Stroke Care Across Borders Increasing Access via Telemedicine

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Disclosures

- No financial relationships with any device or drug companies

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Learning Objectives

- Discuss the challenges in acute ischemic stroke management due to limited time window

- Discuss the use of telemedicine in delivery of hyperacute ischemic stroke intervention

- Discuss effect of telemedicine in regionalization of stroke care and patient outcome

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Take-Home Points

- Intravenous t-PA is effective in ischemic stroke but only few patients have access to treatment

- Telemedicine facilitates IV-tPA treatment and improves treatment rate

- Regionalized stroke system of care can impact stroke outcome using telemedicine

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Time is Brain

- 2 million neurons die per minute
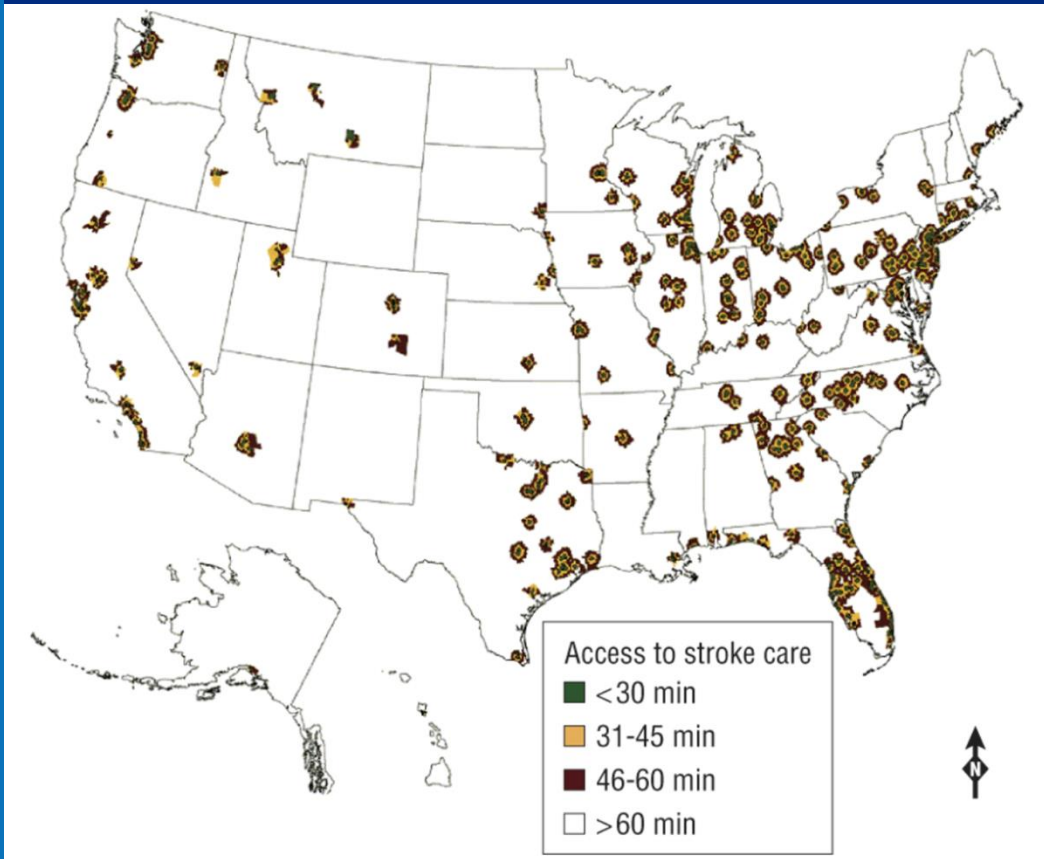
- IV-tPA effect is time-sensitive
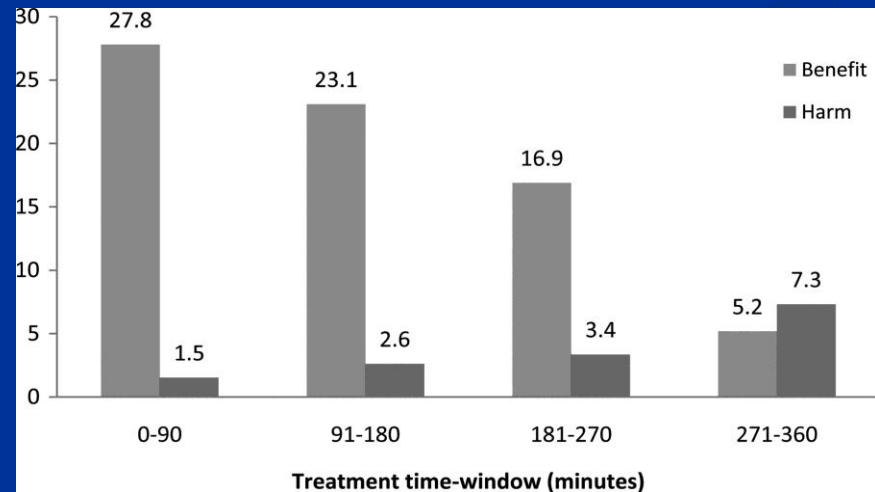
Saver J. Stroke 2006;37:263-266)
Landsberg, M et al. Stroke. 2009;40(6):2079–2084

Who gets treated in Acute Stroke?

- Stroke incidence: A 795,000/year
  - 87% of A Ischemic stroke B(691,650)
  - 38% of B arrive within 3 hours C (282,827)
  - 57% of C may be eligible to tPA (161,211)
- Proportion of eligible patients receiving tPA
  - US overall: 4-8% (6,000-12,000)
  - US primary stroke centers: 8-15%

Heart Disease and Stroke Statistics 2012-Update. Circulation 2012
Mullen MT et al. International Stroke Conf 2013, Honolulu, HI.

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Access to Stroke Care: US

Access to stroke care
- ■ <30 min (green)
- ■ 31-45 min (orange)
- ■ 46-60 min (dark red)
- □ >60 min (white)

All population
    < 30 min 22.3%
    < 45 min 43.2%
    < 60 min 55.4%
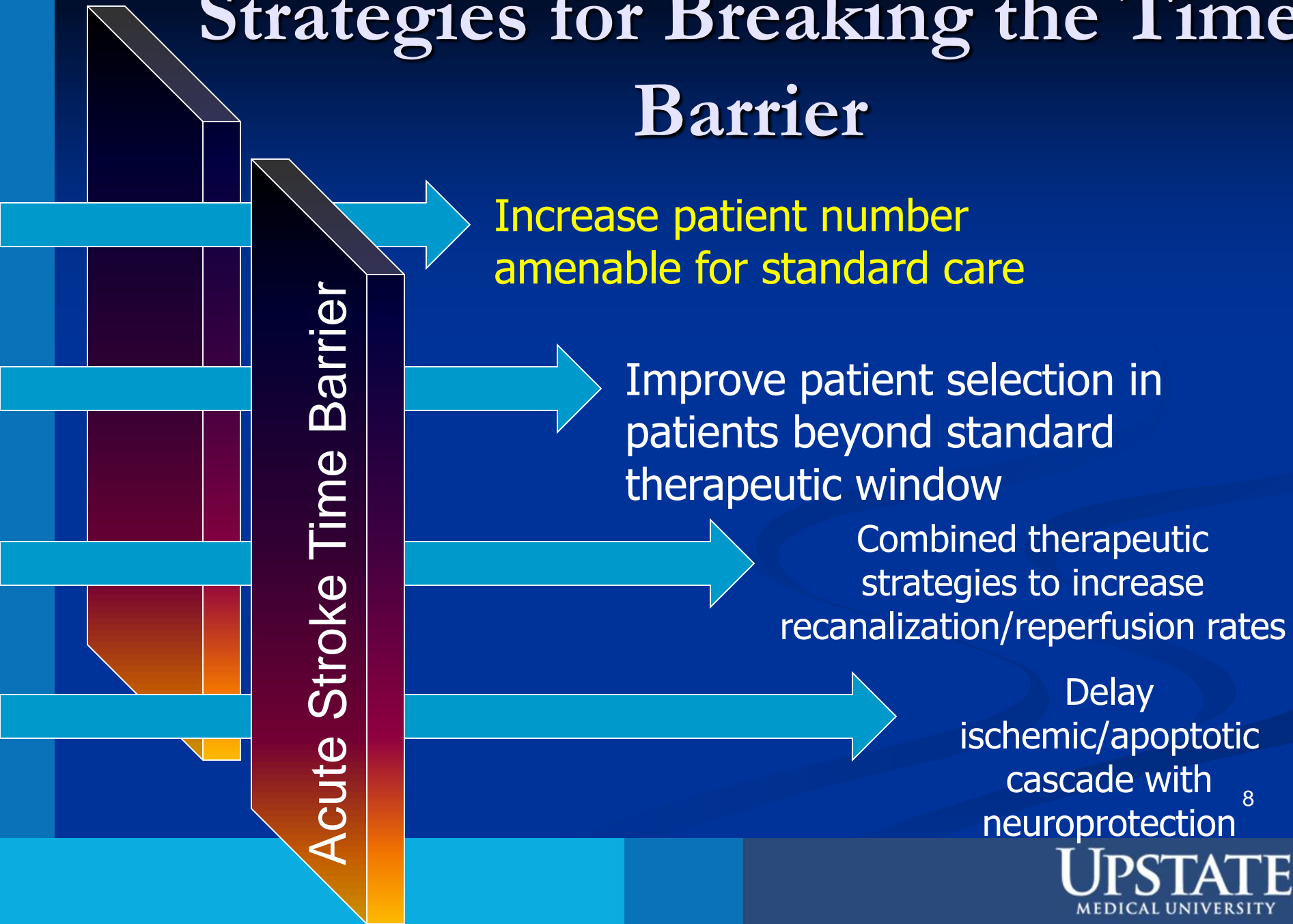
135.7 million without access

For >65 years old
    < 30 min 23.7%
    < 45 min 42.6%
   < 60 min 53.7%

17.9 million elderly w/o access

Albright K et al. Arch Neurol. 2010;67(10):1210-1218

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Strategies for Breaking the Time Barrier

