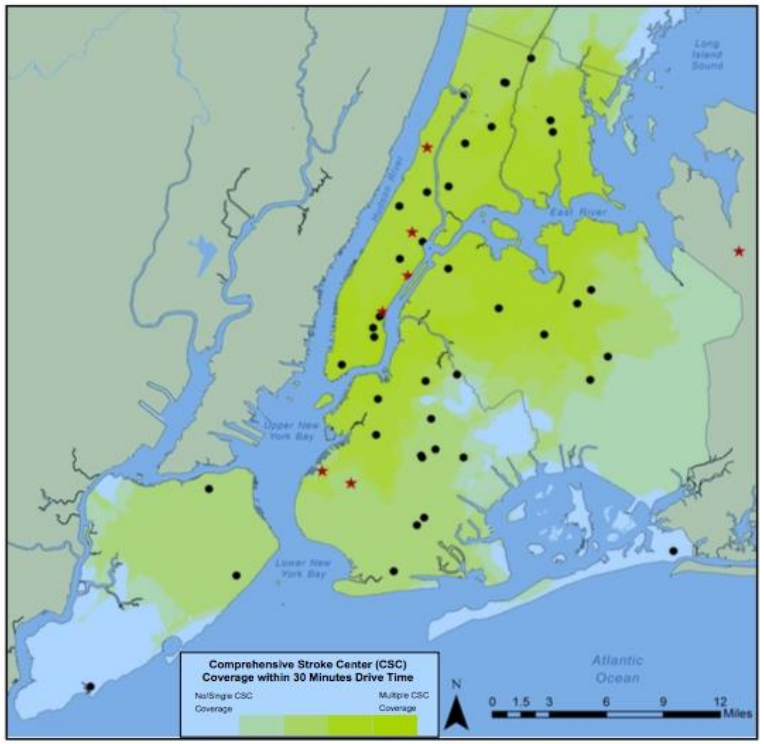
Stroke Systems of Care Development: New York City

GARY HE / EPA



* CSC Designation as of 12/9/16

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Disclosure

- No Financial Disclosures
- Work in Progress
- We are not Stroke Neurologists

Learning Objectives

- Discuss current New York City Prehospital and Hospital (GWTG) stroke data
- Describe New York City proposal for a regional stroke systems of care that incorporates accommodation for Large Vessel Occlusion Strokes
- Identify needed components and constraints for NYC Stroke Systems of Care
- Compare proposed NYC Stroke Triage Algorithm with AHA Mission Lifeline Stroke Triage Algorithm

New York City Prehospital Stroke Data

- Daily EMS 9-1-1 Call Volume Average: 4,000
- Annual EMS Call Volume: 1.46 million
- Daily stroke call volume average: 50 (≈1.25%)
- Estimated LVO patients: 50 x 10% = 5
- Patients eligible for thrombectomy 5 x 30% = 1.5

Stroke Diagnosis Type, 2016
by New York Region
% of patients (number of patients)

Stroke Diagnosis Type	New York Region						
	NYC	Long Island	Hudson Valley/ Westchester	Capital/ Northeastern	Central	Rochester/ Finger Lakes	Western
Ischemic Stroke	60.9% (11,260)	56.8% (5,065)	55.6% (2,992)	66.4% (2,036)	63.6% (2,312)	60% (2,565)	66.8% (2,684)
TIA	16.1% (2,981)	25.2% (2,245)	24.6% (1,325)	18.2% (559)	19.7% (718)	23.4% (1,003)	20.3% (814)
Subarachnoid Hemorrhage	3.5% (644)	3.8% (341)	3.8% (207)	4.0% (122)	4.0% (144)	3.1% (131)	2.9% (117)
Intracerebral Hemorrhage	10.4% (1,922)	10.8% (962)	9.8% (529)	10.1% (311)	10.7% (389)	8.6% (368)	9.2% (369)
Stroke, not otherwise specified	0.2% (41)	0.1% (12)	0.8% (41)	0.5% (15)	0.1% (5)	1.4% (59)	0.3% (11)
Total cases in GWTG	18,502	8,910	5,385	3,068	3,638	4,278	4,019

- Cases with a "missing diagnosis", "no stroke related diagnosis" or "elective carotid intervention only" are not listed here, therefore the sum of the number of patients with each diagnosis may not equal the "Total cases in GWTG" for each region.

