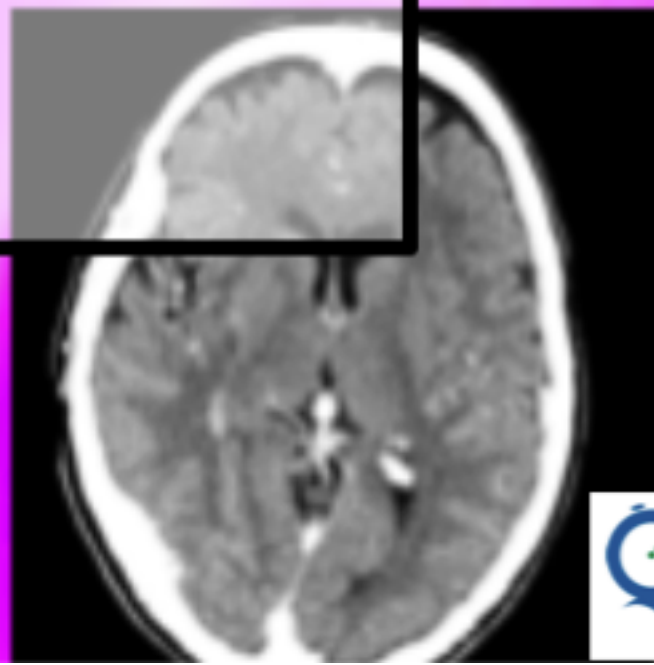


# “Underneath our Noses”: Inpatient Stroke

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# Disclosure

- No Honoraria for current presentation.
- Have Received Honoraria from Bristol-Myers Squibb, Sanofi Aventi, Allergan and Boehringer Ingelheim.
- No other financial interests to disclose.

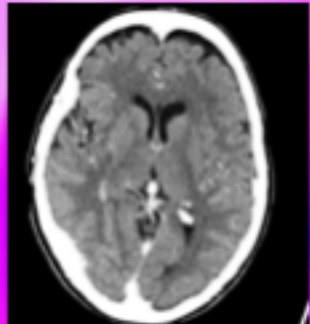


# Objectives

- Review the Epidemiology of Inpatient Stroke
- Case review demonstrating the variability of inpatient-stroke presentation.
- Cases chosen to demonstrate challenges in acute treatment of Stroke in the inpatient setting.
- Emphasis on Symptom Recognition.
- Extrapolation of management principles from the outpatient setting. the impact of strategies of secondary prevention of recurrent stroke And primary prevention of complications on outcome.
- To introduce QA strategies for improving outcomes, local efforts and provincial efforts such as the QuICR project in Stroke Outcomes.
- Review of Inpatient Stroke Algorithm as Interventional Tool.

# Pre-test

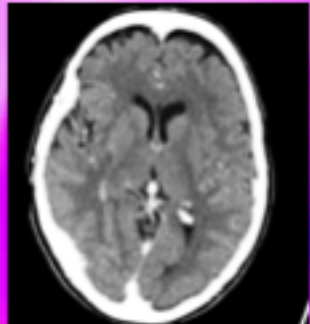
- What Proportion of Total Strokes in Hospital occur in the in-patient setting?
- What are the Outcomes of Patients who experience a stroke in hospital?
- What are the chances of receiving and Acute intervention for Stroke in Patients who experience a stroke in hospital?
- What are the time windows of intervention for i.v. tPA and Endovascular Therapy?
- What are the high risk settings (if any) for inpatient stroke?
- How does inpatient stroke present?
- What is out site based algorithm for inpatient stroke?





# Case 1:

- Patient is a 28 year old woman admitted for femoral embolectomy. History of Mitral Valve Replacement, On Heparin in peri-operative period.
- Patient noted in p.m. to have apparent weakness of left lower and upper extremity.
- Discussed with Stroke-team approx 12-14 hours later.
- Stroke in Rt Fronto-parietal area identified.
- Patient transferred to Stroke Unit for Rehab en route to transfer to Glen Rose Hospital.

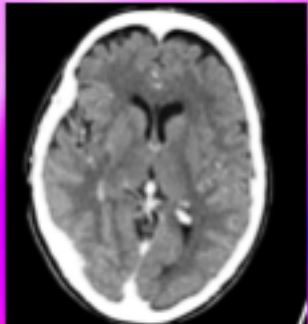


## Case 2:

- Patient is a 70+ year old gentleman.
- POD 1, CEA.
- Presents with Acute Left Hemiplegia, Hemineglect.
- Symptoms identified at approximately 5 hours.
- Plan?
- Discussed with Interventional Radiology, Patient treated “conservatively”

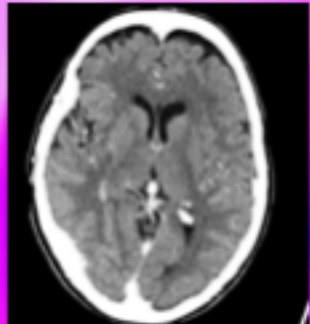
# Cases 1 and 2: Discussion

- Both patients underwent recent high risk procedures and had inherent pre-operative risk factors for stroke.
- Despite this, delay in time to symptoms first recognition.
- Both patients had contraindications to intravenous tPA.



# Symptom Recognition:

- Who most commonly recognizes inpatient stroke?
- Where Does it Happen most frequently?
- What Happens Next?





# Symptom Recognition: Where Does it Happen Most Frequently?

*Stroke Vol 24, No 12 December 1993*

**TABLE 1. Descriptive Data**

Locale	Men	Women	Hospital Service			
			Medicine	Surgery	Neurology	Psychiatry
Duke	23	22	27	12	5	1
Yale	11	7	6	12	0	0
Total	34	29	33	24	5	1

- Cardiology (29%),
- General surgery (19%)
- General medicine (14%), and
- Thoracic surgery (12%).
- The most frequent admission diagnosis was myocardial infarction (14%), followed by coronary artery bypass surgery (11%).

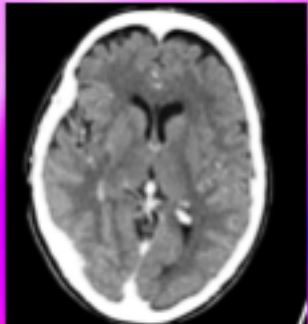
The left side of the slide features a vertical stack of four images. From top to bottom: a blue clock with black hands and numbers on a blue background; a yellow clock with black hands and numbers on a yellow background; a red clock with black hands and numbers on a red background; and a black and white axial brain scan showing a dark area in the left hemisphere.

# Inpatient/Peri-Operative Stroke:

- Peri-operative Stroke
- Prevalance from Heterogenous (Non Cardiac Surgery )Estimates at approx. 0.5%.
- Certain High Risk Procedures have also been identified eg. Hip Replacement/Repair Surgery, Hemicolectomy, Pulmonary Surgery-4%.
- The presence of a previous history of stroke increases risk (15%)

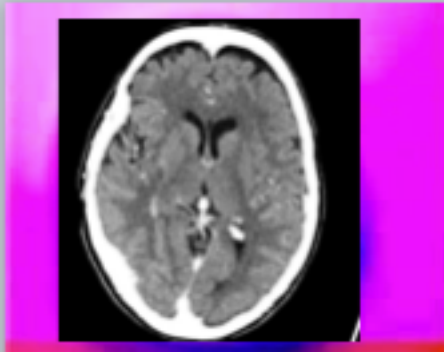
# Post-Operative Stroke

- Mechanisms (Non Cardiac, Non-Vascular):
- Post-operative stress Responses
- Aminergic Effects
- Inflammatory Mediators



