The Critical Role of EMS in Acute Neurologic Emergencies

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MUSC
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Disclosures

- Research support
  - National Institutes of Health funding

    IMS-III*, STOP-IT, ALIAS2*, FAST-MAG*, RAMPART*, POINT
  - Novo Nordisk (drug in kind)
  - Cleveland Clinic (lab in kind)
- National Organizations (my comments today are mine)
  - AHA/ASA leadership and guidelines member
  - JC CSC Technical Advisory Panel
  - NQF Ambulatory Care Committee

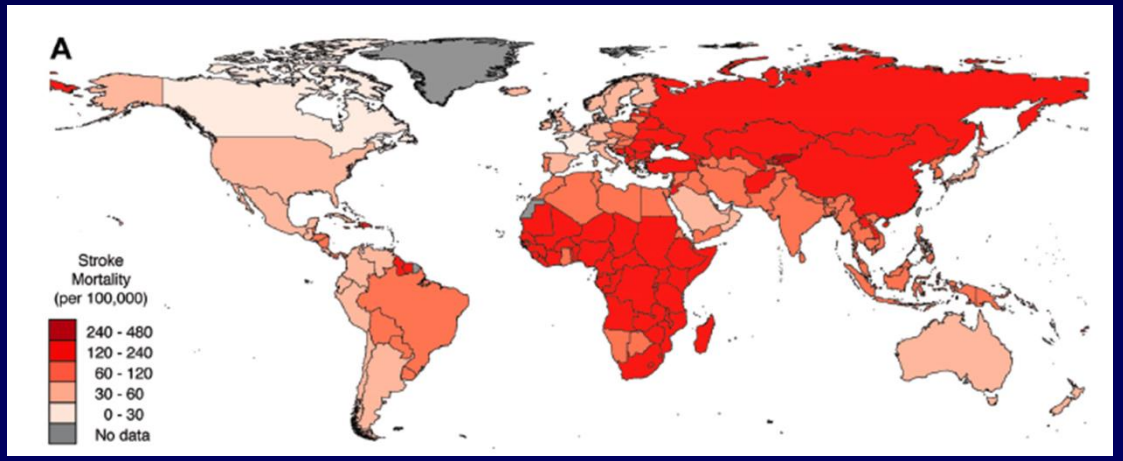
Lecture Goals

- String together 3 important concepts in acute stroke into one passion – stroke care:
  - The growing global burden of stroke is coming soon to a town near you
  - Beyond technology, stroke systems development incorporating EMS makes a tangible impact
  - Review research developments in 2012; humbling yet give us direction for the next decade
  - In the end, go big or get out of the pool

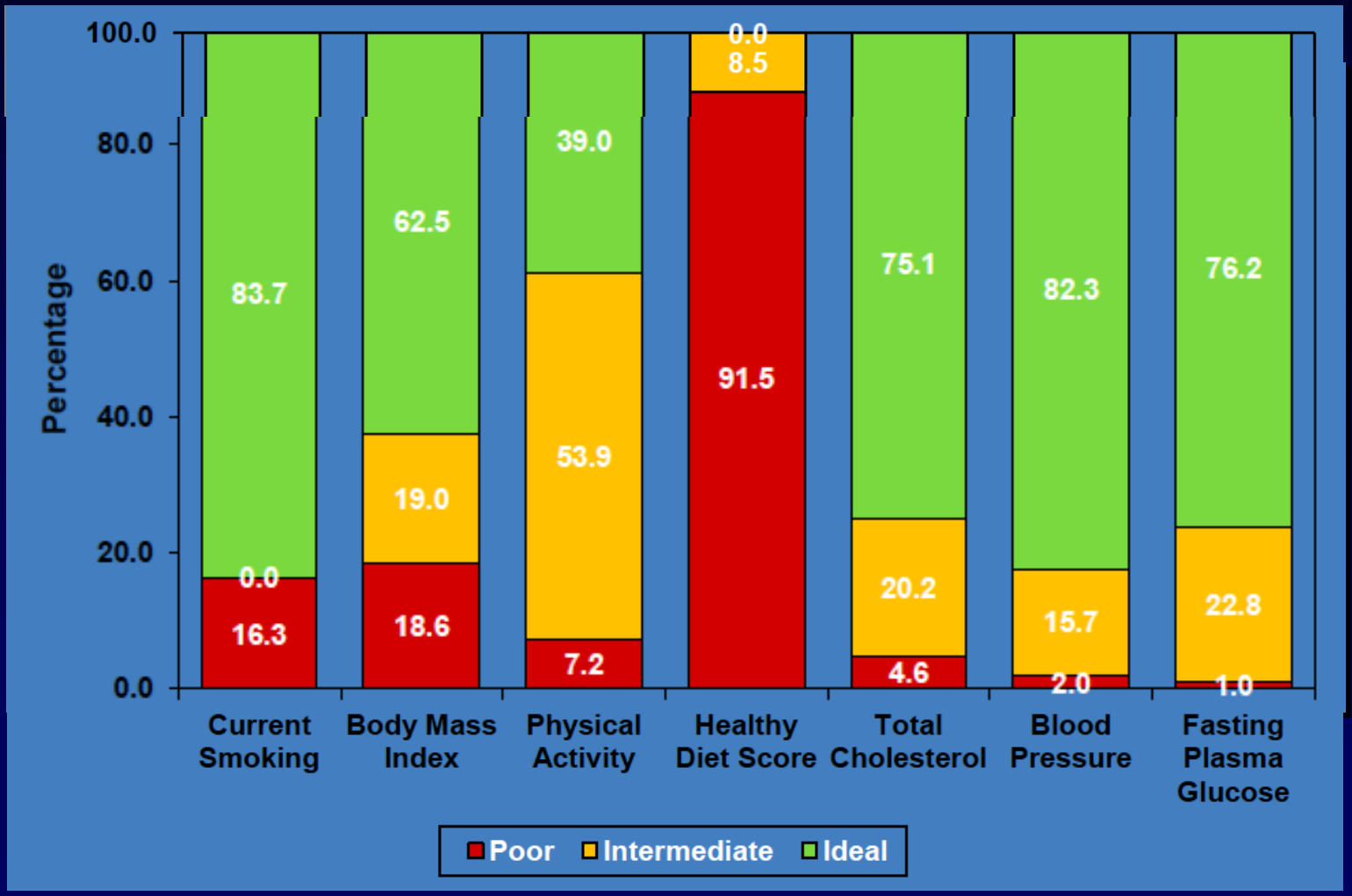
The Building Stroke Tsunami

Global Trends In Stroke

- Stroke is a growing global epidemic
  - 1 in 6 worldwide will have a stroke in their life time
  - 15 million new strokes each year; 6 million will die
  - 30 million stroke survivors with disabilities
  - Disproportionate burden in developing countries and this burden is growing rapidly



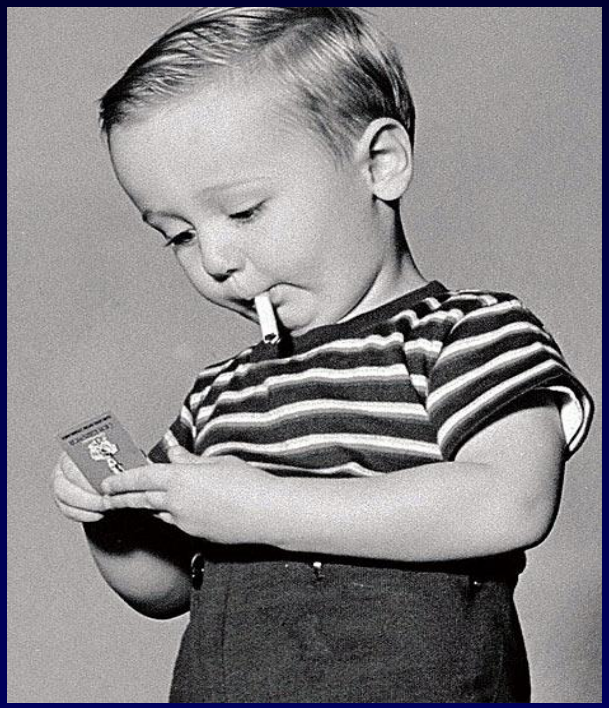
Prevalence Estimates CV Health U.S. Children (NHANES 2007-2008; 12-19 yrs)



Stroke Risk Factors

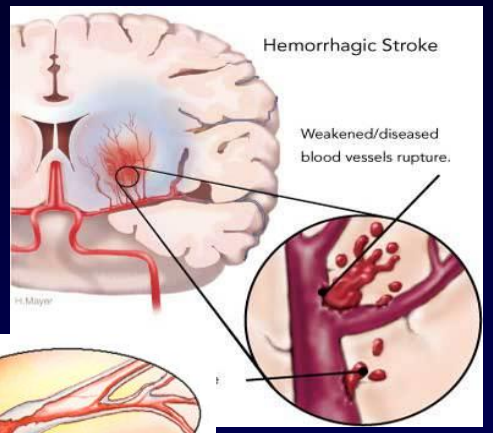
American Heart Association | American Stroke Association

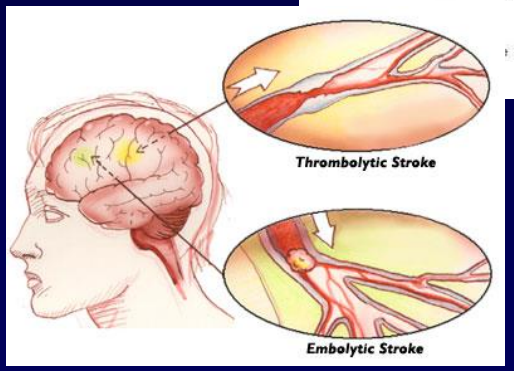
- Hypertension
- Cigarette smoking
- History of TIA
- Heart disease (CHF, AMI)
- Diabetes
- Hypercoagulability
- High RBCs/Sickle cell anemia
- Atrial fibrillation
- Carotid disease

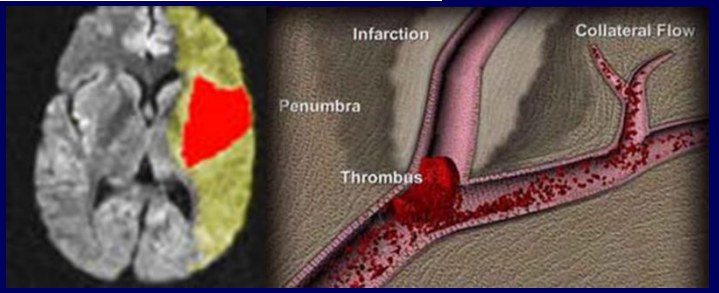


What is a Stroke?

