Lumbar Imaging with Reporting of Epidemiology (LIRE): Preliminary Results of a Secondary Aim

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- **PCORI:** CE-12-11-4469

Disclosures (Jarvik)

- **Physiosonix:** ultrasound company, Founder/stockholder
- **Healthhelp:** utilization review, consultant
- **UpToDate:** Section Editor
- **Evidence Based Neuroimaging Diagnosis and Treatment:** Springer, Co-Editor
Talk Outline

• Brief review of study goals/design
• Progress to date
• Subsequent MR/CT imaging through 90 days
• Next steps
LIRE (pronounced leer) from the French verb, ‘to read’.
Background and Rationale

• Lumbar spine imaging frequently reveals incidental findings

• These findings may have an adverse effect on:
  – Subsequent healthcare utilization
  – Patient health related quality of life
Disc Degeneration in Asx
Primary Hypothesis

• For patients referred from primary care, inserting prevalence benchmark data in lumbar spine imaging reports will reduce overall spine-related healthcare utilization as measured by spine-related relative value units (RVUs)
Secondary Hypotheses

• We also hypothesized that the intervention would decrease:
  – Subsequent cross-sectional imaging (MR/CT)
  – Opioid prescriptions
  – Spinal injections
  – Surgery
Retrospective Pilot Results: Subsequent Imaging Within 1 Yr

P = 0.14
OR* = 0.22

1/71 had macro (1.4%)
12/166 no macro (7.2%)

* Adjusted for imaging severity
Changes in Primary Care Health Care Utilization after Inclusion of Epidemiologic Data in Lumbar Spine MR Imaging Reports for Uncomplicated Low Back Pain

Results:

Patients in the statement group were 12\% less likely to be referred to a spine specialist (137 of 187 [73\%] vs 159 of 188 [85\%]; \( P = .007 \)) and were 7\% less likely to undergo repeat imaging (seven of 187 [4\%] vs 20 of 188 [11\%]; \( P = .01 \)) compared with patients in the nonstatement group. The intervention was not associated with any change in narcotic prescription (53 of 188 [28\%] vs 54 of 187 [29\%]; \( P = .88 \)) or with the rate of low back surgery (24 of 188 [13\%] vs 16 of 187 [9\%]; \( P = .19 \)).

Conclusion:

In this study, inclusion of a simple epidemiologic statement in lumbar MR imaging reports was associated with decreased utilization in high-cost domains of low back pain management.
The following findings are so common in normal, pain-free volunteers, that while we report their presence, they must be interpreted with caution and in the context of the clinical situation. Among people between the age of 40 and 60 years, who do not have back pain, a plain film x-ray will find that about:

- 8 in 10 have disk degeneration
- 6 in 10 have disk height loss

Note that even 3 in 10 means that the finding is quite common in people without back pain.
Randomization

- Cluster (clinic)
- Stepped wedge (one way crossover)
Stepped Wedge RCT

- Exposed to LIRE intervention
- Unexposed to LIRE intervention

*Randomization
- wave 1
- wave 2
- wave 3
- wave 4
- wave 5

Follow-up period
Accrual period

Periods:
- Period 0
- Period 1
- Period 2
- Period 3
- Period 4
- Period 5

Quarters:
- Q1
- Q2
- Q3
- Q4
# Participating Systems

<table>
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<th>Name</th>
<th># Primary Care Clinics (Randomized)</th>
<th># PCPs (Randomized)</th>
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<td>Kaiser Perm. N. California</td>
<td>21</td>
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<tr>
<td>Henry Ford Health System, MI</td>
<td>26</td>
<td>187</td>
</tr>
<tr>
<td>Kaiser Permanente of Washington</td>
<td>19</td>
<td>365</td>
</tr>
<tr>
<td>Mayo Health System</td>
<td>34</td>
<td>400</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>3,301</td>
</tr>
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</table>
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LIRE: Enrollment

**Clinics (n = 100)**
- 34%
- 26%
- 21%
- 19%

**Providers (n = 3,301)**
- 71%
- 6%
- 12%
- 11%

**Patients (n = 246,289)**
- 81%
- 7%
- 5%
- 6%

**Site**
- HFHS
- KP NCAL
- KPWA
- Mayo
Demographics
Patient age at index image

HFHS  KP NCAL  KPWA  Mayo

Age Range
- **18–39**
- **40–60**
- **>60**
Female

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<tr>
<th></th>
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<th>Mayo</th>
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</tr>
<tr>
<td>50%</td>
<td>61%</td>
<td>57%</td>
<td>59%</td>
<td>56%</td>
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Imaging Modality

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</tr>
<tr>
<td>25%</td>
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<td></td>
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</tr>
<tr>
<td>0%</td>
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</table>

Modality: CT, MRI, X-ray
Dealing with Complexities: Timing

O = Ordered

Time
Dealing with Complexities: Timing

O = Ordered
C = Completed

Time
Dealing with Complexities: Timing

Study Day 0

O = Ordered
C = Completed
F = Finalized
Dealing with Complexities: Timing

Index Test (Xray or MRI)

