National Joint Registry

20th Anniversary

Working for patients, committed to excellence for 20 years

- HIPS
- KNEES
- ANKLES
- ELBOWS
- SHOULDERS

20th Annual Report 2023

Surgical data to 31 December 2022

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Additional data and information can also be found on page 5 of the report.

Introduction

This year 2023-24, the NJR celebrates its 20th anniversary. It began capturing hip and knee data in 2003 across England and Wales, but has since expanded to incorporate ankle, elbow and shoulder joints and cover Northern Ireland, the Isle of Man and Guernsey. Representing a greater number of patients, the NJR now has around 3.7 million records and is the largest orthopaedic registry in the world.

The registry is always striving for the best in patient outcomes and safety. Through monitoring the performance of surgeons, hospitals and implants, it is able to identify issues of safety and poor performance, a previous example being the use of metal-on-metal hip implants.

The NJR research programme includes supporting fellowships and application requests to use NJR data. NJR data have been used for a wide range of research studies, which have highlighted and informed best practice in joint replacement surgery, for the benefit of patients.

NJR data was also used in the development of the NJR Patient Decision Support Tool. This can be used by patients considering joint replacement surgery to help them understand the potential benefits and risks and to make informed choices about their treatment in shared decision-making discussions with their clinicians. The NJR has identified, and continues to identify, the effects of the COVID pandemic on the number of joint replacement procedures being undertaken, and the detrimental effect on patient waiting times.

The NJR was recognised by the Independent Medicines & Medical Devices Safety Review, chaired by Baroness Julia Cumberlege, which published its report and findings in 2020, as a 'leader in its field' and 'being an exemplar registry with world-leading expertise'. The NJR was thereafter identified in the government response and implementation reports as being 'widely regarded as setting international best practice in analysing outcomes for device procedures.'

So, what's next?

Patient Reported Outcome Measures (PROMs)
The NJR would like to manage the collection of PROMs across all joints recorded in the registry, (at present it only manages those for shoulders). The NJR records repeat operations (revisions) as a quality measure of outcome, but PROMs is a missing link enabling an understanding of pain and function outcomes, that are also important to patients. Currently PROMs are collected and managed by NHS Digital (who merged with NHSE on 1 February 2023), but the NJR has faced challenges in accessing the resource. In recent years the NJR has proposed to the NHS how it could effectively enhance the collection and administration of PROMs as it continues to work tirelessly to build a fuller understanding of the success of joint replacement surgery.

Patient involvement The NJR recognises the value of patients and is keen to involve them across its work programme. Membership of the NJR Steering Committee includes two patient members and this year an NJR patient network is being developed, to strengthen patient support and ensure greater input across the NJR's work and activities.

As a patient with musculoskeletal joint issues, on behalf of my patient and public peers, I would like to thank the NJR for the work it does, and the progress and achievements it has made over the

* use MY data

This work uses data provided by patients and collected by hospitals as part of their care and support.

last 20 years. We look forward to the future and the continued development of the NJR and what will be accomplished. We thank patients undergoing joint replacement surgery for consenting to provide their data for use by the NJR and the data entry staff in all participating hospitals and units, who ensure that data collected are of high quality, accurate and complete, to meet the stringent requirements for use of data by the NJR.

Robin Brittain,
with support from Gillian Coward
NJR Patient Representatives

Our annual report

The registry's purpose is to record patient information and provide data on the performance and longevity of replacement joint implants, the surgical outcomes for the hospitals where these operations are carried out, and on the performance outcomes of the surgeons who conduct the procedures. We produce this Annual Report, summarising our work and sharing the analysis of data, visually in tables and graphs, for procedures across each of the joints, as well as implant and hospital outcomes.

The report also includes some short excerpts which showcase the NJR's contribution to orthopaedic research activity, demonstrating the value of the use of these collected data. Registry data are made available under strict security conditions to medical and academic researchers, to further progress the pool of work in measuring and understanding which practices provide better outcomes.

The NJR has shown that orthopaedic surgery, as one of the main users of implant devices in the UK, is demonstrating the highest standards of patient safety with regard to their use. A key message from the report is that safety and clinical outcomes continue to improve, as identified through the reduction of revision surgery.

The NJR's data collection and analysis of around 3.7 million records provide the evidence to drive the continuous development and implementation of measures, to ensure implant safety and the enhancement of patient outcomes is always top of the agenda, alongside a focus on reduced revision rates year-on-year, as well as improvements in standards in the quality of care whilst also addressing overall value for money in joint replacement surgery.

Summary of content

Summary	Content	Full information
Foreword	Report foreword from the Chair of the National Joint Registry	In this report and via reports.njrcentre.org.uk
Executive summary	Summary of this year's report by the NJR Editorial Committee Chair and NJR Medical Director	In this report and via reports.njrcentre.org.uk
Clinical activity 2022	Statistics on joint replacement activity for hip, knee, ankle, elbow and shoulder activity for the period 1 January to 31 December 2022	reports.njrcentre.org.uk through interactive reporting
Outcomes after joint replacement surgery 2003-2022	Detailed statistical analyses on hip and knee replacement surgery using data from 1 April 2003 to 31 December 2022. Analysis of primary ankles representing data collected since 1 January 2010. Analyses on data for elbows and shoulders using data collected since 1 April 2012	In this report
Implant and unit-level activity and outcomes	Indicators for hip and knee joint replacement procedures by trust, Local Health Board and unit. Plus commentary on implant performance and those that have higher than expected rates of revision and were reported to the MHRA	In this report and via reports.njrcentre.org.uk and download area
Developments	Information on the work of the NJR committees and NJR work developments to 31 March 2023	reports.njrcentre.org.uk
NJR governance and operational structure	Composition, attendance, declarations of interest for the NJR Steering Committee, sub-committees and committee terms of reference	reports.njrcentre.org.uk and download area
Research	Research papers that have used NJR data that have been published and approved	In this report and via reports.njrcentre.org.uk and download area

NJR Reports (online)

Clinical activity 2022 overview

The interactive parts of our 20th Annual Report can be found online via the registry's dedicated NJR Reports website at: reports.njrcentre.org.uk

Here we present data on clinical activity during the 2022 calendar year. This includes information on the volumes and surgical techniques in relation to procedures submitted to the registry, with the most recent data being for the period 1 January 2022 to 31 December 2022. To be included in these tables and graphs, all procedures must have been entered into the registry by the end of February 2023.

The double page infographic spread at the end of this report offers a visual summary of key facts relating to the analysis of clinical activity during the 2022 calendar year. This can also be downloaded for use as a hospital waiting room poster via **reports.njrcentre.org.uk/downloads**

The information found online now includes historical data, going back to 2005 in most cases. Using the dedicated website, readers are able to access tables and use interactive, filterable graphs to identify the key information and trends associated with the following reports for hip, knee, ankle, elbow and shoulder data (where sufficient data are available):

- Total number of hospitals and treatment centres in England (including the Isle of Man and Guernsey), Wales and Northern Ireland
- Number of participating hospitals and the number and type of procedures performed
- Number of procedures undertaken as a proportion of all procedures submitted annually
- Procedure details by type of provider
- Primary procedure details by type of provider
- Types of primary replacements undertaken
- Patient characteristics for primary replacement procedures, according to procedure type
- Age and gender for primary replacement patients
- Patients' physical status classification (ASA grades) for primary replacement procedures
- Body Mass Index (BMI) for primary replacement patients
- Indications for surgery for primary procedures
- Surgical technique for primary replacement patients
- Thromboprophylaxis regime for primary replacement patients, prescribed at time of operation
- Reported untoward intra-operative events for primary replacement patients, according to procedure type
- Patient characteristics for revision procedures, according to procedure type
- Indications for surgery for revision procedures
- Trends in use of the most commonly used implant brands

For hips specifically

- Components removed during hip revision procedures
- Components used during single-stage hip revision procedures
- Trends in femoral head size and hip articulation for primary procedures

For knees specifically

- Implant constraint for primary procedures
- Bearing type for primary procedures

Navigating NJR Reports

What can you find at NJR Reports online?

Navigate the left-hand side tabs to view information on the volumes and surgical techniques in relation to procedures submitted to the registry.

Left hand tabs: the information is segregated by report and information type. A wealth of updates are available, from further information on data collection and quality, to the work of our committees and progress of NJR work developments.

Top tabs: go straight to the data for each joint type by clicking on the joint icon.

There is also **implant and hospital specific information** available, a **glossary** and a downloadable **infographic** to make all the information as accessible as possible to all our visitors.

Full NJR Reports website at:
reports.njrcentre.org.uk

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1. Chair’s Foreword

Chair's Foreword

Professor Sir Paul Curran, Chair of the National Joint Registry

As I enter my second year as Chair of the National Joint Registry, I am delighted to contribute the Foreword to our Annual Report, in this our 20th year. The registry has grown and matured substantially over the past two decades, and we can take pride as we celebrate the extent of our evolution and the significance of our achievements since data collection began in 2003.

As the largest registry of joint replacement surgery in the world and recognised as a 'global exemplar' of an implantable medical devices registry, the NJR has made and continues to make a considerable contribution. Notably, to patient safety, the orthopaedic profession, implant manufacturers, the NHS and independent sector hospitals and trusts, regulators and government and the many other stakeholders with whom we are pleased to work.

As in each of the past 20 years, this year we have delivered an ambitious programme of work, enhanced patient safety and facilitated world-leading research. The NJR Annual Report provides the opportunity for us to reflect on our achievements and further details of our key developments can be found **online**. It also provides a valuable chance for us to look to the year ahead, with the aim of building on our success and seeking new opportunities to develop the registry further, for the benefit of all our stakeholders. Highlights for the coming year include the launch of our new patient network and finalising our Memorandum of Understanding with HQIP and NHSE which will set out, for the first time, our mutual working and governance arrangements. We will also appoint our first non-clinical PhD student to work with us on AI and invest in an ambitious £1.6M+ development programme, which will see the NJR undertake some exciting new initiatives that will enable us to maintain our global leadership position.

The standing of the NJR is, of course, due to the dedicated team of talented and committed professionals, who strive tirelessly to ensure its success. I have been proud to work with them over the past year and to witness first-hand their hard work and commitment.

There are some important individual contributions which I would like to acknowledge. First, during the year there have been two changes to the NJR Steering Committee. It has been a pleasure to welcome Dr Hassan Achakri, ABHI representative, who succeeded Jeff Stonadge in October 2022 and co-opted member Professor Deborah Eastwood, who succeeded Professor John Skinner as BOA President in September 2022. We look forward to welcoming her successor, Mr Simon Hodkinson, who takes up post in September 2023, and continuing our much-valued relationship with the orthopaedic profession. I thank Hassan and Deborah for their valuable contributions this year.

My grateful thanks also go to the NJR Regional Clinical Coordinators (RCCs) who underpin and champion the NJR's work locally. There have been some changes to RCC committee membership, as terms of office expire, and new members are recruited. I would like to thank all those who left us over the year, for their valuable contributions and welcome their successors. I look forward to working with you.

I would particularly like to thank all members of the NJRSC and sub-committees, and specifically the chairs of those sub-committees for their clinical expertise and leadership: Mr Tim Wilton - Chair, NJR Medical Advisory Committee (and NJR Medical Director & Vice Chair); Mr Peter Howard - Chair, NJR Surgeon Performance and NJR Implant Scrutiny Committees; Professor Mike Reed - Chair, NJR Editorial Committee; Professor Mark Wilkinson - Chair, NJR Research Committee (and PROMs Working Group); and Mr Derek Pegg - Chair, NJR Data Quality and NJR RCC Committees (and MDSv8 Working Group). Without their dedication, the NJR would simply not be a world-leading joint replacement registry. I would encourage you to read the reports from each of the committee chairs at **reports.njrcentre.org.uk** which provide strategic oversight into the main work areas.

My appreciation also goes to our contract partners NEC Software Solutions UK Limited and the Universities of Bristol and Oxford, for the excellent data collection and outcome analysis that support the NJR's work agenda and delivery of our objectives.

I would like to end by extending my thanks to the NJR Management Team, for supporting us all in our work and providing sound operational, contract and financial management, every day, on our behalf.

Finally, at the end of my first year and as we mark our anniversary, I am reminded of how immensely proud I am to be part of the extraordinary organisation that is the NJR and for the privilege to work with such talented professionals. I look forward to the coming year and next stage of the NJR's evolution, as we begin to work closely with the nascent NHSE Outcomes Registries & Patient Safety Programme, where NHSE colleagues will be developing the national medical device information system for patient safety. It will be my pleasure, as Chair, to continue to work with all my NJR colleagues at this exciting time.

Professor Sir Paul Curran
Chair, National Joint Registry

2. Executive Summary

Executive summary

Professor Mike Reed
Chair, Editorial Committee

Mr Tim Wilton
NJR Medical Director

There has been considerable work going on in the NJR over the last year relating to developments of various kinds that may be of interest to the reader. Some of this development work was deferred due to the pandemic and has now been re-introduced and/or completed. The executive summary therefore deals with the impact of some of these changes separately from the summary of findings relating to individual joints.

It has been increasingly unclear for some years whether the use of revision as the main metric for outcome analysis can lead to distortion of the overall outcomes attributed to surgeons, units and implants. This is more so when dealing with some joints than others. This may more greatly impact the results when assessing the outcome of surgeons and units than the results relating to implants, given the smaller numbers involved with surgeons and units. In both cases, some additional secondary measure is desirable and we have used the national PROMs results as one such secondary measure. Unfortunately, this year the usual provision of the PROMs data by NHS Digital was not possible due to changes in the coding within NHS Digital's systems, and we are actively seeking alternatives to enable the future provision of this important additional metric. Shoulder PROMs have not been part of the national PROMs programme and are collected by the NJR. We are actively pursuing ways in which similar PROMs data can be collected across all joint replacements to fulfil this requirement.

The treatment of periprosthetic fractures varies considerably across the country with some surgeons and units preferring internal fixation and some preferring revision of the implant where this is feasible. In the past, internally fixed periprosthetic fractures have not been analysed by the NJR and this has led to an underestimation of the failures of this procedure. The new Minimum Data Set (MDSv8) seeks to address this problem by specifically collecting this information. In addition, other forms of intervention on replaced joints are also now being collected to include most of those interventions that fall short of the strict definition of a 'revision'. We expect this to provide a richer assessment of the overall outcomes of replaced joints in due course. MDSv8 also introduces the collection of more detailed information about revision operations that should allow more appropriate stratification of the outcomes of revision operations according to the complexity of the procedure.

Camouflage of poor results of an implant due to variants being analysed within an entire family (brand) has also been identified as a more significant issue during the last two years. As a result, the larger families of knees, where numbers allow, can be broken down and analysed in sub-groups within each brand. This is being performed routinely for such variants as cruciate-retaining and posterior-stabilised knees (Table 3.K9 (a)) and within those variants according to whether the patella is resurfaced or not (Table 3.K9 (b)). However, where there are sufficient numbers of cases, and particularly where there has been a concern raised about an implant, the analysis has now been more detailed and granular. It is our intention to widen the scope of these more detailed analyses and screening tools are being developed to guide when and how this should be done.

Hip implants have already been mostly separated into the pertinent sub-brand variants for the purposes of the comparative analysis, but it is clearly important that this is done similarly across all joints where relevant variants exist.

The data storage system for the NJR has been re-developed in a major way over the past two years and a number of key functions are now cloud-based. This change has allowed the various systems that previously co-existed but functioned in varying ways, to be re-designed so that they will allow interrogation and report production in the same way and using the same techniques.

There have been changes to UK legislation that make the collection of detailed information about many implantable devices mandatory. This opportunity to collect data about hip hemiarthroplasty used for the treatment of hip fractures has been taken up by the NJR and these will now form part of our routine data collection.

Analysis of the results of procedures at unit and surgeon level has been changed in the last year. Surgeons performing knee replacement are now assessed separately for their outcomes on total knee replacement, unicondylar replacement and patellofemoral replacement, although they are still being provided with their overall outcomes of all three types of operation for continuity and retrospective comparison. This has changed the status of a number of units and surgeons so that a few who were previously at outlier status have found they no longer are, while for some the opposite has occurred.

During the last two years there has been a great deal of work done with the International Society of Arthroplasty Registries (ISAR). They have agreed to adopt the classification system for hip and knee implants which had been developed jointly by the German Arthroplasty Registry (EPRD) and the NJR. This classification system will form the basis of their International Prosthesis Library (IPL). This decision has the capacity to allow all registries to analyse the results of implants in the same way, confident in the knowledge that they are discussing exactly the same variant of a device. Given the variations in sales around the world, and the fact that different variants are used in different parts of the globe and for differing indications, the ability to describe the implant construct with greater accuracy will be crucial when sharing outcome data. Work has now begun jointly with ISAR to develop a similar classification system for shoulder implants.

Commentary on findings

In this annual report there are excellent summaries and commentary in each of the joint replacement sections and we would encourage specialists to read their area of interest in full. We have summarised our key learning points and thoughts.

Hip replacement

This year's annual report is based on almost 1.5 million primary hip replacements performed by over 4,000 surgeons in almost 500 units.

We are now at 20 years since the NJR's data collection commenced and we are reporting a maximum of 19.75 years of follow-up, although the size of some of the groups at longer follow-up is modest.

In the last three years, during and in the aftermath of COVID, the median number of procedures performed by a consultant over a three-year period was 59 (approximately 20 per annum) with a median number of procedures per unit of 492 (approximately 164 per annum). This represents a drop since pre-COVID times when surgeons were performing a median of 64 (approximately 21 per annum) over three years (see NJR Annual Report 2020).

In terms of bearing surface combinations ceramic-on-polyethylene (CoP) is now dominating in both hybrid and uncemented fixations (see Table 3.H2). Metal-on-polythene still dominates in cemented fixations, although fully cemented fixation is now used in less than 20% of all cases. Ceramic-on-ceramic bearings are now infrequently used. However, across the whole life of the registry approximately 30% of hip primaries have been cemented, 37% uncemented, and 25% are hybrid hip replacements.

Resurfacing is continuing at low levels (around 700 per year) and ceramic-on-ceramic hip resurfacing is now shown in Table 3.H1 for the first time, although this is performed in very small numbers.

There is a significant and consistent rise in the numbers of dual mobility hip replacements being performed, with the maximum surgeon volume being over 100 cases per year. This is somewhat surprising given the large number of very successful combinations of unipolar total hip replacements that are demonstrated in the registry with very long follow-up. One might specifically question the underlying reasons for this increase with the relatively low level of revision for dislocation in unipolar bearings that is shown in the registry.

It is worth studying Figure 3.H1 (d). This shows the location and funding of joint replacements over the last 20 years. It demonstrates that NHS-funded operations in NHS facilities peaked in 2014. They stayed level until COVID but have now dropped back to lower than 2007 levels. The independent sector provision has increased hugely over this period, particularly in the last couple of years of COVID recovery and there are now more hip replacements performed in the independent sector than in the NHS. Despite the cost-of-living crisis the number of hip replacements paid for privately has almost doubled since 2019. In terms of overall numbers of hip replacements, 2022 was similar to 2019.

Figure 3.H3 (e) demonstrates an increasing trend towards the 32mm and 36mm CoP bearings in both uncemented and hybrid fixations.

In trauma, the absolute number of total hip replacements performed for hip fractures is lower than recent years pre-COVID levels. It is noted that dual mobility operations for trauma are increasing (Table 3.H12).

Figure 3.H6 looks at revision of uncemented primary hip replacements by bearing. It is worth noting that failure rates of metal-on-polyethylene-on-metal (MoPoM) dual mobility bearings in this group are very high in the first couple of years, exceeding early failure in other implants including resurfacing and metal-on-metal (MoM) hip replacement. Revision rates in the early years are also high in the MoPoM dual mobility hip replacements in hybrid fixations (Figure 3.H7). In both groups the ceramic-on-polyethylene-on-metal (CoPoM) dual mobility bearing appears to be performing better than its metal counterpart, although the numbers are small.

Given the numbers of procedures now being performed, it is reassuring to see (in Figure 3.H10 (h)) the estimates of revision of primary hybrid CoP hip replacements for both the 32mm, and to a lesser extent, the 36mm bearing, have excellent survival. Revision rates in hybrid CoP are less than 2.5% at ten years.

Table 3.H8 details the success rates by brand and bearing surface. There are some outstanding leaders here with a significant number of combinations having a revision rate of less than 2.5% at 15 years. This calls into question whether the current National Institute for Health and Care Excellence (NICE) benchmark of a failure rate of less than 5% at ten years (NICE 2014) remains an appropriate contemporary standard. There is good cause to revisit this benchmark.

Of note, the best performing resurfacing brands have a revision rate of around 10% at 15 years. Analysis of the NJR data demonstrates that for every 100 MoM hip-resurfacing procedures it is estimated

https://www.nice.org.uk/guidance/ta304/chapter/5-Implementation that there would be 7.8 excess revisions by ten years (Hunt et al., 2018). In 2022 there were approximately 700 resurfacing procedures, and this would approximately equate to an additional 55 revision procedures in the first ten years.

In Table 3.H9 we detail the causes for revision by fixation and bearing type. It is worth noting the higher failure rate in MoPoM dual mobility hips compared to its unipolar counterpart. Infection is responsible for almost 2.5 revisions per 1,000 prosthesis-years for these implants, with an all-cause revision rate currently running at nine revisions per 1,000 prosthesis-years. The figure for alternative treatment options, namely unipolar total hip replacement, is around three; although of course the groups of patients may not be directly comparable. The risk of infection, dislocation and periprosthetic fracture all appear higher in dual mobility implants compared to unipolar total hip replacement patients.

Knee replacement

We now have over 1.5 million primary knee joint replacement procedures within the registry performed by 3,613 consultant surgeons in 479 units.

Over the last three years contributing consultant surgeons have performed a median of 89 knee procedures (approximately 30 per annum), and each unit around 492.5 knee procedures (approximately 164 per annum). Knee replacements remain more common in females (56%), with a median age of 70. Over 97% of the cohort are documented as having osteoarthritis.

Cemented total knee replacements make up around 84% of primary knee replacements. Unicondylar knee replacements constitute around 10%.

Close to 60% of total knee replacements are cemented and unconstrained (cruciate-retaining) with a fixed bearing. A much smaller proportion, around 20%, are uncemented or posterior-stabilised, which do not appear to have the same results as cemented and unconstrained. Table 3.K6 demonstrates this across all age groups at ten years and beyond. With very long follow-up some of the groups are too small for results to be conclusive.

Figure 3.K1 (c) clearly shows that primary unicondylar knee replacement is on the rise. Although these did see a drop during 2020 and 2021 because of COVID, there has been a further increase with more unicondylar knee replacements being performed than ever before in the registry. The recovery of unicondylar knee replacements has been much better than total knee replacements post-COVID, and one could speculate this is because of the relatively greater ability for these joint replacements to be performed as day cases. Most unicondylar knee replacement procedures are now performed by surgeons performing more than 25 cases per year.

In contrast Figure 3.K1 (d) shows patellofemoral knee replacement is becoming less popular. There are now fewer than 1,000 cases being performed per year.

As noted with hip replacement, we can see that since 2012 most of the growth in NHS-funded knee replacement procedures has been in the independent sector. There are now fewer NHS-funded knee replacements performed in the NHS than there were in 2007.

Table 3.K2 demonstrates the continued decline in use of both uncemented and hybrid total knee replacement. These now represent 2.1% and 0.2% of our primary procedures respectively.

Females who undergo knee replacement are more likely to receive a total knee replacement than men who are relatively (but not absolutely) more likely to receive unicondylar knee replacement.

There are now multiple brands of knee replacement implant that are performing extremely well with very large numbers being tracked. Surgeons can choose from a wide number of brands with failure rates of less than 4% at 15 years. It is also worth noting that there is some separation in results at 19 years among the big brands, so please refer to Table 3.K9 (b) for further details. Broadly, across the brands, there is a higher revision rate for non-patella resurfaced cemented constrained total knee replacements. This appears to be mainly driven by pain but is very brand-specific (Tables 3.K9 (b) and 3.K10). Figure 3.K4 (a) shows exceptional survival

Hunt LP, Whitehouse MR, Beswick A, Porter ML, Howard P, Blom AW; Implications of Introducing New Technology: Comparative Survivorship Modelling of Metal-on-Metal Hip Replacements and Contemporary Alternatives in the National Joint Registry. J Bone Joint Surg Am. 2018 Feb 7;100(3):189-196.

for monobloc polyethylene tibias, although they appear to have been performed in a slightly older age group, this demands more exploration.

As has been noticed previously, Figure 3.K3 (b) demonstrates that although revision rates increased in the early years of the registry, they have been consistently reducing since 2008. This is consistent with, but less obvious than, the effect in hip replacement that was also influenced by MoM implants. One key point to make around knee replacement is that despite a tsunami of knee revision being predicted in the literature the number of knee revisions has remained remarkably stable, even declining in recent years, although this particular effect is likely to be related to COVID. Figure 3.K5 (a) demonstrates the chance of revision after primary knee replacement is higher in younger patients, and in males.

If unicondylar knee replacements are revised they do not behave like a primary total knee replacement in terms of longer-term survival and some differences are being seen between the commonly used implants. It appears that if a revision of a unicondylar knee replacement is required then the risk of re-revision is higher in uncemented and hybrid components, than it is in unicondylar implants that were initially cemented. Overall, it can be seen in Table 3.K5 that there is still a very significant difference in the revision rate for cemented unicondylar (medial or lateral) knee replacements which is 3.1 times higher than for cemented total knee replacements at ten years, and 3.5 times higher at 15 years. Even the best performing unicondylar knees (cemented fixed or uncemented mobile) have over double the revision rate of the popular unconstrained fixed cemented total knee replacement at ten years.

Patients will often ask how many times a knee replacement can be revised. In practice, there are six patients that have had ten or more revision procedures out of 1.5 million patients with primary procedures. Whether these revisions have ultimately resulted in a good outcome is not known from these data.

Mortality after primary knee replacement surgery is explored in Table 3.K12 (a). This shows some groups, particularly men over 85, are at relatively higher risk with mortality being almost 2% at 90 days, a factor which should be discussed with patients as part of a shared decision-making process for whether to undergo elective knee replacement at this age.

Ankle replacement

In this report we have a maximum follow-up of 12 years for ankle replacements. This cohort represents over 8,000 procedures.

Compared to pre-pandemic rates there has been a reduction in NHS-funded ankle replacements, and an increase in privately-funded cases. Reassuringly, it can be seen in Figure 3.A4 that most ankle replacements are now being conducted by surgeons performing more than seven ankle replacements per year, with large numbers being performed by surgeons performing more than 13. However, around a third of ankle procedures are being performed by surgeons who implant less than seven cases a year. In 2022, only seven units of 161 were performing more than 20 ankle replacement procedures per year. The British Orthopaedic Foot and Ankle Society (BOFAS) has recommended the use of networks and the pooling of resources to encourage specialist units to perform ankle replacement at higher volumes.

The overall headline revision rate is approximately 10% at 12 years. This is very implant specific however, with noticeable differences between implants (Figure 3.A8). It is also clear from Figure 3.A7 that younger patients and female patients are more likely to have a revision. From Table 3.A5, it can be seen that although aseptic loosening remains the most common reason for revision, infection comes a close second. Overall, there is a growth in fixed bearing ankle replacements and a distinct decline in mobile bearings (Figure 3.A5).

The Infinity implant was introduced in 2014 as part of a large multi-centre post-market surveillance study following the discontinuation of the Mobility implant which was the market leader up until that time. The gamble of moving to a fixed bearing implant is thus far supported by outcome data, as both the Infinity and the related prosthesis Inbone appear to have revision rates of less than 5% at seven years. Clearly this is still relatively short follow-up, with the uncertainty of small numbers and ongoing monitoring is essential.

There remains significant concern that we are not capturing arthrodeses or amputations following ankle replacements and thus the failure rate is probably higher than reported. We are hopeful this problem will be addressed by our data quality audits and the introduction of the forthcoming 'reoperation' data entry form.

Elbow replacement

In this report we present data for the first ten years after elbow replacement. This refers to total elbow replacement (with or without radial head replacement), lateral resurfacing and radial head replacement, and since 2018, distal humeral hemiarthroplasty which amounts to over 8,000 procedures. The majority are performed on women (67%). Roughly half of the implants required cement. There has been an increase, apart from during the COVID years, in data entry of elbow replacements. This is likely to be due in part to an increase in volume of procedures, improved reporting of radial head replacement, and inclusion of distal humeral hemiarthroplasties. Around half the cases were performed for trauma but over half of these were radial head replacements. Figure 3.E4 details the increasing proportion of primary total elbow replacements that are performed by higher volume surgeons (those performing more than 13 procedures a year). Figure 3.E3 shows that there still has not been a consistent recovery in practice since COVID.

Table 3.E4 (a) and (b) show the median number of elbow replacements per unit remains around three. Fewer units and surgeons are performing cases however. Some regions do appear to be performing significantly more replacements in elbow replacing units. This is likely to be the result of centralisation of services as part of the Getting It Right First Time (GIRFT) agenda.

It is clear from Figure 3.E5 that for primary total elbow replacement the revision rate for trauma is roughly half than that for an elective indication. This may well describe the frailty of these patients, higher mortality, and their suitability for revision.

Figure 3.E7 details survival rate of distal humeral hemiarthroplasty versus total elbow replacement with acute trauma as the indication. Numbers are small, particularly for the distal humeral hemiarthroplasty, but at the moment they certainly do not appear to be outperforming total elbow replacements.

There is a relative absence of long-term data for elbow replacement with only very small numbers at ten years. Table 3.E8 shows that at five years the linked total elbow replacements brands all have relatively similar survival of around 6 or 7%. These are small numbers in most brands.

The distribution of indications for elective elbow replacement has been consistent over the last five years of data entry with inflammatory arthropathy accounting for 32% of cases.

Although the five-year mortality rate after elbow replacement is consistent between trauma and elective surgery, when radial head replacement is taken out of the data the five-year mortality rate for trauma cases is almost double that of elective indications.

Shoulder replacement

Shoulder replacements have been recorded in the registry since 2012, so we present up to ten years of data. New classifications are now used for analysis. We now have almost 64,000 shoulder replacements under review.

Since the inception of data collection by the NJR, there has been a marked increase in stemmed reverse total shoulder replacements for trauma. Figure 3.S9 appears to demonstrate low revision rates of these stemmed reverse total shoulder replacements performed for trauma with revision at ten years being less than 3%. Reverse polarity shoulder replacements now dominate in trauma, and in elective practice they dominate for the cuff tear arthropathy indication.

Overall, from Table 3.S7 it is clear that men, particularly younger men, have higher failure rates.

Most humeral hemiarthroplasties and total shoulder replacements continue to be performed for osteoarthritis. Elective primary shoulder replacement for trauma appears to have a lower revision rate than when it is performed for elective indications although this may simply be due to the frailty of the patients and therefore revisions perhaps being avoided. This is not because the patients are dying before revision however, as this is accounted for in the data.

Shoulder replacement is the only area where the NJR collects PROMs. PROMs responses appear to be relatively poor and Figure 3.S10 demonstrates that those filling in PROMs questionnaires have a slightly different revision outcome to those that do not complete PROMs. Interestingly at ten years the revision rates of the groups appear similar.

PROMs results are explored in Table 3.S19. In elective practice the PROMs scores for humeral hemiarthroplasties appear lower than those for patients having a reverse total shoulder replacement or a standard total shoulder replacement, although the patients and the indications may differ. We do not have enough data to make comparisons in the trauma group. In elective practice less than 10% of patients have completed a pre-op and a 6-month post-op score (Table 3.S17). Figure 3.S11 clearly demonstrates the reduced chances of a patient gaining improvement if they have a higher pre-op shoulder score. Patients with a pre-op Oxford shoulder score over 40 appear to be more likely to get worse post-operatively.

Figure 3.S8 shows excellent long-term results with large numbers of stemmed reverse polarity total shoulder replacements. The key indication for these appears to have been rotator cuff replacement.

In elective practice, in Table 3.S8, the performance of stemmed conventional total shoulder replacements compared to stemmed reverse polarity shoulder replacements does differ, and at ten years the stemmed reverse polarity shoulder replacement appears to have the edge although it must be appreciated that the indications for both these replacement types are different.

Concluding acknowledgements

The NJR continues to work collaboratively with our many stakeholders; the most important, of course, are the patients we serve, and whom we would like to thank for allowing us to use their data.

The NJR operational collaboration is a huge team effort. Elaine Young, NJR Director of Operations, has demonstrated the great versatility of her leadership and her team.

Many thanks also to the following without which the NJR could not function:

All members of the NJR Steering Committee

Members of the NJR sub-committees:

- Executive
- Data Quality
- Editorial
- Implant Scrutiny
- Medical Advisory
- Regional Clinical Coordinators
- Research
- Surgical Performance

Members of the Data Access Review Group

Members of the NJR Patient Network

Other organisations:

- Medicines and Healthcare products Regulatory Agency (MHRA)
- Care Quality Commission (CQC)
- NHS England (NHSE)
- Welsh Government
- Northern Ireland Executive
- Isle of Man Department of Health
- States of Guernsey
- Independent Healthcare Providers Network Services
- Getting It Right First Time (GIRFT)
- British Orthopaedic Association (BOA)
- British Hip Society (BHS)
- British Association for Surgery of the Knee (BASK)
- British Elbow and Shoulder Society (BESS)
- British Orthopaedic Foot and Ankle Society (BOFAS)
- European Orthopaedic Research Society (EORS)
- Healthcare Quality Improvement Partnership (HQIP)
- Confidentiality Advisory Group (CAG)
- Association of British HealthTech Industries (ABHI)

We are most grateful to our NJR delivery contractors for their very valuable input into the NJR Annual Report and their many other functions. NEC Software Solutions, University of Bristol and University of Oxford teams help us refine and improve each year.

We offer our personal thanks to Vicky McCormack, Report Project Manager, NEC; Deirdra Taylor, Associate Director of Communication and Stakeholder Engagement and Oscar Espinoza, Communication and Design for the NJR, for getting the final report into shape.

Professor Mike Reed

Chair of the NJR Editorial Committee

Mr Tim Wilton

NJR Medical Director

A note on Patient Reported Outcome Measures (PROMs)

In the last NJR Annual Report, we published an exploration of the level of completeness and quality of data from the national PROMs programme and a proposal on how we might report implant-level PROMs in the report in future.

Over the course of the year, we have further consulted with stakeholders, including orthopaedic surgeons and representatives of the implant manufacturing industry, and have received broad support for the inclusion of implant level PROMs using the tables we had proposed last year.

PROMs data for hip and knee replacement surgery is not routinely collected by the NJR, but is a separate programme managed by NHS Digital (now part of NHS England (NHSE)). The NJR accesses the cumulative national PROMs data retrospectively annually through an application to NHSE's Data Access Request Service.

Unfortunately, due to circumstances beyond our control, we have not been able to secure access to these datasets this year. NHSE report that "In 2021 significant changes were made to the processing of Hospital Episode Statistics (HES) data and its associated data fields which are used to link the PROMs-HES data. Redevelopment of an updated linkage process between these data are still outstanding with no definitive date for completion at this present time. This has unfortunately resulted in a pause in the current publication reporting series for PROMs at this time."

NHSE are currently working to identify solutions and once this has been resolved we hope to be able to readdress the reporting of PROMs in the next NJR Annual Report. We are disappointed that we are unable to proceed with this important work to consider these outcomes in respect of implant performance.

Shoulder PROMs collection is overseen directly by the NJR within our geographical areas of operation and so is unaffected by these issues. Please see the shoulder section of the report for more information about shoulder PROMs.

3. Outcomes after joint replacement 2003 to 2022

3.1 Summary of data sources, linkage and methodology

The main outcome analyses in this report relate to primary and revision joint replacements, unless otherwise indicated. We have included all patients with at least one primary joint replacement carried out between 1 April 2003 and 31 December 2022 inclusive, whose records had been submitted to the registry before 1 March 2023.

Information governance and patient confidentiality:

Data are collected via a secure web-based data entry application, then stored and processed in the NEC Software Solutions (NEC) data centre. NEC is ISO 27001 and ISO 9001 accredited and compliant with the NHS's Data Security and Protection Toolkit. Data linkage to other datasets is approved by the Health Research Authority under Section 251 of the NHS Act 2006. Please visit **https://www.hra.nhs.uk/about-us/committees-and-services/confidentiality-advisory-group/**.

Data quality:

High quality data are the foundation of any joint replacement registry and we fully understand and endorse this. It has been mandatory to record hip and knee procedures for the independent sector since 2003 and for the NHS since 2011. Other joints have been mandatory since they were introduced into the dataset.

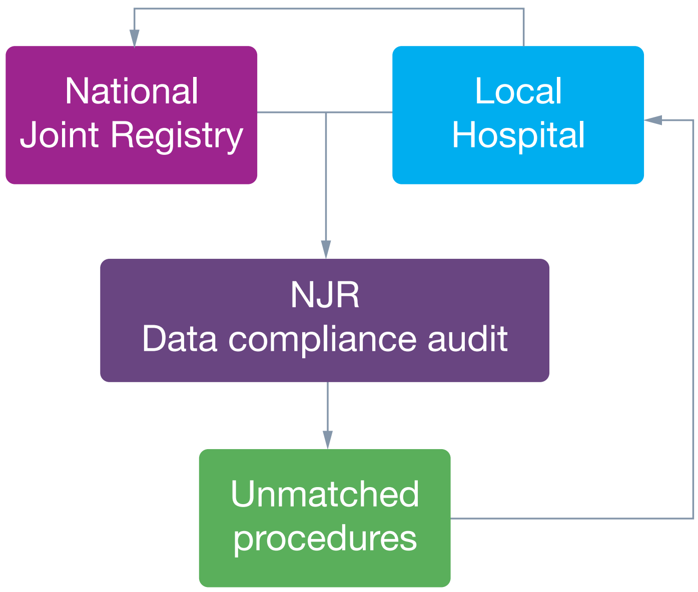
The NJR introduced a comprehensive audit of data quality across all hospitals and in the most recently completed audit for 2020/21, 95.6% of all NJR records could be matched to Hospital Episode Statistics (HES) and local administration systems.

The comparison of data entry onto the registry with Hospital Episode Statistics (HES) data gives a clear indication of the degree to which data might be missing or of any anomalies in data entry, but does not itself supply or correct the missing data. For this reason a formal audit cycle, capable of reconciling the two sources of data and enabling their correction, was set up using data from each NHS and independent hospital's patient administration systems.

Records are identified from the local hospital-based OPCS4 codes and then matched to records held within the registry, see Figure 3.D1 (page 39). Records that are found on the local hospital system but not on the registry can be subsequently uploaded bringing compliance as near to 100% as possible. It is expected that neither the registry nor the local hospital's system alone could be regarded as a definitive list of joint replacements, however the union of both registry and local hospital data can be considered the gold standard from which to calculate voluntary unprompted compliance at upload. This figure is important for healthcare providers as a measure of compliance with data entry processes but does not represent the final data completeness of records in the registry. It is important to note that nearly all unmatched procedures identified by the audit and where the patient has not declined consent are subsequently uploaded into the registry.

Table 3.D1 on page 39 shows the percentage compliance with the data quality audit.

Figure 3.D1 Schematic presentation of NJR data compliance audit.



In 2019 we introduced an automated process enabling units to check their data quality on a monthly or quarterly basis. This covers hip, knee, ankle, elbow and shoulder data and we are seeing this being adopted as routine practice in many hospitals.

This initiative has greatly reduced the number of mismatches between registry and hospital data; compliance and data accuracy has improved greatly since the process was fully embedded in all hospitals.

Table 3.D1 Percentage data quality audit compliance.

Procedure	Percentage missing NJR records (%)						
	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Hip primary	4.30	5.40	4.19	4.16	2.33	2.77	3.80
Hip revision	8.10	11.42	8.74	9.15	4.69	5.75	7.49
Knee primary	3.50	4.86	3.83	3.41	1.58	1.89	2.17
Knee revision	8.80	12.45	9.25	8.77	4.60	4.96	6.55
Ankle primary						2.81	2.87
Ankle revision						16.22	21.74
Elbow primary					15.41	16.87	14.00
Elbow revision					7.27	4.81	1.16
Shoulder primary					3.08	6.42	8.95
Shoulder revision					2.33	2.76	4.74

Note: Percentages for years prior to 2018/19 are pre-audit figures prior to introduction of the automated audit process. Percentages for the 2018/19 audit and beyond are as at 9 June 2023 using the automated process.

Missing data:

The effect of missing data on the statistical analysis of a dataset is well documented. Data which is systematically missing (Missing Not at Random) has the potential to induce bias i.e. to distort the truth. This is why compliance of reporting data to the registry by a specific consultant or unit is essential to the quality assurance process of consultants and units.

Analysis of data which are missing in either a random (Missing Completely At Random) fashion or random within known strata (Missing At Random), e.g. method of fixation, is known to yield unbiased results. We believe that a coordinated systematic agreement of individuals across the registry to under-report the failure of a specific implant is exceedingly unlikely. Nevertheless, we believe if this did happen the issue would be identified and corrected by the audit process. The low revision rates of hip or knee replacements also make it exceedingly difficult to predict which is likely to fail. Therefore, planning to omit selected primary joint replacements which are anticipated to fail within ten years following surgery would be unlikely to succeed. Increased centralisation of some revision joint replacement, by specialist revision surgeons, also means there is little motivation to omit revisions, which would largely have been primary cases of another surgeon or another unit.

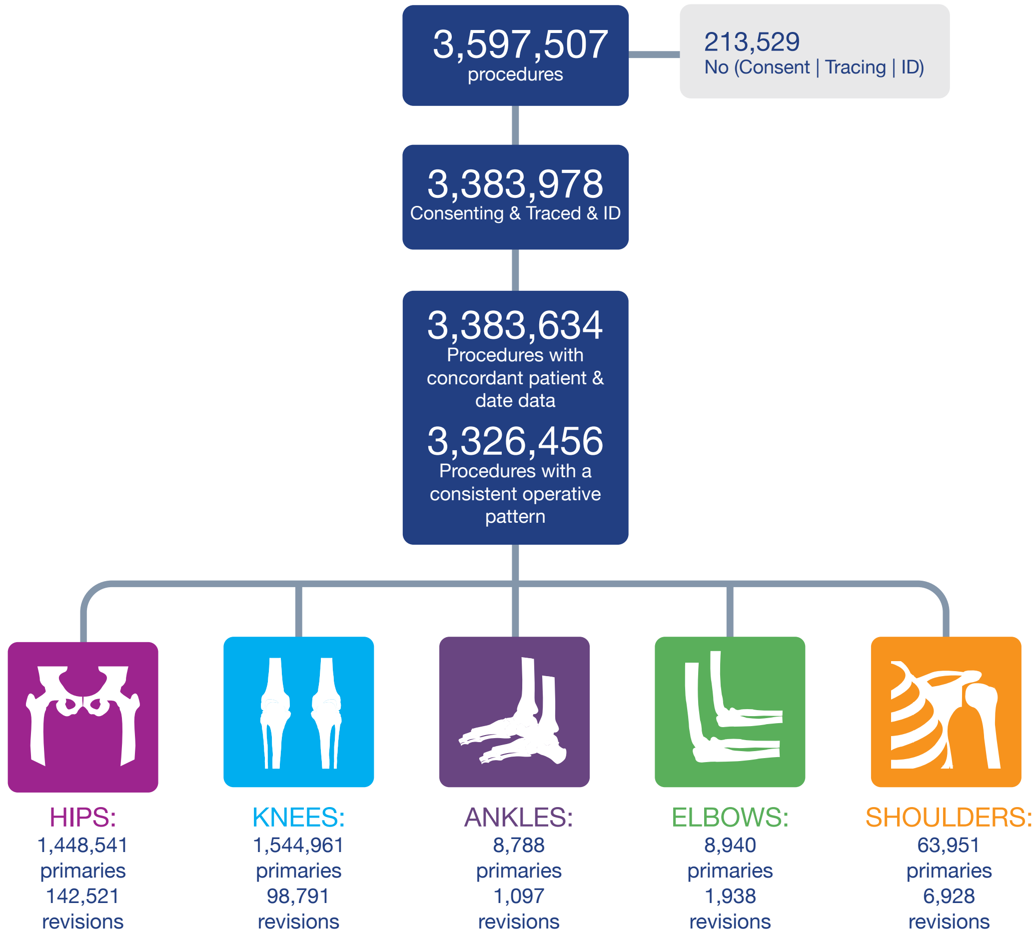
We believe that missing data within the registry can be considered missing completely at random. We propose that this missing data mechanism will ensure that the quality assurance process of implants and procedures entered into the registry is statistically unbiased.

Patient-level data linkage:

Documentation of implant survivorship and mortality requires linkage of person-level identifiers in order to identify primary and revision procedures and mortality events for the same individual.

Starting with a total of 3,597,507 NJR-sourced records, 5.9% were excluded because no suitable person-level identifier was found (Figure 3.D2, page 41). Full details of the inclusion and exclusion criteria can be seen at the beginning of each sub-section of each type of joint replacement. Cases from Northern Ireland and Guernsey were also excluded because of unresolved issues around tracing mortality; and cases from the Isle of Man were also excluded due to the inability to audit them against local hospital data. Patients with longer follow-up may be less representative of the whole cohort of patients undergoing primary joint replacement than those patients with shorter follow-up, due to difficulties with data linkage and differential rates of reporting over time.

Figure 3.D2 Initial numbers of procedures for analysis.



Linkage between primaries and any associated revisions (the 'linked files'):

A total of 3,075,181 linked and analysable primary joint replacements have been recorded by the NJR, i.e. hip, knee, ankle, shoulder or elbow. Implant survivorship is first described with respect to the lifetime of the primary joint only. In sections 3.2 and 3.3, we also provide an overview of further revisions following the first hip or knee revision procedure.

As in previous years, the unit of observation for all sets of survivorship analysis has been taken as the individual primary joint replacement. A patient with left and right replacements of a particular type, therefore, will have two entries, and an assumption is made that the survivorship of a replacement on one side is independent of the other. In practice, this would be difficult to validate, particularly given that some patients will have had primary replacements of other joints that were not recorded in the registry. Established risk factors, such as age, are recorded at the time of primary operation and will therefore be different for the two procedures unless the two operations are performed on the same date.

A revision is defined as any operation where one or more components are added to, removed from or modified in a joint replacement, or if a Debridement And Implant Retention (DAIR) with or without modular exchange is performed. Capturing DAIR with or without modular exchange commenced with the introduction of MDSv7 (June 2018). Prior to this, DAIR with modular exchange was included as a single-stage revision, but DAIR without modular exchange was not captured. Within the report each of these procedure types is included in the analyses as a revision episode. This is distinct from the analyses in the surgeon, unit, and implant performance workstreams where DAIR without modular exchange is not currently included as a revision outcome.

Analytical methods and terminology

The report uses a variety of statistical methods to reflect the diversity and range of performance within joint replacement. Analyses are tailored to ensure results are reported in units that can be easily interpreted. Here we define important concepts which underpin the analyses in the following sections.

All cause / all construct revision

All cause revision is used as the primary outcome in the majority of analyses due to the difficulties in defining cause-specific failure i.e. several indications may have been given for a particular revision. In addition, we consider the construct as a single entity; for example, in hips we do not differentiate between stem and acetabular failure as it is sometimes difficult to identify which prosthetic element failed first or is causally responsible for the failure. It is incorrect to assume that the failure of implants that make up a construct are independent of each other. In knees, we similarly do not differentiate between failure of components within the tibia, femur or patella. Secondary patella resurfacing after a total knee replacement is considered a revision.

In shoulders, elbows and ankles we take the same approach and do not differentiate between the failure of different components within the joint. Conversions of one type of shoulder replacement to another are considered a revision.

Debridement And Implant Retention

Debridement And Implant Retention (DAIR) without modular exchange has been included in the registry data as of MDSv7. DAIRs with modular exchange should have been collected (as a type of single-stage revision) from inception and their reporting in hips, knees, shoulders and elbows, along with all other procedures captured by the NJR, has been mandatory in the NHS since 1 April 2011. Before MDSv7, DAIRs with modular exchange were considered to be a single-stage revision in hip, knee, shoulder and elbow replacements. Ankle replacement DAIRs were not consistently collected prior to MDSv7. In MDSv7, all joint types are treated the same and a DAIR with modular exchange is considered to be a revision in all recorded joint replacements for the purposes of this report. Future reports will reflect changes to the recording of DAIRs introduced in MDSv8.

Terminology note: Hip replacements

There are four distinctive categories reflected in the analysis of data collected in the registry and these are: 1) the type of hip replacement i.e. total hip replacements (THR) and hip resurfacings (the NJR does not currently report data on hip hemiarthroplasty); 2) the fixation of the replacement i.e. cemented, uncemented, hybrid and reverse hybrid; 3) the bearing surfaces of the hip replacement; and 4) the size of femoral head/internal diameter of the acetabular bearing.

Cemented constructs are fixed using bone cement in both the femoral stem and acetabulum. Uncemented constructs rely on press fit and osseous integration within the femur and acetabulum that may be supplemented (e.g. by screw fixation).

Hybrid constructs contain a cemented femoral stem and an uncemented acetabulum. Reverse hybrid constructs contain an uncemented femoral stem and a cemented acetabulum. By convention, the bearing material of the femoral head is listed before the acetabulum. Currently, the seven main categories of bearing surfaces for total hip replacements are ceramic-on-ceramic (CoC), ceramic-on-metal (CoM), ceramic-on-polyethylene (CoP), metal-on-metal (MoM), metal-on-polyethylene (MoP), metal-on-polyethylene-on-metal (MoPoM), ceramic-on-polyethylene-on-metal (CoPoM), and for resurfacing procedures there are MoM and CoC.

The metal-on-metal group in this section refers to patients with a stemmed prosthesis (THR) and metal bearing surfaces (a monobloc metal acetabular cup or a metal acetabular cup with a metal liner). Although they have metal-on-metal bearing surfaces, resurfacing procedures, which have a surface replacement femoral prosthesis combined with a metal acetabular cup, are treated as a separate category. Ceramic-on-ceramic and metal-on-polyethylene resurfacings are now being implanted. Although there are too few metal-on-polyethylene cases to form a new category there are now sufficient ceramic-on-ceramic cases to feature as a separate category. Three bearing materials being listed indicates the use of dual mobility bearing devices. The size of the femoral head or inner diameter of a component is expressed in millimetres.

Terminology note: Knee replacements

Knee replacements within the registry are principally defined by the number and type of compartments replaced, the fixation of the components (cemented, uncemented or hybrid), level of constraint, the mobility of the bearing, whether the implants are of a modular design, and the presence or absence of a patella in the primary knee replacement.

The knee is made up of three compartments: medial, lateral and patellofemoral. When a total knee replacement (TKR) is implanted, the medial and lateral compartments are always replaced, and the patella may be resurfaced. If a single compartment is replaced then the term unicompartmental is applied to the procedure (UKR). The medial, lateral or patellofemoral compartments can all be replaced independently, if clinically appropriate. Medial and lateral unicompartmental knee replacements are also referred to as medial or lateral unicondylar knee replacements. We also use the term multicompartmental knee replacement to indicate the combination of more than one unicompartmental knee replacement.

Knee replacements are also characterised by their level of constraint (stabilisation). For example, there is variation in the constraint of the tibial insert's articulation with the femoral component. Some implants are designed to preserve the posterior cruciate ligament (cruciate retaining (CR)) referred to in this report as unconstrained. At present this group includes other variants such as medial pivot and cruciate-stabilised designs. Other implants use a mechanism (usually a cam and post design) to substitute for the posterior cruciate ligament, that is removed at the time of surgery (posterior stabilised (PS)). In more complex circumstances additional constraint may be necessary to allow the implant to deal with additional ligament deficiency or bone loss (where constrained condylar (CCK) or hinged knee implants may be used) in a primary or revision procedure.

In modular tibial components, the tibial insert may be mobile or remain in a fixed position on the tibial tray. This also applies to medial and lateral unicompartmental knees. Many brands of total knee implant exist in fixed and mobile forms with options for either CR or PS constraint. Tibial elements may or may not be of modular design. Modularity allows some degree of patient-specific customisation. For example, modular tibial components are typically composed of a metal tibial tray and a polyethylene insert which may vary in thickness. Non-modular tibial components consist of an all-polyethylene tibial component (monobloc polyethylene tibia) available in different thicknesses.

We now distinguish between medial and lateral unicondylar knee replacements during the data collection process; however this was not so in earlier versions of the Minimum Data Set (MDS) i.e. those prior to MDSv7.

In addition, we now report multicompartmental knee replacements which may include unicondylar and patellofemoral or two unicondylar replacements.

With regard to the use of the word 'constraint' here, for brevity, total knee replacements are termed unconstrained (instead of posterior cruciate-retaining) or posterior-stabilised (instead of posterior cruciate-sacrificed).

We assume the absence of a patella in the upload of knee components (in MDSv7 and earlier) is indicative that the patella has not been resurfaced.

Terminology note: Ankle replacements

Ankle replacements recorded within the registry are principally uncemented devices. However, in terms of fixation we report the presence or absence of cement used within the ankle construct. The presence of cement is defined by the inclusion of cement product details within the prosthesis upload.

Terminology note: Shoulder replacements

Shoulder replacements within the registry are principally defined by the type and sub-type of replacement. The four main types of replacement are 1) proximal humeral hemiarthroplasty, 2) conventional total shoulder replacement, 3) reverse polarity total shoulder replacement and 4) interpositional arthroplasty. There are three main sub-types based on variations on the humeral side of the joint. These include 1) resurfacing i.e. putting a new metal surface over the existing humeral head, 2) stemless i.e. removing the humeral head and putting on a new head with an anchoring device which does not project beyond the metaphysis of the proximal humerus, and 3) stemmed i.e. replacing the humeral head and utilising an anchoring device which projects into the diaphysis of the humerus.

Descriptive statistics

In simple cases we tend to report simple descriptive statistics including: numbers (n), frequencies (N=), percentages (%), minimums (min), maximums (max), interquartile ranges (IQR) (25th centile, 75th centile), means (SD) and medians (50th centile) of the data.

Survival analysis methods

In more complex analyses that focus on implant failure (denoted revision), recurrent implant failure (re-revision) or mortality we use 'survival analysis methods' which are also known as 'time to event' methods.

Survival analysis methods are necessary in joint replacement data due to a process known as 'censoring'. There are two forms of censoring which are important to consider in joint replacement registry data: administrative censoring and censoring due to events, such as death.

Administrative censoring creates differential amounts of follow-up time, i.e. patients from 2003 will have been followed up for more than 19 years, whilst patient data collected last year will have one year of follow-up or less. Survival analyses methods enable us to include all patients in one analysis without being concerned if patients have one day, one year or one decade of observed follow-up time; these methods automatically adjust analyses for the amount of follow-up time.

In the case of analyses which estimate implant failure, death events are also censored, specifically they are considered non-informative censoring events. This assumes that death is unrelated to a failing implant, and can be safely ignored whilst estimating implant failure (revision). See Sayers et al. 2018 for an extensive discussion on this issue.

Sayers A, Evans JT, Whitehouse MR, Blom AW: Are competing risks models appropriate to describe implant failure? Acta Orthop. 2018 Jun; 89(3): 256-258.

The survival tables in this report show 'Kaplan-Meier' estimates of the cumulative chance (probability) of failure (revision) or death, at different times from the primary operation. In the joint replacement literature they are often referred to as KM or simply survival estimates. We additionally show 95% Confidence Intervals for each estimate (95% CI). Confidence intervals illustrate the uncertainty around the estimate, with wide confidence intervals indicating greater uncertainty than narrow ones. Strictly they are interpreted in the context of repeated sampling i.e. if the data were collected in repeated samples we would expect 95% CIs generated to contain the true estimate in 95% of samples. However, confidence intervals are strongly influenced by the numbers of prosthesis constructs at risk and can become unreliable when the numbers at risk become low. In tables, including risk tables within figures, we highlight in *blue italics* all estimates where there are 250 or fewer prosthesis constructs at risk, or remaining at risk, at that particular time point.

Kaplan-Meier estimates can also be displayed graphically using a connected line plot. Figures are joined using a 'stair-step' function. Each 'stair' is flat, reflecting the constant nature of the estimate between the events of interest. When a new event occurs the survival estimate changes, creating a 'step'. Changes in the numbers at risk because of censoring do not themselves cause a step change but if the numbers at risk become low, when an event does occur, the stair-step might appear quite dramatic. Whenever possible, the numbers at risk at each time point have been included in the figures, allowing the reader to more appropriately interpret the data given the number of constructs at risk. We highlight in *blue italics* all estimates where there are 250 or fewer prosthesis constructs at risk or remaining at risk at that particular time point. The Kaplan-Meier estimates shown are technically 1 minus the Kaplan-Meier estimate multiplied by 100, therefore they estimate the cumulative percentage probability of construct failure.

In the case of revisions, no attempt has been made to adjust for the risk of death, as analyses attempt to estimate the underlying implant failure rate in the absence of death, see Sayers et al. 2018 for an extensive discussion on competing risks. Briefly, the Kaplan-Meier estimator estimates the probability of implant failure (revision) assuming the patient is still alive.

Prosthesis Time Incidence Rates

Prosthesis Time Incidence Rates (PTIR) are used to describe the incidence (the rate of new events) of specific modes of failure in joint replacement. The PTIR expresses the number of revisions divided by the total of the individual prosthesis-years at risk. Figures here show the numbers of revisions per 1,000 years at risk. PTIR in other areas of research are often known as 'person-time' incident rates, however, in joint replacement registries the base unit of analysis is the 'prosthesis construct'.

Note: This method is only appropriate if the hazard rate (the rate at which revisions occur in the unrevised cases) remains constant across the follow-up period. The latter is further explored by sub-dividing the time interval from the primary operation into smaller intervals and calculating PTIRs for each smaller interval.

Sayers A, Evans JT, Whitehouse MR, Blom AW: Are competing risks models appropriate to describe implant failure? Acta Orthop. 2018 Jun; 89(3): 256-258.

3.2 Outcomes after hip replacement

3.2.1 Overview of primary hip replacement surgery

In this section we address revision and mortality outcomes for all primary hip operations performed between 1 April 2003 and 31 December 2022. Patients operated on at the commencement of the registry therefore had a potential 19.75 years of follow-up. This year, follow-up is reported at a maximum of 19 years in the tables and figures, although beyond 15 years the numbers at risk are particularly low in some categories.

Figure 3.H1 (a) (page 48) describes the data cleaning applied to produce the total of 1,448,541 primary hip procedures included in the analyses presented in this section.

Over the lifetime of the registry, the 1,448,541 primary hip replacement procedures contributing to our revision analyses were carried out by a total of 4,039 unique consultant surgeons working across 484 units. Over the last three years (1 January 2020 to 31 December 2022), 245,274 primary hip procedures (representing 16.9% of the current registry volume) were performed by 2,108 consultant surgeons working across 419 units.

Looking at caseload over this three-year period, the median number of primary procedures per consultant surgeon was 59 (interquartile range (IQR) 4 to 174) and the median number of procedures per unit was 492 (IQR 208 to 833). A proportion of surgeons will have commenced practice as a consultant during this period, some may have retired, and some surgeons may have periods of surgical inactivity within the time of coverage of the registry, therefore their apparent caseload would be lower.

The majority of primary hip procedures were carried out on females (females 59.8%; males 40.2%). The median age at primary operation was 69 (IQR 61 to 76) years. Osteoarthritis was given as a documented indication for surgery in 1,320,750 cases (91.2% of the cohort) and was the sole indication given in 1,273,746 (87.9%) primary hip replacements.

Figure 3.H1 (a) Hip cohort flow diagram.

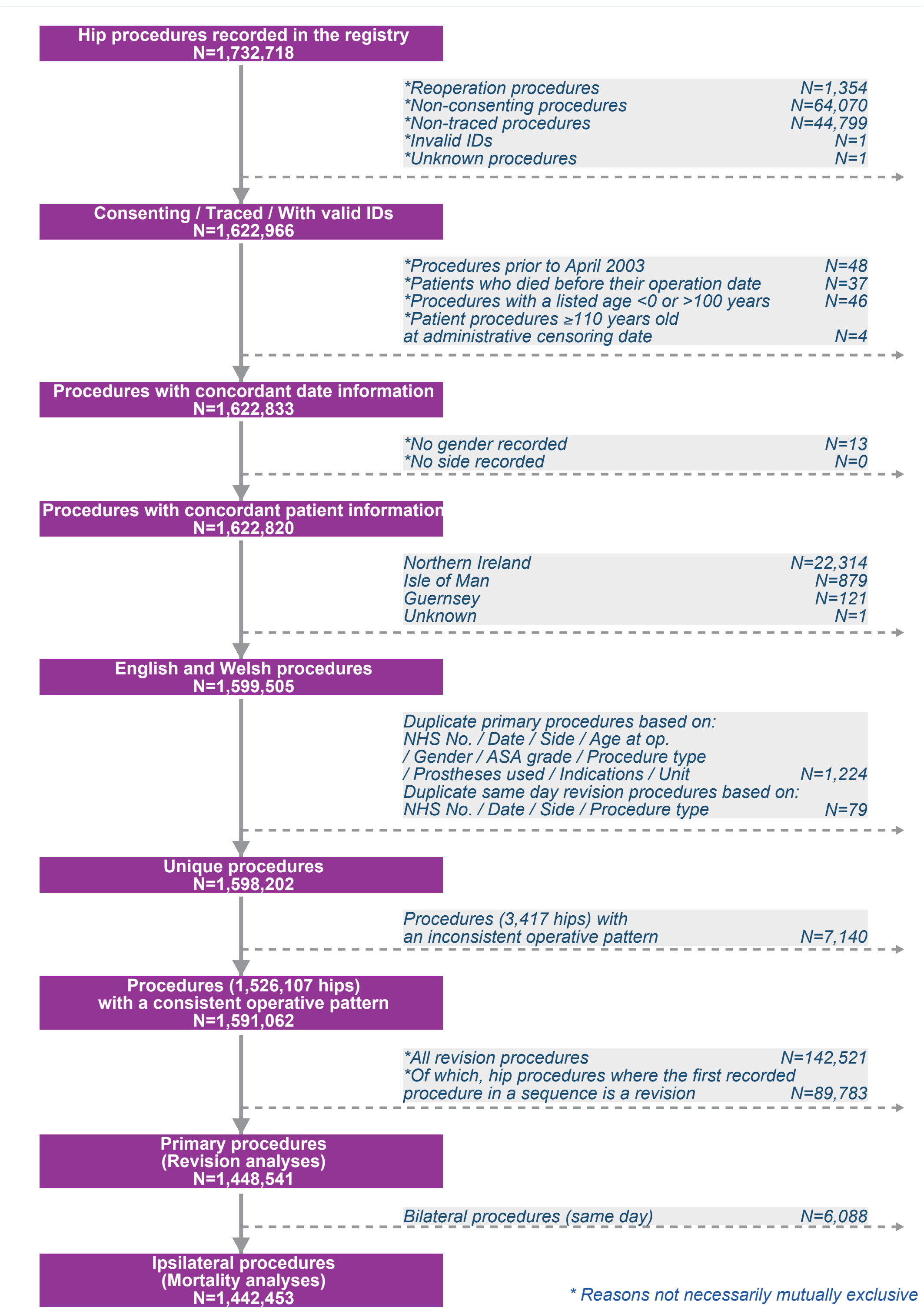


Table 3.H1 Number and percentage of primary hip replacements by fixation and bearing.

Fixation and bearing surface	Number of primary hip operations	Percentage of each bearing type used within each method of fixation	Percentage of all primary hip operations
All cases	**1,448,541**		**100**
All cemented	**432,252**		**29.8**
MoP	368,641	85.3	25.4
MoM	426	0.1	<0.1
CoP	59,975	13.9	4.1
MoPoM	2,798	0.6	0.2
CoPoM	392	0.1	<0.1
Others	20	<0.1	<0.1
All uncemented	**536,411**		**37.0**
MoP	205,001	38.2	14.2
MoM	29,246	5.5	2.0
CoP	156,359	29.1	10.8
CoC	141,144	26.3	9.7
CoM	2,143	0.4	0.1
MoPoM	1,369	0.3	0.1
CoPoM	1,030	0.2	0.1
Others	119	<0.1	<0.1
All hybrid	**360,496**		**24.9**
MoP	189,045	52.4	13.1
MoM	2,448	0.7	0.2
CoP	132,988	36.9	9.2
CoC	27,962	7.8	1.9
MoPoM	5,782	1.6	0.4
CoPoM	2,149	0.6	0.1
Others	122	<0.1	<0.1
All reverse hybrid	**37,102**		**2.6**
MoP	25,002	67.4	1.7
CoP	11,876	32.0	0.8
Others	224	0.6	<0.1
All resurfacing	**42,260**		**2.9**
MoM	41,886	99.1	2.9
CoC	249	0.6	<0.1
Others	125	0.3	<0.1
Unconfirmed	**40,020**		**2.8**

Table 3.H1 shows the breakdown of cases by the method of fixation and within each fixation sub-group, by bearing surfaces. Bearing surface combinations are reported as a separate group where there were 249 or more cases. The most commonly used operation type over the life of the registry (2003 to present) remains as cemented metal-on-polyethylene (85.3% of all cemented primaries, 25.4% of all primaries). Dual mobility bearings are described either as dual mobility, to contrast to standard unipolar bearings, or where numbers allow, are categorised by the material of each part of the bearing surface (e.g. metal-on-polyethylene-on-metal (MoPoM) and ceramic-on-polyethylene-on-metal (CoPoM)). The numbers of other combinations of dual mobility (such as ceramic-on-polyethylene-on-ceramic (CoPoC)) were too small to include as separate groups this year.

Figure 3.H1 (b) Frequency of primary hip replacements within elective cases stratified by procedure type, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

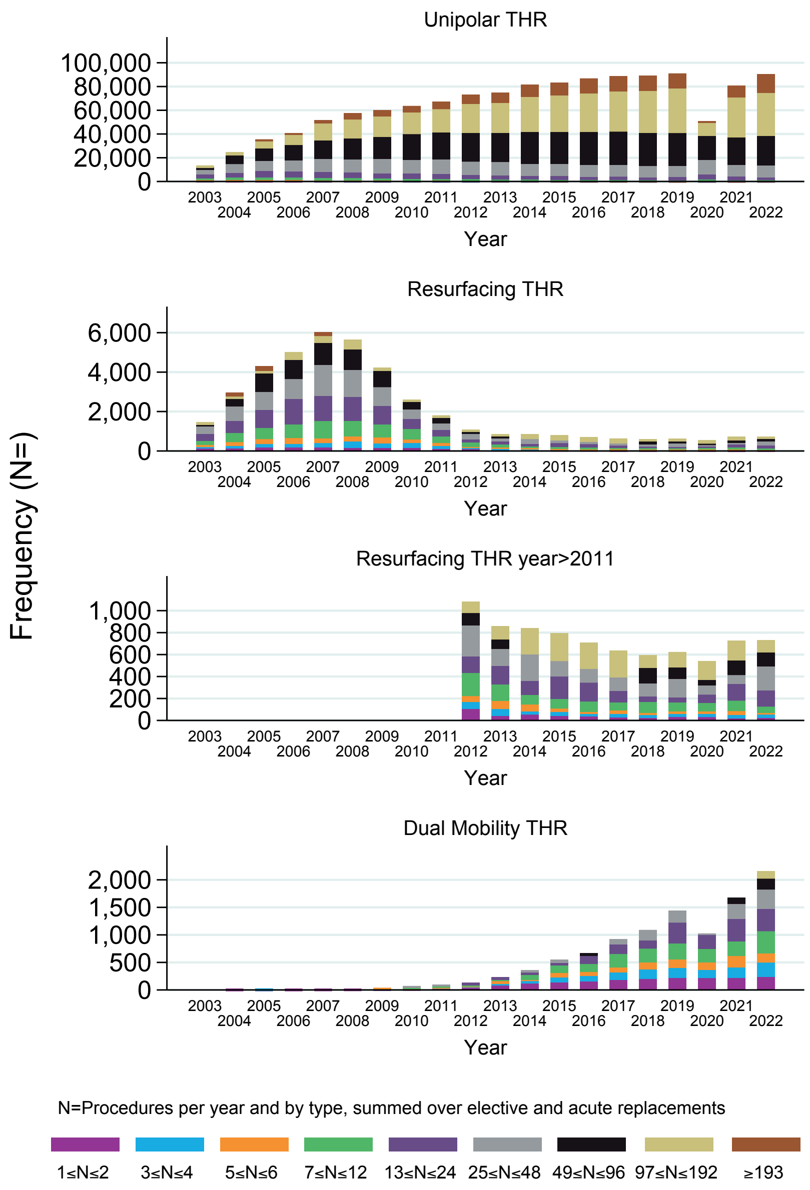


Figure 3.H1 (c) Frequency of primary hip replacements within acute trauma cases stratified by procedure type, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

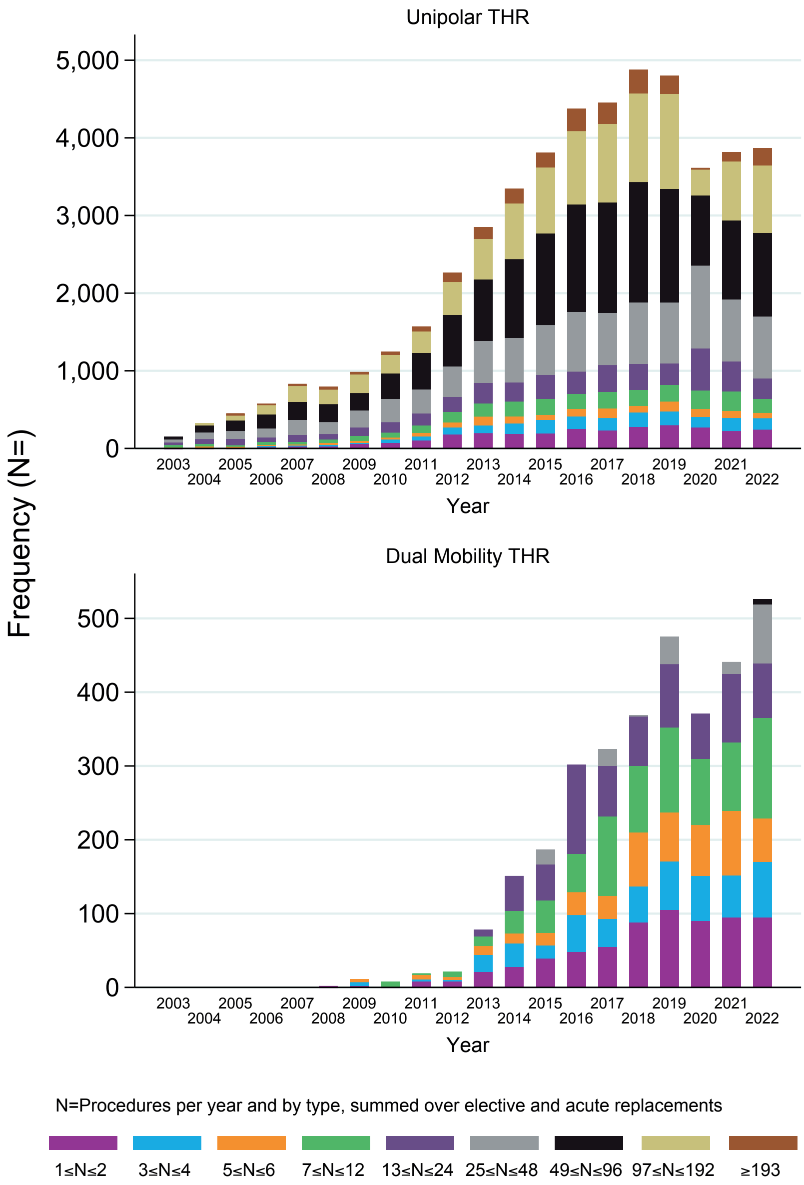


Figure 3.H1 (d) Frequency of elective primary hip replacements by funding status and organisation type, per year.

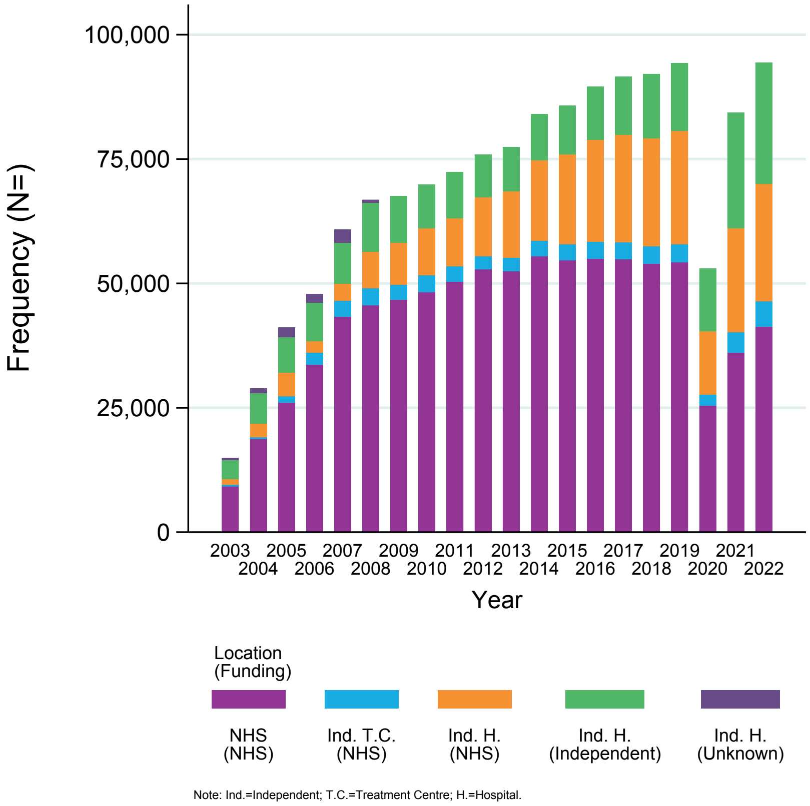


Figure 3.H1 (b) and Figure 3.H1 (c) (pages 50 and 51) show the yearly number of primary total hip replacements performed for elective and acute trauma indications respectively. Elective procedures have been stratified by unipolar, resurfacing and dual mobility total hip replacements. Acute trauma procedures have been stratified by unipolar and dual mobility total hip replacements. Please note the difference in scale of the y-axis between each sub-plot.

Each bar is further stratified by the volume of procedures that the consultant conducted in that year across both elective and acute trauma settings i.e. if a surgeon performed 25 elective unipolar THR procedures and 25 acute trauma unipolar elective procedures their annual total volume would be 50 procedures. Those 50 procedures would contribute to the black sub-division in both elective and acute trauma figures.

Figure 3.H1 (b) shows the annual rates of elective unipolar THR increasing, (with the exception of 2020 due to the COVID pandemic with rates partially recovered in 2021 and almost fully recovered in 2022), with the majority of additional procedures contributed by higher volume surgeons i.e. those performing more than 49 hip procedures a year. In the acute trauma setting there was a rapid expansion of unipolar THRs

recorded in the registry from 2011 until 2018, with a plateau in 2019 and then lower rates during the COVID pandemic, which have persisted.

Figure 3.H1 (b) also shows that after declining substantially in popularity, resurfacing has remained relatively stable over the past five years, with a slight increase in absolute numbers in 2021 and 2022. In 2022 around two-thirds of the resurfacing procedures were performed by consultants who used it in more than 25 cases per year.

Figure 3.H1 (b) and Figure 3.H1 (c) also illustrate the emerging use of dual mobility THR in the elective and acute trauma settings. Prior to 2013, dual mobility THR was relatively rare, but since 2013 its use has increased in both settings, other than 2020 and 2021 where COVID had an impact on case numbers, and it is now more common than hip resurfacing. Over half of dual mobility operations are performed by consultants who conduct seven or more dual mobility hip replacements per year, however, a greater proportion of dual mobility THRs are performed by lower volume surgeons than other types of THR in both the elective and acute trauma setting.

Figure 3.H1 (d) describes the funding status and organisation type (based on organisation type in 2023) of primary hip procedures collected by the NJR. The figure shows a steady increase in the number of THRs that were NHS-funded and performed in NHS hospitals from the beginning of the registry until 2014. After this time, this number plateaued until 2019 and then reduced substantially due to the impact of COVID. The growth in the total number of THRs performed from 2014 to 2019 was largely driven by growth in the number of NHS-funded procedures being performed in independent hospitals. Although the total number of THRs performed in 2022 has nearly recovered to 2019 levels, the recovery of NHS-funded procedures being performed in NHS hospitals is only partial with an increase in the number of NHS-funded procedures performed in independent hospitals and independently funded procedures performed in independent hospitals accounting for the overall recovery.

Table 3.H2 Percentage of primary hip replacements by fixation, bearing and year.

Fixation and bearing surface	2004 n= 44,266	2005 n= 41,698	2006 n= 48,566	2007 n= 61,727	2008 n= 67,725	2009 n= 68,676	2010 n= 71,201	2011 n= 74,152	2012 n= 78,361	2013 n= 80,509	2014 n= 87,774	2015 n= 89,925	2016 n= 94,473	2017 n= 96,611	2018 n= 97,665	2019 n= 99,938	2020 n= 57,309	2021 n= 88,922	2022 n= 99,043
All cemented	53.5	46.0	40.3	37.3	32.0	30.0	29.5	30.2	31.7	32.1	31.1	30.0	28.5	27.3	26.9	25.7	22.3	21.4	19.1
MoP	50.4	42.9	37.3	34.7	29.3	27.2	26.4	26.7	27.8	27.7	26.3	25.0	23.4	22.0	21.7	20.3	17.2	15.6	13.6
MoM	0.2	0.1	0.2	0.2	0.1	<0.1	<0.1	<0.1	0	0	<0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1
CoP	3.0	2.9	2.8	2.4	2.6	2.7	3.1	3.4	3.9	4.3	4.5	4.6	4.7	4.9	4.9	5.1	4.7	5.4	5.2
MoPoM	0	0	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2
CoPoM	0	0	0	0	0	<0.1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1
Others	0	<0.1	0	0	0	0	0	<0.1	<0.1	<0.1	0	0	0	<0.1	0	<0.1	0	<0.1	<0.1
All uncemented	18.3	24.1	28.4	31.5	37.3	40.8	43.2	42.9	44.1	41.9	40.3	39.0	38.2	37.5	36.6	35.1	34.8	35.5	36.2
MoP	7.5	9.4	9.6	10.1	12.3	14.4	16.0	16.5	17.5	17.2	16.7	16.2	15.9	15.5	15.3	13.6	12.4	12.1	12.0
MoM	1.9	5.4	8.4	10.4	11.1	7.9	3.2	0.4	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0
CoP	5.0	5.0	4.5	4.0	3.8	4.5	5.4	5.9	7.2	8.2	9.5	11.4	12.5	14.1	14.9	15.9	17.1	19.1	20.3
CoC	3.9	4.3	5.8	7.0	9.7	13.1	17.5	19.6	19.1	16.3	14.0	11.4	9.7	7.6	6.3	5.3	4.8	3.8	3.3
CoM	<0.1	<0.1	<0.1	0.1	0.4	0.9	1.0	0.5	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	<0.1	<0.1
MoPoM	<0.1	<0.1	0	0	0	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3
CoPoM	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.2	0.3	0.3
Others	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	<0.1	0
All hybrid	12.5	13.9	15.0	14.8	14.7	15.4	15.8	16.7	17.4	19.9	22.7	25.3	27.7	29.8	31.5	34.7	37.8	38.4	40.3
MoP	8.7	9.4	9.8	9.9	9.9	10.4	10.7	11.3	11.4	11.9	13.1	13.9	14.8	15.4	15.1	16.5	16.1	15.4	15.2
MoM	0.7	0.6	0.7	0.8	0.7	0.4	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
CoP	1.5	1.2	1.3	1.0	1.3	1.8	1.9	2.2	3.1	5.1	7.0	8.9	10.7	12.3	14.4	16.1	19.4	21.0	23.0
CoC	1.7	2.8	3.2	3.0	2.7	2.9	3.0	3.1	2.9	2.7	2.4	2.1	1.6	1.4	1.1	0.9	0.7	0.5	0.4
MoPoM	0	<0.1	0	0	0	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.2	1.0	1.1
CoPoM	0	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.3	0.5	0.5	0.7
Others	<0.1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Note: Data from 2003 have been included in 2004 since 2003 was not a complete year. Percentages are calculated as a percentage of total yearly operations.
Note: A zero represents no procedures by this bearing type.

Table 3.H2 (continued)

Fixation and bearing surface	2004 n= 44,266	2005 n= 41,698	2006 n= 48,566	2007 n= 61,727	2008 n= 67,725	2009 n= 68,676	2010 n= 71,201	2011 n= 74,152	2012 n= 78,361	2013 n= 80,509	2014 n= 87,774	2015 n= 89,925	2016 n= 94,473	2017 n= 96,611	2018 n= 97,665	2019 n= 99,938	2020 n= 57,309	2021 n= 88,922	2022 n= 99,043
All reverse hybrid	0.7	0.9	1.0	1.6	2.4	2.6	2.7	3.1	3.1	3.0	3.1	3.2	3.2	3.2	2.9	2.4	2.2	2.4	2.3
MoP	0.5	0.7	0.8	1.0	1.7	1.8	1.9	2.1	2.0	2.0	2.0	2.1	2.2	2.3	2.1	1.6	1.5	1.4	1.4
CoP	0.2	0.2	0.2	0.6	0.7	0.8	0.9	0.9	1.1	1.0	1.1	1.0	1.0	0.9	0.8	0.7	0.7	0.9	0.9
Others	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
All resurfacing	10.1	10.3	10.4	9.8	8.3	6.2	3.7	2.4	1.4	1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.9	0.8	0.7
MoM	10.1	10.3	10.4	9.8	8.3	6.2	3.7	2.4	1.4	1.1	1.0	0.9	0.8	0.6	0.5	0.6	0.8	0.7	0.7
CoC	0	0	0	0	0	0	0	0	0	0	0	0	0	<0.1	0.1	0	0.1	0.1	<0.1
Others	0	<0.1	<0.1	<0.1	0	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Unconfirmed	4.9	4.7	4.9	5.0	5.4	5.0	5.0	4.7	2.3	2.1	1.9	1.6	1.6	1.5	1.5	1.5	1.9	1.6	1.3
All	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: Data from 2003 have been included in 2004 since 2003 was not a complete year. Percentages are calculated as a percentage of total yearly operations.
Note: A zero represents no procedures by this bearing type.

Table 3.H2 (page 54) shows the annual rates by fixation and bearing groups for each year for primary hip replacements. Uncemented and hybrid total hip replacements currently dominate practice, together accounting for 76.5% of all primary hip replacements undertaken in 2022. The proportion of all hips that are cemented has halved to 19.1% between 2006 and 2022. The percentage of hybrid implants used has gone up by over 2.5 times over the same period. The percentage of uncemented implants used increased from 18% to 44% in the first nine years of the registry, but then steadily declined to 35% over the next seven years, before plateauing. Figure 3.H2 (a) illustrates the temporal changes in fixation and type of primary hip replacements. Ceramic-on-polyethylene hybrid THR was the most common type in 2022, being used in 23.0% of cases. Figure 3.H2 (b) (page 57) shows dual mobility bearings as a separate group to illustrate their steadily increasing use, which has been most marked in the hybrid fixation group (see Table 3.H2).

Figure 3.H2 (a) Primary hip type percentages by year of replacement.

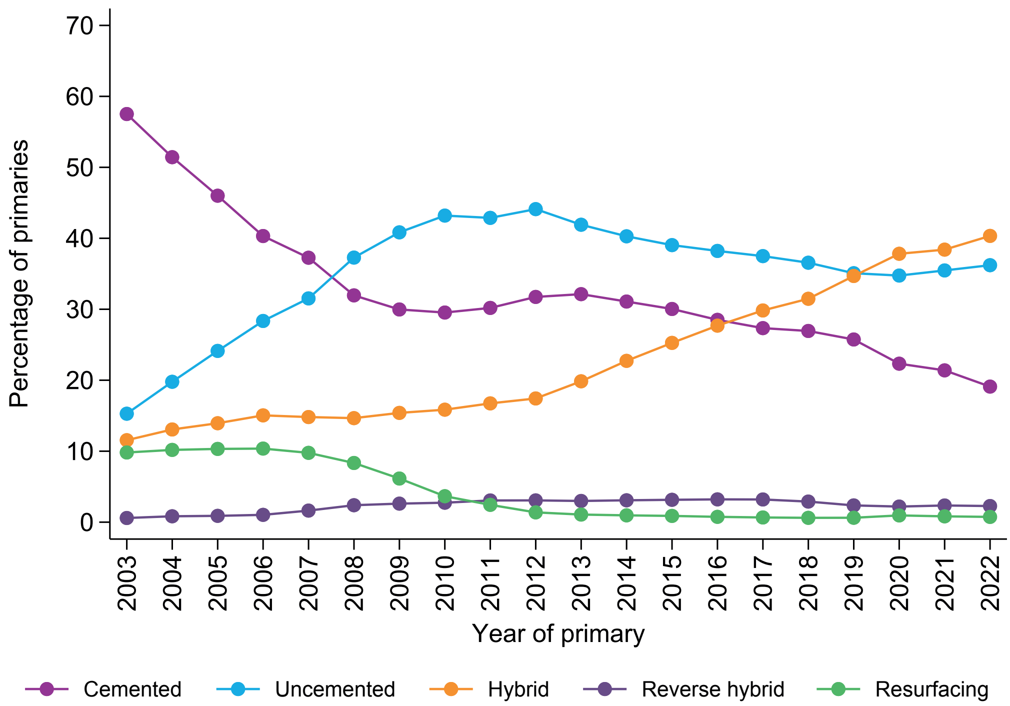


Figure 3.H2 (b) Primary hip type percentages by year of replacement, with dual mobility as a separate category.

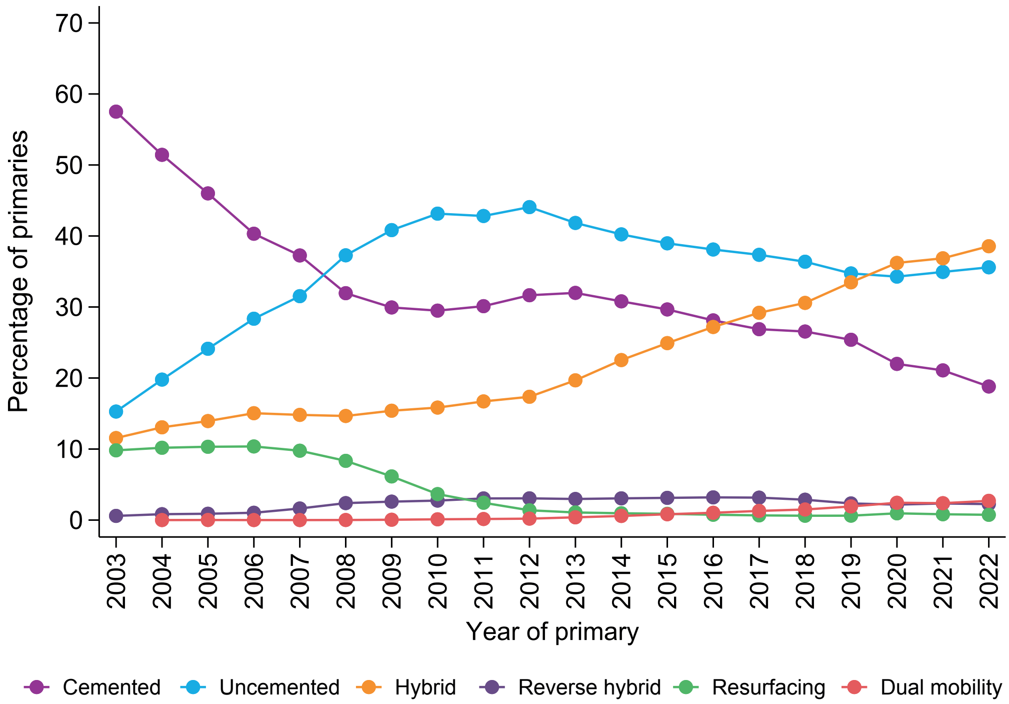
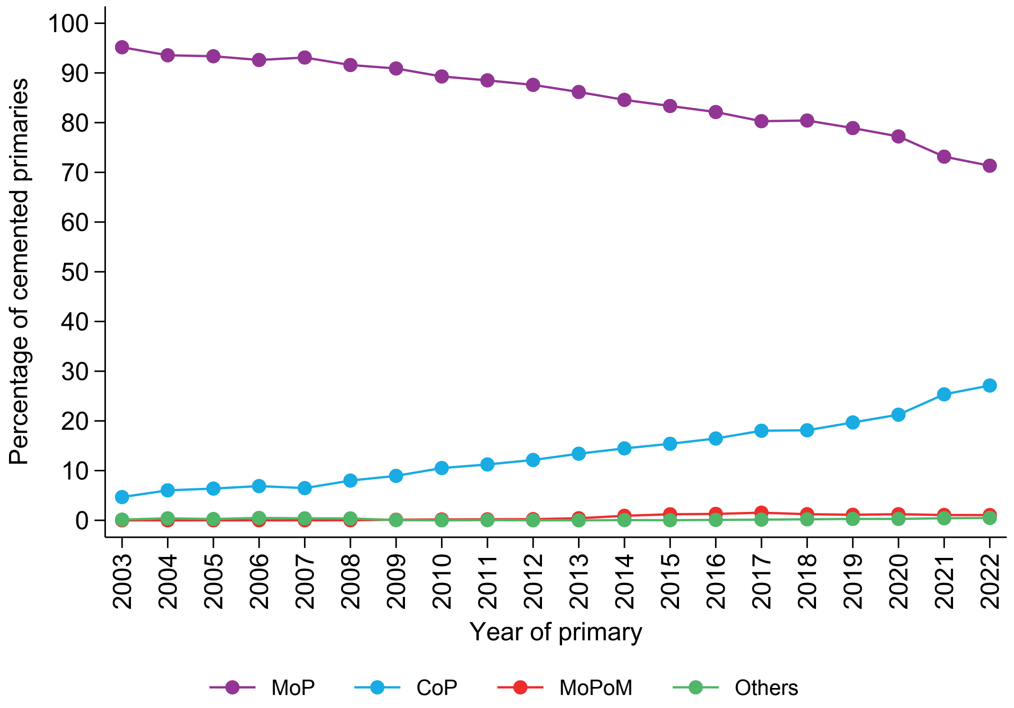


Figure 3.H3 (a) Cemented primary hip replacement bearing surface by year.



Figures 3.H3 (a) to (d) illustrate the temporal changes in the bearing surface combinations used with the type of total hip replacement fixation. Groups that contain more than 500 procedures are plotted separately. Since 2012 there has been a marked increase in the use of ceramic-on-polyethylene bearings and a corresponding decrease in the use of ceramic-on-ceramic bearings. The greatest variation in bearing use is noted in the uncemented fixation group.

Figure 3.H3 (b) Uncemented primary hip replacement bearing surface by year.

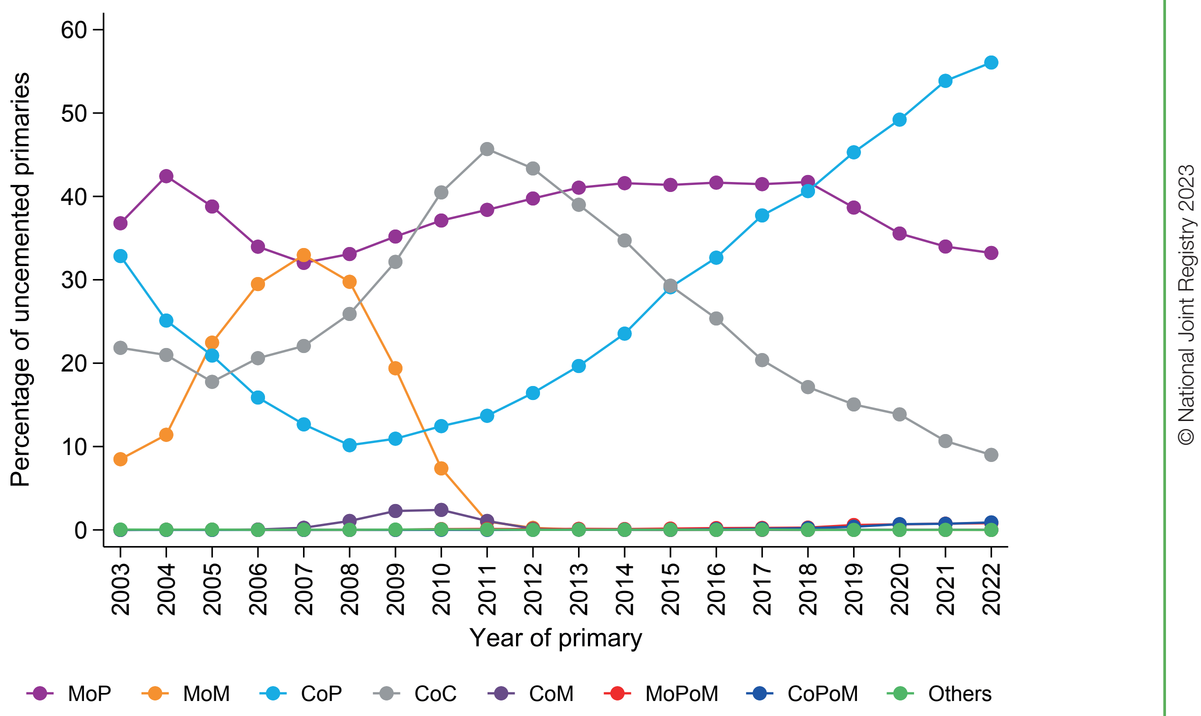


Figure 3.H3 (c) Hybrid primary hip replacement bearing surface by year.

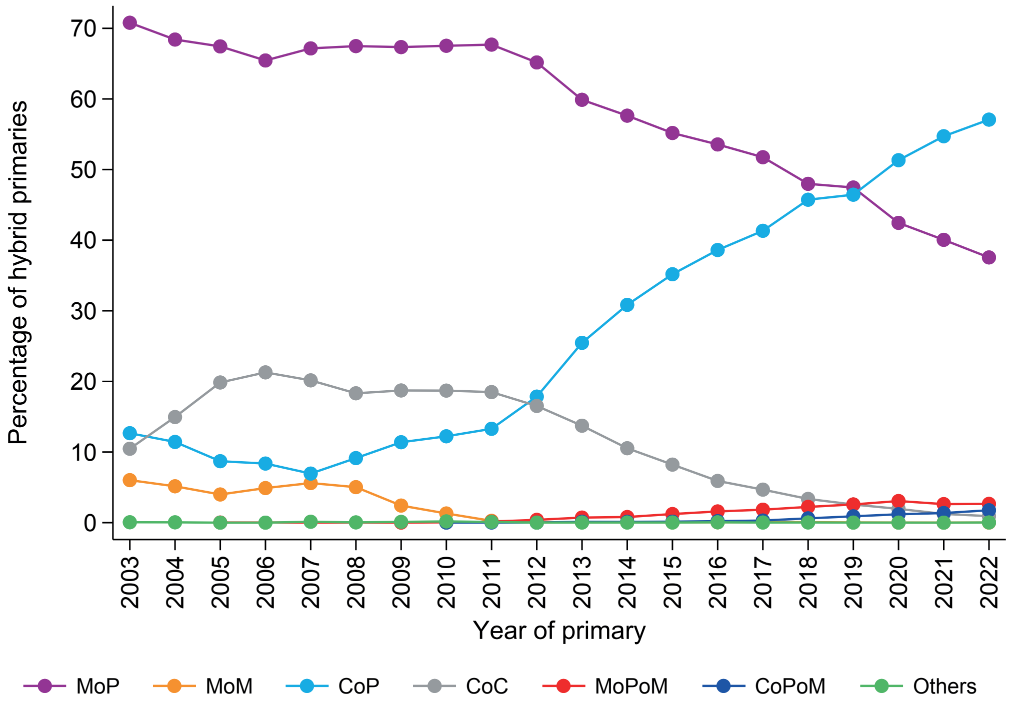


Figure 3.H3 (d) Reverse hybrid primary hip replacement bearing surface by year.

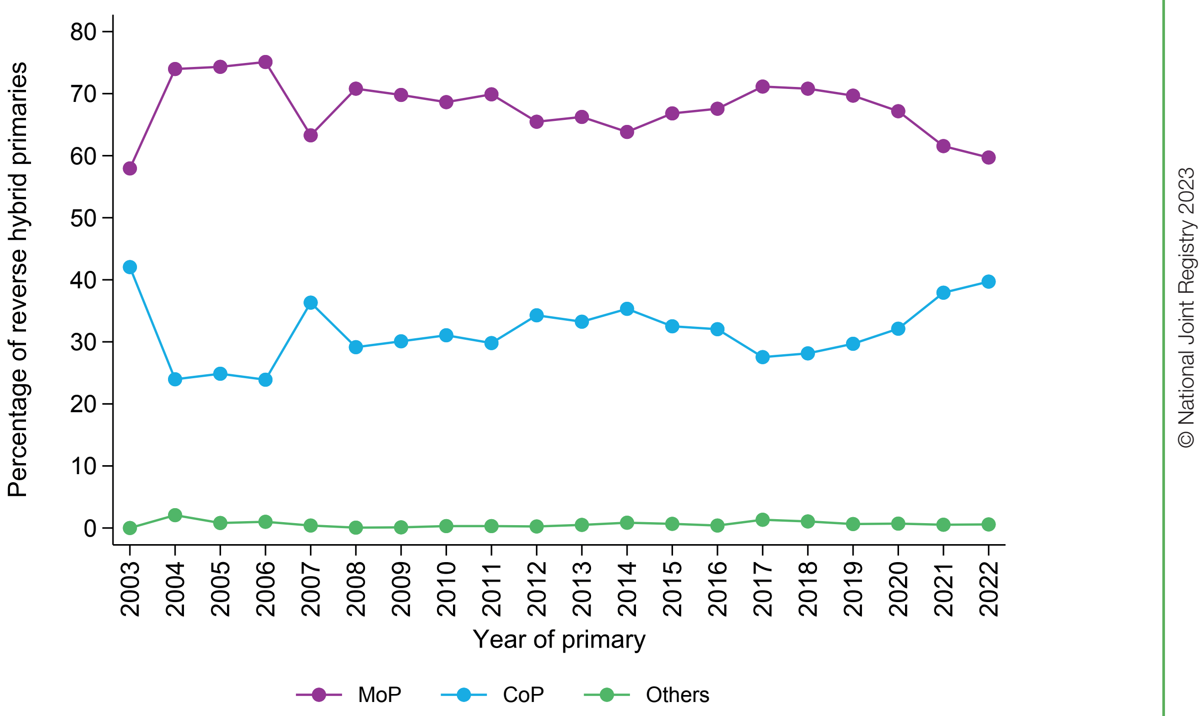
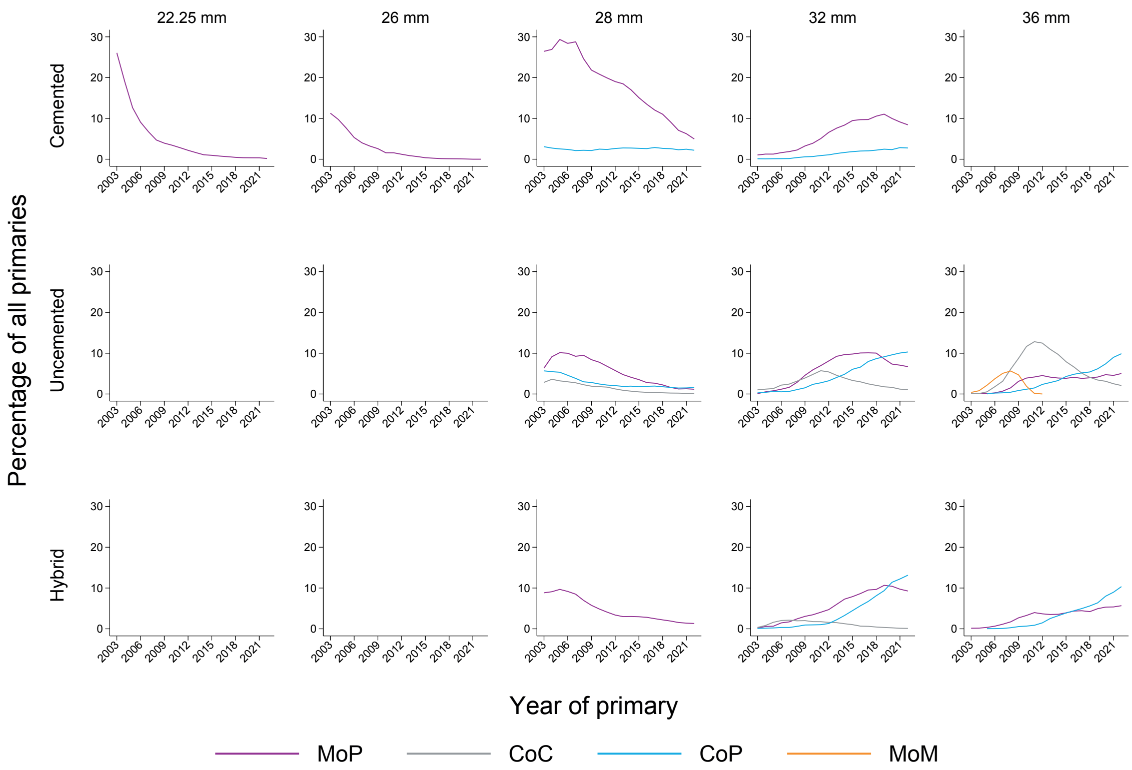


Figure 3.H3 (e) Trends in fixation, bearing and head size in primary unipolar total hip replacement by year.



Note: Only combinations with ≥2% use in any year are plotted.

Figure 3.H3 (e) illustrates the temporal changes in common head sizes, by method of fixation and bearing type in primary unipolar total hip replacement. In 2003, the vast majority of hip replacements utilised heads of 28mm or smaller, across all fixation methods. Since 2003, a progressive shift away from small (22.25mm or 26mm) heads in cemented hip replacements to larger head sizes (>28mm) with alternative fixation methods (uncemented or hybrid) has been observed.

In 2022, as in 2021, the three most common head sizes are 32mm (1st), 36mm (2nd) and 28mm (3rd), with 22.25mm and 26mm rarely being used. Only nine cases of 26mm head usage were recorded for 2022. The use of ceramic-on-ceramic bearings across all head sizes, but most notably 36mm, has declined since 2011. This decline, conversely, corresponds with an increase in ceramic-on-polyethylene bearings with 32mm heads. The choice of bearing, head size and fixation method was much more heterogeneous in 2022 compared to 2003. The dominant choices in 2022 were 32mm and 36mm ceramic-on-polyethylene bearings.

Table 3.H3 (page 63) provides a breakdown by fixation type and bearing surface, describing the age and gender profile of recipients of primary hip replacements. Patients receiving resurfacing and ceramic-on-ceramic bearings tended to be younger and those receiving metal-on-polyethylene-on-metal dual mobility bearings tended to be older than those in the other groups. Those receiving resurfacings were more likely to be younger males.

Table 3.H3 Age at primary hip replacement by fixation and bearing.

Fixation and bearing surface	N	Age (years) Median (IQR*)	Mean (SD)	Male (%)
All cases	**1,448,541**	**69 (61 to 76)**	**68.2 (11.4)**	**40.2**
All cemented	**432,252**	**74 (68 to 80)**	**73.2 (9.1)**	**33.3**
MoP	368,641	75 (70 to 80)	74.5 (8.1)	32.7
MoM	426	72 (65 to 78)	71.4 (9.4)	33.6
CoP	59,975	66 (59 to 72)	65.2 (10.5)	37.0
MoPoM	2,798	77 (70 to 83)	75.5 (10.9)	29.8
CoPoM	392	78 (69 to 83)	74.8 (11.0)	29.1
Others	20	50 (46 to 72)	56.3 (17.3)	50.0
All uncemented	**536,411**	**65 (58 to 72)**	**64.3 (11.3)**	**45.3**
MoP	205,001	71 (64 to 76)	69.7 (9.6)	41.9
MoM	29,246	63 (57 to 70)	63.0 (11.1)	50.7
CoP	156,359	63 (57 to 70)	62.8 (10.1)	47.1
CoC	141,144	60 (52 to 66)	58.5 (11.3)	47.4
CoM	2,143	63 (56 to 69)	62.1 (10.6)	41.9
MoPoM	1,369	71 (61 to 79)	68.9 (13.5)	35.2
CoPoM	1,030	60 (52 to 69)	60.3 (13.4)	58.1
Others	119	62 (52 to 71)	61.1 (13.9)	47.1
All hybrid	**360,496**	**71 (63 to 77)**	**69.3 (10.8)**	**37.4**
MoP	189,045	74 (69 to 79)	73.5 (8.6)	34.8
MoM	2,448	64 (56 to 72)	63.8 (12.1)	47.3
CoP	132,988	66 (59 to 73)	65.5 (10.6)	40.2
CoC	27,962	60 (53 to 66)	59.1 (11.4)	40.9
MoPoM	5,782	76 (68 to 82)	73.8 (11.1)	32.5
CoPoM	2,149	71 (61 to 78)	68.9 (12.3)	43.2
Others	122	68 (59 to 74)	66.4 (12.1)	44.3
All reverse hybrid	**37,102**	**71 (64 to 76)**	**69.7 (9.7)**	**37.2**
MoP	25,002	73 (68 to 78)	72.9 (8.0)	35.9
CoP	11,876	64 (58 to 69)	63.1 (9.6)	39.9
Others	224	75 (63 to 82)	71.2 (13.8)	34.4
All resurfacing	**42,260**	**55 (48 to 60)**	**53.8 (9.2)**	**74.0**
MoM	41,886	55 (48 to 60)	53.8 (9.2)	74.2
CoC	249	53 (47 to 59)	52.5 (9.2)	71.9
Others	125	56 (49 to 63)	55.4 (11.5)	23.2
Unconfirmed	**40,020**	**70 (61 to 77)**	**68.3 (12.5)**	**38.4**

*IQR=interquartile range.

Table 3.H4 Primary hip replacement patient demographics.

	Male N (%)		Female N (%)		All N (%)	
Total		**582,119**		**866,422**		**1,448,541**
ASA 1		99,917 (17.2)		115,340 (13.3)		215,257 (14.9)
ASA 2		379,685 (65.2)		601,476 (69.4)		981,161 (67.7)
ASA 3		98,574 (16.9)		144,891 (16.7)		243,465 (16.8)
ASA 4		3,881 (0.7)		4,620 (0.5)		8,501 (0.6)
ASA 5		62 (<0.1)		95 (<0.1)		157 (<0.1)
Osteoarthritis as the sole reason for primary		520,598 (89.4)		753,148 (86.9)		1,273,746 (87.9)
Osteoarthritis as a reason for primary		538,290 (92.5)		782,460 (90.3)		1,320,750 (91.2)
Age	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
	66.6 (11.6)	68 (59 to 75)	69.2 (11.1)	70 (63 to 77)	68.2 (11.4)	69 (61 to 76)

Table 3.H4 shows the American Society of Anesthesiologists (ASA) grade and indication for primary hip replacement by gender. A greater number of females than males undergo primary hip replacement and two-thirds of patients are ASA grade 2. Only a small number of patients with a grade greater than ASA 3 undergo a primary hip replacement. The majority of cases are performed for osteoarthritis. A total of 1,273,746 (87.9%) primary hip replacements have been recorded in the registry where the sole indication was osteoarthritis.

3.2.2 First revisions after primary hip surgery

A total of 43,682 first revisions of a hip replacement have been linked to a previous primary hip replacement recorded in the registry between 2003 and 2022. Figures 3.H4 (a) and (b) (page 66) illustrate temporal changes in the overall revision rates using Kaplan-Meier estimates; procedures have been grouped by the year of the primary operation. Figure 3.H4 (a) plots each Kaplan-Meier survival curve with a common origin, i.e. time zero is equal to the year of operation. This illustrates that revision rates increased between 2003 and 2007/8 and then declined between 2007/8 and 2022.

Figure 3.H4 (a) KM estimates of cumulative revision by year, in primary hip replacements.

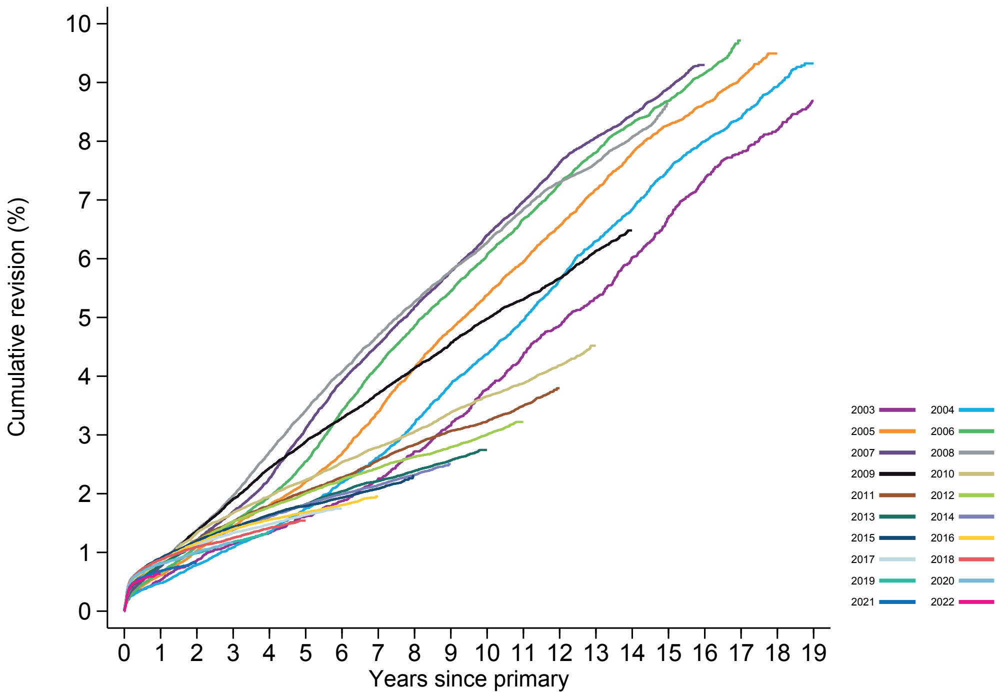


Figure 3.H4 (b) KM estimates of cumulative revision by year, in primary hip replacements plotted by year of primary.

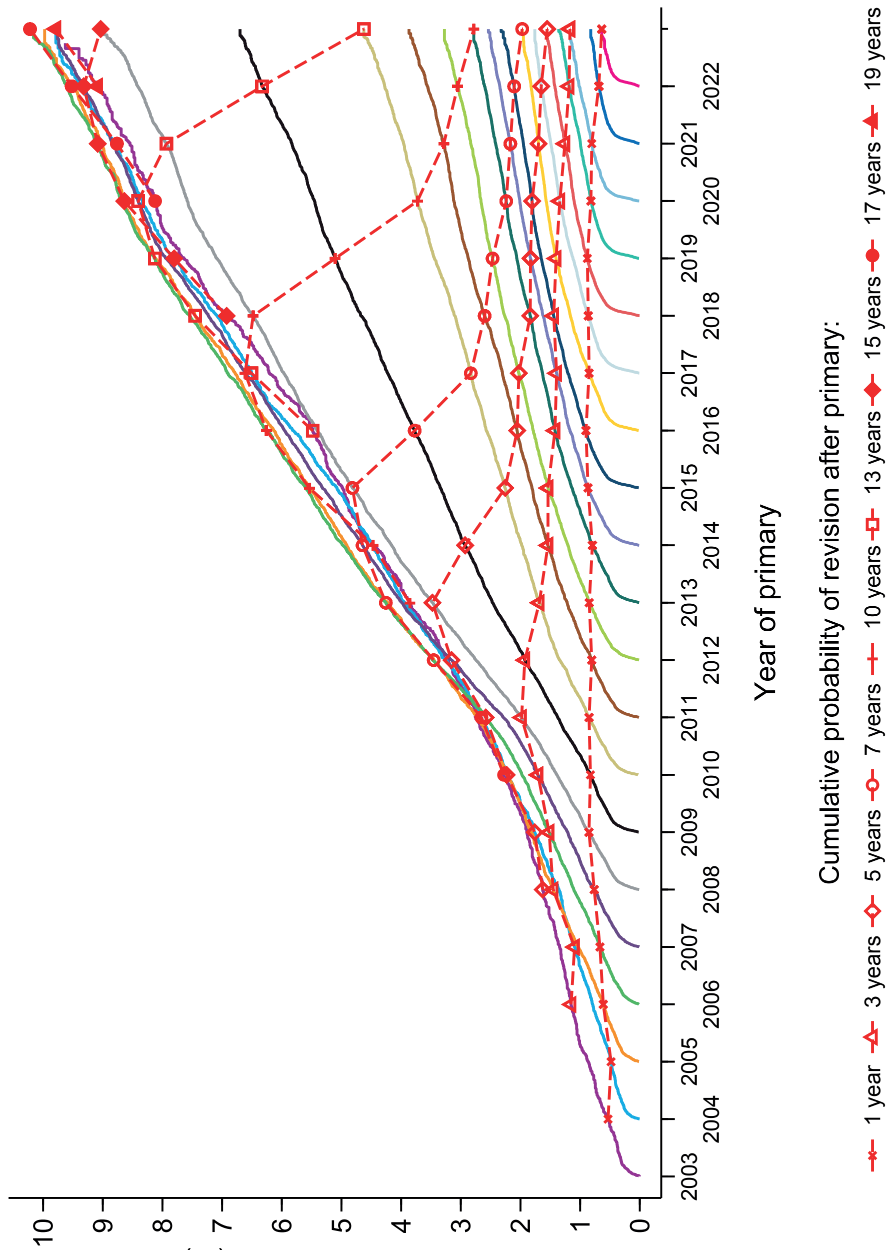


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Figure 3.H4 (c) KM estimates of cumulative revision by year, in primary hip replacements (excluding metal-on-metal bearings) plotted by year of primary.

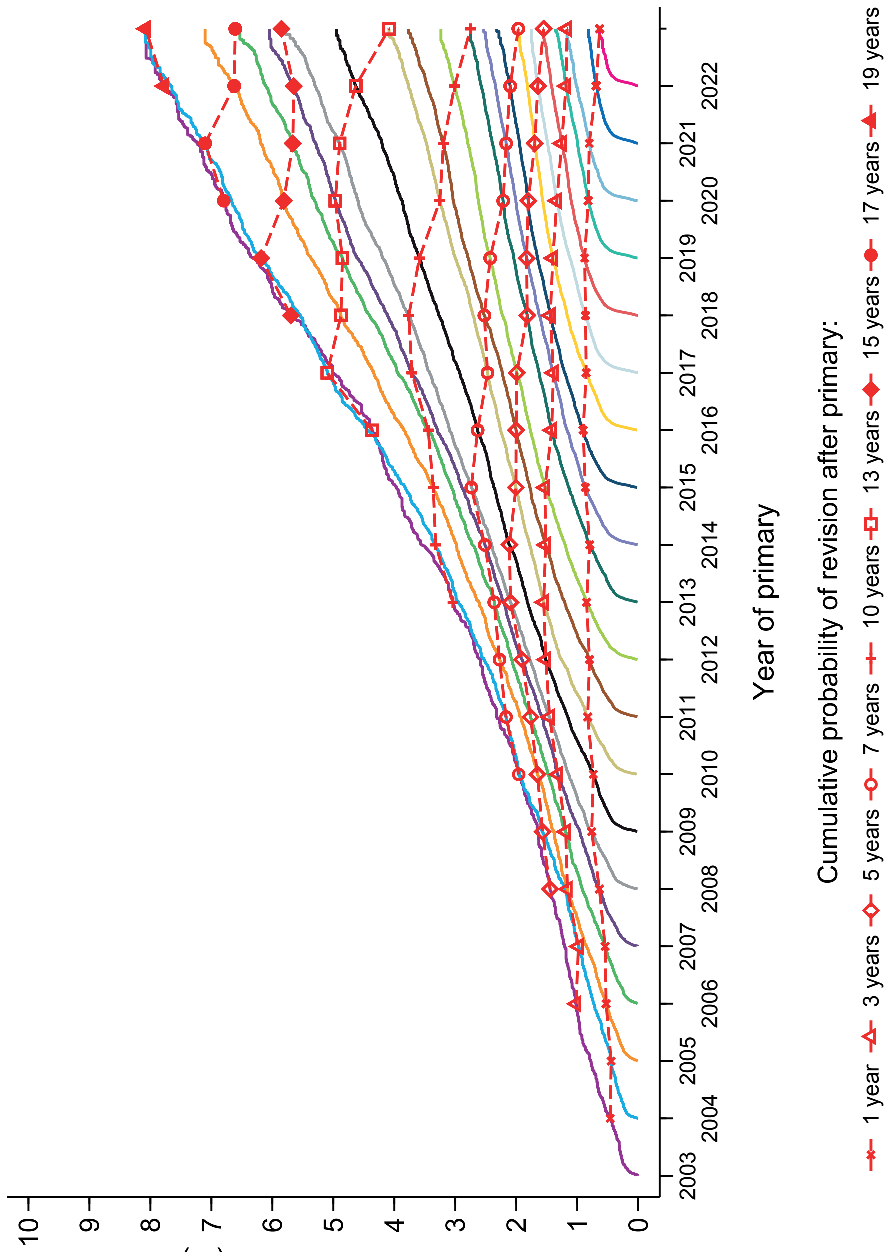


Figure 3.H4 (b) shows the same curves plotted against calendar time, where the origin of each curve is the year of operation. In addition, we have highlighted the revision rate at 1, 3, 5, 7, 10, 13, 15, 17 and 19 years. Figure 3.H4 (b) separates each year, enabling changes in revision estimates over time to be clearly identified. If revision surgery and timing of revision surgery were static across time, it would be expected that all the revision curves would be the same shape and equally spaced; departures from this indicate a change in the number and timing of revision procedures. It is also very clear that the 3, 5, 7, 10 and 13-year rate of revision increases for operations occurring between 2003 and 2008 and then reduces for operations occurring between 2008 and 2022. The early increases may be partly a result of under-reporting in the earlier years of the registry as this wasn't mandatory at that time, but is also contributed to by the usage of metal-on-metal bearings, which peaked in 2008 and then fell (see Table 3.H2 on page 54).

A similar pattern, although smaller in effect, is also observed in knees. Knees were not affected by the high revision rates of metal-on-metal bearings, and thus the decreases observed since 2009 indicate a broader improvement in revision outcomes overall. It appears that this secular decline in revision rate is still ongoing. This improvement suggests the adoption of evidence-based practice to which the NJR's clinician feedback has contributed. For example, for a primary hip replacement performed in 2012, the 10-year revision estimate is 3.0% (95% CI 2.9-3.1) which is below the current NICE recommended threshold of 5% at ten years (NICE, 2014). Prior to 2014, the revision threshold recommended by NICE was 10% at ten years (NICE, 2000).

Figure 3.H4 (c) removes all primary hips with a metal-on-metal bearing from Figure 3.H4 (b). The exclusion of the metal-on-metal bearings illustrates the burden of revision which can be attributed to the revision of metal-on-metal bearings. We now observe a secular decline in the rate of revision in the 3, 5, 7, and 10-year revision estimates originating in 2008-2009 through to the present day which excludes the effect of metal-on-metal bearings.

Table 3.H5 (page 69) provides Kaplan-Meier estimates of the cumulative percentage probability of first revision for any cause, firstly for all cases combined and then by type of fixation and by bearing surface within each fixation group. The table shows updated estimates at 1, 3, 5, 10, 15 and 19 years from the primary operation together with 95% Confidence Intervals (95% CI). Estimates in blue italics indicate time points where 250 or fewer cases remained at risk, meaning that the estimates are less reliable. Kaplan-Meier estimates are not shown at all when the numbers at risk fell below ten cases.

Further revisions in the blue italicised groups would be unlikely (due to such small numbers at risk) and, when they do occur, they may appear to have a disproportionate impact on the Kaplan-Meier estimate, i.e. the step upwards may seem disproportionately large. Furthermore, the upper 95% CI at these time points may be underestimated. Although a number of statistical methods have been proposed to deal with this, they typically give different values and, as yet, there is no clear consensus for the large datasets presented here.

The revision rate of metal-on-polyethylene-on-metal dual mobility bearings appears higher up to five years across all fixation types than that of most of the unipolar bearing combinations, except metal-on-metal. The ceramic-on-polyethylene-on-metal dual mobility bearings show lower revision estimates than the metal-on-polyethylene-on-metal combinations but with overlapping confidence intervals. The relatively small numbers at risk in the dual mobility groups make it difficult to draw firm conclusions yet. The early revision rates for ceramic-on-ceramic resurfacing appear similar to those for metal-on-metal resurfacing which are generally higher than for other unipolar variants. The revision rates at five years appear lower, but the numbers at risk at all time points in the ceramic-on-ceramic resurfacing group are low so this initial report should be treated cautiously.

https://www.nice.org.uk/guidance/ta304
https://www.nice.org.uk/guidance/ta2

Table 3.H5 KM estimates of cumulative revision (95% CI) by fixation and bearing, in primary hip replacements. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Fixation and bearing surface	N	Time since primary: 1 year	3 years	5 years	10 years	15 years	19 years
All cases*	**1,448,541**	**0.80 (0.78-0.81)**	**1.44 (1.42-1.46)**	**2.04 (2.02-2.07)**	**3.89 (3.84-3.93)**	**6.26 (6.18-6.34)**	**8.17 (7.99-8.35)**
All cemented	**432,252**	**0.57 (0.55-0.59)**	**1.08 (1.05-1.11)**	**1.49 (1.46-1.53)**	**2.80 (2.74-2.86)**	**4.95 (4.82-5.08)**	**6.75 (6.47-7.04)**
MoP	368,641	0.58 (0.55-0.60)	1.10 (1.07-1.14)	1.52 (1.48-1.56)	2.87 (2.80-2.94)	5.04 (4.90-5.17)	6.91 (6.60-7.22)
MoM	426	0.71 (0.23-2.18)	1.72 (0.82-3.58)	2.52 (1.36-4.65)	5.70 (3.70-8.74)	*8.22 (5.61-11.97)*	
CoP	59,975	0.51 (0.45-0.57)	0.92 (0.85-1.01)	1.27 (1.18-1.38)	2.21 (2.05-2.38)	4.17 (3.81-4.56)	*5.27 (4.67-5.95)*
MoPoM	2,798	1.10 (0.77-1.59)	1.74 (1.29-2.35)	2.62 (2.00-3.42)	*6.57 (3.39-12.54)*		
CoPoM	392	0.58 (0.14-2.31)	*0.99 (0.31-3.08)*	*0.99 (0.31-3.08)*			
Others	20**	*0*	*0*	*0*	*0*		
All uncemented	**536,411**	**0.93 (0.90-0.95)**	**1.66 (1.63-1.70)**	**2.36 (2.32-2.41)**	**4.45 (4.38-4.53)**	**6.98 (6.84-7.12)**	**9.03 (8.66-9.42)**
MoP	205,001	0.99 (0.95-1.03)	1.57 (1.52-1.63)	1.97 (1.91-2.03)	3.31 (3.21-3.41)	5.64 (5.42-5.88)	8.45 (7.63-9.34)
MoM	29,246	1.06 (0.95-1.19)	3.49 (3.28-3.71)	7.72 (7.41-8.04)	17.77 (17.31-18.23)	22.57 (22.04-23.10)	*25.16 (24.05-26.31)*
CoP	156,359	0.78 (0.74-0.83)	1.27 (1.21-1.33)	1.63 (1.56-1.70)	2.58 (2.46-2.70)	4.03 (3.78-4.29)	5.01 (4.57-5.48)
CoC	141,144	0.95 (0.90-1.00)	1.71 (1.65-1.78)	2.21 (2.13-2.29)	3.31 (3.20-3.41)	4.75 (4.56-4.94)	6.41 (5.72-7.18)
CoM	2,143	0.56 (0.32-0.99)	2.75 (2.13-3.54)	4.80 (3.97-5.81)	8.33 (7.20-9.63)	*11.00 (9.60-12.60)*	
MoPoM	1,369	2.66 (1.92-3.69)	3.30 (2.41-4.52)	3.50 (2.56-4.80)	*3.50 (2.56-4.80)*		
CoPoM	1,030	1.01 (0.55-1.88)	2.25 (1.29-3.92)	*2.25 (1.29-3.92)*			
Others	119**	*3.36 (1.28-8.71)*	*6.81 (3.46-13.15)*	*7.69 (4.08-14.27)*	*15.06 (9.21-24.08)*		
All hybrid	**360,496**	**0.78 (0.76-0.81)**	**1.27 (1.23-1.31)**	**1.70 (1.65-1.75)**	**2.94 (2.86-3.03)**	**4.62 (4.46-4.78)**	**6.47 (6.00-6.99)**
MoP	189,045	0.84 (0.80-0.88)	1.33 (1.28-1.39)	1.76 (1.70-1.83)	2.95 (2.85-3.06)	4.54 (4.34-4.76)	6.38 (5.76-7.07)
MoM	2,448	0.70 (0.43-1.12)	2.67 (2.10-3.40)	5.85 (4.97-6.89)	15.79 (14.31-17.41)	21.10 (19.33-23.02)	*24.82 (22.01-27.92)*
CoP	132,988	0.72 (0.67-0.77)	1.14 (1.08-1.21)	1.46 (1.38-1.53)	2.19 (2.06-2.34)	3.61 (3.20-4.08)	*5.67 (4.52-7.11)*
CoC	27,962	0.61 (0.53-0.71)	1.11 (0.99-1.24)	1.59 (1.44-1.74)	2.66 (2.45-2.87)	3.97 (3.67-4.30)	*5.16 (4.41-6.03)*
MoPoM	5,782	1.23 (0.97-1.56)	1.78 (1.44-2.21)	2.05 (1.64-2.55)	*2.05 (1.64-2.55)*		
CoPoM	2,149	0.81 (0.49-1.32)	1.37 (0.86-2.18)	*1.72 (1.08-2.73)*			
Others	122**	*2.57 (0.83-7.75)*	*2.57 (0.83-7.75)*	*2.57 (0.83-7.75)*	*2.57 (0.83-7.75)*		

*Includes 40,020 with unconfirmed fixation/bearing surface; ** Wide CI because estimates are based on a small group size.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.

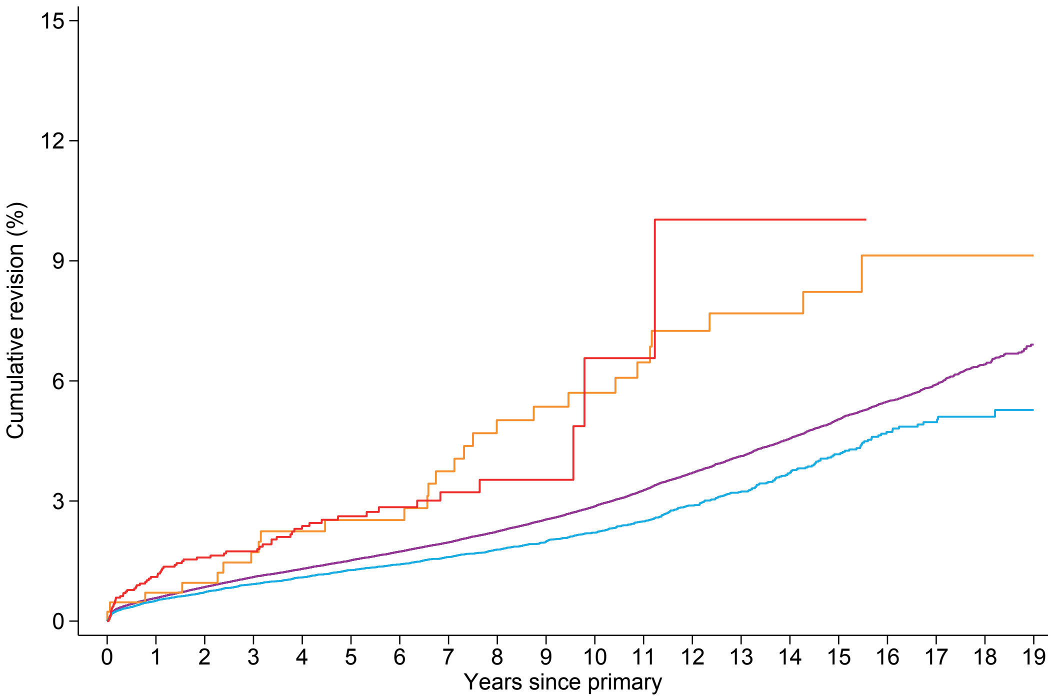
Table 3.H5 (continued)

Fixation and bearing surface	N	Time since primary: 1 year	3 years	5 years	10 years	15 years	19 years
All reverse hybrid	**37,102**	**0.83 (0.74-0.93)**	**1.42 (1.30-1.55)**	**1.89 (1.75-2.05)**	**3.29 (3.05-3.55)**	**6.08 (5.44-6.80)**	*8.75 (6.33-12.03)*
MoP	25,002	0.86 (0.75-0.98)	1.41 (1.27-1.57)	1.87 (1.70-2.06)	3.43 (3.12-3.77)	6.74 (5.85-7.76)	*11.06 (6.84-17.64)*
CoP	11,876	0.75 (0.61-0.93)	1.44 (1.23-1.69)	1.90 (1.65-2.19)	3.01 (2.64-3.44)	4.95 (4.13-5.93)	*5.70 (4.44-7.29)*
Others	224**	*1.39 (0.45-4.24)*	*1.39 (0.45-4.24)*	*3.67 (1.62-8.19)*	*3.67 (1.62-8.19)*	*10.55 (2.90-34.46)*	
All resurfacing	**42,260**	**1.18 (1.08-1.29)**	**2.90 (2.74-3.07)**	**5.06 (4.85-5.28)**	**10.08 (9.78-10.39)**	**13.30 (12.94-13.66)**	**15.04 (14.56-15.53)**
MoM	41,886	1.18 (1.08-1.29)	2.90 (2.74-3.06)	5.06 (4.85-5.28)	10.09 (9.79-10.39)	13.30 (12.94-13.66)	15.04 (14.56-15.54)
CoC	249**	*1.27 (0.41-3.87)*	*1.91 (0.71-5.11)*	*1.91 (0.71-5.11)*			
Others	125**	*1.73 (0.43-6.76)*	*4.94 (2.07-11.55)*	*4.94 (2.07-11.55)*			

*Includes 40,020 with unconfirmed fixation/bearing surface; ** Wide CI because estimates are based on a small group size.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.

Figure 3.H5 KM estimates of cumulative revision in cemented primary hip replacements by bearing.

Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.



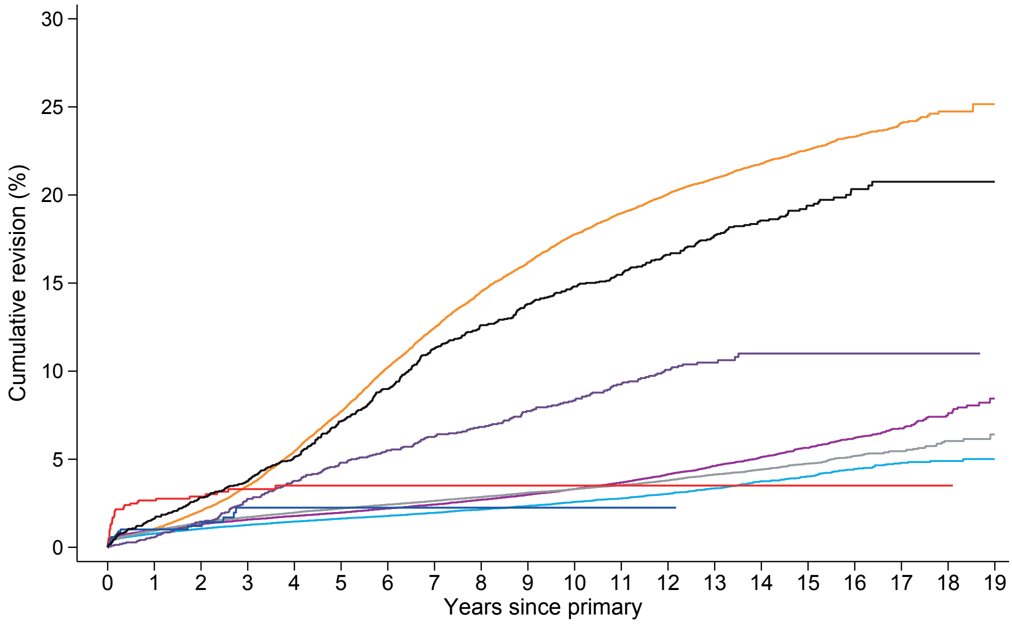
Key: Numbers at risk

MoP	368,641	323,325	275,284	216,732	160,722	110,803	71,742	43,249	20,975	6,628
MoM	426	394	356	328	292	260	*218*	*176*	*81*	*18*
CoP	59,975	48,680	39,839	29,696	20,880	13,525	8,148	4,630	2,256	689
MoPoM	2,798	2,010	1,367	679	*240*	*46*	*16*	*<4*		

Figures 3.H5 to 3.H8 (pages 71 to 75) illustrate the differences between the various bearing surface sub-groups for cemented, uncemented, hybrid and reverse hybrid hips, respectively. Metal-on-metal bearings continue to perform worse than all other options regardless of fixation, apart from in cemented fixation where the results of the rarely used metal-on-metal combination are similar to metal-on-polyethylene-on-metal dual mobility. The revision rates for ceramic-on-polyethylene bearings remain consistently low or equivalent to alternatives across all fixation options out to 15 years and it is encouraging that these are becoming more widely used with time. Dual mobility bearings have higher early revision rates than other options (not including metal-on-metal) for cemented and uncemented fixation, this effect appears to persist in cemented fixation. Although a similar pattern is seen in hybrid fixation, the difference compared to alternatives is smaller. Given the relatively small numbers and the likely case mix selection, these patterns should continue to be monitored.

Figure 3.H6 KM estimates of cumulative revision in uncemented primary hip replacements by bearing.

Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.

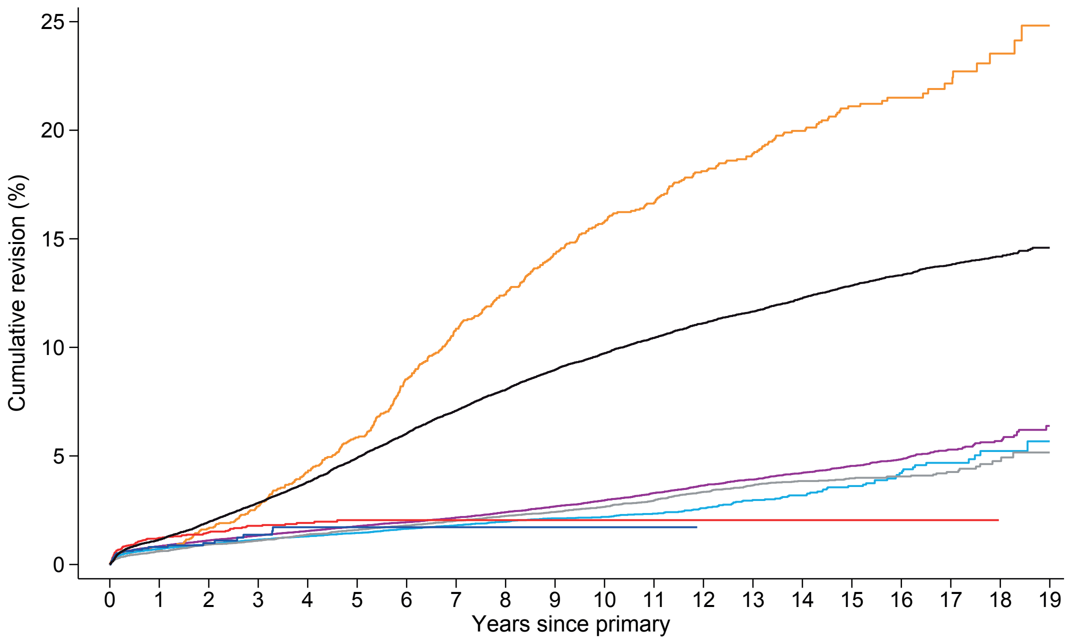


Key:

Numbers at risk

MoP	205,001	174,794	147,444	112,156	79,357	51,217	29,149	14,008	5,470	1,316
MoM	29,246	28,069	26,315	24,040	21,822	19,723	17,532	11,464	3,597	438
CoP	156,359	116,337	88,801	59,672	37,484	22,799	13,409	7,506	3,774	1,171
CoC	141,144	131,305	120,849	105,120	83,994	58,406	31,412	13,147	4,546	1,120
CoM	2,143	2,075	1,969	1,874	1,790	1,647	1,235	*229*	*6*	*<4*
MoPoM	1,369	746	420	*245*	*136*	*69*	*23*	*<4*	*<4*	*<4*
CoPoM	1,030	455	*184*	*62*	*20*	*5*	*<4*			
Resurfacing	2,872	2,671	2,563	2,366	2,252	2,119	1,824	1,199	467	*83*

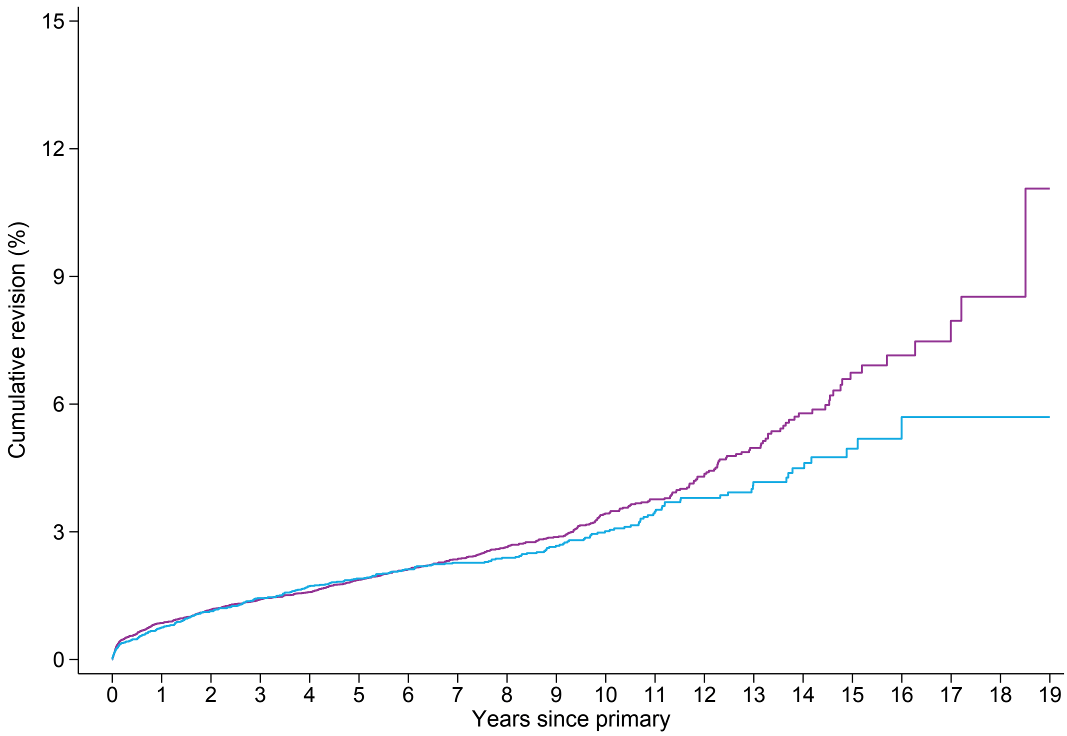
Figure 3.H7 KM estimates of cumulative revision in hybrid primary hip replacements by bearing.
Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.



Key:	Numbers at risk									
MoP	189,045	152,387	120,027	85,953	57,949	37,410	22,949	12,666	5,565	1,557
MoM	2,448	2,341	2,165	1,957	1,757	1,549	1,380	1,039	470	*149*
CoP	132,988	89,091	60,634	34,583	17,343	8,063	4,475	2,325	1,109	357
CoC	27,962	26,599	24,780	21,930	18,208	13,797	9,395	5,677	2,682	567
MoPoM	5,782	3,440	1,783	706	*218*	*47*	*5*	*<4*	*<4*	
CoPoM	2,149	920	368	*111*	*35*	*4*				
Resurfacing	39,386	37,119	35,068	32,874	30,386	27,875	24,532	18,538	9,680	3,155

Figure 3.H8 (a) illustrates the revision rate of metal-on-polyethylene and ceramic-on-polyethylene bearings used with reverse hybrid fixation in primary total hip replacement. Revision rates are similar for the first eleven years, but after this there is a suggestion that outcomes are beginning to diverge with ceramic-on-polyethylene having slightly lower revision estimates. However, more data will be needed to ascertain if this trend represents a meaningful difference.

Figure 3.H8 (a) KM estimates of cumulative revision in reverse hybrid primary hip replacements by bearing.
Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.

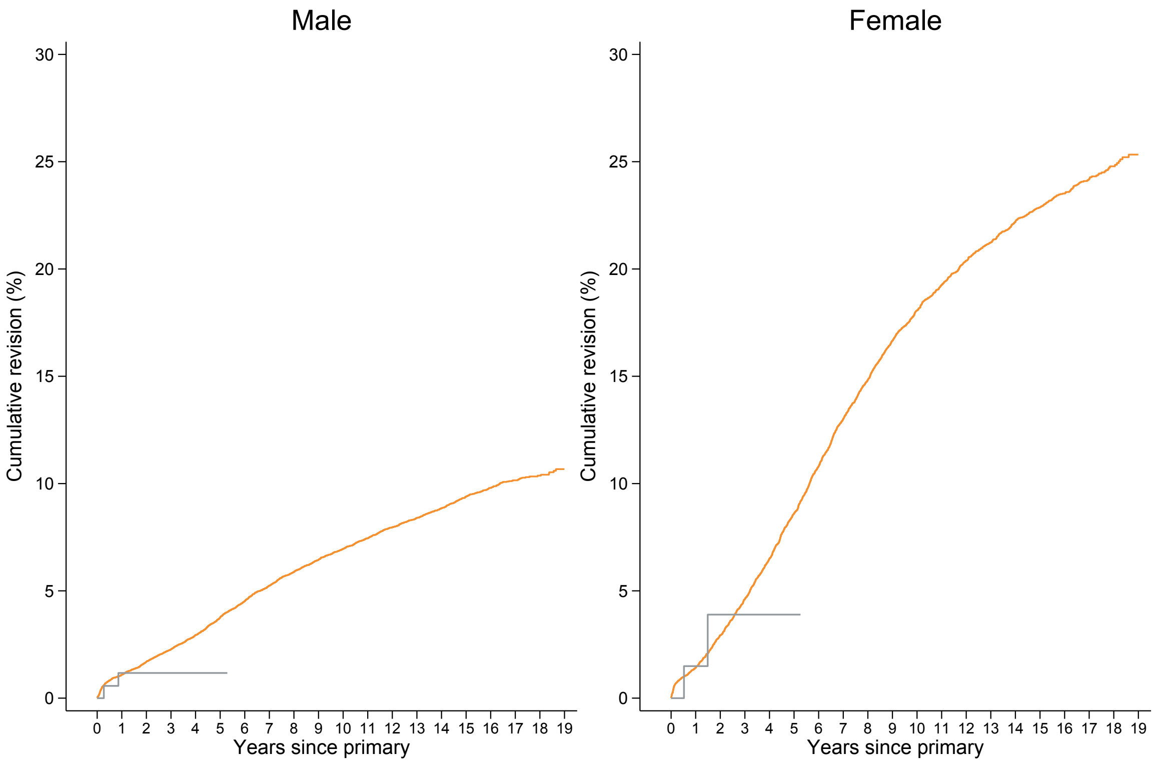


Key: Numbers at risk

Key	0	2	4	6	8	10	12	14	16	18
MoP	25,002	21,278	17,733	12,808	8,495	5,272	2,774	1,160	330	*74*
CoP	11,876	9,905	8,547	6,739	4,733	3,007	1,669	776	*185*	*54*

In Figure 3.H8 (b) we present a comparison between metal-on-metal hip resurfacing and ceramic-on-ceramic hip resurfacing by gender. The numbers of ceramic-on-ceramic resurfacings are very small with very short follow-up and so should be interpreted with utmost caution, but early trajectories between the two groups appear to be broadly similar.

