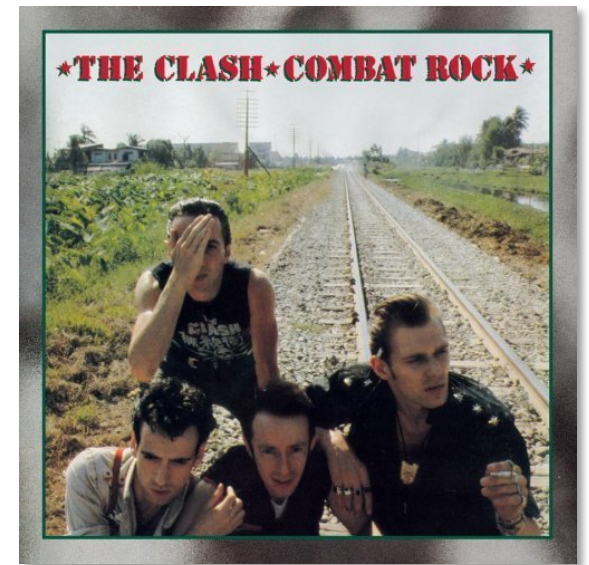




# Stroke in 2019: *Should I Stay or Should I Go?*

Opeolu Adeoye, MD  
Edward Jauch, MD MS

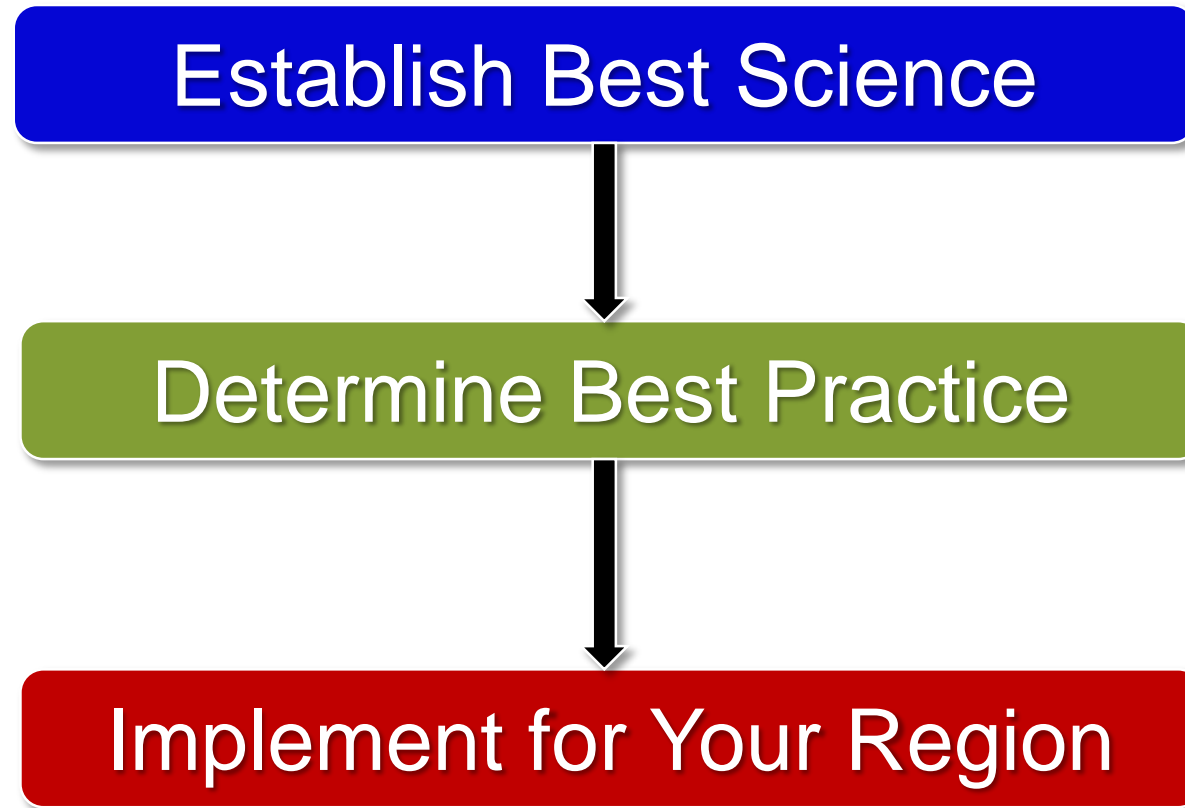


# Objectives

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- Review the basics and the evolving standard of care for ischemic stroke, especially with new advances for large vessel occlusions
- Discuss creating regional, local, and internal stroke systems of care to optimize patient care
- Discuss the prehospital setting and issues associated with assessment and triage
- Discuss opportunities and challenges in interfacility transfer

# Science Translation: From Bench to Bedside

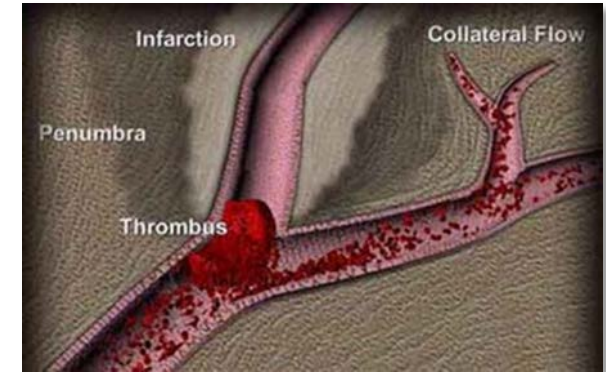


Establish Best Science

# Lessons Learned Over 20 Years

---

- Reperfusion critical
  - Minimize delay
  - Maximize penumbral salvageability
    - Collateral flow
    - Physiologic optimization
- Time to reperfusion
  - Predicts clinical outcomes
  - Significant tolerance-heterogeneity in populations
  - *Should* drive all system development



# Time to Treatment STTC and HERMES Collaborations

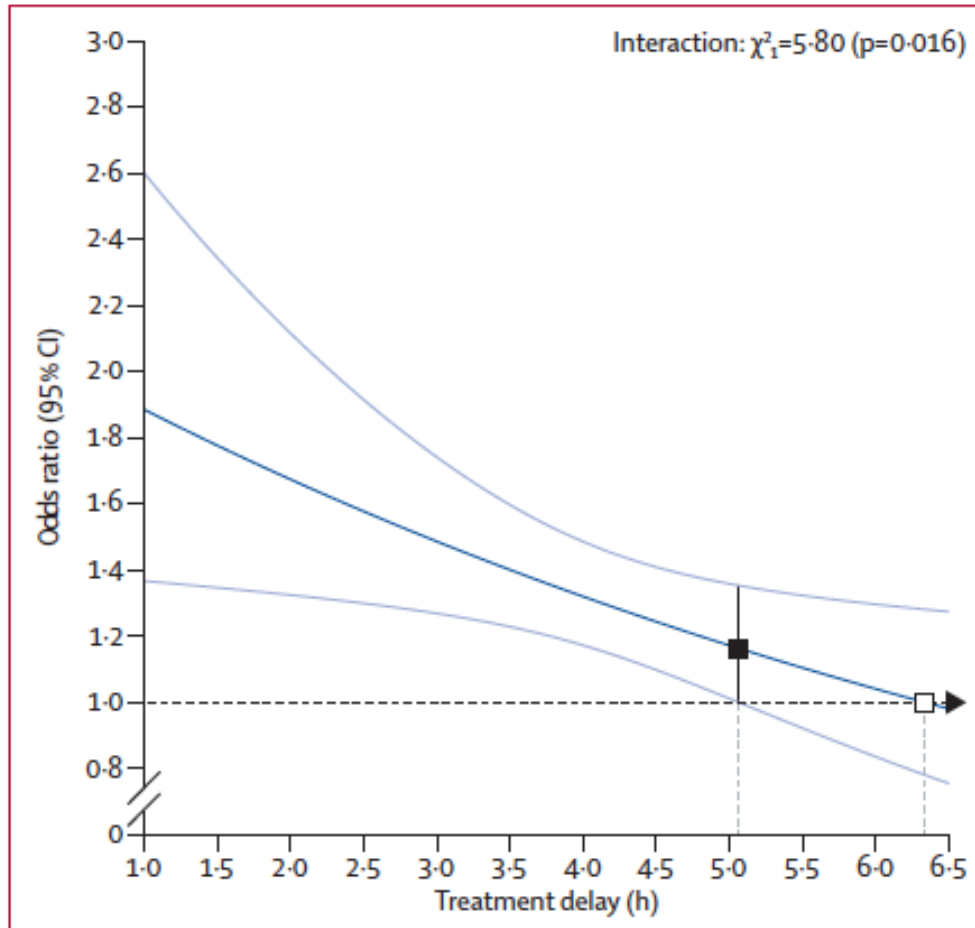
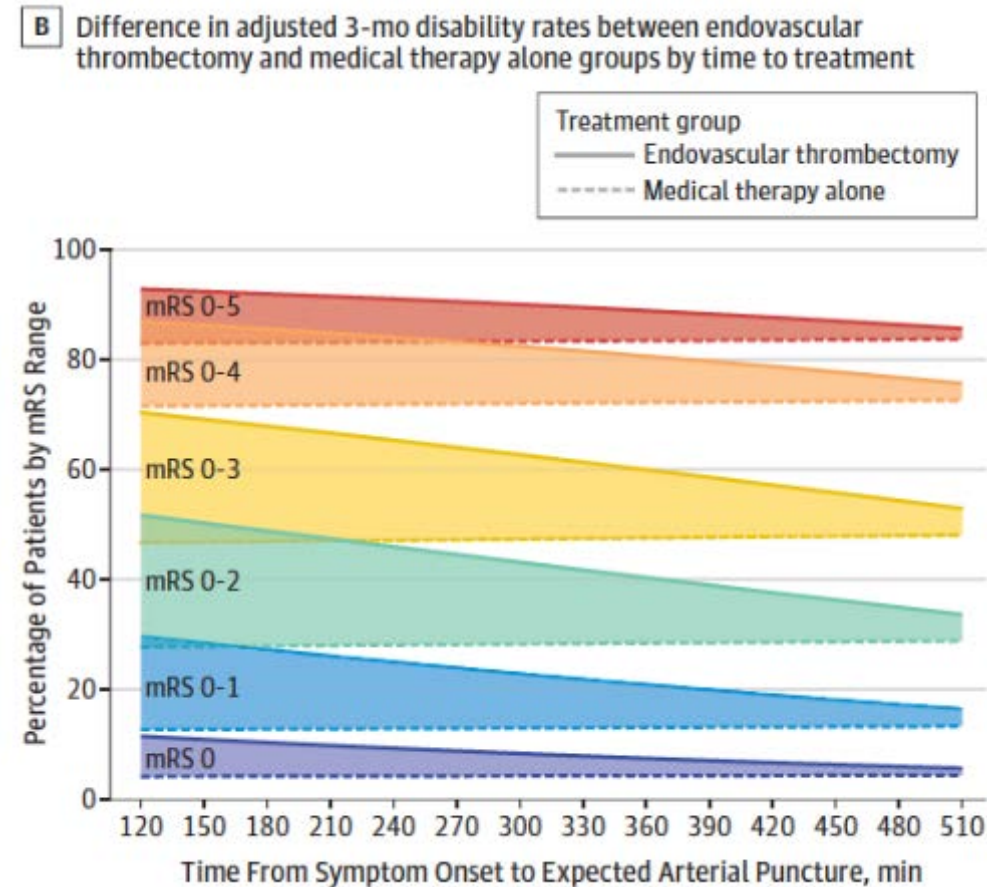


Figure 1: Effect of timing of alteplase treatment on good stroke outcome (mRS 0-1)



(Emberson. *Lancet*. 2014;384:1929-1935)  
 (Saver. *JAMA*. 2016;316(12):1279-1288)

