Institutional Review of Mortality and Documentation in 4,429 Neurosurgery Patients: Are We Improving?

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Aladine A. Elsamadicy, Medical Student
John H. Sampson, Chair
DISCLOSURES

• I have the following financial relationships to disclose:
  – Consultant for RTI Spine
Health data of hospitalized patients are assessed to evaluate safety, quality of care, and to impact reimbursement.

However, the clinical impact of accurate documentation and quality improvement initiatives on health-assessment metrics in neurosurgery are not well described, including:

- Mortality index (MI)
- Risk of mortality (ROM)
- Severity of illness (SOI)
- Case Mix Index (CMI)
Many hospitals use University Health System Consortium (UHC) data assessment for benchmarking and performance improvement
  – Member-owned consortium of 120 academic medical centers (300+ hospitals)
  – Self reported data is evaluated with risk adjustment

UHC is a proxy for the CMS risk-adjustment data (less readily available)
  – External ratings including U.S. News & World Report use CMS risk-adjustment data

Department, hospital, & national databases
Duke Department of Neurosurgery began assessing the quality of our care with UHC data & developed a strong relationship w/ Performance Services

- Assessing trends in surgeon/department data and comparing outcomes to peer neurosurgery centers
- Defining all of the metrics and determining role of documentation vs. patient care vs. both on outcomes
- Defining department goals and satisfying hospital balanced scorecards
- Developing initiatives to improve care and documentation

Taking control of the data:
- Prospective data collection with department database (complications/readmissions & in-hospital mortality)
Quality misconceptions??

- The data cannot be true
- Our patients are the sickest
- Those are not our deaths
- We are documenting well
- Our notes are misread
- Coding is inaccurate
- Few sick patients are biasing the results
MORTALITY INDEX (DEFINITION)

= Observed mortality/ Expected mortality
  – Expected mortality
    • Based on annual risk models
    • Assigns an **expected mortality rate** to patient by diagnosis-related groups (DRGs)
    • Model incorporates multiple variables including:
      – Age, sex, admission source, comorbidities, other factors
• **Severity of Illness (SOI)**
  – Proxy of the extent of physiological decompensation for a patient

• **Risk of Mortality (ROM)**
  – Estimated likelihood of in-hospital death

• **3M APR-DRG classification system used for adjusting data for SOI and ROM**
  – Assigned 1 of 4 levels for admission and discharge

<table>
<thead>
<tr>
<th>Score</th>
<th>CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minor</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>Major</td>
</tr>
<tr>
<td>4</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

• **Case Mix Index (CMI)**
  – Complexity of a patient population
  – Relative value based on DRG and associated comorbidities
  – Value is used in determining the reimbursement
  – Weights are assigned by CMS and updated annually
WHAT IS THE GOAL?

• **Reduce Mortality** and improved **Quality of Care (QC)**
  – Measured by reduced mortality rate/ actual deaths/ *mortality observed*

• Improve **documentation** and **accurately** demonstrate the relative sickness of patient
  – Measured by mortality expected, admission/ discharge SOI and ROM, and CMI

• Differences in **mortality index**, controlling for relative sickness, serves as the proxy for differentiating QC

• Inaccuracy of **documentation** results in potential for inferior hospital outcomes impacting overall institutional status and reimbursement
QUALITY INITIATIVE

July 1, 2015: Implementation of multifactorial quality initiative for the DUMC Neurosurgery Service

1. All surgeons receive monthly email-dashboard displaying month & year-to-date detailed reports on their metrics compared to departmental & national neurosurgery groups

2. Monthly departmental presentations during Neurosurgery Grand Rounds displaying department and surgeon level data including highlighting outliers and rankings

3. Peer NSU review, institutional review, and self review of all inpatient mortality cases including receiving feedback on overall preventability score, root cause analysis, and suggestions for improvement

4. Initiated standardized (best evidence based) care protocols for common neurosurgery diagnoses and tracking to assess impact
July 1, 2015: Implementation of multifactorial quality initiative for the DUMC Neurosurgery Service

