Emergency department management of acute stroke: Saving minutes – what is expected

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Initial Evaluation: EMS

- ABCs
- Stroke screen
  - Preferentially bring to a certified stroke center

- **OBTAIN CELL PHONE NUMBERS FOR FAMILY**
  - ED care providers will need to talk to them!
  - Make sure they stay by the phone and are available!

- **ADVANCE NOTIFICATION TO ED**
  - Allows us to activate stroke team
  - Allows us to prepare for arrival

Boston EMS

Mobile Stroke Units: Lessons for the ED

Mobile Stroke Units can do:

- CT scan
- Thrombolytics
- Triage to endovascular center

https://www.youtube.com/watch?v=3ZW5AWeinEM

B-PROUD study

- Mobile Stroke Unit in Berlin
  - During available hours (7a-11p), all stroke calls led to dispatch of both regular ambulance and MSU.
  - MSU was only available about half the time (logistics)
  - When MSU not available: Control group
- Prospective enrollment and followup:
  - Patients calling EMS within 4 hours of onset who were eligible for tPA or EVT:
    - 749 in MSU group, 794 in control group

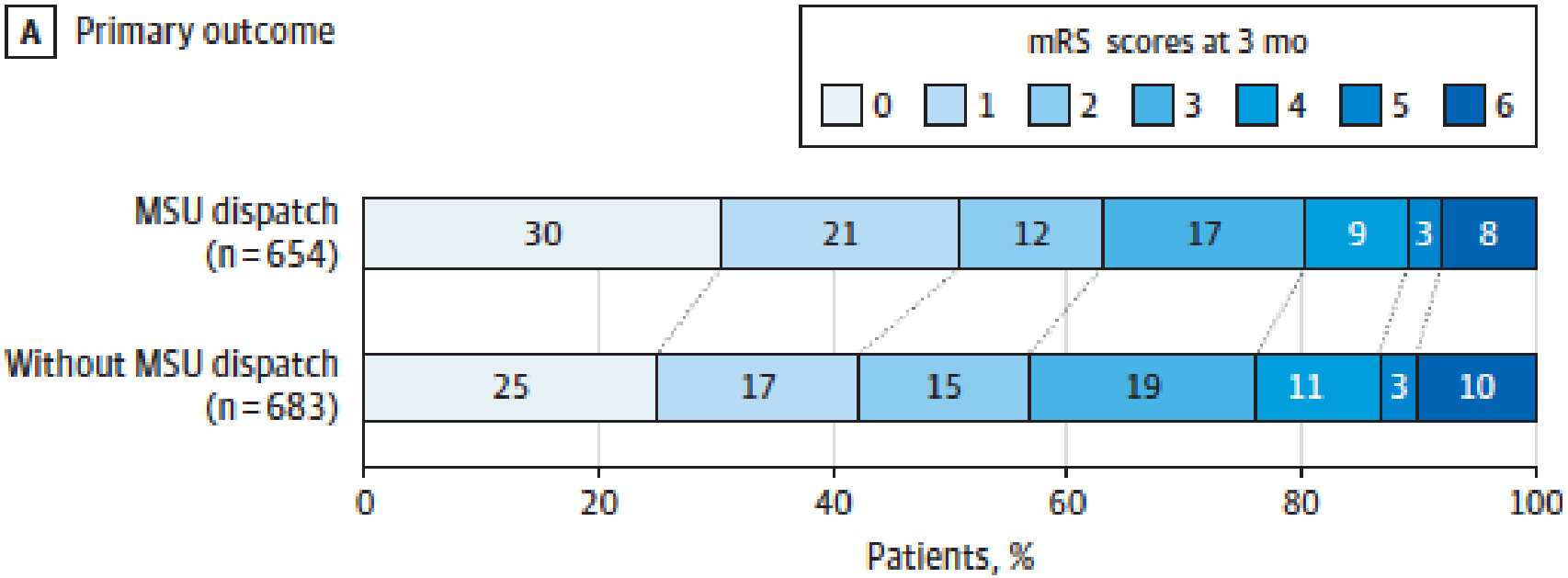
Ebinger M et al, JAMA 2021

Mobile Stroke Units (MSU): Faster

- In the MSU group:
  - More received tPA within 60 minutes of onset
    - 13% vs 4%, aOR 2.96 (1.93-4.53)
    - Note – of those in the control group, DTN time was median 30 minutes. The stroke centers were FAST.