# So, If Time Matters for the Brain

---

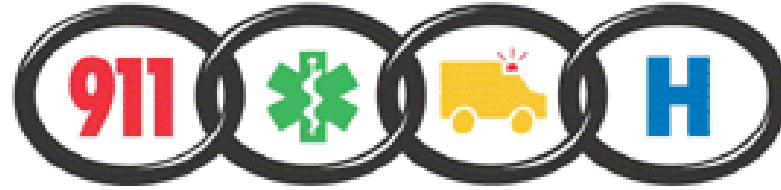
- Focus on what matters, *timely*:
  - Stroke awareness and recognition
  - EMS activation and transport
  - Initial reperfusion strategies
  - Initiation of secondary prevention strategies
  - Rehabilitation evaluation and initiation
  - Prevention of complications
  - Patient and family engagement

Establish Best Science

```
graph TD; A[Establish Best Science] --> B[Determine Best Practice]
```

Determine Best Practice

# Stroke Chain of Survival



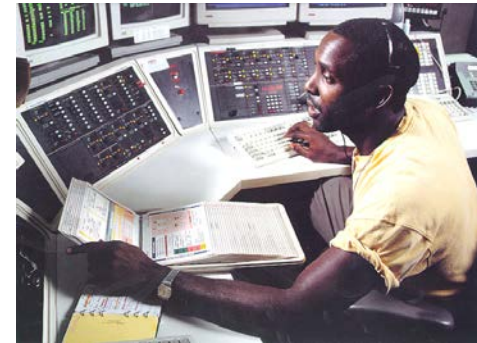
- Detection: Early recognition
- Dispatch: Early EMS activation
- Delivery: Transport & management
- Door: ED triage
- Data: ED evaluation & management
- Decision: Neurology input, therapy selection
- Drug: Thrombolytic & future agents
- Disposition: Admission or transfer

Dispatch: 911

Delivery: Transport & Management

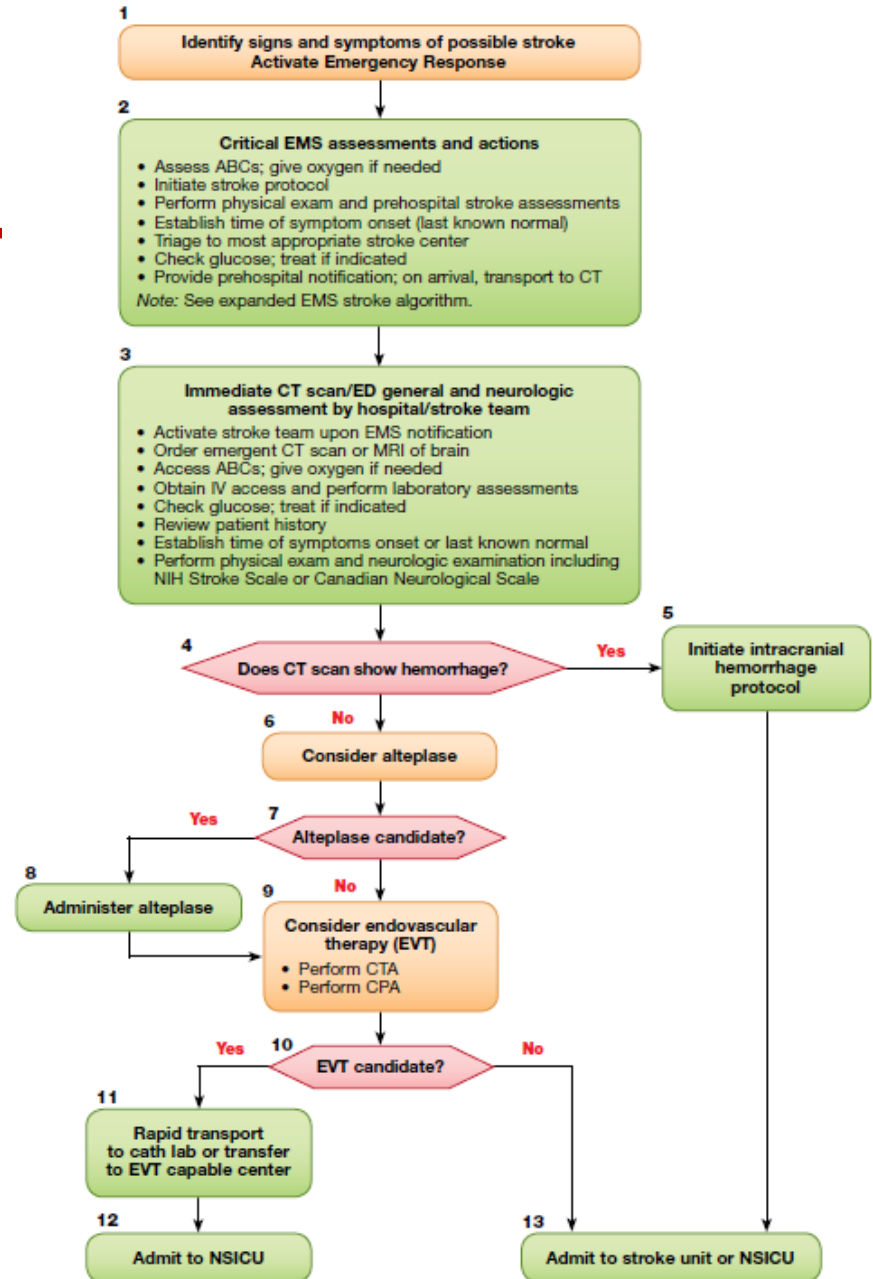
Door: Triage

- 911 dispatch / EMD
- EMS prehospital interventions
  - Neurologic evaluation / Screen / Score
  - Time of onset / Last known normal
  - Glucose
  - Early prehospital notification
  - Means of transport (air medical?)
  - Transport family
- Triage to the most *appropriate* stroke center for the patient and your region



# Next Iteration

- Incorporate
  - Target Stroke I, II, III
  - Mission Lifeline: Stroke
  - 2018 Guidelines



# Stroke Clinical Tools for EMS

---

## Stroke Scales

Cincinnati Prehospital Stroke Scale (CPSS / FAST)

Los Angeles Prehospital Stroke Screen (LAPSS)

Melbourne Ambulance Stroke Screen (MASS)

Miami Emergency Neurologic Deficit Score (MENDS)

Recognition of Stroke in the Emergency Room Score (ROSIER)

## Stroke Scores

National Institute of Health Stroke Scale (NIHSS)

sNIHSS –5 / 8

Cincinnati Prehospital Stroke Severity Screen (CPSSS)

Field Assessment Stroke Triage for Emergency Destination (FAST-ED)

Los Angeles Motor Scale (LAMS)

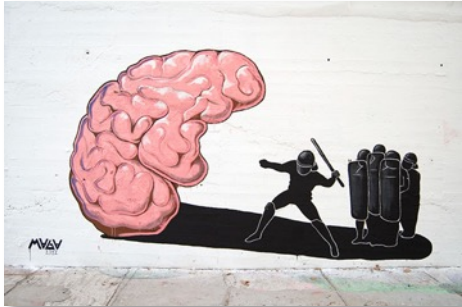
Rapid Arterial Occlusion Evaluation Score (RACE)

Three Item Stroke Scale (3ISS)

For LVO: AUC 0.803-0.821 (CI 0.767-0.857)

# Door: Emergent Triage

# Data: Emergent Evaluation



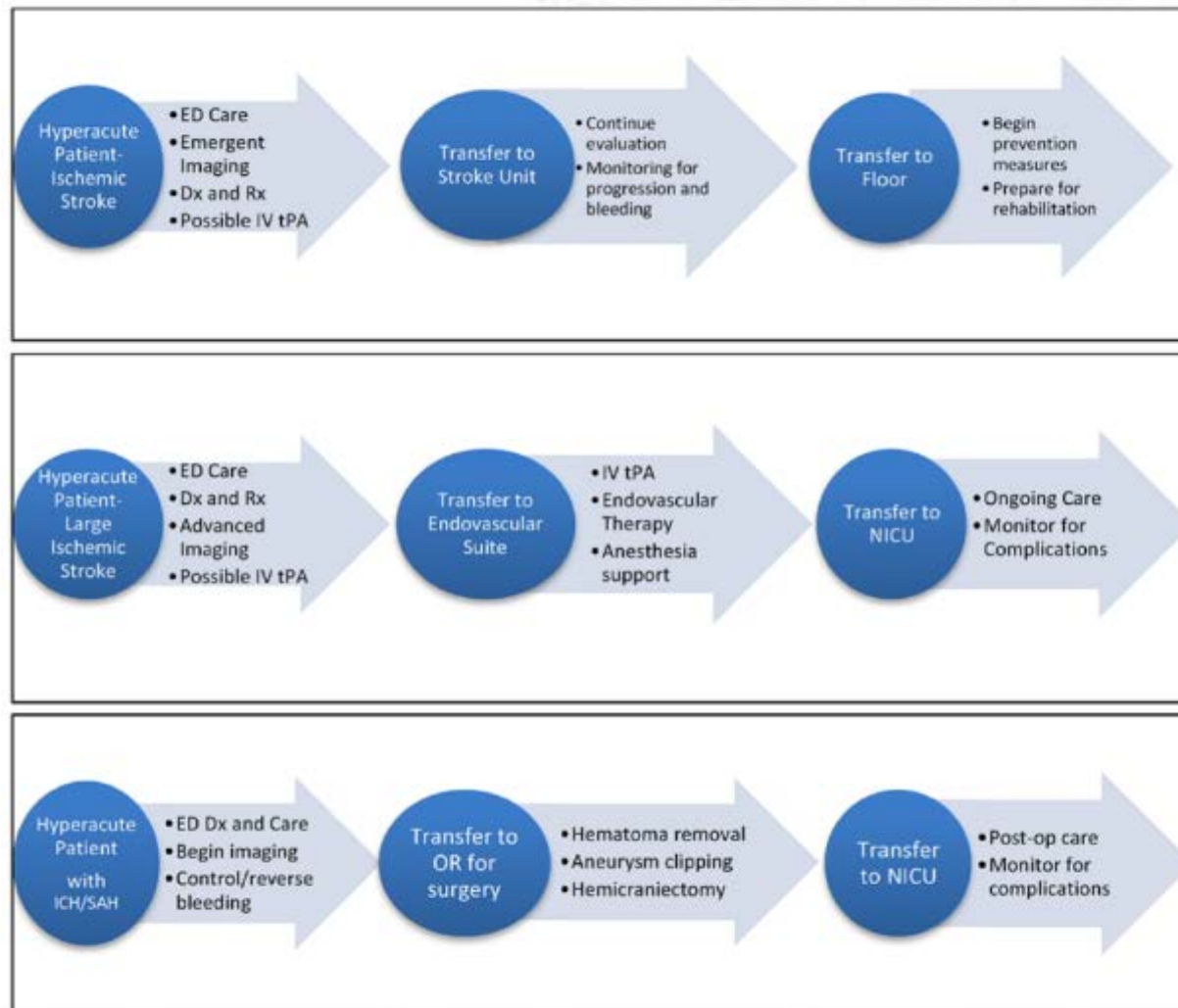
# Decision: Team Approach

## Drug: IV, EVT, Other



# Disposition (Care Transition)

---



Establish Best Science

```
graph TD; A[Establish Best Science] --> B[Determine Best Practice]; B --> C[Implement for Your Region];
```

Determine Best Practice

Implement for Your Region

# Basic Definitions

---

- *Accreditation*

- Obtained by health care organization by undergoing an internal self-assessment as well as a third party, external review process to measure the level of performance benchmarked against established standards.
- The accreditation process considers the achievement of performance standards and internal quality / self-improvement programs, with a focus on patient safety and quality of care.

# Basic Definitions

---

- *Certification*
  - Certification typically builds upon an existing accreditation of the hospital and recognizes unique programs or services within a health care organization (e.g. ischemic stroke, heart disease, total joint replacement and perinatal care).
  - The process of certification is similar to accreditation; involves internal self-assessment of condition or disease specific performance, benchmarked to external best practices, and *third party external review*.

# Basic Definitions

---

- *Designation*
  - A hospital identification process developed at a state or local level.
  - In the process of designation, the state or local government typically with the guidance from a multi-stakeholder advisory committee identifies criteria by which to categorize hospital capabilities for a specific condition or disease state (e.g. adult and pediatric trauma, stroke, myocardial infarction).

