Predictors of diagnostic neuroimaging delay in adult Ontario patients presenting with symptoms suggestive of acute stroke

Kirsteen Burton, MD, MBA, MSc, PhD (candidate, RCPSC CIP)
PGY-2 Resident: University of Toronto Dept. of Medical Imaging
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**Background**

- **Rapid access to diagnostic neuroimaging is critical to the management of acute stroke patients.**
  - **AHA guidelines**: imaging within 25 mins. of ED arrival.
  - 4.5 hour thrombolytic time window.

- **Numerous studies have examined door-to-needle time, but few, door-to-imaging time (DIT).**
  - Those that did: 1) did not attempt to identify factors that impacted DIT; 2) were underpowered; 3) conducted before release of latest AHA guidelines.

- **Objective**: identify factors associated with neuroimaging delay; defined as neuroimaging > 25 mins.

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1 Sauser et. al; Stroke 2014.
2 Kelly et. al; Stroke 2012.
3 Rose et. al; Stroke 2008.
Methods

- **Ontario Stroke Registry**: population-based; adult patients with suspected stroke; seen at all acute care hospitals in Ontario, Canada.
  - **Hospitals**: regional, district & non-stroke centres.
- **Period**: April 2010-March 2011 (13,250 eligible).
- **Exclusions**: patients in whom time of Sx onset was not exactly known; presented beyond 4 hours; died before neuroimaging; hospitals without neuroimaging capacity.
- **Hierarchical, multivariable Cox proportional hazards model**: receipt of rapid neuroimaging to: time b/w Sx onset & neuroimaging; adjusted for demographic, medical history, presentation & hospital factors.
Methods: model variables

- **Demographics:**
  - Age group; gender; income quintile; preferred language; pre-admission independence.

- **Presentation:**
  - NIHSS; business hours; place of residence (home, nursing home, complex continuing care).

- **Past medical history:**
  - Hx of stroke, TIA, ICH; carotid revascularization; DM; HTN; hyperlipidemia; dementia; other CV diseases.

- **Hospital:**
  - Stroke centre designation; rural setting; annual stroke volume.
Results

- 3,984 eligible patients (presented within 4 hours of Sx onset):
  - Mean time from Sx onset: 1.49 hours.
  - Age: 71.5% >64 years old.
  - Stroke severity: 59% NIHSS score <=4.
  - Neuroimaging performed within 25 mins. in 27.3% of patients.
  - Even designated stroke centres provide rapid neuroimaging in a low proportion of patients (26.2%).
## Predictors: rapid neuroimaging

<table>
<thead>
<tr>
<th>Positive predictors (HR, p-value)</th>
<th>Negative predictors (HR, p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time from Sx onset to ED presentation (0.5-1.0hr) (1.59, &lt;0.0001)</td>
<td>Female gender (0.76, &lt;0.0001)</td>
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<tr>
<td>NIHSS score &gt;4 (3.54, &lt;0.0001)</td>
<td>PMHx stroke, TIA, ICH (0.78, &lt;0.001)</td>
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<tr>
<td>Arrived to hospital from nursing, retirement home or complex continuing care (1.21, 0.01)</td>
<td>Rural hospital (0.08, &lt;0.001)</td>
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<td>Regional stroke centre (5.60, &lt;0.001)</td>
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Discussion

- **Female patients**: consistent with findings from other studies which found delays in: neuroimaging; and door-to-doctor time.\(^1,^2,^3\)

- **Rural hospitals**: rural stroke patients are less likely to use EMS;\(^4\) hospitals with greater stroke patient volumes have greater neuroimaging utilization rates.\(^5\)

- **Past Hx stroke/ICH/TIA**:
  - 1) Patient preferences +/- advanced care directives, the effect of which we did not estimate;
  - 2) Hampered patient/caregiver/health care team communication.

\(^1\)Kelly et. al; Stroke 2012.
\(^2\)Gargano et. al; Stroke 2009.
\(^3\)Di Carlo et. al; Stroke 2003.
\(^4\)Ekundayo et. al; Circ Cardiovasc Qual Outcomes 2013.
\(^5\)Saposnik et. al; Neurology 2007.
Conclusions/advances in knowledge

- In Ontario, there is a fundamental inadequacy in the management of patients with suspected, acute stroke.
- Neuroimaging delays are influenced by an array of patient demographic, presentation, medical history, and hospital factors.
- There is an urgent need for quality improvement initiatives to address the issues and increase the numbers of patients who receive appropriate management.
- There's room to improve.
Co-authors:

Dr. Alan Moody\textsuperscript{1,2}
Dr. Moira Kapral\textsuperscript{3,4}
Dr. Murray Krahn\textsuperscript{3,4}
Dr. Andreas Laupacis\textsuperscript{3,4}

\textsuperscript{1}UofT Dept. of Medical Imaging
\textsuperscript{2}UofT Institute of Medical Sciences
\textsuperscript{3}UofT Dept. of Medicine
\textsuperscript{4}UofT Inst. of Health Policy, Management & Evaluation

Email:
kirsteen.burton@utoronto.ca