Better outcomes with MSU

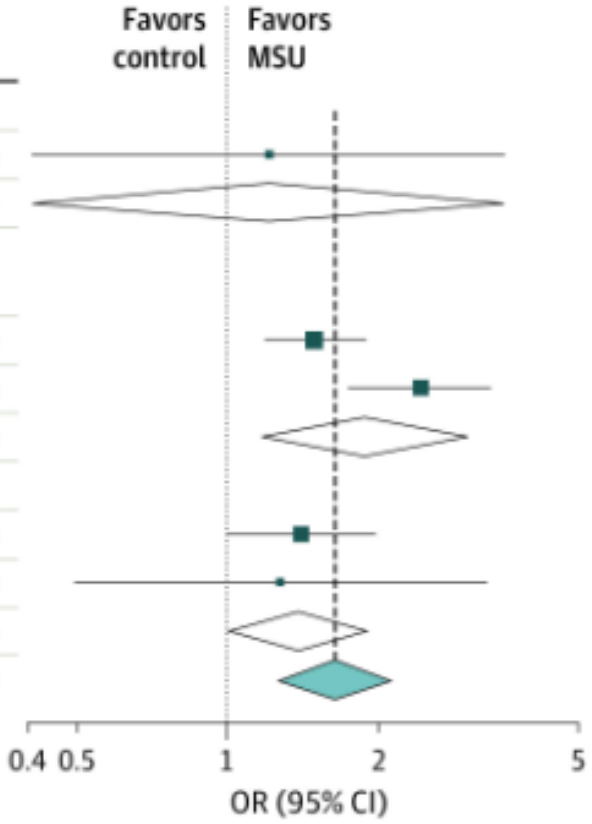
- MSU increased odds of good neurologic outcome (aOR 0.7, 0.6-0.9, p<0.001)
- Lesson: Time is our enemy, even in centers with DTN times of 30 minutes



Meta-analysis of mobile stroke units

Earlier treatment links to better outcomes

Source	No./total No. (%) MSU use	Control	OR (95% CI)
nal file that holds a picture, illustration, ame is jamaneurol-e215321-g001.jpg			
	15/32 (46.9)	17/39 (43.6)	1.21 (0.41-3.58)
			1.21 (0.41-3.58)
Large nonrandomized clinical trials with blinded outcome assessment			
Ebinger et al,[20] 2021[a]	333/654 (50.9)	289/683 (42.3)	1.49 (1.19-1.89)
Grotta et al,[21] 2021	329/598 (55.0)	185/417 (44.4)	2.43 (1.75-3.36)
Subtotal I^2 = 82.5%; P = .02			1.88 (1.17-3.02)
Other observational studies			
Kunz et al,[37] 2016	161/305 (52.8)	166/353 (47.0)	1.40 (1.00-1.97)
Larsen et al,[16] 2021[a]	39/65 (60.0)	52/80 (65.0)	1.28 (0.50-3.29)
Subtotal I^2 = 0%; P = .86			1.39 (1.01-1.91)
Overall I^2 = 47.6%; P = .11			1.64 (1.27-2.13)



Turc G et al, JAMA Neurol 2022

Initial Evaluation: ED

- Send Code Stroke page pre-arrival
- Labs:
  - Fingerstick glucose, CBC, Chem7, coagulation studies, Tn
- Vitals: O_2 saturation
  - Avoid oxygen unless hypoxic

*AHA guidelines: "Only the assessment of blood glucose must precede the initiation of IV alteplase in all patients".

Initial Evaluation

- In parallel:
- History
  - Determine both time of onset AND LSW (relevant for wake up stroke!)
  - May need to reach family via cell phone
- Physical exam
  - ABCs
  - Focused Neurologic exam
    - Obtain NIHSS in parallel with moving to CT, or after CT

Time goals from the AHA:

- Target: Stroke Honor Roll
  - DTN <60 minutes for at least 75% of patients
- Target: Stroke Honor Roll Elite
  - DTN<60 minutes for at least 85% of patients
- Target: Stroke Honor Roll Elite Plus
  - DTN <45 minutes for at least 75% of patients
  - DTN <30 minutes for at least 50% of patients

How long does everything take?