- Hemorrhagic stroke
  - Ruptured vessel with blood extravasation from vessel
- Ischemic stroke
  - Occurs when an artery to the brain is blocked
    - Embolic
    - Thrombotic
- Areas of ischemia
  - Infarct core
  - Salvageable penumbra
  - Ischemic cascade begins immediately

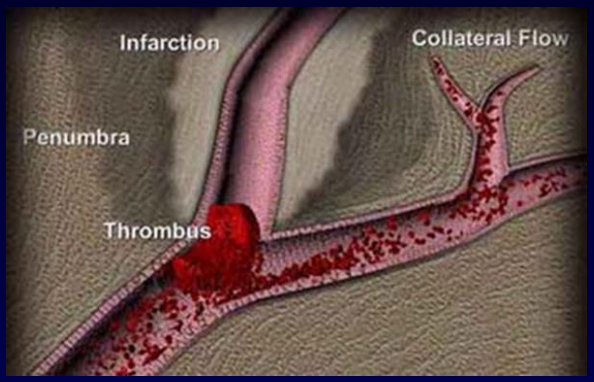






Lessons Learned

- Reperfusion critical
  - Minimize delay
  - Maximize penumbral salvageability
    - Collateral flow
    - Physiologic optimization



- Time to reperfusion (and likely neuroprotection)
  - Singularly drives clinical outcome
  - Affects likelihood of clinical trial success
  - *Should* drive all system development

Importance of Time

- Lost for every hour in ischemic stroke:
  - 120 million neurons
  - 830 billion synapses
  - 447 miles of myelin
- Thrombolysis is time dependent:
  - OR 2.11 0 – 90 mins
  - OR 1.69 91 – 180 mins

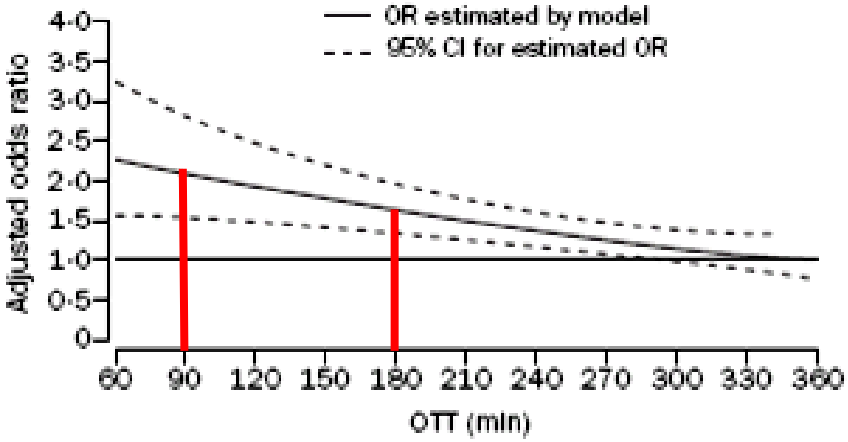


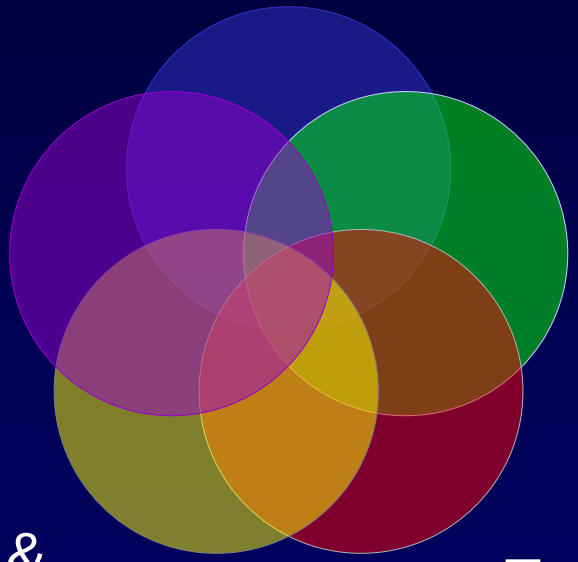
Figure 3: **Model estimating odds ratio for favourable outcome at 3 months in rt-PA-treated patients compared with controls by OTT**

(Saver, *Stroke.* 2006;37;263-266)
(Hacke, *Lancet.* 2004;363:768–74)
(NINDS Study Group, *NEJM.* 1995;333:1581-1587)

Other Time Dependent Neurologic Emergencies Requiring Systems

Coma / Cardiac Arrest

Altered Mental Status



Stroke / TIA

Weak & Dizzy

Traumatic Brain Injury

Time is Brain

Post Cardiac Arrest Management

Cool strategy saves runner

Therapeutic hypothermia used after 74-year-old collapses

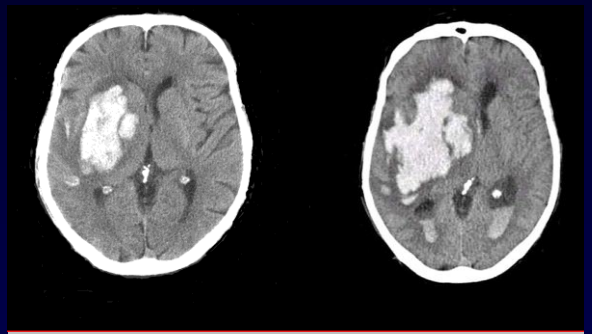
By David Quick
The Post and Courier
Tuesday, June 16, 2009

Herb Rawlings doesn't remember much about this year's Cooper River Bridge Run after he, his younger daughter and her husband split up at the base of bridge's incline.

But minutes later, nearing the crest, the 74-year-old Mount Pleasant man collapsed, suffering his second of two heart attacks in nearly nine years. Luckily, he was near emergency medical crews and received immediate treatment.

Time is Brain
ICH Progression

- Symptoms often progress, associated with ICH growth
- Within 3 hours from onset:
  - 26% with 33% or greater growth in next 1 hour
  - 12% with 33% or greater growth 1-20 hours
- 72% have some hematoma expansion over the first 24 hours



2.0 hours after onset | 6.5 hours after onset

(Brott, *Stroke* 1997;28:1-5)
(Davis SM, et al. *Neurology.* 2006;66:1175-1181)

Stroke Outcomes

- In the 4 million US stroke survivors:

10%	Recover almost completely
25%	Recover with minor impairments
40%	Experience moderate to severe impairments requiring special care
10%	Require care in a nursing home or other long-term care facility
15%	Die shortly after the stroke

ASA Policy Recommendations

Recommendations for the Establishment of Stroke Systems of Care

Recommendations From the American Stroke Association's Task Force on the Development of Stroke Systems

1. Provide rapid access to EMS
2. Promote use of algorithms and protocols by EMS dispatchers
3. Dispatch EMS for strokes with most rapid response
4. Ensure involvement of EM and stroke experts in development of stroke education materials, communications and field assessment, treatment, and transport protocols for EMS
5. Patients with stroke signs or symptoms transported to nearest primary stroke center or hospital with equivalent designation
6. A stroke system should ensure that EMS personnel perform and document assessments and screening of candidates for thrombolysis or other hyperacute interventions

(Schwamm, *Stroke* 2005;111:1078-191)

Guidelines for the Early Management of Patients With Acute Ischemic Stroke : A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Edward C. Jauch, Jeffrey L. Saver, Harold P. Adams, Jr, Askiel Bruno, J.J. (Buddy) Connors, Bart M. Demaerschalk, Pooja Khatri, Paul W. McMullan, Jr, Adnan I. Qureshi, Kenneth Rosenfield, Phillip A. Scott, Debbie R. Summers, David Z. Wang, Max Wintermark and Howard Yonas

- Recommendations:

1. Educational stroke programs for physicians, hospital personnel, and EMS personnel are recommended (IB)
2. 9-1-1 Dispatchers should make stroke a priority dispatch (IB)
3. EMS should use prehospital stroke assessment tools (IB)
4. EMS personnel should begin the initial management in the field (IB)
5. Development of an EMS stroke protocol is strongly encouraged (IB)
6. Patients should be transported rapidly to the closest available PSC or CSC (IA)
7. EMS personnel should provide prehospital notification (IB)
8. EMS should bypass hospitals that do not have resources to treat stroke and go to the closest facility most capable of treating acute stroke (IB)

(Jauch, *Stroke.* 2013;44:870-947)

Trends in Stroke Organization

- Continuation of the regionalization of stroke systems of care
  - State-based / regional plans continue to expand
  - Departments of Health critical to affecting change
  - Often must start modest to avoid “offending” major stakeholders
  - Regionalization extends beyond EMS and triage, timely transfers to better equipped hospitals may need to occur

Stroke System of Care Act of 2011

- Based on recommendations of the Stroke System of Care Study Committee provided for in Act 121 of 2009
- South Carolina General Assembly 119th Session, 2011-2012
- A62, R81, S588
- Sponsors: Senators Jackson, Hayes, O'Dell, Rose, Ford, Knotts
- Introduced in the Senate on February 17, 2011
- Introduced in the House on April 26, 2011
- Last Amended on May 26, 2011
- Passed by the General Assembly on June 1, 2011
- Governor's Action: June 14, 2011, Vetoed
- Legislative veto action(s): Veto overridden

Stroke System of Care Act of 2011

- "… to establish a statewide system of stroke care; to require DHEC to recognize hospitals that are certified to be PSC and to authorize recognition of acute stroke capable centers; to establish a stroke system of care advisory council … to require DHEC to distribute to EMS a list of PSC, ASRH, and CSC and to post this list on the website; to adopt and distribute a nationally standardized stroke-triage assessment tool EMS; to facilitate data collection and analysis for the improvement of stroke care in this state, including establishing a stroke registry task force as a subcommittee of the advisory council; to provide that this article may not be used to restrict a hospital's authority to provide services; and to provide that DHEC responsibilities pursuant to this article are contingent upon adequate funding."

