Big Data in Health Outcomes Research: Clinical Data Collection in Total Knee Replacement Rehabilitation

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CLAIMER: THIS IS NOT BIG DATA...yet.
Why are we doing this?

**Quality of Care**

as the potential and ability to improve the quality and efficiency of care. Big data offers an ability to predict outcomes using the available primary or historical data and provide proof of benefit that could change industry-wide standards of care. Leveraging technology at the patient end can also help with adherence. This will most certainly play an important role in improving outcomes and improve the related quality of life.

**Decision Making**

Enables appropriate use of evidence-based medicine and helps health care providers make more decisions. This, in turn, improves the quality of care provided to the patients. Remote monitoring, profile analytics, and genomic analytics are examples of other applications that influence the decision-process.
Why are we doing this?

Comprehensive Care for Joint Replacement
Medicare Outcomes Don’t Tell the Whole Story

<table>
<thead>
<tr>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>How severe is your stiffness after first waking in the morning?</td>
</tr>
<tr>
<td>None</td>
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<tr>
<td>0</td>
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<thead>
<tr>
<th>Pain. What amount of knee pain have you experienced in the last week during the following activities?</th>
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<tbody>
<tr>
<td>Twisting/pivoting in your knee</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>Straightening knee fully</td>
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<tr>
<td>0</td>
</tr>
<tr>
<td>Going up or down stairs</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>Standing upright</td>
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<td>0</td>
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<thead>
<tr>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising from sitting</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>Bending to floor/pick up an object</td>
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<tr>
<td>0</td>
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</tbody>
</table>
Performance vs. Self-Report

Stevens-Lapsley et al. 2011
Medicare Outcomes Don’t Tell the Whole Story

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.

None | Mild | Moderate | Severe | Extreme
Clinical Data Collection for Patients Undergoing TKR

Step 1: Make it easy
- Feasible
- NOT time consuming
- Outcomes collection is not data management

Step 2: Make it useful
- Outcomes are relevant to clinical decisions
- Research products integrated with practice
Step 1: Make it easy

- Battery of clinical outcomes < 5 min
- Paper-based system, matched to clinical process/flow
Why Health Care Tech Is Still So Bad

ROBERT M. WACHTER  MARCH 21, 2015
Step 1: Make it easy

Data entry/quality checking is not the job of the clinician
Step 2: Make it useful

Outcomes are responsive and meaningful

- Capture the range of relevant outcomes (pain, mobility, strength, etc.)
- Sensitivity to change

Example... Timed Up and Go test vs. SLS
Step 2: Make it useful

Research products are ultimately integrated with clinical practice.

Challenge #1: Patients are under-informed about knee replacement.
Step 2: Make it useful

Research products are ultimately integrated with clinical practice.

Challenge #2: Traditionally, rehab for TKR has adopted a one-size-fits-all approach.
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Patient presentation</td>
<td>Patient enters rehabilitation</td>
<td>• Minimum pain</td>
<td>• Muscle function: 70% of noninvolved extremity</td>
</tr>
<tr>
<td></td>
<td>1–2 days postoperatively</td>
<td>• Full weight bearing except with uncemented or hybrid</td>
<td>• No symptoms of pain or swelling during previous phase</td>
</tr>
<tr>
<td></td>
<td>Postoperative compression dressing</td>
<td>• ROM 0°–60°</td>
<td></td>
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<tr>
<td></td>
<td>Postop pain controlled</td>
<td>• Weight bearing as tolerated with cemented prosthesis, delayed with uncemented or hybrid</td>
<td></td>
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<tr>
<td></td>
<td>ROM 10°–60°</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weight bearing as tolerated with cemented prosthesis, delayed with uncemented or hybrid</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>Key examination procedures</td>
<td>Pain (0–10 scale)</td>
<td>Pain assessment</td>
<td></td>
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<tr>
<td></td>
<td>Monitor for hemarthrosis</td>
<td>Joint effusion—girth</td>
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</tr>
<tr>
<td></td>
<td>ROM</td>
<td>ROM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Patellar mobility</td>
<td>Patellar mobility</td>
<td></td>
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<tr>
<td></td>
<td>Muscle control</td>
<td>Gait analysis</td>
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<td></td>
<td>Soft tissue palpation</td>
<td></td>
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<tr>
<td>Goals</td>
<td>Control postoperative swelling</td>
<td>Reduce swelling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimize pain</td>
<td>• ROM 0°–110° or more</td>
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<tr>
<td></td>
<td>ROM 0°–90°</td>
<td>• Full weight bearing</td>
<td></td>
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<tr>
<td></td>
<td>3/5 to 4/5 muscle strength</td>
<td>• 4/5 to 5/5 strength</td>
<td></td>
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<td></td>
<td>Ambulate with or without assistive device</td>
<td>• Unrestricted ADL function</td>
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<tr>
<td></td>
<td>Establish home exercise program</td>
<td>• Adherence to home exercise program</td>
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<tr>
<td>Interventions</td>
<td>Pain modulation modalities</td>
<td></td>
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<td></td>
<td>Patellar mobilization</td>
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Knee flexion recovery

N=240
Population-level reference chart—Knee Flexion

Knee flexion recovery
N=240
Preop flexion = 130 deg.
Age = 64 years

100 “patients like me”
Population-level reference chart—Knee Flexion

Knee flexion recovery
N=240
PERSONALIZED reference chart—Knee Flexion

Preop flexion = 110 deg.  
Age = 70 years

100 “patients like me”
PERSONALIZED reference chart—Knee Flexion

Preop flexion = 110 deg.
Age = 70 years
Postop flexion = 100 deg

100 “patients like me”
PERSONALIZED reference chart—Knee Flexion

Preop flexion = 110 deg.
Age = 70 years
Postop flexion = 85 deg.

100 “patients like me”
My orthopedist told me I was a ‘perfect candidate,’ being relatively young (I was 62), thin and fit; he said the only concern would be a risk — to 2 percent — of infection. Nothing else.”

Most people do well with intensive physical therapy, but for me it backfired and set up a vicious cycle of inflammation. I needed a different protocol than the standard one that works for the majority. I needed a protocol for patients with histories and conditions like mine.”
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- Muscle function: 70% of noninvolved extremity
- No symptoms of pain or swelling during previous phase

- Pain assessment
- Muscular strength
- Patellar alignment/stability
- Functional status

- Develop maintenance program and educate patient on importance of adherence
- Including methods of joint protection
- Improve cardiopulmonary endurance/aerobic fitness

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Population level reference chart—Timed Up and Go

Days following surgery

Better Performance

Worse Performance
PERSONALIZED reference chart—Timed Up and Go

Age=55
Preop TUG time = 7.5 s
Preop quad strength =
PERSONALIZED reference chart—Timed Up and Go

Age = 70
Preop TUG time = 14.3 seconds
Preop quad strength = 
THE HEROISM OF INCREMENTAL CARE

We devote vast resources to intensive, one-off procedures, while starving the kind of steady, intimate care that often helps people more.

By Atul Gawande
Clinical Databases in Rehab

Opportunity to bridge the gap between research and practice

A user-centered approach to outcomes reporting, design of data collection initiatives

Practice-based evidence

- Inform clinical decisions
- Resource allocation
Limitations and Challenges

- Resource intensive
- Generalizability?
- Scalability?
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