# New York



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## Department of Health

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### Stroke

[Stroke Designation Program](#)

[Coverdell Stroke Program](#)

[Stroke Home](#)

You are Here: [Home Page](#) > [Stroke](#) > New York State Stroke Designation Program

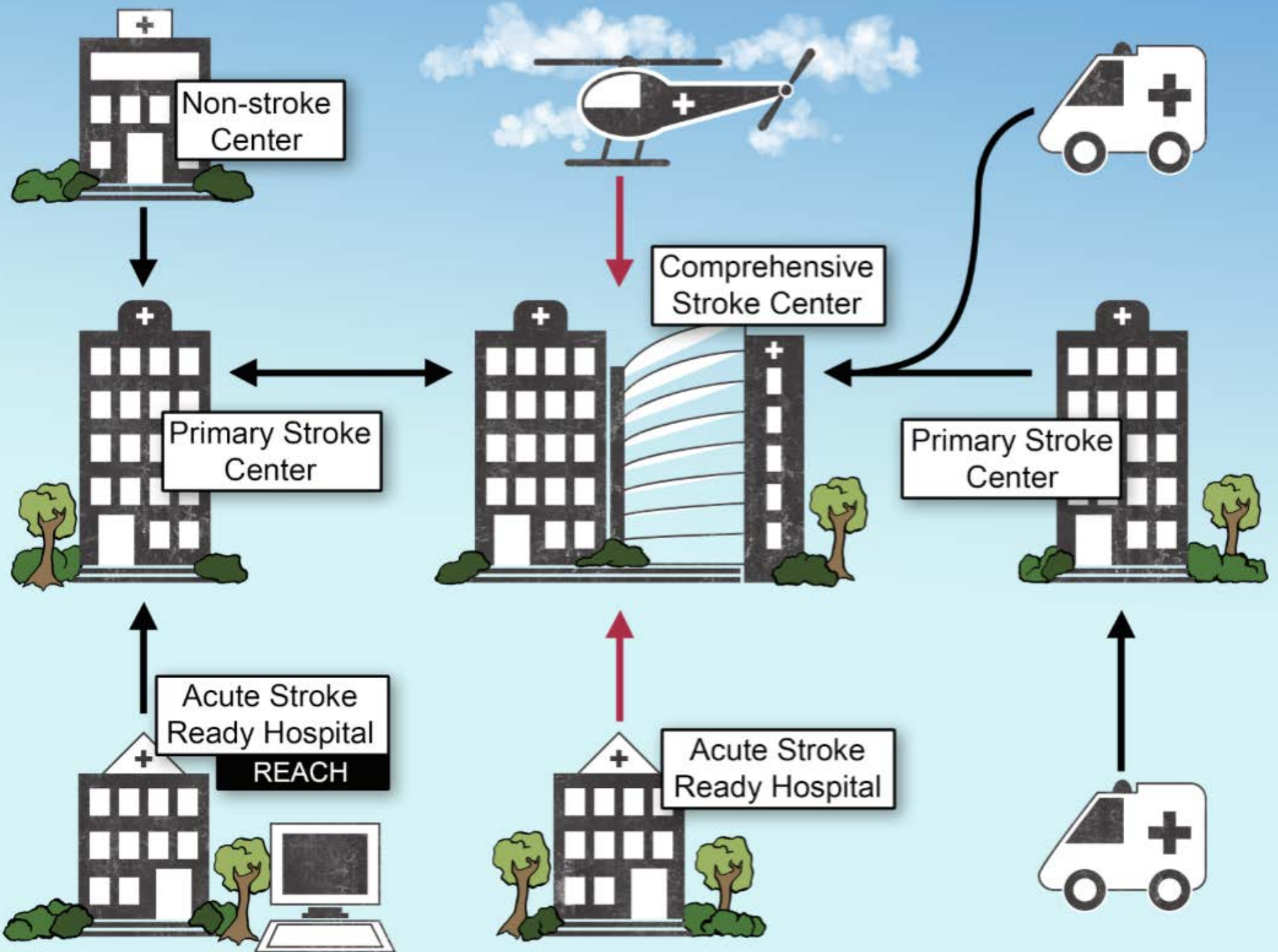
## New York State Stroke Designation Program

### Stroke Designation Program - Adopted March 2019

On March 20, 2019, a new regulation at 10 NYCRR 405.34 was adopted to allow the New York State Designation Program to transition to a three-tiered stroke system of care that recognizes the advanced capabilities of hospitals to treat complex stroke patients in a multi-tiered system. The goal of the Stroke Designation Program is to recognize and treat stroke patients as quickly as possible at the right place.

New York State will recognize and designate hospitals as:

1. Primary Stroke Centers: Capable of treating acute ischemic stroke with IV t-PA and comprehensive supportive care
2. Thrombectomy Capable Stroke Centers: Capable of treating large vessel occlusions with intracranial endovascular intervention



# ASA Policy Statement

## Recommendations for the Establishment of Stroke Systems of Care: A 2019 Update

### A Policy Statement From the American Stroke Association

Opeolu Adeoye, MD, MS, FAHA, Chair; Karin V. Nyström, RN, MSN, FAHA;  
Dileep R. Yavagal, MD; Jean Luciano, CRNP; Raul G. Nogueira, MD;  
Richard D. Zorowitz, MD; Alexander A. Khalessi, MD, MS, FAHA;  
Cheryl Bushnell, MD, MHS, FAHA; William G. Barsan, MD; Peter Panagos, MD;  
Mark J. Alberts, MD, FAHA; A. Colby Tiner, MA; Lee H. Schwamm, MD, FAHA;  
Edward C. Jauch, MD, MS, FAHA



**Figure 1.** The 8 domains of a stroke system of care. EMS indicates emergency medical services.

# Hospital Stroke Capabilities

You will work in one of these

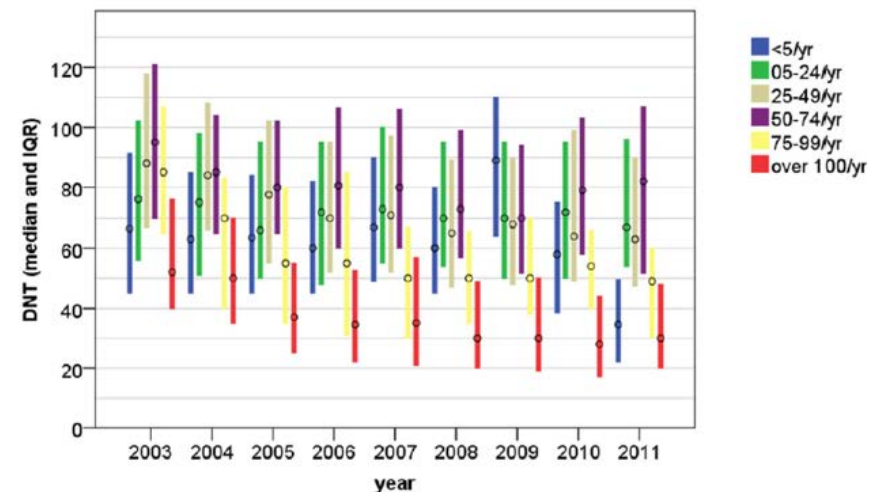
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	ASRH	PSC	TSC	CSC
Typical bed count	25 – 100	100-400	300-600	400-1500
Annual stroke admissions	25-50	50-300	50-600	> 300
Location	Likely rural	Likely urban / suburban	Likely urban / suburban*	Likely urban
Stroke team accessible/available 24h/d, 7d/w	Yes	Yes	Yes	Yes
Noncontrast CT available 24h/d, 7d/w	Yes	Yes	Yes	Yes
Advanced imaging (CTA/CTP/MRI/MRA/MRP) available 24h/d, 7d/w	No	Possibly	Yes	Yes
Intravenous alteplase capable	Yes	Yes	Yes	Yes
Thrombectomy capable 24h/d, 7d/w	No	Possibly*	Yes	Yes
Diagnose stroke pathogenesis/manage post-stroke complications	Unlikely	Yes	Yes	Yes
Access to emergent neurosurgical services	No	Possibly	Possibly	Yes
Admit hemorrhagic stroke	No	Possibly	Possibly	Yes
Clips/coils ruptured intracranial aneurysms	No	Possibly	Possibly	Yes
Dedicated stroke unit	No	Yes*	Yes	Yes
Dedicated neurocritical care unit	No	Possibly	Possibly	Yes
Perform clinical stroke research	Unlikely	Possibly	Possibly	Yes

# Volume Matters

---

- Safe Implementation of Thrombolysis in Stroke registry
- **“Center volume had more robust effect on DTN than year of treatment, and the shortest DTNs were seen in centers with volumes  $\geq 100$  patients/year. Earlier enrollment period was also associated with shorter delays.”**



# Volume Matters

---

- Hospital Morbidity and Mortality Database managed by the Canadian Institute for Health Information

**Results:** Overall, 26,676 patients with ischemic stroke were admitted to 606 hospitals. Seven-day stroke mortality was 7.6% and mortality at discharge was 15.6%. Adverse outcomes were more frequent in patients treated in low-volume facilities (<50 strokes/year) than in those treated in high volume facilities (100 to 199 and >200 strokes patients/year) (for 7-day mortality: 9.5 vs 7.3%,  $p < 0.001$ ; 9.5 vs 6.0%,  $p < 0.001$ ; for discharge mortality: 18.2 vs 15.2%,  $p < 0.001$ ; 18.2 vs 12.8%,  $p < 0.001$ ). The difference persisted after multivariable adjustment or when hospital volume was divided into quartiles.

**Conclusions:** High annual hospital volume was consistently associated with lower stroke mortality. Our study encourages further research to determine whether this is due to differences in case mix, more organized care in high-volume facilities, or differences in the performance or in the processes of care among facilities.

# Volume Matters

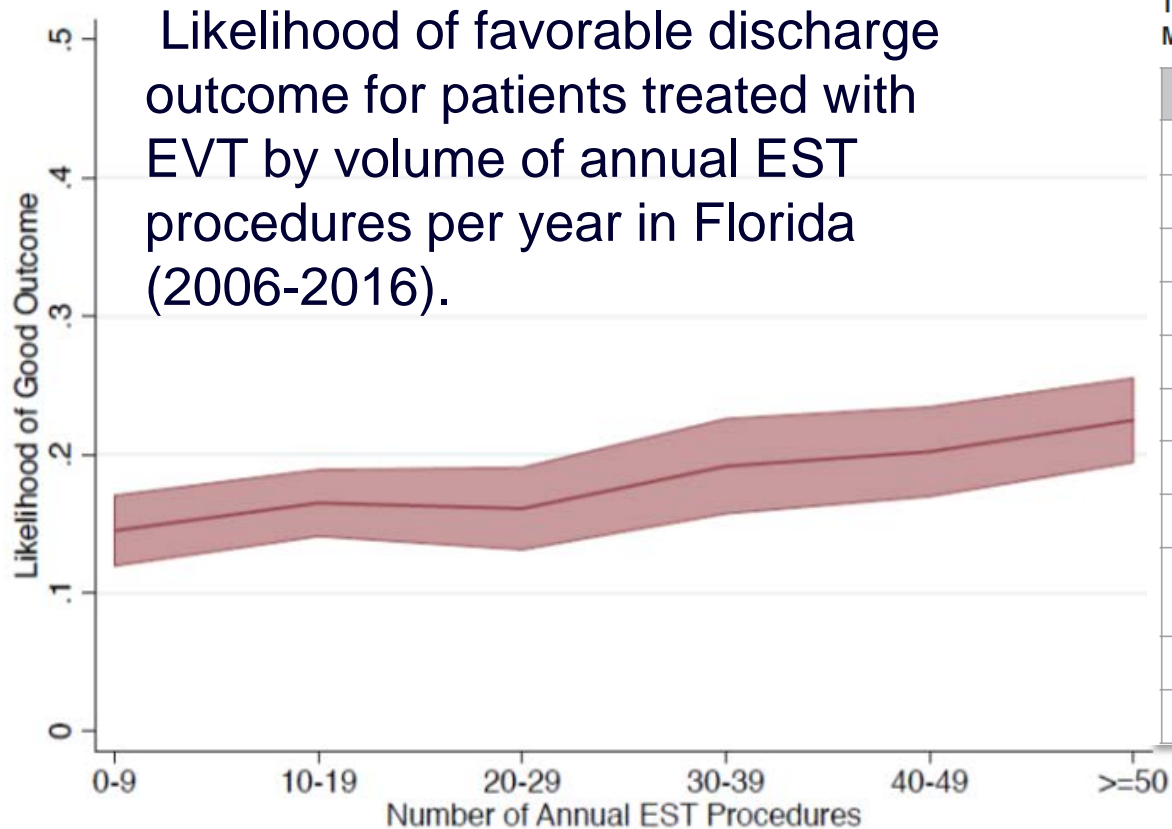


Table 5. Variables Associated With Good Outcome in Univariate and Multivariate Analyses