- One group in Canada had an observer for every stroke
- IQR – 25% to 75%

Sub-tasks	Median time (IQR)
1. Arrival to imaging (prior to imaging)	
1.1. Time to triage and registration	3 (2–7) $n = 159$
1.2. Covid-19 sample collection time	1 (0–1) $n = 84$
1.3. Laboratory sample collection time	3 (2.75–5) $n = 102$
1.4. Time to move to ED bed (for walk-ins and patients requiring stabilization)	1 (1–1.5) $n = 9$
1.5. Time for stabilization	33 (3–45) $n = 3$
1.6. Time to share patient's medical history	2 (1–2) $n = 115$
1.7. Time for neurological evaluation	3 (2–5) $n = 156$
1.8. Time to transport to radiology department from ED	2 (2–2) $n = 168$
2. Imaging acquisition	
2.1. Time to prepare patient for imaging	4 (4–5) $n = 179$
2.2. Time to CT imaging	6 (5–7) $n = 182$
2.3. Time to move patient from CT table to stretcher/ED bed	2 (2–3) $n = 173$

Koca G et al, Front Neurol 2023

How long does everything take?

- Each step costs minutes
- Everything takes longer than you think

3. Treatment decision	Minutes (IQR)
3.1. Treatment decision time	7 (4–11.25) $n = 54$
3.2. Time to revaluation	3 (2.5–8) $n = 9$
3.3. Time to consent conversation	2 (2–3) $n = 24$
3.4. Time for additional steps in treatment decision-making	12.5 (2.8–93.3) $n = 6$
4. Preparations for thrombolysis	
4.1. Time to return ED and to move patient to ED bed	3 (3–4) $n = 25$
4.2. Time for ED room arrangement	4 (1–6.5) $n = 9$
4.3. Time to prepare patient and to mix thrombolysis	7 (3–12) $n = 37$
5. Preparations for EVT	
5.1. Time to prepare angiosuite	34 (26–47.5) $n = 25$
5.2. Time to transport patient to interventional radiology department	2 (1–3) $n = 23$
5.3. Anesthesia assessment time	2 (1–4) $n = 15$
5.4. Patient preparation time	12 (9.5–21.5) $n = 25$

Koca G et al, Front Neurol 2023

How to minimize time to CT

- Direct from ambulance to CT scanner
  - History/physical in triage, or in CT
  - Where to place IV, draw labs?
- Improving door-CT time is good, but only if it improves door-treatment time.
- If you can assess and treat in CT, that can save time.

Minimize time to IV thrombolytics

- Prepare thrombolytic prior to CT
  - Traditionally it can be returned if not used
- Treat based on noncontrast CT
  - Can the radiologist meet the team in CT?
  - Initiate thrombolytics in those eligible
  - Then perform CTA/CTP while infusing
- Do you need advanced imaging for thrombolytic decision?
  - While in process, work in parallel to contact family, draw up meds, etc.

Minimize time to EVT

- Early notification of endovascular teams
- Minimize time to EVT suite
  - Direct from CT -> EVT?
- Transfer patients from outside hospitals
  - If vascular imaging available from OSH, then Direct from ambulance to EVT suite?
  - Otherwise, pit stop in the ED for imaging?
  - Direct from ambulance to imaging to EVT?

Strategies people have used

- 21 EDs in Utah- a range of interventions:
  - Non-ambulance arrivals- walk straight from triage to CT
  - Ambulance arrivals- direct to CT
  - CT tech can perform CT without order
  - RN can call code stroke