Stroke Systems of Care

Study Committee Report

(S*26)

Submitted to the Governor and General Assembly of South Carolina

November 30, 2010

D H E C

PROMOTE PROTECT PROSPER

South Carolina Department of Health and Environmental Control

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State of South Carolina
Office of the Governor

NIKKI R. HALEY
GOVERNOR

1205 PENDLETON STREET
COLUMBIA 29201

July 27, 2011

Mr. Edward Jauch
169 Ashley Avenue, MSC 300
Charleston, SC 29425

Dear Mr. Jauch,

Thank you for your correspondence regarding my veto of Senate Bill 588, the Stroke Prevention Act of 2011. I vetoed this bill because it duplicates services already being provided by the state, and I believe the goals of this bill can be met without growing government.

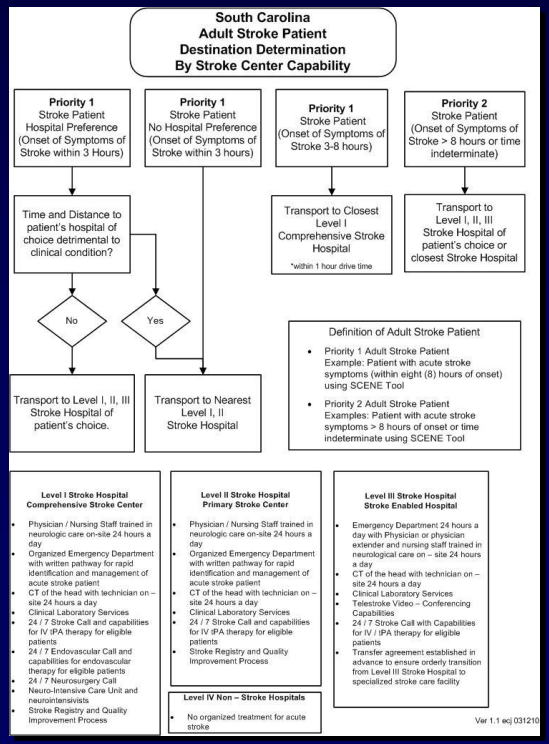
The South Carolina Department of Health and Environmental Control (SCDHEC) already regulates hospitals and promotes programs focused on heart health and stroke prevention. The South Carolina Department of Health and Human Services (SCDHHS) already receives funding to develop rural acute care programs. Accordingly, I directed SCDHHS to review our prevention and treatment efforts because I believe that South Carolina must address the challenges posed by stroke and vascular disease, but can do so using no additional tax dollars.

Again, thank you for your correspondence and do not hesitate to contact my office again if we may be of assistance on this or any other issue. God bless.

My very best,

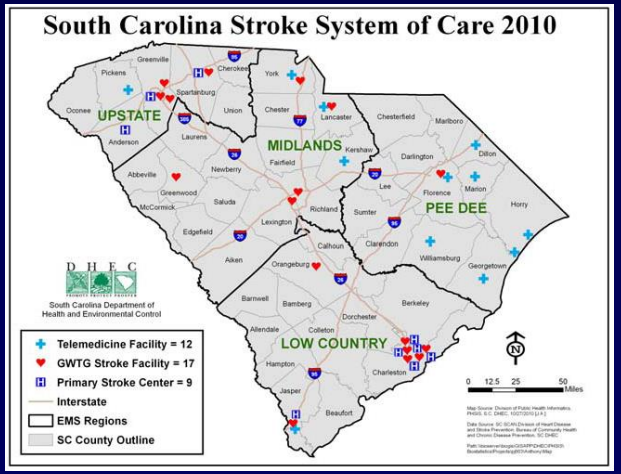
Nikki R. Haley

NRH/jdb



- **The necessary two-thirds vote (42:1) having been received, the veto of the Governor was overridden, and a message was sent to the House accordingly.**
- **Statement by Senator CAMPSEN**

I voted to override the veto of S.588 because of requests from constituents who have been impacted by strokes, and the compelling phone and written communication from Dr. Edward Jauch, Research Director for the Division of Emergency Medicine & Department of Neurosciences at the Medical University of South Carolina, which I have attached below.



Stroke Systems of Care

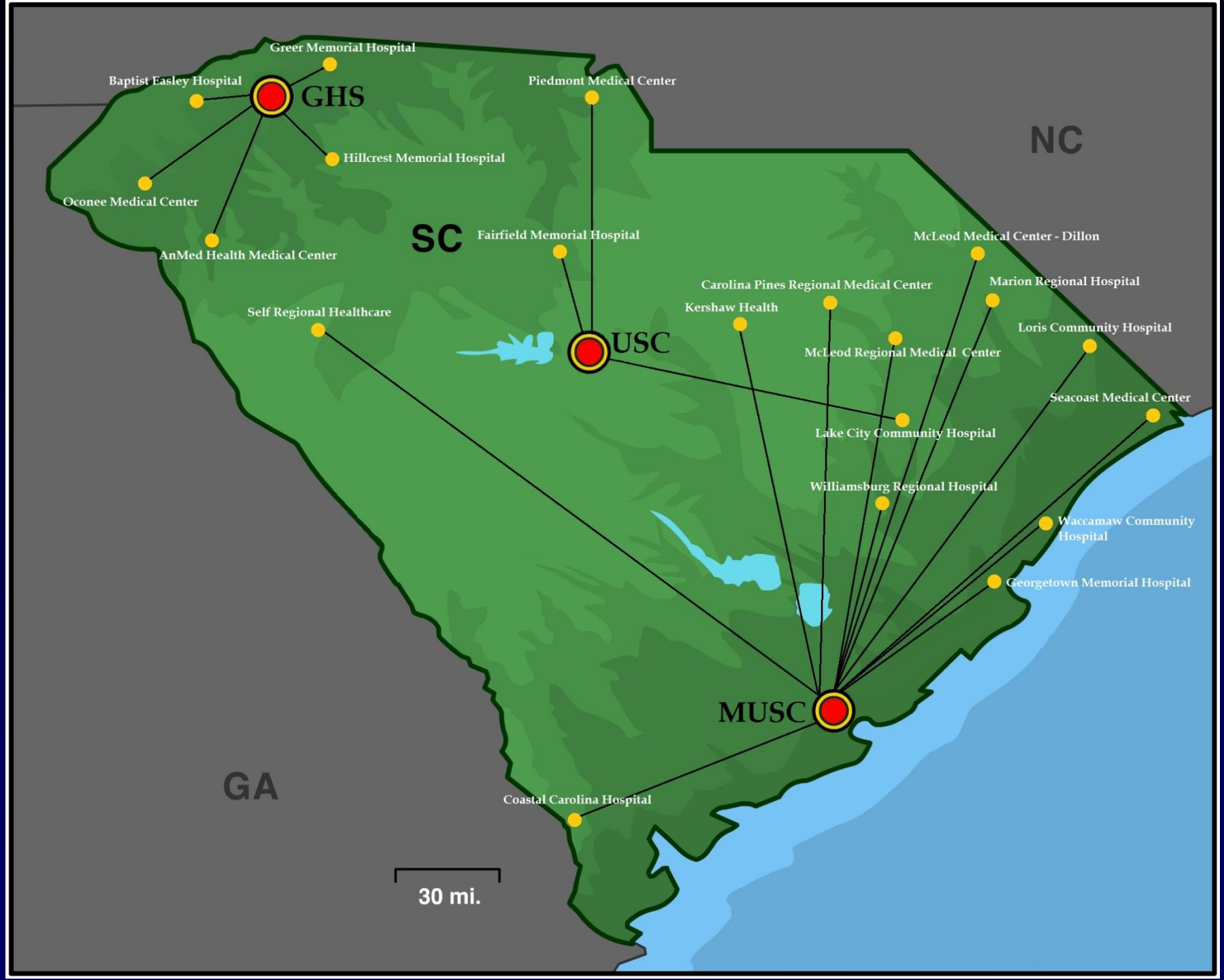
Primary Stroke Center

Comprehensive Stroke Center

Primary Stroke Center

Acute Stroke Ready Hospital

Acute Stroke Ready Hospital

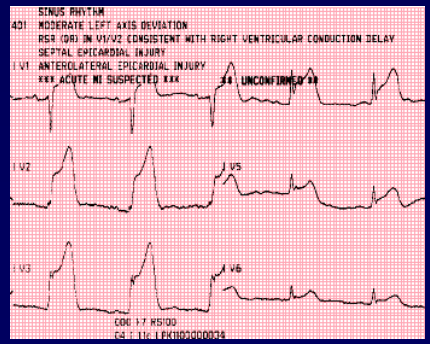

Greer Memorial Hospital
Baptist Easley Hospital
GHS
Piedmont Medical Center
NC
Hillcrest Memorial Hospital
Oconee Medical Center
SC
Fairfield Memorial Hospital
McLeod Medical Center - Dillon
AnMed Health Medical Center
Carolina Pines Regional Medical Center
Marion Regional Hospital
Kershaw Health
Self Regional Healthcare
USC
Loris Community Hospital
McLeod Regional Medical Center
Seacoast Medical Center
Lake City Community Hospital
Williamsburg Regional Hospital
Waccamaw Community Hospital
Georgetown Memorial Hospital
MUSC
GA
Coastal Carolina Hospital
30 mi.

