Hastening Alarm to Treatment Times

Literature Based Opportunities and Early Lessons from Strategies Implemented in Upstate NY

Chris Zammit, MD

Medical Director, Stroke and Neuroscience ICU, Good Samaritan Hospital, Comprehensive Stroke Center

Medical Director, Acute Neurologic Emergencies, TriHealth Hospital System

Objectives

- Understand the relationship between times to treatment and outcomes in acute ischemic stroke
- Understand strategies that hasten door to treatment times
- Understand strategies that hasten the identification and transfer of large vessel occlusions acute ischemic stroke
- Become familiar with prehospital strategies that hasten alarm to treatment times

Time Is Brain—Quantified

(*Stroke*. 2006;37:263-266.)

Jeffrey L. Saver, MD

Estimated Pace of Neural Circuitry Loss in Typical Large Vessel, Supratentorial Acute Ischemic Stroke

	Neurons Lost	Synapses Lost	Myelinated Fibers Lost	Accelerated Aging
Per Stroke	1.2 billion	8.3 trillion	7140 km/4470 miles	36 y
Per Hour	120 million	830 billion	714 km/447 miles	3.6 y
Per Minute	1.9 million	14 billion	12 km/7.5 miles	3.1 wk
Per Second	32 000	230 million	200 meters/218 yards	8.7 h

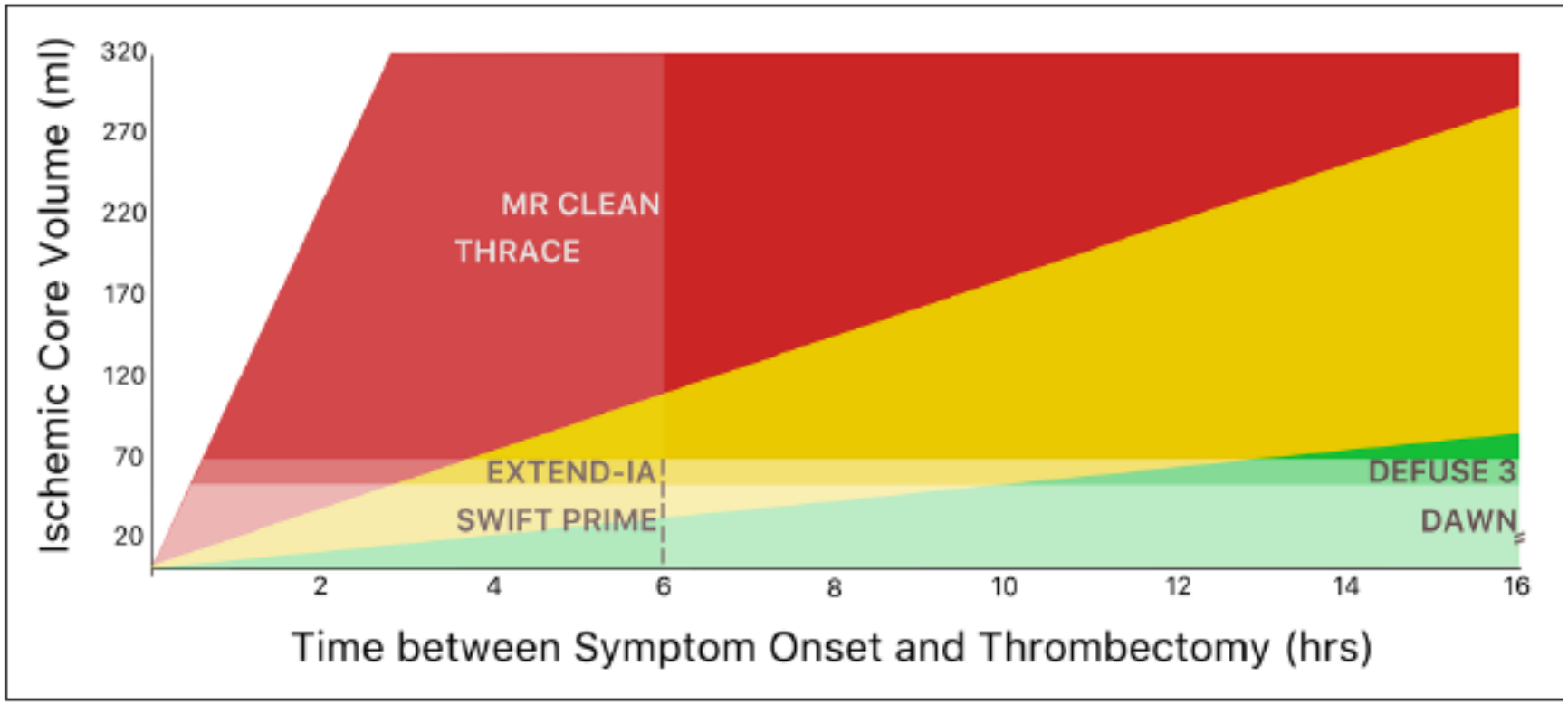
Analogy

Day	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Rainfall	0”	7”	0”	0”	0”	0”	0”

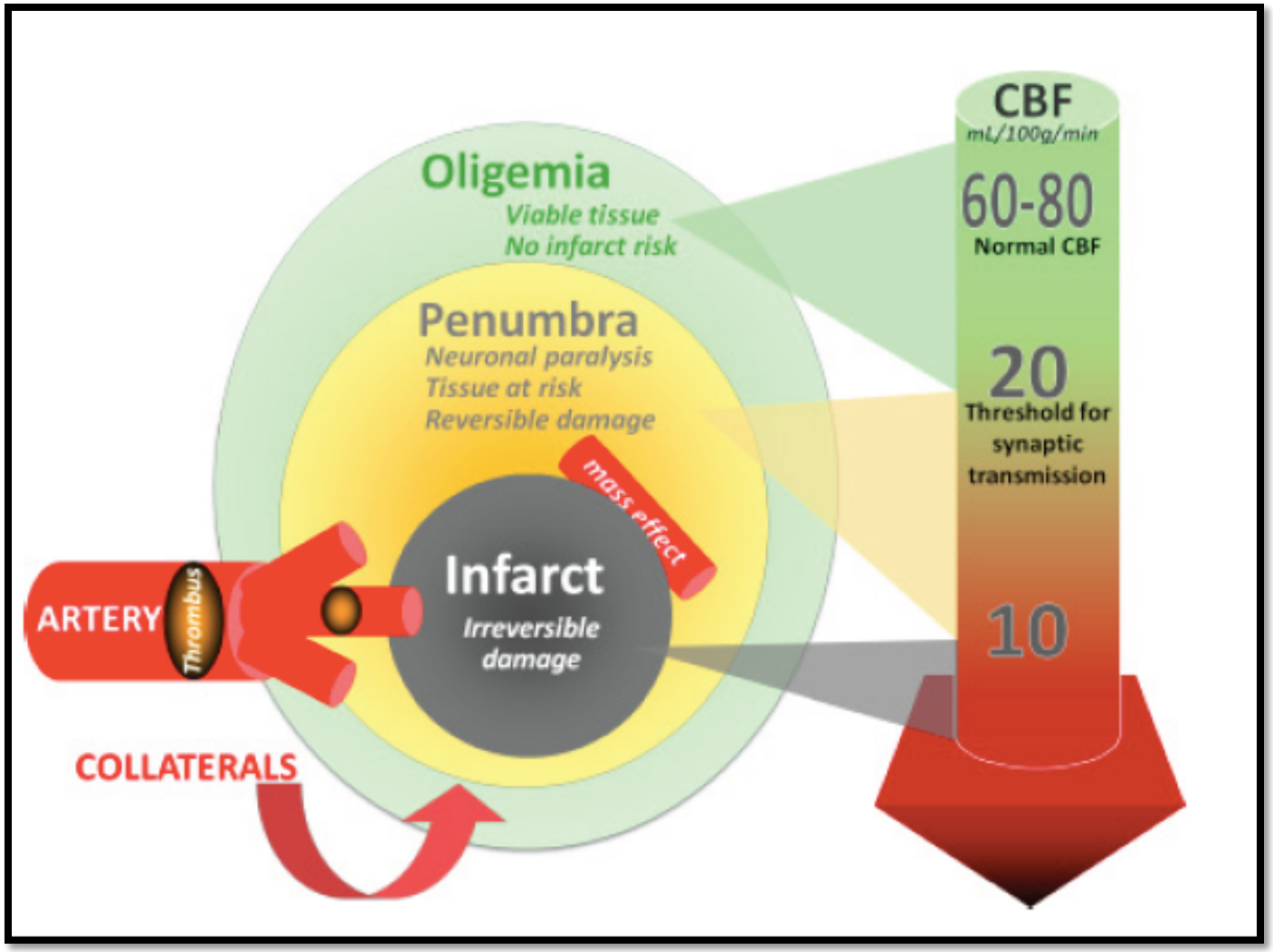
Did it rain 1” per day during this week?

