Benchmarking in Pediatric Transfusion Medicine

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SEAABB
Objectives

- Understand the concept of benchmarking
- Gain insight into the unique implications and challenges of benchmarking in healthcare
- Understand the application(s) of benchmarking to transfusion medicine particularly pediatric transfusion medicine
Benchmarking

- Photocopier invented by Rank Xerox in 1959\(^1\)
  - Dominated the market until 1981 when it’s market decreased to 35%
  - IBM and Kodak developed high-end machines
  - Canon, Richo, Savin dominated the low-end market
  - Xerox: shocked to know that Japanese companies were selling their machines at what it cost Xerox to make theirs!
    - Xerox never looked outside themselves
Benchmarking

• Instituted company wide benchmarking:
  – Quality problems cut by two-thirds
  – Manufacturing costs cut in half
  – Development time cut by two-thirds
  – Direct labor cut by 50 percent and corporate staff cut by 35 percent while increasing volume
Benchmarking

• “The process of measuring ourselves against the products, services, and practices of our toughest competitors.”\(^2\) – David T. Kearns, CEO Xerox

• Benchmarking can be\(^3\):
  – Competitive – examine specific competitor’s product or function
  – Functional – compare similar functions within a broad industry or industry leaders
  – Generic – comparisons regardless of industry as functions similar
Benchmarking

• Continuous cycle of measurement and evaluation
• Systematic and constant activity
• Improve yourself by comparing yourself to others
STOP SHOWING MY BOSS ALL THESE WRONG BENCHMARK NUMBERS!!!
WHAT MAKES YOU THINK THEY ARE WRONG?
WE ARE DIFFERENT, UNIQUE & UNLIKE ANY OTHER LAB DEPT. YOU DON'T KNOW US!
YOU DO REALIZE YOU EXCEEDED OUR BENCHMARK TWICE IN THE PAST YEAR YOU ARE YOUR OWN BEST BENCHMARK.
OH!!! WE BETTERED YOUR BENCHMARKS TWICE?!?!
SEE I TOLD YOU WE WERE UNIQUE
NOW YOU ARE GETTING IT
What is standard of care?
Regional Variations in Diagnostic Practices

Yunjie Song, Ph.D., Jonathan Skinner, Ph.D., Julie Bynum, M.D., M.P.H., Jason Sutherland, Ph.D., John E. Wennberg, M.D., M.P.H., and Elliott S. Fisher, M.D., M.P.H.


Figure 2. Percent Increase in Hierarchical Condition Category (HCC) Scores among Medicare Beneficiaries Who Changed Their Place of Residence.
Higher quintiles indicate a higher intensity of practice. The results were stratified according to the intensity of practice in the Hospital Referral Region in which the beneficiary lived before the move and the one in which he or she lived after the move. Horizontal I bars indicate 95% confidence intervals.
Benchmarking in Healthcare

• Driven by patient outcomes and safety
  – Money not applicable directly

• 3 types of evaluation possible:
  – 1. Evaluation of technical-professional quality (evidence-based medicine)
  – 2. Evaluation of managerial quality
  – 3. Evaluation of quality perceived by users and staff
Benchmarking in Healthcare

• Benchmark issues specific to healthcare:
  – 1. Define what is meant by a result in healthcare (i.e. what is success)
  – 2. Lack of homogeneous measures of results
  – 3. Influence that context in which the structure operates has on results obtained and way of understanding them
  – 4. Lack of a market as an external judge and spokesman of users’ preferences to identify the best performance (i.e. leader in the sector)
## Benchmarking in Transfusion Medicine

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<th>Financial dimension</th>
<th>Organisational need</th>
<th>Fulfilment of expectations</th>
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<td>Production processes</td>
<td>Development of professional skills</td>
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<td>Productive-efficiency factors</td>
<td>Good use of blood and plasma</td>
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<td>Technological stock</td>
<td>Safety, clinical risk, haemovigilance</td>
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<td>Materials and supplies</td>
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<thead>
<tr>
<th>Organisational dimension</th>
<th>Staff</th>
<th>Performances delivered</th>
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<tr>
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<td>Organisational models and network adopted</td>
<td>Products (type and volume)</td>
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<td>Production processes</td>
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<td>Specialities</td>
<td>Due information</td>
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<td>Integration with Donor Associations</td>
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<th>Professional dimension</th>
<th>Adoption of shared protocols/pathways</th>
<th>Access times</th>
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<td>Development of professional skills</td>
<td>Production times</td>
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<td>Distribution times</td>
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<tr>
<td></td>
<td>Safety, clinical risk, haemovigilance</td>
<td>Frequency of activities with respect to need</td>
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<td></td>
<td>Information - communication between donors and patients</td>
<td>Due information</td>
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<td>Product characteristics</td>
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Benchmarking Process

**Road Map for Benchmarking**

1. Use comparison to identify practice differences*

   - Benchmarking is a Continuous Process

2. Introduce factors associated with best practices

3. Re-evaluation of performance

*Steps:
  a) Select benchmarking indicator
  b) Identify comparator(s)
  c) Access/retrieve information
  d) Analyze information to identify factors associated with difference in practice
3 Models of Benchmarking in TM