Figure 3.H8 (b) KM estimates of cumulative revision in resurfacing primary hip replacements by bearing and gender. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk – Male

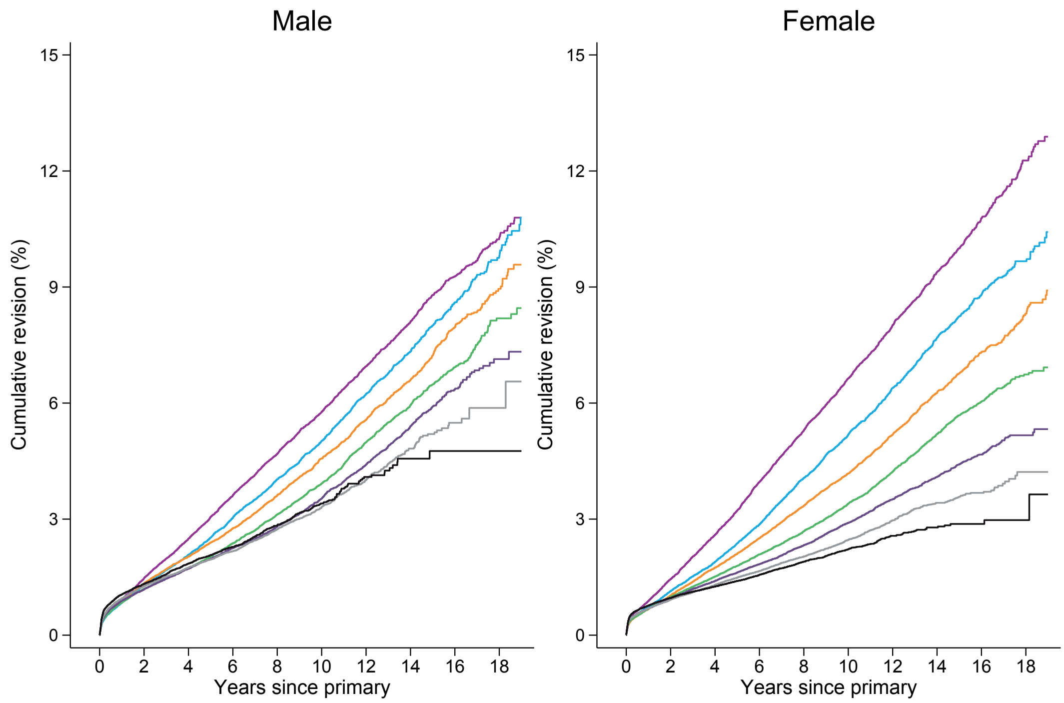
Key	0	2	4	6	8	10	12	14	16	18
MoM	31,081	29,134	27,483	25,775	23,736	21,677	18,717	13,503	6,789	2,163
CoC	*179*	*86*	*56*							

Numbers at risk – Female

Key	0	2	4	6	8	10	12	14	16	18
MoM	10,805	10,453	10,012	9,461	8,900	8,316	7,638	6,233	3,357	1,075
CoC	*70*	*28*	*23*							

In Figure 3.H9 (a), the whole cohort (including those with metal-on-metal bearings) has been sub-divided by age at primary operation and by gender. Across the whole group, there was an inverse relationship between the probability of revision and the age of the patient. A closer look at both genders shows that the variation between the age groups was greater in females than in males; for example, females under 55 years had higher revision rates than their male counterparts in the same age band, whereas females aged 80 years and older had a lower revision rate than their male counterparts.

Figure 3.H9 (a) KM estimates of cumulative revision in all primary hip replacements by gender and age.
Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.



Numbers at risk – Male

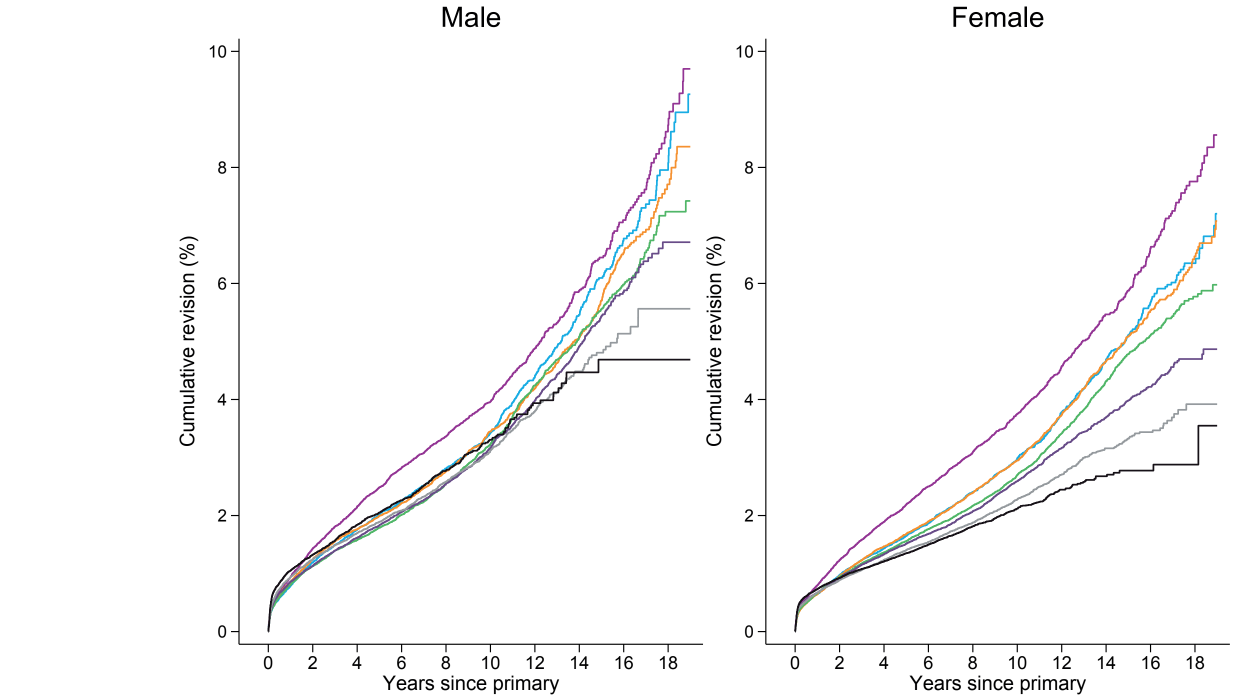
Key:	0	2	4	6	8	10	12	14	16	18
<55y	85,745	73,679	63,396	51,396	40,273	30,208	21,344	13,282	6,433	2,122
55 to 59y	60,191	50,646	43,193	34,766	26,995	20,190	14,256	9,196	4,615	1,417
60 to 64y	82,978	70,173	60,108	48,809	38,202	28,663	19,627	11,715	5,305	1,542
65 to 69y	97,245	82,853	71,079	56,635	42,362	29,533	19,235	11,140	5,022	1,451
70 to 74y	101,405	84,281	69,483	52,741	38,593	26,621	16,582	8,663	3,396	782
75 to 79y	83,429	67,165	53,960	39,520	26,574	16,096	8,512	3,678	1,093	*202*
≥80y	71,126	53,851	39,059	24,236	13,197	6,199	2,486	834	*213*	*39*

Numbers at risk – Female

Key:	0	2	4	6	8	10	12	14	16	18
<55y	86,322	74,006	63,441	50,881	39,324	28,867	19,736	12,117	5,846	1,870
55 to 59y	69,015	58,496	49,945	40,356	31,246	23,436	16,634	10,637	5,408	1,652
60 to 64y	103,958	88,716	76,390	62,026	48,765	36,902	25,335	15,266	6,959	2,126
65 to 69y	141,834	122,027	105,363	84,749	64,119	45,407	30,252	18,084	8,485	2,473
70 to 74y	166,063	139,735	116,588	89,780	66,661	46,715	30,094	16,545	6,960	1,756
75 to 79y	149,040	122,766	101,486	76,965	54,209	35,197	20,580	10,084	3,580	707
≥80y	150,190	120,571	93,565	63,834	39,394	21,397	9,908	3,831	1,061	*167*

In Figure 3.H9 (b), primary total hip replacements with metal-on-metal (or unconfirmed) bearing surfaces and resurfacings have been excluded. The revision rates for the younger females are noticeably lower compared to the data in Figure 3.H9 (a) which includes metal-on-metal bearings; an age trend is seen in both genders but rates for females are lower than for males across the entire age spectrum. The age-mediated disparity in revision rates for females appears to be increasing with longer follow-up.

Figure 3.H9 (b) KM estimates of cumulative revision in all primary hip replacements by gender and age, excluding metal-on-metal hip replacement, unclassified replacements, and resurfacing. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk – Male

Key	0	2	4	6	8	10	12	14	16	18
<55y	64,513	53,819	44,805	34,043	24,288	15,631	8,769	4,522	2,301	805
55 to 59y	49,220	40,318	33,430	25,653	18,588	12,483	7,525	4,342	2,223	732
60 to 64y	72,031	59,833	50,356	39,678	29,734	20,885	12,933	7,150	3,381	1,049
65 to 69y	89,462	75,600	64,257	50,401	36,750	24,561	15,107	8,510	3,994	1,216
70 to 74y	96,026	79,459	65,102	48,859	35,212	23,749	14,354	7,361	2,957	686
75 to 79y	79,900	64,143	51,329	37,297	24,815	14,745	7,566	3,240	981	*185*
≥80y	68,180	51,594	37,347	23,026	12,400	5,738	2,236	745	*191*	*32*

Numbers at risk – Female

Key	0	2	4	6	8	10	12	14	16	18
<55y	75,122	63,419	53,491	41,690	30,820	21,063	12,791	6,800	3,217	1,072
55 to 59y	62,045	51,896	43,688	34,556	25,927	18,515	12,232	7,231	3,737	1,191
60 to 64y	96,330	81,510	69,627	55,812	43,078	31,707	20,822	12,045	5,650	1,803
65 to 69y	134,737	115,435	99,226	79,138	59,122	41,005	26,618	15,668	7,476	2,256
70 to 74y	159,449	133,731	111,156	85,012	62,477	43,200	27,344	14,964	6,438	1,669
75 to 79y	143,371	117,793	97,156	73,259	51,190	32,817	18,933	9,238	3,346	676
≥80y	143,737	115,386	89,488	60,886	37,360	20,126	9,232	3,585	1,015	*166*

Table 3.H6 (page 78) further expands Table 3.H5 (page 69) to show separate estimates for males and females within each of four age bands, <55, 55 to 64, 65 to 74 and ≥75 years. Estimates are shown at 1, 3, 5, 10, 15 and 19 years after the primary operation. These estimates refine results shown in earlier reports, but now with larger numbers of cases and therefore generally narrower confidence intervals. The relatively good results obtained with ceramic-on-ceramic and ceramic-on-polyethylene bearings in younger patients are striking. Resurfacing hip replacement continues to show high revision rates in all groups, especially females. Even in males under 55 years of age, metal-on-metal resurfacing has twice the revision rate of some alternatives out to 15 years. Dual mobility age and gender sub-groups are too small at this stage to provide firm conclusions on relative revision rates.

Table 3.H6 KM estimates of cumulative revision (95% CI) of primary hip replacements by gender, age group, fixation and bearing. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Fixation and bearing surface	Age at primary (years)	Male								Female							
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
All cases	<55	85,745	0.92 (0.86-0.99)	1.98 (1.88-2.08)	3.05 (2.93-3.18)	5.77 (5.58-5.97)	8.79 (8.49-9.10)	10.79 (10.24-11.38)	86,322	0.89 (0.83-0.95)	2.03 (1.93-2.13)	3.22 (3.10-3.35)	6.64 (6.43-6.85)	10.00 (9.67-10.34)	12.89 (12.22-13.58)
All cemented	<55	5,752	0.75 (0.55-1.01)	1.75 (1.43-2.14)	2.36 (1.98-2.82)	4.23 (3.62-4.93)	8.20 (7.02-9.57)	*13.05 (10.69-15.89)*	8,986	0.66 (0.51-0.85)	1.44 (1.21-1.72)	2.12 (1.83-2.47)	4.25 (3.75-4.81)	7.60 (6.67-8.64)	*10.67 (8.88-12.79)*
MoP	<55	2,227	0.96 (0.63-1.47)	2.35 (1.79-3.09)	3.07 (2.41-3.91)	5.50 (4.50-6.71)	10.80 (9.01-12.91)	*16.53 (13.40-20.31)*	3,902	0.87 (0.62-1.21)	1.89 (1.49-2.39)	2.56 (2.09-3.14)	5.17 (4.41-6.05)	8.90 (7.67-10.33)	*12.75 (10.45-15.50)*
CoP	<55	3,451	0.59 (0.38-0.92)	1.35 (1.00-1.82)	1.89 (1.46-2.45)	3.20 (2.53-4.04)	*5.32 (4.02-7.02)*	*7.54 (5.30-10.67)*	4,963	0.45 (0.30-0.69)	1.03 (0.77-1.37)	1.70 (1.35-2.14)	3.32 (2.71-4.07)	6.09 (4.74-7.81)	*6.82 (5.21-8.89)*
MoPoM	<55	50	*2.04 (0.29-13.62)*	*2.04 (0.29-13.62)*	*2.04 (0.29-13.62)*				90	*3.90 (1.27-11.64)*	*5.40 (2.05-13.82)*	*7.29 (3.06-16.87)*			
CoPoM	<55	11							15	*0.00 (.-.)*					
All uncemented	<55	46,795	0.97 (0.88-1.06)	2.05 (1.92-2.19)	3.10 (2.93-3.27)	5.73 (5.46-6.01)	8.84 (8.35-9.37)	*10.89 (9.78-12.12)*	48,812	0.89 (0.81-0.98)	1.92 (1.80-2.05)	2.96 (2.80-3.12)	5.66 (5.40-5.93)	8.37 (7.94-8.82)	*11.51 (10.44-12.67)*
MoP	<55	6,100	0.94 (0.73-1.22)	1.77 (1.46-2.15)	2.47 (2.07-2.93)	4.19 (3.57-4.92)	6.77 (5.56-8.22)	*12.41 (8.11-18.75)*	7,247	0.95 (0.75-1.20)	1.71 (1.43-2.05)	2.38 (2.03-2.79)	3.88 (3.34-4.51)	6.94 (5.80-8.30)	*12.10 (9.23-15.78)*
MoM	<55	3,321	0.72 (0.49-1.08)	3.56 (2.98-4.25)	7.69 (6.83-8.66)	17.59 (16.31-18.95)	22.52 (21.06-24.07)	*24.29 (22.50-26.19)*	2,411	1.91 (1.44-2.54)	5.93 (5.05-6.95)	12.91 (11.63-14.33)	27.03 (25.28-28.87)	32.86 (30.98-34.83)	*35.78 (33.38-38.31)*
CoP	<55	14,990	1.01 (0.86-1.19)	1.72 (1.51-1.96)	2.31 (2.04-2.60)	3.41 (2.96-3.92)	5.43 (4.33-6.79)	*6.70 (5.16-8.67)*	15,136	0.88 (0.74-1.04)	1.48 (1.29-1.71)	1.99 (1.75-2.26)	3.11 (2.70-3.59)	5.42 (4.42-6.64)	*9.53 (6.87-13.13)*
CoC	<55	21,924	0.97 (0.85-1.11)	2.01 (1.83-2.21)	2.78 (2.56-3.01)	4.13 (3.84-4.44)	6.07 (5.47-6.73)	*6.72 (5.95-7.59)*	23,488	0.78 (0.68-0.90)	1.71 (1.55-1.89)	2.34 (2.15-2.55)	3.92 (3.64-4.21)	5.02 (4.60-5.47)	*6.44 (5.47-7.56)*
CoM	<55	191	*1.05 (0.26-4.14)*	*4.75 (2.50-8.93)*	*7.98 (4.89-12.89)*	*12.43 (8.44-18.12)*			267	0.00 (.-.)	4.89 (2.87-8.27)	*8.72 (5.88-12.84)*	*12.23 (8.81-16.85)*		
MoPoM	<55	67	*3.13 (0.79-11.98)*	*3.13 (0.79-11.98)*	*5.83 (1.83-17.72)*				123	*0.82 (0.12-5.68)*	*0.82 (0.12-5.68)*	*0.82 (0.12-5.68)*			
CoPoM	<55	186	*1.14 (0.28-4.47)*	*2.44 (0.72-8.12)*	*2.44 (0.72-8.12)*				123	*1.65 (0.41-6.42)*	*5.43 (1.90-15.04)*	*5.43 (1.90-15.04)*			
Others	<55	16	*0.00 (.-.)*	*6.67 (0.97-38.74)*	*6.67 (0.97-38.74)*				17	*5.88 (0.85-34.98)*	*11.76 (3.08-39.40)*	*11.76 (3.08-39.40)*	*23.98 (9.73-52.04)*		
All hybrid	<55	14,559	0.88 (0.74-1.05)	1.49 (1.30-1.71)	2.09 (1.84-2.36)	4.15 (3.70-4.64)	7.67 (6.73-8.73)	*10.72 (8.79-13.03)*	18,494	0.76 (0.64-0.90)	1.41 (1.24-1.60)	1.96 (1.75-2.19)	3.68 (3.32-4.08)	5.97 (5.32-6.71)	*7.99 (6.55-9.73)*
MoP	<55	2,086	1.61 (1.15-2.26)	2.49 (1.89-3.29)	3.37 (2.63-4.31)	5.95 (4.78-7.41)	*8.88 (6.90-11.39)*	*16.62 (11.29-24.09)*	2,903	0.77 (0.51-1.17)	1.79 (1.35-2.37)	2.29 (1.78-2.95)	4.13 (3.31-5.15)	8.33 (6.60-10.48)	*9.32 (7.34-11.79)*
MoM	<55	291	0.00 (.-.)	2.44 (1.17-5.05)	4.57 (2.68-7.73)	*16.15 (12.32-21.03)*	*25.20 (20.37-30.94)*		211	*1.90 (0.72-4.99)*	*3.82 (1.93-7.50)*	*8.67 (5.55-13.41)*	*21.22 (16.19-27.53)*	*24.23 (18.80-30.90)*	

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.H6 (continued)

Fixation and bearing surface	Age at primary (years)	Male							Female						
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
CoP	<55	8,521	0.85 (0.67-1.07)	1.33 (1.09-1.62)	1.76 (1.46-2.13)	2.68 (2.19-3.29)	5.55 (3.66-8.39)	8.31 (4.82-14.15)	10,230	0.78 (0.62-0.97)	1.33 (1.11-1.59)	1.68 (1.42-1.99)	2.81 (2.32-3.40)	3.98 (2.96-5.36)	9.14 (3.83-20.98)
CoC	<55	3,361	0.57 (0.36-0.89)	1.15 (0.84-1.58)	1.74 (1.34-2.25)	3.14 (2.55-3.86)	5.43 (4.38-6.72)	6.92 (4.91-9.70)	4,794	0.59 (0.41-0.85)	1.10 (0.84-1.44)	1.70 (1.37-2.12)	3.09 (2.59-3.68)	4.75 (4.00-5.64)	6.38 (4.63-8.78)
MoPoM	<55	141	1.43 (0.36-5.59)	2.34 (0.75-7.14)	2.34 (0.75-7.14)				226	2.29 (0.96-5.43)	2.93 (1.32-6.47)	2.93 (1.32-6.47)			
CoPoM	<55	151	0.68 (0.10-4.70)	0.68 (0.10-4.70)	0.68 (0.10-4.70)				121	0.00 (-.-)	1.92 (0.27-12.88)	1.92 (0.27-12.88)			
All reverse hybrid	<55	1,028	1.09 (0.60-1.95)	2.18 (1.43-3.33)	2.82 (1.93-4.13)	5.28 (3.73-7.45)	10.46 (6.96-15.58)		1,467	0.99 (0.59-1.66)	1.68 (1.12-2.52)	2.50 (1.77-3.52)	3.39 (2.43-4.72)	7.08 (4.68-10.66)	
MoP	<55	194	0.54 (0.08-3.77)	3.99 (1.92-8.19)	4.64 (2.34-9.08)	8.07 (4.37-14.65)	15.59 (8.42-27.87)		299	0.36 (0.05-2.51)	1.11 (0.36-3.40)	2.43 (1.09-5.35)	3.69 (1.82-7.39)	7.25 (3.36-15.27)	
CoP	<55	819	1.24 (0.67-2.28)	1.79 (1.06-3.00)	2.44 (1.54-3.85)	4.66 (3.06-7.06)	9.03 (5.33-15.09)		1,148	1.17 (0.68-2.01)	1.86 (1.20-2.87)	2.56 (1.74-3.74)	3.37 (2.31-4.91)	7.26 (4.36-11.95)	
Others	<55	15		0.00 (-.-)	0.00 (-.-)				20		0.00 (-.-)	0.00 (-.-)			
All resurfacing	<55	15,180	0.82 (0.69-0.98)	2.11 (1.89-2.35)	3.73 (3.43-4.05)	7.11 (6.69-7.56)	9.71 (9.18-10.27)	10.81 (10.11-11.55)	5,731	1.24 (0.98-1.56)	4.97 (4.43-5.56)	9.15 (8.42-9.93)	19.48 (18.47-20.54)	24.37 (23.25-25.55)	26.75 (25.37-28.19)
MoM	<55	15,065	0.81 (0.68-0.97)	2.10 (1.88-2.35)	3.72 (3.42-4.05)	7.11 (6.68-7.56)	9.71 (9.17-10.27)	10.80 (10.11-11.55)	5,650	1.24 (0.98-1.56)	4.96 (4.43-5.56)	9.16 (8.44-9.95)	19.48 (18.47-20.55)	24.38 (23.25-25.55)	26.75 (25.38-28.19)
CoC	<55	99	1.11 (0.16-7.63)	1.11 (0.16-7.63)					42	2.56 (0.37-16.84)	6.46 (1.60-24.14)				
Others	<55	16	7.69 (1.12-43.36)						39	0.00 (-.-)	4.00 (0.57-25.16)	4.00 (0.57-25.16)			
All cases	55 to 64	143,169	0.88 (0.83-0.93)	1.70 (1.63-1.77)	2.45 (2.36-2.53)	4.75 (4.61-4.90)	7.55 (7.32-7.79)	10.12 (9.60-10.67)	172,973	0.69 (0.66-0.73)	1.44 (1.38-1.50)	2.21 (2.14-2.29)	4.58 (4.45-4.70)	7.35 (7.14-7.56)	9.52 (9.07-9.99)
All cemented	55 to 64	19,209	0.70 (0.59-0.83)	1.45 (1.28-1.63)	1.94 (1.75-2.16)	3.81 (3.49-4.15)	7.26 (6.67-7.89)	10.18 (9.17-11.30)	32,511	0.47 (0.40-0.55)	1.02 (0.91-1.14)	1.57 (1.44-1.72)	3.24 (3.01-3.48)	6.38 (5.95-6.83)	9.08 (8.23-10.00)
MoP	55 to 64	11,632	0.71 (0.58-0.89)	1.68 (1.46-1.94)	2.24 (1.98-2.54)	4.46 (4.05-4.92)	8.26 (7.56-9.04)	11.49 (10.30-12.79)	20,842	0.53 (0.44-0.64)	1.20 (1.06-1.36)	1.85 (1.67-2.05)	3.72 (3.44-4.03)	7.06 (6.56-7.59)	9.95 (9.01-10.98)
MoM	55 to 64	27		0.00 (-.-)	0.00 (-.-)	0.00 (-.-)			53	1.89 (0.27-12.65)	1.89 (0.27-12.65)	1.89 (0.27-12.65)	6.11 (2.01-17.79)	10.58 (4.53-23.65)	
CoP	55 to 64	7,440	0.69 (0.52-0.91)	1.06 (0.85-1.33)	1.42 (1.16-1.74)	2.43 (2.02-2.92)	4.67 (3.68-5.91)	5.61 (4.34-7.24)	11,406	0.35 (0.26-0.48)	0.67 (0.53-0.85)	1.02 (0.83-1.24)	2.04 (1.72-2.43)	4.25 (3.50-5.16)	5.64 (4.21-7.53)
MoPoM	55 to 64	98	0.00 (-.-)	1.32 (0.19-8.97)	3.29 (0.81-12.87)				182	0.65 (0.09-4.52)	0.65 (0.09-4.52)	1.60 (0.39-6.42)			
CoPoM	55 to 64	11	0.00 (-.-)						28	0.00 (-.-)	0.00 (-.-)				

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.H6 (continued)

Fixation and bearing surface	Age at primary (years)	Male							Female						
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
All uncemented	55 to 64	75,432	0.85 (0.78-0.92)	1.69 (1.60-1.79)	2.45 (2.34-2.58)	4.95 (4.75-5.16)	7.78 (7.43-8.15)	10.54 (9.46-11.74)	83,895	0.75 (0.69-0.81)	1.54 (1.45-1.63)	2.33 (2.22-2.45)	4.73 (4.55-4.91)	7.33 (7.02-7.64)	9.19 (8.45-10.00)
MoP	55 to 64	18,107	0.90 (0.77-1.05)	1.74 (1.55-1.95)	2.23 (2.01-2.47)	3.97 (3.61-4.36)	7.06 (6.31-7.90)	11.56 (9.47-14.06)	22,329	0.72 (0.61-0.84)	1.48 (1.33-1.66)	1.84 (1.66-2.03)	3.33 (3.05-3.64)	5.93 (5.37-6.53)	9.18 (7.23-11.61)
MoM	55 to 64	5,215	0.85 (0.63-1.14)	3.04 (2.61-3.55)	6.62 (5.97-7.34)	16.46 (15.46-17.53)	21.45 (20.29-22.67)	23.57 (21.92-25.33)	4,895	0.92 (0.69-1.23)	3.83 (3.33-4.41)	9.39 (8.60-10.25)	22.52 (21.35-23.74)	27.78 (26.49-29.12)	30.16 (28.24-32.18)
CoP	55 to 64	26,383	0.76 (0.66-0.87)	1.26 (1.13-1.42)	1.64 (1.47-1.82)	2.74 (2.44-3.07)	4.29 (3.68-5.01)	5.02 (4.21-5.98)	28,854	0.61 (0.53-0.71)	1.10 (0.98-1.24)	1.46 (1.31-1.63)	2.54 (2.28-2.84)	3.90 (3.40-4.47)	4.27 (3.67-4.96)
CoC	55 to 64	25,091	0.90 (0.79-1.02)	1.71 (1.56-1.89)	2.22 (2.04-2.41)	3.43 (3.19-3.70)	4.93 (4.47-5.42)	7.61 (5.27-10.94)	27,039	0.88 (0.78-1.00)	1.52 (1.38-1.68)	1.97 (1.80-2.14)	2.88 (2.67-3.10)	4.22 (3.85-4.61)	5.58 (4.60-6.75)
CoM	55 to 64	315	0.63 (0.16-2.51)	2.90 (1.52-5.49)	5.21 (3.22-8.36)	8.05 (5.46-11.78)			468	0.43 (0.11-1.70)	1.95 (1.02-3.71)	3.27 (1.98-5.36)	6.83 (4.85-9.57)	9.86 (7.29-13.28)	
MoPoM	55 to 64	106	0.98 (0.14-6.76)	2.42 (0.59-9.55)	2.42 (0.59-9.55)				160	1.97 (0.64-6.00)	3.39 (1.19-9.45)	3.39 (1.19-9.45)			
CoPoM	55 to 64	196	0.52 (0.07-3.64)	0.52 (0.07-3.64)	0.52 (0.07-3.64)				133	0.82 (0.12-5.68)	2.50 (0.58-10.41)	2.50 (0.58-10.41)			
Others	55 to 64	19	5.26 (0.76-31.88)	5.26 (0.76-31.88)	5.26 (0.76-31.88)				17			5.88 (0.85-34.98)			
All hybrid	55 to 64	29,246	0.87 (0.77-0.98)	1.49 (1.35-1.64)	2.00 (1.83-2.19)	3.42 (3.13-3.73)	5.70 (5.15-6.29)	8.97 (7.51-10.71)	42,674	0.58 (0.51-0.66)	1.11 (1.01-1.22)	1.56 (1.43-1.70)	3.05 (2.82-3.28)	4.65 (4.29-5.04)	6.15 (5.17-7.32)
MoP	55 to 64	7,816	1.06 (0.85-1.31)	1.78 (1.50-2.11)	2.36 (2.03-2.75)	3.80 (3.30-4.37)	5.90 (5.07-6.86)	10.36 (8.04-13.31)	12,915	0.73 (0.59-0.89)	1.22 (1.04-1.43)	1.75 (1.52-2.00)	3.35 (2.99-3.76)	5.45 (4.85-6.12)	7.27 (5.71-9.23)
MoM	55 to 64	371	0.54 (0.14-2.14)	4.14 (2.52-6.77)	7.24 (4.99-10.46)	16.13 (12.65-20.45)	22.92 (18.67-27.97)		405	0.50 (0.12-1.97)	3.28 (1.92-5.59)	7.98 (5.68-11.16)	22.24 (18.34-26.82)	27.66 (23.34-32.59)	29.96 (24.85-35.83)
CoP	55 to 64	16,132	0.80 (0.67-0.95)	1.29 (1.12-1.50)	1.61 (1.40-1.85)	2.53 (2.12-3.02)	4.55 (3.35-6.17)	5.08 (3.61-7.10)	22,235	0.54 (0.45-0.65)	1.02 (0.88-1.17)	1.28 (1.12-1.47)	2.02 (1.73-2.37)	3.24 (2.52-4.17)	4.72 (3.41-6.50)
CoC	55 to 64	4,460	0.68 (0.47-0.96)	1.18 (0.90-1.55)	1.73 (1.38-2.17)	2.75 (2.28-3.33)	4.39 (3.63-5.31)	6.61 (4.53-9.59)	6,500	0.42 (0.29-0.61)	0.99 (0.77-1.26)	1.39 (1.12-1.71)	2.39 (2.02-2.83)	3.05 (2.58-3.59)	3.55 (2.84-4.43)
MoPoM	55 to 64	225	2.90 (1.31-6.34)	2.90 (1.31-6.34)	2.90 (1.31-6.34)				392	1.05 (0.40-2.78)	1.91 (0.83-4.36)	1.91 (0.83-4.36)			
CoPoM	55 to 64	229	1.43 (0.46-4.38)	4.15 (1.78-9.49)	5.62 (2.52-12.29)				210	0.50 (0.07-3.50)	0.50 (0.07-3.50)	2.41 (0.49-11.49)			
Others	55 to 64	13	0.00 (.-)	0.00 (.-)					17	5.88 (0.85-34.98)	5.88 (0.85-34.98)	5.88 (0.85-34.98)	5.88 (0.85-34.98)		

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.H6 (continued)

Fixation and bearing surface	Age at primary (years)	Male							Female						
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
All reverse hybrid	55 to 64	2,979	0.87 (0.59-1.28)	1.71 (1.29-2.28)	2.33 (1.81-3.00)	3.87 (3.03-4.92)	*7.84 (5.73-10.70)*		4,652	0.88 (0.65-1.20)	1.62 (1.28-2.05)	2.16 (1.76-2.66)	3.71 (3.07-4.50)	*6.64 (5.14-8.56)*	*7.52 (5.45-10.33)*
MoP	55 to 64	1,124	0.73 (0.37-1.45)	1.23 (0.72-2.11)	2.09 (1.35-3.24)	4.03 (2.67-6.04)	*9.25 (5.98-14.16)*		1,903	1.18 (0.78-1.78)	1.82 (1.30-2.55)	2.57 (1.91-3.44)	4.57 (3.50-5.96)	*9.25 (6.50-13.09)*	
CoP	55 to 64	1,845	0.96 (0.59-1.53)	2.03 (1.45-2.83)	2.49 (1.83-3.39)	3.78 (2.81-5.10)	*7.06 (4.45-11.12)*		2,730	0.68 (0.43-1.08)	1.50 (1.09-2.07)	1.89 (1.42-2.53)	3.12 (2.37-4.10)	*4.06 (3.02-5.45)*	
Others	55 to 64	10							19	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*			
All resurfacing	55 to 64	12,592	1.18 (1.01-1.39)	2.31 (2.06-2.59)	3.67 (3.34-4.02)	6.77 (6.33-7.25)	9.22 (8.67-9.81)	10.81 (9.97-11.70)	4,431	1.60 (1.27-2.02)	4.36 (3.80-5.01)	8.31 (7.53-9.17)	16.98 (15.89-18.14)	21.67 (20.45-22.97)	*24.26 (22.69-25.92)*
MoM	55 to 64	12,517	1.18 (1.01-1.39)	2.31 (2.05-2.59)	3.66 (3.34-4.01)	6.77 (6.32-7.25)	9.22 (8.67-9.81)	10.80 (9.97-11.70)	4,375	1.62 (1.29-2.05)	4.40 (3.83-5.06)	8.36 (7.58-9.23)	17.03 (15.94-18.19)	21.72 (20.49-23.02)	*24.31 (22.74-25.97)*
CoC	55 to 64	65	*1.56 (0.22-10.58)*	*1.56 (0.22-10.58)*					22	*0.00 (-.-)*					
Others	55 to 64	10							34	*0.00 (-.-)*	*0.00 (-.-)*				
All cases	65 to 74	198,650	0.87 (0.83-0.91)	1.48 (1.42-1.53)	2.01 (1.94-2.07)	3.73 (3.63-3.85)	6.21 (6.00-6.42)	7.98 (7.53-8.46)	307,897	0.69 (0.66-0.72)	1.22 (1.18-1.26)	1.70 (1.65-1.75)	3.14 (3.06-3.22)	5.05 (4.91-5.20)	*6.15 (5.88-6.43)*
All cemented	65 to 74	54,770	0.68 (0.61-0.75)	1.25 (1.16-1.35)	1.74 (1.63-1.86)	3.51 (3.32-3.71)	6.18 (5.83-6.54)	8.01 (7.35-8.73)	104,084	0.48 (0.44-0.52)	1.01 (0.95-1.07)	1.42 (1.34-1.49)	2.66 (2.54-2.78)	4.66 (4.45-4.89)	5.77 (5.39-6.17)
MoP	65 to 74	46,715	0.70 (0.62-0.78)	1.29 (1.19-1.40)	1.79 (1.67-1.93)	3.67 (3.47-3.89)	6.41 (6.05-6.80)	8.21 (7.52-8.96)	89,453	0.47 (0.43-0.52)	1.02 (0.95-1.09)	1.44 (1.36-1.53)	2.74 (2.61-2.87)	4.75 (4.53-4.99)	5.91 (5.51-6.34)
MoM	65 to 74	59	*1.69 (0.24-11.43)*	*3.45 (0.87-13.10)*	*3.45 (0.87-13.10)*	*5.86 (1.89-17.38)*	*9.63 (3.49-25.06)*		104	*0.96 (0.14-6.63)*	*0.96 (0.14-6.63)*	*3.00 (0.98-9.03)*	*6.21 (2.84-13.32)*	*8.82 (4.49-16.96)*	
CoP	65 to 74	7,760	0.54 (0.40-0.74)	0.92 (0.72-1.17)	1.30 (1.05-1.60)	2.15 (1.77-2.62)	3.95 (3.08-5.06)	*6.10 (4.37-8.49)*	13,982	0.52 (0.42-0.66)	0.95 (0.80-1.14)	1.17 (1.00-1.39)	1.87 (1.59-2.20)	3.72 (3.07-4.50)	*4.07 (3.29-5.02)*
MoPoM	65 to 74	203	*1.52 (0.49-4.63)*	*2.79 (1.16-6.62)*	*3.60 (1.61-7.95)*				479	0.89 (0.33-2.35)	0.89 (0.33-2.35)	*1.67 (0.73-3.82)*	*1.67 (0.73-3.82)*		
CoPoM	65 to 74	32	*0.00 (-.-)*	*4.35 (0.62-27.07)*					63	*2.13 (0.30-14.16)*	*2.13 (0.30-14.16)*				
All uncemented	65 to 74	81,245	0.91 (0.84-0.98)	1.56 (1.47-1.65)	2.11 (2.01-2.22)	3.87 (3.70-4.05)	6.49 (6.14-6.86)	*8.42 (7.45-9.52)*	102,476	0.86 (0.80-0.91)	1.47 (1.39-1.55)	2.09 (2.00-2.19)	3.89 (3.74-4.04)	5.94 (5.67-6.22)	*7.14 (6.63-7.69)*
MoP	65 to 74	35,548	0.88 (0.79-0.98)	1.49 (1.37-1.63)	1.85 (1.71-2.01)	3.29 (3.05-3.54)	5.85 (5.30-6.44)	*7.44 (6.34-8.73)*	49,334	0.89 (0.81-0.98)	1.40 (1.30-1.51)	1.78 (1.66-1.91)	3.00 (2.82-3.20)	4.84 (4.48-5.23)	*5.87 (5.20-6.62)*
MoM	65 to 74	4,595	1.07 (0.81-1.41)	2.95 (2.50-3.49)	6.08 (5.42-6.83)	13.65 (12.63-14.74)	17.95 (16.72-19.26)		4,678	1.12 (0.85-1.46)	3.55 (3.05-4.12)	8.62 (7.84-9.48)	19.16 (18.02-20.36)	23.30 (22.00-24.65)	

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.H6 (continued)

Fixation and bearing surface	Age at primary (years)	Male N	Male 1 year	Male 3 years	Male 5 years	Male 10 years	Male 15 years	Male 19 years	Female N	Female 1 year	Female 3 years	Female 5 years	Female 10 years	Female 15 years	Female 19 years
CoP	65 to 74	24,360	0.76 (0.66-0.88)	1.17 (1.04-1.32)	1.40 (1.25-1.58)	2.07 (1.83-2.34)	3.46 (2.86-4.20)	*3.89 (3.15-4.81)*	28,698	0.67 (0.58-0.78)	1.11 (0.99-1.24)	1.41 (1.27-1.57)	2.24 (2.00-2.50)	3.46 (3.01-3.98)	*4.19 (3.49-5.02)*
CoC	65 to 74	16,182	1.12 (0.97-1.30)	1.74 (1.55-1.96)	2.17 (1.95-2.41)	2.93 (2.66-3.22)	4.65 (4.07-5.32)	*7.20 (5.40-9.56)*	18,982	0.92 (0.79-1.06)	1.53 (1.36-1.72)	1.81 (1.62-2.01)	2.49 (2.26-2.74)	3.74 (3.29-4.25)	*5.71 (3.94-8.25)*
CoM	65 to 74	304	1.32 (0.50-3.49)	3.71 (2.07-6.60)	5.13 (3.12-8.36)	*8.95 (6.13-12.98)*			377	0.53 (0.13-2.12)	1.61 (0.73-3.55)	3.52 (2.06-5.99)	7.95 (5.55-11.32)		
MoPoM	65 to 74	120	*0.84 (0.12-5.81)*	*0.84 (0.12-5.81)*	*0.84 (0.12-5.81)*				265	*3.95 (2.14-7.24)*	*5.10 (2.90-8.90)*	*5.10 (2.90-8.90)*	*5.10 (2.90-8.90)*		
CoPoM	65 to 74	127	*0.00 (-.-)*	*2.44 (0.35-16.08)*					118	*0.88 (0.13-6.12)*	*0.88 (0.13-6.12)*	*0.88 (0.13-6.12)*			
Others	65 to 74	9							24	*8.33 (2.15-29.39)*	*12.50 (4.21-33.92)*	*12.50 (4.21-33.92)*	*17.65 (6.96-40.72)*		
All hybrid	**65 to 74**	**48,920**	**0.89 (0.81-0.98)**	**1.43 (1.33-1.55)**	**1.89 (1.76-2.03)**	**3.32 (3.09-3.57)**	**5.21 (4.77-5.68)**	*7.10 (5.92-8.51)*	**83,467**	**0.73 (0.67-0.79)**	**1.14 (1.07-1.22)**	**1.52 (1.43-1.61)**	**2.56 (2.41-2.72)**	**3.81 (3.54-4.10)**	*4.45 (4.03-4.92)*
MoP	65 to 74	25,575	0.96 (0.85-1.09)	1.53 (1.38-1.70)	2.04 (1.86-2.24)	3.60 (3.30-3.93)	5.47 (4.95-6.04)	*6.46 (5.55-7.50)*	46,806	0.77 (0.70-0.86)	1.22 (1.13-1.33)	1.63 (1.51-1.76)	2.69 (2.51-2.90)	3.90 (3.58-4.24)	*4.63 (4.12-5.20)*
MoM	65 to 74	308	0.97 (0.32-2.99)	1.98 (0.90-4.37)	3.78 (2.11-6.72)	*12.81 (9.31-17.49)*	*18.11 (13.57-23.93)*		367	0.82 (0.26-2.52)	1.93 (0.92-4.00)	5.87 (3.87-8.87)	*13.00 (9.83-17.10)*	*16.78 (13.00-21.52)*	
CoP	65 to 74	19,282	0.79 (0.67-0.93)	1.22 (1.06-1.40)	1.54 (1.35-1.76)	2.23 (1.88-2.63)	*3.13 (2.24-4.35)*	*8.42 (4.41-15.79)*	30,766	0.63 (0.55-0.73)	1.00 (0.89-1.13)	1.23 (1.09-1.38)	1.82 (1.59-2.09)	3.24 (2.49-4.22)	*4.05 (2.86-5.72)*
CoC	65 to 74	2,963	0.75 (0.49-1.13)	1.42 (1.05-1.92)	1.92 (1.47-2.50)	2.71 (2.14-3.44)	4.44 (3.49-5.65)		3,988	0.71 (0.49-1.02)	0.94 (0.68-1.30)	1.30 (0.99-1.72)	2.16 (1.71-2.73)	3.03 (2.40-3.83)	
MoPoM	65 to 74	531	2.06 (1.11-3.80)	3.24 (1.91-5.47)	*3.24 (1.91-5.47)*				1,121	1.51 (0.93-2.46)	1.95 (1.24-3.07)	*2.62 (1.60-4.26)*			
CoPoM	65 to 74	242	*1.47 (0.47-4.54)*	*2.40 (0.86-6.61)*	*2.40 (0.86-6.61)*				393	*0.52 (0.13-2.05)*	*0.52 (0.13-2.05)*	*0.52 (0.13-2.05)*			
Others	65 to 74	19	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*				26	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*		
All reverse hybrid	**65 to 74**	**5,515**	**1.00 (0.77-1.31)**	**1.62 (1.30-2.00)**	**2.03 (1.67-2.47)**	**3.52 (2.91-4.24)**	*6.91 (5.21-9.13)*		**9,309**	**0.53 (0.40-0.70)**	**0.98 (0.79-1.21)**	**1.41 (1.17-1.69)**	**2.65 (2.24-3.13)**	**4.76 (3.71-6.09)**	
MoP	65 to 74	3,860	1.17 (0.87-1.56)	1.77 (1.38-2.25)	2.26 (1.81-2.82)	4.11 (3.31-5.09)	*8.86 (6.46-12.10)*		6,834	0.57 (0.41-0.78)	1.01 (0.79-1.29)	1.41 (1.14-1.75)	2.80 (2.32-3.39)	*5.41 (4.03-7.24)*	
CoP	65 to 74	1,641	0.62 (0.33-1.15)	1.27 (0.81-1.99)	1.51 (1.00-2.29)	2.21 (1.51-3.24)	*2.72 (1.69-4.38)*		2,442	0.38 (0.20-0.72)	0.86 (0.55-1.35)	1.36 (0.94-1.97)	2.21 (1.55-3.15)	*3.12 (2.11-4.59)*	
Others	65 to 74	14	*0.00 (-.-)*	*0.00 (-.-)*					33	*3.03 (0.43-19.63)*	*3.03 (0.43-19.63)*	*3.03 (0.43-19.63)*			

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.H6 (continued)

Fixation and bearing surface	Age at primary (years)	Male							Female						
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
All resurfacing	65 to 74	3,286	1.96 (1.54-2.50)	2.91 (2.39-3.56)	4.18 (3.54-4.94)	6.96 (6.10-7.94)	8.49 (7.49-9.62)	*9.33 (8.10-10.75)*	777	1.55 (0.88-2.71)	3.11 (2.09-4.60)	5.76 (4.32-7.66)	13.53 (11.25-16.21)	18.24 (15.52-21.38)	*20.53 (17.30-24.27)*
MoM	65 to 74	3,269	1.97 (1.54-2.51)	2.93 (2.40-3.57)	4.20 (3.55-4.96)	6.98 (6.11-7.96)	8.51 (7.50-9.64)	*9.35 (8.11-10.77)*	751	1.47 (0.82-2.63)	3.07 (2.05-4.59)	5.77 (4.31-7.70)	13.57 (11.28-16.27)	18.30 (15.56-21.46)	*20.58 (17.34-24.34)*
CoC	65 to 74	15	*0.00 (-.-)*						6						
Others	65 to 74	2							20	*5.00 (0.72-30.53)*	*5.00 (0.72-30.53)*				
All cases	≥75	154,555	1.00 (0.95-1.05)	1.54 (1.48-1.61)	2.01 (1.93-2.09)	3.35 (3.22-3.49)	5.14 (4.82-5.47)	*6.29 (5.14-7.70)*	299,230	0.73 (0.70-0.76)	1.12 (1.08-1.16)	1.45 (1.40-1.49)	2.35 (2.28-2.43)	3.33 (3.19-3.48)	*3.99 (3.59-4.42)*
All cemented	≥75	64,048	0.82 (0.76-0.90)	1.36 (1.27-1.46)	1.82 (1.71-1.94)	3.10 (2.91-3.30)	4.53 (4.14-4.95)	*5.02 (4.44-5.68)*	142,892	0.48 (0.44-0.52)	0.85 (0.80-0.90)	1.14 (1.08-1.20)	1.93 (1.84-2.03)	*2.75 (2.57-2.93)*	*3.23 (2.79-3.74)*
MoP	≥75	59,901	0.83 (0.76-0.91)	1.36 (1.27-1.46)	1.83 (1.71-1.95)	3.12 (2.93-3.33)	4.61 (4.21-5.05)	*5.12 (4.52-5.80)*	133,969	0.48 (0.44-0.52)	0.85 (0.80-0.90)	1.14 (1.08-1.20)	1.94 (1.84-2.04)	2.76 (2.58-2.95)	*3.26 (2.81-3.80)*
MoM	≥75	50		*0.00 (-.-)*	*2.27 (0.32-15.06)*	*9.81 (3.17-28.17)*			115	*0.00 (-.-)*	*3.04 (0.99-9.14)*	*3.04 (0.99-9.14)*	*5.88 (2.45-13.76)*	*8.02 (3.54-17.64)*	
CoP	≥75	3,553	0.68 (0.45-1.02)	1.18 (0.85-1.65)	1.53 (1.12-2.08)	1.96 (1.38-2.77)	*1.96 (1.38-2.77)*		7,420	0.42 (0.29-0.60)	0.69 (0.51-0.93)	0.88 (0.66-1.17)	1.38 (1.03-1.84)	*1.91 (1.30-2.80)*	
MoPoM	≥75	482	1.56 (0.75-3.25)	*2.70 (1.49-4.85)*	*4.11 (2.37-7.09)*				1,214	0.86 (0.47-1.60)	1.49 (0.91-2.42)	2.11 (1.35-3.30)	*7.79 (2.15-26.09)*		
CoPoM	≥75	60	*0.00 (-.-)*	*0.00 (-.-)*					172	*0.60 (0.08-4.15)*	*0.60 (0.08-4.15)*	*0.60 (0.08-4.15)*			
All uncemented	≥75	39,767	1.25 (1.15-1.37)	1.80 (1.67-1.94)	2.23 (2.08-2.39)	3.65 (3.40-3.93)	5.89 (5.17-6.70)		57,989	1.22 (1.13-1.31)	1.66 (1.55-1.77)	2.07 (1.95-2.19)	3.38 (3.19-3.58)	5.07 (4.66-5.52)	*5.95 (5.00-7.07)*
MoP	≥75	26,046	1.30 (1.17-1.45)	1.87 (1.71-2.05)	2.23 (2.05-2.43)	3.33 (3.04-3.64)	5.78 (4.75-7.02)		40,290	1.21 (1.11-1.32)	1.59 (1.47-1.72)	1.94 (1.80-2.09)	3.07 (2.85-3.30)	4.83 (4.26-5.46)	
MoM	≥75	1,710	1.01 (0.63-1.62)	1.89 (1.34-2.68)	3.72 (2.88-4.80)	8.59 (7.15-10.31)	*11.18 (9.29-13.43)*		2,421	1.37 (0.98-1.92)	3.15 (2.52-3.94)	5.02 (4.19-6.00)	9.61 (8.38-11.02)	*12.27 (10.75-13.98)*	
CoP	≥75	7,914	1.00 (0.80-1.26)	1.38 (1.14-1.69)	1.73 (1.43-2.10)	2.66 (2.13-3.31)	*4.81 (3.04-7.58)*		10,024	1.03 (0.85-1.25)	1.38 (1.16-1.64)	1.69 (1.43-1.99)	2.60 (2.19-3.08)	*3.15 (2.52-3.93)*	
CoC	≥75	3,719	1.39 (1.06-1.82)	1.97 (1.56-2.48)	2.17 (1.74-2.70)	3.56 (2.91-4.35)	*4.63 (3.51-6.10)*		4,719	1.49 (1.18-1.88)	1.86 (1.50-2.29)	2.08 (1.70-2.54)	2.93 (2.42-3.54)	*4.86 (3.74-6.32)*	
CoM	≥75	88	*0.00 (-.-)*	*0.00 (-.-)*	*2.76 (0.70-10.59)*	*4.26 (1.39-12.63)*			133	*0.00 (-.-)*	*0.78 (0.11-5.37)*	*0.78 (0.11-5.37)*	*1.89 (0.47-7.51)*		
MoPoM	≥75	189	*3.77 (1.82-7.75)*	*3.77 (1.82-7.75)*	*3.77 (1.82-7.75)*	*3.77 (1.82-7.75)*			339	*3.13 (1.69-5.75)*	*3.72 (2.04-6.74)*	*3.72 (2.04-6.74)*	*3.72 (2.04-6.74)*		

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.H6 (continued)

Fixation and bearing surface	Age at primary (years)	Male							Female						
			Time since primary							Time since primary					
		N	1 year	3 years	5 years	10 years	15 years	19 years	N	1 year	3 years	5 years	10 years	15 years	19 years
CoPoM	≥75	89	*2.31 (0.58-8.95)*	*2.31 (0.58-8.95)*					58	*1.72 (0.24-11.62)*	*1.72 (0.24-11.62)*				
Others	≥75	12		*8.33 (1.22-46.10)*					5						
All hybrid	**≥75**	**41,943**	**0.98 (0.89-1.08)**	**1.50 (1.38-1.63)**	**1.97 (1.82-2.13)**	**3.37 (3.07-3.69)**	**4.93 (4.20-5.79)**		**81,193**	**0.74 (0.68-0.80)**	**1.10 (1.03-1.18)**	**1.44 (1.35-1.54)**	**2.08 (1.94-2.24)**	**2.62 (2.36-2.91)**	***3.63 (2.78-4.73)***
MoP	≥75	30,227	0.97 (0.86-1.09)	1.54 (1.40-1.69)	2.03 (1.86-2.22)	3.39 (3.07-3.76)	4.97 (4.20-5.88)		60,717	0.76 (0.69-0.83)	1.13 (1.05-1.22)	1.44 (1.34-1.55)	2.10 (1.94-2.27)	2.68 (2.39-3.01)	*3.82 (2.87-5.07)*
MoM	≥75	188	*0.53 (0.08-3.73)*	*1.12 (0.28-4.41)*	*1.73 (0.56-5.29)*	*10.01 (5.72-17.22)*	*10.01 (5.72-17.22)*		307	0.66 (0.16-2.60)	2.01 (0.91-4.43)	*4.73 (2.77-8.03)*	*9.48 (6.37-14.00)*	*9.48 (6.37-14.00)*	
CoP	≥75	9,569	1.02 (0.83-1.25)	1.37 (1.13-1.66)	1.76 (1.47-2.11)	2.66 (2.09-3.38)	*4.69 (1.99-10.83)*		16,253	0.70 (0.58-0.85)	0.97 (0.82-1.15)	1.38 (1.17-1.63)	1.69 (1.37-2.09)	*2.07 (1.39-3.09)*	
CoC	≥75	654	1.40 (0.73-2.67)	1.57 (0.85-2.90)	1.96 (1.12-3.44)	*3.17 (1.82-5.51)*	*4.58 (2.25-9.21)*		1,242	0.57 (0.27-1.19)	0.83 (0.45-1.54)	1.15 (0.67-1.98)	1.63 (0.98-2.70)	*1.63 (0.98-2.70)*	
MoPoM	≥75	985	1.09 (0.58-2.01)	1.60 (0.92-2.79)	*1.60 (0.92-2.79)*				2,161	0.67 (0.40-1.14)	1.10 (0.69-1.75)	1.46 (0.93-2.28)	*1.46 (0.93-2.28)*		
CoPoM	≥75	306	*0.66 (0.17-2.61)*	*0.66 (0.17-2.61)*	*0.66 (0.17-2.61)*				497	0.89 (0.33-2.36)	*0.89 (0.33-2.36)*	*0.89 (0.33-2.36)*			
Others	≥75	14	*0.00 (.-)*						16	*7.14 (1.04-40.92)*	*7.14 (1.04-40.92)*				
All reverse hybrid	**≥75**	**4,272**	**1.09 (0.81-1.45)**	**1.80 (1.43-2.27)**	**2.42 (1.96-2.99)**	**3.80 (2.99-4.82)**	***5.35 (3.96-7.21)***		**7,880**	**0.81 (0.63-1.04)**	**1.23 (1.00-1.51)**	**1.52 (1.26-1.84)**	**2.84 (2.35-3.42)**	***4.40 (3.42-5.64)***	
MoP	≥75	3,800	1.14 (0.84-1.54)	1.87 (1.47-2.38)	2.46 (1.97-3.06)	3.82 (2.97-4.91)	*5.64 (4.07-7.78)*		6,988	0.79 (0.60-1.02)	1.22 (0.98-1.52)	1.47 (1.20-1.81)	2.83 (2.31-3.47)	*4.23 (3.19-5.60)*	
CoP	≥75	434	0.73 (0.24-2.24)	1.34 (0.55-3.20)	*2.00 (0.95-4.18)*	*3.54 (1.62-7.64)*			817	0.86 (0.41-1.80)	1.15 (0.60-2.20)	1.48 (0.82-2.67)	*2.51 (1.46-4.27)*	*5.00 (2.88-8.63)*	
Others	≥75	38	*0.00 (.-)*	*0.00 (.-)*	*5.88 (0.85-34.98)*				75	*2.86 (0.72-10.97)*	*2.86 (0.72-10.97)*	*9.17 (3.29-24.18)*			
All resurfacing	**≥75**	**231**	***2.18 (0.91-5.16)***	***3.15 (1.51-6.51)***	***4.72 (2.56-8.63)***	***7.12 (4.25-11.79)***	***9.38 (5.10-16.92)***		**32**	***3.13 (0.45-20.18)***	***6.47 (1.65-23.49)***	***6.47 (1.65-23.49)***	***11.66 (3.76-33.02)***		
MoM	≥75	230	*2.19 (0.92-5.18)*	*3.17 (1.52-6.54)*	*4.74 (2.57-8.65)*	*7.13 (4.26-11.81)*	*9.40 (5.11-16.93)*		29	*3.45 (0.49-22.05)*	*7.16 (1.84-25.75)*	*7.16 (1.84-25.75)*	*12.32 (4.04-34.21)*		

Note: All cases includes unconfirmed hip types.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Rows with no data or only zeros have been suppressed.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

3.2.3 Revisions after primary hip replacement: effect of head size for selected bearing surfaces / fixation sub-groups

This section looks at the effect of head size on the probability of revision following primary hip replacement. Fixation and bearing combinations with greater than 10,000 uses are included and head sizes with fewer than 500 implantations within each group are excluded.

This gave us 12 groups:

a) Metal-on-polyethylene cemented hip constructs n=368,603

b) Ceramic-on-polyethylene cemented hip constructs n=59,974

c) Metal-on-polyethylene uncemented hip constructs n=204,446

d) Metal-on-metal uncemented hip constructs n=28,762

e) Ceramic-on-polyethylene uncemented hip constructs n=155,777

f) Ceramic-on-ceramic uncemented hip constructs n=140,897

g) Metal-on-polyethylene hybrid hip constructs n=188,852

h) Ceramic-on-polyethylene hybrid hip constructs n=132,781

i) Ceramic-on-ceramic hybrid hip constructs n=27,430

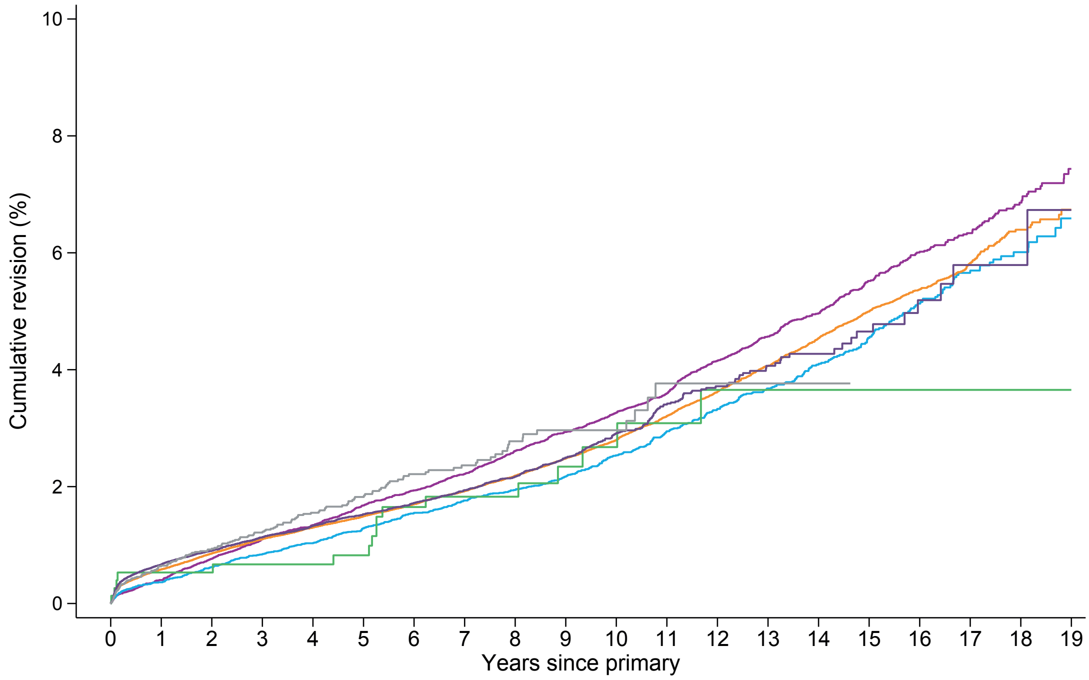
j) Metal-on-polyethylene reverse hybrid hip constructs n=24,189

k) Ceramic-on-polyethylene reverse hybrid hip constructs n=11,875

l) Metal-on-metal resurfacing n=41,262

Figures 3.H10 (a) to 3.H10 (l) (pages 86 to 97) show respective percentage cumulative probabilities of revision (Kaplan-Meier estimates) for various head sizes, for each of the groups with follow-up up to 19 years following the primary hip replacement.

Figure 3.H10 (a) KM estimates of cumulative revision of primary cemented MoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

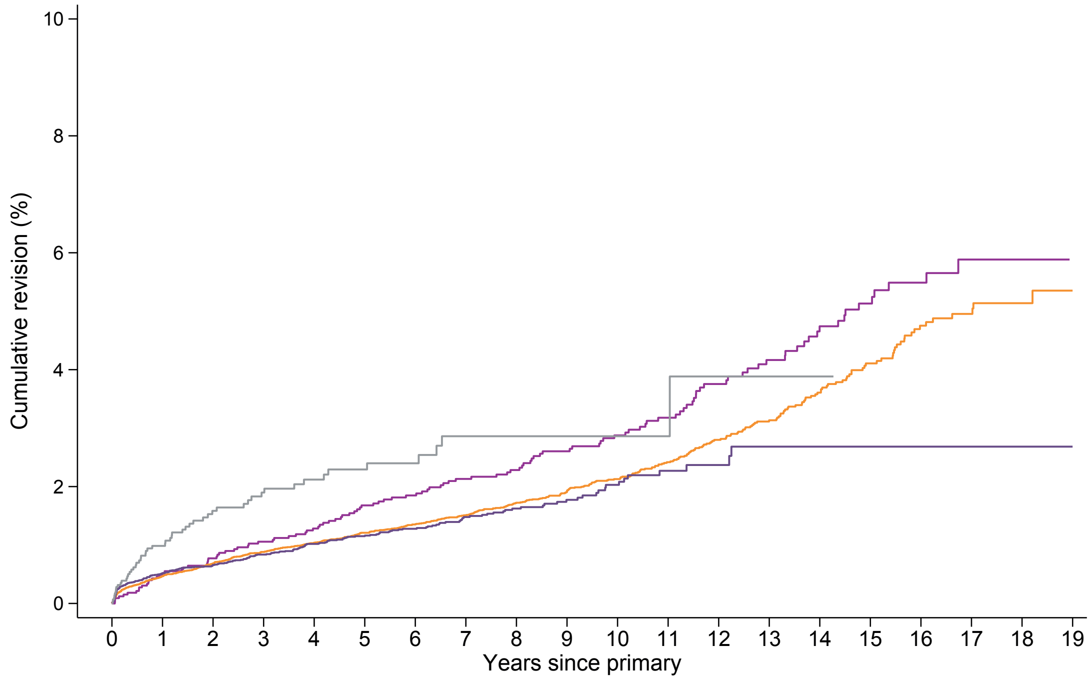


Key: Numbers at risk

Key										
22.25	35,687	33,562	31,067	27,853	24,045	19,765	14,943	10,473	6,289	2,570
26	19,095	18,226	17,043	15,496	13,591	11,148	8,537	5,985	3,405	1,247
28	208,829	189,225	166,293	134,638	101,778	69,994	44,471	25,397	10,832	2,702
30	755	717	657	567	429	*238*	*157*	*86*	*28*	*<4*
32	94,767	74,666	55,266	35,114	19,188	8,968	3,500	1,299	421	*107*
36	9,470	6,900	4,935	3,046	1,677	680	*133*	*9*		

In Figure 3.H10 (a), for cemented metal-on-polyethylene (MoP) hips, there was a statistically significant effect of head size (overall difference P<0.001 by logrank test) on revision rates over the follow-up period. Overall, implants with head size 22.25mm had the worst revision rates over the entire duration of follow-up, but implants with head size 36mm had the worst revision rates in the first nine years of follow-up. The numbers at risk for patients who received 36mm heads after 10 years are too small for meaningful comparison.

Figure 3.H10 (b) KM estimates of cumulative revision of primary cemented CoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

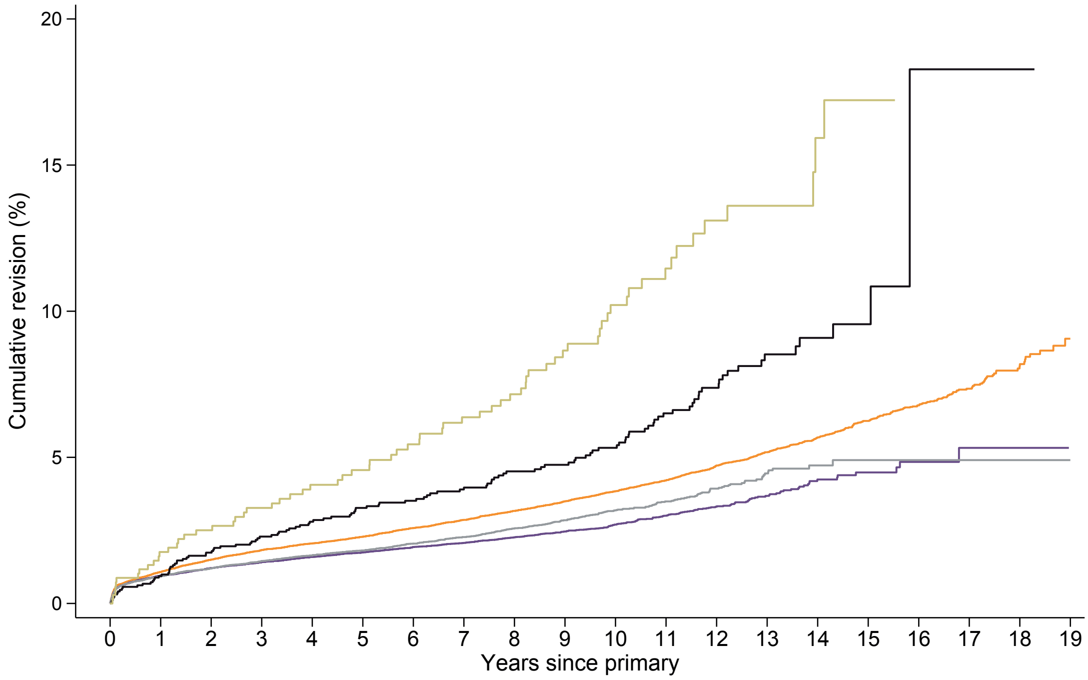


Numbers at risk

Key:	0	2	4	6	8	10	12	14	16	18
22.25	3,272	3,153	3,032	2,828	2,498	2,022	1,522	1,086	594	*148*
28	33,147	28,471	24,209	18,730	13,932	9,450	5,881	3,346	1,609	527
32	20,686	15,320	11,418	7,435	4,111	1,881	701	*195*	*52*	*14*
36	2,869	1,735	1,179	702	338	*171*	*43*	*<4*		

Figure 3.H10 (b) shows revision rates for different head sizes for cemented ceramic-on-polyethylene (CoP) hips. There was a statistically significant effect of head size (overall P<0.001) with 36mm heads having the highest revision rates, followed by 22.25mm heads. The lowest revision rates were achieved with 28mm and 32mm heads.

Figure 3.H10 (c) KM estimates of cumulative revision of primary uncemented MoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



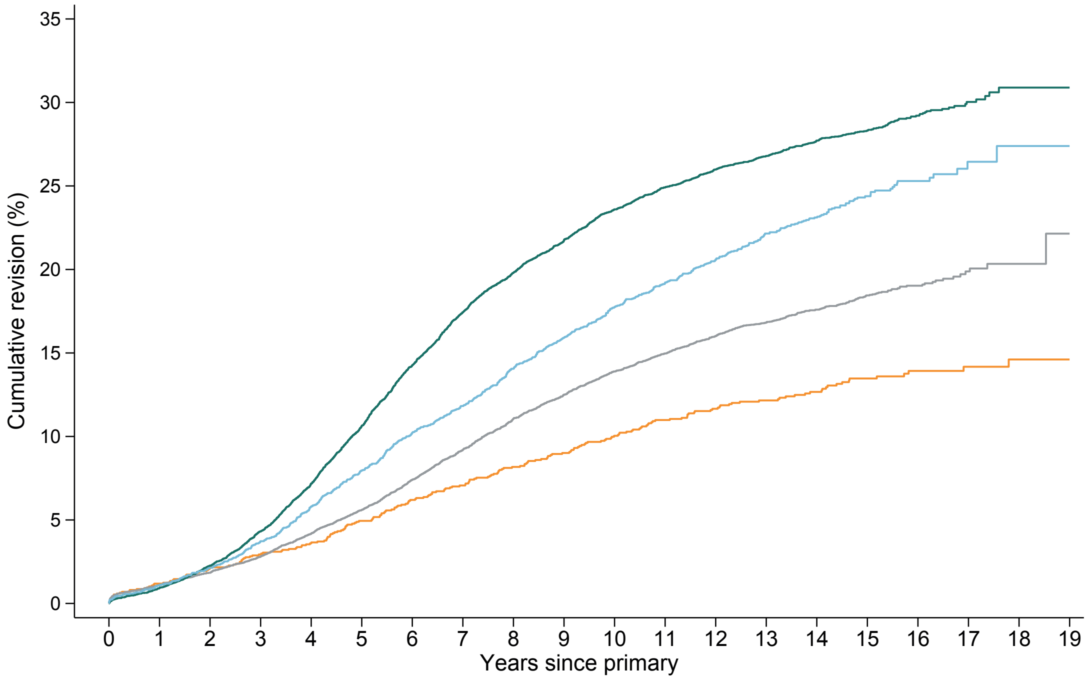
Key:

Numbers at risk

Key										
28	60,425	55,794	51,133	44,225	36,251	27,767	19,026	11,141	4,945	1,222
32	94,548	79,340	64,737	44,775	27,455	14,030	5,775	1,727	387	*48*
36	46,845	36,732	28,887	20,769	13,560	7,841	3,392	728	*73*	*17*
40	1,941	1,815	1,686	1,527	1,341	1,051	655	*244*	*4*	*<4*
44	687	647	598	523	459	322	*181*	*71*		

Figure 3.H10 (c) shows revision rates for uncemented metal-on-polyethylene (MoP) hips. There was a statistically significant effect of head size (overall P<0.001) with head sizes above 36mm having the highest revision rates.

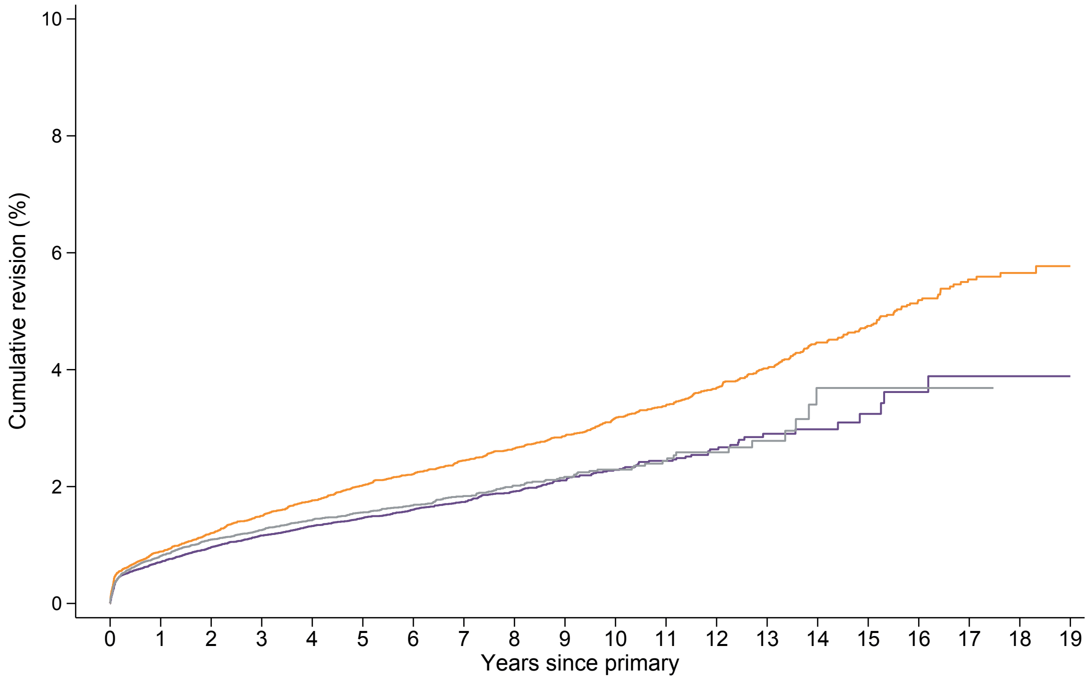
Figure 3.H10 (d) KM estimates of cumulative revision of primary uncemented MoM hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk									
28	1,857	1,796	1,729	1,634	1,555	1,470	1,268	942	475	*164*
36	12,365	11,802	11,117	10,226	9,228	8,248	7,254	4,368	1,222	*119*
38 to 48	10,815	10,425	9,667	8,662	7,787	7,051	6,376	4,441	1,396	*113*
50 to 54	3,725	3,584	3,359	3,097	2,863	2,596	2,313	1,504	456	*38*

Figure 3.H10 (d) shows revision rates for uncemented metal-on-metal (MoM) hips, with a statistically significant difference between the head sizes overall (P<0.001) with the lowest revision rates achieved with the smallest head sizes.

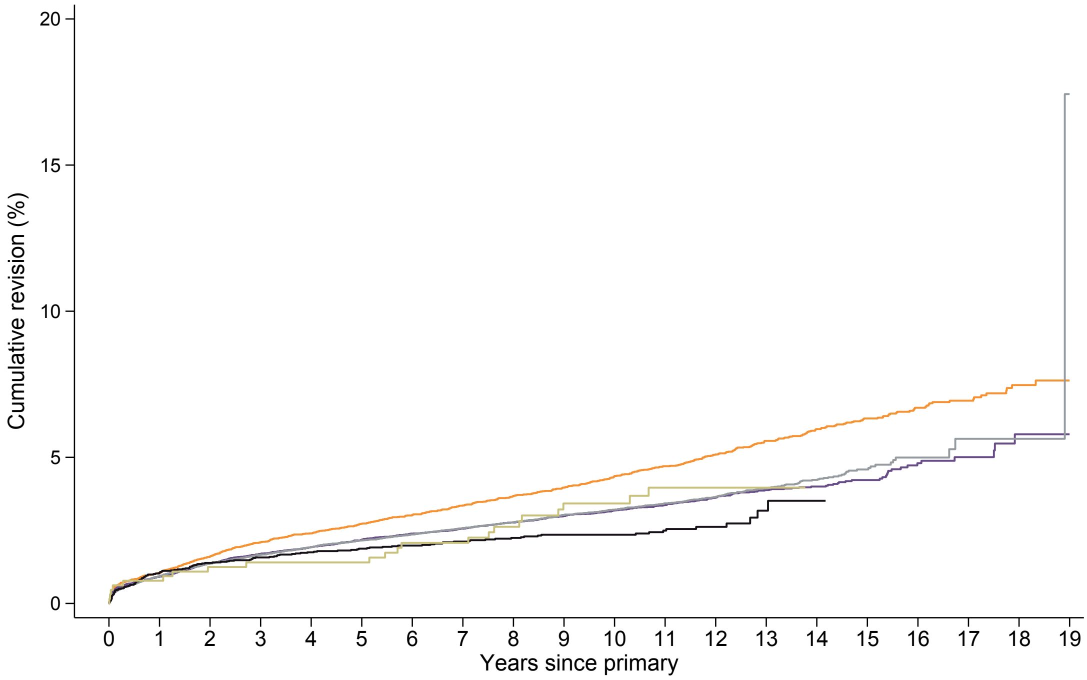
Figure 3.H10 (e) KM estimates of cumulative revision of primary uncemented CoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk									
28	30,176	26,695	23,718	19,709	15,958	12,476	9,219	6,178	3,335	1,082
32	72,576	53,624	39,328	24,087	13,273	6,533	2,813	992	375	*88*
36	53,025	35,508	25,304	15,486	7,920	3,558	1,290	335	*63*	

For uncemented ceramic-on-polyethylene (CoP) hips (Figure 3.H10 (e)), there was a statistically significant difference between the three head sizes shown (P<0.001) with 28mm heads having higher revision rates than 32mm and 36mm heads.

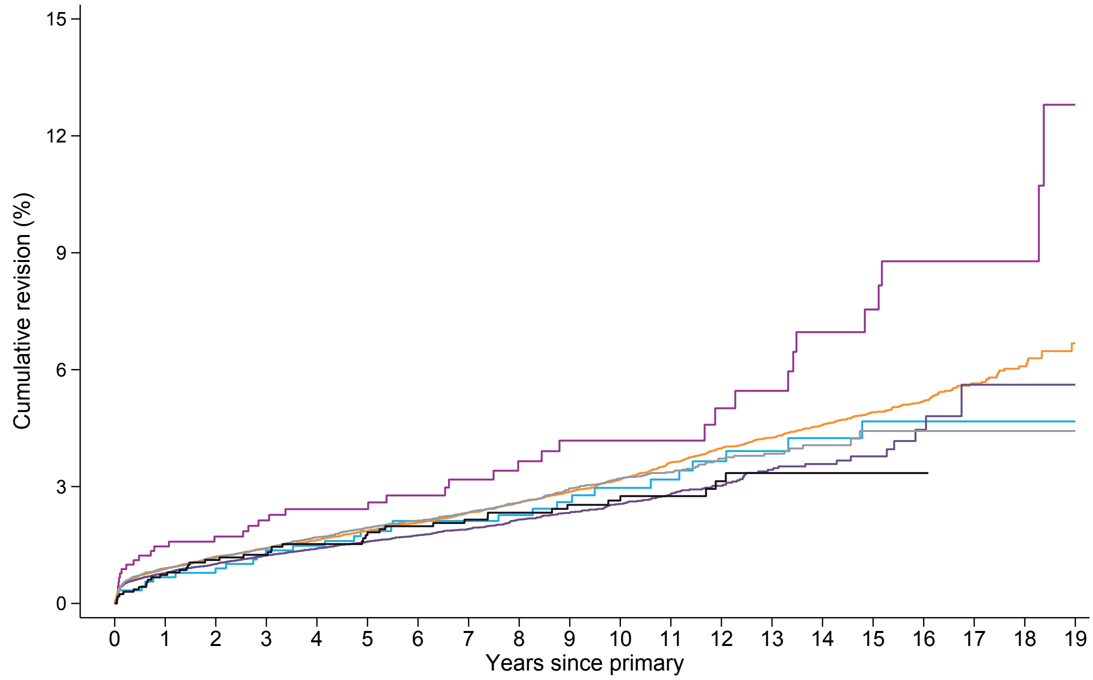
Figure 3.H10 (f) KM estimates of cumulative revision of primary uncemented CoC hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk									
28	13,845	13,261	12,645	11,816	10,761	9,240	7,122	4,950	2,619	812
32	38,649	35,834	32,718	28,021	22,208	15,469	8,313	3,687	1,243	276
36	81,942	76,006	69,725	60,038	46,594	30,547	14,726	4,497	684	*32*
40	5,818	5,335	4,915	4,459	3,738	2,619	1,001	*13*		
44	643	630	618	578	506	391	*191*			

Figure 3.H10 (f) shows revision rates for uncemented ceramic-on-ceramic (CoC) hip replacements by head size. There are statistically significant differences between all five head sizes shown (P<0.001). In the short-term, the larger the head size, the lower the revision rate of the construct, but revision rates begin to rise in 44mm heads after six years.

Figure 3.H10 (g) KM estimates of cumulative revision of primary hybrid MoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

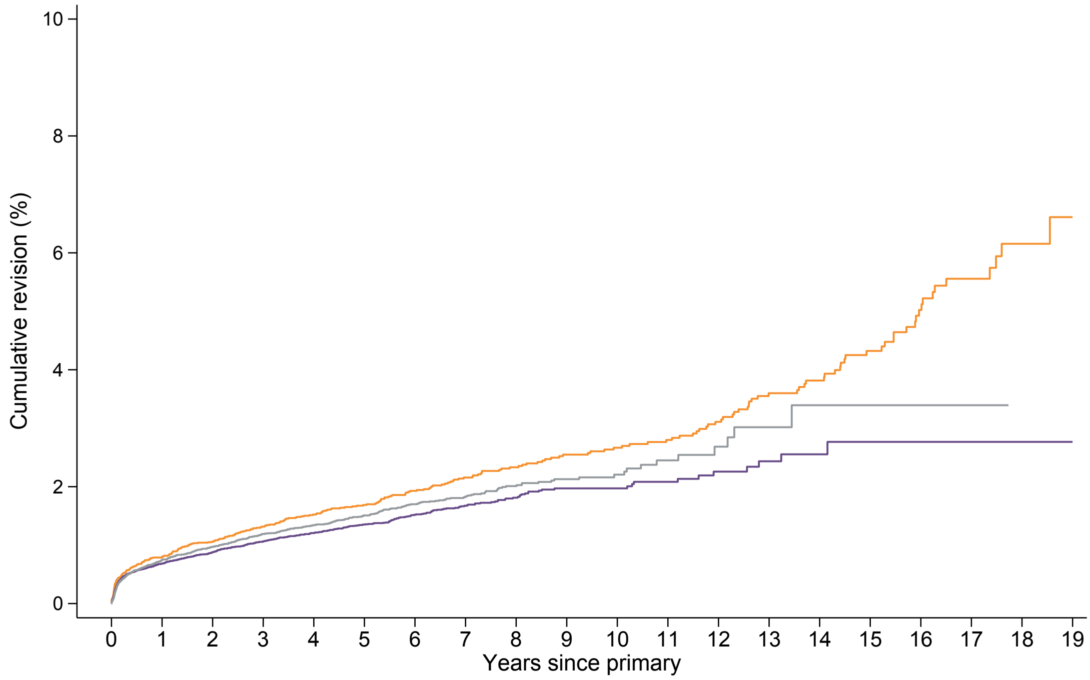


Numbers at risk

Key:	0	2	4	6	8	10	12	14	16	18
22.25	920	747	632	504	393	300	*222*	*179*	*123*	*61*
26	892	867	815	722	618	480	375	256	*160*	*57*
28	49,286	44,904	40,167	33,710	26,999	20,802	15,247	9,872	4,831	1,389
32	87,526	67,705	49,723	31,216	17,383	8,313	3,701	1,286	282	*33*
36	48,560	36,482	27,167	18,455	11,398	6,575	2,877	872	*166*	*17*
40	1,668	1,507	1,362	1,208	1,041	854	478	*184*	*<4*	

Figure 3.H10 (g) shows revision rates for hybrid metal-on-polyethylene hip replacements by head size. There was a statistically significant difference between the six head sizes shown (P<0.001) with 22.25mm heads having higher revision rates than the other heads. Beyond 12 years the numbers at risk are generally low so apparent differences should be interpreted with caution.

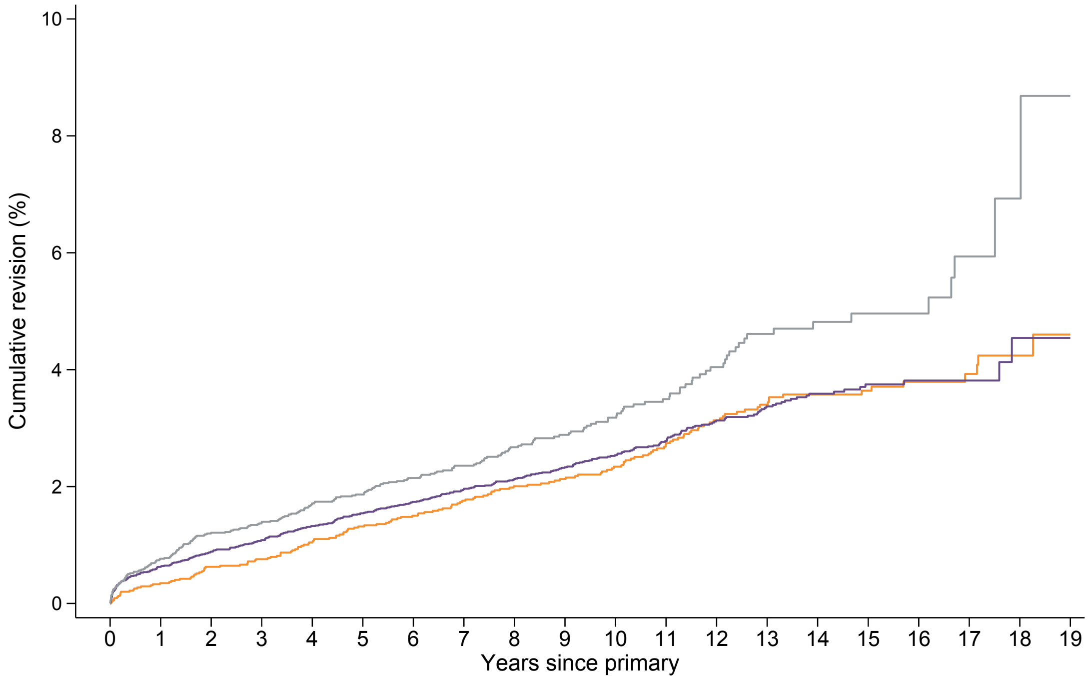
Figure 3.H10 (h) KM estimates of cumulative revision of primary hybrid CoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk									
28	14,613	11,995	9,619	6,658	4,478	3,133	2,342	1,663	959	334
32	67,103	43,891	28,649	15,251	6,914	2,899	1,454	510	*132*	*22*
36	51,065	33,028	22,231	12,613	5,914	2,008	667	*145*	*13*	

Figure 3.H10 (h) shows revision rates for hybrid ceramic-on-polyethylene hip replacements by head size. Bearings with 28mm heads had higher revision rates than those with 32mm and 36mm heads (P<0.001).

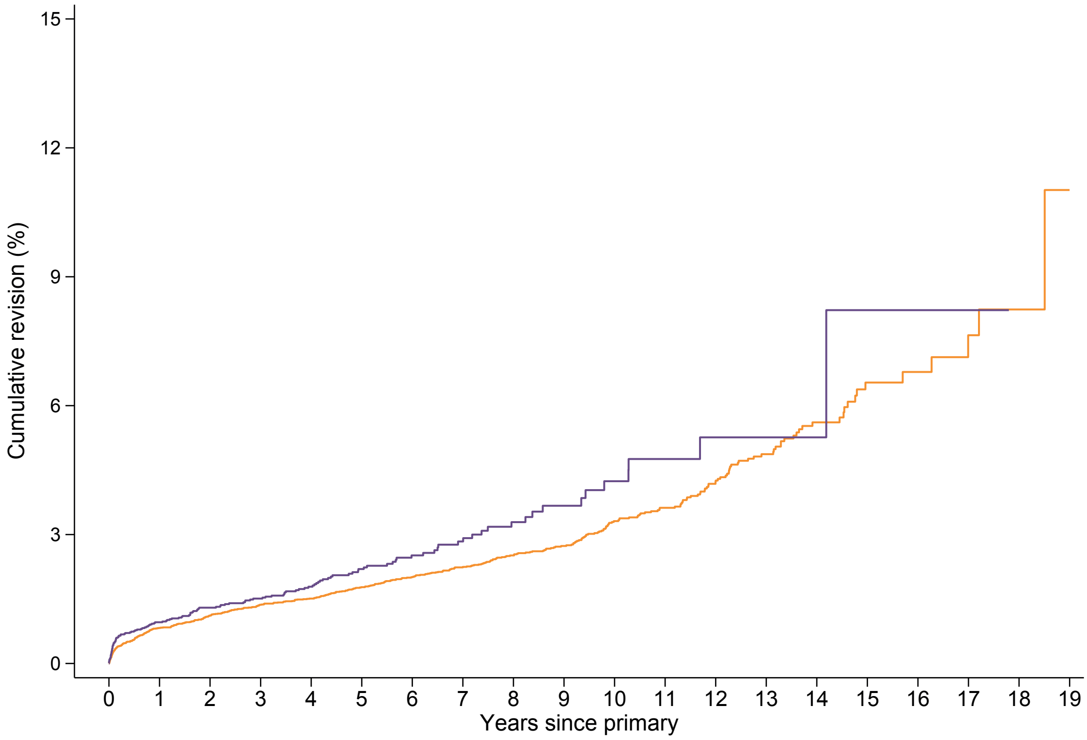
Figure 3.H10 (i) KM estimates of cumulative revision of primary hybrid CoC hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk									
28	5,467	5,335	5,125	4,740	4,193	3,579	2,747	1,842	1,060	337
32	13,631	13,166	12,483	11,285	9,673	7,414	5,114	3,036	1,233	*177*
36	8,332	7,593	6,691	5,500	4,013	2,626	1,490	799	389	*53*

Figure 3.H10 (i) shows revision rates for hybrid ceramic-on-ceramic hip replacements by head size. Bearings with 36mm heads had a higher revision rate than 32mm and 28mm heads (P=0.001).

Figure 3.H10 (j) KM estimates of cumulative revision of primary reverse hybrid MoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

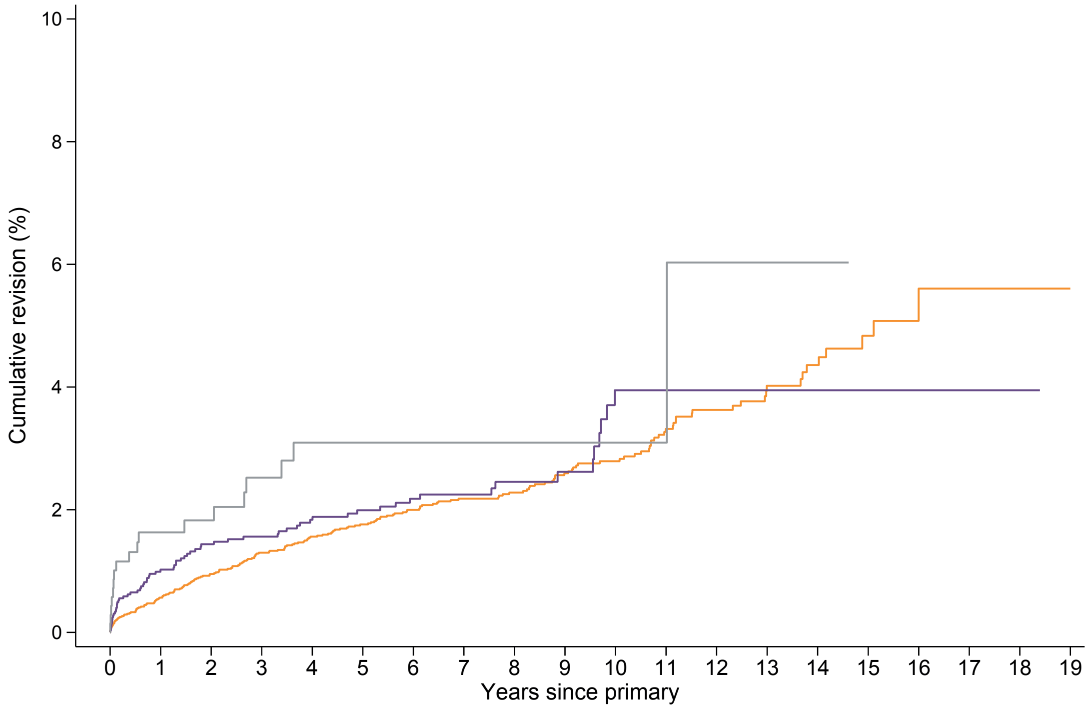


Key: Numbers at risk

28	17,637	15,764	13,717	10,591	7,273	4,632	2,507	1,070	316	*70*
32	6,552	4,877	3,486	1,799	885	422	*160*	*39*	*4*	

Figure 3.H10 (j) shows revision rates for reverse hybrid metal-on-polyethylene hip replacements by head size. There is some evidence that bearings with 28mm heads have a lower revision rate than those with 32mm heads, although comparison beyond ten years is affected by low numbers. (P=0.028).

Figure 3.H10 (k) KM estimates of cumulative revision of primary reverse hybrid CoP hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

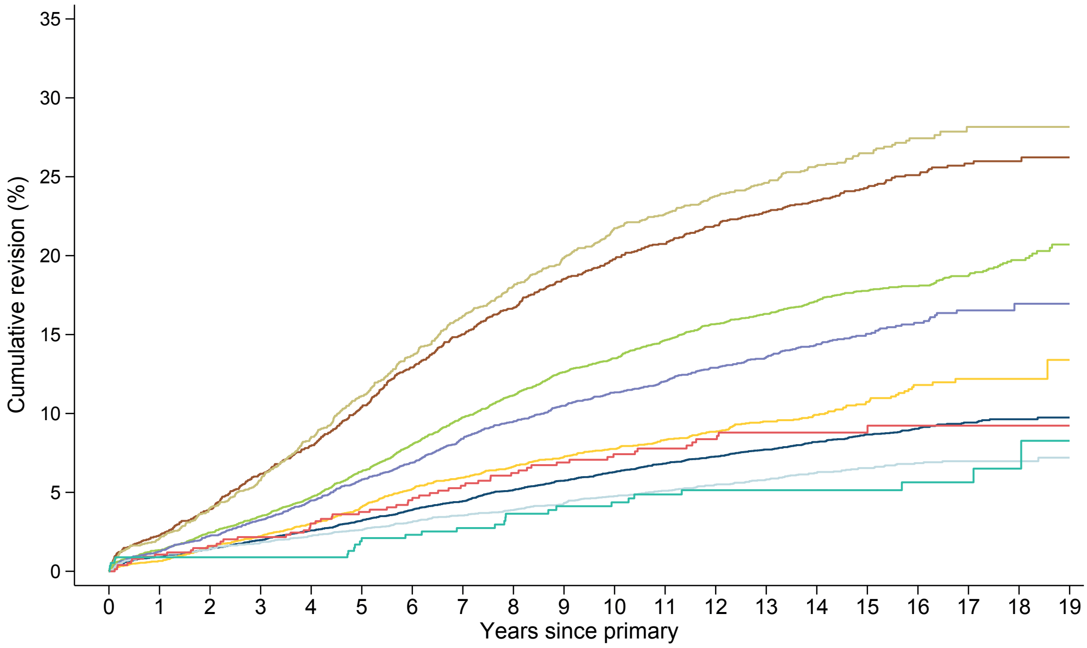


Key:

Head size (mm)	Numbers at risk									
28	7,919	6,991	6,197	5,067	3,773	2,555	1,526	747	*179*	*53*
32	3,262	2,460	2,043	1,465	825	391	*125*	*26*	*6*	*<4*
36	694	453	307	*207*	*135*	*61*	*18*	*<4*		

Figure 3.H10 (k) shows revision rates for reverse hybrid ceramic-on-polyethylene hip replacements by head size. There were no statistically significant differences in revision rates between head sizes (P=0.10).

Figure 3.H10 (l) KM estimates of cumulative revision of primary resurfacing MoM hip replacement by head size (mm). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key: / Numbers at risk

Key	0	2	4	6	8	10	12	14	16	18
42	2,287	2,189	2,081	1,951	1,847	1,746	1,636	1,405	806	309
44	2,262	2,168	2,051	1,923	1,797	1,667	1,509	1,103	450	*96*
46	6,331	6,154	5,976	5,708	5,414	5,063	4,620	3,717	2,093	707
48	4,973	4,720	4,477	4,219	3,886	3,567	3,047	2,033	786	*176*
50	12,444	11,702	11,078	10,400	9,589	8,809	7,725	5,886	3,183	1,085
52	5,411	4,975	4,651	4,302	3,916	3,493	2,836	1,729	621	*136*
54	6,229	5,843	5,463	5,124	4,730	4,300	3,802	2,982	1,731	605
56	762	714	670	635	570	522	440	279	*137*	*22*
58	563	527	497	464	419	387	335	269	*174*	*54*

Figure 3.H10 (l) shows revision rates for resurfacing metal-on-metal hip replacements by head size. There is a strong trend to lower revision rates with larger head sizes (P<0.001).

3.2.4 Revisions after primary hip surgery for the main stem / cup brand combinations

As in previous reports, we include only stem / cup brand combinations with more than 2,500 procedures for cemented, uncemented, hybrid and reverse hybrid hips or more than 1,000 procedures in the case of resurfacings. The figures in blue italics are at time points where 250 or fewer cases remained at risk; no results are shown at all where the number had fallen below ten cases. No attempt has been made to adjust for other factors that may influence the chance of revision, so the figures are unadjusted cumulative probabilities of revision. Given that the sub-groups may differ in composition with respect to age and gender, the percentage of males and the median (IQR) of the ages are also shown in these tables.

Table 3.H7 shows Kaplan-Meier estimates of the cumulative percentage probability of revision of primary hip replacement (for any reason) for the main stem / cup brand constructs.

Table 3.H7 KM estimates of cumulative revision (95% CI) of primary hip replacement by fixation, and stem / cup brand. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Stem:cup brand	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Cemented									
C-Stem AMT Cemented Stem[St] : Charnley and Elite Plus LPW[C]	3,470	75 (70 to 79)	30	0.61 (0.40-0.93)	1.31 (0.98-1.76)	1.62 (1.24-2.11)	2.58 (2.04-3.26)	*4.31 (3.22-5.74)*	
C-Stem AMT Cemented Stem[St] : Elite Plus Ogee[C]	5,096	77 (72 to 81)	34	0.30 (0.18-0.49)	0.93 (0.70-1.25)	1.31 (1.01-1.70)	2.26 (1.76-2.90)	*3.26 (2.36-4.50)*	
C-Stem AMT Cemented Stem[St] : Marathon[C]	20,713	75 (70 to 80)	33	0.57 (0.47-0.69)	0.98 (0.84-1.14)	1.32 (1.14-1.52)	2.02 (1.66-2.46)		
C-Stem Cemented Stem[St] : Elite Plus Ogee[C]	6,226	72 (66 to 77)	39	0.41 (0.27-0.60)	0.89 (0.68-1.16)	1.20 (0.95-1.52)	2.60 (2.15-3.14)	4.50 (3.73-5.41)	*5.00 (4.12-6.06)*
C-Stem Cemented Stem[St] : Marathon[C]	10,172	68 (60 to 75)	41	0.44 (0.33-0.60)	0.91 (0.74-1.12)	1.31 (1.09-1.56)	2.14 (1.79-2.56)		
CPT CoCr Stem[St] : Elite Plus Ogee[C]	2,522	73 (67 to 79)	36	0.60 (0.36-0.99)	1.51 (1.09-2.07)	2.21 (1.69-2.88)	3.99 (3.22-4.93)	*5.76 (4.61-7.18)*	
CPT CoCr Stem[St] : Exceed ABT Cemented[C]	2,528	75 (69 to 80)	36	1.18 (0.82-1.71)	1.75 (1.26-2.42)	2.13 (1.51-2.98)			
CPT CoCr Stem[St] : ZCA[C]	19,168	77 (71 to 81)	31	0.93 (0.80-1.08)	1.53 (1.36-1.72)	2.12 (1.90-2.35)	3.89 (3.52-4.31)	5.41 (4.77-6.12)	*6.52 (5.40-7.87)*
Charnley Cemented Stem[St] : Charnley Cemented Cup[C]	4,701	72 (66 to 78)	38	0.32 (0.19-0.54)	1.12 (0.85-1.47)	1.83 (1.48-2.28)	3.74 (3.19-4.38)	6.03 (5.23-6.95)	*8.21 (6.92-9.72)*
Charnley Cemented Stem[St] : Charnley Ogee[C]	10,629	73 (67 to 78)	38	0.37 (0.27-0.51)	1.20 (1.01-1.43)	1.85 (1.61-2.14)	3.65 (3.28-4.07)	5.91 (5.34-6.54)	7.26 (6.36-8.29)
Charnley Cemented Stem[St] : Charnley and Elite Plus LPW[C]	7,118	74 (68 to 79)	29	0.38 (0.26-0.56)	0.78 (0.60-1.02)	1.17 (0.94-1.46)	2.45 (2.08-2.89)	3.97 (3.40-4.62)	*5.30 (4.24-6.62)*

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H7 (continued)

Stem:cup brand	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Exeter V40[St] : Cenator Cemented Cup[C]	2,528	75 (69 to 80)	32	0.64 (0.39-1.04)	1.38 (0.99-1.93)	2.05 (1.55-2.70)	2.76 (2.16-3.54)	4.30 (3.38-5.45)	*7.06 (4.71-10.52)*
Exeter V40[St] : Charnley and Elite Plus LPW[C]	5,604	73 (68 to 79)	31	0.68 (0.50-0.94)	1.23 (0.97-1.56)	1.49 (1.20-1.86)	2.18 (1.78-2.68)	2.97 (2.33-3.78)	*3.65 (2.63-5.04)*
Exeter V40[St] : Elite Plus Cemented Cup[C]	5,266	73 (67 to 79)	32	0.33 (0.20-0.52)	0.64 (0.46-0.90)	0.88 (0.65-1.17)	1.41 (1.10-1.81)	2.99 (2.32-3.85)	*4.07 (2.80-5.90)*
Exeter V40[St] : Elite Plus Ogee[C]	27,253	74 (69 to 80)	35	0.39 (0.32-0.47)	0.85 (0.75-0.97)	1.19 (1.06-1.33)	2.14 (1.94-2.35)	3.20 (2.89-3.53)	*3.93 (3.44-4.48)*
Exeter V40[St] : Exeter Contemporary Flanged[C]	103,974	74 (69 to 80)	34	0.58 (0.53-0.63)	1.01 (0.95-1.08)	1.36 (1.29-1.44)	2.35 (2.23-2.47)	4.21 (3.94-4.49)	*5.96 (5.02-7.08)*
Exeter V40[St] : Exeter Contemporary Hooded[C]	29,297	75 (70 to 80)	32	0.95 (0.84-1.07)	1.61 (1.47-1.76)	2.16 (1.99-2.33)	3.97 (3.71-4.25)	7.17 (6.64-7.74)	*10.35 (8.94-11.97)*
Exeter V40[St] : Exeter Duration[C]	17,045	73 (67 to 79)	32	0.60 (0.49-0.73)	1.19 (1.03-1.37)	1.62 (1.44-1.83)	3.68 (3.38-4.01)	6.73 (6.19-7.31)	*9.85 (8.44-11.49)*
Exeter V40[St] : Exeter X3 Rimfit[C]	50,809	72 (64 to 78)	33	0.50 (0.44-0.57)	0.85 (0.77-0.94)	1.17 (1.07-1.28)	1.86 (1.65-2.09)		
Exeter V40[St] : Marathon[C]	10,567	72 (65 to 78)	35	0.54 (0.41-0.70)	0.86 (0.69-1.06)	1.09 (0.89-1.33)	1.53 (1.23-1.92)		
Exeter V40[St] : Opera[C]	2,845	74 (68 to 80)	32	0.39 (0.22-0.71)	0.84 (0.56-1.26)	1.27 (0.91-1.78)	3.02 (2.39-3.83)	7.77 (6.16-9.79)	*11.51 (8.60-15.32)*
MS-30[St] : Original ME Muller Low Profile Cup[C]	4,301	75 (69 to 81)	32	0.24 (0.13-0.44)	0.51 (0.33-0.79)	0.71 (0.49-1.03)	1.52 (1.12-2.06)	3.01 (2.08-4.34)	*3.32 (2.27-4.85)*
Muller Straight Stem[St] : Original ME Muller Low Profile Cup[C]	3,094	75 (70 to 80)	27	0.46 (0.27-0.77)	0.88 (0.60-1.29)	1.28 (0.92-1.77)	2.81 (2.18-3.63)	4.79 (3.58-6.40)	*6.16 (4.20-8.98)*
Stanmore Modular Stem[St] : Stanmore-Arcom Cup[C]	5,470	75 (70 to 80)	29	0.44 (0.30-0.66)	1.08 (0.83-1.39)	1.51 (1.21-1.88)	2.44 (2.02-2.94)	4.53 (3.74-5.49)	*5.82 (4.52-7.48)*
Uncemented									
Accolade[St] : Trident[SL]	27,287	66 (59 to 73)	44	0.94 (0.84-1.07)	1.90 (1.74-2.07)	2.52 (2.34-2.71)	3.90 (3.66-4.16)	5.60 (5.18-6.06)	*6.11 (5.46-6.84)*
Accolade II[St] : Trident[SL]	22,999	64 (57 to 72)	47	0.83 (0.71-0.96)	1.28 (1.13-1.46)	1.59 (1.39-1.81)	*1.79 (1.47-2.17)*		
Accolade II[St] : Tritanium[SL]	3,409	62 (54 to 71)	52	0.89 (0.62-1.28)	1.69 (1.25-2.28)	2.53 (1.90-3.35)	*2.67 (2.00-3.55)*		
Anthology[St] : R3 Cementless[SL]	5,425	62 (53 to 69)	42	1.05 (0.81-1.36)	1.62 (1.31-2.00)	2.00 (1.64-2.43)	2.80 (2.29-3.44)		
Corail[St] : ASR Resurfacing Cup[C]	2,797	61 (54 to 67)	54	1.00 (0.69-1.45)	7.37 (6.45-8.40)	23.43 (21.89-25.07)	43.70 (41.82-45.63)	48.63 (46.68-50.61)	
Corail[St] : Duraloc Cementless Cup[SL]	4,042	70 (64 to 75)	39	0.75 (0.52-1.06)	1.66 (1.31-2.11)	2.44 (2.00-2.98)	5.41 (4.72-6.21)	10.32 (9.22-11.53)	*14.22 (12.40-16.28)*
Corail[St] : Pinnacle Gription[SL]	20,622	66 (58 to 73)	43	0.71 (0.60-0.84)	1.30 (1.13-1.50)	1.79 (1.56-2.05)	2.52 (2.10-3.03)		

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H7 (continued)

Stem:cup brand	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Corail[St] : Pinnacle[SL]	190,860	66 (59 to 73)	45	0.75 (0.72-0.79)	1.41 (1.36-1.46)	2.00 (1.94-2.07)	4.01 (3.89-4.13)	6.59 (6.34-6.84)	
Corail[St] : Trilogy[SL]	3,319	67 (60 to 74)	40	0.58 (0.37-0.90)	1.07 (0.77-1.49)	1.60 (1.22-2.10)	2.74 (2.20-3.42)	3.48 (2.75-4.41)	*8.19 (4.77-13.88)*
Furlong Evolution Cementless[St] : Furlong HAC CSF Plus[SL]	6,303	62 (52 to 70)	39	1.21 (0.96-1.52)	1.69 (1.39-2.05)	1.96 (1.63-2.36)	2.37 (1.95-2.88)		
Furlong HAC Stem[St] : CSF[SL]	17,272	69 (63 to 76)	40	1.10 (0.96-1.27)	1.82 (1.63-2.03)	2.20 (1.99-2.43)	3.51 (3.23-3.82)	5.03 (4.65-5.44)	5.78 (5.27-6.33)
Furlong HAC Stem[St] : Furlong HAC CSF Plus[SL]	25,476	66 (59 to 73)	45	1.10 (0.98-1.24)	1.73 (1.57-1.90)	2.00 (1.83-2.18)	2.63 (2.42-2.86)	*3.96 (3.17-4.94)*	
M/L Taper Cementless[St] : Continuum[SL]	6,395	61 (53 to 68)	50	1.23 (0.98-1.53)	1.76 (1.47-2.12)	2.11 (1.78-2.50)	2.80 (2.38-3.29)		
M/L Taper Cementless[St] : Trilogy IT[SL]	6,075	63 (55 to 70)	52	1.20 (0.95-1.51)	1.89 (1.57-2.28)	2.24 (1.88-2.67)	2.82 (2.32-3.43)		
MetaFix Stem[St] : Trinity[SL]	9,276	64 (56 to 70)	46	0.74 (0.58-0.94)	1.04 (0.85-1.29)	1.36 (1.12-1.66)	2.06 (1.64-2.58)		
MiniHip[St] : Trinity[SL]	2,752	56 (49 to 63)	46	1.39 (1.02-1.91)	2.07 (1.59-2.69)	2.30 (1.79-2.96)	2.93 (2.29-3.76)		
Polarstem Cementless[St] : R3 Cementless[SL]	27,529	65 (58 to 72)	47	0.68 (0.59-0.78)	0.92 (0.80-1.05)	1.11 (0.98-1.26)	1.93 (1.57-2.36)		
SL-Plus Cementless Stem[St] : EP-Fit Plus[SL]	3,817	66 (59 to 74)	42	1.45 (1.11-1.88)	3.11 (2.60-3.72)	4.46 (3.84-5.18)	7.11 (6.28-8.04)	8.98 (7.95-10.13)	
Summit Cementless Stem[St] : Pinnacle[SL]	2,632	56 (47 to 63)	51	0.82 (0.53-1.25)	1.15 (0.79-1.66)	1.50 (1.05-2.12)	2.71 (1.90-3.87)	*3.34 (2.34-4.77)*	
Synergy Cementless Stem[St] : R3 Cementless[SL]	4,149	65 (57 to 71)	52	0.92 (0.67-1.26)	1.29 (0.99-1.69)	1.64 (1.29-2.10)	2.51 (1.99-3.16)		
Taperloc Cementless Stem[St] : Exceed ABT[SL]	27,845	65 (58 to 72)	45	1.09 (0.98-1.22)	1.49 (1.35-1.64)	1.76 (1.61-1.92)	2.28 (2.09-2.48)	2.63 (2.36-2.92)	
Taperloc Complete Cementless Stem[St] : Exceed ABT[SL]	3,870	63 (55 to 70)	50	0.88 (0.63-1.23)	1.37 (1.04-1.79)	1.58 (1.22-2.03)	*2.02 (1.56-2.62)*		
Taperloc Complete Cementless Stem[St] : G7 Cementless Acetabular Component[SL]	3,422	65 (57 to 72)	48	0.61 (0.39-0.94)	0.92 (0.63-1.35)	0.99 (0.67-1.44)			
Hybrid									
C-Stem AMT Cemented Stem[St] : Pinnacle Gription[SL]	7,187	73 (66 to 79)	35	0.75 (0.56-0.98)	1.20 (0.91-1.59)	1.82 (1.30-2.53)	*2.74 (1.37-5.43)*		
C-Stem AMT Cemented Stem[St] : Pinnacle[SL]	24,516	72 (65 to 77)	38	0.70 (0.60-0.81)	1.13 (1.00-1.28)	1.44 (1.28-1.62)	2.43 (2.08-2.83)	*2.76 (2.27-3.36)*	

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H7 (continued)

Stem:cup brand	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
CPCS[St] : R3 Cementless[SL]	6,796	74 (68 to 79)	32	0.80 (0.61-1.05)	1.31 (1.05-1.64)	1.70 (1.36-2.13)	*2.17 (1.67-2.81)*		
CPT CoCr Stem[St] : Continuum[SL]	14,367	70 (62 to 77)	37	1.47 (1.28-1.68)	2.12 (1.88-2.38)	2.58 (2.30-2.89)	3.74 (3.21-4.35)		
CPT CoCr Stem[St] : Trabecular Metal Modular Cementless Cup[SL]	3,097	72 (65 to 79)	32	1.09 (0.77-1.53)	1.84 (1.41-2.41)	2.29 (1.79-2.93)	3.99 (3.17-5.01)	*5.10 (3.85-6.74)*	
CPT CoCr Stem[St] : Trilogy IT[SL]	15,273	70 (62 to 76)	38	1.12 (0.96-1.30)	1.70 (1.50-1.94)	2.10 (1.86-2.37)	2.93 (2.47-3.48)		
CPT CoCr Stem[St] : Trilogy[SL]	26,365	71 (65 to 78)	36	0.89 (0.78-1.01)	1.43 (1.29-1.59)	2.08 (1.91-2.28)	3.57 (3.28-3.88)	4.90 (4.41-5.44)	*5.77 (4.90-6.78)*
Exeter V40[St] : ABG II Cementless Cup[SL]	2,714	65 (59 to 73)	34	0.26 (0.12-0.54)	0.71 (0.45-1.11)	1.14 (0.80-1.63)	2.16 (1.65-2.83)	3.88 (3.10-4.87)	*5.06 (3.83-6.66)*
Exeter V40[St] : Pinnacle[SL]	11,069	72 (65 to 78)	39	0.77 (0.62-0.95)	1.15 (0.96-1.38)	1.40 (1.19-1.66)	2.45 (2.05-2.92)	*3.40 (2.73-4.24)*	
Exeter V40[St] : R3 Cementless[SL]	3,740	73 (66 to 79)	30	0.72 (0.49-1.05)	1.17 (0.86-1.60)	1.59 (1.19-2.11)	*2.26 (1.60-3.19)*		
Exeter V40[St] : Trident[SL]	145,762	69 (62 to 76)	39	0.63 (0.59-0.67)	1.05 (0.99-1.11)	1.39 (1.32-1.46)	2.35 (2.23-2.47)	3.57 (3.34-3.82)	*5.08 (4.19-6.14)*
Exeter V40[St] : Trilogy[SL]	15,314	70 (63 to 76)	41	0.57 (0.46-0.71)	0.89 (0.75-1.05)	1.23 (1.07-1.43)	2.11 (1.87-2.38)	3.29 (2.91-3.71)	*4.10 (3.35-5.01)*
Exeter V40[St] : Tritanium[SL]	9,984	68 (60 to 75)	44	1.03 (0.85-1.26)	1.59 (1.34-1.89)	2.10 (1.78-2.47)	2.95 (2.46-3.53)		
TaperFit Cemented Stem[St] : Trinity[SL]	8,551	72 (65 to 77)	34	0.91 (0.73-1.14)	1.37 (1.14-1.66)	1.55 (1.28-1.86)	*2.09 (1.65-2.66)*		
Taperloc Cemented Stem[St] : Exceed ABT[SL]	2,512	75 (70 to 80)	25	0.61 (0.37-1.01)	0.82 (0.52-1.29)	1.04 (0.68-1.59)	*1.14 (0.74-1.75)*		
Reverse hybrid									
Corail[St] : Elite Plus Ogee[C]	3,188	72 (65 to 77)	37	0.66 (0.43-1.01)	1.45 (1.08-1.93)	1.85 (1.43-2.40)	2.86 (2.26-3.62)	*5.39 (4.11-7.05)*	
Corail[St] : Marathon[C]	19,719	70 (64 to 76)	39	0.62 (0.52-0.74)	1.04 (0.90-1.20)	1.31 (1.15-1.50)	2.26 (1.95-2.63)		
Resurfacing									
ASR Resurfacing Cup	2,963	55 (49 to 60)	68	1.65 (1.25-2.18)	5.86 (5.07-6.77)	13.21 (12.03-14.49)	26.16 (24.60-27.80)	30.24 (28.58-31.96)	
Adept Resurfacing Cup	4,178	54 (47 to 59)	77	1.07 (0.80-1.44)	2.40 (1.97-2.93)	4.34 (3.74-5.05)	7.77 (6.93-8.70)	10.47 (9.42-11.63)	
BHR Resurfacing Cup	24,218	55 (48 to 60)	77	1.00 (0.88-1.13)	2.24 (2.06-2.44)	3.44 (3.22-3.69)	7.15 (6.81-7.51)	10.04 (9.61-10.48)	11.76 (11.20-12.36)
Conserve Plus Resurfacing Cup	1,325	56 (50 to 61)	63	2.04 (1.40-2.96)	5.15 (4.08-6.49)	8.28 (6.91-9.90)	13.99 (12.22-16.00)	16.49 (14.54-18.68)	*16.90 (14.88-19.15)*
Cormet 2000 Resurfacing Cup	3,680	55 (48 to 60)	65	1.50 (1.15-1.94)	3.71 (3.14-4.37)	7.64 (6.82-8.55)	16.77 (15.59-18.03)	22.20 (20.85-23.63)	*24.51 (22.83-26.30)*
Durom Resurfacing Cup	1,708	55 (49 to 60)	70	1.35 (0.90-2.02)	3.58 (2.80-4.58)	5.47 (4.49-6.67)	8.47 (7.24-9.91)	10.46 (9.06-12.06)	
Recap Magnum	1,701	54 (49 to 59)	73	1.94 (1.38-2.72)	3.36 (2.60-4.33)	5.56 (4.56-6.76)	10.09 (8.74-11.64)	13.18 (11.53-15.05)	

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H8 further divides the data by stratifying for bearing surface. This table shows the estimated cumulative percentage probability of revision for the resulting fixation / bearing sub-groups, provided there were more than 2,500 procedures for unipolar bearings, or more than 1,000 procedures for dual mobility bearings.

Table 3.H8 KM estimates of cumulative revision (95% CI) of primary hip replacement by fixation, stem / cup brand, and bearing. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Stem:cup brand	Bearing surface	N	Age at primary Median (IQR)	Male (%)	Time since primary					
					1 year	3 years	5 years	10 years	15 years	19 years
Cemented										
C-Stem AMT Cemented Stem[St] : Charnley and Elite Plus LPW[C]	MoP	3,437	75 (71 to 80)	30	0.61 (0.40-0.94)	1.32 (0.99-1.77)	1.63 (1.25-2.13)	2.60 (2.06-3.29)	*4.35 (3.26-5.81)*	
C-Stem AMT Cemented Stem[St] : Elite Plus Ogee[C]	MoP	4,354	77 (73 to 82)	33	0.30 (0.18-0.52)	0.96 (0.70-1.32)	1.35 (1.03-1.78)	2.40 (1.85-3.10)	*3.51 (2.51-4.89)*	
C-Stem AMT Cemented Stem[St] : Marathon[C]	MoP	16,267	77 (72 to 81)	32	0.55 (0.45-0.69)	1.01 (0.85-1.19)	1.39 (1.19-1.63)	2.01 (1.65-2.45)		
C-Stem AMT Cemented Stem[St] : Marathon[C]	CoP	4,446	66 (60 to 72)	36	0.64 (0.43-0.94)	0.86 (0.60-1.22)	0.97 (0.68-1.38)	*1.93 (1.15-3.23)*		
C-Stem Cemented Stem[St] : Elite Plus Ogee[C]	MoP	5,225	73 (68 to 78)	38	0.48 (0.33-0.71)	1.02 (0.77-1.34)	1.32 (1.04-1.69)	2.90 (2.38-3.53)	4.89 (4.02-5.95)	*5.49 (4.47-6.74)*
C-Stem Cemented Stem[St] : Marathon[C]	MoP	5,706	73 (68 to 78)	37	0.37 (0.24-0.57)	0.84 (0.63-1.13)	1.18 (0.92-1.52)	2.03 (1.57-2.63)		
C-Stem Cemented Stem[St] : Marathon[C]	CoP	4,466	59 (52 to 65)	46	0.54 (0.36-0.80)	1.00 (0.74-1.34)	1.47 (1.14-1.89)	2.29 (1.79-2.92)		
CPT CoCr Stem[St] : ZCA[C]	MoP	17,791	77 (72 to 82)	31	0.99 (0.85-1.14)	1.60 (1.42-1.80)	2.21 (1.99-2.45)	4.01 (3.62-4.44)	5.37 (4.74-6.09)	*6.40 (5.28-7.76)*
Charnley Cemented Stem[St] : Charnley Cemented Cup[C]	MoP	4,701	72 (66 to 78)	38	0.32 (0.19-0.54)	1.12 (0.85-1.47)	1.83 (1.48-2.28)	3.74 (3.19-4.38)	6.03 (5.23-6.95)	*8.21 (6.92-9.72)*
Charnley Cemented Stem[St] : Charnley Ogee[C]	MoP	10,629	73 (67 to 78)	38	0.37 (0.27-0.51)	1.20 (1.01-1.43)	1.85 (1.61-2.14)	3.65 (3.28-4.07)	5.91 (5.34-6.54)	7.26 (6.36-8.29)
Charnley Cemented Stem[St] : Charnley and Elite Plus LPW[C]	MoP	7,118	74 (68 to 79)	29	0.38 (0.26-0.56)	0.78 (0.60-1.02)	1.17 (0.94-1.46)	2.45 (2.08-2.89)	3.97 (3.40-4.62)	*5.30 (4.24-6.62)*
Exeter V40[St] : Charnley and Elite Plus LPW[C]	MoP	4,422	75 (71 to 80)	28	0.73 (0.52-1.03)	1.24 (0.95-1.62)	1.49 (1.16-1.91)	2.41 (1.92-3.02)	3.41 (2.62-4.42)	*4.21 (3.00-5.90)*
Exeter V40[St] : Elite Plus Cemented Cup[C]	MoP	4,962	74 (68 to 79)	32	0.34 (0.21-0.55)	0.62 (0.43-0.88)	0.82 (0.60-1.12)	1.35 (1.04-1.75)	2.69 (2.06-3.50)	*3.87 (2.54-5.86)*
Exeter V40[St] : Elite Plus Ogee[C]	MoP	24,490	75 (70 to 80)	34	0.38 (0.31-0.46)	0.86 (0.75-0.98)	1.19 (1.06-1.34)	2.14 (1.93-2.36)	3.20 (2.87-3.55)	*3.94 (3.43-4.53)*
Exeter V40[St] : Elite Plus Ogee[C]	CoP	2,763	67 (61 to 73)	41	0.47 (0.27-0.81)	0.78 (0.51-1.20)	1.16 (0.81-1.67)	2.12 (1.55-2.89)	3.16 (2.29-4.36)	*3.75 (2.49-5.64)*

*Inclusion criteria relaxed to show the newly identified dual mobility hips with at least 1,000 procedures.
Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H8 (continued)

Stem:cup brand	Bearing surface	N	Age at primary Median (IQR)	Male (%)	Time since primary					
					1 year	3 years	5 years	10 years	15 years	19 years
Exeter V40[St] : Exeter Contemporary Flanged[C]	MoP	95,781	75 (70 to 80)	34	0.58 (0.53-0.63)	1.02 (0.95-1.08)	1.37 (1.29-1.45)	2.37 (2.24-2.50)	4.23 (3.95-4.53)	*6.06 (5.03-7.29)*
Exeter V40[St] : Exeter Contemporary Flanged[C]	CoP	8,193	67 (61 to 73)	36	0.57 (0.43-0.76)	0.97 (0.78-1.22)	1.31 (1.07-1.60)	2.10 (1.74-2.54)	3.92 (3.09-4.97)	
Exeter V40[St] : Exeter Contemporary Hooded[C]	MoP	27,371	76 (70 to 81)	32	0.96 (0.86-1.09)	1.62 (1.47-1.78)	2.16 (1.99-2.35)	3.95 (3.68-4.24)	7.19 (6.64-7.79)	*10.14 (8.76-11.72)*
Exeter V40[St] : Exeter Duration[C]	MoP	16,063	74 (68 to 79)	32	0.61 (0.50-0.75)	1.22 (1.06-1.40)	1.67 (1.48-1.88)	3.74 (3.42-4.08)	6.78 (6.22-7.38)	*10.30 (8.71-12.15)*
Exeter V40[St] : Exeter X3 Rimfit[C]	MoP	35,420	74 (68 to 80)	32	0.49 (0.42-0.57)	0.84 (0.74-0.94)	1.13 (1.01-1.27)	1.77 (1.54-2.04)		
Exeter V40[St] : Exeter X3 Rimfit[C]	CoP	15,389	64 (57 to 70)	36	0.52 (0.41-0.65)	0.88 (0.74-1.06)	1.26 (1.07-1.48)	2.03 (1.65-2.50)		
Exeter V40[St] : Marathon[C]	MoP	7,215	75 (70 to 80)	33	0.60 (0.44-0.80)	0.94 (0.73-1.20)	1.14 (0.90-1.44)	1.66 (1.27-2.17)		
Exeter V40[St] : Marathon[C]	CoP	3,352	64 (57.5 to 69)	39	0.41 (0.24-0.70)	0.68 (0.44-1.05)	0.98 (0.66-1.44)	1.26 (0.84-1.88)		
Exeter V40[St] : Novae Liner[DM] : Novae Stick[C]*	MoPoM	1,070	78 (70 to 84)	29	0.53 (0.22-1.28)	1.10 (0.57-2.13)	1.81 (0.99-3.30)	*4.21 (1.35-12.76)*		
Exeter V40[St] : Opera[C]	MoP	2,712	75 (69 to 80)	31	0.37 (0.20-0.69)	0.84 (0.56-1.28)	1.30 (0.93-1.83)	3.11 (2.44-3.95)	7.77 (6.15-9.80)	*11.51 (8.60-15.33)*
MS-30[St] : Original ME Muller Low Profile Cup[C]	CoP	2,733	71 (66 to 76)	31	0.18 (0.08-0.44)	0.54 (0.32-0.91)	0.67 (0.42-1.07)	1.38 (0.94-2.02)	*3.05 (1.95-4.76)*	*3.46 (2.19-5.44)*
Stanmore Modular Stem[St] : Stanmore-Arcom Cup[C]	MoP	4,994	75 (70 to 81)	30	0.40 (0.26-0.63)	1.08 (0.82-1.41)	1.55 (1.24-1.95)	2.50 (2.06-3.04)	4.39 (3.57-5.39)	*5.31 (4.06-6.94)*
Uncemented										
Accolade[St] : Trident[SL]	MoP	12,498	71 (64 to 76)	41	0.96 (0.81-1.15)	1.96 (1.73-2.22)	2.67 (2.40-2.97)	4.73 (4.34-5.16)	7.63 (6.81-8.55)	
Accolade[St] : Trident[SL]	CoP	7,358	61 (55 to 67)	46	0.84 (0.66-1.08)	1.63 (1.36-1.95)	1.98 (1.69-2.33)	2.53 (2.17-2.96)	*3.38 (2.46-4.65)*	
Accolade[St] : Trident[SL]	CoC	7,372	62 (55 to 68)	46	1.01 (0.80-1.26)	2.05 (1.75-2.40)	2.77 (2.42-3.18)	3.77 (3.35-4.24)	4.67 (4.12-5.29)	*4.81 (4.21-5.49)*
Accolade II[St] : Trident[SL]	MoP	6,549	71 (64 to 76)	43	0.96 (0.75-1.24)	1.49 (1.21-1.84)	1.80 (1.46-2.22)			
Accolade II[St] : Trident[SL]	CoP	15,403	62 (55 to 69)	48	0.79 (0.65-0.94)	1.22 (1.03-1.43)	1.44 (1.21-1.71)			
Accolade II[St] : Tritanium[SL]	CoP	2,622	60 (53 to 68)	53	0.88 (0.58-1.33)	1.55 (1.09-2.20)	2.29 (1.63-3.20)			
Anthology[St] : R3 Cementless[SL]	MoP	4,363	63 (55 to 70)	39	1.10 (0.83-1.46)	1.69 (1.34-2.13)	1.96 (1.57-2.44)	2.31 (1.82-2.92)		
Corail[St] : ASR Resurfacing Cup[C]	MoM	2,797	61 (54 to 67)	54	1.00 (0.69-1.45)	7.37 (6.45-8.40)	23.43 (21.89-25.07)	43.70 (41.82-45.63)	48.63 (46.68-50.61)	

*Inclusion criteria relaxed to show the newly identified dual mobility hips with at least 1,000 procedures.
Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H8 (continued)

Stem:cup brand	Bearing surface	N	Age at primary Median (IQR)	Male (%)	Time since primary					
					1 year	3 years	5 years	10 years	15 years	19 years
Corail[St] : Duraloc Cementless Cup[SL]	MoP	3,718	70 (65 to 75)	39	0.62 (0.41-0.93)	1.45 (1.11-1.90)	2.27 (1.83-2.82)	5.29 (4.57-6.12)	9.96 (8.83-11.23)	*14.32 (12.22-16.73)*
Corail[St] : Pinnacle Gription[SL]	MoP	7,456	73 (68 to 78)	39	0.93 (0.72-1.18)	1.50 (1.21-1.86)	1.94 (1.57-2.40)	*2.72 (2.06-3.59)*		
Corail[St] : Pinnacle Gription[SL]	CoP	10,412	63 (56 to 69)	45	0.42 (0.31-0.57)	1.02 (0.79-1.31)	1.31 (1.02-1.68)	*1.62 (1.22-2.14)*		
Corail[St] : Pinnacle Gription[SL]	CoC	2,745	57 (49 to 65)	45	1.12 (0.78-1.59)	1.74 (1.30-2.33)	2.54 (1.98-3.26)	*3.42 (2.59-4.52)*		
Corail[St] : Pinnacle[SL]	MoP	74,553	71 (66 to 77)	41	0.77 (0.71-0.84)	1.25 (1.17-1.33)	1.52 (1.43-1.62)	2.59 (2.44-2.74)	4.31 (3.94-4.70)	
Corail[St] : Pinnacle[SL]	MoM	11,956	67 (60 to 74)	47	0.88 (0.73-1.07)	2.47 (2.20-2.76)	5.19 (4.80-5.61)	13.34 (12.71-14.00)	18.01 (17.23-18.82)	
Corail[St] : Pinnacle[SL]	CoP	57,504	64 (57 to 70)	47	0.65 (0.58-0.72)	1.02 (0.93-1.11)	1.35 (1.25-1.46)	2.26 (2.06-2.48)	3.73 (3.06-4.54)	
Corail[St] : Pinnacle[SL]	CoC	45,009	59 (52 to 65)	49	0.83 (0.75-0.92)	1.74 (1.62-1.87)	2.36 (2.22-2.50)	3.68 (3.49-3.87)	5.34 (4.99-5.72)	
Furlong Evolution Cementless[St] : Furlong HAC CSF Plus[SL]	CoC	5,458	60 (51 to 69)	39	1.13 (0.88-1.46)	1.55 (1.24-1.93)	1.87 (1.52-2.30)	*2.27 (1.83-2.82)*		
Furlong HAC Stem[St] : CSF[SL]	MoP	8,154	73 (67 to 78)	39	1.36 (1.13-1.64)	2.16 (1.87-2.51)	2.50 (2.18-2.87)	4.15 (3.70-4.64)	5.75 (5.13-6.44)	*7.35 (6.15-8.79)*
Furlong HAC Stem[St] : CSF[SL]	CoP	7,434	67 (61 to 73)	41	0.78 (0.61-1.01)	1.36 (1.12-1.66)	1.75 (1.48-2.08)	2.66 (2.30-3.07)	3.95 (3.45-4.51)	*4.50 (3.90-5.19)*
Furlong HAC Stem[St] : Furlong HAC CSF Plus[SL]	MoP	6,056	74 (69 to 79)	39	1.65 (1.35-2.00)	2.29 (1.94-2.71)	2.76 (2.37-3.22)	3.76 (3.24-4.37)		
Furlong HAC Stem[St] : Furlong HAC CSF Plus[SL]	CoP	3,626	67 (62 to 72)	46	0.95 (0.68-1.33)	1.55 (1.19-2.02)	1.76 (1.37-2.26)	2.52 (1.99-3.18)		
Furlong HAC Stem[St] : Furlong HAC CSF Plus[SL]	CoC	15,794	63 (56 to 69)	47	0.93 (0.79-1.09)	1.55 (1.37-1.76)	1.77 (1.57-1.99)	2.26 (2.03-2.53)	*3.64 (2.68-4.93)*	
M/L Taper Cementless[St] : Trilogy IT[SL]	MoP	2,511	70 (64 to 75)	44	1.24 (0.87-1.76)	1.91 (1.44-2.54)	2.44 (1.88-3.15)	*3.04 (2.31-3.98)*		
M/L Taper Cementless[St] : Trilogy IT[SL]	CoP	2,606	60 (53 to 66)	57	1.34 (0.96-1.88)	1.92 (1.44-2.56)	2.24 (1.70-2.95)	*2.36 (1.78-3.11)*		
MetaFix Stem[St] : Trinity[SL]	CoP	4,879	64 (57 to 70)	47	0.75 (0.53-1.04)	0.93 (0.68-1.27)	1.24 (0.91-1.69)	*2.29 (1.17-4.47)*		
MetaFix Stem[St] : Trinity[SL]	CoC	3,161	59 (52 to 66)	46	0.68 (0.44-1.04)	1.03 (0.72-1.46)	1.33 (0.97-1.83)	1.91 (1.40-2.61)		
Polarstem Cementless[St] : R3 Cementless[SL]	MoP	25,428	66 (58 to 73)	47	0.70 (0.60-0.81)	0.94 (0.82-1.07)	1.15 (1.01-1.31)	2.19 (1.69-2.84)		
Synergy Cementless Stem[St] : R3 Cementless[SL]	MoP	3,277	66 (58 to 72)	51	0.98 (0.70-1.39)	1.25 (0.92-1.70)	1.46 (1.10-1.95)	1.85 (1.41-2.43)		

*Inclusion criteria relaxed to show the newly identified dual mobility hips with at least 1,000 procedures.
Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H8 (continued)

Stem:cup brand	Bearing surface	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Taperloc Cementless Stem[St] : Exceed ABT[SL]	MoP	8,746	72 (66 to 77)	40	1.31 (1.09-1.57)	1.79 (1.53-2.09)	2.07 (1.79-2.40)	2.80 (2.43-3.22)	*2.91* *(2.52-3.36)*	
Taperloc Cementless Stem[St] : Exceed ABT[SL]	CoP	6,307	65 (58 to 71)	45	0.80 (0.61-1.05)	1.01 (0.79-1.30)	1.14 (0.90-1.44)	1.59 (1.26-2.01)	*2.38* *(1.74-3.25)*	
Taperloc Cementless Stem[St] : Exceed ABT[SL]	CoC	12,779	61 (54 to 67)	47	1.09 (0.93-1.29)	1.52 (1.32-1.75)	1.83 (1.61-2.09)	2.26 (2.00-2.56)	2.59 (2.24-2.99)	
Hybrid										
C-Stem AMT Cemented Stem[St] : Pinnacle Gription[SL]	MoP	3,775	77 (73 to 81)	33	0.69 (0.47-1.02)	0.81 (0.55-1.19)	1.17 (0.70-1.95)	*2.44* *(0.86-6.83)*		
C-Stem AMT Cemented Stem[St] : Pinnacle Gription[SL]	CoP	3,297	68 (60 to 74)	38	0.80 (0.54-1.20)	1.49 (0.99-2.26)	2.30 (1.41-3.75)			
C-Stem AMT Cemented Stem[St] : Pinnacle[SL]	MoP	12,445	76 (71 to 80)	35	0.75 (0.61-0.92)	1.27 (1.08-1.50)	1.59 (1.36-1.87)	2.28 (1.87-2.79)	*2.43* *(1.94-3.04)*	
C-Stem AMT Cemented Stem[St] : Pinnacle[SL]	CoP	10,104	67 (61 to 73)	42	0.64 (0.50-0.82)	0.93 (0.75-1.16)	1.07 (0.86-1.32)	*1.70* *(1.26-2.29)*		
CPCS[St] : R3 Cementless[SL]	MoP	6,365	74 (69 to 80)	32	0.78 (0.59-1.03)	1.31 (1.03-1.65)	1.67 (1.31-2.12)	*2.07* *(1.58-2.72)*		
CPT CoCr Stem[St] : Continuum[SL]	MoP	7,192	75 (70 to 80)	35	1.58 (1.31-1.90)	2.22 (1.89-2.61)	2.75 (2.35-3.21)	*4.24* *(3.30-5.45)*		
CPT CoCr Stem[St] : Continuum[SL]	CoP	5,663	65 (59 to 71)	39	1.37 (1.09-1.72)	2.00 (1.64-2.44)	2.29 (1.88-2.77)	*2.58* *(2.10-3.17)*		
CPT CoCr Stem[St] : Trilogy IT[SL]	MoP	6,696	74 (69 to 79)	35	1.43 (1.17-1.75)	2.07 (1.74-2.46)	2.45 (2.08-2.90)	*3.83* *(3.00-4.88)*		
CPT CoCr Stem[St] : Trilogy IT[SL]	CoP	7,212	67 (60 to 73)	39	0.86 (0.66-1.10)	1.47 (1.19-1.82)	1.99 (1.62-2.44)	*2.48* *(1.93-3.18)*		
CPT CoCr Stem[St] : Trilogy[SL]	MoP	15,245	73 (67 to 79)	35	0.92 (0.78-1.08)	1.52 (1.33-1.73)	2.29 (2.05-2.55)	4.03 (3.66-4.43)	5.35 (4.80-5.96)	*6.31* *(5.35-7.43)*
CPT CoCr Stem[St] : Trilogy[SL]	CoP	10,597	69 (62 to 75)	37	0.86 (0.70-1.06)	1.32 (1.12-1.57)	1.77 (1.52-2.07)	2.43 (2.07-2.86)	*2.43* *(2.07-2.86)*	
Exeter V40[St] : Pinnacle[SL]	MoP	6,704	75 (70 to 80)	30	0.86 (0.67-1.12)	1.26 (1.01-1.56)	1.56 (1.27-1.90)	2.55 (2.09-3.11)	*3.35* *(2.63-4.26)*	
Exeter V40[St] : Pinnacle[SL]	CoP	4,091	66 (59 to 72)	52	0.54 (0.35-0.82)	0.86 (0.61-1.23)	0.98 (0.70-1.38)	2.06 (1.34-3.18)	*3.27* *(1.74-6.10)*	
Exeter V40[St] : R3 Cementless[SL]	MoP	2,751	75 (69 to 80)	28	0.78 (0.51-1.20)	1.30 (0.93-1.83)	1.70 (1.24-2.33)	*2.44* *(1.71-3.47)*		
Exeter V40[St] : Trident[SL]	MoP	69,230	74 (68 to 79)	37	0.69 (0.63-0.75)	1.14 (1.06-1.22)	1.48 (1.38-1.59)	2.48 (2.31-2.67)	3.81 (3.44-4.22)	
Exeter V40[St] : Trident[SL]	CoP	59,507	66 (58 to 72)	41	0.57 (0.51-0.63)	0.90 (0.82-0.99)	1.17 (1.07-1.28)	1.85 (1.65-2.08)	2.72 (2.13-3.47)	

*Inclusion criteria relaxed to show the newly identified dual mobility hips with at least 1,000 procedures.
Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

Table 3.H8 (continued)

Stem:cup brand	Bearing surface	N	Age at primary Median (IQR)	Male (%)	Time since primary					
					1 year	3 years	5 years	10 years	15 years	19 years
Exeter V40[St] : Trident[SL]	CoC	13,163	59 (53 to 65)	44	0.53 (0.42-0.67)	1.06 (0.89-1.25)	1.53 (1.34-1.76)	2.63 (2.36-2.93)	3.86 (3.48-4.29)	*5.33 (4.22-6.72)*
Exeter V40[St] : Trident[SL]*	MoPoM	2,650	75 (68 to 81)	33	1.00 (0.68-1.48)	1.55 (1.10-2.18)	1.75 (1.24-2.46)			
Exeter V40[St] : Trident[SL]*	CoPoM	1,100	71 (61 to 78)	46	1.07 (0.59-1.94)	1.49 (0.84-2.65)	*1.83 (1.01-3.28)*			
Exeter V40[St] : Trilogy[SL]	MoP	12,343	71 (65 to 77)	40	0.56 (0.45-0.71)	0.87 (0.72-1.06)	1.25 (1.06-1.47)	2.15 (1.87-2.45)	3.35 (2.91-3.85)	*4.28 (3.33-5.50)*
Exeter V40[St] : Trilogy[SL]	CoP	2,830	63 (57 to 68)	43	0.57 (0.35-0.92)	0.93 (0.64-1.37)	1.16 (0.82-1.64)	1.93 (1.45-2.56)	3.06 (2.33-4.01)	*3.58 (2.63-4.88)*
Exeter V40[St] : Tritanium[SL]	MoP	2,646	75 (70 to 80)	38	1.00 (0.67-1.47)	1.56 (1.13-2.17)	2.31 (1.72-3.12)	*3.29 (2.45-4.42)*		
Exeter V40[St] : Tritanium[SL]	CoP	5,976	65 (58 to 71)	47	0.97 (0.75-1.27)	1.51 (1.20-1.90)	1.88 (1.50-2.36)	*2.62 (1.96-3.50)*		
TaperFit Cemented Stem[St] : Trinity[SL]	MoP	4,111	76 (71 to 80)	33	1.12 (0.84-1.50)	1.63 (1.27-2.09)	1.80 (1.41-2.30)	*2.50 (1.83-3.40)*		
TaperFit Cemented Stem[St] : Trinity[SL]	CoP	3,455	69 (62 to 74)	35	0.80 (0.55-1.16)	1.27 (0.92-1.73)	1.41 (1.04-1.92)			
Reverse hybrid										
Corail[St] : Marathon[C]	MoP	13,607	73 (68 to 78)	38	0.66 (0.53-0.81)	1.04 (0.88-1.24)	1.32 (1.12-1.54)	2.37 (1.98-2.83)		
Corail[St] : Marathon[C]	CoP	6,112	63 (57 to 68)	41	0.53 (0.37-0.75)	1.04 (0.80-1.35)	1.31 (1.03-1.67)	2.08 (1.57-2.75)		

*Inclusion criteria relaxed to show the newly identified dual mobility hips with at least 1,000 procedures.
Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: [St]=Stem; [C]=Cup; [SL]=Shell liner.

3.2.5 Revisions for different indications after primary hip replacement

Overall, 43,682 (3.0%) of the 1,448,541 primary hip replacements had an associated first revision. The most common indications for revision were aseptic loosening (10,828), dislocation / subluxation (7,602), periprosthetic fracture (7,176), infection (6,779), adverse soft tissue reaction to particulate debris (6,268, a figure that is likely to be an underestimate due to changes in MDS collection, see later), and pain (5,100). Pain was not usually cited alone; in 3,469 out of the 5,100 instances (68%), it was cited together with one or more other indications. Associated PTIRs for these and the other indications are shown in Table 3.H9 (page 108). Here, implant wear denotes wear of the polyethylene component, wear of the acetabular component or dissociation of the liner.

The number of adverse reactions to particulate debris is likely to be underestimated because this was not requested as it was not available as an indication for revision on the data collection forms in the early phase of the registry, i.e. was not included in MDSv1 and MDSv2. Some of these cases may have recorded the indication for revision as 'other' but this is not definitively known. Adoption of the later revision report forms (MDSv3 onwards) was staggered over time and so a small number of revisions associated with a few primaries as late as 2011 still had revisions reported on MDSv1 and MDSv2 of the data collection forms.

Restricting our analyses to primaries from 2008 onwards, as done in recent annual reports, ensures that >99% of revisions were recorded on later forms (MDSv3 onwards). It was noted that only 2,961 of the 6,268 instances (47.2%) of adverse reactions to particulate debris would thus be included, i.e. 3,307 of the earlier cases are therefore excluded from the analysis. Therefore, two sets of PTIRs are presented: one set for all primary hip replacements in the registry, which are likely to be underestimates of revisions for adverse reactions to particulate debris, and the other set for all primary hip replacements performed since the beginning of 2008, which has better ascertainment but does not include the cases with the longest follow-up.

Table 3.H9 reports revision by indication with further breakdowns by hip fixation and bearing. Metal-on-metal (irrespective of the type of fixation) and resurfacings seem to have the highest PTIRs for both aseptic loosening and pain, but ceramic-on-metal has similarly poor outcomes with rates that are not statistically significantly different. Metal-on-metal bearings have the highest incidence of adverse reaction to particulate debris. Although the numbers are relatively small in comparison to other groups, dual mobility bearings appear to have PTIRs for revision for dislocation / subluxation that are higher than or similar to alternative bearings and higher PTIRs for revision for periprosthetic fracture and infection. It is not yet known how much selection accounts for these observations.