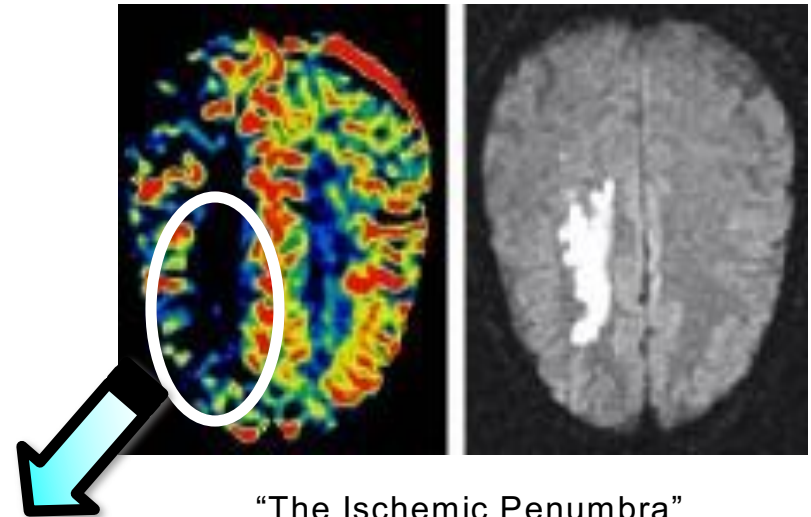
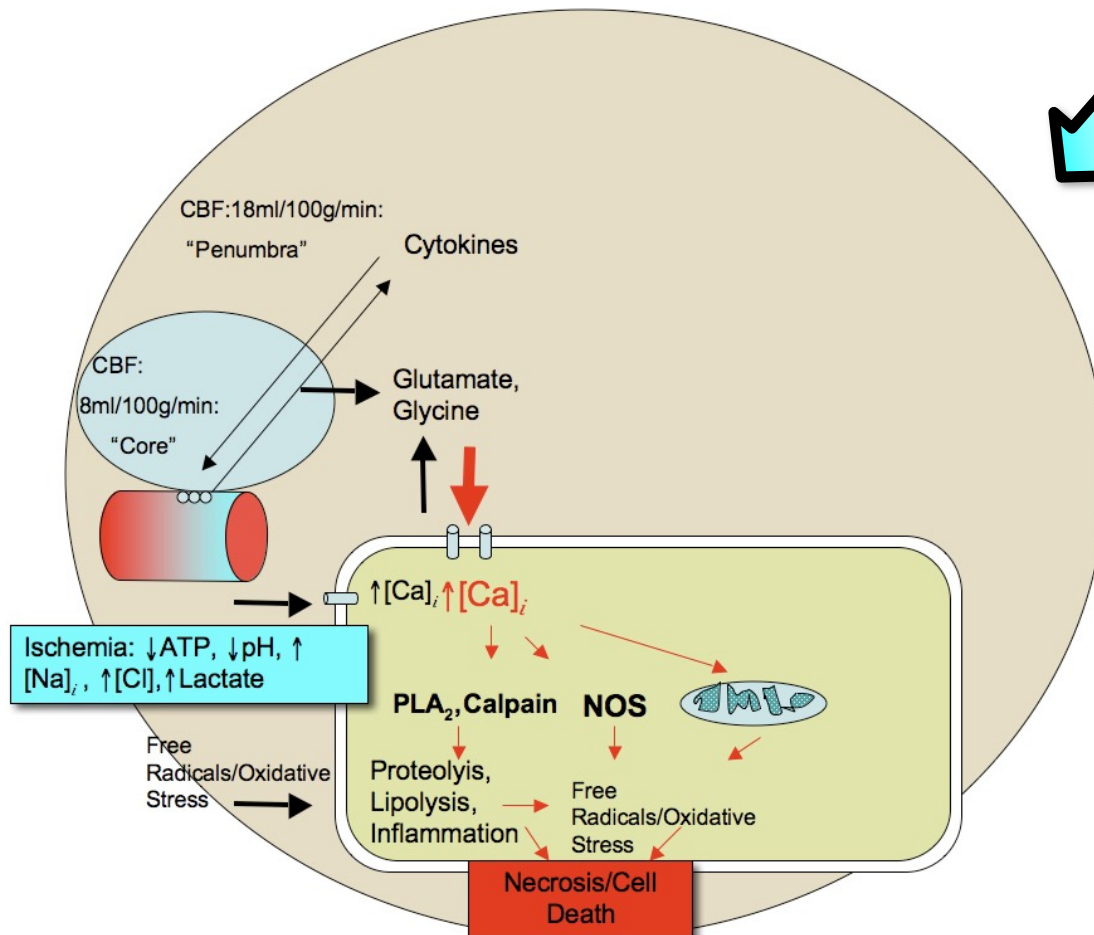
# Inpatient/Peri-operative Stroke

- Prognosis:
- Mortality: 26%
- Patient Characteristics: Typically have a history of Vascular/Cardiac Diagnostic or Therapeutic Intervention.
- 2/3 will occur within first 48 hours post high risk procedures, remaining presenting over a 30 day period
- Dilemma for subsequent management as tPA often contraindicated.





## "The Ischemic Cascade"



"The Ischemic Penumbra"

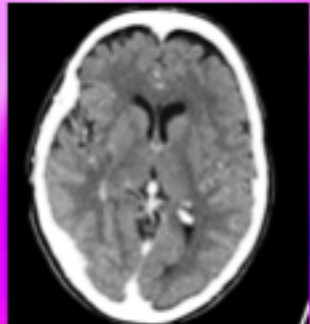
"In patients experiencing a typical large vessel acute ischemic stroke;... In each minute, 1.9 million neurons, 14 billion synapses, and 12 km (7.5 miles) of myelinated fibers are destroyed."

-From: Saver, J; "Time is Brain: Quantified", *Stroke*. 2006;37:263-266.

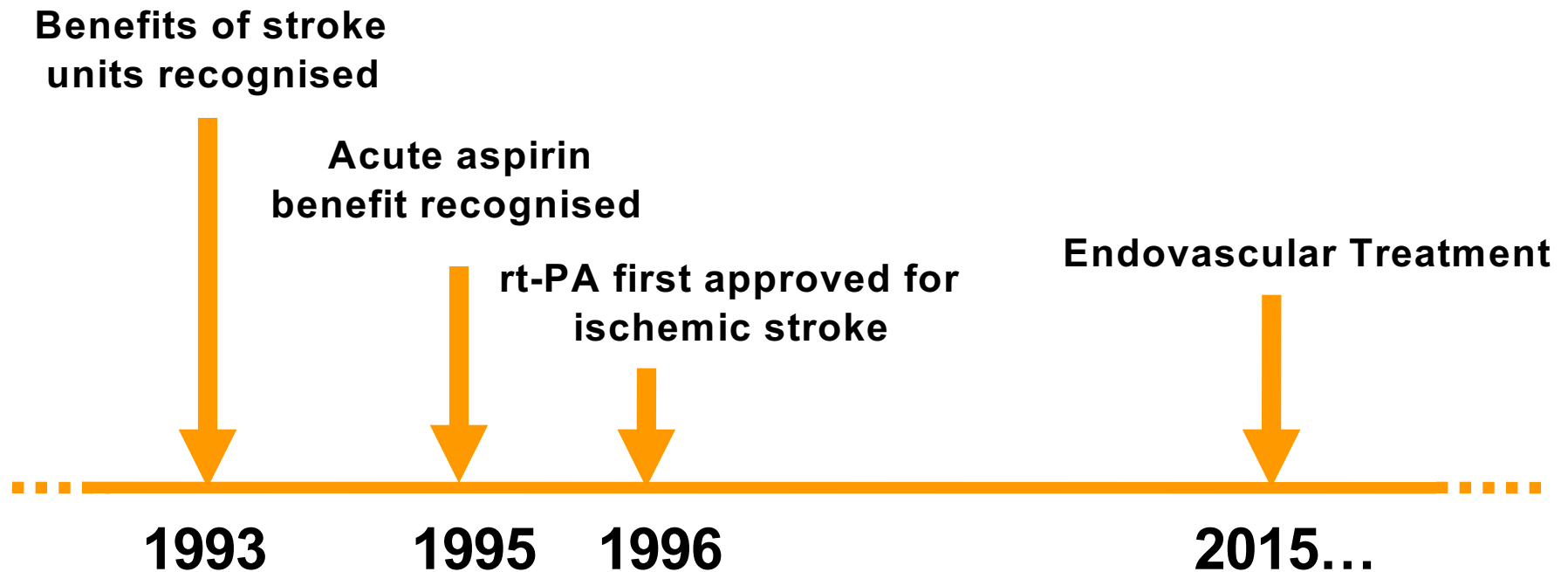
In the absence of Reperfusion; Collaterals Will Fail.

