Telestroke Networks for Management of Acute Ischemic Stroke
Framework

• Clinical problem
• Description of telestroke networks
• Clinical outcomes and cost / cost-effectiveness
• Implications of broad diffusion of best practices
• Impact on quality and outcomes
• Conclusions
Challenges in Acute Stroke Care

- Intravenous thrombolysis reduces long-term disability and is cost-effective in acute ischemic stroke (AIS)

- Intravenous thrombolysis must be delivered within a narrow time window in order for the treatment to be effective

- Lack of stroke specialists and lack of access to endovascular revascularization therapies, especially in rural areas, account for low utilization of intravenous thrombolysis
  - Rate of intravenous thrombolysis is <5% of AIS cases
Telestroke Network Overview

- Telestroke networks leverage the capabilities of telemedicine specifically for stroke care

- Hub-and-Spoke telestroke network
  - Connects multiple spoke hospitals to one hub hospital to provide stroke consultation
  - Spoke hospitals
    - Typically smaller hospitals with less extensive neurology services
    - Underserved hospitals in rural or suburban areas
  - Hub hospitals
    - Typically primary stroke centers with advanced neurological capabilities
    - 24 x 7 support with in-house neurology staff
Hub-and-Spoke Telestroke Networks

• Hub-and-spoke telestroke networks can:
  • Overcome geographic barriers to acute stroke care;
  • Enhance stroke diagnosis;
  • Increase intravenous thrombolysis administration rates;
  • Improve long-term outcomes

• A study published in 2011 found that hub-and-spoke telestroke networks were cost-effective in the long term from a societal perspective

Source:
Patient Flow in Hub-and-Spoke Telestroke Network

• For patients presenting at the Emergency Department at a hub hospital, no major change in patient flow

• For patients presenting in the Emergency Department at a spoke hospital, variations in:
  • Administration of intravenous thrombolysis
  • Treatment with endovascular therapy
  • Transfers from a spoke hospital to hub hospital
  • Discharge status (e.g., another facility, home or in-hospital death)
Patient Flow in Hub-and-Spoke Telestroke Network

Patient presents at Hospital Emergency Room → Spoke vs. Hub

Hub Hospital

Spoke: No telenetwork
- More patients transferred to hubs
- Fewer with access to IV thrombolysis and/or endovascular therapy

Spoke: With telenetwork
- Fewer patients transferred
- More patients receiving IV thrombolysis and/or endovascular therapy
Study Findings: Clinical Outcomes

• Research study conducted in part at Mayo in 2012 assessed cost-effectiveness of telestroke networks from individual hospitals’ perspectives

• Study population
  • Telestroke network with 1 hub and 7 spoke hospitals
  • Total of 1,112 unique AIS patients presenting to the emergency departments in the network hospitals per year

• Clinical outcomes
  • About 114 fewer AIS patients would be admitted to the hub hospital each year, whereas approximately 16 more patients would be admitted to each spoke hospital compared with a no network setting
  • 45 more patients would be treated with intravenous thrombolysis and 20 more with endovascular stroke therapy in a telestroke network per year

Source:
Study Findings: Cost Effectiveness Analysis

• Costs
  • An estimated average cost savings of $358,435 per year for all patients could be achieved with a telestroke network versus without a network during the first 5 years.

Source:
Study Findings: Sensitivity Analysis

• Authors of the study conducted a sensitivity analysis based upon ranges of specific parameters:
  • Network characteristics
    • Number of spokes (1 to 40)
  • Setup and maintenance costs of telestroke systems
  • Marginal costs for treating AIS at the hub or spoke
  • Discharge dispositions associated with endovascular stroke therapy

• Majority of inputs varied by ± 25% of the base-case value

• Sensitivity analyses demonstrated that results of the study were robust overall

Source:
Impact of Broad Diffusion of Telestroke Networks

- Analysis conducted to assess the implications of expanding the establishment of telestroke networks, leveraging best practices

- Research examined the savings potential to hospitals impacted by the following changes in the number of Medicare patients:
  - Increase in number receiving intravenous thrombolysis
  - Increase in number receiving endovascular therapy
  - Decrease in number transferred from spoke to hub hospitals

