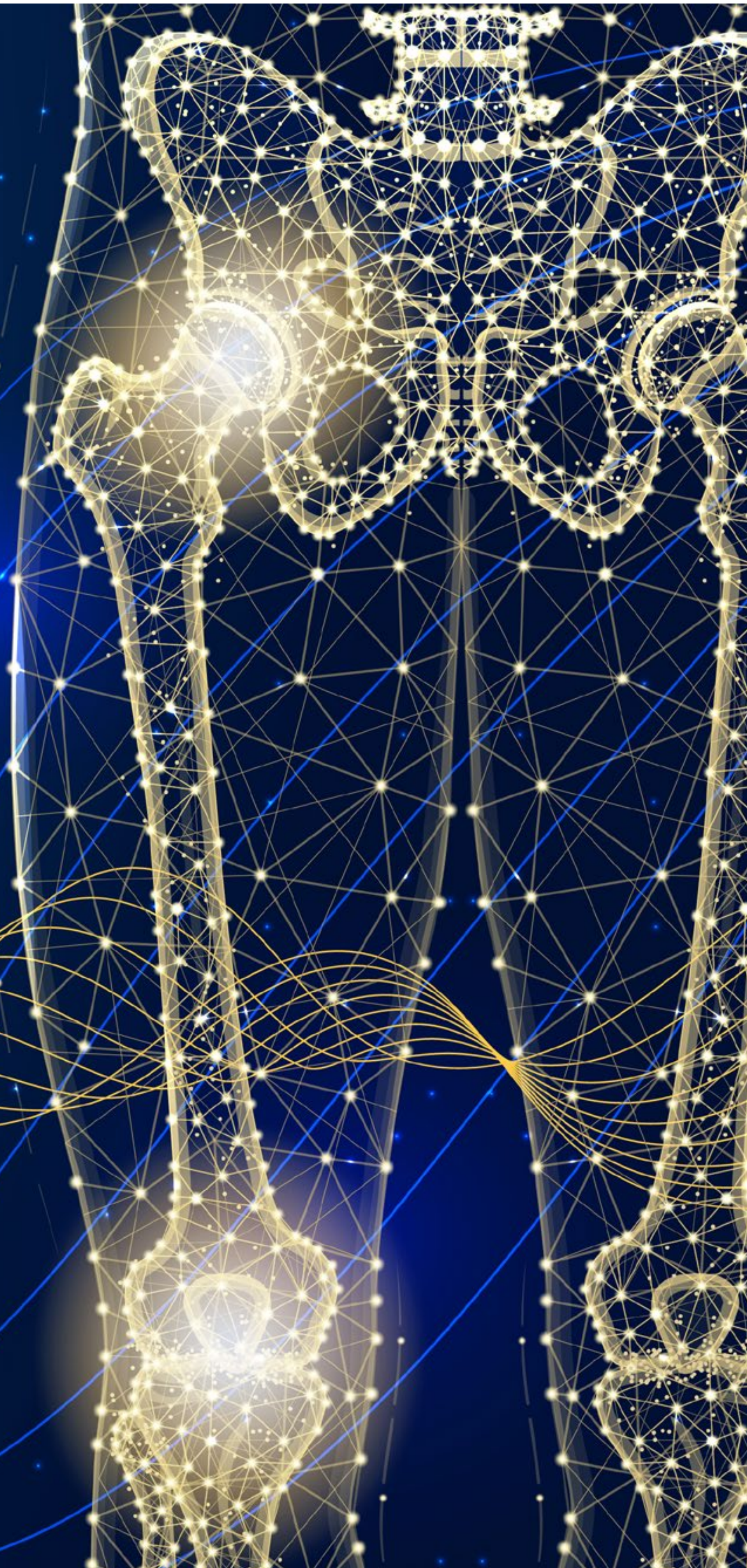
AAOS
American Academy of Orthopaedic Surgeons

AJRR
American Joint Replacement Registry

ANNUAL REPORT 2025



The 12th Annual Report of the AJRR on Hip and Knee Arthroplasty

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Dedication

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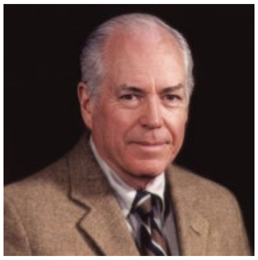


This Annual Report is dedicated to Dr. William H. Harris, a pioneer in hip replacement surgery.

Dr. Harris is a founding member and the first president of The Hip Society (1968-1969), as well as a founding member and past president of the International Hip Society (1992-1994). He served for decades as Chief of the Adult Reconstructive Surgery Unit at the Massachusetts General Hospital (MGH) and was awarded the Alan Gerry Chair as Clinical Professor of Orthopedic Surgery at Harvard Medical School in 1997. He is the founder and director emeritus of the Harris Orthopedic Laboratory at the MGH.

Dr. Harris has been awarded the Lifetime Achievement Award from The Hip Society, the International Hip Society, and the Mueller Foundation. The Hip Society granted Dr. Harris a record 10 honorary awards for outstanding contributions to hip surgery. He is also a three-time recipient of the Kappa Delta Award from the American Academy of Orthopaedic Surgeons (AAOS) for excellence in orthopedic research.

He has authored more than 520 scientific publications and three textbooks on hip surgery, arthritis, and skeletal diseases. He pioneered the MGH Adult Reconstruction Registry and developed the Harris Hip Score, the first hip-specific patient-reported outcome measure (PROM). He has trained generations of fellows who have become international leaders in joint replacement surgery.

As a clinician-scientist, Dr. Harris helped solve some of the most significant challenges in adult reconstructive surgery. He was instrumental in developing chemoprophylaxis protocols to reduce the risk of deep venous thrombosis (DVT) and pulmonary embolism (PE) following hip replacement surgery. His work led to the widespread adoption of warfarin (Coumadin) as the standard DVT prophylaxis for more than two decades.

Early in the evolution of total hip arthroplasty (THA), loosening of cemented acetabular components posed a major problem. In collaboration with Dr. Jorge Galante, Dr. Harris introduced the first cementless acetabular implant—the Harris-Galante I—which offered significantly improved long-term fixation. He and his team then addressed the loosening of cemented femoral components through rigorous laboratory testing of polymethylmethacrylate at MGH. This research informed the development of the first-, second-, and third generation cementing techniques, which remain the benchmark for optimal fixation today.

Perhaps his most transformative contribution was the development of highly crosslinked polyethylene (HXPE). Between 1980 and 2000, polyethylene wear and the resulting osteolysis were the leading causes of hip replacement failure. In response, Dr. Harris assembled a multidisciplinary team dedicated to solving this problem. After years of focused research, they developed and tested the first U.S. Food and Drug Administration (FDA)-approved HXPE. In 1998, Dr. Harris performed the world's first hip replacement using this material at MGH. Remarkably, 27 years later, that patient continues to function well, with minimal wear and no evidence of osteolysis.

Global registry data over the past two decades have confirmed the substantial improvement in implant longevity with HXPE in both hip and knee arthroplasty. Dr. Harris's visionary work continues to shape modern joint replacement and improve patient outcomes worldwide.

Richard L. Illgen II, MD, FAAOS
Editor, AJRR Annual Report, Harris Fellow (1999-2000)

James I. Huddleston, III, MD, FAAOS
Chair, AJRR Steering Committee, MGH Adult Reconstruction Fellow (2004-2005)

Remarks for Dr. Harris

"I had the privilege of training under Dr. Harris as a resident in the 1980s. His methodical and scientific approach to hip arthroplasty was inspirational to me and transformative for the field. I am grateful for all he has done to make hip arthroplasty such a successful and reliable procedure and all he has done for me, personally, to foster my growth as a surgeon and researcher."

Professor of Orthopaedic Surgery

Grainger Director, Rush Arthritis and Orthopaedics Institute

Director, Institute for Translational Medicine

Rush University Medical Center

"Dr. Harris was a visionary and a mentor whose passion for solving clinical problems inspired generations of researchers. Through the team he built and led, he helped pioneer technologies—like highly cross-linked polyethylene—that have improved the lives of millions. His legacy is both deeply personal and profoundly global."

Orhun Muratoglu, PhD

Alan Gerry Professor of Orthopaedic Surgery

Harvard Medical School

"The Harris Joint Registry was established at the Massachusetts General Hospital in 1969. Dr. Harris used this registry and his biomaterial laboratory to relentlessly pursue orthopaedic innovation over the course of decades. Dr. Harris's contributions have been monumental for our profession."

Harry E. Rubash, MD

Chief Emeritus, MGH Department of Orthopaedic Surgery

"Dr. Harris' main drive has always been to objectively document outcomes. The Harris Hip Score is the most used PROM score after total hip replacement surgery and his original article from 1969 (JOA) is one of the most quoted papers in orthopedics.

Dr Harris continued his efforts and started the Harris Orthopaedics Laboratory where the registry idea has been further developed parallel with basic material research. This resulted among many exiting results in the introductions of highly crosslinked polyethylene. The new poly has had a tremendous effect on long-term result of total joint surgery and millions of patients have benefitted from this invention worldwide.

I spent more that 10 years in Boston and experienced the most exciting part of my life in orthopedics due to Dr. Harris's mentorship. I know that many of his fellows have had the same experience from their time with Dr. Harris."

Henrik Malchau, MD, PhD

Professor at Harvard Medical School

Professor Department of Orthopedics, Sahlgrenska University Hospital

"Dr. Harris's vision and leadership on the Adult Reconstruction Service at Massachusetts General Hospital set the standard for clinical and research excellence in hip surgery. His pioneering innovations have changed the course of orthopaedic surgery and have been driven by an innate curiosity coupled with a dedication to improve patient care by setting out to solve real world problems. His commitment to training generations of surgeon-leaders have left an indelible mark on the field, as his legacy and those of his disciples continue to inspire all who work in adult reconstructive surgery."

Hany Bedair, MD

Chief of Arthroplasty, Mass General Brigham

Associate Professor, Harvard Medical School

"It's appropriate that we are dedicating this year's AJRR Annual Report to Dr. William Harris. Dr. Harris spent his professional career focused on tracking patient outcomes in order to improve on the results of hip surgery."

William J. Maloney, MD, FAAOS

Stanford Medicine Outpatient Center

Our Vision

To be the National Registry for orthopaedics through comprehensive data and technology, resulting in optimal patient outcomes.

Foreword

The American Joint Replacement Registry (AJRR) continues to serve as a cornerstone in the effort to improve outcomes for patients undergoing hip and knee replacement surgery.

Now encompassing data from more than 4 million procedures, AJRR enables clinicians, hospitals, manufacturers, and researchers to benchmark performance, identify trends, and advance evidence-based care.

This year's report reflects a growing momentum in orthopaedic data collection, fueled by deeper collaboration between national and regional registries and enhanced by international partnerships. These combined efforts not only improve the quality of patient care but also strengthen the evidence base for implant surveillance, clinical best practices, and health policy decisions.

A notable example of this collaboration is the shared work between AJRR, the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI), and the International Society of Arthroplasty Registries (ISAR). Through benchmarking, shared learning, and innovation, AJRR plays a critical role in elevating orthopaedic care not just in the U.S., but around the world.

The achievements in this report would not be possible without the continued engagement of participating sites and surgeons across the country. We extend our sincere gratitude to those who contribute data, use the insights, and support the growth of the Registry. Your partnership drives progress.

We invite you to explore this year's findings and join us in advancing the quality, safety, and value of joint replacement care.

James I. Huddleston, III, MD, FAAOS
Chair, AJRR Steering Committee

Executive Summary

The AJRR joined the AAOS Registry Program as the inaugural Registry in 2017. It continues to work towards achieving the AAOS Registry Program's goals with guidance from the AAOS Registry Oversight Committee (ROC) and the AJRR Steering Committee. The AAOS Registry Program has continued to grow and has added other orthopaedic sub-specialty registries including the Shoulder & Elbow Registry (SER), the Musculoskeletal Tumor Registry (MsTR), the American Spine Registry (ASR) – a collaborative registry with the American Association of Neurological Surgeons (AANS), and the Fracture & Trauma Registry (FTR).

The past year has been marked by a series of milestones for AJRR including surpassing 4.6 million recorded arthroplasty procedures.

AJRR Annual Report Leadership Update

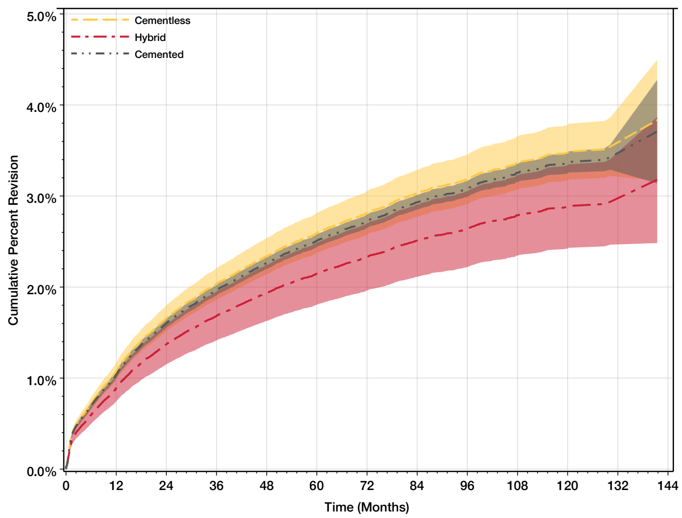
We would like to recognize the substantial achievements of James A. Browne, MD, FAAOS (immediate previous Editor of the AJRR Annual Report). Dr. Browne and the AJRR Analytics team have made significant contributions to improve the AJRR Annual Report over time. The AJRR Steering Committee, led by James I. Huddleston, III, MD, FAAOS (Chair), also provides important input and guidance to improve the quality of the AJRR Annual Report. The AJRR Annual Report continues to evolve and expand its scope. This year the AJRR Annual Report team is under new leadership including Richard L. Illgen II, MD, FAAOS (incoming Editor) and Jeffrey B. Stambough, MD, FAAOS (incoming Deputy Editor).

Highlights from This Year's AJRR Annual Report:

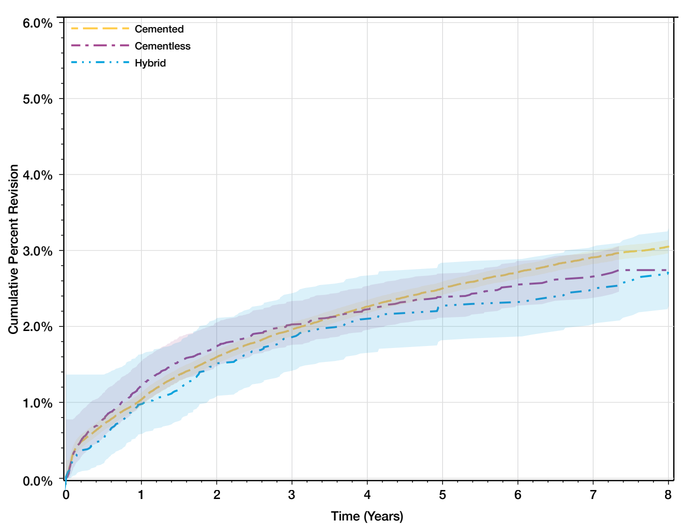
Updated Survival Analysis Method

All cumulative percent revision (CPR) curves in the AJRR Annual Report this year are generated using the Kaplan-Meier (KM) method. Previous Annual Reports have used the Cox method for survivorship analysis. KM does not assume the revision risk remains constant, unlike the Cox Model. The KM methodology supports more straightforward survivorship curve interpretation and more accurate assessment of how the risk of revision changes over time. Patients are censored at death or at the end of the analysis period. KM survivorship curves can be interpreted as the cumulative probability of revision (y-axis) at any given timepoint (x-axis). We have included survivorship figures generated using the Cox Model survivorship curve method used in previous AJRR Annual Reports (Figure 3.11 from 2024) and the updated methodology KM method used in this year's annual report (Figure 3.11).

AJRR Annual Report 2024's Figure. 3.11 Cumulative Percent Revision for Cemented Versus Cementless Fixation Primary Total Knee Arthroplasty in Male Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2023 (Cox Model)



AJRR Annual Report 2025's Figure. 3.11 Cumulative Percent Revision for Cemented Versus Cementless Fixation Primary Total Knee Arthroplasty in Male Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2025 Using New Methodology (Kaplan-Meier)



The 2025 KM analysis allows for the curves to cross compared to the 2024 analysis (Cox Model) that can violate proportional hazards and assumes the revision risk remains constant. The KM analysis has limitations and is not covariate adjusted. The hazard ratios presented alongside our KM analyses are adjusted for age, sex and Charlson Comorbidity Index (CCI) after first testing the Proportional Hazard (PH) assumption. One hazard ratio per treatment group comparison was presented when the PH assumption was met over the time of the study period. If the PH assumption was not met, hazard ratios were generated over the intervals until deviations occurred and additional hazard ratios are presented until PH assumptions are met. For example, if the PH assumption is violated for cement fixation and a deviation is identified at 3 months, a hazard ratio can be reported for the 0–3 month interval, followed by a separate hazard ratio for the period during which the PH assumption holds, such as 3–12 months. Additional hazard ratios may be reported for subsequent intervals as necessary, based on the timing and extent of further deviations. This updated methodology is similar to reporting standards for other national joint registires.

It is important to note that it is possible for the statistical analyses generated with the KM method (not adjusted for covariates) may conflict with statistical analyses generated with hazard ratios (covariate adjusted). These potential conflicts should be recognized when interpreting the survival analyses contained in this report. Additional details regarding statistical methodologies are presented in Appendix F.

Bearing Materials

We have expanded analyses on bearing materials this year to include comparisons of AJRR data with reports from other international registries. Conventional polyethylene (CPE) wear and resulting osteolysis were a leading cause of hip and knee replacement failure prior to the introduction of HXPE. Registries around the world have documented the significant reduction in osteolysis and revision associated with HXPE compared to CPE bearings in primary THA and primary total knee arthroplasty (TKA). Dr. William Harris's visionary work to develop and introduce HXPE continues to shape modern joint replacement and improve patient outcomes worldwide.

Patient-Reported Outcome Measures (PROMs)

The Centers for Medicare & Medicaid Services (CMS) has introduced Hospital Inpatient Quality Reporting (IQR) for Patient-Reported Outcome Performance Measure (PRO-PM) requirements in the United States for patients aged 65 and older. The AJRR updated its PROM data collection portal and the procedure and PROMs file upload specifications in February 2024 to support the reporting of CMS IQR requirements on behalf of participating sites.

All AJRR participating institutions can utilize AJRR for their IQR reporting needs. Information on completeness rates for data submitted to the AJRR including a number of required IQR variables can be found in the PROMs sections for both primary THA and primary TKA in this year's report. The PROMs section in this year's Annual Report has been expanded to include data on percent of cases meeting thresholds of Substantial Clinical Benefit (SCB) for KOOS, JR. and HOOS, JR. Patient acceptable symptomatic state (PASS) was also included as a new threshold and we report both anchor-based and distribution-based minimal clinically important difference (MCID) achievement rates.

Robotics

Robotic assistance in hip and knee arthroplasty has continued to grow in the U.S. and worldwide. This year, we include an expanded robotics analysis section for both primary hip and knee arthroplasty. We describe growth patterns for robotics in the aggregate and include manufacturer-specific growth pattern data. The inclusion of robotics data in this year's Annual Report is an important early step in learning how this fast-growing technology is shaping adult reconstructive surgery. The AJRR, National Joint Registry (NJR), and Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) are working with our industry partners through AdvaMed to standardize robotics data capture and to improve robotics data completeness in the AJRR and other international registries for this important data element.

Richard L. Illgen II, MD, FAAOS
Editor, AJRR Annual Report

Jeffrey B. Stambough, MD, FAAOS
Deputy Editor, AJRR Annual Report

2025 AJRR ANNUAL REPORT HIGHLIGHTS

The AJRR *2025 Annual Report* captured **4.6 million+** hip and knee procedures, including primary and revision arthroplasty procedures, performed between 2012 and 2024 – an increase of 8.8% from the previous edition.

1,200+ Contracted Institutions

5,000 surgeons submitted at least one procedure in 2024

Procedures were submitted from all **50 states** and highest volumes were reported in California, New York, and Florida

80+ Custom Analyses for Industry Sponsors

PROMs October 2025 Update

751 Institutions submitted PROMs data

Expanded PROMs performance rates including:

- ✓ Anchor-Based MCID
- ✓ Distribution-Based MCID
- ✓ SCB
- ✓ PASS
- ✓ CMS IQR THA/TKA PRO-PM reporting rates for key variables

AAOS Registry Analytics Institute® (RAI)

- ✓ Application cycles modified to improve efficiency
- ✓ RAI partnered with The Hip Society, The Knee Society, and AAHKS to provide guidance on recommended topics for project proposals

Significant scientific productivity (2024-2025)

20 Manuscripts
Published since the 2024 AJRR AR

12 Research Presentations
AAHKS Annual Meeting in 2025

11 Posters and Presentations
AAOS Annual Meeting in 2025

AJRR Milestones

By end of 2024, there were 1,212 contracted institutions and 960 submitting data to the AJRR from across all 50 states and the District of Columbia; this represents an 8% increase in procedures from the previous report.

AJRR MILESTONES

- **2010** – Pilot Sites Started
- **2011** – Funding Secured and Full Launch
- **2012** – Enrolled 100th Site
- **2013** – Began Pilot of Data Collection Expansion
- **2014** – Over 150K Procedures, QCDR Designation, 1st Annual Report
- **2015** – Merger of the California Joint Replacement Registry into AJRR
- **2016** – Official Registry of AAHKS, PROM Platform Launched
- **2017** – Over 1M Procedures, RegistryInsights® Platform Launched, Re-integration into AAOS
- **2018** – RegistryInsights® Surgeon Dashboard Launched
- **2019** – Over 1,300 Sites Enrolled and More Than 1.2 Million Patients
- **2020** – Over 2M Procedures Reached from Over 1,400 Sites
- **2021** – Over 2.5 Million Procedures and 2.1 Million Patients Reached
- **2022** – AJRR data goes back a decade – procedures collected from 2012
- **2023** – 10th AJRR Annual Report published
- **2024** – Captured 4 Million Procedures
- **2025** – Integrated Risk Adjustment in Registry Dashboards

The Power of Registry Data

Unified Platform Launching in 2025

AAOS is transitioning several registries to the IQVIA Integrated Health Platform to unify data input, storage, and analytics. AJRR and MsTR will adopt the new system in 2025, followed by the SER and ASR in 2026. Participants can expect streamlined data entry, greater accuracy, and enhanced usability. These upgrades reflect AAOS' ongoing commitment to advancing musculoskeletal care through better data, technology, and actionable insights.

Evolving to Support Better Data

The AJRR continually refines its data specifications to enhance data quality, reduce site burden, and adapt to changes in the healthcare landscape. Updates are currently underway to align with national healthcare interoperability standards, including mapping to SNOMED and LOINC codes and supporting alignment with FHIR/HL7 data exchange protocols. The 2025 data specifications also include a new module to capture ankle arthroplasty procedures, marking a significant step in expanding AJRR's scope across joint replacement care.

The AJRR Steering Committee regularly evaluates and updates data elements, adding new fields as necessary and retiring those no longer useful. Current efforts are focused on defining a Minimum Data Set (MDS) to improve data completeness and usability. The MDS outlines the essential data required for submission—covering patient, component, hospital, surgeon, and procedural identifiers—and provides sites with real-time visibility into the quality and completeness of their submissions.

Introducing the Master Data Dictionary

In 2025, AJRR consolidated data dictionaries and module specifications into a single, unified Master Data Dictionary (MDD). This common schema simplifies data management by standardizing shared data elements across modules. Key benefits of the MDD include:

- Unified documentation
- Flexible array handling
- Enhanced search and filtering capabilities
- Improved support for multi-value fields
- Reduced file management complexity

All AJRR and MsTR participants must transition to the MDD by fall 2026.

CMS Linkages

A longstanding AJRR objective has been to obtain access to CMS claims data. This enables robust linkages between AJRR and Medicare to strengthen quality improvement and patient safety initiatives.

CMS data enhances Registry insights by:

- Filling in comorbidity and mortality information
- Capturing revision surgeries performed outside of AJRR sites
- Supplementing gaps in submitted data

The CMS files include inpatient (148 elements), outpatient (122 elements), and National Death Index (NDI) data. Twelve CMS data fields map directly to AJRR elements, while additional fields are evaluated for use in future analyses.

RegistryInsights® Dashboards

AJRR participants have access to RegistryInsights®, an interactive suite of dashboards offering on-demand, surgeon-specific data visualization. These dashboards support data-driven decisions aimed at improving patient care and surgical outcomes. Dashboard highlights include:

- **Procedure Dashboard:** Tracks THA and TKA procedures, types (e.g., total, unicondylar, revision), length of stay, operation time, patient demographics, and payer mix—helping sites identify trends and plan resources effectively.
- **Post-Operative Dashboard:** Displays 30-day and 90-day outcomes, including complication rates (e.g., infections, DVT, fractures), unplanned readmissions, and revisions—enabling institutions to monitor quality and improve post-op care.
- **PROMs Dashboard:** Summarizes PROMs (PROMIS-10; VR-12; HOOS, JR.; KOOS, JR.), including completion rates and score changes over time, providing critical insights into long-term recovery and quality of life.
- **Performance and Scorecard Dashboards:** Align AJRR data with national quality initiatives such as:
  - Joint Commission Advanced Total Hip and Knee Replacement (THKR) Certification
  - Blue Cross Blue Shield Association (BCBSA) Blue Distinction® Centers
  - CMS Merit-Based Incentive Payment System (MIPS) Clinical Quality Measures (CQMs)
  - CMS IQR THA/TKA PRO-PM and Qualified Clinical Data Registry (QCDR) Measures

These tools help users track both process (e.g., same-day ambulation, PROMs collection) and outcome measures (e.g., complication rates, mortality) over a 3-year look-back period, with national benchmarking for context.

Supporting Sites through the Authorized Vendor Program

To reduce data entry burden and streamline participation, AAOS partners with a vetted list of Authorized Vendors. These third-party electronic health record (EHR) and data solution providers help sites capture, configure, and submit procedural, post-discharge, and patient-reported outcome (PRO) data efficiently. A full list is available in Appendix C.

"AJRR Research Fellows work side-by-side with steering committee members on areas of personal interest – from improving capture rates of specific classes of implants in revision total knee arthroplasty to the design and implementation of clinical research studies within the AJRR infrastructure. Overall, it is rewarding and educational beyond its one-year duration."

Christopher N. Carender, MD
Clinical Assistant Professor
Adult Reconstruction & Joint Replacement
Department of Orthopaedic Surgery
University of Michigan – Michigan Medicine

Strength Through Collaboration

The AJRR continues to grow and strengthen its impact through strategic alliances with organizations that share its mission of advancing quality improvement in musculoskeletal care. These partnerships span the healthcare ecosystem, supporting research, clinical excellence, data sharing, education, and health policy alignment.

American Board of Orthopaedic Surgery Maintenance of Certification

The AAOS Registry Program is approved by the American Board of Orthopaedic Surgery (ABOS) to support Maintenance of Certification (MOC) Part II. Diplomates may receive Self-Assessment Examination (SAE) credits for each year of registry participation, serving as an alternative to the 10 scored and recorded SAE credits required to meet ABOS MOC standards.

Aetna Institutes of Quality

Since 2020, Aetna has designated THKR quality reviews to Joint Commission, requiring sites to achieve Advanced THKR Certification, of which AJRR is a registry requirement. Sites may also meet the requirement through the Det Norske Veritas (DNV) Advanced Certification pathway.

Ambulatory Surgery Center Association

AJRR and the Ambulatory Surgery Center Association (ASCA) collaborate to support data collection in ambulatory surgery centers (ASCs), especially those with low volumes or limited technical capabilities. As more arthroplasty procedures shift to the ASC setting, this collaboration helps ensure that quality and efficiency data are accurately captured and leveraged to improve care.

American Alliance of Orthopaedic Executives

The American Alliance of Orthopaedic Executives (AAOE) supports orthopaedic practice leaders through education, networking, and advocacy. The organization actively promotes data submission to AAOS registries and helps advance excellence in practice management.

American Association of Hip and Knee Surgeons

AJRR is the official registry of the American Association of Hip and Knee Surgeons (AAHKS), with ongoing collaboration on education, outreach, and research. AJRR is promoted through AAHKS publications, events, and its official journal, Arthroplasty Today.

American Hospital Association

The American Hospital Association (AHA) represents hospitals and health systems nationwide and continues its longstanding support of AJRR, including representation on the AJRR Steering Committee.

American Joint Replacement Research Collaborative

Through a P30 grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), Mayo Clinic and AAOS co-lead the American Joint Replacement Research Collaborative (AJRR-C) to expand national research infrastructure. The collaborative provides customized support in epidemiology, biostatistics, health informatics, and study design to facilitate high-quality research using AJRR data. Key focus areas include bias mitigation, risk adjustment, EHR data mining, and standardized outcome reporting.

AJRR Research Fellowship

Supported by a P30 grant, the AJRR Research Fellowship is now in its second year, training the next generation of registry-based researchers. The program has expanded from one fellow to two. Fellows' projects have focused on a variety of initiatives, including using machine learning to extract surgical data from operative notes, designing nested trials within the Registry, and creating a comprehensive library of primary and revision components for both THA and TKA to standardize data granularity across different component types.

America's Health Insurance Plans

America's Health Insurance Plans (AHIP), the national association of health insurers, maintains a seat on the AJRR Steering Committee and supports the Registry's mission through shared goals of improving care quality, outcomes, and access.

BCBSA Blue Distinction Centers

AAOS and BCBSA collaborate to enable participating AJRR sites to opt in for Blue Distinction Center evaluations based on registry-submitted quality outcomes data.

Cigna Pathwell Bone & Joint℠

Cigna requires providers participating in its musculoskeletal care program to submit data to AJRR as part of their quality requirements—reinforcing the importance of registry participation in value-based care models.

Cohere Health

In a first-of-its-kind collaboration with a prior authorization vendor, AAOS and Cohere Health are aligned in efforts to reduce administrative burden and promote best practices. AJRR participants may opt in to send quarterly quality reports to Cohere, qualifying them for full prior authorization waivers ("greenlighting").

OrthoForum and OrthoConnect

AJRR serves as the official registry for OrthoForum and OrthoConnect—networks of large, independent orthopaedic practices. These groups promote innovation, benchmarking, and business collaboration among members, with AJRR providing essential data infrastructure.

QCDR

The AAOS Registry Program is a CMS-designated QCDR. Participation in AJRR helps physicians meet requirements for the MIPS Quality Payment Program (QPP), including MIPS Value Pathways (MVP) and Promoting Interoperability (PI) measures.

The Hip Society

The Hip Society, dedicated to advancing care for hip disorders, aligns closely with AJRR's mission. Several members contribute to AJRR committees and support data-driven improvements in clinical care.

Joint Commission

AAOS and Joint Commission collaborate on quality measures and standards for the Advanced THKR Certification. Since July 1, 2019, AJRR has served as the sole registry pathway to meet this certification's data requirement.

The Knee Society

With a mission to advance education and research in TKA, The Knee Society shares AJRR's commitment to improving outcomes through scientific collaboration. Several members also serve on AJRR committees.

Advancing Arthroplasty Together: National Strength, Global Reach

A Letter from Brian R. Hallstrom, MD, FAOA, FAAOS, President-elect, ISAR

For years, U.S. orthopaedic surgeons made implant and technique decisions based on case reports, industry marketing, and personal experience. While innovations like cross-linked polyethylene have advanced care, others—such as metal-on-metal implants—have caused widespread harm.

AJRR is helping to change that. By tracking implant performance and surgical outcomes nationwide, the Registry supports evidence-based decision-making. Countries like Sweden, Australia, and the U.K. have shown how national registries can improve care. Though the U.S. healthcare system adds complexity, the value and urgency of a national registry like AJRR are clear and the progress is real.

At the state level, I've seen this firsthand through MARCQI. As Co-Founder and Co-Director, I've watched the data drive improvements in outcomes, identify implant issues, promote best practices, and reduce costs. A national program ensures this level of insight reaches every surgeon and every patient.

That's why MARCQI partnered with AJRR from the beginning, and why I've supported its mission since day one.

As President-elect of ISAR, I also see the global value of collaboration. ISAR enables registries around the world to share data, establish benchmarks, and accelerate learning. AJRR's contribution of comprehensive U.S. data strengthens international evidence and brings back insights that elevate care at home.

Together, registries can detect safety issues earlier, evaluate new technologies, reduce complications, and support innovation—all to improve patient outcomes worldwide.

AJRR is also leading the development of the International Prosthesis Library (IPL) in partnership with ISAR. This shared resource will standardize how implant performance is evaluated globally, speeding up approvals, improving oversight, and helping remove underperforming devices more efficiently.

Collaboration among MARCQI, AJRR, and ISAR is essential. Each brings unique strengths: local detail, national reach, and global perspective. Together, they create a powerful engine for continuous improvement and better orthopaedic care for all.

Brian R. Hallstrom, MD, FAOA, FAAOS
Program Director of MARCQI and a Clinical Professor of Orthopaedic Surgery at Michigan Medicine
President-elect, ISAR

ISAR is a global consortium of joint replacement registries established by several mature national registries. The society facilitates the advancement of registry science and observational studies, encourages the development of new national registries around the world, and provides a forum for information sharing to enhance participating countries' ability to meet their own objectives. AJRR is proud to be an associate member of ISAR and the vendor for the IPL.

INSIGHTS

Dedicated to Quality Improvement Initiatives

AAOS continues to advocate for policies that incentivize clinician participation in the AAOS Registry Program. In 2025, one key advocacy effort focused on expanding access to Medicare claims data for QCDRs at a reduced cost. The Access to Claims Data Act (H.R. 4331) was reintroduced in the House of Representatives on a bipartisan basis in July. AAOS strongly supports this bill, which has also been introduced in prior Congresses, and has worked closely with the sponsors on its reintroduction. If passed, this bipartisan legislation would give clinician-led registries access to claims data to evaluate long-term patient outcomes.

At the time of publication, a key win that AAOS has long advocated for was included in the proposed CY2026 Medicare Physician Fee Schedule rule. CMS is proposing—based on feedback from QCDRs including AAOS—that the current requirement for QCDRs to support MIPS MVPs applicable to the MVP participant on whose behalf the QCDR submits MIPS data be sunset. Instead, beginning in 2026, QCDRs must support MVPs applicable to the MVP participant no later than one year after finalization of the MVP. This change will make it easier for QCDRs to support clinicians by allowing registries one year from the introduction of new measures to fully implement them before they will be required to support them for their MVP participants.

CMS continues to propose transitioning from the current MIPS quality reporting and payment program to the MVP system in the coming years, focusing on specific measures and performance categories for different specialties. AAOS opposes making MVPs mandatory for orthopaedic surgeons due to concerns over limited applicability and potential challenges in ensuring relevant measures. AAOS continues to work with lawmakers and regulators to urge collaboration with specialty societies like AAOS in measure development and harmonization, leveraging clinical expertise and existing infrastructure. AAOS is pleased to see that these collaborative efforts have led to the inclusion of more PROMs in the Medicare QPM's measure inventory.

The ability to reuse registry data to enable performance measurement as well as facilitate national registry-driven quality improvement programs has been a focus of the Registry over the past few years. Now, AJRR data can be reused toward:

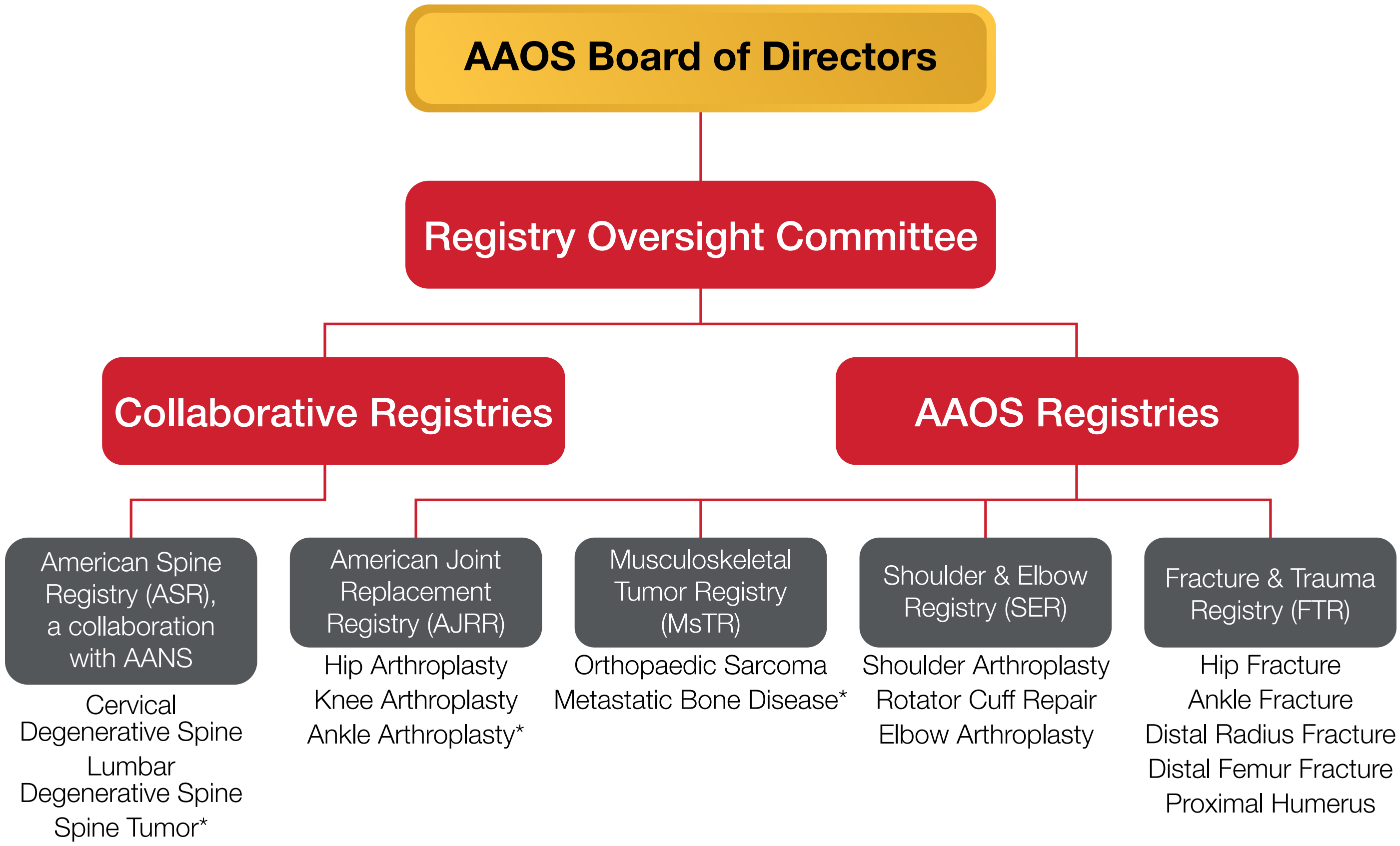
- Joint Commission Advanced THKR Certification
- ABOS MOC for Part II SAE credit
- CMS IQR THA/TKA PRO-PM
- CMS Comprehensive Care for Joint Replacement (CJR) Model
- CMS MIPS PI and QPP
- Accreditation Association for Ambulatory HealthCare (AAAHC) Advanced Orthopaedic Certification
- Aetna Institutes of Quality (IOQ) Orthopaedic Surgery
- BCBSA Blue Distinction® Centers for Knee and Hip Replacement
- Bree Collaborative
- Cigna Pathwell Bone & Joint℠
- DNV Orthopaedic Center of Excellence
- The Alliance QualityPath

To find out more about these and other ways to reuse Registry data, please click here.

About the AJRR

Governance and Structure

The AJRR is overseen by the AJRR Steering Committee which reports to the AAOS ROC and ultimately the AAOS Board of Directors.



Modules in development

"Participating in the AJRR Fellowship has been transformative for my career. I've gained insights from brilliant data scientists and senior orthopedic surgeons, which has deepened my expertise in leveraging registry data to advance quality improvements. As the largest hip and knee arthroplasty Registry in the world, the AJRR provides nearly limitless potential to innovate care for our patients."

Vishal Hegde, MD, FAAOS

Associate Professor

Director of Clinical Research, Adult Reconstruction Division

Director, Adult Reconstruction Fellowship

Department of Orthopaedic Surgery

Johns Hopkins University School of Medicine

2025 AAOS ROC

Overseeing the AJRR Steering Committee is the ROC. The ROC reports to the AAOS Board of Directors and provides guidance and recommendations for all major Registry initiatives.

The ROC is led by the following orthopaedic surgeons:

Steven D Glassman, MD, FAAOS, Co-Chair
Norton Leatherman Spine Center (Louisville, KY)

Bryan D Springer, MD, MBA, FAAOS, Co-Chair
Mayo Clinic Florida (Jacksonville, FL)

Kevin J. Bozic, MD, FAAOS
University of Texas Dell Medical School (Austin, TX)

Michael J. Gardner, MD, FAAOS
FTR Representative
Stanford University Surgery (Redwood City, CA)

Carolyn M Hettrich, MD, FAAOS
SER Representative
North Country Orthopedics (Watertown, NY)

James I. Huddleston, III, MD, FAAOS
AJRR Representative
Stanford University (Woodside, CA)

Benjamin J. Miller, MD, MS, FAAOS
MsTR Representative
University of Iowa (Iowa City, IA)

Kurt P. Spindler, MD, FAAOS
Cleveland Clinic Foundation (Weston, FL)

2025 AJRR Steering Committee

James I. Huddleston, III, MD, FAAOS, Chair
Stanford University (Woodside, CA)

Scott M. Sporer, MD, FAAOS, Vice Chair
AAOS Representative
Midwest Orthopaedics at Rush and Central DuPage Hospital (Wheaton, IL)

James A. Browne, MD, FAAOS
The Knee Society Representative
University of Virginia (Charlottesville, VA)

Antonia F. Chen, MD, MBA, FAAOS
AAOS Representative
University of Texas Southwestern Medical Center (Dallas, TX)

Paul J. Duwelius, MD, FAAOS
AAOS Representative
Orthopedic and Fracture Specialists (Portland, OR)

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President-elect, ISAR
State Registry Representative MARCQI Director
University of Michigan Medical Center

Richard L. Illgen II, MD, FAAOS
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Rush University Medical Center (Chicago, IL)

William J. Long, MD, FAAOS
The Knee Society Representative
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Howard J. Marans, MD
PR Member - Aetna (Santa Ana, CA)

James D. Slover, MD, FAAOS
The Hip Society Representative
Northwell Health (New York, NY)

Bryan D. Springer, MD, FAAOS
AJRR Representative
Mayo Clinic Florida (Jacksonville, FL)

Jeffrey B. Stambough, MD, FAAOS
AAHKS Representative and Co-Editor of the Annual Report
University of Arkansas for Medical Sciences (Little Rock, AR)

Our Mission

To improve orthopaedic care through the collection, analysis, and reporting of actionable data.

AJRR Committees

Many volunteers devote countless hours to ensure that the Registry is of the highest possible quality. Below is a description of all AJRR committees. Full membership details can be found in Appendix D.

Young Physicians Committee
The Young Physicians Committee assists in the management of the registry science curriculum. Committee members play an integral role in reviewing and authoring AJRR data-driven publications and serve as champions for participating institutions and specialties. Their subject-matter expertise in registry data is utilized across a multitude of projects.
Chair: Jeffrey B. Stambough, MD, FAAOS

Data Elements and Analysis Subcommittee
This subcommittee monitors, receives requests, and makes recommendations for additions or deletions to data elements or assessment tools collected by AJRR. The subcommittee makes recommendations to the Data Management Committee for review prior to discussion and final approval by the AJRR Steering Committee.

This subcommittee works with staff and statisticians to determine, develop, and oversee the implementation of appropriate data analysis methodologies and algorithms. The subcommittee's purview includes risk adjustment, scientific integrity of data, rigor of conclusions drawn from Registry data, and consideration of optimal reporting and data analysis to provide actionable data for the benefit of patients and other AJRR stakeholders.
Chair: Scott M. Sporer, MD, FAAOS

Research Projects Subcommittee
Members of the Research Projects Subcommittee review incoming external research proposals and requests and make recommendations for project approvals. The committee developed and now maintains the AAOS Registry Analytics Institute® (RAI). Members provide guidance on the process and grading of submitted proposals.
Chair: Richard L. Illgen II, MD, FAAOS

Public Advisory Board

The Public Advisory Board (PAB) provides direct input to the Steering Committee from both the patient and public perspectives. The PAB members are drawn from a wide variety of public advocacy groups and members of the public who have had joint arthroplasties themselves.

Richard Seiden, Esq., Chair

Chris Michno

William Mulvihill, M.Ed.

JohnMarc Alban, MS, RN, CPHIMS

Outgoing Volunteers

The Registry would like to recognize the work of the following volunteers whose terms concluded in 2025:

ROC

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Stanford Medicine Outpatient Center (Redwood City, CA)

Grant E. Garrigues, MD, FAAOS
SER Reprentative
Midwest Orthopaedics at Rush (Chicago, IL)

AJRR Steering Committee

William A. Jiranek, MD, FACS, FAAOS
AAHKS Representative
Duke University (Durham, NC)

Industry Collaborations

AJRR acknowledges the critical role of device surveillance and high-quality data collection in improving patient outcomes. By partnering with sites and manufacturers, the Registry facilitates a deeper understanding of how implants affect the patient experience and overall quality of life. Through national longitudinal data, AJRR enables collaborative evaluation of implant performance across the healthcare ecosystem.

Thank You to AJRR Industry Supporters and Partners

2025 Supporters

Registry Partners

"BCBSA is committed to making health care affordable and accessible. Its Blue Distinction Centers for Knee and Hip Replacement highlight hospitals and ambulatory surgery centers with strong patient safety, outcomes, and cost-effectiveness. By collaborating with AAOS and using AJRR registry data, BCBSA's streamlined evaluation identifies facilities that reduce readmissions and complications. The Blue Distinction designation helps local companies guide patients to higher-performing providers for better recoveries and health results."

Kari Hedges

Senior Vice President, Market Solutions

Blue Cross and Blue Shield Association

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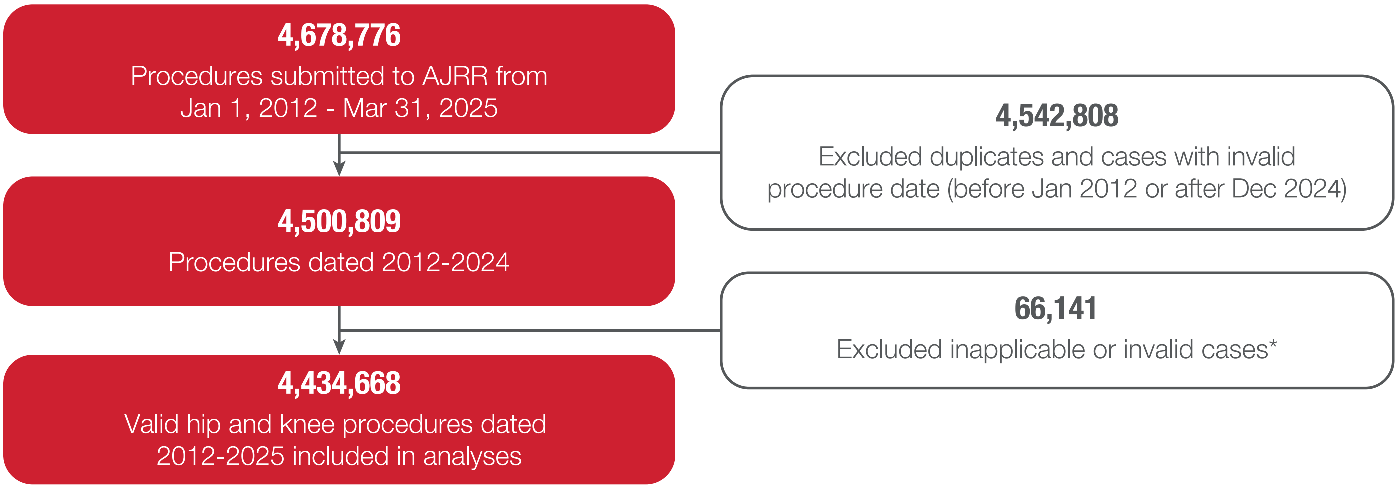
Additional Contributions:

We'd like to thank our colleagues at Mayo for their collaboration on the P-30 Grant. We've enjoyed working together on AJRR-based research analytics and are deeply grateful for the opportunity to learn from subject-matter experts in the arthroplasty field. We look forward to continuing to grow our project potential and portfolio together. AAOS also acknowledges the valuable statistical and analytical contributions of Dirk R. Larson.

Thank you to Vishal Hegde, MD, FAAOS, for his invaluable contribution in meticulously sorting and validating hundreds of thousands of catalog numbers across a wide range of figures for accurate classification. His efforts were instrumental in enabling the development of a minimum of five figures and supporting numerous research papers. This work would not have been possible without his expertise and dedication.

AAOS would also like to acknowledge the valuable statistical and analytical contributions from Isabella Zaniletti, PhD.

Overall Results



**Invalid data=joint procedures not in the hip or knee, procedure codes outside of approved AJRR data specifications, and hemiarthroplasty procedures without a diagnosis of femoral neck fracture.*

Analyses were conducted using a core dataset of hip and knee procedures submitted to the AJRR from Jan. 1, 2012, through March 31, 2025. Cases with invalid data, or procedures dated before Jan. 1, 2012, or after Dec. 31, 2024, were excluded. Data were considered invalid if procedure codes did not match the approved codes listed in the AJRR data specifications, or if they involved hemiarthroplasty procedures without a diagnosis of femoral neck fracture.

AJRR data is supplemented with information from the AHA and CMS when applicable. Any merged datasets are noted in the footnotes of corresponding tables and figures. Additional inclusion or exclusion criteria specific to each analysis are also specified in the corresponding table or figure when applicable.

Procedural Data Metrics

The AJRR 2025 Annual Report analyzed 4,434,668 procedures performed between 2012 and 2024 (Figure 1.1).

In prior AJRR Annual Reports, cumulative procedure volume was presented as a running total of all procedures submitted to the Registry from all previous years. In this year's report, procedure volume is shown instead as the number of procedures submitted per year.

INSIGHTS

The AJRR captured 4.6 million procedures performed between 2012 and 2024.

Data for this report were captured through March 31, 2025, in order to allow institutions time to finalize their 2024 submissions. While AJRR does not mandate a specific submission frequency, quarterly submissions are recommended as a minimum best practice. Beyond expanding facility enrollment, AJRR emphasizes the importance of timely and active data submission. AJRR provides a Registry Support team and Support Specialists to assist with and expedite the submission process to support participating institutions.

The distribution of the number of reported cases to the AJRR stratified by state are reported (Figure 1.2). The highest volume of procedures were reported from California, New York, and Florida (Figure 1.2). Primary TKA procedures continue to represent the majority of procedures within the AJRR (51.2%) followed by primary THA (32.4%) (Figure 1.3).

Demographic trends are reported with the majority of patients being female sex (58.6%) and white race (88.8%) (Figures 1.4-1.5). The identified race category is based on the Department of Health and Human Services (HHS) Implementation Guidance, which is in accordance with the Office of Management and Budget Directive on Race and Ethnicity.

Figure 1.1 **Annual Procedural Volume, By Year 2012-2024 (n=4,434,668)**

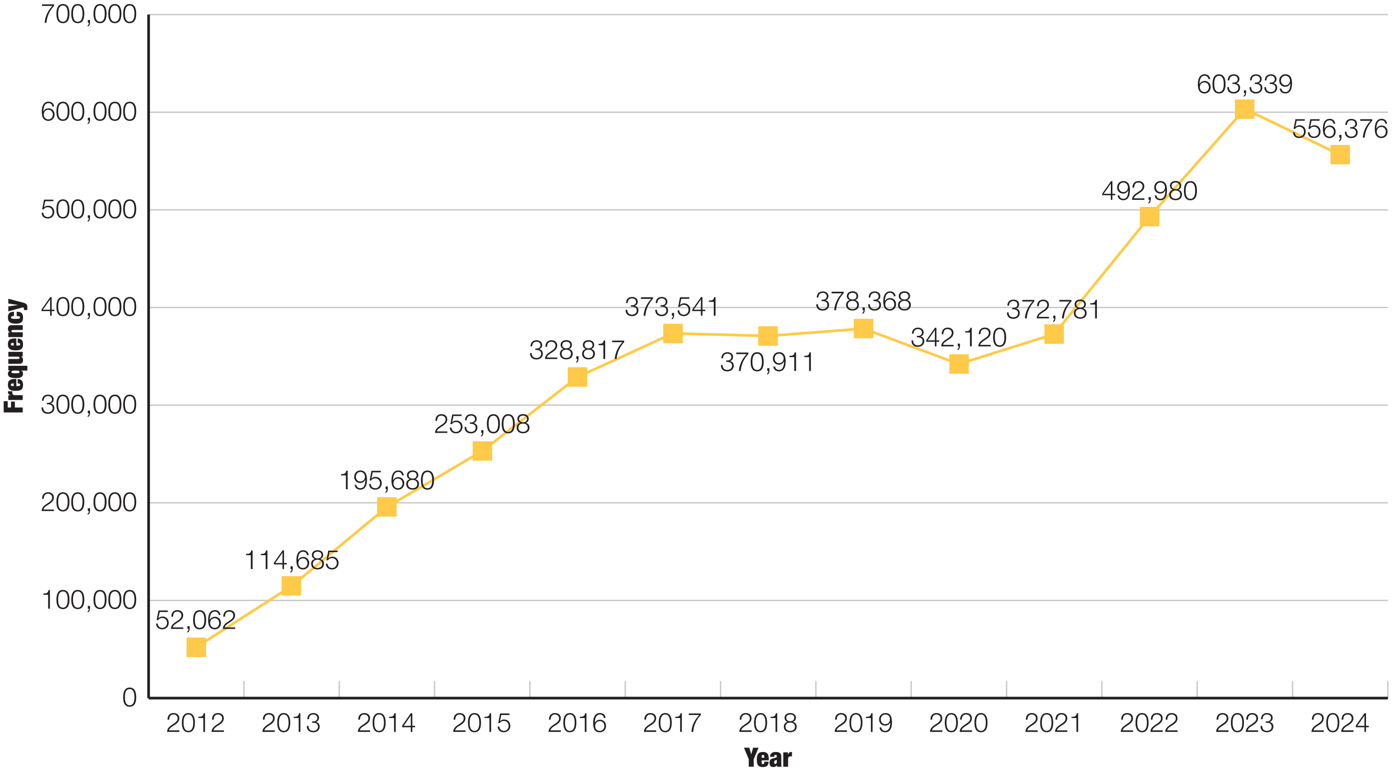


Figure 1.2 **Arthroplasty Procedures by State, 2012-2024 (N=4,427,949)**

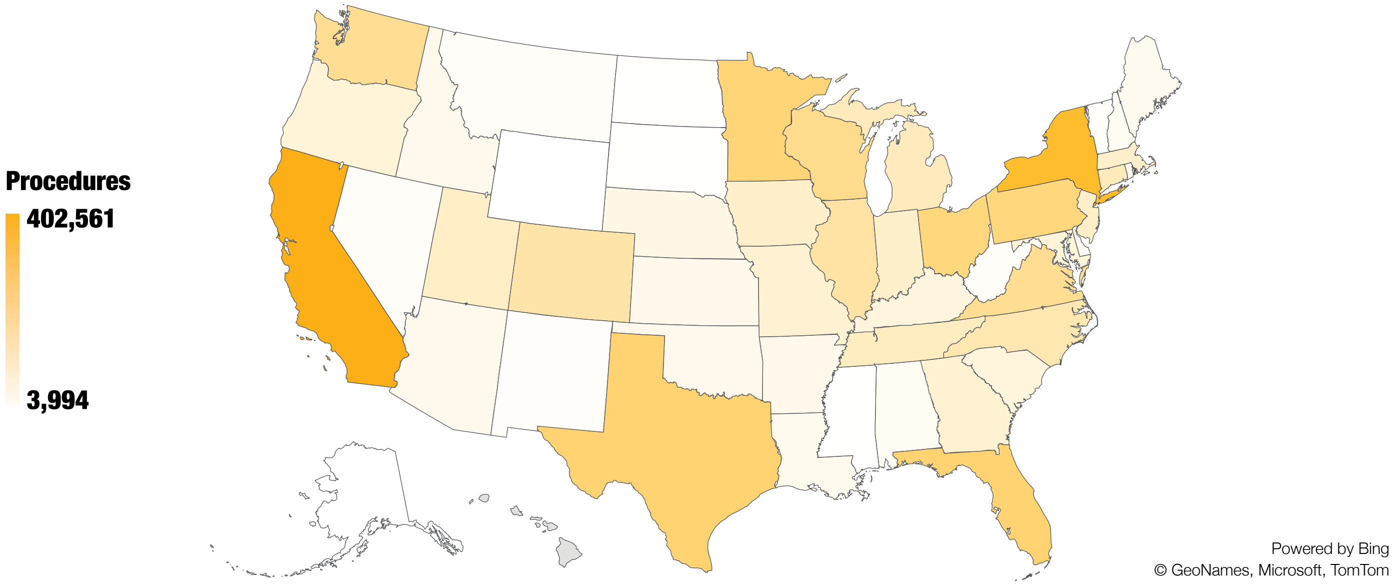


Figure 1.3 **Distribution of Arthroplasty Procedures, 2012-2024 (N=4,434,668)**

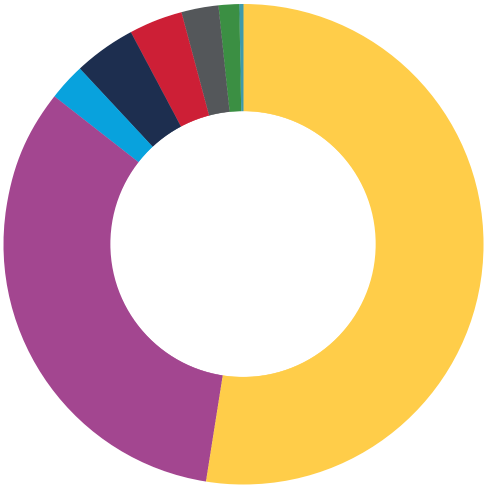
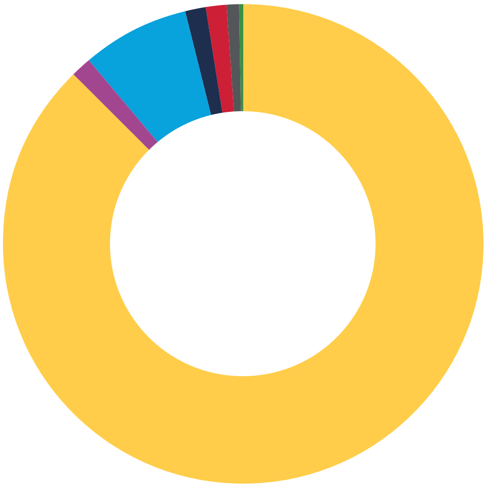


Figure 1.4 **Sex of Patients Undergoing Procedures, 2012-2024 (N=4,434,668)**

Figure 1.5 **Race of Patients Undergoing Procedures, 2012-2024 (N=4.434,668)**



Submitting Facilities

Expanding facility enrollment and improving data submission continue to be major priorities for the AJRR. These initiatives have led to steady growth in the number of hospitals, ASCs, and private practice groups contributing data to AJRR. We report on the number of contracted (currently enrolled) facilities and the number of facilities actively submitting data from 2012 to 2024 for institutions (Figure 1.6) and ASCs (Figure 1.9). Data can be submitted retrospectively which accounts for instances when a higher number of submitting institutions are noted at earlier timepoints. The number of contracted AJRR institutions (Figure 1.6) and contracted AJRR ASCs continues to grow steadily over time (Figure 1.9).

Arthroplasty procedures submitted to the Registry were most frequently performed in medium-sized hospitals (100-399 beds, 38.6%, Figure 1.7) and major and minor teaching institutions (a medical school affiliation or approved internship/residency program, 28.7% and 34.7%, Figure 1.8). Data on hospital information for all AJRR submitting hospitals is supplemented with available data from the AHA survey.

Participation in the AJRR remains voluntary in the U.S. Currently, the AJRR has incomplete capture of primary and revision hip and knee procedures. The AJRR continues to grow in terms of the number of contracted institutions and the percentage of arthroplasties captured nationally. We recognize the importance of continued efforts to expand data capture rates and to improve the quality of our AJRR dataset. Although we recognize the AJRR data capture rates are incomplete, a previous study has established that the distribution of AJRR data for patient age, hospital volume, and geography are proportionally similar to the national experience with hip and knee arthroplasty in the U.S.[1]

Figure 1.6 Number of Submitting by Contracted Institutions by Year (N=1,798)

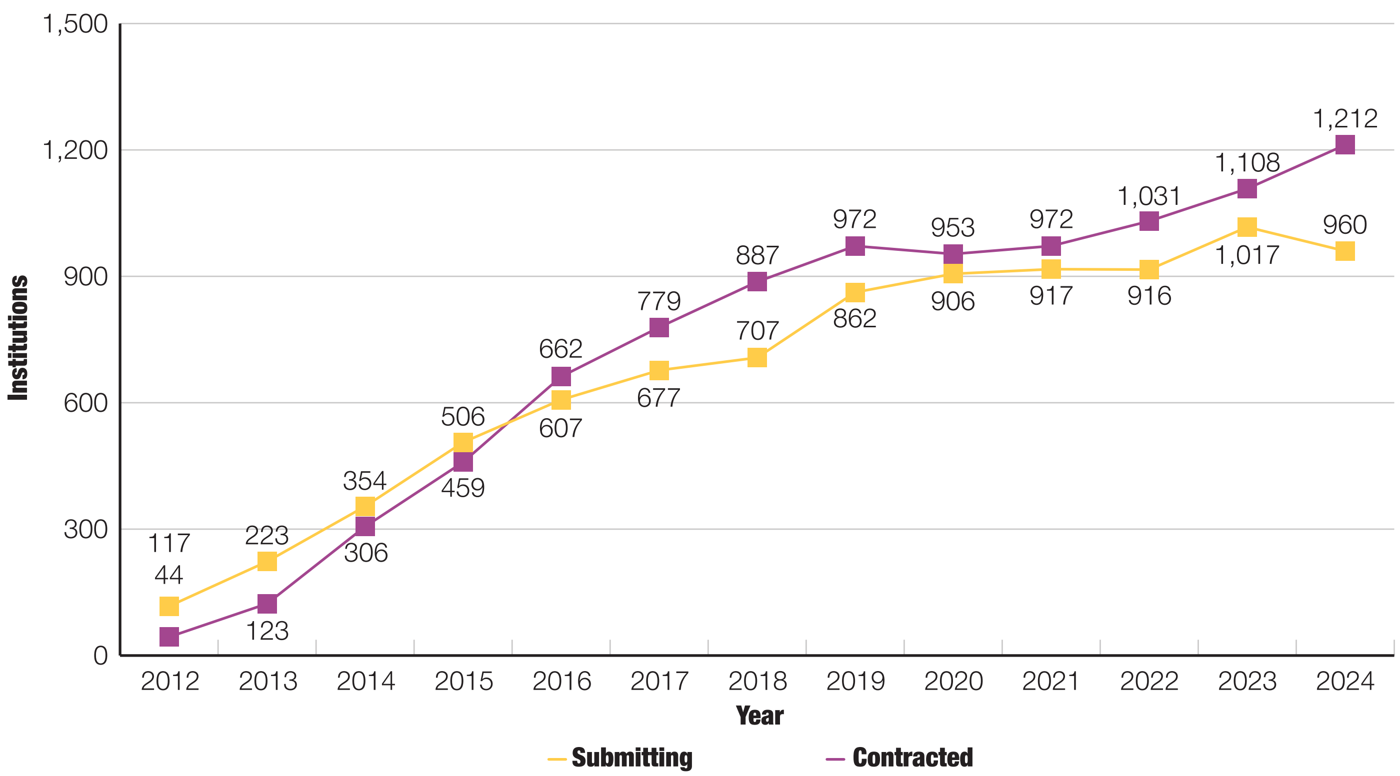


Figure 1.7 Hospital Size (Bed Count) of Submitting Hospitals, 2012-2024 (N=1,447)

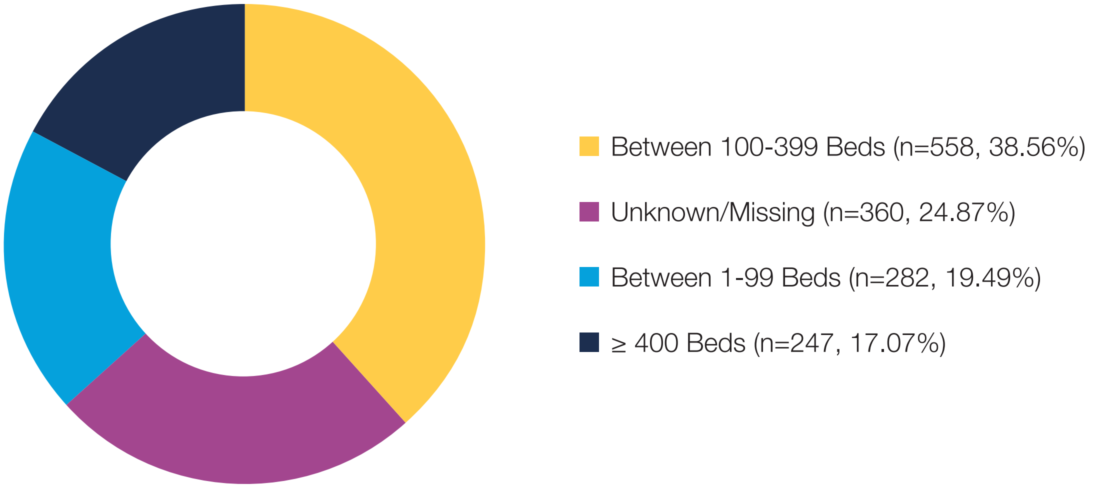
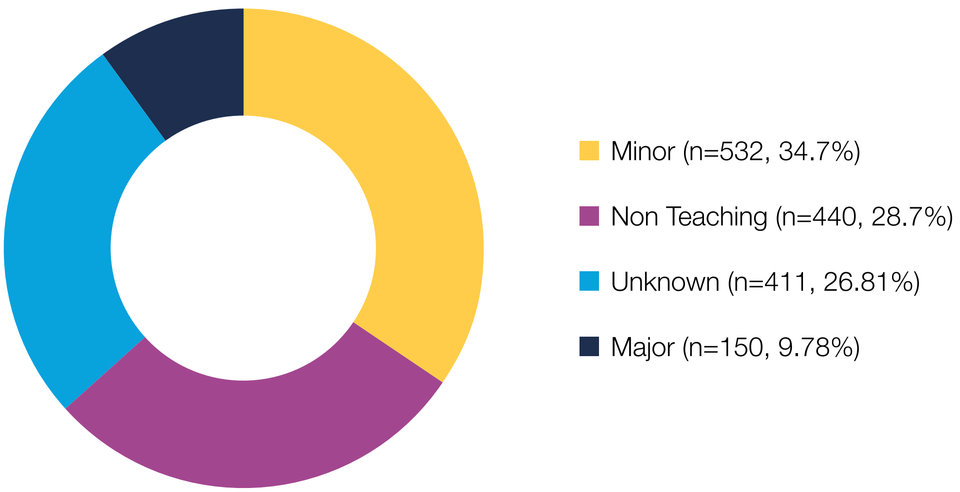


Figure 1.8 Distribution of Submitting Institution Teaching Affiliation, 2012-2024 (N=1,553)



Ambulatory Surgery Centers

ASCs are playing an increasingly important role in total joint arthroplasty (TJA) care in the U.S. While Registry data has historically come primarily from hospitals, the number of arthroplasties performed in ASCs has continued to rise. AAOS has expanded efforts to enroll ASCs in AJRR to better capture this important shift in healthcare delivery since 2018.

ASCs are classified by the submitting institution on their AJRR application and may be either freestanding or hospital-affiliated. The AJRR has documented substantial growth in contracted ASCs from 2013 (1 ASC) to 2024 (107 ASCs) (Figure 1.9). Procedure submissions from ASCs have also increased steadily since 2012 with annual submissions reaching a plateau of approximately 18,000 procedures per year from 2021 through 2024 (Figure 1.10).

Submitting Surgeons

Figure 1.9 **Annual Number of Enrolled Ambulatory Surgery Centers by Year, 2012-2024 (N=174)**

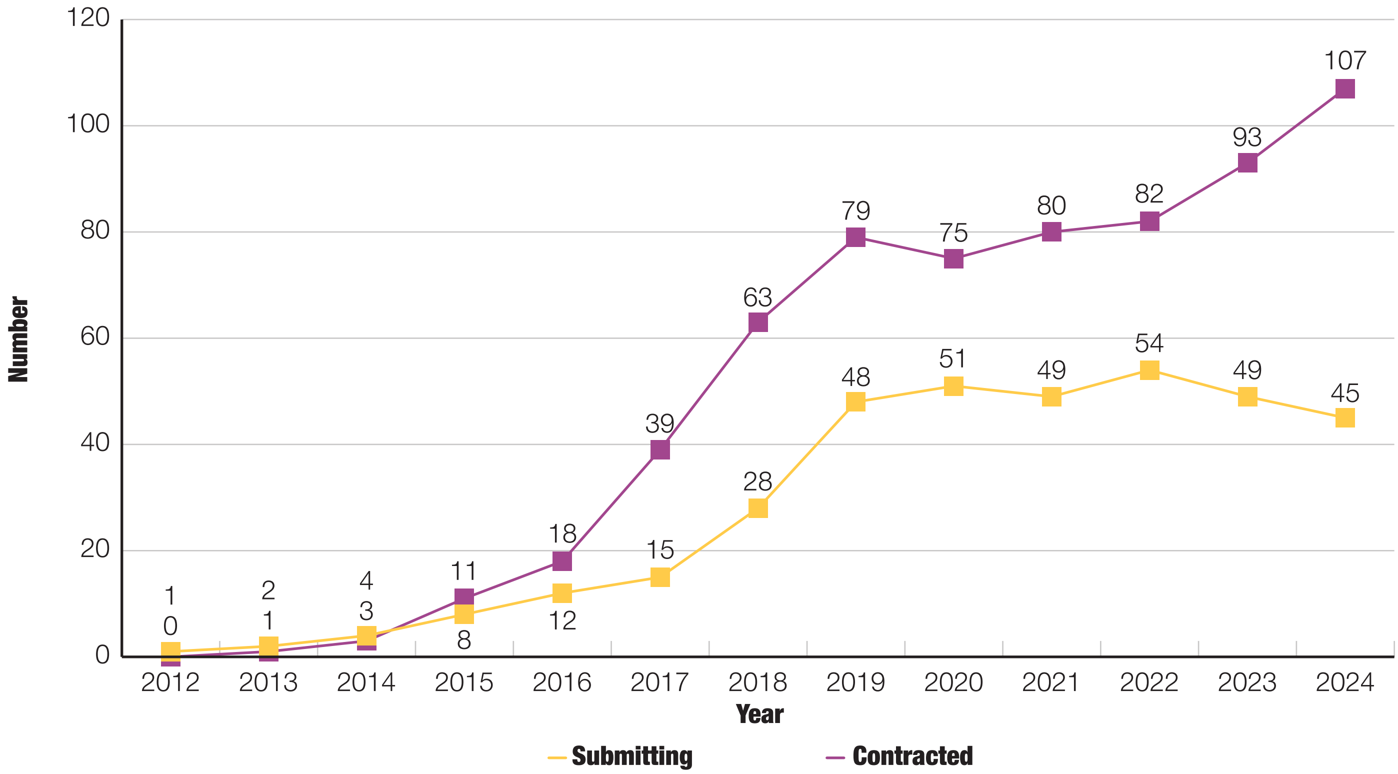
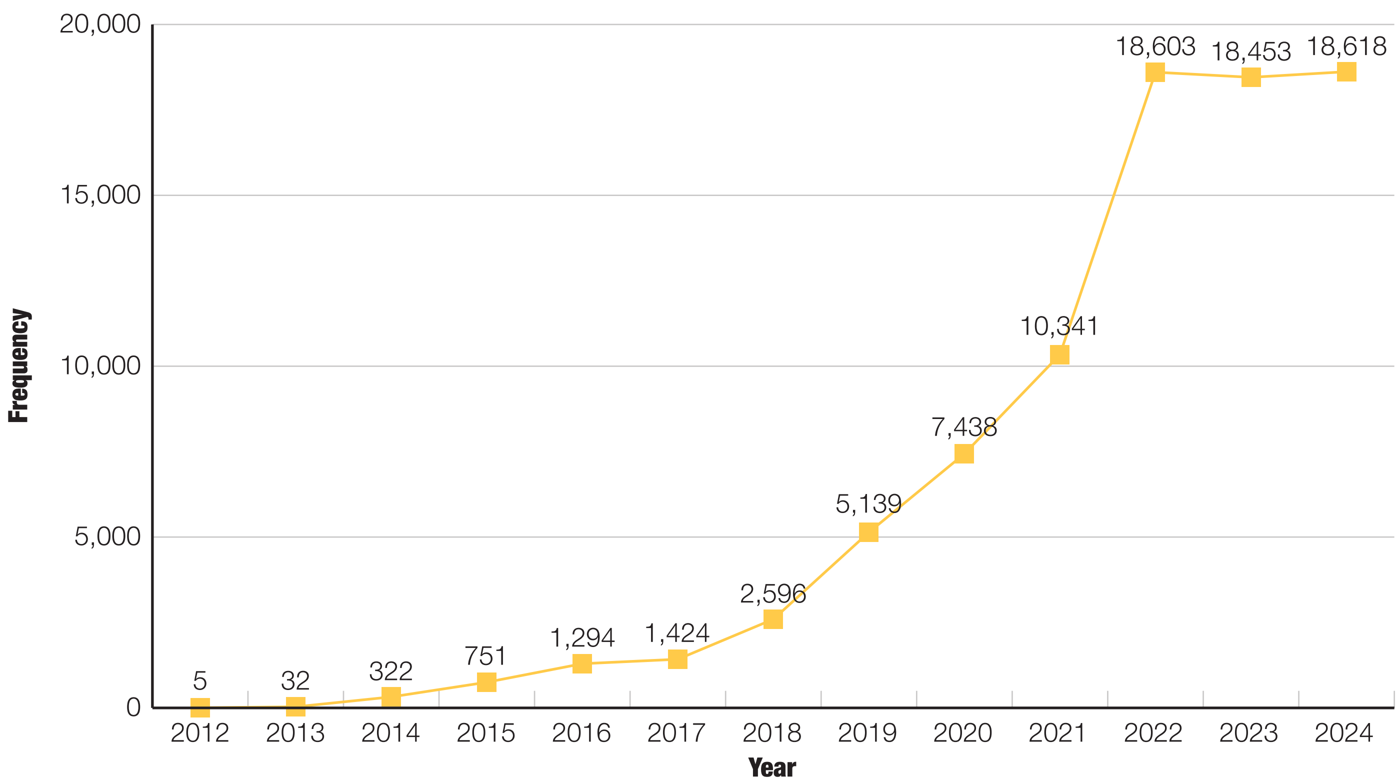


Figure 1.10 **Annual procedure volume from ambulatory surgery centers by year, 2012-2024 (N=85.016)**

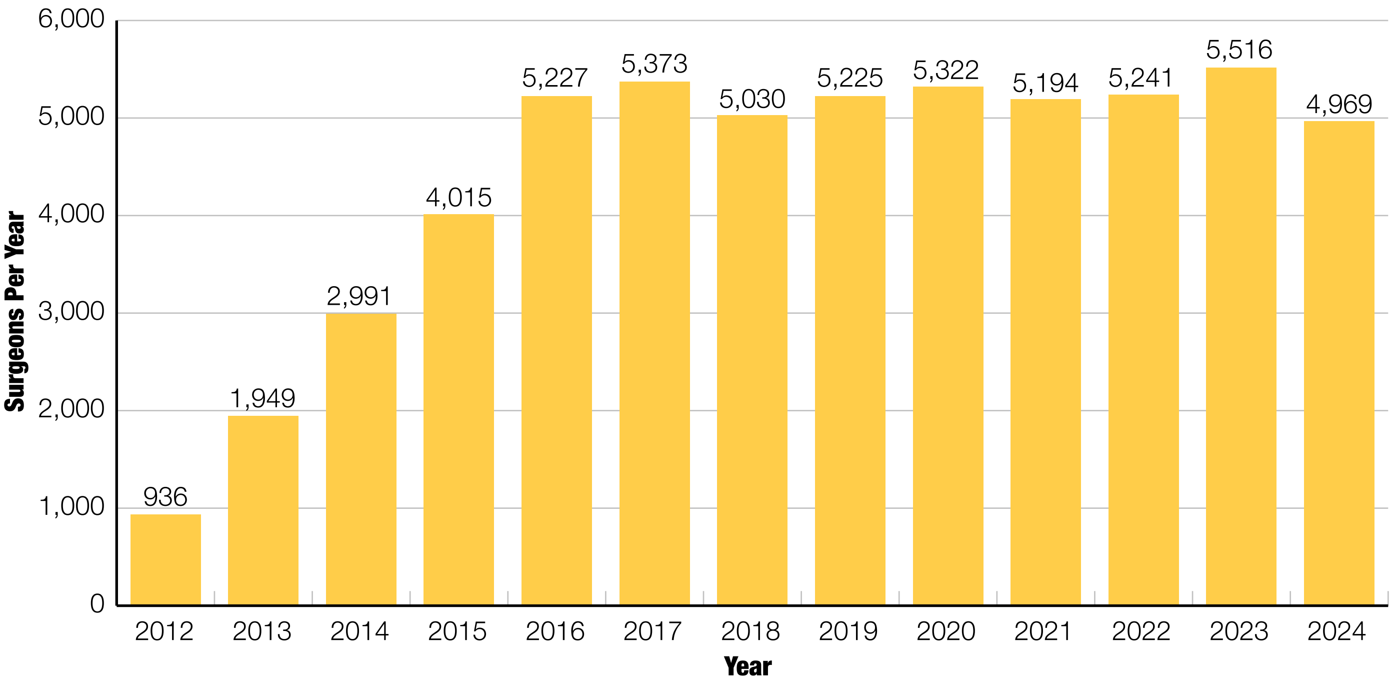


12,049 unique surgeons have submitted at least one procedure to the AJRR through March 31, 2025 (Figure 1.11). This is an increase of 3.8% compared to the 2024 report. The AJRR accepts historical data and many institutions submit data towards the end of the following year. It is therefore anticipated that the number of surgeons with cases submitted to the AJRR in recent years (2018-2024) will continue to increase in future Annual Reports as historical data is retrospectively added. Approximately 5,000 surgeons submitted data to the AJRR in 2024 (Figure 1.11). AJRR participating institutions are required to submit data from all surgeons performing hip or knee arthroplasty procedures at their facility.

INSIGHTS

Approximately 5000 surgeons submitted data to the AJRR in 2024 (Figure 1.11).

Figure 1.11 Cumulative Number of Surgeons Represented in Annual Procedure Submissions, 2012-2024 (N=12,049)



Data Element Completeness

Data completeness represents an important metric of data quality. The AJRR introduced a required MDS (Appendix B) in an effort to improve data completeness. The MDS was introduced in September 2025 and the AJRR is partnering with participating facilities to coordinate data submission modifications to meet this new requirement. MDS will be mandatory for all participating facilities effective September 2026.

Data completeness from specific data elements collected from 2012 to the first quarter of 2025 are reported (Tables 1.1 and 1.2). “Not reported” or “NR” is an accepted value for some data elements. Elements that can automatically be extracted from an EHR including age, gender, procedure code, diagnosis code, date of birth, city, state, zip code, patient name, procedure date, and discharge disposition have rates of data completeness greater than 90% (Table 1.1). These data elements are all part of our MDS (Level 1 data). Some elements are more difficult to achieve automated data extraction and are included in our Supplemental Dataset (Level 2 data), which include anesthesia type, surgical approach, surgical duration, CCI, robotic use, and navigation use (Table 1.2) with rates of data completeness that are often significantly less than data completeness rates noted in the MDS. The AJRR is exploring several options including natural language processing, standardized operative note templates, and artificial intelligence to improve data quality and data completeness. We continue to work with EHR systems as well as vetted Authorized Vendors to reduce data entry burden and streamline participation.

The specific data elements collected by the AJRR are frequently reviewed to ensure relevant data points are being captured. The process to update our data specifications is a lengthy process. Understanding how data is submitted to the AJRR and the percentage of data completeness helps guide decisions regarding data specification updates. The AJRR strives to continually improve the quality of the datasets. The Registry provides participating institutions with dashboards regarding their specific levels of data completeness to encourage continuous quality improvement efforts related to optimizing data submissions.

Table 1.1 Completeness For Minimum Dataset (Level 1 data)

Element	N Total	Percent Reported	Percent NR	Percent Invalid
Principal Procedure Code	4,628,842	99.98	0	0.02
Principal Diagnosis Code	4,628,842	96.7	0	3.3
First Implant Catalog # Listed	4,628,842	89.86	0	10.14
First Implant Lot # Listed	4,628,842	86.21	0	13.79
Date of Birth	4,628,842	100	0	0
Gender	4,628,842	99.59	0.41	0
Zip Code	4,628,842	97.17	0	2.83
First Name	4,628,842	100	0	0
Last Name	4,628,842	99.97	0.03	0
Procedure Date	4,628,842	100	0	0
ADMSN/DSCHG LOS *	3,232,080	98.41	0	1.59
Discharge Disposition Code *	3,232,080	93.51	4.93	1.55

These variables were added in a later specification version and have a different denominator for completeness.

Table 1.2 Completeness for Supplemental Dataset (Level 2 data)

Element	N Total	Percent Reported	Percent NR	Percent Invalid
Incision Start Time (Procedure Start Time)	4628842	76.23	23.04	0.73
Skin Closure Time (Procedure End Time)	4628842	77.85	21.45	0.7
Surgical Approach (Hip/Knee)	4628842	9.86	83.43	6.71
Race	4628842	86.39	13.59	0.02
Comorbidity - POA considered	3232080	29.92	69.25	0.82
Patient Height + Weight	3232080	87.88	0	12.12
Computer Navigation	3232080	33.88	65.7	0.43
Robotic Assisted	3232080	44.39	55.47	0.13
Anesthesia Type	3232080	66.87	29.53	3.6
Charlson Index *	3232080	5.89	92.78	1.33
ASA Classification	3232080	62.58	36.97	0.46
Payer Status	542220	44.14	55.73	0.13

Please note: When the Charlson Index is missing, diagnosis, comorbidity, and CMS data can be used to supplement capture.

HIP ARTHROPLASTY

Hip Overview

AJRR has collected data on 1,849,216 hip procedures from 2012-2024

The majority of surgeons contributing data to AJRR perform both elective primary THA and hip arthroplasty for femoral neck fracture (FNF). Surgeons with at least one relevant hip procedure were included in this analysis. The mean annual number of reported procedures for surgeons performing elective primary THA procedures was 49.4 in 2024. This represents an increase of five procedures annually compared to 2023. The interquartile range (25th-75th percentile) ranged between 8-71 procedures with a median of 28 procedures (Table 2.1). This distribution of procedures is consistent with previous reports of hip arthroplasty in the U.S.[3]

The distribution of hip procedure types in 2024 was stable compared with prior years (Figure 2.1). The “other procedures” category includes interventions such as arthrotomy and conversions from previous hip operations. Hip resurfacing was reported infrequently in the AJRR (0.04% of hip arthroplasties) and average age for hip resurfacing (53.4 years) was younger than reported for primary THA (Table 2.2, Figure 2.2). The average age for elective primary THA was 65.7 years, consistent with previous AJRR reports. Length of stay (LOS) was calculated as the difference between admission and discharge dates across all reporting facilities with hospitalizations of less than one day included in the analysis. The mean LOS for THA has steadily declined from 2012 (3.0 days) to 2024 (1.1 days) (Table 2.3).

Patients with FNF treated with either THA or hemiarthroplasty (HA) had a mean LOS nearly six times longer than the LOS for elective THA patients (5.9 vs. 1.1 days). LOS for THA and HA performed for FNF has remained stable over the past seven years (Figure 2.3).

