TQIP and Risk-Adjusted Benchmarking

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TQIP Participation

<table>
<thead>
<tr>
<th>Center Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Only Centers</td>
<td>278</td>
</tr>
<tr>
<td>Peds Only Centers</td>
<td>27</td>
</tr>
<tr>
<td>Combined Centers</td>
<td>46</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>351</strong></td>
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</tbody>
</table>

What’s new...

- TQIP Level III pilot with 190 centers
- Collaboratives
  - Florida
  - Georgia
  - Michigan
  - Arkansas
TQIP Benchmark Reports

- A TQIP benchmark report compares a trauma center’s performance with regards to the prevalence of an outcome (e.g. mortality) in a specific patient population (i.e. cohort) against the national average
  - Uses both risk-adjustment and risk-stratification

What is Included in a TQIP Benchmark Report?

- Report cycle includes:
  - Site-specific report
  - Aggregate report
  - Site-specific PPT
  - Patient Listing Application
- Site-specific report, or more commonly the TQIP Benchmark Report, includes:
  - Risk-adjustment feedback for major outcomes by patient cohort
  - Risk-stratified, descriptive feedback assessing non-risk-adjusted metrics by patient cohort

What Data Are Used?

- Timeline:
  - Dynamic depending on report in question
  - TQIP reporting cycles are designed to cover the most recently submitted 12 months of data (for adults) or the most recently submitted 24 months of data (for pediatrics)
  - Reports are semi-annual and therefore replace 6 months of old data from the previous reporting cycle with 6 months of newly submitted data
What Data Are Used?

- Patient Inclusion:
  - TQIP inclusion/exclusion criteria describe the patient characteristics which are required for report eligibility
  - These criteria can change over time
  - Submit all patients that meet the NTDS inclusion criteria and TQIP will subset those patients as needed to fit analyses
  - Do not be surprised if only 30-50% of your NTDS qualified patients meet TQIP inclusion criteria – these criteria are designed to isolate to the more severely injured patients

TQIP Inclusion/Exclusion Criteria

- Age 16 years or older
  - Age 0-18 for pediatrics
  - At least one valid trauma ICD-9 code in the range of 800-959.9 (excluding late effects 905-909.9), superficial injuries 910-924.9, and foreign bodies 930-939.9)
  - Trauma type of blunt or penetrating (from primary E-code)
  - Injured patients with at least one AIS=3 or greater in body regions 1 through 8 (AIS crosswalk version 98 was used when available; otherwise, the ICD9 map was used to calculate the AIS score.)
  - AIS=2 or greater in body regions 1 through 8 for pediatrics
  - ED discharge disposition AND hospital discharge disposition cannot both be unknown.
  - Exclude patients with ED discharge disposition of home, home with services, transfer to another hospital, other, or left against medical advice.
  - Exclude patients with pre-existing advanced directive to withhold life sustaining interventions.
## TQIP Inclusion/Exclusion Criteria

- Exclude patients with the following combinations of ED vitals:
  - SBP=0, and Pulse=0, and GCS Motor=1
  - SBP=NK/NR, and Pulse=0, and GCS Motor=NK/NR
  - SBP=0, and Pulse=0, and GCS Motor=NK/NR
  - SBP=NK/NR, and Pulse=0, and GCS Motor=NK/NR
- Exclude patients with the following AIS 98 codes representing severe burns:
  - 912018.3 Burn, 2nd/3rd Degree, 20-29%
  - 912022.4 Burn, 2nd/3rd Degree, 20-29%, w/Face/Hand/Genitalia Involvement
  - 912024.4 Burn, 2nd/3rd Degree, 30-39%
  - 912028.5 Burn, 2nd/3rd Degree, 30-39%, w/Face/Hand/Genitalia/Involvement
  - 912030.5 Burn, 2nd/3rd Degree, 40-89%
  - 912032.6 Burn, 2nd/3rd Degree, >=90%, Including Incineration

## TQIP Inclusion vs. NTDB

- 21%–85% of submitted NTDB patients by hospital meet TQIP inclusion/exclusion criteria in 2013 data
  - 45% in overall TQIP
  - Don’t panic if many fewer patients qualify for TQIP than you submit to the NTDB
  - But check to see if there are patients not in the patient list who you feel should have been included in TQIP

## What is Risk-Adjustment?

Can you tell which hospital is performing better based on these raw event rates?

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Mortality Rate</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
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</table>
What is Risk-Adjustment?

• Patient #1
  • Aged 21
  • MVC
  • No pre-existing conditions
  • 1 injury with AIS severity of 3
  • High vitals upon arrival

• Patient #2
  • Aged 72
  • GSW
  • Dementia; Chronic Renal Failure
  • 3 injuries with AIS severity of 4
  • Low SBP and pulse

Based on this information, would you expect both patients to have the same risk of death?

