

# MRI after a negative CT in hyperacute stroke: A single institution audit

Fateme Salehi<sup>1</sup>, Andrew Leung<sup>1</sup>, Manas Sharma<sup>1</sup>,  
Jennifer Mandzia<sup>2</sup>, David Pelz<sup>1</sup>, Donald H. Lee<sup>1</sup>

1. Department of Radiology, 2. Department of Neurology,  
University of Western Ontario, London, ON

# Disclosures

- None

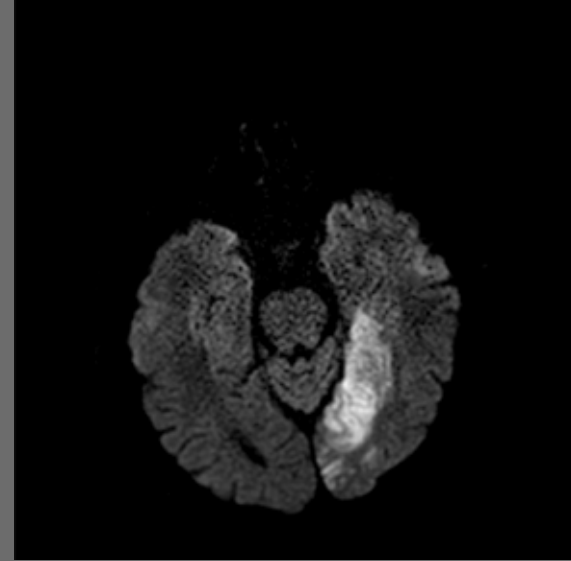
# Introduction

- Stroke is the fourth leading cause of death in Canada. There are between 40,000 to 50,000 strokes in Canada each year.
  - Each year, about 16,000 Canadians die from stroke (15%)
- 40% of stroke patients are left with a moderate to severe impairment
- 10% are so severely disabled they require long-term care
- Stroke costs the Canadian economy \$2.7 billion a year.
- The average acute care costs is about \$27,500 per stroke
- Canadians spend a total of 3 million days in hospital because of stroke.

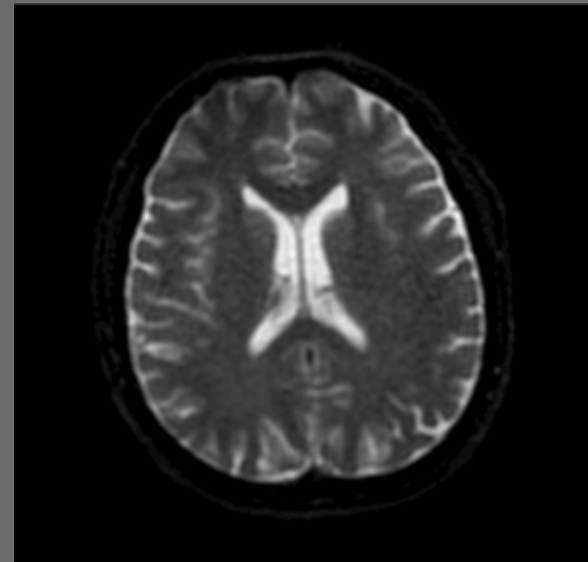
# Introduction

- MRI is superior to CT to diagnose acute ischemic stroke. Because MRI is not always readily available to assess CT negative patients, patients with suspected stroke are admitted, with MRI performed to exclude stroke.
- MRI is not always performed within 24 hours leading to costs associated with preventable length of stay (LOS).
- Our aim is to evaluate the impact of delayed MRI on patient admission, LOS and associated expenses.

CT Negative → MRI DWI Positive



CT Negative → MRI DWI Negative



# Methods

- We reviewed patients with stroke symptoms who underwent CT/CTA as part of our Institutional “Hypertacute Stroke Protocol” during 2014 (Jan – Dec) .
- In patients with negative CT/CTA, we recorded MRI results, patient admission status, LOS and discharge diagnosis.
- Cost of hospital stay was estimated as \$3000/day based on average hospital stay costs.

# Hypothesis

- Timely MRI DWI sequence will facilitate clinical decision making in the setting of TIA symptoms and lead to reduced costs associated with delayed diagnosis of TIA-mimics, including costs of hospital stay and neurology unit stay.

