Advances in Stroke Treatment: The Case for Stroke Systems of Care

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I have nothing to disclose.

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The Problem of Stroke in the U.S.

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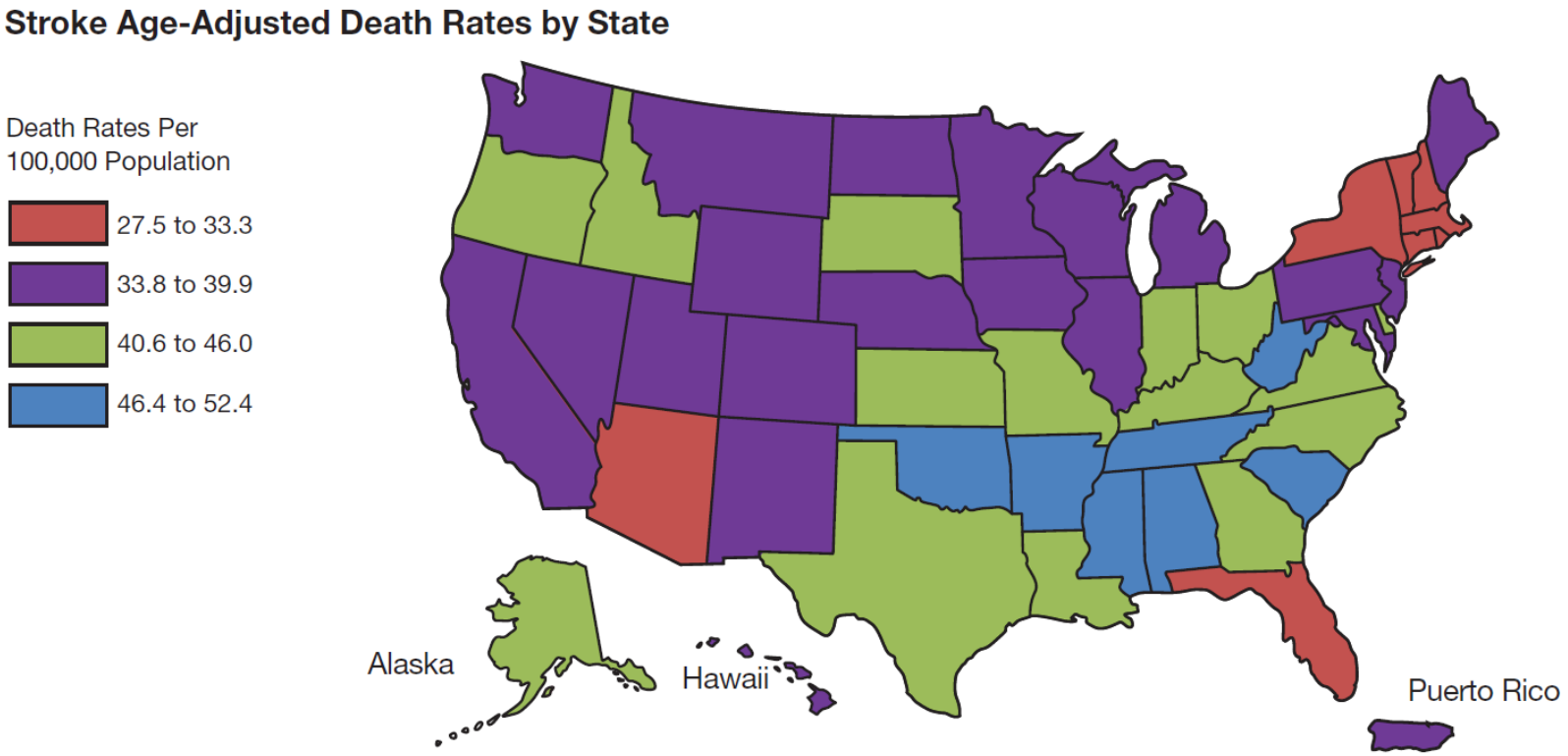
The numbers…

- **795,000** strokes occur each year
- **#1** cause of disability
- **#1** preventable cause of disability
- **1** stroke every **40** seconds
- Stroke is the **#5** cause of death in the U.S.
- **1** death approximately every **4** minutes

American Heart Association (2015)

State-by-State



American Heart Association, 2015

Factors Contributing to the Problem

- Risk factors
- Lack of knowledge regarding stroke signs and symptoms and the need to call 911
- Lack of access
- Reluctance to treat with Activase

All is Not Lost!

