The Future of Stroke

Debbie Summers, MSN, RN, ACNS-BC, CNRN, SCRN, FAHA, ANVP
Saint Luke’s Hospital
Kansas City, MO
Disclosures:

Speakers Bureau for Genentech
Stroke – Fifth Leading Cause of Stroke

<table>
<thead>
<tr>
<th>Cause</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>170.5</td>
<td>169.8</td>
</tr>
<tr>
<td>Cancer</td>
<td>41.5</td>
<td>41.7</td>
</tr>
<tr>
<td>Chronic lower respiratory</td>
<td>41.5</td>
<td>41.7</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>36.9</td>
<td>36.2</td>
</tr>
<tr>
<td>Stroke</td>
<td>23.8</td>
<td>23.5</td>
</tr>
<tr>
<td>Alzheimer’s disease</td>
<td>21.2</td>
<td>21.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>14.4</td>
<td>15.9</td>
</tr>
<tr>
<td>Influenza and pneumonia</td>
<td>13.1</td>
<td>13.2</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>12.6</td>
<td>12.6</td>
</tr>
<tr>
<td>Suicide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Deaths per 100,000 standard population
Stroke Care in the Future

- Systems of Care
- Clinical Aspects
- Financial Aspects

Matchar, Stroke. 2015;46:1414-1421
Organized Care
Systems of Care
# Stroke Boot Camp

**Train and Think F.A.S.T. –**  
**Time Saved Is Brain Saved**

<table>
<thead>
<tr>
<th></th>
<th>Neurons Lost</th>
<th>Synapses Lost</th>
<th>Accelerated Aging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Stroke</td>
<td>1.2 billion</td>
<td>8.3 trillion</td>
<td>36 yrs</td>
</tr>
<tr>
<td>Per Minute</td>
<td>1.9 million</td>
<td>14 billion</td>
<td>3.1 wks</td>
</tr>
<tr>
<td>Per Hour</td>
<td>120 million</td>
<td>830 billion</td>
<td>3.6 yrs</td>
</tr>
</tbody>
</table>

*Neuroscience*
Stroke Outcomes

Association of DTN Time ≤ 60 Minutes with in-Hospital Clinical Outcomes in GWTG-Stroke

25,504 acute ischemic stroke patients treated with tPA within 3 hrs of symptom onset at 1082 hospital sites.

After adjustment, DTN times ≤ 60 minutes was associated with 22% lower odds of in-hospital mortality, adjusted OR, 0.78; 95% CI, 0.69 to 0.90; P=0.0003

Lower rates of sICH and any tPA complications

* Variables included in multivariable GEE models were age, sex, race, prior medical history of AF, stroke/TIA, CHD/MI, carotid stenosis, diabetes, PVD, hypertension, dyslipidemia, smoking, NIHSS (continuous), arrival mode (EMS vs other), arrival time on hours, hospital characteristics of geographic region, academic, PSC, bed size, annual number of strokes, annual number of tPA patients.

Stroke Outcomes

- In 2011 DTN median 81 versus 74 minutes
- In 2014 - Average DTN 74 minutes to 59 minutes.
  - accompanied by improved outcomes
  - reduced mortality
  - fewer treatment complications
  - greater likelihood that patients would go home

*JAMA. 2014;311(16):1632-1640.*
Stroke Outcomes

- Percentage of patients treated within the recommended time frame increased from less than one-third to more than one-half.
- Prior to the program, only 64.7 percent of eligible patients were treated with tPA. After initiation of "Target: Stroke," this increased to 85.2 percent,
Stroke Outcomes

- IMS III showed long delays from
  - IV tpa administration (median 85 min)
  - Puncture to reperfusion (median 85 min)
  - Especially if transferred

- Times improved with
  - Busier Centers
  - Time in trial
  - Introduction of new devices

  » Broderick et al, Circulation July 2014
Time to angiographic reperfusion and clinical outcome after acute ischaemic stroke: an analysis of data from the Interventional Management of Stroke (IMS III) phase 3 trial

Pooja Khatri, Sharon D Yeatts, Mikael Mazighi, Joseph P Broderick, David S Liebeskind, Andrew M Demchuk, Pierre Amarenco, Janice Carrozello, Judith Spilker, Lydia D Foster, Mayank Goyal, Michael D Hill, Yuko Y Palesch, Edward C Jauch, E Clarke Haley, Achaia Vagal, Thomas A Tomsick, for the IMS III Trialists

Increased time to reperfusion was associated with a decreased likelihood of good clinical outcome (unadjusted relative risk for every 30-min delay 0.85 [95% CI 0.77–0.94]; adjusted relative risk 0.88 [0.80–0.98]).

