Kaiser Permanente Total Joint Registry: Enhancing Quality, Patient Safety & Cost Effectiveness

RIAP Conference
July 2016

Liz Paxton
Director Kaiser Permanente National Implant Registries
About Kaiser Permanente

- Nation’s largest nonprofit health plan
- Integrated health care delivery system
  - 9 million members
  - 12,000+ physicians
  - 140,000+ employees
  - 430+ medical offices
- 32 hospitals and medical centers
- 7 regions serving 8 states and D.C.
A Learning Health Care System

Evidence is continually refined as a byproduct of care delivery

Information and evidence transform interactions from reactive to proactive (benefits and harms)

From “A Learning Health Care System for Cancer Care” by Carolyn Clancy, MD, Agency for Healthcare Research and Quality
Goals Kaiser Permanente Registries

- Identify patients at risk for poor outcomes
- Identify clinical best practices for quality improvement
- Identify best performing/outlier devices for our patients
- Device recalls/notifications
- Comparative effectiveness research
<table>
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<tr>
<th>Orthopedic Registries</th>
<th>Cardiac/Vascular</th>
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<td>EVAR</td>
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Kaiser Permanente Registries

- Developed in 2001
- Modeled after Swedish Hip Register
- Methods
  - Standardized documentation
  - Leveraging existing EHR data
    - Patient information
    - Procedures/diagnoses
    - Implant data and clinical attributes library
    - Labs
    - Medications
  - Adverse event electronic screening methods
  - Stringent quality control processes
  - Chart review validation of outcomes (Revision, Infection, DVT, PE)
# Left Knee Implant Registry

## General Information
- **Knee:** Left
- **Date:** July 8, 2016

## Procedure Details
- **Type:** Total Knee Arthroplasty (TKA)
- **Implant:** Ceramic-on-Ceramic

## Clinical Details
- **Diagnosis:** Osteoarthritis
- **Secondary Diagnosis:** Rheumatoid Arthritis
- **Revision:** Yes
- **Conversion:** Yes

## Implant Details
- **Implant Material:** Ceramic
- **Implant Size:** 10 mm

## Soft Tissue and Bone Issues
- **Bone Graft:** None
- **Soft Tissue Release:** None
- **Extensor Tendon:** Yes
- **Patellar Tendon:** Yes
- **Quadriceps Tendon:** Yes
- **Gastrocnemius Tendon:** Yes

## Other Details
- **Procedure Comments:** None
- **Source:** Internal

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**Legend:**
- **TKA:** Total Knee Arthroplasty
- **Revision:** Revision surgery
- **Conversion:** Conversion to a different procedure
- **Bone Graft:** None or Patellar Tendon
- **Soft Tissue Release:** None or Patellar Tendon

**Notes:**
- Use comments for additional details not listed in the table.
### Implant Data Elements Extracted from EHR

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<th>Optime Company</th>
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### Implant Reference Library

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<th>COMPANY NAME</th>
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### Implant Components
- Company Name
- Catalog #
- Lot/Serial #
- Quantity
- Material
- Fixation
- Size
- Mobility
- Stability
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<th>Data aggregation and storage</th>
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<th>Information delivery systems</th>
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<td>Extract Transfer load</td>
<td>Data extraction</td>
<td>Data queries</td>
<td>Annual report</td>
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<tr>
<td>Data cleaning and quality control checks</td>
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<td>Data mining</td>
<td>Risk adjusted medical center reports</td>
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<td>Machine learning</td>
<td>Predictive modeling</td>
<td>Personalized surgeon profiles</td>
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<td>Chart review validation of adverse events</td>
<td>Survival analyses</td>
<td>Recalls/advisories</td>
<td>Identification of outlier implants</td>
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<td>Identification of variation and clinical best practices</td>
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<td>GEMS</td>
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<td>Patient characteristics</td>
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## Identification of Variation

<table>
<thead>
<tr>
<th>Patient</th>
<th>Implant</th>
<th>Surgeon</th>
<th>Medical Center</th>
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</thead>
</table>
| • Individual risk  
  • Subgroups at risk  | • Outliers (best/worst)  | • Individual performance  
  • Clinical best practices  | • Medical center performance         |

**Kaiser Permanente thrive**
KP Tools for Enhancing Quality & Patient care

- Medical center reports
- Individualized surgeon profiles
- Quarterly quality reports
- Patient risk calculators
- Outlier implant reports
- Recall/advisory identification/tracking
- Newsletters/meetings/conferences
- Publications
Identifying Patient Risk Factors
Implant Recalls/Advisories

- 14,000 patients with enhanced surveillance due to 17 recalls in 2014-2015 alone
- Allows immediate notification of patients and lists to surgeons
- Provides a mechanism to monitor patient follow-up related to recall
Risk Factors for Revisions and Complications

Revision Total Hip Arthroplasty: Factors Associated with Re-Revision Surgery
Monti Khatod, MD, Guy Cafri, PhD, Maria C.S. Inacio, PhD, Alan L. Schepps, MS, Elizabeth W. Paxton, MA, and Stefano A. Bini, MD