Of course not!

Different Rates of Stroke Progression



Stroke. 2018;49:768-771.



Eur Neurol 2014;72:309–316

Reframing Time is Brain

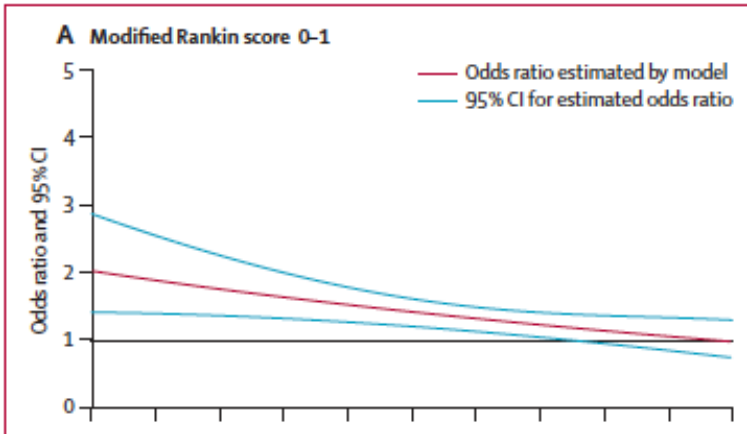
- Brain cells die FAST without blood flow
- In some strokes, there is SOME blood flow, but not enough for the brain to function and not so little that it dies right away
  - The mechanisms that provide that sustaining blood flow fail over hours to days
- In other strokes, blood flow is immediately interrupted and the brain dies VERY quickly

Time to Treatment With Intravenous Tissue Plasminogen Activator and Outcome From Acute Ischemic Stroke

JAMA, June 19, 2013—Vol 309, No. 23

Lancet 2010; 375: 1695–703

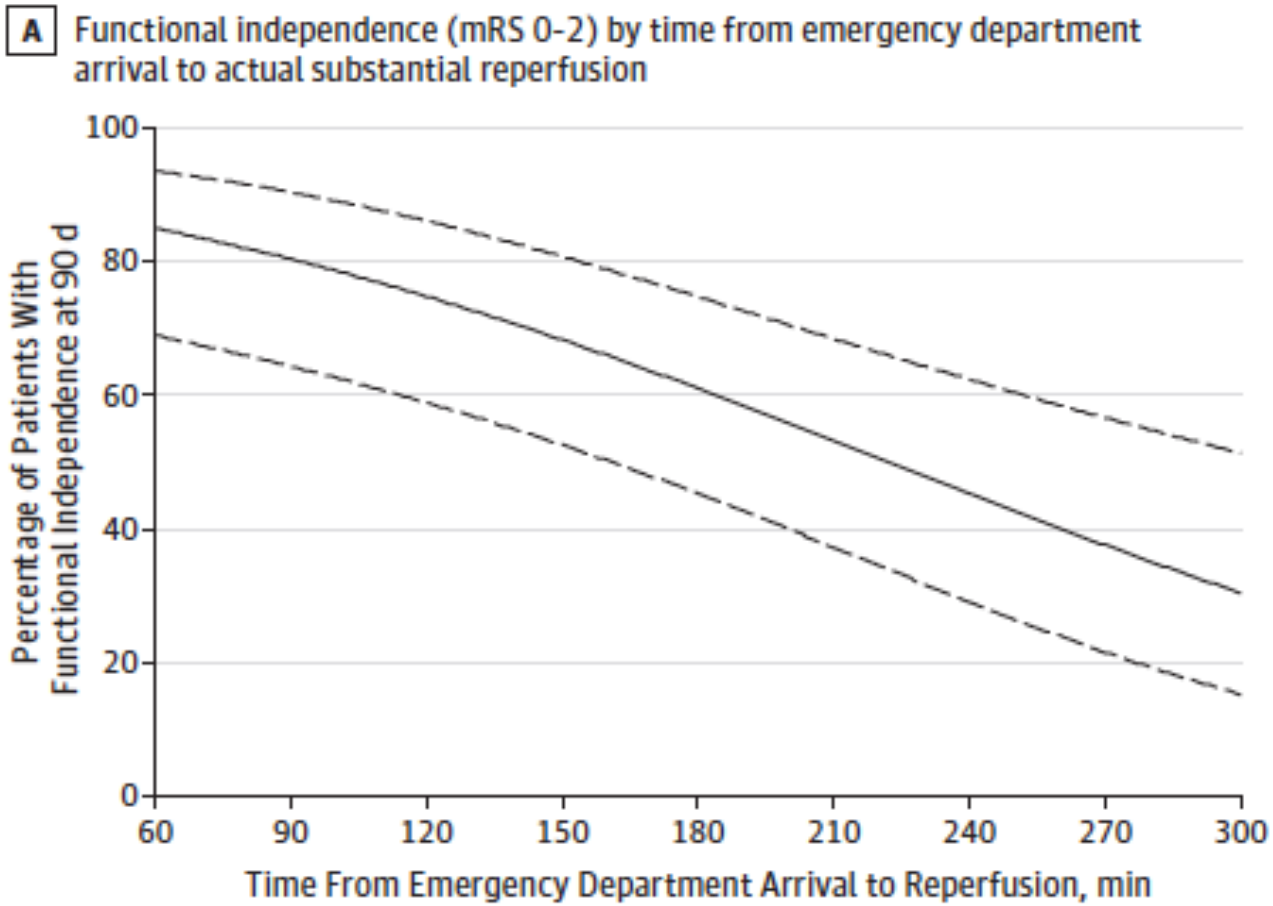
Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials



"Faster onset to treatment, in ***15-minute increments,*** was associated w/

- reduced in-hospital mortality
- reduced symptomatic ICH
- increased achievement of independent ambulation at discharge
- increased discharge to home."

