AAOS
American Academy of Orthopaedic Surgeons

AJRR American Joint Replacement Registry

PATIENT-FACING INTERIM REPORT

BASED ON FIFTH AJRR ANNUAL REPORT ON HIP & KNEE ARTHROPLASTY DATA

FOREWORD

The American Academy of Orthopaedic Surgeons (AAOS) releases an Annual Report summarizing the data submitted to its cornerstone Registry for hip and knee replacements, the American Joint Replacement Registry (AJRR). The purpose of the Annual Report is to provide valuable data driven information with the goal of improving clinical practice and patient outcomes. The 2018 report was no exception, publishing data collected from 2012 through 2017 on 1,186,955 procedures from 1,067 institutions across the entire United States.

This Patient-Facing Interim Report was created with the intent of reviewing the 2018 Annual Report and highlighting the information that could be of most interest to one of our key stakeholders, the patient. A team composed of Surgeon Leaders, the AAOS Public Advisory Board (non-clinical volunteers), and AAOS Registry department staff has prepared the following document hoping those outside of the profession can understand more about these orthopaedic procedures.

As the first of its kind, the AJRR Patient-Facing Interim Report highlights general Registry data including information about hip and knee replacements performed across the United States. Besides providing a high-level summary of these procedures, a discussion about patient-reported outcome measures (PROMs), surveys used to capture outcomes from a patient's perspective, is included.

As you read this report, we trust you gain an understanding of general trends in orthopaedic hip and knee procedures, as well as the benefits of Registry participation. This resource provides an opportunity to learn how data can be used towards improving the quality of care and patient outcomes.

James A. Browne, MD

AJRR Reports Editor

The American Academy of Orthopaedic Surgeons (AAOS) is an organization providing education and practice management services to orthopaedic surgeons and allied health care providers. The Academy serves to improve patient care and provide resources for the public on orthopaedic science. It has grown into the world's largest medical association of musculoskeletal specialists, serving more than 39,000 members worldwide.

A registry is a database that compiles information to increase safety, improve patient outcomes, and promote best clinical practices. The American Joint Replacement Registry (AJRR) is the largest Registry supported by AAOS and collects data on total hip and knee replacements completed in the United States. The AAOS Registry Program's vision goes beyond hips and knees to include additional registries, such as the Shoulder & Elbow Registry (SER), and the Musculoskeletal Tumor (MsT) Registry Pilot. AAOS supports this family of Registries as a means of collecting, analyzing, and sharing data on joint replacement surgeries and other musculoskeletal conditions.

ABOUT THE AMERICAN JOINT REPLACEMENT REGISTRY (AJRR)

In October 2017, AJRR rejoined with the American Academy of Orthopaedic Surgeons (AAOS) to become the cornerstone of the AAOS Registry Program. The mission of the Registry Program is to "Improve orthopaedic care through the collection, analysis, and reporting of actionable data to effect better outcomes and quality." For patients, this means the Registry Program creates an opportunity for collaboration, communication, and use of data to improve care.

AJRR's goal is to provide a centralized database for its participants to collect, store, and access their orthopaedic data. The AJRR database is a collaborative effort among leaders in the orthopaedic field, including AAOS, American Association of Hip and Knee Surgeons, The Hip Society, The Knee Society, hospitals, commercial health plans, medical device manufacturers, and patient representatives. Beginning with the AJRR, the Registry Program is managed by AAOS as a multi-stakeholder participation model. This model is a combined effort supported by leaders in orthopaedics, similarly to the collaborative effort of the AJRR database.

WHY IS A REGISTRY IMPORTANT?

Collecting information on patient care, procedures, and patient outcomes within a Registry allows physicians, health care facilities, and device manufacturers to improve the quality of care provided to patients. It offers information on safety to help reduce complications and future errors, in turn decreasing health care costs with long-term benefits for the patient and the facility. The information collected on medical devices and implants allows long-term tracking, making it easier to identify a defect or issue notification if a problem is detected. Data collection is valuable for researchers, health care providers, and medical educators, advancing medical education to improve the patient's experience and overall outcomes.

WHAT KIND OF INFORMATION IS USED WITHIN THE REGISTRY?

AJRR tracks information related to hip and knee replacements. The collected information, or data, is submitted by participating sites which include hospitals and Ambulatory Surgery Centers (ASCs) following hip or knee replacement procedures. Some of the information may include patient age, gender, and general health, in addition to information on the surgeon and the facility where the surgery was performed. Other content collected includes:

- Reason for the surgery;
- The procedure itself: What was performed, which limb was involved, was it a primary procedure (first replacement surgery) or a revision (removing a previous implant and replacing it with a new one);
- Information on complications: If the patient; experienced any during or after surgery;
- Implant Information: What type of artificial joint or implant components were used

Any collected information is de-identified and securely stored. De-identification is the removal of all personally identifiable information that could be used to connect the person to the information. The Registry adheres to the same patient privacy standards as medical providers and hospitals. Federal laws mandate the security and protection of private health information.

HOW IS THIS INFORMATION USED WITHIN THE REGISTRY?

The data collected is used to compare practice trends and patient outcomes, evaluate patterns, and track performance. For surgeons, it is an opportunity to view information on the surgeries they have performed and compare their data to national averages. For hospitals and facilities where surgery is performed, the information collected will aid in understanding how current practices by the facility and the surgeon contribute to patient outcomes, which in turn, produces improvements and best practice. Medical device/implant manufacturing companies use this information to determine how a device performs and how it may be improved. Finally, patients use information in the Registry to better understand the procedure their physician may be recommending for their plan of care.