Acute Stroke Time Barrier

Increase patient number amenable for standard care

Improve patient selection in patients beyond standard therapeutic window

Combined therapeutic strategies to increase recanalization/reperfusion rates

Delay ischemic/apoptotic cascade with neuroprotection

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Telemedicine

- Telemedicine – "healing at a distance"
  - Use of modern information and communications technologies (ICT's) for health service delivery
- Two types:
  - Store and forward (asynchronous)
  - Real time (synchronous)
- Current applications:
  - Teleradiology, Teledermatology, Telepathology, Telepsychiatry

Telemedicine: direct patient care

- Emergency Department consultation
  - Stroke, Trauma, etc
- Intensive Care consultation/rounding
  - MICU/SICU
- Acute Inpatient Consultation
- Outpatient clinic
  - Dermatology, Psychiatry, Medicine, PT/OT/Speech
- Home Care/Patient monitoring

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TELESTROKE Model
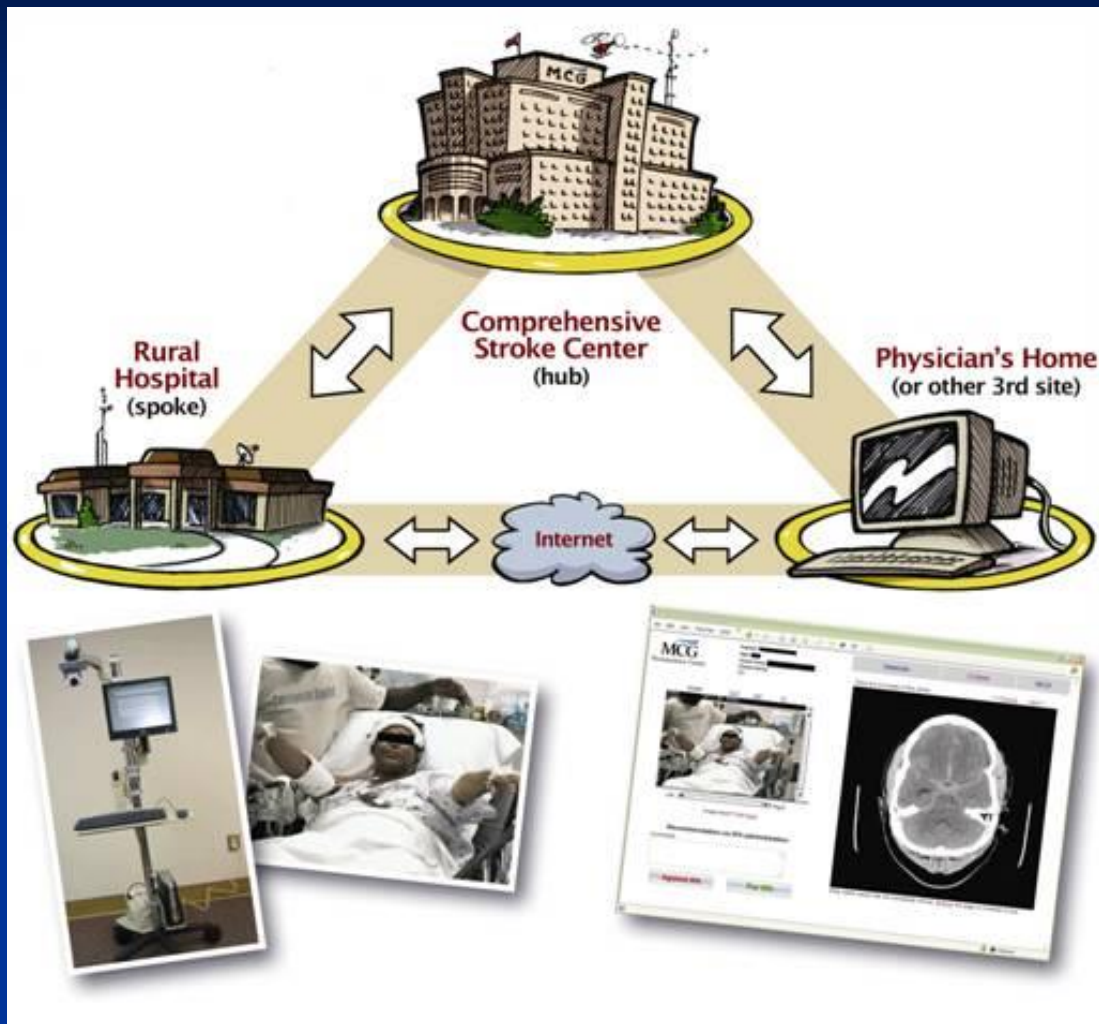
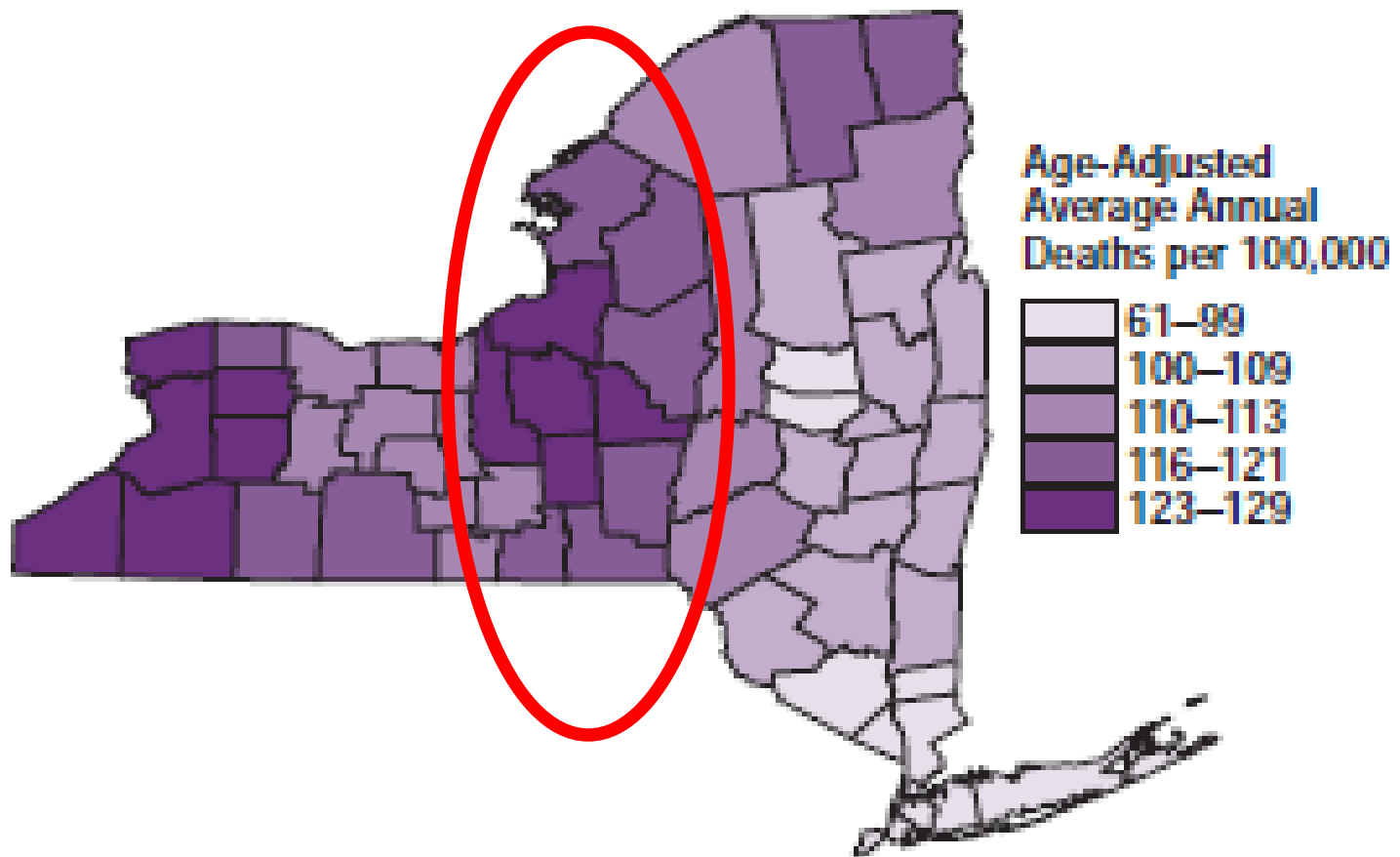TELESTROKE – coined in 1999 to describe IV-tPA treatment remotely using technology

OBJECTIVES
- bring expert to patient at the bedside in real time
- increase number of eligible patients to receive IV-tPA

Levine S, Gorman M. Stroke. 1999 Feb;30(2):464-9

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Upstate Medical University Catchment Area

Stroke Death Rates

Age-Adjusted Average Annual Deaths per 100,000
- 61–99
- 100–109
- 110–113
- 116–121
- 123–129

National Vital Statistics System. US Census Bureau 2013

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Upstate Regional Stroke Initiative 2015

Current Needs/Issues	Telestroke Solution
Effective acute stroke treatment is **time sensitive** (IV-TPA up to 4.5 hours; Endovascular therapy up to 6 hours)	OVERCOMING GEOGRAPHIC BARRIERS: Stroke specialist is brought to the bedside
Time is brain: For every minute of stroke, about 2 million neurons die	INCREASING ACCESS TO HEALTH CARE SERVICES: Patient assessed for appropriateness of acute stroke therapy
None of current community hospitals have 24/7 Neurology/Stroke specialist	
Majority of Central NY population > 1 hour from Upstate Comprehensive Stroke Center (78%)	Intervention started ASAP if indicated
About **1 out of 4** patients transferred for stroke have either insurvivable brain damage or resolved/completed stroke	Patient is evaluated for appropriateness of transfer

