Quality Measurement in Perioperative Care

Michael A. Gropper, MD, PhD
Professor and Chair
Department of Anesthesia and Perioperative Care
UCSF

Disclosures

• NIH
• The Gordon and Betty Moore Foundation
Despite the advantages of anesthesia, Liston, like many other surgeons, proceeded in his usual lightning-quick and bloody way. Spectators in the operating-theater gallery would still get out their pocket watches to time him. The butler’s operation, for instance, took an astonishing 25 seconds from incision to wound closure. (Liston operated so fast that he once accidentally amputated an assistant’s fingers along with a patient’s leg, according to Hollingham. The patient and the assistant both died of sepsis, and a spectator reportedly died of shock, resulting in the only known procedure with a 300% mortality.)
Can we accurately measure quality?
Benchmarking Outcomes

**LOW OUTLIER:** If the upper bound of the O/E confidence interval is ≤1.0, the hospital’s outcomes are statistically **better** than expected.

**HIGH OUTLIER:** If the lower bound of the O/E ratio is ≥1.0, the hospital’s outcomes are statistically **worse** than expected.

*Fig. 1.* Depiction of O/E ratios and identification of outlier status as determined by the ACS NSQIP.

---

**NSQIP VA Hospitals 30d Mortality**

Variation in Hospital Mortality Associated with Inpatient Surgery

Amir A. Ghaferi, M.D., John D. Birkmeyer, M.D., and Justin B. Dimick, M.D., M.P.H.

ABSTRACT

84,750 Patients from NSQIP database

Figure 1. Rates of All Complications, Major Complications, and Death after Major Complications, According to Hospital Quintile of Mortality.

Although rates of all complications and major complications did not vary significantly across hospital mortality quintiles, the rate of death in patients with major complications was almost twice as high in hospitals with very high overall mortality as in those with very low overall mortality (21.4% vs. 12.5%, P<0.001).

Complication rates were the same, but mortality was different at different hospitals.
### Incidence of Complication

<table>
<thead>
<tr>
<th>Variable</th>
<th>Very Low Mortality</th>
<th>Low Mortality</th>
<th>Medium Mortality</th>
<th>High Mortality</th>
<th>Odds Ratio for Very High vs. Very Low Mortality (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of complication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2.0</td>
<td>2.4</td>
<td>1.8</td>
<td>2.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Mechanical ventilation &gt;48 hr</td>
<td>6.6</td>
<td>7.1</td>
<td>6.3</td>
<td>7.0</td>
<td>8.1</td>
</tr>
<tr>
<td>Unplanned intubation</td>
<td>3.6</td>
<td>4.0</td>
<td>3.6</td>
<td>4.5</td>
<td>4.6</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>1.3</td>
<td>1.5</td>
<td>1.2</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>0.7</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Postoperative bleeding</td>
<td>1.2</td>
<td>1.6</td>
<td>1.1</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Deep wound infection</td>
<td>2.1</td>
<td>1.7</td>
<td>1.7</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Organ-space infection</td>
<td>3.1</td>
<td>3.8</td>
<td>2.9</td>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Septic shock</td>
<td>1.6</td>
<td>2.5</td>
<td>1.4</td>
<td>2.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Fascial dehiscence</td>
<td>1.9</td>
<td>1.7</td>
<td>1.4</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Ghaferi et al, NEJM 2009

### Mortality after Complication

<table>
<thead>
<tr>
<th>Variable</th>
<th>Very Low Mortality</th>
<th>Low Mortality</th>
<th>Medium Mortality</th>
<th>High Mortality</th>
<th>Odds Ratio for Very High vs. Very Low Mortality (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality after major complication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>16.3</td>
<td>13.9</td>
<td>20.6</td>
<td>17.0</td>
<td>23.3</td>
</tr>
<tr>
<td>Mechanical ventilation &gt;48 hr</td>
<td>20.6</td>
<td>23.1</td>
<td>28.7</td>
<td>27.3</td>
<td>31.0</td>
</tr>
<tr>
<td>Unplanned intubation</td>
<td>24.8</td>
<td>27.2</td>
<td>26.8</td>
<td>33.4</td>
<td>38.4</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>33.9</td>
<td>43.3</td>
<td>47.7</td>
<td>43.1</td>
<td>48.3</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>29.1</td>
<td>28.4</td>
<td>27.3</td>
<td>36.4</td>
<td>39.5</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>6.9</td>
<td>6.8</td>
<td>7.6</td>
<td>5.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Postoperative bleeding</td>
<td>20.9</td>
<td>33.2</td>
<td>31.4</td>
<td>33.1</td>
<td>30.9</td>
</tr>
<tr>
<td>Deep wound infection</td>
<td>3.2</td>
<td>3.2</td>
<td>3.9</td>
<td>5.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Organ-space infection</td>
<td>4.9</td>
<td>4.2</td>
<td>6.9</td>
<td>8.8</td>
<td>8.8</td>
</tr>
<tr>
<td>Septic shock</td>
<td>28.7</td>
<td>29.2</td>
<td>41.0</td>
<td>36.3</td>
<td>46.2</td>
</tr>
<tr>
<td>Fascial dehiscence</td>
<td>7.0</td>
<td>6.0</td>
<td>8.1</td>
<td>6.9</td>
<td>7.1</td>
</tr>
<tr>
<td>Stroke</td>
<td>22.5</td>
<td>30.4</td>
<td>35.0</td>
<td>41.3</td>
<td>46.4</td>
</tr>
</tbody>
</table>

Ghaferi et al, NEJM 2009
Comparison of Hospital Quality

Objective Rankings?

