

**The Role of Different Types of Stroke Centers
in a Stroke System of Care**

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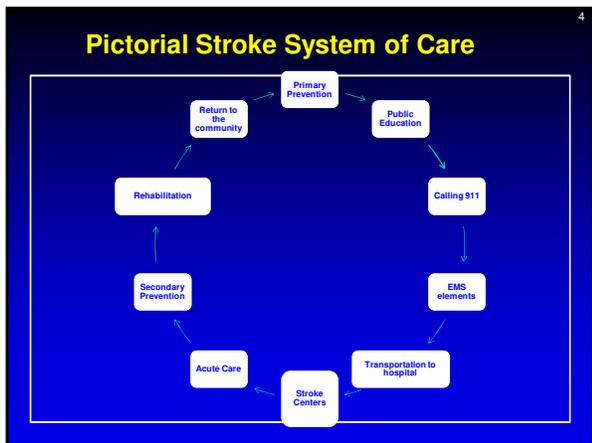
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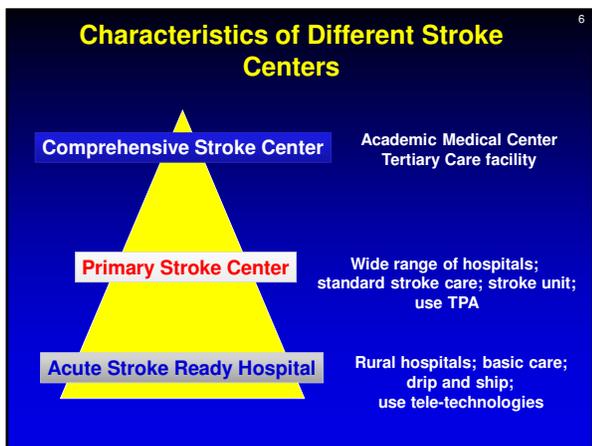
What is a Stroke System of Care?

- A comprehensive, diverse, longitudinal system that address all aspects of stroke care in an organized and coordinated manner
- Spans the spectrum of stroke care from primary prevention, calling 9-1-1, acute care, secondary prevention, rehabilitation, return to the community
- As with any system, it is only as strong as its weakest link
- This talk will focus on the acute care aspects
- But all elements are important
- Will be addressed in an upcoming AHA/ASA publication



EMS Plays a Key Role in a Stroke System

- Is typically the first medical professionals with direct patient contact
- Their initial assessments, actions, treatments, and decisions will have significant consequences in the patient's subsequent care
- Their role in patient triage, diversion, and routing cannot be under-estimated



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Numbers of Various Types of Stroke Centers

Comprehensive Stroke Center 75 to 250 total

Primary Stroke Center Final count 1000-1300

Acute Stroke Ready Hospital Perhaps 1200-1800

> 5000 total acute care hospitals in the U.S.

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Stroke and National Care Paradigms

- CMS is set to introduce 2 new national care measures related to stroke in 2013
- These apply to all stroke patients in any hospital
 1. 30 day all cause mortality for ischemic stroke
 2. 30 day re-admission rates after stroke discharge
- These results will be publicly available and will almost certainly affect reimbursement rates
- CMS will likely not pay for re-admissions

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ASRH: Concept and Targets

- Many stroke patients are in small urban, suburban, and rural areas
- Many have no access to a PSC or CSC
- Defining a sub-PSC tier would be helpful for several reasons:
 - Better define which hospitals in a specific area have some capabilities to care for acute stroke patients
 - Help guide EMS about where to take patients
 - Provide information to patients about where to go if a stroke occurs
 - ASRHs are referred to in some state laws but without specific elements and definitions
- The intent is for an ASRH to be some distance away from a PSC or CSC, not across the street

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Key Elements of the ASRH

- Acute Stroke Team
- Stroke Protocols
- EMS
- ED
- Laboratory Testing
- Rapid Imaging
- Neurosurgical Services
- Stroke Unit (not needed since typically no admissions)
- Transfer agreements to a PSC or CSC
- Telemedicine links to a PSC or CSC
- Medical Leadership and Administrative Support!!!