Why Risk-Adjust?

• TQIP hospitals differ with respect to the demographics, medical history, and injury characteristics of their patients
  • So, comparing raw event rates is comparing apples to oranges
  • TQIP needs to account for patient-to-patient differences in order to fairly quantify hospital-to-hospital differences
  • Therefore, risk-adjustment assigns risk at an individual patient level and then aggregates to the hospital level to provide benchmarking information
  • This allows TQIP to compare hospitals in a way that simulates performance with regards to a similar patient population, therefore accounting for hospital case-mix
Risk-Adjustment Variables

- **DEMOGRAPHICS**
  - Age
  - Gender
  - Race

- **MEDICAL HISTORY: COMORBID CONDITIONS**
  - Cardiovascular Disease (CHF, Angina, MI, Stroke, Hypertension, PVD)
  - Chemotherapy, Disseminated Cancer
  - Liver Disease (Ascites, Varices, Cirrhosis)
  - Substance Abuse (Alcohol, Smoking, Drugs)
  - Others (Bleeding, Dementia, Psychiatric, Diabetes, Renal, Respiratory, Functional Dependence, Steroid Use)

- **VITAL SIGNS**
  - Systolic Blood Pressure
  - Pulse

- **INJURY CHARACTERISTICS**
  - Survival/Complications Risk Ratio
  - GCS Motor Component
  - Mechanism of Injury
  - Transfer Status
  - Pre-Hospital Cardiac Arrest
  - Maximum AIS in all 8 body regions

In total, 34 variables considered in every model

How Does Risk-Adjustment Work?

1. Risk-adjustment trends those risk-adjusted variables, regardless of hospital, with respect to an outcome and establishes a predicted effect of each characteristic on the likelihood of an outcome
2. The effects for all the variables, or coefficients for model covariates, are then combined to create a risk for an individual patient for having an outcome
3. Those individual patient-level risks are then aggregated to a hospital and measured against actual hospital performance using the HLM methodology
What Statistical Models Tell Us

- Risk-adjustment models output a metric called an odds ratio (OR), and also a confidence interval (CI) surrounding that OR estimate.
  - This is a statistical estimate of the likelihood, or odds, that an outcome occurs at your hospital as compared to the likelihood that such an outcome would occur at an "average" TQIP hospital.
- In TQIP models, higher ORs are always less desirable than lower ORs.
  - Higher ORs suggest that the likelihood of an adverse outcome (e.g., mortality) occurring at your hospital is higher than the likelihood of the same adverse outcome occurring at an "average" TQIP hospital, accounting for your patient variability.

What is a Confidence Interval?

- The odds ratios (ORs) TQIP provides are statistical best-estimates, but are still imperfect.
  - As a result, the confidence intervals (CIs) are also provided to accommodate for the range of potential values that could encompass the "real" OR.
  - We are statistically confident that 95% of the time the "real" OR is somewhere within that CI.
  - This is a standard statistical practice.

TQIP Box-Decile Figure
What it Means to be an Outlier

- If a hospital’s OR and CI are entirely above 1, then that hospital is a high outlier, or poor performer. Conversely, if a hospital’s OR and CI are entirely below 1, then that hospital is a low outlier, or good performer.
- If the CI ever includes 1, then the hospital is statistically indistinguishable from an average performing hospital.
- In essence, outlier status indicates that your hospital is statistically different, either positively or negatively, from an “average” TQIP hospital, and warrants attention.

TQIP Box-Decile Figure

What is a Cohort?

- A cohort is a subset of patients isolated based upon specific patient and injury characteristics.
  - E.g. the “Shock” cohort includes patients with a submitted Initial ED/Hospital SBP of ≤ 90
- By embedding our outcome analyses within patient cohorts, we make sure that we are comparing similar patients.
  - In addition to risk-adjustment, this helps us accommodate case-mix across hospitals.
  - Cohorts also narrow the scope of risk-adjusted feedback so that results are more actionable.
Modeled Cohorts

**Adult TQIP**
- All Patients
- Penetrating
- Blunt Multisystem
- Shock
- TBI
- Intubated TBI (iTBI)
- Severe TBI (sTBI)
- Elderly
- Elderly Blunt Multisystem
- IHF

**Pediatric TQIP**
- All Patients
- All Patients, Ages 0-13
- All Patients, Ages 14-18
- TBI
- TBI, Ages 0-13
- TBI, Ages 14-18

Non-Modeled Cohorts

**Adult TQIP**
- Hemorrhagic Shock
- Blunt (and Isolated Blunt) Splenic Injury
- Fractures (Mid-shaft Femur; Open Tibial Shaft)

**Pediatric TQIP**
- Blunt (and Isolated Blunt) Splenic Injury
- Fractures (Mid-shaft Femur; Open Tibial Shaft)

Outcomes

**Adult and Pediatric TQIP**
- Mortality (including discharge to hospice)
- Major Complications
- Major Complications Including Death
- Specific Complications
  - Pneumonia (in TBI)
  - AKI (in Shock)

