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German Arthroplasty Registry (EPRD)

2019 Annual Report

ANNUAL REPORT 2019

The German Arthroplasty Registry
An initiative of the German Society for Orthopaedics and Orthopaedic Surgery e.V. *(DGOOC)*

DEUTSCHE GESELLSCHAFT
FÜR ORTHOPÄDIE UND
ORTHOPÄDISCHE CHIRURGIE

Annual report 2019

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We would like to thank the members of the working groups
for their suggestions and feedback!

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Preamble

The German Arthroplasty Registry (EPRD) has continued to expand over the course of last year even though the individual clinics contribute information on a purely voluntary basis. With more than 300,000 arthroplasty surgery details recorded in 2018, the EPRD is now one of the registries with the highest number of annual entries in the world.
Of course, we are expecting major changes to follow on from the establishment of a new national state-based registry structure. But it is satisfying that the EPRD is serving as a blueprint for this new registry. We are confident that we can retain many of the tried-and-tested structures and expertise provided by medical associations, industry and health insurance funds, even if the framework is likely to change.
In the future and owing to these new structures, we will increasingly collect more information focussing on the structures performing arthroplasties in addition to the details relating to the arthroplasties themselves. In this regard, it will be important, on the one hand, to adequately record and evaluate these aspects of arthroplasties and, on the other hand, to ensure that any conclusions drawn from this data do not have a negative impact on the clinics and surgeons who specialise in complex cases.
We are also very grateful that the pertinent medical society (DGOOC) was able to contribute towards the development of the new registry structures. We would like to take this opportunity to thank you all very much for your support and the trust you bestow on us when forwarding your surgery details to the EPRD.
I hope you enjoy reading our brand new annual report!

Prof. Dr. med. Volkmar Jansson
Scientific Director of the EPRD

1 Introduction

The German Arthroplasty Registry (EPRD) was launched in 2010 as a joint project by doctors, clinics, public health insurance funds and industry to collect data on hip and knee joint replacements throughout Germany to establish a reliable resource assessing arthroplasty surgery outcome over the long term. In the six years spanning the start of data collection in November 2012 until the end of 2018, entries on over one million hip and knee arthroplasties have been submitted to the EPRD, with all data provided on a purely voluntary basis. This *2019 EPRD annual report* presents results that can be drawn from the database to date.
If you are a regular reader of the EPRD's annual reports, you may be wondering why the *2017 annual report* published last year is being followed by the *2019 annual report* this year. Be reassured that you have not missed a report, but that a new naming convention has been adopted: The annual reports are now designated by their publication year rather than the year the data was collected. This also marks the start of a new era in relation to the annual report's content: Jointly with the British NJR (*National Joint Registry*), the world's largest arthroplasty registry by data entries, the EPRD has developed a new, more comprehensive product database structure which was launched last year. This report is the first annual report to be compiled using information from this new database, comprised of over 60,000 individual entries.
Despite all these changes, however, the EPRD is still striving for continuity. The basic structure of the previous annual reports has therefore been largely retained. This means that we start the report by explaining how the registry was initially developed (Chapter 2), followed by some background about the available material data and details about the types of analyses carried out by the EPRD (Chapter 3). The next chapter describes and evaluates the number of arthroplasties included in the registry in 2018 and discusses as well as compares the new emerging trends with observations made in previous years. A key focus of the 2019 report is the survival analysis of components for the different types of arthroplasties and implant systems, presented and discussed in Chapter 5. For the first time ever, we go beyond simply examining the time interval between primary arthroplasties and any subsequent revisions, by also recording what happens after the revisions. The international comparison of individual results is discussed in Chapter 6. This chapter also examines the general question of comparability of results between registries. A short summary of the most significant results is presented at the end of this report in chapter 7.

New developments

- Annual report 2019 – from now on, report named by year of publication
- New product database structure encompassing over 60,000 individual entries
- First ever analysis of re-revisions

2 Progress report

It was in November 2012, that the EPRD first began collecting data on hip and knee arthroplasty surgery as part of a clinical trial. All clinics interested in contributing to the EPRD can do so since July 2013. Thanks to the proactive interest generated and the committed participation of clinics and patients, the registry exceeded its one million arthroplasty benchmark in 2018.

The EPRD is a voluntary registry which relies on the ongoing commitment of participating clinics and on patient consent. Although the number of arthroplasties included in the EPRD increases each year, and with it the German nationwide coverage rates of the total number of hip and knee arthroplasties achieved, the increase has recently been less pronounced than in previous years. The following Figure 2 and Table 1 illustrate the evolution of the annual number of arthroplasties added to the registry as well as the coverage rates achieved. In 2018 more than 300,000 arthroplasties were added to the registry which represents a new record, even though it only corresponds to a small percentage point increase above the previous year's figure.

According to the IQTIG quality report, in Germany alone, hip and knee arthroplasties are performed by more than 1,200 clinics [1]. Last year 716 of these clinics submitted data to the EPRD. If you take a closer look at which clinics are involved, the general picture has essentially remained unchanged for the year as shown in Figure 3: The greater the number of hip and knee arthroplasties a clinic performs, the more likely it is to submit data to the EPRD. While over 90% of clinics performing greater than 500 hip and knee arthroplasties per year submit data to the EPRD, only 15% of clinics performing fewer than 100 arthroplasties per annum contributed data to the registry. This 15% figure actually represents an improvement compared to the previous year. Altogether clinics that submitted data to the registry in 2018, represent 79% of all hip and knee arthroplasties carried out nationwide in Germany in the previous year, based on their quality reports.

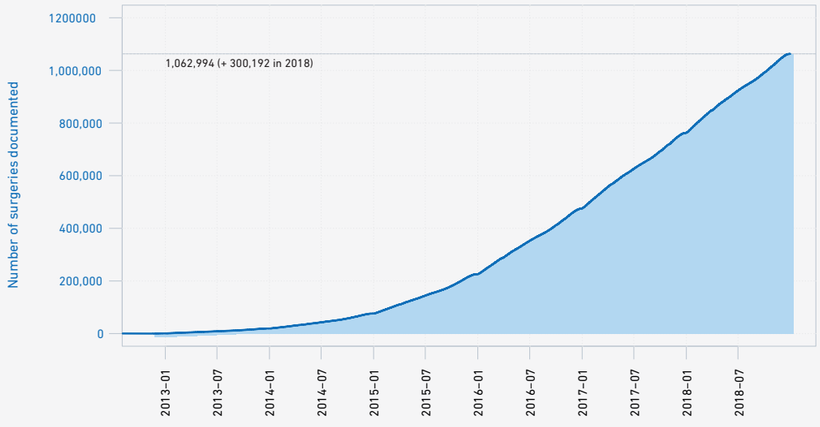


Figure 1: Evolution of the EPRD database inventory over time

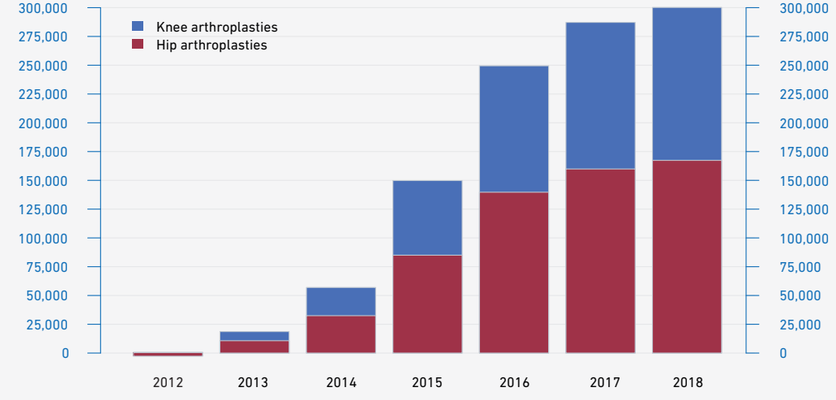


Figure 2: Evolution of surgical documentation submission figures from 2012 to 2018

Table 1: Percentage of hip and knee arthroplasties performed in Germany and included in the registry over time

Year	2012	2013	2014	2015	2016	2017	2018
Number of surgeries documented	695	18,632	56,960	149,823	249,495	287,197	300,192
Estimated total number of hip and knee arthroplasties[1]	400,000	400,000	400,000	420,000	440,000	448,000	450,000
Estimated coverage	0.2%	4.7 %	14.2 %	35.7 %	56.7 %	64.1 %	66.7 %

1 Estimate based on the AQUA and IQTIG hip and knee arthroplasty quality reports for the respective years. Between 2012 and 2014, unicondylar knee arthroplasties were not specified; the number of unicondylar knee arthroplasties was therefore extrapolated based on an estimate of their proportion in the EPRD. Since the data collection year 2018, isolated insert replacements no longer need to be recorded as part of external quality assurance. The total number listed for 2018 is also an extrapolation.

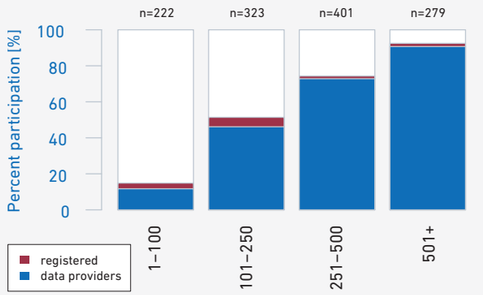


Figure 3: Registry participation by clinic volume [2]

A significant increase in the clinic participation rate and the number of arthroplasties included in the registry is not expected to occur again until 2021, when the Implant Registry Germany (Implantateregister Deutschland, in short "IRD") will start operating as a legally mandatory registry. It is planned that all of the relevant individual entries collected by the EPRD will be transferred to the IRD, although the specifics of the legal data protection requirements governing this transfer have yet to be completely defined.

In addition to the continuous efforts to increase the number of arthroplasties included in the registry as well as the range of details collected, the EPRD has in recent years also become increasingly focussed on expanding international collaborations. Notably a new product database structure was developed in 2018 in collaboration with the *National Joint Registry* (NJR), which is currently the world's largest arthroplasty registry in terms of data entries. This new database harmonises the NJR and the EPRD and although it builds on the EPRD database, it transcends the EPRD in terms of scope and volume. In its current form the new product database already includes over 60,000 individual entries provided by the manufacturers participating in the EPRD. The data evaluated as part of the current report was therefore already extracted from this new product database. Over the medium and long term, this new product database should facilitate even more detailed and in-depth analyses.

In summary

- More than 300,000 surgeries documented in 2018
- Most EPRD submissions are from clinics that perform large numbers of arthroplasties per year
- Classification of the implant product database harmonised with the British NJR

2 Individual clinics are assigned to an arbitrary size category based on the total number of billed arthroplasties identified by OPS codes 5-820 to 5-823 extracted from the clinic's 2017 quality report. (OPS is the German acronym for "Operationen- und Prozedurenschlüssel" which stands for "Operation and Procedure Classification System" and is the German modification of the International Classification of Procedures in Medicine (ICPM)). The light blue bar indicates the proportion of clinics registered with the EPRD, while the blue bar shows the proportion of clinics providing data. Numbers above the bars indicate the number of clinics included in each of the respective categories. The red bar indicates the proportion of clinics registered with the EPRD but not yet providing data, while the blue bar represents the proportion of registered clinics providing data. Numbers above the bars indicate the number of clinics included in each respective category." "The red bar indicates the proportion of clinics registered with the EPRD but not yet providing data, while the blue bar represents the proportion of registered clinics providing data. Numbers above the bars indicate the number of clinics included in each respective categories.

3 Summary of statistical methodology and data linkage

Like its predecessors, this EPRD annual report is subdivided into two parts: Chapter 4 of the report describes the latest arthroplasty data extracted from all arthroplasties that were included in the registry during the 2018 calendar year and summarises general trends and developments regarding arthroplasty and implant preferences. For the survival analysis of arthroplasty components in Chapter 5, the cumulative data comprising all years since inception of the EPRD are considered and the probability of revision surgery evaluated over time. Additional background information required to interpret figures and tables, including supplementary methodological details are inserted in the respective grey text boxes throughout the report.

The following is a general discussion of the basic and specific details relating to the material data. The EPRD distinguishes itself from other registries by collating data from three different sources:

- The most substantial volume of data is derived from the surgical details submitted by the clinics with the informed consent of their respective patients. **Other details recorded in the registry** include general patient information such as height, weight, age and sex as well as very detailed information relating to the actual procedure performed. The clinics specify which joint has been treated, what type of surgery has been carried out, whether previous operations have been performed, why a component revision was necessary and which components were replaced.
- It is crucial to have more information about these variables than simply the item number and a description. To address this, the EPRD, has collaborated with the implant manufacturers, to establish a **product database** which includes a separate and very precise classification for every type of hip and knee arthroplasty component used. This encompasses details about the different materials, the intended type of fixation, the size, the coatings and much more. The product's barcode identification number is then used to call up the component classification from the EPRD product database and to further catalogue the case in the registry. This classification allows information about arthroplasties, which used different implant systems but have the same properties, to be condensed for the purposes of the analysis and thereby facilitates the evaluation of any subsequently effects of these common properties, on the survival analysis of arthroplasty components.

As previously mentioned, we have recently "completely renewed" the product database, in collaboration with the British NJR, which has allowed a significant expansion of the classification features included. Manufacturers participating in the EPRD have been able to enter their product information in this new database since 2018 with the database currently encompassing over 60,000 individual items. Results presented in the following chapters include data extracted from this new product database. Nevertheless, as the new classification differs with

respect to some forms and definitions from the previous classification, several of the values presented below may differ quite significantly from those of previous EPRD reports. A direct comparison of data presented in this report with previous reports is therefore no longer possible or may be limited. To ensure continuity and allow descriptive trends to be compared over time, we have re-analysed all the historical data using this new classification system.

- As the EPRD is a voluntary registry, and is not a mandatory repository for surgical documentation pertaining to every hip and knee arthroplasty performed in Germany, the registry systematically cross-references to several other databases to formulate valid statements about the survival analysis of arthroplasty components and the probability of arthroplasty revision. The two biggest public health insurance associations, i.e. AOK-Bundesverband GbR and Verband der Ersatzkassen e.V. (vdek), provide the EPRD with **routine data** from their members, in full compliance with data protection regulations. These data include specific treatment codes which allow to draw specific valid conclusions about the arthroplasty surgery, even if the intervention was not performed by a clinic participating in the EPRD. This cross-referencing ensures that the registry is informed of any relevant censored events, since events such as death or amputation can be extracted from the above public health funds' databases. This means that the coverage rate achieved by the EPRD is not critical, since there is a reliable alternative source of data for patients whose surgical documentation has not been submitted to the EPRD.

The EPRD strives to be the repository of the most accurate and comprehensive data pertaining to hip and knee arthroplasties. Surgical documents included in the registry are therefore cross-checked for accuracy and consistency. An entry that does not pass this screen is completely excluded from any future analyses until the issue is resolved. The product item number and its classification entered in the registry is crosschecked with the product database. Registry data are also crosschecked against routine health insurance funds data to eliminate any inconsistencies. Since routine data from health insurance funds are essential to make accurate and unbiased statements about the survival analysis of arthroplasty components, only data from patients for whom the corresponding data already exist can be used in these evaluations. This inevitably restricts the survival analysis of arthroplasty components evaluations in Chapter 5 to the data records of patients who are insured with the AOK and the vdek health insurance funds and for whom the intervention occurred long enough ago for the health insurance funds to send this data to the EPRD. There are therefore only approximately 400,000 patient records, which comprise surgical documents, that can be included in the survival analysis of arthroplasty components, out of the total of one million arthroplasties collated in the EPRD.

This is the third annual EPRD report which encompasses the survival analysis of arthroplasty components. This survival analysis plots the probability of arthroplasty revision versus time. The endpoint of the analysis is “revision for any reason”. It includes any arthroplasty which necessitated a revision surgery subsequent to the index arthroplasty. This is the first EPRD annual report to retrospectively analyse revision probabilities spanning a 4-year time period from the primary surgery. Although the main objective is the survival analysis of arthroplasty components between the primary arthroplasty and the first revision of prosthetic components, this report goes one step further by also determining the probability of a second revision subsequent to the first revision[3]. Revision surgery is defined as the removal or the replacement of previously implanted hip or knee arthroplasty components. In contrast, the reoperation of a knee replacement with patellofemoral resurfacing as a consequence of progressive patellofemoral arthrosis is not interpreted as failure of the initial arthroplasty. Irrespective of which components in revision surgery are left untouched and which are replaced, all the components inserted during the index surgery are considered to have reached the endpoint. This definition is particularly significant for the correct assessment of implant-related results in Section 5.2.

In summary

- Survival analyses of arthroplasty components based on a total of 400,000 primary arthroplasties and primary revisions under observation
- Observation period in current report extends up to 4 years after primary arthroplasty

3 Revision surgery may or may not be followed by re-implantation of new arthroplasty components during the same operation (one-stage revision) or at a later date (two-stage revision) and is interpreted as failure of the index arthroplasty. In the case of two-stage revisions, the follow-up period of starts with the second stage.

4 The 2018 operating year

A total of 300,192 operation documents were submitted to the EPRD during the period from January 1 to December 31, 2018. Table 2 summarises the subdivision of these individual entries into the different types of joint arthroplasties.
Notably hip arthroplasties outnumber knee arthroplasties with 56% of all arthroplasty entries in the EPRD representing hip interventions. There is an overrepresentation of women for both hip and knee arthroplasties, with the proportion of male patients around 40%. Effects associated with demographic trends, but also any potential sex-related prevalence of osteoarthritis, particularly with regards to knee osteoarthritis, may impact the genesis of hip or knee pathologies. There are nevertheless distinct prevailing differences between patients who undergo a hip or a knee arthroplasty: The median age of hip arthroplasty patients is 72 years, three years older than patients who undergo a primary knee arthroplasty. The median body mass index (BMI) of knee arthroplasty patients is around 30 and is three points greater than for hip arthroplasty patients. At a height of 1.70 m, this difference in BMI corresponds to a weight difference close to 9 kg. Knee arthroplasty patients therefore carry significantly more weight than hip arthroplasty patients.
The following sub-chapter further describe the latest EPRD hip and knee arthroplasty data by type of intervention. As the EPRD has been collecting data over numerous years, this data can therefore also be analysed to identify short and medium-term outcomes of arthroplasty surgery. The following section discusses arthroplasty surgery outcomes for particular systems and categories in more detail.

Table 2: Proportions of registered procedures by joint and type of intervention - 2018. Absolute numbers given in brackets below the corresponding proportion.

	Proportion [%]	Age	m/f [%]	BMI
All registered procedures	100.0 (300.192)	71	40 / 60	28.3
Primary hip	50.1 (150.284)	72	40 / 60	27.1
Hip reoperation	5.7 (17.081)	75	42 / 58	27.3
Primary knee	39.7 (119.131)	69	39 / 61	30.0
Knee reoperation	4.5 (13.378)	70	41 / 59	30.1
Total femur	0.1 (318)	73	37 / 63	28.7

Presentation of descriptive data

For the purposes of this chapter, the documentation submitted to the EPRD was categorised separately by type of arthroplasty and the following descriptive parameters were determined for each of the categories:

Parameter	Explanation
Proportion [%]	Proportion of operations included in each respective category expressed in %.
Age	Median age of patients in this category. This means that 50% of the patients in this category are not older, and at least 50% are not younger than this age.
m/f [%]	Proportion of men and women in this category expressed in %
BMI	Median BMI of patients in this category. The BMI relates to the subgroup of patients for whom valid information on weight and height was available.

Different arthroplasty items, listed in the surgical documentation obtained from the clinics, are assigned to the classification of the implant components used. Specific categories are defined so that there is no overlap. Generally, the sum of percentages listed adds up to 100% and relates to the total number of surgical arthroplasties documented which were amenable to the application of the respective analysis principles. Where the principles of the analysis could not be applied, because the classification of essential arthroplasty components was, for instance, not specified in the surgical report, these entries were excluded from the analyses.
Analyses of the descriptive data are presented in the form of tables (when the value for specific parameters was known), as illustrated in the following example, as well as figures (to incorporate additional visual elements). Proportions are depicted, relative to an arbitrary baseline set on the left-hand side of each cell, as a shaded horizontal bar with the actual percentage value obtained indicated. The longer the shaded bars the higher percentages. Median age and BMI corresponding to individual categories are listed under the "age" and "BMI" columns and range from 50 to 90 years and from 20 to 35 kg/m², respectively. The BMI and age baseline is set to the left of the column. The sex ratio is also visualised as a horizontal bar, with light blue and pink bars representing the proportion of men and women arthroplasty patients, and the area of each coloured bar being proportional to the male/female ratio.
A notable exception to the previously mentioned rule, namely that the sum of all percentage values listed should add up to 100%, applies to all tables which include indented category items. Indented category items indicate subcategories of the previously mentioned, non-indented category. The sum of all percentages listed for individual subcategories – excluding any rounding errors – adds up to the percentage of the superordinate category.

		Proportion [%]	Age	m/f [%]	BMI
Category A		95.9	72	40 / 60	27.1
Category B		2.3	66	38 / 62	25.7
Subcategory	B1	0.3	57	50 / 50	26.3
Subcategory	B2	1.8	69	36 / 64	25.6
Subcategory	B3	0.1	52	25 / 75	25.8

4.1 Primary hip arthroplasty

For the calendar year 2018, data sets for 150,284 primary hip arthroplasties were received. Tables 3 and 4 list details about the patients who underwent surgery and any previous operations. Tables 3 and 4 characterise operated patients and any previous operations. There is a clear correlation between patient age and sex distribution: The older the patient, the lower the proportion of male patients. While the proportion of male patients when considering all arthroplasties combined is 40%, as mentioned in the introduction, there is a higher representation of male, relative to female, patients amongst patients that are 54 years or younger. There is an almost equal proportion of men and women arthroplasty patients between 55 and 64 years of age. Women are only significantly more represented in the 65 years and older age range. A relevant previous operation was only documented in 3.6% of patients and primarily in younger patients.

Tables 5-15 detail the type of arthroplasty performed and the corresponding patient details. With regard to the choice of arthroplasty and its different components, the following trends can be observed:

- In terms of **Fixation**, a general and sustained trend away from cementing components can be observed among total arthroplasties. The proportion of fully cemented components decreased by three percent from 8.0% to 5.0% between 2014 and 2018, while the proportion of completely uncemented arthroplasties continuously increased from 74.8% to 78.6%. Bone cement is therefore completely dispensed with in more than three quarters of all total hip arthroplasties.
- The types of stems preferentially used over time is also changing. The most frequently used **hip stem type** is still the standard modular head. However, since 2014 its use has decreased by almost 3 percent and in 2018 modular heads "only" represented 88.1% of all primary total hip arthroplasties. Also in decline were femoral neck stems, which had reached their maximum peak of 2.1% in 2015, but represented 1.1% of all primary total hip arthroplasties in 2018, as well as modular stem systems whose use de-

Table 3: Age and sex distribution of primary hip arthroplasty patients in 2018

	Proportion [%]	Age	m/f [%]	BMI
All primary hip arthroplasties	100.0	72	40 / 60	27.1
<45 years	1.9		56 / 44	27.2
45–54 years	7.7		54 / 46	28.1
55–64 years	20.5		49 / 51	28.2
65–74 years	28.4		40 / 60	27.7
75–84 years	33.0		34 / 66	26.4
85 years and older	8.6		28 / 72	24.7
Only men	40.3	69	100 / 0	27.7
Only women	59.7	74	0 / 100	26.6

Table 4: Prior surgery relevant for primary hip arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Without prior operation	96.4	72	40 / 60	27.1
Osteosynthesis / Osteotomy	2.2	67	38 / 62	26.0
Pelvis	0.4	57	48 / 52	26.5
Femur	1.7	70	37 / 63	26.0
Pelvis and Femur	0.1	53	30 / 70	26.3
Femoral head necrosis	0.2	59	58 / 42	26.7
Arthrodesis	<0.1	73	30 / 70	25.5
Other prior operations	1.1	68	42 / 58	26.7

Table 5: Primary hip replacement type in 2018

	Proportion [%]	Age	m/f [%]	BMI
Total	90.6	70	41 / 59	27.4
Hemi-hip	9.4	84	31 / 69	24.2

Table 6: Fixation used in primary total hip arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Uncemented	78.6	67	45 / 55	27.7
Hybrid	14.8	78	30 / 70	26.6
Cemented	5.0	80	26 / 74	26.0
Reverse-hybrid	1.3	76	25 / 75	26.5
Unknown	0.3	73.5	40 / 60	27.2

Table 7: Fixation used in primary hemi-hip arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Cemented	79.7	84	30 / 70	24.2
Uncemented	19.8	83	34 / 66	24.6
Unknown	0.5	78.5	32 / 68	26.1

creased from 1.1% to 0.4% over a two-year period. In contrast, there has been a significant increase in the use of short stems, from 6.6% in 2015 to 9.7% in 2018. Even if their proportion may seem relatively small, some clinics use short stems more often than standard stems.

- From 2014 to 2018, the use of monobloc **cups** decreased by approximately 4 percent. In 2018, they represented 10.2% of all acetabular components used in primary total hip arthroplasty, compared to 14.4% four years earlier. Modular cups which were already frequently used in previous years have gained ground with an increase of greater than 3 percent (from 84.4% to 87.9%). Dual mobility arthroplasties have also progressively increased since 2014 and even though they only represent 0.9% of all acetabular components used in primary total hip arthroplasties in 2018, that represents a 0.5% increase over 2014.
- **Head sizes** used in primary total hip arthroplasties has been limited to three sizes 28 mm, 32 mm and 36 mm since the inception of the EPRD. The 28 mm and 32 mm head sizes are still the least (5.7%) and most (56.0%) frequently used, respectively. But we observe a steady increase in use of the 36-mm head over the past few years, with an increase from 31.4% in 2014 to 37.9%

Table 8: Stem type used in primary total hip arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Hip stem with modular head (standard)	88.1	71	40 / 60	27.4
Short stem	9.7	62	49 / 51	27.7
Femoral neck prosthesis	1.1	59	51 / 49	27.6
Revision/tumour stem	0.5	78	36 / 64	26.0
Modular stem system	0.4	73	36 / 64	27.7
Resurfacing head	0.1	57	88 / 12	28.7
Monobloc	<0.1	78.5	0 / 100	25.9
Unknown	0.1	60	61 / 39	27.6

Table 9: Acetabular component used in primary total hip arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Modular cup	87.9	69	42 / 58	27.5
Monobloc cup	10.2	76	34 / 66	26.8
Dual mobility	0.9	79	32 / 68	26.0
Revision cup	0.9	72	36 / 64	26.7
Unknown	<0.1	77	29 / 71	27.4

Table 10: Reconstruction shell used in primary total hip arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Without reconstruction shell	99.8	70	41 / 59	27.4
With reconstruction shell	0.2	77	31 / 69	25.3

Table 11: Head sizes used in primary total hip arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
28 mm	5.7	72	13 / 87	26.7
32 mm	56.0	71	33 / 67	27.2
36 mm	37.9	69	57 / 43	27.7
Other sizes	0.2	75	25 / 75	25.7
Unknown	0.2	59	75 / 25	29.2

Table 12: Material of the acetabular articulating surface used in primary total hip arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
hXLPE	53.6	70	41 / 59	27.4
hXLPE + antioxidant	17.7	69	43 / 57	27.6
PE	10.9	77	34 / 66	26.9
Ceramic	9.0	63	46 / 54	27.5
mXLPE	8.5	73	41 / 59	27.3
Metal	0.1	57	88 / 12	28.7
Unknown	0.1	73	29 / 71	26.7

Table 13: Modular head used in primary total hip arthroplasties in 2018

	Proportion	Age	m/f [%]	BMI
Ceramic	87.6	69	42 / 58	27.5
Metal	9.1	79	34 / 66	26.5
Ceramicised metal	3.2	69	43 / 57	27.8
Unknown	0.1	65	42 / 58	30.9

in 2018. There is a clear trend in favour of using of larger heads.

- Several trends can also be observed in terms of **material** preferences for tribological bearings i.e. modular head inserts and acetabular articulating surfaces: With respect to the modular head material used in primary total hip arthroplasties, there is a decrease in the proportion of metal heads, from 13.1% in 2014 to 9.1% in 2018 (i.e. a 4 percent decrease). During the same time period, the proportion of ceramicised metal modular heads increased from 0.4% to 3.2%, i.e. ceramicised metal modular heads gained an approximately two third share at the expense of metal heads. The proportion of ceramic heads remained unchanged at 87.6%. In terms of acetabular articulating surfaces, the trend favouring highly cross-linked polyethylene surfaces is continuing. Since 2014 the use of standard polyethylene decreased 9 percent (from 19.9% to 10.9%) that of moderately cross-linked polyethylene decreased 4 percent (from 12.7% to 8.5%) and the use of ceramic inserts decreased by more than 6 percent (from 15.5% to 9.0%), with highly cross-linked polyethylene gaining share accordingly. Both the use of highly cross-linked polyethylene and its antioxidant coupled variant has increased from 2014 to 2018 (from 42.7% to 53.6%, and from 8.9% to 17.7%, respectively).

Table 14: Tribological pairings used in primary total hip arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Ceramic-on-hXLPE	45.9	69	42 / 58	27.5
Ceramic-on-hXLPE + antioxidant	17.1	69	43 / 57	27.6
Ceramic-on-ceramic	9.0	63	46 / 54	27.5
Ceramic-on-PE	8.0	75	35 / 65	27.2
Ceramic-on-mXLPE	7.4	71	42 / 58	27.4
Metal-on-hXLPE	4.8	78	36 / 64	26.8
Ceramicised metal-on-hXLPE	2.8	68	44 / 56	27.8
Metal-on-PE	2.5	81	29 / 71	26.0
Metal-on-hXLPE	1.1	79	33 / 67	26.3
Metal-on-hXLPE + antioxidant	0.5	79	32 / 68	27.0
Ceramicised metal-on-PE	0.4	77	36 / 64	27.5
Metal-on-Metal	0.1	57	88 / 12	28.7
Ceramicised metal-on-hXLPE + antioxidant	<0.1	67	51 / 49	29.9
Ceramicised metal-on-mXLPE	<0.1	59.5	75 / 25	32.0
Unknown	0.1	69	33 / 67	27.5

Table 15: Material of the modular head used in primary hemi-hip arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Metal	95.4	84	31 / 69	24.2
Ceramic	4.3	84	32 / 68	24.7
Ceramicised metal	0.3	85	20 / 80	25.5
Unknown	<0.1	74	100 / 0	22.8

In summary

- Uncemented total hip arthroplasties are still the gold standard in Germany.
- Proportion of short stems approx. 10%
- Increase of 36 mm modular heads (37%)
- Decrease of ceramic inserts (9%)
- Increase of highly cross-linked PE inserts (71%)

4.2 Revision hip arthroplasty

A total of 17,081 reoperations were registered by the EPRD in 2018. 2,428 of these surgeries consisted of two-stage revisions. These can be further subdivided into 861 revisions involving the removal of arthroplasty components and 1,567 documented reimplantations. The fact that the number of reimplantations greatly exceeds the number of component removals suggests that notifying the EPRD of surgery details involving only the removal of components may often be overlooked.

Tables 16-18 detail the characteristics of hip-reoperation patients, the reason for reoperation and the replaced or new components reimplanted. The most common reason given for reoperations was loosening of arthroplasty components (29.8%). Such loosening was more frequently indicated for acetabular cups than stems. Other reasons to substantiate reoperations were infection (15.2%), dislocation (11.7%), periprosthetic fracture (10.9%) and wear (8.1%). “Condition after implant removal” (9.2%) rather stands for the reimplantation of arthroplasty components in a two-stage revision and therefore does not constitute a reason in itself for the reoperation. The failure of arthroplasty components is given as the reason for the reoperation in only 1.8% of cases. At 10.5%, the percentage of “other reasons”, which could not be assigned to any one of the available options, is comparatively high.

Approximately every fourth hip reoperation was a complete exchange, in which both the stem and head components including the acetabular component insert were exchanged. Approximately three quarters of all hip reoperations replaced at least one of the bone-anchored components, i.e. the acetabular cup or the hip stem. In the cases where bone-anchored components were left untouched, head and insert components were exchanged much more frequently (17%) than only one component (8.5%).

