Implementation of Telemedicine for an Effective Stroke Program

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- Attending Physician
- Stroke & Neurocritical Care Service
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- Harvard Medical School (1997 to 2002)
The Academic *Mostly* Bedside Practice
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- Attending Physician
- Stroke Director
- South Shore Hospital
  (2002 to 2006)
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• Attending Physician
  MA Telephysicians
  NJ Telephysicians
  FL Telephysicians
  VA Telephysicians
  TX Telephysicians
  (2005-Present)

• Chief Medical Officer, Specialists On Call, Inc.
  (2004-Present)
  The Blended *Strictly* Telemedical Practice
Financial Disclosures:

• **Specialists On Call, Inc.** (formerly known as Brain Saving Technologies, Inc.) - Telemedicine

• President, **Telephysicians, P.C.’s** – Outsourced Physician Services

• **Neurologica, Inc.** – Portable Imaging
Key Points

1. Telemedicine is not new. *(Five Patients by Michael Crichton, 1968, Nonfiction)*

2. Emergency Neurology Services are hard to sustain.

3. Emergency Neurology is hard to do well.
Case

• 80 year old previously independent woman with vascular risk factor of atrial fibrillation on warfarin presents to community emergency department one hour into episode of inability to speak, left gaze preference, and right hemiplegia.

• INR 1.5
“…a potentially permanent neurological deficit, happening suddenly or rapidly evolving, that is secondary to hypoxia or hemorrhage.”

Raymond D. Adams, MGH/Harvard
Identifying Stroke & IV tPA Eligibility

• Gold Standard Stroke Neurologist:
  – 36/73 consecutive patients diagnosed w/ AIS.
  – 11/36 patients eligible for tPA.

• Agreement with the stroke neurologist for tPA eligibility was 93% of the time by ED attendings, 84% of the time by Neurology residents, and 79% of the time by ED residents.

• False positives were seen in 2 ED Attending cases, 8 ED resident cases, and 11 Neurology resident cases.

Intravenous Thrombolysis

Conclusions

• “Despite an increased incidence of symptomatic intracerebral hemorrhage, treatment with intravenous t-PA within three hours of ischemic stroke improved clinical outcome at three months.”
Early IV tPA Treatment

Client “Protocols”

• “Call for patients that you **know** are having a neurological emergency. Call for patients that you worry **might** be having a neurological emergency.”

• “Every patient with a neurological emergency has a neurological problem. Not every patient with a neurological problem has a neurological emergency.”

• Prioritize Non Contrast Head CT & appropriate lab tests.

• Have study available for specialist review (“pushing the images”).
Client Expectations

• Emergency neurologist returns call to ED within 15 minutes.

• Reviews case doctor to doctor with ED physician initially phone to phone.

• Discusses next steps.

• “Next steps do not always lead to videoconferencing.”
Emergency Neuro Care Center

Internet Monitor

Video Monitor

CT Monitor

CT Workstation
ED Video Conferencing Unit

Videoconferencing
Today’s most advanced videoconferencing codec with remote control and a 23 inch LCD high resolution display.

Mobile
Lockable wheels for stationary or mobile usage. Push handle on back makes this unit easy to navigate in the Emergency Room.

UL2601-1 Approved Medical Device
This device is UL2601-1 approved with a specialized speaker designed for the hospital environment.

Additional Notes:
Full warranty on all components. 24/7 customer support service.
Hemorrhagic Stroke
Type C Occlusion
Telephonic Guidance of Therapy

- 123 consecutive Acute Ischemic Stroke patients in rural hospitals treated with IV tPA between November 2003 and September 2006 and subsequently shipped to a tertiary medical center.
- Treatment selection determined by a stroke neurologist through structured telephone interview with the requesting physician.
- Symptomatic intracranial hemorrhage (2.5%) and in hospital mortality (7.5%) were less frequent compared with the active NINDS treatment group.

• 194 consecutive Acute Ischemic Stroke consults delivered via a Web-based telestroke tool.
• 15% of patients were treated with IV tPA (30).
• There were no symptomatic intracerebral hemorrhages.
• The mean Onset to Treatment time dropped by 30 minutes for the last 20 patients (111 minutes) compared with the first 10 patients (143 minutes).