Arrival Mode, 2016
by New York Region
% of patients (number of patients)

Arrival Mode	New York Region						
	NYC	Long Island	Hudson Valley/ Westchester	Capital/ Northeastern	Central	Rochester/ Finger Lakes	Western
EMS from home/scene	59.7% (9,518)	51.1% (4,170)	54.5% (2,699)	48.9% (1,456)	61.5% (2,080)	50.2% (1,962)	48.3% (1,849)
Private transport/ taxi/other from home/scene	29.4% (4,681)	37.4% (3,055)	35.2% (1,745)	25.9% (771)	20.8% (703)	34.3% (1,342)	30.6% (1,173)
Transfer from other hospital	9.8% (1,566)	11.0% (897)	10.1% (501)	24.9% (741)	16.8% (567)	14.0% (548)	20.7% (793)
Not documented or unknown	0.9% (148)	0.5% (37)	0.2% (8)	0.3% (9)	0.9% (30)	1.4% (53)	0.3% (13)
Total N	15,937	8,160	4,955	2,977	3,382	3,910	3,828

- Cases with a "blank" for Arrival Mode are not listed here, therefore the sum of the number of patients for each arrival mode may not equal the "Total N" for each region.

NYS Department of Health EMS Measures, 2016

by New York Region

% of patients (number of patients)

Measure	New York Region						
	NYC	Long Island	Hudson Valley/ Westchester	Capital/ Northeastern	Central	Rochester/ Finger Lakes	Western
EMS pre-hospital stroke scale*	24.0% (1071)	41.4% (733)	44.4% (626)	35.9% (248)	60.3% (629)	32.6% (296)	63.1% (518)
Stroke team activated prior to arrival**	35.8% (675)	49.5% (437)	36.3% (327)	47.0% (214)	45.9% (373)	71.6% (649)	8.1% (27)

*Percent of patients arriving via EMS who had pre-hospital stroke scale performed.

**Percent of patients arriving via EMS for whom the stroke team was activated prior to patient arrival based upon EMS pre-notification.

NYS Department of Health EMS Measures, 2016

by New York Region

% of patients (number of patients)

Pre-Notification Content*	New York Region						
	NYC	Long Island	Central	Capital/ Northeastern	Hudson Valley/ Westchester	Rochester/ Finger Lakes	Western
Pre-hospital stroke scale findings	43.5% (820)	71.5% (631)	62.9% (511)	33.2% (151)	62.1% (559)	87.4% (567)	69.4% (231)
Patient last known well (LKW)	41% (772)	62.9% (555)	55.6% (452)	33.2% (151)	58.1% (523)	81% (1526)	65.8% (219)
Pre-hospital stroke scale findings AND LKW	37.6% (709)	60.7% (535)	52.3% (425)	30.3% (138)	53.9% (485)	80.1% (520)	61.3% (204)
Total N	1884	882	813	455	900	649	333

*Where prenotification by EMS occurred, information communicated to receiving hospital.

Current NYC REMAC Protocol 412: Stroke

THE REGIONAL EMERGENCY MEDICAL SERVICES COUNCIL OF NEW YORK CITY

BASIC EMERGENCY MEDICAL TECHNICIAN PROTOCOLS
412

STROKE (CEREBROVASCULAR ACCIDENT)

1. Monitor the airway.
2. Administer oxygen.
3. Place the patient in a head-elevated (Semi-Fowler's) or left lateral recumbent (recovery) position as necessary to maintain the airway.

   NOTE: A GLUCOMETER (IF AVAILABLE) SHOULD BE USED TO DOCUMENT BLOOD GLUCOSE LEVEL PRIOR TO ADMINISTRATION OF GLUCOSE, FRUIT JUICE OR SODA.

   IF THE GLUCOMETER READING IS ABOVE 60 MG/DL, TREATMENT FOR HYPOGLYCEMIA SHOULD BE WITHHELD.

   IF GLUCOSE IS BELOW 60, REFER TO PROTOCOL 411 AMS.

4. Assess for Stroke Patient Criteria. (See Appendix R.)
   a. Do **not** delay transport.
5. Transport.

Cincinnati Prehospital Stroke Scale

Stroke Transport Decisions

Acute Stroke

If the historical/physical findings indicate an acute str… NYS (See Appendix R, Stroke Patient Criteria), unless **one**

- The patient is in cardiac arrest;
- The patient has other medical conditions th… ppria… department as per protocol;
- The total time from when the patient's symp… he p… EMS is greater than FIVE (5.0) hours;
- An on-line medical control physician so dire…

