



# Best Practice Acute Stroke Care: Salvaging the Brain and Setting the Stage for Recovery

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# Disclosures

- I have no financial disclosures or conflicts of interest

# Objectives

- To review some of the Best Practice Recommendations for Hyperacute Stroke and what this means for your own skill set
- To discuss how Best Practice Recommendations are incorporated in Acute Stroke Unit design

# Outline

- Best Practice Reality Check
  - Evidence, Practice, Population and People
- Best Practice in the ED/ICU: *Saving the Brain*
- Best Practice in the Stroke Unit: *Setting the Stage for Stroke Recovery*

# Best Practice Reality Check

There are two kinds of experts: academic experts and practical experts. One is not better than the other, but they are very different, and each offers very different value.

— Simon Sinek

# Practice, Populations and People

- From the science, we obtain evidence
- From the evidence, we derive principles of practice
- These principles are consistent from setting to setting...
- ... But their implementation must adapt to the realities of the population and the people who work with that population

# Where do you practice?

Rural Ontario



The Suburbs



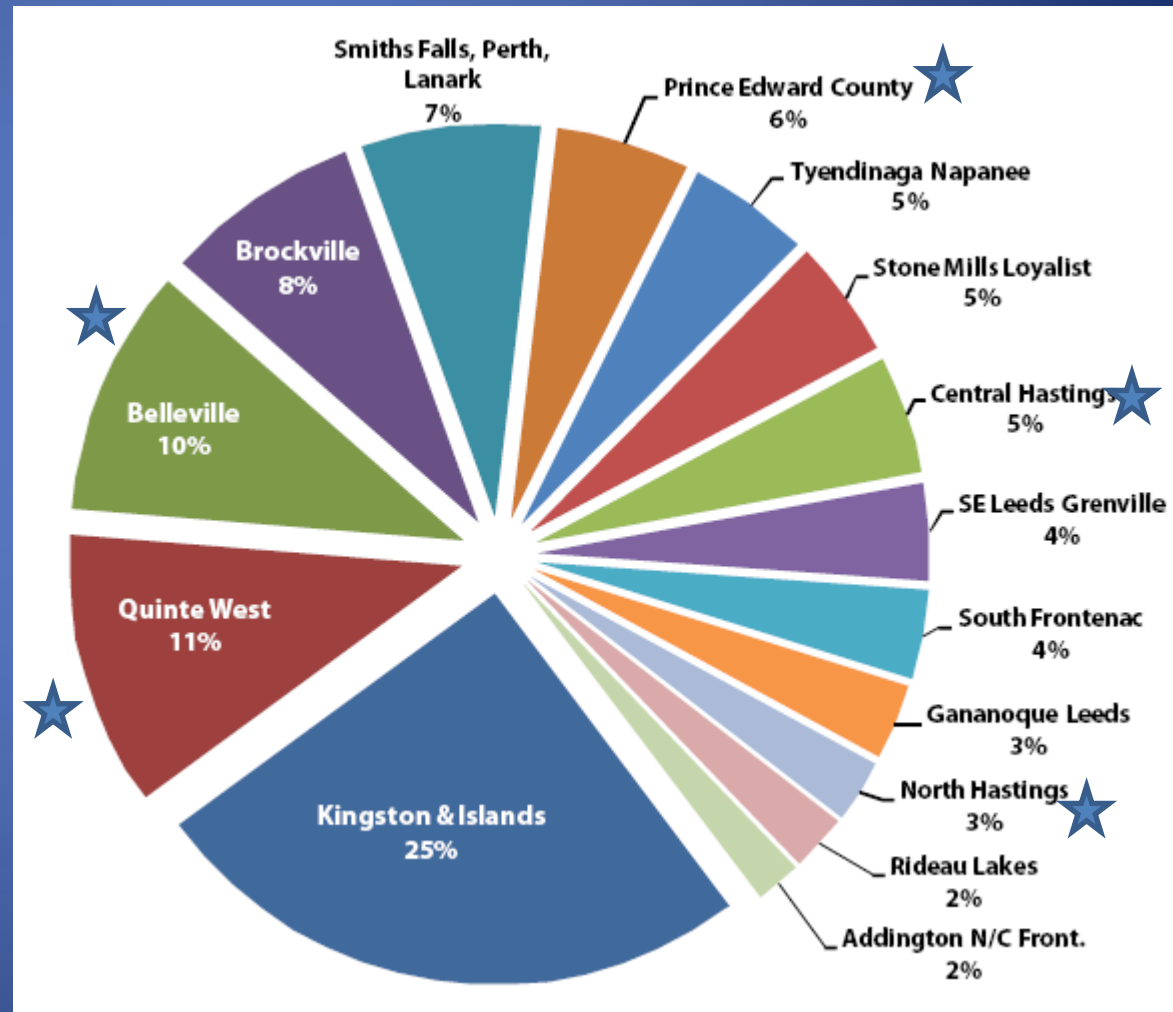
Downtown Toronto, i.e. Hell



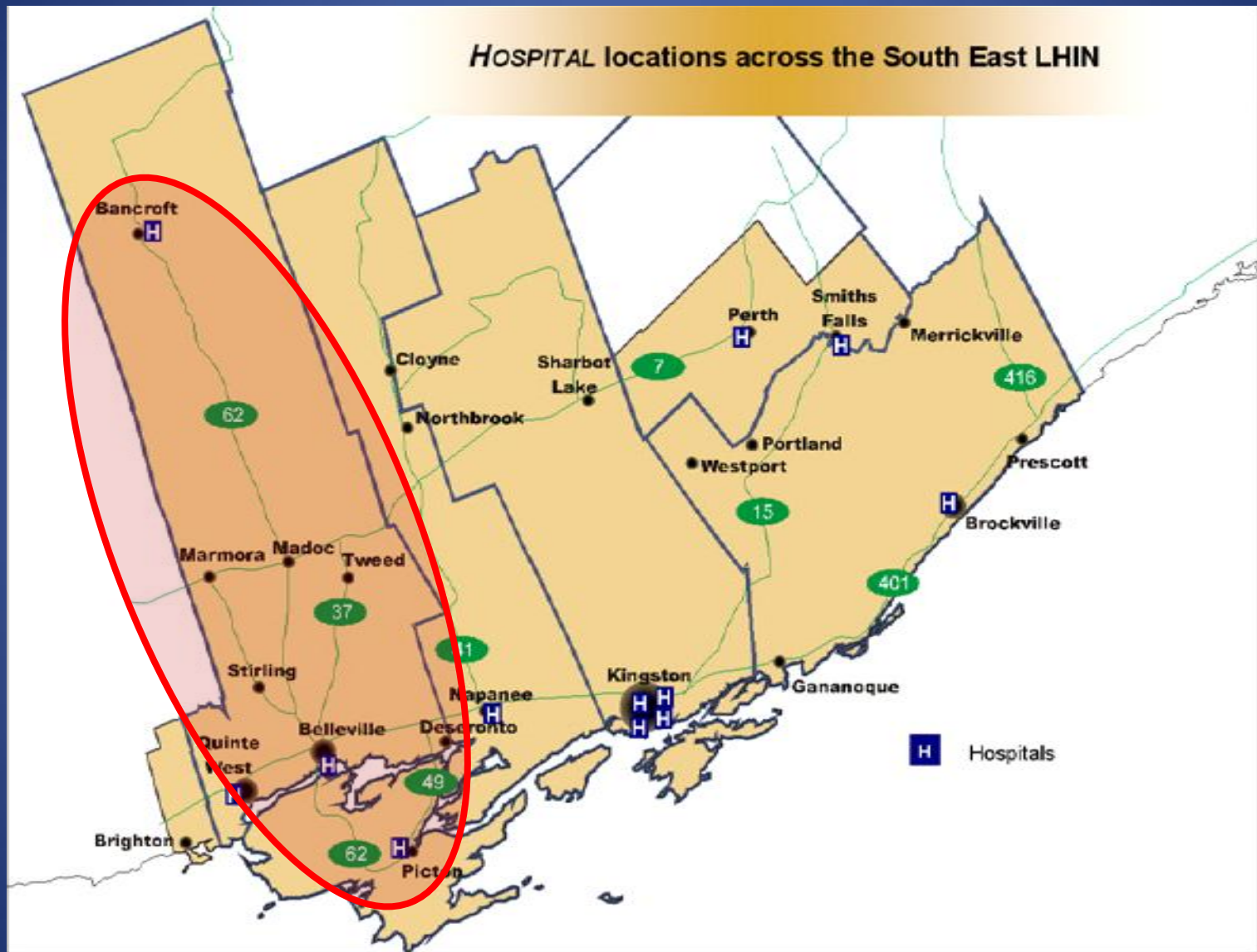
- Best Practice Principles tell us what we should aim to achieve
- But they don't tell us how to achieve it within the context of our practice location

