pre-hospital triage to nearest appropriate stroke center
  - Objective:
    - Create user friendly pre-hospital tool to improve accuracy of stroke diagnosis and improve correct triage decision
      - Timely
      - Evidence based
      - Validated

Coverdell-Murphy Act

- Establish protocols for the assessment, treatment and transport
- Stroke triage assessment tool (FAST)

FAST-ED

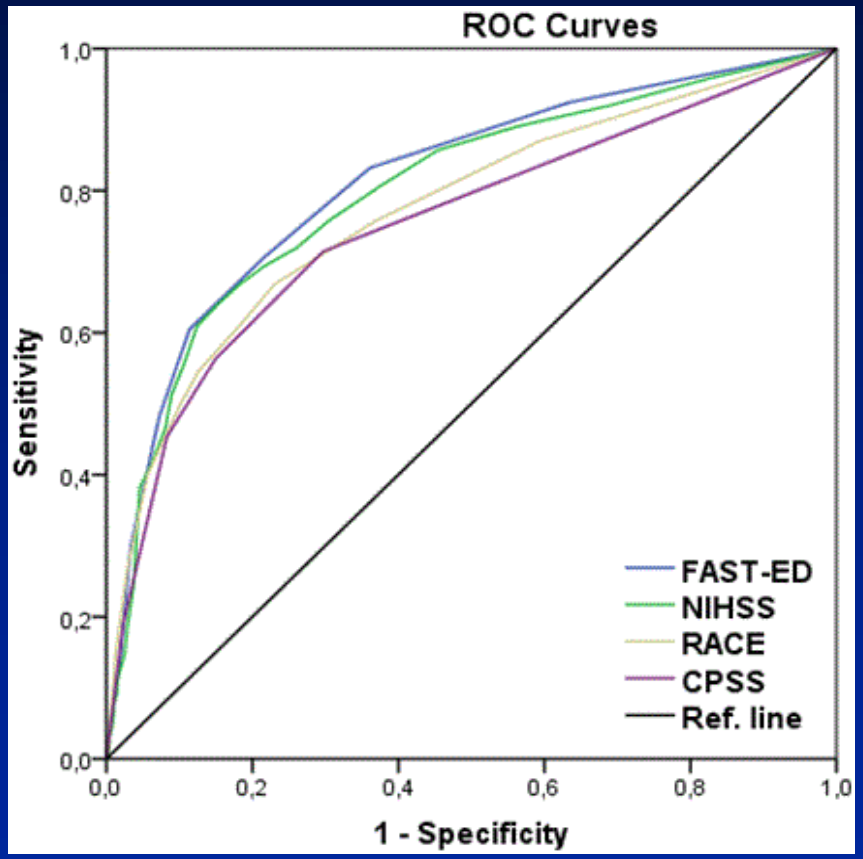
- Face
- Arm
- Speech
- Time
- Eye Deviation
- Denial

Methods

- The FAST-ED scale was designed based on items of the NIHSS with higher predictive value for large artery occlusion: Facial Palsy (scored 0–1), Arm Weakness (0–2), Speech Changes (0–2), Time (documentation for decision making but no points), Eye Deviation (0-2), and Denial/Neglect (0-2).
- The scale was tested on data from 742 consecutive patients enrolled in a prospective cohort study at two university-based hospitals, the Screening Technology and Outcomes Project in Stroke (STOPStroke), in which admission non-enhanced CT scans (NCCT) and computed tomography angiography (CTA) were obtained in all patients suspected of having ischemic stroke (stroke, transient ischemic attack, or stroke mimics) in the first 24 hours of symptom onset. Large artery occlusion was present in 240 (33%).

Submitted for publication

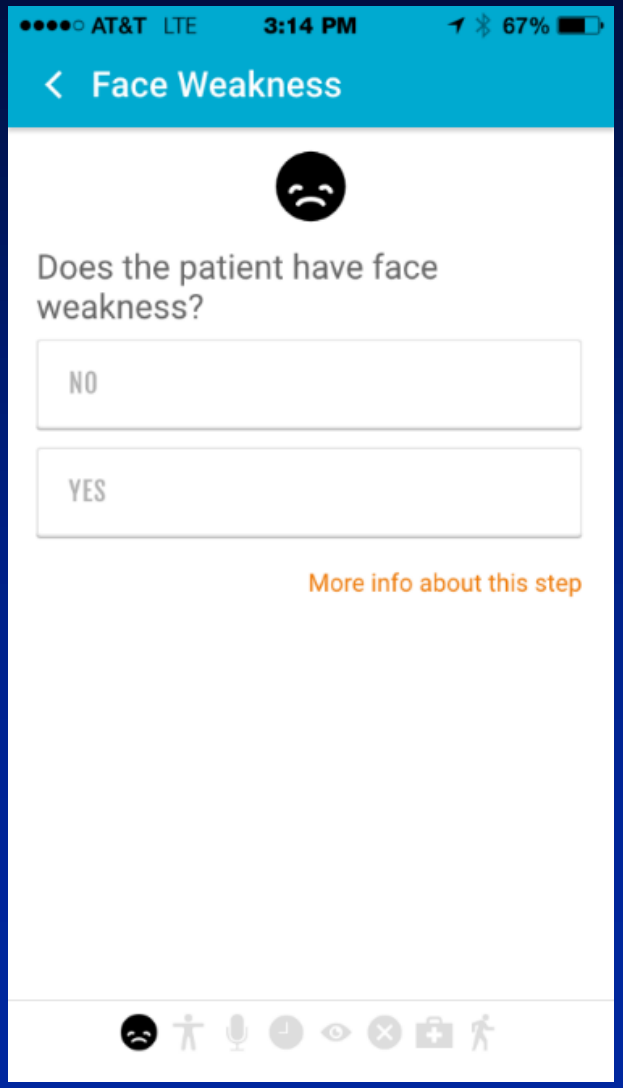
Comparison of FAST-ED to other scales in predicting Large Artery Occlusion (LAO) in acute ischemic stroke