Patients with FNF treated with either THA or HA had a mean LOS nearly six times longer than the LOS for elective THA patients (5.9 vs. 1.1 days)

INSIGHTS

Table 2.1 Average Procedural Volume for Participating Surgeons, 2024

Procedure Type	Surgeons	Procedures	Mean	Median	25th Percentile	75th Percentile
Total Hip Arthroplasty	3,235	159,711	49.4	28	8	71
Hemiarthroplasty	2,512	13,753	5.5	3	2	7
Hip Resurfacing	29	44	1.5	1	1	1
Other Procedures	773	1,581	2.1	1	1	2
Revision Hip Arthroplasty	2,273	15,529	6.8	4	2	9
THA for Fracture	1,692	5,856	3.5	2	1	4

Figure 2.1 Distribution of Procedure Codes for All Hip Arthroplasty Procedures, 2012-2024 (N=1,849,592)

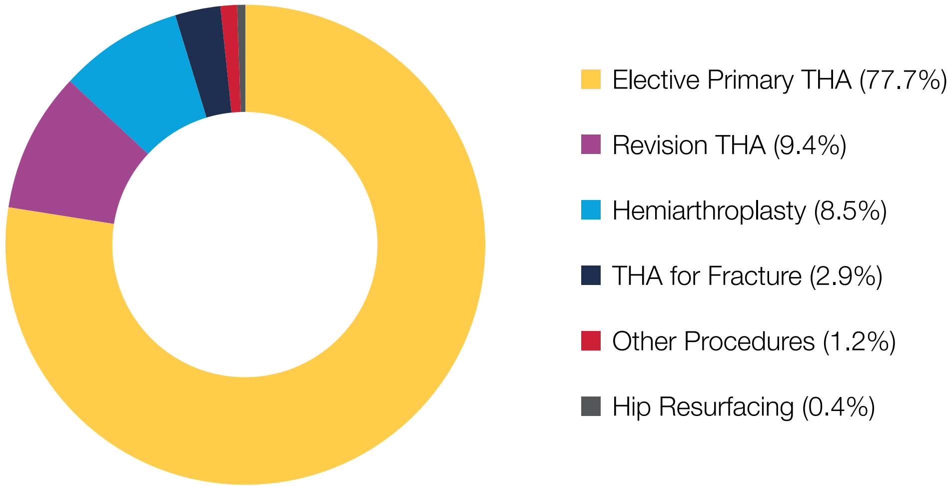


Table 2.2 Mean Age of Patients Undergoing Hip Arthroplasty Procedures, 2012-2024 (N=1,849,216)

Procedure Type	Total	Mean Age (Yrs)	Standard Deviation
Total Hip Arthroplasty	1,437,102	65.7	11.2
Revision Hip Arthroplasty	172,817	67.3	12.6
Hemiarthroplasty	157,959	81.8	9.6
THA for Fracture	52,824	71.8	11.4
Other Procedures	21,636	67.2	21.0
Hip Resurfacing	6,878	53.4	9.6

Figure 2.2 Age Distribution of Hip Arthroplasty Procedures 2012-2024 (N=1,827,580)

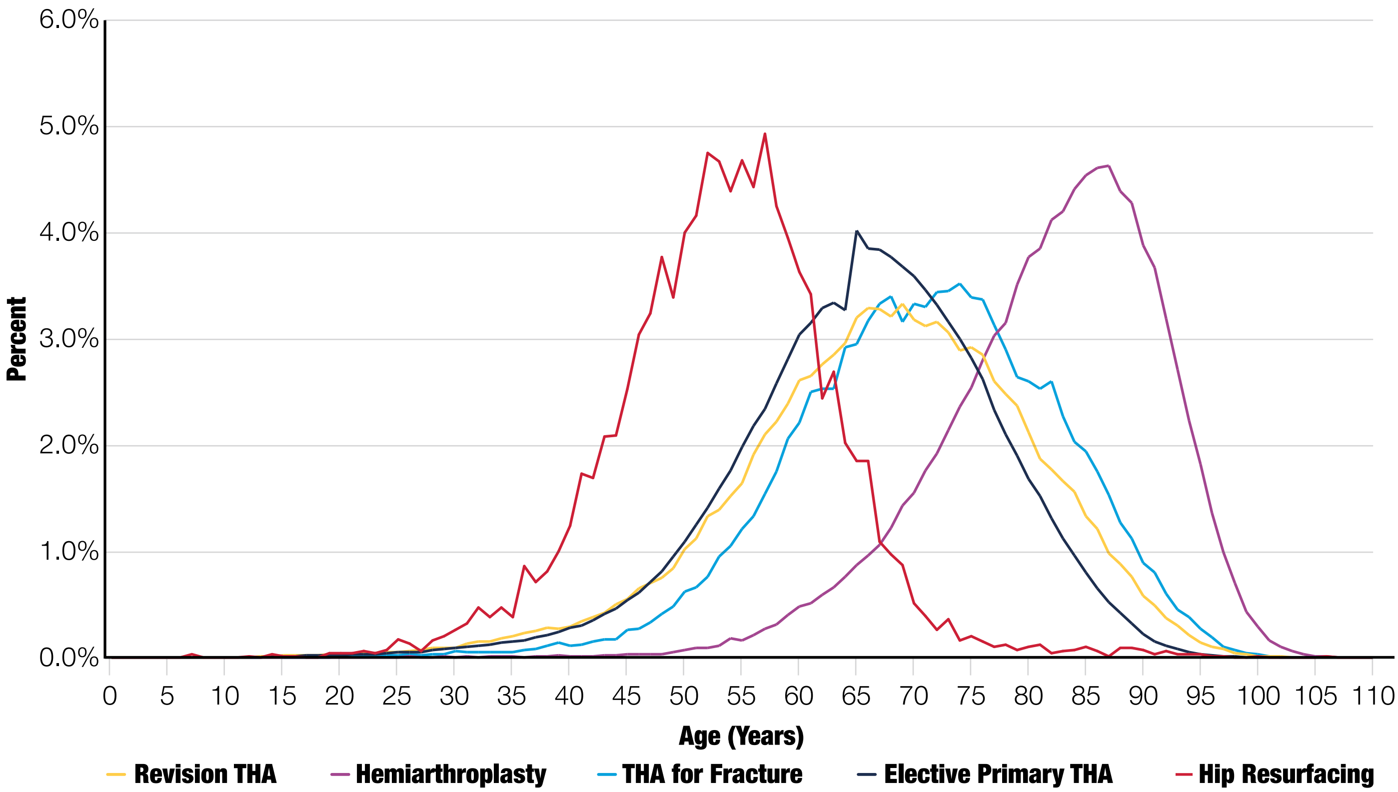
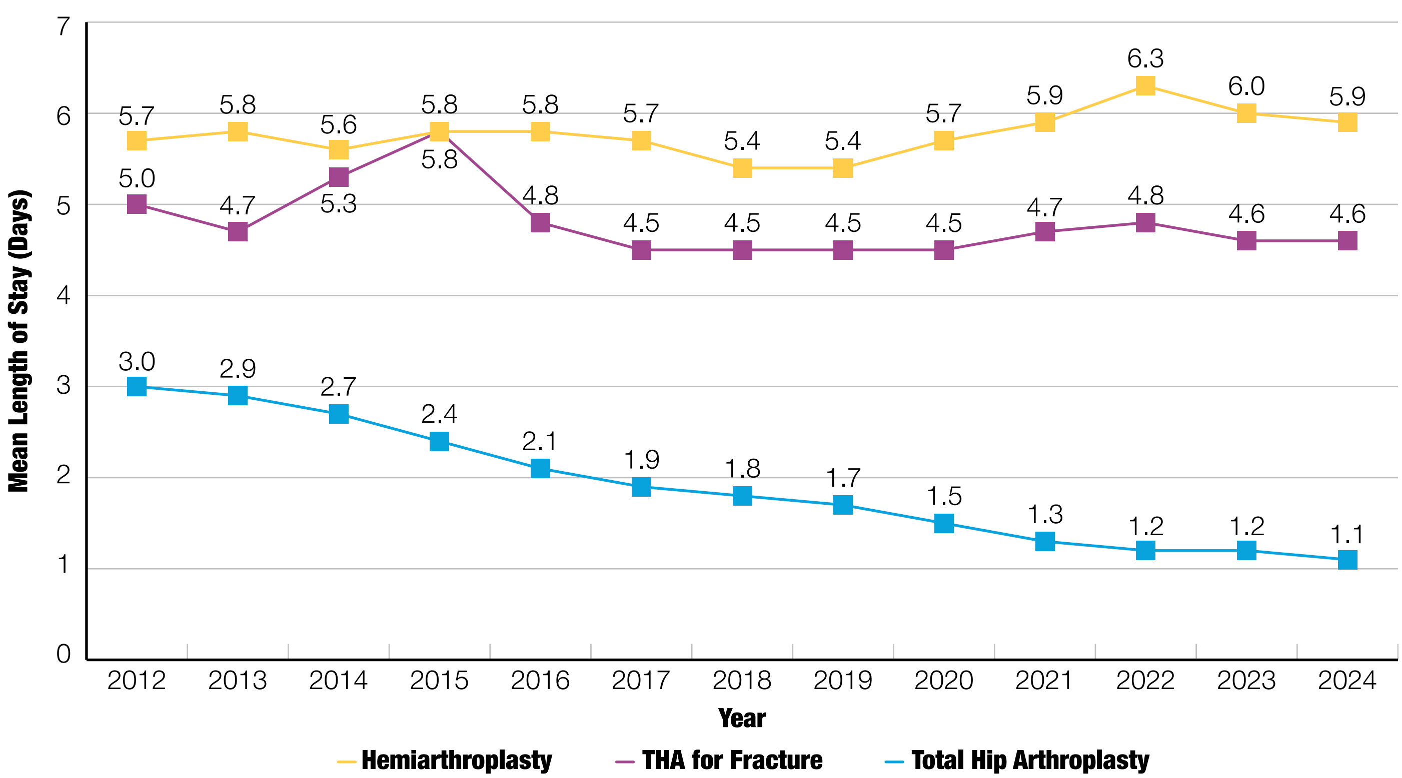


Figure 2.3 Mean Length of Stay for Hip Arthroplasty Procedures, 2012-2024 (N=1,229,671)



Arthroplasty for Femoral Neck Fracture

AJRR has collected data on 175,732 hip arthroplasty procedures for FNF from 2012 to 2024

Displaced FNFs recorded in the AJRR are commonly treated with either HA or THA. The optimal treatment for these fractures remains a topic of debate and is typically individualized to the patient.[3] HA remains the predominant arthroplasty procedure for patients with FNF. Rates of THA to treat FNFs slowly increased from 16.8% in 2012 to 27.2% in 2020 with no significant change over the last 5 years. HA accounts for approximately 72% of all hip arthroplasty procedures performed for FNF in 2024 (Figure 2.4). This pattern is consistent with findings from other national registries.[5]

Age has a significant impact regarding treatment with either HA or THA for FNF. The majority of patients under 60 years of age receive THA rather than HA for treatment of FNFs (Figure 2.5). There is a relatively even split between THA and HA among patients aged 60–69 years and HA becomes the predominant option for patients over 69 years of age (Figure 2.5).

Sex influences the relative frequency of THA for FNF likely related to the higher incidence of age-related osteoporosis among women compared with men. Men accounted for the majority of THAs performed for FNF in the youngest age group (<50 years) and women represented the majority in all other age groups including 69% of cases in patients over 90 years of age (Figure 2.6).

Survivorship was analyzed by comparing THA performed for primary osteoarthritis with HA performed for the treatment of FNF in Medicare patients over 65 years old. Cumulative percent revision (CPR) rates were statistically indistinguishable during the first postoperative month. Between 1–5 years postoperatively, THA demonstrated slightly better survivorship compared with HA (HR: 1.117; 95% CI: 1.031–1.209; p=0.0067). Beyond 5 years, HA showed superior survivorship relative to THA (HR: 0.606; 95% CI: 0.448–0.820; p=0.0012). Further survivorship analyses stratified by age, sex, fixation method, and femoral stem design will be presented in future reports.

Figure 2.4a Total Hip Arthroplasty and Hemiarthroplasty Procedures Performed for Femoral Neck Fracture, 2012-2024 (N=150,344)

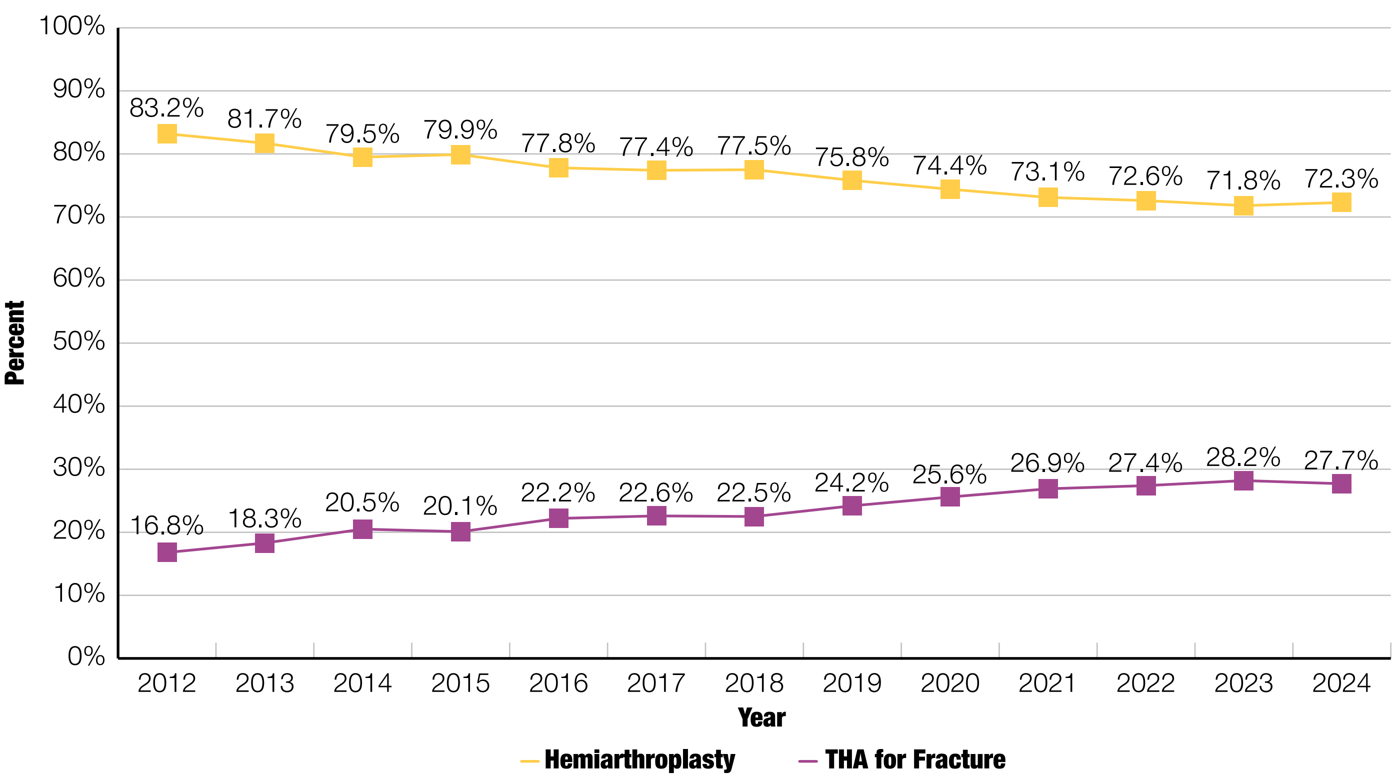
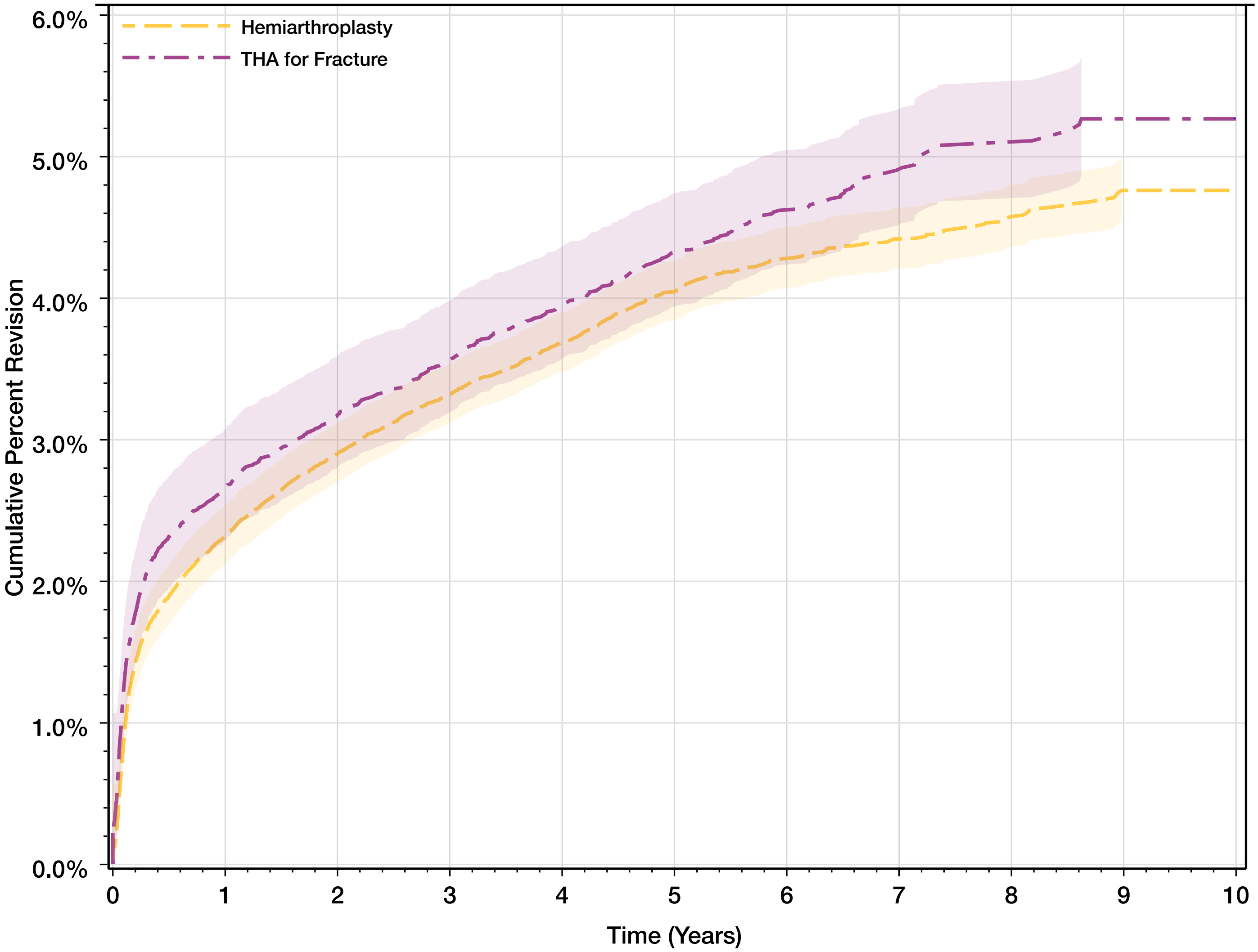


Figure 2.4b **Cumulative Percent Revision for Total Hip Arthroplasty Compared to Hemiarthroplasty Used for Treatment of Fracture Medicare Patients 65 Years of Age and Older with Primary Osteoarthritis, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8	9	10
Hemiarthroplasty	At Risk	134,804	94,936	73,724	56,491	42,728	33,144	25,043	16,806	9,985	5,549	2,873
	KM % revision	0.10 (0.08, 0.11)	2.32 (2.23, 2.41)	2.90 (2.8, 3)	3.32 (3.21, 3.43)	3.68 (3.57, 3.81)	4.05 (3.91, 4.18)	4.28 (4.14, 4.43)	4.42 (4.27, 4.58)	4.57 (4.41, 4.74)	4.76 (4.57, 4.96)	4.76 (4.57, 4.96)
THA for Fracture	At Risk	36,008	27,950	22,032	17,218	13,326	10,136	7,563	5,290	3,260	1,803	961
	KM % revision	0.22 (0.17, 0.27)	2.65 (2.48, 2.82)	3.17 (2.99, 3.37)	3.57 (3.36, 3.78)	3.94 (3.72, 4.18)	4.32 (4.07, 4.58)	4.62 (4.36, 4.91)	4.91 (4.61, 5.22)	5.08 (4.77, 5.42)	5.27 (4.92, 5.65)	5.27 (4.92, 5.65)

Age, Sex, CCI adjusted HR (95% CI), p-value
Hemiarthroplasty vs THA for Fracture at 0-1 Months: 0.878(0.768,1.003), p=0.0548
Hemiarthroplasty vs THA for Fracture at 1 Month-5 Years: 1.117(1.031,1.209), p=0.0067
Hemiarthroplasty vs THA for Fracture at 5-10 Years: 0.606(0.448,0.820), p=0.0012

Figure 2.5 Percent of Total Hip Arthroplasty and Hemiarthroplasty Procedures for Treatment of Femoral Neck Fracture by Age Group, 2012-2024 (N=210,783)

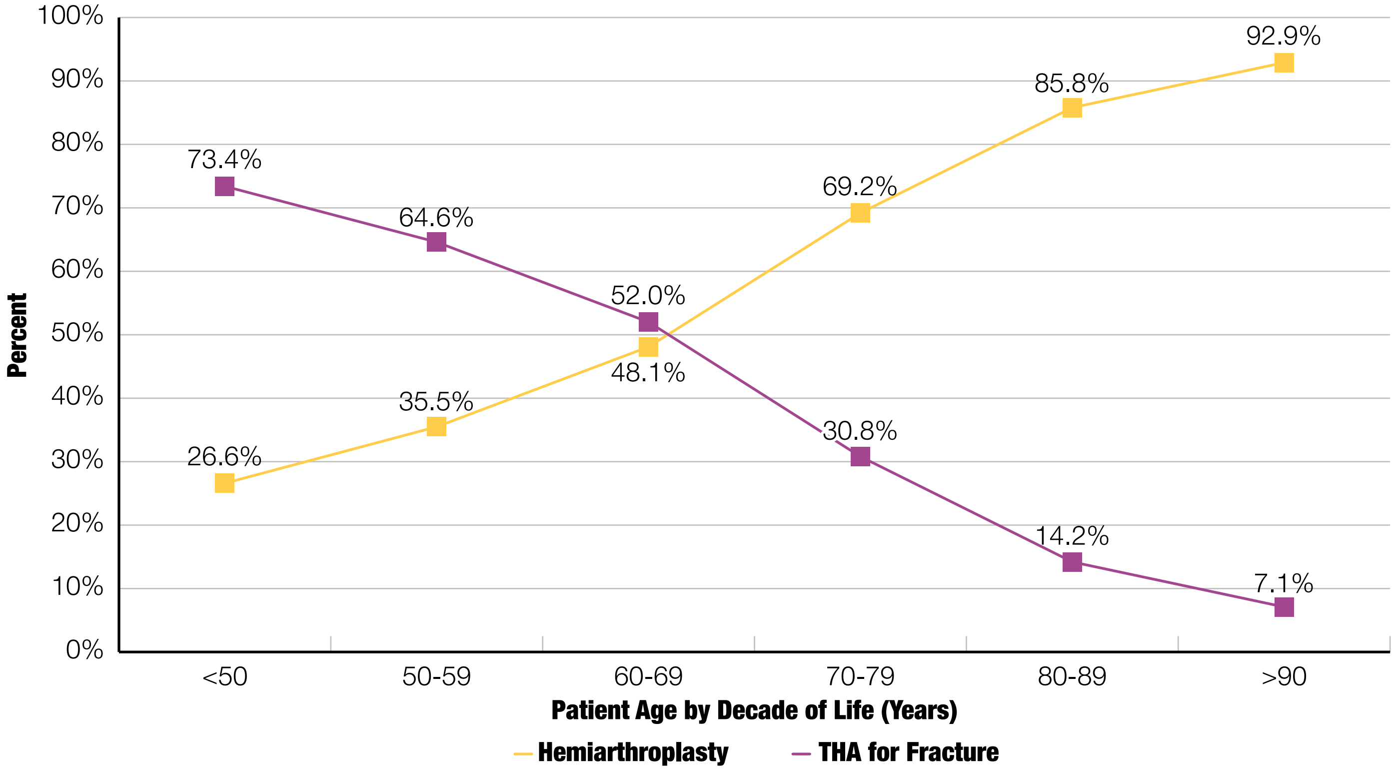
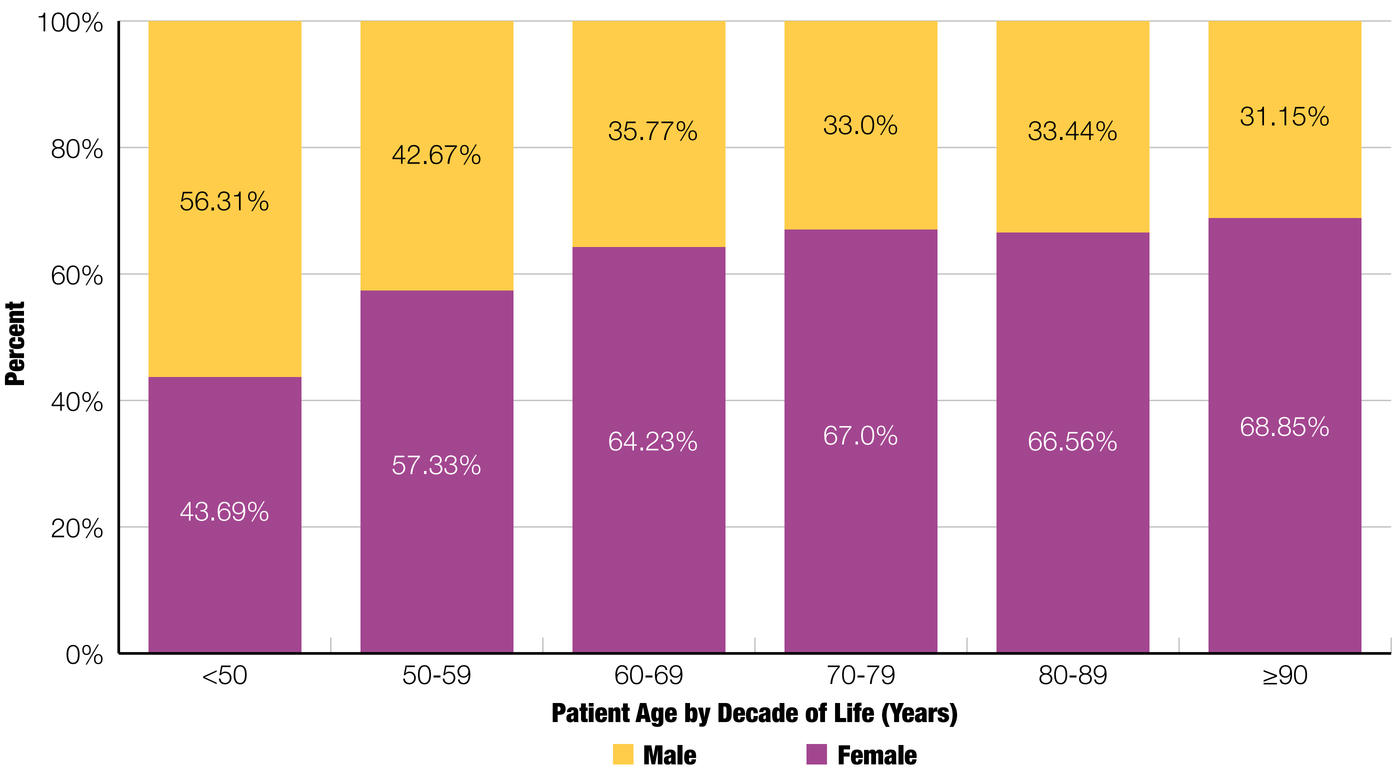


Figure 2.6 Sex Distribution for Total Hip Arthroplasty for Femoral Neck Fracture by Age Group, 2012-2024 (N=52,684)



Cementless femoral fixation is used in the majority of cases in the treatment of FNFs in both HA and THA groups (Figure 2.7 and Figure 2.8). Cemented femoral fixation was more commonly utilized for HA (42.1%) than for THA (23.9%) (Figure 2.7). Utilization of cemented femoral fixation has increased slightly for both HA and THA for FNFs over the past seven years (Figures 2.7 and 2.8).

Figure 2.7 Cemented Fixation for Femoral Stems in Total Hip Arthroplasty for Femoral Neck Fracture, 2012-2024 (N=6479)

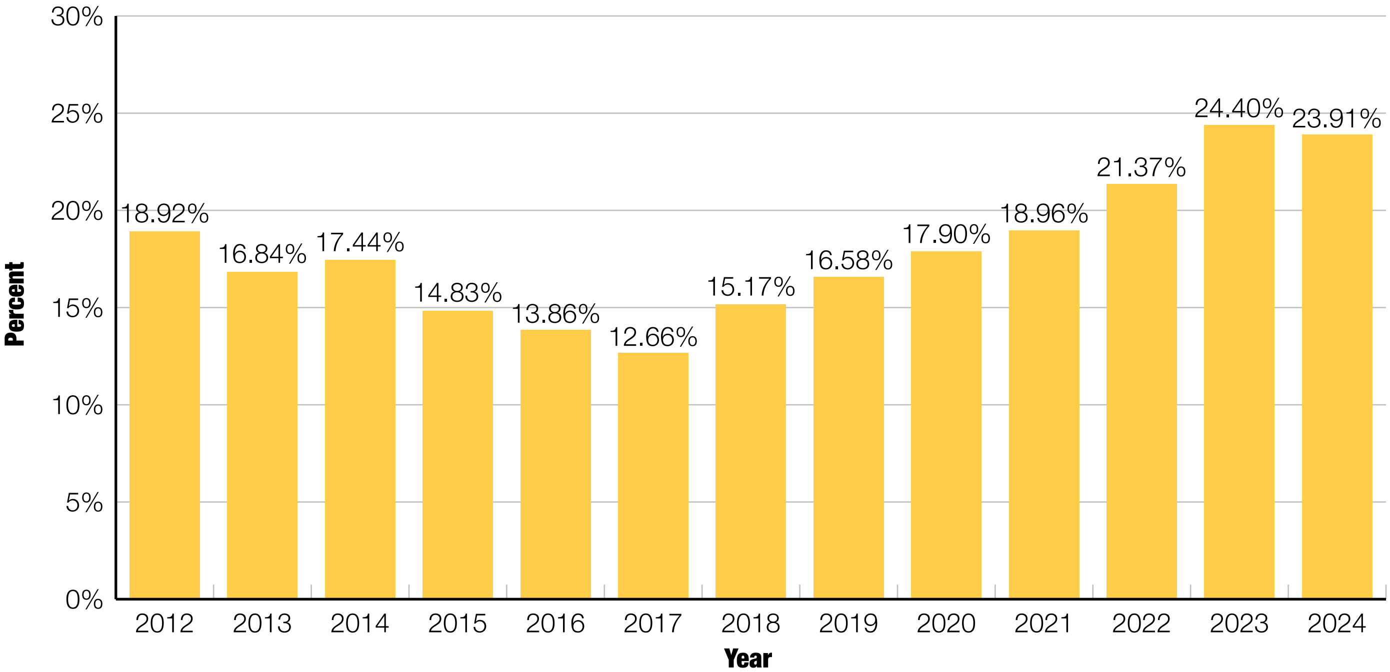
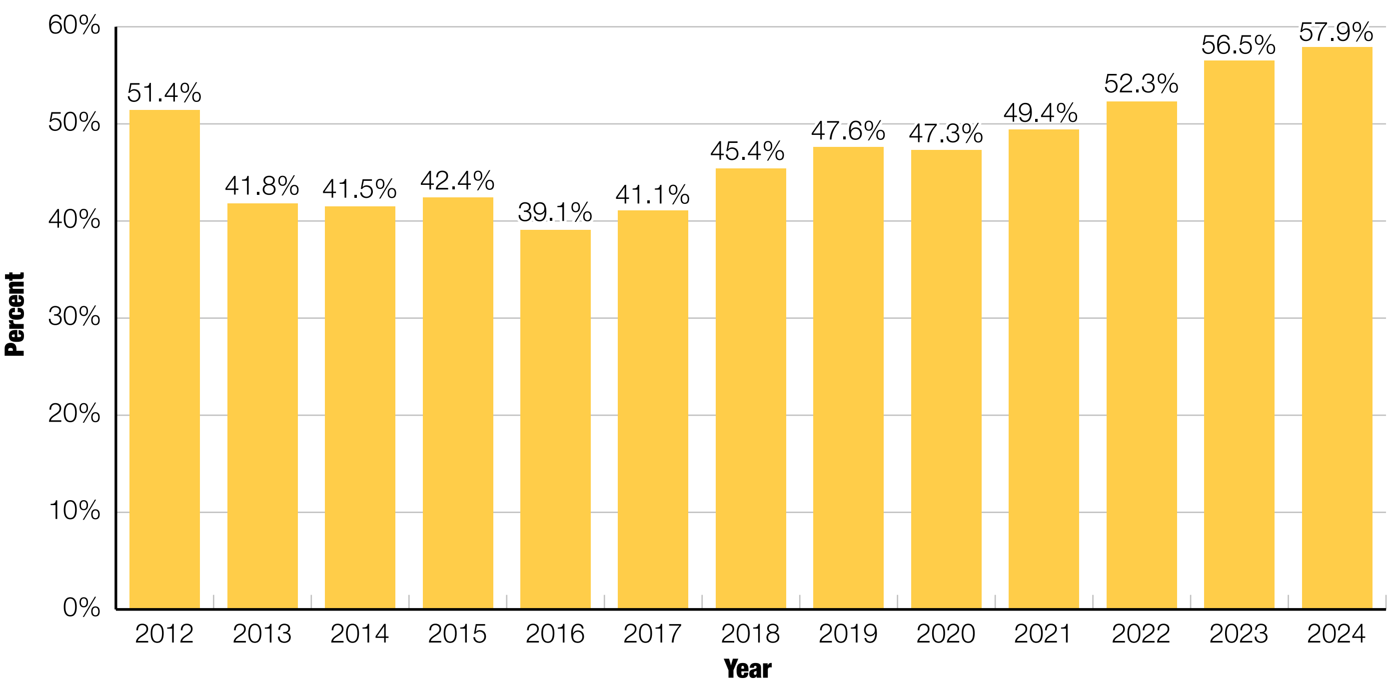


Figure 2.8 Cemented Fixation for Femoral Stems in Hemiarthroplasty for Femoral Neck Fracture, 2012-2024 (N=55,269)

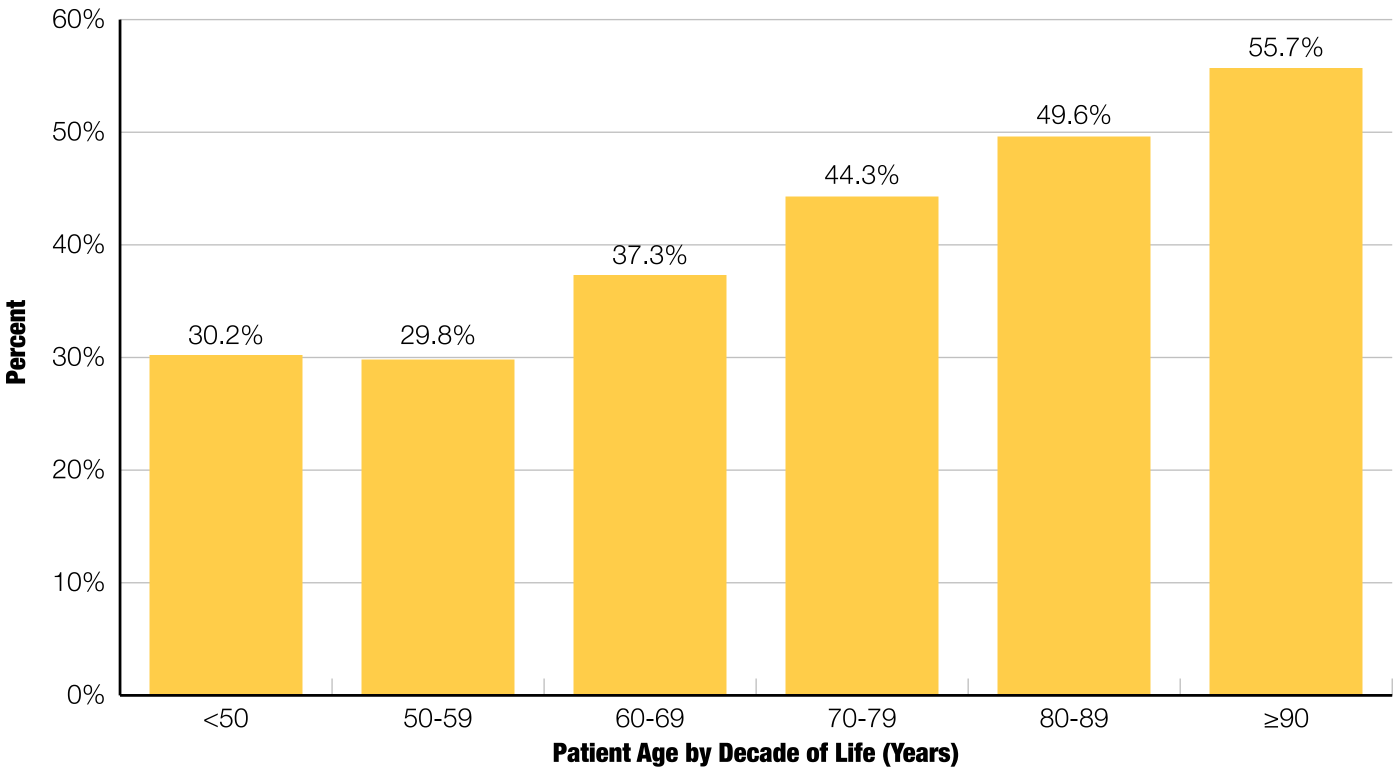


Cemented femoral component fixation in HA for FNF increases in frequency with advancing age (Figure 2.9). Cemented femoral fixation for treatment of FNFs is used in only 52% of patients in the oldest age group (>90 years old) in the U.S.[7-9] Internationally, cemented femoral fixation continues to predominate with the U.K. NJR reporting that 81% of femoral components used to treat FNFs were cemented.[7]

Multiple studies and registry-based analyses have demonstrated superior outcomes including lower revision rates when cemented femoral fixation is used for FNFs and for THA in elderly women with osteoporosis.[24-31] Despite this evidence, cementless fixation remains widely used in the U.S., a phenomenon described as “the cement paradox.”[24] Factors contributing to this underutilization include limited training in cementing techniques, concerns regarding cement implantation syndrome, the additional operative time required compared with cementless fixation, insufficient awareness of the literature, and regional practice variations.

The patterns of underuse of cemented femoral fixation for HA and THA to treat FNF identified in this year’s report highlight an opportunity for quality improvement. Further study is needed to assess the impact of specific cementless femoral stem designs on outcomes of HA and THA performed for FNFs relative to cemented fixation. In particular, comparisons of triple-taper cementless femoral components with a collar with cemented femoral components are warranted.[24-31]

Figure 2.9 Percent of Cemented Stem Fixation Used in Hemiarthroplasty for Femoral Neck Fracture by Age Group, 2012-2024 (N=55,269)



Elective Primary Total Hip Arthroplasty

AJRR has collected data on 1,437,123 elective primary THA procedures from 2012 to 2024

All survival analyses are limited to Medicare patients aged 65 years and older unless otherwise noted in the report. The AJRR datasets are merged with the CMS claims dataset in order to maximize outcome capture. This linkage of AJRR and CMS datasets provides for optimal data capture for cases in which the primary procedure is performed at an AJRR participating facility and the re-admission, complication, or re-operation is performed at a non-AJRR reporting facility. Sex distribution in primary THA reported to the AJRR is affected by age. The majority of patients under 60 years of age undergoing elective primary THA were male with females representing the majority of cases after age 60 (Figure 2.10). The proportion of female patients in primary THA continues to increase steadily with each subsequent decade of life (Figure 2.10).

Thirty-six-millimeter diameter femoral heads remain the most frequently utilized size for primary THA and has steadily increased from 2012 to 2024 (Figure 2.11). Larger head sizes (≥40mm) are used in approximately 12% of cases and have slowly increased from 2012 to 2024 (Figure 2.11). The use of smaller head sizes (≤28mm) has remained relatively rare (<4%) and stable over time. The use of 32mm heads has decreased significantly from 33% in 2012 to 12.8% in 2024. The use of dual mobility (DM) articulations in primary THA peaked in 2020 (8.7%) and has slowly decreased over time (7.2% in 2024). A slight decrease in DM and a slight increase in 40mm head use has been noted over time (Figure 2.11).[11]

Hip resurfacing continues to decline, accounting for only 0.04% of cases reported to the AJRR in 2024.

INSIGHTS

Figure 2.10 Sex Distribution for Elective Primary Total Hip Arthroplasty Procedures by Age Group, 2012-2024 (N=1,431,043)

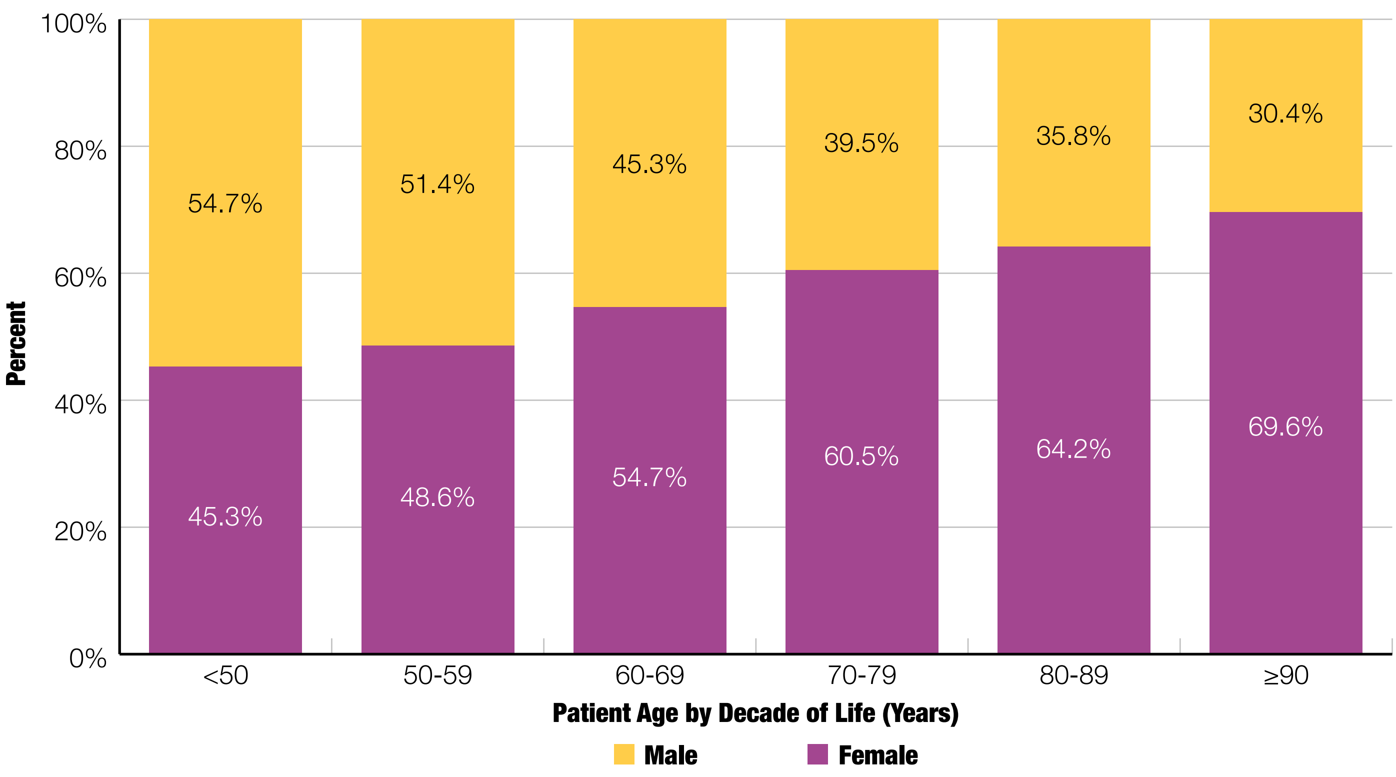
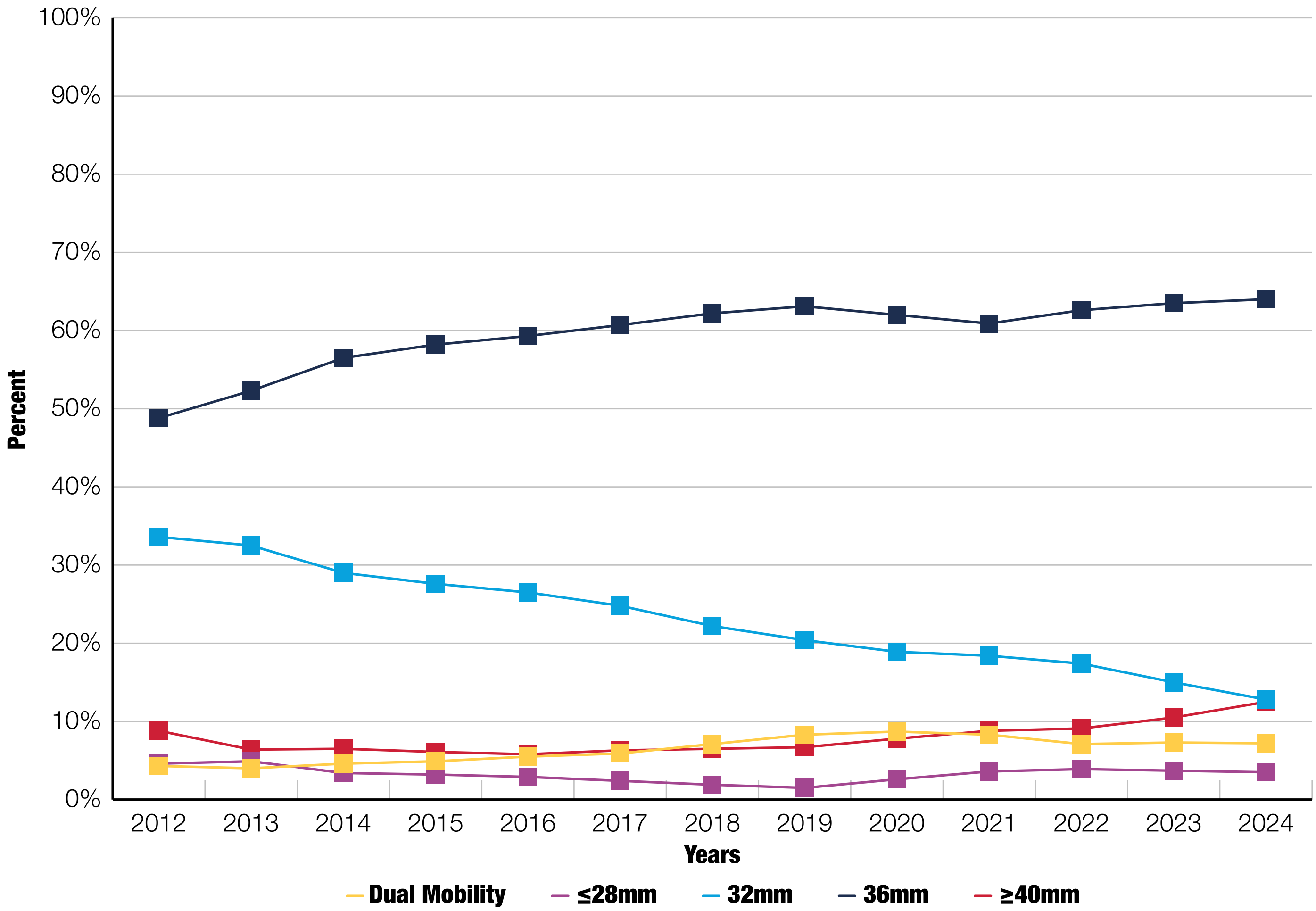


Figure 2.11 Percent Dual Mobility Usage and Femoral Head Sizes Implanted in Elective Primary Total Hip Arthroplasty, 2012-2024 (N=1,116,119)



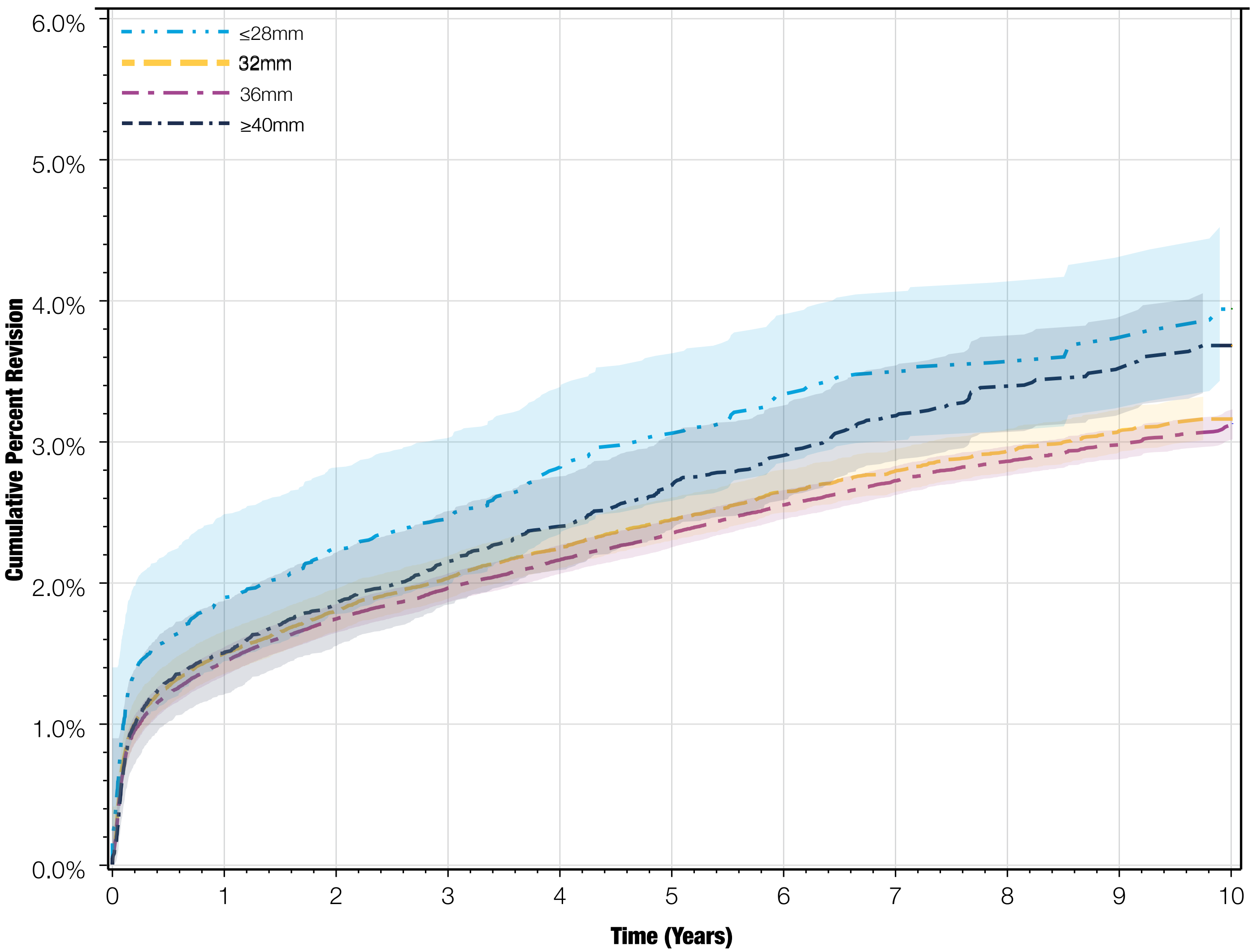
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dual Mobility	4.3	4.0	4.6	4.9	5.5	5.9	7.1	8.3	8.7	8.3	7.1	7.3	7.2
≤28mm	4.6	4.9	3.4	3.2	2.9	2.4	1.9	1.5	2.6	3.6	3.9	3.7	3.5
32mm	33.6	32.5	29.0	27.6	26.5	24.8	22.2	20.4	18.9	18.4	17.4	15.0	12.8
36mm	48.8	52.3	56.5	58.2	59.3	60.7	62.2	63.1	62.0	60.9	62.6	63.5	64.0
≥40mm	8.8	6.4	6.5	6.1	5.8	6.3	6.5	6.7	7.8	8.8	9.1	10.5	12.5

Thirty-six-millimeter diameter femoral heads demonstrated lower CPR compared with 40mm heads at 0-2 years and 2-10 years postoperatively after adjusting for age, sex, and CCI (Figure 2.12). Multiple confounding variables including the potential increased use of 40mm heads in more challenging patients at risk for dislocation were not accounted for in this analysis. There were no statistically significant differences comparing CPR for 28mm vs. 36mm or 32mm vs. 36mm heads at greater than 10 years follow-up interval (Figure 2.12.) Age impacts the relative frequency of DM use in primary THA with less frequent use in patients 50-69 (approximately 7%) compared with patients over 90 years old (10%) (Figure 2.13).

36mm diameter femoral heads demonstrated lower CPR compared with 40mm diameter femoral heads in primary THA patients 65 years of age and older with primary osteoarthritis (HR: 1.381(1.210,1.577), p=<.0001, Figure 2.21.

INSIGHTS

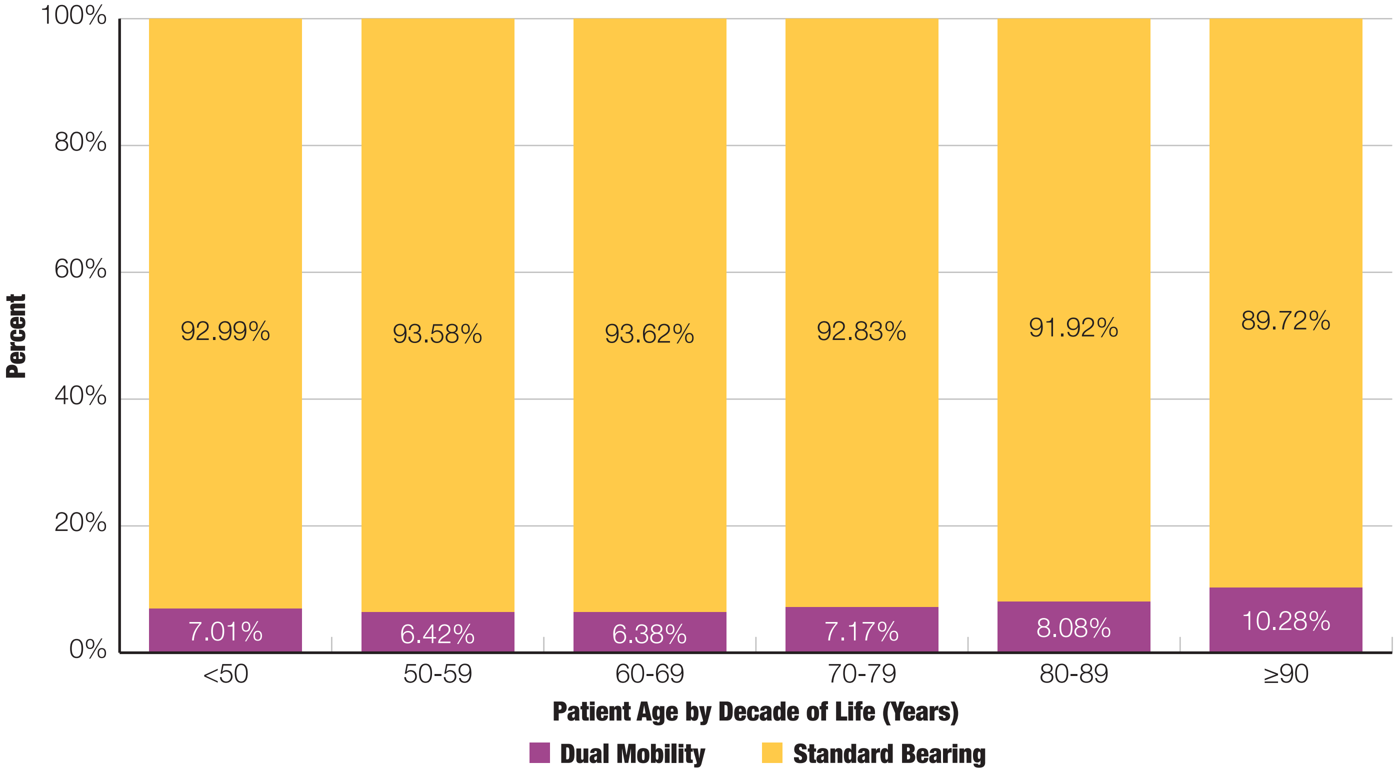
Figure 2.12 **Cumulative Percent Revision for Diameter of Femoral Heads for Elective Primary Total Hip Arthroplasty in Medicare Patients 65 Years of Age and Older with Primary Osteoarthritis, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8	9	10
32mm	At Risk	115,416	104,308	91,672	80,291	70,695	61,519	50,165	38,713	27,273	17,036	9,708
	KM % revision	0.06 (0.05, 0.08)	1.50 (1.43, 1.57)	1.80 (1.72, 1.88)	2.03 (1.95, 2.12)	2.25 (2.16, 2.34)	2.45 (2.35, 2.55)	2.64 (2.54, 2.75)	2.79 (2.69, 2.9)	2.93 (2.82, 3.05)	3.08 (2.95, 3.2)	3.16 (3.03, 3.3)
36mm	At Risk	353,920	302,456	250,530	211,063	179,554	150,336	115,856	84,011	55,411	32,209	17,012
	KM % revision	0.06 (0.05, 0.07)	1.44 (1.4, 1.48)	1.74 (1.7, 1.79)	1.96 (1.91, 2.01)	2.16 (2.11, 2.21)	2.35 (2.3, 2.41)	2.55 (2.49, 2.61)	2.72 (2.66, 2.79)	2.86 (2.79, 2.93)	2.97 (2.9, 3.05)	3.12 (3.03, 3.22)
≤28mm	At Risk	16,019	13,401	10,583	8,307	6,614	5,527	4,762	3,873	2,874	1,906	1,170
	KM % revision	0.19 (0.14, 0.28)	1.89 (1.69, 2.12)	2.23 (2.01, 2.48)	2.45 (2.21, 2.72)	2.82 (2.55, 3.12)	3.06 (2.76, 3.39)	3.33 (3, 3.68)	3.48 (3.14, 3.85)	3.56 (3.21, 3.95)	3.73 (3.35, 4.16)	3.94 (3.5, 4.44)
≥40mm	At Risk	44,761	35,609	27,744	22,379	18,419	14,889	11,397	8,271	5,616	3,522	1,968
	KM % revision	0.04 (0.03, 0.07)	1.50 (1.39, 1.62)	1.85 (1.72, 1.99)	2.14 (2, 2.3)	2.40 (2.24, 2.56)	2.70 (2.52, 2.89)	2.90 (2.71, 3.1)	3.18 (2.97, 3.41)	3.38 (3.15, 3.63)	3.51 (3.26, 3.79)	3.68 (3.39, 4)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
28mm vs 36mm over 10 Years: 1.056(0.931,1.196)p=0.3960
32mm vs 36mm over 10 Years: 1.019(0.971,1.070)p=0.4416
40mm vs 36mm at 0-2 Years: 1.083(1.001,1.172), p=0.0470
40mm vs 36mm at 2-10 Years: 1.381(1.210,1.577), p=<.0001

Figure 2.13 **Dual Mobility Usage as a Percent of all Elective Primary Total Hip Arthroplasty Procedures by Age Group, 2012-2024 (N=1,114,986)**

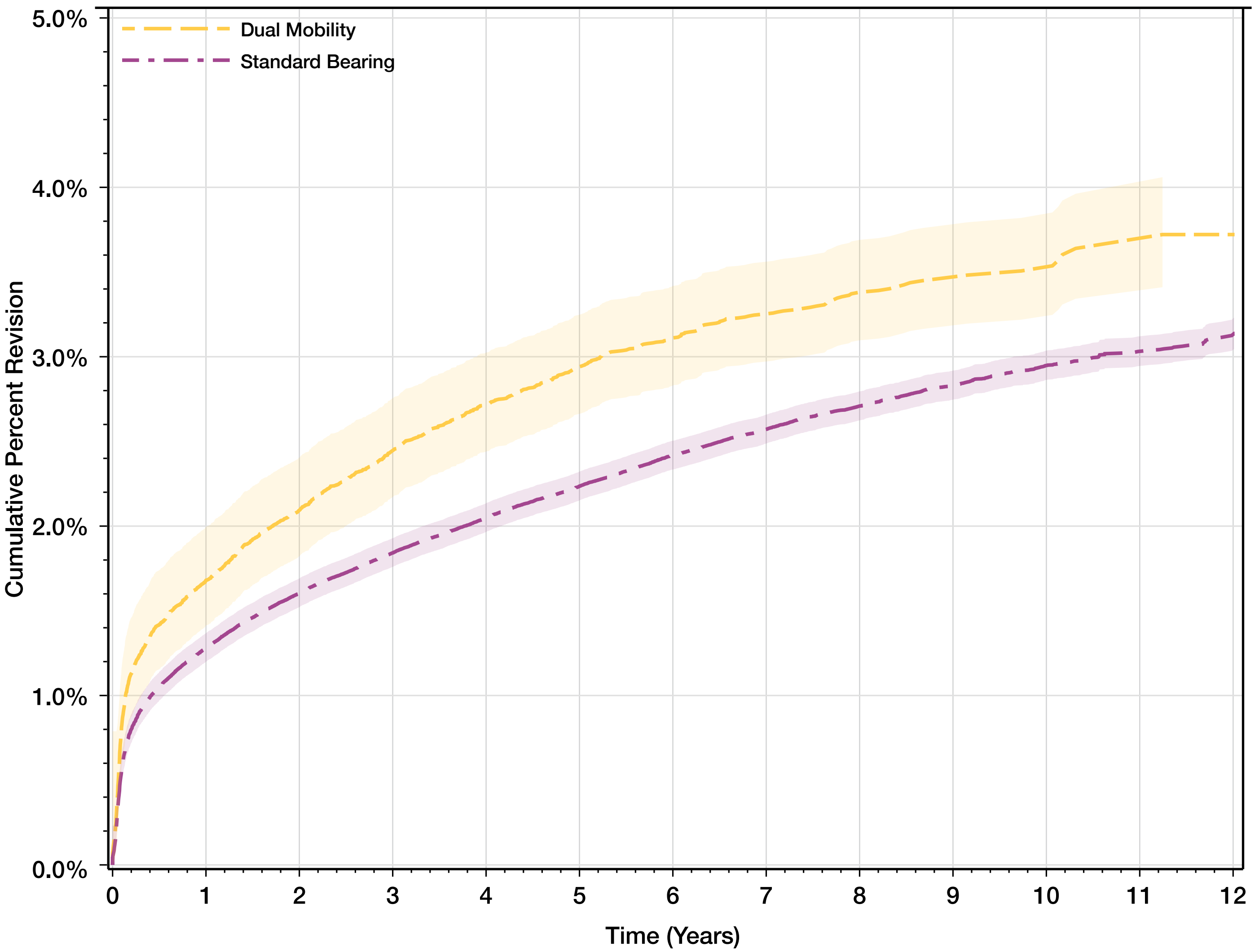


CPR was higher for DM compared with conventional bearings for THAs performed for primary osteoarthritis in patients of all ages (HR 1.2 (1.143,1.260), Figure 2.14) and in patients 65 years of age and older (HR 1.2 (1.138,1.289), p=<.0001, Figure 2.15). This observation represents an association rather than a causal relationship and does not account for potential confounders such as the dislocation risk profile for each patient group.

CPR was higher for DM compared with conventional bearings for THAs performed for primary OA in patients of all ages (HR 1.2 (1.143,1.260), Fig 2.14) and in patients 65 years of age and older (HR 1.2 (1.138,1.289), p=<.0001, Fig 2.15).

INSIGHTS

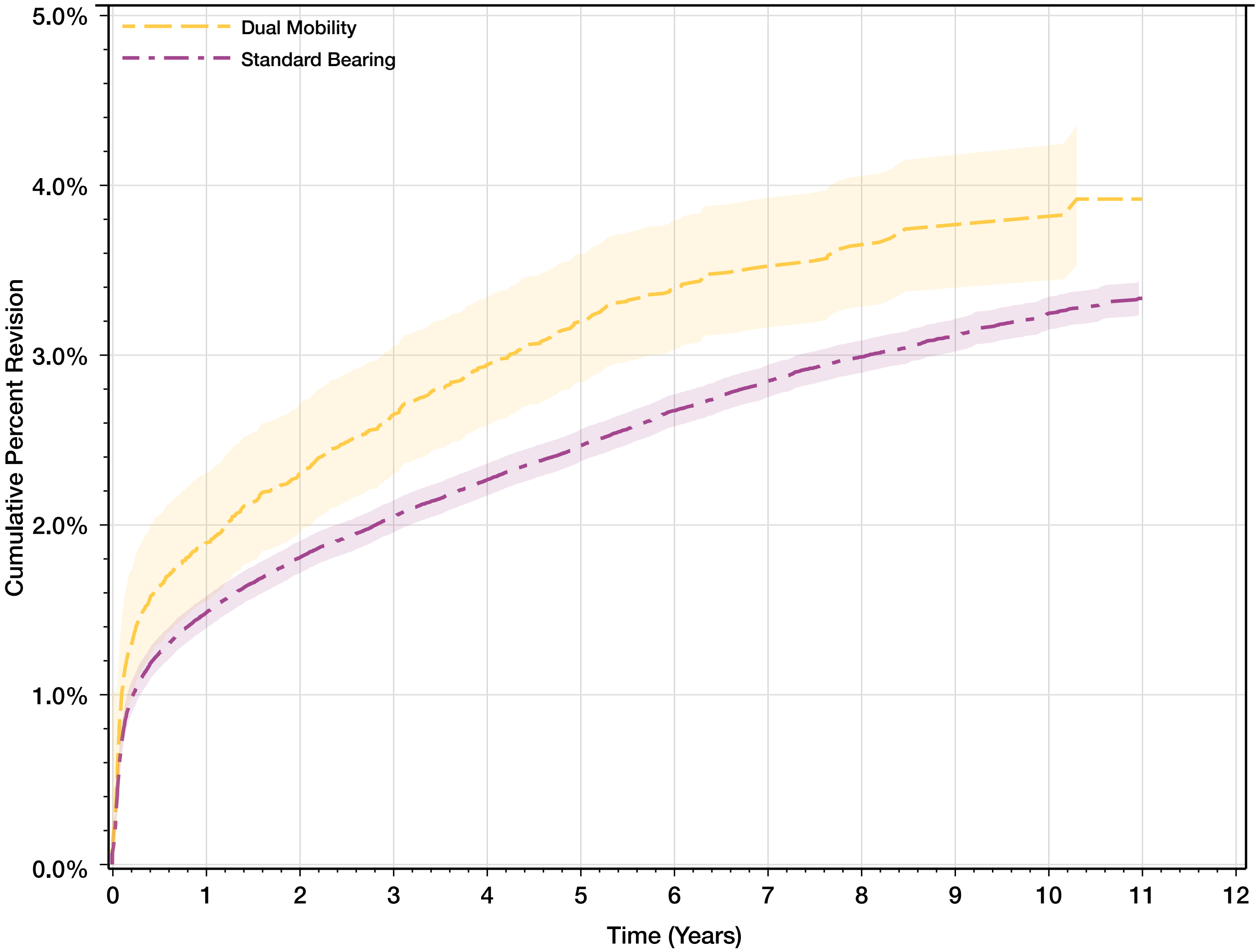
Figure 2.14 Cumulative Percent Revision for Dual Mobility Used for Elective Primary Total Hip Arthroplasty for Patients with Primary Osteoarthritis as Submitted Only to AJRR, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11	12
Dual Mobility	At Risk	75,157	64,566	53,742	45,556	37,881	30,484	22,679	16,118	10,574	6,132	3,317	1,453	515
	KM % revision	0.07 (0.05, 0.09)	1.68 (1.59, 1.77)	2.09 (1.99, 2.2)	2.44 (2.32, 2.56)	2.71 (2.59, 2.84)	2.94 (2.8, 3.08)	3.11 (2.96, 3.25)	3.25 (3.1, 3.4)	3.37 (3.21, 3.54)	3.46 (3.29, 3.64)	3.50 (3.32, 3.69)	3.63 (3.41, 3.87)	3.71 (3.45, 4)
Standard Bearing	At Risk	765,891	706,012	639,239	580,209	521,021	451,104	359,993	272,307	190,005	116,748	65,100	28,116	8,239
	KM % revision	0.05 (0.04, 0.05)	1.28 (1.25, 1.3)	1.60 (1.57, 1.63)	1.84 (1.81, 1.87)	2.05 (2.01, 2.08)	2.23 (2.2, 2.27)	2.41 (2.38, 2.45)	2.57 (2.53, 2.61)	2.70 (2.66, 2.75)	2.83 (2.78, 2.87)	2.94 (2.89, 3)	3.03 (2.97, 3.08)	3.13 (3.05, 3.21)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Dual Mobility vs Standard Bearing at 0-6 Years: 1.200(1.143,1.260), p=<.0001
Dual Mobility vs Standard Bearing at 6-12 Years: 0.866(0.668,1.122), p=0.2760

Figure 2.15 Cumulative Percent Revision for Dual Mobility Used for Elective Primary Total Hip Arthroplasty for Medicare Patients 65 Years of Age and Older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Dual Mobility	At Risk	41,667	35,397	28,861	23,897	19,408	15,307	10,990	7,494	4,698	2,591	1,313	561
	KM % revision	0.09 (0.06, 0.12)	1.89 (1.76, 2.03)	2.30 (2.15, 2.45)	2.64 (2.48, 2.81)	2.94 (2.76, 3.12)	3.19 (3, 3.39)	3.38 (3.18, 3.6)	3.52 (3.3, 3.74)	3.64 (3.41, 3.88)	3.74 (3.49, 4)	3.74 (3.49, 4)	3.91 (3.57, 4.28)
Standard Bearing	At Risk	414,290	378,771	340,176	306,066	272,372	233,922	183,974	136,493	92,523	55,365	30,314	12,906
	KM % revision	0.07 (0.06, 0.07)	1.48 (1.44, 1.52)	1.80 (1.76, 1.84)	2.04 (2, 2.09)	2.26 (2.21, 2.31)	2.46 (2.41, 2.51)	2.67 (2.61, 2.72)	2.84 (2.78, 2.9)	2.98 (2.92, 3.05)	3.11 (3.04, 3.18)	3.24 (3.17, 3.32)	3.33 (3.24, 3.41)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Dual Mobility vs Standard Bearing at 0-7 Years: 1.211(1.138,1.289), p=<.0001
Dual Mobility vs Standard Bearing at 7-11 Years: 0.762(0.438,1.325), p=0.3350

Ceramic remains the most frequently used femoral head material in primary THA (82.5% of cases in 2024, Figure 2.16). The dominant use of ceramic femoral heads is likely related to concerns regarding risk of taper corrosion (mechanically assisted crevice corrosion) more often associated with cobalt-chromium (CoCr) femoral heads.[12] The lowest rate of ceramic head utilization was observed in patients over 90 years of age (66.8%) likely related to cost considerations compared with chromium cobalt femoral heads (Figure 2.17).

Ceramic-on-polyethylene (CoP) was the most common bearing surface in primary THA in 2024 (73.5% of cases, Figure 2.18a). Over the past decade, CoP bearings have increased steadily from 33.2% in 2012 to 73.5% in 2024 (Figure 2.18a). During the same period, metal-on-polyethylene (MoP) use declined markedly from 48.8% in 2012 to 2.9% in 2024. DM and ceramicized metal-on-polyethylene (CMoP) bearings have remained relatively stable, representing a minority of cases ranging from 5.1–7.7% and 5.1–6.7% from 2012 to 2024, respectively (Figure 2.18a).

Figure 2.16 Composition of Femoral Heads for All Elective Primary Total Hip Arthroplasty Procedures Excluding Dual Mobility by Year, 2012-2024 (N=1,008,058)

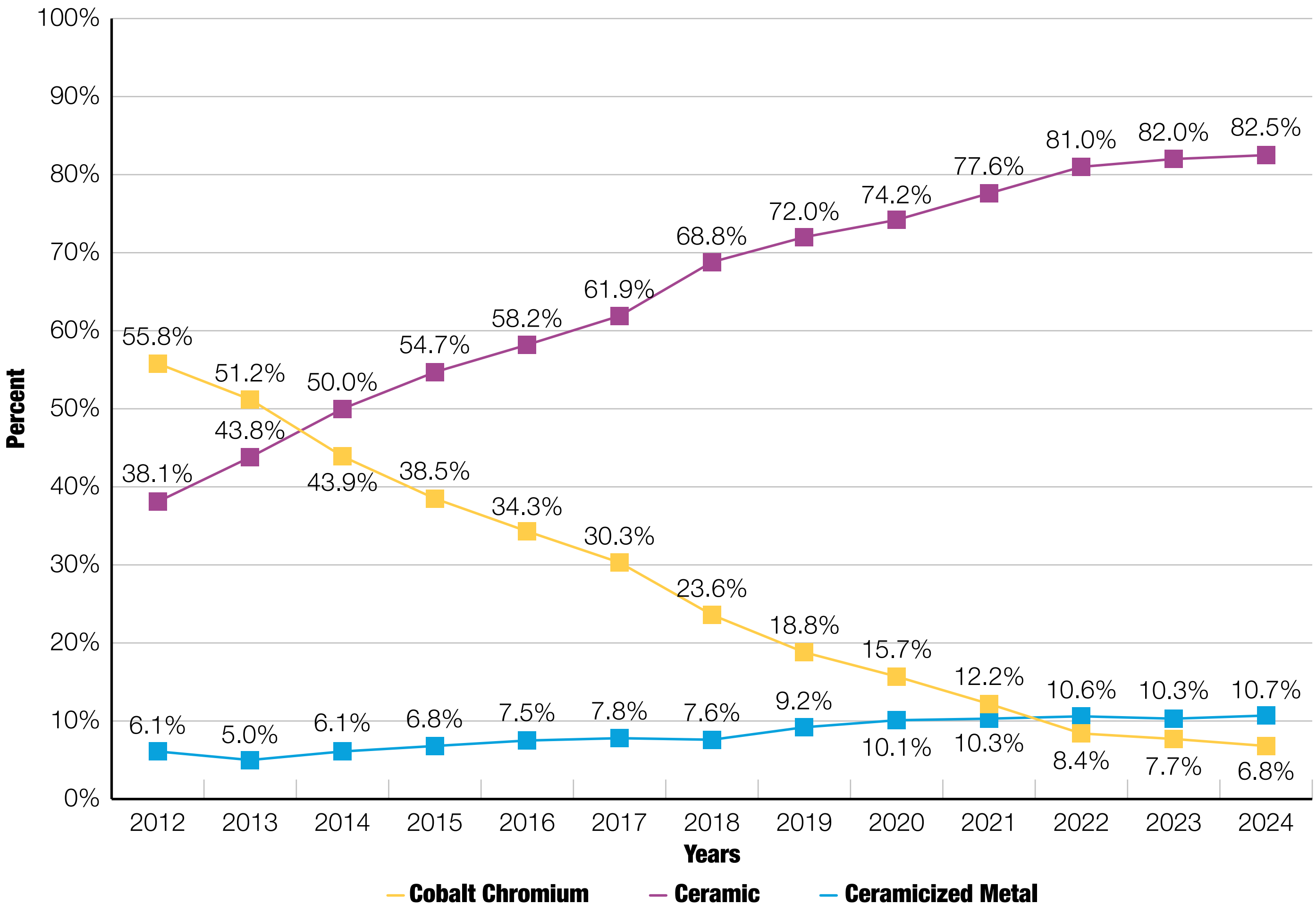
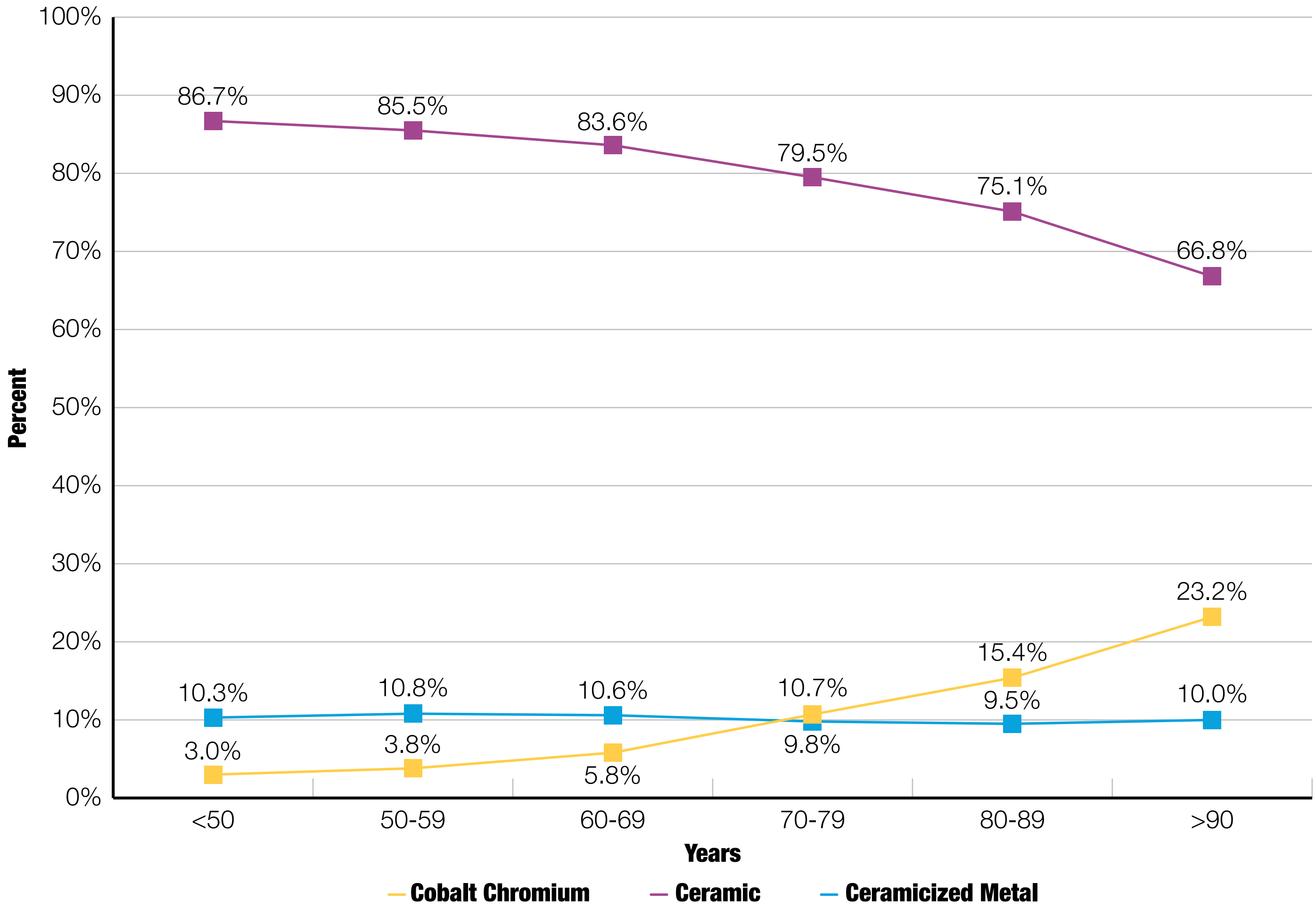


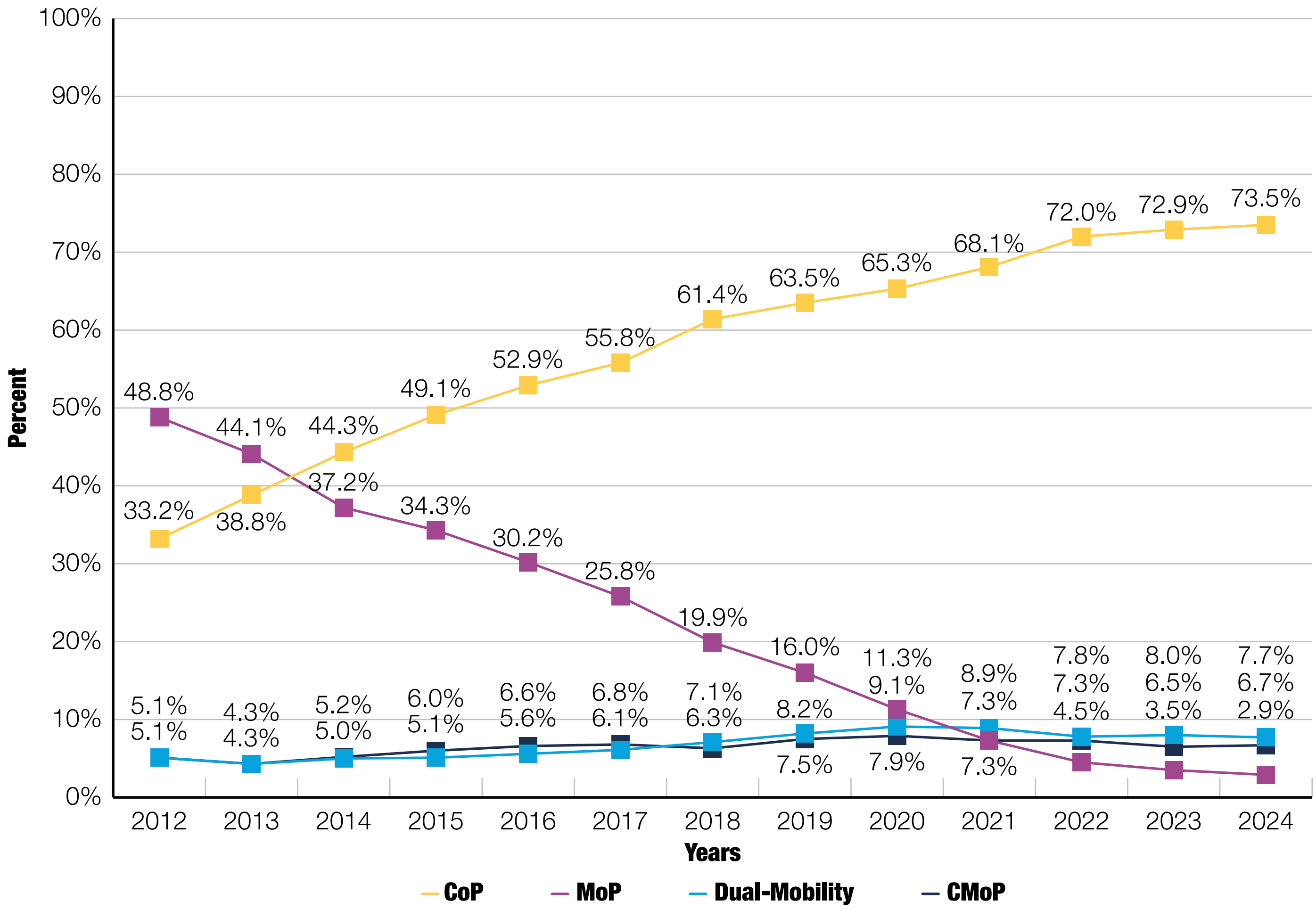
Figure 2.17 **Composition of Femoral Heads for All Elective Primary Total Hip Arthroplasty Procedures Excluding Dual Mobility by Age Group, 2024 (N=135,097)**



"The new AJRR scorecards provide surgeons and hospitals with actionable insights into patient outcomes and procedural trends. From a payor perspective, this evolution in data utilization enhances transparency and supports value-based care models ultimately reducing complications and lowering the total cost of care."

