

Prehospital Stroke Triage and Use of Prehospital Stroke Scales

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Presenter Disclosure Information

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Prehospital Quality Metrics for Stroke

FINANCIAL DISCLOSURE:
No relevant financial relationship exists



Time is Brain



New Studies in Advanced Stroke Care

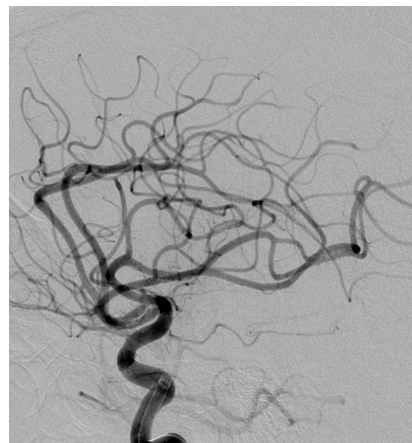
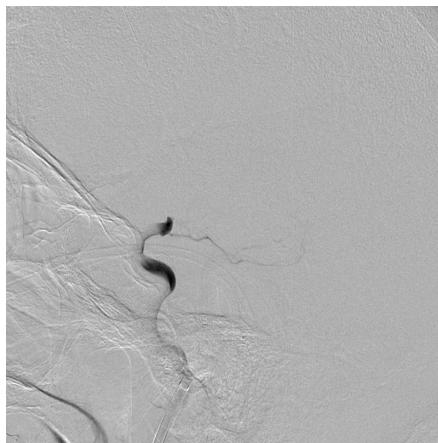
- **5 randomized controlled trials** published since January 2015
 - All provide strong evidence of benefit of intra-arterial therapy for select stroke patients with large vessel occlusions
 - Therapy largely guided by imaging
 - All patients were eligible for thrombolytics if within window prior to intra-arterial therapy

- **Studies:**

- MR CLEAN
- ESCAPE
- EXTEND-IA
- REVASCAT
- SWIFT PRIME



Which Patients have Large Vessel Occlusions?



Treatment Goals for Stroke Patients



The Road Ahead: *Improving Stroke Triage in the Field*



Stroke Ready Hospital

- Can perform a rapid assessment including non-contrast CT scan (to rule out intracranial bleeding)
- Can consult with Neurologists (in person or telemedicine)
- Can administer IV thrombolytics, when needed
- Has protocols for standardized care
- Will usually transfer patients that receive IV thrombolytics



The Joint
Commission



American Heart
Association
American Stroke
Association

CERTIFICATION

Meets standards for

Acute Stroke Ready Hospital

Primary Stroke Center

- Can perform a rapid assessment including CT scan +/- advanced imaging
- Can consult with Neurologists (in person or telemedicine)
- Can administer IV thrombolytics, when needed
- Has protocols for standardized care
- May admit patients that receive IV thrombolytics for continued stroke care



American Heart Association
American Stroke Association
CERTIFIED
Meets standards for
Primary Stroke Center

Comprehensive Stroke Center

In addition to requirements for Primary Stroke Center:

- Dedicated vascular neurologists and neurosurgeons
- Dedicated Neuro ICU beds 24/7
- Advanced imaging capabilities (CTA, MRA)
- Can perform endovascular procedures
- Experience in treating ischemic strokes and hemorrhages



**American Heart Association
American Stroke Association
CERTIFICATION**
Meets standards for
Comprehensive Stroke Center

Primary versus Comprehensive Stroke Centers



**American Heart Association
American Stroke Association
CERTIFIED**

Meets standards for
Primary Stroke Center



**American Heart Association
American Stroke Association
CERTIFICATION**

Meets standards for
Comprehensive Stroke Center



Goals and Metrics for Prehospital Stroke Care

Goals:

- Perform an appropriate prehospital assessment
 - Identify non-stroke illness (e.g. hypoglycemia)
 - Identify stroke
 - Identify stroke severity
- For patients with suspected stroke
 - Time to diagnostic studies
- For patients who are eligible for stroke treatment
 - Time to intervention

