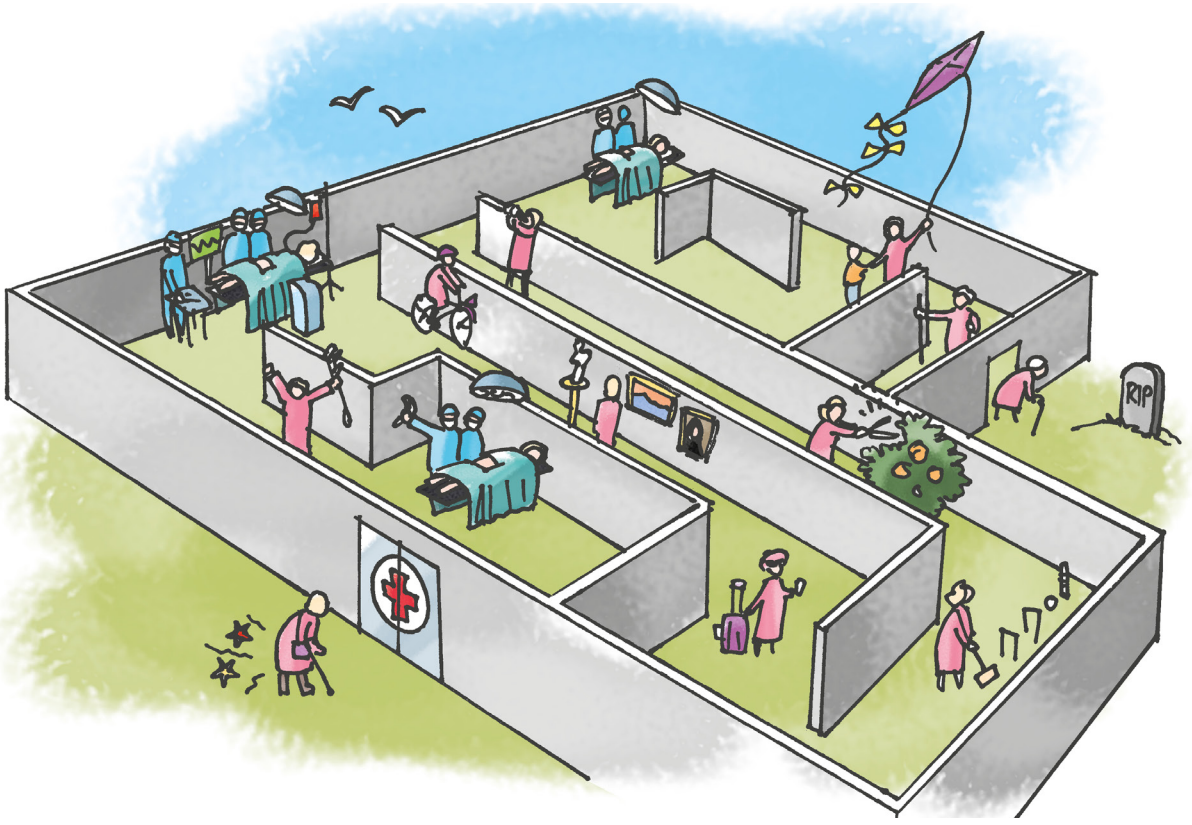
Swedish Hip Arthroplasty Register

Annual Report 2017



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Annual Report 2017

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Contents

The english version of the annual report contains selected tables and graphs. The online swedish version contain all the tables and graphs and is published on the website www.shpr.se.

1 Introduction

Welcome to the Swedish Hip Arthroplasty Register Annual Report for 2017. In January 2017, we launched a new version of the Register, including an update of the content in order to describe more optimally the hip arthroplasty operations that are currently being performed. Moving the Register to a new IT platform opened up a whole range of benefits, including improved validation of input data and a simpler and quicker means of presenting data from the Register. The move to the new IT platform has meant that all programming had to be redone completely in order to produce a full set of tables and graphs for the Annual Report.

The Swedish Hip Arthroplasty Register is a national quality register, the purpose of which is to improve care provision for patients who undergo hip arthroplasty in Sweden. The aim is to register all hip arthroplasties that have taken place, both in public and private sector establishments, and regardless of the condition that led to the operation. The Register was set up in 1979, and this report covers procedures carried out up through to December 31, 2017, making this the 39th operating year for the Register.

Annual production

Production increased during 2017 (Figure 1.1 and 1.2) and for the first time more than 18,000 primary total hip arthroplasties were carried out. To be exact, 18,148 total hip arthroplasties were performed, equivalent to 179 procedures per 100,000 inhabitants. A total of 4,029 primary hemiarthroplasties were carried out, which was down slightly on the figure for the previous year, and overall 6,033 hip arthroplasties were carried out due to acute hip fracture or sequela following a fracture. A total of 2,588 reoperations were registered.

Validation process and completeness

The Register data is subject to continuous validation and quality control. We use a range of methods to assure and maintain a high level of data quality and to improve areas in which there are shortcomings. A key feature of the validation process is the annual completeness analysis, which is carried out through collaboration with the National Board of Health and Welfare Patient Register. The analysis covers all primary procedures, divided into total arthroplasties and hemiarthroplasties. A new development this year is a completeness analysis of revisions. As it is often well into the autumn before the Patient Register data for the preceding year is available, we have published a completeness analysis for the 2016 operating year. The outcome for the country was that 98% of all total arthroplasties, 96% of all hemiarthroplasties, and 93% of all revisions were registered in the Hip Arthroplasty Register. In the Register follow-up routine using patient-reported outcomes – the PROM programme (patient-reported outcome measures) – the response rate for patients with osteoarthritis who underwent surgery in 2016 was 83% preoperatively, and 85% at the one-year follow-up.

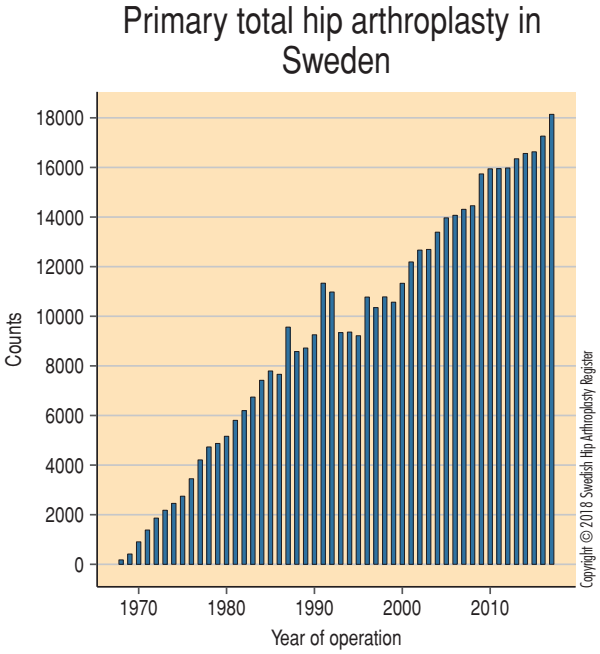


Figure 1.1.

Illustration

The illustration for this year's report illustrates the various paths taken by patients who have undergone hip arthroplasty after primary hip arthroplasty. Previously, we focused on individual hip operations, but we know that a large proportion of patients undergo an operation on the other hip as well as reoperations. In the thesis "Longitudinal outcomes following total hip replacement", Peter Cnudde has made use of what is termed a multistate analysis to describe the probability of various hip-related events. A summary of the thesis, which also analyses trends within Swedish hip arthroplasty, is presented in the report.

In-depth analyses and improvement work

As usual, this year's report contains a range of in-depth analyses. In the primary prosthesis chapter there is an in-depth analysis of the frequently debated issue of choice of fixation. The conclusion that can be drawn with the aid of our register data is that in the majority of cases individuals over the age of 75 ought to be operated on with all cemented fixation. All uncemented fixation could be an alternative for women up to around 55 years of age, and for men up to 65 years of age. We can also report that new prostheses introduced onto the Swedish market, and which have been used to such an extent that a register analysis is meaningful, have revealed good results. The report also contains a comparison between a dual-mobility cup and a conventional cup, although the results are difficult to interpret as it is probably not possible to compensate fully for patient selection. Based on information contained in the

Register, however, we are unable to demonstrate any obvious advantages of using a dual-mobility cup. As part of a thesis project, Georgios Chatziagorou compared the two most common cemented stems used in Sweden in terms of reoperation due to a periprosthetic fracture. The analysis indicates that the Lubinus stem carries a lower risk of a periprosthetic fracture compared with the Exeter stem, even when Vancouver type C fractures are included.

The Hip Arthroplasty Register is one of the world's most extensive reoperation databases, covering over 80,000 operations. It is a valuable means of gaining an understanding of which methods and implants offer the best results. Yosef Tyson, a PhD student in Uppsala, has compared cemented and uncemented stem revision with first-time revision. Even if an increase in the use of uncemented fixation can be noted, the results show that revision with a cemented stem still ought to be considered an attractive first-choice option.

Per Jolbäck, a PhD student in Gothenburg, has examined the link between annual volume on the surgeon level, and the incidence of adverse events within 90 days following a primary total hip arthroplasty. He found that those surgeons with a higher volume have a lower complication rate. The study is an important part of the discussion about how units ought to be organised to allow individual surgeons to maintain and improve their skills.

New adverse event definition and trends

The definition of an adverse event has changed and is similar to the one used by the Swedish Knee Arthroplasty Register. We have analysed how adverse events have developed over time. In the case of 'standard' patients and elective and fracture patients, the incidence of adverse events has fallen over the past 10 years. However, the number of adverse events in conjunction with reoperations has increased. There is considerable variation between different hospitals with regard to the incidence of adverse events for all categories. There is considerable potential for improvement in the care system to avoid adverse events, particularly in the case of fracture patients and in conjunction with reoperations.

The Hip Arthroplasty Register and clinical research

It is heartening to see a continued high level of interest in conducting research using the Hip Arthroplasty Register. We carry out strategic work within the Register to sustain the level of research. At the turn of the year, 22 PhD students were affiliated to the Register. The PhD students base the whole or parts of their thesis work on data from the Hip Arthroplasty Register, and they represent seven Swedish universities (Uppsala University, Lund University, Gothenburg University, Umeå University, Linköping University, Karolinska Institute, and Örebro University). Anne Garland, Per-Erik Johansson and Piotr Kasina defended their theses with the aid of Register articles. During 2017, Register work was presented at some 20

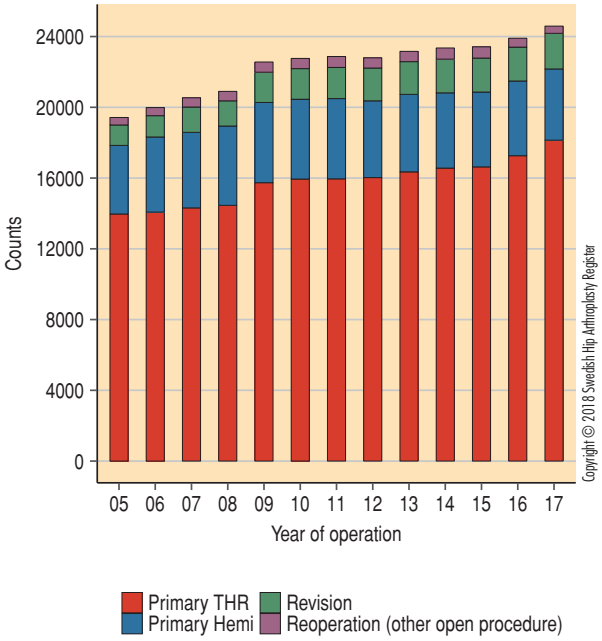


Figure 1.2.

scientific conferences, and we published 16 scientific articles from the Register. During the Academy meeting in San Diego, Henrik Malchau, Johan Kärrholm and colleagues were awarded the prestigious Kappa Delta Award for the summary 'Arthroplasty implant registries over the past five decades: development, current and future impact'.

40 years with the Swedish Hip Arthroplasty Register

Next year, 2019, the Swedish Hip Arthroplasty Register will celebrate its 40th anniversary. The anniversary will be marked by a series of activities, including a register supplement in ACTA Orthopaedica, an anniversary symposium, and a range of special activities for contact secretaries and contact doctors.

Thank you to all employees

A basic prerequisite if the Hip Arthroplasty Register is to work is that units register and provide the requisite information. We appreciate the work and commitment on the part of contact secretaries and contact doctors throughout the country. We are extremely grateful for all the contributions received during the past year.

We would also like to take the opportunity to thank our statistician Szilárd Nemes, who has been with us since 2012. He has in a truly incredible way developed the register statistics, acted as a driving force behind research activities, and supervised PhD students. Szilárd has now been recruited to a new and exciting position and we wish him every success in his new role.

Gothenburg, August 2018

Register Management Team

2 Data quality and validation process

The Register data are subject to continuous validation and quality control. We use a range of methods to assure and maintain a high level of data quality and to improve areas in which there are shortcomings.

2.1 Completeness analysis

A key aspect of the validation work is the annual completeness analysis, which is conducted by linking data with the National Board of Health and Welfare Patient Register. The method is explained in Tables 2.1.1 and 2.1.2. The analysis covers all primary operations, divided into total hip arthroplasties and hemiarthroplasties. As there is a delay before Patient Register data for the previous year is available, a completeness analysis is published for the 2016 operating year. There are units which, in conjunction with subsequent checks or a reoperation, have discovered that an operation has not been registered in the Hip Arthroplasty Register and ex post facto registration takes place. This happens in fewer than 50 operations per year. To illustrate this, we reported in the 2012 Annual Report that 15,978 total hip arthroplasties had been carried out during 2012, but now 16,027 total hip arthroplasties have been registered for that year. To examine trends in the reporting rate, we have commissioned figures for the past 10 years (2007–2016). Completeness throughout the whole period was more than 97%, and since 2010 it has been 98–99% (Figure 2.1.1). The reporting rate is also very good for hemiarthroplasties – 98.1% in 2015 and 96.1% in 2016. During the 10-year period, completeness has been just below 95% or higher.

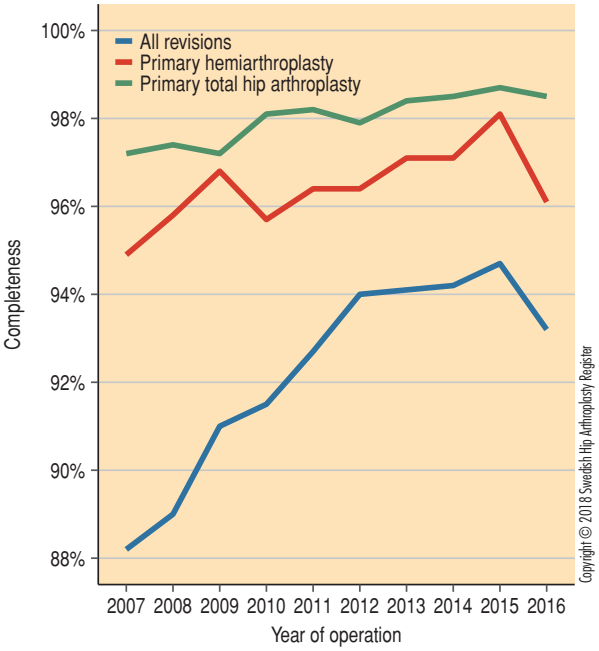


Figure 2.1.1

New in this year's report is the fact that the National Board of Health and Welfare register service has assisted us with a completeness analysis for revisions. In order to conduct the analysis, we have linked the Hip Arthroplasty Register data for the operations that we have categorised as revisions, i.e. removal, replacement, or addition of a prosthesis component. Correct NOMESCO codes for revisions comprises codes in the NFC group (secondary hip arthroplasties) NFU 09 (extraction of a total hip arthroplasty or hemiarthroplasty) or NFU 19 (extraction of a total hip prosthesis). Of the 2,036 revisions that were registered during 2016, 1,848 could be matched to the Patient Register. In addition, a further 148 had been assigned a revision code. This result is a reporting completeness rate of 93.2%. Viewed over the entire period, reporting has gradually improved from just under 90% to at most 94.7% in 2015 (Figure 2.1.1). The best figure was achieved in 2016, with Dalarna and Örebro reporting an impressive 100% completeness rate. Since 2012, Örebro has had 100% completeness. The figure for Norrbotten in 2016 was just 78.3%.

2.2 Completeness analysis per unit

In the report, we present reporting completeness for total hip arthroplasties, hemiarthroplasties, and revisions per hospital for the 2016 operating year (Tables 2.2.1, 2.2.2 and 2.2.3). In the current analysis, we have access to information on the hospital level for 2007–2016, which we would be happy make available to anyone who may be interested. Units with values less than one standard deviation below the national average are marked in red in the table. This was the outcome in 2016 for 25 units for total hip arthroplasties, 16 units for hemiarthroplasties and 17 units for revisions. The deviations are small for the majority of hospitals, although despite the high national average there is clear scope for improvement at a number of units.

Completeness analysis for total and hemi arthroplasties
Total and hemi arthroplasties respectively are compared to the corresponding selection from the national patient register. The completeness is computed as a percentage with: *Numerator* All total and hemi arthroplasties respectively in the hip arthroplasty register. *Denominator* All total and hemi arthroplasties in the hip arthroplasty register, or total and hemi arhtroplasties respectively in the national patient register.
About the comparison Here all total and hemi arthroplasties in the Swedish Hip Arthroplasty Register respectively are compared to the national patient register.
Selection from the hip arthroplasty register All primary total and hemi arthroplasties respectively in the hip arthroplasty register are included.
Selection from the national patient register All care events with measure code NFB29, NFB39, NFB49, NFB62 or NFB99 for total arthroplasties and NFB09 or NFB19 for hemi arthroplasties are included.
Approaches One operation per date of surgery is included. If several hip arthroplasties were carried out on the same patient on the same date, only one is included in the comparison.
Matching criteria Operations are matched through the personal identity number and that the date of surgery in the hip arhtroplasty register lies within the interval between date of admission and date of discharge for the care event in the national patient register.

Table 2.1.1

Completeness revisions
Revisions of hip prostheses are compared to the corresponding selection from the patient registry. The completeness is computed as a percentage with: *Nominator* All revisions of hip prostheses in the hip arthroplasty register. *Denominator* All revisions of hip prostheses in the hip arthroplasty register, or revisions of hip prostheses according to the national patient registry.
Selection from the hip arthroplasty register All revisions of hip prostheses
Selection from the patient registry All operations in outpatient or inpatient care with a measure code NFC*, NFU09 or NFU19.
More on data management One operation per date of surgery is included. If several hip arthroplasties were carried out on the same patient on the same date, only one is included in the comparison.
Matching criteria Operations are matched on personal identity number and that the date of surgery in the hip arthroplasty register lies within the interval between date of admission and date of discharge in the national patient register.

Table 2.1.2

2.3 PROM programme data quality

From 2008, all units in Sweden that carry out hip arthroplasties are registered in a follow-up routine for patient-reported outcome – the PROM programme. The preoperative questionnaire response rate, which for obvious reasons is intended for elective patients, has been very high. Among osteoarthritis patients, the response rate has varied between 86% and 89% since 2011. At one-year follow-up, the response rate in recent years has been between 82% and 92% among osteoarthritis patients. The total drop-out rate, both preoperatively and postoperatively, is around 20%. Whilst the preoperative response rate is relatively stable over time, there has been a slight deterioration in recent years in the response rate at one-year follow-up. From experience, we know that there is a certain time lag between registration and reminders, and consequently the response rate could rise slightly for 2017. The difference between the values for the year and those for previous years can be attributed to the fact that we have included a time interval in relation to the operation date for when preoperative and postoperative questionnaire responses can be classified as valid.

As the input function in the old PROM database required all the questions to be answered, the registered questionnaires are complete. The contact secretaries can supplement incomplete questionnaires by contacting the patient by telephone or letter. If the questionnaires were not complete, it was not possible to register the responses in the database. With our new platform (Stratum), which came into use in January 2017, it is possible to register incomplete PROM questionnaires although the system issues a warning if some of the questions have not been answered.

However, since switching to Stratum at the beginning of 2017 the response rate has fallen. We suspect that a change in the routines for input and mailings has contributed to the decrease, and we hope that the teething problems that arose in the transition from the old platform to the new platform have now been overcome. In 2017, the response rate was 83.4% preoperatively, and 83.3% one year postoperatively (Table 2.3).

2.4 Missing variables

For patients who underwent total hip arthroplasty electively, we have selected the variables diagnosis, ASA, BMI, fixation, and articulation to illustrate the data quality in the Register in terms of how high a proportion of the registered operations have the information in question. A number of boxes on the registration form are compulsory (personal identity number, operation date, side, and diagnosis). Consequently, there is no missing data. As regards ASA and BMI (requires weight and height) these were complete for 99.4% and 98.8% of the registrations respectively in 2017. Fixation (fully cemented, uncemented, hybrid or reversed hybrid) require information about the fixation method for both cup and stem. Complete information for 1.8% of the registrations was missing during 2017. Articulation is a calculation variable that requires that both a femoral head and cup component are entered, and that information about the nature of the component is included in the Register. In the case of registrations during 2017, we could make an articulation calculation in 99.7% of the cases.

In the case of fracture patients who underwent total hip arthroplasty or hemiarthroplasty during 2017, we have chosen to report ASA, BMI, occurrence of dementia (Yes, Suspected, No), diagnosis and fixation (Table 2.4). The fact that BMI was missing in 26.6% of the cases can be explained. In the case of fracture patients, it is in many instances not feasible to measure or produce information about current weight. Information about dementia is missing in just under 10% of the registrations.

2.5 Validation processes

In addition to the completeness analysis described above, the following validation processes are described in the Hip Arthroplasty Register:

- When registering, there are compulsory fields that cannot be left empty, otherwise the data cannot be saved.
- The web module for input contains automatically generated checks of, for example, personal identity number, side, unit, implant combinations, and fixation type.
- Control reports are generated automatically if operation data for one or more variables is missing. In these cases, each unit is contacted, which it then either complements the data directly or sends a copy of the medical records to the Register for further checks.
- Contact secretaries and contact doctors receive reconciliation reports twice a year in order to check that operations that have been reported concur with actual production. Each unit is urged to check its register extract against the local patient administration system.
- For all reoperations, medical notes are sent on a routine basis to the Register for input of the detailed information. In conjunction with registration of the detailed information, a register coordinator checks to ensure the data that has been registered is complete and correct.
- As regards PROM data, checks are made on received and missing registrations via a semi-automated statistics package. Reconciliation is also carried out each year, where each unit has access to information about the number of operations and the number of completed preoperative assessment forms.
- Register coordinators carry out local monitoring on a random basis and in doing so they go through the completeness and data quality (including missing data) for the most recent operating year.

Completeness for total arthroplasties in 2016

Unit	Number[1]	Hip Arthroplasty Register, %[2]	National Patient Register, %[3]
University or regional hospitals			
Karolinska/Huddinge	189	**97.9**	97.4
Karolinska/Solna	112	**88.2**	99.2
Linköping	63	98.4	95.3
SU/Mölndal	596	**97.4**	97.2
SUS/Lund	203	100.0	94.6
SUS/Malmö	30	**90.9**	97.0
Umeå	96	**98.0**	94.9
Uppsala	252	100.0	98.4
Örebro	62	98.4	100.0
County hospitals			
Borås-Skene	251	**97.7**	98.8
Danderyd	324	**96.4**	99.1
Eksjö	232	98.7	99.1
Eskilstuna	107	**97.3**	96.4
Falun	254	98.8	**75.5**
Gävle	249	**98.0**	92.9
Halmstad	206	100.0	98.5
Helsingborg	124	**97.6**	96.9
Hässleholm-Kristianstad	828	100.0	99.4
Jönköping	129	99.2	100.0
Kalmar	173	98.9	98.9
Karlstad	193	**93.7**	95.6
Lidköping-Skövde	514	98.7	97.1
Norrköping	265	99.3	100.0
Sundsvall	49	**98.0**	98.0
Södersjukhuset	411	99.0	99.5
Uddevalla-NÄL	445	99.1	99.1
Varberg	272	100.0	98.5
Västerås	418	**96.8**	98.6
Växjö	132	**96.4**	100.0
Östersund	284	**97.3**	96.6
Rural hospitals			
Alingsås	194	98.5	99.0
Arvika	194	**98.0**	98.5
Enköping	353	100.0	100.0
Gällivare	91	100.0	98.9
Hudiksvall	138	98.6	93.6
Karlskoga	139	100.0	98.6
Karlskrona-Karlshamn	276	98.9	**79.9**
Katrineholm	193	99.5	98.5
Kungälv	202	**98.1**	98.1
Lindesberg	426	100.0	99.5
Ljungby	164	**98.2**	97.6
Lycksele	324	99.7	99.7
Mora	278	98.9	99.3
Norrtälje	159	99.4	98.1
Nyköping	134	98.5	100.0
Oskarshamn	308	99.7	99.0
Piteå	374	**98.2**	100.0
Skellefteå	128	**97.0**	98.5
Sollefteå	194	**98.0**	100.0
Sunderby	32	**72.7**	100.0
Södertälje	129	100.0	98.4
Torsby	129	100.0	98.4
Trelleborg	716	99.2	98.9
Visby	134	**97.1**	97.8
Värnamo	176	98.3	95.5
Västervik	128	100.0	100.0
Ängelholm-Aleris Specialistvård Ängelholm	154	98.7	**88.5**
Örnsköldsvik	183	98.9	98.9
Private hospitals			
Aleris Specialistvård Bollnäs	279	100.0	95.0
Aleris Specialistvård Motala	585	**97.8**	98.3
Aleris Specialistvård Nacka	244	99.2	92.7
Capio Movement*	339	-	**0.0**
Capio Ortopediska Huset	467	99.2	**80.3**
Capio S:t Göran	577	98.6	96.9
Ortho Center IFK-kliniken*	163	-	**0.0**
Ortho Center Stockholm	535	99.4	**87.4**
Sophiahemmet	221	**97.8**	**40.7**
Country	16 923	98.5	93.0

Table 2.2.1

Red marking indicates values that lie below the lower confidence interval in relation to the national average.

[1] Refers to the number of registrations in the Swedish Hip Arthroplasty Register.

[2] Refers to the proportion of registrations which are found in both registries or only in the Swedish Hip Arthroplasty Register.

[3] Refers to the proportion of registrations which are found in both registries or only in the National Patient Register.

**Since these units have not reported any operations to the National Patient Register at the National Board of Health and Welfare, completeness cannot be presented.*

Completeness for hemiarthroplasties in 2016

Unit	Number[1)]	Hip Arthroplasty Register, %[2)]	National Patient Register, %[3)]
University or regional hospitals			
Karolinska/Huddinge	93	96.9	95.8
Karolinska/Solna	60	**89.6**	**91.0**
Linköping	75	97.4	97.4
SU/Mölndal	303	**94.1**	**91.0**
SUS/Lund	165	99.4	96.4
SUS/Malmö	190	97.4	95.4
Umeå	57	100.0	**93.0**
Uppsala	116	100.0	94.0
Örebro	69	97.2	95.8
County hospitals			
Borås-Skene	92	95.8	96.9
Danderyd	159	96.4	94.5
Eksjö	35	100.0	**88.6**
Eskilstuna	69	100.0	94.2
Falun	151	99.3	98.0
Gävle	67	95.7	**85.7**
Halmstad	54	100.0	**90.7**
Helsingborg	149	96.8	96.1
Hässleholm-Kristianstad	121	97.6	**92.7**
Jönköping	45	**91.8**	**83.7**
Kalmar	76	98.7	94.8
Karlskrona-Karlshamn	97	98.0	**84.8**
Karlstad	96	97.0	**87.9**
Lidköping-Skövde	103	**93.6**	94.5
Norrköping	55	98.2	96.4
Sundsvall	97	98.0	97.0
Södersjukhuset	247	98.8	97.6
Uddevalla-NÄL	188	99.5	96.3
Varberg	85	100.0	**90.6**
Västerås	19	100.0	**73.7**
Växjö	56	**94.9**	**91.5**
Ystad	54	**87.1**	98.4
Östersund	82	**94.3**	**92.0**

Unit	Number[1)]	Hip Arthroplasty Register, %[2)]	National Patient Register, %[3)]
Rural hospitals			
Alingsås	43	97.7	95.5
Arvika	4	**50.0**	100.0
Gällivare	36	97.3	**89.2**
Hudiksvall	30	100.0	**86.7**
Karlskoga	51	98.1	98.1
Kungälv	63	100.0	**88.9**
Lindesberg	15	**88.2**	100.0
Ljungby	21	100.0	95.2
Lycksele	22	100.0	**72.7**
Mora	42	97.7	100.0
Norrtälje	37	100.0	97.3
Skellefteå	44	100.0	97.7
Sollefteå	15	100.0	100.0
Sunderby	86	**76.1**	100.0
Södertälje	29	100.0	100.0
Torsby	25	100.0	96.0
Visby	12	**75.0**	**75.0**
Värnamo	23	**82.1**	96.4
Västervik	48	100.0	95.8
Örnsköldsvik	55	100.0	94.5
Private hospitals			
Aleris Specialistvård Motala	40	**93.0**	100.0
Capio S:t Göran	143	**94.1**	93.4
Country	4 209	96.1	94.1

Table 2.2.2

Red marking indicates values that lie below the lower confidence interval in relation to the national average.

[1)] Refers to the number of registrations in the Swedish Hip Arthroplasty Register.

[2)] Refers to the proportion of registrations which are found in both registries or only in the Swedish Hip Arthroplasty Register.

[3)] Refers to the proportion of registrations which are found in both registries or only in the National Patient Register.

Completeness for revisions in 2016

Unit	Number[1]	Hip Arthroplasty Register, %[2]	National Patient Register, %[3]
University or regional hospitals			
Karolinska/Huddinge	74	96.1	93.5
Karolinska/Solna	47	**90.4**	**82.7**
Linköping	37	**86.0**	95.3
SU/Mölndal	148	**91.9**	97.5
SUS/Lund	112	94.9	94.9
Umeå	88	97.8	96.7
Uppsala	121	96.8	95.2
Örebro	51	100.0	96.1
County hospitals			
Borås	46	97.9	93.6
Danderyd	106	94.6	95.5
Eksjö	22	**91.7**	95.8
Eskilstuna	40	97.6	**75.6**
Falun	48	100.0	**64.6**
Gävle	61	98.4	**88.7**
Halmstad	44	100.0	**88.6**
Helsingborg	45	95.7	93.6
Hässleholm-Kristianstad	100	**91.7**	90.8
Jönköping	28	93.3	**90.0**
Kalmar	10	100.0	100.0
Karlstad	51	**89.5**	**89.5**
Lidköping-Skövde	63	100.0	**77.8**
Norrköping	22	95.7	**82.6**
Sundsvall	27	**87.1**	96.8
Södersjukhuset	90	94.7	97.9
Uddevalla-NÄL	58	95.1	96.7
Varberg	22	100.0	100.0
Västerås	76	97.4	94.9
Växjö	19	100.0	94.7
Östersund	48	**85.7**	**87.5**

Unit	Number[1]	Hip Arthroplasty Register, %[2]	National Patient Register, %[3]
Rural hospitals			
Gällivare	11	**91.7**	**83.3**
Karlskrona-Karlshamn	33	**91.7**	91.7
Kungälv	30	96.8	**83.9**
Lindesberg	14	100.0	92.9
Ljungby	11	**91.7**	91.7
Norrtälje	17	94.4	94.4
Nyköping	17	94.4	**66.7**
Piteå	23	100.0	95.7
Skellefteå	16	**88.9**	100.0
Sunderby	2	**18.2**	100.0
Visby	18	**90.0**	95.0
Västervik	21	**91.3**	**78.3**
Private hospitals			
Aleris Specialistvård Motala	23	**85.2**	100.0
Capio S:t Göran	64	**77.1**	92.8
Country	2 036	93.2	91.4

Table 2.2.3

Red marking indicates values that lie below the lower confidence interval in relation to the national average.

[1] Refers to the number of registrations in the Swedish Hip Arthroplasty Register.
[2] Refers to the proportion of registrations which are found in both registries or only in the Swedish Hip Arthroplasty Register.
[3] Refers to the proportion of registrations which are found in both registries or only in the National Patient Register.

** Since these units have not reported any operations to the National Patient Register at the National Board of Health and Welfare, completeness cannot be presented.*

PROM data quality

	2013	2014	2015	2016
All operations with an elective total hip arthroplasty				
Total number of operations	14 326	14 602	14 602	15 164
Deceased within one year	123	115	118	132
Reoperated within one year	254	234	233	276
Included in the routine follow-up within one year	13 949	14 253	14 251	14 756
No preoperative response	2 125	2 427	2 636	2 655
Proportion of all, %	14.8	16.6	18.1	17.5
No postoperative response	1 435	1 689	1 590	2 340
Proportion of those who are included in the follow-up routine, %	10.3	11.9	11.2	15.9
No preoperative or postoperative response	3 147	3 639	3 730	4 402
Proportion of those who are included in the follow-up routine, %	22.6	25.5	26.2	29.8
All operations with a total hip arthroplasty due to primary osteoarthritis				
Total number of operations	13 088	13 369	13 442	13 995
Deceased within one year	97	87	100	104
Reoperated within one year	222	205	195	239
Included in the follow-up routine within one year	12 769	13 077	13 147	13 652
No preoperative response	1 827	2 093	2315	2318
Proportion of all, %	14.0	15.7	17.2	16.6
No postoperative response within one year	1 247	1 462	1 358	2 084
Proportion of those who are included in the follow-up routine, %	9.8	11.2	10.3	15.3
No preoperative or postoperative response	2 750	3 183	3 293	3 922
Proportion of those who are included in follow-up routine, %	21.5	24.3	25.0	28.7

Table 2.3

Data quality of variables

Operational year	2013	2014	2015	2016	2017
Available data for all operations with an elective total hip arthroplasty					
Total number of operations	14 326	14 602	14 602	15 164	15 984
Articulation, %	99.3	99.6	99.8	99.8	99.7
ASA, %	98.4	98.0	98.9	99.2	99.4
BMI, %	97.1	96.9	98.3	98.7	98.8
Diagnosis, %	100.0	100.0	100.0	100.0	100.0
Fixation, %	100.0	100.0	99.9	99.9	98.2
Available data for all total hip arthroplasties due to fracture					
Total number of operations	6 241	6 020	6 103	6 169	6 033
ASA, %	96.8	96.6	96.8	95.1	95.4
BMI, %	65.8	69.1	71.7	72.8	73.4
Dementia, %	65.2	65.0	64.4	62.7	90.5
Diagnosis, %	100.0	100.0	100.0	100.0	100.0
Fixation, %	100.0	100.0	99.9	99.9	99.3

Table 2.4

3 Epidemiology, availability, and gender aspects

3.1 Total hip arthroplasty in Sweden

Incidence

Ever since work with the Hip Arthroplasty Register began, the incidence of total hip arthroplasties has increased steadily in Sweden. During 2017, 18,140 total hip arthroplasties were carried out in Sweden, which is equivalent to 353 procedures per 100,000 inhabitants aged 40 years and older. This represents an increase of 14 percentage points since 2015. In an international comparison, including those countries that report the procedure rate in national quality registers, Sweden is among those with the highest incidence. An obvious explanation for the increasing incidence is the rise in average life expectancy and a higher proportion of elderly people in the population.

Prevalence

We have also studied how prevalence has changed over the years. As the calculation requires information about possible date of death, we have not been able to include those who underwent surgery before 1992, as prior to that arthroplasties were not registered on an individual level. In the analysis, we have included all patients who have undergone a total hip arthroplasty since 1992. We report both the prevalence of prosthesis bearers who have been inserted with a prosthesis unilaterally or bilaterally, as well as the prevalence of bilateral prosthesis bearers. The prevalence is stated as the number of prosthesis bearers per 100,000 inhabitants aged 40 years and older at the end of each year.

At the end of 2017, 175,159 people had undergone at least one total hip arthroplasty since 1991. This means that 3.4% of the population aged 40 and over was a hip prosthesis bearer, an increase of 0.1 percentage points compared with the previous year. Of these, 46,509 people (27%) had a bilateral arthroplasty. Viewed for the whole of the Swedish population in 2017, 1.7% underwent at least a primary hip arthroplasty after 1991. At the end of 2017, the prevalence among those aged 40 and over was lower in men (2.9%) compared with women (3.9%).

Of those who had undergone a procedure on either hip in 1992, 14% were still alive at the end of 2017. The more time after 1992 that is studied, the more exact this reflects the 'true' prevalence figure. The number of people who underwent an operation before 1992, and who were still alive at the end of 2017, is relatively low, albeit not negligible. As incidence has increased steadily, prevalence has also increased. It is stated, for example, that the prevalence per 100,000 people aged 40 and over increased by 14% between 2012 and 2017.

Number of people with at least one hip prosthesis

Number per age group	2002	2007	2012	2017
< 40	685	825	854	853
40–49	1 705	2 476	3 292	3 332
50–59	7 459	8 890	10 674	12 977
60–69	17 510	26 784	33 978	34 424
70–79	29 312	38 369	49 113	65 247
80–89	22 894	32 513	39 662	47 253
90 +	2 916	5 450	8 751	11 073
Total	82 481	115 307	146 324	175 159
Prevalence per 100 000 > = 40	1 845	2 450	2 972	3 392
Men				
< 40	280	355	399	418
40–49	814	1 287	1 772	1 787
50–59	3 617	4 360	5 531	6 847
60–69	7 830	12 298	15 714	16 328
70–79	11 685	15 459	20 240	27 675
80–89	7 226	10 644	13 560	16 654
90 +	612	1 249	2 123	2 711
Total	32 064	45 652	59 339	72 420
Prevalence per 100 000 > = 40	1 498	2 008	2 479	2 864
Women				
< 40	405	470	455	435
40–49	891	1 189	1 520	1 545
50–59	3 842	4 530	5 143	6 130
60–69	9 680	14 486	18 264	18 096
70–79	17 627	22 910	28 873	37 572
80–89	15 668	21 869	26 102	30 599
90 +	2 304	4 201	6 628	8 362
Total	50 417	69 655	86 985	102 739
Prevalence per 100 000 > = 40	2 162	2 863	3 438	3 898

Table 3.1.1 Number of people in Sweden with at least one hip prosthesis who have had surgery after 1991.

Number of people in Sweden with bilateral hip prosthesis

Number per age group	2002	2007	2012	2017
< 40	158	181	189	167
40–49	289	474	661	666
50–59	1 330	1 845	2 266	2 953
60–69	3 289	6 046	8 316	8 807
70–79	4 613	8 190	12 863	18 226
80–89	2 827	5 898	9 106	13 126
90 +	247	685	1 605	2 564
Total	12 753	23 319	35 006	46 509
Prevalence per 100 000 > = 40	284	495	711	902

Table 3.1.2 Number of people in Sweden with bilateral hip prosthesis who have hade surgery after 1991.

3.2 County council production and geographical inequality

"The aim within the healthcare system is to provide good health and care on equal terms for the whole population. Healthcare should be provided with due respect shown for the equal value of all people and the dignity of each individual. Individuals who are in greatest need of the healthcare system should be given priority." This quote is taken from the Healthcare Act (SFS 2017:30).

An important aspect of equality is geographical disparities in how healthcare is provided and run throughout the country. Equality can in the broad sense be related to where the patient lives. The 21 county councils/regions have powers of self-determination with regard to healthcare provision, although they are also required to comply with the Healthcare Act. For a number of years, we have shown an interest in geographical disparities in procedure rate and results. Our 'Sweden maps' have revealed a surprisingly large variation between the county councils.

Production and consumption per 100,000 inhabitants per county council

These figures are based on data from the Hip Arthroplasty Register, population statistics from Statistics Sweden, and the National Tax Agency address register as of December 31, 2017. Production refers to the total number of hip arthroplasties per 100,000 inhabitants, regardless of where the patient lives. Consumption refers to the total number of hip arthroplasties per 100,000 inhabitants, regardless of where the operation was carried out. Consumption thus means that the county councils'/regions' inhabitants have access to hip arthroplasty regardless of whether the procedure is carried out in their home area or in another part of the country.

The spread of production and consumption figures per 100,000 inhabitants shows a considerable variation between providers (private sector units are included geographically). Production is 148–246 per 100,000 inhabitants, and consumption is 147–254 per 100,000 inhabitants. This means that the county councils that produce most have a 66% higher level of production compared with the county council that produces least. As regards consumption, the incidence is 73% higher in the county council area with the highest incidence compared with the county council area that has the lowest incidence. Even if an adjustment is made for differences in age structure, there are considerable disparities in consumption.

3.3 Gender distribution, elective patients

The proportion of women who undergo an operation for a total hip arthroplasty has remained largely the same over the past 10 years at around 57% (Figure 3.3.1). The figures have been adjusted to take account of the gender difference in the population.

The average age in conjunction with an operation was, without exception, higher for women, 69 years, during the 2000s. The average age for men was just under 67 years. Women are overrepresented in the fracture diagnosis group, and fracture patients are usually older, which could be a contributing factor to the difference. It is, however, known from scientific studies that women with osteoarthritis undergo surgery at a later stage of the disease, without any conclusive reasons being found for why this the case.

There is a greater proportion of men who undergo surgery when they are younger – 41% of the men are under the age of 65 compared with 31% of the women. On the other hand, 29% of the women are over the age of 75 compared with 21% of the men. The age group 65–75 years accounts for approximately 40% regardless of gender (Figure 3.3.3 a-b). The changes over time are quite small.

Figure 3.3.4 a-b shows which diagnoses have led to the hip operation in men and women respectively. It should be noted that the Y axis starts at 70%. Osteoarthritis is by far the most common diagnosis for both genders and has increased tangibly for women since 2000. The reason for this is that the number of total hip arthroplasties that have been preceded by unsuccessful internal fixation of hip fractures have fallen radically ('Complication trauma'). This is explained in turn by the fact that Swedish orthopaedic surgeons have for the past 15 years operated on hip fracture patients with hemiarthroplasties to a far greater extent than with internal fixation. A relatively large group also undergo total hip arthroplasty as the primary form of treatment ('Acute trauma, hip fracture'). Even the 'Inflammatory joint disease' group is falling, which is also

Production

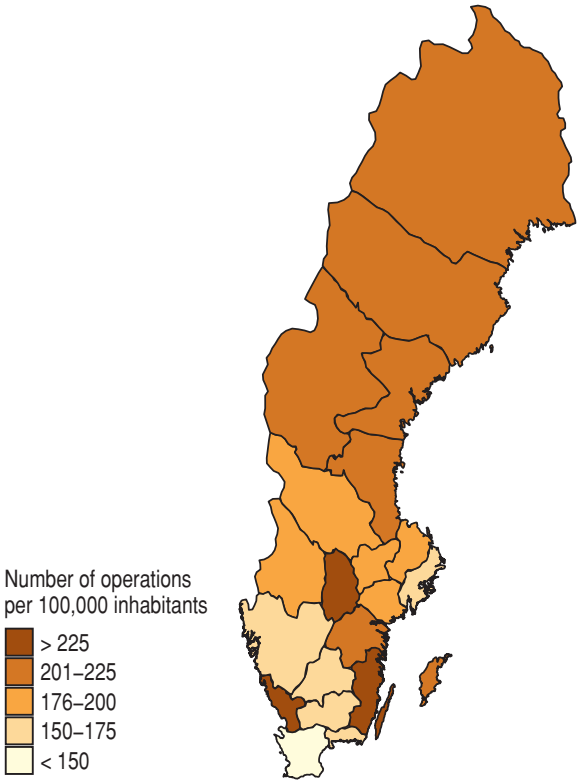
County	Operations	Population	Number[1)]
Stockholm	3 898	2 308 143	169
Uppsala	676	368 971	183
Södermanland	573	291 341	197
Östergötland	945	457 496	207
Jönköping	613	357 237	172
Kronoberg	312	197 519	158
Kalmar	598	243 536	246
Gotland	129	58 595	220
Blekinge	275	159 371	173
Skåne	1 991	1 344 689	148
Halland	769	324 825	237
Västra Götaland	2 616	1 690 782	155
Värmland	538	280 399	192
Örebro	703	298 907	235
Västmanland	516	271 095	190
Dalarna	503	286 165	176
Gävleborg	585	285 637	205
Västernorrland	533	245 968	217
Jämtland	278	129 806	214
Västerbotten	550	268 465	205
Norrbotten	541	251 295	215
Country	18 142	10 120 242	179

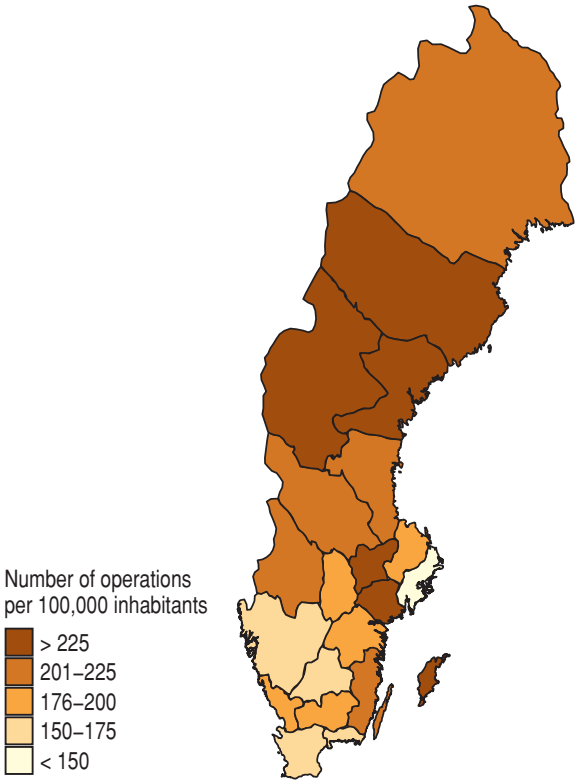
[1)]Number of operations per 100 000 inhabitants.

Consumption

County	Operations	Population	Number[1)]
Stockholm	3 394	2 308 143	147
Uppsala	689	368 971	187
Södermanland	687	291 341	236
Östergötland	832	457 496	182
Jönköping	594	357 237	166
Kronoberg	374	197 519	189
Kalmar	496	243 536	204
Gotland	138	58 595	236
Blekinge	276	159 371	173
Skåne	2 051	1 344 689	153
Halland	613	324 825	189
Västra Götaland	2 591	1 690 782	153
Värmland	617	280 399	220
Örebro	527	298 907	176
Västmanland	660	271 095	243
Dalarna	616	286 165	215
Gävleborg	615	285 637	215
Västernorrland	590	245 968	240
Jämtland	330	129 806	254
Västerbotten	615	268 465	229
Norrbotten	547	251 295	218
Country	18 142	10 120 242	179

[1)]Number of operations per 100 000 inhabitants.

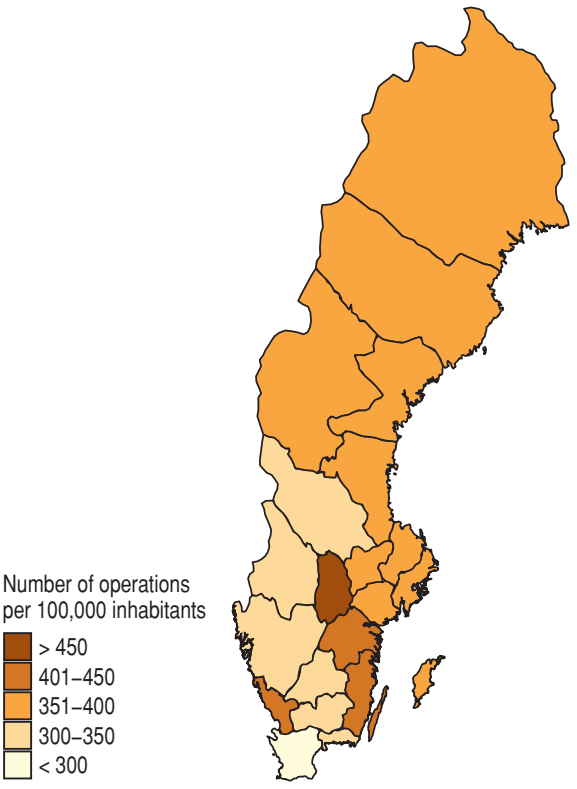




Production for patients 40 years and older

County	Operations	Population	Number[1)]
Stockholm	3 865	1 091 307	354
Uppsala	661	178 230	371
Södermanland	572	155 222	369
Östergötland	938	231 810	405
Jönköping	611	182 681	334
Kronoberg	307	100 695	305
Kalmar	592	135 448	437
Gotland	129	33 911	380
Blekinge	271	86 501	313
Skåne	1 958	673 574	291
Halland	768	172 543	445
Västra Götaland	2 599	848 830	306
Värmland	533	154 448	345
Örebro	702	153 769	457
Västmanland	511	142 688	358
Dalarna	502	157 672	318
Gävleborg	584	157 637	370
Västernorrland	531	136 310	390
Jämtland	277	70 456	393
Västerbotten	542	136 268	398
Norrbotten	533	139 119	383
Country	17 986	5 139 119	350

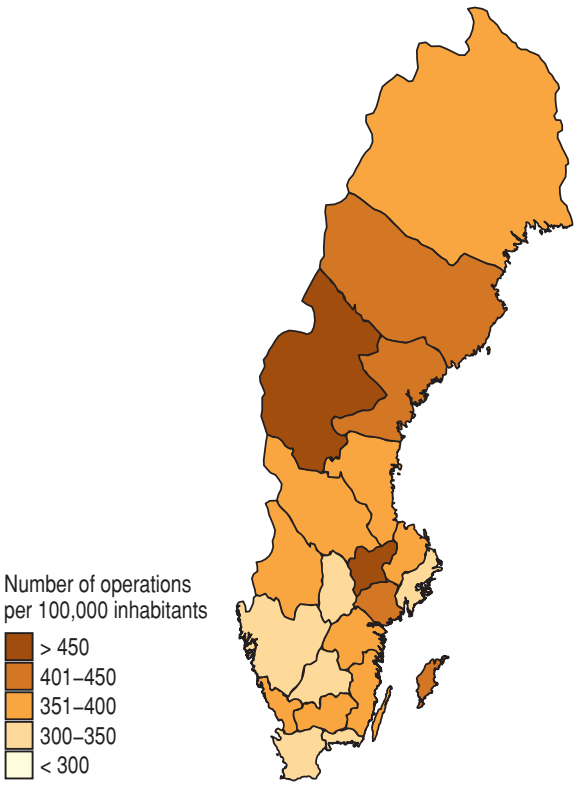
[1)]Number of operations per 100 000 inhabitants.



Consumption for patients 40 years and older

County	Operations	Population	Number[1)]
Stockholm	3 362	1 091 307	308
Uppsala	680	178 230	382
Södermanland	684	155 222	441
Östergötland	825	231 810	356
Jönköping	590	182 681	323
Kronoberg	366	100 695	363
Kalmar	493	135 448	364
Gotland	138	33 911	407
Blekinge	273	86 501	316
Skåne	2 019	673 574	300
Halland	612	172 543	355
Västra Götaland	2 575	848 830	303
Värmland	612	154 448	396
Örebro	526	153 769	342
Västmanland	654	142 688	458
Dalarna	614	157 672	389
Gävleborg	613	157 637	389
Västernorrland	585	136 310	429
Jämtland	329	70 456	467
Västerbotten	608	136 268	446
Norrbotten	539	139 119	387
Country	17 986	5 139 119	350

[1)]Number of operations per 100 000 inhabitants.



the case for men. More effective pharmaceutical treatment for these patients ought to be the explanation. An increase in acute trauma has been noted in men, rising from 3% to just over 7% in 18 years. This could be explained by increased use of total hip arthroplasty as fracture treatment, and a higher proportion of men among hip fracture patients.

The choice of surgical approach does not appear to be affected by the patient's gender (Figure 3.3.5). The most common is a posterior approach followed by a direct lateral approach, both in a lateral position. However Swedish orthopaedic surgeons prefer cemented arthroplasty for women and uncemented arthroplasty for men (Figure 3.3.6). Fracture as a diagnosis, osteoporosis, and high age – all more common in women – are reasons why cemented arthroplasty is a better option.

The patient's degree of morbidity is registered according to the ASA classification (Figure 3.3.7). Gender differences are small, with slightly more men in ASA class I and 3, and more women in ASA class II. Generally, the changes are very small compared with the previous time period. The disparities can be attributed to different diagnosis panoramas and different ages at the time of the procedure.

The majority of men and women are overweight when they undergo surgery. Men are overrepresented in the overweight group whilst women are overrepresented in the normal weight group (Figure 3.3.8).

3.4 Gender division, fracture patients

The average age for men with a hip fracture has stabilised at 80 years, whilst for women it is around 82 years. The number of women over the age of 100 years who undergo hip arthroplasty was three in 2005 compared with 18 in 2017. Four men were over the age of 100 in 2017 but none in 2005. Over the years, 156 women over the age of 100 underwent hip arthroplasty due to fracture compared to 55 men, which is a slight over-representation for men compared with the gender distribution in non-fracture-related arthroplasty in men of the same age.

Men have a poorer prognosis following a hip fracture than women. The register shows that 15% of the men who undergo hip arthroplasty due to a hip fracture in 2017 died within 90 days of the injury. The proportion for women is 8%. Even in recent years these figures have remained constant. In the population, an 85-year-old has on average a remaining life expectancy of 5.5 years (men) and 6.5 years (women) and a hip fracture is therefore a sign of poorer health and represents a tangible threat to life.

Male gender is a risk factor for reoperation according to analyses in Chapter 12, Fracture treatment with total hip arthroplasty or hemiarthroplasty.

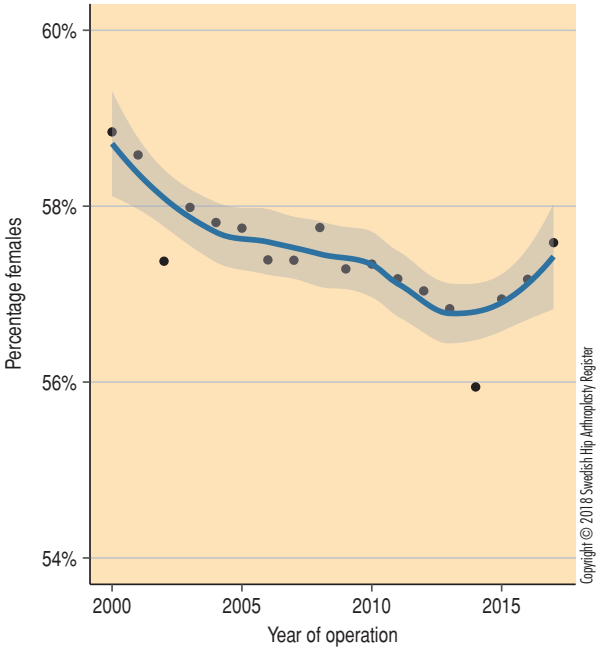


Figure 3.3.1. Proportion women among total hip arthroplasties over time.

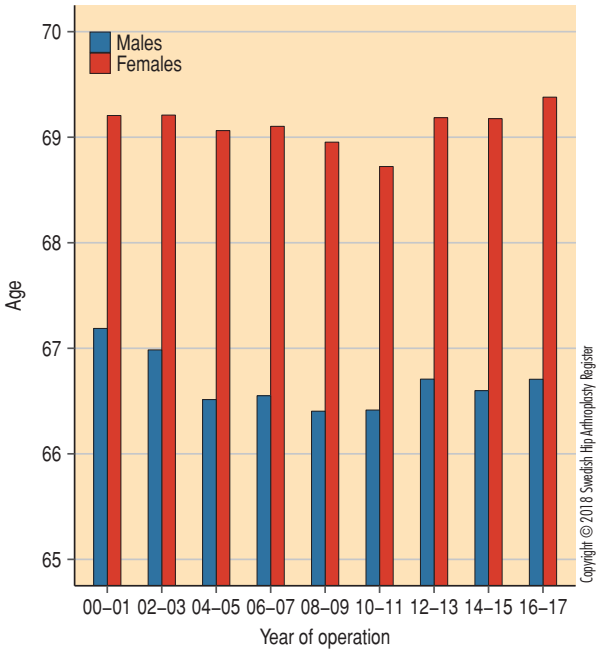


Figure 3.3.2. Mean age for men and women with total hip arthroplasty, 2-year intervals 2000–2017.

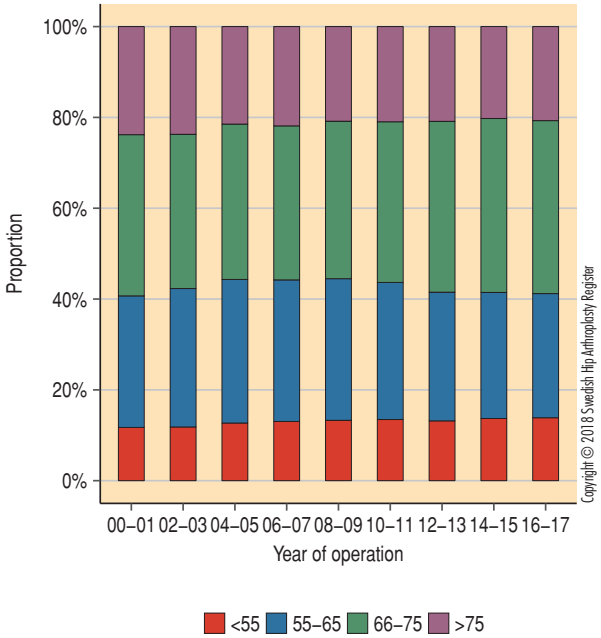


Figure 3.3.3a. Age-distribution divided into four age groups for men, presented by 2-year intervals for the period 2000–2017.