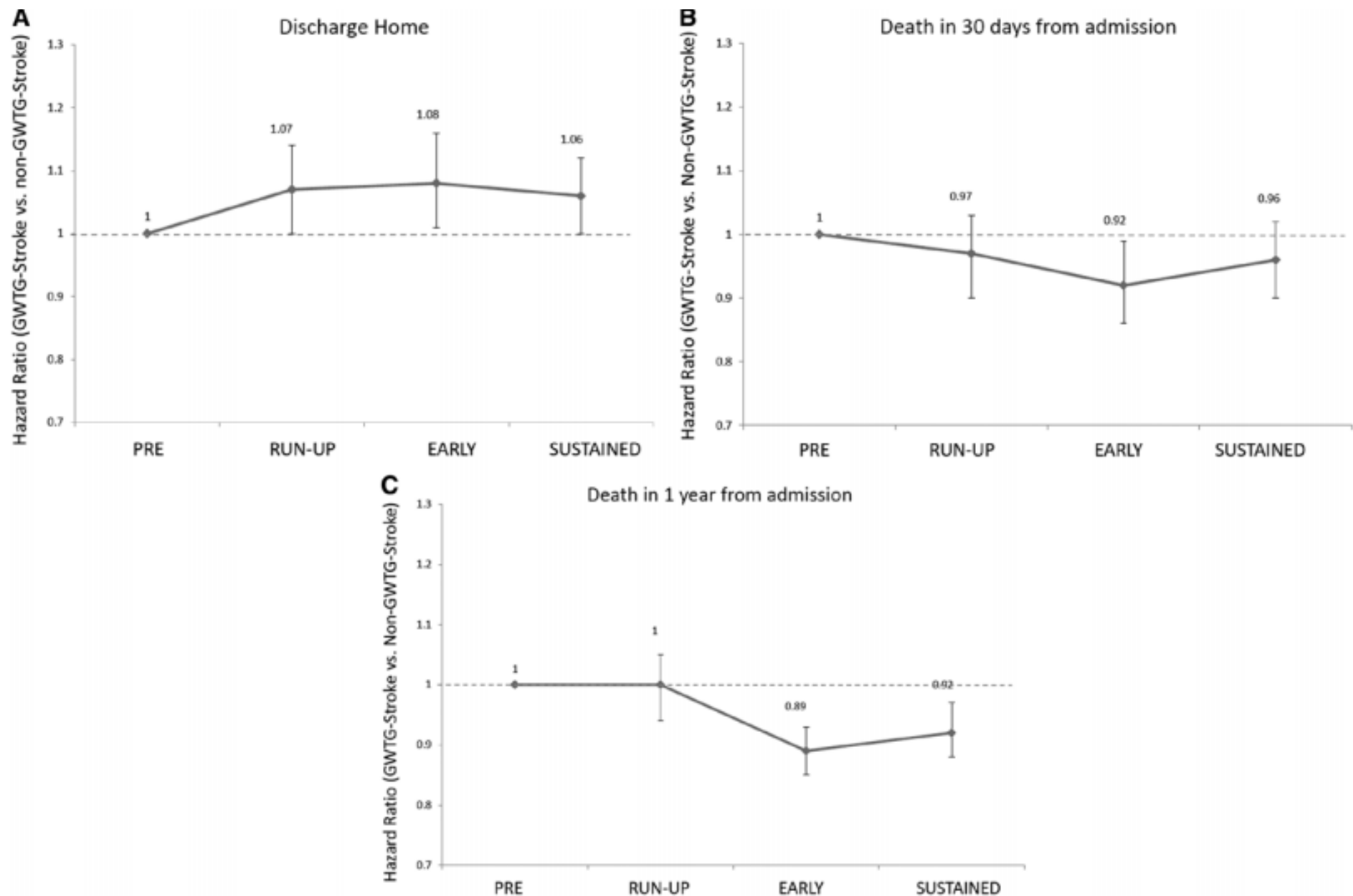
*Variables	$P_{\text{univariate}}$	$P_{\text{multivariate}}$ (OR, 95% CI)
Age	<0.001	<0.001 (0.955, 0.939–0.971)
Male	0.03	0.462
Hypertension	0.04	0.758
Diabetes mellitus	<0.001	<0.001 (0.482, 0.341–0.682)
Smoking	0.006	0.323
Baseline NIHSS	<0.001	<0.001 (0.890, 0.861–0.919)
ASPECTS	<0.001	0.002 (1.281, 1.123–1.461)
Distal ICA involvement	<0.001	0.071
Intravenous tPA administration	0.060	0.282
Recanalization	<0.001	<0.001 (4.105, 2.683–6.281)
EVT-CCV group	0.027	0.005 (1.187, 1.053–1.337)

(Kim, *Stroke*. 2019;50:00-00)  
 (Saber, *Stroke*. 2019;50:00-00)

# Benefits of Quality Improvement

---

- Studies suggest improved processes of care in GWTG-Stroke–participating hospitals
- This improved care has been shown to translate into improved *clinical outcomes* compared with nonparticipating hospitals
  - 366 GWTG-Stroke hospitals, 88584 patients
  - 366 non–GWTG-Stroke hospitals 85401 patients



**Figure 2.** Ratio of changes in outcomes, from Pre time period to Run-Up, Warm-Up, and Sustained time periods, at Get With The Guidelines (GW TG)-Stroke hospitals vs matched non-GW TG-Stroke hospitals, for outcomes of discharge to home (A), 30-day mortality (B), and 1-year mortality (C).

# The Challenge

---

- Goal: right place for the right patient the first time
  - CSC for SAH, ICH, severe AIS
  - “TSC” for regions *without* CSC
  - PSC for AIS and alteplase treatment, as well as stroke unit care
  - ASRH for AIS and timely transfer is essential
  - Ensuring appropriate interactions between system members will benefit all our patients
  - Build a patient-centric system to make this happen

# CSC/TSC Care Is *Not* Just EVT!

---

- Don't be mesmerized solely by \$EVT\$
- EVT is a great advance but
  - 10-20% eligible
  - Not all reperfuse
  - Not all do well
  - Many require NSICU
  - Global care, expert team and practice make the difference



# Application of DAWN Criteria

---

- ● ● ● ● ● ● ● ● ●
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Patients presenting with stroke

# Application of DAWN Criteria

---

●	●	●	●	●	●	●	●	●	●	Patients presenting with stroke
●	●	●	●	●	●	●	●	●	●	Present 6-24 hrs from LKW or
●	●	●	●	●	●	●	●	●	●	NIHSS $\geq 10$
●	●	●	●	●	●	●	●	●	●	
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# Application of DAWN Criteria

---

●	●	●	●	●	●	●	●	●	●	Patients presenting with stroke
●	●	●	●	●	●	●	●	●	●	Present 6-24 hrs from LKW
●	●	●	●	●	●	●	●	●	●	NIHSS $\geq 10$
●	●	●	●	●	●	●	●	●	●	Meet NIHSS and time
●	●	●	●	●	●	●	●	●	●	LVO on imaging
●	●	●	●	●	●	●	●	●	●	Baseline mRS 0-1 and mismatch
●	●	●	●	●	●	●	●	●	●	Eligible for trial 1.7%
●	●	●	●	●	●	●	●	●	●	DEFUSE 3 similarly 2.0%
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# Stroke Care: More Than a Billboard

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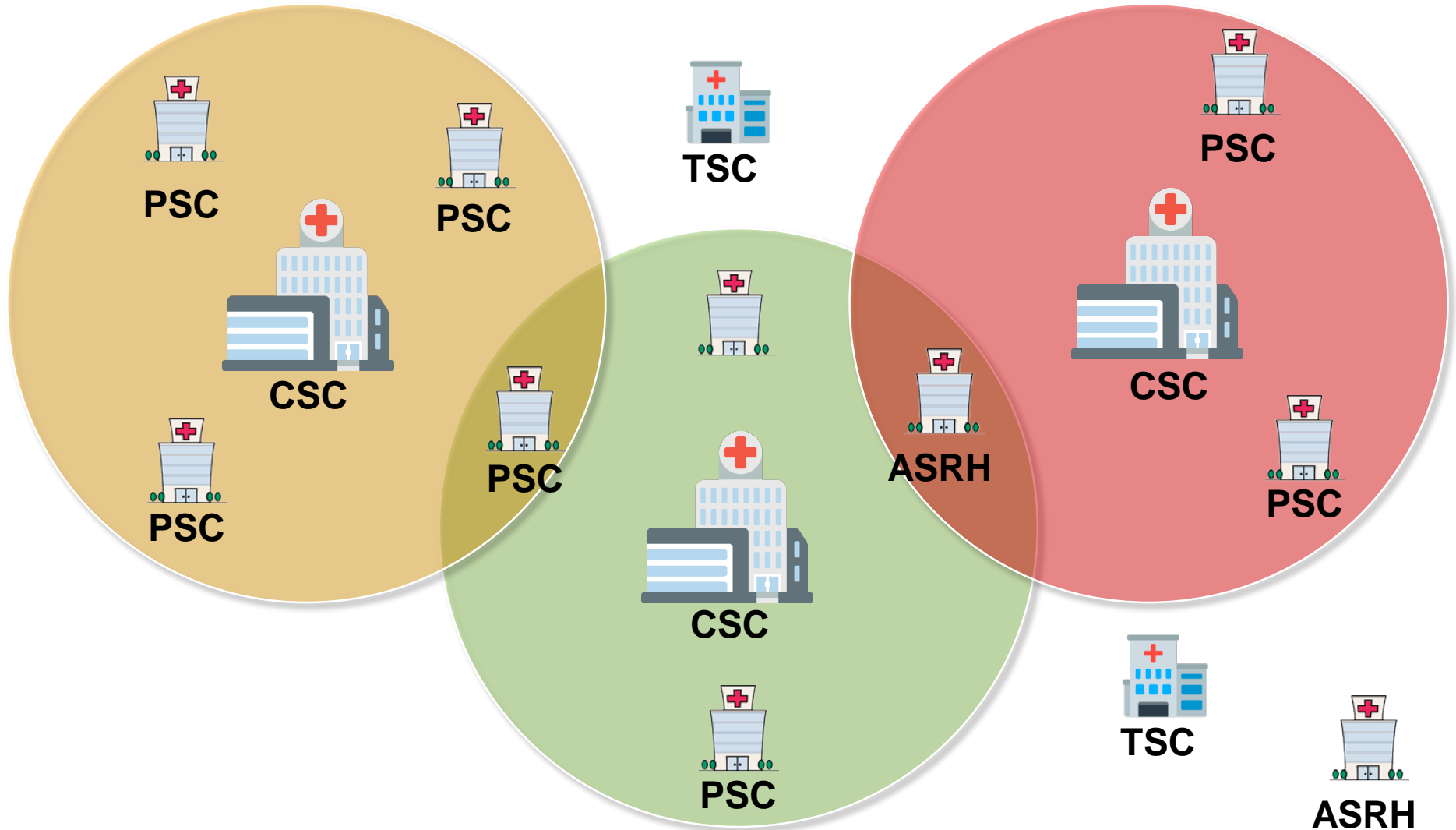
# Trends in Stroke Organization

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- The ideal, develop regionalization of stroke systems of care based on *best practice*
  - State-based / regional planning
    - Departments of Health critical to affecting change
    - All stakeholders engaged from the beginning
    - Build on previous regional success (STEMI)
  - Increase hospital capabilities widely
  - Regionalization extends beyond EMS and triage, timely transfers to better equipped hospitals may need to occur

# Ideal Situation

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# How To Make It Work in LA?