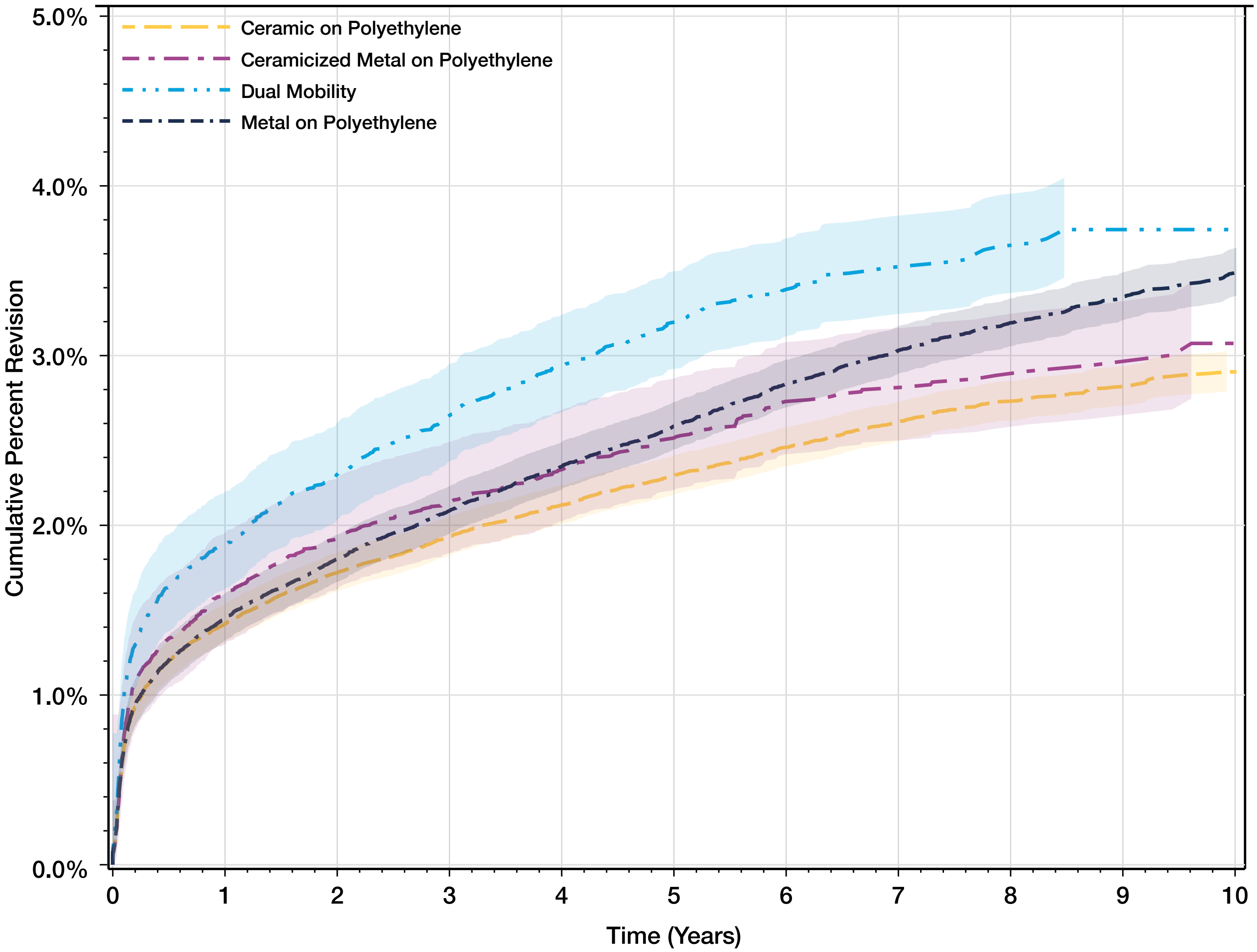
Howard J. Marans, MD, FRCSC
Executive Medical Director
CVS Health/Aetna

Figure 2.18a Elective Primary Total Hip Arthroplasty Bearing Surface Materials by Year, 2012-2024 (N = 1,216,510)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Total N	14,264	29,749	53,724	71,761	98,123	11,0862	11,3068	11,3517	95,896	100,825	123,572	156,956	134,193	1,216,510

Figure 2.18b Cumulative Percent Revision for Bearing Surface Materials Used for Elective Primary Total Hip Arthroplasty for Medicare Patients 65 Years of Age and Older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10
Ceramic on Polyethylene	At Risk	215,674	196,027	172,960	153,100	133,736	111,090	82,266	56,345	35,099	18,885	9,206
	KM % revision	0.06 (0.05, 0.07)	1.42 (1.37, 1.47)	1.72 (1.66, 1.77)	1.93 (1.87, 1.99)	2.12 (2.05, 2.18)	2.29 (2.22, 2.36)	2.46 (2.38, 2.53)	2.61 (2.53, 2.68)	2.73 (2.64, 2.81)	2.81 (2.72, 2.9)	2.90 (2.8, 3)
Ceramicized Metal on Polyethylene	At Risk	35,948	30,551	25,150	20,502	16,927	13,512	9,814	7,000	4,323	2,231	1,030
	KM % revision	0.06 (0.04, 0.1)	1.59 (1.46, 1.73)	1.92 (1.78, 2.07)	2.14 (1.98, 2.3)	2.32 (2.16, 2.5)	2.51 (2.33, 2.7)	2.72 (2.53, 2.93)	2.79 (2.59, 3.01)	2.88 (2.67, 3.11)	2.94 (2.71, 3.18)	3.07 (2.78, 3.38)
Dual Mobility	At Risk	41,667	35,397	28,861	23,897	19,408	15,307	10,990	7,494	4,698	2,591	1,313
	KM % revision	0.09 (0.06, 0.12)	1.89 (1.76, 2.03)	2.30 (2.15, 2.45)	2.64 (2.48, 2.81)	2.94 (2.76, 3.12)	3.19 (3, 3.39)	3.38 (3.18, 3.6)	3.52 (3.3, 3.74)	3.64 (3.41, 3.88)	3.74 (3.49, 4)	3.74 (3.49, 4)
Metal on Polyethylene	At Risk	125,641	119,802	114,303	108,756	101,665	92,543	79,245	64,403	47,440	30,825	17,947
	KM % revision	0.07 (0.06, 0.09)	1.45 (1.39, 1.52)	1.80 (1.72, 1.87)	2.08 (2, 2.16)	2.35 (2.26, 2.43)	2.58 (2.49, 2.67)	2.83 (2.73, 2.92)	3.03 (2.93, 3.13)	3.19 (3.08, 3.29)	3.34 (3.23, 3.46)	3.49 (3.37, 3.62)

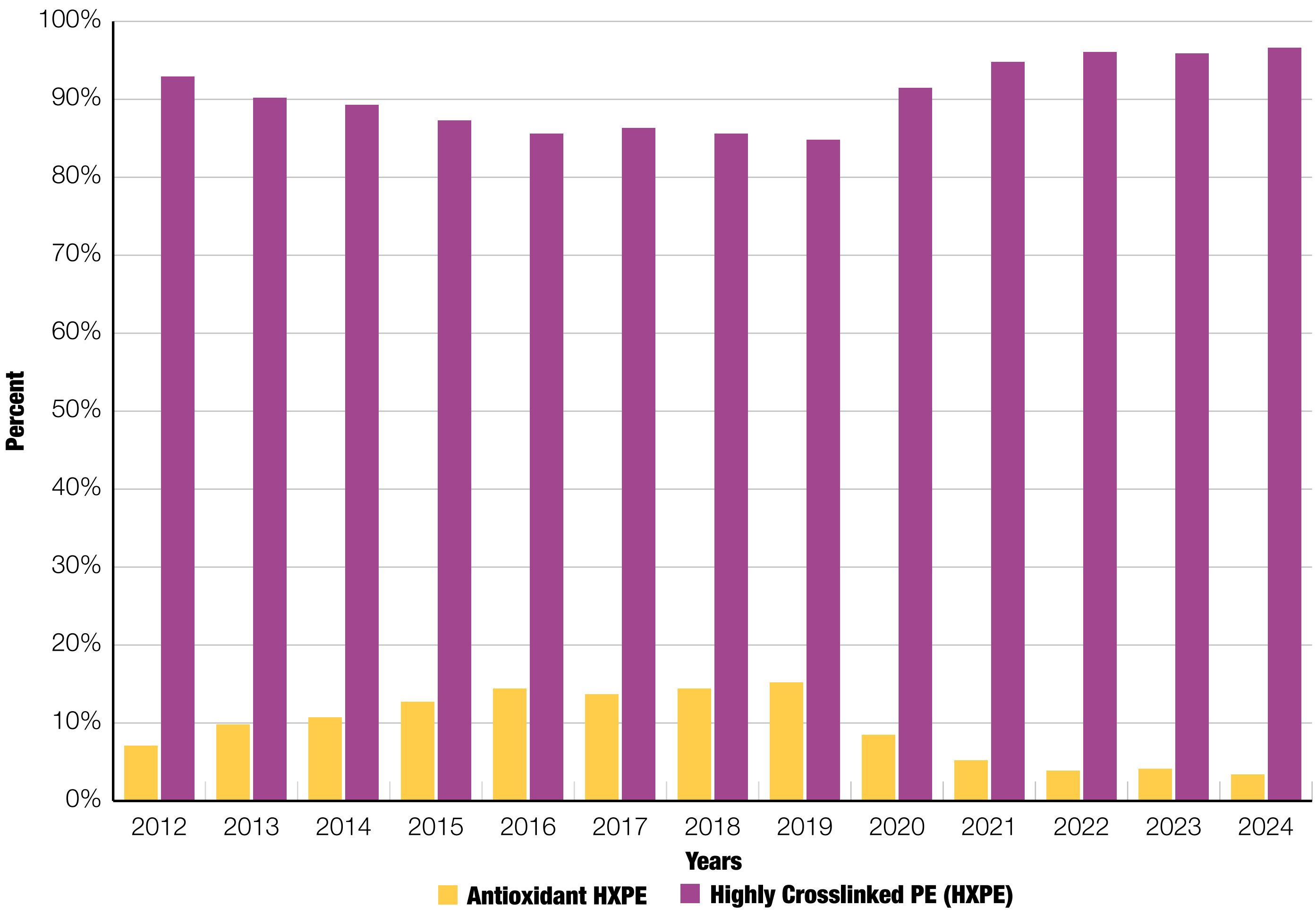
*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Ceramicized Metal on Polyethylene vs Ceramic on Polyethylene over 10 Years: 1.074(0.990,1.165)p=0.0854
Dual Mobility vs Ceramic on Polyethylene at 0-8 Years: 1.294(1.212,1.383), p=<.0001
Dual Mobility vs Ceramic on Polyethylene at 8-10 Years: 0.835(0.298,2.344), p=0.7323
Metal on Polyethylene vs Ceramic on Polyethylene at 0 Months-1 Year: 1.024(0.964,1.088), p=0.4421
Metal on Polyethylene vs Ceramic on Polyethylene at 1-10 Years: 1.344(1.257,1.436), p=<.0001

Dominant Use of Highly Crosslinked Polyethylene in Primary THA

This year's annual report is dedicated to Dr. William H. Harris. He transformed hip replacement surgery with the development and widespread worldwide adoption of HXPE. Polyethylene wear and resulting osteolysis were the leading cause of hip replacement failure prior to the introduction of HXPE. Registries around the world have documented the significant reduction in osteolysis and improved revision rates associated with the routine use of HXPE in THA.

The threshold for classification of a polyethylene liner as highly cross-linked polyethylene is a total radiation dose of 50 kGy (5 Mrad) or more. Antioxidant HXPE is defined as a HXPE liner with an antioxidant component infused or blended in manufacturing. Antioxidant HXPE is used significantly less frequently than HXPE without antioxidant in primary THA (3.4% vs. 96.6%, respectively). The use of antioxidant HXPE has continued to decrease since 2019 (Figure 2.19). The use of CPE in the AJRR primary THA has nearly vanished with <1.0% of annual cases.

Figure 2.19 Elective Primary Total Hip Arthroplasty Liner Polyethylene Material by Year, 2012-2024 (N=839,320)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Antioxidant HXPE	7.1%	9.8%	10.7%	12.7%	14.4%	13.7%	14.4%	15.2%	8.5%	5.2%	3.9%	4.1%	3.4%	—
Highly Crosslinked PE (HXPE)	92.9%	90.2%	89.3%	87.3%	85.6%	86.3%	85.6%	84.8%	91.5%	94.8%	96.1%	95.9%	96.6%	—
Total N	12,778	27,572	50,142	68,106	92,269	101,422	101,391	99,489	72,329	57,745	55,811	56,240	56,240	795,294

The AOANJRR has reported similar rates of combined HXPE and antioxidant HXPE use in elective primary THA (97.1% in 2023, Table 2.3)[7] compared with use in the U.S. (Figure 2.19). The experience documented in the Netherlands (Dutch Arthroplasty Register-LROI) demonstrates slightly lower utilization of HXPE (92.4% in 2023, Table 2.4)[9] compared with rates reported in Australia (97.1% in 2023, Table 2.3) and the United States (99.9%, Figure 2.19). HXPE utilization in primary THA in Sweden is similar to the Netherlands (92% in 2023).[23]

Table 2.3 Utilization Rates of Highly Cross-Linked Polyethylene (HXPE) in Primary Total Hip Arthroplasty for Osteoarthritis in the AOANJRR

Year	Country/Registry	HXPE Hip Usage Rate %
2023	Australia - AOANJRR	97.1%
2022	Australia - AOANJRR	97.5%
2021	Australia - AOANJRR	96.8%
2020	Australia - AOANJRR	97.3%

**Adapted from Lewis P et al.,[7] under CC BY-NC-ND 4.0.*

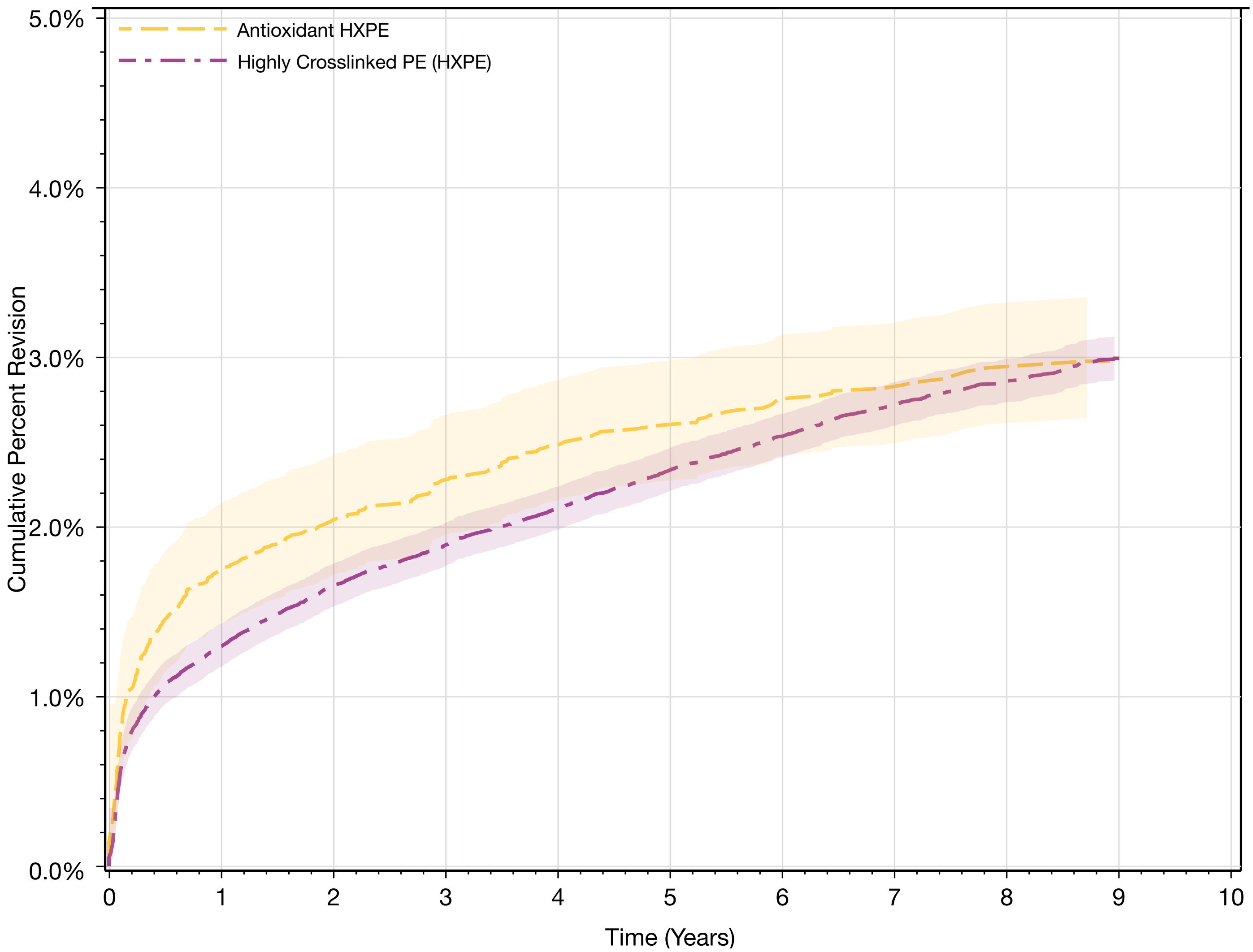
Table 2.4 Dutch Utilization Rates of HXPE in Primary Total Hip Arthroplasty reported in LROI

Year	Country/Registry	HXPE Hip Usage Rate %
2023	Netherlands - LROI	92.4%
2022	Netherlands - LROI	90.3%
2021	Netherlands - LROI	90.1%
2020	Netherlands - LROI	90.3%
2019	Netherlands - LROI	88.9%

**Adapted with permission from Landelijke Registratie Orthopedische Interventies.[9]*

When reviewing the following figures It is important to note that it is possible for the statistical analyses generated with the KM method (not adjusted for covariates) may conflict with statistical analyses generated with hazard ratios (covariate adjusted). These potential conflicts should be recognized when interpreting the survival analyses contained in this report. CPR for HXPE compared with anti-oxidant HXPE in primary THA stratified by age and sex in the U.S. are reported (Figures 2.20 a-d). CPRs were excellent (3-4%) and statistically indistinct for HXPE compared with antioxidant HXPE in primary THA for women <65 years old and women ≥65 years old beyond the 2 year follow up interval (Figures 20b and 20d). CPRs were excellent (2.5-3%) for HXPE and anti-oxidant HXPE in primary THA for men <65 years old and men ≥65 years old at the 10 year follow up interval. CPR for HXPE was higher compared with antioxidant HXPE for men ≥65 years old (HXPE vs. Antioxidant HXPE at 1-9 Years: 1.289(1.081,1.537), p=0.0048) and men <65 years old (HXPE vs. Antioxidant HXPE at 1-11 Years: 1.349(1.140,1.597), p=0.0005) (Figures 2.20a and 2.20c).

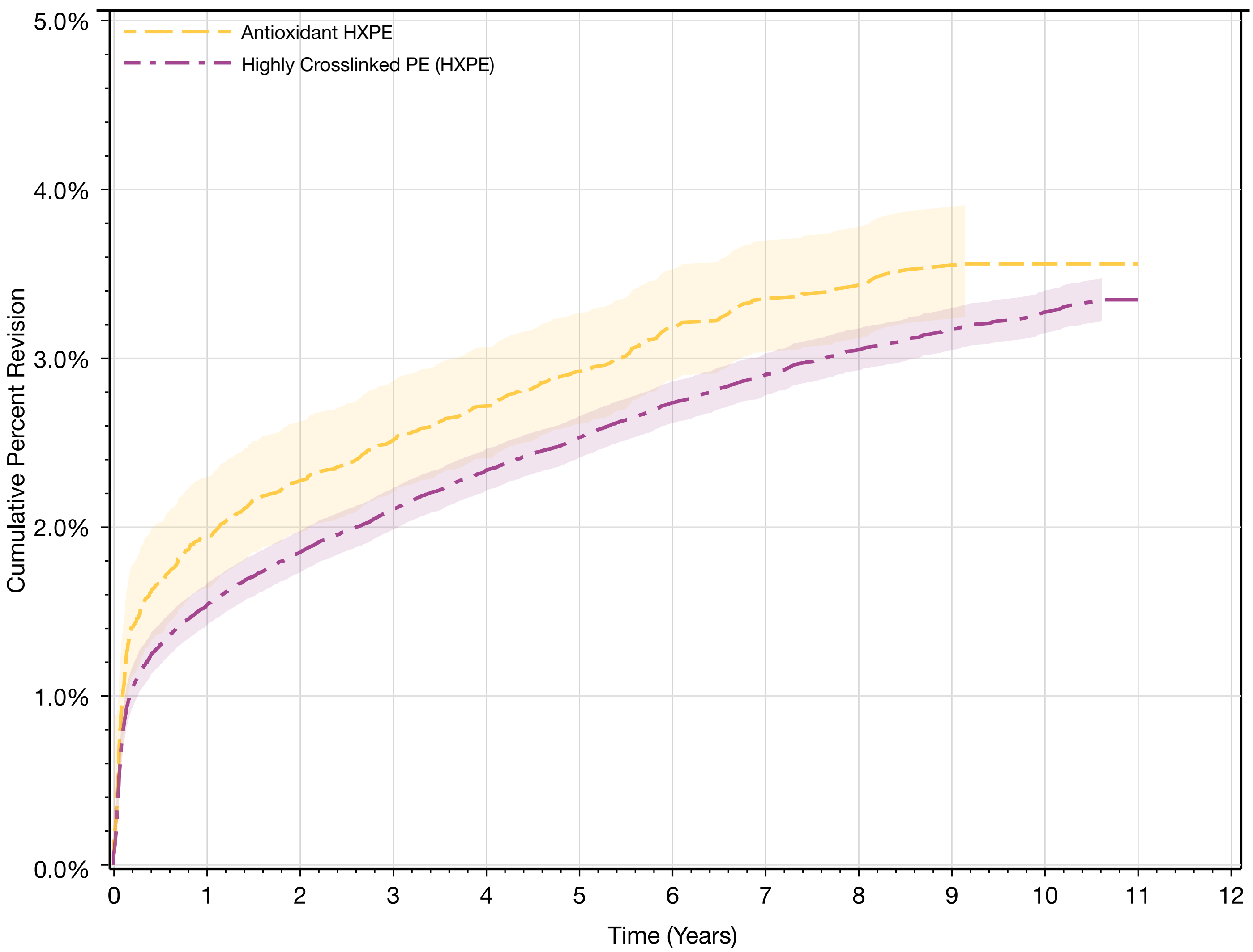
Figure 2.20a Cumulative Percent Revision for Liner Materials Used for Elective Primary Total Hip Arthroplasty in Male Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9
Antioxidant HXPE	At Risk	14,256	13,615	12,980	12,386	11,756	10,484	7,997	5,760	3,783	2,008
	KM % revision	0.15 (0.1, 0.23)	1.74 (1.54, 1.97)	2.04 (1.82, 2.29)	2.27 (2.04, 2.53)	2.47 (2.23, 2.75)	2.59 (2.34, 2.87)	2.74 (2.48, 3.04)	2.81 (2.54, 3.11)	2.93 (2.65, 3.25)	2.97 (2.68, 3.3)
Highly Crosslinked PE (HXPE)	At Risk	147,192	133,303	118,681	106,154	93,493	79,379	62,500	46,715	31,513	18,983
	KM % revision	0.05 (0.04, 0.07)	1.30 (1.24, 1.35)	1.65 (1.58, 1.72)	1.89 (1.82, 1.96)	2.10 (2.03, 2.18)	2.33 (2.25, 2.42)	2.53 (2.44, 2.62)	2.72 (2.62, 2.81)	2.85 (2.75, 2.96)	2.99 (2.88, 3.1)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
HXPE vs Antioxidant HXPE at 0 Months-1 Year: 0.743(0.647,0.854), p=<.0001
HXPE vs Antioxidant HXPE at 1-9 Years: 1.289(1.081,1.537), p=0.0048

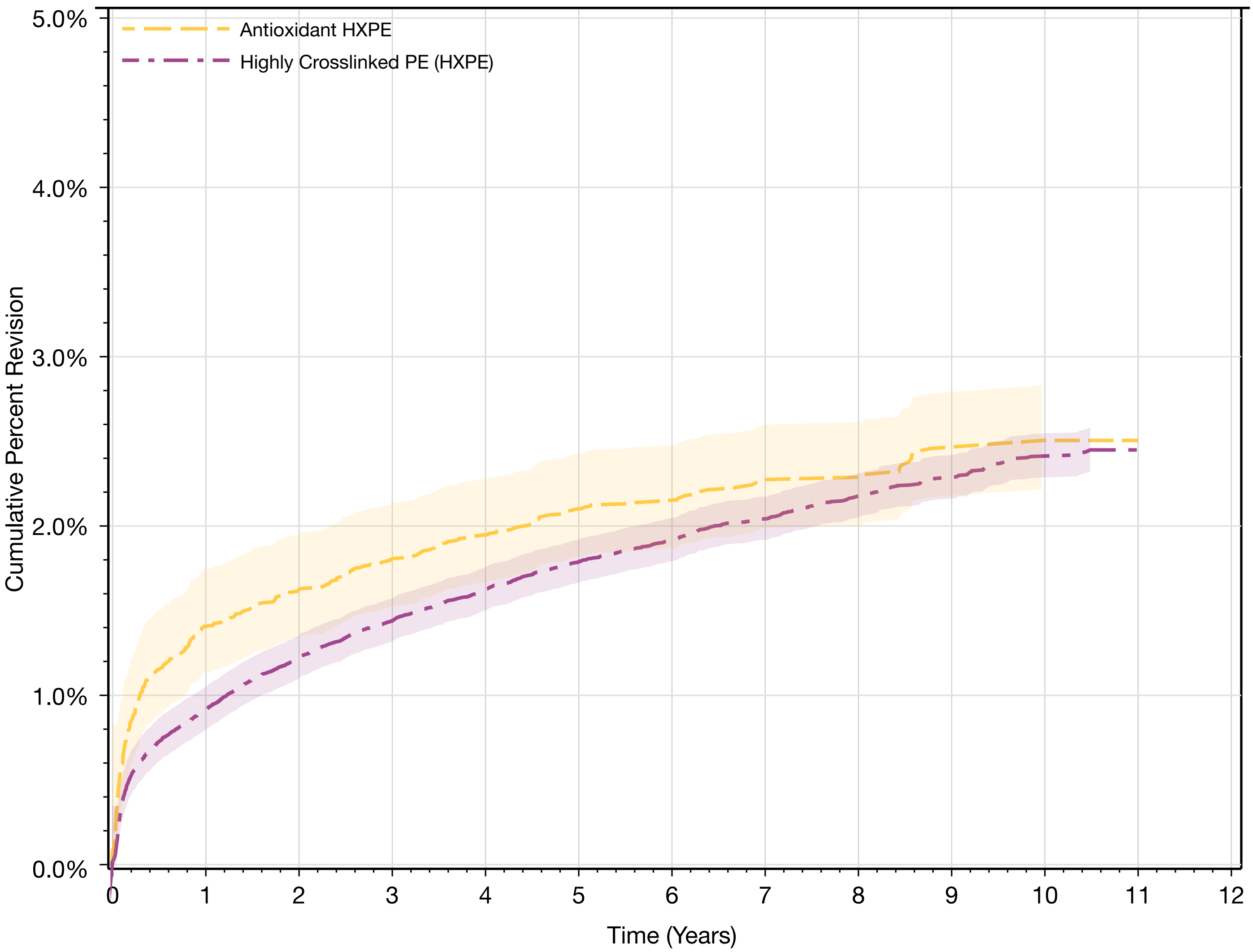
Figure 2.20b Cumulative Percent Revision for Liner Materials Used for Elective Primary Total Hip Arthroplasty in Female Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Antioxidant HXPE	At Risk	21,141	20,204	19,374	18,600	17,607	15,764	11,929	8,524	5,646	3,022	1,543	615
	KM % revision	0.14 (0.1, 0.2)	1.94 (1.76, 2.13)	2.27 (2.08, 2.48)	2.51 (2.31, 2.73)	2.71 (2.5, 2.95)	2.92 (2.7, 3.16)	3.18 (2.94, 3.44)	3.34 (3.1, 3.61)	3.43 (3.17, 3.7)	3.52 (3.26, 3.82)	3.56 (3.28, 3.86)	3.56 (3.28, 3.86)
Highly Crosslinked PE (HXPE)	At Risk	221,600	203,092	182,275	163,646	145,407	124,446	98,238	73,339	50,102	30,257	16,547	7,014
	KM % revision	0.06 (0.05, 0.08)	1.54 (1.49, 1.59)	1.85 (1.79, 1.91)	2.10 (2.04, 2.17)	2.34 (2.27, 2.4)	2.53 (2.46, 2.6)	2.74 (2.66, 2.81)	2.90 (2.82, 2.98)	3.05 (2.97, 3.14)	3.17 (3.08, 3.26)	3.27 (3.17, 3.37)	3.35 (3.24, 3.46)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
HXPE vs Antioxidant HXPE at 0 Months-1 Year: 0.783(0.704,0.871), p=<.0001
HXPE vs Antioxidant HXPE at 1-11 Years: 1.009(0.886,1.149), p=0.8942

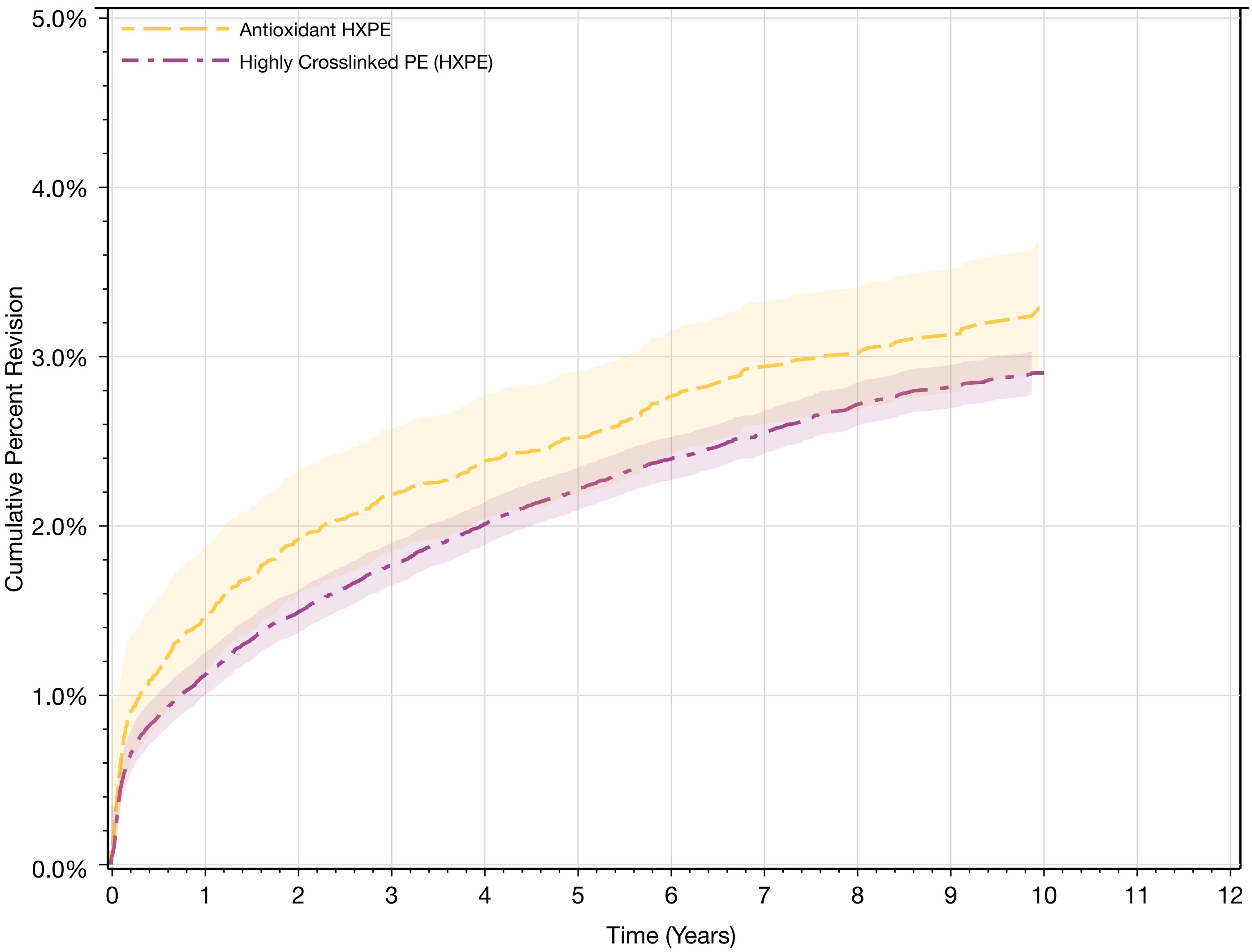
Figure 2.20c Cumulative Percent Revision for Liner Insert Materials Used for Elective Primary Total Hip Arthroplasty in Male Patients under 65 Years of Age with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Antioxidant HXPE	At Risk	18,332	17,851	17,398	16,984	16,403	15,104	12,155	9,357	6,672	3,894	2,031	792
	KM % revision	0.07 (0.04, 0.12)	1.41 (1.25, 1.59)	1.62 (1.45, 1.82)	1.80 (1.62, 2.01)	1.94 (1.75, 2.15)	2.10 (1.9, 2.32)	2.15 (1.94, 2.37)	2.27 (2.06, 2.51)	2.27 (2.06, 2.51)	2.46 (2.22, 2.72)	2.50 (2.25, 2.79)	2.50 (2.25, 2.79)
Highly Crosslinked PE (HXPE)	At Risk	142,785	132,780	121,123	110,756	99,857	86,625	70,821	54,985	39,179	24,732	13,866	6,019
	KM % revision	0.01 (0.01, 0.02)	0.91 (0.87, 0.97)	1.22 (1.16, 1.28)	1.44 (1.38, 1.5)	1.62 (1.56, 1.69)	1.79 (1.72, 1.86)	1.92 (1.84, 1.99)	2.04 (1.96, 2.12)	2.18 (2.09, 2.26)	2.29 (2.19, 2.38)	2.41 (2.31, 2.52)	2.45 (2.34, 2.56)

Age, Sex, CCI adjusted HR (95% CI), p-value
HXPE vs Antioxidant HXPE at 0 Months-1 Year: 0.635(0.554,0.728), p=<.0001
HXPE vs Antioxidant HXPE at 1-11 Years: 1.349(1.140,1.597), p=0.0005

Figure 2.20d Cumulative Percent Revision for Liner Insert Materials Used for Elective Primary Total Hip Arthroplasty in Female Patients Under 65 Years of Age with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10
Antioxidant HXPE	At Risk	17,910	17,389	16,906	16,448	15,890	14,570	11,668	8,906	6,397	3,742	2,046
	KM % revision	0.08 (0.05, 0.14)	1.46 (1.29, 1.64)	1.92 (1.72, 2.13)	2.18 (1.97, 2.41)	2.38 (2.16, 2.62)	2.52 (2.3, 2.76)	2.76 (2.53, 3.02)	2.93 (2.68, 3.2)	3.01 (2.75, 3.28)	3.11 (2.84, 3.4)	3.29 (2.98, 3.62)
Highly Crosslinked PE (HXPE)	At Risk	141,045	131,988	121,101	111,118	100,393	87,265	71,657	55,953	39,985	25,275	14,279
	KM % revision	0.03 (0.02, 0.04)	1.12 (1.06, 1.17)	1.49 (1.42, 1.55)	1.77 (1.7, 1.84)	2.01 (1.93, 2.09)	2.21 (2.13, 2.3)	2.39 (2.31, 2.48)	2.55 (2.46, 2.64)	2.72 (2.62, 2.82)	2.82 (2.72, 2.93)	2.90 (2.79, 3.02)

Age, Sex, CCI adjusted HR (95% CI), p-value
HXPE vs Antioxidant HXPE at 0 Months-2 Years: 0.773(0.688,0.870), p=<.0001
HXPE vs Antioxidant HXPE at 2-10 Years: 1.088(0.925,1.279), p=0.3091

Cement Fixation

Cementless femoral component fixation remains the predominant mode of fixation reported in the AJRR for elective primary THA. Only 4.6% of elective THAs in the U.S. utilized cemented femoral fixation in 2024. Although there has been a slight increase in cemented fixation in recent years, rates have stabilized between 4–5% from 2019 through 2024 (Figure 2.22).

INSIGHTS

Only 4.6% of elective THAs in the United States utilized cemented femoral fixation in 2024 (Figure 2.22).

Cementless femoral fixation in primary THA predominates across all age groups reported to the AJRR including postmenopausal women. The observed frequent utilization of cementless femoral fixation in groups at increased risk for osteoporosis and periprosthetic fracture despite strong evidence of lower revision risk with cemented femoral fixation[27-31] has been termed the "cement paradox.[27]" Factors that contribute to the infrequent use of cemented femoral fixation for patients at high risk for periprosthetic fracture in the United States include limited familiarity with cementing technique, concerns regarding cement implantation syndrome, and the additional operative time associated with cement use. The under-utilization of cemented femoral fixation in primary THA for patients at high risk for periprosthetic fracture represents an opportunity for quality improvement. Future efforts should focus on enhancing physician education regarding the potential benefits of cemented femoral fixation for patients at high risk for periprosthetic fracture. Improved training in cement technique could increase surgeon familiarity with cement fixation, reduce the risk of cement implantation syndrome, and minimize operative time associated with cement use.

The observed frequent utilization of cementless femoral fixation in groups at increased risk for osteoporosis and periprosthetic fracture despite strong evidence of lower revision risk with cemented femoral fixation has been termed the "cement paradox."[27]

INSIGHTS

Figure 2.21 **Cemented and Cementless Femoral Stem Fixation in Elective Primary Total Hip Arthroplasty Procedures by Age Group, 2012-2024 (N=106,206)**

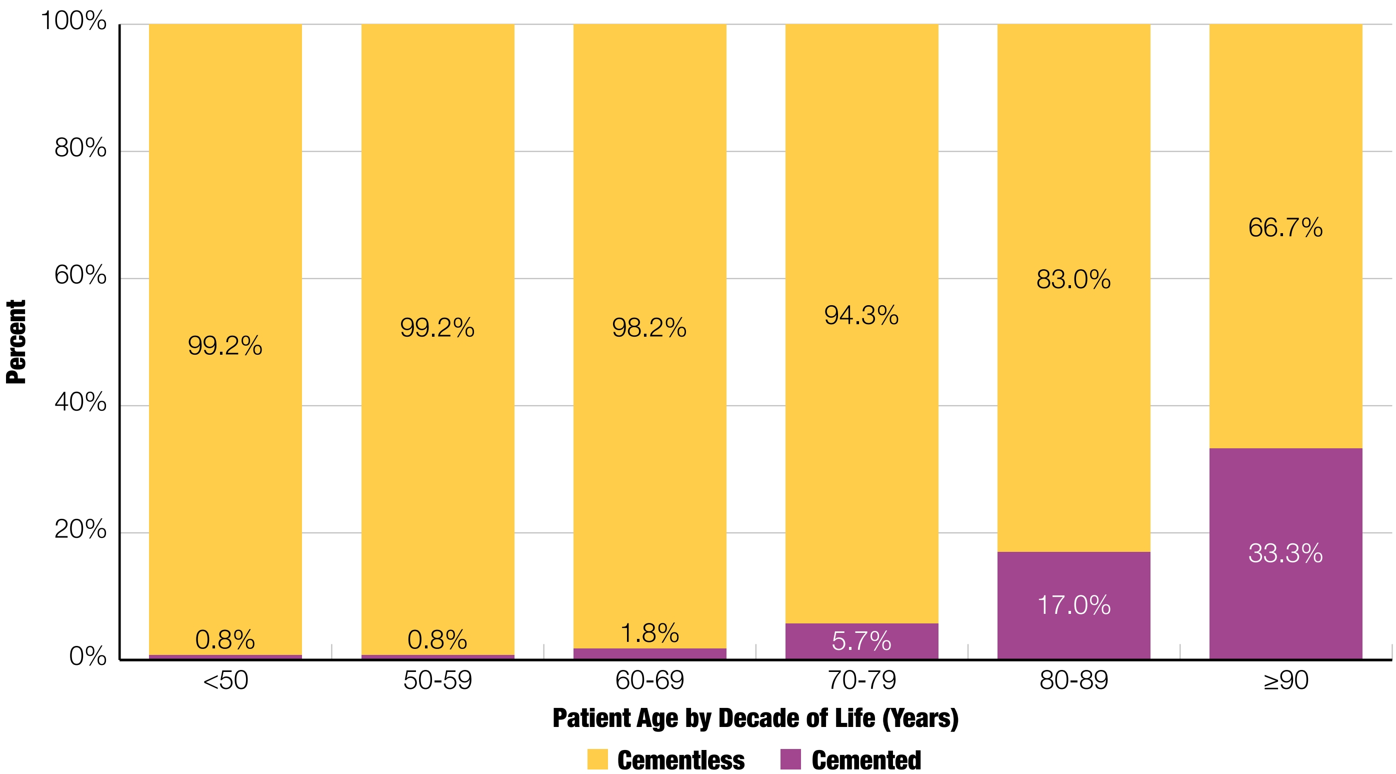
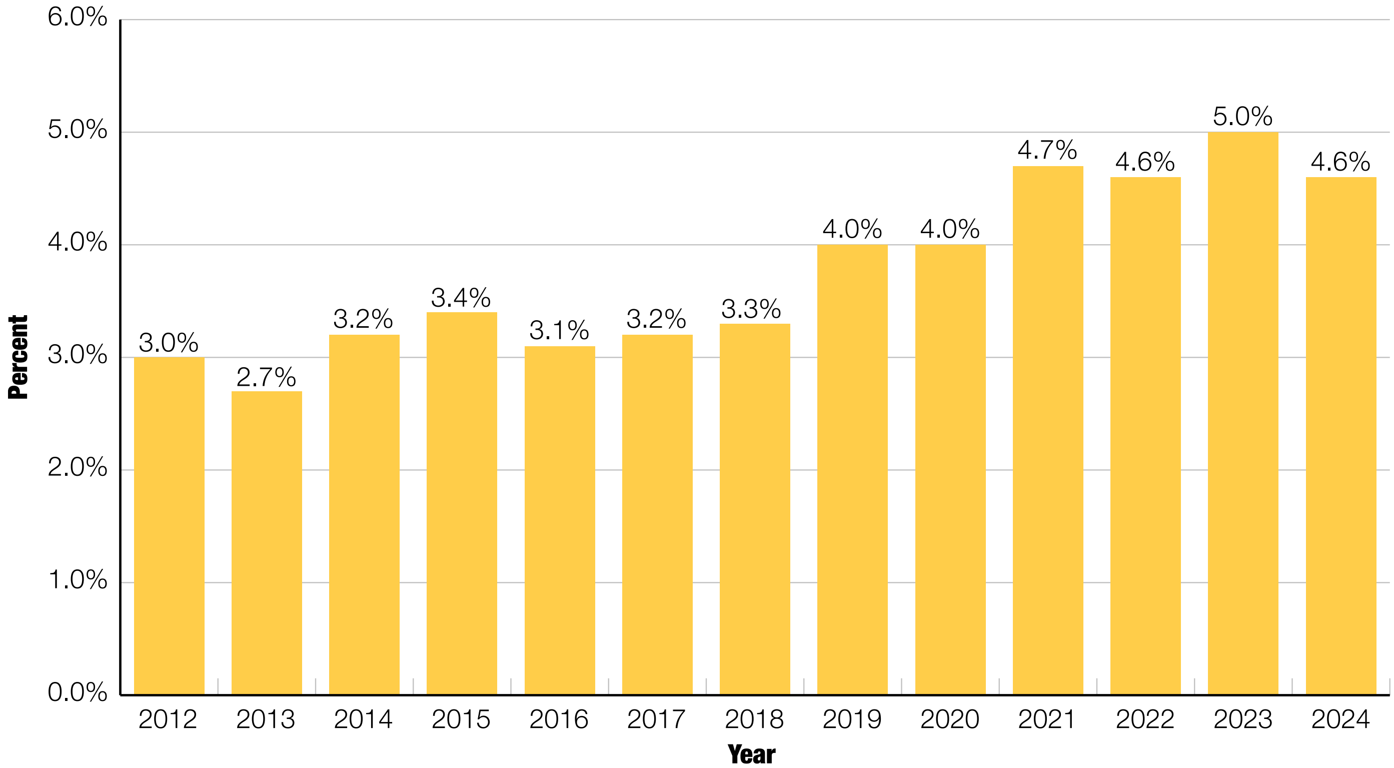


Figure 2.22 Cemented Femoral Stem Fixation in Elective Primary Total Hip Arthroplasty Procedures, 2012-2024 (N=33,747)

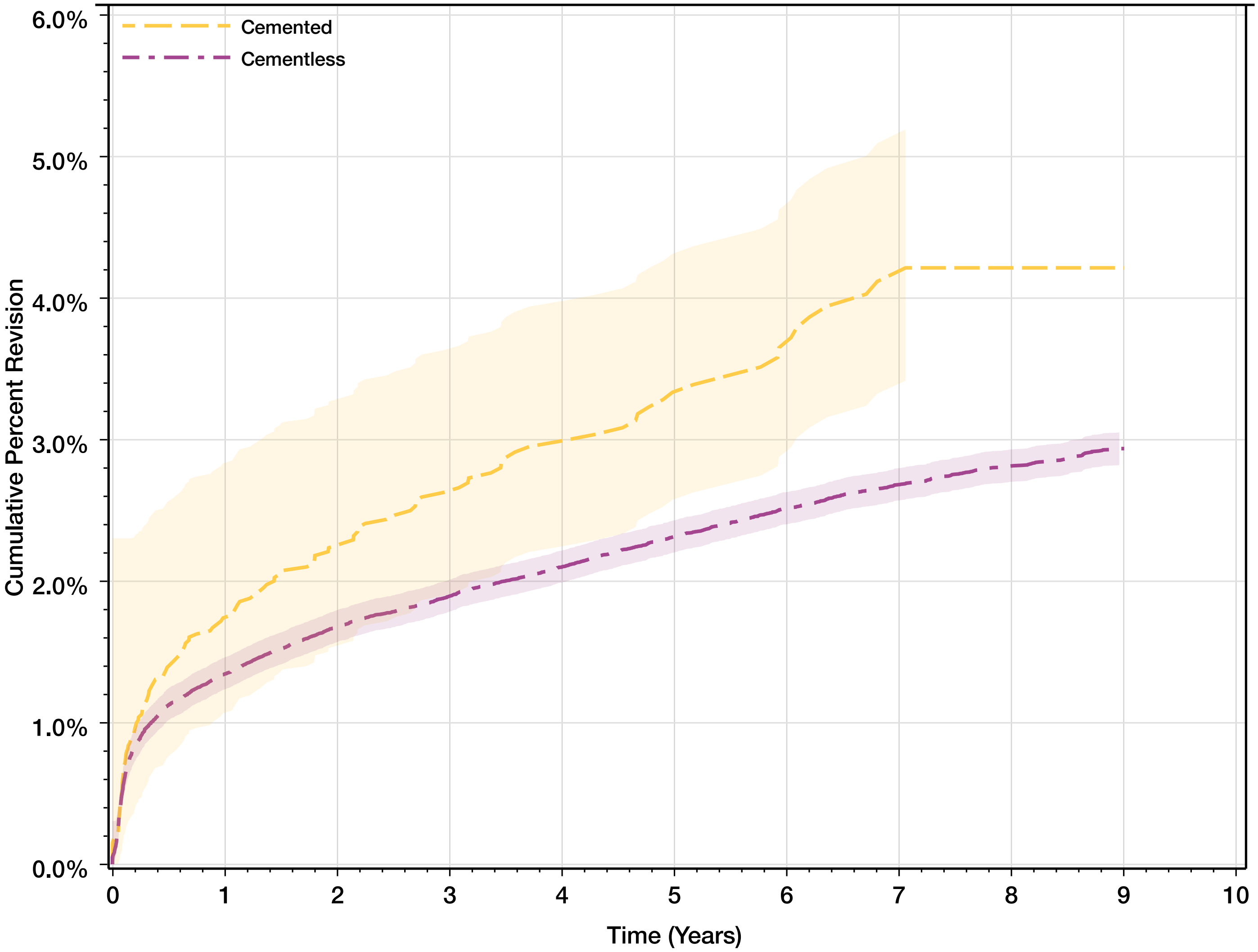


The use of cemented femoral component fixation for primary THA reported to the AJRR (<5%) remains lower than that seen in international registries. The 2025 Annual Report for the NJR in the U.K. reported much higher use of cemented femoral component fixation in primary THA (55.2%) compared with the U.S. (<5%).[33] The Swedish Arthroplasty Register reported a rate similar to the U.K. for cemented femoral fixation in primary THA in 2023 (52%).[23] The AOANJRR reported a rate of cemented femoral fixation in primary THA (38.1% in 2023) that was lower than in the U.K. and Sweden but higher than in the AJRR (<5%).[7]

Mode of fixation impacts CPR in primary THA reported to the AJRR. CPR was higher, but not statistically signifcant, for cementless compared with cemented femoral fixation in women ≥65 years old in primary THA (from 6 months to 5 years, HR 1.095 (0.948,1.265), p=0.2187) with equivalent CPRs noted comparing cement and cementless femoral fixation in men ≥65 years old (HR 1.114 (0.907,1.369)p=0.3029) (Figures 2.23-2.24). CPR rates for periprosthetic fracture were significantly lower for cement compared with cementless fixation in primary THA after adjusting for age and gender (Figures 2.25 from 0 months to 1.5 years, HR 0.189 (0.130,0.275), p=<.0001). It is important to note this analysis does not account for potential confounders that were not examined. Cementless stem design may also have a significant impact on the risk for periprosthetic fracture. Risk of revision comparing different cementless femoral stem designs to cemented femoral fixation in primary THA deserves further analysis.

INSIGHTS	**Cemented femoral fixation was associated with lower CPR within the first 6 months after primary THA compared with cementless fixation in women 65 years of age and older (HR 0.59 (0.51,0.68), p<0.001). No differences in CPR based on mode of fixation were noted beyond 6 months for men or women 65 years of age and older (Figure 2.23-2.24).**

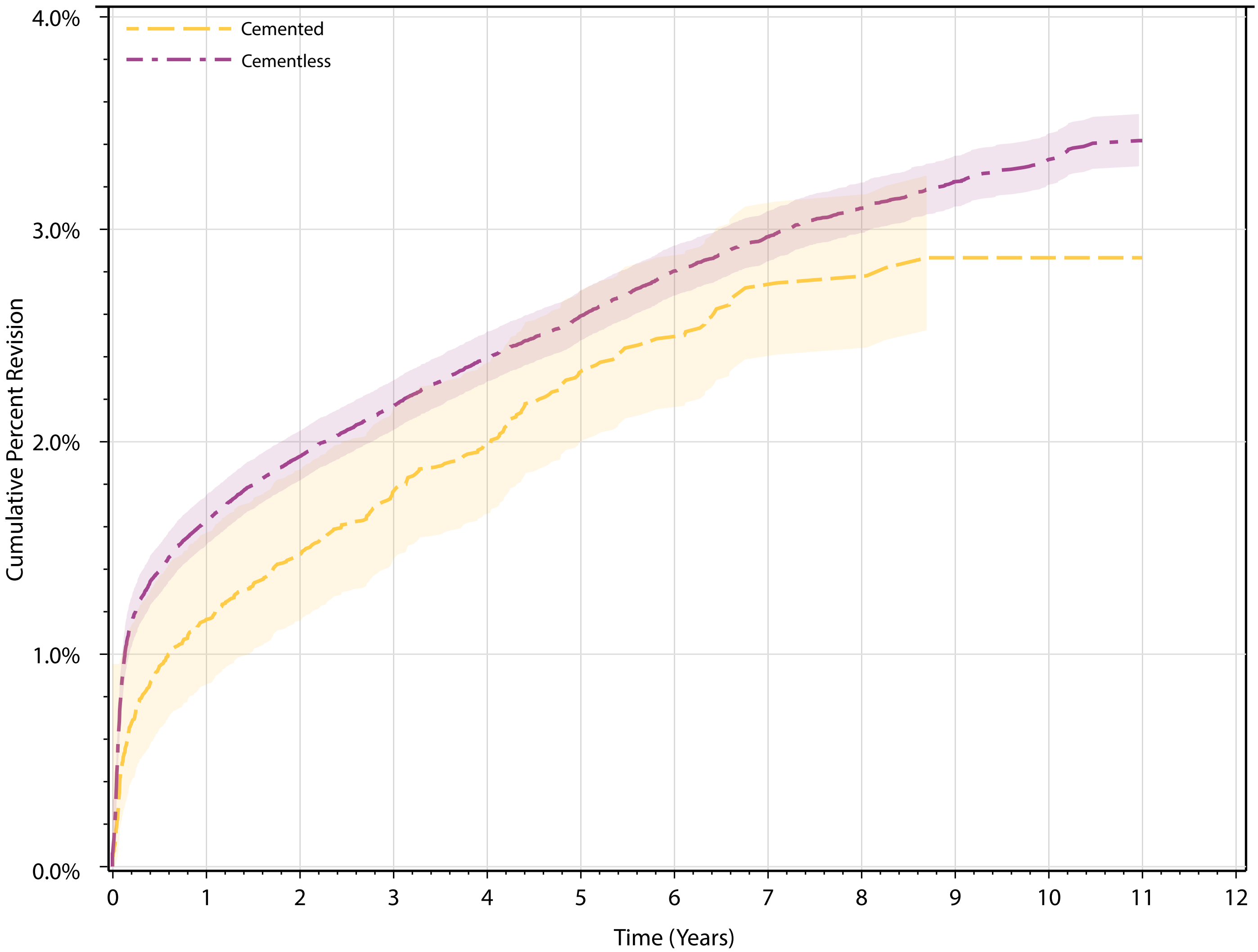
Figure 2.23 Cumulative Percent Revision for Femoral Stem Fixation Used for Elective Primary Total Hip Arthroplasty for Male Medicare Patients 65 Years of Age and Older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9
Cemented	At Risk	5,067	4,305	3,530	2,931	2,332	1,854	1,376	1,010	702	402
	KM % revision	0.14 (0.07, 0.29)	1.74 (1.41, 2.15)	2.24 (1.85, 2.7)	2.63 (2.19, 3.15)	2.95 (2.48, 3.52)	3.33 (2.8, 3.97)	3.65 (3.06, 4.35)	4.12 (3.44, 4.93)	4.21 (3.51, 5.05)	4.21 (3.51, 5.05)
Cementless	At Risk	200,161	173,897	146,974	125,335	107,419	90,814	71,677	53,333	35,727	21,403
	KM % revision	0.05 (0.04, 0.06)	1.34 (1.29, 1.4)	1.68 (1.62, 1.74)	1.89 (1.83, 1.96)	2.10 (2.03, 2.17)	2.31 (2.24, 2.39)	2.51 (2.43, 2.59)	2.68 (2.6, 2.77)	2.81 (2.72, 2.91)	2.94 (2.84, 3.04)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Cemented vs Cementless over 9 Years: 1.114(0.907,1.369)p=0.3029

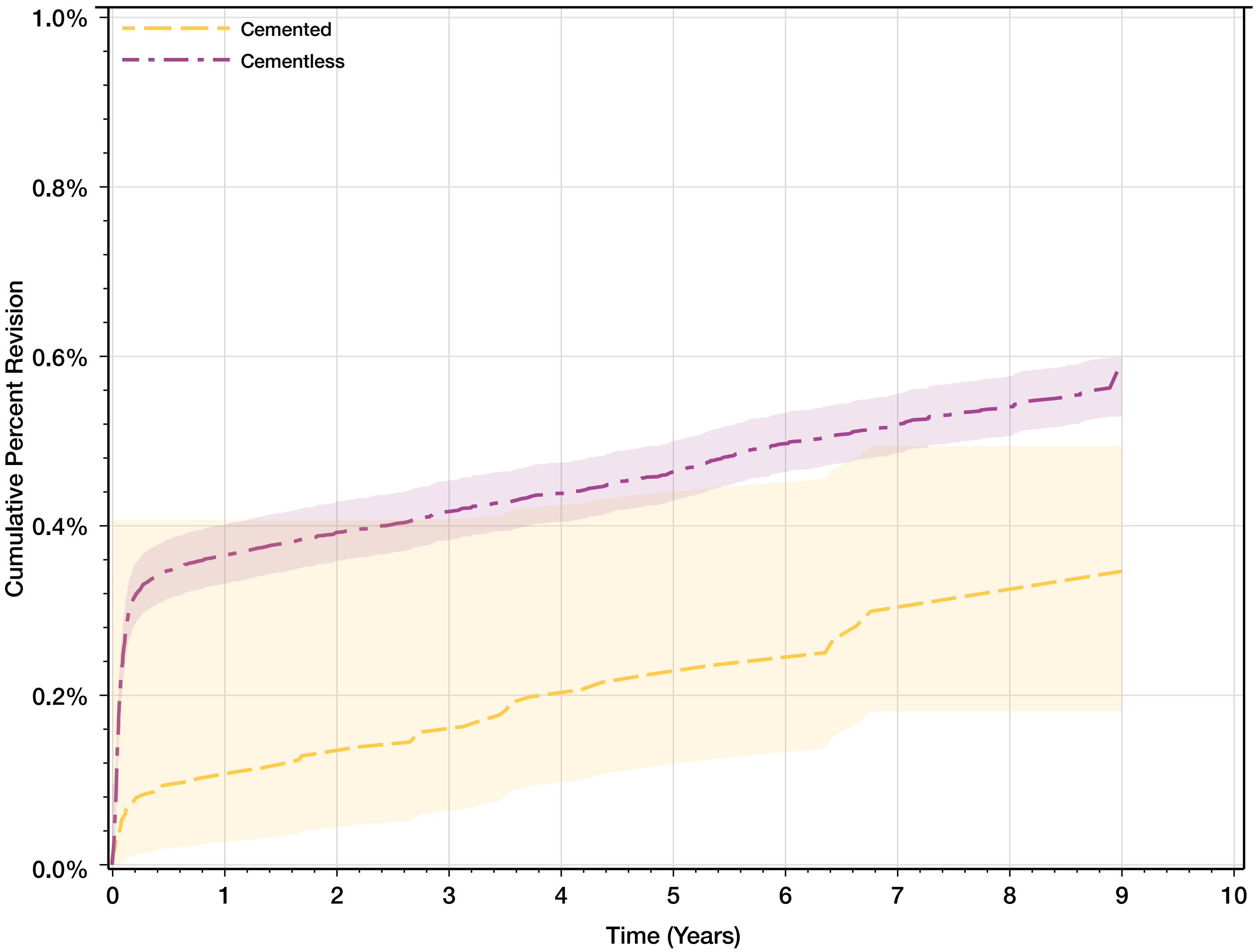
Figure 2.24 Cumulative Percent Revision for Femoral Stem Fixation Used for Elective Primary Total Hip Arthroplasty for Female Medicare Patients 65 Years of Age and Older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Cemented	At Risk	23,274	19,726	15,888	12,939	10,302	8,257	6,113	4,333	2,913	1,709	832	328
	KM % revision	0.04 (0.02, 0.08)	1.16 (1.03, 1.31)	1.47 (1.31, 1.64)	1.76 (1.59, 1.96)	1.98 (1.79, 2.19)	2.32 (2.1, 2.57)	2.48 (2.25, 2.75)	2.72 (2.46, 3.02)	2.75 (2.48, 3.05)	2.87 (2.57, 3.2)	2.87 (2.57, 3.2)	2.87 (2.57, 3.2)
Cementless	At Risk	291,394	253,726	215,747	185,121	159,629	136,126	107,582	79,936	54,101	32,313	17,776	7,666
	KM % revision	0.06 (0.05, 0.07)	1.63 (1.58, 1.67)	1.93 (1.88, 1.98)	2.17 (2.11, 2.22)	2.40 (2.34, 2.46)	2.59 (2.53, 2.66)	2.80 (2.74, 2.87)	2.96 (2.89, 3.04)	3.10 (3.02, 3.18)	3.22 (3.14, 3.31)	3.33 (3.24, 3.42)	3.42 (3.31, 3.53)

*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Cemented vs Cementless at 0-6 Months: 0.589(0.510,0.679), p=<.0001
Cemented vs Cementless at 6 Months-5 Years: 1.095(0.948,1.265), p=0.2187
Cemented vs Cementless at 5-11 Years: 0.898(0.618,1.304), p=0.5718

Figure 2.25 **Stem Fixation and Percent Survival for Revision due to Periprosthetic Fracture for Elective Primary Total Hip Arthroplasty in Patients 65 Years of Age and Older Adjusted for Age and Gender, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8	9
Cemented	At Risk	28,379	24,060	19,433	15,881	12,645	10,115	7,490	5,343	3,615	2,111
	KM % revision	0.01 (0, 0.03)	0.11 (0.07, 0.15)	0.13 (0.1, 0.19)	0.16 (0.11, 0.22)	0.20 (0.15, 0.27)	0.22 (0.17, 0.3)	0.23 (0.17, 0.32)	0.30 (0.22, 0.41)	0.30 (0.22, 0.41)	0.35 (0.24, 0.51)
Cementless	At Risk	493,880	429,521	364,215	311,775	268,297	227,915	179,737	133,287	89,841	53,718
	KM % revision	0.01 (0, 0.01)	0.36 (0.35, 0.38)	0.39 (0.37, 0.41)	0.42 (0.4, 0.43)	0.44 (0.42, 0.46)	0.46 (0.44, 0.48)	0.50 (0.47, 0.52)	0.52 (0.5, 0.54)	0.54 (0.51, 0.56)	0.59 (0.56, 0.62)

*Age, Sex, CCI, CCI * log(CCI), Age * log(Age) adjusted HR (95% CI), p-value*
Cemented vs Cementless at 0 Months-1.5 Years: 0.189(0.130,0.275), p=<.0001
Cemented vs Cementless at 1.5-6 Years: 1.085(0.674,1.748), p=0.7360
Cemented vs Cementless at 6-9 Years: 1.417(0.576,3.489), p=0.4482

Technology Usage in Primary THA

Data completeness and reporting to AJRR on the use of robotics and navigation in primary THA has improved significantly over the last several years. However, data completeness for both computer navigation and robotics this year remains below 50% (approximately 44%) (Table 1.2). The percentage of elective primary THA utilizing robotic assistance is over 6% in 2024 which are slightly lower than the rate reported in 2023's report (7.3%, Figure 2.26). Rates of robotic use in primary THA varies significantly based on the specific robotic platforms used (Figure 2.27). Computer assisted navigation continues to decline with rates of 5% or less over the last several years (Figure 2.26).

Figure 2.26 Rate of Technology Use for Assistance in Elective Primary Total Hip Arthroplasty, 2017-2024

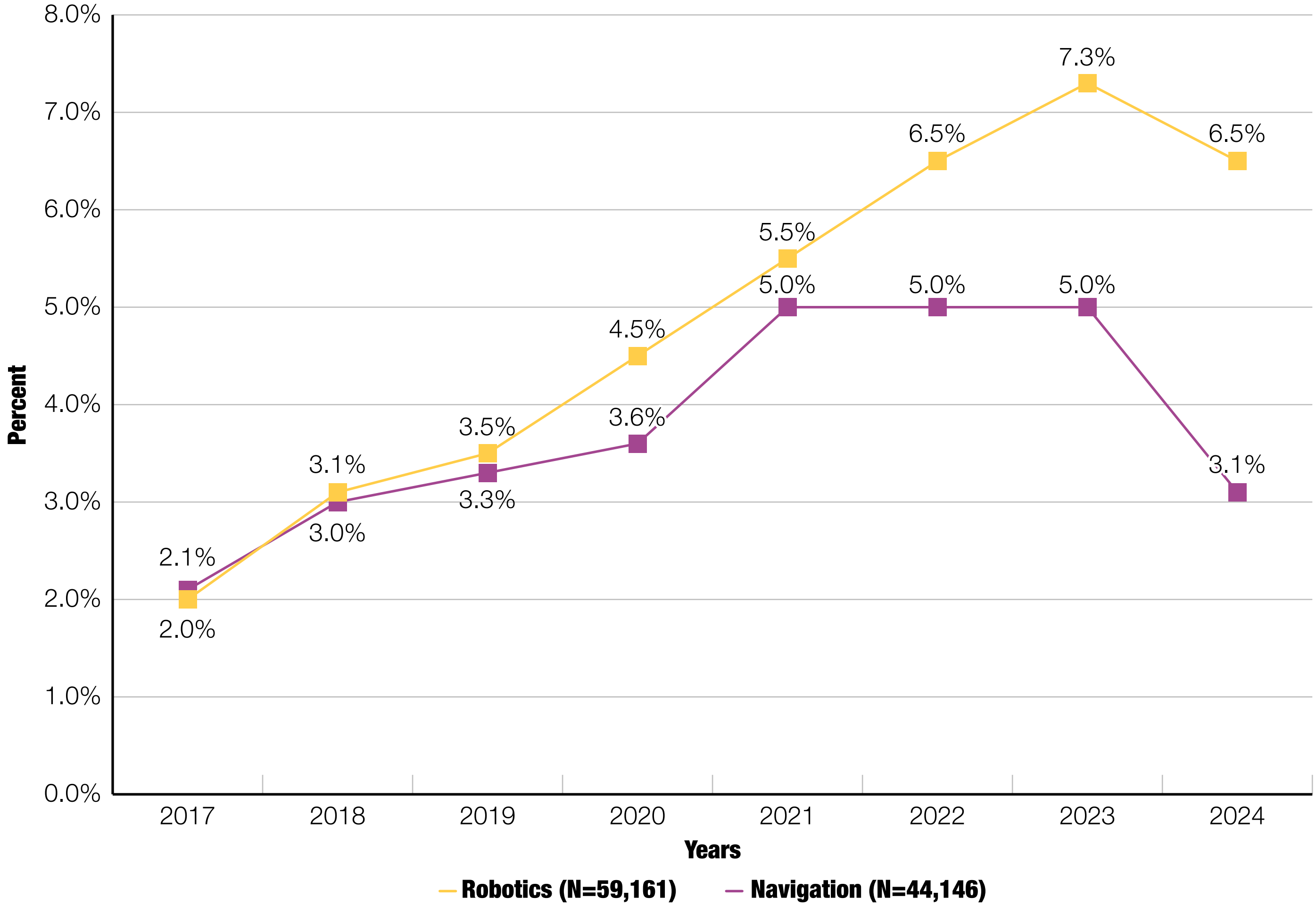
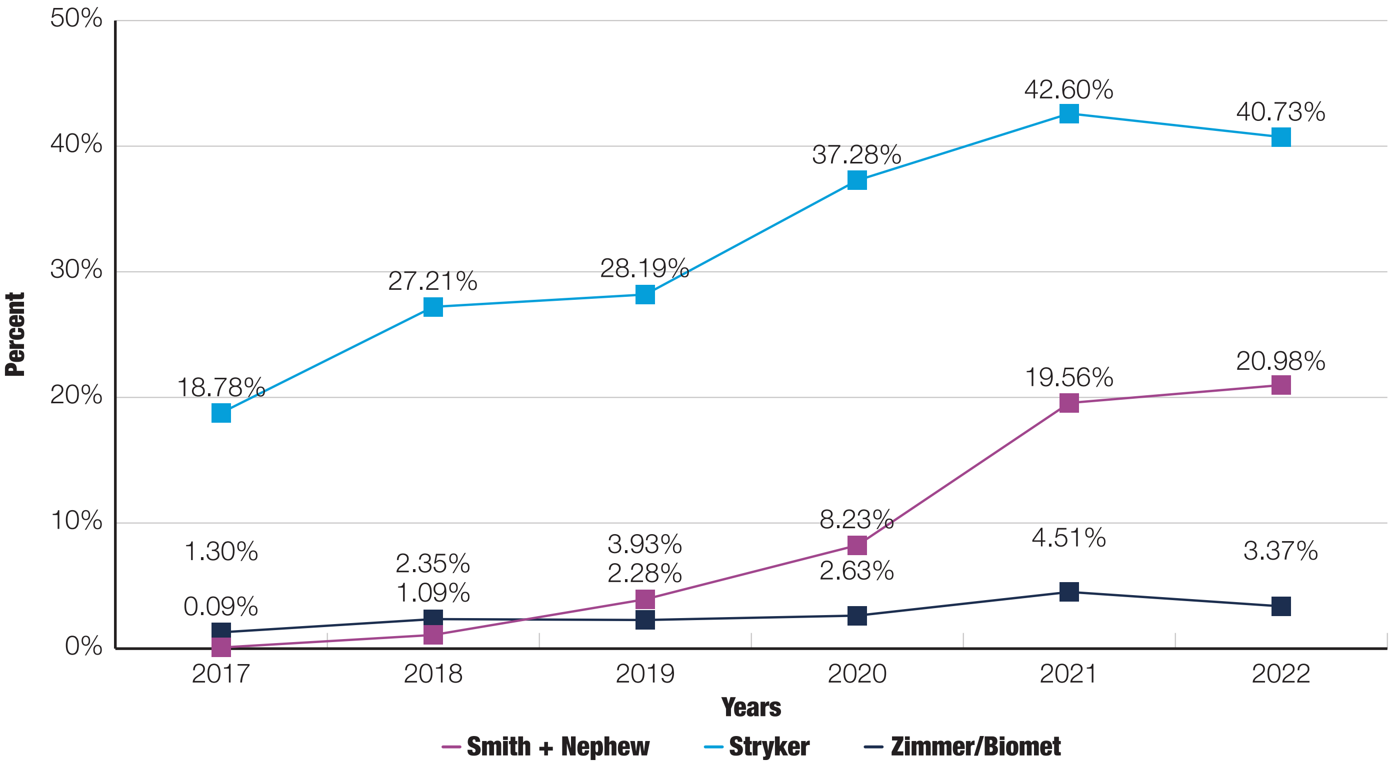


Figure 2.27 Percentage of Manufacturer's Cases with Robotic Use in Primary THA, 2017-2022 (N=93,884)



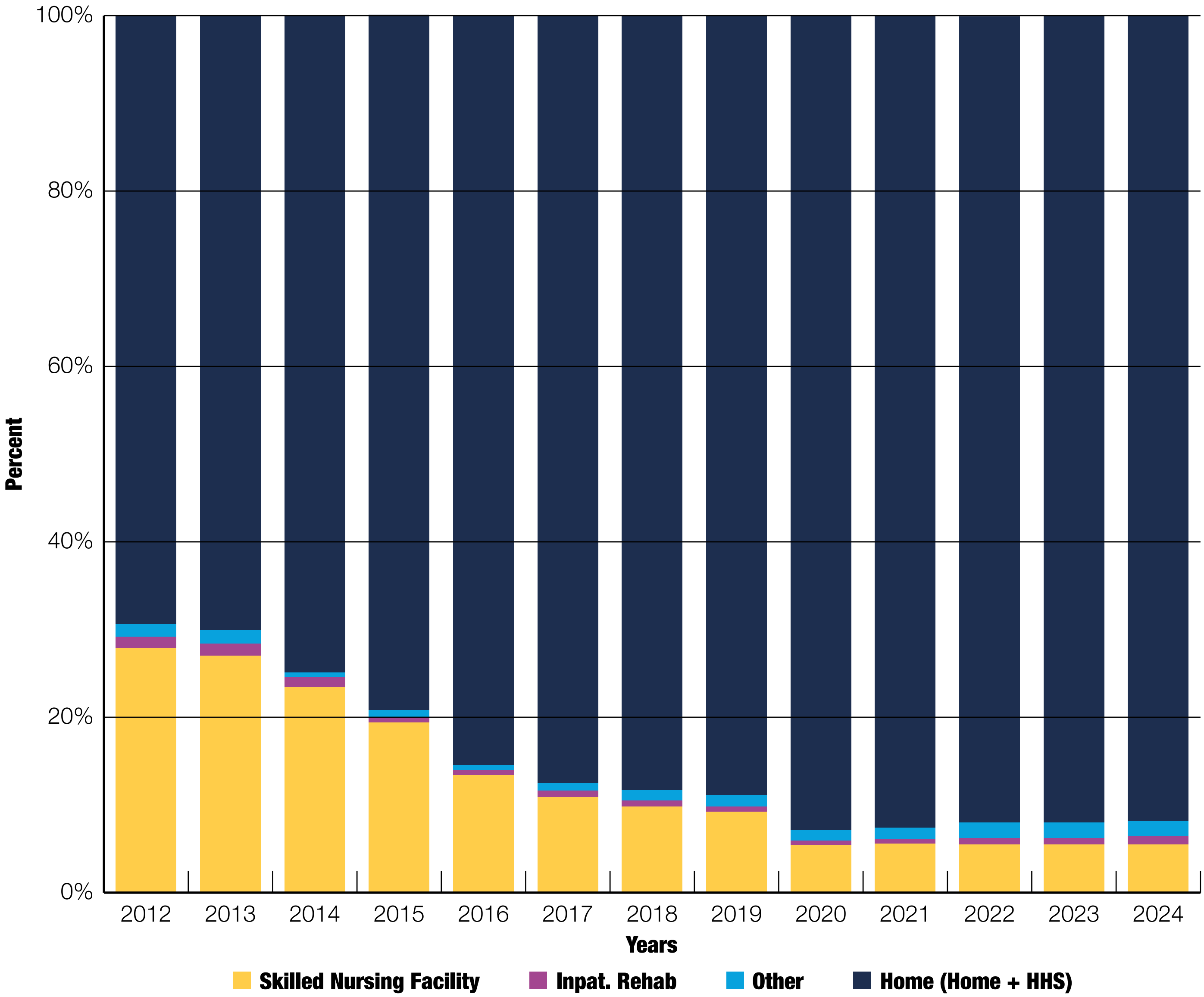
Limitations

AJRR relies on participating institutions submitting data on arthroplasty surgery and only 44% of procedures within the AJRR reported a valid value of "Yes," "No," or "Not Reported" for our discrete robotics field. The percentage of cases reporting robotics has increased steadily over the last several years, but remains a significant limitation for our dataset. Reporting to the AJRR is also voluntary and subject to cluster sampling bias influenced by individual surgeons and institutions. The AJRR is working with our industry partners through AdvaMed to improve data capture rates for robotics. These efforts to improve the quality of data available related to robotic use in the U.S. for primary THA represents an important area of focus for the AJRR. This limitation is highlighted in Figure 2.27 where only the top three manufacturers are reported that have a minimum number of 400 cases. As data capture improves over time, additional manufacturers will be included for trend analysis. It is important to note that the robotics data submitted to the AJRR may be subject to selection bias, as it reflects robotic systems used by submitting institutions.

Discharge Disposition and Anesthesia

The AJRR began reporting discharge disposition in 2017 using CMS-defined Patient Discharge Status Codes (Figure 2.28). Approximately 92% of patients undergoing primary THA were discharged home (Figure 2.28) and approximately 8% were discharge to a skilled nursing facility (SNF). The percentage of patients discharged home has consistently increased and the percentage of patients discharged to SNF has consistently declined over the last several years. All other discharge categories represented a small proportion of cases.

Figure 2.28 Total Hip Arthroplasty Discharge Disposition Codes by Year, 2012-2024 (N=1,008,251)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Skilled Nursing Facility	27.9%	27.0%	23.4%	19.4%	13.4%	10.9%	9.8%	9.2%	5.4%	5.6%	5.5%	5.5%	5.5%
Inpat. Rehab	1.3%	1.4%	1.2%	0.6%	0.6%	0.7%	0.7%	0.6%	0.5%	0.5%	0.7%	0.7%	0.9%
Other	1.4%	1.5%	0.5%	0.8%	0.5%	0.9%	1.2%	1.3%	1.2%	1.3%	1.8%	1.8%	1.8%
Home (Home + HHS)	69.4%	70.1%	74.9%	79.3%	85.5%	87.5%	88.3%	88.9%	92.9%	92.6%	91.9%	92.0%	91.8%

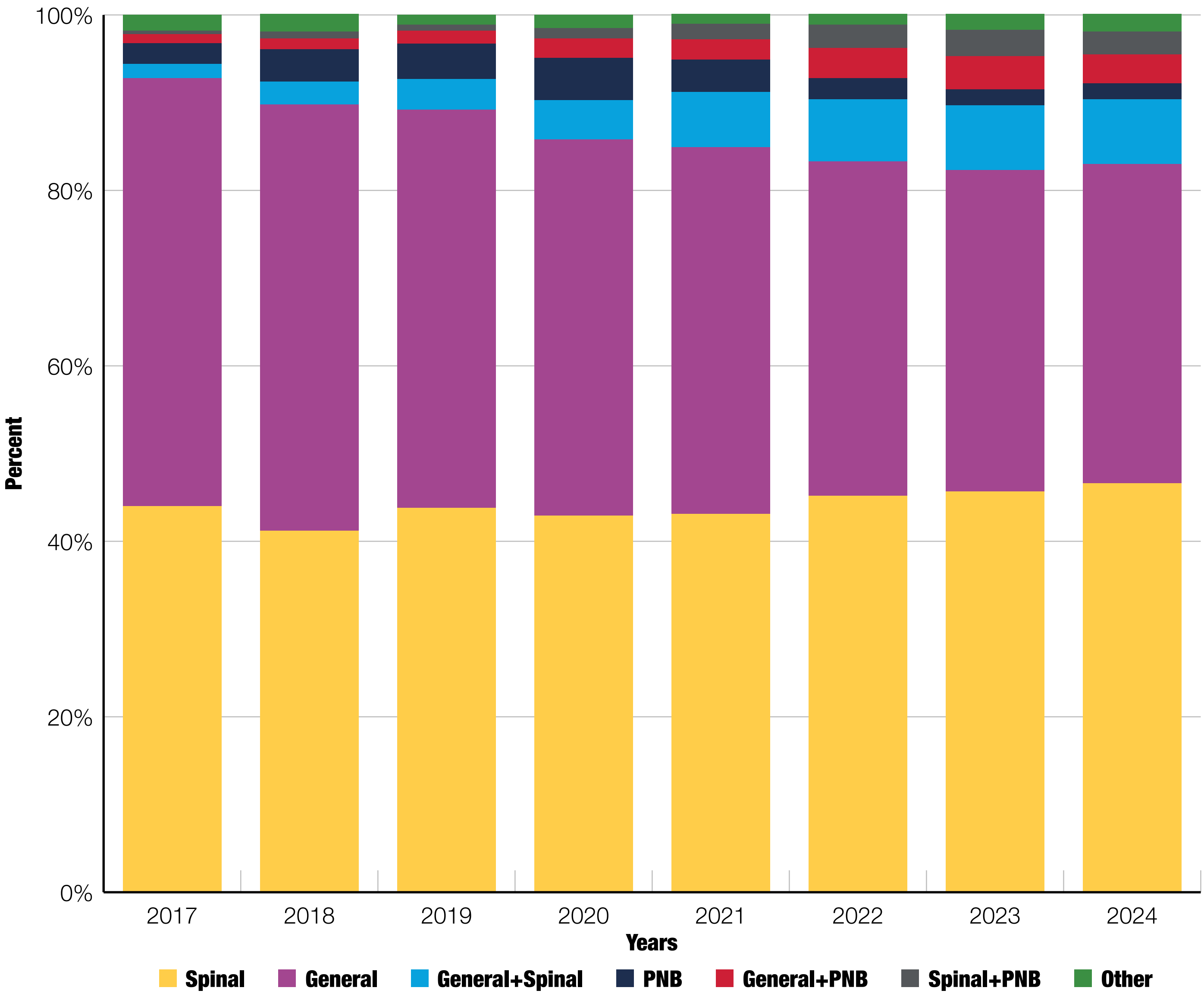
Code	Code Value
Home	Discharged to home/self-care (routine charge).
Home Care Org.	Discharged/transferred to home care of organized home health service organization.
SNF	Discharged/transferred to skilled nursing facility (SNF) with Medicare certification in anticipation of covered skilled care — (For hospitals with an approved swing bed arrangement, use Code 61 - swing bed. For reporting discharges/transfers to a non-certified SNF, the hospital must use Code 04 - ICF.)
Inpat. Rehab	Discharged/transferred to an inpatient rehabilitation facility including distinct units of a hospital (eff. 1/2002).

Anesthesia techniques utilized for patients undergoing an elective primary THA include General, Spinal, and Peripheral Nerve Block (PNB) (Figure 2.29). There has been a consistent decrease in the use of general anesthesia with primary THA over time (Figure 2.29).

INSIGHTS

There has been a consistent decrease in the use of general anesthesia with primary THA over time (Figure 2.29).

Figure 2.29 Elective Primary Total Hip Arthroplasty Anesthesia Technique by Year, 2017-2024 (N=710,409)



	2017	2018	2019	2020	2021	2022	2023	2024
Spinal	44.0%	41.2%	43.8%	42.9%	43.1%	45.2%	45.7%	46.6%
General	48.8%	48.6%	45.4%	42.9%	41.8%	38.1%	36.6%	36.4%
General+Spinal	1.6%	2.6%	3.5%	4.5%	6.3%	7.1%	7.4%	7.4%
PNB	2.4%	3.7%	4.0%	4.8%	3.7%	2.4%	1.8%	1.8%
General+PNB	1.0%	1.2%	1.5%	2.2%	2.3%	3.4%	3.8%	3.3%
Spinal+PNB	0.4%	0.8%	0.7%	1.2%	1.8%	2.7%	3.0%	2.6%
Other	1.8%	2.0%	1.1%	1.5%	1.1%	1.2%	1.8%	2.0%

Primary THA Components

Implant utilization rates in primary THA vary over time. We report on implant utilization in primary THA in the U.S. reported to the AJRR from 2012 through 2024 (Figure 2.29-2.31 and Tables 2.4-2.7). The data presented in this report are based on procedures voluntarily submitted by participating hospitals and surgeons to the AJRR. This report reflects utilization trends and patterns within this specific dataset.

The Actis Duofix stem and Pinnacle cup with a ceramic on polyethylene (CoP) bearing surface continues to be the most frequently implanted combination with increasing utilization over time (Figure 2.30). We report on the eight most implanted stem components used in primary THA by year (Figure 2.31). The Accolade II stem was the most frequently implanted femoral component from 2014-2021 and the Actis Duofix has been the most frequent implant from 2022 to 2024. We report on the eight most implanted cup components in primary THA by year (Figure 2.32). The Pinnacle cup had been implanted most frequently from 2012 to 2023 with the Trident II becoming the most frequent cup implanted in 2024.