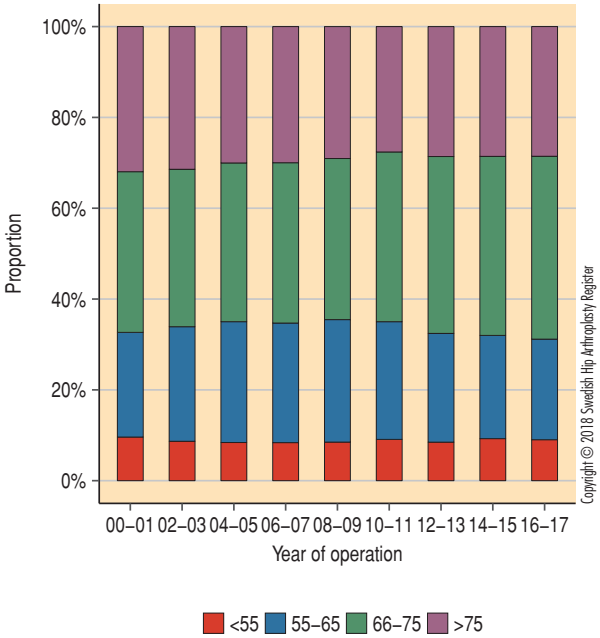


Figure 3.3.3b. Age-distribution divided into four age groups for women, presented by 2-year intervals for the period 2000–2017.

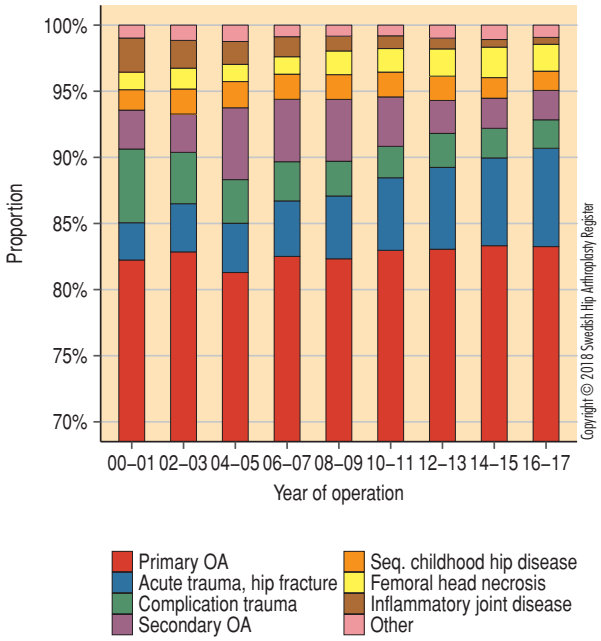


Figure 3.3.4a. The distribution of diagnoses for men, presented by 2-year intevals for the period. Note that the y axis does not start at 0%.

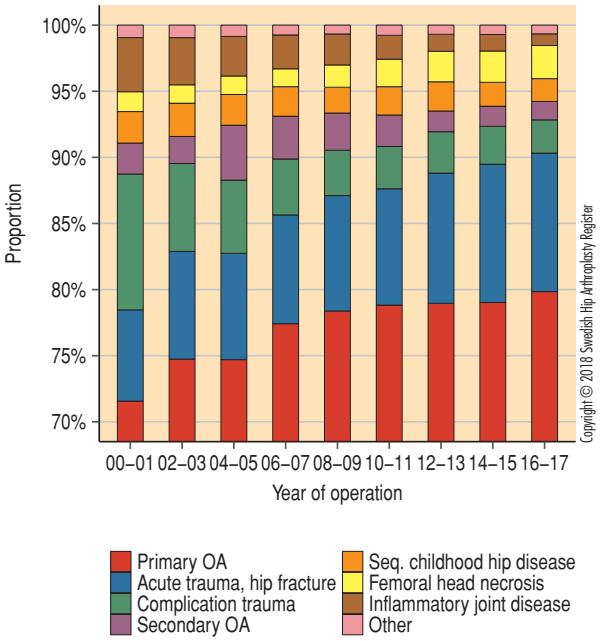


Figure 3.3.4b. The distribution of diagnoses for women, presented by 2-year intevals for the period. Note that the y axis does not start at 0%.

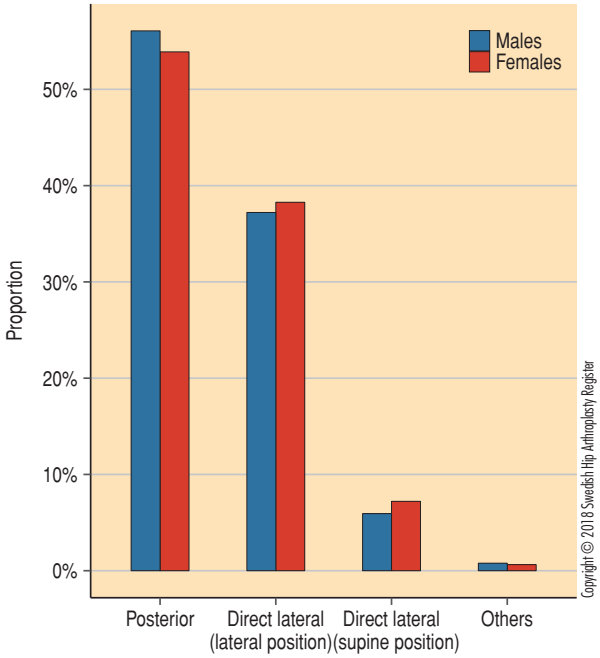


Figure 3.3.5. The distribution of surgical approaches for men and women during 2015–2017.

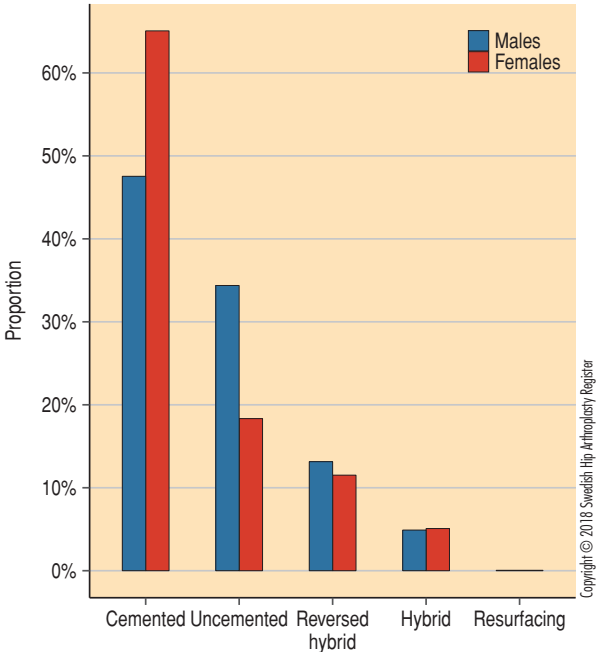


Figure 3.3.6. The distribution of fixation types for men and women during 2015–2017.

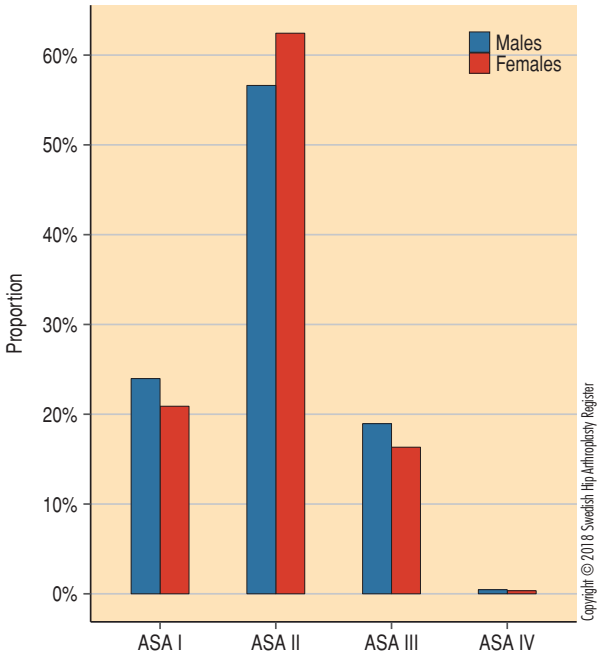


Figure 3.3.7. The distribution of ASA classes for men and women during 2015–2017.

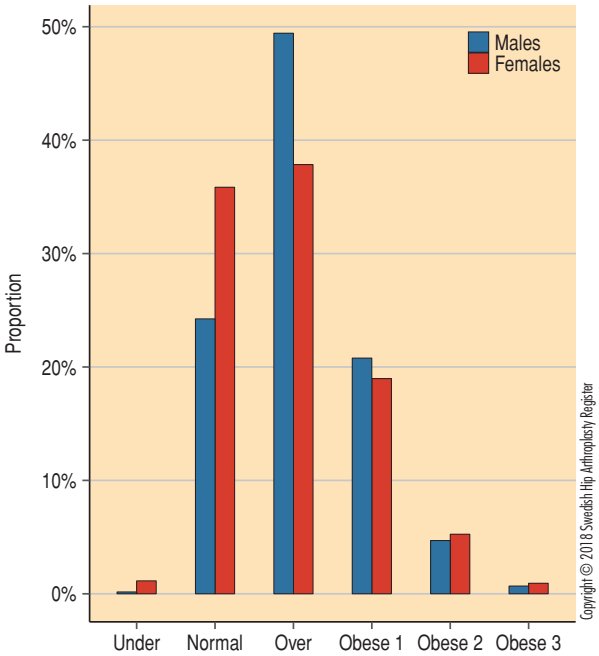


Figure 3.3.8. The distribution of BMI for men and women during 2015–2017. (Underweight is defined by BMI < 18.5, normal weight 18.5–24.9, overweight 25.0–29.9, obese 1 30.0–34.9, obese 2 35.0–399 and obese 3 > 40).

4 Register development, improvement work and research

4.1 Implant manufacturer application

Multiple groups in the community have an interest in the outcome of hip arthroplasties. The patient and the healthcare system are naturally key stakeholders but there are also other parties that are interested in the outcome, such as researchers and implant companies. An ongoing dialogue between implant manufacturers and the Hip Arthroplasty Register benefits industry, and ultimately the patient, in the form of improved product quality.

To promote this interaction, the Hip Arthroplasty Register in 2017 developed a specific data application for the implant industry. The Register previously had a similar, albeit simplified, variant of this service now had the opportunity to develop the functionality and the interface. The application is based on the Stratum IT platform and R-programming.

The Hip Arthroplasty Register was set up in 1979 although collection of data on article number level did not commence until 1999. Experience and data from the past 18 years has made it possible for the Register to launch this type of application, which involves an enormous amount of data. The implant manufacturer application currently provides access to more than 350,000 primary operations, more than 1 million registered inserted components, and more than 6,000 unique articles.

The application comprises four modules, where each company can view its own data in comparison with national data. The 'Volume' module offers access to information about the number of implants inserted on article number level at different units in Sweden. In the 'Revision outcome' module, it is possible to follow on article number level how many articles have been revised during a given time period. In the third module, 'Implant survival', survival is visualised for the implants in the form of an implant survival graph. In the fourth and final module, it is possible to access market shares for different article types on a regional level. Market shares only refer to implants used in primary operations.

To access the app, companies are offered the opportunity to subscribe to the service. Authorisation to access each company's data is controlled via an electronic personal identification system widely used in Sweden, Mobile BankID.

The purpose is for the implant industry, by using register data, to be able to improve its products and services by following up use of implants and analysing complications in the form of revisions.

Hampus Stigbrand, consultant orthopaedic surgeon and responsible for arthroplasties at the ortopaedic unit in Gävle.

4.2 From worst to above the national average through systematic improvement work

Charlotta Sjöstedt

During the period 2009–2012, the orthopaedic unit in Gävle had 5.7% reoperations within two years following primary hip arthroplasty. This was the second-worst figure in the country. A systematic improvement programme with the aid of the Hip Arthroplasty Register has produced results. During the period 2014–2017, the proportion had fallen to 2.1%, which was slightly above the national average.

"Over a two-year period, we continuously and systematically examined our reoperations. At an extended physician's meeting once a year, we categorise all such cases. We noted that dislocations and infections have been a problem," said Hampus Stigbrand, consultant and the person responsible for arthroplasty at the unit.

The changes that need to be made are discussed at section meetings, which are held three times a year. The meetings are attended by doctors, physiotherapists, and contact secretaries. The unit quality enhancement programme has benefited greatly from the recommendations made by the Hip Arthroplasty Register.

"One of the strengths of Swedish Orthopaedics is that we are operationally very cohesive and that we can produce such clear recommendations. Consequently, it is relatively simple to develop the work processes. We are slightly spoiled by having such a highly efficient Hip Arthroplasty Register," said Hampus Stigbrand.

To reduce dislocations, surgeons have started to insert prostheses with a larger caput. They also use dual-articulation cups to a greater extent, and they endeavour to make an anterior approach in conjunction with a fracture indication when the patient is suffering from dementia.

Infections is highlighted

A whole series of changes have been made to reduce the risk of infection.

"We are more aware of the problem, we check the surgical wounds more closely, and we make more frequent use of cement with two different types of antibiotic additives," said Hampus Stigbrand.

In other respects, healthy patients who have undergone routine operations have their stitches removed by a primary care provider. Patients who have been revised, or who have a risk factor for deep infection following arthroplasty, have their stitches removed at the orthopaedic unit, which allows a check to be made to ensure that everything is satisfactory.

Hampus Stigbrand explains that the Hip Arthroplasty Register annual reports have been an excellent source of support when working with infections. Among other things, the Gävle unit has focused on comparisons of different treatment strategies in relation to deep infection following arthroplasty.

"One-stage procedures in conjunction with a deep infection following arthroplasty appear to be safe and produce good results. This appeals to us, and it offers encouragement. We can improve the effectiveness of our work enormously, both for the patients and for the healthcare system, if we strive to guide the process towards more One-stage procedures without this having a negative impact on the result," said Hampus Stigbrand.

Better PROM results

The Gävle unit PROM results one-year postoperatively have also moved in the right direction. The improvement can be noted primarily in the results between 2011–2012 and 2013–2014. This applies to self-assessed health, hip pain, and in particular how satisfied the patients were with the results of the operation. Hampus Stigbrand explains that a number of years ago a special initiative was undertaken to improve the PROM results.

"The patients who were very dissatisfied with our care were called by a secretary. They then had the opportunity to explain what they were dissatisfied with. We found out that the dissatisfaction was, partly, related to how the patient experienced the staff's attitude, an issue that we could address directly. The Gävle unit also sends out its own questionnaire on a regular basis, giving patients who have undergone hip arthroplasty the opportunity to answer questions about the way they were treated, the information that was provided, pain relief, and other similar issues. The responses are used to improve the way we work."

Many operations per inhabitant

In the county of Gävleborg a comparatively large number of hip arthroplasties are carried out in relation to the population. It was suspected that the indication base for the operations was too broad. With the aid of preoperative PROM data, Hampus Stigbrand and his colleagues conducted a review. It emerged that in the lead-up to hip arthroplasty, the average Gävleborg patient reports poorer health, poorer mobility, and more pain than the national average.

"We cannot say for sure why we perform so many hip arthroplasties, but there does not appear to be an indication shift, which reassuringly we could see from the Register data," said Hampus Stigbrand.

4.4 Long-term results following total hip arthroplasty

On March 23, 2018, Peter Cnudde defended his thesis 'Longitudinal outcomes following total hip replacement'. The thesis is based on data from the Hip Arthroplasty Register and on what is termed a multistate analysis. It summarises trends within hip arthroplasty, analyses long-term mortality, and examines over time the likelihood of an operation on the other hip, reoperation, or dying.

Linking data from the Hip Arthroplasty Register with the Statistics Sweden and the National Board of Health and Welfare registers

The good data quality in the Hip Arthroplasty Register opens up considerable potential for studying results and factors that are of significance to the outcome of hip arthroplasty. Linking the register with data from Statistics Sweden and the National Board of Health and Welfare with the aid of personal identity numbers, presents further potential for research in this area. This method of studying outcome or monitoring the morbidity trend has attracted considerable interest worldwide. Following an approved ethics application, a research database was created using data from the Hip Arthroplasty Register, Statistics Sweden, and the National Board of Health and Welfare. This integrated dataset offered an opportunity to study outcome and factors associated with outcome in combination with factors related to patient characteristics, surgical factors and socio-economic conditions. The research database forms the cornerstone for the development of a decision support personal identity numbers. The thesis was founded on this research database in order to study trends within hip arthroplasty in Sweden and to conduct a multistate analysis where a timeline from a hip perspective was set out from the first total hip arthroplasty through to death or the end of the study period. As a result of the Linkage process, we were able to analyse trends between 1999 and 2012.

Trends

The first article in the thesis, dealing with hip arthroplasty trends, presents descriptive statistics and real-time observations of changes in demography, technology, implants, fixation, and outcome. The article could be regarded as a summary of data published in the Hip Arthroplasty Register annual reports. Between 1999 and 2012, the number of total hip arthroplasties in Sweden rose by 50%, and in 2012 almost 16,000 total hip arthroplasties were performed. The clinical indication for the majority of these operations was primarily osteoarthritis, and the proportion of patients with this diagnosis increased between 1999 and 2012 (83% in 2012). The average patient age at the time of the operation fell (68.8 years in 2012). The biggest increase was in the age group 61–70 years. We also noticed an increase in the number of patients with a higher ASA classification, i.e. increased comorbidity. Surgical factors have changed, including a reduction in the care time, an increase in the proportion of operations where use is made of a lateral approach in a lateral position, and an increase in the use of uncemented

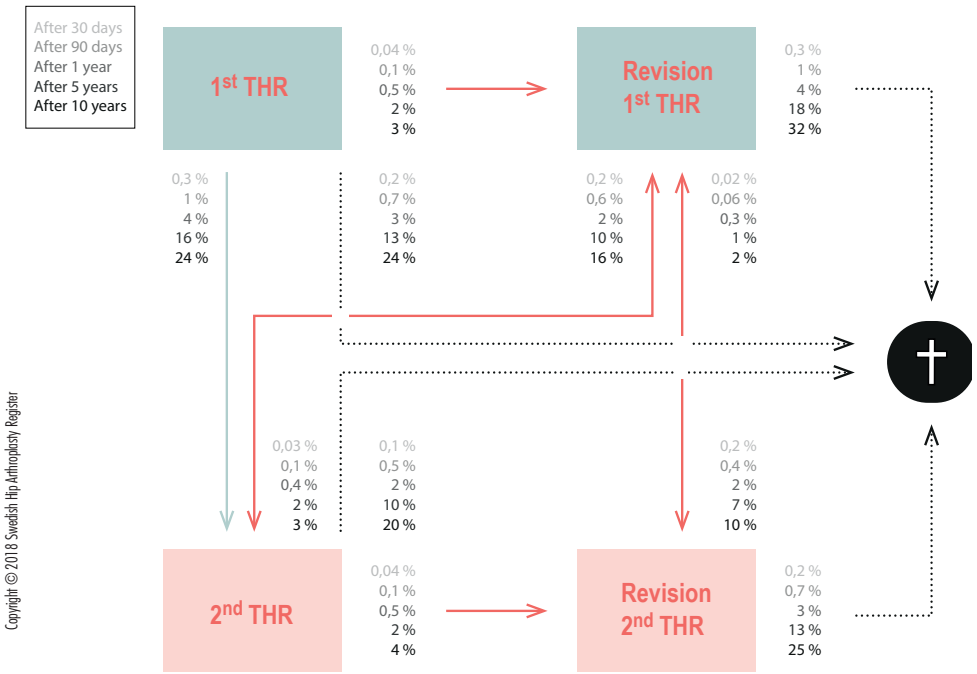


Figure 4.4.1. The probability of having transitioned from one state to another at different time points. THR = total hip replacement

fixation (from 2% to 16%). The reoperation rate within two years has fallen. There is, however, a minimal albeit statistically significant increase in reoperations and revisions after both 30 days and 90 days. The 90-day mortality rate has been reduced from 1.1% in 1999 to 0.7% in 2012. There has been a slight improvement in all patient-reported outcome variables (hip pain, health-related quality of life, and satisfaction). The reduction in postoperative mortality, improvement in the number of revisions and reoperations, and a positive patient-reported outcome, indicate that the work being done by the Hip Arthroplasty Register, in combination with feedback to the profession and healthcare organisations, has improved care provision through the use of evidence-based methodology.

Multistate analysis – a new way of understanding the probability of different hip-related events

Many studies have shown that the majority of patients who have undergone hip arthroplasty live a good life and that they are free of complications after their first hip arthroplasty. There are, however, patients who need to undergo an operation on the same hip again, or on the other hip. We have previously shown that one in four patients may need to undergo an operation on the other hip during the remainder of their lifetime. New statistical techniques, in combination with high-quality data and improved software and hardware, has made it possible, using multistate analysis, to create a timeline with probabilities for different hip-related events. Multistate analysis has been developed with the aim of being able to study transitions between different phases, and it has proved to be valuable for other medical diagnoses and interventions. The analysis has made it possible to describe three statistical metrics: (1) The risk of moving from one stage to another; (2) the probability of movement; and (3) the probability of remaining at one stage. This makes it easy to present and increase our understanding of what to expect after undergoing hip arthroplasty. The thesis includes a pedagogical graphic presentation of the probability of finding oneself at a particular stage at a certain point in time, as well as the probability of moving to another stage (Figure 4.4.1). This aroused considerable interest when it was presented at different congresses. This knowledge can be used to improve our understanding, guide patients in terms of expectations, and facilitate future value-based care. Five different phases are used for the multistate analysis: Primary total hip arthroplasty, total hip arthroplasty on the other hip, revision of the first total hip arthroplasty, revision of the total hip arthroplasty carried out on the other hip, and death. During the study period, 1999–2012, it was twice as likely that a patient would undergo a primary hip arthroplasty on the other hip than die. We also saw that it was 7.5 times more likely that the patient would undergo surgery on the other hip rather than undergo a further operation on the hip that was operated on first. As expected, it was more probable that women had to undergo a bilateral operation, and that women ran a lower risk of being revised or dying prematurely. Comorbidity, measured using Elixhauser's comorbidity index, influenced some of the transitions. A higher index was associated with an increased risk of a revision, an increased risk of death, and an increased risk of death following a revision. Socioeconomic status, based on the highest level of education, influenced a number of the transitions. Lower socioeconomic status was associated with a lower proportion of bilateral procedures, increased mortality, and an increase in the risk of a revision. Other surgical factors had no impact on the risk of moving from one stage to another, with the exception of posterior approach during the primary operation in patients who had undergone bilateral operations.

In summary, the studies allowed in in-depth analysis to be made of trends within total hip arthroplasty in Sweden, and we could identify continuous improvements in results despite differences in the procedure and patient characteristics. With multistate analysis, we have a reliable means of identifying and describing a sophisticated and easily understood timeline from the first elective total hip arthroplasty, and how factors related to the surgical method employed and demographic/socioeconomic features affect the outcome.

5 Register work from an international perspective

5.1 International studies

Sweden has been part of several collaborative research projects with other international registers during 2017. Through collaboration with the Australian Arthroplasty Register we identified differences in the risk for a revision when trabecular metal cups were used in revision and primary hip replacement. Findings from these studies will perhaps result in more a moderate use of this new cup design which probably will contribute to a reduction in the risk of reoperation, both in Sweden and internationally. In a collaboration with Kaiser Permanente Register a new method for analysing data on an aggregated level was presented. This new method is expected to facilitate future international collaboration as there will no longer be a need to provide data related to individual surgeries from different registers. During 2017, the Register was involved in research collaboration linked to 20 cities in the Nordic region (Figure 5.1.1) and a further 13 cities in the USA, Europe, Australia, and New Zealand (Figure 5.1.2). Finally, the Hip Arthroplasty Register, together with other registers, took part in a symposium at the major international meeting of the American Academy of Orthopaedic Surgeons in 2018, during which the significance of the register in national improvement work was highlighted.

Figure 5.1.1. Collaborations in Sweden and other Nordic countries.

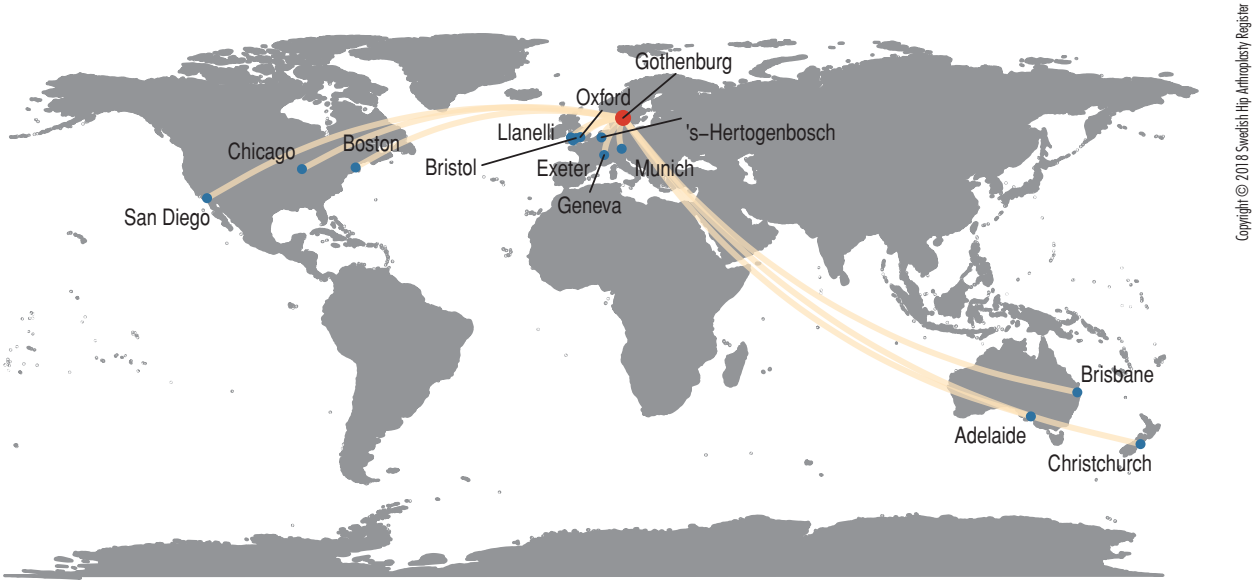


Figure 5.1.2. International collaborations..

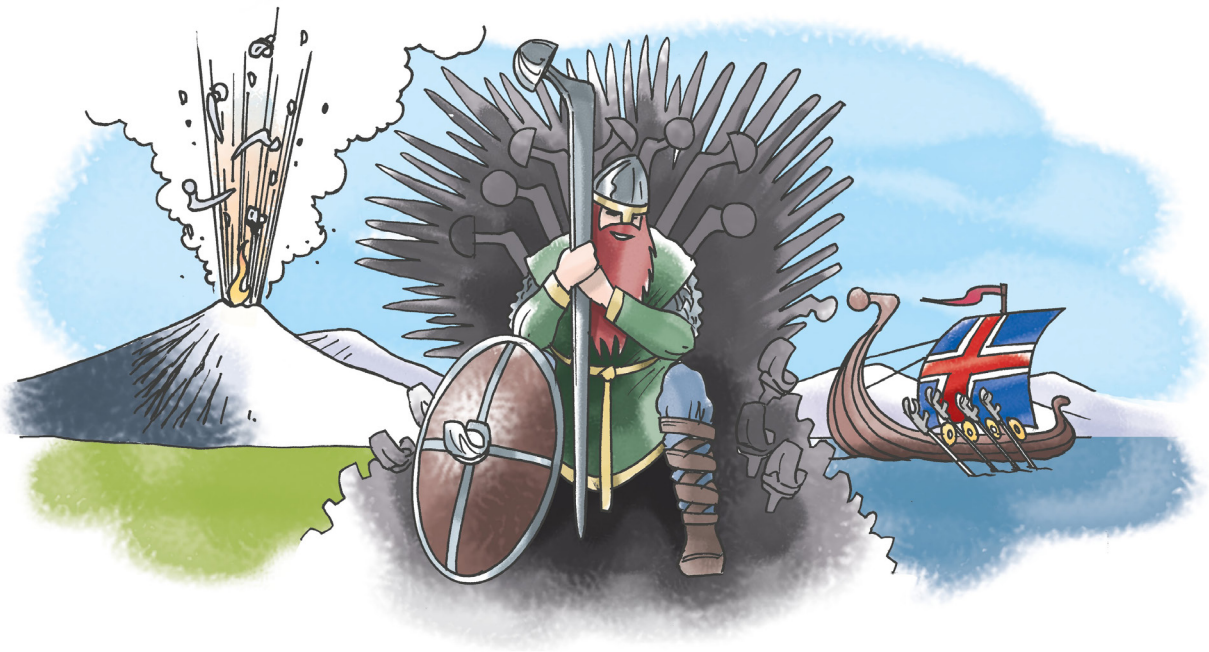
5.2 ISAR Congress 2018

The seventh International Society of Arthroplasty Registries (ISAR) was arranged during 8-11 June 2017. Otto Robertsson hosted the Congress in Reykjavik in Iceland. It was attended by 185 delegates from 22 countries, representing 27 registers. In total, 167 presentations were accepted, either as poster presentations or lectures. During the three days, new register-based research was presented, interspersed with statistical methods, collaboration with industry, future register research, and clinical application of the results. The presentations were followed by interesting and constructive discussions. The Swedish Hip Arthroplasty Register was contributed with 13 lectures during the Congress.

During the statistics session there was a discussions on use of cumulative incidence and Kaplan-Meier estimates when reporting implant survival where Adrian Sayers (from the National Joint Registry (NJR) made a much-appreciated presentation on the subject, entitled 'Death as a competing risk in registry data'. Several presentations addressed the issue of whether there is a link between surgery and the volume and results of operations at the unit and the best way of providing feedback of the results to the surgeon. This is an area in which the Swedish Hip Arthroplasty Register has appointed a work group. One of the sessions focused specifically on infections and included a discussion about the difficulty comparing results between registers and units as there is a disparity in variables being reported but also how to infection is defined.

Surgical approach was another subject that was dealt with in several presentations. The Kaiser Permanente register presented the short-term advantages of a direct anterior approach with regards to dislocation, and the results from the Hip Arthroplasty Register indicated that a posterior approach is not associated with greater risk of dislocation. The Netherlands showed that a direct anterior and posterior approach led to improved patient-reported results compared with a direct lateral and anterolateral approach Several presentations dealt with the complexity of predicting patient satisfaction following hip arthroplasty, and it appears as if more advanced models are needed for this type of simulation, if this is indeed possible. The 'International Prosthesis Library' was also presented during the meeting. The library covers all hip and knee prostheses on the market, complete with a uniform classification of the features of the different prostheses. ISAR has worked for several years to produce this database, which is on a user-friendly internet application. The library will be made available to all prosthesis registers, allowing them to analyse prostheses uniformly on an international level.

After two years as president of ISAR, Richard de Stieger handed over to Liz Paxton from Kaiser Permanente. Ola Rolfson was elected as president elect and will take over as chair in two years' time. The next Congress will be held in Leiden in the Netherlands on June 1–3, 2019. The year after, the Congress will be held in Australia.



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6 Primary prosthesis

The Register's work with developing a new database structure led to adopting a new module for entering data at the beginning of 2017. In order to simplify the work with data and generate real-time reports about respective units this new database is planned to include operations from year 1999. In the annual reports, we will therefore mainly present the relevant primary arthroplasties performed after 1999. The Register's report is built upon a large number of analyses. For the sake of clarity, they are not always presented in their entirety. This year's report presents most of the results, such as Kaplan-Meier survival analysis or regression analysis, usually Cox proportional hazard regression. Kaplan-Meier statistic, which is used in the annual report, describes the proportion of patients, which after a certain number of years, has not been affected by re-operation. Data is presented in proportions, including a 95% confidence interval (C.I.). Regression data is presented with the help of risk ratio (risk ratio, relative risk). Risk ratio describes the degree of increased or decreased risk of the selected outcome (typically revision) compared to the reference group. The risk for the reference group is routinely set to 1.0. If the risk ratio for getting a revision is 2.0, it means that the risk is doubled for the group in question. An increased or decreased risk should be related to the outcome in the reference group. The clinical meaning of a doubled risk has an entirely different significance if in one out of 1000 cases the reference group is revised by 10 years, compared to a reference group, which is revised, by 100 of 1000 cases. In the first scenario indicates a doubling that two hips are expected to suffer a revision in the study group. In the other case, it is about 200. Risk ratio is shortened to RR and indicated here with one decimal and 95% confidence interval (C.I.). The further away the confidence intervals upper and lower limits are from 1.0, the safer it is to say that it differs from the comparison group.

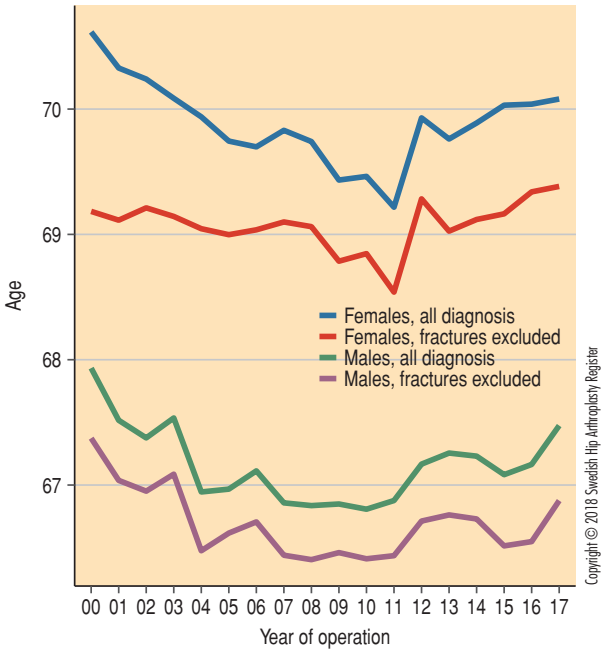

Figure 6.1.1 Trends for average age.

6.1 Demographics

During recent years, the number of registered primary prostheses has, more or less, continuously increased. In 2017, 18 140 primary prostheses were reported, which is an increase of 5% in comparison to the previous year. In 2017, the average age for men was 67.5 and 70.1 for women. From 2000 until 2010–2011, average age has decreased for both genders. During the following years the mean age has successively increased. The same trend is noticeable even if fracture diagnosis is excluded (Figure 6.1.1).

6.2 Diagnosis

The most common reason for total hip arthroplasty is primary osteoarthritis. Since 2000 the proportion of patients operated due to primary osteoarthritis has increased from 75% and was 81 % in 2017. Men dominate this diagnostic group while the relative proportion of women is higher in all the major groups of secondary osteoarthritis. The proportion of patients with an inflammatory joint disease has been substantially reduced since 2000, and in 2017, 0.7% were operated due to this diagnosis. Figure 6.2.1 illustrates the age distribution for the most common diagnosis groups. In general, the mean age at surgery is higher among women than in men. The only exception is the sequelae after hip disease during adolescence (childhood sequelae), where the mean age for both genders is rather similar.

6.3 BMI and ASA classification

Reporting of BMI (Body Mass Index) and ASA class (American Society of Anaesthesiology Physical Status Classification System) to the Swedish Hip Arthroplasty Register began in 2008. For the first year, there was data for 82% and 90% of cases regarding BMI and ASA, respectively, and reporting has continued to improve. In 2017, BMI was reported in 97% and ASA class in 99% of cases.

During the last five years, the mean value for BMI has stayed relatively constant (Table 6.3.1). Possibly, there is a slight tendency towards increasing proportion of patients with different degrees of obesity (BMI ≥30).

Comparison of BMI between diagnostic groups shows, that overweight tends to be most common in groups with primary osteoarthritis, and normal weight and underweight in groups with fracture (Table 6.3.2).

Regarding ASA class, the proportion of healthy patients (class I) continues to decrease as the proportion of patients mainly in class III-V (serious or life-threatening illness) increases (Table 6.3.1). The healthiest patients (according to ASA) can be found in the group with sequelae after hip disease during childhood and the sickest can be found in the group, which undergo operation due to fracture (Table 6.3.2). The trend towards an increasing number of patients with higher ASA class over time could partially be explained by the fact that the proportion of patients with fracture is increasing, although it is also possible, that there are other causes.

As the various diagnostic groups differ, for example, with respect to age, these groups also have different distribution of BMI and ASA class. The highest mean value for BMI can be found in the group with primary osteoarthritis and the lowest in the fracture group. The highest proportion of patients with ASA class III/IV can be found in the fracture group, and the lowest proportion in the group with sequelae after hip disease during childhood.

6.4 Prosthesis selection

Cemented fixation is more common in Sweden than in other Scandinavian countries. Poor results with uncemented fixation during the 1990s resulted in completely cemented fixation reaching a peak of 93% at the turn of the millennium. Hereafter, cemented fixation has declined every year (Figure 6.4.1). During 2017, the proportion of cemented prostheses was 60%. Completely uncemented fixation has instead become ever more common. In 2000, completely uncemented prostheses constituted 2 %. The corresponding proportion in 2017 was 24%. The increase of uncemented fixation has mainly occurred in under 60 age groups, but also in patients who are 60 and older. Since 2012, the proportion of hybrid prostheses (cemented cup, uncemented stem) has decreased. The proportion of hybrid prosthesis (uncemented cup, cemented stem) has during a 10-year period been small and increased during 2007–2010 to about 1.5%, subsequently, a slow increase has occurred, up to 5% in 2017. Resurfacing prostheses were used five times during surgery in 2017. The increased use of uncemented implants in Sweden, mainly among patients older than 70, may be seen as remarkable since the existing data from several international registries does not support using uncemented fixation among this patient group.

Since there is no data supporting the use of uncemented implants for elderly patients the use of such implants for patients older than 70 years should be restricted.

6.5 Most commonly used prosthesis

In 2017, five of the most popular cemented cups account for 91% of the total number of cemented cups inserted in Sweden. Regarding stems, Lubinus SP II, Exeter and MS 30 together constitute more than 99% of all cemented stems.

Selection of uncemented cups shows a greater variation, five typical uncemented cups accounted for 67% of the total. The proportion of cups with trabecular coatings continues to increase. Given the uncertainty, which arose when individual studies report on formation of radiological zones around certain cups with trabecular titanium coating and the increased risk for dislocation for trabecular tantalum cups, in the Register, we would once again urge caution when using trabecular cups, if not absolutely necessary waiting studies with longer follow-ups.

Concerning uncemented stems, the diversification is less pronounced than among cups. Since 2009, the Corail stem has been the most common uncemented stem. The Corail stem is used in 59% of all uncemented stem designs reported to the Register during 2017.

Proportion of BMI and ASA class

selection of diagnosis groups

	Primary osteoarthritis, %	Acute trauma hip fracture, %	Complication trauma, %	Femoral head necrosis, %	Others, %
BMI					
Underweight < 18.5	0.5	4.1	6.4	3.6	2.3
Normal weight 18.5–24.9	30.1	54.5	56.8	37.1	37.1
Overweight 25–29.9	43.3	31.4	26.7	35.5	38.2
Obese I 30–34.9	20.3	7.5	8.1	17.6	16.3
Obese II–III 35+	5.6	2.4	2.0	6.2	5.9
ASA class					
Healthy (I)	21.5	8.9	8.7	11.6	24.4
Mild systemic disease (II)	61.1	52.0	45.9	54.2	49.9
Serious/life threatening illness (III–V)	17.4	39.1	45.4	34.2	25.7

Table 6.3.2

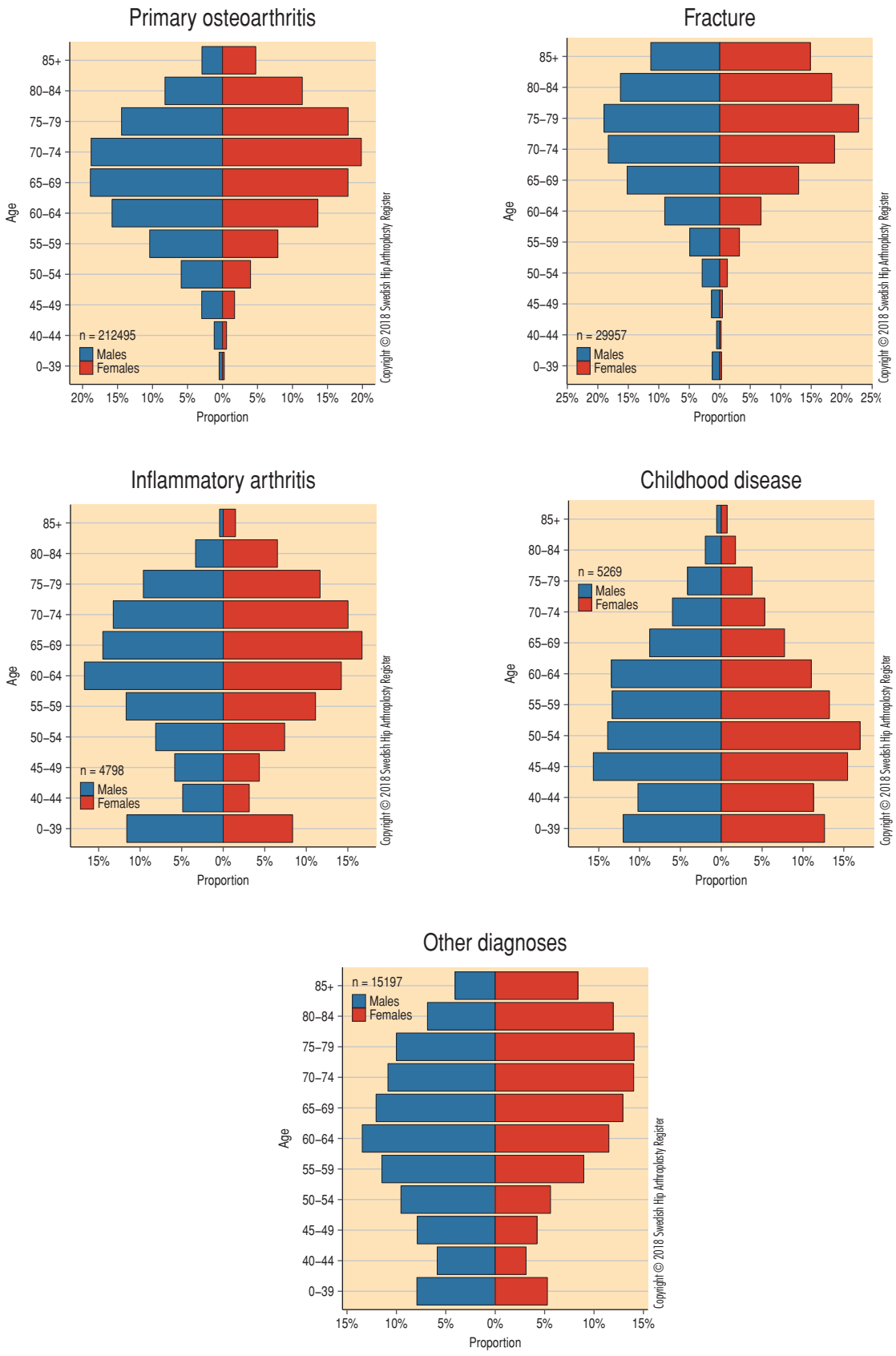

Figure 6.2.1 Age and gender distribution for different diagnosis groups.

Change in BMI and ASA classification in selected years

2013–2017

	2013	2014	2015	2016	2017
BMI					
Existing observations/missing observations	16 350 / 824	16 563 / 817	16 631 / 598	17 263 / 575	18 140 / 540
Average – median					
Men	27.6–27	27.5–26.9	27.6–27.1	27.7–27.2	27.6–27.1
Women	26.7–26.1	26.7–26.1	26.8–26.1	26.7–26.1	26.8–26.2
Underweight < 18.5					
Men, %	0.6	0.4	0.5	0.3	0.3
Women, %	1.8	1.7	2.0	1.8	1.6
Normal weight 18.5–24.9					
Men, %	28.1	27.6	26.2	26.8	26.9
Women, %	38.3	38.1	38.2	38.2	37.5
Overweight 25–29.9					
Men, %	47.4	48.1	48.8	47.3	48.3
Women, %	37.4	37.1	36.7	36.9	36.8
Obese I 30–34.9					
Men, %	19.3	19	19.6	20	19.5
Women, %	16.5	16.9	17.0	17.8	18.3
Obese II–III 35+					
Men, %	4.5	4.7	4.8	5.3	4.8
Women, %	6.0	6.1	6.0	5.1	5.7
ASA class					
Existing observations/missing observations	16 350 / 285	16 563 / 352	16 631 / 232	17 263 / 186	18 140 / 184
Percentage					
Healthy (I)					
Men, %	24.7	23.0	23.4	22.5	21.6
Women, %	21.3	20.8	19.9	19.4	18.9
Mild system disease (II)					
Men, %	55.3	56.4	55.0	55.6	55.6
Women, %	60.4	60.2	60.3	60.4	61.8
Serious/lifethreatening illness (III–V)					
Men, %	20.0	20.6	21.6	21.9	22.8
Women, %	18.3	18.9	19.8	20.2	19.3

Table 6.3.1

Figure 6.4.1 Trends for fixation methods.

6.6 Articulation

For uncemented cups, almost exclusively highly cross-linked polyethylene liners are being used (98% of all operations in 2017). With regards to cemented cups, highly cross-linked polyethylene is used in 82% of cases during 2017.

The proportion of cups with highly cross-linked polyethylene continues to increase (Figure 6.6.1). During 2017, highly cross-linked polyethylene was used at 87% of all hip replacement procedures. The combination of ceramic femoral head-ceramic insert shows also a small increase, from 18% in 2016 to 20% in 2017. Most often, femoral head with a diameter of 32 mm is used. The proportion of femoral head with 36 mm diameter was 11% during 2017. The trends regarding the choice of the different articulations and head sizes are visualized in Figures 6.6.1 and 6.6.2.

6.7 Implant combinations

The most common implant combinations are presented in tables starting from page 35. In the cemented group the use of the combination of Lubinus SP II stem and Lubinus cup is most common. In the uncemented group, the combination of Corail-Pinnacle and W/Gription 100 is increasing. There are also changes in the group for reversed hybrids and hybrids. With several of these combinations, implants from different manufacturers are used. This practise has developed over a long period of time, although it is not recommended by most of the manufacturers. There is also long-term data for several of the implant combinations which have proven to function well. On the Swedish market, there are many manufacturers/importers who provide cups only from a specific manufacturer, but do not provide a stem from the same producer.

6.8 Surgical approach

Since 2005, posterior approach in side position and lateral supine or side position approaches have dominated in Sweden and during 2017, one of these surgical approaches was used in 99% of performed total arthroplasties. The posterior approach in lateral position is still the most common (54%). Lateral approach on the side position was used in 38% of all surgeries and the proportion for lateral approach on the supine position was 7%. Mini-approach and Watson-Jones approach and direct lateral/posterior approach in combination with trochanteric flip osteotomy are only used sporadically. The proportion of the three most used surgical approaches shows no significant variation during the last five years (Figure 6.8.1).

Table 6.8.1 shows the proportion of reoperations within three years. Here, instead of revision, reoperation has been used to include open reductions following dislocations and fractures which have been treated with only osteosynthesis. The highest frequency for reoperations is found in the two groups operated with a mini-approach. In both groups, the proportion of uncemented implants is high, which is likely to affect the risk for reoperation (Table 6.3). The slightly higher risk of

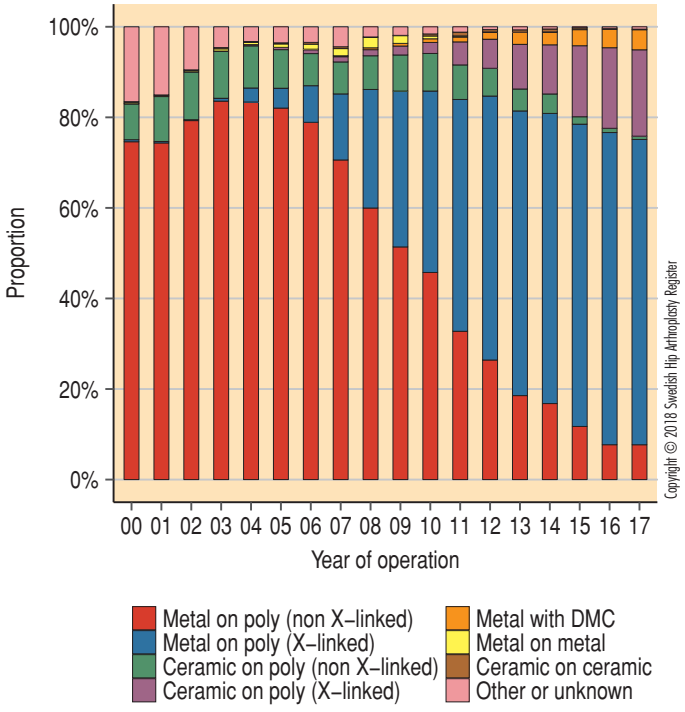

Figure 6.6.1 Trends for articulation.

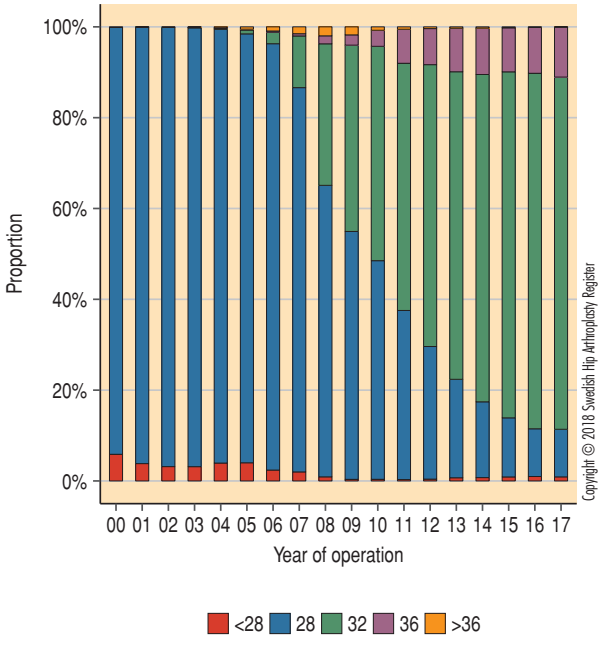

Figure 6.6.2 Trends for femoral head size.

Demographics, fixation method and proportion of reoperated patiens in relation to surgical approach

2000–2017

Surgical approach	Number	Proportion of women, %	Proportion of primary osteoarthritis, %	Proportion of operations with uncemented cup, %	Proportion of operations with uncemented stem, %	Proportion reoperated, %
Posterior approach in lateral position (Moore)	143 251	57.5	81.5	16.7	20.7	2.1
Direct lateral						
Lateral position (Gammer)	101 994	59.8	77.7	19.7	24.0	2.3
Supine position (Hardinge)	17 379	63.5	76.6	4.6	25.0	2.2
Mini-approach						
MIS/1-approach front	796	62.7	86.3	69.6	66.2	3.6
MIS/1-approach, back	415	53.7	76.9	48.9	53.7	2.7
MIS/2-approach	46	47.8	82.6	54.3	60.9	6.6
Watson-Jones (original)	479	53.7	77.5	44.7	56.8	2.5
Trochanter osteotomy						
Direct lateral	439	61.3	66.1	25.3	31.7	3.3
OCM-approach	52	30.8	92.3	90.4	94.2	1.9
No data	2 863	60.4	68.2	16.5	11.3	2.6

Table 6.8.1

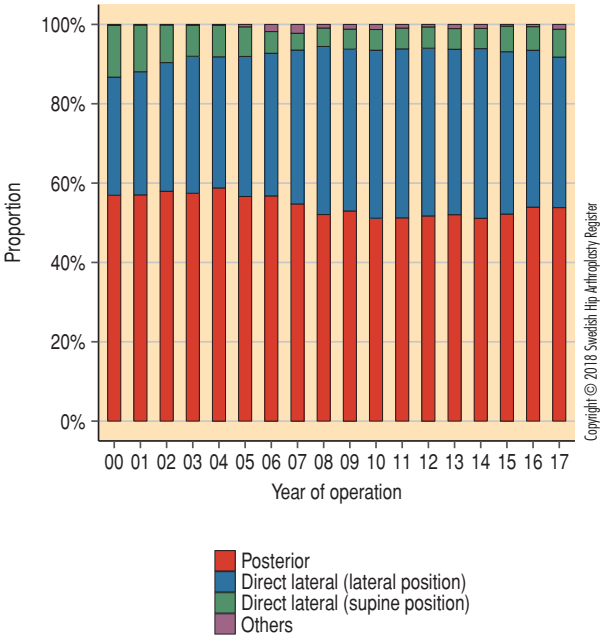

Figure 6.8.1 Trends for approach.

reoperation within two years in the group for lateral approach may be explained by the fact that more patients with secondary osteoarthritis and especially with hip fracture undergo operation with a lateral approach. The relationship between patient demographics, comorbidity, implant selection and choice of surgical approach is complex. Therefore, the data presented should primarily be seen as descriptive.

15 most common implants

Cup (Stem)	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Lubinus x-link (SPII standard)	2 095	2 523	3 080	4 020	4 595	4 587	18 805	22.1
Lubinus (SPII standard)	61 891	2 626	2 316	1 448	1 024	1 087	8 501	10.0
Exeter Rim-fit (Exeter standard)	2 188	1 194	1 598	1 651	1 647	1 532	7 622	9.0
Marathon (Exeter standard)	4 446	1 272	1 088	1 002	937	944	5 243	6.2
Pinnacle W/Gription 100 (Corail)	86	149	412	568	711	1 326	3 166	3.7
ZCA XLPE (MS-30 polerad)	6 020	1 008	524	740	358	235	2 865	3.4
Marathon (Corail)	1 656	450	392	373	349	234	1 798	2.1
Avantage (SPII standard)	343	203	277	297	378	477	1 632	1.9
Exeter Rim-fit (MS-30 polished)	349	169	120	55	477	750	1 571	1.8
Pinnacle 100 (Corail)	845	311	242	237	284	480	1 554	1.8
Exeter Rim-fit (Corail)	165	80	193	277	423	557	1 530	1.8
Trident hemi (Exeter standard)	220	97	154	273	407	504	1 435	1.7
Lubinus x-link (Corail)	116	181	166	223	391	391	1 352	1.6
Trilogy (CLS)	3 266	183	220	223	277	321	1 224	1.4
IP Link (SPII standard)	75	48	165	222	351	364	1 150	1.4
Other	99 006	5 856	5 616	5 022	4 654	4 351	25 499	27.6
Total	182 767	16 350	16 563	16 631	17 263	18 140	84 947	

[1)] Refers to the number of primary total hip arthroplasty performed the last five years.
[2)] Refers to the proportion of the total number of total hip arthroplasty performed during the last five years.

