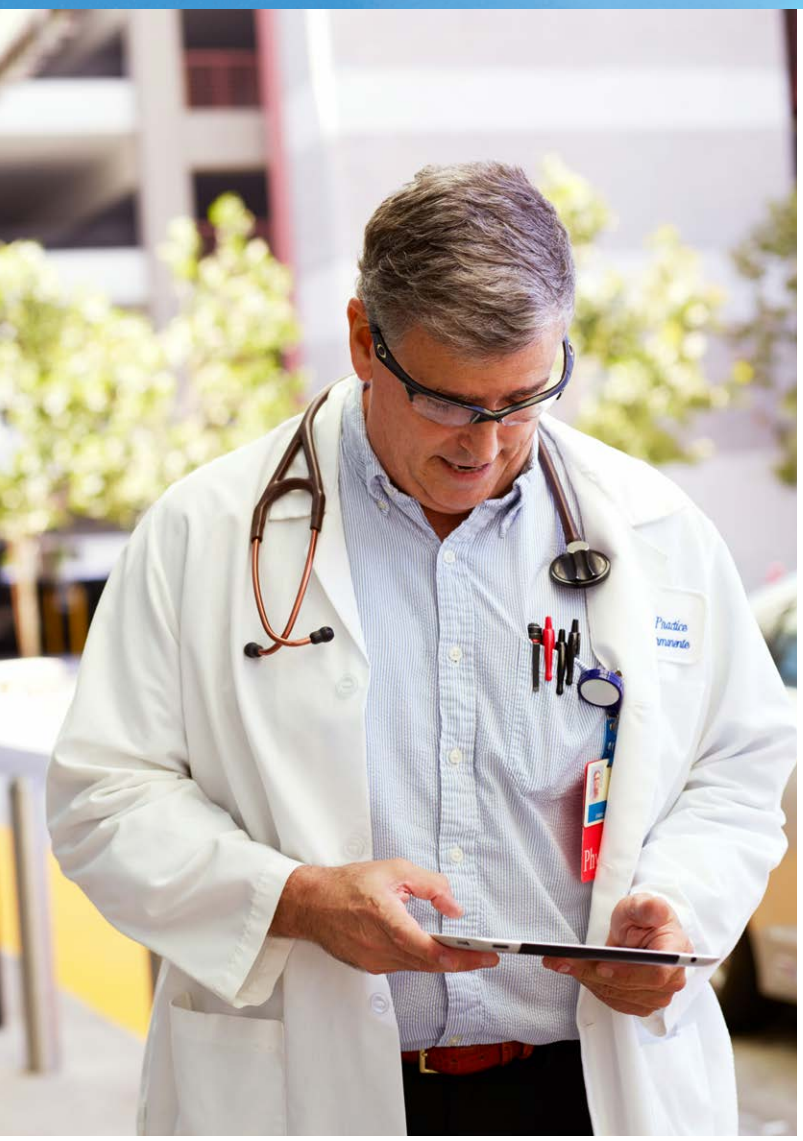
# Kaiser Permanente National Implant Registries



## 2019 Annual Report

KAISER PERMANENTE®

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# Leadership Message

Dear Colleagues,

We are honored to present the 2019 Kaiser Permanente National Implant Registries Annual Report which highlights the critical role of the implant registries in transforming quality of care using an evidence-based medicine approach.

The registries monitor patient characteristics, surgical approaches, implant characteristics, and clinical outcomes for more than 3.05 million cardiac, neurosurgery, orthopedic, and vascular implants for our 12.3 million members. Using this real-world data, the registries provide feedback to our frontline clinicians and staff to enhance patient care and safety using a variety of methods including:

- Research studies and quality reporting tools to identify clinical best practices
- Benchmarking and quality reporting to monitor and identify medical center and regional variation in clinical outcomes
- Outlier implant reports to identify implants with higher and lower than expected clinical performance
- Patient-centered risk calculators to identify individualized patient risk and enhance clinical decision-making at the point of care
- Confidential physician profiles to benchmark clinical practices and outcomes at the medical center, regional and national level

These techniques have transformed care and enhanced patient quality as evidenced in our exemplary clinical outcomes.

The success of the National Implant Registries is the direct result of the dedication and commitment of the Kaiser Permanente physicians and staff who contribute to and use this evidence on a continual basis to guide clinical practice decisions.

Thank you all for your important contributions and continued support enhancing patient safety and quality of care for our members and patients worldwide.

**Liz Paxton, PhD, MA**
*Director, National Implant Registries*

**Tadashi Funahashi, MD**
*Chair, Inter-Regional Implant Registries Committee*

# Inter-Regional Implant Registries Committee Members

## IIRC Membership

Scott H. Adelman, MD, FACC
*Chair, Cardiology Core Group of National Product Council*
*Chair, NCAL Cardiovascular Technology Committee*
*Senior Technology Advisor-Innovation and Advanced Technology*

Ralph G. Brindis, MD, MPH, MACC, FSCAI
*Clinical Professor of Medicine*
*Department of Medicine & the Philip R. Lee Institute for Health Policy Studies*
*University of California, San Francisco*

Patrick Courneya, MD
*Executive Vice President and Chief Medical Officer*
*Kaiser Foundation Hospitals and Health Plan*
*Hospital Quality and Care Delivery Excellence*

Christopher M. Grant, BA
*Executive Vice President and Chief Operating Officer*
*The Permanente Federation*

Jo Carol Hiatt, MD, MBA
*Chair, National Product Council*
*Chair, Inter-Regional New Technologies Committee*
*Assistant Medical Director, Southern California Permanente Medical Group*

Murray N. Ross, PhD
*Vice President and Director of Institute for Health Policy*
*Kaiser Foundation Health Plan Enhancing Patient Safety and Quality of Care*

Ronald A. Navarro, MD
*Regional Coordinating Chief of Orthopedic Surgery, Southern California Permanente Medical Group*
*Assistant Area Medical Director, Surgical and Perioperative Services*
*Lead, Kaiser Permanente Shoulder Arthroplasty Registry*
*Member at Large, Board of Directors, American Academy of Orthopedic Surgeons*

Eric Cain, MD, MBA
*Physician-in-Chief, Fremont Medical Center*

Margaret Mentakis, MD, FACS
*Department of Surgery, South Sacramento*
*Kaiser Permanente HealthConnect Procedural and Perioperative Services*
*The Permanente Medical Group Technology Leader*

# What We Provide

Registries play a critical role in enhancing quality of care by identifying variation and clinical best practices and providing feedback to frontline staff and clinicians using a variety of dynamic feedback mechanisms.

## NATIONAL IMPLANT REGISTRIES

## WHAT WE PROVIDE

**Identifying the most effective surgical techniques and implant devices for quality improvement and safety**

**Assessing patient risk factors for complications using risk calculators at point of care for clinical decision-making**

**Integrating research methodologies with facility level reporting to help support the growth of transformative care model**

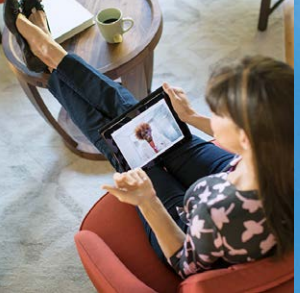
**Monitoring patients with recalled implants**

**Providing confidential feedback to surgeons on their patients' outcomes**

**Monitoring outcomes, including revisions, re-operations, and complications**

**Providing risk-adjusted hospital outcomes and benchmarking for quality improvement**

**Tracking implant usage and performance for contract decision-making**



# National Implant Registries: By the Numbers

8 regions, 9 states representing
12.3 million members

75 medical centers

187 publications in peer-reviewed journals
17 in 2018

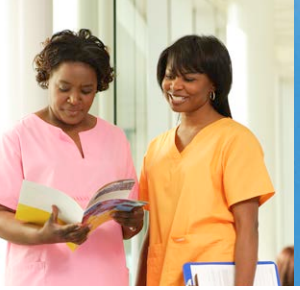
211 posters & presentations at national & international symposia