Hospital Number	Hospital Full Name	Stroke Center
1	New York Presbyterian - Lower Manhattan	X
2	Bellevue Hospital Center	X
3	Beth Israel Medical Center - Petrie Division	X
7	Harlem Hospital Center	X
11	Lenox Hill Hospital	X
12	Metropolitan Hospital Center	
13	Mount Sinai Medical Center	X
14	New York Presbyterian Hospital - New York Weill Cornell Campus	X
16	New York Presbyterian Hospital - Allen Pavilion	X
17	New York Presbyterian Hospital - Columbia Campus	X
18	St. Luke's - Roosevelt Hospital Center - Roosevelt Hospital Division	X
20	St. Luke's - Roosevelt Hospital Center - St. Luke's Hospital Division	X
22	Montefiore Medical Center - Weiler Division	X
23	Bronx Lebanon Hospital Center - Concourse Division	X
25	Jacobi Medical Center	X
27	Lincoln Medical and Mental Health Center	X
29	Montefiore Medical Center	X
31	New York Hospital Medical Center of Queens	X
32	Elmhurst Hospital Center	X
33	Flushing Hospital Medical Center	X
33P	*Flushing Hospital Medical Center*	
34	Jamaica Hospital	X
35	North Shore - Long Island Jewish Medical Center	X
38	Queens Hospital Center	
40	St. John's Episcopal Hospital South Shore Division	X

Hospital Number	Hospital Full Name	Stroke Center
41	Brookdale University Hospital Medical Center	X
42	Coney Island Hospital	X
44	SUNY Downstate Medical Center	X
45	Woodhull Medical and Mental Health Center	X
47	Kingsbrook Jewish Medical Center	X
48	Kings County Hospital Center	X
50	Long Beach Medical Center	X
51	Lutheran Medical Center	X
53	Maimonides Medical Center	X
54	New York Methodist Hospital	X
58	Wyckoff Heights Medical Center	X
59	Staten Island University Hospital - Prince Bay Campus (South)	
60	Richmond University Medical Center	X
62	Staten Island University Hospital - Ocean Breeze Campus (North)	X
70	North Central Bronx Hospital	
71	Mount Sinai Hospital of Queens	X
74	Franklin Hospital Medical Center	X
77	North Shore - Forest Hills	X
78	North Shore University Hospital Center - Manhasset	X
80	Sound Shore Medical Center of Westchester	X
82	Nassau County University Medical Center	X
83	St. Barnabas Hospital	X
88	New York Westchester Square Hospital Medical Center	X
92	New York Community Hospital of Brooklyn	X
93	Beth Israel Medical Center - Kings Highway Division	X
95	Brooklyn Hospital Center	X
96	St. Joseph's Medical Center	X

NYC Regional Emergency Medical Advisory Committee: Stroke Technical Assistance Group

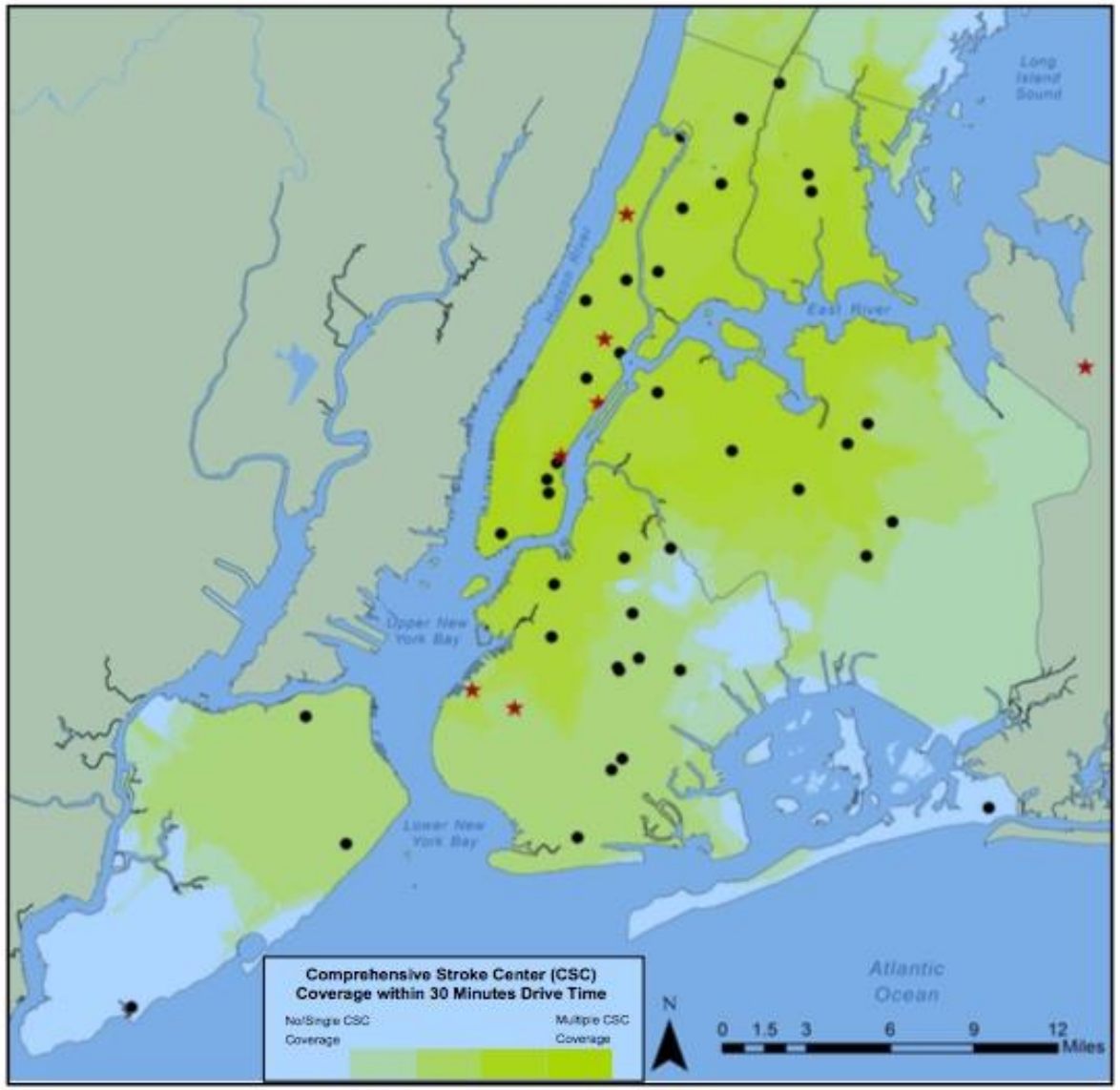
- Goal to develop systems to support new evidence of benefit for thrombectomy for LVO Stroke
- Regional EMS leaders and Emergency Physicians
- Primarily focused on prehospital aspects of system, care and stroke triage
- Ongoing discussion with regional hospital stroke neurology partners

