Cardiology 2018

The Unmeasured Variables Surrounding Care

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CHOP Cardiology 2018

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Disclosures

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- Michael Gaies receives support from the National Heart, Lung, and Blood Institute (K08HL116639, PI: Gaies).

- No conflicts of interest

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"Effective Teams, Improving Outcomes"

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Measured variables

- 196 wins as starting QB
- >66,000 passing yards and 488 touchdowns
- 5 Super Bowl championships
- Good looking, supermodel wife

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Measured variables

- 22 wins as starting QB
- 9752 passing yards and 61 touchdowns
- 3 career playoff games
- Almost retired from football

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Measured variables

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Unmeasured variables

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Unmeasured variables

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- Patient 1 – Neonate s/p uncomplicated S1P (Norwood with aortopulmonary) discharged to ward on POD 8. Witnessed cardiac arrest → ECPR after 40 minutes reuscitation. Immediate return of contractility. Easily supported on ECMO.

- Patient 2 – Neonate with PA/IVS s/p shunt. ECMO in the immediate postoperative period. Long recovery and transferred to the ward on POD 21. Witnessed cardiac arrest → ECPR after 45 minutes of resuscitation. Shunt intervention. Easily supported on ECMO.

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- Patient 1 – Diffuse anoxic brain injury. Withdrawal of care.
- Patient 2

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Unmeasured variables

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Unmeasured variables

- The unmeasured variables surrounding care:
  - "How much of what we observe is explained by what we measure?"
  - "How well can we predict outcomes based on measured variables?"
  - Framework: postoperative outcomes

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Hypotheses

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- Two areas that we don't measure precisely enough
- Both are potentially actionable to improve outcomes for patients
  1. Patient factors that modify response to treatment
  2. Quality of care

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Current State of Outcome Measurement

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Current State of Outcome Measurement

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- Create risk adjustment models to account for unique patient characteristics (case mix)
- Allows calculation of observed-to-expected outcomes (e.g. mortality)
- "Apples to apples" a misnomer

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Current State of Outcome Measurement

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- Key aspects of variables used for risk adjustment (Krumholz et al. *Circulation* 2006):

1. Biologically plausible
2. Prior to care delivered by unit under study
3. Measured accurately and reliably
4. Independent of quality

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Patient Factors

HOW WELL CAN WE PREDICT SURGICAL MORTALITY BASED ON MEASURED VARIABLES?

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Background

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- Current surgical mortality risk adjustment models identify several important patient factors:
  - Surgical complexity, age, extracardiac anomalies, etc.
  - Benchmarking of outcomes across centers
  - *Population-level prediction*

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- Unclear how well these factors predict an *individual's* risk for mortality

- Ultimate goal = Precision Medicine
  - Must understand individual patient characteristics → risk of morbidity and mortality
    - Disease manifestation
    - Therapeutic response

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Objective

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To determine the extent to which measured patient factors explain ***between-patient variability*** in mortality after congenital heart surgery

How well do commonly measured variables predict an individual's risk of mortality?

Study results presented at AHA SS 2017

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Methods

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- Analyzed surgical cases in the **PC^4** database
- August 2014 to May 2016
- All index surgical hospitalizations included

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Methods

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- Evaluated previously validated patient factors used for benchmarking across centers

- Outcome - Proportion of *between-patient variation* in **mortality** explained by:
  - Measured patient factors
  - Center

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Methods

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- Variance partitioning through sequential hierarchical regression
  - First determine the variance explained by measured variables
    - Patient factors
    - Center
  - Residual Intraclass Correlation Coefficient (ICC)
    - "Left over" unexplained variation
    - Can be calculated at the patient level and hospital level

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Results

- 8531 Index operations (22 hospitals)
- As expected, traditional measured patient factors included were all independent significant predictors of mortality (all $p<0.05$):
  - Age
  - Prematurity
  - Weight
  - Chromosomal abnormality/syndrome
  - STS pre-op factors (comorbidities)
  - Surgical complexity (STAT score)