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Elements of an ASRH and PSC

ELEMENT	ASRH	PSC	COMMENT
Acute Stroke Team	15 minute response time	15 minute response time	Minimum 2 members
Stroke Protocols	Revise annually	Revise annually	Applies to all types of strokes
Emergency Medical Services	Training in field assessment tools for stroke	Training in field assessment tools for stroke	At least 2 hours of stroke-related education annually
Emergency Department	Written protocols for treatment and stabilization; 4 annual hours of education	Written protocols for treatment and stabilization; 8 annual hours of education	Physician and nurse education
Laboratory testing/EKG/CXR	Test results available within 45 min of ordering	Test results available within 45 min of ordering	Testing available 24/7
Brain imaging	Test completed and read within 45 minutes of order	Test completed and read within 45 minutes of order	Head CT or MRI acceptable; service available 24/7; may use tele-radiology
Door to Needle	Is 60 minutes reasonable?	60 minutes still the goal	Ideal vs realistic

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Neurosurgical Services at ASRH

- Available within 3 hours of when needed
 - Most likely via transfer
 - Local availability also an option
 - Unlikely this would be achievable with tele-technologies
 - Cannot operate via remote control
 - ? Whether remote triage would be reasonable

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Tele-technologies at an ASRH

- Video conference (VC) or teleconference (TC) for screening for TPA and other acute therapies
 - VC generally more supported and reliable
 - TC for screening and other consultative cases
- Tele-radiology for interpretation of CT/MRI
 - Obviously have to see the images
 - ACR has published technical aspects
 - System must be FDA approved (several already available)
- Must have signed agreements with a PSC or CSC for these services on a 24/7 basis

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Primary Stroke Centers

- About 950 PSCs currently certified by TJC
 - Perhaps another 100 or so certified by another organization
- Mostly urban, suburban
- Provide organized care in most states and regions
- Some academic, some not
- Typically have 300-400 stroke admissions per year
 - Some up to 800-1000/yr

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Updated PSC Recommendations

- MRI with diffusion available for stroke patients
- Vascular imaging for stroke patients
 - MRA of head/neck
 - CTA head/neck
 - Doppler alone not acceptable
- Cardiac imaging
 - TTE, TEE, or cardiac MRI
- Stroke Unit monitoring protocols
 - Multichannel telemetry
 - Clinical monitoring plans
 - Who to call/when to call plans
- Begin rehabilitation efforts ASAP
- Certification by an independent organization

Alberts et al, Stroke, 2011

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NY State PSC Study

- 30,947 patients with acute ischemic stroke
- 2005-2006
- One year follow-up
- 15,297 admitted to a designated stroke center (PSC)
- Used 39,000 and 40,000 patients with GI hemorrhage and MI as internal controls

Xian et al, JAMA, 2011

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NY State Study Mortality Outcomes

Table 3. Mortality at Designated Stroke Centers and Nondesignated Hospitals

	No. (%)		Adjusted Mortality Difference (95% CI) ^a	P Value
	Designated Stroke Center (n = 15 297)	Nondesignated Hospital (n = 15 650)		
1 d	90 (0.6)	134 (0.9)	-0.3 (-0.6 to -0.0)	.04
7 d	665 (4.3)	842 (5.4)	-1.3 (-2.1 to -0.6)	.001
30 d	1543 (10.1)	1951 (12.5)	-2.5 (-3.6 to -1.4)	<.001
1 y	3412 (22.3)	4067 (26.0)	-3.0 (-4.4 to -1.5)	<.001

Xian et al, JAMA, 2011

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Impact of Reduced Death Rates for Stroke