Time to Treatment With Endovascular Thrombectomy and Outcomes From Ischemic Stroke: A Meta-analysis



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

Door-to-Needle (DTN) Strategies

Target: Stroke Phase II Goals: 2014

- Primary Goal: Achieve Door-to-Needle Times within 60 minutes in 75% or more of acute ischemic stroke patients treated with IV tPA.
- Secondary Goal: Achieve Door-to-Needle times within 45 minutes in 50% or more of acute ischemic stroke patients treated with IV tPA.

Target: Stroke Phase III Goals: 2020

NATIONAL GOALS FOR PHASE III

PRIMARY GOALS

- Achieve door-to-needle times within 60 minutes in 85 percent or more of acute ischemic stroke patients treated with IV thrombolytics.
- Achieve door-to-device times (arrival to first pass of thrombectomy device) in 50% or more of eligible acute ischemic stroke patients within 90 minutes (for direct arriving patients) and within 60 minutes (for transfer patients) treated with endovascular therapy (EVT).

SECONDARY GOALS

- Achieve door-to-needle times within 45 minutes in 75 percent or more of acute ischemic stroke patients treated with IV thrombolytics.
- Achieve door-to-needle times within 30 minutes in 50 percent or more of acute ischemic stroke patients treated with IV thrombolytics.

Target: Stroke Best Practices

1. EMS Pre-Notification
2. Stroke Tools: Decision Support, Order-sets, Guidelines, Protocols, NIHSS
3. Rapid Triage Protocol & Stroke Team Notification
4. Single Call Activation System
5. Timer or clock attached to chart, clip board or patient bed
6. Transfer Directly to CT Scanner
    - Quickly determine if NIHSS >/= 6; if so, concurrently perform CT angiography
7. Rapid Acquisition and Interpretation of Brain Imaging
8. Rapid Laboratory Testing (e.g. POC, procedures for lab prioritization)
9. Mix Alteplase Ahead of Time
10. Rapid Access and Administration of IV alteplase
    - "*The initial tPA bolus should be administered while the patient is on the CT table*"
11. Team-Based Approach
12. Prompt Data Feedback

Who Needs Labs before Alteplase?

- “presence of medical conditions associated with coagulation disorders, including the presence of cancer, alcoholism, renal or liver failure or drug abuse.”
- Those on warfarin

Highly Successful DTN Strategies

- Patient Registration Prior to Arrival to review medical records and pre-order tests
- Patient History Prior to Arrival via continuous EMS communication
- Emergency Provider focused training and directed treatment

Reducing in-hospital delay to 20 minutes in stroke thrombolysis

Neurology® 2012;79:306-313

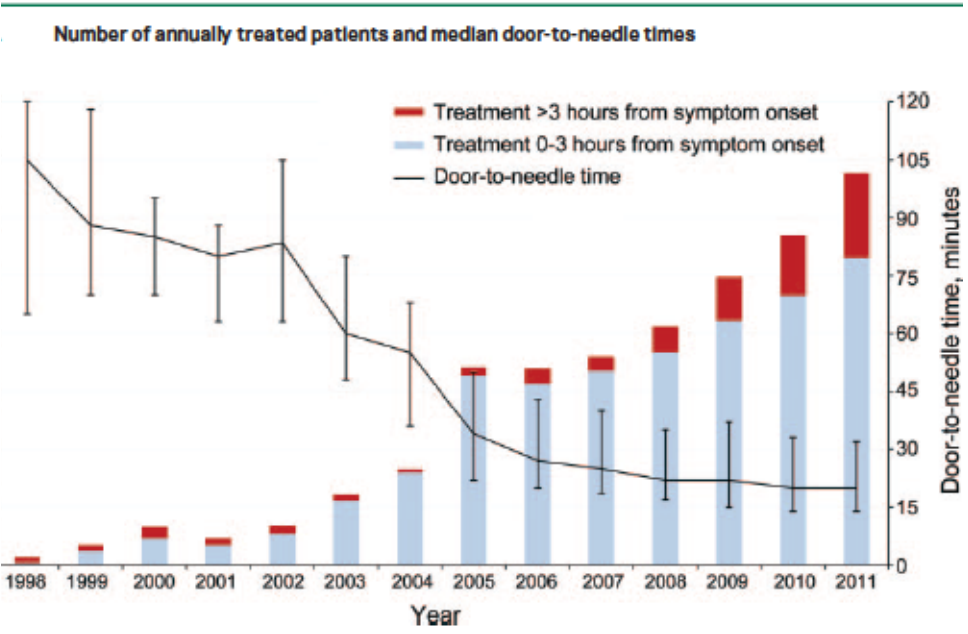


Table 1 Twelve measures to reduce treatment delays

Measure	Description	Year
EMS involvement	Education of dispatchers and EMS personnel, stroke high-priority dispatch	1998
Hospital prenotification	EMS contacts stroke physician directly via mobile phone	2001
Alarm and preorder of tests	Laboratory and CT computer-ordered and alarmed at prenotification	2001
No-delay CT interpretation	Stroke physician interprets the CT scan, not waiting for formal radiology report	2001
Premixing of tPA	With highly suspect thrombolysis candidates, tPA premixed prior to patient arrival	2002
Delivery of tPA on CT table	Bolus administered on CT table	2002
CT relocated to ER	Patient transfers of several hundred meters, including elevators, were no longer needed	2003
CT priority and CT transfer	CT emptied prior to patient arrival, and patient transferred straight onto CT table, not ER bed	2004
Rapid neurologic evaluation	Patient is examined upon arrival, on CT table	2004
Preacquisition of history	Statewide electronic patient records and eyewitness interview before/during transportation	2005
Point-of-care INR	Laboratory personnel draw blood while patient on CT table, and perform instant POC INR	2005
Reduced imaging	While all patients have a CT, advanced imaging reserved for unclear cases only	2005

Reducing in-hospital delay to 20 minutes in stroke thrombolysis

Neurology® 2012;79:306-313

"However, the preliminary history relayed by the EMS, especially on symptom onset, was often not accurate, and reaching next of kin or eyewitnesses afterwards for treatment decisions was difficult. ***The treating stroke physician therefore requested communication with the primary informants over a mobile phone already at prenotification, during EMS contact on-scene, and preferably to have the next of kin cotransported by EMS to allow for rapid additional history taking when need arose. Such history taking during transport was complemented by accessing the provincewide electronic patient records prior to patient arrival."***

Fast Protocol for Treating Acute Ischemic Stroke by Emergency Physicians

Iiro Heikkilä, MD*; Hanna Kuusisto, MD, PhD; Markus Holmberg, MD; Ari Palomäki, MD, PhD