Stroke System Development:
Learn From and Partner With Others

American Heart Association | American Stroke Association

- Provide public education
- Develop regionally specific systems of care
- Identify centers of excellence
- Integrate prehospital care
- Develop strong collaboration with specialists
- Measure quality and performance
- Provide feedback

MISSION: LIFELINE®



Stroke Chain of Survival

American Heart Association | American Stroke Association

- Detection: Early recognition
- Dispatch: Early EMS activation
- Delivery: Transport & management
- Door: ED triage
- Data: ED evaluation & management
- Decision: Neurology input, therapy selection
- Drug: Thrombolytic & future agents
- Disposition: Admission or transfer

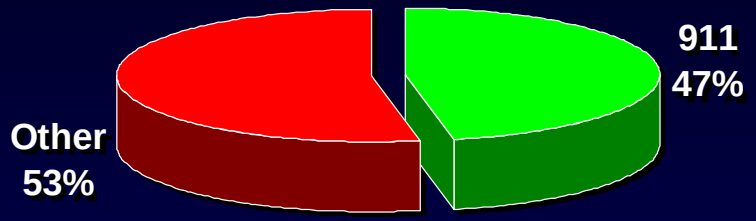
Detection
Ensure Access to EMS and Care

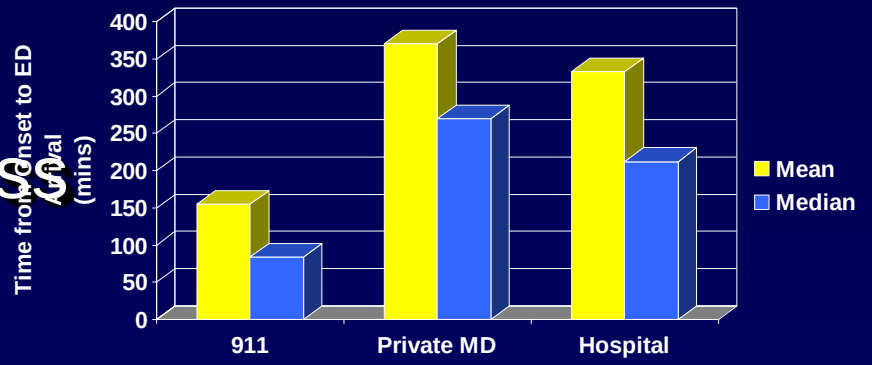
- General patient education on stroke
- Educate public on FAST and need for 911
- Engage medical control and their MD's
- Provide EMS with education and diagnostic tools
  - Prehospital scores
  - Telebat
  - Triage protocols
  - Feedback and training

SPOT A STROKE

Time Delays in Stroke Care

- Only about 25% of stroke patients seek medical care within 6 hours
  - Fewer within 3 hours
  - Lack of 911 use (75%)
- In past EMS did not treat stroke as an emergent illness
- In-hospital delays
  - Worse via the lobby / in house

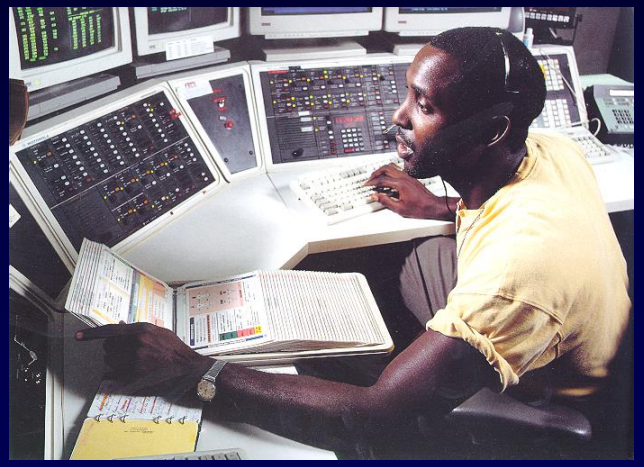




(Barsan, *Arch Int Med* 1993)

Dispatch: 911
Delivery: Transport & Management
Door: Triage

- 911 dispatch
- EMS prehospital interventions
  - Neurologic evaluation / stroke recognition (CPSS, LAPSS, SCENE)
  - Time of onset
  - Medications, history
  - Early hospital prenotification
  - Rapid transport (Air?)
- **Triage** to *most appropriate* stroke hospital



(Silliman, *Stroke*. 2003;34:729 –733)
(Jauch, *Stroke*, 2013)

Cincinnati Prehospital Stroke Scale

Facial Droop

Normal: Both sides of face move equally
Abnormal: One side of face does not move at all

Arm Drift

Normal: Both arms move equally or not at all
Abnormal: One arm drifts compared to the other

Speech

Normal: Patient uses correct words with no slurring
Abnormal: Slurred or inappropriate words or mute

STROKE ALERT / SCENE* TOOL PREHOSPITAL CHECKLIST

*South Carolina Emergency Neurologic Evaluation

DATE & TIMES				
Date:	Dispatch Time:	EMS Arrival:	EMS Departure:	ED Arrival:

BASIC DATA						
Patient name			Age		Gender	
Witness Name			Witness Phone			
Chief Complaint			SBP		DBP	
Last Time Normal		Glucose	Pulse		Resp	

FAST NEUROLOGIC EXAM (Positive if any abnormal)	YES	NO
Facial Droop (Smile, show teeth)		
Arm Drift (Extend both arms, eyes closed)		
Speech ("You can't teach an old dog new tricks")		
STROKE ALET CRITERIA	**YES**	**NO**
Time of onset < 8 hours		
Positive FAST		
Blood glucose > 60 mg/dL (if fingerstick possible)		

If positive FAST and YES to all Stroke Alert Criteria,
transport to nearest stroke capable hospital and call Stroke Alert.
Minimize scene time and transport patient urgently.

Destination Hospital:		Hospital Contact:	

PAST HISTORY / MEDICATIONS / ALLERGIES			
Recent events:	PMH:	Medications:	Allergies:

MANAGEMENT REMINDERRS

Do not treat hypertension
Do not allow aspiration (keep NPO)
Provide oxygen (if O2 sat < 94%)
Do not administer glucose (unless glucose < 60 mg / dL)

STROKE SPECIFC REPORT TO EMERGENCY DEPARTMENT

BASIC DATA	SYMPTOMS	HISTORY	EXAM
• Age • Gender • Chief complaint	• Last normal • Trauma • Seizure • Headache	• Recent surgery • Recent illness • Medications • VS & glucose	• GCS • FAST Scale • Other

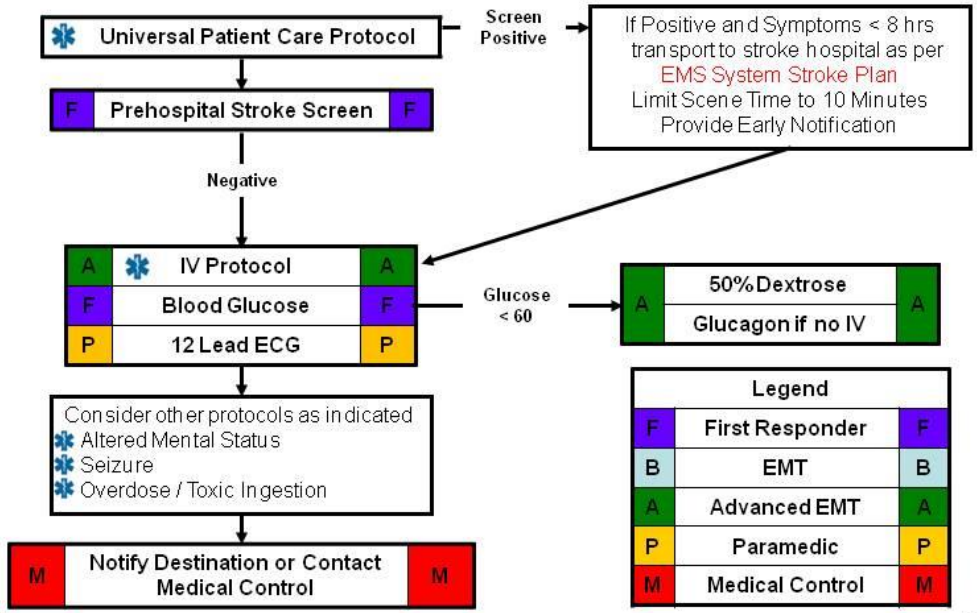
Ver 1.2 ecj

Suspected Stroke

History
- Previous stroke or TIA
- Previous cardiac / vascular surgery
- Associated diseases: atrial fibrillation, CAD, DM, hypertension
- Medications
- History of recent trauma

Signs & Symptoms
- Altered mental status
- One-sided weakness
- One-sided sensory loss
- Vision changes, blindness
- Vertigo / dizziness
- Seizures
- Vomiting
- Headache