Table 16: Age and sex distribution of hip-reoperation patients in 2018

	Proportion [%]	Age	m/f [%]	BMI
All hip reoperations <45	100.0	75	42 / 58	27.2
years 45–54 years	1.7		54 / 46	26.4
55–64 years	5.5		53 / 47	27.8
65–74 years	14.9		50 / 50	29.0
75–84 years	25.3		45 / 55	28.1
85 years and older	41.0		38 / 62	26.8
Only men	11.7		29 / 71	25.0
Only women	41.6	73	100 / 0	27.7
	58.4	76	0 / 100	26.9

Table 17: Reasons for hip reoperations in 2018

	Proportion [%]	Age	m/f [%]	BMI
Infection	15.2	74	49 / 51	28.4
Loosening	29.8	75	41 / 59	27.2
Cup	15.5	75	36 / 64	26.8
Stem	10.9	75	50 / 50	27.6
Cup and stem	3.3	77	41 / 59	27.1
Osteolysis with fixed component	0.9	71	41 / 59	27.3
Cup	0.5	73	38 / 62	27.2
Stem	0.2	70.5	42 / 58	27.2
Cup and stem	0.2	72	50 / 50	27.5
Periprosthetic fracture	10.9	79	32 / 68	25.9
Dislocation	11.7	77	35 / 65	26.6
Wear	8.1	74	40 / 60	27.4
Component failure	1.8	73	48 / 52	28.4
Malalignment	1.6	73	37 / 63	26.6
Progression of arthrosis	0.3	73.5	33 / 67	25.1
Condition after removal	9.2	72	50 / 50	27.8
Other reasons	10.5	74	42 / 58	27.3

Table 18: Components replaced[4] or complemented in hip re-operations in 2018

	Proportion [%]
Head, cup, insert	25.6
Stem, head, cup, insert	23.4
Head, insert	17.0
Stem, head	16.2
Head	7.7
Stem, head, insert	6.7
Cup, insert	2.2
Insert	0.8
only accessories (e.g. screws)	0.4

In summary

- Reasons for hip revisions: loosening (approx. 30%), infection (approx. 15%) and dislocation (approx. 12%)
- Three quarters of primary hip revisions involve exchange of at least one bone-anchored component.

4.3 Primary knee arthroplasty

The EPRD registered a total of 119,131 primary knee arthroplasties in 2018. Tables 19-20 detail the characteristics of primary knee arthroplasty patients and any previous operations. With a median body mass index (BMI) of around 30, which according to the World Health Organization (WHO) corresponds to the obesity threshold, primary knee arthroplasty patients have a considerably higher BMI than primary hip arthroplasty patients. The BMI is even slightly higher in younger patients, which underpins the well-established association between being overweight and premature knee joint wear. In contrast to primary hip arthroplasties, there is no pronounced trend between age group and the proportion of male and female patients in the case of primary knee arthroplasties. A previous surgery was reported in 7.5% of patients. In more than half of these patients, however, none of the specific options probing for additional details about the nature of the prior surgery were selected, instead reference was made to another previous operation.

Tables 21-33 contain details relating to the selected forms and characteristics of arthroplasty. The following specific trends can be observed:

- The **proportion of unicondylar knee arthroplasties** recorded in the EPRD has increased considerably in recent years. For 2018, it was at 12.6%, more than 3 percent higher than three years earlier. There are distinct differences between clinics in terms of the frequency of unicondylar knee arthroplasties: While there are many clinics that only perform a small

4 The EPRD predominantly collates details on components that are implanted, and not on those that are removed. Details about components that are removed are deduced from the revision surgery records. For instance, if records indicated that a new stem was re-implanted during the revision, it is safe to assumed that the stem implanted during the primary arthroplasty was removed. This assumption is only plausible when all components listed in the surgical report directly correspond to items catalogued in the product database. Revisions which list components that are not itemised in the product database are excluded from the analysis.

Table 19: Age and sex distribution of primary knee arthroplasty patients in 2018

	Proportion [%]	Age	m/f [%]	BMI
All primary knee arthroplasties	100.0	69	39 / 61	29.9
<45 years	0.6		36 / 64	31.6
45–54 years	8.0		41 / 59	32.3
55–64 years	25.5		43 / 57	31.6
65–74 years	33.0		39 / 61	30.2
75–84 years	30.3		36 / 64	28.2
85 years and older	2.5		32 / 68	26.8
Only men	38.9	68	100 / 0	29.4
Only women	61.1	70	0 / 100	30.4

Table 20: Prior surgery relevant for primary knee arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
No prior surgery	92.5	70	38 / 62	30.0
Osteosynthesis / Osteotomy	1.8	62	50 / 50	29.3
Femur	0.3	64	45 / 55	28.9
Tibia	1.2	62	51 / 49	29.4
Patella	0.1	65	46 / 54	28.7
In several places	0.2	61	54 / 46	29.6
Capsule-ligament-apparatus	1.5	61	56 / 44	29.3
arthrodesis	<0.1	69	39 / 61	27.7
Other prior surgery	4.1	66	45 / 55	29.7

Table 21: Primary knee replacement type in 2018

	Proportion [%]	Age	m/f [%]	BMI
Total	87.2	70	3862	30.0
Unicond.	12.6	64	3862	29.4
Femoro-patellar	0.2	55	3862	28.7
Other	<0.1	72.5	50 / 50	28.8

number of unicondylar knee arthroplasties, there are also a few clinics for which unicondylar arthroplasties outnumber total knee replacements.

- In Germany unicondylar knee arthroplasties are predominantly cemented. In recent years, the proportion of fully cemented arthroplasties has also increased slightly in the case of total knee arthroplasties. This is at the expense of hybrid arthroplasties, whose proportion has decreased from 8.1% to 5.4% over the past four years.
- With respect to the **selection of knee systems**, there has been a slight increase in the use of *posterior stabilised* and *pivot systems*. The use of posterior stabilised systems without additional constraint has increased by greater than 4 percent over the past three years (from 13.0% to 17.4%). This is in contrast to pivot systems which only represent 1.4% of all primary total knee arthroplasties performed in 2018, but this is still an increase from 0.5% three years earlier. In the EPRD, *cruciate retaining* systems, which allow the posterior cruciate ligament to be preserved, are still significantly more widespread than either posterior stabilised or pivot systems. Cruciate retaining systems were used in 43.9% of cases, while *cruciate retaining/sacrificing* systems, which are suitable for either a cruciate ligament-retaining or a replacement procedure, represented 18.4% of all primary total knee arthroplasties.
- There has been a general trend away from mobile **bearing systems** in both total and unicondylar knee arthroplasties in the past 2-3 years. For total arthroplasties, in which they always represented a relatively small share, their use decreased from 20.1% to 15.7% within two years. For unicondylar knee arthroplasties, which still constitutes the more typical case, their use decreased from 74.8% in 2015 to 63.1% in 2018.
- It is also worth highlighting a number of trends in the choice of **insert materials** for articulation

Table 22: Grade of constraint used in primary total knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Unconstrained	95.4	70	38 / 62	30.0
Cruciate retaining	43.9	70	40 / 60	30.1
Cruciate retaining/sacrificing[5]	18.4	70	38 / 62	29.8
Posterior stabilised	17.4	70	36 / 64	30.1
Cruciate-sacrificing	14.3	71	36 / 64	30.0
Pivot	1.4	70	38 / 62	29.5
Constrained	4.2	74	29 / 71	29.1
Hinged	2.3	76	26 / 74	28.3
Varus-valgus stabilised	2.0	70	33 / 67	29.7
Unknown	0.4	70	30 / 70	29.4

5 The design is suitable for both a cruciate ligament-retaining or a replacement procedure.

Table 23: Type of fixation used in primary total knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Cemented	93.2	70	37 / 63	29.9
Hybrid	5.4	69	44 / 56	30.4
Uncemented	1.2	67	38 / 62	30.4
Reverse-hybrid	<0.1	67	13 / 87	30.0
Unknown	0.1	67.5	48 / 52	27.3

Table 24: Type of fixation used in primary unicondylar knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Cemented	87.0	64	46 / 54	29.4
Uncemented	11.9	64	60 / 40	29.4
Hybrid	0.9	64	40 / 60	28.4
Unknown	0.2	66	42 / 58	28.9

Table 25: Bearing mobility in primary total knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Fixed	84.1	70	38 / 62	30.0
Mobile	15.7	70	38 / 62	29.8
Unknown	0.1	77	22 / 78	28.0

Table 26: Bearing mobility in primary unicondylar knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Mobile	63.1	64	48 / 52	29.4
Fixed	36.8	63	46 / 54	29.4
Unknown	0.1	61	12 / 88	32.0

Table 27: Patellar resurfacing in primary total knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Without patellar resurfacing	88.8	70	38 / 62	30.0
With patellar resurfacing	11.2	70	35 / 65	30.1

Table 28: Composition of articulation surface of femoral components in primary total knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Uncoated metal	91.7	70	39 / 61	29.9
Coated metal	4.7	67	19 / 81	30.5
Ceramicised metal	3.5	65	27 / 73	30.5
Metal Ceramic	<0.1	63	21 / 79	31.2
Unknown	<0.1	53	100 / 0	51.7

Table 29: Composition of articulation surface of tibial components in primary unicondylar knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
PE	45.1	70	38 / 62	29.9
mXLPE	38.3	71	38 / 62	29.9
hXLPE	11.0	68	37 / 63	30.2
hXLPE + antioxidant	5.2	68	41 / 59	29.7
mXLPE + antioxidant	0.5	70	37 / 63	30.5

surfaces. While inserts made of highly cross-linked polyethylene *(hXLPE)* are used in more than half of hip arthroplasties, this type of polyethylene is rather the exception for knee arthroplasties. Nevertheless, the use of hXLPE and hXLPE added with antioxidants in primary total knee arthroplasties has increased by 3.0 and 2.2 percent respectively. As the proportion of moderately cross-linked polyethylenes *(mXLPE)* only decreased slightly during this same time period, the increase in hXLPE was largely at the expense of standard polyethylene inserts. In the case of unicondylar knee arthroplasties, inlays made of highly cross-linked polyethylene added with antioxidants have only been documented in the EPRD since 2017. In 2018, hXLPE added with antioxidant inserts however already represent 4.2% of all primary unicondylar knee arthroplasty tibial components.

Table 30: Tribological pairings in primary total knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
uncoated metal-on-PE	41.3	71	39 / 61	29.8
uncoated metal-on-mXLPE	35.4	71	39 / 61	29.8
uncoated metal-on-hXLPE	9.5	68	36 / 64	30.4
uncoated metal-on-hXLPE + antioxidant	5.1	68	42 / 58	29.7
coated metal-on-mXLPE	2.9	66	16 / 84	30.9
ceramicised metal-on-PE	2.0	65	18 / 82	31.2
Coated metal-on-PE	1.7	68	24 / 76	30.1
Ceramicised metal-on-mXLPE	1.5	66	39 / 61	29.9
Uncoated metal-on-mXLPE + antioxidant	0.5	70	37 / 63	30.5
Coated metal-on-hXLPE + antioxidant	0.1	66	8 / 92	30.4
Ceramic-on-PE	<0.1	63	21 / 79	31.2
Unknown	<0.1	53	100 / 0	51.7

Table 31: Composition of articulation surface of femoral components in primary unicondylar knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
Uncoated metal	88.4	64	49 / 51	29.4
Coated metal	9.4	60	30 / 70	30.0
Ceramicised metal	2.2	59	40 / 60	29.8

Table 32: Composition of articulation surface of tibial components in primary unicondylar knee arthroplasties in 2018

	Proportion [%]	Age	m/f [%]	BMI
mXLPE	75.7	64	48 / 52	29.4
PE	18.8	63	46 / 54	29.4
hXLPE + antioxidant	4.2	62	54 / 46	29.7
hXLPE	1.3	61	45 / 55	29.2

Table 33: Tribological pairings in primary unicondular knee arthroplasty in 2018

	Proportion [%]	Age	m/f [%]	BMI
Uncoated metal-on-mXLPE	67.4	65	50 / 50	29.4
Uncoated metal-on-PE	15.6	64	48 / 52	29.4
Coated metal-on-mXLPE	8.3	60	30 / 70	30.1
Uncoated metal-on-hXLPE + antioxidant	4.2	62	54 / 46	29.7
Ceramicised metal-on-PE	2.2	59	40 / 60	29.8
Uncoated metal-on-hXLPE	1.3	61	45 / 55	29.2
Coated metal-on-PE	1.1	61	32 / 68	28.7

- In the EPRD, primary total knee arthroplasties only rarely also include patellar resurfacing. In 2018, 11.2% of primary arthroplasties also included **patellar resurfacing**. This is 0.8 percent higher compared to the previous year and the highest level recorded since inception of the EPRD.

In summary

- Cementing is standard for knee arthroplasties
- Increase in unicondylar knee arthroplasties (approx. 13%)
- Decrease of mobile bearings

4.4 Revision knee arthroplasty

In 2018, the EPRD recorded 13,378 knee reoperations. 2,148 of these surgeries required the removal followed by the re-implantation of new arthroplasty components as part of a two-stage revision. As with hip revisions, the EPRD was more often notified of knee re-implantations than of first-stage revisions.

The most frequently given reason for a knee reoperation was loosening (25.0%) followed by infection (14.7%), ligament instability (8.9%) and wear (5.7%). The “condition after implant removal” option, only applies to the reimplantation procedure of two-stage revisions and can therefore only be considered as an indirect reason for the reoperation, but it was reported in 10.9% of cases. As with the hip, the failure of knee arthroplasty components is rarely given as a reason for the reoperation (2.0%). In contrast in 18.7% of cases the option “other reason” was selected. This could be interpreted to mean that the actual reason for the knee reoperation could not be assigned to any one of the existing options available for selection.

Table 34: Age and sex distribution of knee-reoperation patients in 2018

	Proportion [%]	Age	m/f [%]	BMI
All knee reoperations	100.0	70	41 / 59	30.0
<45 years	1.2		43 / 57	29.4
45–54 years	7.9		40 / 60	31.2
55–64 years	23.4		46 / 54	31.4
65–74 years	30.1		42 / 58	30.8
75–84 years	32.6		38 / 62	28.7
85 years and older	4.8		30 / 70	26.8
Only men	40.6	69	100 / 0	29.4
Only women	59.4	71	0 / 100	30.5

Table 35: Reasons for knee reoperations in 2018

	Proportion [%]	Age	m/f [%]	BMI
Infection	14.7	72	52 / 48	29.3
Loosening	25.0	70	38 / 62	30.4
Femoral components	4.4	72	41 / 59	29.4
Tibial tray	9.3	69	34 / 66	31.2
Patellar components	0.6	69	31 / 69	29.9
Several components	10.7	72	40 / 60	30.1
Osteolysis with fixed component	1.1	71	52 / 48	30.1
Femoral components	0.3	74	46 / 54	29.4
Tibial tray	0.3	68	54 / 46	30.0
Patellar components	0.1	70.5	30 / 70	31.2
Several components	0.4	71.5	59 / 41	30.7
Periprosthetic fracture	3.0	78	20 / 80	28.3
Ligament instability	8.9	68	31 / 69	30.5
Wear	5.7	73	40 / 60	29.7
Component failure	2.0	70	42 / 58	30.9
Malalignment / rotation revision	1.8	67	31 / 69	30.5
Restricted mobility	4.0	66	38 / 62	30.2
Progression of arthrosis	4.2	70	33 / 67	30.1
Condition after removal	10.9	71	51 / 49	29.7
Other reasons	18.7	69	40 / 60	30.1

Table 36: Components[6] replaced or complemented during knee reoperations in 2018

	Proportion [%]
Femur components, tibial tray, inlay	43.5
Inlay	21.6
Patellar replacement	8.5
Femur components, tibial tray, inlay, patellar replacement	7.5
Inlay, patellar replacement	6.5
Tibial tray, inlay	4.7
Femur components, inlay	2.6
only accessories (e.g. screws)	2.4
Femur components	1.2
Femur components, inlay, patellar replacement	0.6
Tibial tray, inlay, patellar replacement	0.5
Femur components, patellar replacement	0.1

The EPRD is addressing this problem by providing more targeted help and better options to significantly reduce this figure in the future.
In about 61% of documented reoperations, bone-anchored components, i.e. the femoral component or the tibial tray, had to be exchanged. Indeed in 51% of reoperations both components were affected at the same time. Pure insert replacements accounted for 21.6% of knee arthroplasties. A total of approximately 15% of all knee reoperations were complementary interventions involving secondary patellar resurfacing. It can be assumed that these types of patients, with persistent anterior knee pain and a total replacement without patellar resurfacing, therefore underwent a complementary surgery. If a higher insert is replaced at the same time, this can also conceal a correction of an existing collateral ligament instability. While varus-valgus stabilised or hinge systems are rarely chosen for primary knee arthroplasties (only in 4.2% of cases), they are used in approximately 32% of reoperations (19.3% of which are hinge systems).

In summary

- Bone fixation is usually replaced during the reoperation (in 61% of cases)
- Reasons given for knee arthroplasty revisions are loosening (25%) and infection (approx. 15%)

6 The EPRD predominantly collates details on components that are implanted, and not on those that are removed. Details about components that are removed are deduced from the revision surgery records. For instance, if records indicated that a new tibial tray was re-implanted during the revision, it is safe to assume that the tibial tray implanted during the primary arthroplasty was removed. This assumption is only plausible when all components listed in the surgical report directly correspond to items catalogued in the product database. Revisions which list components that are not itemised in the product database are excluded from the analysis.

5 Hip and Knee arthroplasty survival

Survival analysis of arthroplasty components is a useful parameter for assessing the quality of a hip or knee replacement. This is the third consecutive year that the EPRD annual report includes a survival analysis of arthroplasty components and determines the probability of a revision arthroplasty. The observational follow-up period of the EPRD cohort increases from year to year and now covers a period of up to four years from the primary arthroplasty. Compared to the potential "life expectancy" or "survival" of arthroplasty components, which according to long-term data from different registries can exceed 15 years, the EPRD follow-up period is still relatively short and therefore only allows conclusions to be drawn about the early phase of arthroplasty components fitted.

The fact that the arthroplasty follow-up period is still short complicates the analyses and interpretation of results throughout this chapter. Better or worse results in the early stages of an arthroplasty do not necessarily reflect longer term results. A more important consideration is that it is not only the arthroplasty components and their respective properties that influence the survival analysis of arthroplasty components, but that both patient characteristics and the clinic performing the arthroplasty considerably impact arthroplasty outcome. The effects of these patient and care-related influences can be observed, particularly during the early stages of an arthroplasty and can completely mask the contribution of arthroplasty components to the survival analysis. At this point in time there is only very limited scope for an accurate and complete assessment of the contribution of these different, overlapping effects on arthroplasty components' survival. This should be borne in mind, particularly when evaluating the specific arthroplasty component results that form part of the EPRD annual report since last year. After a general introduction of the revision probabilities for primary hip (Section 5.1.1) and knee (Section 5.1.2) arthroplasties, Section 5.1.3 evaluates the contribution of non-implant-related factors on arthroplasty outcome. In

Calculating revision probabilities

The EPRD defines a "revision" as the removal and, if necessary, the replacement of previously implanted hip or knee arthroplasty components. The Kaplan-Meier estimator is used to determine the probability that the revision will not occur within a specified time interval after the primary arthroplasty and that the primary arthroplasty will therefore remain viable. This analysis takes into account that ...

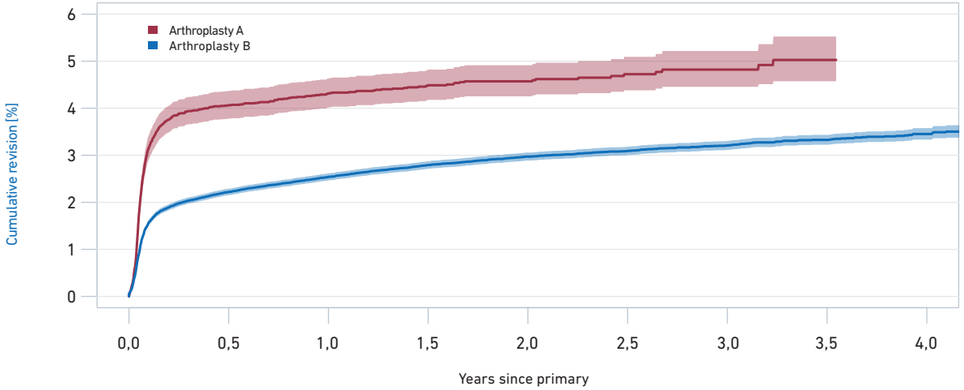
... in the majority of cases examined, the entire observation period has not yet been completed at the time of the evaluation and that

... events such as the death of the patient or a leg amputation make it impossible to observe the arthroplasty revision event.

Results of these estimates are either represented as figures or tables (see the following sections). The reciprocal probabilities of the Kaplan-Meier estimates, i.e. the cumulative revision probabilities, are plotted against each specific time point along with their respective 95% confidence intervals.

Graphed revision probabilities

An example of a representative revision probability graph is shown below. The graph indicates the number of arthroplasty components still under observation at any given time point, i.e. the number of primary arthroplasties observed along a specific time line that did not require revision and that did not cease to be monitored for non-implant-related reasons.



Procedures under observation								
19.849	12.360	9.044	6.431	4.122	2.414	1.251	543	
178.580	149.398	122.090	96.125	70.041	47.675	29.032	16.943	8.172

Representative example of the revision probability of two arthroplasty subgroups. Below the graph displaying revision probabilities with their corresponding 95% confidence intervals, a table lists the actual number of arthroplasties under observation at any of the given time points examined.

Revision probabilities shown in the figures of section 5.1 are based on at least 500 arthroplasties under observation. If more than three curves are shown in any one figure, the confidence intervals are omitted in order to provide a better overview.

Section 5.2, the results for individual implant systems are then presented, each broken down according to the type of fixation and, where necessary, the type of arthroplasty.
At the end of this chapter, we present a fundamentally new way of considering the survival analysis of arthroplasty components. Section 5.3 of this chapter is the first time that the EPRD considers arthroplasty outcome after a revision and estimates the probability of a re-revision.

In summary

Specific implant, clinic, and patient-related effects tend to converge particularly during the early observation phase.

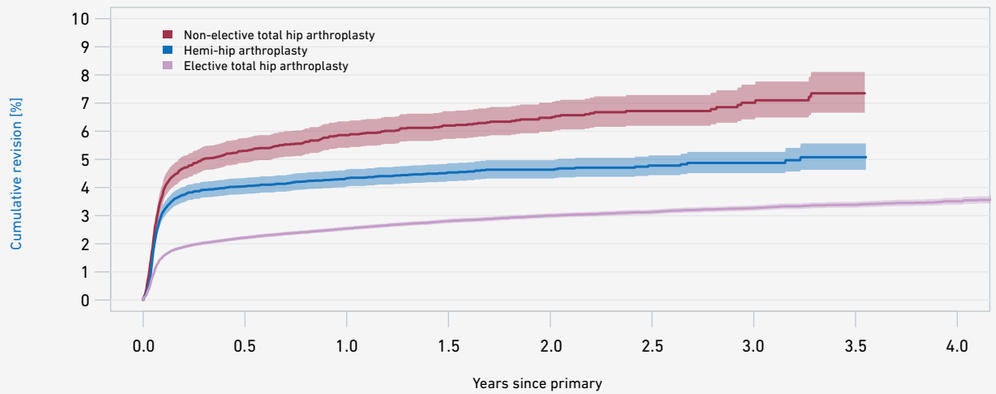
5.1 Revision probability by type of arthroplasty

The following subsections first presents revision probabilities of various types of hip (Section 5.1.1) and knee (Section 5.1.2) arthroplasties. At the end of this subchapter, Section 5.1.3, considers the contributions of several non-implant-related factors which influence arthroplasty survival and should therefore not be neglected particularly when assessing the early stage of arthroplasty outcome presented in the next section.

5.1.1 Comparison of different hip arthroplasty types

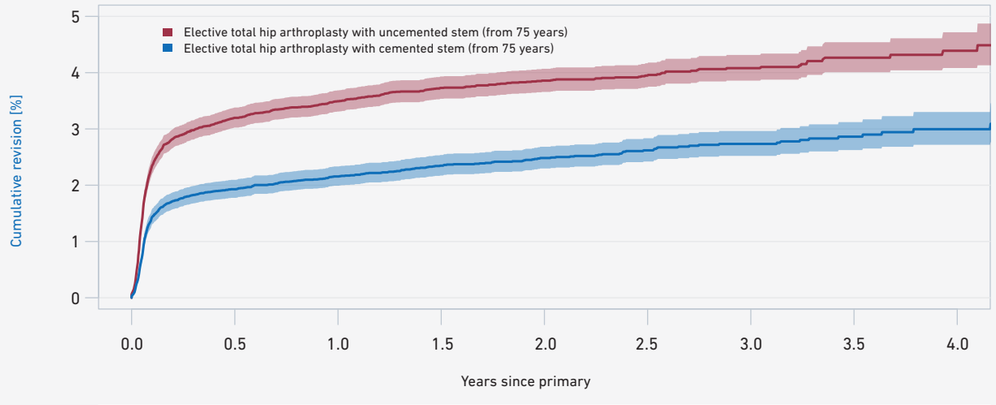
For hip arthroplasties, a basic distinction is made between elective (i.e. planned) and non-elective (performed as part of an emergency treatment) arthroplasties. Elective procedures, required to eventually treat hip osteoarthritis patients, which are invariably total arthroplasties, constitute the majority of these documented arthroplasties. A non-elective intervention is necessary whenever the patient, typically of advanced age, fractures the proximal femur. In this situation and depending on the indication, two fundamentally different types of hip arthroplasty may be performed: a hemi-hip arthroplasty which only replaces the femoral head or alternatively a total hip arthroplasty. The revision probabilities of elective and non-elective total arthroplasties and of hemi-hip arthroplasties[7] over time are shown in Figure 4.
There are significant revision frequency differences between these three basic types of hip arthroplasties: While revision frequencies for elective total arthroplasties and elective partial arthroplasties are 3.3% and 4.9% respectively, the revision frequency for non-elective total arthroplasties is 7.0%, which is considerably higher. All these different types of arthroplasties, exhibit a sharp increase in the curve directly after the primary surgery, which reflects that the majority of the hip arthroplasty revisions become necessary relatively soon after the primary arthroplasty.
The general German nationwide preference for uncemented stems in elective arthroplasties is also mirrored in the EPRD. Even in the case of non-elective total hip arthroplasties, approximately every second arthroplasty is uncemented. With respect to hemi-hip arthroplasties, cemented stems are used in 80% of cases which is considerably more compared to uncemented stems (also refer to Table 7). All three different types of arthroplasties, show the same trend in probability of hip arthroplasty revision, with cemented stems significantly less likely

7 In exceptional cases, a hemi-hip arthroplasty can also be performed as an elective surgical procedure. But this group of elective hemi-hip arthroplasties is too small to be shown separately here.



Procedures under observation									
Non-elective total hip arthroplasty	10.750	7.831	6.041	4.462	3.117	1.926	1.089	533	
Hemi-hip arthroplasty	20.953	12.846	9.240	6.542	4.181	2.450	1.266	547	
Elective total hip arthroplasty	188.694	155.790	125.144	98.175	71.283	48.468	29.446	17.174	8.254

Figure 4: Revision probabilities of elective and non-elective hip arthroplasties



Procedures under observation									
Elective total hip arthroplasty with uncemented stem (from 75 years)	38.879	31.067	24.757	18.806	13.401	8.563	4.940	2.569	1.186
Elective total hip arthroplasty with cemented stem (from 75 years)	29.586	24.161	19.724	15.240	11.350	7.691	4.938	2.775	1.325

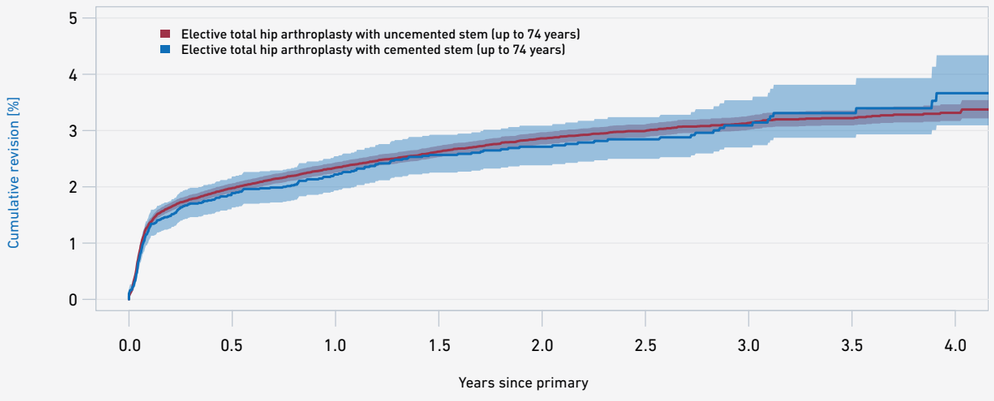
Figure 5: Revision probabilities of elective total hip arthroplasties by fixation of the hip stem used for patients aged 75 years and older.

to require revision, compared to uncemented stems. This trend is considerably smaller for elective total arthroplasties when patient age is pooled, since older patients, particularly patients that are 75 years of age or older, disproportionally contribute to reducing the revision probability of cemented stems (Figure 5). For patients 74 years of age or younger there is little difference in the probability of revision of cemented compared to uncemented stems (Figure 6).

The interpretation of these results is nevertheless confounded by the fact that cemented and uncemented arthroplasties not only greatly differ in terms of their probability of revision, but at least in the case of elective and non-elective total arthroplasties, also differ significantly in terms of patient mortality. Although this correlation holds across all different age groups considered, the differences in patient mortality are likely not due to the cementation itself. As an increase in time from the primary arthroplasty amplifies these differences, it is very likely that the choice of stem fixation introduces a bias relating to the general health of the patient, accordingly the different patient groups can only be compared to a limited extent. A clear difference in revision probability, in the absence of any compounding effects caused by patient mortality, was only observed for hemi-hip arthroplasties (Figure 7).

The following considerations are exclusively restricted to elective total hip arthroplasties with a uncemented stems, which also represents the majority of all hip arthroplasties documented in the EPRD.

As previously mentioned in Section 4.1, the EPRD has, over recent years, recorded a general increase in the prevalence of short stems. In terms of revision probability, short stems, which are typically used in

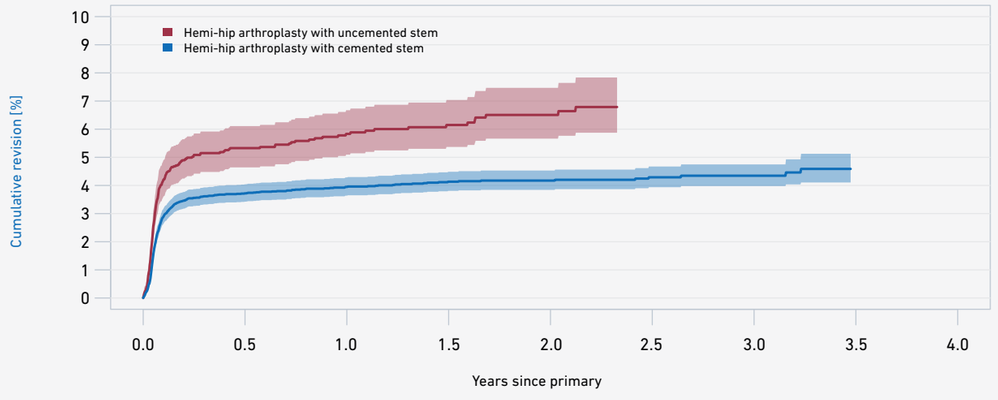


Procedures under observation									
	110.440	92.338	73.890	58.742	42.417	29.305	17.645	10.687	5.111
	9.789	8.224	6.773	5.387	4.115	2.909	1.923	1.143	632

Figure 6: Revision probabilities of elective total hip arthroplasties by fixation of the hip stem used for patients up to 74 years.