Figure 2.30 Elective Primary Total Hip Arthroplasty Femoral Stem/Acetabular Component Combinations by Year, 2012-2024 (N=1,032,027)

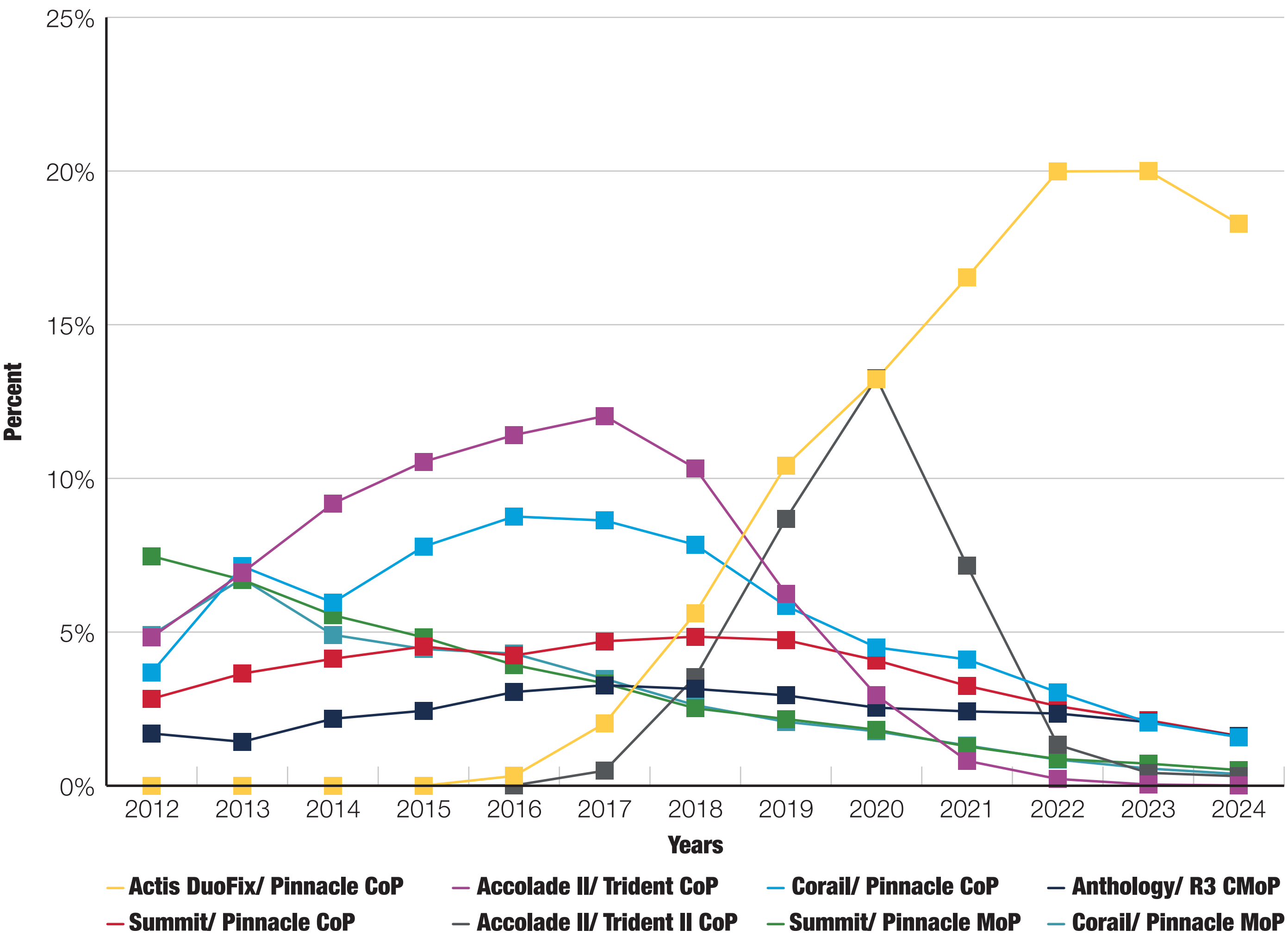


Figure 2.31 **Elective Primary Total Hip Arthroplasty Femoral Stem Components by Year, 2012-2024 (N=1,110,561)**

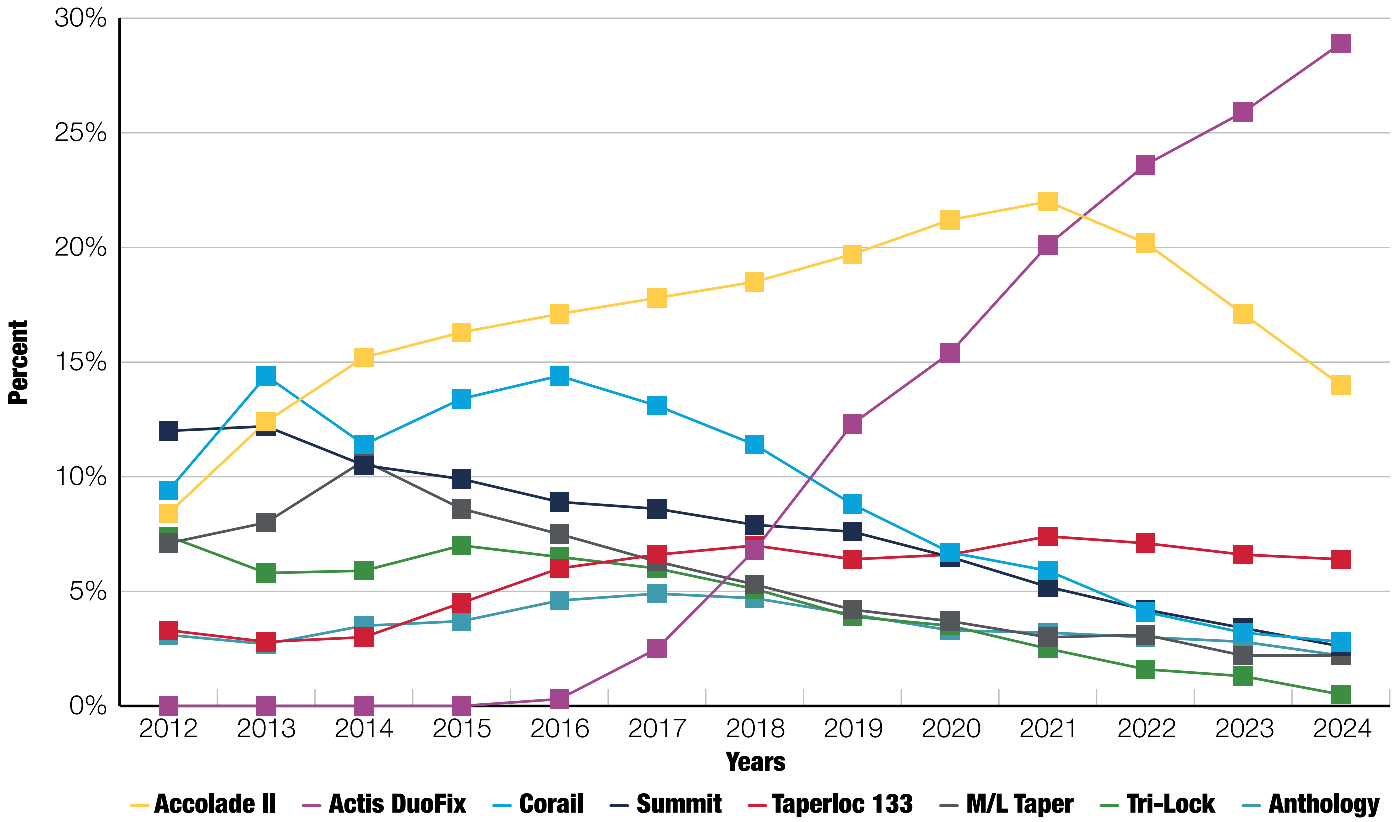
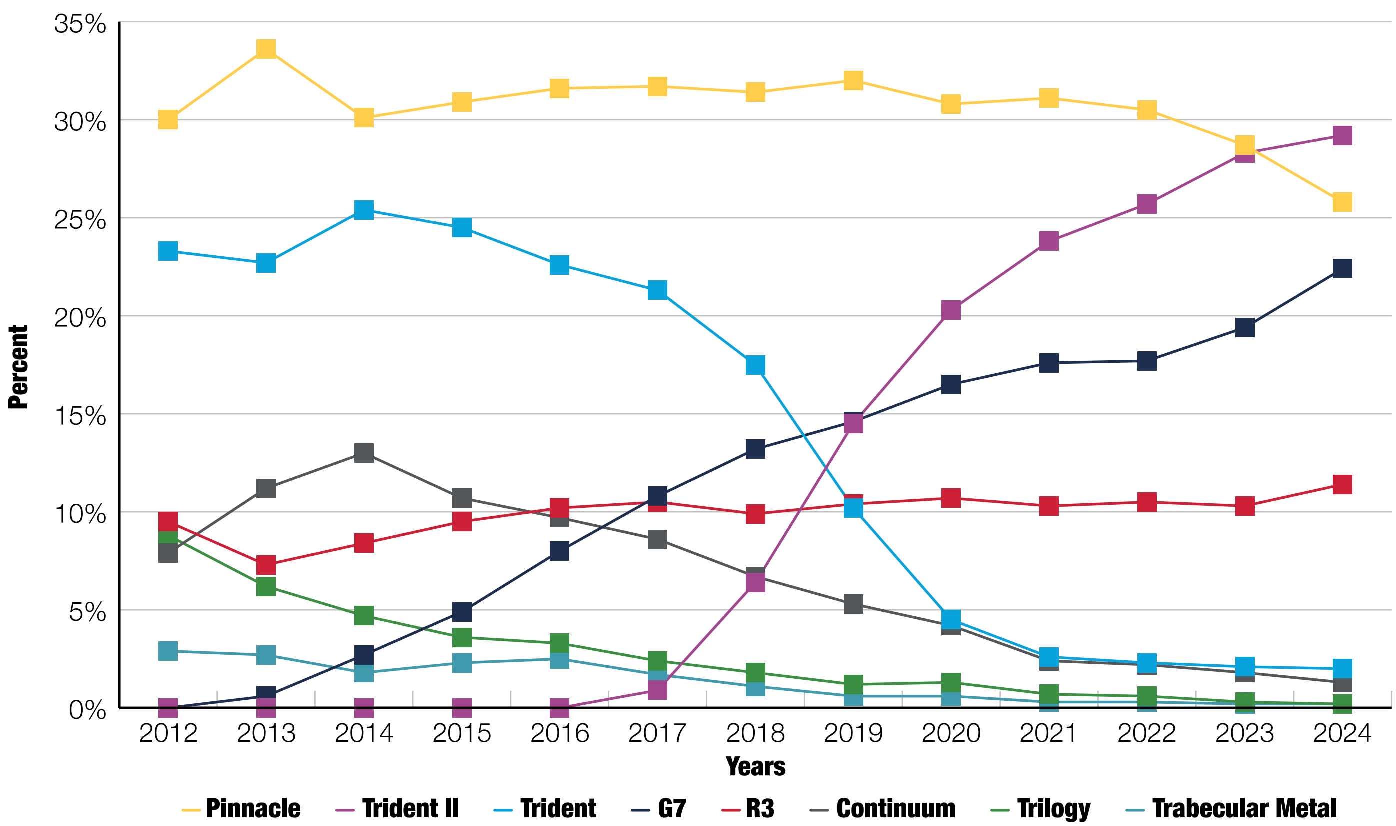


Figure 2.32 **Elective Primary Total Hip Arthroplasty Acetabular Components by Year, 2012-2024 (N=1,144,404)**



CPRs in primary THA specific to different THA construct combinations reported in this year's Annual Report represent clinically useful information for treating orthopaedic surgeons (Table 2.5). The majority of the variation in the hip device-specific survivorship curves appear to occur within one year of the primary procedure. Early failure is typically a result of infection, dislocation, or periprosthetic fracture which may or may not be related to the implant itself. The aggregate cumulative percent revision of included devices was less than 1.5% at one year and just slightly over 3% at ten years for the cementless constructs.

It is important to emphasize that this analysis does not adjust for any potential confounders of patient, procedure, surgeon, or hospital characteristics. The cumulative present revision rate of one implant may also be influenced by other components used in the construct and not reflect the inherent performance of that individual implant alone. Metal-on-metal hip constructs were excluded from all analyses. Devices presented in the analysis were required to meet the minimum case threshold of 400 total procedures.

INSIGHTS

The aggregate cumulative percent revision of included devices was less than 1.5% at one year and just slightly over 3% at ten years for the cementless constructs in primary THA for patients 65 years of age and older with primary OA. (Table 2.5).

Table 2.5 Unadjusted Cumulative Percent Revision of Cementless Hip Arthroplasty Construct Combinations for Primary Total Hip Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
Pinnacle/ Actis DuoFix Cementless	61,920	631	0.80 (0.73, 0.87)	1.04 (0.96, 1.13)	1.19 (1.09, 1.3)	1.24 (1.12, 1.37)	—
Trident II-Tritanium/ Accolade II Cementless	45,169	1,009	1.82 (1.7, 1.95)	2.22 (2.09, 2.37)	2.44 (2.29, 2.6)	2.59 (2.4, 2.8)	—
Pinnacle/ Corail Cementless	41,770	751	0.98 (0.89, 1.08)	1.34 (1.23, 1.45)	1.62 (1.5, 1.75)	1.87 (1.74, 2.01)	2.04 (1.89, 2.2)
Pinnacle/ Summit Cementless	29,425	790	1.67 (1.53, 1.82)	2.14 (1.98, 2.31)	2.47 (2.29, 2.65)	2.77 (2.58, 2.97)	3.03 (2.81, 3.26)
Trident/ Accolade II Cementless	25,462	776	1.58 (1.43, 1.74)	2.32 (2.14, 2.51)	2.78 (2.58, 2.99)	3.11 (2.9, 3.34)	3.36 (3.12, 3.61)
G7/ Taperloc 133 Cementless	22,214	491	1.60 (1.44, 1.77)	2.02 (1.84, 2.22)	2.39 (2.18, 2.62)	2.58 (2.35, 2.83)	2.63 (2.39, 2.89)
Pinnacle/ Tri-Lock Cementless	19,150	432	1.18 (1.04, 1.34)	1.70 (1.52, 1.89)	2.09 (1.89, 2.3)	2.28 (2.07, 2.51)	2.51 (2.27, 2.77)
R3/ Anthology Cementless	18,074	478	1.67 (1.49, 1.87)	2.27 (2.05, 2.5)	2.62 (2.39, 2.87)	2.88 (2.62, 3.15)	3.13 (2.84, 3.45)
R3/ PolarStem Cementless	16,922	318	1.46 (1.29, 1.65)	1.89 (1.68, 2.12)	2.12 (1.88, 2.38)	2.44 (2.12, 2.78)	2.82 (2.25, 3.48)
Trident II-Tritanium/ Insignia Cementless	16,435	180	1.08 (0.93, 1.24)	1.14 (0.98, 1.32)	—	—	—
Trident-Tritanium/ Accolade II Cementless	13,930	620	2.03 (1.81, 2.28)	3.07 (2.79, 3.36)	3.79 (3.48, 4.12)	4.30 (3.97, 4.64)	4.54 (4.2, 4.91)
Continuum/ M/L Taper Cementless	12,533	519	2.41 (2.15, 2.69)	3.21 (2.91, 3.53)	3.76 (3.44, 4.11)	4.17 (3.82, 4.54)	4.55 (4.17, 4.96)
G7/ Taperloc 133 Microplasty Cementless	10,568	260	1.91 (1.66, 2.18)	2.25 (1.98, 2.55)	2.47 (2.17, 2.79)	2.68 (2.36, 3.02)	2.76 (2.43, 3.13)
R3/ Synergy Cementless	8,223	305	2.58 (2.26, 2.94)	3.19 (2.82, 3.59)	3.48 (3.09, 3.9)	3.85 (3.43, 4.3)	4.31 (3.8, 4.86)
Trident II/ Accolade II Cementless	7,302	130	1.50 (1.24, 1.8)	1.81 (1.51, 2.15)	1.90 (1.59, 2.25)	—	—
Trilogy/ M/L Taper Cementless	4,722	201	2.01 (1.64, 2.44)	2.86 (2.41, 3.37)	3.49 (2.98, 4.05)	4.13 (3.57, 4.75)	4.85 (4.2, 5.57)
G7/ Echo Bi-Metric Cementless	4,682	124	1.97 (1.6, 2.39)	2.38 (1.97, 2.85)	2.71 (2.26, 3.23)	2.93 (2.44, 3.48)	2.93 (2.44, 3.48)
G7/ M/L Taper Cementless	4,663	109	1.85 (1.49, 2.27)	2.34 (1.92, 2.83)	2.56 (2.1, 3.1)	2.75 (2.23, 3.36)	—
Pinnacle/ S-ROM Cementless	4,544	148	1.43 (1.12, 1.81)	2.50 (2.07, 3)	3.11 (2.62, 3.67)	3.49 (2.95, 4.1)	3.81 (3.21, 4.49)
Continuum/ Trabecular Metal Cementless	3,043	111	2.37 (1.87, 2.95)	3.05 (2.48, 3.71)	3.55 (2.92, 4.26)	3.68 (3.04, 4.41)	3.95 (3.25, 4.76)
R3/ Synergy HA Cementless	2,915	89	1.51 (1.12, 2.01)	2.05 (1.58, 2.62)	2.67 (2.12, 3.33)	3.09 (2.47, 3.81)	3.67 (2.93, 4.52)
FMP/ Linear Cementless	2,602	54	1.15 (0.8, 1.62)	1.63 (1.19, 2.18)	1.76 (1.3, 2.32)	2.14 (1.62, 2.77)	2.24 (1.69, 2.91)
Trident/ Secur-Fit Max Cementless	2,419	87	2.07 (1.56, 2.7)	3.02 (2.39, 3.77)	3.35 (2.68, 4.13)	3.61 (2.9, 4.42)	3.74 (3.02, 4.58)
Trident II-Tritanium/ Actis DuoFix Cementless	2,383	27	0.88 (0.57, 1.33)	1.20 (0.8, 1.74)	1.30 (0.86, 1.89)	1.30 (0.86, 1.89)	—

Table 2.5 Continued on the next page

**The 95% confidence intervals are included in parenthesis.*

Table 2.5 Unadjusted Cumulative Percent Revision of Cementless Hip Arthroplasty Construct Combinations for Primary Total Hip Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024 (continued)

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
G7/ Actis DuoFix Cementless	2,343	27	1.00 (0.65, 1.48)	1.26 (0.81, 1.88)	1.99 (0.86, 3.98)	1.99 (0.86, 3.98)	—
EMPOWR/ Linear Cementless	2,069	41	1.55 (1.09, 2.16)	2.09 (1.52, 2.81)	2.09 (1.52, 2.81)	—	—
Trident/ Accolade TMZF Cementless	1,936	73	1.24 (0.82, 1.81)	1.55 (1.07, 2.18)	2.38 (1.77, 3.13)	3.06 (2.36, 3.9)	3.88 (3.07, 4.84)
G7/ Avenir-Muller Cementless	1,825	42	1.59 (1.09, 2.25)	2.00 (1.43, 2.73)	2.26 (1.64, 3.04)	2.49 (1.81, 3.34)	—
Trident/ Secur-Fit Cementless	1,705	66	2.17 (1.56, 2.95)	2.97 (2.24, 3.87)	3.86 (3, 4.88)	4.09 (3.2, 5.14)	4.09 (3.2, 5.14)
Trabecular Metal/ M/L Taper Cementless	1,616	62	2.41 (1.75, 3.25)	2.79 (2.07, 3.68)	3.05 (2.29, 3.98)	3.81 (2.94, 4.84)	3.97 (3.08, 5.02)
Trident/ Secur-Fit Plus Max Cementless	1,515	33	1.12 (0.68, 1.76)	1.53 (1, 2.25)	1.67 (1.11, 2.41)	2.10 (1.46, 2.93)	2.18 (1.52, 3.03)
Mallory Head/ Taperloc 133 Cementless	1,468	27	1.02 (0.6, 1.65)	1.36 (0.86, 2.06)	1.50 (0.97, 2.22)	1.65 (1.09, 2.41)	1.92 (1.27, 2.8)
EMPOWR/ TaperFill Cementless	1,384	22	1.38 (0.86, 2.1)	1.65 (1.07, 2.46)	1.65 (1.07, 2.46)	—	—
Trilogy/ VerSys Cementless	1,363	57	1.98 (1.34, 2.83)	2.43 (1.71, 3.36)	3.29 (2.43, 4.35)	3.57 (2.66, 4.68)	4.78 (3.62, 6.18)
Trident II-Tritanium/ Corail Cementless	1,357	13	0.66 (0.33, 1.22)	0.98 (0.55, 1.63)	0.98 (0.55, 1.63)	0.98 (0.55, 1.63)	—
Continuum/ Avenir-Muller Cementless	1,354	44	2.36 (1.65, 3.28)	3.04 (2.22, 4.06)	3.19 (2.35, 4.24)	3.19 (2.35, 4.24)	3.32 (2.44, 4.39)
FMP/ TaperFill Cementless	1,350	38	1.78 (1.17, 2.59)	2.38 (1.66, 3.3)	2.61 (1.85, 3.57)	2.90 (2.09, 3.92)	2.90 (2.09, 3.92)
Continuum/ Fitmore Cementless	1,275	56	2.59 (1.82, 3.57)	3.46 (2.56, 4.58)	3.90 (2.93, 5.07)	4.17 (3.16, 5.38)	4.60 (3.52, 5.89)
Continuum/ Taperloc 133 Cementless	1,272	40	1.89 (1.24, 2.75)	2.65 (1.86, 3.66)	3.13 (2.26, 4.23)	3.24 (2.34, 4.36)	3.45 (2.48, 4.66)
Continuum/ VerSys Cementless	1,257	44	1.43 (0.88, 2.21)	2.64 (1.86, 3.65)	3.07 (2.21, 4.14)	3.47 (2.54, 4.62)	3.78 (2.77, 5.02)
Trident II-Tritanium/ Secur-Fit Cementless	1,239	38	2.50 (1.74, 3.49)	3.07 (2.2, 4.16)	3.19 (2.3, 4.32)	3.19 (2.3, 4.32)	—
Trinity/ TriFit TS Cementless	1,217	38	2.22 (1.5, 3.17)	2.57 (1.79, 3.58)	3.00 (2.13, 4.11)	3.37 (2.38, 4.6)	4.18 (2.54, 6.45)
Trident II-Tritanium/ Secur-Fit Max Cementless	1,204	38	2.49 (1.72, 3.49)	3.12 (2.22, 4.25)	3.54 (2.5, 4.85)	3.54 (2.5, 4.85)	—
Trident II/ Insignia Cementless	1,164	13	1.15 (0.65, 1.92)	1.15 (0.65, 1.92)	—	—	—
Continuum/ Accolade II Cementless	1,107	22	1.26 (0.73, 2.07)	1.63 (1, 2.51)	1.63 (1, 2.51)	2.04 (1.32, 3.02)	2.04 (1.32, 3.02)
Escalade Acetabular System/ Ovation Hip Stem Cementless	1,102	21	1.36 (0.8, 2.19)	1.77 (1.1, 2.7)	2.03 (1.29, 3.04)	2.03 (1.29, 3.04)	2.03 (1.29, 3.04)
G7/ Corail Cementless	1,048	24	1.44 (0.84, 2.31)	1.98 (1.25, 2.98)	2.37 (1.54, 3.48)	2.37 (1.54, 3.48)	2.57 (1.68, 3.78)
Restoration ADM/ Accolade II Cementless	960	18	1.15 (0.61, 1.99)	1.36 (0.76, 2.25)	1.59 (0.93, 2.56)	1.90 (1.15, 2.98)	2.22 (1.31, 3.53)
Mpact/ MasterLoc Cementless	958	31	2.51 (1.65, 3.65)	2.98 (2.03, 4.22)	3.45 (2.39, 4.82)	3.45 (2.39, 4.82)	—
Trident/ Citation Cementless	905	33	1.77 (1.05, 2.79)	2.46 (1.59, 3.63)	2.70 (1.78, 3.93)	3.21 (2.18, 4.54)	4.08 (2.84, 5.65)
Novation/ Alteon Cementless	899	68	2.11 (1.32, 3.22)	2.56 (1.67, 3.75)	3.79 (2.68, 5.19)	7.87 (6.13, 9.88)	10.11 (7.25, 13.51)
R3/ Anthology AFIT Cementless	845	10	1.07 (0.53, 1.95)	1.21 (0.62, 2.16)	1.21 (0.62, 2.16)	1.21 (0.62, 2.16)	—
Trident-Tritanium/ Secur-Fit Cementless	820	45	2.07 (1.26, 3.23)	3.78 (2.63, 5.25)	4.63 (3.34, 6.23)	5.37 (3.97, 7.06)	5.57 (4.12, 7.31)
R3/ Echelon Cementless	812	28	1.35 (0.72, 2.35)	2.74 (1.77, 4.04)	3.46 (2.33, 4.92)	3.63 (2.46, 5.13)	3.63 (2.46, 5.13)
G7/ Fitmore Cementless	807	16	1.39 (0.74, 2.4)	1.72 (0.96, 2.86)	2.34 (1.37, 3.73)	2.34 (1.37, 3.73)	—
Trident-Tritanium/ Secur-Fit Max Cementless	807	32	1.49 (0.82, 2.52)	2.48 (1.57, 3.73)	3.10 (2.06, 4.47)	3.49 (2.37, 4.93)	4.10 (2.86, 5.67)
G7/ Trabecular Metal Cementless	802	29	2.74 (1.77, 4.05)	3.60 (2.45, 5.09)	3.76 (2.57, 5.28)	3.76 (2.57, 5.28)	—
Trident/ Insignia Cementless	792	10	1.29 (0.66, 2.29)	1.29 (0.66, 2.29)	—	—	—
Pinnacle/ AML Cementless	791	25	1.26 (0.65, 2.25)	2.15 (1.31, 3.35)	2.56 (1.62, 3.85)	3.19 (2.1, 4.64)	3.40 (2.25, 4.91)
RingLoc+/ Taperloc 133 Cementless	746	35	2.68 (1.69, 4.03)	3.75 (2.56, 5.3)	4.57 (3.23, 6.24)	4.70 (3.34, 6.4)	4.70 (3.34, 6.4)
Trident-Tritanium/ Accolade TMZF Cementless	722	32	1.66 (0.91, 2.81)	2.35 (1.43, 3.66)	3.19 (2.08, 4.66)	4.02 (2.76, 5.64)	4.61 (3.21, 6.36)
Trident II-Tritanium/ Secur-Fit Plus Max Cementless	718	11	1.54 (0.82, 2.66)	1.54 (0.82, 2.66)	1.54 (0.82, 2.66)	1.54 (0.82, 2.66)	—

Table 2.5 Continued on the next page

**The 95% confidence intervals are included in parenthesis.*

Table 2.5 Unadjusted Cumulative Percent Revision of Cementless Hip Arthroplasty Construct Combinations for Primary Total Hip Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024 (continued)

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
Continuum/ M/L Taper Kinectiv Cementless	711	37	3.09 (2, 4.56)	4.39 (3.05, 6.08)	4.85 (3.43, 6.63)	5.02 (3.57, 6.82)	5.48 (3.92, 7.41)
R3/ Corail Cementless	691	6	0.14 (0.01, 0.79)	0.29 (0.06, 1)	0.59 (0.2, 1.44)	0.89 (0.37, 1.86)	0.89 (0.37, 1.86)
Trabecular Metal/ Trabecular Metal Cementless	631	18	2.06 (1.16, 3.41)	2.40 (1.4, 3.83)	2.75 (1.67, 4.28)	2.98 (1.83, 4.58)	2.98 (1.83, 4.58)
Restoration ADM/ Novation Cementless	627	12	0.64 (0.22, 1.55)	1.12 (0.5, 2.2)	1.60 (0.83, 2.84)	1.77 (0.94, 3.06)	1.99 (1.08, 3.36)
Versafitcup DM/ AMIStem-H Cementless	620	18	1.61 (0.83, 2.86)	2.10 (1.18, 3.47)	2.26 (1.3, 3.67)	2.58 (1.54, 4.06)	2.94 (1.81, 4.5)
Dynasty BioFoam/ ProFemur Gladiator Cementless	590	21	1.53 (0.76, 2.78)	2.41 (1.38, 3.91)	3.00 (1.82, 4.66)	3.93 (2.5, 5.85)	3.93 (2.5, 5.85)
Trabecular Metal/ VerSys Cementless	587	32	2.56 (1.5, 4.08)	3.59 (2.29, 5.33)	4.11 (2.71, 5.94)	5.03 (3.45, 7.03)	5.47 (3.8, 7.57)
RingLoc+/ Echo Bi-Metric Cementless	578	25	1.90 (1.01, 3.28)	2.60 (1.52, 4.14)	3.46 (2.18, 5.19)	4.33 (2.88, 6.21)	4.33 (2.88, 6.21)
G7/ Taperloc Complete XR Cementless	573	10	1.05 (0.44, 2.17)	1.69 (0.83, 3.1)	1.69 (0.83, 3.1)	2.24 (1.06, 4.2)	2.24 (1.06, 4.2)
Regenerex RingLoc+/ Taperloc 133 Cementless	549	19	2.19 (1.2, 3.68)	2.73 (1.6, 4.36)	3.28 (2.02, 5.02)	3.50 (2.18, 5.3)	3.50 (2.18, 5.3)
Consensus/ TaperSet Cementless	536	17	1.49 (0.71, 2.82)	2.62 (1.5, 4.25)	2.83 (1.65, 4.51)	3.26 (1.97, 5.05)	3.26 (1.97, 5.05)
Trident/ ABG II Cementless	535	18	2.62 (1.5, 4.24)	2.80 (1.64, 4.47)	3.37 (2.07, 5.15)	3.37 (2.07, 5.15)	3.37 (2.07, 5.15)
G7/ Summit Cementless	530	10	0.94 (0.36, 2.09)	1.72 (0.85, 3.14)	1.99 (1.02, 3.54)	1.99 (1.02, 3.54)	1.99 (1.02, 3.54)
Provident/ Provident Cementless	520	13	1.92 (0.99, 3.4)	2.31 (1.26, 3.89)	2.31 (1.26, 3.89)	2.57 (1.44, 4.25)	2.57 (1.44, 4.25)
Pinnacle/ CORAIL Cementless	520	8	1.16 (0.49, 2.41)	1.75 (0.81, 3.33)	1.75 (0.81, 3.33)	—	—
Continuum/ Taperloc 133 Microplasty Cementless	509	13	1.97 (1.01, 3.47)	2.17 (1.15, 3.73)	2.17 (1.15, 3.73)	2.58 (1.37, 4.43)	3.56 (1.67, 6.58)
PROCOTYL PRIME/ ProFemur Gladiator Cementless	501	5	1.00 (0.38, 2.22)	1.00 (0.38, 2.22)	1.00 (0.38, 2.22)	—	—
Trident II-Tritanium/ PolarStem Cementless	491	6	1.02 (0.39, 2.25)	1.23 (0.51, 2.54)	1.23 (0.51, 2.54)	—	—
Restoration ADM/ Secur-Fit Plus Max Cementless	489	28	3.68 (2.26, 5.63)	5.32 (3.57, 7.56)	5.73 (3.9, 8.04)	5.73 (3.9, 8.04)	—
G7/ Taperloc Cementless	469	9	1.93 (0.96, 3.51)	1.93 (0.96, 3.51)	1.93 (0.96, 3.51)	1.93 (0.96, 3.51)	1.93 (0.96, 3.51)
Ranawat-Burstein/ Taperloc 133 Cementless	457	12	1.53 (0.69, 3.01)	1.97 (0.97, 3.58)	2.19 (1.12, 3.86)	2.81 (1.52, 4.74)	2.81 (1.52, 4.74)
Trident II-Tritanium/ Restoration Modular Cementless	428	21	4.21 (2.59, 6.43)	5.10 (3.17, 7.69)	5.88 (3.56, 8.99)	5.88 (3.56, 8.99)	—
R3/ Actis DuoFix Cementless	424	0	0.00 (., .)	0.00 (., .)	0.00 (., .)	—	—
Dynasty BioFoam/ ProFemur Z Cementless	413	44	5.57 (3.64, 8.07)	7.99 (5.63, 10.87)	9.44 (6.87, 12.51)	10.67 (7.92, 13.88)	10.67 (7.92, 13.88)
Overall	**439,603**	**10,344**	**1.50 (1.47, 1.54)**	**2.00 (1.96, 2.05)**	**2.37 (2.32, 2.42)**	**2.69 (2.64, 2.74)**	**2.97 (2.9, 3.03)**

**The 95% confidence intervals are included in parenthesis.*
***The Novation Cup was used with two different polyethylene liners, one of which, the Connexion GXL liner, was withdrawn from the market in 2021. The revision rate may not reflect the inherent performance of the femoral component. Ongoing analysis is being performed to better understand the revision rate associated with this implant.*

Revision Hip Arthroplasty

AJRR has collected data on 173,171 revision hip arthroplasty procedures from 2012 to 2024

The data submitted to the AJRR show variability in coding the primary reason for revision surgery. Reasons were determined from diagnosis codes submitted for each case, with up to 10 codes accepted per revision. Depending on the year of the procedure, these were reported as either ICD-9 or ICD-10 codes.

To improve accuracy, the AJRR continues to refine its classification of revision procedures. For patients aged 65 years and older, CMS-provided diagnosis codes are incorporated to supplement registry data and better define reasons for revision. Revision diagnoses were categorized as follows: infection/inflammatory reaction, mechanical complications, instability, aseptic loosening, pain, fracture, wear/osteolysis, and hematoma/wound complications. All submitted code fields were queried for matches within these categories; cases without a match were assigned to an "other" group. Each cause for revision was queried independently, allowing cases to be classified into more than one category when multiple diagnoses were reported. A total of 5,732 cases were excluded due to erroneous or irrelevant diagnoses (e.g., osteoarthritis, cardiac conditions, or unrelated medical comorbidities). All cases undergo regular review to minimize misclassification. We report a summary of all revision procedures reported to either AJRR or CMS (Figure 2.33). Infection remains the most common reason for THA revision (20.8% of cases).

INSIGHTS

Infection remains the most common reason for THA revision (20.8% of cases) and early THA revision (29.5%).

Early Revision THA

Revision surgeries are also reported stratified based on their occurrence from the time of the index primary procedure. An early revision is defined as occurring less than 3 months (90 days) after the primary procedure. This is calculated by subtracting date of revision procedure from the primary procedure date.

There were 17,888 early "linked" early revision THA procedures in AJRR or CMS (Figure 2.34). A "linked" revision is one in which the patient had the primary surgery in a facility that submitted data to AJRR and a revision that was also submitted to the AJRR or CMS. Not all patients will return to the same facility for their revision procedure. In patients 65 years of age and older, the AJRR database is linked to the CMS database and will capture all revisions whether or not they occur at an AJRR participating hospital. In patients less than 65 years old, limitations in data capture remain if the patient returns to a non-AJRR participating hospital for revision THA after a primary THA at an AJRR participating facility. Infection is the most frequent cause for early THA revision (29.5%) (Figure 2.34).

Figure 2.33 Distribution of Diagnosis Associated with All Hip Revisions, 2012-2024 (N=167,439)

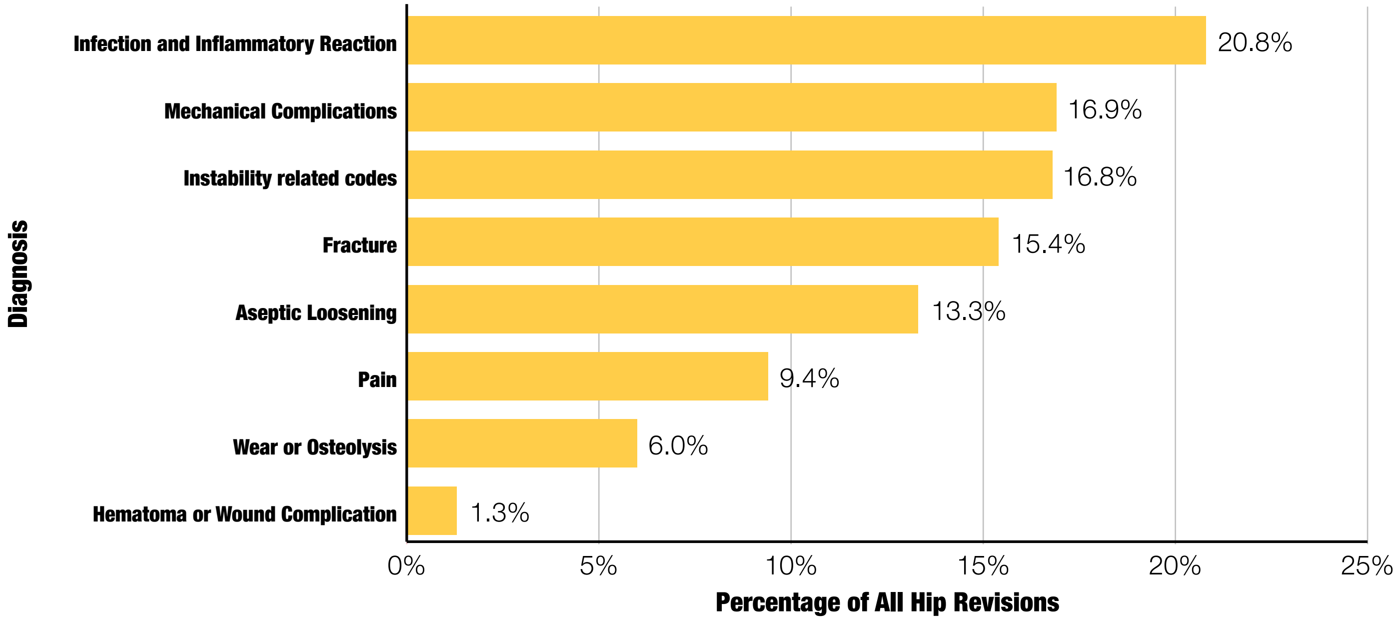
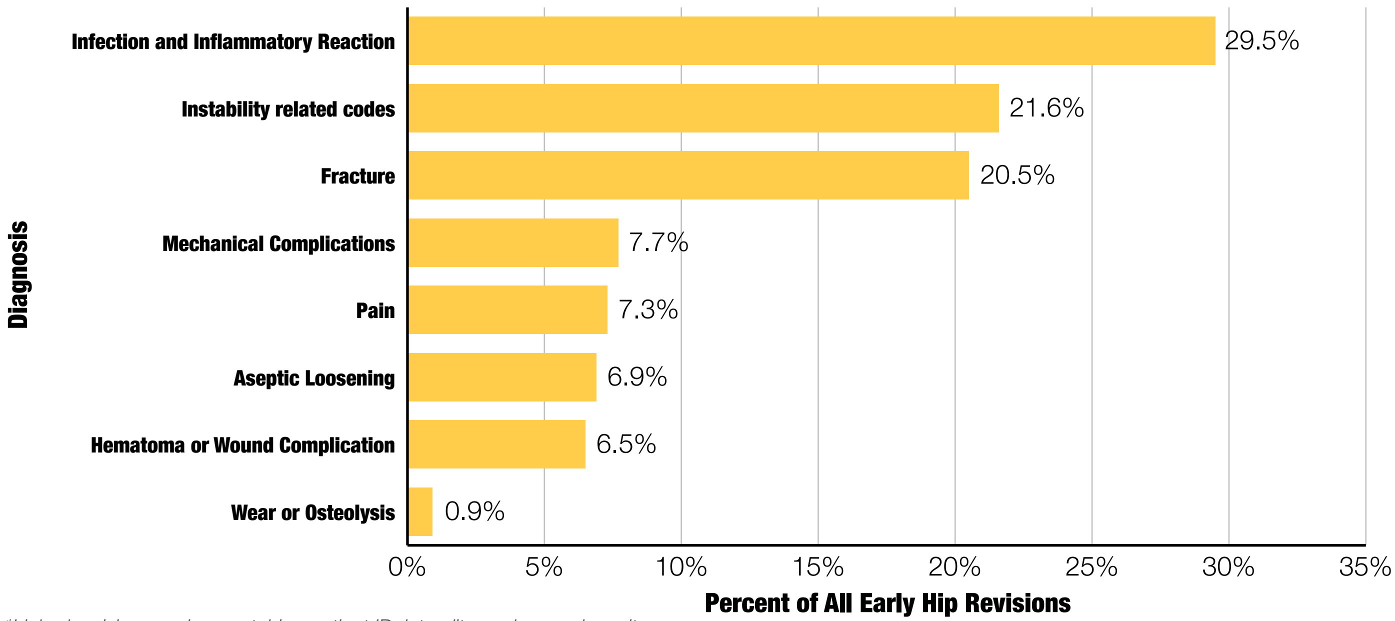


Table 2.6 Distribution of Time Interval Between Elective Primary Hip Arthroplasty Procedures and Revision for Linked Patients, 2012-2024*

Time	Frequency	Percent	Cumulative Frequency	Cumulative Percent
< 3 Months	17,888	43.7%	17,888	43.7%
3 to <6 Months	3,603	8.8%	21,491	52.5%
6-12 Months	4,149	10.14%	25,640	62.64%
>1 Year	15,293	37.36%	40,933	100%

**Linked revision requires matching patient ID, laterality, and procedure site*

Figure 2.34 Distribution of Diagnosis Associated With all Early "Linked" Hip Revisions, 2012-2024 (N=17,900)*



**Linked revision requires matching patient ID, laterality, and procedure site*

The AJRR has reported rates of early THA revision since 2012. Between 2012 and 2024, the overall rates of early revision have remained stable across age groups ranging from 0.9–1.4% (Figure 2.35). The causes of early THA revision have shown some variability over time. THA revisions due to infection have ranged from 11.8–26.3% between 2012 and 2024 (Figure 2.36). Revisions for instability/dislocation have gradually increased over time with a reported rate of 21.3% in 2024 (Figure 2.37).

DM use in revision THA has steadily increased from 2012 to 2024 (Figure 2.38). Smaller head sizes (32mm or less) are used less frequently than head sizes (36mm or greater) in revision THA. Utilization of head sizes <36mm in revision THA have declined steadily between 2012 and 2024. Thirty-six millimeter and ≥40mm head sizes are the most frequently used head sizes in revision THA. Constrained implants maintained consistently low and stable usage throughout this period (4.6-9.3%). DM articulations are used in the majority of cases performed for revision THA due to instability (65.6% in 2024, Figure 2.39). Some DM constructs may erroneously be classified as smaller diameter heads if data reporting is insufficient to distinguish the articulation as DM. This limitation may contribute to the apparent increase in the use of head diameters of 28mm or less seen in revision THA in this report between 2012 and 2024 (Figure 2.38).

INSIGHTS

The prevalence of early hip revisions remains stable with very little variability based on patient age ranging from 0.9%-1.4% (Figure 2.35).

Figure 2.35 Early "Linked" Revisions as a Percent of Elective Primary Hip Arthroplasty Procedures by Age Group, 2012-2024 (N=17,900)

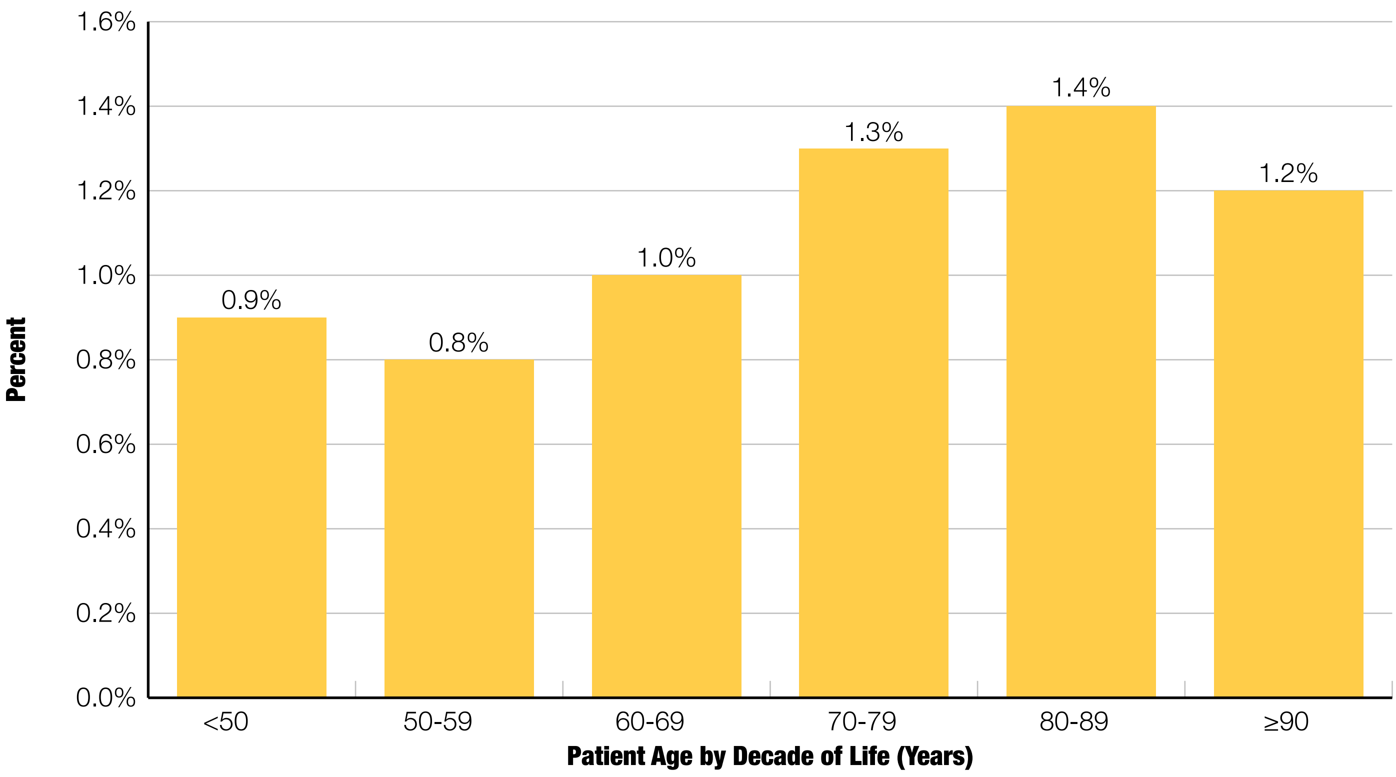


Figure 2.36 **Revisions Due to Infection as a Percentage of All Hip Revisions, 2012-2024 (N=36,944)**

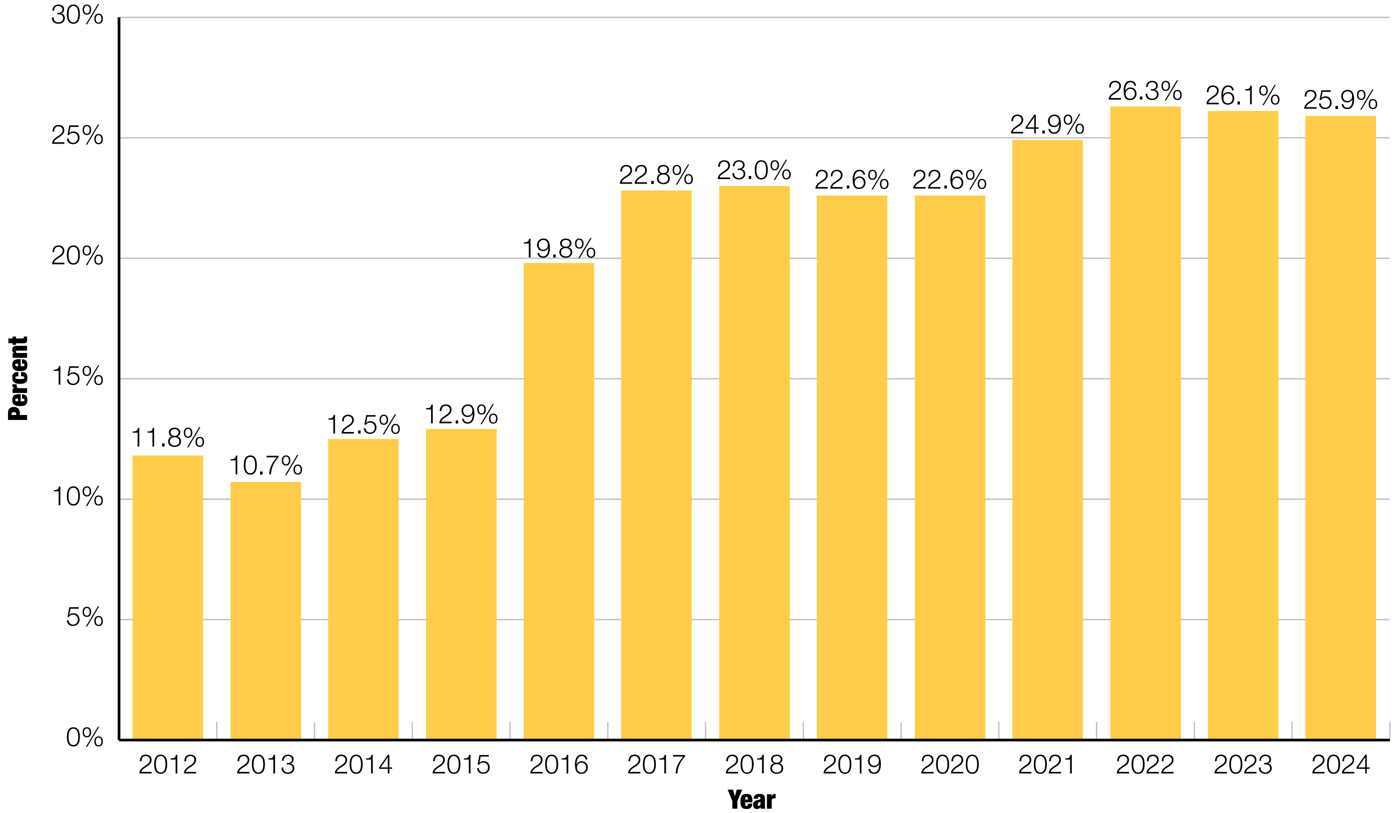


Figure 2.37 **Revisions Due to Instability as a Percentage of All Hip Revisions, 2012-2024 (N=29,794)**

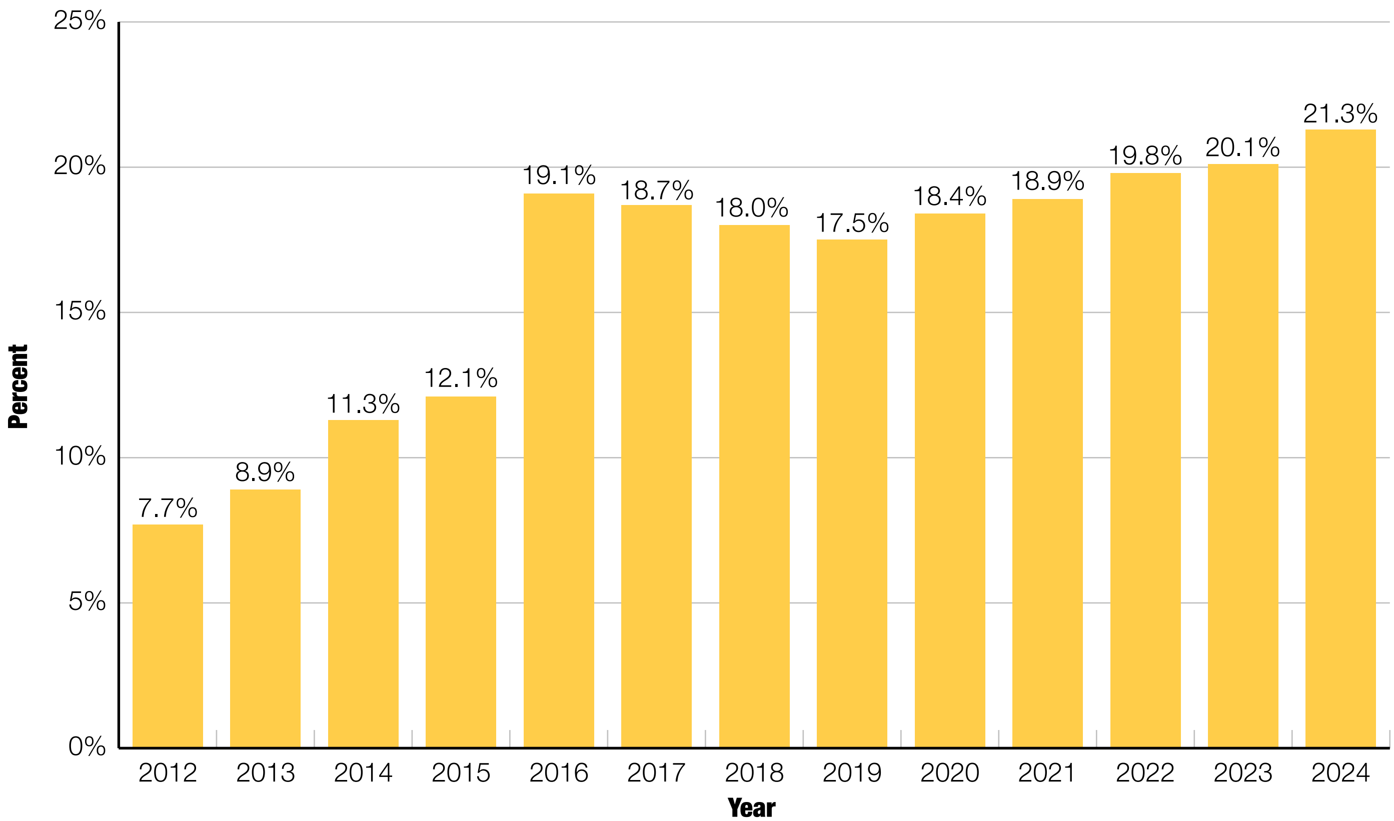


Figure 2.38 Percent Dual Mobility Usage and Femoral Neck Head Sizes Implanted for Hip Revisions, 2012-2024 (N=112,733)

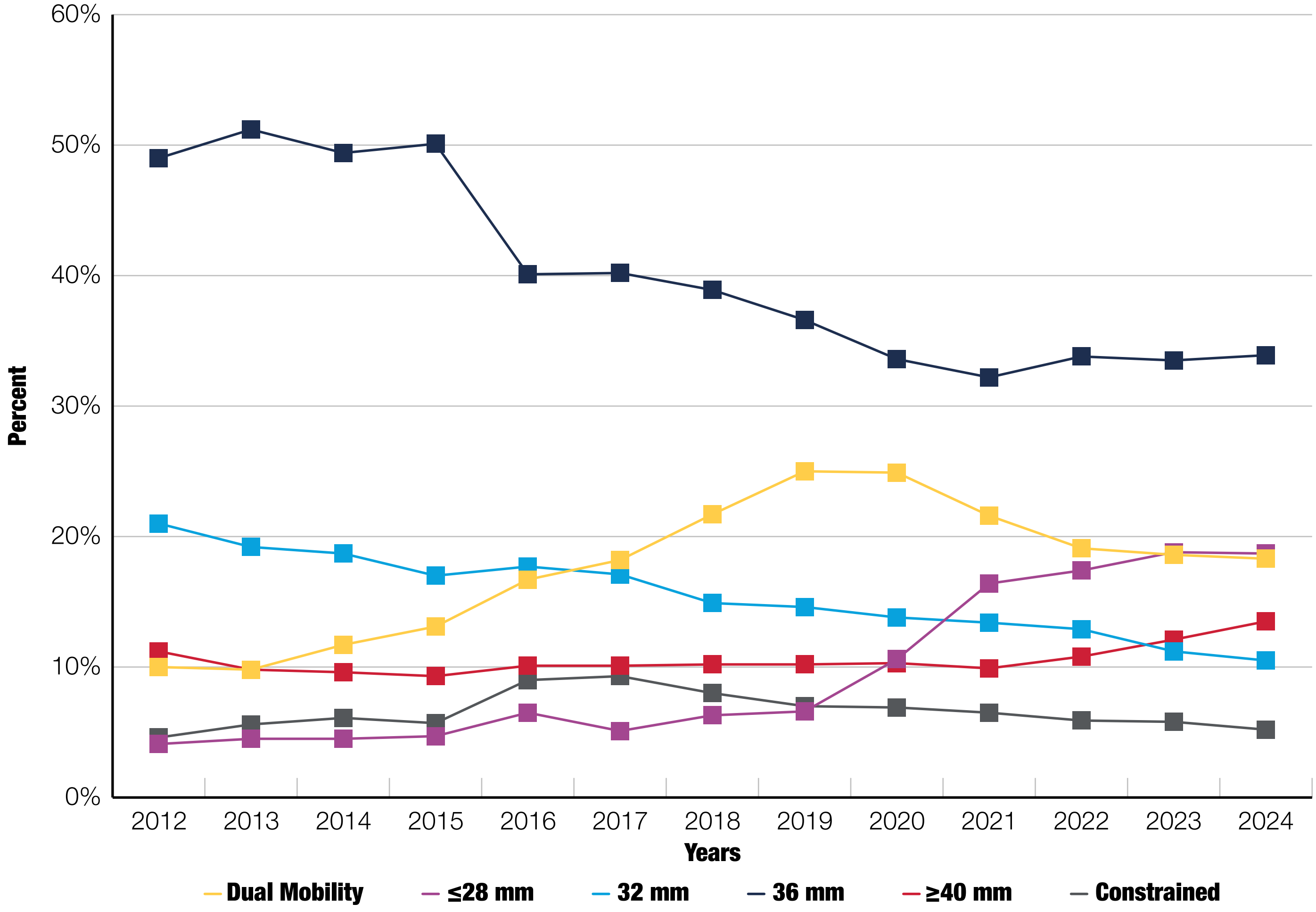
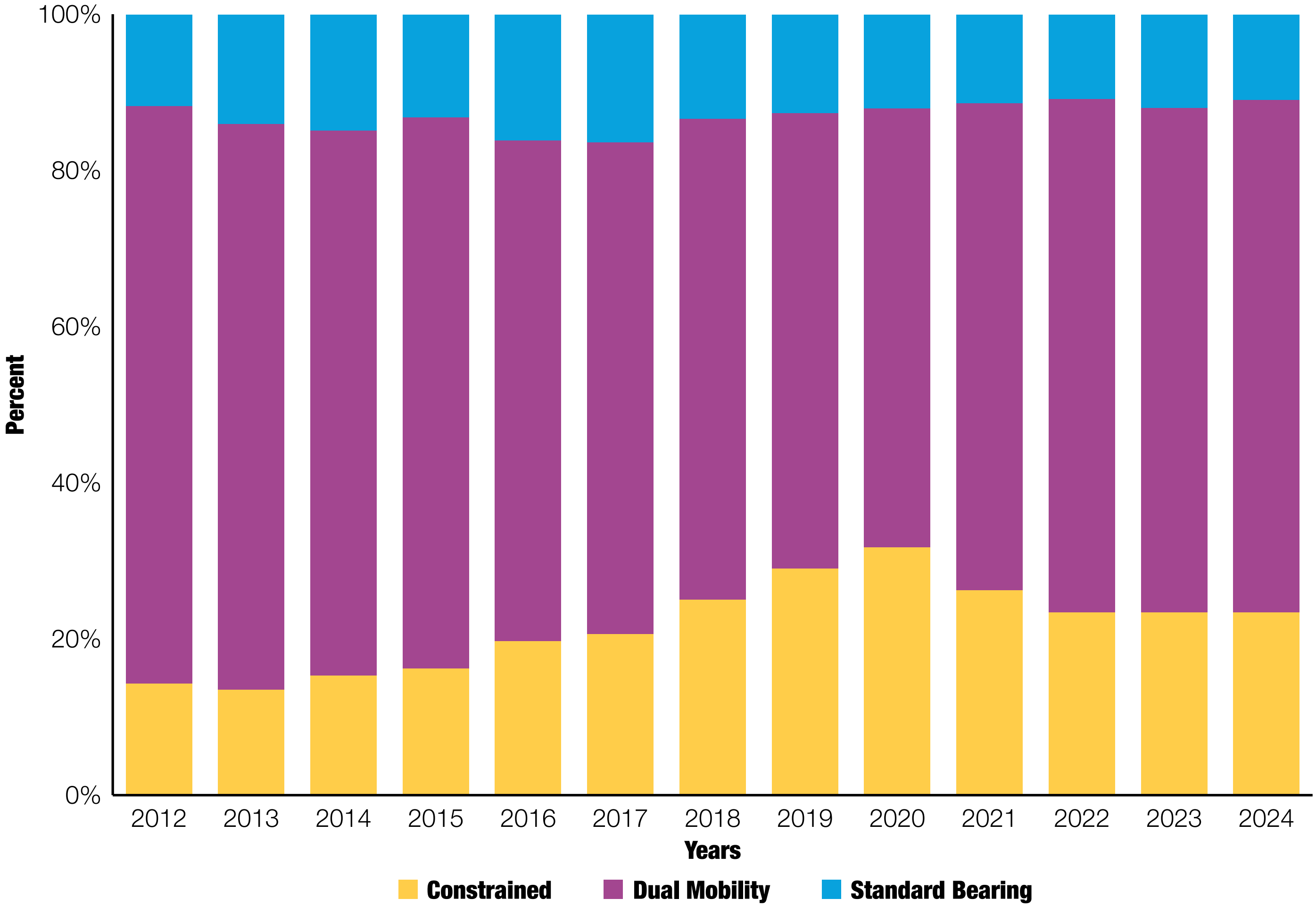


Figure 2.39 Bearing Options Utilized for Hip Revisions Secondary to Dislocation/Instability (N=34,980)

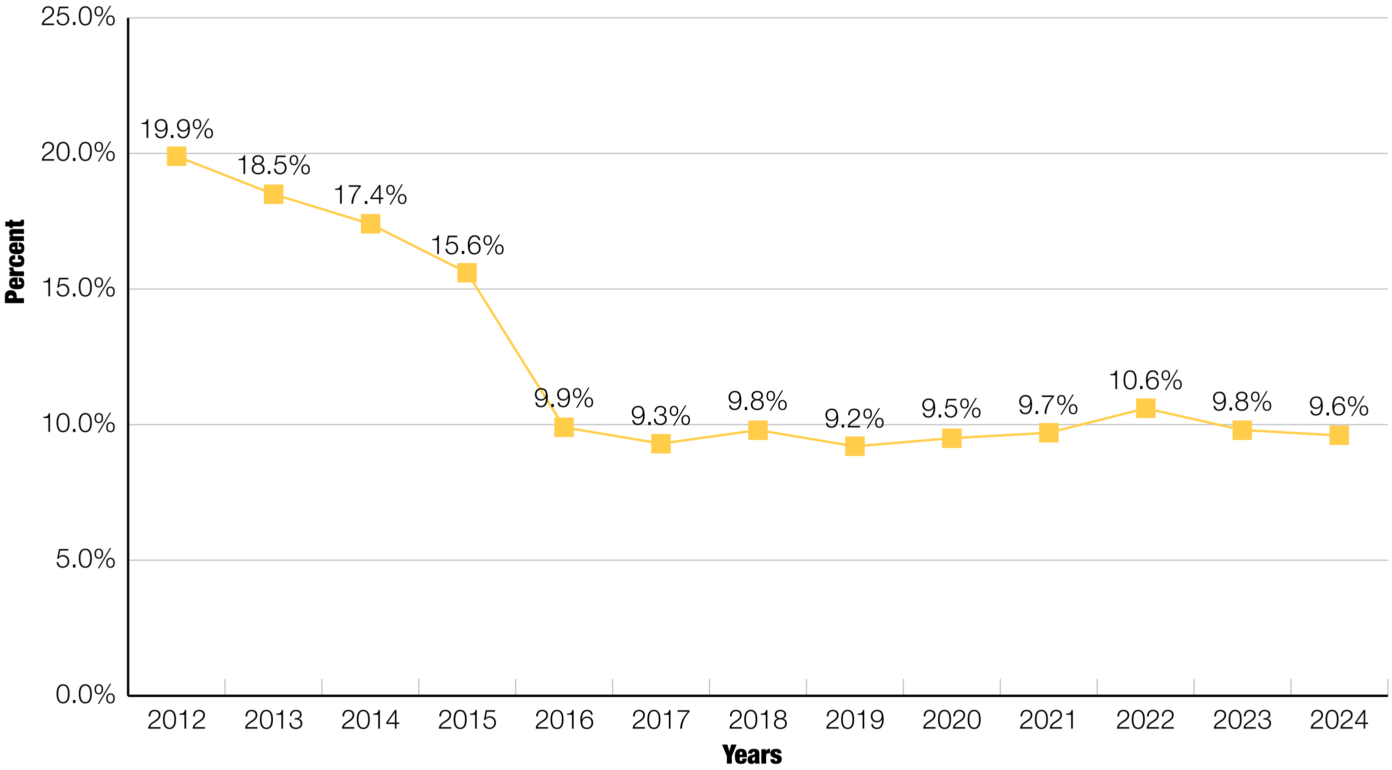


	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Constrained	14.3%	13.5%	15.3%	16.2%	19.7%	20.6%	25.0%	29.0%	31.7%	26.2%	23.4%	23.4%	23.4%
Dual Mobility	73.9%	72.4%	69.8%	70.6%	64.1%	63.0%	61.6%	58.3%	56.2%	62.4%	65.7%	64.6%	65.6%
Standard Bearing	11.8%	14.1%	14.9%	13.2%	16.2%	16.3%	13.4%	12.7%	12.1%	11.4%	10.9%	12.1%	11.0%

Revision Burden

Revision burden is defined as the ratio of implant revisions to the total number of arthroplasties in a specific period (calculated as the number of revision THAs divided by the total number of primary and revision THA procedures by year). The revision burden in the AJRR consistently decreased for several years and has plateaued since 2016 (9-10%, Figure 2.40). The improvement in the burden of revision in total hip arthroplasty seen several years ago may be secondary to reduced osteolysis and wear associated with the routine use of HXPE in THA. It is also possible that Registry participants who submitted data early in the history of the AJRR were more likely to perform revision procedures compared with surgeons who began submitting data later in time.

Figure 2.40 Revision Burden of Elective Primary Total Hip Arthroplasty Procedures, 2012-2024 (N=172,817)



Revision THA Components

Implant utilization rates in revision THA vary over time. We report on implant utilization in revision THA in the U.S. reported to the AJRR from 2012 through 2024 (Figure 2.41-2.42). The data presented in this report are based on procedures voluntarily submitted by participating hospitals and surgeons to the AJRR. This report reflects utilization trends and patterns within this specific dataset.

We report on the eight most frequently used femoral stem components in revision THA from 2012–2024 (Figure 2.41). Over this 13-year period, the Restoration Modular stem has consistently been the most commonly implanted for revision THA. We also report on the eight most frequently used cup components in revision THA during the same time interval. Over this 13-year period, the most frequently implanted cup was Pinnacle from 2012-2015, Trident from 2016-2017, and the G7 from 2018-2024. These data do not account for the date of introduction for any implant system (Figure 2.42).

Figure 2.41 **Revision Hip Arthroplasty Stem Components by Year, 2012-2024 (N=65,896)**

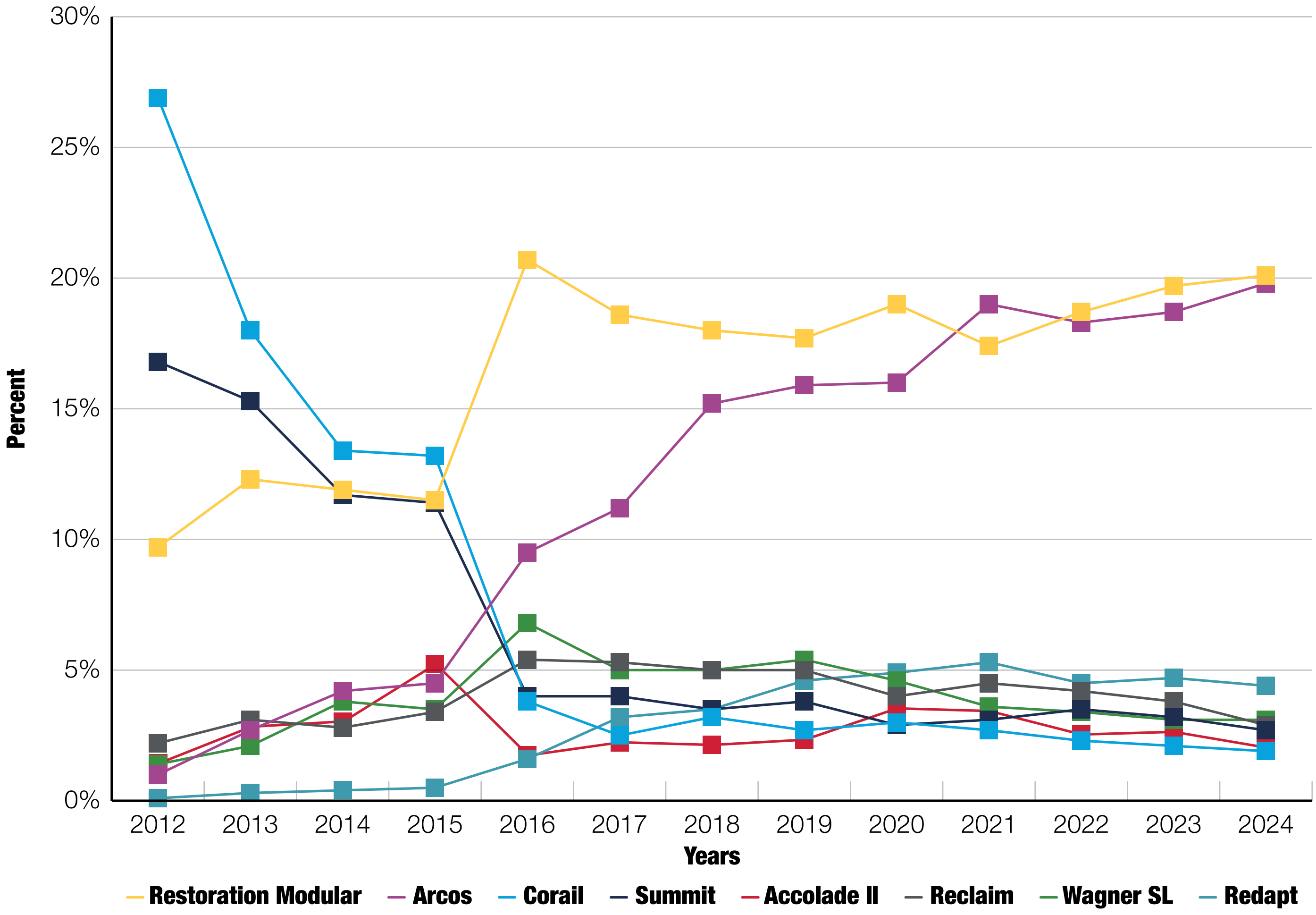
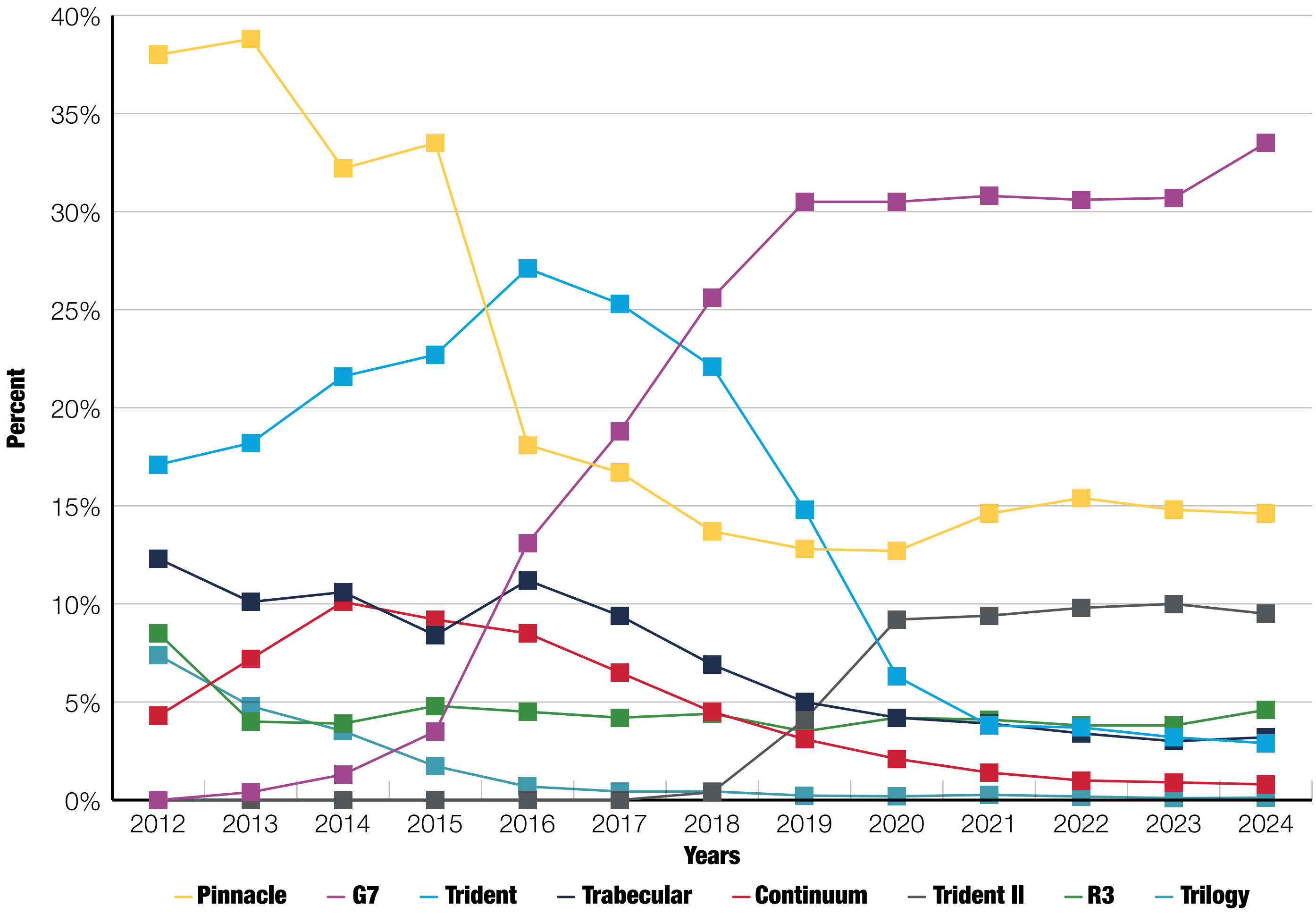


Figure 2.42 Revision Hip Arthroplasty Cup Components by Year, 2012-2023 (N=56,351)



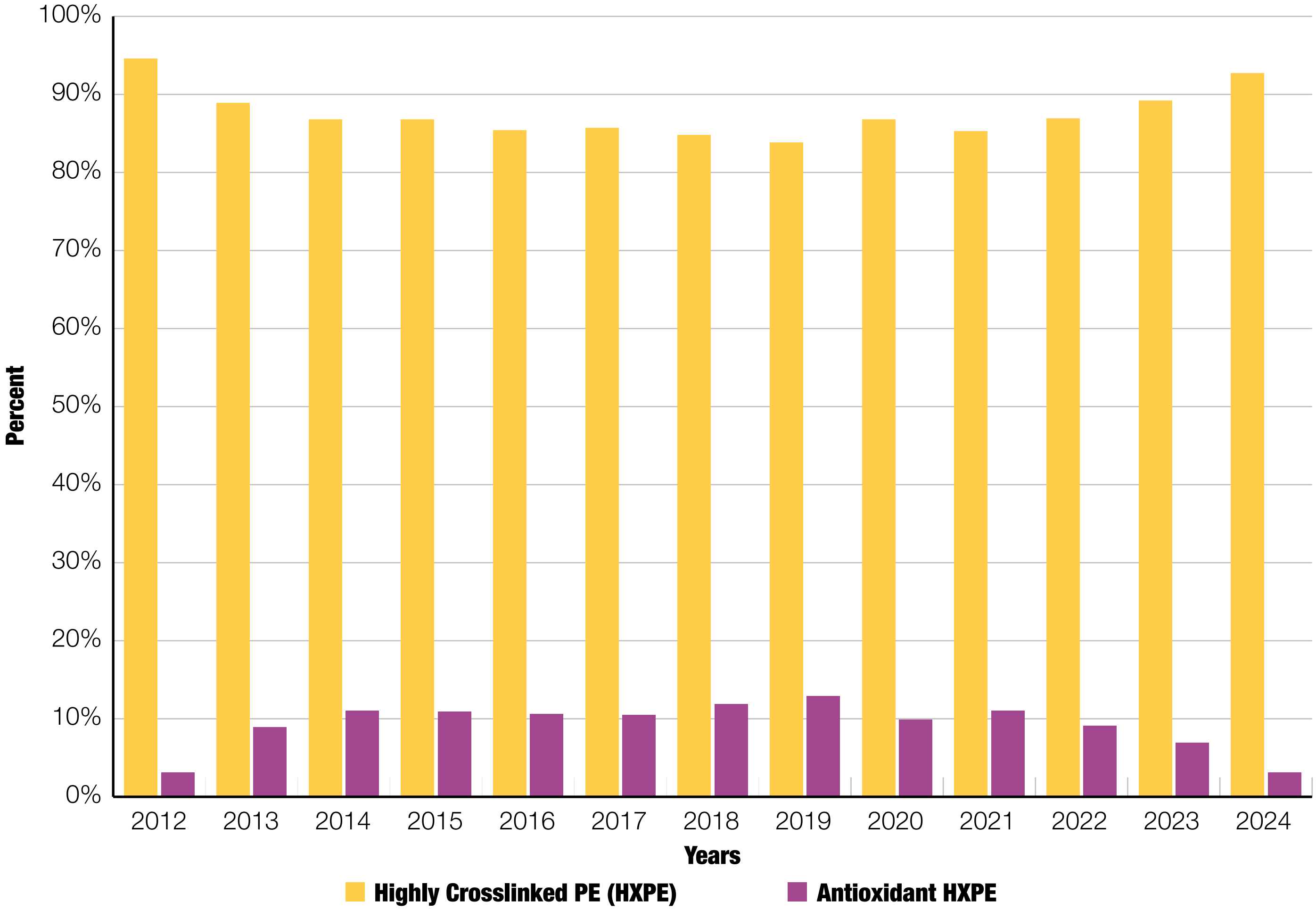
Bearing Surfaces in Revision THA

Nearly all polyethylene used in revision THA reported to the AJRR in 2024 is either HXPE (92.7%) or antioxidant HXPE (3.1%, Fig 2.43). A similar pattern is noted in primary THA (Figure 2.24). CPE is rarely used in revision THA with utilization rates of less than 5%. Dr. William H. Harris and the research group at MGH obtained FDA approval to use HXPE for clinical use in 1999. Over the last 26 years, HXPE has become the nearly universal bearing surface of choice for primary and revision THA. This observation underscores the profound, positive impact Dr. Harris and his research team have had on the field of adult reconstructive surgery and on countless patients worldwide requiring THA and revision THA procedures (Figure 2.43).

INSIGHTS

HXPE has become the nearly universal bearing surface of choice for primary and revision THA worldwide and serves to underscore the profound impact Dr. Harris and his research team have had on the field of adult reconstructive surgery

Figure 2.43 Revision Hip Arthroplasty Liner Polyethylene Material by Year, 2012-2024 (N=84,948)

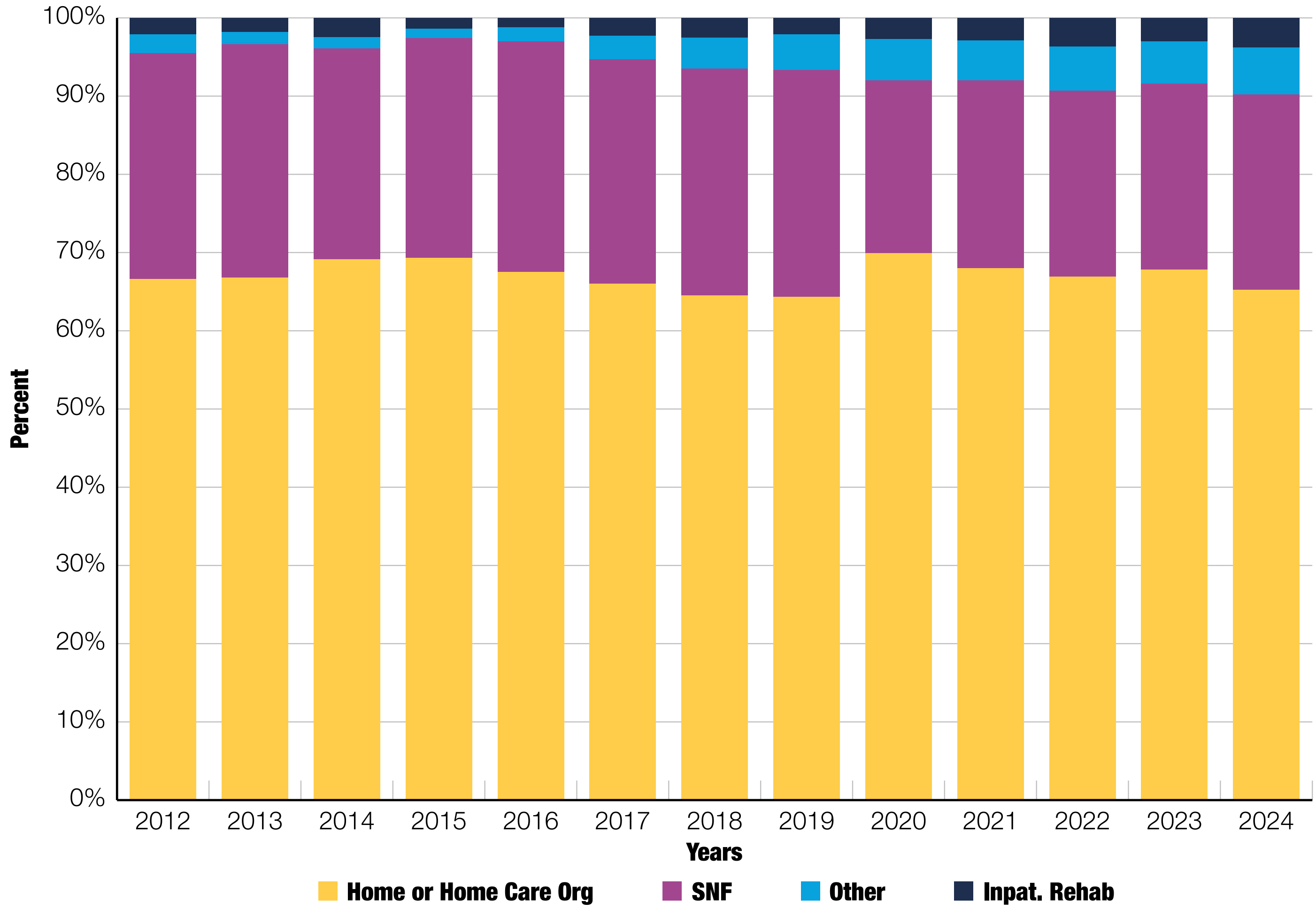


	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Highly Crosslinked PE (HXPE)	94.6%	88.9%	86.8%	86.8%	85.4%	85.7%	84.8%	83.8%	86.8%	85.3%	86.9%	89.2%	92.7%
Antioxidant HXPE	3.1%	8.9%	11.0%	10.9%	10.6%	10.5%	11.9%	12.9%	9.9%	11.0%	9.1%	6.9%	3.1%

Discharge Disposition after Revision THA

We began reporting discharge disposition after revision THA in 2017. The majority of patients are discharged home after revision THA (65.2%) or to SNFs (25.0%) with the remaining minority of patient discharged to inpatient rehabilitation facilities or other locations (Figure 2.44). This pattern of discharge disposition after revision THA has remained stable from 2012-2024 (Figure 2.44).

Figure 2.44 Revision Hip Arthroplasty Discharge Disposition Codes by Year, 2012-2024 (N=119,888)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Home or Home Care Org	66.6%	66.8%	69.1%	69.3%	67.5%	66.0%	64.5%	64.3%	69.9%	68.0%	66.9%	67.8%	65.2%
SNF	28.9%	29.8%	27.0%	28.1%	29.5%	28.7%	29.0%	29.0%	22.1%	24.0%	23.8%	23.8%	25.0%
Other	2.4%	1.6%	1.4%	1.2%	1.8%	3.0%	4.0%	4.6%	5.3%	5.1%	5.6%	5.4%	6.0%
Inpat. Rehab	2.1%	1.9%	2.5%	1.4%	1.2%	2.4%	2.6%	2.1%	2.7%	3.0%	3.7%	3.0%	3.8%

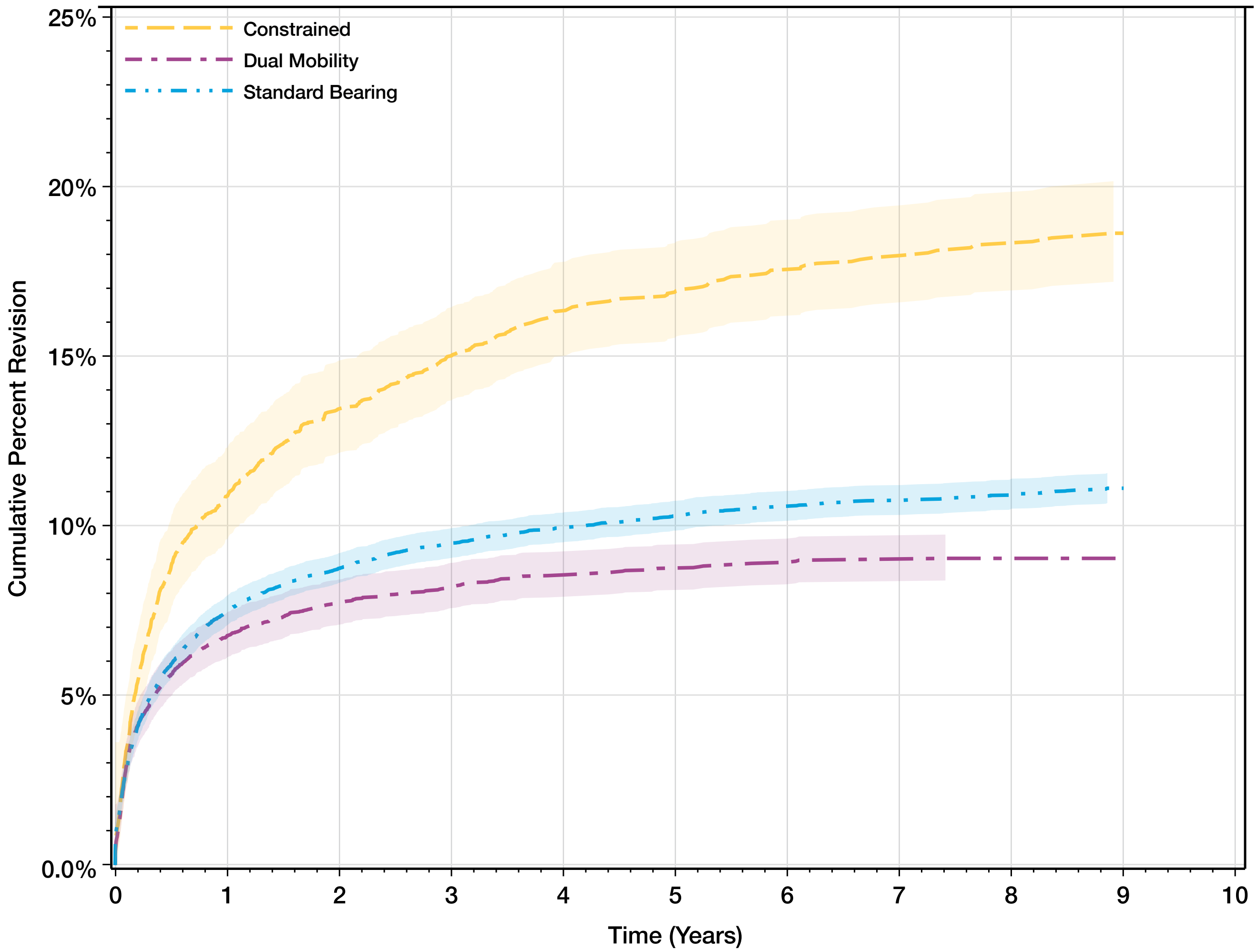
Code	Code Value
Home	Discharged to home/self-care (routine charge).
Home Care Org.	Discharged/transferred to home care of organized home health service organization.
Inpat. Care	Discharged/transferred to other short-term general hospital for inpatient care.
SNF	Discharged/transferred to skilled nursing facility (SNF) with Medicare certification in anticipation of covered skilled care--(For hospitals with an approved swing bed arrangement, use Code 61 - swing bed. For reporting discharges/transfers to a non-certified SNF, the hospital must use Code 04 - ICF.)
Inpat. Rehab	Discharged/transferred to an inpatient rehabilitation facility including distinct units of a hospital (eff. 1/2002).

Revision following previous revision THA (re-revision THA) was investigated for the first time the AJRR 2023 Annual Report (Figure 2.45). The 2023 Annual Report reviewed how DM articulations compared to constrained and standard bearings for the first re-revision analysis. DM demonstrated a significantly lower CPR in re-revision THA cases compared with conventional bearings and constrained liners in patients ≥65 years old after adjusting for age, sex, and CCI. This contrasts with higher CPR noted for DM compared conventional bearings in primary THA cases. These findings represent an association and do not imply any causal relationships.

INSIGHTS

After adjusting for age, sex, and CCI, DM demonstrated a significantly lower CPR in re-revision procedures compared to standard and constrained lined cases in Medicare patients aged 65 and older.