2,566 participating surgeons

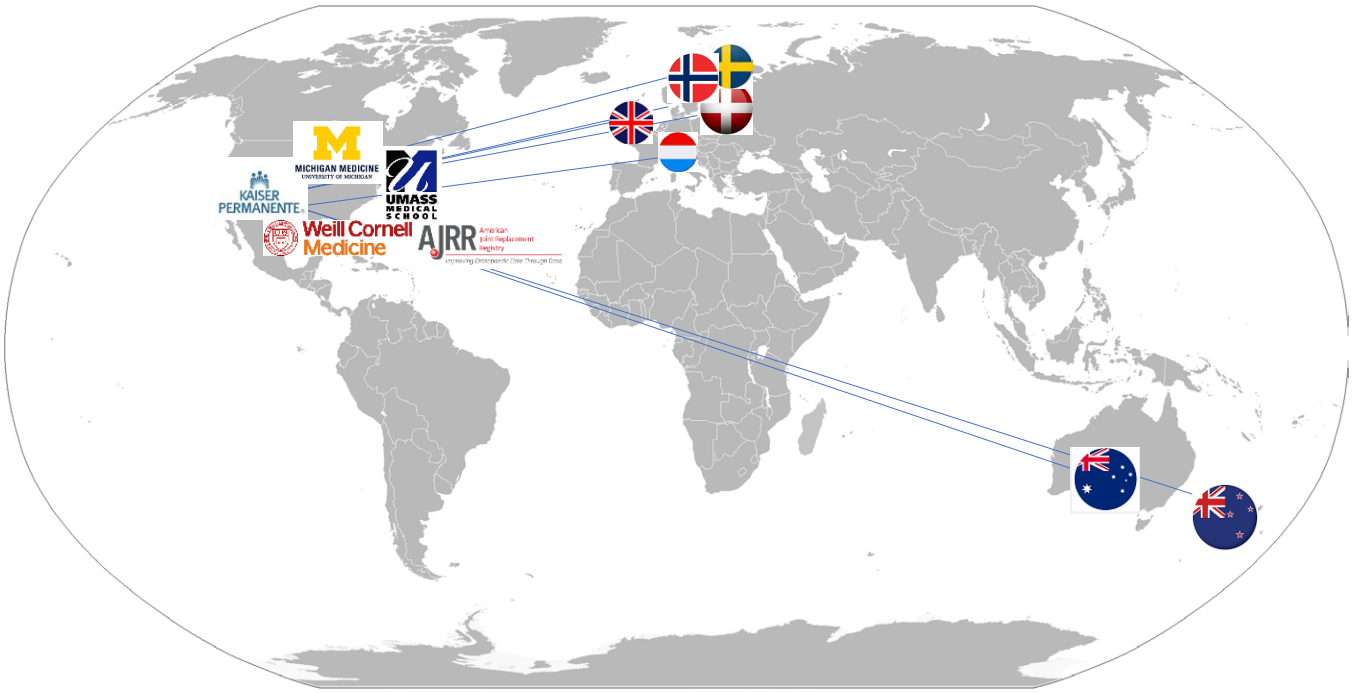
110,026 patients with enhanced surveillance due to 95 recalls from 2000-2018

690,000+ procedures captured and tracked for the patient's lifetime

3.05 million implants registered



# National and International Collaborations




- Full member and President of International Society of Arthroplasty Registries (ISAR) focused on enhancing arthroplasty registries' collaboration to improve global arthroplasty outcomes
- Leading along with Cornell the USA Orthopaedic Coordinated Registries network (OrthoCRN) to enhance postmarket surveillance in the USA
- Member of The Medical Device Epidemiology Network (MDEpiNet), a global public-private partnership advancing the use of real-world data to improve patient outcomes
- National Evaluation System for Health Technology (NEST) pilot project developing objective performance criteria for arthroplasty devices in the USA
- Anterior Cruciate Ligament Reconstruction (ACLR) registry international collaborations with Denmark, Luxembourg, Norway, Sweden, Australia, New Zealand, and the United Kingdom
- Shoulder Arthroplasty Registry (SAR) international collaborations with Denmark, Australia, and Sweden

# Highlights of a Transformative Care Model

## Innovative Tools to Support Clinical Decision Making

Risk calculators, facility specific reports, and surgeon profiles are among the innovative tools that use registry data to support clinical decision making.

**Risk calculators** enable implanting surgeons to predict surgical outcomes for current patients. "I now use the risk calculators to assess my patients prior to surgery similar to the way I use radiographs, clinical exams, and lab work to determine the best path forward for each patient," said orthopedic surgeon Adrian Hinman, MD, San Leandro Medical Center. "Risk calculators help me weigh the risks and benefits of both operative and non-operative treatments and tailor my recommendation to each patient."

**Facility specific reports** clearly identify medical centers with outlying performance to create an opportunity for benchmarking and shared learnings. Once identified as an outlier a deep dive into the underlying reasons as to why a variability in practice or outcomes is occurring is reviewed. "There are very few other organizations that have this commitment to collecting data on quality," said Christopher Grimsrud, MD, PhD, Chief of Orthopedics, Kaiser East Bay Medical Centers. Conversely, facilities demonstrating above average performance are clearly identified as likely sources of best practice learnings. In this way Dr. Grimsrud explains, "the registries are extremely valuable in improving care for our patients."

**Surgeon profiles** serve as confidential report cards which enable surgeons to identify specific areas with outlying performance they can then target for practice improvement. "This gives surgeons an opportunity to reach out to their partners for advice and support," said Dr. Grimsrud.

In Dr. Grimsrud's experience, his surgeon profile provides an added benefit. "I was one of the first surgeons to start doing direct anterior approach total hip replacement in Northern California. The report enabled me to track my results and inform my patients that they could expect good outcomes from surgery with me."

Risk calculators, medical center reports, and surgeon profiles provide real world feedback to clinicians and staff to enhance quality of care.

# Highlights of a Transformative Care Model

## Remote Monitoring for Cardiac Devices Allows for Round-the-Clock Diagnosis Ensuring Device Functionality and Increased Patient Care

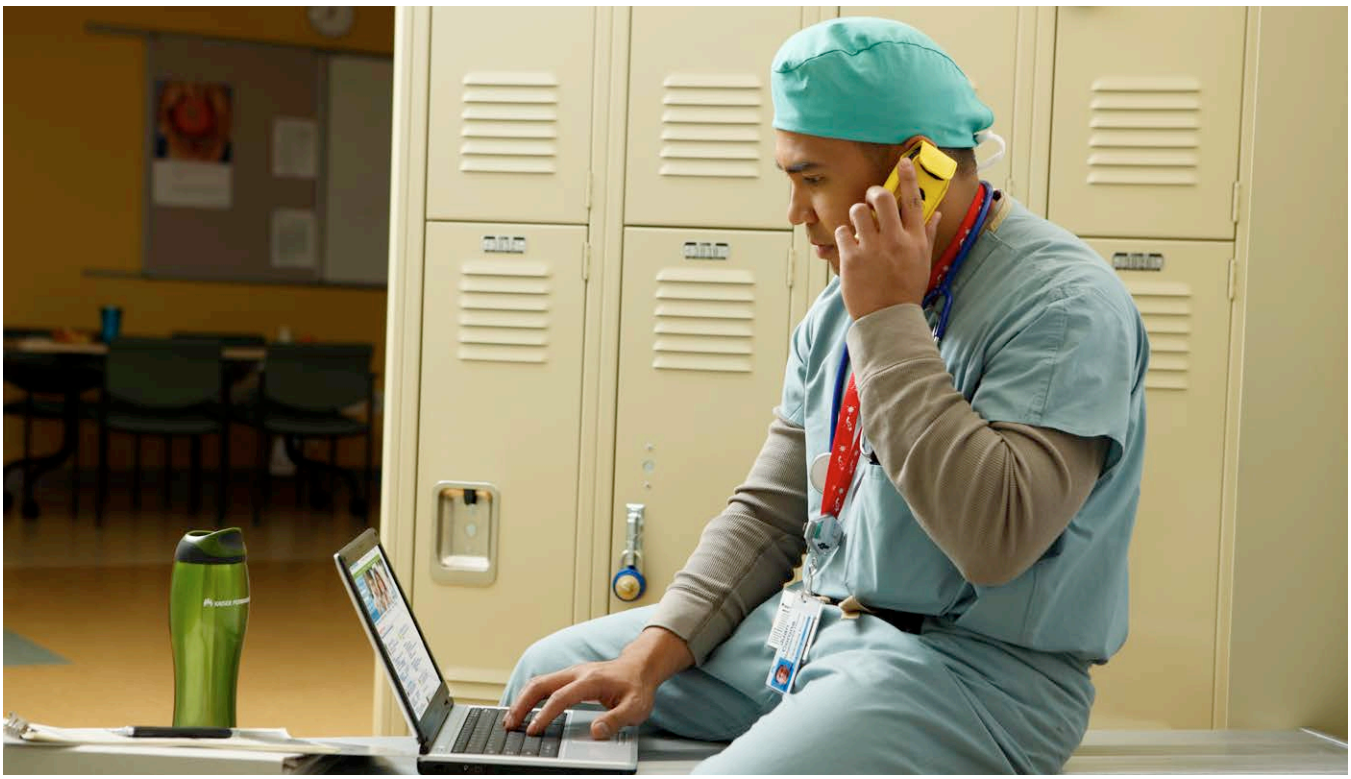
Traditionally, patients with cardiac implantable electronic devices (CIEDs) needed to arrange a clinic or hospital visit every three months to ensure their device was performing properly. Now, through the capabilities of remote monitoring one visit per year is sufficient for most patients.