- Stroke is the 4th leading of death in the US and the 2nd leading cause of death globally
- 2% to 3% reduction in deaths in US means
 - 16,000 to 24,000 fewer deaths in the US
- Globally this means 320,000 to 480,000 fewer stroke deaths each year
- There are very few medical interventions that reduce deaths
 - Trauma centers DO
 - Coronary stenting vs angioplasty DOES NOT
 - CEA vs medical therapy DOES NOT

Hypotheses

- Hospitals certified as Primary Stroke Centers (PSCs) would increase the use of IV TPA in eligible patients
- The longer a hospital was a certified PSC, the rate of IV TPA administration would increase

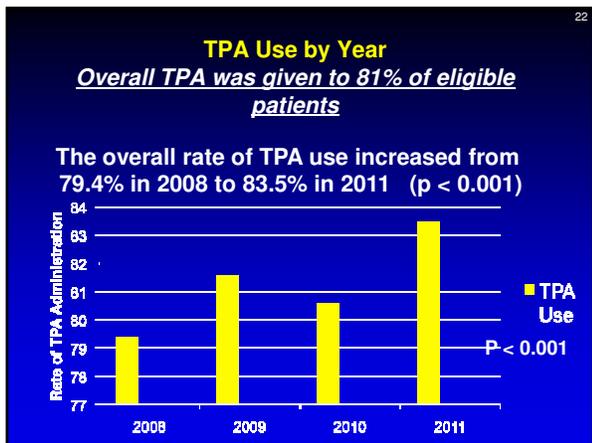
Methods

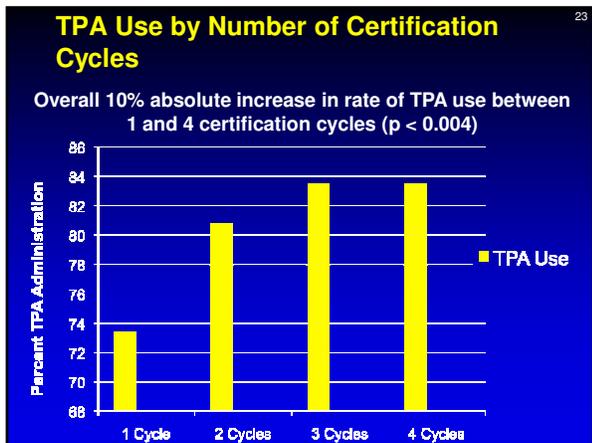
- We analyzed data from PSCs certified by The Joint Commission (TJC) from 2008-2011
- Rates of IV TPA use in eligible patients (ischemic strokes, presentation within 2 hr. of Sx onset/last known normal, no contraindications to TPA therapy)
- Analyzed number of certification cycles, hospital setting, and teaching status

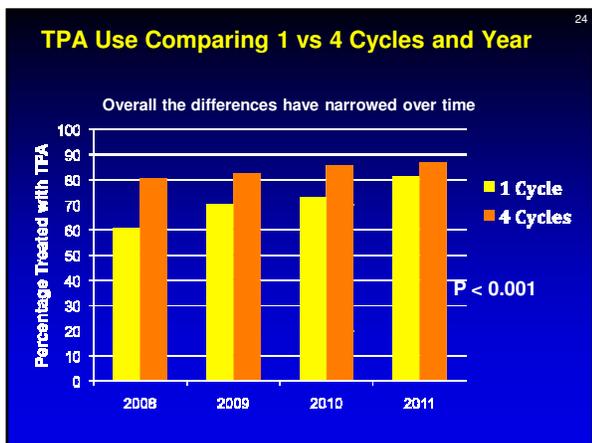
Results

- 34,909 eligible patients at 842 PSCs were identified
- 455 teaching hospitals; 367 non-teaching
- 783 urban; 39 rural
- 1 cycle = 278
- 2 cycles = 235
- 3 cycles = 246
- 4 cycles = 83

