Optimizing Patient Outcomes Following Orthopedic Surgery: The Role of Albumin and the Case For Fast-Track

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Outline

- The Role of Albumin as a Risk Factor for Patient Outcomes in Orthopedic Surgery
  - Background
  - Aims and Significance
  - Methods
  - Results
  - Conclusions
- Optimizing Fast-Track Pathways: Identifying Key Patient-Level and Surgery-Level Predictors
  - Background
  - Aims and Significance
  - Methods
Background

- Risk factors for hospital readmissions
  - Age, BMI, hemoglobin, GFR, albumin (Ellsworth et al, 2016)

- Albumin
  - Standard clinical definitions
  - Marker for malnourishment
  - Immunocompromised patients (Bohl et al, 2016 & Courtney et al, 2015)

Blood vessel

Hypoalbuminemia  Normal Albumin  Hyperalbuminemia

3.5 g/dL  5.0 g/dL

Picture source: http://medifitbiologicals.com/vasodilators/
- Hip/Knee Arthroplasty
  - Joint Replacement/Reconstruction
  - 2 Types
    - Primary
    - Revision

Picture source: https://couse.org/health/HIE%20Multimedia/1/002975.html
Why study albumin?

- **Aim**
  - Identify the relationship between serum albumin and cost of treatment for hip or knee arthroplasties

- **Significance**
  - Albumin has been correlated with higher rates of hospital readmissions due to perioperative complications (Walls *et al.*, 2015 & Merkow *et al.*, 2015)
  - Albumin linked to longer hospital stays (Bohl *et al.*, 2016)
  - Lack of literature evaluating overall treatment cost
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**Why study albumin?**

- 7x risk
- 0.42 days
Methods

- Orthopedic Patient Data Obtained From UPHS Orthopedic Department
  - 83 variables collected, 4763 total patients

- Excluded Data
  - 978 total observations dropped
    - Albumin data missing (845)
    - Other missing variable data (98)
    - Outpatient data (28)
    - Procedures other than arthroplasty (5)
    - Outlier of cost (2)

- Multiple Linear Regressions Run Using Stata 14.1
Variables of Interest

- Continuous variables (n = 3785)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>14772.37</td>
<td>2170.85</td>
<td>84952.97</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>4.201215</td>
<td>2</td>
<td>5.5</td>
</tr>
<tr>
<td>BMI</td>
<td>33.05733</td>
<td>15</td>
<td>71</td>
</tr>
<tr>
<td>Age</td>
<td>62.40713</td>
<td>17</td>
<td>93</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>13.1525</td>
<td>5.7</td>
<td>19.6</td>
</tr>
</tbody>
</table>
Variables of Interest

- Categorical variables (n = 3785)

Readmission Status
- Readmitted
- Not Readmitted

Joint
- Hip
- Knee

Procedure
- Primary
- Revision
Distribution of Procedures

- Hip Primary: 2241
- Hip Revision: 1091
- Knee Primary: 453
- Knee Revision: 152
Results: Cost vs Joint/Procedure

Cost vs Joint and Procedure Type

- Knee Arthroplasty
- Hip Arthroplasty

Procedure Type
- Primary
- Revision
Results: Cost vs Albumin

Cost vs Albumin for Patients at UPHS
## Results: Readmissions vs Albumin

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin</td>
<td>0.4916561</td>
<td>0.001*</td>
</tr>
<tr>
<td>BMI</td>
<td>1.021248</td>
<td>0.046</td>
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<tr>
<td>Age</td>
<td>1.021386</td>
<td>0.009*</td>
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<tr>
<td>Hb</td>
<td>0.9603124</td>
<td>0.481</td>
</tr>
<tr>
<td>GFR</td>
<td>0.6193554</td>
<td>0.072</td>
</tr>
<tr>
<td>Cost</td>
<td>1.000016</td>
<td>0.158</td>
</tr>
<tr>
<td>Joint Type</td>
<td>0.9370874</td>
<td>0.713</td>
</tr>
<tr>
<td>Revision Type</td>
<td>1.322878</td>
<td>0.247</td>
</tr>
</tbody>
</table>
Conclusions

- Joint type (knee/hip) and procedure type (primary/revision) are the main drivers of cost
- Albumin significantly predicts cost
- Lower albumin levels are associated with higher cost
- Albumin is a significant driver of readmissions
What’s Next?

- Implications
  - Pre-screening patients for albumin
  - Future prospective trial looking at the relationship between albumin levels and cost/readmissions
  - Implications for bundled payment

- Limitations
  - Albumin is likely correlated with other drivers of cost
  - Limited physiologic data from patients
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- Early discharge protocols reduce readmission and mortality rates while resulting in significant economic savings.
- Fast-track pathways with a one-day length of stay (LOS) for total hip and knee arthroplasty (THA/TKA) may optimize patient outcomes through multimodal strategies (Sibia, 2017):
  - Early mobilization
  - Patient education
  - Non-opioid pain management
  - Aggressive postoperative fluid administration
  - Regional anesthesia
Background

- Evidence that patients most likely to benefit tend to be younger, male, have lower BMI, shorter surgical times, and received spinal anesthesia
- Evidence that older age and pre-existing comorbidities present considerable risks (Jorgensen, 2013)
- Further identification of risk factors associated with positive and negative outcomes in fast-track THA/TKA is warranted
Aims and Significance

- Determine patient-level and surgery-level factors most relevant to outcomes and cost in fast-track protocols for THA/TKA: Identify the patients best suited for fast-track

- Hip and knee replacement (MS-DRG 469/470) represents Medicare’s most frequently occurring and costly procedure:
  - 446,148 discharges annually and a budget of $6.6 billion (CMS)

- Increased implementation of fast-track protocols have significant implications in cost savings

- Medicare’s bundled payment programs:
  - 2013: Bundled Payment for Care Improvement Initiative (BPCI)
  - 2016: Comprehensive Care for Joint Replacement (CRJ)
Methods

- Data Source: University Health Consortium (Vizient), Hospital of the University of Pennsylvania
- Key Variables
  - Admission Characteristics: Day, Source, Severity
  - Demographics/Patient Characteristics: Age, Sex, BMI, Race, Ethnicity, Insurance Status, Living Alone, Mobility Aids, Can Walk 2+ Blocks
  - Comorbidities: Diabetes, Hypertension, Coronary Artery Disease, COPD, Anemia, Renal Failure, Psychiatric Medications
  - Surgery Characteristics: Operative Time, Surgical Approach, Anesthesia Type, Estimated Blood Loss
  - Post-Surgery: Hours Until First PT, Distance Ambulated
- Compare demographic and clinical characteristics for fast-track pathway versus standard pathway patients: Which patients are the best candidates for fast-track?
Andrew: Lessons Learned

- Balancing research and clinic
- Critically evaluating data
- Implementing research—what is "clinically relevant?"
Robin: Lessons Learned

- Collaborative Nature of Research
- Unexpected Obstacles
- Translating Ideas into Practice
Acknowledgements

• Dr. Atul Kamath
• Pio Finnah
• Paul Staehle
• Joanne Levy
• Safa Browne
• SUMR 2017 Cohort
References: Albumin


References: Fast-Track

5. “Fall-related Admissions After Fast-Track Total Hip and Knee Arthroplasty- Cause of Concern or Consequence of Success?” *Clinical Interventions in Aging*. (Jorgensen 2013).
Thank You!

Questions?