Complications Analyses
Risk-Adjusted vs. Risk-stratified
- Risk-adjusted refers to report structures which are benchmarked based upon statistical models
- Risk-stratified refers to report structures which are benchmarked with descriptive tables, and based upon narrow patient and injury characteristic cohorts

Risk-adjusted
- “Risk-Adjusted” in the title
- Odds ratios included

Risk-stratified
- “All Hospitals” and “Your Hospital” rows

Patient Exclusion and Treatment of Missing Data
- Patients with unknown (insert) are (insert)
  - Complications information; excluded from complications models
  - Comorbid conditions; imputed as having no comorbid conditions
  - May make patients appear healthier than they actually are
  - Vitals (SBP, pulse, GCS motor, etc.); imputed based upon other patients characteristics
    - May not be accurate, especially in the case of patients that could have been excluded based on ‘dead on arrival’ proxy

Hospital Exclusion
- Hospitals with greater than 10% of patients with unknown complications information are excluded from complications analyses (N=22 last report)
- Hospitals with no UTIs submitted to TQIP but do have UTIs indicated on the Medicare Hospital Compare website are excluded from complications analyses (N=2 last report)*
- Hospitals with large gaps in data or long periods of submission inactivity are excluded from the report
- Hospitals with glaring data problems (e.g. 70% mortality)

*This exclusion criteria is being retired for the Fall 2015 report
You Received Your Report – Now What?

Should You Drill Down?
- If … your TQIP Site-specific Benchmark Report indicates your hospital as an outlier for a particular outcome in a particular cohort
- Then…TQIP has indicated that you are statistically different from an “average” hospital with respect to that outcome in that cohort
  - What patients may have driven that outlier status?
  - Why are you different?
    - Data quality?
    - Clinical issue?
    - Structural issue?

Discovering Patients
- TQIP provides the Patient Listing Application, currently accessible from the NTDB Data Center
  - This application contains all of the patient-level information which was used to generate your report
  - Data can be exported and explored in Excel or within the application itself
  - Data is contained in reporting cycles – i.e. data for Spring 2015 report and the Fall 2015 report
  - This tool can be used to identify patients which had an unexpected outcome therefore contributing to hospital benchmarking status (e.g. outlier status)
Who had an Unexpected Outcome?

• The TQIP Patient Listing Application provides the probability of an outcome occurring within a cohort for each patient
• Patients which have a low probability of outcome (e.g. mortality) but had the outcome occur (i.e. died) would have unexpected negative outcomes
• Patient who had a high probability of outcome (e.g. mortality) but did not have the outcome occur (i.e. did not die) would have unexpected positive outcomes

Who had an Unexpected Outcome?

• The appropriate threshold for an expected probability of an outcome is subjective and depends on cohort
• Broadly and conservatively, a death with a probability of less than 20% would be unexpected
• These are the individual patients which are most useful to explore

What Next?

• After you have identified those unexpected outcomes, you must discover what contributed to that status:
  • Is the data that TQIP uses for risk-adjustment accurate?
    ▪ If TQIP does not have appropriate data, then we cannot appropriately assess risk
      ▪ E.g. a 72 year old patient entered as a 27 year old patient will likely show up as having a lower risk of mortality
  • Do you think there is something that TQIP does not account for in their models?
    ▪ If so, please let us know and we can consider improvements
What Next (cont.)?

• Was there a clinical issue with the treatment of this patient?
  • If the data looks good, it is possible that TQIP flagged this patient as unexpected because of an issue or strength with or about care?

• Chance
  • Few patients are marked as unexpected as a product of the model, but not directly related to data quality or clinical care

What Helps?

• As you explore what may contribute to unexpected positive or negative outcomes at your hospital
  • Keep in mind the risk-stratified tables in the TQIP Benchmark Report
    • Is it possible that your ICP timing has an impact on TBI outcomes?
    • Do other tables provide context which may be useful in understanding how/why your hospital is different?
  • Keep in mind the TQIP Best Practices Guidelines
  • Keep in mind timelines
    • Each report is a snapshot in time and does not necessarily indicate a persistent trend. Watch the status over a couple reports

Remember!

• Being a low (good) outlier is also worth exploration
  • Data quality can make someone look unexpectedly good as well as unexpectedly bad
  • Share verified good performance with your team!
  • If you are a high outlier, you are not alone – other people have encountered a similar phenomenon and enacted change
  • Share your PI experience with TQIP and/or plan for publication at the TQIP Annual Meeting so that you can contribute to a library of solutions
Thank you!

SAVE THE DATE!
TQP Annual Scientific Meeting and Training
November 16-17, 2015
Nashville, TN
Overview and first experiences