EMERGENCY MEDICAL SERVICES AGENCY  
LOS ANGELES COUNTY

## What will the System Look Like?

- Currently in LA County we have 44 Stroke Centers
  - Primary Stroke Centers or (PSCs) – 41
  - Comprehensive Stroke Centers (CSCs) - 3
- Over the next 12 to 24 months we would like to approve at least 10 additional CSCs
- **The goal is to improve our Stroke System and patient outcomes by identifying the patient that will benefit from specialized advanced stroke center care.**

# Thrombectomy-capable Stroke Center

---

- TJC, with AHA input, developed an additional level of stroke certification that further recognizes PSCs that perform EVT
- Goal – recognize EVT capable centers where there are *not CSC readily available* and establish standards for them
- The new level of stroke care is called Thrombectomy-capable Stroke Center (TSC)
- The certification program recognizes those centers that meet rigorous standards for performing EVT and caring for patients *after* EVT, recognizing the need for advanced post-thrombectomy care
- This has made a lot of people angry on both sides

# Intent of the TCS Designation

October 19, 2017



Dear Interested Stakeholder:

We write to provide you with additional background on the newest level of stroke center certification, the Thrombectomy-Capable Stroke Center program.

Until recently, The Joint Commission has provided three levels of stroke center certification— Acute Stroke Ready, Primary Stroke, and Comprehensive Stroke. However, there were important differences across Joint Commission-certified primary stroke centers (PSCs); in a recent survey, one third of Joint Commission certified PSCs reported that they routinely performed endovascular thrombectomy (EVT). This is important as studies have shown that EVT for the treatment of large vessel occlusive (LVO) ischemic strokes dramatically improves patient outcomes. EVT is time-sensitive, and current recommendations are that this procedure should ideally be done within six hours of the time the patient was last known well. Therefore, from a public health perspective, a dispersed network of hospitals capable of providing mechanical thrombectomy and post-procedural care is needed so all patients with LVO can rapidly receive the care they need.

In response to the need to identify hospitals that meet rigorous standards for performing EVT and caring for patients after the procedure, The Joint Commission has developed the Thrombectomy-Capable Stroke Center (TSC) certification program, which is offered in collaboration with the American Heart Association/American Stroke Association. The clinical capabilities and certification expectations of a thrombectomy-capable stroke center are greater than those of a primary stroke center but less than those for a comprehensive stroke center (CSC). TSC sites will be held to ALL of the standard and requirements of a PSC and, as such, can be recognized as PSC sites in regional EMS routing plans and, in addition, will need to meet rigorous standards and requirements for the systems that support rapid and effective thrombectomy.

In areas where a patient with a suspected LVO can be brought quickly to a CSC, the CSC is the preferred site of care because a CSC is capable of providing care for all types of strokes. Specifically, CSCs are

capable of performing mechanical thrombectomy for patients found to have an LVO, but they are also capable of providing comprehensive care for patients who are suspected of having an LVO by emergency medical personnel in the field but are then found instead to have intracerebral or subarachnoid hemorrhage after definitive diagnostic procedures are done. CSCs have the expertise and experience to provide the endovascular, neurosurgical, intensive care, and rehabilitative services that both patients with LVO ischemic strokes and those with hemorrhagic strokes need for optimal recovery.

However, there are many areas in the country where patients with suspected LVOs would have a prolonged travel time to reach a CSC, reducing the patients' opportunity for a rapid removal of the thrombus and optimal functional outcomes. In areas without rapid access to a CSC, the TSC certification program provides an important option that EMS providers and state agencies can use to design prehospital triage algorithms and stroke care systems to optimize access to thrombectomy for patients with suspected LVO. In fact, the TSC program was developed when The Joint Commission was collaborating with Los Angeles County to revise their stroke system to improve access to care for patients with suspected LVOs. During that work, it became apparent that there were large areas of the

county that were far from a certified CSC and that had no hospitals that would be likely to be able to become a CSC. Thus, the TSC certification program was developed to help public health agencies build stroke care systems to optimize population health outcomes and eliminate healthcare disparities.

The Joint Commission sets rigorous requirements for stroke certification, guided by scientific advice from diverse group of experts on its Technical Advisory Panels and at the American Heart Association, and input through a public comment process from other organizations around the country. Our organizations are also committed to continuing to receive feedback from stakeholders as we move forward with implementation of this new certification and as the program is updated, as needed and warranted. This will be done through periodic public comment opportunities and other ad hoc venues as needed, and after any major update to the scientific guidelines relevant to this stroke center certification program.

The stroke center review process assesses and attests that hospitals meet the standards in our stroke programs. Ultimately, it is up to government agencies and those who regulate emergency medical services protocols to use this information to review the available resources in their community and decide how best to triage and care for the patients they serve. Optimal triage decisions will depend on travel times in different areas and differences in the door-to-needle time and clinical outcomes at TSCs and CSCs at the hospitals in their area. The Joint Commission and the AHA/ASA stand ready to provide advice and guidance to communities as they design their stroke care systems, including providing data when possible to help guide these decisions. We all want to make sure that patients with stroke receive the best possible care and have the best possible outcomes, and by working together we can achieve these goals.

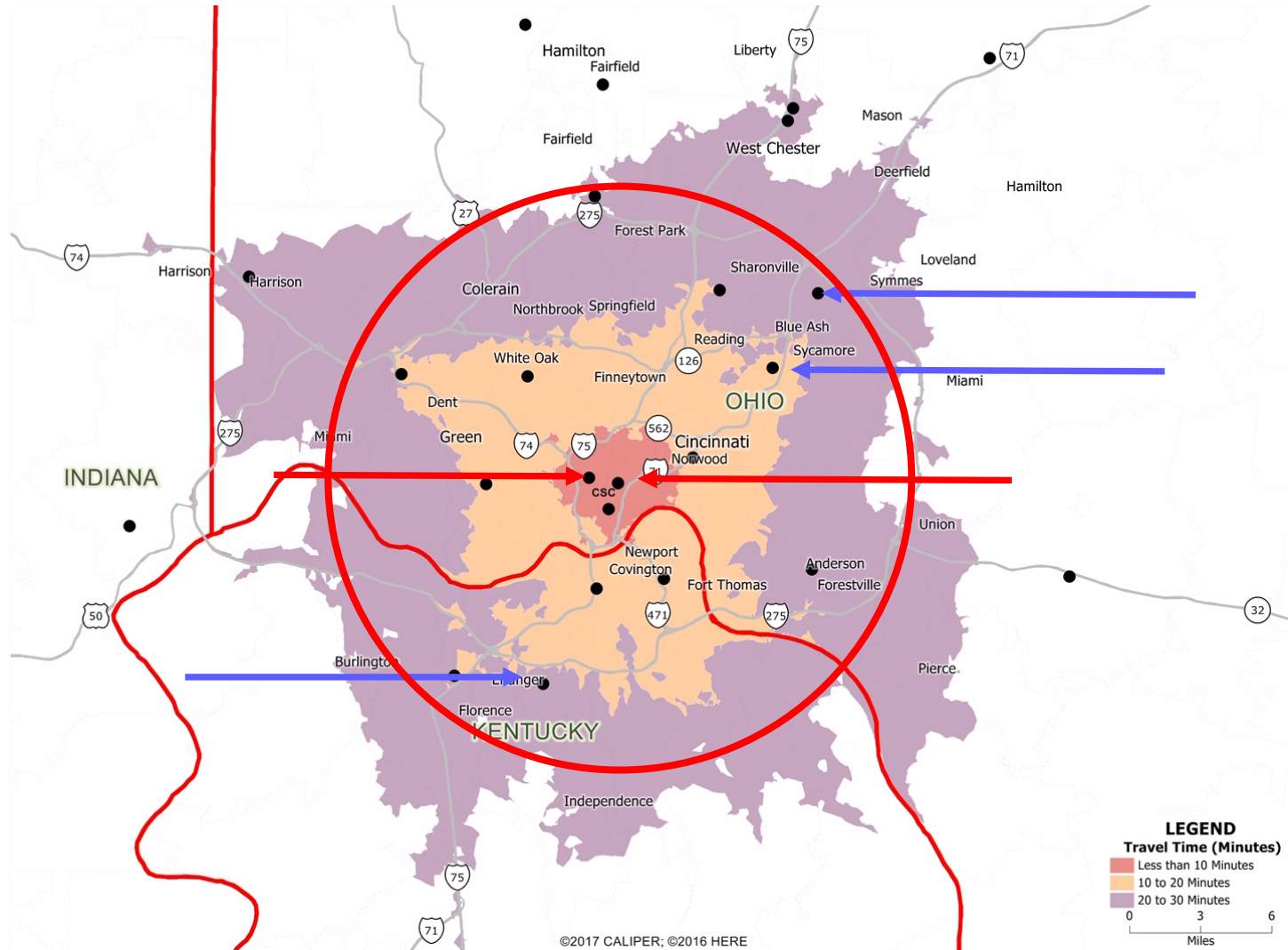
Sincerely,

David W. Baker, MD, MPH, FACP  
Executive Vice President  
Healthcare Quality Evaluation  
The Joint Commission

Lee H. Schwamm, MD, FAHA, FAAN  
Chair, Hospital Accreditation Science Committee, American Heart Association/  
American Stroke Association  
Executive Vice Chairman, Department of Neurology  
C. Miller Fisher Endowed Chair in Vascular Neurology  
Director, MGH Comprehensive Stroke Center  
Director, MGH Center for TeleHealth  
Professor of Neurology, Harvard Medical School

Edward C. Jauch, MD, MS, FAHA, FACEP  
Chair, Hospital Accreditation Stroke Subcommittee, American Heart Association/  
American Stroke Association  
Professor, Chair (Interim), Department of Emergency Medicine  
Professor, Department of Neurosciences  
Medical University of South Carolina  
Professor (Adjunct), Department of Bioengineering  
Clemson University

