Stroke Care Across Borders
Increasing Access via Telemedicine

Julius Gene Latorre, MD, MPH
Associate Professor of Neurology and Neurosurgery
Upstate Medical University
Division of Vascular and Neurocritical Care
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
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.
Time is Brain

■ 2 million neurons die per minute

■ IV-tPA effect is time-sensitive

Saver J. Stroke 2006;37:263-266
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.
Access to Stroke Care: US

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
Strategies for Breaking the 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
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
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

### Current Needs/Issues

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

**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

**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

Does the patient have an intracranial hemorrhage?

Yes

Follow normal transfer process for type of transfer

No

Call Neuro-ICU on call to accept patient

No

Call Stroke attending via cell phone to accept patient

Is the onset of symptoms less than 6 hours?

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, physician’s 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 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 dispositions 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)
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
### Upstate Telestroke

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

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
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)

### NIHSS reliability: Bedside vs Telemedicine

<table>
<thead>
<tr>
<th>NIHSS Item</th>
<th>Goldstein</th>
<th>Brott</th>
<th>Shafqat</th>
<th>Meyer</th>
<th>Meyer</th>
<th>Handschu</th>
<th>Handschu</th>
<th>LaMonte</th>
<th>LaMonte</th>
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<tbody>
<tr>
<td>LOC</td>
<td>0.50</td>
<td>0.49</td>
<td>100%</td>
<td>100%</td>
<td>0.87</td>
<td>0.99</td>
<td>0.97</td>
<td>0.58</td>
<td>0.58</td>
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<tr>
<td>LOC Q</td>
<td>0.64</td>
<td>0.80</td>
<td>0.75</td>
<td>0.93</td>
<td>0.96</td>
<td>0.90</td>
<td>0.88</td>
<td>0.89</td>
<td>0.89</td>
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<tr>
<td>LOC C</td>
<td>0.41</td>
<td>0.58</td>
<td>0.29</td>
<td>100%</td>
<td>100%</td>
<td>0.93</td>
<td>0.89</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>Gaze</td>
<td>0.33</td>
<td>0.82</td>
<td>0.41</td>
<td>100%</td>
<td>100%</td>
<td>0.60</td>
<td>0.88</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Visual Fields</td>
<td>0.57</td>
<td>0.81</td>
<td>0.60</td>
<td>0.93</td>
<td>0.78</td>
<td>0.89</td>
<td>0.83</td>
<td>100%</td>
<td>0.44</td>
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<tr>
<td>Facial Palsy</td>
<td>0.22</td>
<td>0.57</td>
<td>0.40</td>
<td>0.22</td>
<td>0.62</td>
<td>0.85</td>
<td>0.62</td>
<td>-0.11</td>
<td>0.69</td>
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<tr>
<td>Motor Arm</td>
<td>0.77</td>
<td>0.85</td>
<td>0.82</td>
<td>0.88</td>
<td>0.94</td>
<td>0.97</td>
<td>0.74</td>
<td>0.72</td>
<td>0.44</td>
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<tr>
<td>Motor Leg</td>
<td>0.78</td>
<td>0.83</td>
<td>0.83</td>
<td>0.74</td>
<td>0.92</td>
<td>0.89</td>
<td>0.72</td>
<td>0.72</td>
<td>0.58</td>
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<tr>
<td>Ataxia</td>
<td>-0.16</td>
<td>0.57</td>
<td>-0.07</td>
<td>0.34</td>
<td>0.65</td>
<td>0.95</td>
<td>0.94</td>
<td>0.74</td>
<td>100%</td>
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<tr>
<td>Sensory</td>
<td>0.50</td>
<td>0.60</td>
<td>0.48</td>
<td>0.80</td>
<td>100%</td>
<td>0.91</td>
<td>0.83</td>
<td>0.58</td>
<td>100%</td>
</tr>
<tr>
<td>Language</td>
<td>0.79</td>
<td>0.64</td>
<td>0.65</td>
<td>0.73</td>
<td>0.98</td>
<td>0.97</td>
<td>0.97</td>
<td>0.58</td>
<td>100%</td>
</tr>
<tr>
<td>Dysarthria</td>
<td>0.32</td>
<td>0.55</td>
<td>0.55</td>
<td>0.61</td>
<td>0.92</td>
<td>0.93</td>
<td>0.93</td>
<td>0.58</td>
<td>0.38</td>
</tr>
<tr>
<td>Neglect</td>
<td>0.61</td>
<td>0.58</td>
<td>0.77</td>
<td>0.80</td>
<td>0.72</td>
<td>0.96</td>
<td>1.00</td>
<td>0.62</td>
<td>0.58</td>
</tr>
</tbody>
</table>