Table 3.H9 PTIR estimates of indications for hip revision (95% CI) by fixation and bearing.

Fixation and bearing surface	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for: All causes	Aseptic loosening	Pain	Dislocation / Subluxation	Infection	Periprosthetic fracture	Malalignment	Lysis	Implant wear	Implant fracture	Head/socket size mismatch	Adverse reaction to particulate debris**	Adverse reaction to particulate debris for primaries from 1.1.2008***: Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years
All cases*	10,294.8	4.24 (4.20-4.28)	1.05 (1.03-1.07)	0.50 (0.48-0.51)	0.74 (0.72-0.76)	0.66 (0.64-0.67)	0.70 (0.68-0.71)	0.28 (0.27-0.29)	0.26 (0.25-0.27)	0.24 (0.23-0.25)	0.14 (0.13-0.15)	0.03 (0.02-0.03)	0.61 (0.59-0.62)	7,815.9	0.38 (0.37-0.39)
All cemented	3,234.4	3.15 (3.08-3.21)	1.07 (1.04-1.11)	0.21 (0.20-0.23)	0.76 (0.73-0.79)	0.63 (0.60-0.65)	0.54 (0.51-0.56)	0.16 (0.15-0.18)	0.23 (0.21-0.24)	0.19 (0.18-0.21)	0.08 (0.07-0.09)	0.01 (0.01-0.02)	0.03 (0.03-0.04)	2,224.2	0.02 (0.02-0.03)
MoP	2,821.8	3.21 (3.14-3.28)	1.12 (1.08-1.16)	0.22 (0.20-0.23)	0.78 (0.75-0.81)	0.62 (0.59-0.65)	0.55 (0.52-0.58)	0.17 (0.16-0.19)	0.24 (0.22-0.26)	0.20 (0.19-0.22)	0.07 (0.06-0.08)	0.01 (0.01-0.02)	0.03 (0.03-0.04)	1,889.5	0.02 (0.02-0.03)
MoM	4.7	5.80 (3.98-8.46)	1.93 (1.01-3.72)	0.21 (0.03-1.53)	1.07 (0.45-2.58)	0.64 (0.21-2.00)	0.86 (0.32-2.29)	0	1.07 (0.45-2.58)	0.64 (0.21-2.00)	0.86 (0.32-2.29)	0	0.64 (0.21-2.00)	1.0	0
CoP	395.5	2.59 (2.44-2.76)	0.76 (0.68-0.85)	0.17 (0.14-0.22)	0.56 (0.49-0.64)	0.66 (0.58-0.74)	0.39 (0.33-0.46)	0.13 (0.10-0.17)	0.16 (0.12-0.20)	0.12 (0.09-0.16)	0.11 (0.08-0.15)	0.01 (0.00-0.02)	0.03 (0.02-0.06)	321.1	0.03 (0.02-0.06)
MoPoM	11.4	5.64 (4.41-7.20)	0.88 (0.47-1.64)	0.18 (0.04-0.70)	0.97 (0.54-1.75)	1.50 (0.93-2.41)	2.29 (1.56-3.36)	0.09 (0.01-0.63)	0.09 (0.01-0.63)	0	0	0	0	11.3	0
CoPoM	1.1	3.74 (1.40-9.96)	0.93 (0.13-6.63)	0	0.93 (0.13-6.63)	0	1.87 (0.47-7.47)	0	0	0	0	0	0	1.1	0
All uncemented	3,889.3	4.82 (4.75-4.88)	1.16 (1.13-1.20)	0.59 (0.57-0.62)	0.72 (0.70-0.75)	0.63 (0.61-0.66)	0.68 (0.65-0.70)	0.37 (0.35-0.39)	0.26 (0.25-0.28)	0.31 (0.30-0.33)	0.18 (0.17-0.19)	0.04 (0.04-0.05)	0.97 (0.94-1.00)	3,219.1	0.62 (0.59-0.65)
MoP	1,430.1	3.85 (3.75-3.95)	0.91 (0.87-0.97)	0.33 (0.30-0.36)	0.89 (0.84-0.94)	0.59 (0.55-0.63)	0.85 (0.80-0.89)	0.33 (0.30-0.36)	0.22 (0.20-0.25)	0.40 (0.37-0.44)	0.10 (0.08-0.11)	0.04 (0.03-0.05)	0.19 (0.17-0.21)	1,204.5	0.18 (0.16-0.21)
MoM	335.1	17.38 (16.94-17.83)	3.37 (3.18-3.57)	3.11 (2.93-3.31)	0.78 (0.69-0.88)	1.38 (1.26-1.51)	0.91 (0.81-1.02)	0.69 (0.61-0.78)	1.38 (1.26-1.51)	0.58 (0.50-0.66)	0.19 (0.14-0.24)	0.07 (0.05-0.11)	9.60 (9.27-9.94)	168.9	9.15 (8.71-9.62)
CoP	853.2	3.18 (3.06-3.30)	0.75 (0.69-0.81)	0.24 (0.21-0.28)	0.79 (0.73-0.85)	0.61 (0.56-0.67)	0.50 (0.45-0.55)	0.31 (0.28-0.35)	0.11 (0.09-0.13)	0.25 (0.22-0.29)	0.08 (0.07-0.11)	0.03 (0.02-0.05)	0.06 (0.05-0.08)	730.0	0.06 (0.04-0.08)
CoC	1,239.2	3.55 (3.45-3.66)	1.10 (1.04-1.16)	0.45 (0.41-0.49)	0.47 (0.43-0.51)	0.48 (0.44-0.52)	0.53 (0.49-0.57)	0.35 (0.32-0.38)	0.10 (0.09-0.12)	0.18 (0.15-0.20)	0.34 (0.31-0.37)	0.04 (0.03-0.05)	0.13 (0.11-0.15)	1,085.0	0.12 (0.10-0.15)
CoM	23.8	8.61 (7.51-9.87)	3.02 (2.40-3.81)	1.26 (0.88-1.80)	0.50 (0.29-0.89)	0.97 (0.64-1.45)	0.71 (0.44-1.15)	0.63 (0.38-1.05)	0.63 (0.38-1.05)	0.46 (0.26-0.83)	0.21 (0.09-0.50)	0.17 (0.06-0.45)	2.31 (1.77-3.01)	23.1	2.25 (1.72-2.96)
MoPoM	4.5	9.04 (6.66-12.28)	1.32 (0.59-2.95)	0.44 (0.11-1.76)	2.21 (1.19-4.10)	2.43 (1.34-4.38)	2.65 (1.50-4.66)	0.66 (0.21-2.05)	0	0.44 (0.11-1.76)	0	0	0.44 (0.11-1.76)	4.5	0.45 (0.11-1.78)
CoPoM	2.4	6.36 (3.84-10.56)	0.42 (0.06-3.01)	0.42 (0.06-3.01)	0.42 (0.06-3.01)	1.70 (0.64-4.52)	2.97 (1.42-6.23)	0.85 (0.21-3.39)	0	0.85 (0.21-3.39)	0	0	0	2.4	0
Others	1.0	15.04 (9.06-24.94)	1.00 (0.14-7.12)	1.00 (0.14-7.12)	2.00 (0.50-8.02)	2.00 (0.50-8.02)	2.00 (0.50-8.02)	2.00 (0.50-8.02)	2.00 (0.50-8.02)	0	1.00 (0.14-7.12)	2.00 (0.50-8.02)	7.02 (3.35-14.72)	0.8	7.31 (3.28-16.27)

*Including 40,020 with unconfirmed fixation/bearing.
**Rates are likely to be underestimated: this reason was not solicited in the early phase of the registry (revision report forms MDSv1/MDSv2).
***For primaries from 2008 onwards the majority of revision report forms were MDSv3/MDSv6 which explicitly gave this indication for revision as an option.

Table 3.H9 (continued)

Fixation and bearing surface	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for: All causes	Aseptic loosening	Pain	Dislocation / Subluxation	Infection	Periprosthetic fracture	Malalignment	Lysis	Implant wear	Implant fracture	Head/ socket size mismatch	Adverse reaction to particulate debris**	Adverse reaction to particulate debris for primaries from 1.1.2008***: Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years
All hybrid	2,065.0	3.44 (3.37-3.53)	0.47 (0.44-0.50)	0.22 (0.20-0.24)	0.85 (0.81-0.89)	0.77 (0.73-0.81)	0.87 (0.83-0.91)	0.21 (0.19-0.23)	0.16 (0.14-0.17)	0.18 (0.16-0.20)	0.15 (0.13-0.16)	0.02 (0.01-0.03)	0.17 (0.15-0.18)	1,703.9	0.10 (0.09-0.12)
MoP	1,176.7	3.42 (3.32-3.53)	0.49 (0.46-0.54)	0.19 (0.16-0.21)	0.93 (0.87-0.98)	0.75 (0.70-0.80)	0.98 (0.92-1.03)	0.22 (0.19-0.24)	0.17 (0.15-0.20)	0.21 (0.18-0.24)	0.10 (0.08-0.12)	0.02 (0.01-0.02)	0.07 (0.05-0.08)	947.0	0.06 (0.05-0.08)
MoM	28.1	15.45 (14.07-16.98)	2.88 (2.32-3.59)	2.60 (2.07-3.27)	1.14 (0.81-1.61)	1.21 (0.87-1.69)	1.71 (1.29-2.27)	0.43 (0.24-0.75)	1.60 (1.20-2.15)	0.36 (0.19-0.66)	0.36 (0.19-0.66)	0.07 (0.02-0.28)	7.44 (6.50-8.52)	10.3	6.59 (5.19-8.35)
CoP	561.6	3.13 (2.99-3.28)	0.26 (0.22-0.31)	0.12 (0.09-0.15)	0.88 (0.80-0.96)	0.92 (0.85-1.01)	0.72 (0.65-0.79)	0.17 (0.14-0.21)	0.08 (0.06-0.11)	0.12 (0.10-0.15)	0.10 (0.08-0.13)	0.02 (0.01-0.04)	0.03 (0.02-0.05)	527.4	0.03 (0.02-0.05)
CoC	275.2	2.81 (2.62-3.01)	0.51 (0.43-0.60)	0.36 (0.30-0.44)	0.37 (0.31-0.45)	0.45 (0.37-0.53)	0.58 (0.49-0.67)	0.25 (0.20-0.32)	0.12 (0.08-0.16)	0.13 (0.10-0.19)	0.42 (0.35-0.50)	0.02 (0.01-0.05)	0.12 (0.09-0.17)	196.0	0.13 (0.09-0.19)
MoPoM	17.7	5.13 (4.18-6.30)	0.51 (0.26-0.98)	0	1.30 (0.86-1.95)	1.69 (1.18-2.42)	1.35 (0.91-2.02)	0.06 (0.01-0.40)	0.06 (0.01-0.40)	0.39 (0.19-0.83)	0.17 (0.05-0.52)	0	0.06 (0.01-0.40)	17.7	0.06 (0.01-0.40)
CoPoM	4.8	4.83 (3.21-7.27)	0.63 (0.20-1.95)	0	1.05 (0.44-2.52)	1.47 (0.70-3.08)	2.10 (1.13-3.90)	0.21 (0.03-1.49)	0	0.21 (0.03-1.49)	0	0.21 (0.03-1.49)	0	4.8	0
Others	0.9	6.40 (2.88-14.25)	0	0	2.13 (0.53-8.53)	2.13 (0.53-8.53)	0	0	0	0	2.13 (0.53-8.53)	0	1.07 (0.15-7.58)	0.7	1.34 (0.19-9.51)
All reverse hybrid	248.4	3.73 (3.50-3.98)	1.24 (1.11-1.39)	0.25 (0.20-0.32)	0.79 (0.69-0.91)	0.70 (0.60-0.81)	0.70 (0.60-0.81)	0.25 (0.20-0.32)	0.18 (0.14-0.24)	0.23 (0.18-0.30)	0.05 (0.03-0.09)	0.02 (0.01-0.05)	0.06 (0.03-0.10)	221.7	0.05 (0.02-0.08)
MoP	164.5	3.86 (3.57-4.17)	1.21 (1.05-1.39)	0.18 (0.12-0.25)	0.89 (0.75-1.04)	0.70 (0.58-0.84)	0.80 (0.67-0.95)	0.22 (0.16-0.31)	0.21 (0.15-0.29)	0.22 (0.16-0.31)	0.04 (0.02-0.09)	0.02 (0.01-0.06)	0.07 (0.04-0.13)	147.0	0.06 (0.03-0.12)
CoP	82.8	3.44 (3.06-3.86)	1.30 (1.08-1.57)	0.41 (0.29-0.57)	0.59 (0.45-0.78)	0.68 (0.52-0.88)	0.49 (0.36-0.67)	0.30 (0.20-0.45)	0.13 (0.07-0.24)	0.25 (0.17-0.39)	0.05 (0.02-0.13)	0.02 (0.01-0.10)	0.02 (0.01-0.10)	73.8	0.01 (0.00-0.10)
Others	1.1	6.39 (3.05-13.41)	0.91 (0.13-6.48)	0	0.91 (0.13-6.48)	1.83 (0.46-7.30)	0.91 (0.13-6.48)	0.91 (0.13-6.48)	0	0	0.91 (0.13-6.48)	0	0	0.9	0
All resurfacing	511.7	9.59 (9.33-9.87)	2.08 (1.96-2.21)	2.67 (2.54-2.82)	0.23 (0.19-0.27)	0.45 (0.40-0.51)	1.07 (0.98-1.16)	0.52 (0.46-0.58)	0.87 (0.79-0.95)	0.23 (0.19-0.27)	0.21 (0.17-0.25)	0.05 (0.03-0.07)	3.50 (3.34-3.67)	221.4	2.79 (2.58-3.02)
MoM	510.6	9.59 (9.33-9.87)	2.07 (1.95-2.20)	2.68 (2.54-2.82)	0.23 (0.19-0.27)	0.45 (0.40-0.51)	1.06 (0.97-1.15)	0.52 (0.46-0.58)	0.87 (0.79-0.95)	0.23 (0.19-0.27)	0.21 (0.17-0.25)	0.05 (0.03-0.07)	3.51 (3.35-3.67)	220.4	2.80 (2.59-3.03)
CoC	0.6	6.63 (2.49-17.67)	0	0	0	0	4.98 (1.60-15.43)	1.66 (0.23-11.77)	0	0	0	0	0	0.6	0
Others	0.5	12.81 (5.75-28.50)	8.54 (3.20-22.75)	2.13 (0.30-15.15)	0	0	2.13 (0.30-15.15)	0	2.13 (0.30-15.15)	4.27 (1.07-17.07)	2.13 (0.30-15.15)	0	0	0.4	0

*Including 40,020 with unconfirmed fixation/bearing.
**Rates are likely to be underestimated: this reason was not solicited in the early phase of the registry (revision report forms MDSv1/MDSv2).
***For primaries from 2008 onwards the majority of revision report forms were MDSv3/MDSv6 which explicitly gave this indication for revision as an option.

Table 3.H10 PTIR estimates of indications for revision (95% CI) by years following primary hip replacement.

Time since primary	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for:												Adverse reaction to particulate debris for primaries from 1.1.2008***	
		All causes	Aseptic loosening	Pain	Dislocation / Subluxation	Infection	Periprosthetic fracture	Malalignment	Lysis	Implant wear	Implant fracture	Head/socket size mismatch	Adverse reaction to particulate debris**	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years
All cases	10,294.8	4.24 (4.20-4.28)	1.05 (1.03-1.07)	0.50 (0.48-0.51)	0.74 (0.72-0.76)	0.66 (0.64-0.67)	0.70 (0.68-0.71)	0.28 (0.27-0.29)	0.26 (0.25-0.27)	0.24 (0.23-0.25)	0.14 (0.13-0.15)	0.03 (0.02-0.03)	0.61 (0.59-0.62)	7,815.9	0.38 (0.37-0.39)
<1 year	1,380.0	8.18 (8.03-8.34)	0.93 (0.88-0.98)	0.45 (0.42-0.49)	2.41 (2.33-2.49)	2.12 (2.04-2.19)	1.70 (1.63-1.77)	0.66 (0.62-0.71)	0.06 (0.05-0.08)	0.28 (0.25-0.31)	0.19 (0.17-0.21)	0.09 (0.08-0.11)	0.08 (0.07-0.10)	1,186.4	0.10 (0.08-0.11)
1 to <3 years	2,429.0	3.24 (3.17-3.32)	0.86 (0.82-0.89)	0.58 (0.55-0.61)	0.58 (0.55-0.61)	0.65 (0.62-0.68)	0.38 (0.36-0.41)	0.29 (0.27-0.31)	0.12 (0.11-0.13)	0.11 (0.10-0.13)	0.10 (0.09-0.12)	0.02 (0.02-0.03)	0.18 (0.16-0.20)	2,053.2	0.20 (0.18-0.22)
3 to <5 years	2,015.3	3.07 (3.00-3.15)	0.78 (0.74-0.82)	0.59 (0.56-0.63)	0.42 (0.39-0.45)	0.40 (0.38-0.43)	0.44 (0.41-0.47)	0.20 (0.19-0.22)	0.17 (0.15-0.19)	0.15 (0.14-0.17)	0.10 (0.09-0.12)	0.01 (0.01-0.02)	0.54 (0.51-0.57)	1,658.5	0.41 (0.38-0.44)
5 to <7 years	1,556.0	3.50 (3.41-3.59)	0.92 (0.87-0.97)	0.59 (0.55-0.63)	0.39 (0.36-0.42)	0.32 (0.30-0.35)	0.54 (0.50-0.57)	0.19 (0.17-0.21)	0.25 (0.23-0.28)	0.19 (0.17-0.21)	0.12 (0.11-0.14)	0.01 (0.01-0.02)	0.93 (0.89-0.98)	1,222.8	0.52 (0.48-0.57)
7 to <10 years	1,578.1	3.97 (3.87-4.07)	1.23 (1.18-1.28)	0.41 (0.38-0.45)	0.46 (0.43-0.50)	0.32 (0.29-0.34)	0.62 (0.58-0.66)	0.19 (0.17-0.21)	0.40 (0.37-0.43)	0.27 (0.25-0.30)	0.15 (0.14-0.18)	0.01 (0.01-0.02)	1.05 (1.00-1.10)	1,129.8	0.59 (0.55-0.64)
10 to <13 years	869.8	4.81 (4.67-4.96)	1.73 (1.64-1.82)	0.25 (0.22-0.28)	0.50 (0.46-0.55)	0.35 (0.32-0.40)	0.89 (0.83-0.95)	0.17 (0.14-0.20)	0.63 (0.58-0.68)	0.52 (0.47-0.57)	0.20 (0.17-0.23)	0.01 (0.01-0.03)	1.16 (1.09-1.23)	488.6	0.76 (0.69-0.84)
13 to <15 years	292.8	5.21 (4.96-5.48)	2.14 (1.98-2.31)	0.22 (0.17-0.28)	0.52 (0.44-0.61)	0.34 (0.28-0.41)	0.91 (0.81-1.02)	0.14 (0.10-0.19)	0.90 (0.80-1.02)	0.74 (0.65-0.85)	0.26 (0.21-0.33)	0.01 (0.00-0.03)	1.20 (1.08-1.33)	76.7	0.98 (0.78-1.23)
15 to <17 years	132.9	5.03 (4.66-5.42)	2.12 (1.89-2.39)	0.14 (0.09-0.22)	0.59 (0.48-0.74)	0.28 (0.20-0.38)	1.03 (0.87-1.22)	0.19 (0.13-0.28)	0.90 (0.75-1.07)	0.88 (0.73-1.06)	0.24 (0.17-0.34)	0.02 (0.01-0.07)	0.94 (0.79-1.12)		
≥17 years*	41.0	5.49 (4.82-6.26)	2.90 (2.43-3.48)	0.12 (0.05-0.29)	0.44 (0.28-0.70)	0.44 (0.28-0.70)	1.07 (0.80-1.44)	0.24 (0.13-0.45)	1.20 (0.90-1.58)	0.83 (0.59-1.16)	0.29 (0.17-0.52)	0.02 (0.00-0.17)	0.78 (0.55-1.10)		

*Current maximum observed follow-up is 19.75 years.
**Rates are likely to be underestimated: this reason was not solicited in the early phase of the registry (revision report forms MDSv1/MDSv2).
***For primaries from 2008 onwards the majority of revision report forms were MDSv3/MDSv6 which explicitly gave this indication for revision as an option.
Note: Blank cells indicate there are no current data.

In Table 3.H10 (page 110), the PTIRs for each indication are shown separately for different time periods from the primary hip replacement, within the first year, and between 1 to <3, 3 to <5, 5 to <7, 7 to <10, 10 to <13, 13 to <15, 15 to <17, and ≥17 years after surgery (the maximum follow-up for any implant is now 19.75 years). Revision rates due to aseptic loosening are fairly constant until five years and then begin to steadily increase. Revision due to pain rises out to seven years and then declines. The revision rates due to subluxation / dislocation, infection and malalignment were all higher in the first year and then fell. In the case of periprosthetic fracture, the highest rates were seen in the first year, these then declined markedly before beginning to rise again at around seven years. Revision for adverse reaction to particulate debris increased until 15 years before declining, whereas revision for lysis continued to rise with time.

Figures 3.H11 (a) to 3.H11 (g) (pages 112 to 115) show how PTIRs of revision for aseptic loosening, pain, dislocation / subluxation, infection, lysis and adverse soft tissue reaction to particulate debris changed with time. Only sub-groups with a total overall prosthesis-years at risk of more than 150,000 have been included. With time from the operation, PTIRs of revision for aseptic loosening tended to rise in cemented fixations and follow a fairly similar pattern in uncemented metal-on-polyethylene bearings. In uncemented metal-on-metal, they rose for the first seven years and then fell. In uncemented ceramic-on-polyethylene, ceramic-on-ceramic, hybrid ceramic-on-ceramic and resurfacings, the PTIRs were reasonably consistent over time. In hybrid metal-on-polyethylene and ceramic-on-polyethylene bearings, there were marked increases at later time points. For pain, PTIRs were either fairly consistent or had a small initial peak followed by a decline to fairly constant rates for all bearings, apart from uncemented metal-on-metal and resurfacings where rates started high, rose to peaks at five years and then declined. Conversely, there was a high initial rate for dislocation / subluxation in all fixation / bearing groups which later fell but then began to rise in all groups from 13 years onwards apart from cemented metal-on-polyethylene, uncemented metal-on-metal, hybrid ceramic-on-ceramic and resurfacing (Figure 3.H11 (c), page 113). Revision rates for infection were initially high and then fell in all groups apart from uncemented metal-on-metal primary total hip replacement and resurfacing (Figure 3.H11 (d), page 113). The opposite was seen for lysis with increasing rates over time in all groups (Figure 3.H11 (e), page 114).

Revision rates due to an adverse reaction to particulate debris increased with time, up to seven years in uncemented metal-on-metal primary total hip replacement and resurfacings (Figures 3.H11 (f) and (g), pages 114 and 115). Confidence intervals have not been shown here for simplicity but are wide in some groups.

Figure 3.H11 (a) PTIR estimates of aseptic loosening by fixation and bearing.

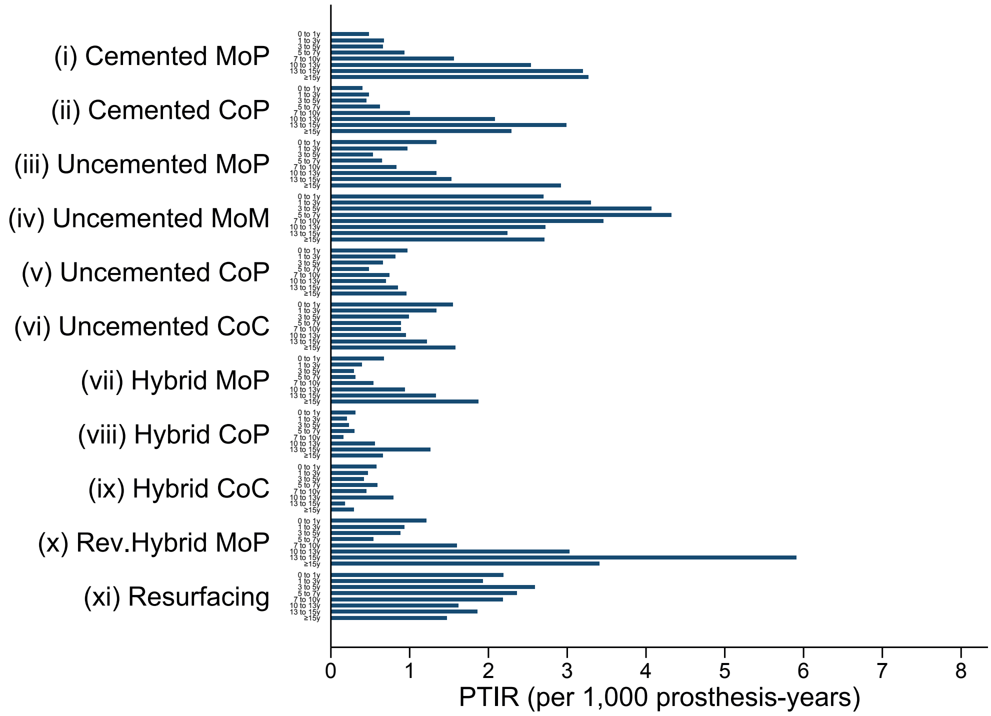


Figure 3.H11 (b) PTIR estimates of pain by fixation and bearing.

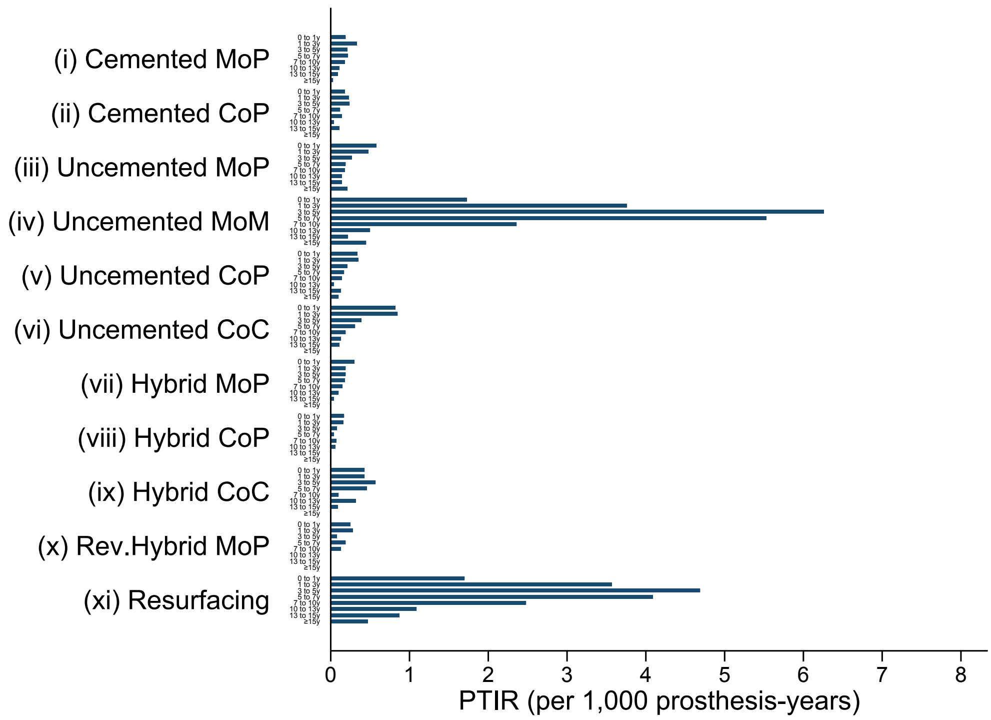


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Figure 3.H11 (c) PTIR estimates of dislocation / subluxation by fixation and bearing.

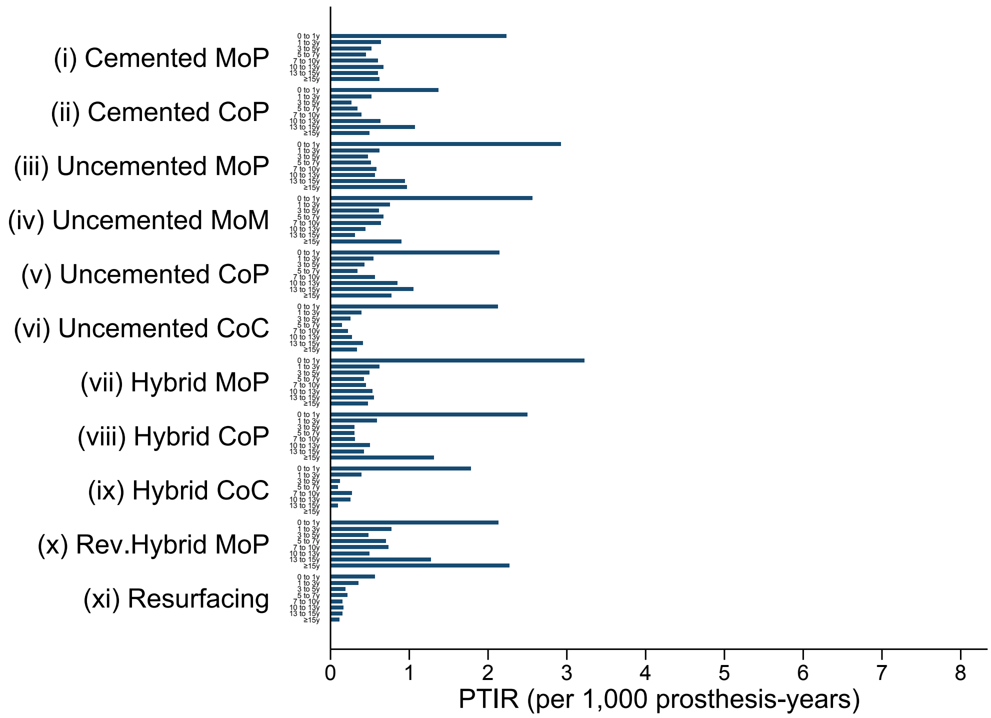


Figure 3.H11 (d) PTIR estimates of infection by fixation and bearing.

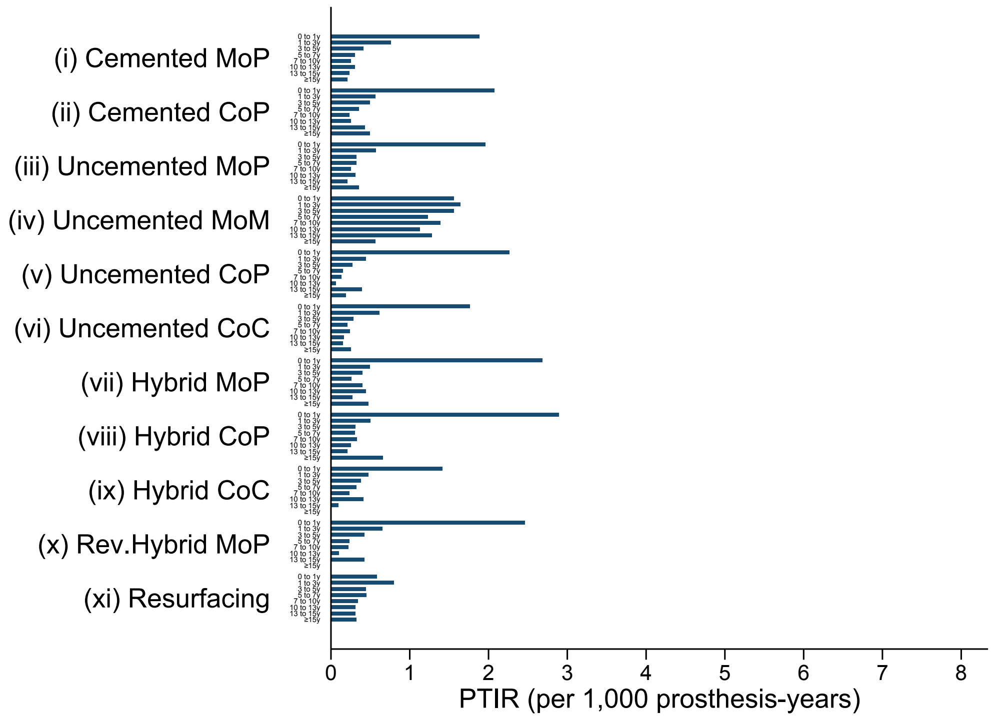


Figure 3.H11 (e) PTIR estimates of lysis by fixation and bearing.

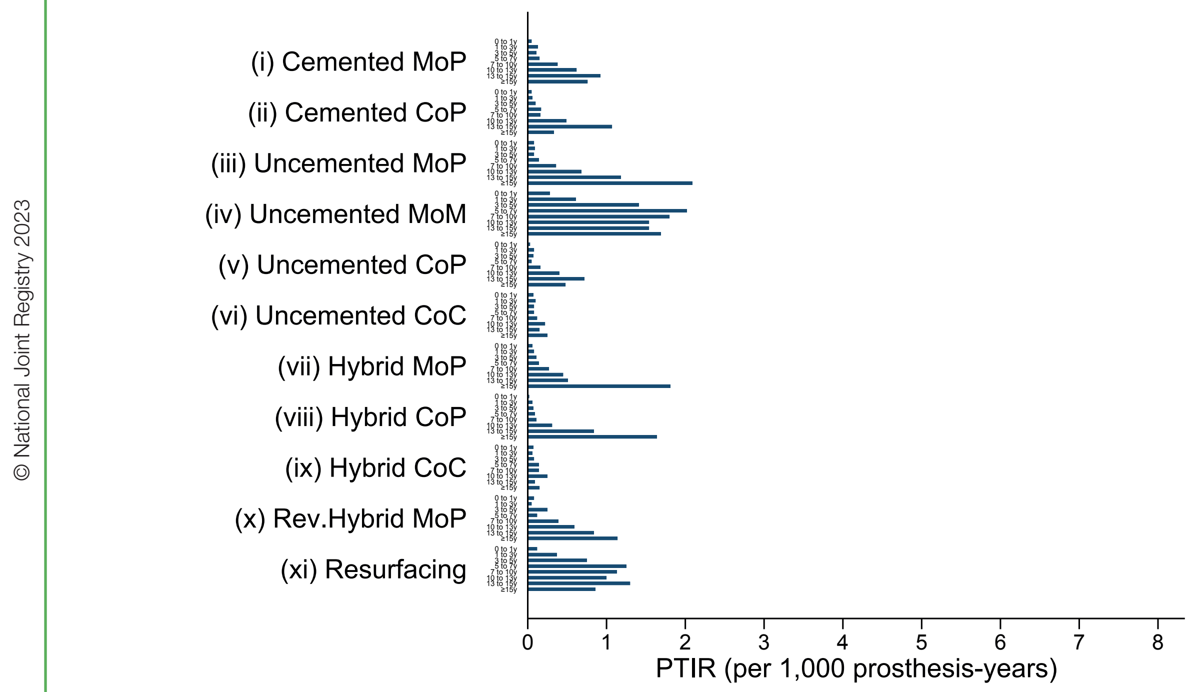


Figure 3.H11 (f) PTIR estimates of adverse soft tissue reaction by fixation and bearing.

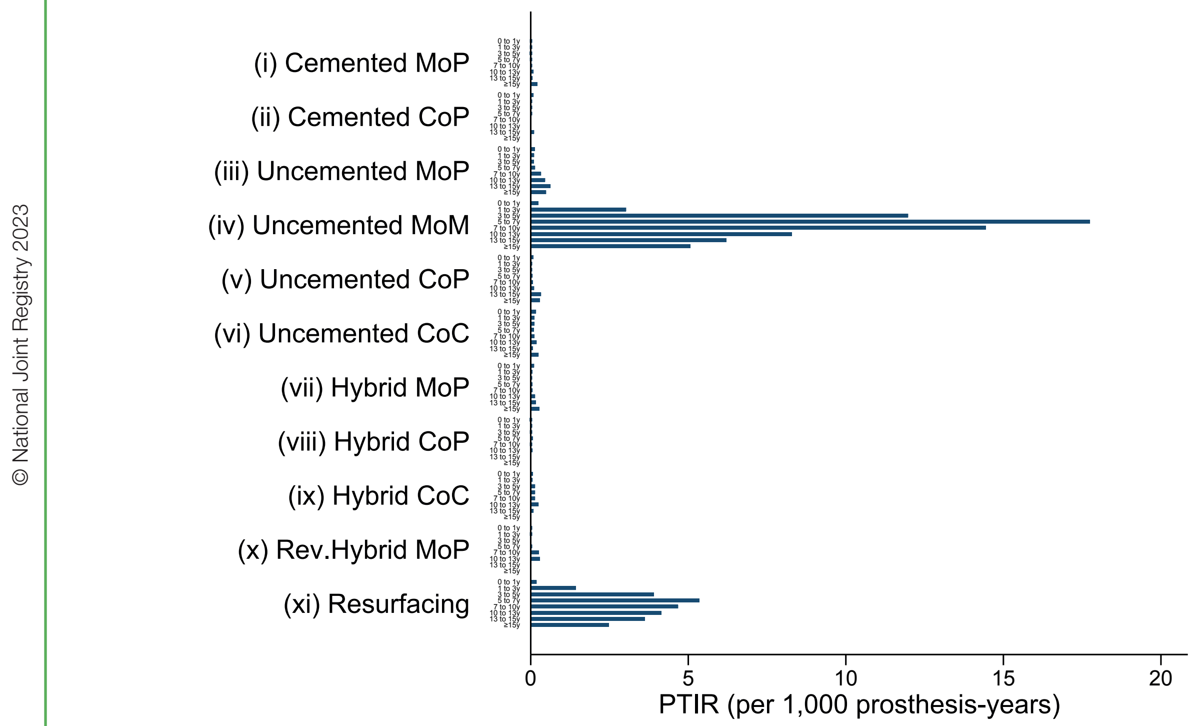
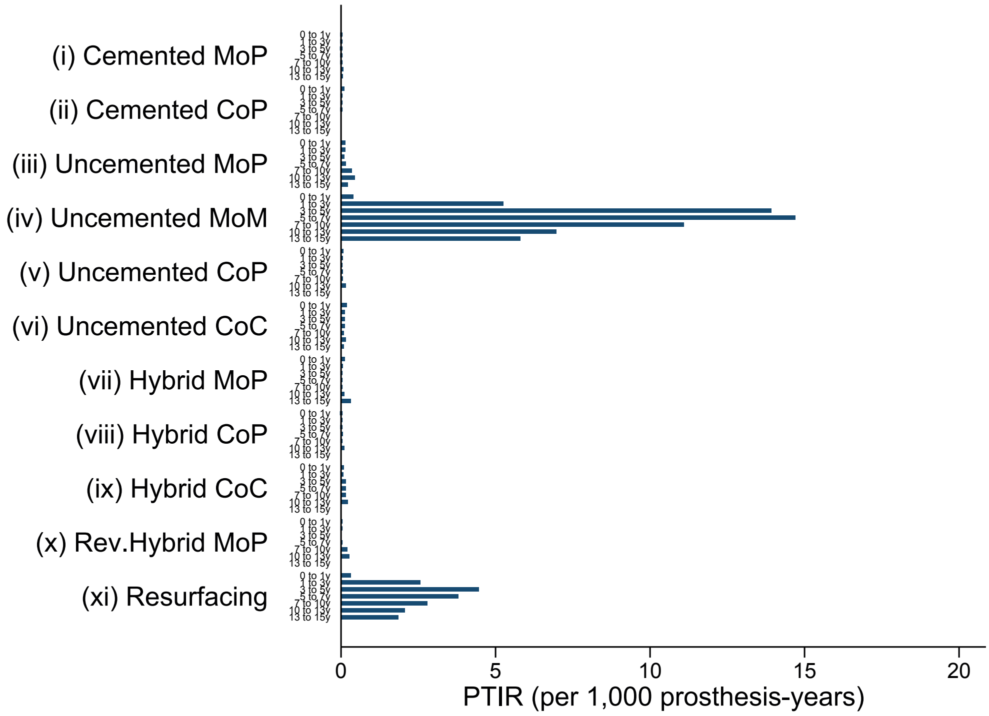


Figure 3.H11 (g) PTIR estimates of adverse soft tissue reaction by fixation and bearing, since 2008.



3.2.6 Mortality after primary hip replacement surgery

In this section we describe the mortality of the cohort up to 19 years from primary hip replacement, according to gender and age group. Deaths recorded after 31 December 2022 were not included in the analysis. For simplicity, we have not taken into account whether the patient had a first (or further) joint revision after the primary operation when calculating the cumulative probability of death. While such surgery may have contributed to the overall mortality, the impact of this is not investigated in this report (see survival analysis methods note in section 3.1). Among the 1,448,541 primary hip replacements, there were 6,088 bilateral operations, with the left and right side operated on the same day; here the second of the two has been excluded, leaving 1,442,452 primary hip replacements, of whom 318,078 had died before the end of 2022.

Table 3.H11 KM estimates of cumulative mortality (95% CI) by age and gender, in primary hip replacement. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

		Time since primary						
Age group	**N**	**30 days**	**90 days**	**1 year**	**5 years**	**10 years**	**15 years**	**19 years**
All cases	**1,442,453***	**0.21 (0.20-0.21)**	**0.45 (0.44-0.46)**	**1.43 (1.41-1.45)**	**9.57 (9.52-9.63)**	**25.56 (25.47-25.66)**	**44.09 (43.94-44.23)**	**58.51 (58.21-58.81)**
Male								
<55 years	84,614	0.07 (0.05-0.09)	0.15 (0.13-0.18)	0.53 (0.48-0.58)	2.35 (2.24-2.47)	5.50 (5.31-5.70)	9.74 (9.41-10.07)	14.48 (13.72-15.29)
55 to 59 years	59,649	0.06 (0.04-0.08)	0.20 (0.17-0.24)	0.63 (0.56-0.69)	3.42 (3.26-3.59)	8.86 (8.57-9.16)	16.93 (16.42-17.46)	26.08 (24.89-27.31)
60 to 64 years	82,449	0.10 (0.08-0.13)	0.23 (0.20-0.26)	0.80 (0.74-0.86)	4.72 (4.56-4.88)	12.37 (12.09-12.66)	24.64 (24.13-25.16)	39.86 (38.55-41.20)
65 to 69 years	96,826	0.15 (0.13-0.18)	0.36 (0.32-0.40)	1.09 (1.03-1.16)	6.87 (6.70-7.05)	18.82 (18.50-19.14)	38.34 (37.78-38.92)	58.30 (56.99-59.61)
70 to 74 years	101,143	0.19 (0.17-0.22)	0.43 (0.39-0.47)	1.56 (1.48-1.63)	10.41 (10.20-10.62)	29.32 (28.95-29.70)	56.86 (56.27-57.45)	*78.34 (77.19-79.48)*
75 to 79 years	83,287	0.37 (0.33-0.41)	0.73 (0.68-0.79)	2.45 (2.35-2.56)	16.67 (16.39-16.95)	46.29 (45.82-46.75)	77.93 (77.33-78.52)	*93.63 (92.59-94.57)*
80 to 84 years	49,215	0.67 (0.60-0.74)	1.34 (1.24-1.45)	3.89 (3.72-4.07)	26.58 (26.14-27.02)	66.80 (66.19-67.41)	92.34 (91.78-92.88)	*99.04 (98.17-99.55)*
≥85 years	21,863	1.53 (1.38-1.71)	2.79 (2.58-3.01)	7.41 (7.06-7.77)	43.16 (42.40-43.92)	85.63 (84.90-86.34)	*98.17 (97.70-98.57)*	*99.12 (98.63-99.46)*
Female								
<55 years	85,533	0.06 (0.05-0.08)	0.21 (0.18-0.24)	0.65 (0.60-0.71)	2.50 (2.39-2.62)	5.18 (5.00-5.37)	8.88 (8.56-9.21)	13.44 (12.60-14.33)
55 to 59 years	68,570	0.06 (0.05-0.09)	0.18 (0.15-0.22)	0.59 (0.54-0.65)	3.03 (2.89-3.18)	7.22 (6.97-7.47)	13.31 (12.88-13.75)	20.92 (19.90-21.98)
60 to 64 years	103,423	0.07 (0.06-0.09)	0.18 (0.16-0.21)	0.60 (0.56-0.65)	3.69 (3.56-3.82)	9.44 (9.21-9.67)	18.98 (18.56-19.40)	30.30 (29.24-31.38)
65 to 69 years	141,288	0.08 (0.07-0.10)	0.21 (0.19-0.24)	0.73 (0.69-0.78)	4.88 (4.76-5.00)	13.85 (13.62-14.09)	29.24 (28.80-29.68)	47.10 (46.05-48.17)
70 to 74 years	165,708	0.11 (0.10-0.13)	0.26 (0.24-0.29)	0.93 (0.88-0.97)	6.97 (6.84-7.11)	21.56 (21.29-21.83)	45.31 (44.84-45.78)	69.21 (68.17-70.25)
75 to 79 years	148,806	0.20 (0.18-0.22)	0.41 (0.38-0.45)	1.43 (1.37-1.49)	11.29 (11.11-11.47)	34.45 (34.11-34.78)	66.30 (65.81-66.79)	*87.23 (86.35-88.09)*
80 to 84 years	99,022	0.33 (0.29-0.37)	0.75 (0.70-0.81)	2.40 (2.31-2.50)	18.30 (18.03-18.57)	53.57 (53.14-54.00)	85.18 (84.71-85.64)	*96.85 (96.18-97.43)*
≥85 years	51,057	0.76 (0.69-0.84)	1.68 (1.57-1.79)	4.64 (4.46-4.83)	31.91 (31.46-32.36)	75.09 (74.55-75.62)	95.84 (95.45-96.21)	*99.24 (98.79-99.55)*

*Some patients had operations on the left and right side on the same day. The second of 6,088 pairs of simultaneous bilateral operations were excluded.

Table 3.H11 shows Kaplan-Meier estimates of cumulative percentage mortality at 30 days, 90 days and at 1, 5, 10, 15 and 19 years from the primary hip replacement, for all cases and by age and gender. It is clear that younger patients had a lower risk of death. These differences were apparent at 30 days, with approximately half the risk of death for a male patient under the age of 55 compared to one aged 65 to 69 years. These differences persisted to one year and then diverged further with four times the risk of death in the older group at 19 years. For a similar age group comparison, there was little initial difference for females, but by 19 years there was three and half times the risk of death in the older group. It is worthy of note that for all cases in the registry, there is almost a 10% risk of death by five years, over 25% by ten years, over 40% by 15 years and approaching 60% by 19 years after primary hip replacement. The median age for undergoing a total hip replacement is 69 years, and for the 50% of patients over this age mortality rates are extremely high by 19 years ranging from 69.21% (95% CI 68.17-70.25) for women aged 70-74 years to 99.12% (95% CI 98.63-99.46) for men aged over 85 years.

3.2.7 Primary hip replacement for fractured neck of femur compared with other reasons for implantation

Total hip replacement is a treatment option for fractured neck of femur and in this section, we report on revision and mortality rates for primary total hip replacements performed because of a fractured neck of femur compared to cases performed for other indications. A total of 55,396 (3.8%) of the primary total hip replacements were performed for a fractured neck of femur (NOF)†.

Table 3.H12 (page 118) shows that the proportion of primary hip replacements performed for an indication of a fractured neck of femur has increased with time to a maximum of 7.5% in 2020. The proportion of THRs performed for fractured neck of femur in 2020 was artificially inflated by the dramatic decrease in elective THRs performed in 2020 due to the impact of COVID, prior to this the peak was 5.7%. The use of dual mobility bearings has become more popular in this group and accounted for 11.2% of cases in 2022. The most striking feature is the marked drop in 2020 in the total annual number of THRs performed for a fractured NOF (4,318 compared to 5,671 in 2019). This is most likely due to the impact of the COVID pandemic possibly through a combination of fewer fractures occurring during lockdown and less or altered provision of care (with a possible shift from THR to hemiarthroplasty). This decrease has been sustained in 2021 with 4,571 THRs performed for fractured neck of femur and 4,690 in 2022. There are usually late registrations of cases into the registry and thus the figures for 2022 may be revised upwards in next year's report, but this observation may also be related to the publication of the HEALTH trial which demonstrated no difference in the risk of secondary procedures for patients receiving total hip replacement or hemiarthroplasty for a displaced hip fracture and a clinically unimportant improvement in function and quality of life for patients receiving a total hip replacement (Bhandari M, et al., 2019).

†These comprised 2,251 cases with the indication for primary hip replacement including fractured neck of femur in the early phase of the registry (i.e. 205,039 implants entered using MDSv1 and v2) and 53,145 cases with indications including acute trauma neck of femur in the later phase (i.e. 1,243,502 entered using MDSv3, v6 and v7).

Bhandari M et al.; Total Hip Arthroplasty or Hemiarthroplasty for Hip Fracture. Value Health. N Engl J Med 2019; 381:2199-2208.

Table 3.H12 Number and percentage of fractured neck of femur in the registry by year.

Year of primary	Primary total hip replacements for all indications N	NOF N (%)	NOF treated with: Dual mobility N (%)	NOF treated with: Unipolar N (%)
2003	14,976	143 (1.0)	0 (0)	127 (88.8)
2004	29,290	298 (1.0)	0 (0)	269 (90.3)
2005	41,698	395 (0.9)	0 (0)	359 (90.9)
2006	48,566	528 (1.1)	0 (0)	475 (90.0)
2007	61,727	787 (1.3)	0 (0)	733 (93.1)
2008	67,725	869 (1.3)	<4 (0.1)	783 (90.1)
2009	68,676	1,083 (1.6)	11 (1.0)	977 (90.2)
2010	71,201	1,371 (1.9)	8 (0.6)	1,247 (91.0)
2011	74,152	1,725 (2.3)	19 (1.1)	1,573 (91.2)
2012	78,361	2,440 (3.1)	21 (0.9)	2,263 (92.7)
2013	80,509	3,120 (3.9)	78 (2.5)	2,851 (91.4)
2014	87,774	3,728 (4.2)	151 (4.1)	3,348 (89.8)
2015	89,925	4,209 (4.7)	187 (4.4)	3,813 (90.6)
2016	94,473	4,879 (5.2)	302 (6.2)	4,375 (89.7)
2017	96,611	5,029 (5.2)	323 (6.4)	4,454 (88.6)
2018	97,665	5,542 (5.7)	369 (6.7)	4,880 (88.1)
2019	99,938	5,671 (5.7)	475 (8.4)	4,801 (84.7)
2020	57,309	4,318 (7.5)	371 (8.6)	3,609 (83.6)
2021	88,922	4,571 (5.1)	441 (9.6)	3,814 (83.4)
2022	99,043	4,690 (4.7)	526 (11.2)	3,870 (82.5)
Total	**1,448,541**	**55,396 (3.8)**	**3,283 (5.9)**	**48,621 (87.8)**

Note: Unipolar includes cemented, uncemented, hybrid, reverse hybrid, and resurfacing hip types, and excludes unconfirmed hip type.

Table 3.H13 Fractured neck of femur versus osteoarthritis only by gender, age and fixation.

	Reason for primary hip replacement	
	Fractured neck of femur (n=55,396)	Osteoarthritis only (n=1,273,746)
% Female	72.0%	59.1%
Median age (IQR)		
Both genders	73 (66 to 78)	70 (62 to 76)
Male only	72 (64 to 78)	68 (60 to 75)
Female only	73 (66 to 78)	71 (63 to 77)
% Hip type*		
All cemented	40.7	30.7
All uncemented	18.5	38.8
All hybrid	38.7	24.8
All reverse hybrid	2.0	2.7
All resurfacing	<0.1	3.1

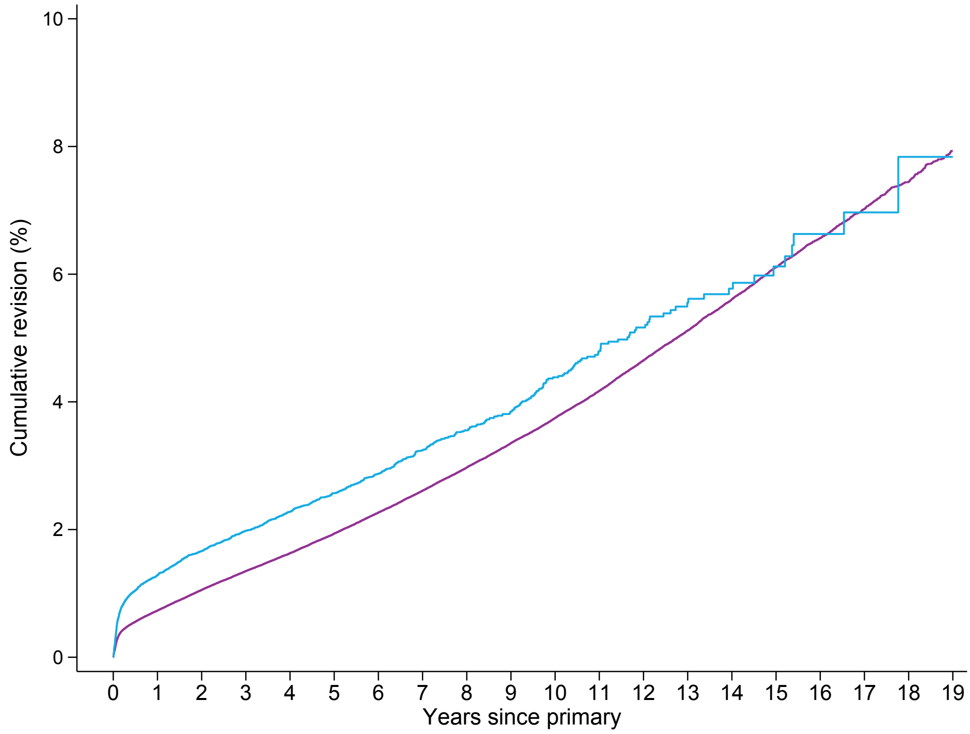
*Excludes 119,399 cases who had other reasons in addition to osteoarthritis.

Table 3.H13 compares the fractured NOF group with the remainder with respect to gender and age composition together and type of hip replacement received. A significantly larger percentage of the fractured NOF cases, compared with the remainder, were female (72.0% versus 59.1%: P<0.001, Chi-squared test).

The fractured NOF cases were significantly older (median age 73 years versus 70 years at operation). We found that cemented and hybrid hips were used more commonly in fractured NOF cases than in hip replacements performed for osteoarthritis only, but cemented fixation was still used in under half of the patients. Figure 3.H12 (a) (page 120) shows that the cumulative revision rate was higher in the fractured NOF cases group compared with the remainder (P<0.001, logrank test). The plotted cumulative revision lines diverge early in the first year and then remain approximately parallel out until about 13 years. This effect was not fully explained by differences in age and gender, as stratification by these variables left the result unchanged (P<0.001 using stratified logrank test: 14 sub-groups of age <55, 55 to 59, 60 to 64, 65 to 69, 70 to 74, 75 to 79, ≥80 for each gender). Figure 3.H12 (b) (page 121) shows similar cumulative revision rates for dual mobility compared to unipolar total hip replacement bearings in the hip fracture population out to six years after which point the numbers fall below 250 in the dual mobility group. While the difference here is not significant, it is interesting that this is a different pattern seen to that for dual mobility bearings in cemented and uncemented fixation groups in elective total hip replacement where the early revision rates appear higher in the dual mobility bearings.

Figure 3.H13 (page 122) shows a markedly higher overall mortality in total hip replacements performed for hip fracture cases compared to cases implanted for osteoarthritis only (P<0.001, logrank test). As in the overall mortality section, the second of 6,089 simultaneous bilateral procedures were excluded. Gender and age differences did not fully explain the difference seen, as a stratified analysis still showed a difference (P<0.001).

Figure 3.H12 (a) KM estimates of cumulative revision for fractured neck of femur and osteoarthritis only cases for primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

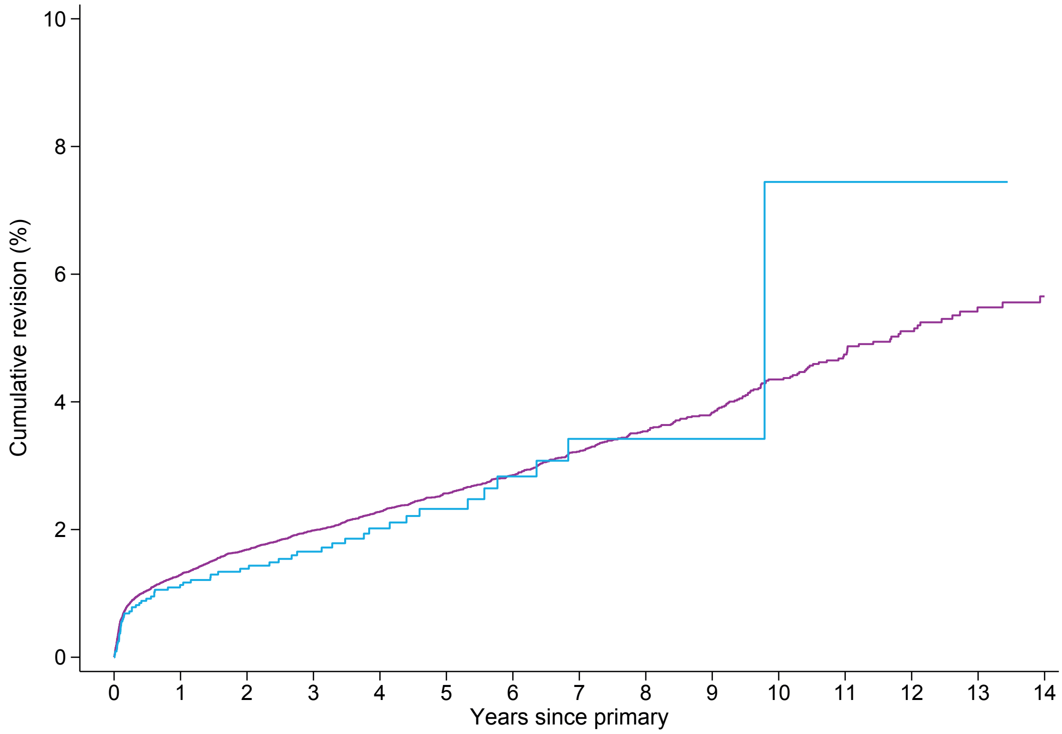


Key:

Numbers at risk

Key	0	2	4	6	8	10	12	14	16	18
Osteoarthritis only	1,273,746	1,071,453	899,047	698,116	515,142	358,599	230,894	131,150	58,171	16,398
Fractured neck of femur	55,396	41,372	29,321	18,154	9,871	4,835	2,319	1,045	363	*90*

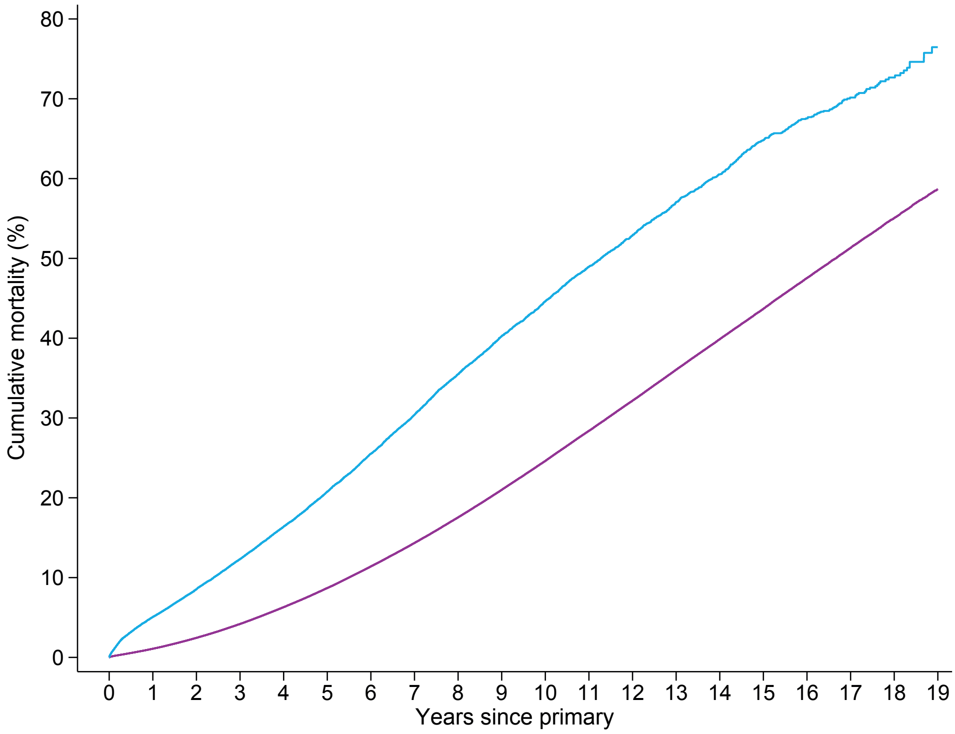
Figure 3.H12 (b) KM estimates of cumulative revision by bearing type for fractured neck of femur cases in primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key: Numbers at risk

Key	0	2	4	6	8	10	12	14
Unipolar bearings	48,621	36,943	26,664	16,692	9,107	4,474	2,135	964
Dual mobility	3,283	2,038	1,112	471	*141*	*16*	*4*	

Figure 3.H13 KM estimates of cumulative mortality for fractured neck of femur and osteoarthritis only in primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk

Key										
Osteoarthritis only	1,268,470	1,078,102	910,027	711,677	530,173	373,761	245,083	142,220	63,701	17,961
Fractured neck of femur	55,355	42,023	29,927	18,653	10,227	5,089	2,474	1,140	407	*105*

3.2.8 Overview of hip revisions

In this section we look at all hip revision procedures performed since the start of the registry, 1 April 2003, up to 31 December 2022, for all patients with valid patient identifiers (i.e. whose data could therefore be linked).

In total, there were 145,521 revisions on 121,248 individual hip replacements in 113,849 different patients. In addition to the 43,682 first revised primary hip replacements described in section 3.2.2 of this report, there were 89,783 revision procedures for which no primary hip replacement had been recorded in the registry. The overwhelming majority of these primaries would have been performed prior to the NJR being launched in 2004.

Revisions are classified as single-stage, stage one and stage two of two-stage revisions. Information on stage one and stage two revisions are entered into the registry separately, whereas in practice a stage two revision has to be linked to a preceding stage one revision. Debridement and Implant Retention (DAIR) with or without modular exchange are included as single-stage procedures. With the introduction of distinct indicators for the DAIR procedures in MDSv7 and introduction of a separate reoperations form in MDSv8, it may be possible to report these as distinct categories in future reports. Although not all patients who undergo a stage one of two revision will undergo a stage two of two revision, in some cases stage one revisions have been entered without a stage two, and vice versa, making identification of individual revision episodes difficult. We have attempted to do this later in this section.

The NJR asks surgeons and those responsible for healthcare delivery to ensure that when primary and revision joint replacement procedures of the hip, knee, ankle, elbow or shoulder are performed, that the relevant MDS form is completed and data entered into the registry. This is a requirement mandated by the Department of Health and Social Care. For the purposes of the Annual Report, revision procedures include any addition, removal or modification of the implants and procedures such as debridement and implant retention with or without implant exchange, excision arthroplasty, amputation and conversion to arthrodesis. The completion of a revision MDS form is also mandatory for a procedure involving modification of a joint by adding another implant to another part of the joint. For the analyses of surgeon performance, hospital performance and implant performance, debridement and implant retention without implant exchange is currently excluded.

Table 3.H14 Number and percentage of hip revisions by procedure type and year.

Year of revision surgery	Type of revision procedure			All procedures
	Single-stage N (%)	Stage one of two-stage N (%)	Stage two of two-stage N (%)	
2003*	16 (1.1)	0 (0.0)	1,455 (98.9)	1,471
2004	1,843 (65.7)	120 (4.3)	841 (30.0)	2,804
2005	3,507 (87.3)	204 (5.1)	305 (7.6)	4,016
2006	4,202 (86.7)	269 (5.6)	373 (7.7)	4,844
2007	5,615 (87.5)	340 (5.3)	463 (7.2)	6,418
2008	6,057 (86.2)	420 (6.0)	550 (7.8)	7,027
2009	6,322 (84.3)	516 (6.9)	661 (8.8)	7,499
2010	7,050 (86.5)	502 (6.2)	598 (7.3)	8,150
2011	7,983 (87.5)	531 (5.8)	611 (6.7)	9,125
2012	9,253 (88.0)	606 (5.8)	650 (6.2)	10,509
2013	8,541 (87.8)	567 (5.8)	623 (6.4)	9,731
2014	8,410 (87.0)	667 (6.9)	594 (6.1)	9,671
2015	8,018 (86.0)	709 (7.6)	597 (6.4)	9,324
2016	7,733 (87.3)	590 (6.7)	539 (6.1)	8,862
2017	7,709 (87.2)	614 (6.9)	520 (5.9)	8,843
2018	7,475 (87.6)	574 (6.7)	481 (5.6)	8,530
2019	7,221 (87.4)	567 (6.9)	472 (5.7)	8,260
2020	4,477 (86.3)	417 (8.0)	293 (5.6)	5,187
2021	5,226 (87.2)	409 (6.8)	357 (6.0)	5,992
2022	5,451 (87.1)	477 (7.6)	330 (5.3)	6,258
Total	**122,109 (85.7)**	**9,099 (6.4)**	**11,313 (7.9)**	**142,521**

*Incomplete year
Note: Single-stages include DAIRs (Debridement And Implant Retention) and hip excision arthroplasty.

Table 3.H14 gives an overview of all hip replacement revision procedures carried out each year since April 2003. There were a maximum number of 13 documented revision procedures associated with any patient's individual hip (right or left), making up eleven revision episodes as two episodes consisted of a stage one of a two-stage procedure and a stage two of a two-stage procedure.

The incidence of revision hip replacement peaked in 2012 and has steadily declined since then, despite the increasing number of at-risk implants due to the increase in primary hip replacements and secular increases in longevity of patients. In the COVID impacted years of 2020 and 2021, the number of revision hip replacements performed were approximately half of the peak rate observed in 2012. The number of revisions performed in 2022 (6,258) remains a quarter lower than the number performed in 2019 prior to the impact of COVID (8,260).

Table 3.H15 (a) Number and percentage of hip revision by indication and procedure type.

Reason	Type of revision procedure		
	Single-stage N (%) (n=122,109)	Stage one of two-stage N (%) (n=9,099)	Stage two of two-stage N (%) (n=11,313)
Aseptic loosening	55,649 (45.6)	1,030 (11.3)	2,368 (20.9)
Dislocation / Subluxation	20,419 (16.7)	361 (4.0)	563 (5.0)
Pain	18,531 (15.2)	827 (9.1)	927 (8.2)
Lysis	17,811 (14.6)	802 (8.8)	725 (6.4)
Implant wear	16,910 (13.8)	356 (3.9)	429 (3.8)
Periprosthetic fracture	15,745 (12.9)	360 (4.0)	511 (4.5)
Other indication	8,170 (6.7)	295 (3.2)	882 (7.8)
Infection	6,625 (5.4)	7,522 (82.7)	7,051 (62.3)
Malalignment	6,508 (5.3)	121 (1.3)	120 (1.1)
Implant fracture	4,569 (3.7)	94 (1.0)	172 (1.5)
Head-socket size mismatch	805 (0.7)	23 (0.3)	27 (0.2)
Adverse reaction to particulate debris*	11,176 (10.6) n=105,903	269 (3.3) n=8,090	185 (2.4) n=7,811

*Not recorded in the early phase of the registry; MDSv3, v6 and v7 only.

Table 3.H15 (b) Number and percentage of hip revision by indication and procedure type in last five years.

Reason	Type of revision procedure		
	Single-stage N (%) (n=29,850)	Stage one of two-stage N (%) (n=2,444)	Stage two of two-stage N (%) (n=1,933)
Aseptic loosening	10,937 (36.6)	180 (7.4)	143 (7.4)
Dislocation / Subluxation	5,896 (19.8)	88 (3.6)	57 (2.9)
Periprosthetic fracture	5,892 (19.7)	106 (4.3)	113 (5.8)
Implant wear	3,885 (13.0)	61 (2.5)	30 (1.6)
Lysis	3,826 (12.8)	182 (7.4)	79 (4.1)
Adverse reaction to particulate debris	2,863 (9.6)	81 (3.3)	49 (2.5)
Infection	2,831 (9.5)	2,164 (88.5)	1,567 (81.1)
Malalignment	1,352 (4.5)	26 (1.1)	11 (0.6)
Implant fracture	1,265 (4.2)	23 (0.9)	16 (0.8)
Other indication	1,237 (4.1)	51 (2.1)	121 (6.3)
Pain	1,050 (3.5)	27 (1.1)	17 (0.9)
Head-socket size mismatch	115 (0.4)	3 (0.1)	0 (0.0)

Table 3.H15 (a) shows the stated indication for the revision hip replacement surgery. Please note that, as several indications can be stated, the indications are not mutually exclusive and therefore column percentages may add up to over 100%. Aseptic loosening is the most common indication for revision.

Table 3.H15 (b) shows the stated indication for revision hip replacement surgery performed in the last five years (1,826 days). The most notable difference between all the data and that recorded in the last five years is pain as an indication for revision falling from 15.2% to 3.5% of single-stage revisions. There is also a higher

proportion of cases revised for periprosthetic fracture in the last five years (19.7% compared to 12.9%) and a higher proportion of cases revised due to infection (9.5% compared to 5.4%). The ratio of stage two of two-stage, stage one of two-stage and single-stage revisions overall (1:0.8:10.8) is different compared to those performed in the last five years (1:1.26:15.4). Please note that higher percentage ratios do not equate to an absolute increase in revisions for a specific cause. Looking at the data for the last five years in comparison to data for the whole registry, the use of single-stage revision for infection in comparison to a two-staged revision approach has increased.

3.2.9 Rates of hip re-revision

In most instances (90% of 121,248 individual patient-sides), the first revision procedure was a single-stage revision, however in the remaining 10% it was part of a two-stage procedure. For a given patient side, survival following the first documented revision hip replacement procedure for those with a linked primary in the registry (n=43,682) has been analysed. This analysis is restricted to patients with a linked primary procedure so that there is confidence that the next observed procedure on the same joint is the first revision episode. If there is no linked primary record in the dataset, it cannot be determined if the first observed revision is the first revision or if it has been preceded by other revision episodes. The time from the first documented revision procedure (of any type) to the time at which a second revision episode was undertaken has been determined. For this purpose, an initial stage one followed by either a stage one or a stage two have been considered to be the same revision episode and these were disregarded, looking instead for the start of a second revision episode (the maximum number of distinct revision episodes was determined to be 11 for any patient-side).

In cases where a stage one of two procedure was followed by a stage two of two procedure within 365 days, we have treated this as a single distinct episode. This definition allows multiple stage one procedures to occur before a new revision episode is triggered. In situations where the first stage one procedure is not followed by a stage two procedure within a 365 day period, the next occurrence of a stage one procedure was considered as a new revision episode.

Kaplan-Meier estimates of the cumulative percentage probability of having a subsequent revision (re-revision) were calculated. There were 5,137 re-revisions and for 8,641 cases the patient died without having been re-revised. The censoring date for the remainder was the end of 2022.

Figure 3.H14 (a) (page 127) plots Kaplan-Meier estimates of the cumulative probability of a subsequent revision between 1 and 19 years since the first revision operation.

Figure 3.H14 (a) KM estimates of cumulative re-revision in linked primary hip replacements (shaded area indicates point-wise 95% CI). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

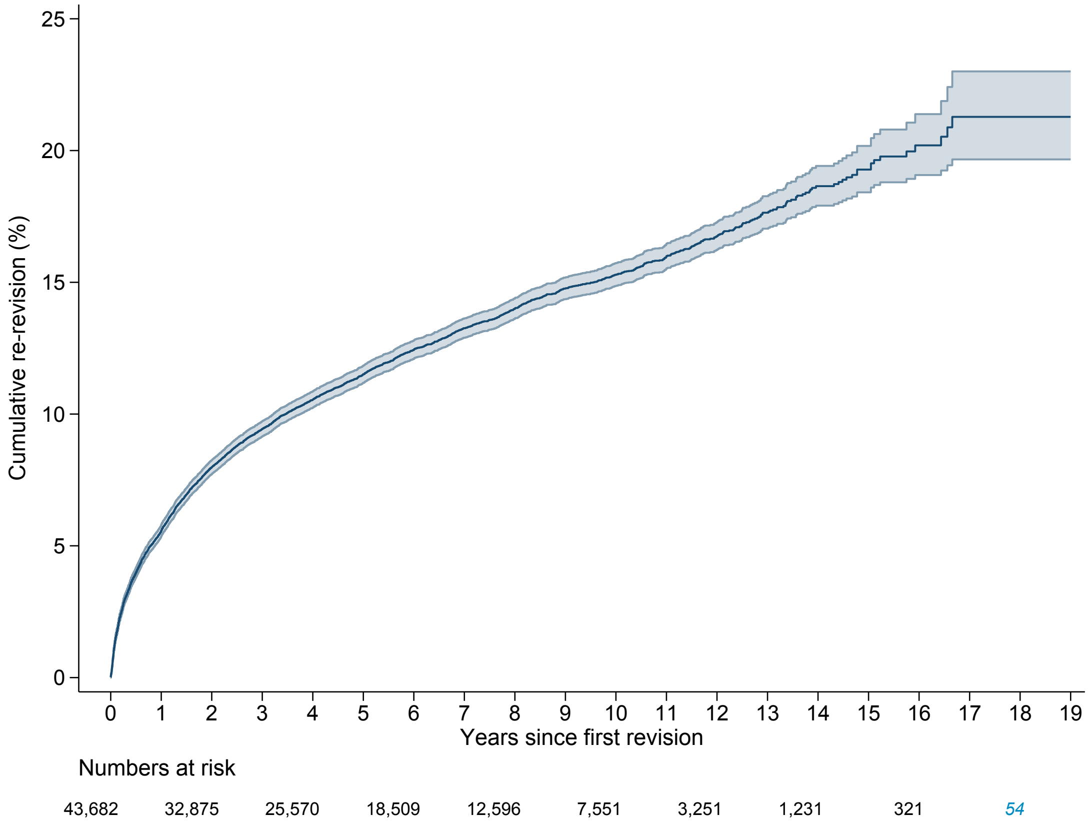
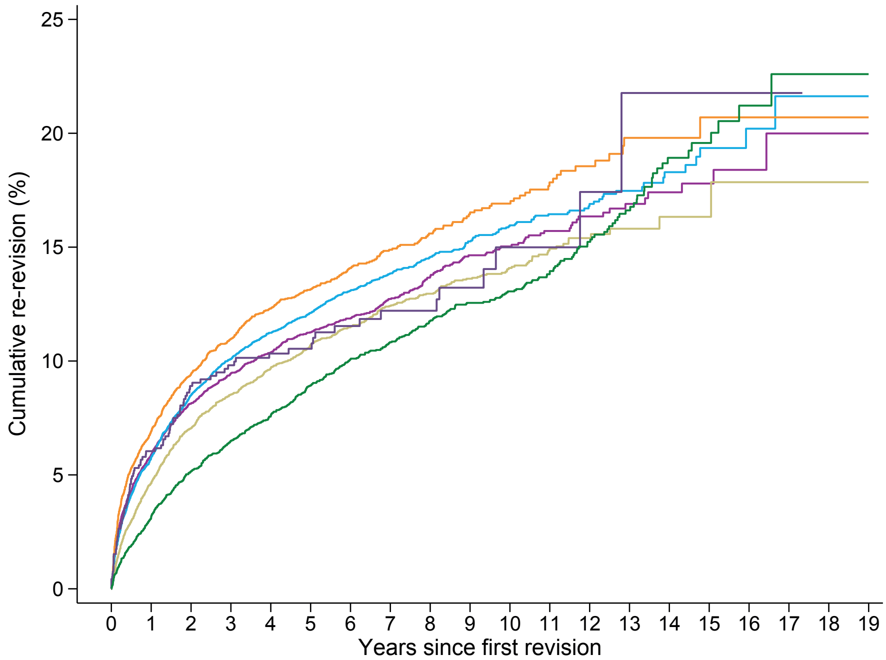


Figure 3.H14 (b) KM estimates of cumulative re-revision by primary fixation in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

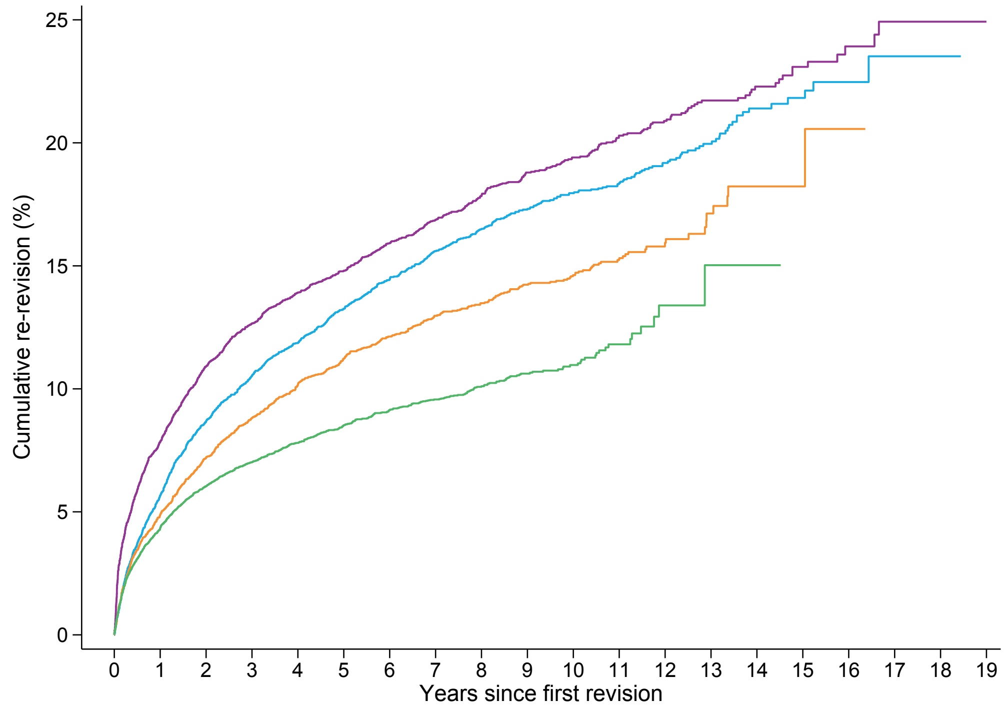
Numbers at risk

Key										
Cemented	10,174	7,178	5,197	3,375	2,069	1,161	564	*241*	*71*	*12*
Uncemented without MoM	12,904	9,591	7,283	5,097	3,251	1,843	842	320	*86*	*14*
Uncemented MoM	5,824	4,977	4,336	3,573	2,690	1,589	480	*132*	*18*	*<4*
Hybrid	7,113	4,827	3,391	2,176	1,271	731	344	*121*	*39*	*7*
Reverse hybrid	926	629	473	303	*180*	*76*	*30*	*8*	*<4*	
Resurfacing	4,909	4,305	3,833	3,173	2,546	1,763	813	334	*86*	*13*

Figure 3.H14 (b) shows estimates of re-revision by type of primary hip replacement. Resurfacing has the lowest re-revision rate until approximately 12 years, after which the revision rate appears to be worse than that associated with alternatives. However, after 12 years the numbers at risk are low and should therefore be interpreted with caution. Uncemented primary total hip replacements have similar rates of re-revision to alternatives up until two years, after that the observed rates of re-revision are higher than alternatives until 12 years when the numbers at risk become small.

Figure 3.H14 (c) shows the relationship between time to first revision and the risk of subsequent revision. The earlier the primary hip replacement is revised, the higher the risk of a second revision. There is a relationship between the indication for first revision and time to first revision; earlier in this report (section 3.2.5) we show, for example, that revisions for dislocation / subluxation, infection and malalignment were more prevalent in the early period after the primary hip replacement, and aseptic loosening and lysis later on.

Figure 3.H14 (c) KM estimates of cumulative re-revision by years to first revision, in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

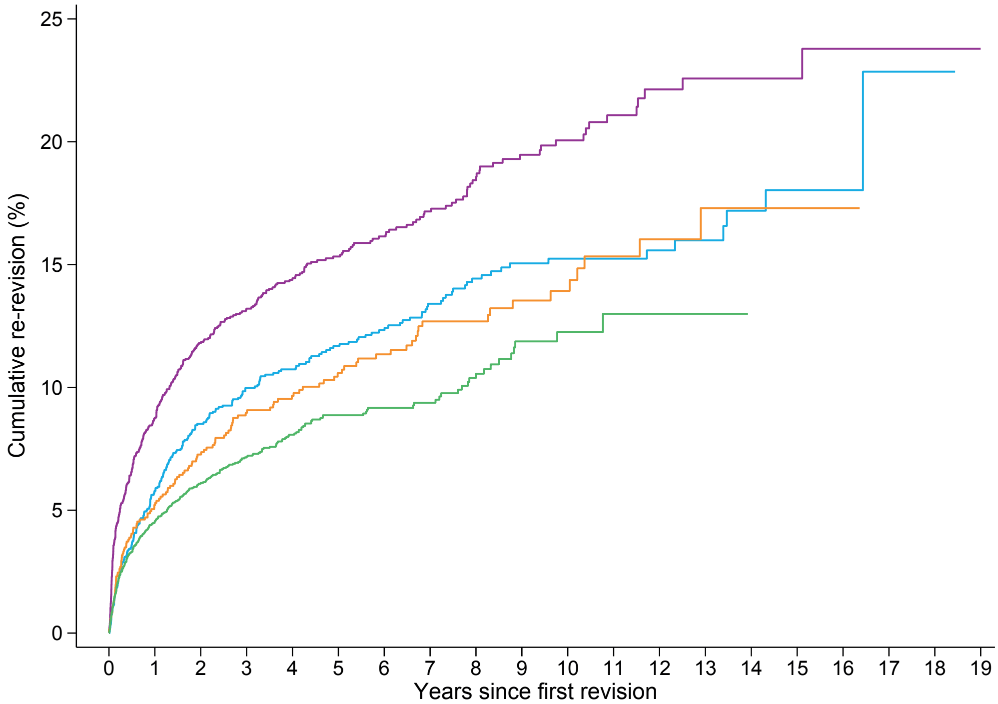


Numbers at risk

Key:	0	2	4	6	8	10	12	14	16	18
First rev. <1y	11,294	8,421	6,559	4,760	3,300	2,193	1,289	628	*219*	*51*
First rev. 1 to 3y	7,878	6,375	5,224	4,088	3,085	2,226	1,231	490	*100*	*<4*
First rev. 3 to 5y	6,193	4,989	4,161	3,407	2,700	1,771	558	*110*	*<4*	
First rev. ≥5y	18,317	13,090	9,626	6,254	3,511	1,361	*173*	*<4*		

For those with a documented primary hip replacement within the registry, Figures 3.H15 (a) to (e) show cumulative re-revision rates following the first revision hip replacement, according to the main fixation used in the primary. Each sub-group has been further sub-divided according to the time interval from the primary hip replacement to the first revision, i.e. less than 1 year, 1 to <3, 3 to <5 and greater than or equal to 5 years. For cemented, uncemented, hybrid, reverse hybrid and resurfacing hip replacements, there was a trend of higher observed re-revision rates in those that had their first revision within one year, between one and three years or three to five years of the initial primary hip replacement.

Figure 3.H15 (a) KM estimates of cumulative re-revision in cemented primary hip replacement by years to first revision, in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

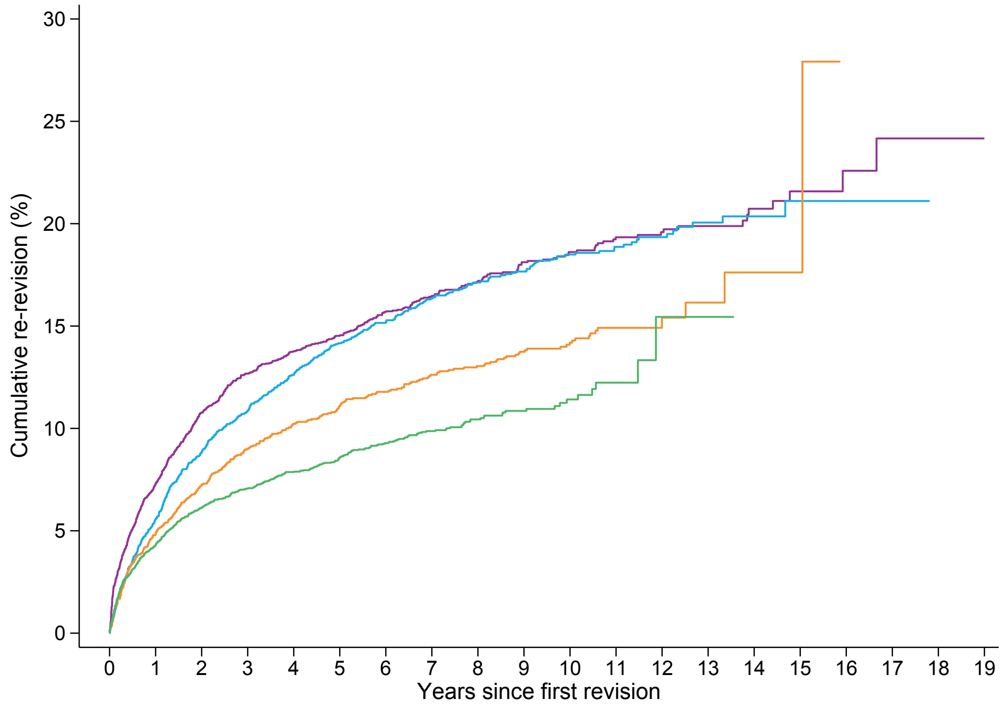


Key:

Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
First rev. <1y	2,420	2,001	1,768	1,575	1,330	1,114	914	736	594	464	367	270	*196*	*150*	*99*	*68*	*42*	*21*	*9*	*<4*
First rev. 1 to 3y	1,934	1,679	1,501	1,358	1,210	1,029	885	752	615	492	402	312	*228*	*157*	*109*	*67*	*27*	*7*	*<4*	
First rev. 3 to 5y	1,322	1,109	983	862	737	628	513	431	345	262	*195*	*146*	*103*	*62*	*33*	*13*	*<4*			
First rev. ≥5y	4,498	3,526	2,926	2,487	1,920	1,436	1,063	756	515	336	*197*	*90*	*37*	*13*						

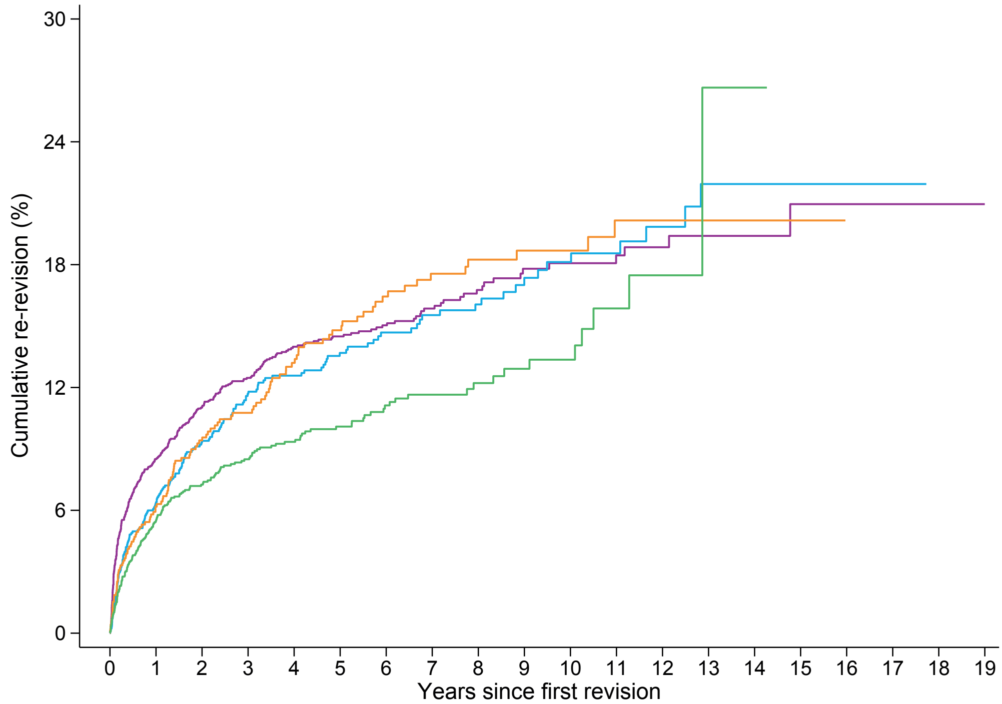
Figure 3.H15 (b) KM estimates of cumulative re-revision in uncemented primary hip replacement by years to first revision, in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
First rev. <1y	4,871	4,173	3,781	3,453	3,056	2,677	2,298	1,980	1,640	1,313	1,067	809	583	416	255	*137*	*71*	*41*	*15*	*4*
First rev. 1 to 3y	3,404	3,106	2,868	2,660	2,392	2,176	1,944	1,716	1,479	1,268	1,040	788	535	306	*170*	*84*	*33*	*12*		
First rev. 3 to 5y	2,754	2,487	2,302	2,146	1,975	1,822	1,671	1,511	1,334	1,147	841	459	*170*	*73*	*27*	*8*				
First rev. ≥5y	7,699	6,421	5,617	4,978	4,196	3,409	2,757	2,100	1,488	926	484	*161*	*34*	*5*						

Figure 3.H15 (c) KM estimates of cumulative re-revision in hybrid primary hip replacement by years to first revision, in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

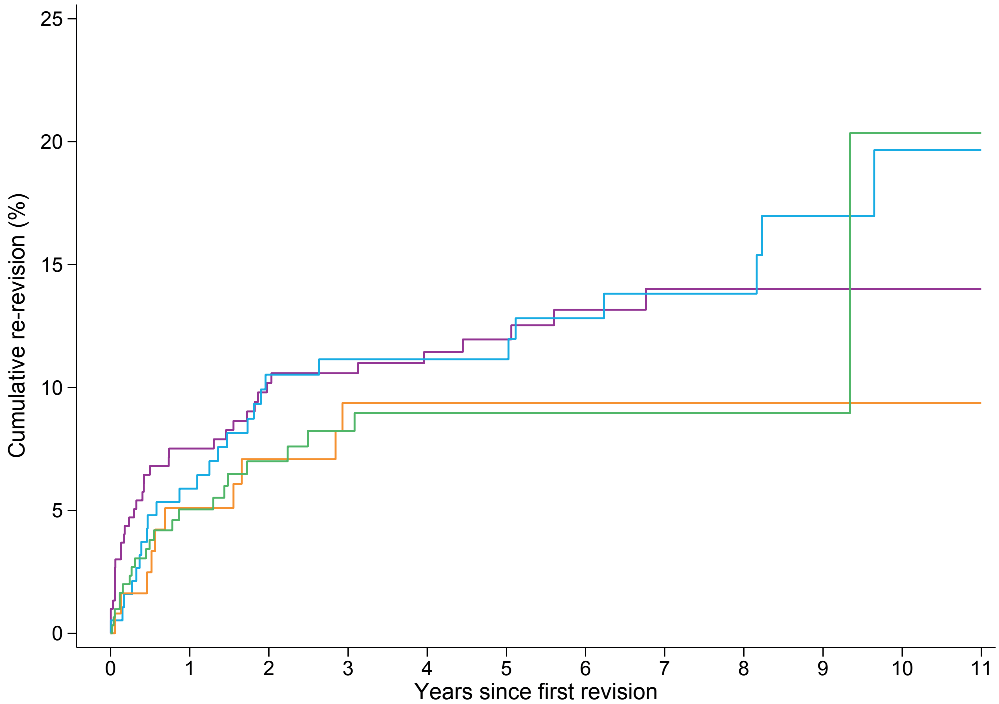


Key:

Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
First rev. <1y	2,739	2,175	1,857	1,628	1,315	1,071	839	637	465	344	277	*213*	*154*	*107*	*64*	*46*	*25*	*14*	*7*	*<4*
First rev. 1 to 3y	1,357	1,158	984	833	704	581	465	365	293	*235*	*192*	*145*	*98*	*69*	*44*	*30*	*14*	*6*		
First rev. 3 to 5y	921	741	629	553	456	389	326	274	*226*	*175*	*133*	*99*	*62*	*33*	*11*	*4*				
First rev. ≥5y	2,096	1,619	1,357	1,141	916	703	546	394	287	*202*	*129*	*60*	*30*	*7*	*<4*					

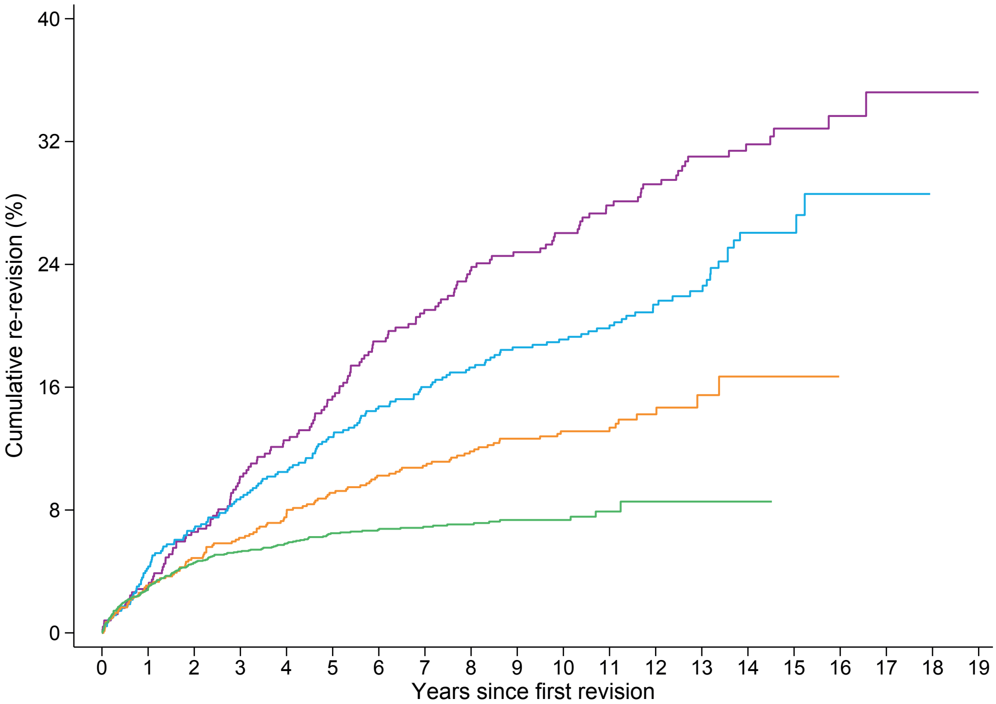
Figure 3.H15 (d) KM estimates of cumulative re-revision in reverse hybrid primary hip replacement by years to first revision, in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk

Key:	0	1	2	3	4	5	6	7	8	9	10	11
First rev. <1y	300	252	*230*	*221*	*191*	*153*	*127*	*96*	*84*	*63*	*39*	*23*
First rev. 1 to 3y	*190*	*172*	*148*	*139*	*124*	*107*	*88*	*72*	*56*	*41*	*28*	*19*
First rev. 3 to 5y	*125*	*104*	*87*	*79*	*64*	*51*	*41*	*29*	*22*	*10*	*7*	*5*
First rev. ≥5y	311	*213*	*164*	*126*	*94*	*61*	*47*	*30*	*18*	*10*	*<4*	*<4*

Figure 3.H15 (e) KM estimates of cumulative re-revision in resurfacing primary hip replacement by years to first revision, in linked primary hip replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
First rev. <1y	495	470	447	422	403	382	359	345	323	306	295	273	*250*	*206*	*161*	*110*	*67*	*32*	*13*	*<4*
First rev. 1 to 3y	699	662	641	618	596	571	550	534	510	492	464	406	305	*216*	*139*	*65*	*19*	*10*		
First rev. 3 to 5y	845	815	795	780	760	735	712	679	649	609	514	360	*197*	*96*	*33*	*9*				
First rev. ≥5y	2,870	2,618	2,422	2,288	2,074	1,812	1,552	1,289	1,064	773	490	*198*	*61*	*16*	*<4*					

Table 3.H16 (a) shows the re-revision rate of the 43,682 primary hip replacements in the registry that were revised, and of these, 5,137 were re-revised. Table 3.H16 (b) shows that primary hip replacements that fail within the first year after surgery have just under twice the chance of needing re-revision at each time point compared with primaries that last more than five years.

Table 3.H16 (a) KM estimates of cumulative re-revision (95% CI). *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

	Number of first revised joints at risk of re-revision	Time since first revision					
		1 year	3 years	5 years	10 years	15 years	19 years
Primary recorded in the registry	43,682	5.57 (5.36-5.80)	9.43 (9.15-9.73)	11.51 (11.18-11.84)	15.29 (14.86-15.73)	19.28 (18.41-20.18)	*21.28 (19.66-23.00)*

Table 3.H16 (b) KM estimates of cumulative re-revision (95% CI) by years since first revision. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Primary in the registry where the first revision took place:	Number of first revised joints at risk of re-revision	Time since first revision						
		1 year	3 years	5 years	7 years	10 years	13 years	15 years
<1 year after primary	11,294	7.84 (7.35-8.36)	12.66 (12.04-13.32)	14.79 (14.10-15.51)	16.88 (16.11-17.67)	19.41 (18.51-20.34)	21.72 (20.62-22.87)	23.09 (21.73-24.52)
1 to <3 years after primary	7,878	5.67 (5.17-6.21)	10.52 (9.84-11.24)	13.26 (12.49-14.08)	15.60 (14.73-16.51)	17.96 (16.98-18.98)	19.96 (18.80-21.18)	21.83 (20.34-23.41)
3 to <5 years after primary	6,193	4.89 (4.38-5.47)	8.81 (8.11-9.58)	11.22 (10.41-12.09)	12.97 (12.08-13.92)	14.62 (13.64-15.68)	17.13 (15.61-18.78)	*18.23 (16.33-20.32)*
≥5 years after primary	18,317	4.34 (4.04-4.65)	7.03 (6.64-7.43)	8.52 (8.08-8.99)	9.57 (9.07-10.09)	10.97 (10.33-11.64)	*15.03 (11.82-19.00)*	

Note: Maximum interval was 19.6 years.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Data have not been presented at 19 years due to low numbers.

Table 3.H16 (c) KM estimates of cumulative re-revision (95% CI) by fixation and bearing used in primary hip replacement. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Fixation and bearing surface	N	Time since first revision						
		1 year	3 years	5 years	7 years	10 years	13 years	15 years
All	43,682	5.57 (5.36-5.80)	9.43 (9.15-9.73)	11.51 (11.18-11.84)	13.26 (12.90-13.63)	15.29 (14.86-15.73)	17.64 (17.04-18.27)	19.28 (18.41-20.18)
All cemented	10,174	5.90 (5.45-6.39)	9.46 (8.87-10.09)	11.27 (10.60-11.97)	12.72 (11.97-13.53)	15.03 (14.07-16.05)	16.90 (15.59-18.31)	*17.79 (16.17-19.56)*
MoP	9,053	5.88 (5.40-6.39)	9.32 (8.70-9.98)	11.01 (10.31-11.75)	12.46 (11.67-13.30)	14.77 (13.76-15.84)	16.20 (14.92-17.58)	*17.19 (15.53-19.02)*
MoM	27	*3.85 (0.55-24.31)*	*3.85 (0.55-24.31)*	*17.65 (6.97-40.67)*	*17.65 (6.97-40.67)*			
CoP	1,026	5.96 (4.63-7.64)	10.89 (9.00-13.15)	13.36 (11.16-15.95)	*14.70 (12.28-17.56)*	*17.17 (14.11-20.80)*	*24.06 (17.70-32.22)*	*24.06 (17.70-32.22)*
MoPoM	64	*10.17 (4.69-21.28)*	*10.17 (4.69-21.28)*	*10.17 (4.69-21.28)*				
All uncemented	18,728	5.41 (5.09-5.75)	9.58 (9.15-10.04)	11.67 (11.18-12.17)	13.40 (12.86-13.96)	15.30 (14.67-15.95)	16.93 (16.11-17.79)	*18.45 (17.12-19.87)*
MoP	5,508	5.74 (5.14-6.40)	9.99 (9.18-10.86)	11.54 (10.65-12.50)	13.70 (12.67-14.82)	15.55 (14.30-16.89)	*16.40 (14.92-18.02)*	*18.57 (15.79-21.77)*
MoM	5,824	4.62 (4.11-5.20)	8.53 (7.82-9.29)	10.70 (9.90-11.56)	12.42 (11.54-13.36)	14.08 (13.11-15.13)	15.81 (14.54-17.18)	*16.33 (14.74-18.07)*
CoP	2,715	5.93 (5.08-6.91)	10.51 (9.34-11.83)	12.48 (11.14-13.96)	13.95 (12.46-15.60)	15.79 (13.98-17.82)	*17.89 (15.28-20.88)*	*19.41 (15.73-23.81)*
CoC	4,405	5.59 (4.94-6.33)	9.81 (8.93-10.77)	12.21 (11.21-13.30)	13.67 (12.58-14.84)	16.03 (14.72-17.44)	*17.92 (16.21-19.79)*	*19.68 (17.15-22.53)*
CoM	205	*7.03 (4.23-11.59)*	*12.10 (8.20-17.67)*	*16.95 (12.10-23.46)*	*17.73 (12.73-24.39)*	*21.64 (15.50-29.75)*		
MoPoM	41	*10.00 (3.88-24.49)*	*13.75 (5.85-30.44)*					
All hybrid	7,113	6.91 (6.33-7.54)	10.97 (10.21-11.77)	13.15 (12.29-14.07)	14.89 (13.91-15.93)	16.91 (15.71-18.20)	*19.80 (17.92-21.85)*	*20.70 (18.22-23.46)*
MoP	4,028	7.03 (6.26-7.88)	10.72 (9.74-11.79)	12.81 (11.70-14.02)	14.30 (13.05-15.66)	16.38 (14.84-18.07)	*18.71 (16.43-21.27)*	*20.14 (16.77-24.08)*
MoM	434	4.05 (2.53-6.43)	10.08 (7.52-13.45)	13.17 (10.19-16.94)	*15.22 (11.94-19.29)*	*17.94 (14.20-22.53)*	*22.46 (17.48-28.59)*	*22.46 (17.48-28.59)*
CoP	1,758	7.31 (6.15-8.68)	11.17 (9.66-12.89)	13.51 (11.74-15.53)	*15.01 (12.93-17.39)*	*15.63 (13.29-18.33)*	*15.63 (13.29-18.33)*	
CoC	773	6.28 (4.76-8.28)	10.74 (8.66-13.27)	12.03 (9.80-14.73)	14.70 (12.06-17.85)	*16.70 (13.56-20.47)*	*21.08 (15.73-27.93)*	*21.08 (15.73-27.93)*
MoPoM	91	*11.24 (5.99-20.56)*	*15.20 (8.56-26.20)*					
CoPoM	23	*18.16 (7.19-41.61)*						
All reverse hybrid	926	6.04 (4.65-7.84)	9.82 (7.95-12.09)	10.54 (8.57-12.92)	*12.21 (9.92-14.98)*	*14.99 (11.68-19.14)*	*21.77 (13.57-33.86)*	
MoP	634	5.52 (3.95-7.68)	9.32 (7.14-12.11)	*10.18 (7.85-13.15)*	*12.27 (9.46-15.83)*	*14.38 (10.63-19.29)*	*26.05 (13.63-46.29)*	
CoP	285	*6.94 (4.48-10.67)*	*10.72 (7.51-15.17)*	*11.19 (7.90-15.74)*	*12.08 (8.50-17.02)*	*15.86 (10.33-23.91)*		
All resurfacing	4,909	3.15 (2.69-3.68)	6.48 (5.81-7.23)	8.94 (8.14-9.81)	10.83 (9.93-11.80)	13.06 (12.03-14.17)	16.62 (15.16-18.20)	*19.58 (17.53-21.83)*
Unconfirmed	1,832	6.66 (5.59-7.94)	9.74 (8.40-11.27)	11.83 (10.31-13.55)	14.72 (12.94-16.71)	16.35 (14.38-18.56)	*18.68 (16.05-21.69)*	*19.39 (16.49-22.73)*

Note: Maximum interval was 19.6 years.
Note: Data have not been presented for 19 years due to low numbers.

Table 3.H16 (c) shows cumulative re-revision rates at 1, 3, 5, 7, 10, 13 and 15 years following the first revision for those with documented primary hip replacements within the registry, broken down by fixation types and bearing surfaces used in the primary hip replacement. The numbers are very low for dual mobility hips and the duration of follow-up is short, but initial results show high failure rates of above 10% at one year in all categories of dual mobility procedures.

The revision rates for revisions following resurfacings were comparatively low, but Figure 3.H14 (b) (page 128) shows that after 12 years the revision rate is becoming higher than those for alternatives.

3.2.10 Reasons for hip re-revision

Tables 3.H17 (a) and (b) (page 138) show a breakdown of the stated indications for the first revision and for any second revision. Please note the indications are not mutually exclusive. Table 3.H17 (a) shows the indications for recorded revisions in the registry and Table 3.H17 (b) reports the indications for the first linked revision and the number and percentage of first linked revisions that were subsequently revised. In the final column in Table 3.H17 (b), we report the indications for all the second linked revisions e.g. 1,056 linked second revisions recorded aseptic loosening as an indication. It is interesting to note that both dislocation and infection are much more common indications for a second revision than for a first revision. This shows the increased risk of instability and infection following the first revision of a hip replacement compared to that of primary hip replacement.

Table 3.H17 (a) Number of revisions by indication for all revisions.

Reason for revision	All recorded revisions, N (%)
Aseptic loosening	59,047 (41.4)
Dislocation / Subluxation	21,343 (15.0)
Infection	21,198 (14.9)
Pain	20,285 (14.2)
Lysis	19,338 (13.6)
Implant wear	17,695 (12.4)
Periprosthetic fracture	16,616 (11.7)
Malalignment	6,749 (4.7)
Implant fracture	4,835 (3.4)
Head/socket size mismatch	855 (0.6)
Other indication	9,347 (6.6)
Adverse reaction to particulate debris*	11,630 (8.2)

*Adverse reaction to particulate debris was only recorded using MDSv3 onwards and as such was only a potential reason for revision among a total of 121,804 revisions as opposed to 142,521 revisions for the other reasons.

Table 3.H17 (b) Number of revisions by indication for first linked revision and second linked re-revision.

Reason for revision	First linked revision		Second linked revision
	N	Subsequently re-revised, N (%)	N
Aseptic loosening	10,828	1,077 (9.9)	1,056
Dislocation / Subluxation	7,602	914 (12.0)	1,271
Periprosthetic fracture	7,176	730 (10.2)	462
Infection	6,779	1,231 (18.2)	1,670
Pain	5,100	676 (13.3)	441
Malalignment	2,837	280 (9.9)	240
Lysis	2,706	229 (8.5)	224
Implant wear	2,510	227 (9.0)	244
Implant fracture	1,447	162 (11.2)	154
Head/socket size mismatch	275	41 (14.9)	17
Other indication	3,352	464 (13.8)	316
Adverse reaction to particulate debris*	2,874	283 (9.8)	137

*Adverse reaction to particulate debris was only recorded using MDSv3 onwards and as such was only a potential reason for revision among a total of 29,025 revisions as opposed to 43,682 revisions for the other reasons.

Tables 3.H18 (a) and (b) (pages 139 and 140) show that the numbers of revisions and the relative proportion of revisions with a linked primary in the registry increased with time. Approximately 60% of revisions performed in 2022 had a linked primary in the registry. This is likely to reflect improved data capture over time, improved linkability of records and the longevity of hip replacements with a proportion of primaries being revised being performed before data capture began or being outside the coverage of the registry.

Table 3.H18 (a) Number of revisions by year.

Year of first revision in the registry*	Number of first revisions*	Number of first revisions (%) with the associated primary recorded in the registry
2003	1,448	43 (3.0)
2004	2,712	144 (5.3)
2005	3,797	306 (8.1)
2006	4,484	464 (10.3)
2007	5,912	815 (13.8)
2008	6,325	1,161 (18.4)
2009	6,563	1,518 (23.1)
2010	7,074	1,958 (27.7)
2011	7,947	2,670 (33.6)
2012	9,027	3,350 (37.1)
2013	8,228	3,061 (37.2)
2014	8,086	3,108 (38.4)
2015	7,654	3,245 (42.4)
2016	7,274	3,247 (44.6)
2017	7,185	3,354 (46.7)
2018	6,925	3,541 (51.1)
2019	6,651	3,574 (53.7)
2020	4,117	2,392 (58.1)
2021	4,777	2,734 (57.2)
2022	5,062	2,997 (59.2)
Total	**121,248**	**43,682 (36.0)**

*First documented revision in the registry.

Table 3.H18 (b) Number of revisions by year, stage, and whether or not primary is in the registry.

Year of first revision in the registry*	Single-stage		First documented stage of two-stage	
	Primary not in the registry	Primary in the registry	Primary not in the registry	Primary in the registry
2003	16	0	1,389	43
2004	1,716	94	852	50
2005	3,161	251	330	55
2006	3,645	376	375	88
2007	4,650	687	447	128
2008	4,694	960	470	201
2009	4,569	1,255	476	263
2010	4,704	1,727	412	231
2011	4,886	2,401	391	269
2012	5,299	3,021	378	329
2013	4,854	2,761	313	300
2014	4,629	2,813	349	295
2015	4,104	2,919	305	326
2016	3,791	2,959	236	288
2017	3,583	3,080	248	274
2018	3,156	3,288	228	253
2019	2,893	3,300	184	274
2020	1,588	2,185	137	207
2021	1,901	2,523	142	211
2022	1,915	2,757	150	240
Total	**69,754**	**39,357**	**7,812**	**4,325**

*First documented revision in the registry.

3.2.11 90-day mortality after hip revision

The overall cumulative percentage mortality at 90 days after hip revision was lower in the cases with a primary hip replacement recorded in the registry compared with the remainder (Kaplan-Meier estimates 1.64% (95% CI 1.52-1.76) versus 2.00% (95% CI 1.90-2.10)), which may reflect the fact that patients in this group were younger at the time of their first revision, median age of 70 (IQR 61 to 77) years compared to the group without primaries documented in the registry who had a median age of 74 (IQR 66 to 80) years. The percentage of males to females was similar in both groups (44.4% versus 42.5% respectively).

3.2.12 Conclusions

As in previous reports, our analysis of implants has been by revision of the construct, rather than revision of a single component, as the mechanisms of failure (such as wear, adverse reaction to particulate debris and dislocation) are interdependent between different parts of the construct. Revision analyses have also been stratified by age and gender. The highest revision rates are among younger females and the lowest among older females. When data on metal-on-metal are excluded, younger females have similar revision rates to younger males. Once again, it must be emphasised that implant survivorship is only one measure of success and cannot be used as an indication of satisfaction, relief of pain, improvement in function and the resulting greater participation in society. The data clearly show that constructs failing at different rates is associated with the age and gender of the recipients.

Overall, the number of primary hip replacements recorded annually in the registry continues to increase with 1,448,541 eligible for analysis. The COVID pandemic had a marked impact on the provision of hip replacement with primary THR decreasing from 99,938 in 2019 to 57,309 in 2020, but numbers have now recovered to 99,043 in 2022, and revision THR falling from 8,260 in 2019 to 5,187 in 2020 and partially recovering to 6,258 in 2022. Due to late registrations the figures listed here will be revised upwards in subsequent reports, so the recovery will be greater than the current data suggests. The overall provision of primary hip replacement has recovered to pre-pandemic levels, but a far greater percentage are now both funded and undertaken in the private sector, with overall NHS provision still markedly below pre-pandemic numbers.

It is interesting to examine the overall secular trends in provision of primary and revision hip replacements. Apart from the COVID-affected years of 2020 and 2021, the trend has been for ever increasing provision of primary hip replacement such that the volume of procedures are close to exceeding 100,000 cases per annum. The provision of, and presumably the requirement for, revision hip replacement increased markedly from 4,016 cases in 2005 to 10,509 in 2012 and then declined to 6,258 in 2022 (with lower numbers in COVID-affected years 2020 and 2021).

Looking at the relationship between year of primary and subsequent revision, between 2004 and 2007 the primaries undertaken each year were at higher risk of being revised than those undertaken the previous year, i.e. outcomes were getting steadily worse. This coincided exactly with the increased use of metal-on-metal stemmed hip replacements and hip resurfacings. This registry and other registries reported poor results with these types of prostheses. Their use then rapidly declined between 2007 and 2011 and the revision rates for primaries performed over that period demonstrated a pronounced decline.

In addition, in the NJR Annual Report 2009, we commented that data suggested that ceramic-on-polyethylene bearings were associated with lower revision rates. Between 2009 and 2022, the use of these bearings has increased approximately five-fold. In 2022 ceramic-on-polyethylene hybrid constructs were the most common type of hip replacement performed (23%), with the second commonest being ceramic-on-polyethylene uncemented hips which accounted for 20% of cases. The decline in revision rates for primaries performed over this period has mirrored the increase in use of these bearings. This rate of decline in revisions by year of primary surgery has slowed over time, particularly since 2013.

The result of surgical practice changing in response to outcomes is that procedures now achieve remarkably low long-term revision rates. The majority of patients undergoing THR are between 65 and 75 years old and a number of different construct types are achieving revision rates of less than 4% at 15 years follow-up. Early data suggest that with some constructs 19-year revision rates of around 5% will be achieved. We also present data here that show that it is very unusual for patients aged over 70 years to still be alive 19 years after their primary. Using existing implants and techniques surgeons are thus capable of performing hip replacements that will last the entire life of nearly all patients above the median age of a patient undergoing hip replacement of 69 years.

This reinforces the argument that any new implants and techniques really need to focus on patients <70 years of age and those undergoing revision surgery. Recent analysis of NJR data has shown strongly that revisions last significantly less long than primaries and that each subsequent revision lasts half as long as its predecessor (**Deere et al 2022**). Getting it right first time really is the solution.

Deere K, Whitehouse MR, Kunutsor SK, Sayers A, Mason J, Blom AW; How long do revised and multiply revised hip replacements last? A retrospective observational study of the National Joint Registry. Lancet Rheumatol. 2022 Jun 23;4(7):e468-e479

The data demonstrating how widespread adoption of technology before long-term outcomes are available can be disastrous continues to grow. The revision rates with metal-on-metal resurfacing continue to increase over time, particularly in women, and the contrast with other implants is stark. For example, the revision rates in women receiving metal-on-metal resurfacing are six-fold higher at 15 years than that achieved with some other commonly used alternatives. This holds true even when stratified for age. Metal-on-metal stemmed and resurfacing implants continue to fail at higher than expected rates and their use is now extremely rare. The best performing brand of resurfacing has a revision rate of 11.76% (95% CI 11.20-12.36) at 19 years. This contrasts with a revision rate of 3.32% (95% CI 2.27-4.85) achieved with a commonly used brand of cemented hip replacement. The use of metal-on-metal bearings has led to a large excess of revisions which would not have occurred if alternate bearings had been used. This has been modelled and published in the Journal of Bone and Joint Surgery. For every 100 MoM hip-resurfacing procedures, it is estimated that there would be 7.8 excess revisions by ten years, and similarly for every 100 stemmed MoM THR procedures that there would be 15.9, which equates to 8,021 excess first revisions (Hunt et al., 2018).

It is important that we monitor the performance of novel bearing designs of hip replacement closely. There is now sufficient data to report on ceramic-on-ceramic resurfacings. The numbers are low and follow-up is short and thus caution is required interpreting these early data, however revision rates in young women appear to already be much higher than in young men. Patients undergoing these procedures need to be monitored very carefully. The use of dual mobility constructs continues to increase with over 13,000 of these now recorded in the registry. The early revision rates with these appear to be slightly higher than alternatives and indications for usage should therefore be carefully considered. It may be that higher revision rates are due to appropriate case mix selection, so it is important to closely monitor the emerging data on these implants. We observed a different pattern when dual mobility is used for patients with a fractured neck of femur in whom we have not observed this early higher rate of revision, but neither has this led to a reduction in revision rates, yet these implants are typically more expensive.

Since the 12th NJR Annual Report in 2015, our data have been presented by age and gender comparing combinations of fixation and bearing. This assists clinicians and patients in choosing classes of prostheses that are the most appropriate for particular patients. For example, in males aged 55 to 64 years, at 15 years post-surgery, hybrid and uncemented ceramic-on-polyethylene and ceramic-on-ceramic constructs as well as cemented ceramic-on-polyethylene constructs have similarly low revision rates of approximately 5%, while cemented metal-on-polyethylene constructs have revision rates of 8.26% (95% CI 7.56-9.04) and uncemented metal-on-polyethylene bearings 7.06% (95% CI 6.31-7.90). Resurfacings in this group have an even higher revision rate at 15 years of 9.22% (95% CI 8.67-9.81). Females aged 55 to 64 years have lower revision rates than males for all fixation/bearing combinations at 15 years, except for those with metal-on-metal bearings, such as resurfacings, where the revision rates are markedly higher for females than males and markedly higher than alternatives. For example, 15-year revision rates with hybrid ceramic-on-ceramic constructs in this group are 3.05% (95% CI 2.58-3.59) compared to metal-on-metal hip resurfacing of 21.72% (95% CI 20.49-23.02).

For patients over 75 years, all combinations except those with metal-on-metal bearings have good outcomes, with cemented and hybrid ceramic-on-polyethylene possibly having the lowest revision rates. The risk of revision at 19 years in this group is very small, males 6.29% (95% CI 5.14-7.70) and females 3.99% (95% CI 3.59-4.42). The 19-year mortality rate in males aged 75 to 79 years is 93.63% (95% CI 92.59-94.57) and in females aged 75 to 79 years is 87.23% (95% CI 86.35-88.09).

Hunt LP, Whitehouse MR, Beswick A, Porter ML, Howard P, Blom AW; Implications of Introducing New Technology: Comparative Survivorship Modelling of Metal-on-Metal Hip Replacements and Contemporary Alternatives in the National Joint Registry. J Bone Joint Surg Am. 2018 Feb 7;100(3):189-196.

We have also examined outcomes of different head sizes (bearing diameters) with alternative fixation and bearing types and these results are interesting. With metal-on-polyethylene and ceramic-on-polyethylene, large head sizes appear to be associated with higher revision rates particularly with 36mm heads used with cemented fixation and heads >36mm used with uncemented fixation. Ceramic-on-ceramic bearings have lower revision rates with larger bearings when used with uncemented fixation in the short-term, but revision rates begin to rise with the largest head sizes beyond six years. Higher revision rates for 36mm compared to smaller heads are also seen in ceramic-on-ceramic hybrid fixations. This demonstrates the importance of examining the entire construct, not just the individual variables such as fixation, composition of bearing and head size.

With regard to specific branded stem / cup combinations, some of the best implant survivorships have still been found to be achieved by mix and match cemented hard-on-soft bearing constructs, although this practice remains contrary to both the MHRA and implant manufacturers' guidelines for usage.

It is encouraging that the most commonly used constructs by brand in cemented and hybrid fixation have good results. This does not hold true for uncemented fixation, but further breakdown by bearing type for commonly used uncemented implants shows that results are acceptable if metal-on-metal bearings are excluded. It is important to note that there is variability in brand level constructs with variation in revision outcomes according to factors such as the bearing combination used. It is therefore important to consider the construct when selecting implants for specific outcomes. We encourage all readers to view Table 3.H8 for fine details of construct performance.

Risk of re-revision rate is strongly associated with time to first revision; 19.41% (95% CI 18.51-20.34) of hips revised within a year of primary surgery are re-revised within ten years. In contrast, when the primary lasts at least five years the re-revision rate is 10.97% (95% CI 10.33-11.64) at ten years. Re-revision rates up to ten years appear to be independent of the fixation and bearing of the primary hip replacement, except for resurfacing procedures which are initially associated with lower re-revision rates, but this pattern appears to begin to wane between seven and ten years after the re-revision. At 13 years re-revision rates are 16.90% (95% CI 15.59-18.31) for cemented primaries, 16.93% (95% CI 16.11-17.79) for uncemented primaries and 16.62% (95% CI 15.16-18.20) for resurfacings.

Overall, this report is good news for patients, clinicians and the healthcare sector. Provision of hip replacement overall has recovered to pre-COVID levels, revision rates continue to decline and clinicians are increasingly utilising constructs with proven longevity. The effect of COVID on absolute provision has been short lived, but profound. In 2020 there was a massive underprovision of primary hip replacement with over 42,000 fewer primary hip replacements performed than in 2019. In 2021, much of this decline was reversed with only 13,000 fewer primary hip replacements than in 2019. This year numbers are roughly the same as in 2019, but continued NHS underprovision has been replaced with private sector provision. The 2020/21 deficit of approximately 55,000 primary hip replacements will need comprehensive planning to resolve.

With the health service having to address an unprecedented backlog of joint replacement with increasing pressure for cost containment, selection of clinically and cost-effective treatments with a good evidence-base will be increasingly important.

3.3 Outcomes after knee replacement

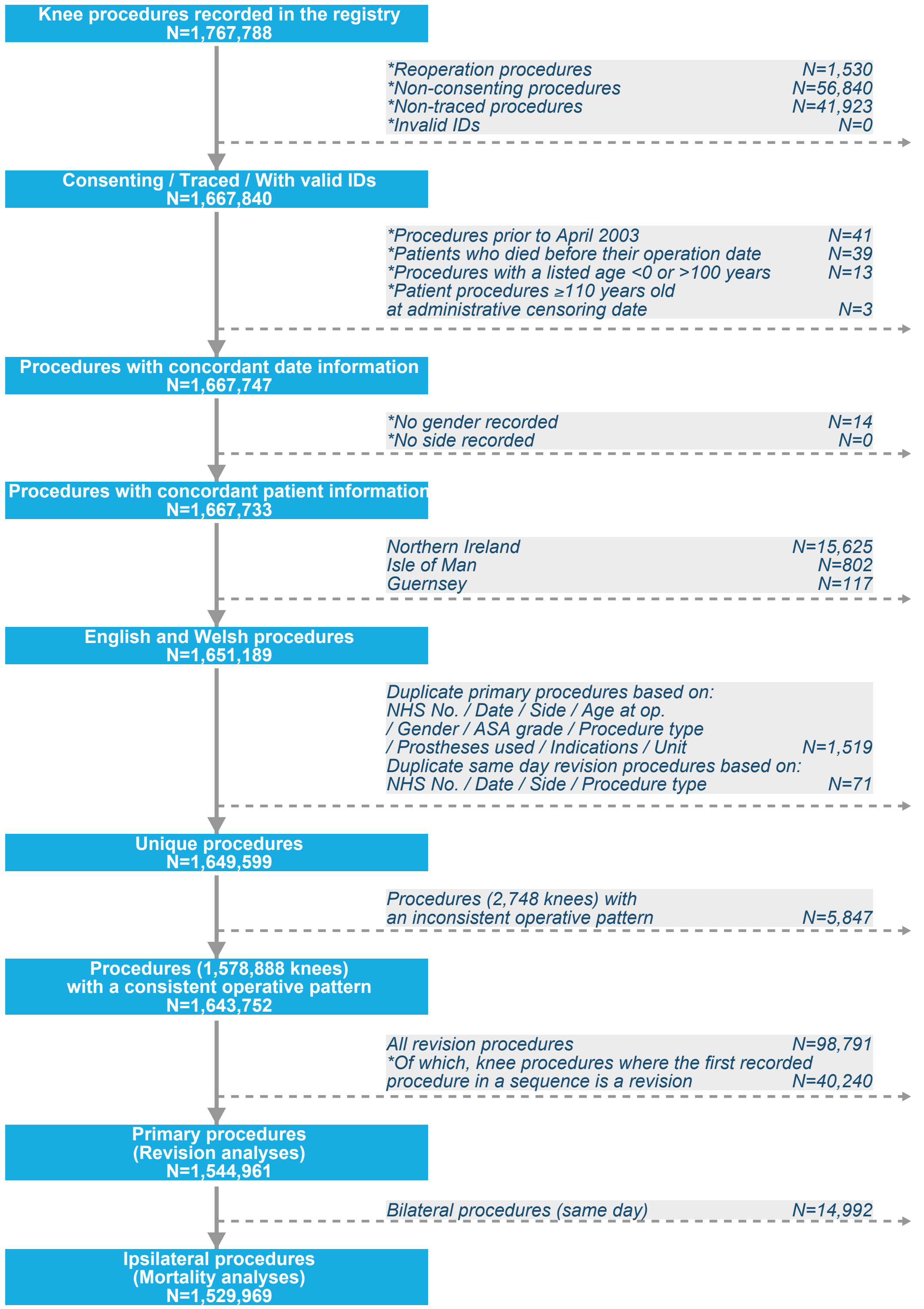
3.3.1 Overview of primary knee replacement surgery

In this section of the report we address revision and mortality outcomes for primary knee operations performed and reported to the registry between 1 April 2003 and 31 December 2022. The very first patients who were entered into the registry therefore had a potential 19.75 years of follow-up.

The outcomes of total and partial knee replacement procedures are discussed throughout this section, hereafter referred to as total (TKR) and unicompartmental (UKR) knee replacement. Unicompartmental knee replacements include both unicondylar knee replacements and patellofemoral knee replacements. Brief details of the type of orthopaedic surgery involved for each form of replacement can be found in section 3.1. We note here that the NJR data collection process now distinguishes between medial and lateral unicondylar replacements, although this was not always the case in the past. This distinction is available for cases reported on the MDSv7 forms but unicondylar cases reported on earlier versions of the MDS form do not make this distinction. Work is ongoing to determine if data entered in previous versions of the MDS forms can be used to identify medial and lateral replacements. If this is possible, it will be reported in future annual reports. The term multicompartmental knee replacement has been introduced to refer to instances when more than one unicompartmental construct is implanted simultaneously i.e. one patellofemoral and one unicondylar, two unicondylar, or one patellofemoral and two unicondylar.

Figure 3.K1 (a) (page 146) describes the data cleaning processes applied to produce the total of 1,544,961 primary knee procedures included in the analyses we present in this section.

Figure 3.K1 (a) Knee cohort flow diagram.



** Reasons not necessarily mutually exclusive*

Over the lifetime of the registry, the 1,544,961 primary knee joint replacement procedures contributing to our revision analyses were carried out by a total of 3,613 unique consultant surgeons working across 479 units.

Over the last three years (1 January 2020 to 31 December 2022), 232,505 primary knee procedures (representing 15% of primary knee replacements currently included in the registry) were performed by 1,856 consultant surgeons working across 408 units. Looking at caseload over this three-year period, the median number of primary procedures per consultant surgeon was 89 (IQR 32 to 173) and the median number of procedures per unit was 492.5 (IQR 168 to 816). A proportion of surgeons will have commenced practice as a consultant during this period, some may have retired, and some surgeons may have periods of surgical inactivity within the coverage of the NJR, therefore their apparent caseload would be lower. It is also pertinent to note that the last three years have been heavily impacted by the COVID pandemic.

Over this three-year period, there have been 198,504 primary TKRs performed by 1,844 surgeons (median=80 cases per surgeon; IQR 29 to 150) in 406 separate units (median=421 cases per unit; IQR 147 to 704). In the same period, there have been 30,976 primary unicondylar knee procedures performed by 820 consultant surgeons (median=20 cases per surgeon; IQR 6 to 51) in 357 units (median=54 cases per unit; IQR 18 to 118).

The majority of primary knee replacements in the registry were carried out on females (females 56.3%; males 43.7%). The median age at primary operation was 70 years (IQR 63 to 76), see Table 3.K3 (page 157) and commentary later for discussion of age at primary by type of knee replacement. Osteoarthritis was given as a documented indication for surgery in 1,505,535 procedures (97.4% of the cohort) and was the sole indication given in 1,493,544 (96.7%) primary knee procedures.

Table 3.K1 (page 148) shows the breakdown of cases by type of knee replacement, the method of fixation, constraint and bearing used. A breakdown within each method of fixation of the percentage of constraint and bearing types used is shown in a separate column. Cemented TKR is the most commonly performed type of knee replacement (83.7% of all primary knee replacements). A further 4% were either all uncemented or hybrid TKRs. Most UKRs were unicondylar (9.8% of the total) with the remainder being patellofemoral (1.1%).

More than half of all operations (58.2%) were TKRs which were all cemented and unconstrained (cruciate retaining) with a fixed bearing, followed by 19.4% which were all cemented and posterior stabilised with a fixed bearing. Uncemented and hybrid prostheses are mostly unconstrained. While uncemented knees are almost equally likely to have a mobile or fixed bearing, hybrid knees are more likely to utilise a fixed bearing. Approximately two-thirds (69.5%) of cemented TKRs are unconstrained and have a fixed bearing. Unicondylar knee surgery has typically involved the use of a mobile bearing (58.1%) but this has been changing in recent years (Table 3.K2, page 154). Some primary knee replacements could not be classified according to their bearing / constraint (approximately 1.4% of the total cohort).

Table 3.K1 Number and percentage of primary knee replacements by fixation, constraint and bearing.

Fixation, constraint and bearing type	Number of primary knee operations	Percentage of each constraint type used within each method of fixation	Percentage of all primary knee operations
All types	1,544,961		100
Total knee replacement			
All cemented	1,293,332		83.7
unconstrained, fixed	898,547	69.5	58.2
unconstrained, mobile	43,521	3.4	2.8
posterior-stabilised, fixed	300,450	23.2	19.4
posterior-stabilised, mobile	14,202	1.1	0.9
constrained condylar	13,969	1.1	0.9
monobloc polyethylene tibia	20,032	1.5	1.3
pre-assembled/hinged/linked	2,611	0.2	0.2
All uncemented	50,966		3.3
unconstrained, fixed	20,696	40.6	1.3
unconstrained, mobile	26,553	52.1	1.7
posterior-stabilised, fixed	3,598	7.1	0.2
other constraints	119	0.2	<0.1
All hybrid	10,355		0.7
unconstrained, fixed	6,700	64.7	0.4
unconstrained, mobile	2,322	22.4	0.2
posterior-stabilised, fixed	1,042	10.1	0.1
other constraints	291	2.8	<0.1
Unicompartmental knee replacement			
All unicondylar, cemented	112,052		7.3
fixed	54,303	48.5	3.5
mobile	50,989	45.5	3.3
monobloc polyethylene tibia	6,760	6.0	0.4
All unicondylar, uncemented/hybrid	38,616		2.5
fixed	1,558	4.0	0.1
mobile	36,582	94.7	2.4
monobloc polyethylene tibia	476	1.2	<0.1
Patellofemoral	17,401		1.1
Multicompartmental	665		<0.1
Unconfirmed	21,574		1.4

Figure 3.K1 (b) Frequency of primary TKR within elective cases stratified by procedure type, bars stacked by volume per consultant per year.

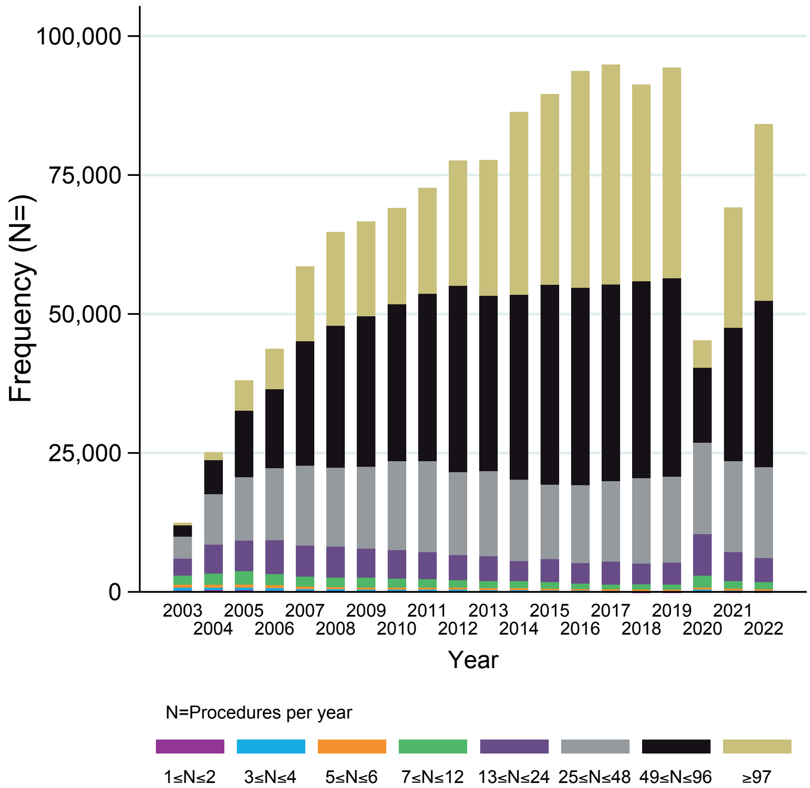


Figure 3.K1 (c) Frequency of primary UKR within elective cases stratified by procedure type, bars stacked by volume per consultant per year.

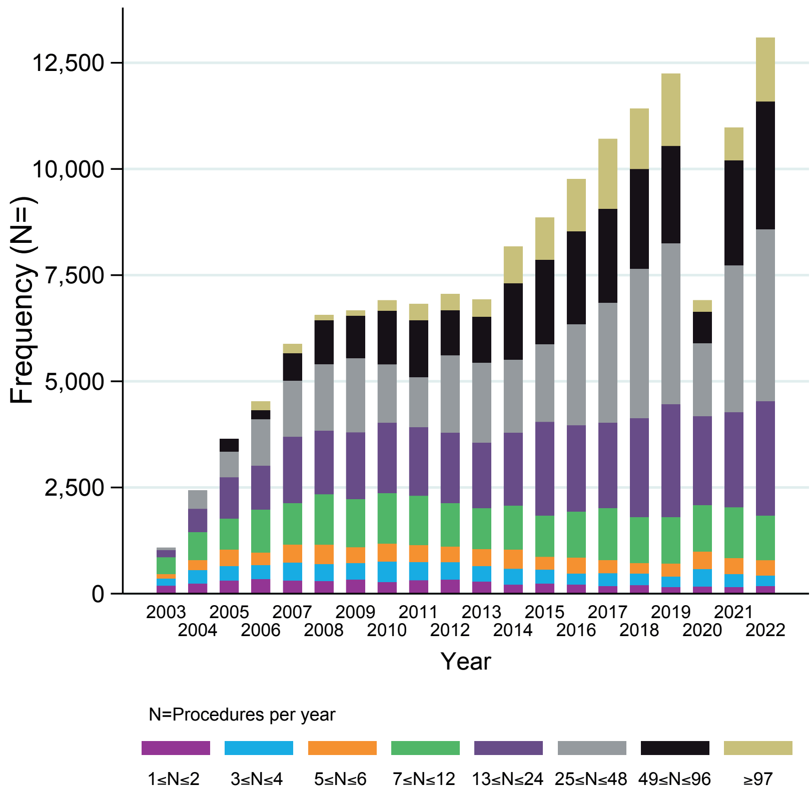


Figure 3.K1 (d) Frequency of primary patellofemoral knee replacements within elective cases stratified by procedure type, bars stacked by volume per consultant per year.

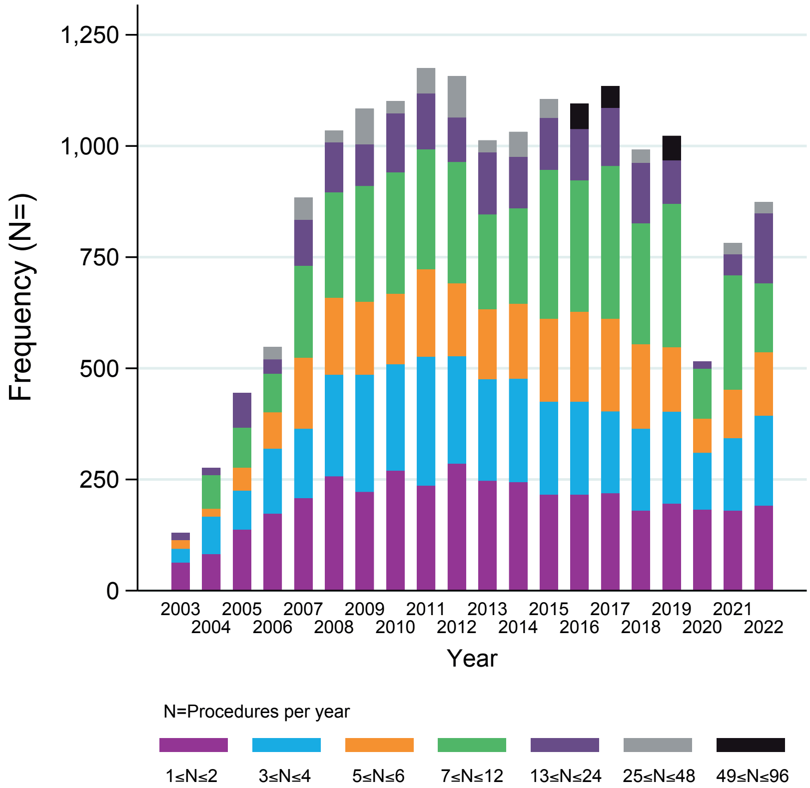
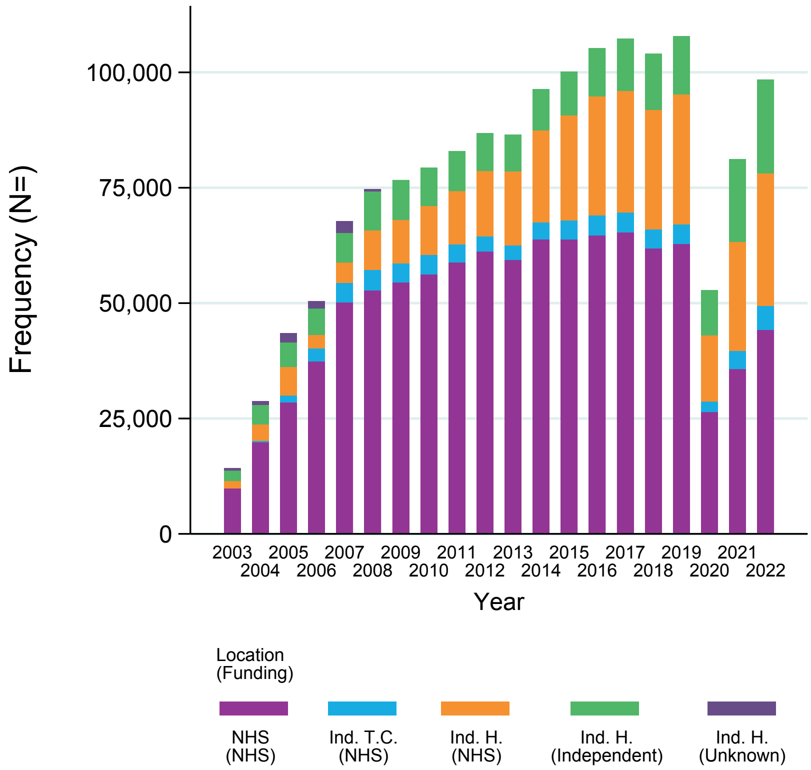


Figure 3.K1 (e) Frequency of elective primary knee replacements by funding status and organisation type, per year.



Note: Ind.=Independent; T.C.=Treatment Centre; H.=Hospital.

Figures 3.K1 (b) to (d) (pages 149 to 151) show the yearly number of primary knee replacements performed for all indications. Procedures have been stratified by total knee, unicondylar and patellofemoral joint replacements. Please note the difference in scale of the y-axis between each plot.

Each bar in the figure is further stratified by the volume of procedures that the consultant performed in that year within that joint replacement type i.e. if a surgeon performed 25 elective TKR procedures, 25 unicondylar knee replacements and 25 patellofemoral joint replacement procedures, their annual total volume would be 75 procedures. However, each 25 procedures are not aggregated and only contribute to the grey sub-division in each figure respectively.

Figure 3.K1 (b) shows that the volume of TKRs increased from when data collection started until 2020 when the impact of COVID took effect. From 2007 until 2020 the majority of TKR procedures were contributed by higher volume surgeons i.e. those performing 49 or more procedures annually. In 2020, the majority of procedures were performed by those performing 48 or fewer procedures annually before the previous pattern was restored in 2021.

Figure 3.K1 (c) shows that the volume of unicondylar knee replacements increased rapidly from 2013 until the impact of COVID in 2020. The recovery of UKR procedure volumes in 2022 has been better than for TKRs. From 2014 until 2020, the majority of UKR procedures were contributed by higher volume consultants i.e. those performing 25 or more procedures annually. In 2020, the majority of procedures were performed by those performing under 25 procedures annually, before the previous pattern was restored in 2021. Only a small proportion of the procedures were contributed by consultants performing fewer than seven unicondylar knee replacements per year.

Figure 3.K1 (d) shows that the volume of patellofemoral knee replacements was fairly constant from 2007 onwards until the impact of COVID in 2020 and partial recovery in 2021 and 2022. From 2007 until 2020, the majority of procedures recorded in the registry were contributed by consultants who performed more than five procedures annually, this reversed in 2020 before being restored in 2021.

Figure 3.K1 (e) describes the funding status and organisation type (based on organisation type in 2023) of primary knee procedures collected by the NJR. The figure shows a steady increase in the number of knee replacements that were NHS-funded and performed in NHS hospitals from the beginning of the registry until 2012. After this time, the number plateaued until 2019 and then reduced substantially due to the impact of COVID. The growth in the total number of knee replacements performed from 2012 to 2019 was largely driven by growth in the number of NHS funded procedures being performed in independent hospitals. Although the total number of knee replacement procedures performed in 2022 has recovered to the level performed in 2014, it has not yet recovered to the level performed in the years 2015 to 2019. The number of NHS-funded procedures being performed in NHS hospitals has only recovered to around 70% of the number in 2019, the partial recovery in volumes has been driven to a greater extent by increases in the number of NHS-funded procedures performed in independent hospitals and independently funded procedures performed in independent hospitals.

Table 3.K2 Percentage of primary knee replacements by fixation, constraint, bearing and year.