# Speed Matters!

- For 1000 treated patients, every 15 minutes of faster treatment resulted in:
  - 18 more patients with improved ambulation at discharge
  - 8 more with fully independent ambulation
  - 7 more discharged home
- However, the population of patients who present with Acute Stroke while admitted in hospital, have been largely excluded from analyses of efficacy as well as from educational strategies targeting outcome.
- The QulCR project now additionally focusing on IHS including patients with symptom onset in ER setting

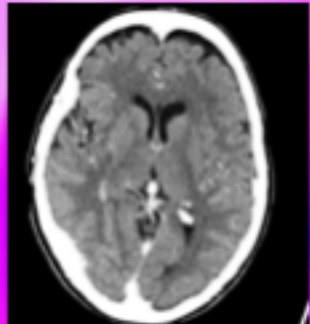


# Advances in the Management of Stroke: A Timeline



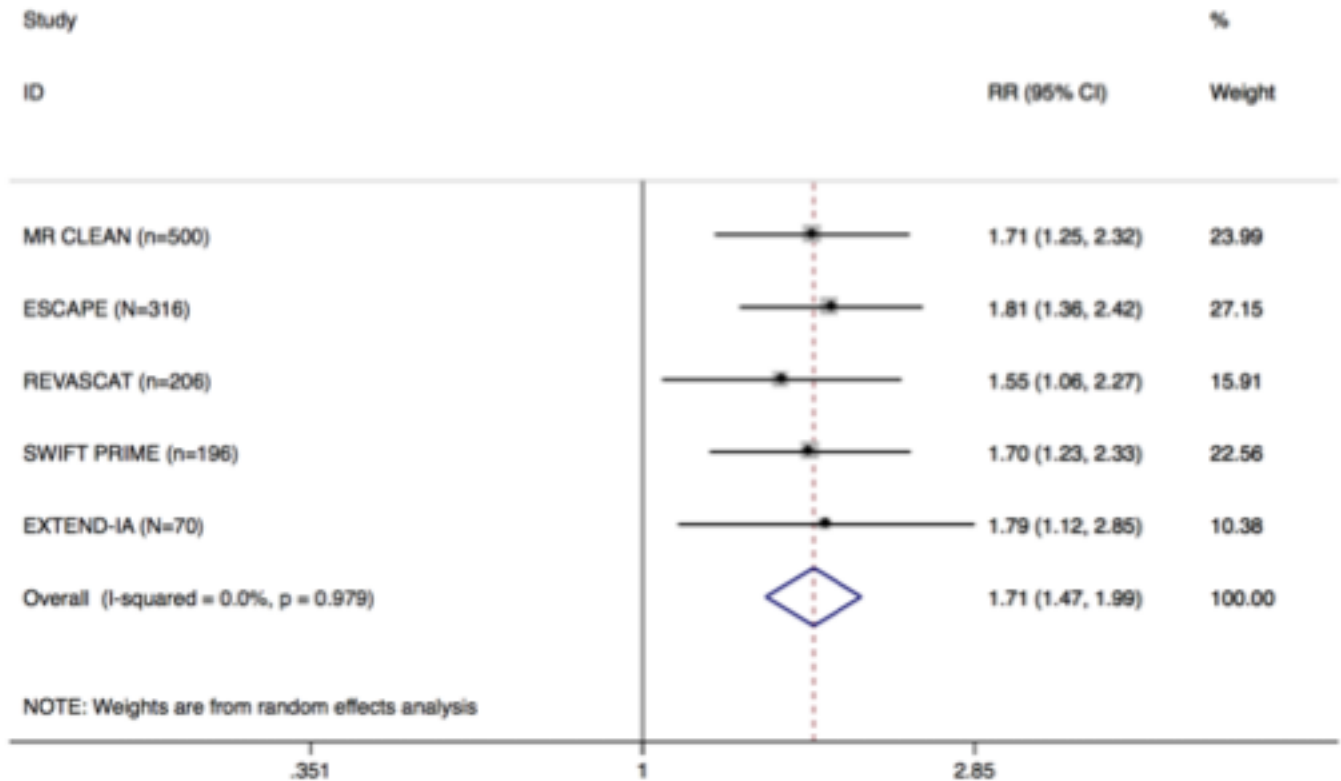
# i.v. tPA: Inclusion/Exclusion

- Inclusion:
  - Clinically: Acute Stroke
  - Onset < 3 hours
  - ("Consider" < 4.5h)
  - No ICH by CT scan
- Exclusion:
  - BP > 185/110 (vs. non tPA parameters of 220/120)
  - Recent Stroke
  - Abnormal Coagulation Profile
  - Recent Trauma or Surgery
  - Recent "Hemorrhage"
  - Blood glucose < 3, > 22





# Endovascular Treatment in Stroke



# Endovascular Therapy for Stroke

i. Endovascular therapy should be offered within a coordinated system of care including agreements with EMS; access to rapid neurovascular (brain and vascular) imaging; coordination between the ED, the stroke team and radiology; local expertise in neurointervention; and access to a stroke unit for ongoing management [Evidence Level A].

ii. Endovascular therapy is indicated in patients based upon imaging selection with noncontrast CT head and CTA (including extracranial and intracranial arteries) [Evidence Level A]. *See Appendix S4 for Inclusion Criteria for endovascular therapy.*

iii. Eligible patients who can be treated within six-hours (*i.e.* whose groin can be punctured within six-hours of symptom onset) should receive endovascular therapy [Evidence Level A]. *Refer to Appendix S4 for Inclusion Criteria for endovascular therapy.*

a. Select patients with disabling stroke presenting between 6 and 12 h of stroke symptom onset, including those with stroke symptoms upon awakening, who meet clinical and imaging criteria, may be considered for endovascular therapy [Evidence Level B], in accordance with local protocols.

b. Time from CT (first slice of the noncontrast CT) to groin puncture should be as fast as possible, ideally less than 60 min [Evidence Level C].

iv. Endovascular therapy is indicated in patients who have received intravenous tPA and those who are not eligible for intravenous tPA [Evidence Level A]. Patients eligible for intravenous tPA as well as endovascular therapy should also

be treated with intravenous tPA, which can be initiated while simultaneously preparing the angiography suite for endovascular therapy [Evidence Level A].

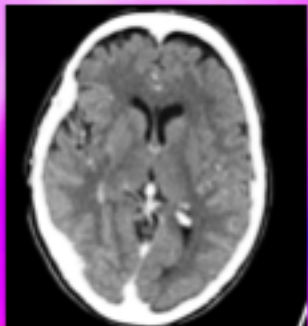
v. Device selection: Retrievable stents are recommended as the first-choice endovascular device [Evidence Level A].

a. Other interventional devices (e.g. thrombus aspiration devices) may be used based on local protocols and expertise [Evidence Level C].

vi. Endovascular procedures should not be performed using elective general anesthesia and intubation in most patients. General anesthesia and intubation should only be used if medically indicated (e.g. for airway compromise, respiratory distress, depressed level of consciousness, severe agitation, or any other indication determined by the treating physician), and in such cases, excessive and prolonged hypotension should be avoided [Evidence Level B].