Remote monitoring is a function of Kaiser Permanente's Cardiac Device Registry which evaluates and monitors device performance and patient outcomes. With its ability to report patient level information to clinicians and front-line staff, remote monitoring enrollment rates have increased by over 20% program-wide since 2017, allowing for the continuous care of nearly 94% of all of Kaiser Permanente's CIED patients.

"Patients get all the advantages of monitoring without having to come in for routine device interrogation," said Nigel Gupta, MD, Director, Regional Cardiac Electrophysiology Services, Los Angeles Medical Center. "We can now tell remotely how each patient's device is performing on a round-the-clock basis and from wherever they happen to be."

Many problems that may formerly have gone undetected for weeks or longer are now being caught in real time. "Earlier detection is the key to preventing serious complications," said Dr. Gupta. "For example, remote monitoring enables us to quickly detect a broken lead in a device so we can get our patient into the operating room right away and fix it. When we detect an arrhythmia, we can often resolve the problem with a medication change right over the phone and thus prevent a bad outcome like stroke or even heart failure."

Kaiser Permanente is currently working to get every patient with a CIED linked to a remote monitoring device and enrollment rates are on the rise. "There really isn't a patient who should not have remote monitoring," said Dr. Gupta. "This is a great use of technology to provide better, more efficient, life-saving care."



# Highlights of a Transformative Care Model

## Risk Factors for Opioid Use After Shoulder Arthroplasty and Anterior Cruciate Ligament Reconstruction

Opioid misuse and abuse have contributed to a significant national crisis, yet opioids remain an important component in relieving pain after orthopedic surgery. Studies conducted using Kaiser Permanente registry data are helping orthopedic surgeons identify patients at risk of prolonged opioid use in order to help ensure the safe and proper use of these medications.

As reported in the 2018 National Implant Registries Annual Report, studies looking at the effects of opioids before and after total joint replacement led to the implementation of strategies to reduce unsafe usage.

Registry studies have also been conducted to identify the risk factors for opioid use following shoulder arthroplasty and anterior cruciate ligament reconstruction. "These studies have helped create an awareness of risk factors we did not have objectively before," said orthopedic surgeon, Anita Rao, MD, Kaiser Permanente Northwest Region. "This awareness is affecting how we prescribe opioids to patients."

Registry study results are regarded as very important in supporting clinicians in the opioid crisis by providing objective data and risk factors that can be used in clinical decision-making and in setting appropriate expectations with patients. The studies also help create protocols and multi-modal treatment plans within the Kaiser Permanente organization that can benefit both patients and providers.

"The heightening interest in what we could do as surgeons to help combat the opioid crisis were key drivers for these studies," said Dr. Rao. "The increased awareness about prescription opioid usage, aided by opioid data from the registry studies, has helped produce early changes in prescribing habits that we anticipate will produce appreciable reductions in opioid usage in the perioperative period."

# Highlights of a Transformative Care Model

## Association Between Race/Ethnicity and Orthopedic Surgical Outcomes Within a Universally Insured Population

Unequal access to health care is among the most commonly cited reasons for racial and ethnic disparities. Prior studies have shown that universal access may mitigate some racial disparities in surgical outcomes.

Kaiser Permanente's universally insured care model offers a unique opportunity to investigate whether racial/ethnic disparities exist within its managed health care system in which all patients have uniform access to care. "We wanted to see if our Kaiser Permanente system fundamentally treated disparities differently since the access to care should be easier," said Ronald Navarro, MD, Regional Chief of Orthopedics, South Bay Medical Center.

Kaiser Permanente conducted multiple studies across its orthopedic registries looking at surgical outcomes based on race and ethnicity in a large managed health care system in which all patients are insured. Study results suggest that, depending on the type of surgery, nonwhite races have better outcomes in most cases, however, "In some studies, our black patients had notably higher rates of ED visits and readmissions," said Dr. Navarro. "Further investigation is warranted to determine reasons for this disparity and identify interventions."

The National Implant Registries' studies build on a growing body of evidence showing that universal access to insurance, integrated health care delivery, and standardization of quality may be central in eliminating race and ethnic disparities.

"By first studying if disparities exist, even in a system that lessens the burden to access care, we can know if there are opportunities for improvement," said Dr. Navarro. "We can then work to lessen disparity if it exists and increase awareness of any biases that might get in the way of equitable care."

# Updates from our Registries

# Anterior Cruciate Ligament Reconstruction Registry

**Description:**

The anterior cruciate ligament reconstruction (ACLR) registry was established in 2005 and tracks implants and outcomes of ACLR cases. As of year-end 2018, there were 49,204 cases in the ACLR registry.

## Clinical Findings

- In our cohort of 19,059 patients with primary ACLR, tibial independent (TI) techniques were used for 12,342 (64.8%) of the ACLRs, and the transtibial (TT) method was used for 6,717 (35.2%). After adjustments for covariates, the TI group had a higher risk of aseptic revision than the TT group, and this risk was 1.41 times higher in patients younger than 22 years specifically. No difference in risk for aseptic reoperation was observed. *(Tejwani et al. 2018)*
- In our combined cohort of 101,125 primary ACLRs across six national, regional, and hospital-based ACLR registry cohorts including Denmark, Luxembourg, Norway, Sweden, the UK, and KP patient demographics and surgical characteristics were observed to understand variation across countries. In all six cohorts, males and soccer injuries were most common. European countries mostly used autografts while allograft was most common in the US. Interference screw was the most frequent femoral fixation in Luxembourg and the US, and suspensory fixation was more frequent in the other countries. Interference was the most frequent tibial fixation type in all six cohorts. Overall adverse events were infrequent. *(Prentice et al. 2018)*
- In our cohort of 6,593 primary ACLRs four femoral-tibial fixation groups were observed to evaluate the risk of aseptic revision and reoperation after hamstring autograft ACLR: crosspin, interference, suspensory, or combination. After adjusting for covariates, revision risk was lower for the crosspin-interference and interference-interference methods compared to the suspensory-interference. In contrast, reoperation risk was higher for crosspin-interference and suspensory-combination methods compared to suspensory-interference. *(Spragg et al. 2018)*