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Results

Proportion of variation explained by measured variables	
Patient factors	30%
Center	4%
Unexplained variation	66%
Proportion of unexplained variation related to unmeasured patient factors	95%
Proportion of unexplained variation related to unmeasured center factors	5%

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- Commonly measured patient factors ***explain a relatively small proportion*** of between-patient variation in mortality

- Unmeasured patient factors a combination of:

  1. Innate characteristics

  2. Events (e.g. complications) - Quality

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- What are the innate characteristics that modify disease and treatment response?
  - Maternal-fetal factors
  - Genetic profile
  - "-omics"
  - Bio-physiologic factors

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Conclusions

Gaining deeper understanding of innate patient factors

Precision medicine approaches to treatment

Improved outcomes

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What about Quality?

HOW WELL CAN WE EXPLAIN SURGICAL MORTALITY BASED ON HOW WE MEASURE QUALITY?

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Quality Measurement Hierarchy

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- Expertise in surgical outcome/quality assessment
- STS and ECHSA databases

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Blind Spots in the Current State

- Outcomes measured across entire hospitalization not granular
- Impossible to disentangle quality of care by surgical, anesthesia, critical care, and non-ICU inpatient care
- Does not provide actionable data for improvement

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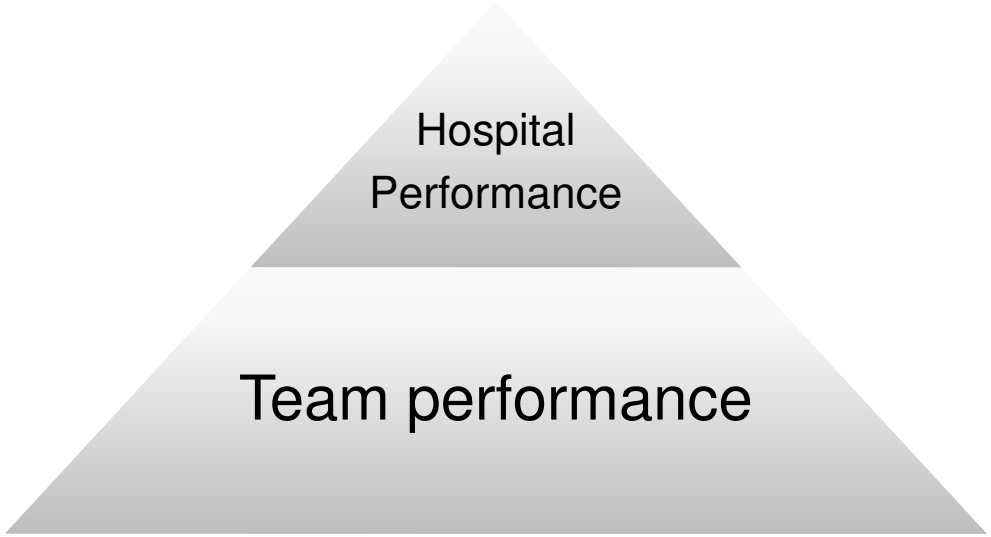
Hierarchy of quality assessment



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Understanding Team Performance

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- Analyze episodes of care in pieces (e.g. post-bypass care in OR, ICU admission)
- Apply risk adjustment methods at the start of episode
- Collect outcome and practice data specific to individual teams

