Come Together: Assessing for Large Vessel Stroke in the pre-hospital setting

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Upstate.edu/stroke

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Disclosures

• No financial disclosures
Objectives

1. Review current regional pre-hospital status
2. Review basic neuro anatomy
3. Examine various pre-hospital stroke assessment tools
4. Discuss other potential pre-hospital tools
5. Examine stroke screening tools through case scenarios
On average, one American dies from a stroke every 4 minutes.

30-50% have lifelong disability.

Stroke costs US estimated $34,000,000,000

What stroke resources are in NYS?

120 DOH Primary Stroke Centers in New York
What stroke resources are in Northern NY?
What types of hospitals are in our region?

10 Comprehensive Stroke Centers in New York
How did the patient’s arrive to Upstate in 2017?

- Direct Admit: 27%
- EMS: 45%
- Car: 14%
- ED/ED: 9%
- Other: 5%

2017 Upstate Stroke Database
Where did our patients come from?

North: 41%
East: 21%
South: 21%
West: 17%

2017 Upstate Stroke Database
What were they diagnosed with?

- Ischemic/TIA: 43%
- Hemorrhagic: 11%
- Other: 46%

2017 Upstate Stroke Database
What does this mean?

Most patients arrived to Upstate via direct admit or via EMS

Almost half of the direct admits were from the North Country

Almost half of the patients were diagnosed as ischemic stroke
Transport the patient to the closest New York State Department of Health designated Stroke Center if the total prehospital time (time from when the patient’s symptoms and/or signs first began to when the patient is expected to arrive at the Stroke Center) is less than five (5) hours.

Transport the patient to the closest appropriate hospital emergency department (ED) if:

- The patient is in cardiac arrest, or
- The patient has an unmanageable airway, or
- The patient has (an) other medical condition(s) that warrant(s) transport to the closest appropriate hospital emergency department (ED) as per protocol, or
- An on-line medical control physician so directs
Why does pre-hospital care matter?

2018 AHA/ASA AIS Guidelines

4. When several IV alteplase–capable hospital options exist within a defined geographic region, the benefit of bypassing the closest to bring the patient to one that offers a higher level of stroke care, including mechanical thrombectomy, is uncertain. Further research is needed.

Rapid, protected, collaborative, regional quality review, including EMS agencies and hospitals, is recommended for operationalized bypass algorithms.
Scenario 1

- Patient wakes up from a nap at 3pm, noted that he can't move his left arm and had noted left facial droop when he looks in the mirror
- Wife reminds him that he at lunch at 1200 and he was completely normal
- He lives in Canton, NY - 2.5 hours from a DOH stroke center

“Transport the patient to the closest New York State Department of Health designated Stroke Center if the total prehospital time (time from when the patient’s symptoms and/or signs first began to when the patient is expected to arrive at the Stroke Center) is less than five (5) hours”

- Patient requires transport to Syracuse?

What do we think about this?
Temporary Fix

North Country Regional Emergency Medical Advisory Committee
Policy Statement
Serving St. Lawrence, Jefferson, and Lewis Counties

Purpose
Clarification of timeline for consideration of EMS transport to a NYS DOH Designated Stroke Center

Background
Current American Heart Association/American Stroke Association (AHA/ASA) guidelines identify the use of intravenous (IV) tPA (activase) for thrombolysis as a standard of care for the ischemic stroke patient that presents to the emergency department within 3 hours of the time that they were last seen well or last known normal (LKW) and meeting the established tPA inclusion criteria. IV tPA may also be administered (off label) beyond 3 hours, up to 4.5 hours, additional inclusion/exclusion criteria, set forth by local hospital policy and procedure, may apply.

NYS EMS Collaborative Protocols have extended the window of transport to a NYS DOH Designated Stroke Center, up to 5 hours from the current 2 hours indicated in NYS DOH BLS protocol. Adherence to this policy change could potentially cause an eligible patient to be

Policy
North Country EMS providers of all levels need to contact medical control if transport to a NYS Designated Stroke Center is outside the 2-hour window. Medical control will assess the patient location and last known well to determine if the transportation to a Stroke Center may be circumvented, therefore allowing the transportation of the patient to a closer tPA capable facility. To maximize the benefit of stroke therapy, the early administration of tPA must be prioritized.