- AR has moved from 1st in the country to 5th in the country in stroke deaths.

- WHY?
  - Paul Coverdell National Acute Stroke Registry (Arkansas received this grant in 2012 but did not receive the grant in 2015)
    - Arkansas Stroke Registry
  - Implementation of tele-stroke networks in rural areas
    - AR Saves

Treating Stroke- 1995 to 2014

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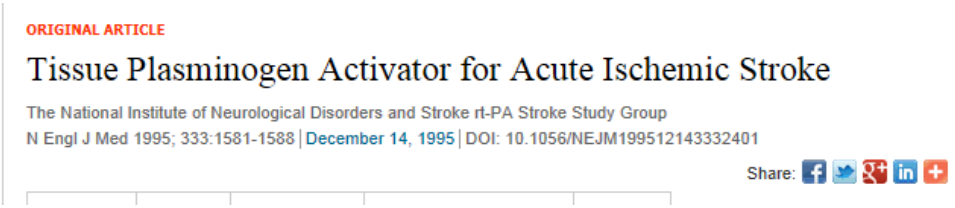
NINDS Trial (January '91 – October '94)

- Two-part trial looking at efficacy of rt-PA in acute ischemic stroke



ORIGINAL ARTICLE

Tissue Plasminogen Activator for Acute Ischemic Stroke

The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group

N Engl J Med 1995; 333:1581-1588 | December 14, 1995 | DOI: 10.1056/NEJM199512143332401

Share:

  - Part 1
    - 291 patients
    - Did t-PA have clinical activity ?
    - Indicated by a 4 point improvement in the NIHSS or resolution of the neurologic deficit at 24 hours
  - Part 2
    - 333 patients
    - Assessed clinical outcome at three months (using the Barthel Index, modified Rankin scale, Glasgow coma scale, & NIHSS)

NINDS Trial

- Patient Selection
  - Clearly defined time of onset
  - Measureable deficit on NIHSS
  - CT negative for ICH

- Exclusions
  - Stroke or serious head trauma in previous 3 months
  - Major surgery in previous 14 days
  - Hx of ICH
  - SPB >185 or DBP>110
  - Rapidly improving or minor symptoms
  - Symptoms suggestive of subarachnoid hemorrhage
  - GI or urinary tract hemorrhage in previous 21 days
  - Arterial puncture at non-compressible site in last 7 days
  - Seizure at onset of stroke
  - Anticoagulants
  - Labs- PT/ PLT/ Glucose
  - Aggressive blood pressure management required

Randomization and Treatment

- Onset of stroke to start of treatment from 0 to 90 minutes and from 91 to 180 minutes
- 0.9 mg/kg total dose with 10% given as bolus
- 90 mg maximum dose

Results

- Part 1- No statistically significant difference detected between groups (treatment vs. placebo) in the primary outcome (symptom resolution or improvement of ≥4 points on the NIHSS)
- Part 2- The number of patients with favorable outcomes (based on NIHSS, Barthel, mRS, & GCS) after 3 months was higher in the treatment group than in the placebo group.

In 1996, alteplase (Activase) received FDA approval for the treatment of acute ischemic stroke within 3 hours after the onset of stoke symptoms.

Treating Stroke in 2016

Endovascular Treatment of Acute Ischemic Stroke

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Randomized Controlled Trials Show the Efficacy of Endovascular Therapy in Ischemic Stroke

The results of these trials were released in February 2015 at the International Stroke Conference.