Fixation, constraint and bearing type	2004 n= 42,832	2005 n= 43,523	2006 n= 50,399	2007 n= 67,715	2008 n= 74,707	2009 n= 76,692	2010 n= 79,301	2011 n= 82,908	2012 n= 86,790	2013 n= 86,526	2014 n= 96,367	2015 n= 100,175	2016 n= 105,275	2017 n= 107,306	2018 n= 104,083	2019 n= 107,857	2020 n= 52,807	2021 n= 81,229	2022 n= 98,469
Total knee replacement																			
All cemented	78.2	79.2	78.8	78.8	79.3	80.2	81.6	83.2	85.7	86.8	86.7	86.7	86.6	86.1	85.5	85.2	83.4	83.1	83.1
unconstrained, fixed	52.0	51.6	49.9	49.7	50.7	52.2	53.5	55.9	58.7	59.4	60.5	61.5	62.3	61.7	61.4	61.6	60.6	61.8	62.7
unconstrained, mobile	4.2	5.9	6.5	6.4	5.7	4.7	4.0	2.9	2.4	2.2	1.9	1.7	1.7	1.6	1.6	1.5	1.7	1.5	1.6
posterior-stabilised, fixed	20.3	19.3	19.6	19.8	20.4	20.8	21.2	21.1	20.8	20.9	20.2	19.8	19.3	19.5	19.1	18.7	17.9	16.2	15.3
posterior-stabilised, mobile	1.0	1.7	1.8	1.6	1.4	1.4	1.4	1.2	1.1	1.2	1.0	0.8	0.6	0.4	0.3	0.3	0.4	0.6	0.7
constrained condylar	0.4	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.5	0.8	1.0	1.2	1.0	1.1	1.3	1.4	1.6	1.8	1.7
monobloc polyethylene tibia	0.2	0.3	0.6	0.9	0.8	0.7	1.0	1.6	2.0	2.1	1.9	1.5	1.5	1.6	1.6	1.4	1.1	1.0	0.9
pre-assembled/hinged/linked	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
All uncemented	6.3	6.0	6.3	6.3	6.0	5.5	4.6	4.0	3.2	2.5	2.5	2.3	2.0	2.0	1.9	1.9	1.8	1.8	2.1
unconstrained, fixed	2.4	2.2	2.4	2.7	2.6	2.5	1.7	1.4	1.0	0.7	0.6	0.7	0.8	0.8	0.8	1.0	1.1	1.1	1.6
unconstrained, mobile	3.3	3.4	3.4	3.2	3.1	2.7	2.7	2.4	2.0	1.6	1.6	1.4	1.1	1.0	0.8	0.8	0.7	0.7	0.5
posterior-stabilised, fixed	0.6	0.4	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1
other constraints	<0.1	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
All hybrid	2.7	2.3	1.7	1.4	1.3	1.2	0.9	0.5	0.4	0.4	0.4	0.4	0.5	0.2	0.3	0.3	0.3	0.3	0.2
unconstrained, fixed	2.3	1.9	1.2	1.0	1.1	0.9	0.7	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
unconstrained, mobile	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.1	0.1	0.1	<0.1	<0.1	<0.1
posterior-stabilised, fixed	0.1	0.1	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.1	0.1
other constraints	<0.1	0.2	0.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	<0.1	0	<0.1	<0.1
Unicompartmental knee replacement																			
All unicondylar, cemented	8.1	8.2	8.8	8.4	8.3	8.0	7.8	7.1	6.9	6.6	6.4	6.1	5.9	6.0	6.7	7.1	8.0	8.3	8.4
fixed	0.9	1.0	1.0	1.0	1.2	1.4	1.8	1.9	2.3	2.7	3.0	3.3	3.6	4.1	5.0	5.7	6.8	7.4	7.7
mobile	6.6	6.2	6.6	6.6	6.5	6.0	5.5	4.7	4.1	3.4	3.0	2.5	1.9	1.7	1.4	1.2	1.0	0.7	0.4
monobloc polyethylene tibia	0.7	0.9	1.2	0.9	0.7	0.6	0.5	0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.2

Note: Data from 2003 have been included in 2004 since 2003 was not a complete year. Percentages are calculated as a percentage of total yearly operations.
Note: A zero represents no procedures of this bearing type.

Table 3.K2 (continued)

Fixation, constraint and bearing type	2004 n= 42,832	2005 n= 43,523	2006 n= 50,399	2007 n= 67,715	2008 n= 74,707	2009 n= 76,692	2010 n= 79,301	2011 n= 82,908	2012 n= 86,790	2013 n= 86,526	2014 n= 96,367	2015 n= 100,175	2016 n= 105,275	2017 n= 107,306	2018 n= 104,083	2019 n= 107,857	2020 n= 52,807	2021 n= 81,229	2022 n= 98,469
All unicondylar, uncemented/hybrid	0.1	0.2	0.2	0.3	0.4	0.7	0.9	1.2	1.2	1.4	2.0	2.8	3.4	4.0	4.3	4.3	5.1	5.2	4.9
fixed	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	<0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1
mobile	<0.1	0.1	0.1	0.2	0.3	0.6	0.7	1.0	1.1	1.4	1.9	2.7	3.3	3.8	4.1	4.1	4.8	5.0	4.8
monobloc polyethylene tibia	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0
Patellofemoral	0.9	1.0	1.1	1.3	1.4	1.4	1.4	1.4	1.3	1.2	1.1	1.1	1.0	1.1	1.0	0.9	1.0	1.0	0.9
Multicompartmental	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Unconfirmed	3.6	3.1	3.1	3.5	3.1	2.9	2.7	2.5	1.1	1.0	0.8	0.6	0.6	0.5	0.4	0.3	0.3	0.3	0.3
All	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: Data from 2003 have been included in 2004 since 2003 was not a complete year. Percentages are calculated as a percentage of total yearly operations.
Note: A zero represents no procedures of this bearing type.

Table 3.K2 (page 154) shows the annual rates for the usage of the different types of primary knee replacements. Overall, more than 90% of all types of primary knee replacement utilised all cemented fixation, and since 2004 the share of all implant replacements of this type has increased by approximately five percentage points. The main decline in the type of primary knee replacements carried out has been in the use of all uncemented and hybrid TKRs over time (now 2.3% of all knee replacements). Usage of each implant of this type has decreased proportionally to less than a quarter of those figures reported for 2004 (when they were 9.0% of all knee replacements).

Figure 3.K2 illustrates the temporal changes in fixation, highlighting the dominance of cemented TKR primaries.

Figure 3.K2 Fixation by year of procedure in primary knee replacement.

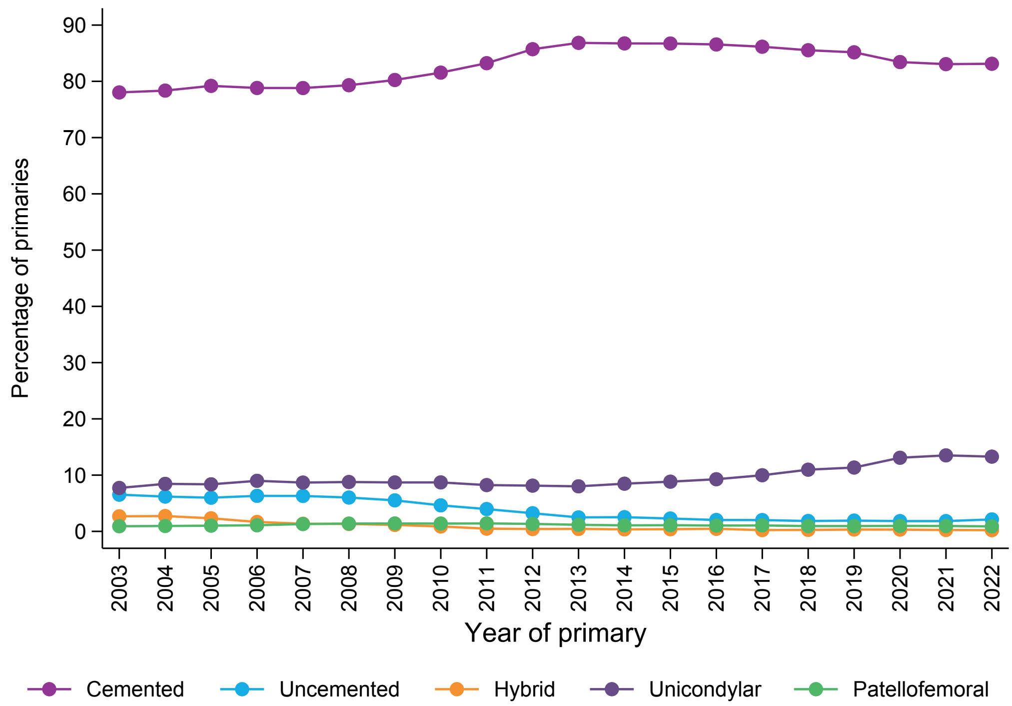


Table 3.K3 Age at primary knee replacement by fixation, constraint and bearing type.

Fixation, constraint and bearing type	N	Age of patient (years)		Male (%)[3]
		Median (IQR)[1]	Mean (SD)[2]	
All types	**1,544,961**	**70 (63 to 76)**	**69.0 (9.6)**	**43.7**
All cemented	**1,293,332**	**70 (64 to 76)**	**69.7 (9.2)**	**42.5**
unconstrained, fixed	898,547	70 (64 to 76)	69.7 (9.1)	43.2
unconstrained, mobile	43,521	69 (62 to 76)	68.8 (9.6)	42.3
posterior-stabilised, fixed	300,450	70 (64 to 77)	69.9 (9.4)	41.1
posterior-stabilised, mobile	14,202	67 (60 to 74)	66.6 (10.1)	44.3
constrained condylar	13,969	71 (63 to 77)	70.0 (10.2)	36.6
monobloc polyethylene tibia	20,032	74 (69 to 79)	73.3 (8.3)	40.8
pre-assembled/hinged/linked	2,611	76 (66 to 83)	73.4 (12.5)	25.7
All uncemented	**50,966**	**69 (62 to 75)**	**68.1 (9.6)**	**49.0**
unconstrained, fixed	20,696	68 (61 to 75)	68.0 (9.7)	50.5
unconstrained, mobile	26,553	69 (62 to 75)	68.4 (9.2)	47.1
posterior-stabilised, fixed	3,598	67 (59 to 74)	66.6 (10.5)	53.3
other constraints	119	66 (58 to 71)	65.1 (9.8)	69.7
All hybrid	**10,355**	**69 (62 to 76)**	**68.7 (9.8)**	**44.7**
unconstrained, fixed	6,700	70 (63 to 76)	69.0 (9.6)	45.4
unconstrained, mobile	2,322	69 (62 to 76)	68.7 (9.8)	40.4
posterior-stabilised, fixed	1,042	69 (61 to 75)	67.7 (10.4)	47.3
other constraints	291	64 (57 to 74)	64.8 (11.0)	50.9
All unicondylar, cemented	**112,052**	**64 (57 to 71)**	**64.0 (9.8)**	**53.7**
fixed	54,303	64 (57 to 71)	63.8 (9.9)	55.7
mobile	50,989	64 (57 to 71)	64.2 (9.5)	51.6
monobloc polyethylene tibia	6,760	64 (57 to 71)	64.0 (10.0)	53.6
All unicondylar, uncemented/hybrid	**38,616**	**65 (58 to 72)**	**64.9 (9.6)**	**55.1**
fixed	1,558	66 (57 to 74)	65.5 (11.3)	42.7
mobile	36,582	65 (58 to 72)	64.9 (9.5)	55.8
monobloc polyethylene tibia	476	65 (58 to 71)	64.6 (9.4)	42.0
Patellofemoral	**17,401**	**58 (50 to 67)**	**58.5 (11.7)**	**22.9**
Multicompartmental	**665**	**60 (54 to 68)**	**61.0 (10.2)**	**47.2**
Unconfirmed	**21,574**	**69 (62 to 76)**	**68.3 (10.3)**	**43.1**

[1]IQR=Interquartile range - age of middle 50% of patients at time of primary knee operation.
[2]SD=Standard deviation.
[3]The percentage male figures are based on the total number of primary knee replacements.

Table 3.K3 (page 157) shows the age and gender distribution of patients undergoing primary knee replacement. The median age of a person receiving a cemented TKR was 70 years (IQR 64 to 76 years). Patients receiving cemented unicondylar prostheses were typically six years younger (median age 64 years; IQR 57 to 71) compared to all types of knee replacement while those receiving uncemented/hybrid unicondylar prostheses were five years younger (median age 65 years; IQR 58 to 72). The patellofemoral group were typically 12 years younger (median age 58 years; IQR 50 to 67) compared to all types of knee replacement. Those receiving multicompartmental knee replacements were typically ten years younger (median age 60 years; IQR 54 to 68) compared to all types of knee replacement.

Females who undergo a primary knee replacement are more likely to receive a TKR; they received 57.5%, 51.0% and 55.3% of cemented, uncemented and hybrid type procedures respectively. Conversely, cemented and uncemented/hybrid unicondylar surgery was performed on a higher proportion of males (53.7% and 55.1% respectively). Patellofemoral surgery was predominantly carried out on females (77.1% of patients) who are typically younger than a TKR or unicondylar patient, with a median age at operation of 58.

Table 3.K4 shows the ASA grade and indication for knee replacement by gender for all primary knee replacements. ASA 2 is the most common ASA grade and only a small number of patients with a grade greater than ASA 3 undergo knee replacement. The majority of cases are performed with osteoarthritis as the sole indication; 1,493,544 (96.7%) of all 1,544,961 knee replacements.

Table 3.K4 Primary knee replacement patient demographics.

	Male	N (%)	Female	N (%)	All	N (%)
Total		**674,698**		**870,263**		**1,544,961**
ASA 1		85,622 (12.7)		83,719 (9.6)		169,341 (11.0)
ASA 2		476,051 (70.6)		637,178 (73.2)		1,113,229 (72.1)
ASA 3		110,593 (16.4)		146,709 (16.9)		257,302 (16.7)
ASA 4		2,373 (0.4)		2,577 (0.3)		4,950 (0.3)
ASA 5		59 (<0.1)		80 (<0.1)		139 (<0.1)
Osteoarthritis as a reason for primary		662,462 (98.2)		843,073 (96.9)		1,505,535 (97.4)
Osteoarthritis as the sole reason for primary		657,125 (97.4)		836,419 (96.1)		1,493,544 (96.7)
Age	Mean (SD) 68.7 (9.3)	Median (IQR) 69 (62 to 75)	Mean (SD) 69.2 (9.7)	Median (IQR) 70 (63 to 76)	Mean (SD) 69.0 (9.6)	Median (IQR) 70 (63 to 76)

Note: Percentages in this table are calculated by column.

3.3.2 First revision after primary knee replacement surgery

In this section, estimates of cumulative revision in the tables are presented at 1, 3, 5, 10, 15 and 19 years. A total of 47,522 first revisions of a knee prosthesis have been linked to registry primary knee replacement surgery records of operations undertaken between 2003 and 2022. Figures 3.K3 (a) and (b) illustrate temporal changes in the overall revision rates using Kaplan-Meier estimates; procedures have been grouped by the year of the primary operation.

Figure 3.K3 (a) (page 160) plots each Kaplan-Meier curve with a common origin, i.e. time zero is equal to the year of operation. This illustrates that there was a small increase in revision estimates up until 2008, followed by a small decline.

Figure 3.K3 (b) (page 161) shows the same curves plotted against calendar time, where the origin of each curve is the year of operation. It separates each year enabling changes in revision estimates to be clearly identified. In addition, the revision rates at 1, 3, 5, 7, 10, 13, 15, 17 and 19 years have been highlighted. If revision rates and timing of revision rates were static across time, it would be expected that all revision curves would be the same shape and equally spaced; a departure from this indicates a change in the number and timing of revision procedures. The cumulative probability of a knee joint being revised at three and five years increased for each operative year group between 2003 and 2008; the probability of being revised at three and five years reduced for operations performed between 2009 and 2022. From the peak in 2008, the yearly survivorship curves are less divergent, i.e. a slowing in the observed trend.

Possible reasons for a peak in the probability of revision in the 2008 cohort out to ten years are: 1) the registry was not capturing the full range and number of operations taking place in units in England and Wales until 2008, and 2) there could be bias in terms of the general overall health, risk of revision, and other key characteristics of the patients on record in the registry in the early years. Given that similar, more marked, patterns are observed in primary hip replacements and that the start of the reduction coincides with the timeline of when NJR clinician feedback and performance analyses were introduced, it is likely that these patterns represent improved survival as a result of clinician feedback and the improved adoption of evidence-based practice.

Figure 3.K3 (a) KM estimates of cumulative revision by year, in primary knee replacements.

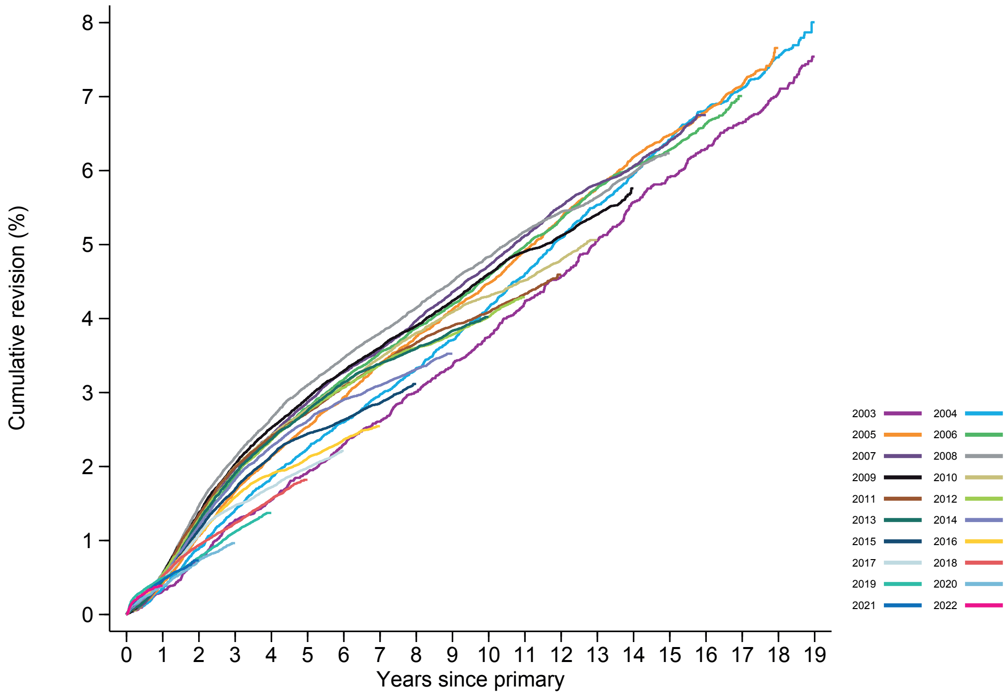


Figure 3.K3 (b) KM estimates of cumulative revision by year, in primary knee replacements plotted by year of primary.

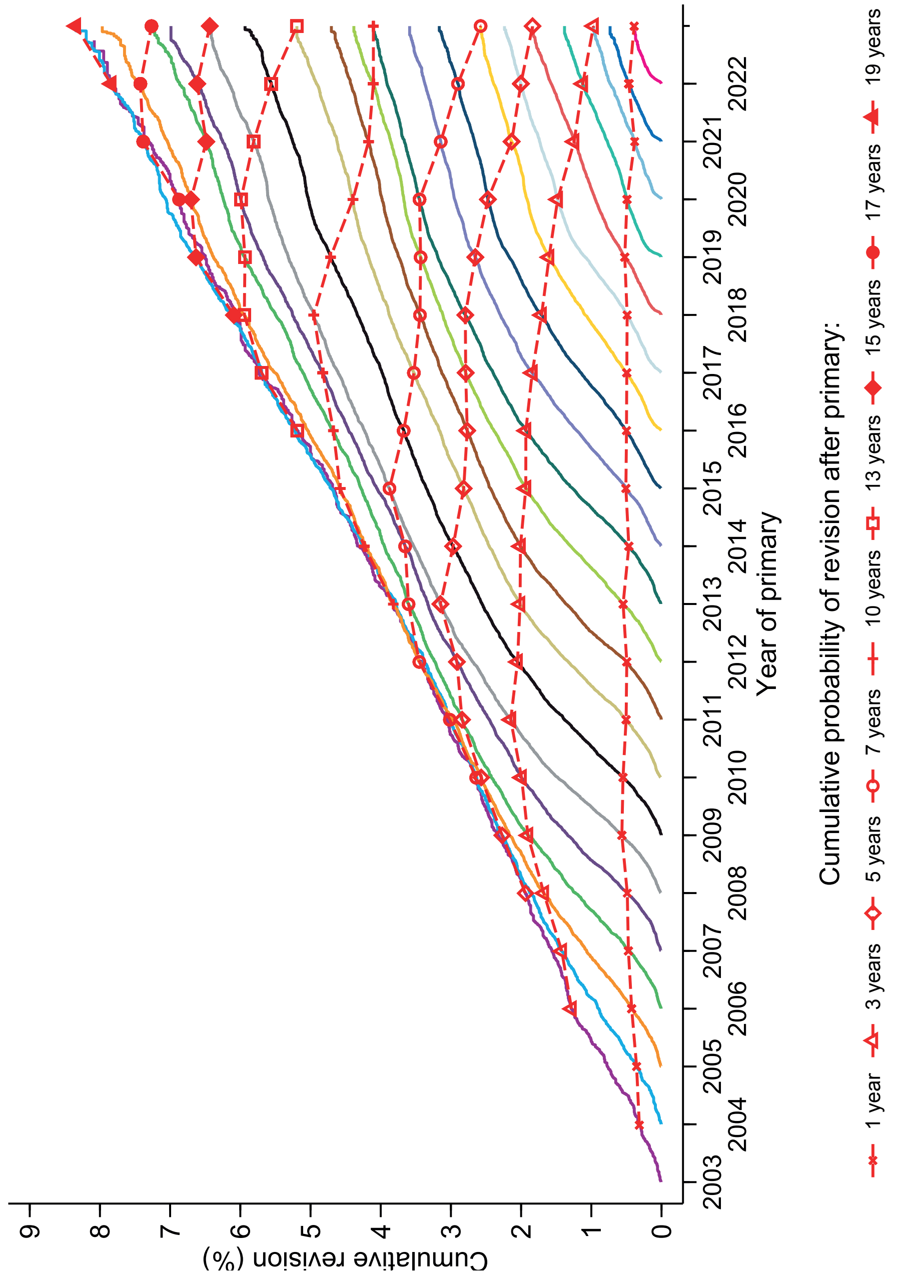


Table 3.K5 KM estimates of cumulative revision (95% CI) by fixation, constraint and bearing, in primary knee replacements. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Fixation, constraint and bearing type	N	Time since primary					
		1 year	3 years	5 years	10 years	15 years	19 years
All types	1,544,961	0.49 (0.48-0.50)	1.68 (1.66-1.70)	2.44 (2.41-2.46)	3.93 (3.89-3.97)	5.56 (5.50-5.63)	7.17 (6.98-7.36)
Unconfirmed	21,574	0.70 (0.59-0.82)	2.21 (2.02-2.42)	3.15 (2.92-3.40)	5.25 (4.93-5.59)	7.07 (6.63-7.53)	*8.56 (7.79-9.41)*
All cemented	1,293,332	0.42 (0.41-0.43)	1.42 (1.40-1.45)	2.04 (2.02-2.07)	3.11 (3.07-3.15)	4.21 (4.15-4.28)	5.33 (5.16-5.52)
unconstrained, fixed	898,547	0.38 (0.37-0.40)	1.31 (1.29-1.34)	1.86 (1.83-1.89)	2.78 (2.74-2.82)	3.86 (3.79-3.94)	5.20 (4.96-5.46)
unconstrained, mobile	43,521	0.51 (0.44-0.58)	1.75 (1.63-1.88)	2.59 (2.44-2.75)	3.98 (3.78-4.20)	5.13 (4.85-5.41)	*5.78 (5.18-6.46)*
posterior-stabilised, fixed	300,450	0.48 (0.46-0.51)	1.64 (1.59-1.69)	2.42 (2.36-2.48)	3.83 (3.75-3.92)	4.96 (4.83-5.09)	5.73 (5.49-5.98)
posterior-stabilised, mobile	14,202	0.65 (0.53-0.80)	2.08 (1.85-2.34)	2.83 (2.56-3.13)	4.15 (3.80-4.53)	5.52 (5.01-6.08)	*5.94 (5.28-6.67)*
constrained condylar	13,969	0.96 (0.80-1.14)	2.05 (1.81-2.33)	2.69 (2.39-3.02)	3.82 (3.33-4.38)	*5.49 (4.24-7.08)*	
monobloc polyethylene tibia	20,032	0.34 (0.27-0.43)	1.20 (1.06-1.37)	1.63 (1.45-1.83)	2.13 (1.90-2.39)	2.61 (2.22-3.07)	*2.90 (2.27-3.70)*
pre-assembled/hinged/linked	2,611	1.99 (1.50-2.63)	4.25 (3.48-5.19)	5.86 (4.89-7.01)	8.82 (7.26-10.69)	*10.73 (8.40-13.67)*	
All uncemented	50,966	0.56 (0.50-0.63)	2.04 (1.92-2.17)	2.77 (2.62-2.92)	3.89 (3.70-4.08)	5.13 (4.88-5.40)	6.57 (5.96-7.24)
unconstrained, fixed	20,696	0.64 (0.53-0.76)	2.23 (2.03-2.46)	2.90 (2.66-3.16)	4.04 (3.74-4.36)	5.28 (4.88-5.71)	*6.34 (5.52-7.26)*
unconstrained, mobile	26,553	0.49 (0.41-0.58)	1.88 (1.72-2.05)	2.62 (2.42-2.82)	3.60 (3.36-3.86)	4.78 (4.45-5.14)	*6.07 (5.29-6.95)*
posterior-stabilised, fixed	3,598	0.68 (0.46-1.01)	2.27 (1.83-2.83)	3.23 (2.67-3.89)	5.27 (4.49-6.19)	7.14 (6.06-8.39)	*11.66 (8.01-16.81)*
other constraints	119	*0*	*0*	*1.11 (0.16-7.63)*	*2.66 (0.66-10.40)*		
All hybrid	10,355	0.52 (0.40-0.68)	1.67 (1.44-1.95)	2.32 (2.03-2.64)	3.46 (3.10-3.88)	4.37 (3.91-4.88)	*5.25 (4.44-6.20)*
unconstrained, fixed	6,700	0.45 (0.32-0.65)	1.57 (1.29-1.91)	2.16 (1.83-2.55)	3.17 (2.75-3.65)	4.03 (3.51-4.62)	*4.83 (3.94-5.90)*
unconstrained, mobile	2,322	0.87 (0.56-1.34)	1.79 (1.32-2.43)	2.47 (1.90-3.21)	3.84 (3.01-4.89)	*5.59 (4.19-7.44)*	*6.35 (4.50-8.93)*
posterior-stabilised, fixed	1,042	0.10 (0.01-0.72)	1.81 (1.09-2.98)	3.10 (2.03-4.73)	5.09 (3.51-7.34)	*5.42 (3.76-7.79)*	
other constraints	291	0.69 (0.17-2.74)	2.83 (1.42-5.57)	3.19 (1.67-6.03)	*4.80 (2.81-8.13)*	*5.32 (3.17-8.87)*	
All unicondylar, cemented	112,052	0.91 (0.86-0.97)	3.45 (3.34-3.57)	5.21 (5.07-5.36)	9.70 (9.48-9.92)	14.68 (14.33-15.04)	19.25 (18.26-20.28)
fixed	54,303	0.58 (0.52-0.66)	2.36 (2.22-2.50)	3.54 (3.36-3.74)	6.79 (6.44-7.16)	10.62 (9.90-11.39)	*14.81 (12.35-17.72)*
mobile	50,989	1.26 (1.16-1.36)	4.31 (4.14-4.50)	6.39 (6.17-6.61)	11.36 (11.06-11.67)	16.61 (16.17-17.05)	21.23 (20.11-22.40)
monobloc polyethylene tibia	6,760	0.73 (0.55-0.97)	4.23 (3.76-4.75)	6.37 (5.79-7.01)	10.58 (9.78-11.45)	14.64 (13.55-15.82)	*18.00 (16.04-20.17)*
All unicondylar, uncemented/hybrid	38,616	1.17 (1.07-1.29)	2.54 (2.37-2.72)	3.59 (3.38-3.82)	7.11 (6.64-7.62)	*12.45 (10.88-14.23)*	
fixed	1,558	0.33 (0.14-0.79)	2.30 (1.61-3.28)	5.17 (3.97-6.70)	9.78 (7.77-12.28)	*13.79 (10.52-17.96)*	
mobile	36,582	1.22 (1.11-1.34)	2.55 (2.37-2.73)	3.50 (3.29-3.73)	6.90 (6.41-7.44)	*12.60 (10.66-14.87)*	
monobloc polyethylene tibia	476	0.42 (0.11-1.67)	2.55 (1.46-4.45)	4.32 (2.81-6.61)	8.61 (6.30-11.71)	*13.81 (9.31-20.24)*	
Patellofemoral	17,401	1.02 (0.88-1.18)	5.48 (5.14-5.85)	9.02 (8.57-9.49)	17.15 (16.47-17.86)	24.28 (23.24-25.37)	*29.61 (27.32-32.05)*
Multicompartmental	665	1.09 (0.52-2.26)	6.96 (5.19-9.31)	9.53 (7.41-12.22)	13.31 (10.66-16.56)	*15.83 (12.50-19.95)*	

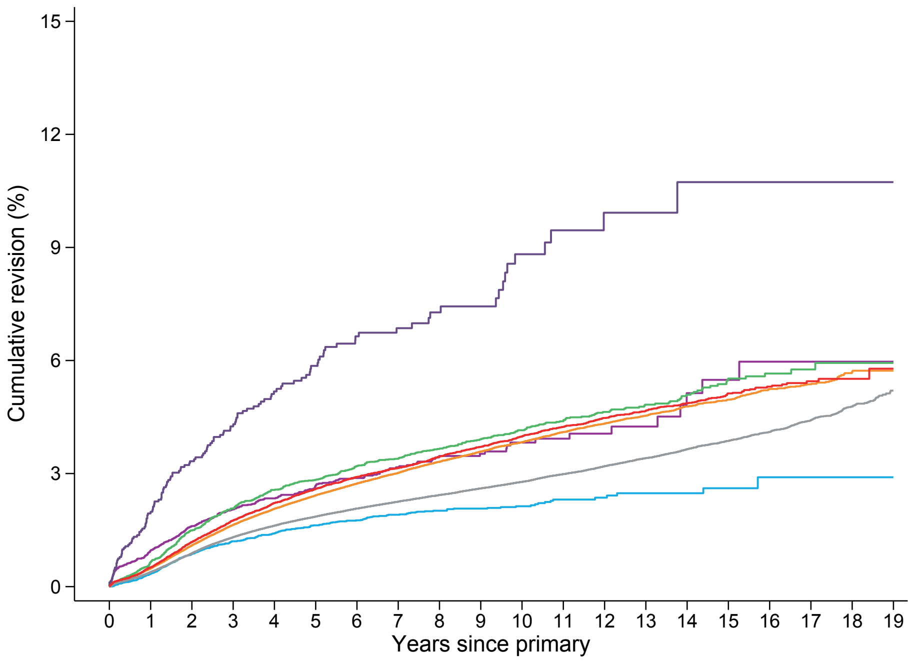
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.

Table 3.K5 (page 162) shows Kaplan-Meier estimates of the cumulative percentage probability of first revision, for any cause, for the cohort of all primary knee replacements. This is broken down for TKR by knee fixation type (cemented, uncemented or hybrid) and sub-divided further within each fixation type by the constraint (unconstrained, posterior-stabilised, constrained condylar and highly constrained implants) and bearing mobility (fixed or mobile) and for UKR, by fixation type and bearing mobility (fixed or mobile). The table shows updated estimates at 1, 3, 5, 10, 15 and 19 years from the primary operation together with 95% Confidence Intervals (95% CI).

Where groups have 250 or fewer cases remaining at risk, the figures are shown in blue italics. Further revisions in these groups would be highly unlikely, and when they do occur, they may appear to have a disproportionate impact on the Kaplan-Meier estimate, i.e. the step upwards may seem disproportionately large. Furthermore, the upper 95% CI at these time points may be underestimated. Although a number of statistical methods have been proposed to deal with this, they typically give different values and, as yet, there is no clear consensus for the large datasets presented here. Kaplan-Meier estimates are not shown at all when the numbers at risk fell below ten.

Figures 3.K4 (a) to 3.K4 (d) (pages 163 to 166) illustrate the differences in revision rates between the types of knee replacement, fixation and constraint. It is worth noting the different vertical scales between the four figures. The results show the lowest revision rates for cemented unconstrained fixed bearing TKRs and cemented TKRs with monobloc polyethylene tibias. The revision rates in cemented TKRs that are posterior-stabilised and those that have mobile bearings remain higher. The revision rates for UKRs remain substantially higher than for TKRs, this is most marked in the patellofemoral replacement and multicompartmental groups.

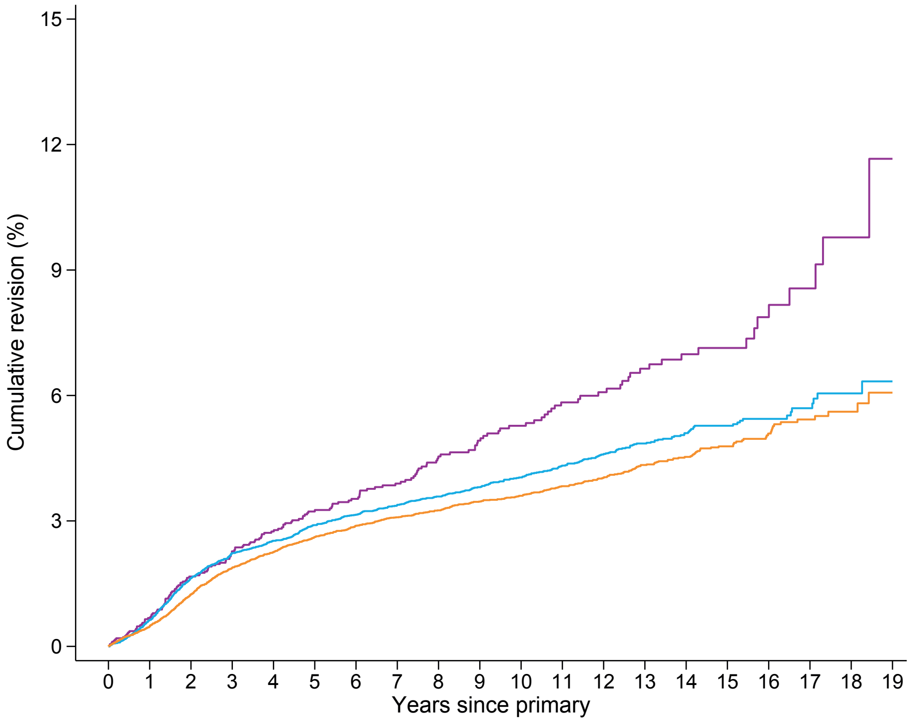
Figure 3.K4 (a) KM estimates of cumulative revision in primary total cemented knee replacements by constraint and bearing. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key: / Numbers at risk

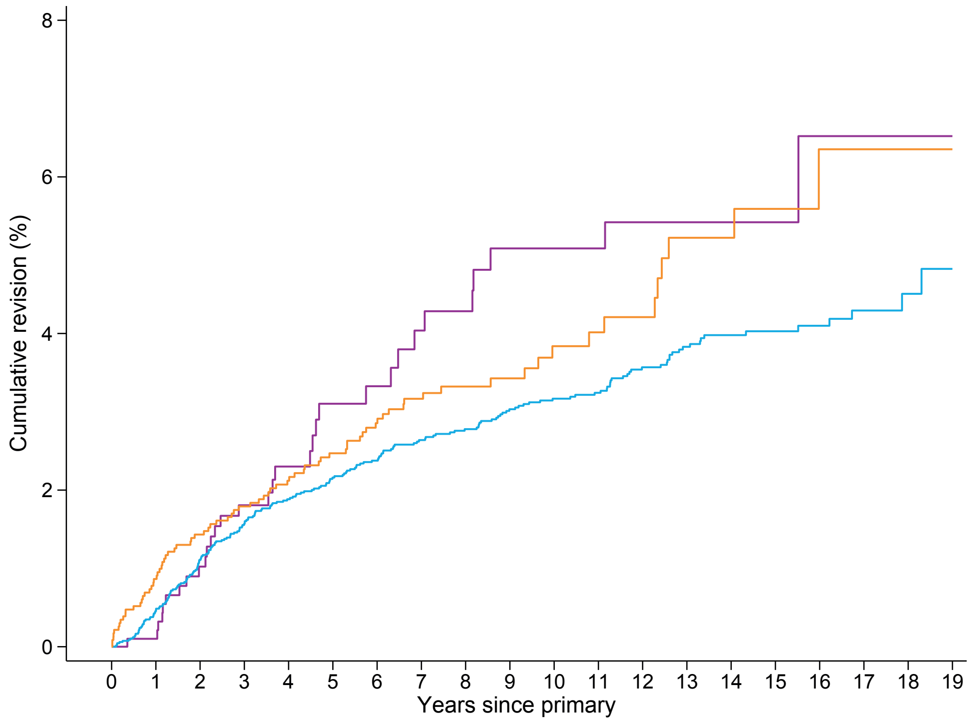
Constrained condylar	13,969	10,263	7,434	4,707	2,471	1,074	543	300	*136*	*32*
Monobloc polyethylene tibia	20,032	17,588	14,662	10,653	7,273	3,954	1,760	867	267	*44*
Posterior-stabilised, fixed	300,450	262,571	221,875	171,845	125,471	85,966	53,466	28,284	11,298	2,969
Posterior-stabilised, mobile	14,202	12,580	11,557	10,286	8,587	6,393	4,455	2,644	1,160	*216*
Pre-assembled/hinged/linked	2,611	1,873	1,392	964	590	340	*193*	*99*	*38*	*10*
Unconstrained, fixed	898,547	761,941	635,974	483,519	343,193	228,995	139,330	74,293	30,089	7,628
Unconstrained, mobile	43,521	39,344	35,104	30,102	25,139	20,198	15,051	9,093	3,507	601

Figure 3.K4 (b) KM estimates of cumulative revision in primary total uncemented knee replacements by constraint and bearing. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk									
Posterior-stabilised, fixed	3,598	3,312	2,956	2,433	1,966	1,462	1,094	691	314	*75*
Unconstrained, fixed	20,696	17,614	15,321	12,877	10,777	8,970	6,657	3,949	1,494	402
Unconstrained, mobile	26,553	24,682	22,470	19,483	16,002	12,384	8,545	5,088	2,193	547

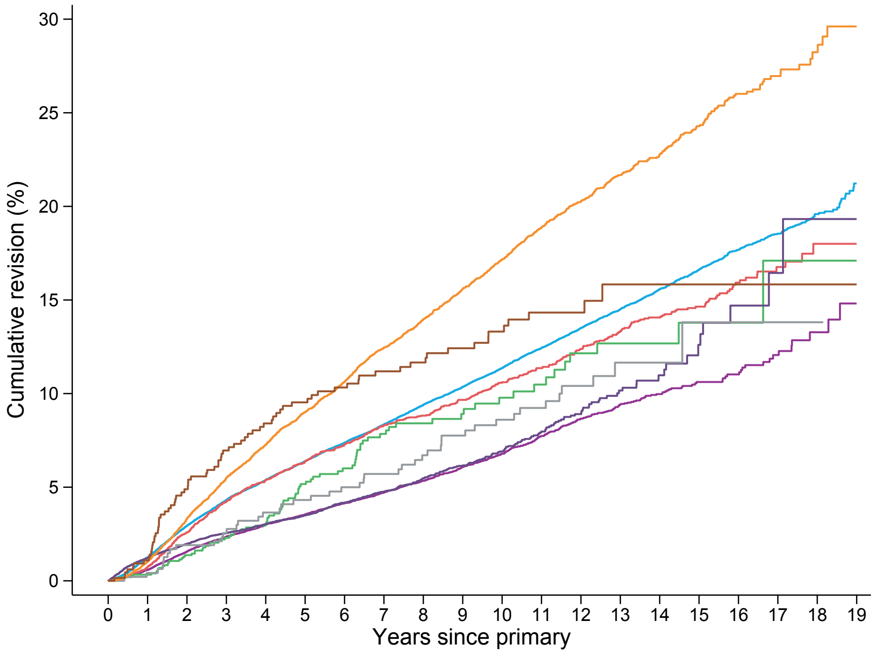
Figure 3.K4 (c) KM estimates of cumulative revision in primary total hybrid knee replacements by constraint and bearing. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk										
Posterior-stabilised, fixed	1,042	791	537	425	366	314	*245*	*141*	*61*	*15*
Unconstrained, fixed	6,700	6,284	5,803	5,289	4,743	4,103	3,319	2,129	1,164	403
Unconstrained, mobile	2,322	2,226	2,017	1,679	1,041	655	411	261	*123*	*44*

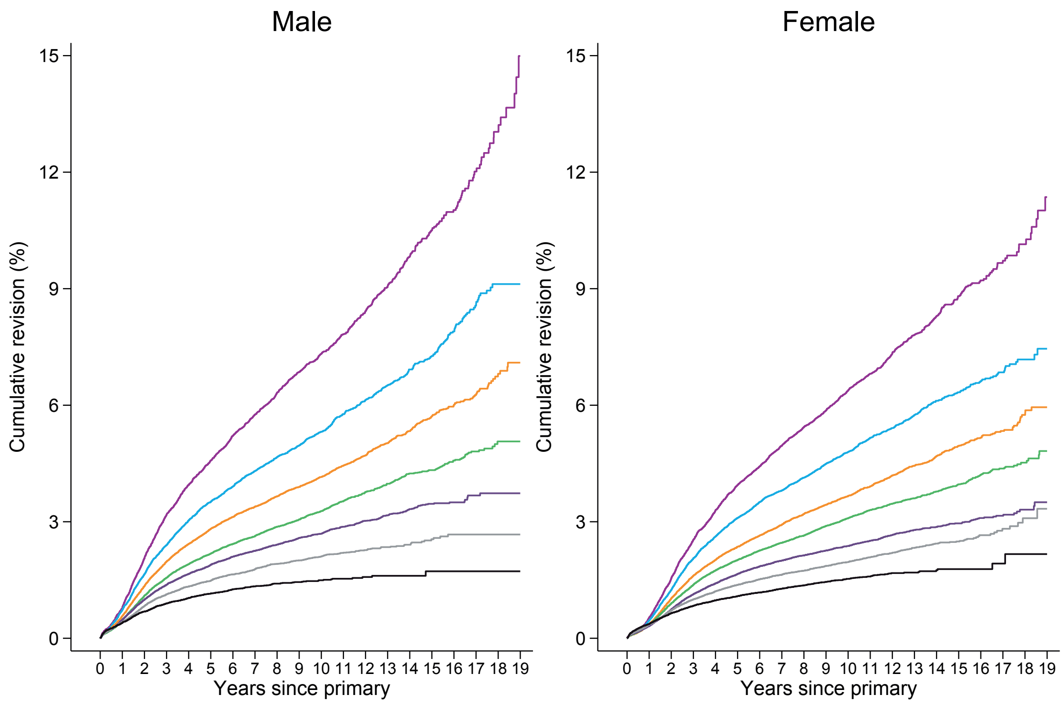
Figure 3.K4 (d) KM estimates of cumulative revision in primary unicondylar or patellofemoral knee replacements by fixation, constraint and bearing. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key: / Numbers at risk

Cemented, fixed	54,303	39,638	29,104	19,218	12,169	7,115	3,881	1,850	733	*170*
Cemented, mobile	50,989	47,966	44,180	39,056	32,954	25,973	18,533	10,974	4,619	1,249
Cemented, monobloc polyethylene tibia	6,760	6,096	5,456	4,666	3,869	3,043	2,236	1,471	670	*132*
Uncemented/hybrid, fixed	1,558	1,252	905	608	412	285	*186*	*98*	*32*	*5*
Uncemented/hybrid, mobile	36,582	26,972	19,590	11,161	5,342	2,568	1,065	310	*79*	*11*
Uncemented/hybrid, monobloc polyethylene tibia	476	461	437	412	366	310	*187*	*63*	*15*	*<4*
Patellofemoral	17,401	15,065	12,787	10,168	7,649	5,522	3,504	1,914	715	*180*
Multicompartmental	665	557	494	432	360	273	*141*	*43*	*7*	*4*

Figure 3.K5 (a) KM estimates of cumulative revision in primary total knee replacements by gender and age.
Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.



Key:

Numbers at risk – Male

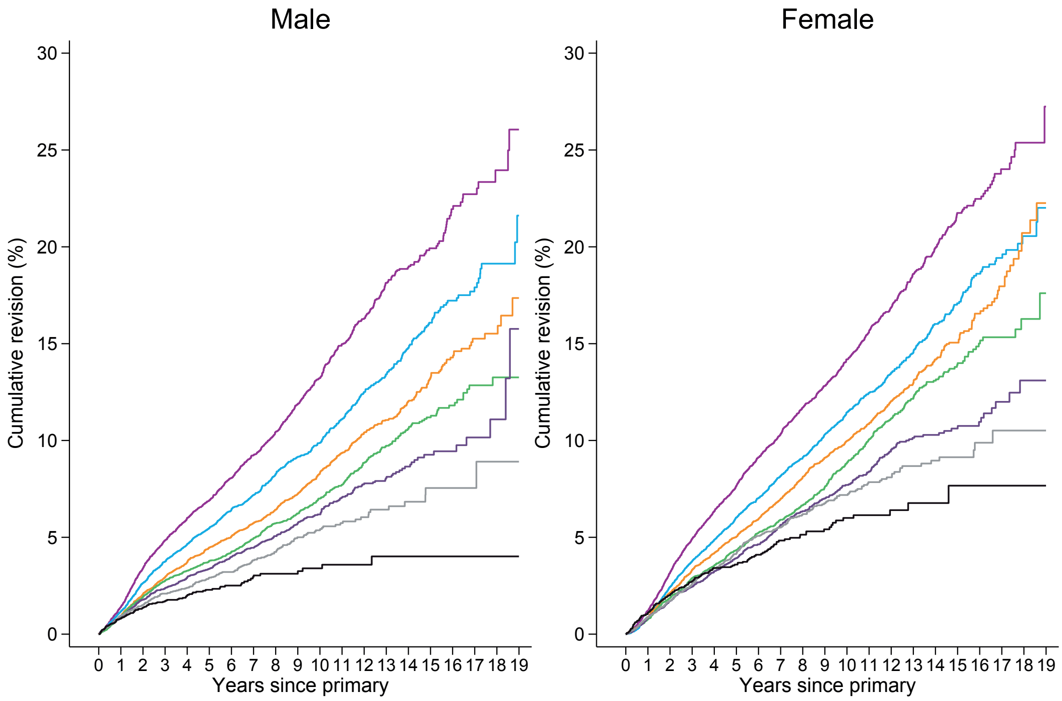
Key										
<55y	32,814	28,884	24,859	19,944	15,020	10,766	7,045	4,047	1,801	493
55 to 59y	49,227	41,996	35,595	28,187	21,177	15,579	10,534	6,411	3,036	844
60 to 64y	87,975	76,015	65,378	52,666	40,863	30,398	20,365	11,692	5,060	1,328
65 to 69y	113,429	98,227	84,322	67,135	49,629	34,562	22,097	12,340	5,141	1,350
70 to 74y	121,570	103,485	86,118	65,324	46,989	31,965	19,725	10,150	3,750	812
75 to 79y	98,986	82,346	67,423	49,798	33,720	20,856	11,510	5,136	1,662	312
≥80y	75,665	60,892	46,220	30,092	17,259	8,694	3,707	1,284	283	*31*

Numbers at risk – Female

Key										
<55y	46,743	41,270	35,476	28,108	21,133	14,978	9,790	5,693	2,534	715
55 to 59y	64,674	56,077	48,200	38,550	29,555	21,540	14,857	9,084	4,083	1,107
60 to 64y	104,036	91,282	79,411	64,360	50,083	37,175	24,930	14,483	6,065	1,590
65 to 69y	139,312	122,584	106,421	85,422	63,765	44,721	29,207	16,919	7,406	1,940
70 to 74y	159,114	137,511	116,131	89,698	66,502	46,767	30,044	16,453	6,488	1,567
75 to 79y	140,995	119,970	100,902	77,938	55,833	36,705	21,759	10,653	3,651	762
≥80y	120,113	100,908	80,983	57,345	36,371	20,344	9,709	3,662	997	*142*

Figure 3.K5 (a) shows that the chance of revision after primary TKR is far higher in younger patient cohorts and that males were slightly more likely, overall, to have a first revision compared to females of comparable grouped age, if they were under the age of 70 when they underwent primary surgery.

Figure 3.K5 (b) KM estimates of cumulative revision in primary unicondylar knee replacements by gender and age. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk (Male)

<55y	11,966	10,096	8,450	6,527	4,779	3,347	2,148	1,160	465	*122*
55 to 59y	12,802	10,284	8,347	6,287	4,638	3,385	2,357	1,428	653	*185*
60 to 64y	16,050	13,048	10,803	8,395	6,462	4,800	3,336	1,989	800	*213*
65 to 69y	15,356	12,611	10,457	8,019	5,829	4,125	2,666	1,531	636	*175*
70 to 74y	12,506	9,870	7,807	5,487	3,873	2,655	1,691	871	304	*70*
75 to 79y	7,971	6,048	4,675	3,319	2,240	1,402	787	381	*121*	*32*
≥80y	4,799	3,559	2,539	1,563	932	539	251	*82*	*29*	*5*

Numbers at risk (Female)

<55y	13,475	11,417	9,484	7,269	5,352	3,780	2,496	1,382	592	*130*
55 to 59y	11,292	9,314	7,680	5,939	4,517	3,382	2,412	1,482	726	*193*
60 to 64y	11,944	9,921	8,328	6,607	5,101	3,881	2,683	1,557	626	*149*
65 to 69y	11,522	9,569	7,961	6,213	4,617	3,308	2,261	1,257	543	*135*
70 to 74y	10,132	8,163	6,533	4,727	3,420	2,445	1,648	940	419	*114*
75 to 79y	6,688	5,225	4,103	3,044	2,202	1,546	1,000	562	*201*	*43*
≥80y	4,165	3,260	2,505	1,725	1,150	699	352	*144*	*33*	*4*

Figure 3.K5 (b) shows that the risk of revision of primary unicondylar knee replacement is, again, substantially higher for younger patient cohorts, but that there are less marked differences in younger patients in the risk of revision according to gender. The risk of revision is higher in all age groups than it is for TKR. Please note the differences in the vertical axes between Figures 3.K5 (a) and (b).

Table 3.K6 (page 169) shows gender and age stratified Kaplan-Meier estimates of the cumulative percentage probability of first revision for any cause, firstly for all cases combined, then by knee fixation / constraint / bearing sub-divisions. Estimates are shown, along with 95% CIs, for males and females within each of four age bands, <55, 55 to 64, 65 to 74 and ≥75 years for revision rate at 1, 3, 5, 10, 15 and 19 years after the primary operation.

Table 3.K6 KM estimates of cumulative revision (95% CI) by gender, age, fixation, constraint and bearing, in primary knee replacements.

Blue italics signify that 250 or fewer cases remained at risk at these time points.

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
			Time since primary							Time since primary					
		N	1 year	3 years	5 years	10 years	15 years	19 years	N	1 year	3 years	5 years	10 years	15 years	19 years
All cases	<55	46,952	1.00 (0.91-1.10)	3.81 (3.63-3.99)	5.46 (5.25-5.69)	9.27 (8.95-9.60)	13.39 (12.89-13.92)	*18.21 (16.63-19.92)*	67,109	0.71 (0.65-0.78)	3.33 (3.19-3.48)	5.22 (5.04-5.41)	9.06 (8.79-9.33)	12.98 (12.55-13.41)	16.54 (15.40-17.75)
Unconfirmed	<55	829	1.70 (1.01-2.86)	4.94 (3.65-6.68)	7.29 (5.68-9.33)	12.53 (10.33-15.16)	*14.87 (12.37-17.83)*	*18.77 (13.87-25.14)*	1,180	1.62 (1.04-2.53)	5.09 (3.97-6.52)	8.30 (6.84-10.05)	12.73 (10.86-14.90)	*17.14 (14.71-19.92)*	*20.44 (16.16-25.67)*
All cemented	<55	30,354	0.79 (0.70-0.90)	3.14 (2.94-3.35)	4.51 (4.27-4.77)	7.27 (6.92-7.63)	10.52 (9.94-11.14)	*15.86 (13.69-18.33)*	44,095	0.52 (0.46-0.60)	2.49 (2.34-2.64)	3.88 (3.69-4.08)	6.33 (6.06-6.62)	8.75 (8.31-9.21)	*11.17 (9.93-12.55)*
unconstrained, fixed	<55	20,259	0.75 (0.64-0.88)	2.87 (2.64-3.12)	3.99 (3.71-4.29)	6.40 (5.99-6.83)	9.41 (8.70-10.19)	*17.07 (13.87-20.92)*	29,907	0.44 (0.37-0.52)	2.13 (1.96-2.31)	3.45 (3.23-3.69)	5.55 (5.23-5.89)	8.09 (7.55-8.67)	*11.25 (9.39-13.46)*
unconstrained, mobile	<55	1,432	1.06 (0.64-1.76)	3.99 (3.07-5.16)	5.76 (4.64-7.14)	8.03 (6.66-9.67)	*11.81 (9.82-14.16)*	*12.59 (10.20-15.50)*	1,830	0.78 (0.46-1.31)	2.89 (2.21-3.79)	4.79 (3.88-5.92)	7.26 (6.07-8.67)	9.53 (7.91-11.45)	*10.83 (8.45-13.84)*
posterior-stabilised, fixed	<55	7,214	0.71 (0.54-0.93)	3.47 (3.05-3.93)	5.44 (4.91-6.03)	9.33 (8.54-10.19)	13.09 (11.84-14.47)	*15.40 (13.26-17.86)*	10,463	0.60 (0.46-0.77)	3.14 (2.81-3.50)	4.64 (4.23-5.09)	8.09 (7.47-8.75)	10.41 (9.51-11.38)	*11.59 (10.15-13.21)*
posterior-stabilised, mobile	<55	758	1.20 (0.63-2.29)	3.99 (2.79-5.69)	5.46 (4.02-7.40)	7.99 (6.16-10.32)	*10.18 (7.77-13.28)*		850	1.33 (0.74-2.40)	4.50 (3.27-6.19)	5.94 (4.50-7.83)	8.20 (6.44-10.40)	*9.38 (7.34-11.95)*	
constrained condylar	<55	420	2.22 (1.16-4.22)	4.83 (3.06-7.57)	*5.60 (3.63-8.60)*	*7.25 (4.77-10.94)*	*10.68 (5.38-20.62)*		609	0.70 (0.26-1.84)	2.65 (1.58-4.45)	3.49 (2.17-5.61)	*5.00 (2.88-8.60)*	*10.52 (4.84-22.04)*	
monobloc polyethylene tibia	<55	191	*0.54 (0.08-3.79)*	*4.53 (2.29-8.86)*	*4.53 (2.29-8.86)*	*6.17 (3.33-11.28)*	*7.94 (4.17-14.83)*		316	0.97 (0.31-2.99)	*3.09 (1.62-5.86)*	*4.38 (2.50-7.61)*	*4.94 (2.87-8.43)*	*7.47 (4.16-13.23)*	
pre-assembled/hinged/linked	<55	80	*2.55 (0.64-9.81)*	*5.26 (2.00-13.42)*	*8.80 (4.01-18.75)*	*16.69 (8.37-31.72)*			120	*3.52 (1.34-9.11)*	*9.37 (5.14-16.74)*	*11.53 (6.70-19.48)*	*20.41 (11.30-35.26)*		
All uncemented	<55	2,076	0.70 (0.41-1.17)	3.70 (2.94-4.64)	5.32 (4.39-6.44)	8.08 (6.85-9.51)	10.91 (9.26-12.84)	*11.28 (9.51-13.36)*	2,175	0.66 (0.39-1.12)	3.47 (2.75-4.36)	5.07 (4.18-6.15)	7.28 (6.15-8.60)	10.07 (8.53-11.86)	*13.12 (10.00-17.13)*
unconstrained, fixed	<55	919	0.90 (0.45-1.80)	3.99 (2.85-5.58)	5.56 (4.17-7.42)	7.75 (5.98-10.01)	*11.03 (8.59-14.11)*		928	0.91 (0.46-1.81)	2.74 (1.83-4.10)	3.77 (2.65-5.36)	6.47 (4.81-8.68)	*9.95 (7.51-13.13)*	
unconstrained, mobile	<55	904	0.68 (0.31-1.51)	3.74 (2.66-5.25)	5.36 (4.03-7.12)	8.43 (6.65-10.66)	*10.76 (8.42-13.71)*	*10.76 (8.42-13.71)*	1,034	0.59 (0.26-1.30)	3.63 (2.63-5.00)	5.44 (4.19-7.07)	7.22 (5.72-9.10)	*9.69 (7.71-12.14)*	
posterior-stabilised, fixed	<55	240	*0.00 (-.-)*	*2.63 (1.19-5.75)*	*4.08 (2.14-7.71)*	*7.54 (4.47-12.57)*	*10.78 (6.59-17.40)*		209	*0.00 (-.-)*	*5.68 (3.18-10.02)*	*8.45 (5.26-13.43)*	*11.27 (7.38-17.02)*	*13.16 (8.35-20.41)*	
other constraints	<55	13							4						
All hybrid	<55	384	0.52 (0.13-2.07)	3.26 (1.86-5.67)	5.55 (3.62-8.48)	*7.81 (5.41-11.20)*	*10.09 (7.18-14.09)*		473	0.64 (0.21-1.98)	2.65 (1.51-4.62)	4.50 (2.93-6.89)	7.11 (5.02-10.04)	*8.74 (6.26-12.15)*	*11.59 (6.75-19.53)*
unconstrained, fixed	<55	217	*0.46 (0.07-3.23)*	*2.88 (1.30-6.30)*	*5.36 (3.00-9.47)*	*6.40 (3.77-10.78)*	*9.14 (5.74-14.39)*		282	0.72 (0.18-2.84)	3.33 (1.75-6.31)	*4.85 (2.84-8.21)*	*6.95 (4.43-10.82)*	*8.66 (5.68-13.08)*	
unconstrained, mobile	<55	79		*2.53 (0.64-9.75)*	*5.17 (1.97-13.19)*	*10.48 (4.99-21.29)*			104	*0.97 (0.14-6.69)*	*1.97 (0.50-7.65)*	*2.98 (0.97-8.96)*	*5.62 (2.33-13.20)*	*11.17 (3.89-29.80)*	

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.K6 (continued)

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
			Time since primary							Time since primary					
		N	1 year	3 years	5 years	10 years	15 years	19 years	N	1 year	3 years	5 years	10 years	15 years	19 years
posterior-stabilised, fixed	<55	54	0.00 (-.-)	0.00 (-.-)	2.38 (0.34-15.72)	8.41 (2.76-24.07)			61	0.00 (-.-)	1.85 (0.26-12.43)	6.53 (2.14-19.02)	8.92 (3.42-22.18)	8.92 (3.42-22.18)	
other constraints	<55	34	2.94 (0.42-19.10)	12.33 (4.81-29.63)	12.33 (4.81-29.63)	12.33 (4.81-29.63)	12.33 (4.81-29.63)		26			3.85 (0.55-24.31)	11.54 (3.87-31.64)	11.54 (3.87-31.64)	
All unicondylar, cemented	<55	9,245	1.39 (1.16-1.65)	5.30 (4.84-5.80)	7.63 (7.07-8.23)	14.07 (13.21-14.97)	20.57 (19.27-21.95)	26.79 (23.29-30.70)	10,404	1.23 (1.03-1.46)	5.30 (4.87-5.77)	8.22 (7.67-8.81)	15.02 (14.20-15.88)	22.47 (21.16-23.85)	27.95 (23.97-32.45)
fixed	<55	4,997	1.01 (0.77-1.34)	3.74 (3.21-4.35)	5.30 (4.64-6.05)	9.35 (8.23-10.61)	14.03 (11.98-16.40)		5,155	0.69 (0.49-0.96)	3.60 (3.09-4.20)	5.51 (4.84-6.27)	11.27 (10.02-12.67)	17.27 (14.84-20.05)	
mobile	<55	3,666	1.75 (1.38-2.24)	6.85 (6.07-7.72)	9.66 (8.74-10.68)	17.11 (15.84-18.46)	24.08 (22.36-25.91)	30.98 (26.62-35.87)	4,650	1.80 (1.45-2.22)	6.61 (5.93-7.37)	10.29 (9.43-11.21)	17.66 (16.52-18.88)	24.96 (23.34-26.67)	30.89 (25.89-36.59)
monobloc polyethylene tibia	<55	582	2.10 (1.20-3.66)	7.31 (5.43-9.79)	11.36 (8.96-14.34)	20.35 (16.94-24.35)	25.36 (21.29-30.05)		599	1.19 (0.57-2.47)	7.95 (6.02-10.47)	11.06 (8.75-13.95)	16.74 (13.76-20.28)	26.20 (21.68-31.46)	
All unicondylar, uncemented/hybrid	<55	2,721	1.45 (1.06-1.99)	3.09 (2.47-3.87)	4.09 (3.34-5.01)	9.16 (7.51-11.15)	18.02 (13.37-24.06)		3,071	1.16 (0.83-1.63)	3.46 (2.83-4.24)	5.45 (4.59-6.47)	9.94 (8.26-11.94)	19.23 (13.59-26.82)	
fixed	<55	132	0.00 (-.-)	2.63 (0.85-7.95)	4.96 (2.07-11.65)	14.08 (7.56-25.38)			155	0.00 (-.-)	3.76 (1.58-8.82)	6.11 (2.90-12.64)	12.76 (6.30-24.90)	27.53 (14.13-49.39)	
mobile	<55	2,560	1.54 (1.13-2.12)	3.06 (2.43-3.86)	3.95 (3.19-4.89)	8.27 (6.66-10.27)	18.58 (12.80-26.55)		2,876	1.25 (0.89-1.74)	3.41 (2.76-4.21)	5.31 (4.43-6.35)	9.54 (7.80-11.65)	15.27 (11.10-20.83)	
monobloc polyethylene tibia	<55	29		6.90 (1.77-24.86)	10.48 (3.50-29.08)	27.89 (14.22-50.19)			40		5.00 (1.27-18.55)	10.00 (3.88-24.49)	17.50 (8.75-33.23)		
Patellofemoral	<55	1,273	2.42 (1.70-3.45)	9.30 (7.78-11.11)	13.27 (11.41-15.40)	21.49 (18.92-24.37)	29.72 (25.86-34.02)		5,596	0.79 (0.59-1.07)	5.72 (5.11-6.40)	9.27 (8.48-10.13)	18.23 (16.99-19.56)	25.85 (23.95-27.86)	35.88 (30.33-42.10)
Multicompartmental	<55	70	1.43 (0.20-9.71)	9.01 (4.15-18.97)	10.55 (5.17-20.88)	12.91 (6.58-24.46)			115	0.90 (0.13-6.22)	9.35 (5.14-16.69)	14.22 (8.83-22.50)	19.86 (12.99-29.69)		
All cases	55 to 64	169,916	0.71 (0.67-0.75)	2.36 (2.29-2.44)	3.44 (3.35-3.53)	5.43 (5.30-5.56)	7.79 (7.58-8.00)	9.80 (9.32-10.31)	199,117	0.47 (0.44-0.50)	2.07 (2.01-2.14)	3.12 (3.04-3.20)	5.16 (5.04-5.28)	7.21 (7.03-7.39)	9.06 (8.66-9.47)
Unconfirmed	55 to 64	2,469	0.94 (0.63-1.41)	2.97 (2.36-3.73)	3.76 (3.06-4.61)	6.46 (5.50-7.58)	9.06 (7.79-10.52)	9.63 (8.17-11.33)	2,958	0.58 (0.36-0.93)	2.91 (2.35-3.60)	3.72 (3.08-4.49)	6.27 (5.40-7.27)	8.62 (7.47-9.93)	11.56 (9.50-14.02)
All cemented	55 to 64	129,026	0.63 (0.59-0.68)	2.12 (2.04-2.20)	3.06 (2.96-3.16)	4.54 (4.41-4.68)	6.27 (6.06-6.49)	7.82 (7.38-8.29)	160,871	0.39 (0.36-0.42)	1.75 (1.68-1.82)	2.59 (2.51-2.68)	4.03 (3.92-4.15)	5.41 (5.24-5.59)	6.36 (6.02-6.72)
unconstrained, fixed	55 to 64	90,992	0.57 (0.52-0.62)	1.95 (1.86-2.05)	2.78 (2.67-2.90)	4.03 (3.88-4.19)	5.75 (5.50-6.02)	7.60 (7.03-8.21)	112,597	0.36 (0.33-0.40)	1.61 (1.53-1.69)	2.33 (2.24-2.43)	3.57 (3.44-3.71)	4.93 (4.72-5.14)	6.03 (5.59-6.50)
unconstrained, mobile	55 to 64	4,916	0.77 (0.56-1.06)	2.67 (2.25-3.18)	3.85 (3.33-4.45)	5.84 (5.17-6.60)	7.46 (6.60-8.41)	9.31 (6.66-12.94)	5,903	0.48 (0.33-0.70)	2.03 (1.69-2.43)	3.05 (2.62-3.54)	4.92 (4.35-5.56)	6.13 (5.44-6.90)	6.69 (5.81-7.69)
posterior-stabilised, fixed	55 to 64	28,673	0.77 (0.67-0.88)	2.49 (2.31-2.68)	3.71 (3.48-3.95)	5.75 (5.43-6.08)	7.59 (7.13-8.07)	8.58 (7.88-9.33)	36,752	0.43 (0.37-0.51)	2.10 (1.96-2.26)	3.25 (3.06-3.45)	5.14 (4.88-5.42)	6.59 (6.22-6.98)	7.35 (6.71-8.03)

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.K6 (continued)

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
			Time since primary							Time since primary					
		N	1 year	3 years	5 years	10 years	15 years	19 years	N	1 year	3 years	5 years	10 years	15 years	19 years
posterior-stabilised, mobile	55 to 64	2,070	0.85 (0.53-1.36)	2.43 (1.83-3.22)	3.10 (2.41-3.98)	4.70 (3.80-5.80)	6.43 (5.12-8.06)		2,343	0.35 (0.18-0.70)	1.75 (1.27-2.39)	2.91 (2.27-3.72)	4.47 (3.65-5.47)	6.22 (5.07-7.61)	6.22 (5.07-7.61)
constrained condylar	55 to 64	1,239	1.13 (0.65-1.93)	2.19 (1.46-3.29)	3.40 (2.40-4.82)	4.56 (3.22-6.42)	4.56 (3.22-6.42)		1,700	0.62 (0.33-1.15)	1.77 (1.19-2.61)	2.49 (1.75-3.53)	5.19 (3.47-7.72)	6.81 (4.35-10.58)	
monobloc polyethylene tibia	55 to 64	1,011	0.73 (0.35-1.52)	1.74 (1.07-2.83)	2.75 (1.85-4.08)	3.52 (2.41-5.12)	3.52 (2.41-5.12)		1,329	0.23 (0.07-0.72)	1.44 (0.90-2.30)	2.16 (1.45-3.21)	3.06 (2.09-4.49)	4.40 (2.85-6.77)	
pre-assembled/hinged/ linked	55 to 64	125	4.97 (2.26-10.74)	10.62 (6.15-17.98)	12.79 (7.74-20.73)	17.69 (10.48-29.01)			247	2.96 (1.42-6.12)	3.96 (2.08-7.50)	5.68 (3.25-9.85)	8.41 (4.97-14.03)	8.41 (4.97-14.03)	
All uncemented	55 to 64	7,014	0.57 (0.42-0.79)	2.30 (1.96-2.70)	3.18 (2.77-3.64)	4.85 (4.32-5.45)	6.17 (5.49-6.92)	7.69 (6.55-9.01)	6,503	0.63 (0.47-0.86)	2.51 (2.14-2.93)	3.58 (3.13-4.08)	5.16 (4.60-5.78)	6.89 (6.16-7.70)	8.73 (7.26-10.48)
unconstrained, fixed	55 to 64	2,977	0.50 (0.29-0.84)	2.45 (1.92-3.11)	3.24 (2.62-4.01)	5.35 (4.47-6.39)	6.48 (5.42-7.74)	7.83 (6.07-10.08)	2,568	0.74 (0.46-1.17)	2.86 (2.25-3.62)	3.60 (2.90-4.46)	5.25 (4.36-6.32)	6.92 (5.80-8.26)	8.04 (6.42-10.05)
unconstrained, mobile	55 to 64	3,356	0.51 (0.32-0.83)	2.25 (1.79-2.83)	3.30 (2.73-3.99)	4.39 (3.70-5.19)	5.86 (4.95-6.94)	7.09 (5.76-8.70)	3,499	0.52 (0.33-0.83)	2.22 (1.78-2.78)	3.48 (2.91-4.16)	4.84 (4.13-5.66)	6.36 (5.42-7.47)	8.70 (6.54-11.54)
posterior-stabilised, fixed	55 to 64	660	1.24 (0.62-2.47)	2.05 (1.20-3.51)	2.40 (1.45-3.95)	5.35 (3.69-7.72)	6.59 (4.57-9.45)		421	0.96 (0.36-2.54)	2.93 (1.67-5.10)	4.24 (2.65-6.73)	7.34 (5.07-10.55)	10.91 (7.84-15.07)	
other constraints	55 to 64	21	0.00 (.-.)	0.00 (.-.)	0.00 (.-.)				15	0.00 (.-.)	0.00 (.-.)				
All hybrid	55 to 64	1,162	0.35 (0.13-0.93)	1.61 (1.02-2.55)	3.06 (2.18-4.28)	4.55 (3.42-6.04)	6.46 (4.95-8.41)	8.47 (6.23-11.48)	1,336	0.53 (0.25-1.11)	2.16 (1.50-3.12)	3.15 (2.32-4.27)	4.89 (3.80-6.30)	5.31 (4.14-6.80)	6.77 (4.81-9.49)
unconstrained, fixed	55 to 64	727	0.28 (0.07-1.11)	1.43 (0.77-2.65)	2.77 (1.78-4.31)	4.08 (2.81-5.90)	5.63 (4.01-7.86)	6.85 (4.73-9.88)	839	0.84 (0.40-1.76)	2.57 (1.68-3.91)	3.58 (2.50-5.12)	5.09 (3.75-6.87)	5.62 (4.19-7.51)	7.03 (4.77-10.28)
unconstrained, mobile	55 to 64	255	0.39 (0.06-2.75)	1.18 (0.38-3.61)	3.23 (1.63-6.36)	3.80 (1.98-7.22)	7.15 (3.37-14.83)		339	0.00 (.-.)	1.19 (0.45-3.15)	1.83 (0.83-4.03)	4.98 (2.63-9.34)	4.98 (2.63-9.34)	
posterior-stabilised, fixed	55 to 64	133	0.00 (.-.)	1.77 (0.44-6.91)	3.13 (0.99-9.66)	6.59 (2.69-15.69)	8.99 (3.92-19.89)		117	0.00 (.-.)	1.99 (0.50-7.73)	4.68 (1.76-12.12)	7.68 (3.48-16.50)	7.68 (3.48-16.50)	
other constraints	55 to 64	47	2.13 (0.30-14.16)	6.38 (2.10-18.50)	6.38 (2.10-18.50)	11.15 (4.78-24.83)	14.11 (6.53-29.02)		41		2.50 (0.36-16.45)	2.50 (0.36-16.45)	2.50 (0.36-16.45)	2.50 (0.36-16.45)	
All unicondylar, cemented	55 to 64	21,594	0.89 (0.77-1.03)	3.50 (3.25-3.77)	5.23 (4.92-5.57)	9.49 (9.01-9.99)	14.95 (14.18-15.76)	19.68 (17.46-22.14)	17,676	0.84 (0.71-0.99)	3.76 (3.47-4.06)	5.92 (5.55-6.31)	11.19 (10.63-11.77)	16.50 (15.67-17.36)	22.44 (20.41-24.64)
fixed	55 to 64	10,775	0.50 (0.38-0.66)	2.07 (1.79-2.40)	3.31 (2.93-3.75)	6.57 (5.84-7.40)	11.13 (9.55-12.95)	11.53 (9.81-13.54)	8,017	0.54 (0.40-0.74)	2.74 (2.37-3.18)	4.21 (3.71-4.77)	7.83 (6.95-8.81)	12.62 (10.80-14.72)	
mobile	55 to 64	9,555	1.31 (1.10-1.56)	4.67 (4.26-5.12)	6.67 (6.18-7.20)	11.32 (10.66-12.03)	17.02 (16.06-18.03)	22.56 (19.89-25.54)	8,533	1.16 (0.95-1.41)	4.44 (4.02-4.91)	7.02 (6.49-7.60)	12.79 (12.05-13.57)	18.46 (17.45-19.53)	23.78 (21.71-26.01)
monobloc polyethylene tibia	55 to 64	1,264	0.73 (0.38-1.40)	4.57 (3.51-5.92)	6.77 (5.46-8.39)	11.05 (9.26-13.16)	15.48 (13.09-18.26)		1,126	0.36 (0.14-0.97)	4.51 (3.42-5.94)	6.41 (5.08-8.07)	12.20 (10.23-14.52)	14.96 (12.62-17.67)	

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.K6 (continued)

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
			Time since primary							Time since primary					
		N	1 year	3 years	5 years	10 years	15 years	19 years	N	1 year	3 years	5 years	10 years	15 years	19 years
All unicondylar, uncemented/hybrid	55 to 64	7,258	1.46 (1.20-1.77)	2.58 (2.21-3.00)	3.71 (3.23-4.25)	6.53 (5.57-7.64)	11.25 (8.68-14.52)		5,560	1.02 (0.78-1.33)	2.68 (2.25-3.19)	3.87 (3.31-4.51)	8.35 (7.10-9.81)	14.44 (10.49-19.72)	
fixed	55 to 64	218	0.00 (-.-)	1.09 (0.27-4.30)	5.27 (2.64-10.35)	7.80 (4.11-14.55)			206	0.00 (-.-)	1.66 (0.54-5.06)	5.39 (2.70-10.59)	10.71 (5.87-19.11)		
mobile	55 to 64	6,974	1.52 (1.25-1.85)	2.65 (2.27-3.09)	3.66 (3.18-4.21)	6.29 (5.33-7.43)	12.07 (8.93-16.21)		5,251	1.06 (0.81-1.39)	2.72 (2.28-3.25)	3.77 (3.21-4.42)	8.21 (6.89-9.76)	15.37 (10.10-23.02)	
monobloc polyethylene tibia	55 to 64	66		0.00 (-.-)	1.67 (0.24-11.25)	8.75 (3.73-19.78)			103	0.97 (0.14-6.69)	2.93 (0.96-8.81)	4.95 (2.09-11.50)	8.39 (4.27-16.13)		
Patellofemoral	55 to 64	1,271	1.81 (1.19-2.73)	5.98 (4.76-7.52)	10.90 (9.17-12.92)	20.89 (18.25-23.86)	28.31 (24.43-32.67)		4,091	0.83 (0.59-1.17)	5.16 (4.50-5.92)	9.08 (8.18-10.07)	17.21 (15.87-18.66)	25.74 (23.67-27.96)	31.80 (27.93-36.05)
Multicompartmental	55 to 64	122	0.00 (-.-)	6.14 (2.97-12.45)	8.01 (4.25-14.84)	11.52 (6.66-19.53)			122	1.70 (0.43-6.61)	7.24 (3.68-13.97)	9.19 (5.04-16.43)	14.62 (8.77-23.81)		
All cases	65 to 74	267,363	0.53 (0.50-0.56)	1.60 (1.55-1.65)	2.23 (2.17-2.29)	3.41 (3.33-3.50)	4.63 (4.49-4.76)	5.46 (5.16-5.77)	326,831	0.37 (0.35-0.39)	1.38 (1.34-1.42)	2.03 (1.98-2.08)	3.20 (3.13-3.28)	4.23 (4.12-4.34)	5.10 (4.83-5.39)
Unconfirmed	65 to 74	3,556	0.63 (0.41-0.95)	1.84 (1.44-2.35)	2.81 (2.30-3.43)	4.32 (3.65-5.10)	5.62 (4.72-6.69)	6.49 (5.31-7.92)	4,229	0.53 (0.35-0.80)	1.64 (1.29-2.08)	2.40 (1.97-2.92)	4.09 (3.49-4.78)	5.39 (4.60-6.32)	5.63 (4.73-6.68)
All cemented	65 to 74	223,509	0.47 (0.45-0.50)	1.45 (1.40-1.50)	2.02 (1.96-2.08)	2.98 (2.89-3.06)	3.91 (3.78-4.05)	4.47 (4.23-4.73)	286,768	0.32 (0.30-0.34)	1.21 (1.17-1.26)	1.79 (1.73-1.84)	2.69 (2.62-2.76)	3.40 (3.29-3.51)	4.07 (3.81-4.35)
unconstrained, fixed	65 to 74	159,415	0.46 (0.43-0.49)	1.34 (1.28-1.40)	1.85 (1.78-1.93)	2.63 (2.54-2.73)	3.53 (3.37-3.70)	4.19 (3.86-4.54)	199,182	0.27 (0.25-0.30)	1.11 (1.06-1.16)	1.62 (1.56-1.68)	2.41 (2.33-2.50)	3.14 (3.01-3.27)	3.86 (3.51-4.25)
unconstrained, mobile	65 to 74	7,178	0.44 (0.31-0.63)	1.73 (1.44-2.07)	2.54 (2.19-2.96)	3.89 (3.41-4.43)	4.86 (4.26-5.54)	5.05 (4.36-5.86)	9,170	0.42 (0.31-0.58)	1.58 (1.34-1.87)	2.28 (1.98-2.62)	3.48 (3.08-3.92)	4.16 (3.67-4.70)	4.16 (3.67-4.70)
posterior-stabilised, fixed	65 to 74	49,576	0.52 (0.46-0.59)	1.67 (1.56-1.79)	2.38 (2.24-2.53)	3.79 (3.59-4.00)	4.80 (4.51-5.11)	5.24 (4.83-5.68)	67,608	0.40 (0.35-0.45)	1.37 (1.28-1.47)	2.11 (2.00-2.23)	3.24 (3.08-3.41)	3.90 (3.69-4.11)	4.63 (4.22-5.08)
posterior-stabilised, mobile	65 to 74	2,197	0.47 (0.25-0.87)	1.87 (1.36-2.56)	2.56 (1.95-3.35)	3.41 (2.66-4.36)	4.45 (3.43-5.77)		2,691	0.65 (0.41-1.05)	1.99 (1.51-2.62)	2.60 (2.04-3.30)	3.87 (3.13-4.79)	4.95 (3.93-6.24)	5.33 (4.13-6.88)
constrained condylar	65 to 74	1,907	0.74 (0.43-1.28)	2.28 (1.64-3.17)	2.99 (2.22-4.03)	3.92 (2.77-5.54)	7.55 (3.79-14.76)		3,189	1.01 (0.71-1.43)	2.02 (1.55-2.62)	2.73 (2.15-3.47)	3.51 (2.75-4.46)	3.51 (2.75-4.46)	
monobloc polyethylene tibia	65 to 74	3,042	0.13 (0.05-0.36)	1.43 (1.04-1.95)	1.87 (1.41-2.47)	2.28 (1.75-2.96)	2.46 (1.85-3.26)		4,489	0.34 (0.21-0.57)	1.35 (1.04-1.75)	1.83 (1.46-2.30)	2.41 (1.95-2.99)	3.17 (2.18-4.59)	
pre-assembled/hinged/ linked	65 to 74	194	3.19 (1.45-6.97)	8.08 (4.86-13.30)	10.56 (6.64-16.57)	13.13 (8.58-19.80)			439	1.44 (0.65-3.17)	3.43 (2.00-5.84)	4.77 (2.98-7.61)	6.21 (3.79-10.10)	6.21 (3.79-10.10)	
All uncemented	65 to 74	9,678	0.58 (0.45-0.76)	1.80 (1.55-2.10)	2.30 (2.00-2.63)	3.22 (2.85-3.64)	3.97 (3.49-4.51)	4.60 (3.82-5.53)	9,570	0.48 (0.36-0.64)	2.16 (1.88-2.48)	2.88 (2.55-3.25)	3.67 (3.28-4.10)	4.67 (4.17-5.23)	6.18 (4.82-7.92)
unconstrained, fixed	65 to 74	3,976	0.66 (0.45-0.98)	2.14 (1.71-2.67)	2.74 (2.24-3.35)	3.70 (3.07-4.44)	4.24 (3.51-5.12)	4.92 (3.58-6.74)	3,640	0.49 (0.30-0.78)	2.43 (1.95-3.01)	3.02 (2.48-3.68)	3.83 (3.19-4.59)	4.97 (4.14-5.96)	5.54 (4.44-6.90)
unconstrained, mobile	65 to 74	5,022	0.46 (0.31-0.70)	1.53 (1.22-1.92)	1.93 (1.57-2.36)	2.84 (2.37-3.40)	3.73 (3.09-4.50)	4.19 (3.33-5.26)	5,384	0.50 (0.35-0.74)	2.02 (1.67-2.44)	2.81 (2.39-3.30)	3.55 (3.06-4.12)	4.37 (3.76-5.09)	5.79 (4.16-8.04)

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.K6 (continued)

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
			Time since primary							Time since primary					
		N	1 year	3 years	5 years	10 years	15 years	19 years	N	1 year	3 years	5 years	10 years	15 years	19 years
posterior-stabilised, fixed	65 to 74	643	1.11 (0.53-2.31)	2.10 (1.22-3.59)	2.84 (1.77-4.53)	3.57 (2.30-5.52)	4.62 (2.90-7.31)		535	0.19 (0.03-1.33)	1.96 (1.06-3.61)	2.80 (1.67-4.68)	3.99 (2.50-6.32)	5.74 (3.54-9.25)	
other constraints	65 to 74	37	0.00 (.-.)	0.00 (.-.)	0.00 (.-.)				11						
All hybrid	65 to 74	1,812	0.51 (0.26-0.97)	1.73 (1.21-2.47)	1.99 (1.42-2.77)	2.87 (2.14-3.84)	3.69 (2.77-4.92)	3.69 (2.77-4.92)	2,088	0.58 (0.33-1.02)	1.63 (1.16-2.28)	1.85 (1.34-2.54)	2.56 (1.93-3.39)	3.38 (2.58-4.43)	3.38 (2.58-4.43)
unconstrained, fixed	65 to 74	1,245	0.33 (0.12-0.86)	1.58 (1.01-2.47)	1.85 (1.22-2.80)	2.61 (1.82-3.74)	3.27 (2.30-4.62)	3.27 (2.30-4.62)	1,355	0.30 (0.11-0.79)	1.21 (0.74-1.96)	1.21 (0.74-1.96)	2.01 (1.36-2.97)	2.92 (2.05-4.15)	2.92 (2.05-4.15)
unconstrained, mobile	65 to 74	356	1.13 (0.43-2.99)	1.70 (0.77-3.76)	2.01 (0.96-4.17)	3.06 (1.65-5.64)	5.96 (2.85-12.23)		495	1.62 (0.81-3.21)	3.27 (2.01-5.28)	3.96 (2.54-6.15)	4.51 (2.96-6.85)	5.21 (3.33-8.12)	
posterior-stabilised, fixed	65 to 74	177	0.60 (0.08-4.15)	3.44 (1.44-8.10)	3.44 (1.44-8.10)	5.26 (2.18-12.40)	5.26 (2.18-12.40)		199	0.00 (.-.)	0.68 (0.10-4.70)	1.54 (0.38-6.08)	1.54 (0.38-6.08)	1.54 (0.38-6.08)	
other constraints	65 to 74	34	0.00 (.-.)	0.00 (.-.)	0.00 (.-.)	0.00 (.-.)	0.00 (.-.)		39			0.00 (.-.)	0.00 (.-.)	0.00 (.-.)	
All unicondylar, cemented	65 to 74	20,196	0.79 (0.67-0.92)	2.69 (2.46-2.94)	3.80 (3.52-4.10)	6.90 (6.46-7.36)	10.68 (9.95-11.45)	13.73 (11.79-15.95)	15,802	0.74 (0.61-0.89)	2.77 (2.51-3.05)	4.36 (4.02-4.72)	8.52 (7.99-9.10)	12.73 (11.92-13.60)	15.95 (13.96-18.20)
fixed	65 to 74	9,828	0.51 (0.38-0.69)	1.87 (1.59-2.20)	2.58 (2.23-2.99)	4.68 (4.01-5.45)	6.66 (5.41-8.17)		7,197	0.49 (0.35-0.69)	1.83 (1.52-2.22)	2.81 (2.38-3.31)	5.10 (4.31-6.02)	6.55 (5.43-7.90)	
mobile	65 to 74	9,166	1.09 (0.89-1.32)	3.33 (2.98-3.73)	4.57 (4.15-5.02)	8.14 (7.55-8.78)	12.23 (11.33-13.19)	15.16 (12.92-17.76)	7,689	1.01 (0.81-1.26)	3.43 (3.05-3.87)	5.39 (4.90-5.93)	10.34 (9.61-11.11)	14.97 (13.96-16.05)	17.95 (15.72-20.45)
monobloc polyethylene tibia	65 to 74	1,202	0.60 (0.29-1.25)	3.23 (2.34-4.45)	5.35 (4.15-6.89)	7.19 (5.72-9.03)	10.60 (8.44-13.28)		916	0.22 (0.06-0.90)	3.08 (2.10-4.48)	4.48 (3.27-6.13)	6.58 (5.01-8.63)	10.27 (7.91-13.30)	
All unicondylar, uncemented/hybrid	65 to 74	7,666	1.16 (0.94-1.44)	2.28 (1.94-2.67)	3.00 (2.59-3.48)	5.73 (4.79-6.83)	9.29 (6.45-13.28)		5,852	0.96 (0.73-1.26)	2.45 (2.05-2.92)	3.45 (2.93-4.04)	7.76 (6.45-9.34)	10.85 (8.29-14.14)	
fixed	65 to 74	201	0.50 (0.07-3.50)	4.53 (2.29-8.86)	6.69 (3.74-11.83)	12.01 (6.85-20.60)			274	0.00 (.-.)	1.48 (0.48-4.52)	5.11 (2.56-10.09)	8.96 (5.08-15.55)		
mobile	65 to 74	7,396	1.18 (0.95-1.46)	2.18 (1.85-2.57)	2.84 (2.43-3.31)	5.50 (4.54-6.65)	10.14 (6.16-16.46)		5,482	1.03 (0.79-1.34)	2.50 (2.08-3.00)	3.36 (2.84-3.96)	8.06 (6.51-9.95)	9.51 (7.18-12.56)	
monobloc polyethylene tibia	65 to 74	69	1.45 (0.21-9.84)	4.44 (1.45-13.13)	5.98 (2.28-15.15)	7.54 (3.21-17.19)			96	0.00 (.-.)	2.12 (0.53-8.20)	3.19 (1.04-9.57)	5.57 (2.35-12.89)		
Patellofemoral	65 to 74	862	1.70 (1.01-2.85)	5.81 (4.37-7.71)	9.45 (7.53-11.83)	17.19 (14.23-20.68)	20.14 (15.96-25.24)		2,439	0.81 (0.52-1.26)	5.09 (4.25-6.08)	7.91 (6.85-9.13)	16.01 (14.35-17.84)	22.45 (20.02-25.13)	22.92 (20.35-25.75)
Multicompartmental	65 to 74	84	2.44 (0.62-9.40)	6.69 (2.83-15.39)	11.69 (5.98-22.17)	15.16 (8.39-26.53)			83	1.27 (0.18-8.65)	6.53 (2.77-14.99)	8.02 (3.68-17.00)	9.66 (4.70-19.28)		
All cases	≥75	190,467	0.44 (0.41-0.47)	1.10 (1.05-1.15)	1.44 (1.38-1.50)	2.08 (1.99-2.17)	2.57 (2.41-2.74)	2.76 (2.50-3.04)	277,206	0.39 (0.36-0.41)	1.00 (0.96-1.04)	1.37 (1.33-1.42)	2.01 (1.94-2.07)	2.51 (2.41-2.62)	3.28 (2.83-3.82)
Unconfirmed	≥75	2,437	0.30 (0.14-0.62)	0.99 (0.65-1.49)	1.52 (1.07-2.14)	2.89 (2.19-3.83)	3.02 (2.28-3.99)		3,916	0.62 (0.42-0.93)	1.35 (1.02-1.78)	1.82 (1.43-2.32)	2.63 (2.12-3.26)	3.04 (2.41-3.83)	3.47 (2.53-4.76)

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.K6 (continued)

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
All cemented	≥75	167,201	0.41 (0.38-0.44)	1.02 (0.97-1.08)	1.33 (1.27-1.39)	1.86 (1.77-1.94)	2.28 (2.12-2.45)	*2.39 (2.19-2.61)*	251,508	0.35 (0.33-0.38)	0.91 (0.87-0.95)	1.23 (1.19-1.28)	1.77 (1.70-1.84)	2.20 (2.10-2.31)	*2.99 (2.46-3.62)*
unconstrained, fixed	≥75	117,150	0.38 (0.35-0.42)	0.97 (0.91-1.03)	1.25 (1.18-1.32)	1.72 (1.62-1.82)	2.13 (1.94-2.33)	*2.24 (2.00-2.52)*	169,045	0.31 (0.28-0.34)	0.84 (0.80-0.89)	1.14 (1.08-1.19)	1.66 (1.58-1.74)	2.10 (1.97-2.23)	*2.97 (2.27-3.90)*
unconstrained, mobile	≥75	4,875	0.40 (0.26-0.63)	1.02 (0.76-1.37)	1.50 (1.17-1.92)	1.98 (1.56-2.51)	*2.13 (1.64-2.76)*		8,217	0.42 (0.30-0.59)	0.90 (0.71-1.14)	1.28 (1.05-1.57)	1.83 (1.52-2.21)	2.25 (1.84-2.75)	*2.84 (2.03-3.95)*
posterior-stabilised, fixed	≥75	38,149	0.48 (0.41-0.55)	1.14 (1.03-1.26)	1.53 (1.40-1.67)	2.22 (2.03-2.43)	2.81 (2.44-3.25)	*2.81 (2.44-3.25)*	62,015	0.39 (0.34-0.44)	1.03 (0.95-1.12)	1.41 (1.31-1.52)	2.00 (1.87-2.14)	2.45 (2.24-2.68)	*2.97 (2.34-3.76)*
posterior-stabilised, mobile	≥75	1,269	0.49 (0.22-1.10)	1.31 (0.79-2.16)	1.42 (0.87-2.32)	1.70 (1.07-2.72)	*1.70 (1.07-2.72)*		2,024	0.56 (0.31-1.01)	1.08 (0.70-1.68)	1.42 (0.96-2.09)	1.91 (1.32-2.76)	*2.35 (1.57-3.50)*	
constrained condylar	≥75	1,547	0.89 (0.52-1.53)	1.62 (1.05-2.49)	1.78 (1.16-2.72)	*2.33 (1.47-3.70)*			3,358	1.05 (0.75-1.47)	1.74 (1.32-2.29)	2.08 (1.58-2.72)	*2.50 (1.84-3.38)*	*2.50 (1.84-3.38)*	
monobloc polyethylene tibia	≥75	3,938	0.26 (0.14-0.49)	0.92 (0.66-1.29)	1.17 (0.86-1.60)	1.58 (1.13-2.22)	*1.58 (1.13-2.22)*		5,716	0.41 (0.28-0.62)	0.80 (0.59-1.08)	1.06 (0.81-1.39)	1.42 (1.08-1.86)	*1.42 (1.08-1.86)*	
pre-assembled/hinged/ linked	≥75	273	*1.13 (0.37-3.47)*	*2.99 (1.43-6.19)*	*4.25 (2.20-8.13)*	*6.43 (3.41-11.96)*			1,133	1.36 (0.81-2.29)	2.64 (1.76-3.93)	3.75 (2.60-5.41)	*5.35 (3.50-8.14)*		
All uncemented	≥75	6,183	0.49 (0.34-0.70)	1.30 (1.04-1.64)	1.72 (1.40-2.10)	2.20 (1.82-2.66)	2.26 (1.87-2.75)		7,767	0.54 (0.40-0.73)	1.27 (1.04-1.55)	1.58 (1.31-1.89)	1.89 (1.59-2.25)	2.71 (2.17-3.38)	*3.61 (2.15-6.02)*
unconstrained, fixed	≥75	2,575	0.55 (0.32-0.94)	1.15 (0.79-1.69)	1.67 (1.20-2.32)	2.00 (1.45-2.75)	*2.14 (1.55-2.97)*		3,113	0.74 (0.49-1.12)	1.57 (1.18-2.10)	1.96 (1.50-2.55)	2.01 (1.54-2.62)	*2.70 (1.99-3.67)*	
unconstrained, mobile	≥75	3,223	0.48 (0.29-0.79)	1.30 (0.95-1.78)	1.61 (1.21-2.14)	2.17 (1.67-2.81)	*2.17 (1.67-2.81)*		4,131	0.39 (0.24-0.64)	1.09 (0.81-1.47)	1.26 (0.95-1.66)	1.67 (1.30-2.16)	2.52 (1.79-3.53)	
posterior-stabilised, fixed	≥75	373	0.27 (0.04-1.93)	2.34 (1.17-4.62)	*2.97 (1.61-5.45)*	*3.90 (2.20-6.84)*	*3.90 (2.20-6.84)*		517	0.59 (0.19-1.80)	0.99 (0.41-2.37)	2.01 (1.04-3.84)	*3.08 (1.73-5.47)*	*4.53 (2.17-9.34)*	
other constraints	≥75	12	*0.00 (-.-)*	*0.00 (-.-)*					6						
All hybrid	≥75	1,267	0.41 (0.17-0.97)	0.85 (0.46-1.57)	1.19 (0.69-2.06)	2.00 (1.24-3.24)	*2.00 (1.24-3.24)*		1,833	0.62 (0.34-1.11)	1.27 (0.84-1.92)	1.47 (1.00-2.17)	2.06 (1.43-2.96)	*2.06 (1.43-2.96)*	
unconstrained, fixed	≥75	856	0.36 (0.12-1.12)	0.88 (0.42-1.83)	1.37 (0.73-2.54)	2.26 (1.32-3.86)	*2.26 (1.32-3.86)*		1,179	0.61 (0.29-1.27)	1.14 (0.67-1.96)	1.45 (0.89-2.36)	2.12 (1.37-3.27)	*2.12 (1.37-3.27)*	
unconstrained, mobile	≥75	249	*0.80 (0.20-3.18)*	*0.80 (0.20-3.18)*	*0.80 (0.20-3.18)*	*1.44 (0.45-4.53)*			445	0.91 (0.34-2.40)	1.38 (0.62-3.05)	1.38 (0.62-3.05)	*1.78 (0.84-3.77)*	*1.78 (0.84-3.77)*	
posterior-stabilised, fixed	≥75	129	*0.00 (-.-)*	*1.02 (0.14-7.02)*	*1.02 (0.14-7.02)*	*1.02 (0.14-7.02)*			172	*0.00 (-.-)*	*2.45 (0.79-7.45)*	*2.45 (0.79-7.45)*	*2.45 (0.79-7.45)*		
other constraints	≥75	33	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*			37	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*		

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

Table 3.K6 (continued)

Fixation, constraint and bearing type	Age at primary (years)	Male							Female						
		N	Time since primary						N	Time since primary					
			1 year	3 years	5 years	10 years	15 years	19 years		1 year	3 years	5 years	10 years	15 years	19 years
All unicondylar, cemented	≥75	9,140	0.74 (0.58-0.94)	1.89 (1.61-2.22)	2.67 (2.32-3.08)	4.78 (4.19-5.46)	6.68 (5.52-8.07)	*7.83 (5.63-10.84)*	7,995	1.02 (0.82-1.28)	2.84 (2.48-3.26)	4.24 (3.77-4.77)	7.14 (6.44-7.92)	9.00 (7.99-10.14)	*10.22 (8.59-12.13)*
fixed	≥75	4,659	0.47 (0.31-0.74)	1.07 (0.78-1.46)	1.54 (1.14-2.07)	2.94 (2.02-4.27)	*4.40 (2.55-7.52)*		3,675	0.67 (0.44-1.02)	2.05 (1.58-2.65)	2.92 (2.31-3.70)	4.42 (3.43-5.69)	*4.83 (3.63-6.41)*	
mobile	≥75	3,909	1.06 (0.78-1.44)	2.68 (2.21-3.25)	3.57 (3.01-4.23)	5.83 (5.03-6.76)	*7.97 (6.54-9.70)*		3,821	1.32 (1.00-1.74)	3.57 (3.02-4.22)	5.27 (4.58-6.05)	8.63 (7.68-9.70)	10.87 (9.56-12.34)	*12.44 (10.34-14.92)*
monobloc polyethylene tibia	≥75	572	0.36 (0.09-1.42)	1.51 (0.76-3.01)	2.91 (1.73-4.88)	*5.85 (3.77-9.02)*	*5.85 (3.77-9.02)*		499	1.04 (0.43-2.48)	1.93 (1.01-3.68)	3.12 (1.86-5.22)	*5.31 (3.46-8.11)*	*5.91 (3.84-9.05)*	
All unicondylar, uncemented/hybrid	≥75	3,630	1.33 (0.99-1.77)	2.08 (1.63-2.66)	2.73 (2.15-3.45)	*4.52 (3.27-6.23)*			2,858	0.77 (0.50-1.18)	1.94 (1.46-2.60)	2.95 (2.28-3.81)	*4.59 (3.53-5.96)*	*5.26 (3.75-7.35)*	
fixed	≥75	115	*0.93 (0.13-6.39)*	*0.93 (0.13-6.39)*	*0.93 (0.13-6.39)*	*6.31 (1.90-19.86)*			257	*1.21 (0.39-3.72)*	*2.26 (0.94-5.38)*	*4.74 (2.28-9.70)*	*5.94 (2.95-11.79)*		
mobile	≥75	3,479	1.35 (1.01-1.82)	2.15 (1.68-2.75)	2.83 (2.23-3.59)	*4.52 (3.19-6.38)*			2,564	0.74 (0.46-1.17)	1.95 (1.43-2.64)	2.84 (2.16-3.73)	*4.65 (3.47-6.21)*		
monobloc polyethylene tibia	≥75	36		*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*			37			*0.00 (-.-)*	*0.00 (-.-)*		
Patellofemoral	≥75	571	0.57 (0.19-1.77)	3.31 (2.04-5.36)	4.36 (2.82-6.70)	*6.76 (4.40-10.32)*	*8.92 (5.59-14.06)*		1,298	0.56 (0.27-1.17)	2.56 (1.80-3.64)	5.31 (4.12-6.84)	9.35 (7.54-11.57)	*9.35 (7.54-11.57)*	
Multicompartmental	≥75	38	*0.00 (-.-)*	*3.70 (0.53-23.51)*	*3.70 (0.53-23.51)*				31	*0.00 (-.-)*	*0.00 (-.-)*	*0.00 (-.-)*			

Note: Total sample on which results are based is 1,544,961 primary knee replacements.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: The observed outcomes outlined here represent aggregate analysis outputs. For an individual patient level estimate of outcome based upon individual patient characteristics, prosthesis selection and surgical technique chosen, we recommend review of the NJR Patient Decision Support Tool.

UKRs seem to fare worse compared to TKRs, with the chance of revision at each estimated time point being approximately double or more than that of a TKR (Table 3.K5, page 162). The revision rate for cemented unicondylar (medial or lateral UKR) knee replacements is 3.1 times higher than the observed rate for cemented TKR at ten years and 3.6 times higher at 19 years. The revision rate for uncemented unicondylar (medial or lateral UKR) knee replacements is 2.3 times higher than for cemented TKR at ten years and three times higher at 15 years, although the numbers for the last estimate are small and so we suggest should be treated with caution. The revision rate for patellofemoral replacement is 5.5 times higher than for cemented TKR at ten years and 5.6 times higher at 19 years although again, we advise a degree of caution since the number of patellofemoral replacements at risk at 19 years is small. Multicompartmental knee replacements have relatively small numbers, and at five years the risk of revision is 4.7 times higher than for cemented TKR, 1.8 times higher than for cemented unicondylar knee replacements and 2.7 times higher than for uncemented unicondylar knee replacements. The rates are approximately equivalent to those seen for patellofemoral replacements.

First revision of an implant is slightly less likely in females than in males overall for cemented TKR but, broadly, a patient from a younger age group is more likely to be revised irrespective of gender, with the youngest group having the worst predicted outcome in terms of the risk of subsequent revision (Table 3.K6, page 169). Conversely, female patients are more likely to have a unicondylar implant revised in the longer term compared to their male, age-equivalent counterparts. For patellofemoral implants, males are generally more likely to undergo revision than their age-matched female counterparts.

The numbers for multicompartmental knee replacements are small in the age and gender stratified groups but overall, the risk of revision is markedly higher than that for TKR and more in keeping with patellofemoral replacement.

3.3.3 Revisions after primary knee replacement surgery by main brands for TKR and UKR

As in previous reports, only brands that have been used in a primary TKR in 1,000 or more operations have been included (Tables 3.K7 (a) (page 177) and Table 3.K8 (page 184)). Table 3.K7 (b) (page 179) shows a breakdown of the brands included in Table 3.K7 (a) according to whether the patella was resurfaced or not at the time of the primary procedure. In Table 3.K9 (a) (page 185) brands are displayed with a breakdown according to fixation, constraint and bearing mobility where there are more than 2,500 operations for TKR and more than 1,000 operations for UKR. Table 3.K9 (b) (page 189) provides an additional breakdown for the TKRs displayed in Table 3.K9 (a) according to whether the patella was resurfaced at the time of primary procedure or not.

Further breakdowns by component are available from other sources, such as ODEP. The figures in blue italics are at time points where 250 or fewer primary knee replacements remained at risk. No results are shown where the number had fallen below ten cases. We have made no attempt to adjust for other factors that may influence the chance of revision, so the figures are unadjusted probabilities. Given that the sub-groups may differ in composition with respect to age and gender, the percentage of males and the median (IQR) of the ages are also shown in these tables.

Table 3.K7 (a) KM estimates of cumulative revision (95% CI) by total knee replacement brands. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary: 1 year	3 years	5 years	10 years	15 years	19 years
All total knee replacements	**1,354,653**	**70 (63 to 76)**	**43**	**0.43 (0.42-0.44)**	**1.45 (1.43-1.47)**	**2.07 (2.05-2.10)**	**3.14 (3.11-3.18)**	**4.25 (4.20-4.32)**	**5.39 (5.23-5.57)**
ACS PC[Fem] ACS[Tib]	1,180	68 (61 to 73)	50	0.77 (0.40-1.47)	2.69 (1.90-3.81)	3.34 (2.44-4.57)	4.42 (3.33-5.87)		
Advance MP Stature[Fem] Advance[Tib]	1,513	69 (62 to 75)	13	0.07 (0.01-0.47)	1.69 (1.15-2.49)	2.61 (1.91-3.57)	3.15 (2.33-4.26)		
Advance MP[Fem] Advance[Tib]	9,063	70 (64 to 76)	48	0.57 (0.43-0.75)	2.02 (1.75-2.34)	2.85 (2.52-3.22)	4.00 (3.57-4.47)	4.77 (4.21-5.39)	*5.91 (4.75-7.35)*
Advance PS[Fem] Advance[Tib]	1,455	72 (66 to 77)	46	0.63 (0.33-1.20)	2.56 (1.85-3.53)	3.49 (2.64-4.61)	5.78 (4.51-7.39)	*7.28 (5.64-9.37)*	
AGC V2[Fem:Tib]	39,167	71 (65 to 77)	43	0.32 (0.27-0.38)	1.53 (1.41-1.66)	2.21 (2.06-2.36)	3.49 (3.30-3.69)	5.36 (5.07-5.66)	7.89 (7.19-8.66)
AGC[Fem] AGC V2[Tib]	28,985	71 (64 to 77)	42	0.31 (0.25-0.38)	1.58 (1.45-1.74)	2.22 (2.06-2.40)	3.49 (3.26-3.72)	5.38 (4.99-5.79)	*9.73 (7.17-13.13)*
AS Columbus Cemented[Fem] Columbus CR/PS[Tib]	2,145	67 (60 to 74)	54	0.35 (0.17-0.74)	1.53 (1.00-2.34)	2.59 (1.77-3.77)	*3.84 (2.61-5.62)*		
Attune[Fem] Attune FB[Tib]	41,513	70 (63 to 76)	44	0.41 (0.35-0.48)	1.39 (1.27-1.53)	2.05 (1.89-2.23)	*4.24 (3.12-5.75)*		
Attune[Fem] Attune RP[Tib]	7,584	70 (63 to 76)	44	0.29 (0.19-0.45)	0.94 (0.71-1.24)	1.38 (1.07-1.78)	*2.62 (1.60-4.28)*		
Columbus Cemented[Fem] Columbus CR/PS[Tib]	17,377	70 (64 to 77)	42	0.46 (0.37-0.57)	1.44 (1.27-1.64)	2.03 (1.81-2.26)	2.93 (2.62-3.27)	3.86 (3.26-4.56)	
E-Motion Bicondylar Knee[Fem] E-Motion FP[Tib]	3,385	68 (61 to 74)	45	0.65 (0.43-0.99)	2.29 (1.83-2.86)	3.27 (2.71-3.94)	4.39 (3.70-5.20)	6.61 (5.36-8.15)	
Endo-Model Standard Rotating Hinge[Fem:Tib]	1,498	76 (69 to 83)	27	1.37 (0.87-2.13)	3.30 (2.44-4.44)	4.97 (3.85-6.41)	7.29 (5.61-9.44)	*9.63 (6.98-13.21)*	
EvolutionMP[Fem:Tib]	2,531	70 (63 to 76)	45	0.50 (0.29-0.89)	1.50 (1.05-2.15)	1.77 (1.25-2.51)			
Genesis II Oxinium[Fem] Genesis II[Tib]	12,494	59 (54 to 65)	40	0.56 (0.44-0.71)	2.25 (1.99-2.53)	3.32 (3.00-3.68)	5.83 (5.34-6.36)	7.33 (6.63-8.10)	
Genesis II[Fem:Tib]	96,920	71 (65 to 77)	42	0.47 (0.42-0.51)	1.45 (1.37-1.53)	1.99 (1.89-2.09)	2.92 (2.79-3.06)	3.54 (3.33-3.76)	*3.62 (3.38-3.87)*
Insall-Burstein II Microport[Fem] Insall-Burstein (Microport)[Tib]	2,031	71 (65 to 77)	45	0.35 (0.17-0.73)	1.73 (1.24-2.42)	2.91 (2.25-3.77)	5.11 (4.18-6.24)	7.06 (5.89-8.44)	*8.08 (6.74-9.68)*
iTotal G2[Fem:Tib]	1,548	66 (59 to 72)	54	0.49 (0.23-1.02)	1.34 (0.83-2.15)	1.63 (1.02-2.59)	*1.93 (1.18-3.16)*		
Journey II BCS Oxinium[Fem] Journey[Tib]	5,732	67 (59 to 73)	41	0.53 (0.36-0.76)	1.89 (1.53-2.34)	2.45 (2.00-3.00)			
Kinemax[Fem:Tib]	11,053	71 (64 to 77)	43	0.25 (0.17-0.36)	1.72 (1.49-1.98)	2.66 (2.37-2.99)	4.68 (4.28-5.12)	6.80 (6.28-7.36)	8.54 (7.71-9.46)
LCS Complete[Fem] M.B.T.[Tib]	30,121	70 (63 to 76)	44	0.42 (0.35-0.50)	1.66 (1.52-1.82)	2.44 (2.27-2.63)	3.54 (3.32-3.78)	4.33 (4.03-4.66)	

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K7 (a) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
LCS[Fem:Tib]	2,087	70 (63 to 76)	41	0.63 (0.36-1.08)	1.71 (1.23-2.37)	2.22 (1.66-2.97)	2.87 (2.21-3.72)	3.64 (2.86-4.63)	*4.07 (3.17-5.22)*
Legion CR COCR[Fem] Genesis II[Tib]	1,072	71 (65 to 77)	44	0.47 (0.20-1.12)	1.53 (0.94-2.49)	2.07 (1.35-3.15)	*2.33 (1.50-3.59)*		
Maxim[Fem:Tib]	1,751	70 (63 to 77)	43	0.41 (0.19-0.85)	1.77 (1.24-2.52)	2.76 (2.08-3.67)	5.46 (4.41-6.75)	9.12 (7.57-10.97)	*14.89 (11.72-18.83)*
METS Hinged/Linked Knee[Fem:Tib]	1,004	74 (63 to 82)	25	3.07 (2.12-4.41)	5.87 (4.44-7.74)	6.69 (5.10-8.75)	*9.87 (6.90-14.01)*		
MRK[Fem:Tib]	16,563	70 (64 to 77)	45	0.32 (0.24-0.42)	1.16 (1.00-1.34)	1.59 (1.40-1.81)	2.44 (2.16-2.75)	2.83 (2.45-3.26)	*2.99 (2.52-3.56)*
Natural Knee II[Fem] NK2[Tib]	2,823	70 (64 to 76)	42	0.32 (0.17-0.62)	1.37 (1.00-1.88)	2.25 (1.75-2.88)	3.99 (3.29-4.82)	7.07 (5.90-8.47)	*7.56 (6.23-9.16)*
Nexgen Hinge Type[Fem:Tib]	1,182	73 (65 to 80)	26	1.16 (0.67-1.99)	2.48 (1.68-3.67)	3.72 (2.63-5.26)	*6.76 (4.69-9.69)*	*10.67 (6.31-17.74)*	
Nexgen LCCK[Fem] Nexgen[Tib]	1,260	71 (63 to 79)	36	1.14 (0.68-1.91)	2.58 (1.80-3.70)	3.26 (2.32-4.57)	*4.61 (3.20-6.62)*	*6.90 (3.95-11.91)*	
Nexgen[Fem:Tib]	192,252	70 (64 to 76)	42	0.38 (0.35-0.41)	1.24 (1.19-1.29)	1.94 (1.87-2.01)	3.36 (3.25-3.46)	4.45 (4.29-4.62)	5.37 (4.99-5.77)
Nexgen[Fem] LPS (Legacy Posterior Stabilised ZimmerBiomet)[Tib]	3,362	67 (59 to 75)	46	0.45 (0.27-0.75)	1.82 (1.41-2.34)	2.54 (2.05-3.15)	4.10 (3.42-4.91)	5.72 (4.74-6.89)	*6.50 (5.25-8.04)*
Nexgen[Fem] TM Monoblock[Tib]	4,295	64 (58 to 71)	57	0.61 (0.42-0.89)	2.61 (2.17-3.14)	3.27 (2.77-3.86)	4.32 (3.73-5.00)	5.12 (4.43-5.92)	*5.60 (4.73-6.62)*
Optetrak CR[Fem] Optetrak[Tib]	1,641	70 (63 to 76)	43	0.86 (0.51-1.45)	3.44 (2.65-4.46)	4.89 (3.93-6.08)	8.04 (6.74-9.58)	11.39 (9.43-13.72)	
Persona CR[Fem] Persona[Tib]	12,181	70 (63 to 76)	45	0.29 (0.20-0.41)	0.71 (0.53-0.96)	1.13 (0.80-1.61)			
Persona PS[Fem] Persona[Tib]	2,134	70 (64 to 77)	42	0.56 (0.31-1.01)	1.92 (1.35-2.73)	3.20 (2.36-4.33)			
PFC Sigma Bicondylar Knee[Fem] M.B.T.[Tib]	17,574	65 (58 to 72)	47	0.63 (0.52-0.76)	1.99 (1.80-2.21)	2.76 (2.52-3.02)	3.89 (3.60-4.20)	5.03 (4.63-5.45)	*5.47 (4.88-6.13)*
PFC Sigma Bicondylar Knee[Fem] PFC Bicondylar[Tib]	186,707	70 (64 to 76)	43	0.40 (0.37-0.43)	1.26 (1.21-1.32)	1.75 (1.68-1.81)	2.46 (2.38-2.54)	3.17 (3.06-3.28)	3.78 (3.57-4.00)
PFC Sigma Bicondylar Knee[Fem] PFC Sigma Bicondylar[Tib]	211,719	70 (64 to 77)	42	0.37 (0.35-0.40)	1.37 (1.31-1.42)	1.92 (1.85-1.98)	2.58 (2.50-2.66)	*3.15 (2.96-3.34)*	
Profix Oxinium[Fem] Profix[Tib]	1,001	61 (56 to 66)	43	0.80 (0.40-1.60)	2.93 (2.04-4.18)	3.23 (2.30-4.54)	4.63 (3.48-6.16)	5.86 (4.52-7.57)	*5.86 (4.52-7.57)*
Profix[Fem:Tib]	3,977	73 (67 to 78)	44	0.41 (0.25-0.66)	1.37 (1.05-1.78)	1.86 (1.48-2.34)	2.70 (2.22-3.28)	3.71 (3.06-4.50)	*4.08 (3.27-5.09)*
Rotaglide+[Fem:Tib]	2,012	70 (63 to 76)	43	0.65 (0.38-1.12)	3.01 (2.34-3.87)	3.87 (3.10-4.83)	6.56 (5.50-7.81)	8.74 (7.44-10.26)	*9.82 (7.93-12.13)*
Rotaglide[Fem:Tib]	1,449	71 (63 to 77)	39	0.56 (0.28-1.11)	2.41 (1.72-3.35)	3.98 (3.07-5.16)	4.85 (3.79-6.20)	*6.69 (5.20-8.59)*	
Saiph[Fem:Tib]	3,155	69 (63 to 75)	44	0.61 (0.38-0.98)	1.33 (0.93-1.90)	1.50 (1.05-2.15)	*3.04 (1.52-6.03)*		

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K7 (a) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Scorpio NRG[Fem:Tib]	14,127	70 (64 to 77)	42	0.41 (0.32-0.53)	1.58 (1.39-1.80)	2.40 (2.16-2.68)	3.65 (3.33-4.00)	4.38 (3.95-4.87)	
Scorpio[Fem:Tib]	3,273	68 (61 to 75)	45	0.37 (0.21-0.65)	2.16 (1.71-2.73)	3.11 (2.56-3.77)	4.68 (3.98-5.50)	5.97 (5.12-6.97)	*6.85* *(5.63-8.32)*
Scorpio[Fem] Scorpio NRG[Tib]	21,809	71 (64 to 77)	42	0.44 (0.36-0.54)	1.82 (1.65-2.01)	2.61 (2.41-2.84)	4.01 (3.75-4.29)	5.20 (4.87-5.54)	*5.52* *(5.15-5.92)*
Sphere[Fem] GMK[Tib]	2,692	69 (62 to 75)	43	0.91 (0.61-1.37)	2.13 (1.59-2.84)	2.75 (2.10-3.62)	*4.38* *(3.08-6.21)*		
TC Plus[Fem:Tib]	16,265	70 (64 to 76)	45	0.67 (0.56-0.81)	1.76 (1.57-1.97)	2.34 (2.12-2.59)	3.44 (3.16-3.75)	4.49 (4.14-4.88)	*6.26* *(4.66-8.37)*
Triathlon[Fem:Tib]	186,270	70 (63 to 76)	43	0.48 (0.44-0.51)	1.38 (1.33-1.44)	1.94 (1.87-2.01)	2.85 (2.74-2.97)	3.72 (3.46-3.99)	
Unity Knee[Fem] Unity[Tib]	1,713	70 (63 to 76)	44	0.30 (0.13-0.73)	0.85 (0.49-1.46)	1.21 (0.75-1.95)			
Vanguard[Fem:Tib]	95,794	70 (64 to 76)	42	0.41 (0.37-0.45)	1.38 (1.30-1.46)	1.95 (1.86-2.05)	2.86 (2.71-3.01)	*3.95* *(3.50-4.45)*	
Vanguard[Fem] Maxim[Tib]	2,391	69 (62 to 76)	41	0.42 (0.23-0.78)	1.74 (1.28-2.38)	2.96 (2.30-3.80)	4.46 (3.59-5.54)	*5.08* *(4.10-6.28)*	

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K7 (b) KM estimates of cumulative revision (95% CI) in total knee replacement brands by whether a patella component was recorded. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Brand[1]	Patella status	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
All total knee replacements	with Patella	543,012	70 (63 to 76)	38	0.42 (0.40-0.43)	1.23 (1.20-1.26)	1.77 (1.74-1.81)	2.79 (2.73-2.85)	3.84 (3.74-3.93)	4.78 (4.51-5.05)
	without Patella	811,641	70 (63 to 76)	46	0.44 (0.42-0.45)	1.59 (1.56-1.62)	2.26 (2.22-2.29)	3.36 (3.31-3.41)	4.51 (4.43-4.58)	5.76 (5.54-5.98)
ACS PC[Fem] ACS[Tib]	with Patella	96	68 (61 to 74)	28	*2.08* *(0.53-8.07)*	*4.26* *(1.62-10.96)*	*4.26* *(1.62-10.96)*			
	without Patella	1,084	68 (61 to 73)	52	0.65 (0.31-1.36)	2.55 (1.76-3.70)	3.24 (2.33-4.51)	4.27 (3.16-5.76)		
Advance MP Stature[Fem] Advance[Tib]	with Patella	509	69 (62 to 75)	12	0.00 (.-.)	0.60 (0.19-1.84)	1.47 (0.70-3.07)	*1.73* *(0.87-3.44)*		
	without Patella	1,004	69 (62 to 75)	14	0.10 (0.01-0.71)	2.25 (1.49-3.40)	3.21 (2.27-4.53)	3.83 (2.75-5.33)		
Advance MP[Fem] Advance[Tib]	with Patella	3,060	70 (63 to 76)	43	0.53 (0.32-0.86)	1.50 (1.12-2.00)	2.01 (1.56-2.59)	3.08 (2.46-3.84)	3.56 (2.81-4.51)	
	without Patella	6,003	70 (64 to 76)	50	0.59 (0.42-0.82)	2.29 (1.93-2.71)	3.29 (2.85-3.79)	4.47 (3.93-5.08)	5.45 (4.70-6.32)	*8.24* *(5.75-11.74)*
Advance PS[Fem] Advance[Tib]	with Patella	256	71 (66 to 76)	36	*1.19* *(0.39-3.65)*	*4.06* *(2.20-7.41)*	*5.40* *(3.17-9.13)*	*8.66* *(5.44-13.63)*	*10.32* *(6.28-16.72)*	
	without Patella	1,199	72 (66 to 78)	48	0.51 (0.23-1.12)	2.24 (1.53-3.27)	3.08 (2.22-4.27)	5.17 (3.86-6.92)	*6.64* *(4.93-8.92)*	

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

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Table 3.K7 (b) (continued)

Brand[1]	Patella status	N	Age at primary Median (IQR)	Male (%)	Time since primary: 1 year	3 years	5 years	10 years	15 years	19 years
AGC V2[Fem:Tib]	with Patella	12,207	71 (65 to 77)	35	0.25 (0.17-0.35)	1.25 (1.07-1.47)	1.84 (1.62-2.11)	3.01 (2.70-3.36)	4.58 (4.09-5.12)	*6.68 (5.61-7.95)*
	without Patella	26,960	71 (65 to 77)	46	0.35 (0.28-0.43)	1.65 (1.51-1.82)	2.37 (2.19-2.56)	3.70 (3.47-3.95)	5.69 (5.34-6.06)	*8.37 (7.51-9.31)*
AGC[Fem] AGC V2[Tib]	with Patella	9,839	71 (64 to 77)	37	0.26 (0.17-0.38)	1.19 (0.99-1.43)	1.67 (1.44-1.95)	2.84 (2.50-3.22)	5.11 (4.46-5.86)	*7.98 (5.04-12.51)*
	without Patella	19,146	71 (64 to 77)	45	0.33 (0.26-0.42)	1.79 (1.61-1.99)	2.50 (2.29-2.74)	3.82 (3.53-4.13)	5.48 (5.01-5.98)	*11.13 (7.33-16.72)*
AS Columbus Cemented[Fem] Columbus CR/ PS[Tib]	with Patella	1,226	66 (60 to 73)	53	0.27 (0.09-0.83)	1.63 (0.96-2.75)	2.48 (1.53-3.99)	*3.92 (2.43-6.27)*		
	without Patella	919	68 (60 to 75)	55	0.47 (0.18-1.25)	1.34 (0.65-2.75)	*2.77 (1.49-5.15)*	*3.58 (1.86-6.83)*		
Attune[Fem] Attune FB[Tib]	with Patella	20,996	70 (63 to 76)	40	0.36 (0.29-0.46)	1.09 (0.94-1.27)	1.64 (1.43-1.88)			
	without Patella	20,517	70 (62 to 76)	47	0.45 (0.37-0.56)	1.67 (1.48-1.88)	2.43 (2.19-2.70)			
Attune[Fem] Attune RP[Tib]	with Patella	4,807	70 (62 to 76)	41	0.33 (0.20-0.56)	0.92 (0.65-1.30)	1.22 (0.88-1.70)	*1.71 (1.15-2.54)*		
	without Patella	2,777	70 (63 to 76)	49	0.22 (0.09-0.53)	0.99 (0.62-1.57)	1.68 (1.13-2.49)	*4.77 (1.87-11.87)*		
Columbus Cemented[Fem] Columbus CR/ PS[Tib]	with Patella	5,280	70 (64 to 76)	36	0.63 (0.44-0.88)	1.29 (1.01-1.65)	1.79 (1.44-2.22)	3.08 (2.44-3.90)	*5.97 (3.86-9.16)*	
	without Patella	12,097	71 (65 to 77)	44	0.39 (0.29-0.52)	1.50 (1.29-1.74)	2.12 (1.87-2.42)	2.90 (2.56-3.30)	*3.42 (2.90-4.04)*	
E-Motion Bicondylar Knee[Fem] E-Motion FP[Tib]	with Patella	299	66 (60 to 73)	33	1.01 (0.33-3.10)	5.51 (3.41-8.84)	*7.70 (5.13-11.46)*	*9.12 (6.05-13.62)*		
	without Patella	3,086	68 (61 to 74)	46	0.62 (0.40-0.97)	1.98 (1.54-2.55)	2.84 (2.30-3.51)	3.95 (3.27-4.77)	*6.22 (4.96-7.79)*	
Endo-Model Standard Rotating Hinge[Fem:Tib]	with Patella	336	76 (68 to 82)	26	1.91 (0.86-4.21)	*3.54 (1.91-6.52)*	*5.56 (3.29-9.33)*	*8.37 (4.71-14.64)*	*11.06 (5.84-20.42)*	
	without Patella	1,162	77 (69 to 83)	27	1.21 (0.70-2.07)	3.22 (2.29-4.53)	4.81 (3.59-6.44)	*6.97 (5.20-9.30)*	*9.21 (6.34-13.27)*	
EvolutionMP[Fem:Tib]	with Patella	1,074	71 (65 to 78)	46	0.60 (0.27-1.33)	1.48 (0.83-2.62)	*1.48 (0.83-2.62)*			
	without Patella	1,457	69 (62 to 76)	45	0.44 (0.20-0.97)	1.50 (0.95-2.38)	1.86 (1.21-2.86)			
Genesis II Oxinium[Fem] Genesis II[Tib]	with Patella	6,921	60 (55 to 66)	37	0.48 (0.34-0.67)	1.60 (1.32-1.94)	2.24 (1.89-2.65)	4.14 (3.58-4.80)	5.44 (4.56-6.48)	
	without Patella	5,573	59 (54 to 65)	43	0.66 (0.48-0.91)	3.01 (2.58-3.51)	4.58 (4.04-5.20)	7.72 (6.92-8.60)	9.43 (8.37-10.61)	
Genesis II[Fem:Tib]	with Patella	47,081	71 (65 to 77)	39	0.47 (0.41-0.54)	1.21 (1.11-1.33)	1.61 (1.49-1.74)	2.41 (2.23-2.60)	2.81 (2.56-3.09)	*2.94 (2.60-3.32)*
	without Patella	49,839	71 (65 to 77)	46	0.46 (0.41-0.53)	1.65 (1.54-1.77)	2.31 (2.17-2.45)	3.35 (3.16-3.55)	4.09 (3.78-4.41)	*4.14 (3.82-4.49)*

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K7 (b) (continued)

Brand[1]	Patella status	N	Age at primary Median (IQR)	Male (%)	Time since primary					
					1 year	3 years	5 years	10 years	15 years	19 years
Insall-Burstein II Microport[Fem] Insall-Burstein (Microport)[Tib]	with Patella	1,114	71 (65 to 77)	43	0.09 (0.01-0.64)	0.75 (0.37-1.49)	2.22 (1.48-3.33)	4.48 (3.34-6.00)	6.55 (5.06-8.46)	*7.65 (5.89-9.89)*
	without Patella	917	71 (65 to 77)	48	0.66 (0.30-1.47)	2.93 (2.01-4.28)	3.75 (2.68-5.24)	5.89 (4.48-7.73)	7.68 (5.97-9.86)	*8.63 (6.69-11.10)*
iTotal G2[Fem:Tib]	with Patella	1,018	67 (60 to 73)	51	0.32 (0.10-1.00)	0.71 (0.32-1.58)	0.71 (0.32-1.58)	*1.23 (0.48-3.16)*		
	without Patella	530	65 (57 to 71)	60	0.79 (0.30-2.10)	2.44 (1.35-4.37)	*3.19 (1.83-5.53)*			
Journey II BCS Oxinium[Fem] Journey[Tib]	with Patella	4,991	67 (60 to 74)	41	0.43 (0.28-0.67)	1.27 (0.96-1.68)	1.60 (1.21-2.10)			
	without Patella	741	65 (57 to 72)	43	1.09 (0.55-2.17)	4.95 (3.58-6.83)	6.26 (4.68-8.36)			
Kinemax[Fem:Tib]	with Patella	4,420	71 (64 to 77)	37	0.25 (0.14-0.45)	1.23 (0.94-1.61)	1.75 (1.39-2.19)	3.64 (3.09-4.29)	5.62 (4.88-6.47)	*7.20 (5.96-8.69)*
	without Patella	6,633	71 (64 to 77)	47	0.24 (0.15-0.40)	2.04 (1.72-2.42)	3.27 (2.86-3.74)	5.37 (4.82-5.98)	7.58 (6.89-8.35)	*9.40 (8.34-10.59)*
LCS Complete[Fem] M.B.T.[Tib]	with Patella	1,543	69 (62 to 75)	33	0.52 (0.26-1.04)	1.86 (1.28-2.70)	3.07 (2.28-4.14)	4.68 (3.59-6.10)	*5.78 (4.35-7.65)*	
	without Patella	28,578	70 (63 to 76)	45	0.41 (0.34-0.49)	1.65 (1.51-1.81)	2.41 (2.23-2.60)	3.49 (3.26-3.73)	4.26 (3.96-4.59)	
LCS[Fem:Tib]	with Patella	225	69 (63 to 76)	37	*1.33 (0.43-4.08)*	*4.53 (2.46-8.26)*	*5.01 (2.80-8.86)*	*5.53 (3.18-9.55)*	*6.98 (4.14-11.62)*	*6.98 (4.14-11.62)*
	without Patella	1,862	70 (63 to 76)	42	0.54 (0.29-1.00)	1.37 (0.93-2.02)	1.89 (1.35-2.63)	2.55 (1.90-3.42)	3.23 (2.46-4.24)	*3.72 (2.80-4.95)*
Legion CR COCR[Fem] Genesis II[Tib]	with Patella	173	69 (62 to 76)	34	*1.16 (0.29-4.57)*	*2.35 (0.89-6.13)*	*2.96 (1.24-6.97)*	*2.96 (1.24-6.97)*		
	without Patella	899	71 (66 to 78)	46	0.34 (0.11-1.04)	1.38 (0.78-2.41)	1.89 (1.16-3.08)	*2.21 (1.34-3.65)*		
Maxim[Fem:Tib]	with Patella	515	71 (63 to 76)	33	0.59 (0.19-1.82)	1.61 (0.81-3.20)	2.25 (1.25-4.03)	5.00 (3.27-7.62)	*6.94 (4.70-10.19)*	
	without Patella	1,236	70 (63 to 77)	47	0.33 (0.12-0.87)	1.83 (1.21-2.77)	2.97 (2.14-4.11)	5.65 (4.42-7.22)	9.89 (8.01-12.18)	*16.38 (12.54-21.25)*
METS Hinged/Linked Knee[Fem:Tib]	with Patella	213	73 (64 to 81)	26	*5.07 (2.76-9.23)*	*9.35 (5.78-14.94)*	*10.41 (6.49-16.49)*			
	without Patella	791	74 (63 to 82)	25	2.53 (1.60-3.99)	4.99 (3.54-7.01)	5.75 (4.12-8.00)	*8.99 (5.83-13.74)*		
MRK[Fem:Tib]	with Patella	5,892	71 (64 to 77)	39	0.26 (0.16-0.43)	1.03 (0.79-1.34)	1.57 (1.26-1.96)	2.41 (1.97-2.96)	2.85 (2.26-3.59)	
	without Patella	10,671	70 (64 to 76)	48	0.35 (0.26-0.49)	1.23 (1.03-1.47)	1.60 (1.37-1.87)	2.45 (2.11-2.85)	2.75 (2.33-3.25)	
Natural Knee II[Fem] NK2[Tib]	with Patella	1,539	70 (64 to 76)	41	0.46 (0.22-0.96)	1.72 (1.17-2.52)	2.70 (1.99-3.66)	4.28 (3.33-5.48)	8.05 (6.33-10.22)	
	without Patella	1,284	70 (63 to 76)	42	0.16 (0.04-0.63)	0.96 (0.55-1.68)	1.70 (1.11-2.60)	3.64 (2.70-4.90)	5.95 (4.51-7.83)	*6.28 (4.74-8.29)*
Nexgen Hinge Type[Fem:Tib]	with Patella	522	73 (65 to 79)	27	1.02 (0.43-2.43)	2.11 (1.09-4.06)	*3.70 (2.11-6.47)*	*3.70 (2.11-6.47)*		
	without Patella	660	74 (64.5 to 80)	26	1.26 (0.63-2.51)	2.77 (1.70-4.49)	3.78 (2.43-5.86)	*8.40 (5.50-12.73)*	*14.13 (7.94-24.44)*	

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K7 (b) (continued)

Brand[1]	Patella status	N	Age at primary Median (IQR)	Male (%)	Time since primary: 1 year	3 years	5 years	10 years	15 years	19 years
Nexgen LCCK[Fem] Nexgen[Tib]	with Patella	617	71 (63 to 78)	35	0.49 (0.16-1.52)	1.54 (0.77-3.07)	1.88 (0.96-3.67)	4.62 (2.34-9.02)	4.62 (2.34-9.02)	
	without Patella	643	72 (64 to 79)	36	1.75 (0.97-3.14)	3.57 (2.34-5.43)	4.53 (3.07-6.68)	4.87 (3.30-7.14)	8.59 (4.32-16.71)	
Nexgen[Fem:Tib]	with Patella	58,238	70 (63 to 76)	37	0.41 (0.36-0.47)	1.28 (1.18-1.38)	2.02 (1.90-2.15)	3.65 (3.45-3.86)	4.82 (4.50-5.15)	5.51 (4.92-6.16)
	without Patella	134,014	70 (64 to 76)	45	0.36 (0.33-0.40)	1.23 (1.17-1.29)	1.90 (1.83-1.98)	3.24 (3.12-3.36)	4.31 (4.12-4.51)	5.33 (4.86-5.84)
Nexgen[Fem] LPS (Legacy Posterior Stabilised ZimmerBiomet)[Tib]	with Patella	1,192	67 (59 to 74)	38	0.43 (0.18-1.03)	2.16 (1.45-3.20)	2.94 (2.08-4.13)	5.62 (4.30-7.33)	7.87 (6.02-10.26)	7.87 (6.02-10.26)
	without Patella	2,170	67 (59 to 75)	51	0.46 (0.25-0.86)	1.64 (1.18-2.28)	2.34 (1.77-3.08)	3.35 (2.62-4.28)	4.53 (3.53-5.82)	5.97 (4.27-8.31)
Nexgen[Fem] TM Monoblock[Tib]	with Patella	416	62 (56 to 69)	56	0.73 (0.23-2.23)	2.43 (1.32-4.48)	3.20 (1.87-5.45)	5.25 (3.41-8.05)	6.22 (4.07-9.44)	
	without Patella	3,879	64 (58 to 71)	57	0.60 (0.40-0.90)	2.63 (2.17-3.19)	3.28 (2.75-3.90)	4.22 (3.60-4.93)	5.00 (4.29-5.83)	5.51 (4.60-6.61)
Optetrak CR[Fem] Optetrak[Tib]	with Patella	648	70 (64 to 76)	43	0.94 (0.42-2.07)	2.39 (1.45-3.93)	3.75 (2.51-5.59)	7.59 (5.64-10.16)	12.70 (9.35-17.13)	
	without Patella	993	69 (63 to 76)	43	0.81 (0.41-1.62)	4.12 (3.04-5.58)	5.64 (4.35-7.30)	8.35 (6.70-10.37)	10.61 (8.36-13.42)	
Persona CR[Fem] Persona[Tib]	with Patella	5,622	70 (62 to 76)	41	0.26 (0.15-0.47)	0.48 (0.28-0.81)	0.59 (0.34-1.02)			
	without Patella	6,559	70 (63 to 76)	49	0.31 (0.20-0.49)	0.86 (0.60-1.24)	1.49 (0.98-2.25)			
Persona PS[Fem] Persona[Tib]	with Patella	936	70 (63 to 77)	36	0.37 (0.12-1.15)	1.71 (0.94-3.10)	2.70 (1.61-4.51)			
	without Patella	1,198	70 (64 to 77)	47	0.70 (0.35-1.40)	2.05 (1.32-3.18)	3.47 (2.39-5.02)			
PFC Sigma Bicondylar Knee[Fem] M.B.T.[Tib]	with Patella	8,892	65 (58 to 72)	43	0.44 (0.32-0.60)	1.68 (1.43-1.97)	2.36 (2.06-2.70)	3.43 (3.05-3.85)	4.40 (3.90-4.97)	4.58 (4.03-5.21)
	without Patella	8,682	65 (58 to 73)	50	0.82 (0.65-1.04)	2.31 (2.02-2.66)	3.17 (2.82-3.57)	4.37 (3.93-4.85)	5.67 (5.08-6.33)	6.32 (5.38-7.41)
PFC Sigma Bicondylar Knee[Fem] PFC Bicondylar[Tib]	with Patella	73,658	71 (64 to 77)	38	0.37 (0.32-0.41)	1.07 (1.00-1.15)	1.52 (1.42-1.61)	2.12 (2.00-2.24)	2.74 (2.58-2.90)	3.21 (2.97-3.47)
	without Patella	113,049	70 (64 to 76)	46	0.42 (0.38-0.46)	1.39 (1.32-1.46)	1.89 (1.81-1.98)	2.68 (2.57-2.79)	3.45 (3.31-3.60)	4.17 (3.86-4.51)
PFC Sigma Bicondylar Knee[Fem] PFC Sigma Bicondylar[Tib]	with Patella	92,933	71 (64 to 77)	38	0.37 (0.33-0.41)	1.14 (1.07-1.21)	1.64 (1.55-1.73)	2.27 (2.15-2.39)	2.65 (2.47-2.84)	
	without Patella	118,786	70 (64 to 77)	45	0.38 (0.34-0.41)	1.54 (1.46-1.61)	2.13 (2.04-2.22)	2.82 (2.71-2.93)	3.52 (3.23-3.84)	
Profix Oxinium[Fem] Profix[Tib]	with Patella	42	61 (58 to 68)	26				2.50 (0.36-16.45)	2.50 (0.36-16.45)	
	without Patella	959	61 (56 to 66)	44	0.84 (0.42-1.67)	3.05 (2.13-4.37)	3.38 (2.40-4.74)	4.73 (3.54-6.30)	6.01 (4.63-7.78)	6.01 (4.63-7.78)
Profix[Fem:Tib]	with Patella	83	73 (65 to 78)	30	0.00 (.-.)	0.00 (.-.)	1.35 (0.19-9.21)	4.07 (1.33-12.10)	6.41 (2.36-16.77)	
	without Patella	3,894	73 (67 to 78)	44	0.42 (0.26-0.68)	1.40 (1.07-1.82)	1.87 (1.48-2.36)	2.67 (2.18-3.25)	3.65 (3.00-4.43)	4.03 (3.21-5.04)

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K7 (b) (continued)

Brand[1]	Patella status	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Rotaglide+[Fem:Tib]	with Patella	1,182	69 (63 to 76)	42	0.85 (0.46-1.58)	2.69 (1.90-3.80)	3.50 (2.58-4.75)	6.18 (4.87-7.83)	8.59 (6.93-10.62)	*10.17 (7.40-13.88)*
	without Patella	830	71 (64 to 77)	45	0.36 (0.12-1.12)	3.48 (2.41-4.99)	4.40 (3.18-6.07)	7.09 (5.45-9.19)	8.94 (6.99-11.39)	*9.31 (7.27-11.89)*
Rotaglide[Fem:Tib]	with Patella	1,430	71 (63 to 77)	39	0.49 (0.24-1.03)	2.37 (1.69-3.31)	3.96 (3.05-5.15)	4.84 (3.78-6.20)	*6.71 (5.21-8.63)*	
	without Patella	19	67 (60 to 75)	37	*5.26 (0.76-31.88)*	*5.26 (0.76-31.88)*	*5.26 (0.76-31.88)*			
Saiph[Fem:Tib]	with Patella	1,864	70 (63 to 75)	38	0.72 (0.41-1.27)	1.13 (0.68-1.88)	1.44 (0.87-2.37)	*4.21 (1.75-9.97)*		
	without Patella	1,291	69 (62 to 75)	53	0.45 (0.19-1.07)	1.57 (0.94-2.61)	1.57 (0.94-2.61)	*1.57 (0.94-2.61)*		
Scorpio NRG[Fem:Tib]	with Patella	7,135	71 (64 to 77)	39	0.45 (0.32-0.64)	1.29 (1.05-1.59)	1.98 (1.68-2.34)	3.12 (2.71-3.60)	*3.82 (3.21-4.55)*	
	without Patella	6,992	70 (64 to 76)	46	0.37 (0.25-0.55)	1.88 (1.58-2.23)	2.84 (2.47-3.26)	4.18 (3.71-4.72)	*4.96 (4.35-5.65)*	
Scorpio[Fem:Tib]	with Patella	965	68 (60 to 75)	40	0.21 (0.05-0.84)	1.70 (1.04-2.76)	2.35 (1.56-3.55)	3.82 (2.74-5.31)	4.69 (3.39-6.47)	*5.46 (3.69-8.04)*
	without Patella	2,308	68 (62 to 75)	47	0.44 (0.23-0.81)	2.35 (1.80-3.07)	3.42 (2.74-4.27)	5.05 (4.19-6.07)	6.49 (5.44-7.73)	*7.39 (5.90-9.23)*
Scorpio[Fem] Scorpio NRG[Tib]	with Patella	8,150	71 (65 to 77)	38	0.32 (0.22-0.47)	1.34 (1.11-1.62)	2.04 (1.75-2.38)	3.25 (2.87-3.68)	4.29 (3.83-4.82)	*4.50 (3.97-5.09)*
	without Patella	13,659	71 (64 to 77)	44	0.51 (0.40-0.64)	2.11 (1.88-2.37)	2.96 (2.68-3.26)	4.47 (4.12-4.84)	5.74 (5.31-6.20)	*6.14 (5.65-6.67)*
Sphere[Fem] GMK[Tib]	with Patella	814	68 (61 to 75)	39	0.83 (0.37-1.84)	1.65 (0.87-3.11)	*2.05 (1.08-3.87)*			
	without Patella	1,878	69 (62 to 76)	45	0.95 (0.59-1.52)	2.27 (1.64-3.15)	2.95 (2.18-3.99)	*4.28 (2.90-6.31)*		
TC Plus[Fem:Tib]	with Patella	893	71 (64 to 76)	37	0.34 (0.11-1.04)	1.36 (0.78-2.39)	2.30 (1.49-3.55)	3.81 (2.67-5.44)	*4.88 (3.49-6.82)*	*5.36 (3.77-7.60)*
	without Patella	15,372	70 (64 to 76)	45	0.69 (0.57-0.84)	1.78 (1.58-2.00)	2.34 (2.11-2.60)	3.42 (3.13-3.74)	4.47 (4.11-4.87)	*6.68 (4.52-9.82)*
Triathlon[Fem:Tib]	with Patella	85,713	70 (63 to 76)	39	0.46 (0.42-0.51)	1.20 (1.12-1.28)	1.68 (1.58-1.79)	2.54 (2.38-2.71)	3.52 (3.12-3.98)	
	without Patella	100,557	70 (63 to 76)	47	0.49 (0.44-0.53)	1.53 (1.45-1.62)	2.15 (2.05-2.25)	3.10 (2.95-3.26)	3.87 (3.56-4.21)	
Unity Knee[Fem] Unity[Tib]	with Patella	1,259	70 (64 to 76)	42	0.25 (0.08-0.76)	0.78 (0.41-1.50)	1.12 (0.63-1.97)			
	without Patella	454	68.5 (61 to 75)	49	0.47 (0.12-1.85)	1.05 (0.39-2.80)	*1.48 (0.60-3.61)*			
Vanguard[Fem:Tib]	with Patella	42,730	70 (64 to 76)	38	0.40 (0.34-0.46)	1.08 (0.98-1.19)	1.56 (1.43-1.70)	2.45 (2.23-2.70)	*3.79 (2.67-5.37)*	
	without Patella	53,064	70 (63 to 76)	45	0.41 (0.36-0.47)	1.60 (1.49-1.72)	2.23 (2.10-2.37)	3.15 (2.95-3.35)	*4.19 (3.71-4.74)*	
Vanguard[Fem] Maxim[Tib]	with Patella	773	68 (60 to 75)	35	0.26 (0.06-1.03)	0.72 (0.30-1.73)	1.16 (0.55-2.47)	2.63 (1.46-4.73)	*3.01 (1.70-5.29)*	
	without Patella	1,618	70 (62 to 76)	44	0.50 (0.25-1.00)	2.21 (1.58-3.08)	3.70 (2.83-4.82)	5.21 (4.13-6.56)	*5.90 (4.69-7.40)*	

[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Tables 3.K7 (a) and (b) and Table 3.K8 show the Kaplan-Meier estimates of the cumulative percentage probability of first revision, for any indication, of a primary TKR (Tables 3.K7 (a) and (b)) and primary UKR (Table 3.K8) by implant brand.

Table 3.K8 KM estimates of cumulative revision (95% CI) by unicompartmental knee replacement brands.
Blue italics signify that 250 or fewer cases remained at risk at these time points.