Figure 2.45 Cumulative Percent Re-Revision after Revision Total Hip Arthroplasty by Liner Type in Medicare Patients 65 Years of Age and Older, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9
Constrained	At Risk	5,582	4,275	3,519	2,890	2,384	1,996	1,582	1,191	823	529
	KM % revision	0.13 (0.06, 0.26)	11.38 (10.56, 12.27)	14.08 (13.15, 15.06)	15.71 (14.71, 16.76)	17.10 (16.04, 18.21)	17.70 (16.61, 18.84)	18.37 (17.25, 19.56)	18.77 (17.61, 19.99)	19.15 (17.96, 20.42)	19.52 (18.26, 20.85)
Dual Mobility	At Risk	11,121	8,898	7,350	6,120	4,999	3,947	2,824	1,909	1,253	774
	KM % revision	0.05 (0.02, 0.12)	7.09 (6.61, 7.59)	8.09 (7.58, 8.63)	8.60 (8.07, 9.17)	8.96 (8.41, 9.54)	9.16 (8.6, 9.76)	9.35 (8.78, 9.96)	9.42 (8.84, 10.03)	9.47 (8.88, 10.1)	9.47 (8.88, 10.1)
Standard Bearing	At Risk	29,365	25,044	22,544	20,369	18,485	16,585	14,233	11,803	9,576	7,637
	KM % revision	0.14 (0.1, 0.19)	7.85 (7.55, 8.17)	9.16 (8.83, 9.51)	9.93 (9.59, 10.29)	10.42 (10.06, 10.79)	10.78 (10.42, 11.16)	11.08 (10.71, 11.47)	11.26 (10.88, 11.65)	11.45 (11.07, 11.85)	11.64 (11.25, 12.04)

*Age, Sex, CCI, CCI, CCI * log(CCI) adjusted HR (95% CI), p-value*
Constrained vs Dual Mobility at 0-6 Months: 1.543(1.369,1.738), p=<.0001
Constrained vs Dual Mobility at 6 Months-9 Years: 2.802(2.401,3.270), p=<.0001
Standard Bearing vs Dual Mobility over 9 Years: 1.213(1.125,1.308)p=<.0001

Patient-Reported Outcome Measures - Total Hip Arthroplasty

PROMs have received increased attention within AJRR and the wider practice of orthopaedic surgery. Value-based payment models made capture of PROMs a prerequisite for various public and private alternative payment models in the U.S. The importance of PROM reporting after THA has also been noted internationally with several other national registries reporting PROMs after THA and the ISAR Steering Committee establishing a working group on PROMs in 2014.[15]

CMS has recently introduced requirements for PROM reporting after primary TKA for IQR. These requirements will be expanded to primary THA in the near future. Compliance with CMS IQR reporting requirements are now linked to hospital reimbursement. The AJRR collects PROMs at three recommended intervals: baseline (preoperatively), 90 days post-discharge, and one year postoperatively. PROMs reporting helps to capture the patients' perspectives on their overall health and function, enables longitudinal assessment of individual patient care, and supports broader evaluation of national outcomes and trends. The AJRR partners with participating institutions support PROM reporting to assist with CMS IQR reporting requirements. The Registry continues to expand options to support PROM submissions to meet shifting CMS IQR thresholds. Sites may collect PROMs electronically via email, computer, or tablet, or submit data obtained through third-party vendors or local systems.

This year, our PROMs section has expanded to include data on percent of cases meeting the CMS IQR thresholds for KOOS, JR. for SCB for primary TKA (a 20-point increase from the preoperative KOOS, JR. score). Similar data analysis will be completed in future AJRR reports for primary THA as CMS provides additional guidance for the IQR program.

Improvement in PROMs can be calculated in two primary ways. The MCID may be derived using a distribution-based method defined as half the standard deviation between preoperative and one-year postoperative scores[24]. Alternatively, anchor-based methods reported in the literature are used to define thresholds for MCID, PASS[24], and SCB[25].

In alignment with the new CMS IQR program for hip and knee arthroplasty, we also reviewed rates of completeness for several required variables submitted to AJRR. More than 50 hospitals requested that AJRR submit IQR data on their behalf. However, not all institutions submitting PROMs to the AJRR provided all required IQR elements and these results should not be interpreted as nationwide rates of compliance with CMS IQR requirements.

AJRR collaborated with CMS to identify what is required for at least 50% of inpatient procedures. The below Table 2.10 illustrates the data elements that are required by the CMS IQR and the time points for collection:

Table 2.7 **Data Elements Required by CMS IQR**

Data Element Type	Preoperative Data Elements	Postoperative Data Elements
Patient-Reported Outcome Measures (PROMs)	THA patients: HOOS, JR TKA patients: KOOS, JR	THA patients: HOOS, JR TKA patients: KOOS, JR
Patient- or Provider-Reported Risk Variables	Mental Health Subscale items from either PROMIS-Global or VR-12	N/A
	Health Literacy (SILS2)	
	BMI or Height/Weight	
	Use of Chronic Narcotics	
	Total Painful Joint Count: Patient-Reported Pain in Non-Operative Lower Extremity Joint	
	Quantified Spinal Pain: Patient-Reported Back Pain, Oswestry Index Question	
Matching Variables	Medicare Provider Number	Medicare Provider Number
	MBI	MBI
	Date of Birth	Date of Birth
	Date of Procedure	Date of Procedure
	Procedure Type	Procedure Type
	Date of Admission	Date of Admission
PROM-related Variables	Date of PRO Data Collection	Date of PRO Data Collection
	Mode of Collection	Mode of Collection
	Person Completing the Survey	Person Completing the Survey
	Generic PROM Version	N/A

BMI: Body Mass Index; HOOS, JR: Hip dysfunction and Osteoarthritis Outcome Score for Joint Replacement; KOOS, JR: Knee injury and Osteoarthritis Outcome Score for Joint Replacement; PROMIS-Global: Patient-Reported Outcomes Measurement Information System; SILS2: Single Item Literacy Screener; VR-12: Veterans Rand-12; MBI: Medicare Beneficiary Identifier; PROM: Patient-reported Outcome Measure

*More information can be found here.

PROMs Insights:

- As of December 31, 2023, 751 sites submitted PROMs data which is a 19% increase from the 2023 report
- The completion rate for “linked” outcomes (those where both a preoperative and one-year postoperative PROM is available on the same procedure) varies between 24-30%, consistent with previous reports
- MCID Distribution-Based Performance:
    - 93% of reported cases met MCID for HOOS, JR.
    - 70.6% of reported cases met PROMIS-10 Physical Health component MCID
    - 81.1% of reported cases met VR-12 Physical Health Component MCID
- MCID Anchor-Based Performance compared with Distribution-Based Performance
    - Anchor-Based MCID for HOOS, JR. is more than double that of the Distribution-Based MCID
    - 84% of reported cases met the Anchor-Based MCID compared with 93% for the Distribution-Based MCID
- PASS Anchor-Base:
    - 62.7% of the reported cases met the PASS threshold for postoperative HOOS, JR.
- SCB Performance:
    - 78.6% of reported cases met the Anchor-Based threshold for HOOS, JR.
- Age Stratification HOOS, JR.:
    - There are minimal differences between response rates of cases across different age groups
    - There are substantial differences between age groups and across PROMs of cases meeting MCID. The highest rates meeting MCID requirements are seen in the lower age group (55-64).
- IQR Requirements in 2024:
    - The lowest rate of completion is seen for answering the CMS IQR required preoperative and postoperative Chronic Narcotics Question (3.8%)
    - The highest rate of completion was seen for cases filling out a preoperative PROMIS-10 (71.1%)

Table 2.8 Preoperative and 1-Year Postoperative PROM Mean Scores After Primary Hip Arthroplasty by PROM, 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Pre or 1-year Postoperative	N	Mean	Standard Deviation
HOOS, JR. (Hip Disability and Osteoarthritis Outcome Score)	Score	Preoperative	199,368	48.2	15.8
		Postoperative	72,788	85.5	16
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	Preoperative	128,629	47.6	10.4
		Postoperative	48,136	51.9	9.6
	Physical T	Preoperative	128,633	38.5	8.9
		Postoperative	48,130	48.8	10.4
VR-12 (The Veterans RAND 12 Item Health Survey)	Mental Health Component	Preoperative	28,816	50.7	12.5
		Postoperative	13,372	55.4	9.6
	Physical Health Component	Preoperative	28,704	30.4	9.2
		Postoperative	13,384	45.6	10.6

Table 2.29 Overall Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Hip Arthroplasty using Distribution-Based MCID by PROM, 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*	Distribution-based MCID
HOOS, JR. (Hip Disability and Osteoarthritis Outcome Score)	Score	198,146	47,967	24.20%	93.30%	7.9
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	128,629	29,395	22.90%	32.60%	5.1
	Physical T	128,633	29,397	22.90%	70.60%	4.7
VR-12 (The Veterans RAND 12 Item Health Survey)	Mental Health Component	28,790	8,506	29.50%	37.60%	5.8
	Physical Health Component	28,704	8,515	29.70%	81.10%	4.8

** Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined to be a positive change score of half the pooled standard deviation.*
***Cases statistically incapable of achieving MCID due to a high preoperative score were excluded.*

Table 2.10 Overall Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Hip Arthroplasty using Anchor-Based MCID for KOOS JR., 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*	Anchor-based MCID Threshold
HOOS, JR. (Hip Disability and Osteoarthritis Outcome Score)	Score	197,096	47,687	24.20%	83.90%	18

**Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined using an anchor-based approach, as described by Lyman SL et al, 2018.*
***Cases statistically incapable of achieving MCID due to a high preoperative score were excluded.*

Table 2.11 Overall 1-Year Postoperative PROM Scores after Primary Hip Arthroplasty using Anchor-Based PASS for HOOS JR., 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Acceptable Improvement*	Anchor-based PASS Threshold
HOOS, JR. (Hip Disability and Osteoarthritis Outcome Score)	Score	n/a	72,788	n/a	62.70%	81

**The patient-acceptable symptom state (PASS) represents a satisfactory clinical state from the patient's perspective. PASS was determined using postoperative scores and an anchor-based approach, based on patients' responses to the question, 'Do you consider that your current state is satisfactory?' as described by Dekhne MS et al, 2024.[24]*

Table 2.12 Overall Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Hip Arthroplasty using Anchor-Based SCB for HOOS JR., 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Substantial Improvement*	Anchor-based SCB Threshold
HOOS, JR. (Hip Disability and Osteoarthritis Outcome Score)	Score	195,592	47,282	24.20%	78.60%	22

**Substantial improvement was calculated by substantial clinical benefit (SCB). SCB was determined using an anchor-based method, as described by Lyman SL et al, 2018.[25]*
***Cases statistically incapable of achieving SCB due to a high preoperative score were excluded.*

Table 2.13 Age-stratified Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Hip Arthroplasty by PROM for Patients 55 Years and Over, 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Age Group (Years)	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*
HOOS, JR. (Hip Disability and Osteoarthritis Outcome Score)	Score	55-64	53,505	12,689	23.70%	93.90%
		65-74	75,274	20,012	26.60%	93.70%
		75-84	37,864	8,993	23.80%	91.90%
		>85	5,573	1,086	19.50%	93.00%
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	55-64	33,774	7,323	21.70%	35.30%
		65-74	49,432	12,624	25.50%	32.30%
		75-84	24,978	5,846	23.40%	29.30%
		>85	3,692	719	19.50%	25.00%
	Physical T	55-64	33,776	7,325	21.70%	72.40%
		65-74	49,436	12,628	25.50%	71.00%
		75-84	24,977	5,844	23.40%	66.50%
		>85	3,693	719	19.50%	61.90%
VR-12	Mental Health Component	55-64	8,380	2,492	29.70%	37.00%
		65-74	10,560	3,310	31.30%	36.20%
		75-84	4,925	1,407	28.60%	41.80%
		>85	786	160	20.40%	43.80%
	Physical Health Component	55-64	8,351	2,494	29.90%	83.80%
		65-74	10,528	3,313	31.50%	81.50%
		75-84	4,913	1,411	28.70%	75.50%
		>85	783	160	20.40%	73.80%

**Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined to be a positive change score of half the pooled standard deviation.*

Table 2.14a Hip PROMs Completeness, 2012-2024

Completion Rates (N =24,418 - Patients with a linked Pre-operative and Post- Operative Hoos JR), aged 65 or older	
Also Completed a PROMIS-10 PROM at the Preoperative Time Point	68.90%
Also Completed a VR-12 PROM at the Preoperative Time Point	14.00%
Answered CJR's Health Literacy question at the Preoperative Time Point	26.60%
Answered CJR's Pain in Lower Extremity Question at the Preoperative Time Point	26.80%
Answered CJR's Back Pain Question at the Preoperative Time Point	30.10%
Answered the Chronic Narcotics Question at the Preoperative Time Point	0.30%
Had a mode of collection reported for HOOS JR at the Preoperative Time Point	38.30%
Had a mode of collection reported for HOOS JR at the Post-operative Time Point	41.40%
Had Person Completing the survey reported at the Preoperative Time Point	38.30%
Had Person Completing the survey reported at the Post-operative Time Point	41.40%

Table 2.14b Hip PROMs Completeness, 2024

Completion Rates (N = 339 - Patients with a linked Pre-operative and Post- Operative Hoos JR) aged 65 or older	
Also Completed a PROMIS-10 PROM at the Preoperative Time Point	71.10%
Also Completed a VR-12 PROM at the Preoperative Time Point	12.10%
Answered CJR's Health Literacy question at the Preoperative Time Point	24.20%
Answered CJR's Pain in Lower Extremity Question at the Preoperative Time Point	25.40%
Answered CJR's Back Pain Question at the Preoperative Time Point	26.30%
Answered the Chronic Narcotics Question at the Preoperative Time Point	3.80%
Had a mode of collection reported for HOOS JR at the Preoperative Time Point	24.50%
Had a mode of collection reported for HOOS JR at the Post-operative Time Point	31.90%
Had Person Completing the survey reported at the Preoperative Time Point	24.50%
Had Person Completing the survey reported at the Post-operative Time Point	31.90%

Knee Arthroplasty

Knee Overview

AJRR has collected data on 2,606,710 knee arthroplasty procedures from 2012 to 2024

TKA continues to account for the majority cases within AJRR and accounts for the most surgeon volume with 3,895 surgeons performing a total of 288,185 procedures in 2024 (Table 3.1). The mean number of TKA procedures per surgeon in 2024 was 74, increasing from 65.4 in 2023 (Table 3.1). The median number of TKA procedures in 2024 was 39 compared to 32 in 2023. Revision TKA was performed by 2,844 surgeons with a mean of 10.7 procedures per surgeon per year and a median of 4 procedures per year in 2024 similar to the observed rates in 2023. Partial knee arthroplasty was performed by 1,486 surgeons with an average of 7.7 procedures per surgeon per year and a median of 3 procedures per year in 2024 similar to rates in 2023.

The mean age for partial knee arthroplasty patients was 64.6 years (SD = 10.8), revision TKA (RevTKA) was 67 years (SD = 10.4), and TKA was 67.8 years (SD = 9.3). These reported mean ages are similar to previous AJRR reports with patients undergoing TKA and revTKA procedures at older mean ages than patients undergoing partial knee replacements (Table 3.2 and Figure 3.1).

The LOS for knee arthroplasty procedures has continued to significantly decrease over time (Figure 3.2). The mean LOS for partial knee arthroplasty in 2024 was 0.4 days compared with 2.2 days in 2012. The LOS for revision TKA has stayed relatively stable ranging from 3.6 days in 2012 to 3.4 days in 2024. LOS for primary TKA was 2.9 days in 2012 and 1.0 day in 2024. These improvements likely reflect advances in anesthetic and surgical techniques as well as recovery protocols, including enhanced recovery after surgery (ERAS) as well as more procedures being performed in outpatient surgery centers over time.

Table 3.1 Average Procedural Volume For Participating Surgeons, 2024

Procedure	Total Surgeons	Total Procedures	Per Surgeon Mean	Per Surgeon Median	25th Percentile	75th Percentile
Partial Knee Arthroplasty	1486	11434	7.69	3	1	7
Revision Knee Arthroplasty	2844	30376	10.68	4	2	11.5
Total Knee Arthroplasty	3895	288185	73.99	39	13	94

Table 3.2 Mean Age of Patients Undergoing Knee Arthroplasty Procedures, 2012-2024 (N=2,606,710)

Procedure	Total	Mean Age (Years)	Standard Deviation
Partial Knee Arthroplasty	108,569	64.6	10.8
Revision Knee Arthroplasty	229,826	67	10.4
Total Knee Arthroplasty	2,268,315	67.8	9.3

Figure 3.1 Age Distribution of Knee Arthroplasty Procedures, 2012-2024 (N=2,651,212)

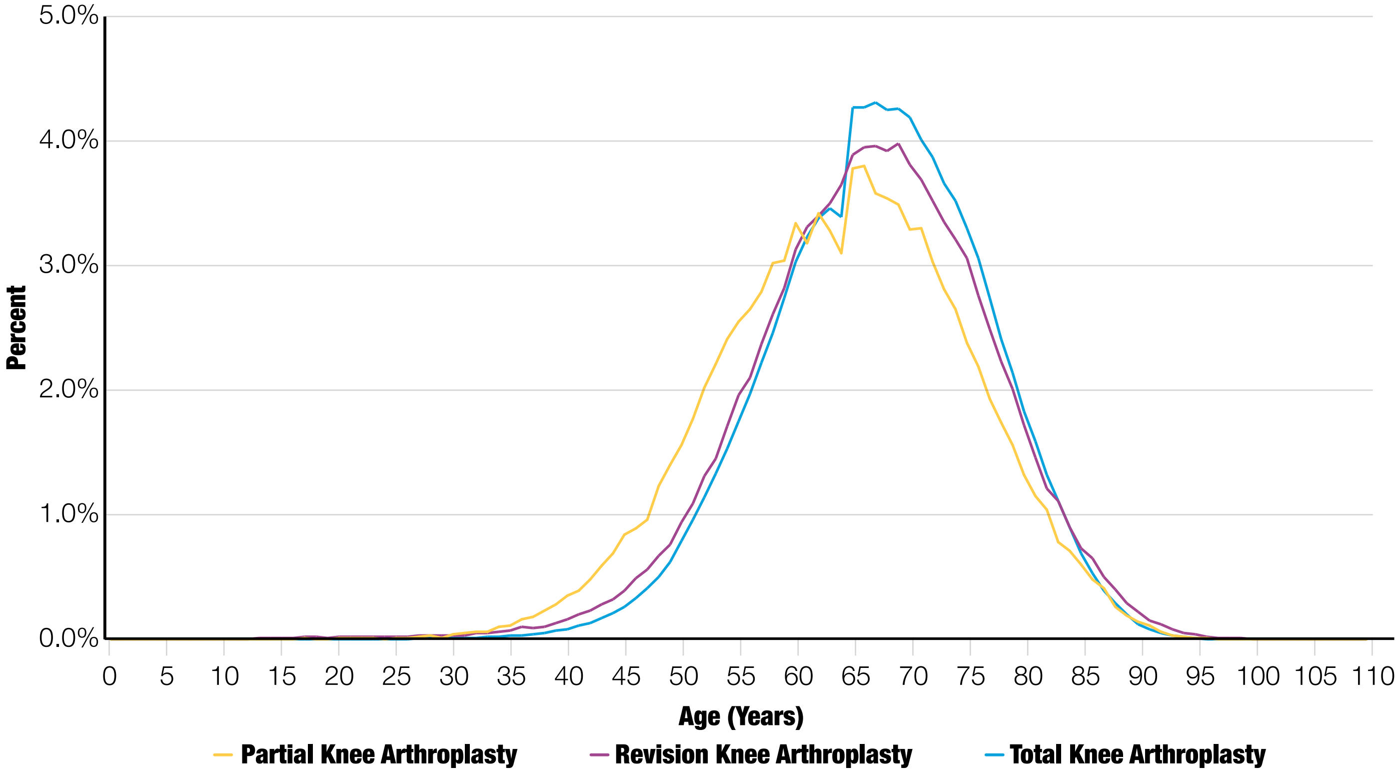
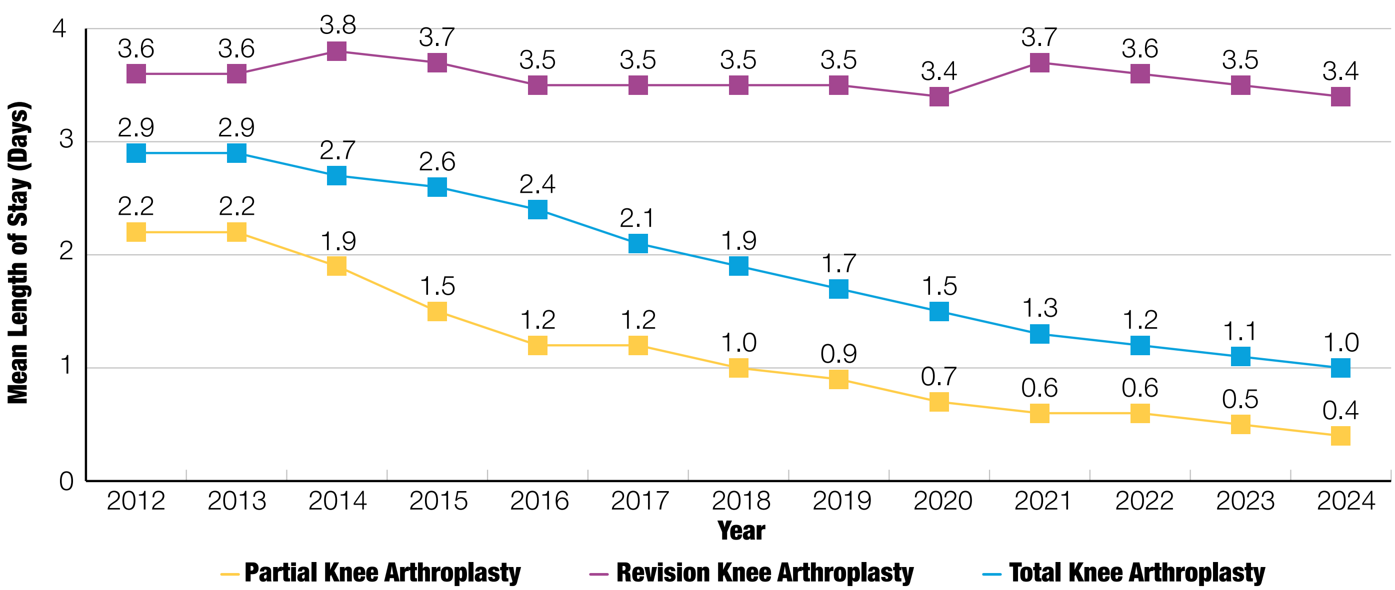


Figure 3.2 Mean Length of Stay for Knee Arthroplasty Procedures, 2012-2024 (N=1,483,055)



Primary Total Knee Arthroplasty

AJRR has collected data on 2,268,315 primary TKA procedures, 2012 to 2024

Primary TKA is performed more frequently in female patients across all age groups (Figure 3.3) The distribution of primary TKA implant designs used from 2012 to 2024 are reported (Figure 3.4). Traditional posterior stabilized designs continue to decrease in frequency representing 34.1% of primary TKAs in 2024. Utilization of medially congruent designs continues to increase in frequency and currently represents the most frequently used bearing surface in primary TKA (42.9% utilization rate).

INSIGHTS

Utilization of medially congruent designs continues to increase in frequency and currently represents the most frequently used bearing surface in primary TKA (42.9% utilization rate) (Figure 3.4)

Figures 3.5a and 3.5b review CPR rates for primary TKA stratified by implant design are reported for patients 65 years of age and older with primary osteoarthritis (Figures 3.5a-b). Ultracongruent and cruciate retaining designs have lower CPR compared to other TKA designs after adjusting for age, sex, and CCI in patients ≥65 years of age. Posterior stabilized TKA designs demonstrated higher CPR than all other designs at most time points. This analysis does not account for numerous potential confounders and the reasons for revision may be unrelated to the implant type (See Appendix F methodology used to generate all revision and survival curves).

Figure 3.3 Sex Distribution of All Total Knee Arthroplasty Procedures by Age Group, 2012-2024 (N=2,2258,956)

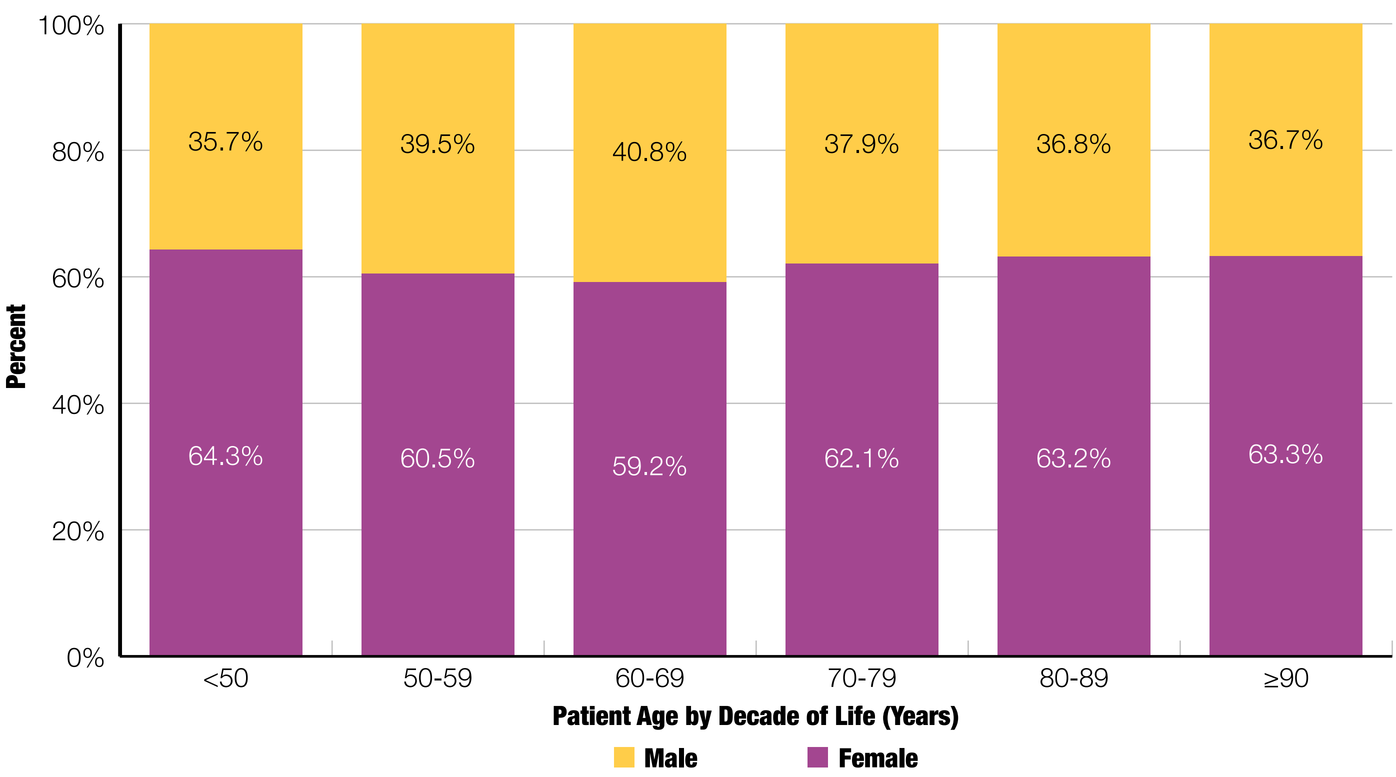
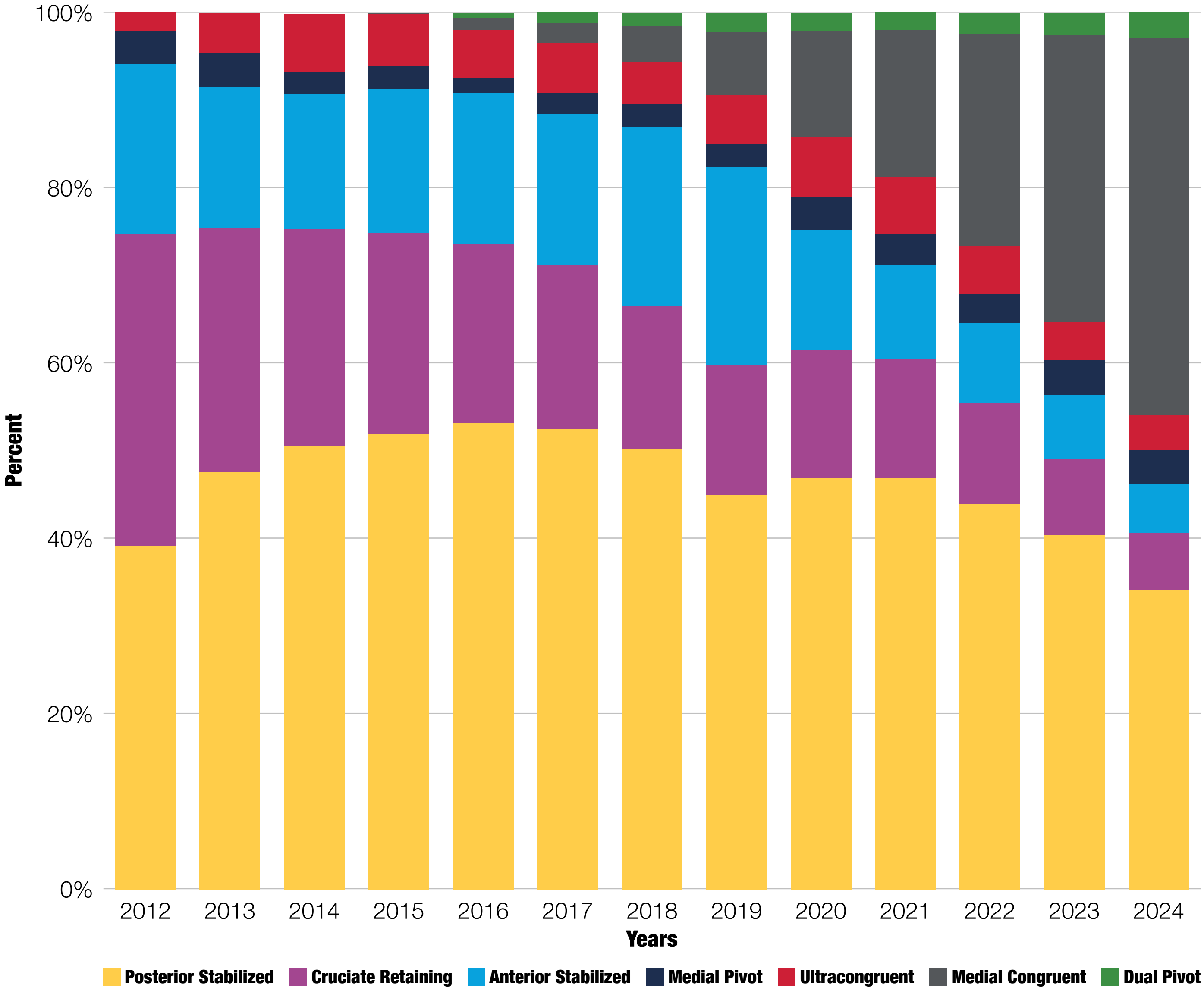
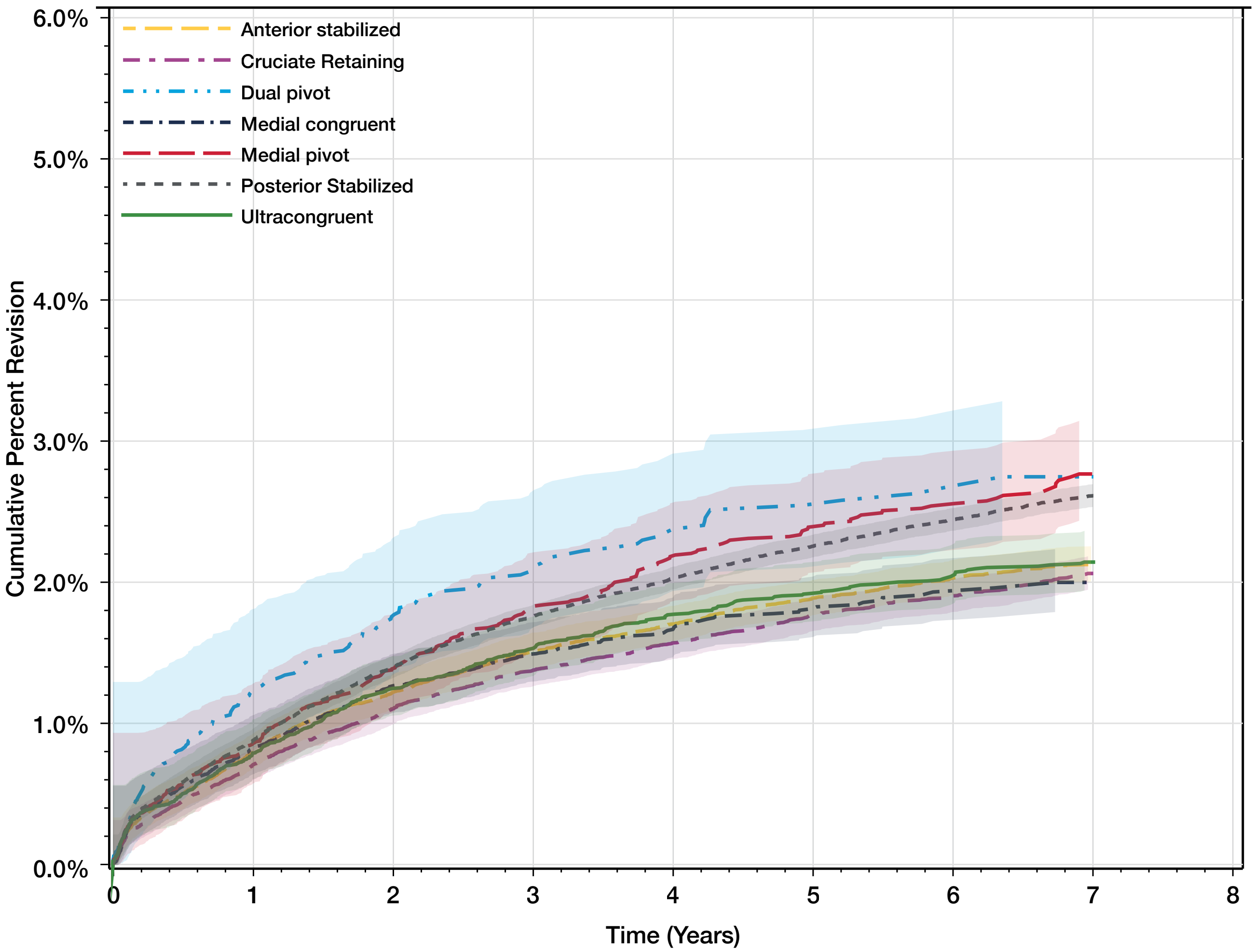


Figure 3.4 **Distribution of Primary Total Knee Arthroplasty Implant Designs, 2012-2024 (N=1,097,180)**



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Posterior Stabilized	39.2%	47.6%	50.6%	51.9%	53.2%	52.5%	50.3%	45.0%	46.9%	46.9%	44.0%	40.4%	34.1%
Cruciate Retaining	35.6%	27.8%	24.7%	23.0%	20.5%	18.8%	16.3%	14.9%	14.6%	13.7%	11.5%	8.8%	6.6%
Anterior Stabilized	19.4%	16.1%	15.4%	16.4%	17.2%	17.2%	20.4%	22.5%	13.8%	10.7%	9.1%	7.2%	5.6%
Medial Pivot	3.8%	3.9%	2.6%	2.6%	1.7%	2.4%	2.6%	2.7%	3.7%	3.5%	3.3%	4.0%	3.9%
Ultracongruent	2.1%	4.6%	6.6%	6.0%	5.5%	5.7%	4.8%	5.6%	6.8%	6.5%	5.5%	4.4%	4.0%
Medial Congruent	0.0%	0.0%	0.0%	0.1%	1.3%	2.3%	4.1%	7.1%	12.2%	16.8%	24.2%	32.7%	42.9%
Dual Pivot	0.0%	0.0%	0.0%	0.0%	0.6%	1.2%	1.5%	2.2%	2.0%	2.0%	2.4%	2.5%	3.0%

Figure 3.5a Cumulative Percent Revision for Primary Total Knee Arthroplasty Implant Designs in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis With Confidence Intervals, 2012-2024

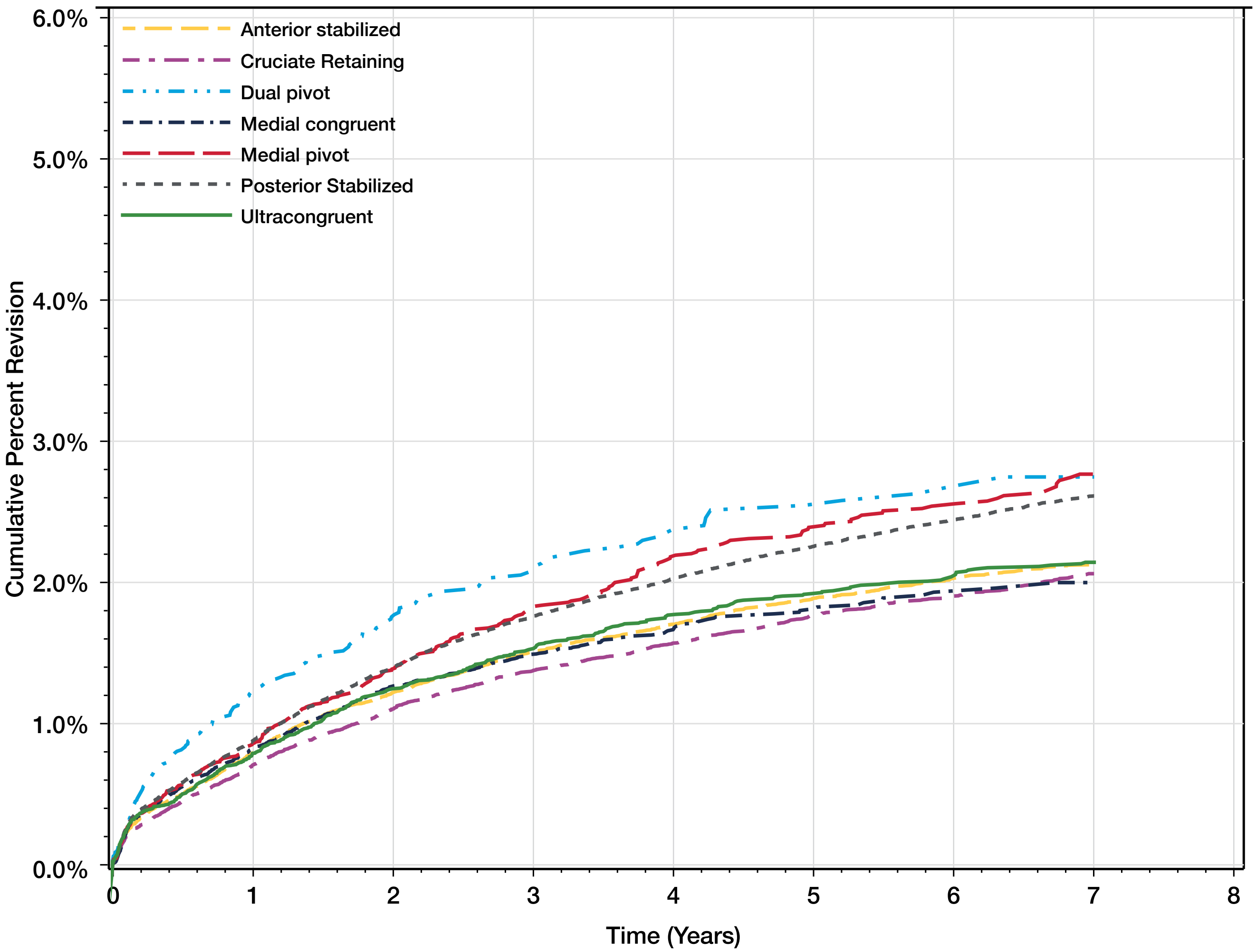


Group	stat	0	1	2	3	4	5	6	7
Anterior stabilized	At Risk	85,297	79,489	72,267	65,337	59,408	53,018	40,120	28,329
	KM % revision	0.02 (0.01, 0.03)	0.80 (0.74, 0.86)	1.22 (1.15, 1.3)	1.52 (1.43, 1.61)	1.71 (1.62, 1.8)	1.89 (1.8, 1.99)	2.03 (1.93, 2.14)	2.13 (2.03, 2.24)
Cruciate Retaining	At Risk	94,374	88,066	79,590	71,568	64,293	57,287	48,143	38,149
	KM % revision	0.02 (0.01, 0.03)	0.71 (0.66, 0.77)	1.11 (1.04, 1.18)	1.38 (1.3, 1.46)	1.57 (1.49, 1.66)	1.77 (1.68, 1.87)	1.91 (1.81, 2.01)	2.07 (1.97, 2.17)
Dual pivot	At Risk	10,738	8,346	6,184	4,665	3,738	2,972	1,800	973
	KM % revision	0.04 (0.01, 0.1)	1.22 (1.03, 1.46)	1.76 (1.51, 2.06)	2.10 (1.81, 2.43)	2.38 (2.05, 2.76)	2.55 (2.2, 2.95)	2.69 (2.31, 3.12)	2.75 (2.36, 3.21)
Medial congruent	At Risk	96,333	62,866	35,503	20,404	12,638	7,923	4,239	1,943
	KM % revision	0.01 (0.01, 0.02)	0.83 (0.77, 0.89)	1.27 (1.18, 1.35)	1.49 (1.39, 1.6)	1.67 (1.55, 1.79)	1.82 (1.68, 1.96)	1.93 (1.78, 2.11)	2.00 (1.82, 2.2)
Medial pivot	At Risk	20,119	16,777	12,955	10,603	8,836	7,211	5,596	4,108
	KM % revision	0.03 (0.02, 0.07)	0.86 (0.74, 1)	1.39 (1.23, 1.58)	1.83 (1.63, 2.05)	2.19 (1.96, 2.44)	2.39 (2.15, 2.67)	2.54 (2.28, 2.84)	2.77 (2.48, 3.09)
Posterior Stabilized	At Risk	283,929	254,021	217,555	187,987	164,287	143,553	117,518	88,113
	KM % revision	0.02 (0.02, 0.03)	0.88 (0.85, 0.92)	1.40 (1.36, 1.45)	1.76 (1.71, 1.81)	2.03 (1.98, 2.09)	2.26 (2.2, 2.32)	2.45 (2.38, 2.51)	2.62 (2.55, 2.69)
Ultracongruent	At Risk	33,866	30,217	25,999	21,994	18,693	15,756	12,420	9,513
	KM % revision	0.02 (0.01, 0.05)	0.79 (0.7, 0.89)	1.25 (1.13, 1.38)	1.53 (1.39, 1.67)	1.77 (1.62, 1.93)	1.93 (1.77, 2.1)	2.04 (1.88, 2.23)	2.15 (1.97, 2.34)

*Age, Sex, CCI, Age * log(time), CCI * log(time) adjusted HR (95% CI), p-value*

Cruciate Retaining vs Posterior Stabilized over 84 Months: 0.819(0.770,0.871)p=<.0001; Medial pivot vs Posterior Stabilized over 84 Months: 1.037(0.922,1.166)p=0.5442; Dual_pivot vs Posterior Stabilized at 0-6 Months: 1.300(1.034,1.634), p=0.0247; Dual_pivot vs Posterior Stabilized at 6 Months-7 Years: 1.031(0.852,1.247), p=0.7553; Anterior_stabilized vs Posterior Stabilized at 0 Months-1.5 Years: 0.939(0.871,1.013), p=0.1046; Anterior_stabilized vs Posterior Stabilized at 1.5-7 Years: 0.749(0.687,0.816), p=<.0001; Medial_congruent vs Posterior Stabilized at 0 Months-1.5 Years: 0.848(0.784,0.916), p=<.0001; Medial_congruent vs Posterior Stabilized at 1.5-6 Years: 0.725(0.627,0.837), p=<.0001; Medial_congruent vs Posterior Stabilized at 6-7 Years: 0.386(0.096,1.555), p=0.1806; Ultracongruent vs Posterior Stabilized at 0 Months-4 Years: 0.882(0.805,0.967), p=0.0077; Ultracongruent vs Posterior Stabilized at 4-7 Years: 0.655(0.499,0.858), p=0.0022

Figure 3.5b Cumulative Percent Revision for Primary Total Knee Arthroplasty Implant Designs in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis Without Confidence Intervals, 2012-2024



Group	stat	0	1	2	3	4	5	6	7
Anterior stabilized	At Risk	85,297	79,489	72,267	65,337	59,408	53,018	40,120	28,329
	KM % revision	0.02 (0.01, 0.03)	0.80 (0.74, 0.86)	1.22 (1.15, 1.3)	1.52 (1.43, 1.61)	1.71 (1.62, 1.8)	1.89 (1.8, 1.99)	2.03 (1.93, 2.14)	2.13 (2.03, 2.24)
Cruciate Retaining	At Risk	94,374	88,066	79,590	71,568	64,293	57,287	48,143	38,149
	KM % revision	0.02 (0.01, 0.03)	0.71 (0.66, 0.77)	1.11 (1.04, 1.18)	1.38 (1.3, 1.46)	1.57 (1.49, 1.66)	1.77 (1.68, 1.87)	1.91 (1.81, 2.01)	2.07 (1.97, 2.17)
Dual pivot	At Risk	10,738	8,346	6,184	4,665	3,738	2,972	1,800	973
	KM % revision	0.04 (0.01, 0.1)	1.22 (1.03, 1.46)	1.76 (1.51, 2.06)	2.10 (1.81, 2.43)	2.38 (2.05, 2.76)	2.55 (2.2, 2.95)	2.69 (2.31, 3.12)	2.75 (2.36, 3.21)
Medial congruent	At Risk	96,333	62,866	35,503	20,404	12,638	7,923	4,239	1,943
	KM % revision	0.01 (0.01, 0.02)	0.83 (0.77, 0.89)	1.27 (1.18, 1.35)	1.49 (1.39, 1.6)	1.67 (1.55, 1.79)	1.82 (1.68, 1.96)	1.93 (1.78, 2.11)	2.00 (1.82, 2.2)
Medial pivot	At Risk	20,119	16,777	12,955	10,603	8,836	7,211	5,596	4,108
	KM % revision	0.03 (0.02, 0.07)	0.86 (0.74, 1)	1.39 (1.23, 1.58)	1.83 (1.63, 2.05)	2.19 (1.96, 2.44)	2.39 (2.15, 2.67)	2.54 (2.28, 2.84)	2.77 (2.48, 3.09)
Posterior Stabilized	At Risk	283,929	254,021	217,555	187,987	164,287	143,553	117,518	88,113
	KM % revision	0.02 (0.02, 0.03)	0.88 (0.85, 0.92)	1.40 (1.36, 1.45)	1.76 (1.71, 1.81)	2.03 (1.98, 2.09)	2.26 (2.2, 2.32)	2.45 (2.38, 2.51)	2.62 (2.55, 2.69)
Ultracongruent	At Risk	33,866	30,217	25,999	21,994	18,693	15,756	12,420	9,513
	KM % revision	0.02 (0.01, 0.05)	0.79 (0.7, 0.89)	1.25 (1.13, 1.38)	1.53 (1.39, 1.67)	1.77 (1.62, 1.93)	1.93 (1.77, 2.1)	2.04 (1.88, 2.23)	2.15 (1.97, 2.34)

*Age, Sex, CCI, Age * log(time), CCI * log(time) adjusted HR (95% CI), p-value*
Cruciate Retaining vs Posterior Stabilized over 84 Months: 0.819(0.770,0.871)p=<.0001; Medial pivot vs Posterior Stabilized over 84 Months: 1.037(0.922,1.166)p=0.5442; Dual_pivot vs Posterior Stabilized at 0-6 Months: 1.300(1.034,1.634), p=0.0247; Dual_pivot vs Posterior Stabilized at 6 Months-7 Years: 1.031(0.852,1.247), p=0.7553; Anterior_stabilized vs Posterior Stabilized at 0 Months-1.5 Years: 0.939(0.871,1.013), p=0.1046; Anterior_stabilized vs Posterior Stabilized at 1.5-7 Years: 0.749(0.687,0.816), p=<.0001; Medial_congruent vs Posterior Stabilized at 0 Months-1.5 Years: 0.848(0.784,0.916), p=<.0001; Medial_congruent vs Posterior Stabilized at 1.5-6 Years: 0.725(0.627,0.837), p=<.0001; Medial_congruent vs Posterior Stabilized at 6-7 Years: 0.386(0.096,1.555), p=0.1806; Ultracongruent vs Posterior Stabilized at 0 Months-4 Years: 0.882(0.805,0.967), p=0.0077; Ultracongruent vs Posterior Stabilized at 4-7 Years: 0.655(0.499,0.858), p=0.0022

Table 3.5b **Restricted Mean Survival Time (RMST) in Months of All Liner Design Groups Compared to Each Other(All Groups Analyzed up to 84 Months and Higher Values Indicate Longer Survival Times)**

Group 1	Group 2	RMST Group 1	RMST Group 2	RMST Difference(CI)	p-value
Anterior stabilized	Cruciate Retaining	82.631(82.566,82.696)	82.718(82.660,82.777)	-0.087(-0.173,-0.001)	0.0472
Anterior stabilized	Dual pivot	82.631(82.566,82.696)	82.222(81.964,82.480)	0.409(0.143,0.675)	0.0026
Anterior stabilized	Medial congruent	82.631(82.566,82.696)	82.659(82.572,82.747)	-0.029(-0.136,0.079)	0.6021
Anterior stabilized	Medial pivot	82.631(82.566,82.696)	82.349(82.192,82.506)	0.282(0.113,0.451)	0.0011
Anterior stabilized	Posterior Stabilized	82.631(82.566,82.696)	82.431(82.391,82.471)	0.200(0.125,0.274)	<.0001
Anterior stabilized	Ultracongruent	82.631(82.566,82.696)	82.608(82.502,82.713)	0.023(-0.100,0.146)	0.7123
Cruciate Retaining	Dual pivot	82.718(82.660,82.777)	82.222(81.964,82.480)	0.496(0.232,0.761)	0.0002
Cruciate Retaining	Medial congruent	82.718(82.660,82.777)	82.659(82.572,82.747)	0.059(-0.045,0.162)	0.2679
Cruciate Retaining	Medial pivot	82.718(82.660,82.777)	82.349(82.192,82.506)	0.369(0.203,0.536)	<.0001
Cruciate Retaining	Posterior Stabilized	82.718(82.660,82.777)	82.431(82.391,82.471)	0.287(0.217,0.357)	<.0001
Cruciate Retaining	Ultracongruent	82.718(82.660,82.777)	82.608(82.502,82.713)	0.110(-0.010,0.230)	0.0713
Dual pivot	Medial congruent	82.222(81.964,82.480)	82.659(82.572,82.747)	-0.438(-0.710,-0.165)	0.0016
Dual pivot	Medial pivot	82.222(81.964,82.480)	82.349(82.192,82.506)	-0.127(-0.429,0.175)	0.4093
Dual pivot	Posterior Stabilized	82.222(81.964,82.480)	82.431(82.391,82.471)	-0.209(-0.470,0.052)	0.116
Dual pivot	Ultracongruent	82.222(81.964,82.480)	82.608(82.502,82.713)	-0.386(-0.664,-0.107)	0.0066
Medial congruent	Medial pivot	82.659(82.572,82.747)	82.349(82.192,82.506)	0.311(0.132,0.489)	0.0007
Medial congruent	Posterior Stabilized	82.659(82.572,82.747)	82.431(82.391,82.471)	0.228(0.133,0.323)	<.0001
Medial congruent	Ultracongruent	82.659(82.572,82.747)	82.608(82.502,82.713)	0.052(-0.084,0.188)	0.4564
Medial pivot	Posterior Stabilized	82.349(82.192,82.506)	82.431(82.391,82.471)	-0.082(-0.243,0.079)	0.3171
Medial pivot	Ultracongruent	82.349(82.192,82.506)	82.608(82.502,82.713)	-0.259(-0.447,-0.071)	0.007
Ultracongruent	Posterior Stabilized	82.608(82.502,82.713)	82.431(82.391,82.471)	0.177(0.065,0.289)	0.002

Bearing Materials in Primary TKA

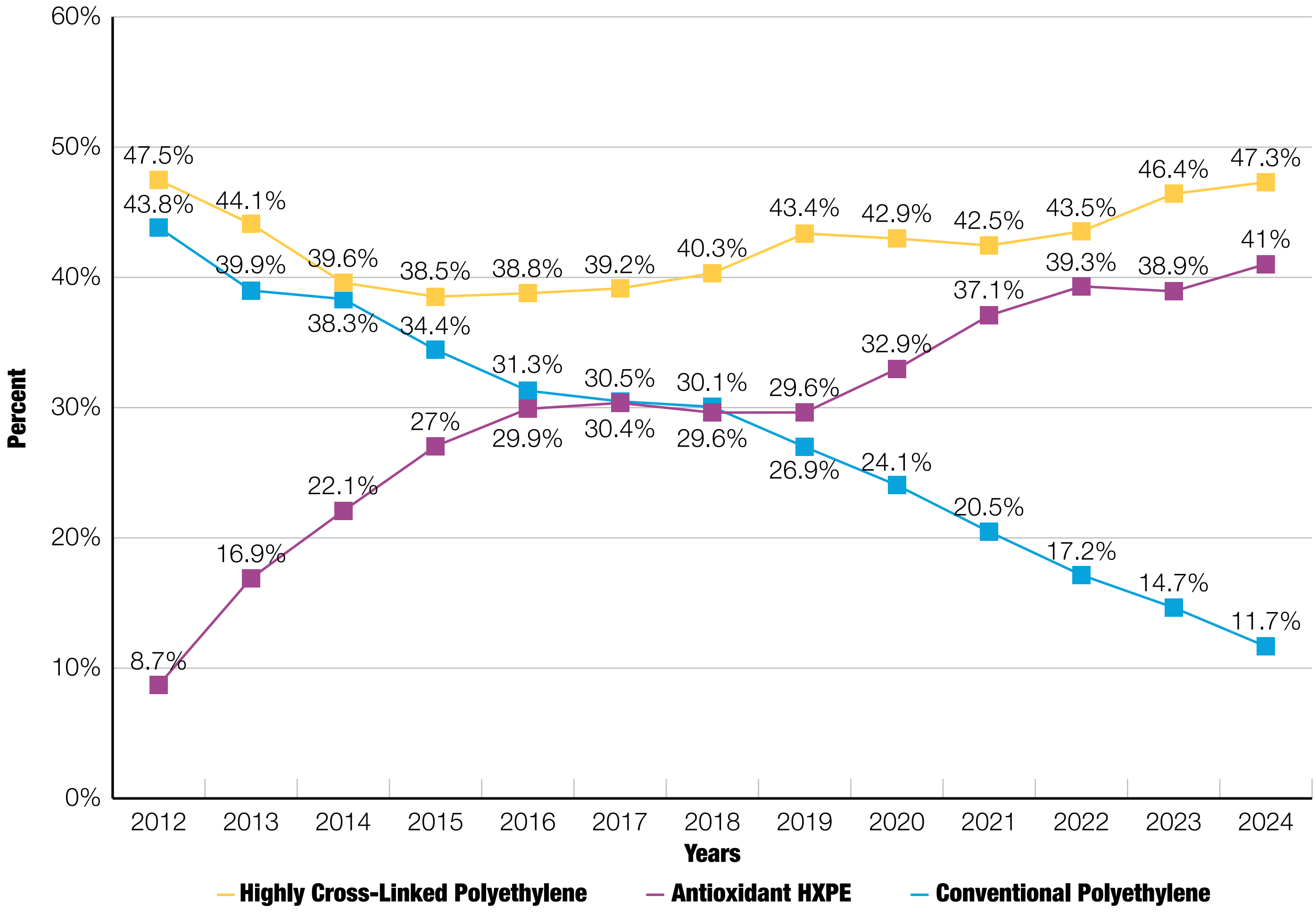
This year's annual report is dedicated to Dr. William H. Harris who transformed hip and knee surgery with the development and widespread adoption of HXPE used in THA and TKA. CPE wear and resulting osteolysis were a leading cause of hip and knee replacement failure prior to the introduction of HXPE. Registries around the world have documented the significant reduction in osteolysis and revision associated with HXPE compared to CPE bearings in primary THA and primary TKA.

Polyethylene is classified as highly cross-linked if it has a total radiation dose of 50 kGy (5 Mrad) or more. Antioxidant HXPE refers to a HXPE that has an antioxidant component infused or blended during manufacturing. In the AJRR, HXPE has consistently been more commonly used than antioxidant HXPE for all elective primary TKAs (Figure 3.6). HXPE and antioxidant HXPE are utilized in 88.3% of primary TKA in 2024 (HXPE 47.3% and antioxidant HXPE 41%). CPE has shown a steady decline in use over time accounting for only 11.7% of primary TKAs in 2024 (Figure 3.6).

INSIGHTS

The vast majority of primary TKA utilize a form of HXPE (88.3%).

Figure 3.6 **Polyethylene Material Use in Primary Total Knee Arthroplasty, 2012-2024 (N = 1,686,204)**



HXPE and antioxidant HXPE are currently used less frequently in primary TKA compared with primary THA as reported in the AJRR and other international registries. The AOANJRR has reported similar rates of HXPE use in primary TKA ranging from 67% to 80.8% from 2020 to 2023 (Table 3.3)[7] compared with AJRR rates ranging from 75.9% to 88.3% from 2020 to 2024 (Figure 3.6). The Dutch Arthroplasty Register (LROI) (Table 3.4) demonstrates substantially lower utilization of HXPE in primary TKA (34.6% and 35% in 2023, respectively) compared with Australia and the U.S.[9]

Table 3.3 Utilization Rates of Highly Cross-Linked Polyethylene (HXPE) in Primary Total Knee Arthroplasty for Osteoarthritis in the AOANJRR

Year	Country/Registry	HXPE Knee Usage Rate %
2023	Australia - AOANJRR	80.8%
2022	Australia - AOANJRR	79.2%
2021	Australia - AOANJRR	75.8%
2020	Australia - AOANJRR	70.9%
2019	Australia - AOANJRR	67.0%

Table 3.4 Utilization Rates of HXPE in Primary Total Knee Arthroplasty in LROI

Year	Country/Registry	HXPE Knee Usage Rate %
2023	Netherlands - LROI	34.6%
2022	Netherlands - LROI	28.5%
2021	Netherlands - LROI	27.4%
2020	Netherlands - LROI	24.0%
2019	Netherlands - LROI	23.0%

The CPR for primary TKA using HXPE, antioxidant HXPE, and CPE bearings in patients aged 65 and older with primary osteoarthritis from 2012 to 2024 are reported (Figure 3.7).

HXPE bearings in primary TKA had a slightly higher risk of revision compared to CPE in the period between 0 months and 1.5 years (HR: 1.095 [1.042, 1.150], p = 0.0003), a lower CPR at the interval between 1.5 and 8 years (HR: 0.922 [0.874, 0.972], p = 0.0024) (Figure 3.7), and no statistically significant differences between 8-12 years follow-up interval. Antioxidant HXPE bearings in primary TKA had a slightly higher risk of revision compared to CPE in the period between 0-6 months follow-up and had no statistically significant differences compared with CPE between 6 months and 11 years follow-up (Figure 3.7).

CPR in primary TKA in patients 65 years of age and older were further stratified by sex (Figures 7a-b). In males over 65 years old, slightly higher CPR were noted comparing HXPE to CPE in the early period between 0 months and 1 year (Figure 3.7a). Statistically significant lower CPR were noted comparing HXPE with CPE over the 1-8 year follow-up interval with no significant difference noted between 8-11 years follow-up (Figure 3.7a). Slightly higher CPR were noted comparing antioxidant HXPE to CPE in the early period between 0 months and 6 months with no statistically significant differences noted between 6 months and 11 year follow up interval.

INSIGHTS

No statistically significant differences in CPR were noted comparing HXPE or antioxidant HXPE with CPE in primary TKA for men or women over 65 years old at beyond the 8 year follow-up interval (Figure 7a-7b)

In females over 65 years old, CPR was slightly higher comparing HXPE with CPE in the early period between 0-2 years follow-up. No significant differences were noted comparing CPR for HXPE or antioxidant HXPE with CPE at intervals beyond 2 years (Figure 3.7b). CPR in primary TKA were further stratified by age and sex (Figures 3.7c-d). In males under 65 years old, HXPE and antioxidant HXPE demonstrated lower CPR compared with CPE in primary TKA at intervals beyond 11 years (Figure 3.7c). In females less than 65 years old, HXPE demonstrated lower CPR compared with CPE in primary TKA at 0-1 year and at intervals beyond 11 years (Figure 3.7d).

INSIGHTS

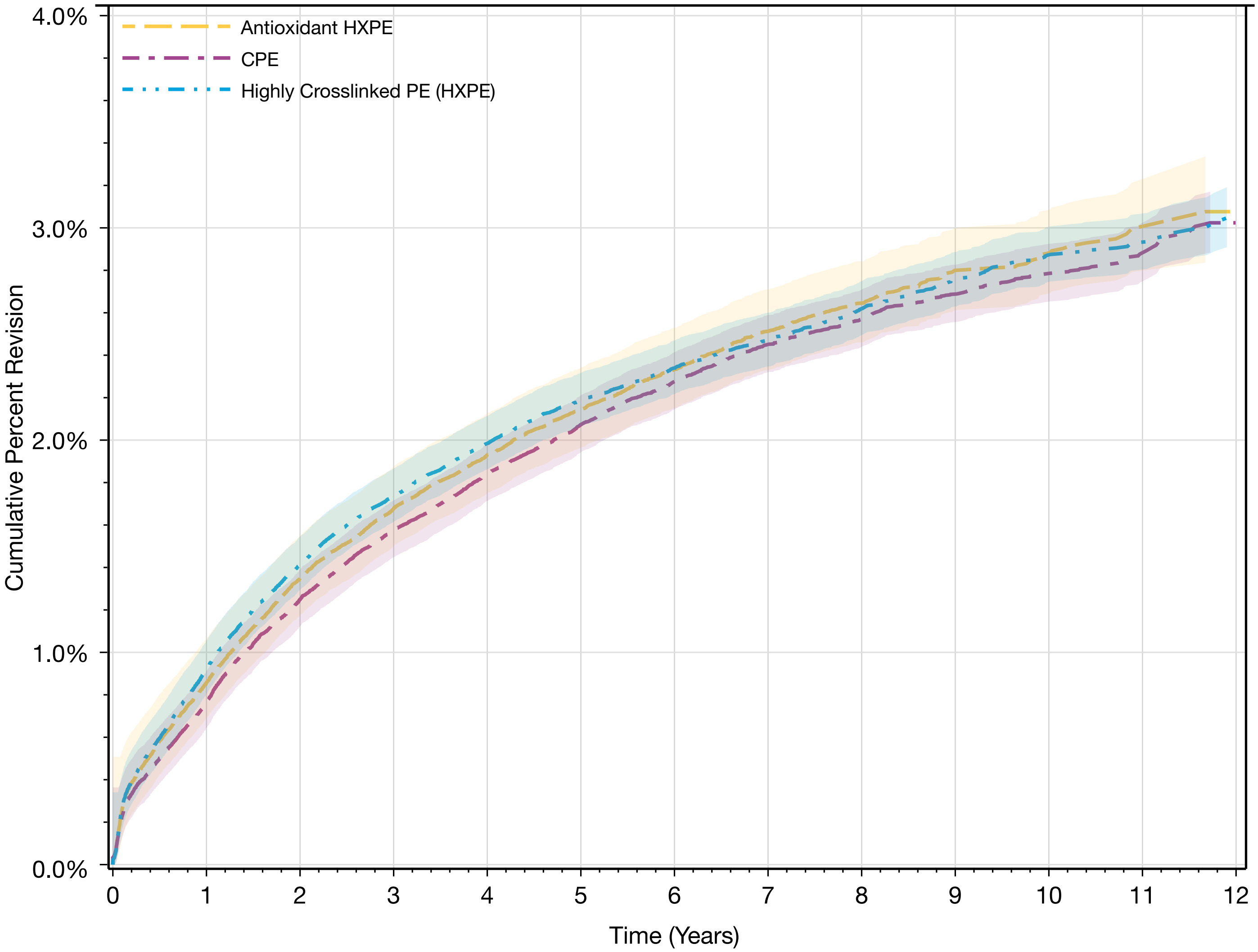
HXPE and antioxidant HXPE demonstrated lower CPR compared with CPE in primary TKA for males and females under 65 years old at intervals beyond 11 years (Figure 3.7c).

It is important to note that certain limitations exist in the AJRR dataset. The AJRR began reporting data in 2012 and the number of participating hospitals has increased significantly over time. Consequently, the number of cases reported at longer follow-up intervals is limited compared to those available at shorter follow-up time points. The observed differences in CPR comparing HXPE and antioxidant HXPE with CPE are relatively small and the limited number of cases available may affect the ability to detect differences at long-term follow-up intervals. Additional analysis is needed with larger sample sizes to better understand the long-term survivorship of HXPE and antioxidant HXPE compared to CPE in primary TKA.

Additionally, the AJRR links its database with the CMS database to capture all revisions in patients 65 years of age and older. Revision cases in CMS patients are therefore captured whether or not the revision is performed at an AJRR participating hospital. In patients under 65 years old, the AJRR may under-capture revision procedures in cases when revisions are performed at non-AJRR participating institutions. The AJRR is working to expand the number of participating hospitals to improve capture rates in non-CMS patients, but this continues to represent a significant limitation regarding reported revision rates in younger age groups.

Similar survivorship patterns comparing HXPE with CPE in primary TKA have been noted in the AOANJRR with CPE demonstrating lower CPR compared with HXPE in the first three months and HXPE demonstrating lower CPR than CPE at longer follow-up intervals.[7] The Australian registry has also noted a similar pattern with regard to CPR and age with younger patients demonstrating the greatest advantages comparing the CPR for HXPE compared to non-HXPE bearings in primary TKA.[7]

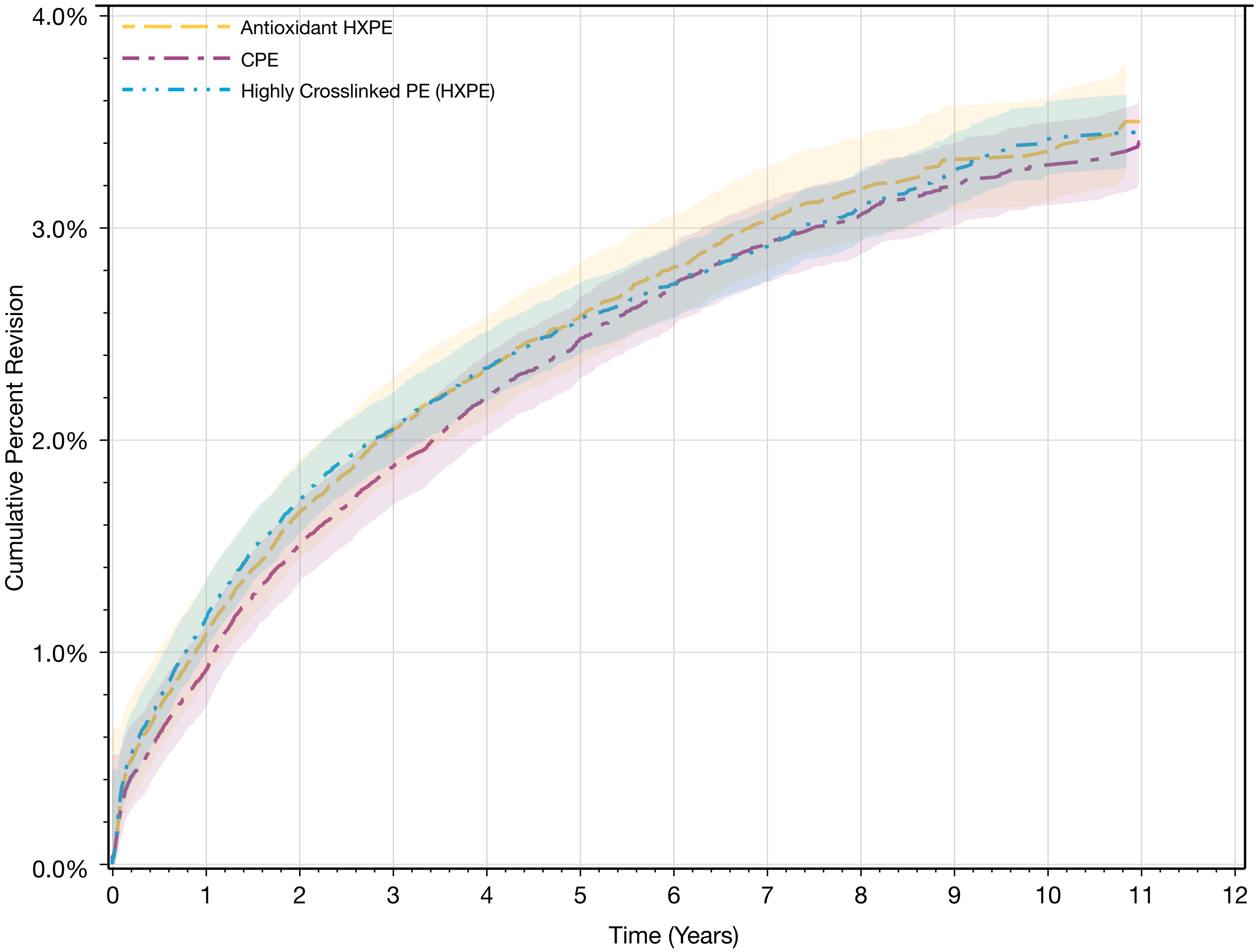
Figure 3.7 Cumulative Percent Revision for Primary Total Knee Arthroplasty Insert Materials in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11	12
Antioxidant Polyethylene	At Risk	319,605	269,033	215,457	174,489	144,754	121,626	95,994	70,607	44,494	23,180	10,254	3,454	519
	KM % revision	0.02 (0.02, 0.03)	0.86 (0.82, 0.89)	1.35 (1.31, 1.39)	1.68 (1.63, 1.73)	1.93 (1.88, 1.99)	2.14 (2.09, 2.21)	2.33 (2.27, 2.4)	2.51 (2.44, 2.58)	2.64 (2.57, 2.72)	2.80 (2.71, 2.89)	2.87 (2.78, 2.97)	3.00 (2.86, 3.13)	3.08 (2.88, 3.29)
Conventional Polyethylene	At Risk	254,361	236,522	212,952	191,742	172,923	153,911	128,677	100,966	71,944	46,636	27,048	12,382	3,819
	KM % revision	0.03 (0.03, 0.04)	0.77 (0.73, 0.8)	1.25 (1.21, 1.29)	1.57 (1.52, 1.63)	1.84 (1.79, 1.9)	2.07 (2.01, 2.13)	2.27 (2.21, 2.34)	2.45 (2.38, 2.52)	2.57 (2.5, 2.64)	2.69 (2.61, 2.76)	2.78 (2.7, 2.87)	2.88 (2.78, 2.97)	3.02 (2.9, 3.15)
Cross-linked Polyethylene	At Risk	401,415	343,689	281,362	236,847	203,170	172,610	136,612	103,527	71,736	44,504	25,203	12,052	3,550
	KM % revision	0.02 (0.02, 0.02)	0.92 (0.89, 0.95)	1.41 (1.38, 1.45)	1.73 (1.69, 1.78)	1.98 (1.94, 2.03)	2.19 (2.13, 2.24)	2.34 (2.28, 2.4)	2.47 (2.41, 2.53)	2.62 (2.55, 2.68)	2.75 (2.68, 2.83)	2.87 (2.79, 2.95)	2.93 (2.84, 3.02)	3.05 (2.93, 3.17)

*Age, Sex CCI, CCI * log(time), Age* log(time) adjusted HR (95% CI), p-value*
Crosslinked vs Conventional at 0 Months-1.5 Years: 1.095(1.042,1.150), p=0.0003
Crosslinked vs Conventional at 1.5-8 Years: 0.922(0.874,0.972), p=0.0024
Crosslinked vs Conventional at 8-12 Years: 1.029(0.815,1.299), p=0.8110
Antioxidant vs Conventional at 0-6 Months: 1.108(1.029,1.193), p=0.0067
Antioxidant vs Conventional at 6 Months-12 Years: 0.970(0.927,1.014), p=0.1735

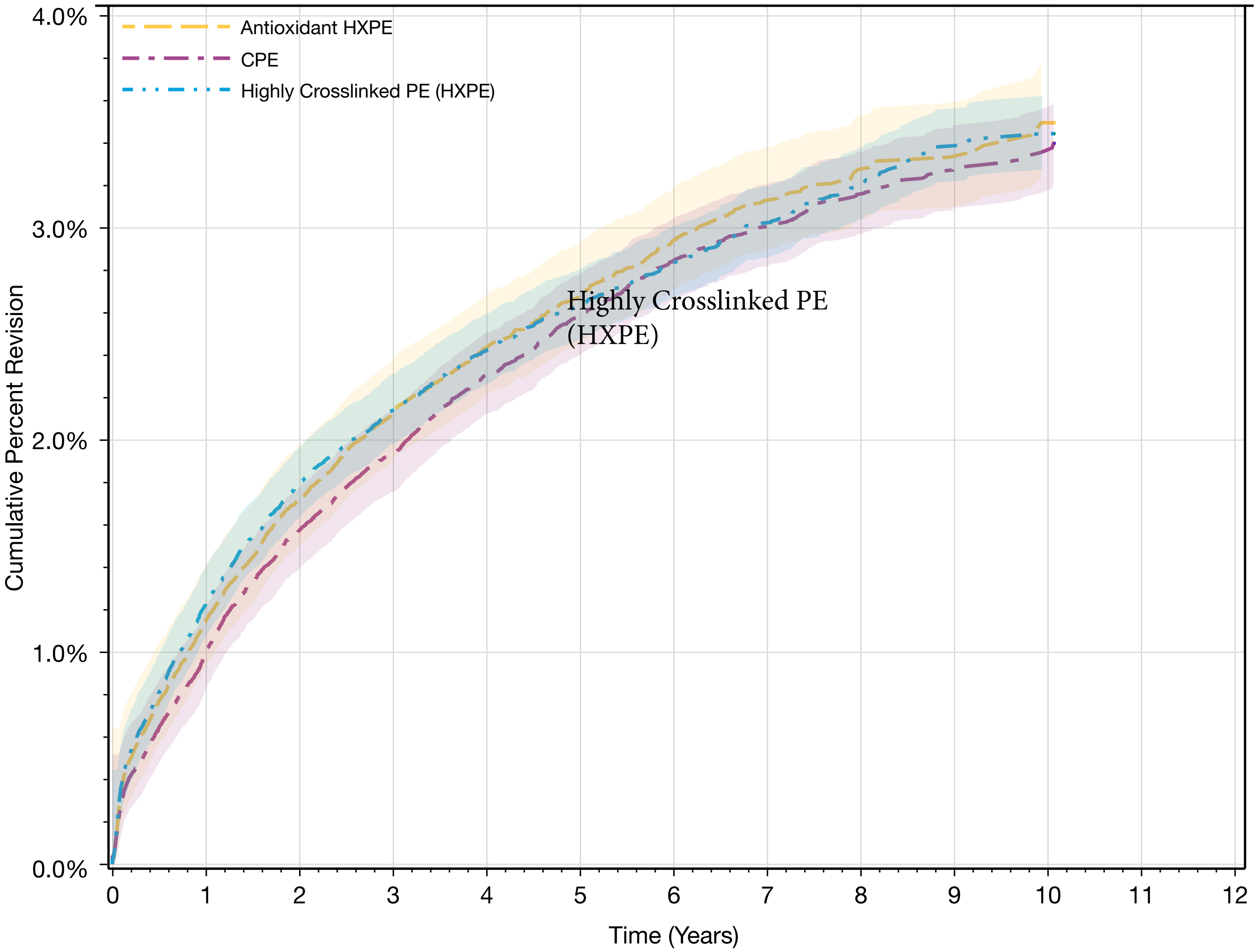
Figure 3.7a Cumulative Percent Revision for Primary Total Knee Arthroplasty Insert Materials in Male Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Antioxidant Polyethylene	At Risk	121,400	102,136	81,953	66,150	54,823	45,798	36,227	26,796	16,902	8,888	3,932	1,327
	KM % revision	0.02 (0.02, 0.03)	1.08 (1.02, 1.14)	1.66 (1.58, 1.73)	2.04 (1.95, 2.13)	2.33 (2.24, 2.43)	2.58 (2.48, 2.69)	2.81 (2.7, 2.93)	3.03 (2.9, 3.15)	3.17 (3.03, 3.3)	3.31 (3.17, 3.47)	3.33 (3.18, 3.49)	3.50 (3.27, 3.73)
Conventional Polyethylene	At Risk	93,995	87,199	78,158	70,121	62,947	55,549	46,418	36,380	25,773	16,533	9,571	4,388
	KM % revision	0.03 (0.02, 0.05)	0.92 (0.86, 0.98)	1.51 (1.43, 1.59)	1.87 (1.78, 1.96)	2.20 (2.1, 2.3)	2.47 (2.37, 2.58)	2.72 (2.6, 2.84)	2.92 (2.8, 3.05)	3.05 (2.93, 3.19)	3.19 (3.05, 3.33)	3.28 (3.14, 3.43)	3.40 (3.23, 3.58)
Cross-linked Polyethylene	At Risk	152,849	130,333	106,375	89,134	76,110	64,294	50,850	38,422	26,542	16,381	9,146	4,412
	KM % revision	0.02 (0.02, 0.03)	1.16 (1.1, 1.21)	1.72 (1.65, 1.79)	2.04 (1.97, 2.12)	2.34 (2.25, 2.42)	2.56 (2.47, 2.66)	2.73 (2.63, 2.83)	2.90 (2.8, 3.01)	3.10 (2.98, 3.21)	3.26 (3.14, 3.39)	3.41 (3.27, 3.56)	3.44 (3.3, 3.6)

*Age, CCI, Age * log(time), CCI * log(time) adjusted HR (95% CI), p-value*
Crosslinked PE vs Conventional PE at 0 Months-1 Year: 1.215(1.117,1.321), p=<.0001
Crosslinked PE vs Conventional PE at 1-8 Years: 0.886(0.825,0.951), p=0.0008
Crosslinked PE vs Conventional PE at 8-11 Years: 1.120(0.769,1.631), p=0.5558
Antioxidant PE vs Conventional PE at 0-6 Months: 1.166(1.047,1.299), p=0.0052
Antioxidant PE vs Conventional PE at 6 Months-11 Years: 0.975(0.912,1.042), p=0.4513

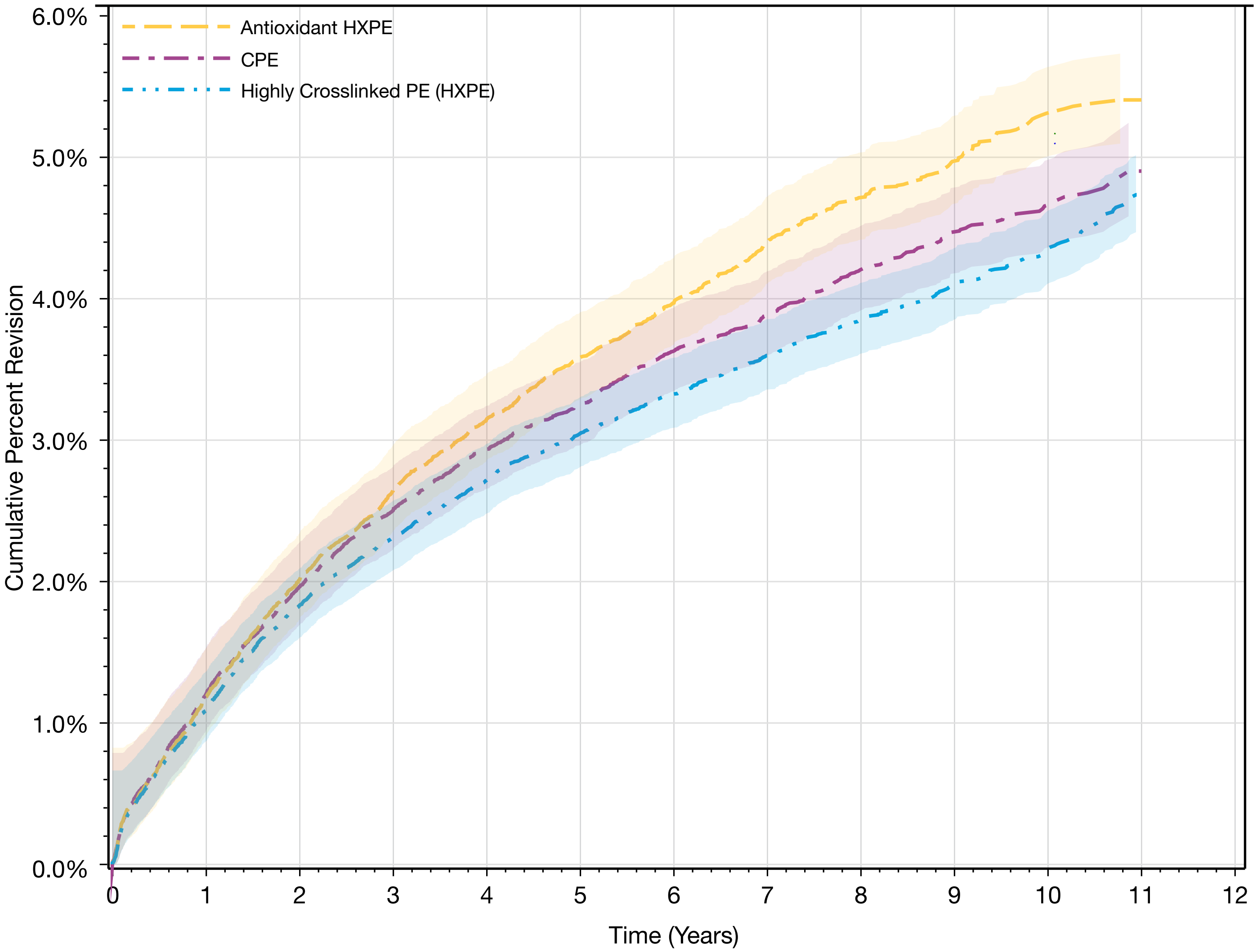
Figure 3.7b **Cumulative Percent Revision for Primary Total Knee Arthroplasty Insert Materials in Female Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Antioxidant PE	At Risk	121,400	102,136	81,953	66,150	54,823	45,798	36,227	26,796	16,902	8,888	3,932	1,327
	KM % revision	0.02 (0.02, 0.03)	1.08 (1.02, 1.14)	1.66 (1.58, 1.73)	2.04 (1.95, 2.13)	2.33 (2.24, 2.43)	2.58 (2.48, 2.69)	2.81 (2.7, 2.93)	3.03 (2.9, 3.15)	3.17 (3.03, 3.3)	3.31 (3.17, 3.47)	3.33 (3.18, 3.49)	3.50 (3.27, 3.73)
Conventional PE	At Risk	93,995	87,199	78,158	70,121	62,947	55,549	46,418	36,380	25,773	16,533	9,571	4,388
	KM % revision	0.03 (0.02, 0.05)	0.92 (0.86, 0.98)	1.51 (1.43, 1.59)	1.87 (1.78, 1.96)	2.20 (2.1, 2.3)	2.47 (2.37, 2.58)	2.72 (2.6, 2.84)	2.92 (2.8, 3.05)	3.05 (2.93, 3.19)	3.19 (3.05, 3.33)	3.28 (3.14, 3.43)	3.40 (3.23, 3.58)
Highly Crosslinked PE (HXPE)	At Risk	152,849	130,333	106,375	89,134	76,110	64,294	50,850	38,422	26,542	16,381	9,146	4,412
	KM % revision	0.02 (0.02, 0.03)	1.16 (1.1, 1.21)	1.72 (1.65, 1.79)	2.04 (1.97, 2.12)	2.34 (2.25, 2.42)	2.56 (2.47, 2.66)	2.73 (2.63, 2.83)	2.90 (2.8, 3.01)	3.10 (2.98, 3.21)	3.26 (3.14, 3.39)	3.41 (3.27, 3.56)	3.44 (3.3, 3.6)

*Age, CCI, Age * log(time), CCI * log(time) adjusted HR (95% CI), p-value*
Crosslinked PE vs Conventional PE at 0 Months-2 Years: 1.084(1.019,1.153), p=0.0108
Crosslinked PE vs Conventional PE at 2-9 Years: 0.928(0.860,1.001), p=0.0541
Crosslinked PE vs Conventional PE at 9-12 Years: 0.882(0.567,1.374), p=0.5797
Antioxidant PE vs Conventional PE over 12 years: 0.989(0.934,1.048)p=0.7068