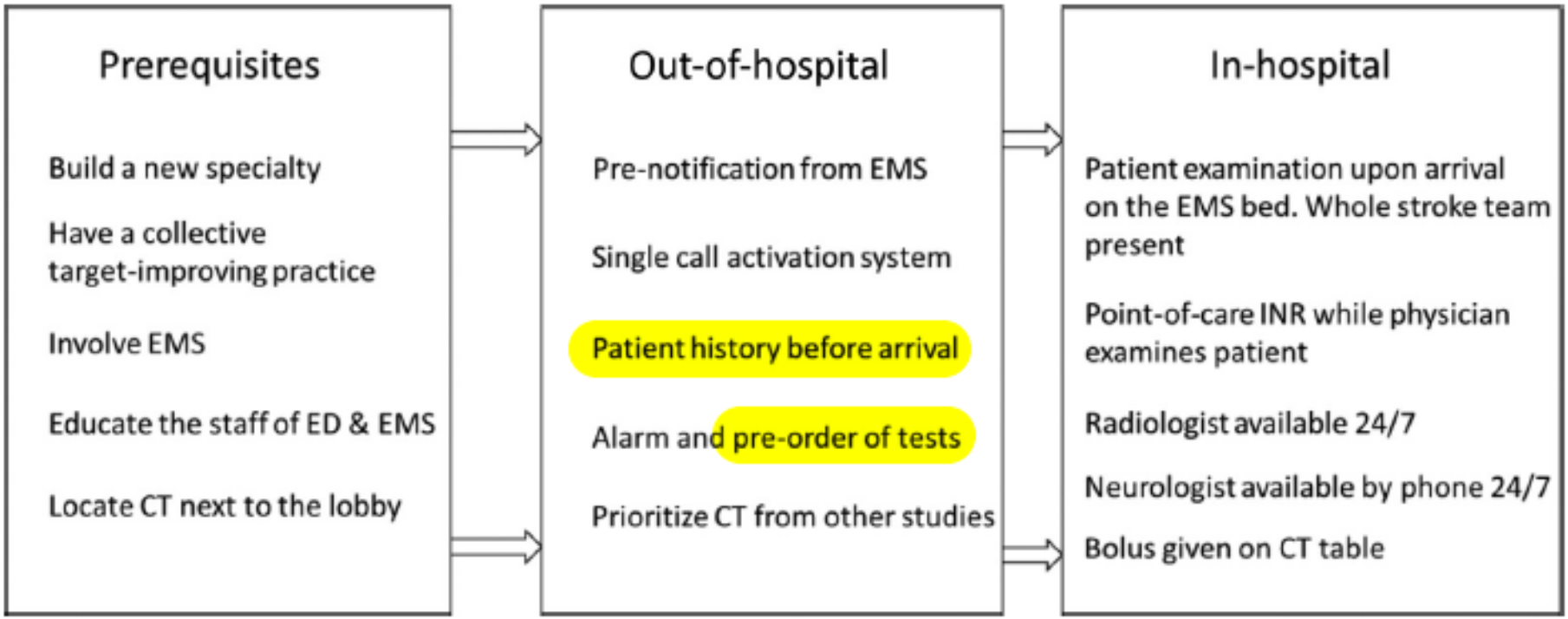
Results: A total of 107 patients with comparable data were treated with tissue plasminogen activator in 2009 to 2012 (group 1) and 46 patients were treated during 12 months in 2013 to 2014 (group 2). Median door-to-needle time was 54 minutes before the reorganization and 20 minutes after it (statistical estimate of difference 32 minutes; 95% confidence interval 26 to 38 minutes). After adjusting for several potential cofounders in multivariable regression analysis, the only factor contributing to a significant reduction in delay was group (after reorganization versus before). Median onset-to-treatment times were 135 and 119 minutes, respectively (statistical estimate of difference 23 minutes; 95% confidence interval 6 to 39 minutes). The rates of symptomatic intracerebral hemorrhage were 4.7% (5/107) and 2.2% (1/46), respectively (difference 2.5%; 95% confidence interval −8.7% to 9.2%). Approximately 70% of treated patients were functionally independent (modified Rankin Scale score 0 to 2) when treated after the reorganization.

Conclusion: Implementation of a stroke protocol with emergency physician–directed acute care decreased both door-to-needle time and onset-to-treatment time without increasing the rate of symptomatic intracerebral hemorrhage. [Ann Emerg Med. 2019;73:105-112.]

Fast Protocol
Emergency Physician Focused Training

- Training in the stroke unit at the neurology ward
- Theoretical teaching and practical training in diagnosing and treating patients with acute ischemic stroke
- Preparation with the electronic patient record after the prenotification given by EMS
- Shadowing of an experienced neurologist in acute neurologic emergencies
- Diagnosis and treatment of their own patients with clinical acute ischemic stroke, under the supervision of the specialist in the ED.
- Radiologists taught emergency physicians the evaluation of head computed tomography (CT) of patients with acute ischemic stroke.

Fast Protocol
Performance Improvement and Process



Improved door-to-needle times and neurologic outcomes when IV tissue plasminogen activator is administered by emergency physicians with advanced neuroscience training☆,☆☆