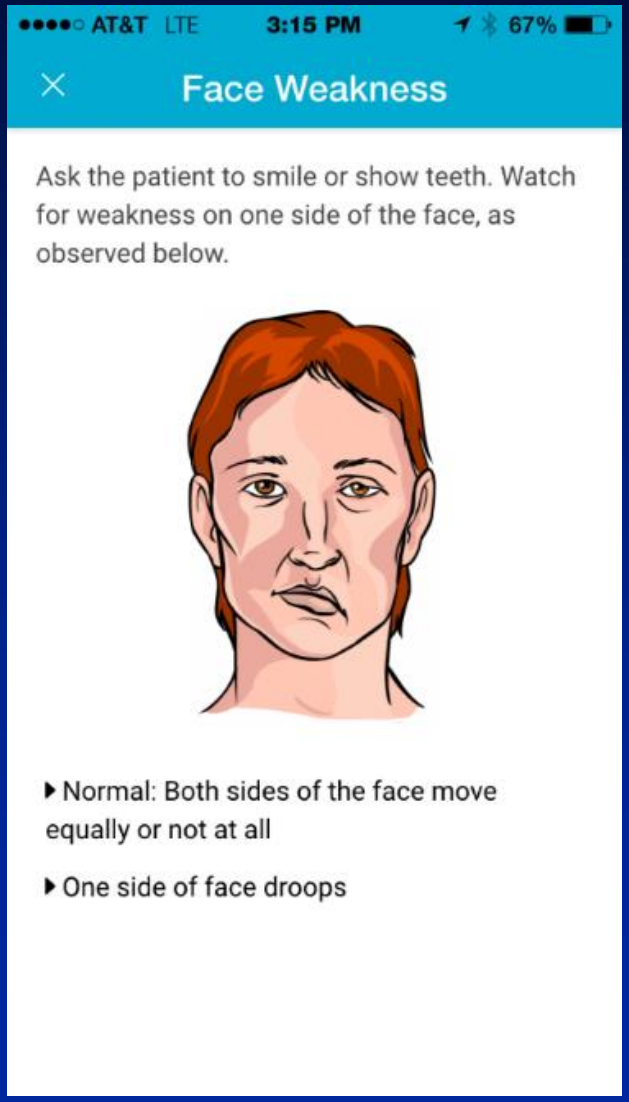


The RACE scale was developed to predict LVO. However, the RACE scale was validated in a population where most of patients were diagnosed with transcranial Doppler which is less sensitive and specific for the detection of LAO than CTA

Submitted for publication

FAST-ED: Smart Phone App





●●●●○ AT&T LTE 3:15 PM 67%

< Arm Weakness

Ask the patient to hold both arms out with palms up and eyes closed for 10 seconds. Does the patient have a drift of one side?