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
All unicompartmental knee replacements	**168,069**	**64 (56 to 71)**	**51**	**0.98 (0.94-1.03)**	**3.49 (3.40-3.59)**	**5.33 (5.21-5.45)**	**10.19 (10.00-10.39)**	**15.48 (15.16-15.81)**	**20.16 (19.26-21.10)**
Unicondylar									
AMC/Uniglide[Fem:Tib]	3,025	64 (57 to 71)	51	2.35 (1.87-2.96)	6.02 (5.23-6.94)	7.71 (6.81-8.73)	12.56 (11.37-13.87)	18.29 (16.51-20.23)	
Journey Uni Oxinium[Fem] Journey Uni[Tib]	1,890	63 (56 to 70)	54	1.29 (0.86-1.93)	2.98 (2.25-3.94)	4.43 (3.45-5.68)	*7.44 (4.73-11.60)*		
MG Uni[Fem:Tib]	2,283	63 (57 to 70)	55	0.88 (0.57-1.36)	4.02 (3.29-4.91)	6.06 (5.15-7.13)	10.29 (9.08-11.65)	13.46 (12.03-15.03)	*16.24 (13.56-19.37)*
Oxford Cementless Partial Knee[Fem:Tib]	33,730	65 (58 to 72)	56	1.14 (1.03-1.27)	2.26 (2.09-2.44)	3.17 (2.95-3.40)	5.91 (5.40-6.46)		
Oxford Cementless Partial Knee[Fem] Oxford Partial Knee[Tib]	2,310	66 (58 to 74)	45	1.17 (0.80-1.72)	3.38 (2.67-4.27)	5.19 (4.25-6.32)	9.31 (7.77-11.14)	*14.35 (11.16-18.36)*	
Oxford Single Peg Cemented Partial Knee[Fem] Oxford Partial Knee[Tib]	43,442	64 (58 to 71)	52	1.22 (1.12-1.32)	4.35 (4.16-4.54)	6.45 (6.22-6.68)	11.46 (11.14-11.78)	16.63 (16.18-17.09)	21.22 (20.05-22.44)
Oxford Twin Peg Cemented Partial Knee[Fem] Oxford Partial Knee[Tib]	6,411	65 (57 to 72)	48	0.79 (0.60-1.04)	2.46 (2.09-2.90)	3.78 (3.29-4.34)	7.09 (6.21-8.08)	*11.54 (9.60-13.83)*	
Persona Partial Knee[Fem:Tib]	5,615	65 (58 to 72)	58	0.28 (0.16-0.49)	1.36 (0.99-1.87)	*1.67 (1.22-2.29)*			
*Physica ZUK[Fem:Tib]	25,354	64 (56 to 71)	55	0.33 (0.26-0.41)	1.66 (1.49-1.84)	2.61 (2.38-2.86)	5.44 (4.98-5.95)	*8.13 (6.90-9.56)*	
Preservation[Fem:Tib]	1,515	62 (56 to 69)	55	2.52 (1.84-3.44)	8.15 (6.87-9.65)	11.63 (10.10-13.37)	17.69 (15.81-19.75)	23.31 (21.15-25.65)	*27.73 (24.36-31.47)*
Restoris[Fem:Tib]	2,187	65 (59 to 73)	59	0.50 (0.26-0.96)	1.74 (1.11-2.73)	*1.74 (1.11-2.73)*			
Sigma HP (Uni)[Fem] Sigma HP[Tib]	15,483	63 (56 to 71)	58	0.67 (0.55-0.82)	2.67 (2.41-2.96)	3.73 (3.41-4.08)	6.42 (5.86-7.02)		
Triathlon Uni[Fem] Triathlon[Tib]	1,908	62 (56 to 70)	56	1.02 (0.64-1.62)	3.82 (2.98-4.88)	6.06 (4.92-7.46)	8.26 (6.74-10.10)		
Patellofemoral									
Avon[Fem]	6,952	58 (50 to 67)	23	0.68 (0.51-0.91)	4.08 (3.62-4.59)	7.14 (6.52-7.82)	14.38 (13.42-15.41)	21.47 (20.06-22.96)	*27.32 (24.47-30.42)*
FPV[Fem]	1,653	59 (52 to 68)	23	0.85 (0.50-1.43)	6.92 (5.79-8.26)	10.12 (8.74-11.69)	18.28 (16.40-20.35)	*23.11 (20.57-25.90)*	
Journey PFJ Oxinium[Fem]	2,398	58 (50 to 66)	23	1.81 (1.34-2.44)	7.23 (6.22-8.39)	12.20 (10.86-13.70)	20.80 (18.89-22.87)	*26.66 (23.86-29.73)*	
Sigma HP (PF)[Fem]	1,304	58 (50 to 66)	23	2.69 (1.94-3.73)	9.50 (8.02-11.23)	13.88 (12.11-15.89)	24.31 (21.75-27.11)		
Zimmer PFJ[Fem]	4,036	56 (49 to 65)	23	0.56 (0.36-0.85)	3.89 (3.28-4.61)	6.40 (5.56-7.35)	12.33 (10.81-14.04)		

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 1,000 primary total knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (a) shows Kaplan-Meier estimates of the cumulative percentage probability of first revision of a primary TKR or primary UKR by implant brand and bearing / constraint type for those brands / bearing types which were implanted on at least 1,000 occasions for UKR and 2,500 occasions for TKR. Patient summaries of age and gender by brand are also given. There are a number of brands achieving less than 3% revision at ten years, even when used in younger patients.

Table 3.K9 (a) KM estimates of cumulative revision (95% CI) by fixation, constraint and brand. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary: 1 year	3 years	5 years	10 years	15 years	19 years
Total knee replacements									
AGC V2[Fem:Tib]									
Cemented, unconstrained, fixed	37,218	71 (65 to 77)	43	0.27 (0.22-0.33)	1.43 (1.31-1.56)	2.10 (1.95-2.25)	3.34 (3.15-3.54)	5.16 (4.87-5.47)	7.70 (6.98-8.49)
AGC[Fem]AGC V2[Tib]									
Cemented, unconstrained, fixed	28,252	71 (64 to 77)	42	0.31 (0.25-0.39)	1.57 (1.43-1.73)	2.21 (2.04-2.39)	3.43 (3.21-3.67)	5.38 (4.98-5.81)	*9.85 (7.20-13.39)*
Advance MP[Fem]Advance[Tib]									
Cemented, unconstrained, fixed	8,884	70 (64 to 76)	48	0.56 (0.42-0.74)	1.97 (1.70-2.28)	2.74 (2.41-3.11)	3.90 (3.48-4.37)	4.69 (4.13-5.32)	*5.85 (4.67-7.31)*
Attune CR Cemented[Fem]Attune FB[Tib]									
Cemented, unconstrained, fixed	28,392	70 (62 to 76)	44	0.39 (0.32-0.47)	1.32 (1.17-1.49)	1.86 (1.66-2.07)			
Attune CR Cemented[Fem]Attune RP[Tib]									
Cemented, unconstrained, mobile	5,608	71 (64 to 77)	43	0.25 (0.15-0.43)	0.89 (0.63-1.24)	1.33 (0.97-1.82)	*2.01 (1.32-3.07)*		
Attune PS Cemented[Fem]Attune FB[Tib]									
Cemented, posterior-stabilised, fixed	13,098	70 (63 to 76)	42	0.45 (0.34-0.58)	1.52 (1.30-1.77)	2.42 (2.12-2.76)			
Columbus Cemented[Fem]Columbus CR/PS[Tib]									
Cemented, unconstrained, fixed	13,939	70 (64 to 76)	43	0.45 (0.35-0.57)	1.42 (1.23-1.63)	1.99 (1.76-2.25)	2.87 (2.54-3.23)	3.84 (3.21-4.58)	
Cemented, constrained condylar	3,070	71 (65 to 77)	38	0.58 (0.36-0.93)	1.57 (1.16-2.13)	2.15 (1.63-2.84)	*3.31 (2.31-4.74)*		
EvolutionMP[Fem:Tib]									
Cemented, unconstrained, fixed	2,530	70 (63 to 76)	45	0.51 (0.29-0.89)	1.50 (1.05-2.15)	1.77 (1.25-2.51)			
Genesis II Oxinium[Fem]Genesis II[Tib]									
Cemented, unconstrained, fixed	8,416	59 (55 to 65)	40	0.55 (0.41-0.74)	1.96 (1.67-2.29)	2.86 (2.50-3.27)	4.77 (4.24-5.37)	6.35 (5.55-7.25)	
Cemented, posterior-stabilised, fixed	3,812	59 (53 to 65)	41	0.59 (0.39-0.90)	2.93 (2.42-3.55)	4.45 (3.80-5.21)	8.26 (7.24-9.42)	*9.64 (8.29-11.18)*	
Genesis II[Fem:Tib]									
Cemented, unconstrained, fixed	70,441	71 (65 to 77)	43	0.40 (0.36-0.45)	1.29 (1.21-1.38)	1.78 (1.67-1.89)	2.59 (2.45-2.74)	3.01 (2.81-3.22)	*3.11 (2.87-3.38)*
Cemented, posterior-stabilised, fixed	24,688	71 (65 to 77)	40	0.65 (0.55-0.76)	1.77 (1.60-1.95)	2.43 (2.23-2.65)	3.69 (3.39-4.01)	4.74 (4.16-5.40)	

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (a) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Journey II BCS Oxinium[Fem]Journey[Tib]									
Cemented, posterior-stabilised, fixed	5,722	67 (59 to 73)	41	0.53 (0.36-0.76)	1.87 (1.51-2.32)	2.43 (1.98-2.98)			
Kinemax[Fem:Tib]									
Cemented, unconstrained, fixed	10,904	71 (64 to 77)	43	0.24 (0.16-0.35)	1.72 (1.49-1.99)	2.65 (2.36-2.97)	4.65 (4.25-5.09)	6.73 (6.21-7.29)	8.50 (7.66-9.42)
LCS Complete[Fem]M.B.T.[Tib]									
Cemented, unconstrained, mobile	12,678	70 (64 to 76)	41	0.40 (0.31-0.53)	1.51 (1.31-1.74)	2.45 (2.19-2.75)	3.94 (3.58-4.34)	4.75 (4.29-5.27)	
Uncemented, unconstrained, mobile	16,494	69 (62 to 75)	47	0.40 (0.32-0.51)	1.78 (1.58-2.00)	2.44 (2.21-2.70)	3.26 (2.98-3.57)	3.98 (3.60-4.40)	
MRK[Fem:Tib]									
Cemented, unconstrained, fixed	16,251	70 (64 to 77)	45	0.31 (0.24-0.41)	1.15 (0.99-1.33)	1.57 (1.38-1.79)	2.43 (2.15-2.75)	2.82 (2.45-3.25)	*2.99 (2.51-3.55)*
Natural Knee II[Fem]NK2[Tib]									
Cemented, unconstrained, fixed	2,692	70 (64 to 76)	41	0.34 (0.18-0.65)	1.44 (1.05-1.97)	2.23 (1.73-2.88)	3.85 (3.15-4.69)	6.91 (5.71-8.35)	*7.45 (6.06-9.13)*
Nexgen[Fem:Tib]									
Cemented, unconstrained, fixed	100,557	70 (63 to 76)	43	0.32 (0.28-0.35)	1.00 (0.94-1.07)	1.47 (1.39-1.55)	2.35 (2.23-2.47)	3.13 (2.92-3.36)	*3.50 (3.10-3.96)*
Cemented, posterior-stabilised, fixed	88,812	70 (64 to 77)	41	0.45 (0.41-0.50)	1.51 (1.43-1.59)	2.45 (2.34-2.56)	4.39 (4.22-4.56)	5.71 (5.46-5.97)	6.75 (6.27-7.27)
Nexgen[Fem]TM Monoblock[Tib]									
Uncemented, unconstrained, fixed	4,012	64 (58 to 71)	58	0.60 (0.40-0.90)	2.59 (2.14-3.14)	3.27 (2.76-3.88)	4.33 (3.72-5.04)	5.09 (4.38-5.91)	*5.58 (4.68-6.64)*
PFC Sigma Bicondylar Knee[Fem]M.B.T.[Tib]									
Cemented, unconstrained, mobile	8,498	64 (58 to 72)	47	0.58 (0.44-0.77)	1.88 (1.61-2.20)	2.63 (2.30-3.00)	3.77 (3.36-4.22)	4.99 (4.45-5.60)	*5.16 (4.58-5.82)*
Cemented, posterior-stabilised, mobile	7,260	65 (59 to 72)	46	0.65 (0.49-0.87)	2.17 (1.86-2.54)	2.99 (2.62-3.42)	4.15 (3.70-4.66)	5.11 (4.51-5.78)	
PFC Sigma Bicondylar Knee[Fem]PFC Bicondylar[Tib]									
Cemented, unconstrained, fixed	146,805	70 (64 to 76)	44	0.39 (0.36-0.43)	1.20 (1.15-1.26)	1.66 (1.59-1.73)	2.31 (2.22-2.40)	2.93 (2.81-3.05)	3.53 (3.28-3.80)
Cemented, posterior-stabilised, fixed	38,163	71 (64 to 77)	41	0.40 (0.34-0.47)	1.48 (1.36-1.61)	2.05 (1.90-2.20)	2.96 (2.78-3.16)	3.88 (3.64-4.13)	4.53 (4.14-4.94)
PFC Sigma Bicondylar Knee[Fem]PFC Sigma Bicondylar[Tib]									
Cemented, unconstrained, fixed	136,396	70 (63 to 76)	43	0.35 (0.32-0.38)	1.28 (1.22-1.35)	1.82 (1.74-1.90)	2.45 (2.35-2.55)	*3.04 (2.78-3.33)*	
Cemented, posterior-stabilised, fixed	59,038	71 (64 to 77)	41	0.44 (0.39-0.49)	1.59 (1.49-1.70)	2.21 (2.09-2.34)	3.02 (2.86-3.18)	*3.63 (3.33-3.95)*	
Cemented, monobloc polyethylene tibia	15,678	74 (69 to 79)	42	0.32 (0.24-0.43)	1.19 (1.02-1.38)	1.56 (1.37-1.79)	1.93 (1.69-2.21)	*2.03 (1.76-2.33)*	
Persona CR[Fem]Persona[Tib]									
Cemented, unconstrained, fixed	10,982	70 (63 to 76)	45	0.30 (0.20-0.43)	0.70 (0.51-0.95)	1.12 (0.79-1.60)			

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (a) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Saiph[Fem:Tib]									
Cemented, unconstrained, fixed	3,155	69 (63 to 75)	44	0.61 (0.38-0.98)	1.33 (0.93-1.90)	1.50 (1.05-2.15)	*3.04 (1.52-6.03)*		
Scorpio NRG[Fem:Tib]									
Cemented, unconstrained, fixed	8,603	70 (64 to 76)	42	0.36 (0.25-0.51)	1.44 (1.21-1.72)	2.34 (2.04-2.69)	3.48 (3.08-3.92)	*4.20 (3.69-4.79)*	
Cemented, posterior-stabilised, fixed	4,742	70 (63 to 77)	43	0.45 (0.29-0.68)	1.70 (1.36-2.11)	2.42 (2.01-2.90)	3.89 (3.34-4.52)	*4.68 (3.90-5.62)*	
Scorpio[Fem]Scorpio NRG[Tib]									
Cemented, unconstrained, fixed	10,515	71 (64 to 77)	42	0.44 (0.33-0.59)	1.84 (1.59-2.11)	2.57 (2.28-2.89)	3.87 (3.50-4.28)	5.05 (4.59-5.56)	*5.30 (4.80-5.85)*
Cemented, posterior-stabilised, fixed	6,085	72 (65 to 77)	40	0.22 (0.13-0.37)	1.66 (1.36-2.02)	2.57 (2.19-3.01)	4.17 (3.67-4.73)	5.55 (4.94-6.24)	*5.95 (5.27-6.71)*
Uncemented, unconstrained, fixed	3,756	70 (64 to 76)	47	0.62 (0.41-0.93)	1.92 (1.52-2.41)	2.59 (2.13-3.16)	3.93 (3.33-4.63)	4.93 (4.21-5.76)	*5.56 (4.45-6.95)*
Sphere[Fem]GMK[Tib]									
Cemented, unconstrained, fixed	2,690	69 (62 to 75)	43	0.92 (0.61-1.37)	2.13 (1.59-2.85)	2.76 (2.10-3.62)	*4.39 (3.09-6.22)*		
TC Plus[Fem:Tib]									
Cemented, unconstrained, fixed	7,942	70 (64 to 76)	46	0.81 (0.63-1.03)	2.00 (1.72-2.34)	2.63 (2.30-3.01)	3.73 (3.32-4.19)	4.81 (4.31-5.36)	*6.11 (5.11-7.29)*
Cemented, unconstrained, mobile	5,461	70 (64 to 76)	44	0.51 (0.36-0.74)	1.48 (1.19-1.84)	2.01 (1.66-2.42)	3.12 (2.67-3.65)	3.91 (3.36-4.53)	
Triathlon[Fem:Tib]									
Cemented, unconstrained, fixed	146,612	70 (63 to 76)	44	0.44 (0.40-0.47)	1.30 (1.24-1.36)	1.82 (1.74-1.90)	2.70 (2.57-2.83)	3.52 (3.24-3.83)	
Cemented, posterior-stabilised, fixed	29,799	70 (63 to 77)	41	0.61 (0.52-0.70)	1.69 (1.54-1.86)	2.41 (2.22-2.62)	3.49 (3.21-3.79)	*4.37 (3.83-4.98)*	
Uncemented, unconstrained, fixed	6,604	68 (61 to 75)	52	0.62 (0.45-0.86)	1.74 (1.41-2.16)	2.21 (1.79-2.71)	2.68 (2.08-3.45)		
Vanguard[Fem:Tib]									
Cemented, unconstrained, fixed	77,140	70 (64 to 76)	42	0.37 (0.33-0.42)	1.30 (1.22-1.39)	1.87 (1.76-1.97)	2.74 (2.58-2.91)	*3.83 (3.35-4.37)*	
Cemented, posterior-stabilised, fixed	11,946	70 (63 to 77)	40	0.63 (0.50-0.79)	2.03 (1.78-2.32)	2.75 (2.45-3.10)	4.03 (3.54-4.58)		
Cemented, constrained condylar	5,121	70 (63 to 76)	37	0.45 (0.29-0.69)	1.18 (0.88-1.58)	1.51 (1.15-1.98)	*1.85 (1.40-2.45)*		
Unicondylar knee replacements									
AMC/Uniglide[Fem:Tib]									
Cemented, monobloc polyethylene tibia	1,087	67 (59 to 75)	50	0.28 (0.09-0.86)	2.99 (2.12-4.20)	4.64 (3.53-6.10)	7.97 (6.39-9.93)	*12.33 (9.82-15.42)*	
Journey Uni Oxinium[Fem]Journey Uni[Tib]									
Cemented, fixed	1,720	63 (56 to 70)	53	1.42 (0.94-2.13)	2.77 (2.04-3.75)	3.97 (3.01-5.24)			
MG Uni[Fem:Tib]									
Cemented, fixed	1,501	62 (56 to 69)	55	1.00 (0.60-1.65)	4.37 (3.44-5.54)	6.57 (5.42-7.96)	11.44 (9.89-13.22)	14.67 (12.86-16.71)	*17.59 (14.32-21.50)*

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (a) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Oxford Cementless Partial Knee[Fem:Tib]									
Uncemented/Hybrid, mobile	33,730	65 (58 to 72)	56	1.14 (1.03-1.27)	2.26 (2.09-2.44)	3.17 (2.95-3.40)	5.91 (5.40-6.46)		
Oxford Cementless Partial Knee[Fem]Oxford Partial Knee[Tib]									
Uncemented/Hybrid, mobile	1,646	66 (58 to 73)	50	1.49 (1.00-2.22)	4.17 (3.28-5.30)	5.68 (4.61-7.00)	9.76 (8.13-11.68)	*14.77 (11.55-18.79)*	
Oxford Single Peg Cemented Partial Knee[Fem]Oxford Partial Knee[Tib]									
Cemented, mobile	43,414	64 (58 to 71)	52	1.22 (1.12-1.32)	4.35 (4.16-4.54)	6.45 (6.22-6.68)	11.46 (11.14-11.78)	16.63 (16.18-17.09)	21.22 (20.05-22.45)
Oxford Twin Peg Cemented Partial Knee[Fem]Oxford Partial Knee[Tib]									
Cemented, mobile	6,099	65 (57 to 72)	49	0.76 (0.57-1.02)	2.46 (2.08-2.91)	3.83 (3.32-4.41)	7.14 (6.25-8.14)	*11.58 (9.65-13.88)*	
Persona Partial Knee[Fem:Tib]									
Cemented, fixed	5,615	65 (58 to 72)	58	0.28 (0.16-0.49)	1.36 (0.99-1.87)	*1.67 (1.22-2.29)*			
***Physica ZUK[Fem:Tib]**									
Cemented, fixed	23,012	64 (56 to 71)	55	0.34 (0.27-0.43)	1.53 (1.36-1.72)	2.42 (2.19-2.68)	5.15 (4.66-5.69)	*7.99 (6.69-9.53)*	
Cemented, monobloc polyethylene tibia	2,342	64 (56 to 71)	55	0.23 (0.09-0.54)	2.75 (2.12-3.56)	4.10 (3.30-5.10)	7.56 (6.23-9.17)		
Restoris[Fem:Tib]									
Cemented, fixed	2,187	65 (59 to 73)	59	0.50 (0.26-0.96)	1.74 (1.11-2.73)	*1.74 (1.11-2.73)*			
Sigma HP (Uni)[Fem]Sigma HP[Tib]									
Cemented, fixed	15,172	63 (56 to 71)	58	0.68 (0.56-0.83)	2.60 (2.34-2.89)	3.61 (3.29-3.96)	6.22 (5.66-6.83)		
Triathlon Uni[Fem]Triathlon[Tib]									
Cemented, fixed	1,908	62 (56 to 70)	56	1.02 (0.64-1.62)	3.82 (2.98-4.88)	6.06 (4.92-7.46)	8.26 (6.74-10.10)		
Patellofemoral knee replacements									
Avon[Fem]									
Patellofemoral	6,952	58 (50 to 67)	23	0.68 (0.51-0.91)	4.08 (3.62-4.59)	7.14 (6.52-7.82)	14.38 (13.42-15.41)	21.47 (20.06-22.96)	*27.32 (24.47-30.42)*
FPV[Fem]									
Patellofemoral	1,653	59 (52 to 68)	23	0.85 (0.50-1.43)	6.92 (5.79-8.26)	10.12 (8.74-11.69)	18.28 (16.40-20.35)	*23.11 (20.57-25.90)*	
Journey PFJ Oxinium[Fem]									
Patellofemoral	2,398	58 (50 to 66)	23	1.81 (1.34-2.44)	7.23 (6.22-8.39)	12.20 (10.86-13.70)	20.80 (18.89-22.87)	*26.66 (23.86-29.73)*	
Sigma HP (PF)[Fem]									
Patellofemoral	1,304	58 (50 to 66)	23	2.69 (1.94-3.73)	9.50 (8.02-11.23)	13.88 (12.11-15.89)	24.31 (21.75-27.11)		
Zimmer PFJ[Fem]									
Patellofemoral	4,036	56 (49 to 65)	23	0.56 (0.36-0.85)	3.89 (3.28-4.61)	6.40 (5.56-7.35)	12.33 (10.81-14.04)		

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) KM estimates of cumulative revision (95% CI) by fixation, constraint, brand and whether a patella component was recorded. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Total knee replacements									
AGC V2[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	11,817	71 (65 to 77)	35	0.23 (0.16-0.34)	1.22 (1.04-1.44)	1.82 (1.59-2.08)	2.97 (2.66-3.32)	4.56 (4.07-5.12)	*6.73 (5.63-8.03)*
Cemented, unconstrained, fixed, without patella	25,401	71 (65 to 77)	46	0.29 (0.23-0.36)	1.53 (1.38-1.69)	2.23 (2.05-2.42)	3.51 (3.27-3.76)	5.42 (5.07-5.80)	*8.09 (7.21-9.07)*
AGC[Fem]AGC V2[Tib]									
Cemented, unconstrained, fixed, with patella	9,587	71 (64 to 77)	37	0.26 (0.18-0.39)	1.20 (1.00-1.44)	1.69 (1.44-1.97)	2.84 (2.50-3.23)	5.22 (4.55-6.00)	*8.24 (5.15-13.04)*
Cemented, unconstrained, fixed, without patella	18,665	71 (64 to 77)	45	0.34 (0.27-0.43)	1.77 (1.59-1.97)	2.48 (2.27-2.72)	3.73 (3.45-4.04)	5.43 (4.95-5.95)	*11.15 (7.27-16.90)*
Advance MP[Fem]Advance[Tib]									
Cemented, unconstrained, fixed, with patella	3,013	70 (63 to 76)	43	0.50 (0.30-0.83)	1.45 (1.08-1.96)	1.94 (1.49-2.51)	3.02 (2.41-3.79)	3.51 (2.76-4.46)	
Cemented, unconstrained, fixed, without patella	5,871	70 (64 to 76)	50	0.59 (0.42-0.82)	2.24 (1.88-2.65)	3.16 (2.73-3.66)	4.35 (3.81-4.97)	5.37 (4.61-6.26)	*8.21 (5.68-11.80)*
Attune CR Cemented[Fem]Attune FB[Tib]									
Cemented, unconstrained, fixed, with patella	12,680	70 (63 to 76)	39	0.30 (0.21-0.42)	1.02 (0.82-1.26)	1.51 (1.25-1.84)			
Cemented, unconstrained, fixed, without patella	15,712	69 (62 to 76)	48	0.45 (0.36-0.58)	1.54 (1.33-1.78)	2.09 (1.84-2.39)			
Attune CR Cemented[Fem]Attune RP[Tib]									
Cemented, unconstrained, mobile, with patella	3,266	71 (64 to 77)	39	0.33 (0.17-0.60)	0.94 (0.62-1.43)	1.20 (0.80-1.80)	*1.96 (0.99-3.86)*		
Cemented, unconstrained, mobile, without patella	2,342	70.5 (63 to 77)	48	0.15 (0.05-0.46)	0.82 (0.46-1.45)	1.53 (0.94-2.48)	*2.14 (1.26-3.64)*		
Attune PS Cemented[Fem]Attune FB[Tib]									
Cemented, posterior-stabilised, fixed, with patella	8,308	71 (63 to 76)	41	0.45 (0.32-0.63)	1.19 (0.96-1.48)	1.80 (1.48-2.18)			
Cemented, posterior-stabilised, fixed, without patella	4,790	70 (62 to 76)	44	0.44 (0.28-0.68)	2.03 (1.64-2.52)	3.39 (2.83-4.06)			
Columbus Cemented[Fem]Columbus CR/PS[Tib]									
Cemented, unconstrained, fixed, with patella	4,306	70 (64 to 76)	37	0.60 (0.41-0.89)	1.25 (0.95-1.65)	1.69 (1.32-2.15)	3.00 (2.33-3.86)	*5.95 (3.80-9.26)*	

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[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Cemented, unconstrained, fixed, without patella	9,633	71 (65 to 76)	46	0.38 (0.27-0.53)	1.48 (1.26-1.75)	2.12 (1.83-2.44)	2.86 (2.49-3.28)	*3.40 (2.85-4.05)*	
Cemented, constrained condylar, with patella	839	70 (64 to 76)	33	0.86 (0.41-1.80)	1.71 (0.99-2.93)	2.44 (1.46-4.05)			
Cemented, constrained condylar, without patella	2,231	71 (65 to 78)	40	0.47 (0.25-0.87)	1.53 (1.06-2.19)	2.03 (1.46-2.82)	*3.44 (2.22-5.29)*		
EvolutionMP[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	1,074	71 (65 to 78)	46	0.60 (0.27-1.33)	1.48 (0.83-2.62)	*1.48 (0.83-2.62)*			
Cemented, unconstrained, fixed, without patella	1,456	69 (62 to 76)	45	0.44 (0.20-0.97)	1.50 (0.95-2.38)	1.87 (1.21-2.87)			
Genesis II Oxinium[Fem]Genesis II[Tib]									
Cemented, unconstrained, fixed, with patella	4,826	59 (55 to 65)	38	0.49 (0.33-0.74)	1.39 (1.09-1.79)	1.91 (1.54-2.37)	3.63 (3.01-4.38)	4.85 (3.90-6.03)	
Cemented, unconstrained, fixed, without patella	3,590	59 (55 to 66)	42	0.63 (0.42-0.96)	2.69 (2.19-3.29)	4.08 (3.45-4.83)	6.22 (5.34-7.24)	8.16 (6.92-9.62)	
Cemented, posterior-stabilised, fixed, with patella	1,969	60 (54 to 67)	35	0.47 (0.25-0.91)	2.17 (1.58-2.97)	3.14 (2.40-4.11)	5.56 (4.39-7.05)	*7.39 (5.27-10.32)*	
Cemented, posterior-stabilised, fixed, without patella	1,843	58 (53 to 63)	47	0.72 (0.42-1.23)	3.68 (2.90-4.67)	5.70 (4.69-6.91)	10.63 (9.09-12.42)	*11.80 (10.02-13.87)*	
Genesis II[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	33,200	72 (66 to 77)	40	0.40 (0.33-0.47)	1.01 (0.91-1.14)	1.34 (1.21-1.48)	2.00 (1.81-2.21)	2.27 (2.02-2.55)	*2.42 (2.05-2.84)*
Cemented, unconstrained, fixed, without patella	37,241	71 (65 to 77)	46	0.40 (0.34-0.47)	1.52 (1.40-1.66)	2.13 (1.98-2.29)	3.06 (2.85-3.28)	3.57 (3.29-3.89)	*3.65 (3.33-4.00)*
Cemented, posterior-stabilised, fixed, with patella	13,600	71 (65 to 77)	36	0.65 (0.52-0.80)	1.68 (1.46-1.92)	2.21 (1.95-2.50)	3.43 (3.03-3.89)	*4.30 (3.64-5.08)*	
Cemented, posterior-stabilised, fixed, without patella	11,088	71 (65 to 78)	44	0.65 (0.51-0.82)	1.87 (1.62-2.15)	2.66 (2.36-3.00)	3.96 (3.53-4.44)	5.12 (4.28-6.11)	
Journey II BCS Oxinium[Fem]Journey[Tib]									
Cemented, posterior-stabilised, fixed, with patella	4,983	67 (60 to 74)	41	0.43 (0.28-0.67)	1.27 (0.96-1.68)	1.60 (1.22-2.11)			
Cemented, posterior-stabilised, fixed, without patella	739	65 (57 to 72)	43	1.10 (0.55-2.18)	4.82 (3.47-6.68)	6.14 (4.57-8.23)			

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Kinemax[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	4,330	71 (64 to 77)	37	0.26 (0.14-0.46)	1.23 (0.94-1.61)	1.73 (1.38-2.18)	3.60 (3.05-4.25)	5.55 (4.81-6.40)	*7.17 (5.91-8.69)*
Cemented, unconstrained, fixed, without patella	6,574	71 (64 to 77)	47	0.23 (0.14-0.38)	2.04 (1.72-2.42)	3.25 (2.84-3.72)	5.35 (4.80-5.96)	7.51 (6.81-8.27)	*9.34 (8.27-10.54)*
LCS Complete[Fem]M.B.T.[Tib]									
Cemented, unconstrained, mobile, with patella	812	70 (63 to 77)	31	0.62 (0.26-1.48)	2.05 (1.26-3.32)	3.47 (2.37-5.06)	6.03 (4.40-8.25)	*6.95 (5.00-9.61)*	
Cemented, unconstrained, mobile, without patella	11,866	71 (64 to 76)	42	0.39 (0.29-0.52)	1.47 (1.27-1.71)	2.38 (2.11-2.69)	3.80 (3.44-4.21)	4.61 (4.13-5.15)	
Uncemented, unconstrained, mobile, with patella	639	68 (61 to 74)	33	0.47 (0.15-1.45)	1.55 (0.81-2.97)	2.39 (1.39-4.11)	*2.67 (1.58-4.50)*	*3.42 (1.89-6.16)*	
Uncemented, unconstrained, mobile, without patella	15,855	69 (63 to 75)	47	0.40 (0.31-0.51)	1.79 (1.59-2.01)	2.44 (2.21-2.71)	3.28 (2.99-3.60)	3.99 (3.61-4.43)	
MRK[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	5,810	71 (64 to 77)	39	0.25 (0.15-0.42)	0.99 (0.75-1.29)	1.53 (1.23-1.92)	2.39 (1.94-2.93)	2.82 (2.23-3.56)	
Cemented, unconstrained, fixed, without patella	10,441	70 (64 to 76)	48	0.35 (0.25-0.49)	1.23 (1.03-1.47)	1.60 (1.36-1.87)	2.46 (2.11-2.86)	2.76 (2.34-3.26)	
Natural Knee II[Fem]NK2[Tib]									
Cemented, unconstrained, fixed, with patella	1,525	70 (64 to 77)	41	0.46 (0.22-0.97)	1.74 (1.19-2.54)	2.72 (2.00-3.70)	4.32 (3.36-5.53)	8.05 (6.31-10.24)	
Cemented, unconstrained, fixed, without patella	1,167	70 (64 to 76)	40	0.17 (0.04-0.69)	1.05 (0.60-1.85)	1.59 (1.01-2.52)	3.24 (2.32-4.51)	5.47 (4.01-7.43)	*5.84 (4.27-7.98)*
Nexgen[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	27,925	70 (63 to 76)	38	0.32 (0.26-0.40)	0.96 (0.85-1.09)	1.41 (1.26-1.57)	2.43 (2.19-2.69)	3.26 (2.83-3.75)	*3.48 (2.90-4.16)*
Cemented, unconstrained, fixed, without patella	72,632	70 (64 to 76)	45	0.31 (0.27-0.36)	1.02 (0.95-1.10)	1.49 (1.40-1.59)	2.32 (2.18-2.46)	3.09 (2.85-3.35)	*3.52 (3.01-4.10)*
Cemented, posterior-stabilised, fixed, with patella	29,449	70 (64 to 76)	36	0.51 (0.43-0.60)	1.58 (1.44-1.74)	2.60 (2.40-2.80)	4.74 (4.43-5.07)	6.14 (5.69-6.63)	*6.75 (6.14-7.43)*
Cemented, posterior-stabilised, fixed, without patella	59,363	71 (64 to 77)	43	0.42 (0.37-0.48)	1.47 (1.37-1.57)	2.38 (2.25-2.52)	4.23 (4.03-4.43)	5.52 (5.23-5.83)	*6.76 (6.12-7.46)*

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	10 years	15 years	19 years
Nexgen[Fem]TM Monoblock[Tib]									
Uncemented, unconstrained, fixed, with patella	379	63 (57 to 69)	58	0.53 (0.13-2.11)	2.14 (1.08-4.23)	2.98 (1.66-5.32)	*4.91 (3.07-7.80)*	*5.98 (3.78-9.40)*	
Uncemented, unconstrained, fixed, without patella	3,633	65 (58 to 72)	58	0.61 (0.40-0.92)	2.64 (2.16-3.22)	3.30 (2.76-3.95)	4.27 (3.64-5.01)	5.00 (4.27-5.86)	*5.52 (4.59-6.65)*
PFC Sigma Bicondylar Knee[Fem]M.B.T.[Tib]									
Cemented, unconstrained, mobile, with patella	3,235	64 (58 to 72)	41	0.47 (0.28-0.77)	2.09 (1.64-2.65)	2.85 (2.32-3.49)	4.23 (3.56-5.02)	5.64 (4.75-6.70)	
Cemented, unconstrained, mobile, without patella	5,263	64 (58 to 71)	51	0.65 (0.47-0.91)	1.76 (1.43-2.16)	2.49 (2.10-2.96)	3.48 (2.99-4.04)	4.55 (3.91-5.31)	
Cemented, posterior-stabilised, mobile, with patella	5,238	64 (59 to 72)	45	0.44 (0.29-0.66)	1.44 (1.15-1.80)	2.07 (1.71-2.50)	2.94 (2.50-3.46)	3.43 (2.89-4.06)	
Cemented, posterior-stabilised, mobile, without patella	2,022	66 (58 to 73)	49	1.20 (0.80-1.78)	4.09 (3.30-5.05)	5.41 (4.49-6.51)	7.33 (6.23-8.63)	9.20 (7.77-10.87)	
PFC Sigma Bicondylar Knee[Fem]PFC Bicondylar[Tib]									
Cemented, unconstrained, fixed, with patella	50,259	71 (64 to 76)	38	0.35 (0.30-0.40)	1.00 (0.91-1.10)	1.44 (1.33-1.56)	1.99 (1.85-2.14)	2.57 (2.38-2.78)	2.93 (2.67-3.23)
Cemented, unconstrained, fixed, without patella	96,546	70 (64 to 76)	46	0.42 (0.38-0.46)	1.31 (1.23-1.38)	1.77 (1.68-1.86)	2.47 (2.36-2.59)	3.11 (2.96-3.27)	3.86 (3.50-4.26)
Cemented, posterior-stabilised, fixed, with patella	22,765	71 (64 to 77)	39	0.40 (0.33-0.49)	1.21 (1.07-1.36)	1.66 (1.50-1.85)	2.36 (2.15-2.59)	3.03 (2.77-3.32)	*3.66 (3.21-4.18)*
Cemented, posterior-stabilised, fixed, without patella	15,398	71 (64 to 77)	45	0.41 (0.32-0.52)	1.87 (1.67-2.10)	2.60 (2.35-2.87)	3.82 (3.50-4.16)	5.09 (4.67-5.55)	*5.78 (5.13-6.52)*
PFC Sigma Bicondylar Knee[Fem]PFC Sigma Bicondylar[Tib]									
Cemented, unconstrained, fixed, with patella	50,230	70 (63 to 76)	37	0.34 (0.29-0.40)	1.10 (1.00-1.20)	1.58 (1.46-1.70)	2.19 (2.03-2.36)	*2.70 (2.40-3.03)*	
Cemented, unconstrained, fixed, without patella	86,166	70 (63 to 76)	46	0.35 (0.31-0.39)	1.38 (1.30-1.47)	1.95 (1.86-2.05)	2.59 (2.46-2.72)	*3.23 (2.87-3.64)*	
Cemented, posterior-stabilised, fixed, with patella	39,609	71 (65 to 77)	40	0.40 (0.34-0.47)	1.21 (1.10-1.32)	1.72 (1.59-1.86)	2.39 (2.21-2.58)	*2.66 (2.44-2.89)*	
Cemented, posterior-stabilised, fixed, without patella	19,429	70 (63 to 77)	45	0.51 (0.42-0.62)	2.34 (2.13-2.57)	3.17 (2.92-3.44)	4.21 (3.90-4.53)		

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Cemented, monobloc polyethylene tibia, with patella	2,970	76 (71 to 81)	37	0.38 (0.21-0.68)	0.97 (0.67-1.41)	1.40 (1.01-1.94)	1.62 (1.17-2.24)	*1.93 (1.36-2.73)*	
Cemented, monobloc polyethylene tibia, without patella	12,708	74 (68 to 79)	43	0.31 (0.23-0.43)	1.24 (1.05-1.46)	1.60 (1.38-1.86)	2.01 (1.74-2.32)	*2.01 (1.74-2.32)*	
Persona CR[Fem]Persona[Tib]									
Cemented, unconstrained, fixed, with patella	5,254	70 (62 to 76)	41	0.28 (0.16-0.49)	0.50 (0.30-0.84)	0.61 (0.35-1.05)			
Cemented, unconstrained, fixed, without patella	5,728	70 (63 to 76)	49	0.32 (0.19-0.52)	0.83 (0.57-1.21)	1.46 (0.95-2.23)			
Saiph[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	1,864	70 (63 to 75)	38	0.72 (0.41-1.27)	1.13 (0.68-1.88)	1.44 (0.87-2.37)	*4.21 (1.75-9.97)*		
Cemented, unconstrained, fixed, without patella	1,291	69 (62 to 75)	53	0.45 (0.19-1.07)	1.57 (0.94-2.61)	1.57 (0.94-2.61)	*1.57 (0.94-2.61)*		
Scorpio NRG[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	3,790	70 (64 to 76)	38	0.42 (0.26-0.69)	1.23 (0.92-1.64)	2.01 (1.60-2.52)	3.20 (2.63-3.88)	*3.80 (3.08-4.68)*	
Cemented, unconstrained, fixed, without patella	4,813	70 (64 to 76)	46	0.31 (0.19-0.52)	1.61 (1.28-2.01)	2.61 (2.19-3.11)	3.71 (3.18-4.32)	*4.50 (3.82-5.31)*	
Cemented, posterior-stabilised, fixed, with patella	3,115	71 (64 to 77)	42	0.48 (0.29-0.80)	1.30 (0.96-1.77)	1.89 (1.46-2.44)	2.99 (2.41-3.71)	*3.80 (2.88-5.02)*	
Cemented, posterior-stabilised, fixed, without patella	1,627	69 (63 to 76)	47	0.37 (0.17-0.82)	2.45 (1.80-3.34)	3.42 (2.63-4.45)	5.57 (4.51-6.87)	*6.32 (5.04-7.91)*	
Scorpio[Fem]Scorpio NRG[Tib]									
Cemented, unconstrained, fixed, with patella	3,070	72 (65 to 77)	38	0.36 (0.20-0.65)	1.23 (0.89-1.69)	1.89 (1.46-2.45)	3.34 (2.73-4.09)	4.23 (3.50-5.12)	*4.65 (3.73-5.79)*
Cemented, unconstrained, fixed, without patella	7,445	70 (64 to 77)	43	0.47 (0.34-0.66)	2.09 (1.78-2.44)	2.85 (2.49-3.26)	4.09 (3.64-4.59)	5.38 (4.82-6.01)	*5.56 (4.98-6.21)*
Cemented, posterior-stabilised, fixed, with patella	3,488	71 (65 to 77)	38	0.14 (0.06-0.35)	1.15 (0.84-1.57)	1.80 (1.40-2.31)	3.03 (2.48-3.70)	4.42 (3.71-5.27)	*4.52 (3.79-5.39)*
Cemented, posterior-stabilised, fixed, without patella	2,597	72 (65 to 77)	42	0.31 (0.16-0.62)	2.35 (1.82-3.02)	3.60 (2.93-4.41)	5.70 (4.83-6.72)	7.07 (6.06-8.25)	*7.87 (6.68-9.27)*

*Denotes that this brand is now marketed by Lima.
[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Uncemented, unconstrained, fixed, with patella	816	71 (63 to 77)	39	0.37 (0.12-1.14)	1.74 (1.04-2.93)	2.52 (1.63-3.88)	3.22 (2.19-4.74)	*3.75 (2.59-5.41)*	
Uncemented, unconstrained, fixed, without patella	2,940	70 (64 to 76)	49	0.68 (0.44-1.06)	1.97 (1.52-2.54)	2.61 (2.09-3.27)	4.13 (3.45-4.95)	5.24 (4.41-6.22)	*5.99 (4.70-7.62)*
Sphere[Fem]GMK[Tib]									
Cemented, unconstrained, fixed, with patella	813	68 (61 to 75)	39	0.83 (0.37-1.84)	1.65 (0.87-3.12)	*2.05 (1.08-3.88)*			
Cemented, unconstrained, fixed, without patella	1,877	69 (62 to 76)	45	0.95 (0.59-1.52)	2.27 (1.64-3.15)	2.95 (2.18-3.99)	*4.28 (2.90-6.31)*		
TC Plus[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	557	71 (64 to 76)	38	0.18 (0.03-1.27)	1.45 (0.73-2.88)	2.57 (1.53-4.31)	3.89 (2.52-5.99)	*5.03 (3.37-7.48)*	
Cemented, unconstrained, fixed, without patella	7,385	70 (64 to 76)	47	0.86 (0.67-1.10)	2.04 (1.74-2.40)	2.63 (2.29-3.03)	3.72 (3.30-4.19)	4.79 (4.27-5.37)	*6.32 (5.17-7.71)*
Cemented, unconstrained, mobile, with patella	238	72 (65 to 77)	36	*0.00 (.-.)*	*0.43 (0.06-3.03)*	*1.33 (0.43-4.07)*	*2.20 (0.79-6.09)*	*2.20 (0.79-6.09)*	
Cemented, unconstrained, mobile, without patella	5,223	70 (64 to 76)	44	0.54 (0.37-0.78)	1.53 (1.23-1.90)	2.04 (1.68-2.46)	3.16 (2.70-3.70)	3.96 (3.41-4.60)	
Triathlon[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	61,226	70 (63 to 76)	39	0.40 (0.35-0.45)	1.10 (1.01-1.19)	1.51 (1.40-1.63)	2.33 (2.15-2.53)	3.40 (2.89-3.99)	
Cemented, unconstrained, fixed, without patella	85,386	70 (63 to 76)	47	0.46 (0.42-0.51)	1.44 (1.35-1.53)	2.03 (1.93-2.14)	2.94 (2.78-3.11)	3.60 (3.28-3.95)	
Cemented, posterior-stabilised, fixed, with patella	20,125	70 (63 to 76)	40	0.57 (0.48-0.69)	1.46 (1.29-1.65)	2.16 (1.94-2.40)	3.11 (2.80-3.46)	*3.83 (3.22-4.57)*	
Cemented, posterior-stabilised, fixed, without patella	9,674	71 (63 to 77)	44	0.67 (0.52-0.86)	2.16 (1.87-2.49)	2.92 (2.57-3.32)	4.27 (3.74-4.87)	*5.43 (4.46-6.61)*	
Uncemented, unconstrained, fixed, with patella	2,360	68 (60 to 75)	48	0.82 (0.50-1.34)	1.44 (0.96-2.17)	1.76 (1.16-2.67)	*1.76 (1.16-2.67)*		
Uncemented, unconstrained, fixed, without patella	4,244	68 (61 to 75)	54	0.52 (0.34-0.81)	1.86 (1.45-2.39)	2.37 (1.87-3.00)	2.88 (2.20-3.77)		
Vanguard[Fem:Tib]									
Cemented, unconstrained, fixed, with patella	32,883	70 (64 to 76)	38	0.35 (0.29-0.42)	0.96 (0.85-1.08)	1.39 (1.25-1.54)	2.32 (2.06-2.61)	*3.96 (2.61-5.99)*	

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[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Cemented, unconstrained, fixed, without patella	44,257	70 (64 to 76)	45	0.39 (0.34-0.46)	1.54 (1.42-1.66)	2.19 (2.04-2.34)	3.04 (2.84-3.25)	*4.02 (3.52-4.58)*	
Cemented, posterior-stabilised, fixed, with patella	6,796	70 (63 to 76)	37	0.61 (0.45-0.84)	1.68 (1.38-2.04)	2.38 (2.00-2.82)	3.22 (2.72-3.81)		
Cemented, posterior-stabilised, fixed, without patella	5,150	70 (63 to 77)	43	0.64 (0.45-0.91)	2.48 (2.06-2.97)	3.23 (2.74-3.80)	4.93 (4.12-5.89)		
Cemented, constrained condylar, with patella	2,793	70 (63 to 76)	33	0.49 (0.28-0.86)	1.03 (0.68-1.57)	1.48 (1.01-2.16)	*1.61 (1.10-2.37)*		
Cemented, constrained condylar, without patella	2,328	70 (63 to 77)	41	0.41 (0.21-0.78)	1.35 (0.90-2.02)	1.54 (1.04-2.28)	*2.11 (1.42-3.12)*		
Unicondylar knee replacements									
AMC/Uniglide[Fem:Tib]									
Cemented, monobloc polyethylene tibia	1,087	67 (59 to 75)	50	0.28 (0.09-0.86)	2.99 (2.12-4.20)	4.64 (3.53-6.10)	7.97 (6.39-9.93)	*12.33 (9.82-15.42)*	
Journey Uni Oxinium[Fem]Journey Uni[Tib]									
Cemented, fixed	1,720	63 (56 to 70)	53	1.42 (0.94-2.13)	2.77 (2.04-3.75)	3.97 (3.01-5.24)			
MG Uni[Fem:Tib]									
Cemented, fixed	1,501	62 (56 to 69)	55	1.00 (0.60-1.65)	4.37 (3.44-5.54)	6.57 (5.42-7.96)	11.44 (9.89-13.22)	14.67 (12.86-16.71)	*17.59 (14.32-21.50)*
Oxford Cementless Partial Knee[Fem:Tib]									
Uncemented/Hybrid, mobile	33,730	65 (58 to 72)	56	1.14 (1.03-1.27)	2.26 (2.09-2.44)	3.17 (2.95-3.40)	5.91 (5.40-6.46)		
Oxford Cementless Partial Knee[Fem]Oxford Partial Knee[Tib]									
Uncemented/Hybrid, mobile	1,646	66 (58 to 73)	50	1.49 (1.00-2.22)	4.17 (3.28-5.30)	5.68 (4.61-7.00)	9.76 (8.13-11.68)	*14.77 (11.55-18.79)*	
Oxford Single Peg Cemented Partial Knee[Fem]Oxford Partial Knee[Tib]									
Cemented, mobile	43,414	64 (58 to 71)	52	1.22 (1.12-1.32)	4.35 (4.16-4.54)	6.45 (6.22-6.68)	11.46 (11.14-11.78)	16.63 (16.18-17.09)	21.22 (20.05-22.45)
Oxford Twin Peg Cemented Partial Knee[Fem]Oxford Partial Knee[Tib]									
Cemented, mobile	6,099	65 (57 to 72)	49	0.76 (0.57-1.02)	2.46 (2.08-2.91)	3.83 (3.32-4.41)	7.14 (6.25-8.14)	*11.58 (9.65-13.88)*	
Persona Partial Knee[Fem:Tib]									
Cemented, fixed	5,615	65 (58 to 72)	58	0.28 (0.16-0.49)	1.36 (0.99-1.87)	*1.67 (1.22-2.29)*			
***Physica ZUK[Fem:Tib]**									
Cemented, fixed	23,012	64 (56 to 71)	55	0.34 (0.27-0.43)	1.53 (1.36-1.72)	2.42 (2.19-2.68)	5.15 (4.66-5.69)	*7.99 (6.69-9.53)*	
Cemented, monobloc polyethylene tibia	2,342	64 (56 to 71)	55	0.23 (0.09-0.54)	2.75 (2.12-3.56)	4.10 (3.30-5.10)	7.56 (6.23-9.17)		

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[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

Table 3.K9 (b) (continued)

Brand[1]	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
Restoris[Fem:Tib]									
Cemented, fixed	2,187	65 (59 to 73)	59	0.50 (0.26-0.96)	1.74 (1.11-2.73)	*1.74 (1.11-2.73)*			
Sigma HP (Uni)[Fem]Sigma HP[Tib]									
Cemented, fixed	15,172	63 (56 to 71)	58	0.68 (0.56-0.83)	2.60 (2.34-2.89)	3.61 (3.29-3.96)	6.22 (5.66-6.83)		
Triathlon Uni[Fem]Triathlon[Tib]									
Cemented, fixed	1,908	62 (56 to 70)	56	1.02 (0.64-1.62)	3.82 (2.98-4.88)	6.06 (4.92-7.46)	8.26 (6.74-10.10)		
Patellofemoral knee replacements									
Avon[Fem]									
Patellofemoral	6,952	58 (50 to 67)	23	0.68 (0.51-0.91)	4.08 (3.62-4.59)	7.14 (6.52-7.82)	14.38 (13.42-15.41)	21.47 (20.06-22.96)	*27.32 (24.47-30.42)*
FPV[Fem]									
Patellofemoral	1,653	59 (52 to 68)	23	0.85 (0.50-1.43)	6.92 (5.79-8.26)	10.12 (8.74-11.69)	18.28 (16.40-20.35)	*23.11 (20.57-25.90)*	
Journey PFJ Oxinium[Fem]									
Patellofemoral	2,398	58 (50 to 66)	23	1.81 (1.34-2.44)	7.23 (6.22-8.39)	12.20 (10.86-13.70)	20.80 (18.89-22.87)	*26.66 (23.86-29.73)*	
Sigma HP (PF)[Fem]									
Patellofemoral	1,304	58 (50 to 66)	23	2.69 (1.94-3.73)	9.50 (8.02-11.23)	13.88 (12.11-15.89)	24.31 (21.75-27.11)		
Zimmer PFJ[Fem]									
Patellofemoral	4,036	56 (49 to 65)	23	0.56 (0.36-0.85)	3.89 (3.28-4.61)	6.40 (5.56-7.35)	12.33 (10.81-14.04)		

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[1]Brands shown have been used in at least 2,500 total primary knee replacement operations for that type of fixation and bearing type and at least 1,000 for unicondylar and patellofemoral knee replacement operations.
Note: Blank cells indicate the number at risk is below ten and therefore estimates are omitted as they are unreliable.
Note: Femoral brand precedes [Fem], tibial brand precedes [Tib]. [Fem:Tib] indicates the same brand for both femoral and tibial component.

3.3.4 Revisions for different indications after primary knee replacement

Table 3.K10 (page 198) shows the revision incidence rates for each indication recorded on data collection forms for knee revision surgery, for all cases and then sub-divided by fixation type and whether the primary procedure was a TKR or a UKR.

For all knee replacements, the highest Prosthesis Time Incidence Rates (PTIRs) for the five most common indications for revision in descending order, were for: aseptic loosening / lysis, infection, progressive arthritis, instability, and pain. For cemented TKR, the highest PTIRs in descending order were aseptic loosening / lysis, infection, instability, pain and ‘other’ indication. Revision incidences for TKRs which were uncemented were lower than cemented TKR for infection, the same for periprosthetic fracture but higher for all other recorded indications.

For cemented unicondylar knee replacements (medial and lateral UKR), the highest three incidence rates for indications for revising the implant were for: progressive arthritis, aseptic loosening / lysis and pain, respectively. For uncemented / hybrid unicondylar knee replacements (medial and lateral UKR) the highest rates were for: progressive arthritis, dislocation / subluxation, and aseptic loosening / lysis. The incidence of revision for pain, aseptic loosening / lysis, implant wear and progressive arthritis were lower for uncemented / hybrid fixation than for cemented but the incidence was higher for dislocation / subluxation and periprosthetic fracture. For patellofemoral replacements, the top three indications for revision were: progressive arthritis, pain and ‘other’ indication. Similarly, for multicompartmental knee replacements, the highest incidence for revision was for progressive arthritis, pain and ‘other’ indication.

In Table 3.K11 (page 201), the PTIRs for each indication are shown separately for different time periods from the primary knee replacement, within the first year from primary operation, and between 1 to <3, 3 to <5, 5 to <7, 7 to <10, 10 to <13, 13 to <15, 15 to <17 and ≥17 years after surgery (the maximum follow-up for any implant is now 19.75 years). It is clear that most of the PTIRs for a particular indication do vary, especially for infection, aseptic loosening / lysis, pain and progressive arthritis for different time intervals after surgery. Infection is most likely to be the reason that a joint is revised in the first year but after seven years or more, is comparatively less likely than some of the other reasons. Conversely, revision between one and three years after surgery is more likely for aseptic loosening / lysis and pain, with incidence rates dropping off for pain later on but rising again for aseptic loosening / lysis. Aseptic loosening / lysis PTIRs continue to remain relatively higher than other indicated reasons for revision for implants surviving for longer periods after surgery.

Table 3.K10 PTIR estimates of indications for revision (95% CI) by fixation, constraint, bearing type and whether a patella component was recorded.

Fixation, constraint and bearing sub-groups	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for: All causes	Pain	Dislocation / Subluxation	Infection	Aseptic loosening / Lysis	Peri-prosthetic fracture	Implant wear[1]	Instability	Malalignment	Other indication[2]	Stiffness[3]: Prosthesis-years at risk (x1,000)	Stiffness[3]: Revisions per 1,000 prosthesis-years	Progressive arthritis[4]: Prosthesis-years at risk (x1,000)	Progressive arthritis[4]: Revisions per 1,000 prosthesis-years
All cases	11,205.1	4.24 (4.20-4.28)	0.58 (0.56-0.59)	0.15 (0.15-0.16)	0.82 (0.81-0.84)	1.13 (1.11-1.15)	0.18 (0.17-0.19)	0.30 (0.29-0.31)	0.60 (0.59-0.61)	0.29 (0.28-0.30)	0.44 (0.43-0.45)	10,925.1	0.25 (0.24-0.26)	8,551.3	0.72 (0.70-0.74)
Total knee replacement															
All cemented	9,264.0	3.38 (3.34-3.42)	0.41 (0.40-0.42)	0.09 (0.08-0.10)	0.89 (0.87-0.91)	0.94 (0.92-0.96)	0.17 (0.16-0.18)	0.19 (0.18-0.20)	0.56 (0.55-0.58)	0.25 (0.24-0.26)	0.31 (0.30-0.32)	9,049.1	0.26 (0.25-0.27)	7,185.3	0.32 (0.31-0.34)
unconstrained, fixed, with patella	2,217.6	2.69 (2.62-2.76)	0.26 (0.24-0.28)	0.07 (0.06-0.09)	0.86 (0.82-0.90)	0.77 (0.74-0.81)	0.14 (0.12-0.16)	0.18 (0.16-0.20)	0.54 (0.51-0.57)	0.22 (0.21-0.24)	0.20 (0.19-0.22)	2,161.7	0.22 (0.21-0.25)	1,755.6	0.02 (0.02-0.03)
unconstrained, fixed, without patella	4,077.5	3.29 (3.24-3.35)	0.48 (0.45-0.50)	0.08 (0.08-0.09)	0.79 (0.76-0.81)	0.76 (0.73-0.79)	0.14 (0.13-0.15)	0.17 (0.16-0.19)	0.52 (0.50-0.55)	0.25 (0.23-0.26)	0.34 (0.33-0.36)	3,990.7	0.27 (0.25-0.29)	3,192.9	0.51 (0.48-0.53)
unconstrained, mobile, with patella	99.0	4.64 (4.24-5.09)	0.45 (0.34-0.61)	0.30 (0.21-0.43)	1.17 (0.98-1.41)	1.51 (1.29-1.78)	0.14 (0.08-0.24)	0.45 (0.34-0.61)	1.00 (0.82-1.22)	0.34 (0.25-0.48)	0.31 (0.22-0.45)	95.3	0.51 (0.39-0.68)	63.1	0
unconstrained, mobile, without patella	300.4	3.70 (3.49-3.93)	0.62 (0.54-0.72)	0.15 (0.11-0.20)	0.74 (0.65-0.85)	1.27 (1.15-1.41)	0.16 (0.12-0.21)	0.29 (0.23-0.36)	0.65 (0.57-0.75)	0.34 (0.28-0.41)	0.31 (0.25-0.38)	293.6	0.33 (0.27-0.40)	184.3	0.29 (0.22-0.38)
posterior-stabilised, fixed, with patella	1,137.0	3.43 (3.33-3.54)	0.27 (0.24-0.31)	0.08 (0.07-0.10)	1.12 (1.06-1.18)	1.18 (1.12-1.25)	0.24 (0.21-0.27)	0.18 (0.16-0.21)	0.55 (0.50-0.59)	0.26 (0.23-0.29)	0.22 (0.19-0.25)	1,109.3	0.23 (0.20-0.26)	887.4	0.03 (0.02-0.04)
posterior-stabilised, fixed, without patella	1,087.7	4.67 (4.55-4.80)	0.55 (0.51-0.59)	0.09 (0.07-0.11)	0.99 (0.94-1.05)	1.56 (1.49-1.64)	0.25 (0.22-0.28)	0.20 (0.17-0.23)	0.69 (0.64-0.74)	0.30 (0.27-0.34)	0.43 (0.40-0.47)	1,057.9	0.29 (0.26-0.32)	823.2	0.62 (0.57-0.68)
posterior-stabilised, mobile, with patella	86.4	3.34 (2.98-3.75)	0.36 (0.25-0.51)	0.08 (0.04-0.17)	0.91 (0.73-1.14)	0.96 (0.77-1.19)	0.20 (0.12-0.32)	0.20 (0.12-0.32)	0.68 (0.53-0.88)	0.21 (0.13-0.33)	0.32 (0.22-0.47)	84.9	0.40 (0.29-0.56)	61.8	0
posterior-stabilised, mobile, without patella	43.5	5.88 (5.20-6.65)	0.92 (0.67-1.25)	0.21 (0.11-0.40)	0.83 (0.60-1.15)	1.17 (0.89-1.54)	0.37 (0.23-0.60)	0.44 (0.28-0.68)	0.99 (0.73-1.33)	0.21 (0.11-0.40)	1.13 (0.85-1.49)	42.3	0.52 (0.34-0.79)	24.9	1.16 (0.81-1.67)
constrained condylar, with patella	30.0	4.20 (3.53-5.00)	0.20 (0.09-0.45)	0.23 (0.11-0.49)	1.90 (1.47-2.46)	0.67 (0.43-1.03)	0.37 (0.20-0.66)	0.13 (0.05-0.36)	0.77 (0.51-1.15)	0.10 (0.03-0.31)	0.43 (0.25-0.75)	29.7	0.24 (0.11-0.49)	27.2	0.11 (0.04-0.34)
constrained condylar, without patella	37.3	5.63 (4.92-6.44)	0.35 (0.20-0.60)	0.27 (0.14-0.50)	2.47 (2.01-3.02)	0.78 (0.54-1.12)	0.46 (0.28-0.73)	0.29 (0.16-0.53)	0.70 (0.47-1.02)	0.40 (0.24-0.67)	0.40 (0.24-0.67)	36.9	0.38 (0.22-0.64)	33.0	0.61 (0.39-0.94)
monobloc polyethylene tibia, with patella	29.5	2.07 (1.61-2.66)	0.20 (0.09-0.45)	0	0.61 (0.38-0.97)	0.58 (0.36-0.93)	0.27 (0.14-0.54)	0.10 (0.03-0.32)	0.54 (0.33-0.89)	0.27 (0.14-0.54)	0.14 (0.05-0.36)	29.4	0.20 (0.09-0.45)	27.4	0
monobloc polyethylene tibia, without patella	104.6	2.69 (2.39-3.02)	0.39 (0.29-0.53)	0.09 (0.04-0.17)	0.68 (0.54-0.86)	0.65 (0.51-0.82)	0.22 (0.15-0.33)	0.06 (0.03-0.13)	0.40 (0.30-0.54)	0.23 (0.15-0.34)	0.29 (0.20-0.41)	104.0	0.19 (0.12-0.30)	93.6	0.17 (0.10-0.28)

[1]The indication implant failure, as reported in annual reports up to 2013, has been renamed implant wear as this reflects the wearing down of the implant but distinguishes from the implant itself breaking.
[2]Other indication now includes other indications not listed, implant fracture and incorrect sizing.
[3]Stiffness appears as a selectable indication in only MDSv2, v3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.
[4]Progressive arthritis appears as a selectable indication in versions MDSv3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.

Table 3.K10 (continued)

Fixation, constraint and bearing sub-groups	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for: All causes	Pain	Dislocation / Subluxation	Infection	Aseptic loosening / Lysis	Peri-prosthetic fracture	Implant wear[1]	Instability	Malalignment	Other indication[2]	Stiffness[3]: Prosthesis-years at risk (x1,000)	Stiffness[3]: Revisions per 1,000 prosthesis-years	Progressive arthritis[4]: Prosthesis-years at risk (x1,000)	Progressive arthritis[4]: Revisions per 1,000 prosthesis-years
pre-assembled/ hinged/linked, with patella	2.6	14.10 (10.22-19.46)	0.38 (0.05-2.71)	1.52 (0.57-4.06)	8.00 (5.22-12.28)	1.52 (0.57-4.06)	1.52 (0.57-4.06)	0.38 (0.05-2.71)	0.38 (0.05-2.71)	0.76 (0.19-3.05)	1.91 (0.79-4.58)	2.6	0.38 (0.05-2.72)	2.0	1.00 (0.25-4.00)
pre-assembled/ hinged/linked, without patella	10.9	9.68 (7.99-11.72)	0.37 (0.14-0.98)	0.74 (0.37-1.47)	3.78 (2.78-5.13)	2.03 (1.34-3.08)	0.83 (0.43-1.59)	0.65 (0.31-1.35)	0.46 (0.19-1.11)	0.74 (0.37-1.47)	1.20 (0.70-2.06)	10.6	0.28 (0.09-0.87)	8.8	0.57 (0.24-1.37)
All uncemented	**458.6**	**4.06 (3.88-4.25)**	**0.72 (0.64-0.80)**	**0.14 (0.11-0.18)**	**0.56 (0.50-0.64)**	**1.40 (1.30-1.52)**	**0.18 (0.15-0.22)**	**0.33 (0.28-0.39)**	**0.69 (0.62-0.77)**	**0.35 (0.30-0.41)**	**0.51 (0.45-0.58)**	**439.2**	**0.32 (0.27-0.38)**	**286.1**	**0.40 (0.33-0.48)**
unconstrained, fixed, with patella	24.3	4.08 (3.35-4.97)	0.25 (0.11-0.55)	0.16 (0.06-0.44)	0.87 (0.56-1.33)	1.57 (1.14-2.15)	0.29 (0.14-0.61)	0.16 (0.06-0.44)	1.07 (0.73-1.57)	0.62 (0.37-1.03)	0.12 (0.04-0.38)	24.0	0.21 (0.09-0.50)	19.2	0.05 (0.01-0.37)
unconstrained, fixed, without patella	152.1	4.24 (3.93-4.58)	0.73 (0.61-0.88)	0.07 (0.04-0.12)	0.55 (0.45-0.68)	1.58 (1.39-1.79)	0.20 (0.14-0.29)	0.34 (0.25-0.44)	0.62 (0.51-0.76)	0.34 (0.25-0.44)	0.56 (0.45-0.69)	144.7	0.31 (0.23-0.42)	92.7	0.52 (0.39-0.69)
unconstrained, mobile, with patella	10.8	5.28 (4.07-6.84)	0.74 (0.37-1.48)	0.19 (0.05-0.74)	0.74 (0.37-1.48)	2.04 (1.34-3.09)	0.19 (0.05-0.74)	1.20 (0.70-2.07)	1.67 (1.05-2.64)	0.83 (0.43-1.60)	0.65 (0.31-1.36)	9.8	0.61 (0.27-1.36)	5.4	0
unconstrained, mobile, without patella	238.4	3.69 (3.46-3.94)	0.70 (0.61-0.82)	0.16 (0.12-0.22)	0.51 (0.43-0.61)	1.21 (1.08-1.36)	0.13 (0.09-0.18)	0.27 (0.21-0.34)	0.61 (0.52-0.72)	0.28 (0.22-0.35)	0.47 (0.39-0.57)	229.3	0.30 (0.23-0.38)	148.2	0.41 (0.32-0.53)
posterior-stabilised, fixed, with patella	6.7	7.48 (5.67-9.88)	1.05 (0.50-2.20)	0.60 (0.22-1.60)	1.50 (0.81-2.78)	2.69 (1.70-4.28)	0.90 (0.40-2.00)	0.75 (0.31-1.80)	1.50 (0.81-2.78)	0.60 (0.22-1.60)	0.60 (0.22-1.60)	6.3	0.80 (0.33-1.92)	4.0	0
posterior-stabilised, fixed, without patella	25.5	5.09 (4.29-6.05)	1.10 (0.76-1.59)	0.27 (0.13-0.58)	0.51 (0.30-0.88)	1.49 (1.08-2.05)	0.24 (0.11-0.52)	0.55 (0.32-0.93)	0.90 (0.60-1.36)	0.59 (0.35-0.97)	0.98 (0.66-1.45)	24.4	0.41 (0.22-0.76)	15.8	0.25 (0.09-0.67)
other constraints, with patella	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0
other constraints, without patella	0.6	3.57 (0.89-14.29)	1.79 (0.25-12.68)	0	1.79 (0.25-12.68)	0	0	0	0	0	0	0.5	1.88 (0.27-13.36)	0.4	0
All hybrid	**102.8**	**3.38 (3.05-3.76)**	**0.53 (0.40-0.69)**	**0.14 (0.08-0.23)**	**0.79 (0.63-0.98)**	**1.09 (0.90-1.31)**	**0.16 (0.10-0.25)**	**0.31 (0.22-0.44)**	**0.57 (0.44-0.74)**	**0.28 (0.20-0.41)**	**0.24 (0.16-0.36)**	**94.6**	**0.19 (0.12-0.30)**	**51.9**	**0.29 (0.17-0.48)**
unconstrained, fixed, with patella	25.9	2.51 (1.97-3.20)	0.39 (0.21-0.72)	0.12 (0.04-0.36)	0.62 (0.38-1.01)	0.89 (0.59-1.34)	0.15 (0.06-0.41)	0.35 (0.18-0.67)	0.66 (0.41-1.06)	0.04 (0.01-0.27)	0.12 (0.04-0.36)	23.6	0.08 (0.02-0.34)	9.2	0
unconstrained, fixed, without patella	47.3	3.28 (2.80-3.84)	0.53 (0.36-0.78)	0.11 (0.04-0.25)	0.76 (0.55-1.06)	0.97 (0.73-1.30)	0.17 (0.08-0.34)	0.27 (0.16-0.47)	0.38 (0.24-0.60)	0.36 (0.22-0.58)	0.30 (0.18-0.50)	42.5	0.16 (0.08-0.35)	23.5	0.34 (0.17-0.68)
unconstrained, mobile, with patella	3.0	5.37 (3.29-8.77)	0	0.67 (0.17-2.69)	1.01 (0.32-3.12)	2.35 (1.12-4.93)	0.34 (0.05-2.38)	0.34 (0.05-2.38)	0.34 (0.05-2.38)	0.34 (0.05-2.38)	0.34 (0.05-2.38)	2.8	0.72 (0.18-2.86)	2.4	0
unconstrained, mobile, without patella	16.2	4.01 (3.15-5.11)	0.56 (0.29-1.07)	0.25 (0.09-0.66)	0.80 (0.47-1.38)	1.48 (0.99-2.21)	0	0.49 (0.25-0.99)	0.93 (0.56-1.54)	0.56 (0.29-1.07)	0.37 (0.17-0.82)	15.5	0.26 (0.10-0.69)	12.1	0.50 (0.22-1.11)

[1]The indication implant failure, as reported in annual reports up to 2013, has been renamed implant wear as this reflects the wearing down of the implant but distinguishes from the implant itself breaking.
[2]Other indication now includes other indications not listed, implant fracture and incorrect sizing.
[3]Stiffness appears as a selectable indication in only MDSv2, v3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.
[4]Progressive arthritis appears as a selectable indication in versions MDSv3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.

Table 3.K10 (continued)

Fixation, constraint and bearing sub-groups	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for: All causes	Pain	Dislocation / Subluxation	Infection	Aseptic loosening / Lysis	Peri-prosthetic fracture	Implant wear[1]	Instability	Malalignment	Other indication[2]	Stiffness[3]: Prosthesis-years at risk (x1,000)	Stiffness[3]: Revisions per 1,000 prosthesis-years	Progressive arthritis[4]: Prosthesis-years at risk (x1,000)	Progressive arthritis[4]: Revisions per 1,000 prosthesis-years
posterior-stabilised, fixed, with patella	3.0	5.06 (3.05-8.39)	1.35 (0.51-3.59)	0	1.69 (0.70-4.05)	2.02 (0.91-4.50)	0.67 (0.17-2.70)	0	0.34 (0.05-2.39)	0	0	2.8	0.35 (0.05-2.49)	2.0	0
posterior-stabilised, fixed, without patella	3.9	4.40 (2.74-7.08)	0.26 (0.04-1.84)	0	1.55 (0.70-3.46)	1.29 (0.54-3.11)	0	0	1.04 (0.39-2.76)	0	0	3.7	0	2.1	0.47 (0.07-3.35)
other constraints, with patella	2.7	4.03 (2.23-7.28)	1.47 (0.55-3.90)	0	0.73 (0.18-2.93)	0.37 (0.05-2.60)	0.37 (0.05-2.60)	0.37 (0.05-2.60)	0.73 (0.18-2.93)	0	0.37 (0.05-2.60)	2.7	0.37 (0.05-2.60)	0.4	0
other constraints, without patella	0.9	4.24 (1.59-11.30)	1.06 (0.15-7.52)	0	0	0	0	0	1.06 (0.15-7.52)	1.06 (0.15-7.52)	0	0.9	1.13 (0.16-8.01)	0.2	0
Unicompartmental knee replacement															
All unicondylar, cemented	844.1	10.52 (10.31-10.74)	1.79 (1.70-1.88)	0.54 (0.50-0.59)	0.42 (0.38-0.47)	2.90 (2.78-3.01)	0.19 (0.16-0.22)	1.11 (1.04-1.18)	0.86 (0.80-0.92)	0.49 (0.45-0.54)	1.32 (1.24-1.40)	820.5	0.15 (0.13-0.18)	615.0	3.46 (3.31-3.61)
fixed	280.2	7.24 (6.93-7.56)	1.21 (1.09-1.35)	0.08 (0.05-0.12)	0.44 (0.37-0.53)	2.00 (1.84-2.18)	0.18 (0.14-0.24)	0.67 (0.58-0.77)	0.55 (0.47-0.65)	0.33 (0.27-0.41)	0.78 (0.68-0.89)	277.5	0.13 (0.10-0.18)	253.1	2.60 (2.40-2.80)
mobile	501.9	12.26 (11.96-12.57)	2.02 (1.90-2.15)	0.85 (0.77-0.94)	0.41 (0.35-0.47)	3.28 (3.13-3.44)	0.18 (0.15-0.22)	1.34 (1.24-1.44)	1.03 (0.95-1.12)	0.57 (0.51-0.64)	1.67 (1.56-1.79)	482.6	0.16 (0.13-0.20)	324.7	4.09 (3.88-4.32)
monobloc polyethylene tibia	62.0	11.28 (10.48-12.15)	2.49 (2.12-2.91)	0.15 (0.08-0.28)	0.45 (0.31-0.65)	3.83 (3.37-4.34)	0.34 (0.22-0.52)	1.18 (0.94-1.48)	0.84 (0.64-1.10)	0.58 (0.42-0.81)	0.89 (0.68-1.16)	60.4	0.20 (0.11-0.35)	37.2	3.76 (3.19-4.44)
All unicondylar, uncemented/hybrid	183.6	7.85 (7.46-8.27)	0.72 (0.61-0.86)	1.20 (1.05-1.37)	0.44 (0.35-0.55)	1.12 (0.98-1.29)	0.54 (0.44-0.66)	0.89 (0.76-1.03)	0.69 (0.58-0.82)	0.36 (0.29-0.46)	1.03 (0.89-1.19)	183.4	0.10 (0.06-0.16)	178.0	2.43 (2.21-2.67)
fixed	9.1	9.89 (8.05-12.16)	1.21 (0.67-2.18)	0.33 (0.11-1.02)	0	3.74 (2.67-5.23)	0.22 (0.05-0.88)	1.43 (0.83-2.46)	1.10 (0.59-2.04)	0.77 (0.37-1.61)	1.43 (0.83-2.46)	9.0	0.22 (0.06-0.89)	7.7	2.98 (1.98-4.48)
mobile	169.6	7.71 (7.30-8.14)	0.65 (0.54-0.78)	1.29 (1.13-1.47)	0.47 (0.38-0.59)	0.94 (0.81-1.10)	0.57 (0.47-0.70)	0.85 (0.72-1.00)	0.67 (0.56-0.81)	0.35 (0.27-0.46)	1.03 (0.88-1.19)	169.5	0.08 (0.05-0.14)	166.0	2.37 (2.15-2.62)
monobloc polyethylene tibia	5.0	9.06 (6.76-12.13)	2.42 (1.37-4.25)	0	0.20 (0.03-1.43)	2.42 (1.37-4.25)	0	1.21 (0.54-2.69)	0.60 (0.19-1.87)	0	0.40 (0.10-1.61)	5.0	0.40 (0.10-1.61)	4.3	3.50 (2.11-5.81)
Patellofemoral	132.3	18.67 (17.95-19.42)	3.66 (3.35-4.00)	0.55 (0.44-0.69)	0.38 (0.29-0.50)	2.22 (1.98-2.49)	0.14 (0.09-0.23)	1.66 (1.46-1.90)	0.82 (0.68-0.99)	1.05 (0.89-1.24)	2.71 (2.45-3.01)	129.5	0.39 (0.29-0.51)	101.9	9.64 (9.06-10.26)
Multicompartmental	5.3	14.64 (11.71-18.30)	3.04 (1.86-4.96)	0.95 (0.40-2.28)	0.38 (0.10-1.52)	1.14 (0.51-2.54)	0.19 (0.03-1.35)	1.14 (0.51-2.54)	0.76 (0.29-2.03)	0.76 (0.29-2.03)	2.85 (1.72-4.73)	5.2	0	4.9	6.34 (4.46-9.02)
Unconfirmed															
	214.4	5.26 (4.96-5.58)	0.69 (0.58-0.81)	0.19 (0.14-0.25)	0.80 (0.69-0.93)	1.49 (1.33-1.66)	0.21 (0.15-0.28)	0.48 (0.39-0.58)	0.78 (0.67-0.91)	0.34 (0.27-0.42)	0.67 (0.57-0.79)	203.7	0.27 (0.21-0.36)	128.3	1.09 (0.92-1.29)

[1]The indication implant failure, as reported in annual reports up to 2013, has been renamed implant wear as this reflects the wearing down of the implant but distinguishes from the implant itself breaking.
[2]Other indication now includes other indications not listed, implant fracture and incorrect sizing.
[3]Stiffness appears as a selectable indication in only MDSv2, v3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.
[4]Progressive arthritis appears as a selectable indication in versions MDSv3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.

Table 3.K11 PTIR estimates of indications for revision (95% CI) by years following primary knee replacement.

Time since primary (years)	Prosthesis-years at risk (x1,000)	Number of revisions per 1,000 prosthesis-years for:										Stiffness[3]		Progressive arthritis[4]	
		All causes	Pain	Dislocation / Subluxation	Infection	Aseptic loosening / Lysis	Peri-prosthetic fracture	Implant wear[1]	Instability	Malalignment	Other indication[2]	Prosthesis-years at risk (x1,000)	Revisions per 1,000 prosthesis-years	Prosthesis-years at risk (x1,000)	Revisions per 1,000 prosthesis-years
All cases	11,205.1	4.24 (4.20-4.28)	0.58 (0.56-0.59)	0.15 (0.15-0.16)	0.82 (0.81-0.84)	1.13 (1.11-1.15)	0.18 (0.17-0.19)	0.30 (0.29-0.31)	0.60 (0.59-0.61)	0.29 (0.28-0.30)	0.44 (0.43-0.45)	10,925.1	0.25 (0.24-0.26)	8,551.3	0.72 (0.70-0.74)
<1	1,483.9	4.94 (4.83-5.05)	0.44 (0.41-0.48)	0.37 (0.34-0.40)	2.04 (1.96-2.11)	0.59 (0.55-0.63)	0.31 (0.28-0.34)	0.18 (0.16-0.20)	0.51 (0.47-0.55)	0.29 (0.27-0.32)	0.56 (0.52-0.59)	1,462.9	0.28 (0.26-0.31)	1,271.7	0.25 (0.23-0.28)
1 to <3	2,649.8	6.02 (5.93-6.12)	1.18 (1.14-1.22)	0.18 (0.17-0.20)	1.15 (1.11-1.19)	1.40 (1.36-1.45)	0.12 (0.11-0.14)	0.18 (0.17-0.20)	0.90 (0.87-0.94)	0.51 (0.49-0.54)	0.70 (0.67-0.74)	2,609.1	0.51 (0.48-0.53)	2,238.9	0.87 (0.83-0.90)
3 to <5	2,220.0	3.88 (3.80-3.96)	0.65 (0.62-0.68)	0.09 (0.08-0.11)	0.59 (0.56-0.63)	1.18 (1.14-1.23)	0.12 (0.11-0.14)	0.18 (0.17-0.20)	0.59 (0.56-0.62)	0.30 (0.28-0.33)	0.40 (0.38-0.43)	2,181.6	0.25 (0.23-0.28)	1,831.1	0.72 (0.68-0.76)
5 to <7	1,716.6	3.18 (3.09-3.26)	0.37 (0.34-0.40)	0.09 (0.08-0.11)	0.45 (0.42-0.49)	1.07 (1.03-1.12)	0.13 (0.12-0.15)	0.25 (0.23-0.27)	0.45 (0.42-0.49)	0.20 (0.18-0.22)	0.32 (0.29-0.35)	1,680.9	0.14 (0.12-0.16)	1,353.4	0.74 (0.70-0.79)
7 to <10	1,730.0	3.04 (2.96-3.12)	0.24 (0.21-0.26)	0.09 (0.08-0.10)	0.35 (0.32-0.38)	1.08 (1.03-1.13)	0.19 (0.17-0.21)	0.38 (0.35-0.41)	0.45 (0.42-0.48)	0.15 (0.13-0.17)	0.26 (0.24-0.29)	1,682.3	0.09 (0.08-0.11)	1,242.3	0.81 (0.76-0.86)
10 to <13	940.0	3.43 (3.31-3.55)	0.16 (0.13-0.18)	0.11 (0.09-0.13)	0.33 (0.30-0.37)	1.21 (1.14-1.28)	0.26 (0.23-0.30)	0.68 (0.63-0.74)	0.49 (0.45-0.54)	0.13 (0.11-0.16)	0.26 (0.23-0.30)	900.1	0.08 (0.06-0.10)	531.1	0.90 (0.82-0.99)
13 to <15	302.7	3.45 (3.24-3.66)	0.11 (0.08-0.16)	0.12 (0.08-0.16)	0.31 (0.25-0.38)	1.37 (1.25-1.51)	0.29 (0.24-0.36)	0.85 (0.75-0.96)	0.49 (0.41-0.57)	0.11 (0.08-0.16)	0.21 (0.17-0.27)	280.7	0.08 (0.05-0.12)	80.3	1.10 (0.89-1.35)
15 to <17	127.0	3.81 (3.49-4.17)	0.13 (0.08-0.22)	0.16 (0.10-0.24)	0.24 (0.17-0.34)	1.38 (1.19-1.60)	0.33 (0.24-0.45)	1.16 (0.98-1.36)	0.76 (0.62-0.92)	0.11 (0.07-0.19)	0.29 (0.21-0.40)	108.5	0.06 (0.02-0.12)	2.0	0.99 (0.25-3.96)
≥17	35.2	4.57 (3.92-5.33)	0	0.20 (0.09-0.42)	0.28 (0.15-0.53)	2.13 (1.70-2.67)	0.51 (0.32-0.81)	1.45 (1.10-1.91)	0.54 (0.34-0.85)	0.09 (0.03-0.26)	0.31 (0.17-0.56)	19.0	0.16 (0.05-0.49)	0.4	2.43 (0.34-17.29)

[1]The indication implant failure, as reported in annual reports up to 2013, has been renamed implant wear as this reflects the wearing down of the implant but distinguishes from the implant itself breaking.
[2]Other indication now includes other indications not listed, implant fracture and incorrect sizing.
[3]Stiffness appears as a selectable indication in only MDSv2, v3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.
[4]Progressive arthritis appears as a selectable indication in versions MDSv3, v6 and v7 of the data collection forms for joint replacement/revision surgery and hence there are fewer prosthesis-years at risk.

3.3.5 Mortality after primary knee replacement surgery

In this section we describe the mortality of the cohort up to 19 years from primary operation, according to gender and age group. Deaths recorded after 31 December 2022 have not been included in the analysis. For simplicity, we have not taken into account whether the patient had a first (or further) joint revision after the primary operation when calculating the cumulative probability of death (see survival analysis methods note in section 3.1). Of the 1,544,961 records of a primary knee replacement, 21,574 unknown knee type records were excluded and there were 14,992 bilateral operations in which the patient had both knees replaced on the same day; here the second of the two has been excluded, leaving 1,345,085 TKR procedures (of whom 307,935 had died before the end of 2022) and 163,690 UKR procedures (of whom 18,181 died before the end of 2022).

Note: These cases were not censored when further revision surgery was undertaken. While such surgery may have contributed to the overall mortality, the impact of this is not investigated in this report. Furthermore, exclusions for unknown knee type and same-day bilateral operations were not mutually exclusive; there was an overlap of 380 cases of unknown knee types with same day bilateral procedures.

Table 3.K12 (a) KM estimates of cumulative mortality (95% CI) by age and gender, in primary TKR. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Age group (years)	N	Time since primary						
		30 days	90 days	1 year	5 years	10 years	15 years	19 years
All cases	1,345,085	0.16 (0.15-0.16)	0.29 (0.29-0.30)	1.01 (1.00-1.03)	8.66 (8.61-8.72)	25.87 (25.77-25.97)	47.66 (47.50-47.82)	65.08 (64.73-65.43)
Male								
<55	32,313	0.04 (0.03-0.07)	0.08 (0.06-0.12)	0.29 (0.23-0.35)	2.16 (1.99-2.33)	6.25 (5.92-6.60)	11.98 (11.35-12.65)	*19.32 (17.46-21.34)*
55 to 59	48,490	0.05 (0.03-0.07)	0.09 (0.07-0.13)	0.35 (0.30-0.41)	2.91 (2.75-3.08)	8.79 (8.46-9.14)	17.95 (17.33-18.59)	28.45 (26.85-30.13)
60 to 64	86,847	0.07 (0.06-0.09)	0.13 (0.11-0.16)	0.46 (0.42-0.51)	4.04 (3.90-4.19)	11.80 (11.52-12.08)	25.39 (24.86-25.93)	40.55 (39.15-41.98)
65 to 69	112,267	0.10 (0.08-0.12)	0.18 (0.15-0.20)	0.67 (0.62-0.72)	5.79 (5.64-5.94)	17.76 (17.47-18.06)	37.84 (37.29-38.39)	58.53 (57.23-59.84)
70 to 74	120,646	0.14 (0.12-0.16)	0.26 (0.24-0.29)	1.03 (0.97-1.09)	9.19 (9.01-9.37)	28.23 (27.88-28.57)	56.12 (55.56-56.67)	*79.66 (78.48-80.82)*
75 to 79	98,461	0.27 (0.24-0.30)	0.50 (0.45-0.54)	1.74 (1.66-1.82)	14.85 (14.60-15.10)	44.37 (43.95-44.79)	76.53 (75.99-77.07)	*93.22 (92.32-94.05)*
80 to 84	54,495	0.54 (0.48-0.60)	0.94 (0.87-1.03)	2.96 (2.82-3.11)	23.89 (23.50-24.29)	63.97 (63.41-64.53)	91.12 (90.60-91.62)	*99.05 (98.17-99.56)*
≥85	20,928	1.05 (0.92-1.19)	1.88 (1.71-2.08)	5.54 (5.23-5.86)	38.62 (37.89-39.36)	82.30 (81.55-83.04)	*97.28 (96.72-97.76)*	*99.37 (97.76-99.88)*
Female								
<55	46,184	0.03 (0.02-0.05)	0.06 (0.04-0.09)	0.23 (0.19-0.28)	1.64 (1.52-1.77)	4.64 (4.39-4.90)	9.94 (9.42-10.49)	*16.29 (14.99-17.70)*
55 to 59	64,087	0.03 (0.02-0.05)	0.06 (0.04-0.08)	0.26 (0.22-0.30)	2.09 (1.97-2.22)	6.31 (6.07-6.57)	14.04 (13.54-14.56)	24.15 (22.74-25.62)
60 to 64	103,229	0.03 (0.02-0.05)	0.09 (0.07-0.11)	0.31 (0.28-0.35)	2.77 (2.66-2.88)	8.77 (8.55-9.00)	19.47 (19.02-19.92)	34.14 (32.78-35.54)
65 to 69	138,449	0.06 (0.05-0.08)	0.12 (0.10-0.14)	0.42 (0.39-0.46)	3.95 (3.84-4.07)	12.91 (12.68-13.15)	29.83 (29.37-30.31)	49.95 (48.71-51.20)
70 to 74	158,371	0.10 (0.08-0.11)	0.18 (0.16-0.20)	0.64 (0.60-0.68)	5.99 (5.86-6.12)	20.49 (20.22-20.76)	45.92 (45.43-46.41)	71.37 (70.26-72.46)
75 to 79	140,501	0.15 (0.13-0.17)	0.29 (0.27-0.32)	1.11 (1.06-1.17)	10.12 (9.94-10.29)	33.73 (33.40-34.07)	66.39 (65.91-66.88)	*86.21 (85.34-87.06)*
80 to 84	84,707	0.27 (0.23-0.30)	0.53 (0.48-0.58)	1.82 (1.73-1.92)	16.30 (16.03-16.57)	51.38 (50.93-51.83)	84.89 (84.39-85.37)	*96.70 (96.00-97.31)*
≥85	35,110	0.55 (0.48-0.64)	1.16 (1.05-1.27)	3.44 (3.25-3.64)	28.52 (28.01-29.05)	72.93 (72.29-73.58)	*95.26 (94.76-95.72)*	*98.86 (98.35-99.23)*

Note: Excludes 9,568 bilateral operations performed on the same day.

Tables 3.K12 (a) and (b), show Kaplan-Meier estimates of cumulative percentage mortality at 30 days, 90 days and at 1, 5, 10, 15 and 19 years following a TKR or UKR, for all cases and by age and gender. Fewer males than females have had a primary knee replacement and, proportionally, more females than males undergo surgery above the age of 75. Males, particularly in the older age groups, had a higher cumulative percentage probability of dying in the short or longer term after their primary knee replacement operation than females in the equivalent age group. The mortality rates are lower in males and females following UKR than TKR, but these figures do not adjust for selection and hence do not account for residual confounding (Hunt et al., 2018).

Table 3.K12 (b) KM estimates of cumulative mortality (95% CI) by age and gender, in primary unicompartmental replacements. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

		Time since primary						
Age group (years)	**N**	**30 days**	**90 days**	**1 year**	**5 years**	**10 years**	**15 years**	**19 years**
All unicondylar	146,541	0.04 (0.03-0.05)	0.08 (0.06-0.09)	0.39 (0.36-0.42)	4.17 (4.06-4.29)	13.16 (12.92-13.41)	27.13 (26.69-27.59)	41.04 (39.91-42.20)
Male								
<55	11,629	0.02 (0.00-0.07)	0.03 (0.01-0.09)	0.17 (0.11-0.27)	1.23 (1.03-1.48)	3.62 (3.19-4.11)	7.75 (6.83-8.78)	*11.00 (9.33-12.95)*
55 to 59	12,363	0.02 (0.01-0.08)	0.03 (0.01-0.09)	0.21 (0.14-0.31)	1.88 (1.62-2.18)	5.98 (5.41-6.61)	12.62 (11.51-13.82)	*20.99 (17.70-24.80)*
60 to 64	15,476	0.06 (0.03-0.11)	0.08 (0.05-0.15)	0.34 (0.26-0.45)	2.86 (2.57-3.17)	8.62 (8.04-9.25)	19.16 (18.00-20.38)	*32.46 (29.01-36.20)*
65 to 69	14,831	0.01 (0.00-0.05)	0.05 (0.02-0.10)	0.32 (0.24-0.43)	4.21 (3.85-4.59)	14.19 (13.42-15.00)	30.68 (29.18-32.23)	*49.20 (45.68-52.85)*
70 to 74	12,128	0.02 (0.01-0.08)	0.07 (0.03-0.13)	0.60 (0.47-0.76)	6.89 (6.38-7.44)	22.29 (21.19-23.43)	48.63 (46.65-50.65)	*71.07 (66.83-75.19)*
75 to 79	7,770	0.08 (0.03-0.17)	0.20 (0.12-0.32)	1.01 (0.80-1.26)	11.14 (10.33-12.01)	36.82 (35.20-38.50)	*69.36 (66.98-71.71)*	*90.05 (85.51-93.65)*
80 to 84	3,488	0.11 (0.04-0.31)	0.26 (0.14-0.50)	1.87 (1.46-2.40)	19.86 (18.33-21.50)	54.21 (51.65-56.81)	*86.73 (83.97-89.22)*	*98.24 (93.62-99.73)*
≥85	1,181	0.42 (0.18-1.02)	0.68 (0.34-1.36)	3.12 (2.24-4.34)	34.17 (30.97-37.61)	*80.74 (76.82-84.37)*	*97.44 (94.02-99.15)*	*98.72 (94.81-99.84)*
Female								
<55	13,193	0.02 (0.00-0.06)	0.02 (0.01-0.07)	0.06 (0.03-0.12)	0.79 (0.64-0.98)	2.63 (2.28-3.03)	5.53 (4.83-6.33)	*9.33 (7.10-12.22)*
55 to 59	11,021	0.01 (0.00-0.06)	0.01 (0.00-0.06)	0.07 (0.03-0.14)	1.05 (0.85-1.30)	3.71 (3.25-4.24)	8.10 (7.20-9.10)	*15.11 (12.01-18.94)*
60 to 64	11,656	0.01 (0.00-0.06)	0.01 (0.00-0.06)	0.14 (0.08-0.22)	1.72 (1.47-2.01)	5.61 (5.07-6.21)	13.36 (12.24-14.58)	*25.97 (22.78-29.51)*
65 to 69	11,264	0.03 (0.01-0.08)	0.07 (0.04-0.14)	0.23 (0.16-0.34)	2.47 (2.17-2.82)	8.33 (7.65-9.07)	20.49 (19.01-22.07)	*33.17 (30.00-36.58)*
70 to 74	9,911	0.06 (0.03-0.13)	0.10 (0.05-0.19)	0.36 (0.26-0.50)	3.85 (3.43-4.32)	13.68 (12.70-14.72)	33.36 (31.46-35.34)	*56.40 (50.86-62.09)*
75 to 79	6,537	0.00 (.-.)	0.06 (0.02-0.17)	0.32 (0.21-0.50)	6.47 (5.80-7.21)	24.27 (22.77-25.86)	54.08 (51.61-56.59)	*77.53 (71.95-82.69)*
80 to 84	3,012	0.10 (0.03-0.31)	0.27 (0.13-0.54)	1.16 (0.83-1.63)	11.55 (10.29-12.96)	41.93 (39.41-44.55)	*78.85 (75.73-81.82)*	*94.67 (90.25-97.51)*
≥85	1,081	0.28 (0.09-0.86)	0.75 (0.37-1.49)	2.82 (1.97-4.04)	21.06 (18.35-24.11)	*63.13 (58.58-67.68)*	*96.39 (92.32-98.64)*	*100 (.-.)*
All patellofemoral	16,514	0.04 (0.02-0.08)	0.12 (0.07-0.18)	0.35 (0.27-0.46)	3.50 (3.21-3.81)	11.09 (10.50-11.71)	22.47 (21.36-23.63)	*33.42 (30.21-36.87)*
All multicompartmental	635	0.00 (.-.)	0.00 (.-.)	0.33 (0.08-1.30)	2.34 (1.36-4.00)	7.97 (5.81-10.88)	*17.02 (11.36-25.05)*	*17.02 (11.36-25.05)*

Note: Excludes 5,044 bilateral operations performed on the same day.

Hunt LP, Whitehouse MR, Howard PW, Ben-Shlomo Y, Blom AW. Using long term mortality to determine which peri-operative risk factors of mortality following hip and knee replacement may be causal. Sci Rep. 2018 Oct 9;8(1):15026.

3.3.6 Overview of knee revisions

In this section we look at all recorded knee revision procedures performed since the registry began on 1 April 2003 up to the end of December 2022, for all patients with valid patient identifiers (i.e. whose data could be linked).

In total there were 98,791 revisions recorded on 81,449 individual patient-sides (77,322 actual patients). In addition to the 47,522 revised primaries described previously, there were 40,240 additional revisions for a patient-side for which there is no associated primary operation recorded in the registry.

We have classified revisions as single-stage, stage one of two-stage, or stage two of two-stage revisions. Information on stage one and stage two of two-stage revisions is entered into the registry separately. Debridement and Implant Retention (DAIR) with or without modular exchange are included as single-stage procedures. With the introduction of distinct indicators for the DAIR procedures in MDSv7 and introduction of a separate reoperations form in MDSv8, it may be possible to report these as distinct categories in future reports. Not all patients who undergo stage one of a two-stage revision will undergo a stage two of two-stage revision. In some cases, stage one revisions have been entered without stage two, and vice versa, making identification of entire patient revision episodes difficult. We have attempted to address this later in this section.

The NJR asks surgeons and those responsible for healthcare delivery to ensure that when primary and revision joint replacement procedures of the hip, knee, ankle, elbow or shoulder are performed, that the relevant MDS form is completed and data entered into the registry. This is a requirement mandated by the Department of Health and Social Care. For the purposes of the Annual Report, revision procedures include any addition, removal or modification of the implants and procedures such as debridement and implant retention with or without implant exchange, excision arthroplasty, amputation and conversion to arthrodesis. The completion of a revision MDS form is also mandatory for a procedure involving modification of a joint by adding another implant to another part of the joint. For the analyses of surgeon performance, hospital performance and implant performance, debridement and implant retention without implant exchange is currently excluded.

Table 3.K13 (page 205) gives an overview of all knee revision procedures carried out each year since April 2003. There were a maximum of 15 documented revision procedures associated with any individual patient-side. The increase in the number of operations over time, until 2020 when rates were impacted by COVID, reflects the increasing number of at-risk implants prevailing in the dataset.

Table 3.K13 Number and percentage of revisions by procedure type and year.

Year of revision surgery	Type of revision procedure			Total revision joint operations
	Single-stage N (%)	Stage one of two-stage N (%)	Stage two of two-stage N (%)	
2003*	7 (1.1)	<4 (0.2)	633 (98.8)	641
2004	713 (57.1)	78 (6.3)	457 (36.6)	1,248
2005	1,488 (73.7)	211 (10.4)	321 (15.9)	2,020
2006	1,948 (75.3)	282 (10.9)	357 (13.8)	2,587
2007	2,663 (75.1)	388 (10.9)	493 (13.9)	3,544
2008	3,331 (75.7)	474 (10.8)	597 (13.6)	4,402
2009	3,716 (76.2)	528 (10.8)	631 (12.9)	4,875
2010	4,183 (77.1)	573 (10.6)	671 (12.4)	5,427
2011	4,342 (77.4)	620 (11.0)	650 (11.6)	5,612
2012	5,013 (78.5)	630 (9.9)	741 (11.6)	6,384
2013	4,706 (78.4)	631 (10.5)	662 (11.0)	5,999
2014	5,086 (78.0)	736 (11.3)	699 (10.7)	6,521
2015	5,354 (79.0)	746 (11.0)	677 (10.0)	6,777
2016	5,570 (80.6)	699 (10.1)	643 (9.3)	6,912
2017	5,672 (80.5)	703 (10.0)	668 (9.5)	7,043
2018	5,696 (82.2)	628 (9.1)	604 (8.7)	6,928
2019	5,951 (83.3)	641 (9.0)	550 (7.7)	7,142
2020	3,285 (79.7)	466 (11.3)	370 (9.0)	4,121
2021	4,295 (83.5)	437 (8.5)	412 (8.0)	5,144
2022	4,575 (83.7)	494 (9.0)	395 (7.2)	5,464
Total	**77,594**	**9,966**	**11,231**	**98,791**

*Incomplete year.
Note: DAIRs without modular exchange weren't recorded prior to MDSv7. DAIRs with modular exchange should have been recorded as a single-stage revision prior to that as these meet the definition of revision used by the NJR and reporting of these procedures is mandatory.

Table 3.K14 (a) shows the stated indications for the revision knee surgery. As more than one reason can be selected, the indications are not mutually exclusive and therefore column percentages do not add up to 100%. Aseptic loosening / lysis is the most common indication for revision, accounting for approximately 40% of single-stage revision operations, while instability, wear, pain and other indications account for between 10% and 20% each. Of the two-stage revision operations, infection is the main indication recorded in approximately 80% of either stage one or stage two procedures. Table 3.K14 (b) presents these results, restricted to the last five years.

Table 3.K14 (a) Number and percentage of knee revision by indication and procedure type.

	Type of revision procedure		
Reason for revision	Single-stage N (%) (n=77,594)	Stage one of two-stage N (%) (n=9,966)	Stage two of two-stage N (%) (n=11,231)
Aseptic loosening / Lysis	29,063 (37.5)	1,709 (17.1)	1,844 (16.4)
Instability	13,341 (17.2)	396 (4.0)	532 (4.7)
Implant wear	10,876 (14.0)	305 (3.1)	332 (3.0)
Pain	10,627 (13.7)	379 (3.8)	539 (4.8)
Other indication	8,401 (10.8)	351 (3.5)	664 (5.9)
Infection	6,517 (8.4)	8,532 (85.6)	8,426 (75.0)
Malalignment	5,491 (7.1)	117 (1.2)	184 (1.6)
Periprosthetic fracture	3,853 (5.0)	147 (1.5)	175 (1.6)
Dislocation / Subluxation	3,167 (4.1)	156 (1.6)	144 (1.3)
Stiffness*	4,304 (5.5) n=77,594	215 (2.2) n=9,966	175 (1.7) n=10,307
Progressive arthritis*	11,154 (15.9) n=70,312	74 (0.8) n=8,934	108 (1.2) n=8,872

*These reasons were not recorded in the earliest phase of the registry; only in MDSv2 onwards for stiffness and MDSv3 onwards for progressive arthritis.
Note: The number of joints on which these two percentages are based is stated beside the percentage figure.
Note: Indications listed are not mutually exclusive.

Table 3.K14 (b) Number and percentage of knee revision by indication and procedure type in the last five years.

	Type of revision procedure		
Reason for revision	Single-stage N (%) (n=23,803)	Stage one of two-stage N (%) (n=2,666)	Stage two of two-stage N (%) (n=2,331)
Aseptic loosening / Lysis	7,578 (31.8)	365 (13.7)	224 (9.6)
Progressive arthritis	5,032 (21.1)	28 (1.1)	51 (2.2)
Instability	4,039 (17.0)	85 (3.2)	63 (2.7)
Implant wear	3,289 (13.8)	52 (2.0)	42 (1.8)
Infection	3,215 (13.5)	2,393 (89.8)	1,971 (84.6)
Other indication	1,910 (8.0)	65 (2.4)	97 (4.2)
Periprosthetic fracture	1,706 (7.2)	37 (1.4)	42 (1.8)
Pain	1,693 (7.1)	28 (1.1)	26 (1.1)
Malalignment	1,321 (5.5)	16 (0.6)	26 (1.1)
Stiffness	1,190 (5.0)	30 (1.1)	29 (1.2)
Dislocation / Subluxation	949 (4.0)	38 (1.4)	17 (0.7)

Note: Indications listed are not mutally exclusive.

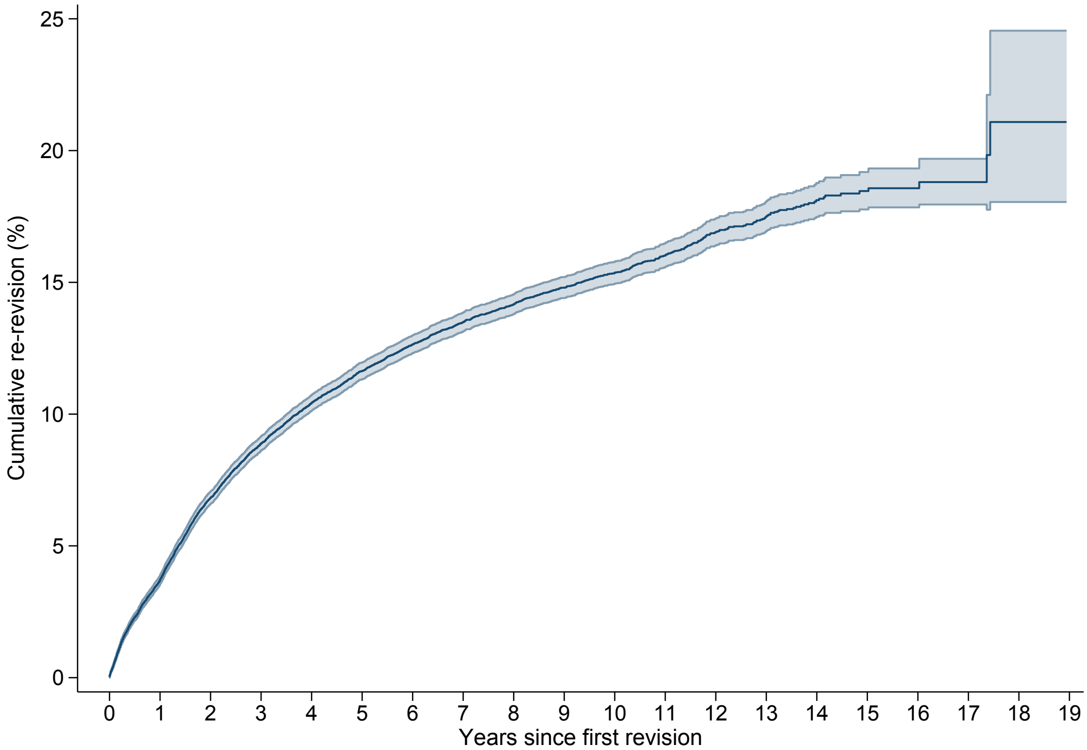
3.3.7 Rates of knee re-revision

In most instances (86%), the first revision procedure was a single-stage revision, in the remaining 14% it was part of a two-stage procedure. For a given patient-side, the implant survival following the first documented revision procedure linked to a primary in the registry (n=47,522) has been analysed. This analysis is restricted to patients with a linked primary procedure so that there is confidence that the next observed procedure on the same joint is the first revision episode. If there is no linked primary record in the dataset, it cannot be determined if the first observed revision is the first revision or has been preceded by other revision episodes. The time from the first documented revision procedure (of any type) to the time at which a second revision procedure was undertaken has been determined. For this purpose, an initial stage one followed by either a stage one or a stage two of a two-stage procedure have been considered to be the same revision episode and these were disregarded, looking instead for the start of a second revision episode.

The maximum number of distinct revision episodes for any patient-side was determined to be 14. In cases where a stage one of two procedure was followed by a stage two of two procedure within 365 days, we have treated this as a single distinct episode. This definition allows multiple stage one procedures to occur before a new revision episode is triggered. In situations where the first stage one procedure is not followed by a stage two procedure within a 365-day period, the next occurrence of a stage one procedure was considered as a new revision episode.

Kaplan-Meier estimates of the cumulative percentage probability of having a subsequent revision (re-revision) were calculated. There were 5,461 re-revisions and for 7,554 cases the patient died without having been re-revised. The censoring date for the remainder was the end of 2022.

Figure 3.K6 (a) KM estimates of cumulative re-revision, in linked primary knee replacements (shaded area indicates point-wise 95% CI). *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk

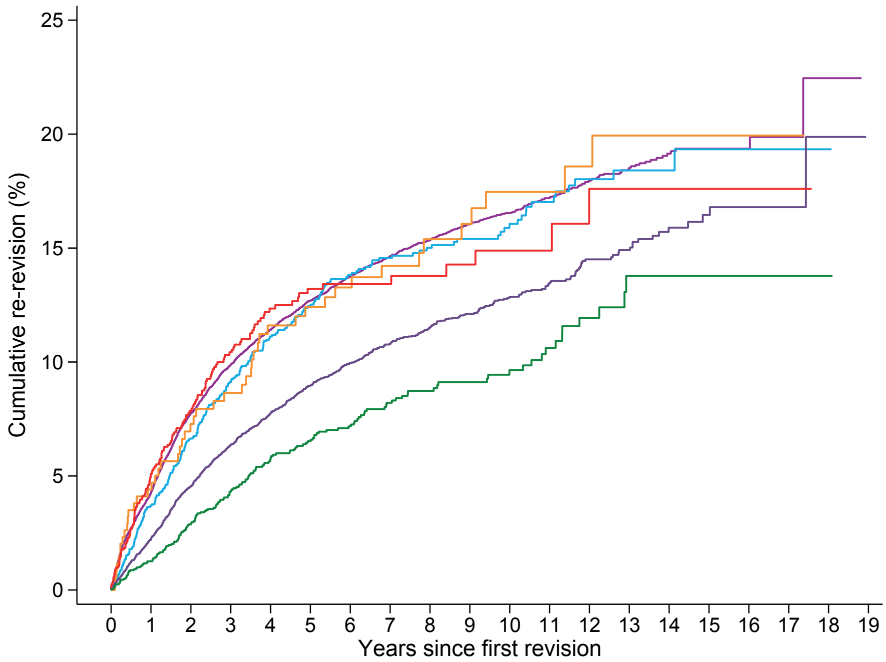
47,522	36,714	28,088	19,548	12,768	7,838	4,009	1,483	352	*23*

Figure 3.K6 (a) plots Kaplan-Meier estimates of the cumulative probability of a subsequent revision in linked revised primary knee replacements as between 1 and 19 years since the primary operation.

Figure 3.K6 (b) shows estimates of re-revision by type of primary knee replacement. Revised patellofemoral knee replacements have the lowest risk of re-revision until ten years, after which the numbers at risk fall to 250 or fewer and should be interpreted with caution. Revised cemented unicondylar knee replacements have the next lowest risk of re-revision until 14 years when again, the numbers at risk become small.

Revised uncemented / hybrid unicondylar knee replacements appear to have a higher risk of re-revision than their cemented counterparts and are equivalent to the rates seen for revised cemented TKRs until five years, after which the numbers in the revised uncemented/hybrid unicondylar group become small.

Figure 3.K6 (b) KM estimates of cumulative re-revision by primary fixation, in linked primary knee replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

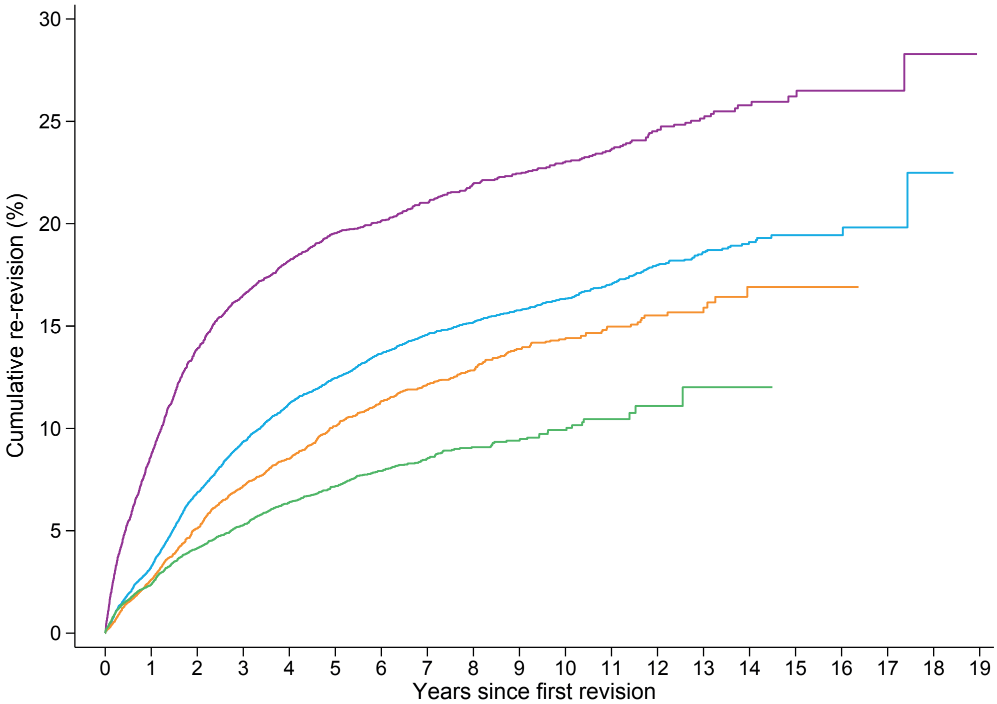


Key:

Numbers at risk

Cemented	31,312	23,722	17,799	11,977	7,542	4,423	2,204	788	*162*	*5*
Uncemented	1,863	1,536	1,272	981	718	485	262	*99*	*28*	*<4*
Hybrid	348	281	*233*	*195*	*143*	*105*	*60*	*21*	*6*	
Unicondylar, cemented	8,882	7,217	5,821	4,311	3,016	1,968	1,063	442	*123*	*14*
Unicondylar, uncemented/hybrid	1,442	954	597	345	*185*	*116*	*54*	*18*	*6*	
Patellofemoral	2,470	2,016	1,582	1,152	746	466	*219*	*60*	*14*	*<4*

Figure 3.K6 (c) KM estimates of cumulative re-revision by years to first revision, in linked primary knee replacements. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

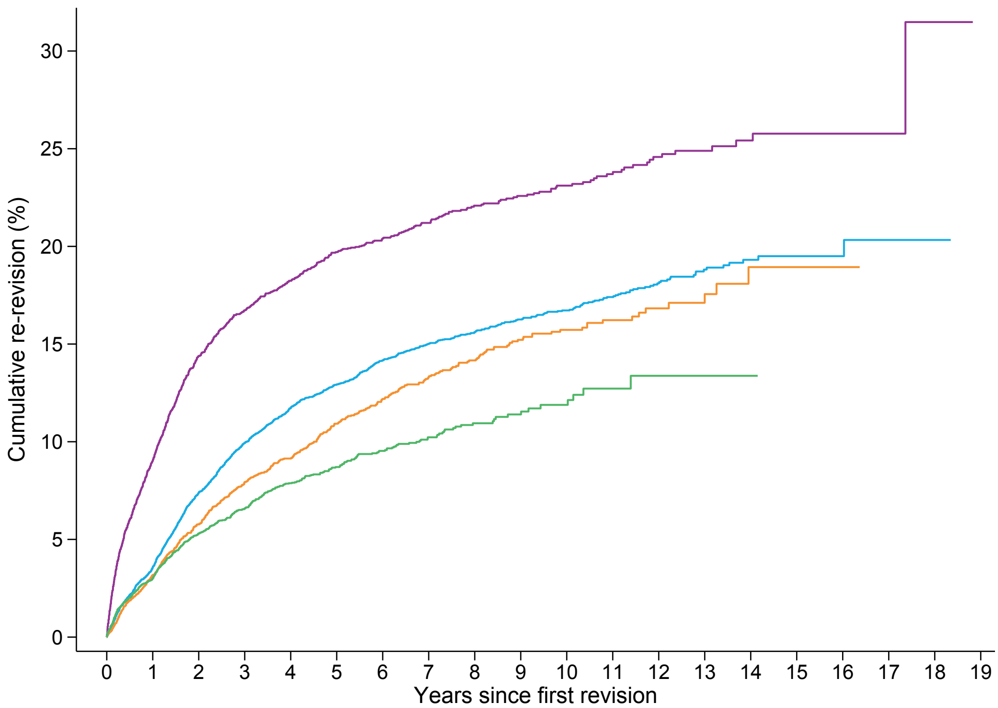
Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
First rev. <1y	7,331	6,166	5,481	4,944	4,227	3,656	3,144	2,666	2,224	1,870	1,533	1,219	962	674	440	262	*136*	*67*	*19*
First rev. 1 to 3y	15,960	14,827	13,551	12,505	11,029	9,720	8,424	7,125	5,974	4,935	3,997	3,034	2,240	1,467	870	459	*213*	*63*	*4*
First rev. 3 to 5y	8,612	7,681	6,852	6,229	5,347	4,495	3,768	3,118	2,555	1,993	1,531	1,014	640	355	*166*	*49*	*<4*		
First rev. ≥5y	15,619	12,884	10,830	9,432	7,485	5,719	4,212	2,992	2,015	1,278	777	381	*167*	*56*	*7*				

Figure 3.K6 (c) shows the relationship between time to first revision and risk of subsequent revision. The earlier the primary knee replacement is revised, the higher the risk of second revision. For example, if a primary knee replacement is revised within the first year of the primary replacement being performed, there is an 8.7% (95% CI 8.1-9.4) re-revision estimate at one year following the first revision, rising to 19.5% (95% CI 18.6-20.5) by five years; if a primary knee replacement is not revised until five years or more after the primary procedure, the re-revision rate is 2.4% (95% CI 2.1-2.7) at one year following the first revision, rising to 7.2% (95% CI 6.7-7.8) by five years.

For those with documented primary knee replacements within the registry, Figures 3.K7 (a) to (f) show cumulative re-revision rates following the first revision, according to the main type of primary knee replacement. We have further sub-divided each sub-group according to the time interval from the primary to the first revision, i.e. less than 1 year, 1 to <3, 3 to <5 and greater than or equal to 5 years. For cemented TKRs, uncemented TKRs, unicondylar and patellofemoral knee replacements, those who had their first revision within one year of the initial primary knee replacement experienced the worst re-revision rates. However, for hybrid TKRs, the worst re-revision rates were experienced by those who had their first revision within three to five years of the initial primary knee replacement. However, the numbers at risk were small in the hybrid group and therefore we advise that the results should be interpreted with caution.

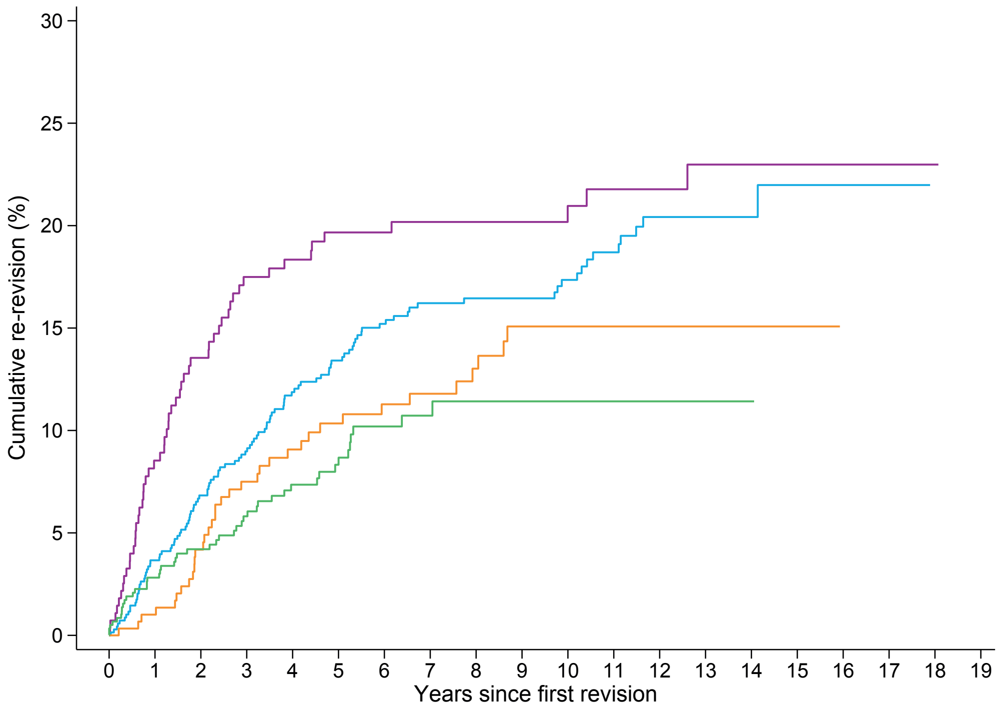
Figure 3.K7 (a) KM estimates of cumulative re-revision in primary cemented TKRs by years to first revision.
Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.



Numbers at risk

Key:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
First rev. <1y	5,272	4,374	3,854	3,458	2,924	2,484	2,089	1,733	1,403	1,145	904	687	519	344	*217*	*124*	*61*	*25*	*4*
First rev. 1 to 3y	11,252	10,378	9,420	8,621	7,512	6,488	5,475	4,557	3,720	2,984	2,339	1,747	1,279	813	479	*243*	*99*	*30*	*<4*
First rev. 3 to 5y	5,890	5,145	4,536	4,066	3,406	2,772	2,258	1,792	1,440	1,100	825	542	332	*185*	*91*	*26*	*<4*		
First rev. ≥5y	8,898	7,130	5,912	5,062	3,957	2,975	2,155	1,491	979	604	355	*174*	*74*	*24*	*<4*				

Figure 3.K7 (b) KM estimates of cumulative re-revision in primary uncemented TKRs by years to first revision. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



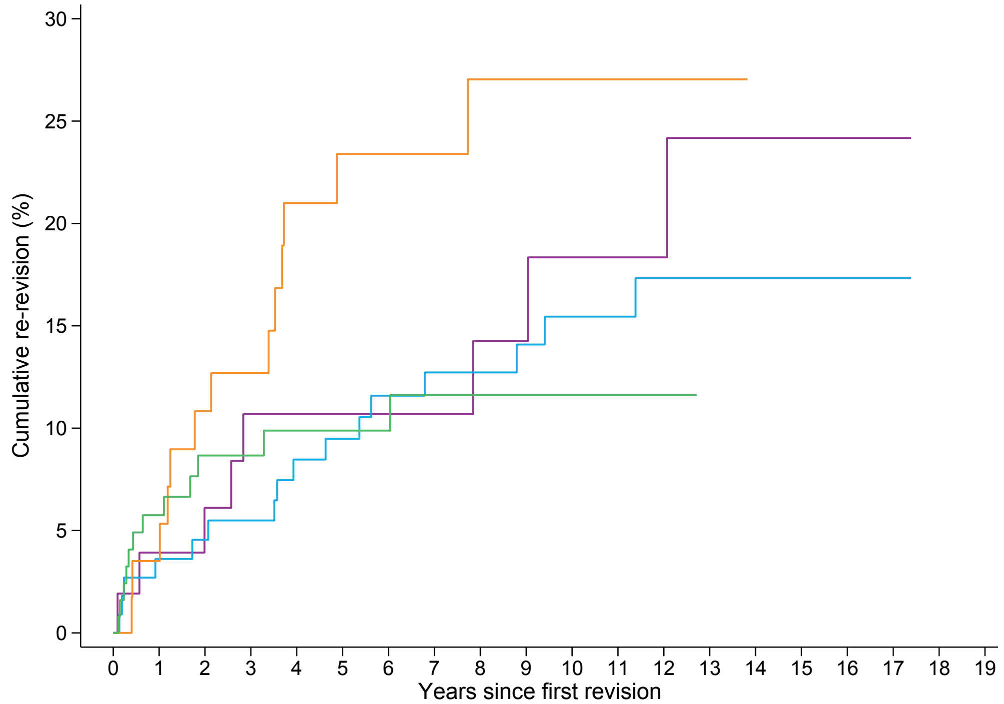
Key:

- First rev. <1y
- First rev. 1 to 3y
- First rev. 3 to 5y
- First rev. ≥5y

Numbers at risk

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
First rev. <1y	277	*238*	*221*	*205*	*190*	*178*	*158*	*144*	*134*	*119*	*101*	*86*	*72*	*55*	*35*	*24*	*13*	*6*	*<4*
First rev. 1 to 3y	690	650	612	584	526	496	446	383	350	310	267	*209*	*150*	*100*	*57*	*33*	*15*	*4*	
First rev. 3 to 5y	304	290	266	*245*	*224*	*200*	*183*	*162*	*139*	*110*	*81*	*52*	*29*	*16*	*6*	*<4*			
First rev. ≥5y	592	513	437	391	332	263	*194*	*130*	*95*	*54*	*36*	*17*	*11*	*<4*	*<4*				

Figure 3.K7 (c) KM estimates of cumulative re-revision in primary hybrid TKRs by years to first revision.
Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.



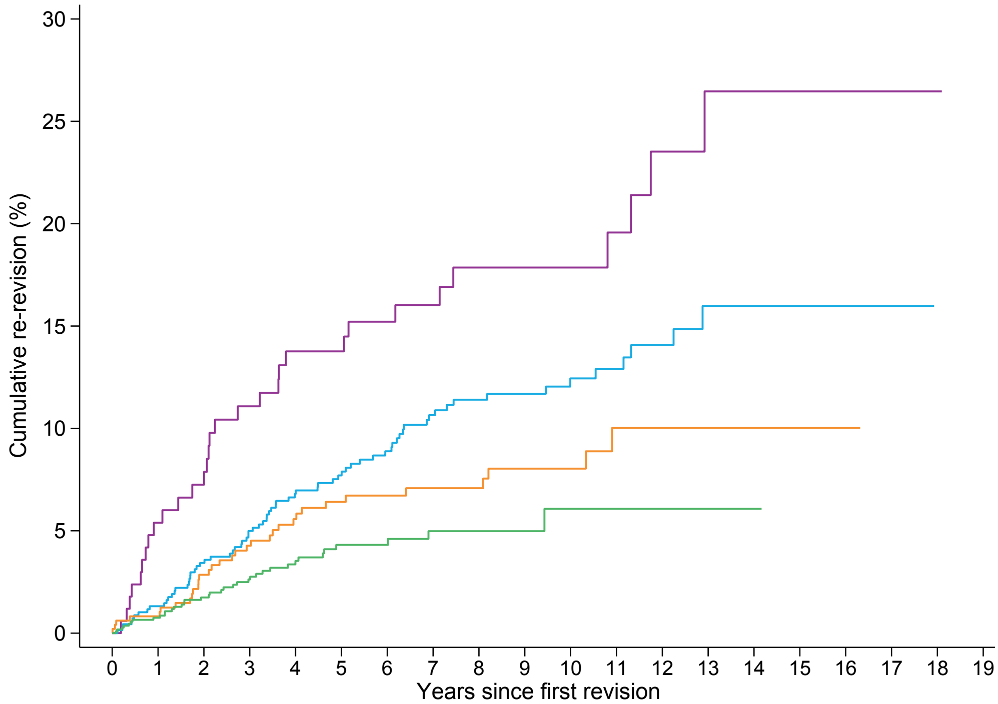
Key:

- First rev. <1y
- First rev. 1 to 3y
- First rev. 3 to 5y
- First rev. ≥5y

Numbers at risk

53	*48*	*43*	*37*	*36*	*36*	*32*	*28*	*24*	*21*	*18*	*17*	*14*	*10*	*6*	*<4*	*<4*	*<4*
112	*106*	*102*	*98*	*91*	*88*	*82*	*76*	*69*	*63*	*57*	*49*	*37*	*27*	*15*	*10*	*4*	*<4*
57	*53*	*48*	*43*	*38*	*32*	*29*	*24*	*20*	*17*	*14*	*10*	*6*	*4*				
126	*108*	*88*	*80*	*68*	*59*	*52*	*38*	*30*	*21*	*16*	*8*	*<4*					

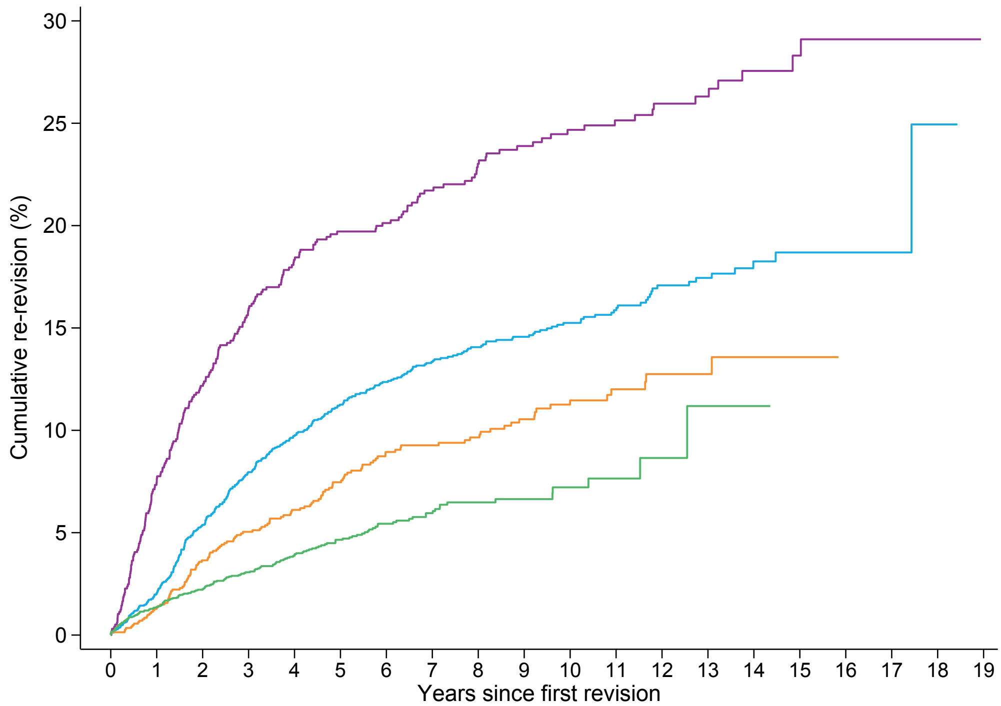
Figure 3.K7 (d) KM estimates of cumulative re-revision in primary patellofemoral knee replacements by years to first revision. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk

Key																			
First rev. <1y	*171*	*156*	*147*	*135*	*125*	*119*	*108*	*96*	*82*	*70*	*59*	*46*	*36*	*24*	*14*	*8*	*4*	*<4*	*<4*
First rev. 1 to 3y	698	666	631	599	544	489	444	374	314	267	*219*	*162*	*123*	*67*	*36*	*16*	*9*	*<4*	
First rev. 3 to 5y	489	462	418	392	345	304	270	*237*	*198*	*159*	*128*	*77*	*48*	*23*	*9*	*<4*	*<4*		
First rev. ≥5y	1,112	954	820	729	568	438	330	*242*	*152*	*103*	*60*	*26*	*12*	*<4*	*<4*				

Figure 3.K7 (e) KM estimates of cumulative re-revision in primary cemented unicondylar knee replacements by years to first revision. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

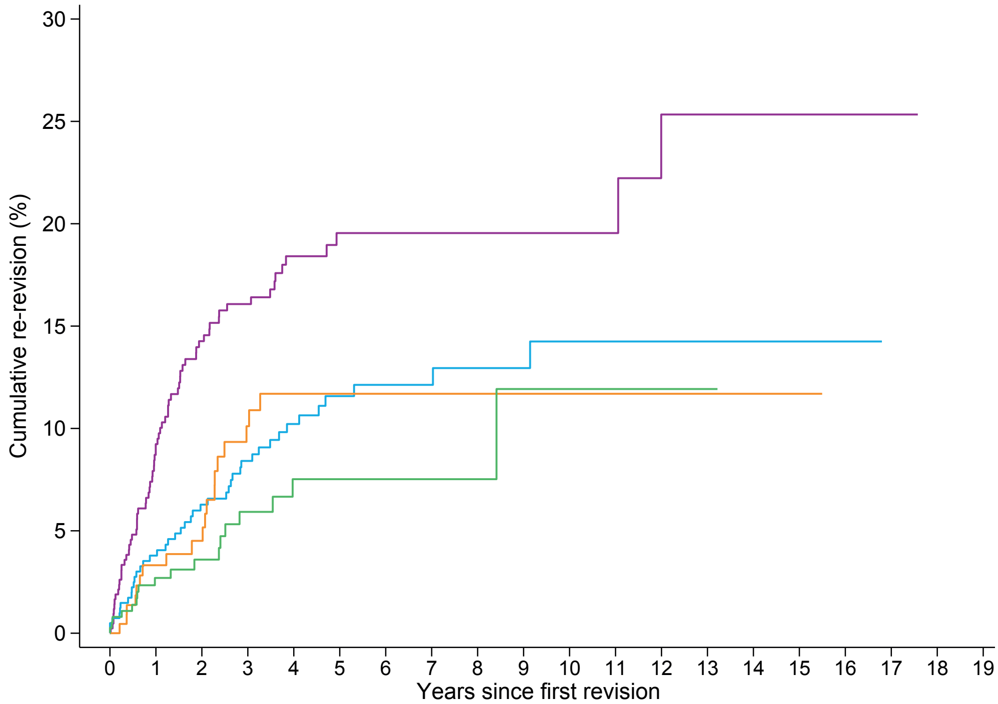


Key:

Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
First rev. <1y	975	870	803	741	664	610	573	516	457	408	354	303	255	*193*	*142*	*90*	*48*	*26*	*11*
First rev. 1 to 3y	2,459	2,345	2,164	2,034	1,882	1,743	1,599	1,411	1,242	1,071	913	722	550	400	*244*	*138*	*75*	*22*	*<4*
First rev. 3 to 5y	1,452	1,366	1,269	1,203	1,095	984	864	767	656	535	430	300	*202*	*111*	*53*	*18*			
First rev. ≥5y	3,996	3,440	2,981	2,664	2,180	1,691	1,275	948	661	429	271	*135*	*56*	*22*	*<4*				

Figure 3.K7 (f) KM estimates of cumulative re-revision in primary uncemented / hybrid unicondylar knee replacements by years to first revision. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
First rev. <1y	428	345	294	255	*187*	*135*	*101*	*71*	*52*	*43*	*40*	*31*	*24*	*15*	*7*	*<4*	*<4*	*<4*
First rev. 1 to 3y	407	362	325	288	*214*	*171*	*144*	*107*	*86*	*69*	*54*	*33*	*21*	*11*	*9*	*6*	*4*	
First rev. 3 to 5y	*227*	*184*	*145*	*116*	*88*	*65*	*46*	*31*	*24*	*18*	*13*	*6*	*5*	*4*	*<4*	*<4*		
First rev. ≥5y	380	271	*190*	*149*	*108*	*75*	*54*	*32*	*23*	*15*	*9*	*4*	*4*	*<4*				

Table 3.K15 (a) KM estimates of cumulative re-revision (95% CI). *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

	Number of first revised joints at risk of re-revision	Time since first revision					
		1 year	3 years	5 years	10 years	15 years	18 years
Primary recorded in the registry	47,522	3.71 (3.54-3.89)	8.88 (8.61-9.15)	11.63 (11.32-11.96)	15.37 (14.95-15.80)	18.46 (17.77-19.19)	*21.08 (18.05-24.55)*

Note: Data are not presented for 19 years due to low numbers.

Table 3.K15 (a) shows the re-revision rate of the 47,522 revised primary knee replacements (46,394 (97.6%) with known knee type at primary procedure) that are registered in the registry. Of these, 5,461 were re-revised.

Table 3.K15 (b) shows that primary knee replacements that are revised within the first year after surgery have approximately two to four times the chance of needing re-revision at each time point compared with primaries that last more than five years.

Table 3.K15 (b) KM estimates of cumulative re-revision (95% CI) by years since first revision. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Primary in the registry where the first revision took place:	Number of first revised joints at risk of re-revision	Time since first revision					
		1 year	3 years	5 years	10 years	15 years	18 years
<1 year after primary	7,331	8.68 (8.05-9.36)	16.50 (15.64-17.41)	19.53 (18.58-20.53)	23.04 (21.93-24.20)	26.21 (24.69-27.81)	*28.29 (24.67-32.32)*
1 to <3 years after primary	15,960	3.25 (2.98-3.54)	9.35 (8.89-9.83)	12.46 (11.93-13.01)	16.35 (15.69-17.03)	19.43 (18.47-20.44)	
3 to <5 years after primary	8,612	2.61 (2.29-2.98)	7.20 (6.64-7.81)	10.10 (9.42-10.84)	14.40 (13.46-15.41)	*16.91 (15.27-18.72)*	
≥5 years after primary*	15,619	2.40 (2.16-2.66)	5.28 (4.90-5.68)	7.16 (6.70-7.66)	9.91 (9.15-10.74)		

*The maximum of this interval was 19.5 years.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Data are not presented for 19 years due to low numbers.

Table 3.K15 (c) shows cumulative re-revision rates at 1, 3, 5, 10 and 15 years following the first revision for those with documented primary knee replacements within the registry, broken down by type of knee replacement, constraint, mobility and whether a patellar component was recorded. Overall, the worst re-revision rates were demonstrated in those where the initial primary had been a cemented TKR, hybrid TKR or an uncemented unicondylar although the confidence intervals broadly overlap after five years in the cemented TKR group and earlier in the other groups.

Table 3.K15 (c) KM estimates of cumulative re-revision (95% CI) by fixation and constraint and whether a patella component was recorded. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Fixation, constraint and bearing type	N	Time since first revision: 1 year	3 years	5 years	10 years	15 years
All types	**47,522**	**3.71 (3.54-3.89)**	**8.88 (8.61-9.15)**	**11.63 (11.32-11.96)**	**15.37 (14.95-15.80)**	**18.46 (17.77-19.19)**
Unconfirmed	**1,128**	**3.09 (2.22-4.30)**	**8.92 (7.33-10.82)**	**11.20 (9.38-13.34)**	**13.32 (11.19-15.81)**	*15.12 (12.29-18.52)*
Cemented	**31,312**	**4.27 (4.05-4.51)**	**9.89 (9.54-10.24)**	**12.70 (12.29-13.11)**	**16.54 (16.00-17.09)**	**19.37 (18.49-20.28)**
unconstrained, fixed, with patella	5,969	5.34 (4.79-5.96)	10.99 (10.17-11.87)	13.54 (12.60-14.55)	17.23 (16.00-18.55)	*20.01 (17.99-22.23)*
unconstrained, fixed, without patella	13,420	3.69 (3.38-4.03)	9.24 (8.73-9.77)	12.21 (11.60-12.84)	15.35 (14.58-16.16)	*17.51 (16.38-18.72)*
unconstrained, mobile, with patella	460	4.26 (2.74-6.60)	13.11 (10.22-16.74)	*16.36 (13.06-20.39)*	*23.64 (19.23-28.86)*	*23.64 (19.23-28.86)*
unconstrained, mobile, without patella	1,112	3.91 (2.91-5.26)	9.65 (7.98-11.64)	13.16 (11.16-15.48)	19.61 (16.92-22.67)	*21.25 (17.78-25.29)*
posterior-stabilised, fixed, with patella	3,904	5.07 (4.41-5.82)	10.62 (9.62-11.70)	13.59 (12.43-14.86)	17.48 (15.94-19.15)	*23.08 (19.65-27.01)*
posterior-stabilised, fixed, without patella	5,082	3.52 (3.04-4.08)	9.00 (8.20-9.87)	11.39 (10.46-12.40)	15.77 (14.46-17.18)	*18.31 (16.35-20.46)*
posterior-stabilised, mobile, with patella	289	*7.20 (4.70-10.94)*	*13.57 (9.97-18.34)*	*13.57 (9.97-18.34)*	*18.07 (13.39-24.14)*	
posterior-stabilised, mobile, without patella	256	*5.24 (3.07-8.85)*	*10.48 (7.20-15.12)*	*15.68 (11.48-21.23)*	*19.61 (14.71-25.89)*	
constrained condylar, with patella	126	*5.81 (2.81-11.82)*	*12.84 (7.56-21.36)*	*12.84 (7.56-21.36)*		
constrained condylar, without patella	210	*4.65 (2.44-8.75)*	*10.21 (6.53-15.78)*	*12.89 (8.49-19.31)*	*14.21 (9.37-21.23)*	
monobloc polyethylene tibia, with patella	61	*3.36 (0.85-12.80)*	*13.41 (6.60-26.18)*	*15.63 (8.10-28.97)*		
monobloc polyethylene tibia, without patella	281	*5.23 (3.13-8.67)*	*8.48 (5.66-12.61)*	*10.37 (7.16-14.89)*	*14.31 (9.76-20.72)*	
pre-assembled/hinged/linked, without patella	105	*12.72 (7.59-20.91)*	*14.85 (9.22-23.44)*	*21.38 (14.24-31.37)*		
Uncemented	**1,863**	**3.70 (2.92-4.68)**	**9.12 (7.85-10.59)**	**12.45 (10.93-14.15)**	**16.06 (14.21-18.13)**	*19.33 (16.54-22.53)*
unconstrained, fixed, with patella	99	*8.70 (4.44-16.66)*	*8.70 (4.44-16.66)*	*12.87 (7.29-22.18)*	*17.23 (10.08-28.56)*	
unconstrained, fixed, without patella	645	3.20 (2.08-4.92)	9.86 (7.71-12.58)	14.07 (11.43-17.26)	*17.42 (14.31-21.12)*	*18.68 (15.23-22.79)*

Note: Maximum follow-up period was 18.9 years.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Data are not presented for 19 years due to low numbers.

Table 3.K15 (c) (continued)

Fixation, constraint and bearing type	N	Time since first revision				
		1 year	3 years	5 years	10 years	15 years
unconstrained, mobile, with patella	57	*1.75 (0.25-11.81)*	*7.50 (2.88-18.80)*	*9.65 (4.12-21.73)*	*14.97 (6.28-33.35)*	
unconstrained, mobile, without patella	880	4.19 (3.04-5.76)	8.48 (6.77-10.60)	11.19 (9.18-13.61)	*15.34 (12.76-18.38)*	*18.09 (14.74-22.10)*
posterior-stabilised, fixed, with patella	50	*2.00 (0.28-13.36)*	*13.15 (6.12-26.99)*	*18.28 (9.54-33.41)*	*18.28 (9.54-33.41)*	
posterior-stabilised, fixed, without patella	130	*0.78 (0.11-5.37)*	*9.52 (5.38-16.57)*	*11.65 (6.91-19.30)*	*12.85 (7.77-20.85)*	
Hybrid	**348**	**4.41 (2.68-7.20)**	**8.64 (6.04-12.29)**	***12.41 (9.17-16.70)***	***17.47 (13.22-22.89)***	***19.94 (14.86-26.46)***
unconstrained, fixed, with patella	65	*4.67 (1.53-13.78)*	*9.66 (4.45-20.26)*	*11.46 (5.62-22.59)*	*14.23 (7.23-26.95)*	
unconstrained, fixed, without patella	155	*5.26 (2.67-10.25)*	*6.75 (3.68-12.19)*	*11.49 (7.18-18.13)*	*18.88 (12.55-27.87)*	
unconstrained, mobile, without patella	65	*4.79 (1.57-14.12)*	*10.22 (4.71-21.42)*	*15.43 (7.87-29.03)*	*15.43 (7.87-29.03)*	
Unicondylar, cemented	**8,882**	**2.25 (1.95-2.58)**	**6.36 (5.85-6.92)**	**8.97 (8.34-9.65)**	**12.87 (12.01-13.78)**	***16.45 (14.97-18.07)***
fixed	2,029	2.30 (1.72-3.08)	7.36 (6.22-8.72)	10.10 (8.69-11.72)	14.75 (12.70-17.11)	*22.95 (17.30-30.10)*
mobile	6,154	2.33 (1.98-2.75)	6.21 (5.61-6.87)	8.71 (7.97-9.50)	12.52 (11.53-13.58)	*15.80 (14.16-17.61)*
monobloc polyethylene tibia	699	1.35 (0.70-2.58)	5.09 (3.62-7.12)	8.32 (6.34-10.88)	*11.48 (8.92-14.72)*	*13.04 (9.85-17.16)*
Unicondylar, uncemented/hybrid	**1,442**	**5.10 (4.04-6.42)**	**10.43 (8.80-12.34)**	**13.21 (11.26-15.47)**	***14.89 (12.41-17.81)***	
fixed	90	*2.44 (0.62-9.43)*	*9.76 (4.76-19.47)*	*9.76 (4.76-19.47)*	*16.23 (8.18-30.74)*	
mobile	1,307	5.38 (4.24-6.81)	10.55 (8.84-12.57)	13.45 (11.38-15.88)	*14.15 (11.89-16.80)*	
monobloc polyethylene tibia	45	*2.38 (0.34-15.72)*	*7.88 (2.60-22.57)*	*14.13 (6.09-30.88)*		
Patellofemoral	**2,470**	**1.26 (0.88-1.79)**	**4.31 (3.54-5.26)**	**6.53 (5.52-7.71)**	**9.64 (8.22-11.29)**	***13.78 (11.07-17.09)***
Multicompartmental	**77**	***5.30 (2.02-13.52)***	***11.03 (5.67-20.88)***	***14.39 (7.97-25.20)***	***23.75 (13.67-39.36)***	

Note: Maximum follow-up period was 18.9 years.
Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Data are not presented for 19 years due to low numbers.

3.3.8 Reasons for knee re-revision

Table 3.K16 (a) Number of revisions by indication for all revisions.

