

# **IRISH NATIONAL ORTHOPAEDIC REGISTER**

## FIRST REPORT



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The National Office of Clinical Audit (NOCA) was established in 2012 to create sustainable clinical audit programmes at national level. NOCA is funded by the Health Service Executive Office of the Chief Clinical Officer and operationally supported by the Royal College of Surgeons in Ireland.

The National Clinical Effectiveness Committee (NCEC) defines national clinical audit as “a cyclical process that aims to improve patient care and outcomes by systematic, structured review and evaluation of clinical care against explicit clinical standards on a national basis” (NCEC, 2015, p. 2). NOCA supports hospitals to learn from their audit cycles.

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## ACKNOWLEDGEMENT OF KEY PARTNERS

This report uses data provided by patients and collected by their healthcare providers as part of their care. NOCA would like to thank all participating hospitals for their valuable contribution, in particular the Audit Coordinators and Clinical Leads. Without their continued support and input, this audit could not produce meaningful analysis of joint replacement in Ireland.

NOCA greatly appreciates the ongoing commitment and support received from The Irish Institute of Trauma and Orthopaedic Surgery (IITOS).



The INOR Governance Committee would like to thank all those who were involved in the early stages of development of INOR and all those who continue to be involved in the implementation phase of the Register. These include but are not limited to:

- HSE Acute Hospitals Division
- HSE National Quality Improvement Team and management
- Project sponsors from the HSE Office of the Chief Information Officer (OcCIO) on behalf of the HSE
- Project managers from the OcCIO, past and present
- NOCA Executive Manager, both past and present
- OpenApp team and management (INOR's system development partner)
- NOCA Information Manager
- NOCA executive management team, both past and present
- NOCA analytical team
- Healthcare Pricing Office
- National Clinical Programme in Trauma and Orthopaedic Surgery
- INOR patients who participate and provide their information to the Register.

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DESIGNED BY  
**SWERVE**

# **Irish National Orthopaedic Register**

## First Report

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17th September, 2021

Dear Mr Cashman,

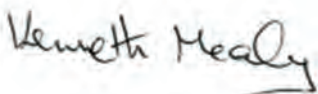
I wish to acknowledge receipt of the *Irish National Orthopaedic Register First Report*.

Following your presentation to the NOCA Governance Board on the 16th September 2021 and feedback garnered from our membership, we are delighted to endorse this report.

I wish to congratulate you, Audit Manager Suzanne Rowley and your governance committee in the development of this report. The Board commends you and your colleagues' sustained efforts over several years in finalising this comprehensive first report focused on arthroplasty.

Please accept this as formal endorsement from the NOCA Governance Board of the *Irish National Orthopaedic Register First Report* and we wish you every success in your ongoing commitment to improving the care of arthroplasty patients.

Yours sincerely,



**Mr Ken Mealy**  
**Chair**  
**National Office of Clinical Audit Governance Board**

# FOREWORD

I am delighted to welcome the publication of the first Irish National Orthopaedic Register (INOR) report and wish to congratulate the writers and management team at the National Office of Clinical Audit. INOR has been in development since 2014 and this report marks a significant milestone for hip and knee replacement surgery patients in Ireland.

The Register was created in order to monitor the performance of implants, institutions and surgical teams. While hip and knee replacement surgeries have very high success rates, outcomes can always be improved.

This report includes information from the first seven participating hospitals in INOR. As the number of participating hospitals (both public and private) increases, the influence of the data will grow. The review of data can drive self-reflection, change and improvement in our orthopaedic services. However, truly effective reports need to be timely and accessible, and include information of the highest quality. As the roll-out of INOR to public hospitals nears completion, we welcome the participation of private hospitals in INOR. All patients who have hip or knee replacement surgery in the Republic of Ireland should be included in the Register regardless of where their surgery takes place.

The Register is an important step in the development of orthopaedic services in Ireland. An independent audit must facilitate a review of what is working well in order to analyse, understand and make changes in the areas where we may not achieve our desired outcomes. I look forward to building the relationship between the Irish Institute of Trauma and Orthopaedic Surgery (IITOS) and INOR in order to achieve the optimum outcomes for joint replacement patients in Ireland.

All those involved in the care of patients who undergo hip or knee replacement surgery will welcome this first INOR report. It is the first review of both clinical and implant details, and it provides a review of patient-reported outcomes. It also reflects the importance of the work that the National Office of Clinical Audit and the INOR Governance Committee are doing.

**Professor John O'Byrne**

*President*

*Irish Institute of Trauma and Orthopaedic Surgery*



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# GLOSSARY OF TERMS AND DEFINITIONS

TERM	EXPLANATION
<b>AHCP</b>	allied healthcare professional
<b>arthroplasty</b>	A procedure where a natural joint is reconstructed with an artificial prosthesis. In this report, hip or knee replacement surgery is referred to as hip or knee arthroplasty. However, the term 'arthroplasty' is interchangeable with the term 'procedure' and sometimes, for ease of understanding, <i>we simply refer to primary or revision hip or knee in the text.</i>
<b>ASA</b>	American Society of Anesthesiologists
<b>ASA grade</b>	The ASA physical status classification system is a scoring system for grading the overall physical condition of the patient, as follows: 1 = fit and healthy; 2 = mild disease, not incapacitating; 3 = incapacitating systemic disease; 4 = life-threatening disease.
<b>ASR</b>	articular surface replacement (hip resurfacing system)
<b>bilateral</b>	Replacing both the left and right hip or knee joints by means of a prosthesis within the same surgery. It may also be referred to as simultaneous joint replacement.
<b>BMI</b>	body mass index Index for weight compared to body length in kilograms per square metre: $\leq 24.99$ = normal weight; 25.00–29.99 = overweight; 30.00–39.99 = obese; $\geq 40.00$ = morbidly obese.
<b>brand</b>	The brand of prosthesis is a type of product manufactured by a particular company under a particular name.
<b>cement</b>	Material (polymethyl methacrylate) used to fixate joint replacements to bone.
<b>cemented</b>	Prosthesis or component designed to be fixed into the bone with cement.
<b>cementless</b>	Prosthesis or component designed to be fixed into the bone without cement.
<b>COC</b>	ceramic-on-ceramic The bearing surface of the ball and socket can be made from a number of different materials, including a ceramic ball and ceramic cup.
<b>COH</b>	Croom Orthopaedic Hospital
<b>component</b>	An artificial or prosthetic implant to replace bone. In this report, we usually use the term 'components', but this may be interchangeable with 'implants'.
<b>COP</b>	ceramic-on-polyethylene The bearing surface of the ball and socket can be made from a number of different materials, including a ceramic ball and polyethylene cup.
<b>DVR</b>	Data Validation Report
<b>DVT</b>	deep vein thrombosis
<b>elective surgery</b>	Elective or planned orthopaedic surgery is defined as a non-emergency surgical procedure, although it can sometimes be urgent.
<b>fixation</b>	Describes how the artificial component is secured into the bone.

TERM	EXPLANATION
<b>HIPE</b>	Hospital In-Patient Enquiry
<b>HIQA</b>	Health Information and Quality Authority
<b>HSE</b>	Health Service Executive
<b>ICD</b>	International Classifications of Diseases ICD-10-AM codes: The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification.
<b>ICT</b>	information and communication technology
<b>ICU</b>	intensive care unit
<b>IITOS</b>	Irish Institute of Trauma and Orthopaedic Surgery
<b>INCC</b>	Irish National Component Catalogue
<b>INOR</b>	Irish National Orthopaedic Register
<b>IPL</b>	International Prosthesis Library
<b>IPMS</b>	Integrated Patient Management System
<b>ISAR</b>	International Society of Arthroplasty Registries
<b>KQI</b>	key quality indicator
<b>KROH</b>	Kilcreene Regional Orthopaedic Hospital
<b>LMWH</b>	low molecular weight heparin
<b>manufacturer</b>	The company that makes the component.
<b>MDM</b>	modular dual mobility (acetabular implant)
<b>MDS</b>	minimum dataset
<b>MOP</b>	metal-on-polyethylene
<b>MPUH</b>	Merlin Park University Hospital
<b>MRHT</b>	Midland Regional Hospital Tullamore
<b>MRN</b>	medical record number
<b>NCHD</b>	non-consultant hospital doctor
<b>NCPT&amp;OS</b>	National Clinical Programme for Trauma and Orthopaedic Surgery
<b>NJR</b>	National Joint Registry
<b>NOCA</b>	National Office of Clinical Audit
<b>NOHC</b>	National Orthopaedic Hospital Cappagh
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OHS</b>	Oxford Hip Score

NAME	DEFINITION
<b>OKS</b>	Oxford Knee Score
<b>OLHN</b>	Our Lady's Hospital, Navan
<b>OoCIO</b>	Office of the Chief Information Officer
<b>OA</b>	Osteoarthritis - a disorder which affects the cartilage of a joint.
<b>PAS</b>	patient administration system
<b>PE</b>	pulmonary embolism
<b>PROM</b>	patient-reported outcome measure
<b>prosthesis</b>	An artificial or prosthetic implant to replace bone.
<b>RCSI</b>	Royal College of Surgeons in Ireland
<b>revision arthroplasty</b>	A revision is defined as reoperation on a previous hip or knee arthroplasty where one or more of the prosthetic components is replaced or removed, or one or more components is added.
<b>SIVUH</b>	South Infirmary Victoria University Hospital
<b>TED</b>	thrombo-embolus deterrent
<b>THR</b>	total hip replacement
<b>TILDA</b>	The Irish Longitudinal Study on Ageing
<b>TKR</b>	total knee replacement
<b>UDI</b>	unique device identifier
<b>UHMWPE</b>	ultra-high molecular weight polyethylene
<b>XLPE</b>	cross-linked UHMWPE

# EXECUTIVE SUMMARY

This is the first report from the Irish National Orthopaedic Register (INOR). This is a significant milestone for the Register, as the report presents data and information on elective hip and knee replacement surgery in INOR. It is also a platform to commence building of more complex reporting of national and local data from the Register. This report includes data that were gathered from the commencement of the Register on 1 December 2014 until 31 July 2019.

This report comprises data from seven hospitals that were implemented in the INOR system at various time points during the reporting period. Over the course of the reporting period, INOR achieved a national coverage rate of 19% and 24% for hip and knee arthroplasty activity, respectively (public hospitals only). Private hospital implementation commenced after the end of the reporting period. While this report allows a review of INOR data for the first time, it is worth noting that any significant clinical conclusions will not be realised until the coverage rate increases to a level that will facilitate this.

INOR is managed by the National Office of Clinical Audit (NOCA) and is clinically supported by, and receives advice from, the Irish Institute of Trauma and Orthopaedic Surgery (IITOS) and the National Clinical Programme for Trauma and Orthopaedic Surgery. It is a joint patient safety collaboration undertaken by both NOCA and the Health Service Executive Office of the Chief Information Officer. INOR is an electronic web-based system that participating hospitals utilise in order to facilitate the collection of pre-defined information in real time along the patient journey, from pre-operative assessment to the time of surgery and at defined time points following a patient's hip or knee arthroplasty. Patients are required to provide consent in order to allow their information to be transferred to NOCA who are a third party in receipt of their data.

The overall number of hip and knee arthroplasties included in the reporting period is 6,594. There were 3,723 hip surgeries (3,344 primary and 379 revision arthroplasties) and 2,871 knee surgeries (2,677 primary and 194 revision arthroplasties).

The data in this report provide insights into patient characteristics and their surgical information; the report also presents clinical outcomes, patient-reported outcome measure (PROM) information, and some activity information on various components used in patients.

The INOR Governance Committee would like to thank all of our participating hospitals, and particularly the individuals who entered information directly into the system. We would like to especially thank the hospital clinical leads and the dedicated and hard-working audit coordinators, on whom INOR relies to manage the Register locally in each hospital.

Finally, a special thanks to our INOR patients who have provided their information so generously across all participating hospitals.

## KEY FINDINGS

# KEY FINDINGS

### KEY FINDINGS

- This report incorporates data from 7 of the 12 public hospitals that complete elective hip or knee arthroplasty. The remaining public sites will be included in the Irish National Orthopaedic Register (INOR) by 2022.
- In the reporting period for this report (1 December 2014 to 31 July 2019), INOR achieved a national coverage rate of 19% and 24% for hip and knee arthroplasty activity, respectively (public hospitals only). Private hospital implementation of INOR commenced in Q4 2020.
- The patient consent rate for INOR during the reporting time frame was 99.6%.
- Patient-reported outcome measure (PROM) questionnaire completion rates were high across both hip and knee arthroplasty patients and across all follow-up time periods. This signifies a patient group that is engaged with the Register.

### KEY FINDINGS: HIPS



- There were 3,723 hip surgeries (3,344 primary and 379 revision arthroplasties) during the reporting period.
- The share of males and females who received a primary hip arthroplasty was the same, at 50%. For revision hip arthroplasties, 51% of patients were male and 49% were female.
- The average age of a patient who had a primary hip surgery was 65 years, while the average age of a revision hip patient was 68 years.
- More than 80% of patients who had a primary hip arthroplasty and more than 90% of patients who had a revision hip arthroplasty had an American Society of Anesthesiologists (ASA) grade of 2 or higher.
- Ninety-three percent of patients who had a primary hip arthroplasty were diagnosed with osteoarthritis, whereas 41% of hip revision patients had a diagnosis of aseptic loosening.
- Patients can receive one or more types of anticoagulant. Low molecular weight heparin (LMWH) was the most commonly used postoperative anticoagulant in patients who had a primary (94%) or revision (97%) hip arthroplasty, while 39% and 43% of all primary and revision patients, respectively, used aspirin postoperatively.
- The posterior approach was the most common surgical approach for both primary and revision hip arthroplasties, with 68% and 69% of primary and revision hip arthroplasties, respectively, being performed using this approach.
- Spinal anaesthetic was used on 93% of primary hip arthroplasty and 84% of revision arthroplasty patients.
- Tranexamic acid was used in 91% of primary hip arthroplasties and 92% of revision arthroplasties.
- A systemic antibiotic prophylaxis was used in 99.7% of primary hip arthroplasties and 100% of revision arthroplasties.
- In INOR, the time frame of early revision surgery is classified as occurring within 1 year of the primary surgery. The rate of early revision surgery in primary hip arthroplasties was 1.1%. Infection and periprosthetic fracture were the two main reasons for early revision surgery.

- Approximately 1% of all patients who had a primary hip arthroplasty experienced either a pulmonary embolism (PE) or deep vein thrombosis (DVT); 0.5% of revision patients experienced a DVT.
- More than one-half (60%) of all primary hip arthroplasties were performed using cementless femoral stem fixation.
- Exeter V40 (Stryker) was the brand used in 96% of cemented femoral stem fixations, while Accolade II (Stryker) was the predominant brand used in cementless fixations.
- Large femoral head sizes (32 mm and 36 mm) accounted for 92% of primary hip replacement articulations.
- Metal-on-polyethylene was the predominant bearing surface used in primary hip arthroplasties.

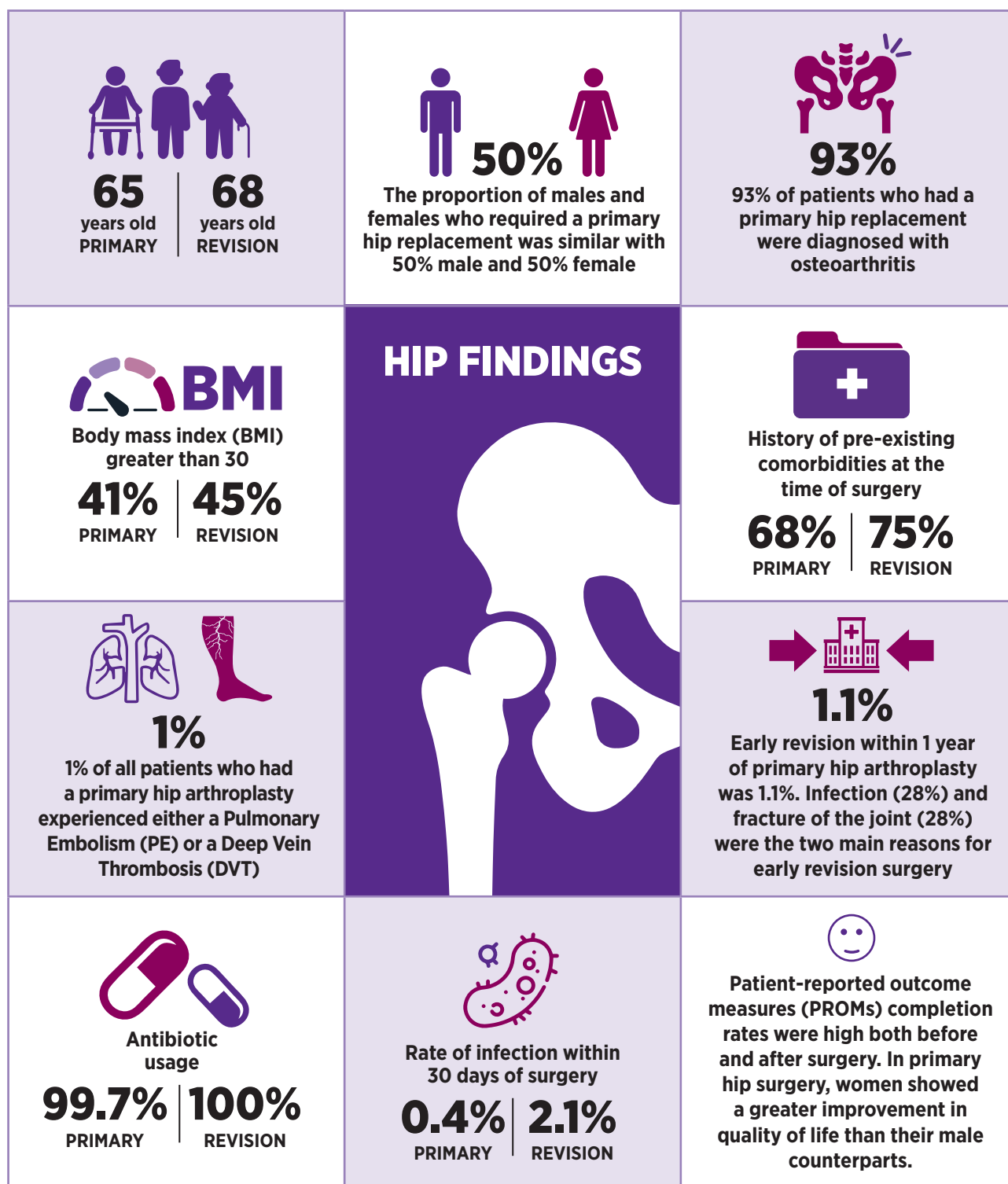
## KEY FINDINGS: KNEES



- There were 2,677 primary (57 patients with 114 bilateral procedures) and 194 revision knee arthroplasties.
- The average age for both primary and revision knee arthroplasty patients was 67 years.
- Twenty-one percent of primary knee arthroplasty patients had an ASA grade of 3 or higher.
- The majority of patients who had a primary knee arthroplasty were diagnosed with osteoarthritis (98%), while instability (27%) and pain of unknown origin (27%) were the most common diagnoses recorded in knee revision arthroplasties.
- Patients can be prescribed more than one type of anticoagulant. LMWH was the most commonly used postoperative anticoagulant in patients who had a primary (95%) and revision (96%) knee arthroplasty, while 42% of all patients used aspirin postoperatively.
- The majority of primary and revision knee arthroplasties were performed using the medial parapatellar approach at 99% and 98% respectively.
- Spinal anaesthetic was the predominant type of anaesthesia used in both primary and revision knee arthroplasty patients at 93% and 78% respectively.
- Tranexamic acid was used in 88% of patients who had a primary knee arthroplasty and 82% of patients who had a revision knee arthroplasty.
- Cefuroxime was the antibiotic most commonly used in patients who had a primary (96%) and revision (70%) knee arthroplasty, while vancomycin was used for almost one-fifth (n=34; 18%) of revision knee arthroplasty patients.
- The rate of joint infections was 0.6% and 2.6% in primary and revision knee arthroplasties, respectively.
- Of all primary knee arthroplasty patients, 1.4% had an early revision knee arthroplasty within 1 year of their initial surgery. Infection was the predominant reason for early revision knee surgery, accounting for 43% of patients who underwent an early revision arthroplasty.
- Of all patients who had a primary knee arthroplasty, 1.6% experienced either DVT or a PE. There were no thromboembolic events reported following revision knee arthroplasties.
- Triathlon (Stryker) was the brand most commonly used in primary knee arthroplasties, and Triathlon TS (Stryker) was the predominant brand used in revision knee arthroplasties.

# KEY FINDINGS

## IRISH NATIONAL ORTHOPAEDIC REGISTER





**3723**  
**HIP REPLACEMENT**  
**SURGERIES\***

**2871**  
**KNEE REPLACEMENT**  
**SURGERIES\***

**7 of 12**  
**ELECTIVE PUBLIC**  
**HOSPITALS**



**67** | **67**  
years old | years old  
**PRIMARY** | **REVISION**



A greater proportion of females  
required knee arthroplasty

**61%** | **57%**  
Female | Female  
**PRIMARY** | **REVISION**



**98%**

98% of patients who had a  
primary knee replacement  
surgery were diagnosed  
with osteoarthritis



Body mass index (BMI)  
greater than 30

**59%** | **55%**  
**PRIMARY** | **REVISION**

## KNEE FINDINGS



History of pre-existing  
comorbidities at the  
time of surgery

**78%** | **77%**  
**PRIMARY** | **REVISION**



**1.6%**

1.6% of patients who had a  
primary knee replacement  
surgery experienced either a  
Pulmonary Embolism (PE) or a  
Deep Vein Thrombosis (DVT)



**1.4%**

1.4% of all primary knee  
replacement surgeries had an early  
revision knee procedure within 1  
year of their initial surgery. 46%  
of these patients required early  
revision surgery due to infection



**100%**

100% of patients who had  
primary and revision surgery  
were prescribed antibiotics



Rate of infection within  
30 days of surgery

**0.6%** | **2.6%**  
**PRIMARY** | **REVISION**



PROMs completion rates for  
knee replacement surgery  
were high both before and  
after surgery. Females showed  
a greater improvement in their  
quality of life at 6 months and  
2 years following both primary  
and revision knee replacement

\* Data in this report includes patients from participating hospitals from 1 December 2014 to 31 July 2019. Hospitals joined INOR at different points during this time period.

# KEY RECOMMENDATIONS

## RECOMMENDATIONS FOR THE NATIONAL OFFICE OF CLINICAL AUDIT

The National Office of Clinical Audit (NOCA) will continue to support hospitals in order to ensure better data quality. NOCA will deliver more timely Data Validation Reports in order to ensure ongoing review of these data accuracy issues.



## RECOMMENDATIONS FOR HOSPITALS/CLINICIANS

Hospital Irish National Orthopaedic Register (INOR) clinical leads and participating consultants are required to take responsibility for the quality of clinical information captured in INOR.



## RECOMMENDATIONS FOR THE HEALTH SERVICE EXECUTIVE

All public patients who have hip or knee replacement surgery should be on INOR regardless of where the surgery takes place.



# CAPTURING PATIENT PERSPECTIVES

Arthritis affects 1 million people in Ireland and is the most common cause of disability in this country. Approximately one in five women (18%) and 10% of men aged over 60 years are living with osteoarthritis (OA). Worryingly, the prevalence of OA is increasing due to the population ageing as well as an increase in contributing factors such as obesity.



One of the striking features of this important inaugural report from the Irish National Orthopaedic Register (INOR) is the close correlation it highlights between OA and hip and knee surgeries. Some 93% and 98% of patients who received primary hip and knee replacements, respectively, had been diagnosed with OA. While every effort is made to ensure that people with OA can live with their condition as positively as possible – taking account of the role of physical activity, diet and treatments – surgery will be part of a large number of patient journeys.

Therefore, having publicly available data regarding clinical outcomes, patient-reported outcome measures (PROMs) and patient characteristics is a positive step forward in terms of transparency and accountability in our health system.

It is significant that the INOR Governance Committee contains two Public and Patient Interest Representatives, of which I am honoured to be one. Arthritis Ireland is the national patient organisation and health research charity for people living with arthritis. In my role as Head of Communications and Advocacy with this organisation, I am acutely aware of the impact that arthritis has on people's lives and the lived reality of the pain and damage it causes. It is therefore highly encouraging to note the improvements in people's quality of life as a result of hip and knee replacement procedures. With a condition for which there is currently no cure, these procedures are truly transformative.

There is another point worth making in relation to the importance of trustworthy health information being publicly available and accessible. Much has been written about this era of misinformation and disinformation and the challenges this poses for patients in identifying which information to trust. It is a constant theme in calls to the Arthritis Ireland helpline and in engagement with the organisation. While this report will largely be of interest to clinicians and professionals working within the orthopaedic space, it is also important for patients and the public. I welcome the fact that it is accompanied by a summary document that will be accessible to a more general audience, which will, in turn, enhance the dissemination and comprehension of the report's findings.

Finally, the publication of this report is a significant event in Irish health. However, it is just the start; we look forward to the expansion and strengthening of INOR and the publication of further, more comprehensive reports in the coming years. Patients and the public will benefit from this work in the same way that the work of INOR itself is enhanced through both patient and public involvement.

## **Brian Lynch**

*Head of Communications and Advocacy, Arthritis Ireland*

*Public and Patient Interest Representative, INOR Governance Committee*

After I had my hip replacement surgery, I was followed up on by the Arthroplasty Nurse Specialist in the hospital where I had my operation. During one conversation, she mentioned an opportunity to be involved with the INOR Governance Committee. Generally, my overall experience of my hip surgery was quite positive, and this prompted me to have a discussion with the INOR Manager about becoming involved.



I am delighted to be involved with INOR and began attending meetings at the end of 2019. I work alongside the orthopaedic surgeons, the INOR Manager, senior healthcare management and the INOR clinical leads, with a shared goal of improving joint replacement surgery. I contribute my opinion on all matters to the INOR Governance Committee and I always feel that my voice is heard. I am empowered to be the voice of the patient and support an open and transparent process of data reporting, and I welcome this first report from INOR. I have been particularly involved in developing the summary report alongside this main national report. The summary report is vital for spreading the findings of this report to a public audience.

There are some items that I intend to work closely on with the INOR Manager in order to improve the patient experience and care provided. One item in particular that I feel warrants further review is the support provided to patients in the immediate week or two after discharge from hospital. I will be working with the INOR Manager and the INOR Governance Committee to identify the actions necessary to improve this area of patient care.

**Plunket O'Reilly**

*Public and Patient Interest Representative  
INOR Governance Committee*

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***One item in particular that I feel warrants further review is the support provided to patients in the immediate week or two after discharge from hospital. I will be working with the INOR Manager and the INOR Governance Committee to identify the actions necessary to improve this area of patient care.***

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# WHAT IS A HIP AND KNEE REPLACEMENT?

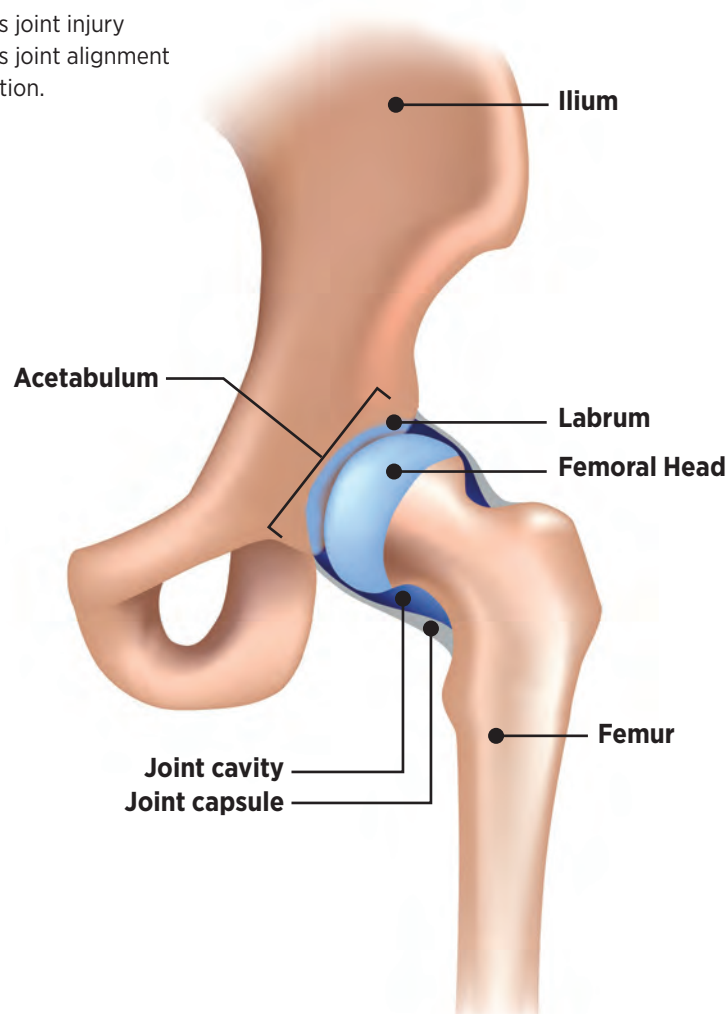
## WHAT IS A HIP REPLACEMENT?

A hip replacement replaces a hip joint that has been damaged, usually by osteoarthritis. The hip joint is a ball and socket joint. The ball is formed by the head of the thigh bone (femur) and fits into the socket (acetabulum). The surface of these bones is coated by a smooth and compressible substance known as articular cartilage. This creates a smooth, low friction surface that helps the bones glide easily across each other.

Osteoarthritis occurs when the articular cartilage wears away, exposing the underlying bone. This causes roughening and distortion of the joint, resulting in painful and restricted movement. A limp can often develop and the leg may become wasted and shortened resulting in increased pain.

There is no single cause of osteoarthritis, however, several factors may increase the risk of developing osteoarthritis.

- Age
- Gender
- Genetics or family history
- Obesity
- Previous joint injury
- Previous joint alignment
- Occupation.



**FIGURE 1: ANATOMY OF THE HIP JOINT**

## HIP REPLACEMENT SURGERY

Hip replacement surgery is nearly always carried out to improve pain and function that cannot be controlled by other methods such as painkillers, physiotherapy or other surgery. A hip replacement or arthroplasty, is an artificial implant that replaces a hip joint that is damaged or arthritic/worn out.