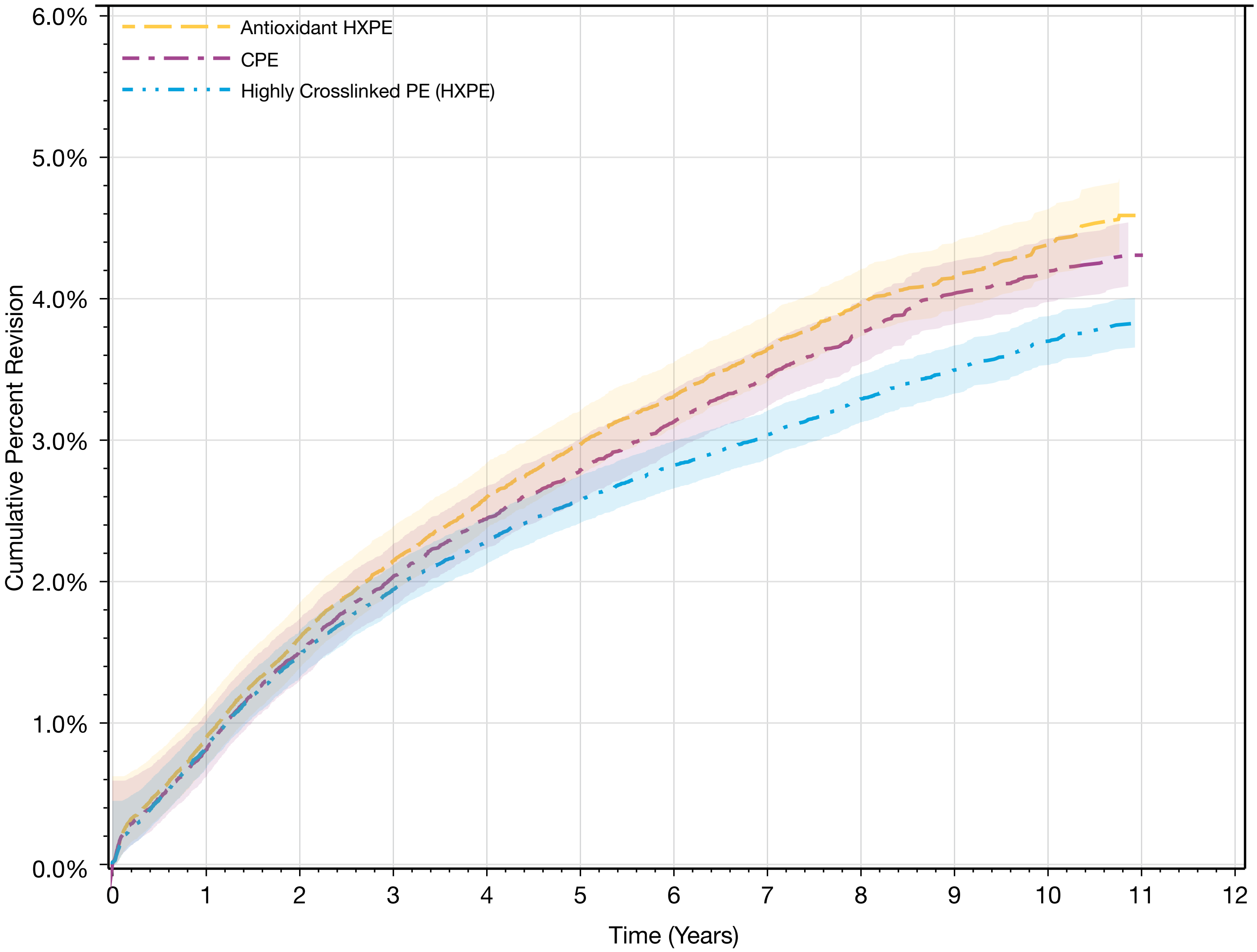
Figure 3.7c **Cumulative Percent Revision for Primary Total Knee Arthroplasty Insert Materials in Male Patients under 65 Years of Age with Primary Osteoarthritis, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Antioxidant PE	At Risk	86,436	76,034	64,751	54,950	47,081	40,295	33,019	25,679	17,469	10,110	5,088	1,862
	KM % revision	0.02 (0.01, 0.03)	1.20 (1.13, 1.28)	1.96 (1.87, 2.06)	2.50 (2.39, 2.62)	2.93 (2.81, 3.06)	3.24 (3.11, 3.38)	3.63 (3.48, 3.78)	3.88 (3.73, 4.04)	4.21 (4.03, 4.38)	4.47 (4.28, 4.67)	4.66 (4.44, 4.88)	4.90 (4.63, 5.19)
Conventional PE	At Risk	48,954	46,271	42,720	39,240	35,675	31,852	27,260	21,969	16,286	11,164	6,658	3,084
	KM % revision	0.01 (0.01, 0.03)	1.18 (1.09, 1.28)	2.01 (1.89, 2.14)	2.64 (2.5, 2.79)	3.14 (2.99, 3.31)	3.58 (3.41, 3.76)	3.97 (3.78, 4.16)	4.40 (4.2, 4.61)	4.71 (4.5, 4.94)	4.97 (4.74, 5.21)	5.31 (5.06, 5.58)	5.41 (5.14, 5.69)
Highly Crosslinked PE (HXPE)	At Risk	108,692	95,767	81,671	70,750	61,618	53,128	43,870	34,803	25,299	16,610	9,792	4,794
	KM % revision	0.01 (0, 0.02)	1.09 (1.03, 1.15)	1.83 (1.75, 1.92)	2.31 (2.22, 2.41)	2.72 (2.61, 2.83)	3.05 (2.93, 3.16)	3.32 (3.2, 3.45)	3.60 (3.47, 3.74)	3.85 (3.71, 4)	4.10 (3.94, 4.26)	4.36 (4.18, 4.54)	4.73 (4.51, 4.97)

*Age, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Antioxidant PE vs Conventional PE over 11 Years: 0.911(0.851,0.975)p=0.0076
Crosslinked PE vs Conventional PE over 11 Years: 0.853(0.799,0.911)p=<.0001

Figure 3.7d Cumulative Percent Revision for Primary Total Knee Arthroplasty Insert Materials in Female Patients Under 65 Years of Age with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Antioxidant PE	At Risk	126,541	110,883	93,747	79,799	68,598	58,873	48,525	37,712	25,740	14,759	7,318	2,686
	KM % revision	0.01 (0.01, 0.02)	0.89 (0.84, 0.95)	1.60 (1.53, 1.68)	2.14 (2.06, 2.23)	2.60 (2.5, 2.7)	2.97 (2.86, 3.08)	3.31 (3.19, 3.43)	3.65 (3.52, 3.78)	3.97 (3.83, 4.11)	4.15 (4, 4.31)	4.38 (4.21, 4.57)	4.59 (4.37, 4.81)
Conventional PE	At Risk	77,449	73,195	67,362	61,876	56,545	50,865	43,849	35,474	26,587	18,454	11,308	5,352
	KM % revision	0.01 (0.01, 0.02)	0.81 (0.75, 0.87)	1.50 (1.42, 1.59)	2.04 (1.94, 2.14)	2.45 (2.33, 2.56)	2.79 (2.67, 2.92)	3.13 (3, 3.27)	3.45 (3.31, 3.6)	3.76 (3.61, 3.92)	4.03 (3.87, 4.21)	4.19 (4.01, 4.38)	4.31 (4.12, 4.51)
Highly Crosslinked PE (HXPE)	At Risk	159,225	140,662	120,355	104,743	91,901	79,981	66,090	52,785	38,577	25,388	15,326	7,399
	KM % revision	0.01 (0.01, 0.02)	0.83 (0.78, 0.88)	1.48 (1.42, 1.54)	1.94 (1.87, 2.02)	2.29 (2.21, 2.37)	2.58 (2.49, 2.67)	2.82 (2.73, 2.92)	3.04 (2.94, 3.14)	3.29 (3.18, 3.4)	3.50 (3.38, 3.62)	3.69 (3.56, 3.83)	3.83 (3.68, 3.98)

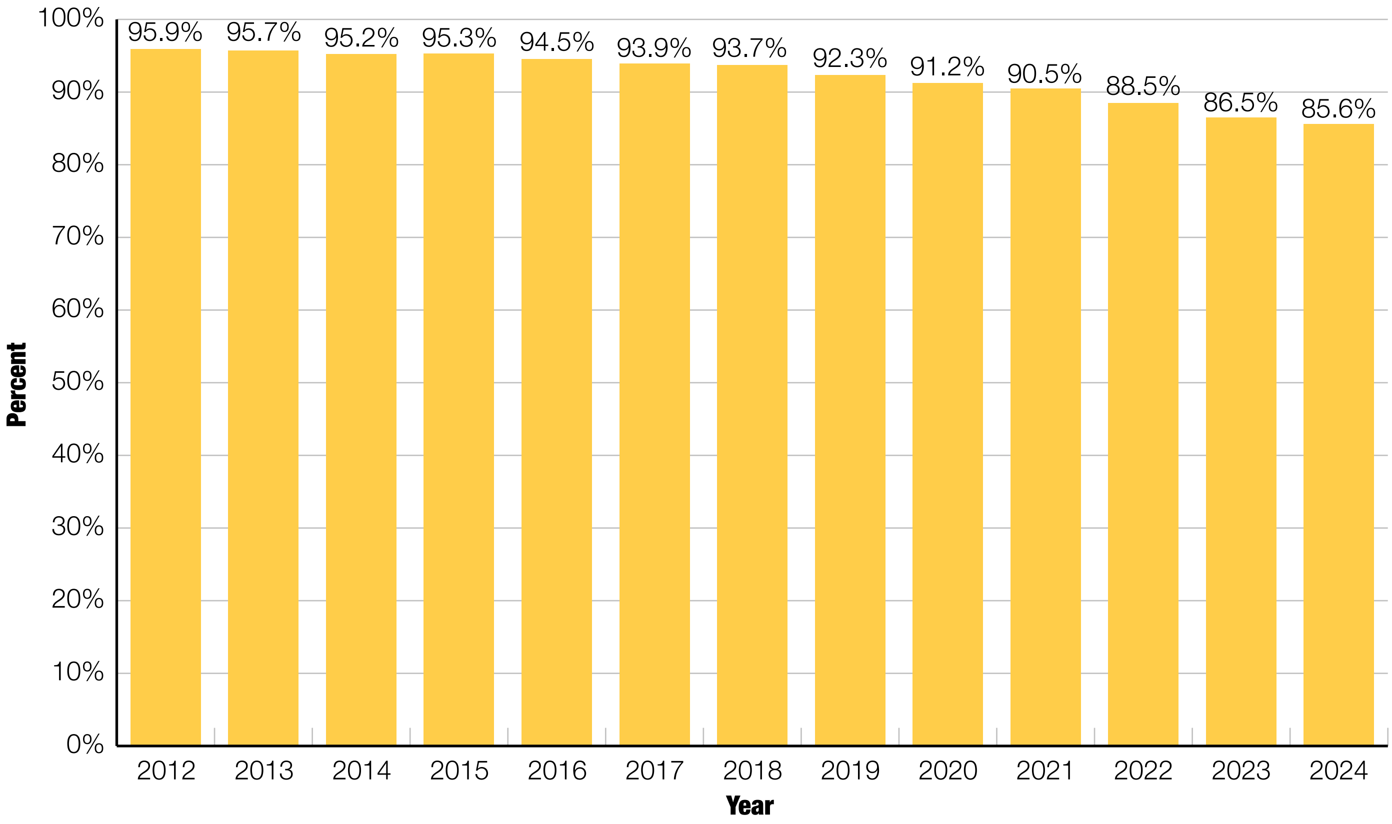
*Age, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Crosslinked PE vs Conventional PE at 0 Months-1 Year: 0.987(0.895,1.088), p=0.7951
Crosslinked PE vs Conventional PE at 1-11 Years: 0.841(0.791,0.893), p=<.0001

Patellar Resurfacing

Patellar resurfacing in primary TKA has steadily decreased in the last decade with rates of 95.9% in 2012 and 85.6% in 2024 (Figure 3.8). Rates of patellar resurfacing also differ substantially at the international level. In 2023, the AOANJRR reported rates of patellar resurfacing in primary TKA increased from 41.5% in 2005 to 78.9% in 2023.[7]

INSIGHTS **Patellar resurfacing in primary TKA has steadily decreased in the last decade with 95.9% use in 2012 and 85.6% use in 2024 (Figure 3.8).**

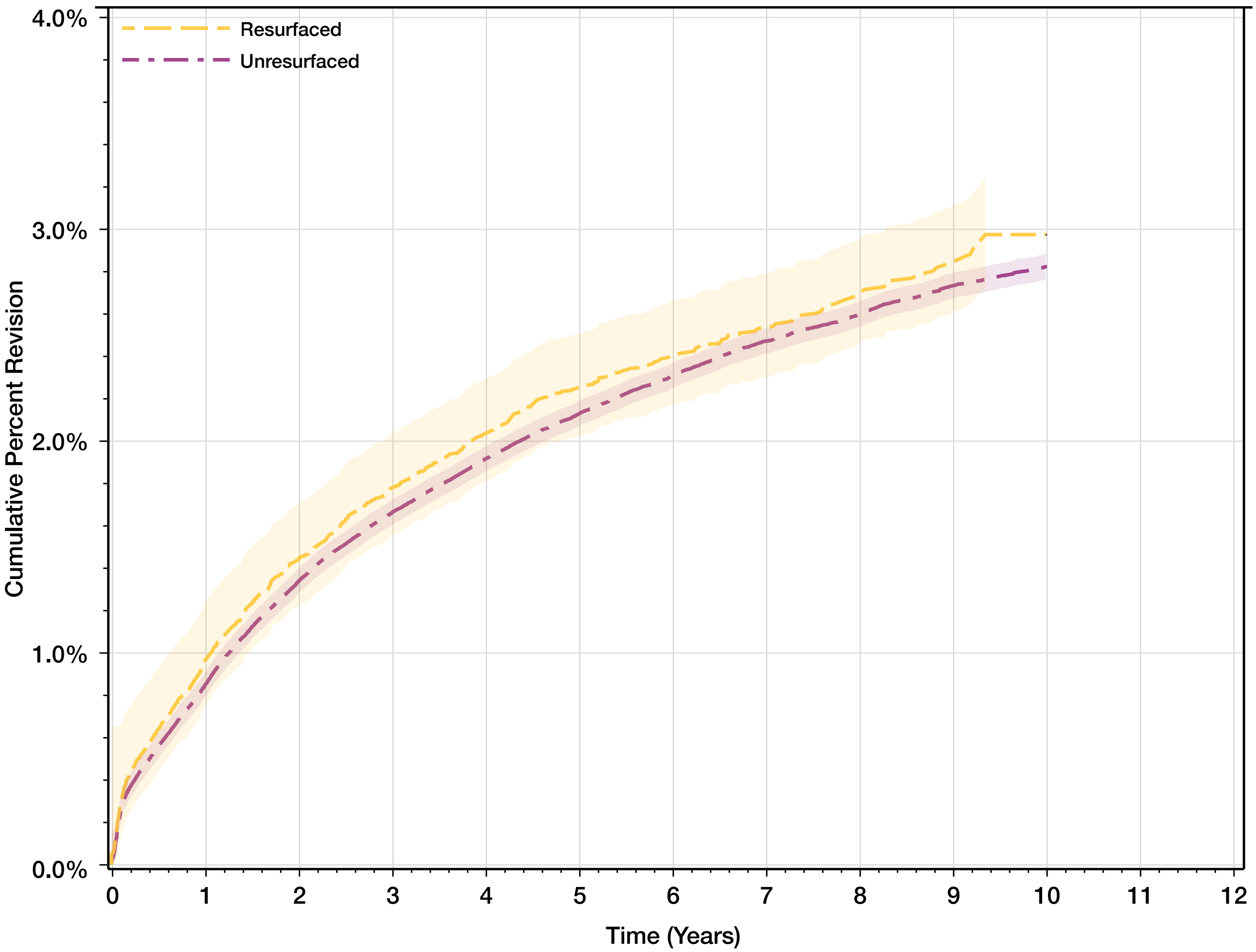
Figure 3.8 **Percentage of Primary Total Knee Arthroplasty with Patellar Resurfacing, 2012-2024 (N=1,519,733)**



CPR rates for primary TKA stratified by the presence or absence of patellar resurfacing in Medicare patients aged 65 years and older with primary osteoarthritis are reported from 2012 to 2024 (Figure 3.9). No statistically significant difference was noted comparing the CPR for primary TKA with or without patellar resurfacing at a 10 years follow-up interval (HR: 1.004(0.944,1.068) p=0.9045) (Figure 3.9). It should be noted that not all potential confounders have been considered in this analysis.

INSIGHTS **No statistically significant difference was noted comparing the CPR for primary TKA with or without patellar resurfacing at a 10 years follow-up interval (HR: 1.004(0.944,1.068) p=0.9045) (Figure 3.9).**

Figure 3.9 **Cumulative Percent Revision for Primary Total Knee Arthroplasty Patellar-Resurfacing in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8	9	10
Resurfaced	At Risk	827,196	729,356	615,157	524,509	453,461	390,367	314,149	237,592	160,840	96,045	51,150
	KM % revision	0.02 (0.02, 0.02)	0.85 (0.83, 0.87)	1.34 (1.31, 1.37)	1.66 (1.63, 1.69)	1.92 (1.88, 1.95)	2.13 (2.09, 2.17)	2.31 (2.27, 2.35)	2.47 (2.43, 2.51)	2.60 (2.56, 2.64)	2.73 (2.69, 2.78)	2.82 (2.77, 2.88)
Unresurfaced	At Risk	75,404	60,765	45,466	35,433	28,985	23,918	18,408	13,616	8,666	4,930	2,641
	KM % revision	0.05 (0.04, 0.07)	0.96 (0.89, 1.04)	1.44 (1.35, 1.54)	1.78 (1.67, 1.89)	2.04 (1.92, 2.16)	2.25 (2.12, 2.39)	2.40 (2.27, 2.55)	2.53 (2.38, 2.69)	2.69 (2.53, 2.87)	2.84 (2.65, 3.04)	2.98 (2.76, 3.2)

*Age, Sex, CCI, Age * log(time), CCI * log(time) adjusted HR (95% CI), p-value*
Unresurfaced vs Resurfaced over 120 Months: 1.004(0.944,1.068)p=0.9045

Cement Fixation

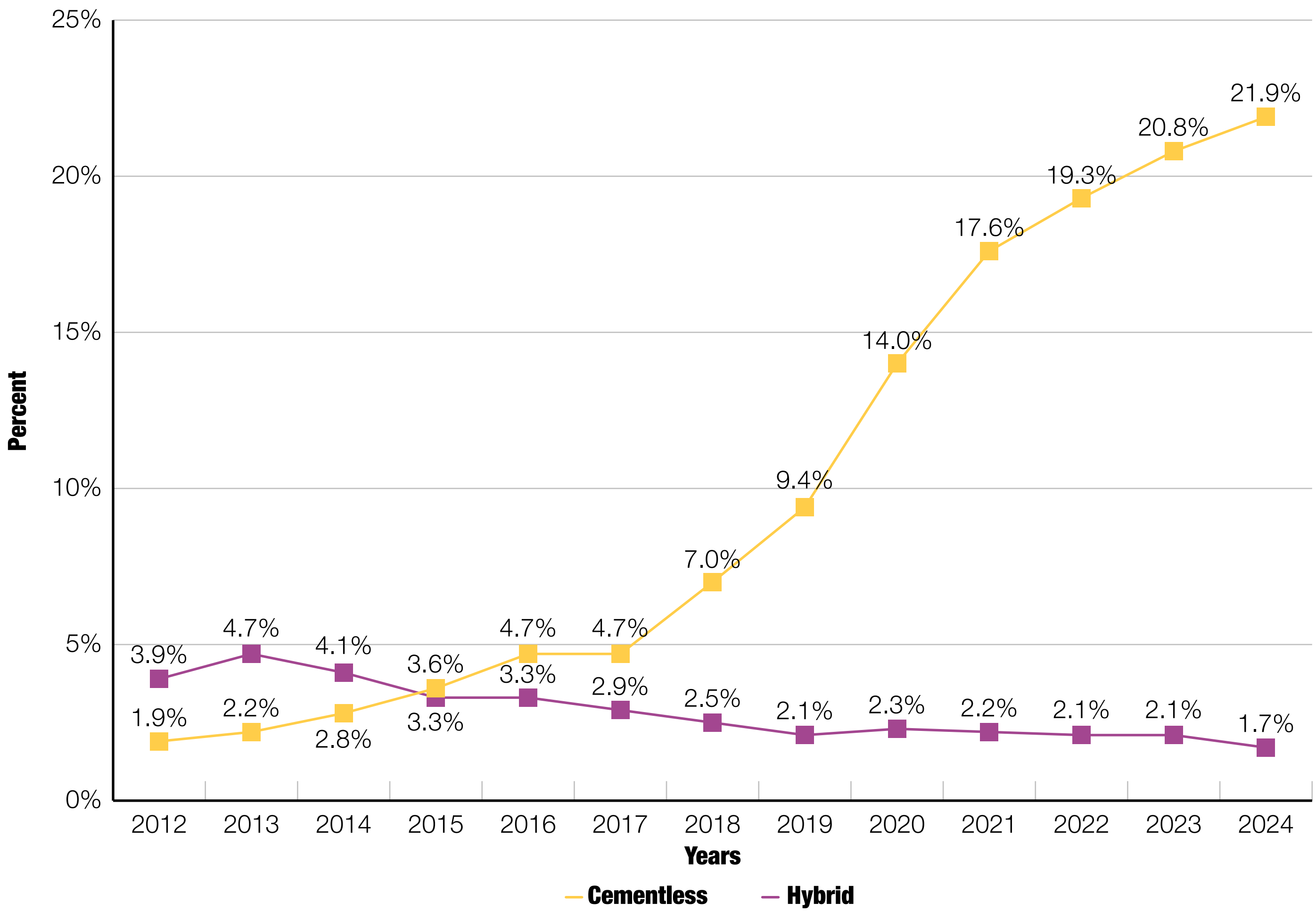
In the U.S., cement (polymethylmethacrylate) remains the predominant method used for fixation of primary TKA components compared to cementless and hybrid fixation. Hybrid fixation refers to any construct where one component (femur or tibia) is cementless whereas the other component (femur or tibia) is cemented.

INSIGHTS

Cementless fixation in primary TKA has seen an approximate 10-fold increase in use over the last decade with rates of 2.2% in 2012 and 21.9% in 2024 (Figure 3.10).

Cementless fixation in primary TKA has seen an approximate 10-fold increase in use over the last decade with rates of 2.2% in 2012 and 21.9% in 2024 (Figure 3.10). Significant international differences exist in the rates of cementless fixation for primary TKA. The AOANJRR documents cementless fixation in primary TKA at similar rates to the U.S. (20.9% in 2023).[9] Lower rates of cementless fixation in primary TKA have been noted in Sweden (6.8% in 2024)[23] and in the U.K. (cementless or hybrid fixation at 3.8% in 2024).[8]

Figure 3.10 Distribution of Hybrid and Cementless Fixation Utilization for Primary Total Knee Arthroplasty, 2012-2024 (N=1,530,764)



The impact of mode of fixation on CPR after primary TKA in the U.S. is influenced by age and gender (Figures 3.11-3.14). Hybrid fixation refers to any construct where one component (femur or tibia) is cementless whereas the other component (femur or tibia) is cemented. In males 65 years of age or older, cementless compared with cemented fixation noted higher early CPR out to 1 year, improved CPR for cementless between 2.5-6 years, and no significant differences beyond 6 years (Figure 3.11). In males 65 years of age and older, no significant differences were noted comparing hybrid with cemented fixation over 8 years (Figure 3.11). These findings do not account for numerous potential confounders.

In females 65 years of age or older, the CPRs were statistically similar for both cemented and cementless fixation across all time points with a slight advantage observed for cemented fixation up to 1.5 years (Figure 3.12) and no significant differences noted at longer follow-up intervals (Figure 3.12). In females 65 years of age and older, no significant differences were noted comparing hybrid with cemented fixation at intervals beyond 3.5 years (Figure 3.12). These findings do not account for numerous potential confounders.

INSIGHTS

No significant differences in CPR were noted comparing cementless to cemented fixation in primary TKA for men aged 65 years old or older beyond 72 months post operatively and for women under 65 years old beyond 18 months post operatively (Figure 3.12).

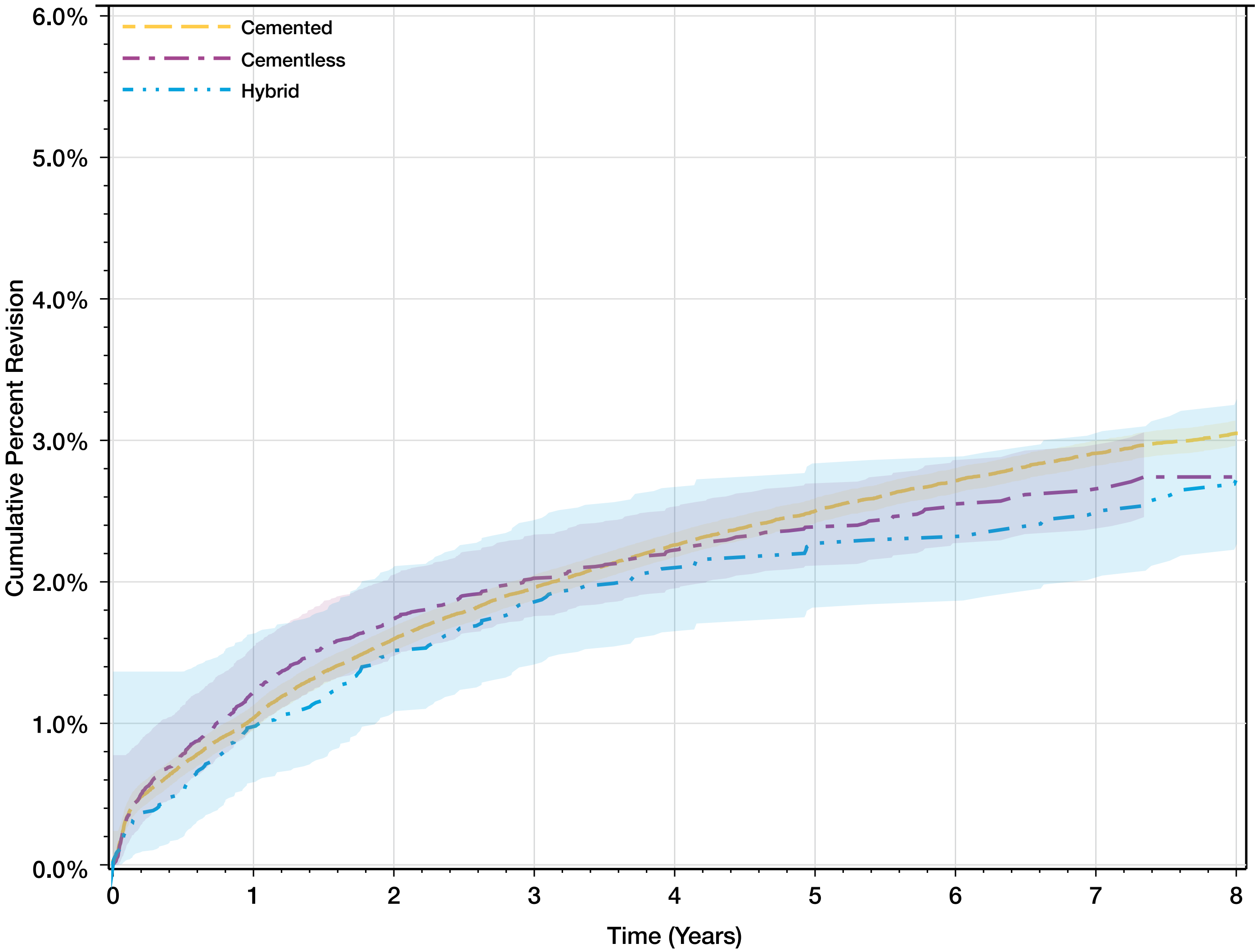
In males under 65 years old, no significant differences were noted comparing cementless to cemented fixation from 0-2 years, a significant advantage for cementless fixation between 2-7.5 years (HR: 0.645 (0.557,0.747), p=<.0001), and no significant difference noted beyond 7.5 years (Figure 3.13). In females under 65 years old, both cementless and hybrid fixation had higher CPR compared to cemented fixation from 0-6 months and no significant differences beyond 6 months (Figure 3.14).

INSIGHTS

No significant differences in CPR were noted comparing cementless to cemented fixation in primary TKA for men under 65 years old beyond 7.5 years post operatively and for women under 65 years old beyond 6 months post operatively (Figure 3.13).

The AJRR links its database with the CMS database to capture all revisions for patients aged 65 and older. As a result, revision cases in CMS patients are recorded regardless of whether the revision occurs at an AJRR-participating hospital. However, for patients under 65 years old, the AJRR may underreport revision procedures that take place at non-AJRR participating institutions. The AJRR aims to expand the number of participating hospitals to improve capture rates for non-CMS patients, but this continues to be a significant limitation regarding reported revision rates in younger age groups.

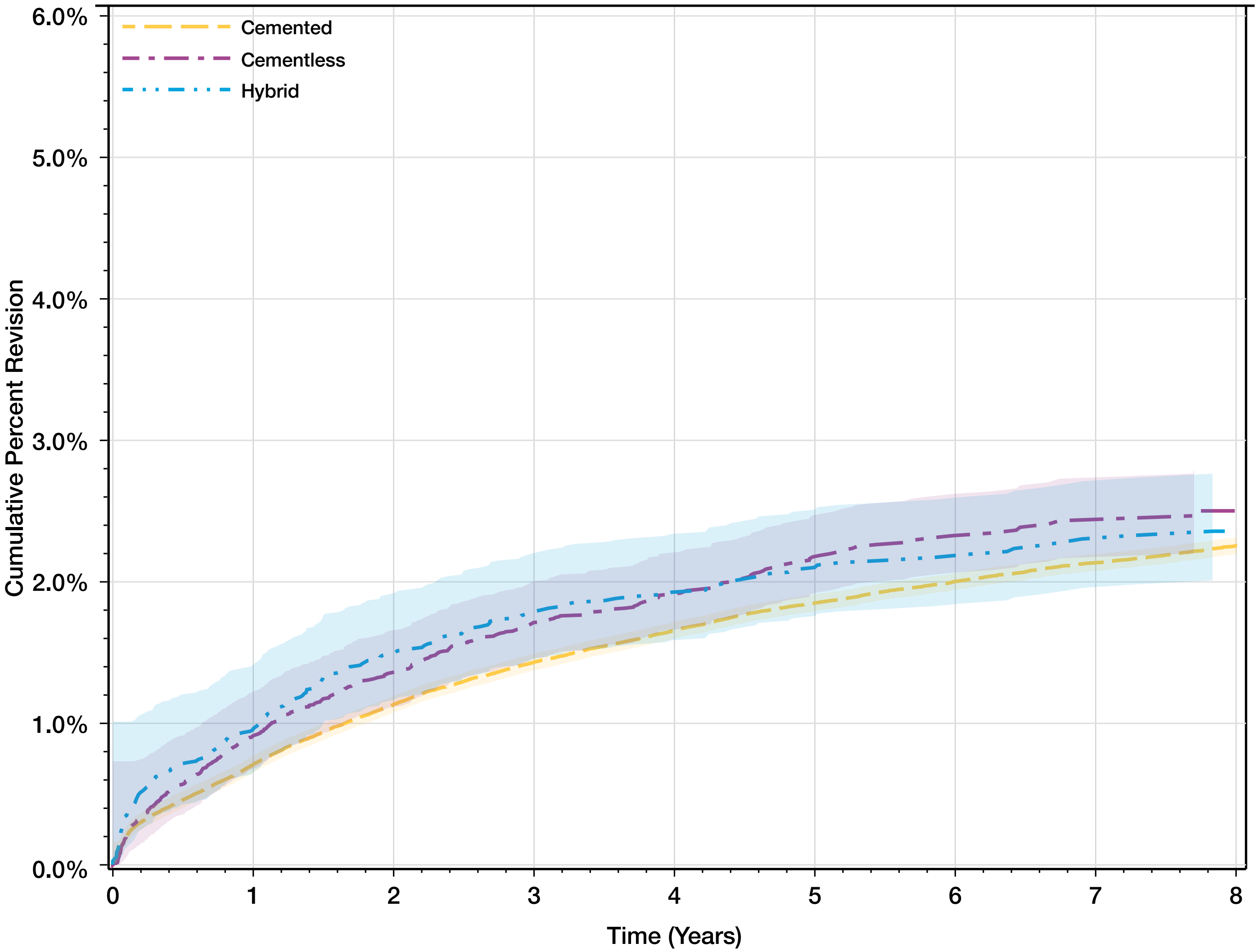
Figure 3.11 Cumulative Percent Revision for Cemented Versus Cementless Fixation Primary Total Knee Arthroplasty in Male Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8
Cemented	At Risk	298,527	263,172	222,998	191,091	166,462	143,474	116,119	88,643	60,129
	KM % revision	0.03 (0.02, 0.03)	1.04 (1, 1.08)	1.60 (1.55, 1.65)	1.96 (1.9, 2.01)	2.26 (2.2, 2.32)	2.50 (2.44, 2.57)	2.72 (2.65, 2.78)	2.91 (2.84, 2.98)	3.05 (2.97, 3.13)
Cementless	At Risk	42,897	33,068	22,747	15,809	11,053	7,688	5,186	3,345	2,094
	KM % revision	0.00 (0, 0.02)	1.22 (1.12, 1.34)	1.73 (1.6, 1.88)	2.03 (1.88, 2.19)	2.22 (2.05, 2.4)	2.39 (2.2, 2.58)	2.55 (2.34, 2.77)	2.64 (2.42, 2.89)	2.74 (2.49, 3.01)
Hybrid	At Risk	7,644	6,851	5,908	5,223	4,636	4,191	3,606	3,000	2,275
	KM % revision	0.03 (0.01, 0.1)	0.97 (0.77, 1.22)	1.50 (1.24, 1.81)	1.85 (1.56, 2.21)	2.09 (1.77, 2.47)	2.27 (1.93, 2.67)	2.30 (1.95, 2.7)	2.47 (2.1, 2.9)	2.73 (2.32, 3.21)

*Age, Age*log(time) , CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Cementless vs Cemented at 0-3 Months: 1.022(0.890,1.174), p=0.7560
Cementless vs Cemented at 3-12 Months: 1.183(1.034,1.353), p=0.0147
Cementless vs Cemented at 12-30 Months: 0.867(0.745,1.010), p=0.0661
Cementless vs Cemented at 30-72 Months: 0.676(0.535,0.853), p=0.0010
Cementless vs Cemented at 72+ Months: 0.573(0.271,1.213), p=0.1456
Hybrid vs Cemented over 96 Months: 0.904(0.766,1.066)p=0.2294

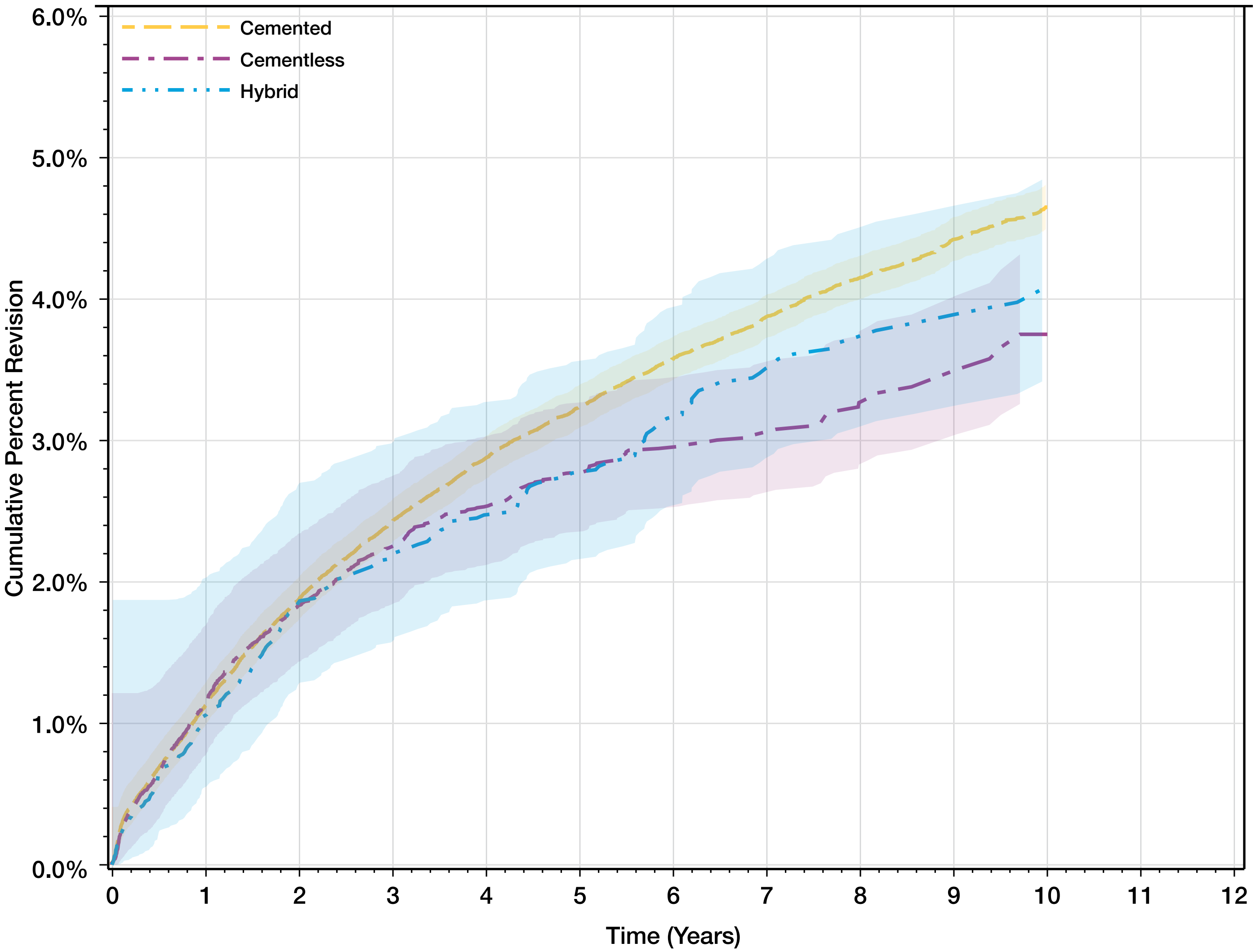
Figure 3.12 **Cumulative Percent Revision for Cemented Versus Cementless Fixation Primary Total Knee Arthroplasty in Female Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024**



Group	stat	0	1	2	3	4	5	6	7	8
Cemented	At Risk	504,897	443,586	374,075	320,761	279,693	242,753	196,265	149,514	101,285
	KM % revision	0.02 (0.02, 0.02)	0.71 (0.69, 0.74)	1.13 (1.1, 1.17)	1.43 (1.4, 1.47)	1.66 (1.62, 1.7)	1.85 (1.81, 1.89)	2.00 (1.96, 2.05)	2.13 (2.09, 2.18)	2.26 (2.2, 2.31)
Cementless	At Risk	48,657	37,209	25,428	17,435	12,087	8,529	5,670	3,671	2,381
	KM % revision	0.01 (0, 0.02)	0.91 (0.83, 1)	1.36 (1.25, 1.48)	1.71 (1.58, 1.86)	1.91 (1.76, 2.08)	2.17 (2, 2.37)	2.33 (2.13, 2.54)	2.43 (2.22, 2.67)	2.50 (2.27, 2.76)
Hybrid	At Risk	11,211	10,031	8,498	7,408	6,555	5,825	4,932	4,094	3,068
	KM % revision	0.03 (0.01, 0.08)	0.96 (0.8, 1.17)	1.49 (1.27, 1.74)	1.79 (1.54, 2.07)	1.93 (1.67, 2.22)	2.10 (1.83, 2.42)	2.17 (1.89, 2.5)	2.30 (2, 2.64)	2.36 (2.05, 2.71)

*Age, Age*log(time), CCI adjusted HR (95% CI), p-value*
Cementless vs Cemented at 0-1 Months: 1.002(0.797,1.261), p=0.9847
Cementless vs Cemented at 1-18 Months: 1.241(1.120,1.375), p=<.0001
Cementless vs Cemented at 18+ Months: 1.031(0.895,1.187), p=0.6760
Hybrid vs Cemented at 0-1 Months: 1.947(1.381,2.746), p=0.0001
Hybrid vs Cemented at 1-6 Months: 1.313(0.966,1.784), p=0.0824
Hybrid vs Cemented at 6-42 Months: 1.054(0.869,1.280), p=0.5915
Hybrid vs Cemented at 42+ Months: 0.720(0.495,1.046), p=0.0845

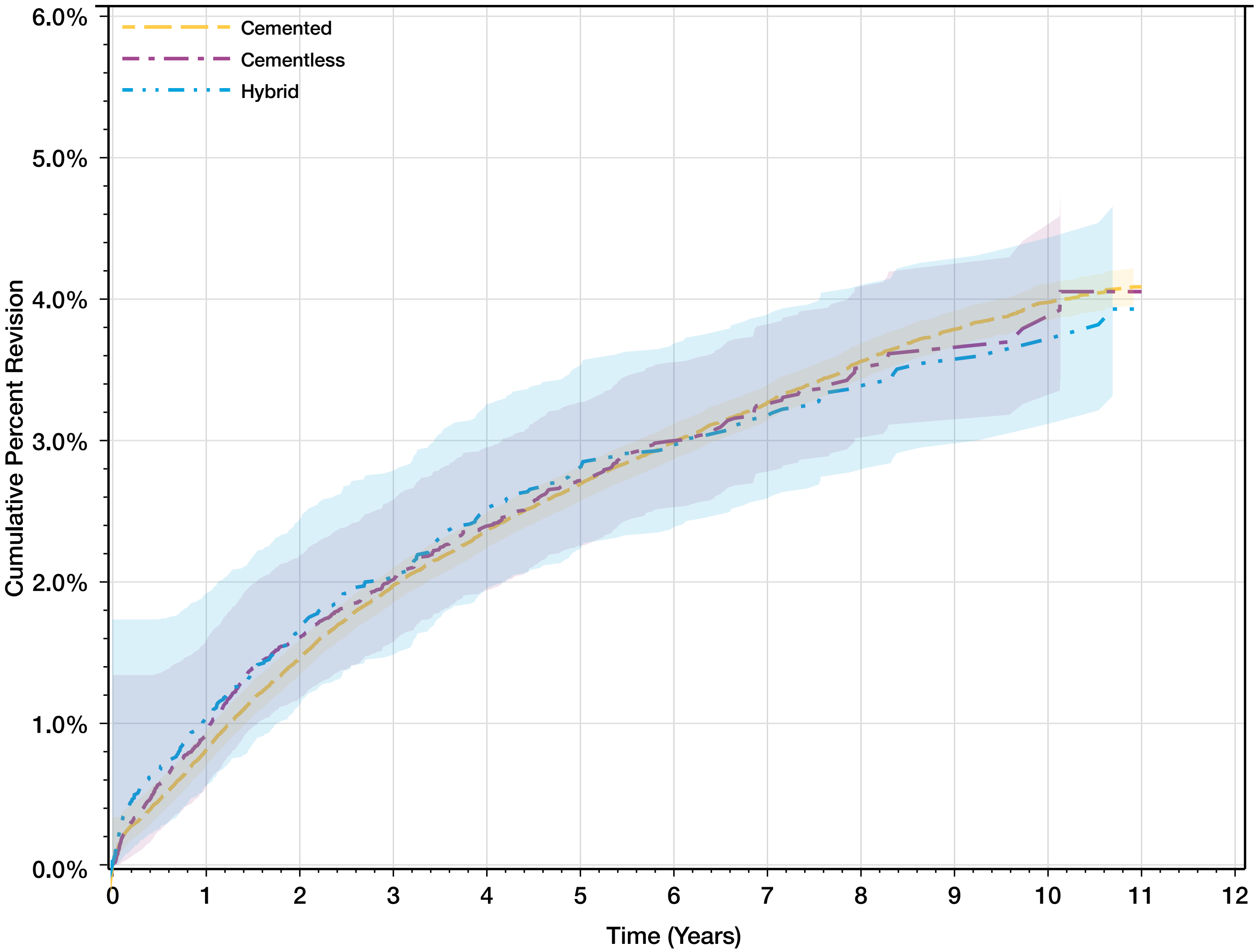
Figure 3.13 Cumulative Percent Revision for Cemented Versus Cementless Fixation Primary Total Knee Arthroplasty in Male Patients Less Than 65 Years of Age with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10
Cemented	At Risk	181,205	165,802	147,517	131,454	117,353	103,344	86,739	69,134	49,651	32,077	18,086
	KM % revision	0.01 (0.01, 0.02)	1.13 (1.08, 1.18)	1.88 (1.81, 1.94)	2.43 (2.35, 2.5)	2.88 (2.79, 2.96)	3.24 (3.15, 3.33)	3.58 (3.48, 3.67)	3.88 (3.77, 3.98)	4.15 (4.04, 4.26)	4.42 (4.3, 4.54)	4.65 (4.52, 4.79)
Cementless	At Risk	40,098	32,958	24,837	18,635	13,731	10,073	7,164	5,004	3,111	1,621	867
	KM % revision	0.01 (0, 0.03)	1.14 (1.04, 1.25)	1.83 (1.7, 1.98)	2.25 (2.09, 2.42)	2.53 (2.35, 2.72)	2.77 (2.57, 2.98)	2.94 (2.73, 3.17)	3.06 (2.83, 3.3)	3.27 (3, 3.56)	3.38 (3.09, 3.7)	3.75 (3.33, 4.23)
Hybrid	At Risk	6,777	6,314	5,578	4,986	4,508	4,062	3,569	2,935	2,235	1,543	1,003
	KM % revision	0.00 (0, 0)	1.05 (0.83, 1.32)	1.85 (1.54, 2.21)	2.17 (1.83, 2.56)	2.47 (2.11, 2.9)	2.77 (2.37, 3.23)	3.16 (2.72, 3.66)	3.51 (3.04, 4.05)	3.73 (3.23, 4.31)	3.83 (3.32, 4.42)	4.07 (3.5, 4.73)

*Age, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Cementless vs Cemented at 0 Months-2 Years: 0.978(0.898,1.066), p=0.6185
Cementless vs Cemented at 2-7.5 Years: 0.645(0.557,0.747), p=<.0001
Cementless vs Cemented at 7.5-10 Years: 1.001(0.584,1.716), p=0.9984
Hybrid vs Cemented over 120 Months: 0.897(0.770,1.045)p=0.1620

Figure 3.14 Cumulative Percent Revision for Cemented Versus Cementless Fixation Primary Total Knee Arthroplasty in Female Patients Less Than 65 Years of Age with Primary Osteoarthritis, 2012-2024



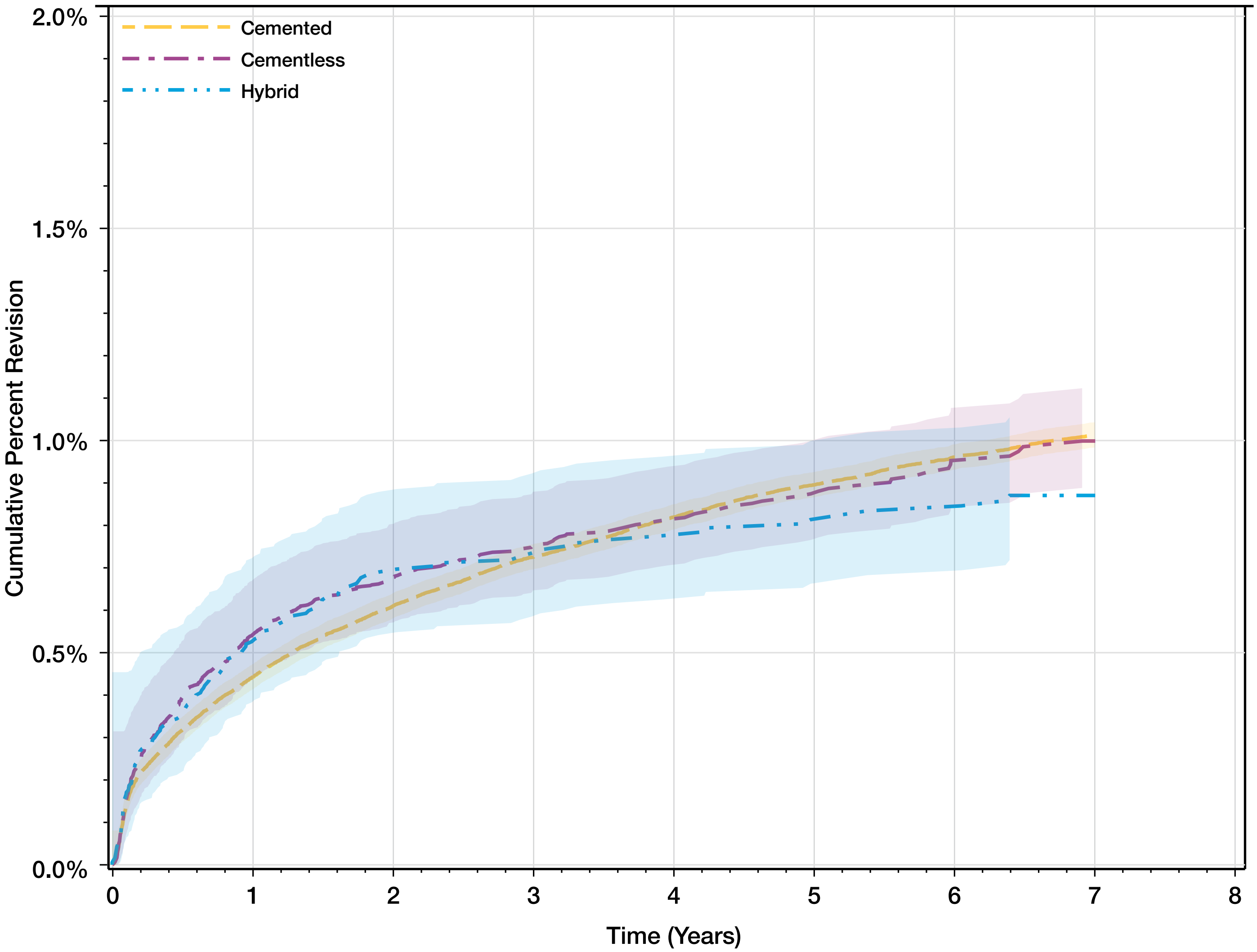
Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
Cemented	At Risk	280,873	255,370	224,987	199,543	178,200	157,011	131,695	104,726	74,914	48,058	27,502	12,207
	KM % revision	0.01 (0.01, 0.02)	0.81 (0.78, 0.85)	1.46 (1.42, 1.51)	1.97 (1.92, 2.03)	2.36 (2.3, 2.42)	2.69 (2.63, 2.76)	2.99 (2.92, 3.06)	3.27 (3.19, 3.35)	3.56 (3.47, 3.65)	3.78 (3.69, 3.88)	3.97 (3.87, 4.08)	4.09 (3.98, 4.2)
Cementless	At Risk	45,142	36,501	27,011	20,016	14,567	10,715	7,524	5,167	3,308	1,709	844	342
	KM % revision	0.00 (0, 0)	0.93 (0.85, 1.03)	1.60 (1.48, 1.74)	2.01 (1.87, 2.17)	2.39 (2.22, 2.57)	2.71 (2.52, 2.92)	2.99 (2.77, 3.23)	3.25 (3, 3.51)	3.51 (3.22, 3.82)	3.61 (3.3, 3.95)	3.79 (3.41, 4.22)	4.05 (3.54, 4.63)
Hybrid	At Risk	9,150	8,490	7,499	6,682	6,034	5,391	4,728	3,970	3,033	2,101	1,406	677
	KM % revision	0.03 (0.01, 0.1)	1.03 (0.84, 1.26)	1.66 (1.41, 1.95)	2.03 (1.75, 2.35)	2.52 (2.2, 2.89)	2.78 (2.43, 3.17)	2.95 (2.59, 3.36)	3.17 (2.79, 3.61)	3.36 (2.96, 3.82)	3.54 (3.11, 4.03)	3.65 (3.2, 4.17)	3.93 (3.39, 4.55)

*Age, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Cementless vs Cemented at 0-6 Months: 1.232(1.074,1.412), p=0.0029
Cementless vs Cemented at 6 Months-11 Years: 0.926(0.853,1.006), p=0.0691
Hybrid vs Cemented at 0-6 Months: 1.448(1.110,1.888), p=0.0064
Hybrid vs Cemented at 6 Months-11 Years: 0.880(0.762,1.016), p=0.0803

Infection is the most common reason for both early and late revisions after primary TKA. The relative rate of revision for infection comparing cemented and cementless fixation in primary TKA remains controversial. Some studies suggest that cementless fixation may lead to lower rates of revision for infection compared to cemented fixation in certain high-risk patient groups.[21-22] In this year's report, we examined the impact of mode of fixation in primary TKA on the age, sex, and CCI adjusted risk of revision due to infection.

For patients aged 65 years and older, we did not find a consistent trend regarding the risk of revision due to infection based on the mode of fixation. Cementless compared to cemented TKAs had a higher CPR for infection within the first 0-6 months post-surgery, a lower CPR for infection between 1.5 to 4 years, and no statistically significant differences at other time points (Figure 3.15). Hybrid fixation demonstrated a lower CPR for infection compared to cemented fixation from 1.5 to 7 years, but no statistically significant difference at other intervals (Figure 3.15)

Figure 3.15 Cumulative Percent Revision for Infection Based on Fixation Method for Primary Total Knee Arthroplasty in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024



Group	stat	0	1	2	3	4	5	6	7
Cemented	At Risk	806,488	709,152	598,658	513,181	447,412	387,261	312,943	238,213
	KM % revision	0.00 (0, 0)	0.44 (0.43, 0.46)	0.61 (0.59, 0.63)	0.73 (0.71, 0.75)	0.82 (0.8, 0.84)	0.90 (0.87, 0.92)	0.96 (0.94, 0.99)	1.01 (0.99, 1.04)
Cementless	At Risk	91,888	70,522	48,324	33,342	23,228	16,271	10,872	7,016
	KM % revision	0.00 (0, 0)	0.54 (0.49, 0.59)	0.68 (0.62, 0.74)	0.75 (0.69, 0.82)	0.81 (0.75, 0.89)	0.87 (0.8, 0.96)	0.95 (0.87, 1.05)	1.00 (0.9, 1.11)
Hybrid	At Risk	18,874	16,898	14,413	12,635	11,195	10,019	8,540	7,095
	KM % revision	0.01 (0, 0.04)	0.53 (0.43, 0.64)	0.69 (0.58, 0.82)	0.73 (0.62, 0.87)	0.78 (0.65, 0.92)	0.81 (0.69, 0.96)	0.83 (0.7, 0.99)	0.87 (0.74, 1.03)

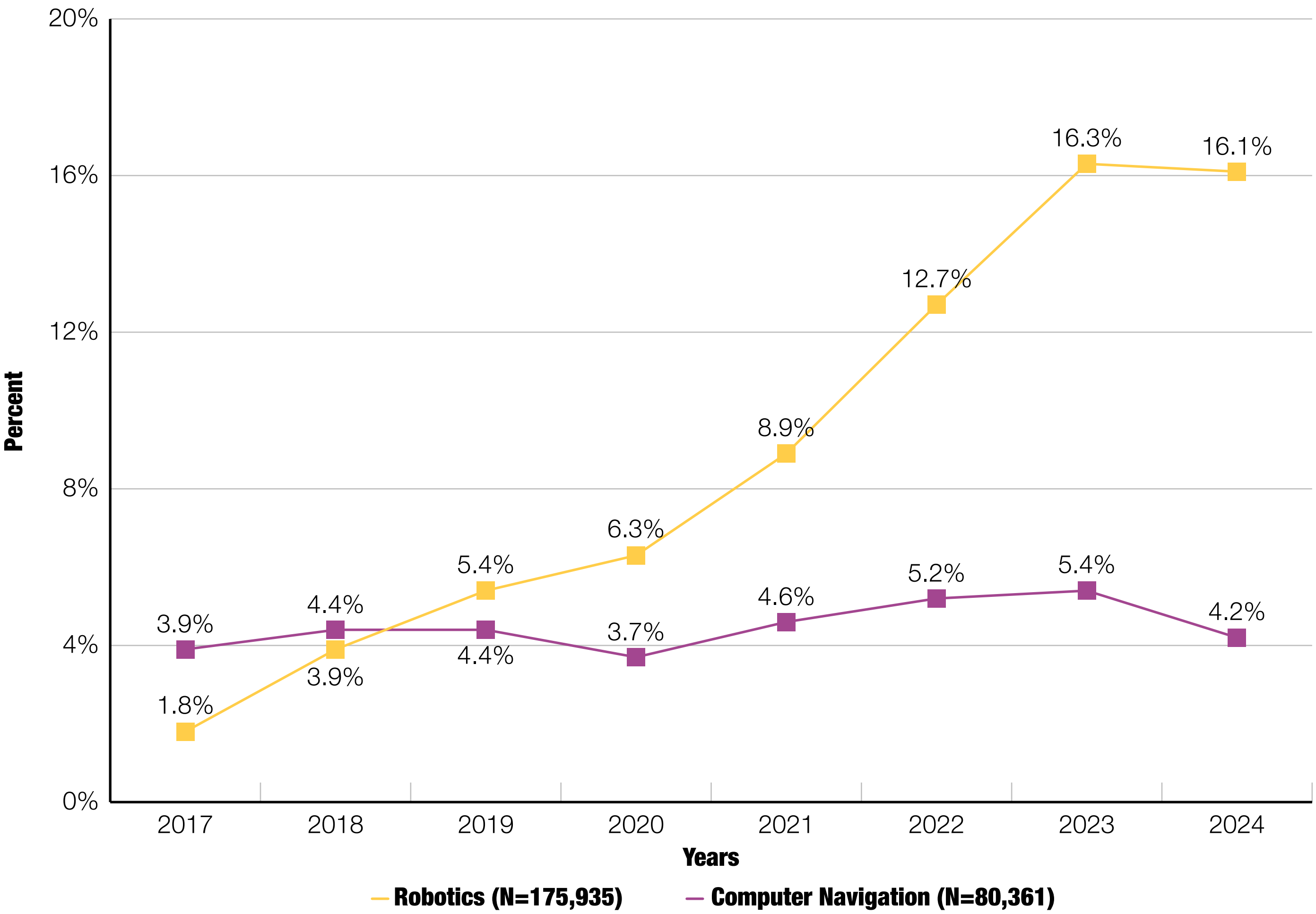
*Age, Sex, CCI, CCI * log(time) adjusted HR (95% CI), p-value*
Cementless vs Cemented at 0-6 Months: 1.167(1.043,1.306), p=0.0072
Cementless vs Cemented at 6 Months-1.5 Years: 1.006(0.860,1.178), p=0.9363
Cementless vs Cemented at 1.5-4.5 Years: 0.620(0.496,0.775), p=<.0001
Cementless vs Cemented at 4.5-7 Years: 0.901(0.570,1.425), p=0.6560
Hybrid vs Cemented at 0 Months-1.5 Years: 1.140(0.944,1.377), p=0.1731
Hybrid vs Cemented at 1.5-7 Years: 0.515(0.359,0.739), p=0.0003

Technology Usage in Primary TKA

Data completeness and reporting to AJRR on the use of robotics and navigation in primary TKA has improved significantly over the last several years. However, data completeness for both computer navigation and robotics this year remains below 50% (Table 1.2). Current initiatives include collaborations between the AJRR, various international registries, and industry partners through AdvaMed to standardize robotic nomenclature for robotic platforms and software versions to optimize data capture rates and improve accuracy for reporting of robotic usage in TKA worldwide.

Trends in robotic usage for primary TKA in the U.S. over time are reported (Figures 3.16-3.17). The use of robotic assistance in primary TKA has significantly increased over the past five years approaching 16.1% in the aggregate analysis in 2024 (Figure 3.16). Rates of robotic use in primary TKA varies significantly based on the specific robotic platforms used (Figure 3.17). The use of navigation alone in primary TKA is rare (3-4%) and has remained stable over the past seven years (Figure 3.16).

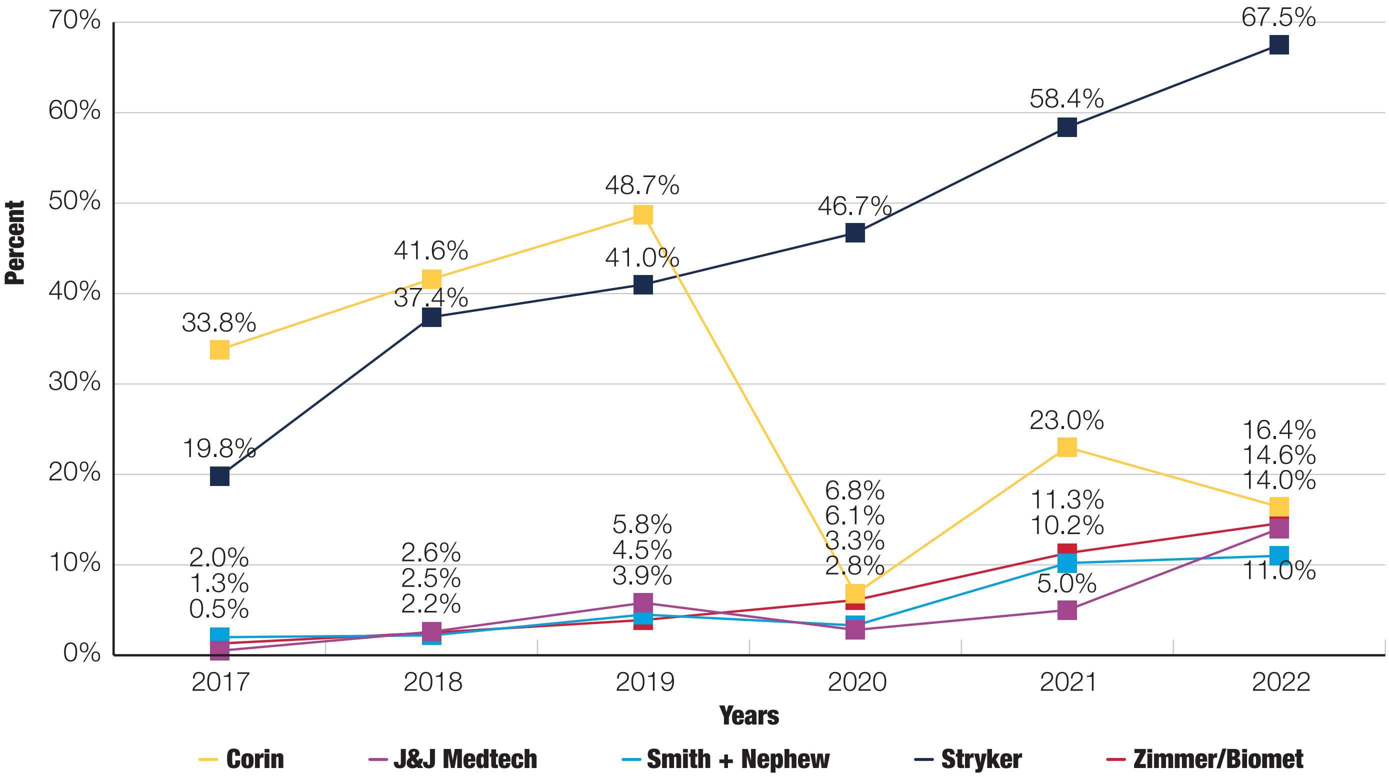
Figure 3.16 **Rate of Technology Use for Assistance in Total Knee Arthroplasty, 2017-2024 (N = 219,627)**



Limitations

AJRR relies on participating institutions submitting data on arthroplasty surgery and only 44% of procedures within the AJRR reported a valid value of "Yes," "No," or "Not Reported" for our discrete robotics field. The percentage of cases reporting robotics has increased steadily over the last several years, but remains a significant limitation for our dataset. Reporting to the AJRR is also voluntary and subject to cluster sampling bias influenced by individual surgeons and institutions. The AJRR is working with our industry partners through AdvaMed to improve data capture rates for robotics. These efforts to improve the quality of data available related to robotic use in the U.S. for primary TKA represents an important area of focus for the AJRR. This limitation is highlighted in Figure 3.17 where only the top five manufacturers are reported that have a minimum number of 400 cases. As data capture improves over time additional manufacturers will be included for trend analysis. It is important to note that the robotics data submitted to the AJRR may be subject to selection bias, as it reflects robotic systems used by submitting institutions.

Figure 3.17 Percentage of Primary TKA with Robotic Use Stratified by Manufacturer, 2017-2022 (N=176,416).

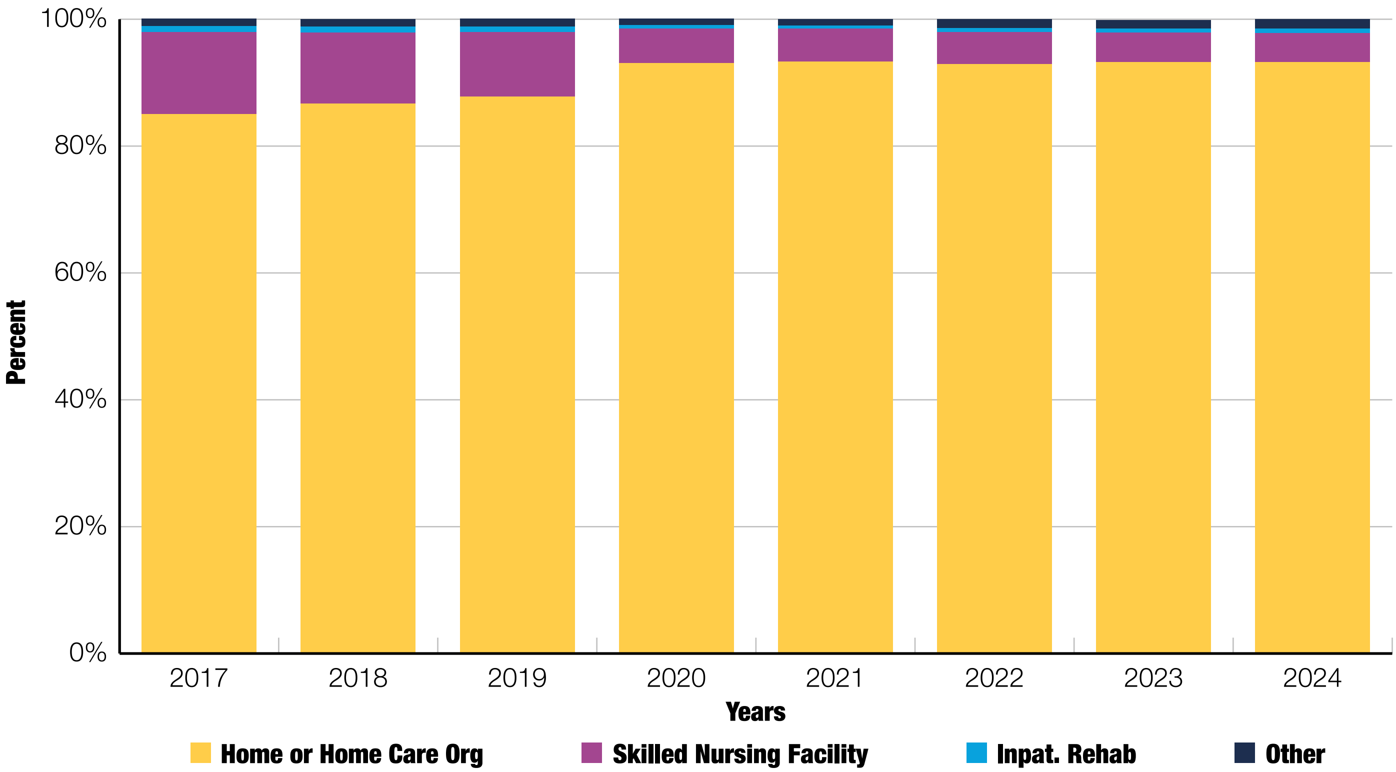


Discharge and Anesthesia

Most patients are discharged home after primary TKA (Figure 3.18). The percentage of patients discharged directly home after primary TKA has increased steadily from 85% in 2012 to 93.2% in 2024. The observed high rate of discharge directly home after primary TKA is likely affected by increased use of accelerated rehabilitation protocols and an increase in outpatient TKA procedures over time.

INSIGHTS **The observed high rate of discharge directly home after primary TKA is likely effected by increased use of accelerated rehabilitation protocols and an increase in outpatient TKA procedures over time.**

Figure 3.18 **Total Knee Arthroplasty Discharge Disposition Codes by Year, 2012-2024 (N=1,542,360)**



	2017	2018	2019	2020	2021	2022	2023	2024
Home or Home Care Org	85.0%	86.7%	87.8%	93.1%	93.3%	92.9%	93.2%	93.2%
Skilled Nursing Facility	13.0%	11.2%	10.2%	5.4%	5.2%	5.1%	4.7%	4.6%
Inpat. Rehab	0.9%	0.9%	0.8%	0.6%	0.5%	0.6%	0.6%	0.7%
Other	1.2%	1.2%	1.3%	1.0%	1.0%	1.4%	1.4%	99.0%

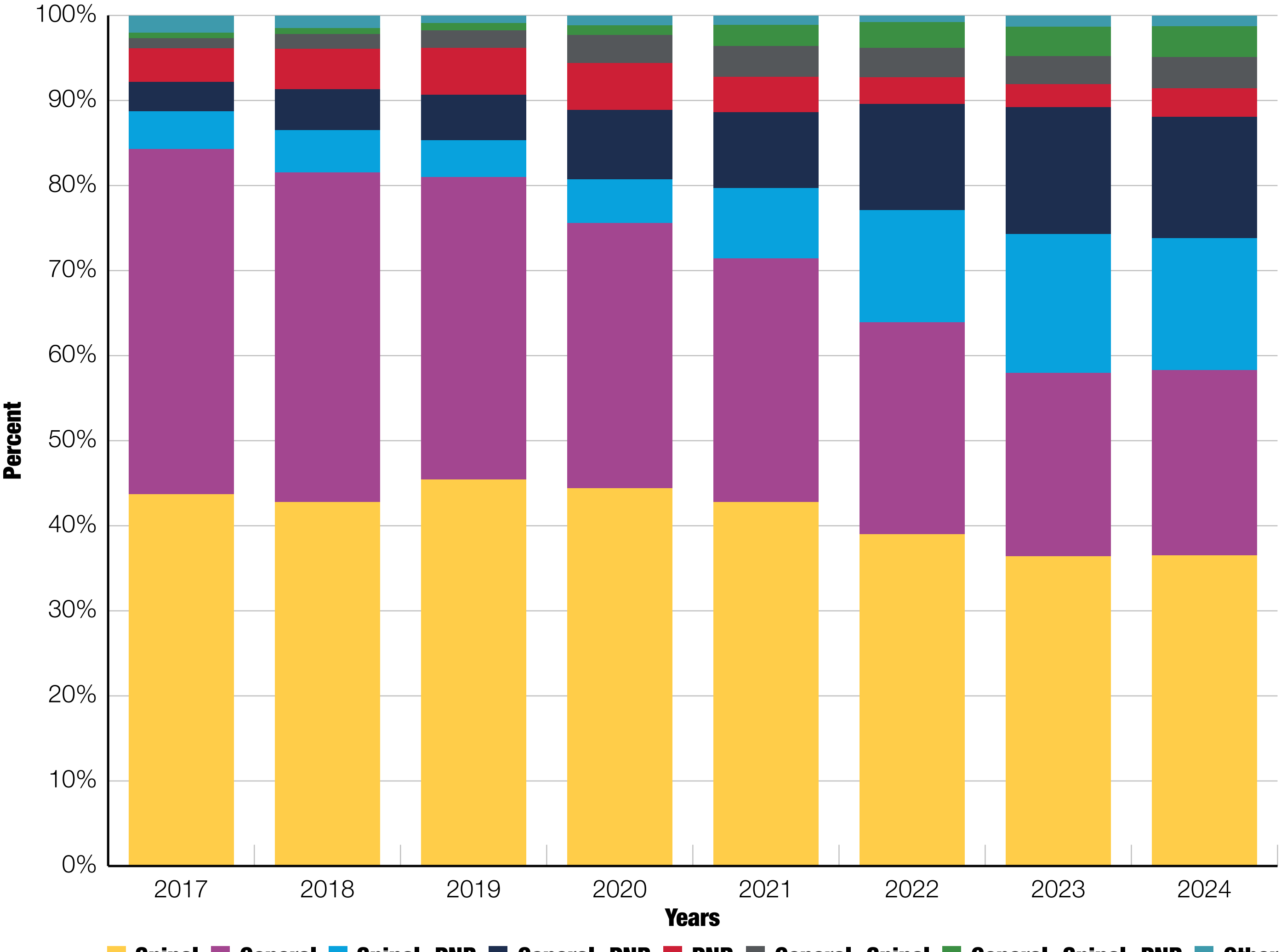
Code	Code Value
Home	Discharged to home/self-care (routine charge).
Home Care Org.	Discharged/transferred to home care of organized home health service organization.
SNF	Discharged/transferred to skilled nursing facility (SNF) with Medicare certification in anticipation of covered skilled care--(For hospitals with an approved swing bed arrangement, use Code 61 - swing bed. For reporting discharges/transfers to a non-certified SNF, the hospital must use Code 04 - ICF.)
Inpat. Rehab	Discharged/transferred to an inpatient rehabilitation facility including distinct units of a hospital (eff. 1/2002).

The majority of primary TKAs in the U.S. are performed using regional techniques 52%- spinal- 36.5% and spinal plus peripheral nerve block (15.5%). Most of the remaining procedures are performed with general anesthesia (GA) (36.1%- general- 21.8%, general plus peripheral nerve block- 14.3% (Figure 3.19). There has been a significant decline over the last 7 years in the use of GA alone from 40.6% of cases in 2017 to 21.8% in 2024.

INSIGHTS

There has been a significant decline over the last 7 years in the use of GA alone from 40.6% of cases in 2017 to 21.8% in 2024 in primary TKA.

Figure 3.19 Primary Total Knee Arthroplasty Anesthesia Type by Year, 2012-2024 (N=1,069,929)



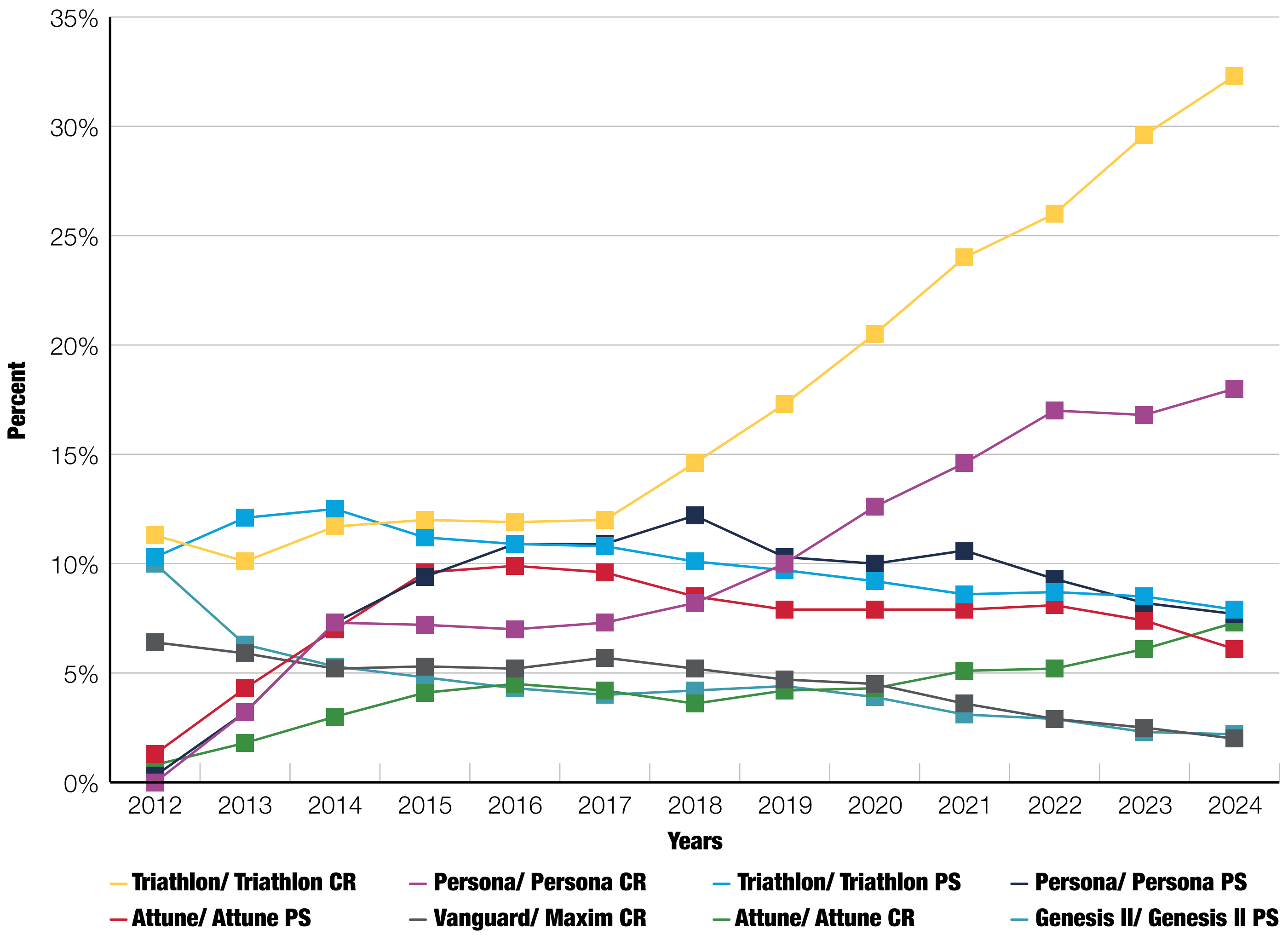
	2017	2018	2019	2020	2021	2022	2023	2024
Spinal	43.7%	42.8%	45.4%	44.4%	42.8%	39.0%	36.4%	36.5%
General	40.6%	38.7%	35.6%	31.2%	28.6%	24.9%	21.6%	21.8%
Spinal+PNB	4.4%	5.0%	4.3%	5.1%	8.3%	13.2%	16.3%	15.5%
General+PNB	3.5%	4.8%	5.4%	8.2%	8.9%	12.5%	14.9%	14.3%
PNB	3.9%	4.8%	5.5%	5.5%	4.2%	3.1%	2.7%	3.3%
General+Spinal	1.2%	1.7%	2.0%	3.3%	3.6%	3.5%	3.3%	3.7%
General+Spinal+PNB	0.7%	0.7%	0.9%	1.1%	2.5%	3.0%	3.5%	3.6%
Other	1.9%	1.5%	1.0%	1.2%	1.2%	0.9%	1.5%	1.4%

Primary TKA Components

Implant utilization rates in primary TKA vary over time. We report on implant utilization in primary TKA in the U.S. reported to the AJRR from 2012 through 2024 (Figure 3.20). The findings in this report are based on procedures voluntarily submitted by participating hospitals and surgeons to the AJRR. This report reflects utilization trends and patterns within this specific AJRR dataset.

The Triathlon/Triathlon CR combination is the most commonly used implant in TKA in the U.S. increasing steadily in use from 11.3% in 2012 to 32.3% in 2024.

Figure 3.20 Primary Total Knee Arthroplasty Femoral/Tibial Component Combinations by Year, 2012-2024 (N=1,675,746)



The ability to review revision rates for particular implant combinations represents one of the strengths of the AJRR. The tables below (Tables 3.5 to 3.7) display CPR for knee implant constructs stratified by bearing surface, degree of constraint, and mode of fixation. In the first year, the knee-device CPR behavior demonstrated very little difference for posterior stabilized and minimally stabilized (cruciate retaining) constructs (Table 3.5).

In patients aged 65 and older, CPR for cemented TKA constructs in the aggregate ranged from 0.84% at 1 year to 2.60% at 10 years. CPR for manufacturer specific cemented TKA constructs generally ranged between 2% and 3% at 10 years. Certain designs, particularly those with smaller sample sizes, were outliers with CPR over 10% at 10 years (Table 3.5).

INSIGHTS

Excellent survivorship was noted for all modes of fixation in primary TKA in patients 65 years of age and older with CPR less than 3% for most designs at the 10-year follow-up interval

In patients aged 65 and older, CPR for manufacturer specific cementless TKA constructs were excellent with rates below 3% at 10 years (Table 3.6). In patients aged 65 and older, CPR for cementless TKA constructs in the aggregate were 1.05% at 1 year and increased to 2.31% at 10 years. In patients aged 65 and older, CPR for hybrid TKA constructs range from 0.86% at 1 year to 2.29% at 10 years (Table 3.7).

It is important to emphasize that this analysis does not adjust for any potential confounders of patient, procedure, or hospital characteristics. The CPR of one implant may also be influenced by other components used in the construct and not reflect the inherent performance of that individual implant alone. Devices presented in the analysis were required to meet the minimum case threshold of 400 total procedures.