Reason for revision	All recorded revisions, N (%)
Aseptic loosening / Lysis	32,616 (33.0)
Infection	23,475 (23.8)
Instability	14,269 (14.4)
Pain	11,545 (11.7)
Implant wear	11,513 (11.7)
Malalignment	5,792 (5.9)
Periprosthetic fracture	4,175 (4.2)
Dislocation / Subluxation	3,467 (3.5)
Other indication	9,416 (9.5)
Stiffness*	4,694 (4.8)
Progressive arthritis**	11,336 (12.9)

*Stiffness as a reason for revision was not recorded in MSDv1 and as such was only a potential reason for revision among a total of 97,867 revisions as opposed to 98,791 revisions for the other reasons.
**Progressive arthritis as a reason for revision was not recorded in MSDv1 or MSDv2 and as such was only a potential reason for revision among a total of 88,118 revisions, as opposed to 98,791 revisions for the other reasons.

Table 3.K16 (b) Number of revisions by indication for first linked revision and second linked re-revision.

	First linked revision		Second linked revision
Reason for revision	N	Subsequently re-revised, N (%)	N
Aseptic loosening / Lysis	12,706	1,294 (10.2)	1,342
Infection	9,220	1,802 (19.5)	2,176
Instability	6,726	725 (10.8)	931
Pain	6,457	756 (11.7)	497
Implant wear	3,331	306 (9.2)	231
Malalignment	3,239	302 (9.3)	276
Periprosthetic fracture	2,015	146 (7.2)	149
Dislocation / Subluxation	1,705	255 (15.0)	237
Other indication	4,940	527 (10.7)	400
Stiffness*	2,778	331 (11.9)	326
Progressive arthritis**	6,157	309 (5.0)	163

*Stiffness as a reason for revision was not recorded in MSDv1 and as such was only a potential reason for revision among a total of 46,352 revisions as opposed to 47,522 revisions for the other reasons.
**Progressive arthritis as a reason for revision was not recorded in MSDv1 or MSDv2 and as such was only a potential reason for revision among a total of 35,778 revisions, as opposed to 47,522 revisions for the other reasons.

Tables 3.K16 (a) and (b) show a breakdown of the stated indications for the first revision and for any second revision. Please note the indications are not mutually exclusive. Table 3.K16 (a) shows the indications for all knee revisions recorded in the registry and Table 3.K16 (b) reports the indications for the first linked revision and the number and percentage of first recorded revisions that were subsequently re-revised. The final column reports the indications for all the second linked revisions. It is interesting to note that infection, dislocation / subluxation, instability and stiffness are more common indications for second revision than for a first revision. This reflects the factors that infection, surgical complexity and soft tissue elements contribute to the outcome of revision knee replacement.

Table 3.K17 (a) Number of revisions by year.

Year of first revision in the registry*	Number of first revisions	Number of first revisions (%) with the associated primary recorded in the registry
2003	633	12 (1.9)
2004	1,191	84 (7.1)
2005	1,860	282 (15.2)
2006	2,343	511 (21.8)
2007	3,166	888 (28.0)
2008	3,815	1,395 (36.6)
2009	4,194	1,834 (43.7)
2010	4,611	2,214 (48.0)
2011	4,692	2,368 (50.5)
2012	5,298	2,983 (56.3)
2013	4,912	2,853 (58.1)
2014	5,256	3,247 (61.8)
2015	5,419	3,535 (65.2)
2016	5,514	3,783 (68.6)
2017	5,610	3,991 (71.1)
2018	5,532	4,120 (74.5)
2019	5,757	4,374 (76.0)
2020	3,192	2,443 (76.5)
2021	4,093	3,161 (77.2)
2022	4,361	3,444 (79.0)
Total	**81,449**	**47,522 (58.3)**

*First documented revision in the registry.

Table 3.K17 (b) Number of revisions by year, stage, and whether or not primary is recorded in the registry.

Year of (first) revision	Single-stage		First documented stage of two-stage	
	Primary not in the registry total per year	Primary in the registry total per year	Primary not in the registry total per year	Primary in the registry total per year
2003	5	<4	616	10
2004	657	48	450	36
2005	1,245	204	333	78
2006	1,494	386	338	125
2007	1,878	672	400	216
2008	2,037	1,095	383	300
2009	1,982	1,506	378	328
2010	2,050	1,820	347	394
2011	2,034	1,939	290	429
2012	2,059	2,516	256	467
2013	1,821	2,419	238	434
2014	1,798	2,750	211	497
2015	1,699	3,050	185	485
2016	1,569	3,343	162	440
2017	1,477	3,530	142	461
2018	1,315	3,678	97	442
2019	1,288	3,951	95	423
2020	680	2,155	69	288
2021	873	2,863	59	298
2022	844	3,127	73	317
Total	**28,805**	**41,054**	**5,122**	**6,468**

Tables 3.K17 (a) and (b) show that the numbers of revisions and the relative proportion of revisions with an associated primary in the registry increased with time. The number of revisions peaked in 2019 (5,757) before the impact of COVID. The number of revisions has only partly recovered to 4,361 in 2022. Almost 80% of those revisions performed in 2022 had a linked primary in the registry. We propose that this is likely to reflect improved data capture over time, improved linkability of records and the longevity of knee replacements, with a proportion of primaries being revised having been performed before registry data capture began or are outside the coverage of the registry.

3.3.9 90-day mortality after knee revision

The overall cumulative percentage probability of mortality at 90 days after knee revision was lower in the cases with their primaries documented in the registry compared with the remainder (Kaplan-Meier estimates 0.82% (95% CI 0.74-0.91) versus 1.08% (95% CI 0.98-1.20)), which may reflect the fact that this patient group was younger at the time of their first revision, with a median age of 68 (IQR 61 to 75) years, compared to the group without primaries documented in the registry who had a median age of 73 (IQR 65 to 79) years. The percentage of males was similar in both groups (45.1% versus 46.7% respectively).

3.3.10 Conclusions

There are now over 1.4 million primary knee replacements recorded in the registry with a maximum follow-up of 19.75 years, making this the largest dataset of its kind in the world. Of these, 96.7% of the procedures were performed for osteoarthritis as the only indication. Approximately 88% of the procedures are TKRs, 10% medial or lateral unicondylar knee replacements and 1% patellofemoral replacements. These overall proportions have remained relatively constant over time but the annual proportion of unicondylar knee replacements has risen since 2013, reaching approximately 10% for the first time in 2017 and rising to 13.4% in 2021. The popularity of uncemented unicondylar replacements has risen relatively rapidly. These made up less than 1% of knee replacements in 2010 and now account for 7.3%, that is over a third of the unicondylar knee replacements performed. This increase in the proportion of primary knee procedures that are unicondylar knee replacements is supported by recent guidance from NICE published in 2020 and Quality Standards published by NICE in 2022 (NICE,2020; NICE,2022). Cemented, unconstrained (cruciate retaining), fixed bearing TKR remains by far the most common type of knee replacement, followed by cemented, posterior stabilised, fixed bearing TKR. Patients who received unicondylar or patellofemoral knee replacement were typically younger than those receiving a TKR. Both TKR and patellofemoral replacement are more likely to be performed on females, whereas unicondylar knee replacement is more likely to be performed on males.

TKRs with a monobloc polyethylene tibia consistently show some of the lowest unadjusted revision rates, although the numbers at risk beyond 15 years are small, so must be interpreted with caution. Cemented TKRs that are unconstrained with a fixed bearing, as well as being the most common type of TKR, consistently show low revision rates in comparison to alternatives; unadjusted revision rates are approximately one percentage point lower in comparison to cemented unconstrained TKRs with a mobile bearing and cemented TKRs that are posterior stabilised, with either a fixed or mobile bearing at 15 years.

Age and gender are associated with the risk of revision surgery. Younger patients and males are more likely to undergo revision and it has previously been felt that this may explain the higher revision rates observed in UKR. We present results divided by gender and age group and these show the risk of revision of a cemented unicondylar knee replacement is at least two times higher in males and 2.4 times higher in females at ten years than a cemented TKR. The distinction of uncemented unicondylar knee replacements shows that revision rates are lower than for cemented unicondylar replacements but remain higher than for cemented TKR. The risk of revision of a patellofemoral replacement is at least 2.9 times higher in both males and females than a cemented TKR across all age groups at ten years and the results of multicompartmental knee replacements show similarly high revision rates.

The most common causes of revision across all primary knee replacements were for aseptic loosening / lysis, infection and progressive arthritis. For uncemented TKRs, the incidence of revision for infection was lower than for cemented TKRs but higher for nearly all other indications. Progression of osteoarthritis elsewhere in the knee is also the fourth most common indication for revision knee replacement. The risk of revision for progressive arthritis, aseptic loosening / lysis and pain were all higher for UKRs than TKRs, but the risk of revision for infection was lower. For cemented unicondylar knee replacements, the highest risk of revision was for progressive arthritis, aseptic loosening / lysis and pain. For uncemented unicondylar knee replacements, the second most common indication was dislocation / subluxation rather than aseptic loosening / lysis which is now the third most common reason. The incidence of revision for indications such as pain and aseptic loosening / lysis was lower for uncemented unicondylar than for cemented, but higher for dislocation / subluxation and periprosthetic fractures.

Infection accounts for the majority of the two-stage revision procedures performed. Approximately 8% of revisions for infection that have been recorded in the registry to date have been single-stage procedures.

https://www.nice.org.uk/guidance/ng157/chapter/Recommendations#procedures-for-primary-elective-knee-replacement
https://www.nice.org.uk/guidance/qs206/chapter/Statement-2-Choice-between-partial-and-total-knee-replacement

At this time, the single-stage group includes DAIR procedures so this indicates low usage and take-up of single-stage revision in the treatment of knee prosthetic joint infection. The soft tissue envelope makes single-stage knee revision surgery potentially more challenging than that in the hip, which may explain the differences in utilisation of a single-stage approach.

The risk of re-revision following a revision procedure is higher than the risk of revision of a primary TKR across all types of knee replacement. The risk of re-revision of a revised patellofemoral replacement is slightly lower than the other types of knee, with the rest being broadly similar. This suggests that caution should be exercised when proposing that a UKR may be considered as an interim procedure or a lesser intervention than a TKR, as the unadjusted re-revision rates are worse than the revision rates for primary TKR, and are broadly similar regardless of the type of the knee replacement implanted at the primary procedure. The risk of re-revision is higher for those revised after a shorter period of time following the primary and is associated with the specific indication for revision. This suggests that not all of the processes that lead to revision are the same and that some have greater impact than others with consequences beyond the initial revision.

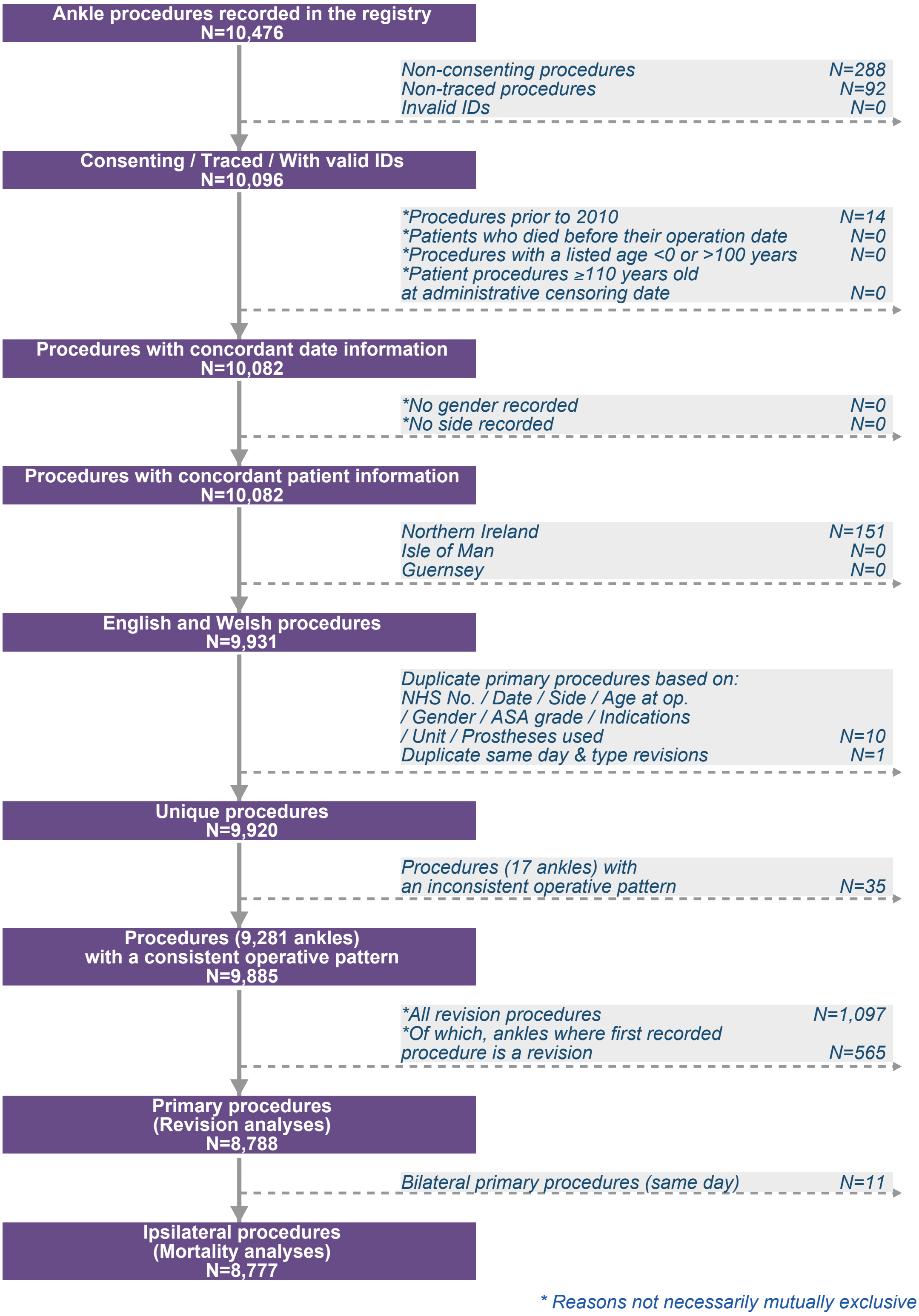
Knee replacement remains a safe procedure with low rates of peri-operative mortality. The rates of mortality are higher for males than those for females. The average age of a patient undergoing a TKR is approximately 70 years; approximately 56% of males and 46% of females in the 70 to 74 age bracket will have died within 15 years of their knee replacement. This means that for the average patient undergoing a knee replacement, their knee replacement should last them for the rest of their life, without the need for revision surgery.

3.4 Outcomes after ankle replacement

3.4.1 Overview of primary ankle replacement surgery

In this section of the report, we look at revision and mortality for all primary ankle operations submitted to the registry from 1 January 2010 up to 31 December 2022. There were, after data cleaning, 8,788 primary ankle operations available for analysis on 8,334 patients. A total of 454 patients had bilateral operations (11 had both sides operated on the same day). All of this information can be seen in the patient flow diagram in Figure 3.A1 on page 227.

Figure 3.A1 Ankle cohort flow diagram.



The median age at primary surgery was 69 years (IQR 62 to 75 years), with an overall range of 17 to 97 years. More procedures were performed in men (59.9%) than in women.

All ankle replacement brands recorded in the registry are uncemented implants, but cement can be used occasionally by surgeons in circumstances such as poor bone stock or low demand patients. Of the 8,788 primary procedures, a total of 8,424 (95.9%) procedures were implanted without cement being listed in the component data. Cement was listed in 364 (4.1%) of primary procedures. Of all total ankle replacement (TAR) procedures, 204 (2.3%) were defined as unconfirmed. Procedures were defined as unconfirmed when they either had insufficient elements to form a coherent construct or they contained custom-made prostheses. Figure 3.A2 illustrates the temporal changes in fixation of primary ankle replacements.

Figure 3.A2 Fixation by year of primary ankle replacement.

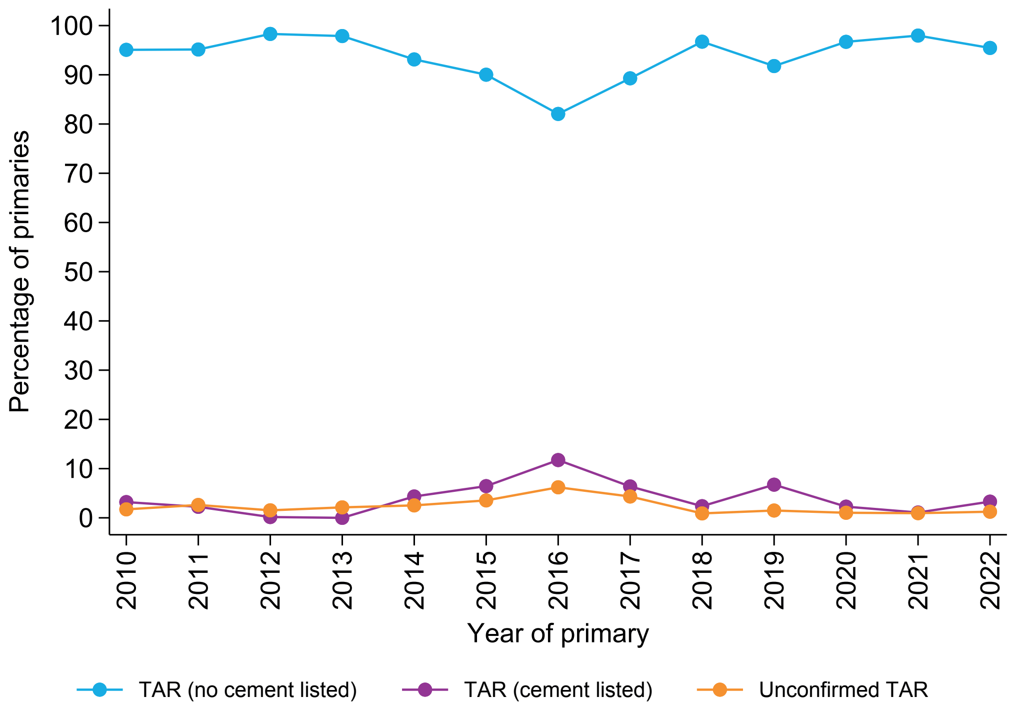


Figure 3.A3 describes the funding status and organisation type (based on organisation type in 2023) of ankle replacement procedures collected by the NJR. Prior to 2020 (COVID) we can see an increase in the absolute number of ankle replacements being provided, which in part is being facilitated by an expansion of NHS funded procedures in both the NHS and the independent sector. Since 2020 we can see that the recovery of ankle replacements is due to an expansion of provision within NHS hospitals as well as a substantial increase in the number of independently funded procedures compared to pre-2020 data.

Figure 3.A3 Frequency of elective primary ankle replacements by funding status and organisation type, per year.

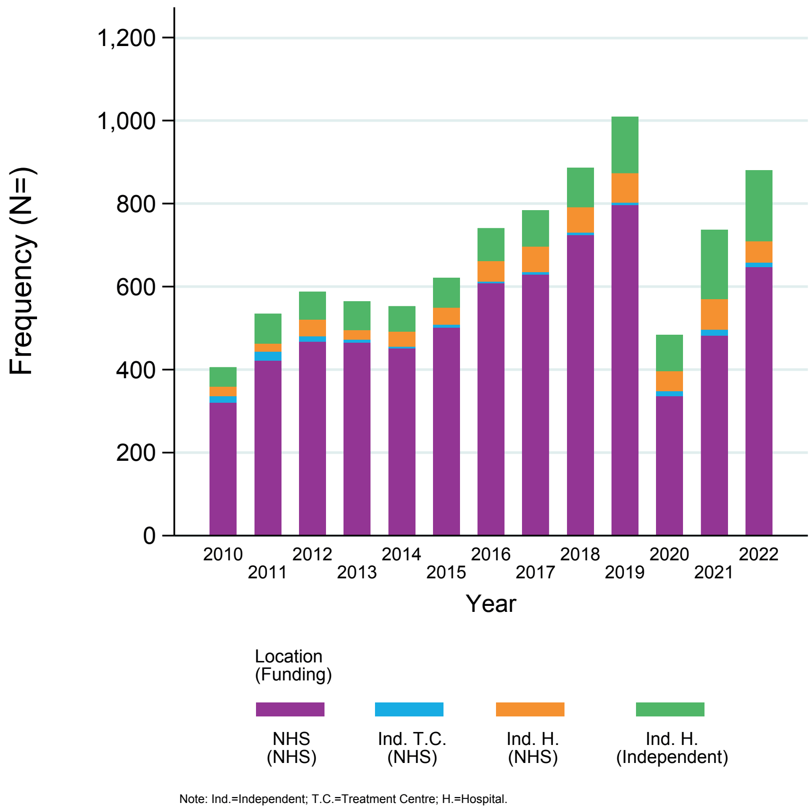


Figure 3.A4 and Figure 3.A5 (page 231) show the yearly number of primary ankle replacements performed for all indications and ankle replacements stratified by fixed and mobile bearings, please note the difference in scale of the y-axis between each plot. Each bar in the figure is further stratified by the volume of procedures that the surgeon conducted in that year, and when procedures are stratified by fixed and mobile bearings the volume of procedures is calculated separately. For example, if a surgeon performed 25 primary ankle replacement procedures, their procedures would have contributed to the grey sub-division in Figure 3.A4. If those procedures consisted of 12 fixed bearings and 13 mobile bearings, those procedures would be represented by green and purple bars respectively in Figure 3.A5.

Figure 3.A4 shows the volume of primary ankle replacements recorded in the registry increasing since 2015 (except for a large drop in 2020 due to the impact of COVID, with numbers not fully recovering since then). The majority of additional procedures were contributed to the registry by higher-volume ankle surgeons i.e. surgeons who perform more than 13 TAR procedures annually.

Figure 3.A5 illustrates that the expansion of TAR procedures has largely been of a fixed bearing design and that the use of mobile bearing has steadily been decreasing. Many of the changes in bearing use are due to the voluntary withdrawal of the Mobility implant in 2014 and the introduction of the Infinity in the same year.

Figure 3.A4 Frequency of primary ankle replacements, bars stacked by volume per consultant per year.

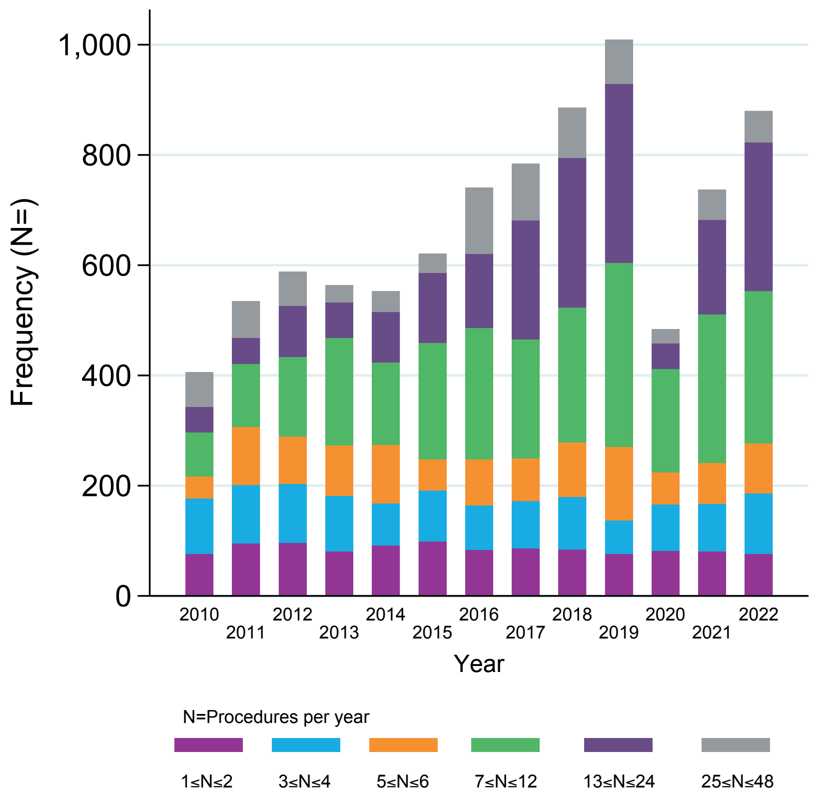


Figure 3.A5 Frequency of primary ankle replacements stratified by fixed and mobile bearings, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

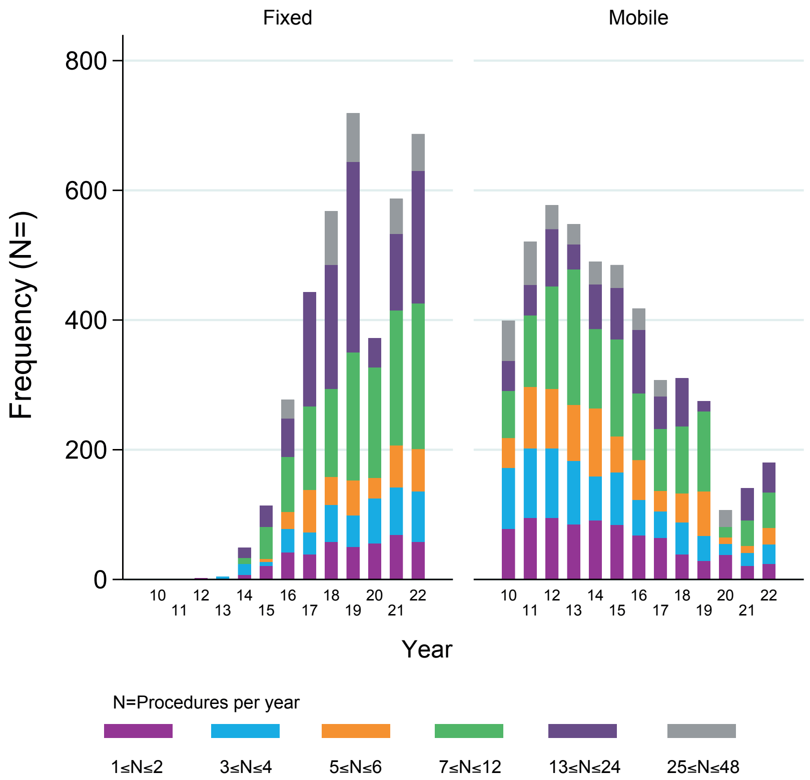


Table 3.A1 Descriptive statistics of ankle procedures performed by consultant and unit by year of surgery.

Number of primary replacements during each year	Year of surgery												
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of procedures in year	**406**	**535**	**588**	**564**	**553**	**621**	**741**	**784**	**886**	**1,009**	**484**	**737**	**880**
Units (N)	104	127	145	134	140	143	144	146	150	161	130	144	161
Mean number of primary replacements per unit	3.9	4.2	4.1	4.2	4.0	4.3	5.1	5.4	5.9	6.3	3.7	5.1	5.5
Primary replacements per unit Median (IQR)	2 (1 to 4)	2 (1 to 5)	2 (1 to 5)	2 (1 to 5)	2 (1 to 4)	2 (1 to 5)	2 (1 to 6.5)	3 (1 to 6)	3 (1 to 7)	3 (2 to 8)	2 (1 to 5)	3 (2 to 6.5)	3 (1 to 7)
Units who entered ≥10 operations (N)	10	10	13	12	11	10	20	18	24	31	9	20	23
Units who entered ≥20 operations (N)	3	3	4	4	4	6	7	6	8	6	2	5	7
Consultants providing operation (N)	107	126	143	134	126	142	137	142	148	156	121	139	154
Mean number of primary replacements per consultant	3.8	4.2	4.1	4.2	4.4	4.4	5.4	5.5	6.0	6.5	4.0	5.3	5.7
Primary replacements per consultant Median (IQR)	2 (1 to 4)	3 (2 to 5)	3 (1 to 5)	3 (1 to 5)	3 (2 to 5)	2 (1 to 6)	3 (2 to 8)	3 (1 to 8)	4 (2 to 8)	5 (2 to 9)	3 (1 to 5)	3 (1 to 7)	4 (2 to 8)
Consultants who entered ≥10 operations (N)	10	11	12	13	10	16	21	29	32	36	9	24	25
Consultants who entered ≥20 operations (N)	2	3	2	2	2	4	5	7	6	5	1	5	6

Note: IQR=interquartile range.

Table 3.A1 shows the number of annually reported cases over the 12-year observation period. In 2019 there were just over one thousand ankle replacement procedures being performed annually. The COVID pandemic resulted in a reduction of procedures with approximately half the volume of procedures being conducted in 2020 compared to 2019. The volume of procedures has again started to increase. The observed increases in 2021 and 2022 largely reflect services recovering from the disruption associated with the pandemic.

A total of 314 consultants carried out the 8,788 reported primary procedures over the 12-year period. The annual mean number of procedures per consultant was 3.8 in 2010 and 5.7 in 2022 and 3.9% of consultants performed 20 or more primary ankle replacements in 2022, with a further 12.3% performing between 10 and 19 primary ankle replacements. Of the 290 units who submitted data to the registry, 11 (3.8%) had carried out 20 or more procedures since the start of data collection. The percentage of units submitting 20 or more ankle primary operations each year does not exceed 5.3% (2018) and was 4.3% in 2022. The number of units submitting more than 20 primary ankle procedures per year has changed from three in 2010 to seven in 2022 and the mean number of primary replacements per unit has also changed from 3.9 to 5.5 respectively across the same time-period.

Table 3.A2 Number and percentage of primary ankle replacements by ankle brand.

Brand	Number of primaries (%)	Number (%) of each brand, for each year of operation												
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Akile	45 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (0.6)	9 (1.2)	12 (1.5)	11 (1.2)	8 (0.8)	<4 (0.2)	0 (0)	0 (0)
Box	810 (9.2)	25 (6.2)	28 (5.2)	47 (8.0)	53 (9.4)	83 (15.0)	134 (21.6)	126 (17.0)	109 (13.9)	103 (11.6)	80 (7.9)	22 (4.5)	0 (0)	0 (0)
CCI	<4 (0.0)	0 (0)	0 (0)	<4 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Cadence	105 (1.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (0.4)	9 (1.1)	15 (1.7)	24 (2.4)	11 (2.3)	23 (3.1)	20 (2.3)
Cremascoli[Talar] [Tibial]	<4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (0.1)	0 (0)
FAR	<4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (0.1)	<4 (0.2)
Hintegra	301 (3.4)	9 (2.2)	17 (3.2)	35 (6.0)	67 (11.9)	47 (8.5)	54 (8.7)	33 (4.5)	9 (1.1)	14 (1.6)	11 (1.1)	0 (0)	0 (0)	5 (0.6)
Hintegra[Talar] [Tibial]	<4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (0.3)
Inbone	182 (2.1)	0 (0)	0 (0)	<4 (0.3)	4 (0.7)	16 (2.9)	<4 (0.5)	26 (3.5)	25 (3.2)	27 (3.0)	18 (1.8)	11 (2.3)	28 (3.8)	22 (2.5)
Inbone[Talar] Infinity[Tibial]	334 (3.8)	0 (0)	0 (0)	0 (0)	0 (0)	5 (0.9)	16 (2.6)	30 (4.0)	31 (4.0)	35 (4.0)	52 (5.2)	34 (7.0)	54 (7.3)	77 (8.8)
Infinity	3,192 (36.3)	0 (0)	0 (0)	0 (0)	0 (0)	28 (5.1)	95 (15.3)	213 (28.7)	378 (48.2)	489 (55.2)	623 (61.7)	316 (65.3)	482 (65.4)	568 (64.5)
Infinity[Talar] Inbone[Tibial]	<4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (0.1)	<4 (0.2)	0 (0)	0 (0)	0 (0)
Mobility	1,136 (12.9)	254 (62.6)	306 (57.2)	286 (48.6)	204 (36.2)	86 (15.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rebalance	63 (0.7)	0 (0)	4 (0.7)	14 (2.4)	13 (2.3)	7 (1.3)	4 (0.6)	13 (1.8)	7 (0.9)	<4 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Salto	332 (3.8)	22 (5.4)	29 (5.4)	40 (6.8)	45 (8.0)	56 (10.1)	55 (8.9)	44 (5.9)	9 (1.1)	11 (1.2)	11 (1.1)	4 (0.8)	<4 (0.3)	4 (0.5)
Star	774 (8.8)	14 (3.4)	28 (5.2)	30 (5.1)	34 (6.0)	59 (10.7)	74 (11.9)	84 (11.3)	100 (12.8)	95 (10.7)	88 (8.7)	52 (10.7)	51 (6.9)	65 (7.4)
Trabecular Metal Total	6 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (0.7)	0 (0)	<4 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Vantage	137 (1.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	17 (1.7)	4 (0.8)	51 (6.9)	65 (7.4)
Zenith	1,156 (13.2)	75 (18.5)	109 (20.4)	124 (21.1)	132 (23.4)	152 (27.5)	160 (25.8)	109 (14.7)	61 (7.8)	75 (8.5)	60 (5.9)	24 (5.0)	37 (5.0)	38 (4.3)
Unconfirmed	**204 (2.3)**	**7 (1.7)**	**14 (2.6)**	**9 (1.5)**	**12 (2.1)**	**14 (2.5)**	**22 (3.5)**	**46 (6.2)**	**34 (4.3)**	**8 (0.9)**	**15 (1.5)**	**5 (1.0)**	**7 (0.9)**	**11 (1.3)**
Total	8,788 (100.0)	406 (100.0)	535 (100.0)	588 (100.0)	564 (100.0)	553 (100.0)	621 (100.0)	741 (100.0)	784 (100.0)	886 (100.0)	1,009 (100.0)	484 (100.0)	737 (100.0)	880 (100.0)

Table 3.A2 shows the number of replacements by implant brand and year of primary operation. The most frequently used brand is the fixed bearing Infinity[Tal:Tib], which represented 64.5% of primary ankle replacements performed in 2022. The use of this brand has risen steeply from its introduction in 2014.

The NJR identifies when components within primary ankle replacements, come from different brands and/or manufacturers (termed mix and match). There are no examples of mix and match between manufacturers for ankle replacements. The Infinity and Inbone implants, both manufactured by the same company, were designed to be interchangeable with a matched articulating surface. This combination represented 8.8% of primary ankle replacements in 2022. Prior to the introduction of the Infinity TAR, the Mobility TAR had been the market leader before it was voluntarily withdrawn from the market in 2014.

In 2022, the four most common brands were Infinity[Tal:Tib] (64.5%), Inbone[Tal]Infinity[Tib] (8.8%), Star[Tal:Tib] (7.4%) and Vantage [Tal:Tib] (7.4%). It was not possible to identify the type of constructs implanted in 11 procedures in 2022.

3.4.2 Revisions after primary ankle replacement surgery

A total of 459 out of the 8,788 primary procedures had a linkable A2 MDS form completed to indicate a revision before the end of 2022. The first revisions shown here include 57 conversions to arthrodesis, 305 single-stage procedures, 76 two-stage procedures, 21 DAIRs, 13 with modular exchange and eight without. No amputations have been recorded, and, given the low rate reported for conversion to arthrodesis, we believe that these small numbers are likely to be a reflection of under-reporting.

Table 3.A3 KM estimates of cumulative revision (95% CI) of primary ankle replacement, by gender and age.
Blue italics signify that 250 or fewer cases remained at risk at these time points.

Age at primary (years)	Number of primaries	Time since primary					
		1 year	3 years	5 years	7 years	10 years	12 years
All cases	**8,788**	**0.77 (0.61-0.99)**	**3.14 (2.77-3.57)**	**5.47 (4.93-6.06)**	**7.09 (6.42-7.81)**	**9.05 (8.17-10.01)**	**9.58 (8.57-10.69)**
Female	**3,520**	**0.75 (0.51-1.12)**	**3.43 (2.83-4.15)**	**5.97 (5.12-6.96)**	**7.80 (6.73-9.02)**	**9.95 (8.55-11.57)**	*10.17 (8.72-11.86)*
<65	1,289	0.83 (0.45-1.53)	5.03 (3.88-6.51)	9.07 (7.41-11.08)	11.78 (9.75-14.18)	*14.66 (12.11-17.70)*	*14.66 (12.11-17.70)*
65 to 74	1,349	0.71 (0.37-1.36)	3.04 (2.19-4.21)	5.18 (3.98-6.74)	7.03 (5.47-9.02)	*9.15 (7.07-11.80)*	*9.15 (7.07-11.80)*
≥75	882	0.72 (0.32-1.59)	1.57 (0.89-2.76)	2.16 (1.29-3.60)	*2.16 (1.29-3.60)*	*2.58 (1.51-4.38)*	*3.97 (1.84-8.45)*
Male	**5,268**	**0.79 (0.58-1.08)**	**2.94 (2.48-3.49)**	**5.12 (4.46-5.88)**	**6.59 (5.78-7.52)**	**8.39 (7.31-9.61)**	*9.19 (7.82-10.79)*
<65	1,668	0.97 (0.59-1.61)	4.33 (3.38-5.53)	6.92 (5.63-8.49)	8.59 (7.05-10.43)	*10.72 (8.75-13.11)*	*11.83 (9.43-14.77)*
65 to 74	2,188	0.72 (0.43-1.19)	2.65 (2.01-3.49)	5.08 (4.10-6.29)	6.99 (5.73-8.51)	8.90 (7.29-10.85)	*9.63 (7.61-12.16)*
≥75	1,412	0.67 (0.35-1.29)	1.70 (1.10-2.63)	2.83 (1.96-4.10)	3.11 (2.13-4.53)	*3.86 (2.56-5.78)*	*3.86 (2.56-5.78)*

Note: Arthrodesis and amputation revision procedures may be under-reported in the registry.

Figure 3.A6 KM estimates of cumulative revision of primary ankle replacement (shaded area indicates point-wise 95% CI).

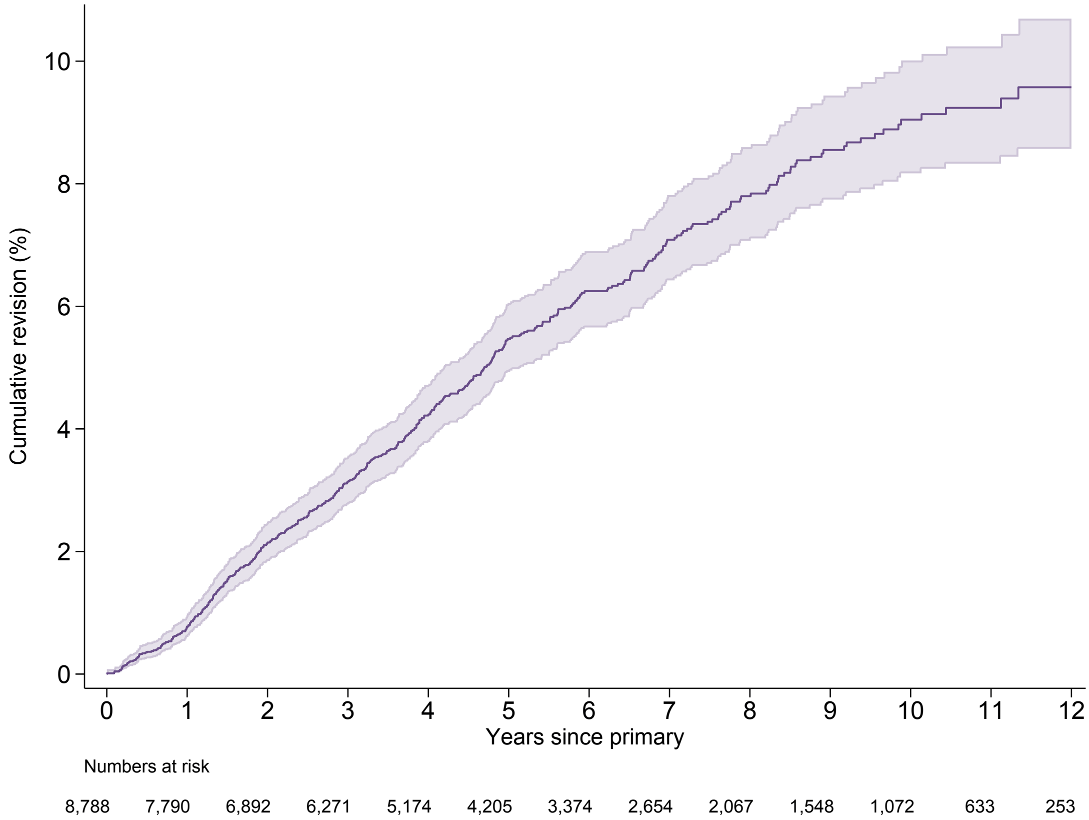
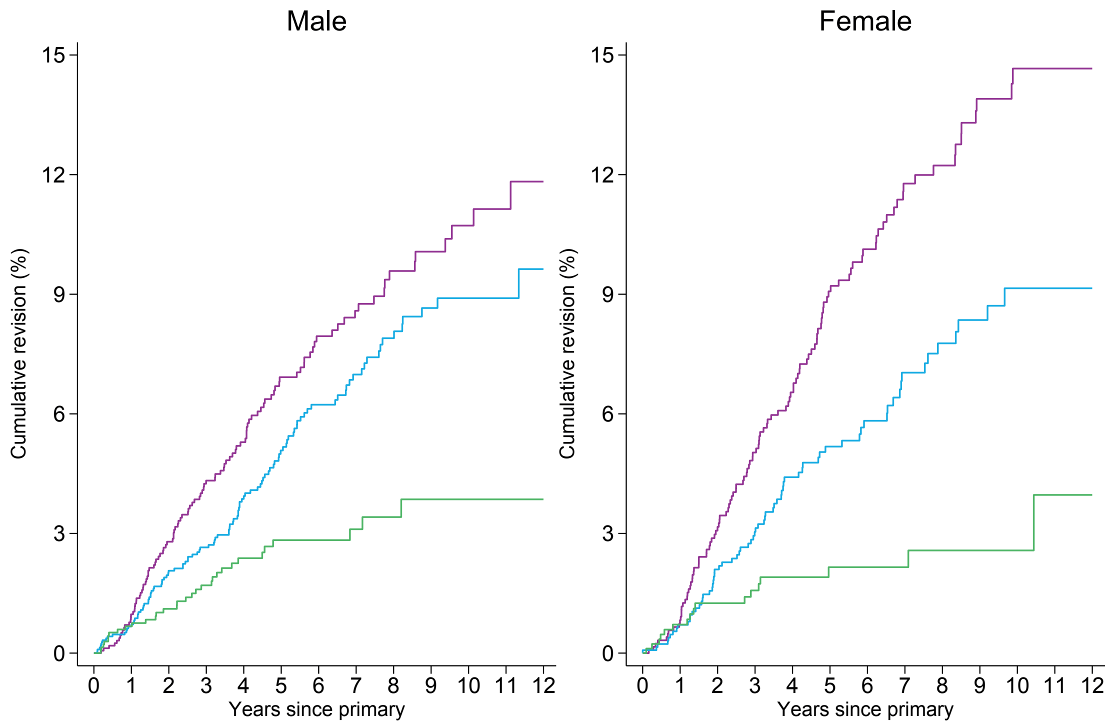


Figure 3.A6 and Table 3.A3 show the overall estimated cumulative percentage probability of (first) revision over time. Table 3.A3 and Figure 3.A7 (page 237) show show the same results stratified by gender and age at primary. Younger people, and particularly younger women, were more likely to experience a revision.

Figure 3.A7 KM estimates of cumulative revision of primary ankle replacement, by gender and age group. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*



Key:

Male – Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10	11	12
<65y	1,668	1,482	1,311	1,197	999	821	673	532	414	322	*229*	*140*	*58*
65-74y	2,188	1,945	1,737	1,598	1,321	1,076	863	683	531	387	274	*160*	*61*
≥75y	1,412	1,229	1,069	951	752	575	443	332	*239*	*159*	*91*	*41*	*16*

Female – Numbers at risk

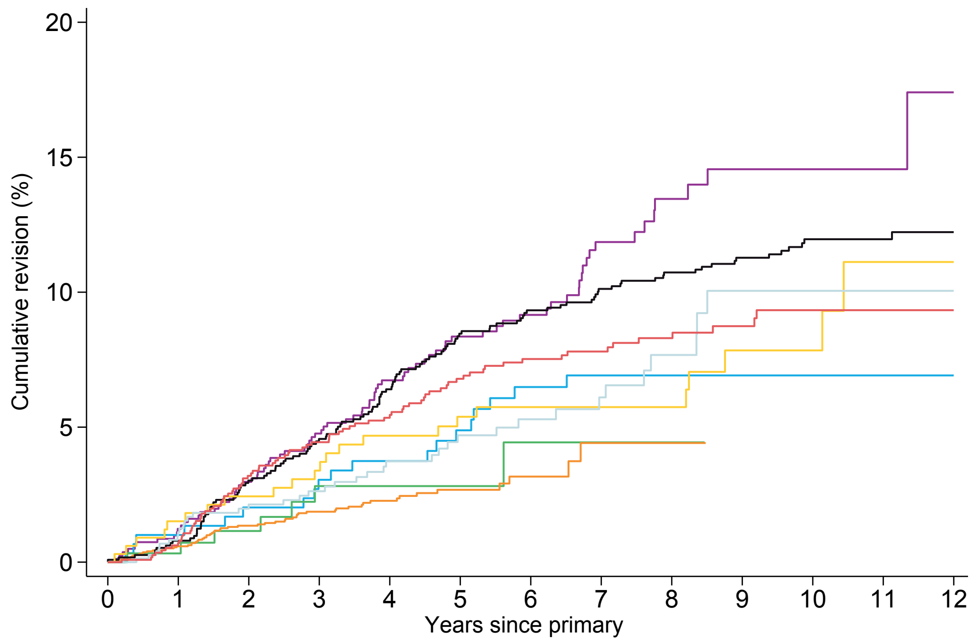
Key	0	1	2	3	4	5	6	7	8	9	10	11	12
<65y	1,289	1,151	1,022	930	803	665	552	432	347	280	*210*	*128*	*56*
65-74y	1,349	1,219	1,091	994	819	677	548	440	351	265	*182*	*116*	*49*
≥75y	882	764	662	601	480	391	295	*235*	*185*	*135*	*86*	*48*	*13*

Table 3.A4 KM estimates of cumulative revision (95% CI) of primary ankle replacement, by brand. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Brand	Number of primaries	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	7 years	10 years	12 years
Box	810	67 (60 to 73)	65	1.24 (0.67-2.28)	4.76 (3.48-6.48)	8.29 (6.52-10.53)	11.67 (9.33-14.55)	*14.23 (11.30-17.84)*	*17.00 (11.74-24.28)*
Hintegra	301	70 (63 to 75)	66	1.00 (0.33-3.08)	3.05 (1.60-5.78)	*4.87 (2.91-8.10)*	*6.89 (4.44-10.62)*	*6.89 (4.44-10.62)*	
Inbone[Talar] Infinity[Tibial]	334	68 (60 to 74)	52	0.31 (0.04-2.19)	*2.75 (1.22-6.11)*	*2.75 (1.22-6.11)*	*4.24 (1.79-9.89)*		
Infinity	3,192	69 (62 to 75)	60	0.57 (0.36-0.92)	1.83 (1.36-2.45)	2.59 (1.96-3.42)	*4.13 (2.68-6.35)*		
Mobility	1,136	68 (61 to 75)	55	0.80 (0.41-1.52)	4.56 (3.49-5.96)	8.46 (6.96-10.27)	10.12 (8.47-12.08)	11.94 (10.11-14.07)	*12.18 (10.31-14.36)*
Salto	332	69 (62 to 74)	59	1.51 (0.63-3.60)	3.39 (1.89-6.04)	5.38 (3.37-8.51)	*5.74 (3.65-8.96)*	*7.74 (4.98-11.93)*	*10.73 (6.55-17.34)*
Star	774	70 (63 to 76)	64	1.10 (0.55-2.18)	2.60 (1.64-4.10)	4.63 (3.19-6.68)	*5.98 (4.17-8.56)*	*9.72 (6.66-14.08)*	*9.72 (6.66-14.08)*
Zenith	1,156	69 (63 to 75)	58	0.71 (0.35-1.41)	4.43 (3.35-5.83)	6.75 (5.38-8.47)	7.75 (6.25-9.60)	*9.24 (7.44-11.45)*	*9.24 (7.44-11.45)*

Note: Blank cells indicate the number at risk is below ten and thus estimates have been omitted as they are highly unreliable.
Note: Brands with fewer than 250 procedures are not reported.
Note: Arthrodesis and amputation revision procedures may be under-reported in the registry.

Figure 3.A8 KM estimates of cumulative revision of primary ankle replacement, by brand. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

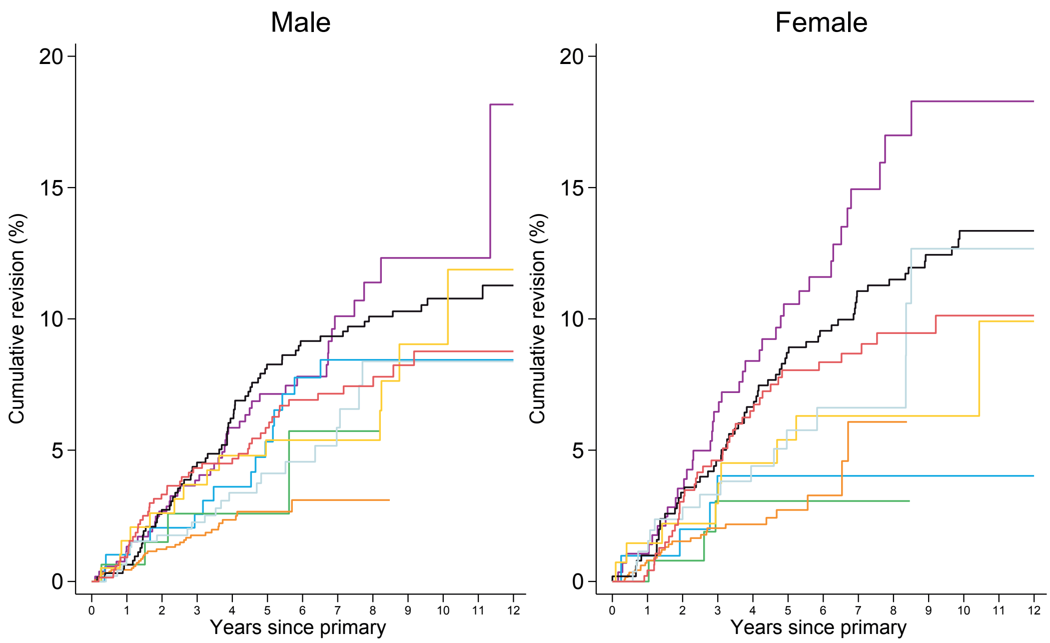


Numbers at risk

Key:	0	1	2	3	4	5	6	7	8	9	10	11	12
Zenith	1,156	1,100	1,027	974	888	790	706	598	451	323	*221*	*129*	*55*
Star	774	694	634	577	480	381	288	*212*	*140*	*85*	*52*	*30*	*7*
Salto	332	322	311	301	281	264	252	*212*	*161*	*103*	*68*	*38*	*14*
Mobility	1,136	1,118	1,082	1,048	1,008	968	933	900	865	763	580	364	*149*
Infinity	3,192	2,587	2,071	1,730	1,133	649	294	*100*	*24*				
Inbone[Talar]Infinity[Tibial]	334	254	*195*	*162*	*112*	*81*	*45*	*16*	*5*				
Hintegra	301	292	288	283	266	*244*	*222*	*190*	*138*	*91*	*39*	*15*	*5*
Box	810	799	775	730	627	517	409	291	*184*	*119*	*76*	*40*	*18*

Table 3.A4 and Figure 3.A8 show the estimated cumulative percentage probability of (first) revision by implant brand with at least 250 uses. Rates are not reported when there are fewer than ten primary procedures at risk of revision for the considered time-period. At one year post-operation, rates of revision were heterogeneous between brands, varying from 0.31% (95% CI 0.04-2.19) to 1.51% (95% CI 0.63-3.60). Larger variations between brands were observed for later post-operative periods, with rates varying from 2.59% (95% CI 1.96-3.42) to 8.46% (95% CI 6.96-10.27) at five years post-operation. At ten years post-operation, the 95% confidence intervals are large, overlapping each other and making interpretation difficult.

Figure 3.A9 KM estimates of cumulative revision of primary ankle replacement, by brand for males and females. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*



Key:

Male – Numbers at risk

Brand	0	1	2	3	4	5	6	7	8	9	10	11	12
Zenith	669	632	591	560	511	455	408	346	257	*179*	*128*	*74*	*32*
Star	494	448	421	385	317	*248*	*185*	*134*	*87*	*54*	*29*	*14*	*<4*
Salto	*195*	*190*	*181*	*175*	*167*	*160*	*150*	*125*	*91*	*53*	*35*	*16*	*6*
Mobility	630	621	601	579	554	528	504	490	469	411	314	*195*	*83*
Infinity	1,916	1,542	1,220	1,009	657	367	*173*	*56*	*13*				
Inbone[Talar]Infinity [Tibial]	*173*	*126*	*93*	*82*	*56*	*40*	*24*	*7*	*<4*				
Hintegra	*198*	*193*	*191*	*189*	*176*	*161*	*142*	*120*	*89*	*56*	*25*	*11*	*<4*
Box	527	519	506	480	400	322	257	*183*	*109*	*71*	*38*	*20*	*7*

Female – Numbers at risk

Brand	0	1	2	3	4	5	6	7	8	9	10	11	12
Zenith	487	468	436	414	377	335	298	252	*194*	*144*	*93*	*55*	*23*
Star	280	*246*	*213*	*192*	*163*	*133*	*103*	*78*	*53*	*31*	*23*	*16*	*4*
Salto	*137*	*132*	*130*	*126*	*114*	*104*	*102*	*87*	*70*	*50*	*33*	*22*	*8*
Mobility	506	497	481	469	454	440	429	410	396	352	266	*169*	*66*
Infinity	1,276	1,045	851	721	476	282	*121*	*44*	*11*				
Inbone[Talar]Infinity [Tibial]	*161*	*128*	*102*	*80*	*56*	*41*	*21*	*9*	*<4*				
Hintegra	*103*	*99*	*97*	*94*	*90*	*83*	*80*	*70*	*49*	*35*	*14*	*4*	*<4*
Box	283	280	269	*250*	*227*	*195*	*152*	*108*	*75*	*48*	*38*	*20*	*11*

Figure 3.A9 shows the estimated cumulative percentage probability of (first) revision by implant brand, stratified by males and females with at least 250 uses overall. The large relative differences between the lowest and highest rates seem to be related to the implant's brand and are unlikely to be entirely due to patient age and gender case mix.

Table 3.A5 Indications for the first revisions following primary ankle replacement.
Note: These are not mutually exclusive.

Indication	Total number revised	Number of revisions per 100 prosthesis-years (95% CI)
Infection	**141**	**0.30 (0.26-0.36)**
Aseptic loosening	**208**	**0.45 (0.39-0.51)**
Aseptic loosening of tibial component only	55	0.12 (0.09-0.15)
Aseptic loosening of talar component only	64	0.14 (0.11-0.18)
Aseptic loosening of both tibial and talar components	89	0.19 (0.16-0.24)
Lysis	**98**	**0.21 (0.17-0.26)**
Lysis of tibial component only	24	0.05 (0.03-0.08)
Lysis of talar component only	38	0.08 (0.06-0.11)
Lysis of both tibial and talar components	36	0.08 (0.06-0.11)
Malalignment	**86**	**0.19 (0.15-0.23)**
Implant fracture	**21**	**0.05 (0.03-0.07)**
Implant fracture of tibial component only	0	0
Implant fracture of talar component only	<4	0.00 (0.00-0.02)
Implant fracture of meniscal component only	17	0.04 (0.02-0.06)
Implant fracture of tibial and talar components	<4	0.00 (0.00-0.02)
Meniscal insert dislocation	**15**	**0.03 (0.02-0.05)**
Wear of polyethylene component	**50**	**0.11 (0.08-0.14)**
Component migration/dissociation	**32**	**0.07 (0.05-0.10)**
Pain	**94**	**0.20 (0.17-0.25)**
Stiffness	**50**	**0.11 (0.08-0.14)**
Soft tissue impingement	**45**	**0.10 (0.07-0.13)**
Other indication for revision	**47**	**0.10 (0.08-0.14)**

Note: Four revision procedures recorded no reason for the revision and were removed from the analysis.
Note: In MDSv4 pain was referred to as Pain (undiagnosed) and in MDSv6 onwards pain was referred to as Unexplained Pain.

Table 3.A5 shows the indications for revision of ankle replacements, with aseptic loosening and infection as the most commonly cited indications.

Of the revisions for infection, 35 (24.8%) were recorded as having a high suspicion of infection (e.g. pus or confirmed micro) and the remaining revisions for infection had a low suspicion (awaiting micro/histo). Out of the 208 revisions for aseptic loosening, 42.8% were performed because of loosening of both the tibial and talar components and 36.7% of patients revised for an indication of lysis had lysis of both tibial and talar components. Of the 21 revisions for implant fracture, 17 (81.0%) were performed for a fractured meniscal insert and fewer than four were performed to treat implant fracture of both tibial and talar components.

The NJR asks surgeons and those responsible for healthcare delivery to ensure that when primary and revision joint replacement procedures of the hip, knee, ankle, elbow or shoulder are performed, that the relevant MDS form is completed and data entered into the registry. This is a requirement mandated by the Department of Health and Social Care. For the purposes of the Annual Report, revision procedures include any addition, removal or modification of the implants and procedures such as debridement and implant retention with or without implant exchange, excision arthroplasty, amputation and conversion to arthrodesis. The completion of a revision MDS form is also mandatory for a procedure involving modification of a joint by adding another implant to another part of the joint. For the analyses of surgeon performance, hospital performance and implant performance, debridement and implant retention without implant exchange is currently excluded.

3.4.3 Mortality after primary ankle replacement surgery

In this analysis, the second of each of the 11 (same day) bilateral procedures were excluded. Among the remaining 8,777, a total of 912 patients had died before the end of 2022, 307 of these were female and 605 were male.

Figure 3.A10 KM estimates of cumulative mortality after primary ankle replacement (shaded area indicates point-wise 95% CI).

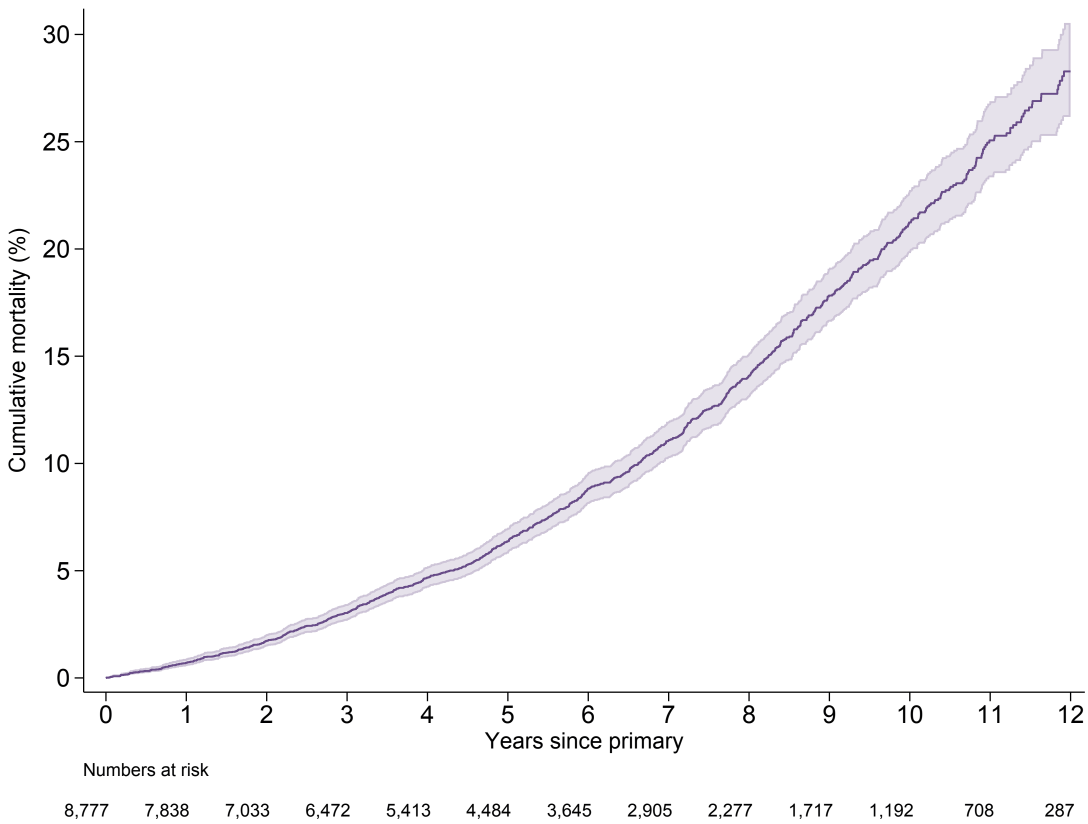
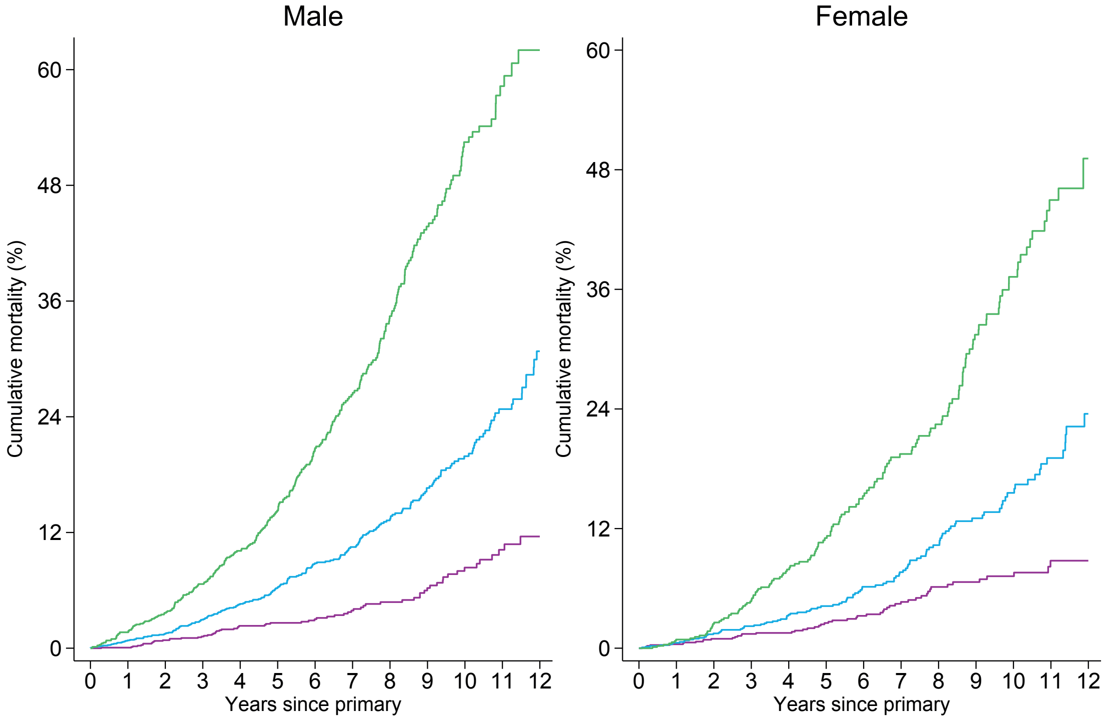


Table 3.A6 KM estimates of cumulative mortality (95% CI) after primary ankle replacement, by gender and age group. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Age at primary (years)	Number of primaries	Time since primary							
		30 days	90 days	1 year	3 years	5 years	7 years	10 years	12 years
All cases	8,777	0.07 (0.03-0.15)	0.16 (0.10-0.27)	0.71 (0.55-0.92)	3.03 (2.66-3.44)	6.37 (5.80-7.01)	11.07 (10.22-11.98)	21.23 (19.81-22.75)	28.28 (26.15-30.54)
Female	3,517	0.03 (0.00-0.20)	0.14 (0.06-0.35)	0.57 (0.36-0.89)	2.52 (2.01-3.15)	5.19 (4.40-6.13)	9.21 (8.02-10.56)	17.20 (15.24-19.38)	*23.26 (20.35-26.52)*
<65	1,287	0.00 (.-.)	0.24 (0.08-0.73)	0.40 (0.17-0.96)	1.43 (0.88-2.33)	2.53 (1.70-3.74)	4.64 (3.36-6.41)	7.22 (5.39-9.65)	*8.78 (6.42-11.95)*
65 to 74	1,348	0.07 (0.01-0.53)	0.15 (0.04-0.60)	0.54 (0.26-1.14)	2.21 (1.51-3.23)	4.23 (3.15-5.66)	7.63 (5.96-9.73)	*15.58 (12.62-19.16)*	*23.51 (18.58-29.50)*
≥75	882	0.00 (.-.)	0.00 (.-.)	0.87 (0.41-1.81)	4.70 (3.36-6.56)	11.05 (8.76-13.89)	*19.49 (16.11-23.47)*	*37.25 (31.71-43.42)*	*49.12 (40.64-58.34)*
Male	5,260	0.10 (0.04-0.23)	0.17 (0.09-0.33)	0.80 (0.59-1.09)	3.37 (2.88-3.95)	7.17 (6.39-8.04)	12.34 (11.20-13.58)	24.14 (22.16-26.26)	*31.97 (29.02-35.14)*
<65	1,667	0.00 (.-.)	0.00 (.-.)	0.06 (0.01-0.44)	1.21 (0.76-1.95)	2.63 (1.87-3.69)	3.91 (2.86-5.32)	8.36 (6.29-11.08)	*11.59 (8.56-15.59)*
65 to 74	2,184	0.14 (0.04-0.43)	0.18 (0.07-0.49)	0.82 (0.51-1.32)	2.95 (2.27-3.83)	6.30 (5.20-7.61)	10.49 (8.93-12.31)	19.91 (17.24-22.93)	*30.80 (26.05-36.18)*
≥75	1,409	0.14 (0.04-0.57)	0.36 (0.15-0.86)	1.66 (1.09-2.51)	6.65 (5.36-8.24)	14.28 (12.20-16.67)	26.29 (23.19-29.71)	*52.48 (47.37-57.79)*	*62.03 (55.27-68.82)*

Note: Some patients had operations on the left and right side on the same day. The second of bilateral operations performed on the same day were excluded.

Figure 3.A11 KM estimates of cumulative mortality after primary ankle replacement by gender and age group. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk

Key	Male 0	1	2	3	4	5	6	7	8	9	10	11	12	Female 0	1	2	3	4	5	6	7	8	9	10	11	12
<65y	1,667	1,495	1,347	1,252	1,059	892	739	593	466	359	257	*161*	*68*	1,287	1,158	1,054	980	861	737	622	500	401	329	253	*151*	*65*
65-74y	2,184	1,954	1,767	1,636	1,372	1,140	931	744	584	435	299	*176*	*69*	1,348	1,227	1,115	1,028	863	723	591	480	387	290	*200*	*127*	*54*
≥75y	1,409	1,234	1,079	965	771	593	460	347	*248*	*164*	*93*	*41*	*16*	882	770	671	611	487	399	302	*241*	*191*	*140*	*90*	*52*	*15*

Figure 3.A10, Table 3.A6, and Figure 3.A11 show the estimated cumulative percentage probability of death at different times after surgery, by gender and age at primary. Male patients and patients of older age were more likely to have died.

3.4.4 Conclusions

Compared to hip, knee, and shoulder replacements included in the NJR Annual Report, primary ankle replacement is a low-volume procedure, and linked first revisions are even lower. A recent study by **Jennison et al. (2023)** suggests that up to one-third of revisions are not reported to the NJR, and in particular there is significant under-reporting of revision to arthrodesis procedures, or revision to amputation, making outcome analysis difficult.

Since the withdrawal of the Mobility implant in 2014, the fixed bearing Infinity implant has rapidly gained popularity to become the market leader and survivorship data are encouraging at present.

Although there has been a trend towards an increasing volume of ankle replacement procedures by unit, the mean number per units had only risen from 3.9 to 6.3 per year between 2010 to 2019, with an expected decline in numbers due to the impact of COVID, that has now partially recovered to be 5.5 per year. In 2022 only 14.3% of units conducting ankle replacements performed more than ten per year and just 4.3% of units performed more than 20 primary procedures. The British Orthopaedic Foot & Ankle Society (BOFAS) and NHS Getting It Right First Time (GIRFT) encourage surgeons to pool resources and create networks, where practicable, to ensure the sharing of best practice and the achievement of the highest standards of care and outcome quality for patients (Bendall et al 2020).

The cumulative percentage probability of 90-day mortality following primary ankle surgery is very low (0.16% (95% CI 0.10-0.27)) and the cumulative percentage of revision at ten years following a primary ankle replacement is 9.05% (95% CI 8.17-10.01). This is likely to be a modest underestimate given the findings of the recent study (Jennison et al 2023). Substantial heterogeneity in the rates of revision was observed between the implant brands used in primary ankle replacement surgery. It is likely that any data missing is Missing At Random in relation to brands and therefore the heterogeneity observed is robust. Our data quality audit programme now routinely captures missing ankle procedures and so these missing data effects will reduce over time.

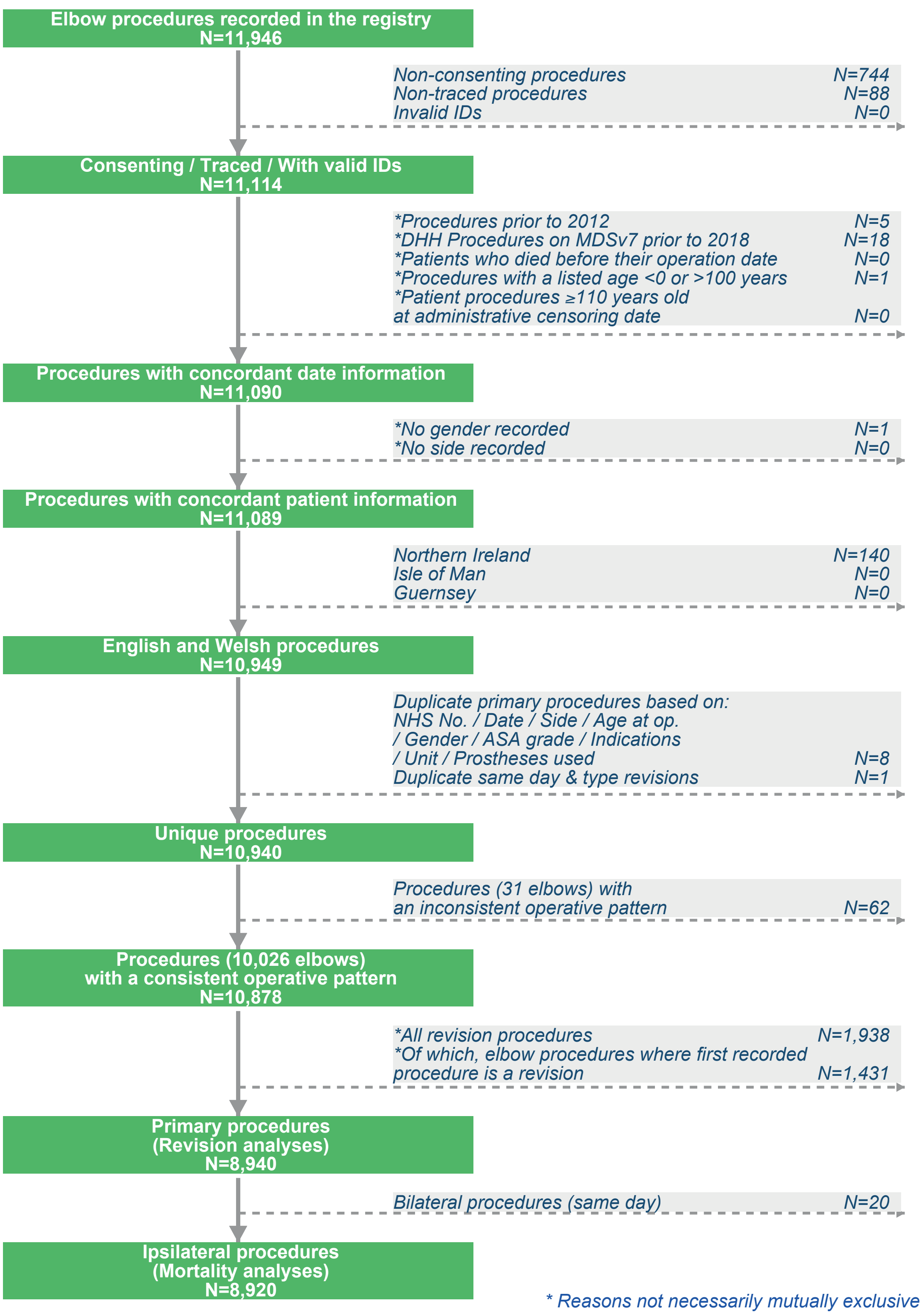
Jennison, T., Ukoumunne, O., Lamb, S., Sharpe, I., & Goldberg, A. J. (2023). How long do ankle arthroplasties last? Bone Joint J, 105(3), 301-306.
Bendall, S. A. G., Goldberg, A., Davis, J., & Takwale, V. (2020). End stage ankle arthritis treatment pathway.

3.5 Outcomes after elbow replacement

3.5.1 Overview of primary elbow replacement surgery

In this section we detail the primary elbow replacements entered into the registry since recording began (1 April 2012) up to the end of 31 December 2022. Data on linked first revision episodes and linked mortality data are presented. Primary elbow replacement in this section refers to total elbow replacement (with or without radial head replacement), distal humeral hemiarthroplasty, lateral resurfacing and radial head replacement. We conducted an extended review of the component labels reported on the primary elbow (E1) MDS form. Our analysis has been able to identify inconsistencies between the type of procedure reported on the MDS form and the component label data uploaded to the registry. Procedures where the reported type of surgery did not match the components listed on the MDS form are classified as unconfirmed in the elbow section of the report.

Figure 3.E1 Elbow cohort flow diagram.



A total of 8,940 primary replacements were available for analysis for a total of 8,670 patients (Figure 3.E1). Of these patients, 270 had documented elbow replacements on both left and right sides, and in 20 patients these were both performed on the same day (bilateral).

The majority of replacements were performed on women (66.6%) and the median age at the time of primary operation was 64 years (IQR 52 to 74), with an overall range of 14 to 99 years. Cement was listed in the component data in 51.0% of the primary elbow procedures.

Table 3.E1 (page 250) shows that the annual number of primary elbow replacements entered into the registry has increased since 2012. While the increase in the early years is in part due to improvement in data capture, the consistent increase observed year-after-year from 2015 to 2019 mostly reflects an increase in the volume of procedures, improved reporting of radial head replacement and inclusion of distal humeral hemiarthroplasties, or a combination of these factors. There is a decrease in 2020 due to the impact of COVID and numbers have not fully recovered since.

Table 3.E1 provides a breakdown by the stated type of replacement. Of all procedures, including the unconfirmed, 49.8% were classified as a total elbow replacement. A total of 475 (5.3%) primary elbow replacements had an unconfirmed status.

Table 3.E2 (page 251) details the type of primary operation in each year and we show that 4,868 (54.5%) elbow replacements were carried out for acute trauma indications. These have been separated from the remaining 4,072 cases performed for elective indications in the rest of this section. Over half (66.7%) of the elbow procedures performed for trauma were confirmed radial head replacements.

Table 3.E1 Number of primary elbow replacements by year and percentage of each type of procedure.

		Year of primary										
	Number of primaries	2012 N (%)	2013 N (%)	2014 N (%)	2015 N (%)	2016 N (%)	2017 N (%)	2018 N (%)	2019 N (%)	2020 N (%)	2021 N (%)	2022 N (%)
All cases	8,940	480 (100)	722 (100)	735 (100)	795 (100)	805 (100)	901 (100)	949 (100)	1,052 (100)	759 (100)	925 (100)	817 (100)
Confirmed elbow replacements	8,465	435 (90.6)	649 (89.9)	705 (95.9)	742 (93.3)	748 (92.9)	847 (94.0)	898 (94.6)	1,025 (97.4)	730 (96.2)	899 (97.2)	787 (96.3)
Total elbow replacement	3,980	258 (53.8)	426 (59.0)	419 (57.0)	438 (55.1)	408 (50.7)	463 (51.4)	399 (42.0)	390 (37.1)	230 (30.3)	278 (30.1)	271 (33.2)
Total elbow replacement inc. radial head replacement	96	13 (2.7)	7 (1.0)	14 (1.9)	10 (1.3)	8 (1.0)	5 (0.6)	10 (1.1)	9 (0.9)	<4 (0.4)	7 (0.8)	10 (1.2)
Radial head replacement	3,929	153 (31.9)	203 (28.1)	269 (36.6)	294 (37.0)	332 (41.2)	378 (42.0)	432 (45.5)	527 (50.1)	414 (54.5)	516 (55.8)	411 (50.3)
Lateral resurfacing	33	11 (2.3)	13 (1.8)	<4 (0.4)	0 (0)	0 (0)	<4 (0.1)	0 (0)	0 (0)	<4 (0.1)	0 (0)	4 (0.5)
Distal humeral hemiarthroplasty	427	-	-	-	-	-	-	57 (6.0)	99 (9.4)	82 (10.8)	98 (10.6)	91 (11.1)
Unconfirmed elbow replacements	475	45 (9.4)	73 (10.1)	30 (4.1)	53 (6.7)	57 (7.1)	54 (6.0)	51 (5.4)	27 (2.6)	29 (3.8)	26 (2.8)	30 (3.7)
Unconfirmed total elbow replacement	373	37 (7.7)	69 (9.6)	24 (3.3)	49 (6.2)	48 (6.0)	47 (5.2)	41 (4.3)	13 (1.2)	15 (2.0)	13 (1.4)	17 (2.1)
Unconfirmed radial head replacement	72	4 (0.8)	<4 (0.4)	6 (0.8)	4 (0.5)	7 (0.9)	6 (0.7)	6 (0.6)	10 (1.0)	8 (1.1)	9 (1.0)	9 (1.1)
Unconfirmed lateral resurfacing	13	4 (0.8)	<4 (0.1)	0 (0)	0 (0)	<4 (0.2)	<4 (0.1)	<4 (0.2)	0 (0)	<4 (0.1)	<4 (0.1)	<4 (0.1)
Unconfirmed distal humeral hemiarthroplasty	17	-	-	-	-	-	-	<4 (0.2)	4 (0.4)	5 (0.7)	<4 (0.3)	<4 (0.4)

Note: Elbow replacements with a mismatch between the type of procedure reported by the surgeon on the MDS form and the recorded component labels on the MDS form, or with no component data in the record, are described as unconfirmed and classified according to the procedure type indicated by the surgeon on the MDS form.

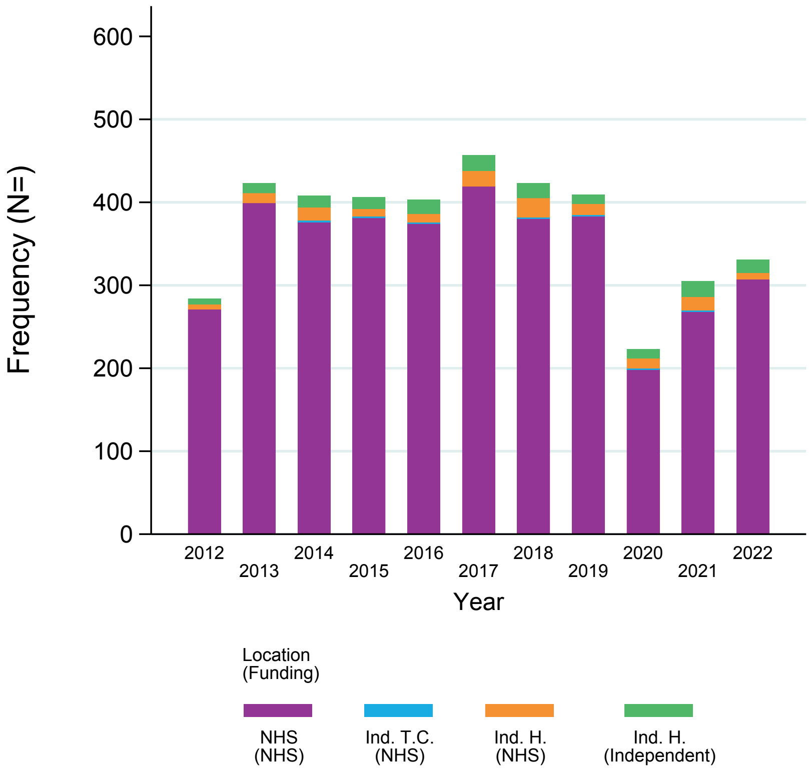
Table 3.E2 Types of primary elbow replacements used in acute trauma and elective cases, by year and type of primary procedure.

		Number of primaries	Year of primary 2012 N (%)	2013 N (%)	2014 N (%)	2015 N (%)	2016 N (%)	2017 N (%)	2018 N (%)	2019 N (%)	2020 N (%)	2021 N (%)	2022 N (%)
Acute trauma	**All cases**	**4,868**	**196 (100)**	**299 (100)**	**327 (100)**	**389 (100)**	**402 (100)**	**444 (100)**	**526 (100)**	**643 (100)**	**536 (100)**	**620 (100)**	**486 (100)**
	Confirmed elbow replacements	**4,623**	**181 (92.3)**	**276 (92.3)**	**312 (95.4)**	**364 (93.6)**	**370 (92.0)**	**405 (91.2)**	**492 (93.5)**	**626 (97.4)**	**516 (96.3)**	**609 (98.2)**	**472 (97.1)**
	Total elbow replacement	988	59 (30.1)	107 (35.8)	94 (28.7)	123 (31.6)	96 (23.9)	96 (21.6)	83 (15.8)	91 (14.2)	92 (17.2)	83 (13.4)	64 (13.2)
	Total elbow replacement inc. radial head replacement	<4	<4 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (0.2)	0 (0)	0 (0)	0 (0)
	Radial head replacement	3,248	121 (61.7)	169 (56.5)	218 (66.7)	241 (62.0)	274 (68.2)	309 (69.6)	362 (68.8)	443 (68.9)	350 (65.3)	433 (69.8)	328 (67.5)
	Lateral resurfacing	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Distal humeral hemiarthroplasty	385	-	-	-	-	-	-	47 (8.9)	91 (14.2)	74 (13.8)	93 (15.0)	80 (16.5)
	Unconfirmed elbow replacements	**245**	**15 (7.7)**	**23 (7.7)**	**15 (4.6)**	**25 (6.4)**	**32 (8.0)**	**39 (8.8)**	**34 (6.5)**	**17 (2.6)**	**20 (3.7)**	**11 (1.8)**	**14 (2.9)**
	Unconfirmed total elbow replacement	178	12 (6.1)	21 (7.0)	9 (2.8)	23 (5.9)	27 (6.7)	34 (7.7)	28 (5.3)	5 (0.8)	9 (1.7)	6 (1.0)	4 (0.8)
	Unconfirmed radial head replacement	55	<4 (1.5)	<4 (0.7)	6 (1.8)	<4 (0.5)	5 (1.2)	5 (1.1)	5 (1.0)	9 (1.4)	7 (1.3)	4 (0.6)	7 (1.4)
	Unconfirmed lateral resurfacing	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Unconfirmed distal humeral hemiarthroplasty	12	-	-	-	-	-	-	<4 (0.2)	<4 (0.5)	4 (0.7)	<4 (0.2)	<4 (0.6)
Elective	**All cases**	**4,072**	**284 (100)**	**423 (100)**	**408 (100)**	**406 (100)**	**403 (100)**	**457 (100)**	**423 (100)**	**409 (100)**	**223 (100)**	**305 (100)**	**331 (100)**
	Confirmed elbow replacements	**3,842**	**254 (89.4)**	**373 (88.2)**	**393 (96.3)**	**378 (93.1)**	**378 (93.8)**	**442 (96.7)**	**406 (96.0)**	**399 (97.6)**	**214 (96.0)**	**290 (95.1)**	**315 (95.2)**
	Total elbow replacement	2,992	199 (70.1)	319 (75.4)	325 (79.7)	315 (77.6)	312 (77.4)	367 (80.3)	316 (74.7)	299 (73.1)	138 (61.9)	195 (63.9)	207 (62.5)
	Total elbow replacement inc. radial head replacement	94	12 (4.2)	7 (1.7)	14 (3.4)	10 (2.5)	8 (2.0)	5 (1.1)	10 (2.4)	8 (2.0)	<4 (1.3)	7 (2.3)	10 (3.0)
	Radial head replacement	681	32 (11.3)	34 (8.0)	51 (12.5)	53 (13.1)	58 (14.4)	69 (15.1)	70 (16.5)	84 (20.5)	64 (28.7)	83 (27.2)	83 (25.1)
	Lateral resurfacing	33	11 (3.9)	13 (3.1)	<4 (0.7)	0 (0)	0 (0)	<4 (0.2)	0 (0)	0 (0)	<4 (0.4)	0 (0)	4 (1.2)
	Distal humeral hemiarthroplasty	42	-	-	-	-	-	-	10 (2.4)	8 (2.0)	8 (3.6)	5 (1.6)	11 (3.3)
	Unconfirmed elbow replacements	**230**	**30 (10.6)**	**50 (11.8)**	**15 (3.7)**	**28 (6.9)**	**25 (6.2)**	**15 (3.3)**	**17 (4.0)**	**10 (2.4)**	**9 (4.0)**	**15 (4.9)**	**16 (4.8)**
	Unconfirmed total elbow replacement	195	25 (8.8)	48 (11.3)	15 (3.7)	26 (6.4)	21 (5.2)	13 (2.8)	13 (3.1)	8 (2.0)	6 (2.7)	7 (2.3)	13 (3.9)
	Unconfirmed radial head replacement	17	<4 (0.4)	<4 (0.2)	0 (0)	<4 (0.5)	<4 (0.5)	<4 (0.2)	<4 (0.2)	<4 (0.2)	<4 (0.4)	5 (1.6)	<4 (0.6)
	Unconfirmed lateral resurfacing	13	4 (1.4)	<4 (0.2)	0 (0)	0 (0)	<4 (0.5)	<4 (0.2)	<4 (0.5)	0 (0)	<4 (0.4)	<4 (0.3)	<4 (0.3)
	Unconfirmed distal humeral hemiarthroplasty	5	-	-	-	-	-	-	<4 (0.2)	<4 (0.2)	<4 (0.4)	<4 (0.7)	0 (0)

Note: Elbow replacements with a mismatch between the type of procedure reported by the surgeon on the MDS form and the recorded component labels on the MDS form, or with no component data in the record, are described as unconfirmed and classified according to the procedure type indicated by the surgeon on the MDS form.

Figure 3.E2 describes the funding status and organisation type (based on organisation type in 2023) of elective elbow replacement procedures collected by the NJR. Prior to 2020 (COVID) we can see a steady number of elective elbow replacements being provided, mostly by NHS providers with NHS funding. Since 2020 we can see that the recovery of elbow replacements follows a similar pattern to pre-2020, with mostly NHS-funded NHS provision.

Figure 3.E2 Frequency of elective primary elbow replacements by funding status and organisation type, per year.



Note: Ind.=Independent; T.C.=Treatment Centre; H.=Hospital.

Figure 3.E3 and Figure 3.E4 (pages 254 and 255) show the yearly number of primary elbow replacements performed for elective and acute trauma indications respectively. Elective and acute trauma procedures have been stratified by total elbow replacements (with or without a radial head replacement), radial head replacements and distal humeral hemiarthroplasty, please note the difference in scale of the y-axis between each sub-plot. Each bar in the figure is further stratified by the volume of procedures that the surgeon conducted in that year across both elective and acute trauma settings i.e. if a surgeon performed 12 elective primary total elbow replacement procedures and 12 acute trauma primary total elbow replacement procedures their annual total volume would be 24 procedures. Those 24 procedures would contribute to the dark purple sub-division in both elective and acute trauma figures shown here.

Figure 3.E3 shows that the volume of elective primary total elbow replacements peaked in 2017 before falling slightly in 2018 and 2019 before the impact of COVID in 2020. The number of surgeons performing one or two procedures annually was falling prior to COVID but remained steady since. Elective radial head replacements are increasingly being recorded in the registry, however the majority of consultants only perform one or two procedures annually. The volume of distal humeral hemiarthroplasty has recovered to above pre-pandemic levels. Figure 3.E4 shows the volume of primary total elbow replacements for acute trauma cases staying relatively constant over the last five years. In the last three years there has been an increasing proportion of primary total elbow replacements performed by higher volume elbow surgeons i.e. those performing more than 13 procedures a year. Radial head replacements for acute trauma peaked in 2019 before falling back due to COVID in 2020, figures recovered in 2021 but have fallen slightly in 2022. The proportion of consultants performing three or more procedures per year was increasing prior to 2020, indicating a degree of specialisation among a minority of consultants. The number of distal humeral hemiarthroplasties for trauma has been fairly consistent since 2019 but a greater volume are now being performed by lower volume consultants.

Figure 3.E3 Frequency of primary elbow replacements within elective cases stratified by procedure type, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

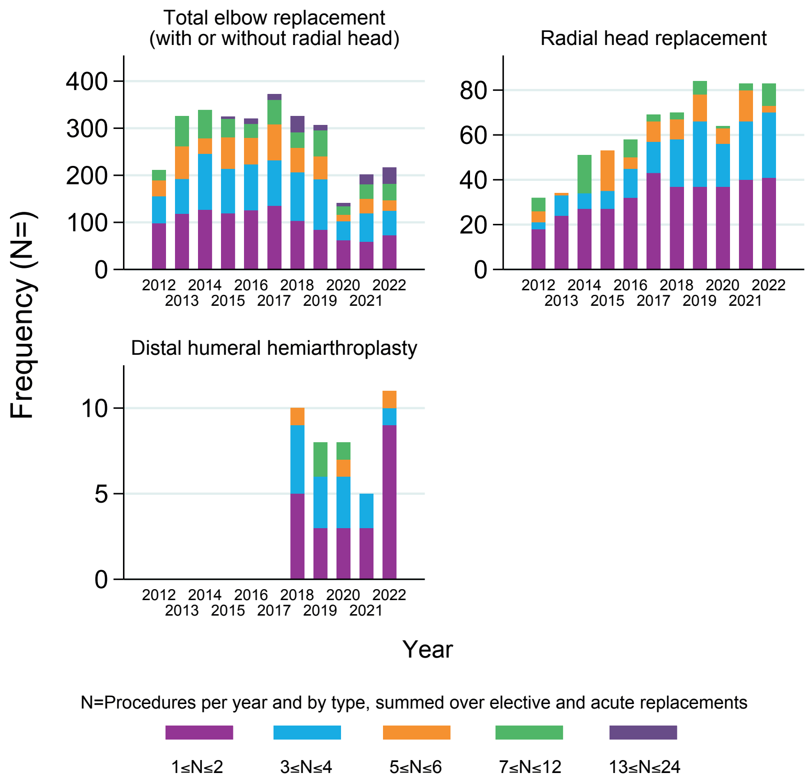


Figure 3.E4 Frequency of primary elbow replacements within acute trauma cases stratified by procedure type, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

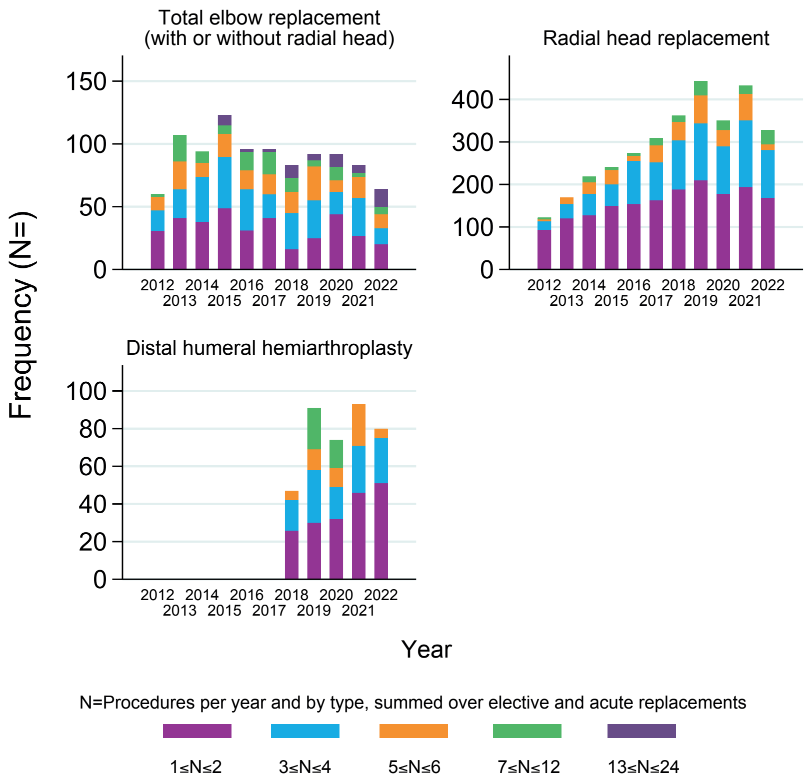


Table 3.E3 Indications for main confirmed types of primary elbow replacements, by year and type of primary operation.

			Acute trauma	Elective						
					Number (%)* for each indication (amongst elective cases only)					
	Year of primary	Number of primaries	Number of cases (%)	Number of cases (%)	Osteoarthritis	Inflammatory arthropathy	Trauma sequelae	Essex Lopresti	Avascular necrosis	Other indication
Total elbow replacement	All cases	3,980	988 (24.8)	2,992 (75.2)	1,027 (34.3)	1,407 (47.0)	546 (18.2)	4 (0.1)	6 (0.2)	148 (4.9)
	2012	258	59 (22.9)	199 (77.1)	67 (33.7)	85 (42.7)	46 (23.1)	<4 (0.5)	0 (0)	12 (6.0)
	2013	426	107 (25.1)	319 (74.9)	122 (38.2)	155 (48.6)	35 (11.0)	<4 (0.3)	<4 (0.3)	21 (6.6)
	2014	419	94 (22.4)	325 (77.6)	122 (37.5)	162 (49.8)	41 (12.6)	0 (0)	0 (0)	15 (4.6)
	2015	438	123 (28.1)	315 (71.9)	110 (34.9)	159 (50.5)	43 (13.7)	0 (0)	<4 (0.6)	19 (6.0)
	2016	408	96 (23.5)	312 (76.5)	106 (34.0)	156 (50.0)	53 (17.0)	0 (0)	0 (0)	12 (3.8)
	2017	463	96 (20.7)	367 (79.3)	120 (32.7)	183 (49.9)	64 (17.4)	<4 (0.3)	<4 (0.3)	16 (4.4)
	2018	399	83 (20.8)	316 (79.2)	108 (34.2)	161 (50.9)	55 (17.4)	<4 (0.3)	0 (0)	11 (3.5)
	2019	390	91 (23.3)	299 (76.7)	99 (33.1)	137 (45.8)	63 (21.1)	0 (0)	0 (0)	14 (4.7)
	2020	230	92 (40.0)	138 (60.0)	45 (32.6)	48 (34.8)	43 (31.2)	0 (0)	0 (0)	8 (5.8)
	2021	278	83 (29.9)	195 (70.1)	71 (36.4)	66 (33.8)	55 (28.2)	0 (0)	<4 (1.0)	8 (4.1)
	2022	271	64 (23.6)	207 (76.4)	57 (27.5)	95 (45.9)	48 (23.2)	0 (0)	0 (0)	12 (5.8)
Radial head replacement	All cases	3,929	3,248	681	83	4	476	50	5	78
	2012	153	121	32	<4	0	20	5	0	4
	2013	203	169	34	7	0	23	0	0	5
	2014	269	218	51	<4	<4	41	4	0	<4
	2015	294	241	53	6	0	43	<4	<4	<4
	2016	332	274	58	7	0	44	<4	<4	5
	2017	378	309	69	8	0	48	6	0	10
	2018	432	362	70	11	0	48	5	0	7
	2019	527	443	84	12	<4	54	5	<4	13
	2020	414	350	64	10	0	35	10	0	10
	2021	516	433	83	10	<4	61	<4	0	9
	2022	411	328	83	7	0	59	8	<4	9
Distal humeral hemiarthroplasty	All cases	427	385	42	9	<4	29	0	0	<4
	2018	57	47	10	<4	<4	6	0	0	0
	2019	99	91	8	<4	0	8	0	0	0
	2020	82	74	8	<4	0	5	0	0	<4
	2021	98	93	5	<4	0	<4	0	0	0
	2022	91	80	11	<4	0	7	0	0	<4

*Percentages are not presented where numbers are too few to be meaningful; please note the listed reasons are not mutually exclusive as more than one reason could have been stated.
Note: Procedures with unconfirmed prostheses and confirmed lateral resurfacing and confirmed total elbow replacement including a radial head replacement were not reported in this table for clarity.
Note: Distal humeral hemiarthroplasty started to be reported in MDSv7 released in June 2018.

Table 3.E3 describes the indications for the primary operation separately by type of primary elbow replacement. Primary operations with an unconfirmed procedure type are excluded from this table.

Please note that the indications for primary elbow replacement are not mutually exclusive since more than one indication could have been provided. Only one indication for surgery, as defined in Table 3.E3, was given for all 4,623 acute trauma cases with a confirmed type of primary procedure. In 164 (4.3%) of the 3,842 elective cases with a confirmed type of primary, more than one indication was given.

Table 3.E4 Number of units and consultant surgeons (cons.) providing primary elbow replacements during each year from the last three years, by region.

(a) All primary elbow replacements (including the confirmed and unconfirmed total, radial head, lateral resurfacing and distal humeral hemiarthroplasty replacements).

	Year of primary														
	2020					2021					2022				
Region	Number of primaries	Number of units	Primary replacements per unit Median (IQR)	Number of cons.	Primary replacements per cons. Median (IQR)	Number of primaries	Number of units	Primary replacements per unit Median (IQR)	Number of cons.	Primary replacements per cons. Median (IQR)	Number of primaries	Number of units	Primary replacements per unit Median (IQR)	Number of cons.	Primary replacements per cons. Median (IQR)
All regions	759	171	3 (1 to 6)	284	5 (3 to 9.5)	925	184	3 (2 to 7.5)	320	7 (3 to 11)	817	175	3 (1 to 7)	278	5 (2 to 10)
East Midlands	47	9	3 (2 to 5)	18	4.5 (3 to 11)	66	13	4 (3 to 7)	26	6 (4 to 10)	44	11	3 (2 to 6)	21	6 (2 to 8)
East of England	60	11	5 (3 to 7)	27	5 (4 to 7)	91	16	5 (2 to 8)	32	8 (5 to 8)	59	13	4 (1 to 6)	23	5 (3 to 11)
London	103	33	2 (1 to 3)	45	2 (2 to 4)	97	23	2 (1 to 7)	40	6 (2 to 9)	96	26	2.5 (1 to 4)	42	4 (2 to 11)
North East	72	15	4 (1 to 8)	22	7 (4 to 10)	101	11	11 (3 to 15)	20	13.5 (11 to 17)	75	12	5.5 (2.5 to 10)	23	10 (4 to 11)
North West	110	26	3 (1 to 7)	49	5 (3 to 7)	149	30	3 (2 to 8)	48	7.5 (3 to 9)	112	25	2 (1 to 5)	40	5 (2 to 9)
South Central	34	7	3 (1 to 8)	11	3 (3 to 12)	51	9	3 (1 to 10)	17	10 (5 to 18)	62	7	9 (5 to 11)	18	11 (7 to 11)
South East Coast	86	20	2.5 (1 to 6)	23	5 (4 to 9)	74	22	2 (1 to 4)	27	4 (2 to 5)	96	21	2 (1 to 6)	21	5 (2 to 8)
South West	71	10	5.5 (1 to 13)	23	7 (4 to 15)	71	16	2 (1.5 to 8)	32	7 (2 to 9)	76	17	3 (1 to 7)	27	7 (2 to 9)
Wales	18	8	1.5 (1 to 2.5)	8	2 (1.5 to 2.5)	43	11	3 (1 to 5)	12	5.5 (3 to 14)	19	9	1 (1 to 2)	7	2 (1 to 8)
West Midlands	62	15	3 (2 to 8)	30	4 (3 to 9)	83	16	2.5 (1 to 6.5)	35	8 (3 to 14)	78	18	2.5 (1 to 4)	32	4 (2.5 to 15)
Yorkshire and the Humber	96	17	3 (1 to 7)	28	8 (4 to 13)	99	17	4 (2 to 8)	31	8 (4 to 9)	100	16	4 (1.5 to 7.5)	24	4 (3 to 11)

Note: Wales includes North, Mid and Central, and South East regions.
Note: IQR=interquartile range.

Table 3.E4 Number of units and consultant surgeons (cons.) providing primary elbow replacements during each year from the last three years, by region.

(b) All confirmed primary total elbow replacements (with or without radial head replacement).

Region	Year of primary														
	2020					2021					2022				
	Number of primaries	Number of units	Median number of primaries per unit (IQR)	Number of cons.	Median number of primaries per cons. (IQR)	Number of primaries	Number of units	Median number of primaries per unit (IQR)	Number of cons.	Median number of primaries per cons. (IQR)	Number of primaries	Number of units	Median number of primaries per unit (IQR)	Number of cons.	Median number of primaries per cons. (IQR)
All regions	233	96	1 (1 to 3)	108	2.5 (1 to 4)	285	105	2 (1 to 3)	105	3 (2 to 5)	281	92	2 (1 to 4)	99	3 (1 to 6)
East Midlands	15	5	3 (1 to 3)	8	3 (2 to 5)	24	6	3 (3 to 7)	8	7 (3 to 7)	12	4	2 (2 to 4)	8	4 (2 to 6)
East of England	20	8	2.5 (1 to 3.5)	9	3 (2 to 4)	27	10	2 (2 to 3)	8	2.5 (2 to 4)	20	6	2 (1 to 6)	5	1 (1 to 3)
London	30	11	1 (1 to 2)	17	2 (1 to 10)	21	10	1 (1 to 3)	13	3 (1 to 4)	31	10	1.5 (1 to 4)	16	5 (2 to 10)
North East	27	12	1 (1 to 3)	12	3 (1.5 to 6)	25	9	2 (1 to 4)	8	3 (1.5 to 5)	23	10	2 (1 to 4)	9	3 (2 to 4)
North West	24	11	1 (1 to 3)	14	2 (1 to 3)	47	18	2 (1 to 3)	16	4 (2 to 5)	39	12	2 (1 to 2.5)	12	4 (2 to 17)
South Central	12	5	2 (1 to 3)	5	3 (2 to 3)	12	6	2 (1 to 3)	5	2 (2 to 2)	19	4	4.5 (1.5 to 8)	6	7 (2 to 9)
South East Coast	28	11	1 (1 to 5)	8	2 (1 to 4)	23	13	2 (1 to 2)	10	2 (1 to 2)	29	10	1.5 (1 to 4)	6	3 (1 to 11)
South West	9	5	2 (1 to 2)	7	2 (1 to 3)	21	10	1.5 (1 to 2)	9	2 (1 to 3)	22	8	2 (1 to 3.5)	8	2.5 (1 to 3.5)
Wales	9	7	1 (1 to 1)	6	1 (1 to 1)	10	6	1.5 (1 to 2)	6	1.5 (1 to 2)	8	7	1 (1 to 1)	4	1 (1 to 1.5)
West Midlands	23	9	2 (1 to 3)	11	3 (1 to 8)	36	7	1 (1 to 6)	12	6 (1 to 21)	35	12	1.5 (1 to 4)	17	4 (3 to 5)
Yorkshire and the Humber	36	12	1 (1 to 3.5)	11	3 (1 to 4)	39	10	3 (2 to 4)	10	4 (2 to 4)	43	9	2 (1 to 5)	8	2 (1 to 9)

Note: Wales includes North, Mid and Central, and South East regions.

Over the last three years (from 2020 to 2022), 2,501 primary elbow replacements were entered into the registry, of which 799 had confirmed components consistent with a total elbow replacement (with or without radial head replacement).

Table 3.E4 (a) and Table 3.E4 (b) show the number of all types of elbow replacement by year and NJR geographical region over this time period, together with the number of units and consultants. A list of units within each NJR region is provided in the downloads section of **reports.njrcentre.org.uk** and further information can be found on **https://surgeonprofile.njrcentre.org.uk**

The median number of elbow replacements per unit has changed very little over the last three years and remains around three per annum with up to nine replacements per unit in the South Central region and as low as one replacement(s) per unit in the Wales region in 2022. These figures are subject to change, as some units may not have submitted all data for 2022 by the time of data analysis.

Table 3.E5 lists the brands used in elbow replacement by confirmed procedure type, with sub-division by acute trauma and elective cases.

Table 3.E5 Brands used in primary elbow replacement by confirmed procedure type.

		Number of primaries	Elective	Acute trauma
Total elbow replacement	All cases	3,980	2,992	988
	Linked:			
	Coonrad Morrey	1,977	1,437	540
	Discovery	1,000	771	229
	GSB III	52	49	<4
	Latitude EV Stem[Hum:Ulna]	208	164	44
	Latitude EV Stem[Hum]Latitude EV Short Stem[Ulna]	60	49	11
	Latitude EV Stem[Hum]Latitude Legacy Stem[Ulna]	<4	<4	0
	Latitude Legacy Stem[Hum:Ulna]	38	29	9
	Latitude Legacy Stem[Hum]Latitude EV Stem[Ulna]	<4	<4	0
	Latitude Legacy Stem[Hum]Latitude Legacy Short Stem[Ulna]	41	33	8
	Latitude[Hum]Latitude EV Short Stem[Ulna]	21	18	<4
	Latitude[Hum]Latitude EV Stem[Ulna]	89	69	20
	MUTARS Stem Cementless[Hum]MUTARS[Ulna]	<4	<4	0
	MUTARS[Hum]Undefined|Custom[Ulna]	<4	<4	0
	Nexel	348	240	108
	Unlinked:			
	IBP	8	8	0
	Latitude EV Stem[Hum:Ulna]	43	36	7
	Latitude EV Stem[Hum]Latitude EV Short Stem[Ulna]	27	26	<4
	Latitude Legacy Stem[Hum:Ulna]	10	10	0
	Latitude Legacy Stem[Hum]Latitude Legacy Short Stem[Ulna]	20	20	0
	Latitude[Hum]Latitude EV Short Stem[Ulna]	7	6	<4
	Latitude[Hum]Latitude EV Stem[Ulna]	15	12	<4

Note: Procedures of unconfirmed type are not reported in this table.
Note: Distal humeral hemiarthroplasty started to be reported in MDSv7 released in June 2018.
Note: [Hum]=Humeral, [Ulna]=Ulna, [Rad]=Radial Head, [LHR]=Lateral humeral resurfacing, [LRR]=Lateral radial resurfacing, [DHH]=Distal humeral hemiarthroplasty.

Table 3.E5 (continued)

		Number of primaries	Elective	Acute trauma
Total elbow replacement inc. radial head replacement	All cases	96	94	<4
	Linked:			
	Latitude EV Stem[Hum]Latitude EV Short Stem[Ulna]Latitude (Legacy | EV)[Rad]	<4	<4	0
	Latitude EV Stem[Hum]Latitude EV Stem[Ulna] Latitude (Legacy | EV)[Rad]	8	7	<4
	Latitude Legacy Stem[Hum]Latitude EV Stem[Ulna]Latitude (Legacy | EV)[Rad]	<4	<4	0
	Latitude Legacy Stem[Hum]Latitude Legacy Short Stem[Ulna]Latitude (Legacy | EV)[Rad]	9	8	<4
	Latitude Legacy Stem[Hum]Latitude Legacy Stem[Ulna]Latitude (Legacy | EV)[Rad]	<4	<4	0
	Latitude[Hum]Latitude EV Stem[Ulna]Latitude (Legacy | EV)[Rad]	5	5	0
	Latitude[Hum]Latitude EV Stem[Ulna] Latitude[Rad]	<4	<4	0
	Unlinked:			
	Latitude EV Stem[Hum]Latitude EV Short Stem[Ulna]Latitude (Legacy | EV)[Rad]	<4	<4	0
	Latitude EV Stem[Hum]Latitude EV Stem[Ulna] Latitude (Legacy | EV)[Rad]	8	8	0
	Latitude EV Stem[Hum]Latitude EV Stem[Ulna] Latitude EV[Rad]	<4	<4	0
	Latitude Legacy Stem[Hum]Latitude Legacy Short Stem[Ulna]Latitude (Legacy | EV)[Rad]	35	35	0
	Latitude Legacy Stem[Hum]Latitude Legacy Stem[Ulna]Latitude (Legacy | EV)[Rad]	10	10	0
	Latitude[Hum]Latitude EV Short Stem[Ulna] Latitude (Legacy | EV)[Rad]	<4	<4	0
	Latitude[Hum]Latitude EV Short Stem[Ulna] Latitude EV[Rad]	<4	<4	0
	Latitude[Hum]Latitude EV Short Stem[Ulna] Latitude[Rad]	4	4	0
	Latitude[Hum]Latitude EV Stem[Ulna]Latitude (Legacy | EV)[Rad]	<4	<4	0
	Latitude[Hum]Latitude EV Stem[Ulna]Latitude EV[Rad]	<4	<4	0
	Latitude[Hum]Latitude EV Stem[Ulna] Latitude[Rad]	<4	<4	0

Note: Procedures of unconfirmed type are not reported in this table.
Note: Distal humeral hemiarthroplasty started to be reported in MDSv7 released in June 2018.
Note: [Hum]=Humeral, [Ulna]=Ulna, [Rad]=Radial Head, [LHR]=Lateral humeral resurfacing, [LRR]=Lateral radial resurfacing, [DHH]=Distal humeral hemiarthroplasty.

Table 3.E5 (continued)

		Number of primaries	Elective	Acute trauma
Radial head replacement	All cases	3,929	681	3,248
	Bipolar:			
	Latitude (Legacy | EV)[Rad]	<4	0	<4
	RHS[Rad]	108	29	79
	rHead Recon[Rad]	13	5	8
	Monopolar:			
	Anatomic[Rad]	2,201	373	1,828
	Ascension[Rad]	177	34	143
	Corin[Rad]	115	14	101
	Evolve Proline[Rad]	793	112	681
	ExploR[Rad]	231	37	194
	Liverpool[Rad]	35	4	31
	MoPyC[Rad]	18	6	12
	Uni-Radial Elbow[Rad]	54	17	37
Lateral resurfacing	All cases	33	33	0
	LRE[LHR:LRR]	32	32	0
	Uni-Elbow[LHR:LRR]	<4	<4	0
Distal humeral hemiarthroplasty	All cases	427	42	385
	Latitude EV Stem[DHH]	269	25	244
	Latitude Legacy Stem[DHH]	20	4	16
	Latitude[DHH]	138	13	125

Note: Procedures of unconfirmed type are not reported in this table.
Note: Distal humeral hemiarthroplasty started to be reported in MDSv7 released in June 2018.
Note: [Hum]=Humeral, [Ulna]=Ulna, [Rad]=Radial Head, [LHR]=Lateral humeral resurfacing, [LRR]=Lateral radial resurfacing, [DHH]=Distal humeral hemiarthroplasty.

The top five constructs (Coonrad Morrey[Hum:Ulna], Discovery[Hum:Ulna], Nexel[Hum:Ulna], Latitude EV Stem[Hum:Ulna], Latitude[Hum]Latitude EV Stem[Ulna]) account for nearly 90.3% of total elbow replacements performed. All total elbow replacements with radial head replacement were performed using the Latitude family of implants. One implant (RHS[Rad]) accounts for 88.5% of the bipolar radial head replacements and two implants (Anatomic[Rad] and Evolve Proline[Rad]) account for 82.6% of the monopolar radial head replacements. Nearly all (97.0%) lateral resurfacing procedures have been performed using the LRE[LHR:LRR] brand. The Latitude system was used for all distal humerus hemiarthroplasty procedures, with the Latitude EV Stem[DHH] accounting for 63.0%.

3.5.2 Revisions after primary elbow replacement surgery

We found that a total of 380 elbow primaries in the registry (103 acute trauma cases and 277 elective) had linked revision procedures recorded up to the end of 2022, including 24 excision procedures, 232 single-stage revisions, 18 DAIRs (13 with modular exchange and five without modular exchange) and 86 stage one of two-stage procedures.

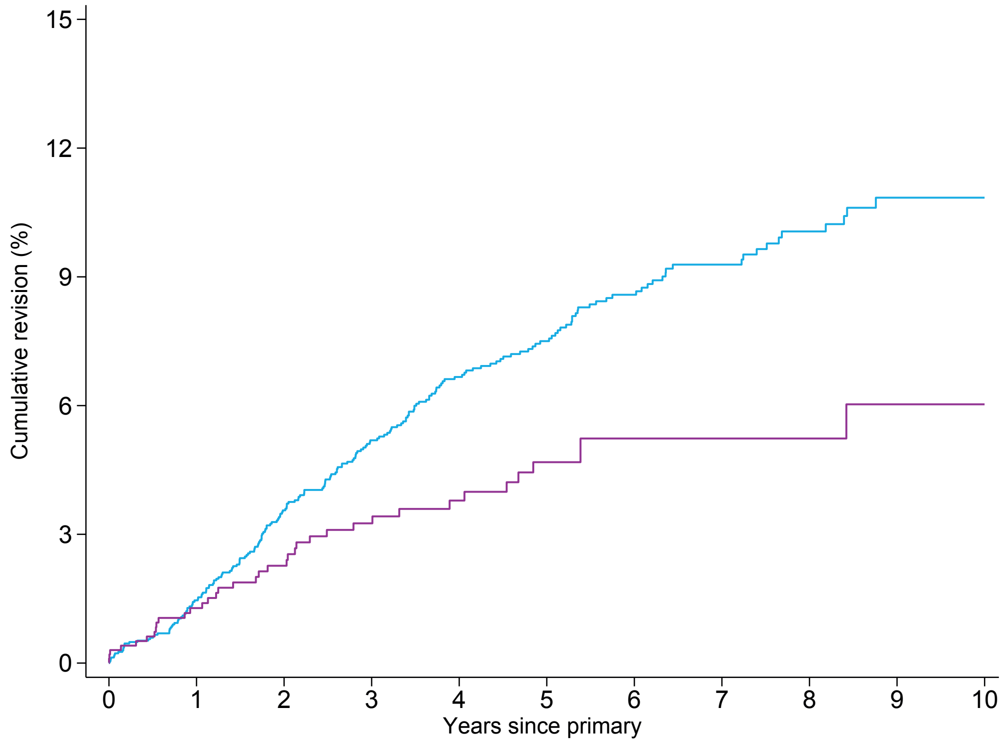
Table 3.E6 KM estimates of cumulative revision (95% CI) by primary elbow procedures for acute trauma and elective cases. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

		Number of primaries	Age at primary Median (IQR)	Male (%)	Time since primary: 1 year	3 years	5 years	7 years	10 years
All acute trauma and elective cases		8,940	64 (52 to 74)	33	1.39 (1.17-1.67)	3.54 (3.14-3.98)	4.85 (4.35-5.40)	5.85 (5.26-6.50)	6.60 (5.88-7.41)
Acute trauma	All acute trauma cases	4,868	61 (48 to 74)	34	1.15 (0.88-1.50)	1.99 (1.61-2.46)	2.50 (2.04-3.07)	2.79 (2.26-3.43)	*2.98 (2.36-3.75)*
	Total elbow replacement	988	77 (71 to 83)	16	1.28 (0.73-2.25)	3.26 (2.24-4.74)	4.69 (3.33-6.59)	*5.25 (3.74-7.34)*	*6.05 (4.09-8.90)*
	Total elbow replacement inc. radial head replacement	<4	75 (71 to 79)	0					
	Radial head replacement	3,248	54 (41.5 to 64)	42	0.83 (0.56-1.21)	1.25 (0.91-1.73)	1.43 (1.04-1.95)	1.65 (1.19-2.30)	*1.65 (1.19-2.30)*
	Distal humeral hemiarthroplasty	385	72 (65 to 79)	16	2.75 (1.49-5.06)	*3.91 (2.27-6.70)*			
	Unconfirmed total elbow replacement	178	75 (66 to 82)	21	*2.83 (1.19-6.66)*	*3.46 (1.57-7.54)*	*3.46 (1.57-7.54)*	*3.46 (1.57-7.54)*	
	Unconfirmed radial head replacement	55	55 (43 to 61)	38	*1.82 (0.26-12.21)*	*3.95 (1.00-14.97)*	*3.95 (1.00-14.97)*	*3.95 (1.00-14.97)*	
	Unconfirmed distal humeral hemiarthroplasty	12	70.5 (63 to 78)	25					
Elective	All elective cases	4,072	67 (56 to 75)	32	1.68 (1.32-2.14)	5.24 (4.54-6.03)	7.29 (6.44-8.26)	8.91 (7.90-10.05)	*10.09 (8.87-11.47)*
	Total elbow replacement	2,992	69 (60 to 76)	29	1.37 (1.00-1.87)	5.05 (4.27-5.97)	7.43 (6.44-8.58)	9.12 (7.93-10.47)	*10.13 (8.76-11.69)*
	Total elbow replacement inc. radial head replacement	94	67 (54 to 73)	34	*4.58 (1.74-11.77)*	*9.93 (5.07-18.94)*	*9.93 (5.07-18.94)*	*14.16 (7.67-25.34)*	
	Radial head replacement	681	52 (40 to 63)	46	2.04 (1.19-3.49)	4.13 (2.78-6.11)	4.67 (3.18-6.84)	*5.55 (3.76-8.16)*	*5.55 (3.76-8.16)*
	Lateral resurfacing	33	56 (44 to 65)	67	*3.33 (0.48-21.39)*	*3.33 (0.48-21.39)*	*6.91 (1.77-24.95)*	*6.91 (1.77-24.95)*	*6.91 (1.77-24.95)*
	Distal humeral hemiarthroplasty	42	73.5 (67 to 81)	24	*2.38 (0.34-15.72)*	*6.00 (1.48-22.56)*			
	Unconfirmed total elbow replacement	195	67 (57 to 76)	29	*3.21 (1.45-7.00)*	*8.88 (5.43-14.33)*	*11.58 (7.52-17.60)*	*12.40 (8.15-18.65)*	*12.40 (8.15-18.65)*
	Unconfirmed radial head replacement	17	62 (48 to 76)	53	*0.00 (.-.)*				
	Unconfirmed lateral resurfacing	13	59 (57 to 66)	38	*0.00 (.-.)*				
	Unconfirmed distal humeral hemiarthroplasty	5	75 (67 to 76)	20					

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: Elbow replacements with a mismatch between the type of procedure reported by the surgeon on the MDS form and the recorded component labels on the MDS form, or with no component data in the record, are described as unconfirmed and classified according to the procedure type indicated by the surgeon on the MDS form.

Table 3.E6 shows Kaplan-Meier estimates of the cumulative percentage probability of revision up to ten years after the primary operation, together with 95% confidence intervals for all cases and for acute trauma and elective cases separately.

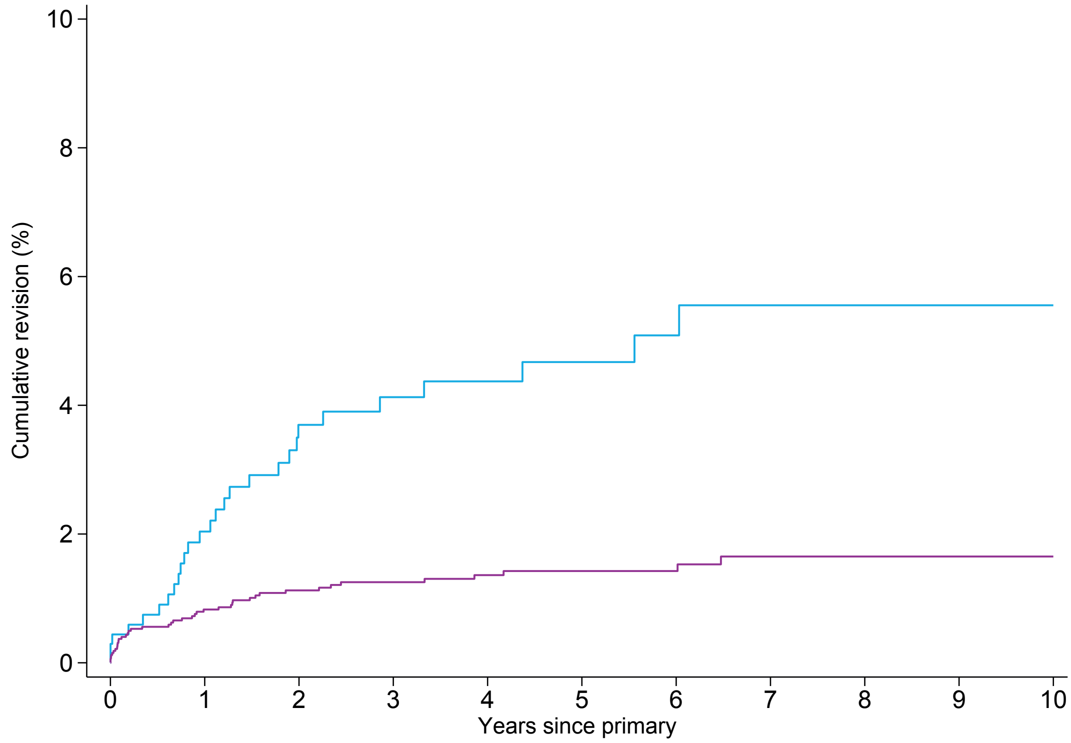
Figure 3.E5 KM estimates of cumulative revision of primary total elbow replacement (with or without a radial head replacement) by acute trauma and elective cases. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk										
Acute trauma	990	854	727	597	480	382	293	*218*	*141*	*82*	*21*
Elective	3,086	2,775	2,464	2,223	1,855	1,488	1,117	823	564	329	*131*

For the sub-group of total elbow replacement shown in Figure 3.E5, we found that the survival of total replacements was comparable for trauma and elective indications up to one year. From one year post-operation onwards, the revision rates were higher for the elective total elbow replacements, but the data for acute trauma are less certain due to the low numbers in the registry and because the confidence intervals of the estimates in both groups overlap. There are insufficient data to compare lateral resurfacing, distal humeral hemiarthroplasty and the other unconfirmed types of primary procedure between elective and trauma indications.

Figure 3.E6 KM estimates of cumulative revision of primary radial head replacement by acute trauma and elective cases. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key: Numbers at risk

Acute trauma	3,248	2,878	2,431	2,072	1,630	1,260	949	672	455	*250*	*102*
Elective	681	580	488	422	341	270	*205*	*153*	*100*	*56*	*29*

Figure 3.E6 shows Kaplan-Meier estimates of the cumulative percentage probability of revision by acute trauma and elective cases in radial head replacements. Revision of radial head replacement may be under-reported as they are frequently revised to an excision arthroplasty which is often poorly recorded by units.

The NJR asks surgeons and those responsible for healthcare delivery to ensure that when primary and revision joint replacement procedures of the hip, knee, ankle, elbow or shoulder are performed, that the relevant MDS form is completed and data entered into the registry. This is a requirement mandated by the Department of Health and Social Care. For the purposes of the Annual Report, revision procedures include any addition, removal or modification of the implants and procedures such as debridement and implant retention with or without implant exchange, excision arthroplasty, amputation and conversion to arthrodesis. The completion of a revision MDS form is also mandatory for a procedure involving modification of a joint by adding another implant to another part of the joint. For the analyses of surgeon performance, hospital performance and implant performance, debridement and implant retention without implant exchange is currently excluded.

Table 3.E7 KM estimates of cumulative revision (95% CI) for primary elbow replacement for acute trauma and elective indications by procedure type, gender, and age group. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

		Age at primary (years)	Number of primaries	Time since primary				
				1 year	3 years	5 years	7 years	10 years
Acute trauma	Total elbow replacement	Male	161	*3.30 (1.39-7.77)*	*6.54 (3.44-12.26)*	*7.90 (4.23-14.50)*	*7.90 (4.23-14.50)*	
		<65	21	*14.79 (5.02-39.19)*				
		65 to 74	44	*2.27 (0.32-15.06)*	*7.70 (2.54-22.11)*	*11.00 (4.22-26.99)*		
		≥75	96	*1.04 (0.15-7.16)*	*2.42 (0.60-9.44)*	*2.42 (0.60-9.44)*		
		Female	827	0.90 (0.43-1.87)	2.64 (1.67-4.17)	4.06 (2.70-6.08)	*4.68 (3.15-6.93)*	*5.57 (3.53-8.73)*
		<65	65	*0*	*5.37 (1.76-15.77)*	*5.37 (1.76-15.77)*	*5.37 (1.76-15.77)*	
		65 to 74	245	*0.41 (0.06-2.89)*	*2.43 (1.02-5.77)*	*6.08 (3.27-11.18)*	*7.01 (3.87-12.54)*	
		≥75	517	1.25 (0.56-2.77)	2.29 (1.23-4.25)	*2.61 (1.44-4.71)*	*3.19 (1.75-5.77)*	
	Radial head replacement	Male	1,380	0.67 (0.35-1.29)	1.12 (0.66-1.89)	1.52 (0.94-2.48)	2.03 (1.23-3.35)	*2.03 (1.23-3.35)*
		<65	1,256	0.74 (0.39-1.42)	1.23 (0.73-2.07)	1.67 (1.03-2.71)	2.21 (1.34-3.63)	*2.21 (1.34-3.63)*
		65 to 74	86	*0*	*0*	*0*	*0*	
		≥75	38	*0*	*0*			
		Female	1,868	0.94 (0.59-1.51)	1.35 (0.90-2.03)	1.35 (0.90-2.03)	1.35 (0.90-2.03)	*1.35 (0.90-2.03)*
		<65	1,224	0.92 (0.51-1.66)	1.44 (0.88-2.35)	1.44 (0.88-2.35)	1.44 (0.88-2.35)	*1.44 (0.88-2.35)*
		65 to 74	444	0.70 (0.23-2.15)	0.96 (0.36-2.53)	*0.96 (0.36-2.53)*	*0.96 (0.36-2.53)*	
		≥75	200	*1.64 (0.53-5.02)*	*1.64 (0.53-5.02)*	*1.64 (0.53-5.02)*	*1.64 (0.53-5.02)*	
	Distal humeral hemiarthroplasty	Male	62	*6.91 (2.64-17.41)*	*6.91 (2.64-17.41)*			
		<65	17	*5.88 (0.85-34.98)*				
		65 to 74	11	*0*				
		≥75	34	*9.65 (3.18-27.27)*	*9.65 (3.18-27.27)*			
		Female	323	*1.92 (0.87-4.23)*	*3.33 (1.72-6.39)*			
		<65	71	*1.43 (0.20-9.71)*	*4.96 (1.61-14.68)*			
		65 to 74	122	*1.66 (0.42-6.47)*	*3.03 (0.95-9.41)*			
		≥75	130	*2.43 (0.79-7.35)*	*2.43 (0.79-7.35)*			

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: Elbow replacements with fewer than 100 procedures are excluded from this table.

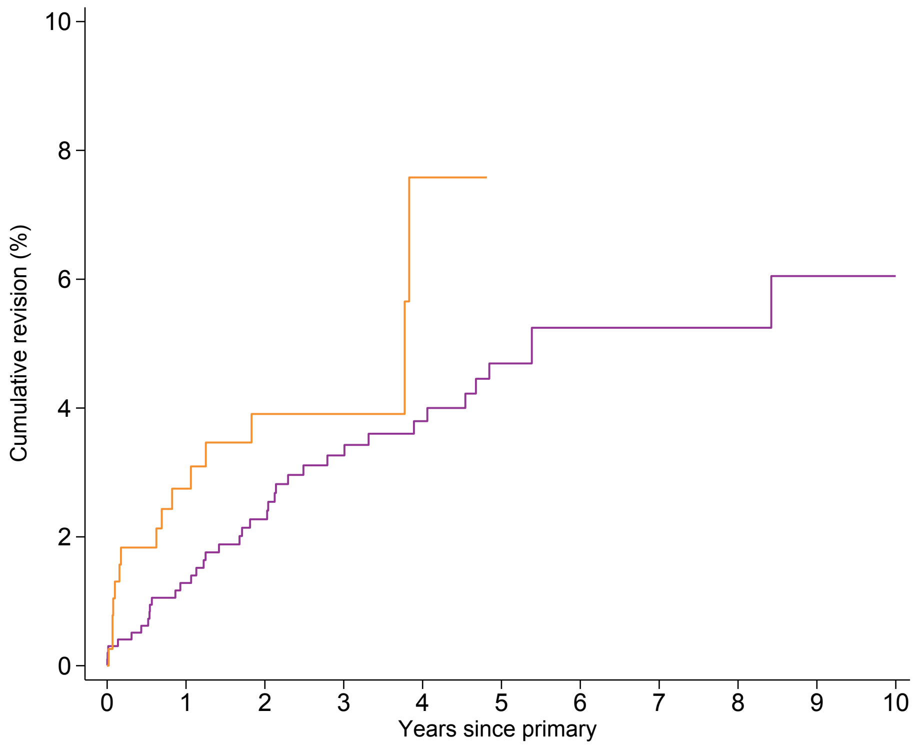
Table 3.E7 (continued)

		Age at primary (years)	Number of primaries	Time since primary				
				1 year	3 years	5 years	7 years	10 years
Elective	Total elbow replacement	Male	871	1.80 (1.09-2.97)	6.75 (5.18-8.76)	9.62 (7.65-12.06)	*11.63 (9.32-14.46)*	*12.54 (9.99-15.67)*
		<65	310	1.98 (0.89-4.36)	*8.39 (5.70-12.26)*	*13.45 (9.86-18.21)*	*15.80 (11.75-21.07)*	*16.87 (12.48-22.59)*
		65 to 74	310	1.65 (0.69-3.92)	*6.08 (3.82-9.61)*	*8.38 (5.56-12.51)*	*10.41 (7.04-15.27)*	*11.50 (7.73-16.94)*
		≥75	251	*1.78 (0.67-4.68)*	*5.33 (2.98-9.44)*	*5.33 (2.98-9.44)*	*6.47 (3.59-11.49)*	
		Female	2,121	1.19 (0.80-1.77)	4.35 (3.50-5.39)	6.53 (5.43-7.84)	8.07 (6.75-9.64)	*9.13 (7.57-10.98)*
		<65	746	1.66 (0.95-2.91)	5.07 (3.65-7.03)	7.36 (5.54-9.73)	*9.97 (7.68-12.88)*	*10.76 (8.30-13.90)*
		65 to 74	729	0.87 (0.39-1.93)	3.86 (2.60-5.71)	5.69 (4.06-7.94)	*6.90 (4.99-9.51)*	*8.86 (6.22-12.54)*
		≥75	646	0.99 (0.44-2.19)	3.96 (2.59-6.03)	*6.39 (4.48-9.09)*	*6.39 (4.48-9.09)*	
	Radial head replacement	Male	313	2.39 (1.15-4.95)	*3.66 (1.98-6.74)*	*4.79 (2.71-8.39)*	*4.79 (2.71-8.39)*	*4.79 (2.71-8.39)*
		<65	283	*2.64 (1.27-5.46)*	*3.53 (1.85-6.69)*	*4.73 (2.61-8.50)*	*4.73 (2.61-8.50)*	*4.73 (2.61-8.50)*
		65 to 74	24	*0*	*7.69 (1.12-43.36)*			
		≥75	6					
		Female	368	1.75 (0.79-3.85)	*4.56 (2.72-7.61)*	*4.56 (2.72-7.61)*	*6.27 (3.69-10.54)*	*6.27 (3.69-10.54)*
		<65	247	*1.30 (0.42-3.98)*	*4.39 (2.30-8.30)*	*4.39 (2.30-8.30)*	*6.71 (3.56-12.45)*	*6.71 (3.56-12.45)*
		65 to 74	94	*2.27 (0.57-8.80)*	*5.07 (1.92-13.05)*	*5.07 (1.92-13.05)*	*5.07 (1.92-13.05)*	
		≥75	27	*4.17 (0.60-26.08)*	*4.17 (0.60-26.08)*			

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: Elbow replacements with fewer than 100 procedures are excluded from this table.

Table 3.E7 presents data for primary total elbow replacement (with and without radial head replacement), radial head replacement, and distal humeral hemiarthroplasty stratified by acute trauma and elective indications, gender, and three age groups. Whilst numbers are currently small for many of the groups, we hope that this provides useful information for surgeons and patients when they are deciding whether or not to have a joint replacement.

Figure 3.E7 KM estimates of cumulative revision of total elbow replacements and distal humeral hemiarthroplasty within the acute trauma cases. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



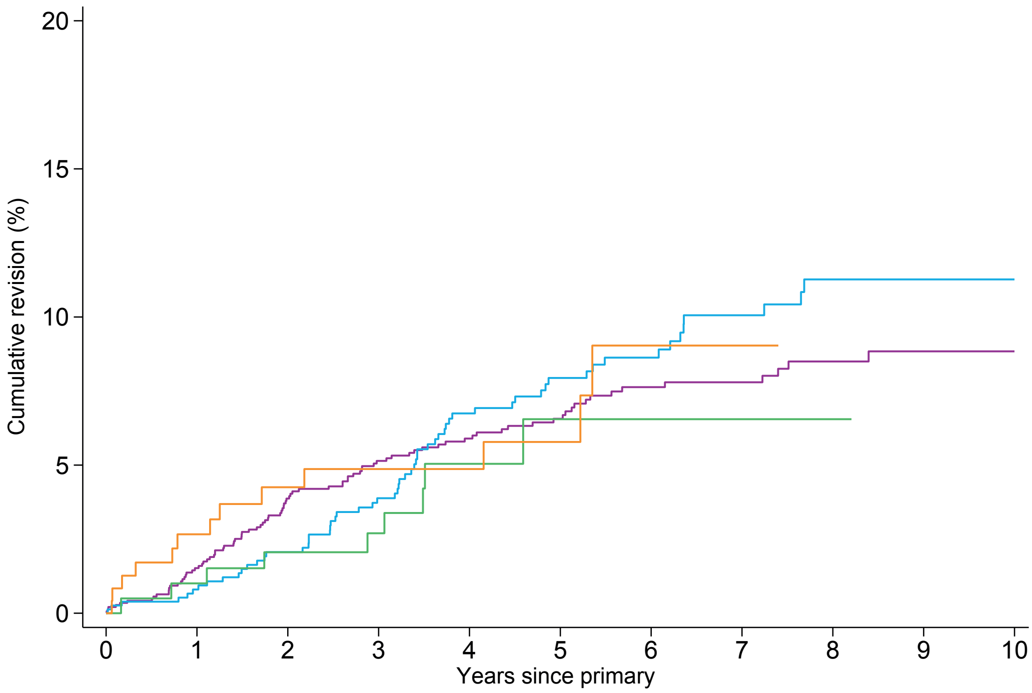
Key:

	Numbers at risk										
Distal humeral hemiarthroplasty	385	291	*191*	*117*	*40*						
Total elbow replacement	988	852	725	595	479	381	292	*217*	*140*	*81*	*20*

Figure 3.E7 shows cumulative rates of revision within the acute trauma cases. These differences remain uncertain and should be treated with caution as the number of procedures and the number of revisions within these groups remain low.

Table 3.E8 (page 269) shows the cumulative probability of revision for brands used in at least 100 primary elbow replacements with a confirmed procedure type. For total elbow replacement, the cumulative revision rates varied between brands from 0.7% to 2.2% in the first post-operative year. At five years post-operation the rates still varied between brands, from 6.1% to 7.2%. However, we note that as numbers are small, this may simply be due to chance. For radial head replacement, the cumulative revision rates varied between brands from 0.5% to 2.3% in the first post-operative year.

Figure 3.E8 KM estimates of cumulative revision of total elbow replacements by implant brand within the elective cases. Elbow replacements with fewer than 100 procedures are excluded. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:	Numbers at risk										
Nexel	*240*	*200*	*163*	*137*	*109*	*72*	*35*	*8*			
Latitude EV Stem	*200*	*194*	*175*	*143*	*88*	*46*	*21*	*6*	*<4*		
Discovery	771	723	669	613	520	434	335	263	*185*	*108*	*39*
Coonrad Morrey	1,437	1,320	1,180	1,074	917	751	588	450	312	*179*	*75*

Figure 3.E8 shows the rate of revision by implant brand within the elective cases. Brand comparisons will become more reliable as the size of the elbow cohort increases over time, and allow further stratification by patient characteristics, acute/elective status and indication for primary surgery.

Table 3.E8 KM estimates of cumulative revision (95% CI) for all primary elbow procedures by implant brand. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

			Number of primaries	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	7 years	10 years
Total elbow replacement	Linked brands	Coonrad Morrey	1,977	72 (64 to 79)	25	1.53 (1.07-2.20)	4.78 (3.87-5.89)	6.08 (5.02-7.37)	7.11 (5.90-8.56)	*8.18 (6.71-9.95)*
		Discovery	1,000	70 (62 to 78)	28	0.72 (0.34-1.50)	3.58 (2.54-5.02)	7.18 (5.56-9.24)	9.13 (7.17-11.58)	*10.14 (7.95-12.89)*
		Latitude EV Stem	208	71 (63 to 77.5)	22	*1.47 (0.48-4.50)*	*3.21 (1.44-7.06)*	*6.56 (3.21-13.17)*		
		Nexel	348	72 (64 to 79)	28	2.16 (1.04-4.49)	*4.19 (2.38-7.31)*	*6.24 (3.68-10.47)*	*9.00 (5.17-15.42)*	
Radial head replacement	Mono-polar brands	Anatomic	2,201	53 (41 to 64)	42	1.04 (0.69-1.57)	1.96 (1.42-2.69)	1.96 (1.42-2.69)	2.12 (1.53-2.95)	*2.12 (1.53-2.95)*
		Ascension	177	53 (40 to 65)	44	*1.14 (0.29-4.49)*	*3.03 (1.27-7.14)*	*4.63 (2.22-9.56)*	*5.63 (2.81-11.11)*	
		Corin	115	55 (46 to 63)	43	*0.87 (0.12-6.01)*	*0.87 (0.12-6.01)*	*0.87 (0.12-6.01)*	*0.87 (0.12-6.01)*	*0.87 (0.12-6.01)*
		Evolve Proline	793	54 (41 to 64)	45	0.53 (0.20-1.41)	0.53 (0.20-1.41)	0.53 (0.20-1.41)	*1.76 (0.64-4.79)*	*1.76 (0.64-4.79)*
		ExploR	231	52 (41 to 62)	45	*2.26 (0.95-5.35)*	*3.22 (1.55-6.65)*	*4.85 (2.49-9.35)*	*4.85 (2.49-9.35)*	
Distal humeral hemiarthroplasty		Latitude EV Stem	269	72 (65 to 80)	20	*2.63 (1.26-5.44)*	*4.27 (2.39-7.59)*			
		Latitude	138	73 (66 to 78)	12	*2.67 (0.84-8.27)*				

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: Elbow replacements with fewer than 100 procedures are excluded from this table.

Table 3.E9 gives a breakdown of the indications for the first data-linked revision procedure. The most common indications for revision remain aseptic loosening and infection. The indications for revision were not mutually exclusive; in 40 of the 380 first revisions more than one indication was stated. A few cases (n=95) had gone on to have further revision procedures. The numbers are too small for any further analysis nor to draw any reliable conclusions.

Table 3.E9 Indications for first data-linked revision after any primary elbow replacement. Acute trauma and elective cases are shown separately, for total elbow replacement, lateral resurfacing, distal humeral hemiarthroplasty, and radial head replacement.

				Indication for first revision procedure					
Type of primary procedure		Number of primaries	Total revised	Aseptic loosening	Failed hemi-arthroplasty	Infection	Instability	Other indication for revision	Peripros-thetic fracture
All acute trauma and elective cases		8,940	380	155	13	108	49	50	48
Acute trauma	Confirmed elbow replacements	4,623	94	29	6	24	18	19	5
Acute trauma	Total elbow replacement	988	37	15	0	17	<4	<4	5
Acute trauma	Total elbow replacement inc. radial head replacement	<4	0	0	0	0	0	0	0
Acute trauma	Radial head replacement	3,248	42	14	0	4	10	15	0
Acute trauma	Lateral resurfacing	0	0	0	0	0	0	0	0
Acute trauma	Distal humeral hemiarthroplasty	385	15	0	6	<4	7	<4	0
Acute trauma	Unconfirmed elbow replacements	245	9	<4	<4	<4	<4	<4	0
Acute trauma	Unconfirmed total elbow replacement	178	6	<4	<4	<4	<4	<4	0
Acute trauma	Unconfirmed radial head replacement	55	<4	<4	0	0	<4	0	0
Acute trauma	Unconfirmed lateral resurfacing	0	0	0	0	0	0	0	0
Acute trauma	Unconfirmed distal humeral hemiarthroplasty	12	<4	0	0	<4	0	0	0

Note: Elbow replacements with a mismatch between the type of procedure reported by the surgeon on the MDS form and the recorded component labels on the MDS form, or with no component data in the record, are described as unconfirmed and classified according to the procedure type indicated by the surgeon on the MDS form.

Table 3.E9 (continued)

	Type of primary procedure	Number of primaries	Total revised	Indication for first revision procedure: Aseptic loosening	Failed hemi-arthroplasty	Infection	Instability	Other indication for revision	Peripros-thetic fracture
Elective	**Confirmed elbow replacements**	**3,842**	**254**	**115**	**4**	**75**	**24**	**27**	**40**
	Total elbow replacement	2,992	209	98	0	68	17	17	35
	Total elbow replacement inc. radial head replacement	94	13	5	0	<4	<4	<4	4
	Radial head replacement	681	28	12	<4	4	5	6	<4
	Lateral resurfacing	33	<4	0	0	0	0	<4	0
	Distal humeral hemiarthroplasty	42	<4	0	<4	0	<4	0	0
	Unconfirmed elbow replacements	**230**	**23**	**9**	**<4**	**6**	**4**	**<4**	**<4**
	Unconfirmed total elbow replacement	195	20	9	<4	6	<4	<4	<4
	Unconfirmed radial head replacement	17	0	0	0	0	0	0	0
	Unconfirmed lateral resurfacing	13	<4	0	0	0	<4	0	<4
	Unconfirmed distal humeral hemiarthroplasty	5	<4	0	0	0	0	<4	0

Note: Elbow replacements with a mismatch between the type of procedure reported by the surgeon on the MDS form and the recorded component labels on the MDS form, or with no component data in the record, are described as unconfirmed and classified according to the procedure type indicated by the surgeon on the MDS form.

