Building the Quality Bridge from Primary to Comprehensive Stroke Centers: Caring for Patients Undergoing Endovascular Stroke Treatment

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UNC Medical Center’s Comprehensive Stroke Center

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UNC Rex Healthcare’s Primary Stroke Center
Disclosures

- No relevant disclosures
Learning Objectives

• The participant will identify three novel strategies to reduce door-to-groin puncture times and door-in-door out times for adult patients undergoing endovascular therapy for acute ischemic stroke.

• The participant will identify how a structured quality improvement methodology improves quality of patient care in time-sensitive scenarios.

• The participant will describe implications for improving patient access to neuro-intervention services including protocol implementation, discovery of large vessel occlusions and patient outcomes.
Background:

- 433 bed community hospital
- Joint Commission Certified Primary Stroke Center
- Located in Raleigh, NC (Wake County)
- 900-1000 stroke discharges annually
- 83% Code Stroke patients arrive by EMS
- Overall 55% arrive by EMS, 30% Private, 8% from OSH, 7% In-house

- 804 bed academic hospital
- Joint Commission Certified Comprehensive Stroke Center
- Located in Chapel Hill, NC (Orange County)
- 900 stroke discharges annually
- 60% of volume from outside hospital transfers
Problems Quality Improvement
Opportunities Identified

- Improve recognition of LVO
- Decrease door-in-door-out times

- Improve transfer & transport processes
- Improve door-to-groin puncture times
Building the Quality Bridge: Experience of the Receiving Facility

Nicole Burnett, BSN, RN, CNRN, SCRN, CCRN-K
Stroke Program Manager
UNC Medical Center’s Comprehensive Stroke Center
UNC Comprehensive Stroke Center’s Performance Improvement Methodology

“The UNC Health Care Improvement System is built on a foundation of lean, with a focus on respect for people and the relentless pursuit of waste reduction to provide more value-add care to our patients.”

-Glen Spivak, UNC Health Care Vice President for Organizational Efficiency
Plan: Pre-Intervention Process Mapped

Pt ID’d
OSH: Bed Assigned
Patient Arrives
Admitted to NSICU, Assessed
Transport to CT

CTA Completed
Transport to NSICU
Awaiting Decision in NSICU
Stroke Attending & Interventionalist Discussion, Decision
Transport to NIR

Cumbersome:
- Low Volume: ~4-8 cases per year
- Lots of Waste: Ave. Door-to-Groin time = 134.3 m
- Communication difficulties
Experiment (‘DO’) Highlights: Streamline Communication

Goal:
• Streamline Communication Amongst Team Members

Eliminate Waste:
• Multiple Phone Calls

Tactics:
• Implemented one-call ‘Code IA Stroke’ Pager
• Activated as a 2\textsuperscript{nd} tier page when patient is identified as a potential candidate in the ED, inpatient or transfer center
• Activated with CTA order or OSH patient acceptance
Experiment (‘DO’) Highlights: Stroke Response Nurse

**Goal:**
- Facilitate Direct-to-CT

**Eliminate Waste:**
- Transport to ICU, Transport to CT

**Tactics:**
- Approved for NSICU staffing to allow for additional RN to be assigned to respond to Code IA Stroke
- Allowed for NSICU RN & Stroke Team to receive report, assess patient and complete CTA all in scanner room
Experiment (‘DO’) Highlights: Auto-Launch

**Goal:**
- Facilitate immediate transport

**Eliminate Waste:**
- Time waiting for bed assignment prior to transport

**Tactics:**
- Leadership involvement
- Auto-launch protocol for air care
- Development of Landing Zone Contingency Plan
- Bedflow in EMR
Experiment Highlights:
New Process

Outside Hospital Patients
Pt ID’d, Code IA Activated

Autolaunch, bed assigned en route or LZ plan activated, Contact information and ETA updates to pager