NO

YES, ONE ARM DRIFTS DOWN

YES, ONE ARM FALLS RAPIDLY

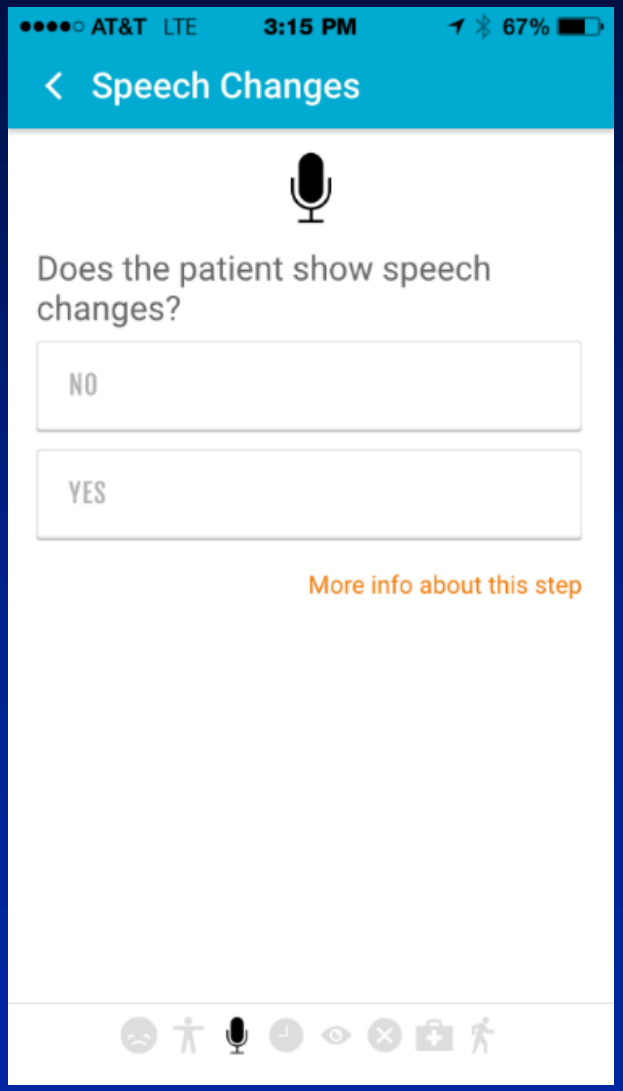
More info about this step

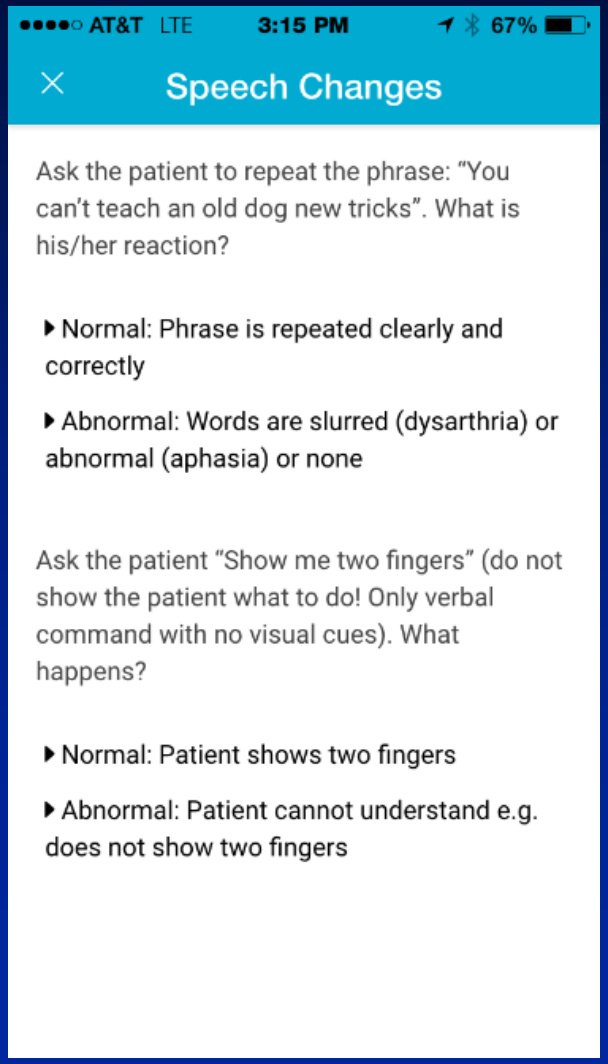
●●●●○ AT&T LTE 3:15 PM 67%

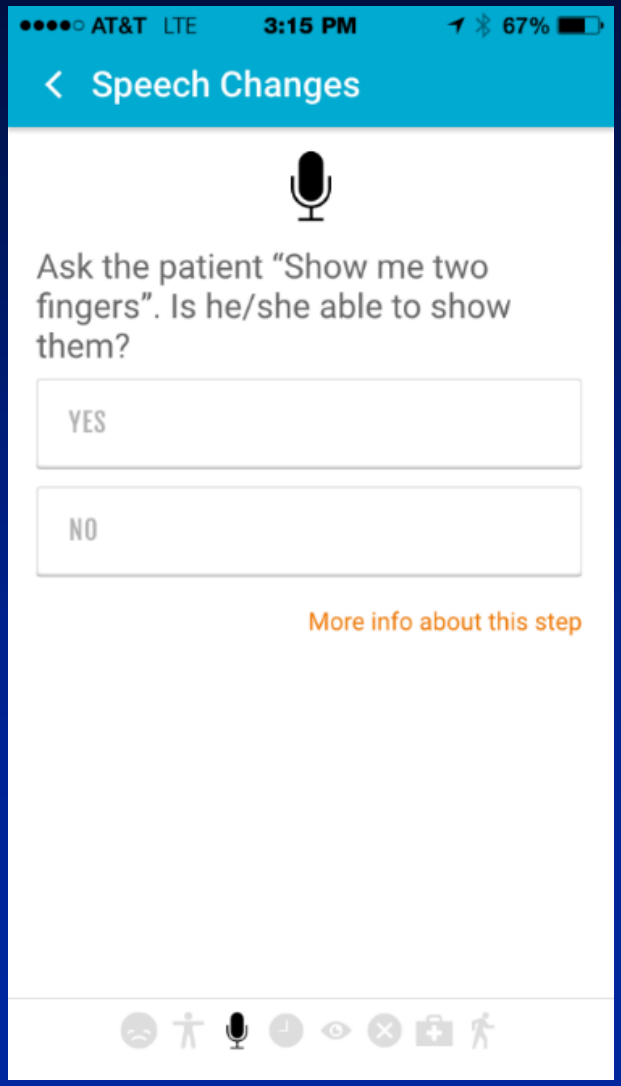
× Arm Weakness

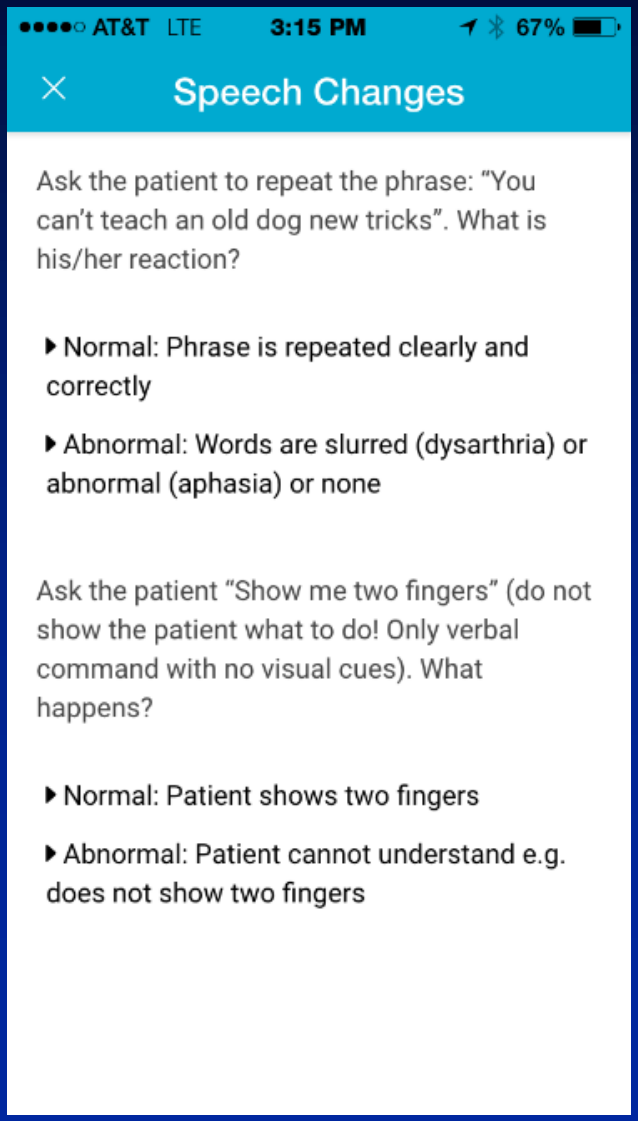
Ask the patient to hold both arms out with palms up and eyes closed for 10 seconds. Watch for a drift of one side, as observed below.