- Research examined the impact on costs associated with initial hospitalization, recurrent stroke, nursing home care, and rehabilitation

- Research examined the impact on Medicare expenditures (plus Medicaid expenditures for nursing homes for dual eligibles)
Broad Diffusion of Best Practices: Findings

- When analyzing only Medicare patients, telestroke networks currently result in net savings to hospitals

<table>
<thead>
<tr>
<th>Number of Telestroke Networks</th>
<th>Total Patients with AIS served</th>
<th>Total Annual Net Savings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>23,389</td>
<td>$ 3.5 M</td>
</tr>
<tr>
<td>Networks by 50%</td>
<td>35,084</td>
<td>$ 5.3 M</td>
</tr>
<tr>
<td>Networks by 100%</td>
<td>46,778</td>
<td>$ 7.0 M</td>
</tr>
<tr>
<td>Networks by 150%</td>
<td>58,473</td>
<td>$ 8.8 M</td>
</tr>
</tbody>
</table>

*Net annual savings to network: $ 68,628 / year

*Net of reimbursements and costs
Broad Diffusion of Best Practices: Findings

- Overall, telestroke networks result in net total cost savings, considering initial hospitalization, recurrent stroke, nursing home and rehabilitation costs.

Changes in cost, by setting and type of care, for Medicare patients

<table>
<thead>
<tr>
<th>Number of Telestroke Networks</th>
<th>Initial Hospitalization</th>
<th>Recurrent Stroke</th>
<th>Nursing Home*</th>
<th>Rehabilitation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>$8.6 M</td>
<td>-$3.5 M</td>
<td>-$1.9 M</td>
<td>-$9.9 M</td>
<td>-$6.7 M</td>
</tr>
<tr>
<td>Networks by 50%</td>
<td>$12.9 M</td>
<td>-$5.2 M</td>
<td>-$2.8 M</td>
<td>-$14.9 M</td>
<td>-$10.0 M</td>
</tr>
<tr>
<td>Networks by 100%</td>
<td>$17.1 M</td>
<td>-$6.9 M</td>
<td>-$3.8 M</td>
<td>-$19.9 M</td>
<td>-$13.5 M</td>
</tr>
<tr>
<td>Networks by 150%</td>
<td>$21.4 M</td>
<td>-$8.6 M</td>
<td>-$4.7 M</td>
<td>-$24.8 M</td>
<td>-$16.7 M</td>
</tr>
</tbody>
</table>

* Nursing home costs for those patients who are dual eligibles (Medicaid and Medicare)
Broad Diffusion of Best Practices: Findings

- Overall, telestroke networks result in reductions in Medicare reimbursements, considering initial hospitalization, recurrent stroke and rehabilitation revenues.

Changes in Medicare and Medicaid reimbursements, including dual eligibles, by setting and type of care:

<table>
<thead>
<tr>
<th>Number of Telestroke Networks</th>
<th>Initial Hospitalization</th>
<th>Recurrent Stroke</th>
<th>Nursing Home*</th>
<th>Rehabilitation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>$ 8.4 M</td>
<td>- $ 3.3 M</td>
<td>- $ 1.8 M</td>
<td>- $ 10.9 M</td>
<td>- $ 7.6 M</td>
</tr>
<tr>
<td>↑ Networks by 50%</td>
<td>$ 12.7 M</td>
<td>- $ 5.0 M</td>
<td>- $ 2.6 M</td>
<td>- $ 16.3 M</td>
<td>- $ 11.2 M</td>
</tr>
<tr>
<td>↑ Networks by 100%</td>
<td>$ 17.0 M</td>
<td>- $ 6.6 M</td>
<td>- $ 3.5 M</td>
<td>- $ 21.8 M</td>
<td>- $ 14.9 M</td>
</tr>
<tr>
<td>↑ Networks by 150%</td>
<td>$ 21.2 M</td>
<td>- $ 8.3 M</td>
<td>- $ 4.4 M</td>
<td>- $ 27.2 M</td>
<td>- $ 18.7 M</td>
</tr>
</tbody>
</table>