15 most common cemented implants

Cup (Stem)	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Lubinus x-link (SPII standard)	2 095	2 523	3 080	4 020	4 595	4 540	18 758	35.2
Lubinus (SPII standard)	61 890	2 626	2 316	1 448	1 024	1 083	8 497	16.0
Exeter Rim-fit (Exeter standard)	2 188	1 194	1 598	1 651	1 647	1 522	7 612	14.3
Marathon (Exeter standard)	4 446	1 272	1 088	1 001	937	901	5 199	9.8
ZCA XLPE (MS-30 polished)	6 020	1 008	524	740	358	235	2 865	5.4
Avantage (SPII standard)	341	203	277	297	378	475	1 630	3.1
Exeter Rim-fit (MS-30 polished)	349	169	120	55	477	750	1 571	2.9
IP Link (SPII standard)	75	48	165	222	351	364	1 150	2.2
Contemporary Hoded Duration (Exeter standard)	5 519	383	187	147	127	201	1 045	2.0
Marathon (SPII standard)	255	106	143	139	172	183	743	1.4
ZCA (MS-30 polished)	280	0	338	216	118	56	728	1.4
ZCA XLPE (SPII standard)	2 012	355	64	15	3	1	438	0.8
Polarcup cemented (SPII standard)	132	65	63	87	81	95	391	0.7
ZCA XLPE (Exeter standard)	771	209	100	50	2	0	361	0.7
Lubinus x-link (Exeter standard)	7	67	30	30	70	68	265	0.5
Other	57 842	517	601	262	325	314	2 019	3.3
Total	144 222	10 745	10 694	10 380	10 665	10 788	53 272	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

15 most common uncemented implants

Cup (Stem)	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Pinnacle W/Gription 100 (Corail)	86	149	412	568	711	1 326	3 166	17.4
Pinnacle 100 (Corail)	845	311	242	237	284	473	1 547	8.5
Trilogy (CLS)	3 266	183	220	223	277	321	1 224	6.7
Continuum (CLS)	286	206	210	194	262	266	1 138	6.3
Exceed ABT Ringlock (Bi-metric X por HA NC)	283	220	227	261	233	144	1 085	6.0
Continuum (Corail)	115	152	228	236	319	72	1 007	5.5
Trilogy IT (Bi-metric X por HA NC)	29	133	169	181	167	126	776	4.3
Trident hemi (Accolade II)	44	123	181	146	140	182	772	4.3
Continuum (Wagner Cone)	54	80	134	110	78	144	546	3.0
Regenerex (Bi-metric X por HA NC)	267	78	124	127	131	38	498	2.7
Pinnacle sector (Corail)	284	85	60	68	135	144	492	2.7
Pinnacle W/Gription Sector (Corail)	1	7	46	82	99	212	446	2.5
Trident hemi (Corail)	19	17	87	98	124	38	364	2.0
Continuum (M/L Taper)	39	126	70	40	27	93	356	2.0
Trident AD WHA (Accolade II)	0	32	101	84	57	81	355	2.0
Other	12 704	1 093	959	875	721	738	4 386	22.3
Total	18 322	2 995	3 470	3 530	3 765	4 398	18 158	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

15 most common hybrid implants

Cup (Stem)	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Trident hemi (Exeter standard)	220	97	154	273	407	504	1 435	43.3
Trilogy (SPII standard)	1 168	50	108	65	13	3	239	7.2
Tritanium (Exeter standard)	20	29	28	31	30	41	159	4.8
Pinnacle sector (SPII standard)	5	0	1	36	55	62	154	4.7
Continuum (MS-30 polished)	22	32	36	22	45	6	141	4.3
Trident AD LW (Exeter standard)	23	11	12	17	29	46	115	3.5
Trilogy IT (SPII standard)	0	0	20	36	22	27	105	3.2
Continuum (SPII standard)	11	22	14	8	12	15	71	2.1
Pinnacle W/Gription Sector (Exeter standard)	0	0	9	13	18	26	66	2.0
TMT revision (SPII standard)	22	10	14	13	9	17	63	1.9
Pinnacle 100 (SPII standard)	11	4	3	23	5	9	44	1.3
Continuum (Exeter standard)	14	10	3	4	17	9	43	1.3
Trident hemi (SPII standard)	14	4	12	6	9	10	41	1.2
Pinnacle W/Gription 100 (SPII standard)	0	0	6	6	8	17	37	1.1
Exceed ABT Ringlock (Exeter standard)	12	14	11	4	4	1	34	1.0
Other	2 853	112	72	101	116	163	564	16.4
Total	4 395	395	503	658	799	956	3 311	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

15 most common reverse hybrid implants

Cup (Stem)	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Marathon (Corail)	1 656	450	392	373	349	113	1 677	17.2
Exeter Rim-fit (Corail)	165	80	193	277	421	524	1 495	15.4
Lubinus x-link (Corail)	116	181	166	223	391	391	1 352	13.9
Lubinus (Corail)	1 959	305	269	223	109	88	994	10.2
Marathon (ABG II HA)	295	124	116	141	152	134	667	6.8
Lubinus x-link (Bi-metric X por HA NC)	60	69	95	117	84	74	439	4.5
Marathon (Bi-metric X por HA NC)	554	134	97	77	75	49	432	4.4
ZCA XLPE (Corail)	443	150	64	103	16	0	333	3.4
Lubinus x-link (M/L Taper)	0	34	46	96	85	21	282	2.9
Contemporary Hoded Duration (Corail)	306	186	22	23	22	18	271	2.8
Exceed ABT E-poly without flange (cem) (Bi-metric X por HA NC)	79	64	66	24	12	3	169	1.7
Lubinus x-link (CLS)	15	12	18	32	33	36	131	1.3
Lubinus (CLS)	479	36	18	27	23	24	128	1.3
ZCA (Corail)	1	0	56	63	8	0	127	1.3
Lubinus x-link (Accolade II)	1	15	10	25	27	16	93	1.0
Other	7 563	304	227	218	202	198	1 149	11.6
Total	13 692	2 144	1 855	2 042	2 009	1 689	9 739	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

15 most common cup components

Cup	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2]
Lubinus x-link	2 309	2 916	3 458	4 562	5 348	5 258	21 542	25.4
Exeter Rim-fit	2 795	1 505	1 968	2 056	2 623	2 917	11 069	13.0
Lubinus	65 520	3 015	2 657	1 735	1 187	1 244	9 838	11.6
Marathon	7 901	2 250	1 881	1 777	1 731	1 623	9 262	10.9
ZCA XLPE	10 788	1 786	787	951	388	239	4151	4.9
Continuum	698	696	758	646	774	631	3 505	4.1
Pinnacle W/Gription 100	89	156	429	581	731	1 370	3 267	3.8
Trident hemi	1 208	314	506	656	736	786	2 998	3.5
Avantage	576	305	351	366	478	614	2 114	2.5
Trilogy	8 953	444	570	384	312	333	2 043	2.4
Pinnacle 100	891	317	248	273	300	503	1 641	1.9
Exceed ABT Ringlock	311	277	257	292	274	245	1 345	1.6
Contemporary Hoded Duration	6 735	577	209	170	150	221	1 327	1.6
Trilogy IT	44	222	289	309	283	214	1 317	1.6
IP Link	89	53	194	244	389	383	1 263	1.5
Other	73 860	1 517	2 001	1 629	1 559	1 559	8 265	9.3
Total	182 767	16 350	16 563	16 631	17 263	18 140	84 947	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

15 most common stem components

Stem	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
SPII standard	77 878	6 287	6 514	6 538	6 871	7 091	33 301	39.2
Exeter standard	39 859	3 385	3 375	3 313	3 428	3 480	16 981	20.0
Corail	8 195	2 385	2 559	2 811	3 146	3 671	14 572	17.2
MS-30 polished	7 639	1 252	1 178	1 095	1 062	1 144	5 731	6.7
Bi-metric X por HA NC	5 079	827	861	837	727	457	3 709	4.4
CLS	8 874	645	630	648	750	819	3 492	4.1
Accolade II	47	211	363	349	340	412	1 675	2.0
M/L Taper	44	235	242	254	218	128	1 077	1.3
ABG II HA	2 383	186	193	188	199	188	954	1.1
Wagner Cone	976	156	203	168	134	204	865	1.0
Accolade straight	1 570	170	72	89	31	37	399	0.5
CPT	2 565	106	22	22	32	58	240	0.3
Exeter long	276	32	31	31	24	29	147	0.2
Fitmore	177	58	45	27	8	1	139	0.2
Echo-Bimetric (FPP)	0	0	0	35	87	6	128	0.2
Other	27 205	415	275	226	206	415	1 537	1.6
Total	182 767	16 350	16 563	16 631	17 263	18 140	84 947	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

Number of total hip arthroplasties per diagnosis och year

2000–2017

Diagnosis	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Primary osteoarthritis	143 841	13 088	13 369	13 442	13 995	14 760	68 654	80.8
Acute trauma. hip fracture	12 166	1 436	1 405	1 526	1 615	1 643	7 625	9.0
Complication or sequelae after fracture or other trauma	7 981	486	445	418	403	432	2 184	2.6
Femoral head necrosis	2 948	366	416	360	391	425	1 958	2.3
Other secondary osteoarthritis	5 918	302	302	308	305	310	1 527	1.8
Sequelae after childhood disease in the hip joint	3 793	340	283	282	281	290	1 476	1.7
Inflammatory joint disease	4 056	163	168	152	132	127	742	0.9
Tumour	1 073	102	111	85	81	81	460	0.5
Acute trauma, other	308	40	34	34	33	42	183	0.2
Other	187	11	14	10	9	26	70	0.1
(missing)	496	16	16	14	18	4	68	0.1
Total	182 767	16 350	16 563	16 631	17 263	18 140	84 947	

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

Number of total hip arthroplasties per diagnosis and age

2000–2017

Diagnosis	< 50 years		50–59 years		60–75 years		> 75 years		Total	%
	Number	%	Number	%	Number	%	Number	%		
Primary osteoarthritis	7 331	55.3	29 335	81.3	118 950	83.9	56 879	74.3	212 495	79.4
Acute trauma, hip fracture	101	0.8	678	1.9	9 333	6.6	9 679	12.6	19 791	7.4
Complication or sequelae after fracture or other trauma	376	2.8	964	2.7	3 781	2.7	5 044	6.6	10 165	3.8
Other secondary osteoarthritis	1 599	12.1	1547	4.3	2 894	2.0	1 405	1.8	7 445	2.8
Sequelae after childhood disease in the hip joint	2 047	15.4	1 536	4.3	1 398	1.0	288	0.4	5 269	2.0
Inflammatory joint disease	735	5.5	749	2.1	1 999	1.4	1 423	1.9	4 906	1.8
Femoral head necrosis	848	6.4	906	2.5	2 315	1.6	729	1.0	4 798	1.8
Tumour	144	1.1	268	0.7	738	0.5	383	0.5	1 533	0.6
Acute trauma. other	21	0.2	32	0.1	178	0.1	260	0.3	491	0.2
Other	35	0.3	38	0.1	93	0.1	91	0.1	257	0.1
(missing)	20	0.2	31	0.1	161	0.1	352	0.5	564	0.2
Total	13 257	100.0	36 084	100.0	141 840	100.0	76 533	100.0	267 714	100.0

Number of total hip arthroplasties with uncemented implants per diagnosis och age

2000–2017

Diagnos	< 50 years		50–59 years		60–75 years		> 75 years		Total	%
	Number	%	Number	%	Number	%	Number	%		
Primary osteoarthritis	4 039	55.8	11 257	84.8	13 332	89.7	897	81.3	29 525	80.9
Sequelae after childhood disease in the hip joint	1 250	17.3	702	5.3	290	2.0	22	2.0	2 264	6.2
Other secondary osteoarthritis	936	12.9	622	4.7	499	3.4	27	2.4	2 084	5.7
Femoral head necrosis	458	6.3	262	2.0	211	1.4	22	2.0	953	2.6
Inflammatory joint disease	318	4.4	149	1.1	169	1.1	15	1.4	651	1.8
Complication or sequelae after fracture or other trauma	177	2.4	193	1.5	163	1.1	63	5.7	596	1.6
Acute trauma, hip fracture	18	0.2	57	0.4	175	1.2	40	3.6	290	0.8
Acute trauma. other	7	0.1	7	0.1	12	0.1	7	0.6	33	0.1
Tumour	9	0.1	9	0.1	4	0.0	1	0.1	23	0.1
Other	14	0.2	8	0.1	8	0.1	1	0.1	31	0.1
(missing)	10	0.1	6	0.0	6	0.0	8	0.7	30	0.1
Total	7 236	100.0	13 272	100.0	14 869	100.0	1 103	100.0	36 480	100.0

Number of primary total hip arthroplasties with cemented implants per diagnosis and age

2000–2017

Diagnosis	< 50 years		50–59 years		60–75 years		> 75 years		Total	%
	Number	%	Number	%	Number	%	Number	%		
Primary osteoarthritis	912	41.2	10 211	74.9	90 921	82.7	53 261	74.3	155 305	78.6
Acute trauma, hip fracture	61	2.8	546	4.0	8 546	7.8	9 166	12.8	18 319	9.3
Complication or sequelae after fracture or other trauma	121	5.5	614	4.5	3 327	3.0	4 717	6.6	8 779	4.4
Other secondary osteoarthritis	265	12.0	571	4.2	1 954	1.8	1 295	1.8	4 085	2.1
Inflammatory joint disease	314	14.2	618	4.5	1 928	1.8	681	1.0	3 541	1.8
Femoral head necrosis	140	6.3	332	2.4	1 492	1.4	1 305	1.8	3 269	1.7
Sequelae efter childhood disease in the hip joint	252	11.4	431	3.2	800	0.7	233	0.3	1 716	0.9
Tumour	124	5.6	249	1.8	697	0.6	370	0.5	1 440	0.7
Acute trauma, other	10	0.5	23	0.2	144	0.1	222	0.3	399	0.2
Other	8	0.4	27	0.2	70	0.1	85	0.1	190	0.1
(missing)	5	0.2	18	0.1	127	0.1	301	0.4	451	0.2
Total	2 212	100.0	13 640	100.0	110 006	100.0	71 636	100.0	197 494	100.0

Number of primary total hip arthroplasties per fixation type and age

2000–2017

Fixation type	< 50 years		50–59 years		60–75 years		> 75 years		Total	%
	Number	%	Number	%	Number	%	Number	%		
Cemented	2 212	16.7	13 640	37.8	110 006	77.6	71 636	93.6	197 494	73.8
Uncemented	7 236	54.6	13 272	36.8	14 869	10.5	1 103	1.4	36 480	13.6
Reverse hybrid	2 120	16.0	6 623	18.4	12 396	8.7	2 292	3.0	23 431	8.8
Hybrid	640	4.8	1 619	4.5	4 057	2.9	1 390	1.8	7 706	2.9
Resurfacing	1 000	7.5	881	2.4	258	0.2	2	0.0	2 141	0.8
(missing)	49	0.4	49	0.1	254	0.2	110	0.1	462	0.2
Total	13 257	100.0	36 084	100.0	141 840	100.0	76 533	100.0	267 714	100.0

Number of primary total hip arthroplasties per type of surgical approach and year

2000–2017

Type of surgical approach	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Posterior approach in lateral position (Moore)	98 525	8 507	8 469	8 680	9 307	9 763	44 726	52.7
Direct lateral approach in lateral position (Gammer)	67 582	6 817	7 083	6 804	6 824	6 884	34 412	40.5
Direct lateral approach in supine position (Hardinge)	12 312	851	846	1 074	1 026	1 270	5 067	6.0
Other	1 536	170	163	71	95	192	691	0.8
(missing)	2 812	5	2	2	11	31	51	0.1
Total	182 767	16 350	16 563	16 631	17 263	18 140	84 947	100

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

Number of primary total hip arthroplasties per type of cement and year

2000–2017

Type of cement	2000–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Refobacin Bone Cement	36 480	6 036	5 917	5 943	6 378	5 841	30 115	35.6
Palacos R+G	37 197	4 515	4 414	4 208	4 109	4 691	21 937	25.9
Cemex Genta Green	0	148	224	56	0	5	433	0.5
CMW med Gentamycin	355	8	70	73	91	118	360	0.4
Copal G+V	0	0	11	25	26	75	137	0.2
Simplex with Tobramycin	47	0	27	45	26	15	113	0.1
Other	70 143	38	31	30	35	43	177	0.2
(completely or partially cementless)	38 434	5 604	5 865	6 233	6 574	7 048	31 324	37.0
Total	182 656	16 349	16 559	16 613	17 239	17 836	84 596	100.0

[1)] Refers to the number of primary total hip arthroplasties performed the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties performed during the last five years.

7 Primary prosthesis – In-depth analyses

7.1 'New' primary prostheses

During the 1980s, the Hip Arthroplasty Register attracted international attention after it made it possible to trace deviating results on both the unit and implant level. In time, this meant the development of a more streamlined process around the operation and stricter selection of implants. The possibility of using an efficient register to systematically define deviating results has been developed by several registers since then. In the United Kingdom, an expert group, the Orthopaedic Data Evaluation Panel (ODEP), was set up to formulate guidelines for assessing new implants. The criteria that were produced have attracted international attention. A similar organisation also exists within the Australian Arthroplasty Register. Within the ODEP, the degree of evidence is divided into several categories. The highest level (10A*) in this grading system means that at least 500 more hip arthroplasties, carried out at more than three centres or by more than three different surgeons who were not involved in the development of the arthroplasty, should have been followed up over a 10-year period. The number of revisions should be less than five per cent or that arthroplasty survival according to Kaplan-Meier should be 90% or higher. The indications for a revision and the number of deaths should be known. Up to 20% lost to follow up is accepted. A similar system exists within the Australian Arthroplasty Register, where the evaluation is divided into three stages. The first stage comprises automated screening. Here arthroplasties that have at least a twofold risk of a revision compared to all the others in the same group are identified. In stage II, these implants are examined with regard to potential reasons for a poor outcome, such as deviating patient selection. Detailed statistical analyses were also made. If necessary, an expert panel could make further analyses and assessments prior to a presentation in the Register's Annual Report (for details, see www.odep.org.uk and Acta Orthop 2013;84(4):348–352).

In Sweden, we have for more than 20 years adopted a restrictive position regarding a change in standard implants. This has proved successful as the clinical results for the majority of the new implants that are introduced onto the market are at best on a par with those that already exist and several of them are poorer. In individual cases, this cautious approach could mean that materials or implants with better qualities than existing materials are introduced late into the Swedish healthcare system. This disadvantage is of relatively little significance in the light of the good results that were noted for the most used types of prostheses in Sweden, and what were at times catastrophic consequences that could ensue from the use of a new and unknown implant in a large number of patients.

Today there are no preclinical tests that could safely determine if a new prosthesis works better or worse than existing prostheses. As the prostheses currently used in Sweden are of a very high standard, it is mainly in selected patient groups that one could expect that further implant development could make a difference. A change of standard implant also involves a certain degree of risk as new routines need to be learned. In the light of this, it would appear self-evident that replacing the implant should only take place in those cases where there is a clinical need and where the replacement implant has documented advantages. Service and pricing also have a role to play, even if the price is often a minor part of the total cost.

Choice of control group

The procedure around implant evaluation is not entirely simple. The majority of registers use a revision as the outcome. This is done regardless of the reason and regardless of the component that is being revised. Certain registers multiply the number of observed components by the number of observation years, which means that account is not taken of the fact that the reasons for the revision vary over time. To the extent a comparison with other prostheses is made, the comparison group could comprise all other implants, all implants in the same product category, or a selected reference group. Sometimes use is made of a fixed limit, equivalent for example to 90% prosthesis survival after 10 years. To date, there has been no established standard. Nor is such a standard entirely easy to achieve as prerequisites vary considerably between different registers with regard to the total number of observations, the total number of implants used within the area covered by the register, the length of the follow-up period, and the amount of data captured by the individual register. In addition, exact quality limits are fabricated limits based on what is deemed to be acceptable at a certain point in time. What is an acceptable standard at present is not necessarily the same 10 or 20 years hence.

Control group – choice of outcome

In this year's follow-up of 'new' implants, we have used the same selection principles for the reference group that were introduced in the 2015 Annual Report. This means a certain degree of flexibility in the sense that the reference value can to a certain extent be changed over time depending on the outcome for the implants that satisfy the basic criteria.

As was the case previously, the outcome does not include all types of revisions. When evaluating the cup, the outcome is replacement of the cup and/or liner, and definitive extraction regardless of whether the stem is replaced or not. The same principle applies to evaluation of stems. Revisions due to infection have been excluded here, as the outcome primarily reflects the care process and patient composition. The surface structure of the implant or other features could possibly affect the risk of infection. As long as this remains unclear, we have opted to exclude revisions due to infection from this evaluation.

Control group – definitions

In this year's analysis, only prostheses inserted from 2007 onwards are included. The aim behind only including the past 11 years is an attempt to make the analysis as representative as possible for the work that is taking place today. During the past decade, the healthcare processes related to arthroplasty have undergone extensive changes, which has probably affected the risk of complications in such a way that it is difficult to gain an overview of the risk and make adjustments for it. We believe that excluding operations carried out more than 11 years ago will result in a fairer comparison.

The control group comprises prosthesis components where at least 50 cases have been followed up for at least 10 years. Inclusion in the control group also requires the prosthesis survival rate at 10 years to be more than 95%. In addition, at least 50 implants must have been inserted during the past two years, of which at least one should be during the most recent observation year (2017).

Control group – implants included

The implants that are included in each control group are presented in Table 7.1.1. Compared with the previous annual report, Contemporary Hooded Duration has returned. The reason for this cup not always being included is that its 10-year survival rate is around 95%, at times below and at times above. This variation is probably random. Other cups in the control group are the same as in the previous annual report (Lubinus with the older type of plastic, ZCA with both the older type of plastic and with XLPE).

In the uncemented cup group, almost all cups in the plastic control group have extra cross-links, which corresponds to the current standard. In Sweden, cups with highly cross-linked polyethylene were introduced several years previously for uncemented cups compared with cemented cups as a result of a more distinct problem with osteolysis around uncemented cups. In the control group, two new variants of the Trident cup have been added, which is the most important reason why this group has increased by almost 50%.

The size of the control group for uncemented stems also increased (approximately 33%). Generally, this reflects, as is the case with the uncemented cup, the fact that we increasingly use uncemented fixation. Also new is that all three of the most-used variations of the Corail stem are included, as both the coxa vara and high-offset variants satisfy the inclusion criteria. The same applies to the Wagner Cone, which was not included last year as there were too few observations after ten years.

In this year's report, we also present a control group for cemented stems. The background to this is that since 2013 more units have begun using a 130 mm Lubinus stem instead of 150 mm, which is by far the most-used length. The 130 mm stem has been used since 1999, although only a few up to 2012, after which the number increased.

Definition and use of the new implant

An implant is defined as new if it was introduced during the period (individual operations carried out before 2007 have been ignored) and fewer than 50 implants have passed the 10-year follow-up point. Furthermore, the number of prostheses reported to the Register during the past two years (at present 2016–2017) must exceed 50 in number, and the prosthesis must have been in use during 2017.

The implants that have been classified as new could have a longer period of documentation abroad although as the completeness and risk of a revision could vary between countries, we consider the domestic analysis to be of value. The starting year in Tables 7.1.2 and 7.1.3 corresponds to the first year when more than 10 prostheses of the type in question were inserted. All data applies from this year. Individual prostheses inserted before the 'starting year' have thus been excluded.

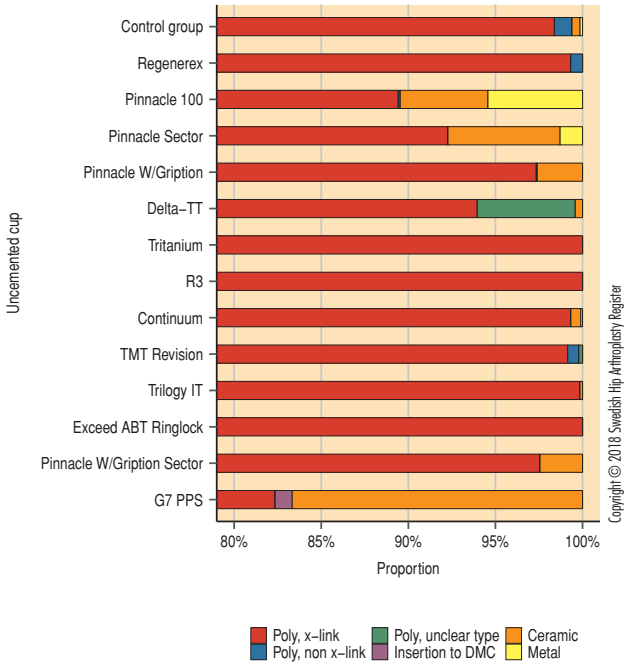

Figure 7.1.1 Type of liner material related to individual cup design. Note that the x-axis starts just below 80%.

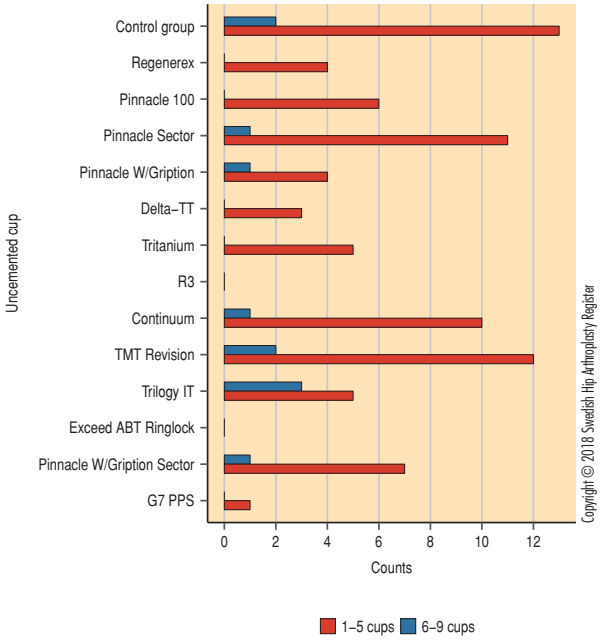

Figure 7.1.2 Units that report insertion of one to five or six to nine uncemented cups presented in Table 7.1.2.

Composition of control groups

Type of component and period for analysis	Number	Prosthesis survival after ten years, 2 SEM*
Cemented cup 2007–2017		
Contemporary hooded duration	6 929	95.6 1.3
Lubinus older type of plastics	41 248	97.6 0.2
ZCA older type of plastics	1 218	97.4 2.2
ZCA XLPE	14 657	97.6 0.6
All	**64 052**	**97.3 0.2**
Uncemented cup 2007–2017		
Allofit	1 387	97.7 2.0
Trident hemi	4 071	96.0 2.4
Trident AD LW	976	96.7 1.5
Trident AD WHA	1 168	97.2 1.4
Trilogy±HA	7 433	98.6 0.4
All	**14 746**	**98.0 0.4**
Cemented stem 2007–2017		
CLS	938	96.0 1.6
Exeter	35 596	98.1 0.3
MS-30	12 196	98. 1 0.8
Lubinus SPII 150 mm	68 062	98. 8 0.2
All	**116 792**	**98.5 0.2**
Uncemented stem 2007–2017		
ABG II HA	2 701	95.3 1.7
Accolade Straight	1 725	98.8 0.8
Bi-Metric X Por HA NC	8 034	98.3 0.5
CLS	9 523	98.4 0.4
Corail#	22 616	98.3 0.4
Wagner Cone	1 565	98.9 0.6
All	**46 164**	**98.1 0.3**

Table 7.1.1. Implants in controls during the analysis of "new" implants in table 2 till 4. For cups only cup revisions and for stems only stem revisions have been included. All causes for revision are included except infection.

**Cup and stem survival respectively, excluding revision due to infection. SEM = standard error of the mean.*
#Including standard, high off-set and coxa vara.

In the control group, the starting year has been set at 2007 to ensure the time periods that are being compared are as similar as possible. In the 'cemented cup' control group, one cup with highly cross-linked polyethylene has been included (ZCA XLPE), as it has a 10-year survival rate in the Register of more than 95% based on more than 50 observations. We would like to point out that in previous analyses, the ZCA cup emerged as being poorer as a result of an increased risk of revision following dislocation. With an increase in observation time, this disadvantage has been more than compensated for by this cup being revised less often as a result of loosening. When assessing an implant, the observation period is very important, which is something we have also demonstrated in other contexts. In the control group for uncemented cups, a liner with highly cross-linked plastic has been used in almost all cases. In a small number of cases, a ceramic insert is used together with different variants of the Pinnacle cup as well as G7 PPS. In individual cases, a metal insert has also been used for Pinnacle (Figure 7.1.1).

When 'new' implants are introduced onto the Swedish market this ought to take place, for several reasons, according to a pre-set plan. It takes a certain amount of time to become accustomed to the new instruments and the surgical technique could vary from the one that the individual surgeon is familiar with. Furthermore, the initial cases need to be followed up in a very structured way. An examination of the uncemented cups presented in Table 7.1.2 reveals that 13 units have only reported insertion of 6–9 each, and as many as 68 units have only reported insertion of 1–5 implants per unit (Figure 7.1.2). In some cases, this can be attributed to the fact that the cup in question is a variation on a basic concept, e.g. Pinnacle or Trident. Even if there are a number of perfectly feasible explanations for this, there are still a remarkably large number of units that use the implant with uncertain documentation on only a small number of occasions.

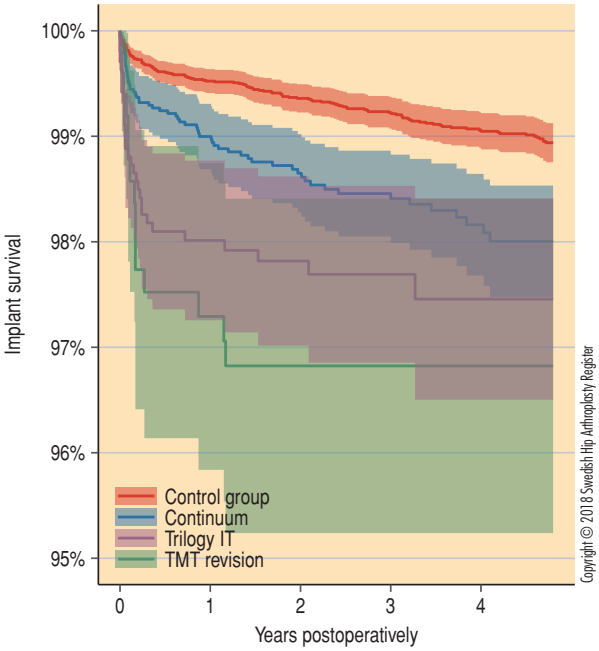

Figure 7.1.3 Cup survival based on revision or extraction of the cup due to non-infectious reasons.

New cemented cups

The cemented cups that were analysed this year are largely the same as the preceding year (Table 7.1.2). None of them has a documented 10-year survival rate in the Register based on at least 50 observations. One cup, Exceed ABT E1, has been excluded as only 26 sockets were inserted during 2016–2017. Only one of the 'new' cups, Avantage, differs from the poorer cups in the control group. The reason for the poor outcome for the Avantage cup is unclear even if case mix almost certainly has a role to play. This cup is chosen more often for elderly patients with a hip fracture compared with the control group (Table 7.1.4). Interestingly, this is also the case for the other two dual-articulation cups in the analysis, ADES and Polarcup. These can be seen in Table 7.1.4, where they have only been included for comparison purposes. Both ADES and Polarcup have, however, been used in fewer cases and have a shorter follow-up time. The comparison could also be scewed as we lack wide-ranging indicators for comorbidity throughout the whole of the period in question. Based on the ASA classification, however, the differences are relatively small. In the group that have been inserted with Avantage, 57.6% of the patients are categorised as ASA Class 3 or higher. In the groups that underwent an operation with Polarcup and cemented ADES, the proportions are 51.2% and 48.7% respectively (see also section 7.2, In-depth analysis of dual-articulation cups).

New uncemented cups

Two variants of the Trident cup (Trident hemi and AD LW) have disappeared from the list as, after 10 years of observation of more than 50 implants, they meet the requirements for inclusion in the reference group. No new uncemented cups have been added. As was the case previously, three cups have significantly lower early survival: Continuum, Trilogy IT, and TMT Revision ($p < 0.0005$, log-rank test). In all cases, dislocation is the most common cause of a revision, and in the case of TM Revision and Trilogy IT, it is almost the only reason. These cups are used at a large number of units: 33, 22 and 12 have used or use Continuum, TMT Revision and Trilogy IT respectively. The revisions are broken down into 15, 8 and 3 of those units with an increasing number depending on how many were inserted. There is therefore no reason in the first instance to suspect that deviating surgical technique is the most important reason. However, these implants could possibly be more difficult to place correctly and/or be designed in a way that dislocation occurs more easily. These theories still remain speculation and the reasons for the dislocation problem must be studied in randomised studies in order to better identify potential causes. Generally, the differences are small, and it is unclear from a long-term perspective whether these disadvantages can be outweighed by other positive features "in the long-term".

"New" cups, number of revisions and prosthesis survival

	Starting year	Number		Follow-up	Cup revisions#, number %		Prosthesis survival#* cup/liner, 2 SEM	
		total	*≥ 2 years*	*average. max*	*total*	*≤ 2 years*	*2 years*	*5 years*
Cup cemented								
ADES Cemented	2013	200	64	1.5 4.1	1 0.5	0 0.0	100.0	–
Avantage Cemented	2007	2 653	1 172	2.3 10.9	49 1.8	38 1.4	98.3 0.6	97.3¤ 1.0
Exeter X3 RimFit	2010	13 864	7 890	2.8 7.4	46 0.3	32 0.2	99.7 0.1	99.5 0.2
Lubinus X-linked	2010	23 850	12 595	2.4 7.9	109 0.5	86 0.4	99.5 0.1	99.2 0.2
Concentric X-linked IP	2011	1 352	532	1.9 6.8	9 0.7	6 0.4	99.4 0.5	97.4 3.0
Marathon XLPE	2008	17 160	12 940	4.1 9.2	106 0.6	62 0.4	99.6 0.1	99.2 0.2
Polarcup	2010	674	334	2.2 6.9	5 0.9	4 0.7	99.0 0.8	99.0 0.8
Control	2007	64 052	57 094	5.8 11.0	965 1.5	386 0.6	99.3 0.1	98.8 0.1
Cup uncemented								
Continuum	2010	4 203	2 670	2.5 7.2	65 1.5	51 1.2	98.5 0.4	98.0¤ 0.5
Delta TT	2012	482	258	2.3 6.1	2 0.4	2 0.4	99.5 0.8	–
Exceed ABT Ringloc	2011	1 654	1 114	3.1 6.8	15 0.9	9 0.5	99.3 0.4	99.8 0.7
G7 PPS	2015	107	19	1.1 2.0	2 1.9	2 1.9	–	–
Pinnacle 100	2007	2 529	1 690	3.7 10.9	31 1.2	14 0.6	99.3 0.4	98.2 0.7
Pinnacle sector	2007	1 013	56	3.5 11.0	10 1.0	7 0.7	99.1 0.7	98.7 0.7
Pinnacle W/Gription 100	2011	3 356	1 221	1.7 6.3	21 0.6	20 0.6	99.2 0.4	99.1 0.4
Pinnacle W/Gription sector	2014	603	167	1.5 4.0	5 1.1	5 0.8	98.9 1.2	–
R3	2014	109	58	2.1 4.0	0 0.0	0 0.0	100.0	–
Regenerex	2008	886	659	3.3 8.6	7 0.8	2 0.2	99.4 0.5	99.1 0.8
TM revision	2008	498	370	3.9 10.0	17 3.4	15 3.0	96.8 1.6	96.3¤ 2.0
Trilogy IT	2011	1 360	807	1.9 5.2	44 3.2	41 3.0	97.7¤ 0.8	–
Tritanium	2010	702	536	3.4 7.1	10 1.4	2 0.3	99.5 0.6	98.1 1.4
Control	2007	14 746	11 552	5.2 11.0	168 1.1	88 0.6	99.3 0.1	98.8 0.2

Table 7.1.2. Cups which have been introduced on the Swedish market from 2007 and that have been used in more than 50 arthroplasties during the past two years and furthermore have been in use in 2017. Bold text indicates that the outcome is worse compared to controls (log-rank test).

#All causes excluding infection.
**Data is presented only for at least 50 observations.*
¤Difference versus control. p < 0.0005. log-rank test.

New cemented stems

Swedish orthopaedic surgeons have thus not introduced any completely new type of cemented stem that satisfies the inclusion criteria for a 'new prosthesis'. However, we have made an analysis of the Lubinus SP II stem, 130 mm in length, as this stem is the most used stem in Sweden and a question has arisen about whether the 150 mm stem length could be replaced by 130 mm without increasing the risk of a revision. One conceivable advantage of the shorter variant could be that a possible future revision is facilitated. Theoretically, the load transfer to the femur could be more beneficial, although no safe data based on clinical material are available and it is uncertain whether any such difference is of clinical significance.

From 1999, the first year in which the Register could separate prosthesis components on a more detailed level, 1,306 Lubinus SP II 130 mm implants have been reported. Through to 2010, the number was fewer than 20 prostheses per year. Thereafter, there was a gradual increase with 461 cases reported in 2017. The number, however, is still low, and during 2017 the 130 mm stem accounted for 6.6% of all the Lubinus SP II stems, 150 mm or shorter, used in a primary operation. In this year's analysis, which runs from 2007, we find that the prosthesis survival rate, based on a stem revision of all non-infectious causes, does not reveal any difference between the Lubinus SP II prosthesis with a shorter stem and the control group. On the other hand, the follow-up period is short. Loosening of the prosthesis and periprosthesis fracture are complications that could possibly occur more easily if a shorter stem is used. These complications only tend to arise after 5–15 years of observation. They are also relatively unusual, requiring a fairly large number of cases before the stem can be included in the comparison groups. In this year's report, we can only state that stem survival in the case of the Lubinus SP II 130 mm during the first two years is on a par with the control group.

New uncemented stems

Compared with the 2016 Annual Report, all three variants of the Corail stem were placed in the control group (Standard, Coxa vara and High offset) as the 10-year survival rate satisfied our requirements. Wagner Cone could also be included. A new stem, SP-CL, has been added. The only two short stems that we have presented here previously, Fitmore and CFP, have almost completely fallen into disuse. During 2017, only one Fitmore stem was reported and no CFP stem.

The SP-CL stem was introduced onto the Swedish market in 2014–2015. Through to 2017, 118 stems were reported. The majority of these are included in different studies and are being monitored according to standardised protocols. To date, fewer than 50 have been followed up over a two-year period, and just one revision not caused by infection has been reported.

The prosthesis types introduced onto the Swedish market, and which are used to such an extent that a register analysis becomes meaningful, show good results. There are, however, implants with certain specific problems that we intend to follow up carefully in the future. At present, it is uncertain whether a number of the disadvantages that could be traced to a specific implant are a result of a non-beneficial case mix (the Avantage cup) or whether it could be attributed to the implant design or the surgical technique (the Continuum, TMT Revision, Trilogy IT cups).

"New" stems, number of revisions and prosthesis survival

	Starting year	Number		Follow-up	Stem revisions#, number %		Prosthesis survival#* Stem, 2 SEM	
		total	*≥ 2 years*	*average. max*	*total*	*≤ 2 years*	*2 years*	*5 years*
Stem cemented								
Lubinus SP2 130 mm	2007	1 234	329	4.7 11.0	469 1.3	336 1.0	99.9 0.2	-
Control	2007	116 792	89 474	4.8 11.0	708 0.6	257 0.2	99.7 0.03	99.4 0.06
Stem uncemented								
Accolade II 55	2012	1 722	947	2.3 5.9	4 0.2	4 0.2	99.7 0.3	–
Echo Bi-Metric 127. 141	2013	211	76	1.9 5.0	3 1.4	3 1.4	98.6 1.6	–
M/L Taper 19	2012	1 121	746	2.7 5.8	3 0.3	2 0.2	99.7 0.3	–
SP-CL. 138	2015	118	10	0.8 2.8	1 0.8	1 0.8		
Control	2007	46 164	34 560	4.8 11.0	499 1.1	355 0.8	99.2 0.1	98.9 0.1

Table 7.1.3. Stems, which have been introduced on the Swedish market from 2007 and which have been used for more than 50 hip arthroplasties during the past two years as well as they have been in use in 2017. No stems differ significantly from the control group (log-rank test).

#All causes except infection.
**Data is presented only for at least 50 observations.*

Demographics and cause for revision for "new" implants which differ from the control group (refers to the same year of operation that is presented in table 7.1.2)

Typ av implantat	Age	Gender	Diagnosis %	Cause for revision number (%)			
	Average SD	*Kvinnor %*	*Primary osteoarthritis/ fracture+sequelae/ other secondary osteoarthritis*	*Loosening/ osteolysis*	*Dislocation*	*Periprosthetic fracture*	*Other**
Cemented cup							
Avantage Cemented	75.5 10.8	63.2	20/66/14	7 (15.2)	19 (41.3)	13 (28.3)	7 (15.2)
ADES¤	75.5 10.8	62.5	33/57/10	0	0	1 (100.0)	0
Polarcup¤	76.2 9.3	62.9	13/77/10	1 (16.7)	4 (66.7)	1 (16.7)	0
Control	71.1 8.8	61.4	83/11/6	410 (42.5)	451 (46.7)	40 (4.1)	64 (6.6)
Ocementerad cup							
Continuum 79	60.9 10.4	48.8	85/3/12	6 (9.2)	50 (76.9)	1 (1.5)	8 (12.3)
TM revision93	59.9 13.8	44.0	53/6/41	0 (0.0)	16 (94.1)	0 (0.0)	1 (5.9)
Trilogy IT 95	66.7 11.3	43.6	83/4.0/13	0 (0.0)	28 (93.3)	1 (3.3)	1 (3.3)
Control	59.8 11.0	46.4	81/4/15	60 (35.7)	71 (42.3)	13 (7.7)	24 (14.3)

Table 7.1.4. Demographical data and cause of revision for the cups, which have been analyzed in table 7.1.2 and that differ significantly through a worse prosthesis survival. Two dual mobility cups (ADES cemented and Polar cup) do not belong to those that differ but are shown for comparison.

**Excluding infection.*
¤Prosthesis survival within the expected interval, data shown for comparison.

8 Reoperation

8.1 Definition and trends

Reoperation covers all types of surgical procedures that can be related directly to a hip arthroplasty, regardless of whether the prosthesis or any of its parts are replaced, extracted, or left untouched. The proportion of all the reoperations carried out (regardless of whether the hip has been re-operated on previously or not) related to the sum of the total number of primary prostheses and reoperations carried out during a one-year period, varied between 11.9% and 14.1% during the period 1992–2016. During 2017, the proportion was slightly lower (11.0%), which is probably due in part to a certain lag in the reporting (Figure 8.1.1). The number of reoperations carried out gradually increased from 1992 through to the period 2010–2012. During this period and the following year, the number was approximately 2,400 per year, decreasing slightly during 2016 and 2017. The reason for this decrease is unclear. It could be a genuine decrease, although it could also be caused by under-reporting of the reoperations, where one part, a few parts, or all parts of the prosthesis are replaced or extracted, e.g. in conjunction with rinsing and synovectomy due to infection, or plate fixation in conjunction with a Vancouver type C fracture (Figure 8.1.2).

To a certain extent, the relationship between reoperations and primary operations offers some idea of the extent to which reoperations represent a load on the healthcare system resources available for hip arthroplasty surgery in a specific country or area, although it is not suitable for use for other purposes due to its sensitivity to fluctuations in the number of primary operations carried out. The quota is also affected by several other factors, such as patient flows between healthcare areas, the attitude of the medical profession to carrying out reoperations, and the length of time during which hip arthroplasty has been practised in a healthcare area. The reporting of reoperations is poorer than for primary operations. This applies in particular to those reoperations where the implant was left untouched, e.g. in conjunction with rinsing and debriding following an infection, or osteosynthesis as a result of certain types of periprosthesis fractures where the prosthesis is left untouched. We have previously pointed out that the increase in the number of what are termed 'other' reoperations that we have seen since the turn of the century could probably be explained in part by the fact that data capture at this time, and for about 10 years subsequently, not only applies to cases reported to the Hip Arthroplasty Register but also to operations that have been identified in conjunction with linking to with the Patient Register. As the 'other' reoperations that were actually carried out provide important information, particularly with regard to assessment of the occurrence of deep prosthesis infection and periprosthesis fracture, we urge our colleagues to support this work in the best possible way through improved reporting on the local level. The majority of reoperations are carried out at county hospitals followed by local hospitals (Figure 8.1.3 a-d). The number of local hospitals, however, was around twice as high as the number of county and private hospitals, and almost

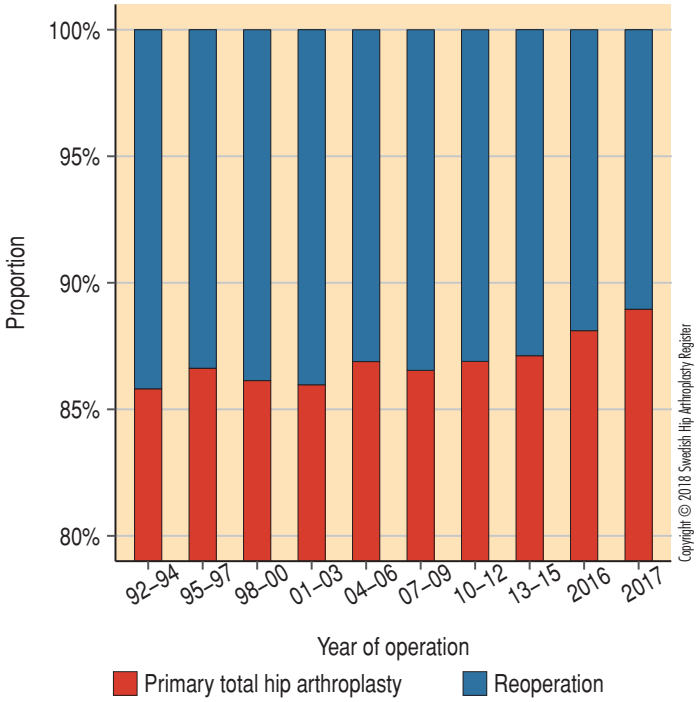

Figure 8.1.1 Distribution of reoperations (revisions+other reoperations) and primary total hip arthroplasties during the period 1992–2017. Note that the scale on the y-axis is adjusted and starts at about 80%. Intervals of more than one year are represented by mean value/year.

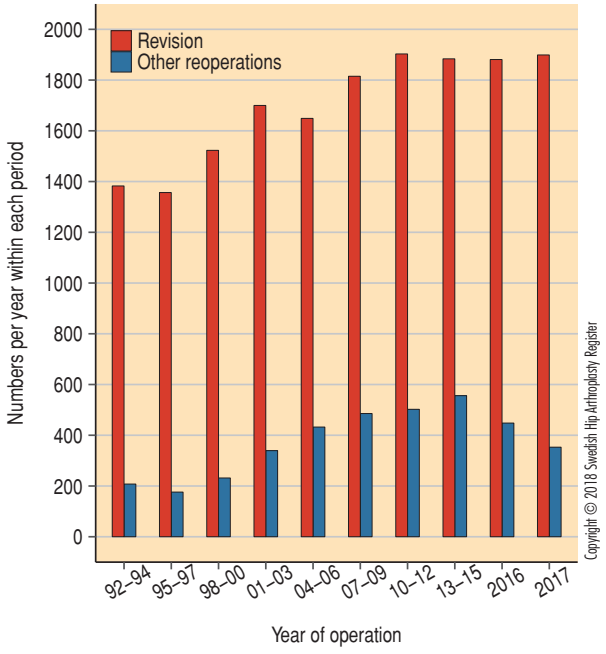

Figure 8.1.2 Total number of revisions and other reoperations during the period 1992–2015. Intervals covering more than one year are represented by mean/year.

five times as high as the number of university or regional hospitals, which means that the number of reoperations per hospital could vary considerably within the same hospital category.

The demography for patients who have undergone a reoperation has changed over time. The changes that have taken place since 1981 are presented in the 2015 Annual Report. We found that the average age between the 1981–1995 period and the 2011–2015 period has increased by approximately three years, and the proportion of patients over the age of 85 has risen from 3.1% to 11.4%.

In this year's report, three periods (2008–2010, 2011–2014 and 2015–2017) are compared. In addition, the corresponding data for primary prostheses inserted during the period 2015–2017 are shown for comparison purposes. During the past 10 years, the age distribution in conjunction with reoperation has remained relatively unchanged. There are slightly

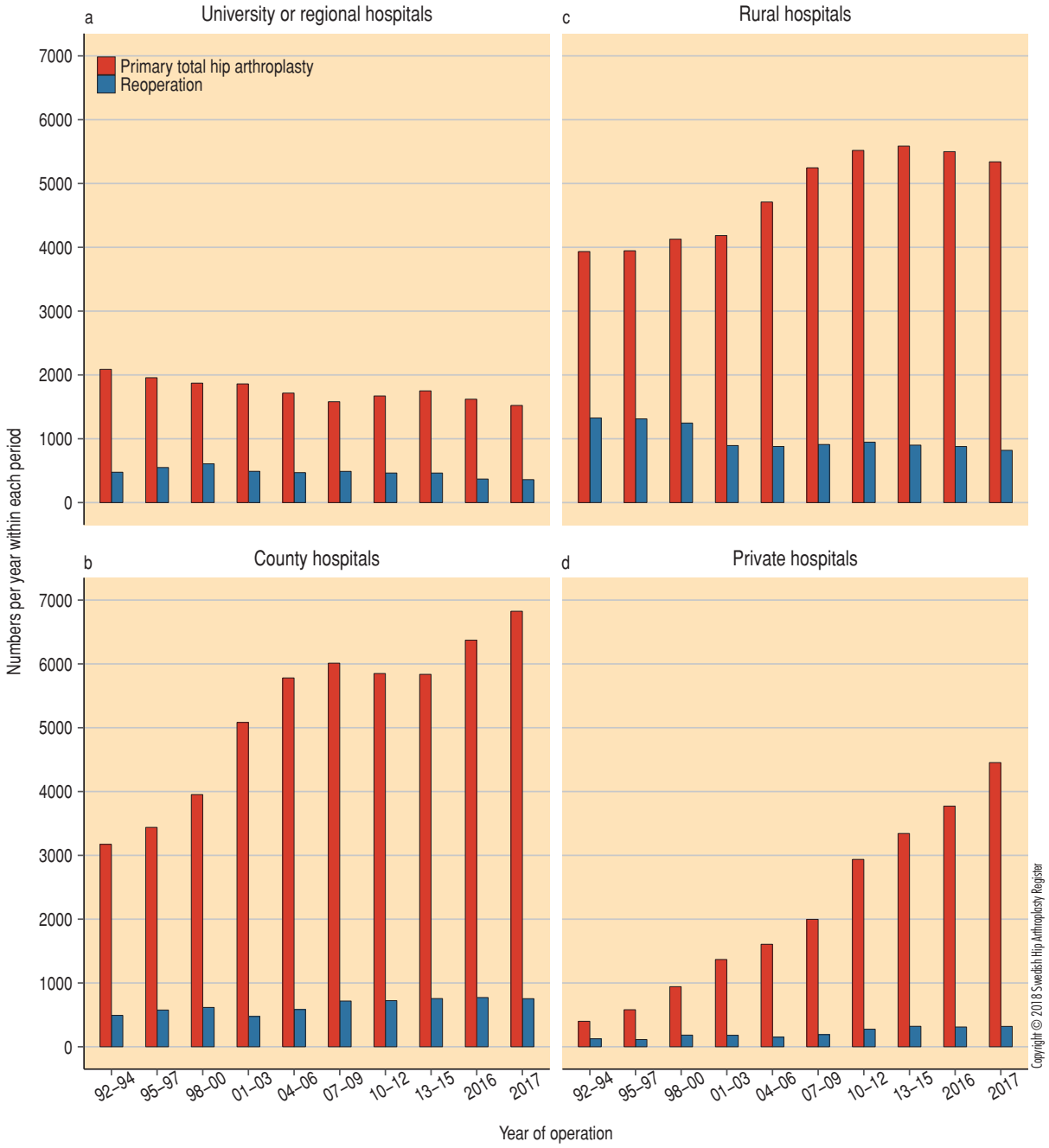

Figure 8.1.3 a-d Distribution of reoperations and primary total hip replacements between different types of hospitals between 1992 and 2017. Most of the reoperations wre performed at county hospitals, which are five times more frequent than university hospitals. a=University Hospital, b=County Hospital, c=Rural Hospital, d=Private Hospital

more women than men who undergo reoperation, although this difference is not as great as it is in the case of a primary operation, which reflects the fact that men are reoperated on more frequently. The proportion with a BMI of 30 or over increased from 24.3% to 26.7% between the periods 2011–2014 and 2015–2017. This proportion was also higher than the equivalent group that received a primary prosthesis during the same period (24.1%). Generally, patients who have undergone a reoperation have a higher degree of comorbidity than those operated with a primary prosthesis. In addition, when a comparison is made between the time periods included in the analysis, the reoperated group reveals a higher degree of comorbidity the closer one comes to the present time. It can also be seen from Table 8.1.1, that virtually all secondary osteoarthritis groups reveal an increased proportion of reoperations compared with the division between primary/secondary osteoarthritis in conjunction with a primary operation.

Reoperation without an implant replacement/ extraction

From 1997, 34.8% of all reoperations were on patients who had previously undergone at least one reoperation. Excluding revisions, this proportion rises to 51.7% for the same period, an increase of around 3% compared with the period 1996–2016. A reoperation without an implant replacement or implant extraction is thus increasingly more prevalent than a revision. A growing number of reoperations due to infection is probably the most important reason for this change. 'Other reoperations' due to infection accounted for an increasing proportion of the total number, rising from 26% during the period 1997–2001 to 54.7% during the period 2012–2016 (Figure 8.1.4). Even if the number of primary hip arthroplasties performed is increasing gradually, the number of reoperations fell during 2017 by around 9% to 45.6%, a trend that we hope will continue. In the previous annual report, we pointed out that the result, measured as a risk of further reoperation due to infection, would be considerably worse if the femoral head was not replaced and also, where appropriate, the liner. It is uncertain whether it is only the actual component replacement that makes a difference. A component replacement probably indicates that the joint really has opened, and it is perhaps also a sign that a surgeon with knowledge of prosthesis surgery was involved, as certain basic knowledge in this field is required to identify the right components and to correctly remove a liner and insert a new liner. In these cases, knowledge of prosthesis surgery would probably also entail knowledge of the art of carrying out a soft tissue revision and rinsing. There is also good reason to speculate on the fact that replacement of the femoral head and liner not only reflects the specific interventions but also the fact that the operation overall was performed more optimally.

Fracture is the second most common reason for a reoperation without replacing or extracting the prosthesis or its parts. In 35.9% of cases, it is stated that the fracture was located at prosthesis height (Vancouver type B) and in 56.0% distally of the prosthesis tip (type C). In other cases, it is mainly a question of trochanteric fixation (3.0%). In 5.1% of cases there is a lack of information about the location of the fracture.

Periprosthesis fractures that are treated without replacing the prosthesis are under-reported. There are several reasons for this. The contact secretaries are perhaps not aware that peri-

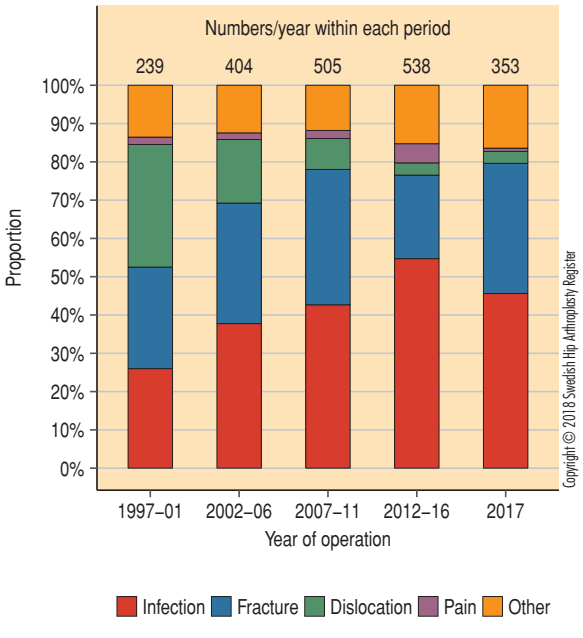

Figure 8.1.4 The four most commonly performed procedures where non of the implant parts are exchanged or removed during the period 1997–2017. Number of procedures are given at the top of each bar corresponding to numbers per year when periods of more than one year are presented.

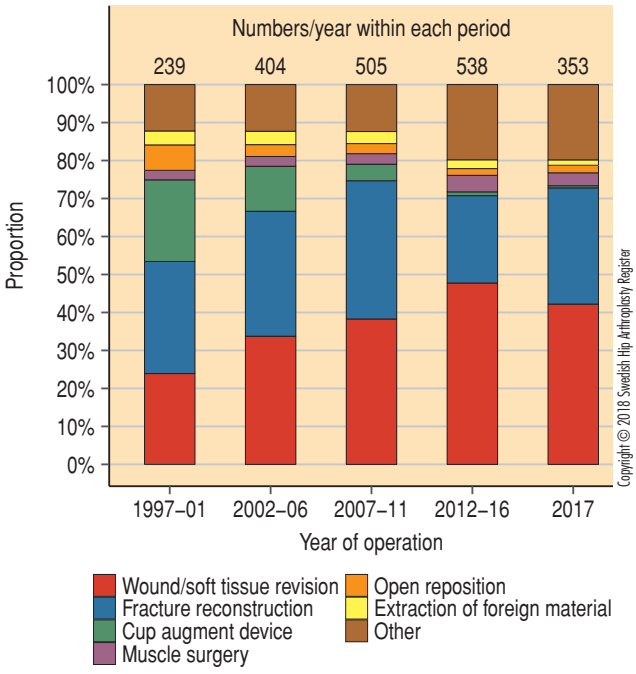

Figure 8.1.5 The six most common types of surgeries performed at reoperations when none of the implant parts are exchanged or removed during the period 1997–2017. Number of procedures are given at the top of each bar corresponding to numbers per year when periods of more than one year are presented.

Demographics during reoperation from the first year for BMI and ASA registration

	Reoperation		Primary operation	
	2008–2010	*2011–2014*	*2015–2017*	*2015–2017*
Number	7 222	9 634	7 043	52 033
Age				
Average SD	*71.9 11.3*	*71.6 11.4*	72.0 11.1	68.9 10.7
< 55 years %	7.4	7.7	7.6	10.2
55–69 years %	30.7	31.3	28.5	37.4
70–84 years %	50.1	49.5	52.0	47.3
≥ 85 years %	11.8	11.5	11.9	5.1
Gender				
Proportion of women %	53.6	50.9	51.2	58.2
BMI				
Number, % of all in the interval	*5 096 71.1*	*8 881 84.3*	*6 354 90.2*	*50 320 96.7*
Average SD	27.1 5.7	27.2 5.5	27.3 5.9	27.1 5.0
< 18.5 %	2.0	1.8	1.4	1.2
18.5–24.9 %	34.1	32.3	33.9	33.2
25–29.9 %	39.7	41.6	37.9	41.6
30–34.9 %	18.1	17.1	19.3	18.6
> 35	6.1	7.2	7.4	5.5
ASA class				
Number, % of all in the interval	*6 029 83.4*	*8 881 92.2*	*6 693 95.0*	*51 431 98.8*
I %	13.2	11.3	8.8	20.7
II %	52.6	50.9	49.9	58.6
III– %	34.2	37.8	41.3	20.8
Diagnosis during primary operation				
Primary osteoarthritis	72.7	72.7	74.8	81.1
Fracture including sequelae	8.8	13.5	11.4	11.6
Inflammatory joint disease	6.9	3.1	2.7	0.8
Sequelae childhood disease	5.2	2.7	2.9	1.6
Femoral head necrosis	4.6	2.8	3.3	2.3
Other secondary osteoarthritis	1.9	5.0	4.9	2.6

Table 8.1.1. Distribution of gender, age, BMI and ASA during all types of reoperations during three periods from 2008 to 2017. Data for primary operated 2015–2017 is shown for comparison.

prosthesis fractures need to be reported or perhaps they are not even informed when they occur. Certain types of fractures (e.g. trochanteric fractures) are often treated without an operation and without the patient receiving hospital care. Data relating to operations carried out during 2001–2011 were linked to the Patient Register in order to acquire a more correct understanding of the number of periprosthesis fractures. The 'missed cases' have now been added to the Hip Prosthesis Register database, which is reflected in the rise in the number of fractures in Figure 8.1.4 during the period 2002–2006. During the period 2012–2016, the proportion fell significantly. The relative increase during 2017 could be a sign of improved reporting. The total number of reoperations has, however, fallen this year, perhaps due to late reporting. It may be advisable therefore to wait until the next annual report before assessing more accurately if it really is the case that reoperations due to infection have fallen, and that periprosthesis fractures have increased.