Time is Brain

Achieving reperfusion at 310 minutes, compared to 280 minutes, corresponds to a 10.6% decrease in the probability of a good outcome.

Khatri P. Neurology 2009; 73 (13): 1066-1072
Every 30 minute delay in reperfusion is a 10% relative reduction in probability of good clinical outcome (mRS 0-2) in adjusted analysis.
Strategies for Reducing the Door-to-Balloon Time in Acute Myocardial Infarction

Elizabeth H. Bradley, Ph.D., Jeph Herrin, Ph.D., Yongfei Wang, M.S., Barbara A. Barton, R.N., Tashonna R. Webster, M.P.H., Jennifer A. Mattera, M.P.H.

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Time Saved Is Brain Saved

Systems of Care
Stroke Boot Camp

Train and Think F.A.S.T. –
Time Saved Is Brain Saved

We Have to Get Organized...

Systems of Care:

• Pre-hospital Systems of Care
  – Community education for symptoms & EMS activation
  – EMS education for recognition and empowered for activation to higher level centers
  – Primary to comprehensive center network
    • Limiting community hospital time/transfer time
  – Efficient in-house triage, activation, treatment with endovascular to ≤ 90 minutes
Stroke Boot Camp
Train and Think F.A.S.T. –
Time Saved Is Brain Saved

Systems of Care: We Have to Get Organized...

• Pre-hospital Systems of Care –
  – EMS leaders and local experts develop triage paradigms and protocols to ensure rapid identification
  – Validated and standardized instrument for stroke screening

• Pre-hospital notification GWTG (n=371,988) shorter door-to-CT (26 min vs 31 min) and shorter DTN (78 min vs 80 min)
EMS transport criteria should be Severity as well as Time based
Los Angeles Motor Scale (LAMS)

- Face weak
  - Absent 0
  - Present 1
- Arm weak
  - Absent 0
  - Drift 1
  - Falls Rapidly 2
- Grip Strength
  - Normal 0
  - Weak 1
  - No grip 2

• 1 or 2 points to the highest center within 15 minutes (likely a minor stroke and probably not a candidate for more aggressive therapy)

• 3-5 points, or any patient who is drowsy or has impaired consciousness goes to CSC (larger stroke that benefits from higher level of care)

The Rapid Arterial Occlusion Evaluation (RACE)

A simple prehospital stroke scale to predict the presence of large vessel occlusion (LVO) in patients with acute stroke

Pérez de la Ossa N et al. Stroke. 2014;45:87-91
<table>
<thead>
<tr>
<th>Item</th>
<th>RACE Score</th>
<th>NIHSS Score Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial palsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mild</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Moderate to severe</td>
<td>2</td>
<td>2–3</td>
</tr>
<tr>
<td>Arm motor function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal to mild</td>
<td>0</td>
<td>0–1</td>
</tr>
<tr>
<td>Moderate</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>2</td>
<td>3–4</td>
</tr>
<tr>
<td>Leg motor function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal to mild</td>
<td>0</td>
<td>0–1</td>
</tr>
<tr>
<td>Moderate</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>2</td>
<td>3–4</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1-2</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td><strong>Head and gaze deviation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>1</td>
<td>1-2</td>
</tr>
<tr>
<td><strong>Aphasia</strong> (if right hemiparesis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performs both tasks correctly</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Performs 1 task correctly</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Performs neither tasks</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Agnosia</strong> (if left hemiparesis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient recognizes his/her arm and the impairment</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Does not recognize his/her arm or the impairment</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Does not recognize his/her arm nor the impairment</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Score total</strong></td>
<td>0-9</td>
<td></td>
</tr>
</tbody>
</table>
Proportion of patients with ischemic stroke with large vessel occlusion (LVO; black), ischemic stroke without LVO (gray), hemorrhagic stroke (dashed), or stroke mimic (white) for every Rapid Arterial oCclusion Evaluation (RACE) scale score.
Interactions
Within Stroke Systems of Care

