


## Mobile Stroke Units

*and why they are the best thing since sliced CT*

David Persse, MD FACEP FAEMS  
 Medical Director, EMS  
 Public Health Authority  
 City of Houston  
 Professor of Medicine, Emergency Medicine and Surgery  
 Baylor College of Medicine



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Walter et al. Lancet Neurol, 2012. Randomized Trial of Prehospital vs ED Lytics

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 0-60 min vs Treatment 60-270 min | OR 1.9




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## Houston Mobile Stroke Unit




- ✓ Standard 12 foot ambulance
- ✓ Portable CT scanner
- ✓ Point-of-care laboratory Tele-radiology & neurology
- ✓ TM VN, RN, CT tech, Medic




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### 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, Guidelines and Procedures; System for accountability
- 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; CRFs and MOP. Grant funding sought
- IRB approval

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### Steps in Establishing the MSU

*Full time Medical Director and Project Manager to take ownership*



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### Steps in Establishing the MSU

*Funding*

**From March 2013– May 2014**

-Successfully raised \$1.8 million from community businesses and leaders

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### Steps in Establishing the MSU

#### Purchase and Buildout



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### Steps in Establishing the MSU

#### Collaborative agreements with stakeholders



- Support from Local EMS
- University of Texas Medical School
- All Comprehensive Stroke Centers (MHH, Houston Meth, BSLCHI, HH)
- Houston Mobile Stroke Unit Consortium
- Third Party Evaluation



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### "For Strokes, Closest Hospital Might Not Be Best"

By Robert Davis  
8/12/2008



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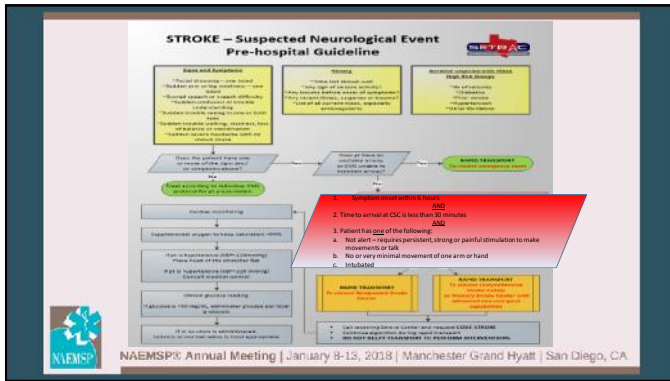
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**EMS transport criteria should be severity as well as time based** Grotta JC, Stroke 2013

**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

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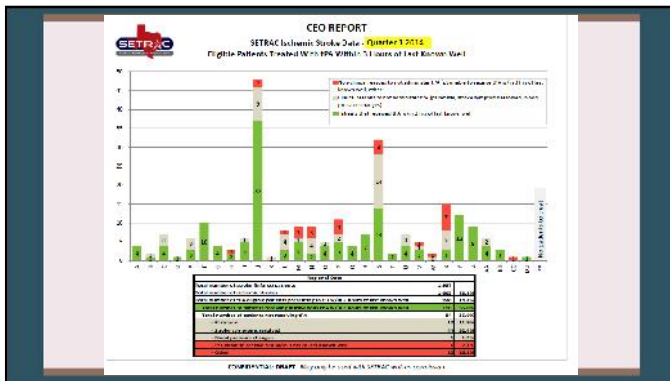
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### Steps in Establishing the MSU

#### 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.



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### 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

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### Steps in Establishing the MSU

#### Licensing and Inspections



- Ambulance Provider License



- Ambulance Provider License  
- Ambulance Driving Permit



- Radiation Safety Protocols, Application & Certification  
- Radiation Safety Inspection



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### 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



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### Steps in Establishing the MSU *Base Station*

- ✓ Dispatch Office
- ✓ Parking
- ✓ Power



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### 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 location and times
- ✓ HIPPA compliant DICOM Sharing grid for sharing CT images



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### 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)



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### Steps in Establishing the MSU

#### Staffing

##### 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!




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### BEST-MSU Study

Benefits of Stroke Treatment Delivered Using a Mobile Stroke Unit Compared to Standard Management by Emergency Medical Services

#### AIMS

1. Determine the logistics and clinical outcomes of MSU vs SM in the U.S.—speed, #, first hour.
2. Can MD be replaced by Telemedicine?
3. What is the Cost-Effectiveness?



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

A. Remote vascular neurologist performing stroke evaluation. B. RT-kiosk mounted on stretcher in ambulance. C. Remote assessment in ambulance with EMS assistance.

	Live Assessments (n = 34)	Recorded Assessments (n = 33)
<b>RELIABILITY</b>		
Intra-class correlation (95% CI) for NIHSS	0.997 (0.992-0.999)	0.993 (0.975-0.999)
<b>VALIDITY</b>		
Matched Scripted NIHSS $\geq 2$ points	88%	70%
Clinical Data points Obtained (12 Items)	96%	96%

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### Cost Projection

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!

vs

Lifetime cost per stroke: \$ 200,000

Therefore, cost neutral if:

**1 MSU results in 7 more patients completely recovering over 5 yrs**

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**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

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**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)



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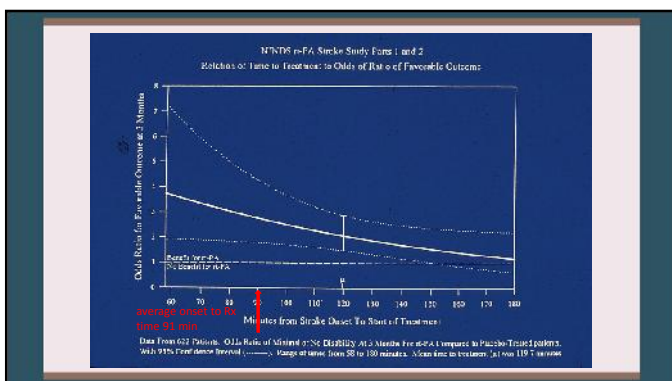
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**Take Home Points**

- 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

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