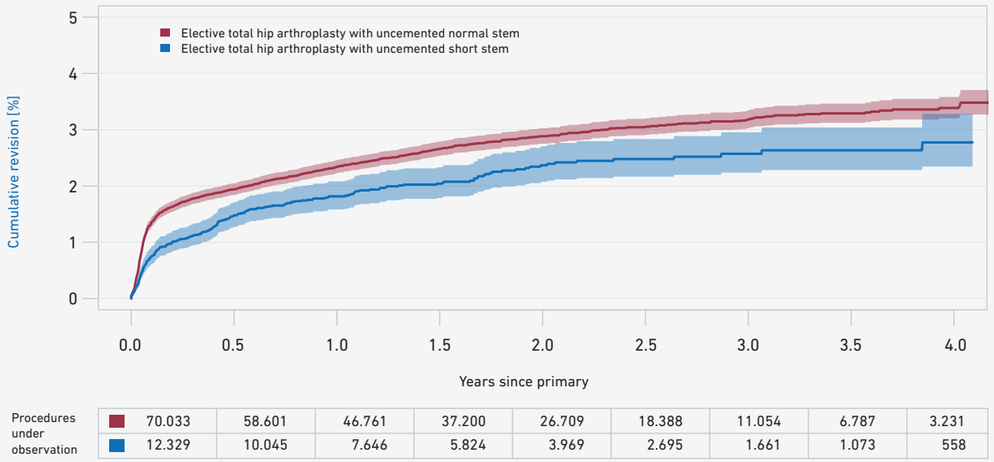
arthroplasties performed in younger patients, give good results compared to standard stems, at least for the first few years after the primary arthroplasty. To compare more homogeneous hemi-hip arthroplasty groups, only patients younger than 70 years of age were included in the analysis depicted in Figure 8, i.e. this being the predominant patient group concerned with short stems. Even though the EPRD data shows that there was an increased prevalence of short stems documented for clinics performing a greater number of arthroplasties, the lower revision probability observed during the initial post implantation time period is also apparent among clinics performing comparable numbers of procedures per calendar year. We cannot yet comment on whether this correlation will persist in the medium to long term.

As previously shown in Table 11, total arthroplasty EPRD records predominantly encompass two different head sizes (32 and 36 mm). The choice of head size depends primarily on the patient's specific anatomy. However, most systems offer a more restricted selection of smaller head sizes for cases requiring implantation of a relatively small cup. There are more options for larger cup diameters. In male patients particularly, larger head components correlate with lower revision probabilities during the early phase of implant life (see Figure 9). One possible explanation may be that larger heads reduce the risk of dislocation. When comparing EPRD records on the reason given for the revision in the group of patients fitted with a 32-mm heads and those fitted with 36-mm heads, it is evident that dislocation is cited less frequently in the 36-mm group than in the 32-mm group (4.7 % compared to 9.4% for men and 5.2 compared to 12.6% in women). The extent to which the lower revision probability correlating with the 36-mm head will persist in the long-term



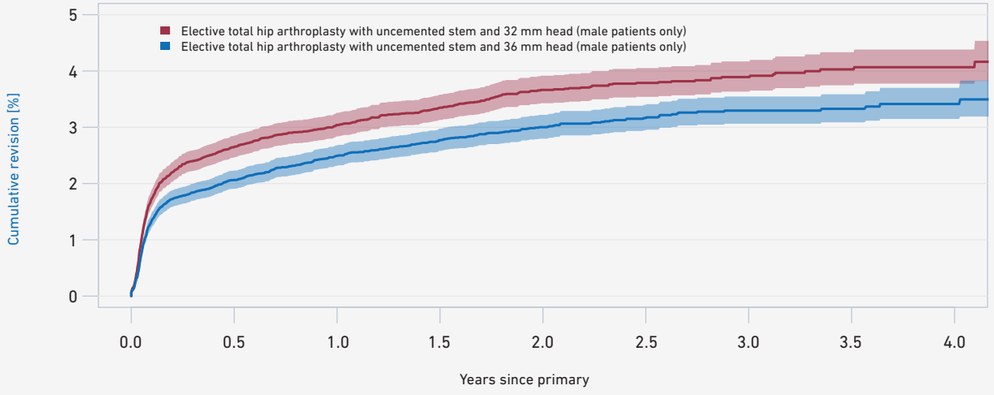
Procedures under observation									
	4.164	2.508	1.762	1.187	723				
	16.684	10.275	7.438	5.330	3.440	2.044	1.068		

Figure 7: Revision probabilities of elective hemi-hip arthroplasties by fixation of the hip stem.



Procedures under observation									
	70.033	58.601	46.761	37.200	26.709	18.388	11.054	6.787	3.231
	12.329	10.045	7.646	5.824	3.969	2.695	1.661	1.073	558

Figure 8: Revision probabilities of elective total hip arthroplasties by fixation of the hip stem used for patients younger than 70 years.



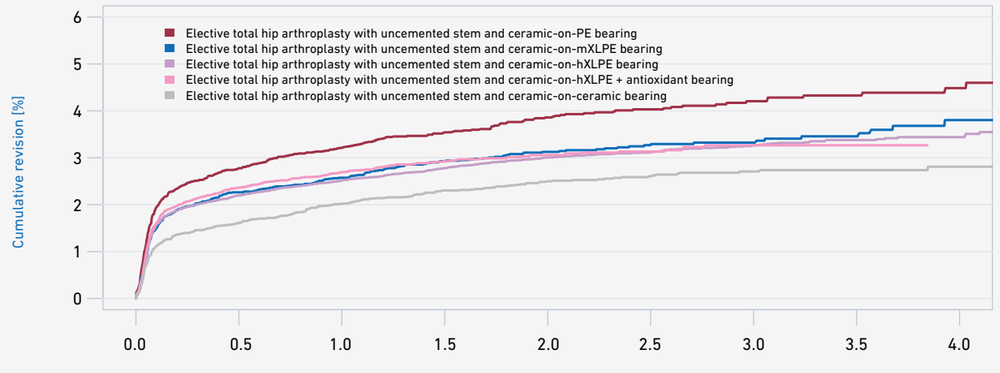
Procedures under observation									
	27.692	22.941	18.255	14.392	10.120	6.990	4.164	2.532	1.159
	30.934	25.615	20.151	15.876	11.253	7.624	4.396	2.610	1.235

Figure 9: Revision probabilities of total hip arthroplasties in men by head size used.

cannot be predicted. Since larger heads may potentially be more prone to wear, a convergence or an abrupt change to the gradient of the lines graphed cannot be excluded over time.

Ceramic head components account for the majority of head components documented in the EPRD (also refer to Table 13). For uncemented total hip arthroplasties, a tribolobical bearing consisting of a ceramic head surface is usually complemented with an acetabular cup consisting of a polyethylene variant surface. Ceramic inserts nonetheless continue to occupy a significant, albeit recently declining, market share. The probability of arthroplasty revision is compared for the five most frequently used bearing types in Figure 10. Data from two of these bearings diverge from the other three: Ceramic-on-PE and ceramic-on-ceramic tribological bearings have a significantly higher and lower probability of revision, respectively.

It should, of course, be reiterated that the differences described, particularly because they arise very early during the arthroplasty follow-up period, may not be exclusively attributed to implant or material effects. The different tribological bearing patient groups are also heterogeneous in terms of patient age: The median patient age of ceramic-on-ceramic tribological bearings is 62 years, which is substantially younger than the other groups, and is in stark contrast to the median age of 71 years for patients with ceramic-on-PE and ceramic-on-mXLPE tribological bearings Furthermore, ceramic-on-PE tribological bearings tend to be favoured by clinics



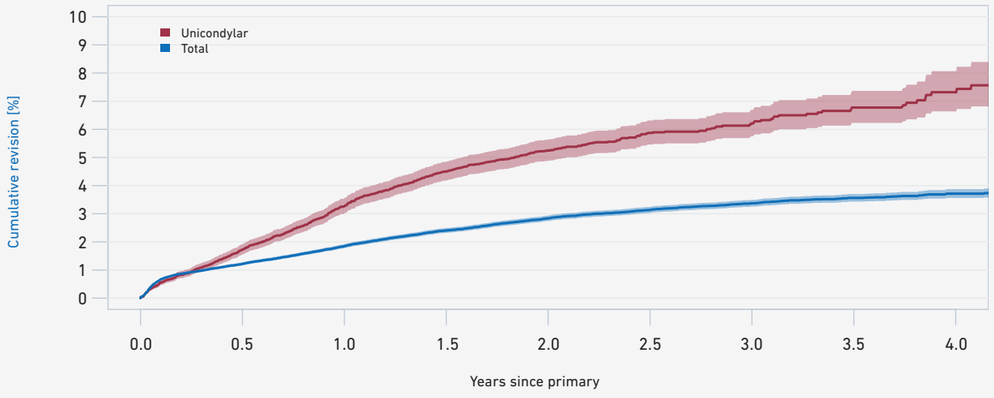
Procedures under observation									
	12.460	10.636	9.015	7.382	5.635	4.065	2.643	1.666	879
	14.446	12.107	9.998	7.976	5.796	3.944	2.386	1.457	686
	71.132	58.985	47.069	37.083	26.747	18.108	10.671	6.098	2.904
	22.766	17.798	13.206	9.532	6.216	3.661	1.868	955	
	17.486	15.072	12.440	10.171	7.541	5.452	3.390	2.156	1.078

Figure 10: Revision probabilities of elective primary total hip arthroplasties using uncemented stems and ceramic heads by acetabular insert material

performing fewer arthroplasties. These two factors may contribute to or accentuate result discrepancies, as illustrated in Section 5.1.3 below.

In summary

- In older patients, uncemented stems are associated with a higher probability of revision
- Lower revision probabilities during the early observation phase of
  - Short stems
  - Larger heads (36 mm), especially in men,
  - Ceramic-on-ceramic tribological bearing



Procedures under observation									
Unicondylar	20.348	16.685	12.775	9.662	6.742	4.345	2.415	1.545	796
Total	156.664	131.711	104.315	82.138	58.872	40.579	24.396	14.329	6.584

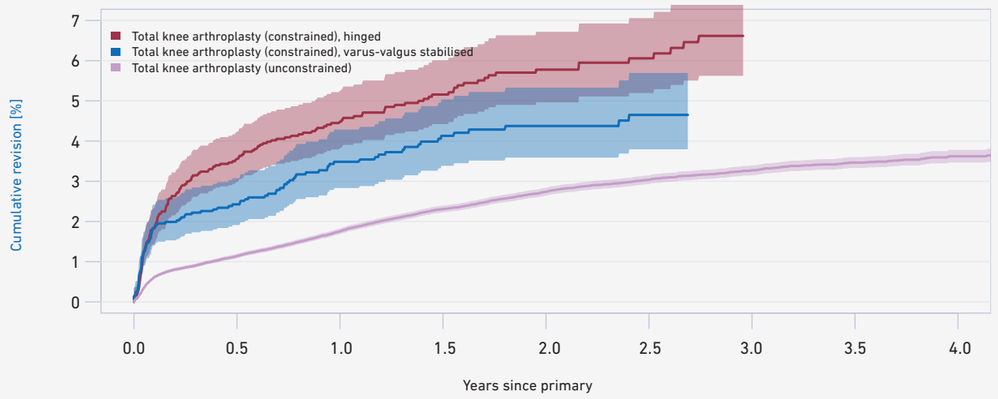
Figure 11: Revision probabilities of elective total and unicondylar knee arthroplasties.

5.1.2 Comparison of different knee arthroplasty types

The revision probabilities of the most common types of knee arthroplasties, namely total and unicondylar knee replacements, are compared in Figure 11. There are clear differences between these two types of arthroplasties: The revision probability of unicondylar knee arthroplasties, four years from primary surgery, is 7.3%, approximately twice that of total knee arthroplasties which have a revision probability of 3.7% for the same time frame. To put these results into perspective, however, it should be noted that arthroplasty groups compared are heterogeneous and not only differ in terms of age, sex distribution and indication, but also in terms of their underlying therapeutic objectives. Unicondylar arthroplasties seek to maximise preservation of the joint surface and ligament integrity, to provide the best possible starting point for any subsequent surgery which may be called for. It is worth highlighting that, although unicondylar arthroplasties have a higher revision probability than total arthroplasties, the absolute difference is significantly lower when the procedure is performed in a clinic specialising in unicondylar arthroplasties (also refer to Figure 25). Greater than two thirds of unicondylar arthroplasty revisions documented in the EPRD, consisted of a conversion to a total knee arthroplasty.

Given the small number of arthroplasties involving patellofemoral resurfacing recorded in the EPRD, these were omitted in the figure. However, based on the EPRD data available to date, it appears that patellofemoral arthroplasties have an even greater re-operation probability than unicondylar arthroplasties, with more than 10% of these arthroplasties requiring a reoperation two years after the primary surgery.

While unicondylar arthroplasties should only be considered if there is unilateral joint wear, in a back-



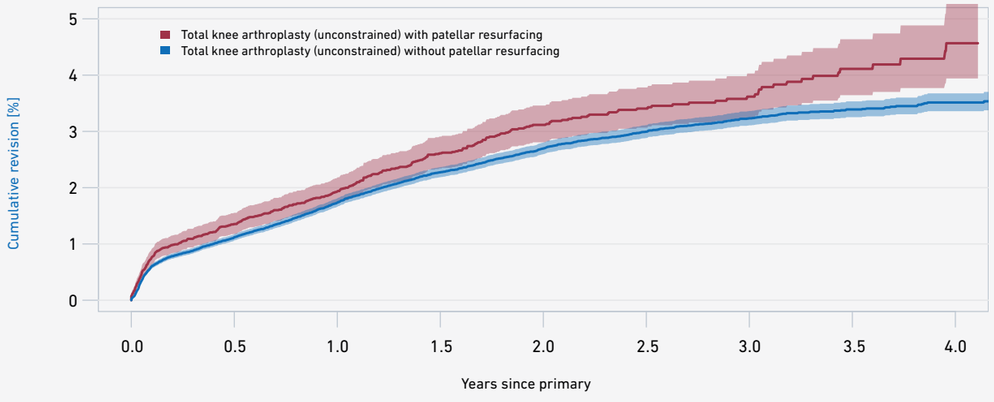
Procedures under observation									
Total knee arthroplasty (constrained), hinged	3.595	2.866	2.274	1.719	1.232	781			
Total knee arthroplasty (constrained), varus-valgus stabilised	2.824	2.289	1.772	1.324	941	618			
Total knee arthroplasty (unconstrained)	150.245	126.556	100.269	79.095	56.699	39.180	23.539	13.843	6.368

Figure 12: Revision probabilities of elective total knee arthroplasties by constraint.

ground of good prevailing bone conditions and a stable ligament context, the range of indications for a total knee arthroplasty is much more diverse. The vast majority of arthroplasty patients undergo total arthroplasties with an *unconstrained* system without any additional lateral stabilisation, which is indicative of an adequate degree of ligament stability in this patient group. But there is a small subgroup of patients who received varus valgus-stabilised or hinge systems, which provide maximum stabilisation. It can be extrapolated that these *constrained* cases likely presented with ligament instabilities or deformations which necessitated the additional stabilisation. Figure 12 illustrates that these different baseline factors directly affect arthroplasty outcome: The higher the degree of constraint the greater the probability of arthroplasty revision.

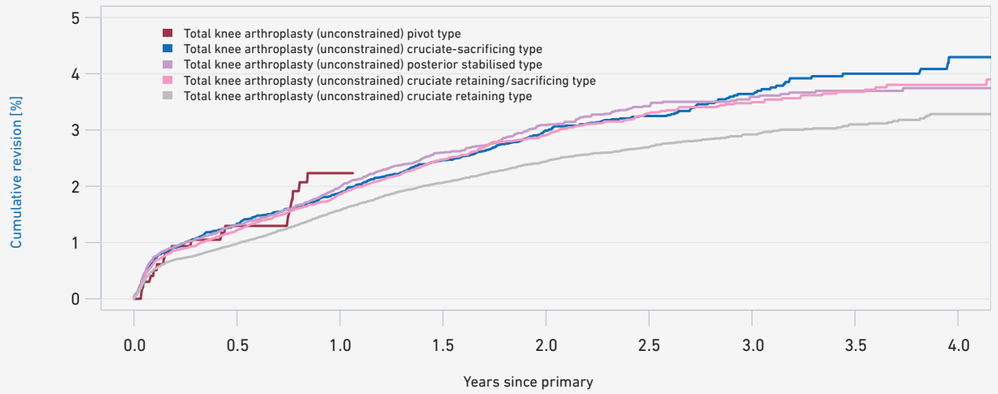
The following observations exclude any further discussion relating to the small number of *constrained* system cases, and will solely focus on total *unconstrained* knee arthroplasties.

EPRD records indicate that patellar resurfacing as part of a primary arthroplasty is rather the exception than the rule (see Table 27). There is however a large degree of heterogeneity between individual clinics: While three quarters of clinics performed no more that 5% of patellar resurfacing concurrently with the primary total knee arthroplasty, at least half of all primary total knee arthroplasties included concurrent patellar resurfacing in one out of twenty clinics. As illustrated in Figure 13, the overall revision probability of primary unconstrained total knee arthroplasties with concurrent patellar resurfacing was slightly higher than primary arthroplasties without concurrent patellar resurfacing. However, there are number of aspects to consider when evaluating this observation: Firstly, it is precisely the clinics that regularly perform patellar resurfacing that tend to perform a greater number of arthroplasties per year compared to the typical clinic participating in the EPRD. This would be expected to introduce a bias towards an underestimation of the actual increase in revision probabilities observed for primary patellar resurfacing – as discussed in Section 5.1.3. The data presented conceals this subtlety since primary patellar resurfacing is averaged out over clinics that perform these procedures almost routinely and clinics that only perform them in exceptional – and perhaps only in very difficult – cases. Secondly, the fundamentally different objectives of patellar resurfacing and the potential impact of different arthroplasty systems may also influence the outcome of primary patellar resurfacing. In addition, the arthroplasty survival analysis is also highly dependent on what defines a primary arthroplasty revision: The definition applied by the EPRD does not consider any patellar resurfacing subsequent to a primary arthroplasty as a revision, but rather as a complementary surgery (see Chapter 3). Consequently, any additional corrections (e.g. replacement with a new higher insert component) performed during patellar resurfacing subsequent to a primary arthroplasty are not included in the arthroplasty survival analysis. Conversely, the replacement of an isolated insert, already constitutes an "event" as far as the arthroplasty survival analysis is concerned irrespectively of whether or not any other different component necessitates a replacement in the future. The registry cannot determine whether the absence of primary patellar resurfacing lowers the probability of a subsequent re-operation based on the currently available data. If the defini-



Procedures under observation									
	15.555	12.914	10.257	8.076	5.791	4.020	2.407	1.438	621
	134.690	113.642	90.012	71.019	50.908	35.160	21.132	12.405	5.747

Figure 13: Revision probabilities of unconstrained total knee arthroplasties by primary patellar resurfacing



Procedures under observation									
	1.012	767	533						
	23.851	20.263	16.271	12.848	9.107	6.113	3.508	1.934	832
	26.185	21.497	16.540	12.710	9.094	6.428	4.168	2.732	1.522
	29.546	25.229	20.392	16.292	11.551	7.931	4.664	2.741	1.209
	69.651	58.800	46.533	36.898	26.773	18.607	11.151	6.411	2.801

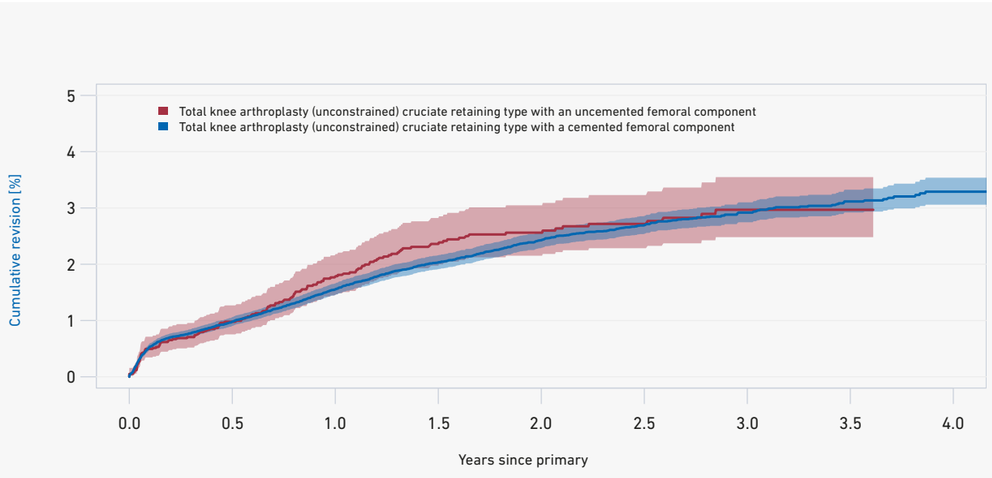
Figure 14: Revision probabilities of unconstrained total knee arthroplasties by knee system

tion of a primary arthroplasty revision is changed to score each complementary patellar resurfacing as a revision event, the difference between the revision probability of a primary arthroplasty with or one without patellar resurfacing may not persist. These results alone are therefore not sufficient for a conclusive appraisal of whether patellar resurfacing carried out as part of the primary arthroplasty is beneficial.

A closer examination of unconstrained total knee arthroplasties by system type (see Figure 14) highlights that *cruciate-retaining* systems distinguish themselves from other systems by their lower revision probabilities. The remaining knee systems evaluated display almost identical revision probabilities. A possible explanation for the better performance of cruciate-retaining systems may be related to the fact that they are exclusively used for cases with good knee stability and kinematics, whereas other systems such as *posterior stabilised* systems are also used in cases with insufficient ligament stability. The unconstrained total knee arthroplasty groups compared may therefore diverge in their initial baseline parameters and their level of wear.

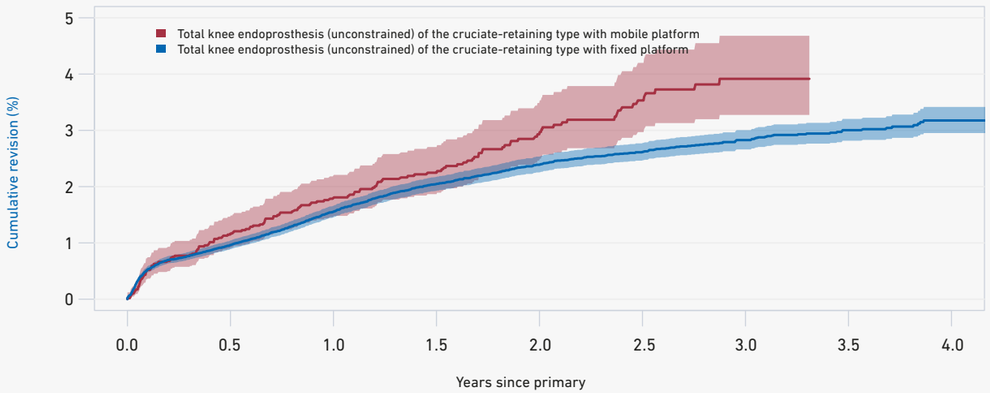
The majority of knee arthroplasties collated in the EPRD include cemented femoral as well as tibial components (also refer to Figures 23 and 24). To date we observe that bone fixation has a relatively minor effect on the revision probability. Although uncemented and hybrid systems have, at least over short time intervals, been found to have higher revision probabilities compared to fully cemented arthroplasties, this increase is not statistically significant and – at least in the case of *cruciate-retaining* systems illustrated in Figure 15 – is not consistent.

An inconsistent picture also emerges when considering the influence of bearing mobility. Depending on the type of knee system, a number of trends are



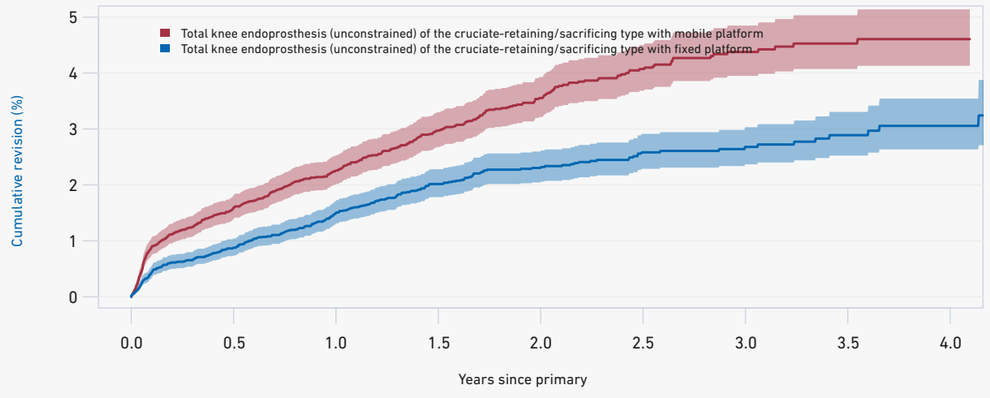
Procedures under observation									
5.916	5.300	4.449	3.660	2.687	1.884	1.102	613	
63.735	53.500	42.084	33.238	24.086	16.723	10.049	5.798	2.558

Figure 15: Revision probabilities of cruciate retaining unconstrained total knee arthroplasties by femoral component fixation



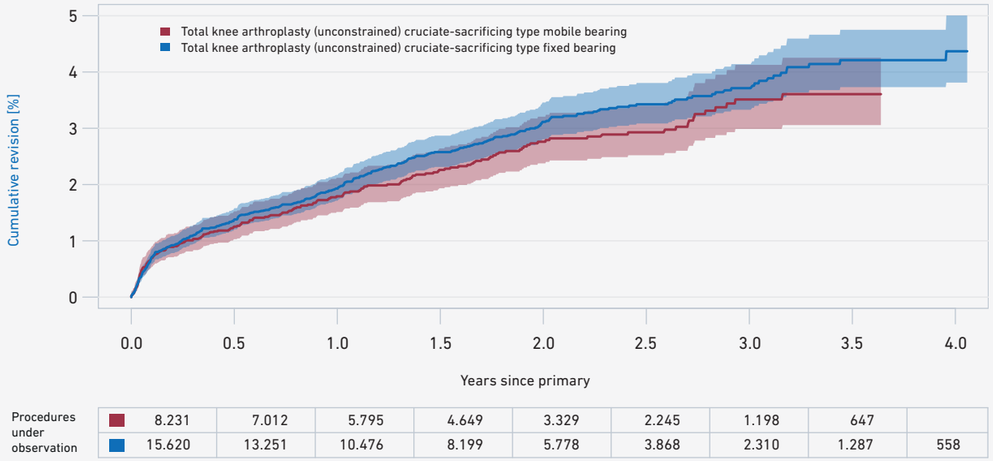
Procedures under observation									
5,849	5,060	4,161	3,332	2,364	1,522	761		
63,802	53,740	42,372	33,566	24,409	17,085	10,390	6,040	2,688

Figure 16: Revision probabilities of cruciate retaining unconstrained total knee arthroplasties by bearing mobility



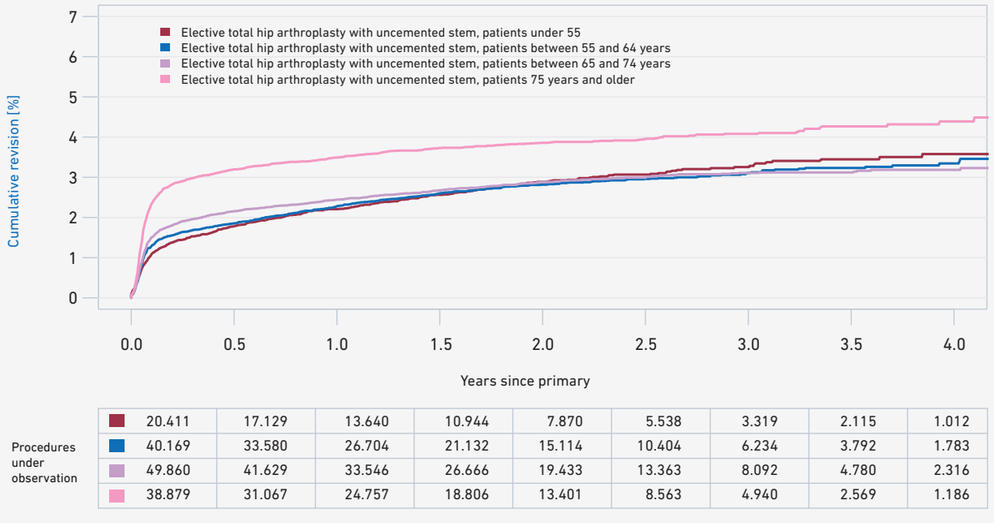
Procedures under observation									
14,183	12,028	9,673	7,798	5,554	3,761	2,219	1,293	556
15,363	13,201	10,719	8,494	5,997	4,170	2,445	1,448	653

Figure 17: Revision probabilities of cruciate retaining/sacrificing unconstrained total knee arthroplasties by bearing mobility



Procedures under observation									
8.231	7.012	5.795	4.649	3.329	2.245	1.198	647	
15.620	13.251	10.476	8.199	5.778	3.868	2.310	1.287	558

Figure 18: Revision probabilities of cruciate-sacrificing unconstrained total knee arthroplasties by bearing mobility



Procedures under observation								
20.411	17.129	13.640	10.944	7.870	5.538	3.319	2.115	1.012
40.169	33.580	26.704	21.132	15.114	10.404	6.234	3.792	1.783
49.860	41.629	33.546	26.666	19.433	13.363	8.092	4.780	2.316
38.879	31.067	24.757	18.806	13.401	8.563	4.940	2.569	1.186

Figure 19: Revision probabilities of elective total hip arthroplasties with uncemented stems by patient age

evident: lower revision probabilities are observed for fixed bearings in the context of cruciate-retaining systems. However, while the revision probability for pure *cruciate-retaining* systems with mobile and fixed bearings only diverge over time (Figure 16), *cruciate retaining/sacrificing* systems display a clear difference right from the start (Figure 17). This could be attributed to the individual, implant systems themselves (see also Table 38). However, not all mobile bearings have higher revision probabilities. In the case of *cruciate-sacrificing* systems, the revision probabilities determined for mobile bearings tend to be lower, although the difference is not significant (Figure 18).

In summary

- During the early observation phase, the revision probabilities of unicondylar knee arthroplasties is higher than it is for total knee arthroplasties
- Revision probabilities
  - Increase with higher degrees of stabilisation
  - Are lower for cruciate retaining knee systems

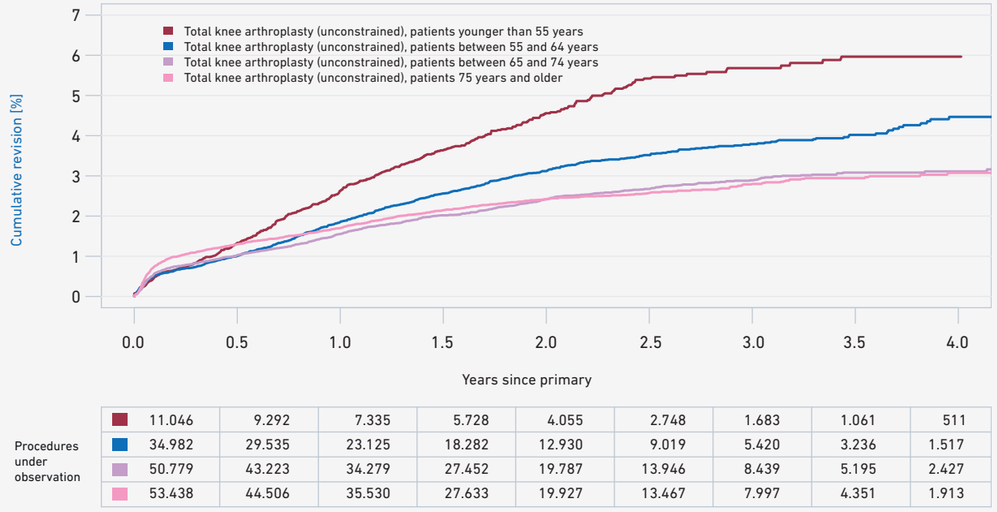
5.1.3 Influence of non-implant-related factors

The revision probabilities for different types of arthroplasty systems were discussed in the previous subsections. This current subsection evaluates revision probability effects of non-implant-related factors by type of arthroplasty.