- MR CLEAN
- EXTEND IA
- SWIFT PRIME
- ESCAPE

Original Articles

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 1, 2015 VOL. 372 NO. 1

A Randomized Trial of Intraarterial Treatment for Acute Ischemic Stroke

O.A. Berkhemer, P.S.S. Fransen, D. Beumer, L.A. van den Berg, H.F. Lingsma, A.J. Yoo, W.J. Schonewille, J.A. Vos, P.J. Nederkoorn, M.J.H. Wermer, M.A.A. van Walderveen, J. Staals, J. Hofmeijer, J.A. van Oostayen, G.J. Lycklama à Nijeholt, J. Boiten, P.A. Brouwer, B.J. Emmer, S.F. de Bruijn, L.C. van Dijk, L.J. Kappelle, R.H. Lo, E.J. van Dijk, J. de Vries, P.L.M. de Kort, W.J.J. van Rooij, J.S.P. van den Berg, B.A.A.M. van Hasselt, L.A.M. Aerden, R.J. Dallinga, M.C. Visser, J.C.J. Bot, P.C. Vroomen, O. Eshghi, T.H.C.M.L. Schreuder, R.J.J. Heijboer, K. Keizer, A.V. Tielbeek, H.M. den Hertog, D.G. Gerrits, R.M. van den Berg-Vos, G.B. Karas, E.W. Steyerberg, H.Z. Flach, H.A. Marquering, M.E.S. Sprengers, S.F.M. Jenniskens, L.F.M. Beenen, R. van den Berg, P.J. Koudstaal, W.H. van Zwam, Y.B.W.E.M. Roos, A. van der Lugt, R.J. van Oostenbrugge, C.B.L.M. Majoie, and D.W.J. Dippel, for the MR CLEAN Investigators*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Endovascular Therapy for Ischemic Stroke with Perfusion-Imaging Selection

B.C.V. Campbell, P.J. Mitchell, T.J. Kleinig, H.M. Dewey, L. Churilov, N. Yassi, B. Yan, R.J. Dowling, M.W. Parsons, T.J. Oxley, T.Y. Wu, M. Brooks, M.A. Simpson, F. Miteff, C.R. Levi, M. Krause, T.J. Harrington, K.C. Faulder, B.S. Steinfort, M. Priglinger, T. Ang, R. Scroop, P.A. Barber, B. McGuinness, T. Wijeratne, T.G. Phan, W. Chong, R.V. Chandra, C.F. Bladin, M. Badve, H. Rice, L. de Villiers, H. Ma, P.M. Desmond, G.A. Donnan, and S.M. Davis, for the EXTEND-IA Investigators*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Randomized Assessment of Rapid Endovascular Treatment of Ischemic Stroke

M. Goyal, A.M. Demchuk, B.K. Menon, M. Eesa, J.L. Rempel, J. Thornton, D. Roy, T.G. Jovin, R.A. Willinsky, B.L. Sapkota, D. Dowlatshahi, D.F. Frei, N.R. Kamal, W.J. Montanera, A.Y. Poppe, K.J. Ryckborst, F.L. Silver, A. Shuaib, D. Tampieri, D. Williams, O.Y. Bang, B.W. Baxter, P.A. Burns, H. Choe, J.-H. Heo, C.A. Holmstedt, B. Jankowitz, M. Kelly, G. Linares, J.L. Mandzia, J. Shankar, S.-I. Sohn, R.H. Swartz, P.A. Barber, S.B. Coutts, E.E. Smith, W.F. Morrish, A. Weill, S. Subramaniam, A.P. Mitha, J.H. Wong, M.W. Lowerison, T.T. Sajobi, and M.D. Hill for the ESCAPE Trial Investigators*

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JUNE 11, 2015 VOL. 372 NO. 24

Stent-Retriever Thrombectomy after Intravenous t-PA vs. t-PA Alone in Stroke

Jeffrey L. Saver, M.D., Mayank Goyal, M.D., Alain Bonafe, M.D., Hans-Christoph Diener, M.D., Ph.D., Elad I. Levy, M.D., Vitor M. Pereira, M.D., Gregory W. Albers, M.D., Christophe Cognard, M.D., David J. Cohen, M.D., Werner Hacke, M.D., Ph.D., Olav Jansen, M.D., Ph.D., Tudor G. Jovin, M.D., Heinrich P. Mattle, M.D., Raul G. Nogueira, M.D., Adnan H. Siddiqui, M.D., Ph.D., Dileep R. Yavagal, M.D., Blaise W. Baxter, M.D., Thomas G. Devlin, M.D., Ph.D., Demetrius K. Lopes, M.D., Vivek K. Reddy, M.D., Richard du Mesnil de Rochemont, M.D., Oliver C. Singer, M.D., and Reza Jahan, M.D., for the SWIFT PRIME Investigators*