**Registry Champions:** Gregory Maletis, MD, Tadashi Funahashi, MD, Anita Rao, MD, Mark Shaieb, MD, Ron Wyatt, MD, Anne Denys, MD, Mark Davies, MD

## Anterior Cruciate Ligament Reconstruction KP Compared To Benchmarks

| | Kaiser Permanente | Danish Cruciate Ligament Register | Norwegian National Knee Ligament Register | Swedish National ACL Register |
|---|---|---|---|---|
| Start Date | Feb-05 | Jul-05 | Jun-04 | Mar-05 |
| Total N | 49,204 | 33,350 | 25,624 | 44,465 |
| Primaries | 43,480 (88.4) | 28,677 (86.3) | 23,337 (91.1) | 41,500 (93.3) |
| Revisions | 5,724 (11.6) | 2,793 (8.4) | 2,287 (8.9) | 2,965 (6.7) |
| Gender<br>Males<br>Females | <br>30,254 (61.5)<br>18,950 (38.5) | <br>20,047 (60.1)<br>13,303 (39.9) | <br>13,179 (56.5)<br>10,158 (43.5) | <br>25,380 (57.1)<br>19,085 (42.9) |
| Age years (at time of surgery)<br><25<br>≥25 | <br>21,916 (44.5)<br>27,286 (55.5) | <br>14,741 (44.2)<br>18,609 (55.8) | <br>10,328 (44.3)<br>13,009 (55.7) | <br>21,956 (49.4)<br>22,509 (50.6) |
| **Outcomes** | | | | |
| Total Reoperations | 4,783 (11.0) | Not reported | 1,498 (6.4) | Not reported |
| Ipsilateral Knee Reoperations | 3,303 (7.6) | Not reported | 769 (3.3) | Not reported |
| Contralateral Knee Operations | 1,480 (3.4) | Not reported | 729 (3.1) | 2,006 (4.8) |
| Revisions 100 persons-yrs | 1,695 (3.9) | Not reported | 1,105 (4.7) | 2,221 (5.4) |
| 1 year incidence<br>3 year incidence | 0.84<br>1.21 | Not reported<br>Not reported | 0.84<br>1.19 | Not Reported<br>Not Reported |

# Cardiac Device Registry

**Description:**

The cardiac device registry was established in 2000, and tracks pacemakers (PM), implantable cardioverter defibrillators (ICD) and cardiac resynchronization therapy (CRT). As of Q4 2018, there are 136,857 devices in the registry (98,836 initial and 38,021 replacements).

## Clinical Findings

- **Battery Longevity:** In 65,261 patients: CRT-D 6%, ICD 15% and PM/CRT-P 79% the 10-year incidence of battery replacement of old generation (OG 2000-2007) and new generation (NG 2008-2017) was reduced in CRT-D (46 to 39%), ICD (41 to 31%), and PM/CRT-P (29 to 18%). 10-year total mortality of OG and NG was similar at 75% for CRT-D, 71% for ICD, and 67% for PM/CRT-P. Death before any replacement was increased in CRT-D (41 to 50%), ICD (45 to 55%), and PM/CRT-P (54 to 61%). With NG devices, only 44% patients in CRT-D, 38% in ICD, and 23% in PM/CRT-P get to their second device before death despite stable overall mortality.
- **Conclusions:** NG device longevity and need for replacement due to malfunction has improved with fewer consequent surgeries. Investments into battery longevity may be better used for other endeavors that help prolong patient survival so they can obtain full benefit from these life-saving yet costly devices.
- **Device Revisions:** The registry tracks all devices undergoing a procedure to explant or replace the device for any reason. Normal battery depletion (ERI) is an expected replacement procedure. Device explant reasons other than ERI include: premature battery depletion, device upgrade/downgrade, mechanical complication of the pulse generator, mechanical complication of a lead, infection, device recall/advisory, pocket erosion/device migration, pocket pain, and other patient anatomy issues. Data is available for quality reporting, research, and medical center specific requests. The overall complication rate for devices, excluding normal ERI, implanted from 2007-2018 is noted on the next page.
- **Lead Revisions:** The registry tracks all leads undergoing a procedure to replace, reposition, or repair the lead due to a mechanical malfunction including: lead dislodgement, perforation, conductor fracture, insulation failure, high/low thresholds, oversensing, undersensing, non-capture, extracardiac stimulation, and lead noise. The overall complication rate for leads implanted from 2007-2018 are found on the following page.

**Registry Champions:** Nigel Gupta, MD, Cesar Alberte-Lista, MD, Jason Rashkin, MD, Brant Liu, MD, Jitesh Vasadia, MD, Rasoul Mokabberi, MD

# Cardiac Device Registry

## Registry Volume By Device Type (2007-2018)

| Device | Dual | Single | Leadless | TOTAL |
|---|---|---|---|---|
| Pacemakers | 78,071 | 14,258 | 97 | 92,426 |
| ICDs | 16,845 | 15,042 | — | 31,887 |
| | **CRT-D** | **CRT-P** | | |
| CRTs | 11,249 | 1,295 | — | 12,544 |

## Overall Complication Rate, For Devices (excluding normal ERI) (2007-2018)

| Device | Total Volume | Complication | % Complication Rate |
|---|---|---|---|
| **Pacemaker** | | | |
| Dual | 55,095 | 639 | 1.16 |
| Single | 8,708 | 56 | 0.64 |
| Leadless | 97 | 1 | 1.03 |
| **ICD** | | | |
| Dual | 11,721 | 184 | 1.57 |
| Single | 10,937 | 85 | 0.78 |
| **CRT** | | | |
| D | 9,374 | 502 | 5.36 |
| P | 1,046 | 27 | 2.58 |

## Overall Complication Rate, For Leads (2007-2018)

| Function | Total Volume | Complication Volume | % Complication Rate |
|---|---|---|---|
| Brady | 102,538 | 2,012 | 1.96 |
| Heart Failure | 7,587 | 237 | 3.12 |
| Tachy | 21,987 | 683 | 3.11 |

# Endovascular Stent Graft Registry

**Description:**

Established in 2010, the endovascular stent graft registry has effectively tracked the deployment and ensured outcomes surveillance of graft devices used in endovascular aneurysm repair (EVAR) procedures for the repair of abdominal aortic aneurysm (AAA). By the end of 2018, the registry monitored 4,499 primary and 469 revision procedures.

## Clinical Findings

- Registry findings have highlighted the clinical importance of evaluating pre-surgical aneurysm size when assessing the need for an EVAR procedure, including pre-surgical surveillance and tracking of aneurysm size prior to an EVAR procedure. Of the 4,499 EVAR cases captured in the registry, the most common aneurysm size was 5.0-5.59 cm (31.8%). In previous years, the most common procedure group were those patients with >6 cm aneurysm size.
- Tracking of EVAR procedure outcomes, including subsequent related procedures (revisions, secondary interventions, and conversion to open repair), is an important role of the registry. The registry identified endoleak as the most common reason for reintervention (14.8%). Revision of the stent graft occurred in 5.1% of all cases.
- The most common hospital length of stay for EVAR patients is 0 to 1 days (60.3% of patients) with the next highest length of hospital stay being 2 days (17.9%).

## Device Recall

- Registry support for surgeons continued in response to the advancement of a AAA device Safety Advisory, into a Class I medical device recall. The recall was due to higher than anticipated type III endoleaks events. The registry promptly identified patients at risk, providing Kaiser Permanente surgeons and medical centers a roster of patients with affected implants, ensuring patients receive appropriate post-market surveillance of their device and treatment as needed.