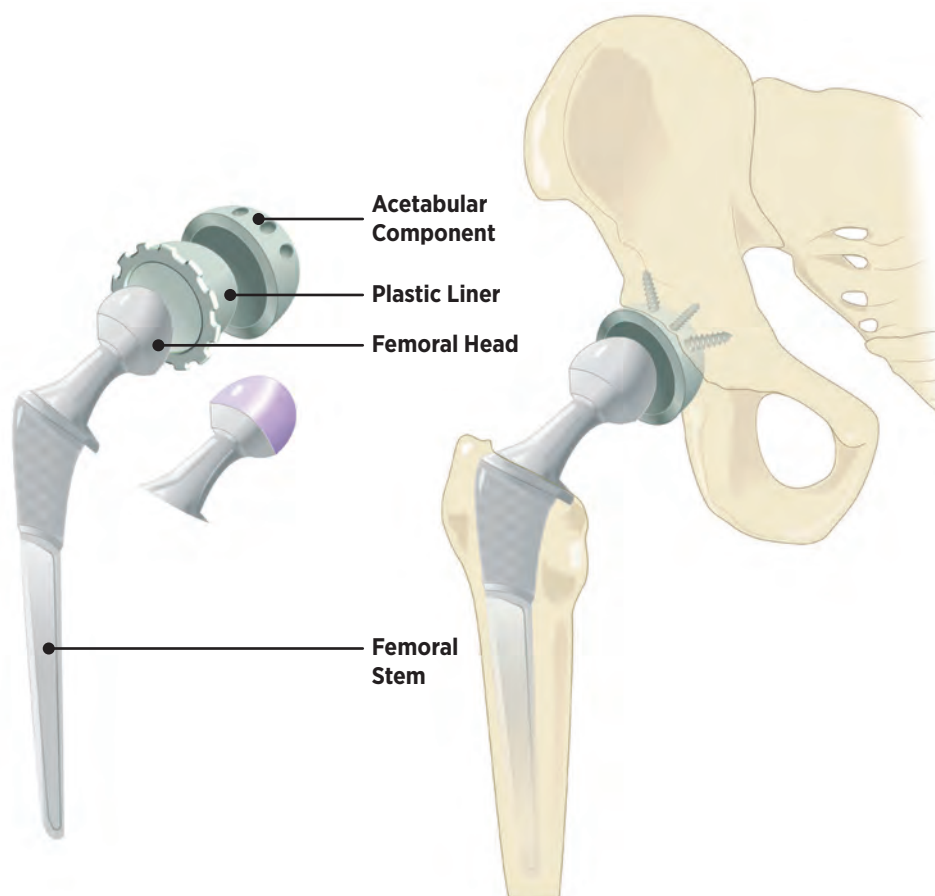
Once the joint capsule has been opened, the hip is dislocated out of the socket, and the head of the femur is removed. The acetabulum or socket is then prepared by removing any remaining cartilage. The new cup is inserted, and this can be secured with screws or cemented in place. The space down the femur bone is then enlarged to accept the new femoral implant, and it can also be pressed in or cemented into place. The new head fits on to the femoral implant, and the hip is reduced back into the socket.

The implants mimic bone shape and can be made of metal, polyethylene or ceramic. Cement may or may not be used to hold the implant in place depending on a surgeon preference, patient's age, bone quality.

The aim of the new joint is to relieve pain, decrease stiffness and may restore leg length and hence improve mobility.

Further information can be obtained from the HSE website.

<https://www2.hse.ie/conditions/hip-replacement/>



**FIGURE 2: HIP REPLACEMENT SURGERY AND IMPLANTS**

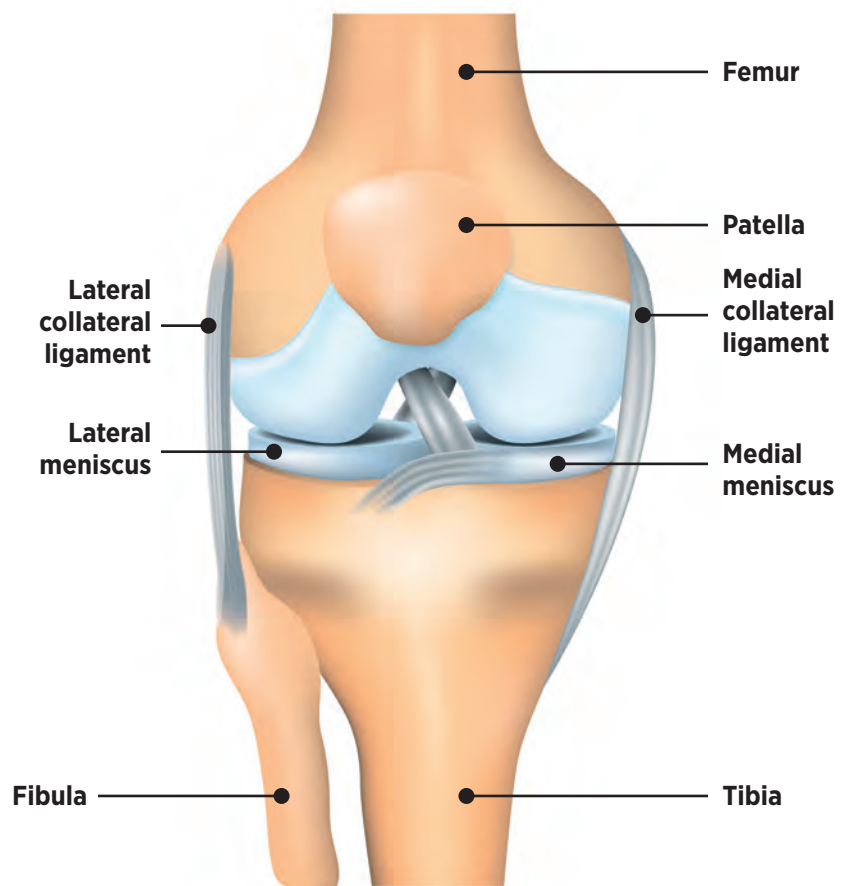
## WHAT IS A KNEE REPLACEMENT?

The knee is a complex hinge joint and one of the largest joints in the body. It is one of the largest joints in the body, formed between three bones – the thigh bone (femur), the shin bone (tibia), and the kneecap (patella).

The surfaces of the thigh (femur) and shin bone (tibia) are smooth and lubricated with joint fluid so they can roll, rotate and glide over each other easily. Cartilage covers the bones evenly, allowing smooth movement.

The knee joint is made stable with the support of strong ligaments. The menisci are two half-moon shaped pads that lie at the bone ends and help absorb shock in the joint. Muscles move the joint and help reduce the stress on the joint e.g. quadriceps and hamstring.

When the cartilage wears away, the result is osteoarthritis. This may lead to pain, stiffness and/or deformity resulting in difficulties with normal daily activities. Depending on the severity of the osteoarthritis, conservative methods of treatment, including physiotherapy and/or injections are often trialled prior to surgery.



**FIGURE 3:** ANATOMY OF THE KNEE JOINT

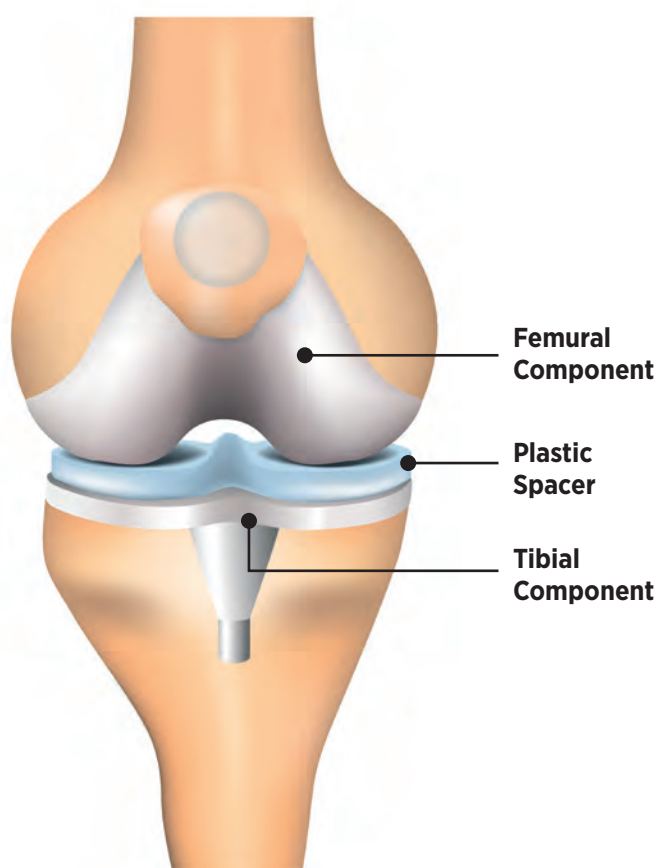
## KNEE REPLACEMENT SURGERY

The aim of the new joint is to relieve pain, decrease stiffness and may restore leg length and hence improve mobility.

Depending on the level of severity of osteoarthritis, that will determine whether a total or partial knee replacement is required. A total knee replacement involves resurfacing the ends of the femur, the tibia and in some cases the underside of the patella with implants. The knee implants are designed to simulate the human anatomy as close as possible.

The procedure is performed by a vertical incision about 10-18cms long at the front of the knee which exposes the inside of the joint. The ends of the thigh bone (femur) and the shin bone (tibia) are removed and sometimes the underside of the knee cap (patella) is removed. The implants are fixed into place usually with cement. The new knee consists of a metal shell on the end of the femur, along with a metal and plastic cover on the tibia.

A partial knee replacement, or sometimes known as a unicompartmental knee surgery, is where only a portion of the knee is resurfaced. A partial knee replacement surgery is conducted via a smaller incision and recovery tends to be quicker.



**FIGURE 4:** KNEE REPLACEMENT SURGERY AND IMPLANTS



# CHAPTER 1 **INTRODUCTION**

[CONTENTS >](#)

# CHAPTER 1: INTRODUCTION

## HIP AND KNEE REPLACEMENT SURGERY

Hip and knee replacements are some of the most frequently performed and effective surgeries worldwide (WHO, 2014). The main indication for hip or knee replacement (joint replacement surgery or arthroplasty) is osteoarthritis, which leads to reduced function and quality of life. Hip and knee replacement surgery is considered one of the most successful surgical procedures in the specialty of orthopaedics (WHO, 2014).

Osteoarthritis is a degenerative form of arthritis characterised by the wearing down of the cartilage that cushions and smooths the movement of joints, most commonly for the hip and knee. It causes pain, swelling and stiffness, resulting in a loss of mobility and function. It is one of the 10 most disabling diseases in developed countries. Worldwide, estimates show that 10% of men and 18% of women aged over 60 years have symptomatic osteoarthritis, including the moderate and severe forms (World Health Organization, 2014). In Ireland, findings from The Irish Longitudinal Study on Ageing (TILDA) identified that the overall prevalence of osteoarthritis was 12.9% (women: 17.3%; men: 9.4%). Prevalence increased with age, with the prevalence of osteoarthritis in those aged 80 years or over being twice of those aged 50–60 years (French *et al.*, 2015).

Since 2000, the number of hip and knee replacements performed each year has increased rapidly in most Organisation for Economic Co-operation and Development (OECD) member countries. On average, hip replacement rates increased by 30% between 2007 and 2017, and knee replacement rates increased by 40% over the same time period. This aligns with the rising incidence and prevalence of osteoarthritis caused by ageing populations and growing obesity rates in OECD member countries (OECD, 2019).

In the Republic of Ireland, it is estimated that there were approximately 7,000 hip and knee replacement surgeries completed in public hospitals in 2019 (Healthcare Pricing Office, 2019). It is estimated that a similar number of surgeries occur in the private hospital setting, but the exact number is not known at this time.

## DEVELOPMENT OF THE IRISH NATIONAL ORTHOPAEDIC REGISTER

Joint replacement registers play an important role in both monitoring clinical outcomes and in publishing data on implant survivorship (Hughes *et al.*, 2017). Many joint replacement (arthroplasty) registers prepare annual reports that include surgical and component information. They provide data on the risk of revision for components, and this information is openly reported on the registers' websites.

Orthopaedic surgeons in Ireland have advocated for an arthroplasty register since the early 2000s. While completing their surgical training internationally, they have utilised international registers and experienced their benefits. Many surgeons have collected data locally in their own practice and within their hospitals in order to monitor their outcomes. Support for a national orthopaedic register gained momentum following the detection of an increased rate of revision for the articular surface replacement (ASR) Hip Resurfacing System, as well as the ASR XL Acetabular System in 2008 (de Steiger *et al.*, 2011), by which point an estimated 3,500 people in Ireland had received implants from these systems during their hip replacement surgery. As there was no national implant register in place at that time, hospitals had to undertake a lengthy review of all theatre diaries and patient charts in order to identify those patients who may have received one of the affected ASR implants during their surgery.

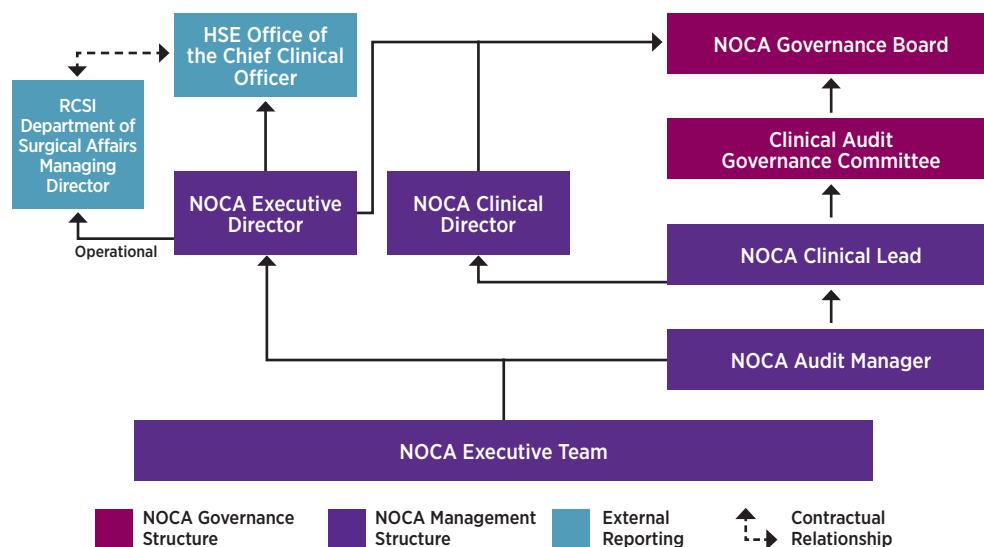
The development of the Irish National Orthopaedic Register (INOR) project began in 2012. Data were collected manually using hard-copy records from 1 December 2014, while the electronic system was built and the system went live on 4 May 2016.

INOR is managed by the National Office of Clinical Audit (NOCA), and is clinically supported and advised by the Irish Institute of Trauma and Orthopaedic Surgery (IITOS) and the National Clinical Programme for Trauma and Orthopaedic Surgery (NCPT&OS). INOR is a joint patient safety collaboration undertaken by both NOCA and the Health Service Executive (HSE) Office of the Chief Information Officer (OoCIO). NOCA has worked closely with the HSE to develop and build a unique solution that collects the data needed to introduce a national electronic arthroplasty register. In collaboration with the HSE, NOCA identified information and communication technology (ICT) systems already in use, and through further development and innovation, these formed a customised INOR ICT prototype. While the electronic system was under development, data collection was done manually using hard-copy records.

Participation in INOR is not mandatory. As each hospital has agreed to participate in the Register, all orthopaedic surgeons at these hospitals have voluntarily chosen to take part. However, INOR would welcome mandatory reporting for both public and private hospitals, as this would facilitate a faster roll-out to hospitals and a higher coverage rate. International registers that include mandatory reporting have high coverage rates (e.g. Norway, with a coverage rate of 97.5% for hip surgery (Norwegian National Advisory Unit on Arthroplasty and Hip Fractures, 2020)) compared to those with partial mandatory participation (e.g. Canada, with a national coverage rate of 73.5% (Canadian Institute for Health Information, 2020)). Interestingly, coverage in the Australian registry is 97.8%, although this registry does not have mandatory reporting. However, the Commonwealth Department of Health in Australia continues to provide funding to maintain the registry through its legislated cost recovery programme (Australian Orthopaedic Association National Joint Replacement Registry, 2020).

INOR has three pillars in its design that NOCA is required to manage and support. First, INOR is a national arthroplasty register. It facilitates the systematic collection of data on patient characteristics, procedures, implants used, and outcomes (both clinical and patient-reported measures) for patients who have elective hip or knee replacement surgery. Second, INOR is also a national information system that enables the capture of register information in real time in each participating hospital. It provides access to information in each hospital that supports patient care. Finally, the Register data will facilitate national and local clinical audit. INOR is a tool that can drive quality improvement in arthroplasty care in Ireland. In time, the data will also be used for research purposes.

NOCA facilitates continuous quality improvement in the Irish healthcare setting by maintaining a portfolio of prioritised national clinical audits which are evaluated in the context of national and international standards. By making reliable data available to those who use, manage and deliver healthcare, clinical audits help to refine Irish healthcare, improve patient outcomes and achieve change at both local and national levels. NOCA works to promote an open culture of shared learning from national clinical audit in order to improve clinical outcomes and patient safety. NOCA is funded by the HSE National Quality Improvement Team, is governed by an independent voluntary board, and is operationally supported by the Royal College of Surgeons in Ireland (RCSI) (Figure 1.1).



**FIGURE 1.1: NATIONAL OFFICE OF CLINICAL AUDIT GOVERNANCE AND MANAGEMENT TEAMS FOR AUDITS**

## IRISH NATIONAL ORTHOPAEDIC REGISTER GOVERNANCE

The INOR Governance Committee members are listed in Appendix 1. Committee membership comprises of clinical experts, public and patient interest representatives, senior healthcare management, and national and local orthopaedic nursing management. The purpose of the INOR Governance Committee is to oversee the INOR clinical audit by:

- providing clinical expertise and guidance to the INOR management team
- shaping the strategic direction of INOR
- providing clinical guidance and expertise to the INOR management team
- ensuring that INOR complies with all legal and statutory requirements, such as freedom of information and data protection
- overseeing compliance with key NOCA policies
- providing assurance to the NOCA Board on the identification and management of INOR risks
- reviewing and agreeing on the content of INOR annual reports before forwarding reports for review and sign-off by the NOCA Board
- monitoring staffing needs for INOR, both within NOCA and at hospital level, and supporting requests for staff as service grows
- acting as an escalation point for subcommittees of the INOR Governance Committee and for the INOR Clinical Leads
- ensuring that INOR adheres to the highest standards of corporate and social responsibility.

The INOR National Clinical Leads, supported by the NOCA Executive Team, have operational responsibility for the implementation of INOR. The operational clinical audit team (INOR Manager, working with the NOCA Clinical Lead and supported by the NOCA Executive Team) is responsible for the development, implementation and reporting from the audit.

## AIMS AND BENEFITS

The main objective of INOR is to monitor the quality and safety of arthroplasty and ensure safe surgical practice for patients. INOR will support hospitals should an implant recall occur.

INOR's secondary objectives are to:

- define the epidemiology of joint replacement surgery in Ireland
- provide timely information on the outcomes of joint replacements
- identify risk factors for poor outcomes
- assist in the assessment and education of clinicians.

As the INOR data mature, the following benefits are expected to be realised:

- early detection of component performance based on the Irish population
- increased patient safety, patient confidence and overall patient experience through hospital participation in the Register.

Information gathered will:

- inform orthopaedic surgeons on which factors impact on surgical outcomes
- provide feedback on national and hospital-level performance
- benchmark hip and knee arthroplasty outcomes both nationally and internationally
- highlight the potential for cost savings through reductions in revision surgery rates and through the central procurement of implants informed by implant performance in INOR.

## WHO IS THIS REPORT AIMED AT?

The data in this main report provide information primarily for surgeons and those associated with the interdisciplinary care of arthroplasty patients, including nursing staff, anaesthetists and allied healthcare professionals. It will assist these professionals to make informed judgements on the best approach to joint replacement surgery. Information contained in the summary report is provided to ensure that a succinct and easily understood synopsis of the main report is available to all those who may be interested.

This report presents INOR data for the first time. Ideally, this first report would include more hospitals and thus have a higher coverage rate, but at this stage in the implementation of INOR, it is vital that all stakeholders – especially our participating hospitals, clinicians and funders – have an opportunity to view the data. As national coverage (from both public and private hospitals) and data in the Register increase and the data mature, more clinical commentary, interpretation, insights and recommendations will be possible and will be included in future reports. In time, this information can be used by both clinicians and policy-makers within the Department of Health, by management within the HSE, by hospital management, and by the NCPT&OS to improve the care and management of arthroplasty patients.

## PURPOSE OF THIS REPORT

One key function of the INOR report is to disseminate information from the Register. This report covers the time period from 1 December 2014 to 31 July 2019, presenting data from early adopter hospitals (Figure 1.2). This first report demonstrates some of the information that will be available in future INOR reports. Demographic, surgical and outcome (both clinical and patient) data are presented in Chapters 4–7. The importance and effectiveness of the Register will be enhanced greatly in time, as more hospitals participate in the audit and with the resultant increase in captured data. The increase in data that are collected will allow for more meaningful outcome analysis to be undertaken.

FIGURE 1.2

# HOSPITALS AND PEOPLE WE WORK WITH

	<b>SAOLTA UNIVERSITY HEALTH CARE GROUP</b> Merlin Park University Hospital (MPUH)
	<b>DUBLIN MIDLANDS HOSPITAL GROUP</b> Midland Regional Hospital Tullamore (MRHT)
	<b>IRELAND EAST HOSPITAL GROUP</b> Our Lady's Hospital, Navan (OLHN) National Orthopaedic Hospital Cappagh (NOHC)
	<b>UL HOSPITAL GROUP</b> Croom Orthopaedic Hospital (COH)
	<b>SOUTH/SOUTH WEST HOSPITAL GROUP</b> South Infirmary Victoria University Hospital (SIVUH) Kilcreene Regional Orthopaedic Hospital (KROH) University Hospital Kerry (UHK)
	<b>PRIVATE HOSPITALS</b> Blackrock Clinic

## MERLIN PARK UNIVERSITY HOSPITAL (MPUH)

**LOCAL AUDIT COORDINATOR:**  
Catriona Flaherty

**CLINICAL LEAD:**  
Mr Colin Murphy

## CROOM ORTHOPAEDIC HOSPITAL CAPPAGH (COH)

**LOCAL AUDIT COORDINATOR:**  
Sinead O'Dwyer

**CLINICAL LEAD:**  
Mr Cian Kennedy

## UNIVERSITY HOSPITAL KERRY (UHK)

**LOCAL AUDIT COORDINATOR:**  
Sinead Healy

**CLINICAL LEAD:**  
Mr John Rice

## SOUTH INFIRMARY VICTORIA UNIVERSITY HOSPITAL (SIVUH)

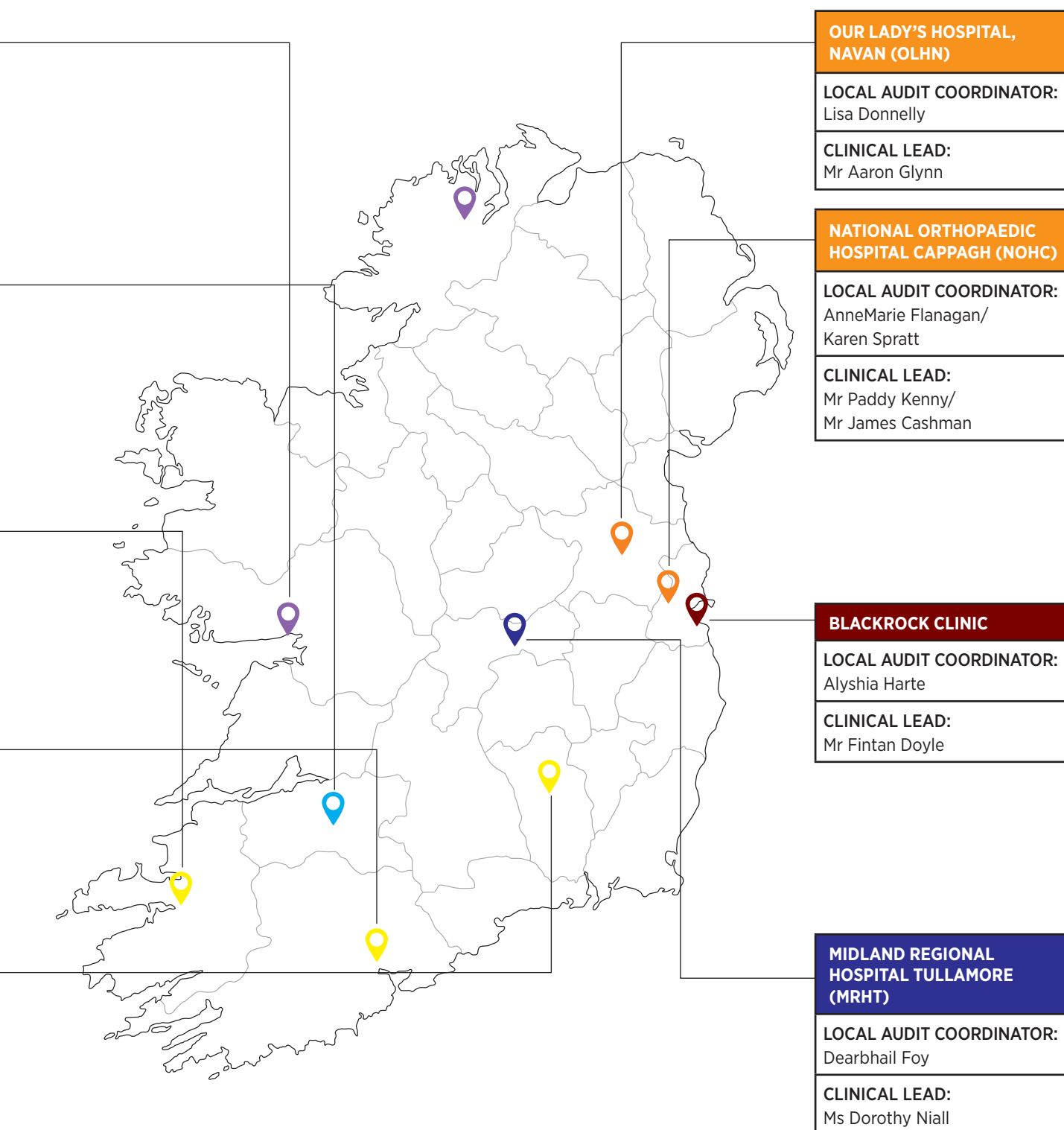
**LOCAL AUDIT COORDINATOR:**  
Katrina Linehan/Noreen Lynch

**CLINICAL LEAD:**  
Mr Shane Guerin

## KILCREENE REGIONAL ORTHOPAEDIC HOSPITAL (KROH)

**LOCAL AUDIT COORDINATOR:**  
Margaret Murphy

**CLINICAL LEAD:**  
Mr Terence Murphy





A photograph of three surgeons in an operating room, wearing blue scrubs, masks, and caps, performing a procedure. A large surgical light is visible above them. The image has a blue tint.

## CHAPTER 2 **METHODOLOGY**

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## CHAPTER 2: METHODOLOGY

### AUDIT METHOD





INOR collects data on elective hip and knee joint replacement arthroplasties (surgeries), both primary and revision, that are carried out in participating hospitals. The INOR Governance Committee has agreed the following inclusion and exclusion criteria for procedures that are included in INOR; these criteria are outlined in the *INOR Inclusion-Exclusion Criteria Hospital Information Leaflet V1.0* (INOR Governance Committee 2018). The inclusion and exclusion criteria for hip and knee replacement surgery are detailed in Tables 2.1 and 2.2, respectively.

The scope of the delivery of INOR implementation is divided into two phases. Phase 1 includes 12 public 'elective' hospitals and 16 private hospitals. Phase 2 will involve 10 'non-elective' hospitals. The majority of patients have their surgery in elective hospitals; however, because of the occasional requirement for intensive care unit (ICU) support due to a patient's pre-existing condition(s), they will be required to have surgery in a hospital that has ICU capacity.

**TABLE 2.1: INCLUSION AND EXCLUSION CRITERIA FOR HIP ARTHROPLASTY**

<b>Inclusion criteria</b>  	<b>Exclusion criteria</b>  
<ul style="list-style-type: none"> <li>• Primary total hip replacement (THR)</li> <li>• Primary total hip resurfacing</li> <li>• Single-stage revision of:               <ul style="list-style-type: none"> <li>- THR</li> <li>- Hip resurfacing</li> </ul> </li> <li>• First stage of two-stage revision of:               <ul style="list-style-type: none"> <li>- THR</li> <li>- Hip resurfacing</li> </ul> </li> <li>• Second stage of two-stage revision of:               <ul style="list-style-type: none"> <li>- THR</li> <li>- Hip resurfacing</li> </ul> </li> <li>• Excision arthroplasty</li> <li>• Revision THR for periprosthetic fracture</li> </ul>	<ul style="list-style-type: none"> <li>• Hemiarthroplasty</li> <li>• Bipolar arthroplasty</li> <li>• Reoperation other than revision</li> <li>• Fracture fixation for periprosthetic fracture around a THR – no removal of components</li> </ul>

**TABLE 2.2: INCLUSION AND EXCLUSION CRITERIA FOR KNEE ARTHROPLASTY**

<b>Inclusion criteria</b>  	<b>Exclusion criteria</b>  
<ul style="list-style-type: none"> <li>• Primary total knee replacement (TKR)</li> <li>• Primary unicondylar knee arthroplasty</li> <li>• Primary patellofemoral arthroplasty</li> <li>• First stage of two-stage revision of:               <ul style="list-style-type: none"> <li>- TKR</li> <li>- Unicondylar knee</li> <li>- Patellofemoral arthroplasty</li> </ul> </li> <li>• Second stage of two-stage revision of:               <ul style="list-style-type: none"> <li>- THR</li> <li>- Knee resurfacing</li> </ul> </li> <li>• Excision arthroplasty</li> <li>• Revision TKR for periprosthetic fracture</li> </ul>	<ul style="list-style-type: none"> <li>• Reoperation other than revision</li> <li>• Fracture fixation for periprosthetic fracture around a TKR – no removal of components</li> </ul>

## DATA COLLECTION



INOR facilitates real-time data capture of hip and knee arthroplasty patients on an electronic register in each participating hospital. INOR interfaces with a hospital's patient administration system (PAS), which, on searching for a patient's medical record number (MRN), returns the patient for selection and, once they are confirmed to be the correct patient, facilitates the population of the INOR patient record with the patient's demographic information. The search is restricted by hospital network Internet protocol addresses. Patient inclusion in INOR in each hospital is filtered by using the 'arthroplasty register' function on the Integrated Patient Management System (IPMS) PAS, or equivalent filtering on the non-IPMS PAS. The data shared relate to patients who are booked for either hip or knee replacement surgery.

Patient information from the PAS that is available to INOR includes:

- MRN
- title
- first name
- surname
- alias
- date of birth
- address
- surgical procedure the patient is booked for
- admission date
- discharge date
- patient's date of decease (flag if appropriate)
- admitting consultant (information is restricted to orthopaedic surgeons who carry out hip and knee replacement surgeries)
- consultant name
- specialty
- Irish Medical Council number.

Data are captured by staff in each hospital following the patient's journey from pre-operative assessment through to surgery and postoperatively for the lifetime of the component or the patient.

The data captured in INOR can be categorised as follows:

- patient demographics
- patient admission, discharge, transfer data
- patient clinical information, including component details
- patient-reported outcome measures (PROMs) – both pre- and postoperative.