American Journal of Emergency Medicine 33 (2015) 234–237

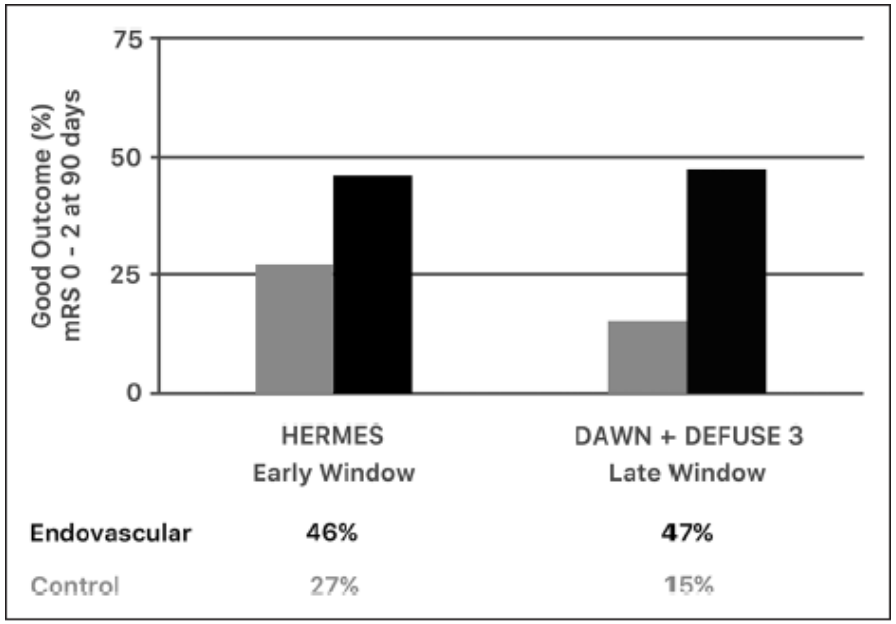
Advanced neuroscience training

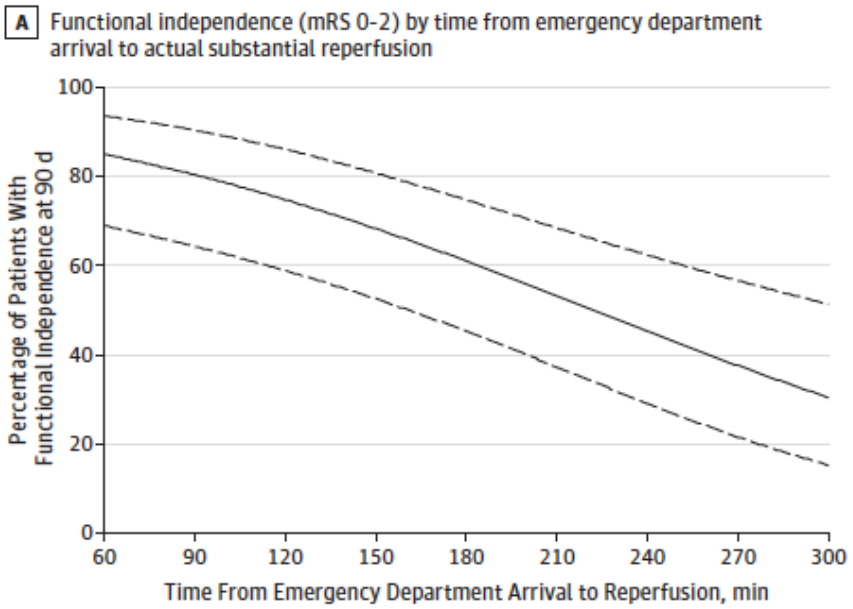
Fellowship training	Contact hours
Neurologic ICU	24
Neuroradiology	24
Stroke unit	16
Cerebrovascular neurosurgical intervention	16
Annual neurologic CME	16
Annual attendance at dedicated neuroscience conference also required	

DTN 83 min vs 35 min

Door-in Door-out (DIDO) for Large Vessel Occlusion (LVO) Acute Ischemic Strokes

Mechanical Thrombectomy Efficacy





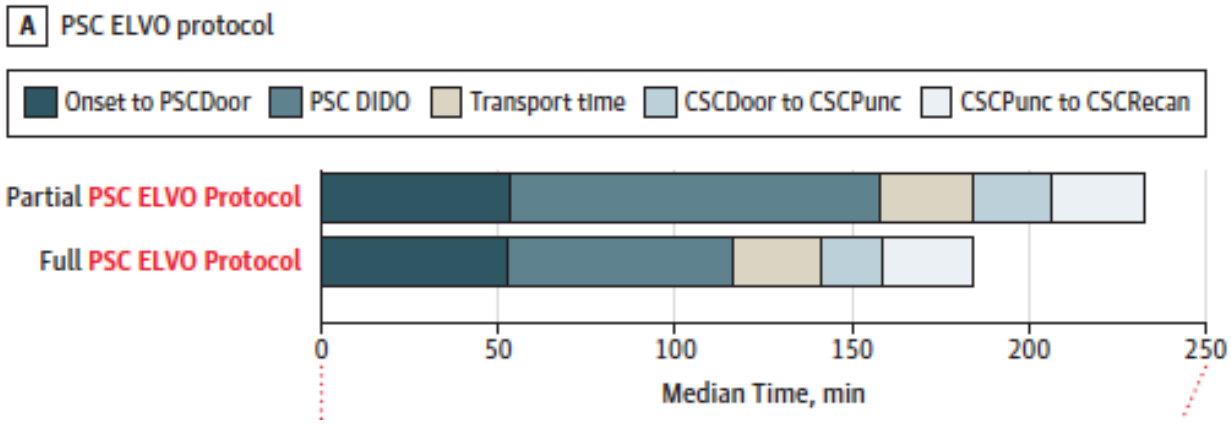
Alberts, Stroke. 2018;49:768-771.
Saver, et al. JAMA. 2016;316(12):1279-1288

Association of a Primary Stroke Center Protocol for Suspected Stroke by Large-Vessel Occlusion With Efficiency of Care and Patient Outcomes

Ryan A. McTaggart, MD; Shadi Yaghi, MD; Shawna M. Cutting, MD, MS; Morgan Hemendinger; Grayson L. Baird, PhD; Richard A. Haas, MD; Karen L. Furie, MD, MPH; Mahesh V. Jayaraman, MD

1. Notify the CSC on arrival
2. Perform computed tomographic angiography concurrently with non-contrast computed tomography of the brain and within 30 minutes of arrival
3. Share imaging data with the CSC using a cloud-based platform.

"When the protocol was fully executed, patients were twice as likely to have a favorable outcome (50% vs 25%, P < .04)."

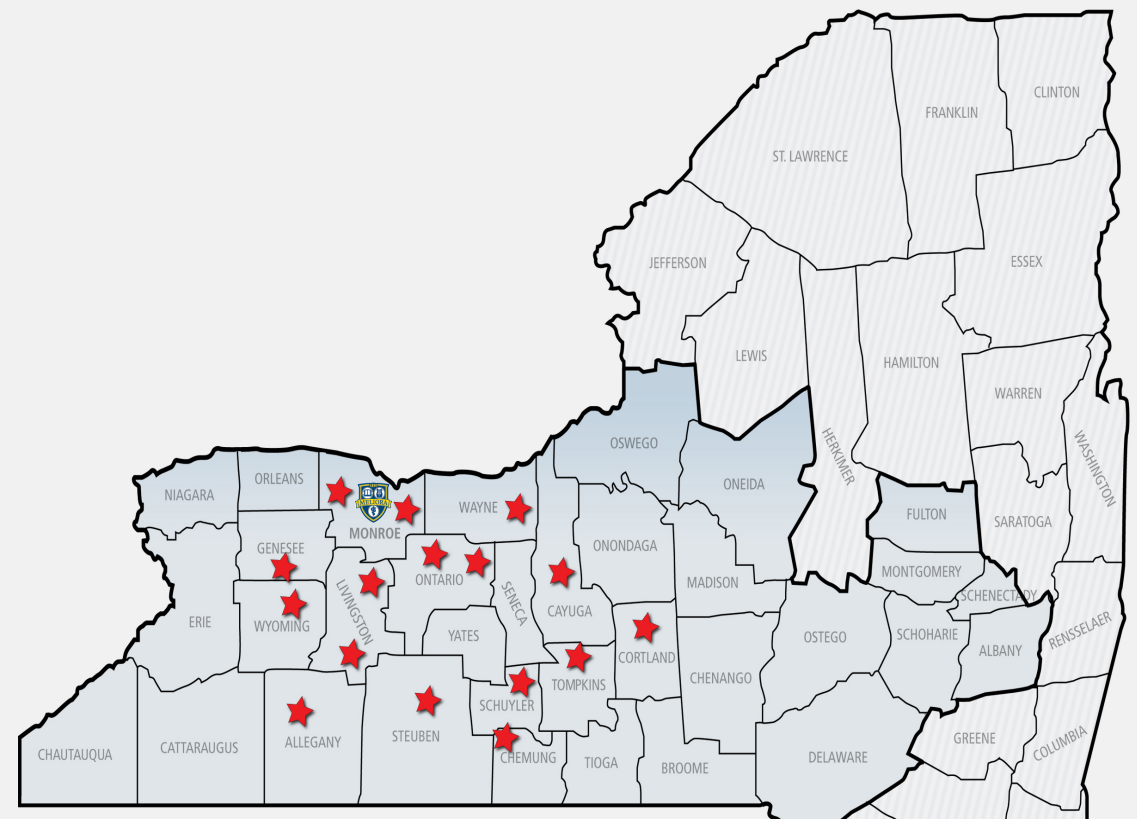


Rhode Island (McTaggart, et al)

