
SCIO Health Analytics®/Predictive Modeling Team
Emily Li, Sr. Manager
AGENDA

• Background
  – Definitions of Preference Sensitive Conditions/Treatments
  – Interventions/Programs Related to Preference Sensitive Treatments
  – Application of Predictive Modeling for Identifying High Risk Patients

• Preference Sensitive Treatment (PST) Impactability Model Overview
  – Part 1: PST Risk Models
  – Part 2: Time Opportunity and Remaining Episode Cost
    Episode Period and Time Opportunity
    Episode Cost
    Remaining Treatment Timeframe
  – Part 3: Impactability Score

• Member Profile and Member List for Interventions
BACKGROUND
Background
Definitions of Preference Sensitive Conditions/Treatments

- **Preference Sensitive Conditions** are conditions in which there are no definitive clinical guidelines and more than one treatment options exist.
  - E.g. low back pain, early-stage breast cancer and prostate cancer, and osteoarthritis.
  - According to the article “Death by Medicine”, 7.5 million unnecessary surgical and medical procedures are performed each year.
  - There is an unnecessary increase in surgical procedures as patients and providers often feel that surgery is the best option to eliminate risk of a relapse*. 

- **Preference Sensitive Treatment (PST)** is medical care for which the clinical evidence does not clearly support one treatment option.
  - The appropriate course of treatment depends on the values or preferences of the patient, caregivers or authorized representatives regarding the benefits, harms and scientific evidence for each treatment option (Dartmouthatlas.org, 2014).
  - The use of such care should depend on the informed patient choice among clinically appropriated treatment options (Compilation of the Social Security Laws, 2005, p343)

*See more at http://www.sciohealthanalytics.com/blog/exchanges/post/preference-sensitive-treatment-models.
Background
Interventions/Programs Related to Preference Sensitive Treatments

• **General Education:** Provide surgery/medication enhanced support tools and aids to educate patients, caregivers, and authorized representatives concerning the relative safety, relative effectiveness (Hom, 2014).

• **Shared Decision Making:** Establish a patient-provider partnership. An approach to care that seeks to fully inform patients about the risks and benefits of available treatments and engage them as participants in decisions about the treatments (Veroff, 2011).
  – Provide patients with surgery/medication enhanced support:
    • Decision making aids via articles, videos
    • Contact with trained health coaches through telephone, mail, e-mail, and the Internet

• **Cost Sharing:** An approach to require patients to share costs for care that lacks a unique standard because costs of preference-sensitive treatments vary (Wennberg, 2005).
  – Patients who want a treatment that is more expensive but not more effective than other options to shoulder the extra cost
Background
Application of Predictive Models for Identifying High Risk Patients

• SCIO’s **first generation** of predictive models for PST conditions
  – Selected preference sensitive conditions
  – Developed a predictive model for each preference sensitive condition
  – Predicted and identified the high risk patients for having surgeries in the next year
  – Implemented over 3 years: to help large employers and care managers to identify target population for interventions
  – SCIO® provides on-going reports to the clients

• SCIO’s PST impactability model, the **second generation** of predictive models for PST conditions:
  – Determines the impactability of patients based on their time opportunity and expected savings based on episodes
  – An episode includes both pre- and post-surgery periods that vary by condition
  – Develops a decision support tool, including the original PST risk scores
  – Adds other key decision making components
SCIO’s Solution Framework

Outreach and Activity Feedback

Feedback Integration

Results from the model for the Member pushed within the client’s system

SCIO® Integrated Warehouse

SCIO® Predictive Models

SCIO® Reporting Warehouse

Reporting and Dashboards

Client’s Tools

Custom Software Development

SCIO® Models

SCIO® Reporting Framework

SCIO® Data Integration

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OVERVIEW OF PST IMPACTABILITY MODEL
Conceptual Diagram of PST Impactability Model

Part 1 – PST Risk Model

Comorbid Conditions
Baseline Utilization
Baseline Treatments

Risk score in the future year

Part 2 – Time Opportunity and Remaining Episode Cost

Treatment Timeframe

Episode Cost

Remaining Opportunity for a Member

Composite score

Opportunity analysis

High-risk, high-cost member list
Objectives of PST Impactability Model

• The main objectives of PST impactability model are to:
  – Provide a decision support tool for care managers or other providers for preference sensitive conditions
    • e.g. providing information about patients’ treatment and treatment phases, likelihood of having surgery, treatment timeframes, and expected savings
  – Identify the targeted patients according to their risk of having surgeries and remaining opportunity for interventions
  – Improve the quality of care through earlier interventions
  – Minimize unnecessary use or misuse of invasive surgeries and reduce costs
# List of Selected Preference Sensitive Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prospective Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate Surgery</td>
<td>X</td>
</tr>
<tr>
<td><strong>Osteoarthritis – Knee</strong></td>
<td>X</td>
</tr>
<tr>
<td>Osteoarthritis – Hip</td>
<td>X</td>
</tr>
<tr>
<td>Low Back Pain</td>
<td>X</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>X</td>
</tr>
</tbody>
</table>
PART 1: PST RISK MODEL
Part 1: Preference Sensitive Treatment Risk Models

