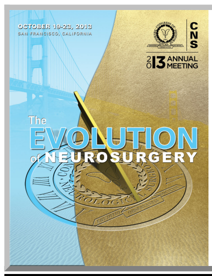

The Development of Code Stroke: Streamlining the Identification and Treatment of Patients with Acute Ischemic Stroke

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Background

Stroke is one of the major causes of death and disability in the US, yet it is under treated by many major medical centers across the country. Timely recognition and treatment of acute ischemic stroke remains a challenge due to confusing clinical presentations, hospital logistics, communication among providers, and lack of standardized treatment algorithms. By creating a system-wide code stroke protocol, the St. John Providence Health System was able to improve documentation, increase intravenous tPA delivery, reduce specialist call back times, improve door to CT scan and door to needle time, as well as identify patients appropriate for endovascular therapy. This poster describes the process we developed to achieve these results.

Introduction

Stroke accounts for:

- 15 million deaths world wide
- 795,000 new cases in the U.S. annually
- 134,000 deaths in the U.S. annually, 4th leading cause of death
- $28.3 billion direct medical expense, $53.9 billion indirect medical expense in 2008
- > 50% of cost incurred after 3 years from initial stroke

Joint Commission

- Accreditation of primary stroke centers in 2003
- Advanced Certification of Comprehensive Stroke Centers in Sep 2012.

Hospitals

- Stroke networks
- Telemedicine
- Acute stroke protocol
- Neuroendovascular Advance Stroke Intervention

Multispecialty Stroke Team

At St. John Providence Health System, stroke team comprise of:

- Emergency medicine physicians
- Stroke neurologists
- Neuroendovascular surgeons
- Neuroradiologists
- Advanced care stroke nurse practitioners
- Physical Medicine and Rehabilitation
- Bed-control
- Neuroscience Intensive Care Unit with board certified intensivist
- Dedicated Neuro Specialty Units for non ICU patients
- Primary Care / Internal Medicine
- Quality Assurance Team

Brief Overview

Patients with suspected stroke at triage:

- High acuity bed in resuscitation area
- ED physician evaluate patients within 5 min, code stroke being activated
- NIHSS being performed on every patient
- Perfect Serve paging system sends page to Neurology, Endovascular Neurosurgery, CT Tech, Radiologist in Reading Room, Anesthesia team, interventional team (FYI page), bed control, NSICU charge nurse
- Neurology and Neuroendovascular physicians confer and evaluate every single case of suspected stroke and formulates a plan with ED physician.
- Imaging studies completed. Official reads of CT Perfusion within 15 minutes of completion and within 45 min of alert activation. Images also being evaluated by neurology and neuroendovascular physicians in correlation with clinical signs and symptoms.
- Treatment being initiated: ivtPA, neuroendovascular intervention, or expectant management
- Stroke pathway initiated for the rest of the hospital stay.
- All time measures and benchmarks are recorded, treatment decision and justification entered into the stroke data base for weekly review and quality assurance

Time Benchmarks for SJPHS Code Stroke

EMERGENT CARE OF THE ACUTE STROKE PATIENT
RECOMMENDED TIME LINE

Time Line

0 min — **Patient arrives to ED with Stroke Symptoms.**

5 min — **RN triage Assessment Completed**

10 min — **Physician Assessment Completed**

ED physician / Rapid Response Team	ED nurse / Staff Nurse
• Determine last know normal. • Obtain a brief history and physical examination	• O2 2L/NC • IV access 2 (large gauge catheters)
• Neurological Examination with NIHSS (ischemic stroke) • Identify any known absolute exclusions for IV tPA	• Telemetry • Pulse oxymetry • Vital signs and Neurological examination
• STAT CT and CTA of the head and neck • CT perfusion (if absolute exclusion from IV tPA identified)	• Prepare for CT scan • Glucose (POC)
• STAT labs	• Blood drawn and sent STAT

15 min — **Activate Stroke Alert:**

25 min — **Brain Imaging Completed**

45 min — **Brain Imaging Results Reported/Lab Results Reported**

60 min — **Initiate Treatment Option**

Evidence Based Reference for Providers

REFERENCE SHEET FOR HEALTH CARE PROVIDERS

Benefit of tPA	Benefit of NO tPA
Less than 3 hours TPA (alteplase) 17% - Normal at 24 hours 31% - Normal at 3 months 20% - Less chance of moderate to severe disability or death	**Less than 3 hours No tPA (alteplase)** 3% - Normal at 24 hours 20% - Normal at 3 months
3 to 4.5 hours* TPA (alteplase) 52% - Normal at 3 months (mRS 0-1) 28% - chances or returning to an independent lifestyle compared to no tPA	**3 to 4.5 hours No tPA (alteplase)** 45% - Normal at 3 months (mRS 0-1)
Risk of tPA	**Risk of NO tPA**
Less than 3 hours TPA (alteplase) 17% - Mortality 40% - Severe Disability or Death 17% - Deterioration within 36 hours 6.4% - Symptomatic ICH	**Less than 3 hours NO tPA (alteplase)** 21% - Mortality 48% - Severe Disability or Death 18% - Deterioration within 36 hours 0.6% - Symptomatic ICH
3 to 4.5 hours* TPA (alteplase) 7.7%- Mortality 7.9% - Symptomatic ICH	**3 to 4.5 hours NO tPA (alteplase)** 8.4% - Mortality 3.5% - Symptomatic ICH
***This does not extend the treatment window for acute stroke. Early treatment remains essential. Treatment with alteplase (tPA) within the first 1.5 hours after onset of stroke doubles the efficacy compared to 1.5-3 hours after onset. For 1 patient to have a favorable outcome (mRS 0-1) after 3 hours, 14 patients will require treatment.**	
Frequency of ICH by Baseline NIHSS Score with tPA treatment:	
NIHSS 0-5 2% - ICH NIHSS 6-10 3% - ICH NIHSS 11-15 5% - ICH NIHSS 16-20 4% - ICH NIHSS >20 17% - ICH	Note: Patients with NIHSS greater than 20 return to normal more frequently with tPA; the rate of death or severe disability is still high (65-70%) either way.

