Get With the Guidelines—Stroke:
What have we learned so far?

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AHA GWTG Program
National voluntary QI initiative to improve guidelines adherence in patients hospitalized with cardiovascular disease and stroke.

GWTG uses collaborative learning sessions, conference calls, e-mail and staff support to assist hospital teams improve acute and secondary prevention care systems.

A web-based Patient Management Tool is used for point of care data collection and decision support, on-demand reporting, communication and patient education.

The GWTG Stroke Program
- Adapted from lessons learned through implementation of GWTG-CAD with small seed funding by CDC PCNASR (Congressional)
- GWTG Stroke Program iterative development from 2001-2003 to identify best practices and mature an IHI-PDSA hybrid QI model
- Pilot testing in 24 hospitals from 2001-2003
- Regional implementation in 99 hospitals from 2003-2004
- National implementation in 2004

GWTG Cumulative Adoption

<table>
<thead>
<tr>
<th>Module</th>
<th>Hospitals</th>
<th>Patient Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td>445</td>
<td>571,467</td>
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<tr>
<td>Heart Failure</td>
<td>430</td>
<td>329,579</td>
</tr>
<tr>
<td>Stroke</td>
<td>1,282</td>
<td>1,000,024</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,157</td>
<td>1,901,070</td>
</tr>
</tbody>
</table>

As of July 17th, 2009

GWTG Stroke Hospitals by State

Rationale

"to prevent underutilization or disparities in the use of therapies recommended in national guidelines, the guideline development and distribution process should recognize and incorporate strategies for increased implementation"

2006 AHA Guidelines for Prevention of Stroke in Patients with Ischemic Stroke or Transient Ischemic Attack
Traditional Approaches Have Failed to Bring Overcome T2 Block

- Retrospective data collection has created small changes in adherence to guideline-derived measures.
- Guideline implementation beyond traditional CME programs is needed to affect utilization by healthcare professionals.
- To ensure that scientific knowledge is translated into practice, the IOM has recommended the establishment of coordinated systems of care that integrate prevention and treatment services and promotion of patient access to evidence-based care.

GWTG Stroke Rationale

- Evidence supports 7 key interventions to improve health outcomes, but many patients do not receive recommended evidence-based therapies.
- Prior to 2000, little systematic effort was applied to improving acute stroke care.
- In the past 10 years several organizations (AHA, TJC, CDC, AAN) have promoted changes in the model of health care delivery to:
  - Increase adherence with delivery of IV tPA
  - Prevention of in hospital complications
  - Improve secondary prevention of stroke

GWTG Measurements

- Two types of performance measurement
  - Item-by-item measurement
    - measures individual performance on a specific measure among eligible patients
  - Summary Measurement
    - Summation of the performance across a series of indicators, like the S&P 500

GWTG Summary Measures

- Composite Performance
  - Denominator: The sum of all care opportunities across all patients
  - Numerator: All care opportunities fulfilled
  - No partial credit for improvements
  - Population based opportunity measure
  - All measures and patients equally weighted

GWTG Stroke Individual item Performance Measures

Acute Hospital Measures
- IV tPA in patients who arrive < 2 hrs after symptom onset (ED < 2 hr + rt-PA)
- Antithrombotic medication <48 hrs of admission (Rx AT <48 hr)
- DVT prophylaxis within 48 hr of admission (DVT Risk < 48 hr)

Discharge Measures
- Antithrombotic medication (Rx AT)
- Anticoagulation for atrial fibrillation (AF Rx)
- Treatment for LDL > 100 (LDL 100 Rx ND)
- Counseling or medication for smoking cessation (Smoke Rx)

*Also track quality, reporting and descriptive measures

Ref: Berwick, JAMA 2006
**Methodology**

- Hospital selection:
  - Voluntary QI program (convenience sample)
  - De-identified: No informed consent or patient contact
- Rolling entry dates for site participation (only 8% dropout)
- Time in program – measured by consecutive time periods of exposure to participation in GWTG
- Single data collection vendor: Outcomes, Inc., MA
  - Low cost to sites
  - Provides site level reports on demand
- Single data analysis center: DCRI
  - Supported by AHA dollars at no cost to sites
  - Performs adjusted analyses on national dataset

- Case ascertainment for stroke or TIA:
  - Prospective – clinical identification
  - And / Or
  - Retrospective - using ICD-9 D/C codes (followed by chart review to confirm eligibility)
  - Codes used for stroke: 433,434,436, and 435 for TIA

**Data Collection**

- Included for each hospitalization:
  - Demographics
  - Medical history
  - Initial head CT findings
  - In-hospital treatment, and events
  - Discharge treatment and counseling
  - Discharge destination
- Concurrent collection encouraged for real-time QI intervention with decision-support during hospitalization