Pre-Arrival Team Huddle 10-15 minute out ETA

Patient arrives, assessed by team, Patient arrival page sent out

CTA Completed, Images Reviewed by Stroke Attending & Radiology, Treatment Decision made and sent out on pager

Transport to NIR, Updates sent to pager, Code IA RN monitors patient during case

ED & Inpatients

ED & Inpatients
Study: Metrics Developed & Goals Set

Activation/Pre-Arrival
- Patient Origin – OSH, ED, Inpatient
- Transport Method
- Transfer Center Call Time
- Code IA Activation

Arrival
- Door Time
- CTA – Order, Read
- Decision

Goals Established:
Door-to-Groin: ≤60m
Door-to-Device: <90m

Treatment
- Groin Puncture Time
- Sedation/Anesthesia
- Treatment Type

- TICI Score
- Complications
Study Highlight: Procedural Sedation & Transition to Anesthesia

- Code Blue Anesthesia ⇔ Procedural Anesthesia
- Cases go much smoother when procedural anesthesia team is notified of the patient sooner, rather than later
- Takes time to ‘book’ cases once high-risk patient is identified
- Many of these cases are complex
  - Underlying cardiovascular diseases, hemodynamic instability
  - Close monitoring – BP challenges
  - Communication challenges (patient/provider)
- Need for ICU level of care in NIR (not just nursing) identified
Act Highlight: Implementation of Anesthesia Presence

• Partnership with anesthesia formed
• Core Implementation Team Developed Framework:
  – Anesthesia presence at all cases, even if no sedation
  – ‘Time is brain’ mindset, anesthesia works in parallel with stroke and NIR teams
  – Key elements are maintaining physiologic goals and limiting patient movement
  – Preference to avoid general anesthesia if possible

• Anesthetic Plan developed:
  - **Plan A** | No sedation, monitoring
  - **Plan B** | Incremental doses of fentanyl
  - **Plan C** | Deep sedation (if candidate) or general anesthesia
Study Highlight: Communication

• As times decreased, communication failures were noted to increase.
• A need to standardized team member roles and responsibilities at each step in the process was identified.
Act Highlight: Implementation of Standardized Communication Tool

- Express Workout to identify key communication steps & team lead for each step:

<table>
<thead>
<tr>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Arrival Information</td>
</tr>
<tr>
<td>Patient Arrival</td>
</tr>
<tr>
<td>Transport Decision</td>
</tr>
<tr>
<td>Treatment Decision</td>
</tr>
<tr>
<td>Pre-Induction Time Out</td>
</tr>
<tr>
<td>Pre-Procedure Time Out</td>
</tr>
<tr>
<td>Intra-Procedure Events</td>
</tr>
<tr>
<td>Post-Procedure Handoff</td>
</tr>
</tbody>
</table>
Act Highlight: Implementation of Standardized Communication Tool
Act Highlights: Revised Process

Outside Hospital Patients

- Pt ID’d, Code IA Activated
- Autolaunch, bed assigned en route or LZ plan activated, Contact information and ETA updates to pager
- Pre-Arrival Team Huddle 10-15 minute out ETA
- Patient arrives, assessed by team, Patient arrival page sent out
- CTA Completed, Images Reviewed by Stroke Attending & Radiology, Tx decision made and sent out on pager
- Transport to NIR Updates sent to pager
- Code IA RN hands off to Anesthesia

Communication Checklist
OVERALL DATA:

<table>
<thead>
<tr>
<th></th>
<th>Baseline/Pre-Intervention</th>
<th>CY15</th>
<th>CY16</th>
<th>CY17</th>
<th>CY18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave Activations Per Month</td>
<td>n/a</td>
<td>6.7</td>
<td>12.3</td>
<td>11.3</td>
<td>11.3</td>
</tr>
<tr>
<td>Ave # Cases per Month</td>
<td>~4-8</td>
<td>2.5</td>
<td>5.5</td>
<td>5.7</td>
<td>7.3</td>
</tr>
</tbody>
</table>
Implementation of Code IA Stroke:
Patient Referral Source (all activations)