Current hospitals in these three counties that are capable of tPA administration include: Samaritan Medical Center, Lewis County General Hospital, Carthage Area Hospital, River Hospital, Claxton-Hepburn Medical Center, Gouverneur Hospital, Canton-Potsdam Hospital, and Massena Hospital.
Same Scenario

- Patient wakes up from a nap at **3pm**, noted that he can't move his right arm and had noted right facial droop when he looks in the mirror.
- Wife Reminds him that he at lunch at 1200 and he was completely normal.
- He lives in Canton, NY- **2.5 hours** from a DOH stroke center, 10 minutes from tPA capable facility.
- **Medical Control is contacted and patient is transported to CPH when he received tPA and makes a full recovery.**
Scenario 2

- Patient wakes up at 8am after going to bed normal at 11pm
- Wife notes right facial droop, right-sided flaccid, trouble speaking, and what she calls “staring to the left”
- Patient lives just outside of Watertown, NY

- Samaritan Medical Center can treat stroke
- Is the patient in the tPA window?
- The patient is 1h20 mins form Syracuse
- **What do we do?**
Why are these scales important?

1) Assessing for potential large vessel occlusion
2) Establishing appropriate hospital destination given current NYS stroke systems of care
Review of Neuro anatomy
Vasculature of the Brain

Anterior Circulation:
- **Internal Carotid Artery (ICA)**
- **L/R Middle Cerebral Artery** (divided into M1, M2, M3, M4 sections)
Vasculature of the Brain

Posterior Circulation:

- Vertebral Artery
- Basilar Artery
Why does FAST often work?

ANTERIOR CIRCULATION
Facial Droop, Arm/Leg Weakness, Speech Trouble ~80%
What else do we have besides FAST?
How can we predict LVO without CT Angiogram?

Motor weakness used in all large vessel screening tools due to central location as well as its link to functional independence on modified rankin scale used for endovascular stroke trials.
How can we predict LVO without CT Angiogram?

**Left MCA**
- Speech Impairment or Lack of Speech
- Lack of Comprehension
- Left Gaze
- Right Facial Droop
- Right Sided Weakness

**Right MCA**
- Slurred Speech
- Left Sided Weakness
- Right Gaze
- Left Facial Droop
- Left sided Neglect

**Brainstem**
- Abnormal Eye Movements
- Field cuts
- Nausea, Vomiting
- Ataxia, Vertigo
- Difficulty Speaking
- Difficulty Swallowing
- Decreased Consciousness
- Crossed Signs (ex: left side facial droop right side weakness)
National Institute of Health Stroke Scale (NIHSS)

- 0-4 points per item
- Range 0-42
- Quantifies level of impairment
- Helps guide treatment decision
- Time consuming

<table>
<thead>
<tr>
<th>Score</th>
<th>Stroke severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No stroke symptoms</td>
</tr>
<tr>
<td>1-4</td>
<td>Minor stroke</td>
</tr>
<tr>
<td>5-15</td>
<td>Moderate stroke</td>
</tr>
<tr>
<td>16-20</td>
<td>Moderate to severe stroke</td>
</tr>
<tr>
<td>21-42</td>
<td>Severe stroke</td>
</tr>
</tbody>
</table>