During the period 1997–2001, around 50 reoperations per year were carried out involving a socket wall addition to prevent dislocation (Figure 8.1.5). Two cases involving a socket wall addition were reported in 2017. We have previously found, most recently in the previous Annual Report, that regardless of the cause a cup revision is preferable in the light of the risk of a new reoperation. The problem with this analysis, as with all register-based analyses, is that it is not possible to fully compensate for variations in patient selection. There could be some justification for treatment using a socket wall addition, although this remains to be seen.

During the period 1997–2001, open repositioning without a component change accounted for 6.7% of all reoperations without a change or extraction of prosthesis components. During the two most recent periods (2012–2016 and 2017), this proportion has been reduced to approximately 2%. If it proves necessary to open the joint in conjunction with repositioning, it is often a case, albeit not always wise, of taking more extensive measures to reduce the risk of further dislocations. Even here, it can be assumed that dislocated prostheses that cannot be repositioned are handed over to orthopaedic surgeons with experience of prosthesis surgery. Surgeons who to an increasingly greater extent choose to carry out a revision instead of open repositioning only.

Between 1997 and 2017, a total of 277 soft tissue procedures were reported. The majority of these are caused by lack of functioning of the gluteus medius. Their relative proportions vary between 2.5% and 4.4%, with an increasing number during recent periods. These problems are most common following a direct lateral approach and are difficult to treat. In an effort to increase our knowledge in this field, a medical records study could be the first step.

It is important to report all reoperations, even the prostheses or any of its parts. Reoperation rate is one of our more important quality parameters.

Patients who undergo reoperation are more frequently male, more often have secondary osteoarthritis, and have a higher BMI and ASA classification compared with the patients operated with a primary hip arthroplasty. Over the past 10 years, patients who have undergone a reoperation increasingly have a BMI of over 30 and are ASA class 3 or higher.

The two most common procedures in conjunction with a reoperation where the implant is not replaced or extracted, are wound and soft tissue revision as a result of infection, and fracture reconstruction in conjunction with a periprosthesis fracture.

8.2 Reoperation within two years

Reoperation within two years is used as a quality indicator for primary hip arthroplasties. The background to this is that the most common causes of early reoperation are infection and dislocation. The breakdown of causes for early reoperation, mainly during the first year after a primary operation, have varied (Figure 8.2.1). At the beginning of the 2000s, dislocation and deep infection were to a large extent equally common. The proportion of reoperations due to dislocation, however, has fallen, whilst the proportion of reoperations due to infection has increased. This could be a result of the fact that we have become more skilled at identifying and taking steps to prevent dislocation. It also indicates that we have adopted a more active approach to surgical treatment in conjunction with infection. It is not possible to assess whether there is also an increased incidence of infection although this cannot be excluded.

The proportion of patients who have undergone a reoperation within two years has varied between 2.1% and 2.4% since 2010. However, it ought to be pointed out that all the patients who underwent an operation during 2016 and 2017 have not passed the two-year limit and the proportion of individuals undergoing reoperation within two years will therefore increase.

Reoperation within two years thus refers to all forms of further surgery after a total hip prosthesis has been inserted. This variable mainly reflects early and serious complications and is therefore a more rapid indicator and easy to use for clinical improvement work compared with 10-year survival, which is an important albeit slow and to a certain extent historic indicator. Reoperation within two years has been selected by the Swedish Association of Local Authorities and Regions and the National Board of Health and Welfare as a national quality indicator for this type of surgery and is included in Care in figures (https://vardenisiffror.se). This indicator should be regarded as one of the most important result metrics reported by the Hip Arthroplasty Register and the one that can be influenced the most.

Definition

'Short-term complication' refers to all forms of open surgery carried out within two years of a primary operation. The most recent four-year period (2014–2017) is being studied. It should be noted that the report only applies to complications that have been resolved surgically. Infections treated with antibiotics and non-surgically treated dislocations are not included in the Register. Patients who have been operated on repeatedly as a result of the same complication are reported as one complication. Patients who are reoperated on at a unit other than the primary unit still come under the primary unit for register purposes. When interpreting the results, units at the same type of hospital should only be compared with regard to differing patient demography. Units that operate on the more serious cases, which carry a greater risk of complications, could thus reveal a higher rate.

Apart from the hospital's different risk profiles, the results ought to be interpreted with some caution, and the following ought to be taken into account:

- There is a variation between units when reporting of a reoperation. Reoperation without replacing implant parts is subject to a higher degree of underreporting than revisions.
- Complication figures are generally low, and a random variation has a considerable impact on the results. This variable can really only be evaluated over time, i.e. if there are clear trends. Table 8.2.2 shows trends in recent years.
- Units that adopt a wait-and-see approach (e.g. those which to a greater extent opt for non-surgical treatment in conjunction with infection and dislocation, have 'falsely' low figures.
- On the other hand, units that are surgically 'aggressive', both in conjunction with suspected early infection and in conjunction with first-time dislocation, have high rates of early complications. The treatment algorithm in conjunction with early suspected deep infection, has changed in recent years. It is becoming increasingly common to intervene surgically at an early stage.

It is important to point out that the indicator 'Reoperation within two years' should not be used to rank the provider. Random variation for what are after all unusual complications, means that individual drop-outs in the registration will have a considerable impact on the ranking of a unit. Irrespective of the hospital category and the results, the units ought to analyse their own complications (without keeping one eye on the national average) and investigate whether there are systematic shortcomings. This should be done as part of an effort to avoid serious complications for the individual patient.

Reoperations within two years for all total arthroplasties are reported on pages 56–58. In the case of the standard patient, the corresponding information is presented in the swedish online edition of the Annual Report (pages 84–86). The online edition of the Annual Report is available at www.shpr.se.

All units ought to conduct an in-depth analysis each year of all cases of reoperation performed within two years. Ideally, contact should be made with the Register Management Team before any analyses of this nature are carried out.

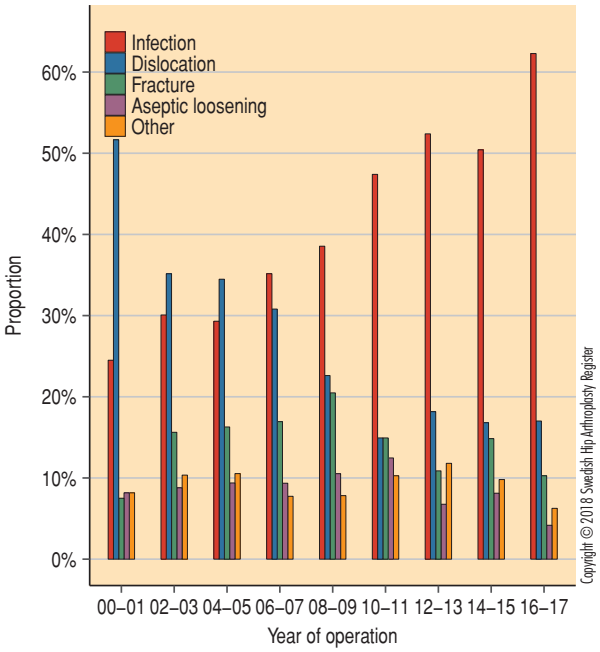

Figure 8.2.1 Distribution of the causes of reoperation within two years after the primary operation divided into six time periods between 2000 and 2017.

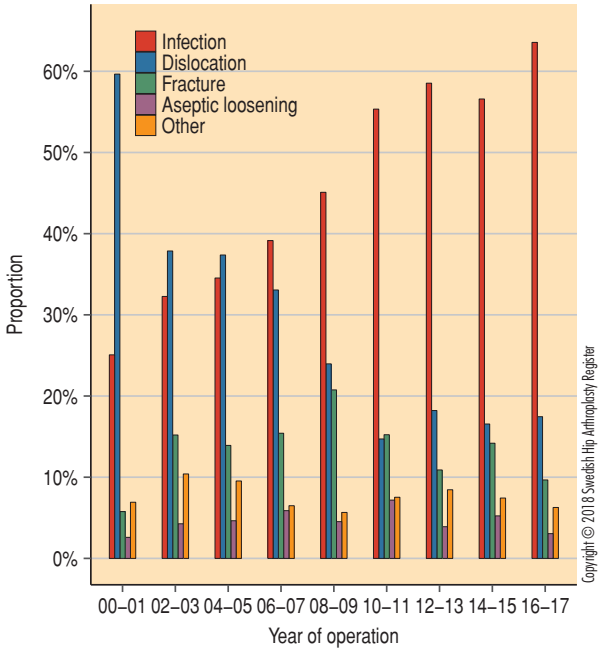

Figure 8.2.2 Distribution of the most common causes for reoperation during the first year after the primary operation divided into different time periods between 2000 and 2017.

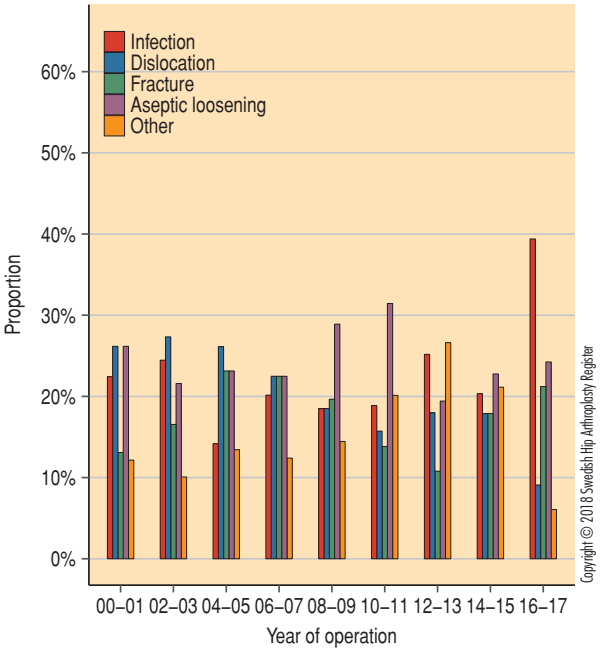

Figure 8.2.3 Distribution of the most common causes for reoperation during the second year after the primary operation divided into different time periods between 2000 and 2016.

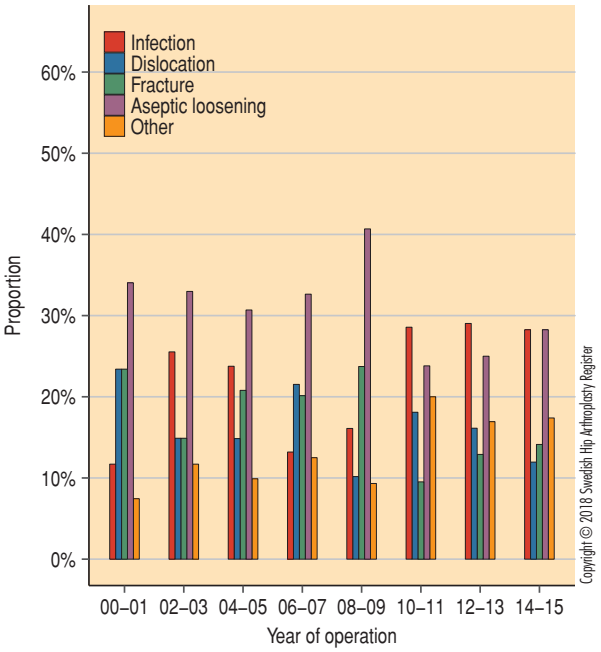

Figure 8.2.4 Distribution of the most common causes for reoperation during the third year after the primary operation divided into different time periods between 2000 and 2015.

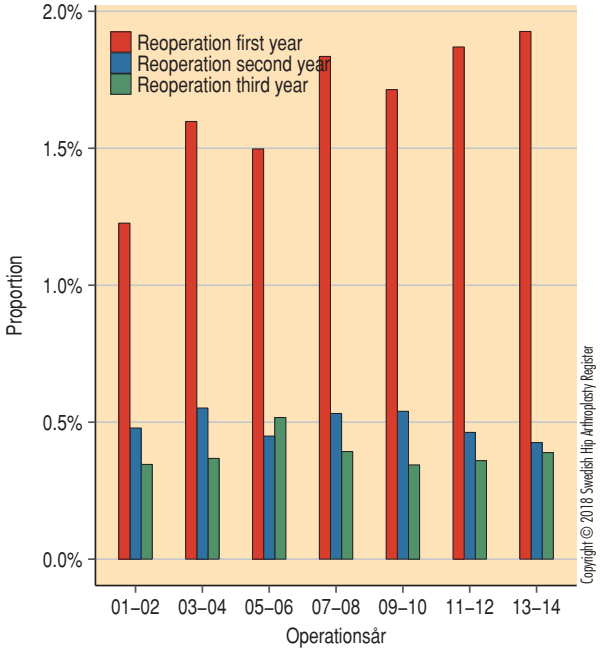

Figure 8.2.5 Proportion of reoperation during the first three years after primary surgery related to year of primary operation. Year of primary operation where the observation time has not yet reached the appointed time, has been excluded.

Reoperations within two years per unit

2014–2017

	Primary op.	Reoperation[1]		Deep infection		Dislocation		Fracture		Other	
Unit	**No.**	**No.**	**No., %[2]**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
University or regional hospital											
Karolinska/Huddinge	886	17	2.1	8	0.9	2	0.2	3	0.4	4	0.5
Karolinska/Solna	613	30	5.3	15	2.5	7	1.2	2	0.4	4	0.7
Linköping	238	5	2.3	1	0.4	4	1.8	0	0.0	0	0.0
SU/Mölndal	2 409	47	2.2	22	1.0	10	0.5	5	0.2	10	0.6
SUS/Lund	723	14	2.0	5	0.7	5	0.7	0	0.0	4	0.6
SUS/Malmö	122	2	1.7	1	0.8	1	0.8	0	0.0	0	0.0
Umeå	376	15	4.5	10	2.7	1	0.3	1	0.4	3	1.1
Uppsala	1 041	37	3.8	20	2.0	6	0.6	2	0.2	9	1.0
Örebro	332	12	4.0	7	2.1	0	0.0	3	1.1	2	0.7
County hospital											
Borås	583	11	2.0	9	1.7	0	0.0	2	0.4	0	0.0
Danderyd	1 309	52	4.1	25	2.0	12	1.0	15	1.2	0	0.0
Eksjö	886	27	3.2	23	2.7	1	0.1	2	0.2	1	0.1
Eskilstuna	443	12	3.2	8	1.9	0	0.0	2	0.6	2	0.7
Falun	1 083	20	2.1	11	1.1	0	0.0	3	0.3	6	0.7
Gävle	935	18	2.1	9	1.0	1	0.1	1	0.1	7	0.9
Halmstad	882	24	3.1	13	1.6	4	0.5	2	0.3	3	0.4
Helsingborg	507	12	2.5	5	1.0	4	0.8	3	0.6	0	0.0
Hässleholm-Kristianstad	3 313	55	1.9	40	1.3	0	0.0	6	0.2	8	0.3
Jönköping	707	16	2.6	9	1.4	2	0.3	1	0.1	4	0.7
Kalmar	680	9	1.5	3	0.5	0	0.0	2	0.4	4	0.6
Karlskrona	134	3	2.5	0	0.0	2	1.6	0	0.0	1	0.9
Karlstad	858	27	3.3	23	2.8	1	0.1	2	0.3	0	0.0
Norrköping	1 044	10	1.1	5	0.5	0	0.0	1	0.1	4	0.5
NÄL	88	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Skövde	651	25	4.0	21	3.4	0	0.0	3	0.5	1	0.2
Sundsvall	333	13	3.9	7	2.1	4	1.2	0	0.0	1	0.3
Södersjukhuset	1 580	54	3.9	26	1.7	5	0.3	18	1.5	5	0.4
Uddevalla	1 538	38	2.8	23	1.6	4	0.4	5	0.3	6	0.5
Varberg	915	12	1.5	3	0.3	3	0.5	2	0.2	3	0.4
Västerås	1 750	50	3.2	26	1.6	14	0.8	1	0.1	5	0.4
Växjö	549	12	2.5	8	1.5	3	0.7	1	0.2	0	0.0
Östersund	1 093	28	2.7	18	1.8	3	0.3	4	0.4	1	0.1

(the table continues on the next page)

Reoperations within two years per unit, cont.

2014–2017

	Primary op.	Reoperation[1]		Deep infection		Dislocation		Fracture		Other	
Unit	No.	No.	No., %[2]	No.	%	No.	%	No.	%	No.	%
Rural hospital											
Alingsås	777	14	1.8	13	1.7	0	0.0	0	0.0	1	0.1
Arvika	816	31	4.2	22	2.8	2	0.3	3	0.4	4	0.6
Enköping	1 457	24	1.9	9	0.6	8	0.6	2	0.2	4	0.4
Frölunda Specialistsjukhus	180	2	1.1	1	0.6	0	0.0	0	0.0	1	0.6
Gällivare	372	3	0.8	3	0.8	0	0.0	0	0.0	0	0.0
Hudiksvall	520	12	2.6	4	0.8	2	0.5	2	0.4	4	0.9
Karlshamn	975	26	3.0	9	1.0	11	1.2	3	0.3	3	0.4
Karlskoga	532	17	3.3	11	2.1	1	0.2	3	0.6	2	0.4
Katrineholm	922	28	3.3	20	2.3	3	0.4	1	0.1	4	0.5
Kungälv	789	21	2.8	17	2.3	1	0.2	2	0.3	1	0.1
Lidköping	1 160	22	2.1	8	0.7	7	0.6	1	0.1	6	0.7
Lindesberg	1 455	13	1.2	8	0.7	3	0.2	1	0.1	0	0.0
Ljungby	684	18	2.8	11	1.6	5	0.9	1	0.1	1	0.2
Lycksele	1 283	20	1.8	14	1.2	2	0.2	1	0.1	3	0.3
Mora	979	13	1.6	6	0.6	3	0.3	0	0.0	4	0.7
Norrtälje	555	13	3.0	6	1.2	2	0.5	0	0.0	5	1.3
Nyköping	641	22	3.6	18	2.9	3	0.5	0	0.0	1	0.2
Oskarshamn	1 124	8	0.9	8	0.9	0	0.0	0	0.0	0	0.0
Piteå	1 441	7	0.6	3	0.2	2	0.2	1	0.1	0	0.0
Skellefteå	524	10	2.4	3	0.7	3	0.9	2	0.4	2	0.4
Skene	550	4	0.8	1	0.2	0	0.0	1	0.2	2	0.4
Sollefteå	767	14	2.0	7	1.1	6	0.8	1	0.1	0	0.0
Sunderby	137	4	3.2	1	0.7	2	1.5	0	0.0	1	1.0
Södertälje	520	21	4.4	14	3.0	2	0.4	2	0.4	3	0.6
Torsby	482	12	2.9	9	2.0	0	0.0	2	0.5	1	0.4
Trelleborg	2 693	30	1.3	8	0.3	9	0.4	10	0.5	2	0.1
Visby	523	12	2.5	4	0.8	3	0.7	1	0.2	4	0.8
Värnamo	562	8	1.7	1	0.2	5	1.0	0	0.0	1	0.3
Västervik	465	6	1.4	6	1.4	0	0.0	0	0.0	0	0.0
Ängelholm	318	4	1.8	1	0.8	2	0.6	1	0.4	0	0.0
Örnsköldsvik	696	6	1.0	3	0.5	2	0.3	0	0.0	1	0.2

(the table continues on the next page)

Reoperations within two years per unit, cont.

2014–2017

	Primary op.	Reoperation[1]		Deep infection		Dislocation		Fracture		Other	
Unit	**No.**	**No.**	**No., %[2]**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Private hospital											
Aleris Specialistvård Bollnäs	1 175	14	1.5	6	0.6	1	0.1	2	0.2	5	0.6
Aleris Specialistvård Motala	2 320	36	1.7	18	0.8	5	0.2	3	0.1	9	0.5
Aleris Specialistvård Nacka	815	15	2.0	5	0.7	2	0.3	6	0.8	1	0.1
Aleris Specialistvård Sabbatsberg	165	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aleris Specialistvård Ängelholm	366	4	1.1	3	0.8	1	0.3	0	0.0	0	0.0
Art Clinic Göteborg	145	1	0.7	1	0.7	0	0.0	0	0.0	0	0.0
Art Clinic Jönköping	141	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Capio Artro Clinic	259	2	1.1	0	0.0	0	0.0	1	0.5	0	0.0
Capio Movement	1 200	34	3.2	17	1.5	10	0.9	1	0.2	6	0.6
Capio Ortopediska Huset	1 928	15	1.0	5	0.3	3	0.2	4	0.3	2	0.2
Capio S:t Göran	2 109	35	1.8	12	0.6	5	0.2	7	0.4	6	0.3
Carlanderska	681	7	1.1	6	0.9	0	0.0	0	0.0	1	0.2
Hermelinen Specialistvård	50	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ortho Center IFK-kliniken	603	2	0.4	2	0.4	0	0.0	0	0.0	0	0.0
Ortho Center Stockholm	2 095	26	1.5	15	0.9	5	0.3	4	0.2	2	0.1
Sophiahemmet	920	19	2.2	5	0.5	3	0.4	9	1.0	2	0.3
Spenshult	97	3	3.1	0	0.0	3	3.1	0	0.0	0	0.0
Country	68 599	1 365	2.2	748	1.2	226	0.4	170	0.3	193	0.4

Table 8.2.1

Units with fewer than 20 primary operations during the period are excluded.

[1] Refers to the number of patients with short term complication, which can differ from the sum of the number of complications since every patient can have more than one type of complication.

[2] All proportions are computed using competing risk during two years of follow-up.

Reoperations within two years per unit – trend
2014–2017

Unit	2010–2013[1)]	2011–2014	2012–2015	2013–2016	2014–2017
	Number, %	Number, %	Number, %	Number, %	Number, %
University or regional hospital					
Karolinska/Huddinge	2.3	2.0	2.1	1.9	2.1
Karolinska/Solna	3.1	3.4	4.7	4.5	5.3
Linköping	3.2	2.7	2.7	3.4	2.3
SU/Mölndal	2.5	2.4	2.1	2.4	2.2
SUS/Lund	3.1	2.8	2.6	2.7	2.0
SUS/Malmö	2.0	1.4	1.3	0.9	1.7
Umeå	4.5	5.9	4.9	4.5	4.5
Uppsala	2.7	3.8	3.7	3.7	3.8
Örebro	2.4	2.4	3.3	3.6	4.0
County hospital					
Borås	2.8	3.3	2.8	2.9	2.0
Danderyd	3.9	4.0	3.7	4.2	4.1
Eksjö	2.0	2.0	2.5	2.6	3.2
Eskilstuna	3.4	3.3	3.0	3.0	3.2
Falun	2.2	1.9	2.0	2.2	2.1
Gävle	4.7	4.4	2.7	2.5	2.1
Halmstad	3.8	3.3	3.2	2.7	3.1
Helsingborg	2.9	2.6	2.5	2.0	2.5
Hässleholm-Kristianstad	1.8	2.0	1.7	1.7	1.9
Jönköping	1.4	1.4	1.5	2.1	2.6
Kalmar	1.3	1.6	1.5	1.9	1.5
Karlskrona	2.7	3.8	3.9	3.2	2.5
Karlstad	5.6	5.1	4.1	4.0	3.3
Norrköping	1.1	1.3	1.2	1.7	1.1
NÄL	-	-	*	0.0	0.0
Skövde	1.4	1.8	2.8	3.8	4.0
Sundsvall	3.4	3.7	3.0	3.6	3.9
Södersjukhuset	3.0	3.4	3.5	3.4	3.9
Uddevalla	1.5	1.6	2.1	2.2	2.8
Varberg	1.4	1.5	1.5	1.8	1.5
Västerås	3.8	3.7	3.2	2.9	3.2
Växjö	2.4	1.9	1.6	2.6	2.5
Östersund	2.8	2.6	2.5	2.2	2.7

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Reoperations within two years per unit – trend, cont.

2014–2017

Unit	2010–2013[1)]	2011–2014	2012–2015	2013–2016	2014–2017
	Number, %	Number, %	Number, %	Number, %	Number, %
Rural hospital					
Alingsås	2.2	1.9	1.7	2.0	1.8
Arvika	2.3	1.8	2.7	3.3	4.2
Enköping	2.2	2.3	2.2	1.9	1.9
Frölunda Specialistsjukhus	1.5	0.6	0.9	1.2	1.1
Gällivare	1.5	1.0	0.8	1.4	0.8
Hudiksvall	2.7	2.5	2.6	2.5	2.6
Karlshamn	1.6	1.8	2.3	2.7	3.0
Karlskoga	1.0	1.4	1.7	2.7	3.3
Katrineholm	1.9	1.8	1.9	2.6	3.3
Kungälv	2.4	2.7	2.9	2.9	2.8
Lidköping	0.8	1.1	1.3	1.6	2.1
Lindesberg	0.8	0.9	0.9	1.4	1.2
Ljungby	1.2	1.8	2.3	2.9	2.8
Lycksele	2.0	2.0	1.8	2.1	1.8
Mora	0.9	1.3	1.6	1.3	1.6
Norrtälje	3.1	2.9	2.7	2.6	3.0
Nyköping	6.9	6.1	4.5	3.6	3.6
Oskarshamn	1.1	0.9	0.9	1.0	0.9
Piteå	0.9	1.0	1.0	0.6	0.6
Skellefteå	1.2	1.8	2.1	2.1	2.4
Skene	2.4	1.6	1.7	1.5	0.8
Sollefteå	0.6	0.8	1.0	1.9	2.0
Sunderby	2.2	3.8	3.5	2.9	3.2
Södertälje	3.9	5.3	6.0	6.6	4.4
Torsby	2.0	2.3	3.4	3.0	2.9
Trelleborg	1.5	1.4	1.3	1.2	1.3
Visby	3.2	3.7	3.0	3.0	2.5
Värnamo	1.4	1.4	2.0	1.6	1.7
Västervik	2.6	2.4	0.9	1.3	1.4
Ängelholm	0.6	1.4	1.6	1.9	1.8
Örnsköldsvik	1.0	1.1	1.0	1.1	1.0

(the table continues on the next page)

Reoperations within two years per unit – trend, cont.

2014–2017

Unit	2010–2013[1)]	2011–2014	2012–2015	2013–2016	2014–2017
	Number, %	Number, %	Number, %	Number, %	Number, %
Private hospital					
Aleris Specialistvård Bollnäs	2.2	1.9	2.0	1.5	1.5
Aleris Specialistvård Motala	2.3	2.2	1.9	1.9	1.7
Aleris Specialistvård Nacka	1.8	2.4	2.4	2.5	2.0
Aleris Specialistvård Sabbatsberg	1.4	0.8	0.8	0.6	0.0
Aleris Specialistvård Ängelholm	*	1.0	1.3	1.3	1.1
Art Clinic Göteborg	-	-	0.0	1.4	0.7
Art Clinic Jönköping	*	0.0	0.0	0.0	0.0
Capio Artro Clinic	-	-	-	-	1.1
Capio Movement	3.8	4.6	4.1	3.7	3.2
Capio Ortopediska Huset	1.1	1.1	1.0	1.2	1.0
Capio S:t Göran	3.4	3.5	2.7	2.2	1.8
Carlanderska	1.8	2.0	1.3	1.5	1.1
Hermelinen Specialistvård	*	*	0.0	0.0	0.0
Ortho Center IFK-kliniken	0.4	0.2	0.4	0.4	0.4
Ortho Center Stockholm	2.9	2.7	2.5	1.7	1.5
Sophiahemmet	1.7	1.7	1.9	1.6	2.2
Spenshult	3.6	3.5	3.7	3.3	3.1
Country	2.3	2.3	2.2	2.3	2.2

Table 8.2.2

[1)]All proportions are computed using competing risk analys during two years of follow-up.
[-)]No operations during this period.
[*)]Fewer than 20 operations during this period.

8.3 Revision

A revision means that a patient who has undergone hip arthroplasty previously will undergo a further operation where part or the whole of the prosthesis is replaced or extracted. In the case of two sessions, the two procedures are registered as one activity (unless stated otherwise) in the graph and the analyses as one activity. If, for example, a primary prosthesis is revised in two sessions, the insertion will be classified as a first-time revision, which thus comprises two consecutive actions. If, on the other hand, the prosthesis is extracted permanently, which means that no prosthetic insertion is registered by the final observation date (in this year's report 31–12–2017), the prosthesis extraction will be classified as a first-time revision. Due to problems related to the transition to a new database structure, we have this year had to treat two-stage procedures separately, which is commented on in more detail below. By the next annual report, we expect this problem to have been resolved.

From the very start in 1979, revisions (and other reoperations) have been reported on the individual level, which offers an opportunity to extract more complete data from this year onwards, as opposed to registration of primary prostheses, where data was linked to the personal identity number for the first time in 1992. Through to 1991, all primary prostheses were reported in the form of aggregated data per unit. Since 1995, when the lowest number of revisions during the period 1992 through to 2017 was reported, the number of revisions has increased by just under 50% whilst the number of primary prostheses has more than doubled (around 117%, Figure 8.3.1 a and b). There has probably not been any great indication shift during this 22–year period, which reflects a tangible improvement in the results even if more sophisticated analysis is required to establish this in a safer way. The increase in the number of revisions which, despite everything, could be seen at the end of the 1990s, can thus be attributed to the fact that a growing number of patients were inserted with a primary prosthesis. Since 2009, the number of revisions has remained relatively consistent at around 1,900 per year.

We can note that from 1992 onwards the number of multiple revisions has increased. This is result of an increasing number of patients being operated on combined with a general increase in life expectancy. The increase is most obvious for those who have been revised more than twice previously, where their relative proportion increased from 4.7% in 1992 to 9.3% in 2017. The corresponding increase for second-time revisions is a more modest 0.4% (Figure 8.3.2).

Patients who undergo a revision differ (likewise those who undergo reoperation) demographically from those patients who were operated on with a primary prosthesis. Generally speaking, they are older, often male, often with secondary osteoarthritis (excluding the hip fracture group) and they have a high degree of comorbidity (Table 8.3.1). A number of these tendencies are accentuated further in patients who undergo multiple pelvic revisions. Among those patients who have undergone at least one revision and have been forced to undergo a further revision, the degree of comorbidity is augmented further and an even higher proportion of these have been initially operated on for secondary osteoarthritis. It is well known that patients with a high BMI are more frequently affected by a range of complications following hip arthroplasty. The proportion with a BMI of 30 or over thus becomes increasingly greater the more revisions the patient has undergone.

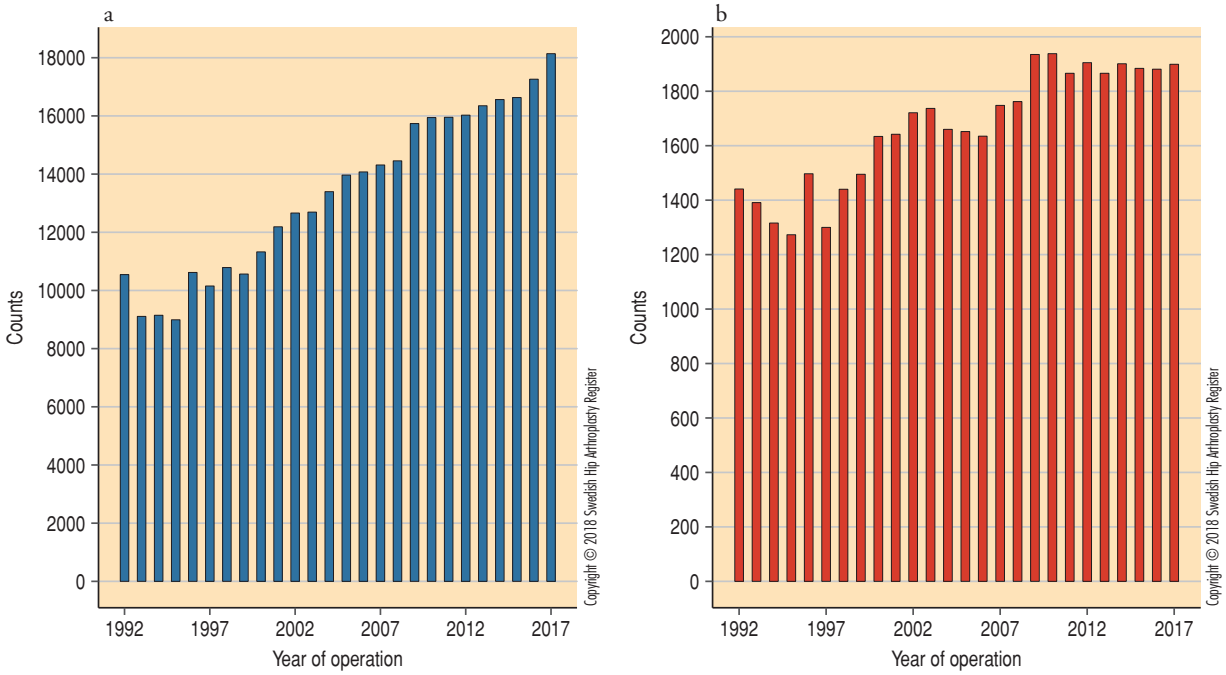


Figure 8.3.1 a-b Number of primary (a) and revision (b) hip arthroplasties 1992 - 2018. The proportional rise of primary procedures is higher than that of revision procedures.

Demographics during initial, secondary and multiple-time revisions and during primary operation 2008–2017

	Number of earlier revisions			Primary operation
	None	1	≥ 2	
Number	13 797	3 424	1 616	163 066
Age				
Average SD	71.6 11.0	*71.1 11.1*	*70.1 11.0*	*68.7 10.8*
<55 years %	7.2	8.1	10.0	10.0
55–69 years %	30.9	31.7	33.6	39.9
70–84 years %	51.5	50.3	49.1	45.0
≥ 85 years %	10.5	9.8	7.3	5.1
Gender				
Proportion of women %	52.0	46.9	48.1	58.2
BMI				
Number, % of all in the interval	12 124 87.9	*2 980 87.0*	*1 372 84.9*	*152 227 93.4*
Average SD	27.2 5.6	27.2 5.7	27.5 5.1	27.1 5.2
<18.5 %	1.3	1.4	2.0	1.2
18.5–24.9 %	33.5	34.0	30.5	33.4
25–29.9 %	41.1	40.1	38.8	41.9
30–34.9 %	18.0	17.4	20.0	18.0
≥35 %	6.2	7.1	8.9	5.1
ASA class				
Number, % of all in the interval	11 730 94.4	*3 025 94.7*	*1 310 91.7*	*158 041 96.9*
I %	12.4	10.5	7.2	22.6
II %	53.4	50.9	48.4	58.3
III– %	34.2	38.6	44.5	19.1
Diagnosis during primary operation*				
Primary osteoarthritis	75.5	70.3	64.2	80.6
Fracture including sequelae	8.0	7.9	9.7	10.9
Inflammatory joint disease	4.9	7.2	9.9	1.2
Sequelae childhood disease	3.5	5.3	5.9	1.9
Femoral head necrosis	3.0	3.5	3.3	2.1
Other secondary osteoarthritis	5.0	5.8	7.0	3.3

Table 8.3.1. Gender and age distribution during inital, secondary and multiple-time revisions from 2008, when registration of ASA class, length och weight began. Data for primary operation are presented for comparison.

Revisions are still carried out at units which, on average during the past three years, operated on fewer than 10 cases per year (Table 8.3.2). Of the 5,664 revisions reported between 2015 and 2017, just over half (51.2%) were performed at 11 units and the remaining 48.8% were performed at 54 units The equivalent analysis of multiply revised hips shows that eight units performed 48,3% of these surgeries, whereas the remaining 51,7% were operated at 43 different units. As regards primary prostheses 20 units performed 51% of the total production in Sweden and further 61 operated the remaining 49%.

For around half of the primary prostheses inserted in Sweden between 2015 and 2017, the procedure was carried out at 25% of the units that perform this type of operation. As regards first-time revisions and multiple revisions, these were carried out at around 19% and 16% respectively of the units that focused on this type of operation. Revisions are thus to a greater extent concentrated at certain hospital units but perhaps not to the extent one might believe.

It ought to be pointed out, however, that the optimal volume of revisions per year per unit is unknown and is certainly difficult to establish, as comorbidity and the technical degree of difficulty can vary considerably between different types of revisions. In addition, the same surgeon operates at different hospitals and consequently hospital volume can only be regarded as a surrogate variable. On the other hand, a revision operation includes so much more than the actual procedure. Consequently, there are a number of advantages of having some degree of centralisation. Revision surgery can require more advanced treatment, both before, during and after surgery. These patients have a higher degree of comorbidity (Table 8.3.1). Preoperative and postoperative complications are considerably more common than is the case with a primary operation. In order to alleviate optimally any preoperative and possible postoperative complications and problems that may arise, access to a bone bank and a broad range of implants is required, as well as knowledgeable and experienced staff.

Table 8.3.2 shows no dramatic changes regarding the division between units with a high and low number of revisions. During the period 2014–2016, six hospitals throughout the country carried out more than 50 such revisions over the three years (570 operations in total). During the following period, the equivalent number of hospitals had increased to nine, which together reported 804 operations. The number of hospitals that carried out eight or fewer multiple revisions per year fell by three, a weak trend but probably in the right direction. At 18 hospitals, 10 or fewer revisions were carried out (106 first-time revisions, 20 other or multiple revisions) during the same period. Of these, 20.6% took the form of a cup revision, 32.5% involved cup/liner replacement, 35.8% involved replacement of the stem, with or without cup replacement, and 9.6% took the form of a complete or incomplete prosthesis extraction. In two cases, information was lacking about the action taken.

A low volume per operating unit does not necessarily mean poorer healthcare quality, as certain units could have stopped operating and moved during the period and could therefore have been affected by a short production period spread out over three years. In other cases, a good level of expertise could be available despite the fact that few revisions were carried out and that certain revisions do not require a high degree of ex-

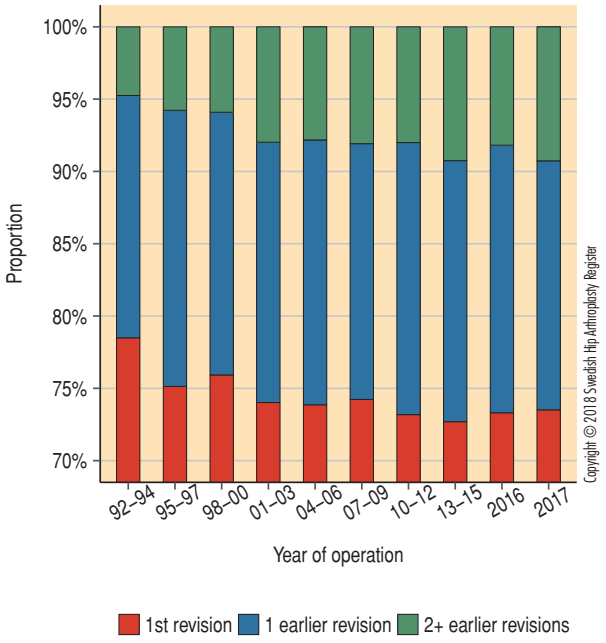


Figure 8.3.2 Relative share of revisions preceded of none, one and two or more previous revisions.

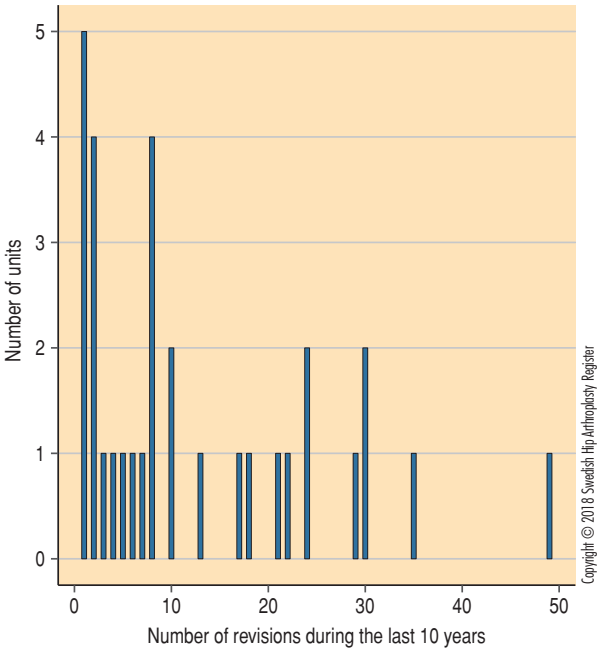


Figure 8.3.3 Number of units that has performed 49 or less revisions revisions during the period 2008 to 2017.

Number of units with different volume of primary and revision arthroplasty 2014–2017

	Number of operating hospitals			
	Primary prosthesis	First revision	≥ 1 earlier revision(s)	Regardless of previous number of revisions
Volume per unit				
1–24	3 *2*	22 *22*	31 *34*	23 *22*
25–49	1 *3*	12 *12*	12 *11*	8 *11*
50–99	3 *5*	16 *15*	*7 4*	12 *11*
100–149	4 *1*	4 *6*	1 *2*	11 *8*
150–199	3 *3*	*6 5*	1 *0*	3 *5*
200–299	5 *5*	4 *4*	–	*6 5*
300–499	18 *22*	–	–	3 *3*
500–999	31 *29*	–	–	–
1 000–1 499	*6 7*	–	–	–
1 500–2 499	*7 5*	–	–	–

Table 8.3.2. Number of units which carry out first-time and multiple-time revisions presented in groups for the period 2015–2017. Numbers for previous period (2014–2016) are presented in italic. Note that volumes are attributed to three years and two-session procedures are counted as one revision.

pertise and long experience. Despite these objections, it could be considered striking that as many as 32 units carried out five revisions or fewer per year over the past 10-year period, and that 20 units carried out an average of one revision or less per year (Figure 8.3.3).

At the Hip Arthroplasty Register we have pointed out that restructuring within the healthcare service meant that university and regional hospitals in particular carry out primary arthroplasties of a standard nature to a decreasing extent. This is not good from a teaching and research and development point of view. Whilst some of these activities could naturally be outsourced, it has nevertheless been shown to be increasingly difficult to conduct clinical research projects for, among other things, logistical reasons when virtually all primary operations need to be performed at units with limited capacity for anything other than pure healthcare. To highlight this situation, we focus here on the number of primary prostheses in relation to the total number of arthroplasties carried out at the same hospital unit. At several units, what would appear to be a satisfactory number of primary prostheses were operated whilst certain units only carry out a small number of procedures. It can also be assumed that several of these operations, despite the diagnosis of primary osteoarthritis, are not of a standard nature (Table 8.3.3).

Reasons for a revision

During the period 1999–2017, aseptic loosening (57.5%), dislocation 13.6%), infection (13.5%) and periprosthesis fracture (9.1%) were the most common reasons for a revision, regardless of whether a hip prosthesis had been revised previously or not. Over time, however, the range of causes changed. Even in 1999, aseptic loosening was the most common reason and gave rise to 69.9% of all revisions. Dislocation came second with 9.9%, followed by periprosthesis fractures (7.3%) and infection (6.9%). After just under two decades, we found that in 2017 loosening as a reason for a revision continued to dominate, despite a considerably lower proportion than in 1999 (2017: 44.6%) followed by deep infection (25.6%), dislocation (13.6%) and periprosthesis fracture (10.5%). In 1999, 989 revisions were carried out due to loosening, and 140 due to infection. In 2017, the equivalent numbers were 772 and 444 respectively. Revisions due to loosening are now fewer in number despite the fact that the patient population who have undergone hip arthroplasty has grown, and despite the fact that life expectancy has increased. On the other hand, the number of revisions due to infection has more than tripled. On December 31, 1999, 88,087 patients who had had at least one hip prosthesis inserted during the period 1992–1999 were still alive. Almost three times as many patients lived up to the end of 2017 with at least one hip prosthesis inserted between 1992 and 2017 (n = 228,400). The true figure is higher, as we lack personal identity numbers for those patients who underwent an operation before 1992, even if the number of prostheses operated per year both during the 1970s and 1980s was considerably lower than is the case today.

Distribution of revisions and primary prostheses 2015–2017 for units which have performed at least 100 revisions during the period

Hospital/unit	Revisions	Primary prostheses		
		Number all diagnosis/ primary osteoarthritis	Proportion all diagnosis, %	Proportion with primary osteoarthritis, %
Borås	100	413/259	80.5	50.5
Capio S:t Göran	172	1 683/1 515	90.7	81.7
Danderyd	304	966/661	76.1	52.0
Eskilstuna	102	346/161	77.2	35.9
Falun	105	758/658	87.8	76.2
Gävle	208	712/342	77.4	37.2
Halmstad	118	641/495	84.5	65.2
Helsingborg	113	398/244	77.9	47.7
Hässleholm-Kristianstad	285	2 466/2 118	89.6	77.0
Karolinska/Huddinge	211	621/346	74.6	41.6
Karlstad	169	610/336	78.3	43.1
Karolinska/Solna	142	429/148	75.1	25.9
Linköping	106	171/80	61.7	28.9
SUS/Lund	287	520/151	64.4	18.7
SU/Mölndal	451	1 815/1 183	80.1	52.2
Skövde	140	515/372	78.6	56.8
Södersjukhuset	214	1 161/762	84.4	55.4
Uddevalla	140	1 148/993	89.1	77.1
Umeå	229	278/61	54.8	12.0
Uppsala	351	757/357	68.3	32.2
Västerås	189	1 314/757	87.4	50.4
Örebro	117	181/68	60.7	22.8
Östersund	120	832/591	87.4	62.1

Table 8.3.3. Number of reported revisions, primary arthroplasties and proportion of primary arthroplasties in relation to the sum of revisions and primary arthroplasties during a three year period for units which have performed 100 revisions or more 2015–2017.

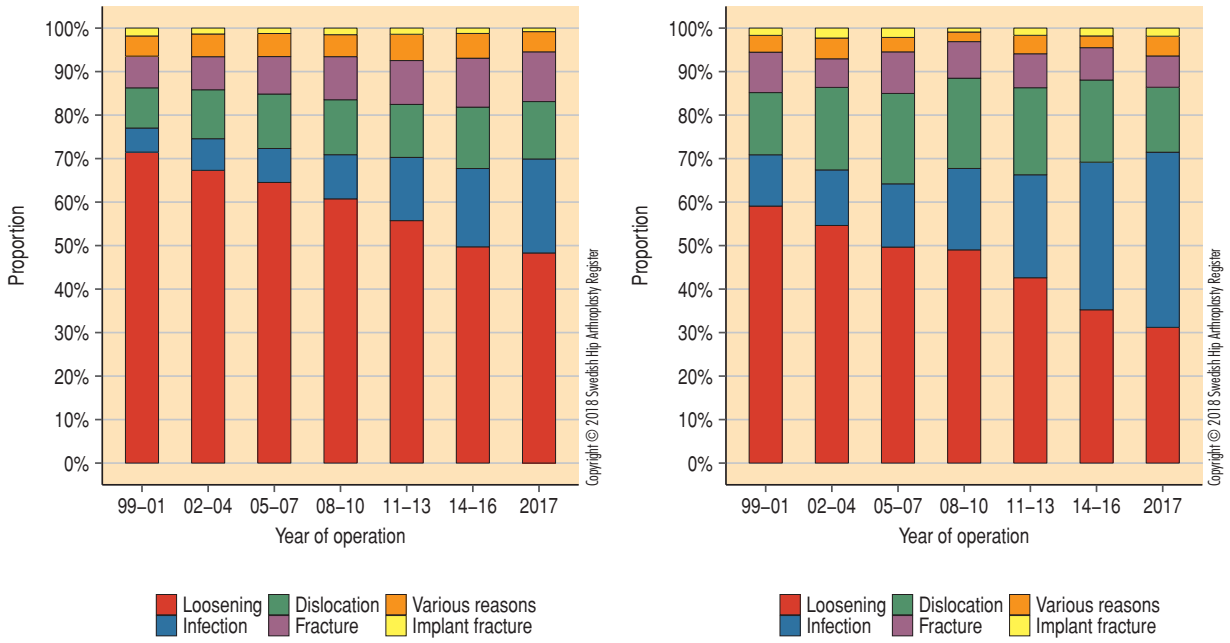


Figure 8.3.4 Distribution of reasons for revision for first time revisions (left, a) and multiple revisions (right, b) during the different periods from 1999 to 2017.

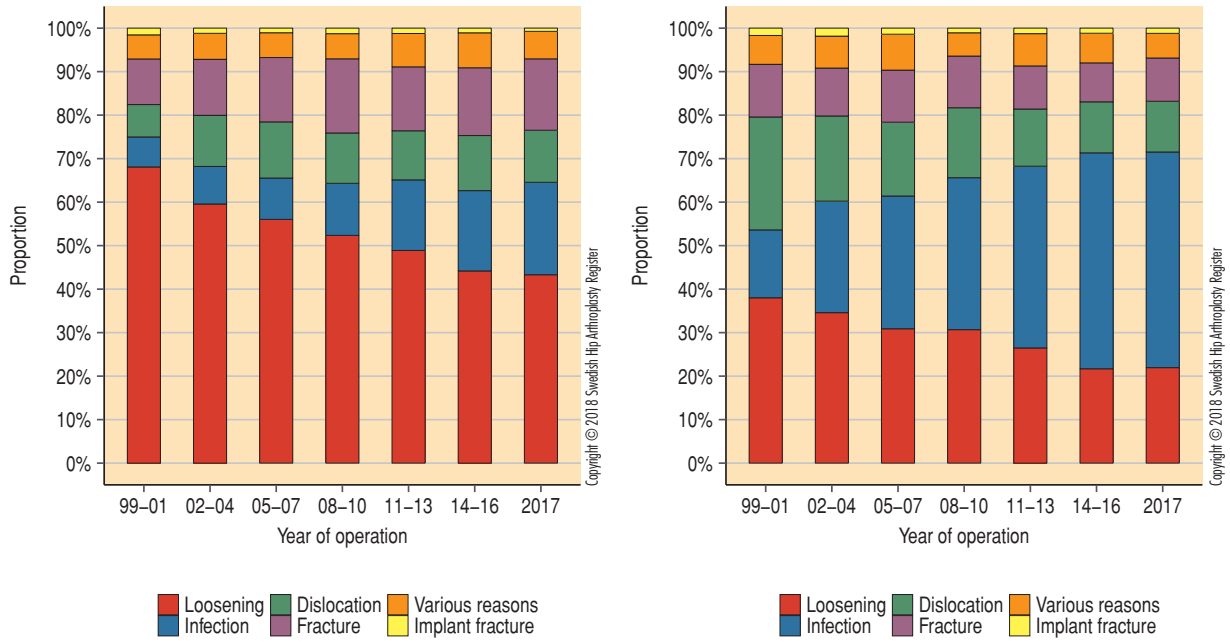


Figure 8.3.5 Distribution of reasons for reoperation in first time reoperations (left, a) and in multipel peoperations during different periods from 1999 to 2017. In comparison with figure 8.3.4 the relative number of procedures due to periprosthetic fracture has increased as regards first time procedures and for infection as regards the group with multipel procedures.

The division between the most common cause categories, loosening (including osteolysis and wear), infection, dislocation and periprosthesis fracture, differs between first-time and multiple revisions. In the case of a first-time revision, loosening/osteolysis/wear dominate (Figure 8.3.4). The same applies to multiple revisions up to and including the period 2014–2016. During 2017, infection is in relative terms the most common reason for a revision. If 'other' reoperations (those reoperations where the actual prosthesis is not touched) are added, the picture changes. In conjunction with the first reoperation, the relative proportion of periprosthesis fractures is generally speaking higher as all fractures that are subjected to locking plate fixation without changing a component are added. In the group of reoperations carried out on patients who have been re-operated on previously, infection is the most common reason, even during the period 2008–2010, and by 2017 it accounted for fewer than half (49.6%, Figure 8.3.5).

Stem fracture is an unusual complication. In the Register, revision as a result of implant breakage is reported. However, exact details are lacking with regard to which component or components are affected. In an analysis of primary prostheses, we have assumed that if the stem of the hip prosthesis is revised as a result of an implant fracture, then it is highly probable that it is a case of a stem fracture, even if this could involve a slight overestimation. Despite this, we report data for individual stems as we consider this information to be of value to the profession. If one uses the aforementioned definition as a starting point, and analyse hip prostheses inserted as part of a primary operation between 1992 and 2017, stem survival after 25 years is highest at 99.3 ± 0.1%. If a closer examination is required of which stems and stem sizes have been affected, along with assurance of the fairness of the examination, prostheses inserted from 1999 onwards must be used as a starting point as this is when detailed information about implant sizes and design began to be collected. Through to 2017, 172 hips had been revised as a result of broken implants, of which 140 had undergone a stem revision. In Table 8.3.4, it is shown which stems have been affected and the extent to which it is primarily a case of the smallest stem size that was used for each group. For the two stems used most in Sweden, and where the stem fracture outcome is sufficiently large for relevant conclusions to be drawn, we find that the very smallest sizes are the most common. In the case of the Exeter stem, the figure is just below one-third of the cases, and for Lubinus SP II over 90% of the fractured SP II stems were of size 01. We have previously pointed out that the Lubinus SP II size 01 ought to be avoided, particularly for active patients with a small medullary canal. This recommendation could also apply to a certain extent to the smaller size of the Exeter stem (size 0). As a stem fracture appears to be extremely unusual for the uncemented stems used in Sweden, this could be an attractive alternative in those cases where there is no possibility of going up in stem size without negatively impacting on the potential for good cemented fixation.

Stems which have been revised due to implant fracture

	Number of stems 1999–2017			
	Total	Number of revisions due to implant fracture	Proportion as per mille	Whereof with the least stem size*
CPT	2 946	2	0.7	1
MS-30	13 468	2	0.1	1
Charnley	5 916	2	0.3	-
Elite plus	1 462	3	2.0	2
SP II	115 007	85	0.7	77
SP II Dysplasi	48	2	41.6	1
Corail	22 777	3	0.1	0
Exeter	58 657	33	0.6	13
Exeter long	438	1	2.3	1
Durom	381	1	2.6	0
Cenator	269	1	3.7	0
Spectron EF Primary	9 929	4	0.4	1
Bi-metric X por HA NC	8 788	2	0.2	0
All 1999–2017#	278 287	140	0.5	97

Table 8.3.4. Stems which have been revised due to implant fracture after primary arthroplasty performed 1999–2017.

**With the least stem size is meant the least stem size that have been used in Sweden and which is registered in the database of the Swedish Hip Arthroplasty Register – data not available.*

#Includes all stem types even the ones where no revision has been reported due to implant fracture.

Uncertain pain was the reason for revision in 0.5% (n = 168) from 1999 onwards. The majority were first-time revisions (n = 135). The number of revisions resulting from problems related to metal articulations, such as a pseudotumour, were cited as the main reason for the revision in 112 cases, and a revision carried out as a result of increased levels of metal ions in 81 cases. The majority of these operations were first-time revisions (n = 168, 87.6%). Of the first-time revisions of implants operated in 1999 or later (n = 155), just under half were revisions of surface replacements (n = 66, 42.6%). A total of 63 (40.6%) comprised other types of metal-metal articulations, the majority with a cup of the surface replacement type and a conventional stem with a large femoral head. Only 25 (16.1%) were a standard prosthesis with a conventional type of cup and stem. Of these, two had ceramic femoral heads and the remaining 23 were made of metal. 18 of the stems were different types of Bi-Metric stems, and the remaining seven comprised six different stem types, of which one was cemented.

It can be assumed that several of these 25 stems were revised due to corrosion between the cone and the condyle. This would thus mean that corrosion of the cone of the prosthesis during the period in question affects just under one primary prosthesis in 10,000. In the case of the Bi-Metric family of prosthesis stems, the equivalent proportion is around 1.7 per thousand (18/10,372). Despite the fact that corrosion of the prosthesis cone is currently attracting an incredible amount of attention, we can note that in Sweden this has been an extremely unusual complication, almost only affecting uncemented prostheses and mainly one particular design. Even for this design, the incidence is less than two per thousand. The reason for this overrepresentation cannot be determined on the basis of register data. One could speculate on factors, such as lack of surgical technique in conjunction with the femoral head being placed on the cone, or the design of the condyle or the Bi-Metric stem. It could also be a combination of these factors.

The reason for a revision varies depending on age (Figure 8.3.6). In this year's analysis, only the two most recent years (2016 and 2017) are included for the data to be current, and there has been a very distinct change even during the past decade. In the case of a first-time revision, the cause group loosening/osteolysis/wear still dominates, particularly in age groups from 60 years and upwards. Infection came second in the up to 79 years age group, whilst both periprosthesis fracture and dislocation account for a large proportion in the 80 years and older age group.

Among those revised at least once previously, infection as a cause dominates up to 79 years of age, followed by loosening/osteolysis/wear. Patients aged 80 years and older are revised primarily due to loosening/osteolysis/wear, followed by infection. Compared with the situation in conjunction with a first-time revision, dislocation and periprosthesis fracture as causes account for 18–19% each, and dislocation as a cause in conjunction with multiple revisions increased to almost 25% and periprosthesis fractures increased to almost 15%.

Multiple revisions

Of the primary operations carried out between 1999 and 2017, 4.1% were revised before December 31, 2017. The corresponding proportion for first-time revisions carried out during the same period is 17.3% and for second-time revisions 22.7%. Prosthesis survival after 16 years, when at least 107 observations remained in each group, was 87.6 ± 0.4% for men and 91.1 ± 0.3% for women in the primary prosthesis group.