Referral Source by Calendar Year (%)

<table>
<thead>
<tr>
<th></th>
<th>ED</th>
<th>Inpatient</th>
<th>OSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY15</td>
<td>21%</td>
<td>6%</td>
<td>73%</td>
</tr>
<tr>
<td>CY16</td>
<td>33.5%</td>
<td>13.3%</td>
<td>53.2%</td>
</tr>
<tr>
<td>CY17</td>
<td>25.0%</td>
<td>8.0%</td>
<td>67.0%</td>
</tr>
</tbody>
</table>

ED: Emergency Department
Inpatient
OSH: Other Sites of Health Care
Implementation of Code IA Stroke: Mean Door to CTA Completion Times (All Activations)

<table>
<thead>
<tr>
<th>OVERALL DATA:</th>
<th>Baseline/Pre-Intervention</th>
<th>CY15</th>
<th>CY16</th>
<th>CY17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Arrival to CTA Read</td>
<td>Not measured</td>
<td>28.2m</td>
<td>25.8m</td>
<td>25.7m</td>
</tr>
</tbody>
</table>
Implementation of Code IA Stroke: Door to Groin Puncture Times (overall)

Overall Data:

<table>
<thead>
<tr>
<th>UNC DTG Puncture Times (Overall)</th>
<th>Baseline/Pre-Intervention</th>
<th>CY15</th>
<th>CY16</th>
<th>CY17</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>134.3m</td>
<td>64.4m</td>
<td>47.2m</td>
<td>35.4m</td>
</tr>
</tbody>
</table>

52% Reduction

64.9% Reduction

73.6% Reduction
Implementation of Code IA Stroke:
Mean Device Times (Overall)
(First Catheter Pass/Placement or First IA tPA Dose)

OVERALL DATA:

<table>
<thead>
<tr>
<th></th>
<th>Baseline/Pre-Intervention</th>
<th>CY15</th>
<th>CY16</th>
<th>CY17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door to Device</td>
<td>Not measured</td>
<td>106.2m</td>
<td>70.8m</td>
<td>66.1m</td>
</tr>
</tbody>
</table>

33.3% Reduction
37.8% Reduction

Door to Device (Overall)
Goal
Building the Quality Bridge: Experience of the Sending Facility

Jackie Thompson, DNP, RN, CMSRN
Stroke Program Coordinator
UNC Rex Primary Stroke Center
UNC Rex Primary Stroke Center’s Methodology

Plan

Multidisciplinary Team Collaboration

Do

In 2015, new evidence for treating patients with Large Vessel occlusions prompted need for changed processes

Act

Acceptance

Study

Overcome Barriers
Monitor performance
Plan:
Assess Current State of Transfers for LVO

Guidelines for Endovascular treatment
Inclusion:
- mRS (Modified Rankin) = 0 or 1
- NIHSS >= 6
- ASPECTS Score > 6
Experiment (‘DO’) Highlights: New Protocol to recognize LVO

Goal:
• Ensure eligible patients are receiving best treatment modality

Maintain or Improve Current Metrics:
• Ensure new process does not negatively affect door to tPA times
• Improve door to CTA times

Tactics:
• New Protocol Implemented
• Staff training – ED MD, ED RN, CT Techs
Experiment (‘DO’) Highlights: Streamline Communication

Goal:
• Streamline Communication to find receiving facility
• Streamline Communication to activate transport

Eliminate Waste:
• Multiple Phone Calls by ED MD to OSH transfer center, accepting MD, bed control, 2\textsuperscript{nd} provider – time and attention

Tactics:
• Utilize UNC Rex Transfer Center for outbound stroke patients
• Leverage UNC Medical Center one-call ‘Code IA Stroke’
Do: New Protocol to address New Guidelines

