Quality Improvement in the Prehospital Setting

Brooke Kearins MSN, CRNP Director, Stroke Services Doylestown Hospital
Scott Henley M.Ed., NRP, FP-C, CCEMTP Deputy Chief & Clinical Coordinator-
Central Bucks Emergency Medical Services

Disclosures

• NO disclosures
Presentation Objectives

Translate the impact of continuous quality improvement initiatives on stroke patient care in the prehospital setting.

- EMS in PA
- Prehospital care
- Prehospital Scales
- Prehospital notification
- Stroke Destination
- Stroke Feedback
- On Horizon

Doylestown Health FY15 Highlights

- Patient discharges 14,295
  - Inpatient: 12,149
  - Outpatient: 2,146
- ED visits 45,903
- Births 1,271
- Inpatient Surgical cases 2,736
- Outpatient Surgical cases 7,244
- Hospital outpatient visits 247,098
- VN/Hospice visits 47,531

- Pine Run Community
  - Skilled Nursing Admissions 522
  - Independent Living residents 335
  - Personal Care Residents 137
Stroke Care at Doylestown Health

- Advanced Certification for Primary Stroke Centers by the Joint Commission
- American Heart Association and American Stroke Association’s Get With The Guidelines® - Stroke Gold Plus award
- Target: Stroke Honor Roll Elite Plus
- Nurse practitioner as full-time director of stroke services. All nurses are certified in the National Institute of Health Stroke Scale.
- Community programs including free stroke screenings, support groups, and education programs for EMS personnel.

Award video
Case study

- 71 year old male J.D.-stroke on 10-11-15
  - PMHx: HTN, Hyperlipidemia, smoker
  - Meds: ASA, Lipitor, Norvasc, hctz
- 17:36 Wife called 911 for sudden onset-pt not answering her during conversation
- 17:45 Unit on scene
- 17:55 called DH as PH stroke alert (paged at DH at 18:02)
- 18:10 arrival at DH. NIHSS 10-aphasia, RUE/RLE drift, facial
  - VS: 168/81, HR 65, RR 16, Pox 98%
  - EKG: SR
- 18:16 CT + CTA
  - CT neg, CTA neg for clot
- 18:55 tPA
- MRI 10-12-15: left frontal/parietal infarct
- 10-14-15 d/c home NIHSS 1-mild aphasia
- 3-2-16 mRS 0

MRI brain
Stroke Systems of Care

“If you’ve seen one EMS agency..... you’ve seen one EMS agency”

- EMS in the United States -
  - 15,000 EMS systems
    - Fire or third-service, 911 or transport or both, volunteers or paid or both, air services, mobile stroke unit, etc.
  - 800,000 EMS personnel
    - EMT-Basic, Advanced EMT, paramedics, PHRN
    - Scope of practice usually by established through state regulation
    - Protocols developed by state, regional or local organizations or agency medical director
  - 16 million transport calls annually
    - Not all communities have 911 emergency medical dispatch
    - Trauma, cardiac arrest, STEMI, altered mental status, stroke, respiratory, psychiatric, etc.
    - Response configuration – 2 paramedics, 1 paramedic and 1 EMT-Basics, 2 EMT-Basics, etc.
  - Stroke training, continuing education, data and quality is highly variable
Prehospital Stroke Mortality

- Approximately 60% of stroke patients are treated and transported by EMS (Ekundayo, 2013)
- 2014 Centers for Disease Control and Prevention stroke mortality -
  - 133,103 total stroke deaths
  - 79,825 deaths prior to inpatient admission (outpatient, ED, DOE, decedent’s home, hospice, nursing home/LTC)

Prehospital Stroke Guideline

Activation of the 911 system by patients or other members of the public is strongly recommended. 911 dispatchers should make stroke a priority dispatch, and transport times should be minimized.
Dispatching Challenges