- Set up a data collection paradigm to determine response times and outcomes
- Develop an action plan to address any deficiencies in the EMS response/hospital to hospital transfers.
  — MO Timed Critical Diagnosis
## Systems of Care Metrics

<table>
<thead>
<tr>
<th>METRIC</th>
<th>POPULATION</th>
<th>GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of EMS patients triage to an ASRH, PSC, CSC</td>
<td>Patients call EMS via 911</td>
<td>Improve presentation times to a stroke center, increase use of IV tPA</td>
</tr>
<tr>
<td>% of IV tpa treated with DTN time $\leq$ 60 min</td>
<td>Patients eligible for IV tPA</td>
<td>Improve use of IV tPA</td>
</tr>
<tr>
<td>Median time to acute reversal of INR in ICH or SAH</td>
<td>ICH/SAH patients with INR $&gt; 1.4$</td>
<td>Reduce time to reversal</td>
</tr>
<tr>
<td>Median time to establish telemedicine link</td>
<td>Patients at non-stroke center</td>
<td>Improve efficiency of telemedicine care and expedite stabilization and transfer</td>
</tr>
<tr>
<td>Median time from ED arrival to second hospital arrival among transferred patients</td>
<td>Patients at remote facilities transferred to PSC or CSC</td>
<td>Reduce transportation times</td>
</tr>
</tbody>
</table>
### Intraarterial Therapy QI Case Review Triggers and Process Metrics

<table>
<thead>
<tr>
<th>Key time intervals</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door to imaging</td>
<td>At least 80% of patients with acute stroke being evaluated for revascularization should have noncontrast head CT or MR study within 25 min from time of arrival, completed and interpreted within 45 min from time of arrival</td>
</tr>
<tr>
<td>Use of CT/MR (for centers that perform MR imaging) as first-step imaging</td>
<td>At centers whose institutional protocols require noninvasive vascular and parenchymal imaging (CT angiography/perfusion or MR imaging/angiography) before intervention, ≥ 80% of all patients potentially eligible for endovascular treatment should undergo these studies</td>
</tr>
<tr>
<td>Door to puncture</td>
<td>≥ 75% of patients treated with endovascular therapy should have a door-to-puncture time &lt; 2 h</td>
</tr>
<tr>
<td>Puncture time to start of revascularization</td>
<td>≥ 50% of patients should have a time from puncture to start of lytic infusion or first pass of mechanical device in the target vessel &lt; 45 min</td>
</tr>
<tr>
<td>Puncture time to revascularization</td>
<td>≥ 50% of patients should have TIMI grade 2 or TICI grade 2a revascularization within 90 min of arterial puncture</td>
</tr>
</tbody>
</table>
### Intra Arterial Therapy QI Case Review Triggers and Process Metrics

<table>
<thead>
<tr>
<th>Outcome metrics</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recanalization/reperfusion</td>
<td>≥ 60% of patients should have TIMI grade 2 or TICI grade 2/3 recanalization for all clot locations at procedure completion</td>
</tr>
<tr>
<td>Postprocedure CT/MR</td>
<td>≥ 90% of patients should have brain CT or MR within 36 h of the end of procedure</td>
</tr>
<tr>
<td>SICH</td>
<td>100% of cases with SICH are reviewed for educational purposes; ≤ 12% of treated patients should develop SICH</td>
</tr>
<tr>
<td>Clinical outcomes</td>
<td>At least 30% of patients with strokes treated by endovascular methods should have an mRS score of 0-2 at 90 d</td>
</tr>
<tr>
<td>Death within 72 h of treatment</td>
<td>100% of deaths within 72 h of the end of procedure are reviewed</td>
</tr>
</tbody>
</table>
• The stroke center shall document review of its cases of stroke patients
  – who receive IV tPA and who remain at the referring hospital > (90) minutes prior to transfer
  – Who do not received IV tPA remain > (60) minutes at the referring hospital prior to transfer
• Follow up to EMS and Transferring Hospital
Clinical Aspects
Science and Technology

Newer Technologies = Better Recanalization

- Solitaire FR
- Trevo
- Separator 3-D
- Penumbra Max System
CRYptogenic STroke and underlying Atrial Fibrillation (CRYSTAL AF): Long-Term Follow-Up Results