Table 3.5 Unadjusted Cumulative Percent Revision of Cemented Knee Arthroplasty Construct Combinations for Primary Total Knee Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
Triathlon/ Triathlon CR Cemented	114,604	1,795	0.77 (0.72, 0.82)	1.34 (1.27, 1.42)	1.73 (1.64, 1.81)	1.96 (1.86, 2.06)	2.25 (2.13, 2.38)
Persona/ Persona CR Cemented	107,534	1,452	0.72 (0.67, 0.77)	1.29 (1.22, 1.36)	1.60 (1.51, 1.69)	1.80 (1.7, 1.91)	2.01 (1.88, 2.15)
Persona/ Persona PS Cemented	88,668	1,834	0.87 (0.81, 0.93)	1.68 (1.6, 1.77)	2.15 (2.04, 2.25)	2.50 (2.38, 2.62)	2.66 (2.53, 2.8)
Triathlon/ Triathlon PS Cemented	76,221	1,698	0.97 (0.91, 1.05)	1.77 (1.67, 1.86)	2.21 (2.1, 2.33)	2.47 (2.35, 2.59)	2.76 (2.62, 2.9)
Attune/ Attune PS Cemented	69,044	1,480	0.81 (0.75, 0.88)	1.67 (1.57, 1.77)	2.15 (2.03, 2.27)	2.52 (2.39, 2.66)	2.83 (2.67, 2.99)
Attune/ Attune CR Cemented	42,740	671	0.77 (0.69, 0.85)	1.39 (1.27, 1.51)	1.78 (1.64, 1.93)	2.04 (1.88, 2.22)	2.40 (2.16, 2.65)
Vanguard/ Maxim CR Cemented	37,003	649	0.71 (0.62, 0.8)	1.36 (1.25, 1.49)	1.66 (1.53, 1.8)	1.90 (1.75, 2.05)	2.17 (2, 2.36)
Genesis II/ Genesis II PS Cemented	34,735	952	1.15 (1.04, 1.27)	2.17 (2.02, 2.33)	2.67 (2.5, 2.86)	3.10 (2.9, 3.3)	3.37 (3.15, 3.6)
Journey II/ Journey II PS Cemented	31,974	763	1.23 (1.11, 1.36)	2.28 (2.11, 2.46)	2.71 (2.52, 2.92)	2.93 (2.72, 3.15)	3.22 (2.94, 3.51)
Sigma/ PFC Sigma CR Cemented	22,665	372	0.65 (0.56, 0.77)	1.16 (1.03, 1.31)	1.44 (1.29, 1.61)	1.63 (1.46, 1.81)	1.92 (1.72, 2.13)
Sigma/ PFC Sigma PS Cemented	20,857	475	0.73 (0.63, 0.86)	1.51 (1.35, 1.68)	1.99 (1.81, 2.19)	2.32 (2.11, 2.54)	2.60 (2.37, 2.85)
Vanguard/ Maxim PS Cemented	18,868	480	0.93 (0.8, 1.07)	1.91 (1.72, 2.12)	2.48 (2.25, 2.72)	2.76 (2.51, 3.02)	3.20 (2.9, 3.52)
Legion/ Genesis II PS Cemented	18,592	395	0.86 (0.73, 1)	1.67 (1.49, 1.87)	2.16 (1.94, 2.39)	2.46 (2.21, 2.72)	2.76 (2.47, 3.08)
Genesis II/ Genesis II CR Cemented	18,145	347	0.75 (0.64, 0.89)	1.53 (1.36, 1.73)	1.91 (1.71, 2.14)	2.17 (1.94, 2.42)	2.38 (2.12, 2.66)
NexGen LPS-Flex/ NexGen PS Cemented	15,184	395	0.80 (0.67, 0.95)	1.53 (1.35, 1.74)	2.12 (1.89, 2.36)	2.43 (2.19, 2.7)	2.91 (2.62, 3.21)
Legion/ Genesis II CR Cemented	9,500	167	0.84 (0.67, 1.04)	1.65 (1.39, 1.93)	1.98 (1.69, 2.31)	2.08 (1.78, 2.43)	2.13 (1.81, 2.48)
Sigma/ MBT PS Cemented	8,881	280	0.89 (0.71, 1.1)	1.84 (1.58, 2.14)	2.54 (2.22, 2.9)	3.06 (2.7, 3.45)	3.71 (3.29, 4.18)
Evolution MP/ Evolution MP PS Cemented	8,127	181	0.78 (0.61, 1)	1.74 (1.46, 2.06)	2.33 (1.99, 2.71)	2.65 (2.27, 3.07)	2.98 (2.54, 3.47)

Table 3.6 continued on next page

**The 95% confidence intervals are included in parenthesis.*

Table 3.5 **Unadjusted Cumulative Percent Revision of Cemented Knee Arthroplasty Construct Combinations for Primary Total Knee Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024**

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
EMPOWR 3D/ EMPOWR CR Cemented	7,910	141	0.99 (0.78, 1.22)	1.66 (1.38, 1.98)	2.08 (1.74, 2.47)	2.31 (1.92, 2.76)	—
Natural-Knee II GS/ Natural-Knee II CR Cemented	7,081	113	0.62 (0.46, 0.83)	1.14 (0.91, 1.42)	1.52 (1.24, 1.83)	1.71 (1.41, 2.05)	1.76 (1.46, 2.12)
GMK Sphere/ GMK Primary CR Cemented	6,216	112	0.89 (0.68, 1.15)	1.69 (1.38, 2.06)	2.03 (1.66, 2.45)	2.39 (1.91, 2.94)	2.39 (1.91, 2.94)
Apex Knee/ Apex Knee CR Cemented	5,468	132	0.97 (0.74, 1.26)	2.01 (1.65, 2.42)	2.46 (2.06, 2.93)	2.74 (2.29, 3.25)	2.90 (2.41, 3.46)
NexGen CR-Flex/ NexGen CR Cemented	4,139	78	0.51 (0.33, 0.76)	1.29 (0.98, 1.68)	1.60 (1.25, 2.02)	1.80 (1.42, 2.25)	2.06 (1.62, 2.57)
Sigma/ MBT CR Cemented	3,576	93	0.81 (0.56, 1.15)	1.48 (1.12, 1.92)	2.36 (1.88, 2.92)	2.74 (2.22, 3.35)	2.90 (2.35, 3.53)
EMPOWR/ EMPOWR PS Cemented	2,728	56	0.73 (0.47, 1.12)	1.56 (1.14, 2.09)	2.39 (1.81, 3.09)	2.47 (1.87, 3.2)	—
Unity Knee System/ Unity Knee System CR Cemented	1,971	25	0.98 (0.61, 1.5)	1.22 (0.79, 1.8)	1.62 (0.99, 2.52)	1.62 (0.99, 2.52)	1.62 (0.99, 2.52)
NexGen CR-Flex/ NexGen Pegged CR Cemented	1,744	34	0.80 (0.46, 1.32)	1.38 (0.91, 2.02)	1.65 (1.12, 2.34)	1.89 (1.31, 2.64)	2.17 (1.49, 3.07)
NexGen LPS-Flex GS/ NexGen PS Cemented	1,609	44	1.06 (0.64, 1.66)	2.04 (1.43, 2.84)	2.65 (1.92, 3.55)	2.73 (1.99, 3.65)	3.10 (2.27, 4.13)
Apex Knee/ Apex Knee PS Cemented	1,255	10	0.32 (0.11, 0.78)	0.52 (0.22, 1.1)	0.79 (0.37, 1.52)	1.38 (0.63, 2.66)	1.38 (0.63, 2.66)
LCS Complete/ MBT CR Cemented	1,217	31	0.66 (0.31, 1.25)	1.48 (0.91, 2.28)	1.81 (1.17, 2.68)	2.21 (1.48, 3.17)	2.83 (1.95, 3.95)
Optetrak Logic/ Optetrak Logic PS Cemented	1,191	66	1.34 (0.8, 2.13)	2.35 (1.6, 3.33)	3.02 (2.16, 4.11)	4.79 (3.67, 6.12)	6.04 (4.69, 7.62)
NexGen/ NexGen CR Cemented	1,000	16	0.40 (0.14, 0.98)	0.90 (0.45, 1.65)	1.31 (0.74, 2.18)	1.55 (0.91, 2.5)	1.70 (1.01, 2.69)
GMK Sphere/ GMK Sphere CR Cemented	841	10	0.60 (0.23, 1.33)	0.74 (0.31, 1.54)	1.95 (0.93, 3.63)	1.95 (0.93, 3.63)	1.95 (0.93, 3.63)
Unity Knee System/ Unity Knee System PS Cemented	742	7	0.41 (0.12, 1.13)	0.86 (0.36, 1.8)	1.11 (0.49, 2.25)	1.11 (0.49, 2.25)	1.11 (0.49, 2.25)
3DKnee/ Foundation CR Cemented	706	20	1.56 (0.83, 2.69)	2.12 (1.24, 3.4)	2.55 (1.57, 3.92)	2.69 (1.68, 4.09)	2.88 (1.82, 4.34)
Genesis II/ Journey II PS Cemented	640	13	0.97 (0.4, 2.01)	3.69 (1.75, 6.8)	4.91 (2.24, 9.16)	4.91 (2.24, 9.16)	4.91 (2.24, 9.16)
GMK Primary/ GMK Primary PS Cemented	627	22	0.64 (0.22, 1.55)	2.25 (1.29, 3.66)	3.07 (1.91, 4.65)	3.61 (2.33, 5.31)	3.61 (2.33, 5.31)
Optetrak Logic/ Optetrak Logic CR Cemented	626	58	0.80 (0.31, 1.78)	2.40 (1.4, 3.83)	6.46 (4.71, 8.59)	9.39 (7.23, 11.88)	9.80 (7.53, 12.43)
LCS Complete/ MBT PS Cemented	622	6	0.00 (., .)	0.80 (0.31, 1.79)	0.98 (0.41, 2.04)	0.98 (0.41, 2.04)	0.98 (0.41, 2.04)
GMK Sphere/ GMK Primary NA Cemented	620	9	1.45 (0.72, 2.65)	1.45 (0.72, 2.65)	1.45 (0.72, 2.65)	1.45 (0.72, 2.65)	—
Natural-Knee II/ Natural-Knee II CR Cemented	523	7	0.76 (0.26, 1.85)	1.15 (0.48, 2.38)	1.15 (0.48, 2.38)	1.38 (0.62, 2.73)	1.38 (0.62, 2.73)
NexGen/ NexGen PS Cemented	444	17	1.35 (0.56, 2.79)	2.70 (1.48, 4.54)	2.94 (1.65, 4.84)	3.68 (2.19, 5.77)	4.32 (2.51, 6.85)
NexGen/ NexGen Pegged CR Cemented	428	6	0.94 (0.32, 2.26)	1.17 (0.45, 2.59)	1.42 (0.59, 2.94)	1.42 (0.59, 2.94)	1.42 (0.59, 2.94)
Evolution MP/ Advance II CR Cemented	420	5	0.95 (0.32, 2.3)	1.19 (0.45, 2.63)	1.19 (0.45, 2.63)	1.19 (0.45, 2.63)	1.19 (0.45, 2.63)
Overall	**797,686**	**15,517**	**0.84 (0.82, 0.86)**	**1.58 (1.55, 1.61)**	**2.01 (1.98, 2.05)**	**2.31 (2.27, 2.34)**	**2.60 (2.55, 2.64)**

**The 95% confidence intervals are included in parenthesis.*

Table 3.6 **Unadjusted Cumulative Percent Revision of Cementless Knee Arthroplasty Construct Combinations for Primary Total Knee Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024**

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
Triathlon/ Triathlon CR Cementless	70,899	1,074	0.99 (0.92, 1.07)	1.61 (1.51, 1.72)	1.93 (1.8, 2.06)	2.13 (1.98, 2.29)	2.22 (2.04, 2.41)
Triathlon/ Triathlon PS Cementless	11,250	251	1.44 (1.23, 1.67)	2.26 (1.98, 2.57)	2.62 (2.3, 2.98)	2.82 (2.45, 3.22)	2.87 (2.49, 3.29)
Attune FB/ Attune CR Cementless	3,878	43	0.91 (0.64, 1.26)	1.81 (0.98, 3.08)	—	—	—
Persona OsseoTi/ Persona CR Cementless	2,656	40	1.43 (0.99, 1.99)	—	—	—	—
Natural-Knee II GS/ Natural-Knee II CR Cementless	663	11	0.60 (0.21, 1.47)	1.21 (0.58, 2.3)	1.72 (0.92, 2.98)	1.72 (0.92, 2.98)	1.72 (0.92, 2.98)
Sigma/ MBT CR Cementless	577	9	0.87 (0.33, 1.93)	1.58 (0.78, 2.88)	1.58 (0.78, 2.88)	1.58 (0.78, 2.88)	1.58 (0.78, 2.88)
Attune FB/ Attune PS Cementless	541	11	1.87 (0.96, 3.3)	2.25 (1.16, 3.94)	—	—	—
Vanguard/ Regenerex CR Cementless	505	9	0.59 (0.17, 1.64)	1.58 (0.75, 2.99)	1.58 (0.75, 2.99)	1.58 (0.75, 2.99)	1.95 (0.94, 3.59)
Overall	**91,065**	**1,451**	**1.05 (0.99, 1.12)**	**1.72 (1.63, 1.82)**	**2.03 (1.92, 2.15)**	**2.22 (2.08, 2.36)**	**2.31 (2.16, 2.47)**

**The 95% confidence intervals are included in parenthesis.*

Table 3.7 **Unadjusted Cumulative Percent Revision of Hybrid Knee Arthroplasty Construct Combinations for Primary Total Knee Arthroplasty in Patients ≥65 Years of Age with Primary Osteoarthritis, 2012-2024**

Group Name	N Total	N Revised	1-Yr	3-Yrs	5-Yrs	7-Yrs	10-Yrs
Triathlon/ Triathlon CR Hybrid	2,743	57	0.89 (0.59, 1.3)	1.66 (1.22, 2.22)	2.18 (1.64, 2.85)	2.33 (1.76, 3.04)	2.69 (2.03, 3.48)
Sigma/ PFC Sigma CR Hybrid	2,681	39	0.48 (0.27, 0.81)	1.01 (0.68, 1.45)	1.29 (0.91, 1.78)	1.39 (0.99, 1.9)	1.59 (1.14, 2.15)
Vanguard/ Maxim CR Hybrid	2,111	57	1.61 (1.14, 2.22)	2.15 (1.6, 2.85)	2.62 (1.98, 3.39)	2.76 (2.1, 3.56)	2.99 (2.27, 3.85)
Persona/ Persona CR Hybrid	2,053	41	0.70 (0.4, 1.15)	1.98 (1.38, 2.76)	2.66 (1.89, 3.63)	2.81 (1.99, 3.83)	2.97 (2.11, 4.05)
Sigma/ MBT CR Hybrid	767	11	0.65 (0.25, 1.45)	1.22 (0.6, 2.23)	1.63 (0.86, 2.84)	1.63 (0.86, 2.84)	1.63 (0.86, 2.84)
Apex Knee/ Apex Knee CR Hybrid	721	19	1.66 (0.91, 2.81)	2.53 (1.56, 3.89)	2.53 (1.56, 3.89)	2.68 (1.67, 4.07)	2.68 (1.67, 4.07)
Triathlon/ Triathlon PS Hybrid	622	9	0.64 (0.22, 1.56)	1.28 (0.56, 2.54)	1.83 (0.89, 3.39)	1.83 (0.89, 3.39)	1.83 (0.89, 3.39)
Natural-Knee II GS/ Natural-Knee II CR Hybrid	610	9	0.33 (0.07, 1.12)	0.83 (0.32, 1.84)	1.02 (0.43, 2.13)	1.68 (0.83, 3.08)	1.68 (0.83, 3.08)
Attune/ Attune CR Hybrid	486	4	0.21 (0.02, 1.1)	1.03 (0.34, 2.52)	1.03 (0.34, 2.52)	—	—
Overall	**12,794**	**246**	**0.86 (0.71, 1.03)**	**1.57 (1.36, 1.8)**	**1.96 (1.71, 2.23)**	**2.11 (1.85, 2.39)**	**2.29 (2.01, 2.6)**

**The 95% confidence intervals are included in parenthesis.*

Partial Knee Arthroplasty

AJRR has collected data on 108,571 partial knee arthroplasty procedures from 2012 to 2024

In 2024, 3.5% of all knee arthroplasties submitted to the AJRR were unicompartmental knee arthroplasties (UKA) (Figure 3.21). The number of surgeons performing UKA has steadily increased from 200 in 2012 (21.6%) to 1,3048 in 2024 (25.4%). The percentage of UKA in the U.S. has remained stable over the last 6 years and comprises between 3.5-4.5% of knee arthroplasty cases (Table 3.8).

Patellofemoral joint arthroplasty (PJA) remains a rare procedure, accounting for 0.3% of all knee arthroplasties in 2024 (Figure 3.22). The number of surgeons performing PJA has increased slightly from 40 in 2012 (4.2%) to 66 in 2024 (1.2%), reflecting a significant decline in utilization (Table 3.8). The New Zealand Joint Registry reported from 1999-2023 a total of 152,786 primary knee arthroplasties of which only 975 (0.6%) were PJA. A decline in PJA have been noted in New Zealand as well with only 88 reported procedures in 2023.[17] The NJR of England and Wales and the Swedish Arthroplasty Register also reported very low rates of PJA in 2024 (1.1% and 0.3%, respectively).[8,9,23] The worldwide decline in PJA use may be related to the higher failure rates noted in multiple national registries compared with medial UKA, lateral UKA, and primary TKA.

Figure 3.21 Medial or Lateral Unicompartmental Knee Arthroplasty as a Percentage of All Primary Knee Arthroplasty, 2012-2024 (N=2,368,212)

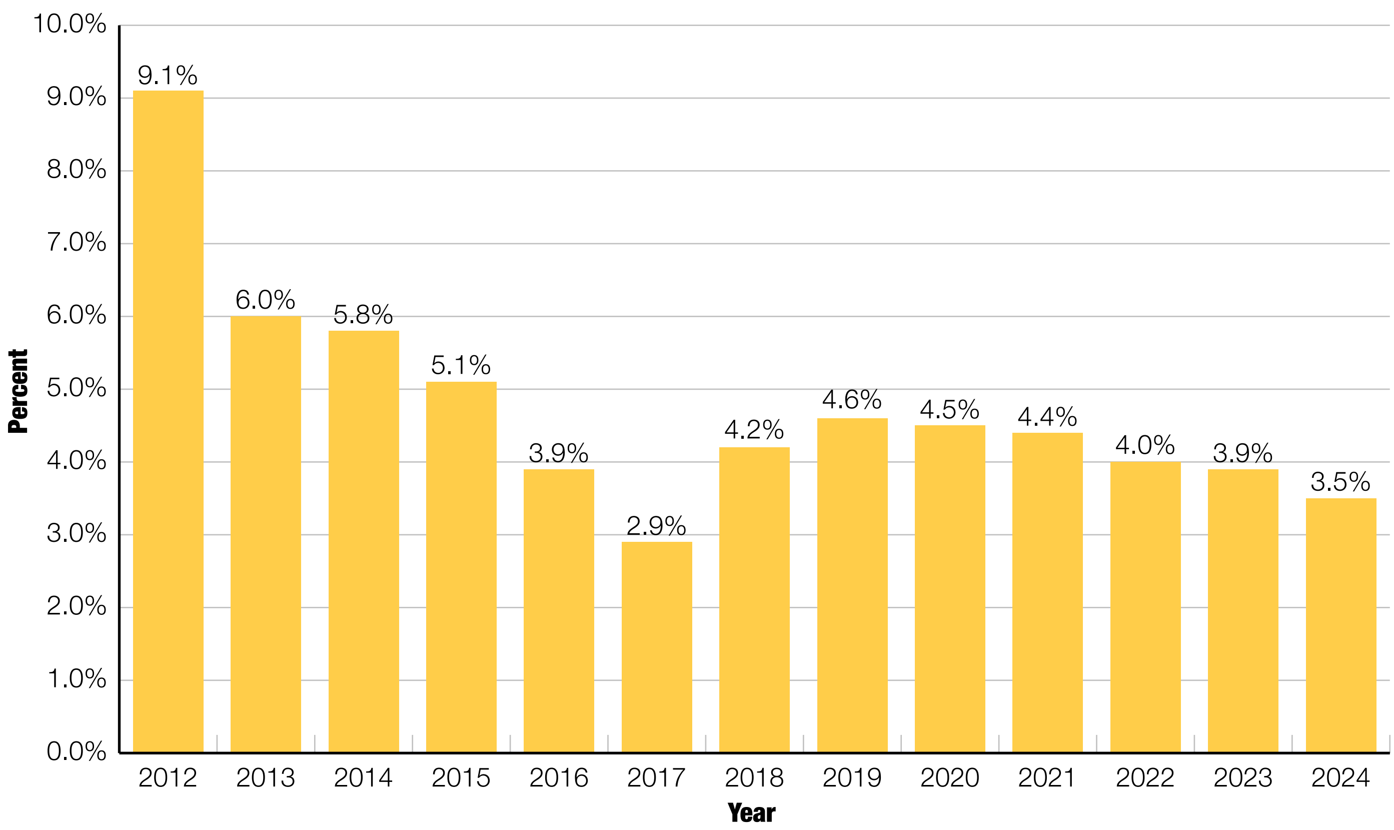


Figure 3.22 Patellofemoral Arthroplasty as a Percentage of All Primary Knee Arthroplasty, 2012-2024 (N=8,674)

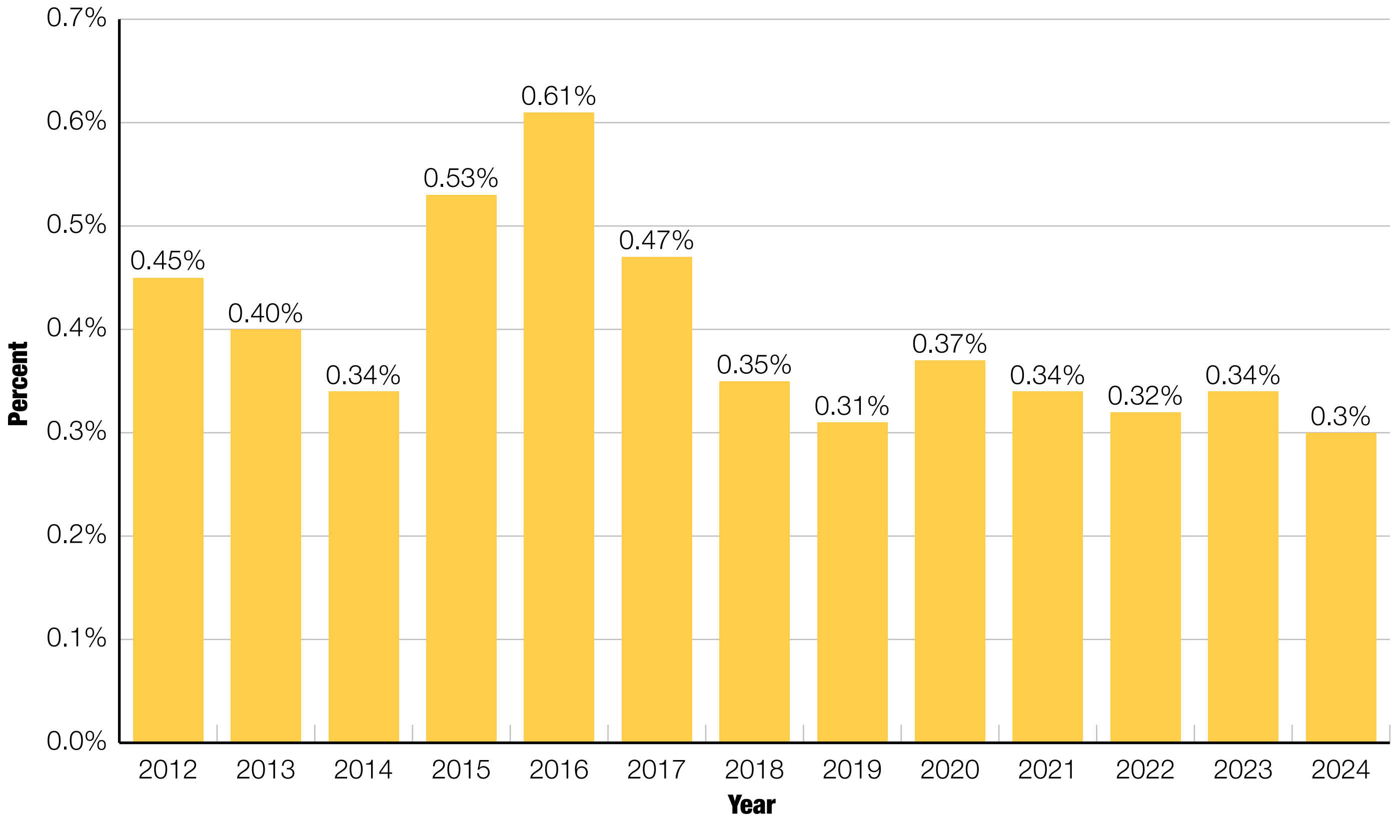
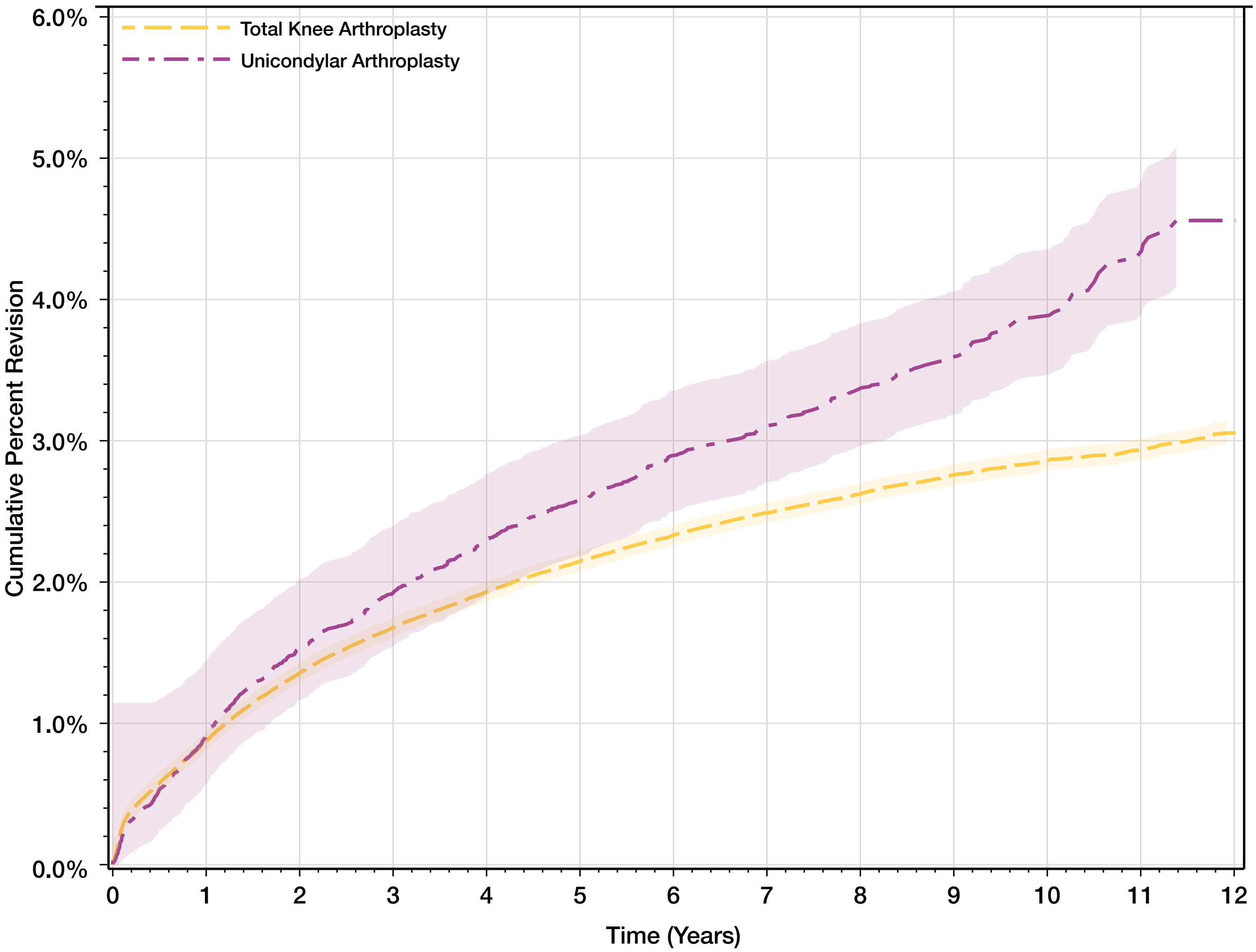


Table 3.8 Surgeons Performing Patellofemoral and Unicompartmental Knee Arthroplasty, 2012-2024

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Surgeons Performing Unicompartmental Knee Arthroplsty	200 (20.8%)	429 (21.6%)	691 (22.7%)	925 (22.9%)	1,048 (21.2%)	976 (19.7%)	1,159 (23.2%)	1,280 (23.9%)	1,254 (23.1%)	1,245 (23.6%)	1,382 (25.0%)	1,513 (25.8%)	1,348 (25.4%)
Suregeons Performing Patellofemoral Arthroplasty	40 (4.2%)	82 (4.1%)	131 (4.3%)	163 (4.0%)	104 (2.1%)	88 (1.8%)	89 (1.78%)	68 (1.3%)	60 (1.1%)	60 (1.1%)	58 (1.1%)	70 (1.1%)	66 (1.2%)
Total number of Surgeons submitting TKA	723 (75.2%)	1,473 (74.2%)	2,218 (73.0%)	2,950 (73.1%)	3,787 (76.7%)	3,904 (78.6%)	3,743 (75.0%)	4,007 (74.8%)	4,112 (75.8%)	3,981 (75.3%)	4,100 (74.0%)	4,293 (73.1%)	3,895 (73.4%)

The CPR for primary TKA and UKA differ significantly for patients aged 65 and older. The rates of CPRs are higher in UKA compared to primary TKA after at longer term follow-up intervals (Figure 3.23).

Figure 3.23 Cumulative Percent Revision of Total Knee Versus Unicondylar Knee Constructs for Femoral Components in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2024

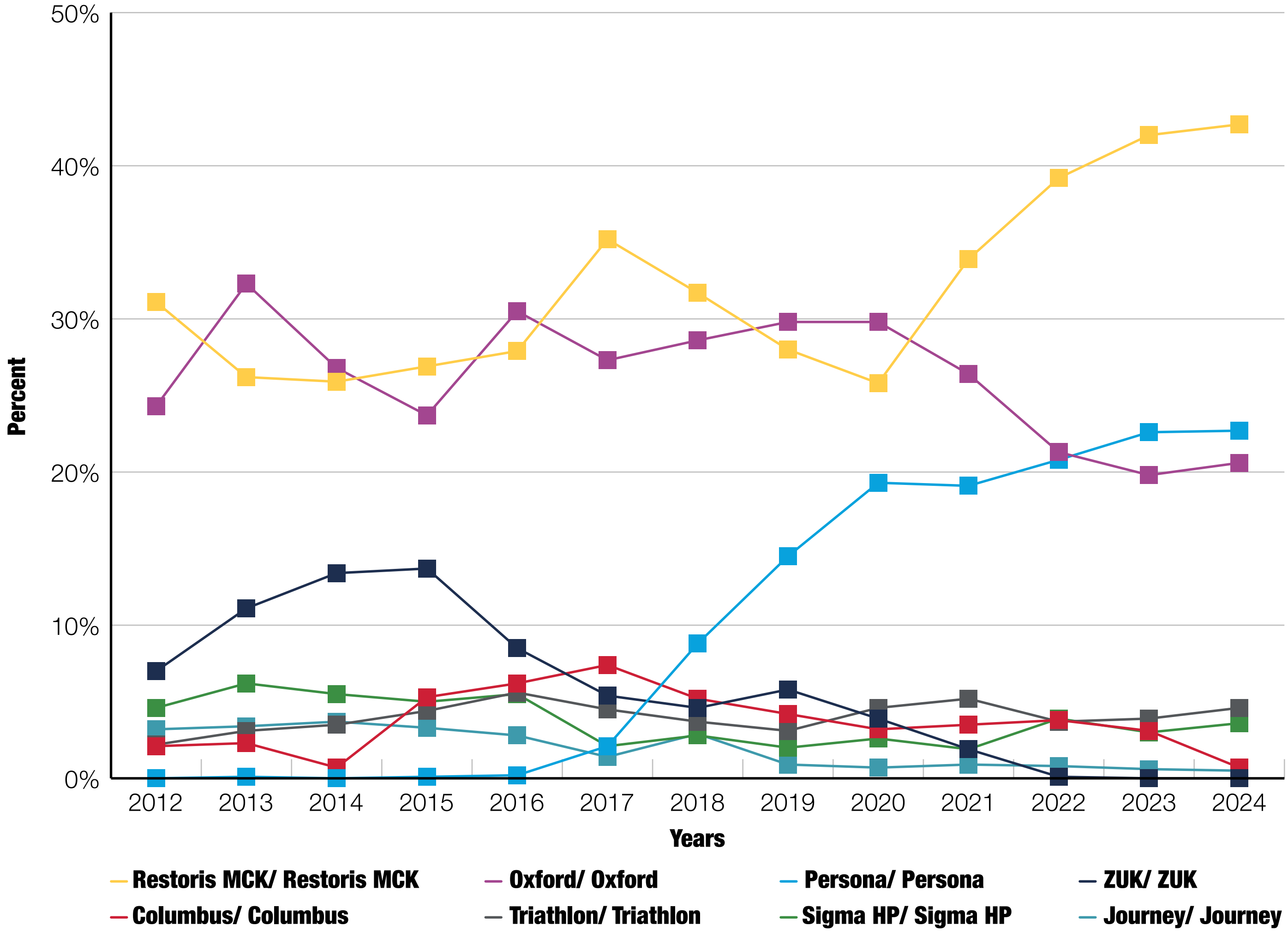


Group	stat	0	1	2	3	4	5	6	7	8	9	10	11	12
Total Knee Arthroplasty	At Risk	1,279,563	1,089,426	897,441	748,846	640,254	544,400	435,908	331,900	225,367	138,285	77,716	35,130	9,776
	KM % revision	0.03 (0.02, 0.03)	0.87 (0.86, 0.89)	1.35 (1.33, 1.38)	1.67 (1.65, 1.7)	1.93 (1.9, 1.96)	2.15 (2.12, 2.18)	2.33 (2.3, 2.36)	2.49 (2.45, 2.52)	2.62 (2.59, 2.66)	2.76 (2.72, 2.8)	2.86 (2.81, 2.9)	2.93 (2.88, 2.98)	3.05 (2.98, 3.12)
Unicondylar Arthroplasty	At Risk	45,543	39,889	33,613	28,565	24,493	20,872	16,521	12,562	9,958	7,171	4,421	2,089	811
	KM % revision	0.01 (0.01, 0.03)	0.91 (0.82, 1)	1.53 (1.41, 1.65)	1.92 (1.79, 2.06)	2.30 (2.15, 2.46)	2.57 (2.41, 2.74)	2.89 (2.71, 3.08)	3.10 (2.9, 3.3)	3.37 (3.15, 3.6)	3.58 (3.35, 3.83)	3.86 (3.6, 4.14)	4.34 (3.99, 4.71)	4.55 (4.15, 4.99)

Age, Sex, CCI adjusted HR (95% CI), p-value
Unicondylar Arthroplasty vs Total Knee Arthroplasty at 0-3 Months: 0.979(0.832,1.151), p=0.7944
Unicondylar Arthroplasty vs Total Knee Arthroplasty at 3 Months-6 Years: 1.346(1.254,1.444), p=<.0001
Unicondylar Arthroplasty vs Total Knee Arthroplasty at 6-12 Years: 1.941(1.609,2.341), p=<.0001

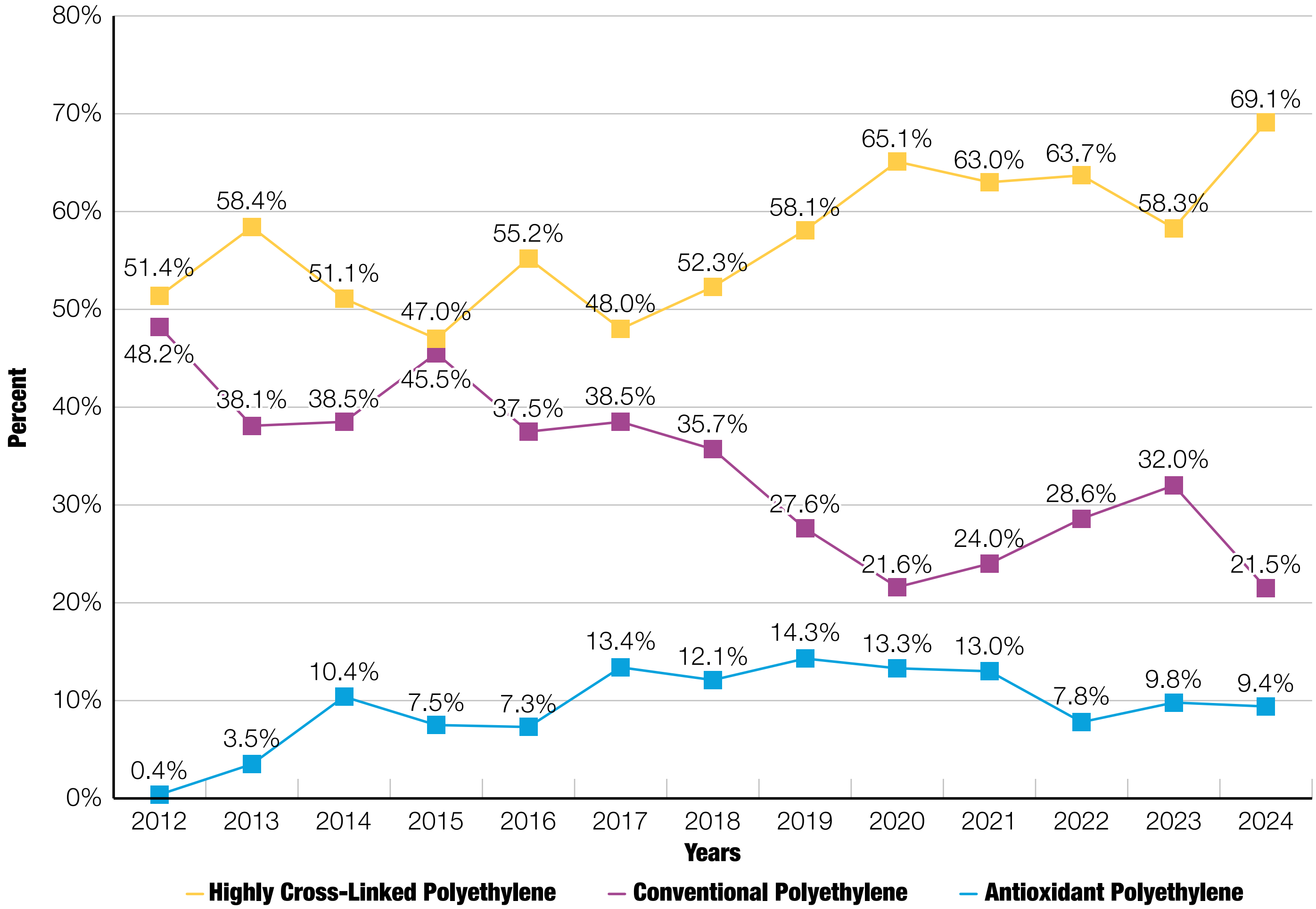
Manufacturer specific data regarding frequency of use for UKA implant constructs are reported (Figure 3.24). The UKA constructs reported by year demonstrates that the most frequently used combination has changed over time. For 2024, the Restoris MultiCompartmental Knee (MCK) was the most frequently implanted combination (42.7%), followed by the Persona UKA (22.7%), and the Oxford UKA (20.6%). The Restoris MCK and the Persona UKA have seen steady growth since 2019 and a decline in use for the Oxford UKA was noted over the same interval (Fig 3.24).

Figure 3.24 Unicondylar Knee Arthroplasty Femoral/Tibial Component Combinations by Year, 2012-2024 (N=67,345)



HXPE and antioxidant HXPE are the most frequent bearing materials used for UKA in the U.S. (69.1% and 21.5%, respectively, Figure 3.25) with CPE accounting for the minority of cases (9.4%). The frequent use of HXPEs likely reflects the preferred superior wear characteristics of HXPE compared with CPE.

Figure 3.25 **Unicondylar Knee Arthroplasty Insert Polyethylene Material by Year, 2012-2024 (N=50,238)**



Revision Knee Arthroplasty

Between 2012 and 2024, AJRR has collected data on 229,826 revision knee arthroplasty procedures. There are ongoing efforts to better identify and characterize the reasons for revision. The data submitted to AJRR contains variability in coding with respect to primary reason for revision. AJRR accepts up to 10 diagnosis codes which can be submitted as either ICD (International Classification of Diseases)-9 or -10 codes depending on the year of the procedure. We supplement AJRR diagnosis codes with CMS-provided diagnosis codes in patients 65 years of age and older to better define the reasons for revision surgery.

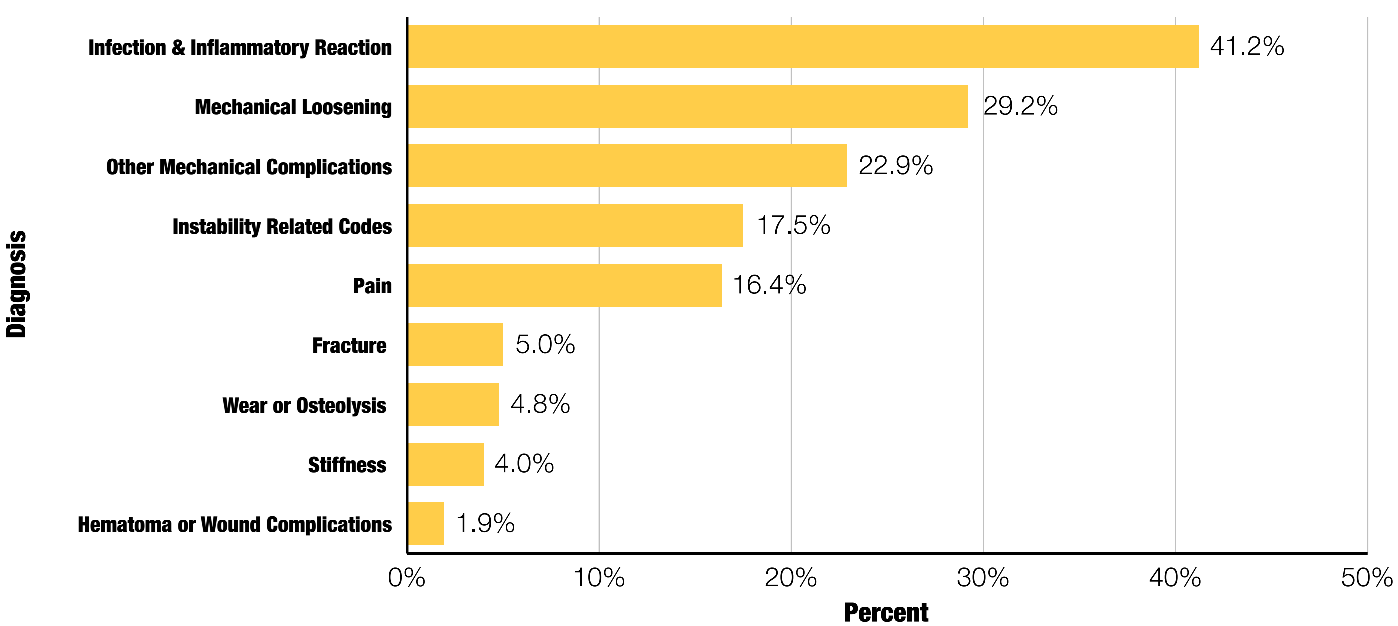
The causes for revision were examined and categorized as follows: infection and inflammatory reaction, mechanical loosening, other mechanical complications, instability related codes, pain, fracture, wear or osteolysis, stiffness, and hematoma or wound complication. All code fields were queried for target codes from these categories, and if none of the submitted codes matched a defined category, the reason for revision was placed in an "other" group.

The summary for distribution of diagnoses associated with all knee revisions performed between 2012 and 2024 are reported (Figure 3.26). Infection and inflammatory reactions are the leading cause of knee revisions, accounting for 41.2% of overall cases (Figure 3.26) and 44.4% of early revisions (Figure 3.27). The percentage of revisions after primary TKA due to infection have increased steadily from 2012 (30.7%) to 2024 (51.8%). The causes for the observed increase in percentage of revision for infection over time are not clear. It is possible that reduced rates of revision for wear and osteolysis related to the more frequent use of HXPE could contribute to the observed relative increase in the rate of revision for infection. Infection continues to represent one of the most significant challenges in care of TKA patients. This trend highlights the need to expand efforts to identify causes and to improve methods to prevent and treat infections after TKA. Mechanical loosening is the second most common cause for revision TKA accounting for 29.2% of cases.

INSIGHTS

Infection and inflammatory reactions are the leading cause of knee revisions, accounting for 41.2% of overall cases (Fig 3.26) and 44.4% of early revisions (Fig 3.27).

Figure 3.26 Distribution of Diagnosis Associated with All Knee Revisions, 2012-2024 (N=260,618)



The time interval from primary TKA to revision TKA for linked patients between 2012 and 2024 is reported (Table 3.9). Revision TKA occurs within 90 days in 20.1% of cases, within the first year in 44.2% of cases, and after one year in 56.8% of cases. The most frequent cause of early revision TKA is infection (44.4%) followed by hematoma or wound complications (14.9%) (Figure 3.27).

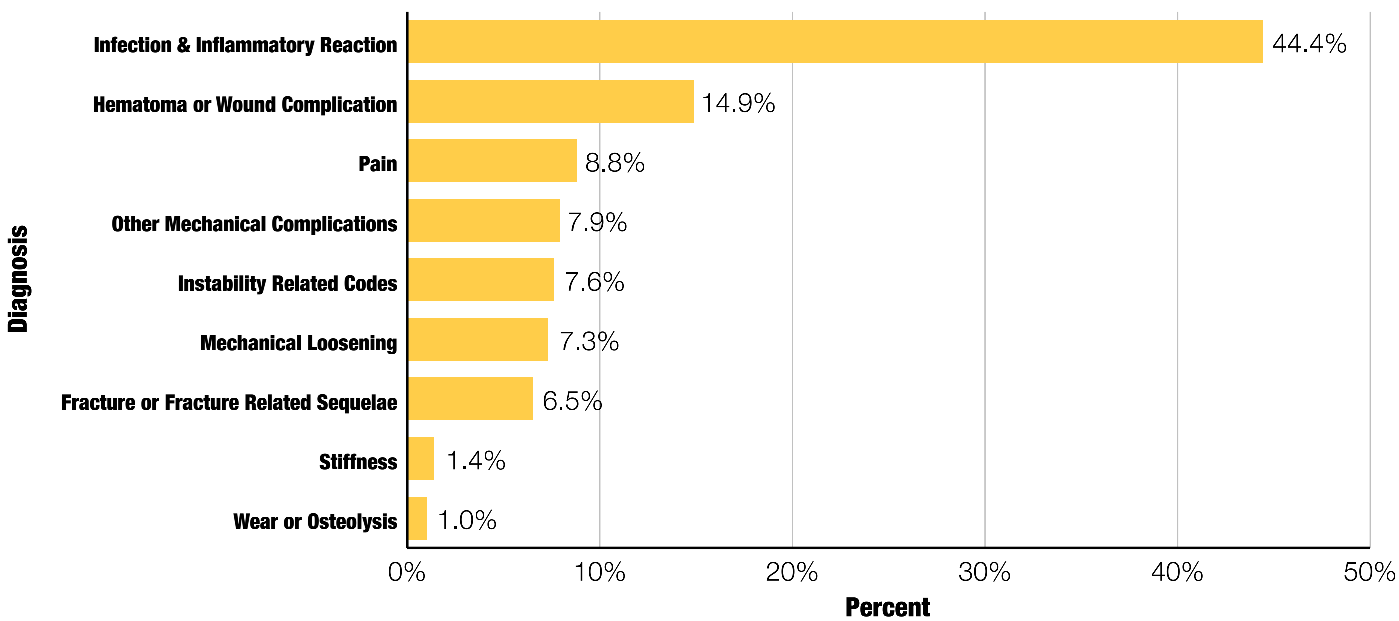
It should be noted that the AJRR links its database with the CMS database to capture all revisions in patients 65 years of age and older. Revision cases in CMS patients are therefore captured whether or not the revision is performed at an AJRR participating hospital. In patients under 65 years old, the AJRR may under-capture revision procedures in cases when revisions are performed at non-AJRR participating institutions. The AJRR aims to expand the number of participating hospitals to improve capture rates in non-CMS patients, but this continues to represent a significant limitation regarding reported revision rates in younger age groups.

Table 3.9 Distribution of Time Interval Between Primary Total Knee Arthroplasty and Revision Procedures for "Linked" Patients, 2012-2024*

Time	Frequency	Percent
<3 Months	10,022	20.1
3 to <6 Months	3,994	8.0
6-12 Months	7,556	15.1
>1 Year	28,391	56.8

Linked revisions require matching patient ID, procedure site, and laterality

Figure 3.27 Distribution of Diagnosis Associated with Early "Linked" Knee Revisions, 2012-2023 (N=7,161)*



Linked revisions require matching patient ID, procedure site, and laterality

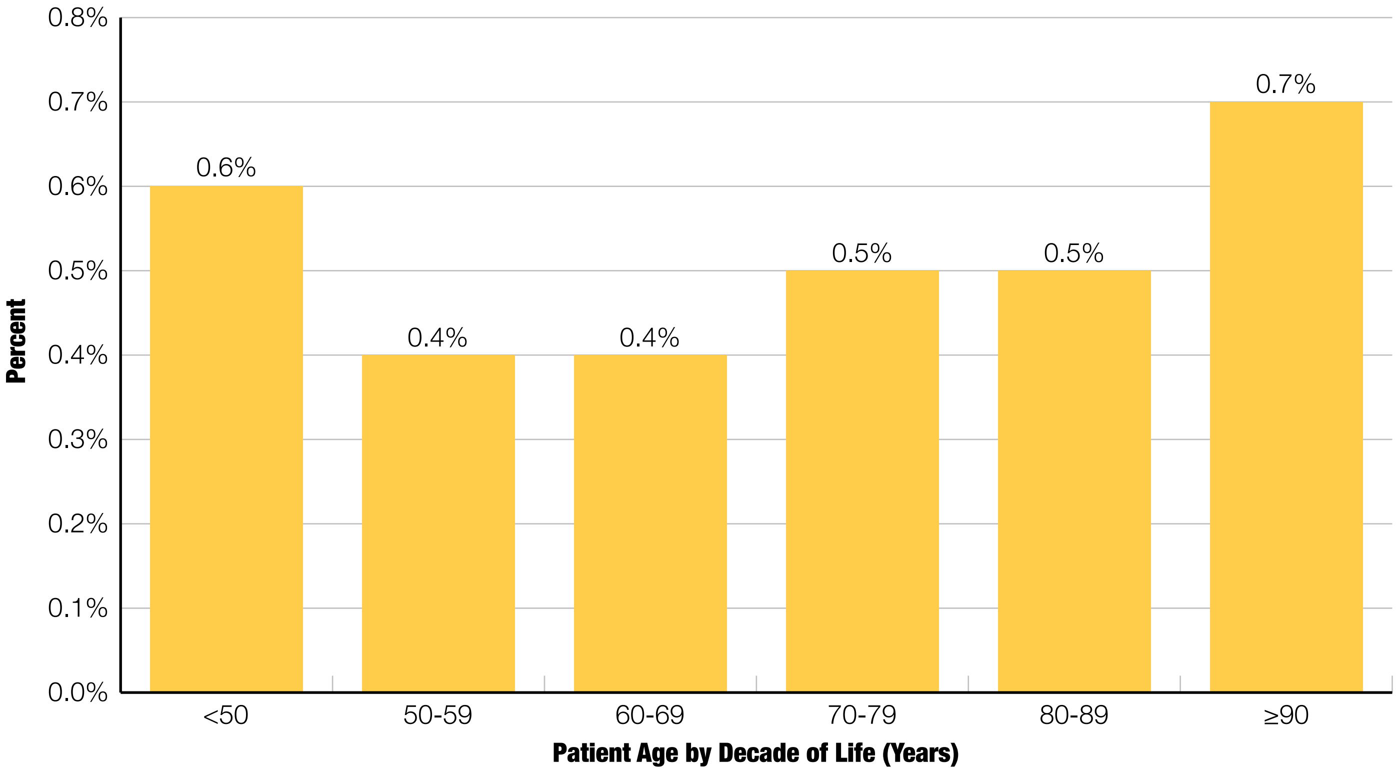
The percentage of early revisions varied somewhat by age with the highest percentage of revisions noted in patients over 90 (0.7%) and under 50 years old (0.6%) (Fig 3.28). All other age groups varied between 0.4-0.5% (Fig 3.28).

The percentage of primary TKA revisions due to infection has consistently increased from 2015 to 2024 accounting for over half of all knee revisions in 2024 (Fig 3.29). These data serve to illustrate that infection is the dominant factor driving the need for early and late revision after primary TKA in the U.S. (Figure 3.29).

INSIGHTS

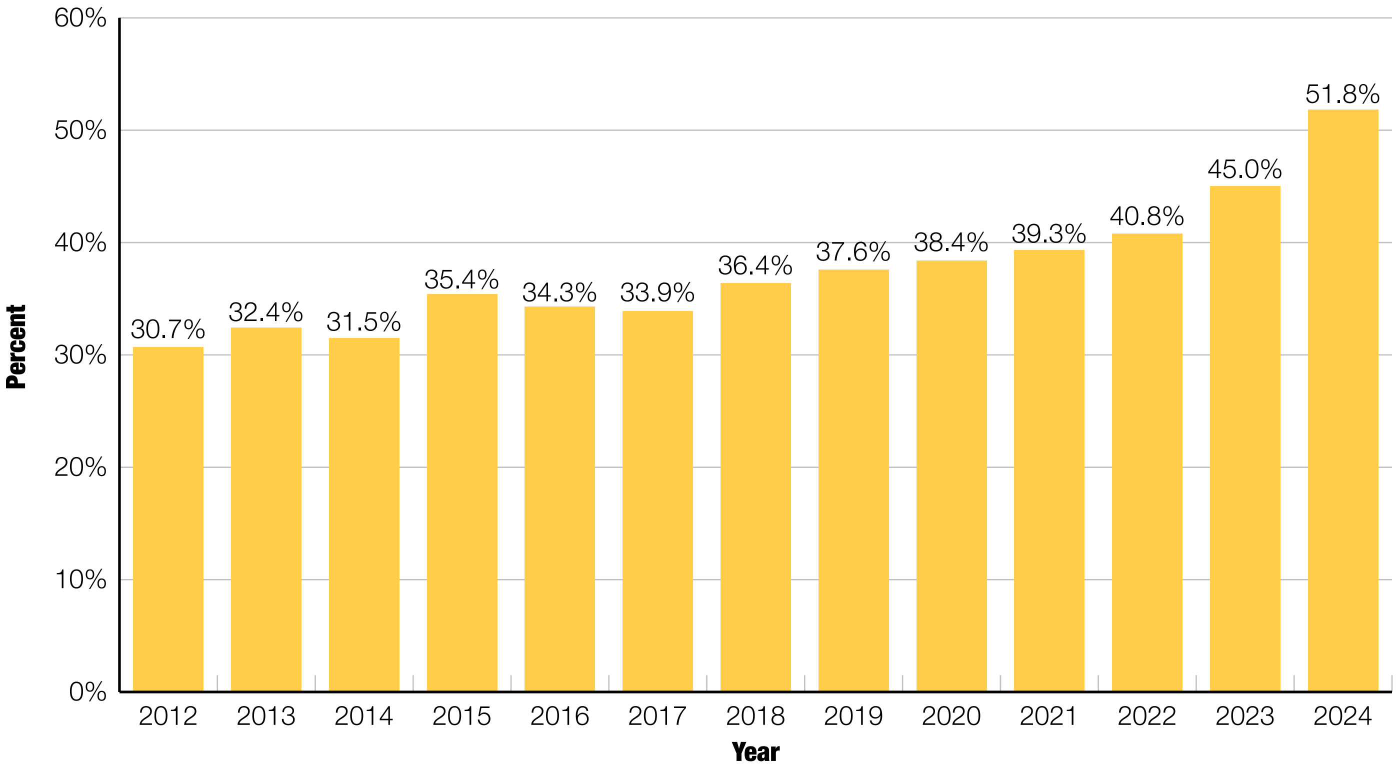
The percentage of primary TKA revisions due to infection has consistently increased from 2015 and accounts for over half of all knee revisions in 2024 (Figure 3.29).

Figure 3.28 Early "Linked" Revisions as a Percent of All Primary Total Knee Arthroplasty Procedures by Age Group 2012-2024 (N=10,344)



**Linked revisions require matching patient ID, procedure site, and laterality*

Figure 3.29 **Percent of Revision Knee Arthroplasty Procedures Due to Infection, 2012-2024 (N=51,816)**



The types of polyethylene bearing materials used for 121,878 revision knee arthroplasty procedures between 2012 and 2024 are reported (Figure 3.30). The three types of polyethylene include CPE, HXPE, and antioxidant HXPE. The majority of revision knee arthroplasty cases use either HXPE (25.8%) or antioxidant HXPE (35.7%) with the minority of cases using CPE (38.5%) (Figure 3.30).

The implant component combinations used in 68,378 revision TKA procedures between 2012 and 2024 are reported (Figure 3.31). Attune (16.5%) and Triathlon TS/Triathlon (13.7%) are the most frequently utilized revision TKA systems with all other manufacturers ranging between 1.3 and 7% utilization (Figure 3.31).

Discharge disposition following revision TKA is reported based on 132,419 cases from 2012 to 2024 (Figure 3.32). Most patients reported in 2024 are discharged home after revision TKA (80.4%) with the remainder discharged to SNF (14%), inpatient rehabilitation centers (1.9%), or other locations (3.7%). This represents a significant increase in percentage of patients discharged home after revision TKA comparing rates in 2012 (67%) with rates in 2024 (80.4%). A corresponding decrease in discharge to SNF has been noted over the same interval with 28.4% discharge to SNF in 2012 and 14.2% in 2024 (Figure 3.32).

INSIGHTS

There has been a significant increase in the percentage of patients discharged home after revision TKA increasing from 67% in 2012 to 80.4% in 2024 (Figure 3.32).

Figure 3.30 **Revision Knee Arthroplasty Insert Polyethylene Material by Year, 2012-2024 (N=143,506)**

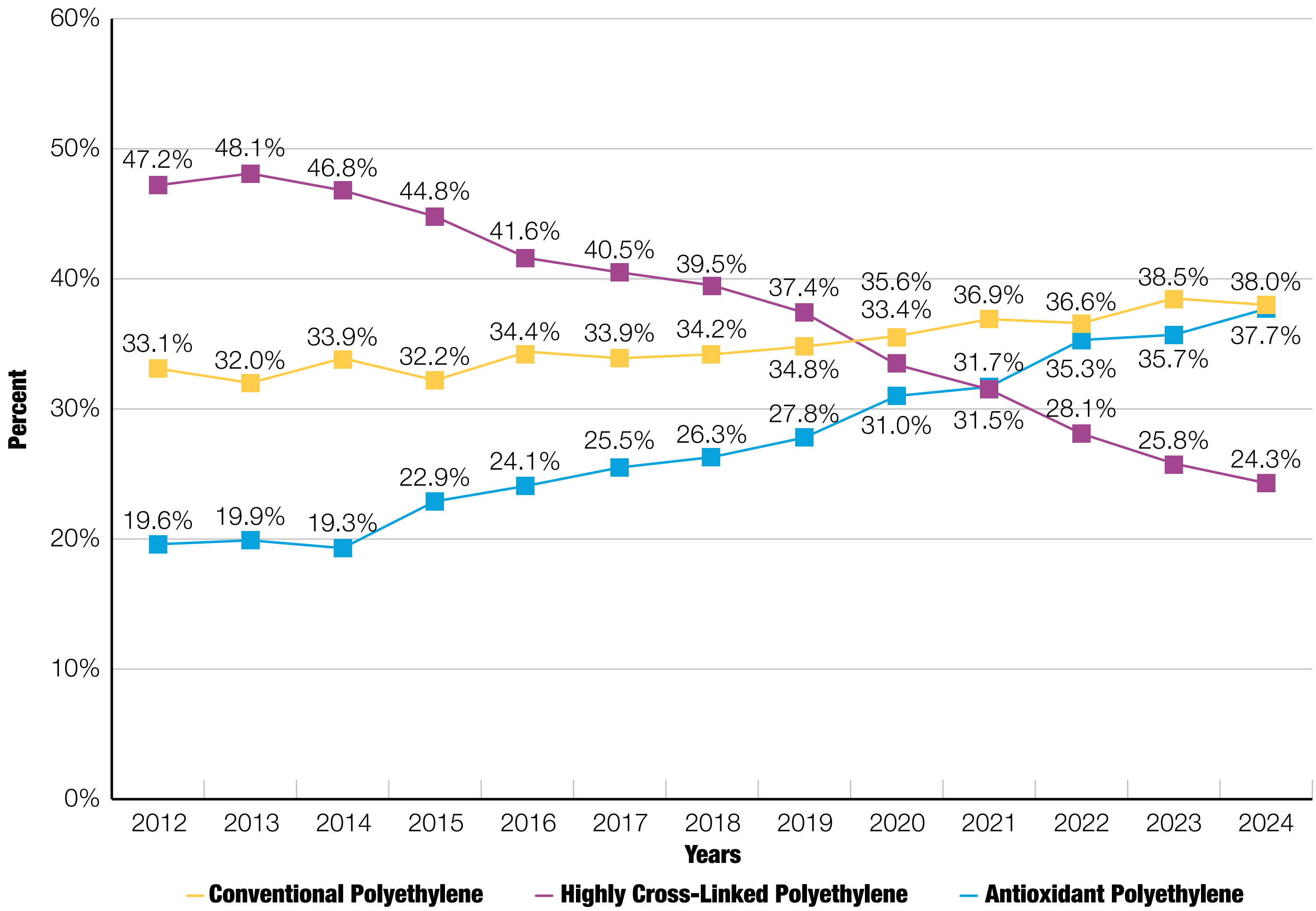


Figure 3.31 Revision Total Knee Arthroplasty Femoral/Tibial Component Combinations by Year, 2012-2024 (N=79,420)

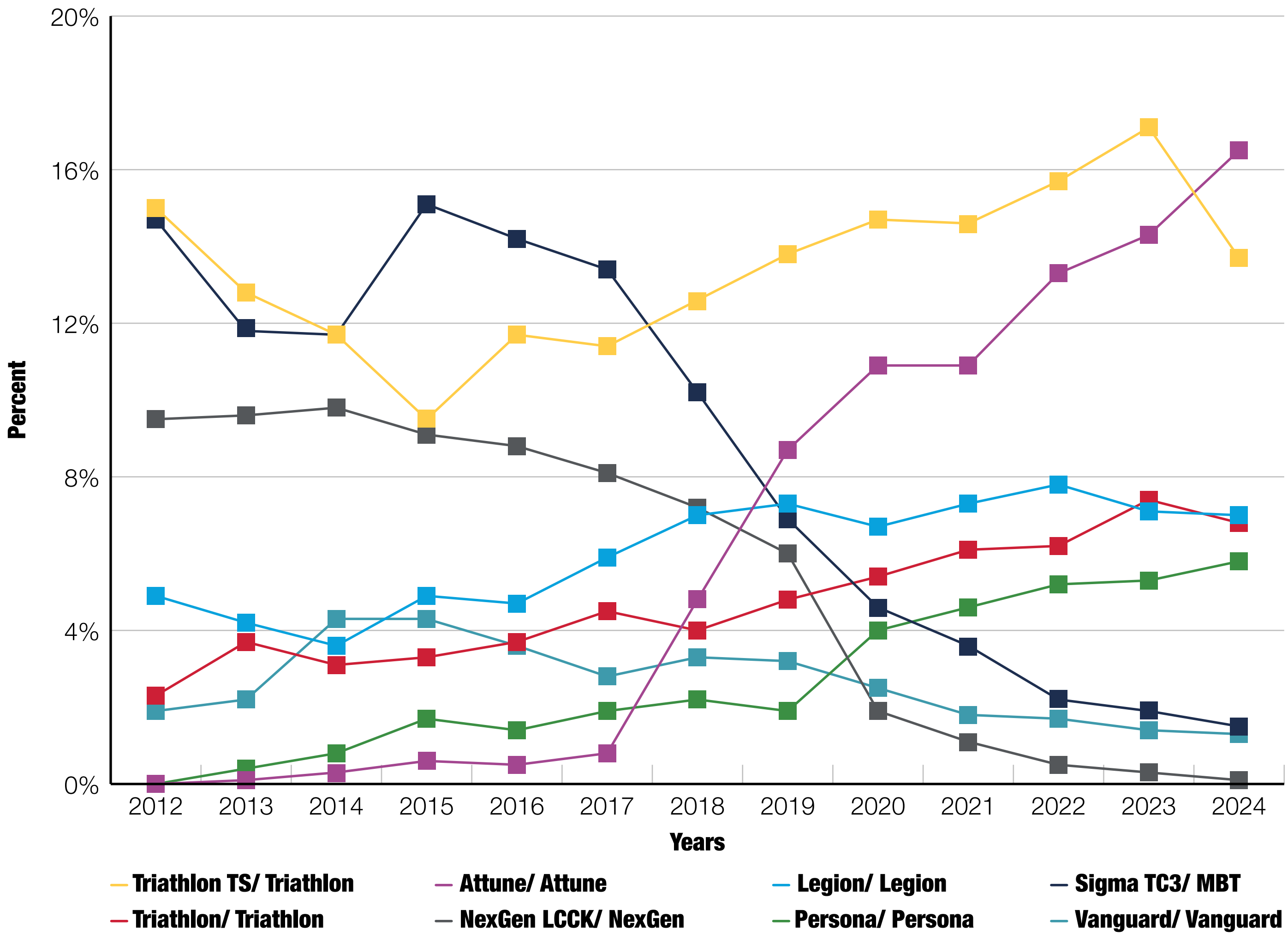
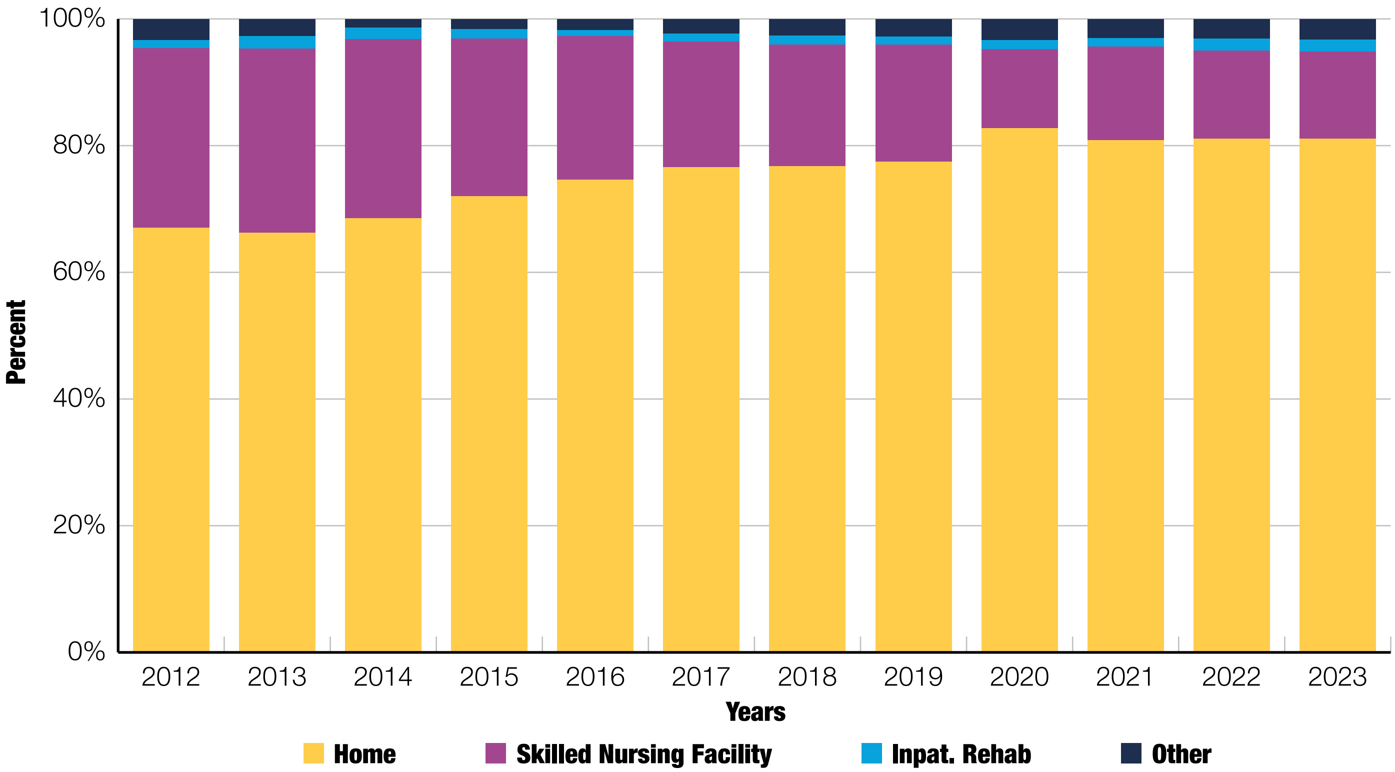


Figure 3.32 **Revision Knee Arthroplasty Discharge Disposition Codes by Year, 2012-2024 (N=132,419)**



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Home	67.0%	66.2%	68.5%	72.0%	74.6%	76.6%	76.7%	77.4%	82.7%	80.8%	81.1%	81.1%
Skilled Nursing Facility	28.4%	29.1%	28.3%	24.9%	22.7%	19.8%	19.2%	18.5%	12.5%	14.8%	13.9%	13.7%
Inpat. Rehab	1.2%	2.0%	1.8%	1.5%	0.9%	1.3%	1.5%	1.3%	1.5%	1.4%	1.9%	1.9%
Other	3.0%	3.0%	1.0%	1.6%	1.9%	2.2%	2.6%	2.9%	3.3%	3.0%	3.1%	3.3%

Code	Code Value
Home	Discharged to home/self-care (routine charge).
Home Care Org.	Discharged/transferred to home care of organized home health service organization.
SNF	Discharged/transferred to skilled nursing facility (SNF) with Medicare certification in anticipation of covered skilled care--(For hospitals with an approved swing bed arrangement, use Code 61 - swing bed. For reporting discharges/transfers to a non-certified SNF, the hospital must use Code 04 - ICF.)
Inpat. Rehab	Discharged/transferred to an inpatient rehabilitation facility including distinct units of a hospital (eff. 1/2002).

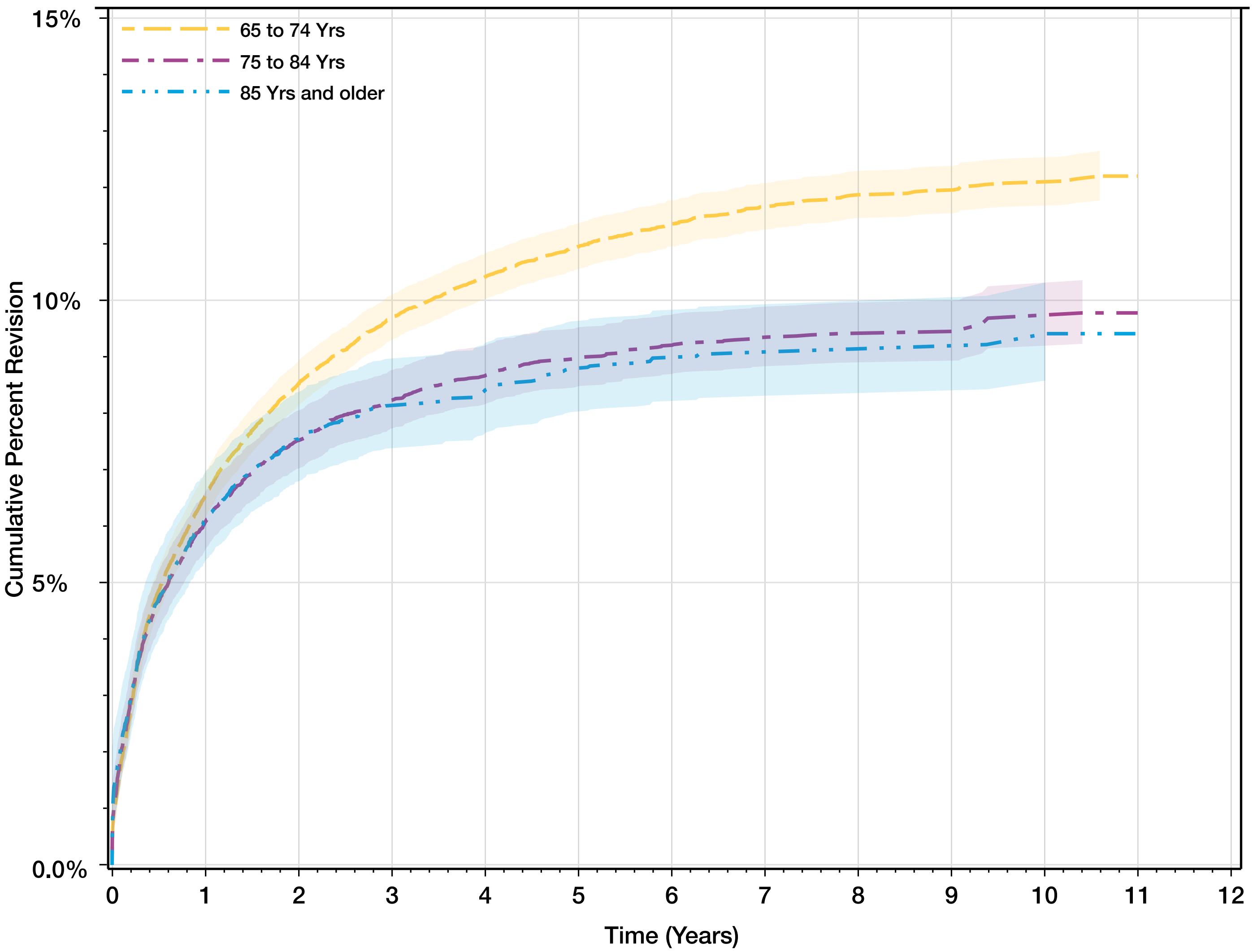
TKA Re-Revision

Re-revision following previous revision TKA was investigated for the first time in last year's Annual Report (Figure 3.33). We stratified risk of re-revision TKA by age. For patients over 65 years of age, younger patients had higher risk of re-revision TKA with patients aged 65-74 years of age having a significantly higher CPR for re-revision compared to patients older than 74 years old after adjusting for sex and CCI (Figure 3.33). Infection was the most frequent reason for re-revision (40.2%), similar to the pattern noted for revision for infection after primary TKA (41.2%) and early revisions for infection after primary TKA (44.4%) (Figure 3.34). Infection is clearly the most dominant cause for revision TKA and re-revision TKA.

INSIGHTS

Infection was the most frequent reason for re-revision TKA (40.2%) (Figure 3.33).

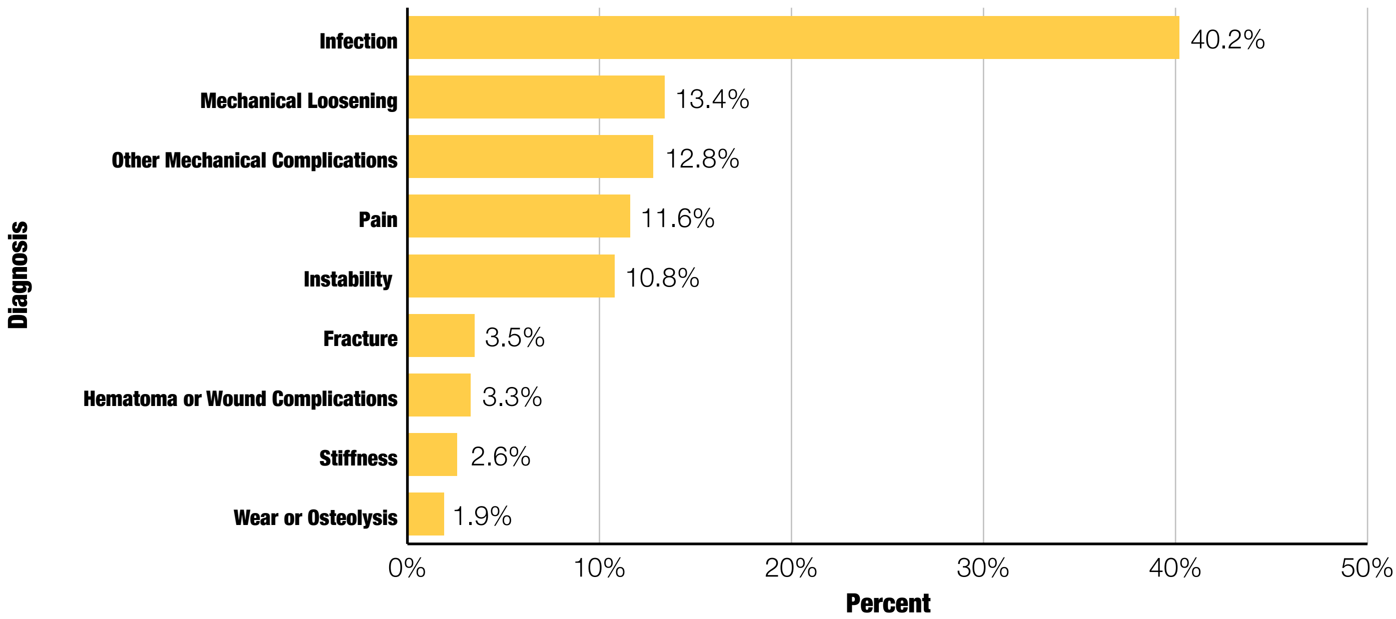
Figure 3.33 Cumulative Percent Rerevision for a Revision Knee Arthroplasty in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis With Confidence Intervals, 2012-2024



Group	stat	0	1	2	3	4	5	6	7	8	9	10	11
65 to 74 Yrs	At Risk	57,594	46,156	37,039	29,666	24,946	20,406	15,856	11,699	8,035	5,043	2,820	1,183
	KM % revision	0.12 (0.09, 0.15)	6.54 (6.33, 6.75)	8.52 (8.28, 8.76)	9.68 (9.42, 9.95)	10.41 (10.13, 10.69)	10.95 (10.66, 11.24)	11.35 (11.05, 11.65)	11.65 (11.34, 11.96)	11.87 (11.55, 12.19)	11.93 (11.61, 12.27)	12.07 (11.73, 12.42)	12.20 (11.83, 12.57)
75 to 84 Yrs	At Risk	31,131	24,105	18,846	14,827	12,107	9,812	7,450	5,408	3,621	2,270	1,286	555
	KM % revision	0.08 (0.05, 0.12)	6.07 (5.8, 6.35)	7.51 (7.21, 7.83)	8.22 (7.9, 8.56)	8.66 (8.32, 9.01)	8.98 (8.63, 9.34)	9.19 (8.83, 9.57)	9.33 (8.96, 9.71)	9.41 (9.03, 9.8)	9.41 (9.03, 9.8)	9.68 (9.25, 10.13)	9.77 (9.31, 10.26)
85 Yrs and older	At Risk	12,991	9,932	7,812	6,119	4,860	3,898	2,936	2,100	1,358	858	474	190
	KM % revision	0.11 (0.06, 0.18)	6.12 (5.71, 6.56)	7.53 (7.06, 8.03)	8.13 (7.63, 8.65)	8.41 (7.9, 8.95)	8.79 (8.25, 9.35)	8.97 (8.42, 9.56)	9.04 (8.48, 9.63)	9.08 (8.52, 9.68)	9.08 (8.52, 9.68)	9.21 (8.6, 9.87)	9.41 (8.7, 10.17)

Sex, CCI adjusted HR (95% CI), p-value
75 to 84 Yrs vs 65 to 74 Yrs at 0 Months-1 Year: 0.765(0.722,0.812), p=<.0001
75 to 84 Yrs vs 65 to 74 Yrs at 1-11 Years: 0.541(0.494,0.594), p=<.0001
85 Yrs and older vs 65 to 74 Yrs at 0-3 Months: 0.809(0.726,0.902), p=0.0001
85 Yrs and older vs 65 to 74 Yrs at 3 Months-11 Years: 0.562(0.513,0.616), p=<.0001

Figure 3.34 Revision Knee Arthroplasty Discharge Disposition Codes by Year, 2012-2023 (N=132,419)



Patient-Reported Outcome Measures - Total Knee Arthroplasty

PROMs have received increased attention within the AJRR and the wider practice of orthopaedic surgery. In the U.S., value-based payment models require capture of PROMs as a prerequisite for various public and private alternative payment models. Internationally, in 2014 the ISAR Steering Committee established a working group in this area to provide advice regarding best practices.[15]

The AJRR collects PROMs at three recommended intervals: baseline (preoperatively), 90 days post-discharge, and one year postoperatively. PROMs capture patients' perspectives on overall health and function, enabling both longitudinal assessment of individual care and broader evaluation of national outcomes and trends.

To support benchmarking, AJRR provides participating sites with national comparisons of PROMs data. With increasing emphasis on the value of PROMs, AJRR has expanded data submission options. Sites may collect PROMs electronically via email, computer, or tablet, or submit data obtained through third-party vendors or local systems.

This year, our PROMs section has expanded to include data on percent of cases for KOOS, JR. meeting thresholds of SCB set at a 20-point increase from the preoperative PROM. PASS was also included as a new threshold for KOOS, JR. and the percentage of patients who met that 71-point postoperative point value has also been reported.

Improvement in PROMs can be calculated in two primary ways. The MCID may be derived using a distribution-based method, defined as half the standard deviation between preoperative and one-year postoperative scores[1]. Alternatively, anchor-based methods reported in the literature are used to define thresholds for MCID, PASS[24], and SCB[25].

In alignment with the new CMS IQR PRO-PM for hip and knee arthroplasty, we also reviewed rates of completeness for several required variables submitted to AJRR. More than 50 hospitals requested that AJRR submit IQR data on their behalf. However, not all institutions submitting PROMs to the AJRR provided all required IQR elements and these results should not be interpreted as nationwide rates of compliance with CMS IQR requirements.

AJRR collaborated with CMS to identify what is required for at least 50% of inpatient procedures. The below graphic illustrates the data elements that are required by the CMS IQR and the time points for collection:

Table 3.10 Data Elements Required by CMS IQR

Data Element Type	Preoperative Data Elements	Postoperative Data Elements
Patient-Reported Outcome Measures (PROMs)	THA patients: HOOS, JR TKA patients: KOOS, JR	THA patients: HOOS, JR TKA patients: KOOS, JR
Patient- or Provider-Reported Risk Variables	Mental Health Subscale items from either PROMIS-Global or VR-12	N/A
	Health Literacy (SILS2)	
	BMI or Height/Weight	
	Use of Chronic Narcotics	
	Total Painful Joint Count: Patient-Reported Pain in Non-Operative Lower Extremity Joint	
	Quantified Spinal Pain: Patient-Reported Back Pain, Oswestry Index Question	
Matching Variables	Medicare Provider Number	Medicare Provider Number
	MBI	MBI
	Date of Birth	Date of Birth
	Date of Procedure	Date of Procedure
	Procedure Type	Procedure Type
	Date of Admission	Date of Admission
PROM-related Variables	Date of PRO Data Collection	Date of PRO Data Collection
	Mode of Collection	Mode of Collection
	Person Completing the Survey	Person Completing the Survey
	Generic PROM Version	N/A

BMI: Body Mass Index; HOOS, JR: Hip dysfunction and Osteoarthritis Outcome Score for Joint Replacement; KOOS, JR: Knee injury and Osteoarthritis Outcome Score for Joint Replacement; PROMIS-Global: Patient-Reported Outcomes Measurement Information System; SILS2: Single Item Literacy Screener; VR-12: Veterans Rand-12; MBI: Medicare Beneficiary Identifier; PROM: Patient-reported Outcome Measure

*More information can be found here

PROMs Insights:

- As of December 31, 2024, 751 sites submitted PROMs data which is a 19% increase from the 2023 report
- The completion rate for "linked" outcomes (those where both a preoperative and one-year postoperative PROM is available on the same procedure) varies between 24-30%, consistent with previous AJRR Annual Reports
- MCID Distribution-Based Performance:
    - 87% of reported cases met MCID for KOOS, JR.
    - 62.5% of reported cases met MCID for PROMIS-10 Physical Health component
    - The VR-12 Physical Health Component MCID performance rate was 72.9%
- MCID Anchor-Based Performance compared with Distribution-Based Performance
    - Anchor-Based MCID for KOOS, JR. is double that of the Distribution-Based MCID
    - Approximately 77% of reported cases met the Anchor-Based MCID compared to the 87% that met the Distribution-Based MCID
- PASS Anchor-Base:
    - 61.5% of KOOS, JR. postoperative PROMs met the PASS threshold
- SCB Performance:
    - Two Thirds of KOOS, JR. cases met the Anchor-Based threshold
- Age Stratification:
    - There are minimal differences between rates of cases meeting MCID across different age groups
- IQR Requirements:
    - The lowest rate of completion is seen for response to the CMS IQR required Chronic Narcotics Question (4.4% of cases that completed both a preoperative and postoperative KOOS, JR. also responded to the CMS IQR narcotic question).
    - The highest rate of completion was seen for cases completing a preoperative PROMIS-10 (74.6%)

Table 3.11 Preoperative and 1-Year Postoperative PROM Mean Scores After Primary Knee Arthroplasty by PROM, 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Pre or 1-year Postoperative	N	Mean	Standard Deviation
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	Preoperative	323,916	47.9	14.3
		Postoperative	115,217	76.3	16.3
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	Preoperative	212,059	48.5	9.6
		Postoperative	77,395	51.6	9.1
	Physical T	Preoperative	212,059	39.5	8.3
		Postoperative	77,380	47.5	9.5
VR-12 (The Veterans RAND 12 Item Health Survey)	Mental Health Component	Preoperative	47,793	51.8	12.4
		Postoperative	21,834	55.3	10
	Physical Health Component	Preoperative	47,611	31.7	9.3
		Postoperative	21,836	43.3	10.4

Table 3.12 Overall Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Knee Arthroplasty using Distribution-Based MCID by PROM, 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*	Distribution-based MCID
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	323,348	76,841	23.80%	86.90%	7.4
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	212,059	47,950	22.60%	32.40%	4.7
	Physical T	212,059	47,942	22.60%	62.50%	4.3
VR-12 (The Veterans RAND 12 Item Health Survey)	Mental Health Component	47,727	14,119	29.60%	32.70%	5.9
	Physical Health Component	47,611	14,125	29.70%	72.90%	4.8

** Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined to be a positive change score of half the pooled standard deviation.*
***Cases statistically incapable of achieving MCID due to a high preoperative score were excluded.*

Table 3.13 Overall Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Knee Arthroplasty using Anchor-Based MCID for KOOS JR., 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*	Anchor-based MCID Threshold
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	322,536	76,648	23.80%	76.90%	14

**Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined using an anchor-based approach, as described by Lyman SL et al, 2018.*
***Cases statistically incapable of achieving MCID due to a high preoperative score were excluded.*

Table 3.14 Overall 1-Year Postoperative PROM Scores after Primary Knee Arthroplasty using Anchor-Based PASS for KOOS JR., 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Acceptable Improvement*	Anchor-based PASS Threshold
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	n/a	115,217	n/a	61.50%	71

**The patient-acceptable symptom state (PASS) represents a satisfactory clinical state from the patient's perspective. PASS was determined using postoperative scores and an anchor-based approach, based on patients' responses to the question, 'Do you consider that your current state is satisfactory?' as described by Dekhne MS et al, 2024.[24]*

Table 3.15 Overall Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Knee Arthroplasty using Anchor-Based SCB for KOOS JR., 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Substantial Improvement*	Anchor-based SCB Threshold
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	321,256	76,328	23.80%	66.50%	20

**Substantial improvement was calculated by substantial clinical benefit (SCB). SCB was determined using an anchor-based method, as described by Lyman SL et al, 2018.[25]*
***Cases statistically incapable of achieving SCB due to a high preoperative score were excluded.*

Table 3.16 Age-stratified Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Knee Arthroplasty by PROM for Patients 55 Years and Over, 2012-2024

Patient-Reported Outcome Measure (PROM)	PROM Component	Age Group (Years)	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	55-64	83,723	19,143	22.90%	87.80%
		65-74	137,582	35,127	25.50%	86.90%
		75-84	69,913	16,011	22.90%	85.60%
		>85	7,139	1,403	19.70%	87.50%
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	55-64	54,013	11,414	21.10%	34.40%
		65-74	90,833	22,186	24.40%	32.40%
		75-84	46,064	10,369	22.50%	29.70%
		>85	4,740	939	19.80%	29.90%
	Physical T	55-64	54,009	11,409	21.10%	64.70%
		65-74	90,841	22,188	24.40%	62.90%
		75-84	46,060	10,368	22.50%	58.60%
		>85	4,740	939	19.80%	59.50%
VR-12	Mental Health Component	55-64	13,477	3,956	29.40%	33.00%
		65-74	19,806	6,145	31.00%	32.00%
		75-84	9,474	2,638	27.80%	32.90%
		>85	1,041	261	25.10%	36.40%
	Physical Health Component	55-64	13,435	3,956	29.40%	75.10%
		65-74	19,761	6,150	31.10%	73.20%
		75-84	9,459	2,638	27.90%	69.50%
		>85	1,038	261	25.10%	63.20%

Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined to be a positive change score of half the pooled standard deviation.