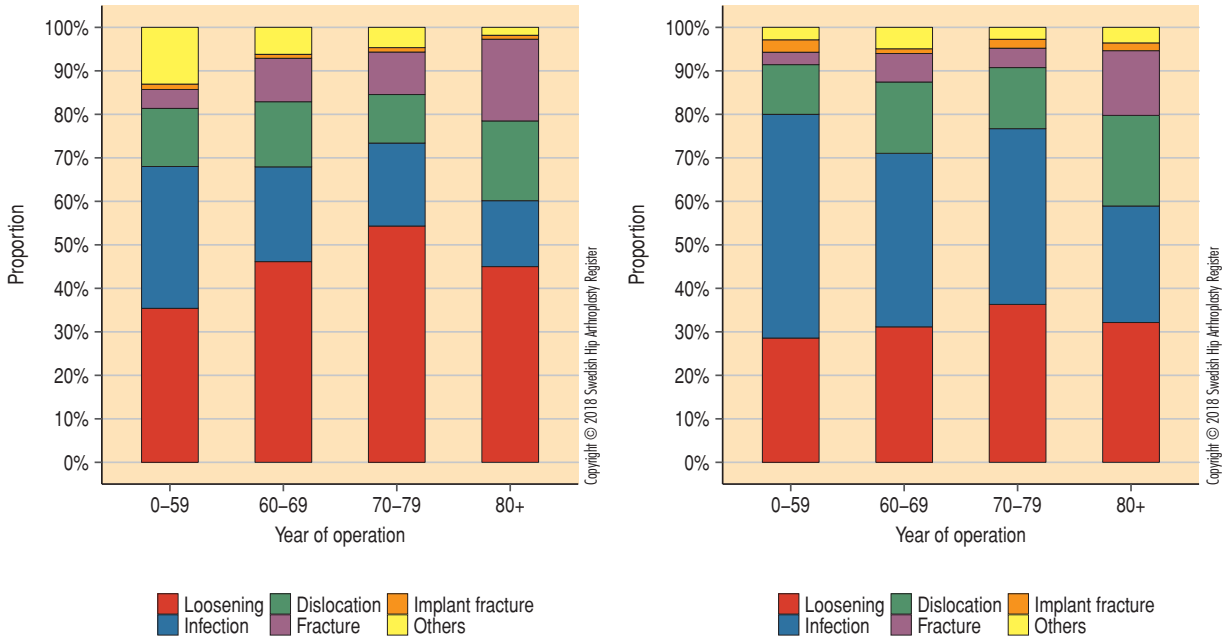


Figure 8.3.6 Distribution of revision causes related to age, first time revisions to the left and cases who has undergone at least one previous revision to the right. Since the reason for revision has changed over time, this year we only present data for 2016 and 2017.

In the first-time revision group, the equivalent survival rate was 68.1 ± 2.0% and 73.8 ± 1.6%, and in conjunction with a second-time revision 62.4 ± 3.0% and 62.3 ± 3.0% respectively (Figure 8.3.7).

Generally, the risk of a revision and re-revision is greater for men than for women, and the prognosis is poorer in conjunction with each revision. Evaluation using a Cox regression analysis and with an adjustment for age in conjunction with a primary operation and primary diagnosis (tumour diagnoses excluded) shows that the risk of (re-)revision is 4.3 times (95% confidence interval: 4.2–4.5) higher after a first-time revision compared with a primary operation, and 6.6 (6.3–6.9) times higher if the patient is revised for a second time. Regardless of whether it is a question of a primary, first-time or second-time revision, men run an increased risk of being (re)revised (1.4, 1.35–1.43).

Reason for a re-revision related to a previous revision cause

The reason why a patient is revised the first time affects the cause profile in conjunction with a possible second-time revision (Table 8.3.5). In the case of a patient who undergoes a first-time revision as a result of loosening/osteolysis, infection or dislocation, there is a significant probability in conjunction with a possible second revision that the patient will be revised for the same reason. The same applies to patients who are affected by a second-time revision. One exception is patients who in conjunction with a first-time revision undergo surgery as a result of a periprosthesis fracture. In these cases, the most common cause of a possible subsequent revision is dislocation followed by loosening and infection, both following first-time and second-time revisions. To ensure the data is reasonably up-to-date, primary and revision operations carried out between 1999 and 2016 are reported.

Cause for secondary and third revision grouped according to prior cause

	Primary arthroplasty 1999–2017 n = 278 248				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
First revision, %	**1.7**	0.9	0.4	0.8	0.3
No revision	95.9				
	Initial revision 1999–2017 n = 24 906				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other/no data available**
Proportion which have been revised, %	12.2	18.7	11.1	16.8	17.7
Cause, %					
Loosening	**6.2**	2.2	3.2	2.2	**5.6**
Infection	1.9	**13.1**	2.3	4.6	2.7
Periprosthetic fracture	1.2	0.6	1.2	0.9	1.5
Dislocation	2.3	2.3	**3.4**	**8.4**	3.5
Other/no data available	0.6	0.5	1.0	0.5	2.1
On to session two					
No rerevision	87.9	81.3	88.9	83.4	84.6
	Secondary revision n = 4 916				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other/no data available**
Proportion which have been revised, %	15.7	21.5	16.4	20.2	19.3
Cause, %					
Loosening	**7.9**	1.1	5.0	3.2	**5.8**
Infection	2.3	**16.7**	2.7	5.5	4.4
Periprosthetic fracture	1.3	0.3	1.1	1.2	1.1
Dislocation	3.2	3.7	**5.9**	**9.2**	5.1
Other	0.9	0.2	1.5	1.1	1.5
No rerevision	84.3	78.4	83.6	79.8	80.6

Table 8.3.5. Distribution of cause for second and third time revision in percentages according to reason for the previous revision. Patients who were primarily operated on or revised during 1999–2017, have been analyzed. The group for loosening includes osteolysis and wear. Operations where a total or parts of a prosthesis have been inserted after an earlier extraction have been excluded why the number is lower than in the previous year.

Following a first-time operation, patients who have been revised due to an infection have the worst prognosis, followed by dislocation. The same applies to a second-time revision. The lowest risk of a further revision can be found in the groups revised due to a periprosthesis fracture. This group also has the highest mortality rate (see 2006 Annual Report).

As can be seen from Table 8.3.5 and Figure A.3.7, the prognosis deteriorates the more revisions the hip arthroplasty is exposed to. The probability that a possible subsequent revision will occur at an early stage increases with the number of procedures undergone previously, particularly in conjunction with a revision due to loosening, and to a certain extent a revision as a result of a periprosthesis fracture. This is illustrated in Figure 8.3.8. A similar, albeit relatively insignificant, tendency can be found in the case of a revision due to infection. Here, around 54–57% of cases are revised within the first year after the immediately preceding measure, and 64–69% within two years depending on whether the immediately preceding activity is a primary operation, first-time revision or multiple revision. In the case of a revision due to dislocation, the relationship is almost the reverse. Following a primary operation, dislocation leads to a revision more quickly than if the hip has been revised previously. More attempts with closed reduction, treatment with orthosis, soft tissue procedures and a socket wall addition (classed as 'Other reoperation') could very well be factors underlying this observation.

Figure 8.3.8 also shows that when assessing the breakdown of the reasons for a revision in, for example, register reports from different countries, it is important to take into account the follow-up period. A short follow-up period tends to result in a high infection rate, dislocation and, in a country that used uncemented stems to a high degree, previous prosthesis fractures. The longer the follow-up period, the more likely it is that a revision due to loosening, osteolysis and wear account for a larger proportion of the different reasons for a revision.

Classification and handling of two-session revisions in this year's report

In this year's report, we have excluded certain data related to session two in conjunction with a two-stage procedure (insertion of a prosthesis following extraction). The reason for this is problems related to the introduction of a new database; problems that we expect to resolve before the next annual report. Even if a two-stage operation can be treated as two activities, it could in certain situations, in an outcome analysis for example, be of value to treat these two procedures as one. If, for example, a patient undergoes two subsequent two-session revisions, this means that the patient has undergone at least four operations (first extraction followed by insertion, and a second extraction followed by insertion). With this approach, the time period after inserting the second prosthesis becomes the follow-up time after a second-time revision. In this year's analysis, these operations are not included, which largely means fewer changes in the data, which this year is presented in Tables 8.3.5 and 8.3.6.

Procedures at revision

Generally speaking, and regardless of the reason for a revision, replacement of the cup and stem have since 1999 been the most common interventions in conjunction with both a first-time revision and a multiple revision. In the case of a first-time

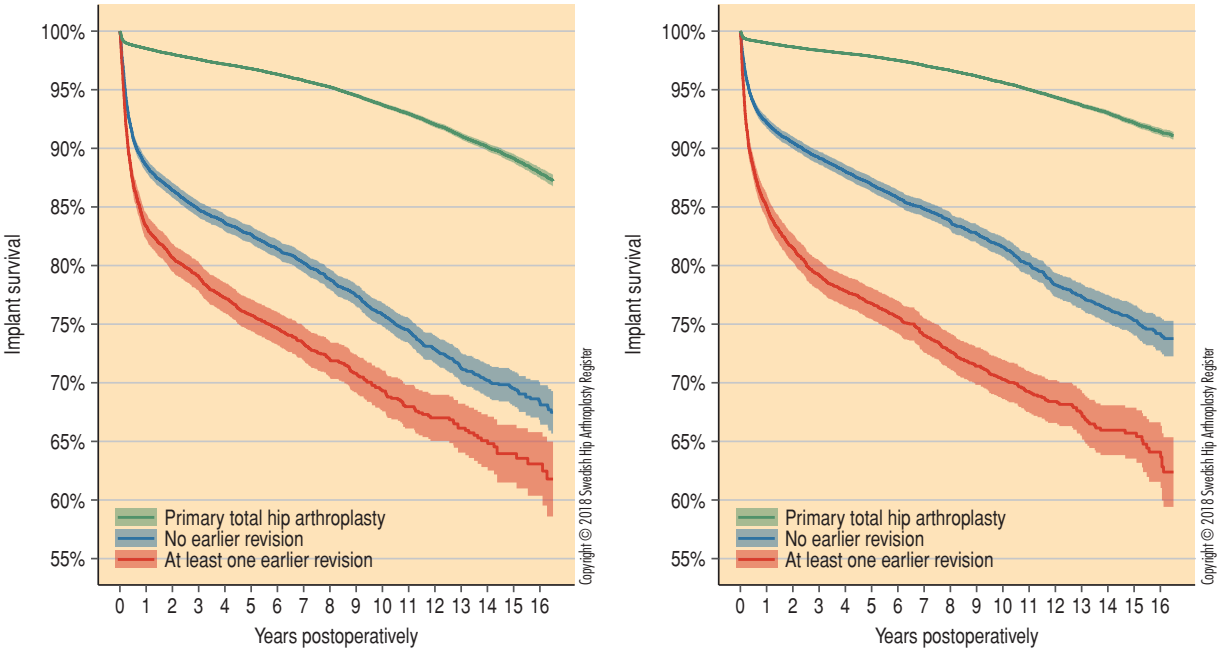


Figure 8.3.7 Survival of primary procedures (males to the left, females to the right, 114 546/163 702 primary procedures), first time revisions (5 633/5 792) and rerevisions (1 850/1 501) performed 1999-2017 including all types of procedures and all reasons for revision as outcome.

revision, however, total replacement tends to be relatively less common in favour of a cup revision. It ought to be pointed out, however, that stem replacement combined with a liner replacement is included in the first group, whilst liner replacement only, with or without replacement of the femoral head at the same time, is in this context counted as a separate group. Replacement of the stem and liner at the same time accounts for only 4–5% of all operations in the stem and cup/liner replacement group, and this procedure thus only has a marginal effect on the overall picture.

Replacement of the femoral head, liner or both constitutes a group of procedures carried out principally in conjunction with a revision due to infection. Their proportion is much the same in conjunction with first-time revisions and multiple revisions, although the total number is naturally considerably lower in conjunction with multiple revisions, as the multiple revisions together only comprise around 26% of all revisions during the period 1999–2017. If all reoperations due to infection are included, e.g. synovectomy and rinsing, without the implant

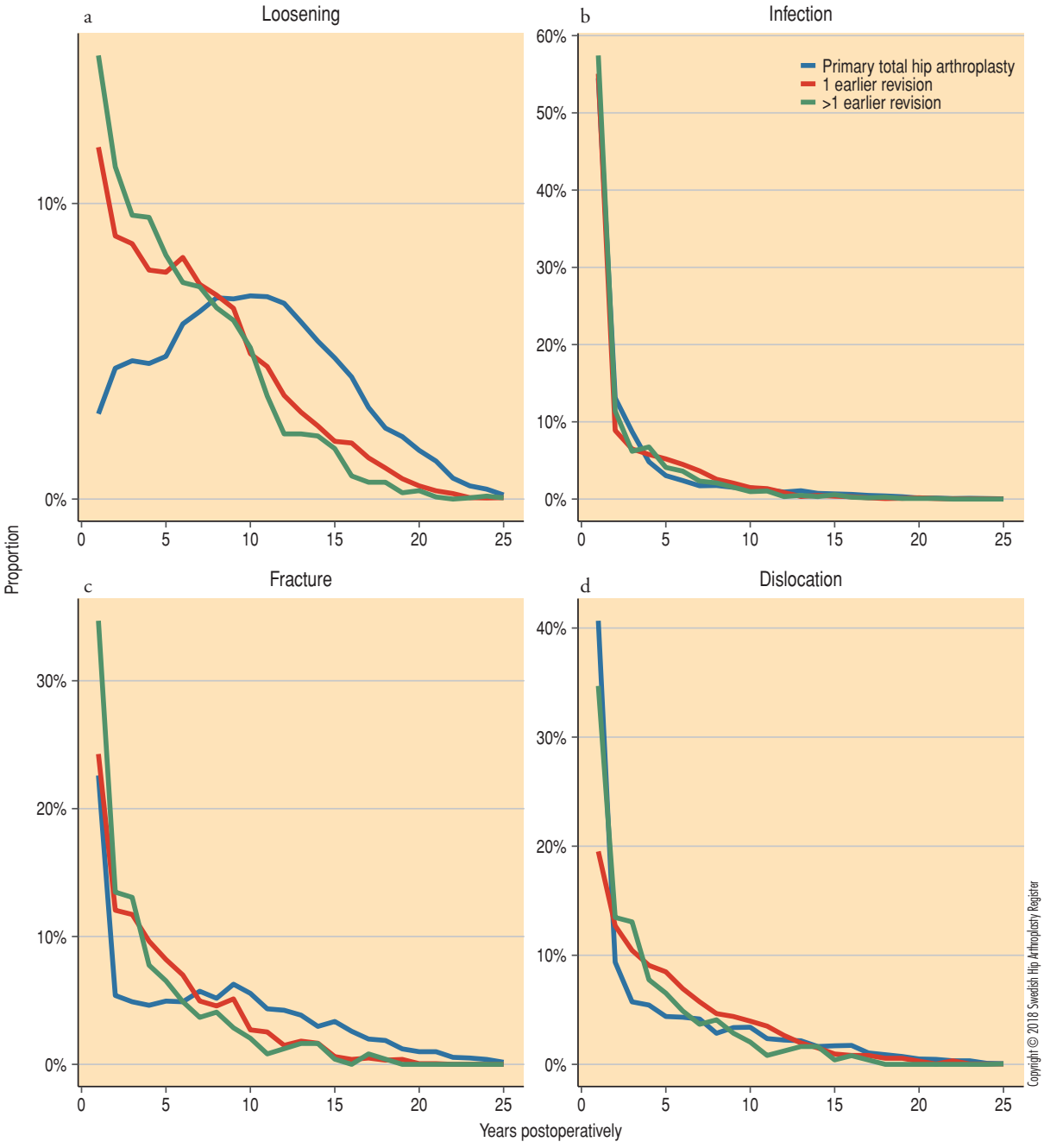


Figure 8.3.8 Time to any revision or rerevision per year split up into the reasons loosening (a), infection (b), periprothetic fracture (c) and dislocation (d). Hip arthroplasties performed 1992 to 2017 are included to illustrate the long-term perspective. Time to the next procedure tends to decrease with increasing number of previously performed procedures as regards the reasons loosening and periprosthetic fracture.

being touched, we find that this procedure is considerably more common if the hip has previously undergone reoperation on one or several occasions for the same reason compared with reoperation for the first time when the femoral head and/or liner replacement is carried out more frequently (see previous annual report, Swedish version).

Choice of procedure related to the revision cause

The type of procedure varies depending on the reason for the revision (Table 8.3.6). In the case of loosening/osteolysis, it is most common to replace both components. The second most common procedure is replacing the cup, whilst isolated stem revision is only carried out in around one in ten cases of a first-time revision, and in one in five cases in conjunction with a multiple revision. In the case of infection, replacing the femoral head and/or liner is most common in conjunction with a first-time revision (42.3%) followed by a two-stage revision (35.2%) and extraction without a registered subsequent fitting of a prosthesis (9.9%). Replacing both a cup and a stem (one-session operation) is carried out in only 8.2% of infection cases. In the event of a multiple revision, a two-session operation is most common (39.3%) followed by caput and/or liner replacement (31.9%). A combined cup/liner and stem replacement (one-session revision) is slightly more common than in conjunction with a first-time revision (9.0%). In the case of periprosthetic fractures, stem replacement, with or without replacing the cup or liner at the same time, not unexpectedly dominates. In this group, there are a number of isolated cup replacements. In odd cases it could be a question of an acetabular fracture, in other cases it can be assumed that some form of osteosynthesis has been carried out, even if this is not always noted in the Register. In the case of dislocation, isolated cup replacement is most common in both groups, followed by femoral head and/or liner replacement, which in 34% of cases of a first-time revision and in 8% of cases of a multiple revision was combined with the insertion of a socket wall addition, a procedure which is nowadays only carried sporadically.

Choice of fixation

The choice of uncemented fixation has a longer tradition in conjunction with a revision than with a primary prosthesis operation. Between 1999 and 2004, however, around 80% of all revision cups were cemented, regardless of whether they were first-time or multiple revisions (Figure 8.3.10 a and b). During the past three years (2015–2017), this number has fallen to 49.4% for a first-time revision and 45.3% for a multiple revision. Dual mobility cups (DMC) cups are also used more frequently (Figure 8.3.11). Between 2015 and 2017, they

Procedure during initial and secondary revision related to revision cause

	Initial revision 1999–2017 n = 24 447				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Number (total)	14 815	2 780	2 279	2 937	1 636
Number, %					
Replacement of cup (±liner)+stem	7 587 *51.2*	228 *8.2*	791 *34.7*	503 *17.1*	468 *28.6*
Replacement of cup (±liner)	5 230 *35.3*	73 *2.6*	75 *3.3*	1 578 *53.7*	542 *33.1*
Replacement of stem	1 691 *11.4*	50 *1.8*	1 333 *58.5*	163 *5.5*	203 *12.4*
Replacement of liner or caput	144 *1.0*	1 176 *42.3*	28 *1.2*	553 *18.8*	412 *25.2*
Extraction, insertion registered	97 *0.7*	979 *35.2*	12 *0.5*	10 *0.3*	4 *0.2*
Extraction, no insertion registerted	66 *0.4*	274 *9.9*	40 *1.8*	130 *4.4*	7 *0.4*
	Secondary revision 1999–2017 n = 4 916				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Number (total)	2 502	853	437	852	272
Number, %					
Replacement of cup (±liner)+stem	1 108 *44.3*	77 *9.0*	133 *30.4*	156 *18.3*	74 *27.2*
Replacement of cup (±liner)	839 *33.5*	24 *2.8*	29 *6.6*	362 *42.5*	65 *23.9*
Replacement of stem	497 *19.9*	14 *1.6*	255 *58.4*	85 *10.0*	78 *28.7*
Replacement of liner or caput	12 *0.5*	272 *31.9*	7 *1.6*	178 *20.9*	48 *17.6*
Extraction, insertion registered	22 *0.9*	335 *39.3*	5 *1.1*	6 *0.7*	3 *1.1*
Extraktion, no insertion registered	24 *1.0*	453 *37.0*	8 *1.8*	65 *7.6*	4 *1.5*

Table 8.3.6. Type of procedure related to cause of revision during first-time and multiple-time revisions performed between 1999 and 2017. Apart from implant change other procedure (for example: fracture reconstruction and osteosynthesis, insertion of a socket wall addition, augment or reinforcement ring can have been performed. Operations where cause and/or procedure is missing as well as surgeries where total arthroplasties or implant components have been inserted after earlier extraction have been excluded hence the number of procedure are lower than previous year.

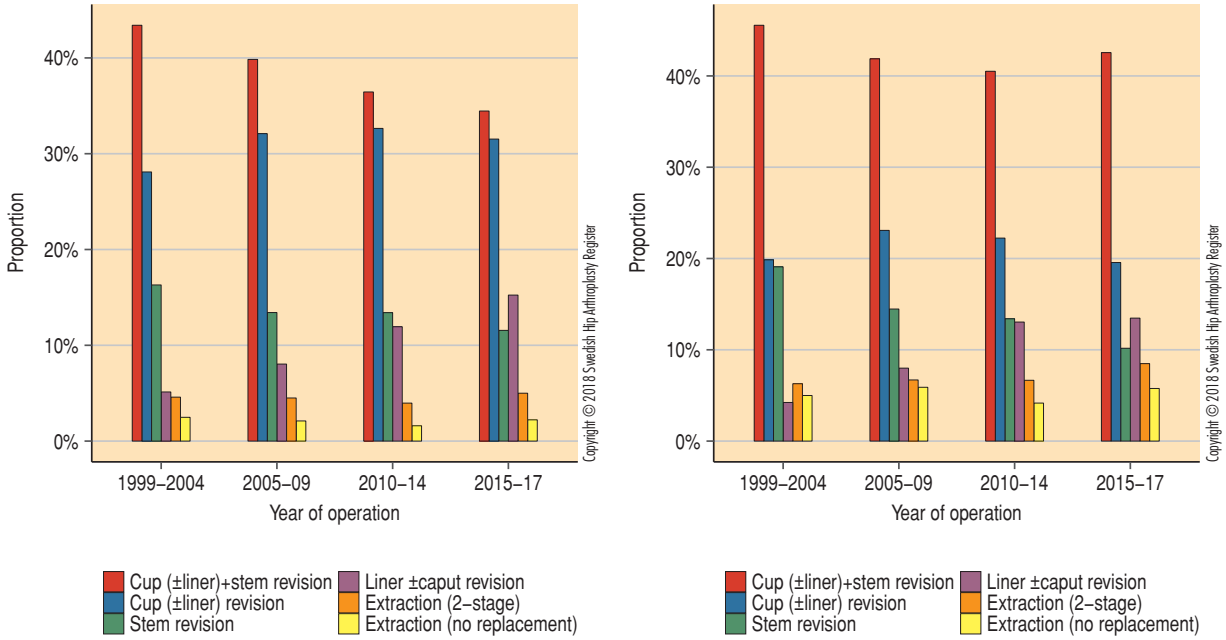


Figure 8.3.9 Distribution of procedures performed at first time (left) and multiple time (right) revisions.

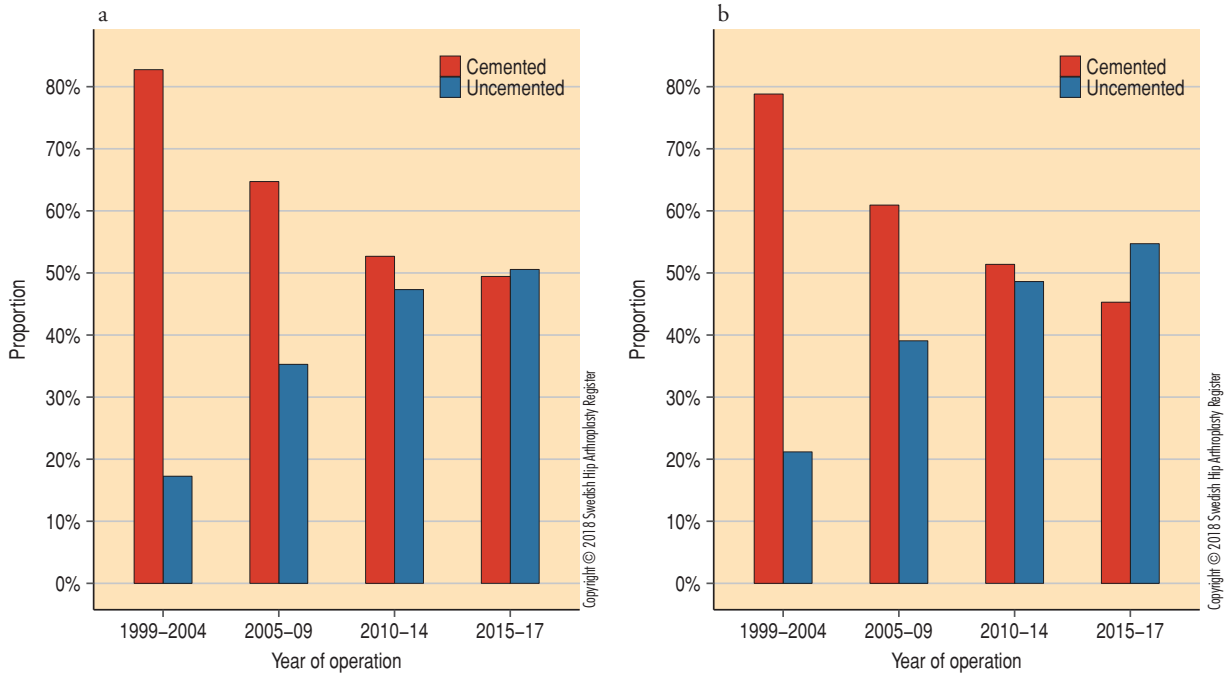


Figure 8.3.10 a-b Distribution of cemented and uncemented fixation of the cup at revisions performed 1999-2017. First time revisions (a) to the left and multipel time revisions (b) to the right.

accounted for more than one-third of all those with cemented fixation, regardless of whether it was a first-time revision or multiple revision (Figure 8.3.11 a). In the case of uncemented fixation, the corresponding figure during the period 2015–2017 was lower, 15.8%, of which the majority (11.6%) comprised standard cups converted to DMC (Figure 8.3.11 b). In the majority of cases, a DMC cup is cemented into an TMT shell, followed by conversion of a Delta cup, where a special metal insert can be used.

During the past two decades, it has been more common, as is the case on the cup side, to use uncemented fixation. This shift is particularly obvious in conjunction with multiple revisions, where uncemented stems have dominated since the period

2010–2014 (Figure 8.3.12 a and b). It is primarily two-part uncemented stems that account for this dominance. Since the beginning of the 2010s, they account for 80–85% of all uncemented stems, regardless of whether it is a first-time revision or a multiple revision (Figure 8.3.13 a and b).

Choice of implant

Table 8.3.7 shows the most-used cemented and uncemented cups and stems during 2017, during the preceding year, and during 2007. This is part of a rolling schedule that is updated on an annual basis. Since 2007, Avantage has become the most-used cemented revision cup. Among the five most-used cups, only the Lubinus cup with XLP plastic remains. In the case of uncemented fixation, the Trilogy cup, which has for several years dominated the Swedish market in conjunction with revision surgery, has disappeared from the list of top alternatives in its original form. This also applies to Mallory Head and Tritanium AD and TMT Modular. During the past two years, TMT revision has dominated, followed by Continuum and Tritanium revisions.

The Exeter stem has been the most used revision stem throughout the whole period if all variants are included. It is then followed by the Lubinus stem. The long Spectron EF stem was still being used during 2016 in individual revision cases, although there are no registered examples of use in conjunction with a revision during 2017. In Table 8.3.7, the stems are not divided into different lengths (apart from separate reporting of the short variant of the Exeter stem intended for cement in cement revisions). Instead, we refer to Figure 8.3.13a, where a division between stems of standard length or shorter, and stems longer than standard, are reported for each type.

Most used cups och stems during revision surgery

2007		2016		2017	
Cup during revision, %					
Cemented number	**768**		**606**		**481**
Lubinus (older plastic)	24.6	Avantage Cemented	34.2	Avantage Cemented	33.7
ZCA XLPE	12.6	Exeter X3 RimFit	22.9	Exeter X3 RimFit	22.5
Elite Ogee	11.5	Lubinus X-linked	17.0	Lubinus X-linked	18.5
Exeter	10.7	Marathon XLPE	11.1	Marathon XLPE	12.9
Contemporary Hooded Duration	9.2	ADES DMC	5.0	ADES DA	3.7
Other	31.5	Other	9.9	Other	8.7
Uncemented number	403		551		551
Trilogy±HA	50.4	TMT revision	35.0	TMT revision	37.3
TMT revision	12.7	Continuum	9.6	Continuum	13.1
TMT modular	10.4	Tritanium Revision	7.6	Tritanium Revision	8.0
Trident AD (LW+WHA)	8.7	Trilogy IT	7.1	Pinnacle W/Gription (100+Sector)	7.0
Mallory Head	7.7	Pinnacle W/Gription (100+Sector)	7.0	Trilogy IT	4.7
Other	11.2	Other	33.7	Other	29.9
Stem during revision, %					
Cemented number	**557**		**453**		**469**
Exeter	34.5	Exeter	43.7	Exeter	47.8
Lubinus SP II	32.9	Lubinus SP II	29.5	Lubinus SP II	32.2
CPT	12.0	Exeter kort rev-stam	11.9	Exeter short rev-stem	9.8
Spectron EF	8.1	CPT	7.5	CPT	6.0
Exeter short revision stem	5.9	Spectron EF	4.0	MS-30	2.1
Other	6.6	Other	3.4	Other	2.1
Uncemented number	**341**		**456**		**414**
MP	40.5	MP	39.3	MP	42.5
Revitan cylinder	24.0	Restoration	20.6	Restoration	21.3
Wagner SL revision	14.4	Revitan cylinder	16.0	Revitan cylinder	15.2
Restoration	6.2	Corail standard	5.3	Corail Revision	7.0
CLS/Corail standard	2.9/2.9	Corail Revision	4.4	Corail standard	2.7
Other	9.1	Other	14.4	Other	11.4

Table 8.3.7. The five most used cemented and uncemented cups and stems during revision surgery given as percentage of the total number of reported implants during 2007, 2016 and 2017. Both first-time and multiple-time revisions are included.

As regards uncemented stems, the modular, two-part variants dominate, with MP, Restoration and Revitan as the top three during 2016 and 2017. Together they account for 75–80% of all stems.

Exactly as with primary surgery, standardisation is greatest when cemented fixation is chosen. The difference is tangible when it comes to the choice of cup, where the 'Other' group accounts for 8.7% of cemented fixation and 29.9% of uncemented fixation. When choosing a stem, the 'Other' group accounts for only 2.1% in the case of cemented fixation and 11.4% in the case of uncemented fixation. It ought to be pointed out that the method of classifying implants to a certain extent affects the size of the 'Other' group but cannot with overwhelming probability account for the majority of the differences that we have noted.

Figure 8.3.11 Distribution of cups of standard and dual mobility type for cemented (a) and uncemented (b) fixation used at revisions perfprmed 1999-2017. In the uncemented cases a DMC cup has most commonly been cemented into a metallic shell designed for uncemented fixation.

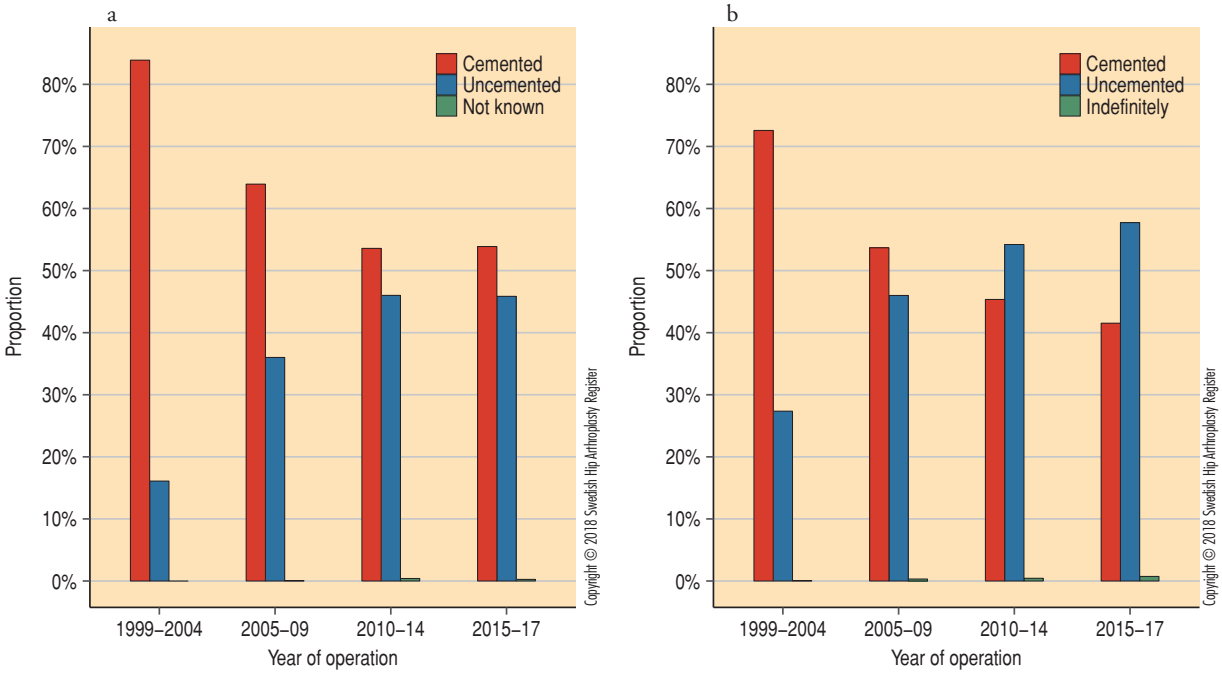


Figure 8.3.12 Distribution of cemented and uncemented fixation of the stem at revisions performed 1999 - 2017. First time revisions to the left (a) and multiple revision to the right (b).

Since 1999, loosening has been the dominant reason behind first-time revisions and multiple revisions although its relative proportion has fallen gradually whilst the proportion of revisions has increased, above all due to infection. During 2017, infection was the most common cause of a revision in those patients who had been revised at least once previously.

If a hip prosthesis is re-revised after a previous revision due to infection, loosening or dislocation, the most probable reason for this subsequent revision will be the same as for the preceding procedure.

Approximately two-thirds of all revisions and re-revisions resulting from infection occur within two years of undergoing the previous primary operation, revision or re-revision.

Corrosion of the prosthesis cone is an extremely unusual complication. It has led to a revision of fewer than 0.1 per thousand of the primary prostheses inserted in Sweden during the period 1999–2017. In the majority of cases, it is different variants of the Bi-Metric stem that have been affected.

At the beginning of the 2000s, the proportion of uncemented implants used in revision surgery increased, although this increase is now waning. One reason is the increasing popularity of cemented, dual-articulation cups. Use of uncemented, two-part stems has also levelled out.

8.4 Five-year and ten-year implant survival rates

In this year's report, we have opted to use a Forest plot to describe five-year and ten-year survival (Figure 8.4.18). The grey line represents the national average, the green line significantly higher, and the red line significantly lower. It is important to bear in mind that very broad confidence intervals reveal few patients, i.e. a small number of events can generate major changes in these groups. We have opted for the five-year survival rate to remove units that operated on fewer than 30 patients, and for the ten-year survival rate we have removed units that operated on fewer than 60 patients. The implant survival rate is based on revisions carried out on hip prostheses inserted during the past five years and the past ten years. This means that the observation period only reaches the 9–10-year interval for those patients who were operated on during the first observation year. As an increasing number of prostheses were inserted during the latter half of the period 2007–2017, the average observation period is less than five years. The most common cause of reoperation is previous aseptic loosening, followed by infection, fracture and dislocation.

The outcome metric is a valuable quality indicator, particularly for those units that have had a relatively intact organisation, and which have not made any major changes in the operating process, including choice of a standard prosthesis during the past ten years. The dislocation and infection outcomes reflect both the process around the primary hip arthroplasty and

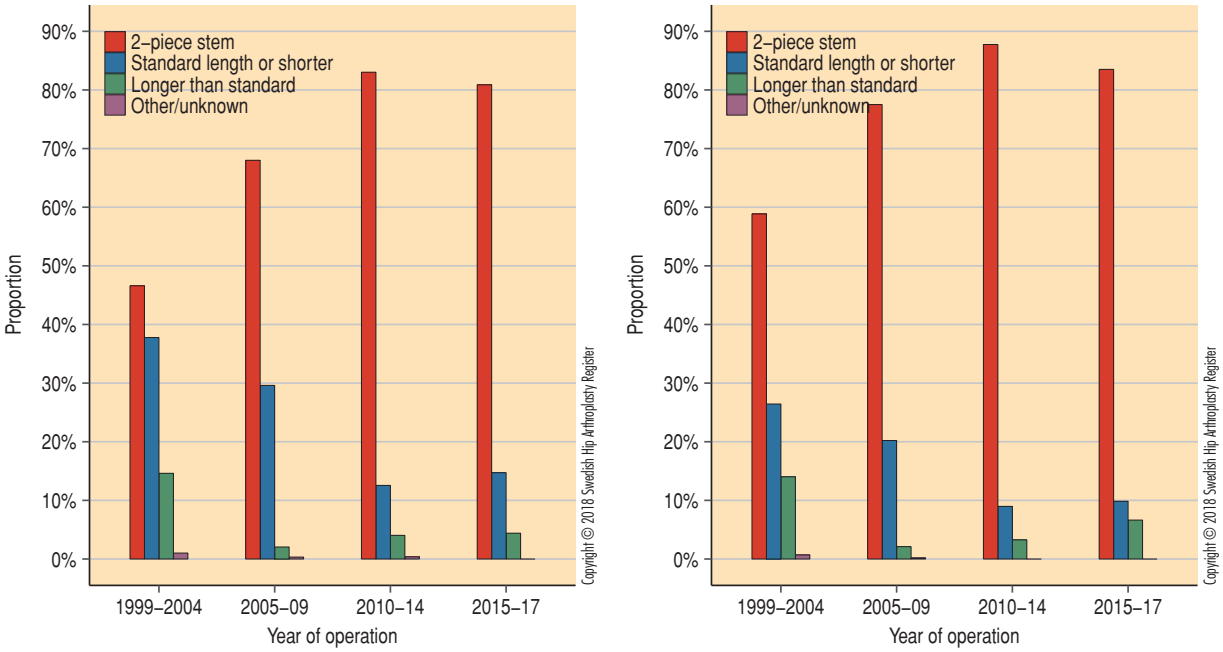


Figure 8.3.13 Distribution of uncemented stem types among primary revisions (left) and multipel revisions (right).

Five years implant survival for different time periods

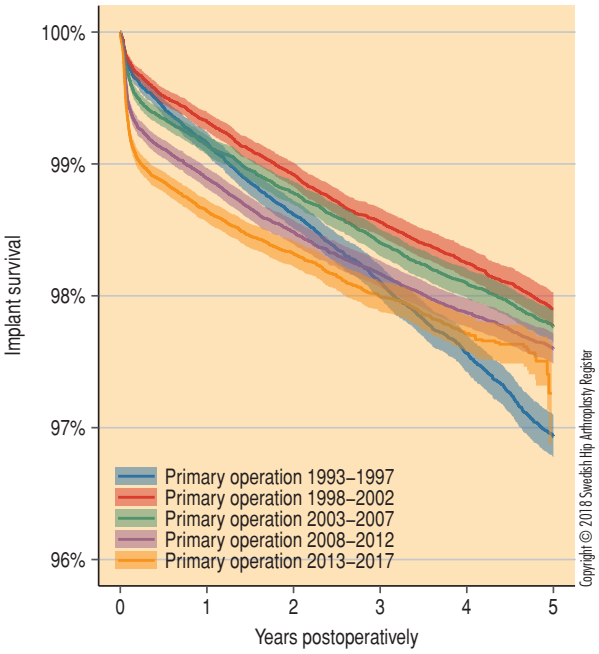


Figure 8.4.1

25 years implant survival for different time periods.

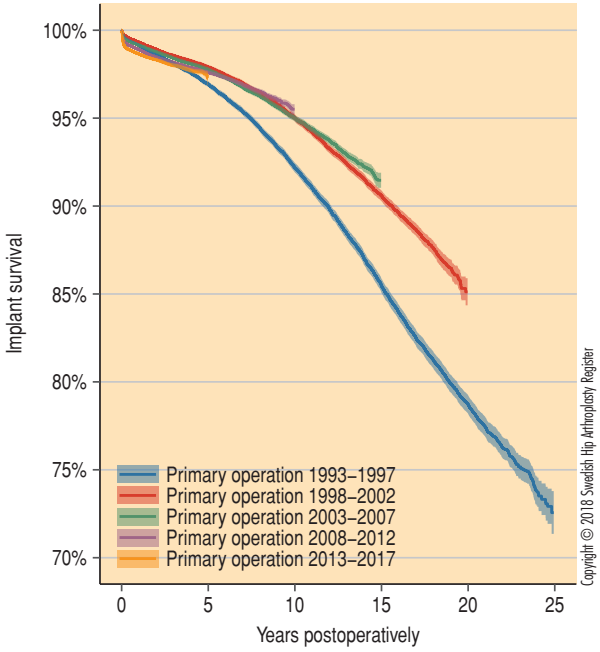


Figure 8.4.2

the unit's patient case mix. The revision rate due to loosening provides relatively good information about how the choice of prosthesis and the surgical technique affect the outcome. For units that have undergone organisational changes during the past ten years, or which have replaced the standard prosthesis, implant survival within 10 years could be more difficult to interpret as it reflects to a lesser degree the current organisation and the current choice of prosthesis. We have therefore added five-year survival, which to a certain extent reflects the current organisation. Consequently, any sign of problems can be picked up on slightly earlier.

Implant survival for the most common stem-cup combinations is presented on pages 103–107 in the swedish online edition of the Annual Report. The online edition of the Annual Report is available at www.shpr.se.

Units with a high revision rate, even if it does not differ significantly from the national average, ought to also take the opportunity to carry out an operational analysis. The first step is to validate published data and thereafter decide whether further improvement measures are justified. It is important to remember, however, that we are within the range 0.950–1,000, i.e. relatively small differences.

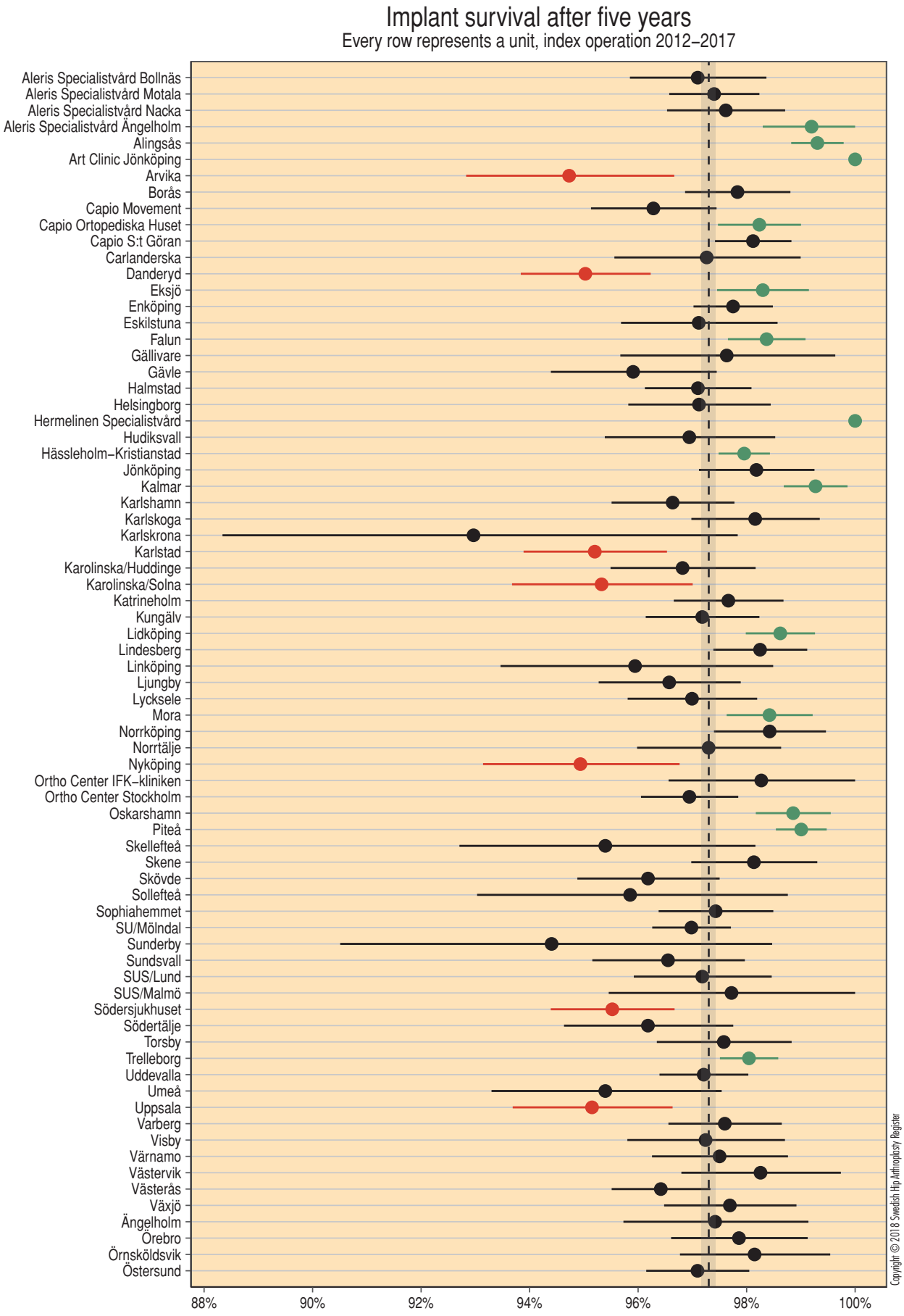


Figure 8.4.18 Implant survival per unit with confidence interval.

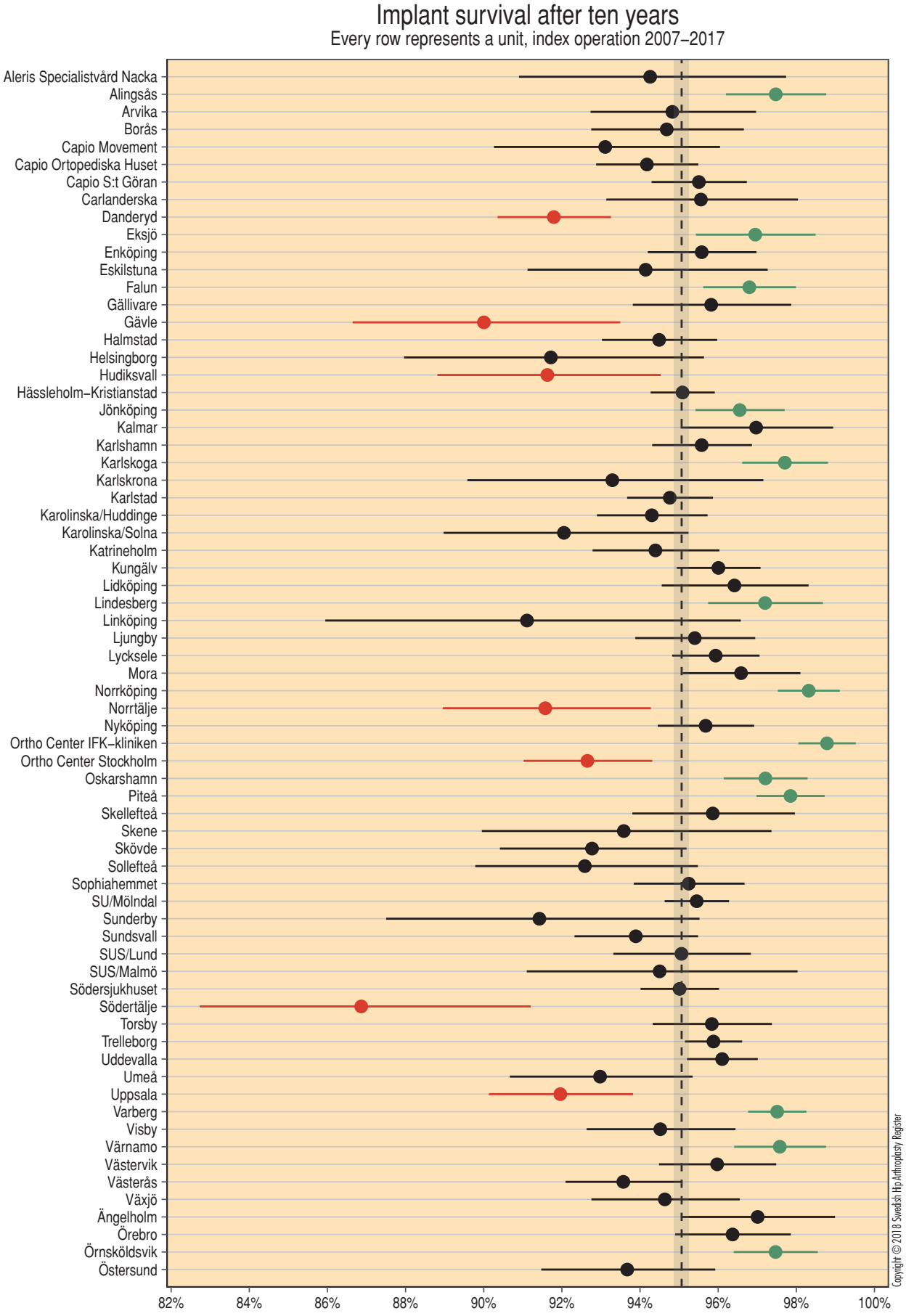


Figure 8.4.19 Implant survival per unit with confidence interval.

9 Patient-reported outcome

9.1 Hip Arthroplasty Register PROM programme

The Register's PROM (patient-reported outcome measures) routine started as a pilot project in Norrland and in the Västra Götaland region in 2002. More units gradually joined, and in 2008 all units were participating in the follow-up routine. The fact that we now have 100% affiliation can be attributed to the Register's well-established data-reporting structure. The programme was launched under the name Hip Dispenser although we have now switched to calling it the PROM programme.

PROM programme's logistics

All patients who undergo elective surgery are asked prior to the operation to complete a questionnaire comprising 12 questions. The questionnaire includes questions about comorbidity and walking ability in order to determine a Charnley classification, as well as questions about hip pain, divided into right and left hip. It also includes the EQ-5D instrument, which measures health-related quality of life. Through to 2017, we used the original EU-5D instrument, which comprises two parts: the first is made up of five general questions, each with three alternative responses. It provides a health profile and can be translated into an index. With effect from 2017, we have been using EQ-5D-5L, which has five alternative answers to each question. The second part of the EQ-5D questionnaire comprises a thermometer, EQ VAS (visual analogue scale), where the patient marks her or his current state of health on a scale of 0–100. Since 2012, a question has been included about whether the patient has met a physiotherapist and taken part in the osteoarthritis exercise programme preoperatively. In 2013, a question was included about smoking. The same PROM questionnaire, with the addition of a question about how satisfied the patient is with the outcome of the operation, is sent to the patient after one, six and ten years. The follow-up routine is handled by a contact secretary, who sends out the questionnaire, enters the questionnaire answers into the PROM database, and sends a reminder after about two months if a person fails to respond.

New in the PROM programme

In conjunction with the launch of a modernised register platform at the beginning of 2017, several changes were made in the PROM programme.

Patients can now choose to receive a follow-up questionnaire by email if they provide their email address.

The smoking question has acquired a number of alternative answers. It is the same question about smoking that is used by the Swedish Fracture Register:

Do you smoke?
- Never smoked ☐
- Former smoker ☐
- Smoker, not daily ☐
- Daily smoker ☐

EQ-5D with five alternative answers (instead of three) has been introduced. The dimensions 'mobility' and 'difference between the two versions' are shown below.

Old EQ-5D with three response levels:
Mobility
- I can walk without difficulty ☐
- I can walk but with some difficulty ☐
- I am bedridden ☐

New EQ-5D with five response levels:
Mobility
- I have no difficulty moving around ☐
- I have some difficulty moving around ☐
- I have moderate difficulty moving around ☐
- I have considerable difficulty moving around ☐
- I am unable to move around ☐

The question about hip pain has been simplified, although now we ask about pain in both the right and left hip. This is the same as the scale used in the Oxford Hip Score. We have chosen to remove the visual analogue scale as many individuals find it difficult to understand the scale, it takes time, and mistakes could easily be made by those who are required to read the scale.

During the past four weeks, how would you describe the pain you normally have in your right hip?

None	Very mild	Mild	Moderate	Severe
☐	☐	☐	☐	☐

During the past four weeks, how would you describe the pain that you normally have in your left hip?

None	Very mild	Mild	Moderate	Severe
☐	☐	☐	☐	☐

The question of how satisfied a person is with the outcome of the operation has changed in a similar way. Previously, we made use of VAS. It should be noted, however, that we now go from 'Very dissatisfied' to 'Very satisfied'

How satisfied are you with the results of your hip arthroplasty?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
☐	☐	☐	☐	☐

In order to be able to use the old VAS values, we have transposed the old values to the new scale. In last year's report we translated the VAS values and arranged them by dividing the VAS scale into five scale stages. Now that we have received data for 2017 with the new questions, we have realised that this approach does not produce a fair translation of the old values. Instead, we have used a distribution-based transposing key. We use the distribution of preoperative and postoperative responses during 2017 as a starting point, and we used this distribution of VAS responses for 2016, see Table 9.1.1.

Transpose key

Pain in operated hip				Satisfaction	
Preoperatively		**Postoperatively**		**Postoperatively**	
0–19 ->	1 None	0–5 ->	1 None	0–9 ->	5 Very satisfied
20–28 ->	2 Very mild	6–19 ->	2 Very mild	10–29 ->	4 Satisfied
29–39 ->	3 Mild	20–34 ->	3 Mild	30–49 ->	3 Neither satisfied nor dissatisfied
40–62 ->	4 Moderate	35–64 ->	4 Moderate	50–69 ->	2 Dissatisfied
63–100 ->	5 Severe	65–100 ->	5 Severe	70–100 ->	1 Very dissatisfied

Table 9.1.1

We also introduced the PROM programme in conjunction with reoperations. The same form was used prior to both primary operations and reoperations. There is thus no need to think about the nature of the operation.

Two different follow-up forms are used: one for those who only have a prosthesis in one hip (one-sided), and the other for those who have a prosthesis in both hips (double-sided). The same follow-up form is used after both primary operations and reoperations.

Improvements in form processing

One-year, six-year and ten-year follow-ups are conducted by email for those patients who wish to be involved, and who have provided an email address. The follow-up form is sent electronically, and it is possible via a link to send the completed form directly to the Register database without any involvement by the unit. For patients who have not provided an email address, the contact secretary sends the form manually by regular mail. The system automatically creates lists of patients who are in line to be followed up. It is easy to maintain an overview of when the form should be sent, if a reminder has been sent, and registration after the responses have been received. It is possible to see the patient's address directly in the system. Logging onto the system is personal and is carried out via an SITHS card or Mobile BankID.

Reoperations are included

Up until 2017, the PROM programme included only primary operations. If the patient needed to undergo a reoperation, she or he was excluded from the follow-up process. In order to follow up and analyse revisions and other reoperations more effectively, these have been included since 2017. This means that everyone who undergoes some form of prosthesis-related operation must be registered in the PROM database. The same preoperative form is used for both primary operations and reoperations.

Timeline adjusted following the most recent hip arthroplasty

Previously, we followed patients on the 'hip level'. Now we use the most recent hip arthroplasty as a basis for calculating when it is time for a follow-up. Consequently, the follow-up schedule is displaced for those patients who undergo a primary operation on the other side, or who undergo reoperation (regardless of the side) during the period prior to the next follow-up. The follow-up thus takes place one, six and ten years after the most recent hip arthroplasty.

9.2 PROM values 2017

In Table 9.2.1, the PROM values for patients who responded to the new form during 2017 are divided according to primary operation (before and one, six and ten years after a primary operation) and a revision (before and one year after a revision). The values are stated as the number and proportions for categoric variables, and as a mean value with a standard deviation for EQ VAS, which is a continuous variable. The tables thus show a cross-section of the different prosthesis populations who responded during 2017 in order to provide a general impression of how patients respond to the PROM questions. It can be noted, for example, that among those who underwent a primary operation six years and ten years ago, 74% and 71% respectively report 'none' or 'very mild' hip pain, and 84% are 'satisfied' or 'very satisfied' with the results of the operation at both follow-up points. The fact that general health-related quality of life is slightly lower among those who respond to the questionnaires at six years and ten years compared with those who responded at one year is natural: they are generally older, and some of them have been affected by other conditions that affect their state of health.

For the first time we can also present PROM for revisions. Prior to a revision, a large proportion, as expected, report 'none' or 'mild' hip pain compared with before they underwent a primary operation. However, a lower proportion state that they are free of pain after one year. One year after a revision, 60% report that they are 'satisfied' or 'very satisfied' with the outcome of the operation, and 16% report that they are 'dissatisfied' or 'very dissatisfied'. One year postoperatively, there is a large difference for all EQ-5D dimensions between those who underwent a primary operation and those who underwent a revision. Those who underwent a revision report more problems with mobility, hygiene, normal day-to-day activities, pain/discomfort, and worry/depression.