Rod S. Passman, MD, MSCE, Johannes Brachmann, MD, Ph.D. Carlos Morillo, MD, Tommaso Sanna, MD, Richard Bernstein, MD, Ph.D., Vincenzo Di Lazzaro, MD, Hans-Christoph Diener, MD, Ph.D., Marilyn Rymer, MD, Frank Beckers, Ph.D, Tyson Rogers, M.S., Paul Ziegler, M.S. for the Crystal AF Investigators
Background

• 30% of ischemic strokes are of unknown mechanism (cryptogenic stroke)
• Atrial fibrillation (AF) is a known cause of ischemic stroke
• Detection of AF should prompt long-term anticoagulation instead of antiplatelet therapy in a patient with prior ischemic stroke
• Optimal monitoring duration to detect AF is currently undetermined
• AF may be paroxysmal, occur rarely, and be asymptomatic, making detection with routine methods difficult
CRYSTAL-AF: Primary Objective

• Assess whether a long-term cardiac monitoring strategy with an insertable cardiac monitor (ICM) is superior to standard monitoring for the detection of AF in patients with cryptogenic stroke
The Future

• We have gone from our first generation of clot removing procedures, which were only moderately good in reopening target arteries, to now having highly effective tools.

• Better patient selection with advancement of non-contrast Imaging to identification of salvageable tissue (Perfusion Imaging) to the latest which is the possibility of looking at collateral flow.
Collaterals

- Numerous stroke clinical trials are demonstrating the profound impact of collaterals on:
  - Recanalization
  - Reperfusion
  - Smaller infarcts
  - Less hemorrhagic transformation
  - Better clinical outcomes
Continuous Monitoring Arm: Insertion of REVEAL® XT

- Minimally invasive outpatient procedure
- Local anesthetic and no leads or fluoroscopy
- 15-30 minute procedure
- Device can be followed remotely
- MRI conditional
- 3 year device longevity
- Automatic AF detection algorithm

Standard Monitoring Arm

- Cardiac monitoring performed according to local standards, after mandated testing completed
- Symptoms consistent with AF were evaluated by study physicians
Conclusions

• AF detection in cryptogenic stroke patients increases over time with monitoring, with an estimated rate of AF detection of 30% in the ICM versus 3% in the control arm at 36 months.

• For those patients with detected AF in the ICM arm, the duration was more than 6 minutes on one or more days in >94% of patients.

• Physicians took action when AF was found with 89% of patients being prescribed OAC.

• Majority of first AF episodes (75%) were asymptomatic.

• At 36 months, more than 250 tests were required in order to find 5 patients with AF in the control arm.

• The time to first AF detection was beyond the time-frame of typical external monitors.

• Long-term continuous monitoring should be performed in patients with cryptogenic stroke.
Theory of Collateral Flow

- The connection between leptomeningeal collateral flow (LMF) and the survival of brain parenchyma during acute ischemia has been confirmed in a large number of clinical studies. Bang OY. Stroke. 2011;42:2235-2239.
Collaterals Avert HT

• Data revealed that therapeutic recanalization in the setting of poor collaterals resulted in a high frequency of HT with worsened clinical neurological status.

• Poor collateral status at baseline may limit effective reperfusion, even when recanalization is successful.
  • Bang OY. Stroke. 2011;42:2235-2239.
Collaterals Avert HT

The higher rate of HT in patients with poor collaterals may be the result of more aggressive revascularization strategies in patients with poor collaterals. Results showed that aggressive treatment (ie, combined fibrinolytics and mechanical/Merci clot retrieval therapy) was associated with HT.

Bang OY. Stroke. 2011;42:2235-2239
Improving Collaterals

• Augmenting cerebral blood flow by:
  • inducing mild hypertension
  • using partial aortic occlusion
  • with sphenopalatine and cervical spinal stimulation
  • using head positioning

Collateral Flow Grading
American Society of Interventional and Therapeutic Neuroradiology Collateral Grading System

<table>
<thead>
<tr>
<th>Grade</th>
<th>Cerebral Collateral Flow Grading Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td>no collaterals visible to ischemic site</td>
</tr>
<tr>
<td>Grade 1</td>
<td>slow collaterals to the periphery of the ischemic site with persistence of defect</td>
</tr>
<tr>
<td>Grade 2</td>
<td>rapid collaterals to the periphery of ischemic site with persistence of some of the defect and to only a portion of the ischemic territory</td>
</tr>
<tr>
<td>Grade 3</td>
<td>collaterals with slow but complete angiographic blood flow of the ischemic bed by the late venous phase</td>
</tr>
<tr>
<td>Grade 4</td>
<td>complete and rapid collateral blood flow to the vascular bed in the entire ischemic territory by retrograde perfusion</td>
</tr>
</tbody>
</table>
Collateral Flow Grading
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CTA to Obtain Collateral Flow