**Code Stroke ED**

**UNC HEALTH CARE**

**Prearrival to 5 Minutes**
- EMS Call Received
- ED Charge Verifies
- Last Known Well < 6 hrs
- Activate Code Stroke

**0 - 10 Minutes**
- Leave on EMS monitor/stretchers
  - If No EMS labs, get labs before CT
  - If EMS labs, labels, scan before CT
- Patient Registered
- Last Known Well Verified, Patient mRs (before onset), Stroke Severity Score
- tPA Only
  - Last Known well < 4.5 hrs
  - Severity Score <=NIHSS 5
  - mRS Before onset 0-5
  - Code Stroke Orders
- Endovascular + tPA
  - Last Known well < 4.5 hrs
  - AND
  - Stroke Severity Score >=NIHSS 6
  - mRS Before onset 0-1
  - Code Stroke Orders
  - CTA Orders - notify CT
- Endovascular Only
  - (Not tPA-Eligible OR LKW 4.5 - 6 hrs)
  - AND
  - Stroke Severity Score >= NIHSS 5
  - mRS Before onset 0-1
  - Code Stroke Orders
  - CTA Orders - notify CT

**10 - 15 Minutes**
- Patient to CT on monitor
- After CT – transfer to Rex stretcher and get actual weight, notify pharmacy of weight
- Return to ED Bay – 12 lead EKG, CXR if indicated, manage BP per protocol, O2 therapy NC pn to keep sat between 92-99%, 2 Large Bore IVs

**15 - 30 Minutes**
- RN or Stroke Coordinator: Complete remainder of Full NIHSS, MD tPA exclusions, lab results, patient education/consent

**Keep NPO**

**CT Results – Hemorrhagic?**
- CTA Causative occlusion of ICA or proximal MCA (M1)
  - AND ASPECTS >=6 and patient agreement
  - Transfer possible to meet LKW to Intervention <=6hrs

**ED MD Call Neurology**
- Charge RN or PCS Contact Transfer Center at ext. 4999

**Transfer Center coordinates transportation and Phone Call from ED MD to Neurointerventionalists**

**30 - 40 Minutes**
- ED MD tPA Order
  - Start tPA/protocol
- Hospitalist Orders to MSICU
- RN EMTALA/Transfer 2454POL
  - Patient/Legal Rep Signs Transfer Consent
  - Critical Care Transport
Do: Utilize UNC Rex Transfer Center and UNC Medical Center Code IA

UNC Rex ED MD to ED Secretary
“Activate the Transfer Center—we have a UNC Code IA for patient room 3”

UNC Rex ED PCS Secretary calls UNC Rex Transfer Center

UNC Rex Transfer Center calls UNC Transfer Center for Possible Code IA Stroke:
- UNC MD reviews images via EPIC
- UNC Rex Transfer Center gives heads up to Critical Care Transport

UNC MD calls Rex Transfer Center and is connected to the Rex ED MD

Three way call to discuss patient:
- UNC MD speaks to Rex ED MD
- UNC MD gets report, accepts patient if appropriate
- Rex transfer center dispatches CCT
- UNC MD consents patient/family over phone while still in Rex ED

Patient leaves UNC Rex ED for UNC Medical Center
Study:
Metrics Developed & Goals Set

**Activation/Pre-Arrival**
- Patient Origin – ED (EMS and Walk-in) and Inpatient
- Code Stroke Activation
- % of Code Strokes receiving CTA to identify LVO – per protocol

**Time to Identification and treatment**
- Door to CT Final
- Door to tPA Times
- Door to CTA Times

**Acceptance and Transport**
- Door to Transfer Center Call
- Door Out

**Goals Established:**
- Door-to-IV Alteplase: <60m
- Appropriate patients get timely CTA
- Door In- Door Out: <120m
Barriers – Pre-implementation

• I heard that XYZ is doing wake-up stroke, 8 hours, 12 hours ....
• EMS is going to bypass us with these patients anyway.
• CTA – that’s a lot of contrast – I don’t believe in all that contrast.
• 2 Large bore IVs – and who do you think is going to do that?
• We can’t keep the patient on the table for that long.
• How many patients is this – that’s a lot of resources.
• It’s so hard to get a patient transferred ....
• Won’t this affect our Door to tPA times?