LVO?
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>DESCRIPTION</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Level of consciousness (Alert, drowsy, etc.)</td>
<td>0 Alert 1 Not alert, arousable w/ min. stimulation 2 Not alert, requires repeated stimulation 3 Coma</td>
<td></td>
</tr>
<tr>
<td>1b. LOC Questions (Month, age)</td>
<td>0 Both questions correct 1 One answer correct 2 Neither question correct</td>
<td></td>
</tr>
<tr>
<td>1c. LOC Commands (Open, close eyes; make fist, let go)</td>
<td>0 Performs both tasks correctly 1 Performs one task correctly 2 Performs neither task correctly</td>
<td></td>
</tr>
<tr>
<td>2. Best Gaze (Eyes open - patient follows finger or face)</td>
<td>0 Normal 1 Partial gaze palsy 2 Forced deviation or total gaze paresis</td>
<td></td>
</tr>
<tr>
<td>3. Visual (Introduce visual stimulus to patient's visual field quadrants)</td>
<td>0 No visual loss 1 Partial hemianopia 2 Complete hemianopia 3 Bilateral hemianopia or blind</td>
<td></td>
</tr>
<tr>
<td>4. Facial palsy (Show teeth, raise eyebrows and squeeze eyes shut)</td>
<td>0 Normal, symmetrical movements 1 Minor paralysis 2 Partial paralysis 3 Complete paralysis</td>
<td></td>
</tr>
<tr>
<td>5a. Motor Arm left 5b. Motor Arm right (Elevate extremity to 90° and score drift/movement)</td>
<td>0 No drift (extends arm 10 sec. w/o drift) 1 Drift (before 10 sec) 2 Some effort against gravity (falls &lt; 10 sec.) 3 No effort against gravity 4 No movement U Unable to score due to: Amputation or other - explain</td>
<td>L R</td>
</tr>
<tr>
<td>6a. Motor Leg left 6b. Motor Leg right (Elevate extremity to 30° and score drift/movement)</td>
<td>0 No drift (extends arm 5 sec. w/o drift) 1 Drift (before 5 sec) 2 Some effort against gravity (falls &lt; 5 sec.) 3 No effort against gravity 4 No movement U Unable to score due to: Amputation or other - explain</td>
<td>L R</td>
</tr>
<tr>
<td>7. Limb Ataxia (Finger-nose, heel-shin)</td>
<td>0 Absent 1 Present in one limb 2 Present in two limbs U Unable to score due to: Amputation or other - explain</td>
<td></td>
</tr>
<tr>
<td>8. Sensory (Pin prick to face, arm trunk, and leg - compare side to side)</td>
<td>0 Normal 1 Mild to moderate sensory loss 2 Severe to total sensory loss</td>
<td></td>
</tr>
<tr>
<td>9. Best Language (Name items, describes a picture, reads sentence)</td>
<td>0 No aphasia 1 Mild to moderate aphasia 2 Severe aphasia 3 Mute</td>
<td></td>
</tr>
<tr>
<td>10. Dysarthria (Evaluate speech clarity by patient repeating listed words)</td>
<td>0 Normal articulation 1 Mild to moderate dysarthria 2 Near to unintelligible U Unable to score due to: Intubation or other - explain</td>
<td></td>
</tr>
<tr>
<td>11. Extinction and Inattention Use information from prior testing to identify neglect or double simultaneous stimuli testing</td>
<td>0 No neglect 1 Partial neglect 2 Complete neglect</td>
<td></td>
</tr>
<tr>
<td>Total NIHSS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pre-hospital recommendations...

- Insert IV
- Drive patient (FAST) to stroke center
- Complete assessment
- Complete paperwork
- Don’t CRASH
- 12-lead EKG
- Blood glucose
- VS
- Call Stroke Center to activate STROKE CODE

Is there time for EMS to complete a (moving) full NIHSS? Is this too complex an assessment for EMS?
Stroke Screen

vs

Stroke Severity Scale

CPSS

LAMS Scale

RACE Scale

MEND

CPSS +

NIHSS

FAST-G

FAST-ED

LAMS

VAN

UPSTATE
COMPREHENSIVE STROKE CENTER
Stroke Screens vs. Stroke Scales

Prehospital Stroke Screen:
• Pre-hospital screening tool
• Do we think that this is a stroke?
• Yes or no?

Prehospital Stroke Severity Scales:
• How severe is this patient?
• Is this an LVO?
• Where do we bring this patient?
Cincinnati Pre-Hospital Stroke Scale: do we think stroke?