**Registry Champions:** Jeffrey Hsu, MD, Nicolas Nelken, MD, Thomas Rehring, MD, Homayon Hajarizadeh, MD, Robert Chang, MD

# Endovascular Stent Graft Registry

## Stent Graft KP Compared To Benchmarks

| | **Study** Total Patient Volume | **Kaiser Permanente** Total Patient Volume | **Study** Mean F/U Time | **Kaiser Permanente** Mean F/U Time | **Study** Estimated Event Rate at 2 Years | **Kaiser Permanente** Estimated Event Rate at 2 Years (95% CI) |
|---|---|---|---|---|---|---|
| Type 1 endoleak | 17,068 | 171 | 2.1 | 3.83 | 3.39 | 2.64 (2.18-3.2) |
| Type 2 endoleak | 17,900 [a] | 156 | 1.84 [a] | 3.83 | 13.04 [a] | 2.35 (1.91-2.89) |
| Type 3 endoleak | 16,116 | 75 | 1.87 | 3.83 | 0.76 | 0.80 (0.56-1.14)[c] |
| Cumulative endoleak | 16,035 | 352 | 2.09 | 3.83 | 18.86 | 4.91 (4.27-5.65) |
| Cumulative endoleak excluding type 2 | 13,636 | 236 | 1.88 | 3.83 | 5.67 | 3.26 (2.75-3.88) |
| Re-intervention Rate | 21,595 [b] | 670 | 2.26 [b] | 3.83 | 11.12 [b] | 10.78 (9.86-11.79) |

[a] Adjusted for the proportion of male patients.
[b] Adjusted for median patient age and mean aneurysm size.
[c] A Class I medical device recall has been issued for the device contributing to increased Type 3 endoleak event rate within the KP patient population.

*Eur J Vasc Endovasc Surg (2018) 55, 177-183*

# Hip Fracture Registry

**Description:**

Established in 2009, the hip fracture registry tracks surgery of the proximal femur. As of December 2018, 49,853 primary hip fracture cases and 1,823 revisions are tracked.

## Clinical Findings:

- A study to assess whether racial and ethnic disparities in hip fracture treatment and outcomes persist within a universally insured population of patients enrolled in an integrated managed care system with equal access and/or standardized protocols, found that postoperative mortality rates were similar across racial and ethnic groups. Compared to white patients, 1-year mortality was similar among black patients, and lower among Hispanic and Asian patients. Black and Hispanic patients had fewer 90-day postoperative complications, compared to white patients. Asian patients had fewer in-hospital decubitus ulcers and 90-day unplanned readmissions, but black patients had more 90-day unplanned readmissions. There were no significant differences between racial/ethnic groups in terms of surgical delay and no differences in 90-day emergency department visits or revisions during the patient's lifetime. *(Okike et al. 2018)*
- Choice of anesthesia technique can affect in-hospital outcomes for fragility hip fracture surgeries and Regional Anesthesia (RA) may offer advantages over General Anesthesia (GA). Compared to RA, GA was associated with higher risk of in-hospital mortality and shorter time to in-hospital mortality. Patients with Conversion (Cv) from RA to GA experienced the highest in-hospital mortality and shortest time to in-hospital mortality. In addition, compared to RA, GA was associated with longer time to discharge and more discharges to a health care facility. *(Qiu et al. 2018)*
- A study of the association of anesthesia technique to mortality and complications within 90 days of surgery for geriatric patients with hip fractures, found that RA was associated with an overall lower risk of mortality and all-cause readmission when compared with GA. During the inpatient stay period, mortality was higher for both GA and Cv from RA to GA. In the period from hospital discharge to 90 days postoperatively, no differences in mortality were observed, however patients undergoing GA had a higher risk for 90-day all-cause readmission, while no difference was observed between Cv and RA 90-day all-cause readmissions. *(Desai et al. 2018)*

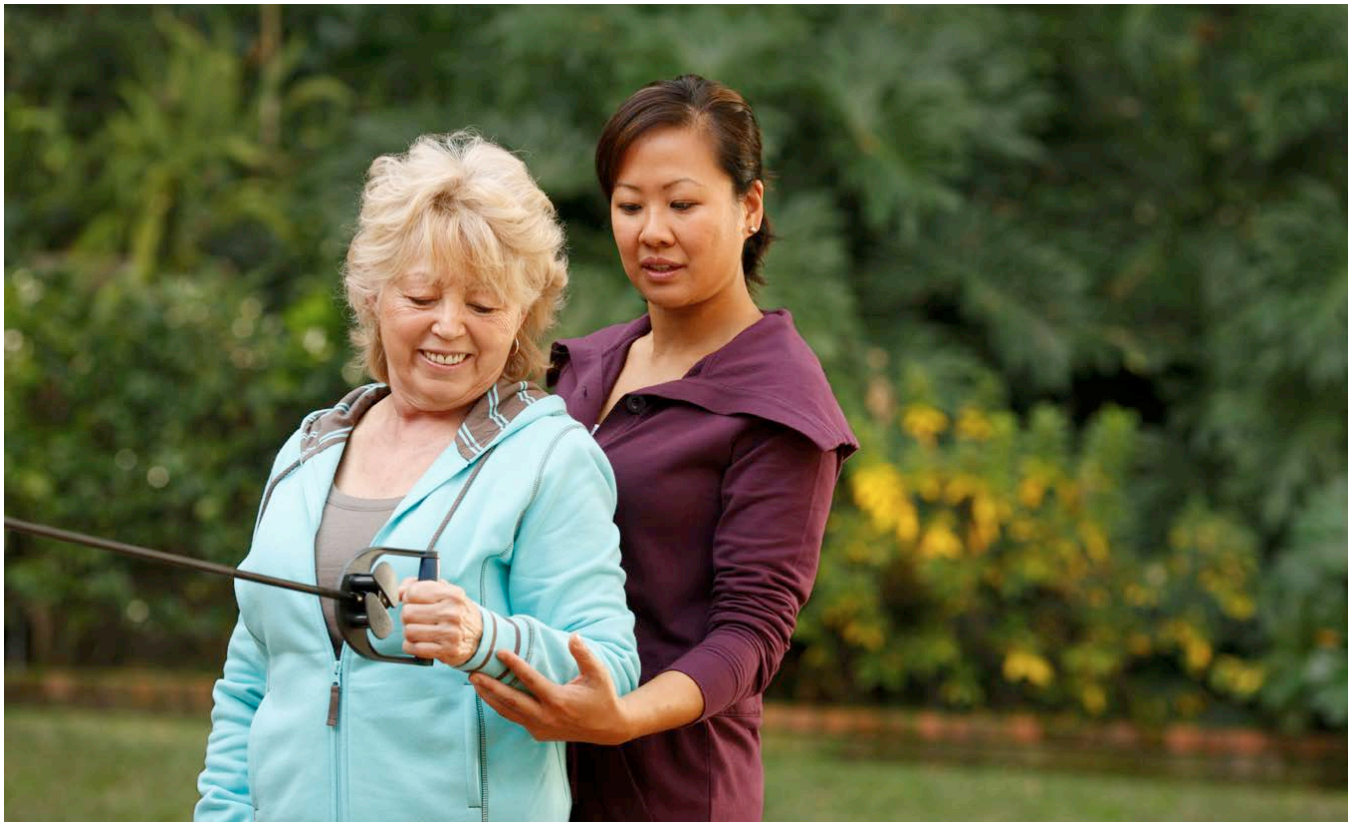
**Registry Champions:** Christopher D Grimsrud, MD, PhD, James M Jackman, MD, Kanu M Okike, MD, Gary L Zohman, MD