# 175,000+ People

- Belleville is the Stroke Centre for about 35% of the population of the SE LHIN



## HOSPITAL locations across the South East LHIN



# Best Practice Sets the Stage for Future Growth

- Belleville has arguably the best stroke centre infrastructure in the SE LHIN
  - *This is the place which has the resources necessary to have an Acute Stroke Unit and Stroke Rehabilitation at the same site*

- “Stroke is one of those rare conditions in Medicine in which the more of it you do, the better you become at it...” – Dr. Andrew Samis
- This is the place which can handle the volume necessary to become one of the best stroke centres, anywhere

- But, in this region where the population is evenly spread between multiple sites, the challenge is to build the relationship and processes necessary which unifies stroke patient flow between all sites

# From the Ambulance to the ICU: Saving the Brain

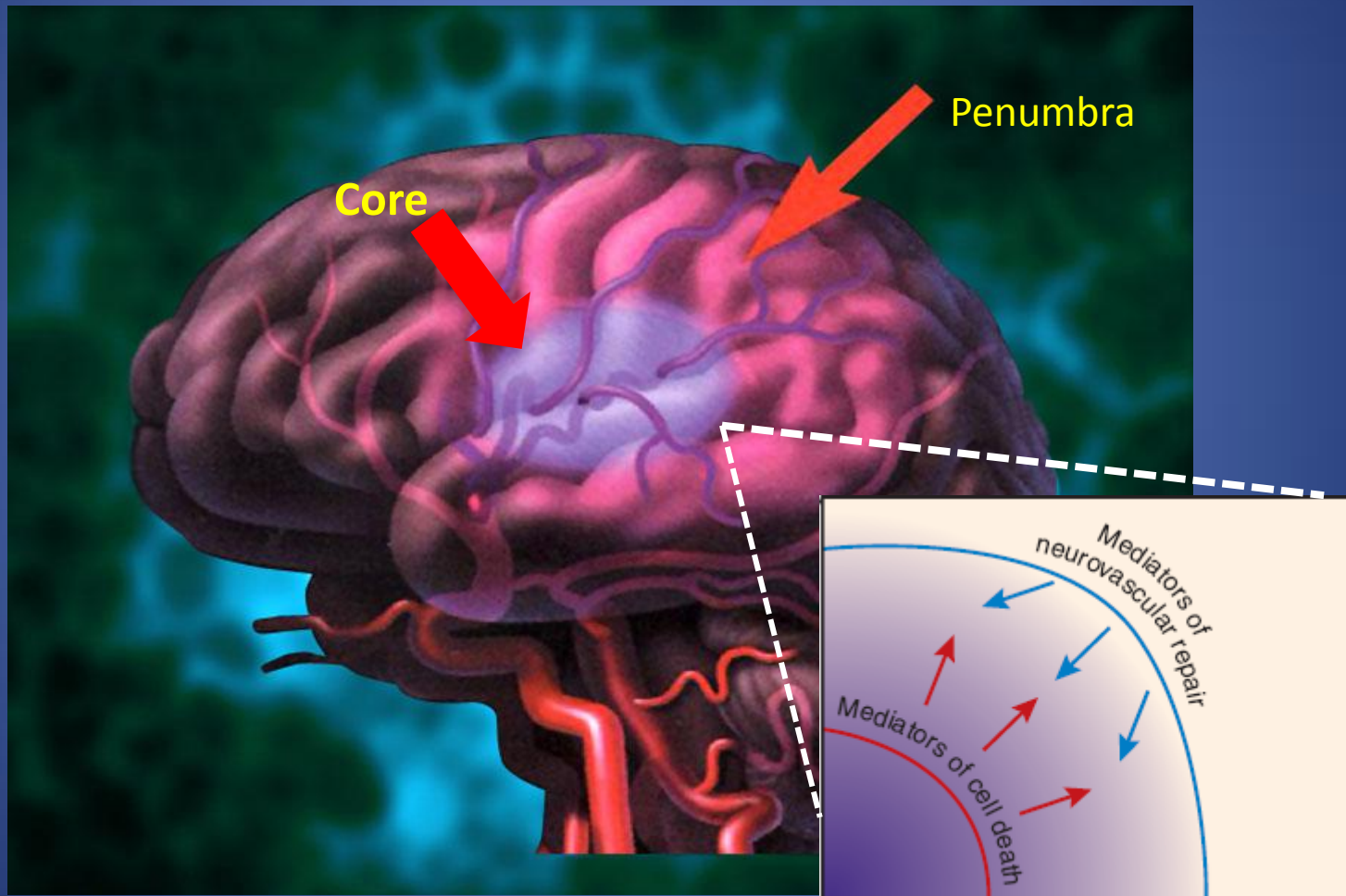
# What are the critical events?

- Stroke onset
- ED arrival
- History, NIHSS, physical exam
- Imaging
- Treatment Decisions
- Transfer to Stroke Unit/Critical Care Unit

Stroke Onset: Rapid, irreversible neuronal death within minutes.. but also continues to occur for days

CSC 2011 ID post-stroke.avi

# Stroke evolution: Injury vs Repair



# But what if we don't need/can't give tPA?

- Reperfusion (with or without tPA) remains our best treatment for acute stroke
- However, we can still help patients enormously *even without tPA*
- *The majority of stroke patients don't receive tPA, but Best Practice Recommendations can still improve the odds of a good outcome*

- Stroke Units are focused exclusively around Best Practice Recommendations and are proven to yield better patients outcomes

# *Hyperacute Stroke*

## *Best Practice Recommendations*

- **3.3.1 Initial Evaluation**
- Patients with suspected acute stroke should have a rapid initial evaluation for airway, breathing and circulation [Evidence Level B].
- A neurological examination should be conducted to determine focal neurological deficits and assess stroke severity [Evidence Level B]. A standardized stroke scale should be used (such as the National Institutes of Health Stroke Scale or the Canadian Neurological Scale).

# *Hyperacute Stroke*

## *Best Practice Recommendations*

- Monitoring: HR, BP, Temp, O<sub>2</sub> sat, Hydration, Swallowing, Seizures[Evidence Level B].
- Bloodwork [Evidence Level B]: lytes, glucose, CBC, INR, PTT, creatinine, GFR, BUN, lipid profile, liver panel, and Trop.
- ECG and CXR [Evidence Level B].
- Patient swallowing screen should be completed as early as possible as part of initial assessment, but should not delay decision-making regarding eligibility for thrombolysis. [Evidence level A].
  - Patients should remain NPO (no oral intake) until swallowing screen completed for patient safety [Evidence Level B]

Best Practice Tip #1. Get More Out of  
Telestroke by Becoming Skilled in  
Doing A Rapid and Accurate  
Neurological History and Exam

# NIHSS

- The National Institutes of Health Stroke Scale is a good focused neurological exam for stroke patients
- 11 items, can be done in about 3 minutes on a good day
- It has reasonable interrater reliability

# *Hyperacute Stroke*

## *Best Practice Recommendations*

- **3.3.2 Neurovascular Imaging**
- All patients with suspected **acute stroke** should undergo brain and vascular imaging of the brain and neck arteries immediately (CT/CTA, or MRI/MRA if urgently available) [Evidence Level A].
- All patients with suspected **transient ischemic attack** should undergo brain imaging immediately (CT, or MRI if urgently available) [Evidence Level A], and vascular imaging of the brain and neck arteries within 24 hours [Evidence Level B].

