TELESTROKE
Stroke Telemedicine in the Midwest

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Disclosures

• No relevant disclosures
• I specifically do not have financial relationship with any telemedicine company.
• I will not be discussing any non-FDA approved therapies
**TELESTROKE***

**Telemedicine:**

- Uses technology to connect the patient and physician with a remote specialist via:
  - Telephone/Internet connection
  - Videoconferencing
  - Teleradiology

* Telestroke is the use of telemedicine for stroke care
  - Allows a neurologist to use an audio/video connection to remotely diagnose, evaluate, and recommend treatment for a patient presenting in an ER

* The term Telestroke was first used and popularized by Steven Levine and Mark Gorman way back in 1999 (Stroke 1999, 30:464)
TELESTROKE

• With advent of acute stroke therapies, it became clear that “Time is Brain”.
• Allows time-sensitive acute stroke consultations to remote locations such as EDs regardless of distance.
• Increasingly forms an important component of stroke systems of care.
Benefit of IV tPA diminishes with time

Pooled analysis from Atlantis, NINDS and ECASS tPA stroke trials – Lancet 2004 363;768
TIME IS BRAIN

Door-to-needle ≤60 min

- ≤10 min: Suspected stroke patient arrives at hospital
- ≤15 min: Initial MD evaluation (including patient history, lab work initiation, and NIHSS assessment)
- ≤25 min: Stroke team notified (including neurologic expertise)
- ≤45 min: CT scan initiated
- ≤60 min: CT and labs interpreted
- ≤60 min: Activase (t-PA) given if patient is eligible*
TELESTROKE

• Over the last 20 years tremendous advances in acute stroke care
  • 1) IV tpa use has gained widespread acceptance
  • 2) Early ASA use has been shown to be beneficial
  • 3) Use of Decompressive Hemicraniectomy in selected patients with malignant infarctions has evolved
  • 4) Stroke units have been shown to save lives
Primary Stroke Centers

- Availability of acute stroke teams – code stroke – 24/7
- Written care protocols that are evidence based and are reviewed periodically and updated
- Involving the EMS and ED in the stroke program
- Availability of neurosurgical expertise in a timely manner – within 2 hrs
- ‘Stroke unit’ formation recommended
Impact of Organized Care

Impact of stroke units on outcomes at 1 year

- **Home (independent)**
  - Control: 33%
  - Stroke unit: 39%

- **Mortality**
  - Control: 28%
  - Stroke unit: 23%

*Median.
† Based on the Wilcoxon rank sum test.
‡ P < 0.05.

Malignant MCA territory Infarction

- Mortality rates up to 80%
- Decompressive surgery helps but has to be timely
Malignant MCA territory Infarction

Vahedi et al. Lancet Neurology 2007;6;215
Almost two thirds of hospitals in the US use IV tpa infrequently or not at all. (Kleindorfer et al. Stroke 2009)

40% of US population live in counties without a hospital providing acute stroke care (> 1 hr from PSC)

An important reason for this is lack of a specialist consultant coverage.

Consequently, an FDA approved and proven therapy for acute ischemic stroke is out of the reach of the majority of the US population.
TELESTROKE NETWORKS

*Partial list.*
TELESTROKE NETWORKS
Different models

Traditional “hub and spoke” model
- Hub hospital: designated stroke center
- Spoke hospitals: lack 24/7 neurology support

“Third-party consult” model
- Spoke contracts with third-party provider
- Neurologist employed by third party
- Spoke develops referral relationship with tertiary hospital for more complex cases

Hardware Requirements

- Desktop PC or laptop
- High speed Internet connection
- Camera mounted at both ends for patient and physician
- IP/ISDN network for video-conferencing
- Data Encryption for HIPPA compliance
TELESTROKE-REALLY?

- Do we really need all this?
- Does it have to be two way audio-video conferencing?
- Can’t the telephone work just as good?
Protocol Adherence and Safety of Intravenous Thrombolysis After Telephone Consultation With a Stroke Center – Uchino et al. 2011