# Hip Fracture Registry

## Hip Fracture
## KP Compared To Benchmarks

| | Kaiser Permanente | UK-Wales-Northern Ireland | Ireland | Australian & New Zealand | Sweden | Norway |
|---|---|---|---|---|---|---|
| **Period** | Historic: 2009-2018<br>Current: 2018 | Historic: 2007-2017<br>Current: 2017 | Historic: 2012-2017<br>Current: 2017 | Historic: 2013-2017<br>Current: 2016-2017 | Historic: 2005-2017<br>Current: 2017 | Historic: 2005-2017<br>Current: 2017 |
| **Cases** | Historic: 49,853<br>Current: 5,987 | Historic: Not Reported<br>Current: 65,958 | Historic: 13,500<br>Current: 3,497 | Historic: 8,697<br>Current: 5,178 | Historic: 75,313<br>Current: 6,033 | Historic: 104,993<br>Current: 8,321 |
| **Female** | 68.3% | Not Reported | 71% | AUS: 70% / NZ: 69% | Not Reported | 69% |
| **Mean Age** | Male: 76<br>Female:<br>80 | Not Reported | 80 | AUS: Mean: 82<br>Median: Male 83,<br>Median: Female: 85<br>NZ: Mean: 83<br>Median: Male 85<br>Median: Female: 85 | Male: 80<br>Female: 82 | Overall: 80<br>Female: 82<br>Male: 77 |
| **Time to Surgery** | Mean: 24.7 hours<br>92.6% < 48 hours | Mean: 33 hours<br>70.2% < 36 hours | 72% < 48 hours | AUS:<br>Median 29 hours<br>NZ:<br>Median 24 hours | Not Reported | 84.8% < 48 hours<br>Mean: 23 hours<br>Median: 21 hours |
| **Length of Stay** | Mean: 4.2 days | Mean: 15.6 days | Mean: 20 days<br>Median: 13 days | AUS<br>Median 7.7 days<br>NZ<br>Median: 5.8 days | Not Reported | Not Reported |
| **Revision Rate** | 1.8% | Not Reported | 1% < 30 days | Not Reported | 4.9% | Reoperation: 9.7% |
| **Mortality** | 9.8% < 90 days | 6.9% < 30 days | Not Reported | Inpatient: 5%<br>15-20% < 1 year<br>post discharge | 90 day<br>Male: 15%<br>Female: 8% | Not Reported |

# Shoulder Arthroplasty Registry



**Description:**

The shoulder arthroplasty registry (SAR), established in 2005, tracks elective and urgent shoulder arthroplasty procedures including total shoulder arthroplasty (TSA), reverse total shoulder arthroplasty (RTSA), hemiarthroplasty (HA) and humeral head resurfacing (HHR). As of year-end 2018, the SAR has captured 19,083 primary shoulder procedures.

## Clinical Findings

- In 2015, RTSA utilization for the treatment of proximal humerus fractures surpassed that of HA for the first time within Kaiser Permanente's health care system. The utilization of RTSA for the treatment of proximal humerus fractures increased from 4.5% of arthroplasties in 2009 to 67.4% of arthroplasties in 2016, an almost 1400% increase. While HA appears to be falling out of favor in the treatment of fractures of the shoulder, surgeons may still be preferentially using the procedure in younger patients. *(Dillon et al. 2019)*
- In our cohort of 510 revision shoulder arthroplasty (SA) procedures 69 (13.5%) had a subsequent re-revision SA procedure. Instability was the primary reason for first revision (24.1%) and re-revision (43.5%). Instability for the first revision was associated with a higher risk of re-revision within 3-months post-revision. Conversion of primary TSA or HEMI to RTSA was associated with a lower risk of re-revision when compared to no conversion procedure. *(Dillon et al. 2019)*
- In our cohort of 5,009 primary SA patients, bisphosphonate use more than one year prior to the index SA procedure was associated with higher aseptic and all-cause revision risks. *(Budge et al. 2019)*

**Registry Champions:** Ronald Navarro, MD, Mark Dillon, MD, Mark Shaieb, MD, Matthew Budge, MD, Anita Rao, MD

# Shoulder Arthroplasty Registry

## Shoulder Arthroplasty KP Compared To Benchmarks

| | Kaiser Permanente | Australia Orthopaedic Association Shoulder Arthroplasty | The New Zealand Joint Registry |
|---|---|---|---|
| Time Period | 2005-2018 | 2004-2017 | 2000-2017 |
| Volume | 19,083 | 40,317 | 9,250 |
| Gender, Female | 56.20% | 62.30% | 63.16% |
| Mean Age (yrs) | 69.67 | 71.56 | 71.00 |
| Revision Rate | TSA: 0.72/ 100 obs yrs<br>RTSA: 1.19/ 100 obs yrs | TSA: 1.62/ 100 obs yrs<br>RTSA: 1.18/ 100 obs yrs | Overall: 0.97/ 100 obs yrs |
| Top 3 Reasons for Primary | Osteoarthritis<br>Rotator Cuff Arthropathy<br>Acute Humerus Fracture | Osteoarthritis<br>Rotator Cuff<br>Fracture | Osteoarthritis<br>Cuff Tear Arthropathy<br>Fracture of Proximal Humerus |
| Top 3 Reasons for Revision | Infection<br>Instability/Dislocation<br>Rotator Cuff Tear | Instability/Dislocation<br>Loosening<br>Rotator Cuff Insufficiency | Pain<br>Subacromial Cuff Impingement<br>Dislocation/Instability anterior |
| **Outcomes** | | | |
| Infection<br>DVT<br>PE | 0.79%<br>0.70%<br>0.52% | Not Reported<br>Not Reported<br>Not Reported | Not Reported<br>Not Reported<br>Not Reported |

# Spine Surgery Registry

## Description

Implemented in 2009, this registry tracks over 38,016 instrumented and non-instrumented spinal procedures performed by the neurosurgery and orthopedic spine surgeons as of year-end 2018. This represents more than 262,000 total implants.

## Clinical Findings

- Using the Kaiser Permanente spine registry, we identified 747 single-level anterior cervical discectomy and fusion (ACDF) cases of 239 (32.0%) who met the criteria for dysphagia with > 48 hr admission. Using univariable and multivariable logistic models for risk factor for dysphagia, we found single-level ACDF at the upper cervical spine (C2-3, C3-4) was the only risk factor for dysphagia. Age, body mass index (BMI) category, gender, American Society of Anesthesiologist's (ASA) classification, smoking, and operative time were not predictive factors. These findings can be used for enhancing patient selection for outpatient single-level ACDF surgery and reducing significant postoperative dysphagia. *(Aguilar et al, 2019)*
- Adult patients in the spine registry with lumbar fusions performed between 2009 and 2013 were included in a study examining weight loss (n=7303). The outcome of interest was ≥5% weight change 1 year postoperative from baseline. Three BMI groups were analyzed (<30; 30-39 obese; ≥40 extremely obese). After risk-adjustment, we found obese and extremely obese patients were more likely to lose a clinically significant amount of weight 1 year after spine surgery (BMI 30-39: OR=1.42, 95% CI 1.22-1.65; BMI ≥40: OR=1.73, 95% CI 1.21-2.47) compared with nonobese patients. *(Akins et al, 2018)*
- Another study investigated differences in reoperation rates for symptomatic nonunions in atlantoaxial (C1-C2) fusions with or without bone morphogenetic protein (BMP). Using data from the spine registry, we identified 58 patients (53.7%) with BMP and 50 patients (46.3%) without BMP with an average follow-up time of 5 years (interquartile range, 2.04-8.49). This was one of the largest retrospective studies on C1-C2 fusions with and without BMP. We found no difference in reoperation rates for symptomatic nonunions using BMP. For the non-BMP group, we found that lamina (+/- allograft) or allograft alone may also be just as effective as iliac crest graft (+/- allograft) in having no reoperations for symptomatic nonunions. *(Guppy et al, 2019)*

**Registry Champions:** Kern Guppy, MD, PhD, Calvin Kuo, MD, Johannes Bernbeck, MD, Harsimran Brara, MD, Kristophe Karami, MD

# Spine Surgery Registry

## Spine Surgery
## KP Compared To Benchmarks

| | Kaiser Permanente | Euro Spine/Spine Tango |
|---|---|---|
| Time Period | 2009-2013, 2016-2018 | 2005-2017 |
| Volume | 38,016 | 114,096 |
| **Demographics** | | |
| Age in Years (Mean) | 57.7 | 57.0 |
| Gender | 51.9% female | 51.0% female |
| Current Smoker | 7.6% | Not Reported |
| Diagnosis - Degenerative | 70.6% | 79.9% |
| **Fusion Approach** | | |
| Anterior Only | 24.5% | Not Reported |
| Posterior Only | 63.5% | Not Reported |
| Combined | 12% | Not Reported |
| **Outcomes** | | |
| Dural Tear | 3.0% | 4.7% |
| Superficial Infection | 0.6% | 2.1% |
| Deep Infection | 0.5% | 4.7% |
| Nonunion | 1.4% | 20.4% |
| Adjacent Segment Disease | 4.4% | 25.0% |

# Total Joint Replacement Registry

## Description

The total joint replacement registry (TJRR), established in 2001, collects patient and surgical implant information, and patient outcomes. Through December 2018, the TJRR tracks over 355,967 procedures (317,706 primary total joint replacements and 23,326 revision cases).