Estimate this is going to be 6-7/month

Transfers take many calls by MD
Study: How many patients is this? That’s a lot of resources. What % of ED Code Stroke patients have CTA?

All ED Code Strokes

OVERALL DATA:

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>CY16</th>
<th>CY17</th>
<th>CY18 – Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave ED Code Strokes Per Month</td>
<td>n/a</td>
<td>32.0</td>
<td>32.7</td>
<td>48.7</td>
</tr>
<tr>
<td>Ave # CTA per Month</td>
<td>n/a</td>
<td>4.3</td>
<td>9.2</td>
<td>28.3</td>
</tr>
<tr>
<td>Ave # Positive CTA per Month</td>
<td>n/a</td>
<td>0.7</td>
<td>2.4</td>
<td>7.0</td>
</tr>
<tr>
<td>Ave # Transfer from ED / Month</td>
<td>n/a</td>
<td>0.5</td>
<td>1.2</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Study: Resources – What if this really is a stroke?
What % ED Code Stroke patients with Ischemic Stroke/TIA get CTA?

ED Code Strokes with Diagnosis of Ischemic Stroke or TIA

<table>
<thead>
<tr>
<th>Quarter</th>
<th>ED Code Strokes</th>
<th>% Getting CTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 Q1</td>
<td>40%</td>
<td>8%</td>
</tr>
<tr>
<td>2016 Q2</td>
<td>50%</td>
<td>20%</td>
</tr>
<tr>
<td>2016 Q3</td>
<td>55%</td>
<td>15%</td>
</tr>
<tr>
<td>2016 Q4</td>
<td>45%</td>
<td>15%</td>
</tr>
<tr>
<td>2017 Q1</td>
<td>50%</td>
<td>32%</td>
</tr>
<tr>
<td>2017 Q2</td>
<td>60%</td>
<td>39%</td>
</tr>
<tr>
<td>2017 Q3</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>2017 Q4</td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td>2018 Q1</td>
<td>80%</td>
<td>79%</td>
</tr>
</tbody>
</table>

2016 Q1
2016 Q2
2016 Q3
2016 Q4
2017 Q1
2017 Q2
2017 Q3
2017 Q4
2018 Q1
Study: Resources - What % of ED Code Stroke patients with Ischemic Stroke/TIA and NIHSS>=6 have CTA?

ED Code Strokes with Ischemic Stroke or TIA and NIHSS>=6

<table>
<thead>
<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>18%</td>
<td>36%</td>
<td>18%</td>
<td>25%</td>
</tr>
<tr>
<td>2017</td>
<td>25%</td>
<td>33%</td>
<td>36%</td>
<td>54%</td>
</tr>
<tr>
<td>2018</td>
<td>43%</td>
<td>41%</td>
<td>77%</td>
<td>86%</td>
</tr>
</tbody>
</table>

ED Code Strokes: % Getting CTA, % Pos CTA, Thrombectomy

2016 Q1: 10% 2016 Q2: 10% 2016 Q3: 10% 2016 Q4: 10%
2017 Q1: 14% 2017 Q2: 29% 2017 Q3: 33% 2017 Q4: 41%
2018 Q1: 54% 2018 Q2: 62% 2018 Q3: 77% 2018 Q4: 86%
Study: Ratio of Positive and Negative CTA Results
For Code Stroke Patients with Stroke or TIA, NIHSS>=6

<table>
<thead>
<tr>
<th>Year</th>
<th>Negative CTA</th>
<th>Positive CTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>2017</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>2018</td>
<td>15</td>
<td>10</td>
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</tbody>
</table>
Study: Resources - What % of ED Code Stroke patients with Ischemic Stroke/TIA and NIHSS<6 have CTA?