4. All surgeons/ residents/ APPs receive ongoing education on better documentation for neurosurgery diagnoses with lectures, 1:1 training, emails, and access to EMR smart phrases

5. Improved direct communication with surgeons and clinical documentation analysts (CDA's) about medical record inquiries and education by performance services on poorly documented cases or areas of improvement

6. Direct communication by performance services to surgeons on all deaths with ROM and SOI less than 4 and mortality index > 1.0 with discussion of areas for improvement

7. Private meetings with surgeons and performance service to further define and explain the quality data results
METHODS

• **Assessment:** We evaluated the impact of our neurosurgical service quality initiative on mortality and documentation assessing ROM, SOI, MI, and CMI.

• **Population:** We analyzed data from our prospective database and UHC risk adjusted data for 4,429 consecutive adult (≥ 18 years) neurosurgery patients and all 109 cases of in-hospital mortality over a 20 months period.

• **Patients were grouped by date of intervention:**
  - **July-2014 to June-2015 ***
    • (Earlier: n=2641)
  - **July-2015 to February-2016**
    • (Later: n=1788)

*** No differences were found between our control year and prior year.
METHODS

Data Collected:

- Admit Date
- Date of Death
- Age
- Monthly Number of Patients on Service
- Present on admission (POA) - ROM & SOI
- Discharge (DC) - ROM & SOI
- Mortality Index (MI) = Observed/Expected
- Case Mix Index (CMI)
- DRG Code
- Neurosurgery or procedure performed
- Elective vs Emergency admission
- Type of Case:
  - Vascular
  - Spine
  - Trauma
  - Other Cranial
  - Other
METHODS

We primarily assessed these metrics for entire neurosurgery population and mortality cases:

1. Present on admission (POA)-ROM & SOI
2. Discharge (DC)-ROM & SOI
3. Mortality Index (MI)
   - OBSERVED MORTALITY
   - EXPECTED MORTALITY
4. Case Mix Index (CMI)
**Statistics:**

- Parametric data were expressed as means and compared via the Student’s t-test.
- Nominal data were compared with Chi-square tests.
- All tests were two-sided and were statistically significant if the p-value was less than 0.05.
- Statistical analysis was performed using JMP of SAS.
RESULTS: MORTALITY (N=109)

Mortality Etiology:
- Vascular: 31%
- Trauma: 32%
- Stroke/Thrombosis: 13%
- Other Cranial Bleeds: 5%
- Tumor: 12%
- Spine: 4%
- Other: 3%

Mean Age: 60.6 years old
Range: [18 – 90]
RESULTS: MORTALITY (N=109)

Neurosurgery Performed
- Yes: 66%
- No: 34%

DRG Classification
- Surgery: 72%
- Medicine: 28%

Emergent: 92%
Elective: 8%
RESULTS: MORTALITY (N=109)

5 Most Common DRG Classifications

<table>
<thead>
<tr>
<th>DRG</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRG 020</td>
<td>9.43%</td>
</tr>
<tr>
<td>DRG 023</td>
<td>26.42%</td>
</tr>
<tr>
<td>DRG 025</td>
<td>18.87%</td>
</tr>
<tr>
<td>DRG 064</td>
<td>9.43%</td>
</tr>
<tr>
<td>DRG 530</td>
<td>7.55%</td>
</tr>
</tbody>
</table>

**DRG 020**: INTRACRANIA VASCULAR PROCEDURES W PDX HEMORRHAGE W MCC  
**DRG 023**: CRANIO W MAJOR DEV IMPL/ACUTE COMPLEX CNS PDX W MCC OR CHEMO IMPLANT  
**DRG 025**: CRANIO TOMY & ENDOVASCULAR INTRACRANIAL PROCEDURES W MCC  
**DRG 064**: INTRACRANIA HEMORRHAGE OR CEREBRAL INFARCTION W MCC  
**DRG 530**: CRANIO TOMY WITH MAJOR CC
RESULTS: TOTAL NSU COHORT (N=4,429)

INCREASING!

