Predictive Modelling of Long-Term Surgical Outcomes for Lumbar Degenerative Disorders and Complex Spinal Deformity: Multidisciplinary conference versus computer modeling
Background

- Complex degenerative and adult deformity spine surgery
  - Significant variability in
    - Surgical approaches
    - Expected clinical outcomes
    - Expected rates of complication

- Predictive modeling
  - Empower informed choice for patients
  - Guides evidence-based treatment recommendations

- With a better understanding of expected outcomes, complications, and cost, the appropriateness of a given surgical procedure in a particular patient can be determined.

- Appropriate surgery is surgery in which the expected and observed benefits of surgery exceed the expected and observed complications of care.
Purpose

• Purpose
  • Identify predictor variables for:
    • Clinical improvement
    • Readmission
    • Revision surgery
    • Cost-effectiveness
    • Appropriateness of surgery

• Develop a prospective predictive model based upon patient specific and diagnosis specific variables

• Compare with this model and established models with accuracy of a multidisciplinary conference
Project Components

- Retrospective chart review based model
- Retrospective large data set model
- Multidisciplinary case based model
- Prospective model testing
Retrospective Data Analysis

- Retrospectively reviewed 100 consecutive patient charts
  - Patients >60 years old
  - >3 level surgery
  - Diagnosis: Adult spinal deformity

- Pre-operative variables of interest
  - Age
  - Gender
  - ASA class
  - Mets Score
  - BMI
  - Smoking status
  - Narcotic usage
  - Staged surgery
  - Number of levels
  - Depression
  - Circumferential fusion
  - Fracture hx
  - DEXA
  - Diabetes status
  - Nutrition
  - Infection hx
  - Renal disease
  - Liver disease
  - DVT/PE hx
  - Cardiac disease
  - Social Support
  - Frailty
• Outcomes
  • Surgical complications
  • Medical complications: DVT/PE, cardiac, Pulm, UTI
  • Surgical site infection
  • Pain mgmt difficulty
  • Transfusion
  • Length of stay
  • Discharge to Home vs SNF vs ARU
  • 30 day and 90 day
    • Readmission
    • Re-operation
Retrospective Model

- Adjustments to project:
  - Focused analysis and predictive modeling of patients with diagnosis of adult spinal deformity only
  - Outcomes limited to 90 days

- Pending Items
  - Collect social support information
  - Frailty index
  - Cost analysis
  - Statistical analysis
Large Data Set Analysis

- Methods: Case control study, administrative claims database
- State inpatient database (SID) Healthcare Cost and Utilization Project - Agency for Healthcare Research and Quality
- North Carolina, Nebraska, New York, and Utah from 2005-2009 and California and Florida from 2005-2010
- Inclusion criteria: Age > 18, patients undergoing lumbar spine surgery using ICD9 codes, exclusion: cancer, infection, trauma diagnoses
- Data extracted for 30 day readmission as well as variables previously identified as risk factors for readmission
Large Data Set Analysis

- Randomly assigned to derivation or validation cohort
- Stepwise multivariate analysis: variables p<0.01 on univariate analysis included in logistic multivariate regression
- Readmission after posterior spine fusion (RAPSF) scoring created, including OR >1.1 and p<0.01 on multivariate analysis
- Numeric value assigned as \([\frac{OR-1}{\text{Sum}(OR-1)}] \times 100\) , and each value was rounded to nearest whole number.
- Linear regression then used to validate model first in derivation cohort and then in validation cohort.
Large Data Set Analysis

- Results: 214788 patients, Derivation cohort: 108514, Validation cohort: 106273
- Readmission rate 12.4% in derivation cohort, 12.5% in validation cohort
### Large Data Set Analysis

- Readmission after posterior spine fusion (RAPSF score)

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<thead>
<tr>
<th>Variable</th>
<th>Score</th>
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<td>Age</td>
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<td>&gt;80</td>
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<td>Race</td>
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<tr>
<td>Other</td>
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<td>Medicaid</td>
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<tr>
<td>Other</td>
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<td>Levels</td>
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<td>3-7 levels</td>
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<td>&gt;7 levels</td>
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<tr>
<td>Diabetes without Chronic Comp</td>
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<tr>
<td>Diabetes with Chronic Comp</td>
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<td>Hemiplegia/Paraplegia</td>
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<td>Mild Liver Disease</td>
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<td>Renal Disease</td>
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<td>Rheumatic disease</td>
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**Readmission after posterior spine fusion (RAPSF score)**
Large Data Set Analysis

- Derivation cohort
- Coefficient: 0.012
- R2 = 0.92
Large Data Set Analysis

- Validation cohort:
- Coefficient: 0.013
- R² = 0.95
Multidisciplinary Group Model

https://ucsf.co1.qualtrics.com/jfe/form/SV_9sr32Xa6hPb8UXH

CASE 1:

70F independent non smoker, c/o low back pain, limited walking ability, and paresthesias to buttocks, diagnosed with scoliosis, DDD, and lumbar stenosis.

Prior Spine Surgeries: none

PMH: supraventricular tachycardia, GERD, HTN

Meds: verapamil, omeprazole, vitamin D3

Bone: Osteopenia

BMI: 25

ASA: 2

Exam: motor: 4/5 Left iliospsoas, EHL; sensory: diminished Left L4; no myelopathy

ODI: Preop: 76.48

EQ5D: Preop: 0.708
Multidisciplinary Group Model

- Adjustments to project:
  - 20 representative cases presented to group then compared against established predictive models (Sage NSQIP)
  - Online Survey instead of group conference with questionnaire

- Pending Items
  - Collect online survey data
    - Email
    - Group conference
  - Data analysis
Prospective Model Testing

• Pending Items
  • Retrospective data collection and analysis completion
  • Develop/train prospective model with observations gather retrospectively
  • Apply model prospectively - Multi-center