NYC Regional Emergency Medical Advisory Committee: Stroke Technical Assistance Group

Key Recommendations:

- Extend stroke window to 5 hours from Last Known Well to EMS Contact *(Completed -4/17)*
- Add Glucometry to BLS stroke protocol *(Completed 4/17)*
- Identified current and planned stroke resources (CSC and TSC Hospitals) (Completed – Initial 12/16)
- Proposed stroke protocol based on LAMS+SPEECH
- Determined need for ongoing quality assurance and improvement

NYC Hospitals by Comprehensive Stroke Center (CSC) Designation*
and 30 Minute Drive Time Range from CSCs



* CSC Designation as of 12/9/16

Clinical Scales Do Not Reliably Identify Acute Ischemic Stroke Patients With Large-Artery Occlusion

Guillaume Turc, PhD*; Benjamin Maïer, MD*; Olivier Naggara, PhD; Pierre Seners, MD; Clothilde Isabel, MD; Marie Tisserand, PhD; Igor Raynouard, MD; Myriam Edjlali, MD; David Calvet, PhD; Jean-Claude Baron, ScD; Jean-Louis Mas, MD; Catherine Oppenheim, PhD

Clinical Scores to Predict Large-Artery Occlusion

Score/Cutoff	n (%)	False-Negative Rate=1−Sensitivity, % (95% CI)	False-Positive Rate=1−Specificity, % (95% CI)	Accuracy, % (95% CI)
NIHSS score, ≥14[8]	278 (28)	39 (34–44)	12 (9–14)	79 (77–82)
NIHSS score, ≥11[6,7,21]	356 (35)	27 (22–32)	17 (14–20)	79 (77–82)
NIHSS score, ≥10[22]	388 (39)	24 (19–28)	20 (17–23)	78 (76–81)
NIHSS score, ≥9 (0–3 h) or ≥7 (3–6 h)[2,20]	452 (45)	19 (15–23)	28 (24–31)	75 (73–78)
NIHSS score, ≥6[9]	556 (55)	13 (9–16)	40 (36–43)	69 (66–72)
NIHSS score, ≥5	606 (60)	10 (7–13)	46 (42–50)	66 (63–69)
NIHSS score, ≥4	669 (67)	7 (4–9)	54 (50–57)	62 (59–65)
RACE score, ≥5[6]	320 (32)	33 (28–38)	15 (12–17)	79 (77–82)
3I-SS score, ≥4[8]	133 (13)	70 (65–75)	5 (4–7)	74 (71–76)
mNIHSS[12] score, ≥7*	407 (41)	23 (19–28)	23 (20–26)	77 (74–80)
aNIHSS score, ≥1[17]	779 (78)	5 (3–8)	69 (66–73)	52 (49–55)
OoH-NIHSS score, ≥1[17]; CPSS score, ≥1[13]	832 (83)	4 (2–6)	76 (73–80)	47 (44–50)
sNIHSS-1[16] score, ≥2*	347 (35)	34 (29–39)	19 (16–22)	76 (73–79)
sNIHSS-5[16] score, ≥4*	372 (37)	28 (23–33)	20 (17–23)	77 (75–80)
sNIHSS-8[16] score, ≥6*	405 (40)	23 (18–27)	22 (19–25)	78 (75–80)
CPSSS score, ≥2[14]	324 (32)	35 (30–40)	16 (13–19)	78 (75–80)
MPSS[15] score, ≥3*	511 (51)	16 (12–20)	35 (31–38)	71 (69–74)
rNIHSS: profile A, B, C, D, or E (vs profile F)	535 (53)	17 (13–21)	39 (35–42)	68 (66–71)
ROSIER[19] score, ≥4*	421 (42)	21 (17–26)	24 (21–27)	77 (74–79)