The information is gathered by the clinical teams at the point of care from pre-operative and perioperative assessment and postoperatively at defined follow-up intervals: 6 months, 2 years, 5 years and every 5 years thereafter for the duration of the component or the lifetime of the patient. Table 2.3 outlines those who have the clinical responsibility for data capture within INOR. Also, as part of INOR, PROMs are completed by the patient pre- and postoperatively and at the same follow-up intervals as the post-operative review.

At the time of the pre-operative assessment, information on comorbidities and body mass index is collected. Following surgery, the surgeon enters clinical information into the perioperative form, which generates and auto populates an electronic postoperative note. The postoperative template was signed off by the IITOS Lower Limb Arthroplasty Committee; this ensures a uniform postoperative note in all hospitals where INOR exists.

Component details are entered into INOR by scanning the component barcodes at the time of surgery. INOR is constructed to facilitate the scanning of the majority of component barcodes (more than 85% of components can be scanned into the Register). NOCA continually reviews the barcode configuration in order to improve this process. In the event of a component that does not automatically scan, the user is prompted to enter the component details (reference and lot numbers) in order to search for the component. If a component is not included in the INOR component catalogue, the user can manually enter the component details in specified fields. This notifies the INOR management team to follow up with the component supplier in order to upload the component details and update the catalogue accordingly.



In order to facilitate INOR's primary function of identifying patients in the component recall process, the system needs to capture identifiable patient information while also adhering to the General Data Protection Regulation (*Regulation European Union 2016/679*) and the Data Protection Act 2018 (*Data Protection Act 2018 Number 7 of 2018*). Patients are invited to participate in the Register and must provide written informed consent that allows transfer of their identifiable data to NOCA when their consent status is 'Yes'. Patients can opt not to consent, and by doing so, their consent status is 'No' and their identifiable data are not shared with NOCA.

As well as facilitating the component recall process, consent within INOR allows the data to be used for audit or service improvement purposes. Currently, INOR data cannot be utilised for research purposes; however, a research consent function was introduced into INOR in September 2021. The standard consent process is completed prior to surgery, generally by the pre-operative assessment nurse. There is a safeguard in place to allow for the system to record the components electronically to support patient contact in the event of a recall if the patient gets to theatre without following the standard consent process. The patient's consent status is set to 'Unknown' in such instances, which raises an alert for the local audit coordinator to follow up and gain their consent. The 'Unknown' is treated like a 'No' in terms of consent until a patient indicates otherwise in writing. In some hospitals, where resources allow, the local audit coordinator will visit the patient on the ward after surgery and ask them to sign the consent form; otherwise, consent is collected at the 6-month postoperative assessment clinic. Patient consent for INOR is extremely high, at 99.6%.

**TABLE 2.3: DATA COLLECTION IN THE IRISH NATIONAL ORTHOPAEDIC REGISTER**

Responsible person	INOR dataset
<ul style="list-style-type: none"> <li>Pre-operative assessment nurse/Allied healthcare professional (AHCP)</li> </ul>	<ul style="list-style-type: none"> <li>Consent status</li> <li>Pre-operative assessment</li> </ul>
<ul style="list-style-type: none"> <li>Patient</li> </ul>	<ul style="list-style-type: none"> <li>Pre-operative assessment PROMs</li> <li>Postoperative assessment PROMs</li> </ul>
<ul style="list-style-type: none"> <li>Theatre nurse</li> </ul>	<ul style="list-style-type: none"> <li>Component details</li> </ul>
<ul style="list-style-type: none"> <li>Orthopaedic surgeon</li> </ul>	<ul style="list-style-type: none"> <li>Perioperative details</li> </ul>
<ul style="list-style-type: none"> <li>Local audit coordinator (usually an arthroplasty nurse specialist or AHCP)</li> </ul>	<ul style="list-style-type: none"> <li>Postoperative assessment</li> </ul>

The local audit coordinator manages the quality of INOR data within their own hospital. In conjunction with the local clinical lead, the local audit coordinator is responsible for the hospital data quality and integrity. NOCA provides them with a validation process that requires management of the data for accuracy, validity, completeness and reliability within their own hospital. The inclusion of data was closed out for surgery completed on 31 July 2019.

## DATA ANALYSIS

The data included in this report date back to the commencement of the Register in SIVUH on 1 December 2014. Data collection was done manually using hard-copy records while the electronic system was built, and electronic capture of data commenced on 4 May 2016. The hard-copy data captured by staff in SIVUH were retrospectively added to the system by NOCA staff. Table 2.4 outlines the seven hospitals included in this report along with the dates for which they have collected data.

**TABLE 2.4: IRISH NATIONAL ORTHOPAEDIC REGISTER HOSPITALS INCLUDED IN THE REPORT**

Hospital	Date hospital commenced in INOR	End date
SIVUH	01/12/2014	31/07/2019
MRHT	10/04/2017	31/07/2019
COH	05/03/2018	31/07/2019
KROH	30/04/2018	31/07/2019
OLHN	17/09/2018	31/07/2019
MPUH	04/03/2019	31/07/2019
NOHC	10/06/2019	31/07/2019

The Register data analysis was completed and categorised by hip (primary and revision) and knee (primary and revision) surgery data. Although hip and knee surgery data are reported separately in this report, primary and revision data are frequently reported together in tables and figures. In all future reporting, primary and revision surgery data will be reported separately in different chapters. Only patients who consented to be in the Register are included in this report.<sup>1</sup>

Data reporting for this first INOR report consists primarily of activity reports. At this time, a review of activity data is appropriate. Only national-level data are reported, with hospital-level and trend analysis reporting to be delivered in the second and subsequent INOR reports. Analysis for the national report was completed by the NOCA data analytics team.

<sup>1</sup> **Consent** is defined as follows:

- If the patient has consented to the use of their information, status equals yes.
- If the patient has died, they are deemed to have consented regardless of consent status.
- Any patient who did not consent is deemed to have not consented, regardless of any other recorded consent status, with the exception of deceased patients.



# CHAPTER 3

## DATA QUALITY



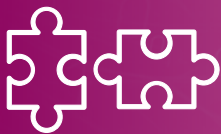
**Relevance**



**Accuracy and  
reliability**



**Timeliness and  
punctuality**



**Coherence and  
comparability**



**Accessibility  
and clarity**

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## CHAPTER 3: DATA QUALITY


The purpose of the data quality statement (Table 3.1) is to highlight the assessment of the quality of the INOR data contained in this report using internationally agreed dimensions of data quality as laid out in the Health Information and Quality Authority's (HIQA's) *Guidance on a data quality framework for health and social care* (HIQA, 2018).

This data quality statement supports the interpretation and judgement of the information gathered during the reporting time period from 1 December 2014 to 31 July 2019 and identifies strengths and areas for improvement, such as the creation of new Data Validation Reports and local reports, as well as trend analysis.


For orthopaedic surgeons, hospital managers, policy-makers and patients alike, having accurate and complete data is an absolute necessity. It is vital that INOR collects the most relevant, timely, accurate and high-quality data in order to provide robust evidence to support decision-making with regard to patient safety and standards in quality of care.

### DATA QUALITY STATEMENT


**TABLE 3.1: OVERVIEW OF DATA QUALITY FOR IRISH NATIONAL ORTHOPAEDIC REGISTER DATA**

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension
<b>Relevance</b> 	<b>Relevant data meet the current and potential future needs of users.</b>	<p>As well as the INOR minimum dataset (MDS), INOR data collection contains supplementary information that includes patient demographics, clinical information, intraoperative and component details, and follow-up and complication data, as well as patient outcome scores. The INOR MDS and supplementary information was agreed and signed off by the INOR Governance Committee.</p> <p>Extra information in the postoperative note, which is outside the remit of the INOR MDS, is captured within INOR in order to facilitate a nationally agreed postoperative note template and standardised information output in all hospitals nationally. This was approved by the IITOS Lower Limb Arthroplasty Committee. A standard postoperative note not only adds value to the audit itself, but it also supports a standardised best practice approach to postoperative documentation.</p> <p>Additional fields in the MDS were also included in order to facilitate effective and efficient data capture within an electronic hospital-based system, compared with a paper-based model. These include perioperative findings and some postoperative instructions in order to ensure that the clinical care of the patient is maintained. Although these are not part of the national audit, the hospitals have access to these data within their data extract, and these data can be used for local audit purposes.</p> <p>The INOR team works in collaboration with data users to determine relevance. During the report period, data users include the hospital business lead(s); nursing staff in pre-operative assessment and theatre; health and social care professionals; orthopaedic surgeons; local audit coordinators; and NOCA for national reporting.</p>

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension
<b>Relevance</b> <i>(Continued)</i> 	<b>Relevant data meet the current and potential future needs of users.</b>	<p>INOR has a defined change management process. Minor revisions of the dataset have occurred with the addition of new hospitals to the Register. This is managed by the <i>INOR Change Management Policy</i> (INOR Governance Committee 2018). These revisions have been agreed to either improve the quality of the data output or to facilitate more efficient data capture for INOR users.</p> <p>Clinical or MDS change requests were discussed by the INOR change control committee, which issued an advisory to approve or disapprove each change. Technical changes were discussed with the INOR management team. All changes were discussed and agreed by the INOR Governance Committee. Following change approval, the outcome was discussed and agreed by the INOR Project Board if funding was required. All changes were prioritised by urgency.</p> <p>There are minor change requests that require further analysis or review when further amendments to the system allow. Following these amendments, any further changes to the MDS will be made biannually or when urgently required in order to minimise the impact on reporting. NOCA facilitates regular workshops with users for ongoing evaluation. Feedback is provided through monthly calls with the audit coordinators, who gather evaluations from users in hospitals. All changes to the MDS are agreed by the INOR Governance Committee. INOR system amendments are reviewed and agreed by INOR management. The INOR Change Management policy will be replaced by an overall NOCA policy in 2022.</p> <p>Access to INOR data, both locally and nationally, has been limited to activity reporting within the system. INOR has an agreed reporting strategy with immediate to long-term goals for local and national reporting. As of 2021, each participating hospital has the ability to access and use its own activity data. Hospitals have received their own local reports in conjunction with the publication of the national report. Individual hospital reports currently include comparisons with the national mean statistics.</p> <p>Access to data reports from INOR has so far been limited. All hospital data requests for audit and service evaluation will now be requested by the <i>INOR Data Access Form V1.0</i> (NOCA 2021). All local data requests are logged on the INOR data request log. Access to national INOR data will be evaluated through the NOCA Data Access Policy in 2022 and will require review and sign-off by the INOR Governance Committee. The NOCA Data Access Policy will supersede the INOR Data Access Request Form in time. Access for research is not available in INOR at this time, as consent for research has not been obtained from patients. The introduction of a consent process for research in INOR is planned to commence in September 2021.</p>


Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension																																																	
<div>Accuracy and reliability</div> <div></div>	<p>The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether those data consistently measure, over time, the reality of the metrics that they were designed to represent.</p>	<p>The scope of delivery of INOR includes all elective hip and knee replacement patients who undergo surgery in the Republic of Ireland. It includes primary and revision hip and knee arthroplasty. Detailed inclusion and exclusion criteria for the inclusion of hip and knee arthroplasty patients are provided in the INOR Inclusion-Exclusion Criteria V1.0 (INOR Governance 2018), as outlined in Tables 2.1 and 2.2 in Chapter 2.</p> <div><p><b>TABLE 3.2: IRISH NATIONAL ORTHOPAEDIC REGISTER ANNUAL ACTIVITY COMPARED TO HOSPITAL IN-PATIENT ENQUIRY ACTIVITY (1 DECEMBER 2014 UNTIL 31 JULY 2019)</b></p><table><tr><th>Year</th><th>INOR</th><th>Hospital In-Patient Enquiry (HIPE)</th><th>National coverage for hips (primary and revision)</th><th>INOR</th><th>HIPE</th><th>National coverage for Knees (primary and revision)</th></tr><tr><td>2015</td><td>412</td><td>4311</td><td>10%</td><td>427</td><td>2589</td><td>16%</td></tr><tr><td>2016</td><td>439</td><td>4274</td><td>10%</td><td>412</td><td>2508</td><td>16%</td></tr><tr><td>2017</td><td>582</td><td>4290</td><td>14%</td><td>429</td><td>2548</td><td>17%</td></tr><tr><td>2018</td><td>1155</td><td>4290</td><td>27%</td><td>762</td><td>2548</td><td>30%</td></tr><tr><td>2019<sup>2</sup></td><td>1125</td><td>2495</td><td>45%</td><td>834</td><td>1516</td><td>55%</td></tr><tr><td><b>Total</b></td><td><b>3713</b></td><td><b>19 660</b></td><td><b>19%</b></td><td><b>2864</b></td><td><b>11 709</b></td><td><b>24%</b></td></tr></table></div> <p>A complete and correct INOR is indispensable for the quality of arthroplasty outcome information. The coverage of the public hospital population in this report is determined by comparing INOR activity for each hospital against HIPE activity for the same period. In this reporting period, INOR achieved a national coverage rate of 19% and 24% (Table 3.2) for hip and knee arthroplasty, respectively, when INOR activity was benchmarked against the HIPE data (Healthcare Pricing Office, 2019) collected during the same time period. It is extremely encouraging that INOR was achieving 45% and 55% public hospital coverage for hip and knee arthroplasty, respectively, by the end of July 2019 (Table 3.2).</p> <p>INOR coverage in each participating hospital is high, with 98% and 100% coverage for hip and knee procedures, respectively, in participating hospitals during the reporting time period (Table 3.3). As previously discussed, activity in the private hospitals is not known, so we cannot currently ascertain coverage across all hospitals.</p>	Year	INOR	Hospital In-Patient Enquiry (HIPE)	National coverage for hips (primary and revision)	INOR	HIPE	National coverage for Knees (primary and revision)	2015	412	4311	10%	427	2589	16%	2016	439	4274	10%	412	2508	16%	2017	582	4290	14%	429	2548	17%	2018	1155	4290	27%	762	2548	30%	2019 <sup>2</sup>	1125	2495	45%	834	1516	55%	<b>Total</b>	<b>3713</b>	<b>19 660</b>	<b>19%</b>	<b>2864</b>	<b>11 709</b>	<b>24%</b>
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<sup>2</sup> Data for 2019 include data up to 31 July 2019.



Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension																																																																						
<div>Accuracy and reliability</div> <div>(Continued)</div> <div></div>	<p>The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether those data consistently measure, over time, the reality of the metrics that they were designed to represent.</p>	<div><b>TABLE 3.3: IRISH NATIONAL ORTHOPAEDIC REGISTER COVERAGE COMPARED TO HOSPITAL IN-PATIENT ENQUIRY COVERAGE FOR THE REPORT INCLUSION PERIOD, BY HOSPITAL</b></div> <table><tr><th></th><th colspan="3">Primary and revision hips</th><th colspan="3">Primary and revision knees</th></tr><tr><th>Hospital</th><th>INOR</th><th>HIPE</th><th>Coverage</th><th>INOR</th><th>HIPE</th><th>Coverage</th></tr><tr><td>NOHC</td><td>110</td><td>116</td><td>95%</td><td>118</td><td>118</td><td>100%</td></tr><tr><td>COH</td><td>463</td><td>468</td><td>99%</td><td>308</td><td>308</td><td>100%</td></tr><tr><td>KROH</td><td>465</td><td>465</td><td>100%</td><td>266</td><td>266</td><td>100%</td></tr><tr><td>MPUH<sup>3</sup></td><td>93</td><td>126</td><td>74%</td><td>42</td><td>50</td><td>84%</td></tr><tr><td>MRHT<sup>4</sup></td><td>431</td><td>465</td><td>93%</td><td>281</td><td>281</td><td>100%</td></tr><tr><td>OLHN</td><td>276</td><td>276</td><td>100%</td><td>221</td><td>221</td><td>100%</td></tr><tr><td>SIVUH</td><td>1885</td><td>1885</td><td>100%</td><td>1635</td><td>1635</td><td>100%</td></tr><tr><td>Total</td><td>3723</td><td>3801</td><td>98%</td><td>2871</td><td>2879</td><td>100%</td></tr></table> <p>All users of the INOR system are trained by either the NOCA team prior to the system going live in each hospital or by a local audit coordinator after the system is implemented. A user cannot access the system without a username and password and cannot receive access to the system without completing the training programme.</p> <p>User guidance manuals and simple instruction sheets are available in order to make the system easier to use and enhance data quality for each module and for specific users. If significant quality issues exist (e.g. high rates of manually added alerts in a participating hospital), this could warrant further training by the local audit coordinator or the INOR Manager if required.</p> <p>Data from the INOR pilot hospital, SIVUH, were collected on paper from 1 December 2014 to 4 May 2016, so there are some missing data items from this hospital. In addition, the 12-item short form health survey (SF12) PROMs were collected on paper as the patient quality-of-life measurement tool, but with the introduction of the electronic system, the hospital commenced using the five level health questionnaire EQ-5D-5L, (EuroQoL Research Foundation, 2019) as the quality-of-life PROM. For the 1,054 patients whose data were collected on paper, only the Oxford Hip/Knee Score PROM data are available on INOR. The paper collection process was highly valuable in determining the dataset and refining the electronic system. The INOR Governance Committee wishes to express deep gratitude to all staff and participating patients in SIVUH for their involvement as the INOR pilot site.</p> <p>A historical Data Validation Report (DVR) for INOR was developed prior to this report. The DVR was piloted in December 2019 and was rolled out</p>		Primary and revision hips			Primary and revision knees			Hospital	INOR	HIPE	Coverage	INOR	HIPE	Coverage	NOHC	110	116	95%	118	118	100%	COH	463	468	99%	308	308	100%	KROH	465	465	100%	266	266	100%	MPUH <sup>3</sup>	93	126	74%	42	50	84%	MRHT <sup>4</sup>	431	465	93%	281	281	100%	OLHN	276	276	100%	221	221	100%	SIVUH	1885	1885	100%	1635	1635	100%	Total	3723	3801	98%	2871	2879	100%
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Total	3723	3801	98%	2871	2879	100%																																																																		

<sup>3</sup> HIPE activity for MPUH includes activity for University Hospital Galway, so figures will not match.

<sup>4</sup> HIPE data for MRHT include patients who had non-elective hip surgery and therefore are outside of the scope of INOR.

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension
<b>Accuracy and reliability</b> <i>(Continued)</i> 	<p>The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether those data consistently measure, over time, the reality of the metrics that they were designed to represent.</p>	<p>in February 2020 to all participating hospitals for all data. Data variations were reviewed locally and amended if required. A more detailed DVR is under development in 2021 with the aim of ensuring that validation and data changes are completed in a more regular and timely fashion.</p> <p>Following a review of the report data both nationally and locally in hospitals, there were some data quality issues identified, particularly in the perioperative form. The consensus from meetings with hospitals and hospital clinical leads was that enhanced education and ownership of the data by the orthopaedic surgeons will lead to improved data capture. These matters are addressed in Recommendations 1 and 2 in Chapter 9 (page 124 and 125).</p> <p>NOCA staff have access to the International Prosthesis Library (IPL) from the International Society of Arthroplasty Registries (ISAR) Global Arthroplasty Product Library. The Irish National Component Catalogue (INCC) is the primary source of component information for INOR use, but the IPL is utilised for data validation and facilitates the completion of missing attributes for reporting on component data in INOR.</p>

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension
<b>Coherence and comparability</b> 	<p>Coherent and comparable data are consistent over time and across providers and can be easily combined with other sources.</p>	<p>The INOR MDS was developed following a review and evaluation of international arthroplasty register datasets. It incorporates three out of four levels of data, which include patient and surgery information (level 1), demographic and comorbidity data (level 2) and PROMs (level 3). Level 4 data includes radiological information and is not included in INOR at this time. With the increased amount of Registry data, it provides an important source of data for evidence-based medical decision-making.</p> <p>The use of international agreed comparators allows the INOR data to be benchmarked both locally and internationally. The MDS from the International Society of International Registers <i>Recommended National Arthroplasty Registries Essential MDS</i> (2007) is incorporated in the INOR MDS. This enables current and future collaborations to compare and benchmark INOR outcome and key quality indicator (KQI) data between hospitals, and our national data with those of other countries.</p> <p>Prior to the commencement of INOR, INOR management completed a review of PROMs used in other international registers. Following this assessment, the INOR Governance Committee agreed to incorporate two standardised patient-reported performance scores into the Register. They include the Oxford Hip Score (Dawson, et al., 1996) and the Oxford Knee Score (Dawson et al., 1998), as well as a generic EQ-5D five-dimension measure (EuroQoL Research Foundation, 2019).</p> <p>For the first time, INOR's PROM data for 2016–2018 will be included in the Organisation for Economic Co-operation and Development's (OECD's) <i>Health at a Glance 2021: OECD Indicators</i> report, which is due to be published in November 2021. As advised in the <i>OECD Health at a Glance 2019: OECD Indicators</i> (OECD, 2019), the goal of the 2019 report is to develop international benchmarks of health system performance as reported by patients themselves. (Canadian Institute for Health Information, Organisation for Economic Co-operation and Development, 2019)</p>

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension
<b>Timeliness and punctuality</b> 	<p>Timely data are collected within a reasonable agreed time period after the activity that they measure. Punctuality refers to whether data are delivered on the dates promised, advertised, or announced.</p>	<p>INOR data are collected in real time and are entered electronically at the point of care by patients and clinical staff into a bespoke, secure web application. In the event that the system is unavailable – which would mainly be due to network connectivity issues – the data are collected on paper and entered into the system once INOR is available.</p> <p>The capture of the postoperative assessment data can pose a challenge. Patients sometimes do not present for appointments (either in hospital or remotely), which can delay follow-up data capture and PROM collection. The data collection time frame closes 7 months postoperatively. This facilitates the capture of the 6-month postoperative patient assessment review and the reporting of complication data by the local audit coordinator. The postoperative assessment reviews can be completed in person or remotely. The 6-month review is normally done in person and all further follow-up reviews are completed remotely.</p> <p>In 2019, NOCA was in the position to add a data analyst to support and put structures in place to manage INOR reporting requirements. Reporting on the data is complex, with complicated data relationships between clinical, component and PROM information within the Register. The analytical team has built a data structure that will now facilitate more timely data reporting going forward. Hospitals received their data in advance of national reporting. The delivery of hospital-level quarterly reports in Q3 2021 will both improve data quality and allow the data to be utilised for audit, quality improvement and service evaluation. While the analysis of the data in this first report has been delayed, the structures are now in place to deliver future national reports in a more timely manner.</p> <p>A reporting strategy has been developed for INOR in order to enable the planning and delivery of an annual report and regular or quarterly reports, as well as access for hospitals to real-time patient data. This will be continually reviewed and evaluated by the INOR Governance Committee.</p>
<b>Accessibility and clarity</b> 	<p>Data are easily obtainable and clearly presented in a way that can be understood.</p>	<p>In 2019, a detailed data dictionary was developed in line with HIQA's <i>Guidance on a data quality framework for health and social care</i> (2018). In September 2021, INOR participating hospitals will receive a more detailed data definition dictionary that can be accessed by all users. This will provide detailed information on each data item, which will reduce inaccurate interpretation and data quality issues.</p> <p>INOR data can now be compared both locally and nationally, as well as with international datasets.</p> <p>In addition to the annual national report, the quarterly reports will include a concise overview of activity and quality indicators for each hospital. This will be reported graphically in order to be easily understood at both the clinical and operational levels.</p> <p>As previously mentioned, access to patient-level data in each hospital is one of the main reporting requirements of INOR. Hospitals require access to their own data in order to facilitate use of these data for quality and service improvement, as well as for audit.</p>

## INOR DATA QUALITY IMPROVEMENT PLAN

Table 3.4 outlines some tasks for delivery by INOR management in order to improve the quality of data within INOR.

**TABLE 3.4: IRISH NATIONAL ORTHOPAEDIC REGISTER DATA QUALITY IMPROVEMENT PLAN**

Item	Details	Delivery date
Data definition dictionary	Detailed current version of data dictionary	September 2021
Quarterly reports	Hospital-level reports include activity and KQIs	Q3 2021
Research consent	Add research consent to current consent for inclusion of patient data in research projects	September 2021
Access for hospitals to patient-level data	Develop a tool within the INOR system that allows hospitals to have appropriate access to patient-level data	Scope and planning commenced in September 2021





# CHAPTER 4 **PATIENT CHARACTERISTICS AND SURGERY DETAILS**

[CONTENTS >](#)

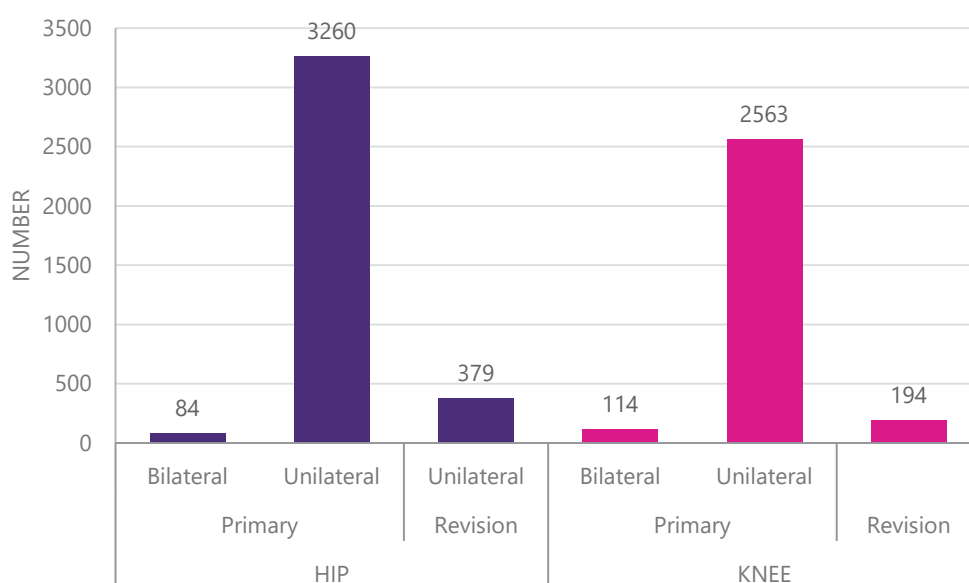
# CHAPTER 4: PATIENT CHARACTERISTICS AND SURGERY DETAILS

## INTRODUCTION

This chapter provides an overview of the characteristics of patients and details of their hip or knee arthroplasties completed during the reporting period (1 December 2014 to 31 July 2019). It includes information on all patients who have consented to participate in the Register. As highlighted in table 3.2 in Chapter 3, this report incorporates a subset of the national hip and knee arthroplasty population, and these data are outlined in Chapters 4–7.<sup>5</sup>

## PROCEDURES PERFORMED

The overall number of hip and knee arthroplasties included in the reporting period was 6,594. There were 3,723 hip surgeries, including 3,344 primary arthroplasties (42 patients with 84 bilateral procedures) and 379 revision arthroplasties. Of the 2,871 knee surgeries, there were 2,677 primary knee arthroplasties (57 patients with 114 bilateral procedures) and 194 revision knee arthroplasties (Figure 4.1).



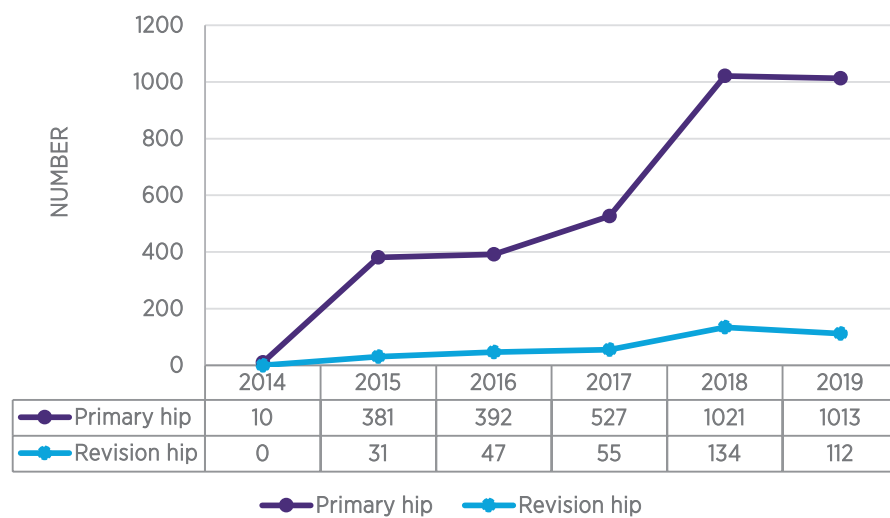
**FIGURE 4.1: NUMBER OF HIP AND KNEE ARTHROPLASTIES INCLUDED IN THE IRISH NATIONAL ORTHOPAEDIC REGISTER (N=6594)<sup>5a, 5b</sup>**

<sup>5a</sup> In this report, hip or knee replacement surgery is referred to as hip or knee arthroplasty. However, the term 'arthroplasty' is interchangeable with the term 'procedure' and sometimes, for ease of understanding, we simply refer to primary or revision hip or knee in the text..

<sup>5b</sup> Revision knee procedures include bilateral procedures. They cannot be reported separately as activity <5.

## HIP ARTHROPLASTY PROCEDURES PERFORMED

Figure 4.2 presents the number of hip arthroplasties included in INOR during the reporting period, broken down by year. As the number of INOR participating hospitals has increased, the number of hip procedures, both primary and revision, included in INOR has been increasing significantly every year.

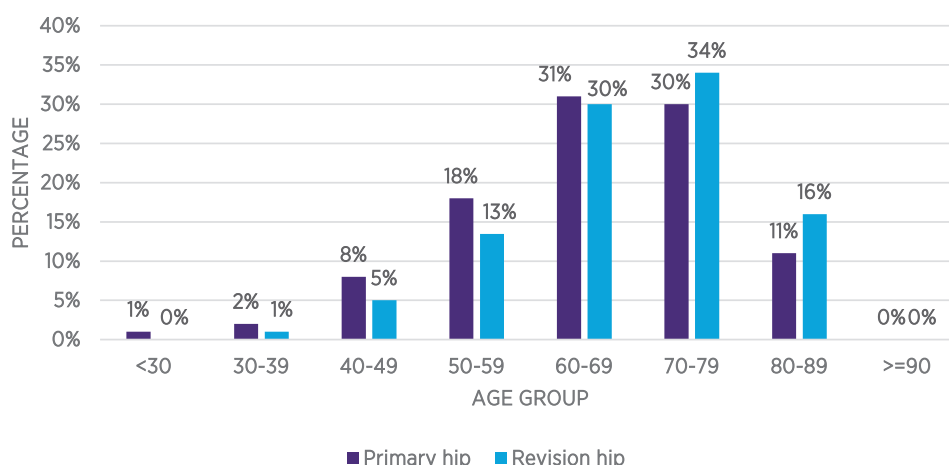


**FIGURE 4.2:** NUMBER OF HIP ARTHROPLASTIES INCLUDED IN THE IRISH NATIONAL ORTHOPAEDIC REGISTER, BY YEAR (PRIMARY: n=3344; REVISION: n=379)<sup>6</sup>

<sup>6</sup> In 2019, the reporting period ended on 31 July; thus, only 7 months' worth of data have been reported on for that year.