<table>
<thead>
<tr>
<th>Rank</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mayo Clinic, Rochester, Minnesota</td>
</tr>
<tr>
<td>2</td>
<td>Massachusetts General Hospital, Boston</td>
</tr>
<tr>
<td>3</td>
<td>Johns Hopkins Hospital, Baltimore</td>
</tr>
<tr>
<td>4</td>
<td>Cleveland Clinic</td>
</tr>
<tr>
<td>5</td>
<td>UCLA Medical Center, Los Angeles</td>
</tr>
<tr>
<td>6</td>
<td>New York-Presbyterian University Hospital of Columbia and Cornell, New York</td>
</tr>
<tr>
<td>7</td>
<td>Hospitals of the University of Pennsylvania-Penn Presbyterian, Philadelphia</td>
</tr>
<tr>
<td>8</td>
<td><strong>UCSF Medical Center, San Francisco</strong></td>
</tr>
<tr>
<td>9</td>
<td>Brigham and Women's Hospital, Boston</td>
</tr>
<tr>
<td>10</td>
<td>Northwestern Memorial Hospital, Chicago</td>
</tr>
</tbody>
</table>
US News & World Report
Hospital Rankings: Methodology

- Reputation (32.5%): Physician survey
- Mortality Index (32.5%): Medicare data
- Patient Safety (5%): SSI, VAP, CRBSI, etc
- Other (30%): RN staffing, technology, other data from American Hospital Association, intensivist staffing, etc.

### Weighting of Patient Safety Index

<table>
<thead>
<tr>
<th>PSI</th>
<th>Weight in the Best Hospitals Patient Safety Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI 02: Death in Low-Mortality DRGs</td>
<td>7.8%</td>
</tr>
<tr>
<td>PSI 04: Failure to Rescue</td>
<td>0.2%</td>
</tr>
<tr>
<td>PSI 06: Iatrogenic Pneumothorax</td>
<td>38.6%</td>
</tr>
<tr>
<td>PSI 09: Postoperative Hemorrhage or Hematoma</td>
<td>8.4%</td>
</tr>
<tr>
<td>PSI 11: Postoperative Respiratory Failure</td>
<td>3.4%</td>
</tr>
<tr>
<td>PSI 14: Postoperative Wound Dehiscence</td>
<td>1.8%</td>
</tr>
<tr>
<td>PSI 15: Accidental Puncture or Laceration</td>
<td>40.1%</td>
</tr>
</tbody>
</table>
OMG!

The IHQ score can be thought of as a simple weighted sum of structural, process, and outcomes measures. The weights for the structural measures are factor loadings, and the weights for the process and outcomes measures are equal to the sum of all structural measure factors.

\[
IHQ_i = \{.3(S_{ni} \times F_{ni}) + (S_{2i} \times F_{2i}) + \ldots + (S_{mi} \times F_{mi})/ + .325(P_i \times \sum F_i) + .325(M_i \times \sum F_i) + .05P_{Si}\},
\]

where

- \( IHQ_i \) = index for hospital quality for specialty \( i \);
- \( S_{ni} \) = standardized value for structural indicator \( n \) (STRUCTURE), for specialty \( i \);
- \( F_{ni} \) = factor loadings for structural indicator \( n \) for specialty \( i \);
- \( P_i \) = standardized nomination score (PROCESS) for specialty \( i \);
- \( M_i \) = standardized mortality score (OUTCOMES) for specialty \( i \); and
- \( P_{Si} \) = standardized patient safety index score for specialty \( i \).

### Reputation!

<table>
<thead>
<tr>
<th>Rank</th>
<th>Hospital</th>
<th>U.S. News Score</th>
<th>Reputation (%)</th>
<th>Relative mortality (below 1.00 is better)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cleveland Clinic</td>
<td>100.0</td>
<td>70.8</td>
<td>0.47</td>
</tr>
<tr>
<td>2</td>
<td>Mayo Clinic, Rochester, Minn.</td>
<td>88.1</td>
<td>54.1</td>
<td>0.72</td>
</tr>
<tr>
<td>3</td>
<td>Johns Hopkins Hospital, Baltimore</td>
<td>70.1</td>
<td>26.4</td>
<td>0.61</td>
</tr>
<tr>
<td>4</td>
<td>Texas Heart Institute at St. Luke's Episcopal Hospital, Houston</td>
<td>70.0</td>
<td>24.8</td>
<td>0.61</td>
</tr>
<tr>
<td>5</td>
<td>Massachusetts General Hospital, Boston</td>
<td>65.3</td>
<td>22.5</td>
<td>0.73</td>
</tr>
<tr>
<td>6</td>
<td>New York-Presbyterian University Hospital of Columbia and Cornell</td>
<td>62.6</td>
<td>16.3</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Of course, Penn State doesn’t have a law school.”
The “Triple Aim” of Healthcare

Per capita cost

Population Health

Experience of Care

The Future

EMERGE
Why can a PCA keep giving dilaudid when the Patient’s oxygen saturation is falling?