# Audit Standards and Target

- **Standards**

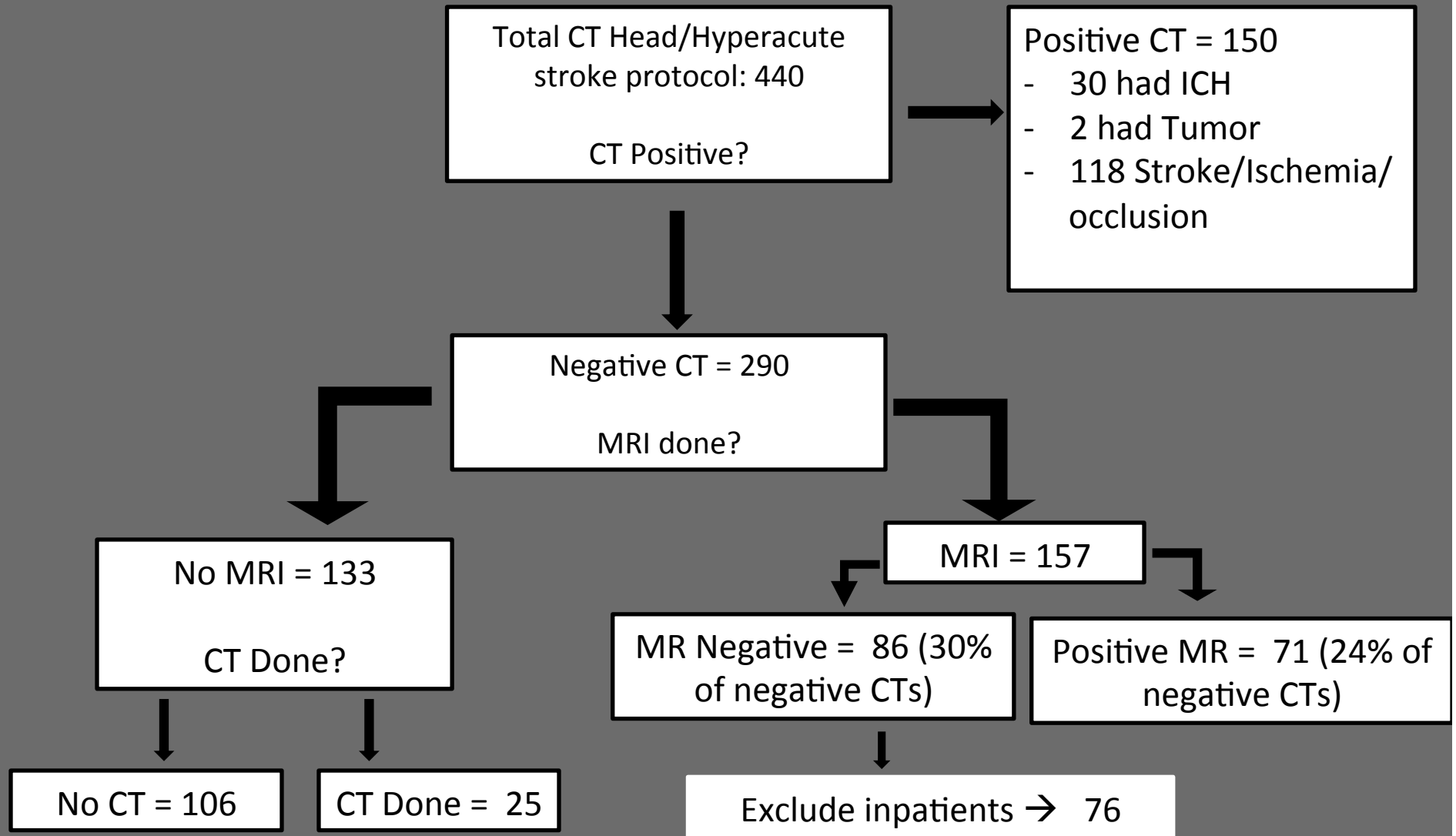
MRI should be performed within 12 hours in hyperacute stroke patients with negative CT/CTA.

## **Audit Target**

Standard should be achieved in over 90% of cases.