Risk Factors Associated with Deep Surgical Site Infections After Primary Total Knee Arthroplasty
Robert S. Namba, MD, Maria C.S. Inacio, MS, and Elizabeth W. Paxton, MA

Risk factors for Total Hip Arthroplasty Aseptic Revision
Monti Khatod, MD a, Guy Cafri, PhD b, Robert S. Namba, MD c, Maria C.S. Inacio, PhD b, Elizabeth W. Paxton, MA b

Risk Factors for Total Knee Arthroplasty Aseptic Revision
Robert S. Namba, MD a, Guy Cafri, PhD b, Monti Khatod, MD c, Maria C.S. Inacio, PhD b, Timothy W. Brox, MD d, Elizabeth W. Paxton, MA b

Are There Modifiable Risk Factors for Hospital Readmission After Total Hip Arthroplasty in a US Healthcare System?
Elizabeth W. Paxton MA, Maria C. S. Inacio PhD, Jasvinder A. Singh MD, MPH, Rebecca Love MPH, RN, Stefano A. Bini MD, Robert S. Namba MD

Association of Bisphosphonate Use and Risk of Revision After THA: Outcomes From a US Total Joint Replacement Registry
Monti Khatod MD, Maria C. S. Inacio PhD, Richard M. Dell MD, Stefano A. Bini MD, Elizabeth W. Paxton MA, Robert S. Namba MD
Patient Risk Calculators

Risk Calculators Predict Failures of Knee and Hip Arthroplasties: Findings from a Large Health Maintenance Organization

Elizabeth W. Paxton MA, Maria C. S. Inacio PhD, Monti Khatod MD, Eric Yue MD, Tadashi Fumahashi MD, Thomas Barber MD
Identifying Clinical Best Practices and Providing Surgeon Feedback
Identification of Clinical Best Practices

Pulmonary Embolism Prophylaxis in More Than 30,000 Total Knee Arthroplasty Patients: Is There a Best Choice?
Monti Khatod, MD,* Maria C.S. Inacio, MS, Stefa and Elizabeth W. Paxton, MA

Anterior and Anterolateral Approaches for THA Are Associated With Lower Dislocation Risk Without Higher Revision Risk
Dhiren Sheth MD, Guy Cafri PhD, Maria C. S. Inacio PhD, Elizabeth W. Paxton MA, Robert S. Namba MD

Can total knee arthroplasty be safely performed in patients with chronic renal disease?
An evaluation of perioperative morbidity in 2,686 procedures from a Total Joint Replacement Registry
Alexander Miric, Maria CS Inacio, and Robert S Namba

Antibiotic cement was associated with half the risk of re-revision in 1,154 aseptic revision total knee arthroplasties
Stefano A Bini, Priscilla H Chan, Maria C S Inacio, Elizabeth W Paxton & Monti Khatod
TKA General Anesthesia

- General anesthesia found to be a significant risk factor for PE compared to non–general anesthesia, increasing the odds of an event by 67% (95% CI, 14%-144%; P = .009)
Confidential Surgeon Profiles

- Personal practice profiles to allow surgeons to compare their patient demographics, implants, techniques and outcomes to others in their medical center, region, and nationwide.
Identifying the Best Implants For Our Patients
Outlier Implants

Screening for Outliers
- Flag implants with revision rate (per 100 component years) 2 times that of its group, e.g. THA, BHR, TKA, UKA

Risk-Adjustment
- Risk-adjusted by diagnosis, gender, and age
- Focus on implants with > 500 cases
- Survival analysis

Follow-up and Dissemination
- Monitor outliers with short-term follow-up and small Ns
- Confirmatory analyses with other national registries
- Share findings with surgeons
Device Comparative Effectiveness

Is There a Difference in Total Knee Arthroplasty Risk of Revision in Highly Crosslinked versus Conventional Polyethylene?

Elizabeth W. Paxton MA, Maria C. S. Inacio PhD, Steven Kurtz PhD, Rebecca Love MPH, RN, Guy Cafri PhD, Robert S. Namba MD

KNEE
Increased risk of revision for high flexion total knee replacement with thicker tibial liners

KNEE
Does pre-coating total knee tibial implants affect the risk of aseptic revision?

ORIGINAL ARTICLE
Evaluation of total hip arthroplasty devices using a total joint replacement registry
Elizabeth W. Paxton*, Christopher F. Ake, Maria C. S. Inacio, Monti Khatod, Danica Marinac-Dabic and Art Sedrakyan

Metal-on-conventional Polyethylene Total Hip Arthroplasty Bearing Surfaces Have a Higher Risk of Revision Than Metal-on-highly Crosslinked Polyethylene: Results From a US Registry

Elizabeth W. Paxton MA, Maria C. S. Inacio PhD, Robert S. Namba MD, Rebecca Love MPH, RN, Steven M. Kurtz PhD

Acta Orthopaedica 2013; 84 (5): x–x

Monoblock all-polyethylene tibial components have a lower risk of early revision than metal-backed modular components
A registry study of 27,657 primary total knee arthroplasties