- Normal: both arms remain extended equally or drifts equally or do not move at all
- One arm drifts down
- One arm falls rapidly or no movement at all


AT&T LTE 3:15 PM 67%
Speech Changes
Does the patient show speech changes?
NO
YES
More info about this step


AT&T LTE 3:15 PM 67%
Speech Changes
Ask the patient to repeat the phrase: "You can't teach an old dog new tricks". What is his/her reaction?
Normal: Phrase is repeated clearly and correctly
Abnormal: Words are slurred (dysarthria) or abnormal (aphasia) or none
Ask the patient "Show me two fingers" (do not show the patient what to do! Only verbal command with no visual cues). What happens?
Normal: Patient shows two fingers
Abnormal: Patient cannot understand e.g. does not show two fingers


AT&T LTE 3:15 PM 67%
Speech Changes
Ask the patient "Show me two fingers". Is he/she able to show them?
YES
NO
More info about this step


AT&T LTE 3:15 PM 67%
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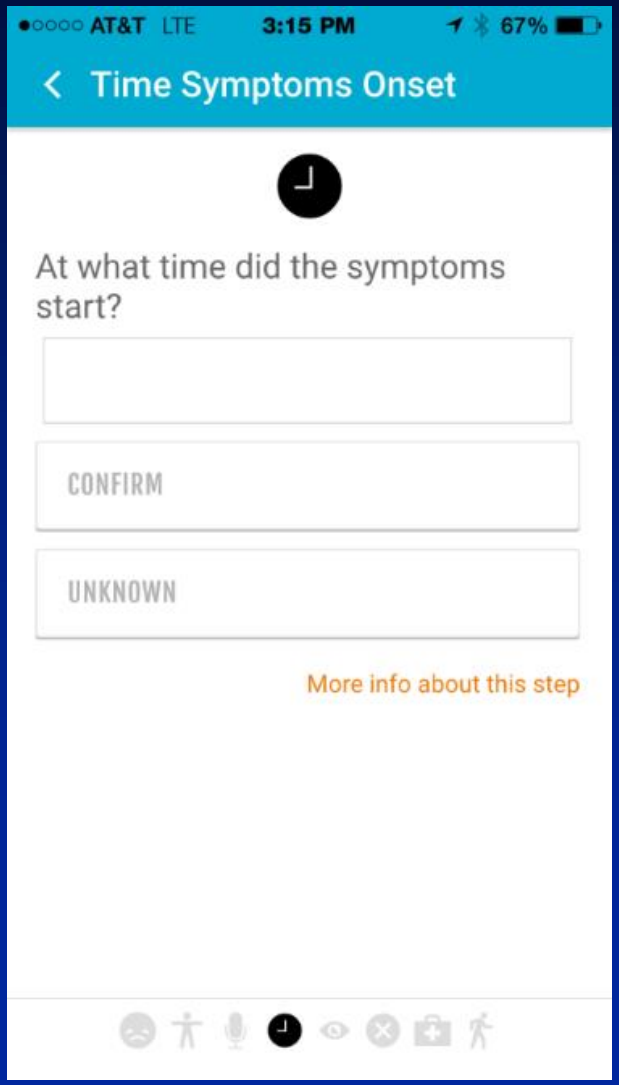
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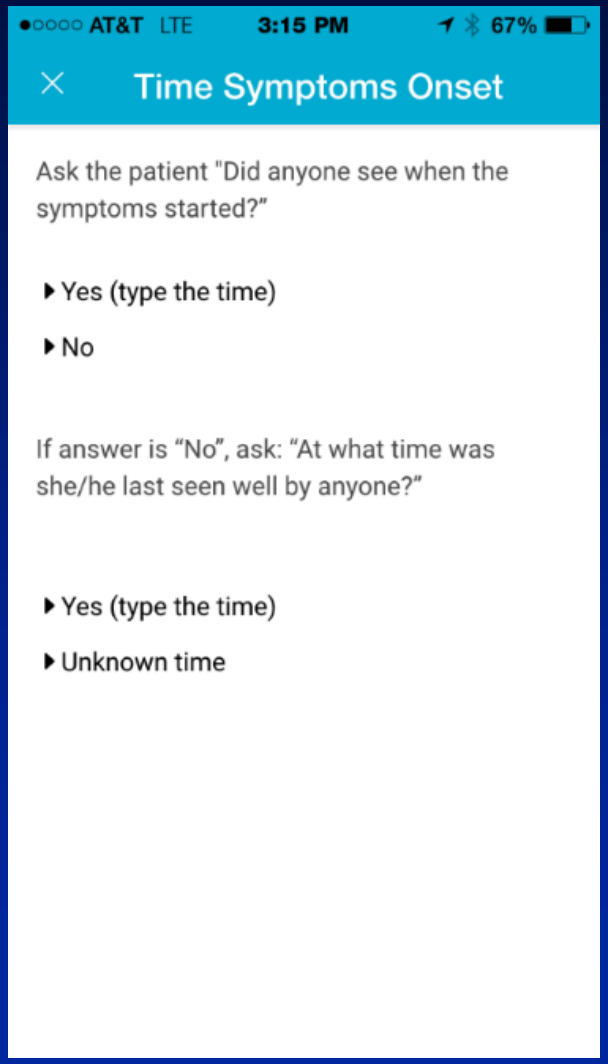
Time Symptoms Onset
At what time did the symptoms start?
CONFIRM
UNKNOWN
More info about this step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Time Symptoms Onset
Ask the patient "Did anyone see when the symptoms started?"
Yes (type the time)
No
If answer is "No", ask: "At what time was she/he last seen well by anyone?"
Yes (type the time)
Unknown time