<table>
<thead>
<tr>
<th>Rate of protocol deviations per person</th>
<th>Treat and transfer</th>
<th>Transfer and treat</th>
<th>Control: stroke center presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of protocol deviations per person</td>
<td>38.3% (51/133); $P &lt; .001$; OR = 9.3 (3.7-33.7)</td>
<td>14.3% (5/35); $P = .12$; OR = 2.7 (0.57-12.5)</td>
<td>5.8% (5/86)</td>
</tr>
<tr>
<td>Protocol deviations</td>
<td>55 deviations in 51 persons</td>
<td>5 deviations in 5 persons</td>
<td>5 deviations in 5 persons</td>
</tr>
<tr>
<td>Time to treatment &gt;3 hours or uncertain</td>
<td>20 (36%)</td>
<td>1</td>
<td>2 (both 5 minutes beyond 3 hours)</td>
</tr>
<tr>
<td>Incorrect dosing</td>
<td>19 (35%)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Medication coadministration</td>
<td>7 (13%): 4 antiplatelets, 2 heparin, 1 both</td>
<td>0</td>
<td>1 heparin use</td>
</tr>
<tr>
<td>Blood pressure elevation</td>
<td>4 (7%): 3 pretreatment, 1 posttreatment</td>
<td>1 posttreatment</td>
<td>1 pretreatment</td>
</tr>
<tr>
<td>Seizure at onset</td>
<td>2 (4%)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Coagulopathy</td>
<td>2 (4%): 1 elevated INR, 1 thrombocytopenia</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CT imaging</td>
<td>1 (2%) CT showed recent stroke</td>
<td>0</td>
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</table>
Telestroke
NIHSS

• NIHSS is the commonest scale to determine severity & judge efficacy of therapy at follow up.

• Correlations between bedside and remote locations ($r=0.9552, P<0.0001$) were very strong. (Wang et al. Stroke 2003)
TELESTROKE
Reliability of the Radiology

• Telestroke requires accurate and reliable reading of at least plain CT scans
• The best scenario is remote access to the PACS system or the DICOM data
• Excellent inter-rater agreement has been demonstrated in the remote reading of CT scans (Johnston and Worral, 2003)
TELESTROKE-Finnish Experience

• Prospective cohort study
• Describe 3 month outcomes of patients after getting thrombolysis
• Compare outcomes at spokes compared to hub which is a University Hospital
• 3 month mRS 0-2- 49% vs 58 % (p=0.21)
• 3 month mortality- 11.5% vs 10.2% (p=0.66)
• ICH rates - 6.7% vs 9 % ( p= 0.4)

Thus

• DRIP & SHIP comparable to DRIP & KEEP!

Sairanen et al. Neurology 2011;76:1145-1152
TELESTROKE- US experience

The STRokE DOC trial compared the effectiveness of telemedicine vs telephone modalities for decision making in acute telestroke consultations

Meyer et al. STROKE- 2008
TELESTROKE- US experience

- Stroke-Doc trial- Stroke 2010 Demaershalk et al.
- Prospective study
- Showed feasibility of Telestroke network over large geographical area in AZ (Mayo Clinic)
- Reported that 85% treatment decisions were deemed correct
- Learning curve for technology use – technical problems reported in 74%.
TELESTROKE
When to Transfer

Hess and Switzer, NEUROLOGY 2011
Thrombolysis rates increased

- Almost all centers report increased thrombolysis rates with telestroke
- Schwamm et al. report 5.6% thrombolysis rate among all pts with ischemic stroke compared to 0% before telestroke services on an island off the Massachusetts coast (Acad Emer Med 2004)
- 0.8% thrombolysis rate vs 4.3% after telemedicine set up – UT-Houston
Partner Hospitals

Battle Creek Health System
Cheboygan Memorial
Deckerville Community Hospital
Garden City Hospital
Gratiot Medical Center
Harbor Beach Community Hospital
Hills & Dales General Hospital
Hurley Medical Center
Huron Medical Center
Kalkaska Memorial Health Center
McKenzie Memorial Hospital
Mecosta County Medical Center
Mercy Health Partners- Lakeshore Mercy Medical Center
Mercy Health Partners – Muskegon
Mercy Hospital – Cadillac
Mercy Hospital – Grayling
Mid Michigan Medical Center-Clare
Mid Michigan Medical Center-Gladwin
Mid Michigan Medical Center-Midland
Munson Medical Center
Otsego Memorial Hospital
Paul Oliver Memorial Hospital
POH Regional Medical Center
St. Joseph Mercy Ann Arbor
St. Joseph Mercy Livingston
St. Joseph Mercy Oakland
St. Joseph Mercy Port Huron
St. Joseph Mercy Saline
St. Mary Mercy Livonia
Saint Mary’s Health Care
West Branch Regional Medical Center
TELESTROKE has increased thrombolysis administration in MSN

Thrombolysis administered

- 2008: 22
- 2009: 25
- 2010: 30
- 2011 (April)*: 20

33% increase over previous year
Remote consult characteristics

- Time of Call Received to Call Returned Avg (Mins)
- Time of Call Received to Robot Connection Avg (Mins)
- Consult Duration Avg (Mins)