Table 3.17a Knee PROMs Completeness, 2012-2024 (All Time)

Completion Rates (N =42,706 - Patients with a linked Preoperative and Postoperative Koos JR), aged 65 or older	Percent Complete
Also Completed a PROMIS-10 PROM at the Preoperative Time Point	69.40%
Also Completed a VR-12 PROM at the Preoperative Time Point	14.80%
Answered CJR's Health Literacy question at the Preoperative Time Point	29.20%
Answered CJR's Pain in Lower Extremity Question at the Preoperative Time Point	29.50%
Answered CJR's Back Pain Question at the Preoperative Time Point	32.30%
Answered the Chronic Narcotics Question at the Preoperative Time Point*	0.30%
Had a mode of collection reported for KOOS JR at the Preoperative Time Point	41.70%
Had a mode of collection reported for KOOS JR at the Post-operative Time Point	44.60%
Had Person Completing the survey reported at the Preoperative Time Point	24.40%
Had Person Completing the survey reported at the Post-operative Time Point	31.90%

Table 3.17b Knee PROMs Completeness, 2024

Completion Rates (N = 665 - Patients with a linked Preoperative and Post-Operative Koos JR) aged 65 or older	Percent Complete
Also Completed a PROMIS-10 PROM at the Preoperative Time Point	74.60%
Also Completed a VR-12 PROM at the Preoperative Time Point	11.60%
Answered CJR's Health Literacy question at the Preoperative Time Point	24.20%
Answered CJR's Pain in Lower Extremity Question at the Preoperative Time Point	22.70%
Answered CJR's Back Pain Question at the Preoperative Time Point	25.30%
Answered the Chronic Narcotics Question at the Preoperative Time Point	4.40%
Had a mode of collection reported for KOOS JR at the Preoperative Time Point	41.70%
Had a mode of collection reported for KOOS JR at the Post-operative Time Point	44.60%
Had Person Completing the survey reported at the Preoperative Time Point	24.40%
Had Person Completing the survey reported at the Post-operative Time Point	31.90%

Appendices and References

Appendix A

AJRR Publications 2025

The goal of the AAOS RAI is to provide a resource to the scientific community to further understand and improve orthopaedic and musculoskeletal care by making data analyses available. RAI also provides physicians and clinician-scientists access to information beyond what is already published in the AJRR Annual Report. Investigators can submit hypotheses regarding information in AAOS registries and linked CMS clinical databases. The AJRR Research Subcommittee provides a systematic and transparent peer review process for proposal approval. Data analysis for approved clinical projects are completed by the AAOS Combined Analytics Team. Completed RAI approved clinical projects have been submitted to a variety of orthopaedic conferences for presentations and to peer-reviewed journals for publication. Please see a list of recent posters, presentations, and publications derived from AJRR data projects below. Click to learn more about the RAI application process or review all previous publications and presentations here.

1. Bender JM, Yang J, Sterling ON, et al. Does femoral head size matter? A comparison of 32-, 36-, and 40-millimeter heads in primary total hip arthroplasty: an American Joint Replacement Registry analysis. *J Arthroplasty*. 2025;40(9):2347-2352. doi:10.1016/j.arth.2025.02.060
2. Carender CN, Jimenez E, De A, Berry DJ, Abdel MP, Bedard NA. Effects of surgeon volume on outcomes following primary total knee arthroplasty in the morbidly obese: an analysis from the American Joint Replacement Registry. *J Arthroplasty*. 2025;40(9 suppl 1):S220-S228. doi:10.1016/j.arth.2025.05.022
3. Kagan R, García Vélez DA, Pelt CE, et al. Body mass index is not associated with risk for mechanical loosening following primary total knee arthroplasty: an analysis from the American Joint Replacement Registry. *J Arthroplasty*. 2025;40(9):2298-2302. doi:10.1016/j.arth.2025.02.053
4. Kelly M, Kagan RP, Zaniletti I, et al. Decreased revision risk with cementless collared metadiaphyseal-filling stems compared to cemented fixation in patients 65 years and older. *J Arthroplasty*. 2025;40(9 suppl 1):S278-S284. doi:10.1016/j.arth.2025.04.033
5. Salmons HI, Donnelly PC, Guy DK, Abdel MP. Hemiarthroplasty versus total hip arthroplasty for femoral neck fracture in the elderly: an analysis from the American Joint Replacement Registry. *J Arthroplasty*. Published online July 24, 2025. doi:10.1016/j.arth.2025.07.043
6. Carender CN, Jimenez E, De A, Berry DJ, Abdel MP, Bedard NA. Effects of surgeon volume on outcomes following primary total hip arthroplasty in the morbidly obese: an analysis from the American Joint Replacement Registry. *J Arthroplasty*. Published online July 18, 2025. doi:10.1016/j.arth.2025.07.037
7. Pius AK, Sporer SM, Sterling O, et al. Navigated and robotic total knee arthroplasty do not confer improved 5-year survivorship compared to conventional total knee arthroplasty: an analysis from the American Joint Replacement Registry. *J Arthroplasty*. 2025;40(7 suppl 1):S130-S139. doi:10.1016/j.arth.2025.03.047
8. Hegde V, Pelt CE, De A, Zaniletti I, Kagan R. Mobile bearing total knee arthroplasty is associated with an increased risk of mechanical loosening: a follow-up analysis of the American Joint Replacement Registry. *J Arthroplasty*. Published online May 8, 2025. doi:10.1016/j.arth.2025.04.091

9. Heckmann ND, Palmer RC, Otero JE, et al. Dual-mobility articulations in primary total hip arthroplasty: mid-term outcomes from the American Joint Replacement Registry. *J Arthroplasty*. 2025;40(5):1252-1257.e3. doi:10.1016/j.arth.2024.10.135

10. Kirchner GJ, Stambough JB, Jimenez E, Mullen K, Nikkel LE. Robotic assistance is not associated with decreased early revisions in cementless TKA: an analysis of the American Joint Replacement Registry. *Clin Orthop Relat Res*. 2025;483(3):431-438. doi: 10.1097/corr.0000000000003330

11. Yang J, Bartoletta JJ, Fernando ND, Manner PA, Chen AF, Hernandez NM. Is younger age a risk factor for failure following aseptic revision total knee arthroplasty? *J Arthroplasty*. 2025;40(6):1594-1599.e2. doi:10.1016/j.arth.2024.11.014

12. Kagan R, Andrawis J, Kendall J, De A, Mullen K, Sassoon AA. Lower associated risk of revision with all-polyethylene tibial components in total knee arthroplasty: an analysis of the American Joint Replacement Registry. *J Arthroplasty*. 2025;40(1):80-83. doi: 10.1016/j.arth.2024.06.060

13. DeMik DE, Lizcano JD, Jimenez E, Mullen KJ, Lonner JH, Krueger CA. Does resurfacing the patella increase the risk of extensor mechanism injury within the first 2 years after total knee arthroplasty? *J Knee Surg*. 2025;38(3):110-114. doi: 10.1055/a-2413-3876

14. García Vélez DA, Buddhiraju A, Kagan R, et al. Leaving the patella unresurfaced does not increase the risk of short-term revision following total knee arthroplasty: an analysis from the American Joint Replacement Registry. *J Knee Surg*. 2025;38(3):122-129. doi: 10.1055/a-2468-6289

15. Hohmann AL, Linton AA, Olin BR, et al. Does the addition of a tibial stem extender in total knee arthroplasty decrease risk of aseptic loosening in patients with obesity? An analysis from the American Joint Replacement Registry. *J Knee Surg*. 2025;38(3):115-121. doi: 10.1055/a-2411-0721

16. Kagan R, Pelt CE, Khanuja HS, et al. Selective use of modern cementless total knee arthroplasty is not associated with increased risk of revision in patients aged 65 or greater: an analysis from the American Joint Replacement Registry. *J Knee Surg*. 2025;38(3):130-135. doi: 10.1055/a-2332-5762

17. Schaffler BC, Zaniletti I, Arshi A, De M, Schwarzkopf R, Rozell JC. Risk of early manipulation in cemented versus cementless TKA: an analysis of the American Joint Replacement Registry. *J Arthroplasty*. Published online April 8, 2025. doi:10.1016/j.arth.2025.04.008

18. Sassoon AA, Taylor JM, Jimenez E, Stancil R, Cannady D, De A. Periprosthetic fractures: a rising tide of hip arthroplasty failure noted in the American Joint Replacement Registry and the preventative role of cemented stems. *J Arthroplasty*. 2024;39(9 suppl 2):S454-S458. doi: 10.1016/j.arth.2024.06.038

19. De A, Chalmers BP, Springer BD, Browne JA, Lewallen DG, Stambough JB. What is the incidence of and outcomes after debridement, antibiotics, and implant retention (DAIR) for the treatment of periprosthetic joint infections in the AJRR population? *Clin Orthop Relat Res*. 2024;482(11):2042-2051. doi: 10.1097/corr.0000000000003138

20. Telang S, Heckmann ND, Olsen A, De A, Stambough JB. Spinal anesthesia in total hip arthroplasty is associated with improved outcomes in the American Joint Replacement Registry population. *Arthroplast Today*. 2024;30:101566. doi: 10.1016/j.artd.2024.101566

Appendix B

Data Element Review

Minimum Data Set (MDS):

Core data elements required as part of standard Registry participation. These represent the baseline information every site must provide.

- Patient Name (Last, First)
- Patient Date of Birth
- Diagnosis (ICD-9/10)
- Patient Sex
- Patient Zip Code
- Hospital or Surgery Center Name
- Hospital or Surgery NPI
- Surgeon National Provider Identifier (NPI)
- Procedure Codes (ICD-10 and CPT)
- Length of Stay
- Procedure Date
- Laterality
- Implants (Component Name, Manufacturer, Catalog Number, Lot Number)
- Discharge Disposition

Hospital Inpatient Quality Reporting (IQR) Program (CMS):

Data elements required by CMS for the Hospital IQR Program.

- Chronic Narcotics Use
- Medicare Beneficiary ID
- Person Completing Survey
- Patient-Reported Outcome Measures (PROMs) Date of Collection
- PROMs Time Point
- Data Collection Mode
- Hip dysfunction and Osteoarthritis Outcome Score for Joint Replacement (HOOS, JR)
- Knee injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS, JR)
- Patient-Reported Outcomes Measurement Information System (PROMIS) 10-Item Global Health
- Veterans RAND 12-Item Health Survey (VR-12)
- Comprehensive Joint Replacement (CJR) Risk Assessment (Low Back Pain, Health Literacy, Total Painful Joint Count)

Joint Commission Elements:

Data elements required to meet Joint Commission Advanced Total Hip and Knee Replacement certification and accreditation reporting standards.

- Patient Residence
- Anesthesia Type
- Ambulation Day of Surgery
- Regional Anesthesia Exemption
- Discharge Disposition
- HOOS, JR
- KOOS, JR
- PROMIS
- VR-12

Other Registry-Related Data Elements:

Data elements collected to support Registry analytics, quality improvement, and research initiatives. They provide additional clinical, procedural, and outcome context that enhances the value of the Registry dataset.

- Social Security Number
- Comorbidities
- Patient Gender
- Patient Ethnicity
- Patient City, State, Country
- Patient Email Address/Phone Number
- Patient Use of Tobacco
- Patient Height/Weight/BMI
- Patients Risk Factors (substance use screening)
- Registry
- Registry Account ID
- Version of Data Specifications
- Submission Type
- Surgeon Name (First & Last Name)
- Trainee Information
- Operative Duration
- Surgical Approach/Technique
- Anesthesia Technique
- Computer/Robotic Assisted Surgery
- Tourniquet Use
- Blood Transfusion/Amount
- Tranexamic Acid Usage
- Physical Therapy Day 0
- VTE Prophylaxis
- Perioperative Antibiotics
- Periarticular Injection
- Multi-Modal Pain Management
- Shared Decision Making
- American Society of Anesthesiologists (ASA) Class

Postoperative Complications:

- Early revisions (unexpected return to OR)
- All-cause unexpected/unplanned readmissions
- Operative and Post-Discharge Complications
- Readmission Comorbidities and present-on-admission (POA) Status
- Readmission Diagnosis (ICD-10)
- Readmission Procedures (if applicable)
- Readmission Length of Stay
- Readmission Height/Weight/BMI
- Charlson Comorbidity Index

Patient Reported Outcome Measures (PROMs):

- Harris Hip Score
- Hip disability and Osteoarthritis Outcome Score (HOOS)
- Knee injury and Osteoarthritis Outcome Score (KOOS)
- Medical Outcomes Study 36-Item Short Form Health Survey (SF-36)
- Medical Outcomes Study 12-Item Short Form Health Survey (SF-12)
- Oxford Hip and Knee Scores
- The Knee Society Knee Scoring System
- Western Ontario and McMaster Universities Arthritis Index (WOMAC)
- EuroQol 5-Dimension Survey (EQ-5D, 3L and 5L versions)
- PROMIS Family of Measures (PROMIS-29 Profile, Physical Function, Physical Function CAT, Pain Interference, Pain Interference CAT, Emotional Distress – Anxiety, Emotional Distress – Depression, Global, CAT summary scores)
- CollaboRATE (Shared Decision-Making measure)
- University of California Los Angeles (UCLA) Activity Score
- Pain Visual Analog Scale (Pain VAS)

Appendix C

AAOS Authorized Vendor Program

The AAOS Authorized Vendor Program was created to minimize the data entry burden and enhance the data submission process. The following vendors have been approved for this program.

- Algos Pathways
- Cedaron
- Clinect Healthcare
- CODE Technology
- DeliverHealth
- DTX Medical
- FORCE Therapeutics
- Health Catalyst (Twistle)
- Health Information Alliance, Inc.
- HealthTrust Performance Group
- HOPCo
- Huma Therapeutics Limited
- IPlusElements, Inc. (Ohtari)
- Kermit
- MedTrak, Inc. (CareSense System)
- Medtronic
- MiCare Path
- [m]pirik
- Mytonomy
- OBERD
- OM1
- Ortech, Inc.
- OrthoVitals
- Outcome MD
- PatientIQ
- Pro-Mapp Health, Inc.
- Q-Centrix
- Surgical Information Systems
- ValidCare
- VisionTree
- Vox Telehealth
- Zimmer Biomet

For updates to the list and more information on the AAOS Authorized Vendor Program, please visit here.

Appendix D

AJRR Committees

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Appendix E

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Participating Institutions

Alabama

Cullman Regional Medical Center
Huntsville Hospital
Jack Hughston Memorial Hospital
Mobile Infirmary
Providence Hospital
South Baldwin Regional Medical Center
St. Vincent's Birmingham
Athens-Limestone Hospital
Decatur Morgan Hospital
USA Health University Hospital

Alaska

Alaska Regional Hospital
Alpine Surgery Center
Central Peninsula Hospital
Creekside Surgery Center
Providence Alaska Medical Center
Providence Kodiak Island Medical Center
PeaceHealth Orthopedic & Sports Medicine in Ketchikan
Bartlett Regional Hospital

Arizona

Arizona Spine & Joint Hospital
Banner-University Medical Center South
Banner-University Medical Center Tucson
Carondelet St. Joseph's Hospital
Flagstaff Medical Center
Mayo Clinic in Arizona
Mountain Vista Medical Center
North Valley Surgery Center
Northwest Medical Center
OASIS Hospital*
Tempe St. Luke's Hospital
Verde Valley Medical Center
Chandler Regional Medical Center
Gateway Surgery Center
Mercy Gilbert Medical Center
Oro Valley Hospital
Shane Martin, MD of Greater Phoenix Orthopedics
Sonoran Orthopaedic Trauma Surgeons
St. Luke's Medical Center
University Orthopedic Specialists

Arkansas

Arkansas Specialty Surgery Center
Arkansas Surgical Hospital
CHI St. Vincent Hot Springs*
CHI St. Vincent Infirmary
Martin Knee & Sports Medicine Center
Mercy Hospital Fort Smith
Mercy Hospital Northwest Arkansas
Mercy Orthopedic Hospital Fort Smith
Northwest Health Physicians' Specialty Hospital*
Northwest Medical Center-Bentonville
Northwest Medical Center-Springdale
OrthoSurgeons
St. Bernards Medical Center*
University of Arkansas for Medical Sciences
Washington Regional Medical Center*
White River Medical Center
National Park Medical Center

California

Adventist Health Bakersfield
Adventist Health Hanford
Adventist Health Lodi Memorial
Adventist Health Sonora
Adventist Health St. Helena*
Alta Bates Summit Medical Center | Alta Bates Campus
Alta Bates Summit Medical Center | Summit Campus
Arroyo Grande Community Hospital
Bakersfield Memorial Hospital*
Barton Memorial Hospital
California Pacific Medical Center
Casa Colina Hospital and Centers for Healthcare*
Cedars-Sinai Medical Center
Clovis Community Medical Center
Community Hospital of the Monterey Peninsula
Community Memorial Hospital
Dameron Hospital
Doctors Medical Center of Modesto
Eisenhower Medical Center
El Camino Hospital, Los Gatos Campus
Emanuel Medical Center
Enloe Medical Center
Feather River Hospital
French Hospital Medical Center*
Fresno Surgical Hospital
Glendale Adventist Medical Center
Golden State Orthopedics & Spine
Goleta Valley Cottage Hospital
Hoag Orthopedic Institute
Howard Memorial Hospital
Huntington Hospital
Inland Valley Medical Center*
John Muir Health, Concord Medical Center
John Muir Health, Walnut Creek Medical Center
Keck Medicine of USC
La Veta Surgery Center
Loma Linda University Health
Long Beach Medical Center
Los Robles Regional Medical Center
Marian Regional Medical Center
Marina del Rey Hospital
Memorial Medical Center*
Mercy General Hospital*
Mercy Hospital of Folsom
Mercy Medical Center
Mercy Medical Center Merced*
Mercy San Juan Medical Center

Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Methodist Hospital of Sacramento*
Mills-Peninsula Medical Center
Mission Hospital-Mission Viejo
Monterey Peninsula Surgery Center
NorthBay Medical Center
NorthBay VacaValley Hospital
Novato Community Hospital*
Ojai Valley Community Hospital
Orange Coast Medical Center
Palomar Medical Center Escondido
Palomar Medical Center Poway*
Petaluma Valley Hospital
PIH Health-Whittier
Pomona Valley Hospital Medical Center
Presidio Surgery Center*
Providence Holy Cross Medical Center
Providence Little Company of Mary Medical Center-San Pedro
Providence Little Company of Mary Medical Center Torrance
Providence Saint John's Health Center
Providence Saint Joseph Medical Center
Providence Santa Rosa Memorial Hospital
Providence St. Joseph Hospital Eureka
Providence St. Joseph Hospital of Orange
Providence St. Jude Medical Center*
Providence St. Mary Medical Center*
Providence Tarzana Medical Center
Queen of the Valley Medical Center
Redlands Community Hospital
Redwood Memorial Hospital
Riverside Community Hospital
Riverside University Health System*
Ronald Reagan UCLA Medical Center
Saddleback Medical Center
Saint Agnes Medical Center
Salinas Valley Memorial Healthcare System
San Antonio Regional Hospital*
Santa Barbara Cottage Hospital*
Santa Clara Valley Medical Center
Santa Rosa Surgery and Endoscopy Center
Scripps Green Hospital
Sequoia Hospital
Sharp Chula Vista Medical Center
Sharp Coronado Hospital
Sharp Grossmont Hospital
Sharp Memorial Hospital
Shasta Regional Medical Center
Simi Valley Hospital
Sonoma Valley Hospital
St. Joseph Hospital Eureka
St. Joseph's Medical Center*
St. Mary Medical Center
St. Bernardine Medical Center
Stanford Health Care*
Stanford Health Care Tri-Valley*
Sutter Alhambra Surgery Center
Sutter Medical Center, Sacramento Surgery Center*
Sutter Sierra Surgery Center
Sutter Surgical Hospital North Valley
Tahoe Forest Hospital
Temecula Valley Hospital
The Bahamas Surgery Center
The Center for Orthopedic Surgery
Torrance Memorial Medical Center*
Tri-city Medical Center
UCLA Santa Monica Medical Center
UCSF Medical Center
Ukiah Valley Medical Center
Washington Hospital Healthcare System
West Coast Joint and Spine Surgery Center*
West Hills Hospital & Medical Center
White Memorial Medical Center
Adventist Health Delano
Adventist Health Specialty Bakersfield
Adventist Health Tehachapi Valley
Alvarado Hospital Medical Center
Campus Surgery Center
Carlsbad Surgery Center
Coast Surgery Center
Corona Regional Medical Center
Desert Regional Medical Center
Dignity Health-St. Mary Medical Center
Dominican Hospital
Eden Medical Center
Fort Sutter Surgery Center
Good Samaritan Hospital
Henry Mayo Newhall Hospital
La Jolla Orthopedic Surgery Center
Mammoth Hospital
Memorial Hospital Los Banos
Mercy Hospital Downtown-Bakersfield
Mercy Medical Center Redding
Mission Valley Heights Surgery Center
North Bay Regional Surgery Center
North Tahoe Orthopedics
Northridge Hospital Medical Center
Otay Lakes Surgery Center
Palmdale Regional Medical Center
Poway Surgery Center
Rancho Springs Medical Center*
San Leandro Surgery Center
St. John's Pleasant Valley Hospital
St. John's Regional Medical Center
Stockton Surgery Center
Surgery Center of Long Beach
Sutter Amador Hospital
Sutter Auburn Faith Hospital
Sutter Auburn Surgery Center
Sutter Davis Hospital Outpatient (Ambulatory) Surgery Center
Sutter Elk Grove Surgery Center
Sutter Fairfield Surgery Center
Sutter Maternity & Surgery Center
Sutter North Surgery and Endoscopy Center
Sutter Roseville Medical Center Surgery Center
Sutter Solano Medical Center Surgery Center
Sutter Tracy Community Hospital
UCSF Medical Center at Mount Zion
USC Verdugo Hills Hospital

**Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.*

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Colorado

AdventHealth Parker
Animas Surgical Hospital
Avista Adventist Hospital
Boulder Community Health
Castle Rock Adventist Hospital
Colorado Joint Replacement
Crown Point Surgery Center
Denver Health Medical Center
Littleton Adventist Hospital
Longmont United Hospital
Mercy Regional Medical Center
North Suburban Medical Center
OCC Surgery Center Inverness
OrthoColorado Hospital
Penrose Hospital
Porter Adventist Hospital
Pueblo Bone & Joint Clinic, LLC
Rose Medical Center*
Sky Ridge Medical Center*
St. Anthony Hospital
St. Anthony North Health Campus
St. Anthony Summit Medical Center
St. Francis Medical Center
St. Mary-Corwin Medical Center
St. Mary's Medical Center
St. Thomas More Hospital
Steamboat Orthopaedic & Spine Institute
Swedish Medical Center
The Medical Center of Aurora
UCHealth Broomfield Hospital
UCHealth Grandview Hospital
UCHealth Greeley Medical Center
UCHealth Highlands Ranch Hospital
UCHealth Longs Peak Hospital
UCHealth Medical Center of the Rockies
UCHealth Memorial Hospital Central
UCHealth Pikes Peak Regional Hospital
UCHealth Poudre Valley Hospital
UCHealth University of Colorado Hospital
UCHealth Yampa Valley Medical Center
Valley View Hospital
Panorama Orthopedics & Spine Center
Penrose-St. Francis Urgent Care
Presbyterian St. Luke's Medical Center
UCHealth Inverness Orthopedics and Spine Surgery Center

Connecticut

Backus Hospital*
Bridgeport Hospital Milford Campus-Milford
Danbury Hospital*
Glastonbury Surgery Center
Hartford Hospital*
Middlesex Hospital
MidState Medical Center*
New Milford Hospital
Norwalk Hospital*
Saint Francis Hospital and Medical Center*
Sharon Hospital
St. Vincent's Medical Center*
Stamford Hospital
The Hospital of Central Connecticut-New Britain General Campus
Waterbury Hospital
Western Connecticut Orthopedic Surgical Center
Windham Hospital
Yale New Haven Health Bridgeport Hospital*
Yale New Haven Health Greenwich Hospital*
Yale New Haven Health Lawrence + Memorial Hospital
Yale New Haven Health Saint Raphael Campus*
Yale New Haven Hospital York Street Campus
Johnson Memorial Hospital
Saint Mary's Hospital
Valley Orthopaedic Specialists, LLC

Delaware

Bayhealth Hospital, Kent Campus
Bayhealth Hospital, Sussex Campus
Christiana Hospital*
St. Francis Healthcare
TidalHealth Nanticoke
Wilmington Hospital
First State Orthopaedics
Orthopaedic Associates of Southern Delaware, P.A.
Saint Francis Hospital

District of Columbia

Providence Hospital
Sibley Memorial Hospital-Johns Hopkins Medicine
The George Washington University Hospital

Florida

AdventHealth Altamonte Springs
AdventHealth Carrollwood*
AdventHealth Celebration
AdventHealth North Pinellas*
AdventHealth Ocala
AdventHealth Orlando
AdventHealth Waterman
AdventHealth Wesley Chapel
AdventHealth Winter Park
AdventHealth-Zephyrhills Hospital*
Andrews Institute Ambulatory Surgery Center
Ascension St. Vincent's Medical Center Clay County Hospital
Ascension St. Vincent's Medical Center Riverside Hospital
Ascension St. Vincent's Southside Hospital
Ascension St. Vincent's St. Johns County
Aventura Hospital and Medical Center
Baptist Hospital
Bartow Regional Medical Center
Blake Medical Center
Brandon Regional Hospital

**Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.*

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Broward Health North*
Cape Coral Hospital
Cleveland Clinic Florida
Cleveland Clinic Florida-Weston
Cleveland Clinic Indian River Hospital
Cleveland Clinic Tradition Hospital
Coral Gables Hospital
Doctors Hospital of Sarasota
Dr. P. Phillips Hospital*
Fawcett Memorial Hospital
Flagler Hospital
Florida Medical Center
Fort Walton Beach Medical Center
Gulf Breeze Hospital
Gulf Coast Medical Center
Gulf Coast Regional Medical Center
Health Central Hospital
Holy Cross Hospital
Indian River Medical Center
JFK Medical Center
Jupiter Medical Center
Kendall Regional Medical Center
Largo Medical Center
Lee Memorial Hospital
Martin Memorial Medical Center
Mayo Clinic in Florida*
Mease Countryside Hospital
Mease Dunedin Hospital
Medical Center of Trinity
Memorial Hospital Jacksonville*
Memorial Hospital of Tampa
Memorial Hospital West*
Morton Plant Hospital
Morton Plant North Bay Hospital
North Florida Regional Medical Center
Oak Hill Hospital
Ocala Regional Medical Center
Orlando Health Jewett Orthopedic Institute
Orlando Health Orlando Regional Medical Center
Orlando Health South Seminole Hospital
Orthopaedic Surgery Center
Orthopaedic Surgery Center of Ocala
Osceola Regional Medical Center
Palms of Pasadena Hospital
Parrish Medical Center
Physicians Regional Medical Center-Collier Boulevard
Physicians Regional Medical Center-Pine Ridge
Regional Medical Center Bayonet Point
Rockledge Regional Medical Center
Sarasota Memorial
Sarasota Memorial Hospital-Venice
South Bay Hospital
South Florida Baptist Hospital
St. Anthony's Hospital
St. Joseph's Hospital-North
St. Joseph's Hospital Tampa
St. Joseph's Hospital-South
St. Lucie Medical Center
Tallahassee Memorial HealthCare
The Orthopaedic Institute
Toman Orthopedics and Sports Medicine
UF Health Shands Hospital
University Hospital & Medical Center
University of Florida Health
University of Miami Hospital
West Florida Hospital
Westside Regional Medical Center
Winter Haven Hospital
AdventHealth Palm Coast Parkway
AdventHealth Polk
Andrews Institute for Orthopaedics & Sports Medicine
BayCare Hospital Wesley Chapel
Broward Health Medical Center
Cleveland Clinic Martin South Hospital
Florida Joint & Spine Institute
HCA Florida University Hospital
Lakewood Ranch Medical Center
Manatee Memorial Hospital
Medical Center Clinic
NCH North Hospital
Orlando Orthopaedic Center
OrthoCare Florida
Orthopedic Center of Palm Beach County
Orthopedic Special Surgery of Palm Beaches
Pensacola Orthopaedics & Sports Medicine
Wellington Regional Medical Center
Weston Outpatient Surgical Center

Georgia

Advanced Center for Joint Surgery
Atlanta Medical Center
Atlanta Medical Center South
Augusta-Aiken Orthopedic Specialists Surgery Center
Burke Health
Cartersville Medical Center
Coffee Regional Medical Center
Coliseum Medical Centers
Colquitt Regional Medical Center
Eastside Medical Center
Emory Decatur Hospital
Emory Johns Creek Hospital*
Emory Saint Joseph's Hospital
Emory University Hospital Midtown
Emory University Orthopaedics & Spine Hospital*
Houston Medical Center
Memorial University Medical Center
Navicent Health
Northwest Plaza ASC, LLC
Optim Medical Center-Tattnall
Optim Surgery Center
Perry Hospital
Piedmont Atlanta Hospital
Piedmont Augusta
Piedmont Columbus Regional Northside Campus
Piedmont Fayette Hospital
Piedmont Henry Hospital
Piedmont Newnan Hospital
Redmond Regional Medical Center
Southeast Georgia Health System-Brunswick Campus
Southeast Georgia Health System-Camden Campus

**Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.*

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

St. Francis Hospital*
St. Mary's Good Samaritan Hospital
St. Mary's Hospital
St. Mary's Athens Ambulatory Surgery Center
St. Mary's Sacred Heart Hospital
WellStar Cobb Hospital
WellStar Douglas Hospital
WellStar Kennestone Hospital
Wellstar North Fulton Medical Center
WellStar Paulding Hospital
WellStar Spalding Medical Center
WellStar West Georgia Medical Center
Wellstar Windy Hill Hospital*
AdventHealth Redmond
Coliseum Northside Hospital
Floyd Medical Center
OrthoGeorgia
Summit Sports Medicine & Orthopedic Surgery

Hawaii

Adventist Health Castle
Hawaii Pacific Health
Pali Momi Medical Center
Straub Clinic and Hospital
The Queen's Medical Center*
Wilcox Memorial Hospital

Idaho

Cassia Regional Medical Center
Kootenai Outpatient Surgery
Madison Memorial Hospital
Northwest Specialty Hospital
St. Alphonsus General Surgery & Bariatric Clinic
St. Alphonsus Medical Center Nampa Campus
St. Alphonsus Regional Medical Center
St. Joseph Regional Medical Center
St. Luke's Boise Medical Center
St. Luke's Meridian Medical Center

Illinois

Adult & Pediatric Orthopedics
Advocate Christ Medical Center
Advocate Condell Medical Center
Advocate Good Samaritan Hospital
Advocate Good Shepherd Hospital
Advocate Illinois Masonic Medical Center
Advocate Lutheran General Hospital
Advocate Sherman Hospital
Advocate South Suburban Hospital
Advocate Trinity Hospital
AMITA Health Adventist Medical Center Hinsdale
AMITA Health Alexian Brothers Medical Center Elk Grove Village
AMITA Health Resurrection Medical Center Chicago
AMITA Health Saint Joseph Hospital Chicago
AMITA Health Saint Joseph Hospital Elgin
AMITA Health St. Alexius Medical Center Hoffman Estates
AMITA Health St. Mary's Hospital Kankakee
Blessing Health System
Centegra Hospital McHenry
Centegra Hospital Woodstock
DuPage Medical Group
Evanston Hospital
FHN Memorial Hospital
Genesis Medical Center, Silvis
Gibson Area Hospital
Glenbrook Hospital
Highland Park Hospital
HSHS St. Anthony's Memorial Hospital*
Memorial Medical Center-Springfield
Mount Sinai Hospital
Northwestern Medicine Central DuPage Hospital
Northwestern Medicine Delnor Hospital
Northwestern Medicine Huntley Hospital
Northwestern Medicine Kishwaukee Hospital*
Northwestern Medicine Lake Forest Hospital
Northwestern Memorial Hospital
OrthoIllinois
Orthopedic & Sports Medicine Clinic
OSF Saint Anthony Medical Center
OSF Saint Anthony's Health Center
OSF Saint Elizabeth Medical Center
OSF Saint Francis Medical Center
OSF Saint James-John W. Albrecht Medical Center
OSF St. Joseph Medical Center
OSF St. Mary Medical Center
Palos Community Hospital
Rockford Memorial Hospital
Rush University Medical Center
Sarah Bush Lincoln Health Center
Skokie Hospital
South Shore Hospital
Swedish American Hospital
UnityPoint Health-Methodist
UnityPoint Health-Proctor
UnityPoint Health-Trinity Rock Island
Valley Ambulatory Surgery Center
Weiss Memorial Hospital
Advocate BroMenn Medical Center
Advocate Eureka Hospital
AMITA Health Adventist Medical Center La Grange
Bonutti Orthopedic Clinic
Center For Minimally Invasive Surgery
CGH Medical Center
Deaconess Illinois Medical Center
Decatur Orthopaedic Center
Edward Hospital
Elmhurst Hospital
Gold Coast Surgicenter
Gottlieb Memorial Hospital
HSHS St. John's Hospital
Loyola University Medical Center
Memorial Hospital of Carbondale
Mercy Hospital & Medical Center

*Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

NorthShore Orthopaedic & Spine Institute
Northwest Community Hospital
OSF Heart of Mary Medical Center
OSF Holy Family Medical Center
OSF Sacred Heart Medical Center
OSF Saint Luke Medical Center
OSF Saint Paul Medical Center
Raycraft & Jones Orthopaedics
Riverside Medical Center
SIH Herrin Hospital

Indiana

Allied Physicians Surgery Center
Baptist Health Floyd
Columbus Regional Health Orthopedics and Sports Medicine
Elkhart General Hospital*
Franciscan Health Carmel
Franciscan Health Indianapolis
Franciscan Health Moorseville
Hancock Regional Hospital
Indiana Regional Medical Center
Indiana University Health West Hospital
IU Health Ball Memorial Hospital
IU Health Bloomington Hospital*
IU Health North Hospital
IU Health Saxony Hospital*
IU Health Saxony Surgery Center
Main Hospital*
Major Health Partners Medical Center
Memorial Hospital and HealthCare Center
Memorial Hospital of South Bend*
OrthoIndy Northwest
Plymouth Medical Center
Porter Regional Hospital
Riverview Health Westfield Hospital
Schneck Medical Center
Sidney & Lois Eskenazi Hospital
St. Joseph Regional Medical Center
St. Mary Medical Center*
The Orthopedic Hospital
Indiana Hand to Shoulder Center
Indiana University Health Methodist Hospital*
Indiana University Health White Memorial Hospital
IU Health Arnett Hospital
IU Health Bedford Hospital
IU Health Beltway Surgery Centers*
IU Health Blackford Hospital
IU Health Eagle Highlands Surgery Center*
IU Health Jay Hospital
IU Health Meridian South Surgery Center
IU Health Morgan*
IU Health Paoli Hospital
IU Health Tipton Hospital
IU Health University Hospital
Munster Specialty Surgery Center
Parkview Ortho Hospital
Riley Hospital for Children at IU Health
Senate Street Surgery Center*

Iowa

Advanced Surgery Center of Central Iowa
Allen Hospital
Buena Vista Regional Medical Center
CHI Health Mercy Council Bluffs*
Finley Hospital
Genesis Medical Center, Davenport
Great River Orthopaedic Specialists
Greater Regional Health
Iowa Lutheran Hospital
Iowa Methodist Medical Center
Iowa Specialty Hospital-Clarion
Lakes Regional Healthcare
Marengo Memorial Hospital
Mercy Medical Center-Cedar Rapids
Mercy Medical Center-Clinton
Mercy Medical Center-Des Moines
Mercy Medical Center-Dubuque
Mercy Medical Center-Sioux City
Mercy Medical Center-West Lakes
MercyOne North Iowa Medical Center
Methodist West Hospital
Mississippi Valley Surgery Center
Orthopaedic Outpatient Surgery Center
Spencer Hospital
St. Luke's Hospital
St. Luke's Regional Medical Center
Steindler Orthopedic Clinic
UnityPoint Health-Trinity Bettendorf
UnityPoint Health-Trinity Muscatine
UnityPoint Health-Trinity Regional Medical Center
UnityPoint Marshalltown
University of Iowa Hospitals & Clinics
Ankeny Medical Park Surgery Center
CHI Health Mercy Corning
Mahaska Health Main Campus
MercyOne Cedar Falls Medical Center
MercyOne Des Moines Medical Center
MercyOne New Hampton Medical Center
MercyOne Primghar Medical Center
MercyOne Waterloo Medical Center
MercyOne West Des Moines Medical Center

Kansas

AdventHealth Shawnee Mission
Ascension Via Christi Hospital in Manhattan
Hays Medical Center
Hutchinson Regional Medical Center
Kansas City Orthopaedic Institute
Lawrence Memorial Hospital*
LMH Health
Menorah Medical Center
Newton Medical Center
St. Catherine Hospital
Stormont-Vail Health*
The University of Kansas Health System
Wesley Medical Center
Wesley Woodlawn Hospital & ER
AdventHealth Ottawa
Bob Wilson Memorial Hospital
Mercy Specialty Hospital-Southeast Kansas
St. Rose Ambulatory & Surgery Center

**Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.*

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Kentucky

Baptist Health Corbin
Baptist Health La Grange
Baptist Health Lexington
Baptist Health Louisville
Baptist Health Paducah
Baptist Health Richmond
Hardin Memorial Hospital*
Jewish Hospital
King's Daughters Medical Center*
Mercy Health-Lourdes Hospital
Methodist Hospital
Norton Audubon Hospital
Norton Brownsboro Hospital
Norton Hospital
Norton Women's & Children's Hospital
Owensboro Health Regional Hospital
Pomeroy & Rhoads Orthopaedics, PLLC
Saint Joseph East
Saint Joseph London
St. Elizabeth Hospital Edgewood
TriStar Greenview Regional Hospital
University of Kentucky Albert B. Chandler Hospital
UofL Health-UofL Hospital
Bluegrass Orthopaedics
Med Center Health Orthopaedics & Sports Medicine
South Central Kentucky Orthopedics

Louisiana

AVALA
Doctors Hospital at Deer Creek
East Jefferson General Hospital
Lafayette General Medical Center
Lafayette Surgical Specialty Hospital
Ochsner Baptist-A Campus of Ochsner Medical Center
Ochsner Hospital for Orthopedics & Sports Medicine
Ochsner Medical Center*
Ochsner Medical Center-Kenner
Ochsner Medical Center-West Bank Campus
Our Lady of Lourdes Regional Medical Center
Park Place Surgical Hospital
Specialists Hospital Shreveport
Thibodeaux Regional Medical Center
Tulane Lakeside Hospital
Willis-Knighton Medical Center
Willis Knighton Pierremont
Christus Ochsner St. Patrick Hospital
Lafayette Bone & Joint Clinic
Red River Surgery Center
West Bank Surgery Center

Maine

Central Maine Orthopaedics
Falmouth Orthopedic Center
Maine Medical Center*
MaineGeneral Medical Center
MaineHealth Maine Medical Center Biddeford
MaineHealth Surgery Center Scarborough
Northern Light Eastern Maine Medical Center
Northern Light Mercy Hospital*
OA Centers for Orthopaedics
St. Mary's Regional Medical Center

Maryland

Anne Arundel Medical Center
Atlantic General Hospital
GBMC HealthCare*
Harborside Surgery Center
Holy Cross Germantown Hospital
Holy Cross Hospital
Howard County General Hospital
Johns Hopkins Bayview Medical Center*
MedStar Union Memorial Hospital
Mercy Medical Center
Meritus Medical Center
Peninsula Regional Medical Center*
Saint Agnes Healthcare*
Suburban Hospital
SurgCenter of Western Maryland, LLC
Surgery Center of Easton
University of Maryland Baltimore Washington Medical Center
University of Maryland Charles Regional Medical Center
University of Maryland Harford Memorial Hospital
University of Maryland Medical Center
University of Maryland Medical Center Midtown Campus
University of Maryland Rehabilitation & Orthopaedic Institute
University of Maryland Shore Medical Center at Easton
University of Maryland St. Joseph Medical Center
University of Maryland Upper Chesapeake Health
Western Maryland Health System
Capitol Orthopaedics and Rehabilitation, LLC
ChristianaCare Union Hospital
Frederick Health Hospital
Greenspring Surgery Center, LLC
Sinai Hospital of Baltimore

Massachusetts

Anna Jaques Hospital
Baystate Orthopedic Surgery Center
Berkshire Medical Center
Beth Israel Deaconness Hospital-Plymouth
Beth Israel Deaconness Medical Center
Beverly Hospital
Boston Medical Center
Brigham and Women's Faulkner Hospital
Brigham and Women's Hospital
Charlton Memorial Hospital*
Emerson Hospital
Good Samaritan Medical Center
Holy Family Hospital*
Lahey Hospital & Medical Center
Lowell General Hospital
Massachusetts General Hospital

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Those that contributed data by 7/14/25 are highlighted.

New England Baptist Hospital*
Orthopedic Surgery Center of the North Shore
Quincy Medical Center
Saint Anne's Hospital*
Signature Healthcare Brockton Hospital
South Shore Hospital
Sports Medicine North Orthopedic Surgery
St. Luke's Hospital*
Winchester Hospital
Beth Israel Deaconess Hospital-Milton
Boston Out-Patient Surgical Suites, LLC
Longview Orthopaedic Center, LLC
Mercy Medical Center
Mount Auburn Hospital
Tobey Hospital*

Michigan

Alliance Surgery Center
Ascension Borgess Medical Center
Ascension Genesys Hospital
Ascension Macomb-Oakland Hospital, Madison Heights Campus
Ascension Macomb-Oakland Hospital, Warren Campus
Ascension Providence Hospital, Novi Campus
Ascension Providence Hospital, Southfield
Ascension Providence Rochester Hospital
Ascension River District Hospital
Ascension St. John Hospital
Ascension St. Mary's Hospital*
Bronson Battle Creek Hospital
Bronson LakeView Hospital
Bronson Methodist Hospital
Bronson South Haven Hospital
Henry Ford Hospital
Henry Ford Macomb Hospital
Henry Ford West Bloomfield Hospital
Henry Ford Wyandotte Hospital
Holland Hospital
Hurley Medical Center
McLaren Flint
McLaren Greater Lansing
Mercy Health Hackely
Mercy Health Muskegon
Mercy Health St. Mary's
Michigan Surgical Hospital
MidMichigan Medical Center-Midland
Munson Healthcare Cadillac Hospital
Munson Medical Center
OSF St. Francis Hospital & Medical Group
Red Cedar Surgery Center, LLC*
Sparrow Health System
Spectrum Health Hospitals Blodgett Hospital
Spectrum Health Lakeland
Spectrum Health Ludington Hospital
St. Joseph Mercy Ann Arbor*
St. Joseph Mercy Brighton Health Center
St. Joseph Mercy Chelsea
St. Joseph Mercy Oakland Hospital
St. Mary Mercy Livonia Hospital
St. Joseph Mercy Livingston Hospital
University of Michigan Health System
UP Health System-Marquette
William Beaumont Hospital
Memorial Healthcare
Mercy Health Lakeshore
Mercy Health Southwest
Muskegon Surgery Center

Minnesota

Abbott Northwestern Hospital*
Alomere Health
Astera Health Main Campus
Buffalo Hospital
Cambridge Medical Center
CHI St. Gabriel's Health
Crosstown Surgery Center
Cuyuna Regional Medical Center*
Douglas County Hospital
Eagan Surgery Center
Essentia Health-St. Joseph's Medical Center (Brainerd)*
Essentia Health-St. Mary's Medical Center
Fairview Northland Medical Center
Fairview Ridges Hospital
Fairview Southdale Hospital
HealthEast Clinic-Woodwinds
HealthEast St. John's Hospital
HealthEast St. Joseph's Hospital
Hennepin County Medical Center
High Pointe Surgery Center
Lakeview Hospital
Mayo Clinic Health System in Austin
Mayo Clinic Health System in Mankato
Mayo Clinic Health System in Red Wing
Mayo Clinic in Rochester
Mercy Hospital
Mercy Hospital-Unity Campus
Minnesota Valley Surgery Center, LLC
New Ulm Medical Center
North Memorial Health Hospital
Orthopaedic & Fracture Clinic
Owatonna Hospital
Park Nicollet Methodist Hospital
Regina Hospital
Regions Hospital
Ridgeview Medical Center
River's Edge Hospital and Clinic
Riverwood Healthcare Center
Sanford Bemidji Medical Center
St. Cloud Hospital
St. Francis Regional Medical Center
St. Gabriel's Hospital
St. Luke's
Two Twelve Surgery Center
United Hospital
University of Minnesota Medical Center
Vadnais Heights Surgery Center*
WestHealth Surgery Center
Abbott Northwestern-WestHealth
St. Cloud Surgical Center
St. Mary's Hospital
TRIA Orthopaedic Center

**Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.*

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Mississippi

Baptist Medical Center
Capital Ortho
Columbus Orthopaedic Outpatient Center*
Merit Health River Oaks
Mississippi Valley Surgery Center and Endoscopy Center
OrthoSouth Southaven Surgery Center
Singing River Hospital
St. Dominic Hospital
Univeristy of Mississippi Medical Center
North Mississippi Medical Center
Ocean Springs Hospital

Missouri

CoxHealth
Liberty Hospital Orthopaedics
Mercy Hospital Carthage
Mercy Hospital Jefferson
Mercy Hospital Joplin
Mercy Hospital Lebanon
Mercy Hospital Lincoln
Mercy Hospital South
Mercy Hospital Springfield*
Mercy Hospital St. Louis
Mercy Hospital Washington
Mercy Orthopedic Hospital Springfield
Meyer Orthopedic & Rehabilitation Hospital
Missouri Orthopaedic Institute
Mosaic Life Care
North Kansas City Hospital*
Pawsat, M.D. & Maeda, M.D. P.C.
Phelps Health Hospital
Saint Francis Medical Center
Saint Luke's East Hospital*
Saint Luke's Surgicenter-Lee's Summit, LLC*
Signature Medical Group
Southeast Hospital
St. Joseph Outpatient Surgery Center, LLC
St. Luke's Hospital
St. Luke's Hospital-Chesterfield
The Surgical Center at Columbia Orthopaedic Group
Total Joint Center of the Northland
Truman Medical Center-Lakewood*
Cox Medical Center Branson
Cox Monett Hospital
Mercy Center for Performance Medicine and Specialty Care
Orthopedic Associates
SSM Health DePaul Hospital-St. Louis*
SSM Health St. Mary's Hospital-Jefferson City

Montana

Benefis Health System
Bozeman Health Deaconess Hospital
Great Falls Clinic Hospital
Northern Montana Hospital
Providence St. Joseph Medical Center
St. Patrick Hospital
Frances Mahon Deaconess Hospital*

Nebraska

CHI Health Immanuel
CHI Health Lakeside
CHI Health Midlands
Creighton University Medical Center-Bergan Mercy
Great Plains Health
Lincoln Surgical Hospital
Midwest Surgical Hospital
Nebraska Medicine
Nebraska Orthopaedic Hospital
CHI Health Good Samaritan
CHI Health St. Elizabeth
Columbus Community Hospital
Creighton Univeristy Medical Center
MercyOne Oakland Medical Center

Nevada

MountainView Hospital
Northern Nevada Medical Center*
Reno Orthopedic Surgery Center
Renown Regional Medical Center
Renown South Meadows Medical Center
Southern Hills Hospital & Medical Center
Summerlin Hospital Medical Center
Sunrise Hospital & Medical Center
Centennial Hills Hospital Medical Center
Desert Springs Hospital
Henderson Hospital
Orthopaedic Institute of Henderson
Orthopedic Specialty Hospital of Nevada
Spring Valley Hospital Medical Center
University Medical Center of Southern Nevada
Valley Hospital Medical Center

New Hampshire

Atlantic Coast Surgical Suites
Concord Hospital
Dartmouth-Hitchcock Medical Center
Elliot 1-Day Surgery
Elliot Hospital
Lighthouse Surgical Suites, LLC*
North Atlantic Surgical Suites
Northridge Surgical Suites*
Portsmouth Regional Hospital
Southern NH Medical Center
Concord Orthopaedics
Exeter Hospital

New Jersey

Bayshore Medical Center
CentraState Medical Center
Chilton Medical Center
Englewood Hospital
Hackensack University Medical Center*
Holy Name Medical Center
Jersey City Medical Center

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Those that contributed data by 7/14/25 are highlighted.

Jersey Shore University Medical Center*
JFK Medical Center
Morristown Medical Center*
Newton Medical Center
Northern Monmouth Regional Surgery Center
Ocean Medical Center
Overlook Medical Center*
Palisades Medical Center
Princeton Medical Center*
Raritan Bay Medical Center
Riverview Medical Center*
Robert Wood Johnson University Hospital New Brunswick
Robert Wood Johnson University Hospital Somerset
Southern Ocean Medical Center
St. Francis Medical Center
St. Luke's Warren Campus
St. Peter's University Hospital
The Valley Hospital
Virtua Marlton Hospital
Virtua Memorial Hospital
Virtua Voorhees Hospital
Clara Maass Medical Center
Community Medical Center
Eastern Orthopedic Associates
Hudson Crossing Surgery Center
Lourdes Medical Center of Burlington County
Monmouth Medical Center
Monmouth Medical Center Southern Campus
Newark Beth Israel Medical Center
Robert Wood Johnson University Hospital Hamilton
Robert Wood Johnson University Hospital Rahway
Saint Barnabas Medical Center
Surgical Center at Millburn, LLC
The Center for Ambulatory Surgery
Virtua Mount Holly Hospital

New Mexico

CHRISTUS St. Vincent Regional Medical Center*
Memorial Medical Center-Las Cruces
MountainView Regional Medical Center
Presbyterian Hospital
Presbyterian Rust Medical Center
UNM Sandoval Regional Medical Center
Covenant Health Hobbs Hospital

New York

Alice Hyde Medical Center
Center for Advanced Ambulatory Surgery
Champlain Valley Physicians Hospital
Crouse Hospital
Glen Falls Hospital
Highland Hospital*
Hospital for Special Surgery
Huntington Hospital*
Jamaica Hospital Medical Center
John T. Mather Memorial Hospital
Kenmore Mercy Hospital
Lenox Hill Hospital
Long Island Jewish Forest Hills
Long Island Jewish Medical Center*
Long Island Jewish Valley Stream
Lourdes Hospital
Maimonides Medical Center
Maimonides Midwood Community Hospital
Mohawk Valley Health System
Montefiore Medical Center*
Mount Sinai Brooklyn
Mount Sinai Queens
Mount Sinai South Nassau*
Mount Sinai St. Luke's*
Mount Sinai West
Newark-Wayne Community Hospital
NewYork-Presbyterian Brooklyn Methodist Hospital
NewYork-Presbyterian Queens
NewYork-Presbyterian/Columbia University Irving Medical Center
North Shore University Hospital*
Northern Dutchess Hospital
Northern Westchester Hospital*
NYC Health + Hospitals/Elmhurst*
Oswego Hospital
Peconic Bay Medical Center
Phelps Hospital
Plainview Hospital
Putnam Hospital
Rochester General Hospital
Samaritan Hospital
South Shore University Hospital*
St. Charles Hospital*
St. Francis Hospital
St. Joseph's Hospital Health Center
St. Peter's Hospital
Staten Island University Hospital*
Stony Brook University Hospital
Syosset Hospital
The Hospital for Joint Diseases
The Mount Sinai Hospital*
UHS Binghamton General Hospital
UHS Wilson Medical Center
Unity Hospital
UPMC Chautauqua
Upstate University Hospital-Community Campus
Upstate University Hospital-Downtown Campus
White Plains Hospital
Winthrop-University Hospital
Wyoming County Community Health System
Wyoming County Community Hospital
Albany Memorial Hospital
Capital Region Ambulatory Surgery Center, LLC
Clifton Springs Hospital & Clinic
Excelsior Orthopaedics
Mercy Hospital of Buffalo
Mount St. Mary's Hospital and Health Center
NewYork-Presbyterian Lawrence Hospital

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Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

NewYork-Presbyterian Lower Manhattan Hospital
NewYork-Presbyterian/Weill Cornell Medical Center
Rochester Surgery Center*
Saint Mary's Hospital
Sisters of Charity Hospital
Sisters of Charity Hospital, St. Joseph Campus
United Memorial Medical Center
Vassar Brothers Medical Center

North Carolina

Atrium Health Mercy, a facility of Carolinas Medical Center
Blue Ridge Surgery Center
Capital City Surgery Center
Columbus Regional Healthcare System
Cone Health Annie Penn Hospital
Cone Health Wesley Long Hospital
Davie Medical Center*
Duke Ambulatory Surgery Center Arringdon
ECU Health Beaufort Hospital, a campus of ECU Health Medical Center
ECU Health Chowan Hospital
ECU Health Duplin Hospital
ECU Health Edgecombe Hospital
ECU Health North Hospital
ECU Health Roanoke-Chowan Hospital
ECU Health SurgiCenter
EmergeOrtho-Triangle Orthopedic Associates
FirstHealth Moore Regional Hospital
Greensboro Orthopaedics
High Point Medical Center
Hugh Chatham Memorial Hospital*
Lexington Medical Center
Mission Hospital
Moses H. Cone Memorial Hospital
Nash General Hospital
New Hanover Regional Medical Center
North Carolina Specialty Hospital*
Northern Hospital of Surry County
Novant Health Brunswick Medical Center
Novant Health Charlotte Orthopaedic Hospital
Novant Health Clemmons Medical Center
Novant Health Forsyth Medical Center
Novant Health Huntersville Medical Center
Novant Health Kernersville Medical Center
Novant Health Matthews Medical Center
Novant Health Rowan Medical Center
Novant Health Thomasville Medical Center
Novant Health UVA Prince William Medical Center
Sentara Albemarle Medical Center
Surgical Center of Greensboro
The Outer Banks Hospital
The Surgical Center of Morehead City
UNC Health Wayne
Wake Forest Baptist Medical Center
WakeMed Cary Hospital
WakeMed North Hospital
WakeMed Raleigh Campus
AdventHealth Hendersonville
Atrium Health Lincoln
Atrium Health's Carolinas Medical Center
Carolina Sports Medicine & Orthopaedic Specialists
Cary Orthopaedics
Viewmont Surgery Center

North Dakota

CHI St. Alexius Health Bismark*
Sanford Medical Center Fargo
Sanford Medical Center-Bismarck*

Ohio

Adena Regional Medical Center*
Bethesda Butler Hospital
Bethesda North Hospital
Blanchard Valley Health System
Cleveland Clinic Fairview Hospital
Cleveland Clinic Lakewood
Cleveland Clinic Main Campus
Crystal Clinic Orthopaedic Center
Euclid Hospital
Firelands Regional Medical Center
Fort Hamilton Hospital
Genesis Healthcare System
Good Samaritan Hospital*
Grandview Medical Center
Grant Medical Center
Greater Dayton Surgery Center
Greene Memorial Hospital
Hillcrest Hospital
Indu and Raj Soin Medical Center
Kettering Medical Center
King's Daughters Medical Center Ohio
Licking Memorial Hospital
Lutheran Hospital
Marymount Hospital
McCullough-Hyde Memorial Hospital
Medina Hospital
MetroHealth Medical Center Main Campus
Mount Carmel East
Mount Carmel New Albany
Mount Carmel St. Ann's
Mount Carmel West
Northpointe Surgical Suites*
OhioHealth Mansfield Hospital*
Ohio Specialty Surgical Suites*
Ohio Valley Surgical Hospital*
Ontario Hospital
Orthopedic ONE
Selby General Hospital
South Pointe Hospital
Southview Medical Center
Southwest General Health Center
St. Vincent Medical Center (Sisters of Charity-OH)
Summa Health System-Barberton Campus
Summa Health Wadsworth-Rittman Medical Center

**Achieved The Joint Commission Advanced Certification for Total Hip and Total Knee Replacement by 9/23/25.*

Institutions that joined AJRR by 7/22/25 are included.
Those that contributed data by 7/14/25 are highlighted.

Sycamore Medical Center
The Christ Hospital Health Network*
The Jewish Hospital-Mercy Health
The Ohio State University Wexner Medical Center
The Surgical Hospital at Southwoods
TriHealth Evendale Hospital
Trumbull Regional Medical Center*
UH Ahuja Medical Center
UH Bedford Medical Center, a campus of Regional Hospitals
UH Cleveland Medical Center
UH Conneaut Medical Center
UH Elyria Medical Center
UH Geauga Medical Center
UH Geneba Medical Center
UH Lake West Medical Center
UH Parma Medical Center
UH Portage Medical Center
UH Richmond Medical Center, a campus of Regional Hospitals
UH Samaritan Medical Center
UH St. John Medical Center
UH TriPoint Medical Center
White Fence Surgical Suites
Amherst Family Health Center
Ashtabula County Medical Center
Beacon Orthopaedics & Sports Medicine Evendale
Beacon Orthopaedics & Sports Medicine Summit Woods
Beacon Orthopaedics & Sports Medicine Western Hills
Cleveland Clinic Children's Hospital for Rehabilitation
Cleveland Clinic Mercy Hospital
First Settlement Orthopaedics
Mercy Health-West Hospital
Mercy Health Anderson Hospital
Mercy Health Clermont Hospital
Mercy Health Fairfield Hospital
Northside Regional Medical Center

Oklahoma

Ascension St. John Jane Phillips
Comanche County Memorial Hospital
Community Hospital North Campus
Community Hospital South Campus
Duncan Regional Hospital*
Hillcrest Hospital South
Mercy Hospital Ada
Mercy Hospital Ardmore
Mercy Hospital Oklahoma City
Norman Regional Hospital
Northwest Surgical Hospital
Southwestern Medical Center
St. John Broken Arrow
St. Mary's Regional Medical Center*
Stillwater Medical Center
Tulsa Spine & Specialty Hospital

Oregon

Adventist Health Portland
Good Samaritan Regional Medical Center
Hillsboro Medical Center
Hope Orthopedics
Legacy Emanuel Medical Center
Legacy Good Samaritan Medical Center
Legacy Meridian Park Medical Center
Legacy Mount Hood Medical Center
Legacy Silverton Medical Center
Oregon Health & Science University
Oregon Surgical Institute
PeaceHealth Orthopedics at Peace Harbor
Providence Hood River Memorial Hospital
Providence Medford Medical Center
Providence Milwaukie Hospital
Providence Newberg Medical Center
Providence Portland Medical Center
Providence Seaside Hospital
Providence St. Vincent Medical Center
Providence Willamette Falls Medical Center
Salem Health
Samaritan Albany General Hospital
St. Alphonsus Medical Center Baker City
St. Alphonsus Medical Center Ontario
St. Charles Health System
Surgery Center of Southern Oregon
Tillamook Regional Medical Center
Willamette Surgery Center
Willamette Valley Medical Center*
Bend Surgery Center
CHI Mercy Health Mercy Medical Center
Oregon Orthopedic & Sports Medicine Clinic
Orthopedic + Fracture Specialists
Portland Knee Clinic
South Portland Surgical Center

Pennsylvania

Abington-Lansdale Hospital, Jefferson Health
Abington Hospital-Jefferson Health
ACMH Hospital
Advanced Surgical Hospital
Barry A. Ruht MD PC
Bryn Mawr Hospital*
Butler Memorial Hospital
Conemaugh Memorial Medical Center*
Doylestown Hospital
Doylestown Surgery Center*
Excela Health Latrobe Hospital
Excela Health Westmoreland Hospital
Geisinger Community Medical Center
Geisinger Lewistown Hospital
Geisinger Medical Center
Geisinger Shamokin Area Community Hospital
Geisinger South Wilkes-Barre
Geisinger Wyoming Valley Medical Center
Heritage Valley Beaver
Heritage Valley Sewickley
Indiana Regional Medical Center
Jefferson Hospital*
Lancaster General Hospital
Lankenau Medical Center*

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Those that contributed data by 7/14/25 are highlighted.

Mercy Fitzgerald Hospital
Monongahela Valley Hospital
Moses Taylor Hospital
Mount Nittany Medical Center
Nazareth Hospital
North Pointe Surgery Center
Orthopaedic & Spine Specialists
OSS Orthopaedic Hospital*
Paoli Hospital*
Penn Highlands Healthcare
Penn Presbyterian Medical Center
Penn State Milton S. Hershey Medical Center
Pennsylvania Hospital
Phoenixville Hospital*
Reading Hospital*
Regional Hospital of Scranton
Restore Orthopaedic Surgical Institute
Riddle Hospital*
Rothman Orthopaedic Institute
St. Clair Hospital*
St. Luke's Allentown Campus
St. Luke's Anderson Campus
St. Luke's Carbon Campus
St. Luke's Easton Campus
St. Luke's Upper Bucks Campus
St. Luke's University Hospital - Bethlehem Campus
St. Mary Medical Center
Thomas Jefferson University Hospital
UPMC Altoona
UPMC Carlisle
UPMC East
UPMC Hamot
UPMC Hanover
UPMC Horizon
UPMC Jameson
UPMC Magee-Womens Hospital
UPMC McKeesport
UPMC Memorial
UPMC Mercy
UPMC Northwest
UPMC Passavant-McCandless
UPMC Pinnacle
UPMC Pinnacle Community Osteopathic*
UPMC Pinnacle Harrisburg
UPMC Pinnacle Lititz
UPMC Pinnacle West Shore*
UPMC Presbyterian
UPMC Shadyside
UPMC St. Margaret
UPMC Williamsport*
ValueHealth Muve-Warminster
ValueHealth Muve-West Chester*
WellSpan Gettysburg Hospital
WellSpan Surgery & Rehabilitation Hospital
WellSpan York Hospital
Allegheny General Hospital
Chan Soon-Shion Medical Center at Windber
Geisinger Jersey Shore Hospital
Geisinger Woodbine Lane
Lehigh Valley Hospital-Cedar Crest
Lehigh Valley Hospital-Dickson City
Lehigh Valley Hospital-Hazleton
Mercy Catholic Medical Center-Mercy Philadelphia Campus
Richards Orthopaedics Center & Sports Medicine
Rothman Orthopaedic Specialty Hospital
Surgery Center of Allentown
The Hospital of the University of Pennsylvania
UPMC Children's Hospital of Pittsburgh

Puerto Rico

Hospital Menonita Aibonito

Rhode Island

Kent Hospital*
Newport Hospital*
South County Hospital*
The Miriam Hospital*
Yale New Haven Health Westerly Hospital
Ortho Rhode Island Warwick Campus

South Carolina

AnMed Medical Center
Beaufort Memorial Hospital*
Bon Secours St. Francis Hospital*
Carolina Orthopedics
Carolina Pines Regional Medical Center
Chapin Surgery Center
East Cooper Medical Center
Grand Strand Medical Center
McLeod Health Cheraw
McLeod Health Clarendon
McLeod Health Dillon
McLeod Health Seacoast
McLeod Regional Medical Center
Medical University of South Carolina*
Oconee Memorial Hospital
Palmetto Health Baptist
Palmetto Health Richland
Pelham Medical Center
Prisma Health Baptist Hospital
Prisma Health Patewood Hospital*
Providence Orthopedic Hospital
Roper St. Francis Hospital
Roper St. Francis Mount Pleasant Hospital
Self Regional Healthcare
Trident Medical Center
Baptist Easley Hospital
Carolina Coast Surgery Center
Conway Medical Center
Lexington Medical Center Main Campus
Novant Health Gaffney Medical Center
Prisma Health Baptist Parkridge Hospital
St. Francis Downtown

South Dakota

Avera McKennan Hospital & University Health Center
Black Hills Surgical Hospital
Sanford USD Medical Center
Dunes Surgical Hospital

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Tennessee

Baptist Memorial Hospital-Collierville
Baptist Memorial Hospital-Memphis*
Bristol Regional Medical Center*
CHI Memorial Hospital Chattanooga
Erlanger Baroness Hospital
Erlanger East Hospital
Fort Loudoun Medical Center
Fort Sanders Regional Medical Center
Henry County Medical Center
Huntsville Hospital
Indian Lake Surgery Center
Indian Path Community Hospital
Johnson City Medical Center
LeConte Medical Center
Maury Regional Medical Center*
Methodist Medical Center of Oak Ridge
Mid-Tennessee Bone & Joint Clinic, P.C.
Morristown-Hamblen Healthcare System
OrthoSouth Germantown Surgery Center
OrthoTennessee
Parkridge East Hospital
Parkridge Medical Center
Parkwest Medical Center
Physicians Regional Medical Center
Physicians Surgery Center
Premier Orthopedic Surgery Center
Roane Medical Center
Saint Thomas Midtown Hospital
Saint Thomas River Park Hospital
Saint Thomas Rutherford Hospital
Saint Thomas West Hospital
St. Francis Hospital
Tennessee Orthopaedic Alliance
TriStar Centennial Medical Center
TriStar Hendersonville Medical Center
TriStar Horizon Medical Center
TriStar Skyline Medical Center
TriStar Southern Hills Medical Center
TriStar StoneCrest Medical Center
TriStar Summit Medical Center
Turkey Creek Medical Center
University of Tennessee Medical Center
Vanderbilt University Medical Center
Wolf River Surgery Center
CHI Memorial Hospital Hixson
Claiborne Medical Center
Cookeville Regional Medical Center*
Cumberland Medical Center

Texas

Advanced Surgical Care of Boerne
AdventHealth Central Texas
Ascension Seton Hays
Ascension Seton Medical Center Austin
Ascension Seton Northwest Hospital
Ascension Seton Southwest
Ascension Seton Williamson
Baptist Beaumont Hospital of Southeast Texas
Baylor Scott & White All Saints Medical Center-Fort Worth
Baylor Scott & White Medical Center-Carrollton
Baylor Scott & White Medical Center-Frisco*
Baylor Scott & White Medical Center-Garland
Baylor Scott & White Medical Center-Grapevine
Baylor Scott & White Medical Center-Irving
Baylor Scott & White Medical Center-McKinney
Baylor Scott & White Medical Center-Plano
Baylor Scott & White Medical Center-Uptown*
Baylor Scott & White Medical Center-Waxahachie
Baylor Scott & White Surgical Hospital Fort Worth*
Baylor Surgical Hospital at Las Colinas
Baylor University Medical Center*
CHRISTUS Good Shepherd Medical Center-Longview*
CHRISTUS Good Shepherd Medical Center-Marshall
CHRISTUS Mother Frances Hospital-Tyler*
Christus Southeast Texas Hospital-St. Elizabeth
CHRISTUS Spohn Hospital Corpus Christi-Memorial
CHRISTUS Spohn Hospital Corpus Christi-South
College Station Medical Center
Collom & Carney Clinic Association
Cornerstone Regional Hospital
Corpus Christi Medical Center
Covenant Children's Hospital
Covenant Health Plainview*
Covenant Medical Center
Covenant Specialty Hospital
Dallas Orthopedic & Shoulder Institute
Dell Seton Medical Center at The University of Texas
Del Sol Medical Center
Doctors Hospital at Renaissance*
El Paso Specialty Hospital
Grace Surgical Hospital
Harlingen Medical Center
HCA Houston Healthcare Clear Lake
Hill Country Memorial Hospital
Houston Methodist Hospital
Houston Methodist Sugar Land Hospital
Inov8 Surgical
JPS Health Network
Lake Granbury Medical Center*
Las Palmas Medical Center
Legent Orthopedic Hospital
Medical City Dallas Hospital
Medical City Denton
Medical City Surgery Center Fort Worth
Memorial Hermann Memorial City Medical Center*
Memorial Hermann Orthopedic & Spine Hospital
Memorial Hermann Rockets Orthopedic Hospital*
Memorial Hermann Southwest Hospital
Methodist Hospital
Methodist Hospital for Surgery

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Methodist McKinney Hospital, LLC
Methodist Stone Oak Hospital
Methodist Texsan Hospital
Metropolitan Methodist Hospital
Midland Memorial Hospital
Momentum Specialty Surgery Center
Muve-Lakeway Ambulatory Surgical Center, LLC
Nix Health
North Central Baptist Hospital*
North Central Surgical Center Hospital*
Northeast Baptist Hospital*
Northeast Methodist Hosptial
Paris Orthopedics & Sports Medicine
Scott & White Memorial Hospital-Temple
Seton Highland Lakes Hospital
South Texas Spine and Surgical Hospital*
South Texas Surgical Hospital
St. David's Georgetown Hospital
St. David's Medical Center
St. David's North Austin Medical Center
St. David's Round Rock Medical Center
St. David's South Austin Medical Center
St. David's Surgical Hospital
St. Joseph Health System
St. Luke's Health-Lakeside Hospital*
St. Luke's Health-Memorial Lufkin
Texas Health Arlington Memorial Hospital*
Texas Health Center for Diagnostics & Surgery
Texas Health Dallas
Texas Health Harris Methodist Hospital Fort Worth*
Texas Health Harris Methodist Hospital Southwest/Clearfork*
Texas Health Harris Methodist Hospital Southwest Fort Worth*
Texas Health Joint Replacement Surgery Center
Texas Health Orthopedic Surgery Center Flower Mound
Texas Health Presbyterian Hospital Allen
Texas Health Presbyterian Hospital Denton
Texas Health Presbyterian Hospital Flower Mound
Texas Health Presbyterian Hospital Plano*
Texas Health Presbyterian Hospital Rockwall
Texas Health Surgery Center Addison
Texas Health Surgery Center Cleburne
Texas Health Surgery Center Heritage
Texas Institute for Surgery
Texas Orthopaedic Associates
Texas Orthopedic Hospital*
Texas Orthopedics*
Texas Orthopedics, Sports & Rehabilitation Associates
Texas Spine and Joint Hospital
Texoma Medical Center*
The Carrell Clinic
The Medical Center of Southeast Texas
The Physicians Centre Hospital
United Regional HealthCare System*
University Hospital
UT Southwestern Medical Center
W.B. Carrell Clinic
Wise Health Surgical Hospital
Advent Orthopaedics
Baylor Scott & White Medical Center-Trophy Club
Baylor Scott & White Texas Spine & Joint Hospital
Baylor St. Luke's Medical Center
Covenant Hospital Levelland
Cross Timbers Orthopedics
Doctors Hospital of Laredo
Edinburg Regional Medical Center
Fort Duncan Regional Medical Center
Jeff Zhao, D.O.
McAllen Medical Center
Northwest Texas Healthcare System
Peterson Health
Seton Medical Center Harker Heights
Stefan Kreuzer
SurgCenter of Plano
University of Texas Health Science Center at San Antonio

Utah

Altaview Hospital
American Fork Hospital
Bear River Valley Hospital
Cedar City Hospital
Dixie Regional Medical Center
Heber Valley Hospital
Intermountain Medical Center
Lakeview Hospital
Layton Hospital
LDS Hospital
Logan Regional Hospital
Maple Grove Hospital
McKay-Dee Hospital
McKay-Dee Surgical Center
Mountain View Hospital
North Memorial Health at Maple Grove Medical Center
North Memorial Health Hospital
Ogden Regional Medical Center*
Park City Hospital
Primary Children's Hospital
Riverton Hospital
Salt Lake Regional Medical Center
Sevier Valley Hospital
St. Mark's Hospital
Timpanogos Regional Hospital
TOSH-The Orthopedic Specialty Hospital
Univeristy of Utah Health
Utah Valley Hospital
Cedar Orthopedic Surgery Center
Orem Community Hospital

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Vermont

Central Vermont Medical Center
Copley Hospital
Northeastern Vermont Regional Hospital
Porter Medical Center
Rutland Regional Medical Center
The University of Vermont Medical Center
Northwestern Medical Center, Inc.

Virginia

Carilion New River Valley Medical Center*
Carilion Roanoke Memorial Hospital*
CJW Medical Center*
Henrico Doctors' Hospital
Inova Fair Oaks Hospital
Inova Loudoun Hospital
Inova Mount Vernon Hospital
Johnston Memorial Hospital
Mary Washington Hospital
Novant Health Prince William Medical Center
Novant Health UVA Haymarket Medical Center
OrthoVirginia
Reston Hospital Center*
Riverside Doctors' Hospital Williamsburg
Riverside Regional Medical Center
Riverside Tappahannock Hospital
Riverside Walter Reed Hospital
Sentara CarePlex Hospital
Sentara Leigh Hospital
Sentara Martha Jefferson Hospital
Sentara Norfolk General Hospital
Sentara Northern Virginia Medical Center
Sentara Obici Hospital
Sentara Princess Anne Hospital
Sentara RMH Medical Center
Sentara Virginia Beach General Hospital
Sentara Williamsburg Regional Medical Center
The Surgery Center of Lynchburg
University Medical Center*
VCU Medical Center
Virginia Hospital Center
Centra Health
Inova Fairfax Hospital

Washington

Capital Medical Center
Cascade Valley Hospital
Central Washington Hospital
Everett Bone and Joint
EvergreenHealth Medical Center
Harrison Medical Center
Highline Medical Center
Kadlec Regional Medical Center
Lakewood Surgery Center
Legacy Salmon Creek Medical Center
MultiCare Allenmore Hospital & Medical Center
MultiCare Auburn Medical Center
MultiCare Deaconess Hospital
MultiCare Good Samaritan Hospital*
MultiCare Tacoma General Hospital*
Multicare Valley Hospital*
Northwest Hospital & Medical Center
Olympic Medical Center
Overlake Medical Center
PeaceHealth Orthopedic & Sports Medicine at Medical Office Plaza
Proliance Center for Outpatient Spine and Joint Surgery of Puget Sound
Proliance Eastside Surgery Center
Proliance Highlands Surgery Center
Providence Centralia Hospital
Providence Holy Family Hospital-Spokane
Providence Mount Carmel Hospital
Providence Regional Medical Center Everett Colby Campus
Providence Sacred Heart Medical Center
Providence St. Joseph's Hospital
Providence St. Mary Medical Center*
Providence St. Peter Hospital
Samaritan Healthcare
Seattle Orthopedic Center Surgery
Seattle Surgery Center
Skagit Northwest Orthopedics
Skagit Valley Hospital
St. Anthony Hospital
St. Clare Hospital
St. Elizabeth Hospital
St. Francis Hospital
St. Joseph Medical Center
Swedish Health Ballard Campus
Swedish Health Edmonds Campus
Swedish Health First Hill Campus
Swedish Health Issaquah Campus
The Surgery Center at Rainier
The Surgery Center at TCO Kennewick
Trios Health
Valley Medical Center
Virginia Mason Medical Center
Walla Walla General Hospital
Yakima Valley Memorial Hospital
Dan Downey, MD
Edmonds Center for Outpatient Surgery
MultiCare Covington Medical Center
Olympia Surgery Center
PeaceHealth Orthopedics & Sports Medicine in Lynden
Providence Regional Medical Center Everett Pacific Campus
Southwest Seattle Ambulatory Surgery Center
Wenatchee Valley Hospital & Clinics

West Virginia

Cabell Huntington Hospital*
Grant Memorial Hospital
J.W. Ruby Memorial Hospital
Mon Health Center for Outpatient Surgery*
Princeton Community Hospital
Thomas Memorial Hospital*
West Virginia University Hospital*
Saint Francis Hospital

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Wisconsin

Amery Hospital & Clinic
Ascension NE Wisconsin - St. Elizabeth Campus
Ascension SE Wisconsin Hospital - Elmbrook Campus
Ascension SE Wisconsin Hospital - Franklin Campus
Ascension St. Mary's Hospital
Ascension St. Michael's Hospital
Aurora BayCare Medical Center
Aurora Lakeland Medical Center
Aurora Medical Center-Bay Area
Aurora Medical Center-Burlington
Aurora Medical Center-Grafton
Aurora Medical Center-Kenosha
Aurora Medical Center-Manitowoc County
Aurora Medical Center-Mount Pleasant
Aurora Medical Center-Oshkosh
Aurora Medical Center-Sheboygan County
Aurora Medical Center-Summit
Aurora Medical Center-Washington County
Aurora Sinai Medical Center
Aurora St. Luke's Medical Center
Aurora St. Luke's South Shore of Aurora HealthCare Metro, Inc.
Aurora West Allis Medical Center
Beaver Dam Community Hospitals
Beloit Memorial Hospital*
Berlin Memorial Hospital
Columbus Community Hospital
Community Memorial Hospital
Fort HealthCare
Froedtert Hospital
Froedtert Community Memorial Hospital*
Gundersen Health System
Hayward Area Memorial Hospital
HSHS St. Mary's Hospital Medical Center
HSHS St. Nicholas Hospital
HSHS St. Vincent Hospital
Hudson Hospital & Clinic
Lakeview Hospital
Lakeview Medical Center
Marshfield Clinic Wasau Center
Marshfield Medical Center-Beaver Dam
Marshfield Medical Center-Eau Claire*
Marshfield Medical Center-Marshfield
Marshfield Medical Center-Minocqua
Marshfield Medical Center-Neillsville
Marshfield Medical Center-Rice Lake
Marshfield Medical Center-Weston
Mayo Clinic Health System-Franciscan Healthcare
Mayo Clinic Health System in Eau Claire
Memorial Medical Center
Mercyhealth Hospital & Trauma Center
Mercyhealth Hospital and Medical Center-Walworth
Midwest Orthopedic Specialty Hospital
Monroe Clinic Hospital
OakLeaf Surgical Hospital
Oconomowoc Memorial Hospital*
Orthopedic & Sports Surgery Center
Orthopedic Hospital of Wisconsin
Osceola Medical Center
Prairie Ridge Health
ProHealth Waukesha Memorial Hospital
Ripon Medical Center
River Falls Area Hospital
Sauk Prairie Hospital
Southwest Health
SSM Health St. Clare Hospital-Janesville
St. Agnes Hospital
St. Croix Regional Medical Center
St. John's Hospital
St. Joseph's Hospital, West Bend
Surgery Center of Wisconsin Rapids
ThedaCare Medical Center-New London
ThedaCare Medical Center-Shawano
ThedaCare Medical Center-Waupaca
ThedaCare Regional Medical Center-Appleton
ThedaCare Regional Medical Center-Neenah
Tomah Memorial Hospital
UnityPoint Health-Meriter
University of Wisconsin Hospitals and Clinics
Vernon Memorial Healthcare
Watertown Regional Medical Center
Waupun Memorial Hospital
Westfields Hospital & Clinic
Wisconsin Specialty Surgery Center*
Ascension All Saints Hospital-Spring Street Campus
Ascension NE Wisconsin-Mercy Campus
Aspirus HealthCare
Aurora Health Center in Milwaukee
Aurora Health Center in Pleasant Prairie
Bellin Health Oconto Hospital
Bellin Health Surgery & Specialty Center
Bellin Hospital
Divine Savior Healthcare
Froedtert South
Marshfield Clinic Minocqua Center
Orthopedic & Sports Medicine Specialists of Green Bay
SSM Health St. Clare Hospital-Baraboo
SSM Health St. Mary's Hospital-Madison

Wyoming

Cheyenne Regional Medical Center
Fairview Lakes Medical Center
Mountain View Regional Hospital
Powder River Surgery Center
St. John's Medical Center
Summit Medical Center*
Wyoming Medical Center

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Appendix F

Dataset Development

All AJRR patients undergoing primary total joint replacement or revision surgery were identified using International Classification of Diseases (ICD-9/10) and Current Procedural Terminology (CPT) codes from both the AJRR and CMS datasets.

Revisions were "linked" to primary procedures when laterality matched between the primary and revision arthroplasty, and when the revision occurred after the index procedure. AJRR collects laterality as a discrete data element. Because ICD-9 does not specify laterality, linkage required cross-referencing with AJRR data and CPT modifiers (LT, RT), as well as ICD-10 codes when available.

For ICD-9 coding, revisions were assumed to be linked to a prior primary procedure if the revision code postdated the index surgery; this assumption was later validated in the AJRR database. ICD-10 coding allows (but does not require) both removal and replacement codes and has the advantage of including laterality.

The same postdating assumptions were applied with ICD-10, using either acceptable single revision codes or dual code permutations. In summary, when ICD-10 coding was available, laterality was used directly to link primary and revision procedures. When ICD-9 coding was used, revisions were linked to prior primary procedures by sequence, with laterality verified during subsequent validation.

Patients were tracked for the dataset from 2012-2024. Follow-up was calculated from the time of procedure until Dec. 31, 2024. The primary timescale was "years to revision." Patients were tracked for potential outcomes (e.g., death, dislocation, and instability) from the procedure date until Dec. 31, 2024. Death was identified from the National Death Index (2012-2016), AJRR data (collected as an optional discrete data element, 2012-2024), or CMS data (2012-2024). The CMS Research Data Assistance Center (ResDAC) data team provided AJRR with a unique identifier that matches an AJRR case record to a CMS claim file. Observations from ICD-9 codes were excluded where patients were noted to have mismatched laterality for primary and revision, or revisions without a previous record of a primary arthroplasty in the AJRR database. When laterality could not be determined after applying these methods, the primary and revision procedures were not linked and were excluded from analyses. A merged AJRR–CMS dataset was used for all survivorship analyses unless otherwise specified.

Survival Analysis Methods

Patients were tracked from 2012-2024. Patients were considered "not failed" if they did not have the outcome of interest (revision within the study period). Primary procedures were counted as failed and the survivorship recorded if revision was identified or found within either the AJRR or Medicare dataset. If a patient does not appear as a revision or death event in AJRR or CMS databases, they were assumed to have a functioning implant throughout the cutoff date of analysis. When comparing groups, the 95% confidence intervals and p-values of the hazard ratios were used to determine statistical significance.

Beginning in 2025, all CPR curves in the AJRR annual report are generated using the KM method, with revision for any cause as the endpoint. Patients are censored at death or at the end of the analysis period. These curves can be interpreted as the cumulative probability of revision (y-axis) at any given timepoint (x-axis).

This represents a change from prior AJRR reports, which used Cox proportional hazards models adjusted for age, sex, and CCI. While Cox models account for covariates, they assume that hazard ratios remain constant over time—a condition frequently violated in arthroplasty outcomes.

By contrast, KM analysis does not rely on the proportional hazards assumption, allowing the distance between survival curves to vary over time. This provides a more transparent and flexible representation of revision risk, though without covariate adjustment.

The final follow-up time for each survival curve was selected by reviewing both the number of patients remaining at risk in each group and the point at which the curve flattened for an extended period in the smallest group.

For example, if the larger group has outcome events extending to 12 years, but the smaller group's curve becomes flat at year 9 with no further events, then 9 years is chosen as the final follow-up for all groups.

This approach reduces the risk of misinterpretation. Survival curves often flatten when the number left at risk becomes very small, making it difficult to detect additional events. If curves cross at the tail under these conditions, it may falsely suggest that the smaller group performs better, when the difference is due to low numbers rather than true outcome differences.

Although the CPR curves themselves are not covariate adjusted, the hazard ratios presented below them are still adjusted for age, sex, and CCI after first testing the Proportional Hazard (PH) assumption. This assumption was assessed by checking for significant correlations between the scaled Schoenfeld residuals and time for each model variable, and by plotting these residuals to look for trends over time. A piecewise Cox Model with time-dependent coefficients was implemented when the PH assumption was violated. If age and CCI did not meet the assumption, then interactions between those variables and the log of follow-up time were included in the model. Sex was included as a stratification factor in all models and therefore removed the need to test this variable for proportionality as each sex was allowed to have their own baseline hazard. Only one hazard ratio per treatment group comparison was presented when the PH assumption was met. However, if the assumption was not met, then the Schoenfeld residual plot was evaluated to determine the time points that there were deviations in the trend line. Then separate hazard ratios are shown for each time period. This time-dependent model is described in more detail by Kleinbaum and Klein[32].

When interpreting any survival analysis contained in this report, it is important to note that it is possible for the KM plots to conflict with the hazard ratios that are presented. The primary reason for this potential conflict is that the KM plots have no adjustment for confounding factors, whereas the hazard ratios are covariate adjusted. Similarly, when proportional hazards are not met, the KM curves may appear to cross at different time points than the time points shown for the hazard ratios. The time points were chosen based on only the Schoenfeld residual plots from the full multivariable model, which can often reveal different cut-points than the survival curves.

For the Kaplan Meier Estimate/at risk tables under each survival curve plot, pointwise confidence intervals are presented along with cumulative percent revision estimates. These represent the confidence intervals at each specific time point and will generally get wider as the number at risk gets smaller. In the Kaplan Meier plots, simultaneous Hall-Wellner confidence bands around each curve are shown. These represent the confidence intervals of the survival function over the course of the entire cumulative percent revision curve rather than at a specific time point. These intervals will generally remain a constant width over the course of the curve, and they may not exactly match the pointwise intervals present in the tables.

Restricted Mean Survival Time

For the knee implant constraint analysis, an additional restricted mean survival time (RMST) model controlling for age, sex, and CCI was conducted (Table 3.5). The RMST is interpreted as the average survival time in months up to a maximum of 84 months for each group. Since the RMST represents the area under the survival curve, it does not require the PH assumption to be met. The RMST model was done to allow for more straight forward pairwise comparisons of the seven constraint groups to each other.

Disclaimer

These analyses are based on retrospective, observational data from a large national registry and administrative database. As such, causation cannot be established—only associations can be described. Further analyses are often required to better understand the underlying reasons for observed associations.

In addition, AJRR data are collected at the construct level, not the component level. For example, if a patient received four components and later required revision, the Registry cannot determine which specific component failed. Outcomes are therefore reported for the overall construct rather than for individual components.

SAS Version 9.4 was used for all statistical analyses

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