Diagnostic Imaging and the SPINE
A Surgeon’s Perspective

Y. Raja Rampersaud, MD, FRCS(C)
President Canadian Spine Society,
Associate Professor, Divisions of Orthopaedic and Neurosurgery,
Spinal Program, Toronto Western Hospital,
University Health Network,
University of Toronto, Canada
Objectives

- LBP
- Diagnostic Utilization
- Problem
- Cost
- Possible Solutions
Overview

• LBP = common complaint
  – Most benign / High frequency of recurrence

• Clinical practice guidelines (CPGs)
  – Numerous / Helpful
  – Numerous limitations
    – often not practical
    – do not consider patient preference
    – do not consider real world implementation challenges

• Imaging Recommendations
  – LBP – > 6 weeks (ACR and CAR)
Investigations

- 45 yo male with 2 years of recurrent back dominant pain
  - No neurologic or leg symptoms or signs
  - X-ray shows some mild degeneration
  - Both patient and PCP are frustrated
  - MRI
Investigations

- 45 yo male LBP
  - Diffuse degenerative disc disease
  - L5-S1 herniated disc impinging on the S1 nerve root

- Diagnosis?
- Now what?
Healthcare Utilization Following Lumbar Spine MRI Ordered By Primary Care Physicians

You JJ, Symons S, Bederman S, Rampersaud R.
Specialist Referral

Incidence of specialist referral during a maximum 3 years follow-up was:

- Neurologist: 19.7%
- Neurosurgeon: 15.6%
- Orthopedic surgeon: 33.6%
- Physical medicine & rehab: 11.6%
- Rheumatologist: 3.1%
Imaging

• Increased utilization of spine MRI
  – 600% increase in Ontario

• Reasons for ordering
  – Aid in diagnosis
  – Patient request
  – Specialist referral (esp. surgical)
  – Medicolegal

90% of MRIs for LBP are abnormal

< 2% of CTs for Headache are abnormal

Value of a negative test is nearly non-existent for LBP

2% of CT scans of the brain for headache found abnormalities that could explain the headache, while over 90% of MRI scans of the spine for back pain were abnormal, although the clinical importance of the abnormalities was unclear.
MRI and the Lumbar Spine

• Modality of choice in evaluation of most spinal disorders.
  o Incidental “abnormal” findings common within asymptomatic individuals.
    o 57-80% abnormalities for those over the age of 60
  o Poor correlation with patient symptoms, therapeutic decision-making and patient outcome.

MRI and Spine

- Descriptive MRI reports are often “concerning”
  - “large disc herniation”
  - “indentation of the cauda equina”
  - “effacement of the spinal cord”
  - “severe diffuse degenerative disc”…etc
MRI and Spine

- Descriptive MRI reports are often “concerning”
  - “large disc herniation”
  - “indentation of the cauda equina”
  - “effacement of the spinal cord”
  - “severe diffuse degenerative disc”…etc

- Clinically insignificant abnormalities

- “Certificate of disability”
Investigations

• 45 yo male LBP

Multiple imaging sequences were obtained through the lumbar spine without the use of contrast.

There are 5 lumbar-type vertebrae. The conus ends appropriately at the L1 level. A tiny focus of low signal intensity is noted within the L2 vertebral body on both T1 and T2-weighted images. In the absence of malignancy, this likely is a small bone island. Vertebral body height is well maintained. A small hemangioma is noted in the T11 and T12 vertebral bodies.

The L1-L2, L2-L3 and L3-L4 levels demonstrate degenerative disc disease.

The L4-L5 level demonstrates degenerative disc disease. There is a small annular tear in a right paracentral location.

The L5-S1 level demonstrates degenerative disc disease. There is a mild broad-based disc bulge. There is a small left paracentral herniated disc which is impinging on the left S1 nerve root.

IMPRESSION:

1. Degenerative disc disease throughout the lumbar spine.

2. Small annular tear in a right paracentral location at the L4-L5 level.
Figure 1. A comparison of the total amount of intervertebral disk abnormalities on MRI between the surgical & non-surgical populations.

- Surgical Population: 4.0 ± 0.5
- Non-surgical Population: 3.5 ± 0.5
Type of Abnormalities

Figure 2. The prevalence rate for different types of structural abnormalities present on MRI for surgical and non-surgical individuals.