O = Ordered
C = Completed
F = Finalized
Outcome Definition (MR/CT)

Study Day 0

Study Day 90

O = Ordered
C = Completed
F = Finalized
Outcome Definition (MR/CT)

Study Day 0

O C F

Study Day 90

O C F

O = Ordered
C = Completed
F = Finalized
Outcome Definition (MR/CT)

O = Ordered
C = Completed
F = Finalized

Study Day 0

Study Day 90
Outcome Definition (MR/CT)

O = Ordered
C = Completed
F = Finalized

Study Day 0

Study Day 90
Outcome Definition (MR/CT)

O = Ordered
C = Completed
F = Finalized

Study Day 0

O  C  F

Study Day 90

O  C  F
Ordered after index and completed within 90 days

Study Day 0

O = Ordered
C = Completed
F = Finalized

Study Day 90

Site A
Xray 12.6%
MR 1.9%

Site B
Xray 13.5%
MR 3.2%
Ordered before index and completed between 0-90 days

Study Day 0

Site A | Site B
---|---
Xray | 2.9% | 1.5%
MR | 0% | 0.1%

Study Day 90

O = Ordered
C = Completed
F = Finalized
Ordered 0-90 days after index but finalized after 90 days

Study Day 0

Study Day 90

Site A
Xray 0.7%
MR 0.2%

Site B
Xray 0.3%
MR 0.2%

O = Ordered
C = Completed
F = Finalized
Time between MR Order and Completion

- Site A
- Site B

Number of Days

0% 5% 10% 15% 20% 25% 30% 35% 40%
Intervention Adherence

- Site A: 98%
- Site B: 86%
Stepped Wedge RCT

Exposed to LIRE intervention

Unexposed to LIRE intervention

*Randomization

wave 1
wave 2
wave 3
wave 4
wave 5

Follow-up period
Accrual period

Period 0 Period 1 Period 2 Period 3 Period 4 Period 5
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
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These Are Preliminary Results

• Results are preliminary since we continue careful and deliberate data cleaning, an iterative process
• Have completed this process for 2 of 4 sites for secondary outcome: subsequent CT or MR by 90 days
Cumulative Incidence of MR/CT Imaging Over All Waves

Site B

Index Image Type

- XR
- MR

Days after Index Image

Incidence
Cumulative Incidence of MR/CT by Intervention/Control Group

- **XRay**
- **MR**

Days after Index Image

- **Control**
- **Intervention**

Sites:
- Site A
- Site B
## X-ray Cohort

<table>
<thead>
<tr>
<th>Site</th>
<th>Clinic Wave</th>
<th>Control</th>
<th>Intervention</th>
<th>Difference (I-C)</th>
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<td></td>
<td>N</td>
<td>90-day MR/CT</td>
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<tr>
<td>A</td>
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<td>296</td>
<td>37</td>
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<td>1,231</td>
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## MR Cohort

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<td>20,277</td>
<td>635</td>
<td>3.1%</td>
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</table>
Talk Outline

• Brief review of study goals/design
• Progress to date
• Subsequent MR/CT imaging through 90 days
• Next steps
Analysis in Progress

- Fixed effects: age, gender, site, 6-month time point, clinic size, and baseline comorbidity
- GEE and NLMIXED
- Separate models for XR and MR
“Now! ... That should clear up a few things around here!”
Some Key Lessons Learned

• Prior
  – Keep intervention as simple as possible
  – Minimize burden on system partners

• Current
  – Big data sets are complex
  – Understanding complexities iterative process that takes time
Key People

- Katie James, PA, MPH, Director
- Brian Bresnahan, PhD- Health Econ
- Bryan Comstock, MS- Biostats
- Janna Friedly, MD- Rehab
- Laurie Gold, PhD- Radiology
- Patrick Heagerty, PhD- Biostats
- Larry Kessler, PhD- HSR
- Danielle Lavallee, Pharm D, PhD
- Eric Meier, MS- Biostats
- Nancy Organ, BA- Statistics
- Kari Stephens, PhD- Informatics
- Judy Turner, PhD- Psychol/Psych
- Sean Rundell, DPT, PhD
- Zachary Marcum, PharmD, PhD
- Katherine Tan, PhD Candidate, Biostats
- Rick Deyo, MD, MPH- OHSU
- Dan Cherkin, PhD- KPWA
- Karen Sherman, PhD- KPWA
- Heidi Berthoud, KPWA
- Brent Griffith, MD- HFHS
- Dave Nerenz, PhD- HFHS
- Dave Kallmes, MD- Mayo
- Patrick Luetmer, MD- Mayo
- Andy Avins, MD, MPH- KPNC
Why Pragmatic Trials Are Important

The Great Zeferelli’s chair worked a lot better in controlled conditions.
Time between Order and Completion for MR and XR

Number of Days

MR

XR

Site A

Site B
MR/CT Rates by Age and Gender

![Graph showing MR/CT rates by age and gender for Site A and Site B. The graph includes lines for male and female, with different trends observed across age groups.](image-url)