Changing Landscape of Stroke Systems

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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 Stroke 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

<table>
<thead>
<tr>
<th>Ischemic Stroke (80%)</th>
<th>Hemorrhagic Stroke (20%)</th>
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<tbody>
<tr>
<td><strong>Atherothrombotic Cerebrovascular Disease (20%)</strong></td>
<td><strong>Intracerebral Hemorrhage (70%)</strong></td>
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<tr>
<td><strong>Lacunar (25%)</strong> (small vessel disease)</td>
<td><strong>Subarachnoid Hemorrhage (30%)</strong></td>
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<td><strong>Cryptogenic (30%)</strong></td>
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<tr>
<td><strong>Cardioembolic (20%)</strong></td>
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Albers GW. Personal communication. February 27, 2003.
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?
Task Force for Stroke Systems of Care

- Describe the current fragmentation of stroke care
- Describe components of a stroke system
- Recommend methods for encouraging the implementation of stroke systems

System = Network

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.
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 Association (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)
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)

Hospital pre-notification by EMS, GCASR 2006-2013

Percent

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Percent</th>
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<tbody>
<tr>
<td>2006</td>
<td>54</td>
</tr>
<tr>
<td>2007</td>
<td>53</td>
</tr>
<tr>
<td>2008</td>
<td>51</td>
</tr>
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<td>2010</td>
<td>57</td>
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<tr>
<td>2011</td>
<td>55</td>
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<tr>
<td>2012</td>
<td>56</td>
</tr>
<tr>
<td>2013</td>
<td>63</td>
</tr>
</tbody>
</table>
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
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- Discharged on cholesterol reducing medication
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

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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 Gircus
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.


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

Clot material removed

Stent retriever

12 cc syringe for size comparison

After clot removed, normal blood flow to left brain
First Neuroendovascular OR inside Neurocritical Care ICU
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
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)
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

Submitted for publication

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.
FAST-ED: Smart Phone App

Face Weakness

Does the patient have face weakness?

- NO
- YES

More info about this step

Face Weakness

Ask the patient to smile or show teeth. Watch for weakness on one side of the face, as observed below.

- Normal: Both sides of the face move equally or not at all
- One side of face droops
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

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
Speech Changes

Does the patient show speech changes?

- **NO**
- **YES**

More info about this step

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
Ask the patient “Show me two fingers”. Is he/she able to show them?

- **YES**
- **NO**

More info about this step

Ask the patient to repeat the phrase: “You can’t teach an old dog new tricks”. What is his/her reaction?

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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 what time did the symptoms start?

CONFIRM

UNKNOWN

More info about this step

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
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

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
Denial

Does the patient recognize his/her weakness?

- YES
- NO

More info about this step

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?“.

- 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
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

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
WARNING

Maximum score will not exceed 1

Form answers have indicated that this patient must be taken to a PSC

GO TO A PSC
SCORE REACHED 3

Form answers have indicated a CRITICAL state for this patient.

GO TO A CSC
Thank you

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