- Degenerative Disc Disease
- Disk Herniation
- Spinal Stenosis
- Instability
- Previous Surgery

Surgical Population

Stenosis: OR = 1.6 (surgical)
Spondylolisthesis: OR = 2.8 (surgical)

*p < 0.01
MRI ≠ Symptom Correlation

Asymptomatic

Diffuse - Severe  Focal - Mild
LBP Case

- 45 yo male with 2 years of recurrent back dominant pain
  - No neurologic or leg symptoms or signs
  - X-ray shows some mild degeneration
  - Both patient and PCP are frustrated
- MRI
  - Diffuse degenerative disc disease
  - L5-S1 herniated disc impinging on the S1 nerve root
Wrong Care at the Wrong Time

- Surgical referral stream
  - 6-12+ mths wait (if agree to see)
  - No change or worsening symptoms
Wrong Care at the Wrong Time

- Non-surgical, “I can’t help you”
  - Advice given by some
  - Surgeons typically unwilling or unable to do non-op care
  - Referral back to PCP/ PMR/Pain etc
    - Challenging problem with limited resource

- We have to do better for our patients!
Primary Care Barriers

• Understanding Primary Care Physicians’ Challenges, Barriers and Priorities in Caring for Patients with Low Back Pain.
  – Alleyne J, Harvey B, Meuser J, Rampersaud R.

• Systematic Review, small focus group and a survey of family physicians (n=325) across Ontario
What do patients want?

- Imaging test
- Funded physiotherapy
- Note for work activity restrictions
PCP perspective

- Barriers
  - lack of comfort in dealing with complex or recurrent LBP
  - occupational issues
  - lack of patient-friendly key messages
  - lack of easy to use education and assessment tools
  - pain management
PCP perspective

- Education needs regarding the timing and clinical interpretation of imaging reports
Reported reason for specialist referral

- Spine / Neurosurgeon
  - compression of neurologic structures reported on imaging
  - constant leg pain and/or altered sensation
  - patient request for a second opinion.
Proposal for the Development of a Provincial Program to increase access to elective spine care in Ontario

- Submitted by: Ontario Spine Surgeons
- Proposal Written by:
  - Ontario Orthopaedic Expert Panel
    - Add Hoc Multidisciplinary Team
  - Canadian Spine Society
- 14 Centers with annual budget of $3.2m
Ministry Proposal

• Triage Centers
  – Upstream
    • Shared care with PCP
    • Patient Centered Care
      – CPGs / Best Practices
      – Imaging criteria
  – Education, Education, Education
    www.BackCareCanada.ca
BackCareCanada.ca

BackCareCanada.ca was developed by health professionals to provide reliable information & advice based on the latest research & expert opinion.

The goal is to help you better manage your symptoms and to make more informed decisions about seeking treatment.
Cost

- Wait – Times
  - QOL
  - Loss productivity
  - Chronic Disease
  - Human Health Care Resources

- $$ $$ $$
Cost-Effectiveness Analysis of a Reduction in Diagnostic Imaging in Degenerative Spinal Disorders

Joanne S. M. Kim, M.Sc.
Joyce Z. Dong, B.Sc.
Stacey Brener, B.Sc.
Peter C. Coyte, Ph.D.
Y. Raja Rampersaud, M.D.
Study Objectives

- Reduce unnecessary use of imaging thereby improving its efficiency
- Determine cost implications of eliminating umbrella use of CT/MRI from a health care perspective
## Data on 2,046 Patients

<table>
<thead>
<tr>
<th>Condition</th>
<th>Diagnosis</th>
<th># Patients</th>
<th># Surgical</th>
<th># Non-surgical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar disc herniation/sciatica/radiculopathy</td>
<td>MRI</td>
<td>623</td>
<td>486</td>
<td>137</td>
</tr>
<tr>
<td>Lumbar spinal stenosis/claudication</td>
<td>MRI</td>
<td>228</td>
<td>196</td>
<td>32</td>
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<tr>
<td>Degenerative spondylolisthesis</td>
<td>X-ray</td>
<td>87</td>
<td>80</td>
<td>7</td>
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<tr>
<td>Isthmic spondylolisthesis</td>
<td>X-ray</td>
<td>103</td>
<td>91</td>
<td>12</td>
</tr>
<tr>
<td>Cervical radiculopathy/herniated nucleus pulposus</td>
<td>MRI</td>
<td>139</td>
<td>86</td>
<td>53</td>
</tr>
<tr>
<td>Cervical myelopathy/stenosis</td>
<td>MRI</td>
<td>26</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>Axial back pain/DDD*/stenosis/facet osteoarthritis</td>
<td>CA*</td>
<td>470</td>
<td>114</td>
<td>356</td>
</tr>
<tr>
<td>Axial neck pain/DDD*/spondylosis</td>
<td>CA*</td>
<td>58</td>
<td>5</td>
<td>53</td>
</tr>
<tr>
<td>Coronal deformity/scoliosis</td>
<td>X-ray</td>
<td>50</td>
<td>22</td>
<td>28</td>
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<tr>
<td>Sagittal deformity/kyphosis</td>
<td>X-ray</td>
<td>19</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Tumour/infection</td>
<td>MRI</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Inflammatory/rheumatoid arthritis/ankylosing spondylitis</td>
<td>MRI</td>
<td>11</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Myofascial/multifactorial/chronic/regional pain syndrome</td>
<td>CA*</td>
<td>134</td>
<td>5</td>
<td>129</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>MRI</td>
<td>80</td>
<td>24</td>
<td>56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>NA</td>
<td>2,046</td>
<td>1,162</td>
<td>884</td>
</tr>
</tbody>
</table>