Collateral Score System

score 0  score 1  score 2  score 3  score 4
DO WE NEED THIS ADVANCED Imaging?
Alberta Stroke Program Early CT Score (ASPECT)

- 10 point quantitative topographic CT scan score to assess early ischemic changes of the MCA region
- Assessed at 2 standardized regions
  - Ganglionic Level where the thalamus, basal ganglia and caudate are visible
  - Supraganglionic level which includes the corona radiata and centrum semiovale
10 Regions of MCA

- M1, M2, M3, M4, M5, M6
- caudate nucleus (C)
- lentiform nucleus (L)
- internal capsule (IC)
- insular cortex (I)

For each area involved in ischemia depicted at unenhanced CT, one point is subtracted from the total score of 10.
ASPECT Score

Normal ASPECT score is 10
Deduct 1 point for each area involved.
A score of 7 or less --Correlates with poor functional outcome and hemorrhage.
*Limitation – Only scores the MCA
Time Will Tell....

Ongoing

– Dawn Trial
  • CT or MR perfusion selection with wake up strokes and strokes >8 hours from onset
  • Wake up Symptomatic Stroke – Benefit of Intravenous Clot Busters or Endovascular Intervention (WASSABI)
    • Natarajan Stroke 2009; 40: 3269-3274
Manipulating the Time Window

- Increasing collateralization
- Increasing Venous return/Volume – NS bolus
- Attention to BP
- Positioning
- Balloon pumps/mechanical counter-pulsation
- Neuroprotection agents; hypothermia
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Zero Degree HOB Positioning:
Reducing Risk from Serious Adverse Events

Anne W. Alexandrov, PhD, CCRN, NVRN-BC, ANVP-BC, FAAN
Professor, University of Tennessee Health Science Center
Memphis & Australian Catholic University;
NET SMART Program Director
anne@outcomesmgmt.org
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CLOTBUST - 2004
CLOTBUST-ER

- rt-PA + transcranial ultrasound vs. rt-PA alone
- 2-hours ultrasound or sham-ultrasound
- 830 patients planned
  - ~75% completed enrollment with 2015 target end
- Dr. Andrei Alexandrov, PI
A Hands-free (HF) device components, including demonstration of headframe on a volunteer.
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Strategy
Telemedicine
Stroke Boot Camp
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www.mobilestrokeunit.com
Germany 2008

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Mobile Unit</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke Patients given tPA (%)</td>
<td>33</td>
<td>21</td>
</tr>
<tr>
<td>Time to tPA (min)</td>
<td>52</td>
<td>77</td>
</tr>
</tbody>
</table>

Ebinger M et al. JAMA Neurol 2014 Nov 17;
HOUSTON MSU
Standard 12 foot ambulance
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Time Saved Is Brain Saved
BEST MSU Study

- **Benefits of Stroke Treatment Delivered Using a Mobile Stroke Unit Compared to Standard Management by EMS**

- **Aims**
  - Determine the logistic and clinical outcomes of MSU vs SM in the U.S. – speek, #, first hour.
  - Can MD/Nurse be replaced by Telemedicine?
  - What is the Cost Effectiveness?
Innovative Care Delivery

1. Use of a team of nurses and CAN to maximize use of acute treatment and primary and secondary stroke prevention

2. Transition of the care for low-risk patients with TIA from inpatient settings to outpatient clinics or observation units

3. Increases in access to and delivery of tPA via tele-stroke systems and remote expert supervision to avoid potential delay in emergency care

4. Strengthening of community programs to ensure smooth transition to home programs to reduce readmission for individuals at high risk.

*Matchar, Stroke. 2015;46:1414-1421*
Improving Acute Ischemic Stroke Treatment Rates:

Can a Non-Traditional Stroke Response Team Measure Up?