## Clinical findings

- In evaluating Total Joint Arthroplasty (TJA) opioids prescriptions the majority of preoperative, and late postoperative, narcotics prescriptions were by primary care physicians. Preoperative opioid use has been identified as a risk factor for prolonged postoperative TJA opioid use and should be avoided before surgery. Only 13%-14% of preoperative opioids were prescribed by orthopedic surgeons. This study suggests better communication between health care practitioners, standardized screening procedures, creation of patient pain medication contracts, and discussion of how long opioids should be used may reduce opioid use. *(Namba et al. 2018)*
- A study examining factors associated with prolonged opioid use found the number of preoperative prescriptions for opioids and NSAIDs and younger patient age was associated with higher number of postoperative opioid prescriptions in every period after total knee arthroplasty (TKA). During the first 90 days after surgery, 92.7% of patients had a prescription for opioids dispensed. For subsequent periods, the percentages of patients still taking opioids were, 42.1% in days 91-180, 32.2% in days 181-270, and 30.4% in days 271-360. Patient factors associated with intermediate- and long-term opioid usage after TKA include female gender, younger age, depression, and anxiety. The most common opioid-related comorbidities were anxiety, depression, and substance abuse. *(Namba et al. 2018)*
- A TJRR study identified pain and swelling as the most frequent reasons for emergency department (ED) visits in the first 90 days following primary elective unilateral total hip arthroplasty (THA) and TKA. At least one 90-day ED-only visit occurred for 13.4% of THA and 13.8% of TKA patients, most common in the first 30 postoperative days for both THA and TKA. Most common reasons for ED visits was pain for THA (12.8%) and TKA (15.8%) patients. Swelling was the reason for THA (15.6%) and TKA (15.6%) ED visits. Readmissions were more common in the 31-90-day period for both THA and TKA, with at least one 90-day readmission following the primary procedure occurring for 4.5% of THA and 5.5% of TKA patients. The most frequent reasons for readmissions after THA, included infection 12.5% and unrelated elective procedures 9.0%, and after TKA, gastrointestinal 19.1% and manipulation under anesthesia 9.4%. Interventions to help prevent or alleviate unnecessary hospital returns may include: patient-specific pain medication protocols; proactive nursing follow-up phone calls within the first 2 days after discharge, and earlier and more frequent home care team contacts with patient after discharge; patient education materials with detailed information about pain and swelling; and more specific instructions and triage algorithms for nursing call centers. *(Kelly et al. 2018)*

**Registry Champions:** Maurice Cates, MD, Adrian D Hinman, MD, Matthew P Kelly, MD, Erik W Kroger, MD, Gregory Y Lee, MD, Mark Melberg, MD, Le Don A Robinson, MD, Thomas C Stoll, MD

## Total Hip Replacement
## KP Compared To Benchmarks

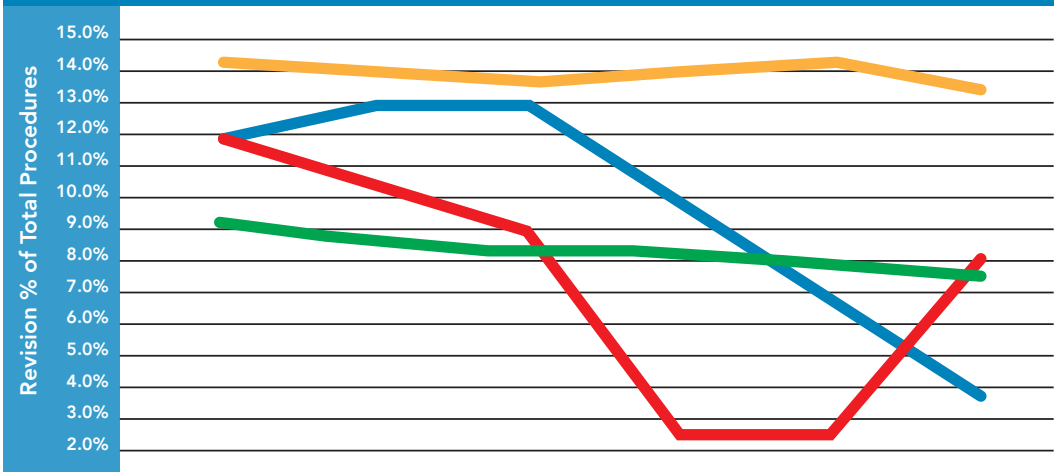
| | Established | Current Period | Primary Cases | Revision Cases | Age | Female % | 10 yr. Survival % (CI) |
|---|---|---|---|---|---|---|---|
| Kaiser Permanente | 2001 | 2018 | 11,877 | 914 | Mean: 66.2<br>Male: 64.7, Female: 67.3 | 57.9 | 95.2<br>(94.7-95.6) |
| AJRR | 2012 | 2012-2017 | 374,873 | 37,672 | Mean: 65.5 (2017) | 55.5 | Not Reported |
| Australia | 1999 | 2017 | 32,155 | 3,140 | 86.3 | 54.3 | 93.5<br>(93.4-93.7) |
| United Kingdom | 2003 | 2015-2017 | 272,496 | 23,846 | Mean: 68.0<br>Median: 69 (IQR 61-76) | 59.8 | 95.0<br>(94.9-95.1) |
| Sweden | 1979 | 2017 | 18,140 | 2,242 | Mean:<br>Male: 67.5, Female: 70.1 | 57.0 | 95.8<br>(95.6-95.9) |
| Norway | 1987 | 2018 | 9,553 | 1,422 | Mean: 68.9<br>Male: 67.0, Female: 69.8 | 66.7 | 93.7<br>(93.5-93.9) |

## Total Knee Replacement
## KP Compared To Benchmarks

| | Established | Current Period | Primary Cases | Revision Cases | Age | Female % | 10 yr. Survival % (CI) |
|---|---|---|---|---|---|---|---|
| Kaiser Permanente | 2001 | 2018 | 21,104 | 1,138 | Mean: 67.5<br>Male: 67.2, Female: 67.7 | 60.6 | 95.8<br>(95.7-95.9) |
| AJRR | 2012 | 2012-2017 | 650,674 | 43,693 | Mean: 66.8 | 61.0 | Not Reported |
| Australia | 1999 | 2017 | 48,040 | 3,840 | 89.6% <80yrs | 56.7 | 94.7<br>(94.6-94.7) |
| United Kingdom | 2003 | 2015-2017 | 303,960 | 17,304 | Mean: 68.9<br>Median: 69 (IQR 63-76) | 56.8 | 95.6<br>(95.6-95.7) |
| Sweden | 1974 | 2017 | 14,957 | 731 | Mean:<br>Male: 67.5, Female: 70.1 | 57.0 | 95.5<br>(95.4-95.6) |
| Norway | 1994 | 2018 | 6,905 | 648 | Mean: 68.2<br>Male: 67.9, Female: 68.4 | 62.5 | 94.3<br>(93.9-94.7) |