*CA, clinical assessment.
Study Design

• **Usual care** (some CT/all MRI) vs. **triage program** (no CT/some MRI)

• **Outcome:**
  - number of surgical candidates identified
  - MRIs used for diagnosis

• **Incremental cost components:**
  - CTs, MRIs, X-rays, and consultations

• **Cost-effectiveness analysis:**
  - Use of natural units and resource utilization
Decision Tree

PCP, primary care provider; SS, spine surgeon; APP, advance practice physiotherapist
Outcome and Cost Analyses

<table>
<thead>
<tr>
<th></th>
<th># Surgical candidates</th>
<th># Diagnostic MRIs</th>
<th>Outcome (surgical candidates/MRI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usual Care</td>
<td>1,162</td>
<td>3,069</td>
<td>0.379</td>
</tr>
<tr>
<td>Triage Program</td>
<td>1,038</td>
<td>1,228</td>
<td>0.845</td>
</tr>
<tr>
<td>Difference</td>
<td>124</td>
<td>1,841</td>
<td>0.466</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>CTs</th>
<th>MRIs</th>
<th>SS Consult</th>
<th>Post Care</th>
<th>X-rays</th>
<th>APP Consult</th>
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</thead>
<tbody>
<tr>
<td>Quantities</td>
<td>869</td>
<td>1,841</td>
<td>662</td>
<td>N/A</td>
<td>1,914</td>
<td>5,576</td>
</tr>
<tr>
<td>Prices (2009 CAD)*</td>
<td>$532</td>
<td>$899</td>
<td>$76.30</td>
<td>N/A</td>
<td>$91.58</td>
<td>$31.87</td>
</tr>
<tr>
<td>Costs (Q x P)</td>
<td>$462,308</td>
<td>$1,655,059</td>
<td>$50,511</td>
<td>$216,021</td>
<td>$126,747</td>
<td>$177,707</td>
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<tr>
<td>Cost Difference</td>
<td>$2,007,977</td>
<td>in savings</td>
<td>for study duration of 31 months</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Triage program is more effective and cheaper. It is **dominating**.

*From OCCI and OHIP SoB
Sensitivity Analyses (1)

- Varying Unit Cost
- If no x-ray/CT
  - MRI < $84
Sensitivity Analyses (2)

- Triage model always resulted in cost savings
  - Assessor (PCP, Surgeon)
  - X-ray / CT (0-100%)
Provincial Implications

<table>
<thead>
<tr>
<th># Spine Surgeries per Year</th>
<th># Surgeons</th>
<th># Orthopaedic Surgeons</th>
<th># Neurosurgeons</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-49</td>
<td>11</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>50-74</td>
<td>12</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>75-99</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>&gt;100</td>
<td>31</td>
<td>17</td>
<td>14</td>
</tr>
</tbody>
</table>

Triage program would save Ontario $24,234,929 per year
Implications

• Improved efficiency of MRI use
  • MRI reallocation and wait times reduction

• Resource reallocation of cost savings
  • Education programs
    - For both PCPs & patients
  • Human resources
    - Training and hiring new personnel
  • Establishment of back pain centres
    - Multidisciplinary teams
    - Diagnose, treat, and educate
Limitations

- **Generalizability**
  - Data collected from one clinician’s practice

- **Costing assumptions**
  - Macro-costing
  - Ontario Cost Casing Initiative self-reported data

- **Lay belief in MRI**
  - Patient pressure for MRI and consultations
Conclusions

• The proposed triage program improves efficiency of imaging usage
• The proposed triage program generates savings to the provincial health care system
• Future directions:
  • Provincial data and extrapolation
    • Referred
    • Bigger group who only see PCP
  • Knowledge translation to clinical practice should involve all stakeholders.