FAST ED: A Novel EMS Screening Approach for Stroke Triage

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MARCUS STROKE & NEUROSCIENCE CENTER
Grady
Disclosures and Acknowledgments

- All the FAST-ED system development was done gratis.
- The algorithm development was led by a group of academic stroke neurologists with the input of multiple other stroke experts and EMS personnel.
- The application development included the pro-bono collaboration of two medical software companies:
  - Allm group, Tokyo, Japan (App final programming and maintenance)
  - Medicinia, Sao Paulo, Brazil (initial prototyping for proof of concept).
- An agreement was made with all parts involved to provide the App to EMS and other users free of charge (Freeware).
- The presenter has no financial conflict of interest related to this work.
Outcomes After Reperfusion:

Outcomes = \frac{\text{Collaterals}}{\text{Time}}

\uparrow \text{Time to Reperfusion} = \downarrow \text{Good Clinical Outcome}

4\% \text{ of pts} \uparrow \text{disability for every 15-min delay after ED arrival}

Saver J et al. JAMA. 2016;316(12):1279-1288

\uparrow \text{Time to Treatment} = \uparrow \text{Basal Ganglia ICH}

11\% \text{ RR} \uparrow \text{for every 10-min delay}

Raychev R et al. ISC 2012

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Shortening Ictus to Reperfusion Times:

- **Ictus**
  - Stroke Sx Recognition 911 Call
- **Triage/Transport**
  - PSC
  - CSC
- **ED Door**
- **CT/MRI**
  - ? IV tPA
- **Puncture**
  - mTICI 2b-3

**Primary Prevention**
**Public Education**
**Mobile Stroke Units**
- Field Triage Scales
- Smartphone Apps
- EMS Teleconsulation
**Bypass ED & CT/MRI**
- Dx + Rx Hybrid Suites
**Faster Access**
- ? Direct Carotid
- Radial
- Better Tools
**Best Tool to Specific Clots**

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Mobile Stroke Units

Better and faster field selection and treatment
Is There a Future to MSU?

Wall Street - 1987
Shortening Ictus to Door Times: Better Triage and More Effective Transport
Field Stroke Triage Scales

RACE: The Rapid Arterial Occlusion Evaluation Scale

CPSS: The Cincinnati Prehospital Stroke Severity Scale

LAMS: Los Angeles Motor Scale

VAN: Vision, Aphasia, Neglect

FAST-ED: Field Assessment Stroke Triage for Emergency Destination
FAST ED: Field Stroke Triage Scale

Field Assessment Stroke Triage for Emergency Destination

The FAST-ED scale and its equivalence to the NIHSS.

<table>
<thead>
<tr>
<th>Item</th>
<th>FAST-ED Score</th>
<th>NIHSS Score Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial palsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal or minor paralysis</td>
<td>0</td>
<td>0 - 1</td>
</tr>
<tr>
<td>Partial or complete paralysis</td>
<td>1</td>
<td>2 - 3</td>
</tr>
<tr>
<td>Arm weakness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No drift</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Drift or some effort against gravity</td>
<td>1</td>
<td>1 - 2</td>
</tr>
<tr>
<td>No effort against gravity or no movement</td>
<td>2</td>
<td>3 - 4</td>
</tr>
<tr>
<td>Speech changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mild to moderate</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Severe, global aphasia or mute</td>
<td>2</td>
<td>2 - 3</td>
</tr>
<tr>
<td>Eye deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Partial</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Forced deviation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Denial / Neglect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Extinction to bilateral simultaneous stimulation in only one sensory modality</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Does not recognize own hand or orients only to one side of the body</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Proportion of patients with LVOS according to the FAST-ED scale.

Only ternary scale according to overall %LVOS AND frequency of M2 vs. M1. vs. ICA

Better adjustability to different patient scenarios than binary scales.

Hosmer and Lemeshow test: 0.62
Only 1-point for face and no leg points to minimize redundancy of motor exam – does not discriminate subcortical vs. cortical. More points for cortical findings e.g. gaze deviation, expressive aphasia. 

Field Assessment Stroke Triage for Emergency Destination

**FAST-ED: Field Stroke Triage Scale**

The FAST-ED scale and its equivalence to the NIHSS.

