Variation in Quality by Hospital Characteristics: True or False?

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Quality Indicators Overview

- The AHRQ QI are a set of more than 90 quantitative indicators of health care quality.

- The area level indicators characterize quality of care for ambulatory care sensitive conditions by portion of the country, e.g., by county.

- The provider level indicators characterize quality of hospital care.

- The indicators are calculated using hospital inpatient administrative data.

- See [www.qualityindicators.ahrq.gov](http://www.qualityindicators.ahrq.gov)
Four Modules

- **Prevention Quality Indicators (PQI)**
  - Potentially avoidable hospital admissions – by area

- **Inpatient Quality Indicators (IQI)**
  - Reflect care inside hospitals and by area
  - Mortality for medical conditions and surgical procedures

- **Patient Safety Indicators (PSI)**
  - Reflect care inside the hospital
  - Potentially avoidable complications and iatrogenic events

- **Pediatric Quality Indicators (PDI)**
  - Reflect care inside the hospital and by area
  - Specific to children and neonates
Software Updates and QI Types

- Software updated frequently
  - Fiscal year coding updates
  - Changes to reference population
  - Changes to numerator and denominator
  - Changes to statistical methods
  - Currently Version 4.5

- Three types of indicators
  - Count and Volume Indicators
  - Area-Level Rate Indicators
  - Provider- (Hospital-) Level Rate Indicators
Focus on Provider-Level Rate Indicators

- Numerator is count of records that match QI specification
  - E.g., hip replacement mortality rate; pressure ulcer rate

- Denominator is count of persons at risk in the hospital
  - E.g., persons who had hip replacement surgery
Provider-Level Rate Indicators - Methods

- Risk adjusted using several types of covariates (customized model for each QI)

- Outcome or risk factor might be present on admission (POA); POA sometimes missing and imputed

- Smooth rates using shrinkage estimator
  - Weighted average of risk-adjusted rate from hospital and nationwide reference population rate
  - Weights are calculated using signal variance and noise variance
Indicators of hospital quality are used in a number of high-profile, high-stakes programs to compare hospital quality on a national scale across a variety of hospital types.

The use of the indicators in comparative reporting has been critiqued in the popular press and academic literature.

- Use of administrative data
- Quality indicator specifications
- Methods used to calculate the rates
Example of the Critique – Teaching Status

- Rates for many indicators differ on average between hospitals that provide medical education and those that do not.

- Critics argue that teaching hospital rates for some measures differ for reasons not related to quality.

- What can explain differences in rates by teaching status?
  - Differences in coding, data sources, and so on
  - Unaccounted for differences in patient risk
  - Relationship with volume
  - Quality
Exploratory Data Analysis: Data

- Research focused on IQI, PSI, and PDI individual and composite measures
- Data source – State Inpatient Databases (SID), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality
- 12 states*, ~ 1,500 hospitals
- All inpatient hospital discharges for 2009 and 2010
- Hospital characteristics – American Hospital Association (AHA) 2010
- AHRQ QI software v4.4

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Exploratory Data Analysis: Hospital Characteristics

- **Structural characteristics**
  - Bed size
  - Teaching status

- **Aggregate patient characteristics**
  - DSH status
  - Race

- **Market characteristics**
  - Urban
  - Median income
Exploratory Data Analysis: Methods

- **Analysis of differences by hospital characteristics**
  - Comparison of means and overall distribution
  - In raw, risk-adjusted, and smoothed rates
  - In coding frequencies
  - In risk

- **Differences in relation to volume**
  - Reliability weights
  - Classification and Regression Tree (CART)
  - Multivariate regression
Differences by Teaching Status: Examples

- PSI 12: Post-operative Pulmonary Embolism/Deep Vein Thrombosis
  - Risk-adjusted and smoothed rates of teaching hospitals significantly worse than those of non-teaching hospitals, raw rates no different

- IQI 20: Pneumonia mortality
  - Risk-adjusted and smoothed rates of teaching hospitals significantly better than those of non-teaching hospitals, raw rates no different
Do Teaching Hospitals List More Codes on Administrative Data Sources?

Number of diagnoses per discharge by teaching status

Do Teaching Hospitals Have Riskier Patients?


Kernel density

predicted value

0

0.002

0.004

0.006

0.008

0.01

0

100

200

300

400

PSI12 - PE/DVT

non-teaching

Teaching
What Is the Relationship Between Volume and QI Rates?

Relationship with Volume: Reliability Weights

What Is the Relationship Between Volume and QI Rates?

- Degree of smoothing, by hospital size

![Graph showing the relationship between PSI 12 rates and hospital size](image)

What Is the Relationship Between Volume and QI Rates?

- Rates grouped by bed size in CART analysis

What Is the Relationship Between Volume and QI Rates?

- Rates by teaching status, stratified by volume

Classification And Regression Tree analysis
PSI12, Smoothed Rate

1. bed-size: $p < 0.001$
   - {272 +}
   - {< 55, 131 - 271, 55 - 130}

2. Teaching Status: $p < 0.001$
   - {Teaching}
   - No Teaching

   - Node 3 (n = 228)
   - Node 4 (n = 179)

3. bed-size: $p = 0.033$
   - {< 55}
   - {131 - 271, 55 - 130}

   - Node 6 (n = 288)
   - Node 7 (n = 708)

What Is the Relationship Between Volume and QI Rates?

- Multivariate model with bed size and teaching status

<table>
<thead>
<tr>
<th>Hospital Characteristic</th>
<th>IQI 20 – Coefficients (standard errors)</th>
<th>PSI 12 – Coefficients (standard errors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed Size (&lt; 55 omitted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 to 130</td>
<td>- 0.11 (0.08)</td>
<td>- 0.39 (0.15) **</td>
</tr>
<tr>
<td>131 to 271</td>
<td>- 0.35 (0.09) ***</td>
<td>0.38 (0.16) **</td>
</tr>
<tr>
<td>272 or more</td>
<td>- 0.21 (0.08) ***</td>
<td>- 0.43 (0.15) ***</td>
</tr>
<tr>
<td>Teaching Hospital</td>
<td>- 0.06 (0.08)</td>
<td>0.51 (0.14) ***</td>
</tr>
</tbody>
</table>

* Significantly different from zero at the 0.10 level, two-tailed test.
** Significantly different from zero at the 0.05 level, two-tailed test.
*** Significantly different from zero at the 0.01 level, two-tailed test.

Quality

- It is difficult to distinguish other factors that influence variation by teaching status versus variation due to factors we seek to estimate – quality.

- Ongoing analyses
  - Matching analysis by discharge characteristics
  - Simulations of patient populations with known characteristics
  - IV analysis using travel time and distance to hospitals