#### Study Specific Kappa Scoring

<table>
<thead>
<tr>
<th>% Excellent</th>
<th>Weighted</th>
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<tbody>
<tr>
<td>&gt; 0.60 = Excellent</td>
<td>5/13 (38%)</td>
</tr>
<tr>
<td>&gt; 0.80 = Excellent</td>
<td>4/13 (31%)</td>
</tr>
<tr>
<td>&gt; 0.75 = Excellent</td>
<td>4/13 (31%)</td>
</tr>
<tr>
<td>&gt; 0.75 = Excellent</td>
<td>4/13 (31%)</td>
</tr>
<tr>
<td>Weighted</td>
<td>13/13 (100%)</td>
</tr>
<tr>
<td>Weighted</td>
<td>12/13 (92%)</td>
</tr>
<tr>
<td>r &gt; 0.5 = good</td>
<td>6/15 (40%)</td>
</tr>
<tr>
<td>r &gt; 0.5 = good</td>
<td>6/15 (40%)</td>
</tr>
</tbody>
</table>

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

Telestroke Review

- Multiple studies have documented equal or improved time targets for thrombolysis with establishment of telestroke.

Muller-Barna P et al. Stroke 2014;45(9):2739-44.
Case 1

AP – 33F with no known medical problem
Case 1: AP

- 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
Case 1 – AP Admission CT
Case 1: AP

- 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)
Case 1: AP

T+3h Px arrived at Hub Hospital (Upstate University Hospital)

NIHSS=17
Case 1: AP

T+3h Px arrived at Hub Hospital (Upstate University Hospital)

In-house stroke code ACTIVATED

NIHSS=17

CT/CTA done 7 min post arrival

Symptom Onset
T=0

Pre-hospital Transport
Pre tPA
NIHSS=12

Spoke Hospital Course

Inter-Facility Transport

ED Arrival
T+30m

Telesstroke Code Activation T+48m

In-House stroke Code Activation T+3h0m
- 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
Case 1: AP

Symptom Onset T=0

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

Hub Hospital Course

ED Arrival T+30m

Pre tPA NIHSS=12

IV-tPA T+1h38m

Mech Thromb Groin:T+4h19m

Telestroke Code Activation T+48m

In-House stroke Code Activation T+3h0m

Groin puncture 79 min post arrival (Standard <90)

Neuro-IR Code Activation T+3h15m

NIHSS=12

Spoke Hospital Course

Hub Hospital Course
Case 1: AP

- Symptom Onset: T=0
- Pre-hospital Transport
  - Pre-tPA NIHSS=12
- Spoke Hospital Course
  - Telestroke Code Activation T+48m
- Inter-Facility Transport
  - In-House stroke Code Activation T+3h0m
- Hub Hospital Course
  - Groin puncture 79 min post arrival (Standard <90)
  - Recanalization 99 min post arrival (Standard <120)
  - Neuro-IR Code Activation T+3h15m
  - Mech Thromb Groin: T+4h19m
  - IV-tPA T+1h38m
  - TICI IIb T+4h39m
Case 1: AP

Symptom Onset T=0

Pre-hospital Transport

Pre tPA NIHSS=12

ED Arrival T+30m

Spoke Hospital Course

IV-tPA T+1h38m

Inter-Facility Transport

Pre MT NIHSS=17

In-House stroke Code Activation T+3h0m

Hub Hospital Course

Post MT NIHSS=8

Telestroke Code Activation T+48m

24 hr NIHSS=3

Mech Thromb Groin:T+4h19m

Recanalization 99 min post arrival (Standard <120)