Study	Population	Sample	Design	Results
MR CLEAN- 16 medical centers in the Netherlands	Proximal artery occlusion in the anterior cerebral circulation that could be treated within 6 hours of symptom onset	500 Patients	Intra-arterial treatment plus usual care vs. usual care alone	13.5 percentage points difference in the rate of functional independence (modified Rankin score) at 90 days. No significant difference in mortality or symptomatic intracerebral hemorrhage.
SWIFT PRIME- 39 medical centers in the U.S. and Europe	Moderate-to-severe neurologic deficits; occlusion of the intracranial internal carotid artery, the first segment of the middle cerebral artery, or both; initiation of endovascular treatment within 6 hours of last known well	196 patients	tPA alone vs. tPA with endovascular thrombectomy within 6 hours of symptom onset	Study stopped early due to efficacy. Rate of substantial reperfusion at the end of the procedure was 88%. Rate of functional independence (mRS) was 60% vs. 35% at 90 days.
EXTEND IA- 14 centers in Australia and New Zealand	Able to receive tPA within 4.5 hours of stroke onset, anterior circulation ischemic stroke, occlusion of the ICA or the 1st or 2nd segment of the MCA, endovascular therapy initiated within 6 hours and completed within 8 hours of stroke onset, functional independence before the stroke, evaluation of the ischemic penumbra via CT Perfusion imaging.	70 patients	tPA alone vs. tPA with endovascular thrombectomy	Stopped early because of efficacy. Improved reperfusion of the ischemic territory at 24 hours. Increased neurologic improvement at 3 days. Improved functional outcome at 90 days (mRS).
ESCAPE- 22 centers worldwide	Adults with a disabling ischemic stroke with previous functional independence. Up to 12 hours after symptom onset. Occluded proximal artery in anterior circulation with moderate-to-good collateral circulation. Evaluation with CTA.	316 patients	tPA alone vs. tPA with endovascular thrombectomy	Stopped early because of efficacy. Increased functional independence at 90 days (mRS). Reduced mortality

This led to a change in the guidelines

- The American Heart Association/ American Stroke Association released the *2015 AHA/ASA Focused Update of the 2013 Guidelines for the Early Management of Patients With Acute Ischemic Stroke Regarding Endovascular Treatment*
- In this update, the AHA/ASA recognizes that endovascular procedures have provided clinical benefit for patients with acute ischemic stroke. The guidelines also recommend that stroke systems of care should be implemented to support delivery of this care.

Commonality in Endovascular Trials

- Centers participating in these trials all had the resources systems in place to provide comprehensive stroke care in an efficient manner.
- Higher volume centers provide better outcomes than lower volume centers.
- The success of these trials was in part due to the existence of stroke systems of care at these centers that allowed for rapid identification, imaging, and treatment by providers with expertise in acute stroke care.

(Mocco, et al., 2015)

Implementation of Stroke Systems of Care

AHA/ASA Policy Statement

Interactions Within Stroke Systems of Care

A Policy Statement From the American Heart Association/American Stroke Association

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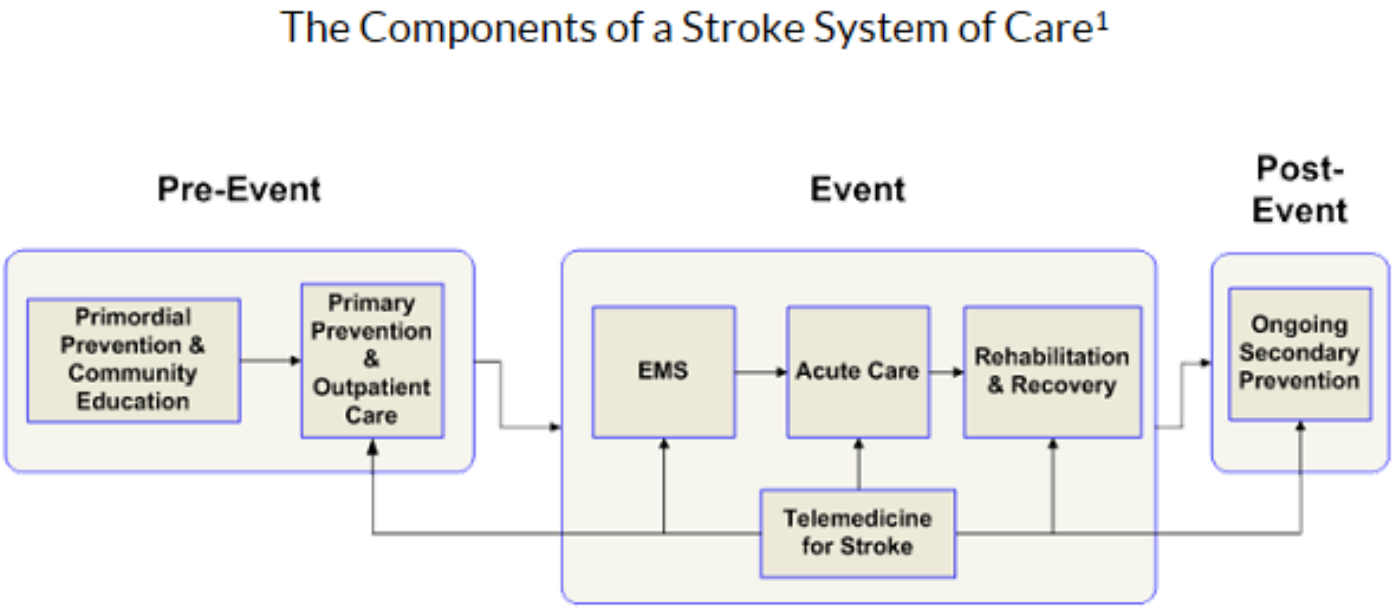
Areas Addressed by the AHA/ASA Guidelines