Data Sources

- Commercial data from the database of SCIO Health Analytics®, with 2 million lives each year between 2010-2012.
- Study Period

Baseline period: Late 2010 – Late 2011, depending on the claim lag

- Claim lag: 25-38 days
- Prediction period: 2012
Part 1: Preference Sensitive Treatment Risk Models

Model Development

• Oversampling because of small response rate
• Split sample approach: training, validation, and hold-out samples
• Logistic regression model

PST Risk Model

• Dependent Variable: Indicator for condition specific surgery in the next year.
• Independent Variables: Demographics, diagnosis codes, procedure codes, comorbidity conditions, service utilizations, and socioeconomic status.
Part 1: Preference Sensitive Treatment Risk Models

Model Performance

<table>
<thead>
<tr>
<th>Preference Sensitive Condition</th>
<th>ROC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarthritis-knee</td>
<td>0.806</td>
</tr>
<tr>
<td>Osteoarthritis-hip</td>
<td>0.847</td>
</tr>
<tr>
<td>Low Back Pain</td>
<td>0.813</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>0.740</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Prostate Cancer</td>
<td>0.789</td>
</tr>
</tbody>
</table>

External Sample Validation

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity and Specificity for Knee PST Risk Model</td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.401</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.935</td>
</tr>
<tr>
<td>Positive Predictive Value</td>
<td>0.131</td>
</tr>
<tr>
<td>Negative Predicted Value</td>
<td>0.984</td>
</tr>
</tbody>
</table>
PART 2: TIME OPPORTUNITY AND REMAINING EPISODE COST
Part 2: Time Opportunity and Remaining Episode Cost

Treatment Phases

Knee Preference Sensitive Procedure Model Feedback

<table>
<thead>
<tr>
<th>Phase 1 – Severity 1 Selected Procedures</th>
<th>Phase 2 – Severity 2 Selected Procedures</th>
<th>Phase 3 – Severity 3 Selected Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• X-Ray of the Knee</td>
<td>• Diagnostic Knee Arthroscopy</td>
<td>• Partial Knee Replacement</td>
</tr>
<tr>
<td>• CAT Scan of the Knee</td>
<td>• Arthroscopic Drainage of Knee</td>
<td>• Total Knee Replacement</td>
</tr>
<tr>
<td>• MRI of the Knee</td>
<td>• Arthroscopic Knee Surgery – Chondroplasty</td>
<td>• Total Knee Replacement Revision</td>
</tr>
<tr>
<td>• Physical Therapy</td>
<td>• Arthroscopic Knee Surgery – Synovectomy</td>
<td></td>
</tr>
<tr>
<td>• Knee Brace</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Part 2: Time Opportunity and Remaining Episode Cost

**Episode Period and Time Opportunity**

An episode includes both pre- and post-surgery periods that vary by condition. The time opportunity is the pre-surgery period.

<table>
<thead>
<tr>
<th>Preference Sensitive Conditions</th>
<th>Pre-surgery Period</th>
<th>Post-surgery Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarthritis-knee</td>
<td>9 months</td>
<td>8 months</td>
</tr>
<tr>
<td>Osteoarthritis-hip</td>
<td>9 months</td>
<td>8 months</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>4 months</td>
<td>9 months</td>
</tr>
</tbody>
</table>

**Time Opportunity**
Part 2: Time Opportunity and Remaining Episode Cost

**Episode Cost**

<table>
<thead>
<tr>
<th>Initial Treatment Severity</th>
<th>Surgery Severity</th>
<th>Post-surgery Treatment Severity</th>
<th>Total Average Episode Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>$10,723</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>$18,723</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>$34,500</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>1</td>
<td>$26,581</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>$33,044</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>$54,638</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
<td>$26,739</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>$79,715</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>$96,642</td>
</tr>
</tbody>
</table>

Given the same health plan, the average episode costs for patients vary by the initial treatment severity and most severe treatment for the entire episode.
Part 2: Time Opportunity and Remaining Episode Cost

Remaining Treatment Timeframe

Knee Replacement Episode

The remaining episode cost is determined based on the remaining treatment timeframe.
PART 3 IMPACTABILITY SCORE
Part 3: Create Impactability Score

- PST Impactability score contains information about both PST score and episode cost, allowing it to convert probability of surgery to expected cost.
- Since PST impactability score is created based on expected savings, they can be summed to create a composite score.
- The PST impactability model generates both an individual score for each condition and a composite score for the two conditions. Thus, the model is able to rank patients not only within one condition but also across several conditions.

\[
\text{PST impactability score} = \text{function} (\text{PST risk scores, remaining episode cost})
\]

\[\sum \text{function} (\text{PST risk scores, remaining episode cost})\]
### Part 3: Retrospective Analysis – Knee Replacement

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of OA Patients</th>
<th>Expected Savings Lowest</th>
<th>Expected Savings Highest</th>
<th>Patients with Surgery</th>
<th>% of Surgery for Top 5% Patients</th>
<th>% of Expected Saving for Top 5% Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,594</td>
<td>2.5%</td>
<td>$9,743</td>
<td>281</td>
<td>19%</td>
<td>31%</td>
</tr>
<tr>
<td>2</td>
<td>1,594</td>
<td>2.5%</td>
<td>$4,887</td>
<td>179</td>
<td>12%</td>
<td>31%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Total</td>
<td>63,772</td>
<td>100.0%</td>
<td>$0</td>
<td>1,477</td>
<td>100%</td>
<td>33%</td>
</tr>
</tbody>
</table>

31% of osteoarthritis patients with the highest impactability scores (top 5%) for knee replacement actually had surgeries in the next year, which account for 33% of the total expected surgery costs.
MEMBER PROFILE AND MEMBER LIST FOR INTERVENTIONS
Table Construct

- Table shows one row for each member.
- Timeframe is based on incurred date.