National Institutes of Medicine Stroke Scale

INSTRUCTIONS	SCALE DEFINITION	SCORE
1. A) Level of Consciousness	0 = Alert; keenly responsive. 1 = Not alert, but arousable by minor stimulation 2 = Not alert; requires repeated stimulation to attend, or requires strong or painful stimulation to make movements. 3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, and areflexic	
B) LOC Questions (Age & Month)	0 = Answers both questions correctly. 1 = Answers one question correctly. 2 = Answers neither question correctly.	
C) LOC Commands	0 = Performs both tasks correctly. 1 = Performs one task correctly. 2 = Performs neither task correctly.	
2. Best Gaze	0 = Normal 1 = Partial gaze palsy 2 = Forced deviation	
3. Visual	0 = No visual loss. 1 = Partial hemianopia. 2 = Complete hemianopia. 3 = Bilateral hemianopia (blind)	
4. Facial Palsy	0 = Normal symmetrical movements. 1 = Minor paralysis 2 = Partial paralysis 3 = Complete paralysis of one or both sides.	
5. A) Motor Arm - Left	0 = No drift for full 10 seconds	
B) Motor Arm - Right	0 = Drift 1 = Some effort against gravity 2 = No effort against gravity; limb falls	
6. A) Motor Leg - Left	0 = No movement	
B) Motor Leg - Right	0 = Amputation or joint fusion	
7. Limb Ataxia	0 = Absent. 1 = Present in one limb. 2 = Present in two limbs. UN = Amputation or joint fusion	
8. Sensory	0 = Normal, no sensory loss. 1 = Mild-to-moderate sensory loss. 2 = Severe to total sensory loss.	
9. Best Language	0 = No aphasia, normal. 1 = Mild-to-moderate aphasia. 2 = Severe aphasia. 3 = Mute, global aphasia.	
10. Dysarthria	0 = Normal. 1 = Mild-to-moderate dysarthria. 2 = Severe dysarthria. UN = Intubated or other physical barrier	
11. Extinction and Inattention	0 = No abnormality. 1 = Inattention or extinction to bilateral simultaneous stimulation in one sensory modality (visual, tactile, auditory, etc). 2 = Profound hemi-inattention or extinction (>1 modality)	

Comparing National Institutes of Health Stroke Scale Among a Stroke Team and Helicopter Emergency Medical Service Providers

Matthew R. Kesinger, BA; Denise J. Sequeira, BA; Samantha Buffalini, RN(c); Francis X. Guyette, MD, MPH

Background and Purpose—The use of tissue-type plasminogen activator is limited to a maximum of 4.5 hours after symptom-onset. Endovascular recanalization may improve outcomes for large-vessel occlusions (LVO), but efficacy decreases with time from symptom-onset. A National Institutes of Health Stroke Scale (NIHSS) score ≥ 12 is predictive of LVOs and could be used to triage patients if appropriately used by prehospital providers. The NIHSS has been considered too complex and has not been validated in the prehospital setting.

Methods—We reviewed all patients with ischemic stroke transported by helicopter emergency medical services (HEMS) to a single comprehensive stroke center in 2010. HEMS NIHSS were compared with in-hospital stroke team physician scores. NIHSS was categorized based on 3 clinically relevant groupings and ability to predict LVO was investigated.

Results—Three-hundred five patients met inclusion criteria, 68.9% having LVO. Moderate agreement existed between HEMS and physicians (72.1%; $\kappa=0.571$). Interclass correlation was 0.879 (95% confidence interval, 0.849–0.904). Excluding patients with tissue-type plasminogen activator before HEMS transport, there were 216 patients and good agreement (82.7%; $\kappa=0.619$). Among patients presenting within 8 hours postonset and NIHSS ≥ 12 , HEMS had a sensitivity of 55.9% and positive predictive value of 83.7% in predicting LVO.

Conclusions—HEMS providers can administer NIHSS with moderate to good agreement with the receiving stroke team. The use of the NIHSS in HEMS may identify patients with LVO and inform triage decisions for patients ineligible for tissue-type plasminogen activator. (*Stroke*, 2015;46:575-578. DOI: 10.1161/STROKEAHA.114.007850.)



How should EMS providers identify stroke and especially those with large vessel occlusion?