Overall Registry Numbers

Since 2010, AJRR has grown at a rapid pace. By the end of 2018, with over 1.4 million cumulative procedures, AJRR is considered the largest total hip and knee arthroplasty Registry in the world based on annual procedural count.

2017: A Year of Progress and Growth

More than 300,000 procedures have been submitted to AJRR as 2017 procedures. These procedures come from 796 institutions and over 4,900 surgeons across the United States. Ambulatory surgery centers (ASCs) and private practice groups are becoming key participants as total joint arthroplasty (TJA) is increasingly performed in the outpatient setting.

2018: A Year of Accelerated Growth

- Largest total hip and knee arthroplasty Registry in the world by annual procedural count with 1,432,491 procedures
- 25-30% of the estimated annual procedural volume in the United States
- 1,166 contracted participants
- 8,603 surgeons contributed cases
- 146 sites submitted PRO data
- 51,186 completed PRO patient surveys

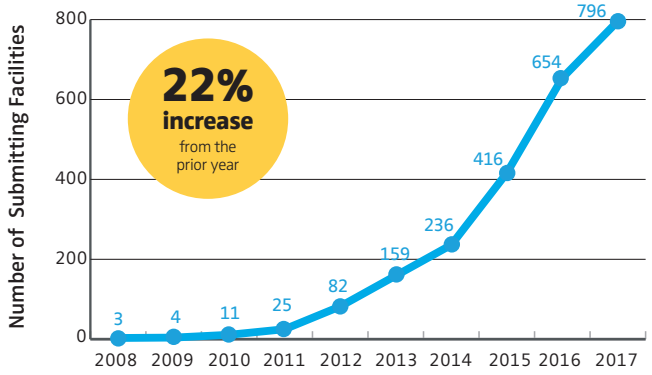
*As of publication deadline, August 31, 2018

Increase In Institutional Enrollment 2010-2018

2010	2011	2012	2013	2014	2015	2016	2017	2018
6	**15**	**122**	**219**	**417**	**612**	**854**	**964**	**1,166**

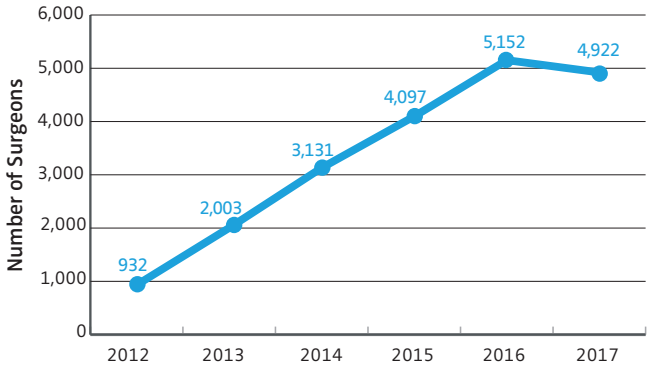
In 2017, of the facilities enrolled and participating in the Registry Program, 796 actively submitted data, a 22% increase from the prior year. Participating facilities come from all 50 states across the U.S. (Figure 1).

Figure 1: Number of Facilities Submitting Data by Year



By the end of 2017, AJRR collected data on arthroplasty procedures performed by more than 4,900 surgeons (Figure 2). AJRR participating hospitals reported data for an average of 11 surgeons (range 1-54), which include those conducting only the occasional procedure. Participating hospitals are required to submit data from all surgeons performing joint arthroplasty at their facility.

Figure 2: Total Number of Surgeons Submitting Data by Year



More than 1.1 million hip and knee replacement procedures have been submitted to AJRR between 2012 and 2017 (Figure 3). This includes information submitted by hospitals and ASCs and has grown by over 38% in the last year. ASCs are health care facilities and an alternative option to a hospital for patients needing surgical procedures. As AJRR adds participants, they will be able to submit data from as early as 2012; yearly volumes from prior years are continually updated. Figure 4 shows the distribution, or number of different types of procedures submitted to the Registry.

Figure 3: Cumulative Procedural Volume

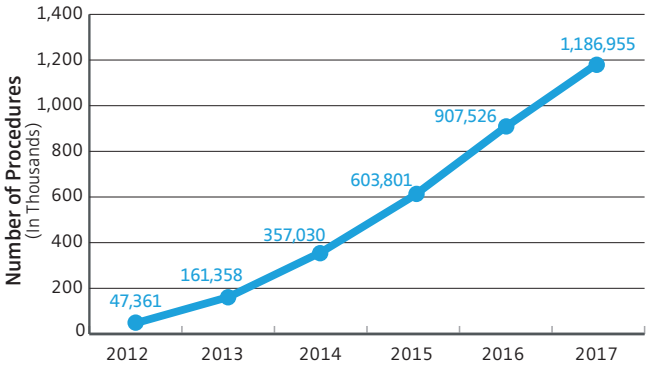
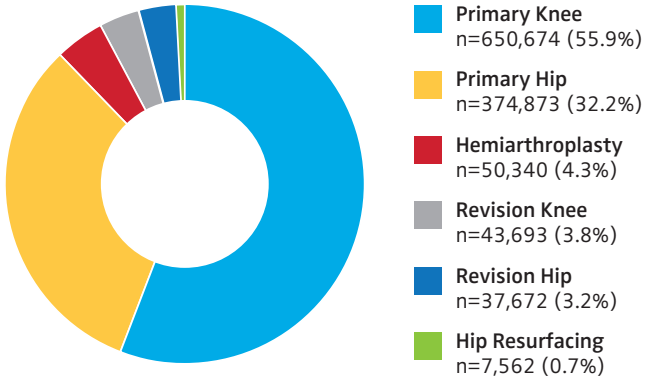