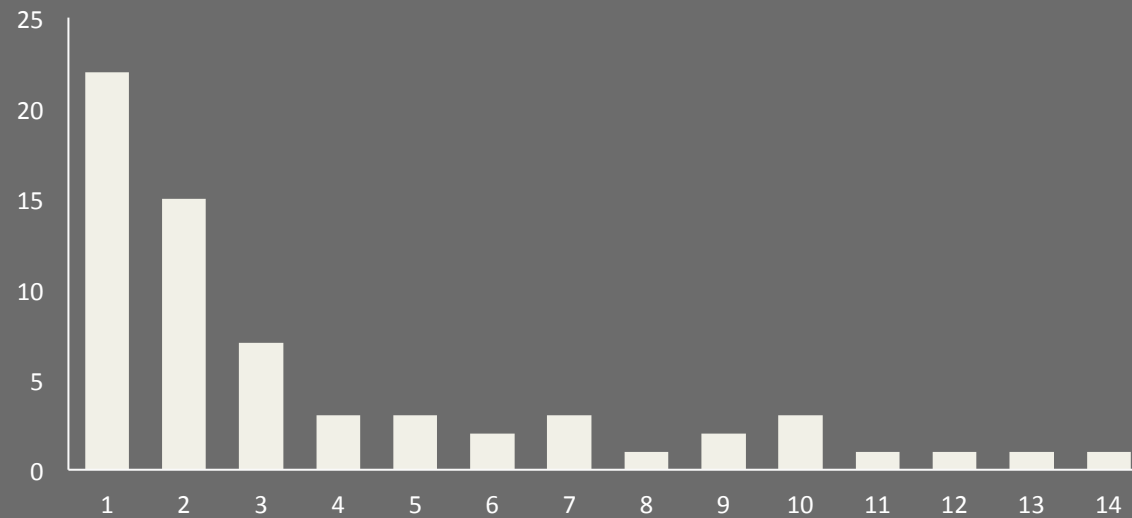
# Results



# Results

- 76 Patients had Negative CT AND MRI
- 11 were discharged same day
- 37 (57%) had LOS 1 or 2 days
- 52 (68%) had LOS 1-3 days