- Interactions within Stroke Systems of Care
- Levels and Types of Hospital Care
- Interactions Between Medical Staff at a Stroke Center
- Initial Assessment, Stabilization, and Care at the Hospital
- Transfer Protocols and Criteria
- Telemedicine
- Principles on Rules and Regulations
- Reimbursement Issues
- Legal Issues in Stroke Care
- Monitoring/Quality Program and Data Collection Elements
- Rehabilitation

What is a Stroke System of Care?



CDC, 2015

Development of Systems of Care

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Recommendations from the Brain Attack Coalition

- In 2000, the Brain Attack Coalition published a vision for regional organization of stroke care.
- This was followed by guidelines developed by the AHA/ASA and the Brain Attack Coalition that refined recommendations for development of regional systems of care.

(Song & Saver, 2012)

Pre-event

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Public Education

- Risk factors and prevention
- Stroke signs and symptoms and the need to seek emergency care
  - Reduce time delays between symptom onset and ER arrival.

Event

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Pre-hospital Stroke Care

- The Brain Attack Coalition recommended that EMS systems train paramedics to recognize stroke in the field and route ambulances to stroke centers.
  - LA Pre-hospital Stroke Scale
- This is echoed in the 2013 guidelines on stroke systems of care published by the AHA/ASA.
  - Extra transportation time should be limited to 15 to 20 minutes if there are several acceptable options in the geographic area.

Hospital Certification for Stroke

- TJC began certifying hospitals as Primary Stroke Centers in December 2003.
- States such as Florida, Oklahoma and New Jersey developed their own certification programs.

Hospital Certification for Stroke

- Based on hospital ability
- Levels of Care
  - Acute Stroke Ready (ASR) Hospitals
  - Primary Stroke Centers (PSC)
  - Comprehensive Stroke Centers (CSC)

Acute Stroke Ready

- Launched in July 2015
- Type of Care
  - Dedicated stroke-focused program
  - Telemedicine available within 20 minutes of it being deemed necessary
  - Transfer protocols in place with a PSC or CSC

(The Joint Commission, 2015)

ArSRH- Arkansas Stroke Ready Hospital

- Part of a statewide pilot program
- 9 hospitals designated as ARSRH hospitals

Primary Stroke Center

- Type of Care
  - Administration of IV thrombolytics
  - Designated stroke unit
  - Support patient self-management
- In Arkansas
  - Baptist Health Medical Center- LR
  - Sparks- Ft. Smith
  - Mercy Hospital- Ft. Smith
  - UAMS- LR
  - Washington Regional Medical Center- Fayetteville

Primary Stroke Center

In a retrospective cohort study examining data obtained from the National Inpatient Sample from 2004 to 2009, researchers found that 6.7% of patients treated for AIS at PSCs received Activase, compared to 2.2% at non-PSCs.

(Mullen et al., 2013)

Comprehensive Stroke Center

- Type of Care
  - Significant infrastructure, staff, and training to be able to provide state-of-the-art care
  - Dedicated Neuro ICU beds
  - Advanced imaging capability
  - Care for patients with subarachnoid hemorrhage with endovascular coiling or surgical clipping
  - Coordinate post-hospital care for patients
  - Use peer-review process to monitor care
- Currently there are no certified CSCs in Arkansas

(The Joint Commission, 2015)