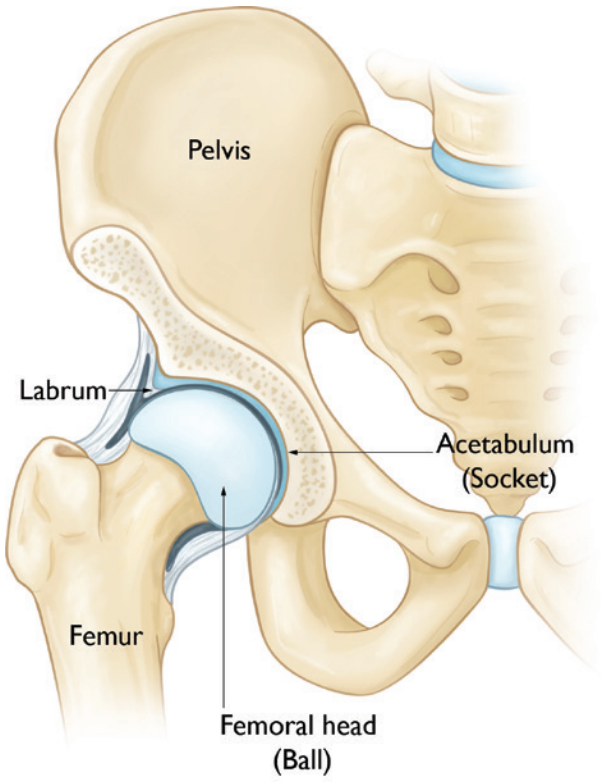
Figure 4: Distribution of Procedures (N=1,164,814)



HIP REPLACEMENT

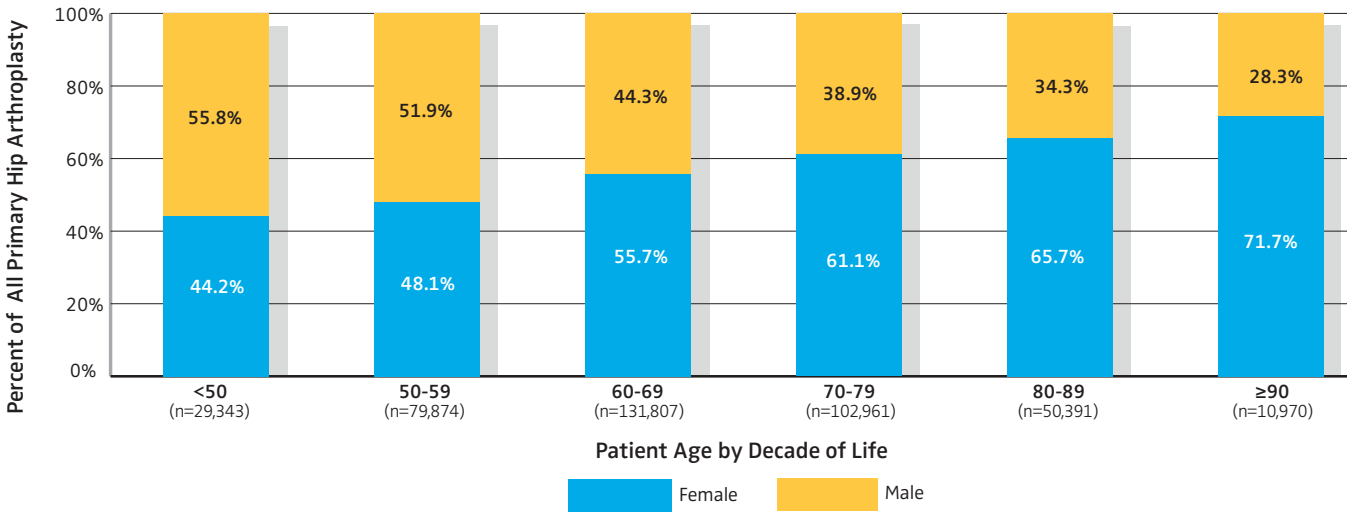
Total hip arthroplasty (THA) or total hip replacement is the surgical replacement of the hip joint with artificial components or surfaces. A partial hip replacement, or hemiarthroplasty, only involves half the hip. Both are reconstructive procedures performed to manage disease of the hip joint, such as osteoarthritis, that did not respond to conventional medical therapy. These procedures are also commonly performed for patients who have broken their hip.

The hip is a ''ball and socket'' joint. The ''ball'' is at the top of the thigh bone (femur) and called the femoral head. The ''socket'' is part of the pelvis and called the acetabulum. With hip replacement surgery, only the femoral head may be replaced (partial hip replacement), but 80% of the time, both parts of the joint will be replaced (total hip replacement). When this surgery is originally performed, it is a ''primary'' hip replacement. If it is re-done at any time following the first surgery, it is termed a ''revision.''