- 1212 sq miles
- ~1.05 million people

Rochester, NY Region

- Monroe County alone 1367 sq miles
- 14 more counties
- ~ 1.7 million people



The University of Rochester Medical Center (URMC)

“Code LVO” Pathway

“Code LVO”: Goals

- Identify all Acute Ischemic Strokes due to Large Vessel Occlusions in our region meeting AHA/ASA recommendations for endovascular treatment
- Allow patients with ischemic strokes to remain at their local community hospital when transfer to a CSC is unlikely to be of benefit
- Median DIDO time of 60 minutes
- Median OSH door to CSC Skin Puncture time of 120 minutes

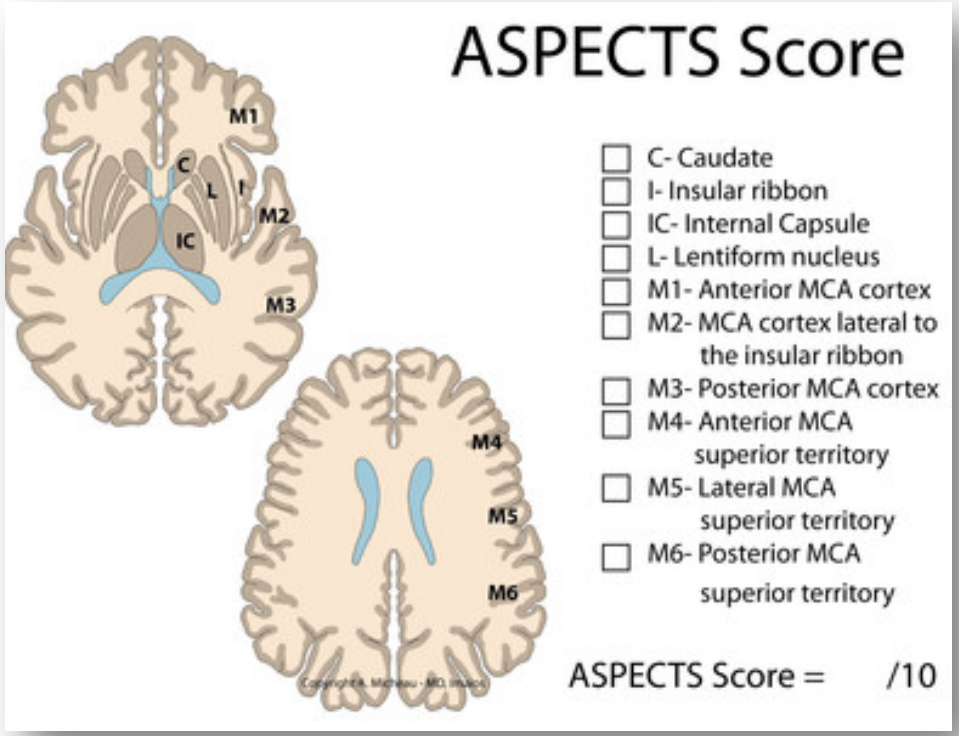
“Code LVO” Qualifying Criteria

NIHSS $\geq$ 6

ASPECTS $\geq$ 6

Anterior Circulation LVO (ICA or Proximal MCA, i.e. M1)

ASPECTS: Alberta Stroke Program Early CT Score



http://www.aspectsinstroke.com/

Lancet 2000; **355:** 1670–74

<u>Look at all Cuts</u>

CT cuts at level of Basal Ganglia

C/ IC/ L/ I

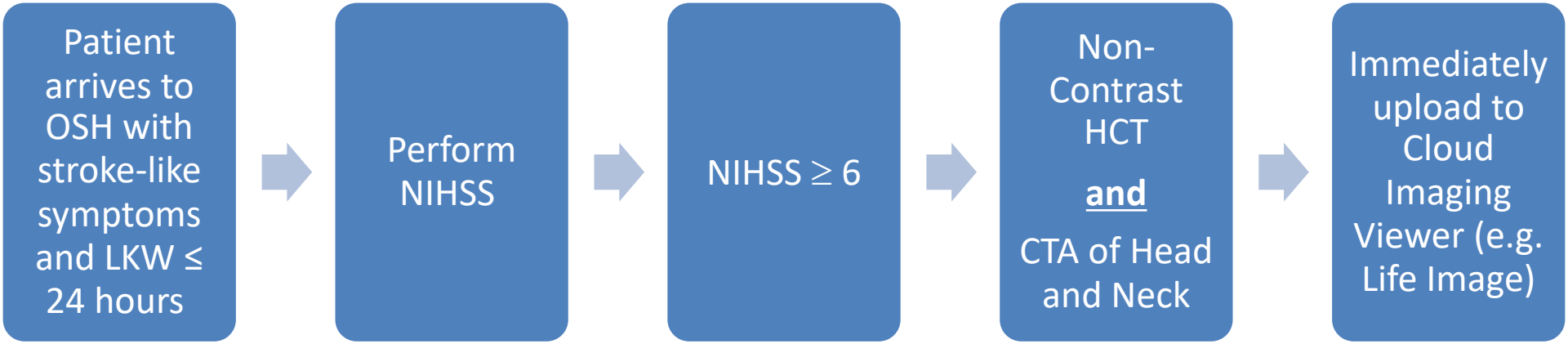
M1/ M2/ M3

CT Cuts > 1 cm rostral to Basal Ganglia:

M4/ M5/ M6

Lose 1 point for each area with EIC

“Code LVO”: Identification



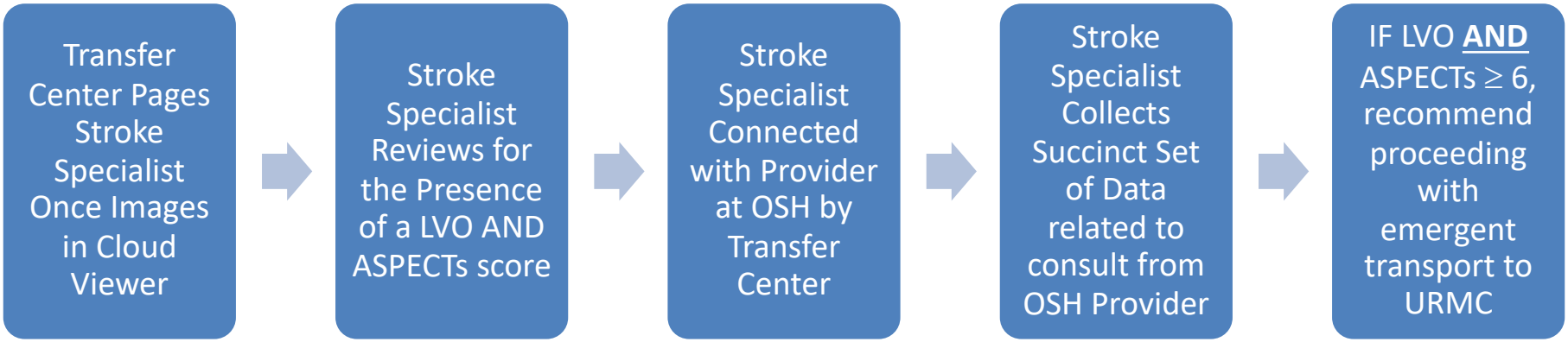
Code LVO: Parallel Processes

NIHSS ≥ 10

- HCT and CTA of Head and Neck
- Call Transfer Center and say "Code LVO at ____" and send face-sheet
- Auto-Launch Transport (HEMS vs Ground)
- Routine ED evaluation for IV tPA