**Statistical Analysis Con’t**

- Compliance (%) in each year and trends over the 5 years are reported.
- Explored improvement over time (adjusted for secular trends) CMH and Jonckheere-Terpstra test
- Multivariable logistic regression models using a generalized estimating equation (GEE) method – to account for in-hospital clustering
- Main variables of interest:
  - Differences in performance between hospitals over time and by hospital characteristics (e.g., regions, bed size, teaching status, annual number of stroke discharges, length of participation)
Statistical Analysis Con’t

- Adjustment for site level differences in patient characteristics and prior medical history (age, gender, race, BMI, AFib, previous stroke/TIA, CAD/prior MI, carotid stenosis, DM, PVD, HTN, dyslipidemia and smoking)

- Additional analyses were performed to assess for secular trends and to see if improvements were equally distributed across all hospital subtypes.

GWTG-S Effectiveness Study of Adherence to Guideline-Based Care

- N = 322,847 patients from 790 hospitals
- 4.25 years of program participation
- GWTG population
  - similar in many ways when compared to other trends and to see if improvements were equally distributed across all hospital subtypes.
  - racial make-up similar to the US pop 2000 census
  - Similar to National Inpatient Sample NIS 2000 LOS (5.19 vs. 4.7 days) and in-hospital mortality (4.21% vs. 4.09%)

GWTG-S Patient Characteristics

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>Total %</th>
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<td>Demographics</td>
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<td></td>
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<tr>
<td>Age (y)</td>
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<td>70(0-92)</td>
<td>70(0-92)</td>
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<td>70(0-92)</td>
<td>70(0-92)</td>
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<tr>
<td>Elix lab test, g/dL</td>
<td>2.0 (1.0-3.0)</td>
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<td>2.0 (1.0-3.0)</td>
<td>2.0 (1.0-3.0)</td>
<td>2.0 (1.0-3.0)</td>
<td>2.0 (1.0-3.0)</td>
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Largely stable over time

<table>
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<tr>
<th>Hospital Characteristics</th>
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<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
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<td>Teaching* (major or minor)</td>
<td>81.7</td>
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<td>52.1</td>
<td>42.1</td>
<td>31.2</td>
<td>22.1</td>
<td>14.2</td>
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<td>Average stroke discharge, %</td>
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<td>&lt;100</td>
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<td>20.6</td>
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<td>&gt;200</td>
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<td>93.3</td>
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<td>93.3</td>
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<tr>
<td>Geographic region, %</td>
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<td></td>
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<td>North</td>
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<td>40.1</td>
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<td>40.1</td>
<td>40.1</td>
<td>40.1</td>
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<tr>
<td>West</td>
<td>39.7</td>
<td>39.7</td>
<td>39.7</td>
<td>39.7</td>
<td>39.7</td>
<td>39.7</td>
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</tr>
</tbody>
</table>

Significance was assessed by Cochran-Mantel-Haenszel trend square test for ordered subtypes and the Jonckheere-Terpstra test for nonordered outcomes.

"Teaching" value according to the American Hospital Association database.

2010: 322,847 patients from 790 hospitals
2016: 322,847 patients from 790 hospitals

Improvement Over Time in GWTG-Stroke

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>Baseline</td>
<td>80.0%</td>
<td>85.0%</td>
<td>87.0%</td>
<td>89.0%</td>
<td>90.0%</td>
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</tbody>
</table>

Among eligible cases
Improvement Over Time in GWTG-Stroke Composite and All-or-None Care Measures


Analyzing Improvement Controlling for Secular Trends

- Use the composite measure of performance to summarize improvement into a single summary variable
- Examine factors that were associated with improvement over time
- Limited by no concurrent controls

What Statistical Methods?

- Multivariable logistic regression models using a generalized estimating equation (GEE) method — to account for in-hospital clustering.
- Hierarchical models using hospital specific intercept as a random effect

Large dataset issues

- Given the very large data set, traditional model building approaches that identify independent predictors based on statistical significance may introduce erroneous associations
- Other alternatives include using pre-specified covariates based on prior literature

Analyzing the Effects of Time Spent in the GWTG-S Program

- All hospitals improved over time
- We identified those hospital characteristics that demonstrated a significant interaction with the “time in GWTG-Stroke” variable
- These were bed capacity, annual stroke discharge volume and teaching status

<table>
<thead>
<tr>
<th>Table 4. Multivariable Logistic Regression Model of Hospital Characteristics Associated With Composite Score Adherence in GWTG-Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Characteristic</td>
</tr>
<tr>
<td>Time in GWTG-Stroke (per 1 y)</td>
</tr>
<tr>
<td>Calendar time (per 1 y)</td>
</tr>
<tr>
<td>Bed size (per 100 units)</td>
</tr>
<tr>
<td>Teaching hospital</td>
</tr>
<tr>
<td>Geographic region (all 4 regions)</td>
</tr>
<tr>
<td>Annual stroke discharges</td>
</tr>
<tr>
<td>0–100</td>
</tr>
<tr>
<td>101–300</td>
</tr>
<tr>
<td>&gt; 300 (reference)</td>
</tr>
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</table>

*Odds ratio (OR) was adjusted for the patient baseline characteristics set by
Not all horses run at the same speed.