- This first link in the stroke chain of survival needs strengthening in order to provide prompt and timely emergency care for these patients.
- People who contact the EMS about non-stroke conditions rarely say stroke, limb weakness, speech problems or facial weakness.
- Medical Priority Dispatch System (MPDS, Priority Dispatch Corporation) is the most widely used dispatcher guide in the United States
  - Sensitivity 41%, Specificity 96%
  - Positive Predictive Value 42%-45% (Ramanujam, 2008, Buck, 2009)
- UK Study - less than one quarter received the highest priority of ambulance response. (Deakin, 2009)

When a question of stroke is raised, dispatchers are instructed to ask the caller the following key questions in the following sequence:
1) Is s/he completely awake (alert)?
2) Is s/he breathing normally?
3) Is s/he able to talk normally?
4) Tell me why you think it’s a STROKE?
   Movement problems
   Speech problems
   Numbness or tingling
5) When did this start (happen)?
6) Has s/he ever had a STROKE before?

Prehospital Stroke Guideline

Prehospital care providers should use prehospital stroke assessment tools, such as LAMS or CPSS
Prehospital Stroke Scales

Stroke Identification Scales
- Stroke Scales Cincinnati Prehospital Stroke Scale (CPSS)
- Face Arm Speech Test (FAST)
- Los Angeles Prehospital Stroke Screen (LAPSS)
- Medic Prehospital Assessment for Code Stroke (Med PACS)
- Melbourne Ambulance Stroke Screen (MASS)
- Ontario Prehospital Stroke Screening Tool (OPSS)
- Recognition of Stroke in the Emergency Room Score (ROSIER)

Stroke Severity Scales
- Severity Scales Rapid Arterial Occlusion Evaluation Scale (RACE)
- Los Ángeles Motor Scale (LAMS)
- Cincinnati Prehospital Stroke Severity Scale (CPSSS)
- Kurashiki Prehospital Stroke Scale (KPSS)
- National Institutes of Health Stroke Scale (NIHSS)
- sNIHSS-8
- sNIHSS-5

Prehospital Identification Scales
- Prehospital stroke scales varied in their accuracy and missed up to 30% of acute strokes in the field. (Brandler, 2014)
- Inconsistencies in performance may be due to sample size disparity, variability in stroke scale training, and divergent provider educational standards.

<table>
<thead>
<tr>
<th>Stroke scale</th>
<th>Field</th>
<th>Sample size</th>
<th>Stroke prevalence</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>LR</th>
<th>LR (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bros et al. 2010</td>
<td>300</td>
<td>70% (59-81)</td>
<td>80% (79-81)</td>
<td>59% (58-61)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>Bros et al. 2010</td>
<td>300</td>
<td>70% (59-81)</td>
<td>80% (79-81)</td>
<td>59% (58-61)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>Stumacher et al. 2010</td>
<td>406</td>
<td>40% (34-45)</td>
<td>70% (67-72)</td>
<td>20% (18-22)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>LAPSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kocarev et al.</td>
<td>206</td>
<td>17% (13-24)</td>
<td>90% (86-94)</td>
<td>97% (94-98)</td>
<td>30% (28-32)</td>
<td>2.00 (1.80-2.22)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>Mayer-Arndt et al.</td>
<td>206</td>
<td>17% (13-24)</td>
<td>90% (86-94)</td>
<td>97% (94-98)</td>
<td>30% (28-32)</td>
<td>2.00 (1.80-2.22)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>Cremer et al. 2010</td>
<td>100</td>
<td>70% (63-77)</td>
<td>80% (76-85)</td>
<td>80% (76-85)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>Dore et al. 2010</td>
<td>1130</td>
<td>80% (78-84)</td>
<td>90% (87-93)</td>
<td>97% (94-98)</td>
<td>30% (28-32)</td>
<td>2.00 (1.80-2.22)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>MASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bros et al. 2010</td>
<td>300</td>
<td>70% (59-81)</td>
<td>80% (79-81)</td>
<td>59% (58-61)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>Bros et al. 2010</td>
<td>300</td>
<td>70% (59-81)</td>
<td>80% (79-81)</td>
<td>59% (58-61)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>MedPACS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stumacher et al. 2010</td>
<td>406</td>
<td>40% (34-45)</td>
<td>70% (67-72)</td>
<td>20% (18-22)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>DPSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dradler et al.</td>
<td>504</td>
<td>57% (51-63)</td>
<td>70% (67-72)</td>
<td>20% (18-22)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>ROSIER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolegil et al.</td>
<td>205</td>
<td>40% (34-45)</td>
<td>70% (67-72)</td>
<td>20% (18-22)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
<tr>
<td>FAST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolegil et al.</td>
<td>205</td>
<td>40% (34-45)</td>
<td>70% (67-72)</td>
<td>20% (18-22)</td>
<td>20% (18-22)</td>
<td>1.02 (1.00-1.04)</td>
<td>1.00 (0.99-1.01)</td>
</tr>
</tbody>
</table>