Maria C S Inacio2, Robert S Namba1, Dhiren Sheth1, and Elizabeth W Paxton2

Acta Orthopaedica 2013; 84 (2): x–x

Alternative bearings in total knee arthroplasty: risk of early revision compared to traditional bearings An analysis of 62,177 primary cases
Maria C S Inacio, Guy Cafri, Elizabeth W Paxton, Steven M Kurts, and Robert S Namba
Total Knee Arthroplasty LCS Implant

Percent of Primary TKR Cases with LCS Implant

- Yearly percentage of primary total knee replacement (TKR) cases with LCS implant.
Early Identification of Outlier Devices and Changes in Clinical Practice

- Registry findings:
  - HRs had a higher risk of revision than THA (HR=3.51, 2.02-6.10), p<.001
- Reduction in HR program-wide
Total Hip Arthroplasty Bearing Surface

- Metal-on-conventional polyethylene and metal-on-metal shown to have higher risk of revision and are decreasing in use
- Metal-on-highly crosslinked polyethylene has a lower risk of revision than other bearing surfaces and use is increasing

![Graph showing primary THA bearing surface from 2001 to 2012. The graph indicates a decrease in metal-on-conventional and metal-on-metal bearings, and an increase in metal-on-crosslink bearings.](image-url)
Identifying Hospital Variation and Best Practices
Hospital Variation and Improvement

- **Methods**
  - Observed vs expected risk adjusted revision rate for THR/TKR
  - Limited to facilities performing 500 total joints per year
  - 5 medical centers (out of 35) were identified as outliers
  - Independent, outside orthopedic surgeons reviewed two sites
    - Radiologic and chart review of ALL revisions was done
    - All total joint surgeons attended presentation of recommendations
- **Results:** Four of the medical centers improved their revision rates
# Quarterly Quality Reports

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<th>90-Day Deep Infection Rate</th>
<th>90-Day DVT Rate</th>
<th>90-Day PE Rate</th>
<th>90-Day Mortality Rate</th>
<th>30-Day UNPLANNED Inpatient Readmission Rate</th>
<th>30-Day Emergency Visit Rate</th>
<th>Length of Stay (Median)</th>
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<td>&lt;= 1.0%</td>
<td>&lt;= 0.5%</td>
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</table>
Changes in Practice and Improved Patient Outcomes

Overall 30-Day Emergency Visit Rate: 11.94%

KNEE 30-DAY EMERGENCY VISIT RATE

Overall Emergency Visit Rate  —  Emergency Visit Rate  —  UCL  —  +2SD  —  +1SD  —  -1SD  —  -2SD  —  LCL
Cost effectiveness

- Identify best performing implants for national contracting decisions
- Evaluate expensive new technology claims
- Early identification and prevention of inferior implants
- Reduce revisions associated with less successful techniques/implants
  - Complicated revisions $100,000 USD
Total joint Replacement Outcomes
## Total Joint Complications

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<tr>
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<th>Primary Total Hips</th>
<th>Revision Total Hips</th>
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<tbody>
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<td><strong>Deep SSI</strong></td>
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<tr>
<td><strong>DVT</strong></td>
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<td>.8%</td>
</tr>
<tr>
<td><strong>PE</strong></td>
<td>.5%</td>
<td>.4%</td>
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<tr>
<td><strong>Primary Total Knees</strong></td>
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<tr>
<td><strong>Deep SSI</strong></td>
<td>.7%</td>
<td>1.7%</td>
</tr>
<tr>
<td><strong>DVT</strong></td>
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<td>.4%</td>
</tr>
<tr>
<td><strong>PE</strong></td>
<td>.6%</td>
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Revision Burden

THA Revision Burden

TKA Revision Burden

KP | US | NJR-UK | Norway
# Longitudinal Tracking of Procedures/Devices

<table>
<thead>
<tr>
<th>Registry</th>
<th>Total Joint Replacement 10-year Survival % (CI)</th>
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<tbody>
<tr>
<td></td>
<td>Hip</td>
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<tr>
<td>KP (2001-2013)</td>
<td>95.4 (95.1-95.7)</td>
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<tr>
<td>Australia (1999-2013)</td>
<td>93.2 (93.1-93.4)</td>
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<tr>
<td>Sweden (2003-2012)</td>
<td>94.6 (94.3-94.9)</td>
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<tr>
<td>New Zealand (1999-2013)</td>
<td>93.10%</td>
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<tr>
<td>NJR (2002-2013)</td>
<td>94.25 (94.09-94.45)</td>
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</table>
Value of Registries

- Provide quality, relevant clinical information to physicians, hospitals, patients, industry, regulators in real time based on real world experience

- Continuous Quality Improvement
  - Identification of variation in practices and outcomes
  - Identification and dissemination of clinical best practices
  - Clinician ownership is a critical factor in change

- Patient Safety
  - Identification of patient risk factors
  - Useful for recalls, advisories, and adverse event surveillance

- Comparative effectiveness
Conclusions

- Registries are vital for patient safety, quality improvement and cost-effectiveness
- A variety of quality improvement tools can be used to provide feedback to patients, surgeons, and hospitals
- Feedback on clinical best practices results in quality improvement and enhanced clinical outcomes for total joint replacement