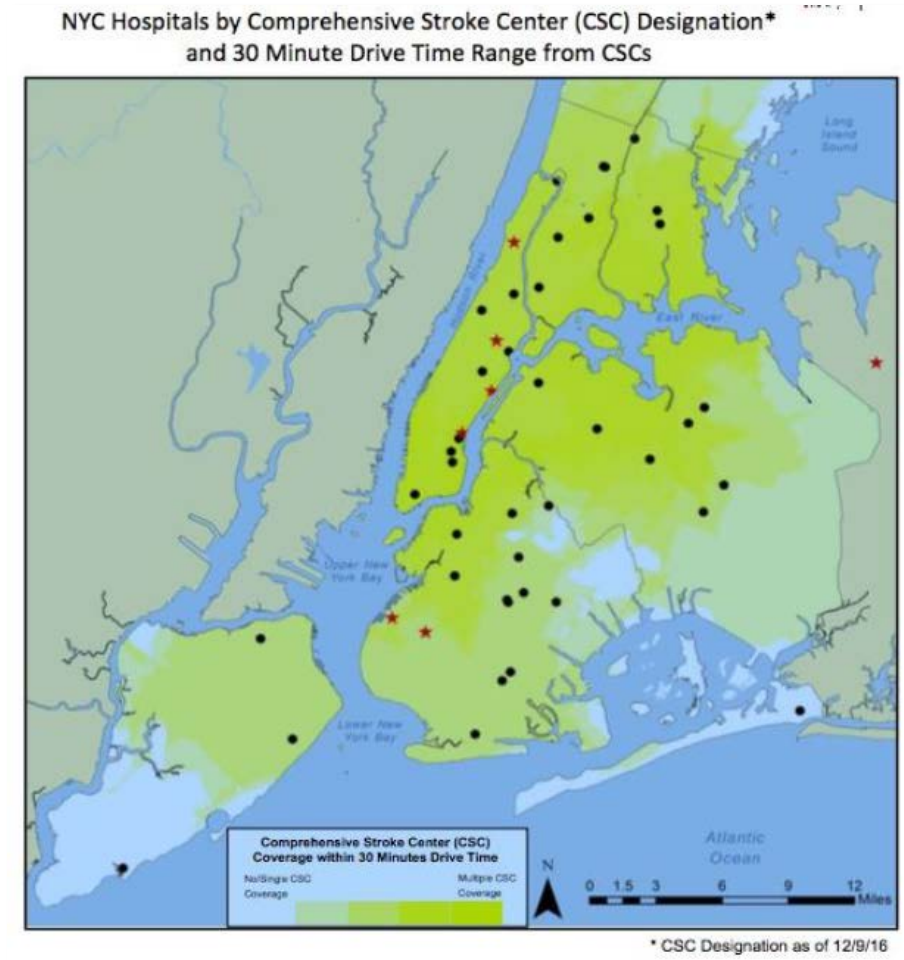
# Challenges of TSC Certification



# New York City

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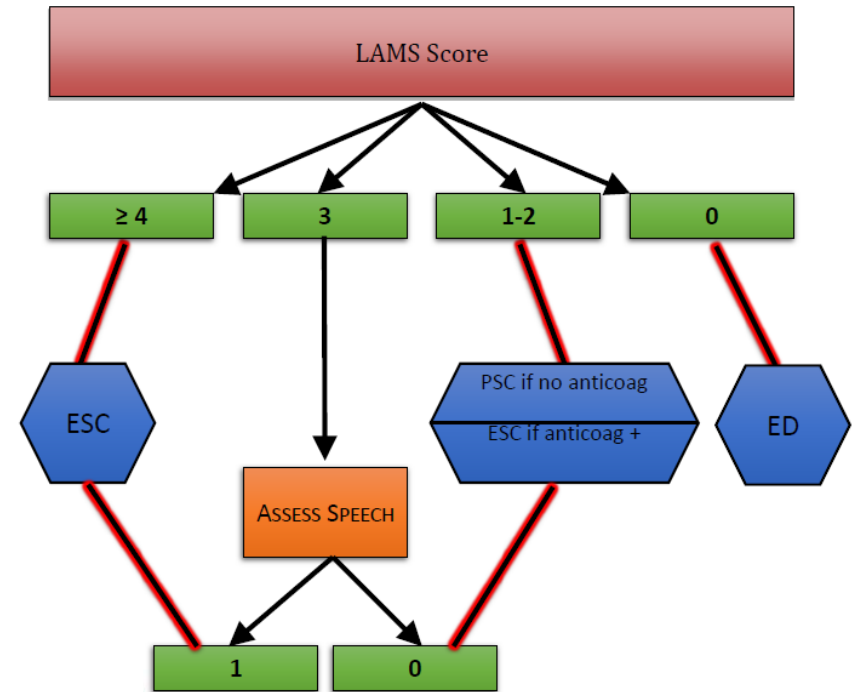
- Prehospital data
  - Volumes
    - 4,000 daily EMS 911 calls
    - 1.46 million calls annually
  - Stroke calls
    - ~50 per day (1.25%)
    - 5 estimated LVO patients
    - 1.5 LVO patients potentially eligible for EVT



# New York City

---

- Prehospital data
  - Performance measures
    - LAMS + Speech tool
    - 30 mins bypass time
    - LKW time < 5 hrs
    - 24% stroke scale use
    - 36% prehospital notification
  - Unique features
    - MSU in Manhattan
    - MIST Team from Mt Sinai



# An Example from South Carolina Stroke Systems of Care Act

Stroke Systems of Care  
Study Committee Report  
(S\*26)

Submitted to the Governor and General Assembly of South Carolina

November 30, 2010



NICHOLAS R. HALES  
GOVERNOR

July 27, 2011

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

Dear Mr. Jusch,

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.

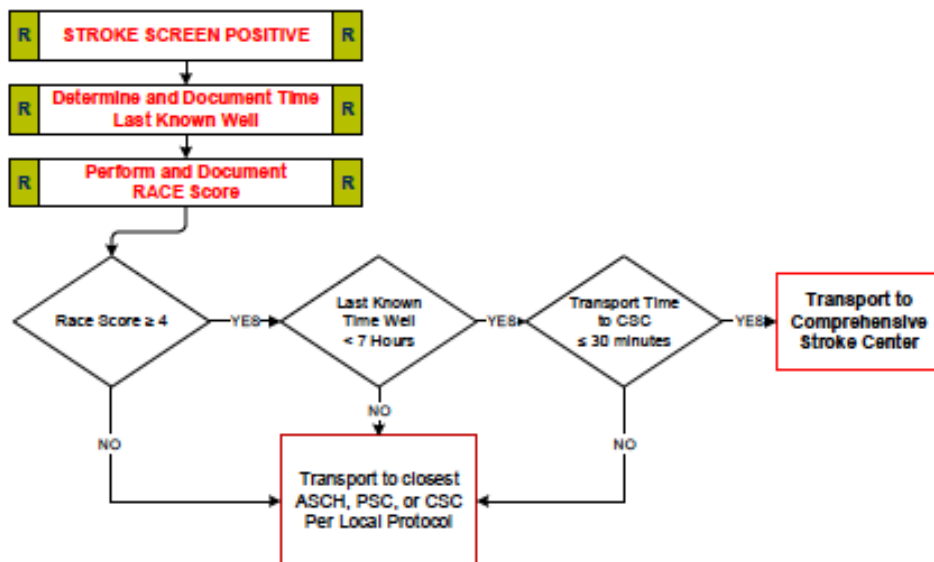
My very best,  
*Nicholas R. Hales*  
Nicholas R. Hales  
NRH/jfb



Ratified	6/08/2011
Vetoed by the Governor	6/14/2011
Veto overridden by Senate	6/21/2011
Veto overridden by House	6/21/2011
Ed's happy dance	6/22/2011



## Adult Stroke Patient Destination Determination by Stroke Center Capability



ADULT MEDICAL: Stroke Destination

### COMPREHENSIVE STROKE CENTER

- Physician / Nursing Staff trained in neurologic care on-site 24 hours a day
- Organized Emergency Department with written pathway for rapid identification and management of acute stroke patient
- CT of the head with technician on-site 24 hours a day
- Clinical Laboratory Services
- 24 / 7 Stroke Call and capabilities for IV tPA therapy for eligible patients
- 24 / 7 Endovascular Call and capabilities for endovascular therapy for eligible patients
- 24 / 7 Neurosurgery Call
- Neuro-Intensive Care Unit and neurointensivists
- Stroke Registry and Quality Improvement Process
- Accredited Comprehensive Stroke Center (CSC)

### PRIMARY STROKE CENTER

- Physician / Nursing Staff trained in neurologic care on-site 24 hours a day
- Organized Emergency Department with written pathway for rapid identification and management of acute stroke patient
- CT of the head with technician on-site 24 hours a day
- Clinical Laboratory Services
- 24 / 7 Stroke Call and capabilities for IV tPA therapy for eligible patients
- Stroke Registry and Quality Improvement Process
- Accredited Primary Stroke Center (PSC)

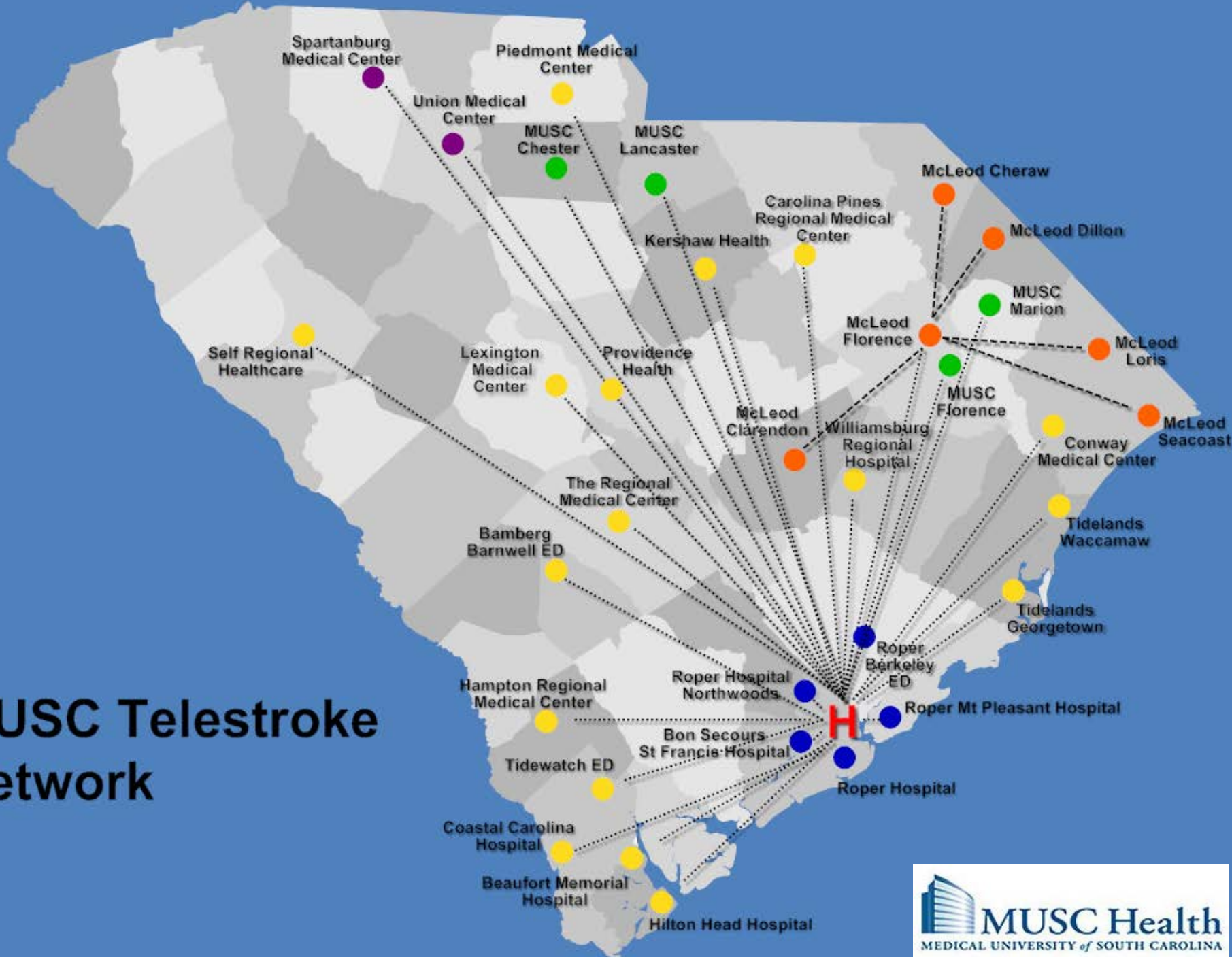
### Non-Stroke Hospitals

No organized treatment for acute stroke

### ACUTE STROKE CAPABLE CENTER

- Emergency Department 24 hours a day with Physician or physician extender and nursing staff trained in neurologic care on-site 24 hours a day.
- CT of the head with technician on-site 24 hours a day
- Clinical Laboratory Services
- Telectroke Video – Conferencing Capabilities
- 24 / 7 with Capabilities for IV tPA therapy for eligible patients
- Transfer agreement established in advance to ensure orderly transition from Level II Stroke Hospital to specialized stroke care facility
- Stroke Registry and Quality Improvement Process
- Accredited Acute Stroke Capable Hospital (ASCH)