●○○○○ AT&T LTE 3:16 PM 67%

< Eye Deviation

Does the patient have gaze deviation to any side?

NO

YES, MILD DEVIATION / GAZE PREFERENCE

YES, FORCED GAZE DEVIATION

More info about this step

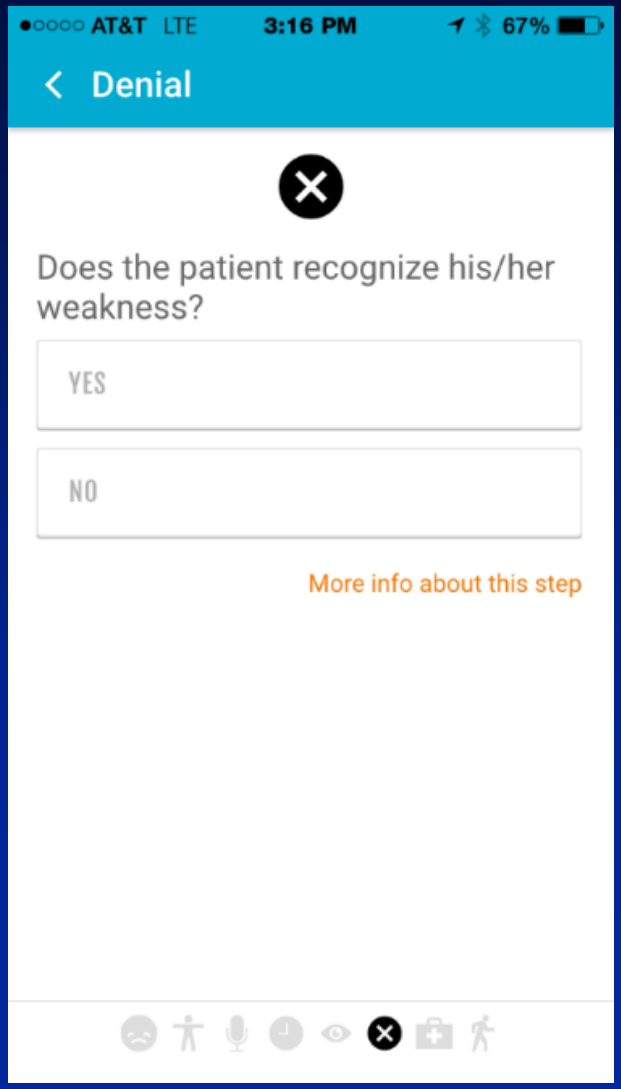
●○○○○ AT&T LTE 3:16 PM 67%

× Eye Deviation

Check the patient's eyes to see if he/ she has a gaze deviation to one side or the other, as observed below.

Ask the patient to follow your finger as you move it from right to left and back from left to right.