3.5.3 Mortality after primary elbow replacement surgery

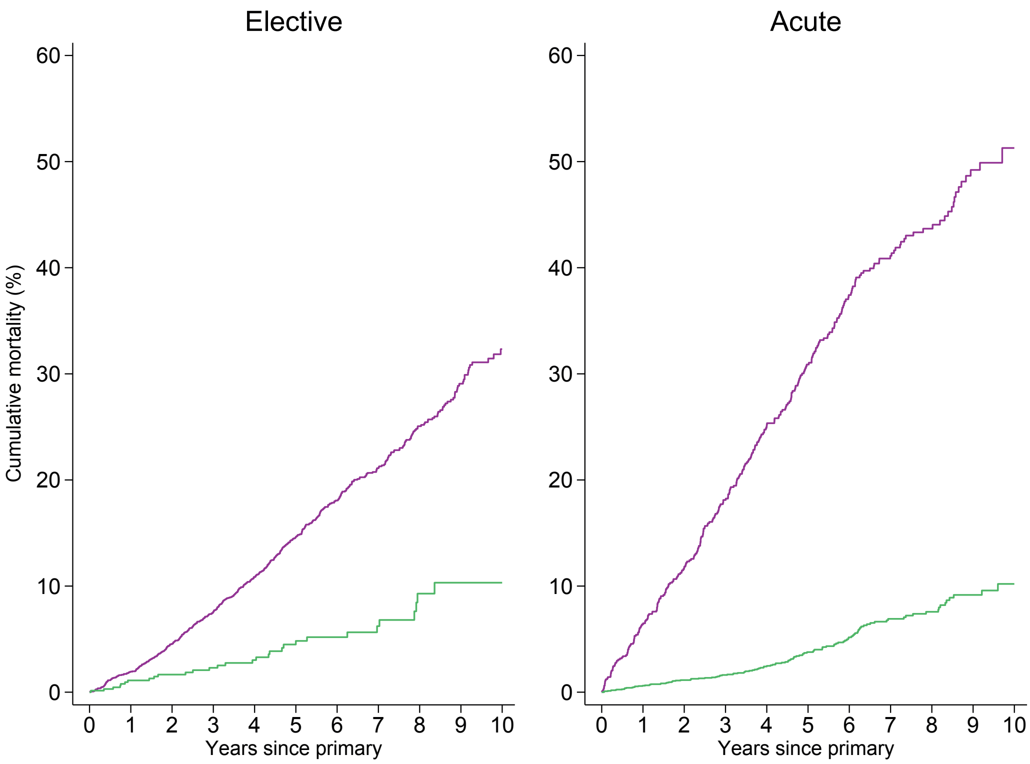
For this analysis, the second procedure of a pair of bilateral operations performed on the same day was excluded (Figure 3.E1 on page 248). Among the remaining 8,920 procedures, 1,146 of the recipients had died by the end of December 2022.

Table 3.E10 KM estimates of cumulative mortality (95% CI) by time from primary elbow replacement, for acute trauma and elective cases.
Blue italics signify that 250 or fewer cases remained at risk at these time points.

		Number of primaries	Age at primary Median (IQR)	Male (%)	Time since primary 30 days	90 days	1 year	3 years	5 years	7 years	10 years
All acute trauma and elective cases		8,920	64 (52 to 74)	33	0.19 (0.12-0.31)	0.48 (0.35-0.64)	1.97 (1.69-2.29)	6.35 (5.82-6.93)	12.25 (11.45-13.10)	18.01 (16.95-19.12)	26.59 (24.85-28.44)
Acute trauma	All acute trauma cases	4,855	61 (48 to 74)	34	0.29 (0.17-0.49)	0.58 (0.40-0.84)	2.05 (1.68-2.50)	6.09 (5.39-6.88)	11.68 (10.58-12.87)	17.47 (15.97-19.10)	*24.24 (21.77-26.93)*
	Total elbow replacement	987	77 (71 to 83)	16	1.02 (0.55-1.88)	2.04 (1.32-3.15)	6.39 (5.00-8.13)	18.11 (15.70-20.84)	30.88 (27.70-34.33)	*41.12 (37.40-45.06)*	*51.28 (46.00-56.79)*
	Total elbow replacement inc. radial head replacement	<4	75 (71 to 79)	0							
	Radial head replacement	3,236	54 (42 to 64)	42	0.09 (0.03-0.29)	0.19 (0.08-0.42)	0.62 (0.39-0.96)	1.62 (1.21-2.18)	3.78 (3.01-4.74)	6.91 (5.67-8.41)	*10.20 (8.08-12.84)*
	Distal humeral hemiarthroplasty	385	72 (65 to 79)	16	0.00 (.-.)	0.26 (0.04-1.85)	2.34 (1.17-4.62)	*7.01 (4.34-11.22)*			
	Unconfirmed total elbow replacement	178	75 (66 to 82)	21	*0.56 (0.08-3.92)*	*0.56 (0.08-3.92)*	*3.96 (1.91-8.12)*	*14.73 (10.19-21.02)*	*25.80 (19.63-33.46)*	*35.86 (27.94-45.23)*	
	Unconfirmed radial head replacement	55	55 (43 to 61)	38		*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*9.85 (2.54-34.14)*	
	Unconfirmed distal humeral hemiarthroplasty	12	70.5 (63 to 78)	25							
Elective	All elective cases	4,065	67 (56 to 75)	32	0.07 (0.02-0.23)	0.35 (0.21-0.59)	1.87 (1.49-2.35)	6.63 (5.85-7.50)	12.82 (11.69-14.05)	18.54 (17.08-20.10)	*28.43 (26.05-30.98)*
	Total elbow replacement	2,989	69 (60 to 76)	29	0.07 (0.02-0.27)	0.37 (0.21-0.67)	1.94 (1.49-2.51)	7.57 (6.63-8.64)	14.61 (13.24-16.10)	21.11 (19.35-23.00)	*32.33 (29.36-35.52)*
	Total elbow replacement inc. radial head replacement	94	67 (54 to 73)	34	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*2.67 (0.67-10.24)*	*7.20 (3.05-16.50)*	*12.95 (6.61-24.50)*	
	Radial head replacement	677	52 (40 to 63)	46	0.15 (0.02-1.05)	0.15 (0.02-1.05)	1.11 (0.53-2.32)	2.30 (1.34-3.94)	4.83 (3.16-7.36)	*6.23 (4.11-9.38)*	*10.32 (6.75-15.61)*
	Lateral resurfacing	33	56 (44 to 65)	67	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*	*3.85 (0.55-24.31)*
	Distal humeral hemiarthroplasty	42	73.5 (67 to 81)	24	*0.00 (.-.)*	*0.00 (.-.)*	*3.23 (0.46-20.77)*	*3.23 (0.46-20.77)*			
	Unconfirmed total elbow replacement	195	67 (57 to 76)	29	*0.00 (.-.)*	*1.03 (0.26-4.07)*	*4.75 (2.50-8.93)*	*9.91 (6.35-15.28)*	*16.07 (11.36-22.46)*	*21.62 (16.04-28.78)*	*31.83 (24.64-40.50)*
	Unconfirmed radial head replacement	17	62 (48 to 76)	53	*0.00 (.-.)*	*0.00 (.-.)*	*0.00 (.-.)*				
	Unconfirmed lateral resurfacing	13	59 (57 to 66)	38			*0.00 (.-.)*	*0.00 (.-.)*			
	Unconfirmed distal humeral hemiarthroplasty	5	75 (67 to 76)	20							

Note: Blank cells indicate that the number at risk at the time shown has fallen below ten and thus estimates have been omitted as they are highly unreliable.
Note: Elbow replacements with a mismatch between the type of procedure reported by the surgeon on the MDS form and the recorded component labels on the MDS form, or with no component data in the record, are described as unconfirmed and classified according to the procedure type indicated by the surgeon on the MDS form.

Figure 3.E9 KM estimates of cumulative mortality of total elbow replacement and radial head replacement for acute trauma and elective cases. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk

	Elective 0	1	2	3	4	5	6	7	8	9	10	Acute 0	1	2	3	4	5	6	7	8	9	10
Total elbow replacement	2,989	2,728	2,469	2,263	1,913	1,553	1,182	882	609	355	*136*	987	863	742	615	498	403	310	*231*	*149*	*83*	*20*
Radial head replacement	677	590	506	441	358	286	*217*	*161*	*108*	*61*	*30*	3,236	2,888	2,449	2,096	1,655	1,282	967	688	466	254	*103*

Table 3.E10 and Figure 3.E9 show the overall cumulative percentage probability of mortality shown separately for acute trauma and elective cases.

The mortality rate at five years after primary total elbow replacement for trauma is 111.4% higher than the rate in elective total elbow arthroplasty, with a five-year mortality rate of 30.9% for trauma indications. These differences are likely to be a due to demographic differences in patient characteristics and indications for undergoing surgery.

3.5.4 Conclusions

The annual number of primary elbow replacement procedures entered into the registry has increased since 2012, other than in 2020 which was profoundly affected by COVID and numbers have not fully recovered since. The NJR has the largest registry of elbow replacements globally. An audit of elbow replacement data has been conducted which has led to a further 11% increase in procedures available for reporting compared to last year's report.

The type of procedure reported is determined from two sources of information. The first is the procedure type recorded on the MDS data collection form by the surgeon at the time of the procedure. The second source is the set of component labels attached to the MDS form and recorded at upload of the record. When there is a mismatch between these two sources, i.e. the components entered do not match the procedure type recorded or in the case where there are no component data at all in the data entry record, the procedure type is reported as unconfirmed. Work is ongoing to reconcile these unconfirmed procedures and reduce their 'unconfirmed' status, and data show significant reduction since 2012. This will enhance the comprehensiveness and utility of the data moving forward, whilst the audit of procedures recorded has led to an improvement in the completeness of data available for analysis.

Distal humeral hemiarthroplasty was not included in the MDS until June 2018. Despite this, it appears to be increasing overall, while total numbers remain low. Most distal humeral hemiarthroplasty and radial head replacement procedures are performed for acute trauma and trauma sequelae as expected. Early results suggest that revision rates up to three years are higher for distal humeral hemiarthroplasty than total elbow replacement or radial head replacement for acute trauma patients, but should be treated with caution due to low numbers.

The distribution of indications for elective elbow replacement has been consistent over the last five years of data entry with inflammatory arthropathy accounting for 32.4% of cases. In 2022 there were 281 confirmed elective and acute trauma primary total elbow replacements (including ten with radial head replacements) performed in 92 units by 99 consultants. The volume of procedures does not show large variation, however the number of units performing elbow replacements has declined from 96 in 2020 and the number of consultants from 108 in 2020. It has been the intention of the NHSE GIRFT programme to centralise total elbow replacement surgery across fewer specialist centres so these data are encouraging that this is being achieved, although this comparison may have been affected by the impact of COVID on the post-2020 figures. It should be noted that the median numbers of primary procedures per unit and per surgeon have not changed significantly from 2020 to those reported in 2022.

The Kaplan-Meier estimate of cumulative revision of total elbow replacement at five years was 4.69% (95% CI 3.33-6.59) for trauma patients and 7.43% (95% CI 6.44-8.58) for elective cases. Minor disparities in the rate of revision were observed between implant brands. Brand comparisons will become more evident and reliable as the size of the elbow cohort increases over time. We note that the main indications for revision were infection and aseptic loosening and this is observed for both acute trauma and elective cases.

The five-year mortality rate for elbow replacement in all cases is 12.25% (95% CI 11.45-13.10) with little difference between trauma and elective surgery, mostly because of the large number of radial head replacements in the trauma group. When considering only total elbow replacement without radial head replacement, the five-year mortality rate for trauma cases is double that with elective indications.

3.6 Outcomes after shoulder replacement

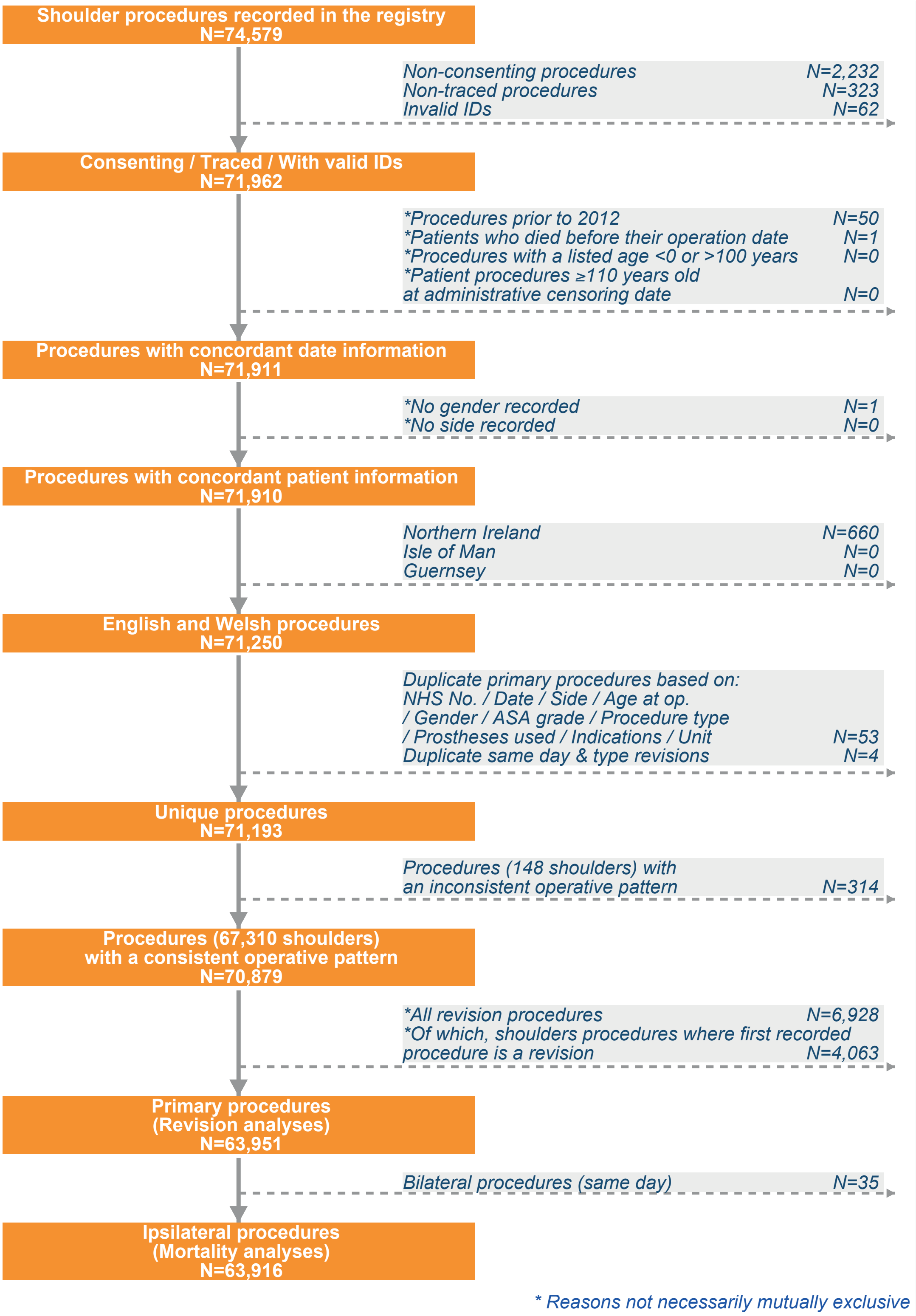
3.6.1 Overview of primary shoulder replacement surgery

Shoulder replacements have been recorded in the registry since 2012. In this section we address an overview of the (data linked) primary shoulder replacements performed up to 31 December 2022 and also document the first revision and mortality, when these events had occurred following a primary shoulder replacement.

In 2018 and 2019 a rigorous review of the shoulder data was undertaken due to the rapid expansion of shoulder implant types available. As a consequence of this review, new classifications and component attributes are now used within the report to define the primary groupings throughout the whole of this section. The report has now moved to whole construct validation, ensuring all relevant elements required to build a construct are present in a procedure. We have cross-checked the implanted construct with the indicated procedure at the time of the surgery and positively confirmed the implanted construct matches the reported procedure. This has led to the definition of unconfirmed constructs of which there are either insufficient implants listed to make up a complete construct, or the implants used do not match the indicated procedure. A total of 6,886 (10.8%) procedures are unconfirmed; although the volume is expected to improve in future reports, with the development of more rigorous checks.

We define a stemmed humeral component as a humeral component in which any part enters the humeral diaphysis, while a stemless humeral component is defined as being completely confined to the metaphysis with no part entering the diaphysis.

Figure 3.S1 Shoulder cohort flow diagram.



A total of 63,951 primary shoulder replacements were available for our analysis in a total of 58,359 patients. Of these patients, 5,592 had documented replacements on both left and right sides, 35 of which were bilateral simultaneous operations (left and right on the same day). See Figure 3.S1 for a detailed description of patients included in this section.

Table 3.S1 Number and percentage of primary shoulder replacements (elective or acute trauma), by year and type of shoulder replacement.

	All years N (%)	Year of primary 2012 N (%)	2013 N (%)	2014 N (%)	2015 N (%)	2016 N (%)	2017 N (%)	2018 N (%)	2019 N (%)	2020 N (%)	2021 N (%)	2022 N (%)
All cases	63,951 (100.0)	2,566 (100)	4,436 (100)	5,328 (100)	5,765 (100)	6,573 (100)	7,028 (100)	7,310 (100)	7,831 (100)	4,252 (100)	6,082 (100)	6,780 (100)
Proximal humeral hemiarthroplasty	8,980 (14.0)	902 (35.2)	1,321 (29.8)	1,292 (24.2)	1,073 (18.6)	1,024 (15.6)	842 (12.0)	717 (9.8)	691 (8.8)	348 (8.2)	413 (6.8)	357 (5.3)
Resurfacing	3,057 (4.8)	489 (19.1)	608 (13.7)	538 (10.1)	378 (6.6)	371 (5.6)	221 (3.1)	148 (2.0)	131 (1.7)	64 (1.5)	67 (1.1)	42 (0.6)
Stemless	1,374 (2.1)	69 (2.7)	132 (3.0)	165 (3.1)	142 (2.5)	166 (2.5)	172 (2.4)	176 (2.4)	168 (2.1)	51 (1.2)	68 (1.1)	65 (1.0)
Stemmed	4,549 (7.1)	344 (13.4)	581 (13.1)	589 (11.1)	553 (9.6)	487 (7.4)	449 (6.4)	393 (5.4)	392 (5.0)	233 (5.5)	278 (4.6)	250 (3.7)
Total shoulder replacement	16,639 (26.0)	631 (24.6)	1,179 (26.6)	1,538 (28.9)	1,773 (30.8)	1,908 (29.0)	1,987 (28.3)	1,918 (26.2)	1,961 (25.0)	997 (23.4)	1,342 (22.1)	1,405 (20.7)
Resurfacing	487 (0.8)	49 (1.9)	99 (2.2)	82 (1.5)	88 (1.5)	78 (1.2)	45 (0.6)	24 (0.3)	15 (0.2)	6 (0.1)	<4 (<0.1)	0 (0)
Stemless	6,393 (10.0)	137 (5.3)	257 (5.8)	392 (7.4)	504 (8.7)	633 (9.6)	735 (10.5)	862 (11.8)	953 (12.2)	520 (12.2)	676 (11.1)	724 (10.7)
Stemmed	9,759 (15.3)	445 (17.3)	823 (18.6)	1,064 (20.0)	1,181 (20.5)	1,197 (18.2)	1,207 (17.2)	1,032 (14.1)	993 (12.7)	471 (11.1)	665 (10.9)	681 (10.0)
Reverse polarity total shoulder replacement	31,441 (49.2)	688 (26.8)	1,353 (30.5)	1,910 (35.8)	2,333 (40.5)	3,018 (45.9)	3,621 (51.5)	4,007 (54.8)	4,616 (58.9)	2,486 (58.5)	3,491 (57.4)	3,918 (57.8)
Stemless	314 (0.5)	5 (0.2)	14 (0.3)	15 (0.3)	26 (0.5)	25 (0.4)	21 (0.3)	38 (0.5)	23 (0.3)	19 (0.4)	58 (1.0)	70 (1.0)
Stemmed	31,127 (48.7)	683 (26.6)	1,339 (30.2)	1,895 (35.6)	2,307 (40.0)	2,993 (45.5)	3,600 (51.2)	3,969 (54.3)	4,593 (58.7)	2,467 (58.0)	3,433 (56.4)	3,848 (56.8)
Interpositional arthroplasty	5 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<4 (<0.1)	<4 (<0.1)	0 (0)	0 (0)	0 (0)
Unconfirmed	6,886 (10.8)	345 (13.4)	583 (13.1)	588 (11.0)	586 (10.2)	623 (9.5)	578 (8.2)	666 (9.1)	560 (7.2)	421 (9.9)	836 (13.7)	1,100 (16.2)
Unconfirmed HHA	461 (0.7)	22 (0.9)	59 (1.3)	40 (0.8)	45 (0.8)	39 (0.6)	36 (0.5)	46 (0.6)	46 (0.6)	32 (0.8)	44 (0.7)	52 (0.8)
Unconfirmed TSR	2,156 (3.4)	203 (7.9)	313 (7.1)	310 (5.8)	261 (4.5)	274 (4.2)	205 (2.9)	173 (2.4)	83 (1.1)	72 (1.7)	113 (1.9)	149 (2.2)
Unconfirmed RTSR	4,262 (6.7)	120 (4.7)	211 (4.8)	238 (4.5)	280 (4.9)	310 (4.7)	337 (4.8)	443 (6.1)	430 (5.5)	317 (7.5)	677 (11.1)	899 (13.3)
Unconfirmed IPA	7 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (0.1)	<4 (<0.1)	0 (0)	<4 (<0.1)	0 (0)

Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S1 illustrates the number of shoulder replacements and how they have changed across time. There was a steady increase in the number of primary shoulder replacements year-on-year prior to the COVID pandemic. Since 2020 the number of shoulder replacements has increased again but has not yet reached the levels recorded in 2019. Table 3.S1 also illustrates relative proportions of proximal humeral hemiarthroplasty (HHA), conventional total shoulder replacement (TSR) and reverse polarity total shoulder replacement (RTSR). There was an increasing preference for reverse polarity total shoulder replacement year-on-year until 2019 and since then it has plateaued.

The number of unconfirmed procedures contained within the registry is illustrated. Using more evolved methods of construct and procedure cross-validation, procedures with insufficient prostheses elements to build a unique construct, or a construct that disagrees with the procedure indicated at the time of surgery are identified. It is noted that entering all the elements of reverse polarity total shoulder replacements appears to have been particularly challenging and so it is urged that those completing the data entry forms and entering data should pay particular attention to these procedures.

Figure 3.S2 Frequency of elective primary shoulder replacements by funding status and organisation type, per year.

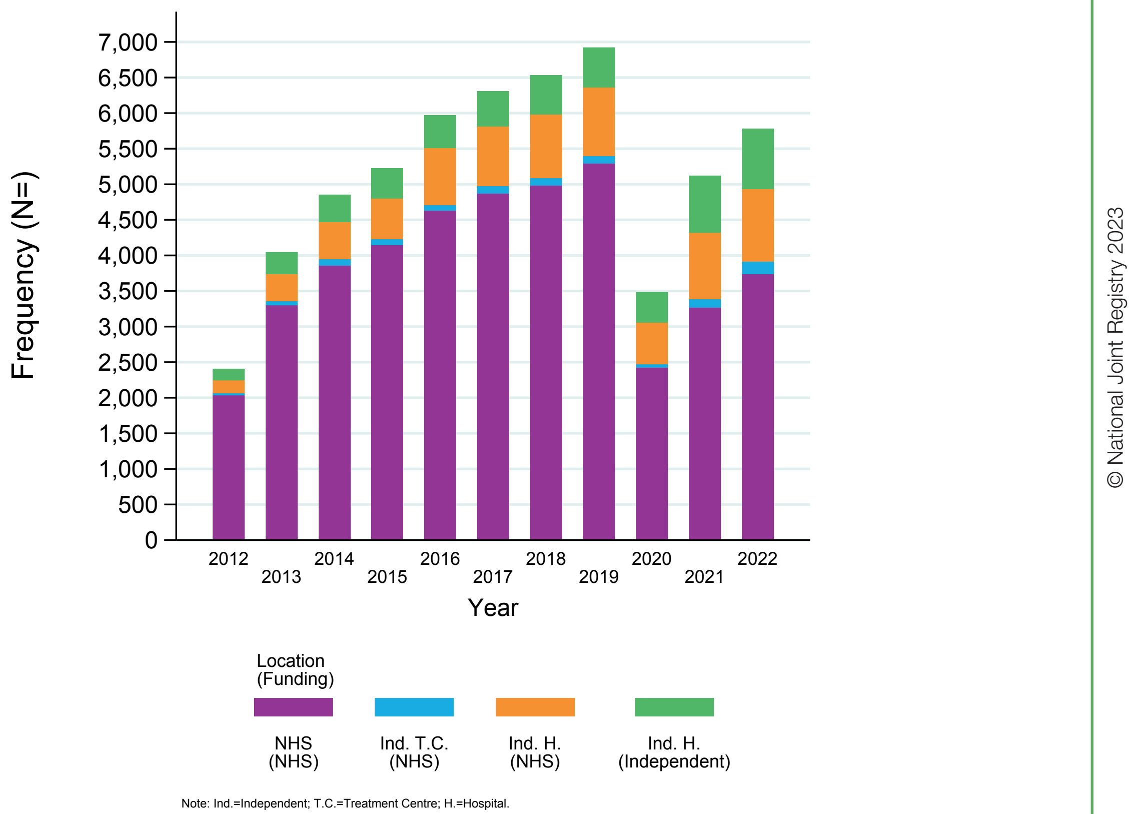


Figure 3.S2 describes the funding status and organisation type (based on organisation type in 2023) of elective primary shoulder replacement procedures collected by the NJR. Prior to 2020 (COVID) we can see an increase in the absolute number of joint replacements being provided, which in part is being facilitated by an expansion of NHS-funded procedures in both the NHS and the independent sector. Since 2020 we can see that the recovery of shoulder replacement is due to an expansion of provision within the independent sector (both NHS- and independently-funded). Notably, there has been a substantial increase in the number of independently-funded procedures compared to pre-2020 data.

Figure 3.S3 and Figure 3.S4 (pages 281 to 282) show the yearly number of primary shoulder replacements performed for elective and acute trauma indications respectively. Elective and acute trauma procedures have been stratified by procedure type. (Please note the difference in scale of the y-axis between each sub-plot.) Each bar is further stratified by the volume of procedures that the surgeon conducted in that year across both elective and acute trauma settings i.e. if a surgeon performed 24 elective primary stemmed humeral hemiarthroplasty procedures and 24 acute stemmed humeral hemiarthroplasty procedures their annual total volume would be 48 procedures. Those 48 procedures would contribute to the grey sub-division in both elective and acute trauma figures.

Figure 3.S3 shows a complex pattern of increasing and decreasing treatment preferences for elective indications. Resurfacing humeral hemiarthroplasty and resurfacing total shoulder replacements have declined since the start of data collection, while stemless total shoulder replacements have steadily increased, and the volume of stemmed reverse polarity total shoulder replacement has increased substantially. There has been a decrease in the use of stemmed humeral hemiarthroplasty and stemmed total shoulder replacements, whilst the growth in stemless total shoulder replacements and stemmed reverse polarity total shoulder replacements appears to be occurring in higher-volume shoulder surgeons.

Figure 3.S4 shows that the popularity of stemmed humeral hemiarthroplasty for acute trauma indications has reduced over the last few years, while the popularity of stemmed reverse polarity total shoulder replacements has been steadily increasing. Stemmed reverse polarity total shoulder replacements are increasingly conducted by higher-volume surgeons.

Figure 3.S3 Frequency of primary shoulder replacements within elective patients stratified by procedure type, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

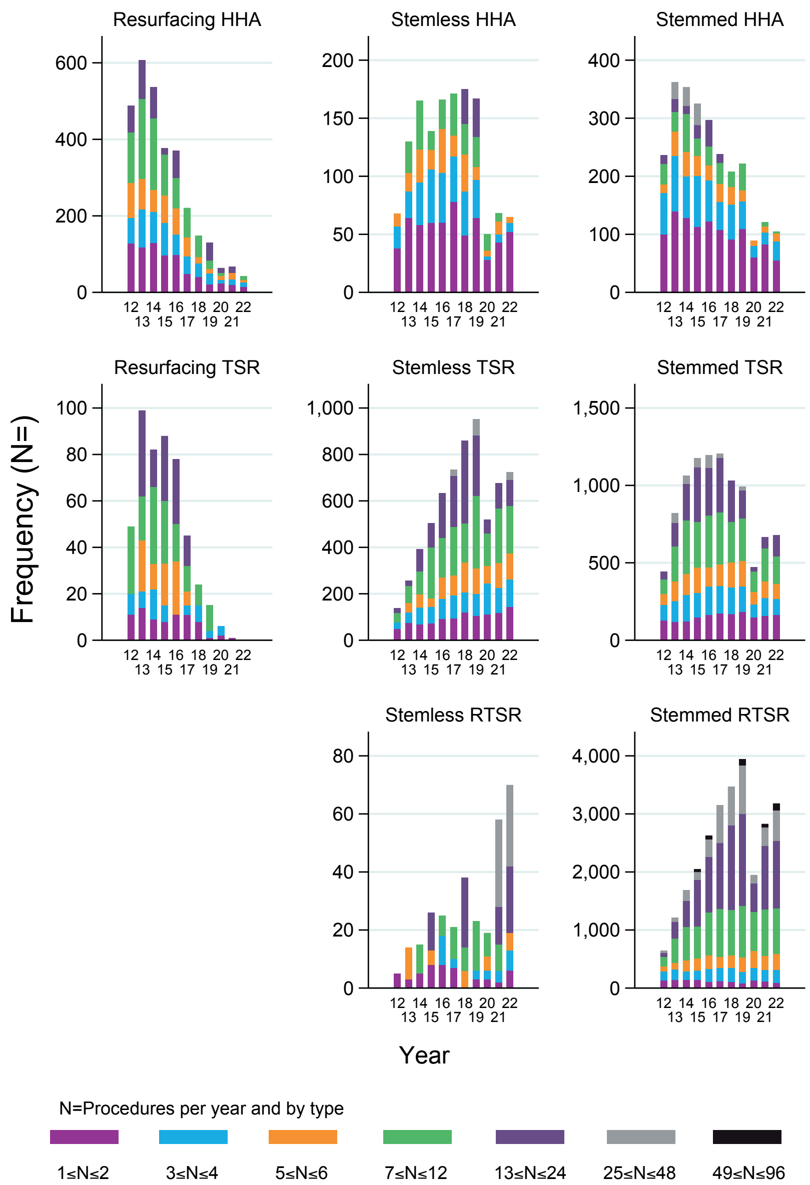


Figure 3.S4 Frequency of primary shoulder replacements within acute trauma patients stratified by procedure type, bars stacked by volume per consultant per year. Graphs by confirmed procedure type.

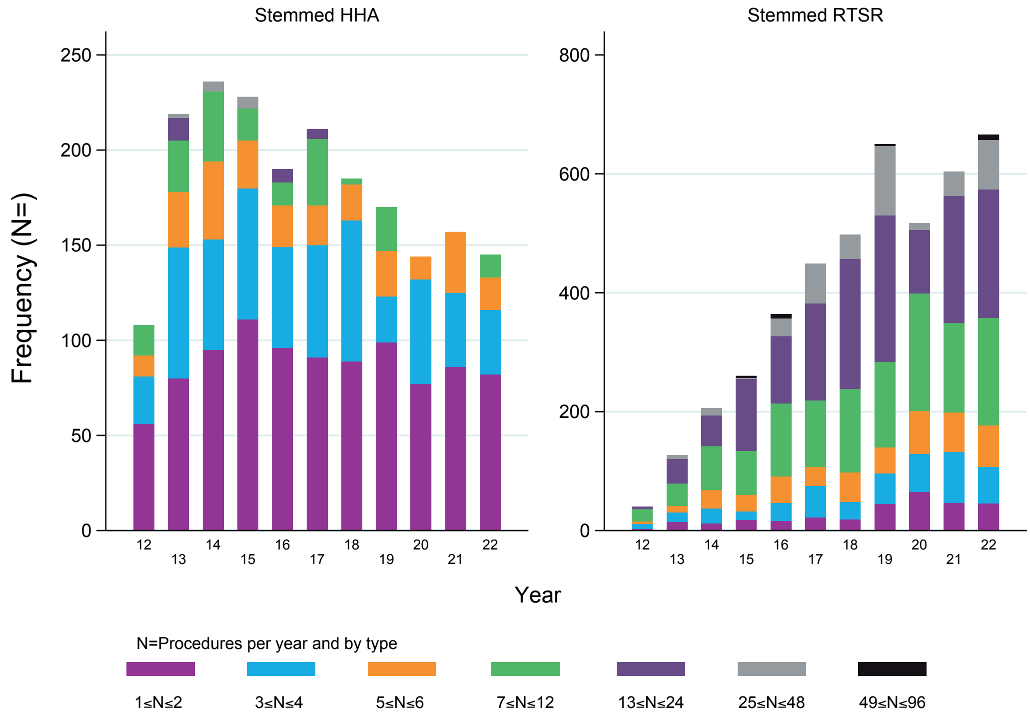
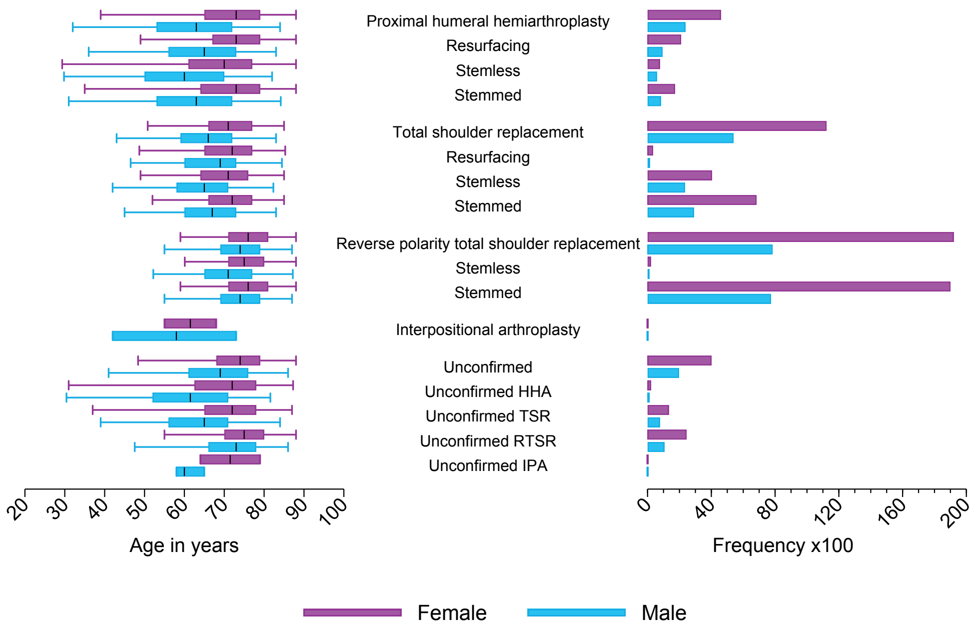
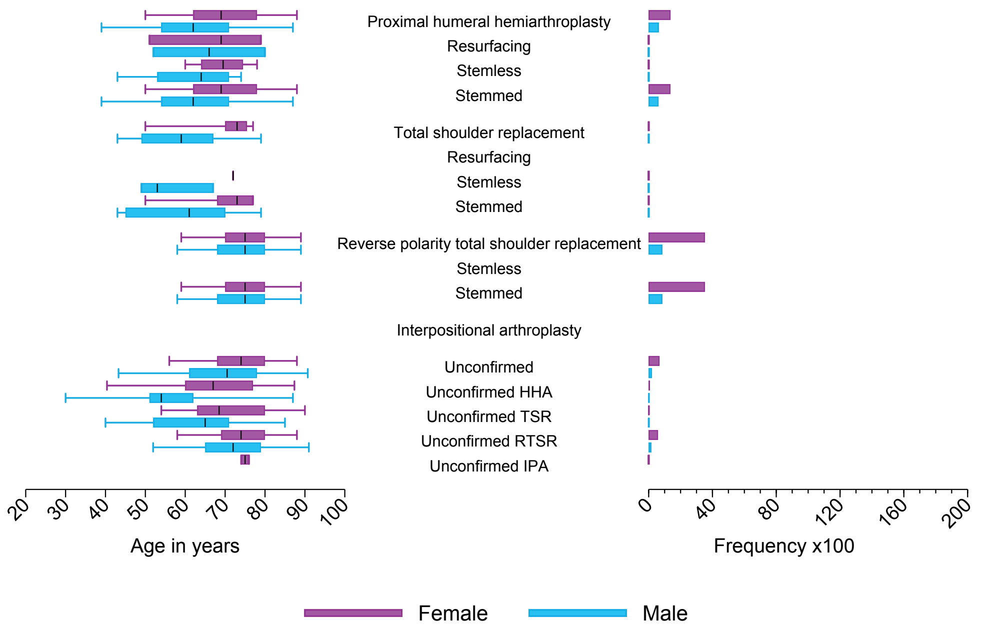


Figure 3.S5 Age (Box and whiskers*) and frequency of primary shoulder replacements by gender and type of shoulder replacement for elective indications.



*| represents the median, boxes represent lower and upper interquartile range, whiskers represent the 2.5th and 97.5th centile of the distribution.

Figure 3.S6 Age (Box and whiskers*) and frequency of primary shoulder replacements by gender and type of shoulder replacement for acute trauma indications.



*| represents the median, boxes represent lower and upper interquartile range, whiskers represent the 2.5th and 97.5th centile of the distribution.

Figure 3.S5 and Figure 3.S6 illustrate the age and gender differences between the different types and sub-types of shoulder replacements for elective indications and acute indications respectively, using a modified 'box and whiskers' plot. The whiskers represent the 2.5th and 97.5th centile of the distribution. The figures also show the frequency of procedures by gender and procedure type. Women tend to be older than men at the time of primary operation and those receiving reverse polarity total shoulder replacements tend to be older than those receiving proximal humeral hemiarthroplasty or conventional total shoulder replacements. The majority of procedures recorded within the registry are reverse polarity total shoulder replacements, and the majority of unconfirmed procedures consist of reverse polarity total shoulder replacements.

Table 3.S2 Demographic characteristics of patients undergoing primary shoulder replacements, by acute or elective indications and type of shoulder replacement.

	Shoulder type	Number of cases	Male N (%)	Age at primary (years) Median (IQR*)	Range**
Acute trauma	All cases	7,303	1,699 (23.3)	73 (67 to 79)	27 to 99
	Proximal humeral hemiarthroplasty	2,009	633 (31.5)	68 (59 to 76)	27 to 96
	Total shoulder replacement	17	9 (52.9)	68 (53 to 73)	43 to 79
	Reverse polarity total shoulder replacement	4,380	847 (19.3)	75 (70 to 80)	42 to 99
	Interpositional arthroplasty	0	0 (0.0)	0 (0 to 0)	0 to 0
	Unconfirmed	897	210 (23.4)	73 (67 to 79)	30 to 95
Elective	All cases	56,648	17,584 (31.0)	73 (67 to 79)	17 to 100
	Proximal humeral hemiarthroplasty	6,971	2,365 (33.9)	70 (60 to 77)	17 to 95
	Resurfacing	3,051	942 (30.9)	71 (63 to 78)	19 to 95
	Stemless	1,364	591 (43.3)	66 (55 to 75)	17 to 93
	Stemmed	2,556	832 (32.6)	70 (59 to 78)	19 to 95
	Total shoulder replacement	16,622	5,391 (32.4)	70 (63 to 75)	18 to 99
	Resurfacing	487	140 (28.7)	71 (63 to 76)	29 to 95
	Stemless	6,389	2,346 (36.7)	69 (62 to 75)	18 to 99
	Stemmed	9,746	2,905 (29.8)	70 (64 to 76)	24 to 96
	Reverse polarity total shoulder replacement	27,061	7,850 (29.0)	76 (71 to 80)	17 to 100
	Stemless	314	111 (35.4)	74 (69 to 79)	47 to 91
	Stemmed	26,747	7,739 (28.9)	76 (71 to 80)	17 to 100
	Interpositional arthroplasty	5	<4 (60.0)	58 (55 to 68)	42 to 73
	Unconfirmed	5,989	1,975 (33.0)	73 (66 to 79)	18 to 96
	Unconfirmed HHA	364	136 (37.4)	69 (57 to 75)	18 to 92
	Unconfirmed TSR	2,107	775 (36.8)	69 (61 to 76)	20 to 96
	Unconfirmed RTSR	3,513	1,061 (30.2)	75 (69 to 80)	18 to 95
	Unconfirmed IPA	5	<4 (60.0)	64 (60 to 65)	58 to 79

*IQR: Interquartile range, i.e. 25th and 75th centile.
**Range: Lowest and highest observed values.
Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S2 displays similar information to Figure 3.S5 and Figure 3.S6, with results separated by acute trauma and elective procedures.

Table 3.S3 Numbers of units and consultant surgeons providing primary shoulder replacements and median and interquartile range of procedures performed by unit and consultant, by year, last five years and overall.

Year of primary	Primary replacements N	Units providing primary replacements in each year N	Primary replacements per unit Median (IQR)	Consultants providing primary replacements in each year N	Primary replacements per consultant Median (IQR)
All years	**63,951**	**421**	**96 (40 to 213)**	**970**	**21 (2 to 97)**
Last 5 years	**32,255**	**406**	**57 (26 to 117)**	**704**	**28 (5 to 72.5)**
2012	2,566	263	6 (3 to 12)	380	4 (2 to 9)
2013	4,436	312	9 (4 to 18)	434	7 (2 to 15)
2014	5,328	338	10 (4 to 21)	456	8 (3 to 17)
2015	5,765	347	11 (4 to 23)	485	8 (3 to 17)
2016	6,573	348	14 (5 to 26)	494	10 (4 to 19)
2017	7,028	364	14 (5 to 27)	495	10 (5 to 21)
2018	7,310	368	14 (5 to 28.5)	510	11 (4 to 21)
2019	7,831	374	14.5 (6 to 29)	520	11 (5 to 22)
2020	4,252	360	8 (4 to 16)	486	7 (3 to 13)
2021	6,082	376	12 (6 to 23)	504	9 (4 to 18)
2022	6,780	372	13 (6 to 25)	514	10 (4 to 18)

Table 3.S3 illustrates the number of primary shoulder replacements and the number of units and consultants conducting shoulder replacements within the registry. The table also illustrates the median and interquartile range of the number of replacements performed within each unit or by each consultant. This is displayed overall, aggregated by the last five years of data, and by year of data collection.

The results illustrate that the median, and interquartile range, number of procedures performed by units and consultants remained static for the last few years until 2019 and the subsequent impact of COVID. There are currently 13 (6 to 25) procedures per unit and 10 (4 to 18) procedures per consultant which is almost recovered to pre-COVID levels.

Table 3.S4 Number and percentage of primary shoulder replacements by indication and type of shoulder replacement.

	Acute trauma	Elective							
			N (%)* for each indication in elective procedures only						
	Number of cases N (%)	Number of cases N (%)	Osteoarthritis	Cuff tear arthropathy	Trauma sequelae	Other inflamatory arthropathy	Avascular necrosis	Other causes***	Cuff tear without arthropathy**
All cases	7,303 (100)	56,648 (100)	34,224 (100)	15,523 (100)	4,068 (100)	2,164 (100)	1,799 (100)	1,385 (100)	1,029 (100)
Proximal humeral hemiarthroplasty	2,009 (27.5)	6,971 (12.3)	5,184 (15.1)	371 (2.4)	634 (15.6)	413 (19.1)	588 (32.7)	214 (15.5)	11 (1.1)
Resurfacing	6 (0.1)	3,051 (5.4)	2,600 (7.6)	168 (1.1)	75 (1.8)	166 (7.7)	109 (6.1)	55 (4.0)	<4 (0.2)
Stemless	10 (0.1)	1,364 (2.4)	1,093 (3.2)	19 (0.1)	92 (2.3)	66 (3.0)	146 (8.1)	44 (3.2)	0 (0)
Stemmed	1,993 (27.3)	2,556 (4.5)	1,491 (4.4)	184 (1.2)	467 (11.5)	181 (8.4)	333 (18.5)	115 (8.3)	9 (0.9)
Total shoulder replacement	17 (0.2)	16,622 (29.3)	15,481 (45.2)	37 (0.2)	326 (8.0)	564 (26.1)	431 (24.0)	221 (16.0)	5 (0.5)
Resurfacing	0 (0)	487 (0.9)	465 (1.4)	0 (0)	4 (0.1)	22 (1.0)	<4 (0.1)	4 (0.3)	0 (0)
Stemless	4 (0.1)	6,389 (11.3)	5,928 (17.3)	11 (0.1)	131 (3.2)	223 (10.3)	148 (8.2)	111 (8.0)	<4 (0.2)
Stemmed	13 (0.2)	9,746 (17.2)	9,088 (26.6)	26 (0.2)	191 (4.7)	319 (14.7)	281 (15.6)	106 (7.7)	<4 (0.3)
Reverse polarity total shoulder replacement	4,380 (60.0)	27,061 (47.8)	10,319 (30.2)	13,378 (86.2)	2,538 (62.4)	920 (42.5)	598 (33.2)	660 (47.7)	917 (89.1)
Stemless	0 (0)	314 (0.6)	138 (0.4)	149 (1.0)	11 (0.3)	7 (0.3)	6 (0.3)	<4 (0.1)	14 (1.4)
Stemmed	4,380 (60.0)	26,747 (47.2)	10,181 (29.7)	13,229 (85.2)	2,527 (62.1)	913 (42.2)	592 (32.9)	658 (47.5)	903 (87.8)
Interpositional arthroplasty	0 (0)	5 (<0.1)	5 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Unconfirmed	897 (12.3)	5,989 (10.6)	3,235 (9.5)	1,737 (11.2)	570 (14.0)	267 (12.3)	182 (10.1)	290 (20.9)	96 (9.3)
Unconfirmed HHA	97 (1.3)	364 (0.6)	203 (0.6)	54 (0.3)	46 (1.1)	17 (0.8)	34 (1.9)	36 (2.6)	<4 (0.2)
Unconfirmed TSR	49 (0.7)	2,107 (3.7)	1,713 (5.0)	132 (0.9)	90 (2.2)	89 (4.1)	53 (2.9)	106 (7.7)	<4 (0.1)
Unconfirmed RTSR	749 (10.3)	3,513 (6.2)	1,316 (3.8)	1,551 (10.0)	432 (10.6)	161 (7.4)	95 (5.3)	148 (10.7)	93 (9.0)
Unconfirmed IPA	<4 (<0.1)	5 (<0.1)	<4 (<0.1)	0 (0)	<4 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)

*Percentages are based on the total number of elective cases; please note the listed reasons are not mutually exclusive as more than one reason could have been stated.
**Only recorded in MDSv7 introduced in June 2018. Total cases recorded using MDSv7 =29,815.
***Includes 102 metastatic cancer/malignancies documented since MDSv6 (N=53,936), together with 345 dislocations documented since MDSv7 (N=29,815).
Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S4 illustrates the number and percentage of primary shoulder procedures by the type and sub-type of shoulder replacement for both acute trauma and elective procedures. The indication for surgery in elective procedures is also illustrated. The majority of proximal humeral hemiarthroplasty and conventional total shoulder replacement procedures recorded in the registry are for an indication of osteoarthritis. Reverse polarity total shoulder replacements are the most common procedure performed for cuff tear arthropathy, trauma sequelae, other inflammatory arthropathy, avascular necrosis, other causes and cuff tear without arthropathy. It is important to note that the indications for shoulder surgery recorded in the registry are not mutually exclusive; 83.7% of procedures list a single indication for the cause of surgery with the remainder recording more than one indication.

Table 3.S5 (a) Number of resurfacing proximal humeral hemiarthroplasty replacements between 2012 and 2022 and within the last year by brand construct.

			Primary operations all years			Primary operations in 2022		
	Manufacturer(s)	Shoulder construct	All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Resurfacing HHA	Wright	Aequalis Resurfacing[HH.Resurf]	257	0	257	0	0	0
	FH	Arrow[HH.Resurf]	36	0	36	0	0	0
	Zimmer Biomet	Copeland[HH.Resurf]	1,709	<4	1,706	21	0	21
	DePuy	Epoca[HH.Resurf]	112	<4	111	0	0	0
	Exactech	Equinoxe[HH.Resurf:H.RPeg]	63	0	63	8	0	8
	DePuy	Global CAP[HH.Resurf]	638	<4	636	12	0	12
	Lima	SMR[HH.Resurf]	23	0	23	0	0	0
	Lima	SMR[HH.Resurf:H.RPeg]	110	0	110	0	0	0
	JRI	Vaios[HH.Resurf]	104	0	104	0	0	0

Table 3.S5 (b) Number of stemless proximal humeral hemiarthroplasty replacements between 2012 and 2022 and within the last year by brand construct.

			Primary operations all years			Primary operations in 2022		
	Manufacturer(s)	Shoulder construct	All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Stemless HHA	Zimmer Biomet	Versa-Dial[HH.Stand]: Nano[H.Stemless]	60	<4	59	<4	0	<4
	Mathys	Affinis[HH.Stand:H.Stemless]	659	5	654	32	0	32
	Arthrex	Eclipse[HH.Stand:H.Stemless]	152	<4	151	13	0	13
	DePuy	Global ICON[HH.Stand:H.Stemless]	22	0	22	<4	0	<4
	Lima	SMR[HH.Stand:H.Stemless]	39	0	39	6	0	6
	Zimmer Biomet	Sidus[HH.Stand:H.Stemless]	185	<4	184	4	0	4
	Wright	Simpliciti[HH.Stand:H.Stemless]	178	0	178	7	0	7
	Zimmer Biomet	TESS[HH.Stand:H.Stemless]	76	<4	74	0	0	0

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (c) Number of stemmed proximal humeral hemiarthroplasty replacements between 2012 and 2022 and within the last year by brand construct.

	Manufacturer(s)	Shoulder construct	Primary operations all years			Primary operations in 2022		
			All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Stemmed HHA	Wright	Aequalis[HH.Stand]: Aequalis-Fracture[H.Standard]	260	222	38	15	12	<4
	Zimmer Biomet	Bigliani/Flatow[HH.Stand]: Anatomical[H.Mod]	22	<4	19	0	0	0
	Wright	Aequalis[HH.Stand]: Ascend Flex[H.Standard]	335	10	325	39	4	35
	Zimmer Biomet	Versa-Dial[HH.Stand]: Comprehensive[H.Standard]	169	8	161	14	0	14
	Zimmer Biomet	Versa-Dial[HH.Stand]: Comprehensive Fracture[H.Standard]	241	195	46	32	26	6
	Zimmer Biomet	Bio-Modular[HH.Stand]: Comprehensive Fracture[H.Standard]	19	15	4	0	0	0
	DePuy	Global Unite[HH.Stand]: Global AP[H.Mod]	11	0	11	0	0	0
	DePuy	Global Advantage[HH.Stand]: Global FX[H.Standard]	226	182	44	<4	<4	0
	Zimmer Biomet	Bigliani/Flatow[HH.Stand]: TM[H.Dia]	24	<4	23	0	0	0
	Wright	Aequalis[HH.Stand:H.Standard]	198	4	194	0	0	0
	Mathys	Affinis[HH.Stand:H.Standard]	70	4	66	<4	<4	0
	Mathys	Affinis[HH.Stand:H.NeckBody:H.Dia]	245	210	35	13	12	<4
	Zimmer Biomet	Anatomical[HH.Stand:H.Mod]	22	<4	20	0	0	0
	Zimmer Biomet	Anatomical Fracture[HH.Stand:H.Mod]	46	35	11	0	0	0
	FH	Arrow[HH.Stand:H.Standard]	33	5	28	0	0	0
	Wright	Ascend Flex[HH.Stand:H.Standard]	196	16	180	9	5	4
	Zimmer Biomet	Bigliani/Flatow[HH.Stand:H.Dia]	47	12	35	0	0	0
	Zimmer Biomet	Bio-Modular[HH.Stand:H.Standard]	11	6	5	0	0	0
	DePuy	Delta Xtend[HH.Stand:H.Standard]	43	<4	41	0	0	0
	DePuy	Epoca[HH.Stand:H.Mod]	115	51	64	0	0	0
	Exactech	Equinoxe[HH.Stand:H.Mod]	153	6	147	17	<4	16
	Exactech	Equinoxe[HH.Stand:H.Standard]	313	271	42	37	35	<4
	DePuy	Global AP[HH.Stand:H.Mod]	253	6	247	0	0	0
	DePuy	Global Advantage[HH.Stand:H.Standard]	340	74	266	4	0	4
	DePuy	Global Unite[HH.Stand:H.Mod]	29	17	12	0	0	0
	DePuy	Global Unite[HH.Stand:H.NeckBody:H.Mod]	398	305	93	31	25	6
	Smith & Nephew	Neer[H.MBStem]	24	8	16	0	0	0
	Zimmer Biomet	Nottingham[HH.Stand:H.Standard]	38	18	20	0	0	0
	Corin	Oxford[HH.Stand:H.Standard]	83	5	78	0	0	0
	Lima	SMR[HH.Stand:H.NeckBody:H.Dia]	371	211	160	29	19	10
	Lima	SMR[HH.Stand:H.Dia]	13	7	6	<4	0	<4
	JRI	Vaios[HH.Stand:H.NeckBody:H.Dia]	90	46	44	0	0	0

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (d) Number of resurfacing total shoulder replacement replacements between 2012 and 2022 and within the last year by brand construct.

			Primary operations all years			Primary operations in 2022		
	Manufacturer(s)	Shoulder construct	All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Resurfacing TSR	Wright	Aequalis[G.Ana]: Aequalis Resurfacing[HH.Resurf]	25	0	25	0	0	0
	Wright	Aequalis Perform+[G.Ana]: Aequalis Resurfacing[HH.Resurf]	14	0	14	0	0	0
	FH	Arrow[G.Ana:HH.Resurf]	15	0	15	0	0	0
	DePuy	Epoca[G.Ana:HH.Resurf]	126	0	126	0	0	0
	DePuy	Epoca[G.BP:G.Ana:HH.Resurf]	204	0	204	0	0	0
	DePuy	Epoca[G.Peg:G.Ana:HH.Resurf]	54	0	54	0	0	0
	Exactech	Equinoxe[G.Ana:HH.Resurf:H.RPeg]	32	0	32	0	0	0

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (e) Number of stemless conventional total shoulder replacement replacements between 2012 and 2022 and within the last year by brand construct.

	Manufacturer(s)	Shoulder construct	Primary operations all years			Primary operations in 2022		
			All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Stemless TSR	DePuy:Mathys	Epoca[G.BP]: Epoca[G.Ana]: Affinis[HH.Stand]: Affinis[H.Stemless]	39	0	39	0	0	0
	Arthrex:DePuy	Global Anchor Peg[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	11	0	11	0	0	0
	Arthrex:DePuy	Epoca[G.Peg]: Epoca[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	15	0	15	0	0	0
	Arthrex:Wright	Aequalis[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	77	0	77	0	0	0
	Arthrex	Univers II[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	532	0	532	40	0	40
	Arthrex:DePuy	Epoca[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	16	0	16	0	0	0
	Arthrex	Universal[G.BP]: Universal[G.Lin]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	92	0	92	17	0	17
	Arthrex:DePuy	Epoca[G.BP]: Epoca[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	51	0	51	0	0	0
	DePuy	Global[G.Ana]: Global ICON[HH.Stand]: Global ICON[H.Stemless]	14	0	14	0	0	0
	DePuy	Global Anchor Peg[G.Ana]: Global ICON[HH.Stand]: Global ICON[H.Stemless]	415	0	415	96	0	96
	Zimmer Biomet	Comprehensive[G.Ana]: Versa-Dial[HH.Stand]: Nano[H.Stemless]	10	0	10	<4	0	<4
	Zimmer Biomet	Comprehensive[G.Peg]: Comprehensive[G.Ana]: Versa-Dial[HH.Stand]: Nano[H.Stemless]	696	<4	695	83	0	83
	Zimmer Biomet	Bigliani/Flatow[G.Ana]: Bigliani/Flatow[HH.Stand]: Sidus[H.Stemless]	18	0	18	0	0	0
	Zimmer Biomet	TM[G.Ana]: Sidus[HH.Stand]: Sidus[H.Stemless]	104	<4	103	0	0	0
	Zimmer Biomet	Comprehensive[G.Peg]: Comprehensive[G.Ana]: Sidus[HH.Stand]: Sidus[H.Stemless]	222	0	222	48	0	48
	Zimmer Biomet	Anatomical[G.Ana]: Sidus[HH.Stand]: Sidus[H.Stemless]	74	0	74	<4	0	<4
	Zimmer Biomet	Bigliani/Flatow[G.Ana]: Sidus[HH.Stand]: Sidus[H.Stemless]	27	0	27	0	0	0
	Zimmer Biomet	TM[G.Ana]: Bigliani/Flatow[HH.Stand]: Sidus[H.Stemless]	33	0	33	0	0	0
	Wright	Aequalis[G.Ana]: Simpliciti[HH.Stand]: Simpliciti[H.Stemless]	87	0	87	0	0	0
	Wright	Aequalis Perform+[G.Ana]: Simpliciti[HH.Stand]: Simpliciti[H.Stemless]	981	<4	980	157	0	157
	Wright	Affiniti[G.Ana]: Simpliciti[HH.Stand]: Simpliciti[H.Stemless]	10	0	10	0	0	0
	Mathys	Affinis[G.Ana:HH.Stand:H.Stemless]	2,498	0	2,498	251	0	251
	Lima	SMR[G.BP:G.Lin:HH.Stand:H.Stemless]	178	0	178	5	0	5
	Lima	SMR[G.Ana:HH.Stand:H.Stemless]	77	0	77	19	0	19
	Zimmer Biomet	TESS[G.Ana:HH.Stand:H.Stemless]	69	0	69	0	0	0

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (f) Number of stemmed conventional total shoulder replacements between 2012 and 2022 and within the last year by brand construct.

	Manufacturer(s)	Shoulder construct	Primary operations all years			Primary operations in 2022		
			All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Stemmed TSR	Wright	Aequalis Perform+[G.Ana]: Aequalis[HH.Stand]: Aequalis[H.Standard]	50	0	50	0	0	0
	Wright	Aequalis[G.Ana]: Aequalis[HH.Stand]: Aequalis-Press-Fit[H.Standard]	10	0	10	0	0	0
	Wright	Aequalis Perform+[G.Ana]: Affiniti[HH.Stand]: Affiniti[H.Standard]	12	0	12	0	0	0
	Zimmer Biomet	Comprehensive[G.Peg]: Comprehensive[G.Ana]: Anatomical[HH.Stand]: Anatomical[H.Mod]	11	0	11	0	0	0
	Zimmer Biomet	Anatomical[G.Ana]: Bigliani/Flatow[HH.Stand]: Anatomical[H.Mod]	24	0	24	0	0	0
	Zimmer Biomet	TM[G.Ana]: Bigliani/Flatow[HH.Stand]: Anatomical[H.Mod]	123	0	123	0	0	0
	Zimmer Biomet	TM Reverse[G.BP]: TM[G.Ana]: Bigliani/Flatow[HH.Stand]: Anatomical[H.Mod]	18	0	18	0	0	0
	Zimmer Biomet	Bigliani/Flatow[G.Ana]: Bigliani/Flatow[HH.Stand]: Anatomical[H.Mod]	69	0	69	0	0	0
	Zimmer Biomet	TM[G.Ana]: Anatomical[HH.Stand]: Anatomical[H.Mod]	12	<4	11	0	0	0
	Wright	Aequalis[G.Ana]: Ascend[HH.Stand]: Ascend[H.Standard]	24	0	24	0	0	0
	Wright	Aequalis[G.Ana]: Ascend Flex[HH.Stand]: Ascend Flex[H.Standard]	20	0	20	0	0	0
	Wright	Aequalis Perform+[G.Ana]: Ascend Flex[HH.Stand]: Ascend Flex[H.Standard]	1,890	0	1,890	288	0	288
	Zimmer Biomet	Comprehensive[G.Ana]: Versa-Dial[HH.Stand]: Comprehensive[H.Standard]	20	0	20	5	0	5
	Zimmer Biomet	Comprehensive[G.Peg]: Comprehensive[G.Ana]: Versa-Dial[HH.Stand]: Comprehensive[H.Standard]	1,114	<4	1,111	130	0	130
	DePuy	Global Anchor Peg[G.Ana]: Global AP[HH.Stand]: Global AP[H.Mod]	1,058	0	1,058	<4	0	<4
	DePuy	Global Anchor Peg[G.Ana]: Global Unite[HH.Stand]: Global AP[H.Mod]	198	0	198	25	0	25
	DePuy	Global[G.Ana]: Global AP[HH.Stand]: Global AP[H.Mod]	59	0	59	0	0	0
	DePuy	Global[G.Ana]: Global Advantage[HH.Stand]: Global Advantage[H.Standard]	562	0	562	<4	0	<4
	DePuy	Global Anchor Peg[G.Ana]: Global Advantage[HH.Stand]: Global Advantage[H.Standard]	309	0	309	33	0	33
	DePuy	Global Anchor Peg[G.Ana]: Global Unite[HH.Stand]: Global Unite[H.Mod]	29	0	29	<4	0	<4
	DePuy	Global Anchor Peg[G.Ana]: Global Unite[HH.Stand]: Global Unite[H.NeckBody]: Global Unite[H.Mod]	572	<4	571	35	0	35
	DePuy	Global[G.Ana]: Global Unite[HH.Stand]: Global Unite[H.NeckBody]: Global Unite[H.Mod]	38	0	38	0	0	0
	Arthrex:DePuy	Univers II[G.Ana]: Global Unite[HH.Stand]: Global Unite[H.NeckBody]: Global Unite[H.Mod]	22	0	22	0	0	0

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (f) (continued)

	Manufacturer(s)	Shoulder construct	Primary operations all years All cases N	Primary operations all years Acute trauma N	Primary operations all years Elective N	Primary operations in 2022 All cases N	Primary operations in 2022 Acute trauma N	Primary operations in 2022 Elective N
Stemmed TSR	Lima	Axioma[G.Peg]: Axioma[G.BP]: SMR[G.Lin]: SMR[HH.Stand]: SMR[H.NeckBody]: SMR[H.Dia]	35	0	35	<4	0	<4
	Zimmer Biomet	TM[G.Ana]: Bigliani/Flatow[HH.Stand]: TM[H.Dia]	47	0	47	0	0	0
	Zimmer Biomet	Bigliani/Flatow[G.Ana]: Bigliani/Flatow[HH.Stand]: TM[H.Dia]	30	0	30	0	0	0
	Wright	Aequalis[G.Ana:HH.Stand:H.Standard]	195	0	195	0	0	0
	Mathys	Affinis[G.Ana:HH.Stand:H.Standard]	111	<4	110	5	0	5
	Zimmer Biomet	Anatomical[G.Ana:HH.Stand:H.Mod]	85	0	85	0	0	0
	FH	Arrow[G.Ana:HH.Stand:H.Standard]	193	<4	192	9	<4	8
	FH	Arrow[G.BP:G.Lin:HH.Stand:H.Standard]	26	0	26	<4	0	<4
	Zimmer Biomet	Bigliani/Flatow[G.Ana:HH.Stand:H.Dia]	58	0	58	0	0	0
	DePuy	Epoca[G.Ana:HH.Stand:H.Mod]	315	0	315	0	0	0
	DePuy	Epoca[G.Peg:G.Ana:HH.Stand:H.Mod]	155	0	155	0	0	0
	DePuy	Epoca[G.BP:G.Ana:HH.Stand:H.Mod]	65	<4	63	0	0	0
	Exactech	Equinoxe[G.Ana:HH.Stand:H.Mod]	1,423	<4	1,421	118	0	118
	Medacta	Medacta[G.Ana:HH.Stand:H.NeckBody:H.Standard]	26	0	26	<4	0	<4
	Lima	SMR[G.BP:G.Lin:HH.Stand:H.NeckBody:H.Dia]	433	<4	432	14	<4	13
	Lima	SMR[G.Ana:HH.Stand:H.NeckBody:H.Dia]	54	0	54	<4	0	<4
	JRI	Vaios[G.BP:G.Ana:HH.Stand:H.NeckBody:H.Dia]	125	0	125	0	0	0

Table 3.S5 (g) Number of stemless reverse polarity total shoulder replacements between 2012 and 2022 and within the last year by brand construct.

	Manufacturer(s)	Shoulder construct	Primary operations all years All cases N	Primary operations all years Acute trauma N	Primary operations all years Elective N	Primary operations in 2022 All cases N	Primary operations in 2022 Acute trauma N	Primary operations in 2022 Elective N
Stemless RTSR	Zimmer Biomet	Comprehensive[G.BP]: Versa-Dial[G.Sph]: Comprehensive[H.RevBear]: Nano[H.Stemless]	37	0	37	0	0	0
	Lima	SMR[G.BP:G.Sph:H.RevBear:H.Stemless]	264	0	264	70	0	70
	Zimmer Biomet	TESS[G.BP:G.Sph:H.RevBear:H.Stemless]	11	0	11	0	0	0

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (h) Number of stemmed reverse polarity total shoulder replacement replacements between 2012 and 2022 and within the last year by brand construct.

	Manufacturer(s)	Shoulder construct	Primary operations all years			Primary operations in 2022		
			All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Stemmed RTSR	Wright	Aequalis Perform Reversed[G.BP]: Aequalis Perform Reversed[G.Sph]: Aequalis Reversed Fracture[H.RevBear]: Aequalis Reversed Fracture[H.Standard]	81	57	24	29	21	8
	Wright	Aequalis-Reversed II[G.BP]: Aequalis-Reversed II[G.Sph]: Aequalis-Reversed II[H.RevBear]: Aequalis Reversed Fracture[H.Standard]	490	382	108	61	53	8
	Wright	Aequalis-Reversed II[G.BP]: Aequalis-Reversed II[G.Sph]: Aequalis-Reversed II[H.RevBear]: Aequalis Reversed Fracture[H.Spacer]: Aequalis Reversed Fracture[H.Standard]	12	10	<4	<4	<4	0
	Wright	Aequalis Perform Reversed[G.BP]: Aequalis Perform Reversed[G.Sph]: Aequalis-Reversed II[H.RevBear]: Aequalis Reversed Fracture[H.Standard]	182	141	41	56	43	13
	Wright	Aequalis-Reversed II[G.BP]: Aequalis-Reversed II[G.Sph]: Aequalis Reversed Fracture[H.RevBear]: Aequalis Reversed Fracture[H.Standard]	100	72	28	21	15	6
	Wright	Aequalis Perform Reversed[G.BP]: Aequalis Perform Reversed[G.Sph]: Aequalis-Reversed II[H.RevBear]: Aequalis-Reversed II[H.RevCup]: Aequalis-Reversed II[H.Dia]	197	10	187	28	0	28
	DJO	RSP[G.BP]: RSP[G.Sph]: RSP[H.RevBear]: AltiVate[H.Standard]	13	<4	11	<4	<4	<4
	Zimmer Biomet	Anatomical I/R[G.BP]: Anatomical I/R[G.Sph]: Anatomical I/R[H.RevBear]: Anatomical[H.Mod]	13	0	13	0	0	0
	Zimmer Biomet	TM Reverse[G.BP]: TM Reverse[G.Sph]: Anatomical I/R[H.RevBear]: Anatomical[H.Mod]	1,324	42	1,282	134	<4	131
	Zimmer Biomet	TM Reverse[G.BP]: TM Reverse[G.Sph]: Anatomical I/R[H.RevBear]: Anatomical Fracture[H.Mod]	197	167	30	36	33	<4
	Zimmer Biomet	TM Reverse[G.BP]: TM Reverse[G.Sph]: Anatomical I/R[H.RevBear]: Anatomical Fracture[H.Dia]	13	9	4	<4	<4	<4
	Wright	Aequalis Perform Reversed[G.BP]: Unbranded[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.RevCup]: Ascend Flex[H.Standard]	49	0	49	18	0	18
	Wright	Aequalis Perform Reversed[G.BP]: Aequalis Perform Reversed[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.RevCup]: Ascend Flex[H.Standard]	2,132	61	2,071	574	15	559
	Wright	Aequalis-Reversed II[G.BP]: Aequalis-Reversed II[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.Standard]	18	<4	17	<4	0	<4
	Wright	Aequalis Perform Reversed[G.BP]: Aequalis Perform Reversed[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.Standard]	25	<4	23	9	0	9
	Wright	Aequalis-Reversed II[G.BP]: Aequalis-Reversed II[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.RevCup]: Ascend Flex[H.Standard]	1,920	21	1,899	222	<4	220

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (h) (continued)

	Manufacturer(s)	Shoulder construct	Primary operations all years: All cases N	Primary operations all years: Acute trauma N	Primary operations all years: Elective N	Primary operations in 2022: All cases N	Primary operations in 2022: Acute trauma N	Primary operations in 2022: Elective N
Stemmed RTSR	Zimmer Biomet	Comprehensive[G.BP]: Versa-Dial[G.Sph]: Comprehensive[H.RevBear]: Comprehensive[H.Standard]	3,162	134	3,028	411	12	399
	Zimmer Biomet	TM Reverse[G.BP]: TM Reverse[G.Sph]: Comprehensive[H.RevBear]: Comprehensive[H.Standard]	10	<4	9	<4	0	<4
	Zimmer Biomet	Comprehensive[G.BP]: Versa-Dial Glenosphere[G.Sph]: Comprehensive[H.RevBear]: Comprehensive[H.Standard]	14	<4	13	<4	0	<4
	Zimmer Biomet	Comprehensive[G.BP]: Versa-Dial[G.Sph]: Comprehensive[H.RevBear]: Comprehensive Fracture[H.Standard]	675	553	122	104	90	14
	Zimmer Biomet	Comprehensive[G.BP]: Versa-Dial[G.Sph]: Comprehensive[H.RevBear]: Comprehensive Segmental Revision[H.NeckBody]: Comprehensive Segmental Revision[H.Dia]	23	5	18	<4	0	<4
	DePuy	Delta Xtend[G.BP]: Delta Xtend[G.Sph]: Delta Xtend[H.RevBear]: Delta Xtend[H.RevCup]: Global Unite[H.Mod]	165	98	67	35	20	15
	Lima	Axioma[G.Peg]: Axioma[G.BP]: SMR[G.Sph]: SMR[H.RevBear]: SMR[H.RevCup]: SMR[H.Dia]	127	<4	124	7	0	7
	Lima	Axioma[G.BP]: SMR[G.Sph]: SMR[H.RevBear]: SMR[H.RevCup]: SMR[H.Dia]	95	4	91	0	0	0
	Zimmer Biomet	Comprehensive[G.BP]: Versa-Dial[G.Sph]: TM Reverse[H.RevBear]: TM Reverse[H.Mod]	49	0	49	<4	0	<4
	Zimmer Biomet	TM Reverse[G.BP]: TM Reverse[G.Sph]: Anatomical I/R[H.RevBear]: Unbranded[H.Mod]	12	12	0	<4	<4	0
	Arthrex	Universal[G.BP]: Univers Reverse[G.Sph]: Univers Reverse[H.RevBear]: Univers Reverse[H.Standard]	226	25	201	12	<4	11
	Arthrex	Universal[G.BP]: Univers Reverse[G.Sph]: Univers Reverse[H.RevBear]: Univers Reverse[H.Spacer]: Univers Reverse[H.Standard]	14	<4	12	<4	<4	0
	Arthrex	Universal[G.BP]: Univers Reverse[G.Sph]: Univers Reverse[H.RevBear]: Univers Reverse[H.RevCup]: Univers Reverse[H.Standard]	52	7	45	0	0	0
	Arthrex	Universal[G.BP]: Univers Reverse[G.Sph]: Univers Reverse[H.RevBear]: Univers Reverse[H.RevCup]: Univers Reverse[H.Spacer]: Univers Reverse[H.Standard]	10	<4	8	0	0	0
	Wright	Aequalis-Reversed II[G.BP:G.Sph:H.RevBear:H.Dia]	21	0	21	<4	0	<4
	Wright	Aequalis-Reversed II[G.BP:G.Sph:H.RevBear:H.RevCup:H.Spacer:H.Dia]	18	0	18	0	0	0
	Wright	Aequalis-Reversed II[G.BP:G.Sph:H.RevBear:H.RevCup:H.Dia]	1,282	28	1,254	47	<4	46
	Mathys	Affinis[G.BP:G.Sph:H.RevBear:H.Dia]	269	203	66	29	21	8
	Mathys	Affinis[G.BP:G.Sph:H.RevBear:H.Spacer:H.Standard]	15	<4	13	0	0	0
	Mathys	Affinis[G.BP:G.Sph:H.RevBear:H.Standard]	948	37	911	65	<4	62
	FH	Arrow[G.BP:G.Sph:H.RevBear:H.Standard]	209	40	169	8	<4	5
	DePuy	Delta Xtend[G.BP:G.Sph:H.RevBear:H.Mod]	44	5	39	<4	<4	0
	DePuy	Delta Xtend[G.BP:G.Sph:H.RevBear:H.Spacer:H.Standard]	100	38	62	10	4	6

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (h) (continued)

	Manufacturer(s)	Shoulder construct	Primary operations all years			Primary operations in 2022		
			All cases N	Acute trauma N	Elective N	All cases N	Acute trauma N	Elective N
Stemmed RTSR	DePuy	Delta Xtend[G.BP:G.Sph:H.RevBear:H.Standard]	3,520	679	2,841	264	66	198
	DePuy	Delta Xtend[G.BP:G.Sph:H.RevBear:H.RevCup:H.Spacer:H.Mod]	28	<4	25	5	0	5
	DePuy	Delta Xtend[G.BP:G.Sph:H.RevBear:H.RevCup:H.Mod]	3,106	90	3,016	234	10	224
	Exactech	Equinoxe[G.BP:G.Sph:H.RevBear:H.Standard]	654	518	136	118	93	25
	Exactech	Equinoxe[G.BP:G.Sph:H.RevBear:H.Mod]	4,007	70	3,937	671	8	663
	Stanmore	METS[G.Sph:H.RevBear:H.Mod]	13	0	13	0	0	0
	DJO	RSP[G.BP:G.Sph:H.RevBear:H.Standard]	657	53	604	87	6	81
	DJO	RSP[G.BP:G.Sph:H.RevBear:H.Mod]	28	<4	25	0	0	0
	DJO	RSP[G.BP:G.Sph:H.RevBear:H.Spacer:H.Standard]	15	<4	13	<4	0	<4
	Lima	SMR[G.BP:G.Sph:H.RevBear:H.RevCup:H.Spacer:H.Dia]	193	53	140	19	9	10
	Lima	SMR[G.BP:G.Sph:H.RevBear:H.Dia]	27	8	19	7	<4	5
	Lima	SMR[G.BP:G.Sph:H.RevBear:H.RevCup:H.Dia]	2,363	491	1,872	279	90	189
	Zimmer Biomet	TM Reverse[G.BP:G.Sph:H.RevBear:H.Mod]	814	96	718	66	12	54
	Zimmer Biomet	TM Reverse[G.BP:G.Sph:H.RevBear:H.Spacer:H.Mod]	11	<4	8	<4	0	<4
	JRI	Vaios[G.BP:G.Sph:H.RevBear:H.NeckBody:H.Dia]	406	56	350	15	11	4
	Innovative	Verso[G.BP:G.Sph:H.RevBear:H.Standard]	841	53	788	129	9	120

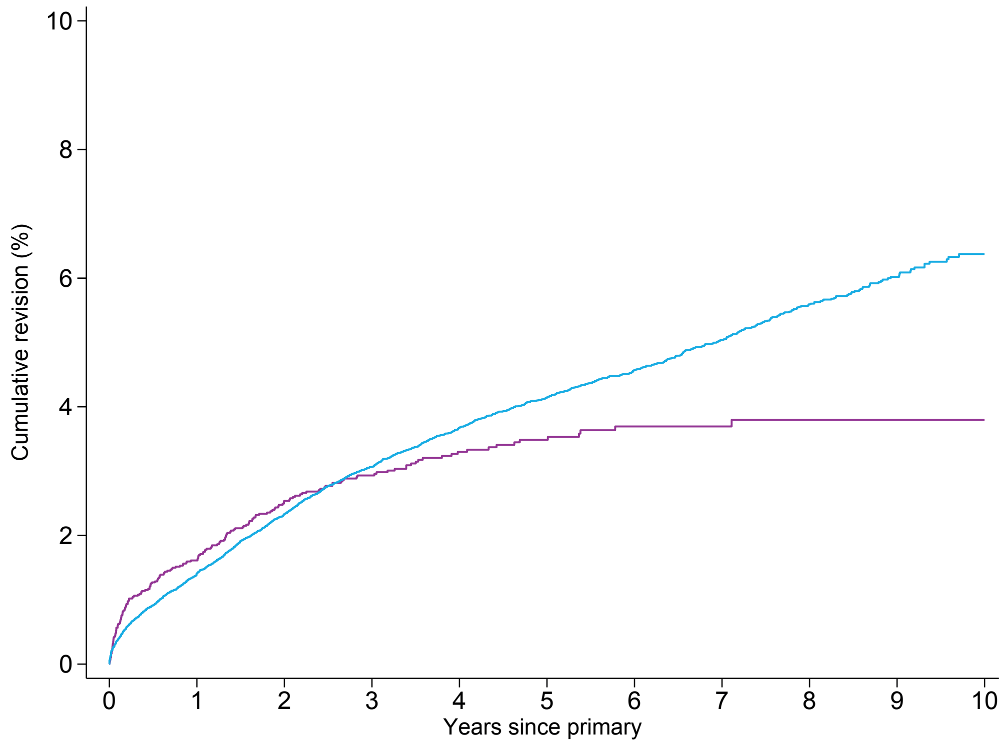
Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf.=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S5 (a) to Table 3.S5 (h) illustrate the shoulder construct used by sub-type of the primary shoulder replacement for overall procedures and by acute and elective sub-divisions. Implants are only listed if they have been used on ten or more occasions overall, or five occasions within the last year, respectively. Results illustrate the frequency of all implanted constructs across all years of data collection within the registry i.e. between 2012 and 2022. The frequency of shoulder constructs within the last year of the data collection is also illustrated to indicate contemporary practice. Constructs and prostheses elements are suffixed '[ ]' to indicate the implants that make up the construct. In the cases of 'within manufacturer and brand construct', this suffix is placed after the brand name; whereas within 'mix and match constructs', the suffix is placed immediately after the brand of the implanted element. While the detail in reporting of constructs has become more granular, the complexity has necessarily increased to reflect the diversity of implanted elements and will facilitate improved implant scrutiny. Given the rapid evolution and heterogeneity of shoulder prostheses, it is expected that the classification system will evolve year-on-year with the introduction of new types of prostheses and the combinations in which these are used by surgeons.

3.6.2 Revisions after primary shoulder replacement surgery

We present results in this section as percentage cumulative revision of primary shoulder replacements. Results are estimated using the 1-Kaplan-Meier method; 95% CIs are shown within tables and when the number at risk is 250 or fewer, estimates are shown in blue italics to indicate that caution is required in interpreting the results. Data are presented up to ten years, which is the last full year of data collection within the registry. Figures also include an 'at-risk table' which presents the number of individuals at risk of revision at the time indicated.

Figure 3.S7 KM estimates of cumulative revision for primary shoulder replacement by acute trauma and elective cases. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Numbers at risk

Key:	0	1	2	3	4	5	6	7	8	9	10
Acute trauma	7,303	5,960	4,799	3,909	2,946	2,148	1,477	974	585	299	*74*
Elective	56,648	49,471	43,239	38,637	31,052	24,168	17,946	12,365	7,852	4,163	1,410

Table 3.S6 KM estimates of cumulative revision (95% CI) for primary shoulder replacement for all cases, acute trauma and elective cases. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	7 years	10 years
All cases	63,951	73 (67 to 79)	30	1.43 (1.34-1.53)	3.06 (2.91-3.20)	4.09 (3.91-4.27)	4.94 (4.72-5.16)	6.19 (5.85-6.55)
Acute trauma	7,303	73 (67 to 79)	23	1.61 (1.34-1.94)	2.93 (2.53-3.39)	3.49 (3.02-4.02)	3.69 (3.19-4.27)	*3.80 (3.27-4.42)*
Elective	56,648	73 (67 to 79)	31	1.41 (1.31-1.51)	3.06 (2.91-3.22)	4.14 (3.96-4.33)	5.04 (4.82-5.28)	6.38 (6.01-6.76)

Figure 3.S7 and Table 3.S6 illustrate the cumulative revision of primary shoulder procedures performed overall (shown in Table 3.S6 only) and by acute trauma and elective procedures. Our results indicate that the risk of revision is comparable for the first three years following surgery, at which point it starts to diverge. This is not related to mortality because patients are censored from the analysis at death. The risk of revision for acute trauma patients tends to be lower, but the number of patients still at risk at ten years is small and therefore should be interpreted cautiously.

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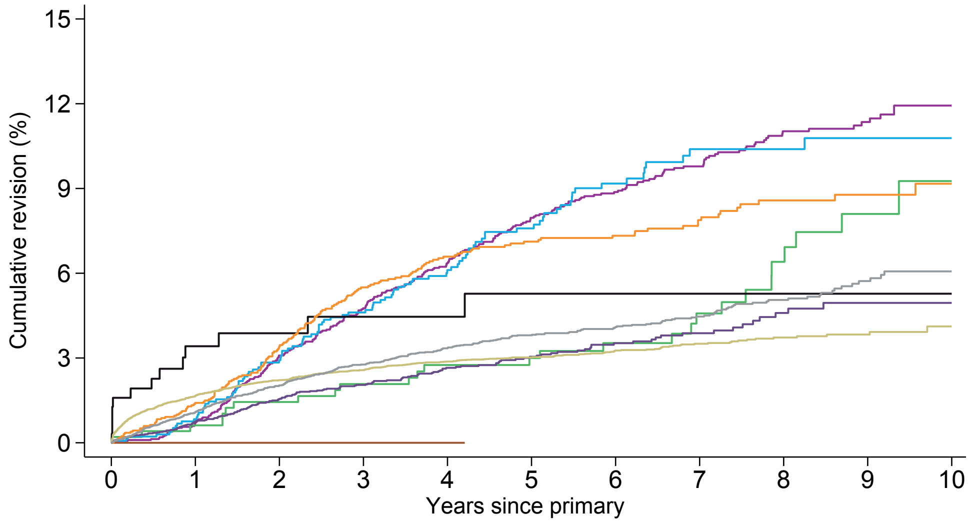
Table 3.S7 KM estimates of cumulative revision (95% CI) for primary shoulder replacement for elective cases by gender and age group. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Gender	Age at primary (years)	N	Time since primary 1 year	3 years	5 years	7 years	10 years
Female	All	39,064	1.00 (0.90-1.10)	2.46 (2.30-2.63)	3.41 (3.21-3.63)	4.18 (3.93-4.44)	5.38 (4.98-5.81)
	<55	1,367	2.45 (1.74-3.44)	7.05 (5.74-8.66)	9.30 (7.72-11.18)	10.76 (8.95-12.92)	*14.43 (11.51-18.01)*
	55 to 64	4,182	1.23 (0.93-1.63)	3.81 (3.22-4.50)	5.83 (5.05-6.73)	7.63 (6.64-8.76)	*9.94 (8.53-11.58)*
	65 to 74	14,183	1.08 (0.92-1.27)	2.70 (2.43-3.00)	3.77 (3.43-4.14)	4.72 (4.29-5.18)	6.17 (5.48-6.94)
	≥75	19,332	0.78 (0.66-0.91)	1.63 (1.45-1.84)	2.14 (1.92-2.39)	2.40 (2.15-2.68)	2.62 (2.32-2.96)
Male	All	17,584	2.32 (2.11-2.56)	4.43 (4.11-4.77)	5.79 (5.41-6.20)	7.01 (6.54-7.51)	8.68 (7.92-9.50)
	<55	1,852	2.71 (2.05-3.59)	6.97 (5.82-8.34)	10.57 (9.08-12.30)	14.03 (12.11-16.22)	*16.94 (14.26-20.06)*
	55 to 64	3,406	2.17 (1.72-2.73)	4.56 (3.86-5.39)	5.93 (5.08-6.91)	7.31 (6.27-8.51)	*8.86 (7.38-10.62)*
	65 to 74	6,595	2.15 (1.82-2.54)	3.87 (3.40-4.40)	5.23 (4.65-5.88)	6.16 (5.48-6.94)	*7.68 (6.57-8.98)*
	≥75	5,731	2.49 (2.11-2.94)	4.13 (3.61-4.73)	4.58 (4.01-5.23)	5.02 (4.36-5.76)	*6.10 (4.99-7.45)*

Table 3.S7 further breaks down the cumulative revision of primary shoulder procedures for elective patients, by gender and age group. Results indicate that females have a lower risk of revision in the long term compared to males and that younger patients have an increased risk of revision compared to older patients.

Figure 3.S8 KM estimates of cumulative revision for primary elective shoulder replacement by type of shoulder replacement. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key: Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10
Resurfacing HHA	3,051	2,965	2,787	2,605	2,367	2,117	1,853	1,468	1,100	698	291
Stemless HHA	1,364	1,279	1,171	1,087	893	699	530	369	256	*137*	*38*
Stemmed HHA	2,556	2,371	2,149	1,968	1,688	1,433	1,176	902	605	359	*140*
Resurfacing TSR	487	481	470	451	424	393	341	261	*180*	*114*	*34*
Stemless TSR	6,389	5,589	4,833	4,251	3,256	2,387	1,676	1,087	629	296	*101*
Stemmed TSR	9,746	8,907	8,093	7,458	6,339	5,211	3,997	2,832	1,790	926	310
Stemless RTSR	314	*232*	*171*	*149*	*123*	*87*	*64*	*40*	*21*	*8*	*<4*
Stemmed RTSR	26,747	22,755	19,423	16,952	12,807	9,303	6,312	3,946	2,295	1,069	299
IPA	*5*	*5*	*5*	*5*	*<4*						

Note: HHA=Humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S8 KM estimates of cumulative revision (95% CI) for primary shoulder replacement for elective cases by shoulder type. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Elective	N	Age at primary Median (IQR)	Male (%)	Time since primary: 1 year	3 years	5 years	7 years	10 years
Proximal humeral hemiarthroplasty	**6,971**	**70 (60 to 77)**	**34**	**0.98 (0.78-1.25)**	**5.00 (4.49-5.56)**	**7.62 (6.98-8.33)**	**9.24 (8.50-10.05)**	**10.91 (9.98-11.92)**
Resurfacing	3,051	71 (63 to 78)	31	0.70 (0.45-1.07)	4.76 (4.04-5.60)	7.96 (7.01-9.04)	9.78 (8.69-11.00)	11.94 (10.58-13.45)
Stemless	1,364	66 (55 to 74.5)	43	0.84 (0.46-1.50)	4.61 (3.57-5.94)	7.59 (6.17-9.32)	10.39 (8.55-12.61)	*10.78 (8.82-13.15)*
Stemmed	2,556	70 (59 to 78)	33	1.41 (1.02-1.96)	5.50 (4.64-6.52)	7.12 (6.11-8.29)	7.88 (6.77-9.16)	*9.17 (7.73-10.85)*
Total shoulder replacement	**16,622**	**70 (63 to 75)**	**32**	**0.94 (0.80-1.11)**	**2.48 (2.24-2.75)**	**3.50 (3.20-3.83)**	**4.27 (3.90-4.67)**	**5.98 (5.34-6.69)**
Resurfacing	487	71 (63 to 76)	29	0.62 (0.20-1.90)	2.08 (1.12-3.83)	3.00 (1.78-5.01)	4.58 (2.91-7.16)	*9.26 (6.03-14.09)*
Stemless	6,389	69 (62 to 75)	37	0.75 (0.56-1.00)	2.05 (1.70-2.47)	3.05 (2.58-3.60)	3.88 (3.27-4.60)	*4.95 (4.04-6.06)*
Stemmed	9,746	70 (64 to 76)	30	1.09 (0.90-1.32)	2.77 (2.45-3.14)	3.80 (3.41-4.25)	4.47 (4.01-4.98)	6.07 (5.30-6.93)
Reverse polarity total shoulder replacement	**27,061**	**76 (71 to 80)**	**29**	**1.68 (1.53-1.85)**	**2.59 (2.40-2.80)**	**3.05 (2.82-3.28)**	**3.52 (3.25-3.82)**	**4.13 (3.61-4.73)**
Stemless	314	74 (69 to 79)	35	*3.42 (1.85-6.28)*	*4.46 (2.52-7.82)*	*5.28 (3.00-9.21)*	*5.28 (3.00-9.21)*	
Stemmed	26,747	76 (71 to 80)	29	1.66 (1.52-1.83)	2.57 (2.38-2.78)	3.02 (2.80-3.26)	3.51 (3.23-3.81)	4.12 (3.60-4.72)
Interpositional arthroplasty	**5**	**58 (55 to 68)**	**60**					
Unconfirmed	**5,989**	**73 (66 to 79)**	**33**	**1.94 (1.61-2.34)**	**4.04 (3.52-4.64)**	**5.33 (4.70-6.05)**	**6.65 (5.88-7.52)**	***7.87 (6.79-9.11)***
Unconfirmed HHA	364	69 (57 to 75)	37	1.68 (0.76-3.71)	6.52 (4.25-9.95)	*7.73 (5.18-11.44)*	*9.68 (6.57-14.15)*	*9.68 (6.57-14.15)*
Unconfirmed TSR	2,107	69 (61 to 76)	37	1.14 (0.76-1.71)	4.13 (3.32-5.15)	6.10 (5.07-7.33)	7.67 (6.45-9.10)	*9.41 (7.74-11.43)*
Unconfirmed RTSR	3,513	75 (69 to 80)	30	2.47 (1.99-3.07)	3.47 (2.85-4.21)	4.07 (3.36-4.92)	4.90 (4.02-5.96)	*5.41 (4.32-6.76)*
Unconfirmed IPA	5	64 (60 to 65)	60					

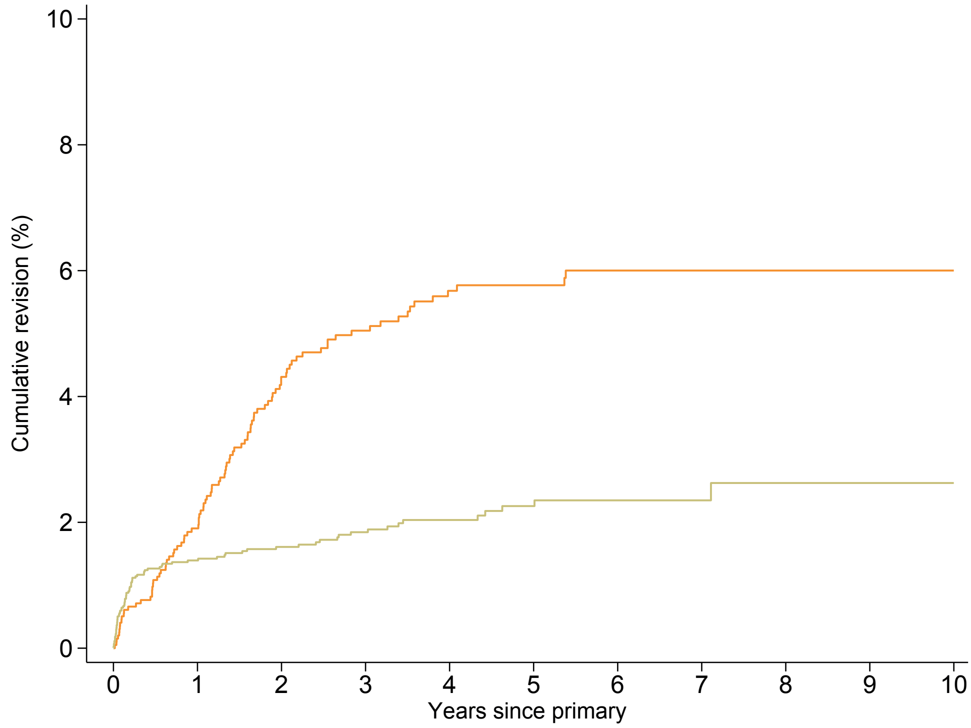
Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S8 and Figure 3.S8 report cumulative revision of primary shoulder procedures, for elective patients, by type (Table 3.S8 only) and sub-type of shoulder construct.

Proximal humeral hemiarthroplasties undergo revision at a higher rate than either conventional total shoulder replacements or reverse polarity total shoulder replacements. The extent to which proximal humeral hemiarthroplasty procedures are seen as 'revisable' procedures compared to total shoulder replacements should be considered when interpreting the results. Furthermore, while Table 3.S8 and Figure 3.S8 suggest a stemmed proximal humeral hemiarthroplasty might be the better choice over a stemless or resurfacing humeral hemiarthroplasty, the latter group are more straightforward to revise than a stemmed implant and so caution is again needed interpreting these sub-group results.

The cumulative risk of revision of stemless reverse polarity total shoulder replacements is higher compared to stemmed versions. This needs careful interpretation as the number of stemless reverse polarity replacements is low, however it is worth noting that some stemless reverse polarity brands have been withdrawn from the market. The performance of stemmed conventional total shoulder replacement compared to stemmed reverse polarity shoulder replacements is of particular interest. Reverse polarity total shoulder replacements tend to have an initially higher revision rate which then plateaus, whereas the conventional total shoulder replacements increase more slowly but at a constant rate and therefore exceed the cumulative risk of revision of reverse polarity total replacements and overall is 1.85% higher at ten years. The extent to which the different indications for surgery are confounding results is not clear and results should be interpreted cautiously.

Figure 3.S9 KM estimates of cumulative revision for primary shoulder replacement for acute trauma cases by shoulder type. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk

Key	0	1	2	3	4	5	6	7	8	9	10
Stemmed HHA	1,993	1,723	1,492	1,299	1,087	883	672	508	333	*178*	*52*
Stemmed RTSR	4,380	3,537	2,830	2,240	1,577	1,076	667	376	*199*	*88*	*17*

Note: HHA=Humeral hemiarthroplasty, RTSR=Reverse polarity total shoulder replacement.

Table 3.S9 KM estimates of cumulative revision (95% CI) for primary shoulder replacement for acute trauma cases by shoulder type. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Acute trauma	N	Age at primary Median (IQR)	Male (%)	Time since primary 1 year	3 years	5 years	7 years	10 years
Proximal humeral hemiarthroplasty	**2,009**	**68 (59 to 76)**	**32**	**1.94 (1.41-2.67)**	**5.05 (4.12-6.20)**	**5.85 (4.82-7.11)**	**6.08 (5.01-7.38)**	*6.08 (5.01-7.38)*
Resurfacing	6	67.5 (52 to 79)	50					
Stemless	10	68.5 (59 to 71)	60					
Stemmed	1,993	68 (59 to 76)	31	1.90 (1.38-2.63)	5.05 (4.11-6.20)	5.77 (4.74-7.02)	6.00 (4.93-7.30)	*6.00 (4.93-7.30)*
Total shoulder replacement	**17**	**68 (53 to 73)**	**53**	*0.00 (.-.)*	*0.00 (.-.)*			
Stemless	4	60 (51 to 69.5)	75					
Stemmed	13	70 (59 to 74)	46	*0.00 (.-.)*	*0.00 (.-.)*			
Reverse polarity total shoulder replacement	**4,380**	**75 (70 to 80)**	**19**	**1.39 (1.08-1.80)**	**1.84 (1.46-2.33)**	**2.26 (1.79-2.86)**	**2.35 (1.85-2.98)**	*2.63 (1.95-3.53)*
Stemmed	4,380	75 (70 to 80)	19	1.39 (1.08-1.80)	1.84 (1.46-2.33)	2.26 (1.79-2.86)	2.35 (1.85-2.98)	*2.63 (1.95-3.53)*
Unconfirmed	**897**	**73 (67 to 79)**	**23**	**1.91 (1.17-3.09)**	**2.84 (1.84-4.39)**	*3.34 (2.08-5.32)*	*4.06 (2.41-6.78)*	
Unconfirmed HHA	97	63 (55 to 74)	34	*4.41 (1.68-11.34)*	*5.68 (2.40-13.16)*	*5.68 (2.40-13.16)*	*10.17 (3.82-25.57)*	
Unconfirmed TSR	49	67 (61 to 75)	39	*0.00 (.-.)*	*7.33 (2.41-21.12)*	*7.33 (2.41-21.12)*	*7.33 (2.41-21.12)*	
Unconfirmed RTSR	749	74 (68 to 80)	21	1.70 (0.97-2.98)	1.91 (1.11-3.28)	*2.59 (1.35-4.94)*	*2.59 (1.35-4.94)*	
Unconfirmed IPA	<4	75 (74 to 76)	0					

Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S9 and Figure 3.S9 report the cumulative revision of primary shoulder procedures, for acute trauma patients, by type (Table 3.S9 only) and sub-type of shoulder construct. Proximal humeral hemiarthroplasties undergo revision at a higher rate than reverse polarity total shoulder replacements.

The extent to which proximal humeral hemiarthroplasty procedures are seen as 'revisable' procedures compared to total shoulder replacements and the demographic characteristics of the patients should be considered when interpreting the results.

Table 3.S10 KM estimates of cumulative revision (95% CI) for primary shoulder replacement for elective cases by brand construct in constructs with greater than 250 implantations. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

	Shoulder construct	N	Time since primary: 1 year	3 years	5 years	7 years	10 years
Resurfacing HHA	Aequalis Resurfacing[HH.Resurf]	257	0.39 (0.06-2.74)	*4.34 (2.43-7.70)*	*6.47 (4.01-10.34)*	*9.02 (5.95-13.56)*	*9.02 (5.95-13.56)*
	Copeland[HH.Resurf]	1,706	0.47 (0.24-0.95)	3.90 (3.06-4.97)	7.14 (5.95-8.56)	8.87 (7.51-10.48)	*10.84 (9.17-12.79)*
	Global CAP[HH.Resurf]	636	0.96 (0.43-2.12)	4.83 (3.38-6.88)	8.27 (6.27-10.86)	10.63 (8.27-13.61)	*14.51 (11.11-18.84)*
Stemless HHA	Affinis[HH.Stand:H.Stemless]	654	0.31 (0.08-1.25)	2.83 (1.77-4.51)	5.71 (4.00-8.11)	*7.99 (5.70-11.15)*	
Stemmed HHA	Aequalis[HH.Stand]: Ascend Flex[H.Standard]	325	1.88 (0.85-4.14)	*5.81 (3.59-9.36)*	*10.64 (7.01-15.99)*	*12.58 (7.94-19.65)*	
	Global Advantage[HH.Stand:H.Standard]	266	1.14 (0.37-3.49)	*3.98 (2.16-7.27)*	*4.87 (2.79-8.43)*	*5.35 (3.14-9.06)*	*7.07 (3.80-12.97)*
Stemless TSR	Univers II[G.Ana]: Eclipse[HH.Stand]: Eclipse[H.Stemless]	532	0.19 (0.03-1.33)	1.74 (0.87-3.45)	*3.05 (1.71-5.41)*	*4.94 (2.82-8.56)*	*4.94 (2.82-8.56)*
	Global Anchor Peg[G.Ana]: Global ICON[HH.Stand]: Global ICON[H.Stemless]	415	0.25 (0.03-1.74)	*0.97 (0.31-3.05)*			
	Comprehensive[G.Peg]: Comprehensive[G.Ana]: Versa-Dial[HH.Stand]: Nano[H.Stemless]	695	1.20 (0.60-2.39)	3.21 (2.05-5.00)	*4.64 (3.08-6.97)*	*4.64 (3.08-6.97)*	
	Aequalis Perform+[G.Ana]: Simpliciti[HH.Stand]: Simpliciti[H.Stemless]	980	0.58 (0.24-1.39)	1.74 (1.01-3.00)	2.06 (1.19-3.55)	*2.06 (1.19-3.55)*	
	Affinis[G.Ana:HH.Stand:H.Stemless]	2,498	0.38 (0.20-0.73)	1.08 (0.71-1.62)	1.59 (1.10-2.28)	2.04 (1.39-2.97)	*2.38 (1.55-3.67)*
Stemmed TSR	Aequalis Perform+[G.Ana]: Ascend Flex[HH.Stand]: Ascend Flex[H.Standard]	1,890	0.18 (0.06-0.55)	1.26 (0.79-2.00)	1.99 (1.33-2.95)	*2.84 (1.72-4.66)*	
	Comprehensive[G.Peg]: Comprehensive[G.Ana]: Versa-Dial[HH.Stand]: Comprehensive[H.Standard]	1,111	1.63 (1.02-2.61)	4.24 (3.12-5.74)	5.17 (3.87-6.88)	*5.39 (4.04-7.17)*	*5.39 (4.04-7.17)*
	Global Anchor Peg[G.Ana]: Global AP[HH.Stand]: Global AP[H.Mod]	1,058	0.28 (0.09-0.88)	1.15 (0.66-2.02)	1.67 (1.04-2.68)	2.03 (1.31-3.13)	*2.53 (1.61-3.95)*
	Global Anchor Peg[G.Ana]: Global Advantage[HH.Stand]: Global Advantage[H.Standard]	309	0.35 (0.05-2.44)	*2.00 (0.83-4.75)*	*2.98 (1.42-6.19)*	*2.98 (1.42-6.19)*	
	Global[G.Ana]: Global Advantage[HH.Stand]: Global Advantage[H.Standard]	562	0.54 (0.17-1.65)	1.28 (0.61-2.67)	2.16 (1.20-3.88)	2.16 (1.20-3.88)	*3.96 (1.88-8.24)*
	Global Anchor Peg[G.Ana]: Global Unite[HH.Stand]: Global Unite[H.NeckBody]: Global Unite[H.Mod]	571	0.72 (0.27-1.92)	1.91 (1.03-3.53)	2.72 (1.57-4.68)	*2.72 (1.57-4.68)*	
	Epoca[G.Ana:HH.Stand:H.Mod]	315	0.32 (0.04-2.23)	1.30 (0.49-3.44)	1.98 (0.90-4.36)	*2.46 (1.17-5.12)*	*3.73 (1.89-7.28)*
	Equinoxe[G.Ana:HH.Stand:H.Mod]	1,421	1.25 (0.78-2.00)	3.39 (2.51-4.56)	4.42 (3.36-5.81)	5.33 (4.02-7.05)	*6.40 (4.60-8.89)*
	SMR[G.BP:G.Lin:HH.Stand:H.NeckBody:H.Dia]	432	3.30 (1.97-5.51)	7.77 (5.55-10.81)	9.76 (7.21-13.13)	*10.57 (7.86-14.14)*	*13.04 (9.68-17.46)*
Stemless RTSR	SMR[G.BP:G.Sph:H.RevBear:H.Stemless]	264	*2.17 (0.90-5.16)*	*2.76 (1.23-6.10)*	*2.76 (1.23-6.10)*	*2.76 (1.23-6.10)*	

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S10 (continued)

	Shoulder construct	N	Time since primary 1 year	3 years	5 years	7 years	10 years
Stemmed RTSR	TM Reverse[G.BP]: TM Reverse[G.Sph]: Anatomical I/R[H.RevBear]: Anatomical[H.Mod]	1,282	2.02 (1.37-2.98)	3.48 (2.56-4.72)	4.25 (3.18-5.67)	*4.78 (3.54-6.42)*	*4.78 (3.54-6.42)*
	Aequalis Perform Reversed[G.BP]: Aequalis Perform Reversed[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.RevCup]: Ascend Flex[H.Standard]	2,071	1.55 (1.09-2.22)	2.60 (1.89-3.59)	*2.89 (2.10-3.98)*		
	Aequalis-Reversed II[G.BP]: Aequalis-Reversed II[G.Sph]: Ascend Flex[H.RevBear]: Ascend Flex[H.RevCup]: Ascend Flex[H.Standard]	1,899	1.20 (0.79-1.82)	1.85 (1.31-2.61)	2.12 (1.52-2.95)	*4.01 (2.66-6.02)*	
	Comprehensive[G.BP]: Versa-Dial[G.Sph]: Comprehensive[H.RevBear]: Comprehensive[H.Standard]	3,028	1.24 (0.89-1.71)	1.63 (1.21-2.18)	1.82 (1.37-2.43)	1.82 (1.37-2.43)	*1.82 (1.37-2.43)*
	Aequalis-Reversed II[G.BP:G.Sph:H.RevBear:H.RevCup:H.Dia]	1,254	1.31 (0.80-2.12)	2.01 (1.35-2.98)	2.11 (1.43-3.11)	2.60 (1.73-3.91)	*3.47 (2.29-5.24)*
	Affinis[G.BP:G.Sph:H.RevBear:H.Standard]	911	3.26 (2.28-4.66)	4.83 (3.58-6.52)	5.83 (4.37-7.76)	*6.68 (4.91-9.05)*	*6.68 (4.91-9.05)*
	Delta Xtend[G.BP:G.Sph:H.RevBear:H.RevCup:H.Mod]	3,016	1.10 (0.78-1.55)	1.79 (1.36-2.36)	1.95 (1.49-2.55)	2.37 (1.78-3.14)	*2.82 (1.90-4.16)*
	Delta Xtend[G.BP:G.Sph:H.RevBear:H.Standard]	2,841	1.25 (0.90-1.74)	1.50 (1.11-2.03)	1.72 (1.29-2.31)	2.08 (1.55-2.80)	*2.08 (1.55-2.80)*
	Equinoxe[G.BP:G.Sph:H.RevBear:H.Mod]	3,937	1.40 (1.06-1.84)	2.40 (1.92-2.99)	3.44 (2.79-4.22)	4.02 (3.20-5.03)	*4.86 (3.56-6.63)*
	RSP[G.BP:G.Sph:H.RevBear:H.Standard]	604	2.06 (1.17-3.60)	2.73 (1.65-4.51)	*4.06 (2.44-6.72)*	*4.06 (2.44-6.72)*	
	SMR[G.BP:G.Sph:H.RevBear:H.RevCup:H.Dia]	1,872	1.87 (1.34-2.61)	3.22 (2.47-4.20)	3.30 (2.54-4.29)	*3.80 (2.83-5.09)*	*3.80 (2.83-5.09)*
	TM Reverse[G.BP:G.Sph:H.RevBear:H.Mod]	718	0.87 (0.39-1.93)	1.74 (0.96-3.13)	2.37 (1.40-4.00)	*2.37 (1.40-4.00)*	
	Vaios[G.BP:G.Sph:H.RevBear:H.NeckBody:H.Dia]	350	2.60 (1.36-4.94)	4.45 (2.71-7.28)	*4.86 (3.00-7.83)*	*5.32 (3.32-8.46)*	*7.69 (4.51-12.95)*
	Verso[G.BP:G.Sph:H.RevBear:H.Standard]	788	2.26 (1.41-3.61)	3.27 (2.18-4.90)	4.05 (2.73-5.97)	*5.30 (3.40-8.22)*	

Note: HH.=Humeral head, H.=Humerus, G.=Glenoid, Resurf=Resurfacing, RPeg=Resurfacing peg, Ana=Anatomic, BP=Baseplate, Peg=Peg, Stand=Standard, Lin=Liner, Sph=Sphere, RevBear=Reverse bearing, Stand=Standard, NeckBody=Modular neck body, Mod=Modular Stem, MBStem=Monobloc stem, Dia=Diaphyseal stem, RevBear=Reverse bearing, RevCup=Reverse cup.
Note: Data are sorted by the brand of the humeral component.

Table 3.S10 reports cumulative revision of primary shoulder procedures for elective patients by shoulder construct. All constructs that have been used on more than 250 occasions are reported. Where the construct is solely built from within the same product line the elements used to build the construct are suffixed in [ ] following the brand. Where the construct is built from different product lines, the prosthesis is indicated in [ ] immediately after. The description of constructs is necessarily complex, this reflects the extensive modularity of modern shoulder prostheses. All results should be viewed in the context of observational data and due consideration given to the volume of unconfirmed prostheses.

Table 3.S11 PTIR estimates of indications for shoulder revision (95% CI) for acute trauma by type of shoulder replacement between 2012 and 2022.

Acute trauma	Events N	Prosthesis-years at risk (x100)	Number of revisions per 100 prosthesis-years at risk for: All causes	Infection	Instability | Dislocation	Cuff insufficiency	Aseptic loosening | Lysis	Peri-prosthetic fracture	Other indications
All cases	**204**	**266.9**	**0.76 (0.67-0.88)**	**0.14 (0.10-0.19)**	**0.28 (0.22-0.35)**	**0.18 (0.14-0.24)**	**0.05 (0.03-0.09)**	**0.03 (0.02-0.06)**	**0.07 (0.05-0.12)**
Proximal humeral hemiarthroplasty	100	93.1	1.07 (0.88-1.31)	0.14 (0.08-0.24)	0.23 (0.15-0.35)	0.48 (0.36-0.65)	0.05 (0.02-0.13)	0.01 (0.00-0.08)	0.16 (0.10-0.27)
Total shoulder replacement	0	0.9	0	0	0	0	0	0	0
Reverse polarity total shoulder replacement	81	147.1	0.55 (0.44-0.68)	0.14 (0.09-0.22)	0.27 (0.20-0.37)	0	0.05 (0.02-0.10)	0.03 (0.01-0.08)	0.03 (0.01-0.07)
Unconfirmed	23	25.8	0.89 (0.59-1.34)	0.12 (0.04-0.36)	0.54 (0.32-0.92)	0.15 (0.06-0.41)	0.08 (0.02-0.31)	0.12 (0.04-0.36)	0.04 (0.01-0.27)

Table 3.S11 and Table 3.S12 (page 307) describe the prosthesis time incidence rate (PTIR) per 100 years of follow-up for the reported indication for revision in acute trauma patients receiving a primary shoulder replacement. Table 3.S11 reports indications for all patients across the life of the registry i.e. between 2012 and 2022, this was achieved by aggregating indications for revision across the different minimum datasets. Table 3.S12 reports data for patients whose information was entered following the introduction of MDSv7.

Cuff insufficiency is the leading indication for revision for those who receive a proximal humeral hemiarthroplasty for acute trauma, whereas instability or dislocation, or infection are the leading causes in reverse polarity total shoulder replacements when performed for acute trauma, see Table 3.S11. The low number of primary replacements and even lower frequency of revisions for patients whose data were entered using the most recent minimum dataset makes results difficult to interpret. It is important to note that the indications for revision are not mutually exclusive and 14.2%, 74.0%, and 9.3% recorded none, one and two indications for revision respectively.

Table 3.S12 PTIR estimates of indications for shoulder revision (95% CI) for acute trauma by type of shoulder replacement using reports from MDSv7.

Acute trauma	Events N	Prosthesis-years at risk (x100)	Number of revisions per 100 prosthesis-years at risk for :									
			All causes	Aseptic loosening humerus	Aseptic loosening glenoid	Stiffness	Component dissociation	Native glenoid surface erosion	Implant fracture	Lysis glenoid	Dislocation	Unexplained pain
All cases	91	84.9	1.07 (0.87-1.32)	0.05 (0.02-0.13)	0.01 (0.00-0.08)	0.05 (0.02-0.13)	0.04 (0.01-0.11)	0.01 (0.00-0.08)	0.01 (0.00-0.08)	0.01 (0.00-0.08)	0.31 (0.21-0.45)	0.02 (0.01-0.09)
Proximal humeral hemiarthroplasty	26	16.3	1.59 (1.09-2.34)	0.12 (0.03-0.49)	0	0.25 (0.09-0.65)	0.06 (0.01-0.44)	0.06 (0.01-0.44)	0	0.06 (0.01-0.44)	0.31 (0.13-0.74)	0.06 (0.01-0.44)
Total shoulder replacement	0	0.1	0	0	0	0	0	0	0	0	0	0
Reverse polarity total shoulder replacement	50	57.5	0.87 (0.66-1.15)	0.03 (0.01-0.14)	0.02 (0.00-0.12)	0	0.03 (0.01-0.14)	0	0.02 (0.00-0.12)	0	0.26 (0.16-0.43)	0.02 (0.00-0.12)
Unconfirmed	15	11.0	1.36 (0.82-2.26)	0	0	0	0	0	0	0	0.54 (0.24-1.21)	0

Note: Suppressed due to zero events: Impingement, Glenoid implant wear, Lysis humerus.

Table 3.S13 PTIR estimates of indications for shoulder revision (95% CI) for elective procedures by type of shoulder replacement between 2012 and 2022.

Elective	Events N	Prosthesis-years at risk (x100)	Number of revisions per 100 prosthesis-years at risk for: All causes	Infection	Instability | Dislocation	Cuff insufficiency	Aseptic loosening | Lysis	Peri-prosthetic fracture	Other indications
All cases	**2,133**	**2,576.6**	**0.83 (0.79-0.86)**	**0.12 (0.11-0.14)**	**0.21 (0.19-0.23)**	**0.20 (0.19-0.22)**	**0.11 (0.10-0.13)**	**0.05 (0.04-0.06)**	**0.13 (0.12-0.15)**
Proximal humeral hemiarthroplasty	**558**	**409.3**	**1.36 (1.25-1.48)**	**0.07 (0.05-0.10)**	**0.11 (0.08-0.15)**	**0.47 (0.40-0.54)**	**0.09 (0.07-0.13)**	**0.02 (0.01-0.04)**	**0.45 (0.39-0.52)**
Resurfacing	281	197.7	1.42 (1.26-1.60)	0.07 (0.04-0.11)	0.09 (0.05-0.14)	0.49 (0.40-0.60)	0.11 (0.07-0.16)	0.04 (0.02-0.07)	0.46 (0.37-0.56)
Stemless	104	71.2	1.46 (1.21-1.77)	0.06 (0.02-0.15)	0.08 (0.04-0.19)	0.46 (0.33-0.65)	0.07 (0.03-0.17)	0.01 (0.00-0.10)	0.55 (0.40-0.75)
Stemmed	173	140.5	1.23 (1.06-1.43)	0.09 (0.05-0.15)	0.16 (0.10-0.24)	0.43 (0.34-0.56)	0.09 (0.05-0.15)	0.01 (0.00-0.05)	0.41 (0.31-0.53)
Total shoulder replacement	**561**	**812.3**	**0.69 (0.64-0.75)**	**0.06 (0.05-0.08)**	**0.21 (0.18-0.24)**	**0.33 (0.30-0.38)**	**0.13 (0.11-0.16)**	**0.03 (0.02-0.04)**	**0.11 (0.09-0.14)**
Resurfacing	27	33.9	0.80 (0.55-1.16)	0.06 (0.01-0.24)	0.12 (0.04-0.31)	0.44 (0.27-0.73)	0.09 (0.03-0.27)	0.06 (0.01-0.24)	0.27 (0.14-0.51)
Stemless	168	272.2	0.62 (0.53-0.72)	0.07 (0.04-0.10)	0.20 (0.15-0.26)	0.29 (0.23-0.36)	0.10 (0.07-0.14)	0.04 (0.02-0.07)	0.08 (0.05-0.12)
Stemmed	366	506.2	0.72 (0.65-0.80)	0.06 (0.04-0.08)	0.22 (0.19-0.27)	0.35 (0.30-0.41)	0.15 (0.12-0.19)	0.02 (0.01-0.04)	0.12 (0.09-0.15)
Reverse polarity total shoulder replacement	**733**	**1,090.6**	**0.67 (0.63-0.72)**	**0.17 (0.15-0.20)**	**0.24 (0.21-0.27)**	**0.01 (0.01-0.02)**	**0.10 (0.08-0.12)**	**0.07 (0.05-0.08)**	**0.03 (0.02-0.04)**
Stemless	13	10.5	1.24 (0.72-2.13)	0.19 (0.05-0.76)	0.19 (0.05-0.76)	0.10 (0.01-0.67)	0.48 (0.20-1.14)	0.10 (0.01-0.67)	0
Stemmed	720	1,080.1	0.67 (0.62-0.72)	0.17 (0.15-0.20)	0.24 (0.21-0.27)	0.01 (0.01-0.02)	0.10 (0.08-0.12)	0.06 (0.05-0.08)	0.03 (0.02-0.05)
Interpositional arthroplasty	**0**	**0.2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Unconfirmed	**281**	**264.2**	**1.06 (0.95-1.20)**	**0.17 (0.12-0.22)**	**0.24 (0.19-0.31)**	**0.19 (0.14-0.25)**	**0.16 (0.11-0.21)**	**0.08 (0.05-0.12)**	**0.11 (0.08-0.16)**
Unconfirmed HHA	26	17.9	1.45 (0.99-2.14)	0.34 (0.15-0.75)	0.06 (0.01-0.40)	0.45 (0.22-0.89)	0.11 (0.03-0.45)	0.11 (0.03-0.45)	0.28 (0.12-0.67)
Unconfirmed TSR	134	120.2	1.11 (0.94-1.32)	0.06 (0.03-0.12)	0.17 (0.11-0.27)	0.31 (0.22-0.42)	0.20 (0.13-0.30)	0.03 (0.01-0.09)	0.17 (0.11-0.26)
Unconfirmed RTSR	121	126.0	0.96 (0.80-1.15)	0.25 (0.17-0.35)	0.33 (0.24-0.44)	0.03 (0.01-0.08)	0.12 (0.07-0.20)	0.11 (0.07-0.19)	0.03 (0.01-0.08)
Unconfirmed IPA	0	0.2	0	0	0	0	0	0	0

Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S14 PTIR estimates of indications for shoulder revision (95% CI) for elective procedures by type of shoulder replacement using reports from MDSv7.

Elective	Events N	Prosthesis-years at risk (x100)	Number of revisions per 100 prosthesis-years at risk for: All causes	Aseptic loosening humerus	Aseptic loosening glenoid	Stiffness	Impingement	Component dissociation	Glenoid implant wear	Native glenoid surface erosion	Implant fracture	Lysis humerus	Lysis glenoid	Dislocation	Unexplained pain
All cases	527	59.6	8.85 (8.12-9.63)	0.22 (0.13-0.38)	0.76 (0.56-1.01)	0.22 (0.13-0.38)	0.17 (0.09-0.31)	0.71 (0.52-0.95)	0.18 (0.10-0.33)	0.49 (0.34-0.70)	0.07 (0.03-0.18)	0.03 (0.01-0.13)	0.15 (0.08-0.29)	1.26 (1.00-1.58)	0.42 (0.28-0.62)
Proximal humeral hemiarthroplasty	63	4.2	15.18 (11.86-19.43)	0.24 (0.03-1.71)	0	2.17 (1.13-4.17)	0.24 (0.03-1.71)	0.24 (0.03-1.71)	0.48 (0.12-1.93)	6.26 (4.26-9.20)	0	0	0	1.93 (0.96-3.85)	2.65 (1.47-4.79)
Resurfacing	16	1.1	14.33 (8.78-23.39)	0	0	1.79 (0.45-7.16)	0	0	0.90 (0.13-6.36)	7.17 (3.58-14.33)	0	0	0	0	5.37 (2.41-11.96)
Stemless	12	1.3	8.96 (5.09-15.77)	0	0	0	0	0	0.75 (0.11-5.30)	2.99 (1.12-7.96)	0	0	0	0.75 (0.11-5.30)	1.49 (0.37-5.97)
Stemmed	35	1.7	20.65 (14.83-28.77)	0.59 (0.08-4.19)	0	4.13 (1.97-8.66)	0.59 (0.08-4.19)	0.59 (0.08-4.19)	0	8.26 (4.89-13.95)	0	0	0	4.13 (1.97-8.66)	1.77 (0.57-5.49)
Total shoulder replacement	106	16.9	6.26 (5.17-7.57)	0.18 (0.06-0.55)	1.06 (0.67-1.69)	0.18 (0.06-0.55)	0.12 (0.03-0.47)	0.30 (0.12-0.71)	0.30 (0.12-0.71)	0.06 (0.01-0.42)	0	0	0.12 (0.03-0.47)	0.71 (0.40-1.25)	0.24 (0.09-0.63)
Resurfacing	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Stemless	45	8.2	5.49 (4.10-7.36)	0.12 (0.02-0.87)	0.73 (0.33-1.63)	0	0	0.37 (0.12-1.14)	0.12 (0.02-0.87)	0	0	0	0	0.49 (0.18-1.30)	0.12 (0.02-0.87)
Stemmed	61	8.6	7.09 (5.52-9.11)	0.23 (0.06-0.93)	1.39 (0.79-2.46)	0.35 (0.11-1.08)	0.23 (0.06-0.93)	0.23 (0.06-0.93)	0.46 (0.17-1.24)	0.12 (0.02-0.83)	0	0	0.23 (0.06-0.93)	0.93 (0.47-1.86)	0.35 (0.11-1.08)
Reverse polarity total shoulder replacement	287	33.3	8.63 (7.68-9.68)	0.24 (0.12-0.48)	0.69 (0.46-1.04)	0	0.18 (0.08-0.40)	0.90 (0.63-1.29)	0.06 (0.02-0.24)	0.03 (0.00-0.21)	0.09 (0.03-0.28)	0.06 (0.02-0.24)	0.21 (0.10-0.44)	1.44 (1.09-1.91)	0.24 (0.12-0.48)
Stemless	<4	0.3	6.13 (1.53-24.51)	3.06 (0.43-21.76)	3.06 (0.43-21.76)	0	0	0	0	0	0	0	0	0	0
Stemmed	285	32.9	8.65 (7.70-9.71)	0.21 (0.10-0.45)	0.67 (0.44-1.01)	0	0.18 (0.08-0.41)	0.91 (0.64-1.30)	0.06 (0.02-0.24)	0.03 (0.00-0.22)	0.09 (0.03-0.28)	0.06 (0.02-0.24)	0.21 (0.10-0.45)	1.46 (1.10-1.93)	0.24 (0.12-0.49)
Interpositional arthroplasty	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unconfirmed	71	5.2	13.69 (10.85-17.27)	0.19 (0.03-1.37)	0.77 (0.29-2.05)	0.19 (0.03-1.37)	0.19 (0.03-1.37)	1.16 (0.52-2.57)	0.39 (0.10-1.54)	0.19 (0.03-1.37)	0.19 (0.03-1.37)	0	0	1.35 (0.64-2.83)	0.39 (0.10-1.54)
Unconfirmed HHA	8	0.3	23.74 (11.87-47.48)	0	0	0	2.97 (0.42-21.07)	0	2.97 (0.42-21.07)	0	0	0	0	0	2.97 (0.42-21.07)
Unconfirmed TSR	11	1.1	9.92 (5.49-17.91)	0	0.90 (0.13-6.40)	0.90 (0.13-6.40)	0	0.90 (0.13-6.40)	0.90 (0.13-6.40)	0	0	0	0	0	0.90 (0.13-6.40)
Unconfirmed RTSR	52	3.7	13.96 (10.63-18.32)	0.27 (0.04-1.91)	0.81 (0.26-2.50)	0	0	1.34 (0.56-3.22)	0	0.27 (0.04-1.91)	0.27 (0.04-1.91)	0	0	1.88 (0.90-3.94)	0
Unconfirmed IPA	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S13 and Table 3.S14 describe the prosthesis time incidence rate (PTIR) per 100 years of follow-up for the reported indication for revision in elective patients receiving a primary shoulder replacement by type and sub-type of shoulder replacement.

Table 3.S13 reports indications for all patients across the life of the registry i.e. between 2012 and 2022. This was achieved by aggregating indications for revision across the different minimum datasets. Table 3.S14 reports data for patients whose information was entered following the introduction of MDSv7.

For elective primary replacements, cuff insufficiency is the leading indication for revision for those who receive a proximal humeral hemiarthroplasty or conventional total shoulder replacement, whereas instability or dislocation is the leading cause in reverse polarity total shoulder replacements, see Table 3.S13. It is important to note the indications for revision are not mutually exclusive and 18.5%, 66.2%, and 12.5% of patients recorded none, one and two indications for revision respectively.

The NJR asks surgeons and those responsible for healthcare delivery to ensure that when primary and revision joint replacement procedures of the hip, knee, ankle, elbow or shoulder are performed, that the relevant MDS form is completed and data entered into the registry. This is a requirement mandated by the Department of Health and Social Care. For the purposes of the Annual Report, revision procedures include any addition, removal or modification of the implants and procedures such as debridement and implant retention with or without implant exchange, excision arthroplasty, amputation and conversion to arthrodesis. The completion of a revision MDS form is also mandatory for a procedure involving modification of a joint by adding another implant to another part of the joint. For the analyses of surgeon performance, hospital performance and implant performance, debridement and implant retention without implant exchange is currently excluded.

3.6.3 Patient Reported Outcome Measures (PROMs) Oxford Shoulder Scores (OSS) associated with primary shoulder replacement surgery

The Oxford Shoulder Score (OSS) is a validated patient reported outcome measure for use in shoulder surgery. It consists of 12 pain and function items which address problems that the patient may have encountered with their shoulder over the preceding four weeks (Dawson et al., 1996). The score is coded from zero to four (from 'worst' to 'best') and then summed in line with updated OSS recommendations (Dawson et al., 2009). The final total score ranges from zero to 48, with 48 representing the 'best' outcome and zero the 'worst'. Where up to two items were missing, the average of the remaining items can be substituted for the missing values (Dawson et al., 2009). If more than two items were missing, the results have to be disregarded.

Dawson J, Fitzpatrick R, Carr A, JBJS, 1996: 78-B, 593-600.
Dawson J, Rogers K, Fitzpatrick R and Carr A, Arch Orthop Trauma Surg, 2009, 129:119-123.

Table 3.S15 Number and percentage of patients who completed an Oxford Shoulder Score (OSS) by acute trauma and elective indications, by the collection window of interest at different time points.

		Pre-operative OSS			6-month OSS			3-year OSS			5-year OSS		
		N	Eligible (%)	Responders (%)	N	Eligible (%)	Responders (%)	N	Eligible (%)	Responders (%)	N	Eligible (%)	Responders (%)
Acute trauma	All eligible cases	7,303	(100)		6,668	(100)		4,024	(100)		2,233	(100)	
	All responders	597	(8.2)	(100)	2,283	(34.2)	(100)	256	(6.4)	(100)	340	(15.2)	(100)
	All complete* within window of interest	440	(6.0)	(73.7)	1,671	(25.1)	(73.2)	249	(6.2)	(97.3)	335	(15.0)	(98.5)
	OSS collected before window of interest	<4	(<0.1)	(0.3)	4	(0.1)	(0.2)	<4	(<0.1)	(0.4)	<4	(<0.1)	(0.3)
	1 to 9 Items completed	<4	(<0.1)	(0.2)	0	(0)	(0)	0	(0)	(0)	0	(<0.1)	(<0.1)
	10 to 11 Items completed	0	(0)	(0)	<4	(<0.1)	(<0.1)	0	(<0.1)	(<0.1)	<4	(0)	(0.3)
	12 Items completed	<4	(<0.1)	(0.2)	<4	(<0.1)	(0.1)	<4	(<0.1)	(0.4)	0	(<0.1)	(<0.1)
	OSS collected within window of interest	450	(6.2)	(75.4)	1,682	(25.2)	(73.7)	253	(6.3)	(98.8)	337	(15.1)	(99.1)
	1 to 9 Items completed	10	(0.1)	(1.7)	11	(0.2)	(0.5)	4	(0.1)	(1.6)	<4	(0.1)	(0.6)
	10 to 11 Items completed	24	(0.3)	(4.0)	97	(1.5)	(4.2)	6	(0.1)	(2.3)	10	(0.4)	(2.9)
	12 Items completed	416	(5.7)	(69.7)	1,574	(23.6)	(68.9)	243	(6.0)	(94.9)	325	(14.6)	(95.6)
	OSS collected after window of interest	145	(2.0)	(24.3)	574	(8.6)	(25.1)	<4	(<0.1)	(0.8)	<4	(0.1)	(0.6)
	1 to 9 Items completed	23	(0.3)	(3.9)	<4	(<0.1)	(0.1)	0	(<0.1)	(<0.1)	0	(<0.1)	(<0.1)
	10 to 11 Items completed	8	(0.1)	(1.3)	39	(0.6)	(1.7)	0	(<0.1)	(<0.1)	0	(<0.1)	(<0.1)
	12 Items completed	114	(1.6)	(19.1)	532	(8.0)	(23.3)	<4	(<0.1)	(0.8)	<4	(0.1)	(0.6)
Elective	All eligible cases	56,648	(100)		53,402	(100)		39,860	(100)		25,340	(100)	
	All responders	20,122	(35.5)	(100)	24,396	(45.7)	(100)	3,048	(7.6)	(100)	4,408	(17.4)	(100)
	All complete* within window of interest	14,010	(24.7)	(69.6)	17,128	(32.1)	(70.2)	2,992	(7.5)	(98.2)	4,332	(17.1)	(98.3)
	OSS collected before window of interest	1,225	(2.2)	(6.1)	122	(0.2)	(0.5)	7	(<0.1)	(0.2)	15	(0.1)	(0.3)
	1 to 9 Items completed	5	(<0.1)	(<0.1)	<4	(<0.1)	(<0.1)	0	(<0.1)	(<0.1)	0	(<0.1)	(<0.1)
	10 to 11 Items completed	28	(<0.1)	(0.1)	10	(<0.1)	(<0.1)	<4	(<0.1)	(<0.1)	<4	(<0.1)	(<0.1)
	12 Items completed	1,192	(2.1)	(5.9)	111	(0.2)	(0.5)	6	(<0.1)	(0.2)	14	(0.1)	(0.3)
	OSS collected within window of interest	14,086	(24.9)	(70.0)	17,245	(32.3)	(70.7)	3,021	(7.6)	(99.1)	4,381	(17.3)	(99.4)
	1 to 9 Items completed	76	(0.1)	(0.4)	117	(0.2)	(0.5)	29	(0.1)	(1.0)	49	(0.2)	(1.1)
	10 to 11 Items completed	543	(1.0)	(2.7)	980	(1.8)	(4.0)	213	(0.5)	(7.0)	287	(1.1)	(6.5)
	12 Items completed	13,467	(23.8)	(66.9)	16,148	(30.2)	(66.2)	2,779	(7.0)	(91.2)	4,045	(16.0)	(91.8)
	OSS collected after window of interest	4,811	(8.5)	(23.9)	6,836	(12.8)	(28.0)	20	(0.1)	(0.7)	12	(<0.1)	(0.3)
	1 to 9 Items completed	140	(0.2)	(0.7)	48	(0.1)	(0.2)	0	(<0.1)	(<0.1)	<4	(<0.1)	(<0.1)
	10 to 11 Items completed	395	(0.7)	(2.0)	370	(0.7)	(1.5)	0	(<0.1)	(<0.1)	<4	(<0.1)	(0.1)
	12 Items completed	4,276	(7.5)	(21.3)	6,418	(12.0)	(26.3)	20	(0.1)	(0.7)	8	(<0.1)	(0.2)

*Complete corresponds to 10 or more items completed.
Note: Window of interest: Pre-operative[-90 to 0 days], 6 months [5 to 8 months], 3 years [2 years 11 months to 3 years 6 months], 5 years [4 years 11 months to 5 years 6 months].

Table 3.S15 provides a detailed description of the number of patients reporting an OSS questionnaire pre-operatively, 6 months, 3 years and 5 years following surgery for patients undergoing primary shoulder replacement for acute trauma or elective indications. The responses are further divided by how close to the time point of interest it was collected and the completeness of each of the PROMs questionnaires. The results are expressed absolutely (N) and as a percentage (%) of 'Eligible' participants and those who 'Responded' to the PROMs questionnaires. Eligibility is defined as being alive at the time point of interest and also having sufficient follow-up time following primary surgery.

How close the response was to the time point of interest is categorised by defining 'windows of interest'. The pre-operative window of interest is 90 days prior to the primary surgery until the day of the primary operation. The 6-month data collection window of interest ranges from 5 months to 8 months, i.e. spanning a 3-month window of interest. The 3- and 5-year data collections had windows of interest ranging from 1 month prior to 3 and 5 years respectively to 6 months after i.e. spanning a 7-month window of interest.

Ensuring data is collected pre-operatively by hospitals is very important. In order to assess the efficacy of a surgical technique or implantable construct, understanding where the patient started is critical in order to understand how the patient is likely to respond to surgery. Collecting pre-operative PROMs post-operatively is likely to induce recall bias and for this reason the end of the pre-operative window was strictly defined as 'the day of surgery'. Table 3.S15 clearly illustrates only a small minority of eligible patients complete an OSS questionnaire prior to surgery and within the window of interest.

Given the low compliance in pre-operative score collection by hospitals delivering shoulder replacement surgery, the potential for bias in interpreting results is clear. Collection and compliance with reporting at 6 months, 3 and 5 years is substantially better than pre-operative rates, but the response rate of all eligible participants is still less than 50% in all instances. The British Elbow and Shoulder Society (BESS) have deemed shoulder PROMs essential in the assessment of patient outcomes and surveillance after shoulder replacement surgery. The low pre-operative compliance with PROMs data collection by units is therefore particularly concerning.

Table 3.S16 Number and percentage of patients who, cross-sectionally, completed Oxford Shoulder Score (OSS) by overall, acute trauma, elective and by year of primary operation, within the collection window of interest, with valid measurements at the time points of interest.

	Year of primary	Potential cases	OSS completed at:			
			Pre-op	6 months	3 years	5 years
		N	N (% of Pre-op)	N (% of Pre-op)	N (% of Pre-op)	N (% of Pre-op)
Acute trauma & elective	All years	63,951	14,450 (22.6)	18,799 (31.3)	3,241 (7.4)	4,667 (16.9)
	2012	2,566	672 (26.2)	344 (13.5)	0 (0)	1,129 (51.0)
	2013	4,436	1,077 (24.3)	1,883 (42.8)	0 (0)	1,354 (35.3)
	2014	5,328	1,415 (26.6)	298 (5.6)	2,067 (41.5)	1,839 (39.8)
	2015	5,765	1,491 (25.9)	857 (15.0)	729 (13.5)	345 (6.9)
	2016	6,573	1,486 (22.6)	26 (0.4)	266 (4.3)	0 (0)
	2017	7,028	1,494 (21.3)	4,674 (67.1)	179 (2.7)	0 (0)
	2018	7,310	1,434 (19.6)	5,016 (69.1)	0 (0)	--
	2019	7,831	1,802 (23.0)	4,128 (53.1)	0 (0)	--
	2020	4,252	966 (22.7)	423 (10.0)	--	--
	2021	6,082	1,327 (21.8)	811 (13.4)	--	--
	2022	6,780	1,286 (19.0)	339 (10.1)	--	--
Acute trauma	All years	7,303	440 (6.0)	1,671 (25.1)	249 (6.2)	335 (15.0)
	2012	162	11 (6.8)	17 (10.9)	0 (0)	52 (40.6)
	2013	389	42 (10.8)	149 (39.2)	0 (0)	100 (33.1)
	2014	474	36 (7.6)	33 (7.2)	162 (40.7)	145 (42.2)
	2015	539	31 (5.8)	92 (17.4)	76 (16.2)	38 (9.2)
	2016	602	41 (6.8)	7 (1.2)	9 (1.7)	0 (0)
	2017	718	35 (4.9)	441 (62.9)	<4 (0.3)	0 (0)
	2018	777	50 (6.4)	471 (61.6)	0 (0)	--
	2019	907	54 (6.0)	402 (45.3)	0 (0)	--
	2020	767	51 (6.6)	20 (2.7)	--	--
	2021	964	56 (5.8)	31 (3.3)	--	--
	2022	1,004	33 (3.3)	8 (1.6)	--	--
Elective	All years	56,648	14,010 (24.7)	17,128 (32.1)	2,992 (7.5)	4,332 (17.1)
	2012	2,404	661 (27.5)	327 (13.7)	0 (0)	1,077 (51.6)
	2013	4,047	1,035 (25.6)	1,734 (43.2)	0 (0)	1,254 (35.5)
	2014	4,854	1,379 (28.4)	265 (5.5)	1,905 (41.6)	1,694 (39.6)
	2015	5,226	1,460 (27.9)	765 (14.7)	653 (13.3)	307 (6.7)
	2016	5,971	1,445 (24.2)	19 (0.3)	257 (4.5)	0 (0)
	2017	6,310	1,459 (23.1)	4,233 (67.6)	177 (3.0)	0 (0)
	2018	6,533	1,384 (21.2)	4,545 (70.0)	0 (0)	--
	2019	6,924	1,748 (25.2)	3,726 (54.2)	0 (0)	--
	2020	3,485	915 (26.3)	403 (11.6)	--	--
	2021	5,118	1,271 (24.8)	780 (15.3)	--	--
	2022	5,776	1,253 (21.7)	331 (11.6)	--	--

Note: Cells with a -- indicate that there are currently no data for this follow-up period.

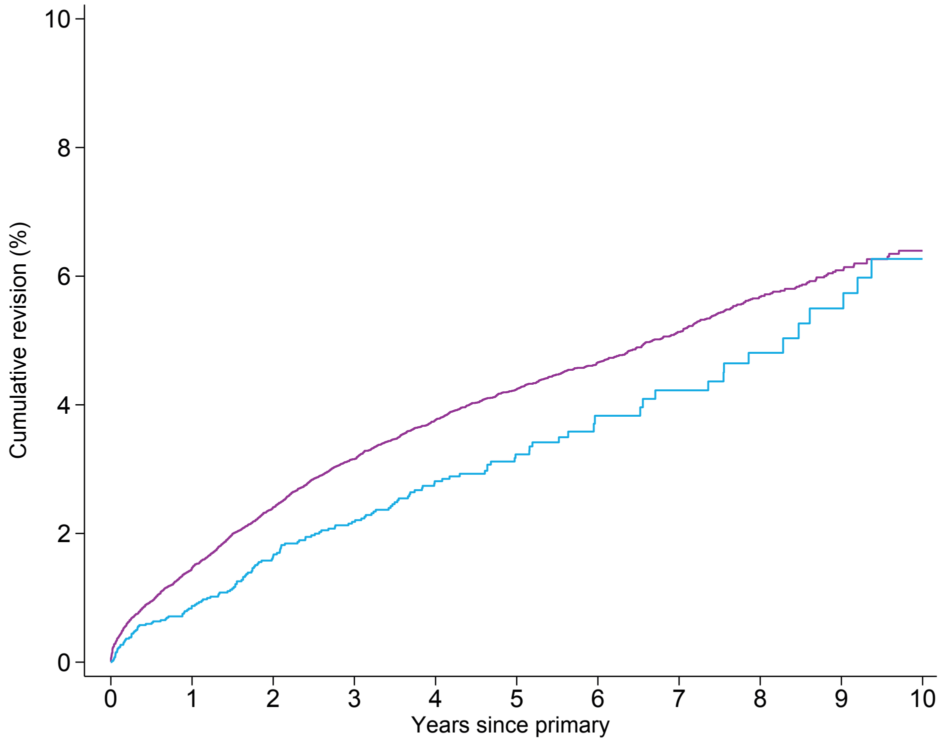
Table 3.S16 provides a detailed description of the number of patients reporting complete OSS within the window of interest pre-operatively and at 6 months, 3 years and 5 years by the year of surgery for patients undergoing primary shoulder replacement for acute trauma or elective indications. The denominator used to calculate percentages is the number of patients alive at the milestone of interest. Where numbers appear without a percentage in parentheses, the PROMs were collected prior to the target date but within the window of interest. The data illustrate that collection and submission of pre-operative PROMs by hospitals is consistently poor, with less than 30% of elective patients having their PROMs data submitted. In recent years the compliance with 6-month reporting has steadily improved.

Table 3.S17 Number and percentage of patients who completed longitudinal Oxford Shoulder Score (OSS) by overall, acute trauma, elective and by year of primary operation, within the collection window of interest, with valid measurements at the time points of interest.

	Year of primary	Potential cases	OSS completed at:					
			Pre-op	Pre-op, 6m	Pre-op, 3y	Pre-op, 5y	Pre-op, 6m, 3y	Pre-op, 6m, 3y, 5y
		N	N	N (% of Pre-op)	N (% of Pre-op)	N (% of Pre-op)	N (% of Pre-op)	N (% of Pre-op)
Acute trauma & elective	All years	63,951	14,450	5,366 (37.1)	1,144 (7.9)	1,371 (9.5)	355 (2.5)	118 (0.8)
	2012	2,566	672	91 (13.5)	0 (0)	344 (51.2)	0 (0)	0 (0)
	2013	4,436	1,077	527 (48.9)	0 (0)	369 (34.3)	0 (0)	0 (0)
	2014	5,328	1,415	83 (5.9)	614 (43.4)	561 (39.6)	62 (4.4)	49 (3.5)
	2015	5,765	1,491	239 (16.0)	201 (13.5)	97 (6.5)	185 (12.4)	69 (4.6)
	2016	6,573	1,486	5 (0.3)	200 (13.5)	0 (0)	<4 (0.2)	0 (0)
	2017	7,028	1,494	1,049 (70.2)	129 (8.6)	0 (0)	105 (7.0)	0 (0)
	2018	7,310	1,434	1,054 (73.5)	0 (0)	0 (0)	0 (0)	0 (0)
	2019	7,831	1,802	955 (53.0)	0 (0)	0 (0)	0 (0)	0 (0)
	2020	4,252	966	380 (39.3)	0 (0)	0 (0)	0 (0)	0 (0)
	2021	6,082	1,327	711 (53.6)	0 (0)	0 (0)	0 (0)	0 (0)
	2022	6,780	1,286	272 (21.2)	0 (0)	0 (0)	0 (0)	0 (0)
Acute trauma	All years	7,303	440	158 (35.9)	25 (5.7)	29 (6.6)	<4 (0.5)	<4 (0.2)
	2012	162	11	<4 (9.1)	0 (0)	4 (36.4)	0 (0)	0 (0)
	2013	389	42	17 (40.5)	0 (0)	13 (31.0)	0 (0)	0 (0)
	2014	474	36	<4 (2.8)	14 (38.9)	11 (30.6)	0 (0)	0 (0)
	2015	539	31	<4 (9.7)	<4 (6.5)	<4 (3.2)	<4 (3.2)	<4 (3.2)
	2016	602	41	0 (0)	7 (17.1)	0 (0)	0 (0)	0 (0)
	2017	718	35	21 (60.0)	<4 (5.7)	0 (0)	<4 (2.9)	0 (0)
	2018	777	50	33 (66.0)	0 (0)	0 (0)	0 (0)	0 (0)
	2019	907	54	29 (53.7)	0 (0)	0 (0)	0 (0)	0 (0)
	2020	767	51	19 (37.3)	0 (0)	0 (0)	0 (0)	0 (0)
	2021	964	56	27 (48.2)	0 (0)	0 (0)	0 (0)	0 (0)
	2022	1,004	33	7 (21.2)	0 (0)	0 (0)	0 (0)	0 (0)
Elective	All years	56,648	14,010	5,208 (37.2)	1,119 (8.0)	1,342 (9.6)	353 (2.5)	117 (0.8)
	2012	2,404	661	90 (13.6)	0 (0)	340 (51.4)	0 (0)	0 (0)
	2013	4,047	1,035	510 (49.3)	0 (0)	356 (34.4)	0 (0)	0 (0)
	2014	4,854	1,379	82 (5.9)	600 (43.5)	550 (39.9)	62 (4.5)	49 (3.6)
	2015	5,226	1,460	236 (16.2)	199 (13.6)	96 (6.6)	184 (12.6)	68 (4.7)
	2016	5,971	1,445	5 (0.3)	193 (13.4)	0 (0)	<4 (0.2)	0 (0)
	2017	6,310	1,459	1,028 (70.5)	127 (8.7)	0 (0)	104 (7.1)	0 (0)
	2018	6,533	1,384	1,021 (73.8)	0 (0)	0 (0)	0 (0)	0 (0)
	2019	6,924	1,748	926 (53.0)	0 (0)	0 (0)	0 (0)	0 (0)
	2020	3,485	915	361 (39.5)	0 (0)	0 (0)	0 (0)	0 (0)
	2021	5,118	1,271	684 (53.8)	0 (0)	0 (0)	0 (0)	0 (0)
	2022	5,776	1,253	265 (21.1)	0 (0)	0 (0)	0 (0)	0 (0)

Table 3.S17 describes the number and percentage of paired measurements available for longitudinal analyses for all patients undergoing primary shoulder replacement for acute trauma or elective indications. The denominator used to calculate percentages is the number of pre-operative measurements. The numerator is the number of responses within the window of interest, see Table 3.S15, with no more than two items missing responses. The proportion of patients available for a paired longitudinal analysis at any time point is low, and the proportion of patients with serial measurements at any time point is even lower. While the proportion of patients with pre-operative and 6-month OSS has increased in recent years (excluding 2020 due to COVID), this still only represents 11.7% of all eligible primary replacements.

