Introduction

- 40% of the US population resides in counties without a hospital engaged in acute stroke assessment & care
- Gap due to insufficient numbers of stroke centers and availability of stroke specialists
- Long distances between remotely located stroke patients and centrally located stroke centers
- Underutilization of acute stroke treatments
- Telemedicine can overcome that gap
Telephone Specificity & Sensitivity

- Telephone specificity is high - excellent
- When neurologists decide that patients are thrombolytic candidates by telephone (ruling-in), they are largely correct
- Telephone sensitivity is low - poor
- When neurologists decide that patients are not thrombolytic candidates by telephone (ruling-out), they make many errors
  - The telephone-only results in under-treating of eligible candidates and telemedicine performance is better
  - “Minor deficit, rapid improvement” issue is better evaluated with camera
Diagnosis

• Stroke mimics range from 8-33%
• AV telemedicine capability assists neurologists discriminating stroke from non-stroke
• Telemedicine is 93% correct in diagnosing stroke (vs 82% telephone)

Sairanen T et al. Two years of Finnish telestroke. Neurology 2011;76:1145-1152
Emergency physicians are hesitant to accept sole responsibility for determining thrombolysis eligibility.

Emergency physicians may underutilize available acute stroke treatments.

On the contrary, 90% of rural emergency physicians are receptive to telestroke.

Emergency physicians and neurologists agree that telestroke:
- Improves diagnosis and treatment
- Reduces geographical differences in care
- Is superior to telephone consultation.

AHA/ASA recommendations for implementation of telemedicine within stroke systems of care

“Whenever local or on-site acute stroke expertise or resources are insufficient to provide around the clock coverage for a healthcare facility, telestroke systems should be deployed.”
Knowledge & Training

• Only 5% stroke specialists claim to be very knowledgeable of telestroke
  • 22% knowledgeable,
  • 53% superficial knowledge,
  • 20% not knowledgeable

• Mayo Clinic Teleneurology training
  • Residents, fellows, consultants

Morbidity & Mortality

- Lower mortality (and trend to lower morbidity) in telemedicine vs telephone trial
- STRokE DOC pooled analysis revealed no difference in 90-day functional outcomes

Handschen et al. J Neurol 2008 and Demaerschalk et al Stroke 2010
National Telestroke Networks - 2011

41 networks
29 states
Regional representation of Mayo Clinic Telestroke Network
National representation of Mayo Clinic Telestroke Network
International representation of Mayo Clinic Telestroke Network
Work or Home Office
Traveling
Telestroke Tool Box

2 way Audio/Video Communication Robot Platform

iPod Touch, iPhone, or iPad

Laptop/PC/Ultra Mobile Portable Computer (UMPC)

Webcam

PACS Access

Headphones with Microphone
Anywhere
Smartphone Teleradiology is Successfully Incorporated Into a Telestroke Network Environment

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**Diagram:**

1. Scanned images stored on PACS
2. ER Physician sends Stroke Alert to Neurologist
3. Neurologist queries ResMD server
4. PACS server accesses Image data
5. Neurologist reviews acute images
6. Clinical consult provided to spoke ER physician

Confidential patient information does not persist on the mobile device when the application is closed.
Smartphone (Video-phone) NIHSS

- 40 physicians, performed NIHSS on standardized patient (actor) with bedside EMT vs. face-to-face exam
- 480 pair comparisons of NIHSS scores
- High overall inter-rater agreement 0.99 (95% CI 0.992 – 0.995)

Gonzalez MA et al. Stroke 2011
STARR Trial Results
ClinicalTrials.gov Identifier: NCT00829361

• 28 min ED arrival to telestroke page
• 1 min for neurologist to return call
• 22 min consult time
• 86 min door to needle
• 5% post thrombolysis SICH
• 30% transfer
## Telestroke Timeline Targets

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency department arrival</td>
<td>0</td>
</tr>
<tr>
<td>Triage nurse assessment</td>
<td>5</td>
</tr>
<tr>
<td>Emergency physician assessment</td>
<td>10</td>
</tr>
<tr>
<td>Laboratory tests and CT of head ordered</td>
<td>15</td>
</tr>
<tr>
<td>Laboratory tests and CT of head conducted</td>
<td>25</td>
</tr>
<tr>
<td>Telesstroke hotline activated by spoke hospital</td>
<td>30</td>
</tr>
<tr>
<td>Preliminary telephone communication between hub and spoke</td>
<td>35</td>
</tr>
<tr>
<td>2 way AV telesstroke consultation commences</td>
<td>40</td>
</tr>
<tr>
<td>Teleradiology review of CT head</td>
<td>45</td>
</tr>
<tr>
<td>Diagnosis of stroke established and eligibility for acute treatment</td>
<td>55</td>
</tr>
<tr>
<td>Treatment recommended and administered</td>
<td>60</td>
</tr>
<tr>
<td>Telesstroke consultation ends with admission or transfer arranged</td>
<td>65</td>
</tr>
<tr>
<td>Consultation note dictated by hub neurologist</td>
<td>75</td>
</tr>
<tr>
<td>Consultation note transcribed and transmitted to spoke hospital</td>
<td>120</td>
</tr>
</tbody>
</table>
Concluding Remarks

• Stroke underserved areas exist in rural and urban environments
  • In developed and developing countries

• Telemedicine is better than telephone

• Telestroke has transitioned from research to routine practice

• Expansion from small regional networks to large national & international networks is realistic

• Telemedicine technologies continue to advance at impressive rate
Mayo Clinic Teleconcussion

- Concussion and TBI
  - Sports related concussion
    - 44M children each year in organized sports
    - 170M adults engaged in physical activities/sports
    - 1.7-3.8M sports related TBIs per year
  - Children and adolescents recover slower
  - Females more susceptible
    - Lower reporting in males
    - Biomechanical differences
*Mayo Clinic Teleconcussion*

- **Sports concussion laws:**
  - Passed
    - Alabama
    - Alaska
    - Arizona
    - Colorado
    - Connecticut
    - Delaware
    - District of Columbia
    - Idaho
    - Illinois
    - Indiana
    - Iowa
    - Kansas
    - Louisiana
    - Maine
    - Maryland
    - Massachusetts
    - Minnesota
  - Pending
    - Missouri
    - Nebraska
    - New Jersey
    - New Mexico
    - New York
    - North Carolina
    - North Dakota
    - Oklahoma
    - Oregon
    - Rhode Island
    - South Dakota
    - Texas
    - Utah
    - Vermont
    - Virginia
    - Washington
    - Wyoming

- **Introduced**
  - California
  - Florida
  - Maryland
  - New Hampshire
  - North Carolina
  - Pennsylvania
  - Rhode Island
  - South Dakota
  - Texas
  - Utah
  - Vermont
  - Virginia
  - Washington
  - Wyoming
Arizona Senate Bill 1521

Concussion education required for coaches, athletes, and parents

Concussed athletes must be removed from play immediately

Concussed athletes must be evaluated and cleared for return to play by a health care provider trained in the evaluation and management of concussion
Current laws mandate evaluation and clearance of concussed athletes by trained healthcare providers.

Research is being conducted to support the use of teleconcussion as an effective way to bring concussion expertise to rural Arizona.

Telemedicine is effective at providing specialty care to rural communities.

1:3 Arizonans and 1:4 Missourians live in rural communities.