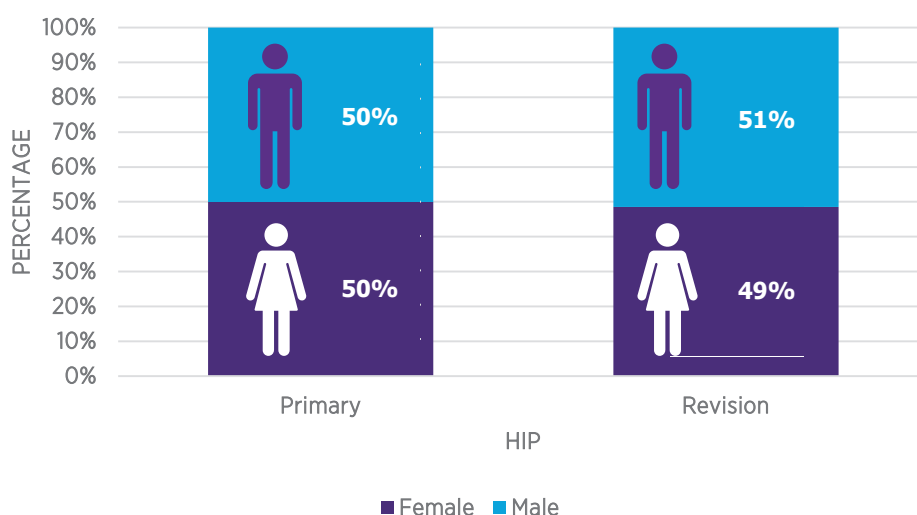
## PATIENT DEMOGRAPHICS

The mean age of a patient who had a primary hip procedure over the reporting period was 65 years (median=67 years), while the mean age of a patient who had a revision hip procedure was 68 years (median=70 years). People who received a primary or revision hip procedure were more likely to be in the older age categories than in the younger categories (Figure 4.3).



**FIGURE 4.3: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS, BY AGE GROUP (PRIMARY: n=3344; REVISION: n=379)<sup>7</sup>**

The proportion of males and females who required a primary or revision hip procedure was similar over the reporting period (Figure 4.4).



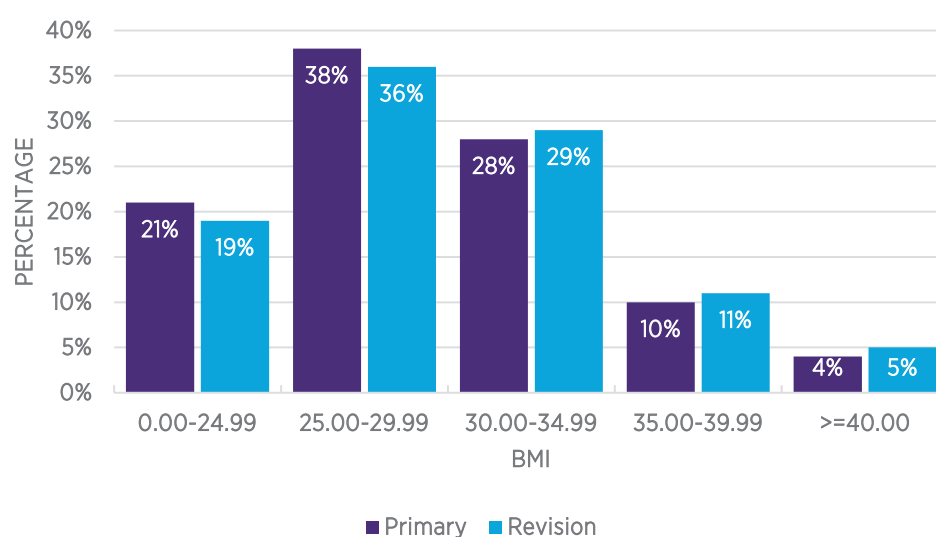
**FIGURE 4.4: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS, BY SEX (PRIMARY: n=3344; REVISION: n=379)<sup>8</sup>**

<sup>7</sup> Percentages may not sum to 100% due to rounding.

<sup>8</sup> Percentages may not sum to 100% due to rounding.

## HEALTH STATUS AND COMORBIDITIES

Being overweight (BMI of 25–30) is associated with a significantly younger age at time of primary hip arthroplasty and obese patients (patients with a BMI over 30) are likely to experience a higher rate of peri-operative complications (Haynes *et al.*, 2017). In INOR, the largest proportion of primary and revision hip arthroplasty patients had a body mass index (BMI) in the range of 25–29 (classified as overweight) (Figure 4.5). Forty-one percent (n=1372) of primary and 45% (n=170) of revision hip patients had a BMI greater than 30 (classified as obese).



**FIGURE 4.5: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS, BY BODY MASS INDEX**  
(PRIMARY: n=3344; REVISION: n=379)<sup>9,10</sup>

In INOR, pre-existing comorbidities (or conditions) are categorised into nine body systems. The pre-operative assessment team in each hospital is provided with guidance on individual diseases and conditions and how they are assigned to each category in the pre-operative assessment form. More than two-thirds (68%; n=2274) of patients who had primary hip arthroplasty and 75% (n=284) of those who had revision arthroplasty had at least one pre-existing disease at the time of surgery. Seven percent (n=240) of primary arthroplasty patients and 10% (n=38) of revision arthroplasty patients had a medical history of three comorbidities. More than one-half (52%; n=1736) of patients who had a primary hip procedure and 60% (n=229) of those who had a revision hip arthroplasty had a pre-existing cardiac disease (Table 4.1).

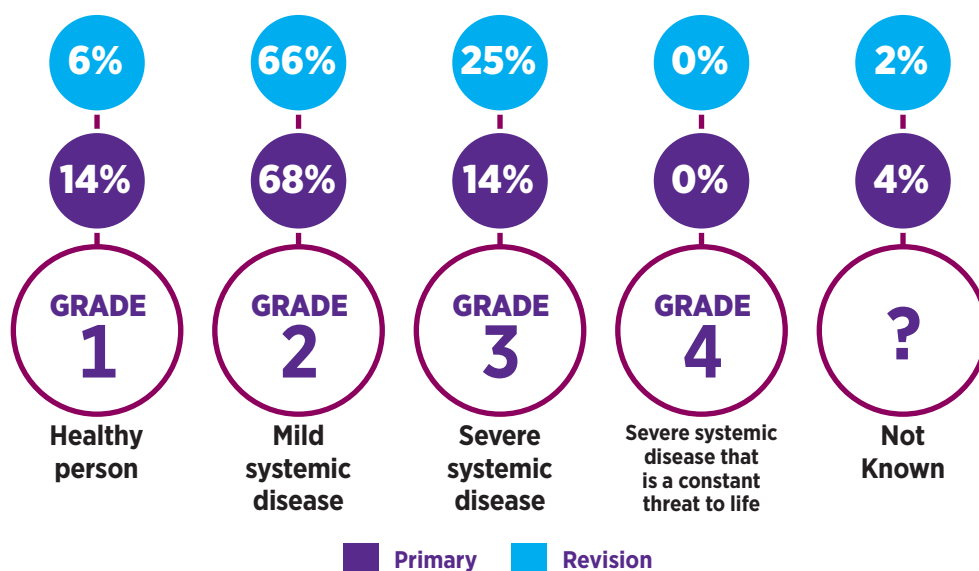
<sup>9</sup> Percentages may not sum to 100% due to rounding.

<sup>10</sup> Unknown BMI data relate to missing information from the initial paper data collection period.

**TABLE 4.1:** PERCENTAGE OF COMORBIDITIES AMONG HIP ARTHROPLASTY PATIENTS, BY TYPE OF COMORBIDITY (PRIMARY: n=3344; REVISION: n=379)<sup>11</sup>

Comorbidity	Primary		Revision	
	n	%	n	%
None	1070	32.0%	95	25.1%
Cardiac	1736	51.9%	229	60.4%
Endocrine	605	18.1%	71	18.7%
Respiratory	442	13.2%	40	10.6%
Vascular	174	5.2%	28	7.4%
Haematological	145	4.3%	26	6.9%
Cerebrovascular	127	3.8%	17	4.5%
Renal	110	3.3%	17	4.5%
Neuromuscular	108	3.2%	9	2.4%
Immunosuppressive condition	70	2.1%	16	4.2%

The American Society of Anesthesiologists (ASA) physical status classification system (American Society of Anesthesiologists, 2020) is a tool used in preparation for surgery to help predict risks in each patient. Eighty-two percent (n=2741) of patients who had a primary hip arthroplasty and 92% (n=347) of patients who had a revision hip arthroplasty had an ASA grade of 2 or higher (Figure 4.6).



**FIGURE 4.6:** AMERICAN SOCIETY OF ANESTHESIOLOGISTS GRADE HIP ARTHROPLASTY PATIENTS (PRIMARY: n=3344; REVISION: n=379)<sup>12</sup>

<sup>11</sup> Patients may have had more than one comorbidity; therefore, the total percentage is greater than 100%.

<sup>12</sup> Percentages may not sum to 100% due to rounding.

## SURGICAL DIAGNOSIS

Table 4.2 presents the most common reasons why patients had a primary or revision hip arthroplasty. A patient may have had more than one diagnosis recorded. The majority of patients who had a primary hip procedure performed were diagnosed with osteoarthritis (n=3119; 93%), while the most common diagnosis recorded for patients who had a revision hip procedure was aseptic loosening (n=157; 41%). Following a clinical review of the reasons for revision surgery, two surgical diagnoses were explored: component failure (17%) and pain of unknown origin (11%). These findings are outside what is expected when benchmarked with international registers. A rate of 17% for component failure is considered to be due to inaccurate data capture by users within the system rather than being a true reflection of any significant component issue. There were no issues (i.e. component recalls) identified with any implants during the data collection time period.

The share of patients with a 'pain of unknown origin' diagnosis as the primary reason for revision surgery is expected to be lower based on comparisons with international data; for example, the United Kingdom's National Joint Registry (NJR) reported a hip revision rate of 1.4–5.3% for an indication of pain over the 5-year period from 2014 to 2019 (NJR, 2020). While it is true that pain can sometimes lead to revision surgery, it is not usually the primary reason. These data are collected via the perioperative form in participating hospitals, and measures to improve the quality of these data are addressed in Recommendations 1 and 2, page 124-125.

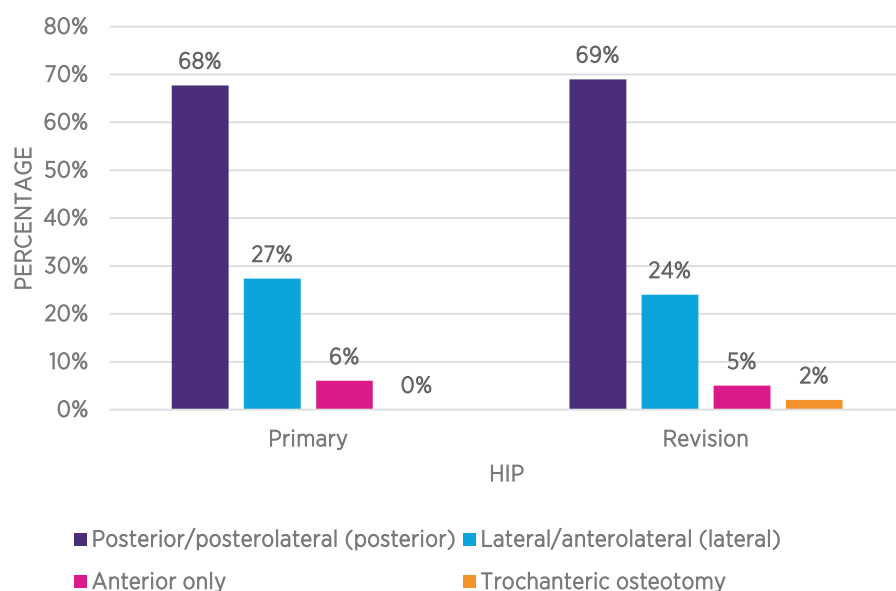
**TABLE 4.2: DIAGNOSIS FOR SURGERY (PRIMARY: n=3344; REVISION: n=379)<sup>13</sup>**

Primary	n	%	Revision	n	%
Osteoarthritis	3119	93.3%	Aseptic loosening	157	41.4%
Developmental dysplasia of the hip	50	1.5%	Component failure	65	17.2%
Avascular necrosis	40	1.2%	Infection	73	19.3%
Post-traumatic	38	1.1%	Instability	51	13.5%
Rheumatoid arthritis	26	0.8%	Pain of unknown origin	43	11.3%
Femoral acetabular impingement	17	0.5%	Periprosthetic fracture	34	9.0%
Perthes disease	16	0.5%	Other	25	6.6%
Slipped upper femoral epiphysis	14	0.4%			
Other	99	3.0%			

<sup>13</sup> A patient may have had more than one diagnosis; therefore, the total percentage is greater than 100%.

## SURGICAL APPROACH

The most common surgical approach for both primary and revision hip arthroplasty was posterior/posterolateral (posterior), with 68% (n=2265) of primary and 69% (n=263) of revision hip arthroplasties being performed using this approach (Figure 4.7). A clinical review of surgical approach explored the finding of a high rate of anterior approach (6% of primary and 5% of revision hip procedures). Given that there are few surgeons using the anterior surgical approach in Ireland, the report data reflect a much higher rate of this approach than expected. This finding was considered a data capture error due to misinterpretation, which requires ongoing education and prompt validation in order to ensure more accurate data entry. These data are collected via the perioperative form in the participating hospitals, and measures to improve the quality of these data are addressed in Recommendations 1 and 2, page 124-125.



**FIGURE 4.7: SURGICAL APPROACH FOR HIP ARTHROPLASTY (PRIMARY: n=3344; REVISION: n=379)<sup>14</sup>**

<sup>14</sup> Percentages may not sum to 100% due to rounding.

## ANTIBIOTIC USAGE

All patients who have hip arthroplasty should receive prophylactic antibiotics. A systemic antibiotic prophylaxis was used in 99.7% of primary and 100.0% of revision hip arthroplasties over the reporting period. Cefuroxime was the antibiotic given to the majority of patients who had a primary (n=3215; 96%) or revision (n=277; 73%) hip procedure (Table 4.3).

**TABLE 4.3: ANTIBIOTICS USED DURING SURGERY ON PATIENTS WHO HAD A HIP ARTHROPLASTY (PRIMARY: n=3344; REVISION: n=379)<sup>15</sup>**

Primary	n	%	Revision	n	%
None	9	0.3%	Cefuroxime	277	73.1%
Cefuroxime	3215	96.1%	Vancomycin	70	18.5%
Teicoplanin	74	2.2%	Teicoplanin	45	11.9%
Vancomycin	33	1.0%	Flucloxacillin	8	2.1%
Gentamicin	28	0.8%	Tazocin	7	1.8%
Other	24	0.7%	Other	21	5.5%

## ANAESTHESIA TYPE

Spinal anaesthetic was used in the majority of primary hip arthroplasties (n=3110; 93%) performed during the reporting period. With regard to hip revision arthroplasty, 84% (n=317) of patients had spinal anaesthesia, while 21% (n=79) of patients had general anaesthesia (Table 4.4).

**TABLE 4.4: TYPE OF ANAESTHETIC USED DURING HIP ARTHROPLASTY PROCEDURES (PRIMARY: n=3344; REVISION: n=379)<sup>16</sup>**

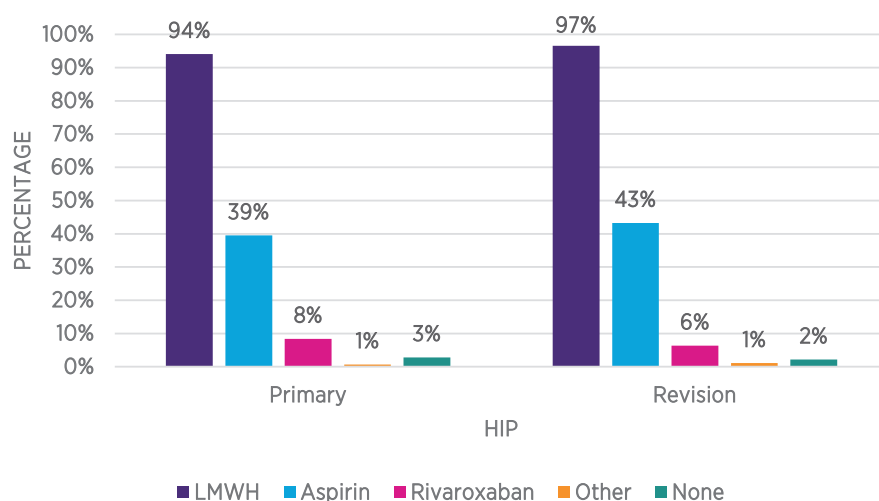
Primary	n	%	Revision	n	%
Spinal	3110	93.0%	Spinal	317	83.6%
General	213	6.4%	General	79	20.8%
Sedation	150	4.5%	Sedation	12	3.2%
Epidural	97	2.9%	Epidural	11	2.9%
Regional	65	1.9%	Regional	9	2.4%
Local	11	0.3%			

<sup>15</sup> A patient may have had more than one antibiotic; therefore, the total percentage is greater than 100%.

<sup>16</sup> A patient may have had more than one anaesthesia type; therefore, the total percentage is greater than 100%.

## CHEMICAL THROMBOPROPHYLAXIS USE

Low molecular weight heparin (LMWH) was the most commonly used postoperative anticoagulant in patients who had a primary (n=3147; 94%) or revision (n=366; 97%) hip arthroplasty, while 39% and 43% of all primary and revision patients, respectively, used aspirin postoperatively (Figure 4.8).



**FIGURE 4.8:** TYPE OF CHEMICAL THROMBOPROPHYLAXIS USED (PRIMARY: n=3344; REVISION: n=379)<sup>17, 18</sup>

## MECHANICAL THROMBOPROPHYLAXIS USE

Thrombo-embolus deterrent (TED) stockings were the predominant type of mechanical thromboprophylaxis used in both primary (n=1742; 52%) and revision (n=181; 48%) hip arthroplasty patients (Table 4.5).

**TABLE 4.5:** TYPE OF MECHANICAL THROMBOPROPHYLAXIS USED (PRIMARY: n=3344; REVISION: n=379)<sup>19</sup>

Primary	n	%	Revision	n	%
None	178	5.3%	None	20	5.3%
TED stockings	1742	52.1%	TED stockings	181	47.8%
Foot pump	1545	46.2%	Foot pump	177	46.7%
Intermittent calf compression	639	19.1%	Intermittent calf compression	66	17.4%
Other	24	0.7%			

<sup>17</sup> A patient may have received more than one type of chemical prophylaxis; therefore, the total percentage is greater than 100%.

<sup>18</sup> For primary hip patients, 'Other' includes warfarin, dabigatran and pentasaccharide; for revision hip patients, 'Other' includes pentasaccharide.

<sup>19</sup> A patient may have received more than one type of mechanical prophylaxis; therefore, the total percentage is greater than 100%.

## TRANEXAMIC ACID PROPHYLAXIS

Tranexamic acid was used in 91% (n=3042) of patients who had a primary hip arthroplasty, and in 92% (n=349) of patients who had a revision hip arthroplasty (Table 4.6).

**TABLE 4.6: USE OF TRANEXAMIC ACID (PRIMARY: n=3344; REVISION: n=379)**








Tranexamic acid used	Primary		Revision	
	n	%	n	%
Yes	3042	91.0%	349	92.1%
No	302	9.0%	30	7.9%

## DRAIN USAGE

Across both primary and revision hip arthroplasty patients, drains were infrequently used (Table 4.7).

**TABLE 4.7: USE OF DRAINS (PRIMARY: n=3344; REVISION: n=379)**

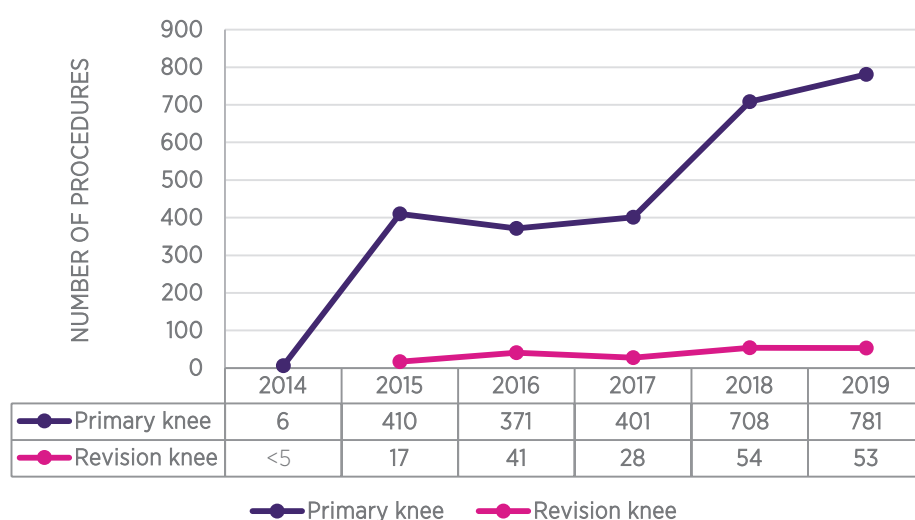
	Primary		Revision	
	n	%	n	%
Yes	157	4.7%	38	10.0%
No	3187	95.3%	341	90.0%

	 HIP	 AGE	 ASA GRADE	 BMI	 SEX
 PRIMARY	PRIMARY	65	2	25-29	MALE/ FEMALE
 REVISION	REVISION	68	2	25-29	MALE/ FEMALE

**FIGURE 4.9: TYPICAL HIP ARTHROPLASTY PATIENT**

## KNEE ARTHROPLASTY PROCEDURES PERFORMED

Figure 4.10 presents the number of knee arthroplasties included in INOR over the reporting period, broken down by year. As the number of hospitals participating in INOR increased, the number of primary and revision knee arthroplasties included in INOR has also increased significantly every year.

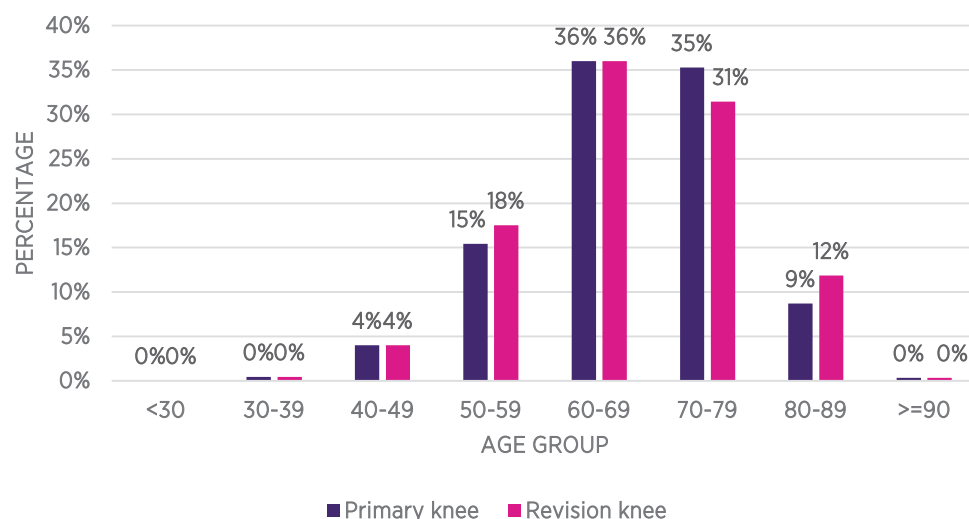


**FIGURE 4.10:** NUMBER OF KNEE ARTHROPLASTIES INCLUDED IN THE IRISH NATIONAL ORTHOPAEDIC REGISTER, BY YEAR (PRIMARY: n=2677; REVISION: n=194)<sup>20</sup>

<sup>20</sup> In 2019, the reporting period ended on 31 July; thus, only 7 months' worth of data have been reported on for that year.

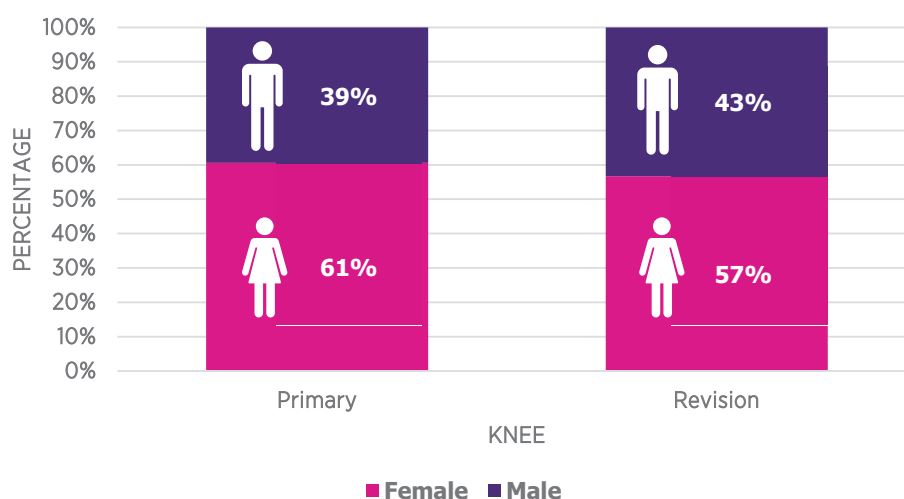
## PATIENT DEMOGRAPHICS

The average age of a patient who had a primary knee procedure during the reporting period was 67 years (median=68 years); this was the same for patients who had a revision knee procedure (median=67 years). People aged 60–79 years made up the largest proportion of primary or revision knee arthroplasty recipients (Figure 4.11).



**FIGURE 4.11: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY AGE GROUP**  
(PRIMARY: n=2677; REVISION: n=194)<sup>21</sup>

A greater proportion of females compared to males required a primary or revision knee arthroplasty over the reporting period (Figure 4.12).



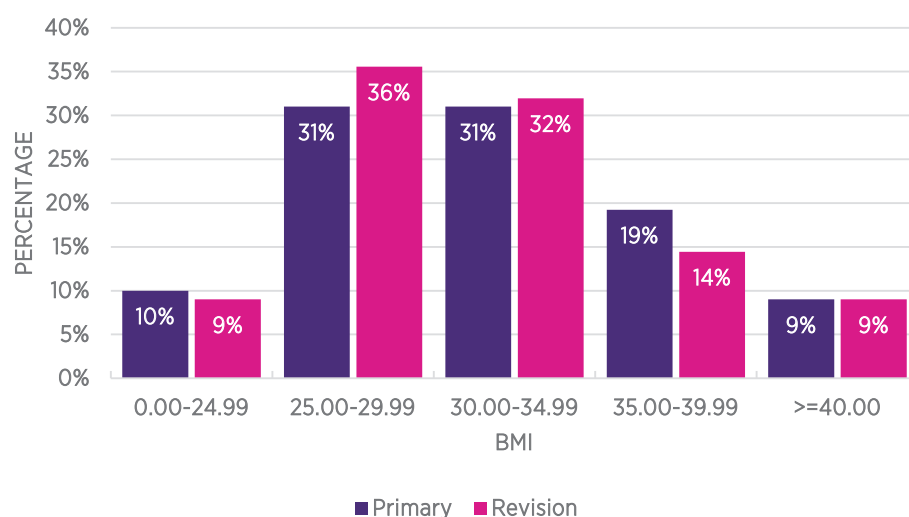
**FIGURE 4.12: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY SEX** (PRIMARY: n=2677; REVISION: n=194)<sup>22</sup>

<sup>21</sup> Percentages may not sum to 100% due to rounding.

<sup>22</sup> Percentages may not sum to 100% due to rounding.

## HEALTH STATUS AND COMORBIDITIES

Most primary and revision knee arthroplasties were among patients with a BMI of 25.00–29.99 (defined as overweight) (Figure 4.13). Only about 10% of primary and revision knee arthroplasty patients were noted to have a BMI in the normal range (<25).



**FIGURE 4.13:** PERCENTAGE OF KNEE ARTHROPLASTY IRISH NATIONAL ORTHOPAEDIC REGISTER PATIENTS, BY BODY MASS INDEX (PRIMARY: n=2677; REVISION: n=194)<sup>23,24</sup>

Seventy-eight percent (n=3362) of primary and 77% (n=255) of revision knee arthroplasty patients had a pre-existing comorbidity at the time of surgery. Almost 10% (n=266) of primary and 13% (n=26) of revision knee patients had a clinical history of three or more pre-existing comorbidities. About the same share of patients who had a primary knee arthroplasty (62%; n=1667) and who had a revision knee procedure (62%; n=120) had a pre-existing cardiac condition (Table 4.8).

<sup>23</sup> Percentages may not sum to 100% due to rounding.

<sup>24</sup> Unknown BMI data relate to missing information from the initial paper data collection period.

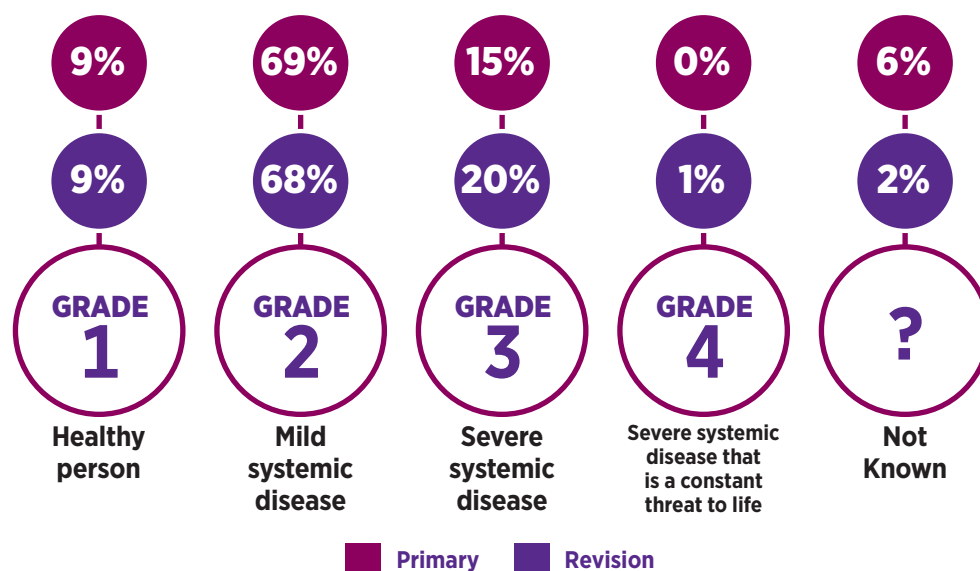
**TABLE 4.8: PERCENTAGE OF COMORBIDITIES AMONG KNEE ARTHROPLASTY PATIENTS, BY COMORBIDITY TYPE (PRIMARY: n=2677; REVISION: n=194)<sup>25</sup>**

Comorbidity	Primary		Revision	
	n	%	n	%
None	598	22.3%	45	23.2%
Cardiac	1667	62.3%	120	61.9%
Endocrine	623	23.3%	48	24.7%
Respiratory	434	16.2%	33	17.0%
Vascular	153	5.7%	7	3.6%
Haematological	136	5.1%	9	4.6%
Cerebrovascular	114	4.3%	11	5.7%
Neuromuscular	98	3.7%	11	5.7%
Renal	79	3.0%	12	6.2%
Immunosuppressive condition	58	2.2%	~	*

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

Over the reporting period, 85% (n=2264) of INOR patients who had a primary knee arthroplasty and 89% (n=172) who had a revision knee arthroplasty were classified as having an ASA grade (American Society of Anesthesiologists, 2020) of 2 or higher (Figure 4.14). An ASA grade of 2 or higher indicated patients who had comorbidities at the time of surgery.