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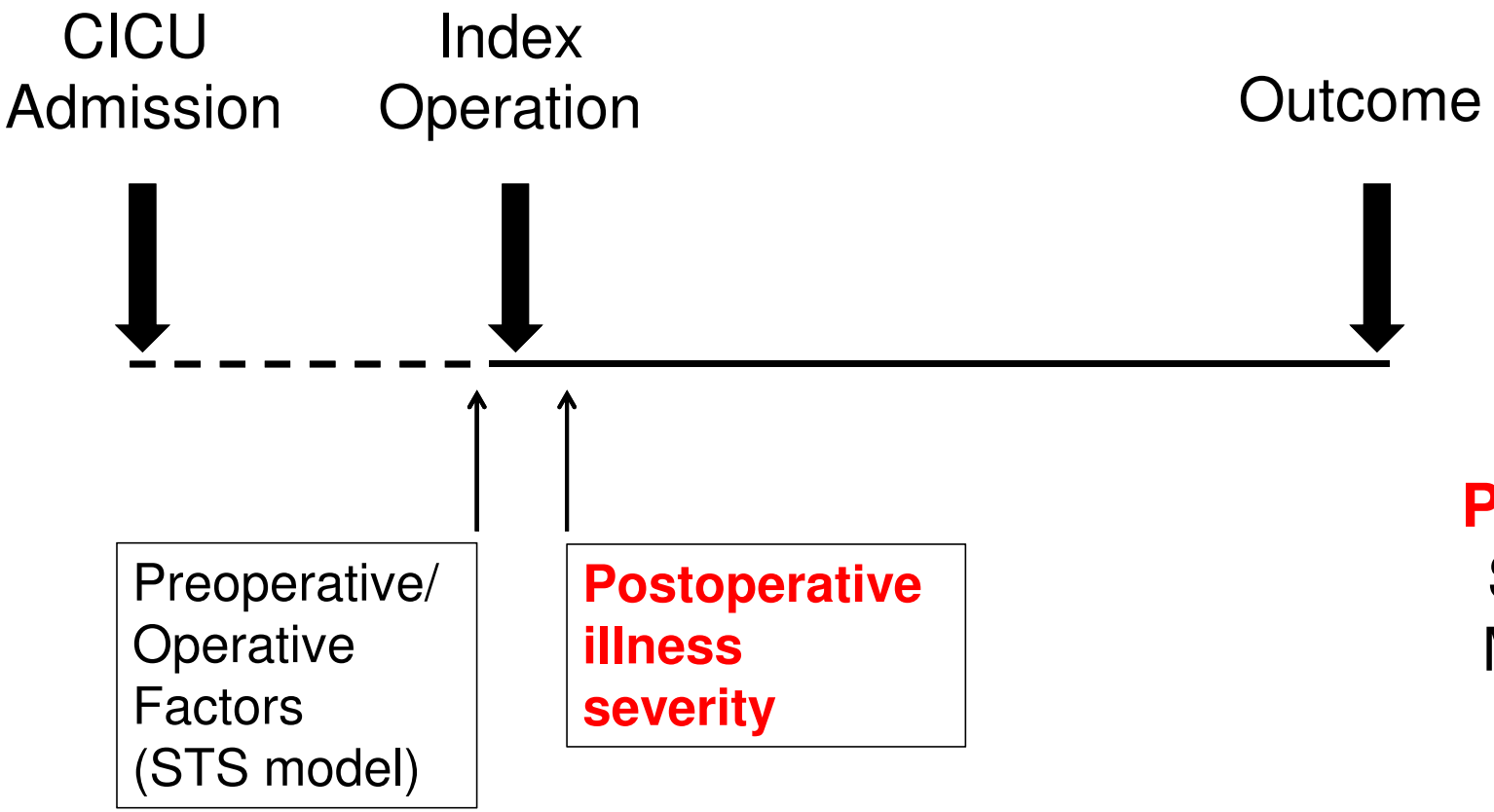
Disentangling CICU quality from Intraoperative quality



PC⁴ CICU Surgical Mortality Model

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Final Frontier of Quality Measurement