Best Practice Tip #2: Become Familiar  
with Reading a Non-Contrast CT Scan  
of the Head, and a CT Angiogram

- If your history and neurological exam tell you that it's a stroke, and the imaging rules out contraindications (i.e. intracranial hemorrhage), then it is perfectly sound to treat with IV tPA

# Code Stroke is like NASCAR

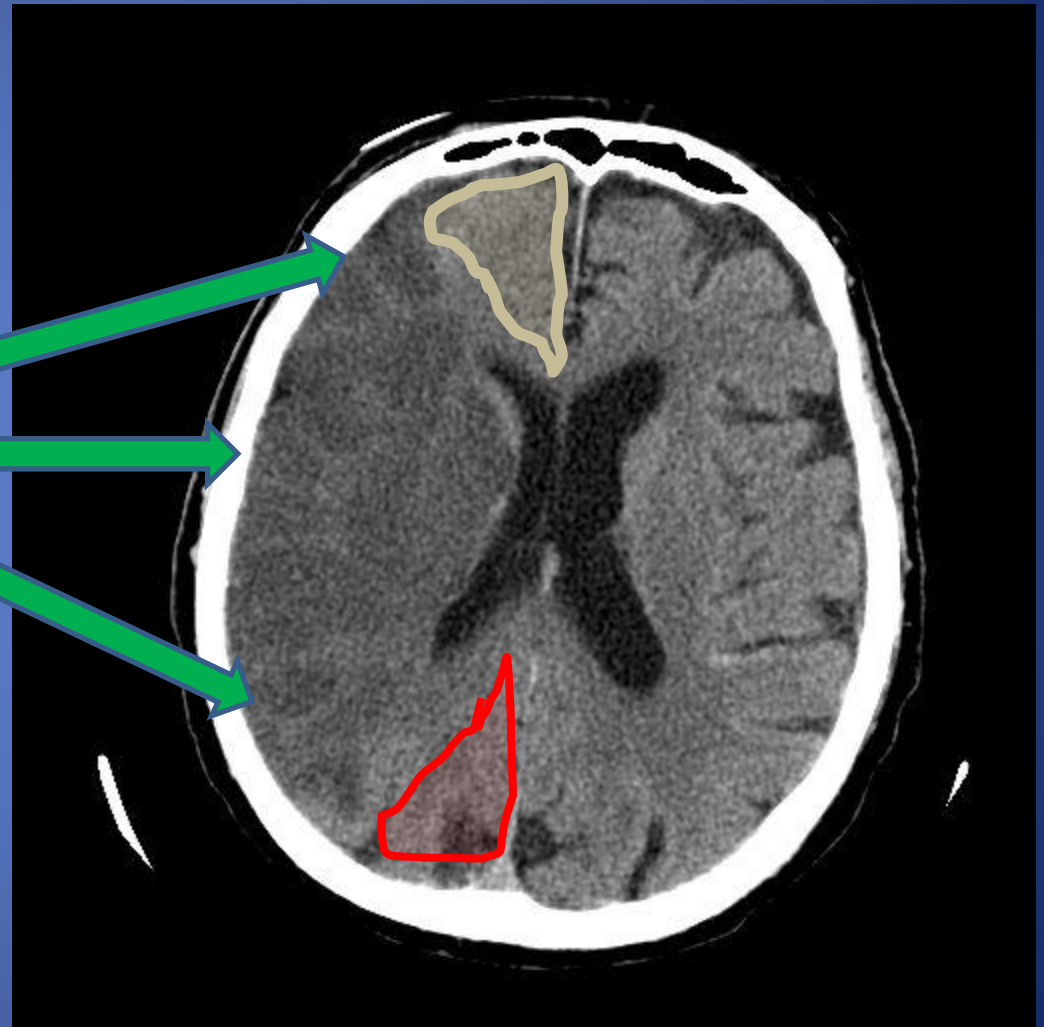


- No one waits around for others to finish their specific task. Everything is done in parallel as much as possible.

- Vascular imaging in acute stroke can tell you if an endovascular option could be considered and may tell you the stroke etiology
- But the main treatment decisions in most cases can be made from the history, exam and a plain CT head

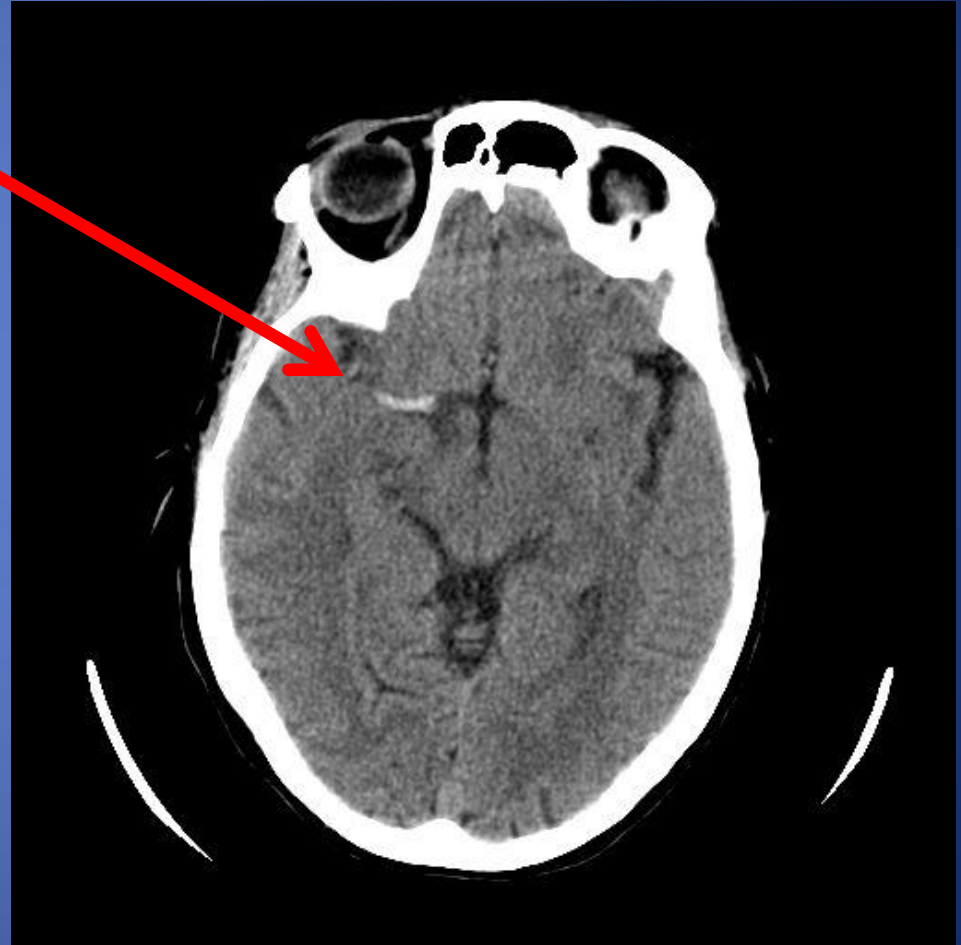
# Case 1. Right Middle Cerebral Artery Infarct

- Note the large hypodensity “wedge” of the RMCA territory infarction
- The Anterior (yellow) and Posterior (red) Cerebral Artery territories are spared