Table 2: Operating characteristics of prehospital stroke scales

Abbreviations: CPSS = Cincinnati Prehospital Stroke Scale; FAST = Face Arm Speech Test; LAPSS = Los Angeles Prehospital Stroke Scale; LR = Likelihood ratio; MASS = Melbourne Ambulance Stroke Screen; MedPACS = Medic Prehospital Assessment for Code Stroke; OPSS = Ontario Prehospital Stroke Screening Tool; ROSIER = Recognition of Stroke in the Emergency Room. 95% confidence interval in parentheses.
Prehospital Severity Scales

- **Stroke Severity Scale**
  - Designed based on elements of the NIHSS
  - Thought to be simpler to assess by field providers than a full NIHSS
  - **LAMS (Nazliel, 2008)**
    - Score ≥4 Sens 81% Spec: 89% for LVO
  - **RACE (Herrerra, 2014)**
    - Score ≥5 Sens: 85% Spec: 65% for LVO
  - **CPSSS (McMullen, 2015)**
    - Score ≥2 Sens: 83% Spec: 40% for LVO

<table>
<thead>
<tr>
<th>Table 1: RACE Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACE Score</td>
</tr>
<tr>
<td>Facial palsy</td>
</tr>
<tr>
<td>Absent</td>
</tr>
<tr>
<td>Mild</td>
</tr>
<tr>
<td>Moderate to severe</td>
</tr>
<tr>
<td>Arm motor function</td>
</tr>
<tr>
<td>Normal to mild</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Severe</td>
</tr>
<tr>
<td>Leg motor function</td>
</tr>
<tr>
<td>Normal to mild</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Severe</td>
</tr>
<tr>
<td>Head and gaze deviation</td>
</tr>
<tr>
<td>Absent</td>
</tr>
<tr>
<td>Present</td>
</tr>
<tr>
<td>Aphasia (of right hemisphere)</td>
</tr>
<tr>
<td>Performs both tasks correctly</td>
</tr>
<tr>
<td>Performs 1 task correctly</td>
</tr>
<tr>
<td>Performs neither tasks</td>
</tr>
<tr>
<td>Aphasia (of left hemisphere)</td>
</tr>
<tr>
<td>Patient recognizes their arm and the impairment</td>
</tr>
<tr>
<td>Does not recognize their arm or the impairment</td>
</tr>
<tr>
<td>Score total</td>
</tr>
</tbody>
</table>

Patients should be transported rapidly to the closest available certified primary stroke center or comprehensive stroke center or, if no such centers exist, the most appropriate institution that provides emergency stroke care as described in the 2013 guidelines. In some instances, this may involve air medical transport and hospital bypass.
There should be no more than a 15 minute delay caused by taking a patient to the next highest level of stroke care.

- Primary Stroke Centers in Pennsylvania
  - Established under Act 54 (signed by Gov. Corbett, May 2012): Commonwealth must keep a list of accredited primary stroke centers
  
  - DOH must establish protocols for treatment and transport of stroke patients to the closest primary stroke center
    - Using Cincinnati Prehospital Stroke Scale
    - **Stroke Destination.** A ground ambulance may transport a patient with suspected acute stroke to the closest primary stroke center. It is reasonable to bypass a closer facility and transport directly to a DOH recognized primary stroke center if the ground transport time is < 45 minutes. Consider air transport if ground transport to the closest certified stroke center is >45 minutes.
EMS personnel should provide prehospital notification to the receiving hospital that a potential stroke patient is en route so that the appropriate hospital resources may be mobilized prior to patient arrival.