Two such factors that are recorded when an intervention is entered in the EPRD are patient age and sex. When examining the influence of the patient's age, differences and similarities can be observed for the two most common types of arthroplasties, elective total hip arthroplasties with uncemented stems and total knee arthroplasties without any additional constrain. As previously mentioned in the case of total hip arthroplasties (Figure 19), the older the patient, the higher the likelihood of revision during the first months following the arthroplasty. The group of patients aged 75 years and older show significantly higher revision probabilities right from the start. The curves for the age groups up to 74 years are closer together and intersect over time, so that towards the end of the observation period, the probability of revision for younger patients is slightly higher.

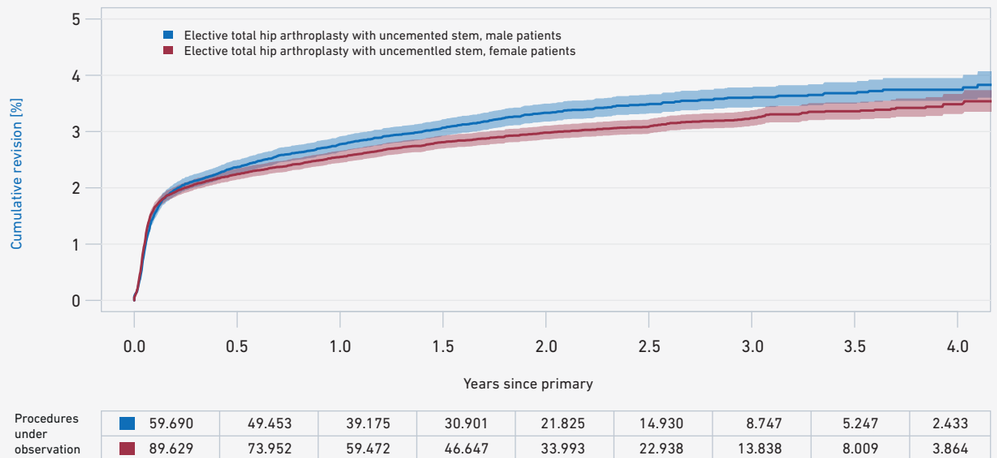
The clear separation of data from the group of patients aged 75 years and older from the other patient age subgroups is remarkable. This difference is not apparent for total hip arthroplasties with cemented stems where the probability of revision for the 75 year and older age subgroup is generally significantly lower than that for uncemented stems (also refer to Figure 5 and Figure 6).

With total knee arthroplasties, as Figure 20 illustrates, the older patient group also has the highest probability of revision during the first months following the arthroplasty, but the difference is noticeably lower than for hip arthroplasties. Over time, the probability of total knee arthroplasty revision for younger patient subgroups increases significantly, so that the picture is completely inversed after just six months. Six months after total knee arthroplasty the highest revision probabilities are initially observed in patients younger than 55 years, subsequently followed by the group of patients between 55 and 64 years of age. While revision probabilities for the 65 to 74-year subgroup and for patients older than 75 are essentially superimposed two years after the total knee arthroplasty, revision probabilities for the two younger patient subgroups



Procedures under observation									
11.046	9.292	7.335	5.728	4.055	2.748	1.683	1.061	511
34.982	29.535	23.125	18.282	12.930	9.019	5.420	3.236	1.517
50.779	43.223	34.279	27.452	19.787	13.946	8.439	5.195	2.427
53.438	44.506	35.530	27.633	19.927	13.467	7.997	4.351	1.913

Figure 20: Revision probabilities of unconstrained total knee arthroplasties by patient age



Procedures under observation								
59.690	49.453	39.175	30.901	21.825	14.930	8.747	5.247	2.433
89.629	73.952	59.472	46.647	33.993	22.938	13.838	8.009	3.864

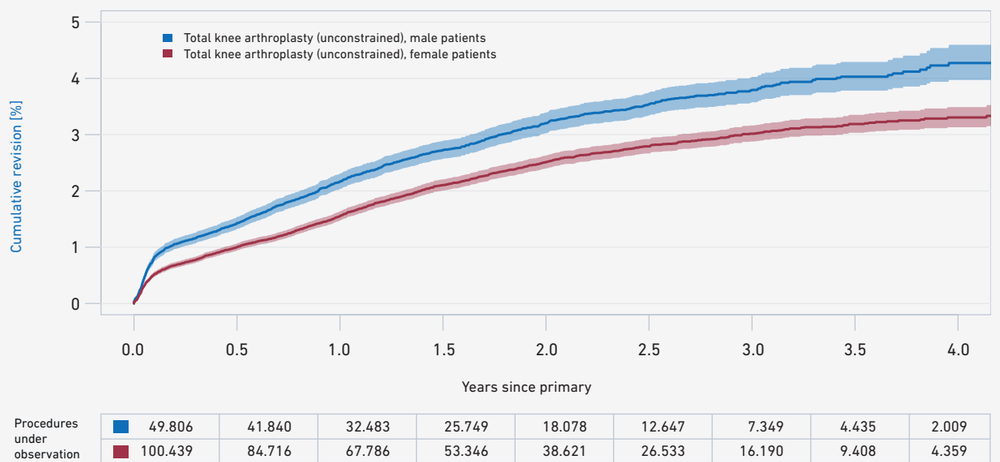
Figure 21: Revision probabilities of elective uncemented total hip arthroplasties by sex

differ significantly beyond this 2-year time point.

Even when these different age groups are further subdivided by patient sex, correlations between patient age and revision probabilities described in the previous paragraphs remain unchanged. A number of other observations are revealed when considering the male/female subdivided data: in general, significantly higher revision probabilities across most of the different types of arthroplasties are observed for men (see the Figure 21 and Figure 22). These differences are further exacerbated over time. This effect is maintained when only considering patients of comparable age, although its impact is sometimes more pronounced for certain age groups than for others. The one notable exception being unicondylar knee arthroplasties: Revision probabilities for male patients starting from approximately one year after the primary arthroplasty tend to be slightly lower compared to female patients, although the differences are not significant.

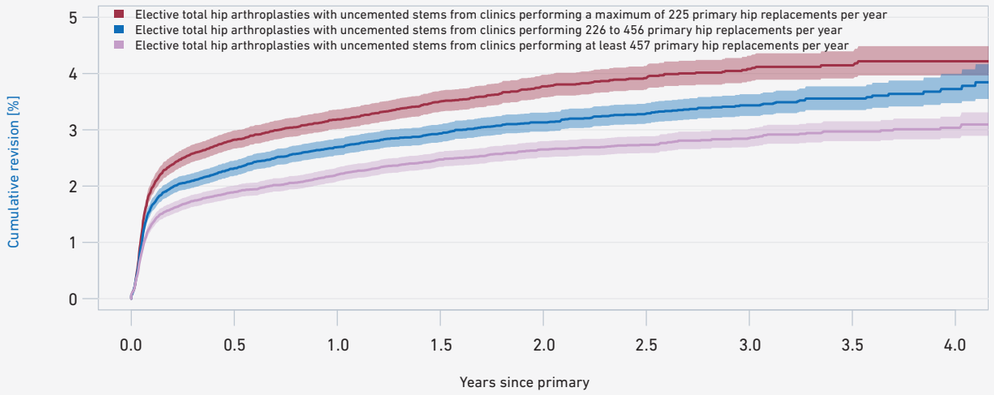
In addition to age and sex, the patient's height and weight have also been recorded since 2018. These variables – and in particular those derived from BMI *(body mass index)* – are also expected to impact revision probabilities. As the EPRD only started collating these variables last year, this data is only available for a fraction of the patients in the registry and only for comparatively recent arthroplasties. Accordingly, this current annual report will refrain from examining any potential effects of patient height, weight and BMI on arthroplasty revision probability.

As well as patient-related factors, arthroplasty outcome is also affected by several characteristics of the clinics performing the procedures. This is illustrated below by evaluating how a clinic's cumulative experience with respect to the different types of arthroplasties can impact the arthroplasty revision probability. An individual clinic's cumulative arthroplasty experience, was quantified by extracting the num-



Procedures under observation								
49.806	41.840	32.483	25.749	18.078	12.647	7.349	4.435	2.009
100.439	84.716	67.786	53.346	38.621	26.533	16.190	9.408	4.359

Figure 22: Revision probabilities of unconstrained total knee arthroplasties by sex



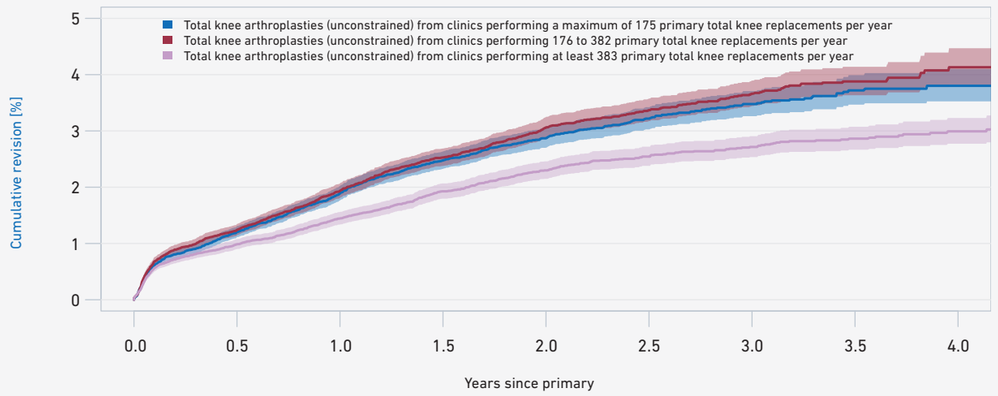
Procedures under observation									
42.297	34.803	27.541	21.405	14.967	9.729	5.282	2.743	991
48.683	40.252	32.076	25.269	18.113	12.474	7.632	4.337	1.810
58.171	48.184	38.864	30.709	22.581	15.525	9.551	6.061	3.414

Figure 23: Revision probabilities of elective total hip arthroplasties with uncemented stems by clinic volume (total hip arthroplasties performed in the clinic according to the 2017 quality report - median number of treatments in the groups per cluster: 159, 318 and 681)

ber of primary hip, total knee and unicondylar knee arthroplasties performed by the facility from the clinic's annual quality report[8]. The number of specific arthroplasties performed by clinics each year was partitioned into 3 quantiles to identify clinics performing a low, medium and high number of arthroplasties per year. This procedure was repeated for all of the previously mentioned types of arthroplasties. Partitioning normally distributed data into tertiles is designed to ensure that the number of arthroplasties considered in the three resulting continuous intervals is comparable, at least at the start of the follow-up period. It is worth noting that only a very small proportion of clinics, which perform few replacements per year, currently contribute data to the EPRD (also refer to Figure 3). This means that focussing on these types of clinics, that perform a relatively small number of arthroplasties each year, is unlikely to be representative of the German nationwide picture for this size of clinic.

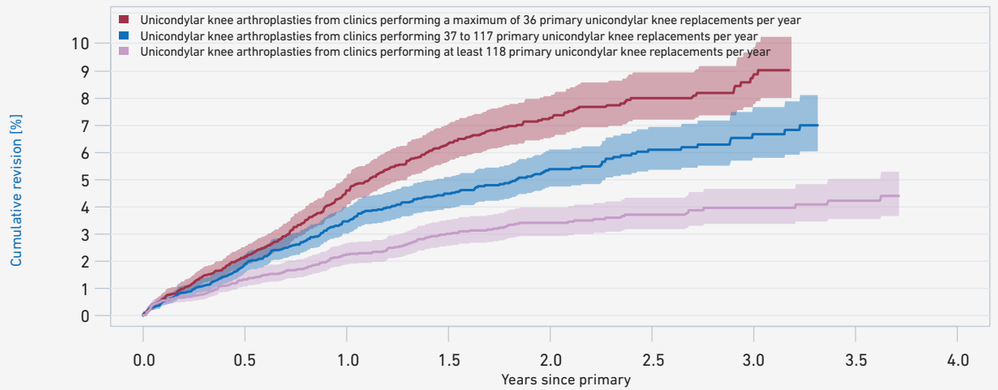
Figures 23, 24 and 25, illustrate correlations between the number of annual elective uncemented total hip,unconstrained total knee and unicondylar arthroplasties clinics perform per year and the revision probabilities for these respective arthroplasties. In general, the greater the clinic's experience,

8 The latest available version of the clinic's quality report, which covers the calendar year 2017, was used in the analysis. The number of specific arthroplasties performed by individual clinics is derived from three OPS codes: 5-820 (corresponds to hip arthroplasties), 5-822 with the exception of code 5-822.0 (corresponds to total knee arthroplasties), and 5-822.0 (corresponds to unicondylar knee arthroplasties). Where an individual code comprised less than 5 arthroplasties, these cases were not specifically detailed in the report, instead, they were scored as a "1" in the analyses, to comply with data protection regulations. Arthroplasties were excluded from the analysis when the clinic performing the surgery could not be paired with its corresponding quality report.



Procedures under observation									
49.850	41.855	32.620	25.423	17.659	11.762	6.551	3.514	1.352
50.161	42.213	33.163	25.881	18.438	12.714	7.565	4.071	1.517
49.908	42.165	34.168	27.479	20.310	14.420	9.154	6.025	3.343

Figure 24: Revision probabilities of unconstrained total knee arthroplasty by clinic volume (total knee arthroplasties performed in the clinic according to the quality report 2017 - median number of treatments in the different groups per cluster: 106, 259 and 704)



Procedures under observation									
6.919	5.621	4.194	3.110	2.091	1.330	721		
6.745	5.551	4.201	3.147	2.165	1.398	758		
6.681	5.510	4.377	3.402	2.483	1.614	933	693	

Figure 25: Revision probabilities of unicondylar knee arthroplasty by clinic volume (unicondylar knee arthroplasties performed in the clinic according to the quality report 2017 - median treatment numbers in the different groups per cluster: 20, 61 and 578)

which is a proxy for the actual number of specific arthroplasties a clinic reports per year, the lower the revision probabilities. This correlation is particularly evident in the case of unicondylar knee arthroplasties as illustrated in Figure 25: three years after the primary surgery, the probability of unicondylar knee arthroplasty revisions in the group of clinics performing the highest number these types of arthroplasties is only half that of the group of clinics performing the lowest number of these arthroplasties per year.

In summary

- Patient-related factors such as age and gender greatly affect revision probabilities
- A clinic's institutional experience also considerably impacts the arthroplasty revision probability, particularly in the case of unicondylar knee arthroplasties

5.2 Revision probabilities for particular implant sytems (brands) and combinations

This year, as in previous years, the EPRD presents the raw data for all the different types of arthroplasty systems as well as different combinations of systems collated in the database. For hip arthroplasties, this extends to individual combinations of stem and cup systems (Table 37), while for knee arthroplasties data from different combinations of femoral and tibial components are listed (Table 38). For hip replacements, Tables 39 and 40 list results for the stem and the acetabular cup, which are obtained by considering each component in isolation across all the possible different combinations.

Since certain arthroplasty systems are only used for very specific indications, i.e. the starting conditions are not necessarily the same for each system, these types of systems have been grouped together with comparable systems for the purposes of Table 37. Hip arthroplasties have been grouped into categories based on fixation and knee arthroplasties into categories based on arthroplasty type (i.e. total knee or unicondylar), fixation, system and degree of constraint. Within each of these categories, implant systems are listed in alphabetical order.

To ensure that the data is robust, Table 37 only presents outcomes for systems based on a minimum of 300 primary arthroplasties sourced from at least 3 clinics. If, over time, the number of cases under observation falls below a threshold of 150 arthroplasties, this is represented in italics to indicate the higher degree of uncertainty associated with this data. If the number of arthroplasties under observation falls below 50 for one single time point, no further values will be specified. For hip arthroplasties, only elective procedures are considered. This means that any hemi-hip or total hip arthroplasty to treat a femoral neck fracture, for example, is not included in the data. Interpretation of the data needs to consider that arthroplasty outcome may not solely be attributed to the implant component, but also to the circumstances of the arthroplasty as well as other characteristics of the arthroplasty patient group (see Section 5.1.3). In order to, at least partially, represent these potential contributing factors Table 37 also lists arthroplasty patients' characteristics (e.g. median age and male/female ratio), as well as the proportion of arthroplasties that were performed by clinics reporting low, medium and high numbers of arthroplasties per year[9].

Tabular representation of revision probabilities

Tables list the following implant-related parameters:
Number lists all arthroplasties which use this implant system or combination of implant components,
Hospitals denotes the number of clinics that provided documents for these arthroplasties,
Age denotes the median age and age quartiles of these arthroplasty patients,
m/f is the proportion of male and female arthroplasty patients.
%L, %M and **%H** refers to the proportion of arthroplasties provided by clinics performing low, medium or high number of such arthroplasties per year. The following table applies the same arbitrarily assigned cut-offs used in Figures 23 to 25 for each of these three groups:

	Number of arthroplasties performed		
	low	medium	high
Primary hip arthroplasties	0 to 225	226 to 456	457 and more
Primary total knee arthroplasties	0 to 175	176 to 382	383 and more
Primary unicondylar knee arthroplasties	0 to 36	37 to 117	118 and more

The probability of revision column also lists the respective 95% confidence intervals (square brackets) and the number of arthroplasties that remain under observation (subscript round brackets). The probability of revision and confidence intervals are italicised when less that 150 arthroplasties remain under observation. Revision probabilities based on fewer than 50 arthroplasties are not reported.

9 Individual clinics are arbitrarily subdivided into low, medium and high tertiles based on the total number of billed arthroplasties identified by the corresponding OPS codes extracted from their 2017 quality report (also refer to section 5.1.3). This process was repeated for each different arthroplasty type examined (i.e. total hip, total knee and unicondylar knee arthroplasties) and by extension for the number of each corresponding type of arthroplasty performed by individual clinics. As quality reports were not available for all clinics or could not be assigned to all clinics which submitted documents to the EPRD, a number of arthroplasties could not be assigned to the low, medium or high subgroups. Consequently, some percentages may not add up to a total of 100%, but may in some instance be less that 100%.

Elective total hip arthroplasties									Revision probability by			
Hip stem	Acetabular cup	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented stem												
A2 Kurzschaft (ImplanTec)	ANA.NOVA® Alpha Pfanne (ImplanTec)	851	16	64 (57 - 70)	43/57	6	34	60	1,2 [0,6; 2,3] [356]	*1,5 [0,8; 2,9]* [82]		
A2 Kurzschaft (ImplanTec)	ANA.NOVA® Hybrid Pfanne (ImplanTec)	1.420	20	62 (56 - 69)	38/62	15	24	62	1,0 [0,6; 1,8] [663]	*1,6 [0,7; 3,4]* [136]		
Accolade II Stem (Stryker)	Trident Cup (Stryker)	1.875	33	68 (60 - 75)	42/58	19	42	39	2,9 [2,1; 3,8] [901]	3,2 [2,4; 4,2] [445]	3,5 [2,5; 4,7] [153]	
Accolade II Stem (Stryker)	Trident TC Cup (Stryker)	406	9	69 (62 - 75)	38/62	16	34	50	2,0 [1,0; 4,0] [360]	2,6 [1,4; 4,8] [277]	*3,2 [1,7; 5,8]* [53]	
Accolade II Stem (Stryker)	Tritanium Cup (Stryker)	805	17	68 (61 - 75)	43/57	22	74	4	2,0 [1,2; 3,3] [558]	2,2 [1,3; 3,5] [294]	*3,4 [2,0; 5,6]* [114]	
Alloclassic (Zimmer)	Alloclassic (Zimmer)	352	7	67 (59 - 75)	31/69	66	12	21	3,9 [2,3; 6,6] [266]	4,3 [2,5; 7,1] [190]	*4,3 [2,5; 7,1]* [89]	
Alloclassic (Zimmer)	Allofit (Zimmer)	5.138	52	70 (62 - 76)	35/65	24	18	58	2,5 [2,1; 3,0] [3.775]	2,9 [2,5; 3,5] [2.560]	3,0 [2,6; 3,6] [1.195]	3,6 [2,9; 4,5] [294]
Alpha-Fit (Corin)	Trinity no Hole (Corin)	377	3	75 (69 - 79)	31/69	24	0	76	1,4 [0,6; 3,4] [263]	1,9 [0,8; 4,3] [195]	*1,9 [0,8; 4,3]* [120]	
AMISTEM (Medacta)	VERSAFITCUP CC TRIO (Medacta)	559	22	67 (58 - 75)	41/59	29	60	10	3,1 [1,9; 5,1] [358]	3,8 [2,4; 6,0] [153]		
ANA.NOVA® Alpha Schaft (ImplanTec)	ANA.NOVA® Alpha Pfanne (ImplanTec)	570	6	70 (63 - 76)	43/57	0	68	32	3,6 [2,3; 5,7] [379]	4,2 [2,8; 6,5] [241]	*4,2 [2,8; 6,5]* [55]	
ANA.NOVA® Alpha Schaft (ImplanTec)	ANA.NOVA® Hybrid Pfanne (ImplanTec)	453	7	69 (61 - 75)	39/61	43	48	10	2,7 [1,6; 4,8] [270]	*3,1 [1,8; 5,4]* [145]		
Avenir (Zimmer)	Allofit (Zimmer)	6.703	92	71 (63 - 77)	39/61	49	17	33	2,6 [2,3; 3,1] [4.019]	2,8 [2,4; 3,3] [1.976]	2,8 [2,4; 3,3] [565]	*2,8 [2,4; 3,3]* [66]
Avenir (Zimmer)	Allofit IT (Zimmer)	909	24	67 (59 - 75)	41/59	59	3	38	2,7 [1,7; 4,0] [499]	3,1 [2,1; 4,7] [191]		
BICONTACT H (Aesculap)	PLASMACUP SC (Aesculap)	1.216	17	70 (63 - 76)	50/50	4	83	13	2,2 [1,5; 3,2] [910]	2,3 [1,6; 3,4] [617]	2,3 [1,6; 3,4] [299]	*2,3 [1,6; 3,4]* [58]
BICONTACT H (Aesculap)	PLASMAFIT PLUS (Aesculap)	1.783	52	71 (64 - 76)	53/47	17	58	24	3,8 [3,0; 4,9] [1.223]	4,1 [3,2; 5,2] [739]	4,3 [3,3; 5,4] [396]	*4,3 [3,3; 5,4]* [128]
BICONTACT H (Aesculap)	PLASMAFIT POLY (Aesculap)	499	33	71 (63 - 76)	49/51	32	64	4	3,8 [2,4; 6,0] [329]	4,5 [2,9; 6,9] [206]	*5,3 [3,3; 8,4]* [78]	
BICONTACT S (Aesculap)	PLASMACUP SC (Aesculap)	1.461	22	72 (67 - 76)	32/68	21	38	40	2,0 [1,4; 2,9] [1.162]	2,8 [2,0; 3,8] [804]	2,9 [2,1; 4,0] [417]	3,5 [2,3; 5,3] [154]
BICONTACT S (Aesculap)	PLASMAFIT PLUS (Aesculap)	2.862	69	71 (64 - 77)	35/65	36	45	19	2,6 [2,1; 3,3] [2.004]	3,0 [2,4; 3,7] [1.218]	3,1 [2,5; 3,8] [606]	3,1 [2,5; 3,8] [195]
BICONTACT S (Aesculap)	PLASMAFIT POLY (Aesculap)	1.093	35	72 (65 - 77)	38/62	44	54	3	5,5 [4,3; 7,1] [651]	6,0 [4,6; 7,7] [313]	*6,0 [4,6; 7,7]* [80]	
CLS Spotorno (Zimmer)	Allofit (Zimmer)	12.312	134	66 (58 - 73)	43/57	26	24	50	2,7 [2,5; 3,1] [8.892]	3,2 [2,9; 3,6] [5.552]	3,5 [3,2; 3,9] [2.647]	3,5 [3,2; 3,9] [823]
CLS Spotorno (Zimmer)	Allofit IT (Zimmer)	1.035	23	66 (58 - 74)	44/56	17	5	78	1,4 [0,8; 2,3] [818]	2,2 [1,4; 3,4] [633]	2,2 [1,4; 3,4] [387]	2,2 [1,4; 3,4] [222]

Table 37: Implant results of acetabular component combinations in elective total primary hip arthroplasties. For each type of fixation (uncemented, hybrid, cemented) combinations are listed alphabetically according to acetabular components.

Elective total hip arthroplasties									Revision probability by			
Hip stem	Acetabular cup	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented stem												
CLS Spotorno (Zimmer)	Trilogy IT (Zimmer)	611	3	68 (61 - 74)	39/61	0	100	0	2,7 [1,7; 4,4] [434]	3,3 [2,1; 5,2] [286]	*4,0 [2,4; 6,6]* [123]	
CORAIL AMT-Hüftschaft (DePuy)	Allofit (Zimmer)	1.100	11	70 (61 - 77)	32/68	1	3	95	2,6 [1,7; 3,7] [627]	2,7 [1,9; 4,0] [284]		
CORAIL AMT-Hüftschaft (DePuy)	Allofit IT (Zimmer)	383	5	72 (67 - 77)	38/62	93	0	7	3,2 [1,8; 5,5] [351]	4,4 [2,7; 7,0] [266]		
CORAIL AMT-Hüftschaft (DePuy)	DURALOC OPTION Press Fit-Hüftpfanne (DePuy)	372	8	69 (60 - 75)	38/62	51	22	27	4,9 [3,1; 7,7] [273]	5,3 [3,4; 8,3] [176]	*5,3 [3,4; 8,3]* [66]	
CORAIL AMT-Hüftschaft (DePuy)	PINNACLE Press Fit-Hüftpfanne (DePuy)	17.878	132	70 (62 - 77)	37/63	32	28	40	2,5 [2,3; 2,8] [11.467]	3,0 [2,8; 3,3] [6.132]	3,3 [3,0; 3,6] [2.258]	3,6 [3,2; 4,0] [620]
CORAIL AMT-Hüftschaft (DePuy)	PINNACLE SPIROFIT-Schraubpfanne (DePuy)	313	15	76 (70 - 80)	25/75	63	32	4	3,6 [2,0; 6,5] [250]	4,1 [2,3; 7,1] [162]	*4,9 [2,8; 8,5]* [85]	
EXCEPTION (Biomet)	Allofit (Zimmer)	641	8	67 (59 - 74)	50/50	3	39	58	5,0 [3,5; 7,1] [301]	*5,0 [3,5; 7,1]* [53]		
EXCIA T (Aesculap)	PLASMAFIT PLUS (Aesculap)	1.004	38	70 (62 - 76)	33/67	40	45	15	2,9 [1,9; 4,2] [532]	*3,5 [2,4; 5,1]* [143]		
EXCIA T (Aesculap)	PLASMAFIT POLY (Aesculap)	1.393	30	69 (61 - 76)	37/63	32	17	50	3,7 [2,7; 4,8] [778]	3,7 [2,7; 4,8] [285]		
EXCIA TL (Aesculap)	PLASMAFIT PLUS (Aesculap)	405	35	68 (61 - 75)	54/46	25	62	13	3,5 [2,0; 5,9] [284]	*4,3 [2,6; 7,2]* [115]		
EXCIA TL (Aesculap)	PLASMAFIT POLY (Aesculap)	911	25	70 (63 - 76)	50/50	20	16	64	1,8 [1,1; 3,0] [506]	2,5 [1,5; 4,0] [195]		
Fitmore (Zimmer)	Allofit (Zimmer)	9.142	140	62 (55 - 69)	46/54	26	31	43	1,9 [1,6; 2,2] [6.020]	2,3 [2,0; 2,7] [3.536]	2,4 [2,1; 2,8] [1.507]	2,7 [2,3; 3,3] [331]
Fitmore (Zimmer)	Allofit IT (Zimmer)	1.157	42	57 (51 - 63)	46/54	37	20	42	2,9 [2,0; 4,1] [812]	3,8 [2,7; 5,2] [461]	4,1 [2,9; 5,7] [203]	*4,1 [2,9; 5,7]* [68]
Fitmore (Zimmer)	Trilogy (Zimmer)	1.294	12	61 (55 - 66)	41/59	16	31	52	2,0 [1,4; 3,0] [941]	2,3 [1,6; 3,4] [612]	2,7 [1,9; 3,9] [316]	3,5 [2,3; 5,4] [164]
GTS (Biomet)	Allofit (Zimmer)	409	10	66 (59 - 72)	43/57	20	15	65	2,9 [1,6; 5,2] [208]	*3,6 [2,0; 6,6]* [116]		
LCU (Waldemar Link)	CombiCup PF (Waldemar Link)	558	15	68 (62 - 74)	43/57	39	2	59	3,0 [1,8; 5,0] [306]	*3,6 [2,1; 6,1]* [68]		
M/L Taper (Zimmer)	Allofit (Zimmer)	2.758	18	69 (62 - 75)	42/58	14	17	69	2,8 [2,2; 3,5] [1.816]	3,4 [2,7; 4,2] [941]	3,6 [2,9; 4,6] [404]	*4,2 [3,2; 5,5]* [101]
M/L Taper (Zimmer)	Trilogy (Zimmer)	439	3	69 (63 - 72)	32/68	15	15	70	0,9 [0,3; 2,4] [404]	1,2 [0,5; 3,0] [317]	1,2 [0,5; 3,0] [206]	*1,2 [0,5; 3,0]* [119]
METABLOC (Zimmer)	Allofit (Zimmer)	426	12	73 (66 - 78)	39/61	84	16	0	2,0 [1,0; 3,9] [368]	2,3 [1,2; 4,3] [249]	*2,7 [1,4; 5,0]* [144]	*2,7 [1,4; 5,0]* [70]
Metafix (Corin)	Trinity Hole (Corin)	316	8	74 (66 - 79)	35/65	81	19	0	2,1 [0,9; 4,5] [220]	*2,1 [0,9; 4,5]* [126]	*2,1 [0,9; 4,5]* [51]	
Metafix (Corin)	Trinity no Hole (Corin)	584	7	71 (65 - 76)	44/56	21	79	0	1,6 [0,8; 3,0] [465]	2,0 [1,1; 3,6] [309]	*2,0 [1,1; 3,6]* [141]	
METHA (Aesculap)	PLASMACUP SC (Aesculap)	606	21	59 (53 - 64)	44/56	12	21	67	1,6 [0,8; 3,0] [445]	2,5 [1,5; 4,4] [323]	2,5 [1,5; 4,4] [206]	*2,5 [1,5; 4,4]* [105]

Table 37 (continued)