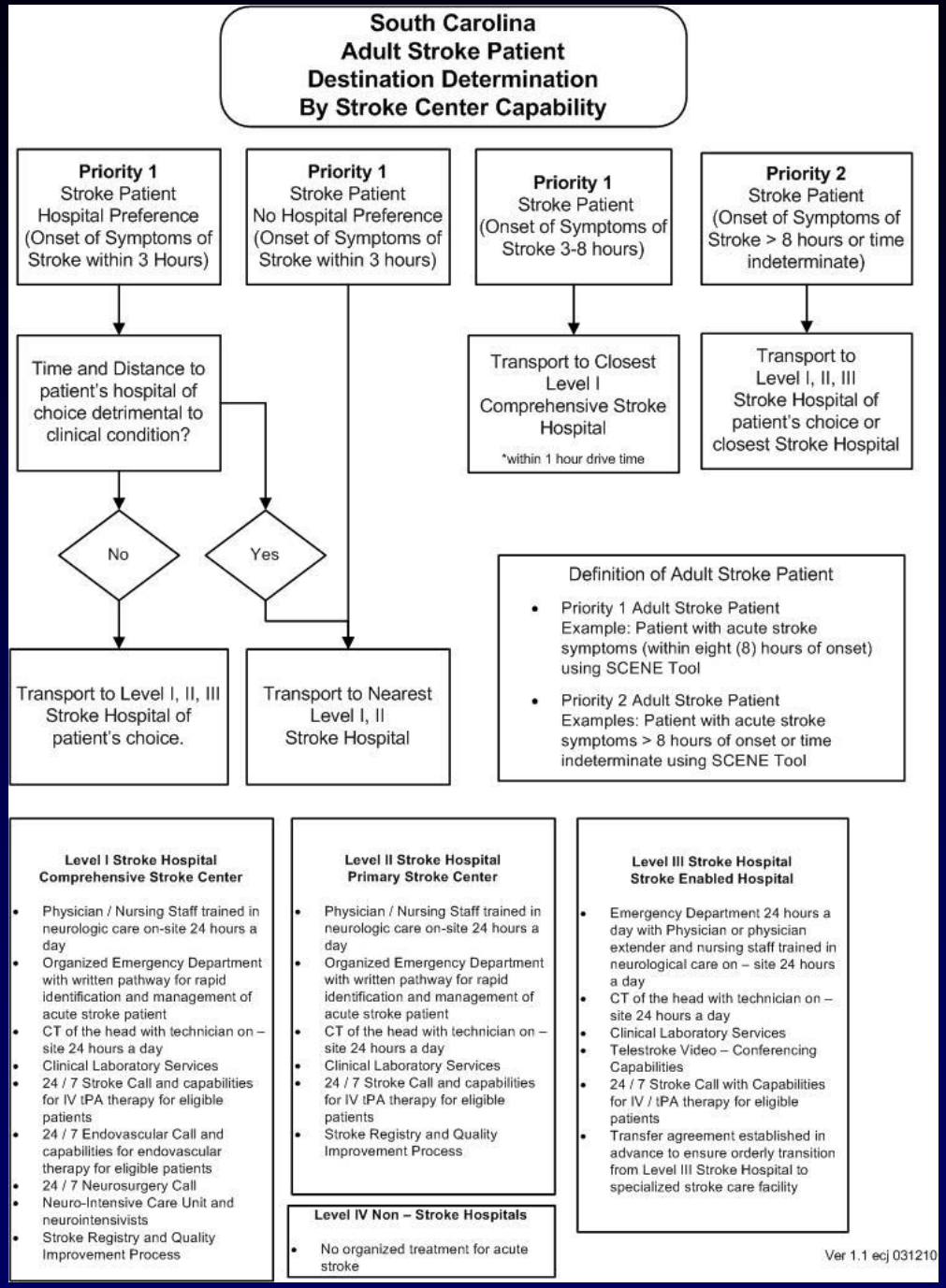
Differential
- See Altered Mental Status
- Stroke
- Transient ischemic attack
- Hypoglycemia
- Seizure
- Trauma
- Tumor



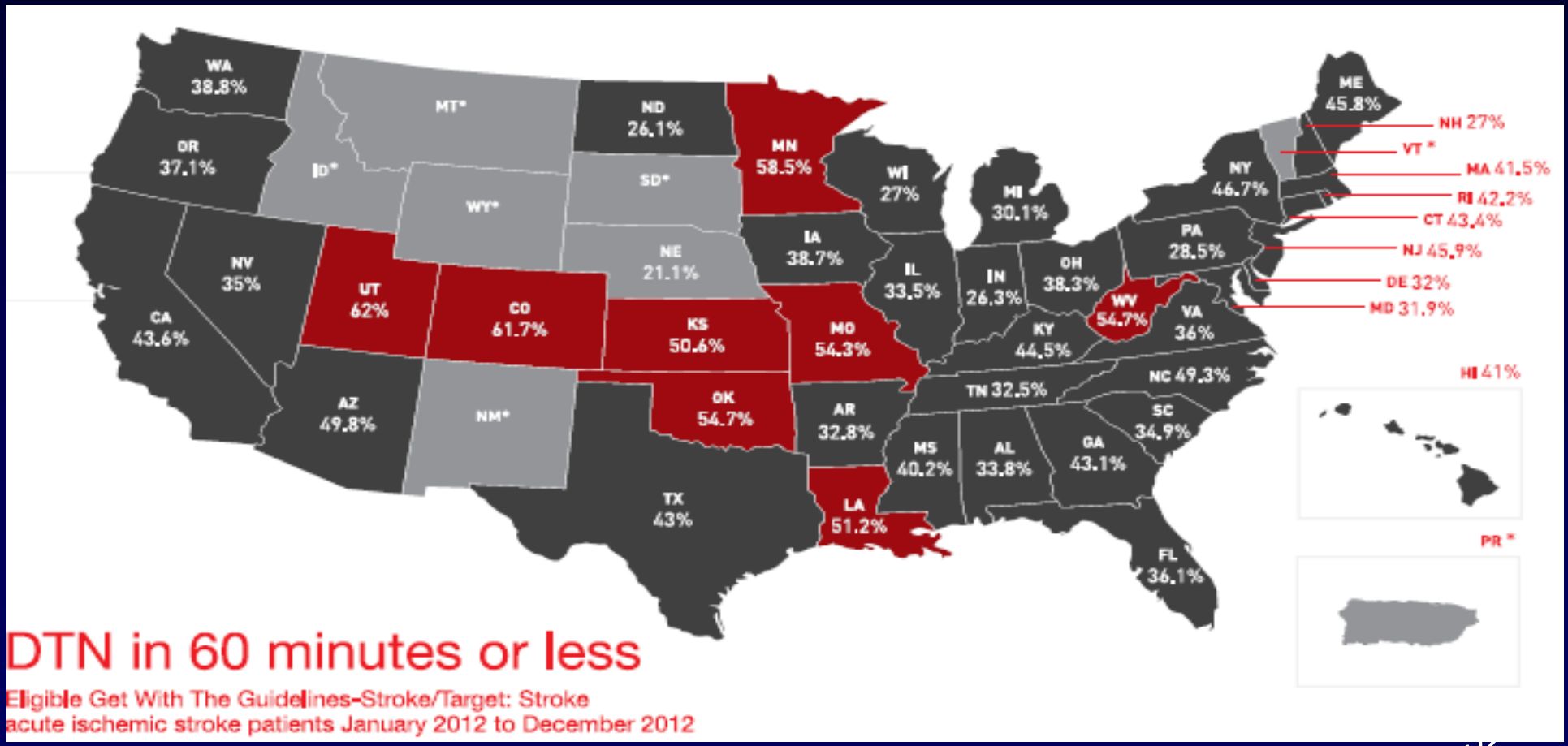
Pearls
- Items in Red are key performance measures used in the EMS Acute Stroke Care Toolkit
- Stroke Center destination hospitals should be identified in the region according to SC DHEC standards
- Recommended exam: Mental status, HEENT, lungs, heart, abdomen, extremities, neuro
- The Reperfusion checklist should be completed for any suspected stroke patient. With a duration of symptoms < 8 hours, scene times should be limited to 10 mins. Early destination notification/activation should be provided and transport time minimized based on EMS System Stroke Plan
- Onset of symptoms is defined as the last witnessed time patient was symptom free
- Hypoglycemia can present with localized neurologic deficits
- Document the SCENE Tool in the PCR

EMS Triage

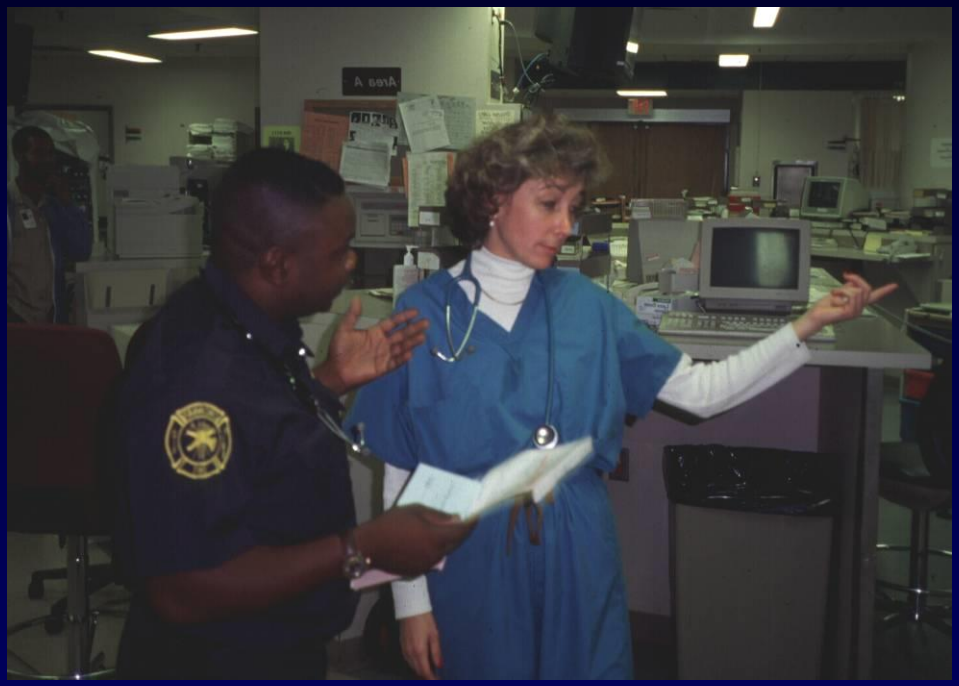
- Increasingly complex
  - Tiers of stroke care
  - Time windows
  - IV / IA potential
  - Stroke severity
  - Transport distances
  - Currently available resources