- Normal Gaze: No deviation, i.e., eyes move to both sides equally
- Mild Deviation/ Gaze Preference: Eyes are preferentially moved to the right or left but patient is able to follow finger to the other side
- Forced Gaze Deviation: Eyes are deviated to one side and do not move to the other side e.g. cannot follow finger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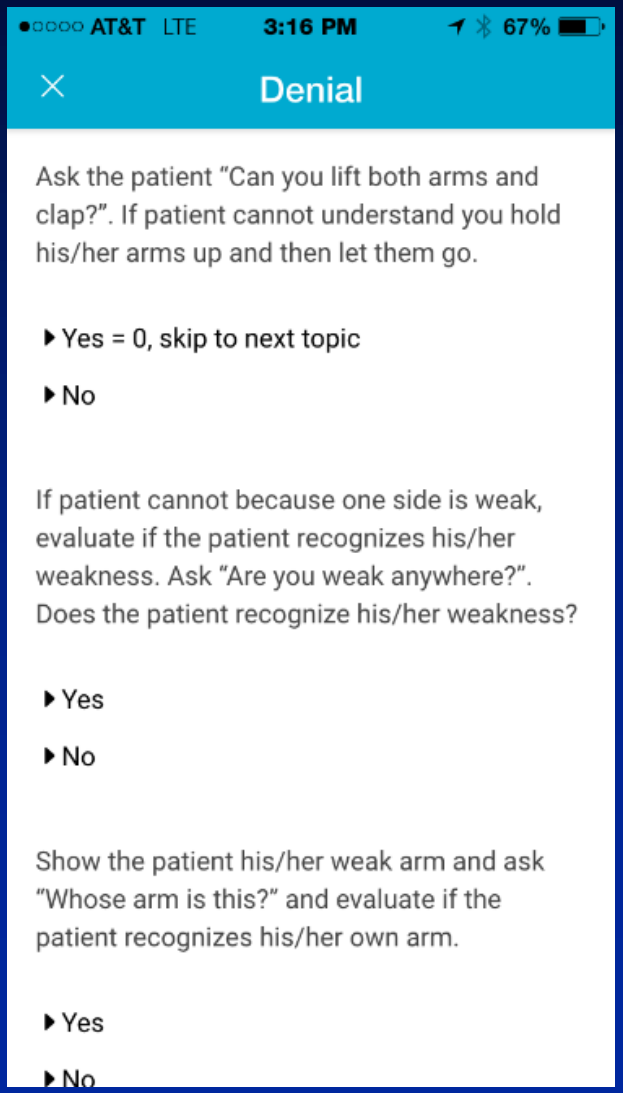
Denial
Does the patient recognize his/her weakness?
YES
NO
More info about this step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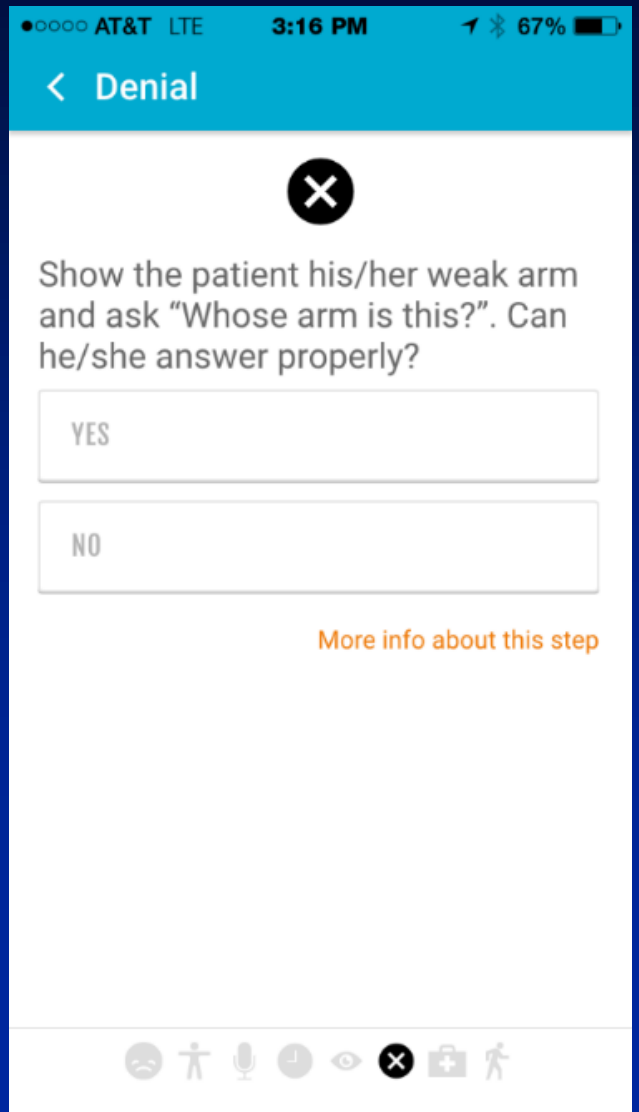
Denial
Ask the patient "Can you lift both arms and clap?". If patient cannot understand you hold his/her arms up and then let them go.