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<td>Speech changes</td>
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<td></td>
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<tr>
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<td>0</td>
<td>0</td>
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<tr>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Partial</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Forced deviation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cenial / Neglect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Does not recognize own hand or orients only to one side of the body</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Only ternary scale according to overall %LVOS AND frequency of M2 vs. M1. vs. ICA. Better adjustability to different patient scenarios than binary scales.
FAST ED: Field Stroke Triage Scale

STOP Stroke cohort:
- 727 AIS + CTA 0-24h
- 240 LVOS (33%)
  - ICA: 53 (7.3%)
  - MCA-M1: 98 (13.5%)
  - MCA-M2: 74 (10.2%)
  - Basilar: 15 (2.1%)
- AUC
  - FAST-ED: 0.81
  - NIHSS: 0.80
  - RACE: 0.77
  - CPSSS: 0.75

Bernese Stroke cohort:
- 1085 AIS + MRA/CTA 0-6h
- 657 LVOS (60.5%)
  - ICA: 220 (20.3%)
  - MCA-M1: 277 (25.5%)
  - MCA-M2: 160 (14.7%)
  - Basilar: 0 (0%)
  - ACA 11 (1%), M3/4 86 (8%)
- AUC
  - FAST-ED: 0.847
  - NIHSS: 0.846
  - RACE: 0.831
  - CPSSS: 0.802

P = 0.002

Table 3. Comparison of Thresholds of the FAST-ED, RACE, CPSS, and NIHSS According to Sensitivity, Specificity, PPV and NPV, and Accuracy

<table>
<thead>
<tr>
<th></th>
<th>FAST-ED</th>
<th>FAST-ED</th>
<th>RACE</th>
<th>CPSS</th>
<th>NIHSS</th>
<th>NIHSS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥3</td>
<td>≥4</td>
<td>≥5</td>
<td>≥2</td>
<td>≥6</td>
<td>≥10</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.71</td>
<td>0.61</td>
<td>0.55</td>
<td>0.56</td>
<td>0.70</td>
<td>0.64</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.78</td>
<td>0.89</td>
<td>0.87</td>
<td>0.85</td>
<td>0.70</td>
<td>0.85</td>
</tr>
<tr>
<td>PPV</td>
<td>0.62</td>
<td>0.72</td>
<td>0.68</td>
<td>0.65</td>
<td>0.55</td>
<td>0.68</td>
</tr>
<tr>
<td>NPV</td>
<td>0.84</td>
<td>0.82</td>
<td>0.79</td>
<td>0.78</td>
<td>0.85</td>
<td>0.83</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.76</td>
<td>0.79</td>
<td>0.77</td>
<td>0.75</td>
<td>0.72</td>
<td>0.78</td>
</tr>
</tbody>
</table>


Heldner M et al. Stroke. 2016 Sep;47(9):e23


Raul Nogueira, MD

Figure 1. A: Receiver operating characteristic curves comparing the discrimination of Field Assessment Stroke Triage for Emergency Desi- nation (FAST-ED), National Institutes of Health Stroke Scale (NIHSS), Rapid Arterial Occlusion Evaluation (RACE), and Cincinnati Prehos-pital Stroke Severity (CPSSS) scales for the detection of large vessel occlusion stroke (all subjects). B. Subjects who performed computed tomography within 3 hours of symptom onset (n = 510). C. Subjects who performed computed tomography within 3 hours of symptom onset (n = 510). All individual curves presented a P value < 0.001.
Clinical Scales for Field Assessment:

- Published cutoffs = ≥20% of LVOS pts sent to a PSC.
- Cutoffs reducing the false-negative rate to 10% = sending almost every patient to a CSC.
- Scales will never be perfect:
  - ~15% strokes = hemorrhage
  - Lacunes and distal occlusions of eloquent branches can result in high stroke severity.
- However, this is not simply about LVOS prediction. It is about best patient triage in the field:
  - False-negative LVOS = LVOS with low severity = better collateral flow = better natural history, higher chances of IV tPA response, and longer window for IAT. So less harm if goes to PSC and then transferred.
  - False-positive LVOS = Lacunes and eloquent distal occlusions = should use scales that minimize risk of lacune vs. LVOS misdiagnosis and have multi-topographic cortical representation.
**Why FAST ED?**