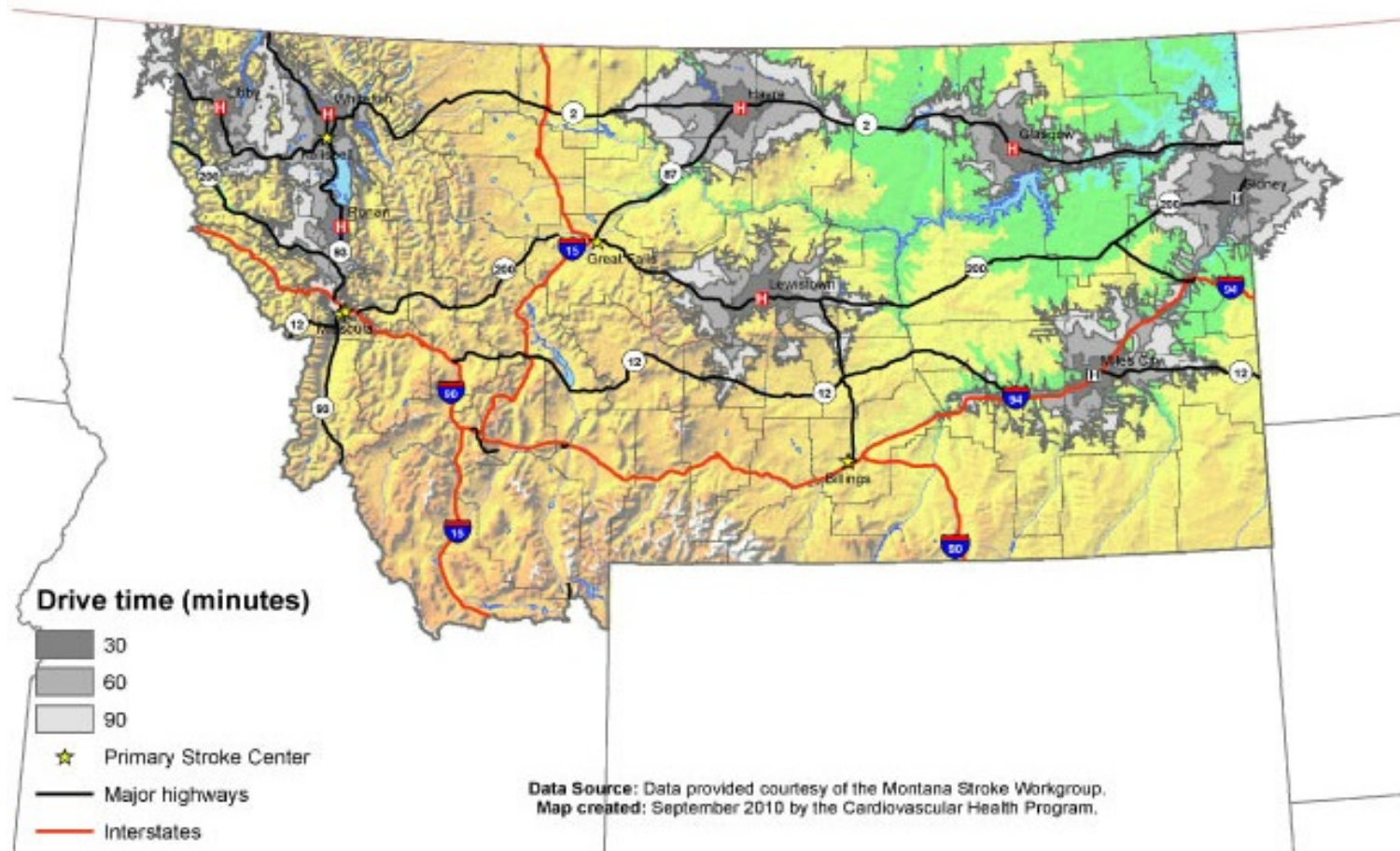
# MUSC Telestroke Network



# Other End of the Spectrum

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30-, 60-, and 90- minute drive times to current and projected telestroke sites, Montana, September 2010.

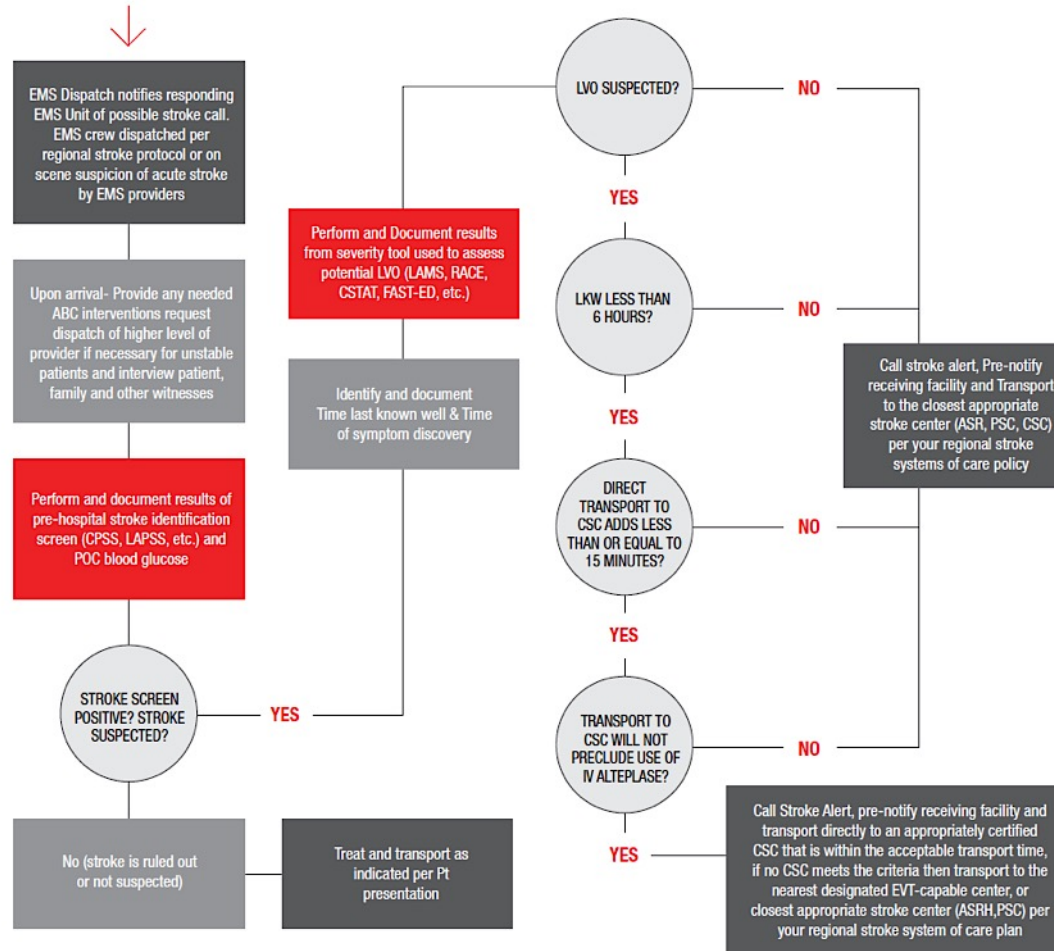


# So Where Does EMS Go?

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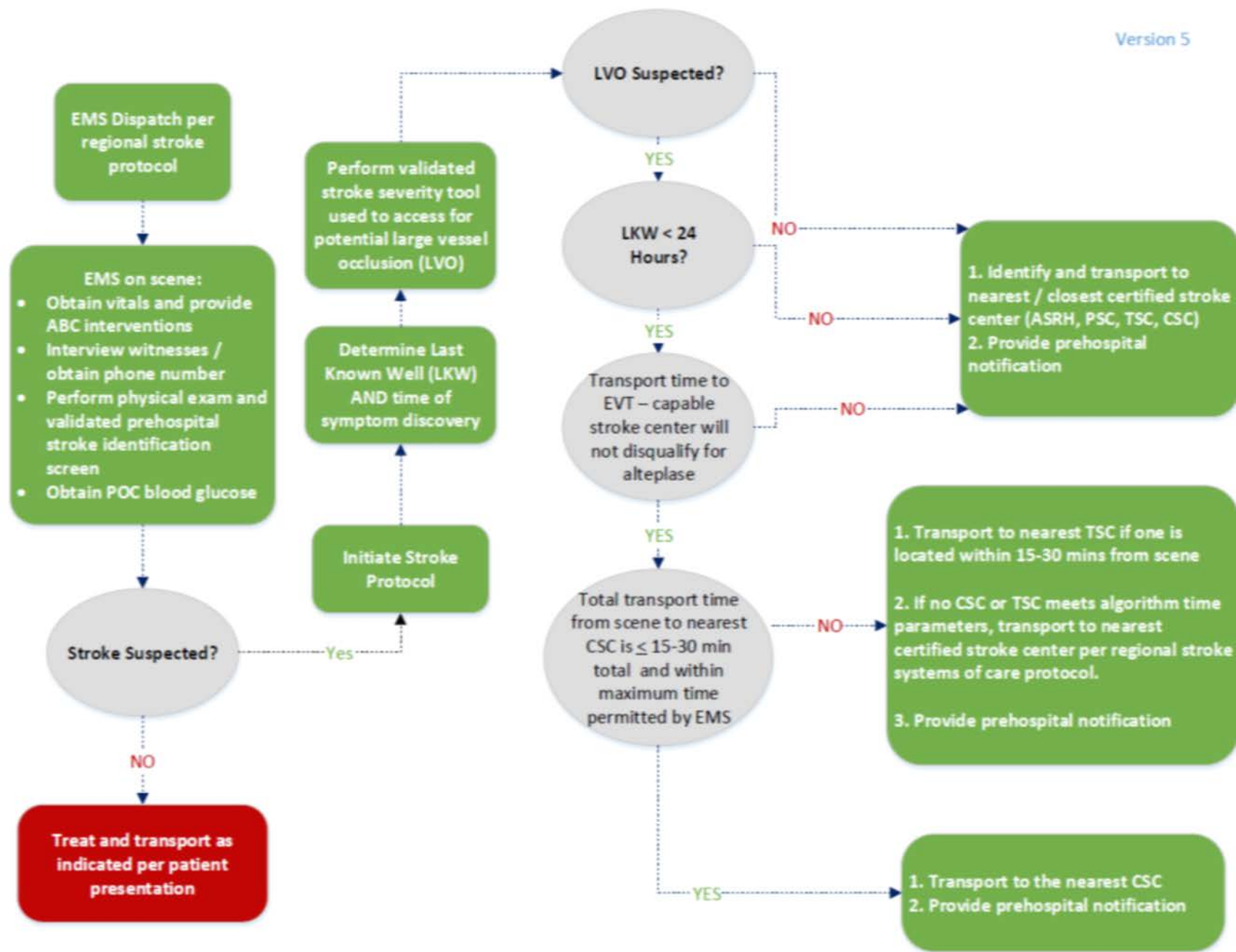


# SEVERITY-BASED STROKE TRIAGE ALGORITHM FOR EMS



## ON SCENE

- Interview patient, family members and other witnesses to determine Last Known Well (LKW) time and time of Symptom Discovery.
- Attempt to identify possible stroke mimics (eg, seizure, migraine, intoxication) and determine if patient has pre-existing substantial disability (need for nursing home care or inability to walk without help from others).
- Encourage family to go directly to E.
- ED if not transported with patient and obtain mobile number of next of kin and witnesses.
- If Mobile Stroke Unit available—follow Mobile Stroke Unit Protocol
- Each EMS agency should utilize a published and validated stroke screen to assess patients with non-traumatic onset of focal neurologic deficits and validated tool to assess possible Large Vessel Occlusion (LVO).
- Patients who are eligible for IV Alteplase if transported to nearest ASRH or PSC should not be rerouted to a CSC or EVT-capable Center if doing so would result in a delay that would make them ineligible for IV Alteplase.
- Collect current medications (especially anticoagulants) and co-morbid conditions (eg, Serious kidney or liver disease, recent surgery, procedures or stroke) that may impact treatment decisions. Do not delay transport in collecting this information.