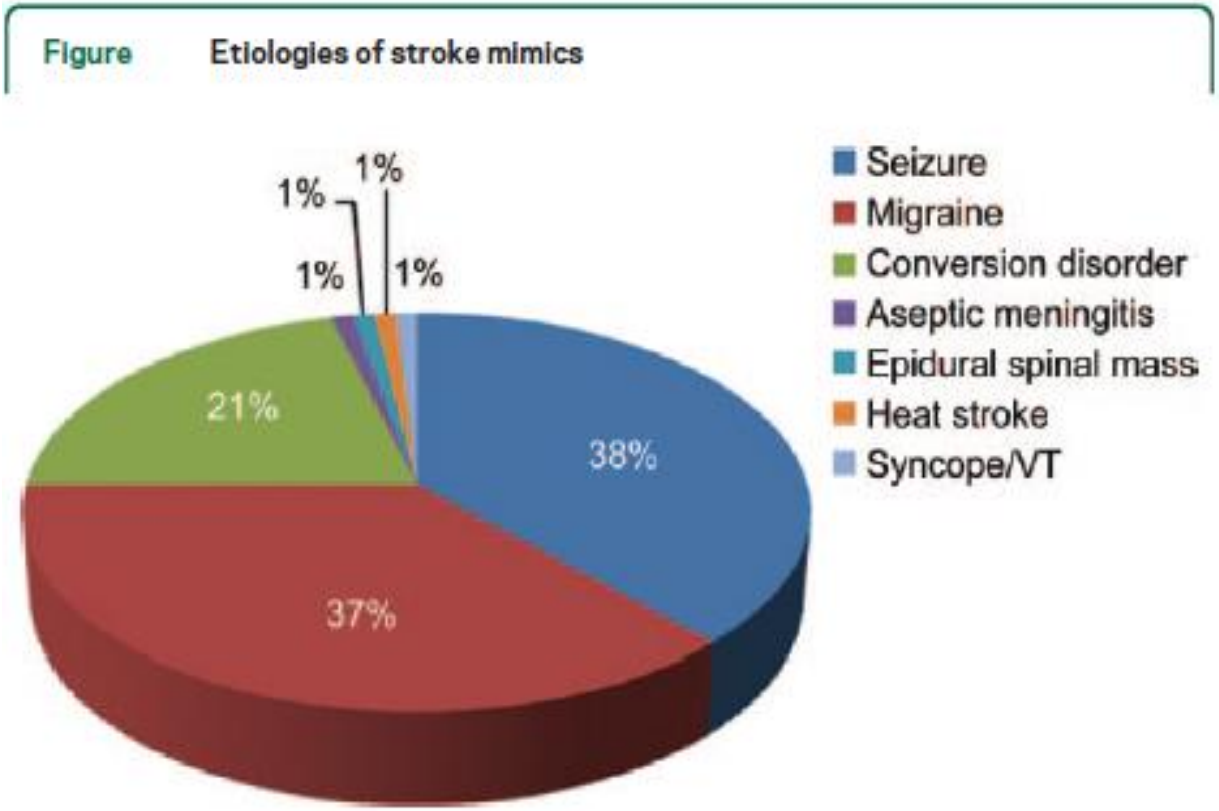
McKee K et al, Circ Cardiovasc Qual Outcomes 2024

Evaluate for Stroke Mimics?

Psychogenic	**Lack of objective cranial nerve findings, neurological findings in a nonvascular distribution, inconsistent examination**
Seizures	**History of seizures, witnessed seizure activity, postictal period**
Hypoglycemia	**History of diabetes, low serum glucose, decreased level of consciousness**
Migraine with aura (complicated migraine)	**History of similar events, preceding aura, headache**
Hypertensive encephalopathy	**Headache, delirium, significant hypertension, cortical blindness, cerebral edema, seizure**
Wernicke's encephalopathy	**History of alcohol abuse, ataxia, ophthalmoplegia, confusion**
CNS abscess	**History of drug abuse, endocarditis, medical device implant with fever**
CNS tumor	**Gradual progression of symptoms, other primary malignancy, seizure at onset**
Drug toxicity	**Lithium, phenytoin, carbamazepine**

Etiology of stroke mimics

- One review of 100 patients who received tPA and had negative MRI:



Chernyshev et al. Neurology 2010 74(17):1340-5.

Logistics:

- High acuity, very crowded environment.
- No beds are immediately available in the ED.
- No nurses immediately available.
- When a new patient arrives, a bed must be cleared (AND CLEANED)
- Our slowest door-needle times for stroke are often when the ED is busiest.
- Patients are unstable or become unstable (they fail the ABCs).

Team approach

- Clarify roles in advance. For example:
  - ED team: Quick exam, ABCs, move to CT
    - Or, meet the patient in triage and go straight to CT?
    - ABC, IV access in CT?
    - Need for BP control? Intubation?
    - Reach family, obtain contact info?
  - Neuro team
    - Rapid neuro exam
    - Communicate with family
    - Rapid imaging review
  - Radiology team
    - Meet team in CT? Or in the ED?