3I-SS indicates 3-item stroke scale; aNIHSS, abbreviated NIHSS; CI, confidence interval; CPSS, Cincinnati Prehospital Stroke Scale; CPSSS, Cincinnati Prehospital Stroke Severity Scale; mNIHSS, modified NIHSS; MPSS, Maria Prehospital Stroke Scale; NIHSS, National Institute of Health Stroke Scale; OoH-NIHSS, out of hospital NIHSS; RACE, Rapid Arterial Occlusion Evaluation Scale; rNIHSS, retrospective NIHSS; ROSIER, Recognition of Stroke in the Emergency Room; and sNIHSS, shortened versions of the NIHSS.

*As no published cutoff was available for these scores to predict large-artery occlusion, we used the cutoff maximizing the sum of sensitivity and specificity in our cohort.

(*Stroke*. 2016;47:1466-1472. DOI: 10.1161/STROKEAHA.116.013144.)

Challenges of Identifying Stroke Scale for New York City

- No “12 Lead ECG Equivalent for Stroke”
- Lack of definitive evidence for stroke severity scales in prehospital setting
- Resource limitations
  - Basic Life Support (BLS) response
  - On-line Medical Control constraints
  - Training requirements for large number of providers
- Must be simple, easy to train and balance over and under triage

Proposed NYC Stroke Triage Protocol

- Derived from Los Angeles Stroke Scale/ Los Angeles Motor Scale

Exclusion criteria:

1.	LOC	Yes	No
2.	SZ (current or PMH)	Yes	No
3.	FS < 60	Yes	No
4.	Last known well > 5 hours	Yes	No
5.	Age < 45 y/o	Yes	No
6.	Trauma causing symptoms	Yes	No
7.	Wheelchair/bed ridden	Yes	No

Proposed NYC Stroke Triage Protocol

If all NO, proceed with LAMS:

Assess facial droop –	0 (absent)	1 (present)	
Assess arm weakness –	0 (absent)	1 (drifts down)	2 (falls rapidly)
Assess grip strength –	0 (normal)	1 (weak grip)	2 (no grip)