Wendy L. Dusenbury, DNP, APRN-BC, CNRN, ANVP-BC
Anne W. Alexandrov, PhD, RN, ANVP-BC, CCRN, FAAN
Scott Taylor, PharmD

Via Christi Hospitals-Wichita St. Francis Campus, Wichita, KS
Wichita State University, Wichita, KS
University of Alabama-Birmingham
University of Tennessee Health Science Center, Memphis, TN
Australian Catholic University-Sydney

1, 2, 3
4, 5
Non-Standard Inclusion & Exclusion Criteria for Intravenous Alteplase Administration in Acute Ischemic Stroke

Anne W. Alexandrov
PhD, CCRN, NVRN-BC, ANVP-BC, FAAN
Professor, University of Tennessee Health Science Center,
Memphis & Australian Catholic University, Sydney
Program Director, NET SMART

The U.S. SHOULD BE the leading provider of IV tPA for acute ischemic stroke

- First country to approve intravenous alteplase for treatment of acute ischemic stroke
- Currently, more than 1000 certified Stroke Centers in operation
  — NINDS 1997 recommended purpose of Stroke Centers: To administer IV tPA
On Label Warnings...NOT Contraindications

- NIHSS >22 at presentation
- Major early infarct signs by an imaging technique (e.g., substantial edema, mass effect, or midline shift)
- Blood glucose levels <30 mg/dL or >400 mg/dL
- Minor neurological deficit
- Rapidly improving symptoms

Exclusion Criteria **Beyond** the Activase® Label:

- (44%) Rapid improvement despite remaining disabling deficit
- (30%) NIHSS > 22
- (26%) Concurrent AMI
- (22%) Receiving anticoagulation regardless of lab results
- (21%) Minor stroke symptoms with NIHSS < 7
- (20%) Suspected (not witnessed) seizure

(16%) Age > 80 years (3-hour protocol)
- (14%) Large vessel occlusion that may benefit from IA
- (8%) Elevated hepatic function labs
- (7%) Nicardipine treatment for blood pressure control
- (7%) Decreased level of consciousness on clinical examination
- (6%) Unable to obtain written informed consent in time for treatment (3 hour window)
- (5%) Currently receiving multiple antiplatelets (i.e. clopidogrel / ASA)
Additionally...

- 24% limited tPA treatment window to 3 hours
- Academic hospital tPA treatment rates were significantly higher than community hospitals:
  - Academic hospital IV tPA treatment rate: 10.8 ± 7.7 (median 8)
  - Community hospital IV tPA treatment rate: 8 ± 5.9 (median 6)
    - t = 2.3; mean difference 2.75; p = .026, 95% CI 3.3-5.2
- As the number of non-standard inclusions/exclusions increased, the tPA treatment rate decreased
  - (r = -.153; p = .038)
- Utilization of non-standard inclusions/exclusions was predicted by hospital type (community), admission volume (low), and use of the 3 hour window (p < .0001).

Classification of sICH: Reliability in Question...

- Official definitions support classification of sICH for most (86%) certified Stroke Centers, however the most common definition (48%) reported was, “any hemorrhage on non-contrast CT or MRI in combination with any clinical deterioration.”
- Only 17% identified the definition for sICH adopted by TJC (ECASS-3 definition).
  - Among those that adhered to the TJC definition, sICH rates were significantly lower at 3% ± 2.3% (median 3%; t = 4.7; mean difference = 7.7; p < .0001, 95% CI 4.4-10.95), compared to 10.6% ± 17.5% (median 6%).
Financial Aspects
• By 2030, 3.88% of the US population >18 years of age is projected to have had a stroke.

• Between 2012 and 2030, total direct annual stroke-related medical costs are expected to increase from $71.55 billion to $183.13 billion.

• Real indirect annual costs (attributable to lost productivity) are projected to rise from $33.65 billion to $56.54 billion over the same period.

• Overall, total annual costs of stroke are projected to increase to $240.67 billion by 2030, an increase of 129%.

Stroke. 2013;44:2361-2375
• Two Initiatives
  1. CMS Inpatient Quality Reporting (IQR)
  2. Hospital Value-Based Purchasing (VBP) Programs
CMS Inpatient Quality Reporting Program (IQR)

- January 1, 2013 hospitals were required to report on the 8 Stroke Quality Measures.
  - IQR requires hospitals to report to CMS on the quality measures in order to receive higher annual updates to the Medicare MS-DRG update rates.
  - IQR then authorizes CMS to pay a higher annual percentage if hospital successfully reports on the 50+ designated quality measures.