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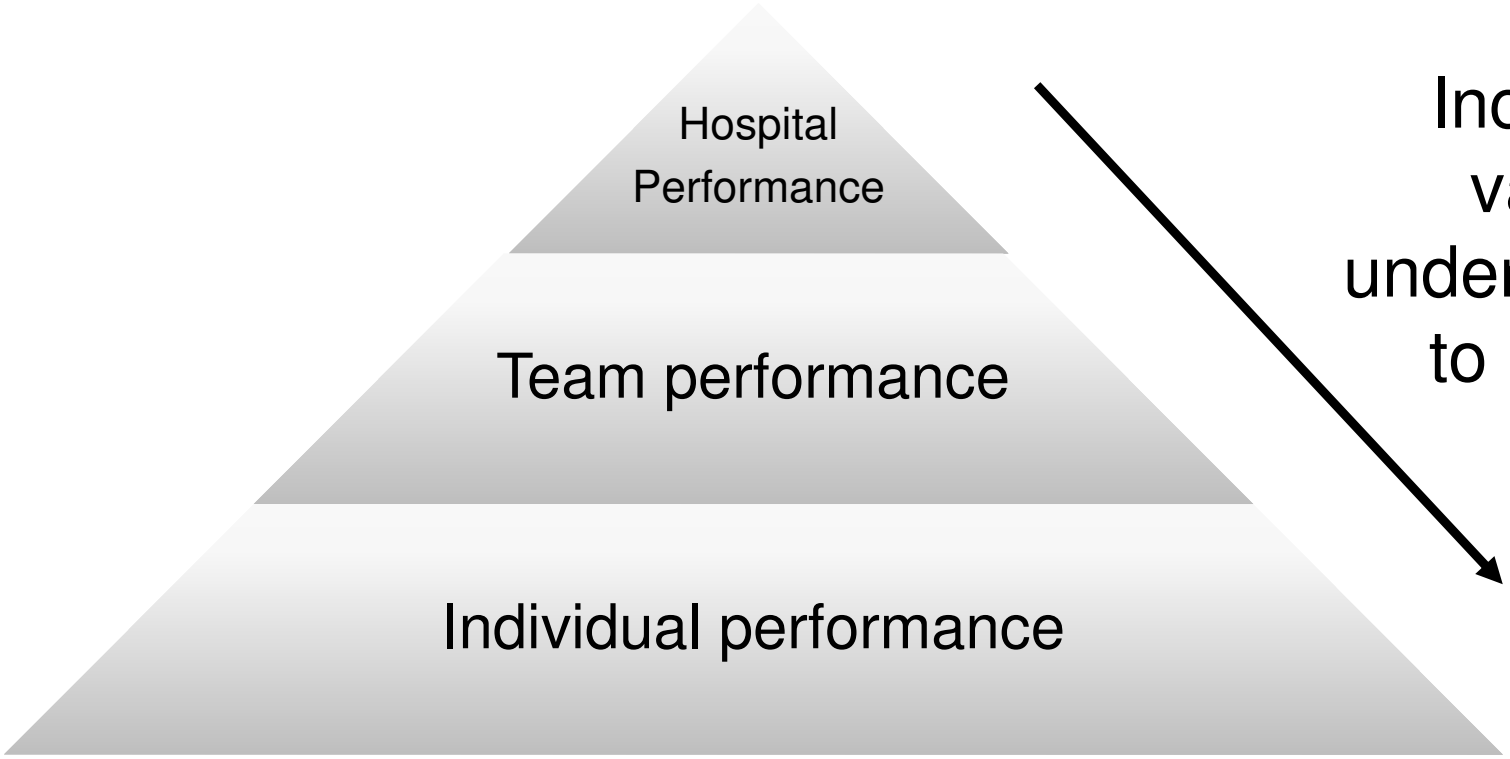

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The NEW ENGLAND JOURNAL of MEDICINE

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SPECIAL ARTICLE

Surgical Skill and Complication Rates after Bariatric Surgery

John D. Birkmeyer, M.D., Jonathan F. Finks, M.D., Amanda O'Reilly, R.N., M.S., Mary Oerline, M.S., Arthur M. Carlin, M.D., Andre R. Nunn, M.D., Justin Dimick, M.D., M.P.H., Mousumi Banerjee, Ph.D., and Nancy J.O. Birkmeyer, Ph.D., for the Michigan Bariatric Surgery Collaborative