### Field Stroke Scales:

<table>
<thead>
<tr>
<th>Item</th>
<th>FAST-ED</th>
<th>RACE</th>
<th>CPSSS</th>
<th>LAMS</th>
<th>VAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial palsy</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Arm motor function</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>++**</td>
</tr>
<tr>
<td>Leg motor function</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gaze deviation</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Receptive Aphasia*</td>
<td>1</td>
<td>2</td>
<td>0.5*</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Expressive Aphasia*</td>
<td>1</td>
<td>-</td>
<td>0.5*</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Anosognosia‡‡</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Asomatognosia‡‡</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Hand Grip</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Sensory Extinction</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>+</td>
</tr>
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<td>Visual Field Cut</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Double Vision</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Best LVOS Cut-off</strong></td>
<td>≥4</td>
<td>≥5</td>
<td>≥2</td>
<td>≥4</td>
<td>++/+</td>
</tr>
</tbody>
</table>

* Aphas: Ask the patient to (1) “close your eyes”; (2) “make a fist” and evaluate if the patient obeys.
‡‡ Agnosia: Ask the patient: (1) while showing him/her the paretic arm: “Whose arm is this” and evaluate if the patient recognizes his own arm. (2) “Can you lift both arms and clap” and evaluate if the patient recognizes his functional impairment.
*CPSSS: Ask age and month. Ask close eyes and open/close hands both need to be present to score a total of one point.
**Arm weakness is a sine qua non condition
Why FAST ED?

Field Stroke Scales:

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</tr>
<tr>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Expressive Aphasia*</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Anosognosia††</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Asomatognosia††</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

FAST-ED vs. RACE:

- Overall very Similar; FAST-ED slightly simpler.
- RACE computes +1 for Face and +2 for Leg:
  - Higher chance of misdiagnosing a "Pure Motor Stroke" as a LVOS!
  - Pure motor strokes are common: 12.7% (222/1761) of all strokes in a large population study.¹
  - 85% (189/1761) of Pure Motor Strokes are Lacunes.¹
  - Positive Predictive Value for Pure Motor Syndrome being a Lacune on MRI: 75%.²
- RACE computes less value for Gaze deviation (-1 point in 5- vs. 4-point cut-off scale)
  - Gaze deviation = highest predictor of LVOS in at least 2 studies.³,⁴
- RACE computes 2 points for receptive aphasia (redundant) and 0 for expressive aphasia.

¹Arboix et al. J Neurol Neurosurg Psychiatry 2001;71:239–242
**Why FAST ED?**

### Field Stroke Scales:

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<tr>
<th>Item</th>
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<th>CPSSS</th>
</tr>
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<td>-</td>
</tr>
</tbody>
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**FAST-ED vs. CPSSSS:**

- Overall very Similar;
- CPSSSS only scores motor arm.
- CPSSSS only computes aphasia if Global. No points for isolated expressive or receptive aphasia.
- CPSSSS does not specifically computes neglect = inferior for right-sided LVOS.

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Why FAST ED?

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<tr>
<td>Hand Grip</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

FAST-ED vs. LAMS:
- LAMS would lead to all patients with dense hemiplegia including those with pure motor syndrome to CSCs when many of these patients may have a lacune.
Why FAST ED?

Field Stroke Scales:

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<th>VAN</th>
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</tr>
</tbody>
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FAST-ED vs. VAN:
- VAN requires EMS personnel to become familiar and potentially perform many additional tests including visual field examination which can be difficult in many stroke patients. Despite greater complexity no quantification.
FAST ED Approach: Beyond the Scale

The FAST ED App is not just a simple scale but a highly elaborated decision-making algorithm with real-time assessment regarding individual qualification for the different stroke treatment options based on patient’s characteristics and field transportation times.
But once you pick up the patient from the scene ...
Where should we take the stroke patient?
To the closest stroke center may NOT be the correct answer ...
So ... to where?
It will all depend on ....

Patient condition.... Eligibility for the different treatment options....

- When did symptoms begin?
- Severity of symptoms
- Are there witness to LKW
- Anticoagulants?
- etc…

And a distance/time from the site to a primary or comprehensive stroke center
Solution!