Devices don’t share data!

Patients are objectified and families are alienated
Up to 50% of MD and RN shift is spent on computer

Design Thinking:

- Culture (CUSP)
- Workflow
- Technology

Innovation & opportunity for safe design
CUSP Training

- Train all staff in the science of safety
- Engage staff to identify defects
- Senior executive partnership/safety rounds
- Continue to learn from defects
- Implement tools for improvement

Current State

- Clinicians don’t see the same information
- Clinicians use different terminology/language
- Important patient data can be overlooked
- Easy to forget to complete important screening and tasks- risk of memory based work
The 7 Preventable Harms

1. Central line-associated bloodstream infection
2. Ventilator associated events (VAP, Barotrauma)
3. Venous thromboembolic events (DVT/PE)
4. Delirium
5. ICU acquired weakness
6. Loss of respect and dignity
7. Care inconsistent with patient goals
Meet John Connor
Harms Monitor Display

VAE Specific Display elements:
- SAT - Spontaneous Awakening Trial
- TV - Tidal Volume Mode
- SBT - Spontaneous Breathing Trial
- SUP - Stress Ulcer Prophylaxis
  - Airway = Subglottic suction
  - ILS - Inline Suction
  - HOB - Head of Bed
  - Oral Care
Pain and Delirium

SAT - Spontaneous Awakening Trial
Pain
RASS
Sedatives
CAM-ICU
Benzodiazepines

Delirium Guide

CARE TEAM PORTAL
24Aug2015 13:12
JOHN CONNOR
13 CL, Room 30
3

Delirium
Last Updated: 31Aug2015 13:10

SAT

Pain

RASS

Sedatives

CAM-ICU

Benzodiazepines

Pain score above daily pain goal
Pain score at or below pain goal
No pain goal set

Analytixs

CAM-ICU positive or CAM-ICU not completed
Patient CAM-ICU negative

No analgesic drugs ordered
No analgesic drugs ordered

No sedative drugs ordered
No sedative drugs ordered

No analgesic drugs ordered
No analgesic drugs ordered

Not given
Given
Contraindicated or not needed
Harms Monitor Display

Respect & Dignity
Patient Family Portal

Patient Family Portal: Home Screen
Goals While In The ICU

What are your most important goals during your stay in the ICU? (You may select multiple goals below)

- Cure my medical problem(s)
- Allow me to live longer
- Improve my current health and/or function
- Maintain my current health and/or function
- Allow me to accomplish something particular in my life
- Make me comfortable, even though I know I may not be cured
- Learn more about my medical problem(s)

Please list any additional goals you would like your care team to know about.

Submit

Have less pain, be able to go back to work

You may change your responses at any time, or press the 'Enter/Space' key in the top left to clear.

Family Involvement: Patient Family Portal

ACTIVITY MENU
We ask you for your help through most of the care options that you may choose.

- Entertainment
- Hair Care
- Bathing
- Oral Care

- Hand Care
- Massage
- Arm & Leg Repositioning
- Bedside Table

- Stretching
- Breathing Exercises
- Physical Therapy
- ICU Diary
Thank you, 9/13 ICU Nurses, for identifying what equipment families ask about & and what they want to know about it!
(You probably don't even remember that email, but a lot of you responded)
Keeping patients safe
Preventing harms and promoting patient well-being

Criticalcareinnovationsgroup.org

Preventing CLABSI
Preventing physical impairment
Meeting patients' goals of care
Protecting against Delirium

Promoting respect and dignity
Preventing VAHI
Protecting against VTE

The final Implementation, at ICU bedside
Conclusions

• Perioperative Providers have made great strides in quality improvement, but best practices are inconsistently applied

• We are beginning to leverage both technology and culture training to comprehensively prevent patient harm in critically ill patients

• Use a systems engineering approach to get practitioners to provide the best care, every time, and then begin to hold individuals and groups accountable for the quality of care

• Patients and families should be integrated into the care team
### Collaborators

**UCSF**
- Hildy Schell, RN
- Min Zhu, MHA
- Kevin Thornton, MD
- Angela Lipshutz, MD
- Kathleen Turner, RN
- Priyanka Agarwal, MD
- Raman Khanna, MD
- Denise Barchas, MD
- Jayne Astor, RN
- Charlotte Garwood, RN

**Johns Hopkins/APL**
- Jennifer Schwarz, NP
- Kendall Gross, PharmD
- Brian Daniel, RRT
- Robert Newton
- Jenica Cimino
- Peter Pronovost, MD
- Adam Sapirstein, MD
- Alan Ravitz, PhD