**Prehospital Stroke Guideline**

EMS transportation at highest priority and hospital prenotification were associated with faster in-hospital stroke response and represent logical targets for EMS quality improvement efforts.

- Compliance was highest for prehospital documentation of a glucose level (86.0%) and stroke screen (78.5%) and lowest for on-scene time less than or equal to 15 minutes (46.8%), hospital prenotification (56.5%), and transportation at highest priority (55.4%).

Increasing EMS interactions with emergency physicians, standardizing handoff processes may serve as potential solutions for the high-risk EMS-ED patient transition (Meisel, 2015)

- 4 key potential ways to improve the structure and process of the handoff: (1) communicate directly with the ED provider responsible for the patient’s care; (2) increase interdisciplinary feedback, transparency, and shared understanding of scope of practice between out-of-hospital and hospital-based providers; (3) standardize some (but not all) aspects of the handoff; and (4) harness technology to close gaps in information exchange.

**Stroke Pre-notification**
Pre-notification in PA 2015

<table>
<thead>
<tr>
<th>Benchmark Group</th>
<th>Time Period</th>
<th>Numerator</th>
<th>Denominator</th>
<th>% of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>All PA Hospitals</td>
<td>Jan 2015</td>
<td>613</td>
<td>1430</td>
<td>55.9%</td>
</tr>
<tr>
<td></td>
<td>Feb 2015</td>
<td>741</td>
<td>1270</td>
<td>58.3%</td>
</tr>
<tr>
<td></td>
<td>Mar 2015</td>
<td>755</td>
<td>1333</td>
<td>56.0%</td>
</tr>
<tr>
<td></td>
<td>Apr 2015</td>
<td>774</td>
<td>1378</td>
<td>56.2%</td>
</tr>
<tr>
<td></td>
<td>May 2015</td>
<td>747</td>
<td>1318</td>
<td>56.7%</td>
</tr>
<tr>
<td></td>
<td>Jun 2015</td>
<td>759</td>
<td>1335</td>
<td>56.9%</td>
</tr>
<tr>
<td></td>
<td>Jul 2015</td>
<td>612</td>
<td>1406</td>
<td>57.0%</td>
</tr>
<tr>
<td></td>
<td>Aug 2015</td>
<td>723</td>
<td>1288</td>
<td>57.0%</td>
</tr>
<tr>
<td></td>
<td>Sep 2015</td>
<td>788</td>
<td>1309</td>
<td>60.2%</td>
</tr>
<tr>
<td></td>
<td>Oct 2015</td>
<td>771</td>
<td>1346</td>
<td>57.3%</td>
</tr>
<tr>
<td></td>
<td>Nov 2015</td>
<td>797</td>
<td>1221</td>
<td>57.9%</td>
</tr>
<tr>
<td></td>
<td>Dec 2015</td>
<td>738</td>
<td>1336</td>
<td>59.3%</td>
</tr>
</tbody>
</table>

Pre-notification at DH

Arrival Method by Quarter

Arrival Modes:
- Walking
- Ambulance
- Not From Field

Quarter:
- 2013-1
- 2013-2
- 2013-3
- 2013-4
- 2014-1
- 2014-2
- 2014-3
- 2014-4
- 2015-1
- 2015-2
- 2015-3
- 2015-4
To increase both the number of patients who are treated and the quality of care, educational stroke programs for physicians, hospital personnel, and EMS personnel are recommended.

