Mobile Stroke Units
and why they are the best thing since sliced CT

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Ebinger et al JAMA 311:2014. 31% of patients treated with tPA within 60 minutes of onset c/w 4.9% with standard management

Discharge Home
Treatment 0-40 min vs Treatment 60-270 min
0.013

Standard 12 foot ambulance
Portable CT scanner
Point-of-care laboratory Tele-radiology & neurology
TM VN, RN, CT tech, Medic
Steps in Establishing the MSU

March 2013 - Feb 2014

- Full time Medical Director and Project Manager take ownership
- Funding
- Purchase and buildout
- Collaborative agreements with stakeholders (UT, MHH, other CSCs, EMS)
- Policies, procedures and accountability system for accreditation
- State and City inspection and licensing
- Radiation safety inspection and certification
- Insurance on vehicle and personnel
- Staffing
- Supplies and equipment
- Secure location, power, office
- EMS education
- EMS communication pathway
- HIPPA compliant grid for CT transmission
- Study protocol developed, DRRs and NSF - Grant funding sought
- IRB approval

Steps in Establishing the MSU

Full time Medical Director and Project Manager to take ownership

“Life is a major project of utmost importance. But if you no budget, no guidelines, no support staff, and it’s due in 10 minutes... At last, here’s your chance to really impress everyone.”

Steps in Establishing the MSU

Funding

From March 2013 - May 2014
- Successfully raised $1.8 million from community businesses and leaders
Steps in Establishing the MSU
Purchase and Buildout

• Support from Local EMS
• University of Texas Medical School
• All Comprehensive Stroke Centers (MHH, Hou Meth, BSGCH, WH)
• Houston Mobile Stroke Unit Consortium
• Third Party Evaluation

Steps in Establishing the MSU
Collaborative agreements with stakeholders

“For Strokes, Closest Hospital Might Not Be Best”
By Robert Davis
8/12/2008
1. Symptom onset within 6 hours AND
2. Time to arrival at CSC is less than 30 minutes AND
3. Patient has one of the following:
   a. Not alert – requires persistent, strong or painful stimulation to make movements or talk
   b. No or very minimal movement of one arm or hand
   c. Intubated

EMS transport criteria should be severity as well as time based

LAMS
- Face weak
  - Absent 0
  - Present 1
- Arm weak
  - Absent 0
  - Drift 1
  - Falls rapidly 2
- Grip strength
  - Normal 0
  - Weak 1
  - No grip 2

1 or 2 points goes to the highest center within 15 minutes
4 - 5 points, or any patient who is drowsy or has impaired consciousness, goes to a CSC (these are bigger strokes that would benefit from higher level of care).
- > 80% likely these are large artery strokes
- May benefit from IAT
- Qualify for research trials,
- Need hemicraniectomy

Grotta JC, Stroke 2013
Steps in Establishing the MSU

Develop Accountability System

- Write and implement physician standing orders/protocols
- Adult ALS protocols (SZ, MI, airway)
- Develop guidelines for staff expectations including QA, QI for all equipment, maintenance & certifications.

Steps in Establishing the MSU

Supplies and Equipment

- Stocked for Adult Advanced Life Support unit
  - Oxygen
  - Cardiac Monitor
  - IV pumps
  - Suction
  - Medications (ALS, tPA, Nicardipine...)
  - Point of Care Lab Equipment
  - Telemedicine Hardware
  - Daily Quality Assurance checks for scanner and vehicle

Steps in Establishing the MSU

Licensing and Inspections

- Ambulance Provider License
- Ambulance Driving Permit
- Radiation Safety Protocols, Application & Certification
- Radiation Safety Inspection
Steps in Establishing the MSU

**Insurance**
- **Vehicle** – Full commercial emergency vehicle coverage
- **Equipment & Scanner** – Increase property insurance coverage within the vehicle
- **Staff** – UT job description includes MSU field work
- **Malpractice** – Confirmation that all physicians malpractice covers their practice on the MSU

**Steps in Establishing the MSU**

**Base Station**
- Dispatch Office
- Parking
- Power

**Steps in Establishing the MSU**

**Communication and Technology Systems**
- Dispatch Pathway Development with 3 different cities
- Houston Fire Dept. Radios and Pagers
- Dispatch numbers and phones
- Mobile Data Terminal – to track locations and times
- HIPPA compliant DICOM Sharing grid for sharing CT images
Steps in Establishing the MSU

**MSU Training**

- ACLS training of MSU staff
- Stroke Teams at 3 CSC Facilities (ER, Research, Stroke Coordinators)
- 2200/4000 Houston Fire (FR, Paramedics, Dispatch and Call Receivers)
- All incoming Houston Fire Cadets
- West University Dispatch and Fire/EMS
- Bellaire Dispatch and Fire/EMS
- Southeast Texas Advisory Council (SETRAC)

**Who is inside?**

- Licensed Vascular Neurologist with an ACLS Certification
- Critical Care/ER trained Registered Nurse with ACLS certification
- Licensed Paramedic with ACLS certification
- Licensed CT radiology technician with BLS certification
- Telemedicine Doc!

**AIMS**

1. Determine the logistics and clinical outcomes of MSU vs SM in the U.S.—speed, II, first hour.
2. Can MD be replaced by Telemedicine?
3. What is the Cost-Effectiveness?
How Reliable is TM in a Mobile Stroke Unit?

Telemedicine Reliability?: Wu et al—PURSUIT study, Stroke 45:2014

Table 1: Data Analysis

<table>
<thead>
<tr>
<th></th>
<th>Live Assessments</th>
<th>Recorded Assessments</th>
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</thead>
<tbody>
<tr>
<td><strong>RELIABILITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intra-class correlation (95% CI) for NIHSS</td>
<td>0.997 (0.992 - 0.999)</td>
<td>0.993 (0.975 - 0.999)</td>
</tr>
<tr>
<td><strong>VALIDITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matched Scripted NIHSS</td>
<td>± 2 points</td>
<td>88%</td>
</tr>
<tr>
<td>Clinical Data points Obtained (12 items)</td>
<td>96%</td>
<td>96%</td>
</tr>
</tbody>
</table>

Cost of CT Scanner $375,000
Ambulance Retrofit $60,000
TM equipment $30,000
Cost of added paramedic and TM coverage X 5 yrs $1,000,000
Total fixed and continuing costs for 1 MSU X 5 yrs $1,465,000

Less than the cost to sustain an endovascular program!

Lifetime cost per stroke: $200,000

Therefore, cost neutral if: 1 MSU results in 7 more patients completely recovering over 5 yrs
About 2-4 runs/day
1 rt-PA treatment per 5 calls

rt-PA Exclusions:
• Time (too long or uncertain),
• Too mild
• Too sick
• Mimics
  • Hypoglycemia
  • Seizure
  • Migraine
  • Psychiatric

BEST-MSU enrollments - First Three Years
• 262 Treated with rt-PA (2.4/wk, 87/6 months a year)
• 93 More Transported
  • ICH (treated w/reversal or antihypertensives)
  • Sz (loaded with Keppra)
  • Too mild
  • Uncertain onset time
  • Other (tumor, cerv. spond.)
• Avg. on-scene time – 21 min
• Symptom onset to t-PA treatment
  • 40% 0-60 min  (vs 0% control)
  • 39% 61-80 min  (vs 20% control)
  • 21% 81-270 min  (vs 80% control)
Take Home Points

• Pre-hospital triage and treatment will be the next quantum leap forward in speeding treatment and improving outcomes

• Before this strategy is widely implemented in the U.S., we need more data on feasibility, outcomes and costs

• These are the Aims of the BEST-MSU study