**FIGURE 4.14: PERCENTAGE OF KNEE ARTHROPLASTY IRISH NATIONAL ORTHOPAEDIC REGISTER PATIENTS, BY AMERICAN SOCIETY OF ANESTHESIOLOGISTS GRADE (PRIMARY: n=2677; REVISION: n=194)**

<sup>25</sup> A patient may have had more than one comorbidity; therefore, the total percentage is greater than 100%.

## SURGICAL DIAGNOSIS

Table 4.9 presents the reasons why patients had a primary or revision knee arthroplasty. A patient may have had more than one diagnosis recorded. The majority of patients who had a primary knee procedure were diagnosed with osteoarthritis (n=2611; 98%), while instability (n=53; 27%) and pain of unknown origin (n=52; 27%) were the most common diagnoses recorded for revision knee arthroplasty. This share of revision knee arthroplasty patients diagnosed with pain of unknown origin is similar to that recorded for revision hip arthroplasty.

Following a clinical review of the reasons for revision surgery, the surgical diagnosis of pain of unknown origin was explored. The percentage of patients with this diagnosis is outside what is expected when compared with international registers; for example, the NJR in the United Kingdom reported a knee revision rate of 2–10% for an indication of pain over the 5-year period from 2014 to 2019 (NJR, 2020). While pain is a valid reason for revision surgery, it should almost always be accompanied by another primary reason (e.g. infection or instability). This finding may be related to inaccurate data capture within the system rather than being a true reflection of surgical diagnoses. These data are collected via the perioperative form in participating hospitals, and measures to improve the quality of these data are addressed in Recommendations 1 and 2, pages 124–125.

**TABLE 4.9: DIAGNOSIS FOR SURGERY (PRIMARY: n=2677; REVISION: n=194)<sup>26</sup>**

Primary	n	%	Revision	n	%
Osteoarthritis	2611	97.5%	Instability	53	27.3%
Rheumatoid arthritis	53	2.0%	Pain of unknown origin	52	26.8%
Post-traumatic	30	1.1%	Infection	39	20.1%
Other <sup>27</sup>	18	0.7%	Aseptic loosening – tibia	28	14.4%
			Malalignment	23	11.9%
			Aseptic loosening – femur	19	9.8%
			Other <sup>28</sup>	22	11.3%

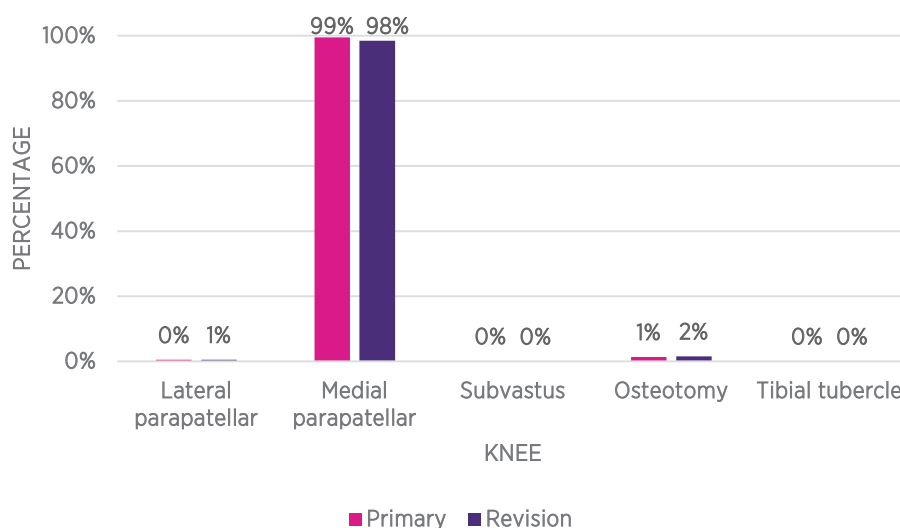
<sup>26</sup> A patient may have had more than one diagnosis; therefore, the total percentage is greater than 100%.

<sup>27</sup> 'Other' includes the category 'other', as well as 'post-infective' and 'avascular necrosis'.

<sup>28</sup> 'Other' includes the category 'other', as well as 'component failure – tibia' and 'periprosthetic fracture – femur', which have small numbers of patients and thus have been combined.

## SURGICAL APPROACH

The majority of primary and revision knee arthroplasties were performed using the medial parapatellar approach (Figure 4.15).



**FIGURE 4.15:** PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY SURGICAL APPROACH (PRIMARY: n=2677; REVISION: n=194)<sup>29</sup>

## ANTIBIOTIC USAGE

All patients who have knee arthroplasty should receive prophylactic antibiotics. 99.7% of primary knee patients received antibiotics and 100% of revision knee patients. During the reporting period, Cefuroxime was the antibiotic most commonly used in both primary (n=2563; 96%) and revision (n=136; 70%) knee arthroplasty patients. Vancomycin was used in almost one-fifth (n=34; 18%) of knee revision patients (Table 4.10).

**TABLE 4.10:** ANTIBIOTICS USED IN PRIMARY OR REVISION KNEE ARTHROPLASTY (PRIMARY: n=2677; REVISION: n=194)<sup>30</sup>

Primary	n	%	Revision	n	%
None	7	0.3%	Cefuroxime	136	70.1%
Cefuroxime	2563	95.7%	Teicoplanin	22	11.3%
Teicoplanin	57	2.1%	Vancomycin	34	17.5%
Vancomycin	29	1.1%	Other <sup>31</sup>	17	8.8%
Gentamicin	15	0.6%			
Other <sup>32</sup>	32	1.2%			

<sup>29</sup> Percentages may not sum to 100% due to rounding.

<sup>30</sup> A patient may have had more than one antibiotic; therefore, the total percentage is greater than 100%.

<sup>31</sup> 'Other' includes the category 'other', as well as clindamycin, flucloxacillin, tazocin and gentamicin.

<sup>32</sup> 'Other' includes the category 'other', as well as clindamycin, tazocin and flucloxacillin.

## ANAESTHESIA TYPE

In patients who underwent a primary knee arthroplasty, spinal anaesthetic was the predominant type of anaesthesia used (n=2488; 93%) (Table 4.11). Spinal anaesthetic was also the most commonly used type of anaesthesia in patients who underwent a revision knee arthroplasty (n=151; 78%), while one-quarter (n=48; 25%) of revision knee patients received a general anaesthetic (Table 4.11).

**TABLE 4.11: TYPE OF ANAESTHETIC USED DURING KNEE ARTHROPLASTY PROCEDURES (PRIMARY: N=2677; REVISION: N=194)<sup>33</sup>**

Primary	n	%	Revision	n	%
Spinal	2488	92.9%	Spinal	151	77.8%
Sedation	189	7.1%	General	48	24.7%
Regional	148	5.5%	Regional	13	6.7%
General	129	4.8%	Sedation	6	3.1%
Epidural	94	3.5%	Epidural	*	*
Local	28	1.0%	Local	~	*

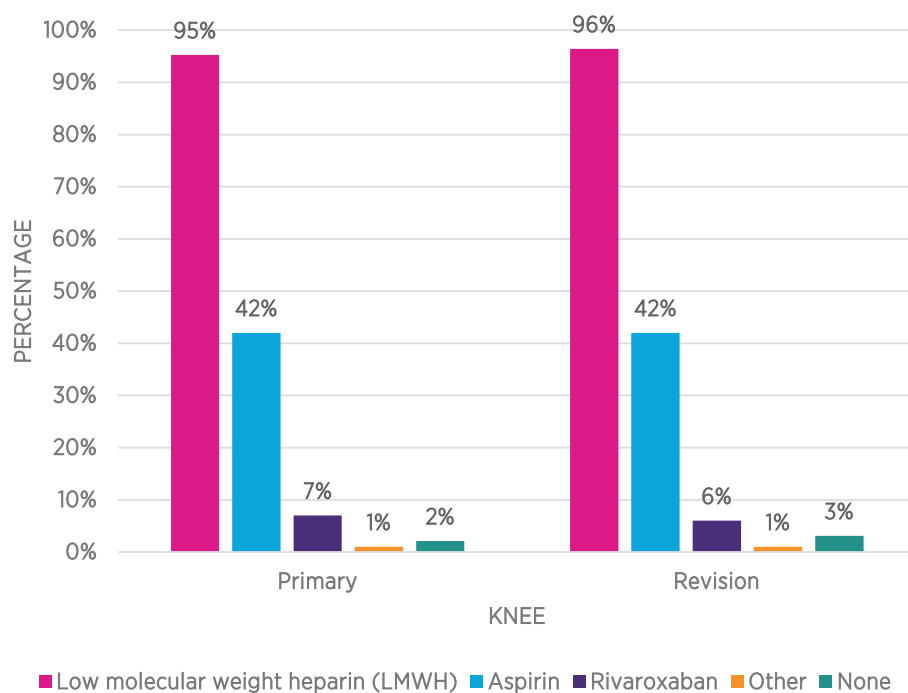
- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

<sup>33</sup> A patient may have had more than one anaesthesia type; therefore, the total percentage is greater than 100%.

## CHEMICAL THROMBOPROPHYLAXIS USE

LMWH was the most commonly used anticoagulant in patients who had a primary (n=2549; 95%) and revision (n=187; 96%) knee arthroplasty, while 42% of primary and revision knee patients used aspirin (Figure 4.16).



**FIGURE 4.16:** PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY TYPE OF CHEMICAL THROMBOPROPHYLAXIS USED (PRIMARY: n=2677; REVISION: n=194)<sup>34,35</sup>

<sup>34</sup> A patient may have received more than one type of chemical prophylaxis; therefore, the total percentage is greater than 100%.

<sup>35</sup> For primary knee patients, 'Other' includes warfarin, dabigatran and pentasaccharide; for revision knee patients, 'Other' includes warfarin.

## MECHANICAL THROMBOPROPHYLAXIS USE

A foot pump was the predominant type of mechanical thromboprophylaxis used in both primary (n=1341; 50%) and revision (n=109; 56%) knee arthroplasties (Table 4.12).

**TABLE 4.12: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY TYPE OF MECHANICAL THROMBOPROPHYLAXIS USED (PRIMARY: n=2677; REVISION: n=194)**

Primary	n	%	Revision	n	%
None	145	5.4%	None	14	7.2%
Foot pump	1341	50.1%	Foot pump	109	56.2%
TED stockings	1312	49.0%	TED stockings	72	37.1%
Intermittent calf compression	617	23.0%	Intermittent calf compression	30	15.5%
Other	19	0.7%			

## TRANEXAMIC ACID PROPHYLAXIS

Tranexamic acid was used in 88% (n=2343) of patients who had a primary knee arthroplasty, and in 82% (n=159) of patients who had a revision knee arthroplasty (Table 4.13).

**TABLE 4.13: USE OF TRANEXAMIC ACID (PRIMARY: n=2677; REVISION: n=194)**








	Primary		Revision	
Tranexamic acid used	n	%	n	%
Yes	2343	87.5%	159	82.0%
No	334	12.5%	35	18.0%

## DRAIN USAGE

Across both primary and revision knee patient groups, drains were infrequently used (Table 4.14).

**TABLE 4.14:** USE OF DRAINS (PRIMARY: n=2677; REVISION: n=194)

	Primary		Revision	
	n	%	n	%
Yes	268	10.0%	26	13.4%
No	2409	90.0%	168	86.6%

	 KNEE	 AGE	 ASA GRADE	 BMI	 SEX
 PRIMARY	PRIMARY	67	2	25-29	FEMALE
 REVISION	REVISION	67	2	25-29	FEMALE

**FIGURE 4.17:** TYPICAL KNEE ARTHROPLASTY PATIENT

## KEY FINDINGS FROM CHAPTER 4



### HIP ARTHROPLASTY

- There were 3,723 hip arthroplasties performed over the reporting period (3,344 primary (42 patients - 84 bilateral procedures) and 379 revision hip procedures).
- The average age of a patient who had a primary hip arthroplasty over the reporting period was 65 years (median=67 years), while the average age of a patient who had a revision hip arthroplasty was 68 years (median=70 years). People who received a primary or revision hip procedure were more likely to be in the older age categories than in the younger categories.
- The proportion of males and females who required a primary or revision hip arthroplasty was similar over the reporting period.
- Ninety-three percent of patients who had a primary hip arthroplasty were diagnosed with osteoarthritis, while 41% of hip revision patients had a diagnosis of aseptic loosening.
- Forty-one percent of primary and 45% of revision hip patients had a BMI greater than 30.
- Eighty-two percent of patients who had a primary hip arthroplasty and 92% of patients who had a revision hip arthroplasty had an ASA grade of 2 or higher.
- The most common surgical approach for both primary and revision hip arthroplasty was a posterior approach, with 68% and 69% of primary and revision hip arthroplasties, respectively, being performed using this approach.
- Systemic antibiotic prophylaxis was used in 99.7% of primary and 100.0% of revision hip arthroplasty patients.
- Spinal anaesthetic was used on 93% of primary and 84% of revision hip arthroplasty patients.
- Tranexamic acid was used in 91% of primary and 92% of revision hip arthroplasty patients.


## KEY FINDINGS FROM CHAPTER 4



## KNEE ARTHROPLASTY

- There were 2,677 primary knee arthroplasties (57 patients - 114 bilateral procedures) and 194 revision knee arthroplasties.
- The average age for both primary and revision knee arthroplasty patients was 67 years.
- A greater proportion of females compared to males required a primary or revision knee arthroplasty during the reporting period.
- The majority of patients who had a primary knee procedure were diagnosed with osteoarthritis (98%), while instability (27.3%) was the most common diagnosis recorded for knee revision arthroplasty.
- Most primary and revision knee arthroplasties were among patients with a BMI of 25.00–29.99. Only about 10% of primary and revision knee arthroplasty patients were noted to have a BMI in the normal range (<25).
- Over the reporting period, 85% (n=2264) of INOR patients who had a primary knee arthroplasty and 89% (n=172) who had a revision knee arthroplasty were classified as having an ASA grade of 2 or higher.
- The majority of primary and revision knee arthroplasties were performed using the medial parapatellar approach.
- 99.7% of primary knee arthroplasty patients and 100% who had revision knee arthroplasty received prophylactic antibiotics.
- Spinal anaesthetic was the predominant type of anaesthesia used in patients who underwent a primary knee arthroplasty (93%) and revision knee arthroplasty (78%).
- Tranexamic acid was used in 88% of patients who had a primary knee arthroplasty, and in 82% of patients who had a revision knee arthroplasty.



A close-up photograph of a person's knee, which is the central focus of the image. The knee is covered with a large, curved white medical bandage and a smaller, rectangular white adhesive patch. The person is wearing light blue shorts. The background is a blurred white surface, likely a hospital bed or floor. The overall tone is clinical and professional.

## CHAPTER 5 **CLINICAL OUTCOMES AND KEY QUALITY INDICATORS**

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## CHAPTER 5: CLINICAL OUTCOMES AND KEY QUALITY INDICATORS

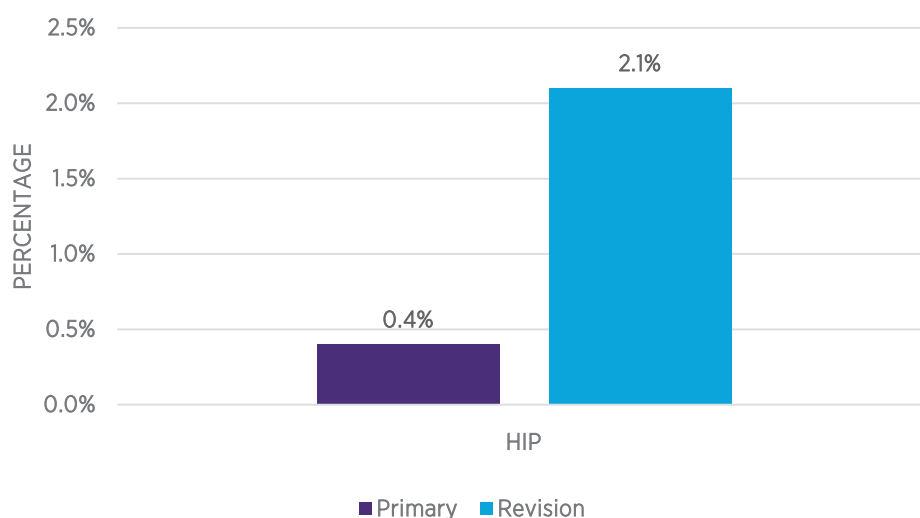
This chapter presents the data on clinical outcomes, which include the proportion of patients who had complications following their hip or knee arthroplasty, the type of complications they experienced, and key quality indicators. Currently, there are no international agreed standards for quality indicators for hip and knee arthroplasty. INOR has developed quality indicators to measure complication rates in the Register. INOR Clinical Governance identified five major complications that can occur in hip or knee arthroplasties. These complications are measured within 30 days of surgery unless otherwise stated.

The local audit coordinator in each hospital captures the complication data within INOR during the patient follow-up or review. The local audit coordinator reviews all patients postoperatively at agreed time points: 6 months, 2 years, 5 years and every 5 years thereafter.

### HIP ARTHROPLASTY

#### INFECTION RATE WITHIN 30 DAYS OF SURGERY

In INOR, in order to ensure that an infection in a patient is appropriately diagnosed, it is categorised as diagnosed by an orthopaedic surgeon. The rate of infection for both primary and revision hip arthroplasties within 30 days of surgery is presented in Figure 5.1. Thirteen infections (0.4%) were recorded in the 3,344 patients who had a primary hip arthroplasty, compared to 8 infections (2.1%) recorded in the 379 patients who had a revision hip arthroplasty. The complexity of revision arthroplasty increases the chance of surgical infections.



**FIGURE 5.1:** PERCENTAGE OF PATIENTS WHO HAD AN INFECTION WITHIN 30 DAYS OF HIP ARTHROPLASTY (PRIMARY: n=3344; REVISION: n=379)

## EARLY REVISION RATE WITHIN 1 YEAR OF PRIMARY HIP SURGERY

In INOR, a revision is defined as reoperation on a previous primary hip arthroplasty where one or more prosthetic components is replaced, removed or added. An early revision is classified as having taken place within 1 year of the primary surgery. Early revision can occur for a number of reasons and represents a significant event in a patient's arthroplasty journey. While early revision surgeries are uncommon, they have been identified as one of the key quality indicators in INOR. During the reporting period, 1.1% (n=36) of patients who had a primary arthroplasty captured in INOR had a revision procedure within the first year after this surgery. Patients may have one or more reasons for revision. The reasons for revision in the 36 patients who had an early revision are outlined in Table 5.1. The two main reasons for early revision surgeries were infection (n=10; 27.8%) and periprosthetic fracture (n=10, 27.8%).

Complications which had five or fewer cases each have been grouped as 'Other' in order to avoid identification. These complications include instability, aseptic loosening, component failure, pain of unknown origin and leg length discrepancy.

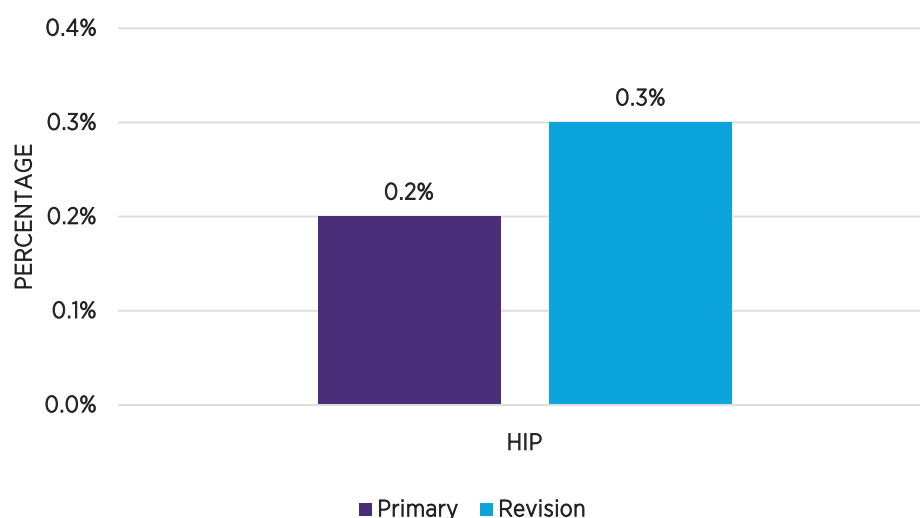
**TABLE 5.1: REASONS FOR EARLY REVISION HIP ARTHROPLASTY WITHIN 1 YEAR OF PRIMARY ARTHROPLASTY (n=36)<sup>36</sup>**

Reason for revision	n	%
Infection	10	27.8%
Periprosthetic fracture	10	27.8%
Dislocation	7	19.4%
Other	13	36.1%

<sup>36</sup> A patient may have had more than one reason for revision surgery; therefore, the total percentage is greater than 100%.

## RATE OF PERIPROSTHETIC FRACTURE WITHIN 30 DAYS OF SURGERY

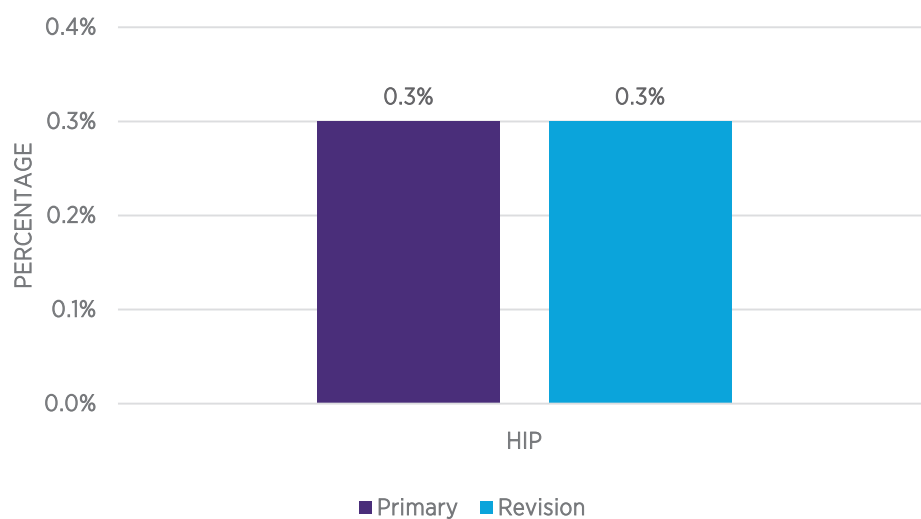
A periprosthetic fracture is a broken bone that occurs around the implants of a total hip replacement. With hip arthroplasty, a periprosthetic fracture is classified as a serious complication and would almost always result in further arthroplasty. Figure 5.2 outlines the rate of periprosthetic fractures that occurred within 30 days of primary or revision hip arthroplasty. Within the reporting period, a very small number of primary hip patients experienced a periprosthetic fracture within 30 days of their surgery (n=7; 0.2%).



**FIGURE 5.2:** PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD A PERIPROSTHETIC FRACTURE WITHIN 30 DAYS OF SURGERY (PRIMARY: n=3344; REVISION: n=379)

## RATE OF DISLOCATION WITHIN 30 DAYS OF SURGERY

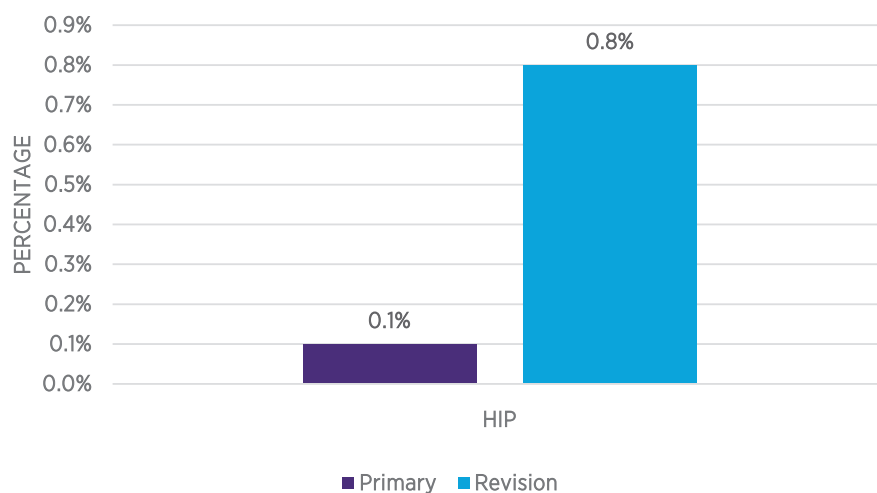
Patients can experience a dislocation following their surgery and may have multiple dislocations over time, but for the purposes of this report, only the initial dislocation is reported. For both primary and revision arthroplasty, the rate of dislocation within 30 days of the procedure was 0.3% (Figure 5.3).



**FIGURE 5.3:** PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD A DISLOCATION WITHIN 30 DAYS OF SURGERY (PRIMARY: n=3344; REVISION: n=379)

## RATE OF WOUND HAEMATOMA WITHIN 30 DAYS OF SURGERY

In INOR, complications of a haematoma are recorded if a patient requires a return to theatre for treatment. Less than 1% of patients experienced a wound haematoma within 30 days of either a primary or revision hip arthroplasty (Figure 5.4).

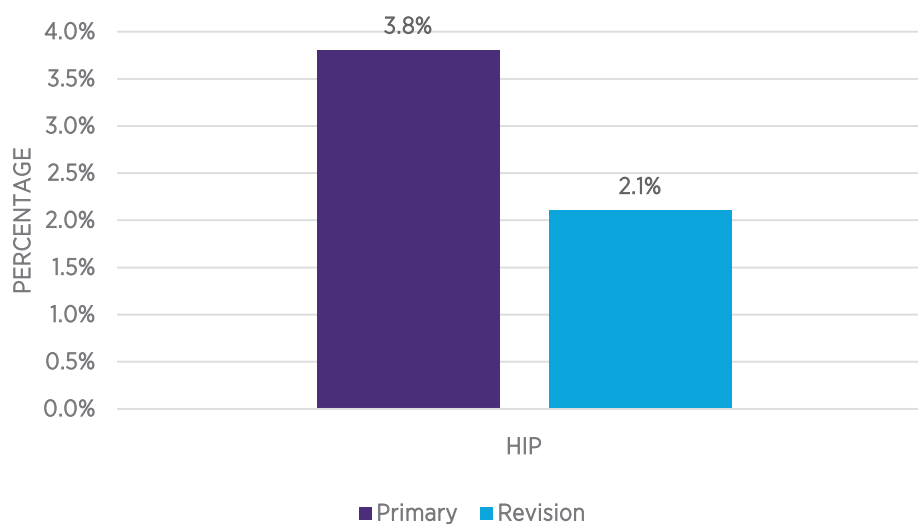


**FIGURE 5.4:** PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD A WOUND HAEMATOMA WITHIN 30 DAYS OF SURGERY (PRIMARY: n=3344; REVISION: n=379)

## RATE OF CARDIOPULMONARY COMPLICATIONS WITHIN 30 DAYS OF SURGERY

In INOR, cardiopulmonary complications captured range from major (e.g. heart attack or stroke) to a minor hypertensive episode. Within this first INOR report, all cardiopulmonary complications are reported, regardless of their severity; this results in an overall higher than expected complication rate. In future reports, a further breakdown by severity will be outlined.

The rate of postoperative cardiopulmonary complications (both major and minor) as captured by the local audit coordinators was 3.8% (n=128) and 2.1% (n=8) for primary and revision hip arthroplasty, respectively. This represents a broad spectrum of cardiovascular complications (Figure 5.5).





**FIGURE 5.5:** PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD CARDIOPULMONARY COMPLICATIONS WITHIN 30 DAYS OF SURGERY (PRIMARY: n=3344; REVISION: n=379)

## RATE OF THROMBOEMBOLIC EVENTS WITHIN 90 DAYS OF SURGERY

Of all hip arthroplasty patients (both primary and revision), 0.8% (n=29) experienced either a pulmonary embolism (PE) or deep vein thrombosis (DVT) (Table 5.2). When stratified by age and sex, a PE or DVT was found to have predominantly occurred in males and females aged 70–89 years following a primary hip arthroplasty, and in females aged 60–69 years following a revision hip procedure. The rate of a PE and DVT in revision arthroplasty was 0.5% respectively.

**TABLE 5.2:** RATE OF PULMONARY EMBOLISM AND DEEP VEIN THROMBOSIS IN HIP ARTHROPLASTY PATIENTS WITHIN 90 DAYS OF SURGERY (PRIMARY: n=3344; REVISION: n=379)

			Primary		Revision	
			n	%	n	%
	<b>PE</b>	PULMONARY EMBOLISM	15	0.4%	2	0.5%
	<b>DVT</b>	DEEP VEIN THROMBOSIS	14	0.4%	2	0.5%

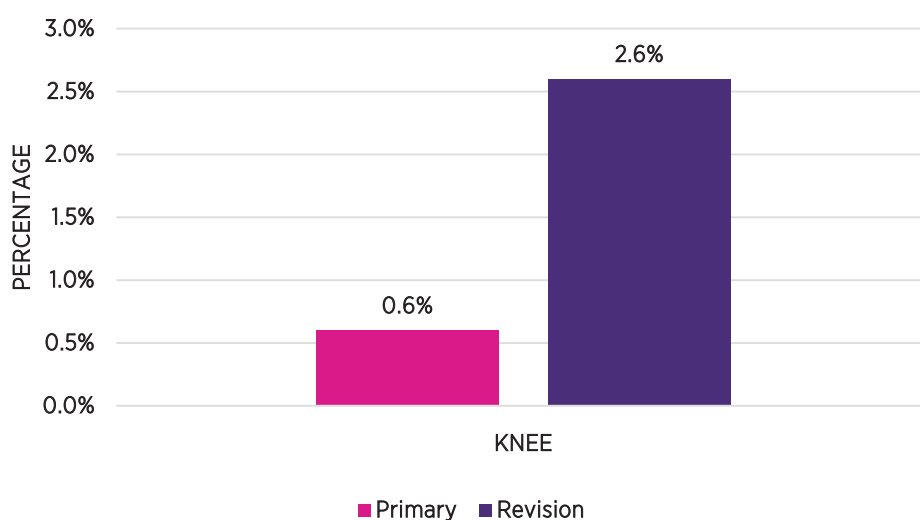
## RATE OF MORTALITY WITHIN 30 DAYS OF HIP ARTHROPLASTY

The death of patients following hip arthroplasty is very rare. The mortality rate within 30 days of surgery among INOR patients was 0.1% and 0.3% for primary and revision arthroplasty, respectively.