Scores

2014 - 2016
RESULTS: TOTAL NSU COHORT (N=4,429)

Present on Admission (POA)

ROM

<table>
<thead>
<tr>
<th></th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>POA</td>
<td>1.46</td>
<td>1.53</td>
</tr>
</tbody>
</table>

SOI

<table>
<thead>
<tr>
<th></th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>POA</td>
<td>1.84</td>
<td>1.96</td>
</tr>
</tbody>
</table>

p=0.01*
p<0.01*
RESULTS: TOTAL NSU COHORT (N=4,429)

Discharge (DC)

- ROM
  - Earlier: 1.58
  - Later: 1.69
  - p<0.01*

- SOI
  - Earlier: 1.95
  - Later: 2.09
  - p<0.01*
RESULTS: TOTAL NSU COHORT (N=4,429)

Scores 2014 - 2016

CMI

INCREASING!
RESULTS: TOTAL NSU COHORT (N=4,429)

Case Mix Index (CMI)

- Earlier: 2.96
- Later: 3.17

p=0.03*
RESULTS: TOTAL NSU COHORT (N=4,429)

Mortality***
(Mean per Month)

<table>
<thead>
<tr>
<th></th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>4.17</td>
<td>2.75</td>
</tr>
<tr>
<td>Expected</td>
<td>4.11</td>
<td>4</td>
</tr>
</tbody>
</table>

\[ p=0.13 \quad \text{Earlier} \]
\[ p=0.87 \quad \text{Later} \]
RESULTS: TOTAL NSU COHORT (N=4,429)

Mortality Index (MI)***

- Earlier: 0.98
- Later: 0.72

p=0.19
RESULTS: MORTALITY (N=109)

Mortality Etiology
(Earlier: n=71, Later: n=38)

<table>
<thead>
<tr>
<th>Category</th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Stroke/Thrombosis</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Bleed/Hypertensive</td>
<td>32%</td>
<td>31%</td>
</tr>
<tr>
<td>Vascular</td>
<td>30%</td>
<td>31%</td>
</tr>
<tr>
<td>Trauma</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Spine</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Tumor</td>
<td>11%</td>
<td>14%</td>
</tr>
</tbody>
</table>
RESULTS: MORTALITY (N=109)

Present on Admission (POA)

<table>
<thead>
<tr>
<th></th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROM</td>
<td>3.69</td>
<td>3.58</td>
</tr>
<tr>
<td>SOI</td>
<td>3.75</td>
<td>3.53</td>
</tr>
</tbody>
</table>

p=0.5

p=0.11
RESULTS: MORTALITY (N=109)

Discharge (DC)

<table>
<thead>
<tr>
<th>ROM</th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.96</td>
<td>3.92</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOI</th>
<th>Earlier</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.93</td>
<td>3.89</td>
</tr>
</tbody>
</table>

p=0.47
p=0.56
RESULTS: MORTALITY (N=109)

Mortality Expected Per Month

- Earlier
- Later

p=0.52

Goal is = 1.0 for all deaths
RESULTS: MORTALITY (N=109)

Present on Admission (POA)

<table>
<thead>
<tr>
<th></th>
<th>Yes NSU</th>
<th>No NSU</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROM</td>
<td>3.54</td>
<td>3.86</td>
</tr>
<tr>
<td>SOI</td>
<td>3.59</td>
<td>3.81</td>
</tr>
</tbody>
</table>

Discharge (DC)

<table>
<thead>
<tr>
<th></th>
<th>Yes NSU</th>
<th>No NSU</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROM</td>
<td>3.93</td>
<td>3.97</td>
</tr>
<tr>
<td>SOI</td>
<td>3.92</td>
<td>3.92</td>
</tr>
</tbody>
</table>

Mortality Expected

<table>
<thead>
<tr>
<th></th>
<th>Yes NSU</th>
<th>No NSU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.41</td>
<td>0.62</td>
</tr>
</tbody>
</table>

p<0.01*
p=0.035*
p=0.29
p=0.95

Does Neurosurgery Intervention Make A Difference?
Who do we operate on?
## RESULTS: OVERALL