Note: NIHSS 6-9 should have CTA done on arrival. If local read is LVO, Auto-Launch transport and Call Transfer center, as per above

“Code LVO”: CSC Process



Information Obtained in Consult

- NIHSS
- Method of Transport
- Anticoagulant Use + INR or Last Dose of Medication
- tPA yes/no
- LKWT
- Family contact name & phone number
- +/- Baseline Functional Status

CSC Process, Confirmed Transfer

- OSH RN -> URMC RN Report
- URMC sends “Code LVO” Page to
  - Mobilize the OR and NeuroICU
  - Provide notification to ED, Neurology, and NSGY of patient’s ETA

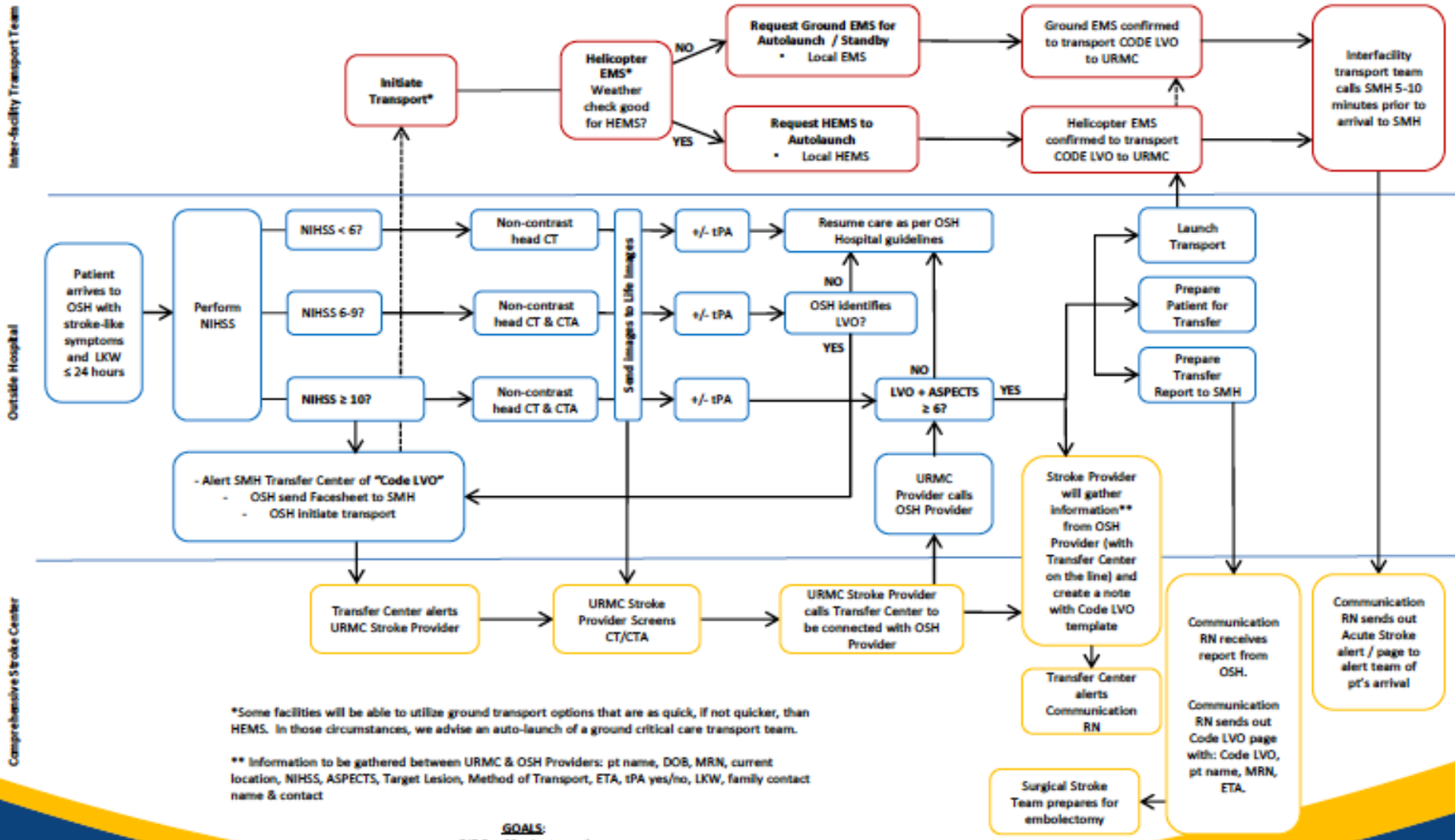
“Code LVO” Results through 12/2018

Metric	Pre-Code LVO	Post-Code LVO	Absolute Diff
Hospital 1 Median DIDO	2:17	1:29	**-0:48**
Hospital 2 Median DIDO	2:07	1:43	**-0:24**
Hospital 3 Median DIDO	2:07	0:57	**-1:10**
Aggregate Median DIDO	2:10	1:20	**-0:50**
% DIDO < 60 minutes	1.1%	15.4%	**+14.3%**
Thrombectomy Attempt Rate	25.4%	53.9%	**+29.5%**
Mortality Rate	27.2%	16.7%	**-10.5%**

2018 “Code LVO” Results vs New York State

Metric	Code-LVO Hospitals	New York State	Difference
Median DIDO	1:20	2:10	**- 0:50**
% DIDO < 60 min	15.4%	3.7%	**+11.7%**

Outside Hospital (OSH) - CODE LVO Stroke



*Some facilities will be able to utilize ground transport options that are as quick, if not quicker, than HEMS. In those circumstances, we advise an auto-launch of a ground critical care transport team.

** Information to be gathered between URMC & OSH Providers: pt name, DOB, MRN, current location, NIHSS, ASPECTS, Target Lesion, Method of Transport, ETA, tPA yes/no, LKW, family contact name & contact

GOALS:
DIDO – 60 minute goal
OSH door to Skin Puncture – 120 minutes goal

For more information, please contact:

Christopher Zammit, MD
Assistant Professor of Emergency Medicine, Neurology, Neurosurgery, and Medicine
Attending Neurointensivist and Emergency Physician
University of Rochester Medical Center
585-273-4058, Christopher_Zammit@urmc.Rochester.edu

Sarah Gallagher, RN
Regional Stroke Coordinator
Comprehensive Stroke Center
University of Rochester Medical Center
585-727-1649, Sarah_Gallagher@urmc.Rochester.edu