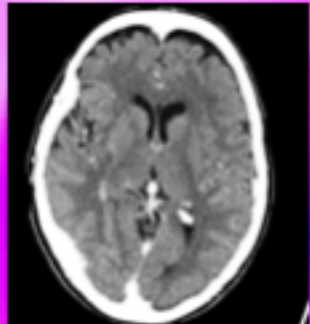
From Canadian Best Practice Guidelines Update: Hyperacute Stroke

**■ Thus Endovascular Treatments May Allow for Treatment of Certain Post-operative Inpatient Populations Previously Excluded, From Acute Stroke Interventions.**



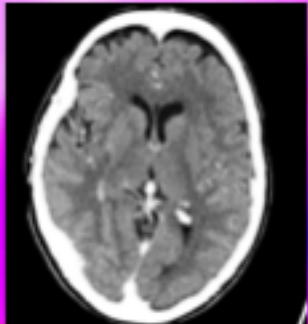
# TIA vs. Hyperacute Stroke?

- How do we know that we are not treating a TIA with tPA?
- <2% of patient not treated will resolve <24 h vs. 12% with treatment (NINDS trial, NEJM 1995).
- <1 in 6 patients with symptoms at 1 h will resolve (Levy DE, Neurology 1988).
- 30% of acutely presenting patients with rapid improvement, will show clinical deterioration or death.
- Relapsing deficits an important presentation in the inpatient/ER setting.



# Post-Operative Stroke

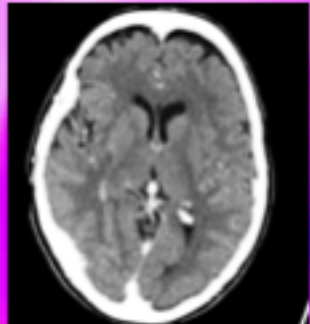
- Acute Treatment Strategies:
- iv tPA?
- EVT?





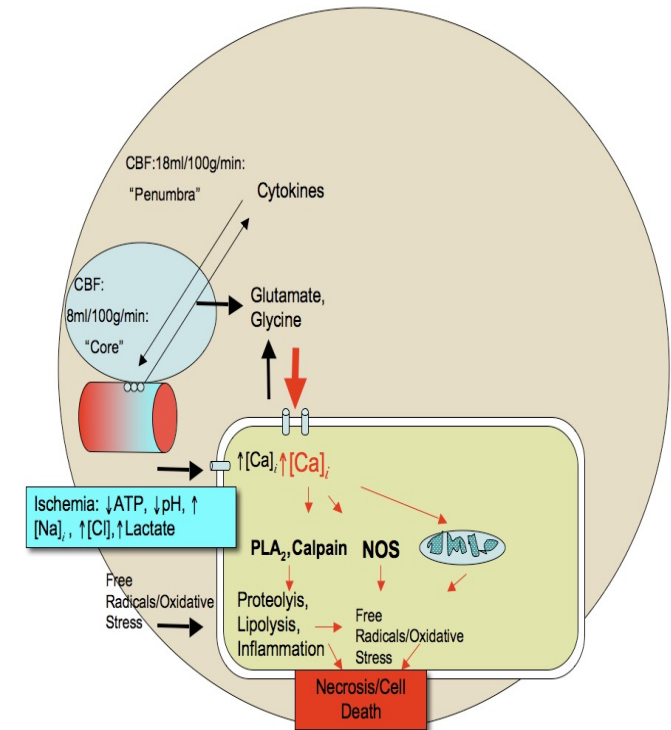
## Discussion:

- Is there Evidence of Impact with Intervention in the Inpatient Stroke Setting?



# “Acute Stroke Interventions”

- Inpatient stroke comprises approximately 10 (4-15%) of all strokes admitted to hospital.
- Increased mortality, length of stay, and more patients referred for inpatient rehabilitation in IHS patients than that seen in OHS patients.
- Fewer proportion of IHS patients receive acute stroke interventions (ASI) than OHS patients.
- The proportion of the total stroke patients undergoing acute stroke interventions that are IHS patients is approximately 10 %.
- IHS patients who receive treatment, better treatment times and comparably good functional outcomes of treatment.
- Awareness of Site Based Stroke Protocols and Early Symptoms Recognition Key areas of education to positively impact outcome.



# Symptom Recognition:

- “Summary” Scales and “Slogans” useful for Public Education and Pre-Hospital assessments.
- Inpatient providers of care require greater familiarity with “inpatient stroke chameleons” and their common misdiagnosis (eg. “hypoglycemia”, “narcotic effect”, “anxiety”)
- Cognitive symptoms, and delays in recovery times important clues suggesting need for detailed assessment of possible stroke
- Challenges to assessment in the peri-operative setting require high degree of vigilance and recognition of the diversity of presentation.

Stroke is a medical emergency.

## LEARN THE SIGNS OF STROKE

**F**ACE is it drooping?  
**A**RMS can you raise both?  
**S**PEECH is it slurred or jumbled?  
**T**IME to call 9-1-1 right away.

© Heart And Stroke Foundation of Canada, 2014

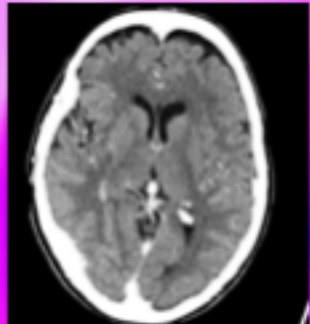
Table 2. Knowledge of Stroke Warning Signs (n=875)

Correct Answers	No. of Responses (%)
Numbness or weakness	780 (86.9%)
Confusion, trouble speaking, or understanding	725 (82.9%)
Trouble walking, dizziness, or loss of balance or coordination	89 (10.2%)
Headache	159 (18.2%)
Trouble seeing	126 (14.4%)
≥1 warning signs correct	820 (93.7%)
≥2 warning signs correct	782 (87.1%)
3 warning signs correct	270 (30.9%)

Edelman, E. et. al. Stroke Awareness Among Inpatient Nursing Staff at an Academic Centre, *Stroke* 2014, 45: 271-73

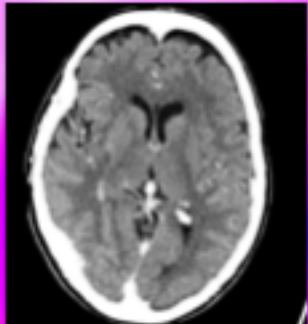
# Symptom Recognition:

- Who most commonly recognizes inpatient stroke?
- Where Does it Happen most frequently?
- What Happens Next?



# Symptom Recognition: Who Most Commonly Recognizes Inpatient stroke?

- Nursing Staff (63%)
- Inpatient (16%)
- Physician Staff (10%)
- Family (8%)
- MD/Nurse (3%)
- from : Alberts et al, Stroke Vol 24, No 12 December 1993





# Symptom Recognition: What Happens Next? (Then)

Alberts et al Evaluation Times for Patients With In-Hospital Strokes

1821

TABLE 6. Data for Specific Time Intervals

Locale	≤90	91–180	181–360	361–720	>720	Total
Duke	9 (14)	11 (17)	4 (6)	7 (11)	14 (22)	47 (70)
Yale	9 (14)	6 (10)	0	1 (2)	2 (3)	18 (29)
Total	18 (28)	17 (27)	4 (6)	8 (13)	16 (25)	65 (99)*

All times are in minutes. Numbers in parentheses are percentages.

\*Numbers do not add up to 100% due to rounding off.