Alberts et al, presented at ISC, February 2011, New Orleans

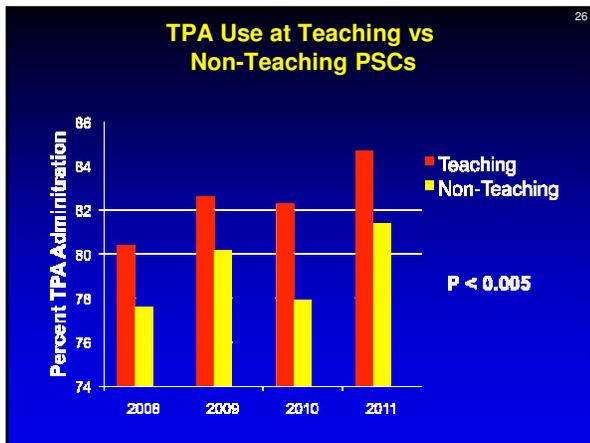


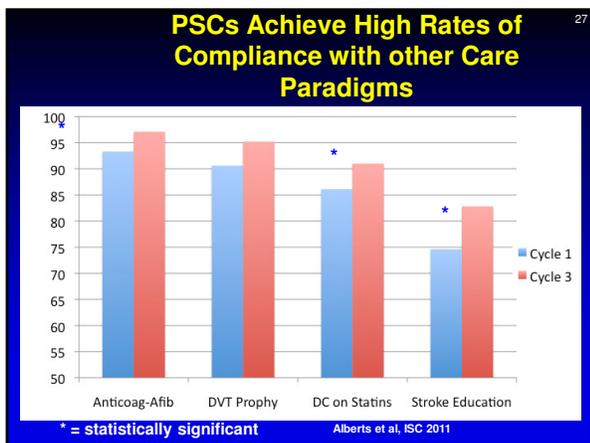




IV TPA Use by Hospital Characteristics ²⁵

- TPA use was higher at teaching hospitals vs non-teaching hospitals, though the actual numbers are quite close:
 - 82.2% Teaching
 - 79.0% Non-teaching ($p < 0.001$)
- Urban hospitals had higher rates of TPA use compared to non-urban hospitals
 - 81.3% Urban
 - 72.5 Non-urban ($p < 0.001$)





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PERFECT Study-Finland

- Compared outcomes among patients admitted to different types of hospitals
- Used BAC criteria for PSC and CSC
- Adjusted for baseline differences

CSC = 20,045 PSC = 10,749 GH = 30,891

Outcome adjusted for patient demographics, OR (95% CI)	CSC	PSC	GH
Case-fatality by 1 year	0.84 (0.80–0.89)	0.89 (0.84–0.94)	1
Institutional care at 1 year	0.87 (0.82–0.93)	0.89 (0.83–0.96)	1
Home at 1 year	1.22 (1.17–1.28)	1.16 (1.10–1.23)	1

Meretoja et al, Stroke, 2010

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Patient Types at a Comprehensive Stroke Center

- Large complex ischemic strokes
 - Endovascular therapy
 - Hemispherectomy
 - Systemic disease with multi-organ involvement
 - High ICP
 - Cryptogenic etiology
- Intracerebral hemorrhage
 - ICU level care
 - Neurosurgical interventions
- Subarachnoid hemorrhage
 - ICU level care
 - Endovascular and neurosurgical therapies
 - Vasospasm treatments

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Key Elements of a Comprehensive Stroke Center

- All components of a Primary Stroke Center, **plus**
 - Availability of advanced imaging techniques
 - ✦ MRI/MRA, CTA, DSA, TCD
 - Availability of personnel trained in vascular neurology, neurosurgery, endovascular techniques
 - **24/7 availability of personnel, imaging, OR, and endovascular facilities (i.e. a hospital cannot be a CSC from just 8AM to 5PM)**
 - ICU/Neuroscience ICU
 - Stroke registry
 - Experience and expertise treating patients with large strokes, ICH, SAH

DSA = digital subtraction angiography; TCD = transcranial Doppler.
Alberts MJ, et al. Stroke. 2005;36:1157-1161.