- Stroke Scales
 - Cincinnati Prehospital Stroke Scale (CPSS)
 - Face Arm Speech Test (FAST)
 - Los Angeles Prehospital Stroke Screen (LAPSS)
 - Medic Prehospital Assessment for Code Stroke (Med PACS)
 - Melbourne Ambulance Stroke Screen (MASS)
 - Ontario Prehospital Stroke Screening Tool (OPSS)
 - Recognition of Stroke in the Emergency Room Score (ROSIER)
- Severity Scales
 - Rapid Arterial Occlusion Evaluation Scale (RACE)
 - Los Angeles Motor Scale (LAMS)
 - Kurashiki Prehospital Stroke Scale (KPSS)
 - National Institutes of Health Stroke Scale (NIHSS)
 - sNIHSS-8
 - sNIHSS-5
 - Cincinnati Prehospital Stroke Severity Scale (CPSSS)

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Cincinnati Prehospital Stroke Scale (CPSS)

- First published in 1997
- Primary stroke identification scale used in PA
- Exam:
 - Facial palsy
 - Arm drift
 - Abnormal speech
- Sensitivity 59-95% (prior literature)
- Does not distinguish large-vessel occlusion

986 ACADEMIC EMERGENCY MEDICINE OCT 1997 VOL 4/NO 10

Early Stroke Recognition: Developing an Out-of-hospital NIH Stroke Scale

Rashmi Kothari, MD, Kent Hall, MD, Thomas Brot, MD, Joseph Broderick, MD

ABSTRACT

Objective: To develop an abbreviated and practical neurologic scale that could assist emergency medical services or triage personnel in identifying patients with stroke.

Methods: A prospective, observational, cohort study was performed at university-based EDs. Participants were 74 patients treated in a thrombolytic stroke trial and 225 consecutive non-stroke patients evaluated during 4 random 12-hour shifts in the ED. Scores on the NIH Stroke Scale were obtained for all patients by physicians. Items of this scale were modified and recoded to a binomial (normal or abnormal) scale. Serial univariate analyses using χ^2 were performed to rank items. Recursive partitioning was then performed to develop the decision rule for predicting the presence of stroke.

Results: Three items identified 100% of patients with stroke: facial palsy, motor arm, and dysarthria. An Abbreviated NIH Stroke Scale based on these items had a sensitivity of 100% and a specificity of 92%. A proposed Out-of-hospital NIH Stroke Scale consisting of facial palsy, motor arm, and a combination of dysarthria and best language items (abnormal speech) had a sensitivity of 100% and a specificity of 88%.

Conclusion: Using the derivation data set, a proposed Out-of-hospital NIH Stroke Scale had a high sensitivity and specificity for identifying patients with stroke when performed by physicians in this group of 299 ED patients. Prospective studies of other health care professionals using the scale in the out-of-hospital arena are needed.

Key words: out-of-hospital; emergency medical services; EMS; paramedic; stroke; cerebral ischemia; diagnosis; score.

Acad. Emerg. Med. 1997; 4:986-990.

Los Angeles Prehospital Stroke Screen (LAPSS)

- First published in 1998
- History factors:
 - Age >45 years
 - No seizures or epilepsy
 - Symptoms <12 hours
 - Not wheelchair/bedridden
 - Glucose 60-400
- Exam Factors:
 - Facial smile/grimace
 - Grip
 - Arm strength
 - [each only unilateral]

DESIGN AND RETROSPECTIVE ANALYSIS OF THE LOS ANGELES PREHOSPITAL STROKE SCREEN (LAPSS)

Chelsea S. Kidwell, MD, Jeffrey L. Saver, MD, Glenn B. Schubert, MPH, Marc Eckstein, MD, Sidney Starkman, MD

PREHOSPITAL EMERGENCY CARE 1998;2:267-273

- Sensitivity 44-94% (prior literature)
- Does not distinguish large-vessel occlusion

Cincinnati Prehospital Stroke Severity Scale

Design and Validation of a Prehospital Scale to Predict Stroke Severity

Cincinnati Prehospital Stroke Severity Scale

Brian S. Katz, MD; Jason T. McMullan, MD; Heidi Sucharew, PhD; Opeolu Adeoye, MD, MS; Joseph P. Broderick, MD

Stroke. 2015;46:1508-1512.

- Based on CPSS
- ≥ 2 suggests LVO
- Sensitivity 75%
- Specificity 85%

Exam	NIHSS	Points
Conjugate gaze deviation	≥ 1 for Gaze	0 or 2
LOC	≥ 1 for 1b or 1c	0-1
Arm Strength	≥ 2 for Motor Arm	0-1
Total		0-4

Los Angeles Motor Score

THE LOS ANGELES MOTOR SCALE (LAMS):

A NEW MEASURE TO CHARACTERIZE STROKE SEVERITY IN THE FIELD

Jennifer N. Llanes, BA, Chelsea S. Kidwell, MD, Sidney Starkman, MD,
Megan C. Leary, MD, Marc Eckstein, MD, Jeffrey L. Saver, MD