Stroke Triage app: FastED
### FAST-ED Approach: Rationale

<table>
<thead>
<tr>
<th>Who is the Patient?</th>
<th>Destination</th>
<th>Variables to Consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likely a candidate for <strong>IV t-PA only</strong></td>
<td>Closest Stroke Center (likely a PSC)</td>
<td>Anticoagulation? Age ≤ 80 vs. &gt;80? (IV t-PA Window) Time Last Known Well (TLKW)?</td>
</tr>
<tr>
<td>Likely a candidate for <strong>ET only</strong></td>
<td>Closest CSC</td>
<td>Probability of LVOS e.g. Mid-High Scale Score?</td>
</tr>
<tr>
<td>Likely a candidate for <strong>both IV t-PA and ET</strong></td>
<td>CSC vs. PSC depending on:</td>
<td>Additional transport time - CSC vs. PSC?</td>
</tr>
<tr>
<td></td>
<td>• Likelihood of LVOS</td>
<td>• High (60-85%) LVOS Probability</td>
</tr>
<tr>
<td></td>
<td>• Additional transport time to CSC</td>
<td>• Moderate (~30%) LVOS Probability</td>
</tr>
<tr>
<td>Not likely a candidate for <strong>either IV t-PA or ET</strong></td>
<td>Closest Stroke Center (likely a PSC)</td>
<td>Low (&lt;15%) LVOS Probability, Anticoagulation, IV tPA Window</td>
</tr>
</tbody>
</table>
FAST-ED Approach: Rationale

Is the Patient a Potential Candidate for IV tPA based on time?

TLKW to Needle = Current Time – TLKW + B + C ≤ IV tPA Window

How Much Longer it would take to transport the patient to a CSC vs. PSC?

GPS Function
Traffic Information

Symptom to EMS
Site to Door (B)
Door to Needle (C)

Not controllable
Pre set time: NO

Time site-to-door calculated by the software w GPS (B)
Calculate: time difference CSC - PSC

Controllable
Pre set time at median door-to-needle time for the region (60 min in GA) but adjustable

Raul Nogueira, MD
Drip 'n Ship vs. Mothership for Endovascular Treatment: Modeling the Best Transportation Options for Optimal Outcomes

CSC DTN:
30 min

Table. List of Time Assumptions Made in the Model

<table>
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CSC indicates Comprehensive Stroke Centers; DNT, door-to-needle time; NA, not available; and PSC, Primary Stroke Centers.

*Sensitivity analysis is performed on these constants. For Mothership, DNT at CSC of 60 min and door-to-reperfusion of 200 min is also included. Additionally, the tipping point of door to reperfusion in the Drip 'n Ship option is also modeled.

Milne et al. Stroke. 2017 Jan 18. pii: STROKEAHA.1
Drip 'n Ship vs. Mothership for Endovascular Treatment: Modeling the Best Transportation Options for Optimal Outcomes

CSC DTN: 30 min

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Milne et al. *Stroke*. 2017 Jan 18. pii: STROKEAHA.1
The Assessment

The 5 assessments for the computation:

Info Automatically Generated by the App:

- **Time to PSC or CSC**: The app uses GPS and a Database of stroke centers to list up the Primary and Comprehensive Stroke Centers and the time that would take to travel from the current location.

Info Entered by EMS:

- **Use of Anticoagulant ASSESSMENT**: Yes vs. No vs. Unknown (if unknown, the system will assume = no)

- **AGE ASSESSMENT**: > 80 vs. ≤ 80 vs. Unknown (if unknown, the system will assume ≤ 80)

- **TLKW = Time Last known well**: Determine the TIME when the stroke started or last seen at baseline. (If it is unknown, the system will assume as above 270 min)

- **5 to 7 questions of SCORE ASSESSMENT**: Determine the SCORE (= severity of the Stroke), quick exam by EMS
App interface

Asking the use or anticoagulant and the age

**IS THE PATIENT ON ANTICOAGULANT / BLOOD THINNERS?**

**YES**
- Coumadin/Warfarin, Pradaxa / Dabigatran, Eliquis / Apixaban, Xarelto / Rivaroxaban, Savaysa / Edoxaban / Heparin / Enoxaparin

**NO**

**UNKNOWN**

**HOW OLD IS THE PATIENT?**

**OLDER THAN 80 YEARS OLD**

**80 YEARS OLD OR YOUNGER**

**AGE IS UNKNOWN**
App interface

Asking time of symptom start. If it is unknown, ask the time patient last seen well.

**DID ANYONE SEE WHEN THE SYMPTOMS STARTED?**

**YES, ENTER TIME**

*Please leave it blank if the patient was NOT seen by anyone over the last 24 hours.*

**NO**

**WHAT TIME WAS THE PATIENT LAST SEEN WELL?**

**YES, ENTER TIME**

*Please leave it blank if the patient was NOT seen by anyone over the last 24 hours.*

**UNKNOWN**

This question is skipped if the previous one is answered.
App interface

**Question A**

**DOES THE PATIENT HAVE FACIAL WEAKNESS?**

- **NORMAL**
  Both sides of the face move equally or not at all. (Score: 0)

- **ABNORMAL**
  One side of the face droops or is clearly asymmetric. (Score: 1)