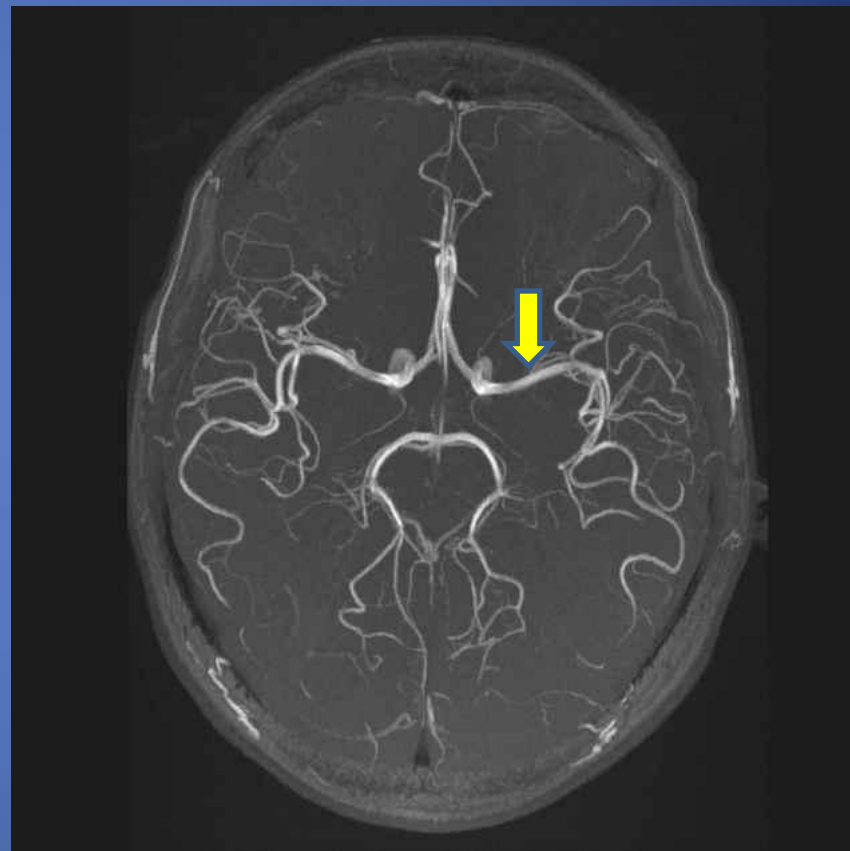
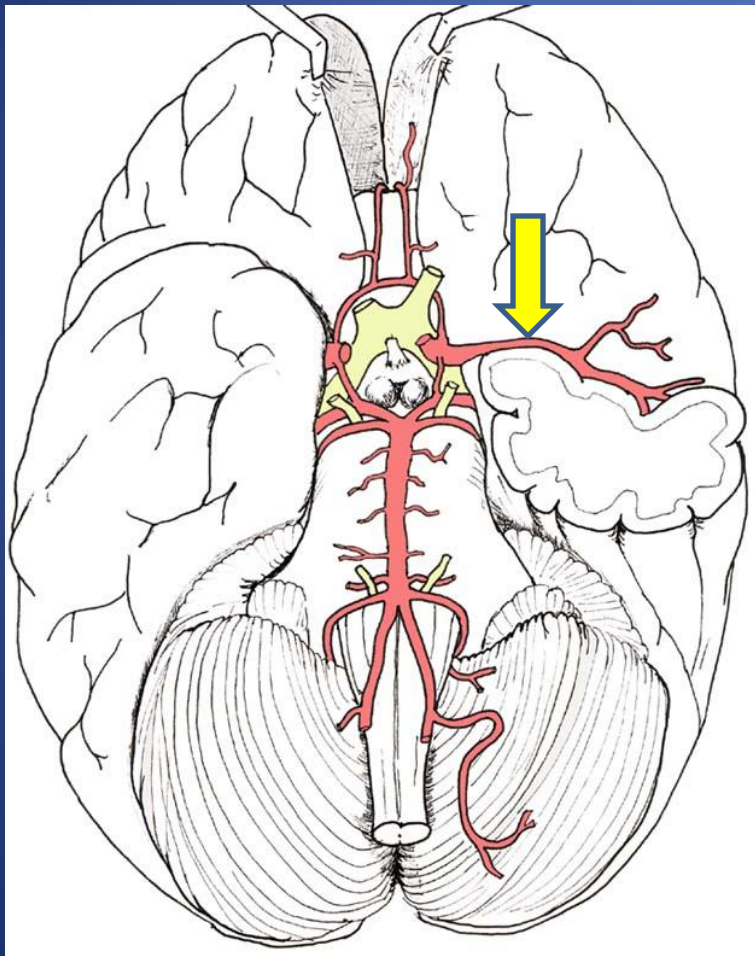


## Case 2

- Another RMCA stroke
- Note the bright horizontal line where the RMCA is supposed to be
- “Hyperdense sign”
  - This suggests acute thrombus



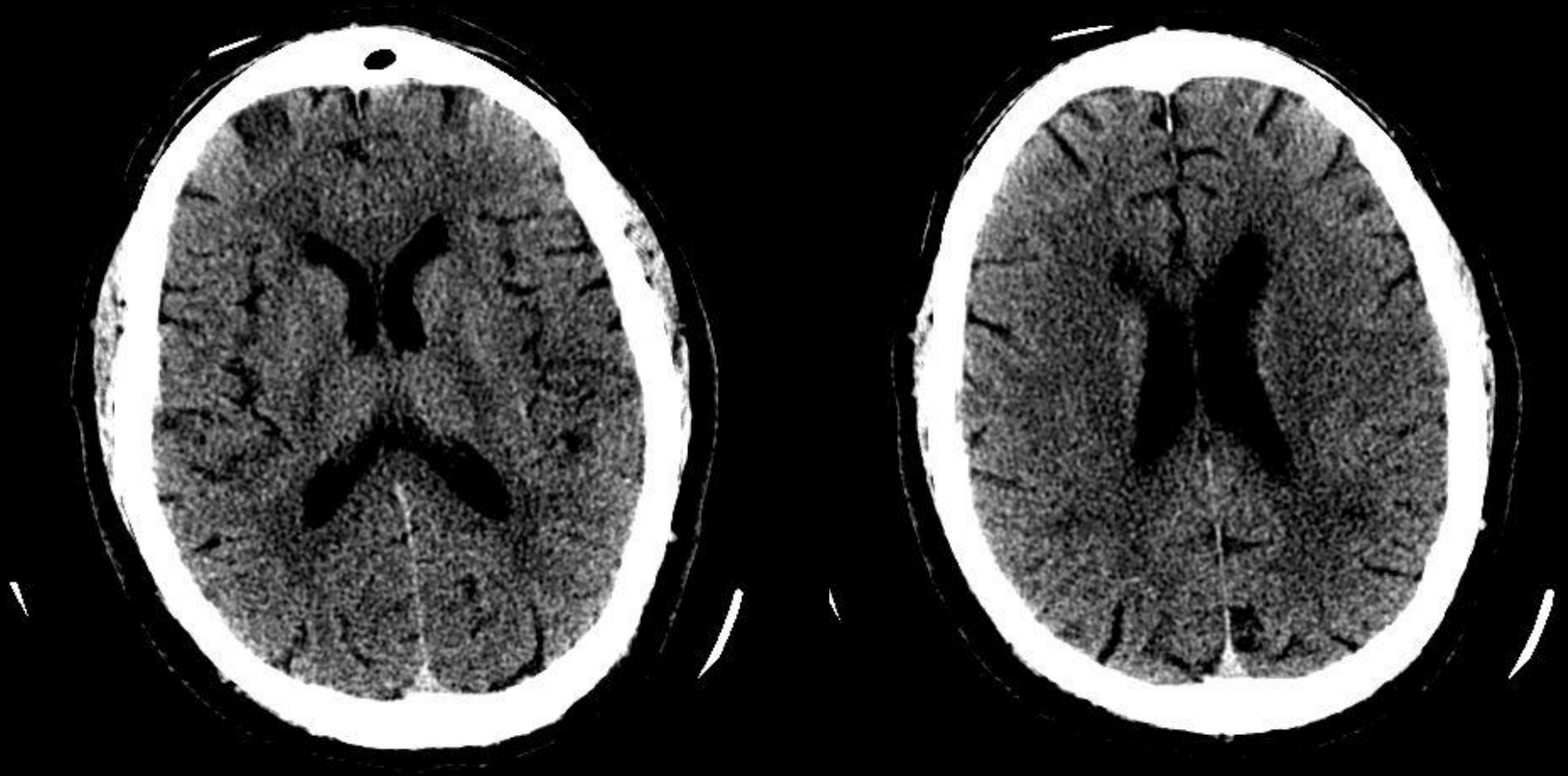
# Middle cerebral artery



# Case 3

- 61 yo M (RHD) global aphasia, right hemiparesis (lower face, arm, leg), right side sensory loss, right homonymous hemianopia, gaze preference to left
- Localizes to LMCA territory
  - **Language impairment** is a key localizing feature in LMCA stroke and indicates cortical involvement