Upstate Comprehensive Stroke Center Telemedicine Project
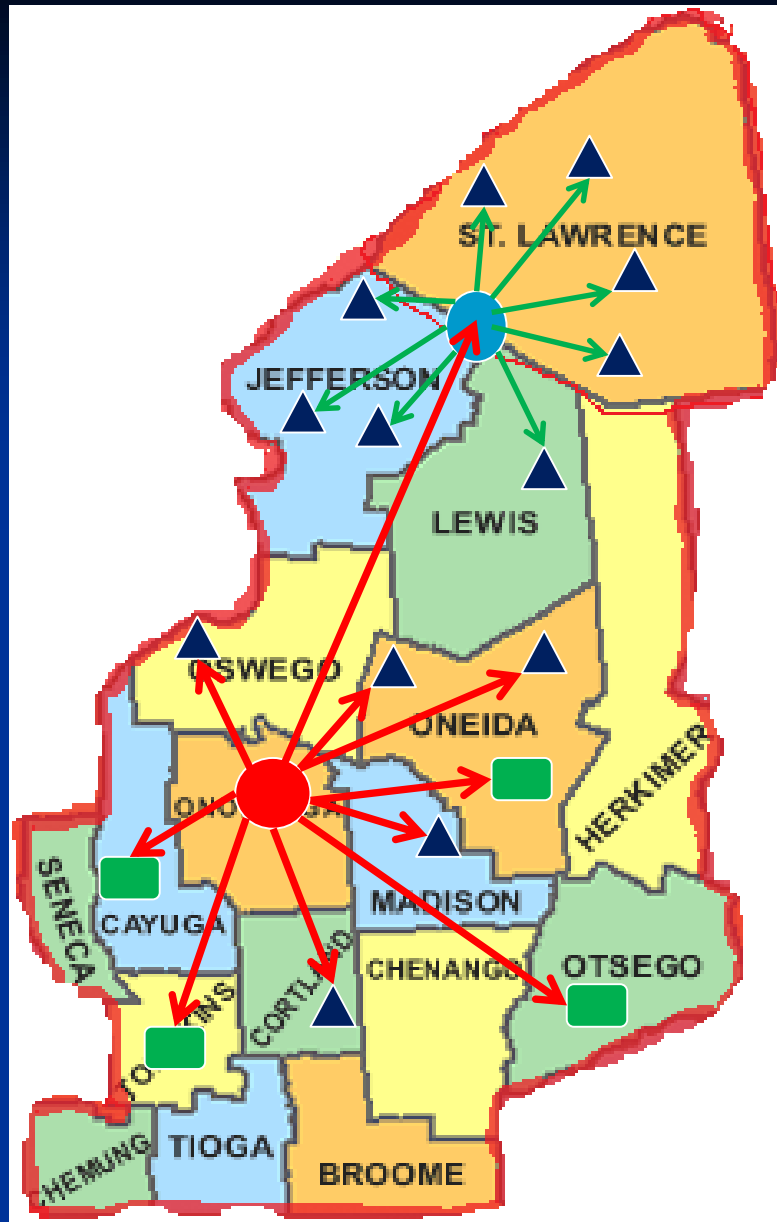
Fort Drum Coalition
  - Samaritan Med Ctr
  - Lewis County Hosp
  - Carthage Area Hosp
  - River Hospital
  - Clifton-Fine Hosp
  - Gouvernour Hosp
  - Canton-Potsdam Hosp
  - Claxton-Hepburn Hosp

Oswego Hospital
Rome Memorial Hosp
Faxton-St Lukes Hosp
St. Elizabeth Med Ctr
Oneida Healthcare Ctr
Mary Imogenes Bassett Hosp
Cortland Regional Med Ctr
Cayuga Med Ctr
Auburn Community Hosp

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Telestroke Implementation

- People
    - Designated contact person/champion
    - Administrative support
    - ED: physicians, nursing, ancillary
    - Radiology, Laboratory, Pharmacy services
- Technology
    - VPN Tunnel
    - High Speed Internet/Wireless Access
    - Telemedicine Cart
- Dedicated nursing units
    - If spoke will admit/keep the patient
- Administrative Issues
    - Hub Specialist credentialing for telemedicine consulting privileges
    - Memorandum of agreement/transfer agreement

Telemedicine: Logistics

- Environment of Equipment
- Medical Specialties servicing
- Training required of users
- Integration with existing IT infrastructure
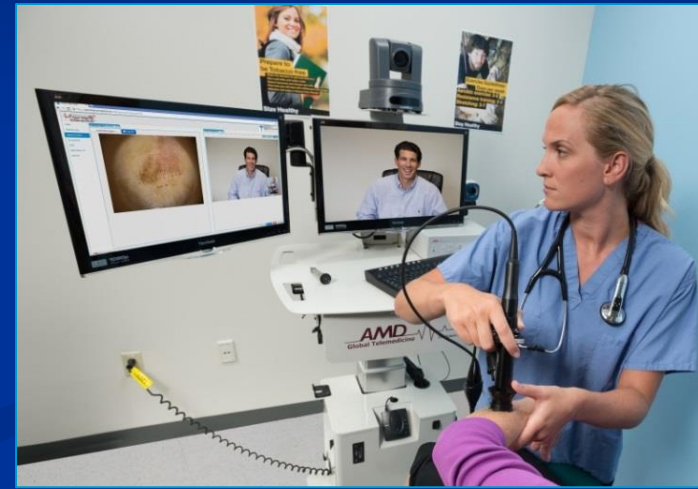
Telemedicine Equipment/Technology

- Encounter Management Software
- Medical Devices and Equipment
- Telemedicine Systems and Mobile carts

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Telestroke Consult Criteria

- Currently limited to 0-6 hour Acute telestroke consultation

- Consult criteria
  - Last Known Well (LKW) within 6 hours
  - CT brain negative for hemorrhage
  - Persistent symptom (NIHSS > 0)

- Patients not meeting criteria will have regular phone consultation

Acute Stroke Management Protocol

Time 0: Patient enters Emergency Department. If suspected stroke, time starts.
ED Nurse obtains vital signs, insert peripheral IV, draws blood and sends STAT CBC, Coags, BMP

Time 10: ED Provider assess patient and determines NIHSS
Time patient is last seen well (or Time symptom started) is determined
Patient medical history is obtained (allergies, home medication, recent surgery, bleeding)

Time 20: Patient is brought to CT scanner

Time 25: CT brain completed. If no hemorrhage, activate Telemedicine protocol

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OPTION 1. CT showed No acute findings

Time 30: Telemedicine Consult starts
Laboratory test result determined
Patient examined via telemedicine

Time 45: If no contraindication, TPA order placed
TPA bolus given, TPA drip started
Patient prepared for transfer to Upstate

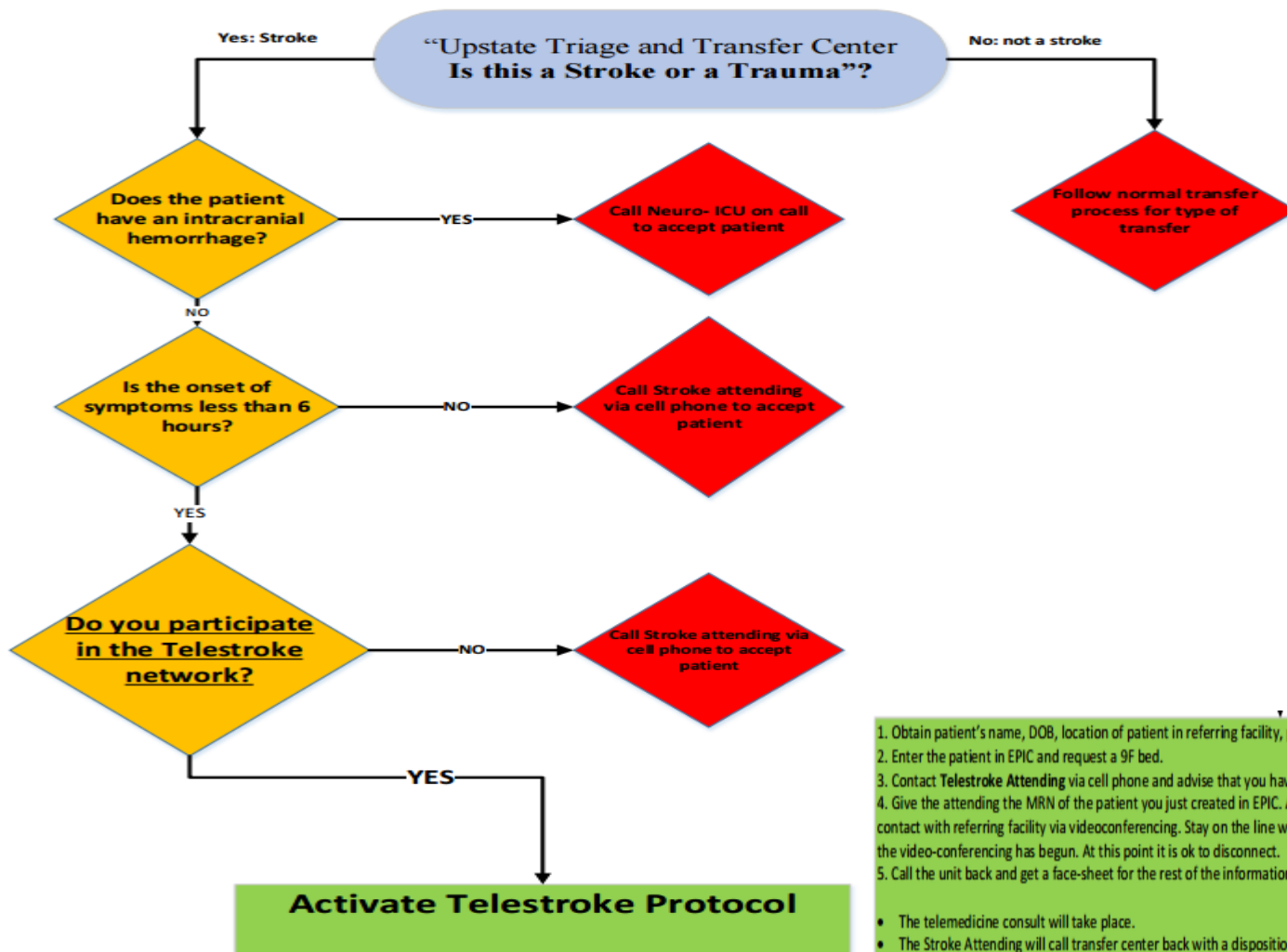**Time 60:** Patient leaves for Upstate

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OPTION 2. CT showed No acute findings

Time 30: Telemedicine Consult starts
Laboratory test result determined
Patient examined via telemedicine