- Assess for facial droop:
  - have the patient show teeth or smile
- Assess for arm drift:
  - have the patient close eyes and hold both arms straight for 10 seconds
- Assess for abnormal speech:
  - have the patient say, “you can’t teach an old dog new tricks”
(2-45) General: Stroke

EMT

- ABCs and vital signs
- Airway management and appropriate oxygen therapy
- Check blood glucose level, if equipped. If abnormal, refer to the “General: Hyperglycemia” or “General: Hypoglycemia” protocol, as indicated
- Perform a neurological exam, including Cincinnati Stroke Scale or other regionally approved stroke scale
- Determine the exact time the patient was last in his or her usual state of health and/or seen without symptoms by interviewing the patient, family, and bystanders
- If time from symptom onset to estimated arrival in the ED will be less than 5 hours, transport the patient to a NYS DOH Designated Stroke Center, or consult medical control to discuss an appropriate destination facility
- Notify the destination hospital ASAP
- Request ALS, if available, but do not delay transport to appropriate hospital

EMT STOP
Current EMS Protocols

(2-45) General: Stroke

**EMT**

- ABCs and vital signs
- Airway management and appropriate oxygen therapy
- Check blood glucose level if equipped. If abnormal, refer to the “General: Hyperglycemia”

**Perform a neurological exam, including Cincinnati Stroke Scale or other regionally approved stroke scale**

- Determine the exact time the patient was last in his or her usual state of health and/or seen without symptoms by interviewing the patient, family, and bystanders
- If time from symptom onset to estimated arrival in the ED will be less than 5 hours, transport the patient to a NYS DOH Designated Stroke Center, or consult medical control to discuss an appropriate destination facility
- Notify the destination hospital ASAP
- Request ALS, if available, but do not delay transport to appropriate hospital

\[ EMT \text{ STOP} \]
Notify the destination hospital ASAP
Imagine if we could incorporate alternate scales to help identify severity of stroke?
There’s an app for that.
Los Angeles Motor Scale (LAMS)

- Facial Droop (0-2)
- Arm strength (0-2)
- Grip strength (0-2)

*LAMS >4 carries and over seven-fold increase in risk for large vessel occlusion*
Rapid Arterial Occlusion Evaluation (RACE)

<table>
<thead>
<tr>
<th>Item</th>
<th>Instruction</th>
<th>RACE score</th>
<th>NIHSS score equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial palsy</td>
<td>Ask the patient to show teeth</td>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(symmetrical movement)</td>
<td>Mild</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(slightly asymmetrical)</td>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(completely asymmetrical)</td>
<td>Severe</td>
<td>3</td>
</tr>
<tr>
<td>Arm motor function</td>
<td>Extending the arm of the patient 90 degrees (if sitting) or 45 degrees (if supine)</td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>to mild (limb upheld more than 10 seconds)</td>
<td>Moderate</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(limb upheld less than 10 seconds)</td>
<td>Severe</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(patient do not rise the arm against gravity)</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Leg motor function</td>
<td>Extending the leg of the patient 30 degrees (if supine)</td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>to mild (limb upheld more than 5 seconds)</td>
<td>Moderate</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(limb upheld less than 5 seconds)</td>
<td>Severe</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(patient do not rise the leg against gravity)</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Head and gaze deviation</td>
<td>Observe eyes and cephalic deviation to one side</td>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(eye movements to both sides were possible and no cephalic deviation was observed)</td>
<td>1-2</td>
<td></td>
</tr>
<tr>
<td>Aphasia (if right hemiparesis)</td>
<td>Ask the patient two verbal orders - “close your eyes” - “make a fist”</td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(performs both tasks correctly)</td>
<td>Moderate</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(performs one task correctly)</td>
<td>Severe</td>
<td>2</td>
</tr>
<tr>
<td>Agnosia (if left hemiparesis)</td>
<td>Asking: - “Who is this arm” while showing him/her the paretic arm (anosognosia)</td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>“Can you move well this arm?” (anosognosia)</td>
<td>Moderate</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(anosognosia)</td>
<td>Severe</td>
<td>2</td>
</tr>
</tbody>
</table>

**Score ≥ 5 could indicate LVO**

- Facial Palsy
- Arm/Leg motor function
- Head and gaze deviation
- Agnosia/neglect
- Aphasia/language
Cincinnati Prehospital Stroke Severity Scale (CPSSS)

- Ranges from 0-4 points
- Composed and scored by individual NIHSS items
  - 2 points for presence of conjugate gaze (NIHSS≥1)
  - 1 point for presence of arm weakness (NIHSS≥2)
  - 1 point for presence abnormal level of consciousness commands and questions (NIHSS level of consciousness≥1 each)
VAN Scale