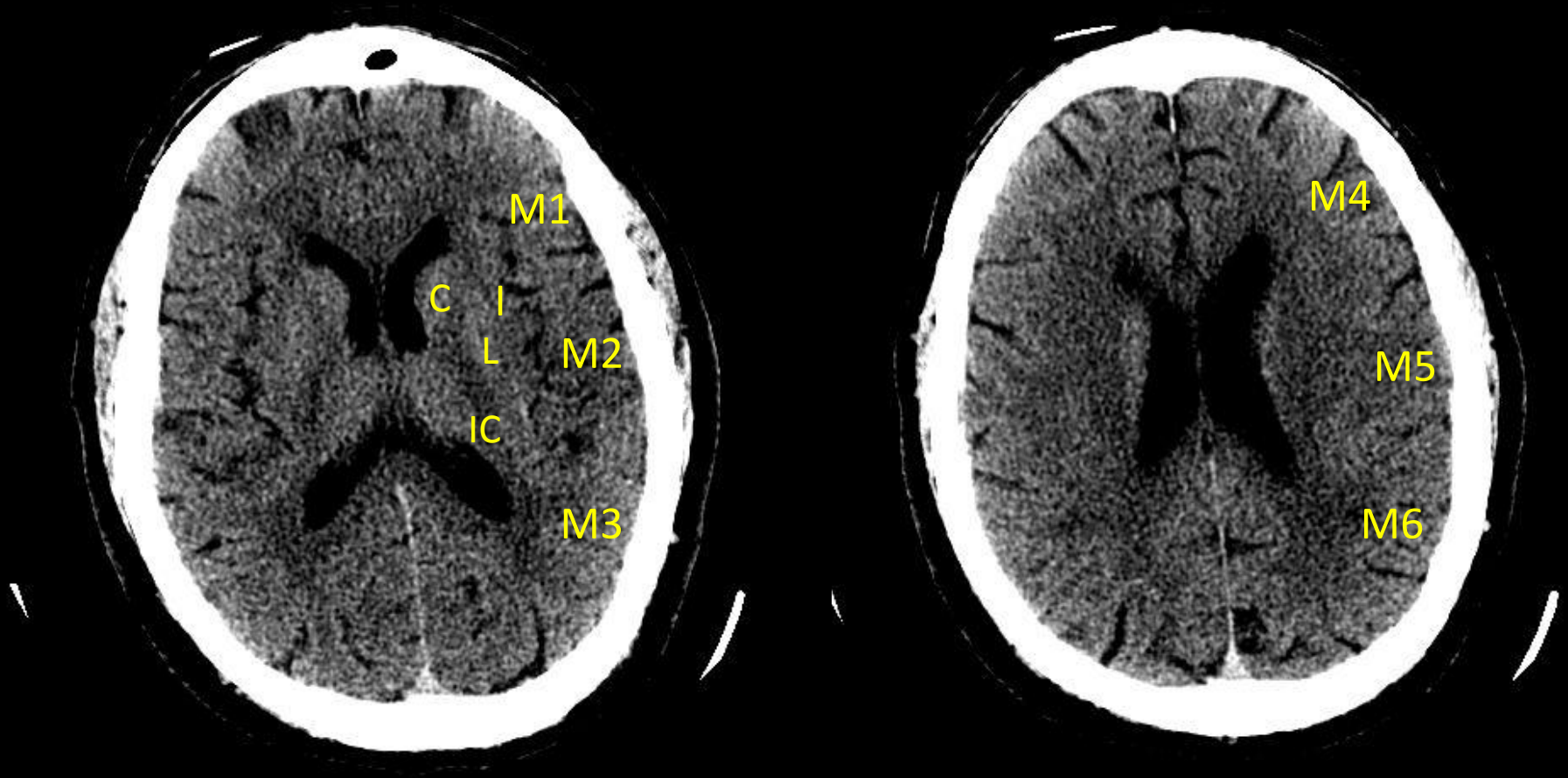
Where is the infarct?



# Detecting early cerebral ischemia on CT scan

- Loss of grey-white differentiation
  - You may have to adjust the brightness and contrast (the “window width” and “window level”)
- Loss of sulci
- Use the same system every time you look at a CT for possible acute stroke
  - For example, the Alberta Stroke Program Early CT Score (ASPECTS)

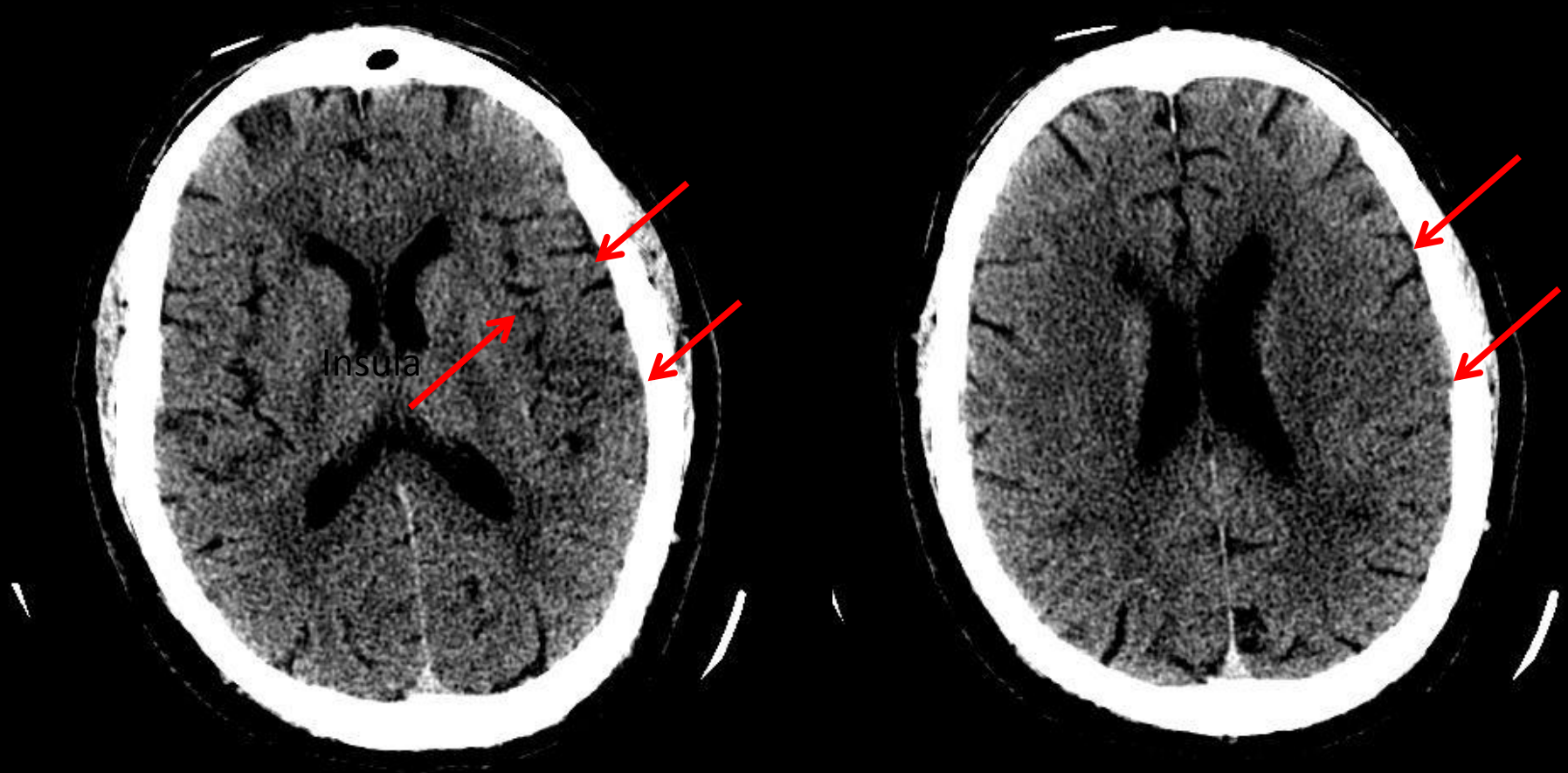
# Alberta Stroke Program Early CT Score



C = caudate, L = lentiform, I = insula, IC = internal capsule

M1, M2, M3 = anterior, lateral, posterior MCA territory; M4 to M6 are above the lentiform nuclei

# Can you see the infarct using ASPECTS?



# *Hyperacute Stroke*

## *Best Practice Recommendations*

- **3.3.4 Acute Blood Pressure Management**
- **Ischemic stroke eligible for thrombolytic therapy:** Very high BP (>185/110mmHg) should be treated concurrently in patients receiving thrombolytic therapy for acute ischemic stroke as this may reduce the risk of secondary intracranial hemorrhage. [Evidence Level B].
- **Ischemic stroke patients not eligible for thrombolytic therapy:** Treatment of hypertension in the setting of acute ischemic stroke should not be routinely undertaken [Evidence Level C].
  - Extreme blood pressure elevation (e.g. systolic > 220 or diastolic > 120mmHg) may be treated to reduce the blood pressure by ~15 percent, and not more than 25%, over the first 24h with gradual reduction thereafter [Evidence Level C];
  - **Avoid excessive lowering of blood pressure** [Evidence Level C].