- If LAMS sum ≥ 4, transport to Endovascular Stroke Center

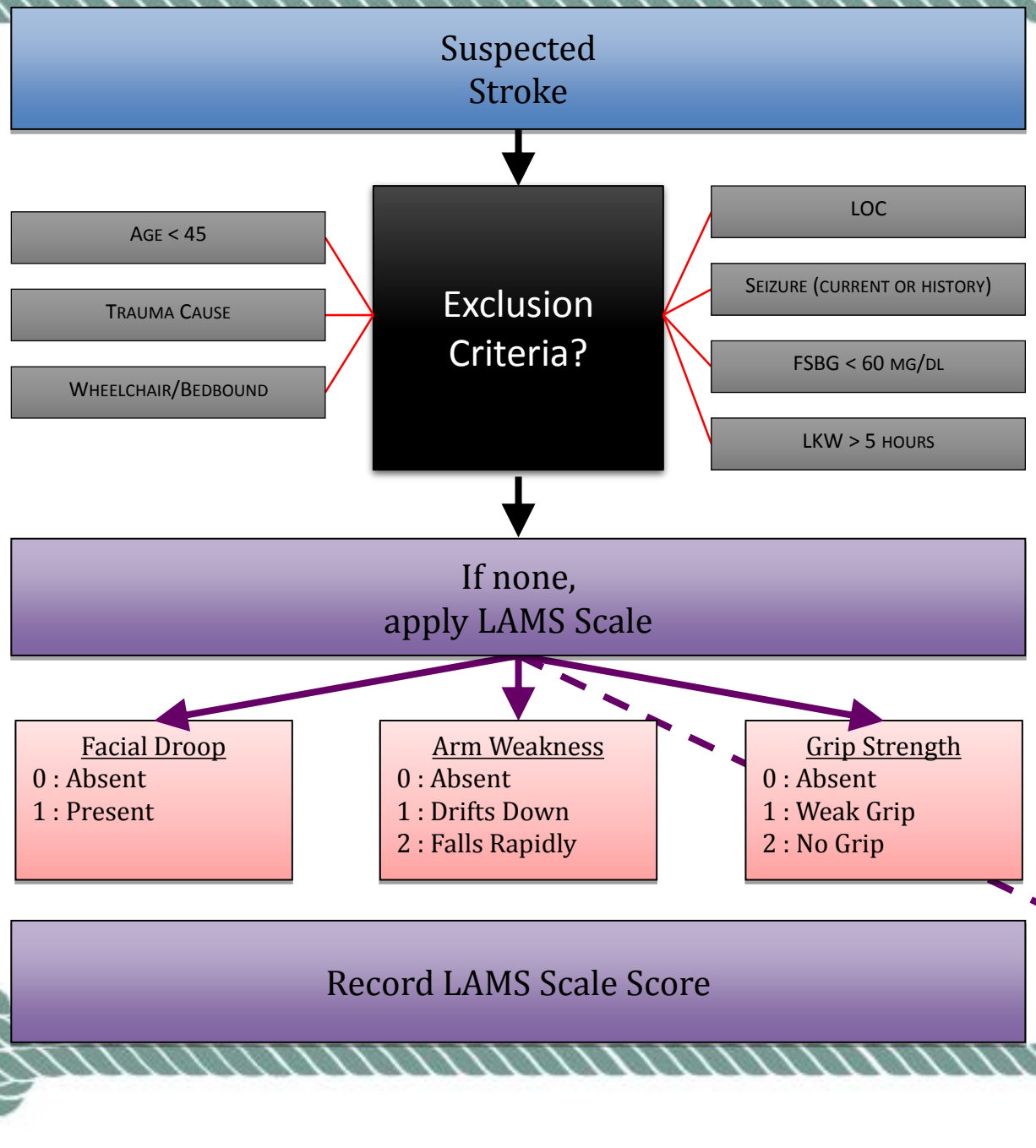
→ LA Motor Scale

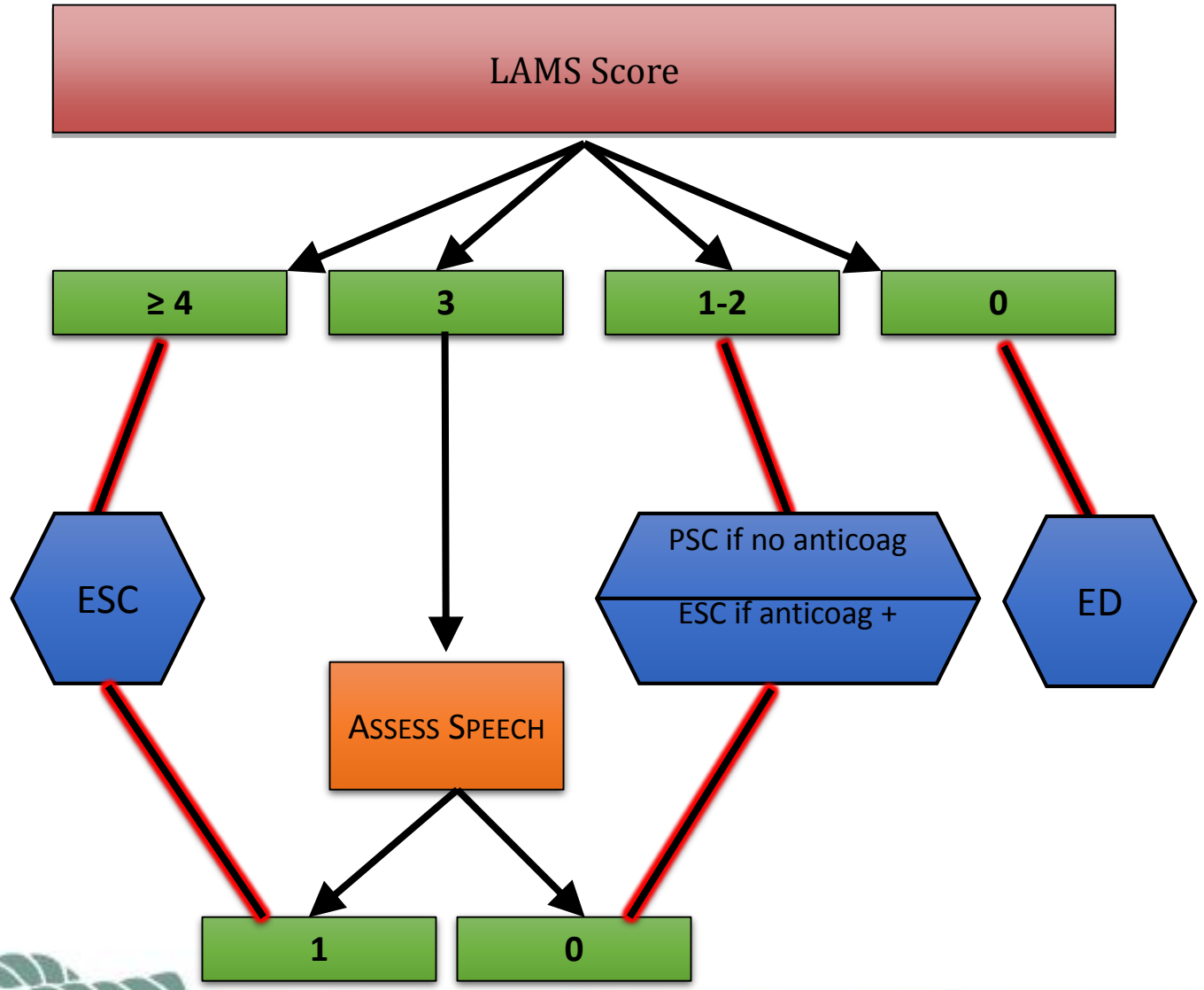
- If LAMS sum = 3, assess speech – 0 (normal) 1 (abnormal)
  - If LAMS + Speech sum = 4, transport to Endovascular Stroke Center, otherwise transport to Primary Stroke Center