## KNEE ARTHROPLASTY

### INFECTION RATE WITHIN 30 DAYS OF SURGERY

In order to ensure that an infection in a patient is appropriately diagnosed, it is categorised as diagnosed by an orthopaedic surgeon. Infections in both primary and revision knee arthroplasties within 30 days of surgery are presented in Figure 5.6. Of the 2,677 primary knee surgeries performed during the reporting period, only 16 infections (0.6%) within 30 days of surgery were recorded. Furthermore, 5 infections (2.6%) were recorded within 30 days of surgery in the 194 patients who had revision knee procedures. The complexity of revision knee arthroplasty increases the chance of surgical complications and, in this case, the rate of infection.



**FIGURE 5.6:** PERCENTAGE OF PATIENTS WHO HAD AN INFECTION WITHIN 30 DAYS OF KNEE ARTHROPLASTY (PRIMARY: n=2677; REVISION: n=194)

## EARLY REVISION RATE WITHIN 1 YEAR OF PRIMARY KNEE SURGERY

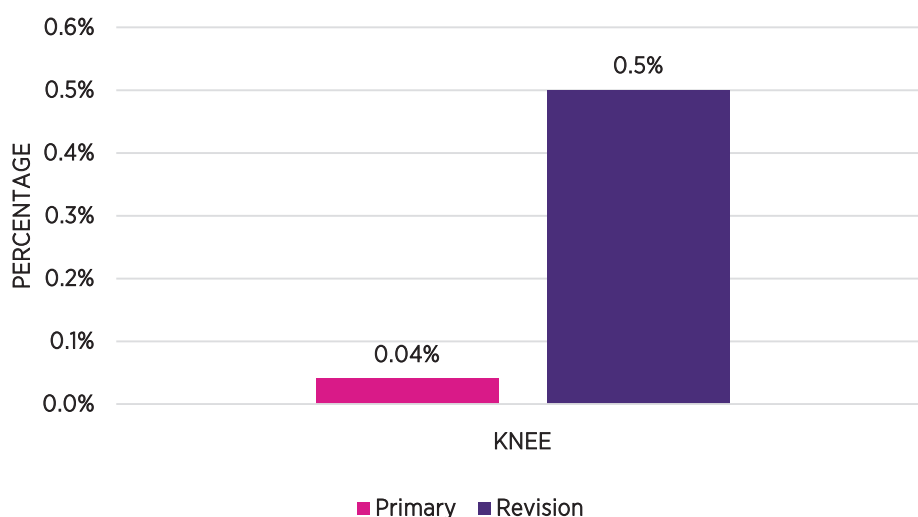
In INOR, a revision is defined as reoperation on a previous knee arthroplasty where one or more prosthetic components is replaced, removed or added. As in hip revision arthroplasty, an early knee revision is classified as having taken place within 1 year of the primary procedure. Early revision in knee arthroplasties can occur for a number of reasons and represents a significant event in a patient's knee arthroplasty journey. While early revision surgeries in knees are uncommon, they have been identified as one of the key quality indicators in INOR. During the reporting period, 1.4% (n=37) of all primary knee arthroplasties had an early revision knee procedure within 1 year of initial surgery. The reasons for revision are outlined in Table 5.3, with infection being the main reason for early revision knee arthroplasty, accounting for 46% (n=17) of patients. Complications that had five or fewer cases each have been grouped as 'Other' in order to avoid identification. These complications include pain of unknown origin, periprosthetic fracture, aseptic loosening, post-trauma fracture and unknown reason.

**TABLE 5.3: REASONS FOR EARLY REVISION KNEE ARTHROPLASTY WITHIN 1 YEAR OF PRIMARY ARTHROPLASTY (n=37)**

Reason for revision	n	%
Infection	17	46.0%
Instability	8	21.6%
Other	12	32.4%
Total	37	100.0%

## RATE OF PERIPROSTHETIC FRACTURE WITHIN 30 DAYS OF SURGERY

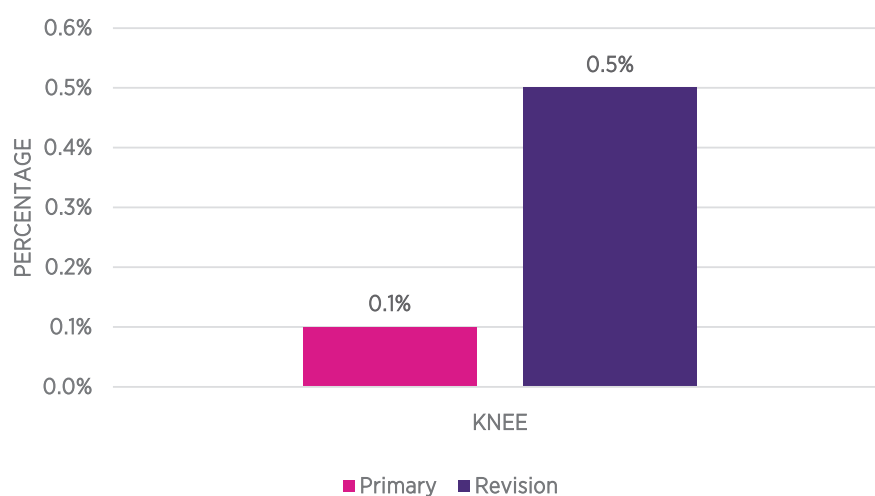
The rate of periprosthetic fracture was 0.04% and 0.50% in primary and revision knee arthroplasties, respectively (Figure 5.7).



**FIGURE 5.7:** PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS WHO HAD A PERIPROSTHETIC FRACTURE WITHIN 30 DAYS OF SURGERY (PRIMARY: n=2677; REVISION: n=194)

## RATE OF INSTABILITY WITHIN 30 DAYS OF SURGERY

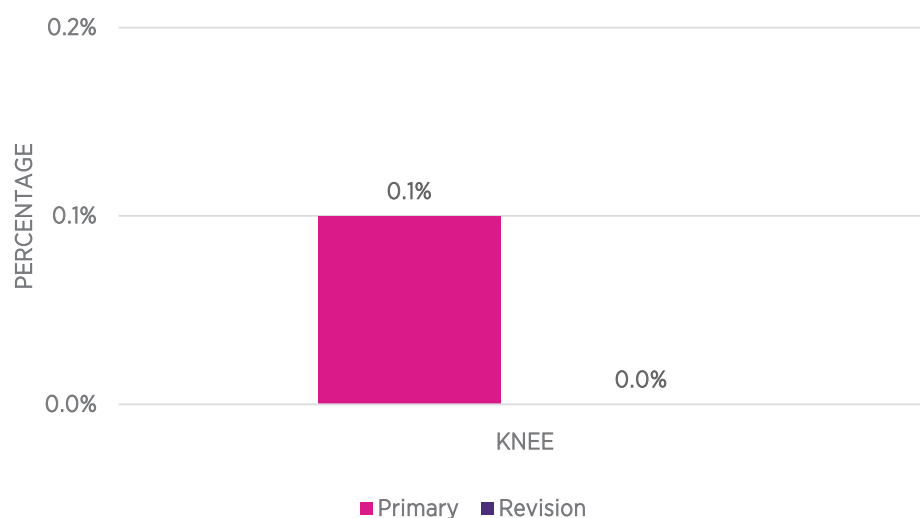
The rate of instability was 0.1% in primary and 0.5% in revision knee arthroplasty patients (Figure 5.8).



**FIGURE 5.8:** PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS WHO HAD INSTABILITY WITHIN 30 DAYS OF SURGERY (PRIMARY: n=2677; REVISION: n=194)

## RATE OF WOUND HAEMATOMA WITHIN 30 DAYS OF SURGERY

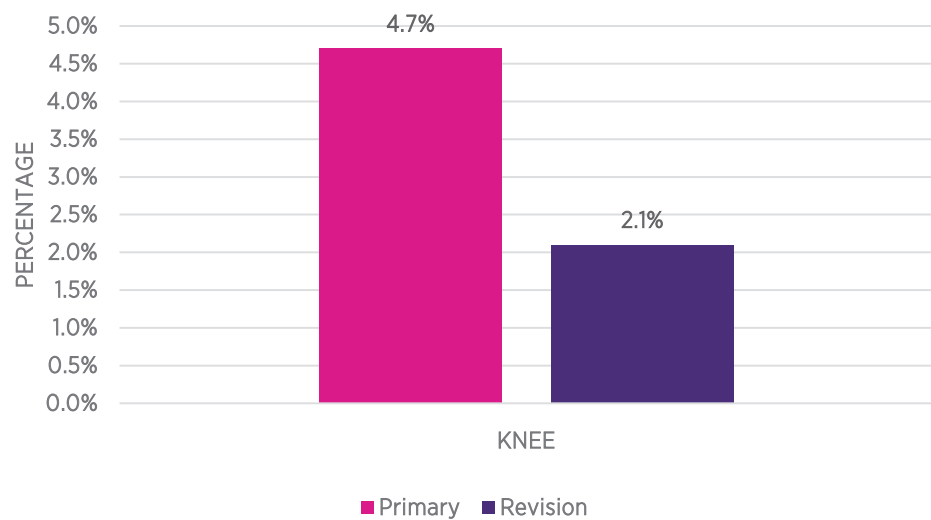
In INOR, complications of a haematoma are recorded if a patient requires a return to theatre for treatment. The rate of wound haematoma in both primary and revision knee arthroplasty was low, at 0.1% and 0.0%, respectively. Historically, knee haematoma and wound ooze were significant problems for total knee arthroplasty. The advent of modern anaesthesia techniques and the use of tranexamic acid has made a notable difference in rates of wound haematoma, as seen in the low rate noted in the data (Figure 5.9).



**FIGURE 5.9:** PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS WHO HAD A WOUND HAEMATOMA WITHIN 30 DAYS OF SURGERY (PRIMARY: n=2677; REVISION: n=194)

## RATE OF CARDIOPULMONARY COMPLICATIONS WITHIN 30 DAYS OF SURGERY

Similar to hip arthroplasty, cardiopulmonary complications captured within INOR range from very significant to a minor episode. Within this first report, all cardiopulmonary complications are reported, regardless of their severity; this results in an overall higher than expected complication rate. The rate of complications was 4.7% and 2.1% in primary and revision knee arthroplasty respectively. In future reports, a more detailed review by severity will be outlined.





**FIGURE 5.10:** PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS WHO HAD CARDIOPULMONARY COMPLICATIONS WITHIN 30 DAYS OF SURGERY (PRIMARY: n=2677; REVISION: n=194)

## RATE OF THROMBOEMBOLIC EVENTS WITHIN 90 DAYS OF SURGERY

A review of thromboembolic events finds the rate of DVT and PE in patients who had a primary or revision knee arthroplasty. Of all patients who had a primary knee arthroplasty, 1.2% (n=32) experienced a DVT and 0.4% (n=13) experienced a PE (Table 5.4). There were no thromboembolic events reported following a revision knee arthroplasty.

**TABLE 5.4:** RATE OF THROMBOEMBOLIC EVENT IN PRIMARY KNEE ARTHROPLASTY PATIENTS WITHIN 90 DAYS OF SURGERY (n=2677)

			Primary	
			n	%
	<b>DVT</b>	DEEP VEIN THROMBOSIS	32	1.2%
	<b>PE</b>	PULMONARY EMBOLISM	13	0.4%

## RATE OF MORTALITY IN KNEE ARTHROPLASTY PATIENTS WITHIN 30 DAYS OF SURGERY

There were no cases of mortality reported in patients who underwent a primary or revision knee arthroplasty during the reporting period.

## KEY FINDINGS FROM CHAPTER 5



## HIP ARTHROPLASTY

- The rate of joint infections in primary and revision hip arthroplasty patients was 0.4% and 2.1%, respectively.
- The early revision rate within 1 year of primary hip arthroplasty was 1.1% over the reporting period. Infection and periprosthetic fracture were the two main reasons for early revision surgery.
- The rate of cardiopulmonary complications was high for both primary and revision hip arthroplasty patients. This was due to the reporting of all cardiopulmonary complications, from significant to very minor. A further stratification of severity will be set out in future reports.
- Of all patients who had a primary hip arthroplasty, 0.8% (n=29) experienced either a PE or DVT.
- The rate of mortality within 30 days among INOR patients was 0.1% and 0.3% for primary and revision hip arthroplasty, respectively.

## KEY FINDINGS FROM CHAPTER 5



## KNEE ARTHROPLASTY

- The rate of joint infections in knee arthroplasty patients was 0.6% and 2.6% in primary and revision knee arthroplasties, respectively.
- Of all primary knee arthroplasty patients, 1.4% had an early revision knee procedure within 1 year of their initial surgery. Infection was the predominant reason for early revision knee surgery, accounting for 46% of patients who underwent a revision knee arthroplasty.
- The rate of periprosthetic fracture was 0.04% and 0.50% in primary and revision knee arthroplasties, respectively.
- The rate of instability was 0.1% in primary and 0.5% in revision knee arthroplasty patients.
- The rate of wound haematoma in both primary and revision knee arthroplasty was low, at 0.1% and 0.0%, respectively.
- Of patients who had a primary knee arthroplasty, 1.6% experienced either a DVT or a PE.
- There were no cases of mortality reported in any patients who underwent a primary or revision knee arthroplasty during the reporting period.



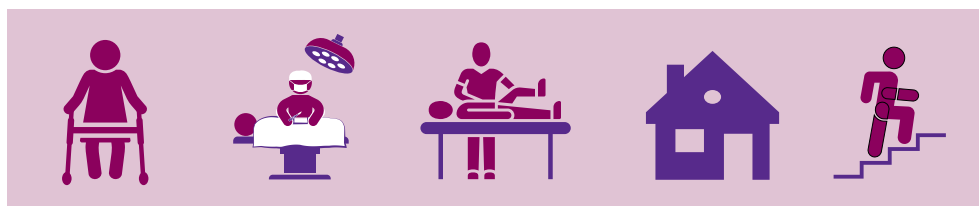
A close-up photograph showing a healthcare worker in blue scrubs assisting an elderly patient. The worker's hands are gently holding the patient's hands, which are resting on a cane. The patient is wearing a blue button-down shirt under a light-colored cardigan and grey trousers. The background is softly blurred, suggesting an indoor clinical or home care setting.

## CHAPTER 6

# PATIENT-REPORTED OUTCOME MEASURES

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## CHAPTER 6: PATIENT-REPORTED OUTCOME MEASURES



This chapter will address patient-reported outcome measures (PROMs). PROMs are questionnaires completed by INOR patients so that information on aspects of their overall quality of life – including symptoms; functional status; and physical, mental and social health – can be obtained.

These questionnaires are completed by patients before surgery and at specified time points (6 months, 2 years, 5 years and every 5 years thereafter) after their surgery.

PROMs are categorised as generic (can be applied across different populations) or condition specific (used to assess outcomes that are characteristic of, or unique to, hip or knee arthroplasty). Typically, both questionnaires are completed concurrently. Table 6.1 lists the questionnaires used to capture PROMs for both hip and knee arthroplasty patients in INOR.

**TABLE 6.1: TYPE OF PATIENT-REPORTED OUTCOME MEASURE QUESTIONNAIRES INCLUDED IN THE IRISH NATIONAL ORTHOPAEDIC REGISTER**

Arthroplasty type	Generic questionnaire <sup>37</sup>	Condition-specific questionnaire
Hip arthroplasty	EQ-5D-5L	Oxford Hip Score (OHS)
Knee arthroplasty	EQ-5D-5L	Oxford Knee Score (OKS)

The OHS/OKS (Murray *et al.*, 2007) and EQ-5D-5L (EuroQoL Research Foundation, 2019) are PROM tools owned by Oxford University Innovation Limited and the EuroQoL Research Foundation respectively. They are licensed to INOR for use within the Register.

The OHS and OKS measure the physical functioning and pain of patients with osteoarthritis in the hip or knee. The scores range from 0 to 48, with 0 representing no functional ability and 48 representing the most functional ability.

The EQ-5D-5L measure is a descriptive system comprising five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The score ranges from 0 to 1, where 0 represents no quality of life and 1 represents the best quality of life.

PROMs are fundamental to understanding the outcomes of patients who undergo hip and knee arthroplasty and how this surgery makes a difference to their health and quality of life, providing insight into the effectiveness of care.

PROM data can provide important information on value-based care; support quality assurance and improvement initiatives; help refine surgical indications; improve shared decision-making between a surgeon and patient; and provide information to support appropriate surgical timing (Wilson *et al.*, 2019).

<sup>37</sup> The EQ-5D-5L questionnaire was introduced on 4 May 2016. No patients reached the 5-year follow-up time point during the reporting period.

## HIP ARTHROPLASTY

### PROM COMPLETION RATES

In general, the proportion of primary and revision hip arthroplasty patients with both PROM questionnaires completed (OHS and EQ-5D-5L) was high across all time points both before and after surgery (Tables 6.2a and 6.2b). On review, a lower than expected completion rate among patients at the pre-operative stage of their revision surgery was found to be due to that surgery not always being planned. The pre-operative assessment review may not need to be repeated for a revision surgery if it is being performed within a short time of the primary surgery, and a revision surgery patient may not have the opportunity to complete their PROM questionnaire.

**TABLE 6.2A: PERCENTAGE AND NUMBER OF COMPLETED OXFORD HIP SCORE PATIENT-REPORTED OUTCOME MEASURE QUESTIONNAIRES FOR PRIMARY AND REVISION HIP ARTHROPLASTY**

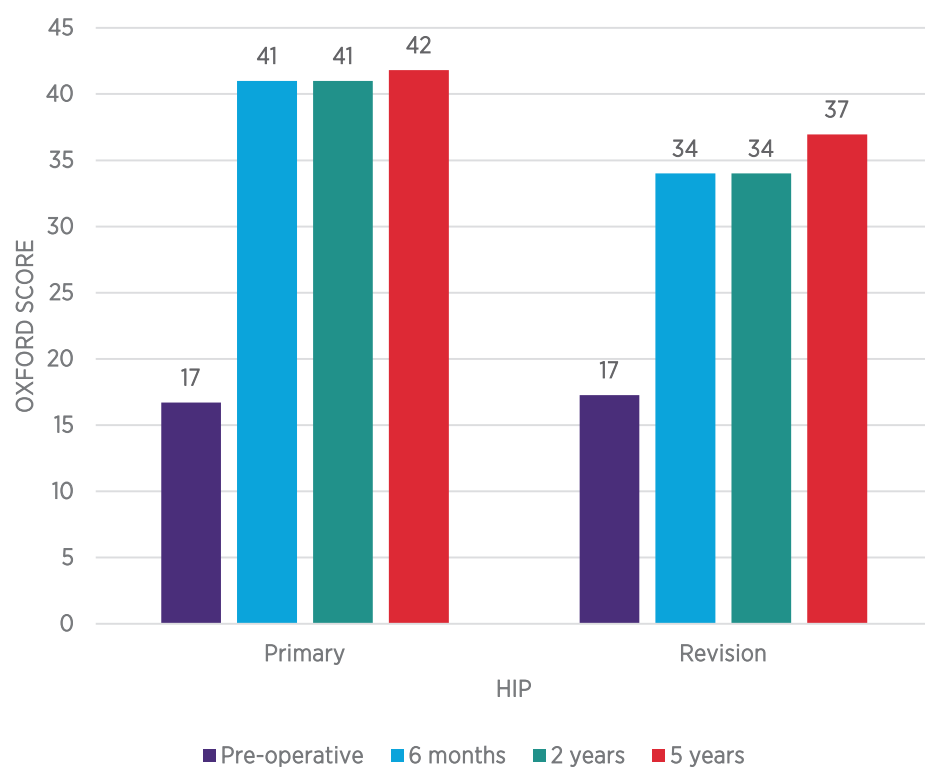
	Number of OHS questionnaires completed	Number of hip arthroplasties	%
<b>Primary</b>			
Pre-operatively	2980	3181	93.7%
6 months	3080	3181	96.8%
2 years	1779	1929	92.2%
5 years	268	294	91.2%
<b>Revision</b>			
Pre-operatively	267	331	80.7%
6 months	299	331	90.3%
2 years	171	197	86.8%
5 years	22	24	91.7%

**TABLE 6.2B: PERCENTAGE AND NUMBER OF COMPLETED EQ-5D-5L PATIENT-REPORTED OUTCOME MEASURE QUESTIONNAIRES FOR PRIMARY AND REVISION HIP ARTHROPLASTY**

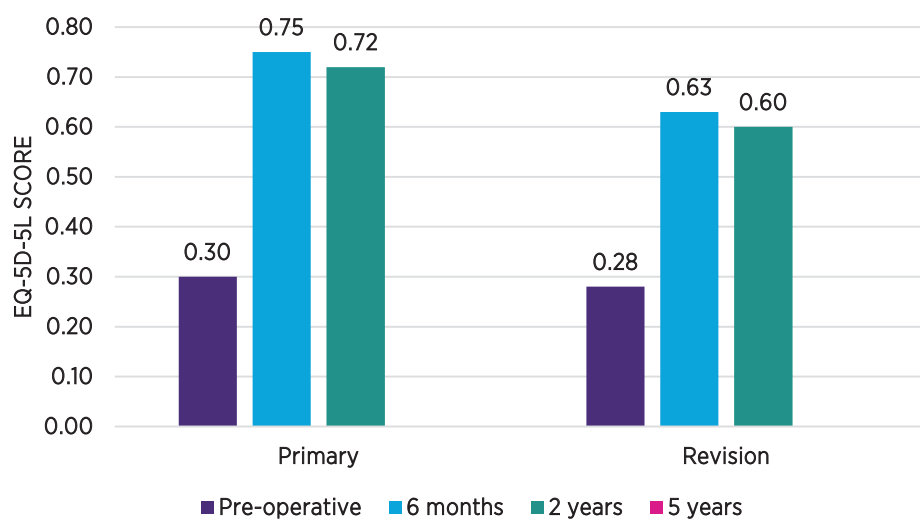
	Number of EQ-5D-5L questionnaires completed	Number of hip arthroplasties	%
<b>Primary</b>			
Pre-operatively	2443	2646	92.3%
6 months	2548	2646	96.3%
2 years	1264	1399	90.4%
5 years	0	0	0.0%
<b>Revision</b>			
Pre-operatively	207	275	75.3%
6 months	248	275	90.2%
2 years	120	146	82.2%
5 years	0	0	0.0%

## COMPARISON OF PRE- AND POSTOPERATIVE PROM SCORES

In primary hip patients, the mean PROM scores increased from the pre-operative period to the 6-month postoperative time point across both PROM questionnaires. In these patients, the mean OHS increased by 24 points following surgery, from a mean score of 17 recorded pre-operatively to a mean score of 41 recorded at 6 months following surgery. This remained stable at the 2- and 5-year follow-up time points. In revision hip patients, the mean OHS increased by 17 points, from a mean score of 17 recorded pre-operatively to a mean score of 34 recorded at 6 months following surgery. This score also remained stable at the 2- and 5-year time points (Figure 6.1a). Similarly, the average EQ-5D-5L score increased in patients who had either a primary or revision hip arthroplasty, indicating improved quality of life at 6 months, which was preserved at 2 years (Figure 6.1b).



**FIGURE 6.1A:** AVERAGE OXFORD HIP SCORE PATIENT-REPORTED OUTCOME MEASURE FOR PRIMARY AND REVISION HIP ARTHROPLASTY PATIENTS



**FIGURE 6.1B:** AVERAGE EQ-5D-5L SCORES FOR PRIMARY AND REVISION HIP ARTHROPLASTY PATIENTS

## DEMOGRAPHICS

The mean OHS increased across all age groups at 6 months following primary hip arthroplasty. Patients in the younger age groups (<40 years) recorded the smallest mean increase at their 2-year follow-up, while patients in the oldest age group (≥90 years) recorded the greatest mean increase at the same time point. At the 5-year follow-up time point there was a decline in the number of patients who completed the OHS questionnaire; nevertheless, the mean difference from pre-surgery to 5 years was much smaller across all age groups than it was at the 6-month and 2-year time points (Table 6.3). In patients who had a revision hip arthroplasty, those in the 70–79 years age group recorded the greatest mean increase in OHS at 6 months after surgery (Table 6.3).

Reviewing the impact of a patient's sex on the OHS PROM, at 6 months following primary hip surgery, female patients recorded a slightly greater mean increase than their male counterparts. This difference continued at the 2- and 5-year follow-up time points (Table 6.4). In contrast, at 6 months and 2 years following revision hip procedures, male patients recorded a greater mean increase in OHS than female patients (Table 6.4).

**TABLE 6.3: AVERAGE OXFORD HIP SCORE FOR PRIMARY AND REVISION HIP ARTHROPLASTY PATIENTS, BY AGE GROUP**

Stage	Pre-operative		6 months			2 years			5 years		
Primary	Average OHS	n	Average OHS	n	Mean difference from Pre-surgery to 6 months	Average OHS	n	Mean difference from Pre-surgery to 2 years	Average OHS	n	Mean difference from Pre-surgery to 5 years
Age Group											
<30 years	18.2	11	44.8	11	26.6	~	~	~	0.0	0	0.0
30-39 years	15.4	34	38.8	34	23.4	36.6	19	21.2	~	~	~
40-49 years	16.2	165	40.1	165	23.9	40.2	99	24.0	43.6	13	27.4
50-59 years	17.1	462	41.0	462	23.9	41.7	251	24.6	43.0	30	25.9
60-69 years	17.0	865	41.4	865	24.4	43.2	536	26.2	42.9	80	25.9
70-79 years	16.9	1038	41.4	1038	24.5	40.3	627	23.4	43.5	98	26.6
80-89 years	16.1	558	40.9	558	24.8	40.9	360	24.8	38.0	63	21.9
≥90 years	13.9	48	40.3	48	26.4	41.3	32	27.4	30.3	7	16.4
<b>Total</b>	<b>16.7</b>	<b>3181</b>	<b>41.1</b>	<b>3181</b>	<b>24.4</b>	<b>41.4</b>	<b>1929</b>	<b>24.7</b>	<b>41.8</b>	<b>294</b>	<b>25.1</b>
Stage	Pre-operative		6 months			2 years			5 years		
Revision	Average OHS	n	Average OHS	n	Mean difference from Pre-surgery to 6 months	Average OHS	n	Mean difference from Pre-surgery to 2 years	Average OHS	n	Mean difference from Pre-surgery to 5 years
Age Group											
<30 years	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
30-39 years	~	~	~	~	~	~	~	~	0.0	0	0.0
40-49 years	18.8	9	32.4	9	13.6	~	~	~	0.0	0	0.0
50-59 years	19.7	35	32.2	35	12.5	37.9	25	18.2	~	~	~
60-69 years	16.5	74	30.8	74	14.3	34.6	41	18.1	~	~	~
70-79 years	18.0	130	36.8	130	18.8	35.5	74	17.5	46.6	8	28.6
80-89 years	16.1	69	33.4	69	17.3	29.1	42	13.0	33.4	7	17.3
≥90 years	11.8	12	24.3	12	12.5	31.4	8	19.6	~	~	~
<b>Total</b>	<b>17.3</b>	<b>331</b>	<b>33.7</b>	<b>331</b>	<b>16.4</b>	<b>34.4</b>	<b>197</b>	<b>17.1</b>	<b>37.0</b>	<b>24</b>	<b>19.7</b>

~ Denotes five cases or fewer

**TABLE 6.4: AVERAGE OXFORD HIP SCORE FOR PRIMARY AND REVISION HIP ARTHROPLASTY PATIENTS, BY SEX**

	Pre-operative		6 months			2 years			5 years		
Primary	Average OHS	n	Average OHS	n	Mean difference from Pre-surgery to 6 months	Average OHS	n	Mean difference from Pre-surgery to 2 years	Average OHS	n	Mean difference from Pre-surgery to 5 years
Sex											
Female	15.4	1587	40.1	1587	24.7	41.0	963	25.6	41.5	142	26.1
Male	18.0	1594	42.2	1594	24.2	41.7	966	23.7	42.1	152	24.1
Total	16.7	3181	41.1	3181	24.4	41.4	1929	24.7	41.8	294	25.1
Revision	Pre-operative		6 months			2 years			5 years		
Revision	Average OHS	n	Average OHS	n	Mean difference from Pre-surgery to 6 months	Average OHS	n	Mean difference from Pre-surgery to 2 years	Average OHS	n	Mean difference from Pre-surgery to 5 years
Sex											
Female	16.7	160	31.8	160	15.1	33.5	97	16.8	39.7	12	23.0
Male	17.8	171	35.5	171	17.7	35.2	100	17.4	34.3	12	16.5
Total	17.3	331	33.7	331	16.4	34.4	197	17.1	37.0	24	19.7

## KNEE ARTHROPLASTY

### PROM COMPLETION RATES

The proportion of primary and revision knee arthroplasty patients completing both the OKS and the EQ-5D-5L PROMs was high across all time points both pre- and postoperatively. Patients had higher completion rates for the OKS than the EQ-5D-5L, with patients also having completed the 5-year follow-up for the OKS (Tables 6.5a and 6.5b). No patients included in this report have completed the 5-year follow-up for the EQ-5D-5L, as it was introduced less than 5 years before the end of the data collection period. Similar to hip arthroplasty patients, the lower than expected completion rate at the pre-operative stage of revision knee arthroplasties was because revision surgery was often unplanned; therefore, a patient may not have had the opportunity to complete the PROM questionnaire prior to surgery.

**TABLE 6.5A: PERCENTAGE OF COMPLETED OXFORD KNEE SCORE PATIENT-REPORTED OUTCOME MEASURE QUESTIONNAIRES FOR PRIMARY AND REVISION KNEE ARTHROPLASTY**

	Number of OKS questionnaires completed	Number of knee arthroplasties	%
<b>Primary</b>			
Pre-operatively	2384	2548	93.6%
6 months	2469	2548	96.9%
2 years	1500	1598	93.9%
5 years	319	334	95.5%
<b>Revision</b>			
Pre-operatively	133	154	86.4%
6 months	143	154	92.9%
2 years	86	96	89.6%
5 years	9	13	69.2%

**TABLE 6.5B: PERCENTAGE AND NUMBER OF COMPLETED EQ-5D-5L QUESTIONNAIRES FOR PRIMARY AND REVISION KNEE ARTHROPLASTY**

	Number of EQ-5D-5L questionnaires completed	Number of knee arthroplasties	%
<b>Primary</b>			
Pre-operatively	1843	1982	93.0%
6 months	1912	1982	96.5%
2 years	958	1041	92.0%
5 years	0	0	0.0%
<b>Revision</b>			
Pre-operatively	100	116	86.2%
6 months	109	116	94.0%
2 years	52	61	85.2%
5 years	0	0	0.0%

## COMPARISON OF PRE- AND POSTOPERATIVE PROM SCORES

In primary knee arthroplasty patients, the mean PROM scores increased from the pre-operative period across both measures (the OKS and the EQ-5D-5L). In primary knee surgery patients, the OKS increased by almost 20 points, from an average score of 17.8 recorded pre-operatively to an average score of 37.6 recorded at 6 months following surgery. This mean increase remained constant at the 2- and 5-year follow-up time points (Table 6.6a). In revision knee arthroplasty patients, the OKS increased by almost 18 points, from an average score of 13.8 recorded pre-operatively to an average score of 31.6 recorded at 6 months following surgery. This also remained constant at the 2- and 5-year follow-up time points (Table 6.6a). Similarly, following either a primary or revision knee arthroplasty, the average EQ-5D-5L score increased, indicating improved quality of life at 6 months following surgery which remained constant at 2 years (Table 6.6b).