Acute Stroke & Videoconferencing

• 234 acute ischemic stroke patients randomized between telephonic vs. telestroke guidance in 4 “spoke” hospitals over 3.5 years.
• Primary endpoint: Post treatment consensus as to the correct treatment recommendation.
• “Correct treatment recommendation” achieved significantly more often in videoconferencing group (98% vs. 82%).
• No significant differences in tPA utilization, rates of hemorrhage, functional outcomes.

NIH Stroke Scale

Telemedical Neurology Exam

- Not the same as a bedside exam.
- It is many times quicker to accomplish.
- It is at times equivalent (NIHSS).
- It is at times inferior (e.g., subtle sensory or motor findings or diagnoses that require confident reflex testing).
TEMPiS
The German Experience

Univ.-Klinik Regensburg
Burglengenfeld
Cham
Straubing
Deggendorf
Mainkofen
Passau
Ingolstadt
Kelheim
Dachau
Freising
Landshut
Mühldorf
Eggenfelden
Ebersberg
Wasserburg
Traunstein
Vogtareuth
Bad Tölz
Rosenheim

Comprehensive Stroke Center
Stroke Units
Neurosurgery Department
Neurology Department
Hospitals with CCT
Telestroke & TPA Administration

- 2600/4700 (55%) patients presented with ischemic stroke (Acute + Subacute) to 12 Regional Hospitals in Bavaria.
- 1480/4700 (31%) patients presented with threatened stroke (TIA).
- 115/2600 (4.4%) ischemic stroke patients received tPA via Telestroke Consultation.

Telestroke & TPA Administration

- 1290/1880 (68%) patients presented with ischemic stroke (Acute + Subacute) to 2 Academic Stroke Centers in Bavaria.
- 370/1880 (20%) patients presented with threatened stroke (TIA).
- 110/1290 (8.6%) ischemic stroke patients received tPA via Bedside Consultation.

Telestroke & Patient Outcome

• 5 Regional Hospitals with Telestroke Support were compared with 5 similarly sized Regional Hospitals in Bavaria.

• Prospective, non-randomized, open intervention study.

• 3122 patients included in the final analysis.

(Audebert H et al. (2006) Effects of the implementation of a telemedical stroke network: The Telemedic Pilot Project for Integrative Stroke Care (Tempis) in Bavaria, Germany. Lancet Neurol 5: 742-748.)
Telestroke & Patient Outcome

- The consultation rate was only **36%** (20-53%) in Telestroke hospitals.
- **56%** of patients treated in Telestroke hospitals versus **46%** of patients in regional hospitals had a good outcome at 3 months (i.e., living at home without a severe disability).

(Audebert H et al. (2006) Effects of the implementation of a telemedical stroke network: The Telemedic Pilot Project for Integrative Stroke Care (Tempis) in Bavaria, Germany. Lancet Neurol 5: 742-748.)
Telestroke & Patient Outcome

• 74% of patients in Telestroke hospitals received rapid brain imaging versus 32% in regional hospitals.

• 73% of patients in Telestroke hospitals received a standardized test for dysphagia versus 48% of patients in regional hospitals.

(Audebert H et al. (2006) Effects of the implementation of a telemedical stroke network: The Telemedic Pilot Project for Integrative Stroke Care (Tempis) in Bavaria, Germany. Lancet Neurol 5: 742-748.)
Telestroke & Patient Outcome

- **85%** of patients in Telestroke hospitals received Physical Therapy versus **49%** in regional hospitals.
- **83%** of patients in Telestroke hospitals received a carotid ultrasound versus **62%** of patients in regional hospitals.

The SOC Experience:
March 1 – August 31, 2008

• Greater than 1500 Emergency Neurology Consults.
• Majority were presumptive Cerebrovascular Emergencies (including ICH) ~ 70 %.
• Potential thrombolytic candidates were all patients presented to an Emergency Neurologist less than 3 hours from onset of serious or debilitating stroke symptoms.
• Other Emergency Neurology Consult requests included Seizure (7%), Encephalopathy (5%), Migraine (5%), Syncope (2%), Vestibulopathy (2%), Transient Global Amnesia (1%), Tumor (1%).
The SOC Experience:  
March 1 – August 31, 2008

• **Clear Opportunity:** tPA delivered to 59% of patients presenting with Acute Ischemic Stroke (147).

• **Clear and Potential Opportunity:** tPA delivered to 24% of patients presenting with Acute Ischemic Stroke + Acute Threatened Stroke (356).

• **Clear and Future Opportunity:** tPA delivered to 19% of patients presenting with Acute + Subacute Ischemic Stroke (466).