Elective total hip arthroplasties									Revision probability by			
Hip stem	Acetabular cup	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented stem												
METHA (Aesculap)	PLASMAFIT PLUS (Aesculap)	2.130	78	58 (52 - 63)	48/52	26	38	36	3,2 [2,5; 4,1] [1.446]	3,8 [3,0; 4,8] [851]	4,1 [3,2; 5,1] [432]	*4,1 [3,2; 5,1]* [125]
METHA (Aesculap)	PLASMAFIT POLY (Aesculap)	572	45	56 (50 - 61)	52/48	46	40	14	3,4 [2,1; 5,4] [313]	4,2 [2,6; 6,7] [158]	*4,2 [2,6; 6,7]* [56]	
MiniHip (Corin)	Trinity Hole (Corin)	679	25	61 (54 - 67)	49/51	70	26	3	1,8 [1,0; 3,2] [486]	2,1 [1,2; 3,5] [287]	*2,1 [1,2; 3,5]* [117]	
MiniHip (Corin)	Trinity no Hole (Corin)	479	14	61 (54 - 67)	42/58	36	24	39	3,8 [2,4; 6,0] [267]	*4,7 [3,0; 7,5]* [134]		
Nanos Schenkelhalsprothese (OHST / Smith & Nephew)	Allofit (Zimmer)	609	14	63 (56 - 69)	49/51	2	38	60	1,9 [1,0; 3,4] [477]	1,9 [1,0; 3,4] [308]	*1,9 [1,0; 3,4]* [118]	
Nanos Schenkelhalsprothese (OHST / Smith & Nephew)	HI Lubricer Schale (Smith & Nephew)	388	10	61.5 (55 - 68)	49/51	15	60	25	1,3 [0,5; 3,1] [283]	2,2 [1,0; 4,6] [189]		
Nanos Schenkelhalsprothese (OHST / Smith & Nephew)	R3 (Smith & Nephew)	568	41	58 (51 - 64)	48/52	41	33	27	3,6 [2,3; 5,6] [337]	3,6 [2,3; 5,6] [163]		
optimys (Mathys)	Allofit (Zimmer)	1.328	13	63 (56 - 70)	45/55	5	13	81	1,5 [1,0; 2,4] [822]	1,5 [1,0; 2,4] [395]	1,5 [1,0; 2,4] [169]	
optimys (Mathys)	aneXys Flex (Mathys)	534	23	60 (54 - 65)	51/49	27	31	42	2,5 [1,4; 4,5] [274]	*2,5 [1,4; 4,5]* [50]		
optimys (Mathys)	RM Pressfit (Mathys)	336	6	71 (63 - 76)	41/59	0	10	90	2,9 [1,5; 5,4] [202]	*2,9 [1,5; 5,4]* [87]		
optimys (Mathys)	RM Pressfit vitamys (Mathys)	4.032	44	65 (58 - 73)	44/56	6	28	66	1,6 [1,2; 2,0] [2.363]	1,9 [1,4; 2,4] [1.080]	2,0 [1,5; 2,6] [293]	*2,0 [1,5; 2,6]* [67]
Polarschaft (Smith & Nephew)	EP-FIT PLUS (Smith & Nephew)	845	29	68 (60 - 75)	47/53	41	58	1	2,2 [1,4; 3,5] [597]	2,6 [1,6; 4,0] [284]		
Polarschaft (Smith & Nephew)	HI Lubricer Schale (Smith & Nephew)	1.467	11	71 (63 - 77)	34/66	30	24	46	2,4 [1,8; 3,4] [957]	2,8 [2,0; 3,9] [524]	2,8 [2,0; 3,9] [217]	*2,8 [2,0; 3,9]* [78]
Polarschaft (Smith & Nephew)	R3 (Smith & Nephew)	3.130	56	69 (62 - 76)	43/57	50	48	1	2,8 [2,3; 3,5] [1.788]	3,0 [2,4; 3,7] [776]	3,0 [2,4; 3,7] [223]	
Proxy PLUS Schaft (Smith & Nephew)	EP-FIT PLUS (Smith & Nephew)	315	11	70 (62 - 75)	45/55	61	28	11	3,9 [2,2; 6,7] [268]	4,8 [2,8; 8,0] [178]	*5,3 [3,2; 8,8]* [86]	
Pyramid (Atesos)	Pyramid (Atesos)	1.616	20	71 (63 - 76)	37/63	16	62	22	2,7 [2,0; 3,6] [1.156]	3,5 [2,6; 4,6] [648]	3,5 [2,6; 4,6] [195]	
QUADRA (Medacta)	VERSAFITCUP CC TRIO (Medacta)	3.226	40	68 (61 - 75)	37/63	8	62	30	2,4 [1,9; 3,0] [1.714]	2,7 [2,1; 3,4] [635]	*2,7 [2,1; 3,4]* [77]	
SL-PLUS Schaft (Smith & Nephew)	Allofit (Zimmer)	541	9	64 (57 - 71)	37/63	3	33	64	3,7 [2,4; 5,7] [494]	4,8 [3,2; 7,0] [425]	5,3 [3,6; 7,6] [365]	5,5 [3,8; 7,9] [271]
SL-PLUS Schaft (Smith & Nephew)	BICON-PLUS (Smith & Nephew)	930	22	72,5 (65 - 77)	37/63	19	80	2	2,7 [1,8; 4,0] [746]	4,2 [3,0; 5,9] [543]	5,1 [3,7; 7,1] [323]	*6,6 [4,3; 9,9]* [76]
SL-PLUS Schaft (Smith & Nephew)	R3 (Smith & Nephew)	1.032	19	69 (63 - 76)	34/66	10	60	30	3,8 [2,7; 5,2] [650]	4,1 [3,0; 5,7] [341]	*4,1 [3,0; 5,7]* [115]	

Table 37 (continued)

Elective total hip arthroplasties									Revision probability by			
Hip stem	Acetabular cup	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented stem												
SL MIA Schaft (Smith & Nephew)	Allofit (Zimmer)	490	12	71 (63 - 77)	30/70	4	91	5	1,9 [1,0; 3,6] [292]	*1,9 [1,0; 3,6]* [107]		
SL MIA Schaft (Smith & Nephew)	BICON-PLUS (Smith & Nephew)	610	15	71 (63 - 76)	36/64	23	77	0	1,7 [0,9; 3,1] [541]	1,9 [1,0; 3,4] [455]	2,4 [1,4; 4,0] [321]	2,4 [1,4; 4,0] [168]
SL MIA Schaft (Smith & Nephew)	EP-FIT PLUS (Smith & Nephew)	490	8	73 (64 - 78)	39/61	92	8	0	2,9 [1,7; 4,9] [410]	4,2 [2,7; 6,5] [256]	*4,2 [2,7; 6,5]* [103]	
SL MIA Schaft (Smith & Nephew)	R3 (Smith & Nephew)	742	21	70 (61 - 76)	39/61	35	55	10	2,8 [1,8; 4,3] [353]	*2,8 [1,8; 4,3]* [89]		
SP-CL (Waldemar Link)	Allofit (Zimmer)	861	9	64 (57 - 70)	38/62	6	5	89	4,4 [3,1; 6,1] [527]	4,9 [3,5; 6,8] [196]		
SP-CL (Waldemar Link)	CombiCup PF (Waldemar Link)	415	20	66 (57 - 71)	37/63	32	26	41	4,4 [2,7; 6,9] [289]	*4,7 [3,0; 7,4]* [142]		
Taperloc (Biomet)	Allofit (Zimmer)	330	11	64 (59 - 71)	41/59	31	68	1	3,4 [1,8; 6,2] [162]			
Taperloc (Biomet)	G7 (Biomet)	1.267	8	69 (62 - 76)	35/65	28	24	48	2,3 [1,6; 3,3] [806]	2,9 [2,0; 4,2] [318]		
TRENDHIP L (Aesculap)	PLASMAFIT POLY (Aesculap)	578	17	68 (61 - 76)	59/41	12	20	68	1,9 [1,0; 3,5] [296]	1,9 [1,0; 3,5] [180]	*1,9 [1,0; 3,5]* [77]	
TRENDHIP S (Aesculap)	PLASMAFIT PLUS (Aesculap)	441	22	70 (62 - 77)	33/67	78	14	8	2,7 [1,5; 4,9] [272]	*3,1 [1,8; 5,5]* [139]		
TRENDHIP S (Aesculap)	PLASMAFIT POLY (Aesculap)	1.043	19	70 (62 - 76)	32/68	33	33	34	1,7 [1,1; 2,8] [478]	1,9 [1,2; 3,1] [259]	*1,9 [1,2; 3,1]* [121]	
TRILOCK®-Hüftschaft (DePuy)	PINNACLE Press Fit-Hüftpfanne (DePuy)	1.539	33	59 (53 - 66)	47/53	8	42	49	2,3 [1,7; 3,3] [1.086]	2,8 [2,0; 3,8] [668]	3,4 [2,4; 4,8] [309]	*4,4 [2,9; 6,5]* [81]
twinSys (Mathys)	RM Classic (Mathys)	392	7	74 (67 - 78)	33/67	34	3	63	1,0 [0,4; 2,8] [307]	1,7 [0,8; 3,8] [258]	2,6 [1,3; 5,3] [207]	2,6 [1,3; 5,3] [182]
twinSys (Mathys)	RM Pressfit (Mathys)	377	8	75 (69 - 79)	40/60	3	23	74	2,4 [1,3; 4,6] [322]	3,0 [1,7; 5,4] [226]	*3,0 [1,7; 5,4]* [123]	
twinSys (Mathys)	RM Pressfit vitamys (Mathys)	1.022	22	72 (64 - 77)	36/64	22	34	44	1,9 [1,2; 3,0] [608]	2,4 [1,5; 3,8] [294]	2,8 [1,7; 4,4] [153]	
Hybrid												
Avenir (Zimmer)	Allofit (Zimmer)	652	46	79 (75 - 83)	22/78	35	18	47	2,8 [1,8; 4,5] [414]	3,6 [2,3; 5,6] [222]	*3,6 [2,3; 5,6]* [92]	
BICONTACT S (Aesculap)	PLASMAFIT PLUS (Aesculap)	378	38	78 (74 - 81)	22/78	59	38	3	1,6 [0,7; 3,5] [275]	1,6 [0,7; 3,5] [160]	*2,3 [1,0; 5,3]* [81]	
BICONTACT S (Aesculap)	PLASMAFIT POLY (Aesculap)	304	24	78 (75 - 82)	18/82	37	63	0	1,5 [0,6; 4,1] [218]	*2,2 [0,9; 5,3]* [128]	*2,2 [0,9; 5,3]* [57]	
CCA (Mathys)	Allofit (Zimmer)	416	4	76 (73 - 80)	32/68	11	89	0	2,4 [1,3; 4,5] [384]	3,2 [1,9; 5,5] [333]	3,5 [2,1; 5,9] [232]	4,0 [2,4; 6,7] [159]
CORAIL AMT-Hüftschaft (DePuy)	PINNACLE Press Fit-Hüftpfanne (DePuy)	305	49	78 (73 - 81)	45/55	44	27	30	3,5 [1,8; 6,6] [157]	*4,1 [2,2; 7,8]* [74]		
EXCIA T (Aesculap)	PLASMAFIT PLUS (Aesculap)	323	24	77 (73 - 81)	21/79	32	66	2	2,9 [1,5; 5,5] [176]	*3,5 [1,8; 6,4]* [98]		

Table 37 (continued)

Elective total hip arthroplasties									Revision probability by			
Hip stem	Acetabular cup	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Hybrid												
M.E.M. Geradschaft (Zimmer)	Allofit (Zimmer)	7.046	122	78 (74 - 81)	27/73	29	41	30	2,0 [1,7; 2,4] [4.429]	2,2 [1,9; 2,6] [2.321]	2,4 [2,0; 2,8] [963]	2,6 [2,1; 3,2] [209]
M.E.M. Geradschaft (Zimmer)	Trilogy (Zimmer)	915	10	77 (74 - 80)	30/70	12	55	33	0,8 [0,4; 1,7] [726]	1,0 [0,5; 2,0] [488]	1,2 [0,6; 2,4] [257]	*1,2 [0,6; 2,4]* [116]
METABLOC (Zimmer)	Allofit (Zimmer)	1.037	23	78 (75 - 81)	27/73	42	44	14	2,1 [1,4; 3,2] [713]	2,3 [1,5; 3,5] [447]	2,9 [1,9; 4,5] [206]	*2,9 [1,9; 4,5]* [57]
MS-30 (Zimmer)	Allofit (Zimmer)	1.999	24	77 (73 - 81)	26/74	13	39	48	1,7 [1,3; 2,4] [1.483]	2,0 [1,4; 2,7] [907]	2,2 [1,6; 3,1] [352]	
Müller Geradschaft (Smith & Nephew)	R3 (Smith & Nephew)	330	9	78 (75 - 81)	34/66	5	12	83	4,4 [2,5; 7,4] [161]			
Polarschaft (Smith & Nephew)	R3 (Smith & Nephew)	499	34	78 (75 - 82)	22/78	44	56	0	3,1 [1,8; 5,2] [254]	*3,1 [1,8; 5,2]* [82]		
QUADRA (Medacta)	VERSAFITCUP CC TRIO (Medacta)	465	25	79 (76 - 82)	24/76	6	44	50	2,3 [1,3; 4,3] [203]	*2,3 [1,3; 4,3]* [72]		
SPII® Modell Lubinus (Waldemar Link)	Allofit (Zimmer)	2.241	28	77 (73 - 80)	29/71	2	16	81	2,5 [1,9; 3,3] [1.494]	2,8 [2,1; 3,6] [823]	3,0 [2,3; 3,9] [408]	3,8 [2,6; 5,6] [151]
SPII® Modell Lubinus (Waldemar Link)	CombiCup PF (Waldemar Link)	687	28	77 (73 - 80)	28/72	34	48	17	1,2 [0,6; 2,3] [459]	2,0 [1,1; 3,6] [283]	*2,0 [1,1; 3,6]* [98]	
twinSys (Mathys)	RM Pressfit vitamys (Mathys)	376	13	78 (71 - 81)	22/78	7	27	66	2,2 [1,0; 4,8] [170]	*3,5 [1,5; 8,0]* [57]		
cemented												
BICONTACT S (Aesculap)	ALL POLY CUP STANDARD (Aesculap)	773	45	80 (77 - 84)	21/79	36	44	20	2,4 [1,5; 3,8] [589]	2,4 [1,5; 3,8] [402]	2,7 [1,7; 4,2] [231]	*2,7 [1,7; 4,2]* [98]
CS PLUS Schaft (Smith & Nephew)	Müller II Pfanne (Smith & Nephew)	460	19	79 (76 - 82)	26/74	21	76	3	0,7 [0,2; 2,1] [357]	1,5 [0,6; 3,7] [228]	*3,1 [1,3; 7,1]* [76]	
M.E.M. Geradschaft (Zimmer)	Flachprofil (Zimmer)	2.545	103	80 (76 - 83)	24/76	36	22	39	2,1 [1,6; 2,7] [1.760]	2,4 [1,9; 3,2] [1.096]	2,8 [2,1; 3,6] [525]	2,8 [2,1; 3,6] [165]
MS-30 (Zimmer)	Flachprofil (Zimmer)	337	21	79 (75 - 82)	23/77	19	70	11	1,1 [0,3; 3,4] [232]	1,5 [0,6; 4,0] [164]	*2,6 [1,0; 6,7]* [76]	
Polarschaft (Smith & Nephew)	Müller II Pfanne (Smith & Nephew)	367	21	80 (77 - 84)	22/78	52	48	0	3,1 [1,8; 5,6] [217]	*3,9 [2,1; 7,2]* [90]		
SPII® Modell Lubinus (Waldemar Link)	Endo-Modell Mark III (Waldemar Link)	415	6	76 (73 - 81)	20/80	0	2	98	1,5 [0,7; 3,3] [370]	2,0 [1,0; 4,0] [319]	2,0 [1,0; 4,0] [263]	2,5 [1,3; 4,8] [182]
SPII® Modell Lubinus (Waldemar Link)	IP-Hüftpfannen, X-Linked (Waldemar Link)	542	15	80 (77 - 83)	26/74	8	76	16	2,6 [1,5; 4,4] [378]	3,1 [1,9; 5,2] [233]	*3,1 [1,9; 5,2]* [87]	
SPII® Modell Lubinus (Waldemar Link)	Kunststoffpfanne Modell Lubinus (Waldemar Link)	486	17	79 (74 - 83)	25/75	5	18	76	0,9 [0,3; 2,3] [365]	1,2 [0,5; 2,9] [208]	*1,2 [0,5; 2,9]* [108]	
reverse-hybrid												
CORAIL AMT-Hüftschaft (DePuy)	TRILOC® II-PE-Hüftpfanne (DePuy)	554	58	79 (74 - 83)	17/83	45	31	24	2,3 [1,3; 4,1] [401]	2,3 [1,3; 4,1] [238]	*2,7 [1,6; 4,8]* [72]	

Table 37 (continued)

Knee arthroplasties									Revision probability by			
Femoral components	Tibial components	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Total arthroplasties (unconstrained), cruciate retaining, fixed bearing, cemented												
ACS cemented (Implantcast)	ACS FB cemented (Implantcast)	376	32	67 (59 - 75)	22/78	71	25	4	3,6 [2,1; 6,4] (214)	*5,9 [3,5; 9,7]* (89)		
ATTUNE Femur (DePuy)	ATTUNE Tibia (DePuy)	3.193	81	67 (60 - 75)	37/63	26	29	44	1,7 [1,3; 2,3] (2.076)	3,0 [2,3; 3,8] (1.097)	3,2 [2,5; 4,1] (503)	3,2 [2,5; 4,1] (157)
balanSys Bicondylar system (Mathys)	balanSys PS Bicondylar system (Mathys)	1.033	14	72 (65 - 77)	34/66	35	38	27	2,5 [1,6; 3,7] (655)	3,1 [2,1; 4,7] (281)	*3,8 [2,4; 6,0]* (81)	
COLUMBUS CR (Aesculap)	COLUMBUS CR/PS (Aesculap)	6.201	104	71 (63 - 77)	32/68	56	37	7	1,2 [1,0; 1,6] (4.102)	2,0 [1,6; 2,4] (2.334)	2,5 [2,0; 3,0] (999)	2,9 [2,3; 3,7] (304)
COLUMBUS CR (Aesculap)	COLUMBUS CRA/PSA (Aesculap)	1.348	26	70 (62 - 77)	36/64	21	67	12	1,2 [0,7; 2,0] (784)	1,7 [1,1; 2,8] (352)	*1,7 [1,1; 2,8]* (112)	
EFK (OHST Medizintechnik)	EFK (OHST Medizintechnik)	2.949	51	72 (64 - 77)	34/66	30	48	22	1,4 [1,0; 1,9] (2.700)	2,0 [1,6; 2,6] (1.890)	2,4 [1,9; 3,2] (680)	*3,9 [2,4; 6,3]* (65)
GENESIS II CR COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	4.518	74	70 (62 - 76)	33/67	49	34	16	1,8 [1,4; 2,2] (3.211)	2,8 [2,3; 3,4] (1.904)	3,4 [2,8; 4,2] (856)	4,0 [3,1; 5,1] (214)
GENESIS II CR OXINIUM (Smith & Nephew)	Genesis II (Smith & Nephew)	1.465	89	66 (58 - 73)	20/80	34	14	52	1,3 [0,8; 2,1] (1.049)	2,7 [1,9; 3,9] (674)	2,7 [1,9; 3,9] (342)	2,7 [1,9; 3,9] (171)
GENESIS II LDK COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	1.719	13	70 (63 - 76)	36/64	36	26	38	2,2 [1,6; 3,1] (1.277)	3,3 [2,5; 4,4] (920)	4,0 [3,1; 5,3] (409)	*4,0 [3,1; 5,3]* (114)
INNEX (Zimmer)	INNEX (Zimmer)	750	24	74 (66 - 78)	42/58	92	8	0	2,4 [1,4; 3,9] (518)	2,4 [1,4; 3,9] (297)	*2,4 [1,4; 3,9]* (145)	
JOURNEY II CR OXINIUM (Smith & Nephew)	JOURNEY (Smith & Nephew)	534	18	66 (59 - 74)	37/63	39	53	8	3,1 [1,8; 5,2] (238)	*3,7 [2,1; 6,3]* (86)		
LEGION CR COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	3.270	73	71 (63 - 77)	37/63	29	50	21	1,8 [1,3; 2,4] (1.448)	2,7 [2,0; 3,7] (505)	*2,9 [2,1; 4,0]* (53)	
LEGION CR OXINIUM (Smith & Nephew)	Genesis II (Smith & Nephew)	797	76	64 (57 - 72)	15/85	22	37	41	2,4 [1,4; 4,1] (378)	*3,8 [2,2; 6,5]* (98)		
Natural Knee NK Flex (Zimmer)	Natural Knee NK II (Zimmer)	337	10	73 (63 - 78)	34/66	47	33	4	1,3 [0,5; 3,4] (229)	*2,9 [1,3; 6,2]* (129)	*3,7 [1,8; 7,8]* (79)	
NexGen CR-Flex-Gender (Zimmer)	NexGen (Zimmer)	2.564	77	70 (62 - 76)	8/92	23	27	51	0,7 [0,4; 1,2] (1.756)	1,7 [1,2; 2,4] (1.109)	2,0 [1,4; 2,8] (537)	2,0 [1,4; 2,8] (225)
NexGen CR-Flex (Zimmer)	NexGen (Zimmer)	9.361	89	72 (64 - 77)	40/60	26	23	51	1,3 [1,1; 1,6] (6.307)	1,9 [1,6; 2,3] (3.782)	2,1 [1,8; 2,5] (1.841)	2,3 [1,9; 2,8] (604)
NexGen CR (Zimmer)	NexGen (Zimmer)	2.560	38	70 (62 - 76)	43/57	19	16	65	1,1 [0,7; 1,6] (1.821)	1,9 [1,4; 2,7] (1.234)	2,3 [1,7; 3,1] (685)	3,1 [2,1; 4,6] (186)
Persona (Zimmer)	Persona (Zimmer)	1.267	40	69 (62 - 76)	39/61	54	24	22	1,6 [1,0; 2,6] (739)	1,6 [1,0; 2,6] (332)	*1,6 [1,0; 2,6]* (100)	
Scorpio NRG CR (Stryker)	Scorpio (Stryker)	328	7	71 (63 - 77)	30/70	89	11	0	0,9 [0,3; 2,9] (295)	2,1 [1,0; 4,8] (194)	*4,0 [1,9; 8,6]* (91)	
TC-PLUS CR (Smith & Nephew)	TC-PLUS (Smith & Nephew)	2.088	36	72 (64 - 77)	36/64	35	44	21	1,2 [0,7; 1,8] (1.054)	1,6 [1,0; 2,4] (444)	*1,6 [1,0; 2,4]* (109)	
Triathlon CR (Stryker)	Triathlon (Stryker)	4.453	62	71 (63 - 77)	36/64	51	33	16	1,7 [1,3; 2,1] (2.905)	2,5 [2,0; 3,2] (1.674)	3,5 [2,8; 4,3] (774)	3,9 [3,0; 5,1] (215)
Total arthroplasties (unconstrained), cruciate retaining, fixed bearing, cemented												

Table 37 (continued)

Knee arthroplasties									Revision probability by			
Femoral components	Tibial components	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Vanguard (Biomet)	Vanguard (Biomet)	5,853	64	72 (63 - 77)	33/67	31	40	29	2.0 [1.6; 2.4] (3,741)	2.7 [2.3; 3.3] (2,029)	3.3 [2.7; 4.0] (691)	*3.8 [3.0; 4.9]* (66)
Total arthroplasties (unconstrained), cruciate retaining, fixed bearing, hybrid												
COLUMBUS CR zf (Aesculap)	COLUMBUS CR/PS (Aesculap)	361	5	69 (62 - 76)	36/64	69	31	0	4,8 [3,0; 7,8] (258)	*5,2 [3,3; 8,3]* (145)		
EFK (OHST Medizintechnik)	EFK (OHST Medizintechnik)	1.118	16	70 (62 - 76)	38/62	8	73	19	1,4 [0,8; 2,2] (1.060)	1,8 [1,2; 2,8] (816)	2,2 [1,4; 3,4] (393)	*2,2 [1,4; 3,4]* (56)
GENESIS II CR COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	327	4	69 (63 - 76)	41/59	35	0	65	0,7 [0,2; 2,9] (268)	1,5 [0,6; 4,0] (198)	*2,1 [0,9; 5,0]* (138)	*2,1 [0,9; 5,0]* (69)
NexGen CR-Flex (Zimmer)	NexGen (Zimmer)	562	17	69 (61 - 76)	48/52	27	54	19	0,8 [0,3; 2,2] (364)	2,4 [1,3; 4,7] (178)	*2,4 [1,3; 4,7]* (85)	
NexGen CR (Zimmer)	NexGen (Zimmer)	428	6	69 (62 - 75)	45/55	78	22	0	0,5 [0,1; 1,9] (376)	0,8 [0,2; 2,3] (232)	*1,6 [0,5; 5,1]* (95)	
Vanguard (Biomet)	Vanguard (Biomet)	397	6	68 (60 - 74)	40/60	10	20	70	1,9 [0,8; 4,2] (247)	*3,2 [1,7; 6,2]* (133)		
Total arthroplasties (unconstrained), cruciate retaining, mobile bearing, cemented												
ACS cemented (Implantcast)	ACS MB cemented (Implantcast)	352	19	72 (64 - 77)	29/71	90	9	1	2,7 [1,4; 5,1] (251)	4,3 [2,4; 7,6] (152)	*4,3 [2,4; 7,6]* (57)	
ATTUNE Femur (DePuy)	ATTUNE Tibia (DePuy)	931	15	70 (63 - 75)	34/66	30	4	66	1,6 [0,9; 2,8] (635)	2,5 [1,5; 4,1] (357)	*3,6 [2,2; 5,8]* (80)	
COLUMBUS CR (Aesculap)	COLUMBUS RP (Aesculap)	1.243	20	72 (65 - 77)	32/68	49	51	0	1,4 [0,9; 2,3] (854)	2,5 [1,6; 3,8] (480)	3,7 [2,4; 5,6] (189)	*3,7 [2,4; 5,6]* (53)
INNEX (Zimmer)	INNEX (Zimmer)	815	55	71 (63 - 77)	98/2	41	24	34	2,1 [1,3; 3,5] (583)	3,2 [2,1; 5,0] (326)	*4,3 [2,6; 6,9]* (105)	
NexGen CR-Flex (Zimmer)	NexGen CR (Zimmer)	430	10	71 (64 - 76)	44/56	6	44	50	0,7 [0,2; 2,3] (332)	1,7 [0,8; 3,8] (269)	*2,1 [1,0; 4,4]* (122)	
Total arthroplasties (unconstrained), cruciate retaining, mobile bearing, hybrid												
TC-PLUS CR (Smith & Nephew)	TC-PLUS SB (Smith & Nephew)	315	4	70 (62 - 77)	34/66	2	98	0	2.6 [1.3; 5.1] (267)	*4.6 [2.7; 7.8]* (149)		
Total arthroplasties (unconstrained), cruciate retaining/sacrificing, fixed bearing, cemented												
3D (Speetec Implantate Gmbh)	3D (Speetec Implantate Gmbh)	1,263	19	71 (63 - 77)	34/66	37	51	12	2.2 [1.5; 3.2] (951)	2.9 [2.1; 4.2] (568)	3.4 [2.4; 4.8] (228)	
SIGMA® Femur (DePuy)	SIGMA® Tibia (DePuy)	12,846	112	71 (63 - 77)	34/66	27	34	37	1.5 [1.2; 1.7] (8,963)	2.3 [2.0; 2.6] (4,968)	2.7 [2.4; 3.1] (2,005)	3.2 [2.7; 3.7] (571)
Unity CR cmtd (Corin)	Unity cmtd (Corin)	305	10	75 (68 - 78)	24/76	8	40	51	1.3 [0.4; 3.9] (217)	*1.8 [0.7; 4.7]* (133)	*1.8 [0.7; 4.7]* (66)	
Total arthroplasties (unconstrained), cruciate retaining/sacrificing, fixed bearing, hybrid												

Table 38: Implant results for femoro-tibial combinations in knee arthroplasty. For each type of arthroplasty and fixation (uncemented, hybrid, cemented) combinations are listed alphabetically according to femoral components.

Knee arthroplasties									Revision probability by			
Femoral components	Tibial components	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
SIGMA® Femur (DePuy)	SIGMA® Tibia (DePuy)	515	12	69 (61 - 76)	39/61	59	0	41	1.1 [0.4; 2.6] [347]	1.1 [0.4; 2.6] [199]	*1.1 [0.4; 2.6]* [78]	
Total arthroplasties (unconstrained), cruciate retaining/sacrificing, mobile bearing, cemented												
E.MOTION FP/UC (Aesculap)	E.MOTION UC/PS (Aesculap)	4,967	71	70 (62 - 77)	32/68	43	42	15	2.3 [1.9; 2.8] [3,102]	3.9 [3.3; 4.6] [1,619]	4.7 [3.9; 5.6] [636]	*5.1 [4.2; 6.1]* [149]
LCS® COMPLETE Femur (DePuy)	MBT Tibia (DePuy)	3,874	55	71 (64 - 77)	37/63	30	15	55	2.2 [1.8; 2.7] [3,017]	3.1 [2.6; 3.8] [1,988]	3.6 [3.0; 4.3] [910]	3.7 [3.0; 4.5] [167]
SIGMA® Femur (DePuy)	MBT Tibia (DePuy)	992	23	72 (64 - 77)	34/66	38	41	21	2.8 [1.9; 4.1] [635]	4.1 [2.9; 5.8] [342]	*5.9 [4.1; 8.4]* [76]	
Total arthroplasties (unconstrained), cruciate retaining/sacrificing, mobile bearing, hybrid												
LCS® COMPLETE Femur (DePuy)	MBT Tibia (DePuy)	2,037	33	70 (62 - 77)	35/65	23	29	48	2.7 [2.1; 3.6] [1,317]	3.9 [3.0; 5.0] [703]	5.5 [4.1; 7.3] [254]	*5.5 [4.1; 7.3]* [98]
Total arthroplasties (unconstrained), cruciate retaining/sacrificing, mobile bearing, uncemented												
LCS® COMPLETE Femur (DePuy)	LCS® COMPLETE Tibia (DePuy)	321	60	64 (57 - 72)	7/93	43	27	31	2.5 [1.2; 5.2] [192]	*5.9 [3.2; 10.5]* [80]		
LCS® COMPLETE Femur (DePuy)	MBT Tibia (DePuy)	876	21	70 (61 - 76)	35/65	29	53	18	1.3 [0.7; 2.3] [620]	3.1 [2.0; 4.8] [377]	3.7 [2.4; 5.7] [155]	*3.7 [2.4; 5.7]* [73]
Total arthroplasties (unconstrained), cruciate-sacrificing, fixed bearing, cemented												
ATTUNE Femur (DePuy)	ATTUNE Tibia (DePuy)	775	49	68 (59 - 75)	36/64	30	50	20	2,3 [1,4; 3,7] [582]	4,0 [2,7; 6,0] [327]	4,0 [2,7; 6,0] [161]	
balanSys Bicondylar system (Mathys)	balanSys PS Bicondylar system (Mathys)	760	19	70 (62 - 77)	26/74	49	32	19	1,7 [0,9; 3,0] [413]	2,9 [1,7; 5,0] [208]	*4,9 [2,8; 8,6]* [113]	
COLUMBUS CR (Aesculap)	COLUMBUS CR/PS (Aesculap)	1.138	59	71 (62 - 77)	23/77	47	30	23	2,5 [1,7; 3,7] [735]	3,5 [2,5; 5,0] [387]	*4,1 [2,7; 6,3]* [122]	
COLUMBUS CR (Aesculap)	COLUMBUS CRA/PSA (Aesculap)	470	18	69 (61 - 77)	30/70	40	51	9	1,6 [0,8; 3,4] [290]	3,0 [1,6; 5,4] [155]		
INNEX (Zimmer)	INNEX (Zimmer)	817	37	72 (64 - 78)	39/61	50	21	29	1,4 [0,7; 2,5] [502]	1,6 [0,9; 3,0] [250]	*2,1 [1,1; 4,0]* [78]	
INNEX Gender (Zimmer)	INNEX (Zimmer)	466	29	72 (66 - 78)	20/80	38	13	49	2,4 [1,3; 4,5] [287]	2,8 [1,5; 5,0] [183]	*3,3 [1,8; 6,0]* [65]	
Natural Knee NK Flex (Zimmer)	Natural Knee NK II (Zimmer)	383	10	68 (60 - 75)	32/68	28	5	66	2,2 [1,1; 4,4] [287]	2,6 [1,4; 5,0] [207]	*3,3 [1,7; 6,3]* [119]	*3,3 [1,7; 6,3]* [60]
Natural Knee NK II (Zimmer)	Natural Knee NK II (Zimmer)	342	8	73 (67 - 77)	28/72	14	65	21	2,1 [1,0; 4,3] [328]	3,1 [1,7; 5,6] [245]	3,1 [1,7; 5,6] [176]	*3,1 [1,7; 5,6]* [70]
Persona (Zimmer)	Persona (Zimmer)	1.493	35	68 (60 - 76)	33/67	20	9	71	1,1 [0,7; 1,8] [1.002]	1,9 [1,3; 3,0] [385]	*2,3 [1,4; 3,6]* [72]	
SIGMA® Femur (DePuy)	SIGMA® Tibia (DePuy)	2.655	79	72 (63 - 77)	33/67	26	30	44	2,9 [2,3; 3,6] [1.880]	4,1 [3,3; 5,1] [1.044]	4,7 [3,7; 5,8] [391]	*5,2 [4,1; 6,6]* [125]
Triathlon CR (Stryker)	Triathlon (Stryker)	824	17	71 (63 - 77)	33/67	34	38	26	1,8 [1,0; 3,2] [441]	2,6 [1,5; 4,4] [283]	*3,5 [2,1; 5,9]* [149]	
Vanguard (Biomet)	Vanguard (Biomet)	3.504	58	72 (64 - 78)	27/73	22	55	22	1,4 [1,0; 1,9] [2.293]	2,7 [2,1; 3,5] [1.239]	3,1 [2,4; 4,0] [437]	*4,9 [2,6; 9,2]* [51]