- **Vision** - field double vision, blind spot
- **Aphasia** - Expressive or receptive aphasia (language)
- **Neglect** - Ignoring one side of the body, decreased sensation to one side

+ Sudden weakness on one side = VAN Positive = likely LVO
Field Assessment Stroke Triage For Emergency Destination

FAST-ED

- Facial Droop
- Arm weakness
- Speech Changes
- Eye Deviation
- Denial/neglect

**FAST-ED ≥ 4 can indicate LVO (NIHSS > 6)**
Miami Emergency Neurological Deficit Exam (MEND)

There’s an app for that too...

- 12 tests/assessment points
- Assesses Cranial Nerves and vision
- Assesses coordination/balance
- Anterior and posterior circulation
- “MEND Positive/Negative”
S^3 Scale...

Syracuse Stroke Severity Scale

1. Is it cloudy today?
2. Did it snow yesterday?
3. Are you going out to eat?

(This is a joke)
Do any of these scales sound reasonable and why?...think of what occurs during a LVO
A current comparison of many


“No scale predicted LVO with both high sensitivity and high specificity. Systems that use LVO prediction instruments for triage will miss some patients with LVO and milder stroke. More prospective studies are needed to assess the accuracy of LVO prediction instruments in the prehospital setting in all patients with suspected stroke, including patients with hemorrhagic stroke and stroke mimics”. (Smith, et al. 2018)

**NIHSS, CPSSS, LAMS, RACE, 2-item Stroke Scale...NO FAST-ED**
Figure 2. Proportion of patients with large vessel occlusion strokes according to the Field Assessment Stroke Triage for Emergency Destination (FAST-ED) scale. Hosmer and Lemeshow test: 0.62. (Lima, 2016)
FAST-ED (and we’re already basically using it) (Lima, 2016)
Six of One, Half a Dozen of the Other: Single-Center Retrospective Comparison of Prehospital Large Vessel Occlusion Tools (2018)

<table>
<thead>
<tr>
<th></th>
<th>PASS</th>
<th>VAN</th>
<th>RACE</th>
<th>CPSSS</th>
<th>FAST-ED</th>
<th>NIHSS&gt;=6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>85.17%</td>
<td>88.97%</td>
<td>72.41%</td>
<td>78.28%</td>
<td>81.38%</td>
<td>94.14%</td>
</tr>
<tr>
<td>Specificity</td>
<td>81.70%</td>
<td>74.08%</td>
<td>89.60%</td>
<td>86.09%</td>
<td>86.82%</td>
<td>71.16%</td>
</tr>
<tr>
<td>PPV</td>
<td>66.40%</td>
<td>59.31%</td>
<td>74.73%</td>
<td>70.50%</td>
<td>72.39%</td>
<td>58.09%</td>
</tr>
<tr>
<td>NPV</td>
<td>92.85%</td>
<td>94.05%</td>
<td>88.44%</td>
<td>90.32%</td>
<td>91.65%</td>
<td>96.62%</td>
</tr>
</tbody>
</table>