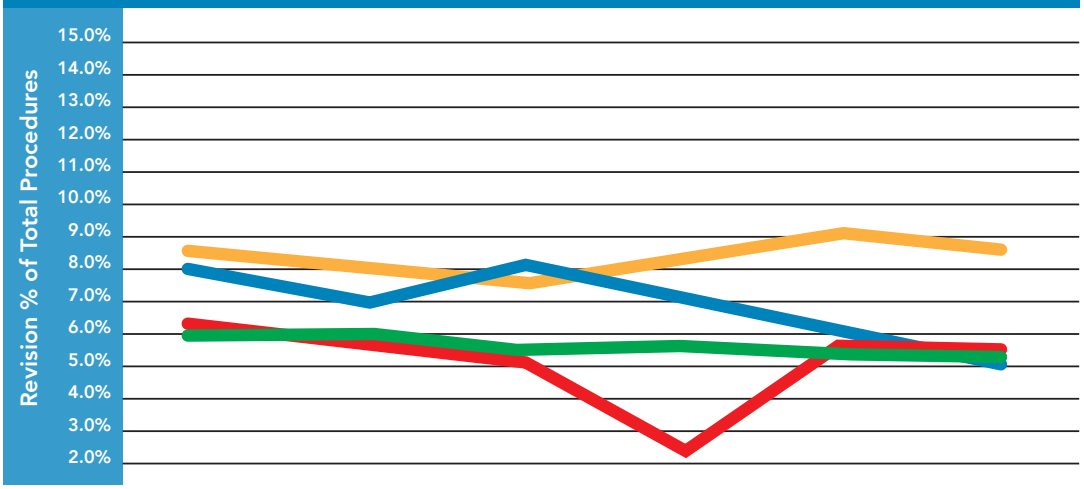
# Total Joint Replacement Registry

## Annual Total Hip Arthroplasty (THA) Revision Burden




| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| KP | 9.2% | 8.9% | 8.4% | 8.4% | 7.9% | 7.6% |
| AJRR | 12.0% | 13.0% | 13.0% | 10.0% | 7.0% | 4.0% |
| NJR | 11.7% | 10.4% | 9.0% | 2.6% | 2.7% | 8.0% |
| NAR | 14.3% | 13.9% | 13.7% | 14.2% | 14.2% | 13.6% |

## Annual Total Knee Arthroplasty (TKA) Revision Burden




| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| KP | 5.9% | 5.9% | 5.5% | 5.8% | 5.4% | 5.3% |
| AJRR | 8.0% | 7.0% | 8.0% | 7.0% | 6.0% | 5.0% |
| NJR | 6.1% | 5.6% | 5.2% | 2.3% | 5.6% | 5.4% |
| NAR | 8.5% | 7.9% | 7.5% | 8.4% | 9.1% | 8.6% |

**Registries:**

KP: Kaiser Permanente Implant Registries
AJRR: American Joint Replacement Registry
NJR: National Joint Registry, UK
NAR: Norwegian Arthroplasty Register

# Implant Registries Staff

**Management Team**

| | |
|---|---|
| Liz Paxton, PhD, MA | Director |
| Jessica Harris, MS, RD | Manager |
| Kenneth Sucher, MS | Manager |

**Administrative Team**

| | |
|---|---|
| Raffaella Cowell | Staff Specialist |
| Donna Leck | Research Administrative Analyst |

**Biostatisticians/Research Scientists**

| | |
|---|---|
| Priscilla Chan, MS | Biostatistician III |
| Heather Prentice, PhD, MPH | Research Scientist Investigator |
| Kathryn Royse, PhD, MSPH, MPH | Research Scientist Investigator |

**Database Administrators**

| | |
|---|---|
| Kim Phan, BA | Lead Systems Administrator |
| Buu Truong, BS, MIS | Senior Application Programmer/Analyst |

**Data Consultants/Programmers**

| | |
|---|---|
| Yuexin (Cindy) Chen, BS | Senior Data Consultant |
| Eric Chiu, PhD | Data Consultant |
| Tomy Huon, BS | Programmer III |
| Hong (Maggie) Sun, MS | Programmer II |
| Michael Reyes, BS | Programmer II |
| Craig Salman, BS | Programmer II |

**Data Quality**

| | |
|---|---|
| Chelsea Reyes | Data Quality Project Manager |

**Project Managers**

| | |
|---|---|
| William Burfeind, MAS | Project Manager III |
| Brian Fasig, PhD | Project Manager III |

**Research Associates**

| | |
|---|---|
| Janine Cruz, BA | Research Associate II |
| Tia Mullane, BA | Research Associate II |
| Juan Ruiz | Research Associate II |
| Nicole Caballero, BS | Research Associate II |
| Scott Thomas, BS | Research Associate II |

# Publications

## Anterior Cruciate Ligament Reconstruction

### 2018


Prentice HA, Lind M, Mouton C, Persson A, Magnusson H, Gabr A, Seil R, Engebretsen L, Samuelsson K, Karlsson J, Forssblad M, Haddad FS, Spalding T, Funahashi TT, Paxton LW, Maletis GB. (2018). "Patient Demographic and Surgical Characteristics in Anterior Cruciate Ligament Reconstruction: A Description of Registries from Six Countries." Br J Sports Med, 52(11): 716-22.

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### 2016


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Tibor L, Chan PH, Funahashi T, Wyatt R, Maletis GB, Inacio MC. (2016). "Surgical Technique Trends in Primary ACL Reconstruction from 2007 to 2014." J Bone Joint Surg Am, 13(98): 1079-89.


### 2015


Inacio MC, Chen Y, Maletis GB, Ake CF, Fithian DC, Granan LP. (2015). "Injury Pathology at the Time of Anterior Cruciate Ligament Reconstruction Associations with Self-Assessment of Knee Function." Clin J Sport Med, 24(6): 461–7.

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**Anterior Cruciate Ligament Reconstruction**

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**Anterior Cruciate Ligament Reconstruction**

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**Anterior Cruciate Ligament Reconstruction**

*continued*

## 2003

Ohara W, Paxton E, Fithian C. (2003). "Epidemiology of Knee Ligament Injuries." Pedowitz, Robert A., O'Connor, John J., and Akeson. "Wayne H. Daniel's Knee Injuries: Ligament and Cartilage Structure, Function, Injury, and Repair" (2nd edition): 311-44.

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Fithian D, Paxton E, Goltz D. (2002). "Fate of the Anterior Cruciate Ligament-Injured Knee." Orthop Clin North Am, 33(4): 621-36.

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## 2016

Gupta N, Kiley ML, Anthony F, Young C, Brar S. (2016). "Multi-Center, Community-Based Cardiac Implantable Electronic Devices Registry: Population, Device Utilization, and Outcomes." J Am Heart Assoc, 4(3): 1-9.

## 2015

Krishnaswami A, Kiley M, Anthony F, Chen Y, Chen J, Rajagopal S, Liu T, Young C, Paxton E. (2015). "Effect of Advancing Age and Multiple Chronic Conditions on Mortality in Patients with End-Stage Renal Disease After Implantable Cardioverter-Defibrillator Placement." Perm J, 20(1): 27-32.

### Endovascular Stent Graft

## 2018

Hye RJ, Janarious AU, Chan PH, Cafri G, Chang RW, Rehring TF, Nelken NA, Hill BB. (2018). "Survival and Re-intervention Risk by Patient Age and Preoperative Abdominal Aortic Aneurysm (AAA) Diameter Following Endovascular Aneurysm Repair (EVAR)." Annals of Vascular Surgery, 54 (215-25).

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### Heart Valve Replacement

## 2013

Chen JC, Pfeffer T, Johnstone S, Chen Y, Kiley M-L, Richter R, Lee H. (2013). "Analysis of Mitral Valve Replacement Outcomes is Enhanced by Meaningful Clinical Use of Electronic Health Records." Perm J, 17(2): 12-6.

### Hip Fracture

## 2018

Qiu C, Chan PH, Zohman GL, Prentice HA, Hunt JJ, LaPlace DC, Nguyen VT, Diekmann GR, Maletis GB, Desai V. (2018). "Impact on Anesthesia on Hospital Mortality and Morbidities in Geriatric Patients Following Emergency Hip Fracture Surgery." J Orthop Trauma, 32(3): 116-23.

# Publications

**Hip Fracture**

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