Where to target QA efforts

- Systematic review of quality projects
- Highest yield things to target:
  - **-Triage and stroke team activation**
  - **CT workflow**

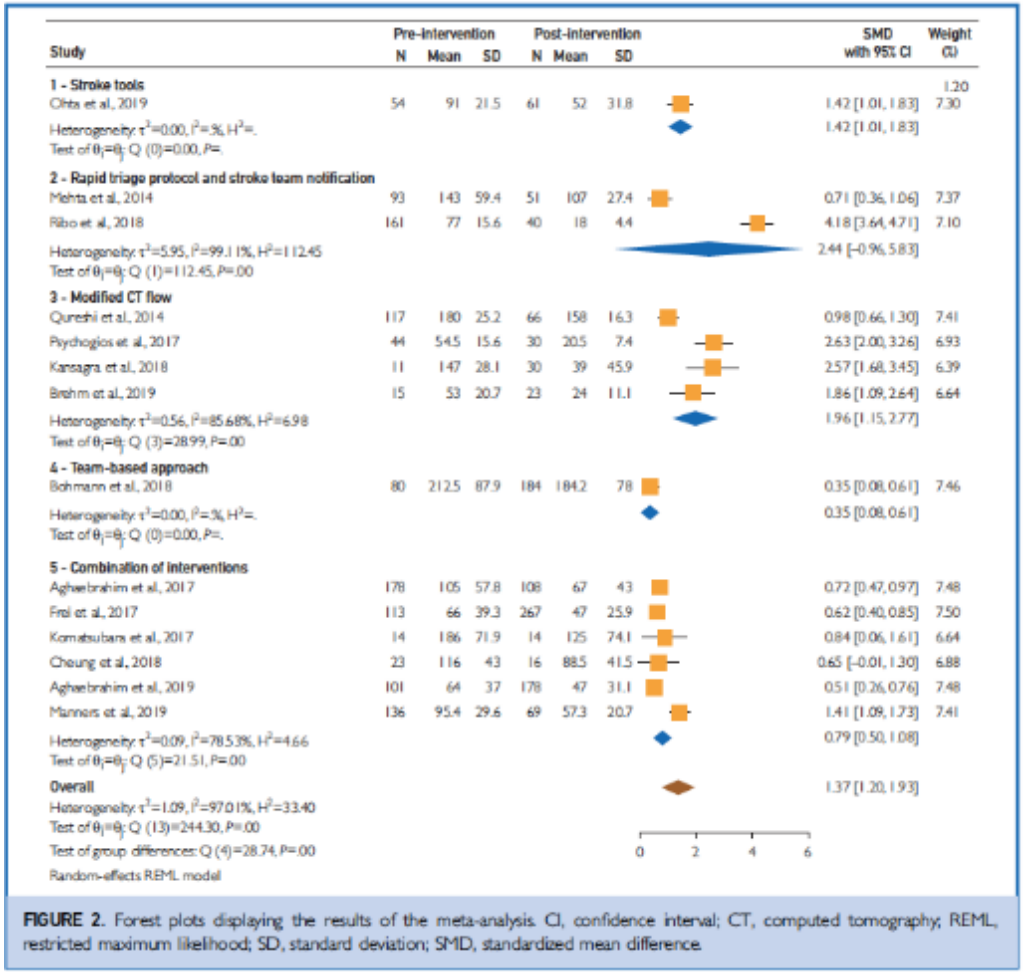


FIGURE 2. Forest plots displaying the results of the meta-analysis. CI, confidence interval; CT, computed tomography; REML, restricted maximum likelihood; SD, standard deviation; SMD, standardized mean difference.

Rangel I, et al, Mayo Clin Proc 2022

Team training

- One simulation training program in the Czech Republic trained stroke teams in 9/45 stroke centers.
- DTN time shorter in the trained centers (p=0.01)
- Conclusion: Consider simulation training for stroke teams.

Svobodova V et al, BMJ Open Qual 2023

Conclusions

- How to reduce time to treatment?
  - Pre-notification when possible
  - Direct to CT when possible
  - Minimize avoidable steps when possible
  - Team approach and team training