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MBSC
Michigan Bariatric Surgery Collaborative

PC4Quality.org

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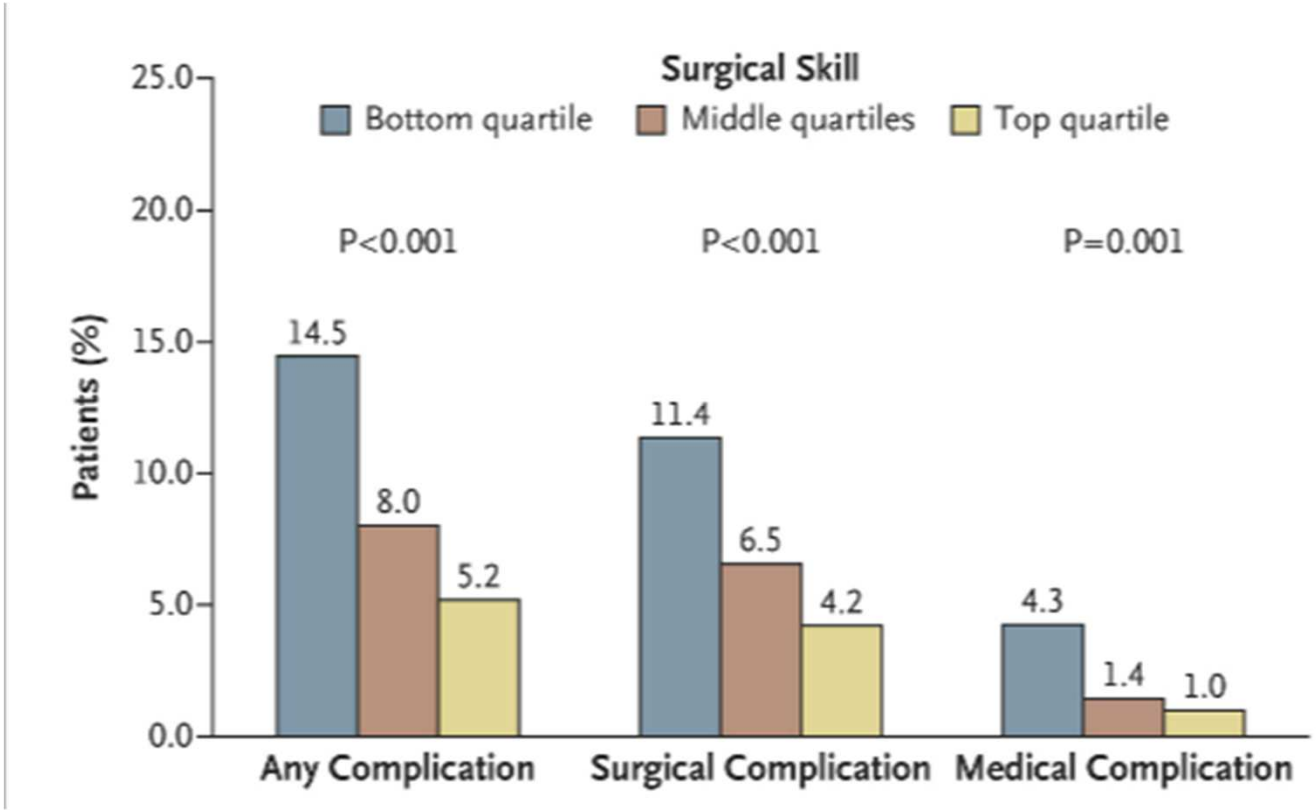
Birkmeyer et al. – Surgical Skill



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Conclusions

- Unmeasured variables are our blind spots
- Improve our measurement to improve our practice
- Responsibility to improve is on all of us

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Thank You