Time 45: TPA not indicated
Patient deemed appropriate to stay
Patient prepared for admission

Time 60: Patient leaves ED to floor

OPTION 3. CT showed intracranial hemorrhage

Time 30: Call to Upstate Transfer Center for transfer
Transfer Center facilitates conference with Neuro-ICU on Call

Time 35: Patient accepted for transfer.
Patient prepared for transfer to Upstate

Time 45: Patient leaves for Upstate

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Transfer Center Protocol

"Upstate Triage and Transfer Center **Is this a Stroke or a Trauma"?**

Yes: Stroke

No: not a stroke

Does the patient have an intracranial hemorrhage? —YES→ **Call Neuro- ICU on call to accept patient**

Follow normal transfer process for type of transfer

NO

Is the onset of symptoms less than 6 hours? —NO→ **Call Stroke attending via cell phone to accept patient**

YES

Do you participate in the Telestroke network? —NO→ **Call Stroke attending via cell phone to accept patient**

—YES—

Activate Telestroke Protocol

1. Obtain patient's name, DOB, location of patient in referring facility, physicians name and call back number.
2. Enter the patient in EPIC and request a 9F bed.
3. Contact **Telestroke Attending** via cell phone and advise that you have a telestroke consult request.
4. Give the attending the MRN of the patient you just created in EPIC. At this time the attending will sign on to a computer and make contact with referring facility via videoconferencing. Stay on the line with Stroke attending and referring physician until they confirm that the video-conferencing has begun. At this point it is ok to disconnect.
5. Call the unit back and get a face-sheet for the rest of the information on this patient.

- The telemedicine consult will take place.
- The Stroke Attending will call transfer center back with a disposition for the patient (are they being transferred or not)
- Call the NS and advise her of the priority bed request.
- Please make sure the bed requested was on the right unit.
- Please ask the UH Stroke Attending how they would like this patient to come (ground unit, or by helicopter)

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Being a Remote Provider

- 24/7 availability when on call

- Off-HUB: Carries a laptop with mobile broadband

- In-HUB: within 5 minutes of Telestroke station

- During consultation

  - Access spoke patient imaging

  - Access telemedicine cart for televideo consultation

  - Access Hub EMR for consult documentation, routing to spoke

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Upstate Telestroke

Category	Schuyler Hospital	E.J.Noble Hospital	Rome Memorial Hospital	Cortland Regional Hospital	Oneida Hospital	TOTAL
Number of Beds	25 beds	37 beds	130 beds	162 beds	101 beds	
Location	90 mi SW	125 mi N	50 mi E	35 mi S	35 mi E	
Total Consults	17	28	17	82	8	152
TPA use	4	3	0	7	0	14
TPA rate	23.5%	10.7%	0	8.5%	0	9.2%

Upstate Thrombolysis rate: 21.1%   National thrombolysis Rate: 8.3% (PSC) 7.0% (US Hosp)

UPSTATE TELESTROKE NETWORK:

1. Samaritan Medical Center
2. River Hospital
3. Carthage Area Hospital
4. Claxton-Hepburn Medical Center
5. Cortland Regional Medical Center
6. Gouverneur Hospital
7. Canton-Potsdam Hospital
8. Lewis County General Hospital
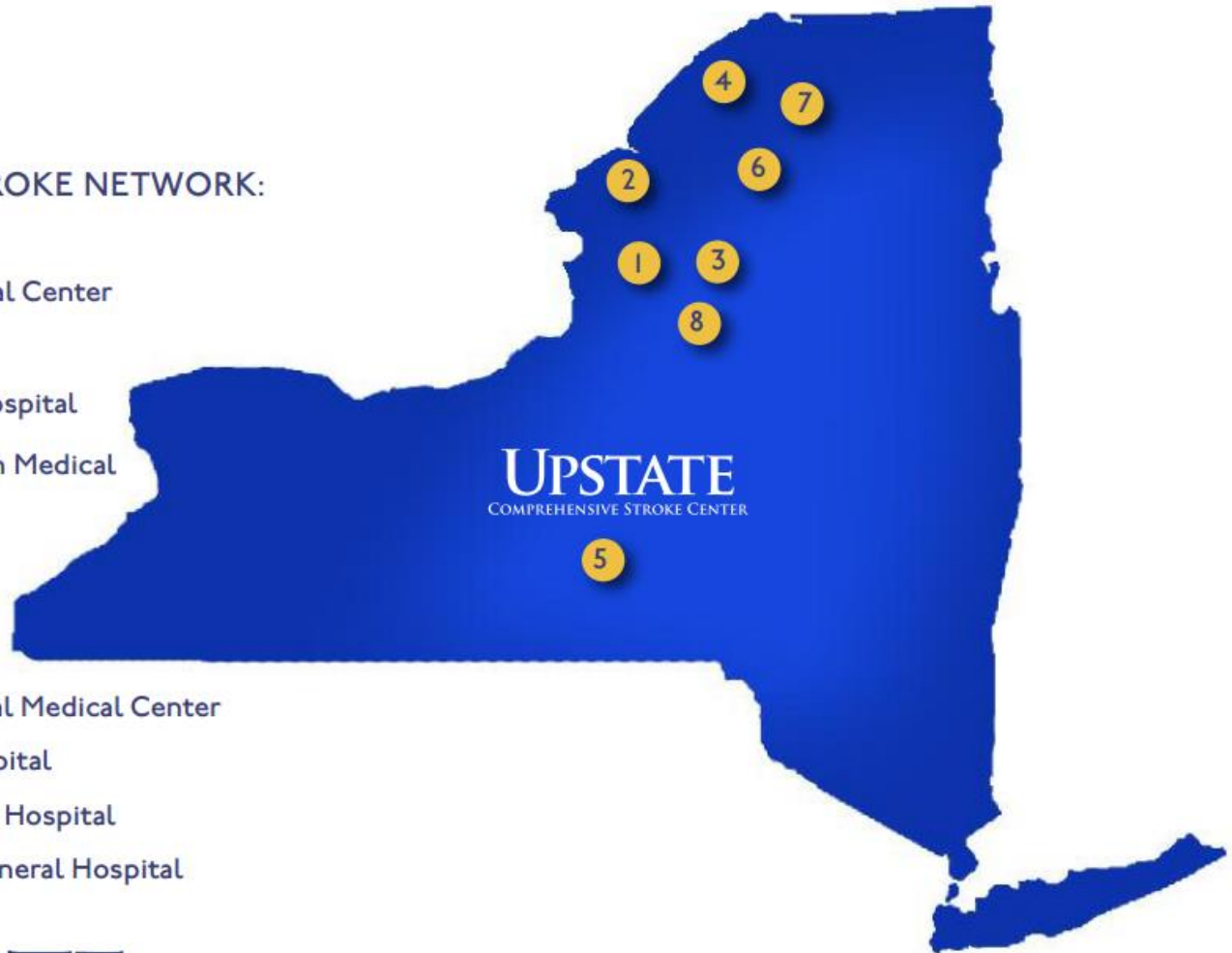
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COMPREHENSIVE STROKE CENTER

750 EAST ADAMS STREET | SYRACUSE, NY | WWW.UPSTATE.EDU/STROKE

Telestroke Review

- Compared with phone consultation
  - Accuracy of diagnosis better: 87.7% vs 63.8% (p 0.001)
  - Correct Tx decision higher: 98% vs 82% (p=0.0009)
  - Higher Iv-Tpa treatment rate: 4.3-30% (vs 1-3%)

- Compared with direct patient encounter
  - Same sICH rate: 4% vs 5% (p=0.21)
  - Same 90-d Mortality: 16% vs 18% (p=0.2)
  - Improved good outcome: 66% vs 46% (p=0.0001) 25

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NIHSS reliability: Bedside vs Telemedicine

NIHSS Item	Goldstein	Brott	Shafqat	Meyer	Meyer	Handschu	Handschu	LaMonte	LaMonte
	Bedside vs. Bedside	Bedside vs. Bedside	Telemed vs. Bedside non-acute	Telemed vs. Bedside non-acute	Telemed vs. Bedside-untrained non-acute	Telemed vs. Bedside (0-36 hrs)	Telemed vs. Bedside (0-6 hrs)	Lab Simulation vs. Videotape (1 LS vs. 2 VT)	Lab Simulation vs. Videotape (2 LS vs. 1 VT)
LOC	0.50	0.49	100% Agree	100% Agree	0.87	0.99	0.97	100% Agree	100% Agree
LOC Q	0.64	0.80	0.75	0.93	0.96	0.90	0.88	0.58	0.58
LOC C	0.41	0.58	0.29	100% Agree	100% Agree	0.93	0.89	100% Agree	100% Agree
Gaze	0.33	0.82	0.41	100% Agree	0.60	0.95	0.88	100% Agree	100% Agree
Visual Fields	0.57	0.81	0.60	0.93	0.78	0.89	0.83	100% Agree	0.44
Facial Palsy	0.22	0.57	0.40	0.22	0.62	0.85	0.62	-0.11	0.69
Motor Arm	0.77	0.85	0.82	0.88 0.82	0.94 0.97	0.90	0.74	0.74 100% Agree	100% Agree 100% Agree
Motor Leg	0.78	0.83	0.83	0.74 0.80	0.95 0.89	0.92	0.72	0.72 0.44	0.44 0.58
Ataxia	-0.16	0.57	-0.07	0.34	0.65	0.95	0.94	100% Agree	100% Agree
Sensory	0.50	0.60	0.48	0.80	100% Agree	0.91	0.83	0.58	100% Agree
Language	0.79	0.64	0.65	0.73	0.89	0.98	0.97	0.58	0.67
Dysarthria	0.32	0.55	0.55	0.61	0.60	0.92	0.93	0.58	0.38
Neglect	0.61	0.58	0.77	0.80	0.72	0.96	1.00	0.62	0.58
Study Specific Kappa Scoring	> 0.60 = Excellent	>0.80 = Excellent	>0.75 = Excellent	>0.75 = Excellent	≥0.75 = Excellent	Weighted	Weighted	r > 0.5 = good	r > 0.5 = good
% Excellent	5/13 (38%)	4/13 (31%)	4/13 (31%)	10/15 (67%)	10/15 (67%)	13/13 (100%)	12/13 (92%)	6/15 (40%)	7/15 (47%)
% Moderate	4/13 (31%)	9/13 (69%)	7/13 (54%)	3/15 (20%)	5/15 (33%)	0/13 (0%)	1/13 (8%)	7/15 (47%)	5/15 (33%)
% Poor	4/13 (31%)	0/13 (0%)	2/13 (15%)	2/15 (13%)	0/15 (0%)	0/13 (0%)	0/13 (0%)	2/15 (13%)	3/15 (20%)