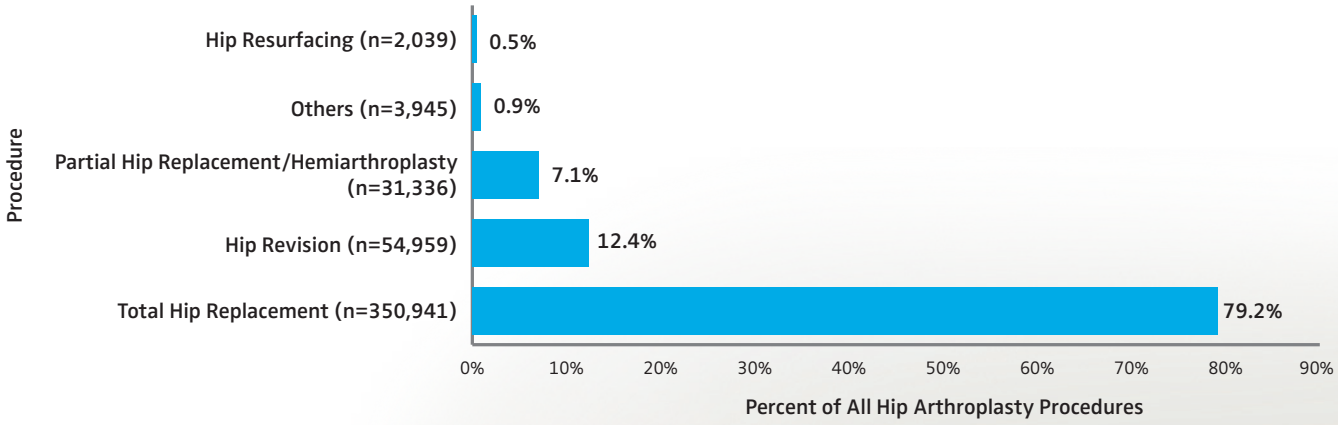
Before age 60, most first-time hip replacements are done in men (about 56%). After age 60, this trend reverses, and more procedures are done in women, with the gap growing wider among older age groups. The average age for first-time hip replacements in 2017 was 65.5 years and the average age of patients undergoing revision surgery was 67.4 years. Figure 5 shows the gender distribution for all primary, first-time, hip arthroplasties done by age. Almost two-thirds of first-time replacements among people in their 80s are performed in women.

Figure 5: Gender Distribution of Primary Hip Arthroplasty by Age 2012-2017 (N=405,346)



There are many types of hip procedures. Almost 80% of hip procedures are first-time hip replacements, about 12% are revisions of previous hip replacements, and about 7% are partial hip replacements. Hip resurfacing is an uncommon procedure that is similar to a conventional total hip arthroplasty but does not remove the entire femoral head. (Figure 6)

Figure 6: Procedure Codes for All Hip Procedures 2012-2017 (N=443,219)



HIP REPLACEMENT REVISION

When an initial hip implant is put in, it is considered a ''primary'' hip replacement. In some cases, after the primary procedure, either shortly after or years after, a ''re-do'' (revision) is needed. Early revisions are considered to be those surgeries that are done less than three months after the initial procedure. Figure 7 shows the top reasons an early revision may be completed and Figure 8 shows the top reasons for all revisions following an initial hip arthroplasty. Table 1 below these figures explain what each diagnosis means. Often, the need for early revision is linked to either a patient's comorbidity, the presence of another disease or condition, or a complication from the procedure, such as dislocation, infection, or fracture. Rarely is this ever due to a defect in the device itself. Some revisions are done many years later and the reason is often linked to wearing down of or loosening of the original implant. Data in the Registry can ''link'' information about primary and revision hip replacements to better understand what happened to joint replacements over time and how to help them last as long as possible.

Figure 7: ICD Diagnosis Codes for "Linked" Hip Revisions (N=5,434) All Early Revisions (within 90 Days of Surgery)

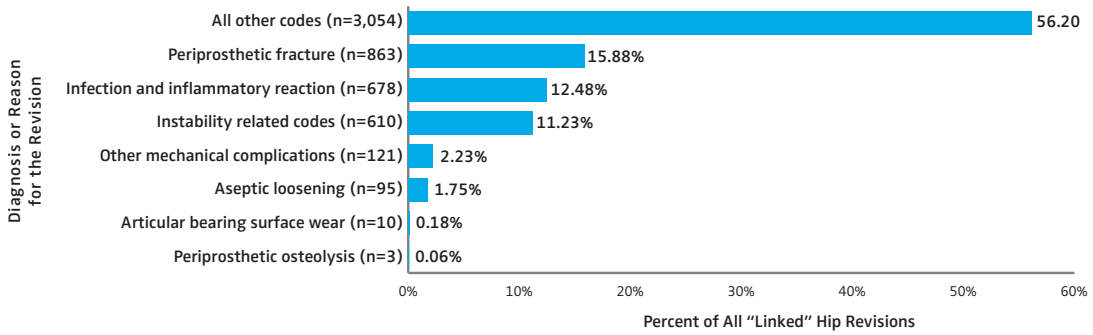
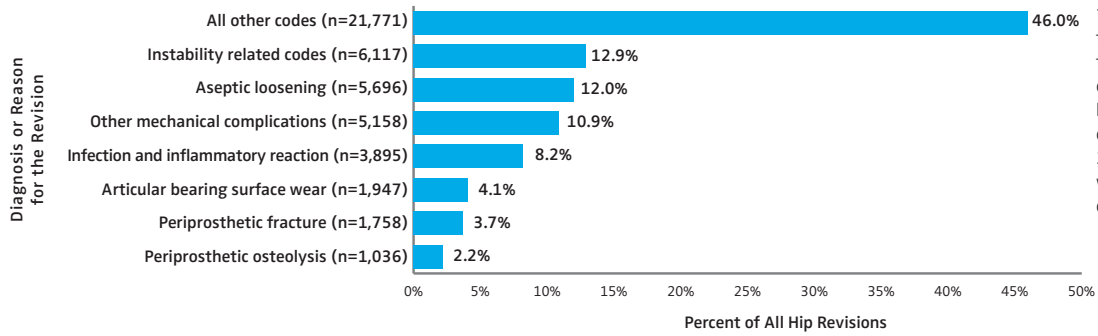


Figure 8: ICD Diagnosis Codes for All Hip Revisions (N=47,378)



*Percentages in the text reflect the numerator of the diagnosis listed and the denominator of 25,607 cases with a confirmed diagnosis.