**TABLE 6.6A: AVERAGE OXFORD KNEE SCORE FOR PRIMARY AND REVISION KNEE ARTHROPLASTY**

	Number of knee arthroplasties	Average OKS
<b>Primary</b>		
Pre-operatively	2548	17.8
6 months	2548	37.6
2 years	1598	39.4
5 years	334	40.1
<b>Revision</b>		
Pre-operatively	154	13.8
6 months	154	31.6
2 years	96	32.2
5 years	13	27.8

**TABLE 6.6B: AVERAGE EQ-5D-5L SCORES FOR PRIMARY AND REVISION KNEE ARTHROPLASTY**

	Number of knee arthroplasties	Average EQ-5D-5L score
<b>Primary</b>		
Pre-operatively	1982	0.36
6 months	1982	0.74
2 years	1041	0.71
<b>Revision</b>		
Pre-operatively	116	0.28
6 months	116	0.63
2 years	61	0.67

## DEMOGRAPHICS

In patients who had primary knee arthroplasty, the mean OKS increased in all age groups at 6 months, compared to their pre-operative scores. The number of completed questionnaires in each age group at the 2- and 5-year follow-up time points was very small. In subsequent reports, when the numbers increase, all age groups will be reported on in more detail (Table 6.7).

The mean difference in OKS at 6 months and 2 years following a primary knee arthroplasty was greater in females than in their male counterparts (Table 6.8). In patients who had a revision knee arthroplasty, the data show a similar pattern (Table 6.8).

**TABLE 6.7: AVERAGE OXFORD KNEE SCORE FOR PRIMARY AND REVISION KNEE ARTHROPLASTY PATIENTS, BY AGE GROUP**

Stage	Pre-operative		6 months			2 years			5 years		
Primary	Average OKS	n	Average OKS	n	Mean difference from Pre-surgery to 6 months	Average OKS	n	Mean difference from Pre-surgery to 2 years	Average OKS	n	Mean difference from Pre-surgery to 5 years
<b>Age Group</b>											
<30 years	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
30-39 years	~	~	~	~	~	~	~	20.0	0.0	0	0.0
40-49 years	17.4	45	34.7	45	17.3	33.4	27	16.0	39.4	7	22.0
50-59 years	16.8	276	36.6	276	19.8	38.9	168	22.1	38.4	28	21.6
60-69 years	17.9	727	37.6	727	19.7	39.9	427	22.0	42.5	67	24.6
70-79 years	18.2	1049	38.6	1049	20.4	40.0	662	21.8	41.7	131	23.5
80-89 years	17.5	417	36.2	417	18.7	38.4	287	20.9	37.9	92	20.4
≥90 years	15.1	33	35.3	33	20.2	37.2	26	22.1	25.7	9	10.6
<b>Total</b>	<b>17.8</b>	<b>2548</b>	<b>37.6</b>	<b>2548</b>	<b>19.8</b>	<b>39.4</b>	<b>1598</b>	<b>21.6</b>	<b>40.1</b>	<b>334</b>	<b>22.3</b>
Stage	Pre-operative		6 months			2 years			5 years		
Revision	Average OKS	n	Average OKS	n	Mean difference from Pre-surgery to 6 months	Average OKS	n	Mean difference from Pre-surgery to 2 years	Average OKS	n	Mean difference from Pre-surgery to 5 years
<b>Age Group</b>											
<30 years	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
30-39 years	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
40-49 years	~	~	~	~	~	~	~	~	0.0	0	0.0
50-59 years	12.3	18	34.1	18	21.8	32.3	14	20.0	~	~	~
60-69 years	16.6	42	32.1	42	15.5	29.7	27	13.1	~	~	~
70-79 years	13.2	62	30.4	62	17.2	33.5	37	20.3	24.3	8	11.1
80-89 years	13.5	26	34.9	26	21.4	32.4	14	18.9	0.0	0	0.0
≥90 years	~	~	~	~	~	~	~	~	0.0	0	0.0
<b>Total</b>	<b>13.8</b>	<b>154</b>	<b>31.6</b>	<b>154</b>	<b>17.8</b>	<b>32.2</b>	<b>96</b>	<b>18.4</b>	<b>27.8</b>	<b>13</b>	<b>14.0</b>

~ Denotes five cases or fewer

**TABLE 6.8: AVERAGE OXFORD KNEE SCORE FOR PRIMARY AND REVISION KNEE ARTHROPLASTY PATIENTS, BY SEX**

	Pre-operative		6 months			2 years			5 years		
Primary	Average OKS	n	Average OKS	n	Mean difference from Pre-surgery to 6 months	Average OKS	n	Mean difference from Pre-surgery to 2 years	Average OKS	n	Mean difference from Pre-surgery to 5 years
Sex											
Female	16.9	1543	37.0	1543	20.1	38.8	971	21.9	39.0	193	22.1
Male	19.1	1005	38.5	1005	19.4	40.3	627	21.2	41.6	141	22.5
Total	17.8	2548	37.6	2548	19.8	39.4	1598	21.6	40.1	334	22.3
	Pre-operative		6 months			2 years			5 years		
Revision	Average OKS	n	Average OKS	n	Mean difference from Pre-surgery to 6 months	Average OKS	n	Mean difference from Pre-surgery to 2 years	Average OKS	n	Mean difference from Pre-surgery to 5 years
Sex											
Female	13.2	89	31.3	89	18.1	34.6	51	21.4	26.4	9	13.2
Male	14.8	65	31.9	65	17.1	29.6	45	14.8	-	-	-
Total	13.8	154	31.6	154	17.8	32.2	96	18.4	27.8	13	14.0

- Denotes five cases or fewer

## KEY FINDINGS FROM CHAPTER 6



### HIP ARTHROPLASTY

- The PROM questionnaire completion rates in INOR for both the OHS and EQ-5D-5L were high.
- Among primary hip arthroplasty patients, 94% completed their OHS PROM questionnaire pre-operatively, while 97%, 92% and 91% completed it at 6 months, 2 years and 5 years, respectively.
- Among revision hip arthroplasty patients, 81% with planned surgery completed their OHS PROM questionnaire pre-operatively, while 90%, 87% and 92% completed it at 6 months, 2 years and 5 years, respectively.
- Similar high completion rates were reported for the EQ-5D-5L for both primary and revision hip surgery patients.
- In primary hip arthroplasty patients, the mean PROM scores increased from the pre-operative period to the 6-month follow-up time point across both PROM questionnaires. In these patients, the mean OHS increased by 24 points between the pre-operative and 6-month follow-up time point, and this increase remained constant at the 2- and 5-year follow-ups.
- When assessing PROM scores across patients by age group, the mean OHS increased across all age groups at 6 months following primary hip arthroplasty. Patients in the younger age groups (<40 years) recorded the smallest mean increase at their 2-year follow-up, while patients in the oldest age group (≥90 years) recorded the greatest mean increase at the same time point.
- Reviewing the impact of a patient's sex on the OHS PROM, at 6 months following primary hip surgery, female patients recorded a greater mean increase in OHS than their male counterparts. This difference continued at the 2- and 5-year follow-up time points. In contrast, at 6 months and 2 years following revision hip arthroplasty, male patients recorded a greater mean increase in OHS than female patients.

## KEY FINDINGS FROM CHAPTER 6



## KNEE ARTHROPLASTY

- The PROM questionnaire completion rates in INOR for both the OKS and EQ-5D-5L were high.
- For the OKS, 94% of primary knee arthroplasty patients with planned surgery completed their questionnaire pre-operatively, while 97%, 94% and 96% completed it at 6 months, 2 years and 5 years, respectively.
- For revision knee arthroplasty patients, 86% of patients with planned surgery completed their OKS PROM questionnaire pre-operatively, while 93%, 90% and 69% completed it at 6 months, 2 years and 5 years, respectively.
- Similar high completion rates were reported for the EQ-5D-5L for both primary and revision knee surgery patients.
- In patients who had primary knee surgery, the mean difference increased in the OKS in all age groups at 6 months compared to their scores before surgery.
- The mean difference in OKS at 6 months and 2 years following a primary knee arthroplasty was greater in female patients than in their male counterparts. The analysis of the OKS showed a similar pattern in revision knee arthroplasty patients.



# CHAPTER 7

# COMPONENTS



[CONTENTS >](#)

## CHAPTER 7: COMPONENTS

This chapter provides a summary of the data for and analysis of the components used in primary and revision hip and knee arthroplasty. In this first INOR report, component-based reporting is primarily activity based, and the component data collected were biased against the hospitals included within the reporting period for this report. Future collaboration with other international registries and the International Society of Arthroplasty Registries (ISAR) will enable the development of more complex component reporting, including survival analysis.

Cases of hip or knee replacement surgeries where the component was not available were excluded from the analysis and are specified within this chapter as 'missing component'. This chapter also describes the fixation method, along with the most commonly used brands of prosthesis and their combinations in hip and knee arthroplasty.

### IRISH NATIONAL COMPONENT CATALOGUE

The core element of the Irish National Component Catalogue is an index of hip and knee components available from each manufacturer, which facilitates accurate barcode scanning or component detail entry at the point of implant usage in hospitals. In the absence of a unique device identifier (UDI), the process is based on the catalogue or part number that the manufacturer assigned to a component so that it is specifically identified. The International Prosthesis Library (IPL) was utilised as a secondary reference to enable grouping of components according to characteristics; for example, component type. INOR would like to acknowledge the ISAR for allowing/facilitating access to the IPL, which provided valuable information on component attributes and classification.

## HIP ARTHROPLASTY

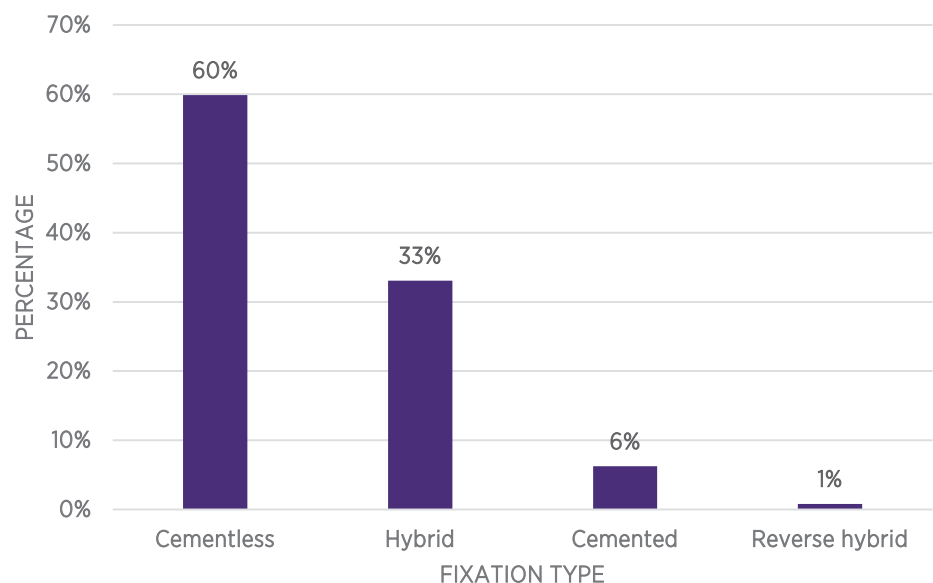
### PRIMARY HIP ARTHROPLASTY

#### CHARACTERISTICS OF FIXATION

Primary arthroplasty fixation is classified as follows:

- cemented (both acetabular and femoral components)
- cementless (both components)
- hybrid (cemented femur and cementless cup);
- reverse hybrid (cemented cup with cementless femur).

In total, 60% (n=1977) of all primary hip arthroplasties were performed using cementless fixation, while one-third (n=1092) were performed using a hybrid fixation (Figure 7.1). Tables 7.1 and 7.2 provide an overview of the brands used for each fixation type. Of the patients who had a cemented femoral stem fixation, Exeter V40 (Stryker) was used in 96% (n=1247) of cases (Table 7.1). There was greater variation in the brand of femoral stem used in patients who underwent a cementless fixation, where Accolade II (Stryker) was used in just under one-half (n=882; 44%) of patients, while Tri-Lock (DePuy) was used in almost one-quarter (n=483; 24%) of patients (Table 7.2).



**FIGURE 7.1:** PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY FIXATION TYPE (n=3302)

**TABLE 7.1:** CEMENTED FEMORAL STEM BRANDS FOR PRIMARY TOTAL HIP ARTHROPLASTY (n=1298)

Manufacturer: brand	n	%
Stryker: Exeter V40	1247	96.1%
DePuy: C-Stem AMT	36	2.8%
DePuy: Charnley	9	0.7%
Other <sup>38</sup>	6	0.4%
<b>Total</b>	<b>1298</b>	<b>100.0%</b>

**TABLE 7.2:** CEMENTLESS FEMORAL STEM BRANDS FOR PRIMARY TOTAL HIP ARTHROPLASTY (n=2000)

Manufacturer: brand	n	%
Stryker: Accolade II	882	44.1%
DePuy: Tri-Lock	483	24.2%
DePuy: Summit	273	13.7%
DePuy: Corail	247	12.4%
Smith & Nephew: Synergy	39	2.0%
Zimmer Biomet: Taperloc	26	1.3%
Medacta: Masterloc	19	1.0%
DePuy: S-Rom	7	0.4%
Stryker: Secure Fit Advanced	7	0.4%
Smith & Nephew: Polarstem	6	0.3%
Other <sup>39</sup>	11	0.6%
<b>Total</b>	<b>2000</b>	<b>100.0%</b>

<sup>38</sup> 'Other' femoral stem brands include Summit and CPCS.<sup>39</sup> 'Other' cementless femoral stem brands include Metha, Modulus, Reclaim and Restoration.

For primary total hip arthroplasty patients in whom a cemented acetabular fixation was used, Exeter X3 Rimfit (Stryker) was the most common (n=98; 42%), closely followed by Exeter Contemporary (Stryker) (n=89; 38%). For cementless acetabular fixation, Trident (Stryker) and Pinnacle (Depuy) together accounted for 86% (n=2639) of arthroplasties (Table 7.3).

**TABLE 7.3: ACETABULAR CUP/SHELL BRANDS FOR PRIMARY TOTAL HIP ARTHROPLASTY**

Manufacturer: brand	n	%
<b>CEMENTED</b>		
Stryker: Exeter X3 Rimfit	98	41.7%
Stryker: Exeter Contemporary	89	37.9%
DePuy: Elite	27	11.5%
DePuy: Marathon	15	6.4%
Other	6	2.6%
Total	235	100.0%
<b>CEMENTLESS</b>		
Stryker: Trident	1648	53.7%
DePuy: Pinnacle	991	32.3%
Stryker: Tritanium	274	8.9%
Zimmer Biomet: G7	83	2.7%
Smith & Nephew: R3	48	1.6%
Medacta: Mpact	19	0.6%
Other <sup>41</sup>	5	0.2%
<b>Total</b>	<b>3068</b>	<b>100.0%</b>

<sup>40</sup> 'Other' cemented acetabular cup/shell brands include Delta-One-TT and Trident.

<sup>41</sup> 'Other' cementless acetabular cup/shell brands include Continuum, Novae, Plasmfit and Trabecular Metal Shell.

Table 7.4 presents an overview of the different combinations, by manufacturer and brand, of acetabular cup and femoral stem components used in primary hip arthroplasties. Overall, the majority of femoral stem and acetabular cup combinations used in primary hip arthroplasty are from the same manufacturer (97%), with a low occurrence of combinations from different manufacturers; some of these are represented in the 'Other' group in Table 7.4.

**TABLE 7.4: COMBINATIONS OF ACETABULAR CUP AND FEMORAL STEM FOR PRIMARY TOTAL HIP ARTHROPLASTY<sup>42</sup>**

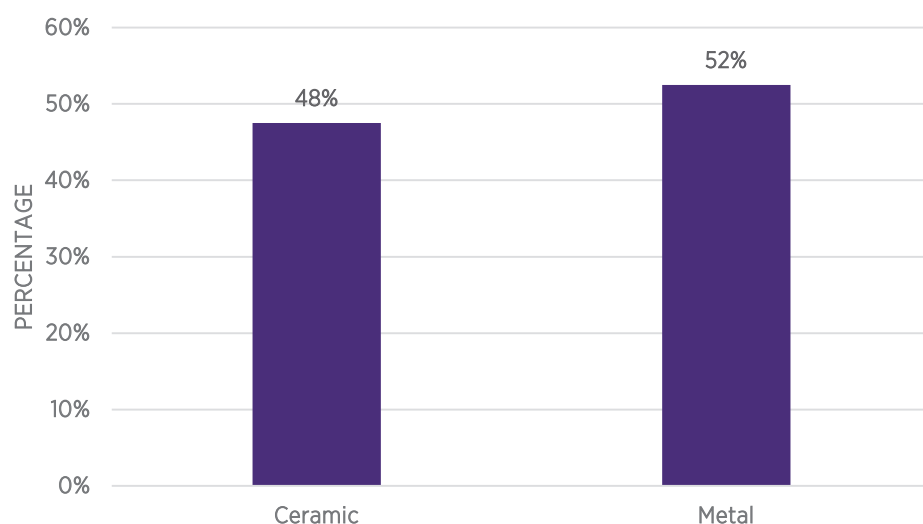
<b>Stryker: Trident</b>	<b>n</b>	<b>%</b>
Stryker: Exeter V40	958	58.2%
Stryker: Accolade II	670	40.7%
DePuy: Corail	9	0.5%
Stryker: Secure Fit Advanced	7	0.4%
Other	3	0.2%
<b>Total</b>	<b>1647</b>	<b>100.0%</b>
<b>DePuy: Pinnacle</b>	<b>n</b>	<b>%</b>
DePuy: Tri-Lock	482	48.6%
DePuy: Summit	273	27.5%
DePuy: Corail	174	17.6%
Stryker: Exeter V40	29	2.9%
DePuy: C-Stem AMT	24	2.4%
DePuy: S-Rom	7	0.7%
Other	2	0.2%
<b>Total</b>	<b>991</b>	<b>100.0%</b>
<b>Stryker: Tritanium</b>	<b>n</b>	<b>%</b>
Stryker: Accolade II	196	71.8%
Stryker: Exeter V40	74	27.1%
Other	3	1.1%
<b>Total</b>	<b>273</b>	<b>100.0%</b>
<b>Stryker: Exeter X3 Rimfit</b>	<b>n</b>	<b>%</b>
Stryker: Exeter V40	95	96.9%
Accolade II	3	3.1%
<b>Total</b>	<b>98</b>	<b>100.0%</b>

<sup>42</sup> Percentages calculated based on the sum of all numerators in each acetabular cup group.

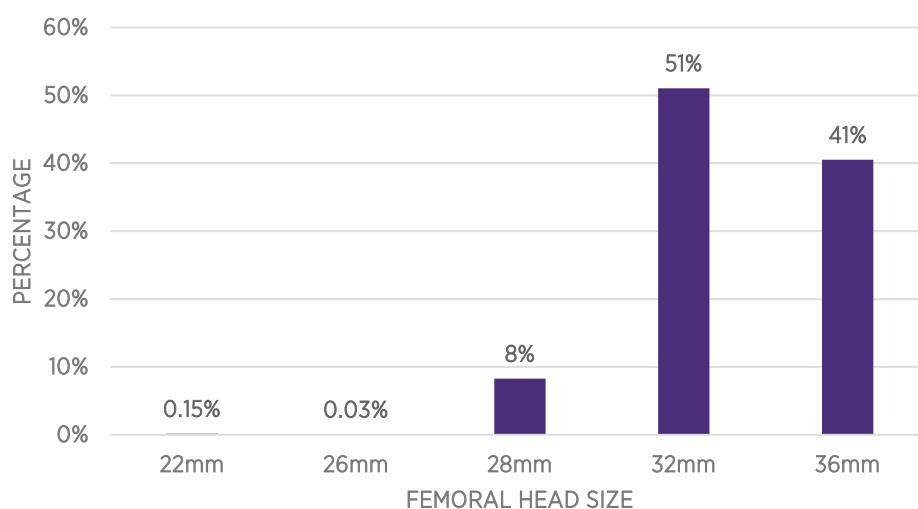
<b>Stryker: Exeter Contemporary</b>	<b>n</b>	<b>%</b>
Stryker: Exeter V40	71	79.8%
Stryker: Accolade II	13	14.6%
Other	5	5.6%
<b>Total</b>	<b>89</b>	<b>100.0%</b>
<b>Zimmer Biomet: G7</b>	<b>n</b>	<b>%</b>
DePuy: Corail	57	68.7%
Zimmer Biomet: Taperloc	25	30.1%
Other	1	1.2%
<b>Total</b>	<b>83</b>	<b>100.0%</b>
<b>Smith &amp; Nephew: R3</b>	<b>n</b>	<b>%</b>
Smith & Nephew: Synergy	39	79.6%
Smith & Nephew: Polarstem	6	12.2%
Other	4	8.2%
<b>Total</b>	<b>49</b>	<b>100.0%</b>
<b>DePuy: Elite</b>	<b>n</b>	<b>%</b>
Stryker: Exeter V40	16	59.3%
DePuy: Charnley	9	33.3%
Other	2	7.4%
<b>Total</b>	<b>27</b>	<b>100.0%</b>
<b>Medacta: Mpact</b>	<b>n</b>	<b>%</b>
Medacta: Masterloc	19	100.0%
<b>Total</b>	<b>19</b>	<b>100.0%</b>
<b>DePuy: Marathon</b>	<b>n</b>	<b>%</b>
DePuy: C-Stem AMT	11	73.3%
DePuy: Corail	2	13.3%
Stryker: Exeter V40	2	13.3%
<b>Total</b>	<b>15</b>	<b>100.0%</b>
<b>Other</b>	<b>9</b>	<b>100.0%</b>

## CHARACTERISTICS OF FEMORAL HEADS

This report includes all primary hip arthroplasties for which a femoral head was used, excluding arthroplasties where Monobloc stems were used (<1%). A metal femoral head was used in just over one-half (n=1720; 52%) of all INOR primary hip arthroplasties carried out in the reporting period (Figure 7.2). A femoral head size of 32 mm was used in more than one-half (n=1674; 51%) of primary hip arthroplasties (Figure 7.3). Findings from other international arthroplasty registers have shown that the use of larger sizes of femoral heads in primary total hip arthroplasties has increased, with 32 mm and 36 mm being the most commonly used sizes. As the development of design and material composition of total hip arthroplasty components continues to progress, it will be interesting to examine the different combinations of acetabular components bearing surface articulations and the most common material, including polyethylene, ultra-high molecular weight polyethylene (UHMWPE) or cross-linked UHMWPE (XLPE).

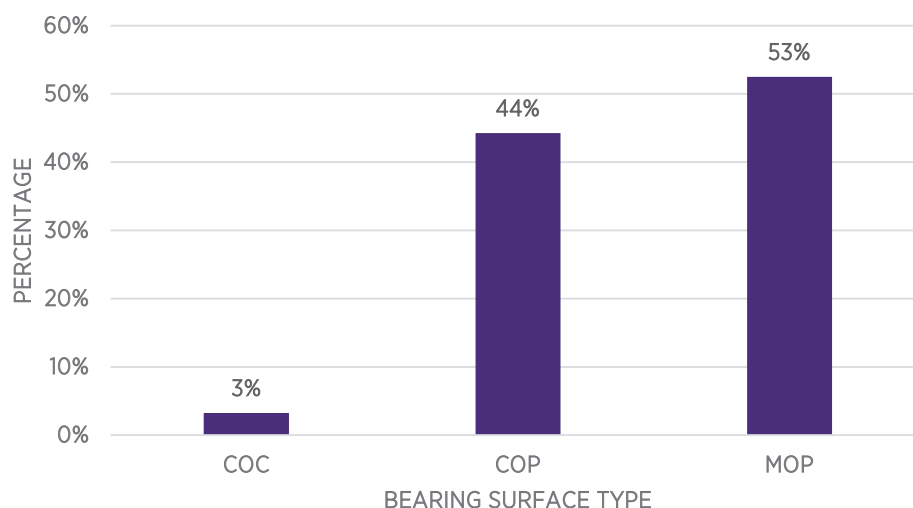


**FIGURE 7.2:** PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY FEMORAL HEAD MATERIAL TYPE (n=3277)



**FIGURE 7.3:** PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY FEMORAL HEAD SIZE (n=3279)<sup>43</sup>

The three main categories of bearing surface for primary hip arthroplasties reported were metal-on-polyethylene (MOP), ceramic-on-polyethylene (COP) and ceramic-on-ceramic (COC). The predominant articulation in INOR primary hip arthroplasty patients was MOP (n=1717; 53%), closely followed by COP (n=1447; 44%) (Figure 7.4). The data in this section do not represent the use of modular dual mobility (MDM) articulations, although a minority of articulations of this type were noted and will be represented in future reporting.



**FIGURE 7.4:** PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY BEARING SURFACE (n=3270)

<sup>43</sup> Percentages may not sum to 100% due to rounding.

REVISION HIP ARTHROPLASTY

Analysis on revision hip component characteristics will develop significantly as the number of patients in the Register increase, including analysis of the femoral head size, bearing options chosen and the overall implant survival patterns.

Among patients who had a revision hip procedure, 71% (n=1745) had both the acetabular and femoral components revised (Figure 7.5 and Table 7.5). Where a femoral component was revised, the most commonly used component was Exeter V40 (Stryker) (n=85; 34.1%), followed by Restoration (Stryker), which was used in approximately one-fifth (22%; n=55) of arthroplasties (Table 7.6). Where an acetabular component was revised, the most common implant used in the revision surgery was Pinnacle (DePuy) (Table 7.7).

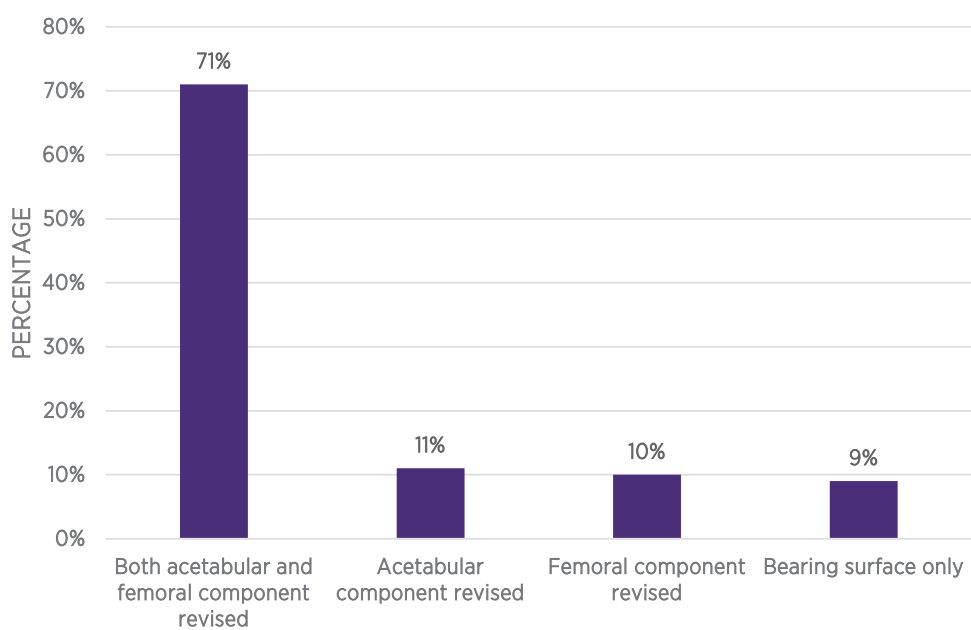


FIGURE 7.5: COMPONENTS REVISED DURING REVISION HIP ARTHROPLASTY (n=247)<sup>44</sup>

TABLE 7.5: COMPONENTS REVISED DURING REVISION HIP ARTHROPLASTY

Components	n	%
Both acetabular and femoral component revised	175	70.9%
Acetabular component revised	26	10.5%
Femoral component revised	24	9.7%
Bearing surface only	22	8.9%
Total	247	100.0%

<sup>44</sup> Percentages may not sum to 100% due to rounding.

**TABLE 7.6: FEMORAL STEM BRANDS FOR REVISION HIP ARTHROPLASTY (n=249)**

Manufacturer: brand	n	%
Stryker: Exeter V40	85	34.1%
Stryker: Restoration	55	22.1%
DePuy: Reclaim	35	14.1%
DePuy: C-Stem AMT	27	10.8%
DePuy: Summit	19	7.6%
Stryker: Accolade II	9	3.6%
Stryker: GMRS	7	2.8%
DePuy: Corail	6	2.4%
Other <sup>45</sup>	6	2.4%
<b>Total</b>	<b>249</b>	<b>100.0%</b>

**TABLE 7.7: ACETABULAR CUP BRANDS FOR REVISION HIP ARTHROPLASTY (n=266)**

Manufacturer: brand	n	%
DePuy: Pinnacle	108	40.6%
Stryker: Tritanium	58	21.8%
Stryker: Trident	56	21.1%
Stryker: Exeter Contemporary	14	5.3%
Stryker: Exeter X3 Rimfit	12	4.5%
Zimmer Biomet: Trabecular Metal (Shell)	8	3.0%
Other <sup>46</sup>	10	3.8%
<b>Total</b>	<b>266</b>	<b>100.0%</b>

<sup>45</sup> 'Other' femoral stem brands include CPT, Taperloc, Tri-Lock and Solution.

<sup>46</sup> 'Other' acetabular cup brands include Marathon, Elite, R3, Redapt, Plasmfit, Continuu and G7.

## KNEE ARTHROPLASTY

### CHARACTERISTICS

INOR uses the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) (Healthcare Pricing Office, 2019) procedure codes to describe knee arthroplasties that are entered into the Register. Two types of primary knee replacement are identified in this report: total condylar knee arthroplasty and unicompartmental knee arthroplasty. For the purposes of this first INOR report, unicompartmental knee replacement includes both unicondylar and patellofemoral joint knee arthroplasty. Total knee arthroplasty will be further defined in future reports by the fixation of knee components, the mobility of the bearing and the level of constraint according to whether they are minimally stabilised (cruciate retaining) or posteriorly stabilised.

Table 7.8 shows the number and percentage of knee arthroplasties performed by type during the reporting period. Overall, total condylar knee arthroplasty predominated in both the bilateral (n=55; 100.0%) and unilateral (n=2504; 91.7%) procedure groups. There was variation in the brands used for primary knee arthroplasty, where Triathlon (Stryker) was used in almost one-half (47.3%; n=1234) of all INOR patients, while just over one-quarter (25.8%; n=672) of arthroplasties used Attune (DePuy) (Table 7.9). Of the revision knee arthroplasties carried out during the reporting period, Triathlon TS (Stryker) was the brand most commonly used (n=63; 55.3%) (Table 7.10).