### Total Neurosurgery Population (n=4,429)

<table>
<thead>
<tr>
<th>Variables (Mean per month)</th>
<th>Earlier (n=2641)</th>
<th>Later (n=1788)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality Observed (n)</td>
<td>4.17</td>
<td>2.75</td>
<td>0.13</td>
</tr>
<tr>
<td>Mortality/Month (%)</td>
<td>1.92</td>
<td>1.22</td>
<td>0.09</td>
</tr>
<tr>
<td>Mortality Expected (n)</td>
<td>4.11</td>
<td>4.00</td>
<td>0.87</td>
</tr>
<tr>
<td>Mortality Index (Observed/Expected)</td>
<td>0.98</td>
<td>0.72</td>
<td>0.19</td>
</tr>
<tr>
<td>CMI</td>
<td>2.96</td>
<td>3.17</td>
<td>0.03*</td>
</tr>
<tr>
<td>POA – ROM</td>
<td>1.46</td>
<td>1.53</td>
<td>0.01*</td>
</tr>
<tr>
<td>POA – SOI</td>
<td>1.84</td>
<td>1.96</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td>DC – ROM</td>
<td>1.58</td>
<td>1.69</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td>DC – SOI</td>
<td>1.95</td>
<td>2.09</td>
<td>&lt;0.01*</td>
</tr>
</tbody>
</table>

### Neurosurgery Mortality Cases (n=109)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Earlier (n=71)</th>
<th>Later (n=38)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurosurgery Was Performed (%)</td>
<td>65.71</td>
<td>65.79</td>
<td>0.99</td>
</tr>
<tr>
<td>Emergency Admission (%)</td>
<td>91.55</td>
<td>89.47</td>
<td>0.74</td>
</tr>
<tr>
<td>Mortality Expected</td>
<td>0.50</td>
<td>0.45</td>
<td>0.52</td>
</tr>
<tr>
<td>POA - ROM</td>
<td>3.69</td>
<td>3.58</td>
<td>0.50</td>
</tr>
<tr>
<td>POA - SOI</td>
<td>3.75</td>
<td>3.53</td>
<td>0.11</td>
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<tr>
<td>DC - SOI</td>
<td>3.93</td>
<td>3.89</td>
<td>0.56</td>
</tr>
</tbody>
</table>
LIMITATIONS

• **#1**: Two populations could have unidentified differences despite similar demographics
• **#2**: Seasonal data could have impacted results
• **#3**: Inherent limits of assessing population level data and databases
• **#4**: Intervention went live on July 1\textsuperscript{st}, but some of these initiatives were discussed before this point potentially biasing impact
• **#5** We primarily assessed in hospital deaths
This study demonstrates that the total neurosurgery population presented with **worse overall sickness** and greater **complexity** over time

- Significant increase in overall POA & DC SOI/ROM and CMI in later period
- This increase could also reflect better **documentation**
There are signs of improvements in neurosurgical quality of care with reduced mortality \( \textit{observed} \) and overall improved mortality index, but there were no apparent improvements in mortality-related documentation \( \textit{mortality expected, ROM, or SOI} \).
Our assessment of the mortalities suggests that the risk models based on charted and coded data may not accurately account for all relevant factors contributing to severity of the disease. Example: Neurological exam.
Thus, efforts to improve **accuracy** and **detail** of **clinical documentation**, which is central to **improving patient care**, may not always impact a department’s mortality score.

A focus on **reducing mortality** may be higher yield.
• **#1:** Neurosurgery templated notes in EMR
  – Neurosurgery problem based note to assist documentation of clinical appropriate neurosurgery comorbidities
  – Learning from the results of this study as well

• **#2:** Identifying patients unsuitable for neurosurgery intervention secondary to too high risk or ones who are unlikely to benefit with evidence based protocols

• **#3:** Continued peer review
REFERENCES

1. https://www.karenzupko.com/service/icd-10-cm-documentation-for-neurosurgery/
2. http://www.uhc.edu
Thank You