**Model I: Regional/National**
- All hospitals participate
- Extract data from existing sources
- Identify indicators of interest
- Central coordinator analyse data (per hospital and/or stratified)
- Reports made available on Website and to participants
- Benchmarking workshops to explore practice variation
- Implement Changes
- Re-evaluate

**Model II: Sentinel Sites**
- Site enrolment by a central coordinator
- Indicators identified in cooperation or by central coordinator
- Each site report data
- Central coordinator analyse data
- Reports made available on Website and to participants
- Benchmarking workshops to explore practice variation
- Other hospitals can take initiative to do their own comparison

**Model III: Institutional Initiated**
- Individual institution identifies indicator(s) of interest
- Institution identifies appropriate comparator(s)
- Institution collects data from comparator(s)
- Institution analyses data
- Participants meet to identify reasons for differences
- Implement Changes
- Re-evaluate
Potential Uses of Benchmarking in TM
So how do we get there?
Example: Finnish Project for Optimizing Blood Use

Fig. 1. Mean use of RBCs in primary hip replacement in Finnish hospitals (2002).
Example: Finnish Project for Optimizing Blood Use\textsuperscript{7}

Difference Reduced to 2.4 Fold
Applications back home.....

By Steve Lovelace http://mapsontheweb.zoom-maps.com/image/51078776659
Blood Management in US

• Effective blood management is a transfusion service priority
• Crossmatch to Transfusion Ratio: 2:1
  – Supported by College of American Pathologists
    C:T ratio = \# crossmatched RBC units
    \# Transfused RBC units
  – Q-Probe Studies of 12, 288, 404 Red Blood Cell Units in 1639 Hospitals
    • Included nondirected allogeneic, directed allogeneic, directed autologous PRBC units
    • Unclear contribution from pediatric patients?

Blood Utilization: Pediatric Perspective

• 2 year retrospective audit (Jan 1, 2006-Dec 31, 2007)
  – Examined all surgical RBC usage:
    • 24 preoperative,
    • Intraoperative
    • 24 hours postoperative period

Blood Utilization: Pediatric Perspective

• Results:
  – 21,441 patients underwent 35,511 anesthetic episodes
  – 9838 RBC units released
  – 4070 (41%) in entire operative period
  – Pre: 871 (22%); Intra: 2001 (49%); Post: 1198 (29%)
  – CT surgery: 2359 units
  – “Surgery accounts for substantial proportion of total RBC use”

Blood Utilization: Pediatric Perspective

- Retrospective audit in pediatric surgical RBC usage
  - Heterogeneity in pediatric population
  - C:T ratio will not accurately reflect RBCs usage
  - Aliquots for neonates do not require crossmatch
  - Propose: Prepare to Transfusion ratio (P:T)
    - Crossmatched allogeneic and autologous units
    - Uncrossmatched neonatal RBC aliquots

Blood Utilization: Pediatric Perspective

• 6 month retrospective audit of procedure-specific RBC preparation volume (Vp) and RBC transfusion volumes (Vt)
  • $\text{PT} = \frac{V_p}{V_t}$
  – Surgical specialties:
    • Neurosurgery
    • Orthopedics
    • General
    • Plastics
    • Urology
    • Gastrointestinal

Blood Utilization: Pediatric Perspective

• Results:
  – RBC prepared for 332 surgeries
  – Transfused in 113
  – P:T was 3.5:1 (range 2.7:1 – 46:0)

• Conclusions:
  – “Potentially excessive preoperative RBC preparations”

Our Institution

• Institutional Policy
  – Do not crossmatch RBC aliquots for infants <4 months of age
    (in presence of negative antibody screen)
  – Use CPDA-1, prestorage leukocyte-reduced, irradiated RBC units, < 14 days old for all cardiac surgical patients
  • Assumed volume of 250 mL
Questions

• Evaluate the efficiency of our blood inventory management in children and infants undergoing cardiac surgery
  – Define P:T ratios for red blood cell (RBC) transfusions
  – Define discard RBC volumes: intraoperatively and postoperatively
Hypothesis

- P:T ratio > 2:1
- Discard percentages > 3%
Methods

• January – February 2012: All children and infants undergoing cardiac surgery
  – Re-explorations, repairs, ECMO, TPE excluded

• Parameters examined:
  – Sex and Age
  – Preoperative diagnosis
  – Preoperative laboratory values (i.e. Hb, Hct)
  – Volume of RBC prepared/crossmatched
  – 24 hours preoperative, Intraoperative, and 24 hours Postoperative
    • Volume of RBC transfused
  – Intraoperative
    • Volume(s) of other blood products transfused
  – Intraoperative and Postoperative
    • Volume of RBC discarded
## Results: Patient Population