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Key Personnel at a CSC

- CSC Director—most likely an MD with advanced training in vascular neurology
- Neurosurgeon(s) with training in vascular neurosurgery
- Endovascular expertise for lytic/mechanical therapy, coiling, stenting, etc.
- Intensivist/Neuro-intensivist for ICU staffing
- Nursing personnel for stroke unit, ICU/NICU, endovascular, OR, etc.
- Advanced practice nurses for stroke registry, education, referrals
- Therapists and pharmacists—patient care and research studies

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CSC Requirements

- **MRI available for stroke patients; 24/7**
- **MRI with diffusion 24/7**
- **Vascular imaging for stroke patients**
 - **MRA of head/neck 24/7**
 - **CTA head/neck 24/7**
 - **TCD**
 - **Carotid Doppler**
 - **Catheter angiography 24/7**

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CSC must have NICU beds

- MDs and nurses with experience and expertise caring for complex stroke patients
 - Includes ischemic strokes, ICH, SAH
 - 24/7 staffing and capability
- Does this need to be a separate NICU?
 - probably not
- Does this require a certified neuro-intensivist?
 - Unlikely
- Can this requirement be met by a few NICU beds in a larger MICU/SICU with a general intensivist/pulmonologist/anesthesiologist?
 - Perhaps

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CSC-Volume Requirements

- The CSC will care for at least 20 subarachnoid hemorrhage patients per year.
- The CSC will perform at least 10 craniotomy surgeries for aneurysm per year.
- The CSC will perform at least 15 endovascular coiling surgeries (either acute or elective) for aneurysm per year.
- Some of these may be revised based on concerns from NSGY
- The CSC will administer IV tPA to at least 25 eligible patients per year.
 - Telemedicine cases are counted

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Research at a CSC

- This is a new, unique requirement
- Based on two factors:
 - 1. This should be part of the mission of a CSC
 - 2. Participation in research generally improves outcomes
- Must be an IRB-approved project
 - This is meant to avoid data-base and registry type projects
- Research must be patient-oriented
 - This is meant to exclude animal focused projects which may not impact patient care

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Telemedicine at a CSC

- Most CSCs will have some type of telemedicine arrangement
 - Telephone consults
 - Full video conferencing with radiology feeds
 - Remote robotic interactions
- Link CSC to PSCs and ASRHs in their network
- Pre-arranged consultations and transfers
 - Specify vendors, logistical issues, platforms, reimbursement, legal issues
 - Decide who to transfer and how to transfer

Outcomes at a CSC: Finland Study

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Table 4. Outcome of Finnish Patients With Ischemic Stroke

	CSC (n=20 045)	PSC (n=10 749)	GH (n=30 891)
Unadjusted outcome, no. (%)			
Case-fatality by 1 year	3321 (16.6)	2051 (19.1)	8428 (27.3)
Institutional care at 1 year	1773 (8.8)	1037 (9.6)	4071 (13.2)
Home at 1 year	14 951 (74.6)	7661 (71.3)	18 392 (59.5)
Outcome adjusted for patient demographics, OR (95% CI)			
Case-fatality by 1 year	0.84 (0.80–0.89)	0.89 (0.84–0.94)	1
Institutional care at 1 year	0.87 (0.82–0.93)	0.89 (0.83–0.96)	1
Home at 1 year	1.22 (1.17–1.28)	1.16 (1.10–1.23)	1