PROM responses 2017

	Primary arthroplasty				Revision	
	Pre-operatively	Postoperatively			Pre-operatively	Post-operatively
		1 year	6 years	10 years		1 year
Number	11 065	13 490	9 517	6 300	383	903
Hip pain in the operated hip, %						
None	97 (0.9)	6 882 (51.1)	5 155 (54.3)	3 269 (52.1)	11 (2.9)	305 (33.9)
Very mild	94 (0.9)	3 262 (24.2)	1 854 (19.5)	1 199 (19.1)	24 (6.3)	199 (22.1)
Mild	393 (3.6)	1 656 (12.3)	1 100 (11.6)	762 (12.1)	34 (8.9)	152 (16.9)
Moderate	3 997 (36.2)	1 324 (9.8)	1 097 (11.6)	814 (13.0)	158 (41.4)	189 (21.0)
Severe	6 456 (58.5)	341 (2.5)	286 (3.0)	231 (3.7)	155 (40.6)	54 (6.0)
Mobility, %						
I have no problems in walking about	281 (2.5)	6 582 (48.8)	4 425 (46.5)	2 601 (41.3)	26 (6.8)	274 (30.3)
I have slight problems in walking about	1 273 (11.5)	3 395 (25.2)	2 186 (23.0)	1 413 (22.4)	68 (17.8)	224 (24.8)
I have moderate problems in walking about	4 041 (36.5)	2 388 (17.7)	1 797 (18.9)	1 309 (20.8)	133 (34.7)	240 (26.6)
I have severe problems in walking about	5 145 (46.5)	1 021 (7.6)	950 (10.0)	811 (12.9)	132 (34.5)	127 (14.1)
I am unable to walk about	325 (2.9)	104 (0.8)	159 (1.7)	166 (2.6)	24 (6.3)	38 (4.2)
Self-care, %						
I have no problems washing or dressing myself	3 319 (30.0)	9 867 (73.1)	6 869 (72.2)	4 169 (66.2)	162 (42.3)	508 (56.3)
I have slight problems washing or dressing myself	3 479 (31.4)	2 501 (18.5)	1 647 (17.3)	1 186 (18.8)	106 (27.7)	227 (25.1)
I have moderate problems washing or dressing myselft	3 256 (29.4)	878 (6.5)	723 (7.6)	630 (10.0)	83 (21.7)	123 (13.6)
I have severe problems washing or dressing myselft	968 (8.7)	196 (1.5)	209 (2.2)	214 (3.4)	30 (7.8)	31 (3.4)
I am unable to wash or dress myself	43 (0.4)	48 (0.4)	69 (0.7)	101 (1.6)	2 (0.5)	14 (1.6)
Usual activities, %						
I have no problems doing my usual activities	624 (5.6)	6 453 (47.8)	4 464 (46.9)	2 723 (43.2)	46 (12.0)	280 (31.0)
I have slight problems doing my usual activities	1 875 (16.9)	3 964 (29.4)	2 572 (27.0)	1 585 (25.2)	71 (18.5)	241 (26.7)
I have moderate problems doing my usual activities	3 708 (33.5)	2 070 (15.3)	1 526 (16.0)	1 152 (18.3)	119 (31.1)	225 (24.9)
I have severe problems doing my usual activities	3 846 (34.8)	755 (5.6)	719 (7.6)	618 (9.8)	102 (26.6)	112 (12.4)
I am unable to do my usual activities	1 012 (9.1)	248 (1.8)	236 (2.5)	222 (3.5)	45 (11.7)	45 (5.0)

(the table continues on the next page)

PROM responses 2017, cont.

	Primary arthroplasty				Revision	
	Pre-operatively	Postoperatively			Pre-operatively	Post-operatively
		1 year	6 years	10 years		1 year
Pain/discomfort, %						
I have no pain or discomfort	28 (0.3)	4 843 (35.9)	3 407 (35.8)	2 021 (32.1)	8 (2.1)	199 (22.1)
I have slight pain or discomfort	338 (3.1)	4 681 (34.7)	2 841 (29.9)	1 874 (29.7)	51 (13.3)	303 (33.6)
I have moderate pain or discomfort	4 298 (38.8)	3 038 (22.5)	2 420 (25.4)	1 753 (27.8)	167 (43.6)	286 (31.7)
I have severe pain or discomfort	5 761 (52.1)	849 (6.3)	776 (8.2)	587 (9.3)	140 (36.6)	100 (11.1)
I have extreme pain or discomfort	640 (5.8)	79 (0.6)	73 (0.8)	65 (1.0)	17 (4.4)	14 (1.6)
Anxiety/depression, %						
I am not anxious or depressed	4 274 (38.6)	9 470 (70.2)	6 363 (66.9)	4 000 (63.5)	153 (40.1)	482 (53.4)
I am slightly anxious or depressed	4 176 (37.7)	2 906 (21.5)	2 190 (23.0)	1 556 (24.7)	150 (39.3)	259 (28.7)
I am moderately anxious or depressed	1 903 (17.2)	782 (5.8)	705 (7.4)	547 (8.7)	48 (12.6)	115 (12.7)
I am severly anxious or depressed	619 (5.6)	277 (2.1)	218 (2.3)	158 (2.5)	28 (7.3)	41 (4.5)
I am extremely anxious or depressed	93 (0.8)	55 (0.4)	41 (0.4)	39 (0.6)	3 (0.8)	5 (0.6)
EQ VAS, average (standard deviation)	56.3 (22.4)	75.6 (19.5)	72.5 (21.6)	69.6 (22.1)	56.3 (23.4)	66.6 (23.2)
Satisfaction with the operation, %						
Very dissatisfied		326 (2.4)	266 (2.8)	161 (2.6)		58 (6.5)
Dissatisfied		519 (3.9)	428 (4.5)	265 (4.2)		84 (9.4)
Neither dissatisfied nor satisfied		1 101 (8.2)	830 (8.8)	526 (8.4)		142 (15.9)
Satisfied		3 196 (23.8)	2 363 (25.0)	1 647 (26.4)		272 (30.4)
Very satisfied		8 292 (61.7)	5 560 (58.9)	3 646 (58.4)		338 (37.8)

Table 9.2.1

9.3 Number of persons satisfied with the surgical outcome

As the new PROM questionnaire includes a different formulation of the question relating to whether the patient is satisfied with the outcome of an operation, only the results for those who underwent an operation during 2016 and who answered the new version of the question during 2017 are presented. The formulation of the question means that a slightly lower proportion report that they are satisfied (those who answered 'satisfied' or 'very satisfied') with the result compared with the classification that was made using the previous VAS values (VAS 0–40 are counted as 'satisfied'). With the new method of measuring satisfaction, 85.4% reported that they were 'satisfied' or 'very satisfied'. This should not be compared with the previous annual reports as the method differs. In last year's report, which covered operations performed during 2014–2015, the figure was 88.7%. For the trend graphs in section 9.4, we have taken this difference into account by transferring the VAS values to the Likert scale using a distribution-based method (see section 9.1).

Major differences between units

Table 9.3.1 shows values for units with 20 or more registrations. It can be noted that there are considerable differences between the units; the proportion of 'satisfied' goes from 62% to 94%. 13 units have a proportion of satisfied patients lower than 80%, and 11 units are on 90% or higher. Among the major producers, it can be noted that Hässleholm, Ortho Center Stockholm and Trelleborg have a high proportion of satisfied patients.

Patient satisfaction

Primary arthroplasty 2016

Unit	Number	%
Aleris Specialistvård Bollnäs	257	85.6
Aleris Specialistvård Motala	495	89.1
Aleris Specialistvård Nacka	208	83.2
Aleris Specialistvård Ängelholm	69	87.0
Alingsås	162	84.0
Art Clinic Göteborg	34	88.2
Art Clinic Jönköping	32	93.8
Arvika	174	80.5
Borås	99	83.8
Capio Movement	279	86.7
Capio Ortopediska Huset	381	82.2
Capio S:t Göran	382	82.7
Carlanderska	127	88.2
Danderyd	235	81.3
Eksjö	196	87.8
Enköping	254	82.7
Eskilstuna	85	78.8
Falun	211	83.9
Gällivare	77	80.5
Gävle	192	84.9
Halmstad	157	84.7
Helsingborg	83	81.9
Hudiksvall	100	82.0
Hässleholm-Kristianstad	706	91.9
Jönköping	103	81.6
Kalmar	140	89.3
Karlshamn	225	86.7
Karlskoga	110	80.0
Karlskrona	24	70.8
Karlstad	158	78.5
Karolinska/Huddinge	124	87.1
Karolinska/Solna	48	91.7
Katrineholm	160	81.2
Kungälv	174	77.6
Lidköping	231	89.6
Lindesberg	286	90.9
Linköping	49	69.4

Unit	Number	%
Ljungby	133	84.2
Lycksele	249	85.9
Mora	215	86.0
Norrköping	198	78.8
Norrtälje	116	80.2
Nyköping	97	76.3
NÄL	30	83.3
Ortho Center IFK-kliniken	146	93.8
Ortho Center Stockholm	454	91.0
Oskarshamn	265	89.1
Piteå	331	90.0
Skellefteå	100	84.0
Skene	86	79.1
Skövde	169	85.2
Sophiahemmet	163	92.6
SU/Mölndal	464	82.3
SUS/Lund	151	85.4
SUS/Malmö	21	61.9
Södersjukhuset	296	79.4
Södertälje	98	80.6
Torsby	107	85.0
Trelleborg	619	90.0
Uddevalla	326	80.1
Umeå	67	86.6
Uppsala	121	76.9
Varberg	239	85.8
Visby	104	86.5
Värnamo	147	83.7
Västervik	113	87.6
Växjö	99	79.8
Ängelholm	55	90.9
Örebro	43	88.4
Örnsköldsvik	151	91.4
Östersund	242	87.6
Country	13 059	85.4

Table 9.3.1

Units with less than 20 respondents during 2016 have been excluded.

9.4 Patient-reported outcome per unit – presentation process

The graphs on pages 120–136 in the swedish online edition of the Annual Report (available at www.shpr.se) illustrate the trend for the PROM results one year postoperatively per operating unit. The values are presented as average values. The values shown refer to four two-year periods from 2009/2010 to 2015/2016. We only show values for those units that have at least 20 registrations during at least two time periods. The PROM variables produced are:

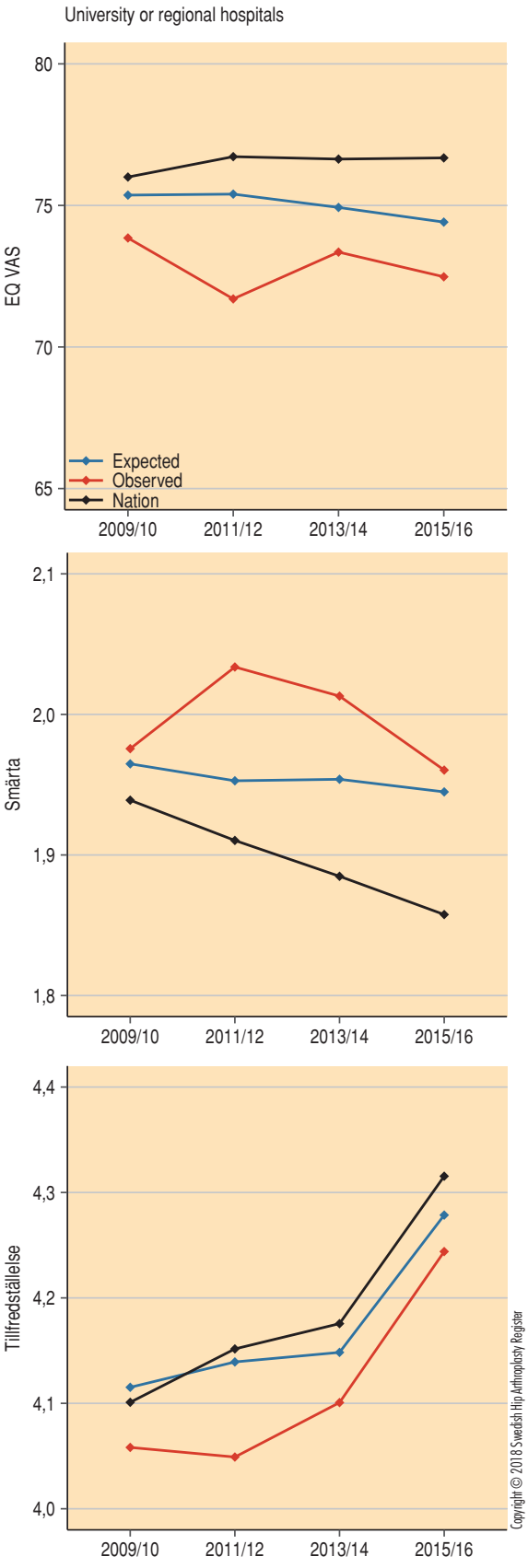
1) EQ VAS, which indicates self-reported state of health on a scale of 0–100,
2) Pain (in the operated hip), which is indicated on a scale of 1–5 (see section 9.1) and
3) How satisfied the patient is with the result of the operation on a scale of 1–5 (see section 9.1).

In the case of EQ VAS, the higher the value, the better the person's self-estimated health. For pain, the reverse is the case: low values indicate a low level of pain. For satisfaction, high values represent a positive outcome. Black dots/lines are the national averages and are thus identical in all the graphs that show the same outcome metric. Red dots/lines show the observed values for each unit, and the blue dots/lines show the expected results for the units following adjustment for age, gender, diagnosis, Charnley classification and preoperative PROM values. If the black and blue lines are close to each other (e.g. Nyköping) the unit's demography can be assumed to be representative for the country, but if they are far apart (e.g. Ortho Center IFK Clinic) there are differences in age, gender, diagnosis, Charnley classification and/or preoperative PROM values. As an example, the values for university and regional hospitals are shown here (Figure 9.4.1) and they clearly indicate that the observed values (red lines) are poorer than those expected (blue lines), which are in turn lower than the national average (black line).

Positive trend with major differences between units

For PROM variables, there is a trend on a national level towards an improved state of health over time, which we have also reported in previous annual reports. This positive trend is of course encouraging. Since 2015, we also present trends in the PROM results on the unit level. The idea is to highlight trends in such a way that each unit can see how the trend appears in relation to the rest of the country and the expected results for the unit.

There are a number of clinical results that are particularly illustrative, or which for other reasons are worth commenting on. The trend in Visby is interesting. The expected values have been consistently close to the national average for the whole period. From having more pain and a lower degree of satisfaction during the first three time periods, both pain and satisfaction are now in line with the average. Other units that have shown a positive development during the most recent two-year period are Lidköping, Ortho Center Stockholm, Örnsköldsvik, Västervik, Södertälje, Helsingborg, Karolinska/Huddinge, Karlstad, Mora, Skellefteå, Skövde and SU/Mölndal.



9.4.1 Presentation of PROMs, University and regional hospital as example. The full set of graphs per unit are available in the online Swedish version of the annual report.

In the case of Eksjö, the expected values are better than the national average, although for pain and satisfaction the relationship is the reverse. Nevertheless, a positive trend has been noted for these outcome parameters. In the case of Eskilstuna, a significant deterioration has been noted for the most recent time period for all outcome metrics, which ought to give rise to a detailed analysis on the local level. A number of other units that have a negative trend for the most recent time period are Karlskoga, Ängelholm, Umeå and Söder Hospital.

Lindesberg, Oskarshamn, Östersund and Hässleholm are good examples of units that have a better outcome than the national average and are clearly better than the expected values. Hässleholm carries out most elective hip arthroplasties in Sweden. Here the patients report a better than average state of health, less pain, and more satisfaction than expected. There is a distinct improvement trend.

How can the PROM results be improved?

How can patient-reported outcomes be improved? By its very nature, register data cannot provide reasons for causal links in order to provide concrete advice in this area. With the aid of register data, we have been able to demonstrate an association between surgical details, such as surgical approaches and fixation method, and patient-reported outcome. The effects are not sufficiently tangible to induce us to recommend changing the routine for surgical approach or type of fixation, as such a change could have undesired consequences on other levels. Experience and those who have developed different programmes for enhanced recovery or fast-track, support the assertion that observing care in decisions relating to an operation, good preoperative information, optimisation of patients, continuity in contact with doctors and other care provider categories, a carefully considered care process, ultra-early mobilisation, short care time, and optimised pain therapy, result in a better patient-reported outcome.

9.5 Physiotherapy, osteoarthritis exercise programme, and smoking

Table 9.5.1 shows the proportion of those who responded to the preoperative PROM questionnaire who reported that they have been to a physiotherapist, taken part in the supported osteoarthritis self-management programme and that they are smokers. The proportions are presented on the unit level and refer to those who underwent surgery for osteoarthritis during 2016–2017 and where the response rate is also shown.

What proportion take part in the osteoarthritis exercise programme?

In 2012, a question was introduced into the preoperative PROM questionnaire regarding contact with the physiotherapist and participation in the osteoarthritis exercise programme. The questions were: 'During the time you have had problems with your hip have you been to a physiotherapist to address your hip problems?' And 'During the time you have had problems with your hip have you taken part in the supported osteoarthritis self-management programme (could have been many years before the operation for some and a slightly shorter period for others)?' This year's analysis, which covered the period 2016–2017, shows clear differences between the units. The proportion of patients who underwent surgery for osteoarthritis (ICD codes M 16.0-M 16.9) and who have been in contact with the physiotherapist varied from 59% (Visby) to 91% (Art Clinic Gothenburg). In the case of the osteoarthritis exercise programme, the proportions varied from 21% (Halmstad) to 69% (Lycksele). On the national level, 41% of all osteoarthritis patients who responded to the questionnaire stated that they had taken part in the osteoarthritis exercise programme. The proportion who reported that they had met a physiotherapist and that they had taken part in the osteoarthritis exercise programme is increasing steadily over time. Differences between units could to a certain extent be a reflection of the degree of access to physiotherapy and the osteoarthritis exercise programme in different county council areas and regions.

Smoking

Smoking is a well-established risk factor for complications following the majority of surgical interventions. Stopping smoking 6–8 weeks before and after the operation proved to be an effective way of reducing the risk of complications. However, the effects of smoking on pain alleviation, function and other patient-reported outcome parameters following hip arthroplasty have not been examined. In 2013, the Hip Arthroplasty Register introduced a question about smoking into the preoperative routine questionnaire. The question was formulated very simply 'Do you smoke?' The response alternatives were 'Never been a smoker', 'Former smoker', 'Smoker, not daily', and 'Daily smoker'.

During 2016 and 2017, 29,910 patients underwent hip arthroplasty due to osteoarthritis, and 24,367 (81%) completed the preoperative questionnaire. Of these, 5.1% stated that they were smokers. There were major differences between the unit with regard to the proportion of smokers (0–12%). The proportion of smokers has fallen compared to previous years, and the variation between units is also falling.

Smoking, physiotherapy and osteoarthritis exercise programme before hip arthroplasty

Unit	Number (diagnosis M16.0-M16.9)	Number of responses	Proportion smokers, %	Proportion physiotherapy, %	Proportion osteo-arthritis exercise programme, %	Response rate, %
Aleris Specialistvård Bollnäs	547	506	4.6	73	42	93
Aleris Specialistvård Motala	1 191	975	4.6	75	58	82
Aleris Specialistvård Nacka	478	164	6.1	90	25	34
Aleris Specialistvård Ängelholm	150	125	6.4	70	34	83
Alingsås	380	335	3.9	84	60	88
Art Clinic Göteborg	120	65	1.5	91	48	54
Art Clinic Jönköping	107	103	1.9	83	37	96
Arvika	399	294	5.8	81	67	74
Borås	180	146	6.2	70	33	81
Capio Artro Clinic	255	217	6.5	79	35	85
Capio Movement	662	589	4.6	78	34	89
Capio Ortopediska Huset	1 062	953	8.0	76	37	90
Capio S:t Göran	1 071	730	4.7	70	35	68
Carlanderska	376	348	4.3	83	32	93
Danderyd	483	340	8.6	72	34	70
Eksjö	395	379	2.1	68	30	96
Enköping	758	579	5.9	78	43	76
Eskilstuna	126	80	7.5	71	25	63
Falun	456	347	8.1	64	52	76
Gällivare	154	93	5.4	62	38	60
Gävle	227	206	9.7	69	44	91
Halmstad	328	237	8.0	76	21	72
Helsingborg	112	95	2.1	68	25	85
Hudiksvall	167	149	4.0	69	32	89
Hässleholm-Kristianstad	1 458	1 409	4.1	70	24	97
Jönköping	258	234	2.1	71	32	91
Kalmar	269	260	0.4	69	48	97
Karlshamn	441	426	2.8	73	50	97
Karlskoga	139	92	2.2	71	38	66
Karlstad	215	191	7.9	75	59	89
Karolinska/Huddinge	237	174	8.6	76	27	73
Karolinska/Solna	101	69	11.6	77	28	68
Katrineholm	436	425	4.9	72	38	97
Kungälv	357	291	9.1	75	45	82
Lidköping	556	420	5.7	78	49	76
Lindesberg	983	933	7.0	78	40	95
Ljungby	293	281	4.6	64	30	96

(the table continues on the next page)

Smoking, physiotherapy and osteoarthritis exercise programme before hip arthroplasty, cont.

Unit	Number (diagnosis M16.0-M16.9)	Number of responses	Proportion smokers, %	Proportion physiotherapy, %	Proportion osteo-arthritis exercise programme, %	Response rate, %
Lycksele	628	445	0.9	80	69	71
Mora	489	369	4.3	74	40	75
Norrköping	391	330	3.3	75	67	84
Norrtälje	271	171	10.1	64	39	63
Nyköping	221	175	6.3	74	47	79
Ortho Center IFK-kliniken	335	241	3.3	84	37	72
Ortho Center Stockholm	1 143	1 066	4.7	81	41	93
Oskarshamn	592	546	4.4	73	47	92
Piteå	744	472	2.3	80	39	63
Skellefteå	226	196	1.0	78	63	87
Skene	270	214	4.3	78	39	79
Skövde	251	199	9.3	78	38	79
Sollefteå	494	218	1.8	68	52	44
Sophiahemmet	487	438	8.2	78	23	90
SU/Mölndal	870	622	1.8	72	38	71
SUS/Lund	109	59	10.0	63	23	54
Södersjukhuset	517	358	6.7	74	28	69
Södertälje	246	226	9.1	77	47	92
Torsby	238	229	9.2	72	59	96
Trelleborg	1 309	1 188	7.2	70	36	91
Uddevalla	726	580	6.6	78	54	80
Umeå	61	46	2.2	67	39	75
Uppsala	281	241	5.4	74	33	86
Varberg	450	354	1.7	74	30	79
Visby	225	178	4.0	59	42	79
Värnamo	266	250	1.2	67	25	94
Västervik	235	186	3.8	68	41	79
Västerås	586	472	6.1	75	62	81
Växjö	182	139	0.7	71	28	76
Ängelholm	206	171	6.6	73	40	83
Örebro	52	48	6.2	73	25	92
Örnsköldsvik	310	244	0.0	76	50	79
Östersund	428	402	2.3	74	66	94
Country	29 910	24 367	5.1	74	41	81

Table 9.5.1

Units with less than 20 respondents during 2016–2017 have been excluded.

10 90-day mortality following hip arthroplasty

Each surgical procedure entails a risk for the patient. Hip arthroplasty is no exception. On the contrary, an increased risk of infection and thromboembolic incidents is well documented. At the same time, the procedure is regarded as routine surgery, which in combination with the demand for a high level of production and short care times, could at worst lead to a complication being discovered too late. Before they decide whether to undergo a planned operation or not, detailed information must be given to the patient, including information that a planned total arthroplasty involves an increased risk of mortality during the first month compared with non-operated peers.

90-day mortality is an open reported variable at the unit level. The Hip Arthroplasty Register database is updated several times each year with information from the Swedish Tax Agency about the patients' possible date of death.

The indications for arthroplasty are gradually widening. Patients undergoing surgery are both older and younger than previously. The older patients naturally run a greater risk of serious complications whilst younger patients who undergo surgery appear to have a greater degree of comorbidity. At present, more risk patients are operated on compared with previously, particularly at the larger units. An important group of risk patients are those who undergo total arthroplasty following an acute hip fracture. These individuals do not have the same possibility of stabilising existing health problems prior to the operation as fracture surgery must take place within a day or so. This can be contrasted with those who undergo a planned, osteoarthritis-related hip arthroplasty, where the date of the operation can be postponed until the patient is sufficiently well for the operation to go ahead.

10.1 Total hip arthroplasty

90-day mortality is an indicator that is often used to evaluate the risks resulting from different medical therapies. The reasons why a patient should die either during the actual hip operation or within 90 days (and for reasons related to the procedure) could be many although the predominant reasons ought to be cardiovascular, cerebrovascular or thromboembolic diseases.

The mortality figures are low. It should be noted that the results are reported in parts per thousand. Consequently, the past four years are analysed as a whole to compensate to a certain extent for the risk of random variation.

90-day mortality is higher following an operation at a university/regional hospital and a county hospital compared with a rural hospital, and particularly compared with private care units. The disparities reflect the different composition of patient groups who are operated on at each hospital. Units that operate on fewer than 70% osteoarthritis patients have a considerably higher mortality rate, which can be attributed to the large number of fracture patients and in certain cases to the number of tumour cases.

The 90-day mortality rate at Swedish hospitals varied during the period 2014–2017 from 0–45‰. The national average is 7.1‰.

Regardless of whether the unit considers the mortality figures to be 'expected' or not, we ought to analyse mortality figures and their causes on a regular basis as part of patient safety work. It is also vitally important that the units at hospitals that take care of newly operated patients with complications inform the operating unit about these cases. If the orthopaedic surgeon does not see reports of these very serious incidents, it would easy to assume they do not occur.

In in-depth analyses based on register data with regard to mortality following total hip arthroplasty we can see the significance of both preoperative comorbidity and socioeconomic background. Whether the prosthesis is cemented or not is of lesser clinical relevance. Those patients with a fully cemented total prosthesis reveal a higher level of mortality during the first two weeks, although thereafter they have a lower level of mortality than non-operated controls. Nor can any relevant difference in 90-day mortality be noted in conjunction with current patient selection for concurrent bilateral hip arthroplasty.

10.2 Fracture patients

A hip fracture patient runs a considerably higher risk of dying than a patient who undergoes a planned procedure due to osteoarthritis and other conditions. Regardless of her/his state of health, a fracture patient requires acute surgery. They are also generally more ill and more elderly than osteoarthritis patients. The 90-day mortality rate in the country was just below 13% in 2017, the same as the previous year. Depending on which patients undergo hip arthroplasty, the mortality rate will vary. If the most seriously ill patients instead receive internal fixation – in the majority of cases an inferior alternative – the mortality rate falls. The mortality rate varies from one hospital to another – by 8–18% at the larger units. The table on page 94 includes a number of factors that could increase the risk of early death: aged patients, male gender, morbidity, and acute fracture procedures (as opposed to planned secondary procedures). If the unit's mortality rate is higher than what could be expected based on the 'risk profile', the clinical pathway ought to be analysed in detail.

Mortality within 90 days

Primary total hip arthroplasty 2014–2017

Unit	Number[1)]	Primary osteoarthritis, %[2)]	≥ 60, %[3)]	Women, %[4)]	Mortality, ‰[5)]
University or regional hospital					
Karolinska/Huddinge	886	58	76	59	13.9
Karolinska/Solna	613	38	68	58	14.9
Linköping	238	45	56	49	21.6
SU/Mölndal	2 409	66	79	61	9.4
SUS/Lund	723	31	83	61	25.4
SUS/Malmö	122	2	98	70	0.0
Umeå	376	25	81	59	19.0
Uppsala	1 041	47	69	60	22.8
Örebro	332	50	76	57	12.1
County hospital					
Borås	583	62	88	59	12.3
Danderyd	1 309	69	87	61	9.3
Eksjö	886	89	82	55	3.5
Eskilstuna	443	46	89	58	30.3
Falun	1 083	88	81	58	5.7
Gävle	935	50	86	60	19.5
Halmstad	882	78	84	57	10.3
Helsingborg	507	61	89	57	12.0
Hässleholm-Kristianstad	3 313	85	84	55	4.6
Jönköping	707	74	87	62	13.3
Kalmar	680	75	84	56	7.5
Karlskrona	134	13	95	73	45.4
Karlstad	858	57	84	60	13.0
Norrköping	1 044	68	83	58	10.9
NÄL	88	7	98	66	12.8
Skövde	651	74	84	59	9.4
Sundsvall	333	48	84	59	9.1
Södersjukhuset	1 580	65	86	62	7.8
Uddevalla	1538	85	83	57	8.8
Varberg	915	85	88	60	4.5
Västerås	1 750	58	88	60	35.7
Växjö	549	75	82	62	5.6
Östersund	1 093	71	87	60	6.5

(the table continues on the next page)

Mortality within 90 days, cont.

Primary total hip arthroplasty 2014–2017

Unit	Number[1)]	Primary osteoarthritis, %[2)]	≥ 60, %[3)]	Women, %[4)]	Mortality, ‰[5)]
Rural hospital					
Alingsås	777	92	86	59	2.6
Arvika	816	97	86	59	0.0
Enköping	1 457	98	90	61	1.4
Frölunda Specialistsjukhus	180	99	87	60	0.0
Gällivare	372	76	82	51	11.1
Hudiksvall	520	65	88	58	11.6
Karlshamn	975	90	84	56	1.1
Karlskoga	532	86	89	59	9.4
Katrineholm	922	98	82	57	2.2
Kungälv	789	87	85	62	2.5
Lidköping	1 160	92	86	55	1.8
Lindesberg	1 455	89	85	59	1.5
Ljungby	684	79	86	56	10.5
Lycksele	1 283	96	83	56	1.6
Mora	979	91	86	56	2.1
Norrtälje	555	83	88	62	0.0
Nyköping	641	65	89	61	41.4
Oskarshamn	1 124	96	81	56	1.8
Piteå	1 441	92	82	59	2.2
Skellefteå	524	78	84	60	13.6
Skene	550	90	80	60	0.0
Sollefteå	767	88	88	58	8.3
Sunderby	137	3	94	53	44.5
Södertälje	520	79	84	58	8.0
Torsby	482	89	86	55	10.6
Trelleborg	2 693	89	77	58	1.1
Visby	523	79	84	61	1.9
Värnamo	562	86	84	58	1.9
Västervik	465	87	83	58	4.4
Ängelholm	318	92	80	61	0.0
Örnsköldsvik	696	89	86	60	1.4

(the table continues on the next page)

Mortality within 90 days, cont.

Primary total hip arthroplasty, 2014–2017

Unit	Number[1)]	Primary osteoarthritis, %[2)]	≥ 60, %[3)]	Women, %[4)]	Mortality, ‰[5)]
Private hospital					
Aleris Specialistvård Bollnäs	1 175	96	81	55	2.6
Aleris Specialistvård Motala	2 320	96	85	55	1.8
Aleris Specialistvård Nacka	815	99	78	64	0.0
Aleris Specialistvård Sabbatsberg	165	96	81	58	0.0
Aleris Specialistvård Ängelholm	366	96	84	59	5.6
Art Clinic Göteborg	145	100	79	54	0.0
Art Clinic Jönköping	141	100	72	47	0.0
Capio Artro Clinic	259	96	69	66	5.3
Capio Movement	1 200	98	77	54	1.8
Capio Ortopediska Huset	1 928	97	72	58	0.5
Capio S:t Göran	2 107	89	84	64	3.4
Carlanderska	681	98	65	46	0.0
Hermelinen Specialistvård	50	84	42	34	0.0
Ortho Center IFK-kliniken	603	94	52	38	0.0
Ortho Center Stockholm	2 095	97	76	59	0.5
Sophiahemmet	920	100	52	39	2.3
Spenshult	97	81	80	65	0.0
Country	68 597	81	82	58	7.1

[1)] Refers to the number of primary arthroplasties during the period. Units with fewer than 20 primary arthroplasties during the period are excluded.

[2)] Proportion of patients operated due to primary osteoarthritis.

[3)] Refers to the number of primary arthroplasties performed on the age group 60 years and older.

[4)] Refers to the number of women during the period.

[5)] Proportion of patiens with ASA class IV.

[5)] 90-days mortality per mille (proportion of patients who have died 90 days after primary arthroplasty).

Mortality within 90 days

Fracture patients primary arthroplasty, 2014–2017

Unit	Number[1)]	> 80, %[2)]	Men, %[3)]	ASA=III, %[4)]	ASA=IV, %[5)]	Acute fracture, %	Mortality, %[6)]
University or regional hospital							
Karolinska/Huddinge	495	58	38	61	9	90	12.9
Karolinska/Solna	301	56	33	65	11	86	14.5
Linköping	379	64	36	50	10	93	11.5
SU/Mölndal	1 646	60	35	48	5	93	13.5
SUS/Lund	864	55	33	61	4	89	9.6
SUS/Malmö	833	65	31	77	7	97	12.2
Umeå	409	56	35	58	6	94	13.4
Uppsala	806	56	34	61	7	92	12.6
Örebro	319	61	30	44	4	85	9.6
County hospital							
Borås	508	69	33	46	4	93	11.7
Danderyd	905	59	29	64	7	88	9.6
Eksjö	257	67	33	50	3	95	14.5
Eskilstuna	450	61	33	46	7	91	15.0
Falun	618	63	35	51	7	93	14.1
Gävle	617	60	32	41	7	94	15.0
Halmstad	399	63	32	43	4	91	10.6
Helsingborg	775	62	31	46	5	93	13.8
Hässleholm-Kristianstad	745	59	36	51	6	88	15.1
Jönköping	321	64	28	55	7	94	11.5
Kalmar	337	57	29	40	2	94	10.3
Karlskrona	484	66	29	42	3	96	14.3
Karlstad	646	60	35	57	7	94	15.3
Norrköping	453	61	34	48	4	88	14.5
NÄL	479	62	35	61	9	98	17.2
Skövde	461	60	34	43	5	91	13.5
Sundsvall	481	56	34	47	3	95	13.9
Södersjukhuset	1 372	61	33	63	8	87	12.2
Uddevalla	447	61	37	55	5	88	12.6
Varberg	394	61	36	43	4	92	11.7
Västerås	658	57	31	65	6	92	10.6
Växjö	282	60	30	57	5	92	7.6
Ystad	132	71	29	58	10	99	12.5
Östersund	447	60	30	42	9	93	10.6

(the table continues on the next page)

Mortality within 90 days, cont.

Fracture patients primary arthroplasty, 2014–2017

Unit	Number[1)]	> 80, %[2)]	Men, %[3)]	ASA=III, %[4)]	ASA=IV, %[5)]	Acute fracture, %	Mortality, %[6)]
Rural hospital							
Alingsås	177	56	41	54	9	94	11.0
Arvika	29	59	45	38	7	86	10.3
Gällivare	196	53	35	44	13	94	14.1
Hudiksvall	309	57	36	42	6	92	14.5
Karlskoga	236	58	34	44	5	95	14.9
Kungälv	333	57	39	46	6	96	13.0
Lidköping	213	68	31	43	1	90	11.4
Lindesberg	116	59	34	39	5	89	8.1
Ljungby	206	67	32	51	0	88	10.0
Lycksele	106	54	29	58	1	93	14.3
Mora	275	57	35	38	4	89	12.6
Norrtälje	176	53	31	66	5	89	12.1
Nyköping	185	62	32	55	1	92	11.7
Piteå	31	19	48	32	0	16	3.3
Skellefteå	215	48	27	44	5	86	10.4
Sollefteå	94	56	36	46	3	94	12.8
Sunderby	532	59	37	61	10	98	15.3
Södertälje	186	47	34	68	4	95	10.0
Torsby	143	59	38	57	4	94	13.5
Trelleborg	42	12	29	12	0	0	2.4
Visby	141	57	26	40	4	89	13.6
Värnamo	161	64	32	42	4	97	8.3
Västervik	206	63	30	31	3	94	11.0
Örnsköldsvik	246	62	32	55	9	94	14.5
Private hospital							
Aleris Specialistvård Motala	183	67	34	62	6	86	17.9
Capio S:t Göran	804	68	32	61	6	93	14.4
Country	24 325	60	33	53	6	92	12.7

[1)] Refers to the number of primary arthroplasties during the period. Units with fewer than 20 primary arthroplasties during the period are excluded.

[2)] Refers to the proportion of operations on patients over 80 years.

[3)] Refers to the proportion of men being operated during the period.

[4)] Proportion of patiens with ASA class III.

[5)] Proportion of patients with ASA class IV.

[6)] 90-days mortality percentage (proportion of patients who have died 90 days after primary arthroplasty).

11 Adverse events within 30 days and 90 days

The Hip Arthroplasty Register began reporting adverse events in 2007. Apart from a change in the Swedish terminology, a more significant change is that we have reformulated the definition of adverse event. We have opted to use the definition formulated by the Knee Arthroplasty Register in collaboration with the National Board of Health and Welfare. We have also modified the definition to suit hip arthroplasty procedures. The quality indicator is based on linking the Register's data with the National Board of Health and Welfare Patient Register, where a list of diagnoses and intervention codes used in conjunction with primary care admission or later admission is sought. As there is often a delay late into the year before the Patient Register data is complete for the preceding operating year, we have opted to include data up to October 1, 2016 in order to be able to acquire a complete 90-day follow-up. By reason of the fact that we have amended the definition of adverse event, we have conducted a national analysis of the most recent 10-year period. New for this year is that we also present adverse events following the first reoperation.

11.1 Method

The information in the Hip Arthroplasty Register relating to hip arthroplasties (and reoperations) is used together with admissions with complication codes in the National Board of Health and Welfare Patient Register (PAR) in order to analyse readmissions following hip arthroplasty.

Only one operation (the most recent) is taken into account when both hips were operated on within 90 days. Details are included in the Hip Arthroplasty Register of all admissions that matched hip arthroplasty in terms of personal identity number, and where the date of the operation listed in the Hip Arthroplasty Register fell between the admission date and discharge date at an inpatient facility registered in PAR, or where the admission date in PAR fell within 90 days after the date of the operation (or the reoperation date in the case of reoperations). In order to include a full 90-day follow-up period, hip arthroplasties carried out after October 1, 2016 were excluded.

An adverse event is linked to hip arthroplasty via the selections described in the code list.

The indicator is then calculated as a proportion of hip arthroplasties followed by an adverse event from all hip arthroplasties in each analysis group (primary elective total arthroplasties, standard patients, fracture patients and first reoperation).

Definition of adverse events

The term 'adverse events' refers to all forms of readmission that can be assumed to be linked to the procedure that was carried out. This not only applies to local complications but also to general complications and death. The complications are divided into surgical, cardiovascular and medical complications, and are based on diagnosis and intervention codes used in conjunction with inpatient care that are reported in PAR. The surgical complications are also divided into intervention diagnosis codes, which indicate a complication, as well as diagnosis codes for hip conditions that are probably a complication following the operation. The codes are listed in Table 11.1.1, and the method is described in detail in the 'Method' box.

We report results on the hospital level for
1) Elective total arthroplasties where acute fracture patients, sequelae following a hip fracture, and tumour patients have been excluded.
2) Fracture patients who have undergone total arthroplasty or hemiarthroplasty as a result of an acute fracture or sequelae following a hip fracture
3) The standard patient
4) Patients who undergo a first reoperation.

Trends

Over the 10-year period 2007–2016, the proportion of adverse events fell for elective, standard and fracture patients (Figure 11.1.1). In the case of elective patients, the 90-day incidence fell from 8% to 6%, for the standard patient it fell from 6% to 4%, and for fracture patients from 34% to 31%. However, the complication rate for first-time reoperations increased from 23% to 30% (Figure 11.1.2). This information should be interpreted cautiously. In the group of patients who underwent a reoperation for the first time, all patients are included, regardless of the diagnosis, in conjunction with the primary operation, or if the primary operation was total arthroplasty or hemiarthroplasty. As we started registration of hemiarthroplasties (and reoperations following hemiarthroplasty) in 2005, the proportion who underwent hemiarthroplasty among those who underwent a reoperation has gradually increased. For obvious reasons, these patients run a high risk of experiencing complications even after a reoperation. In addition, diagnosis registration of both local and general complications has improved over time. Nevertheless, we have identified an area in which there is scope for improvement.

Strengths, sources of error, and weaknesses

The possibility of linking Register data with the Patient Register means that we can incorporate an important quality indicator that provides guidance on early adverse events. This is a variable which, in addition to reoperations and mortality, is not picked up on in the Register. We regard the new set of codes that define an adverse event as being better at capturing events that are probably linked to the operation and which could potentially be avoided or prevented. The strengths of the analysis are underpinned by the fact that we use a set of codes that were originally produced by the Knee Arthroplasty Register through in-depth work carried out together with the National Board of Health and Welfare.

There are of course weaknesses and sources of error in the analysis. For example, only adverse events that occurred during primary care or in conjunction with readmission are included. Outpatient visits are not included, which could mean that a dislocation that is repositioned at an accident and emergency unit, and where the patient then returns home, are not picked up on. This also applies, for example, to venous thromboses, which in the majority of cases do not lead to inpatient care. Furthermore, the coding routines differ between county coun-

cils and hospitals. In certain cases, there could be financial incentives to register a large number of codes in order to raise the DRG (diagnosis-related group) score, where the threshold for including certain complication codes differs between units.

Comparing results between units is not the primary purpose of the quality indicator. The most important thing is to follow a unit´s results over time and stimulate local analyses in order to acquire a better understanding panoramically of adverse events and thus identify areas for improvement.

Finally, the Register would like to extend its sincere thanks to Erik Wahlström at the National Board of Health and Welfare Register Service for his help and service-mindedness in the work involved in making the analyses.

- **The definition of an adverse event has changed and is similar to the definition used by the Knee Arthroplasty Register.**
- **For both the standard patient as well as elective and fracture patients, the incidence of adverse events has fallen over the past 10 years.**
- **Adverse events following a first-time reoperation have increased.**
- **There is a significant variation between different hospitals in the incidence of adverse events for all categories.**
- **There are major opportunities for improvement in the care system in order to avoid adverse events, particularly for fracture patients and in conjunction with reoperations.**

11.2 Results on unit level 2014–2016

The incidence of adverse events within 30 and 90 days for elective patients, standard patients, fracture patients, first reoperations and other or later reoperations (Tables 11.2.1–11.2.5) is presented on the unit level. In all categories there is considerable variation between units and a number of units are well above the national average. For elective patients, the variation in adverse events within 90 days is 0–12%, with a national average of just over 5%. The variation for elective patients is 0–13%, with an average of just under 4%. Fracture patients vary between 16% and 42%, with a national average of 31%. The greatest spread is noted for reoperations, where the incidence varies from 0% to 54%, with an average of 28%.

Adverse events for fracture patients

A person who fractures their hip, and subsequently undergoes hip arthroplasty, is often an individual with one or more diseases. Only 4% belong to ASA class I, i.e. completely healthy. Furthermore, it is important to operate on a hip fracture within 1–2 days, and there is thus very little opportunity to optimise health status before the procedure. This can be contrasted with an individual with osteoarthritis, who undergoes surgery following a careful review of their general health. A person who is far too ill is often advised to refrain from undergoing surgery, as opposed to the fracture patient, who must always undergo surgery. Consequently, adverse events are more common following a fracture arthroplasty procedure and the panorama is different. For fracture patients, the Register has opted to also add codes for urinary tract infection, as it is both a known and an avoidable complication (related to the use of a urinary catheter) and a disease that can seriously affect an aged individual.

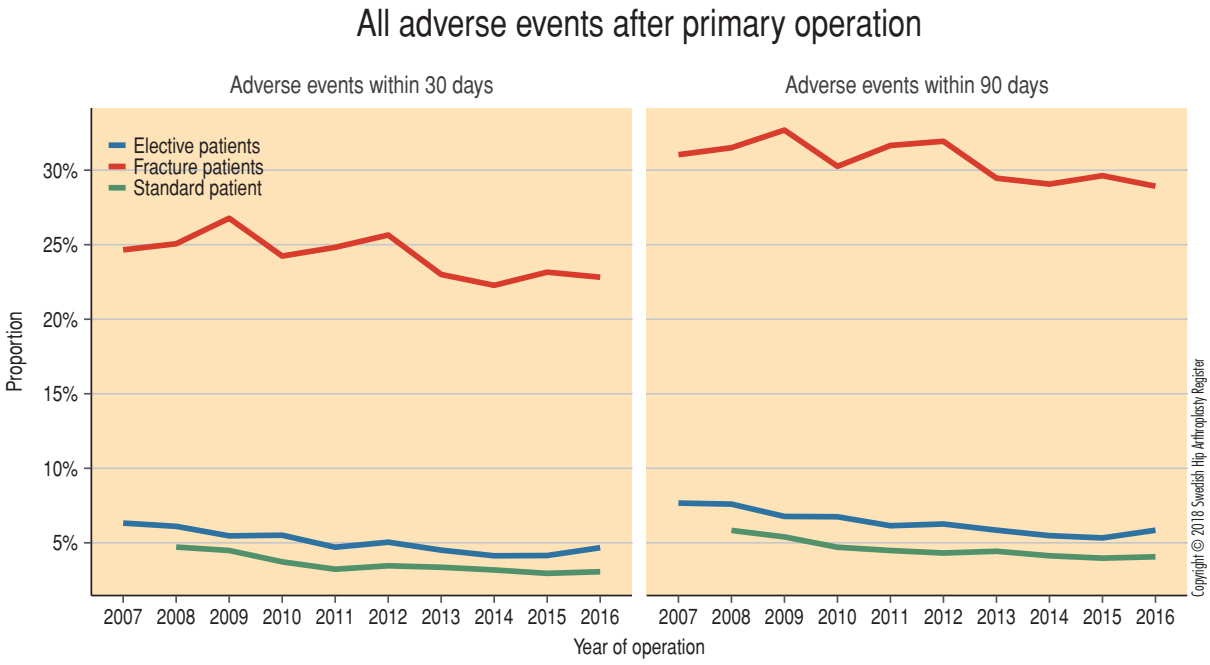


Figure 11.1.1

If all types of adverse events are taken into account, the occurrence has remained essentially unchanged over the past 10 years for both women and men. Women are affected in 25–30% of cases within 90 days, compared with men, who are affected in 35–40% of cases. The number of hip-related events ('surgical events') is falling for both genders. This probably reflects a better choice of operating technique (direct lateral approach, cemented arthroplasty etc.) in recent years compared with 2007. Cardiovascular events for women are also falling.

Men develop complications to a greater extent than women. The difference between the genders is greater following a fracture than following an osteoarthritis procedure. Scientific studies are consistent in their finding that the prognosis

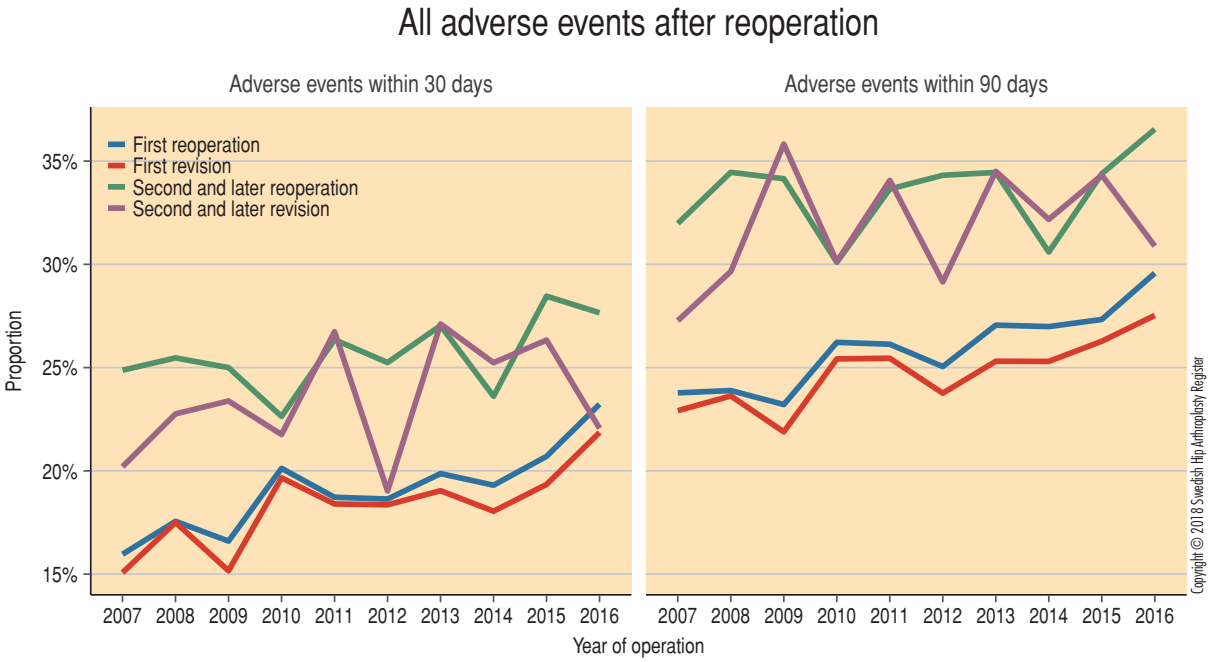


Figure 11.1.2

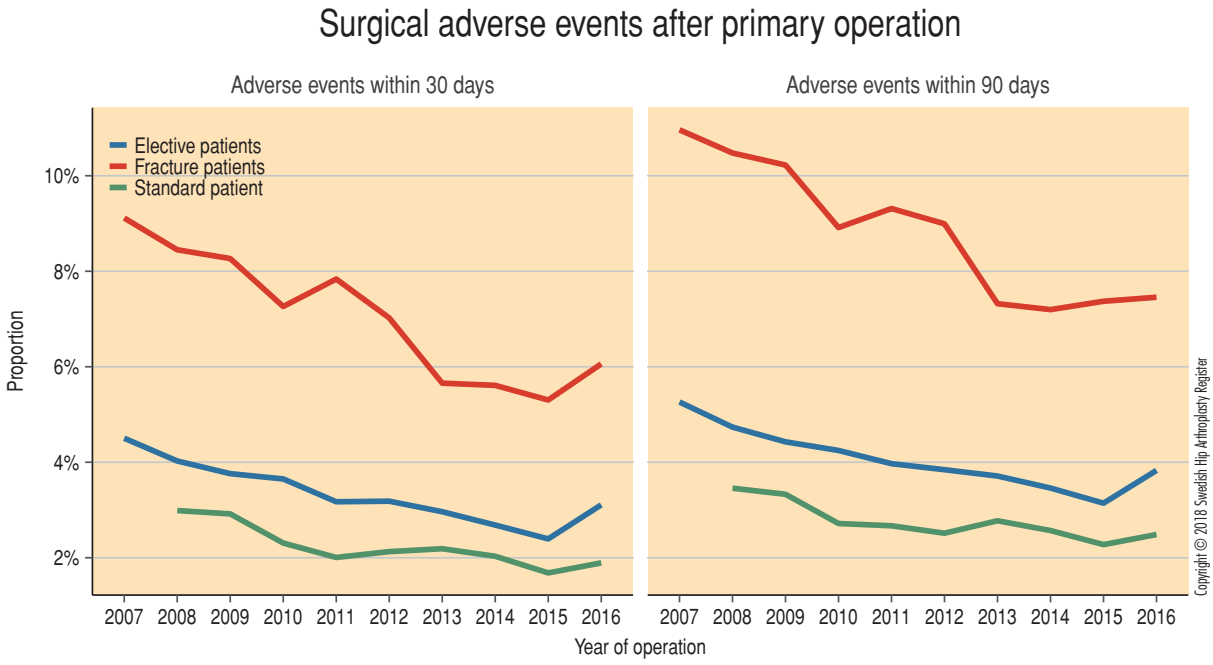


Figure 11.1.3

following a hip fracture is poorer for men, a contributing factor being that men are less healthy at the time of the fracture.

The mortality rate during the first six months is high. It should be borne in mind that a number of deaths are due to other reasons, although it is estimated that one in four deaths are directly related to the fracture.

The fact that hip fracture patients are affected more frequently by complications could naturally be a reflection of their morbidity before the fracture, although better care, both in conjunction with the operation and subsequently, could realistically reduce the risk. The focus in present-day healthcare is often on short care times and streamlining the care process. Current research shows, however, that adopting a multidisciplinary approach with both orthopaedic and geriatric experts would benefit the patient.