Table 38 (continued)

Knee arthroplasties									Revision probability by			
Femoral components	Tibial components	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Total arthroplasties (unconstrained), cruciate-sacrificing, fixed bearing, hybrid												
balanSys Bicondylar system (Mathys)	balanSys PS Bicondylar system (Mathys)	573	6	70 (62 - 76)	43/57	1	99	0	2.3 [1.3; 3.9] [377]	4.0 [2.4; 6.5] [194]	*4.6 [2.8; 7.5]* [101]	
Total arthroplasties (unconstrained), cruciate-sacrificing, mobile bearing, cemented												
COLUMBUS CR (Aesculap)	COLUMBUS UCR (Aesculap)	764	4	70 (62 - 76)	40/60	10	49	40	0.9 [0.4; 2.0] [623]	1.9 [1.1; 3.3] [426]	2.2 [1.3; 4.0] [211]	
INNEX (Zimmer)	INNEX (Zimmer)	3,171	57	73 (65 - 78)	29/71	44	26	30	2.1 [1.7; 2.7] [2,204]	3.1 [2.4; 3.8] [1,248]	4.2 [3.3; 5.4] [421]	
INNEX Gender (Zimmer)	INNEX (Zimmer)	2,270	54	72 (64 - 77)	16/84	31	24	45	1.6 [1.2; 2.3] [1,530]	2.5 [1.8; 3.4] [790]	2.7 [1.9; 3.6] [203]	
SIGMA® Femur (DePuy)	MBT Tibia (DePuy)	343	35	72 (64 - 78)	27/73	62	27	11	2.1 [0.9; 4.6] [216]	*3.4 [1.6; 7.0]* [106]		
Total arthroplasties (unconstrained), cruciate-sacrificing, mobile bearing, hybrid												
balanSys Bicondylar system (Mathys)	balanSys Bicondylar system (Mathys)	499	3	70 (61 - 76)	36/64	4	96	0	2.1 [1.1; 3.9] [404]	3.2 [1.9; 5.4] [304]	3.7 [2.2; 6.2] [196]	*3.7 [2.2; 6.2]* [126]
Total arthroplasties (unconstrained), posterior stabilised, cemented												
balanSys Bicondylar system (Mathys)	balanSys PS Bicondylar system (Mathys)	784	18	73 (64 - 78)	34/66	34	39	27	2,7 [1,7; 4,4] [367]	5,5 [3,7; 8,3] [200]	*6,6 [4,4; 9,9]* [104]	
E.MOTION PS (Aesculap)	E.MOTION UC/PS (Aesculap)	357	16	67 (61 - 74)	36/64	27	21	52	3,2 [1,8; 5,7] [315]	5,4 [3,5; 8,5] [204]	*5,9 [3,8; 9,2]* [115]	
E.MOTION PS PRO (Aesculap)	E.MOTION UC/PS (Aesculap)	966	26	69 (62 - 77)	28/72	19	68	13	1,0 [0,5; 2,0] [576]	1,9 [1,1; 3,5] [281]	*2,7 [1,3; 5,5]* [111]	
GEMINI SL Fixed Bearing PS (zementiert) (Waldemar Link)	GEMINI SL Fixed Bearing CR/ PS (zementiert) (Waldemar Link)	313	17	73 (65 - 78)	32/68	48	31	21	2,6 [1,2; 5,3] [152]	*2,6 [1,2; 5,3]* [63]		
GENESIS II PS COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	1.932	53	72 (64 - 78)	34/66	25	32	43	2,6 [1,9; 3,5] [1.240]	3,4 [2,6; 4,5] [574]	3,9 [2,9; 5,2] [223]	*3,9 [2,9; 5,2]* [56]
JOURNEY II BCS OXINIUM (Smith & Nephew)	JOURNEY (Smith & Nephew)	886	27	69 (62 - 76)	31/69	11	18	71	3,1 [2,1; 4,7] [522]	*4,4 [2,9; 6,6]* [134]		
LEGION CR COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	320	16	72 (64 - 78)	6/94	7	50	43	*1,9 [0,8; 4,6]* [130]	*1,9 [0,8; 4,6]* [56]		
LEGION PS COCR (Smith & Nephew)	Genesis II (Smith & Nephew)	1.413	44	71 (63 - 77)	43/57	22	42	37	2,4 [1,6; 3,4] [628]	3,1 [2,1; 4,5] [230]	*3,1 [2,1; 4,5]* [62]	
LEGION PS OXINIUM (Smith & Nephew)	Genesis II (Smith & Nephew)	582	51	67 (60 - 75)	20/80	9	23	68	1,2 [0,5; 2,6] [371]	2,4 [1,3; 4,4] [229]	*3,0 [1,6; 5,6]* [117]	*4,3 [2,0; 9,0]* [53]
NexGen LPS-Flex-Gender (Zimmer)	NexGen (Zimmer)	1.987	58	69 (61 - 76)	7/93	28	12	61	1,4 [0,9; 2,0] [1.396]	2,4 [1,8; 3,4] [841]	3,3 [2,3; 4,5] [438]	3,3 [2,3; 4,5] [213]
NexGen LPS-Flex (Zimmer)	NexGen (Zimmer)	6.729	163	69 (61 - 76)	30/70	31	23	46	2,0 [1,6; 2,3] [4.431]	3,0 [2,6; 3,6] [2.529]	3,3 [2,8; 3,9] [1.116]	3,4 [2,9; 4,1] [361]
NexGen LPS (Zimmer)	NexGen (Zimmer)	4.946	34	70 (62 - 76)	38/62	13	21	66	1,2 [0,9; 1,6] [3.614]	1,9 [1,5; 2,4] [2.370]	2,1 [1,6; 2,6] [1.263]	2,2 [1,8; 2,8] [595]

Table 38 (continued)

Knee arthroplasties									Revision probability by			
Femoral components	Tibial components	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Total arthroplasties (unconstrained), posterior stabilised, cemented												
Persona (Zimmer)	Persona (Zimmer)	444	28	68 (60 - 75)	42/58	35	15	50	2.0 [1.0; 4.0] [243]	*3.1 [1.6; 6.0]* [106]		
Triathlon PS (Stryker)	Triathlon (Stryker)	1,627	49	72 (63 - 77)	34/66	26	23	51	2.8 [2.0; 4.0] [781]	4.4 [3.2; 6.0] [328]	*4.7 [3.4; 6.5]* [125]	
Vanguard (Biomet)	Vanguard (Biomet)	705	27	72 (64 - 78)	28/72	41	19	41	2.2 [1.3; 3.8] [444]	3.8 [2.4; 6.1] [225]	*4.4 [2.7; 6.9]* [63]	
VEGA PS (Aesculap)	VEGA PS (Aesculap)	615	22	69 (59 - 76)	32/68	48	42	11	2.4 [1.4; 4.1] [377]	3.5 [2.1; 5.8] [237]	*5.4 [3.2; 9.1]* [105]	
Total arthroplasties (unconstrained), pivot, fixed bearing, cemented												
MicroPort (MicroPort)	MicroPort (MicroPort)	712	15	70 (61 - 76)	39/61	27	12	61	1.9 [1.1; 3.5] [375]	*3.8 [2.3; 6.5]* [105]		
Total arthroplasties (unconstrained), varus-valgus stabilised, fixed bearing, cemented												
NexGen LCCK (Zimmer)	NexGen (Zimmer)	864	70	72 (62 - 79)	30/70	23	37	40	3.0 [2.0; 4.5] [596]	3.0 [2.0; 4.5] [329]	*3.0 [2.0; 4.5]* [129]	
Vanguard (Biomet)	Vanguard (Biomet)	300	15	71 (64 - 77)	31/69	13	23	64	2.2 [1.0; 4.9] [192]	*5.2 [2.9; 9.5]* [113]		
Total arthroplasties (unconstrained), hinge, fixed bearing, cemented												
ENDURO (Aesculap)	ENDURO (Aesculap)	869	110	75 (67 - 79)	23/77	61	32	7	4.0 [2.9; 5.7] [544]	4.6 [3.3; 6.4] [328]	*4.9 [3.5; 6.9]* [140]	
NexGen RHK (Zimmer)	NexGen RHK (Zimmer)	591	93	75 (67 - 80)	23/77	27	48	24	3.8 [2.5; 5.8] [360]	5.1 [3.4; 7.7] [202]	*6.0 [3.8; 9.3]* [96]	
RT-Plus (Smith & Nephew)	RT-Plus (Smith & Nephew)	1,101	103	77 (71 - 81)	20/80	38	53	9	4.3 [3.2; 5.7] [741]	6.1 [4.6; 7.9] [411]	7.3 [5.4; 9.7] [150]	
RT-Plus Modular (Smith & Nephew)	RT-Plus Modular (Smith & Nephew)	327	72	74 (65 - 79)	29/71	48	38	15	4.8 [2.9; 7.9] [230]	*6.3 [4.0; 10.0]* [119]		
Unicondylar arthroplasties, fixed bearing, cemented												
JOURNEY UNI COCR (Smith & Nephew)	JOURNEY UNI (Smith & Nephew)	354	47	64 (58 - 70)	46/54	67	31	2	2,8 [1,4; 5,6] [200]	*4,5 [2,4; 8,0]* [92]		
JOURNEY UNI OXINIUM (Smith & Nephew)	JOURNEY UNI (Smith & Nephew)	357	78	59 (54 - 66)	34/66	56	36	8	4,8 [2,9; 8,1] [203]	*7,3 [4,6; 11,7]* [90]		
Oxford (Biomet)	Oxford (Biomet)	341	12	71 (63 - 77)	15/85	2	1	97	0,7 [0,2; 2,7] [175]	*2,0 [0,7; 5,5]* [69]		
SIGMA® HP Partial-Kniesystem (DePuy)	SIGMA® HP Partial-Kniesystem (DePuy)	1.869	63	63 (57 - 72)	43/57	30	43	26	1,7 [1,1; 2,5] [1.239]	4,0 [3,0; 5,3] [691]	4,7 [3,5; 6,2] [257]	*7,0 [4,6; 10,5]* [63]
Triathlon PKR (Stryker)	Triathlon PKR (Stryker)	303	22	62 (56 - 70)	43/57	73	27	0	4,9 [2,9; 8,3] [210]	*6,4 [4,0; 10,3]* [111]	*6,4 [4,0; 10,3]* [56]	
UNIVATION XF (Aesculap)	UNIVATION XF (Aesculap)	713	50	63 (56 - 71)	41/59	45	46	10	5,8 [4,1; 8,2] [318]	*8,8 [6,1; 12,7]* [96]		

Table 38 (continued)

Knee arthroplasties									Revision probability by			
Femoral components	Tibial components	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
ZUK (Lima)	ZUK (Lima)	1.786	59	66 (58 - 74)	42/58	32	12	56	1,7 [1,2; 2,5] (1.145)	2,9 [2,1; 4,1] (525)		
Unicondylar knee arthroplasties, mobile bearing, cemented												
Oxford (Biomet)	Oxford (Biomet)	10.112	298	64 (57 - 73)	41/59	37	37	26	3,2 [2,8; 3,6] (6.450)	4,9 [4,4; 5,4] (3.485)	5,8 [5,2; 6,5] (1.313)	7,1 [6,1; 8,1] (419)
Schlittenprothese (Waldemar Link)	Schlittenprothese All-Poly (Waldemar Link)	307	22	64 (55 - 72)	50/50	27	73	0	3,6 [2,0; 6,7] (214)	*8,3 [5,3; 12,8]* (134)	*11,7 [7,7; 17,6]* (61)	
Unicondylar knee arthroplasties, mobile bearing, uncemented												
Oxford (Biomet)	Oxford (Biomet)	2,531	56	63 (56 - 71)	55/45	6	21	72	3.5 [2.8; 4.4] (1,612)	5.0 [4.1; 6.1] (932)	6.2 [5.1; 7.6] (425)	6.7 [5.3; 8.4] (173)

Table 38 (continued)

Elective total hip arthroplasties								Revision probability by			
Hip stem	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented hip stems											
A2 Kurzschaft (ImplanTec)	2.394	30	63 (57 - 70)	39/61	11	27	63	1,1 [0,7; 1,7] [1.103]	1,5 [0,9; 2,5] [278]		
Accolade II Stem (Stryker)	3.440	42	68 (61 - 75)	42/58	19	52	29	2,5 [2,0; 3,1] [2.072]	2,8 [2,3; 3,5] [1.180]	3,4 [2,7; 4,2] [381]	
Actinia cementless (Implantcast)	575	13	74 (67 - 79)	35/65	81	19	0	5,0 [3,4; 7,2] [317]	*5,7 [4,0; 8,3]* [89]		
Alloclassic (Zimmer)	6.274	63	69 (62 - 76)	35/65	26	18	56	2,7 [2,4; 3,2] [4.572]	3,2 [2,7; 3,7] [3.052]	3,4 [2,9; 3,9] [1.395]	3,9 [3,3; 4,7] [332]
Alpha-Fit (Corin)	580	3	75 (69 - 79)	28/72	36	0	64	1,7 [0,9; 3,2] [400]	2,0 [1,1; 3,8] [297]	2,0 [1,1; 3,8] [175]	
AMISTEM (Medacta)	588	23	67 (58 - 75)	42/58	32	58	9	3,0 [1,8; 4,8] [385]	3,6 [2,2; 5,7] [168]		
ANA.NOVA® Alpha Schaft (ImplanTec)	1.038	9	69 (62 - 76)	41/59	19	59	22	3,2 [2,3; 4,5] [659]	3,7 [2,7; 5,2] [395]	*3,7 [2,7; 5,2]* [77]	
Avenir (Zimmer)	7.984	105	71 (63 - 76)	39/61	49	16	34	2,8 [2,4; 3,2] [4.719]	3,0 [2,6; 3,4] [2.249]	3,0 [2,7; 3,5] [636]	*3,0 [2,7; 3,5]* [81]
BICONTACT H (Aesculap)	4.049	85	71 (63 - 76)	51/49	16	66	18	3,2 [2,7; 3,8] [2.824]	3,5 [2,9; 4,1] [1.779]	3,6 [3,0; 4,3] [890]	3,6 [3,0; 4,3] [224]
BICONTACT S (Aesculap)	6.183	104	71 (64 - 76)	35/65	35	44	21	3,0 [2,6; 3,5] [4.375]	3,5 [3,0; 4,0] [2.688]	3,6 [3,1; 4,1] [1.279]	3,9 [3,3; 4,6] [407]
BICONTACT SD (Aesculap)	458	41	65 (57 - 72)	9/91	20	55	25	2,5 [1,4; 4,5] [328]	3,1 [1,8; 5,3] [189]	*3,1 [1,8; 5,3]* [85]	
CBC Evolution (Mathys)	501	13	67 (61 - 74)	37/63	20	74	6	2,5 [1,4; 4,3] [400]	3,7 [2,2; 6,0] [263]	*3,7 [2,2; 6,0]* [103]	*3,7 [2,2; 6,0]* [60]
CFP (Waldemar Link)	926	24	61 (54 - 67)	55/45	11	18	70	1,7 [1,0; 2,8] [727]	2,3 [1,5; 3,7] [466]	2,3 [1,5; 3,7] [259]	2,3 [1,5; 3,7] [174]
CLS Spotorno (Zimmer)	14.822	158	66 (58 - 73)	42/58	25	26	48	2,7 [2,5; 3,0] [10.783]	3,3 [3,0; 3,6] [6.888]	3,5 [3,2; 3,9] [3.366]	3,5 [3,2; 3,9] [1.103]
CORAIL AMT-Hüftschaft (DePuy)	21.326	140	71 (62 - 77)	36/64	33	27	40	2,7 [2,4; 2,9] [13.960]	3,2 [2,9; 3,4] [7.727]	3,4 [3,1; 3,7] [2.865]	3,7 [3,3; 4,1] [809]
EcoFit cpTi (Implantcast)	682	10	74 (67 - 78)	30/70	13	4	82	5,2 [3,7; 7,2] [426]	5,7 [4,1; 7,9] [212]		
EcoFit HA (Implantcast)	339	6	73 (64 - 78)	45/55	65	33	2	2,5 [1,3; 4,9] [190]	*2,5 [1,3; 4,9]* [61]		
EXCEPTION (Biomet)	658	9	67 (59 - 74)	50/50	3	40	57	4,9 [3,4; 6,9] [314]	*4,9 [3,4; 6,9]* [60]		
EXCIA (Aesculap)	310	15	72 (64 - 76)	34/66	91	9	0	5,0 [3,0; 8,1] [251]	5,0 [3,0; 8,1] [172]	*5,7 [3,4; 9,2]* [86]	
EXCIA T (Aesculap)	2.501	62	70 (62 - 76)	35/65	37	29	35	3,3 [2,6; 4,1] [1.359]	3,6 [2,9; 4,5] [447]		
EXCIA TL (Aesculap)	1.408	55	70 (62 - 76)	50/50	22	32	46	2,2 [1,5; 3,2] [845]	2,9 [2,0; 4,1] [335]		
Uncemented hip stems											

Table 38 (continued)

Elective total hip arthroplasties								Revision probability by			
Hip stem	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Fitmore (Zimmer)	12.155	174	61 (54 - 68)	45/55	27	30	43	2,1 [1,8; 2,4] (8.181)	2,5 [2,3; 2,9] (4.863)	2,8 [2,4; 3,1] (2.124)	3,1 [2,7; 3,6] (590)
GTS (Biomet)	1.125	23	65 (57 - 72)	39/61	36	7	57	3,7 [2,7; 5,1] (672)	4,5 [3,3; 6,1] (365)	*4,5 [3,3; 6,1]* (128)	
Konusprothese (Zimmer)	833	79	58 (49 - 69)	16/84	8	16	76	2,6 [1,7; 4,0] (644)	3,5 [2,4; 5,1] (448)	4,4 [3,0; 6,4] (265)	*4,4 [3,0; 6,4]* (111)
LCU (Waldemar Link)	1.257	22	67 (60 - 74)	46/54	36	29	35	2,5 [1,7; 3,6] (700)	3,0 [2,0; 4,5] (218)		
M/L Taper (Zimmer)	3.334	20	69 (62 - 74)	41/59	14	17	69	2,5 [2,0; 3,1] (2.322)	3,0 [2,4; 3,7] (1.319)	3,2 [2,6; 3,9] (636)	3,5 [2,8; 4,5] (227)
METABLOC (Zimmer)	574	14	73 (66 - 78)	38/62	88	12	0	2,2 [1,3; 3,8] (471)	2,4 [1,4; 4,2] (298)	*2,8 [1,6; 4,7]* (147)	*2,8 [1,6; 4,7]* (70)
Metafix (Corin)	929	11	73 (65 - 77)	40/60	42	58	0	1,7 [1,0; 2,8] (708)	2,0 [1,2; 3,2] (450)	2,0 [1,2; 3,2] (193)	
METHA (Aesculap)	3.989	132	57 (51 - 63)	48/52	26	34	40	2,7 [2,2; 3,2] (2.754)	3,4 [2,8; 4,1] (1.767)	3,6 [3,0; 4,3] (920)	3,6 [3,0; 4,3] (316)
MiniHip (Corin)	1.204	32	60 (54 - 67)	46/54	56	25	19	2,5 [1,8; 3,6] (784)	3,2 [2,2; 4,5] (438)	3,5 [2,4; 5,1] (167)	
Nanos Schenkelhalsprothese (OHST / Smith & Nephew)	2.766	93	59 (53 - 66)	49/51	19	35	46	2,1 [1,6; 2,7] (2.008)	2,3 [1,8; 3,0] (1.319)	2,6 [2,0; 3,3] (398)	
optimys (Mathys)	6.780	62	64 (57 - 72)	44/56	7	26	67	1,7 [1,4; 2,1] (4.031)	1,9 [1,6; 2,3] (1.830)	2,0 [1,6; 2,4] (550)	*2,2 [1,7; 2,8]* (101)
Polarschaft (Smith & Nephew)	6.313	80	69 (62 - 76)	40/60	40	47	12	2,5 [2,1; 2,9] (3.958)	2,9 [2,5; 3,4] (1.946)	3,2 [2,6; 3,8] (658)	3,4 [2,7; 4,2] (158)
Proxy PLUS Schaft (Smith & Nephew)	693	22	69 (62 - 75)	44/56	54	39	7	3,5 [2,4; 5,2] (546)	4,4 [3,0; 6,3] (339)	*4,7 [3,2; 6,7]* (128)	
Pyramid (Atesos)	1.668	21	71 (63 - 77)	36/64	17	62	21	2,7 [2,0; 3,6] (1.193)	3,5 [2,6; 4,6] (667)	3,5 [2,6; 4,6] (203)	
QUADRA (Medacta)	3.399	42	68 (61 - 76)	37/63	9	61	29	2,4 [1,9; 3,0] (1.836)	2,8 [2,2; 3,5] (688)	*2,8 [2,2; 3,5]* (85)	
SBG-Schaft (Smith & Nephew)	348	7	72 (65 - 78)	34/66	23	77	0	5,4 [3,5; 8,5] (259)	5,8 [3,7; 9,0] (166)	*7,2 [4,6; 11,0]* (86)	
SL-PLUS Schaft (Smith & Nephew)	3.498	51	69 (62 - 75)	36/64	15	60	25	3,4 [2,8; 4,1] (2.681)	4,3 [3,7; 5,1] (1.883)	4,9 [4,2; 5,8] (1.034)	5,3 [4,5; 6,4] (407)
SL MIA Schaft (Smith & Nephew)	2.726	44	71 (63 - 77)	36/64	34	60	5	2,4 [1,8; 3,0] (1.816)	2,7 [2,2; 3,5] (1.030)	3,0 [2,3; 3,8] (489)	3,0 [2,3; 3,8] (195)
SP-CL (Waldemar Link)	1.491	34	65 (57 - 71)	37/63	17	14	69	4,7 [3,7; 6,0] (901)	5,1 [4,0; 6,5] (376)	*5,5 [4,2; 7,1]* (54)	
SPS Evolution (Symbios)	460	11	64 (57 - 71)	44/56	51	16	33	2,2 [1,2; 4,1] (275)	*2,2 [1,2; 4,1]* (135)		
Taperloc (Biomet)	1.936	22	69 (61 - 76)	36/64	38	30	32	2,5 [1,8; 3,3] (1.273)	3,3 [2,5; 4,3] (600)	3,3 [2,5; 4,3] (180)	
TAPERLOC COMPLETE (Biomet)	1.640	12	66 (59 - 74)	43/57	2	2	96	1,8 [1,3; 2,6] (997)	1,8 [1,3; 2,6] (492)		

Table 39: Implant results for hip stems in elective primary total hip arthroplasty. For each type of fixation (uncemented, cemented) hip stems are listed alphabetically.

Elective total hip arthroplasties								Revision probability by			
Hip stem	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented hip stems											
TRENDHIP L (Aesculap)	857	30	69 (61 - 76)	55/45	24	20	56	2,1 [1,3; 3,4] [457]	2,5 [1,5; 4,1] [264]	*2,5 [1,5; 4,1]* [110]	
TRENDHIP S (Aesculap)	1.763	35	70 (63 - 77)	31/69	50	26	24	2,1 [1,5; 2,9] [927]	2,3 [1,6; 3,2] [489]	2,3 [1,6; 3,2] [172]	
TRILOCK®-Hüftschaft (DePuy)	2.273	34	61 (54 - 67)	46/54	6	48	46	2,2 [1,6; 2,9] [1.711]	2,7 [2,1; 3,5] [1.083]	3,5 [2,6; 4,6] [454]	*4,1 [3,0; 5,7]* [97]
TRJ (Aesculap)	477	22	71 (62 - 77)	36/64	55	39	6	1,8 [0,9; 3,5] [345]	2,1 [1,1; 4,1] [237]	*2,6 [1,4; 5,0]* [121]	
twinSys (Mathys)	2.288	34	73 (66 - 78)	37/63	23	29	48	2,1 [1,6; 2,8] [1.530]	2,7 [2,1; 3,5] [917]	3,1 [2,4; 4,1] [539]	3,1 [2,4; 4,1] [246]
Cemented hip stems											
ABG II Stem (Stryker)	413	11	79 (76 - 82)	22/78	18	23	59	3,3 [1,9; 5,6] [260]	4,3 [2,5; 7,2] [153]	*5,0 [2,9; 8,5]* [53]	
AS PLUS Schaft (Smith & Nephew)	537	19	79 (76 - 83)	22/78	17	80	0	3,7 [2,4; 5,8] [368]	4,0 [2,6; 6,2] [221]	*4,0 [2,6; 6,2]* [64]	
Avenir (Zimmer)	983	54	79 (75 - 83)	23/77	37	25	36	3,1 [2,1; 4,4] [582]	3,6 [2,5; 5,2] [299]	*3,6 [2,5; 5,2]* [123]	
Bicana (Implantcast)	344	16	78 (75 - 81)	29/71	10	77	1	3,6 [2,0; 6,2] [293]	4,3 [2,6; 7,1] [249]	4,7 [2,8; 7,7] [182]	
BICONTACT H (Aesculap)	498	42	79 (76 - 83)	34/66	29	61	11	2,7 [1,6; 4,7] [340]	3,1 [1,8; 5,3] [204]	*3,1 [1,8; 5,3]* [100]	
BICONTACT S (Aesculap)	1.796	72	79 (76 - 83)	22/78	40	43	17	2,1 [1,6; 3,0] [1.346]	2,3 [1,7; 3,2] [854]	2,6 [1,9; 3,5] [440]	3,1 [2,2; 4,3] [168]
C-STEM AMT-Hüftschaft (DePuy)	374	7	79 (76 - 83)	20/80	9	91	0	1,7 [0,8; 3,7] [265]	2,2 [1,0; 4,6] [160]	*2,2 [1,0; 4,6]* [81]	
CCA (Mathys)	1.009	17	77 (74 - 81)	30/70	22	67	12	2,8 [1,9; 4,0] [825]	3,5 [2,5; 4,9] [606]	3,6 [2,6; 5,1] [349]	4,4 [3,0; 6,2] [209]
CORAIL AMT-Hüftschaft (DePuy)	506	59	79 (74 - 82)	42/58	37	29	34	3,5 [2,2; 5,7] [288]	3,9 [2,4; 6,3] [151]		
CS PLUS Schaft (Smith & Nephew)	841	31	78 (75 - 82)	26/74	16	66	18	1,4 [0,8; 2,4] [546]	1,9 [1,1; 3,4] [340]	*2,9 [1,6; 5,3]* [130]	
EXCIA (Aesculap)	463	25	79 (75 - 82)	27/73	61	39	0	1,1 [0,5; 2,7] [379]	1,4 [0,6; 3,1] [281]	*2,0 [0,9; 4,3]* [140]	
EXCIA T (Aesculap)	807	47	78 (74 - 82)	22/78	49	39	12	2,0 [1,2; 3,2] [415]	2,2 [1,3; 3,6] [190]		
EXCIA TL (Aesculap)	304	34	79 (75 - 83)	28/72	30	44	26	1,0 [0,3; 3,2] [174]	*1,8 [0,6; 5,2]* [105]		
LCP (Waldemar Link)	345	8	81 (78 - 84)	14/86	25	1	74	3,3 [1,9; 6,0] [211]	*3,3 [1,9; 6,0]* [92]	*4,5 [2,3; 8,6]* [58]	
M.E.M. Geradschaft (Zimmer)	11.412	149	78 (75 - 82)	26/74	30	37	32	2,0 [1,8; 2,3] [7.493]	2,2 [2,0; 2,6] [4.171]	2,4 [2,1; 2,8] [1.870]	2,6 [2,2; 2,9] [534]
METABLOC (Zimmer)	1.621	27	79 (75 - 82)	27/73	43	46	11	2,4 [1,7; 3,2] [1.114]	2,5 [1,8; 3,4] [690]	3,0 [2,2; 4,2] [302]	*3,0 [2,2; 4,2]* [77]

Table 39 (continued)

Elective total hip arthroplasties								Revision probability by			
Hip stem	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Cemented hip stems											
MS-30 (Zimmer)	2.423	31	77 (73 - 81)	26/74	13	45	42	1,7 [1,3; 2,3] [1.783]	2,0 [1,5; 2,7] [1.112]	2,4 [1,8; 3,3] [442]	
Müller Geradschaft (Smith & Nephew)	1.041	30	78 (75 - 81)	26/74	14	22	64	2,5 [1,7; 3,8] [745]	2,7 [1,8; 4,0] [424]	2,7 [1,8; 4,0] [187]	
Polarschaft (Smith & Nephew)	1.274	57	79 (76 - 82)	23/77	47	51	2	3,0 [2,1; 4,1] [764]	3,2 [2,3; 4,5] [333]	*3,2 [2,3; 4,5]* [123]	
QUADRA (Medacta)	576	27	79 (76 - 83)	24/76	7	45	48	2,2 [1,3; 3,9] [278]	*2,2 [1,3; 3,9]* [90]		
SPII® Modell Lubinus (Waldemar Link)	6.320	76	77 (74 - 81)	27/73	10	28	62	1,9 [1,5; 2,2] [4.497]	2,4 [2,0; 2,8] [2.718]	2,7 [2,2; 3,2] [1.275]	3,1 [2,5; 3,9] [442]
Standard C Cem (Waldemar Link)	359	4	77 (74 - 81)	30/70	76	3	21	0,6 [0,1; 2,4] [242]	*1,5 [0,6; 4,2]* [128]		
Taperloc Cemented (Biomet)	498	19	79 (75 - 83)	14/86	27	33	40	1,7 [0,8; 3,3] [280]	*2,5 [1,3; 4,9]* [146]		
twinSys (Mathys)	823	26	79 (74 - 82)	24/76	28	35	37	1,9 [1,1; 3,2] [497]	2,4 [1,4; 3,9] [256]	*2,4 [1,4; 3,9]* [126]	

Table 39 (continued)