Green= excellent agreement   Yellow= moderate agreement   Red= poor agreement

Schwamm L et al. Stroke. 2009;40:2616-2634
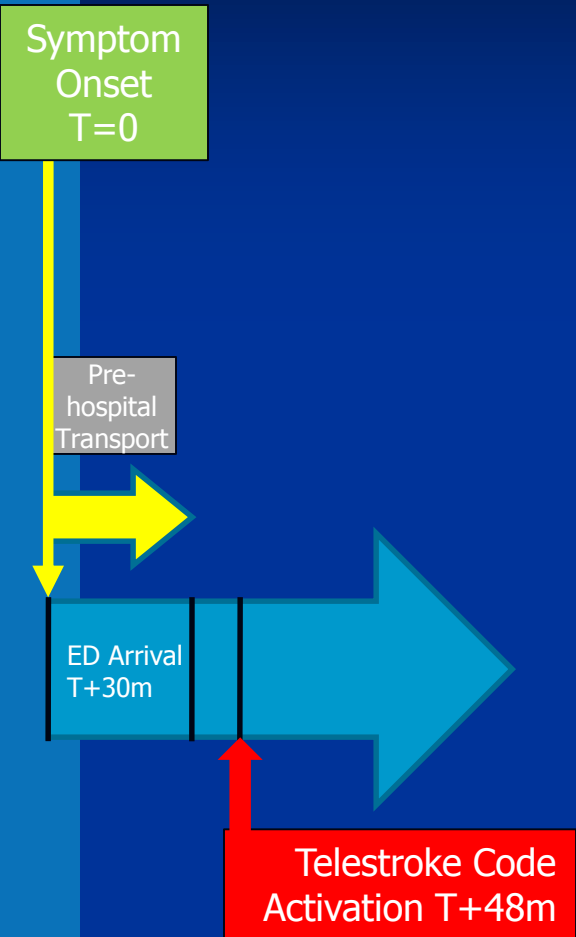
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Telestroke Review

- Multiple studies have documented equal or improved time targets for thrombolysis with establishment of telestroke
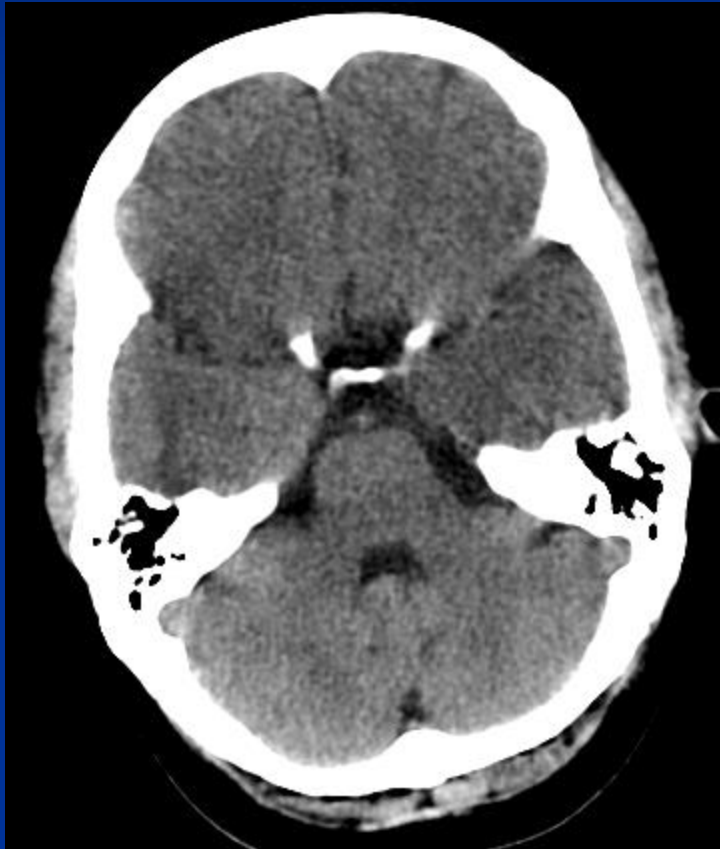
Nardetto L et al. Neurol Sci 2016;37(5):725-30.
Muller-Barna P et al. Stroke 2014;45(9):2739-44.
Hubert GJ et al. Stroke 2016;47(12):2999-3004.

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Case 1

AP – 33F with no known medical problem

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Case 1: AP

Symptom Onset T=0

Pre-hospital Transport

ED Arrival T+30m

Telestroke Code Activation T+48m

- March 11, 2017 at 3:00 pm
- Sudden onset of aphasia/R weakness

- Ambulance called, brought to one of Upstate Telestroke Spoke Hospital (Samaritan Medical Center)

- Within 18 minutes of arrival, **Telestroke consult ACTIVATED**

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Case 1 – AP Admission CT

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Case 1: AP

Symptom Onset T=0

IV-tPA T+1h38m

Pre tPA NIHSS=12

Pre-hospital Transport

Spoke Hospital Course

ED Arrival T+30m

Telestroke Code Activation T+48m
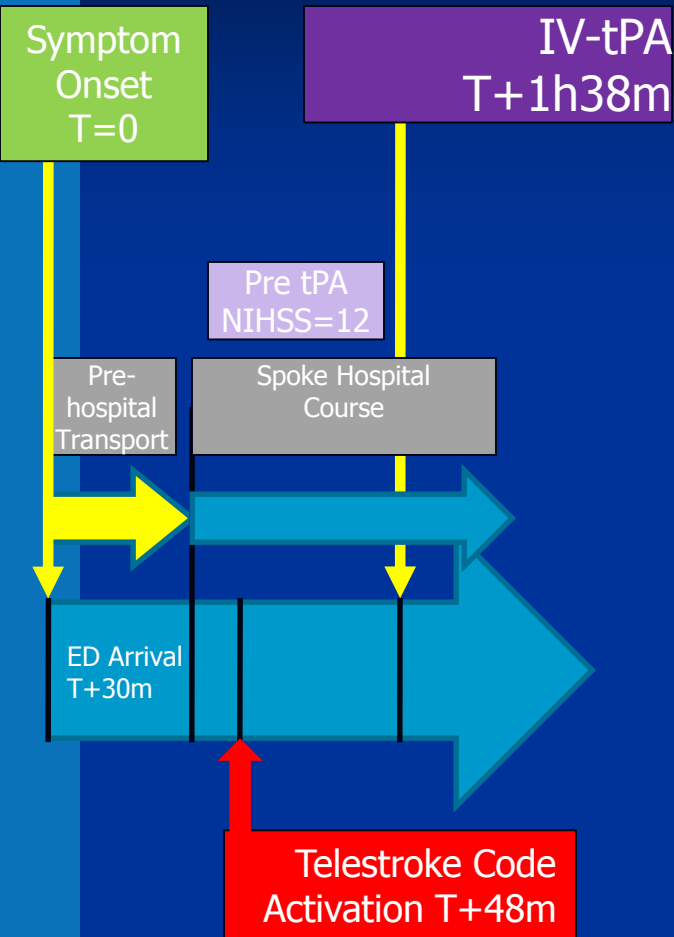
- Via Telestroke: NIHSS=12
- Suspicion of stroke mimic (young age, no risk factors) but televideo exam showed objective focal finding consistent with L MCA ischemia

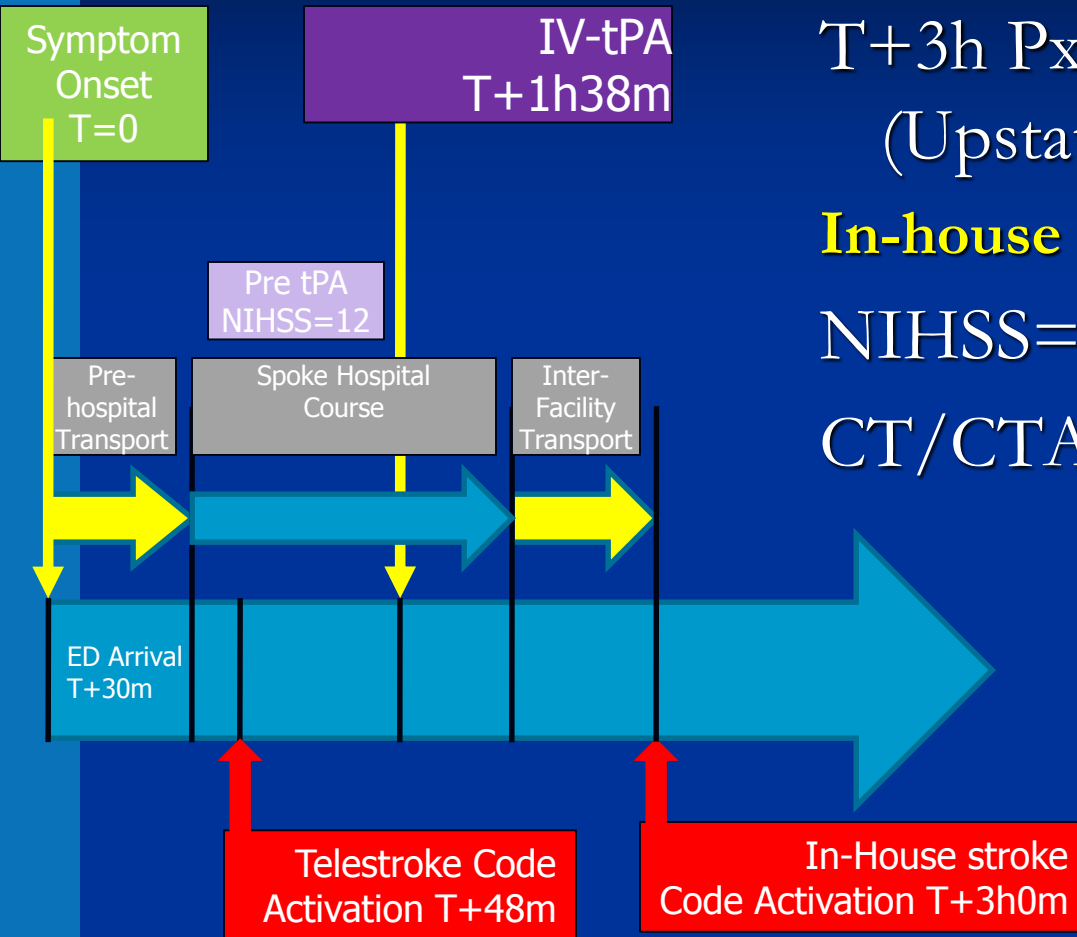**Onset-to-Treatment (OTT)=98 min**

Door-to-Needle (DTN)=58 min (Standard <60)