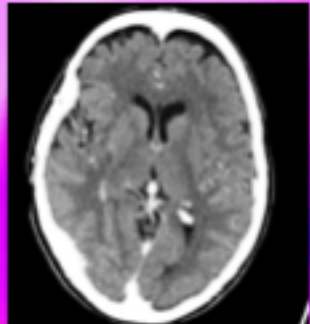
TABLE 5. Median and Mean Percentages for Each Time Epoch by Locale and Hospital Service

Epoch	Median Percentages			
	Duke Medical, n=27*	Duke Surgical, n=12*	Yale Medical, n=6	Yale Surgical, n=12
D1	0	0	0	0
D2	0	0	7.6	8.0
D3	68.1	78.4	27.5	54.4
D4	15.6	11.1	53.3	37.5
Epoch	Mean Percentages			
	Duke Medical, n=27*	Duke Surgical, n=12*	Yale Medical, n=6	Yale Surgical, n=12
D1	6.8	0.3	1.3	1.3
D2	2.5	4.6	18.5	6.3
D3	61.0	71.3	34.8	53.7
D4	28.6	23.3	45.4	38.7

- D1, epoch between initial symptom recognition and notification of any medical personnel;
- D2, epoch between medical personnel notification and physician notification;
- D3, epoch between physician notification and calling neurology;
- D4, epoch between calling neurology and a neurologist's or a neurology house officer's seeing the patient.

# Symptom Recognition: What Happens Next? (Now)

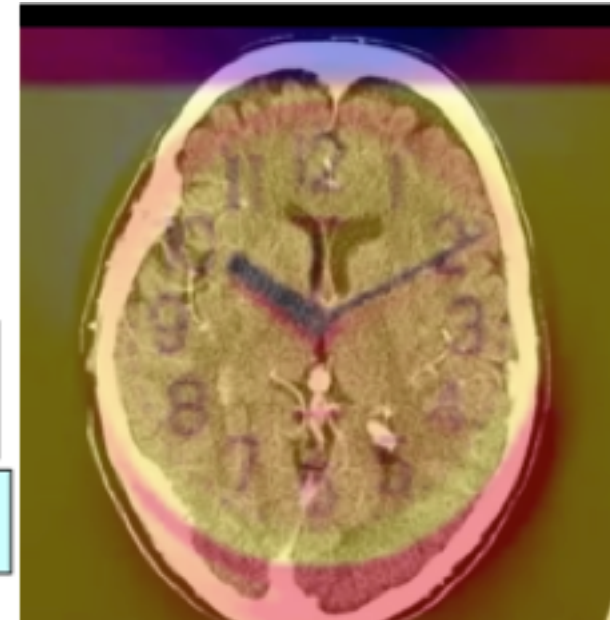
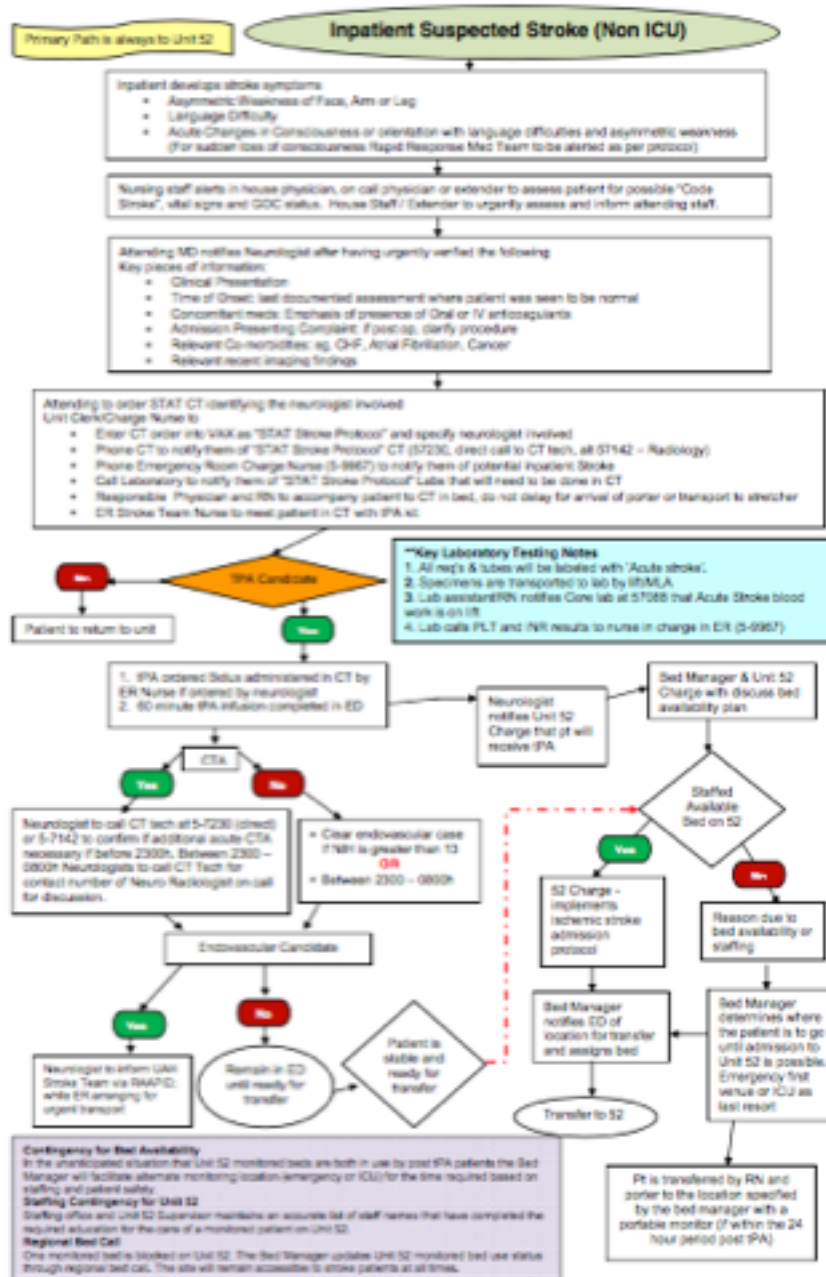
- Schurman et al. J Neurol (2016) 263:550–557:(33.5 %) the time of stroke onset was indefinable due to sedation, delayed report on symptoms by the patient or atypical presentation.
- Saltman et. al. JAMA Neurol. 2015;72(7):749-755: 75% IHS consulted by neurology, However lower percentage of IHS undergoing brain imaging <2 hours of symptom recognition (32% vs 63%; adjusted odds ratio [AOR] = 0.21; 95% CI, 0.18-0.24;  $P < .001$ ). Decreased tPA, and increased time to treatment; fewer of these patients received thrombolysis within 90 minutes of diagnosis compared with their counterparts who had community-onset stroke (29% vs 72%;  $P < .001$ )



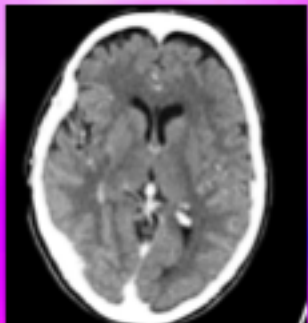
# Inpatient Protocol: Impact

- Yoo et al. International Journal of Stroke 2016, Vol. 11(6) 656–662:
- Retrospective and Prospective Cross Sectional study investigating outcomes in IHS treated cases 2002-2015.
- Implemented a CPOE (EMR) system in high risk wards in 2008.
- System immediately coupled symptoms recognition/documentation with both alerting of physicians and ordering of diagnostic investigations.
- In the target-ward group, the median time intervals from symptom onset to notification and to brain imaging were significantly reduced by 22min (P. 0.033) and 50min (P< 0.001), respectively the median times from symptom onset to IV t-PA and to arterial puncture were reduced by 55 min (P. 0.001) and 130 min (P. 0.011), respectively. No significant decrease with time in control wards, after program implementation.