Meretoja et al, Stroke, 2010

Steps in Transforming From a PSC to a CSC

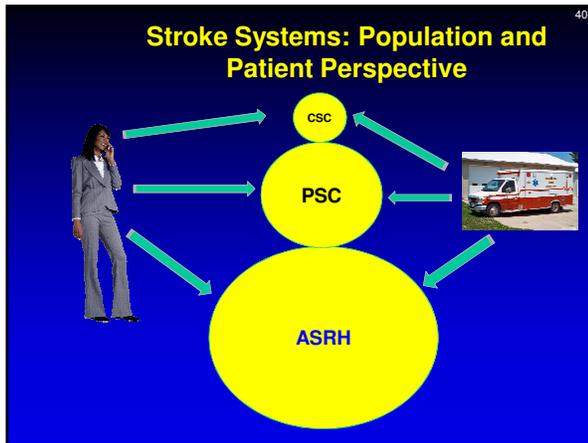
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|---|---|
| <ul style="list-style-type: none"> • <u>Key PSC elements</u> <ul style="list-style-type: none"> – Stroke Unit; no NICU – MRI, MRA, CTA – NSGY within 2 hours – No endovascular – No vascular neurology – No specific volume requirements – No research requirement | <ul style="list-style-type: none"> • <u>Key CSC elements</u> <ul style="list-style-type: none"> – Stroke Unit + NICU – MRI, CTA, MRA, angiography available 24/7 – NSGY 24/7 – Endovascular 24/7 – Vascular neurology 24/7 – Specific volume requirements – Research requirement |
|---|---|

Growth from a PSC to CSC: Key Questions

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- Does my hospital have the case volume to support the programs and investments and meet TJC requirements?
 - A large focus of CSCS is on ICH, SAH; these make up about 15% to 20% of all strokes
- Can my hospital make the financial commitment to become a CSC?
 - Hiring new personnel
 - Dedicated endovascular suites
 - NSGY programs
 - NICU programs
 - 24/7 coverage needed in many areas



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By-passing Hospitals in a Stroke System of Care

- With multiple hospitals of various capabilities in a geographic area (or Stroke System), how can we properly triage and divert patients to the most appropriate facility?

Guiding Principles # 1

If all are close, go to the highest level Stroke Center initially

WHY?

- We do not know the type of stroke
- Patients can deteriorate
- Unclear what tests and treatments will be needed.

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By-passing Hospitals

Guiding Principle # 2

Time is more important than distance, because time is brain

- Factors to consider include:
 - ◊ Weather
 - ◊ Traffic
 - ◊ Local geography
 - ◊ Mode of transportation

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By-passing Hospitals

Guiding Principle # 3

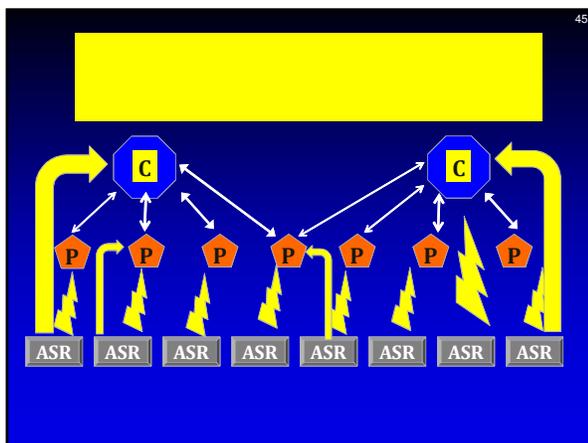
To make the best decision, personnel must know the actual capabilities of their local hospitals as well as the EMS system

- Not every hospital that claims to be a PSC or CSC will have those capabilities
- EMS triage and routing skills may vary by city and region
- All politics are local!!!

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EMS Field Triage and By-Pass

- Final Principle
 1. Avoid by-passing another hospital (PSC, CSC) if that will add **more than 15-20** minutes of transportation time
 2. This time is used for many other field transportation systems
 3. Exception would be some compelling reason to by-pass lower level facility
 1. High likelihood they will need a CSC level facility



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Conclusions

- The Stroke Center care paradigm ensures that patients will receive the proper level of care in each case
- Becoming a CSC will involve a significant investment for some hospitals, but will provide benefits for patients and the hospitals
- A Stroke System of Care will promote a flexible system that can adapt and fit a variety of regional and geographic scenarios
- Improved outcomes will reduce the financial burdens on government and health care systems