MSN telestroke metrics

**Door to Needle Avg (Hours)**

- 2008: 1.3
- 2009: 1.3
- 2010: 1.3
- 2011: 1.2

**MSN Consult Time to Needle Average (Mins)**

- 2008: 48.0
- 2009: 48.0
- 2010: 46.0
- 2011: 42.0

**Initial NIH Score (Average)**

- 2008: 11.6
- 2009: 11.0
- 2010: 11.2
- 2011: 10.8

**D/C NIH (Average)**

- 2008: 2.5
- 2009: 3.7
- 2010: 3.8
- 2011: 4.7

**Average**

- 2008: 3.7
- 2009: 11.1
- 2010: 11.1
- 2011: 11.1
Neuroendovascular Volumes - St. Joseph Mercy-Oakland

Fiscal Year 2008 - 2011

Volume

- FY 2008: 149
- FY 2009: 130
- FY 2010: 107
- FY 2011: 218

Percent of change: 104% (FY 10-FY 11)
TELESTROKE-Challenges

- Reimbursement
- Initial cost and ongoing maintenance of equipment
- Comfort level with technology
- Reliability of technology
- Initial and ongoing training needs and costs
- Licensing and credentialing concerns
- Liability
# TELESTROKE-Networks

Survey of US Telestroke Projects (2007 data)

<table>
<thead>
<tr>
<th>Institution</th>
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<th>No. States</th>
<th>No. Hubs</th>
<th>No. Spokes</th>
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<td>4</td>
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TELESTROKE - Reimbursement

• Medicare- Requires use of interactive audio-video telecommunications for telestroke but only for patients from rural HPSA or a county outside a metropolitan statistical area
• Medicaid- some states (including MI) provide reimbursement. (same level as in-person consults)
• Private health plans ( currently > 130)
• Drip and Ship scenario-new code (since 2008)
## TELESTROKE - Reimbursement

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<td>Third party</td>
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<td>×</td>
<td></td>
<td>×</td>
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Infrastructure Costs

- Capital investment required for purchase and maintenance of hardware, related software
- Secure means of transmitting data - ISDN & Internet access
- Image sharing technology
- Provider Education
- Administrative & legal costs
Funding Resources

- Institutional Funds
- State and Federal Support
- Philanthropy
- Spoke hospital fees
<table>
<thead>
<tr>
<th>Institution</th>
<th>Hub city</th>
<th>Funding Source</th>
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<td>DMC-WSU SOM</td>
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Regulatory Issues

- Physician Credentialing and Licensure
- Special Purpose License
- Administrative Burden
- Malpractice and Medical Liability
- HIPPA
## TELESTROKE - regulations

<table>
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<tr>
<th>Institution</th>
<th>Hub city</th>
<th>Regulatory Environment</th>
<th>EMS routing</th>
<th>Additional malpractice</th>
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<td>yes</td>
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<tr>
<td>DMC-WSU SOM</td>
<td>Detroit</td>
<td>Primary Stroke center</td>
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<td>no</td>
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<tr>
<td>MSN</td>
<td>Pontiac</td>
<td>Self designated stroke center</td>
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<tr>
<td>Montana</td>
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TELESTROKE

• Is the added cost worth it?
• No good data and has not yet been well studied
• Difficult to ascertain costs of unnecessary transfers
• But value proposition to acute care hospitals without on site neurology/stroke coverage seems to be understood by more and more hospital CEOs.
ASA Guidelines 2009*

AHA/ASA

“Telestroke networks should be deployed wherever a lack of readily available stroke expertise prevents patients in a given community from accessing a primary stroke center (or center of equivalent capability) within a reasonable distance or travel time to permit eligibility for intravenous thrombolytic therapy.”

1) Use of telestroke for NIHSS – Class 1, level of evidence A
2) Use of telestroke for teleradiology – Class 1, level of evidence A
3) Use of telestroke for determining thrombolysis – Class 1, level of evidence B
4) Use of telephonic consultations without reviewing CT scans – Class 2b, level of evidence B

Schwamm et al. Stroke 2009;40:2616

*AAN affirms this statement
Conclusions

• Telestroke is a process of consultation using two way interactive audio and video conferencing – not a new medical therapy
• It is increasingly becoming part of stroke systems of care
• Allows evidence based acute stroke therapies to be available to patients in a timely manner that might otherwise be unavailable to them
Conclusions

- Increased rate of accurate assessment and appropriate treatment
- Ability to provide acute stroke treatment to patients in underserved and remote areas
- Improved outcomes, reduced morbidity and mortality
- Fewer protocol violations
- Greater opportunity for medical support and backup
- Increased administration of alteplase (also known as t-PA) in eligible patients
THANK YOU