Overview - Hospital Value Based Purchasing (VBP) Program

- Mandated by the Affordable Care Act to link payment to quality.
- Starting Fiscal Year (FY) 2013 payment, 1% of Inpatient Prospective Payment System base operating payment linked to performance on quality measures.
- Percentage increases by 0.25% annually until FY 2017 (2% starting in FY 2017).
- Current measures include MI, PN, CHF, SCIP, HAIs, 30 Day mortality measures, and patient experience of care.
- Stroke core measures are possibly going to be incorporated into VBP in the future.
2014 Stroke Measure Introduction

• January 1, 2014 started the reporting on Stroke 30 day mortality rate and Stroke 30 day readmission rate. These measures will affect payment in FY 2016 (Oct 1, 2015- Sep 30, 2016).

Why Stroke Mortality and Readmissions?

- One of the leading causes of death in the U.S.
- Survivors frequently experience significant disability and increased dependency on the healthcare system.
- Variation across hospitals indicates room for improvement.
- These are not National Quality Forum (NQF) endorsed.
- Ischemic stroke only.
Stroke Mortality: Opportunity for Improvement

• National mortality rate: 15.6%
• Hospital risk standardized mortality rate (RSMR) range: 8.5%-23.3%.
Stroke Readmission: Opportunity for Improvement

- National readmission rate: 13.8%
- Hospital risk standardized readmission rate (RSRR) range: 9.1%-20.6%
Design of Stroke Mortality and Readmission Measures

- Developed and calculated using administrative claims data.
- Includes Medicare Fee For Service (FFS) patients aged ≥ 65 admitted for acute ischemic stroke in 2009-2011.
- Includes non-federal acute care hospitals. Critical access hospitals are included.
- Reported as risk-standardized mortality (RSMR) and readmission (RSRR) rates
Measure Outcomes

• Mortality Outcomes:
  • Death from any cause within 30 days of admission date for index hospitalization.

• Readmission outcomes:
  • All cause unplanned re-admission
    • To any acute care hospital
    • Within 30 days of discharge
    • Multiple readmissions within 30 days of discharge only count as one outcome event.
  • Controls for planned readmissions (surgery: pacer, coil.....)
CMS and Where Your Data is Reported:

- Consumers can look at data on your hospital reported through the IQR program on the Hospital Compare website:
- www.hospitalcompare.hhs.gov
How the 2% Reduction Works

• If a hospital does not report this quality data- the amount of re-imbursement update increase will be reduced by 2%

• MS-DRGs are used to reimburse hospitals for inpatient stays by CMS.
  • Inpatient stays are assigned to an MS-DRG based on Diagnosis, primary procedures and 2nd dx. Stroke (06_s).
  • Hospitals payments are updated based on specific rates assigned for the MS-DRGs.

• Each year the amount of re-imbursement is updated based on price increases for goods and services→ if a hospital reports the 57 measures they receive the full updated payment.
• Bundled Payments for Care Improvement - (BPCI) initiatives launched to explore innovative payment method in 2013.
  • Choose from 48 episodes of care including stroke, and enter into payment arrangements with Medicare accountability for cost and performance.
  • Payment for an episode of care – acute admission through rehabilitation

• Special challenges in establishing bundled payment for stroke:
  • Heterogeneity
  • Wide range of pre-event disability and comorbidity
  • Effects and management are similarly diverse
• Another salient feature of stroke is that the opportunity for improving patient outcomes and care efficiency is normally not in the hospital phase (where length of stay has already been driven down and there is generally no high cost procedure to streamline)

• If bundled payment is to make a positive difference for stroke patients, it must include secondary prevention and rehabilitation. Coordination of care is especially crucial.
• Limited empirical data available on bundled payment

• May improve as results emerge from the ongoing CMS BPCI Initiative. Under the BPCI, 6256 organizations are participating in providing stroke care under bundled payments.

• Of these participants, 70% chose to be paid for postacute care only (so-called Model 3), whereas 29% enrolled in a bundled for acute care hospital stay plus postacute care (so-called Model 2). The majority of participants selected to include an episode of care definition extending 90 days from discharge (Model 2) or initiation of the postacute episode (Model 3).

A GLIMPSE INTO THE FUTURE OF STROKE CARE

https://youtu.be/jnEdaslPtEg
Stroke Boot Camp

Train and Think F.A.S.T. –
Time Saved Is Brain Saved

dsummers@saint-lukes.org