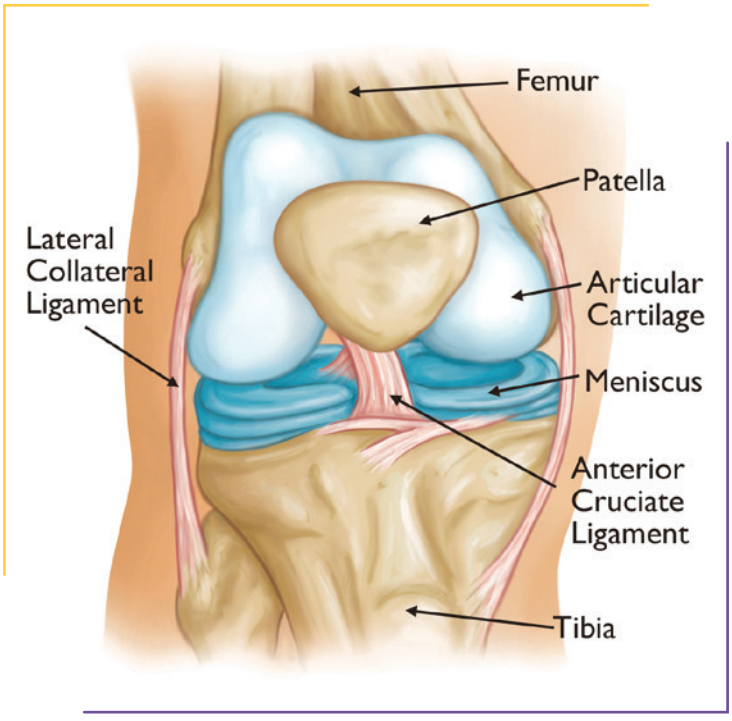
Table 1: Figures 7 and 8 Diagnosis or Reason for Revision Explained

Diagnosis or Reason for Early Revision	Description
All Other Codes	Any other issue involving an implant or impairment in joint function following arthroplasty that is not outlined below. It may also include comorbidities, or other diagnoses, the patient had prior to surgery.
Periprosthetic Fracture	A fracture surrounding the implant.
Instability Related Codes	Instability includes a portion of the prosthesis becoming loose or dislocation of the joint.
Infection and Inflammatory Reaction	Infection surrounding the implant may require revision to fully treat the infection and restore joint function. Physicians will work to differentiate between an infection and inflammation to identify the best plan of care for the patient.
Other Mechanical Complications	This includes issues related to the implant alignment, ability to load the surgical side and any movement specific impairments involving the joint or surrounding soft tissue.
Aseptic Loosening	An abnormal or insufficient bond between the implant and the bone causing the implant to become loose.
Articular Bearing Surface Wear	Bearing surfaces are the two implant surfaces meeting together to form a joint. Excessive friction causes wear to these surfaces, and it may cause changes that alter alignment, create particle debris, reduce mobility and eventually cause the implant to fail.
Periprosthetic Osteolysis	When debris from an implant is present, it causes inflammation. The inflammation triggers a response where there is resorption or weakening of the bone matrix. Long term, this may cause aseptic loosening and it requires revision.

KNEE REPLACEMENT

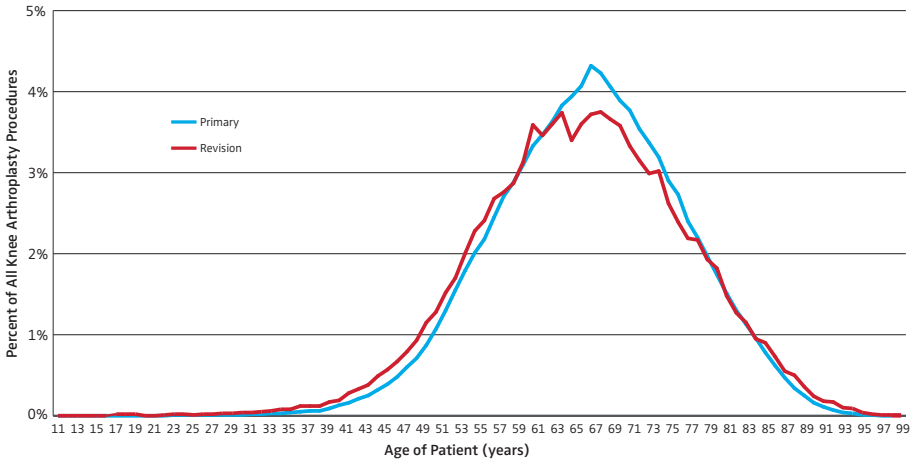
A total knee arthroplasty (TKA) or total knee replacement consists of removal of the diseased or injured articular surfaces of the knee followed by resurfacing with a metal and hard plastic (polyethylene prosthetic) components. The most common reason for knee replacement surgery is to relieve symptoms caused by osteoarthritis. It is a non-emergency elective surgery which is scheduled in advance and should be considered after conventional alternatives have been unsuccessful.

With knee arthroplasty, two joint surfaces are involved, the femur at the thighbone and the tibia at the lower leg. In most cases, a component is attached to the bottom end of the thighbone (femur) and the top end of the shin (tibia), allowing the knee to glide smoothly with bending and straightening. If only part of the joint surface is damaged, a surgeon may only replace the damaged area. This is termed a partial knee replacement or unicompartmental surgery. Some patients experience damage at both knees, and in select cases, a surgeon will schedule knee replacement surgery on both legs the same day.



Based on the information from contributing sites, the average age for both primary and revision knee surgery has increased by more than one year between 2012-2017. Figure 9 shows what percentage of procedures were done at each age. The average age for patients undergoing a primary knee replacement in this sample was 66.8 years.