TICI IIb T+4h39m

Groin puncture 79 min post arrival (Standard <90)

Pre MT NIHSS=17

Neuro-IR Code Activation T+3h15m

Post MT NIHSS=8

24 hr NIHSS=3
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
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

Pre tPA NIHSS=12

Pre-hospital Transport

Spoke Hospital Course

Inter-Facility Transport

Mech Thromb Groin:T+4h19m

TICI IIb T+4h39m

Pre MT NIHSS=17

Post MT NIHSS=8

24 hr NIHSS=3

Hub Hospital Course

Discharged Home T+4days

ED Arrival T+30m

Telestroke Code Activation T+48m

In-House stroke Code Activation T+3h0m

Neuro-IR Code Activation T+3h15m

Discharge NIHSS=2
Neurocritical Care in Upstate New York:
“To Cure Sometimes, to Relieve Often, to Comfort Always.”

By Julius Cane LaRue, 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 (UUBH) 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.

UUBH became the first state-designated Stroke Center in central New York in 2006 and the first hospital in the state to receive ENTV Primary Stroke Center certification in 2008. UUBH has continually excelled in patient care, receiving the CVDI/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 2010, the new Heart and Vascular Center opened.

The Neuro ICU at Upstate was established in 2006, directed by Dr. Robert Klotz. In 2007, the service began to admit patients with neurocritical care needs requiring intensive care. This resulted in the creation of the Upstate Neurosurgery ICU as an open unit with patients being co-managed by the neurosurgeons and medical or surgical intensivists. The current Neurointensive Care Unit is in the Upstate Neuroscience Tower and is certified to enter patients with neurocritical care needs. This has led to an increased number of patients requiring neurocritical care, which has doubled in the past decade.

Neurocritical Care Service could be firmly established. Under the chairmanship of Dr. Jeremy Sheffer, Dr. Vinod Madireddi and Julius Cane Larue were recruited in 2007. Initially, most of the patients admitted to the Neurocritical Care service were complicated ischemic and hemorrhagic stroke patients. Over time, the service has assumed a primary role in managing patients traditionally admitted to Neuro ICU (such as TBI, cardiac ICUs, surgical ICUs), or medical conditions requiring neurointensive care.

The service has grown in size and scope, with a strong collaborative relationship with Neurosurgery. Dr. Desai serves as co-director of the service.

The Neuro ICU at Upstate continues to expand its patient population. Patients with primary brain injury, traumatic brain injury, stroke, and severe head injury are admitted. The service has grown to 12 beds and now includes a 6-bed Neurointensive Care Unit. The service has also expanded to include a 6-bed Cardiac Critical Care Unit and a 4-bed Neurocritical Care Unit.

Upstate Neurocritical Care Unit, 10-12th Floors, Upstate Medical University, Syracuse, NY 13210. For more information, call 315-464-8320.

Neurocritical Care in Upstate New York:
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continued on page 20

State-of-the-art, multi-modality monitoring of brain-injured patients is routine, including ICP, LIS, HR, continuous quantitative EEG, TC, and invasive and minimally invasive hemodynamic monitoring. The neurointensivist routinely perform therapeutic hypothermia management for cardiac arrest and refractory intracranial hypertension, including mechanical ventilation, central lines, thoracic brachioscopy, RAPP (Remote Arterial Pressure Monitoring), and continuous EEG analysis.

The Neurocritical Care Service at Upstate University Hospital in Syracuse, NY, continues to evolve. In 2008, with the addition of a 6-bed Neurointensive Care Unit and a 10-bed Cardiac Critical Care Unit, the SCU has become the only ICU in New York State dedicated to the treatment of neurointensive care patients.

The Neurocritical Care Unit at Upstate University Hospital is staffed by a team of experienced and dedicated healthcare providers, including nurses, nurses' assistants, respiratory therapists, and physicians. The unit is equipped with state-of-the-art medical equipment, ensuring the best possible care for our patients.

UPSTATE UNIVERSITY HOSPITAL
222 Barnes St.
Syracuse, NY 13209

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