<table>
<thead>
<tr>
<th>Quarter</th>
<th>ED Code Strokes</th>
<th>% Getting CTA</th>
<th>% Pos CTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 Q1</td>
<td>25</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>2016 Q2</td>
<td>30</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>2016 Q3</td>
<td>35</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>2016 Q4</td>
<td>40</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2017 Q1</td>
<td>45</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>2017 Q2</td>
<td>50</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>2017 Q3</td>
<td>55</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>2017 Q4</td>
<td>60</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>2018 Q1</td>
<td>65</td>
<td>66%</td>
<td></td>
</tr>
</tbody>
</table>

1 patient transferred Q1 2016, NIHSS = 3 – without a CTA, at request of patient
Accepted at OSH for consideration of IA
Study: Resources – Are we using resources for stroke mimics? What % of ED Code Stroke patients with ICH or Mimic have CTA?
Study: Impact on Door to CTA Final times

Door to CTA Report to ED MD – minutes

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Number</th>
<th>Average</th>
<th>Median</th>
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<tbody>
<tr>
<td>2016-Q1</td>
<td>4</td>
<td>73</td>
<td>58</td>
</tr>
<tr>
<td>2016-Q2</td>
<td>14</td>
<td>135</td>
<td>119</td>
</tr>
<tr>
<td>2016-Q3</td>
<td>23</td>
<td>104</td>
<td>77</td>
</tr>
<tr>
<td>2016-Q4</td>
<td>11</td>
<td>110</td>
<td>79</td>
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<tr>
<td>2017-Q1</td>
<td>11</td>
<td>81</td>
<td>70</td>
</tr>
<tr>
<td>2017-Q2</td>
<td>31</td>
<td>80</td>
<td>59</td>
</tr>
<tr>
<td>2017-Q3</td>
<td>29</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>2017-Q4</td>
<td>40</td>
<td>64</td>
<td>54</td>
</tr>
<tr>
<td>2018-Q1</td>
<td>85</td>
<td>61</td>
<td>51</td>
</tr>
</tbody>
</table>
Study: Won’t This Affect our Door to tPA times?
- In fact, it improved

Time to Intravenous Thrombolytic Therapy - Door to initiation in 60 minutes or less

- 1st Half 2015: 33.0%
- 2015: 57.1%
- 2016: 52.9%
- 2017: 82.1%
- 2018: 87.5%
Study: Impact on Door In – Door Out times

Door In door Out / Door to Groin Puncture

October 2015

UNC HEALTH CARE NEUROCARE
Study: Identification of LVO and subsequent transfer
Numbers of Thrombectomy Cases:

<table>
<thead>
<tr>
<th>Quarter</th>
<th>In-house</th>
<th>ED</th>
</tr>
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<tbody>
<tr>
<td>2016-Q1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
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<td>1</td>
</tr>
<tr>
<td>2016-Q3</td>
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<td>1</td>
</tr>
<tr>
<td>2016-Q4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2017-Q1</td>
<td>2</td>
<td>5</td>
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<td>2017-Q2</td>
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<td>7</td>
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<tr>
<td>2018-Q1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
CASE STUDY EXAMPLE
Case Study

- 64 year old female
- Past medical history:

<table>
<thead>
<tr>
<th>Hypertension</th>
<th>Coronary Artery Disease</th>
<th>Chronic Kidney Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperlipidemia</td>
<td>Diabetes</td>
<td>Previous Stroke (7 years ago)</td>
</tr>
</tbody>
</table>