# What Could Go Wrong?

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- EMS
  - Lack of specificity in LVO tools (FP, FN)
  - Longer transports, especially for rural agencies
- Hospitals
  - CSC over-crowding
  - Impedes PSC evolution to CSC
  - Limit non-CSC experience with severe strokes (nonreperfusion candidates, in-house, etc)
  - Dilution of expertise and volume

Establish Best Science

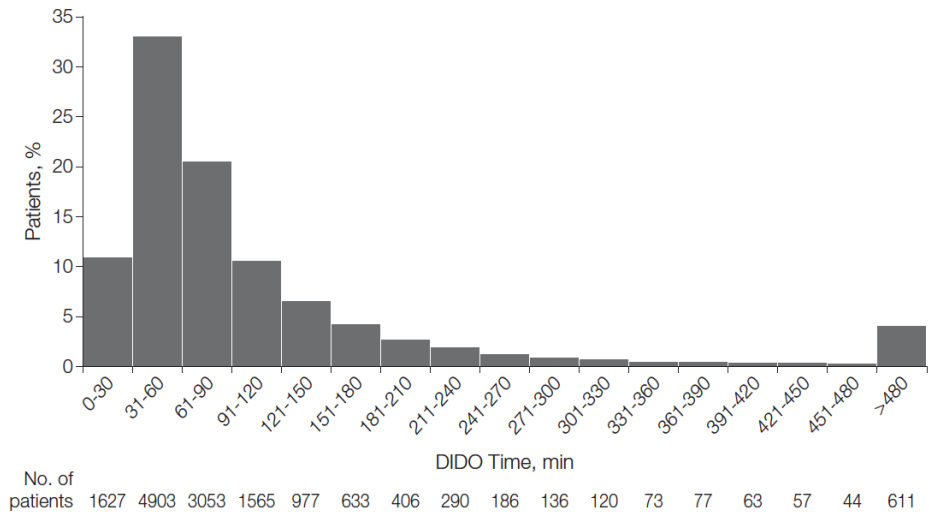
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graph TD; A[Establish Best Science] --> B[Determine Best Practice]; B --> C[Implement for Your Hospital];
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Determine Best Practice

Implement for Your Hospital

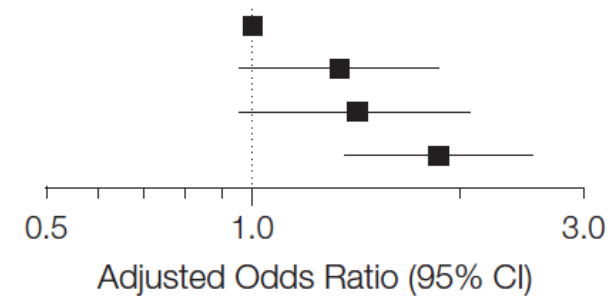
# Impact of Timely Transfer: STEMI

**Figure 1.** Distribution of DIDO Times Among 14 821 Patients With STEMI Transferred for Primary Percutaneous Coronary Intervention



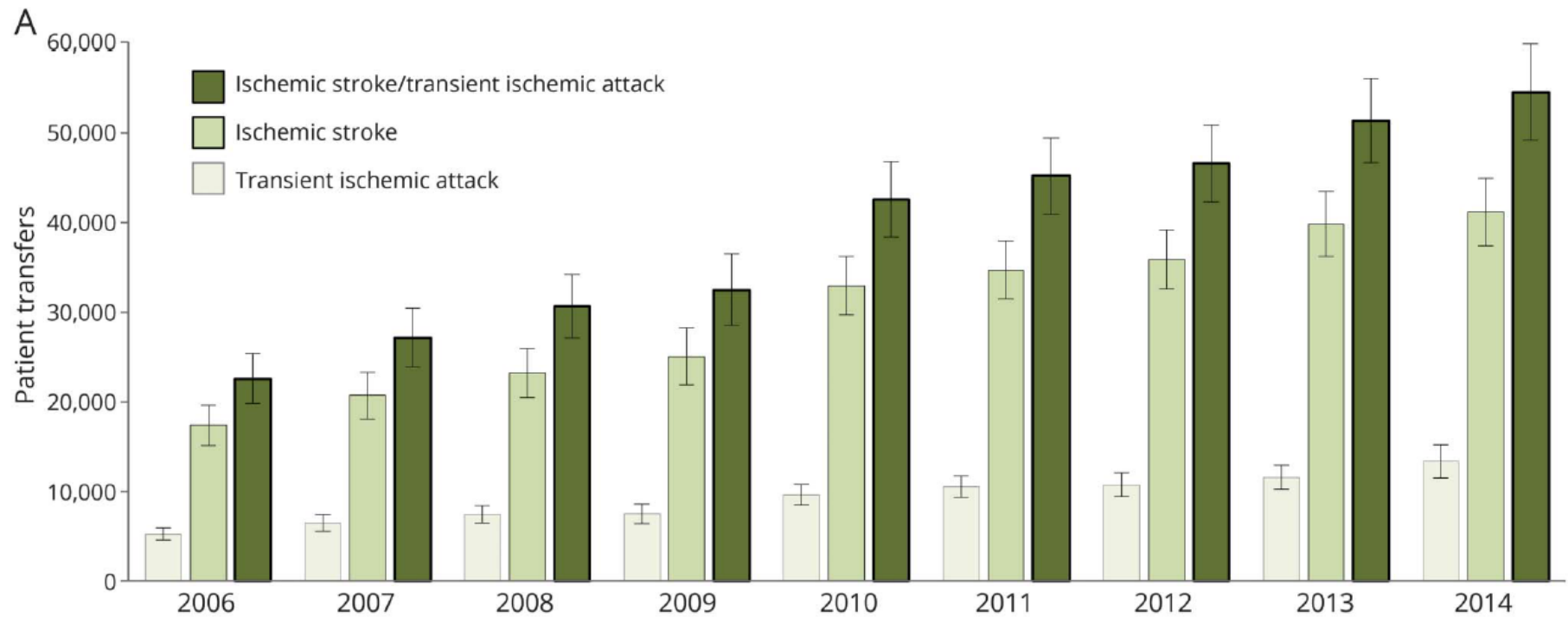
**Figure 3.** Association of DIDO Time With In-Hospital Mortality

DIDO Time, min	Mortality, No. of Patients/Total (%)	Adjusted Odds Ratio (95% CI)
≤30	43/1600 (2.7)	1.0 (Reference)
31-60	192/4841 (4.0)	1.34 (0.96-1.86)
61-90	146/3013 (4.9)	1.41 (0.96-2.06)
>90	430/5176 (8.3)	1.86 (1.36-2.54)



# Stroke Transfers in the U.S.

**Figure 2** Changes in the number and rate of US ischemic stroke and TIA transfers, 2006–2014



(George, *Neurology*. 2018;90:e1561-e1569)

# Who to Transfer?

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- It depends on
  - The patient / family
    - Acute issues (stroke severity)
    - Comorbidities
  - The geographic location
  - The referring hospital capabilities
  - The receiving hospital capabilities
  - Other



# Acute Stroke Transfer Scenarios

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- Critical access hospital
  - Almost everyone
- Primary stroke center
  - Severe w/ LVO +/- penumbra, or unique strokes
- Primary stroke center with EVT
  - Completed LVO infarct, or unique strokes
  - Off hours LVO stroke with penumbra
- Thrombectomy-capable stroke center
  - Completed LVO infarct, or unique strokes

# Optimizing Processes for Transfer

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

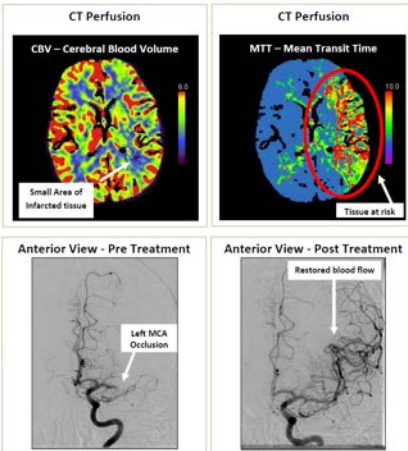


# The Importance of Feedback

## THE CLINICAL BENEFITS OF IV-tPA and/or INTRA-ARTERIAL EMBOLECTOMY IN AN ACUTE STROKE PATIENT

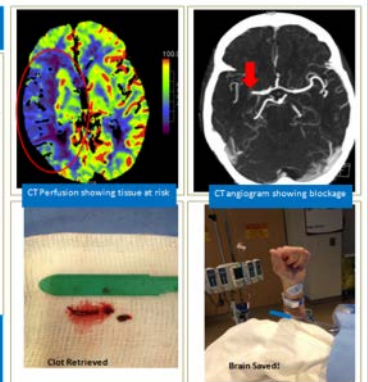
- PATIENT PRESENTATION/NEUROLOGIC EXAMINATION**
- 62 year old man, last seen normal at 01:00 (wake up stroke), wakes from sleep ~ 6:30 AM with right sided hemiplegia and aphasia.
  - EMS identifies patient as a stroke and transported to Grand Strand Regional Center Emergency Department.
  - Grand Strand staff contacts MUSC Neurology for possible IA therapy.
  - His initial NIH stroke scale score (NIHSS) was 18, suggesting a large vessel clot in the left middle cerebral artery and high risk for death or severe disability.
  - Patient outside 4.5 hour tPA window but noncontrast CT was normal suggesting opportunity.
  - Patient rapidly transported to MUSC Emergency Department. Pre-arrival notification allowed Stroke Team to meet patient and taken directly to CT showing brain at risk but still alive.
  - Patient taken to Interventional Neuroradiology for intra-arterial therapy.
- INTERVENTION**
- Large catheter used to directly aspirate the bulk of the thrombus.
  - The patient was successfully treated with blood flow restored in 30 minutes!
- OUTCOME**
- 72 hours, moving right side (NIHSS 5), and treated for newly diagnosed atrial fibrillation.
  - Day 5 patient suffered second embolic stroke requiring repeat IA therapy; now recovering.
- TAKE AWAYS**
- Each link in the *Chain of Survival* moved very quickly, maximizing salvageable brain.
  - Advanced imaging allowed team to find large part of the brain that was still salvageable.
  - Endovascular recanalization was achieved in 20 minutes with advanced catheters.

**COMPREHENSIVE STROKE AND CEREBROVASCULAR CENTER**  
 Medical University of South Carolina Stroke Team Number: 843-792-4457  
 Key healthcare professionals involved in this case:  
 Grand Strand RMC: Emergency Department staff  
 MUSC ED: Drs. Greg Hall and Jake Fulkerson, Laura Brigada RN  
 Stroke Team: Drs. Shelly Ozark, Christine Holmstedt, Blake Grider  
 Interventionalists: Drs. Ray Turner, Harris Hawk, and Alessandro Spitzer, Brian Coy RT



## THE CLINICAL BENEFITS OF RAPID COMPREHENSIVE STROKE CARE

- PATIENT PRESENTATION/NEUROLOGIC EXAMINATION NIHSS= 16**
- 73yo woman with a past medical history of hypertension awoke normal at 7am, began to feel gurgling and diaphoretic a short time later and went back to bed where she developed left sided weakness and numbness. EMS was called and she was brought to an outside hospital where a REACH telemedicine consult was performed. The patient was given IV tPA at 9am and flown to MUSC for possible thrombectomy ( clot-removal). On arrival at MUSC patient had right gaze deviation, left visual field cut, left hemiparesis and hemisensory loss and left neglect. CT angiogram revealed a clot in the M3 division of the right MCA.
- INTERVENTION**
- The patient was taken for mechanical thrombectomy and the clot removed with excellent restoration in blood flow.
- OUTCOME NIHSS= 03**
- Immediately following the procedure, patient showed dramatic improvement (see to the right) and was able to move her left arm and leg against gravity. At discharge she had only mild weakness and minor facial droop.
- TAKE AWAYS**
- Rapid treatment with IV tPA combined with mechanical thrombectomy may lead to dramatic improves in stroke patient outcome.



I will bug you about this pin until it's physically on my white coat next to my name, Zile



Electronic version until I get back from LA

Much appreciated



# The Future

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- Performance based certification
- State-based legislative programs for SSOC
- Evolving screens / tools / devices
- Evolving destination protocols
- Evolving transfer criteria
- Addressing interfacility transport means
- Addressing interfacility DiDo
- Feedback and recognition of each contribution

# Conclusion

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- No matter where you practice you will see stroke
- Acute treatments' *efficacies* are almost asymptotic
- Now the goal is to maximize their *effectiveness*
  - Create a local stroke system of care
  - Build a resourced and supported **team**
  - Apply best practices to each location in system
  - Measure success on outcomes not check boxes
- Recognize importance of sustained public education, secondary prevention and rehabilitation