# *Hyperacute Stroke*

## *Best Practice Recommendations*

- **3.3.5 Blood Glucose Abnormalities**
- All patients with suspected acute stroke should have their blood glucose concentration checked immediately [Evidence Level B].
- Blood glucose measurement should be repeated if the first random glucose value is elevated greater than 11.0 mmol/L. The repeat measures should include a fasting glucose and an HbA1c [Evidence Level C].
- Hypoglycemia should be corrected immediately [Evidence Level B].

# *Hyperacute Stroke*

## *Best Practice Recommendations*

- **3.3.6 Additional Management Considerations in the Emergency Department**
- For some patients, based on clinical presentation and medical history, additional investigations should be considered [Evidence level B].
- The use of indwelling urethral catheters should be avoided due to the risk of urinary tract infections [Evidence Level A].
  - If used, **indwelling catheters should be assessed daily and removed as soon as possible** [Evidence Level A].
  - **Fluid status and urinary retention** should be assessed as part of vital sign assessments [Evidence Level C].
  - Excellent pericare and infection prevention strategies should be implemented to minimize risk of infections [Evidence Level C].

- In this next case, see if you can keep track of the Best Practice Recommendations that were not followed
- Think of how this affected the patient

# Case: When Best Practice is Not Followed In the ED

- 75 year old woman, high functioning
- **5pm:** Sudden change in affect. Blunted response to verbal replies. 15 second delay in speech. ? Mild right face droop and right arm weakness, resolved within 10 minutes. Complains of left side headache.
- **5:30 pm.** EMS notes no focal signs.

- **8pm.** Seen by ER doc: Speaks in full sentences, moves arms and legs, seems mentally slow but no need for acute stroke protocol. Possible TIA/minor stroke?
- CT head: no acute ischemia.
- Consult Internist if patient still feeling confused in the morning

- **2am.** Examined by Clinical Clerk, who will review with staff in the morning.
- **8am.** Seen by Internist. Possible stroke. Patient is tired, sleeps for rest of the morning.
- **1pm.** Patient still seems slow, persistent left side headache. ? Migraine. Neurology consulted.

# Case, continued

- **2pm.** Neurologist shows up after lunch.
- BP 95/70. Neurological exam shows:
  - Right face and arm weakness (mild)
  - Mild dysmetria right arm
  - Slow in verbal response, almost apathetic
  - NIHSS = 3
- **2:05 pm.** Neurologist reviews CT head from night before.

# Questions

- What has gone wrong in this case so far?
- What Best Practice Recommendations should have been followed?