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Case 1: AP

Symptom Onset T=0

IV-tPA T+1h38m
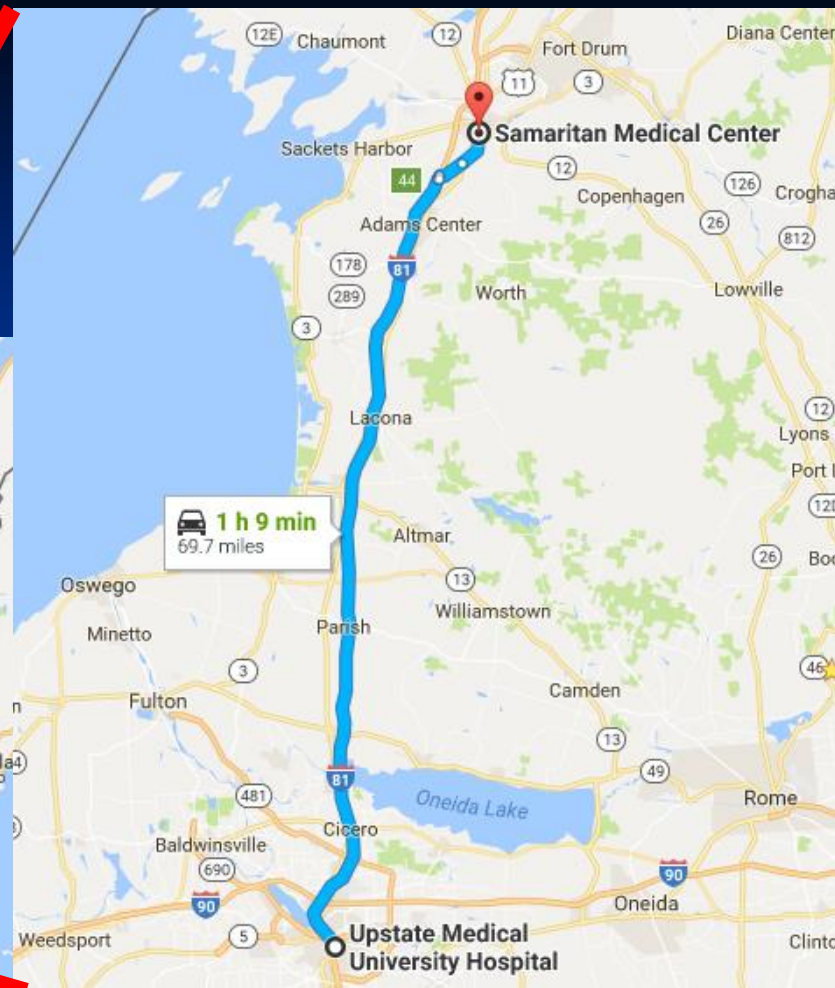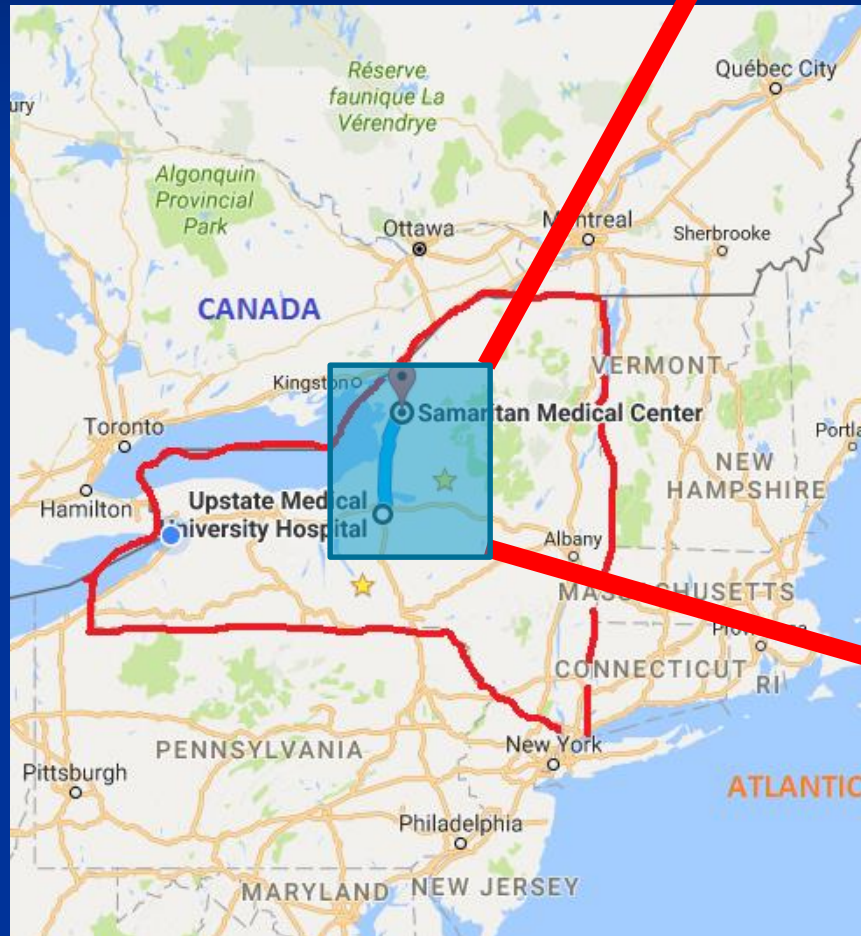
T+3h Px arrived at Hub Hospital (Upstate University Hospital)

NIHSS=17

Pre tPA NIHSS=12

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

ED Arrival T+30m

Telestroke Code Activation T+48m

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Case 1: AP

Symptom Onset T=0

IV-tPA T+1h38m

Pre tPA NIHSS=12

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

ED Arrival T+30m

Telestroke Code Activation T+48m

In-House stroke Code Activation T+3h0m
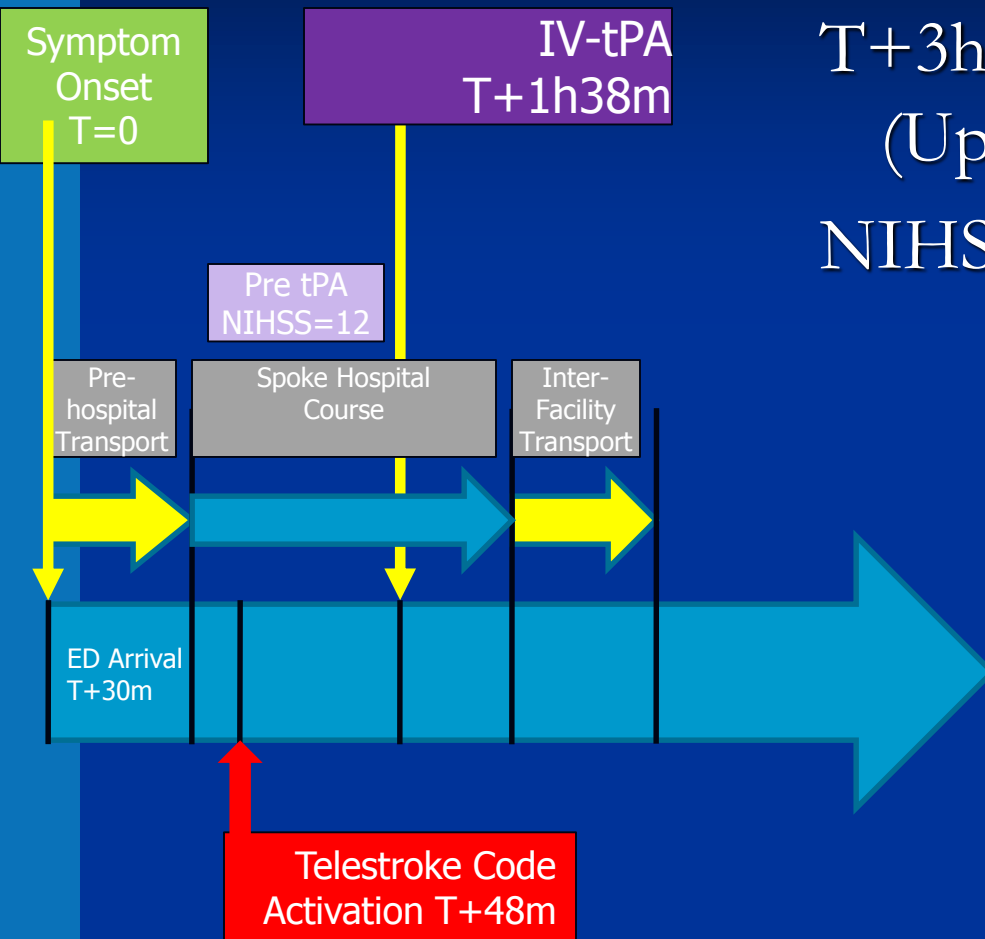
T+3h Px arrived at Hub Hospital (Upstate University Hospital)

