Retrospective Application of a Modified ROSIER Scale in Patients Undergoing MRI for Suspicion of Stroke
Authors and Disclosures

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Imaging appropriate in the setting of “new focal deficit”
- Symptoms may be fixed or worsening
- Criteria are unclear on what qualifies as a focal deficit
- Many conditions are mimics (i.e., posterior circulation infarct versus benign paroxysmal positional vertigo)

Symptoms < 6 hours
Imaging Goals:
1. Exclude hemorrhage so that rtPA can be given
2. Guide mechanical thrombectomy

Symptoms > 6 hours
Imaging Goals:
1. Confirm diagnosis
2. Demonstrate lesion location
3. Determine age and severity of stroke
Utilization and Cost of Stroking Imaging

- Burke et al. (2012) observed wide geographic variation in utilization and cost of stroke imaging.
- Cost of diagnostic imaging as part of stroke hospitalization rose 1999-2008, rivaling patient room cost.
- Reflecting decline in growth of imaging (Dodoo et al, 2013), stroke imaging utilization may have tapered.
Recognition of Stroke in the Emergency Room (ROSIER) 
A Fast, Standardized Stroke Exam

• Meant to be given quickly by ER staff

• Demonstrated sensitivity 93% and specificity 83% for neurologist confirmed stroke cases (Nor et al., 2005)

• Has been validated in other clinical settings, but requires higher sensitivity to definitively rule out stroke (Mingfeng et al., 2012)
Study Objectives

• Source patients who had an MRI for a possible stroke
• Review electronic health records to determine:
  – Ordering clinician
  – The documented history and physical exam
  – Patient demographic background and history
• Retrospectively apply a modified, possibly more sensitive ROSIER (four additional physical exam items) to the documented physical exam of the team ordering the MRI
• Estimate the potential annual savings from reduced imaging costs had the ROSIER Plus been applied
Methods

• After obtaining IRB approval, sourced 333 consecutive patients from the log book of a Siemens Skyra 3T MRI scanner, only selecting “Stroke” or “Brain COW” studies (2/3/2013 – 10/7/2015)

• Acquired the electronic health record (WebCIS before 4/2014 or EPIC after 4/2014)

• Identified ordering physician and assessed physician H&P or ED Provider Note

• Determined if acute ischemic stroke was included in the physician’s differential diagnosis using personal review and 7 CVA-related search terms
Methods

• Excluded the following cases:
  – Did not include CVA in the differential diagnosis (ddx) (n=115)
  – Outpatient imaging (n=28)
  – Imaging ordered >24 hours post admission
  – Transfers (n=22)
  – “Silent strokes” (n=6)
  – Seizure disorder was included in the ddx (n = 4)

• The remaining cases (n = 126) fell into four groups
  – CVA+ (n=28): ddx of CVA, discharge diagnosis (dcdx) of CVA
  – CVA- (n=73): ddx of CVA, no dcdx of CVA
  – TIA+ (n=19): ddx of CVA, dcdx of TIA
  – CVA-/MRI+ (n=6): ddx of CVA, no dcdx of CVA, findings on MRI
Methods

- Applied **ROSIER Plus** scale to the ordering team’s physical exam
- If a physical exam item was not recorded, assumed the finding was not present
- Applied the misclassification rate to all patients who received stroke imaging at UNC 7/2014-6/2015 to estimate annual cost savings
ROSIER Plus Scale Performance

### ROSIER Plus Score Performance

<table>
<thead>
<tr>
<th>ROSIER Plus Score</th>
<th>CVA+</th>
<th>CVA-TIA+</th>
<th>CVA-, MRI+</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>0</td>
<td>3</td>
<td>0, 0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>29</td>
<td>5, 0</td>
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<tr>
<td>1</td>
<td>10</td>
<td>22</td>
<td>6, 4</td>
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<td>2, 0</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0, 0</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0</td>
<td>1, 0</td>
</tr>
</tbody>
</table>

- No cases with a ROSIER Plus < or = 0 had a discharge diagnosis of stroke
- Of the 5 TIA cases that had a ROSIER Plus < or = 0, 3 had positive findings on MRI
- All cases that did not have a stroke or TIA but positive findings on MRI were ruled in by ROSIER Plus
- Overall, applying the ROSIER Plus scale to rule out stroke would have reduced imaging by 31.7%
## Cost Estimation

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Professional Costs per Study ($)</th>
<th>Technical Costs per Study ($)</th>
<th>Studies Performed 7/2014-6/2015</th>
<th>Total Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>127</td>
<td>102</td>
<td>369</td>
<td>84,224</td>
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<tr>
<td>MRI</td>
<td>341</td>
<td>266</td>
<td>806</td>
<td>489,242</td>
</tr>
</tbody>
</table>

Estimated Cost Savings (Misclassification rate = 31.7%) $181,692

## Future Directions

- Make further modifications to the scale that incorporate demographic data and medical history using logistic regression analysis or artificial neural networks.
- Consider stepwise changes in the diagnostic course (i.e., if the CT is normal, how much more unlikely is a stroke?).
- Apply the ROSIER Plus scale prospectively to ensure all pertinent physical exam items are completed.
- Apply time-dependent, activity-based methods to gauge the true cost of stroke imaging.