Delivery: Prompt Transport & Pre-arrival Notification



“Typical” ED Response



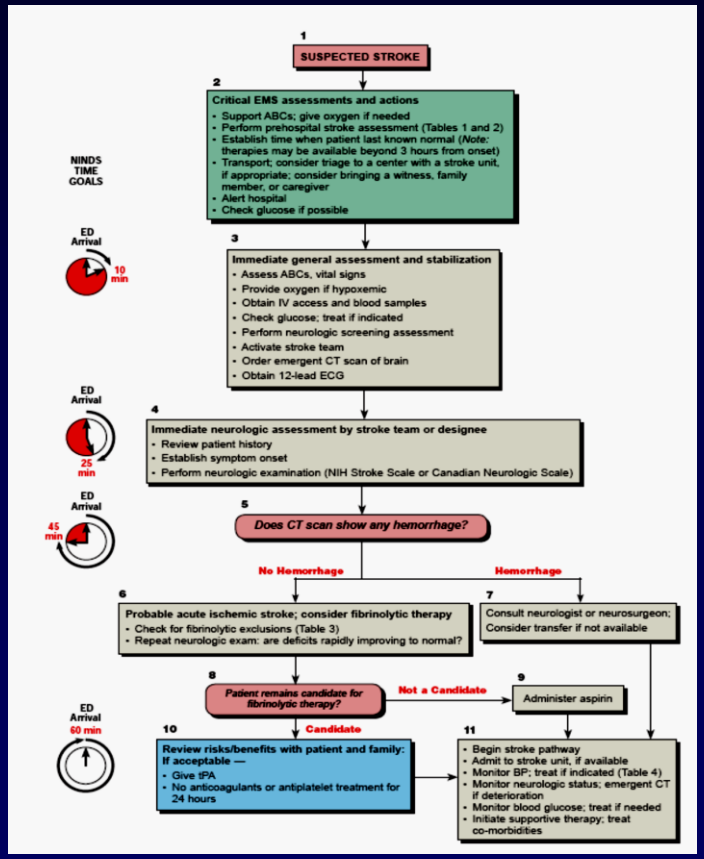
EMS – rush rush rush

ED – take stretcher in the hallway

Door: Emergent Triage
Data: ED Evaluation (Triad)

NINDS Recommendations and AHA/ ASA & ACLS Guidelines

- Door-to-MD: 10 minutes
- Door-to-Stroke Team notification: 15 minutes
- Door-to-CT scan: 25 minutes
- Door-to-Needle: 60 minutes
- Door-to-Admission: 3 hours



(NINDS National Symposium on Acute Stroke, 2003)
(Jauch, ACLS *Stroke.* 2010)
(Jauch, *Stroke*, 2013)

Data: Collection & Preparation

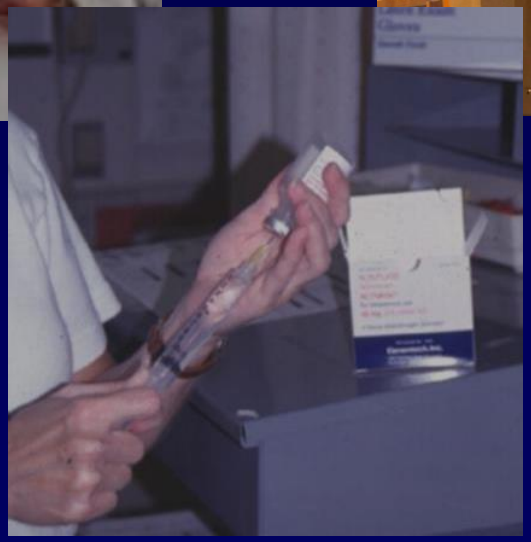
- Check glucose & labs
- Two large IV lines
- Oxygen as needed
- Cardiac monitor
- Continuous pulse-ox
- Stat non-contrast CT scan
- Begin general management
- Activate “Stroke Team”
- Confirm onset
- Perform neuro exam
- Get “real” rt-PA
  - Prepare to mix
  - Have pharmacy alerted
- Discuss with patient and family potential treatments

Imaging and Interpretation

- Neuro-imaging protocols
  - 24 / 7 availability & priority
  - CT staff on stroke pager
  - Priority scan & interpretation
- CT / MR
  - Use nearest scanner
  - CT/CTA/CTP increasingly common but do not slow IV tPA

(Patel, *JAMA* 2001:286;2830-2830)
(Nedeltchev, *Stroke* 2003:34:1230-1234)

Decision: Team Approach
Drug: IV, IA, Mechanical, Other



General Stroke Management

- Cardiac monitor
  - Observe for ischemic changes or atrial fibrillation
- Intravenous fluids
  - Avoid D5W and excessive fluid administration
  - IV normal saline at 50 cc / hr unless otherwise required
- NPO
  - Aspiration risk, avoid PO until swallowing assessed
- Blood pressure
  - No prehospital intervention
  - Function of fibrinolytic eligibility
  - Without tPA modest reduction ~15% in 24 hrs

Current Treatment Options

- Physiologic optimization
- No thrombolytics
  - Aspirin
- Intravenous rt-PA
- Other investigational treatment
  - Intra-arterial thrombolysis
  - Low dose IV rt-PA followed by IA rt-PA
  - Thrombectomy
  - Other

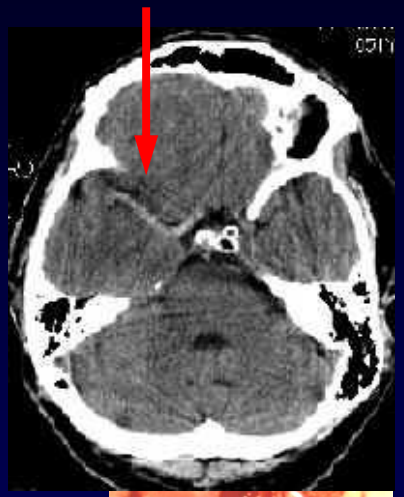
Recanalization Strategies

- FDA cleared interventions:
  - IV tPA (0-3 hours) Approved 1996
  - IV tPA (3-4.5 hours) Denied request 2012
  - Thrombectomy devices Cleared for clot removal

Time Window	0-3 hrs	3-4.5 hrs	3-6 hrs	Up to 8 hrs
Options	• IV tPA • Device	• IV tPA •Device	• IA Lytic • Device	• Device

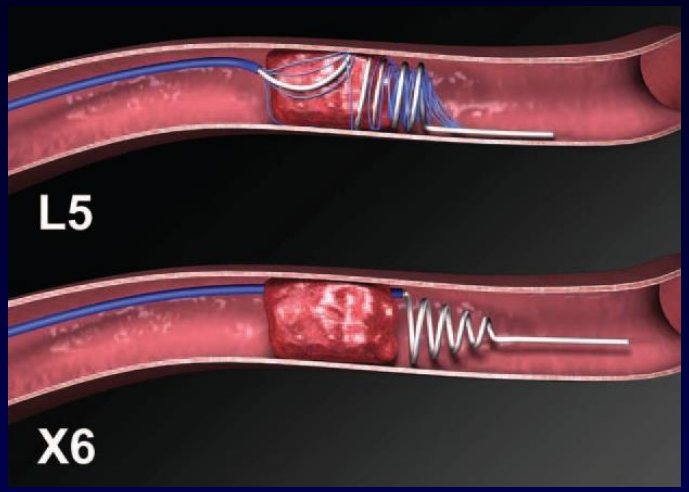
Limitations of IV tPA

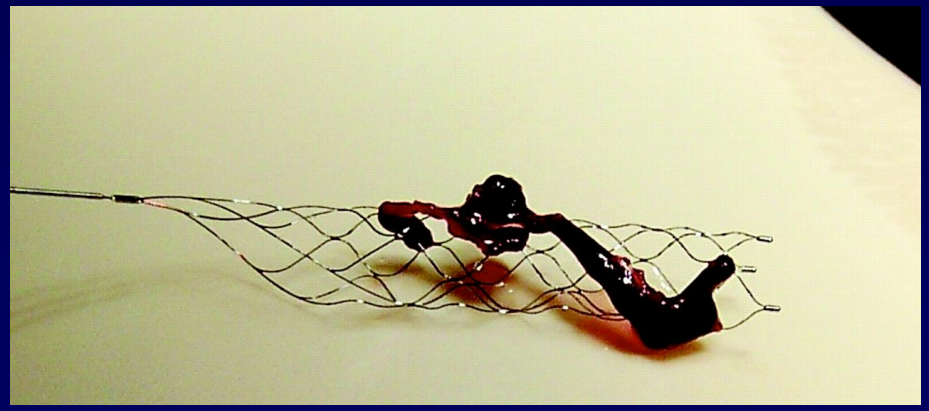
- Generalizability
  - 4% utilization of tPA
  - ~25% present within 3 hours; 29% eligible
- Big stroke are tough
  - Baseline NIHSS >10 and a dense MCA sign predicted poor clinical outcome
  - Recanalization rate at very best 30% for large vessel occlusion
- Sustained recanalization in only 10-20%
- Increased risk of sICH with larger strokes