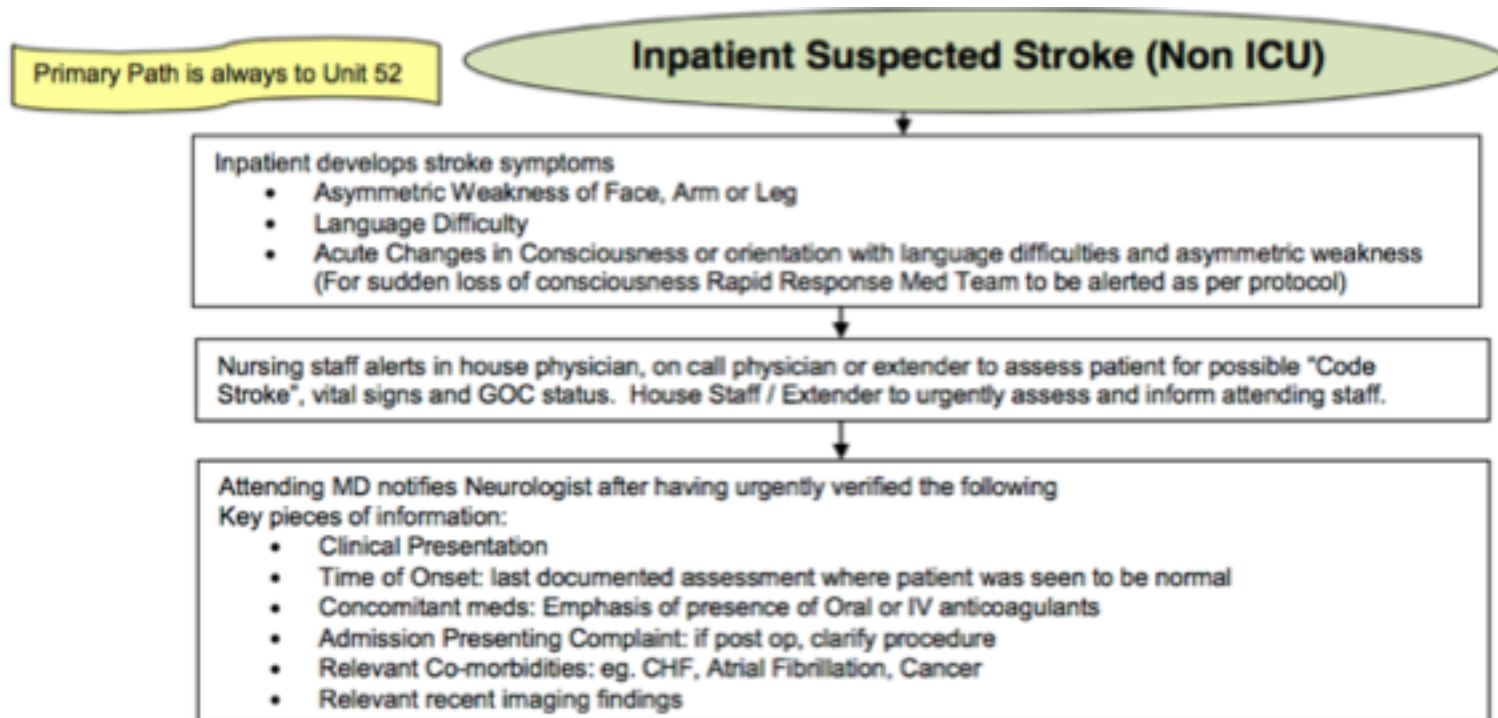


CT<sup>2</sup>  
Communicate  
Transport  
Treatment



# Phase I: Communicate

## GNCH Inpatient Suspected Stroke Algorithm for Ischemic Stroke Patients



- Establish Protocols for Who to Contact and How.
- Clarify what information is to be communicated.
- Clarify what resources are to be mobilized and how.



# Phase 2: Transport

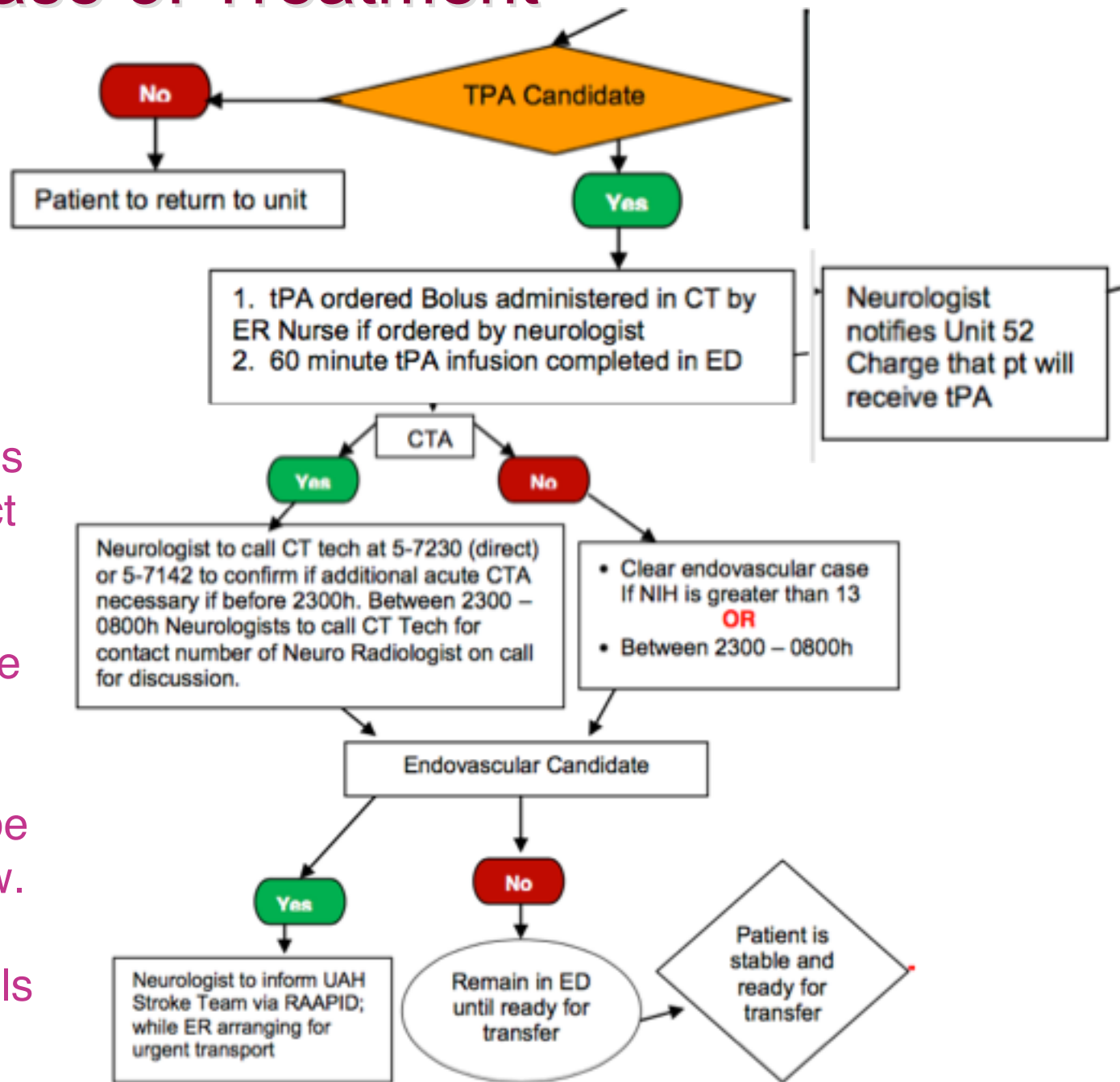
Attending to order STAT CT identifying the neurologist involved