Outcomes

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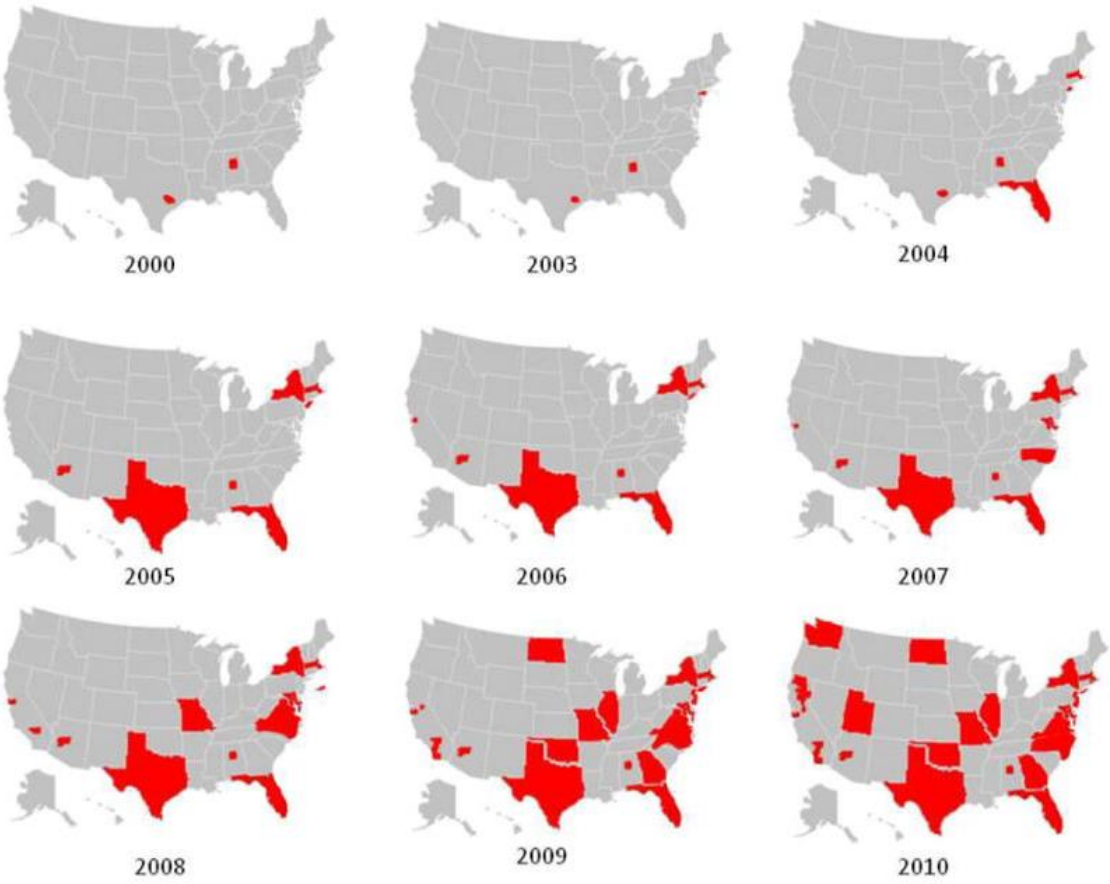
Stroke System Outcomes

- In 2000, 1.5% of the US population was covered by EMS routing protocols. In 2010, this coverage expanded to 53% of the population.

(Song & Saver, 2012).



Cartographs depicting the dissemination of acute stroke EMS preferential routing systems to stroke centers in the United States 2000-2010.

Stroke System Outcomes

- Decrease in treatment delays
- Increased treatment rates
- Decreased mortality and disability related to stroke
- Reduced financial burden to patients and payors

Stroke System Outcomes

- Quality of care
- Resource allocation

"The regionalization of care will better coordinate resources such as EMS, stroke centers, and telemedicine. A key goal of a stroke system of care is to ensure that all stroke patients are rapidly identified, transported, or transferred in a timely fashion to a hospital that can provide the most appropriate level of care for the particular clinical situation"

System Development

- Determine the number of each type of hospital needed in an area.
- Establish telemedicine link from the ASRHs to the PSC or CSC
- Develop transfer agreements and protocols
- Engage EMS as the point-of-contact for initial care **and as the link between the different types of centers**

What's Next?

- Continue to advocate for a system of care in our state
- Participate in regional system efforts
- Engage our legislature
- Engage in learning opportunities to improve stroke care in your area

STROKE IS AN EMERGENCY!
Know the signs and symptoms!

Courtesy of AHA/ASA, 2015

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