In this analysis, it is evident that there are distinct trade-offs, with no tool being superior when it comes to having both optimal sensitivity and specificity. Although the NIHSS is the most sensitive tool, use of this scale is not practical in the prehospital setting. Therefore, we support the use of simple tools such as PASS and VAN given the relative ease with which these tools can be learned and applied by EMS. (Ermak, 2018)
Large vessel occlusion scales increase delivery to endovascular centers without excessive harm from misclassifications (2017)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Typical</th>
<th></th>
<th>Atypical</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVO (95% CI)</td>
<td>Non-LVO (95% CI)</td>
<td>LVO (95% CI)</td>
<td>Non-LVO (95% CI)</td>
<td></td>
</tr>
<tr>
<td>RACE ≥5</td>
<td>0.96 (0.91–1.0)</td>
<td>0.97 (0.95–0.99)</td>
<td>0.16 (0.02–0.30)</td>
<td>0.30 (0.17–0.43)</td>
<td></td>
</tr>
<tr>
<td>LAMS ≥4</td>
<td>0.94 (0.87–1.0)</td>
<td>0.95 (0.93–0.97)</td>
<td>0.19 (0.05–0.34)</td>
<td>0.08 (0.0–0.16)</td>
<td></td>
</tr>
<tr>
<td>FAST-ED ≥4</td>
<td>0.98 (0.94–1.0)</td>
<td>0.97 (0.96–0.99)</td>
<td>0.23 (0.07–0.38)</td>
<td>0.04 (0.0–0.10)</td>
<td></td>
</tr>
<tr>
<td>PASS ≥2</td>
<td>0.96 (0.91–1.0)</td>
<td>0.92 (0.90–0.95)</td>
<td>0.29 (0.12–0.46)</td>
<td>0.06 (0.0–0.13)</td>
<td></td>
</tr>
<tr>
<td>CPSSS ≥2</td>
<td>0.88 (0.79–0.97)</td>
<td>0.94 (0.92–0.96)</td>
<td>0.03 (0–0.10)</td>
<td>0.10 (0.01–0.19)</td>
<td></td>
</tr>
</tbody>
</table>

CI indicates confidence interval; CPSSS, Cincinnati Prehospital Stroke Severity Scale; CT, computed tomography; FAST-ED, Field Assessment Stroke Triage for Emergency Destination; LAMS, Los Angeles Motor Scale; LVO, large vessel occlusion; PASS, Prehospital Acute Stroke Severity scale; and RACE, Rapid Arterial Occlusion Evaluation.

Atypical presentations accounted for the bulk of scale misclassifications, but the majority of these misclassifications were not detrimental, and use of LVO scales would significantly increase timely delivery to endovascular centers... (Zhao, 2017)
What are we looking at as a region?

RSTAC:
• Membership from both Central and Northern New York
• EMS Sub-committee
• Endorsing the use of FAST-ED in our region

Next steps:
1. Receive initial approval from CNY REMAC
2. Pitch to the RSTAC Group for review
3. Develop educational roll-out plan
Scenario 2

- Patient wakes up at 0800 after going to bed normal at 1100
- Wife notes right facial droop, right-sided flaccid, trouble speaking, and what she calls “staring to the left”
- Patient lives just outside of Watertown, NY

- Samaritan Medical Center can treat stroke
- Is the patient in the tPA window?
- The patient is 1h20 mins form Syracuse
- **FAST-ED Scale?**
  - Facial droop - 1
  - No arm strength - 2
  - Mild to moderate speech changes -1
  - Forced Eye deviation – 2
  - Score = 6 ( Likely LVO)
- Ground EMS notifies LifeNet for emergent transport to CSC
What steps have we done to help?
The Mobile Stroke Treatment Unit... the Holy Grail?
Mobile Stroke Treatment Unit

Cost:
• $600,000 - $1,000,000 each
• Annual operating cost (to run 12 hours each day) $950,000 - $1,200,000

Availability:
• Last year there were 20+ MSU circulating around the US
Mobile Stroke Treatment Unit

But is it effective?

- Management of tissue plasminogen activator eligible acute ischemic stroke patients by a mobile stroke unit could potentially result in less disability and healthcare utilization, and be cost effective.

Table 1. Time metrics for an on-board (OB) vs. telemedicine (TM) vascular neurologist on the MSU

<table>
<thead>
<tr>
<th>Physician</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Median</th>
<th>25th Percentile</th>
<th>75th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MSU Arrival to tPA Decision (minutes)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB</td>
<td>163</td>
<td>18.9</td>
<td>7.7</td>
<td>18.0</td>
<td>14.0</td>
<td>23.0</td>
</tr>
<tr>
<td>TM</td>
<td>39</td>
<td>21.2</td>
<td>7.6</td>
<td>21.0</td>
<td>16.0</td>
<td>26.0</td>
</tr>
<tr>
<td><strong>MSU Arrival to tPA Bolus (minutes)</strong></td>
<td></td>
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<tr>
<td>OB</td>
<td>110</td>
<td>24.1</td>
<td>6.3</td>
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<tr>
<td>TM</td>
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<td>6.4</td>
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Bowry, 2018)
Contact Information

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Upstate Stroke Center
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