• **Total Clear, Potential, and Future Opportunity:** tPA delivered to 10% of patients presenting with Acute + Subacute Ischemic Stroke + Threatened Stroke (833)
Case

• 80 year old previously independent woman with vascular risk factor of atrial fibrillation on warfarin presents to community emergency department one hour into episode of inability to speak, left gaze preference, and right hemiplegia.

• INR 1.5
### Neuro-Critical Care Recommendations

**ALLERGIES:**

**HEIGHT:** __________  **WEIGHT:** __________  

**DATE**  | **TIME**  | **am/pm**
---|---|---

**tPA ACUTE ISCHEMIC STROKE RECOMMENDATION SET**

- **Checklist for Administration of Thrombolytic Therapy for Acute Ischemic Stroke completed**
- **Admit to a Critical Care Unit**
  - Total Activase (tPA) dose (0.9 mg per kg – not to exceed 90 mg)
  - tPA bolus dose over one minute (10%)
  - tPA dose mg continuous IV infusion over sixty minutes. When the volume alarm sounds, add 20 cc of NS to the bottle and infuse at the rate of infusion (90%).
- **No Anti-platelet agents, Coumadin or Heparin for 24 hours**
- **Compression boots to both legs**
- **Repeat head CT scan in 24 hours**

**TREATMENTS:**

- **NPO until speech evaluation and recommendations have been made**
- **Hourly intake and output**
- **Neurological and Vital Signs checked q 15 minutes x 2 hours, q 30 minutes for 6 hours, and q 1 hour for 16 hours using non-invasive methods**
- **Notify physician**
  - if systolic B/P > 160 or < 110
  - if diastolic B/P > 100 or < 50
  - if BP outside of above parameters, monitor q 5 mins until additional orders are received
- **IV Fluids**
- **Glucaic all stools**
- **No Foley until (date) (time)**
- **No NG tube until (date) (time)**
- **No venipunctures or arterial punctures until (date) (time)**
- **CBC, PTT, PT, INR, BMP (indicate date/time)**
- **Oxygen**
- **Other labs**
- **Consult Neurology for stroke management post-tPA**

**ACTIVITIES:**

- **Bed rest**

**Physician’s Signature Transcribed by RN Signature/Date/Time**

Name ____________________________, MD

(Date) ____________________________

**Name ________________________, RN**  

Date __________

(Time) __________
Clinical Pathways

- Standardized care protocols.
- Decreased in-hospital morbidity.
- Early rehabilitation assessments.
- Focused evaluations to reduce the risk of recurrent stroke.

Stroke Center Designation in MA

- Smaller hospitals (< 150 beds) were significantly less likely to be interested in Primary Stroke Service designation in 2003.
- By December 2005, 6 months after stroke center legislation, 92% of all hospitals had achieved PSS designation.
- Smaller hospitals were significantly more likely to use telemedicine to achieve PSS designation.

(Smith EE et al. (2008) Stroke Center designation can be achieved by small hospitals: The Massachusetts Experience. Crit Pathw Cardiology 7: 173-7.)
Take Home Lessons

“If a hospital needs help to administer acute stroke therapies, it probably also needs advice and assistance for other neurological emergencies.”

“TIA is a **threatened stroke** and should be viewed as a neurological emergency.”

“It is easier to prevent the next stroke than it is to treat the present stroke.”
Emergency Neurology

Client Requirements:

- Rapidly Available
- Reliable
- Easy to use
- Clinically Consistent
- Clinically Useful
Emergency Neurology

Staffing Requirements:

• Rapidly Available
• Reliable
• Redundant
• Technologically Capable
• Clinically Cohesive
Emergency Neurology

Practical Requirements:

• Geographically Distributed Physicians.
• Internet Based Connectivity.
• Location Limited Practice Venues.

“Getting the right doctor to the right patient at the right time.”
Take Forward Lessons

1. “Most emergency neurology happens in the emergency department.”

2. “The longer that a patient is in the hospital, the harder it is to provide effective telemedical care.”

3. “Telemedical Neurology is different than but Complimentary to Bedside Neurology.”
Late IV tPA Treatment

Acute Stroke

“Despite advances in imaging, vascular intervention, and video medicine, for the foreseeable future, Acute Stroke will remain a disease that is far easier to prevent than it is to treat.”

- Dr. Colin Timothy McDonald (2005)
The Future of Emergency Neurology