Gender Disparities/Differences
- Because women have a longer life expectancy, more stroke events occur in women than in men.
- Women have higher stroke mortality in the oldest age groups and worse functional outcomes following a stroke than men.
- This gender gap will increase dramatically over the next decade based on demographic trends.
- These disparities remain after adjustment for baseline differences in age and stroke risk factors.

Basic Results of Gender Analysis
- 383,318 acute ischemic stroke admissions from 1,139 hospitals.
- Women were older and more likely to present by ambulance, have a past medical history of atrial fibrillation or hypertension, and less likely to have a history of heart disease, dyslipidemia, or smoking.

### Table 5: Improvement in Composite Performance per Program Year in SMTG-Stroke by Hospital Type

<table>
<thead>
<tr>
<th>Hospital Characteristics</th>
<th>Adjusted OR*</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital bed capacity, a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–50</td>
<td>1.07</td>
<td>1.00–1.14</td>
<td>0.07</td>
</tr>
<tr>
<td>51–200</td>
<td>1.51</td>
<td>1.05–1.87</td>
<td>0.0003</td>
</tr>
<tr>
<td>201–300</td>
<td>1.74</td>
<td>1.08–2.00</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>301–400</td>
<td>1.77</td>
<td>1.11–2.80</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>&gt;400</td>
<td>1.20</td>
<td>1.20–2.30</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Average stroke discharge volume, a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–100</td>
<td>1.52</td>
<td>1.03–1.24</td>
<td>0.007</td>
</tr>
<tr>
<td>101–200</td>
<td>1.72</td>
<td>1.06–1.88</td>
<td>0.0001</td>
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<tr>
<td>&gt;200</td>
<td>1.20</td>
<td>1.10–1.30</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Teaching status</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Teaching hospitals</td>
<td>1.14</td>
<td>1.06–1.21</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Remote teaching hospitals</td>
<td>1.02</td>
<td>1.05–1.07</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

### Gender and Age distribution

#### Basic Results of Gender Analysis
- 383,318 acute ischemic stroke admissions from 1,139 hospitals.
- Women were older and more likely to present by ambulance, have a past medical history of atrial fibrillation or hypertension, and less likely to have a history of heart disease, dyslipidemia, or smoking.
Unadjusted Analysis of Gender, Age & Defect-Free Adherence

Univariate Analysis
Gender vs. Discharge Outcomes

Variable | Level | Total N (%) | Male N (%) | Female N (%) | P-value
---|---|---|---|---|---
Discharge Status | Died | 21426 | 5.8 | 9560 | 5.2 | 1.004 | 0.60 | 0.999
| Discharge Destination (if alive) | Skilled Nursing Facility | 17240 | 20.3 | 8905 | 20.4 | 0.659 | 0.10 | 0.999
| Rehabilitation | 8048 | 19.3 | 3579 | 21.1 | 3001 | 20.2 | 0.024 | 0.40 | 0.999
| Hospital | 12450 | 20.5 | 6255 | 20.5 | 6203 | 20.5 | 0.999 | 0.999 | 0.999
| Transfer to Acute Care Facility | Other | 7508 | 3.9 | 3529 | 3.6 | 3979 | 3.9 | 0.000 | 0.999
| Ambulance Status | Independent | 18591 | 83.2 | 8737 | 83.5 | 9831 | 83.1 | 0.000 | 0.999
| With Assistance | 10763 | 26.8 | 4700 | 26.5 | 6062 | 26.8 | 0.000 | 0.999
| Unable | 7506 | 19.2 | 3527 | 19.6 | 3979 | 19.8 | 0.000 | 0.999
| Not Documented | 36251 | 9.6 | 17343 | 9.5 | 18907 | 9.4 | 0.000 | 0.999
Length of stay (days) | Median | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0

Influence of Stroke Subtype on Inpatient Stroke Care

- 905 hospitals contributed 479,284 consecutive stroke and TIA admissions.
- Stroke subtypes were
  - 61.7% IS
  - 23.8% TIA
  - 11.1% ICH
  - 3.5% SAH

Gender Discussion

- Small but significant disparities remain even after risk adjustment such that women appear to systematically receive evidence-based care less often in GWTG
- Further study in independent datasets is needed
Selected References

- Nolan T, Berwick DM. All-or-none measurement raises the bar on performance. JAMA. 2006 Mar 8;295(10):1168-70.