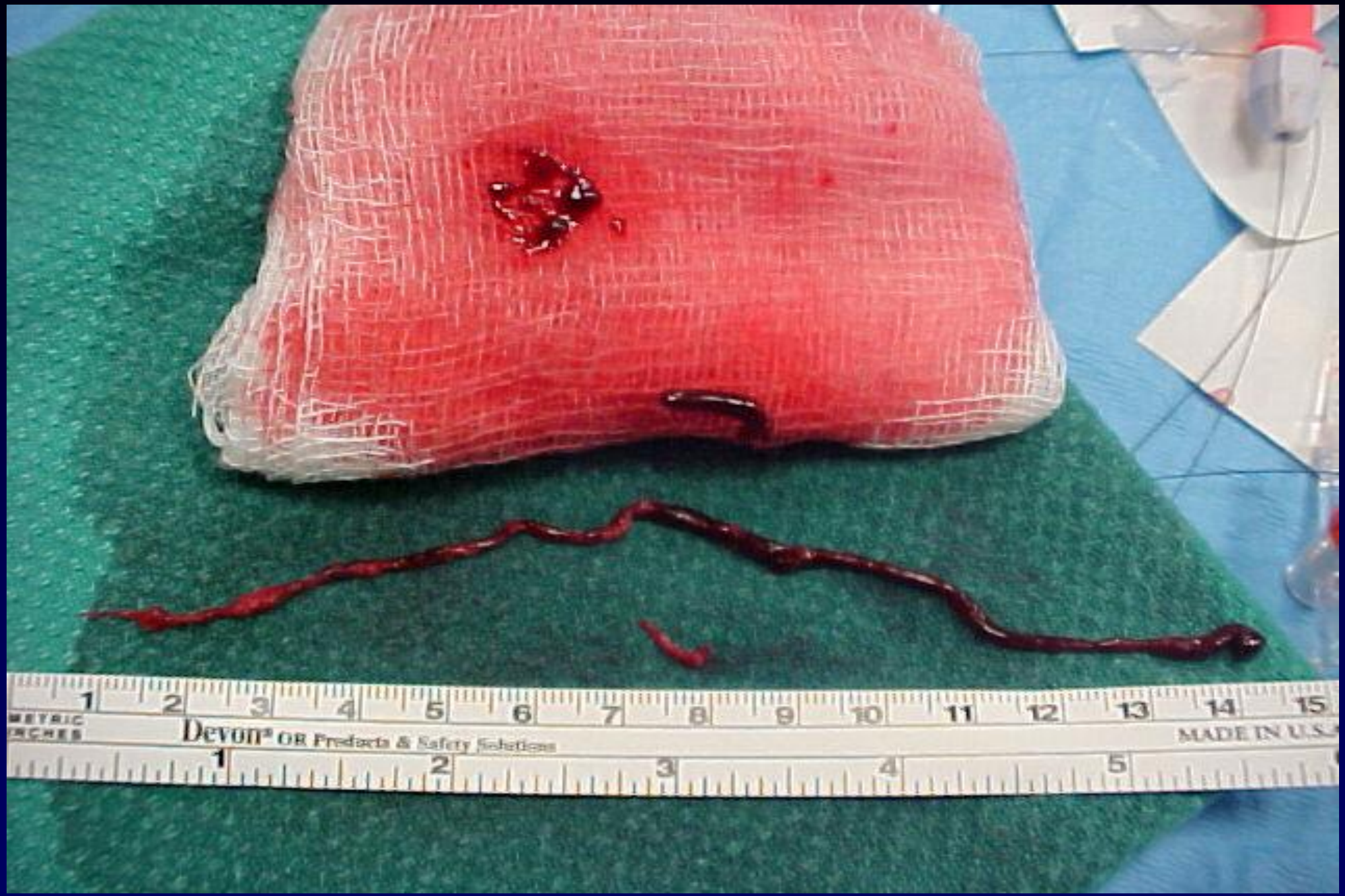


(Kleindorfer *Stroke* 2004; 35:27-29)
(Tomsick. AJNR 1996; 17:79-85)
(Genentech, Summary basis for Activase approval. NDA. PLA96-0350)
(Alexandrov. *NEJM* 2004;10:1379-83)

Intra-Arterial Strategies

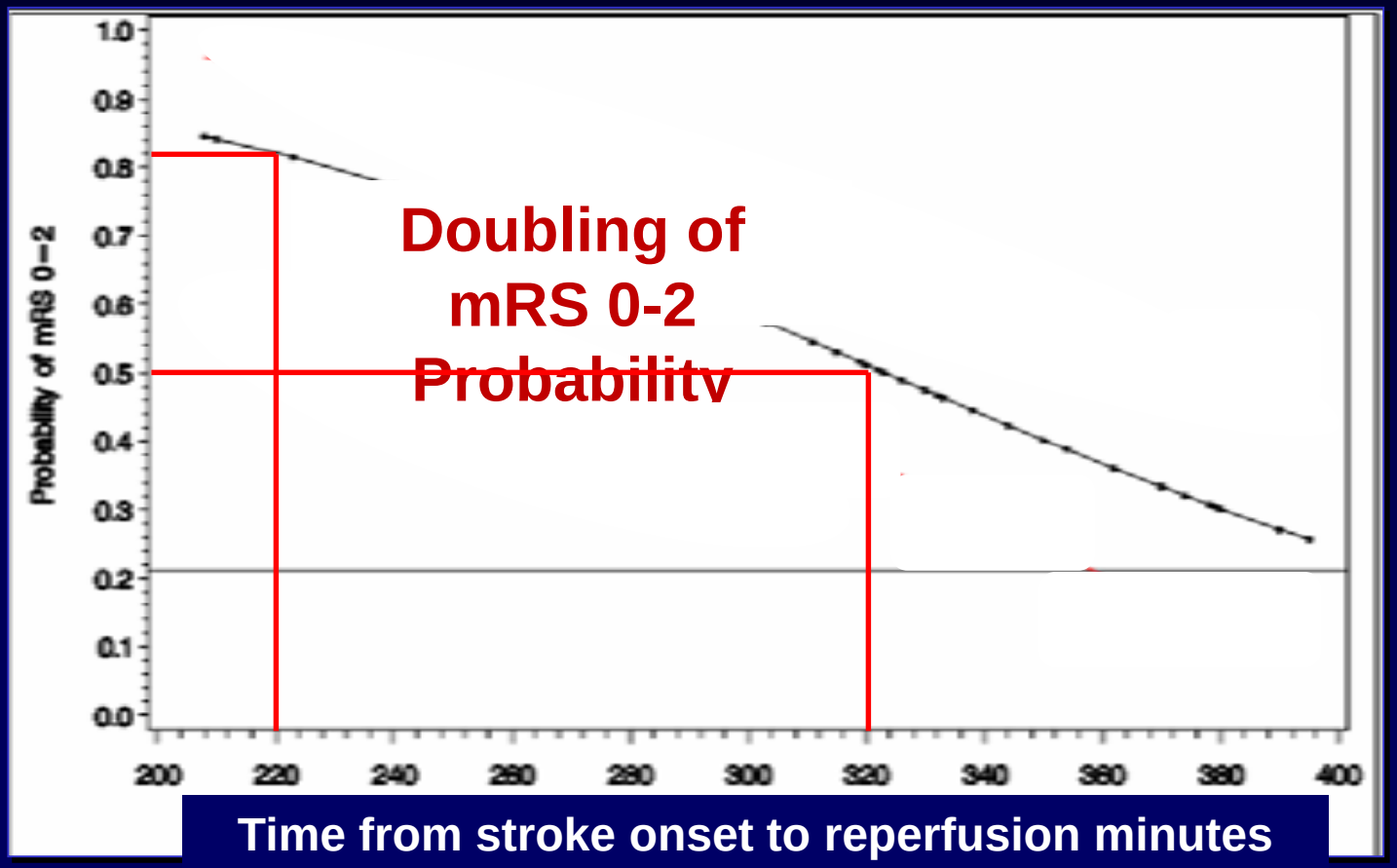





Devon OR Products & Safety Solutions
MADE IN U.S.

Reperfusion Time and Outcome

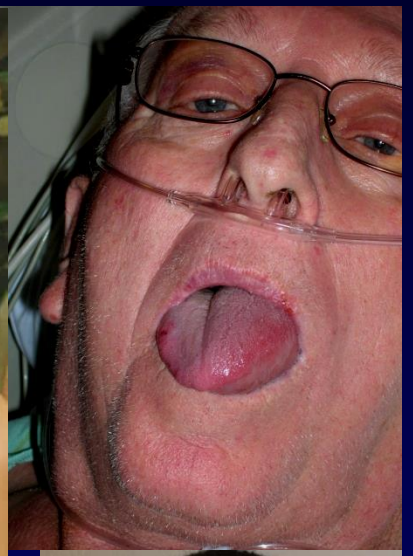
- OTD 150’
- Now
  - DTN 78’
  - NTG 86’
  - DTG 166’
- Possible
  - DTN 30’
  - NTG 30’
  - DTG 60’
  - Save 106’



(Khatri, ISC 2008 New Orleans)

Other Considerations

- Comorbidity management
  - CHF AMI Aortic dissection
- Complication management
  - Angioedema
  - Respiratory compromise
  - Bleeding / hypotension
  - Malignant cerebral edema
- No inpatient beds



Disposition: Early Stroke Care

- Begin Acute Stroke Pathway
- ICU / Stroke Unit admission *now*
  - 24 hrs for tPA
  - Q 15’ X 6 hours, Q 1^{o}x18 hours
- Facilitate medical or surgical measures to improve outcome after stroke
  - Optimize blood pressure, glucose, temp
- Begin to prevent subacute complications
- Plan for long-term therapies to prevent recurrent stroke
- Start efforts to *restore* neurological function

(Summers, *Stroke*. 2011)
(Jauch, *Stroke*. 2013)

Pay Attention to the Transfer

- Plan ahead!
  - Know who, how and when
  - Train on post-tPA protocol
    - Blood pressure & bleeding precautions
    - Angioedema
    - Follow the neuro exam
    - Ensure communication en route
  - Know where to go when you get there
  - Like prehospital EMS, provide feedback

The Future of Stroke Treatment

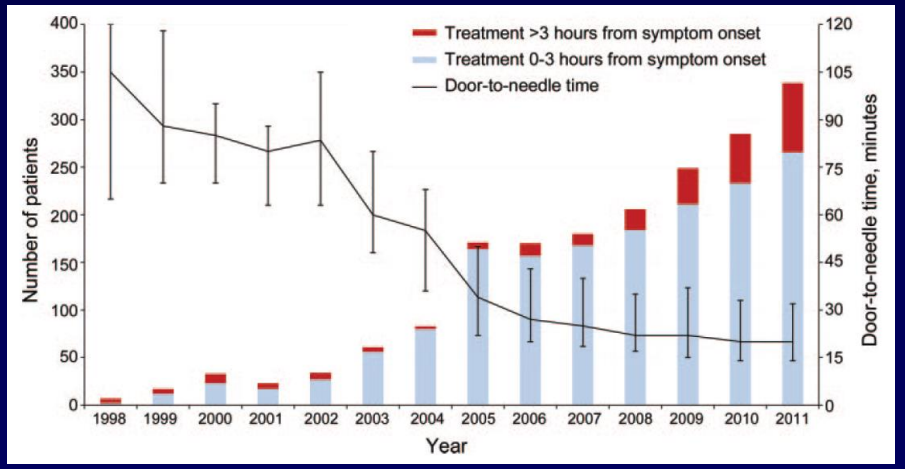
- ***Prevention Prevention Prevention***
- Quality and Process Improvement (GWTG)
- Increased public education and EMS integration
- Stroke Systems — ASRH, PSC, CSC
- Refining and defining windows
- New diagnostic tools — Neuroimaging, markers
- Reperfusion
  - Thrombolytics — ProUK, TNK, rPA, Ancrod
  - Intra-arterial approaches — IA, devices, stents
  - Combination agents — Antiplatelets, LMWH
- Cerebral protection — Hypothermia, HBO, neuroprotection
- Surgical — Hemicraniectomy, cell transplant
- Rehabilitation — Constraint therapy

What Is the World Doing?