**Prehospital Stroke Guideline**

- Communication between EMS and ED is a key ingredient to improving time to treatment, standardizing the message supports consistency in care
  - Successfully increases percentage of patients meeting STEMI guidelines
  - Improves relationships with hospitals

- Lack of educational feedback from hospital staff and physicians and continuing medical education on stroke were reported as major deterrents to enhancing their diagnostic acumen. (Hodell, 2016)

- Create a standardized feedback loop, exchange of important information to refine stroke systems of care,
Stroke Feedback

- Communication between EMS and ED is a key ingredient to improving time to treatment, standardizing the message supports consistency in care
  - Successfully to increase percentage of patients meeting STEMI and stroke guidelines (Scholz, 2012; Choi, 2014)
  - Improves relationships with hospitals
- Lack of educational feedback from hospital staff and physicians and continuing medical education on stroke were reported as major deterrents to enhancing their diagnostic acumen. (Hodell, 2016)
- Create a standardized feedback loop, exchange of important information to refine stroke systems of care,

![Components of contact-to-balloon time](image)

Essential to Successful Feedback

- Determine with EMS agencies the most important information to include in feedback -
  - Pre-hospital information
  - In-hospital information
  - System Goals
  - Provider contact information
  - Optional: Imaging to further engage pre-hospital providers
- Quick reporting is essential - 24-48 hour turn around
- Provided for good and bad outcomes
- Case reports and quarterly report cards
- Ideally all stroke centers within a region using a similar form
- Include on stroke team meeting
On the horizon with EMS

- Mission: Lifeline Stroke
  - Statewide and regional taskforces
  - EMS recognition
    - Measures in development

- Seamless patient care report
  - Connecting EMS data with Get With The Guideline-Stroke

- Braining imagining using mobile CT

- Mobile Integrate Healthcare (aka Community Paramedicine)
  - The provision of healthcare using patient-centered, mobile resources in the out-of-hospital environment including – chronic disease management, preventive care or post-discharge follow-up visits; or transport or referral to a broad spectrum of appropriate care, not limited to hospital emergency departments.

- Performance Reporting and Payment Reform
  - First measures developed – stroke
    - Process and outcome

---

STROKE CASE STUDY

**Stoke Alert:** 10/11/2015

| Step | Time | Minutes | Calculation | Time | EMS
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:10</td>
<td>10:00</td>
<td>20:00</td>
<td>30:00</td>
<td>40:00</td>
<td></td>
</tr>
<tr>
<td>Mode of Arrival</td>
<td>Ambulance</td>
<td>Central Bucks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MD at Bedside</td>
<td>18:10</td>
<td>30:00</td>
<td>Door to Doc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator Called; Stroke Alert</td>
<td>18:02</td>
<td>Door to Stroke Alert</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT</td>
<td>18:16</td>
<td>Door to CT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT Read</td>
<td>18:20</td>
<td>Door to CT Read</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKG</td>
<td>18:52</td>
<td>Door to EKG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Results</td>
<td>18:47</td>
<td>Door to Lab Results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPA Administered</td>
<td>18:55</td>
<td>Door to TPA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed/ Transfer</td>
<td>20:26</td>
<td>Door to Bed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Time from Door to TPA:** 45 minutes

**Order Set Used:** ED Physician: McHugh

**Comments:** Aphasia-onset 1730 witnessed by wife. CT neg. CTA neg. IV tpa given. Not IAT candidate with neg CTA.

**Outcomes:** MRI brain left frontal/parietal infarct

---

**American Heart Association**

Life is why™

**American Stroke Association**

Life is why™
EMS measures

### Stroke Measure Example

<table>
<thead>
<tr>
<th>Condition</th>
<th>Access to hospital system data (ideal)</th>
<th>EMS only data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>For patients with a Positive In-hospital Stroke Diagnosis Average Time from Last Known Well to Intervention Hospital Diagnosed Stroke not identified Pre-hospital</td>
<td>Suspected Stroke Receiving Pre-hospital Stroke Assessment Blood Glucose for Positive Pre-hospital Stroke Assessment Pre-Hospital Notification Positive Stroke Assessments transported to Stroke Center Positive Stroke Assessments with Last Known Well (LKW) Documented For patients with a Positive Stroke Assessment, Average Time from Last Known Well to Arrival at Stroke Center Pre-Hospital Stroke Care Bundle</td>
</tr>
</tbody>
</table>

### Questions/Next Step

- What will you do differently now?