Figure 9: Age Distribution of Knee Arthroplasty Procedures 2012-2016 (N=680,238)



KNEE REPLACEMENT REVISION

When an initial knee implant is put in, it is a "primary" knee replacement. In some instances, it is necessary for a patient to undergo a "re-do" (revision). Among all "linked" revisions reported to AJRR from 2012-2017, most were done from 6-12 months after the initial surgery. For all early revisions (done within three months from the first surgery), the most common reason was due to either infection or an inflammatory reaction (Figure 10). It is uncommon to have an early knee revision due to an issue with a device implant. Other times, a revision is done many years later for reasons related to wearing down or loosening for the original implant. The data in the Registry will be able to "link" information about primary and revision knee replacements to better understand what happens to joint replacements over time and how to help them last as long as possible.

Figure 10: Most Frequently Reported ICD Diagnosis Codes for Early Knee Revisions (<3 Months to Revision) (N=1,877)

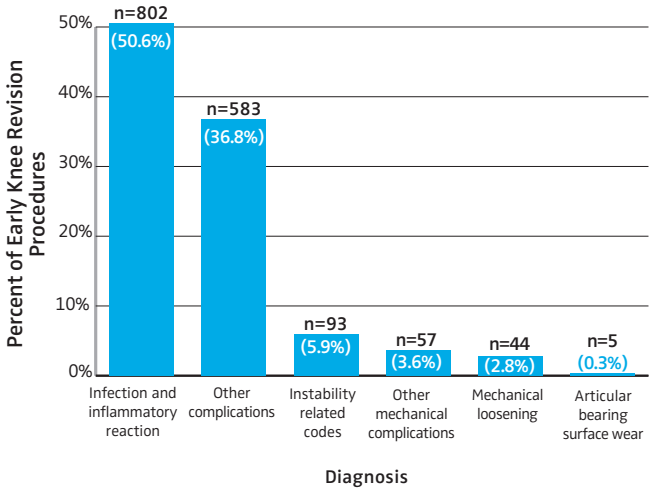


Table 2: Figure 10 Diagnosis or Reason for Early Revision Explained

Diagnosis or Reason for Early Revision	Description
Infection and Inflammatory Reaction	Infection surrounding the implant may require revision to fully treat the infection and restore joint function. Physicians will work to differentiate between an infection and inflammation to identify the best plan of care for the patient.
Other Complications	Other complications may be related to any comorbidities, or other diagnoses, the patient had prior to surgery.
Instability Related Codes	Instability includes a portion of the prosthesis becoming loose or dislocation of the joint.
Other Mechanical Complications	This includes issues related to the implant alignment, ability to load the surgical side and any movement specific impairments involving the joint or surrounding soft tissue.
Mechanical Loosening	Mechanical loosening may be related to the loading and activity level the patient places on the implant. It may also be related to the quality of the bone, the patient's health status and any bone deformity preoperatively.
Articular Bearing Surface Wear	Bearing surfaces are the two implant surfaces meeting together to form a joint. Excessive friction causes wear to these surfaces, and it may cause changes that alter alignment, create particle debris, reduce mobility and eventually cause the implant to fail.

There was a total of 9,175 "linked" revision procedures, where the Registry had information on both the initial knee replacement and the revision. Of all the "linked" revision procedures, 20.5% were done in the first three months after the first surgery and 28.2% were done more than a year after the initial knee replacement. (Table 3).

Although early revisions to an initial knee replacement are rare, the most common reason is due to infection and other complications (87.4%).

Table 3: Time Interval between Primary and Revision for "Linked" Patients

Time Interval	N
<3 Months	1877
3-5 Months	1658
6-12 Months	3044
>1 Year	2596

PATIENT-REPORTED OUTCOME MEASURES (PROMS)

Patient-reported outcomes (PRO) were added to the Registry Program's list of collected data items in 2014. A PRO is any information on the results of health care that comes directly from patients without being modified or interpreted by health professionals.

A PROM is a survey that captures a patient's self-assessment, or personal feelings, regarding their health status. Surveys are often specific to a body region, such as hip or knee, but also include questions related to physical function, mental attitude, mobility, social function, and bodily pain. Surveys may ask patients questions regarding pain and stiffness with activities such as sitting, standing, walking, climbing stairs, or performing activities of daily living.

Why are PROMs important?

PROMs serve as valuable tools in understanding a patient's health status from their perspective. PROMs provide information to physicians and guide the care team in making the best decisions for the patient's care. PRO data is generally collected before and after surgery. In the first year, it is often collected at three-, six-, and nine-month intervals, and one year after surgery. This allows long-term tracking of a patient's status and the patient's perspective of the surgical outcome.

Data collection provides quality information on the facility and surgeon as well. In promoting best practices, this data may provide information on implementing changes to improve the patient experience. Additionally, PROMs may be used for shared-decision making and identify patients at-risk for poor outcomes or who have a lower chance of success. [1,2]

While there are many types of PROM surveys, the four submitted to AJRR the most include:

1. Hip disability and osteoarthritis outcome score (HOOS Jr)
2. Knee injury and osteoarthritis outcome score (KOOS Jr)
3. Patient-Reported Outcomes Measurement Information System (PROMIS-10 Global)
4. Veterans Rand 12-Item Health Survey (VR-12)

HOOS Jr and KOOS Jr are tools measuring joint specific pain and physical function for hip and knee, respectively. Items are specific to pain and Activities of Daily Living (ADLs); a higher score represents better function. PROMIS-10 Global is a tool used to measure symptoms, functioning, and health care related quality for a variety of chronic diseases or conditions. The VR-12 is the summary of a physical score and a mental score. It provides a contrast between a patient's physical and mental health status.