PREHOSPITAL EMERGENCY CARE 2004;8:46-50

- Based on LAPSS
- Score ≥ 4 suggests LVO
- Sensitivity 67-81%
- Specificity 81-89%

Exam	Points
Facial Strength	0-1
Grip Strength	0-2
Arm Strength	0-2
Total	0-5 (unilateral)

Design and Validation of a Prehospital Stroke Scale to Predict Large Arterial Occlusion

The Rapid Arterial Occlusion Evaluation Scale

Natalia Pérez de la Ossa, MD, PhD; David Carrera, MD; Montse Gorchs, BD;
Marisol Querol, BD; Mònica Millán, MD, PhD; Meritxell Gomis, MD, PhD;
Laura Dorado, MD, PhD; Elena López-Cancio, MD, PhD; María Hernández-Pérez, MD;
Vicente Chicharro, MD; Xavier Escalada, MD; Xavier Jiménez, MD, PhD; Antoni Dávalos, MD, PhD

(*Stroke*. 2014;45:87-91.)

- Introduced 2014 with internal validation in Barcelona, Spain
- Thought to be simpler to assess by field providers than scores used in the hospital (e.g. NIH Stroke Scale)
- Currently being assessed in various EMS systems for prehospital stroke severity screening

RACE Score

- 6 data points
 - 2 already part of CPSS
- Adds:
 - Leg weakness
 - Head/eye gaze deviation
 - Performing 2 commands (Aphasia)
 - Recognizing arm and clapping (Agnosia)

Table 1. RACE Scale

Item	RACE Score	NIHSS Score Equivalence
Facial palsy		
Absent	0	0
Mild	1	1
Moderate to severe	2	2-3
Arm motor function		
Normal to mild	0	0-1
Moderate	1	2
Severe	2	3-4
Leg motor function		
Normal to mild	0	0-1
Moderate	1	2
Severe	2	3-4
Head and gaze deviation		
Absent	0	0
Present	1	1-2
Aphasia* (if right hemiparesis)		
Performs both tasks correctly	0	0
Performs 1 task correctly	1	1
Performs neither tasks	2	2
Agnosia† (if left hemiparesis)		
Patient recognizes his/her arm and the impairment	0	0
Does not recognize his/her arm or the impairment	1	1
Does not recognize his/her arm nor the impairment	2	2
Score total	0-9	

RACE Score

- Large-vessel occlusion suspected if score ≥ 5
 - Sensitivity: 85%
 - Specificity: 65%
- Published score based on internal validation
- Undergoing further investigation in our EMS region

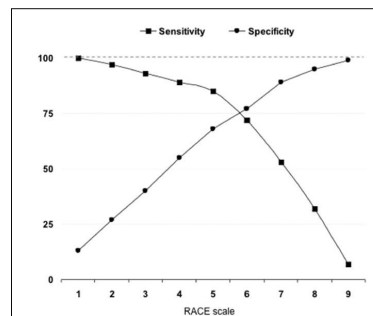


Figure 1. Sensitivity (squares) and specificity (circles) of different cutoff values of the Rapid Arterial Occlusion Evaluation (RACE) scale for the detection of large vessel occlusion.

Validation of Prehospital Stroke Scales in Patients Transported by Air Medical Services

- Retrospective study of patients transported by STAT MedEvac between 2010-2015 for suspected stroke
 - Excluded patients with known intracranial hemorrhage
 - Stroke severity scores derived from NIHSS performed by air medical crews
- Data from prehospital records and Get with the Guidelines database
- Results
 - 1,244 cases included
 - 941 interfacility
 - 303 scene transports



Calculation of Stroke Severity Scores

	NIHSS	CPSSS	KPSS	LAMS	sNIHSS-8	sNIHSS-5	RACE
Alertness	0 1-2 3	-	0 1 2	-	0 1-2 3	-	-
Orientation	0 1-2	0 1	0 1	-	-	-	-
Commands	0 1-2	0 1	-	-	-	-	0 1-2
Best Gaze	0 1-2	0 2	-	-	0 1-2	0 1-2	0 1
Visual	0-3	-	-	-	0-3	0-3	-
Facial Palsy	0 1 2-3	-	-	0 1 1	0 1 2-3	-	0 1 2
Grip Strength	-	-	-	0-2S	-	-	-
Motor Arm ^b	0 1 2 3-4	0 0 1 1	0 1 2 2	0 1 2 2	-	-	0 0 1 2
Motor Leg ^b	0 1 2 3-4	-	0 1 2 2	-	0 1 2 3-4	0 1 2 3-4	0 0 1 2
Language (Aphasia)	0 1-2 3	-	0 1 2	-	0 1-2 3	0 1-2 3	-
Dysarthria	0 1-2	-	0 1	-	0 1-2	-	-
Extinction & Inattention	0-2	-	-	-	-	-	0-2
Score Range	0 to 42	0 to 4	0 to 13**	0 to 10	0 to 24	0 to 16	0 to 9