LOS Distribution



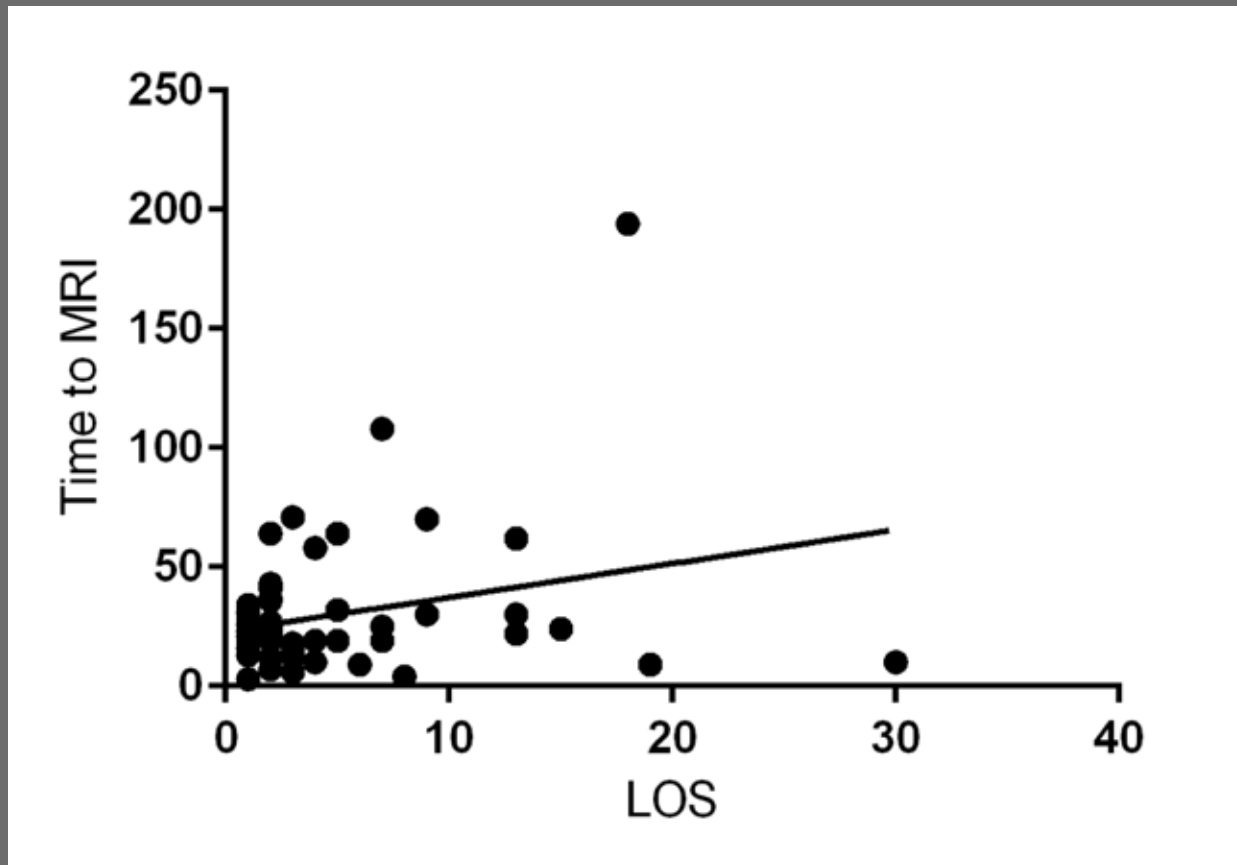
# Results

- Patient characteristics
  - Average: LOS 4.5 days
  - Range: 1 – 30 days
  - 57 % stayed 1 or 2 days, 68% 1-3 days
  - Average time to MRI from initial CT 28.1 hrs (Range 2 – 194)

LOS (Days)	N	Age	Gender (M:F)	Time to MRI (Hrs)
0	11	58	6:5	6
1	22	61	9:13	21.3
2	15	72.5	3:12	29.6
3 or more	28	67.2	15:13	36.2

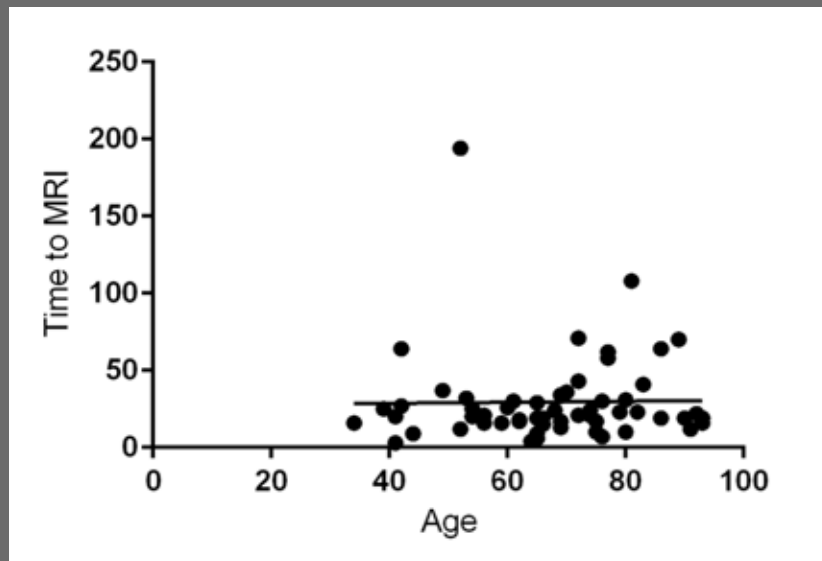
# Time to MRI and LOS

(P = 0.04)