_Aphasic patients may respond better if you mimic so try that. If clearly asymmetric at baseline at baseline score as abnormal._

**Question B**

**DOES THE PATIENT HAVE ARM WEAKNESS?**

- **NO WEAKNESS**
  Both arms remain up > 10 seconds or slowly drift down equally. (Score: 0)

- **MILD**
  One arm drifts down in < 10 seconds but has antigravity strength. (Score: 1)

- **MODERATE / SEVERE**
  One or both arms fall rapidly, have no movement against gravity, or no movement at all. (Score: 2)

If patient cannot understand hold his/her arms up and then let them go.
**App interface**

**Question C**

**CHECK SPEECH CONTENT & ASK THE PATIENT TO NAME 3 COMMON ITEMS:**

**NORMAL**
Speech content normal AND names 2 - 3 items correctly. (Score: 0)

**ABNORMAL**
Speech content clearly abnormal OR names only 0 - 1 items correctly. (Score: 1)

*If speech is slurred but makes sense and naming is correct score as normal!*

**Question D**

**ASK THE PATIENT:**
"SHOW ME TWO FINGERS"

**NORMAL**
Patient shows two fingers. (Score: 0)

**ABNORMAL**
Patient cannot understand / does not show two fingers. (Score: 1)

**Question E**

**DOES THE PATIENT HAVE GAZE DEVIATION TO EITHER SIDE?**

**NORMAL**
No deviation, eyes move to both sides equally. (Score: 0)

**GAZE PREFERENCE**
Patient has clear difficulty when looking to one side (left or right). (Score: 1)

**FORCED DEVIATION**
Eyes are deviated to one side and do not move to the other side (e.g. cannot follow finger). (Score: 2)

Some patients will follow your face better than your finger so can try that instead.
These two questions will only show up if Question “B” = 1 or 2 (+ weakness) AND Question “D” = 0 (normal comprehension)

**Question G**

**ASk the Patient:** "Are you weak anywhere?"

**NORMAL**
The patient recognizes the weakness (Score: 0)

**ABNORMAL**
The patient is weak but does NOT recognize the weakness (Score: 1)

**Question H**

**ASk the Patient:** "Whose arm is this?"

**NORMAL**
Patient recognizes his/her weak arm. (Score: 0)

**ABNORMAL**
Patient does NOT recognize his/her weak arm. (Score: 1)
Triage App -> Scoring and assessment

Once press “GO TO... “, it will bring the list of PSC and/or CSC

LVO Probability: ~ 60 – 80%

LVO Probability: ~ 30% + t-PA Eligible

LVO Probability: < 15%

The assessment indicates that the patient should be taken to the closest stroke center.
FAST ED Smartphone App: Output

The algorithm calculates the best options for Stroke Centers (CSC vs. closest center) in order of arrival time/traffic/distance.

FAST-ED lists up the closest stroke centers or CSCs, depending on the algorithm assessment, in order of time distance, with the closest one first based on the ambulance location.

Raul Nogueira, MD
FAST ED SCORE = 6
Large Vessel Occlusion Probability: 60% – 85%

The assessment indicates that the patient should be taken to the closest COMPREHENSIVE stroke center (CSC)

CRITICAL

Click below for the closest Comprehensive Stroke Center

Go to closest CSC

Grady Memorial Hospital
4 mins | 1.9 km

Emory University Hospital Mid...
7 mins | 4.4 km

Atlanta Medical Center
8 mins | 3.4 km

Atlanta Medical Center – South
10 mins | 10.8 km

Piedmont Hospital
12 mins | 10.7 km
The Algorithm
Is the patient using anticoagulant?

**YES**

- Score < 2
  - CSC-PSC > 10min*
    - Go to CLOSEST Stroke Center (PSC or CSC)

- Score >= 2
  - CSC-PSC <= 10 min*
    - Go to Comprehensive Stroke Center (CSC)

**NO**

- Age > 80?
  - YES
    - Pg 2
  - NO
    - Pg 3

* Pre-set at 10 minutes. Time can be adjusted
Assumption: Patient is NOT using Anti-coagulant, and Patient age > 80 years OLD

LKWT to needle: current time – LKWT + B + C > A

Score >= 4
- CSC-PSC <= F
  - "F" is pre-set at 60 min but can be changed for different regions
  - Consider Calling Air Transport to CSC (click to contact closest med flight airbase) OR Transport to closest PSC (click for GPS guidance)
- CSC-PSC > F