UR MEDICINE

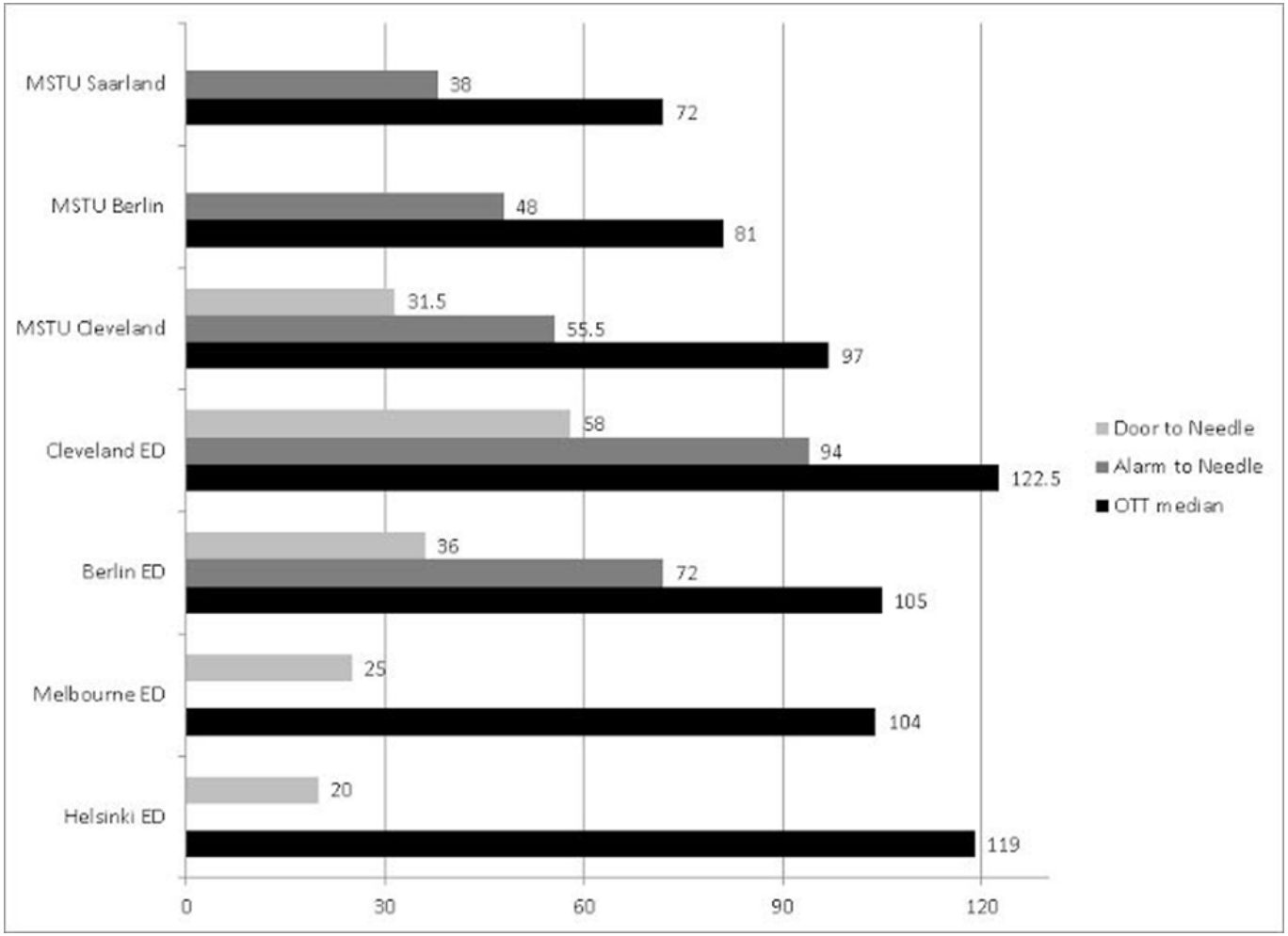
The Joint Commission · American Heart Association · American Stroke Association
CERTIFICATION
Comprehensive Stroke Center

Code LVO Acknowledgements

- Regional ED nurses and physicians
- Regional Stroke directors, providers and coordinators
- Critical care transport teams
- URMC Transfer center
- URMC ED and ICU teams
- URMC Cerebrovascular team
  - Tarun Bhalla, MD PhD, Thomas Mattingly MD
- URMC Radiology/ IR
- URMC OR teams and Anesthesiology
- Sarah Gallagher, BS, RN, CCRN-K, SCRN, URMC regional stroke coordinator
- Diana Proper, MS, RT, URMC Neurosurgery Stroke Data Coordinator


Mobile Stroke Unit
UR
MEDICINE
Made possible
by a lead gift from
Elena Prokupets
AMR
UR
MEDICINE
SINTON EM

MSU Programs Comparison Worldwide



JAMA Neurology | Original Investigation

Prehospital Stroke Management Optimized by Use of Clinical Scoring vs Mobile Stroke Unit for Triage of Patients With Stroke

A Randomized Clinical Trial

JAMA Neurol. doi:10.1001/jamaneurol.2019.2829
Published online September 3, 2019.

RESULTS A predefined interim analysis was performed after 116 patients of the planned 232 patients had been enrolled. Of these, 53 were included in the OPM group (67.9% women; mean [SD] age, 74 [11] years) and 63 in the MSU group (57.1% women; mean [SD] age, 75 [11] years). The primary end point, an accurate triage decision, was reached for 37 of 53 patients (69.8%) in the OPM group and for 63 of 63 patients (100%) in the MSU group (difference, 30.2%; 95% CI, 17.8%-42.5%; $P < .001$). Whereas 7 of 17 OPM patients (41.2%) with LVO or ICH required secondary transfers from a PSC to a CSC, none of the 11 MSU patients (0%)

Emergency Department Door-to-Puncture Time Since 2014

Observations From the BEST-MSU Study

Alexandra L. Czap, MD; James C Grotta, MD; Stephanie A. Parker, RN; Jose-Miguel Yamal, PhD;

(*Stroke*. 2019;50:1774-1780. DOI: 10.1161/STROKEAHA.119.025106.)

Door to Groin Puncture 10 minutes faster for MSU patients

URMC Hospital Treatment Case

- 86 y.o. male presented with R sided weakness, R facial droop and dysarthria.
- EMS with a pre-arrival notification that included CPSS, LKW.
- Stroke alert activated.
- On initial exam at SMH, the patient had a NIHSS of 12 for gaze palsy, right facial droop, right arm/leg weakness, left gaze preference, right field cut, and both aphasia and dysarthria.
- Head CT showed no hemorrhage.
- CTA showed a left M1 occlusion and proximal LICA occlusion.
- Determined to be a candidate for IV thrombolytic therapy.
- LOS 2 days, discharged to home, NIHSS 2.

Pre-arrival EMS call	- 28 min
Door to Stroke Alert	- 13 min
Door to MD	0 min
Door to CT	8 min
Door to tPA	18 min

Alarm to Treatment: 46 minutes

URMC MSU Case

LKW / Symptom Discovery	09:00
MSU Dispatch	09:07
MSU Arrival to Scene	09:10
MSU Patient Contact	09:12
On MSU	09:28
Stroke Specialist Contact	
CT Slice	09:30
CT Push	09:32
CT Read	09:33
Treatment Decision Time	
Departure from Scene	09:35
tPA start time	09:37

Dispatch to Arrival	*00:03*
Arrival to MSU door	*00:18*
Door to CT	*00:02*
Dispatch to CT	*00:23*
Total Scene Time	*00:25*
Door to tPA	***00:09***
Dispatch to tPA	*00:30*

Alarm to Treatment: 30 minutes

Discharge NIHSS 0

Discharged home with PT services

URMC MSU Workflow

Thank you