→ Speech

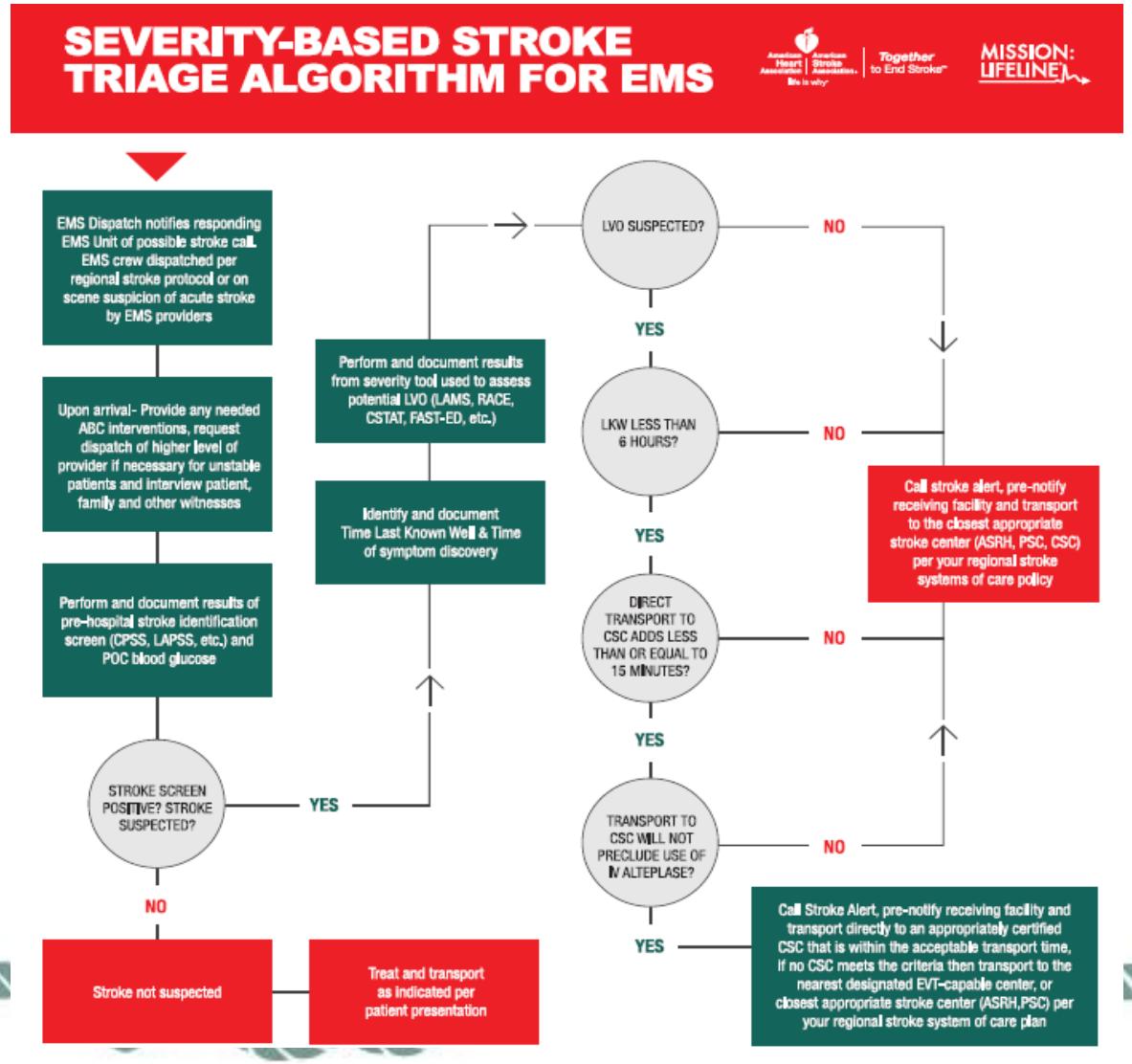
- If LAMS sum = 1-2, transport to Primary Stroke Center
- If LAMS sum = 0, transport to closest appropriate Emergency Department
- If patient on anticoagulants, and LAMS sum = 1-3, transport to Endovascular Stroke Center.
- If expected transport time to Endovascular Stroke Center exceeds 30 minutes, transport to Primary Stroke Center.