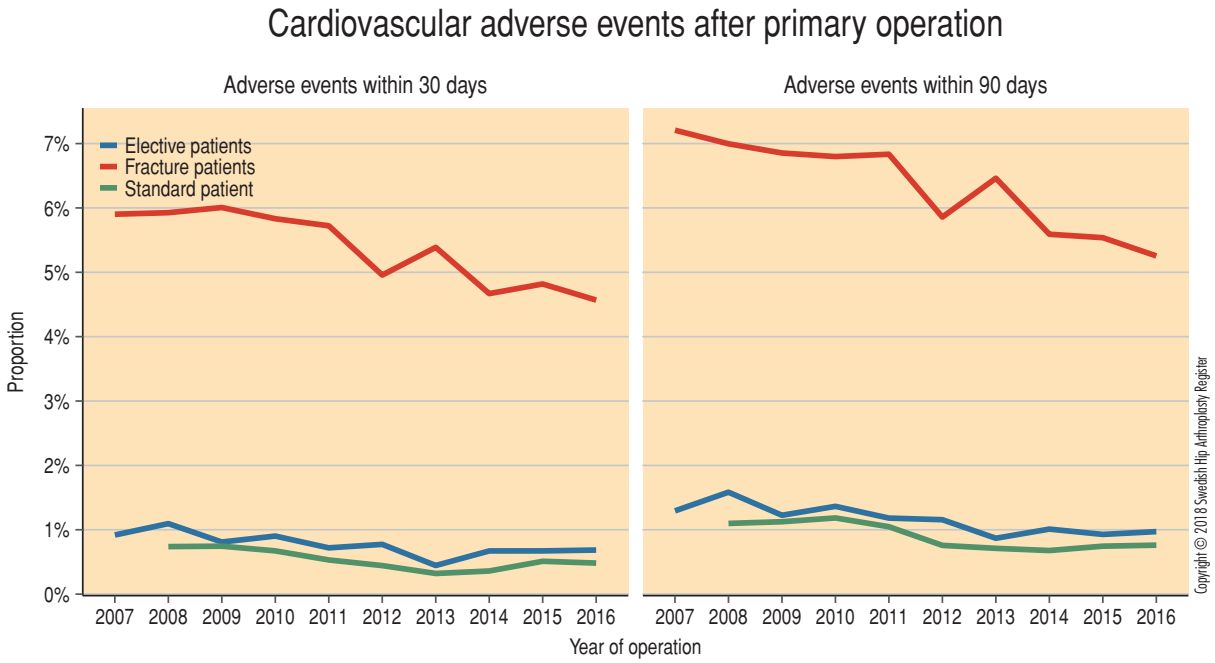


Figure 11.1.4

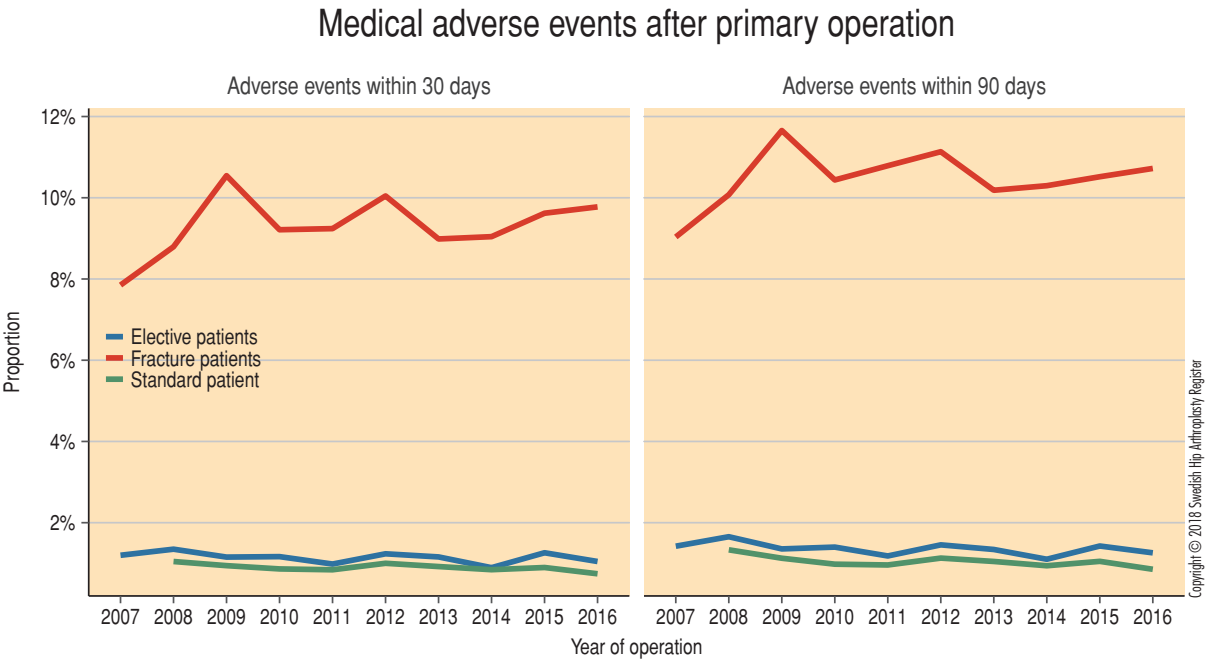


Figure 11.1.5

Codes for adverse events

	Used for primary arthroplasties	Used for reoperations and revisions	ICD 10 and KVÅ codes	Additional codes for fractures
Surgical				
A Measure code for hip arthroplasties. Complications or suspected complications.	If the measure occurs after the date of surgery OR during a care event after the date of surgery.	If the measure occurs during a care event after the date of surgery.	NFA02, NFA11, NFA12, NFA20, NFA21, NFA22, NFC*, NFF*, NFG*, NFH*, NFJ*, NFK*, NFL*, NFM*, NFQ09, NFS*, NFT*, NFU09, NFU19, NFU39, NFU89, NFU99, NFW*, QDA10, QDB00, QDB05, QDB99, QDE35, QDG30, TNF05, TNF10	
	If the measure occurs during a care event after the date of surgery.	If the measure occurs during a care event after the date of surgery.	NFU49	
DA Diagnosis for complication codes which should have been used during complication.	If they occur as main or secondary diagnosis during the date of surgery or as main diagnosis during rehospitalization.	If they occur as main diagnosis during rehospitalization.	G978, G979, M966F, M968, M969, T810, T812, T813, T814, T815, T816, T817, T818, T818W, T819, T840, T840F, T843, T843F, T844, T845, T845F, T847, T847F, T848, T848F, T849, T888, T889	
DB Diagnosis for hip related illnesses. Probably complication near the operation.	If they occur as main or secondary diagnosis during the date of surgery or as main diagnosis during rehospitalization.	If they occur as main diagnosis during rehospitalization.	G570, G571, G572, M000, M000F, M002F, M008F, M009F, M243, M244, M244F, S730, S74*, S75*, S76*	
	If they occur as main diagnosis during rehospitalization.	If they occur as main diagnosis during rehospitalization.	M240F, M245F, M246F, M610F, M621F, M662F, M663F, M843F, M860F , M861F , M866, M866F , M895E	
Cardiovascular				
DC Diagnosis for serious cardiovascular illnesses. Probably complication near the operation.	If they occur as main or secondary diagnosis during the date of surgery or as main diagnosis during rehospitalization.	If they occur as main or secondary diagnosis during the date of surgery or as main diagnosis during rehospitalization.	I21*, I24*, I260, I269, I460, I461, I469, I490, I60*, I61*, I62*, I63*, I649, I65*, I66*, I72*, I74*, I770, I771, I772, I819, I82*, I978, I979, J809, J819, T811	
Medical				
DM Diagnosis for medical illnesses. Can be related to operation if they occur shortly thereafter.	If they occur as main or secondary diagnosis during the date of operation or as main diagnosis during rehospitalization.	If they occur as main or secondary diagnosis during the date of operation or as main diagnosis during rehospitalization.	I80*, J13*-J18*, J952, J953, J955, J958, J959, J96*, J981, K25*, K26*, K27*, L89*, N17*, N990, N998, N999, R339	N300, N308, N309, N390
	If they occur as main diagnosis during rehospitalization.	If they occur as main diagnosis during rehospitalization.	J20*-J22*, K29*, K590, N991	

Table 11.1.1

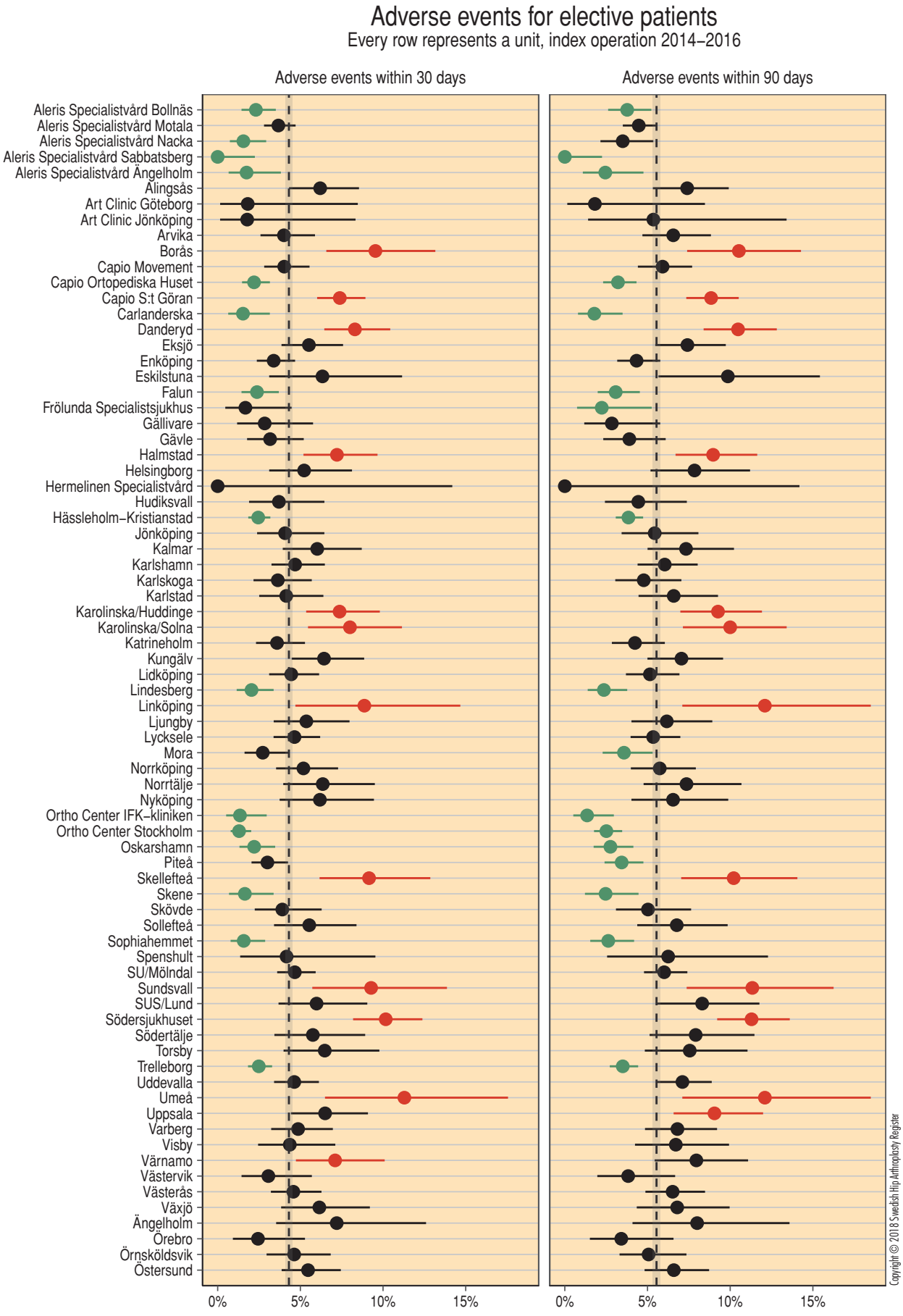


Figure 11.2.1 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

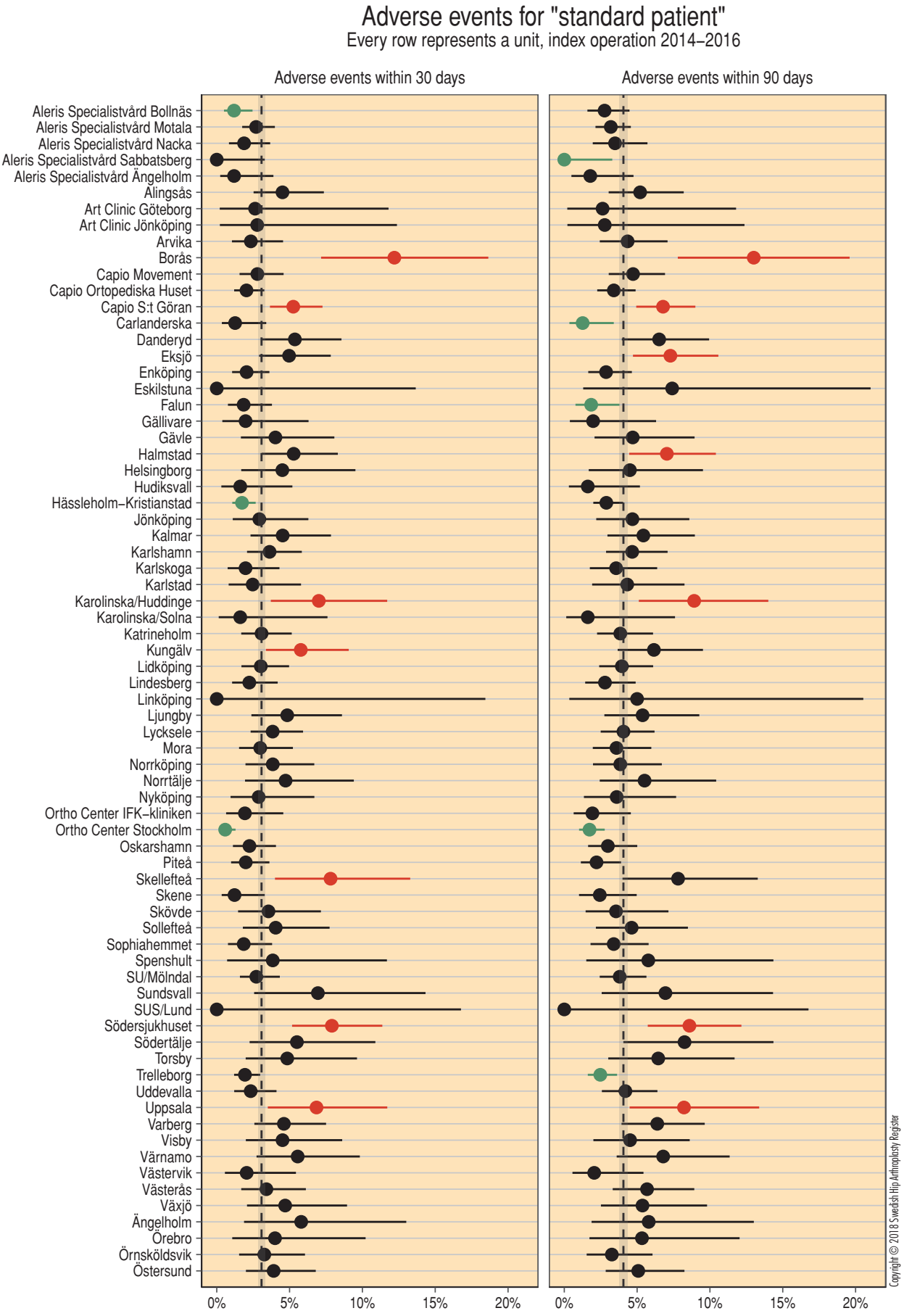


Figure 11.2.2 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

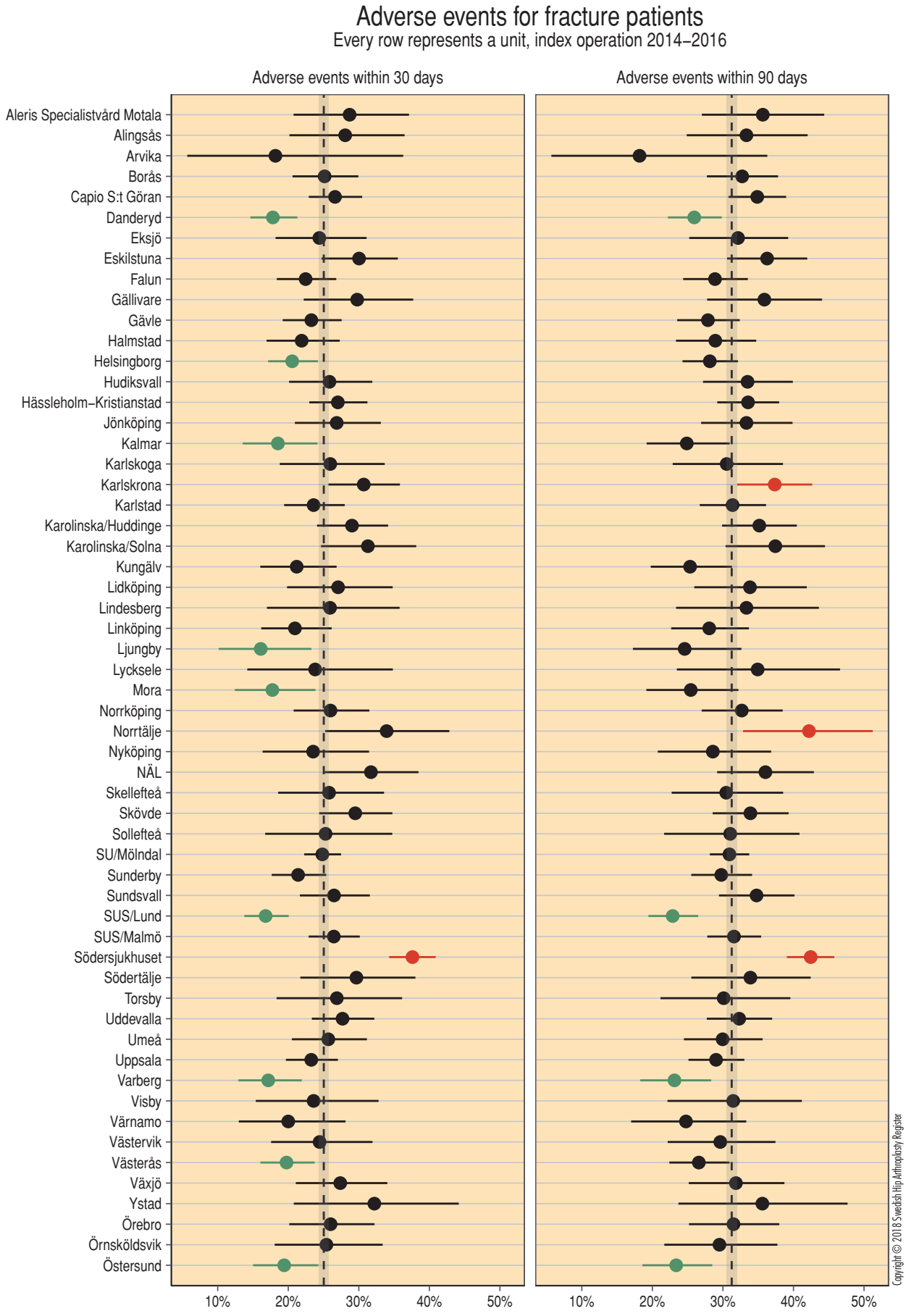


Figure 11.2.3 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

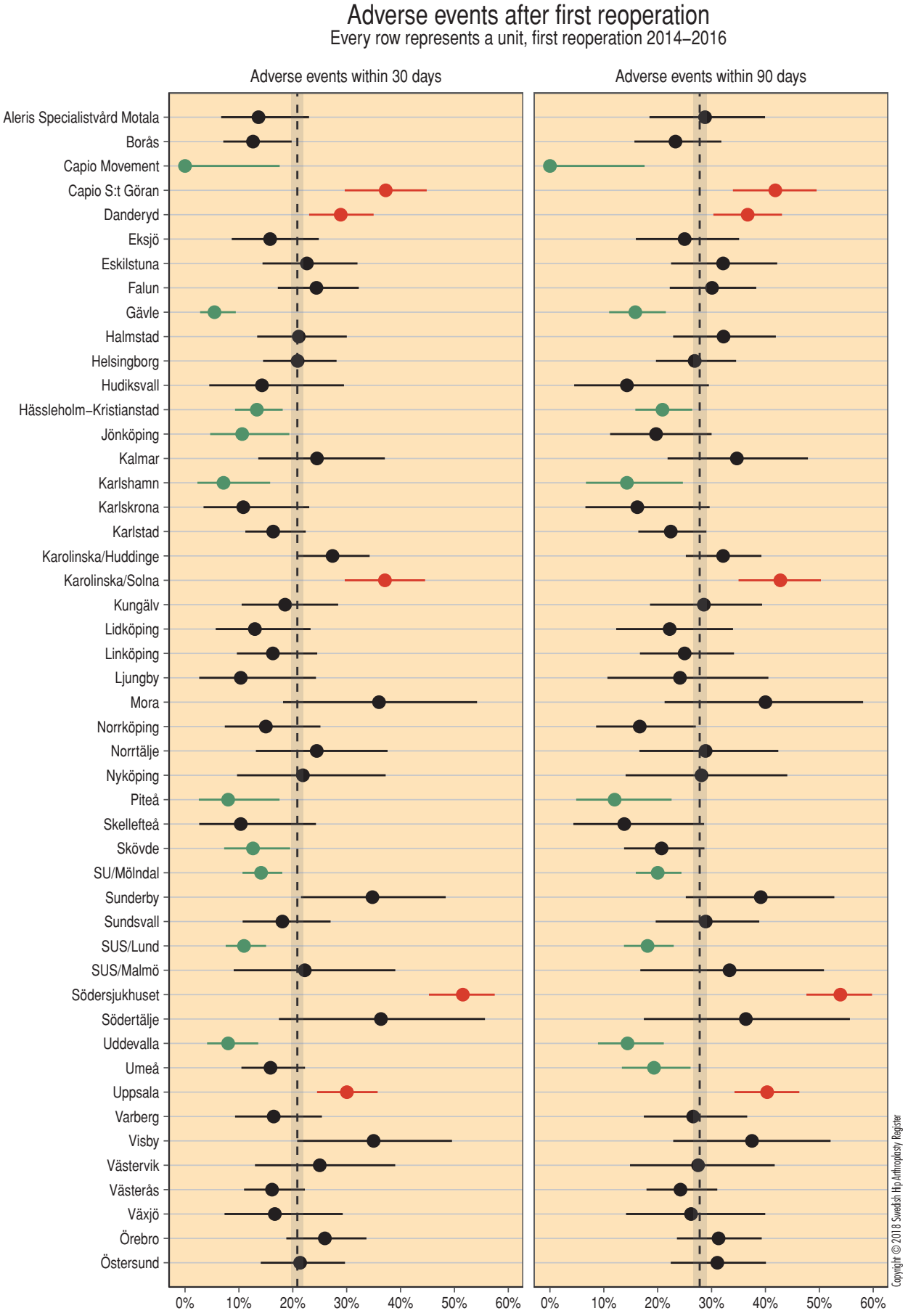


Figure 11.2.4 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

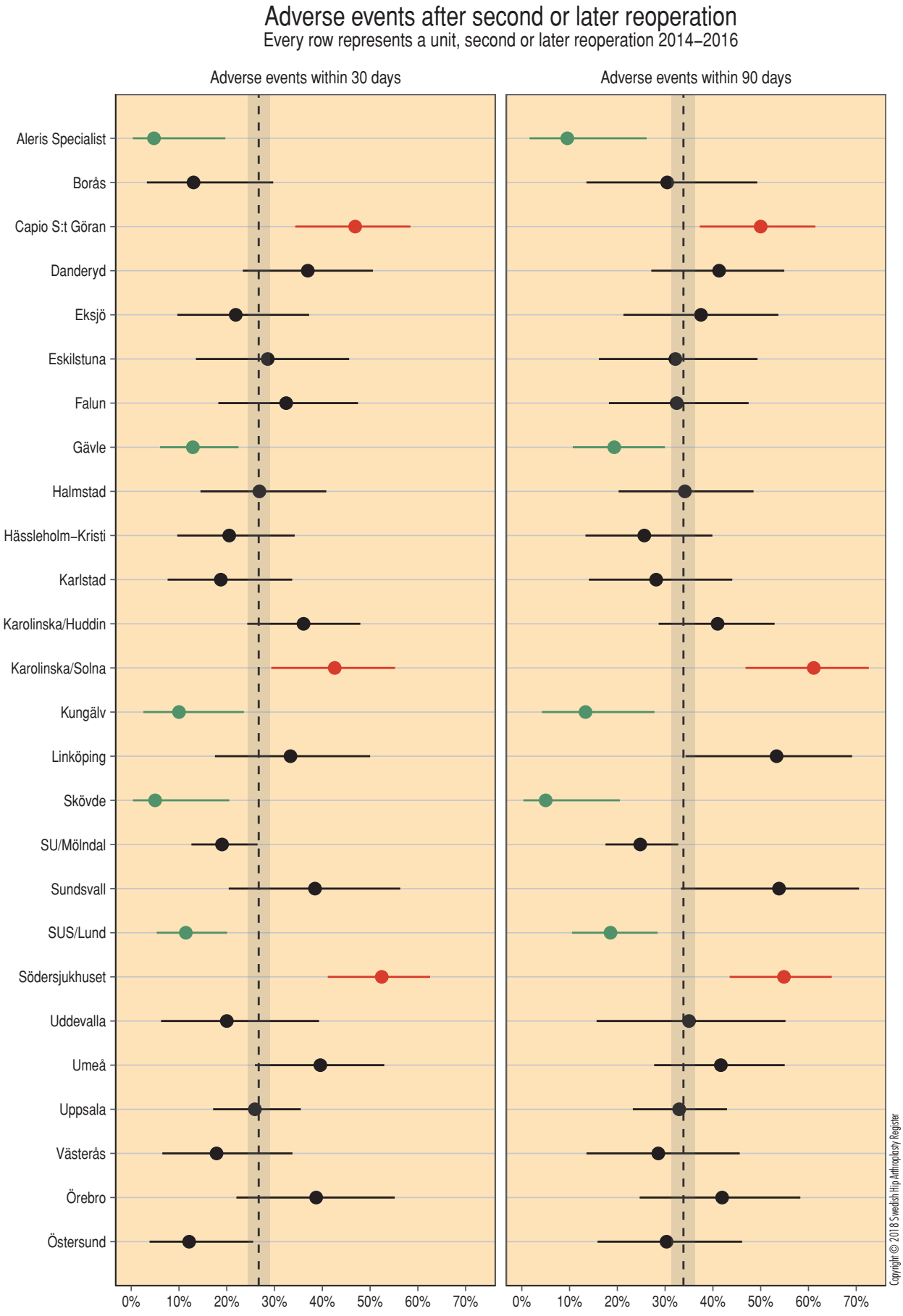


Figure 11.2.5 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

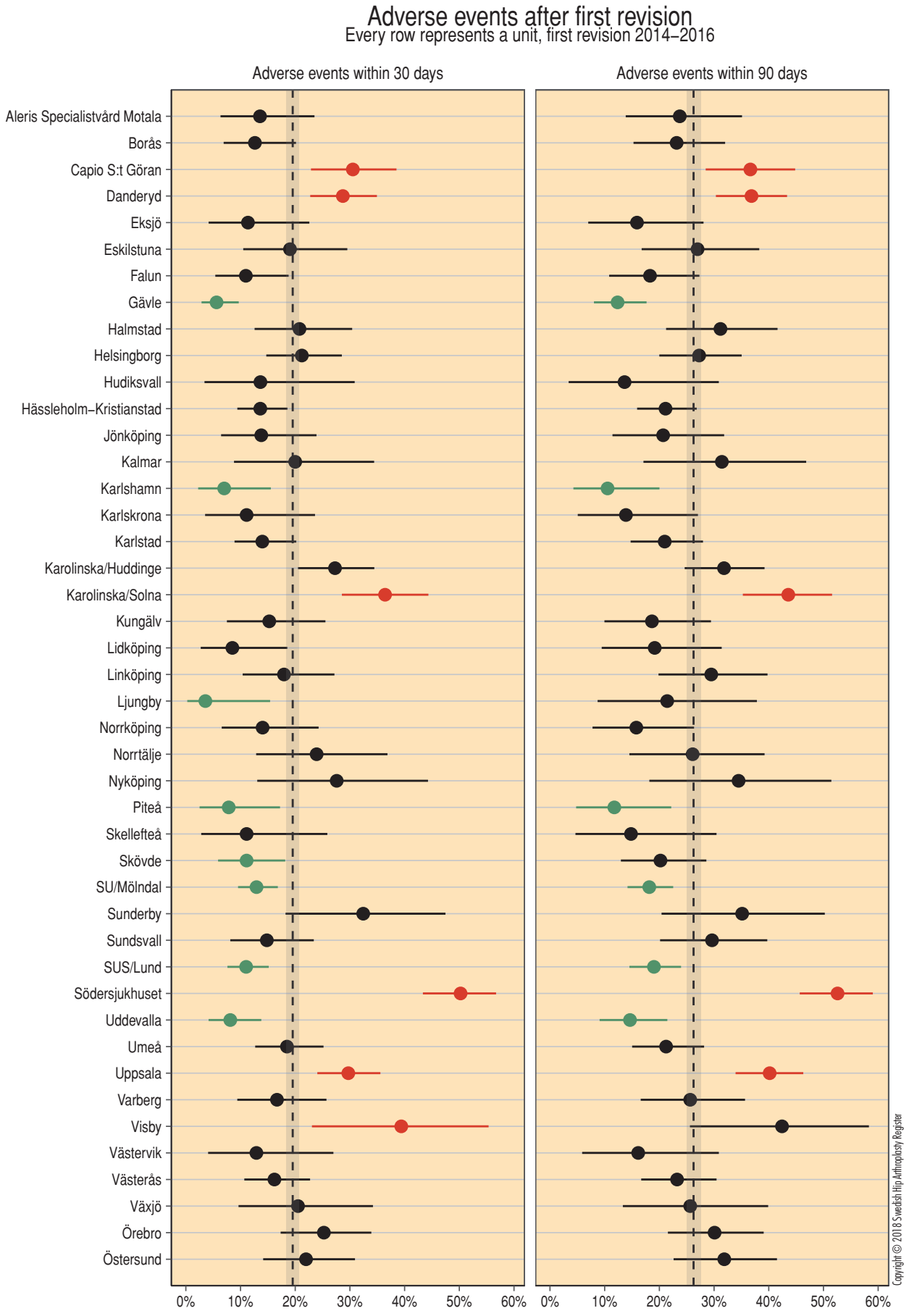


Figure 11.2.6 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

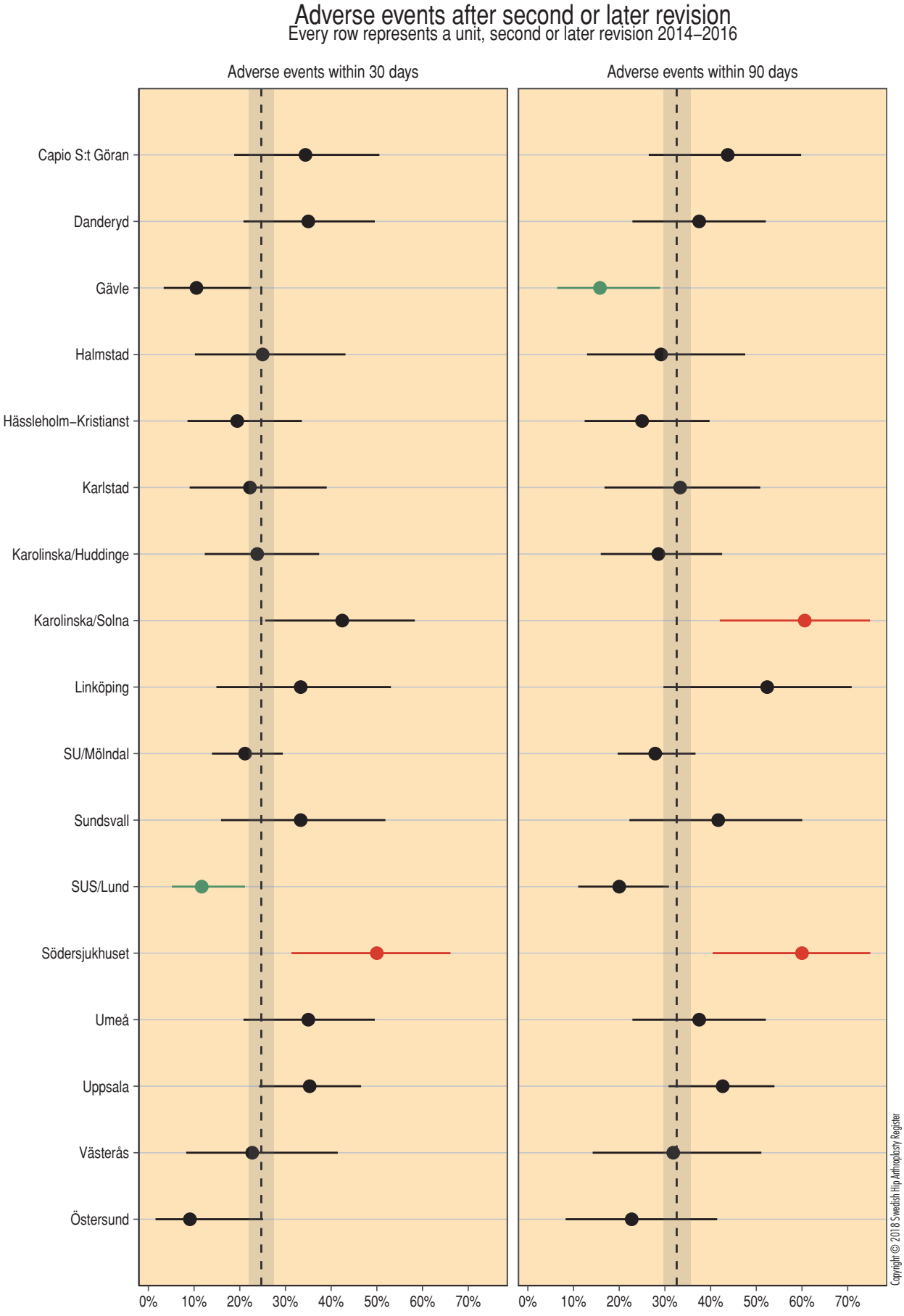


Figure 11.2.7 The proportion adverse events at unit level. Units with less than 20 registrations have been excluded.

12 Fracture treatment with total arthroplasty or hemiarthroplasty

This chapter covers total hip arthroplasties and hemiarthroplasties performed due to acute fractures and sequelae following an early hip fracture. In total, 6,033 operations were registered in 2017, which means that we can note a steady level of around 6,000 procedures per year during the past decade. The analyses in this chapter are based on 75,313 operations carried out between 2005 and 2017. Monoblock prostheses, which are no longer used, have been excluded. The number in each age group – under 75 years, 75–85 years, over 85 years – has stabilised in recent years, and is around 1,300, 2,400 and 2,300 each year respectively (Figure 12.1).

For hemiarthroplasty patients, the incidence of dementia is also registered. In 2005, 28% had some degree of dementia. The proportion increases each year, and in 2017, 37% of hip arthroplasty patients were suffering from either obvious or suspected dementia.

Choice of implant and technique

Both bipolar (1,017) and unipolar (2,920) hemiarthroplasties fell slightly in 2017, whilst total hip arthroplasties continued to increase, with 2,075 patients undergoing total hip arthroplasty last year (Figure 12.2). Two-thirds were operated on via a direct lateral approach, and one-third via a posterior approach (4,245 and 1,680 respectively). There have not been any major changes over the past five years (Figure 12.3).

As previously, a small number of implant models are used: the three most common stems cover more than 90% of the operations. There are more options for a hemi head or acetabulum cup, with the 10 most common accounting for 86%. There are very small changes with regard to the choice of stem (Table 12.1). On the cup side, the Avantage dual mobility cup continues to increase. Just over 2% of uncemented stems were used in 2017, which is a decrease compared with previous years, and such a low proportion is probably unique compared to other countries (Table 12.2). Prosthesis survival data[1] has been calculated for the most common stem types for fracture patients. The four most common cemented stems have approximately the same six-year survival rate, i.e. 95–96% (Figure 12.8–11). The uncemented stem Corail is presented as a group, as the different variants represent far too small a number for analysis (Figure 12.12). This prosthesis survival rate is poorer than the cemented stems at six years, although the confidence interval is wide at the end of the follow-up period. The results for all stems should of course be interpreted cautiously, as a varying degree of revision reporting and different treatment strategies in conjunction with complications etc., could produce a displaced picture of the true clinical results.

The most common cemented stem types provide a relatively good result with comparatively few reoperations. However, reality for the patient could be different – not all complications lead to a reoperation.

Reoperation and revision

In total, 3,745 reoperations have been reported to the Register since 2005, representing a reoperation rate of 4.9%. Revisions account for 2,540 of these, where the prosthesis is replaced or extracted, either wholly or in part.

A Kaplan–Meier analysis[2] shows that younger patients undergo revision surgery to a greater extent than older patients (Figure 12.4). In this respect, we must point out that the corresponding figure in last year's annual report was incorrect. Those who receive a prosthesis after internal fixation of the fracture failed (secondary prosthesis) also run an increased risk (Figure 12.5). The same type of survival analysis regarding approach shows that a lateral approach is preferable – from a revision risk point of view – during the first 10 years. Thereafter, the difference is no longer significant (Figure 12.6). The different prostheses carry the same risk of a revision throughout the whole of the follow-up period with one exception. Bipolar hemiarthroplasty reveals a higher risk of revision during the first two years compared with unipolar hemiarthroplasty and total arthroplasty (Figure 12.7). It should be noted that in previous annual reports the Register used reoperation as an outcome in this analysis. This year revision is used.

During the first years of registration, the Register identified an increased risk of revision for bipolar heads. Continued follow-up has shown that the increased risk only applies to early revision. If the protective effect with regard to acetabulum erosion (see below) is included, bipolar arthroplasty now appears to be a good alternative for individuals who are considered to have many years of life remaining after the fracture. Total arthroplasty in certain analyses (see below) results in a

	Primary arthroplasty 2005–2017		Primary arthroplasty 2017	
	Number	%	Number	%
Aseptic loosening	194	0.3	2	0.0
Deep infection	1 250	1.7	100	1.7
Fracture	805	1.1	5	0.1
Implant fracture	3	0.0	-	-
Dislocation	1 077	1.4	64	1.1
Technical cause	40	0.1	5	0.1
Pain	50	0.1	-	-
Other	81	0.1	2	0.0
Acetabular erosion	51	0.1	-	-
No reoperation	71 762	95.3	5 834	97.0
Total	75 313	100.0	6 012	100.0

Number of reoperations (secondary open surgery) and its causes, reported to the register until 2017–12–31.

[1]Observe that the registry has used reoperation as outcome in this analysis in earlier yearly reports. This year revision is used.

reduced reoperation risk. If the clinical studies that exist are considered as well, total arthroplasty is the better alternative for slightly younger, healthier and active fracture patients. However, the procedure could be technically more demanding than for hemiarthroplasty, and the unit's emergency care expertise could be crucial to the choice of prosthesis.

Table 12.3 shows reoperations within six months at participating units. For the country as a whole, the proportion is 3% and between units the proportion varies from 0% to 12%. The majority of reoperations thus take place early on. This is an important quality indicator, although the report should be read with some reservations. A number of unreported cases could exist for different reasons. In addition to underreporting, the units could be inclined to a varying degree to operate in the event of complications. There is a desire perhaps not to expose an aged fracture patient to a new operation for medical reasons, or it could be that the patient declines the offer. Local treatment traditions can also have an impact. In the case of a suspected infection, for example, the operation is nowadays usually carried out on an acute basis and the infected tissue is debrided and resected in an attempt, in combination with the right antibiotics, to heal an infection and preserve the primary prosthesis. How forthwith this infection diagnosis and treatment is, varies between units throughout the country and could to a certain extent explain the variation in the reoperation rate.

If a unit mainly carried out secondary prosthesis procedures, this could explain the higher reoperation rate (Figure 12.5). Another reason for a higher reoperation rate could be use of either an uncemented stem or a posterior approach, which could entail an increased risk of periprosthetic fracture or dislocation. If a unit has a high proportion of reoperations, the Register proposes a local improvement programme, including an in-depth analysis. This could take place within the framework of a resident's project, and the Register Management Team is willing to help and mediate the experience available from previous quality assurance initiatives. As always, the reoperations are listed under the hospital that carried out the primary procedure, regardless of where the reoperation takes place.

Reoperation – risk factors

With a Cox regression analysis, we evaluate how the factors covered by the Register affect the risk of complications that lead to a reoperation. Certain factors cannot be influenced – men, for example, run a higher risk of reoperation than women. Younger people run a higher risk than older people. A reoperation as an outcome is a relatively blunt instrument. A number of patients who suffer complications are either advised not to undergo a new operation or they make the decision personally not to undergo a new operation, among other things for health reasons. The Register is also aware of a certain degree of underreporting of reoperations. In this case, we appeal to participating units to establish and maintain good routines, and to bear in mind that all open interventions in and around the hip should be reported. Soft tissue procedures in conjunction with an infection and fracture surgery without revision of the implant itself in particular tend to be forgotten.

The orthopaedic surgeon chooses the implant according to the patient's general health and level of functioning. Healthy, active patients often undergo total arthroplasty. They live for a relatively long period of time after their hip fracture and in time they may develop complications. In that case, because they are healthy, they to a large extent undergo a reoperation. The opposite applies to those who undergo a unipolar arthroplasty – they live for a short period of time and could be too ill to undergo surgery again. Consequently, unipolar arthroplasty is might be associated with far fewer reoperations than total arthroplasties. As a result, the comparison between the prostheses needs to be adjusted for other factors in the regression analyses presented below.

Patients under the age of 75

The unadjusted reoperation rate is just over 6%. The 'classic' risk factors, i.e. male gender and secondary intervention (joint arthroplasty following failed internal fixation) entail a clear increase in risk. Posterior approach and uncemented stem also increase the risk of reoperation, regardless of the cause. Total arthroplasty is associated with a lower risk of reoperation than hemiarthroplasty. The result remains following adjustment for the ASA classification and BMI. Healthier patients (ASA 1–2) run a lower risk of undergoing a reoperation than those classified as ASA 3–5. Patients who are overweight are also at greater risk compared with those whose weight is normal. Underweight does not have any impact.

	Number of primary arthroplasties	Unipolar prosthesis		Bipolar prosthesis		Total prosthesis		All prostheses	
		Number	%	Number	%	Number	%	Number	%
< 75 years	15 393	152	6.0	154	7.9	703	6.4	1 009	6.6
75–85 years	28 599	569	4.8	449	5.4	412	4.9	1 430	5.0
> 85 years	31 321	617	3.4	468	4.5	134	4.6	1 219	3.9

Number of reoperations (secondary open surgery) divided into age groups and types of prostheses which have been reported to the registry until 2017–12–31. Observe that thess are unadjusted results.

Patients between the age of 75 and 85

The reoperation rate is slightly lower (5%), although the risk factors are roughly the same as for those under the age of 75. The patient's BMI, however, does not impact on the risk of reoperation. If we restrict the analysis to those who have undergone hemiarthroplasty, no difference is noticed in the risk between bipolar and unipolar arthroplasty. Dementia increases the risk of reoperation.

Patients over the age of 85

The oldest group has the highest rate of early mortality, which could be the reason for the slightly lower reoperation rate, 4%. The risk factors are mainly the same as those in the younger age groups. BMI is not considered to be of any significance. In the separate hemiarthroplasty analysis, adjusted for ASA classification, unipolar arthroplasty is associated with a lower risk of reoperation compared with bipolar arthroplasty.

Clinical significance

Sweden's low proportion of uncemented stems, unique by international standards, would appear to be wise as this type of stem involves an increased risk of periprosthetic fracture. Unipolar arthroplasty seems to function well in the oldest age group, although it reveals a clear association with acetabulum erosion and ought to be avoided in those patients with long expected survival and a high level of activity. Total arthroplasty is associated with the lowest reoperation risk, particularly in the under-75 age group. The use of total arthroplasty is also gradually increasing in Sweden.

In the case of hemiarthroplasty, a posterior approach continues to be associated with both a clear increase in the risk of dislocation, and an increased risk of reoperation in general, and should be avoided.

The end result for the different types of arthroplasty, i.e. total arthroplasty, unipolar arthroplasty, unipolar hemiarthroplasty, and bipolar hemiarthroplasty, are the same, measured in terms of prosthesis survival. The result can be interpreted as such that Swedish orthopaedic surgeons choose a suitable implant for their different patient groups, i.e. the implant that best meets the patient's functional requirements.

An uncemented stem and posterior approach increase the risk of reoperation in general, and periprosthetic fracture and dislocation in particular. Based on the manner in which Swedish orthopaedic surgeons opt to use the different types of arthroplasty, this results in relatively similar results regarding arthroplasty survival. Unipolar hemiarthroplasty increases the risk of reoperation as a result of acetabulum erosion, thus making it a poor choice for active patients with a long remaining life expectancy.

It should be borne in mind that all open procedures in and around the hip must be reported. Do not forget to report soft tissue procedures in conjunction with infection and fracture surgery.

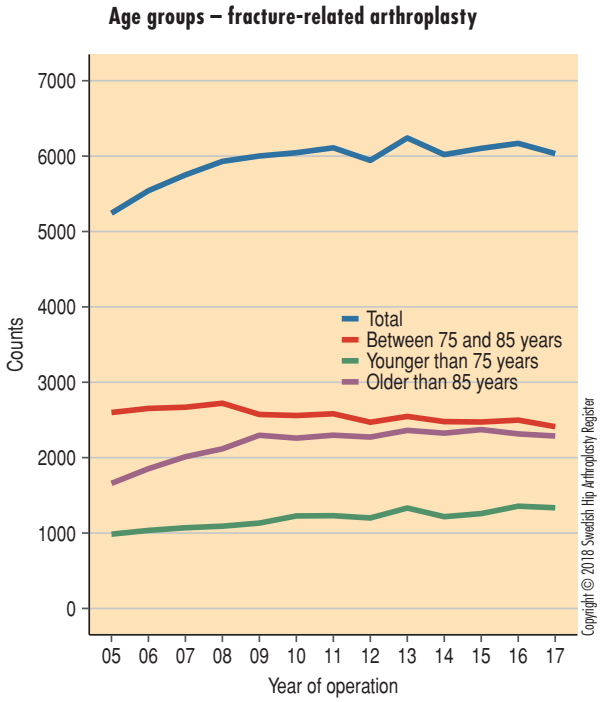


Figure 12.1

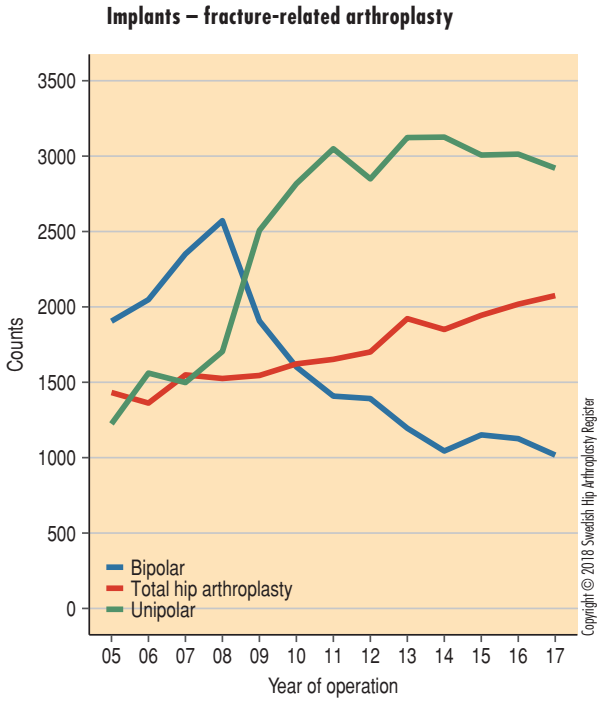


Figure 12.2

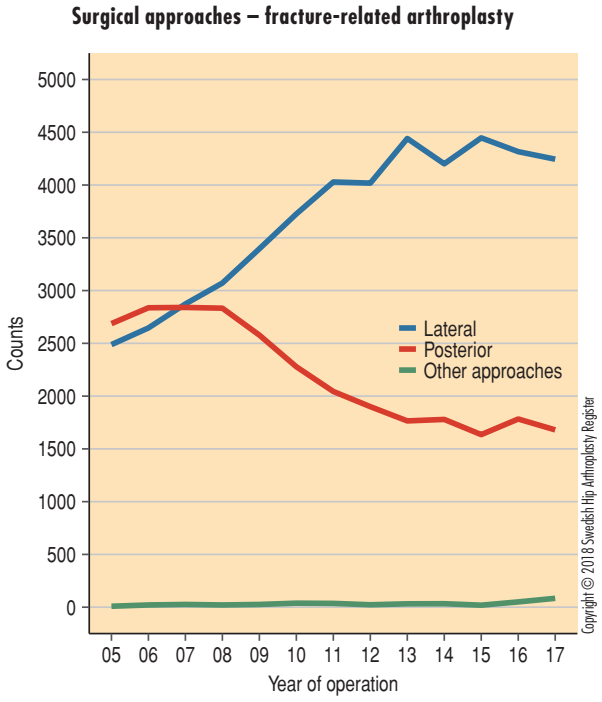


Figure 12.3

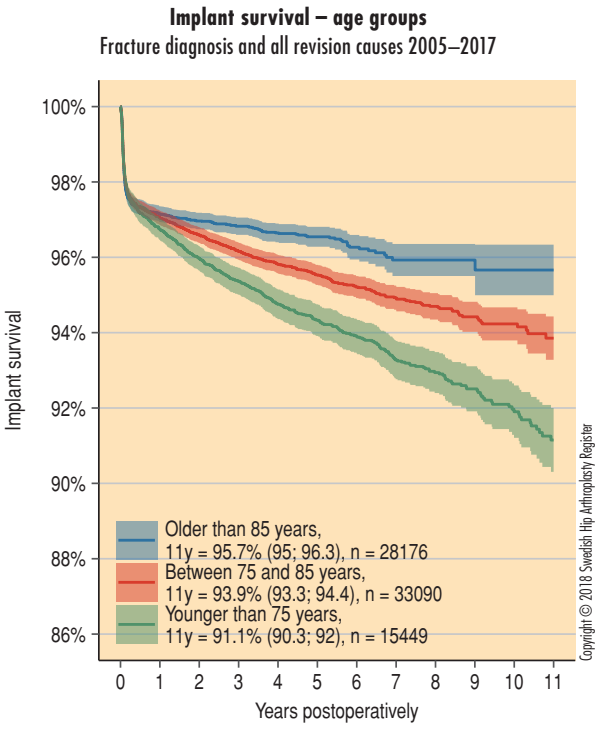


Figure 12.4

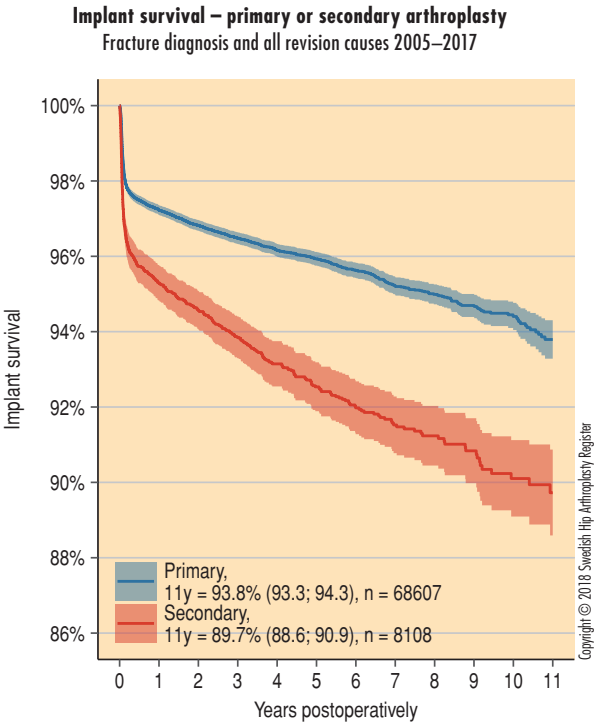


Figure 12.5

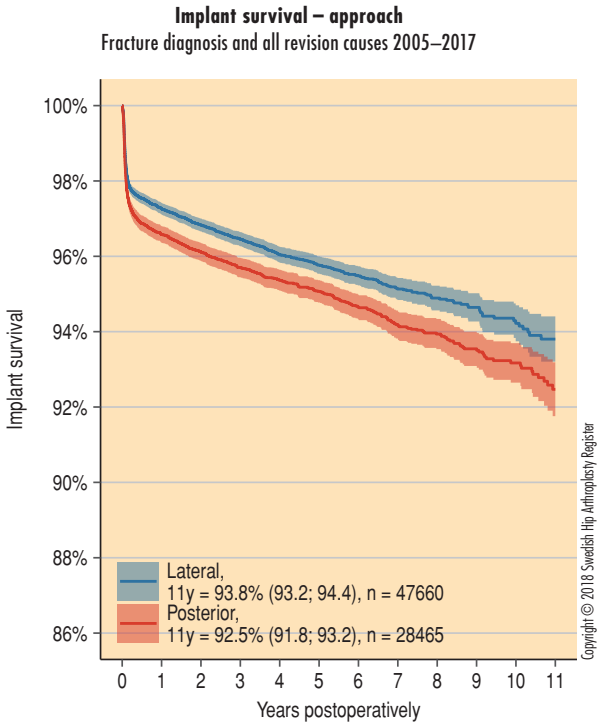


Figure 12.6

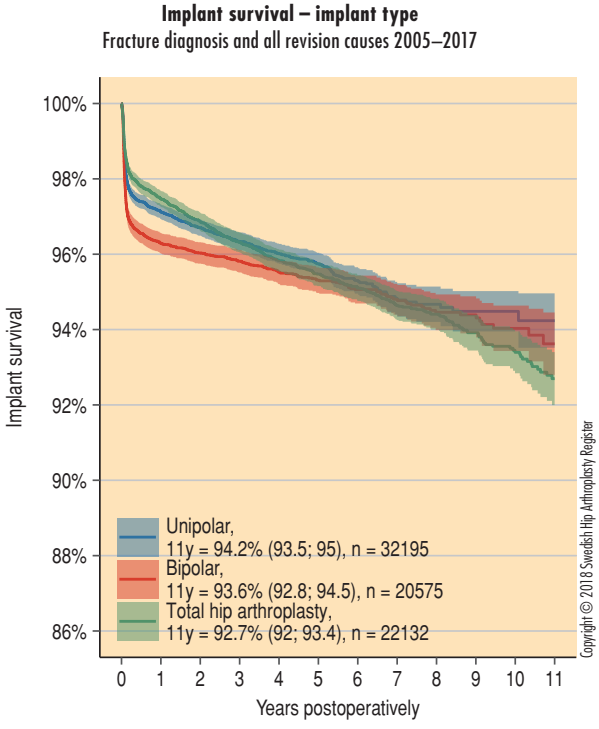


Figure 12.7

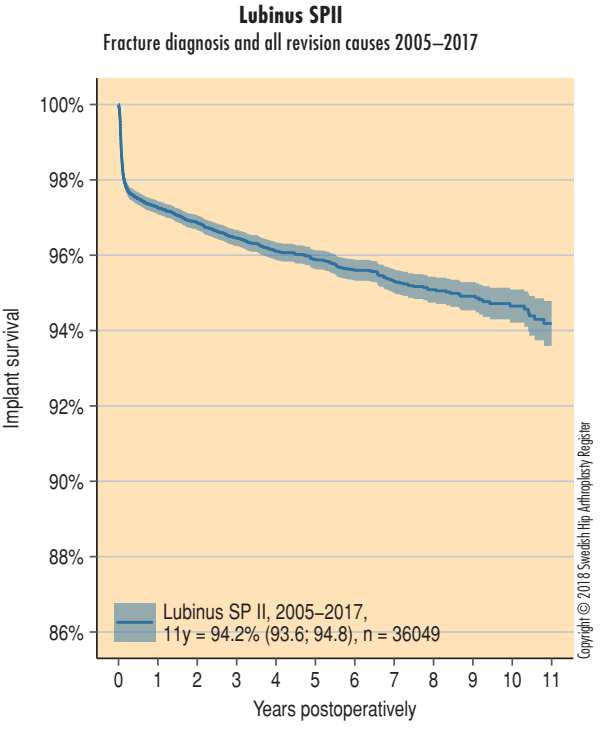


Figure 12.8

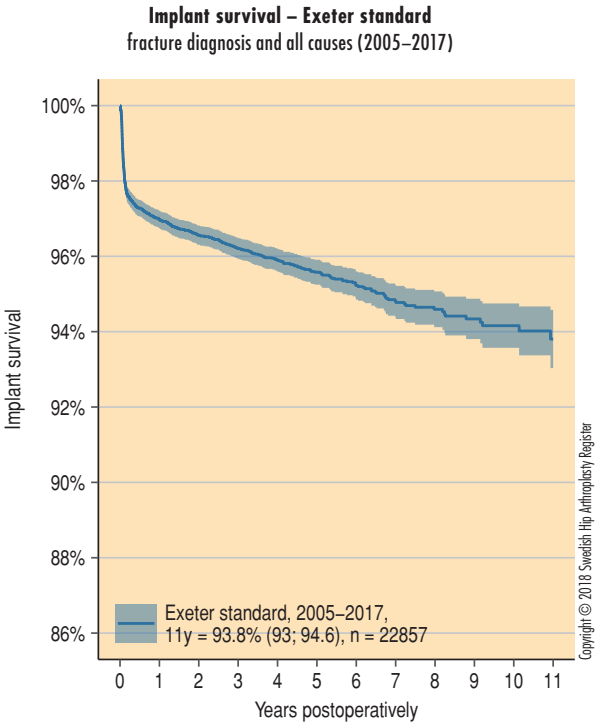


Figure 12.9

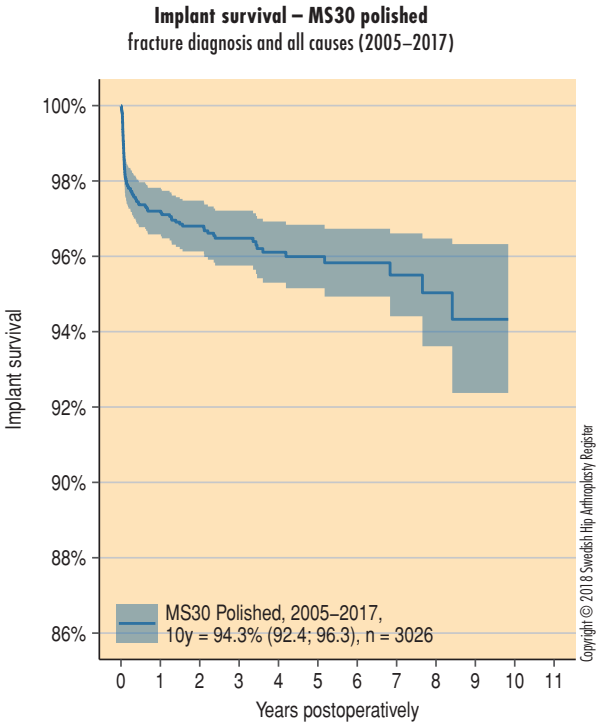


Figure 12.10

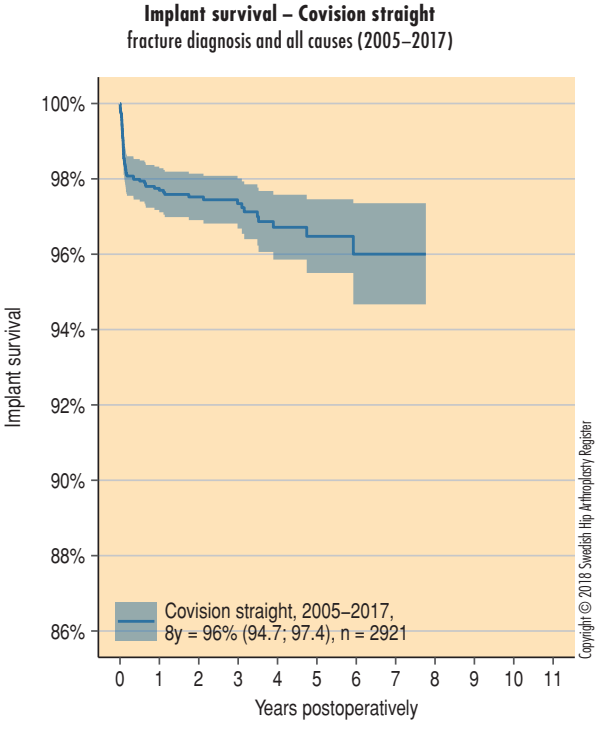


Figure 12.11

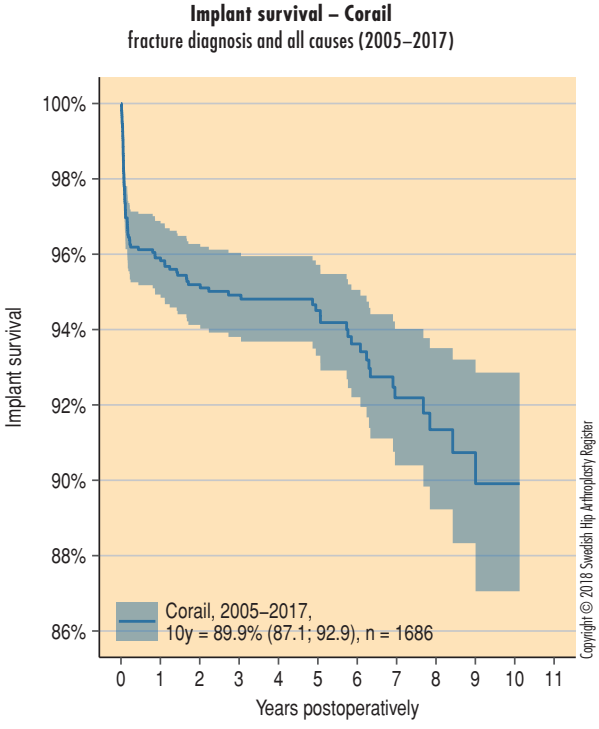


Figure 12.12

15 most common stem components for fracture patients

Stem	2005–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
SPII standard	20 790	2 751	2 976	3 081	3 390	3 318	15 516	50.8
Exeter standard	12 755	2 057	2 076	2 119	1 994	1 954	10 200	33.4
MS-30 polished	1 447	325	323	321	318	304	1 591	5.2
Covision straight	1 353	373	385	345	251	231	1 585	5.2
Corail	1 192	126	110	108	79	72	495	1.6
CPT	2 674	382	7	4	2	10	405	1.3
Exeter long	216	34	38	29	23	33	157	0.5
Bi-metric X por HA NC	227	46	17	14	11	7	95	0.3
Wagner Cone	76	29	21	17	12	12	91	0.3
Restoration	54	16	7	12	19	12	66	0.2
MP proximal standard	92	20	18	10	4	13	65	0.2
CLS	197	13	5	12	4	11	45	0.1
CPT long rev	50	13	6	3	7	2	31	0.1
Accolade straight	41	10	4	3	1	7	25	0.1
Accolade II	0	3	5	0	7	8	23	0.1
Other	5 376	43	22	20	32	37	154	0.3
Total	46 540	6 241	6 020	6 098	6 154	6 031	30 544	

Table 12.1

[1)] Refers to the number of performed arthroplasties during the last five years.
[2)] Refers to the proportion of the total number of primary arthroplasties performed the last five years.

15 most common cup/head components

Cup/hemiprosthesis head	2005–2012	2013	2014	2015	2016	2017	Total[1)]	%[2)]
Unipolar prosthesis head (Link)	7 968	1 557	1 758	1 755	1 971	1 939	8 980	29.4
UHR Universal Head	5 122	670	742	836	831	777	3 856	12.6
Unitrax modular endohead	996	564	524	468	534	656	2 746	9.0
Lubinus x-link	205	250	338	466	611	548	2 213	7.2
Covision unipolär	1 367	376	397	348	253	227	1 601	5.2
Marathon	1 164	393	324	302	269	274	1 562	5.1
Lubinus	5 002	446	373	297	152	146	1 414	4.6
Avantage	382	203	235	232	321	401	1 392	4.6
V40 unipolar	3 671	367	348	336	158	8	1 217	4.0
Exeter Rim-fit	158	151	184	224	275	305	1 139	3.7
Vario cup	6 676	186	128	131	159	108	712	2.3
MultiPolar Bipolar Cup	454	126	137	145	135	131	674	2.2
Unipolar	713	90	96	100	97	90	473	1.5
Polarcup cemented	121	76	60	83	90	95	404	1.3
IP Link	52	33	64	71	83	92	343	1.1
Other	10 730	752	312	308	214	215	1 801	5.7
Total	44 781	6 240	6 020	6 102	6 153	6 012	30 527	

Table 12.2

[1)] Refers to the number of performed primary arthroplasties the past five years.
[2)] Refers to the proportion av the total number of primary arthroplasties performed the past five years.