Intracerebral Hemorrhage	
Symptoms ICH	— NIHSS decrease in LOC (1a) greater than or equal to 1 — Increase in NIHSS greater than or equal to 4 — Acute hypertension — Nausea — Vomiting — New headache
If you suspect ICH	— Discontinue tPA (alteplase) — Obtain stat CT — Draw blood for PT, PTT, Fibrinogen, Type and Screen — Prepare Cryoprecipitate 5-8 Units — Prepare Platelets 6-8 Units — Fresh Frozen Plasma 5-8 Units
ICH verified on CT	— Obtain lab results — Stat Neurosurgery Consult — Consider Cryoprecipitate and Platelets — Consider Hematology consult — Consider second CT to assess ICH progress

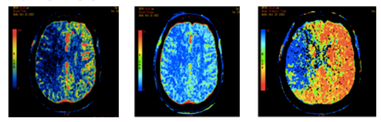
Neuroendovascular Intervention

CONSIDERATION FOR ENDOVASCULAR TREATMENT
INCLUSION CHECKLIST

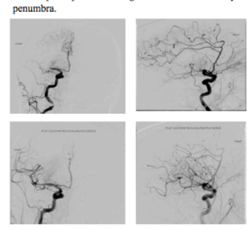
YES	NO	INCLUSION CRITERIA FOR INTRA ARTERIAL THROMBOLYTICS/THROMBECTOMY
		Patient with a contraindication to IV tPA and within 8 hours of symptom onset **OR** awoke with symptoms **OR** symptoms suggestive of posterior circulation stroke.
		No response or improvement in NIHSS within one hour of IV tPA administration **OR** receiving IV tPA and neurological deficits attributable to large vessel occlusion (NIHSS greater than 9)
		Pretreatment CT head reviewed and less than 1/3 of arterial territory with infarction
		Pretreatment CT perfusion of the head reviewed and evidence of penumbra.

Above: Part of the stroke pathway package includes a checklist for indications for neuroendovascular intervention

Physiologic imaging studies: CT Perfusion / MR Perfusion used to determine Penumbra



Above: CT Perfusion Images: Blood flow map, blood volume map, and mean transit time map in a patient with right middle cerebral artery occlusion with significant penumbra.

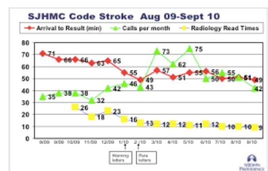


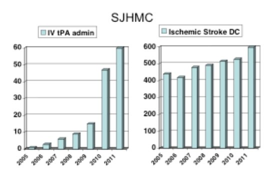
Top Left: Cerebral angiography AP and Lateral views demonstrated a patient with right middle cerebral artery occlusion.

Bottom Left: After successful mechanical thrombectomy with Solitaire FR revasculariation device.

Outcomes

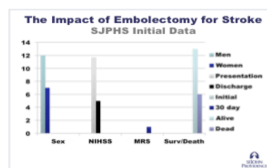
Right: Code Stroke Data at St. John Hospital and Medical Center from 08/2009 to 09/2010. Door to CT result time is shown in red, number of Calls per month is shown in green, and interpretation time from CT completion to result (in min) is shown in yellow.



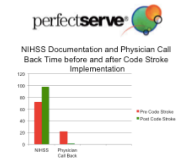


Left: Number of patients received ivtPA as well as number of patients discharged with a diagnosis of ischemic stroke at St. John Hospital and Medical Center from 2005 to 2011.

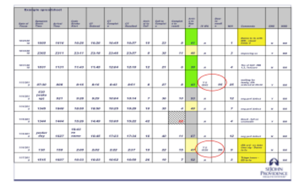
Right: The impact of embolectomy for patients with acute ischemic stroke, data from St. John Providence Health System from March 2012 to September 2012.



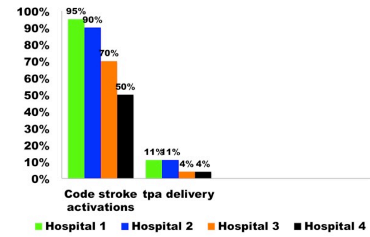
Quality Assurance



Right: Weekly Stroke Process Data sheet listing objective time benchmarks for each code stroke alert at each of the participating hospitals of St. John Providence Health System. Significant delays in diagnostic and treatment are examined and recommendations are made to improve identified defects in the system.



Percentage of Code Stroke Activation



Percentage of Code Stroke Activations of patients with acute ischemic stroke at four primary stroke center designated emergency departments of the St. John Providence Health System as well as IV-tPA administration rate in each ED in 2010.

Summary

Outcome following an acute ischemic stroke depends on timely diagnosis and reperfusion of the ischemic brain. By creating a "code stroke" protocol, we have demonstrated significant improvement in the diagnosis and treatment of patients with stroke through a process that delivers specialty care to the patients point of access to our care system and eliminates traditional obstacles at a major regional stroke center with objective, measurable improvement in outcomes. The process was subsequently scaled to a system level and then to a network level. Our protocol may be used as a model for other centers to enhance their stroke programs.