Performance of Stroke Severity Scales for Identifying Large Vessel Occlusion

	Classified	Sensitivity	Specificity	J
NIHSS				
≥ 7	71%	71% (67-75)	72% (64-74)	0.43
≥ 8	70%	67% (63-71)	76% (70-80)	0.43
≥ 9	69%	65% (61-68)	81% (76-85)	0.46
≥ 10	68%	62% (58-66)	82% (77-86)	0.44
≥ 11	65%	57% (53-61)	84% (80-88)	0.41
CPSSS				
≥ 0	74%	100% (99-100)	0% (0-0.02)	0.0
≥ 1	71%	72% (68-76)	69% (62-73)	0.41
≥ 2	61%	52% (48-56)	84% (80-88)	0.36
≥ 3	56%	42% (38-46)	92% (88-94)	0.34
KPSS				
≥ 3	71%	75% (72-79)	58% (52-63)	0.33
≥ 4	68%	68% (64-72)	67% (61-72)	0.35
≥ 5	65%	60% (55-63)	78% (73-83)	0.38
≥ 6	53%	43% (39-47)	84% (80-88)	0.27
≥ 7	47%	32% (29-37)	90% (86-93)	0.22
LAMS				
≥ 1	74%	87% (84-90)	38% (33-44)	0.25
≥ 2	70%	77% (73-80)	52% (46-58)	0.29
≥ 3	66%	65% (61-69)	68% (62-73)	0.33
≥ 4	47%	33% (29-37)	89% (85-92)	0.22
≥ 5	36%	15% (12-18)	97% (94-98)	0.12

	Classified	Sensitivity	Specificity	J
sNIHSS-8				
≥ 8	66%	99% (98-99)	2% (1-5)	0.1
≥ 9	70%	73% (69-76)	62% (55-67)	0.35
≥ 10	66%	63% (58-66)	76% (71-81)	0.39
≥ 11	60%	51% (47-55)	84% (80-88)	0.35
≥ 12	53%	39% (35-43)	90% (86-93)	0.29
sNIHSS-5				
≥ 4	66%	99% (98-99)	1% (0-3)	0.0
≥ 5	73%	99% (97-99)	2% (0-4)	0.1
≥ 6	67%	66% (62-70)	68% (62-73)	0.34
≥ 7	61%	53% (49-57)	81% (76-85)	0.34
≥ 8	56%	44% (40-49)	89% (84-92)	0.33
RACE				
≥ 3	70%	68% (64-72)	72% (66-77)	0.40
≥ 4	66%	62% (58-66)	78% (72-82)	0.40
≥ 5	64%	56% (52-60)	85% (80-86)	0.41
≥ 6	59%	47% (44-52)	88% (83-91)	0.35
≥ 7	52%	37% (33-41)	92% (88-94)	0.29

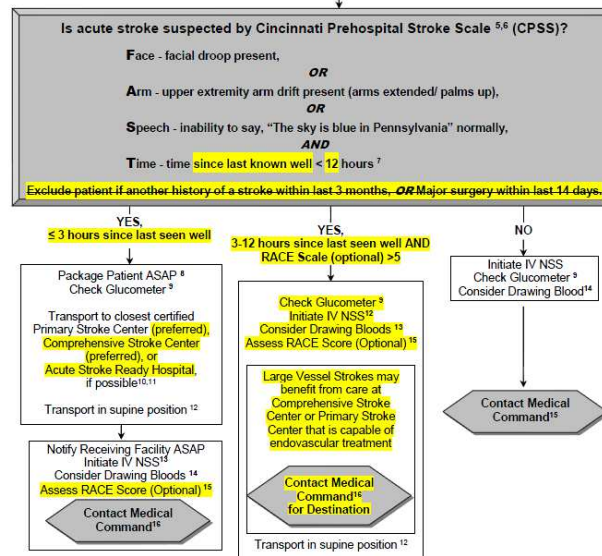
Modified RACE Score Rapid Arterial Occlusion Evaluation