→ Integrated Transport Decision Plan


Suspected Stroke
Age < 45
Trauma Cause
Wheelchair/Bedbound
Exclusion Criteria?
LOC
Seizure (current or history)
FSBG < 60 mg/dL
LKW > 5 hours
If none, apply LAMS Scale
Facial Droop
0 : Absent
1 : Present
Arm Weakness
0 : Absent
1 : Drifts Down
2 : Falls Rapidly
Grip Strength
0 : Absent
1 : Weak Grip
2 : No Grip
Record LAMS Scale Score
Speech (LAMS=3)
(if required)
0 : Normal
1 : Abnormal


LAMS Score
≥ 4
3
1-2
0
ESC
PSC if no anticoag
ESC if anticoag +
ED
Assess Speech
1
0

AHA Stroke Triage Algorithm



ON SCENE

- Interview patient, family members and other witnesses to determine Last Known Well (LKW) time and time of Symptom Discovery.
- Attempt to identify possible stroke mimics (eg, seizure, migraine, intoxication) and determine if patient has pre-existing substantial disability (need for nursing homecare or inability to walk without help from others).
- Encourage family to go directly to Emergency Department if not transported with patient and obtain mobile number of next of kin and witnesses.
- If Mobile Stroke Unit available—follow Mobile Stroke Unit Protocol.
- Each EMS agency should utilize a published and validated stroke screen to assess patients with non-traumatic onset of focal neurologic deficits and validated tool to assess possible Large Vessel Occlusion (LVO).
- Patients who are eligible for IV Alteplase if transported to nearest Acute Stroke Ready Hospital (ASRH) or PSC should not be rerouted to a CSC or Thrombectomy-capable Stroke Center if doing so would result in a delay that would make them ineligible for IV Alteplase.
- Collect a list of current medications (especially anticoagulants) and obtain patient history including co-morbid conditions (eg. serious kidney or liver disease, recent surgery, procedures or stroke) that may impact treatment decisions.

Comparison of NYC v. AHA Algorithm

- AHA uses Stroke Identification THEN Stroke Severity
- NYC combines both steps into one step
- AHA recommends 15 minute > than PSC and NYC uses 30 minute total transport time
- AHA uses 6 hour LKW time and NYC uses 5 hour LKW to EMS contact to allow for on-scene evaluation, transport and ED evaluation (Future extension possible)

Next Steps: Broadening the care

- 40% or more of stroke patients arrive in means other than EMS
- Patients who are > 30 minutes from CSC/TSC will require “drip and ship” care
- Mandates robust pre-arranged transfer agreements and operations for potential LVO stroke patients
- Quality Improvement data collection is imperative and must integrate EMS and hospital data

Next Steps: Building Partnerships and Consensus

- Working with NYC members of New York State Stroke Advisory Committee and AHA NYC Stroke Taskforce
- Partnering with AHA and Greater New York Hospital Association to ensure seamless alignment of stroke care in New York City from EMS patient contact through definitive care
- Working with NYS Department of Health to identify appropriate State Level designations of CSC and TSC.

Challenges in Stroke Triage

- Same challenges as all systems with local variations
- Time is brain
- Overtriage v. undertriage
- Primary transport v. Drip and Ship.

Challenges in NYC Systems of Care

- Regional discussions for almost 2 years
- Complexity of New York City Health Care Landscape
- Need to avoid disparity of care for population

Questions?

Thank you

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- Molly Perini
- Ethan Brandler
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- NYS Stroke Advisory Group
- GNYHA, FDNY and REMAC