“Big Data” in Rehabilitation

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“Big Data” in Rehabilitation

- **Summary of Challenges**
  - We do not routinely collect outcomes
  - Practice patterns are extremely variable (i.e. difficult to define “standard” care)
  - Patient satisfaction is typically the main goal
  - Measures of physical functioning do not correlate with patient-reported measures

- In order to use “big data” we have to first generate it
Total Knee Arthroplasty Projections
(Present→2030)

- Ranked 3rd in 2013 U.S. inpatient procedures
  (all age groups, includes maternal/neonatal)

- 1st for Age Group 65-74
Total Knee Arthroplasty Projections (Present → 2030)

- Projected growth was 673%
- Hist. numbers even with projections, but rate of growth is lower

**1990-2002 NIS Projections Compared to Known NIS Stats**

- Projected growth
- Hist. numbers even with projections, but rate of growth is lower

Projections based on rate of increase in TKA operations.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2013
Indi

duality vs Standardization

Individuality vs Standardization

University of Colorado
Anschutz Medical Campus

Physical Therapy Program
How Do We Get on the Same Page?
Intermountain Health

- Discovered large variations in treatment process for total knee replacement.
  - Across and within expert Physical Therapists
- “Borrowed” an EBP protocol from University of Delaware and implemented process of care.
- Implemented the protocol using Lean principles
  - Built it into workflow—made it automatic
  - Therapists encouraged to vary based on patient need
  - Variances and patient outcomes fed back in a Lean Learning Loop
## Intervention

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Milestone</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td>Able to complete 3x8 reps without fatigue(^{10})</td>
<td>Measures of pain and disability.</td>
</tr>
<tr>
<td>NMES</td>
<td>Pain at rest &lt;4/10(^{10})</td>
<td>Measure AROM/PROM each visit</td>
</tr>
<tr>
<td>Volitional Strength</td>
<td>AROM/PROM &lt;10-90(^{10})</td>
<td>Interventions in each category:</td>
</tr>
<tr>
<td>Balance &amp; Agility</td>
<td>Independence with mobility in and out of home(^{10})</td>
<td>• ROM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Volitional strength</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Balance/Agility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perform NMES per protocol at least one visit during entire episode of PT care.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implement passive stretch program</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance Measure</td>
</tr>
</tbody>
</table>
Why do people elect to undergo TKA?
TKA Outcomes: Pain

- 90% of patients have a substantial reduction in their knee pain

- Pain reduction = #1 Benefit of TKA

TKA Outcomes: Function

Large losses in strength and function in the first 48hrs after TKA:
- Quadriceps strength decreases by 80%
- Walking distance decreases by 70%

Large losses in strength and function in the first 4 weeks post TKA:
- Quadriceps strength decreases by 50-60%
- Quadriceps activation decreases by 20%
- Walking distance decreases by 40%
- Stair climbing speed decreases by 90%

Bade, 2010; Mizner, 2005; Dennis 2014
TKA Outcomes: Function

Long-term deficits in strength and function compared to healthy adults:

- 40% deficits in quadriceps strength
- 30% deficits in walking distance
- 105% deficit in stair climbing speed

Bade, 2010; Mizner, 2005
Stair Climbing Performance After TKA

* Significantly different from healthy adults

Bade et al, 2010
Six-Minute Walk Distance After TKA

**Healthy Adults**

<table>
<thead>
<tr>
<th>Time Point</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop</td>
<td>400</td>
</tr>
<tr>
<td>1 Month</td>
<td>400</td>
</tr>
<tr>
<td>3 Month</td>
<td>400</td>
</tr>
<tr>
<td>6 Month</td>
<td>400</td>
</tr>
</tbody>
</table>

* Significantly different from healthy adults

Bade et al, 2010

* Increased Performance

* Decreased Performance
What are patient’s perceptions of outcomes?
Patient Report of Outcomes

KOOS Sub-Scores

- Symptoms
- ADL
- S&R
- QoL
- Pain

Stevens-Lapsley et al. 2011
Performance vs Self-Report

Stevens-Lapsley et al. 2011
Why the Disconnect?

- Patient’s knee pain is reduced/absent.

Why is function so limited?

- Orthopedic community historically focused on knee flexibility...
What do we monitor following TKA?

- Historically, knee flexibility has been a marker of the success of surgery.
- Medicare now requires monitoring of patient outcomes by self-report only.
**Stiffness.** The following question concerns the amount of joint stiffness you have experienced during the last week in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>How severe is your stiffness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>after first wakening in the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morning?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pain.** What amount of knee pain have you experienced in the last week during the following activities?

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twisting/pivoting in your knee</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Straightening knee fully</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Going up or down stairs</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Standing upright</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Function, Daily Living.** The following questions concern your physical function. For each of the following activities, please circle a number to indicate the degree of difficulty you have experienced in the last week, due to your knee.

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising from sitting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Bending to floor/pick up an</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>object</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provider Use Only

<table>
<thead>
<tr>
<th>Total</th>
</tr>
</thead>
</table>
What should we measure following TKA?

- **Low floor**
  - Timed up and go
  - Usual walking speed

- **High ceiling**
  - 30-second chair rise
  - Joint-specific measures
    - Quad strength
TKA Rehab—Outcomes form

Patient Name: __________________________  Date: __________________________

Surgeon: __________________________  Involved Knee: R L  Date of Surgery: __________________________

Visit: Pre-OP  PT Eval  Re-eval  GRAD  6 MOS  1 Year  2 Year  Total visits ______

Patient Specific Functional Scale (NOTE: must be the same activities each visit): (0=can’t do; 10=able to do as if before knee problem)

Activity 1: __________________________  Score (0-10): __________________________

Activity 2: __________________________  Score (0-10): __________________________

Activity 3: __________________________  Score (0-10): __________________________

TUG:

Trial 1 ___ ___ ___ s  Trial 2 ___ ___ ___ s

Assistive Device
Name  Cane  Crutches  FWW
Other: __________

4 m walk test:

Trial 1 ___ ___ ___ s  Trial 2 ___ ___ ___ s

Assistive Device
Name  Cane  Crutches  FWW
Other: __________

30 sec sit-to-stand  # of full stands in 30 seconds (hands across chest): __________

Quad strength:

Trial 1
Uninvolved ___ ___ ___ lbs
Involved ___ ___ ___ lbs

Trial 2
Uninvolved ___ ___ ___ lbs
Involved ___ ___ ___ lbs

Knee Active ROM:
Flex ________°  Ext ________°  + hyper - lag
To Follow…

- Andy Kittelson is going to talk more about the implementation challenges we encountered in the Implementation/Dissemination panel.