EMS Service:	Patient Name:	DOB: / /	Date of Exam: / /	Time:
EMS Unit:	Symptom Onset Date: / /		Time:	Onset witnessed by:
Speech*	Ask patient to repeat the phrase: "The sky is blue in Pennsylvania"	No numerical value		<input type="checkbox"/> Normal Speech <input type="checkbox"/> Abnormal Speech
Facial Palsy*	Ask patient to smile and show their teeth	<ul style="list-style-type: none"> Absent (no facial movement) Mild (some facial movement) Moderate to severe (little to no facial movement) 		0 1 2
Arm Motor Function*	Ask patient to raise both arms, palms up, for 10 seconds	<ul style="list-style-type: none"> Normal (no drift to mild drift) Moderate (able to lift arm but unable to hold for 10 secs) Severe (unable to lift either arm against gravity) 		0 1 2
Leg Motor Function	Ask patient to raise each leg, one at a time, and hold for 5 seconds	<ul style="list-style-type: none"> Normal (no drift to mild drift) Moderate (able to lift leg, unable to hold for 5 secs) Severe (unable to lift either leg against gravity) 		0 1 2
Head & Gaze Deviation	Ask patient to move their eyes horizontally by tracking your finger and assess gaze deviation	<ul style="list-style-type: none"> Absent (moves both eyes to track finger) Present (fixed or unable to shift gaze past midline) 		0 1
Aphasia	Ask patient to follow 2 commands: 1. Close your eyes 2. Make a fist (on unaffected side)	<ul style="list-style-type: none"> Performs both tasks correctly Performs 1 task correctly Performs neither task correctly 		0 1 2
Agnosia	Determine if patient recognizes deficit: 1. Ask the patient (while pointing at affected arm): "Whose arms is this?" 2. Ask the patient to clap their hands	<ul style="list-style-type: none"> Recognizes arm & claps or recognizes inability to clap Cannot perform one of the tasks Cannot perform either task 		0 1 2
<p>If total score ≥ 5 and time from last known well to arrival at the closest Primary Stroke Center will be >3 hours, contact Medical Command for consideration of transport to a facility capable of performing endovascular interventions.</p>				Total: <input type="text"/>
Patient's Next of Kin:		Relationship:	Phone Number:	
Has the patient taken any direct thrombin inhibitors within last 48 hours? Yes <input type="checkbox"/> No <input type="checkbox"/> Some examples include; Coumadin (Warfarin), Pradaxa, Xarelto, Eliquis.				

* Any abnormal finding in speech, facial palsy, or arm motor function is a positive finding for the Cincinnati Prehospital Stroke Screen.

* A RACE score ≥ 5 is a strong indication of a large vessel occlusion (LVO). Treatment with tPA alone is not as effective as tPA and endovascular treatment.

Updated Stroke Triage Protocol in Pennsylvania



UPMC Stroke Alerts

	Time since last known well		
	< 6 Hours	6 – 24 Hours	>24 Hours
RACE score ≥5 or NIHSS ≥8	Level 1	Level 1	No Alert
RACE score <5 and NIHSS <8 Or Unknown Values	Level 1	Level 2	No Alert

Anticipated Treatment Goals:
Level 1 Alert → Direct to CT if available
Level 2 Alert → Prompt evaluation in room

Stroke Metrics: Assessment

- For patients with stroke-like symptoms
 - % of cases with glucose
 - % of cases with stroke scale
- Performance of stroke scale
 - Sensitivity / Specificity
 - Positive Predictive Value

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Stroke Metrics: Resources and Transport

- For patients with stroke-like symptoms
 - % of cases with appropriate stroke alert
 - % of tPA-eligible stroke patients transported to an appropriate stroke center
 - % of tPA-eligible stroke patients transported to an interventional or comprehensive stroke center

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Stroke Metrics: Times

Time Point	Interval
Last Known Well	
Dispatch Time	
First Medical Contact (EMS)	Response Time
Hospital Notification	Notification Time
Arrival to ED	Time to ED
CT of the Head	Time to CT
IV tPA	Time to Needle
Arrival to Intervention Lab	Time to Lab
Initiation of Endovascular Treatment	Time to Intervention