Higher PROM survey scores are desirable and indicate greater patient satisfaction. On average, as seen in Table 4 and Figure 11, patients report higher scores one year after surgery compared to before surgery. The *mean score* obtained with the one-year post-operative survey is consistently higher than the pre-operative score on the same survey.

These PROM surveys are valuable in measuring where a patient is before surgery and comparing where an average patient is one year after surgery, from the patient perspective. It is important for patients to understand that while average scores can be helpful in developing expectations for outcome, individual results may vary due to a variety of factors.

Figure 11: Patient Reported Outcome Measure (PROM) Survery

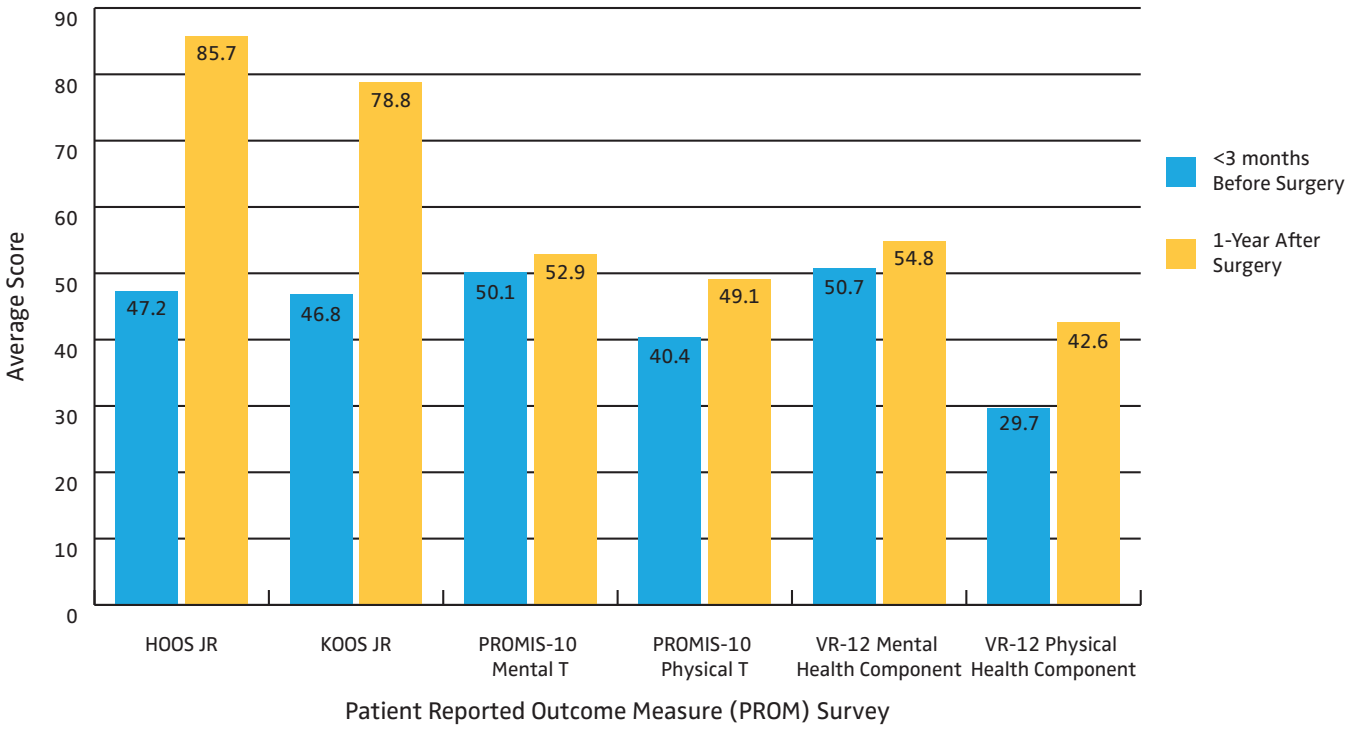


Table 4: Average Score <3 months Before Surgery and 1-year After Surgery for all PROMs

Patient Reported Outcome Measure (PROM)	PROM Component	Interval	Number Submitted	Mean Score
HOOS JR	Score	<3 months Before Surgery	7,317	47.2
		1-year After Surgery	1,636	85.7
KOOS JR	Score	<3 months Before Surgery	13.853	46.8
		1-year After Surgery	3,373	78.8
PROMIS-10	Mental Test	<3 months Before Surgery	12,926	50.1
		1-year After Surgery	3,055	52.9
	Physical Test	<3 months Before Surgery	12,926	40.4
		1-year After Surgery	3,055	49.1
VR-12	Mental Health Componet	<3 months Before Surgery	23,307	50.7
		1-year After Surgery	11.089	54.8
	Physical Health Component	<3 months Before Surgery	19,571	29.7
		1-year After Surgery	9,441	42.6

ACKNOWLEDGMENTS

PUBLIC ADVISORY BOARD

AAOS values the voice of the patient and accordingly supports the Public Advisory Board (PAB) within the AAOS Registry Program and alongside the AJRR Steering Committee. PAB provides a public voice in data collection and reporting, helping to increase the quality of care, improving patient outcomes, and promoting best practices. The mission of the PAB is to improve the value of the Registry Program by more effectively ensuring a public voice in a Registry's data collection, reporting, and utilization activities. The following individuals currently volunteer on the PAB:

Margaret VanAmringe, MHS, Chair
John A. Canning Jr.
Timothy M. Mojonnier*
Richard Seiden, Esq.*
Diana Stilwell, MPH*

**AAOS, including AJRR and the Registry Program, wish to thank these members of PAB who volunteered to contribute to this publication of the Patient-Facing Interim Report, representing the public voice in the orthopaedic community.*

AAOS REGISTRY STAFF

The AAOS Registry Department would like to acknowledge the efforts of the following individuals for their contributions in publishing this report:

Emily Lee
Dena Weitzman, OD
Diane Ziegenhorn, PT, DPT, MHA

RESOURCES

Learn more about the AAOS Registry Program and arthroplasty procedures by visiting the patient section of the AJRR website www.AJRR.net/for-patients

If you have questions regarding the AAOS Registry Program, your care, or your specific case, speak with your surgeon and clinical care team.