**TABLE 7.8: NUMBER AND PERCENTAGE OF KNEE ARTHROPLASTIES, BY TYPE OF KNEE REPLACEMENT**

Laterality and arthroplasty type	n	%
<b>BILATERAL</b>		
Total condylar knee arthroplasty	55	100.0%
<b>Total</b>	<b>55</b>	<b>100.0%</b>
<b>UNILATERAL</b>		
Total condylar knee arthroplasty	2504	91.7%
Unicompartmental knee arthroplasty	57	2.1%
Revision total condylar knee arthroplasty	171	6.3%
<b>Total</b>	<b>2732</b>	<b>100.0%</b>

**TABLE 7.9: BRANDS FOR PRIMARY KNEE ARTHROPLASTY (n=2609)**

Manufacturer: brand	n	%
Stryker: Triathlon	1234	47.3%
DePuy: Attune	672	25.8%
DEPUY: LCS	422	16.2%
DePuy: Sigma	94	3.6%
B Braun Aesculap: Columbus	51	2.0%
Smith & Nephew: Legion	32	1.2%
Zimmer Biomet: Oxford 3	18	0.7%
Zimmer Biomet: Vanguard	17	0.7%
Zimmer Biomet: Persona	14	0.5%
Stryker: Triathlon PKR	10	0.4%
Smith & Nephew: Journey	7	0.3%
Arthrosurface: Hemicap PF Wave	6	0.2%
DePuy: Sigma HP	6	0.2%
Stryker: Avon	6	0.2%
Others <sup>47</sup>	20	0.8%
<b>Total</b>	<b>2609</b>	<b>100.0%</b>

**TABLE 7.10: BRANDS FOR REVISION TOTAL KNEE ARTHROPLASTY (n=114)**

Manufacturer: brand	n	%
Stryker: Triathlon TS	63	55.3%
Smith & Nephew: Legion	17	14.9%
DePuy: Sigma	9	7.9%
DePuy: Attune	6	5.3%
Other <sup>48</sup>	19	16.7%
<b>Total</b>	<b>114</b>	<b>100.0%</b>

<sup>47</sup> 'Other' knee arthroplasty component brands include Zuk, S-Rom, Journey II, Genesis II, MRH, Journey II Oxinium and GMRS.

<sup>48</sup> 'Other' knee arthroplasty component brands include LPS, LCS, MRH, GMRS and Nexgen LCCK and DePuy: S-ROM Noiles.

### KEY FINDINGS FROM CHAPTER 7



#### HIP ARTHROPLASTY

- More than one-half (60%) of all primary hip arthroplasties were performed using cementless femoral stem fixation.
- Exeter V40 (Stryker) was the brand used in 96% of cemented femoral stem fixations, while Accolade II (Stryker) was the predominant brand used in cementless fixations.
- Ninety-six percent of primary hip arthroplasties used components from the same manufacturer.
- Large sizes of femoral heads (32 mm and 36 mm) accounted for 92% of primary hip replacement articulations.
- MOP was the predominant bearing surface type used in primary hip arthroplasty.
- Seventy-one percent of revision hip arthroplasty involved revisions of both the acetabular and femoral components.

### KEY FINDINGS FROM CHAPTER 7



#### KNEE ARTHROPLASTY

- Total condylar knee arthroplasty was the predominant type of knee arthroplasty recorded over the reporting period.
- Triathlon (Stryker) was the brand most commonly used in primary knee arthroplasty, and Triathlon TS (Stryker) was the brand most commonly used in revision knee arthroplasty.



## CHAPTER 8

# AUDIT UPDATE

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## CHAPTER 8: AUDIT UPDATE

From the commencement of the Register on 1 December 2014 to the end of the reporting period on 31 July 2019, INOR has made significant progress, albeit of a protracted nature. There have been many challenges along the way, including resources (ICT and analytical) in NOCA and locally in hospitals (no local audit coordinator); technical challenges due to differing information and communication technology (ICT) systems in hospitals; and the development of analytical expertise and clinical interpretation to report on information in INOR. However, the continued support and determination of NOCA, the INOR Governance Committee, the Health Service Executive (HSE), the National Clinical Programme for Trauma and Orthopaedic Surgery (NCPT&OS) and especially the participating hospitals has helped overcome these challenges in order to build a strong foundation for INOR.

This first report is a significant milestone for INOR. The importance of this report is that it proves that detailed and useful information on arthroplasty can be collected. It also demonstrates a method of presenting the data and provides the opportunity for our stakeholders to supply very welcome feedback, which will be facilitated by our current mechanisms of monthly audit meetings and biannual workshops with the participating hospitals. Together with guidance and external expertise from well-established registers, this feedback will assist in prioritising the reporting structure and output. Through this process, it will be possible to enhance both the quality of information reported and the output style. In this manner, with appropriate mechanisms in place, information will be made available to orthopaedic surgeons, hospitals, NCPT&OS, orthopaedic and health service management, and – most importantly – patients. Overall, this represents a commitment to quality improvement and audit in hip and knee replacement surgery in Ireland.

### RECALL UPDATE

As mentioned in Chapter 1, the primary function of INOR is to assist in the identification of patients if a component recall occurs. During the time period covered by this report, no component recalls were reported to INOR.



### FUTURE REPORTING

The annual report is only one method through which the Register intends to provide information on findings in the Register. Our analytical team, guided by the developing INOR Report Strategy, has already developed quarterly reports which will be delivered to hospitals with some basic activity information and five quality indicators. There are no recognised international standards for hip and knee replacement outcome data similar to those of the Irish Hip Fracture Database (British Orthopaedic Association, 2007); however, there is sufficient evidence to construct our own quality indicators to benchmark Irish practice. As of 2021, INOR reports on five key quality indicators; other quality indicators that will be incorporated as soon as possible are consent, length of stay, and completion rates, as well as other quality measures that may need consideration as the data mature.



As well as quarterly reports, a key priority of the NOCA reporting development plan, currently in the planning stages, is to develop mechanisms for real-time data reporting where hospitals and orthopaedic surgeons can access their own data. In addition to access to local report data, it is also vital that the hospitals have access to their patient-level data. The current reporting structure of INOR does not allow a hospital to access its own patient-level data through the INOR system itself; this is currently facilitated by NOCA. The aim for Q4 2021 to Q1 2022 is to develop the functionality within INOR to allow a hospital (with the correct data access policies and procedures in place) to be able to access its patient-level data for use in audit, quality improvement and service evaluation.

A large variety of components are currently available on the Irish market. Although the mid- to long-term survival rate of the majority of these components is known from other long-established registers, it is essential that we know the outcome of components used in Irish hip and knee arthroplasties. There is a requirement to understand and evaluate the surgical technique and specific patient characteristics of our Irish population and how these affect outcomes. More complex reporting, including survival analysis, will be included in the next and subsequent reports. As the patient numbers in Ireland are comparatively small, discussions around future collaborations with other international registries, with the International Society of Arthroplasty Registries (ISAR) or with our European Union counterparts need to be considered, in particular around components. Our excellent patient-reported outcome measure coverage, as noted in Chapter 6, will provide extra evidence to support our clinical outcome information.

The next (second) national report will encompass data covering the time frame from August 2019 to December 2020. This report will be delivered in a timely fashion now that the core reporting structure for INOR is in place. Subsequent reports will be published yearly from that point on.

## DATA QUALITY IMPROVEMENTS



INOR management will continue to work with our analytical team and with the hospitals in order to improve data quality. There are some minor system enhancements in progress during 2021 that will improve both data capture and quality, and will facilitate easier reporting by our analytical team. There are developments planned for the Irish National Component Catalogue (INCC) in order to ensure more flexible and comprehensive reporting. The requirements for the inclusion of any new component characteristics in the catalogue for reporting will be driven by our stakeholders. The INCC requires ongoing resources to manage the information on components within the catalogue. A resource is required to manage some of the fundamental tasks of the INCC that include:

- management of manually added component alerts from new components used in hospitals
- validation of individual component, combination combinations and INCC validation for reporting
- Ensure catalogue completeness in order to enable scanning of components in hospitals
- development of component reports
- management of the component recall process (report creation, validation, communication with hospitals)
- Investigate and secure access to a single source of medical device information for component reporting (whether it is the INCC, the International Prosthesis Library, other or a combination of any of the available sources).

NOCA will complete a feasibility study of the risks and benefits of collaboration with an international implant catalogue.

Along with these system enhancements, the continued enhancement of the INOR Data Validation Report (DVR) in order to assist hospitals in identifying data quality issues will be planned well in advance of the end of the next reporting period. NOCA will review and monitor any data issues and plan future education or workshops around these matters.

## RESEARCH CONSENT

Although consent for research purposes is not currently facilitated, INOR management plan to introduce research consent in September 2021 and will include a new consent form and patient information leaflet (Note: may be delayed with malware attack and currently no availability to the INOR system).



## HOSPITAL IMPLEMENTATION

The roll-out of hospital implementation will continue with the completion of the remaining elective hospitals within the phase I plan. The escalation of delivery of the planned roll-out of the private hospitals will gather pace as their interest in participation in INOR has grown in recent months. The roll-outs of both the public and private hospitals have been delayed significantly by COVID-19 and the malware attack, which has resulted in INOR management having limited or no access to on-site resources (personnel and ICT) in hospitals.



## TRAINING, EDUCATION AND SUPPORT

It is important to ensure that all changes and developments are communicated effectively with the audit coordinators and INOR system users in each hospital. Communication and updates are regularly provided through the following methods:

- audit coordinator meetings with the INOR team every month using a virtual platform
- on-site training, education and support facilitated by the INOR manager(s) as required
- short targeted training videos
- combined clinical lead and audit coordinator workshop(s). NOCA hosted the first combined workshop with clinical lead participation in April 2021; going forward, these workshops will occur biannually.



NOCA and the INOR Governance Committee are delighted to host the ISAR's International Congress of Arthroplasty Registries in May 2022 in Dublin. We hope to welcome participants from all around the world. As INOR is a young and developing Register, it is a wonderful honour to host this event.



## CHAPTER 9

# **RECOMMENDATIONS AND CONCLUSION**

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# CHAPTER 9: RECOMMENDATIONS AND CONCLUSION

## RECOMMENDATIONS FOR THE NATIONAL OFFICE OF CLINICAL AUDIT

### RECOMMENDATION 1

**The National Office of Clinical Audit (NOCA) will continue to support hospitals in order to ensure better data quality. NOCA will deliver more timely Data Validation Reports in order to ensure ongoing review of these data quality issues.**

#### Rationale

- In order for both NOCA and the hospitals to use INOR data for audit and quality improvement, it is very important that the information in the Register is complete, valid and reported in a timely fashion.

#### Evidence

- Timely data are collected within a reasonable agreed time period after the activity that they measure. Punctuality refers to whether data are delivered or reported on the dates promised, advertised or announced (Health Information and Quality Authority, 2018).

#### What action should be taken?

- The functionality of the current Data Validation Report (DVR) should be developed in order to include extra checks on data items that have been identified as having data quality issues. Data quality outlier reports should also be provided to the hospital in a timely fashion in order to facilitate validation and checks with patient charts.
- Clarification and more detailed guidelines of definitions at the clinical level should be provided through the development of a detailed INOR data definition dictionary.
- Targeted short education sessions – including short videos and face-to-face sessions – and ‘cheat sheets’ should be provided for the key roles and areas that have been identified as having quality issues.
- Responsibility for continuous data quality issues should be transferred to the clinical lead in each hospital.
- INOR should be incorporated into the hospital induction programme for the non-consultant hospital doctors (NCHDs).

#### Who will benefit from this action/recommendation?

- The accuracy of data in INOR will be improved.

#### Who is responsible for implementing this recommendation?

- INOR management, clinical leads and audit coordinators in each participating hospital.
- The NCPT&OS.

#### When will this be implemented?

- The new DVR will be delivered to hospitals in Q3 2021.
- NOCA will provide training material regarding quality issues in advance of NCHD changeover.
- The data definition dictionary will be delivered to hospitals in September 2021.
- The INOR induction programme was included in the NCHD changeover in July 2021.

## RECOMMENDATIONS FOR HOSPITALS/CLINICIANS

### RECOMMENDATION 2

**Hospital Irish National Orthopaedic Register (INOR) clinical leads and participating consultants are required to take responsibility for the quality of clinical information captured in INOR.**

#### Rationale

- Where data quality issues have been identified in any hospital, the issues cannot be rectified until changes and supports are implemented. The findings of this report have revealed data quality issues in some areas, and feedback has been provided to the hospitals. The changes required need to be supported in each hospital and this can only be achieved with the support of the INOR Clinical Lead.

#### Evidence

- Safe, reliable healthcare, and ancillary services such as clinical audit and research, depend on access to and use of quality data. Good quality data lead to good information informing decisions on clinical care, service delivery and policy. Good data quality requires personal responsibility and accountability for recording and documenting the health and social care services provided (Health Information and Quality Authority, 2012). The Health Information and Quality Authority (2018; 2012) recommends that healthcare organisations – including both hospitals managing patients having elective hip and knee arthroplasty and organisations managing national data collections (e.g. NOCA) – have processes in place in order to produce and disseminate data that accurately and reliably portray reality.

#### What action should be taken?

- Review DVRs with local audit coordinators in order to ascertain if they incorporate all data quality issues locally.
- Schedule regular INOR multidisciplinary team meetings in hospitals, which include consultants and NCHDs, in order to provide feedback to INOR users on any ongoing data quality issues or inaccurate interpretations of data.
- Each participating hospital should mandate INOR education as part of the NCHD induction programme.
- INOR management will support these actions by providing any required reports, training material, etc.

#### Who will benefit from this action/recommendation?

- The accuracy of data in INOR will be improved.

#### Who is responsible for implementing this recommendation?

- Hospital clinical leads.
- The NCPT&OS.

#### When will this be implemented?

- NCHD education was commenced in July 2021.
- The clinical lead and multidisciplinary team meetings will take place from Q4 2021 to Q2 2022.
- The new DVRs, which will include feedback from NOCA regarding data quality outliers, will be rolled out in September 2021.

## RECOMMENDATIONS FOR THE HEALTH SERVICE EXECUTIVE

## RECOMMENDATION 3

**All public patients who have hip or knee replacement surgery should be on INOR regardless of where the surgery takes place.**

## Rationale

- INOR is an important Irish public health venture: for the first time, INOR will facilitate the assessment of the variation in surgical techniques and practice in hospitals and between consultants. The Register will be able to provide information on implant performance, joint replacement surgery, and best practice for patients, surgeons, hospitals, manufacturers and healthcare management. This also presents tremendous opportunities for research into the factors that influence patients' progress and outcomes after surgery.
- The Register will identify those who have a specific implant in the event of a component recall. Therefore, in order to ensure that their implants are traceable and are monitored for their lifetime, all public patients should have the opportunity to participate in the Register.
- All public patients, regardless of where they have their surgery (e.g. in private hospitals or 'non-elective' hospitals), should be able to participate in INOR. The current consent rate in INOR is 99.7%. Most patients wish to participate in the Register and ensure that their implants are traceable.

## Evidence

- Well-established national joint replacement registers have shown quality improvements in patient care through availability of audit data (National Joint Registry, 2008), especially with reductions in revision rates in patients who had hip replacement surgery. In Sweden, one of the longest established registers has seen the revision rate of primary hip arthroplasty decrease by approximately 50% over time, which was associated with a drastic reduction in the number of different components available for use (Labek *et al.*, 2011). For INOR, a high participation rate is essential in order to ensure good quality information.

## What action should be taken?

- Complete the implementation of INOR in the remaining elective public hospitals.
- Advocate to private hospitals to participate in INOR.
- Require all public patients treated in private hospitals to be included in INOR.

## Who will benefit from this action/recommendation?

- All patients who have hip or knee arthroplasty will benefit from timely reporting in the case of a component recall.
- All patients who have hip or knee arthroplasty will be monitored in order to ensure the quality and safety of arthroplasty surgery and ensure safe surgical practice.

## Who is responsible for implementing this recommendation?

- The NOCA INOR management team is responsible for completing the implementation of INOR in public hospitals.
- The HSE Acute Hospitals Division is responsible for ensuring that all public patients can be included in INOR.
- Both NOCA (INOR) and the HSE (Acute Hospitals Division and the NCPT&OS) will continue to liaise with private hospitals in order to bring them onto the INOR platform.

## When will this be implemented?

- As soon as possible.

## CONCLUSION

This report is a significant landmark for INOR. This first INOR report presents information on patient characteristics and on both clinical and patient outcomes in those who had a hip and knee replacement in Ireland during the reporting period. It also provides an initial review of the types of components used in hip and knee arthroplasties. The power of these data will be enhanced as the level of national coverage increases. It is vital that, as well as achieving full coverage in our public hospitals, information from private hospitals is included in future reports. We look forward to further increasing the participation of hospitals in 2021 and into 2022.

It is vital that INOR reports are delivered in a timely fashion and the mechanism has now been developed to guarantee this. In parallel with the delivery of national reports, structures to produce hospital-level reports and ensure access to patient-level data are in development. With appropriate mechanisms in place, information will be made available in a timely manner to orthopaedic surgeons, hospitals, orthopaedic and health service management, and – most importantly – patients.

We thank the leadership of the hospital clinical leads and all the system users who enter patient information directly into INOR. The INOR Governance Committee appreciates the dedication of the audit coordinators who work to continually improve the quality of information in INOR.

This report represents a commitment to quality improvement and audit in hip and knee arthroplasty in Ireland.





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## **Radial artery**

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the elbo  
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About halfway  
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ep vein.

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# APPENDICES

A photograph of a meeting table with several people. In the foreground, a person's hand is holding a blue pen over a blue tablet. Another person's hand is visible on the left, holding a white tablet. In the background, another person is holding a clipboard with a pen. The scene is brightly lit, suggesting a professional or medical setting.

# APPENDIX 1: INOR GOVERNANCE COMMITTEE

Organisation	Name
<b>Mr Paddy Kenny</b>	Chairperson of the INOR Governance Committee Consultant Orthopaedic Surgeon National Clinical Lead, National Clinical Programme for Trauma and Orthopaedic Surgery
<b>Mr David Moore</b>	Joint Clinical Lead of the INOR Governance Committee Consultant Orthopaedic Surgeon National Clinical Lead, National Clinical Programme for Trauma and Orthopaedic Surgery
<b>Mr James Cashman</b>	Joint Clinical Lead of the INOR Governance Committee Consultant Orthopaedic Surgeon
<b>Mr Maurice Neligan</b>	Joint Clinical Lead of the INOR Governance Committee, representing the private hospitals Consultant Orthopaedic Surgeon
<b>Mr Pdraig O'Loughlin</b>	Joint Clinical Lead of the INOR Governance Committee Consultant Orthopaedic Surgeon
<b>Suzanne Rowley</b>	INOR Manager, NOCA
<b>Deborah McDaniel</b>	INOR Assistant Manager, NOCA
<b>Collette Tully</b>	NOCA Executive Manager
<b>Ruth Kiely<sup>49</sup></b>	Manager, National Clinical Programme for Trauma and Orthopaedic Surgery
<b>Deirdre Lang</b>	Director of Nursing/National Lead Older Persons Services/Clinical and Integrated Programmes at Health Service Executive
<b>Orlagh Claffey</b>	Chief Operations Officer (Interim), Dublin Midlands Hospital Group
<b>Dearbhail Foy</b>	Arthroplasty Nurse Specialist at Midland Regional Hospital Tullamore
<b>Vacant<sup>50</sup></b>	National Physiotherapy Lead
<b>Rosemary Masterson</b>	Irish Orthopaedic Nursing Group Representative
<b>Plunket O'Reilly</b>	Public and Patient Interest Representative
<b>Brian Lynch</b>	Head of Communications and Advocacy, Arthritis Ireland Public and Patient Interest Representative

<sup>49</sup> Position previously held by Catherine Farrell until December 2019.

<sup>50</sup> Vacant as of Q2 2021. New nomination awaited from the Irish Society of Chartered Physiotherapists. Previously held by Ruth Kiely until Q1 2021.

## APPENDIX 2: LIST OF OTHER COMBINATIONS OF COMPONENTS (TABLE 7.4)

<ul style="list-style-type: none"> <li>• Stryker (Trident): Stryker (Restoration), DePuy (Summit), DePuy (C-Stem AMT)</li> </ul>
<ul style="list-style-type: none"> <li>• Depuy (Pinnacle): LIMA (Modulus), Smith &amp; Nephew (Synergy)</li> </ul>
<ul style="list-style-type: none"> <li>• Stryker (Tritanium): Stryker (Restoration), Depuy (Tri-Lock), Depuy (Reclaim)</li> </ul>
<ul style="list-style-type: none"> <li>• Stryker (Exeter X3 Rimfit): Stryker (Accolade II)</li> </ul>
<ul style="list-style-type: none"> <li>• Stryker (Exeter Contemporary): DePuy (Corail), Stryker (Restoration)</li> </ul>
<ul style="list-style-type: none"> <li>• Zimmer Biomet (G7): Stryker (Exeter V40)</li> </ul>
<ul style="list-style-type: none"> <li>• Smith &amp; Nephew (R3): DePuy (Summit), Smith &amp; Nephew (CPCS)</li> </ul>
<ul style="list-style-type: none"> <li>• DePuy (Elite): DePuy (Summit)</li> </ul>
<ul style="list-style-type: none"> <li>• DePuy (Marathon): DePuy (Corail), Stryker (Exeter V40)</li> </ul>
<ul style="list-style-type: none"> <li>• LIMA (Delta-One-TT): LIMA: Modulus</li> </ul>
<ul style="list-style-type: none"> <li>• B Braun Aesculap (Plasmafit): B Braun Aesculap (Metha)</li> </ul>
<ul style="list-style-type: none"> <li>• Zimmer Biomet (Trabecular Metal (Shell): Stryker (Exeter V40)</li> </ul>
<ul style="list-style-type: none"> <li>• Serf (Novae): DePuy (Corail)</li> </ul>
<ul style="list-style-type: none"> <li>• Zimmer Biomet (Continuum): Stryker (Exeter V40).</li> </ul>

## APPENDIX 3: FREQUENCY TABLES

Figures for which the total sample size shown was less than five cases (Figures 5.4 and 5.7–5.9) are not presented as frequency tables in Appendix 3.

### CHAPTER 4

**FIGURE 4.3: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS, BY AGE GROUP (PRIMARY: n=3344; REVISION: n=379)**

Age group	Primary		Revision	
	n	%	n	%
<30	17	0.5%	~	*
30–39	57	1.7%	~	*
40–49	257	7.7%	19	5.0%
50–59	611	18.3%	51	13.5%
60–69	1035	31.0%	115	30.3%
70–79	987	29.5%	128	33.8%
80–89	366	10.9%	61	16.1%
≥90	14	0.4%	~	*
Total	3344	100.0%	379	100.0%

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.4: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS, BY SEX (PRIMARY: n=3344; REVISION: n=379)**

Sex	Primary		Revision	
	n	%	n	%
Female	1670	49.9%	184	48.5%
Male	1674	50.1%	195	51.5%
Total	3344	100.0%	379	100.0%

**FIGURE 4.5: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS, BY BODY MASS INDEX (PRIMARY: n=3344; REVISION: n=379)**

BMI range	Primary		Revision	
	n	%	n	%
0.00–24.99	707	21.1%	73	19.3%
25.00–29.99	1265	37.8%	136	35.9%
30.00–34.99	929	27.8%	110	29.0%
35.00–39.99	318	9.5%	42	11.1%
≥40.00	125	3.7%	18	4.7%
Total	3344	100.0%	379	100.0%

**FIGURE 4.6: AMERICAN SOCIETY OF ANESTHESIOLOGISTS GRADE RECORDED FOR HIP ARTHROPLASTY PATIENTS (PRIMARY: n=3344; REVISION: n=379)**

ASA grade	Primary		Revision	
	n	%	n	%
ASA grade 1	478	14.3%	23	6.1%
ASA grade 2	2267	67.8%	250	66.0%
ASA grade 3	470	14.1%	96	25.3%
ASA grade 4	~	*	~	*
Not known	*	*	*	*
Total	3344	100.0%	379	100.0%

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.7: SURGICAL APPROACH FOR HIP ARTHROPLASTY (PRIMARY: n=3344; REVISION: n=379)**

	Primary		Revision	
	n	%	n	%
Trochanteric osteotomy	~	*	19	5.0%
Lateral/anterolateral (lateral)	891	26.6%	91	24.0%
Anterior only	*	*	6	1.6%
Posterior/posterolateral (posterior)	2265	67.7%	263	69.4%
Total	3344	100.0%	379	100.0%

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.8: TYPE OF CHEMICAL THROMBOPROPHYLAXIS USED (PRIMARY: n=3344; REVISION: n=379)**

Chemical thromboprophylaxis	Primary		Revision	
	n	%	n	%
None	94	2.8%	8	2.1%
Aspirin	1320	39.5%	164	43.3%
Low molecular weight heparin (LMWH)	3147	94.1%	366	96.6%
Rivaroxaban	280	8.4%	24	6.3%
Other	23	0.7%	~	*

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.11: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY AGE GROUP (PRIMARY: n=2677; REVISION: n=194)**

Age group	Primary		Revision	
	n	%	n	%
<30	~	*	0	0.0%
30-39	12	0.4%	0	0.0%
40-49	105	3.9%	7	3.6%
50-59	413	15.4%	34	17.5%
60-69	960	35.9%	69	35.6%
70-79	944	35.3%	61	31.4%
80-89	233	8.7%	23	11.9%
≥90	9	0.3%	0	0.0%
Total	2677	100.0%	194	100.0%

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.12: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY SEX (PRIMARY: n=2677; REVISION: n=194)**

Sex	Primary		Revision	
	n	%	n	%
Female	1622	60.6%	110	56.7%
Male	1055	39.4%	84	43.3%
Total	2677	100.0%	194	100.0%

**FIGURE 4.13: PERCENTAGE OF KNEE ARTHROPLASTY IRISH NATIONAL ORTHOPAEDIC REGISTER PATIENTS, BY BODY MASS INDEX (PRIMARY: n=2677; REVISION: n=194)**

BMI Group	Primary		Revision	
	n	%	n	%
0.00-24.99	260	9.7%	18	9.3%
25.00-29.99	837	31.3%	69	35.6%
30.00-34.99	824	30.8%	62	32.0%
35.00-39.99	515	19.2%	28	14.4%
≥40.00	241	9.0%	17	8.8%
Total	2677	100.0%	194	100.0%

**FIGURE 4.14: PERCENTAGE OF KNEE ARTHROPLASTY IRISH NATIONAL ORTHOPAEDIC REGISTER PATIENTS, BY AMERICAN SOCIETY OF ANESTHESIOLOGISTS GRADE (PRIMARY: n=2677; REVISION: n=194)**

	Primary		Revision	
ASA grade	n	%	n	%
ASA grade 1	253	9.5%	18	9.3%
ASA grade 2	1856	69.3%	131	67.5%
ASA grade 3	405	15.1%	39	20.1%
ASA grade 4	~	*	~	*
Not known	160	6.0%	~	*
Total	2677	100.0%	194	100.0%

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.15: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY SURGICAL APPROACH (PRIMARY: n=2677; REVISION: n=194)**

	Primary		Revision	
Surgical approach	n	%	n	%
Lateral parapatellar	13	0.5%	~	*
Medial parapatellar	2662	99.4%	191	98.5%
Subvastus	~	*	0	0.0%
Osteotomy	~	*	~	*
Tibial tubercle	~	*	0	0.0%
Total	2677	100.0%	194	100.0%

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.16: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS, BY TYPE OF CHEMICAL THROMBOPROPHYLAXIS USED (PRIMARY: n=2677; REVISION: n=194)**

	Primary		Revision	
Chemical thromboprophylaxis	n	%	n	%
None	56	2.1%	6	3.1%
Aspirin	1123	41.9%	82	42.3%
Low molecular weight heparin (LMWH)	2549	95.2%	187	96.4%
Rivaroxaban	185	6.9%	12	6.2%
Other	25	0.9%	~	*

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

## CHAPTER 5

**FIGURE 5.1: PERCENTAGE OF PATIENTS WHO HAD AN INFECTION WITHIN 30 DAYS OF HIP ARTHROPLASTY**

Primary (n=3344)		Revision (n=379)	
n	%	n	%
13	0.4%	8	2.1%

**FIGURE 5.2: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD A PERIPROSTHETIC FRACTURE WITHIN 30 DAYS OF SURGERY**

Primary (n=3344)		Revision (n=379)	
n	%	n	%
6	0.2%	~	*

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 5.3: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD A DISLOCATION WITHIN 30 DAYS OF SURGERY**

Primary (n=3344)		Revision (n=379)	
n	%	n	%
9	0.3%	~	*

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 5.5: PERCENTAGE OF HIP ARTHROPLASTY PATIENTS WHO HAD CARDIOPULMONARY COMPLICATIONS WITHIN 30 DAYS OF SURGERY (PRIMARY: n=3344; REVISION: n=379)**

Primary (n=3344)		Revision (n=379)	
n	%	n	%
128	3.8%	8	2.1%

**FIGURE 5.6: PERCENTAGE OF PATIENTS WHO HAD AN INFECTION WITHIN 30 DAYS OF KNEE ARTHROPLASTY (PRIMARY: n=2677; REVISION: n=194)**

Primary (n=2677)		Revision (n=194)	
n	%	n	%
16	0.6%	~	*

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 5.10: PERCENTAGE OF KNEE ARTHROPLASTY PATIENTS WHO HAD CARDIOPULMONARY COMPLICATIONS WITHIN 30 DAYS OF SURGERY (PRIMARY: n=2677; REVISION: n=194)**

Primary (n=2677)		Revision (n=194)	
n	%	n	%
126	4.7%	~	*

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

## CHAPTER 7

**FIGURE 7.1: PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY FIXATION TYPE (n=3302)**

	Primary	
	n	%
Cementless	1977	59.9%
Hybrid	1092	33.1%
Cemented	206	6.2%
Reverse hybrid	27	0.8%
Total	3302	100.0%

**FIGURE 7.2: PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY FEMORAL HEAD MATERIAL TYPE (n=3277)**

	Primary	
	n	%
Ceramic	1557	47.5%
Metal	1720	52.5%
Total	3277	100.0%

**FIGURE 7.3: PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY FEMORAL HEAD SIZE (n=3279)**

	Primary	
	n	%
22 mm	~	*
26 mm	~	*
28 mm	271	8.3%
32 mm	1674	51.1%
36 mm	1328	40.5%
Total	3279	100.0%

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 7.4: PERCENTAGE OF PRIMARY HIP ARTHROPLASTIES, BY BEARING SURFACE (n=3270)**

Bearing surface material	Primary	
	n	%
Ceramic-on-ceramic (COC)	106	3.2%
Ceramic-on-polyethylene (COP)	1447	44.3%
Metal-on-polyethylene (MOP)	1717	52.5%
Total	3270	100.0%

**FIGURE 7.5: COMPONENTS REVISED DURING REVISION HIP ARTHROPLASTY (n=247)**

	Primary	
	n	%
Both acetabular and femoral component revised	175	70.9%
Acetabular component revised	26	10.5%
Femoral component revised	24	9.7%
Bearing surface only	22	8.9%
Total	247	100.0%



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