* Nursing home costs for those patients who are dual eligible (Medicaid and Medicare)
Impact of Telestroke Network on Quality of Care and Outcomes

• Improved patient outcomes from intravenous thrombolysis:
  • Improved functional outcomes – higher percent with no significant disability
    • Reduction in handicap
    • Significantly higher overall self-report health
    • 564 qualify-adjusted life years (QALY) saved over 30 years per 1,000 patients treated

• Intravenous thrombolysis coupled with endovascular therapy:
  • Improved neurological status within 24 hours and after 90 days

Sources:
1 Based on the Rankin scale. Findings from Lars Ehlers, PhD, MSc (econ); Grethe Andersen, DMSc, PhD, MD; Lone Beltorf Clausen, MSc; Merete Bech, MSc; Mette Kjølby, PhD, DDS. Cost-Effectiveness of Intravenous Thrombolysis With Alteplase Within a 3-Hour Window After Acute Ischemic Stroke. Stroke. 2007;38:85-89.
2 Based on the Oxford handicap scale (http://dx.doi.org/10.1016/S1474-4422(13)70149-2).
4 Mikael Mazighi MD a c, Jean-Michel Serfaty MD b, Julien Labreuche BST c, Jean-Pierre Laissy MD b, Elena Meseguer MD a c, Philippa C Lavallée MD a c, Lucie Cabrejo MD a c, Tarik Slaoui MD a c, Céline Guidoux MD a c, Bertrand Lapergue MD a c, Isabelle F Klein MD b c, Jean-Marc Olivot MD a, Gai Raphaeli MD. Comparison of intravenous alteplase with a combined intravenous—endovascular approach in patients with stroke and confirmed arterial occlusion (RECANALISE study): a prospective cohort study.
Conclusions

• Telestroke networks achieve net annual cost savings for Medicare patients and for all patients

• Medicare expenditures decrease overall when considering inpatient, recurrent stroke and rehabilitation reimbursements
  • Increase in initial hospitalization expenditures offset by decrease in expenditures for recurrent stroke and rehabilitation care
  • Further decreases realized from dual eligibles in reduction in nursing home payments

• Increase in telestroke networks also leads to improved patient outcomes and quality of care
  • Networks create increased access to effective treatments such IV thrombolysis and endovascular therapy

• Continued expansion of telestroke networks across the country benefits patients, hospitals and Medicare
Appendix: Stroke Occurrence

- Approximately 795,000 Americans experience a stroke each year

- Approximately 185,000 strokes each year are recurrent strokes
  - Within 5 years of a stroke, 24 percent of women and 42 percent of men will experience a recurrent stroke
  - Recurrent strokes often have a higher rate of death and disability because parts of the brain already injured by the original stroke may not be as resilient
Appendix: Detailed Patient Flow in Telestroke Network

[Diagram depicting the patient flow in a telestroke network, with decision points for patient evaluation, diagnosis, and treatment pathways, including administration of IV thrombolysis and endovascular therapy.]
Appendix: Impact on Medicare Expenditures

• Due to increase in patients receiving IV thrombolysis and/or endovascular therapy, Medicare expenditures for the initial stroke hospitalization may increase
  • An analysis of Medicare expenditures with networks estimates < 5% increase compared to no networks
  • Overall expenditures reduced considering recurrent stroke, inpatient rehabilitation and nursing home expenditures (the latter in dual eligibles)

• Potential impact on Medicare expenditures for initial inpatient hospitalization:

<table>
<thead>
<tr>
<th>Number of telestroke networks</th>
<th>Total Medicare Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Networks</td>
</tr>
<tr>
<td>Current</td>
<td>$ 754 M</td>
</tr>
<tr>
<td>Networks by 50%</td>
<td>$ 1.1 B</td>
</tr>
<tr>
<td>Networks by 100%</td>
<td>$ 1.5 B</td>
</tr>
<tr>
<td>Networks by 150%</td>
<td>$ 1.8 B</td>
</tr>
</tbody>
</table>

% Change, Medicare Expenditures: 4.8%
No change as number of networks increases