- Finland
  - Government led plan
  - One CSC for the entire city and resourced appropriately
- India
  - State-based stroke organization (preliminary)
  - Prevention focus – the “polypill”
- Brazil
  - Governmental negotiated pricing for rtPA / free to hospitals
- England
  - Government defined clinical and research stroke centers

Learn From Finland –
Where There is a Will ….

- Funnel *all* to a well resourced institution
  - No PSC or CSC, all go to Helsinki University Hospital
  - 24/7 neurology presence in ED
  - Proximate CT
- Act on encode
  - EMS talks to neurologist
  - Clinical history from EMR
  - Premix tPA
  - Bolus while in CT

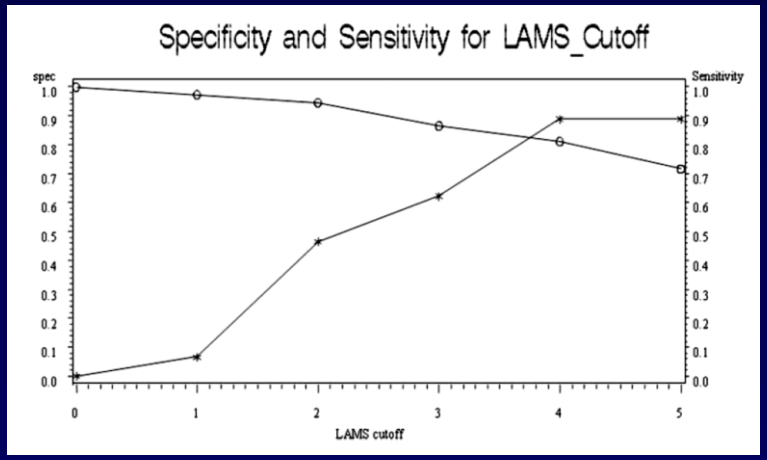


(Meretoja, *Neurology.* 2012;79:306-313)

Enhanced Prehospital Triage

- Like trauma and STEMI systems, triage based on specific patient characteristics
  - Severity, comorbidities, medications, etc

LAMS	
Facial droop	0,1
Arm drift	0,1,2
Grip strength	0,1,2



Prehospital Stroke Scale Identifies Large Arterial Occlusions

LAMS ≥ 4	
Sens	0.81
Spec	0.89
P/NLR	7.36 / 0.21

NIHSS ≥ 11	
Sens	0.91
Spec	0.87

(Nazliel, *Stroke.* 2008;39:2264-2267)

Prehospital Stroke Research

- Diagnosis
  - Stroke score tool (MUSC, Vanderbilt, UT)
  - Telemedicine
  - Ultrasound
- Therapeutic interventions
  - FAST-MAG
    - 1298 pts; 2^{o} from onset
  - Stroke Emergency Mobile Unit (STEMO)
    - Cuts DTN by 1/3rd

Learn From Industry –
Toyota Value Stream Analysis

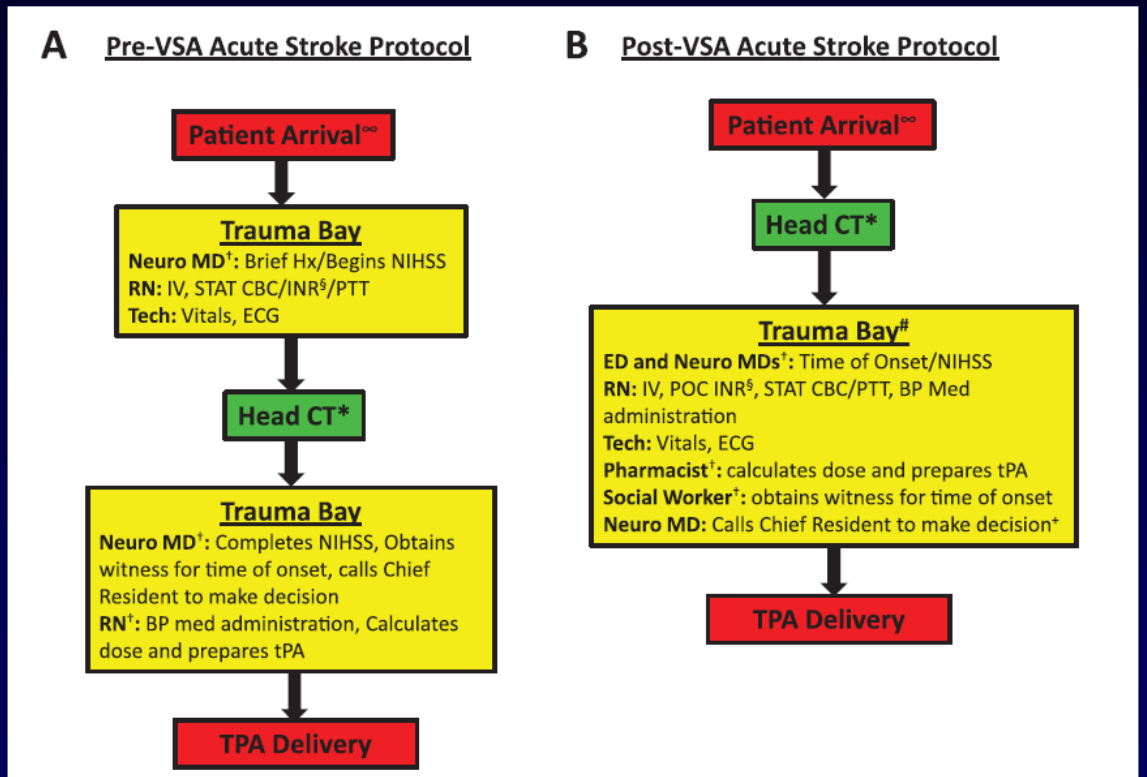


Table 2. Protocol Metrics and Outcomes Pre- and Post-VSA

	Pre-VSA January 1, 2009, to February 28, 2011 (N=132)	Post-VSA March 1, 2011, to March 1, 2012 (N=87)	*P* Value
Door-to-needle time, min*	60 [46–73]	39 [28–56]	<0.0001
Percent patients with DNT ≤60 min	52%	78%	<0.0001
Onset-to-needle time, min*	131 [105–165]	111 [80–158]	0.016
Door-to-CT time,†, min*	16 [10–22]	1 [0–4]	<0.0001
Door-to-CBC time,† min*	22 [16–29]	24 [17–34]	0.13
Door-to-PTT time,† min*	34 [29–42]	40 [31–47]	0.14
Symptomatic ICH	3.0%	3.4%	1.0
Favorable discharge location‡	76%	83%	0.24
90-d mRS 0 to 2§	49%	43%	0.34
Length of hospital stay, d*	4 [3–7]	3 [2–6]	0.056
Stroke mimic	6.8%	11.5%	0.33

(Ford, *Stroke*. 2012)

Education for Providers

American Heart Association | American Stroke Association

- **Acute stroke online**
  - Stroke chain of survival
  - Pathophysiology
  - Transition to critical care and rehabilitation
  - Definitions of stroke types
  - Stroke risk factors, recognition, management
- **Stroke Pre-hospital care online**
  - Pathophysiology
  - Differential diagnosis
  - Assessment
  - Risk factors
  - Recognition
  - Management

The Future: Integration of Care

Prompt Recognition
911 Activation
Priority Dispatch

Diagnosis and Treatment During Transport

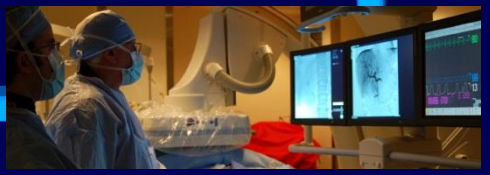
EMS Triage to Regional Stroke Center

Advanced Brain Imaging / Diagnostic Markers

Computer Assisted Therapy

Nerve growth stimulants

Admit to Stroke Unit / NSICU



Thrombolytic and Neuroprotective Drugs / Reperfusion Strategies

Full Recovery

Prevention Strategies

Stroke Best Practice

1. Prehospital stroke tools
2. Advance hospital notification by EMS
3. Rapid triage and Stroke Team notification (single call)
4. Transfer Directly to CT Scanner
5. Rapid acquisition and interpretation of brain imaging
6. Rapid laboratory testing
7. Rapid access to IV rtPA (premix)
8. Team-Based approach
9. Prompt feedback and continuous quality improvement
10. Share successes widely and be proud of your contribution

Summary

- EMS is the critical first step in acute stroke care
- Most if not all neurologic emergencies will have very narrow therapeutic windows
- Reperfusion is essential but general physiologic management equally important
- Prehospital care plays a key role in acute stroke systems of care regionally and is *the* most important partner in the system.

Thanks to My Teammates