Elective total hip arthroplasties								Revision probability by			
Acetabular cups	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Uncemented acetabular cups											
Alloclassic (Zimmer)	465	9	70 (60 - 77)	28/72	69	14	17	3,2 [1,9; 5,3] [356]	3,8 [2,3; 6,1] [256]	*3,8 [2,3; 6,1]* [130]	
Alloclassic Variall (Zimmer)	353	11	72 (62 - 77)	35/65	10	69	0	0,7 [0,2; 2,8] [237]	1,3 [0,4; 4,1] [150]	*1,3 [0,4; 4,1]* [80]	
Allofit (Zimmer)	59.289	282	70 (61 - 77)	38/62	25	28	47	2,4 [2,3; 2,6] [39.850]	2,8 [2,7; 3,0] [23.127]	3,0 [2,9; 3,2] [10.171]	3,3 [3,1; 3,5] [2.808]
Allofit IT (Zimmer)	4.526	74	65 (56 - 74)	40/60	42	8	50	2,3 [1,9; 2,8] [3.249]	3,0 [2,5; 3,6] [1.977]	3,2 [2,6; 3,8] [882]	3,3 [2,7; 4,0] [405]
ANA.NOVA® Alpha Pfanne (ImplanTec)	1.729	19	67 (59 - 74)	42/58	11	48	42	2,3 [1,6; 3,2] [895]	2,8 [2,0; 3,9] [368]	*2,8 [2,0; 3,9]* [68]	
ANA.NOVA® Hybrid Pfanne (ImplanTec)	3.249	37	67 (59 - 75)	36/64	36	23	41	2,0 [1,6; 2,6] [1.920]	2,5 [1,9; 3,2] [894]	*2,8 [2,1; 3,8]* [141]	
aneXys Flex (Mathys)	980	30	64 (57 - 73)	46/54	34	41	25	3,0 [2,1; 4,4] [524]	*3,5 [2,4; 5,0]* [135]		
BICON-PLUS (Smith & Nephew)	2.139	44	71 (63 - 77)	37/63	22	73	5	2,3 [1,7; 3,0] [1.769]	3,0 [2,4; 3,9] [1.309]	3,7 [2,9; 4,7] [801]	4,2 [3,2; 5,5] [260]
CombiCup PF (Waldemar Link)	2.038	48	71 (63 - 77)	38/62	33	30	37	2,3 [1,7; 3,1] [1.337]	2,9 [2,2; 3,8] [651]	3,3 [2,5; 4,5] [227]	*3,3 [2,5; 4,5]* [50]
CombiCup SC (Waldemar Link)	675	9	71 (61 - 78)	42/58	66	14	20	2,7 [1,6; 4,3] [418]	3,6 [2,2; 5,6] [213]	*3,6 [2,2; 5,6]* [56]	
DURALOC OPTION Press Fit-Hüftpfanne (DePuy)	958	12	69 (61 - 75)	40/60	22	49	29	3,2 [2,2; 4,5] [792]	3,9 [2,8; 5,4] [572]	3,9 [2,8; 5,4] [255]	
EcoFit cpTi (Implantcast)	418	18	73 (65 - 77)	38/62	57	2	40	4,0 [2,5; 6,4] [315]	5,0 [3,2; 7,7] [206]		
EcoFit EPORE (Implantcast)	579	6	75 (68 - 80)	31/69	4	34	63	3,8 [2,5; 5,8] [279]			
EcoFit NH cpTi (Implantcast)	552	10	72 (64 - 77)	39/61	95	5	0	3,5 [2,3; 5,5] [366]	3,9 [2,5; 6,0] [178]	*5,4 [2,9; 10,1]* [57]	
EL PFANNE (Smith & Nephew)	351	4	71 (63 - 77)	32/68	65	35	0	4,9 [3,1; 7,7] [326]	4,9 [3,1; 7,7] [311]	5,2 [3,3; 8,1] [290]	5,9 [3,9; 9,1] [153]
EP-FIT PLUS (Smith & Nephew)	2.615	54	70 (61 - 76)	43/57	49	49	3	2,8 [2,2; 3,5] [2.084]	3,3 [2,7; 4,1] [1.307]	3,4 [2,7; 4,2] [508]	*3,4 [2,7; 4,2]* [125]
Exceed (Biomet)	335	9	72 (63 - 77)	34/66	75	17	8	2,7 [1,4; 5,1] [313]	3,3 [1,9; 5,9] [298]	3,3 [1,9; 5,9] [181]	
Fitmore (Zimmer)	614	12	68 (59 - 75)	35/65	51	5	44	2,1 [1,2; 3,7] [441]	2,6 [1,5; 4,4] [229]	*3,6 [2,1; 6,1]* [77]	
G7 (Biomet)	1.821	17	71 (62 - 77)	34/66	34	25	40	2,7 [2,0; 3,6] [1.127]	3,5 [2,7; 4,7] [511]	*3,5 [2,7; 4,7]* [101]	
HI Lubricer Schale (Smith & Nephew)	3.318	30	71 (62 - 77)	35/65	24	40	36	2,7 [2,2; 3,3] [2.203]	3,3 [2,7; 4,0] [1.308]	3,6 [2,9; 4,5] [516]	*4,4 [3,2; 6,2]* [127]
PINNACLE Press Fit-Hüftpfanne (DePuy)	20.728	151	70 (61 - 76)	38/62	30	30	40	2,5 [2,3; 2,8] [13.373]	3,1 [2,8; 3,3] [7.294]	3,3 [3,0; 3,6] [2.745]	3,7 [3,3; 4,1] [744]
Uncemented acetabular cups											

Table 39 (continued)

Elective total hip arthroplasties								Revision probability by			
Acetabular cups	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
PINNACLE SPIROFIT-Schraubpfanne (DePuy)	416	17	75 (66 - 79)	26/74	51	37	12	3,7 [2,2; 6,1] (331)	4,0 [2,5; 6,5] (213)	*4,6 [2,8; 7,4]* (132)	
PLASMACUP DC (Aesculap)	744	10	66 (56 - 75)	30/70	11	40	50	3,1 [2,1; 4,7] (626)	3,5 [2,4; 5,1] (482)	3,7 [2,5; 5,4] (275)	*4,5 [3,0; 6,6]* (102)
PLASMACUP delta (Aesculap)	328	18	61 (55 - 67)	58/42	12	75	12	0,6 [0,2; 2,5] (227)	*0,6 [0,2; 2,5]* (143)	*0,6 [0,2; 2,5]* (79)	
PLASMACUP SC (Aesculap)	3.904	36	70 (62 - 76)	39/61	18	47	35	2,0 [1,6; 2,5] (2.956)	2,5 [2,1; 3,1] (2.028)	2,6 [2,1; 3,2] (1.062)	2,8 [2,2; 3,6] (356)
PLASMAFIT PLUS (Aesculap)	11.252	133	69 (60 - 76)	40/60	34	46	20	3,0 [2,7; 3,3] (7.595)	3,4 [3,1; 3,8] (4.303)	3,6 [3,3; 4,0] (1.988)	3,7 [3,3; 4,2] (518)
PLASMAFIT POLY (Aesculap)	8.944	92	70 (61 - 76)	39/61	26	27	47	2,8 [2,4; 3,1] (5.057)	3,1 [2,7; 3,5] (2.422)	3,2 [2,8; 3,7] (543)	*3,2 [2,8; 3,7]* (74)
PROCOTYL® L BEADED (MicroPort)	445	16	68 (59 - 75)	38/62	23	75	2	2,7 [1,5; 4,9] (273)	*3,5 [2,0; 6,0]* (141)		
Pyramid (Atesos)	1.695	21	71 (64 - 77)	36/64	16	62	22	2,7 [2,0; 3,6] (1.213)	3,5 [2,7; 4,6] (679)	3,5 [2,7; 4,6] (204)	
R3 (Smith & Nephew)	7.629	91	70 (62 - 77)	39/61	37	44	18	3,1 [2,7; 3,5] (4.385)	3,3 [2,9; 3,8] (1.975)	3,6 [3,1; 4,2] (590)	*4,6 [3,2; 6,5]* (103)
REFLECTION (Smith & Nephew)	663	8	68 (59 - 75)	37/63	1	44	55	2,0 [1,2; 3,4] (444)	2,5 [1,5; 4,1] (294)	*2,8 [1,7; 4,6]* (53)	
RM Classic (Mathys)	1.320	16	75 (68 - 79)	30/70	34	19	48	2,9 [2,1; 4,0] (1.078)	3,4 [2,5; 4,6] (821)	3,8 [2,8; 5,1] (425)	4,4 [3,2; 6,1] (209)
RM Pressfit (Mathys)	805	11	74 (67 - 79)	40/60	5	20	75	2,5 [1,6; 3,9] (592)	2,9 [1,9; 4,4] (349)	2,9 [1,9; 4,4] (156)	
RM Pressfit vitamys (Mathys)	6.034	52	68 (60 - 76)	40/60	9	29	62	1,7 [1,4; 2,0] (3.587)	2,0 [1,6; 2,4] (1.748)	2,3 [1,9; 2,9] (635)	*2,5 [1,9; 3,2]* (131)
SCREWCUP SC (Aesculap)	1.203	47	72 (63 - 77)	36/64	53	43	4	2,4 [1,7; 3,5] (754)	3,0 [2,0; 4,3] (410)	3,6 [2,4; 5,2] (202)	*3,6 [2,4; 5,2]* (64)
seleXys PC (Mathys)	364	6	70.5 (61 - 76)	40/60	24	76	0	1,1 [0,4; 3,0] (256)	*1,1 [0,4; 3,0]* (136)		
T.O.P. Hüftpfannensystem (Waldemar Link)	336	8	62 (56 - 69)	50/50	4	14	82	2,4 [1,2; 4,8] (304)	2,7 [1,4; 5,2] (267)	2,7 [1,4; 5,2] (191)	*2,7 [1,4; 5,2]* (135)
TM Modular (Zimmer)	723	81	63 (53 - 73)	27/73	21	30	48	6,2 [4,6; 8,3] (486)	7,4 [5,6; 9,7] (296)	*7,4 [5,6; 9,7]* (147)	
Trident Cup (Stryker)	2.904	47	70 (61 - 77)	40/60	31	39	30	3,0 [2,4; 3,7] (1.591)	3,7 [3,0; 4,6] (840)	4,1 [3,2; 5,1] (289)	
Trident TC Cup (Stryker)	747	15	73 (65 - 78)	32/68	25	30	44	2,7 [1,8; 4,2] (662)	3,4 [2,3; 5,0] (505)	*4,0 [2,7; 6,0]* (135)	
Trilogy (Zimmer)	3.935	22	68 (60 - 75)	37/63	15	44	41	1,9 [1,5; 2,4] (3.016)	2,5 [2,0; 3,0] (1.998)	2,8 [2,2; 3,4] (1.021)	3,1 [2,4; 3,8] (439)
Trilogy IT (Zimmer)	871	5	71 (62 - 77)	38/62	5	95	0	2,9 [1,9; 4,3] (625)	3,3 [2,2; 4,8] (420)	3,7 [2,5; 5,7] (183)	
Trinity Hole (Corin)	1.089	31	65 (57 - 74)	42/58	74	23	3	1,8 [1,2; 2,9] (777)	2,0 [1,3; 3,0] (455)	2,0 [1,3; 3,0] (181)	
Uncemented acetabular cups											

Table 40: Implant results for acetabular components in elective primary total hip arthroplasty. For each type of fixation (uncemented, cemented) acetabular component are listed alphabetically.

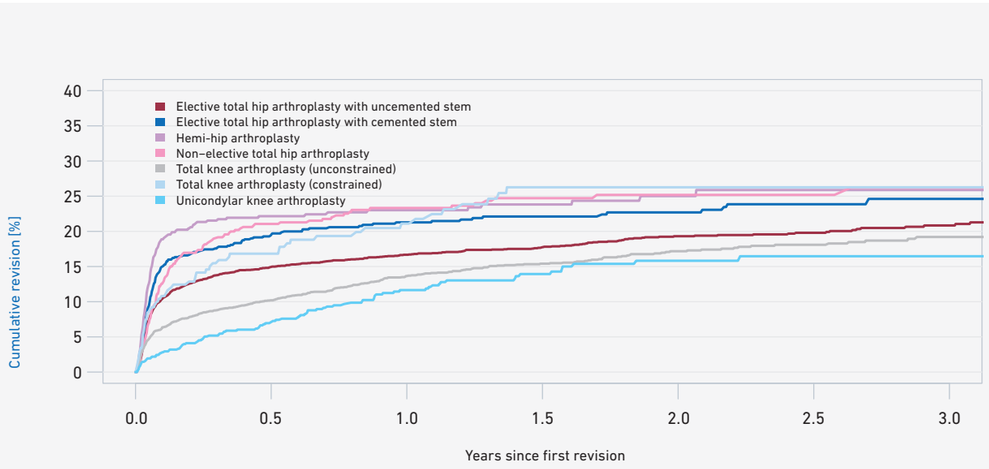
Elective total hip arthroplasties								Revision probability by			
Acetabular cups	Number	Hospitals	Age	m/f	%L	%M	%H	1 year	2 years	3 years	4 years
Trinity no Hole (Corin)	1,627	17	70 (61 - 76)	39/61	28	42	30	2.2 [1.6; 3.0] [1,164]	2.7 [2.0; 3.7] [746]	3.0 [2.2; 4.2] [336]	
Tritanium Cup (Stryker)	925	19	69 (62 - 76)	42/58	22	73	4	2.1 [1.3; 3.2] [628]	2.2 [1.4; 3.5] [325]	*3.3 [2.1; 5.4]* [116]	
VERSAFITCUP CC TRIO (Medacta)	4,326	43	70 (61 - 77)	36/64	10	60	29	2.5 [2.0; 3.0] [2,315]	2.8 [2.3; 3.4] [876]	*2.8 [2.3; 3.4]* [99]	
Cemented acetabular cups											
ALL POLY CUP STANDARD (Aesculap)	2.266	109	79 (75 - 83)	23/77	50	35	15	2,2 [1,7; 3,0] [1.563]	2,6 [2,0; 3,4] [980]	2,9 [2,2; 3,8] [480]	2,9 [2,2; 3,8] [172]
CCB (Mathys)	418	30	79 (74 - 82)	22/78	64	30	6	3,1 [1,8; 5,4] [277]	3,5 [2,0; 5,9] [156]	*3,5 [2,0; 5,9]* [70]	
Endo-Modell Mark III (Waldemar Link)	504	6	76 (72 - 81)	19/81	0	2	98	1,6 [0,8; 3,2] [446]	2,1 [1,1; 3,8] [379]	2,6 [1,5; 4,6] [307]	3,0 [1,7; 5,2] [215]
Flachprofil (Zimmer)	4.380	204	79 (75 - 83)	24/76	30	33	35	2,5 [2,1; 3,1] [2.972]	2,9 [2,4; 3,5] [1.825]	3,5 [2,8; 4,2] [798]	3,5 [2,8; 4,2] [235]
IP-Hüftpfannen, X-Linked (Waldemar Link)	613	17	80 (77 - 83)	27/73	9	72	19	2,4 [1,4; 4,1] [417]	3,2 [2,0; 5,1] [248]	*3,2 [2,0; 5,1]* [90]	
Kunststoffpfanne Modell Lubinus (Waldemar Link)	605	26	78 (74 - 82)	25/75	14	19	67	1,6 [0,8; 3,0] [444]	1,8 [1,0; 3,4] [249]	*2,3 [1,2; 4,2]* [124]	*2,3 [1,2; 4,2]* [51]
Müller II Pfanne (Smith & Nephew)	1.760	79	79 (76 - 83)	23/77	29	64	7	2,1 [1,5; 2,9] [1.273]	2,9 [2,1; 3,9] [743]	3,8 [2,7; 5,3] [300]	
TRILOC® II-PE-Hüftpfanne (DePuy)	746	66	79 (74 - 83)	21/79	42	35	23	2,3 [1,4; 3,7] [537]	2,3 [1,4; 3,7] [332]	*3,1 [1,8; 5,1]* [117]	

Table 40 (continued)

5.3 Re-revision probability of hip and knee arthroplasties

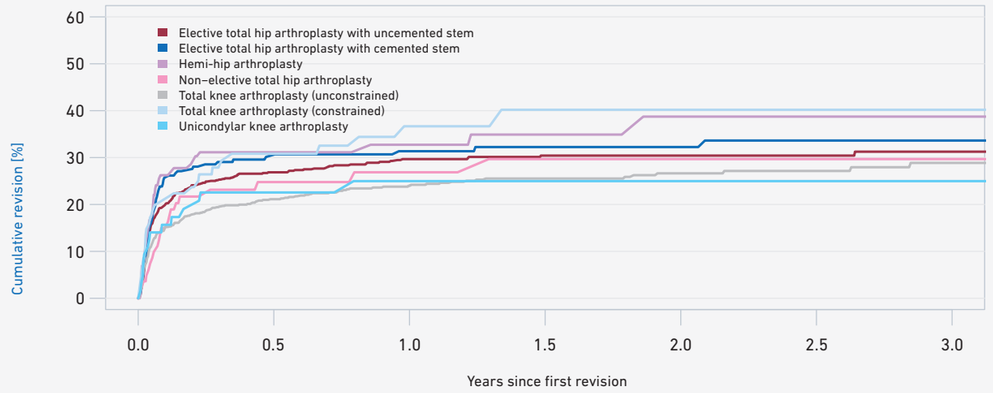
Analyses performed so far in this and previous year's reports have focused on quantifying the arthroplasty revision probability, as a function of the time elapsed since the primary arthroplasty. The EPRD has now established a database of almost 400,000 primary arthroplasties under observation, cross-referenced to several health insurance funds' databases. Owing to the fact that at least 11,000 of these arthroplasties have now undergone one or more revisions, this dataset has become sufficiently large to start addressing the most pressing question that is not only relevant to patients but also to the wider arthroplasty community, namely, how likely is an arthroplasty that has already undergone a first revision require re-revision?

As shown in the following graphs, the probability of a second revision is significantly higher than the probability of a first revision after a primary arthroplasty. This can be illustrated in general terms: While approximately 11,000 out of a total of 400,000 primary arthroplasties were eventually revised, 1,800 of these 11,000 revisions – i.e. about every sixth patient – required at least one other second revision. The percent of re-revisions expressed as a proportion of primary revisions is therefore significantly higher than the percent of first revisions relative to total primary arthroplasties.



Procedures under observation							
4.190	2.835	2.195	1.588	1.066	669	377
917	573	427	313	223	136	66
737	335	227	157	97	54	26
602	354	255	183	121	76	47
3.357	2.336	1.680	1.187	765	466	265
264	174	123	82	56	33	18
836	593	419	261	161	102	51

Figure 26: Probabilities of a second revision by type of primary arthroplasty over time



Procedures under observation							
853	477	351	243	152	96	54
234	126	99	64	50	34	12
178	62	38	21	15	10	5
86	46	28	24	20	13	8
861	519	381	264	176	112	62
82	45	28	14	10	5	2
65	38	23	10	8	4	2

Figure 27: Probabilities of a second revision after revision for infection by type of primary arthroplasty over time

To address this question in more detail we need to consider different scenarios. The probability of a second revision is contingent on the type of primary arthroplasty. Figure 26 plots the probability of a second revision for all 11,000 revisions under observation by type of primary arthroplasty over time[10].

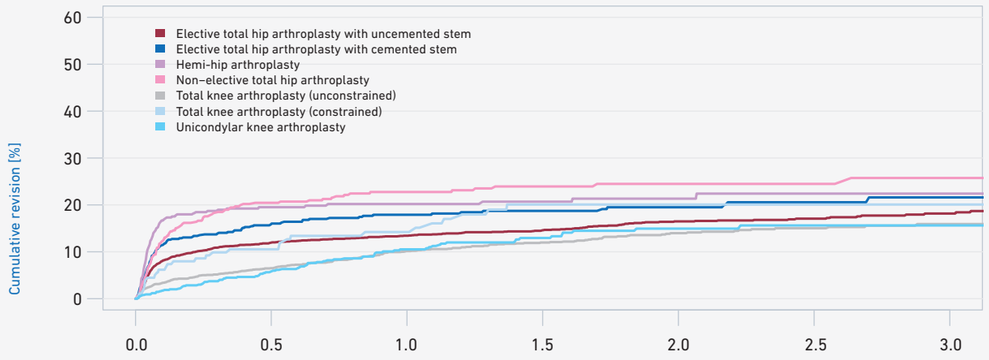
Two years after the primary arthroplasty, the overall probabilities of a second revision ranges from 15.8 to 26.3%, depending on the type of primary arthroplasty. Unicondylar knee arthroplasties and *unconstrained* total knee arthroplasties have the lowest second revision probabilities with 15.8% and 17.2% of revisions necessitating a second revision, respectively. While hemi-hip and non-elective total hip arthroplasties as well as *constrained* total knee arthroplasties exhibit the highest probability of second revision. In the case of hip arthroplasties in particular, there is a sharp increase in the probability of second revision immediately after the first revision.

We observed a large range of probabilities for the second revision depending on the reason for the first revision. Figures 27 and 28 plot the probabilities of second revision, performed due to infection or other reasons, by type of primary arthroplasty

10 For the purposes of this section the removal and the subsequent re-implantation of new arthroplasty components as part of a two-stage revision are considered to constitute one single revision event. The timing of this revision event is defined as the time recorded at the re-implantation of new arthroplasty components.

over time[11].

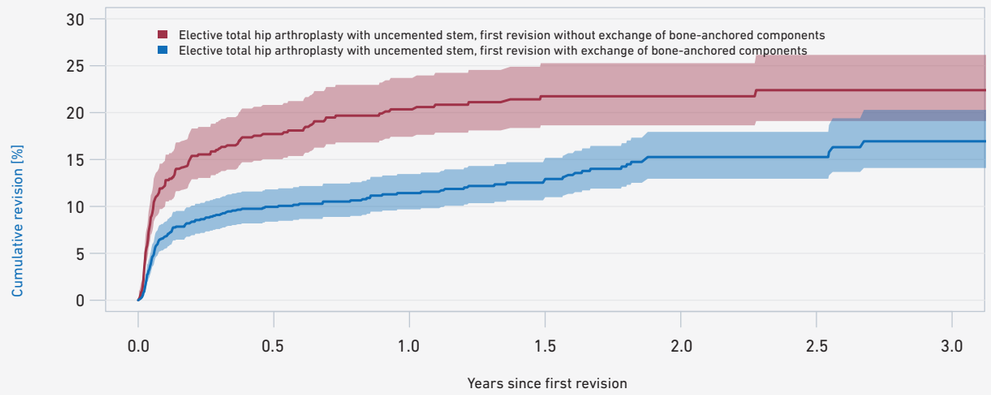
At two years from the primary arthroplasty, the probability of a second revision after a first revision due to infection is between 25.0% and 40.2% depending on the type of primary arthroplasty (see Figure 27). This is compared to the probability of a non-infection-related second revision which ranges from 14.0% to 24.5% and is therefore considerably lower than the revision for infection even though it still represents a relatively frequent event (see Figure 28). After a revision for infection an even more pronounced increase in the probability of a re-revision is observed within the first few weeks after the primary revision.



Procedures under observation							
3.337	2.358	1.844	1.345	914	573	323
683	447	328	249	173	102	54
559	273	189	136	82	44	21
516	308	227	159	101	63	39
2.496	1.817	1.299	923	589	354	203
182	129	95	68	46	28	16
771	555	396	251	153	98	49

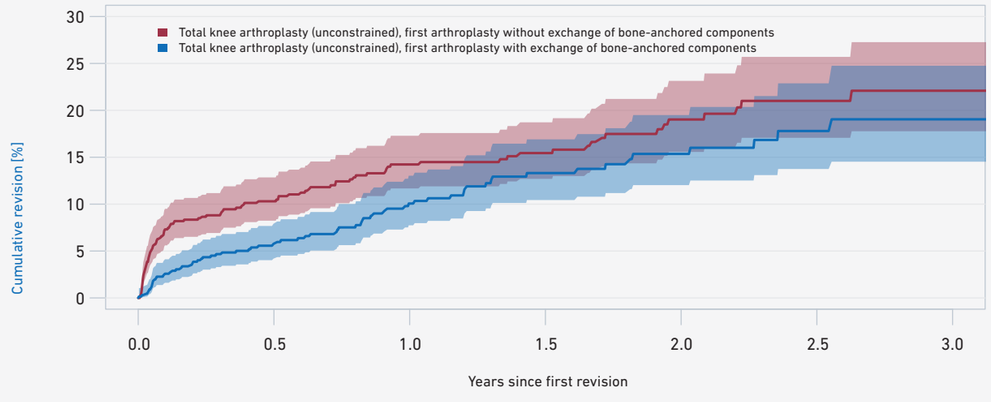
Figure 28: Probabilities of a second revision after a revision not due to infection by type of primary arthroplasty over time

11 The clinics' data on the reason for the revision are used to determine whether or not an infection was present. However, if no reason for the revision is given, e.g. because the revision was not carried out in a clinic participating in the EPRD and the reason only emerged from the routine health insurance funds' data, the main diagnosis stated in the latter was considered decisive. If the routine data lists the revision as T84.5 (infection and inflammatory reaction due to a joint arthroplasty), it is surmised that the revision was required because of an infection.



Procedures under observation							
712	451	337	236	166	92	40
1.241	867	635	443	292	173	96

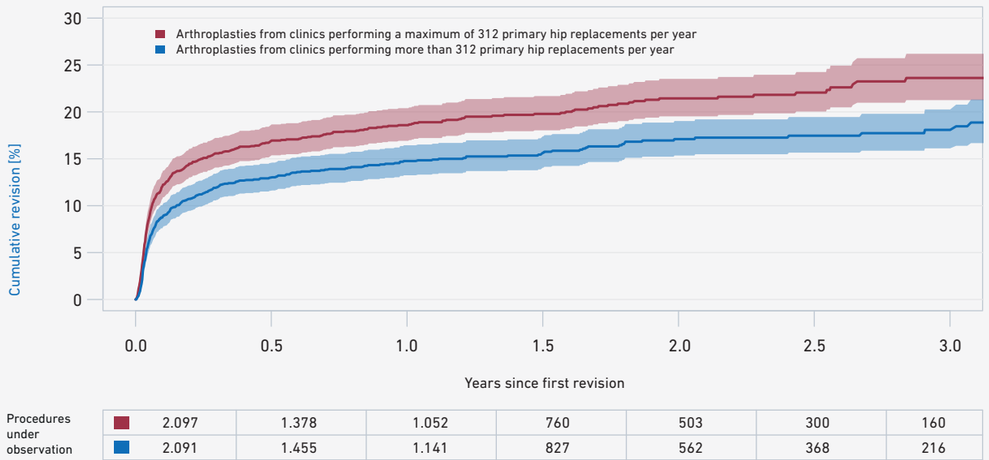
Figure 29: Probabilities of second revision after exchange of bone-anchored or non-bone-anchored components of an elective total hip arthroplasty with an uncemented stem



Procedures under observation							
714	497	344	237	146	87	45
681	474	329	215	134	71	32

Figure 30: Probabilities a second revision after exchange of bone-anchored or non-bone-anchored components for elective unconstrained total knee arthroplasties

Data from the approximately 11,000 primary revisions is documented directly in the registry and is also sourced from health insurance funds' billing details[12]. This means that all individual item numbers can be cross-checked to determine exactly which components were replaced during the revision[13]. These data are used to investigate the two most frequently documented types of arthroplasties in the EPRD, namely elective total hip arthroplasties with uncemented stems and *unconstrained* total knee arthroplasties in order to determine whether any differences in second revision probabilities are observed when bone-anchored components – i.e. stem and acetabular components in the case of hip arthroplasties and femoral/tibial components in the case of knee arthroplasties – or non-bone-anchored components are exchanged during the primary revision. As illustrated in Figures 29 and 30 distinct trends can be observed: The probability of second revision is somewhat increased, at least during the initial period following the primary revision, when a bone-anchored component was not exchanged during the primary revision. This tendency persists when primary revisions are subdivided into infection-related or non-infection-related causative events.

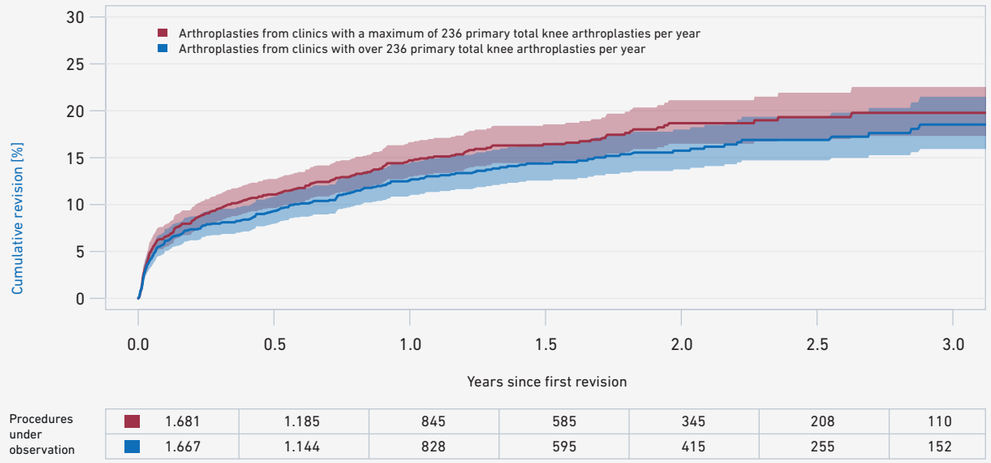


Procedures under observation							
2.097	1.378	1.052	760	503	300	160
2.091	1.455	1.141	827	562	368	216

Figure 31: Probabilities of a second revision following elective total hip arthroplasty with an uncemented stem by clinic volume. Arbitrarily subdivided into two groups of approximately equal size based on the OPS frequencies listed in the latest quality report of the clinic.

12 The OPS codes, acquired from routine health insurance funds' data, are also available for revisions. In practice, however, this data does not automatically provide conclusive information about the replaced components.

13 Provided that re-implanted components figure in the product database.



Procedures under observation							
1.681	1.185	845	585	345	208	110
1.667	1.144	828	595	415	255	152

Figure 32: Probabilities of a second revision following primary elective unconstrained total knee arthroplasty by clinic volume. Arbitrarily subdivided into two groups of approximately equal size based on the OPS frequencies listed in the latest quality report of the clinic.

To derive a general recommendation from this observation, namely that bone-anchored components should be systematically exchanged during revisions, seems too narrow: A revision which leaves bone-anchored components untouched, is a less invasive intervention for the patient and, depending on the reason for the revision, may also offer the opportunity to permanently resolve the underlying problem. The feasibility of not replacing a bone-anchored component during a primary revision should at least be explored objectively to avoid any potential future re-operations.

It has already been pointed out elsewhere in this report that the institutional experience of individual clinics can have a major impact on the success of an arthroplasty. Primary arthroplasties performed by experienced clinics, i.e. clinics that perform a greater number of arthroplasties per year, are generally less likely to require revision (see section 5.1.3). The extent to which the probability of a re-revision depends on the clinic's experience was also examined using two different approaches. We initially considered the impact of the level of experience of the clinic performing the primary revision on the probability of the arthroplasty requiring a second revision. We subsequently also analysed how the level of experience of the clinic which performed the primary arthroplasty influenced the probability of a re-revision. Both approaches indicated that the more experienced clinics, which performed a larger relative volume of primary arthroplasties and revisions per year, achieved better results. This trend was more pronounced for total hip arthroplasties with uncemented stems than for elective unconstrained total knee arthroplasties. Figures 31 and 32 illustrate that the level of experience of the clinic performing the

primary arthroplasty had the greatest impact on the probability of a re-revision. This may be attributed to the fact that a large volume of primary revisions is performed by the same clinic that carried out the primary arthroplasty, but it also underlines the fundamental importance of the primary arthroplasty on the overall outcome of the arthroplasty.

In summary

Probabilities of a second revision within 3 years of the primary revision...

- 25-40% after periprosthetic joint infection
- 14-25% not infection-related
- tend to be lower when bone-anchored components are replaced as part of the first revision

6 Results in international comparison

Data from a number of regional and national registries have contributed significantly to further characterise the clinical picture of hip and knee arthroplasty, over many years. The general pertinence of the data contributed by these registries is therefore uncontested. This is especially relevant since similar types of arthroplasties are performed almost everywhere in the world and because most of the implants used are in fact identical. A relatively young registry such as the EPRD, which contrary to various other international registries cannot yet draw on decades of retrospective data, can nevertheless provide important insights by considering data obtained in other countries.

However, as already stated in this and previous EPRD annual reports, any comparisons based on data from different registries requires a great deal of stringency in order to avoid any misinterpretations. With all the commonalities shared between arthroplasty registries worldwide, it should not be forgotten that there are sometimes fundamental differences between them, both in terms of external circumstances such as the prevailing type of procedure and the underlying healthcare systems, as well as the nature of data recorded in the registries and the definitions applied.