Figure 3.S10 KM estimates of cumulative revision for primary elective shoulder replacements for patients with and without valid PROMs. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*

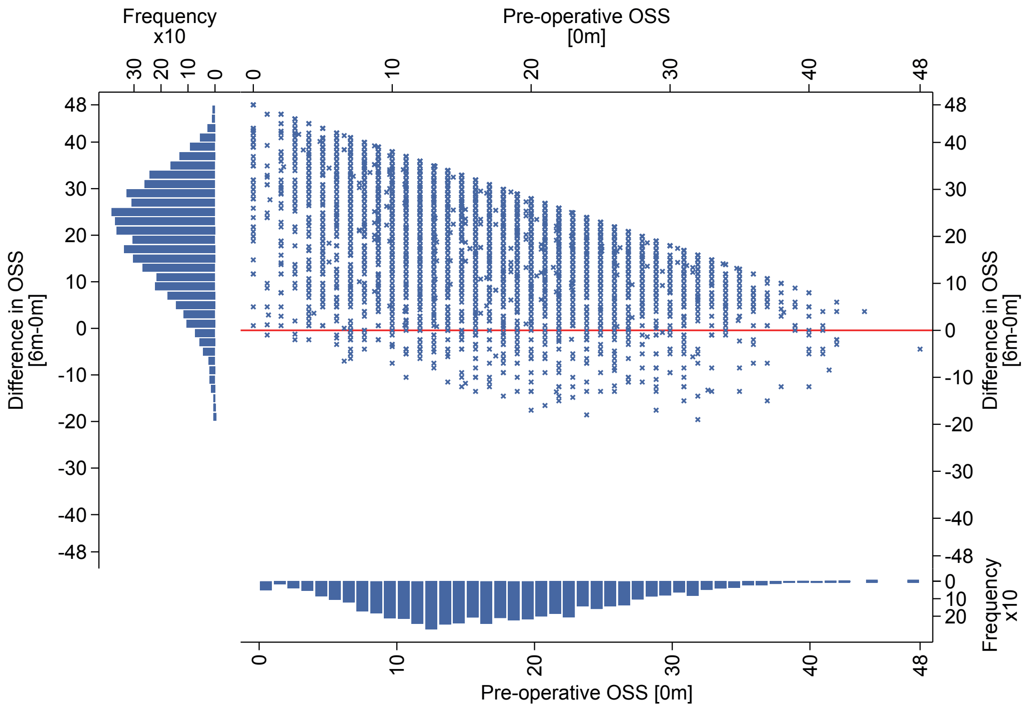


Key:

Numbers at risk											
Non PROMs cohort	51,440	44,594	39,127	34,960	28,344	22,446	17,184	11,658	7,369	3,766	1,348
PROMs cohort	5,208	4,877	4,112	3,677	2,708	1,722	762	707	483	397	*62*

Figure 3.S10 reports the cumulative revision rate for elective patients undergoing primary shoulder replacements who completed pre-operative and 6-month PROMs assessments within the specified window of interest. Results indicate a different cumulative revision rate for patients who are included in the PROMs cohort versus those who are not. This difference suggests the group of patients responding to the PROMs questionnaires are different from those who are not responding and so are not representative of the larger population. This highlights the risk of using incomplete datasets to make inferences for the larger cohort and the data from this PROMs cohort need to be interpreted cautiously despite their relatively large size. If anything it indicates that the PROMs cohort is likely to be a more 'satisfied' group of patients as their revision rates are lower than the non-PROMs cohort.

Figure 3.S11 Distribution and scatter of pre-operative Oxford Shoulder Score (OSS) and the change in OSS (post-pre) score for those receiving elective shoulder replacements for valid measurements within the collection window of interest.



Note: Elective patients with pre and 6 month presented only, N=5,208.

Figure 3.S11 illustrates the distribution of pre-operative OSS and change in OSS between the pre-operative and the 6-month assessment. Results are displayed for patients with elective indications for primary shoulder replacement only. It also illustrates the association between pre-operative OSS and the change in OSS. While pre-operative and change in OSS are approximately normally distributed, this hides the ceiling effect within the assessment of the change score. This makes the interpretation of change in OSS particularly challenging and highlights the necessity of ascertaining a pre-operative PROMs when assessing the efficacy of any intervention associated with a primary shoulder replacement. In the absence of specialist methods which account for floor and ceiling effects, a simple analysis of change scores is reported to be the most appropriate (Glymour et al., 2005). At six months following surgery, 5.1% of patients reported a score worse than they did pre-operatively. This figure is reduced compared to previous years due to the more refined inclusion/exclusion criteria of the PROMs cohort as defined previously.

Glymour M., et al. American Journal of Epidemiology, 2005: 162(3), 267-278.

Table 3.S18 Descriptive statistics of the pre-operative, 6-month and the change in Oxford Shoulder Score (OSS) by overall, acute trauma, elective and by year of primary operation, within the collection window of interest, with valid measurements pre-operatively and 6 months post-operatively.

	Year of primary	Complete cases N	OSS [0 min, 48 max]					
			Pre-op		6-month		(6-month - Pre-op)	
			Mean (SD)	[25,50,75]th	Mean (SD)	[25,50,75]th	Mean (SD)	[25,50,75]th
Acute trauma & elective	All years	5,366	16.6 (8.5)	[10, 16, 22]	35.9 (10.4)	[30, 39, 44]	19.4 (11.6)	[12, 20, 28]
	2012	91	17.6 (7.9)	[12, 16, 23]	33.8 (11.8)	[28, 37, 43]	16.2 (11.7)	[8, 16, 25]
	2013	527	17.5 (8.6)	[11, 17, 23]	33.8 (10.7)	[27, 36, 43]	16.3 (12.0)	[8, 17, 25]
	2014	83	16.2 (8.0)	[10, 15, 22]	34.0 (11.1)	[25, 36, 42]	17.7 (10.2)	[12, 17, 25]
	2015	239	16.0 (7.7)	[11, 15, 21]	33.8 (11.1)	[28, 36, 43]	17.8 (11.0)	[10, 19, 26]
	2016	5	17.4 (9.3)	[9, 18, 26]	42.6 (6.1)	[37, 46, 47]	25.2 (11.4)	[22, 28, 29]
	2017	1,049	16.8 (8.4)	[11, 16, 22]	36.0 (10.3)	[30, 39, 44]	19.1 (11.6)	[12, 20, 28]
	2018	1,054	16.4 (8.6)	[10, 16, 22]	36.2 (10.4)	[30, 39, 44]	19.8 (11.7)	[13, 21, 28]
	2019	955	16.8 (8.4)	[11, 16, 22]	36.6 (10.1)	[31, 40, 44]	19.8 (11.1)	[13, 21, 28]
	2020	380	16.5 (8.4)	[10, 16, 23]	37.0 (9.8)	[32, 40, 44]	20.6 (11.2)	[13, 22, 29]
	2021	711	16.1 (8.5)	[10, 15, 22]	36.4 (10.3)	[30, 40, 44]	20.4 (11.9)	[13, 22, 29]
	2022	272	15.7 (8.8)	[9, 15, 22]	36.9 (10.0)	[32, 40, 45]	21.2 (11.5)	[14, 22, 29]
Acute trauma	All years	158	11.7 (15.4)	[0, 5, 13]	31.4 (12.1)	[21, 34, 42]	19.6 (19.6)	[9, 23, 35]
	2012	<4	42.0 (.)	[42, 42, 42]	39.0 (.)	[39, 39, 39]	-3.0 (.)	[-3, -3, -3]
	2013	17	11.9 (14.7)	[2, 8, 12]	33.3 (13.8)	[25, 41, 44]	21.3 (23.8)	[17, 27, 40]
	2014	<4	8.0 (.)	[8, 8, 8]	14.0 (.)	[14, 14, 14]	6.0 (.)	[6, 6, 6]
	2015	<4	7.3 (4.9)	[4, 5, 13]	35.0 (11.5)	[22, 39, 44]	27.7 (16.4)	[9, 34, 40]
	2016	0						
	2017	21	15.4 (17.3)	[1, 8, 24]	31.4 (10.7)	[22, 34, 36]	16.0 (21.3)	[3, 22, 27]
	2018	33	16.6 (16.2)	[4, 11, 28]	28.7 (10.8)	[20, 30, 37]	12.1 (19.7)	[-3, 14, 29]
	2019	29	8.6 (13.3)	[0, 2, 12]	31.5 (12.8)	[20, 32, 43]	22.9 (15.9)	[14, 25, 33]
	2020	19	4.4 (8.8)	[0, 0, 4]	29.3 (12.7)	[18, 34, 41]	24.9 (12.2)	[13, 27, 37]
	2021	27	11.9 (17.1)	[0, 4, 15]	32.9 (12.7)	[21, 38, 43]	21.1 (21.7)	[12, 24, 40]
	2022	7	7.6 (17.9)	[0, 0, 3]	38.3 (10.9)	[37, 42, 45]	30.7 (18.7)	[12, 38, 42]
Elective	All years	5,208	16.7 (8.1)	[11, 16, 22]	36.1 (10.3)	[30, 39, 44]	19.4 (11.3)	[12, 20, 28]
	2012	90	17.3 (7.5)	[12, 16, 22]	33.7 (11.8)	[28, 37, 43]	16.4 (11.6)	[9, 16, 25]
	2013	510	17.7 (8.3)	[11, 17, 23]	33.8 (10.6)	[27, 36, 43]	16.2 (11.4)	[8, 17, 24]
	2014	82	16.3 (8.0)	[10, 15, 22]	34.2 (10.9)	[26, 37, 42]	17.9 (10.2)	[12, 17, 25]
	2015	236	16.1 (7.6)	[11, 16, 21]	33.8 (11.1)	[28, 36, 43]	17.7 (10.9)	[10, 19, 26]
	2016	5	17.4 (9.3)	[9, 18, 26]	42.6 (6.1)	[37, 46, 47]	25.2 (11.4)	[22, 28, 29]
	2017	1,028	16.8 (8.2)	[11, 16, 22]	36.1 (10.2)	[30, 39, 44]	19.2 (11.4)	[12, 20, 28]
	2018	1,021	16.4 (8.2)	[11, 16, 22]	36.4 (10.3)	[31, 39, 44]	20.1 (11.3)	[13, 21, 28]
	2019	926	17.0 (8.1)	[11, 16, 22]	36.8 (10.0)	[31, 40, 44]	19.7 (10.9)	[13, 21, 28]
	2020	361	17.1 (7.9)	[11, 17, 23]	37.4 (9.4)	[33, 40, 44]	20.3 (11.1)	[13, 21, 29]
	2021	684	16.2 (8.0)	[10, 16, 22]	36.6 (10.2)	[30, 40, 45]	20.3 (11.3)	[13, 22, 29]
	2022	265	15.9 (8.4)	[9, 15, 22]	36.9 (10.0)	[32, 40, 45]	21.0 (11.2)	[14, 22, 29]

Table 3.S18 presents descriptive statistics, mean and standard deviation, median and interquartile range, by year of primary shoulder replacements overall, and by those receiving shoulder replacements for acute trauma or elective indications. Results are presented only for those with measurements pre-operatively and at six months, within the window of interest and with no more than two items missing. The number of patients with valid OSS that receive primary shoulder replacements is relatively low, however the results appear to be broadly concordant with those receiving primary shoulder replacement for elective indications. The change in OSS has tended to improve across the life of the registry, but the significance of this is very unclear given the potential for bias due to the lack of a representative sample.

Table 3.S19 Descriptive statistics of the pre-operative, 6-month and the change in Oxford Shoulder Score (OSS) by overall, acute trauma, elective and by shoulder type, within the collection window of interest, with valid measurements pre-operatively and 6 months post-operatively.

			OSS [0 min, 48 max]					
			Pre-op		6-month		(6-month - Pre-op)	
	Primary procedure	Complete cases N	Mean (SD)	[25,50,75]th	Mean (SD)	[25,50,75]th	Mean (SD)	[25,50,75]th
Acute trauma & elective	**Proximal humeral hemiarthroplasty**	**468**	**17.7 (9.3)**	**[11, 17, 23]**	**31.5 (11.8)**	**[23, 34, 42]**	**13.8 (12.4)**	**[6, 14, 23]**
	Resurfacing	216	18.0 (8.4)	[12, 18, 23]	32.5 (11.5)	[26, 35, 42]	14.5 (11.5)	[7, 15, 24]
	Stemless	94	20.2 (8.7)	[16, 19, 23]	33.3 (11.1)	[26, 36, 42]	13.2 (10.7)	[6, 14, 20]
	Stemmed	158	15.9 (10.3)	[9, 14, 22]	29.1 (12.3)	[19, 31, 40]	13.2 (14.4)	[4, 14, 24]
	Total shoulder replacement	**1,625**	**17.6 (8.1)**	**[12, 17, 23]**	**38.7 (9.1)**	**[35, 41, 45]**	**21.1 (10.5)**	**[14, 22, 29]**
	Resurfacing	60	18.9 (8.0)	[13, 20, 24]	39.1 (7.3)	[35, 40, 45]	20.2 (9.4)	[13, 21, 26]
	Stemless	750	17.8 (8.2)	[12, 17, 24]	39.0 (8.9)	[35, 41, 46]	21.1 (10.3)	[15, 22, 29]
	Stemmed	815	17.3 (7.9)	[12, 17, 23]	38.5 (9.4)	[34, 41, 45]	21.2 (10.7)	[14, 22, 29]
	Reverse polarity total shoulder replacement	**2,890**	**15.8 (8.4)**	**[10, 15, 21]**	**35.1 (10.5)**	**[29, 38, 43]**	**19.3 (11.8)**	**[12, 20, 28]**
	Stemless	83	16.2 (7.2)	[9, 16, 22]	36.2 (9.2)	[30, 38, 44]	20.0 (11.6)	[10, 23, 28]
	Stemmed	2,807	15.8 (8.4)	[10, 15, 21]	35.1 (10.5)	[29, 38, 43]	19.3 (11.8)	[12, 20, 28]
	Interpositional arthroplasty	**0**						
	Unconfirmed	**383**	**16.4 (9.1)**	**[10, 16, 23]**	**35.4 (10.0)**	**[29, 38, 44]**	**19.0 (11.7)**	**[11, 19, 28]**
	Unconfirmed HHA	17	18.3 (10.1)	[11, 15, 23]	28.9 (13.2)	[20, 26, 42]	10.6 (15.7)	[4, 10, 21]
	Unconfirmed TSR	145	17.8 (8.6)	[10, 18, 25]	37.0 (10.1)	[31, 40, 45]	19.2 (11.1)	[12, 20, 27]
	Unconfirmed RTSR	221	15.4 (9.2)	[9, 14, 21]	34.9 (9.4)	[28, 38, 42]	19.5 (11.5)	[11, 19, 28]
	Unconfirmed IPA	0						
Acute trauma	**Proximal humeral hemiarthroplasty**	**26**	**15.2 (16.4)**	**[3, 10, 17]**	**27.9 (13.4)**	**[18, 28, 41]**	**12.7 (24.0)**	**[2, 17, 30]**
	Resurfacing	0						
	Stemless	0						
	Stemmed	26	15.2 (16.4)	[3, 10, 17]	27.9 (13.4)	[18, 28, 41]	12.7 (24.0)	[2, 17, 30]
	Total shoulder replacement	**<4**	**12.0 (.)**	**[12, 12, 12]**	**43.0 (.)**	**[43, 43, 43]**	**31.0 (.)**	**[31, 31, 31]**
	Resurfacing	0						
	Stemless	<4	12.0 (.)	[12, 12, 12]	43.0 (.)	[43, 43, 43]	31.0 (.)	[31, 31, 31]
	Stemmed	0						
	Reverse polarity total shoulder replacement	**110**	**12.1 (15.7)**	**[0, 5, 15]**	**31.3 (12.2)**	**[22, 34, 43]**	**19.2 (18.5)**	**[9, 22, 34]**
	Stemless	0						
	Stemmed	110	12.1 (15.7)	[0, 5, 15]	31.3 (12.2)	[22, 34, 43]	19.2 (18.5)	[9, 22, 34]
	Interpositional arthroplasty	**0**						
	Unconfirmed	**21**	**5.4 (11.2)**	**[0, 0, 6]**	**35.6 (8.7)**	**[28, 38, 42]**	**30.2 (15.2)**	**[22, 33, 39]**
	Unconfirmed HHA	<4	48.0 (.)	[48, 48, 48]	26.0 (.)	[26, 26, 26]	-22.0 (.)	[-22, -22, -22]
	Unconfirmed TSR	0						
	Unconfirmed RTSR	20	3.3 (5.7)	[0, 0, 6]	36.0 (8.7)	[32, 39, 42]	32.8 (9.6)	[25, 34, 41]
	Unconfirmed IPA	0						

Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

Table 3.S19 (continued)

	Primary procedure	Complete cases N	OSS [0 min, 48 max] Pre-op Mean (SD)	Pre-op [25,50,75]th	6-month Mean (SD)	6-month [25,50,75]th	(6-month - Pre-op) Mean (SD)	(6-month - Pre-op) [25,50,75]th
Elective	**Proximal humeral hemiarthroplasty**	**442**	**17.9 (8.7)**	**[11, 18, 23]**	**31.8 (11.7)**	**[24, 34, 42]**	**13.9 (11.4)**	**[7, 14, 22]**
	Resurfacing	216	18.0 (8.4)	[12, 18, 23]	32.5 (11.5)	[26, 35, 42]	14.5 (11.5)	[7, 15, 24]
	Stemless	94	20.2 (8.7)	[16, 19, 23]	33.3 (11.1)	[26, 36, 42]	13.2 (10.7)	[6, 14, 20]
	Stemmed	132	16.0 (8.7)	[10, 14, 22]	29.3 (12.2)	[21, 31, 40]	13.3 (11.7)	[5, 14, 23]
	Total shoulder replacement	**1,624**	**17.6 (8.1)**	**[12, 17, 23]**	**38.7 (9.1)**	**[35, 41, 45]**	**21.1 (10.5)**	**[14, 22, 29]**
	Resurfacing	60	18.9 (8.0)	[13, 20, 24]	39.1 (7.3)	[35, 40, 45]	20.2 (9.4)	[13, 21, 26]
	Stemless	749	17.8 (8.3)	[12, 17, 24]	39.0 (8.9)	[35, 41, 46]	21.1 (10.3)	[15, 22, 29]
	Stemmed	815	17.3 (7.9)	[12, 17, 23]	38.5 (9.4)	[34, 41, 45]	21.2 (10.7)	[14, 22, 29]
	Reverse polarity total shoulder replacement	**2,780**	**16.0 (7.9)**	**[10, 15, 21]**	**35.3 (10.4)**	**[29, 38, 43]**	**19.3 (11.4)**	**[12, 20, 28]**
	Stemless	83	16.2 (7.2)	[9, 16, 22]	36.2 (9.2)	[30, 38, 44]	20.0 (11.6)	[10, 23, 28]
	Stemmed	2,697	16.0 (8.0)	[10, 15, 21]	35.3 (10.4)	[29, 38, 43]	19.3 (11.4)	[12, 20, 28]
	Interpositional arthroplasty	**0**						
	Unconfirmed	**362**	**17.1 (8.5)**	**[11, 16, 23]**	**35.4 (10.1)**	**[29, 38, 44]**	**18.3 (11.1)**	**[11, 19, 27]**
	Unconfirmed HHA	16	16.4 (6.8)	[11, 15, 22]	29.1 (13.7)	[19, 28, 43]	12.6 (13.7)	[6, 12, 22]
	Unconfirmed TSR	145	17.8 (8.6)	[10, 18, 25]	37.0 (10.1)	[31, 40, 45]	19.2 (11.1)	[12, 20, 27]
	Unconfirmed RTSR	201	16.6 (8.6)	[11, 16, 21]	34.8 (9.5)	[28, 37, 43]	18.2 (10.9)	[11, 18, 26]
	Unconfirmed IPA	0						

Note: HHA=Proximal humeral hemiarthroplasty, TSR=Total shoulder replacement, RTSR=Reverse polarity total shoulder replacement, IPA=Interpositional arthroplasty.

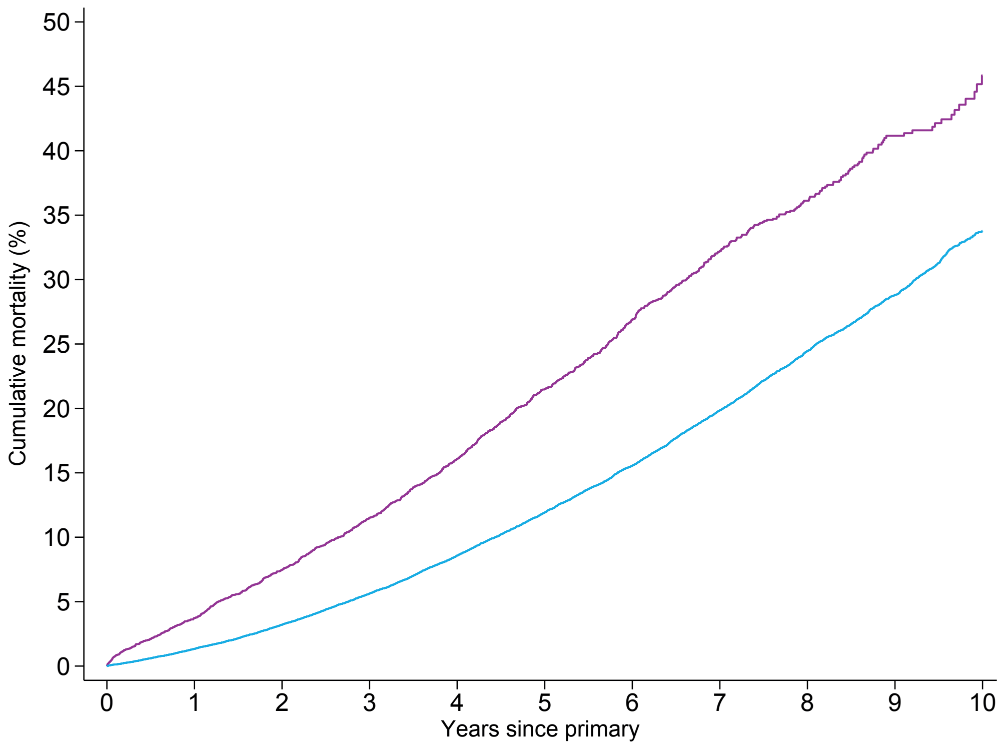
Table 3.S19 presents descriptive statistics, mean and standard deviation, median and interquartile range, by type and sub-type of primary shoulder replacements overall, and by those receiving shoulder replacements for acute trauma or elective indications. Results are presented only for those with measurements pre-operatively and at six months, within the window of interest and with no more than two items missing. The number of patients receiving a primary shoulder replacement for acute trauma indications is small.

Table 3.S19 clearly illustrates that the change between pre-operative and 6-month assessment of OSS while positive, is still substantially less for patients receiving a proximal humeral hemiarthroplasty compared to either a conventional total or reverse polarity total shoulder replacement. The change in OSS between conventional total shoulder replacement versus reverse polarity total shoulder replacement and sub-type versus type of shoulder replacement is broadly similar.

3.6.4 Mortality after primary shoulder replacement surgery

This following section describes the mortality profile for patients receiving primary shoulder replacements. Where patients received same-day bilateral procedures (N=35), see Figure 3.S1 (page 277), they were excluded from the analysis to avoid double counting. This results in 63,916 patient procedures being included in the analysis, with 9,280 observed deaths.

Figure 3.S12 KM estimates of cumulative mortality by acute trauma and elective indications for patients undergoing primary shoulder replacement. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



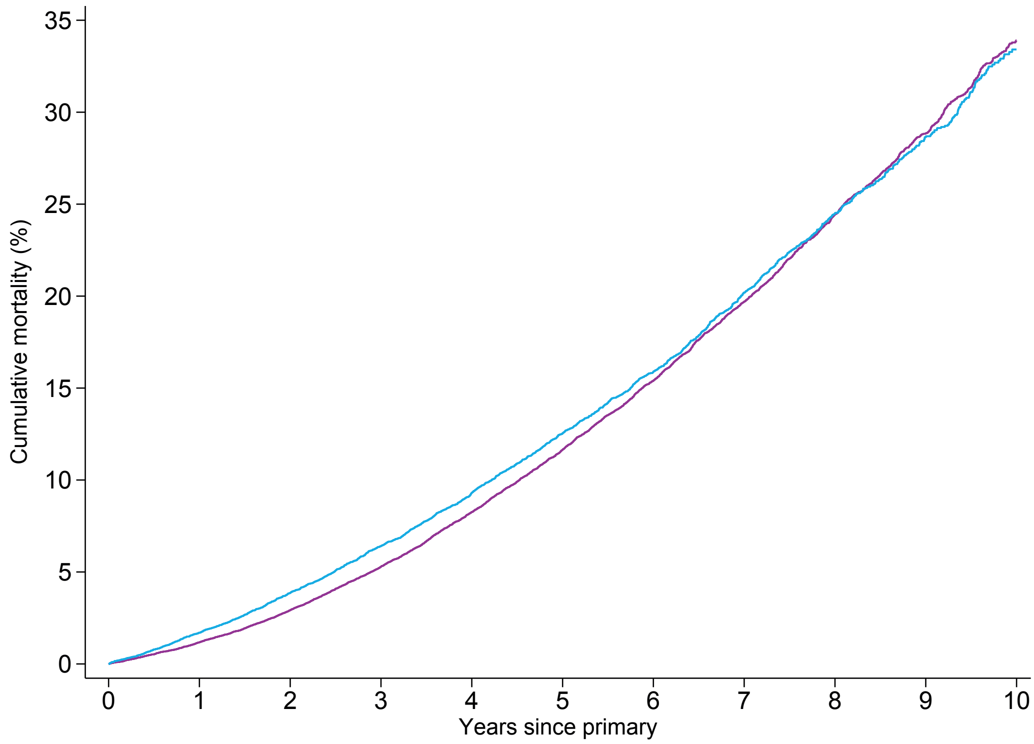
Key:	Numbers at risk										
Acute trauma	7,287	6,039	4,907	4,015	3,043	2,227	1,538	1,017	613	315	*79*
Elective	56,629	50,158	44,248	39,850	32,288	25,332	18,944	13,154	8,465	4,536	1,561

Table 3.S20 KM estimates of cumulative mortality (95% CI) by acute trauma and elective indications for patients undergoing primary shoulder replacement. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

	N	Age at primary Median (IQR)	Male (%)	Time since primary 30 days	90 days	1 year	3 years	5 years	7 years	10 years
All cases	63,916	73 (67 to 79)	30	0.19 (0.15-0.22)	0.40 (0.36-0.46)	1.60 (1.51-1.71)	6.27 (6.07-6.48)	12.90 (12.58-13.21)	21.05 (20.61-21.51)	34.88 (34.01-35.77)
Acute trauma	7,287	73 (67 to 79)	23	0.73 (0.56-0.96)	1.34 (1.09-1.63)	3.73 (3.31-4.21)	11.52 (10.72-12.38)	21.50 (20.30-22.76)	32.23 (30.56-33.96)	*45.85 (42.43-49.42)*
Elective	56,629	73 (67 to 79)	31	0.11 (0.09-0.15)	0.29 (0.24-0.33)	1.33 (1.24-1.44)	5.64 (5.44-5.85)	11.92 (11.61-12.25)	19.86 (19.40-20.32)	33.77 (32.87-34.69)

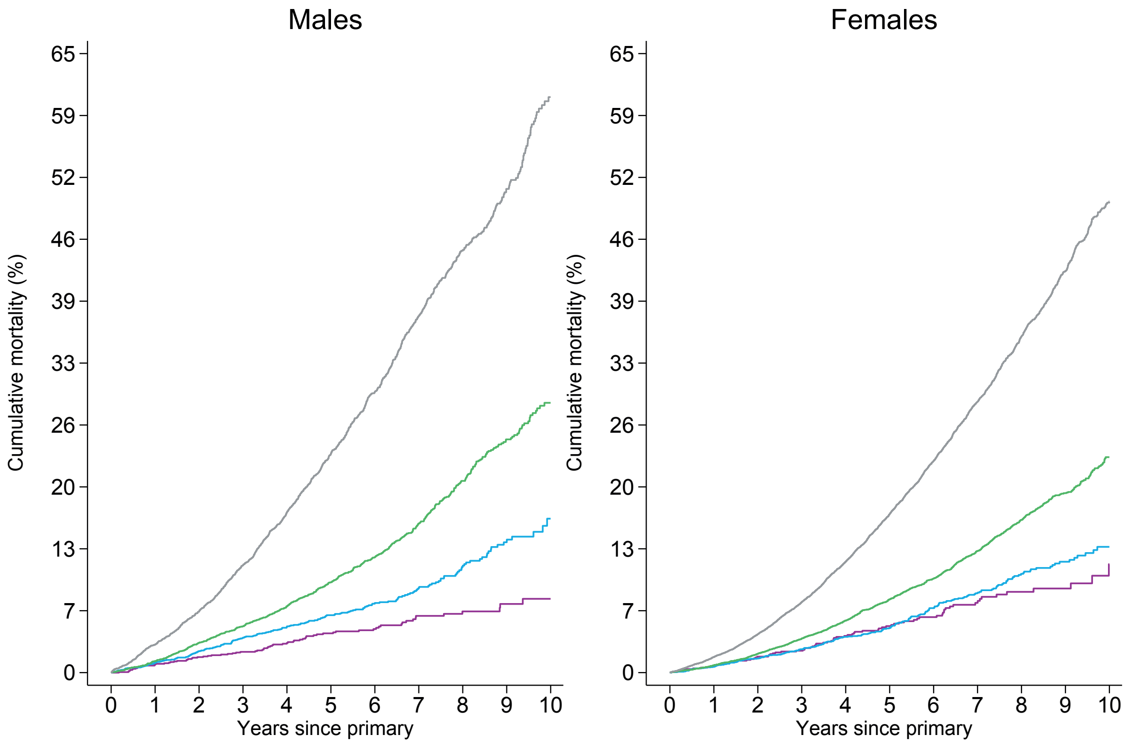
Figure 3.S12 and Table 3.S20 describe the mortality of patients receiving a primary shoulder replacement up to ten years following the primary procedure for all patients (Table 3.S20 only) and patients undergoing surgery for acute trauma and elective indications separately. Data is shown at 30 and 90 days following the primary procedure and then at 1, 3, 5, 7 and 10 years. Table 3.S20 indicates the importance of separating the data for patients receiving a primary shoulder replacement for acute trauma from the data for those with elective indications, due to the differences in the frailty of the patient population despite their similar age profile, see Table 3.S2 (page 285).

Figure 3.S13 KM estimates of cumulative mortality for primary elective shoulder replacement by gender.



Key:	Numbers at risk										
Female	39,049	34,775	30,839	27,836	22,587	17,781	13,303	9,298	5,989	3,188	1,104
Male	17,580	15,383	13,409	12,014	9,701	7,551	5,641	3,856	2,476	1,348	457

Figure 3.S14 KM estimates of cumulative mortality for primary elective shoulder replacement by age group and gender. *Blue italics in the numbers at risk table signify that 250 or fewer cases remained at risk at these time points.*



Key:

Numbers at risk – Males

Key	0	1	2	3	4	5	6	7	8	9	10
<55y	1,851	1,649	1,481	1,364	1,153	939	741	531	363	*218*	*89*
55 to 64y	3,404	2,989	2,594	2,333	1,910	1,520	1,174	830	556	310	*96*
65 to 74y	6,595	5,833	5,134	4,668	3,845	3,004	2,241	1,565	1,011	547	*187*
≥75y	5,730	4,912	4,200	3,649	2,793	2,088	1,485	930	546	273	*85*

Numbers at risk – Females

Key	0	1	2	3	4	5	6	7	8	9	10
<55y	1,366	1,250	1,141	1,066	915	766	624	444	296	*173*	*72*
55 to 64y	4,181	3,701	3,267	2,965	2,431	1,981	1,532	1,147	773	462	*180*
65 to 74y	14,174	12,831	11,467	10,500	8,629	6,909	5,259	3,771	2,496	1,352	472
≥75y	19,328	16,993	14,964	13,305	10,612	8,125	5,888	3,936	2,424	1,201	380

Table 3.S21 KM estimates of cumulative mortality (95% CI) for primary shoulder replacement for elective cases by gender and age group. *Blue italics signify that 250 or fewer cases remained at risk at these time points.*

Gender	Age at primary (years)	N	Time since primary 30 days	90 days	1 year	3 years	5 years	7 years	10 years
Female	All	39,049	0.09 (0.07-0.13)	0.25 (0.20-0.30)	1.17 (1.07-1.29)	5.30 (5.06-5.55)	11.64 (11.27-12.03)	19.70 (19.16-20.26)	33.91 (32.83-35.02)
	<55	1,366	0.07 (0.01-0.52)	0.22 (0.07-0.69)	0.68 (0.36-1.31)	2.30 (1.59-3.32)	4.89 (3.74-6.37)	7.33 (5.77-9.27)	*11.39 (8.25-15.61)*
	55 to 64	4,181	0.05 (0.01-0.19)	0.10 (0.04-0.26)	0.61 (0.41-0.91)	2.46 (1.99-3.03)	4.69 (3.98-5.52)	8.41 (7.31-9.66)	*13.21 (11.30-15.41)*
	65 to 74	14,174	0.06 (0.03-0.12)	0.19 (0.13-0.27)	0.76 (0.62-0.92)	3.59 (3.27-3.94)	7.69 (7.19-8.23)	12.78 (12.04-13.56)	22.62 (21.09-24.25)
	≥75	19,328	0.13 (0.09-0.19)	0.33 (0.26-0.42)	1.64 (1.46-1.83)	7.41 (7.01-7.83)	16.64 (16.01-17.29)	28.46 (27.55-29.39)	49.48 (47.70-51.29)
Male	All	17,580	0.16 (0.11-0.23)	0.37 (0.29-0.47)	1.70 (1.51-1.91)	6.41 (6.03-6.82)	12.55 (11.97-13.16)	20.19 (19.36-21.05)	33.41 (31.78-35.10)
	<55	1,851	0.00 (.-.)	0.06 (0.01-0.39)	0.86 (0.52-1.43)	2.18 (1.57-3.03)	4.12 (3.19-5.33)	5.96 (4.67-7.58)	*7.75 (5.85-10.23)*
	55 to 64	3,404	0.12 (0.04-0.31)	0.30 (0.16-0.55)	1.03 (0.73-1.45)	3.67 (3.03-4.44)	6.03 (5.15-7.07)	8.89 (7.64-10.33)	*16.17 (13.32-19.55)*
	65 to 74	6,595	0.06 (0.02-0.16)	0.21 (0.13-0.36)	1.21 (0.96-1.51)	4.86 (4.33-5.47)	9.48 (8.67-10.36)	15.66 (14.46-16.95)	*28.33 (25.90-30.94)*
	≥75	5,730	0.35 (0.23-0.54)	0.69 (0.50-0.94)	2.94 (2.52-3.43)	11.28 (10.40-12.22)	23.03 (21.71-24.42)	37.46 (35.62-39.36)	*60.43 (56.84-64.05)*

Table 3.S21, Figure 3.S13 and Figure 3.S14 describe the mortality of patients receiving a primary shoulder replacement up to ten years following the primary procedure by gender and age group of the patients undergoing surgery for elective indications only. Data are shown at 30 and 90 days following the index procedure in Table 3.S21 and then at 1, 3, 5, 7 and 10 years. Mortality differences between the genders are small and, while males have higher mortality within the first five years following surgery, mortality in the longer term appears more comparable, see Figure 3.S13. This is partly explained by differences in the age of male and female patients when they have their primary shoulder replacement. When mortality is further divided by age (see Figure 3.S14), it is clear that older males have higher mortality than older females, this pattern first becomes evident after the age of 65.

3.6.5 Conclusions

In this year's report, we provide extensive insight into the use and performance of shoulder constructs used in primary shoulder replacements and give a detailed description of revision rates by the indication for surgery. A detailed description of the longitudinal PROMs data collection is also provided for both elective and trauma patients.

The pattern of use of primary shoulder replacements has continued to be documented. In recent years, we have extensively revised shoulder implant data processing and, building on the recent internal and external validation, it is now possible to report at the level of the construct. This detailed level of reporting has led to new and interesting insights, but it has also highlighted some inconsistencies within data recorded in the registry, such as the unconfirmed procedures that are now reported. The volume of unconfirmed proximal humeral hemiarthroplasty is consistently low, and the volume of unconfirmed conventional total shoulder replacements has fallen since the start of the registry. However, the volume of unconfirmed reverse polarity total shoulder replacements is consistently high and has increased in recent years. The volume of unconfirmed reverse polarity total shoulder replacements is of concern as this now represents a significant proportion of all primary replacements. The lack of completeness hampers one of the core functions of the registry, which is to provide a comprehensive record of all implanted prostheses.

There are now 63,951 shoulder replacements eligible for analysis, after the application of our data cleaning processes. Patterns of use and the completeness of data are becoming clearer and revision rates out to ten years can be analysed. PROMs data continue to be collected so that patient outcomes in terms of pain and function can also be assessed alongside revision rates. It has previously been identified that some patients who have worse post-operative PROMs scores, i.e. a poor outcome, are not captured by the metric of revision surgery.

Confirmed reverse polarity total shoulder replacement made up 57.8% of all shoulder replacements in 2022 and the patterns of use observed in previous reports continue. This high level of use across indications indicates a growing confidence in this implant and a rapid change of practice in the NJR's operational geographical areas, despite limited high-level outcome evidence. Proximal humeral hemiarthroplasties, and to some extent conventional total shoulder replacements, are declining in numbers.

Revision rates this year do not alter the pattern observed last year. Revision rates in patients under the age of 55 years continue to be high and are now 10.6% and 9.3% in males and females respectively at five years. These revision figures should be addressed in clinical discussions with younger patients wishing to undergo shoulder replacement surgery.

At present, reverse polarity total shoulder replacement demonstrates the lowest revision rates at ten years. However, it is worth highlighting that these procedures have a higher early revision rate compared to stemmed conventional total shoulder replacements, until approximately three years following surgery. After three years the revision rate of stemmed reverse polarity shoulder replacements falls below stemmed conventional total shoulder replacements. The observed non-proportionality between conventional and reverse bearings combined with the differing indications between the two procedures does not necessarily mean that reverse polarity shoulder replacements should be favoured over conventional total shoulder replacement, particularly for indications that would normally indicate the latter.

More elective proximal humeral hemiarthroplasties are now being revised after the first year of surgery, with stemmed hemiarthroplasty seeming to outperform either resurfacing or stemless hemiarthroplasty. While it may be argued that the higher revision rate is mediated by the ease of the revision procedure, the PROMs data evidenced in this report do not support this. The change in PROMs score between the pre-operative and 6-month assessment following surgery suggests less improvement and that the group of patients that receive a humeral hemiarthroplasty report less positive outcome measures with the primary operation compared to others.

We suggest that more in-depth analysis which accounts for case mix should be conducted as, while the age and gender distribution is similar, the distribution of indications for which patients undergo proximal humeral hemiarthroplasty is different to that of either conventional total shoulder replacement or reverse polarity shoulder replacement, with a much higher proportion of patients indicating avascular necrosis. An in-depth analysis accounting for the variety of indications collected by the registry and other clinically relevant factors may help surgeons select different treatment modalities for patients.

This year we have presented a detailed description of PROMs data with reference to not only those who have responded, but the entire cohort of patients receiving a primary shoulder replacement. The pre-operative scores are administered and collected by units and our analysis demonstrates that unit compliance is poor. Better collection strategies need to be developed nationally to improve this low compliance. The post-operative shoulder PROMs are administered directly to patients on the NJR's behalf by their authorised contractor, NEC Software Solutions and consideration of how many people respond and the timing of when they respond is now also being addressed. The completeness of measures cross-sectionally and importantly from a longitudinal perspective and how this has changed across the years has been described. A pre-operative and 6-month matched elective cohort of 5,208 patients is now available for analysis but the representative nature of these data compared to the whole cohort is not clear. It illustrates, in those who completed the PROMs, that shoulder replacement surgery results in substantial improvement in both pain and function for patients. However, it is less clear how those who do not complete the PROMs fare, and the revision rate of those who do not respond to the PROMs questionnaires does appear to be different and higher, when it is compared to those who do respond.

The largest benefit gains by elective patients can be observed in those patients receiving a conventional total shoulder replacement, followed closely by those receiving a reverse polarity shoulder replacement, which is thereafter followed by those receiving a proximal humeral hemiarthroplasty.

Overall, in this section of the report we have shown that the volume of shoulder replacement surgery in the registry continues to grow rapidly and now presents an opportunity for outcomes to be assessed both by revision rates and by PROMs, although careful consideration of the latter in respect to its generalisability is required. Importantly, our new approach of whole construct validation using new classifications and component attributes will lead to more meaningful analysis and provision of useful information for patients, surgeons and other interested stakeholders.

3.7 NJR Supported Research

NJR Supported Research

The NJR encourages use of the registry dataset to answer research questions that add value to our knowledge about joint replacement practice, clinical performance, cost-effectiveness and patient safety.

Researchers use the data to analyse questions about outcomes in relation to particular underlying disease and patient comorbidity, as well as examine clinical and cost-effectiveness outcomes related to the implant prosthesis used. Over the last 12 months, 13 papers have been published using NJR data, covering a broad range of topics across the shoulder, hip, knee and ankle joints.

In this section we include brief summaries for three papers that have been published during the past year which illustrate the opportunities for external researchers to access and analyse the NJR dataset to answer questions about joint replacement outcomes. Each of them demonstrates the value of the use of these collected data to the orthopaedic community to ultimately improve patient outcomes.

During our 20th anniversary year, and in support of the BOA's spotlight on sustainability, we have also featured two short summaries from researchers who have focused on the challenges of climate change and on what can be done in the orthopaedic sector to recognise the impact surgery has had on the accumulation of waste and offer suggestions for action towards greater sustainability.

Further details all research publications using NJR data can be found in Appendix 4 at **reports.njrcentre.org.uk/downloads**.

3.7.1 What effect have NHS commissioners' policies for body mass index had on access to knee replacement surgery in England? An interrupted time series analysis from the National Joint Registry

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Introduction

Pathways to surgery across the NHS are increasingly incorporating 'health optimisation' interventions to encourage patients to lose excess weight, most commonly for hip and knee elective surgery pathways. The intended outcomes include a reduction in surgical procedures, improved safety, outcomes and recovery from surgery and taking the wider public health opportunity offered by the 'teachable moment' of surgery to trigger lasting lifestyle change. Despite National Institute for Health and Care Excellence (NICE) guidance to the contrary, 'health optimisation' policies with mandatory body mass index (BMI) thresholds are increasingly used to alter access to joint replacement surgery. Variation in policy use resulted from differing decisions by clinical commissioning groups (CCGs) in England. Policies range in severity from the provision of weight management advice to mandatory extra waiting periods or BMI thresholds for surgical referral.

Using data from the National Joint Registry (NJR), we modelled the impact introduction of these policies has had on trends in rates of elective knee replacement surgery and compared outcomes in areas with and without BMI policies.

Methods

Health optimisation policy information was available for 130 of the 181 CCGs in England in 2019, of which 74 (56.9%) had no policy (control CCGs), and 56 (43.1%) had a policy (intervention CCGs). Policy introduction dates ranged from mid-2013 to mid-2018. The study sample consisted of 481,555 patients aged 40+ years who had a primary total or unicompartmental knee replacement between January 2009 and December 2019 in one of the 130 CCGs, with osteoarthritis as a primary reason for surgery recorded in the registry. We used the index of multiple deprivation (IMD) score for the patient's residential area to categorise patients into quintiles of socioeconomic deprivation.

The primary outcome was the rate of provision of primary knee replacement for each CCG. For each annual quarter in each CCG, rates (expressed as per 100,000 persons) of surgery were determined by aggregating the number of eligible primary knee replacement procedures (numerator) and using the count of the population aged 40+ years living in each of these CCG localities in 2019 as the denominator. A single-segmented linear regression model provided an overall national estimate of the impact of health optimisation policy introduction in England. Stratifications of the trends in surgery data for the time series analyses were conducted by policy severity, BMI group, IMD category, and public versus privately funded operations. All statistical analyses were conducted using Stata/MP version 16.1.

Results

The interrupted time series analysis of pooled data for all intervention and all control CCGs with alignment of their policy start dates is presented in Figure 3.1. Before policy introduction both the intervention and control CCGs had an increasing trend in the rate of primary knee replacement surgery. Intervention CCGs had a higher rate of surgery than the control CCGs in any given quarter before policy introduction.

From the point of policy introduction, control group CCGs had no directional change in their trend; the rate of surgery continued to increase over time, although at a reduced rate (Table 3.1). In contrast, for the intervention CCGs, there was a reversal in trend at the point of policy introduction, which was sustained over time resulting in the mean rate of surgery becoming lower for intervention CCGs in any given quarter than for control CCGs.

Figure 3.1 Interrupted time series analyses of rate of knee replacement surgery per 100,000 population aged 40+ from pooled data for all intervention and control CCGs (n=130).

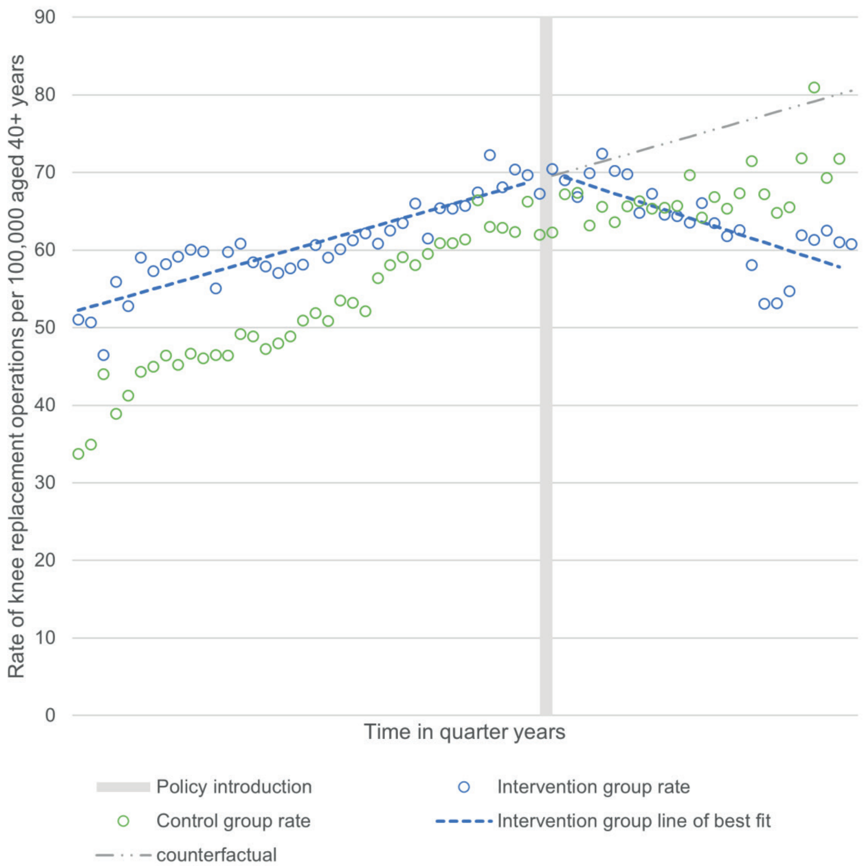

Table 3.1 Interrupted time series segmented linear regression and difference in difference analyses before and after policy introduction in intervention and control CCGs.

		Pre-policy introduction period			Policy introduction			Post-policy introduction period					
Outcome		Quarterly trend	95% CI		Level change	95% CI		Quarterly trend	95% CI		Change in quarterly trend compared to pre-intervention	95% CI	
Rate of knee replacement surgery in 100,000 population aged 40+ years	Intervention	0.46	0.36	0.55	1.30	-1.56	4.16	-0.52	-0.76	-0.29	-0.98	-1.22	-0.74
	Control	0.76	0.68	0.83	-2.97	-5.53	-0.42	0.34	0.17	0.50	-0.42	-0.57	-0.27
	Difference in differences; intervention rate minus control rate	-0.30	-0.40	-0.20	4.28	0.89	7.66	-0.86	-1.07	-0.65	-0.56	-0.76	-0.36

Table 3.1 presents the interrupted time series segmented linear regression model outputs for the control and intervention CCGs. There was strong evidence that there was a change in trend from the pre- to post-policy introduction period for the intervention CCGs: trend change -0.98 per quarter, 95% confidence interval (CI) -1.22 to -0.74, P<0.001. The difference-in-differences analyses results indicate that the rate of knee replacement operations decreased by an additional 0.56 (95% CI -0.76 to -0.36) operations per 100,000 aged 40+ per quarter in the intervention CCGs compared to the control CCGs.

There were significant changes in patient characteristics after policy introduction in intervention CCGs, indicating that there was a differential impact of policies on patient groups. Table 3.2 presents the patient characteristics in the CCGs at baseline, at 18-months post-policy introduction and at 3 years post-policy introduction. Post-policy introduction, patients in intervention CCGs were more likely to be: less deprived, higher American Society of Anesthesiologists (ASA) grade and privately funded.

Table 3.2 Operation rate and patient characteristics of intervention and control CCGs pre- and post- policy introduction.

	Control CCGs (no policy introduced during study period)			Intervention CCGs (policy introduced during study period)		
Operation and patient characteristics	baseline 18m pre	18m post	3y post	baseline 18m pre	18m post	3y post
	N=74	N=74	N=37	N=56	N=56	N=30
Knee replacement operations rate per 100,000 population aged 40+years per quarter (mean)	61.36	63.58	69.65	65.69	70.19	63.55
Age (mean)	69.35	69.42	68.85	69.86	69.82	69.94
Gender (% male)	41.8%	42.0%	39.9%	41.2%	42.4%	39.2%
BMI missing (%)	27.9%	20.8%	22.2%	23.9%	21.5%	22.9%
BMI (mean kg/m^2)	31.23	30.82	31.05	31.12	30.76	30.76
Underweight: BMI below 18 kg/m^2 (%)	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
Healthy weight: BMI 18 to 24.9 kg/m^2 (%)	8.9%	10.2%	9.7%	10.7%	9.1%	9.1%
Overweight: BMI 25 to 29.9 kg/m^2 (%)	33.0%	33.4%	31.9%	33.2%	35.0%	35.3%
Obese category 1: BMI 30 to 34.9 kg/m^2 (%)	32.2%	32.1%	30.9%	32.3%	32.3%	31.9%
Obese category 2: BMI 35 to 39.9 kg/m^2 (%)	17.7%	17.9%	18.4%	16.1%	17.7%	15.6%
Obese category 3: BMI 40+ kg/m^2 (%)	8.2%	6.3%	9.1%	7.7%	5.9%	8.1%
Independently funded surgery (%)	8.9%	10.3%	8.3%	11.1%	12.5%	13.8%
ASA* Grade (mean)	2.10	2.14	2.14	2.08	2.14	2.11
1 – normal health (%)	8.4%	6.9%	7.9%	8.7%	7.4%	8.2%
2 (%)	73.7%	72.3%	70.8%	74.7%	71.1%	72.6%
3, 4 or 5 – poorest health (%)	17.8%	20.8%	21.4%	16.7%	21.5%	19.3%
Index of Multiple Deprivation (mean score)	16026	16158	15787	18979	18919	19728
Least deprived 20%	17.5%	17.4%	17.9%	25.6%	24.7%	29.5%
Less deprived 20-40%	19.3%	21.3%	18.6%	25.2%	25.4%	23.8%
Mid 20% deprived	21.3%	20.0%	18.9%	22.1%	22.5%	20.9%
More deprived 20-40%	24.0%	22.5%	25.3%	16.3%	16.4%	16.8%
Most deprived 20%	17.8%	18.8%	19.3%	10.8%	11.1%	8.9%

*American Society of Anesthesiologists.

Discussion

Introduction of a BMI health optimisation policy for knee replacement surgery is associated with a significant downward trend in rate of knee operations, with a 14.1% reduction in the rate of surgery after 3 years compared to what would have been expected. After policy introduction, patients receiving surgery are more likely to be affluent, independently funded and have a higher comorbidity score (ASA grade).

A reduction in the rate of surgery may represent a decrease in need for surgery, inappropriate restriction in access to surgery, or a combination of both. Qualitative investigation into patients' experiences will be necessary to understand the mechanism of effect, however evidence shows >10% weight loss is needed for substantial symptom improvement in knee osteoarthritis and so the reduction in rate of surgery seen here is unlikely to be accounted for through weight loss alone. The policies may have prevented access to surgery for patients in need of surgery, but who were unable or unwilling to lose sufficient weight to reach eligibility thresholds.

Despite National Institute for Health and Care Excellence (NICE) guidance stating that obesity should not preclude referral to surgery in osteoarthritis, CCG referral criteria are inconsistent in respect of NICE guidance. There is no consistent evidence that patients with obesity have substantially worse outcomes from joint replacement surgery nor that weight loss before joint replacement surgery has any effect on infection or readmission rates. The need for surgery is higher in patients of lower socioeconomic status, and evidence that BMI eligibility criteria for joint replacement may worsen racial and socioeconomic disparities has been reported previously. Data from this study show rates decreased most in more deprived groups.

Conclusion

In summary, our study has reported strong evidence that commissioning policies for body mass index that alter access to surgery for knee replacement are followed by a reduction in the rate of surgery, though the mechanism for this reduction is not yet understood. Stratification of data in this study suggests that the policies may be worsening health inequalities by reducing the number of operations provided to socioeconomically deprived patients as well as driving patients towards independently-funded surgery.

3.7.2 How long do revised and multiply revised hip replacements last? A retrospective observational study of the National Joint Registry

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Background

Hip replacements are common and effective operations but patients that undergo this intervention are at risk of the replacements failing, requiring costly and often complex revision surgery with poorer outcomes than primary surgery. For patients to make informed choices they need to understand the entire patient pathway from intervention to death. However, there is paucity of reliable data examining the treatment pathway for hip replacements over the life of the patient in terms of risk of revision and re-revisions. Using data from the largest joint replacement database in the world, we aimed to ascertain how long revision hip replacements last and how long each subsequent revision lasts before having repeat revision.

Methods

We collected data on hip replacement revision procedures gathered in the National Joint Registry from hospitals in England and Wales, between April 2003 and Dec 2019. The data were cleaned using standard methods (see published manuscript). Our inclusion criteria were all first revisions, with an identifiable primary procedure, with osteoarthritis as the sole indication for the original primary procedure. From this we split our remaining population into two distinct groups: firstly, all total hips with osteoarthritis as the sole indication for the primary procedure, and secondly, all hip resurfacing primaries with osteoarthritis as the sole indication for the primary.

We used Kaplan-Meier estimates to describe the cumulative probability of revision hip replacement in all cases where we could find a link between a known primary operation and subsequent revision of the same side hip (left or right). All data were censored at date of death or at the end of the study period (Dec 31, 2019). Kaplan-Meier estimates of the survivorship were produced for the first revision, the second revision (i.e. the re-revision) and the third revision (i.e. the second re-revision).

We also produced Kaplan-Meier estimates with 95% CI, stratified by age (grouped as younger than 55 years, 55 to 64 years, 65 to 74 years, and 75 years and older) and gender, as well as estimates of the survivorship of the first revision stratified by the time interval between the primary operation and the first revision, and the survivorship of the second revision stratified by the time interval between first and second revision. All analyses were done using Stata/SE (version 15.1).

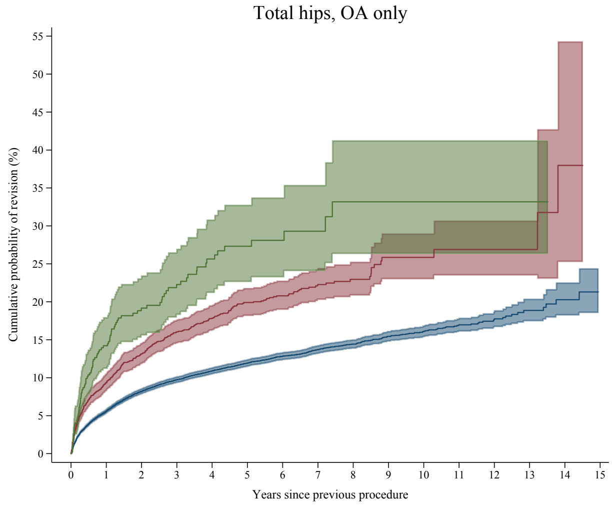
Results

The 2020 National Joint Registry annual report cohort consisted of 1,191,253 primary hip replacements. In this cohort 1,090,244 (91.5%) of the primary procedures listed osteoarthritis as an indication for surgery, with 1,052,601 (88.4%) stating osteoarthritis as the sole indication for the primary procedure. We identified 34,978 first documented revisions, with a linked primary procedure in the data. Of these, 5,968 had an unknown hip type at primary replacement, or listed an indication for primary replacement other than osteoarthritis and were thus excluded from the analysis. This gave us 29,010 first linked revisions in our analysis, of which 25,082 (86.5%) were after total hip replacements and 3,928 (13.5%) were after hip resurfacings.

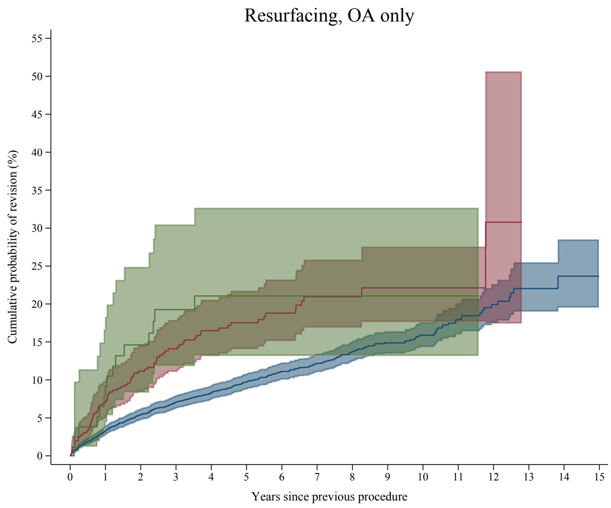
Out of the revisions of the total hip replacement population with a linked primary, 2,712 (10.8%) of the first revisions were subsequently re-revised (second revision), with 453 (1.8%) going on to have a third revision. In the hip resurfacing population, 457 (11.6%) of the first revisions were subsequently re-revised (second revision), with 79 (2.0%) going on to have a third revision. The total hip replacement group were on average ten years older than the resurfacing population at time of first revision (mean age 70.2 years [SD 10.6] versus 59.8 [9.0]). Revisions in the resurfacing group were more likely to be single-stage procedures than in the total hip replacement group, as were second revisions and third revisions.

Figure 3.2 (page 336) shows that 21.3% (95% CI 18.6–24.4) of first revisions (second prosthetic hip) after initial primary total hip replacement were revised (to third prosthetic hips) within 15 years. Whereas 22.3% (20.3–24.4) of second revisions (third prosthetic hips) were revised (to fourth prosthetic hips) within seven years, and 22.3% (18.3–27.0) of third revision (fourth prosthetic hip) were revised (to fifth prosthetic hips) within three years. There was a similar trend in the resurfacing study population.

Figure 3.2 Kaplan-Meier estimates of cumulative revision in patients with linked primary hip replacements by first revision, second revision, and third revision.



Key, with N of subsequent revision:	Numbers at risk															
First revision (N=2712)	25082	20601	17332	14573	12080	9710	7581	5704	3853	2467	1581	927	524	250	113	35
Second revision (N=453)	2712	2066	1675	1321	1077	825	638	437	266	148	82	36	22	16	8	4
Third revision (N=99)	453	316	233	188	138	98	61	41	28	17	7	3	2	1	0	0



Key, with N of subsequent revision:	Numbers at risk															
First revision (N=457)	3928	3594	3274	2961	2669	2374	2043	1661	1179	783	521	334	193	83	42	12
Second revision (N=79)	457	393	345	300	257	215	168	128	78	42	27	19	6	1	1	1
Third revision (N=15)	79	68	56	47	40	26	18	10	7	4	3	1	0	0	0	0

Note: Populations not mutally exclusive; second and third revision are a subset of the first revision population

Survivorship of the first revision was similar in males and females for both study populations as shown in Table 3.3. A similar pattern was seen for males and females in revision rates for second and third revisions. Re-revision was higher in younger patients, in both males and females.

Table 3.3 Kaplan-Meier estimates of cumulative re-revision in both study populations, stratified by sex and age.

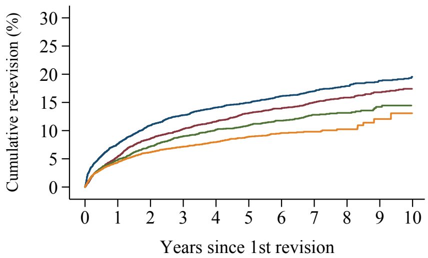
Age group (years)	Hip type	N (%)	Time since first revision						
			1 year	3 years	5 years	7 years	10 years	13 years	15 years
All cases	Total hips	25,082 (100%)	5.58 (5.30-5.88)	9.73 (9.34-10.14)	11.92 (11.47-12.39)	13.70 (13.18-14.24)	16.09 (15.38-16.83)	18.87 (17.48-20.36)	21.31 (18.57-24.38)
	Resurfacing	3,928 (100%)	3.26 (2.74-3.87)	7.05 (6.27-7.94)	9.75 (8.79-10.80)	12.19 (11.07-13.40)	15.89 (14.37-17.55)	22.05 (19.04-25.45)	23.67 (19.57-28.47)
Females	Total hips	14,016 (55.9%)	5.45 (5.08-5.85)	9.58 (9.07-10.12)	11.60 (11.02-12.22)	13.39 (12.71-14.10)	15.60 (14.69-16.57)	*19.24 (17.18-21.52)*	*20.83 (17.97-24.07)*
	Resurfacing	1,929 (49.1%)	3.03 (2.35-3.92)	6.80 (5.72-8.07)	9.90 (8.56-11.43)	12.40 (10.84-14.17)	*15.58 (13.54-17.89)*	*21.23 (16.90-26.48)*	*25.17 (17.58-35.25)*
Female (<55)	Total hips	1,017 (4.1%)	6.77 (5.36-8.52)	11.69 (9.79-13.94)	15.21 (12.96-17.80)	17.72 (15.16-20.65)	*21.56 (18.12-25.53)*	*26.33 (21.01-32.71)*	*26.33 (21.01-32.71)*
	Resurfacing	513 (13.1%)	3.91 (2.54-6.00)	8.74 (6.58-11.57)	14.40 (11.56-17.86)	17.24 (14.08-21.01)	*20.76 (17.03-25.19)*	*27.05 (20.32-35.46)*	..
Female (55 to 64)	Total hips	2,522 (10.1%)	5.28 (4.47-6.25)	11.12 (9.89-12.49)	13.34 (11.96-14.86)	14.98 (13.46-16.65)	17.38 (15.53-19.43)	*23.03 (18.43-28.55)*	*25.11 (19.40-32.13)*
	Resurfacing	875 (22.3%)	3.17 (2.18-4.59)	6.03 (4.60-7.88)	8.30 (6.57-10.46)	10.81 (8.74-13.33)	*13.06 (10.59-16.05)*	*18.86 (13.53-25.96)*	*23.93 (14.74-37.44)*
Female (65 to 74)	Total hips	5,112 (20.4%)	5.28 (4.69-5.94)	9.81 (8.98-10.72)	11.88 (10.93-12.91)	13.46 (12.38-14.62)	15.71 (14.23-17.32)	*17.24 (14.87-19.94)*	*19.21 (15.12-24.25)*
	Resurfacing	481 (12.2%)	2.15 (1.16-3.97)	6.47 (4.47-9.32)	*7.76 (5.50-10.91)*	*9.54 (6.85-13.21)*	*16.07 (9.58-26.28)*	*16.07 (9.58-26.28)*	..
Female (≥75)	Total hips	5,365 (21.4%)	5.41 (4.82-6.07)	7.95 (7.20-8.77)	9.35 (8.48-10.30)	11.26 (10.15-12.48)	*12.44 (10.99-14.07)*	*15.59 (12.32-19.62)*	*15.59 (12.32-19.62)*
	Resurfacing	60 (1.5%)	*0*	*2.63 (0.37-17.25)*	*2.63 (0.37-17.25)*	*2.63 (0.37-17.25)*	..	..	..
Males	Total hips	11,066 (44.1%)	5.76 (5.33-6.22)	9.93 (9.34-10.55)	12.34 (11.65-13.06)	14.11 (13.32-14.95)	16.75 (15.64-17.92)	*18.41 (16.73-20.24)*	*22.44 (17.04-29.23)*
	Resurfacing	1,999 (50.9%)	3.47 (2.75-4.39)	7.30 (6.20-8.59)	9.58 (8.28-11.08)	11.96 (10.43-13.69)	16.19 (14.02-18.65)	*22.72 (18.63-27.55)*	*22.72 (18.63-27.55)*
Male (<55)	Total hips	977 (3.9%)	5.29 (4.03-6.92)	11.85 (9.87-14.19)	16.21 (13.79-19.01)	18.74 (15.98-21.93)	*20.44 (17.31-24.05)*	*22.25 (17.87-27.51)*	*29.32 (17.86-45.77)*
	Resurfacing	539 (13.7%)	3.39 (2.15-5.33)	9.22 (7.01-12.09)	12.74 (10.06-16.07)	16.83 (13.65-20.65)	*20.78 (17.01-25.27)*	*24.25 (18.67-31.16)*	*24.25 (18.67-31.16)*
Male (55 to 64)	Total hips	2,276 (9.1%)	5.58 (4.70-6.63)	10.33 (9.09-11.74)	13.32 (11.85-14.96)	15.63 (13.94-17.50)	*18.95 (16.59-21.61)*	*20.96 (17.39-25.15)*	*27.55 (16.96-42.82)*
	Resurfacing	792 (20.2%)	3.58 (2.49-5.15)	6.37 (4.84-8.37)	8.91 (7.01-11.29)	10.37 (8.26-12.99)	*14.94 (11.77-18.86)*	*24.61 (18.18-32.82)*	*24.61 (18.18-32.82)*
Male (65 to 74)	Total hips	3,922 (15.6%)	5.83 (5.12-6.63)	9.87 (8.91-10.92)	12.24 (11.13-13.45)	13.66 (12.42-15.01)	16.40 (14.75-18.22)	*18.27 (15.83-21.05)*	*18.27 (15.83-21.05)*
	Resurfacing	571 (14.5%)	3.43 (2.20-5.33)	6.70 (4.82-9.27)	7.25 (5.27-9.95)	*9.16 (6.73-12.42)*	*11.95 (8.26-17.14)*	*13.83 (9.16-20.59)*	*13.83 (9.16-20.59)*
Male (≥75)	Total hips	3,891 (15.5%)	5.91 (5.18-6.73)	9.05 (8.10-10.10)	10.18 (9.11-11.36)	11.62 (10.30-13.11)	*13.44 (11.39-15.82)*	*13.44 (11.39-15.82)*	..
	Resurfacing	97 (2.5%)	*3.17 (1.03-9.52)*	*7.02 (3.20-15.05)*	*7.02 (3.20-15.05)*	*7.02 (3.20-15.05)*	*38.02 (8.55-92.27)*	..	..

Note: Blue italics represent estimates where the number at risk has fallen to 250 or fewer cases. Blank cell indicates that the number at risk has fallen below 10, thus estimates have been removed as they would be highly unreliable.

Figure 3.3 shows the trend between cumulative revision and the time interval between the previous two episodes. Generally, the longer the previous prosthesis was in situ the lower the subsequent revision rate. This is seen in both study populations, for survivorship of the first revision (second prosthetic hip) and the second revision (third prosthetic hip).

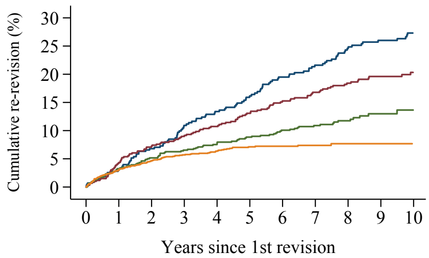
Figure 3.3 Kaplan-Meier estimates of cumulative probability of revision by time between previous revision episodes, in patients with linked primary hip replacements, stratified by total hip replacements and resurfacing.

Total hip, OA only. Survivorship of 1st revision (2nd prosthetic hip)



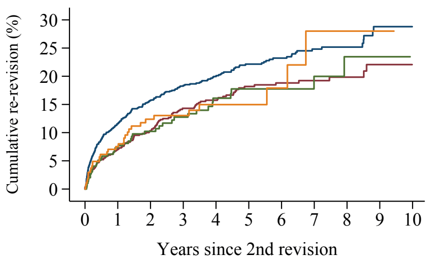
Time between previous episodes	Numbers at risk										
<1 year	6992	5750	4877	4136	3478	2839	2269	1849	1401	1018	739
1 to 3 years	5169	4435	3899	3414	2991	2545	2146	1768	1366	961	618
3 to 5 years	3775	3256	2899	2557	2263	1967	1651	1231	748	369	193
≥5 years	9146	7160	5657	4466	3348	2359	1515	856	338	119	31

Resurfacing, OA only. Survivorship of 1st revision (2nd prosthetic hip)



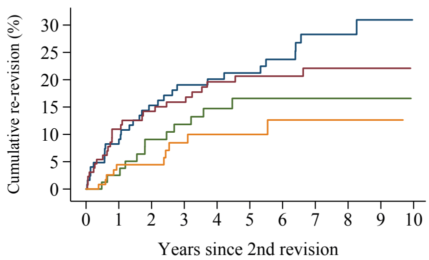
Time between previous episodes	Numbers at risk										
<1 year	431	414	391	365	350	329	310	296	273	247	213
1 to 3 years	600	570	541	522	503	478	459	428	377	286	204
3 to 5 years	742	711	691	671	642	611	574	490	341	188	88
≥5 years	2155	1899	1651	1403	1174	956	700	447	188	62	16

Total hip, OA only. Survivorship of 2nd revision (3rd prosthetic hip)



Time between previous episodes	Numbers at risk										
<1 year	1325	985	791	626	519	408	329	233	142	85	48
1 to 3 years	808	650	554	447	377	297	236	156	101	53	28
3 to 5 years	300	243	193	150	112	79	52	36	20	9	6
≥5 years	279	188	137	98	69	41	21	12	3	1	

Resurfacing, OA only. Survivorship of 2nd revision (3rd prosthetic hip)



Time between previous episodes	Numbers at risk										
<1 year	124	107	92	83	75	65	54	41	29	20	15
1 to 3 years	131	111	103	92	81	72	62	51	38	16	10
3 to 5 years	80	76	68	64	51	36	27	21	8	5	2
≥5 years	122	99	82	61	50	42	25	15	3	1	

Discussion

In this study, we showed that if the primary hip resurfacing or primary total hip replacement undergoes a first revision to a second prosthetic hip, there is an approximate 20% chance that this will be revised within 15 years requiring a second revision (implantation of a third prosthetic hip). The second revision has an approximate 20% chance of needing a third revision within seven years (a fourth prosthetic hip) which in turn has an approximate 20% chance of undergoing a fourth revision (fifth prosthetic hip) within three years. Furthermore, the longer the primary prosthetic hip lasts, the longer the first revision (second prosthetic hip) is likely to last, although the risk of needing further revision is higher in younger patients.

Patients and surgeons thus need to understand that even though hip replacements are excellent at improving pain and function[1] and usually last a remarkably long time, if they are revised, successive replacements (revision procedures) are progressively and markedly less successful. We should therefore make every effort to aim for a strategy of one replacement to last a lifetime to optimise patient outcome, reduce the treatment burden on patients, and to reduce the high costs associated with performing revision hip replacements.

To decide whether to undergo intervention, patients need the best possible information regarding their individual risk of needing to have further intervention in the future. We have highlighted that younger patients need to be made aware that they are at higher risk of multiple revisions. Approximately 20% of first revision will be replaced within 15 years compared with seven years for second revision and three years for third revisions. Patients should also be counselled that if they do have a revision, they are more likely to need re-revision after this than they were after a primary procedure and that the period that subsequent revisions last approximately halves each time a hip is revised.

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3.7.3 How long do ankle replacements last? A data linkage study using the National Joint Registry and Hospital Episode Statistics Datasets

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Bone Joint J. 2023 Mar 1;105-B(3):301-306.

https://doi.org/10.1302/0301-620X.105B3.BJJ-2022-0806.R1

Introduction

The surgical treatment of end-stage ankle arthritis includes ankle fusion (AF) and total ankle replacement (TAR). Despite the increased numbers of ankle replacements being performed there is a shortage of long-term data on survivorship. The National Joint Registry (NJR) for England, Wales and Northern Ireland has been collecting data on ankle replacements since 2010 and now has the world's largest dataset of ankle replacements, but relies on self-reporting of failures. Unlike hip or knee replacements which are most usually revised to another joint replacement, with ankles revision can commonly be to joint fusion or even to below knee amputation.

Both the NJR and the British Orthopaedic Foot & Ankle Society have stated that there may be under-reporting of revisions to the NJR and hence by linking NJR data with Hospital Episode Statistics (HES), our aim was to determine the actual survival rates of ankle replacements over the last decade. We aimed to compare survivorship between NJR data and data linked with HES. In addition, we aimed to analyse differences in survivorship across implant types.

Methodology

NJR and HES data linkage

A data linkage study was undertaken by combining NJR data and the HES dataset. Data linkage was performed on prospectively collected data from the NJR and data from HES.

Codes used to determine failure of ankle replacement

The primary outcome of failure was defined as the removal or exchange of any components of the implanted device inserted during the primary ankle replacement procedure. This included single-stage revision, exchange of polyethylene, first stage of two-stage revision, second stage of two-stage revision, conversion of TAR to arthrodesis and conversion of TAR to amputation. A failure was recorded if a failure was found in either the NJR or the HES dataset. For cases of two-stage surgery, the date of failure was determined by the date of first stage of operation.

Statistical analysis

Statistical analyses were undertaken using Stata (Version 15). Kaplan-Meier survival charts demonstrated survivorship. Cox proportional hazards regression models with the Breslow method for ties were fitted to compare failure rates of different ankle replacements that had been performed in over 100 cases. A multivariable model was fitted adjusting for potential confounding risk factors of failure with the Infinity implant used as reference. Hazard ratios (HR) for individual implants were estimated and 95% confidence intervals (CI) and p values are reported.

Results

A total of 5,562 primary ankle replacements were recorded in the NJR data between 1st April 2010 and 31st December 2018. To ensure a minimum of 1 year follow-up linkage analysis continued until 31st December 2019. The linked data showed unadjusted 1-year survival of ankle replacements of 98.8% (95% CI 98.4%-99.0%). The 3-year survival in 4,318 patients was 94.2% (95% CI 93.5%-94.9%), the 5-year survival in 2,725 patients was 90.2% (95% CI 89.2%-91.1%), and the 10-year survival in 199 patients was 86.2% (95% CI 84.6%-87.6%). The survival of linked data was found to be 0.4% lower than NJR data at 1 year, 2.2% lower than NJR at 3 years, 3.3% lower than NJR data at 5 years and 4.7% lower than NJR at 10 years (see Table 3.4 on page 341).

Table 3.4 Life table of survivorship of primary ankle replacements based on NJR and linked data.

Implant	1-year survival (N=5562)	3-year survival (N=4318)	5-year survival (N=2725)	7-year survival (N=1605)	10-year survival (N=199)
NJR data	99.2% (99.0-99.4)	96.4% (95.8-96.9)	93.5% (91.8-93.5)	92.1% (91.1-93.0)	90.9% (89.5-92.1)
Linked data	98.8% (98.4-99.0)	94.2% (93.5-94.9)	90.2% (89.2-91.1)	88.1% (86.9-89.2)	86.2% (84.6-87.6)
Difference	-0.4%	-2.2%	-3.3%	-4.0%	-4.7%

Of the 5,562 implants in the NJR data 290 (5.2%) had failed according to NJR and 430 (7.7%) had failed on the linked data. Therefore 140 (33%) TAR failures appear not to have been reported to the NJR using an A2 (revision) form. When a primary ankle replacement failed, 66.7% were converted to a revision ankle replacement, 30.5% were converted to a fusion and 2.8% underwent a below knee amputation. When we separately analysed the failures that were not recorded on an NJR A2 form, we found that 20.9% of revision ankle replacements were not recorded, 51.9% of conversion to ankle fusion and 100% of amputations were not recorded.

Fixed versus mobile bearing implants

There were 4,011 mobile bearing implants and 1,549 fixed bearing implants. The 1-year survival of fixed bearing implants was 99.0% (95% CI 98.3-99.4) and mobile was 98.7% (95% CI 98.3-99.9). The 5-year survivorship for fixed bearing implants was 94.3% (95% CI 91.3-96.3) compared to 89.4% (95% CI 88.3-90.4) for mobile bearing implants. The hazard ratio of failure for mobile versus fixed bearing was 2.92 (95% CI 1.94-4.40) (P<0.001).

Implant survival by implant

A Cox regression model adjusting for age, gender, BMI, deformity, previous infection, ASA, CCI, indication for primary replacement, alignment, presence of subtalar joint stiffness, and range of motion for all implants with over 100 procedures, demonstrated that compared to the best surviving implant (Infinity), only the STAR (HR 1.60 95% CI 0.87-2.96) and INBONE (HR 0.38 95% CI 0.05-2.84) did not have a statistically significantly worse survivorship. The BOX (HR 3.27 95% CI 1.97-5.42), Hintegra (HR 2.43 95% CI 1.32-4.42), Mobility (HR 3.55 95% CI 2.23-5.66), Salto (HR 3.02 95% CI 1.72-5.32) and Zenith (HR 2.75 95% CI 1.70-4.46) all had an increased risk of failure relative to the Infinity Implant (see Table 3.5 on page 341).

Table 3.5 Survivorship of different brands of ankle replacements. *Data where fewer than 100 implants are at risk are shown in blue italics.*

Implant	N	1-year survival	N	3-year survival	N	5-year survival	N	7-year survival	N	10-year survival
Akile	*34*	*1*	*22*	*96.36 (76.88-99.48)*	*4*	*96.36 (76.88-99.48)*				
Box	683	98.38 (97.09-99.10)	536	93.10 (90.72-94.88)	293	86.52 (82.80-89.48)	115	84.10 (79.32-87.85)	*10*	*84.10 (79.32-87.85)*
Cadence	*24*	*1.00 (1.00-1.00)*	*8*	*1.00 (1.00-1.00)*						
Hintegra	297	98.98 (96.88-99.67)	268	95.39 (92.19-97.30)	205	92.57 (88.52-95.23)	*96*	*89.62 (84.45-93.14)*	*7*	*84.35 (74.07-90.80)*
INBONE	127	1 (1.00-1.00)	*89*	*1 (1.00-1.00)*	*31*	*97.83 (85.55-99.69)*	*7*	*97.83 (85.55-99.69)*		
Infinity	1362	99.01 (98.30-99.42)	726	96.97 (95.61-97.92)	117	94.26 (89.87-96.78)				
Mobility*	1116	98.20 (97.23-98.84)	1048	91.79 (90.02-93.26)	973	87.17 (85.04-89.01)	802	85.10 (82.81-87.10)	122	84.04 (81.55-86.22)
Rebalance	*60*	*98.31 (88.57-99.76)*	*57*	*96.40 (86.31-99.09)*	*33*	*93.96 (82.15-98.04)*	*23*	*93.96 (82.15-98.04)*		
Salto	315	97.45 (94.97-98.72)	285	92.75 (89.20-95.17)	209	87.82 (83.30-91.18)	105	85.44 (80.05-89.46)	*10*	*85.44 (80.05-89.46)*
STAR	530	99.03 (97.68-99.59)	399	96.72 (94.59-98.02)	218	94.70 (91.70-96.64)	*86*	*92.09 (86.54-95.41)*	*7*	*81.49 (64.95-90.74)*
Zenith	1006	99.20 (98.41-99.60)	872	93.79 (92.04-95.17)	640	90.85 (88.68-92.61)	369	89.14 (86.60-91.22)	*43*	*86.79 (83.42-89.51)*

*Withdrawn June 2014.

Discussion

We believe this to be the largest study of the survivorship of ankle replacements to date in which we demonstrate a 5-year survival rate of ankle replacements of 90.2%. The differences between the NJR and the HES datasets suggests that up to one-third of A2 forms are not completed or submitted to the NJR when an ankle replacement fails and is revised. Our data suggest that a higher proportion of revisions to fusion were recorded in the patients where no NJR A2 form was submitted and hence this would support the notion that surgeons may not be completing the NJR A2 form for conversions of a primary ankle replacement to fusion.

This study found that approximately two-thirds of ankle replacements that failed were revised to another replacement, and a third converted to fusion. This contrasts with the data from the Swedish Ankle Registry that demonstrated 62.8% of failures were converted to a fusion, and only 37.2% converted to a revision ankle replacement. This difference may be due to the introduction of revision implants to the market over the last 5 years.

Our study shows that fixed bearing implants have better survivorship than mobile bearing implants at 5 years. It is important to point out that the STAR implant, despite being a mobile bearing implant, shows good survivorship in our study as did some other mobile bearing implants but the numbers at risk are too small to be meaningfully interpreted.

The NJR is the world's largest dataset on ankle replacements. We show that despite reporting being a mandated requirement, approximately one-third of failed ankle replacements have not been reported using current methods. This highlights the importance of accurate completion of surgical data collection. The current most used implants for ankle replacements are demonstrating improved survivorship compared to those that have been withdrawn from the market. Longer term follow-up will be required to ensure that this continues.

Conclusion

Ankle replacements have 5-year survival rates of 90.2%. One-third of failures are not reported. Fixed bearing implants have demonstrated higher survivorship than mobile bearing implants. There are differences in survival between implants.

3.7.4 NJR/BOA Sustainable Surgery Fellowships 2023-2024

Climate change is undeniable and poses the greatest risk to human health in the 21st century[1]. Action is urgently needed to tackle the climate and health emergency before us and sustainability must be embedded in all our practices within healthcare to help achieve these targets. As of July 2022, the NHS is committed to achieving a 'net zero' carbon footprint by 2045[2], however the NHS currently produces in excess of 500,000 tonnes of waste and 25 mega-tonnes of CO_2 annually[3,4] equating to over one-third of the United Kingdom's public sector emissions. The NJR and BOA have appointed two sustainable surgery fellows, supporting the development of more sustainable practices in orthopaedic surgery (and joint replacement in particular), whose work and future plans are outlined below.

The environmental impact of total hip and knee replacement and the effects of real-time waste segregation

Rohan Prakash, Deborah Eastwood, Mike Reed, Yuvraj Agrawal

Background

Surgery is three- to six-times more energy intense than the work of any other department within a hospital[5] and within orthopaedics, joint replacement has been shown to generate the greatest amount of waste per case compared to other sub-specialties[6]. Operating room waste is segregated into different streams which are either recycled, disposed of to landfill sites, or undergo costly and energy-intensive incineration processes[3]. Currently, very limited data on waste generation from lower limb joint replacement exists. The available data highlight a disappointingly low proportion of waste being recycled, despite a large proportion of waste generated being potentially recyclable materials, including plastics[7-9]. We sought to quantify and define the waste generated from primary hip and knee replacements in the United Kingdom, and subsequently identify and implement strategies to reduce the carbon footprint.

Pilot data

A waste audit of 15 primary total hip replacement (THR) and 16 primary total knee replacement (TKR) cases was conducted between April and July 2022 at The Royal Orthopaedic Hospital NHS Trust, a tertiary orthopaedic hospital. Waste was categorised into: general, hazardous, recycling, sharps, and linens. Waste bin-liners in each category were weighed at the completion of each case. Items disposed of as general waste were also catalogued for a sample of ten THR and ten TKR cases, with recyclability of items determined based on packaging labels.

Average total waste generated for THR and TKR was 14.46kg and 17.16kg respectively. Only 2.9% (0.42kg) of waste was recycled in THR and just 5.4% (0.93kg) in TKR cases. Hazardous waste made up the largest proportion for both THR (73.4%) and TKR (69.2%). General (non-hazardous) waste made up 11.3% and 15.1% of total waste for THR and TKR. In the general waste, despite predominantly plastic packaging, only two items were labelled as recyclable.

Based on these results, we estimated over 3.1 million kg of waste is generated from all primary hip and knee replacement cases annually in England, Wales and NI. The hazardous waste stream made up the largest proportion, though previous studies suggest that a significant proportion of this is often misallocated[10,11]. Hazardous waste is estimated to generate 569-1074 kg CO_2e/t, compared to 21-65 kg CO_2e/t for recyclable waste[12].

Effect of real-time waste segregation

A further study was conducted at the same hospital with the aim to investigate the potential environmental benefits of diligent waste segregation. Our trust's waste management lead was invited to theatre to help assess and categorise the waste produced, and thereafter helped to set up the optimum waste segregation strategy according to the current trust and local waste disposal policy. The majority of packaging was deemed unsuitable for recycling locally due to the heterogeneity of plastics and lack of clear labelling as recyclable. Between February and April 2023, for ten primary hip and ten primary knee replacement cases, an un-scrubbed team member actively segregated waste into the appropriate streams in real-time and the different streams were weighed. The study demonstrated a 17.2% (1.83kg) and 21.1% (2.51kg) reduction in hazardous waste generation for THR and TKR cases respectively. Overall mean waste produced was reduced to 13.59kg (94%) and 14.87kg (87%) for those THR and TKR cases.

Future work

Preliminary data from this study illustrate the significant impact of diligent waste segregation at a single hospital centre. The study also highlighted the need for suppliers of medical devices and implants to utilise recyclable packaging and to drastically improve labelling. Currently, none of the implant packaging from even the major suppliers has any information on the recyclability of the packaging.

Our next step is to generate large-scale data from multiple hospital centres to more accurately quantify waste generation from primary hip and knee replacement taking into account varying practices across trusts nationally. With support from the NJR, BOA and trainee Collaborative Orthopaedic Research Network (CORNET), a variety of educational resources will be created and distributed both directly to participating centres and also via their websites, communication teams and social media platforms. Participating centres will reassess waste management after identifying and implementing strategies to optimise waste segregation locally. Through this we aim to ultimately reduce the environmental impact of joint replacement in the UK and drive meaningful change, in coordination with industry.

Sustainability in Orthopaedic Surgery: Time for Action

Hammad Parwaiz, Deborah Eastwood, Mike Reed

Strategies to help deliver net zero include the Centre for Sustainable Healthcare's four principles of sustainable clinical practice: surgical disease prevention, patient education and empowerment, lean service delivery and low carbon alternatives[13]. In order to measure the environmental impact of an activity or use of a resource, we quantify this as the carbon footprint - this is defined as the sum of direct and indirect greenhouse gas emissions which are attributable to a given process, product or organisation, and is expressed in kilograms of carbon dioxide equivalent (CO_2e). Within the theatre setting, consumable waste accounts for 32% of the surgical carbon footprint (excluding anaesthetic gases) and energy consumption accounts for 58%[14]. Examples of sustainable strategies employed include a reduction in the use of desflurane in anaesthetics (a volatile gas with far greater greenhouse warming potential than other commonly used anaesthetic gases)[15], use of volatile capture technology to capture harmful gases exhaled by the patient during anaesthesia before they are released into the atmosphere, saving water by using alcohol-based hand rub[16,17], the use of lean instrument sets[18-20], reducing waste from unnecessarily opened items that remain unused[21], reducing the use of single-use items[22], increasing recycling to reduce the carbon footprint of waste management[23] and turning off theatre ventilation systems when not in use[24].

In England, the NJR and BOA are taking a central role in sustainability in orthopaedic surgery. This project builds on previous work looking at how to embrace technology and telemedicine to reduce the environmental impact of current trauma and orthopaedic practice. We have reviewed the impact of the implementation of virtual fracture clinics during the COVID pandemic from the triple bottom line framework, showing that they reduce the carbon footprint of outpatient clinics, are cost efficient for the trust whilst being acceptable to patients[25]. Elsewhere, the introduction of telephone follow-up clinics for elective hand surgery was also found to be preferred by the majority of patients[26], and in some trusts such telephone follow-up clinics have also been introduced for the patient's first post-operative clinic for hip and knee replacement patients. The use of telemedicine has the potential to reduce the NHS carbon footprint[27] and could be one tool to help achieve net zero.

Planned projects include:

1. Mapping the carbon footprint of the entire patient journey through both a total knee and total hip replacement from GP referral to outpatient clinic attendance to post-operative rehabilitation and follow-up. It is hoped that we can identify 'carbon hotspots' along this journey that can be targeted for future interventions to reduce the carbon footprint. These may include unnecessary or duplicated pre- and post-operative clinics and follow-ups, as well as the modes of transport

used by the patient. Approximately 10% of the NHS carbon footprint in 2019 was related to staff commute and patient and visitor travel[28], and it is estimated that 5% of all road travel in the UK is NHS related[2]. Although some previous work has looked at carbon hotspots in theatre[24,29], little data that has looked at other aspects of the patient's journey through their surgery is available.

2. The BOA will be launching our "SOS: Sustainability in Orthopaedic Surgery" social media and website campaign in combination with the NJR and other stakeholders. We hope that through this awareness-raising activity we can generate discussion and debate amongst clinicians and educate the orthopaedic community on the environmental impacts of orthopaedic surgery and how each one of us can contribute and make our practices more sustainable. It will be an opportunity to showcase case studies from around the country and to coordinate sustainability projects on a larger scale.

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4. Implant and unit-level activity and outcomes

This section of the annual report gives performance and data entry quality indicators for trusts and local health boards (many of whom comprise more than one hospital) and independent (private) providers in England, Wales, Northern Ireland, the Isle of Man and Guernsey for the 2022 calendar year. Outcomes analysis after hip and knee replacement surgery is also provided for the period 2013 to 2023.

This section also provides data for implant outliers since 2003 and further information on notification and last usage date.

The full analysis for units can be found in the document available in the downloads section at reports.njrcentre.org.uk

4.1 Implant performance

The NJR Implant Scrutiny Committee reports Level 1 outlier implants to the MHRA. There are currently 12 hip stems, 11 hip acetabular (cup) components and 33 hip stem / cup combinations reported. A total of 18 knee brands are currently reported. Knee implants with and without patella resurfacing are now included in implant outlier analysis.

An implant is considered to be a Level 1 outlier when its Prosthesis Time Incident Rate (PTIR) is more than twice the PTIR of the group, allowing for confidence intervals. These are shown as the number of revisions per 100 prosthesis-years. As of March 2015, we have started to identify the best performing implants, these would have a PTIR less than half that of their group, allowing for confidence intervals. To date no implants have reached that level.

Components and constructs previously reported to MHRA, but no longer at Level 1 using the PTIR method are identified.

Table 4.1 Level 1 outlier stems reported to MHRA.

Stem name	Number implanted	Latest PTIR	Notified as outlier	Last implanted
ASR†	2,976	2.40	2010	2010
Corin Proxima*	111	1.92	2011	2009
S-ROM Cementless stem*	3,885	1.09	2013	Still in use
Adept Cementless stem*	228	1.74	2017	2010
Freeman Cementless*	338	1.27	2019	2010
DePuy Proxima	341	1.20	2019	2014
Twinsys Cementless Stem	1,066	1.04	2019	2018
Alloclassic Cementless Stem*†	268	1.14	2020	2020
ESOP Stem*	102	1.45	2020	2017
Bimetric Cementless Stem*	4,965	0.81	2021	Still in use
SP II Cemented Revision†	136	1.25	2021	Still in use
CBC*	331	1.12	2022	2014
Aura II Cementless Stem	304	1.04	2022	2007
Zimmer Thrust Plate*	114	1.21	2023	2009
Edinburgh	127	1.08	2023	2013

*Inclusion here is mainly due to metal-on-metal combinations.
†No longer at Level 1. The reasons for this are usually either that the metal-on-metal cases have had proportionately less contribution with time, or a reflection of the limitations of the PTIR method used over the longer term.

Table 4.2 Level 1 outlier acetabular components reported to MHRA.

Cup name	Number implanted	Latest PTIR	Notified as outlier	Last implanted
ASR*	6,361	3.42	2010	2017
Ultima MoM cup*	194	1.55	2010	2006
R3 with metal liner*	151	2.89	2011	2018
M2A38*	1,490	1.62	2014	2011
Delta One TT	635	1.23	2015	Still in use
Trabecular Metal Revision Shell	468	1.45	2017	Still in use
seleXys TH+*	184	1.74	2018	2011
Pinnacle with metal liner*	15,687	1.29	2018	2013
ADES Cemented†	784	0.66	2018	2020
MIHR cup*	258	1.71	2019	2011
Bi-Mentum DM Cemented†	963	0.69	2022	Still in use
ACE*	225	2.00	2022	Still in use
Edinburgh	151	1.08	2023	2013
Procotyl L†	142	1.15	2023	Still in use

*Inclusion here is mainly due to metal-on-metal combinations.
†No longer at Level 1. The reasons for this are usually either that the metal-on-metal cases have had proportionately less contribution with time, or a reflection of the limitations of the PTIR method used over the longer term.

Table 4.3 Level 1 outlier stem / acetabular component combinations reported to MHRA.

Combination	Number implanted	Latest PTIR	Notified as outlier	Last implanted
ASR Resurfacing Head / ASR Resurfacing Cup*†	2,966	2.40	2010	2010
Metafix Stem / Cormet 2000 Resurfacing Cup*	174	2.26	2010	2011
CPT CoCr Stem / Adept Resurfacing Cup*	269	2.74	2011	2010
Corail / ASR Resurfacing Cup*	2,774	4.74	2011	2010
CPT CoCr Stem / BHR Resurfacing Cup*	117	2.44	2011	2010
Accolade / Mitch TRH Cup*	275	2.74	2011	2011
Summit Cementless Stem / ASR Resurfacing Cup*	129	4.20	2012	2017
CPT CoCr Stem / Durom Resurfacing Cup*	185	2.21	2012	2009
S-Rom Cementless Stem / ASR Resurfacing Cup*	151	3.44	2012	2010
CPCS / BHR Resurfacing Cup*	256	1.40	2012	2010
Anthology / BHR Resurfacing Cup*	514	2.59	2012	2011
SL-Plus Cementless Stem / Cormet 2000 Resurfacing Cup*	432	2.10	2013	2010
Profemur L Modular / Conserve Plus Resurfacing Cup*	164	2.28	2013	2010
Bimetric Cementless Stem / M2A 38*	1,303	1.65	2014	2011
Corin Proxima / Cormet 2000 Resurfacing Cup*	108	1.99	2015	2009
Synergy Cementless Stem / BHR Resurfacing Cup*	1,607	1.97	2016	2011
Adept Cementless Stem / Adept Resurfacing Cup*	201	1.86	2017	2010
Exeter V40 / Trabecular Metal Revision Shell	239	1.23	2017	Still in use
CLS Spotorno Cementless Stem / Adept Resurfacing Cup*	218	2.58	2017	2011
Spectron / Opera	220	1.05	2018	2014
Exeter V40 / Mitch TRH Cup*	126	1.97	2018	2010
Twinsys Cementless Stem / Adept Resurfacing Cup*	131	2.09	2018	2010
CLS Spotorno Cementless Stem / Durom Resurfacing Cup*	938	1.56	2018	2012
S-Rom Cementless Stem / Pinnacle*	2,209	1.12	2018	Still in use
S-Rom Cementless Stem / Ultima Mom Cup*	105	1.35	2019	2005
Taperloc Cementless Stem / M2A 38*	139	1.44	2019	2010
Versys FMT Cementless Stem / Durom Resurfacing Cup*	189	1.28	2019	2010
Restoration Cementless Stem / Tritanium	148	2.51	2020	Still in use
Furlong HAC Stem / MIHR Cup*	135	1.31	2020	2010
Bimetric Cementless Stem / Recap Magnum*†	667	0.89	2022	2011
C-Stem AMT Cemented Stem† / Bi-Mentum DM Cemented†	444	1.18	2022	Still in use
Exeter V40 / G7 Cementless Acetabular Component	344	1.46	2022	Still in use
CBC / seleXys TH+*	102	1.51	2022	2011
Exeter V40 / Delta One TT	127	1.30	2022	Still in use
Edinburgh / Edinburgh Cup	122	1.12	2023	2013
Furlong HAC Stem / Adept Resurfacing Cup*	314	1.01	2023	2010

*Metal-on-metal.
†No longer at Level 1. The reasons for this are usually either that the metal-on-metal cases have had proportionately less contribution with time, or a reflection of the limitations of the PTIR method used over the longer term.

Knee implant performance

Table 4.4 Level 1 outlier implants reported to MHRA.

Knee brand	Number implanted	Latest PTIR	Notified as outlier	Last implanted
JRI Bicondylar Knee	250	1.73	2009	2010
Tack	232	1.60	2009	2008
St Leger	104	1.64	2011	2005
Journey Deuce†	151	2.33	2014	2013
SLK Evo	106	1.79	2016	2013
ACS	205	1.47	2017	Still in use
Journey Oxinium	834	0.91	2017	2014
Noiles*	660	1.30	2018	Still in use
METS Hinged/Linked Knee*	1,106	1.26	2021	Still in use
Endo-Model Modular Rotating Hinge*	309	1.90	2019	Still in use
Journey II BCS Oxinium without primary patella	747	1.20	2020	Still in use
E-Motion Bicondylar Knee with primary patella	339	1.05	2020	2021
Genesis II Oxinium (NP) without patella	5,703	0.76	2021	Still in use
LCS PFJ	225	4.61	2021	2010
RHK without primary patella	184	1.20	2021	2018
Genesis II Oxinium PS	3,919	0.81	2021	Still in use
Optetrak PS	414	0.99	2022	2013
Optetrak CR	1,669	0.79	2023	2015
Origin Knee	112	2.62	2023	Still in use

*Hinged knee prostheses are more often used in complex primaries, when compared to all total knee replacements.
†No longer at Level 1. The reasons for this are usually a reflection of the limitations of the PTIR method used over the longer term.
Note: Analysis of knee replacements with and without patella resurfacing commenced in March 2020. Analysis by constraint (CR/PS/Constrained) commenced in March 2021.

Implants may be subjected to closer scrutiny under certain conditions, such as when reports are received from surgeons concerned about the performance of certain variants, or when a device seems to have a very specific mode of failure. Kaplan-Meier analysis of revision rate is performed, using the average for all knees recorded in the registry as the "expected" value, and if necessary, followed up with other statistical tests. If a variant is found to be significantly ($P<0.001$) outside the expected range, then this is also reported to the implant manufacturer and the MHRA.

Any surgeons who have specific concerns about the performance of joint replacement implants and/or specific variants that would benefit from closer examination, can contact the NJR Implant Scrutiny Committee at njr@njr.org.uk.

4.2 Clinical activity

Overall in 2022, 138 NHS trusts and local health boards (comprising 254 separate hospitals) and 179 independent hospitals were open and eligible to report patient procedures to the registry. Data were not submitted in 2022 by six NHS hospitals and four independent hospitals.

Of those hospitals submitting data, the proportion of patients who gave permission (consent) for their details to be entered into the registry were:

NHS hospitals

- 44% of NHS hospitals achieved a consent rate greater than 95%
- 29% achieved a consent rate of 80% to 95%
- 27% recorded a consent rate of less than 80%

Independent hospitals

- 67% of independent hospitals achieved a consent rate greater than 95%
- 23% achieved a consent rate of 80% to 95%
- 10% recorded a consent rate of less than 80%

There has been an increase in recorded consent for all submitting units when compared to the previous year, with those achieving a higher than 95% rate rising to 54%, from 47% in 2021 (43% in 2020). Consent rates are returning to pre-pandemic levels; this can be related to the ratio of elective to trauma cases, which changed significantly during 2020, having a higher proportion of trauma cases compared to previous years. There was a significant reduction in elective cases due to COVID and trauma cases have a higher rate where NJR consent is not obtained.

Similarly, the proportion of entries in which there are significant data to enable the patient to be linked to an NHS number (linkability) is listed.

NHS hospitals

- 77% achieved a proportion of patients with a linkable NHS number greater than 95%
- 18% achieved a proportion of 80% to 95%
- 5% recorded a proportion of less than 80%

Independent hospitals

- 77.7% achieved a proportion of patients with a linkable NHS number greater than 95%
- 17.7% achieved a proportion of 80% to 95%
- 4.6% recorded a proportion of less than 80%

In 2022, 77% of all submitting units achieved over 95% linkability, a slight increase on the rate seen in 2021.

Note: Independent hospitals might be expected to have lower linkability rates than NHS hospitals, as a proportion of their patients may come from overseas and do not have an NHS number.

4.3 Outlier units for 90-day mortality and revision rates for the period 2013 to 2023

The observed numbers of revisions of hip and knee replacements for each hospital were compared to the numbers expected, given the unit's case mix in respect of age, gender and reason for primary surgery. Hospitals with a much higher than expected revision rate for hip and knee replacement have been identified. These hospitals had a revision rate that was above the upper of the 99.8% control limits (these limits approximate to +/-3 standard deviations). We would expect 0.2% (i.e. one in 500) to lie outside the control limits by chance, with approximately half of these (one in 1,000) to be above the upper limit.

Following discussions with the British Association for Surgery of the Knee (BASK) and British Orthopaedic Association (BOA), our alarm process has been amended to identify surgeons who appear as potential outliers for their total knee replacement (TKR) practice data and/or their unicondylar knee (UKR) practice and/or their patellofemoral joint replacement (PFJ) data alone rather than just based on their overall knee practice. Units are now notified for these sub-strata, but also for their overall knee replacement outcomes.

Ten hospitals had higher than expected rates of revision for hip replacement over the past five years, while 24 hospitals had higher than expected rates over the past ten years.

Over the five-year period, eight hospitals were identified with higher than expected overall knee revision rates, while eight were identified for total knee replacement, three for unicondylar knee replacement and none for patellofemoral knee replacement. Over the past ten years, higher than expected overall knee revision rates were seen for 25 hospitals, while 24 hospitals had higher rates for total knee replacement, eight for unicondylar knee replacement and two for patellofemoral knee replacement.

The 90-day mortality rate for primary hip and knee replacement was calculated using the last five years of data for all hospitals by plotting standardised mortality ratios for each hospital against the expected number of deaths. No hospitals had higher than expected mortality rates for either hip or knee replacement.

Note: The case mix for mortality includes age, gender and ASA grade. Trauma cases have been excluded from both the hip and knee mortality analyses together with hips implanted for failed hemiarthroplasty or for metastatic cancer (the latter only from November 2014 when recording of this reason began). Also, where both left and right side joints were implanted on the same day, only one side was included in the analysis.

Note: Any units identified as potential outliers here have been notified. All units are provided with an NJR Annual Clinical Report and additionally have access to the online NJR Management Feedback service.

Important note about the outlier hospitals listed

In earlier annual reports, we reported outlying hospitals based on all cases submitted to the registry since 1 April 2003. To reflect changes in hospital practices and component use, we now report outlying hospitals based on the last five years (17 February 2018 to 17 February 2023) and ten years of data (17 February 2013 to 17 February 2023 inclusive, the latter date being when the dataset was cut). These cuts of data exclude the majority of withdrawn outlier implants and metal-on-metal total hip replacements from analysis, and thus better represent contemporary practice.

Table 4.5 Outliers for hip mortality rates since 2018[1].

Hospital name
None identified

Table 4.6 Outliers for knee mortality rates since 2018[1].

Hospital name
None identified

Table 4.7 Outliers for hip revision rates, all linked primaries from 2018[1].

Hospital name
Broadgreen Hospital, Liverpool
Hexham General Hospital
King Edward VII's Hospital Sister Agnes, London
Milton Keynes Hospital
Mount Vernon Treatment Centre, Middlesex
North Manchester General Hospital
North Tyneside General Hospital, Oxford
Nuffield Orthopaedic Centre
Spire Liverpool Hospital
Wansbeck Hospital

Table 4.8 Outliers for hip revision rates, all linked primaries from 2013[2].

Hospital name
Basingstoke and North Hampshire Hospital
Bassetlaw Hospital, Northamptonshire
Broadgreen Hospital, Liverpool
Dewsbury and District Hospital
Fitzwilliam Hospital, Peterborough
Hull Royal Infirmary
John Radcliffe Hospital, Oxford
King Edward VII's Hospital Sister Agnes, London
London Bridge Hospital
Meriden Hospital, Coventry
Milton Keynes Hospital
North Tyneside General Hospital
Nuffield Orthopaedic Centre, Oxford
Orthopaedics and Spine Specialist Hospital, Peterborough
Peterborough City Hospital
Salisbury District Hospital
Southampton General Hospital
Spire Hartswood Hospital, Brentwood
Spire Methley Park Hospital, Leeds
St Richard's Hospital, Chichester
The Tunbridge Wells Hospital
University Hospital Aintree
Wansbeck Hospital
Weston General Hospital

Table 4.9 Outliers for overall knee revision rates, all linked primaries from 2018[1].

Hospital name
Bath Clinic
Guy's Hospital, London
Hospital of St John and St Elizabeth, London
King Edward VII's Hospital Sister Agnes, London
Milton Keynes Hospital
Mount Vernon Treatment Centre, Middlesex
Nuffield Orthopaedic Centre, Oxford
Spire Southampton Hospital

Table 4.10 Outliers for overall knee revision rates, all linked primaries from 2013[2].

Hospital name
Ashford Hospital
Bishops Wood Hospital, Middlesex
Ealing Hospital
Guy's Hospital, London
Heatherwood Hospital, Ascot
Hillingdon Hospital, Uxbridge
Hospital of St John and St Elizabeth, London
King Edward VII's Hospital Sister Agnes, London
London Independent Hospital
Meriden Hospital, Coventry
Mount Vernon Treatment Centre, Middlesex
Nottingham City Hospital
Nuffield Health Haywards Heath Hospital
Nuffield Orthopaedic Centre, Oxford
Orthopaedics and Spine Specialist Hospital, Peterborough
Scarborough General Hospital
Southmead Hospital, Bristol
Spire Hull and East Riding Hospital
Spire Southampton Hospital
Springfield Hospital, Chelmsford
St Mary's Hospital, Isle of Wight
St Richard's Hospital, Chichester
Sussex Orthopaedic Centre, Haywards Heath
The London Clinic
The Royal National Orthopaedic Hospital (Stanmore), London

Table 4.11 Outliers for total knee replacement revision rates, all linked primaries from 2018[1].

Hospital name
Bath Clinic
Guy's Hospital, London
Hospital of St John and St Elizabeth, London
Mount Vernon Treatment Centre, Middlesex
Nuffield Orthopaedic Centre, Oxford
Southmead Hospital, Bristol
Spire Southampton Hospital
Torbay Hospital

Table 4.12 Outliers for total knee replacement revision rates, all linked primaries from 2013[2].

Hospital name
Bath Clinic
Ealing Hospital
Guy's Hospital, London
Heatherwood Hospital, Ascot
Hillingdon Hospital, Uxbridge
Hospital of St John and St Elizabeth, London
London Independent Hospital
Mount Vernon Treatment Centre, Middlesex
Nevill Hall Hospital, Abergavenny
Nottingham City Hospital
Nuffield Health Haywards Heath Hospital
Nuffield Orthopaedic Centre, Oxford
Ormskirk and District General Hospital
Orthopaedics and Spine Specialist Hospital, Peterborough
Southampton General Hospital
Southmead Hospital, Bristol
Spire Hull and East Riding Hospital
Spire Southampton Hospital
St Mary's Hospital, Isle of Wight
St Richard's Hospital, Chichester
Sussex Orthopaedic Centre, Haywards Heath
The Royal National Orthopaedic Hospital (Stanmore), London
Torbay Hospital
University Hospital Llandough

Table 4.13 Outliers for unicondylar knee replacement revision rates, all linked primaries from 2018[1].

Hospital name
King Edward VII's Hospital Sister Agnes, London
Springfield Hospital, Chelmsford
St Michael's Hospital, Enfield

Table 4.14 Outliers for unicondylar knee replacement revision rates, all linked primaries from 2013[2].

Hospital name
Ashford Hospital
Barnsley District General Hospital
Bishops Wood Hospital, Middlesex
King Edward VII's Hospital Sister Agnes, London
Meriden Hospital, Coventry
Springfield Hospital, Chelmsford
Sunderland Royal Hospital
The Cherwell Hospital, Banbury

Table 4.15 Outliers for patellofemoral knee replacement revision rates, all linked primaries from 2018[1].

Hospital name
None identified

Table 4.16 Outliers for patellofemoral knee replacement revision rates, all linked primaries from 2013[2].

Hospital name
Meriden Hospital, Middlesex
Nuffield Health Tees Hospital

[1] Date range 17 February 2018 to 17 February 2023 inclusive.
[2] Date range 17 February 2013 to 17 February 2023 inclusive.

4.4 Better than expected performance

This year we have again listed hospitals where revision rates are statistically better than expected. The lists here show units that lie below the 99.8% control limit which also achieved greater than 90% compliance across all of the NJR data quality audits. Units with lower data quality compliance are automatically excluded from these lists, but can revisit their automated audits to improve their compliance results.

Table 4.17 Better than expected hip revision rates, all linked primaries from 2018[1].

Hospital name
None identified

Table 4.18 Better than expected hip revision rates, all linked primaries from 2013[2].

Hospital name
Bedford Hospital South Wing
Calderdale Royal Hospital, Halifax
Craigavon Area Hospital
Goring Hall Hospital, Worthing
Ipswich Hospital
Musgrave Park Hospital, Belfast
Practice Plus Group Hospital - Emersons Green, Bristol
Sunderland Royal Hospital
The Horder Centre, Crowborough
Ulster Independent Clinic, Belfast

Table 4.19 Better than expected overall knee revision rates, all linked primaries from 2018[1].

Hospital name
None identified

Table 4.20 Better than expected overall knee revision rates, all linked primaries from 2013[2].

Hospital name
Craigavon Area Hospital
Hexham General Hospital
Ipswich Hospital
Musgrave Park Hospital, Belfast
Norfolk and Norwich Hospital
North Tyneside General Hospital
Nottingham Woodthorpe Hospital
Nuffield Health Cambridge Hospital
Nuffield Health Wolverhampton Hospital
Practice Plus Group Hospital - Emersons Green, Bristol
Spire Norwich Hospital
Stepping Hill Hospital, Stockport
The Elective Orthopaedic Centre, London
The Horder Centre, Crowborough

Table 4.21 Better than expected total knee replacement revision rates, all linked primaries from 2018[1].

Hospital name
None identified

Table 4.22 Better than expected total knee replacement revision rates, all linked primaries from 2013[2].

Hospital name
Alexandra Hospital, Redditch
Hexham General Hospital
Ipswich Hospital
Musgrave Park Hospital, Belfast
Norfolk and Norwich Hospital
North Tyneside General Hospital
Nottingham Woodthorpe Hospital
Nuffield Health Cambridge Hospital
Nuffield Health Wolverhampton Hospital
Spire Norwich Hospital
The Elective Orthopaedic Centre, London
The Horder Centre, Crowborough
Whiston Hospital, Prescot

[1] Date range 17 February 2018 to 17 February 2023 inclusive.
[2] Date range 17 February 2013 to 17 February 2023 inclusive.

Table 4.23 Better than expected unicondylar knee replacement revision rates, all linked primaries from 2018[1].

Hospital name
None identified

Table 4.24 Better than expected unicondylar knee replacement revision rates, all linked primaries from 2013[2].

Hospital name
Nuffield Health Derby Hospital
Nuffield Orthopaedic Centre, Oxford
Practice Plus Group Hospital - Emersons Green, Bristol
Royal Derby Hospital

Table 4.25 Better than expected patellofemoral knee replacement revision rates, all linked primaries from 2018[1].

Hospital name
None identified

Table 4.26 Better than expected patellofemoral knee replacement revision rates, all linked primaries from 2013[2].

Hospital name
None identified

[1] Date range 17 February 2018 to 17 February 2023 inclusive.
[2] Date range 17 February 2013 to 17 February 2023 inclusive.

Glossary

A	
ABHI	Association of British HealthTech Industries – the UK trade association of medical device suppliers.
Acetabular component	The portion of a total hip replacement prosthesis that is inserted into the acetabulum – the socket part of a ball and socket joint.
Acetabular cup	See Acetabular component.
Acetabular prosthesis	See Acetabular component.
Administrative censoring	Administrative censoring is the process of defining the end of the observation period for the cohort. All patients are assumed to have experienced either a revision, be dead, or alive and unrevised at the censoring date.
ALVAL	Aseptic Lymphocyte-dominated Vasculitis-Associated Lesion. This term is used in the Annual Report to describe the generality of adverse responses to metal debris, but in its strict sense refers to the delayed type-IV hypersensitivity response.
Amputation	The surgical removal of a limb or part of a limb.
Antibiotic-loaded bone cement	A bone cement which contains pre-mixed antibiotics, this is distinct from plain bone cement which contains no antibiotics. See Bone cement.
Arthrodesis	A procedure where the bones of a natural joint are fused together (stiffened).
Arthroplasty	A procedure where a native joint is surgically reconstructed or replaced with an artificial prosthesis.
ASA	American Society of Anesthesiologists scoring system for grading the overall physical condition of the patient, as follows: P1 – fit and healthy; P2 – mild disease, not incapacitating; P3 – incapacitating systemic disease; P4 – life threatening disease; P5 – expected to die within 24 hrs without an operation.
B	
BASK	British Association for Surgery of the Knee.
Bearing type	The two surfaces that articulate together in a joint replacement. Options described in the report include metal-on-polyethylene, metal-on-metal, ceramic-on-polyethylene, ceramic-on-metal, ceramic-on-ceramic and in dual mobility hip replacements metal-on-polyethylene-on-metal and ceramic-on-polyethylene-on-metal.
BESS	British Elbow and Shoulder Society.
Beyond Compliance	A system of post market surveillance initiated in 2013. Under this system, Beyond Compliance collates NJR data, national PROMs and data from implanting surgeons, and monitors the usage and performance of implants which are new to the market.
BHS	British Hip Society.
Bilateral operation	Operation performed on both sides, e.g. left and right knee procedures, carried out on the same day or on different days.
BOA	British Orthopaedic Association. The surgical specialty association for trauma and orthopaedics in the UK.
Body mass index (BMI)	A statistical tool used to estimate a healthy body weight based on an individual's height. The BMI is calculated by dividing a person's weight (kg) by the square of their height (m^2).
BOFAS	British Orthopaedic Foot and Ankle Society.
Bone cement	The material used to fix cemented joint replacements to bone – polymethyl methacrylate (PMMA).
BOTA	British Orthopaedic Trainees Association.
Brand (of prosthesis)	The brand of a prosthesis (or implant) is the manufacturer's product name, e.g. the Exeter V40 brand for hips, the PFC Sigma brand for knees, the Zenith brand for ankles, the Delta Xtend brand for shoulders and the Coonrad Morrey for elbows.
C	
Case ascertainment	Proportion of all relevant joint replacement procedures performed that are entered into the registry.
Case mix	Term used to describe variation in surgical practice, relating to factors such as indications for surgery, patient age and gender.

Ceiling effect	A measurement limitation of an outcome measure where the highest possible score or close to the highest score of a measurement instrument is reached, making differentiation not possible within that group, or this may reflect that the intended domain has not been accurately measured by the instrument. There is no consensus on the proportion of individuals that need to fall into this group or whether it should only apply for the highest score or also to those close to the highest score. See also Floor effect.
Cement	See Bone cement.
Cemented	Prostheses designed to be fixed into the bone using bone cement.
Cementless	See Uncemented.
Compliance	The percentage of total joint procedures that have been entered into the registry where the denominator is defined as the number of all eligible procedures.
Confidence Interval (CI)	A 'Confidence Interval' (CI) illustrates the uncertainty of an estimated statistic. For example, a CI for the cumulative probability of revision tells us the probability that 'true' (population) probability of revision will fall between the range of values on a specified percentage, typically 95%, of occasions if the data collection was repeated.
Confounding	Confounding occurs when either a measured or unmeasured factor (variable) distorts the true relationship between the exposure and outcome of interest. For example, a comparison of the revision rates between two distinct types of implant may be 'confounded' because one implant has been used on an older group of patients compared to the other. In this context, age may be a 'confounder' if it distorts the relationship between implant type and outcome i.e. revision rate. Statistical methods may help to 'adjust' for such confounding factors however residual confounding of an association may always persist.
Conventional total shoulder replacement	Replacement of the shoulder joint which replicates the normal anatomical features of a shoulder joint.
Coverage	Scope of inclusion criteria for the registry. Data submission has been mandatory for independent organisations since 1 April 2003 and for NHS organisations since 1 April 2011. See also NJR definition.
COVID	Coronavirus disease following infection from the SARS-CoV-2 virus.
Cox 'proportional hazards' model	A type of multivariable regression model used in survival analysis to look at the effects of a number of variables ('exposures') on outcome (first revision or death). The effect of each variable is adjusted for the effects of all the other 'exposure' variables in the model. Some regression models used in survival modelling make assumptions about the way the hazard rate changes with time (see 'hazard rate'). The Cox model doesn't make any assumptions about how the hazard rate changes, however it does assume that the exposure variables affect the hazard rates in a 'proportional' way.
CQC	Care Quality Commission. Regulators of care provided by the NHS, local authorities, private companies and voluntary organisations.
Cumulative Incidence Function (CIF)	A different way of estimating failure compared to Kaplan-Meier, see Kaplan-Meier. Also known as observed or crude failure, as the estimate reflects what is seen in practice.
Cup	See Acetabular component.
D	
DAIR	Debridement And Implant Retention. In cases of infection, the surgeon may debride (surgically clean) the surgical site and retain the joint replacement implants. The NJR does not collect data on Antibiotic use and therefore DAIR in our context focuses on implant and procedure data.
DAIR with Modular Exchange	Debridement And Implant Retention with Modular Exchange. In cases of infection where the implants are modular, the surgeon may debride (surgically clean) the surgical site, exchange the modular components (e.g. head, acetabular liner) and retain the non-modular joint replacement implants.
Data collection periods for annual report analysis	Outcomes analyses present data for hip, knee, ankle, elbow and shoulder procedures that took place between 1 April 2003 and 31 December 2022 inclusive. Hospital (unit) level analyses present data for hip and knee procedures undertaken between 1 January and 31 December 2022 inclusive. Online interactive reporting presents data for each calendar year - 1 January to 31 December inclusive. Hospital (unit) outlier analysis is performed on the last five and ten years of data up to 17 February 2023.
DDH	Developmental dysplasia of the hip. A condition where the hip joint is malformed, usually with a shallow socket (acetabulum), which may cause instability.
Distal humeral hemiarthroplasty	A type of elbow replacement which only replaces the distal part of the humerus.

DHSC	Department of Health and Social Care.
Dual mobility	Dual mobility is a type of total hip replacement which contains two articulating bearing surfaces. The distal bearing surface consists of a standard femoral head which articulates within a large polyethylene bearing. The proximal bearing surface consists of an acetabular bearing which articulates against a large polyethylene bearing. The femoral head and acetabular bearing can be made of metal or ceramic.
DVT	Deep vein thrombosis. A blood clot that can form in the veins of the leg and is recognised as a significant risk after joint replacement surgery.
E	
Episode	An event involving a patient procedure such as a primary or revision total prosthetic replacement. An episode can also consist of two consecutive procedures, e.g. a stage one of two-stage revision, followed by a stage two of two-stage revision.
Excision arthroplasty	A procedure where the articular ends of the bones are simply excised, so that a gap is created between them, or when a joint replacement is removed and not replaced by another prosthesis.
F	
Femoral component (hip)	Part of a total hip joint that is inserted into the femur (thigh bone) of the patient. It normally consists of a stem and head (ball).
Femoral component (knee)	Portion of a knee prosthesis that is used to replace the articulating surface of the femur (thigh bone).
Femoral head	Spherical portion of the femoral component of the artificial hip replacement. May be modular or non-modular i.e. attached to the stem, see monobloc.
Femoral prosthesis	Portion of a total joint replacement used to replace damaged parts of the femur (thigh bone).
Femoral stem	The part of a modular femoral component inserted into the femur (thigh bone). It has a femoral head mounted on it to form the complete femoral component in hip replacement or may be added to the femoral component of a total knee replacement, usually in the revision setting.
Floor effect	A measurement limitation of an outcome measure where the lowest possible score or close to the lowest score of a measurement instrument is reached making differentiation not possible within that group, or this may reflect that the intended domain has not been accurately measured by the instrument. There is no consensus on the proportion of individuals that need to fall into this group, or whether it should only apply for the lowest score or also to those close to the lowest score. See also Ceiling effect.
Funnel plot	A graphical device to compare unit or surgeon performance. Measures of performance (e.g. a ratio of number of observed events to the expected number based on case mix) are plotted against an interpretable measure of precision. Control limits are shown to indicate acceptable performance. Points outside of the control limits suggest 'special cause' as opposed to 'common cause' variation (see for example D Spiegelhalter, Stats in Medicine, 2005).
G	
Glenoid component	The portion of a total shoulder replacement prosthesis that is inserted into the scapula – the socket part of a ball and socket joint in conventional shoulder replacement or the ball part in reverse shoulder replacement.
H	
Hazard rate	Rate at which 'failures' occur at a given point in time after the operation conditional on 'survival' up to that point. In the case of first revision, for example, this is the rate at which new revisions occur in those previously unrevised.
Head	See Femoral head and/or Humeral head and/or Radial head component (elbow).
Healthcare provider	NHS or independent sector organisation that provides healthcare; in the case of the NJR, orthopaedic hip, knee, ankle, elbow or shoulder replacement surgery.
HES	Hospital Episode Statistics. A data source managed by NHS England which contains data on conditions (ICD-10 codes), procedures (OPCS-4 codes) in addition to other hospital statistics collected routinely by NHS hospitals in England.
Highly cross-linked polyethylene	See Modified Polyethylene.

HQIP	Healthcare Quality Improvement Partnership. Hosts the NJR on behalf of NHS England. Promotes quality in health and social care services and works to increase the impact that clinical audit has nationally.
Humeral component (elbow/distal)	Part of a total elbow joint that is inserted into the humerus (upper arm bone) of the patient to replace the articulating surface of the humerus.
Humeral component (shoulder/ proximal)	Part of a total or partial shoulder replacement that is inserted into the humerus (upper arm bone) of the patient. It normally consists of a humeral stem and head (ball) in conventional shoulder replacement or a humeral stem and a humeral cup in a reverse shoulder replacement.
Humeral head	Domed head portion of the humeral component of the artificial shoulder replacement attached to the humeral stem.
Humeral prosthesis	Portion of a shoulder replacement used to replace damaged parts of the humerus (upper arm bone).
Humeral stem	The part of a modular humeral component inserted into the humerus (upper arm bone). Has a humeral head or humeral cup mounted on it to form the complete humeral implant.
Hybrid procedure	Joint replacement procedure in which cement is used to fix one prosthetic component while the other is cementless. For hip procedures, the term hybrid covers both reverse hybrid (uncemented stem, cemented socket) and hybrid (cemented stem, uncemented socket) unless separately defined.
I	
ID	A generic term for pseudo anonymised patient identification number, whether that be a pseudo anonymised NHS number, local hospital patient identifier or combination of personal characteristics.
Image/computer-guided surgery	Surgery performed by the surgeon, using real-time images and data computed from these to assist alignment and positioning of prosthetic components.
Inconsistent operative pattern	A sequence of operations where the primary operation is not the first operation in the sequence or where there are multiple primary operations.
Independent hospital	A hospital managed by a commercial company that predominantly treats privately-funded patients but does also treat NHS-funded patients.
Index joint	The primary joint replacement that is the subject of an NJR entry.
Indication (for surgery)	The cause or reason for surgery. The NJR system allows for more than one indication to be recorded.
Ipsilateral procedure	An operation performed on one side, e.g. left or right knee procedures.
IQR	The interquartile range shows a range of values from the 25th (first quartile) and 75th (third quartile) centiles of a variables distribution.
ISTC	Independent sector treatment centre. See Treatment centre.
K	
Kaplan-Meier	Used to estimate the cumulative probability of ‘failure’ at various times from the primary operation, also known as Net Failure. ‘Failure’ may be either a first revision or a death, depending on the context. The method properly takes into account ‘censored’ data. Censorings arise from incomplete follow-up; for revision, for example, a patient may have died or reached the end of the analysis period (end of 2022) without having been revised.
L	
Lateral resurfacing (elbow)	Partial resurfacing of the elbow with a humeral surface replacement component used with a lateral resurfacing head inserted with or without cement.
LHMoM	Large head metal-on-metal. Where a metal femoral head of 36mm diameter or greater is used in conjunction with a femoral stem, and is articulating with either a metal resurfacing cup or a metal liner in a modular acetabular cup. Resurfacing hip replacements are excluded from this group.
Linkable percentage	Linkable percentage is the percentage of all relevant procedures that have been entered into the registry, which may be linked via NHS number to other procedures performed on the same patient.
Linkable procedures	Procedures entered into the NJR database that are linkable to a patient’s previous or subsequent procedures by the patient’s NHS number.
Linked total elbow	Where the humeral and ulnar parts of a total elbow replacement are structurally coupled.

LMWH	Low molecular weight Heparin. A blood-thinning drug used in the prevention and treatment of deep vein thrombosis (DVT).
Lysis	Refers to osteolysis and describes focal periprosthetic loss of bone that occurs as an inflammatory response to debris generated from the prosthesis materials.
M	
MDS	Minimum Data Set, the set of data fields collected by the NJR. Some of the data fields are mandatory (i.e. they must be filled in). Fields that relate to patients' personal details must only be completed where informed patient consent has been obtained.
MDSv1	Minimum Data Set version one, used to collect data from 1 April 2003. MDSv1 closed to new data entry on 1 April 2005.
MDSv2	Minimum Data Set version two, introduced on 1 April 2004. MDSv2 replaced MDSv1.
MDSv3	Minimum Data Set version three, introduced on 1 November 2007 replacing MDSv2.
MDSv4	Minimum Data Set version four, introduced on 1 April 2010 replacing MDSv3. This dataset has the same hip and knee MDSv3 dataset but includes the data collection for total ankle replacement procedures.
MDSv5	Minimum Data Set version five, introduced on 1 April 2012 replacing MDSv4. This dataset has the same hip, knee and ankle MDSv4 dataset but includes the data collection for total elbow and total shoulder replacement procedures.
MDSv6	Minimum Data Set version six, introduced on 14 November 2014 replacing MDSv5. This dataset includes the data collection for hip, knee, ankle, elbow and shoulder replacement procedures.
MDSv7	Minimum Data Set version seven, introduced on 4 June 2018 replacing MDSv6. This dataset includes reclassification and amendments to data collection for hip, knee, ankle, elbow and shoulder replacement procedures.
MDSv8	Minimum Data Set version eight, introduced on 12 June 2023 replacing MDSv7. This dataset includes amendments to data collection for hip, knee, ankle, elbow and shoulder replacement procedures and the introduction of data collection for Reoperations other than revision.
MHRA	Medicines and Healthcare products Regulatory Agency. The UK regulatory body for medical devices.
Minimally-invasive surgery	Surgery performed using small incisions (usually less than 10cm). This may require the use of special instruments.
Mix and match	Mix and match describes when the components of the joint construct come from different brands and/or manufacturers.
Modified Polyethylene (MP)	Any component made of polyethylene which has been modified in some way in order to improve its performance characteristics. Some of these processes involve chemical changes, such as increasing the cross-linking of the polymer chains or the addition of vitamin E and/or other antioxidants. Others are physical processes such as heat pressing or irradiation in a vacuum or inert gas.
Modular	Component composed of more than one piece, e.g. a modular acetabular cup shell component with a modular cup liner, or femoral stem coupled with a femoral head.
Monobloc	Component composed of, or supplied as, one piece, the antonym of modular e.g. a monobloc knee tibial component.
Multicompartmental knee replacement	More than one compartmental knee replacement within the same operation e.g. a unicondylar knee replacement and patellofemoral knee replacement, a medial and a lateral unicondylar knee replacement or a medial and a lateral and patellofemoral unicondylar knee replacement.
N	
NHSE	National Health Service England
NHS No.	Pseudo anonymised National Health Service Number.
NICE	National Institute for Health and Care Excellence.
NICE benchmark	The NICE benchmark of performance is defined as a 5% prosthesis failure rate at ten years.
NJR	The National Joint Registry (NJR), which covers England, Wales, Northern Ireland, the Isle of Man and Guernsey, has collected and analysed information from both the NHS and independent healthcare sectors on hip and knee replacements since 1 April 2003, ankle replacements since 1 April 2010, and elbow and shoulder replacements since April 2012.

NJR Stats Online	Online facility for viewing and downloading NJR statistics at https://surgeonprofile.njrcentre.org.uk/Home/StatsIndex.
Non-inferiority framework	In non-inferiority design we test whether a construct is not worse than the best performing or benchmark construct, within a pre-specified range (the non-inferiority margin). Constructs which perform below this range are considered to be worse than or inferior to the benchmark.
O	
ODEP	Orthopaedic Data Evaluation Panel of the NHS Supply Chain. www.odep.org.uk.
ODEP ratings	A letter and star rating awarded to implants based on their performance at specified time points. See www.odep.org.uk for more details.
OPCS-4	Office of Population, Censuses and Surveys: Classification of Interventions and Procedures, version 4 – a list of surgical procedures and codes.
Outlier	Data for a surgeon, unit or implant brand that falls outside of acceptable control limits. See also 'Funnel plot'. A Level One implant outlier is defined as having a PTIR of more than twice the group average. A Level Two implant outlier is defined as having a PTIR of 1.5 times the group average.
OSS	Oxford Shoulder Score. A 12-item patient-reported outcome measure specifically designed and developed for assessing outcomes of shoulder surgery i.e. for assessing the impact on patients' quality of life of degenerative conditions such as arthritis and rotator cuff problems.
P	
Patellar resurfacing	Replacement of the surface of the patella (knee cap) with a prosthesis.
Patellofemoral knee replacement	Procedure involving replacement of the trochlear and replacement resurfacing of the patella.
Patellofemoral prosthesis	Two-piece knee prosthesis that provides a prosthetic (knee) articulation surface between the patella and trochlear.
Patient consent	Patient personal details may only be submitted to the NJR where explicit informed patient consent has been given or where patient consent has not been recorded. If a patient declines to give consent, only the anonymous operation and implant data may be submitted.
Patient physical status	See ASA.
PDS	The Personal Demographics Service is the national electronic database of NHS patient demographic details. The NJR uses the PDS Demographics Batch Service (DBS) to source missing NHS numbers and to determine when patients recorded in the registry have died.
PEDW	Patient Episode Database for Wales. The Welsh equivalent to Hospital Episode Statistics (HES) in England.
Primary hip/knee/ankle/elbow/ shoulder replacement	The first time a joint replacement operation is performed on any individual joint in a patient.
Procedure	A single operation. See also Primary hip/knee/ankle/elbow/shoulder replacement and Revision hip/ knee/ankle/elbow/shoulder replacement.
PROM(s)	Patient Reported Outcome Measure(s). Questionnaires completed by patients, giving insight as to how they individually feel and function both before and after surgery.
Prosthesis	Orthopaedic implant used in joint replacement procedures, e.g. a total hip, a unicondylar knee, a total ankle, a reverse shoulder or a radial head replacement.
Prosthesis-time	The total of the length of time a prosthesis was 'at risk' of revision. In the calculation of PTIRs for revision, for example, each individual prosthesis construct time is measured from the date of the primary operation to the date of first revision or, if there has been no revision, the date of patient's death or the administrative censoring date.
Proximal humeral hemiarthroplasty	A shoulder replacement procedure which replaces only the humeral side of the shoulder joint.
PTIR	Prosthesis-Time Incidence Rate. The total number of events (e.g. first revisions) divided by the total of the lengths of times the prosthesis was at risk (see 'Prosthesis-time').
Pulmonary embolism	A pulmonary embolism is a blockage in the pulmonary artery, which is the blood vessel that carries blood from the heart to the lungs.

R	
Radial head component (elbow)	Part of a partial elbow joint that is inserted into the radius (outer lower arm bone) of the patient to replace the articulating surface of the radial head. May be monobloc or modular.
Region	NJR regions are based on the former NHS Strategic Health Authority areas. These organisations were responsible for managing local performance and implementing national policy at a regional level until 2013.
Resurfacing (hip)	Resurfacing of the femoral head with a surface replacement femoral prosthesis and insertion of a monobloc acetabular cup, with or without cement.
Resurfacing (knee)	See Patellar resurfacing.
Resurfacing (shoulder)	Resurfacing of the humeral head with a surface replacement humeral prosthesis inserted, with or without cement.
Reverse polarity total shoulder replacement	Replacement of the shoulder joint where a glenoid head is attached to the scapula and the humeral cup to the humerus.
Revision burden	The proportion of revision procedures carried out as a percentage of the total number of surgeries on that particular joint.
Revision hip/knee/ankle/elbow/ shoulder replacement	A revision is defined as any operation where one or more components are added to, removed from or modified in a joint replacement or if a Debridement And Implant Retention (DAIR) with or without modular exchange is performed. Capturing DAIR with or without modular exchange commenced with the introduction of MDSv7. Prior to this DAIR with modular exchange was included as a single-stage revision but DAIR without modular exchange was not captured. Within the annual report, each of these procedure types is included in the analyses as a revision episode. This is distinct from the analyses in the surgeon, unit, and implant performance work streams where DAIR without modular exchange is not currently included as a revision outcome.
S	
Shoulder humeral hemiarthroplasty	Replacement of the humeral head with a humeral stem and head or shoulder resurfacing component which articulates with the natural glenoid.
Single-stage revision	A complete revision procedure carried out in a single operation, i.e. components removed and replaced under one anaesthetic.
SOAL	Lower Layer Super Output Areas. Geographical areas for the collection and publication of small area statistics. These are designed to contain a minimum population of 1,000 and a mean population size of 1,500. Please also see Office for National Statistics at www.ons.gov.uk.
Stemless shoulder replacement	A shoulder replacement where the most distal element of humeral section does not project beyond the metaphyseal bone of the proximal humerus.
Stemmed shoulder replacement	A shoulder replacement where the most distal element of humeral section projects into the diaphysis of the proximal humerus.
Subtalar	The joints between the talus and the calcaneum, also known as the talocalcaneal joints.
Surgical approach	Method used by a surgeon to gain access to, and expose, the joint.
Survival (or failure) analysis	Statistical methods to look at time to a defined failure ‘event’ (for example either first revision or death); see Kaplan-Meier estimates and Cox ‘proportional hazards’ models. These methods can take into account cases with incomplete follow-up (‘censored’ observations).
T	
Talar component	Portion of an ankle prosthesis that is used to replace the articulating surface of the talus at the ankle joint.
TAR	Total ankle replacement (total ankle arthroplasty). Replacement of both tibial and talar surfaces, in most cases implanted without cement.
TED stockings	Thrombo embolic deterrent (TED) stockings. Elasticised stockings that can be worn by patients following surgery and which may help reduce the risk of deep vein thrombosis (DVT).
THR	Total hip replacement (total hip arthroplasty). Replacement of the femoral head with a stemmed femoral prosthesis and insertion of an acetabular cup, with or without cement.

Thromboprophylaxis	Drug or other post-operative regime prescribed to patients with the aim of preventing blood clot formation, usually deep vein thrombosis (DVT), in the post-operative period.
Tibial component (ankle)	Portion of an ankle prosthesis that is used to replace the articulating surface of the tibia (shin bone) at the ankle joint.
Tibial component (knee)	Portion of a knee prosthesis that is used to replace the articulating surface of the tibia (shin bone) at the knee joint. May be modular or monobloc (one piece).
TKR	Total knee replacement (total knee arthroplasty). Replacement of both tibial and femoral condyles (with or without resurfacing of the patella), with or without cement.
Total condylar knee	Type of knee prosthesis that replaces the complete contact area between the femur and the tibia of a patient's knee.
Total elbow replacement	Replacement of the elbow joint which consists of both humeral and ulna prostheses.
Treatment centre	Treatment centres are dedicated units that offer elective and short-stay surgery and diagnostic procedures in specialties such as ophthalmology, orthopaedic and other conditions. These include hip, knee, ankle, elbow, and shoulder replacements. Treatment centres may be privately-funded (independent sector treatment centre – ISTC). NHS Treatment Centres exist but their data are included in those of the English NHS trusts and Welsh Local Health Boards to which they are attached.
Trochanter	Bony protuberance of the femur, the greater trochanter is found on its upper outer aspect and is the site of attachment of the abductor muscles. The lesser trochanter is medial and inferior to this and is the site of attachment of the psoas tendon.
Trochanteric osteotomy	A procedure to temporarily remove and then reattach the greater trochanter, used to aid exposure of hip joint during some types of total hip replacement and now usually used only in complex procedures.
Two-stage revision	A revision procedure carried out as two operations, i.e. under two separate anaesthetics, most often used in the treatment of prosthetic joint infection.
Type (of prosthesis)	Type of prosthesis is the generic description of a prosthesis, e.g. modular cemented stem (hip), patellofemoral joint (knee), talar component (ankle), reverse shoulder (shoulder) and radial head replacement (elbow).
U	
Ulnar component (elbow)	Part of a total elbow joint that is inserted into the ulna (inner lower arm bone) of the patient to replace the articulating surface of the ulna. May be linked or unlinked.
Uncemented	Prostheses designed to be fixed into the bone by an initial press-fit and then bony ingrowth or ongrowth, without using cement.
Unconfirmed prostheses construct	A joint replacement which has been uploaded with either an insufficient number of elements to form a construct, or prostheses elements which are not concordant with the procedure indicated by the surgeon.
Unicompartmental knee replacement	Procedure where only one compartment of the knee joint is replaced, also known as partial knee replacement. The lateral (outside), medial (inside) and patellofemoral (under the knee cap) compartments are replaced individually.
Unicondylar arthroplasty	Replacement of one tibial condyle and one femoral condyle in the knee, with or without resurfacing of the patella.
Unicondylar knee replacement	See Unicondylar arthroplasty.
Unilateral operation	Operation performed on one side only, e.g. left hip.
Unlinked total elbow	Where the humeral and ulnar parts of a total elbow replacement are apposed but not structurally coupled.

Summary of key facts about joint replacement during the 2022 calendar year

Hips

NJR Patient Consent

recorded by the NJR since April 2003

2022

99,043 primary replacement procedures

60% female

average ages: male 67.3, female 69.7

Data:

- 5% Acute trauma
- 91% Osteoarthritis
- average BMI **28.7** 'Overweight'*

Knees

NJR Patient Consent

recorded by the NJR since April 2003

2022

98,469 primary replacement procedures

55% female

average ages: male 69.1, female 69.5

Data:

- 98% Osteoarthritis
- 13% Unicondylar knee replacements
- average BMI **30.7** 'Obese'*

Ankles

NJR Patient Consent

recorded by the NJR since April 2010

2022

880 primary replacement procedures

39% female

average ages: male 68.5, female 67.3

Data:

- 92% Osteoarthritis
- 6% Rheumatoid arthritis and other inflammatory joint problems
- average BMI **29.5** 'Overweight'*

Elbows

NJR Patient Consent

recorded by the NJR since April 2012

2022

817 primary replacement procedures

68% female

average ages: male 53.6, female 64.8

Data:

- 34% Total elbow replacement (with or without a radial head)
- 50% Radial head replacements
- 11% Distal humeral hemiarthroplasty

Shoulders

NJR Patient Consent

recorded by the NJR since April 2012

2022

6,780 primary replacement procedures

68% female

average ages: male 69.0, female 73.7

Data:

- 15% Acute trauma
- 59% Osteoarthritis
- 26% Elective cuff tear arthropathy

*Description based on NHS categorisation.

For more data on clinical activity during the 2022 calendar year visit reports.njrcentre.org.uk

Information governance and patient confidentiality

The NJR ensures that all patient data is processed and handled in line with international and UK standards and within UK and European legislation: protecting and applying strict controls on the use of patient data is of the highest importance. NJR data are collected via a web-based data entry application and stored and processed in NEC Software Solutions (NEC) data centre. NEC is accredited to ISO/IEC 27001:2013, ISO/IEC 9001:2015, ISO/IEC 20000, Cyber Essentials Plus, and Healthcare Data Storage (HDS). NEC is also registered on the NHS Data Security and Protection Toolkit with a status of 'Exceeds Standards'.

For research and analysis purposes, NJR data are annually linked to data from other healthcare systems using patient identifiers, principally a patient's NHS number. These other datasets include the Hospital Episodes Statistics (HES) service, data from the NHS England Patient Reported Outcomes Measures (PROMs) programme, and Civil Registration data (all provided by NHS England), and the Patient Episode Database Wales (PEDW) (provided by Digital Health and Care Wales). The purpose of linking to these datasets is to expand and broaden the type of analyses that the NJR can undertake without having to collect additional data. This linkage has been approved by the Health Research Authority under Section 251 of the NHS Act 2006 on the basis of improving patient safety and patient outcomes: the support provides the legal basis for undertaking the linkage of NJR data to the health datasets listed above.

Once the datasets have been linked, patient identifiable data are removed from the new dataset so that it is not possible to identify any patient. These data are then made available to the NJR's statistics and analysis team at the University of Bristol whose processing of the data is compliant with the NHS Data Security and Protection Toolkit. The work undertaken by the University of Bristol is directed by the NJR's Steering Committee and the NJR's Editorial Committee and the results of the analyses are published in the NJR's Annual Report and in professional journals. All published data is based on anonymised data, this means that no patient could be identified.

Terms and conditions for use of data

Do you wish to use NJR data and statistics for presentations, reports and other publications? You can source these on Bookshelf https://www.ncbi.nlm.nih.gov/books/NBK559966/ In quoting or publishing NJR data, screen shots from NJR reports or websites we request that you reference the 'National Joint Registry'. State the time-period covered, procedures included and also include reference to any other filters that have been applied to the data. This is particularly important if the information is in the public domain.

Where possible, include a link to www.njrcentre.org.uk so that the audience is able to seek out further context and information on published joint replacement statistics.

Disclaimer

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20th Anniversary

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SHOULDERS

This document is available to download in PDF format at reports.njrcentre.org.uk, along with additional data and information on NJR progress and developments, clinical activity as well as implant and unit-level activity and outcomes.

At the time of publication, every effort has been made to ensure that the information contained in this report is accurate.
If amendments or corrections are required after publication, they will be published on the NJR website at www.njrcentre.org.uk and on the dedicated NJR Reports website at reports.njrcentre.org.uk.