For additional information on hip and knee arthroplasty:

American Academy of Orthopaedic Surgeons (AAOS) OrthoInfo
https://orthoinfo.aaos.org

American Association of Hip and Knee Surgeons
http://www.aahks.org/care-for-hips-and-knees

National Institute of Arthritis and Musculoskeletal and Skin Diseases
http://www.niams.nih.gov

WebMD
http://www.webmd.com

AJRR BLOGS

Learn from other patients by reading about their experiences with joint replacement:

Public Advisory Board is the Voice of the Patient
http://blog.ajrr.net/ajrr-public-advisory-board-is-the-voice-of-the-patient

Guest Blogs available from other patients following their joint replacement experience

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1. Baumhauer, J.F. Patient-Reported Outcomes — Are They Living Up to Their Potential? N Engl J Med. 2017;377(1):6-9. doi: 10.1056/NEJMp1702978.

2. Franklin PD, Lewallen D, Bozic K, Hallstrom B, Jiranek W, Ayers DC. Implementation of patient-reported outcome measures in U.S. Total joint replacement registries: rationale, status, and plans. J Bone Joint Surg Am. 2014;96 Suppl 1:104-9. doi: 10.2106/JBJS.N.00328.

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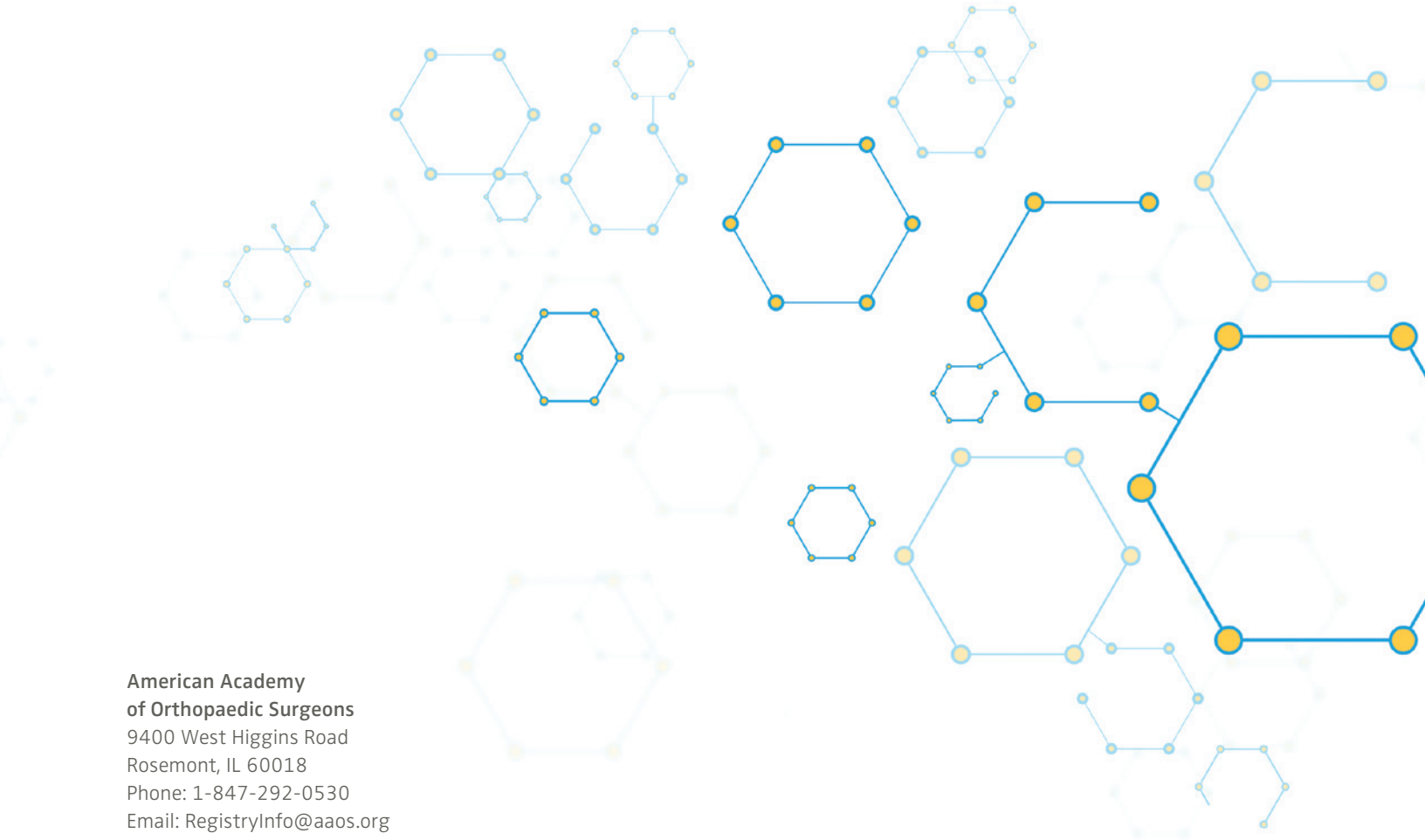
At the time of publication, every effort was made to ensure the information contained in this report was accurate.



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