Yes = 0, skip to next topic
No
If patient cannot because one side is weak, evaluate if the patient recognizes his/her weakness. Ask "Are you weak anywhere?". Does the patient recognize his/her weakness?
Yes
No
Show the patient his/her weak arm and ask "Whose arm is this?" and evaluate if the patient recognizes his/her own arm.
Yes
No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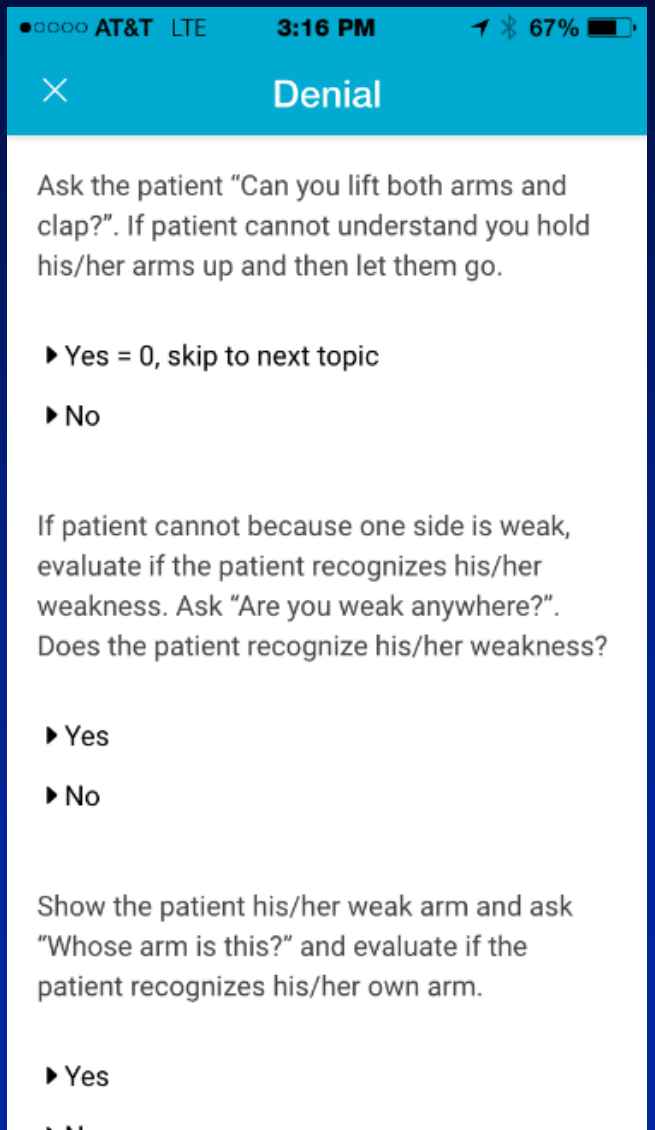
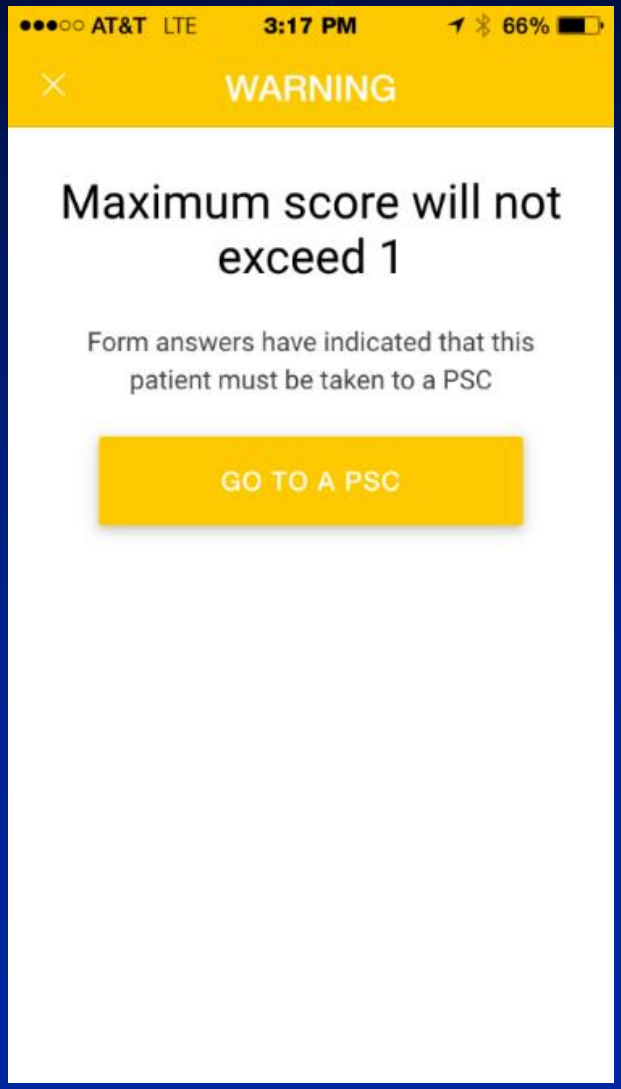
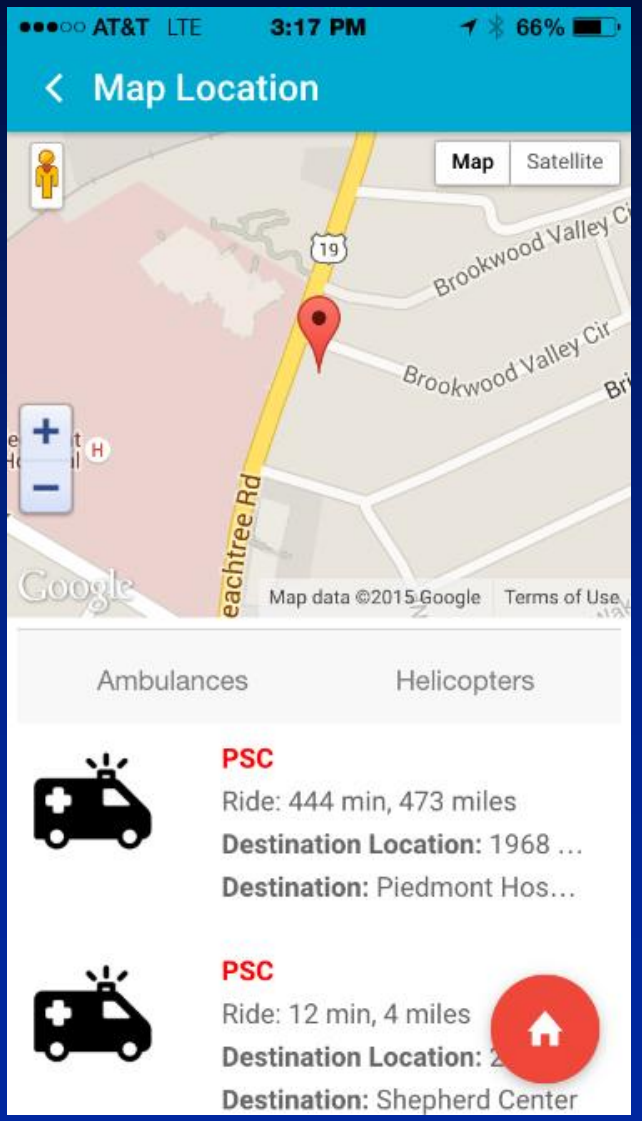
Denial
Show the patient his/her weak arm and ask “Whose arm is this?”. Can he/she answer properly?
YES
NO
More info about this step