- At 3:30am, the patient walked out of the bathroom without difficulty. She spoke normally to her family at that time.
- At 3:45am, she was no longer able to speak.
- At a baseline, she has some trouble with handwriting from her previous stroke but no other difficulties (mRS=1)
- Later that morning when she noted that symptoms were not resolving, 911 was called and she was transported to Rex Emergency Department.
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>06:19</td>
<td>Arrived at UNC Rex ED</td>
</tr>
<tr>
<td>06:24</td>
<td>Transported to CT Scan</td>
</tr>
<tr>
<td>06:35</td>
<td>CT Completed</td>
</tr>
<tr>
<td></td>
<td>Results Called to ED MD: No acute intracranial abnormality; old</td>
</tr>
<tr>
<td></td>
<td>lacunar infarct in L basal ganglia</td>
</tr>
<tr>
<td>06:40</td>
<td>NIH Stroke Scale Completed: 7</td>
</tr>
<tr>
<td></td>
<td>2 pts LOC questions</td>
</tr>
<tr>
<td></td>
<td>1pt Facial palsy</td>
</tr>
<tr>
<td></td>
<td>1pt Motor arm, right</td>
</tr>
<tr>
<td></td>
<td>1pt Motor leg, right</td>
</tr>
<tr>
<td></td>
<td>2pts Language</td>
</tr>
</tbody>
</table>
**Case Study**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>06:50</td>
<td><strong>IV Treatment Decision</strong>&lt;br&gt;Determined after discussion with family that patient was not a candidate for IV tPA due to LKN and history of diabetes and previous stroke.</td>
</tr>
<tr>
<td>06:55</td>
<td><strong>Transport to CT Scan</strong>&lt;br&gt;Patient transported to CT Scan, CTA completed</td>
</tr>
<tr>
<td>07:05</td>
<td><strong>CTA Results</strong>&lt;br&gt;Results called to ED MD: Proximal mid left M1 MCA occlusion</td>
</tr>
<tr>
<td>07:06</td>
<td><strong>UNC Medical Center Transfer Center Called</strong>&lt;br&gt;Notification of Possible Code IA Stroke</td>
</tr>
</tbody>
</table>

**Door to Transfer Center Call: 47 minutes**
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:12</td>
<td>Patient Accepted to UNC Medical Center as Code IA Stroke Transfer</td>
</tr>
<tr>
<td>7:15</td>
<td>UNC Rex Critical Care Transport Auto-launch Dispatched</td>
</tr>
<tr>
<td>7:19</td>
<td>Code IA Stroke Pager Activated</td>
</tr>
<tr>
<td>7:25</td>
<td>UNC Rex Critical Care Transport at bedside</td>
</tr>
<tr>
<td>7:29</td>
<td>Patient Departs UNC Rex Hospital and en route to UNC Medical Center</td>
</tr>
</tbody>
</table>

**Door-in-Door-out Time:** 70 minutes

**7:33 ETA Update** to Code IA Stroke Pager
7:59 Patient Arrives to CT Scan at UNC Medical Center
Code IA Pager Updated with Arrival Page

Transport Time: 30 minutes

08:00 Arrival NIH Stroke Scale Performed: 9
2pts LOC Questions
1pt LOC Commands
1pt Motor Arm, Right
3pts Motor Leg, Right
2pts Language

08:01 Non Contrast CT ordered

08:05 Non Contrast CT completed
No changes
Patient transported to Neurointerventional Radiology

Door to CT Results: 5 minutes
Case Study

08:15 Pre-Procedure Time Out

08:22 Groin Puncture

Door to Groin Puncture: 23 minutes

08:42 Clot Retrieval
MCA M1 Clot Retrieved with Solitaire® Device, TICI 2B

Door (UNC) to Revascularization: 43 minutes

Door in (Rex) to Revascularization (UNC): 143 minutes
Case Study

Pre-Intervention Angiogram

Post-Intervention Angiogram
Case Study

• Discharged to Acute Inpatient Rehabilitation on hospital day 5
• Discharge NIH Stroke Scale: 5
  – 2 pts LOC commands
  – 2 pts aphasia
  – 1 pt facial droop
• Discharge Modified Rankin Score: 4
• 90-day Modified Rankin Score: 2
Thank You!

I tried my process improvement skills at home: I showed my wife how she can make breakfast in less than 20 minutes.

Did it work?

Yes... Now, I make breakfast in 10 minutes.

Questions

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