In-house stroke code ACTIVATED

NIHSS=17

CT/CTA done 7 min post arrival

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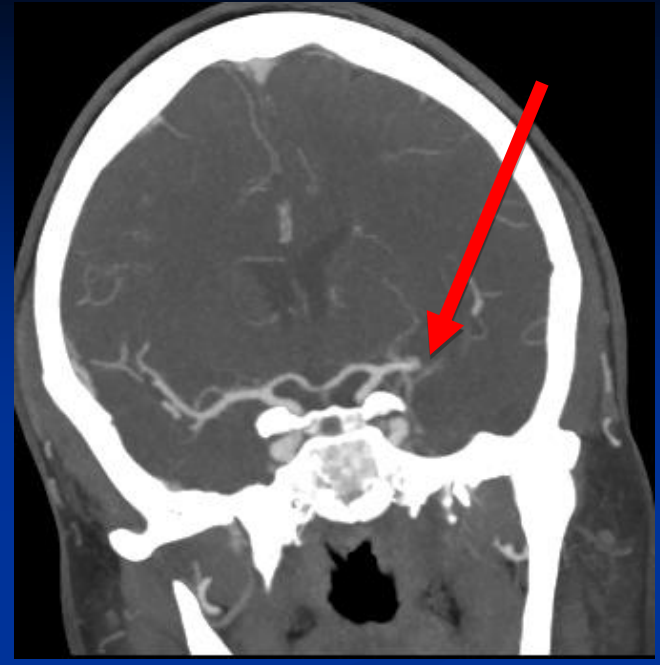
- T+03:06 CT/CTA done
  - CT hyperdense L-MCA, minimal early ischemic change (ASPECT Score 8-9)
  - CTA shows target vessel occlusion
  - **Neuro-Interventional Stroke Code ACTIVATED**

Case 1: AP

CT showed L MCA hyperdensity

ASPECT score 8-9
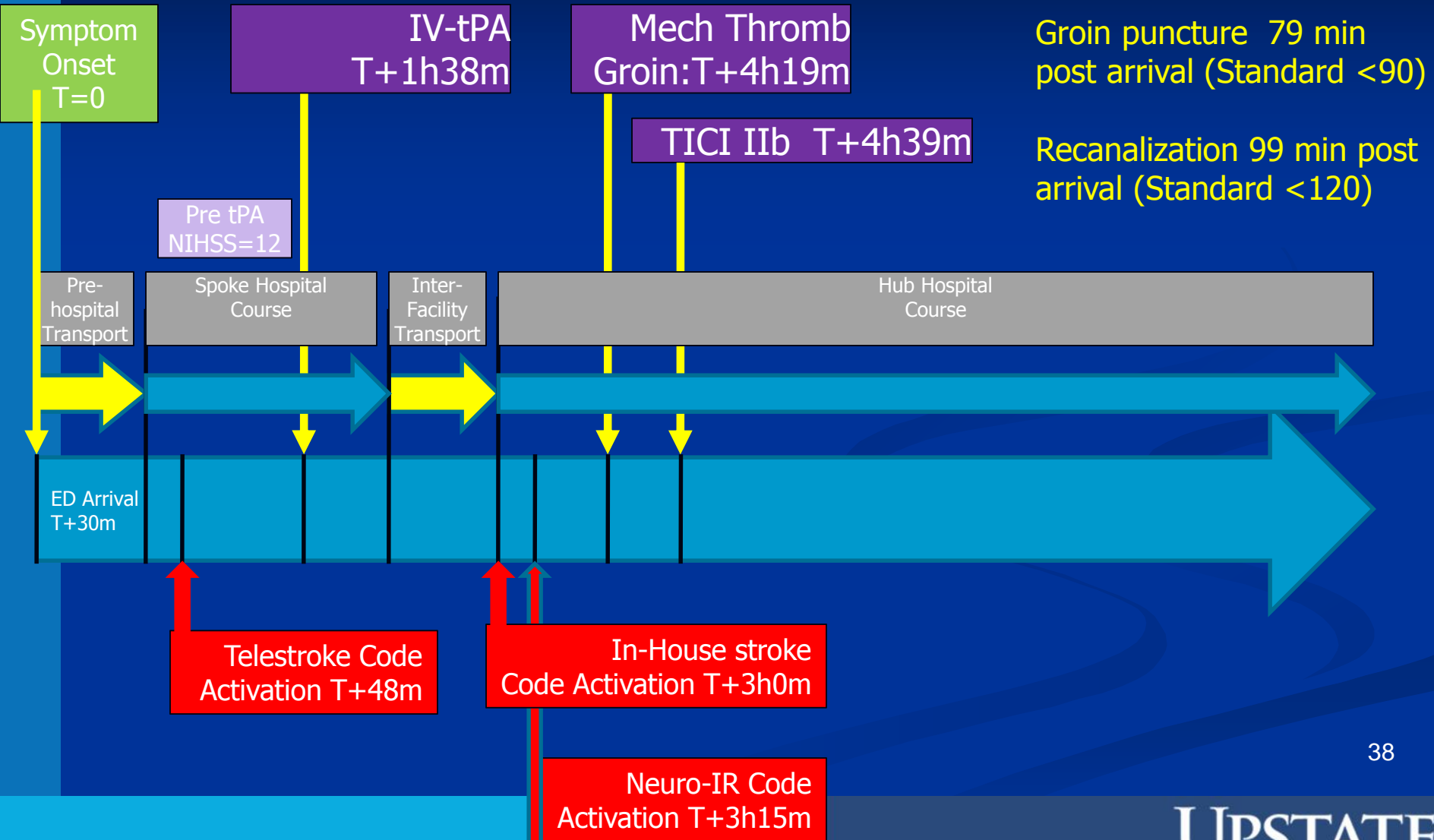
CTA showed L MCA M1 occlusion

Neuro-IR code ACTIVATED

Symptom
Onset
T=0

IV-tPA
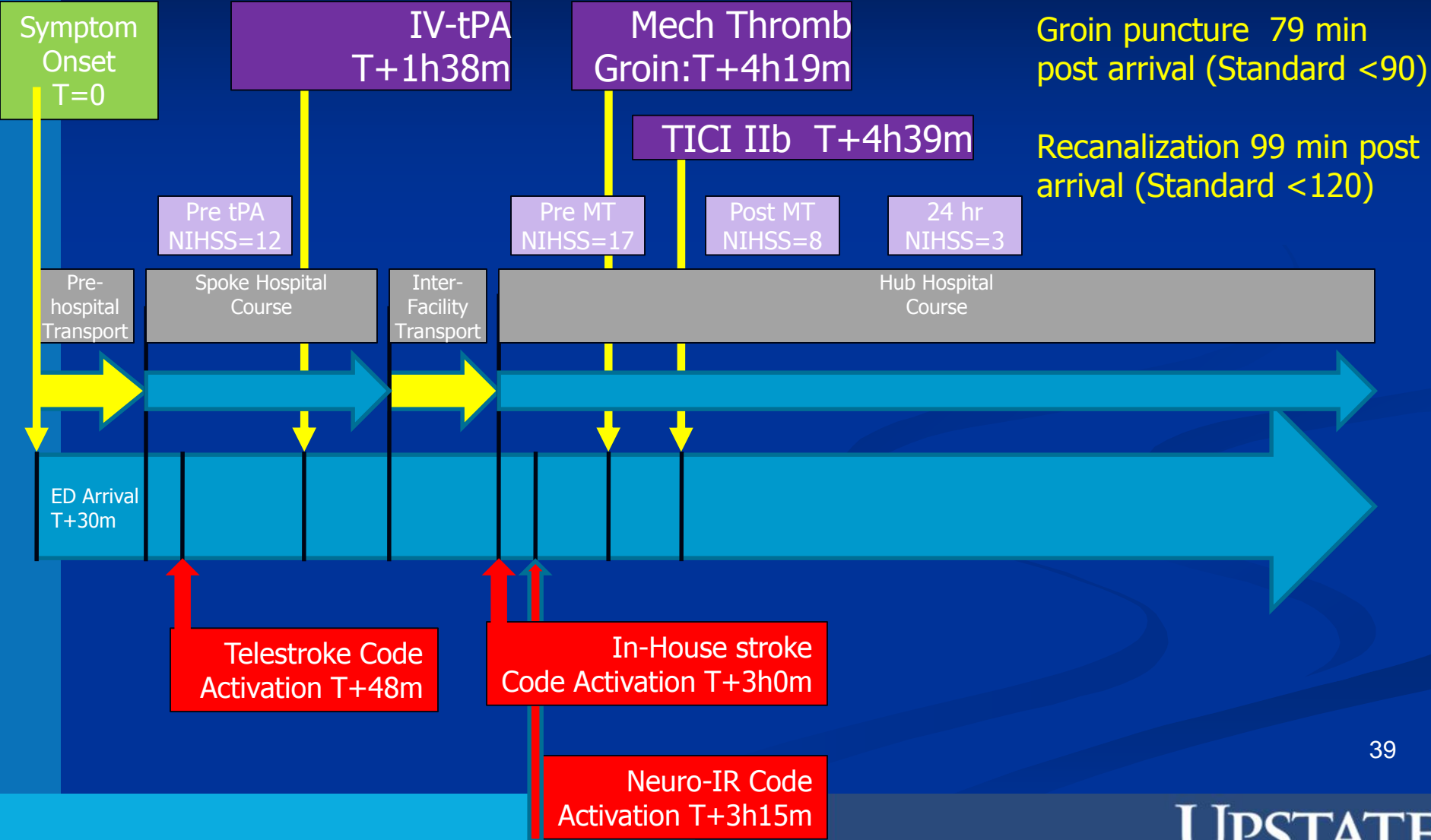T+1h38m

Pre tPA
NIHSS=12

Pre-
hospital
Transport

Spoke Hospital
Course

Inter-
Facility
Transport

ED Arrival
T+30m

Telestroke Code
Activation T+48m

In-House stroke
Code Activation T+3h0m

Neuro-IR Code
Activation T+3h15m

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Case 1: AP

Symptom Onset T=0

IV-tPA T+1h38m

Mech Thromb Groin:T+4h19m

Groin puncture 79 min post arrival (Standard <90)

Pre tPA NIHSS=12

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

Hub Hospital Course

ED Arrival T+30m

Telestroke Code Activation T+48m

In-House stroke Code Activation T+3h0m

Neuro-IR Code Activation T+3h15m

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Case 1: AP

Symptom
Onset
T=0

IV-tPA
T+1h38m

Mech Thromb
Groin:T+4h19m

Groin puncture 79 min
post arrival (Standard <90)