AT&T LTE 3:16 PM 67%
Denial
Ask the patient “Can you lift both arms and clap?”. If patient cannot understand you hold his/her arms up and then let them go.
Yes = 0, skip to next topic
No
If patient cannot because one side is weak, evaluate if the patient recognizes his/her weakness. Ask “Are you weak anywhere?”. Does the patient recognize his/her weakness?
Yes
No
Show the patient his/her weak arm and ask “Whose arm is this?” and evaluate if the patient recognizes his/her own arm.
Yes


●●●○○ AT&T LTE 3:17 PM 66%
WARNING
Maximum score will not exceed 1
Form answers have indicated that this patient must be taken to a PSC
GO TO A PSC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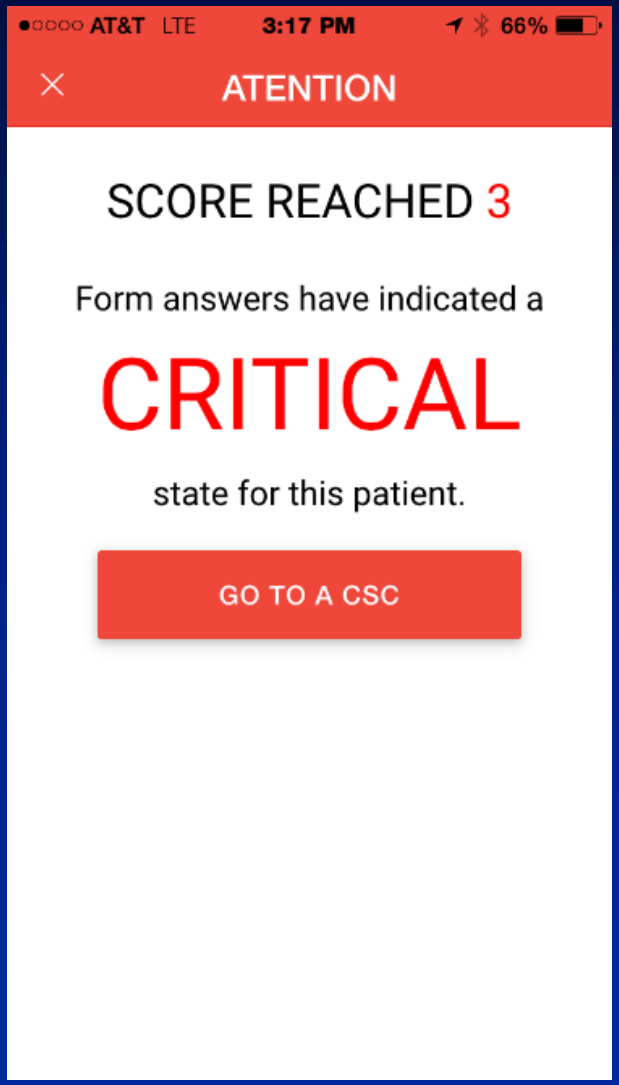
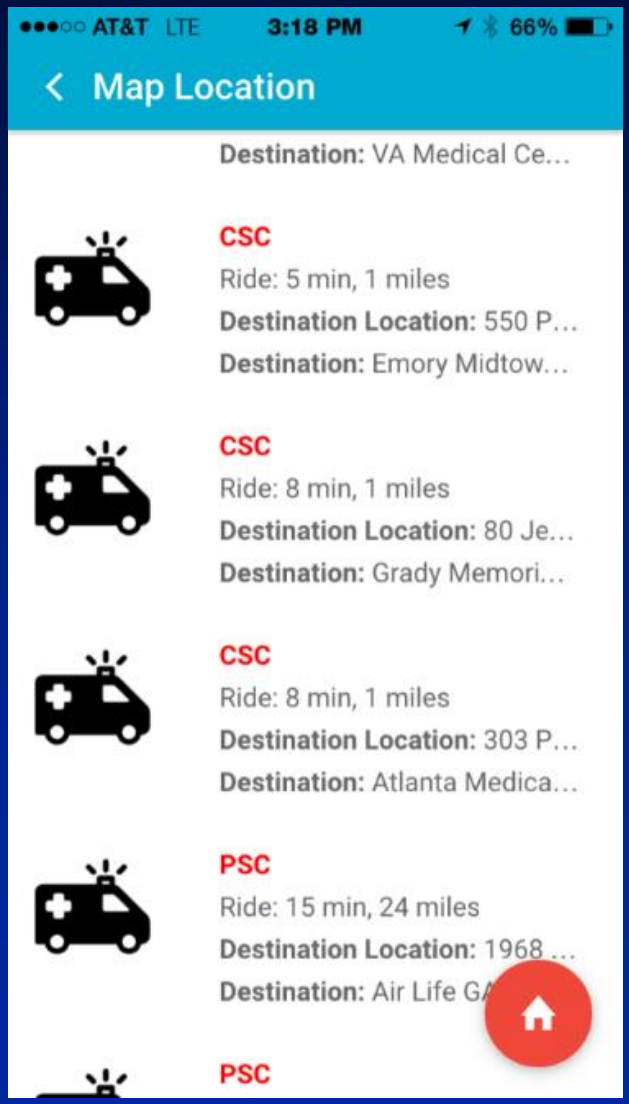
Map Location
Map
Satellite
19
Brookwood Valley Cir
Brookwood Valley Cir
Google
Map data ©2015 Google
Terms of Use
Ambulances
Helicopters
PSC
Ride: 444 min, 473 miles
Destination Location: 1968 ...
Destination: Piedmont Hos...
PSC
Ride: 12 min, 4 miles
Destination: Shepherd Center


●○○○○ AT&T LTE 3:17 PM 66%
ATTENTION
SCORE REACHED 3
Form answers have indicated a
CRITICAL
state for this patient.
GO TO A CSC


●●●○○ AT&T LTE 3:18 PM 66%
Map Location
Destination: VA Medical Ce...
CSC
Ride: 5 min, 1 miles
Destination Location: 550 P...
Destination: Emory Midtow...
CSC
Ride: 8 min, 1 miles
Destination Location: 80 Je...
Destination: Grady Memori...
CSC
Ride: 8 min, 1 miles
Destination Location: 303 P...
Destination: Atlanta Medica...
PSC
Ride: 15 min, 24 miles
Destination Location: 1968 ...
Destination: Air Life GA
PSC

Thank you

Contact info: mfranke@emory.edu