Unit Clerk/Charge Nurse to

- Enter CT order into VAX as "STAT Stroke Protocol" and specify neurologist involved
- Phone CT to notify them of "STAT Stroke Protocol" CT (57230, direct call to CT tech, alt 57142 – Radiology)
- Phone Emergency Room Charge Nurse (5-9967) to notify them of potential inpatient Stroke
- Call Laboratory to notify them of "STAT Stroke Protocol" Labs that will need to be done in CT
- Responsible Physician and RN to accompany patient to CT in bed, do not delay for arrival of porter or transport to stretcher
- ER Stroke Team Nurse to meet patient in CT with tPA kit

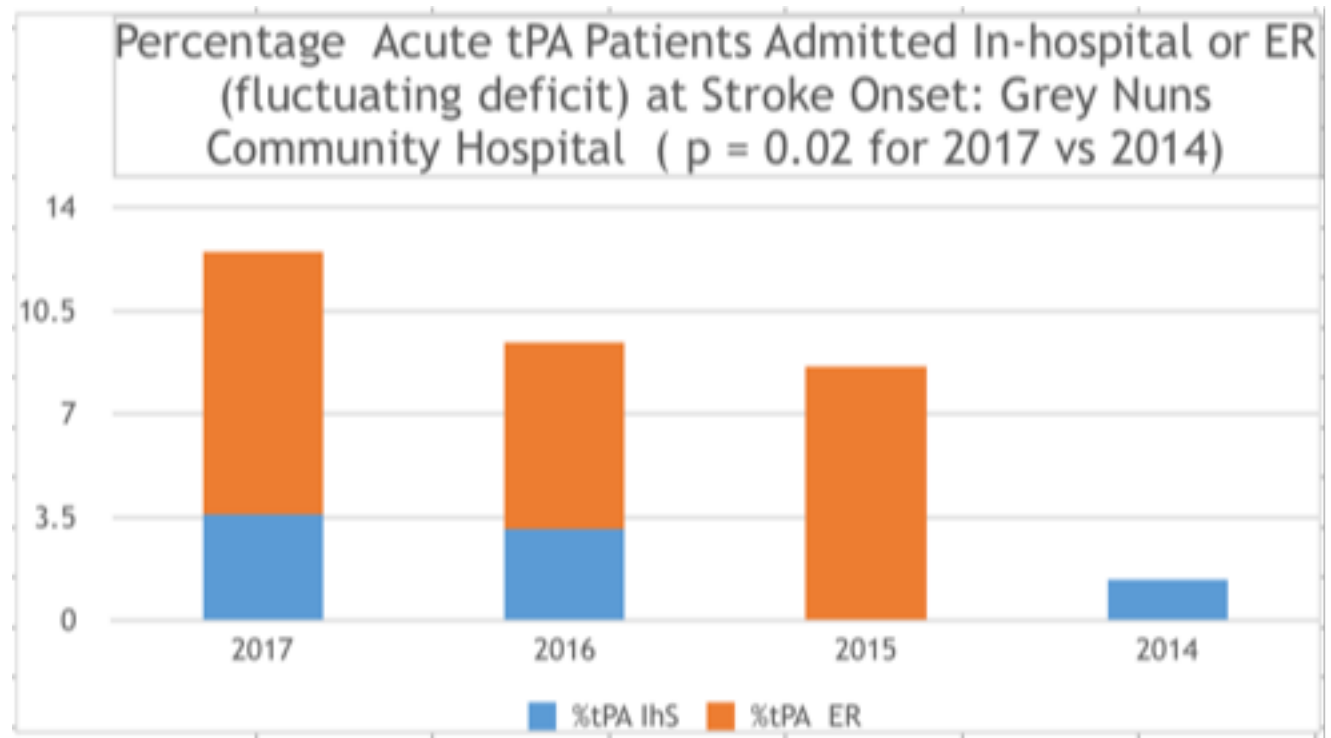
- Geography will vary from site to site.
- Imaging may be Site Based or Off Site.
- Goal should be to rapidly mobilize transport diagnostic tests (Lab and CT) while simultaneously preparing for transfer/treatment.

# Phase 3: Treatment



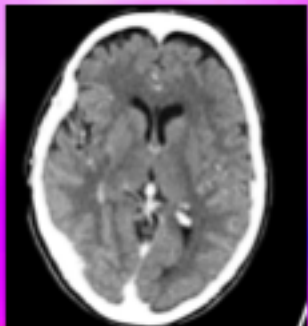
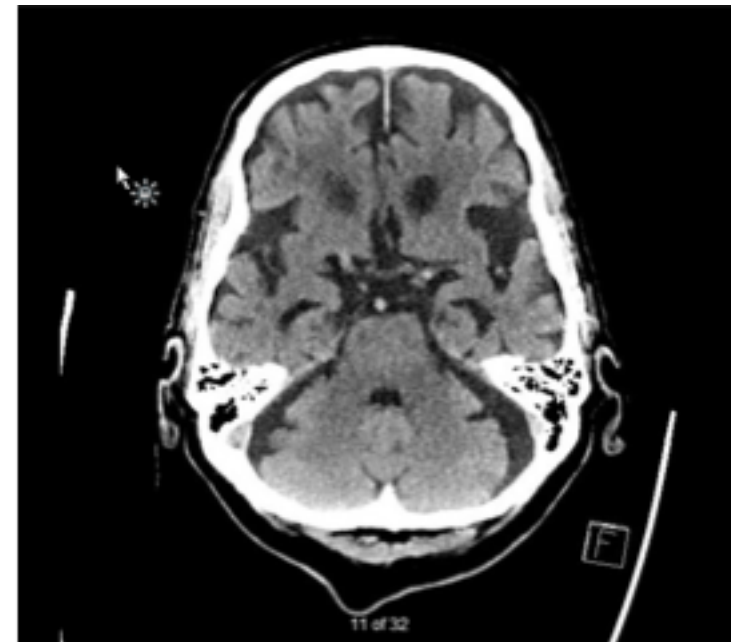
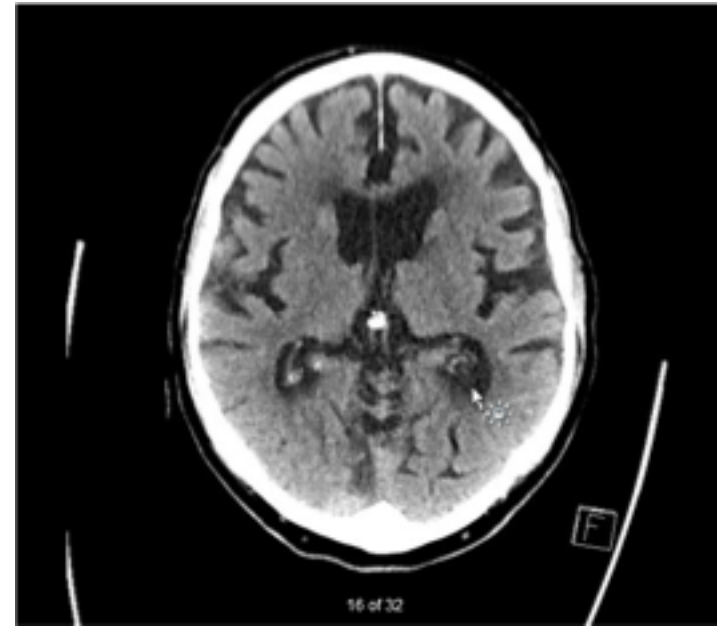
- Establish Protocols for Who to Contact and How.
- Clarify what information is to be communicated.
- Clarify what resources are to be mobilized and how.
- Utilize existing resources protocols for OHS

# Inpatient Protocol: Impact



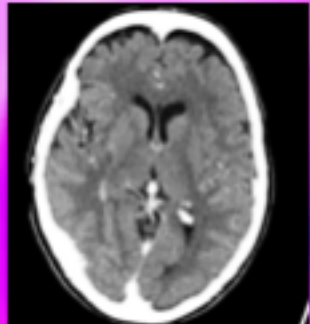
# Case 3:

- Patient 68 year old man admitted for bilateral femoral revascularization.
- Past medical history of Chronic Renal failure and Atrial Fibrillation with no previous history of stroke.
- Patient underwent serial bilateral endovascular percutaneous SFA angioplasties.
- Medications included ASA/Plavix, and Unfractionated Heparin for DVT prophylaxis.
- Last seen normal at 10:30 during nursing check and blood draw.
- Noted approximately 1 hour later to be non responsive and demonstrating left sided weakness.
- CT acquired and Neurology paged by house staff after discussing with MRP.  
(Communicate, Transport)



## Case 3: Treatment

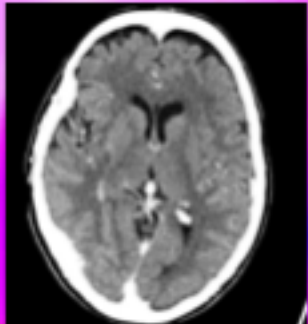
- Patient had shown interim improvement.
- Now alert
- Left sided hemifacial weakness and dysarthria
- Gaze preference to right.
- Mild Left sided hemiparesis
- Extinction to Double Simultaneous stimulation.
- NIH 5
- Exam suggestive of partial recanalization and distal migration of clot, suspicion that patient will not be EVT candidate.
- Coags performed which showed normal range.
- tPA given at 2:45 (within 4.5 hour time window).
- Intrainfusional TCD monitoring verified recanalization of proximal vessels, thus precluding the need for transfer.
- 24 h patient has returned to baseline with mild persisting hemifacial weakness.





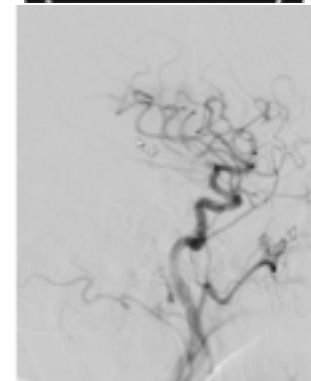
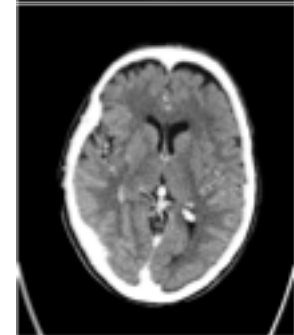
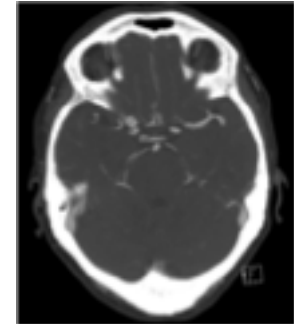
## Case 4:

- Patient 72 year old woman admitted for CHF exacerbation/pneumonia. Approximately 1 week into admission patient noted to be weak of right hand side and poorly communicative. Last seen well by nursing staff 2 1/2 hours ago.
- Patient discussed with Stroke Staff on-call (**Communicate**)
- Charge Nurses on Stroke Unit and ER alerted. Urgent labs drawn verifying normal coagulation parameters and patient transferred to Stroke Unit from CT scan. (**Transport**)
- ER nursing staff dispatched to Stroke Unit to facilitate mixing and administration of tPA.
- Patient received i.v. tPA at 3h 45 minutes from presumed onset. (**Treatment**)
- Following day, marked improvement of deficits.



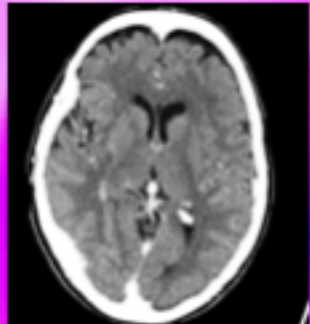
## Case 5:

- Patient is a 72 year old woman POD right Knee Replacement.
- The patient was last seen normal effectively at 0100 hours on the early morning of April 7, 2017.
- At about 2 a.m. in the morning nursing personnel visited the patient and noted garbled speech. The clinical associate was contacted, and then Neurology on call contacted.
- Clinical associate informed at 2:04 hours and discussed the case with the radiology resident at 2:13 a.m.
- imaging study (CT/CTA) was done at 2:47 a.m.
- Patient discussed with myself at 3:00 a.m. (**Communicate**)
- Patient transported to UAH (4:13am), (**Transport**)
- Repeat routine head CT (4:32am) and transfer to Angio suite for EVT (4:46am). NIH 14, Dense Hemiplegia and Hemineglect. (**Treatment**)
- 24 h post NIH of 6, Inpatient course of ongoing clinical improvement with patient transferred onward to the Glenrose for inpatient rehab.



# Acute In-patient and Post-Operative Stroke is an Emergency!

- Practical applications:
- Inpatient Stroke as a Whole approx. 10% of Strokes
- Vascular Procedures are High risk.
- Vigilant monitoring and Symptom Recognition are key, Both for Early mobilization of Acute tPA pathways and early treatment/prevention of potential sub-acute complications.
- Familiarity with Existing Site Based Protocols for Acute Stroke is Necessary for Prompt Assessment and Treatment.
- Site based protocols should take into logistic realities and involve all stakeholders, eg DI, ER, ICU and after hours support.
- CT<sup>2</sup> : Communicate, Transport, Treatment.
- Educational Strategies, including the implementation of Mock “Stroke Codes” necessary, and targeting of high risk patients/settings as well as unusual presentation of IHS important.
- Education of Patients and Family Members admitted for high risk procedures potential strategy.





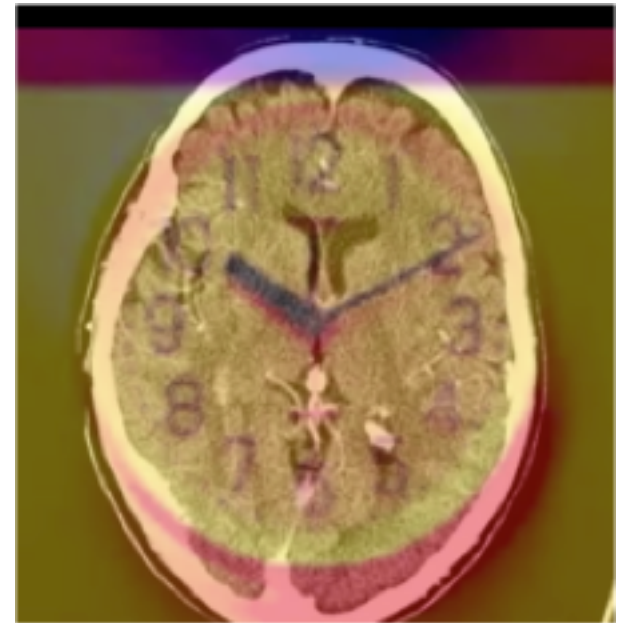
# Thank You!



The Birth of Athena, Boston Museum of  
Fine Arts

# Acute In-patient and Post-Operative Stroke Is An Emergency!

- Practical applications:
- Inpatient Stroke as a Whole approx. 10% of Strokes
- Vascular Procedures are High risk.
- Vigilant monitoring and Symptom Recognition are key, Both for Early mobilization of Acute tPA pathways and early treatment/prevention of potential sub-acute complications.
- Familiarity with Existing Site Based Protocols for Acute Stroke is Necessary for Prompt Assessment and Treatment.
- Please page acute stroke pager for any suspected acute inpatient stroke.
- Early recognition, Communication and Transport for urgent imaging will increase the number of patients who may receive effective Treatment.



CT<sup>2</sup>  
Communicate  
Transport  
Treatment