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Study Population (N=75)</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
<td>7 months (0 days – 15 years)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>41% female</td>
</tr>
<tr>
<td></td>
<td>59% male</td>
</tr>
<tr>
<td><strong>Preoperative Laboratory Parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>12.9 g/dL, (9.3-16.4 g/dL)</td>
</tr>
<tr>
<td>Platelet count</td>
<td>306 x10⁹/µL, (83-635 x 10⁹/µL)</td>
</tr>
<tr>
<td>Prothrombin Time</td>
<td>14.1sec., (11.8-18.2 sec.)</td>
</tr>
<tr>
<td><strong>% of procedures on Cardiopulmonary Bypass</strong></td>
<td>88%</td>
</tr>
<tr>
<td><strong>% transfused RBC 24 hours prior to surgery; Volume transfused</strong></td>
<td>16%; 250mL (50 – 750 mL)</td>
</tr>
</tbody>
</table>

*Reported as median with range*
# Results: Top 9 Preoperative Diagnoses (N=75)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N (%)</th>
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<tbody>
<tr>
<td>Ventricular Septal Defect (VSD)</td>
<td>14 (19%)</td>
</tr>
<tr>
<td>Tetralogy of Fallot</td>
<td>9 (12%)</td>
</tr>
<tr>
<td>Hypoplastic Left Heart Syndrome</td>
<td>8 (11%)</td>
</tr>
<tr>
<td>Aortic valve stenosis/atresia</td>
<td>8 (11%)</td>
</tr>
<tr>
<td>Pulmonary artery anomaly with VSD</td>
<td>5 (7%)</td>
</tr>
<tr>
<td>Single ventricle (i.e., heterotaxia)</td>
<td>5 (7%)</td>
</tr>
<tr>
<td>Pulmonary artery anomalies</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Coarctation of Aorta</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Pulmonary venous anomaly</td>
<td>3 (4%)</td>
</tr>
</tbody>
</table>
Median Volumes RBC Utilization: Order to Transfuse

- Volume RBC Ordered
- Volume of RBC Prepared
- Volume of RBC Transfused Intraop
Intraoperative Blood Product Usage

Median volumes transfused (mL)

- Plasma: 169 mL, 24%
- Platelets: 116 mL
- Cryoprecipitate: 35 mL, 76%
Results

• Preparation to Transfusion Ratio = 4:1
  1000 mL prepared / 250 mL transfused

• PRBC wastage intraoperatively and postoperatively: 10% (data available for 48 patients, 64%)

  Wastage = Median volume discarded (100 mL, range 40–210mL)  
  Median volume prepared (1000 mL, range 45 – 1500mL)
Conclusions

• P:T ratio for 75 children and neonates undergoing cardiac surgery of 4:1
  – Higher than CAP recommendation of 2:1

• Wastage higher than expected
  – But still < 1 unit of CPDA-1 RBCs
  – What is optimal wastage in this population?
    • Hypothesis was based on data in adult patients
Conclusions

• Limitations:
  – Small N (75) over short time period (2 months)
  – Did not completely capture wastage data
  – Data extraction limitations

• Additional benchmarking data required!
  – Optimal P:T ratios for common pediatric cardiac surgical procedures
    • Other institutions
  – Potential Pediatric Blood Order Schedule
Next Steps

• Take this project to first Sentinel sites then Regionally
  – Develop standard blood utilization guidelines/benchmarks for pediatric patients undergoing cardiac surgery
• Begin to establish Pediatric Maximum Blood Order Schedule
• Establish blood transfusion guidelines for specific pediatric populations – link to clinical outcomes
• Developing a national group committed to benchmarking in pediatric transfusion medicine
  – AABB subcommittee
Children with Sickle Cell Disease

CHOP
- 1028 active sickle kids
- 23 Chronic simple transfusion
- 69 Chronic exchange

Children’s National
- 1550 active sickle kids
- 85 Chronic simple transfusion
- 15 Chronic exchange

CHOA
- 1650 active sickle kids
- 165 Chronic simple transfusion
- 7 Chronic exchange
Georgia Variations in SCD Transfusions

• 18 yo male with SCD and history of antibodies to: C, e, K, Fya, S
  – Seen at Hughes for primary sickle care
  – Had leg ulcer debridement at another local hospital
  – Transfused RBCs – not matched for e
  – Post-Hb is 9g/dL
  – Presents 1 week later with Hb of 5.4 g/dL
    • Transferred from Hughes to Egleston
    • Spends 3 days in my PICU

• We NEED to work together to provide better care for these patients regionally!
Final Thought

Benchmarking in transfusion medicine

Blood utilization
- Monitoring transfusion practices

Blood acquisition
- Blood pack faults
  - Methods for surveillance of quality
  - Monitoring Blood Component Production

Safety
- Patient identification accuracy
- Serological and immunological testing of patients and donors
- Monitoring sample collection
- Monitoring medical event reporting systems

Administrative aspects
- Inventory management
- Marketing
- Labor efficiency
- Organizational aspects
- Research
- Economical aspects
- Training and Education
References

Thank you! Questions please.