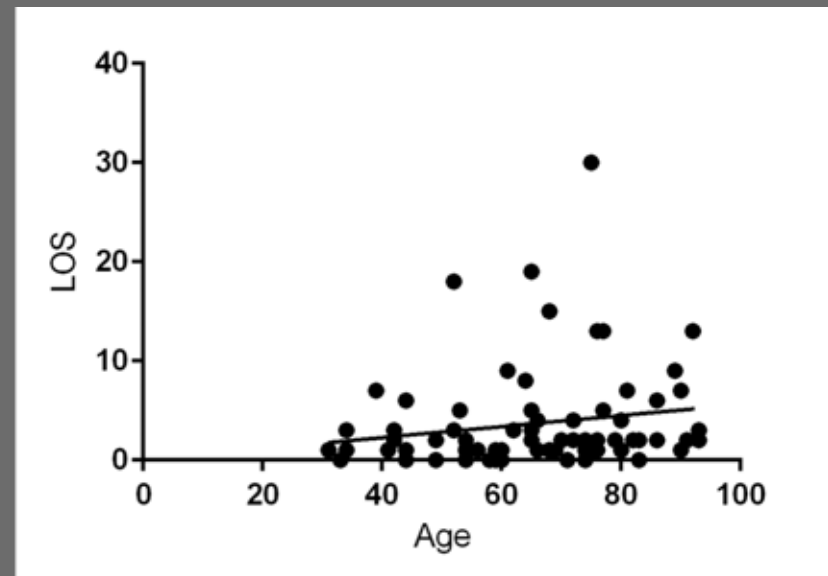


# Age vs. Time to MRI and LOS

Time to MRI (P = 0.9)



LOS (P = 0.15)



# Results

- 11 patients were not admitted
  - 3 had same day MRI and were discharged
    - Length of time to MRI: 2 – 12 hours
  - 9 were seen in TIA Clinic within 2 weeks and had outpatient MRI before or after TIA clinic

Discharge Diagnosis	Patients
TIA, symptoms resolved, TIA clinic F/U	7
Same day MRI, nil acute	3
Functional	1

# LOS 1 and 2 days (N = 37)










Discharge Diagnosis	Patients
TIA, No significant stenosis	18
Transient weakness, NYD	4
Vertigo	2
Functional/Psychiatric	3
Anxiety	2
Seizure	1
Migraine	2
Syncope NYD	1
Overdose	1
UTI	1
HTN Encephalopathy	1
Dental Anesthetic	1
Total	37

# LOS 3 (N = 7)

Discharge Diagnosis	Patients
HTN	1
Viral meningitis/encephalitis	2
TIA, no significant stenosis (one prolonged stay due to AKI)	3
Dysarthria NYD	1
Total	7



# LOS 4 or more days (N = 15)

LOS	Diagnosis
4	Confusion, NYD 
4	Dysarthria, NYD
4	LOC NYD 
5	HTN Encephalopathy
5	Psychiatric
5	TIA with severe symptomatic stenosis, had CEA
6	Seizure/PRES
6	TIA
7	Hyponatremia 
7	MR negative stroke
7	MR negative stroke
8	MRI negative stroke
9	Headache and delirium 
9	AKI 
13	Delirium 
13	GBM 
13	Hyponatremia, NYD 
15	Facial droop NYD
18	Delirium 
19	Recurrent paralysis NYD
30	Encephalopathy

# Projected Costs

- 17 patients had **non neurological discharge diagnosis**, total of LOS = 130 days
  - Estimated cost: **\$390,000**
- 37 patients had discharge **diagnosis other than TIA or stroke**, with LOS of 284 total
  - Estimated cost: **\$852,000**

# Discussion

- The diagnosis of TIA is difficult and doubt often remains, even after expert clinical assessment, whether or not the event was a TIA.
- Of patients presenting with symptoms suggesting a TIA, about half prove to have some other cause.
- MRI DWI is needed where the diagnosis or location of the lesion remains in doubt.
- MRI may determine vertebral (brain/brainstem) or carotid neck territory involvement, prompting further carotid investigation where appropriate. Multiple lesions may suggest a cardiac source of the clot(s), and prompt investigation of the heart.

# Discussion

- Several factors contribute to LOS after a TIA-like presentation
- MRI availability is one of the factors:
  - Delayed MRI is associated with delayed discharge.
- DWI sequence is rapid and low cost, and may help with clinical decision making and triaging of patients, thereby reducing costs associated with LOS in general and stay at neurology bed in particular
- Patients with non-neurological diagnosis should be admitted to appropriate services instead of mobilizing stroke team and resources.

# Future Directions

- Discussion of results with Neurology Stroke Team Leader, Neuroradiologists, and ED physicians to facilitate rapid access to MRI as requested by the Stroke Team leader
- Work with MRI technologists to streamline access
- Re-evaluate CT negative MRI negative LOS to compare costs over a similar period

Thank you