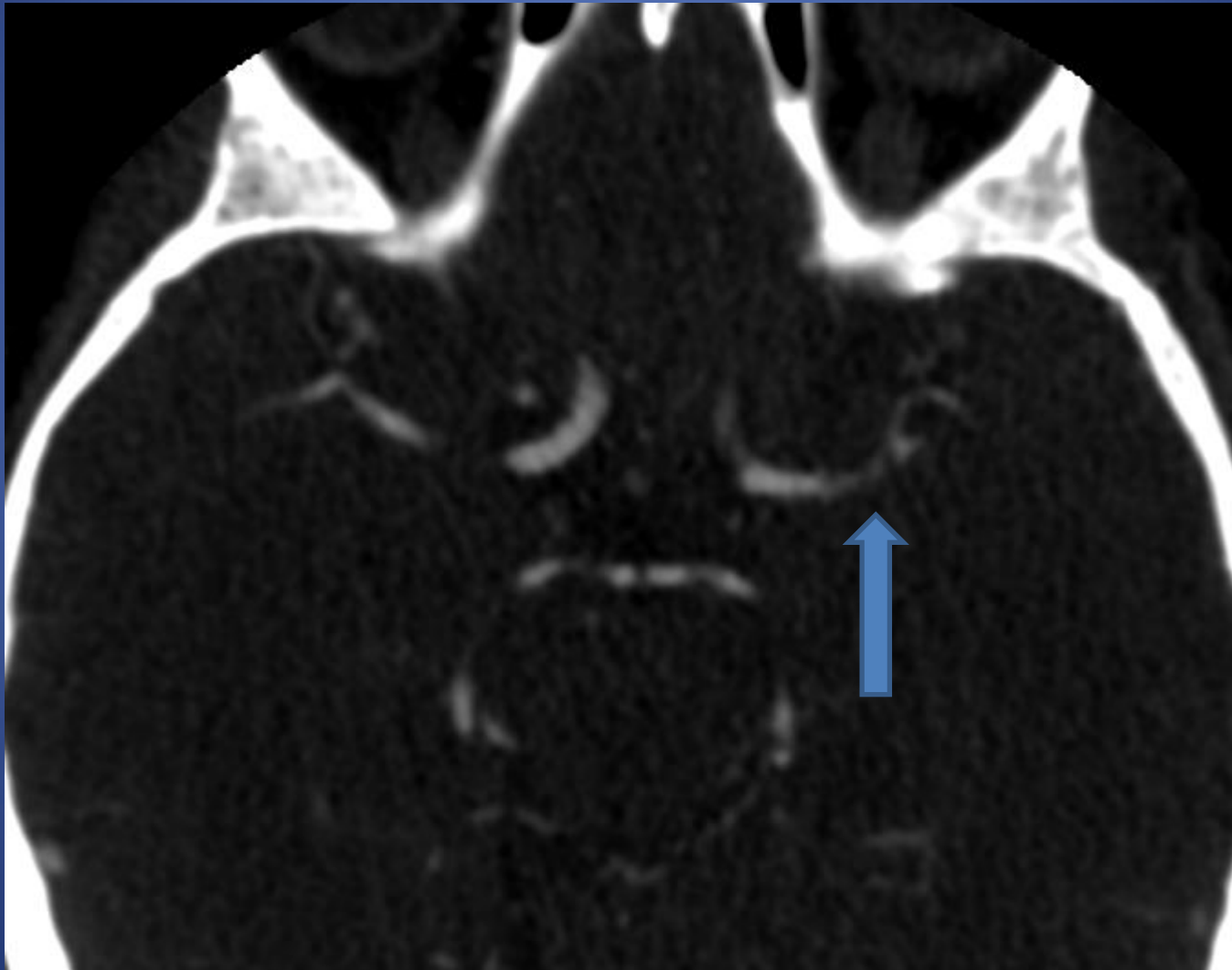






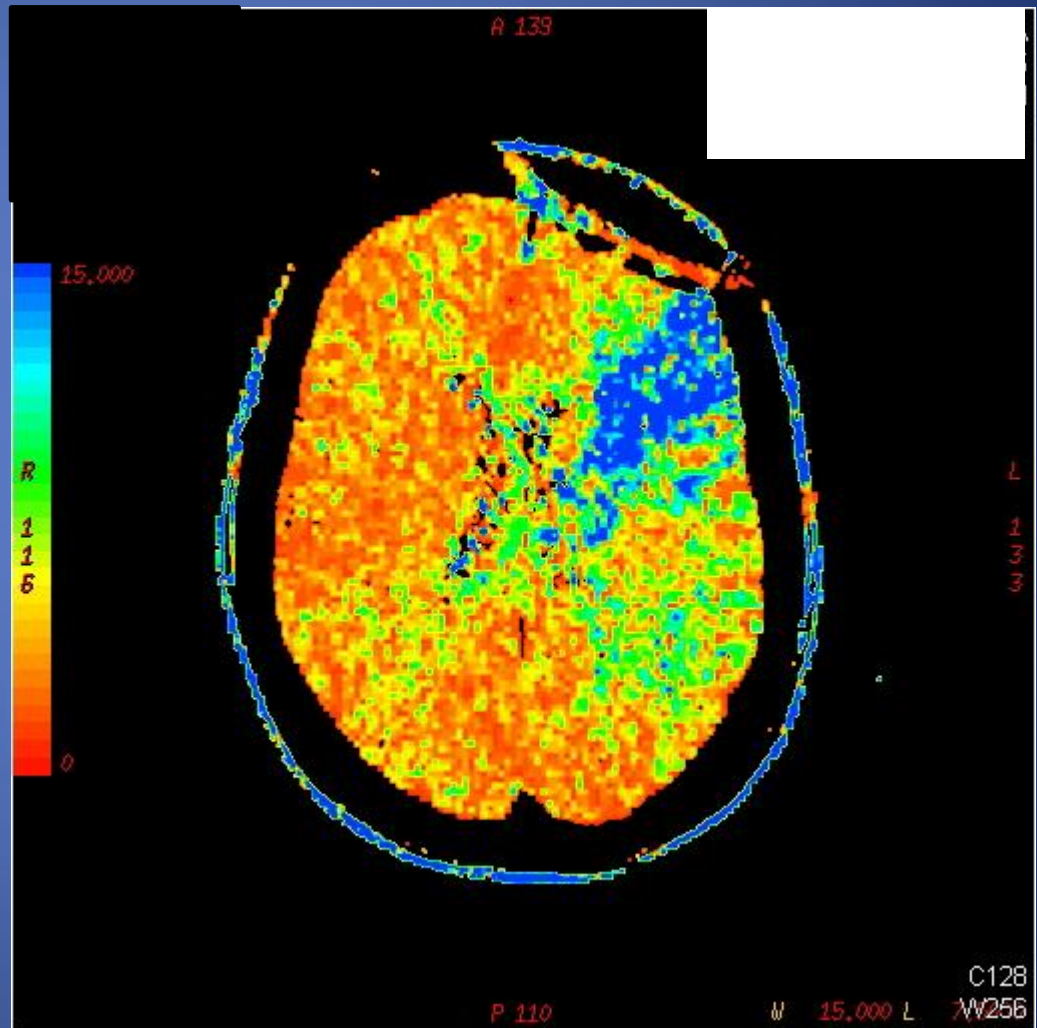
- **2:10pm.** Neurologist orders STAT CT angiography and CT perfusion scan.

# Partial Clot in Left MCA



# CT Perfusion scan

- Acute left MCA stroke, outside of thrombolysis window



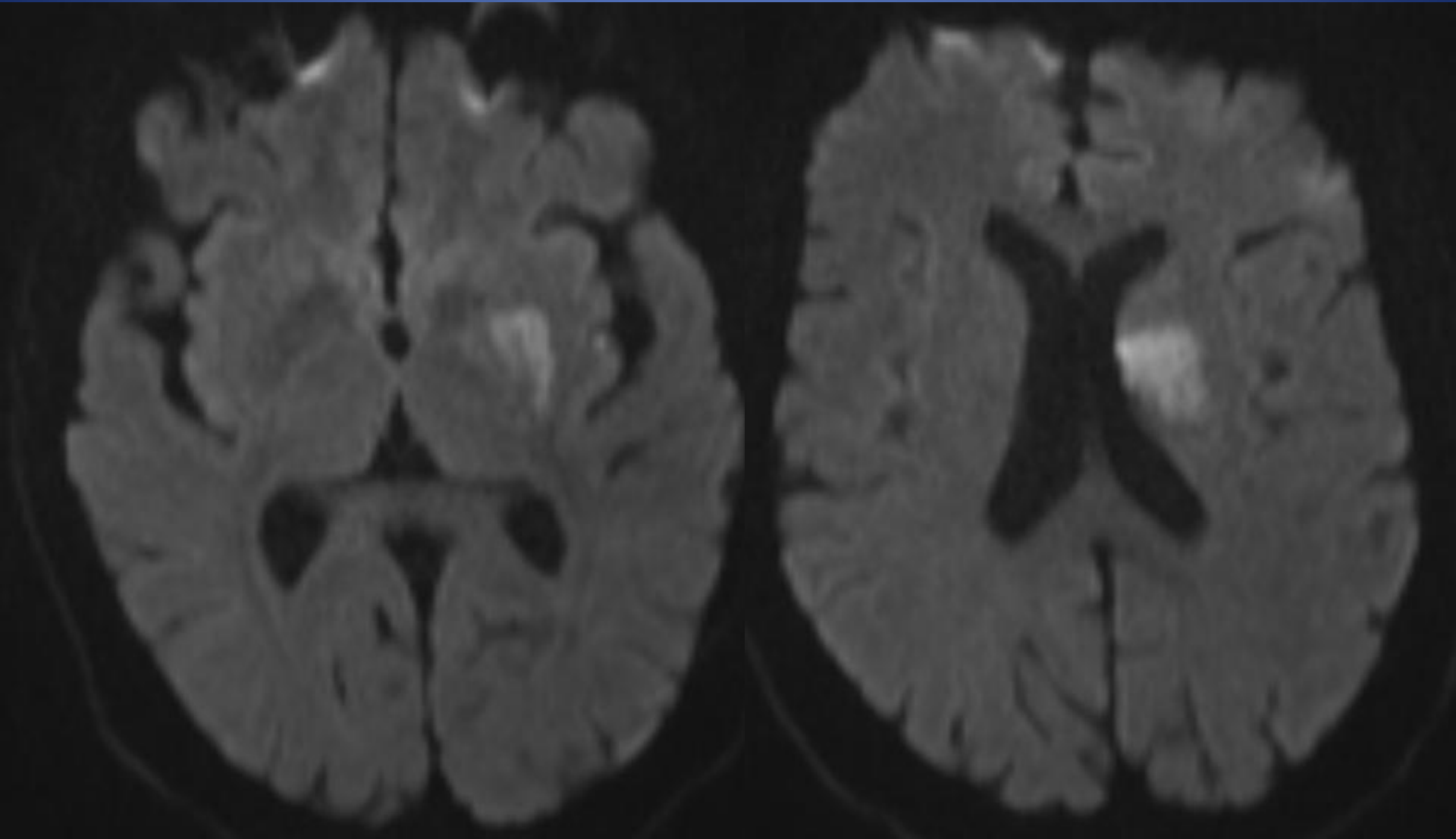
# Best Practice Principles that were neglected in this case

- Neurological history: Right side weakness
- Neurological exam: NIHSS = 3
- NPO???
- Monitor hydration and blood pressure
- Immediate neurovascular imaging
  - Too mild to justify risk of tPA, but LMCA stenosis suggests that blood flow is compromised and must be restored
  - She is slow and apathetic because she has infarcted the left caudate body
  - Because she is slow and apathetic, she has neglected to drink or alert anyone that she is thirsty

# Case, continued

- **2:20 pm.** Reverse Trendelenburg. One litre normal saline then maintenance
- **2:30pm.** BP 110/70. Right side weakness resolved.

MRI at 48 hours: Left lentiform,  
caudate and corona radiata infarct



# Case outcome

- It took several months for cognition to improve
  - Still a little mentally slower than before
  - Risk for vascular cognitive impairment is high

# Stroke Unit: Setting the Stage for Recovery

# What is a Stroke Unit?

- Geographically consolidated placement of stroke patients
- Interdisciplinary team of physiotherapists, occupational therapists, dietitian, speech language pathologist, pharmacist, social worker, doctors, nurses, discharge planners, case managers, spiritual care, rec therapists, patient advisors, community support liaisons
- Clear protocols, standards, care plans and expectations

- “Prognosis of stroke patients is more dependent on the **enthusiasm** and **activity** of the treating team than on radiological or laboratory facilities”
  - Kaste M, Scand J Rehabil Med 1981;13(2-3):89-92

# Mobile Stroke Unit



# Stroke Units Save Lives

- Stroke Unit Trialists' Collaboration identified 31 randomized and quasi-randomized trials (n=6,936)
- Stroke patients who receive stroke unit care are more likely to survive, return home, and regain independence as compared to patients who receive less organized conventional care (Stroke Unit Trialists' Collaboration, 2009).