Score 2 - 3
- CSC-PSC <= E
  - "E" is pre-set at 30 min but can be changed for different regions

Score < 2
- CSC-PSC <= E
- CSC-PSC > E

Score < 4
- CSC-PSD > D
  - "D" is pre-set at 30 min but can be changed for different regions

Score >= 4
- CSC-PSC <= D

Go to CLOSEST Stroke Center (PSC or CSC)

Not much to be done. But taking to PSC to free the Ambulance from very severe case

Go to Comprehensive Stroke Center (CSC)
The Algorithm page 3
Based on: Distance between PSC & CSC, ANTICOAGULANT, SCORE, AGE and TIME

Assumption: Patient is NOT using Anti-coagulant, and
Patient age <= 80 years OLD

LKWT to needle: current time – LKWT + B + C > 270”

- Score >= 4
  - CSC-PSC <= F
    - “F” is pre-set at 60 min but can be changed for different regions
    - Consider Calling Air Transport to CSC (click to contact closest med flight airbase) OR Transport to closest PSC (click for GPS guidance)
  - CSC-PSC > F

- Score 2 - 3
  - CSC-PSC <= E
    - “E” is pre-set at 30 min but can be changed for different regions
  - CSC-PSC > E

- Score < 2

- Score < 4
  - CSC-PSD > D
    - “D” is pre-set at 30 min but can be changed for different regions

- Score >= 4
  - CSC-PSC <= D

Go to CLOSET Stroke Center (PSC or CSC)

Not much to be done. But taking to PSC to free the Ambulance from very severe case

Go to Comprehensive Stroke Center (CSC)
App makes over 50 decisions like this!
Configuration can only be controlled by regional administrator of the App e.g. EMS leadership, Regional Stroke and AHA leadership
Stroke Center Database including hospital categorization (CSC vs. PSC) must be created for each state/region. Data must be provided by a reliable and unbiased source e.g. State EMS Department, Regional AHA Office

For questions and suggestions please contact:

- Raul Nogueira, MD: rnoguei@emory.edu
- Alex Yeh: alex@allm.net
- Carol Fleming, RN: cfleming1@gmh.edu
JOIN App: a HIPPA Complaint Communication system

- EMS Hospital Pre-Notification including FAST-ED itemized score
- EMS Ambulance Tracker
- EMS-MD; PSC-CSC MDs, intra-Hospital MD-MD communication and videoconferencing
- Imaging DICOM Viewer
FAST ED Smartphone App: Integration

From FAST ED Triage App -> JOIN App

1. FAST-ED
2. JOIN EMS Pre-Notification
3. JOIN Registration and Team Activation
4. JOIN Ambulance Tracker

Example Case:
- **Case:** GA0025
- **ETA:** 12 min
- **LVOP:** 60-85%
- **Time symptoms started:** 14:30
- **Anticoagulant:** no
- **FAST-ED:** 3
  - **Face:** 1

From FAST ED Triage App:
- **Patient ID:**
  - **AP:**
  - **WEIGHT:**
  - **NIHSS:**
  - **GROUP:**
  - **Superior CCT**
- **On Set / LKW:**
  - **Contact:**
  - **Type:**
  - **Transfer:**
- **View Location**

**Hospitals:**
- Grady Memorial Hospital
- Emory University Hospital Midtown
- Atlanta Medical Center
- Atlanta Medical Center – South
- Piedmont Hospital
CHAT ROOM
one-to-one or group chat

DICOM Viewer

Video Conferencing
Phase 1

EMS group are established in JOIN, and the neuro/ER doctors of the hospital are invited to the group.
Phase 2

Hospital have their own tenant, and will form JOIN group. EMS are not part of these groups.
Example of Group list for Paramedic in EMS A

Example of Group list for Paramedic in EMS B

Example of Group list for Doctors in Hospital Y
Once the system is implemented, the doctors will receive notification if someone posts a message or images in the group. The doctor doesn’t need to be in the hospital or at PACs station to get the images. This is the concept of ANYWHERE and ANYTIME.
Inter-hospital connectivity

Connecting doctors from different branches, hospitals or institution is very simple.

The implementation is done by hospital, but the network is build on top of people network, and not between hospitals and institutions, which makes the PROJECT very **SCALABLE** and **FAST IMPLEMENTATION**
Even connecting ambulances and EMS team for communication during the transfers and precise information exchange while the ambulance is on its way.
from PSC and/or Ambulance to CSC
JOIN secured Video-Chat
Thank you for your attention!