The example of a total knee arthroplasty can be used to illustrate potential problems that may arise when comparing data from different registries and why this type of data is not directly transferable from one registry to another. Firstly, there are obvious differences in general arthroplasty practices between countries: Even though cementing practices for total knee arthroplasties performed in different countries comply to the same international standards, in other aspects, such as whether or not patellar resurfacing is performed at the same time as the primary arthroplasty for instance, there are distinct differences between countries or rather registries (see Section 6.2). Definition-related deviations between registries should also be highlighted: The EPRD does not, for instance, define resurfacing of the patella, which is required after a primary arthroplasty, as a revision but rather as a complementary operation. This is in contrast to other registries, such as the NJR, that classify this type of scenario as a revision. If the EPRD were to apply the same definition as the British NJR, the revision probability of an *unconstrained* total knee arthroplasty, three years after the primary replacement would be approximately one percent higher i.e. 4.2% instead of the 3.3% shown in Figure 12.

Remarkably, despite this difference between the definitions applied, the British NJR reports revision probabilities for unconstrained total knee arthroplasties below the 2% mark, which is considerable lower than the corresponding EPRD result [2]. If variations in definitions are ignored, revision probabilities for unconstrained total knee arthroplasties reported by the American AJRR and the Swedish SKAR are approximately 2% or just over, while the Australian AOANJRR reported a 2.7% figure. The Dutch LROI registry was the only registry examined that reported a revision probability exceeding 3%, which is similar to the EPRD figure [3-6]. A key factor underpinning the validity of the data is the depth of coverage, both with regards to the primary arthroplasty but even more so in relation to the revision. Such inter-registry differences require further consideration. The EPRD, specifically restricts the survival analysis of arthroplasty components

to its patient population for which routine data is available (previously discussed in Chapter 3). This ensures close to complete coverage in terms of revisions. It is reasonable to assume that many other factors – such as whether or not there is a waiting list for elective surgery or whether the patient can be operated immediately, should a problem arise – contribute to these often very different results for what appears, at first glance, to be a very similar operation. Different reimbursement schemes may also influence the number of revisions performed or at least the timing of revisions by offering targeted restrictions or incentives. Ultimately, the only thing that can be surmised is that a direct comparison of absolute revision probabilities between registries would not appear to be generally useful.

The following example serves to illustrate that caution is also called for when transferring emerging trends from one registry to another, even if these trends are considered relative to their own overall contexts: Like the EPRD (see Section 5.1.3), the Dutch LROI examines the influence of patient age and sex on the probability of revision [6]. There is a good agreement, particularly in relation to total knee arthroplasties, in terms of how correlations are established: Indeed, both registries show a significantly increased revision probability for younger age groups. While the Dutch registry also reports the same trend for total hip arthroplasties, this is in complete contrast to the EPRD data. The EPRD reveals that patients aged 75 and older have the highest total hip replacement revision probability. This deviation is all the more remarkable because Germany and the Netherlands share comparatively similar mainstream hip arthroplasty practices.

The following sections specifically deal with individual aspects of hip and knee arthroplasties and compare data extracted from the last published annual report of each of the respective registries considered. This means that all comparisons relate to procedures carried out during the 2017 calendar year. Where arthroplasty details from the different registries could not be attributed to a specific arthroplasty category in the tables, they were generalised over several corresponding categories. If no comparable data could be obtained from a given registry, that registry was excluded from the comparison.

6.1 Hip arthroplasty-international comparison

Note!

Data from international registries are not directly comparable due to differences in structure, scoring methodology and public health care systems.

There is an extremely large variability internationally around the fundamental preference for cemented, partially cemented and uncemented hip arthroplasties. While the proportion of completely uncemented arthroplasties in the EPRD for 2018 was 78.6% (see also Table 6), which is rather high by international standards, in Sweden this type of fixation is still the exception rather than the rule. However, the annual Swedish SHAR hip registry report highlights that since the turn of the millennium the annual proportion of fully uncemented arthroplasties has steadily increased from 2% to 24%. Indeed, in the patients younger than 60 years, the proportion of completely uncemented arthroplasties is to date significantly higher than the proportion of (partially) cemented arthroplasties. The SHAR expresses concern that Swedish patients over the age of 70 are also increasingly receiving uncemented replacements even though this trend is not based on any explicit clinical evidence [7]. At this juncture, it should be noted that the EPRD data indicates that the probability of revision in the 75+ age group is also significantly lower for cemented stem (compare Chapter 5.1.1 Figure 5) than for uncemented stems.

	Australia [%]	Germany [%][14]	NJR [%]	Netherlands [%]	Sweden [%]	US [%]
Uncemented	63	79	38	65	24	95
Hybrid, reverse	-	1	3	4	10	
Cemented	3	5	28	26	60	5
Hybrid	35	15	30	5	5	

Table 41: An international comparison of bone-fixation in total hip arthroplasty

Despite the fact that the (North) American AJRR registry is still far removed from a full national coverage compared to the EPRD, it is still worth considering prevailing AJRR trends. It is safe to assume that the 95% prevalence of uncemented stems reported in the US, makes America the absolute worldwide leader for this type of arthroplasty. It concerns 95% of 70 and 79-year-old patients and some two thirds of 80+ year old patients. This represents yet another peculiar feature resulting from international comparisons. The American data also tends to show a lower revision probability for uncemented stems in all age groups considered, with the notable exception of women in the over 80 age group, where the trend is reversed [3].

An interesting trend is also observed in the world's largest registry, the NJR, in terms of primary hip arthroplasty fixation. The proportion of completely uncemented and fully cemented arthroplasties has tended to decrease in recent years in favour of hybrid arthroplasties. Arthroplasties consisting of a cemented stem opposed to a non-cemented cup have recently increased to 30% in the NJR, only to be surpassed by Australia where these types of arthroplasties represent a 35% share [2, 5]. Hybrid arthroplasties in particular tend to show lower revision probabilities compared to completely uncemented arthroplasties in the Australian registry. When considering different age groups, however, there is no significant difference in the revision probabilities by type of fixation for younger patients, which is consistent with the EPRD data (also refer to Figure 6). In the older age groups, hybrid, followed by fully cemented replacements tend to have lower revision probabilities compared to uncemented arthroplasties [5]. The British NJR also confirms the higher revision probabilities for uncemented components five years after the primary arthroplasty. But the relatively high proportion of "metal-on-metal" tribological bearings that are still under observation may influence this result. These

14 The EPRD also takes into account arthroplasties resulting from femoral neck fractures. Other registries do not include trauma surgery.

types of tribological bearings were well represented in some countries during the first decade of the 21st century, but have now almost completely disappeared from the market because of their generally increased revision probabilities.
As a general trend throughout the registries considered the use of fully cemented hip arthroplasties continues to decline in favour of partially cemented systems. What should be discussed is therefore which patients would benefit most from fully cemented or hybrid systems.
The proportion of different component head sizes used also illustrates the disparity of approaches implemented in individual countries: In Europe, and particularly in Germany and Sweden, the 32 mm head is still the overriding standard, while very small or very large heads are rarely or not at all used [7]. The proportion of 36 mm head sizes in the EPRD is approximately 37%, which is the highest when compared across the other European registries. In the US, however, the 36-mm head component is used in 58% of all primary total hip arthroplasties and continues to be the most frequently used size, with more extreme head sizes such as 40 mm also gaining market share. It is interesting to note that there is a general trend in the US towards more extreme sizes, with head components of less that 28 mm also increasing in popularity. The AJRR interprets this observation to reflect the increasing use (around 10% in 2017) of dual mobility systems. According to the AJRR, after a three-year observation period, 32 mm and 36 mm head sizes correlated with an approximately 3% lower revision probability compared to smaller or larger head sizes which yielded revision probabilities of around 5% [3]. No registry provides a general answer to the question of which head diameter is the "best".
With regards to head component materials, ceramics occupy first place in Germany with a share of 88% of all total hip arthroplasties (also refer to Table 13). This trend is also reflected internationally. Over the past five years, the proportion of ceramic heads recorded in the NJR and the Swedish registry also increased but at 42% and 32%, respectively, it still represents a relative smaller proportion of arthroplasties in these countries [2, 7]. The report by the Dutch LROI explicitly records the proportion of ceramicised metal head components. At 7%, their share is approximately 2-fold greater than that reported in the latest EPRD data [6].
The proportion of purely ceramic tribological bearings recorded in the NJR and the EPRD is still relatively high at 9%, even if it has tended to decrease over recent years [2].

	Germany [%]	Netherlands [%]	Sweden[15] [%]	US [%]
< 28 mm	0	17	<1	14
28 mm	6		10	
32 mm	54	62	78	23
36 mm	37	20	11	58
> 36 mm	0	1	0	5

Table 42: An international comparison of head sizes in primary total hip arthroplasty

	Germany [%]	NJR [%]	Netherlands [%]	Sweden [%]	US [%]
Ceramic	88	42	67	32	52
Metal[16]	12	57	33	66	48
Unknown	0	1	0	1	-

Table 43: An international comparison of head component material for total hip arthroplasty

15 Because the proportions are not listed as actual numbers in the annual report, estimates were extrapolated from the graph.
16 The proportions of ceramicised metal heads were included in the "metal" category as far as possible.

In summary

In total hip arthroplasties:

- Full cementation is decreasing worldwide
- In some countries, the proportion of hybrid arthroplasties is increasing
- Dominant head size: 32 mm in Europe, 36 mm in the US

6.2 Knee arthroplasty - international comparison

Primary total knee arthroplasty fixation presents a much more homogenous picture across international comparisons than is the case for total hip arthroplasties. The "conventional" knee arthroplasty fixation is still full cementation. Even in Australia, where the proportion of fully cemented arthroplasties is traditionally lower than it is in other established registries, it has risen to 68% in recent years. As with hip arthroplasties, the proportion of hybrid arthroplasties is by far the highest in Australia, where it represents 21% of all total knee arthroplasties [5].
But knee arthroplasty practices also reveal differences in current international trends. While in the European registries very few primary knee arthroplasties also comprise concurrent resurfacing of the patella, the proportion of these types of arthroplasties in Australia has increased from 44% to 67% over the past 15 years. This is in stark contrast to the Swedish situation where a progressive reduction in the proportion of primary knee arthroplasties with patellar resurfacing from over 50% to just under 2% has been observed since the 1980s. This highlights the very distinct inter-registry differences that exist between data collected in individual countries

by their own established registries. The Australian report confirms that the revision probability of a primary total knee arthroplasty is reduced if patellar resurfacing is performed at the same time as the primary arthroplasty. But the definition of what constitutes a revision differs between the EPRD and the AOANJRR, as the Australian registry scores any re-operation involving patellar resurfacing required after the index surgery as a revision, whereas the EPRD does not. The Swedish registry data illustrates how complex it becomes to interpret results. During the 1990s, when patellar resurfacing during the primary total knee arthroplasty was still common practice in Sweden, the data indicated that total knee arthroplasties without patellar resurfacing had higher revision probabilities. The Swedish registry nevertheless shows that this trend has reversed over the last 10 years, which opens up a large range of hypotheses to substantiate this intra-registry difference [4]. The United States, is the clear leader of patellar resurfacing as part of a primary total knee arthroplasty as its registry consistently reports such procedures to account for 92% of all primary total knee arthroplasties performed. But the registry is yet to disclose any revision probability data pertaining to this specific group of patients [3].

	Australia [%]	Germany [%]	NJR [%]	Netherlands [%]	Sweden[17] [%]
Cemented	68	93	95	93	93
Uncemented	11	1	2	4	7
Hybrid	21	5	1	3	0

Table 44: An international comparison of total knee arthroplasty fixation

	Australia [%]	Germany [%]	Netherlands [%]	Sweden [%]	US [%]
without patellar resurfacing	33	89	80	98	8
with patellar resurfacing	67	11	20	2	92

Table 45: An international comparison of primary patellar resurfacing in total knee arthroplasty

17 Because the proportions are not listed as actual numbers in the annual report, estimates were extrapolated from the graph.

	Australia [%]	Germany [%][18]	NJR [%][19]	Netherlands [%]	Sweden [%]	US [%]
Posterior stabilised systems	23	19	23	60	9	52

Table 46: An international comparison of the proportion of posterior stabilised systems in total knee arthroplasty

	Germany [%]	Netherlands [%]	NJR [%]	US [%]
Fixed bearing	84	91	96	91
Mobile bearing	16	9	3	9

Table 47: An international comparison of bearing mobility in total knee arthroplasty

The proportion of posterior stabilised systems reported also varies significantly between registries. While these systems make up less than one quarter of all arthroplasties in Australia, Sweden and in the NJR as well as the EPRD, they make up greater than one half of all arthroplasties reported in the Dutch and US registries. Some very distinct inter-registry differences can also be observed between revision probabilities of *posterior stabilised* systems and other (predominantly cruciate-retaining) *unconstrained* systems. Long-term data from the British NJR and the Australian AOANJRR, but also from the American AJRR, for example, show lower revision probabilities for *cruciate-retaining* systems compared to *posterior stabilised* systems after a three year observation period [2, 3, 5]. As previously described in Chapter 5.1.2, the EPRD data is consistent with this trend.

Mobile bearings are rather the exception in total knee arthroplasties. Even though the proportion of these systems at 16% is relatively high in Germany, the national trend is also pointing to a shift away from mobile bearings (refer to Chapter 4.3). There is unfortunately still no comparative data for revision probabilities of mobile bearings from the Netherlands and the US, where these systems represent a 9% share [3, 6]. The NJR and the Australian registry generally report higher revision probabilities for mobile bearings, but in contrast to the EPRD, these two registries do not differentiate between different types of knee systems (CR, PS etc.) (also refer to Figure 16 to Figure 18) [2, 5].

There are also considerable country differences with respect to unicondylar knee arthroplasties: In the US, their share was recently only approximately 2%, while they represented 6% of all knee arthroplasties in Australia which was a slight upward trend [3, 5]. Among the European registries considered, the percentages were con-

18 Varus-Valgus stabilized systems were included in the overall EPRD percentages.
19 Proportion of cemented knee systems.

sistently higher: 8% in Sweden, 10% in the NJR, 12% in the Netherlands (12%) and the EPRD [2, 4, 6].

In summary

Fully cemented arthroplasties

- are the gold standard (68-95%)
- In Europe, they are mainly performed without patellar resurfacing (80-98%). This is in contrast to the US trend.
- Fixed bearing systems prevail (84-96%)

7 Summary

In the seventh year of its data acquisition phase, the German Arthroplasty Registry's principle objective is to ensure the continuity and the successful development of the registry. The number of hip and knee arthroplasties registered for the 2018 operating year increased again year-on-year to include a total of 300,192 surgeries. By the end of 2018, the EPRD crossed the 1 million hip and knee arthroplasty benchmark. This makes the EPRD the second largest national registry in Europe - just behind the British National Joint Registry (NJR) - and one of the largest registries in the world.

For the data acquisition year 2018, a total of over 167,000 hip and over 132,000 knee arthroplasty documents were submitted to the registry by 716 different clinics. As the EPRD is a voluntary registry, its coverage rate increased to capture almost 67% of all annual hip and knee arthroplasties performed in Germany. Nonetheless smaller clinics are still underrepresented in the registry. With participation in the registry made mandatory for all clinics as part of the planned start of the Implant Registry Germany in 2021, this shortfall is expected to resolve, at the latest, by 2021.

A key development in this year's progress report is the completion of the harmonisation of the product database with that of the British NJR. In collaboration with the NJR, a harmonised classification structure has been created based on the product database established by the EPRD, which enables even more detailed, in-depth, but also international analyses of arthroplasties to be performed. The participating manufacturers have so far entered over 60,000 individual items to the EPRD product database and the current annual report is the first report to present analyses based on this data.

The 2018 operating year

In 2018, the EPRD reported a continuation of the increase in the general volume of uncemented total hip arthroplasties from the previous year. Indeed, the latest data indicates that 78.6% of all total hip arthroplasties were implanted completely without cement. The EPRD also noted a slight increase in short stems and 36-mm head components, even if at 9.7% and 37.9% respectively, these trends are by no means general practice in the field. In contrast, the proportion of ceramic head components has remained almost unchanged from the previous year. They represent 7 out of every 8 total hip arthroplasties. The recent increase in the proportion of ceramicised metal head components has been less at the expense of ceramic heads and more at the expense of conventional metal head components. In terms of acetabular cups, head components are increasingly matched with a highly cross-linked polyethylene (hXLPE) insert. In 2014, "only" approximately 51.6% of all hip arthroplasties used an hXLPE insert with or without antioxidants, while in 2018 that share rose to 71.3%. In contrast, the use of ceramic insert components, has been steadily decreasing in the EPRD every year. In 2018 only 9% of total arthroplasties had fully ceramic tribological bearings, compared to over 15% in 2014.

In the case of knee arthroplasties, full cementation remains the gold standard in Germany. Partially cemented arthroplasties have declined even further in

favour of complete cementation. A slight increase in *posterior stabilised* and *pivot* knee systems is also observed, with *cruciate-retaining* systems representing 43.9% and *cruciate retaining/sacrificing* systems 18.4% of all total knee replacements, respectively. The use of mobile bearings for both unicondylar (63.1%) and bicondylar (15.7%) arthroplasties has been decreasing in recent years. The EPRD also observes a slight but persistent trend favouring unicondylar knee arthroplasties over bicondylar systems. In 2018, unicondylar replacements represented 12.6% of all the different types of arthroplasties combined, which is more than three percent higher compared to three years earlier. But the preference for unicondylar knee arthroplasties differs greatly between clinics. Many clinics rarely perform unicondylar arthroplasties but there are a few highly specialised centres where this procedure is more common than total knee arthroplasties.

Survival analysis of arthroplasty components

The previous EPRD report already commented on the multi-factorial complexities of arthroplasty component survival analyses in the evaluation of different individual arthroplasty components. The EPRD is therefore neither able nor willing to give any explicit recommendations about particular types of arthroplasty and/or the use of specific arthroplasty components. The improved understanding gained from the EPRD arthroplasty component survival analyses should therefore be considered critically and where appropriate used to further enhance the quality of various aspects of arthroplasty for the individual patient.

The survival analyses do, above all else, clearly indicate that, in addition to specific arthroplasty components, both the clinics performing the arthroplasty and the patients themselves exert a considerable influence on the probability of arthroplasty revision. There is a general trend which correlates the number of specific hip and knee arthroplasties a clinic performs, per year, to a lower revision probability for the specific arthroplasty performed. This is particularly evident in the case of unicondylar knee replacements, where the revision probability at three years after the primary arthroplasty in clinics that rarely perform these types of procedures is twice that of clinics that perform such replacements almost by default. Patient age and sex also considerably influence revision probability. The EPRD observes that the hip and total knee arthroplasty revision probability is generally higher for men compared to women. Younger total knee arthroplasty patients have higher revision probabilities. Uncemented elective total hip arthroplasty patients older than 75 years of age have considerably higher revision probabilities compared to younger patient age groups. Within the same patient age group cemented stems had significantly lower revision probabilities when compared to uncemented stems.

Short stems, which are increasingly favoured, show promising results over a four-year observation period. The 36-mm head components, which are also lately being used in increasing proportions, correlate with lower revision probabilities during the early observation period (particularly in men) compared to smaller heads. This appears to be due to the lower frequency of dislocation observed with the larger head component sizes. Even though the use of ceramic tribological bearings is decreasing in Germany, EPRD data indicates that this type of bearing correlates with a very low revision probability.

Total knee arthroplasties, which primarily use knee systems with higher degrees of constraint (i.e. hinge or varus-valgus-stabilised systems) correlate with higher revision probabilities over time. *Unconstrained* and *cruciate-retaining* systems correlate with lower revision probabilities. This observation may however be confounded by specific aspects of patient selection. Data for the mobile bearings is inconsistent. Generally, mobile bearings have higher revision probabilities than fixed systems, but this does not apply to all types of knee systems.

The 2019 EPRD report for the first time also analyses the probability of a second revision after a first arthroplasty revision. The probability of a second revision is generally considerably higher than the first revision of an index arthroplasty. Depending on the type of primary arthroplasty, the probability of a second revision subsequent to the first revision is between 15.8% and 26.3% at two years from the primary arthroplasty. In the case of a primary revision due to infection, the probability of a second revision is even higher at between 25.0 and 40.2%, compared to a second revision probability of between 14.0 to 24.5% for non-infection related reasons.

International comparison

In this current annual report, the EPRD has devoted an entire chapter to the discussion of data reported by other international arthroplasty registries. International divergences are not only reflected by differences in the prevalence of systems and types of arthroplasties, but also point to specific inter-registry methodological differences in scoring revision probabilities. This is primarily due to the application of a different definition of what is procedurally considered to constitute a revision, but is also caused by individual fundamental differences in the underlying registry structures and the corresponding healthcare systems from which the respective registries acquire data. In some cases, these distinctions affect not only the general magnitude of revision probabilities, but also more basic trends. The Dutch LROI registry, for instance, identifies a similar correlation between knee arthroplasty outcome and patient age as the EPRD, but a diametrically opposed association for hip arthroplasties. This makes the ongoing dynamic development of the EPRD all the more important to guarantee the accurate representation and a thorough analysis of the arthroplasty status in Germany based on factual evidence.

8 Glossary

The following overview is intended to briefly explain the terms and designations used in the tables and texts.

TERM	EXPLANATION
Acetabular component	Part of the hip arthroplasty that replaces the acetabulum. The acetabular component can either consist of one part (monobloc) or of several parts (modular acetabular component). Typically, a modular acetabular component consists of a metal cup and an acetabular insert.
Acetabular cup	See: "Acetabular component".
Antioxidant	Additive / chemical compound, such as Vitamin E, which reduces oxidation of the polyethylene used in arthroplasty.
Bicondylar knee arthroplasty	Replacement of the articular surfaces of both femoral condyles and the tibial plateau of the knee joint, with or without simultaneous replacement of the posterior patella surface. Also refer to "Unicondylar knee arthroplasty" and "Total knee arthroplasty".
Ceramicised metal	Implant components that consist of a zirconium alloy substrate and a ceramic surface modification - oxidised zirconium alloy.
Coated metal	Implant components that have been coated with ceramics (e.g. titanium nitride).
Complementary surgery	Patellar resurfacing following primary bicondylar knee arthroplasty on the same joint affected by "normal" progression of the disease, is a complementary operation, rather than a revision operation.
Confidence interval	Interval that contains the true value within a specified probability range (confidence level)
Constraint	Knee replacements are characterised by their level of constraint (stabilisation). In this report, we define "unconstrained" knee systems as cruciate-retaining, cruciate-retaining/sacrificing, pure cruciate sacrificing and also posterior stabilised systems without varus-valgus stabilisation. Varus-valgus stabilised and (rigid/rotational) hinge systems are considered as "constrained".
Cruciate retaining	Design preserving the posterior cruciate ligament without constraining knee motion/kinematic.
Cruciate retaining/sacrificing	The design is suitable for both a cruciate ligament-retaining or a replacement procedure.
Cruciate sacrificing	Design replacing the posterior cruciate ligament with kinematic, which partially permits a limited relative motion in all three planes.
Cup	See: "Acetabular component".
Dual mobility	In case of a dual mobility arthroplasty the acetabular insert is designed (convex surface) to articulate with a dual mobility acetabular component. It is inserted into the concave surface of this bone facing shell. The femoral head is usually inserted into the dual mobility insert which is in turn inserted into the bone facing shell.
Femoral component (hip)	Arthroplasty component inserted into the proximal femur. It is either already inseparably connected to the femoral head (monobloc) or a modular head can be attached to obtain a complete femoral component (modular head stem), it can also include a modular structure with a modular neck or proximal section (modular stem).
Femoral component (knee)	Arthroplasty component inserted onto the distal femur. It can form either one single femoral condyle or both femoral condyles, and the femoral trochlear.
Femoral neck prosthesis	A hip stem component that is primarily fixed in the femoral neck. This also includes large head mid neck resection "resurfacing" prosthesis.
Fixed bearing	Monobloc design of the tibial tray or modular connection between the tibial tray and the tibial insert without permitting any relative movement between these components. As opposed to a mobile bearing
Head (component)	See: "Modular head".
Hemiarthroplasty	In contrast to a total arthroplasty, a hemiarthroplasty (hemi = half) does not replace the entire joint but only part of it. A typical example is a dual-head arthroplasty, in which only the femoral component of the hip joint is replaced with the head, but not the acetabular component
Hinge	Describes coupled knee systems with lateral joint stability and with a simple (single degree of mobility = a "rigid hinge") or a rotating hinge joint between the femoral component and the tibial tray.
Hip stem	See: "Femoral component (hip)".
hXLPE	Highly cross-linked polyethylene (UHMWPE). Also refer to "Polyethylene (PE)".
Hybrid	Arthroplasty in which one component is cemented while the other is not cemented. In hip replacement, „hybrid" refers to the combination of a cemented stem and a uncemented acetabular component, while „reverse hybrid" refers to the combination of an uncemented stem and a cemented acetabular component. In the case of knee arthroplasty, „hybrid" refers to the combination of cemented tibial support and uncemented femoral component and „reverse hybrid" the reverse combination.
Insert	Tibial inserts are part of a knee replacement and are attached to the superior surface of the tibial tray and provide the articulating surface with the femoral component. Acetabular Inserts are part of a hip replacement and are inserted inside of a modular acetabular component.
Kaplan-Meier estimator	Statistical methodology to determine the probability that a given event of interest will not occur within a specified time interval. Events that make it impossible to observe the occurrence of the given events can be taken into account in the calculation and can be censored.

TERM	EXPLANATION
Mobile bearing	Mobile connection between the tibial tray and the tibial insert. As opposed to a fixed platform.
Modular cup	"An acetabular component designed to accommodate a separate bearing surface within its internal diameter. Also refer to ""Monobloc cup"" and ""Acetabular component""."
Modular head	"Femoral head with an upper convex surface which articulates with the acetabular articular surface. At its distal aspect, there is a female taper which is designed to engage with the male taper of a modular femoral stem or modular femoral neck. Heads are available in varying sizes to match the internal diameter of the acetabular articulating surface"
Modular stem	A femoral stem component that is composed of several parts and which also requires a modular head. Also refer to "Monobloc stem" and "Femoral component (hip)"
Monobloc	A component consisting of one part, e.g. for hip replacement a stem component with an integrated head or a polyethylene cup that does not require a separate insert.
Monobloc cup	An acetabular component, which usually consists of one part or parts that have been "inseparably" pre-assembled/connected. In contrast, modular cups consist of at least two parts, which are usually only connected to one another during the implantation. Also refer to "Modular cup" and "Femoral component (hip)"
Monobloc stem	A femoral stem component that consists of one part and which does not require a separate head component. In contrast, other stems consist of at least two parts. Also refer to "Modular stem" and "Femoral component (hip)"
mXLPE	Moderately cross-linked polyethylene (UHMWPE).
Partial knee arthroplasty	In a partial knee prosthesis only part of the joint surface is replaced. A typical example is a unicondylar prosthesis in which only the medial/lateral part of the knee joint is replaced, but not the entire knee joint. Also refer to "Total knee arthroplasty"
Partially cemented	Partially cemented indicates that one component is not cemented and the other is. Also refer to "Hybrid".
Patellar component	"Component of the retropatellar replacement. While this often only consists of a polyethylene cap, which is cemented into the posterior surface of the patella, there are also designs in which a polyethylene cap is fixed to a metal base plate. Also refer to ""Patellar resurfacing""."
Patellar resurfacing	Use of an implant replacing the articulation surface of the kneecap. Also refer to "Complementary surgery".
Patellofemoral arthroplasty	Artificial replacement of the patella surface and the trochlea (groove in the thighbone).
Periprosthetic joint infection	These infections are generally a bacterial colonisation of an implanted endoprosthesis. This is a particularly dreaded complication, which is difficult and time-consuming to treat surgically. Typically, the infection is caused by pathogens that are part of the normal human skin and mucosal flora.
Pivot	Describes knee systems designed to support natural rotation/translation kinematics.

TERM	EXPLANATION
Polyethylene (PE)	Polyethylene (abbreviation PE) is a thermoplastic made by chain polymerisation of ethene [CH2=CH2], from which prosthetic components (e.g. inserts) can be produced. In arthroplasty, ultra high molecular weight polyethylene (UHMWPE) is usually used. This can subsequently be modified by irradiating and coupling to antioxidants. Also refer to "hXLPE or mXLPE".
Posterior stabilised	Design allowing the posterior cruciate ligament to be replaced with a mechanical element such as an articulated polyethylene extension which controls and limits anterior and/or posterior movement.
Primary implantation	See: "Primary surgery".
Primary surgery	The primary implantation of one or more arthroplasty components in a particular joint.
Reconstruction shell	A device to provide structural stability to the pelvis prior to implanting the definitive acetabular articular component. Such a device may be required in bony defect situations. This may be the case in revision surgery, but also in primary surgery where pelvic discontinuity arises secondary to bony loss, e.g. tumour or post-traumatic reconstructions.
Reoperation	Umbrella term including revision arthroplasty, where components are exchanged and complementary surgery where further arthroplasty components are added to compensate for natural disease progression
Reverse-hybrid	See: Hybrid
Revision cup	Monobloc or modular acetabulum component with added design characteristics for bridging acetabular bone defects or for added bony fixation (e.g. additional screw hole).
Revision stem	A hip stem component that is specifically designed for replacement operations.
Revision surgery	Surgery referring to the removal and, if necessary, the replacement of previously implanted hip or knee arthroplasty components. Revision surgery may or may not be followed by re-implantation of new arthroplasty components during the same operation (one-stage revision) or at a later date (two-stage revision) and is interpreted as failure of the index arthroplasty. In contrast, the reoperation of a knee replacement with patellofemoral-resurfacing as a consequence of progressive patellofemoral arthrosis is not interpreted as failure of the initial arthroplasty. Also refer to "Reoperation" and "Complementary surgery".
Routine data	Data stored by public health insurance companies, in particular for administrative and billing purposes, in accordance with §301 SGB V (German Social Code, Book V). This data, which includes ICD codes for main and secondary diagnoses as well as OPS codes for treatments, is delivered to the EPRD together with the vital status of the participating patients twice a year. The data is used to supplement the case documentation submitted directly to the registry from participating hospitals.
Short stem	Hip stem components that are specified by the manufacturer as anchoring in the metaphyseal area. These include: Femoral neck-preserving systems, in which only the femoral head is removed and the femoral neck is left intact, femoral neck-preserving systems, in which parts of the femoral neck are also removed, and femoral neck-resecting systems, in which the femoral neck is also completely removed.

TERM	EXPLANATION
Surface replacement (hip)	Surface replacement of the femoral head (resurfacing head) and/or the acetabular cup (surface replacement cup). The "resurfacing head" is used to describe a femoral component that is designed only to cover the patient's own femoral head. There may be an anchoring device which is integral to the component and which extends into the femoral neck. It is used with a corresponding "surface replacement cup" which is made of one piece of material (monobloc).
Tibial tray	The component that replaces / resurfaces the upper tibia can be modular (more than one piece and accepts an insert, monobloc (one piece), preassembled (the insert and tibial tray are assembled by the manufacturer but can be separated) or prefixed (where the tibial tray and insert are assembled by the manufacturer and cannot be separated).
Total hip arthroplasty	Orthopaedic implant intended to replace a hip joint within the body. In contrast to a hemiarthroplasty, a total hip arthroplasty replaces the entire joint.
Total knee arthroplasty	A knee arthroplasty in which all three compartments of the knee joint (medial and lateral part of the tibio-femoral joint and the patello-femoral joint) are completely replaced. In Germany, primary knee arthroplasties only rarely include patellar resurfacing. Strictly speaking, these cases should not be classified as total knee arthroplasties, but rather as a bicondylar surface replacement. None-the-less the term "total knee arthroplasty" has become established for bicondylar surface replacements in Germany.
Tribological bearing	Describes the materials of the two surfaces that move against one another in a joint replacement. Examples are: metal-on-polyethylene, metal-on-metal, ceramic-on-polyethylene, ceramic-on-ceramic. In this report, the material listed first always refers to the femoral component of the articulation.
Uncoated metal	Implant components that have not been ceramic coated.
Unicondylar knee arthroplasty	Replacement of only one femoral condyle and the corresponding portion of the tibial plateau of the knee joint, with or without simultaneous patella resurfacing. Also refer to "Bicondylar knee arthroplasty".

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