- At one year, significant reduction in:
  - Death (OR=0.82, 95% CI 0.73 to 0.92,  $p=0.001$ )
  - Death or institutionalization (OR=0.81, 95% CI 0.74 to 0.90,  $p<0.001$ )
  - Death or dependency (OR=0.79, 95% CI 0.71 to 0.88,  $p<0.001$ )
- Based on the results from three trials, the authors also reported that the benefits of stroke unit care are maintained for periods up to 5 and 10 years post-stroke.

Stroke Units work in clinical trials, do  
they work in real life?

# Stroke Units in Their Natural Habitat: Systematic Review of Observational Studies

Pamela Seenan, Marita Long and Peter Langhorne

*Stroke*. 2007;38:1886-1892; originally published online April 26, 2007;

- Twenty-five observational studies (n=42,236)
- Within 1 year of stroke, Stroke Units significantly reduced the odds of:
  - Death (odds ratio=0.79, 95% CI=0.73 to 0.86;  $p<0.001$ )
  - Death or poor outcome (odds ratio=0.87, 95% CI=0.80 to 0.95;  $p=0.002$ )

## Early admission to stroke unit influences clinical outcome

G. Silvestrelli, L. Parnetti, M. Paciaroni, V. Caso, F. Corea, R. Vitali, G. Capocchi and G. Agnelli  
*Neuroscience, University of Perugia, Perugia, Italy*

- Stroke Units have more benefit when the patient gets admitted earlier
  - In non-tPA patients, admission to the Stroke Unit within 3 hours of stroke onset was associated with a much better functional outcome than was seen in patients admitted more than 3 hours after onset

Stroke Units:  
Why do they work?

# Organization, Communication, Expertise

- Best Practice Recommendations account for every detail of inpatient care
- Multiple tasks are done in parallel every day by an interprofessional team
- Team members communicate better in a geographically consolidated unit
- Everyone can refer to a common care plan
- Fewer distractions
- Expertise becomes established over time

# Eight Key Elements of Stroke Unit Design

- Specialized care for patients with ischemic stroke, intracerebral hemorrhage (ICH), and transient ischemic attack (TIA) (care may be expanded in some institutions to include patients with subarachnoid hemorrhage [SAH] and other neurovascular conditions)

- Consistent clustered model where all stroke patients are cared for on the same hospital ward with dedicated stroke beds by trained and experienced staff, including rehabilitation professionals

- Protocols in place for hyperacute and acute stroke management, and seamless transitions between stages of care (including pre-hospital, emergency department and inpatient care)

- Dysphagia screening protocols in place to assess all stroke patients without prolonged time delays prior to commencing oral nutrition and oral medications

- Discharge planning starting as soon as possible after admission, and anticipating discharge needs to facilitate smooth transitions
- This can include using instruments like the AlphaFIM

- Daily patient care rounds with interprofessional stroke team to conduct case reviews, discuss patient management issues, family concerns or needs, and discharge planning (discharge or transition to the next step in their care, timing, transition requirements)

- Patient and family education that is formal, coordinated, and addresses learning needs and responds to patient and family readiness

- Ongoing professional development for all staff
  - stroke knowledge, evidence-based best practices, skill building, orientation of trainees

# QBP



- Health System Funding Reform
- Quality Based Procedures
- Stroke is being rolled out this year
- Mostly, this is a way to drive hospitals towards adopting Best Practice Recommendations

# Quality-Based Procedures: Clinical Handbook for **Stroke**

Health Quality Ontario &  
Ministry of Health and Long-Term Care

January 2013



# QBP in the ED

Recommended Practice	Relevant Guidelines/Evidence
Rapid initial evaluation for airway, breathing, circulation	Canadian Best Practices Recommendations for Stroke Care, 2010 ( <i>Evidence Level B</i> )
All patients should undergo a neurological examination to determine focal neurological deficits and assess stroke severity ( <i>Evidence Level B</i> ) on a standardized stroke scale (either the NIHSS or CNS for stroke)	Canadian Best Practices Recommendations for Stroke Care 2010 ( <i>Evidence Level B</i> )
All patients should undergo brain imaging (MRI or CT) immediately and vascular imaging of the brain and neck arteries as soon as possible (1)	Canadian Best Practices Recommendations for Stroke Care 2010 ( <i>Evidence Level A</i> )
All patients should undergo vascular imaging of the brain and neck arteries as soon as possible	( <i>Evidence Level B</i> )
All patients presenting within 48 hours of symptom onset or with persistent or fluctuating motor or speech symptoms should undergo immediate vascular imaging of the neck arteries (carotid ultrasound, CTA, or MRA) for patients eligible for revascularization (unless the patient is clearly not a candidate for revascularization)	( <i>Evidence Level B</i> )
ECG should be completed to detect atrial fibrillation and other acute arrhythmias <sup>20</sup>	Canadian Best Practices Recommendations for Stroke Care 2010 ( <i>Evidence Level B</i> )

# QBP and Stroke Unit

**Table 10: Acute Admission for Ischemic Stroke Patients**

Recommended Practice	Relevant Guidelines/Evidence
Patients should be admitted to a specialized, geographically defined hospital unit dedicated to the management of stroke patients	HQO stroke evidence-based analysis (Moderate quality evidence)  Canadian Best Practices Recommendations for Stroke Care 2010 (Evidence Level A)
The core stroke unit team should consist of health care professionals with stroke expertise in medicine, nursing, occupational therapy, physiotherapy, speech–language pathology, social work, and clinical nutrition (a dietitian).	Canadian Best Practices Recommendations for Stroke Care 2010 (Evidence Level A)
To have the necessary stroke expertise, the health care professionals spend the vast majority of their time treating stroke patients and regularly complete education about stroke care	Canadian Best Practices Recommendations for Stroke Care 2010  Foley et al. 2012 <sup>24</sup>
Stroke patients should be placed NPO and have their swallowing ability screened using a simple, valid, reliable, bedside testing protocol as part of their initial assessment and before initiating oral medications, fluids, or food.	Canadian Best Practices Recommendations for Stroke Care 2010 (Evidence Level B)
Patients who are not alert within the first 24 hours should be monitored closely. Dysphagia screening should be performed when clinically appropriate	Canadian Best Practices Recommendations for Stroke Care 2010 (Evidence Level C)
Patients with stroke presenting with features indicating dysphagia or pulmonary aspiration should receive a full clinical assessment of their swallowing ability by a S–LP or appropriately trained specialists who would advise on swallowing ability and required consistency of diet and fluids	Canadian Best Practice Recommendations for Stroke Care 2010 (Evidence Level B)
All stroke patients admitted to hospital with acute stroke should be mobilized early and as frequently as possible and preferably within 24 hours of stroke symptom onset, unless contraindicated	Canadian Best Practices Recommendations for Stroke Care 2010 (Evidence Level B)
Therapy to promote recovery of motor impairments should commence within 48 hours of stroke according to best practices	Canadian Best Practices Recommendations for Stroke Care 2010
The interprofessional team should assess stroke patients within 48 hours of admission to hospital and formulate a management plan	Canadian Best Practices Recommendations for Stroke Care 2010

# Stroke Unit Volume: 165 pts/yr

## Module 4A: Acute Inpatient Admission of Ischemic Stroke Patients

This module identifies best practices for acute inpatient admission of ischemic stroke patients. To optimize outcomes and efficiencies, stroke volumes should be at least 165 ischemic stroke patients per year per organization. Greater volumes are likely to confer additional benefits (based on an analysis of the Discharge Abstract Database, 2002–2009<sup>23</sup>). The appropriate critical mass for an integrated stroke unit (a specialized inpatient stroke unit that provides both acute and rehabilitation interventions) has not been determined. Guidelines for the development of stroke units are available at [www.strokebestpractices.ca](http://www.strokebestpractices.ca).

# Summary

- **You are the true experts** on implementing Best Practice Recommendations
  - What you will accomplish here will help the people in this region
  - Other regions will try to emulate you
- Train your Stroke Team to assess a neurological history and exam quickly
- Train your Stroke Team to read CT scans
- Transition patients quickly from ED to ICU to ASU

# Summary

- Stroke Unit Design:
  - Specialized care
  - Consolidated
  - Dysphagia screen
  - Protocols
  - Early discharge planning
  - Rounds
  - Patient and family education
  - Continuous professional development