TICI IIb T+4h39m

Recanalization 99 min post
arrival (Standard <120)

Pre tPA
NIHSS=12

Pre-hospital Transport	Spoke Hospital Course	Inter-Facility Transport	Hub Hospital Course

ED Arrival
T+30m

Telestroke Code
Activation T+48m

In-House stroke
Code Activation T+3h0m

Neuro-IR Code
Activation T+3h15m

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Case 1: AP

Symptom Onset T=0

IV-tPA T+1h38m

Mech Thromb Groin:T+4h19m

TICI IIb T+4h39m

Groin puncture 79 min post arrival (Standard <90)

Recanalization 99 min post arrival (Standard <120)

Pre tPA NIHSS=12

Pre MT NIHSS=17

Post MT NIHSS=8

24 hr NIHSS=3

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

Hub Hospital Course

ED Arrival T+30m

Telestroke Code Activation T+48m

In-House stroke Code Activation T+3h0m

Neuro-IR Code Activation T+3h15m

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R-arm strength improved on angio table

Procedural times
Angio-suite arrival: 19:08
Groin puncture: **19:21**
M1 Reperfusion TICI2b: 19:41
M2 Reperfusion TICI2b: **19:54**
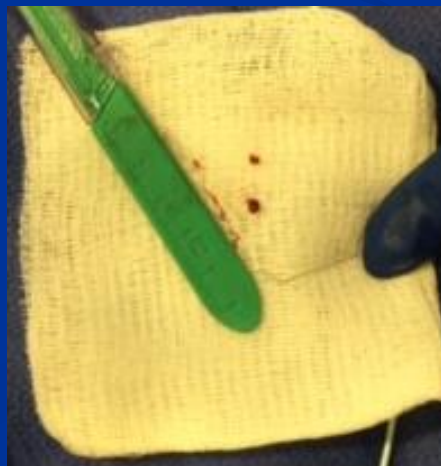
MRI brain post-recanalization
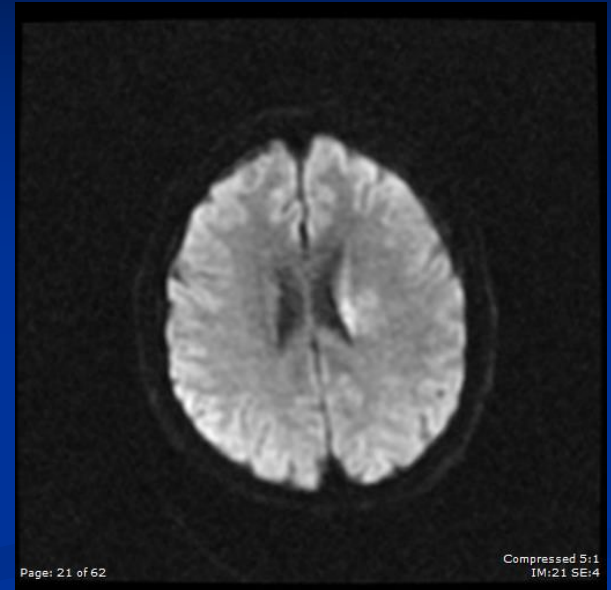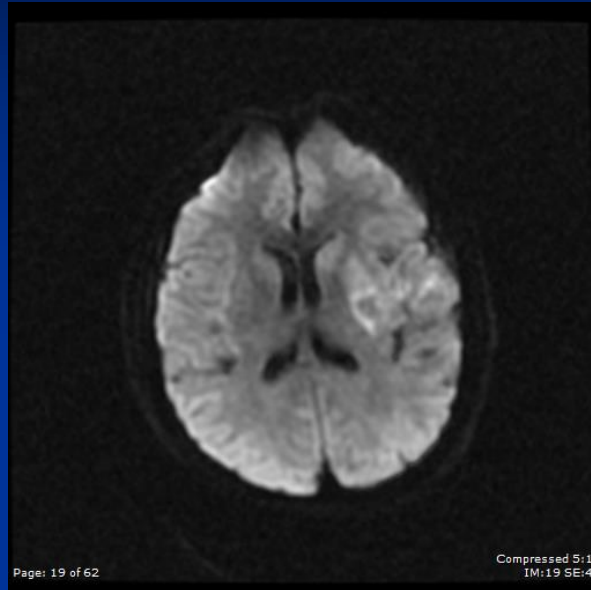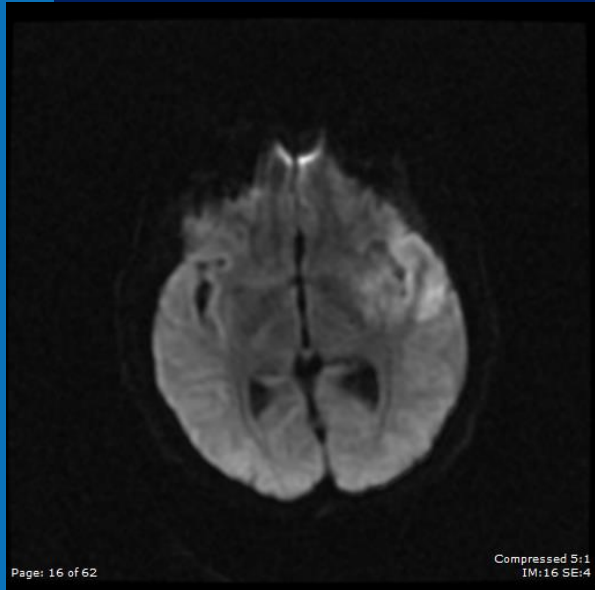
Minimal deep infarct on MR DWI, consistent with CT. Sparing of large territory at risk.

Case 1: AP

Symptom Onset T=0

IV-tPA T+1h38m

Mech Thromb Groin:T+4h19m

TICI IIb T+4h39m

Discharged Home T+4days

Pre tPA NIHSS=12

Pre MT NIHSS=17

Post MT NIHSS=8

24 hr NIHSS=3

Discharge NIHSS=2

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

Hub Hospital Course

ED Arrival T+30m

Telestroke Code Activation T+48m

In-House stroke Code Activation T+3h0m

Neuro-IR Code Activation T+3h15m

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CURRENTS

Thank You!

FEATURED PROGRAM

Neurocritical Care in Upstate New York:

"To Cure Sometimes, to Relieve Often, to Comfort Always."

By Julius Gene Latorre, MD, MPH

Located in Syracuse, NY, Upstate Medical University is the major provider of quality medical education and health care in the region. Established in 1834, it is one of the oldest medical universities in the U.S. and the first medical school to grant a medical degree to a woman (Elizabeth Blackwell in 1849). In 1964, the medical university established the Upstate University Hospital (UUH) as the only academic medical center in central New York and the only Level 1 trauma center serving a 17-county region with 1.8 million people.

UUH became the first state-designated Stroke Center in central New York in 2006 and the first hospital in the state to receive DNV Primary Stroke Center certification in 2010. UUH has continually excelled in patient care, receiving the CWTC-Stroke Gold Plus Quality Achievement Award for two consecutive years. In 2008, the East Tower opened which included a ninth floor dedicated to neurosciences with an 11-bed Neuro ICU and 16-bed step down and stroke unit. In 2011, the new Heart and Vascular Center opened.

The Neuro ICU at Upstate was established in the [...] pioneering neurosurgical educator, Dr. Robert King advocated for a separate unit for patients with neurosurgical issues requiring intensive care. This resulted in the creation of a separate bed Neurosurgery ICU as an open unit with patients being co-managed by the neurosurgeons and medical or surgical intensivists. Attempts at staffing the ICU with a dedicated neurointensivist started in 1997 with the hiring of Dr. Michael de Georgia. However, it would take another decade before the [...]

Upstate University Hospital in Syracuse, NY

FEATURED PROGRAM

State-of-the-art, multi-modality monitoring of brain-injured patients is routine, including ICP, Licox, NIRS, continuous quantitative EEG, ETCO2, and invasive and minimally-invasive hemodynamic monitoring. The neurointensivists routinely perform therapeutic hypothermia management for cardiac arrest and refractory intracranial hypertension [...] tracheal intubation, central lines, fiberoptic bronchoscopy, [...] monitor insertion, TCD, and continuous video EEG analysis.

The Neurocritical Care Service al[...] graduate medical education at Up[...]. Dr. [...] established the UCNS-accredited Neurocritical [...] program in 2008, with [...] to two [...] two [...] rotating residents. During off hours [...] weekends, the service [...] One of the service is also [...] in providing a rich ICU experience. Neuro[...]gery, and Medicine residents at Upstate, ering year-round didactic lectures and conferences. We have hosted visiting medical students and physicians from [...] around the world.

The Neuro ICU service actively participates in several multicenter clinical trials (IMS-III, CLEAR-IVH, INTREPID, and POINT). In addition, we are also conducting investigator-initiated research projects in nutritional interventions for TBI, NIRS monitoring, and predictors of extubation failure in stroke, among other topics.

The Neurocritical Care Service has made significant contributions to patient care at Upstate. Under our leadership, UUH became the first hospital in the area to offer therapeutic hypothermia for cardiac arrest survivors in 2008. The Neuro ICU service was also instrumental in streamlining the processes and protocols for organ donation at Upstate, resulting in a significant increase in donor conversion and staff participation throughout the institution. Strong collaboration in a multidisciplinary environment has been one of the key factors in the success and growth of the program, accompanied by a sustained shift in attitude away from the therapeutic nihilism commonly encountered in the care of brain injury patients.

The Featured Program column seeks to enrich the outlook of NCS members by highlighting programs that are undertaking innovative approaches to the practice of neurocritical care. If you are interested in contributing an article, please contact me at rgexcad1@jfmi.edu. In this issue, we feature the Neuro ICU group at Upstate University Hospital who are working to expand the scope of neurocritical care services.

- *Romergryko Geocadin, MD, Section Editor*

Upstate Neurocritical Care Team. From Left: Dr. Latorre (Attending), Dr. El-zammar (Attending), Dr. Elnour (Fellow), Dr. Schmidt (Resident), Dr. Ali (Resident), Dr. Yonaty (NP), Dr. Devasenapathy (Attending). Not in picture, Brian Lancer (NP)

The Neurocritical Care Unit staff led by Catherine Stephens (front right).