Abbreviation Key

PST = Preference Sensitive Treatment

*Full list of PST Conditions on slide 15

<table>
<thead>
<tr>
<th>Member ID</th>
<th>Measurement End Date</th>
<th>PST Risk Score</th>
<th>Highest Severity</th>
<th>Highest-severity Treatment Date</th>
<th>Highest-severity Treatment</th>
<th>Latest Treatment</th>
<th>Remaining Time Opportunity (Months)</th>
<th>Remaining Episode Cost (Low-High)</th>
<th>Expected Saving Median (Low-High)</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>12/31/2011</td>
<td>0.904</td>
<td>2</td>
<td>03/16/2011</td>
<td>Arthroscopy</td>
<td>Lubrication Injections, Cortisone</td>
<td>1</td>
<td>$26,739-$79,715</td>
<td>$48,117 ($24,172-$72,062)</td>
<td>1</td>
</tr>
<tr>
<td>002</td>
<td>12/31/2011</td>
<td>0.327</td>
<td>1</td>
<td>11/14/2011</td>
<td>Cortisone</td>
<td>Cortisone</td>
<td>8</td>
<td>$10,723-$54,638</td>
<td>$10,487 ($3,441-$17,532)</td>
<td>2</td>
</tr>
<tr>
<td>003</td>
<td>12/31/2011</td>
<td>0.321</td>
<td>1</td>
<td>1/19/2011</td>
<td>PT</td>
<td>PT</td>
<td>1</td>
<td>$8,610-$52,534</td>
<td>$10,008 ($2,819 - $17,198)</td>
<td>3</td>
</tr>
<tr>
<td>004</td>
<td>12/31/2011</td>
<td>0.192</td>
<td>1</td>
<td>6/28/2011</td>
<td>MRI</td>
<td>PT</td>
<td>2</td>
<td>$9,680-$53,600</td>
<td>$6,086 ($1,862-$10,310)</td>
<td>4</td>
</tr>
</tbody>
</table>

Member List with their Preference Sensitive Treatments – Knee

To Answer

- How do I know who is at risk for future procedures and for whom is there the highest opportunity for interventions?
- For what preference sensitive conditions might the member be treated that requires additional intervention?
### Member List with their Preference Sensitive Treatments — *All PSCs*

<table>
<thead>
<tr>
<th>Member ID</th>
<th>Measurement End Date</th>
<th>Expected Saving Median (Low-High) Knee</th>
<th>Expected Saving Median (Low-High) Hip</th>
<th>Expected Saving Median (Low-High) PCA</th>
<th>Expected Saving Median (Low-High) LBP</th>
<th>No. of Preference Sensitive Conditions</th>
<th>Composite Score Median (Low-High)</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>12/31/2011</td>
<td>$740 ($221-$1,258)</td>
<td>$377 ($188-$565)</td>
<td>$0</td>
<td>$50,264 ($8,015, $92,513)</td>
<td>...</td>
<td>$49,381 ($8,425-$94,336)</td>
<td>1</td>
</tr>
<tr>
<td>002</td>
<td>12/31/2011</td>
<td>$48,117 (24,172, $72,062)</td>
<td>$143 ($74, $213)</td>
<td>$0</td>
<td>$1,615 ($258, $2,973)</td>
<td>...</td>
<td>$49,890 ($24,515-$75,265)</td>
<td>2</td>
</tr>
<tr>
<td>003</td>
<td>12/31/2011</td>
<td>$0</td>
<td>$0</td>
<td>$44,752 ($36,474, 53,029)</td>
<td>$3,090 ($447, $5,733)</td>
<td>...</td>
<td>$47,841 ($36,921-$58,762)</td>
<td>3</td>
</tr>
<tr>
<td>004</td>
<td>12/31/2011</td>
<td>$0</td>
<td>$147 ($75, $219)</td>
<td>$0</td>
<td>$46,557 ($7,424, $85,689)</td>
<td>...</td>
<td>$46,704 ($7,499-$85,909)</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table Construct
- Table shows one row for each member.
- Timeframe is based on incurred date.

### To Answer
- How do I know who is at risk for future procedures and for whom is there the highest opportunity for interventions?
- For what preference sensitive conditions might the member be treated that requires additional intervention?

### Abbreviation Key
PST = Preference Sensitive Treatment

*Full list of PST Conditions on slide 17
THANK YOU!
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