Reoperations within six months per unit

Fracture patients 2015–2017

Unit	No. of primary arthrplasties[1)]	No. of re-operations[2)]	%[3)]
University or regional hospital			
Karolinska/Huddinge	259	11	4.5
Karolinska/Solna	143	9	6.4
Linköping	170	4	2.5
SU/Mölndal	825	9	1.1
SUS/Lund	426	13	3.1
SUS/Malmö	404	14	3.6
Umeå	215	5	2.4
Uppsala	409	13	3.4
Örebro	155	6	4.0
County hospital			
Borås	236	5	2.2
Danderyd	482	11	2.4
Eksjö	117	9	8.4
Eskilstuna	234	11	5.0
Falun	329	16	5.1
Gävle	306	4	1.3
Halmstad	200	7	3.7
Helsingborg	383	17	4.7
Hässleholm-Kristianstad	367	12	3.4
Jönköping	158	7	4.6
Kalmar	196	2	1.0
Karlskrona	246	6	2.6
Karlstad	361	10	2.9
Norrköping	236	1	0.4
NÄL	459	6	1.4
Skövde	229	12	5.4
Sundsvall	246	5	2.0
Södersjukhuset	670	16	2.5
Uddevalla	23	0	0.0
Varberg	190	4	2.2
Västerås	340	9	2.8
Växjö	152	2	1.4
Ystad	105	1	1.0
Östersund	236	9	4.0

Unit	No. of primary arthrplasties[1)]	No. of re-operations[2)]	%[3)]
Rural hospital			
Alingsås	89	10	11.7
Gällivare	81	6	7.8
Hudiksvall	125	3	2.5
Karlskoga	142	12	8.5
Kungälv	163	3	2.1
Lidköping	102	3	3.0
Lindesberg	54	3	5.9
Ljungby	102	5	5.0
Lycksele	58	1	1.7
Mora	128	4	3.2
Norrtälje	88	4	4.6
Nyköping	95	4	4.4
Piteå	25	0	0.0
Skellefteå	123	5	4.2
Sollefteå	21	0	0.0
Sunderby	198	3	1.6
Södertälje	95	3	3.4
Torsby	74	0	0.0
Trelleborg	25	0	0.0
Visby	60	2	3.4
Värnamo	88	4	5.0
Västervik	108	3	2.9
Örnsköldsvik	158	1	0.7
Private hospital			
Aleris Specialistvård Motala	81	1	1.3
Capio S:t Göran	373	9	2.6
Country	12 203	355	3.0

Table 12.3

[1)] Refers to the number of primary operations during the period. Units with fewer than 20 primary arthroplasties are excluded.

[2)] Refers to the number of reoperations within six months.

[3)] Proportion of reoperations computed using competing risk analysis at six months follow-up.

13 Register development – value compasses

The Hip Arthroplasty Register began reporting hospital results openly in 1999. The number of variables reported in this way has increased over the years, and they are presented in tabular form at different places in this report. These tables are by necessity extensive, and at times difficult to interpret. Furthermore, it is difficult using tables to acquire a quick overview of the results of the units in multiple dimensions. In order to facilitate interpretation and to quickly gain an overview of the results of the units, we make use of what is termed the value compass, which includes seven or eight outcome variables (compass points). The compasses are produced purely with the aim of acquiring a quick and pedagogical overview. A deviating result in a value compass is an indication that there is scope for improvement. The compass ought to be viewed as a simple signalling system. We have produced value compasses for all total arthroplasty patients, standard patients, and patients who have undergone an arthroplasty procedure as a result of a fracture.

Each variable has been re-scaled to values from 0 to 1. The lowest value (0.0) for the variables is the origin and the highest value (1.0) is on the periphery. The limits are determined by taking the highest and lowest mean value (on the unit level) +/- one standard deviation. The national mean value is stated for each compass point through the outer edge of the red area. Each unit's mean value for the variable in question is given for each compass point through the outer edge of the green area. The values within the red area are lower than the national mean value, and values outside the red area are higher. The more of the red field that can be seen, the poorer the results. It should be noted that the observation period for the variables differs.

13.1 Register follow-up after total hip arthroplasty

Result variables in value compasses:

- Patient satisfaction at one-year follow-up.
- Pain relief. The value is calculated by subtracting the pain value reported one year after the operation from the preoperative pain value.
- Improvement in health-related quality of life (gain in the EQ-5D index). The value is calculated by subtracting the EQ-5D index one year after the operation from the preoperative EQ-5D index.
- 'Adverse events' within 90 days. For definitions, see the "Adverse event' section in Chapter 13. The indicator also includes mortality. Reporting 'adverse events' using a higher number and variability creates a dimension in the compasses that offers greater scope for improvement.
- Completeness. Completeness on the individual level according to the most recent linkage with the Patient Register at the National Board of Health and Welfare.
- Reoperation within two years. Reports all forms of reoperation within two years following a primary operation and during the most recent four-year period.
- Five-year implant survival. Implant survival after five years using Kaplan–Meier statistics.
- Ten-year implant survival. The same variable as above but with a longer follow-up period. As selection as a 'standard patient' is based, among other things, on BMI and ASA classification (which we have registered since 2008), there is no data available for 10-year implant survival for a standard patient.

Linked to the value compass for each unit is a graphic representation of the unit's case mix. This part is designed in the same way as the value compass, and it includes some of the patient-related variables which when analysing the Register's database were shown to be linked to patient-reported outcome and long-term results with regard to revision requirements. The larger the green area in this figure, the better the patient profile for the unit in question. For a standard patient, there are no case mix compasses as an adjustment has already been made for this via the selection process.

- Charnley classification. Patients who are classified as Charnley class A or B (without other diseases and/or problems in joints other than the hips which affect the patient's ability to walk) run a low risk of complications and have a better patient-reported outcome.
- Number of primary osteoarthritis patients. Compared with other underlying joint diseases, primary osteoarthritis is associated with a lower risk of complications and a better patient-reported outcome.
- Number of patients aged 60 or older. Individuals over the age of 60 run a lower risk of a reoperation.
- Number of women. Women run a lower risk of a reoperation.

13.2 Register follow-up after hip arthroplasty as treatment for a hip fracture

The value compasses, a reflection of the units´ results, include total arthroplasties and hemiarthroplasties due to hip fractures. The value compasses include five variables (compass points), including adverse events. The fracture compasses are limited by the fact that many of the fracture patients are not covered by the Register's PROM programme.

The purpose of the presentation is that each hospital should be able to compare itself with the national mean value and identify any problem areas that could give rise to local improvement work. The results must be viewed in context, where many factors come into play. The value compass can be regarded as a balanced scorecard. The larger the area, the better the total multidimensional result for each unit.

We have chosen slightly different result variables for fracture-related arthroplasties compared with the result variables for elective total arthroplasties. The observation times for a reoperation and arthroplasty survival are shorter as individuals with a hip fracture have a shorter remaining life expectancy due to

their high age and diseases. The majority of reoperations take place within a few months, and long-term complications are uncommon.

- Completeness on an individual level for hemiarthroplasty according to the latest linkage with the Patient Register (2016).
- Adverse events within 90 days. Adverse events according to the latest linkage with the Patient Register. These are defined as cardiovascular and cerebrovascular conditions, thromboembolic disease, pneumonia, gastric ulcers and urinary tract infection if these have resulted in readmission or death. All types of reoperation of the hip are also included.
- 90-day mortality. In the international literature, this variable is used to monitor mortality following hip arthroplasty.
- Reoperation within six months. All open, subsequent procedures on the hip in question.
- Implant survival after one year using Kaplan–Meier statistics.

The selection of fracture patients who receive hip arthroplasty (instead of internal fixation) can vary depending on the hospital, and each unit's case mix must be interpreted alongside its value compass. The case mix framework is designed in the same way as the value compass and includes the variables that prove to be crucial demographic parameters for the risk of reoperation and to a certain extent mortality. The larger the surface in this figure, the more advantageous the patient profile for the unit in question.

- Proportion of patients aged 85 years or older. A high age protects against reoperation and revision. There could be many reasons for this: reduced activity reduces the risk, for example, of erosion and probably dislocation. Short remaining life expectancy means that loosening does not have time to develop. On the other hand, the 'risk reduction' that can be observed may be caused by the fact that an older individual, despite suffering a complication, is advised not to undergo a reoperation or revision for medical reasons. Units that operate on a large number of patients over the age of 85 achieve better results with regard to reoperation/revision but poorer results with regard to mortality.
- The proportion of acute fractures (diagnosis S72.0). The more patients with an acute fracture diagnosis the unit operates on, the better the long-term results according to the regression analysis of the database conducted by the Register.
- Proportion of non-dementia patients. In the figure, the unit's proportion of patients who are assessed to be cognitively intact. Dementia has a higher mortality rate following hip fracture. If the unit has a large proportion of non-dementia patients, its mortality figures are improved.
- Proportion of women. Women generally have better results than men in terms of the need for reoperation/revision, particularly due to the lower risk of periprosthetic fracture.

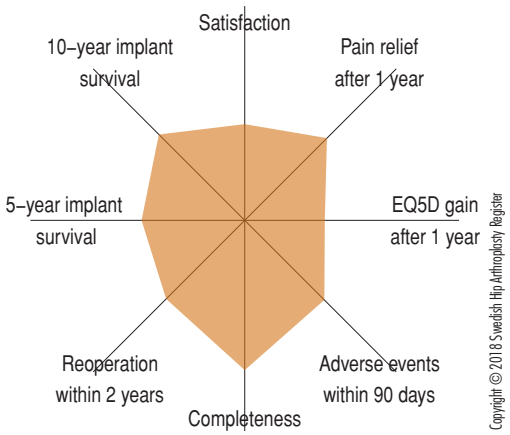
Discussion

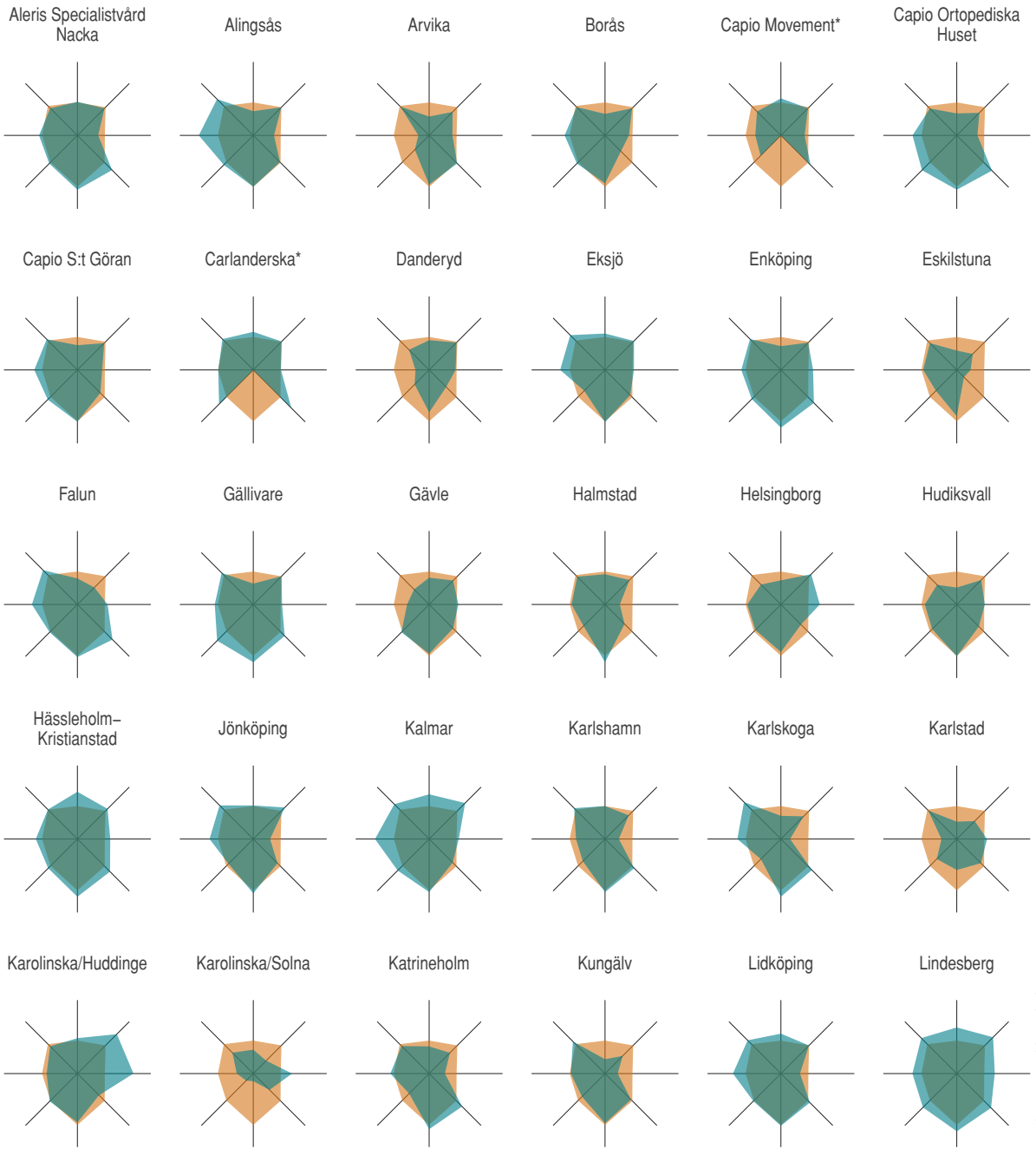
By comparing value compasses in previous years, the development can be followed over time. Compared with 2016, Karlstad and Skellefteå, for example, have clearly improved their value compasses. At the same time, it can be noted that Torsby, Västerås, Växjö, Örebro and Örnsköldsvik have retained the improvement achieved during the previous period. Some hospitals, however, still report poor or deteriorating results, which ought to give rise to a local analysis of the different factors that affect the clinical results and the subsequent measures taken. The Register willingly mediates the experience that is available following equivalent analyses at other hospitals, and it is also available to provide practical assistance. Simply experiencing a decrease in completeness, as is the case in Sunderbyn, Värnamo and Ystad, ought to be relatively easy to rectify by means of a review of the unit´s routines. In this respect, we would like to point out that individual units have 'zero' on the completeness axis as the completeness analysis is based on hemiarthroplasty registration. The units in question in effect only carry out total arthroplasties and completeness should thus not be deemed to be a problem. They are marked with an asterisk in the figures.

In aged hip fracture patients who are also ill, non-surgical treatment of complications is a more common problem than in osteoarthritis patients. For both infections and dislocations, the treatment could in certain circumstances be aimed at the symptoms, thus avoiding surgery, e.g. if a new operation were to be associated with substantial medical risks. Non-surgical treatment could therefore be most appropriate, and when making an assessment of the value compasses, the relationship ought to be taken into account. On the other hand, a higher incidence of reoperations and revisions could to a certain extent be an indication that an active approach to complications has been adopted.

Quality indicator

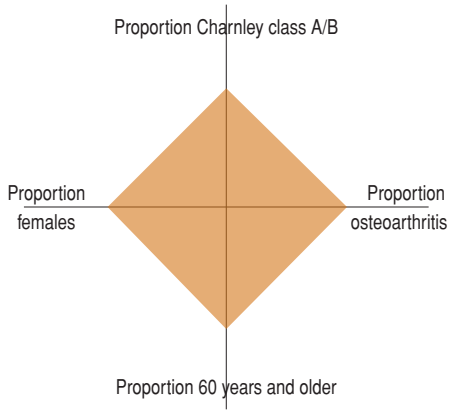
Value compass – national average





Case–mix–profile

National average



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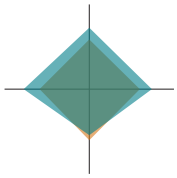

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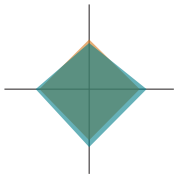
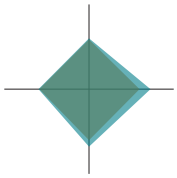
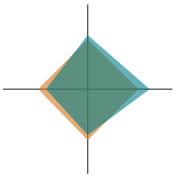


Arvika



Borås

Capio Movement



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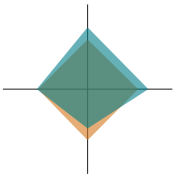

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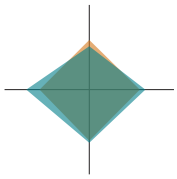
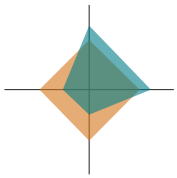


Carlanderska



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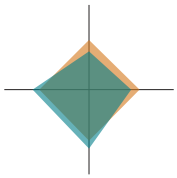

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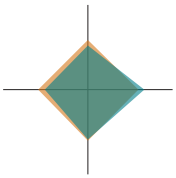
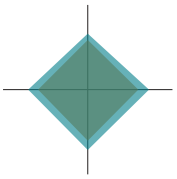


Enköping



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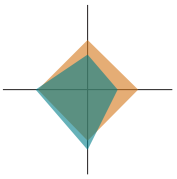

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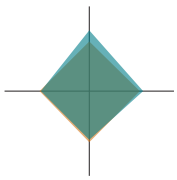
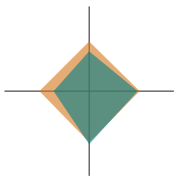
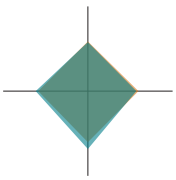


Gällivare

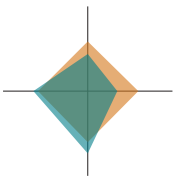


Gävle

Halmstad



Helsingborg



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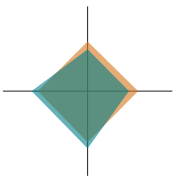
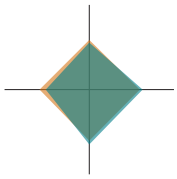
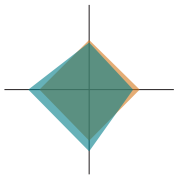


Hässleholm–Kristianstad



Jönköping



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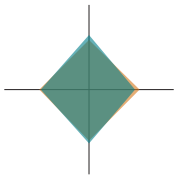

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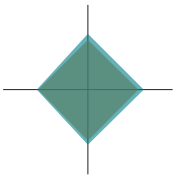
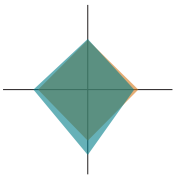


Karlskoga



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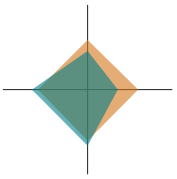

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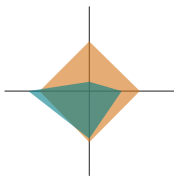

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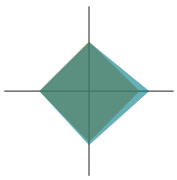

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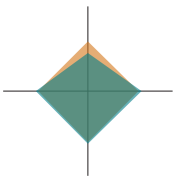

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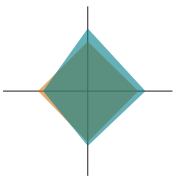

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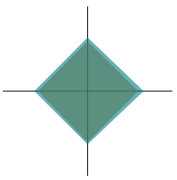

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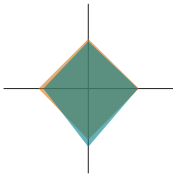

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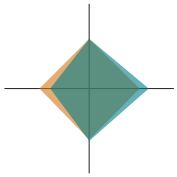

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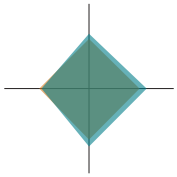

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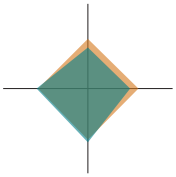

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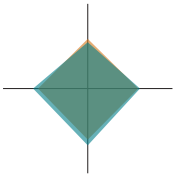

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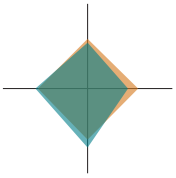

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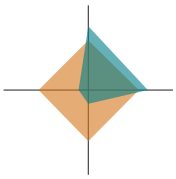

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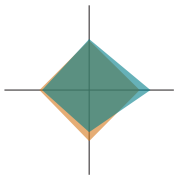

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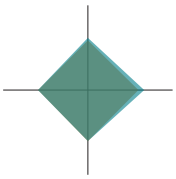

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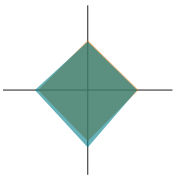

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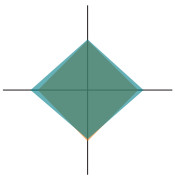

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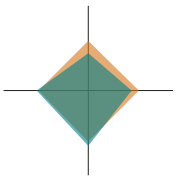

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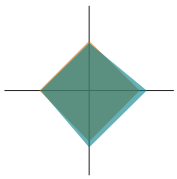

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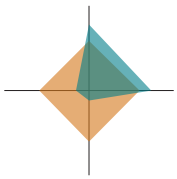

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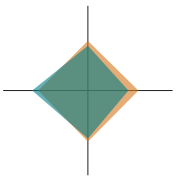

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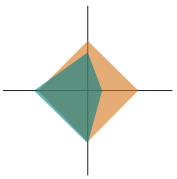

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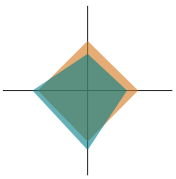

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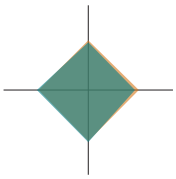

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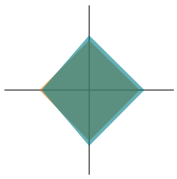

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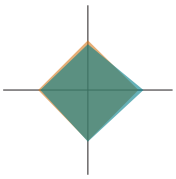

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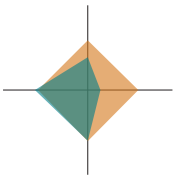

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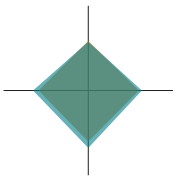

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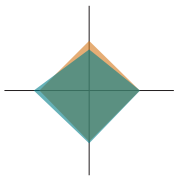

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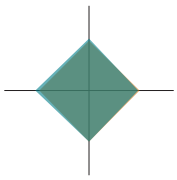

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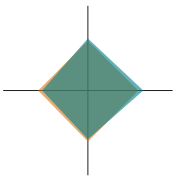

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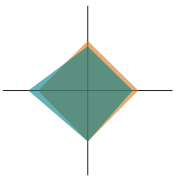

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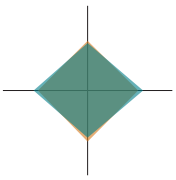

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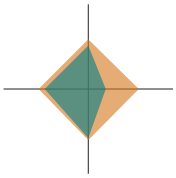

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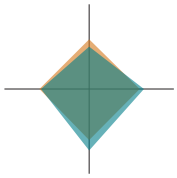
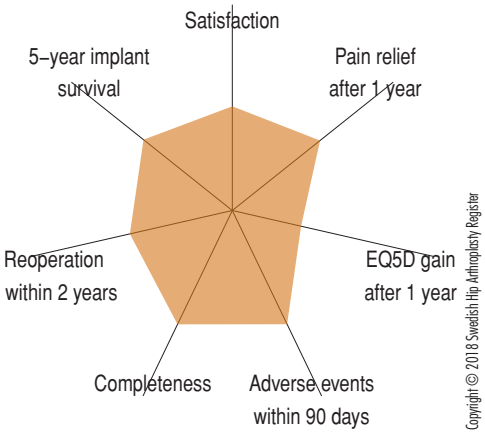
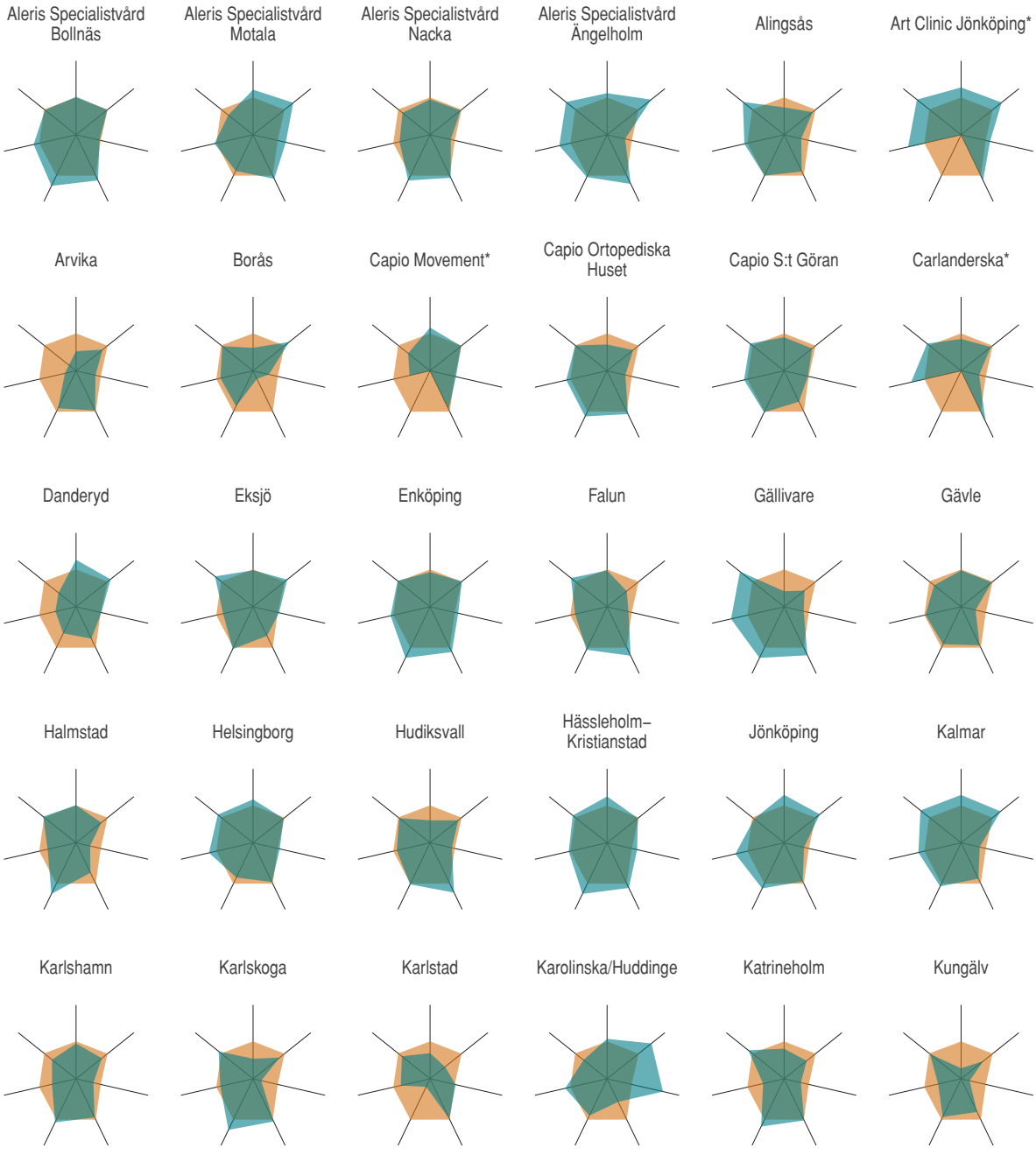


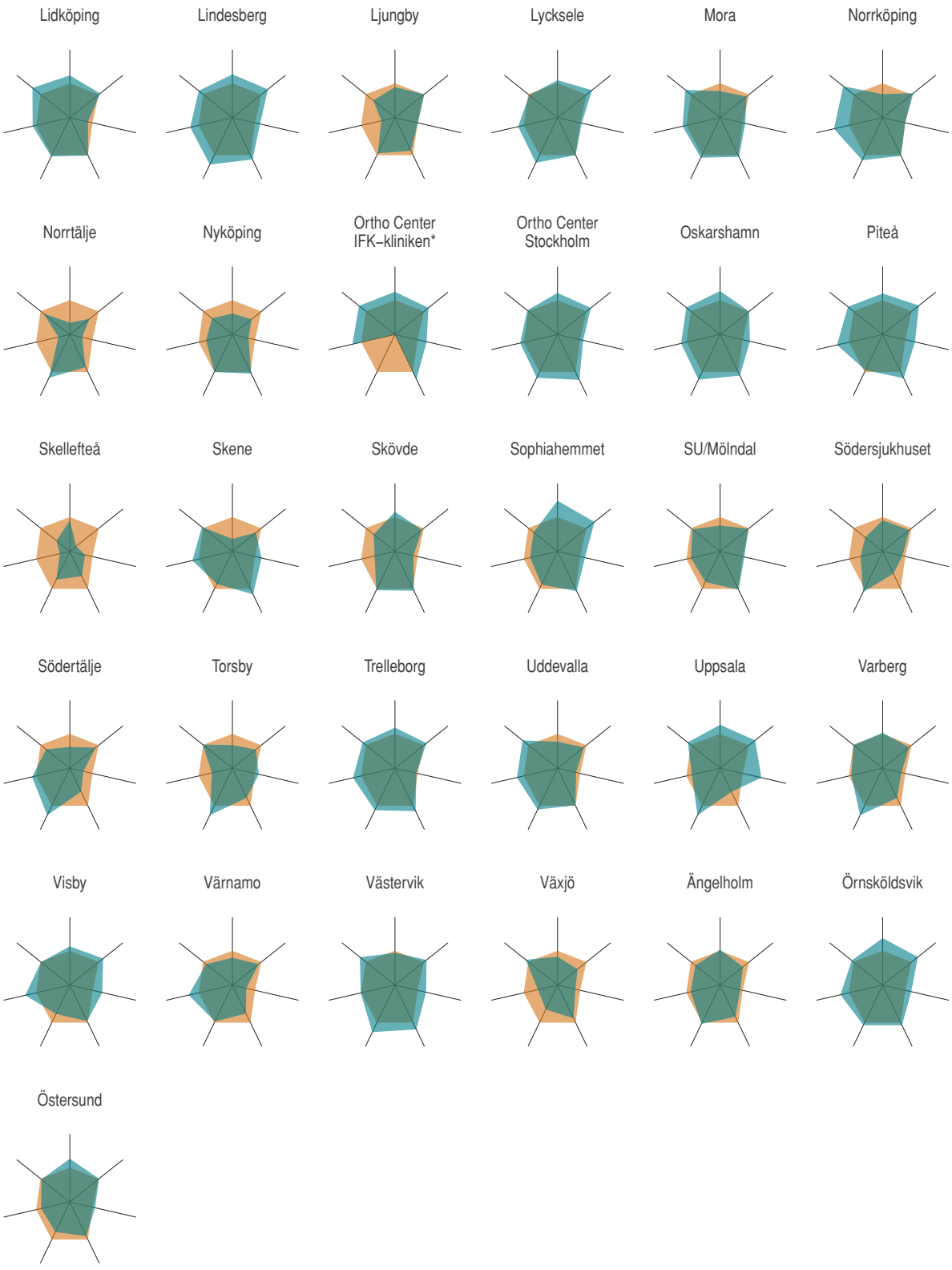
Östersund

Quality indicator for the "standard patient"

Value compass – national average



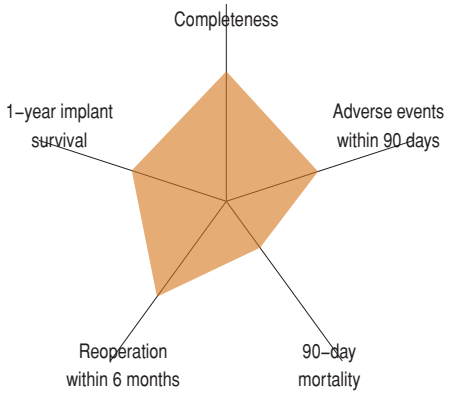


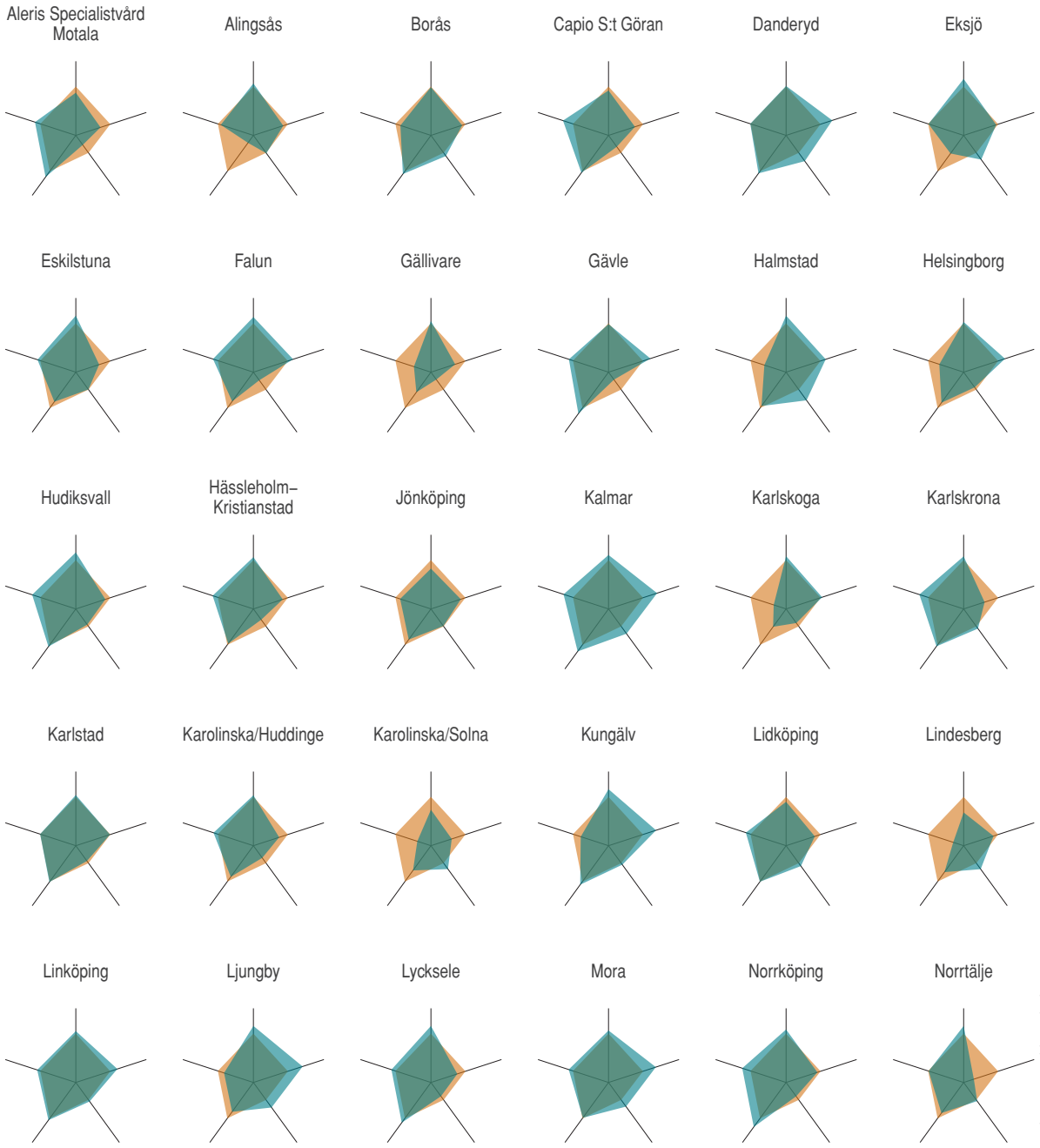


*Completeness cannot be calculated since the units have not reported operations to the National Patient Register at the National Board of Health and Welfare.

Quality indicator for hip fracture patients

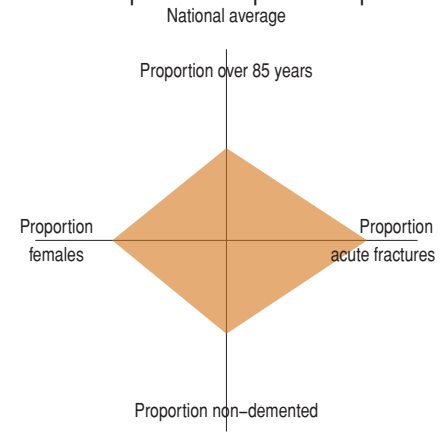
Value compass – national average

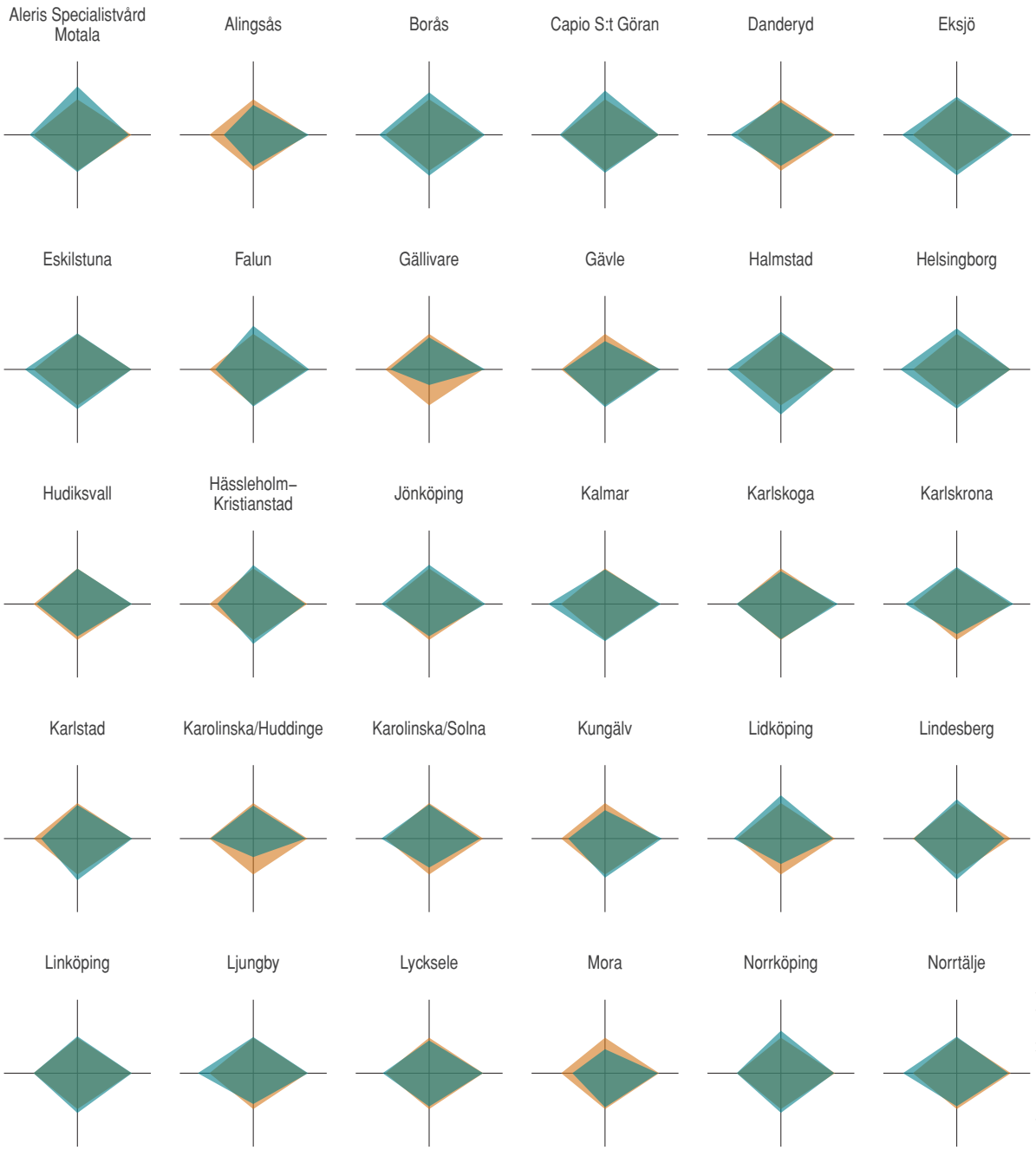


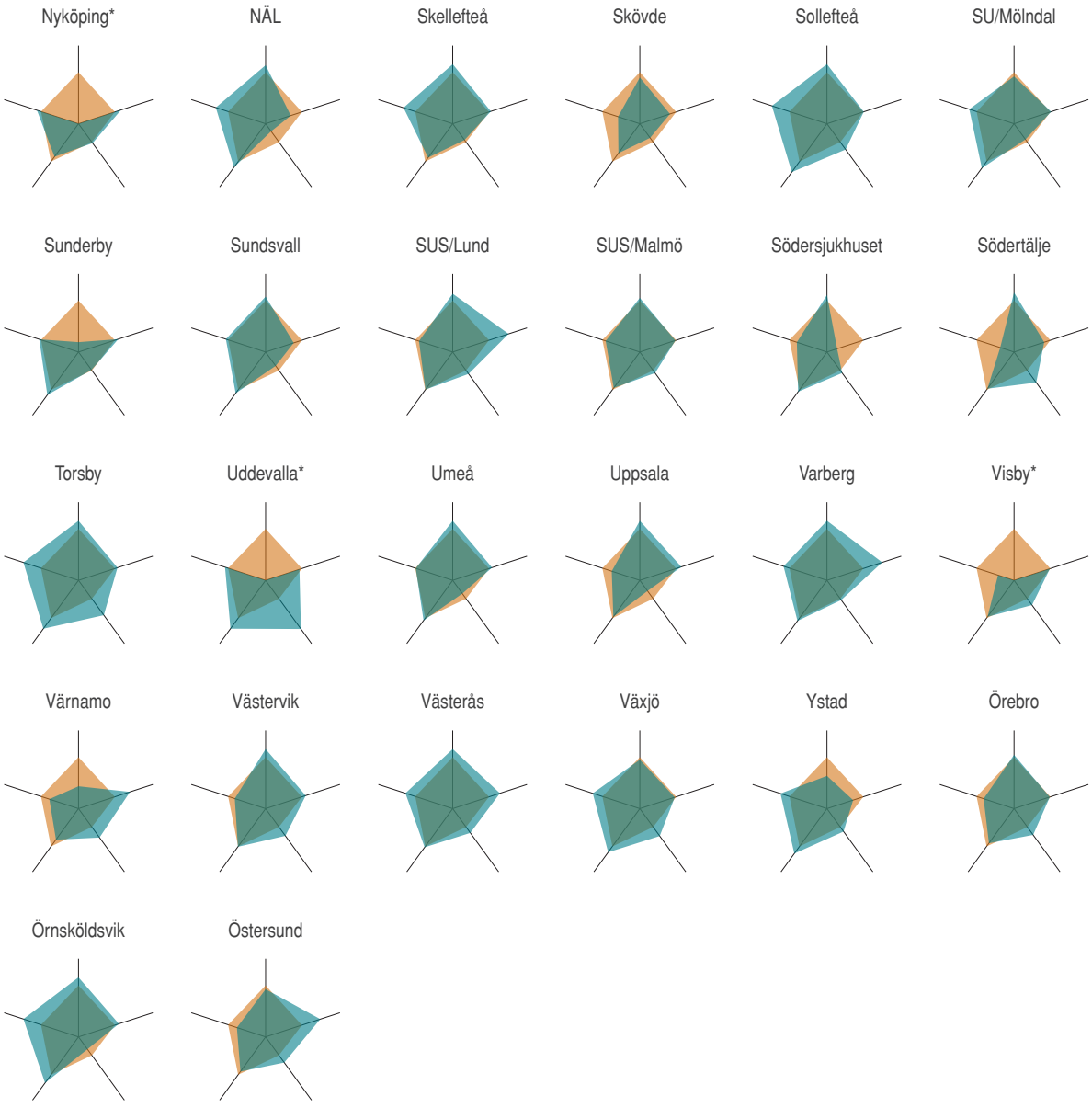


*Units with few hemiarthroplasties used (the axis is based on completeness for hemis).

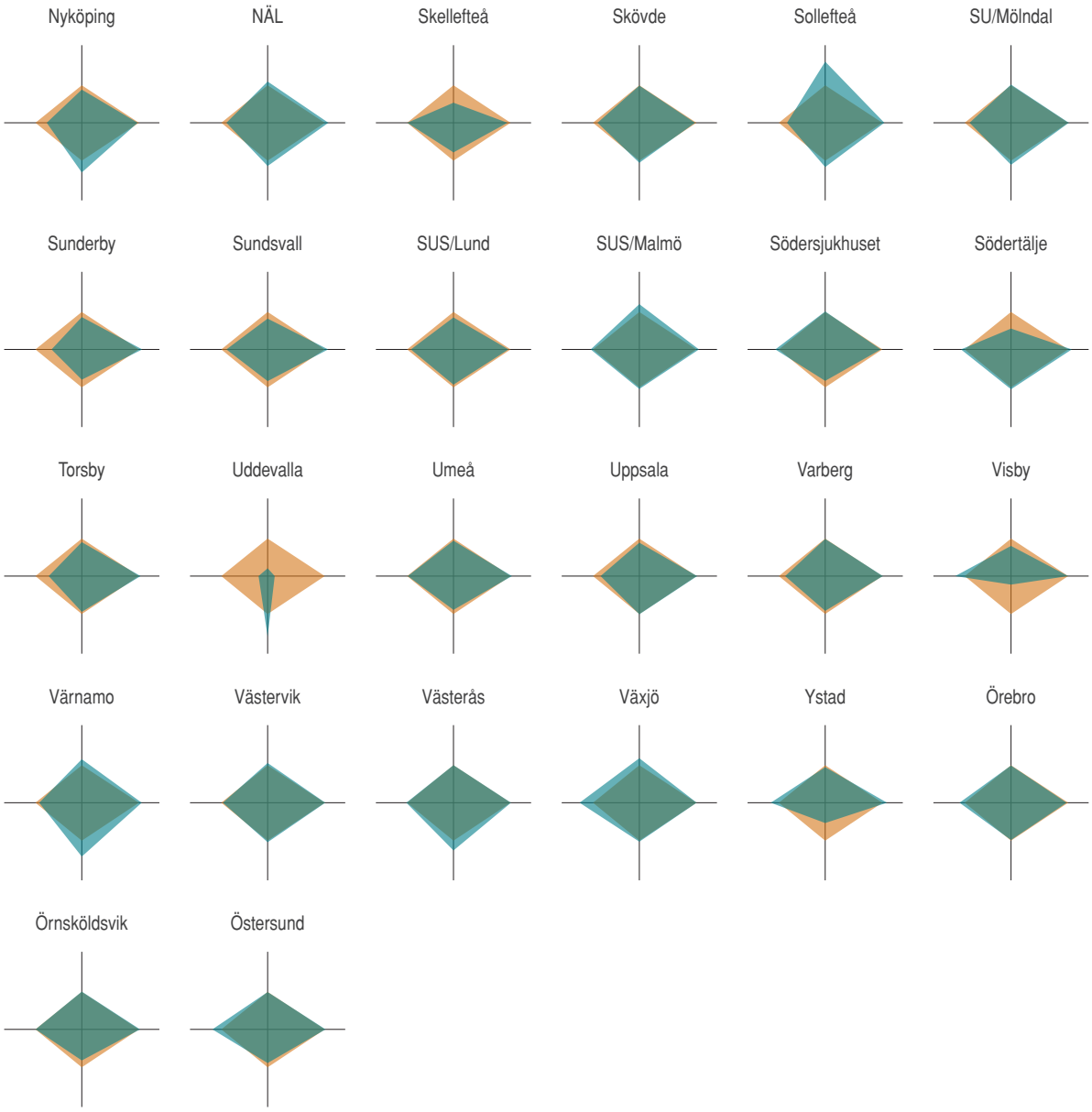
Case–mix–profile for hip fracture patients







*Units with few hemiarthroplasties used (the axis is based on completeness for hemis).



14 The Hip Arthroplasty Register and clinical research

According to an agreement between the state and the Swedish Association of Local Authorities and Regions (SALAR) regarding funding of the quality registers, the vision is that the Swedish National Quality Register should contribute to saving lives and achieve equal health, and be used actively for follow-up, learning, quality development, improvement, research, and guidance. The aim is that quality registers should be an integral part of a national system for collective knowledge control and follow-up of Swedish healthcare, and an important source of support to achieve knowledge-based, equal health and resource-effective care and welfare. National quality registers should be used as part of an improvement programme within care and welfare and as a source of know-how for clinical research, including collaboration with the life science sector. Apart from covering operational costs, grants from SALAR and the state should be channelled into the first two remits. The idea is that register-based research should be funded from other sources.

What is research and what are register operations?

The limit for what can be deemed to be clinical research and evaluation of the work that is being carried out and improvement work is, however, unclear. All registered analysis aimed at feedback of results and operational improvements is founded on scientific methods. In the Annual Report, we publish focused in-depth analyses, validation studies and the linking of data with other health data registers that is carried out according to established register research methods. Within the Register, ongoing work takes place according to scientific principles aimed at improving and developing the methods used in register work. Despite the fact that central grants are not intended for research, SALAR and the Agency for Health and Care Services evaluate the research activities of the Register on a regular basis. A high degree of research activity is a criterion for granting a register the highest certification level.

22 Dissertations from the Hip Arthroplasty Register

We have carried out strategic work within the Register to improve the infrastructure with the purpose of increasing and reinforcing research activities. This has produced good results, which can be noted in, among other things, the fact that we have had 22 PhD students linked to the Register. These PhD students have based the whole or part of their dissertation work on data from the Hip Arthroplasty Register and represent seven Swedish universities (Uppsala University, Lund University, Gothenburg University, Umeå University, Linköping University, the Karolinska Institute, and Örebro University). In 2017, 15 scientific articles from the Register were published, and we had more than 50 presentations at national and international meetings. Since 1986, when Lennart Ahnfelt defended the first Hip Register-based dissertation, a further 21 PhD students have produced dissertations based on data from the Register and under the supervision of Register staff. A strong contributing factor behind the steady increase in research activity is that the Register now has two biostatisticians who work full-time for the Register.

Linkage studies

A further explanation for the increase in research activity is that we are utilising other health data registers to a greater extent as part of research. As everything is based on personal identity numbers, linking the Register data with other data sources, such as Statistics Sweden, regional patient registers and the health data register kept by the National Board of Health and Welfare, offers unique research opportunities. In 2016, we published a description of the process of linking data from the National Board of Health and Welfare, Statistics Sweden, and the Hip Arthroplasty Register (Cnudde et al, BMC Musculoskelet Disord. 2016 Oct 4;17(1):414). During the past year, we have worked on updating the research database to ensure it includes all patients who underwent surgery up to 2016.

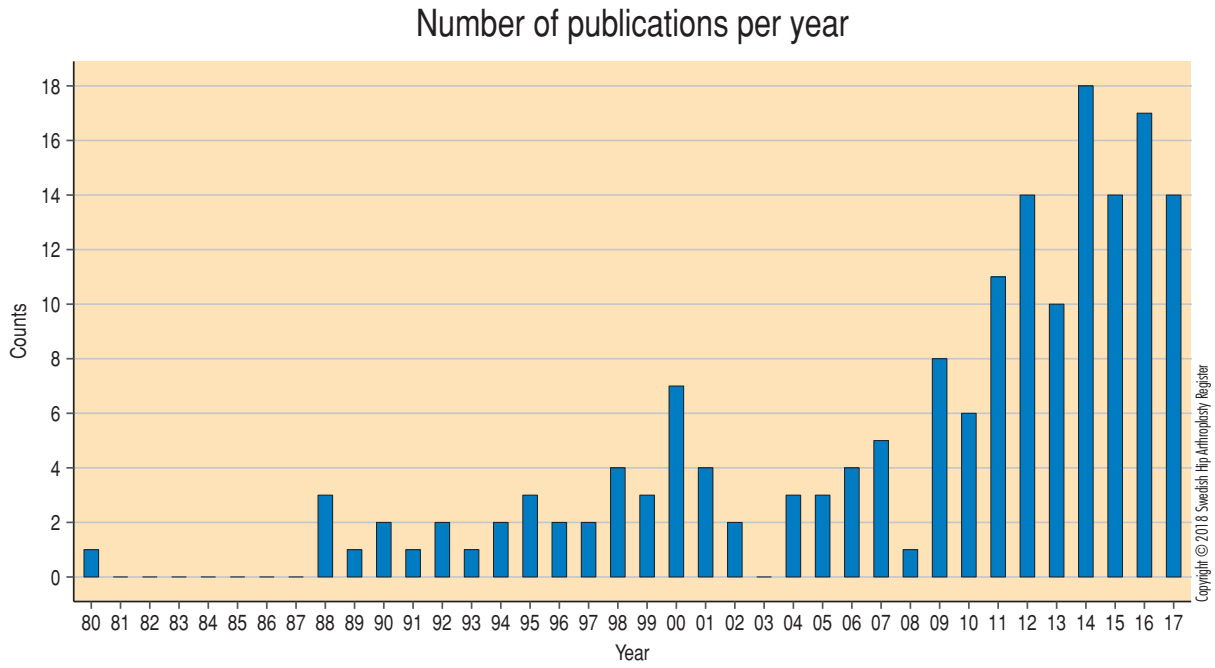
Why is observational research needed?

Register studies and randomised clinical trials (RCT) complement each other. Research within the field of joint arthroplasty requires a long follow-up period and a large number of patients. A number of important outcome parameters (reoperations, arthroplasty survival and mortality) represent relatively few incidents. This means that register studies are particularly good in conjunction with research within joint arthroplasty. Register studies have particular advantages that can be highlighted in this context:

- Register studies represent results in practice. This means that the results have a high degree of generalisation. A register study provides a fair picture of how a certain form of treatment functions within routine healthcare in the standard population.
- Regardless of whether one is studying exposure or outcome, a register study, due to its size and long follow-up period, means that it is possible to study events that seldom occur.
- Registration of an individual in a quality register does not require written informed consent. This means that it is easier to compile complete data and that data collection can take place at a low cost.
- The continuous longitudinal collection of data means that it is possible to analyse changes in patient demography, treatment, and results over time.

What is required in order to use register data for research purposes?

All register-based research requires approval from the Ethics Review Committee. All information in the Register is deemed to be in the public domain although it is protected by the Public Access to Information and Secrecy Act. The Register Manager has been delegated by the Västra Götaland Region Central Data Controller to assume responsibility for reviewing confidentiality in conjunction with a data request. We use a special form for data requests. In order to define roles and to be able to publish popular science information about current studies, we also require that the researchers who are involved draw up a research contract according to the template issued by the Register.



The rules relating to register research are available in their entirety http://www.kvalitetsregister.se/forskning/forskaparegisterdata.1907.html

The register has a tested and reliable template for ethics applications relating to research that makes use of the Hip Arthroplasty Register.

All research projects are documented in the project database and are published on the website. If anyone wishes to discuss research projects, we recommend that the Register Manager be contacted. Development Manager Johanna Vinblad has special responsibility for administering research contracts, data applications, and EPN applications.

The Register Management Team is open to ideas, proposals and discussions about collaboration in new register studies.

All tools are available on SODA

In order to ensure maximum data security, all data that is used in research is stored on a server (SODA server = Secure On-line Data Access). Using this server, the user has access to a virtual computer via two-factor authentication. The virtual computer contains project-specific databases, every conceivable statistical programme, the Office package, and other software.

Residential programme for register researchers

Since 2012, the Register has arranged a two-day residential research programme in January each year. All PhD students, supervisors and other research workers who contribute to the work taking place within the Register are invited to attend. Both general and specific research issues are discussed in a workshop setting. This year's meeting (2018) had over 20 participants and was arranged in collaboration with the Knee Arthroplasty Register, the Fracture Register and the BOA Register. All PhD students gave short presentations about their respective projects and received feedback. We also had a mini-defence, where Nils Hailer was the external examiner for Peter Cnudde's dissertation.

PhD Defences 2017

April 29 — Anne Garland, Uppsala University. Early mortality after total hip replacement in Sweden

September 29 — Per-Erik Johansson. Gothenburg University Improvements in total hip arthroplasty – did they work? Evaluation of different concepts and the consequences of wear

December 8 — Piotr Kasina, Karolinska Institute. Hip arthroplasty – infections, thromboembolic events and surgical environment

Defences 2018 (up to August)

March 23 — Peter Cnudde, Gothenburg University. Longitudinal outcome following total hip replacement. Time trends, sequence of events and study of factors influencing implant survival and mortality

June 5 — Ted Eneqvist, Gothenburg University. The clinical utility of patient-reported outcome measures in total hip replacement and lumbar spine surgery

The Register databases are also suitable for scientific work during specialist surgery, degree projects run within the medical programme, and other masters' theses. During the past five years, a whole range of projects of this nature have been conducted and many of them are summarised in the annual reports.

A large number of researchers contribute to Register activities

Within the Register Management Team and the Steering Committee there are senior researchers who act as supervisors and assistant supervisors for the PhD students linked to the Register. This group carries on a wide range of research within the field. There are current studies dealing with different implants and types of fixation, epidemiology, health economics, equal care, hip fractures and arthroplasty, periprosthetic fractures, revision surgery, statistical methodology and patient-reported outcome following an arthroplasty. The group includes:

Johan Kärrholm, Gothenburg
Cecilia Rogmark, Malmö
Ola Rolfson, Gothenburg
Henrik Malchau, Gothenburg
Maziar Mohaddes, Gothenburg
Hans Lindahl, Lidköping
Leif Dahlberg, Lund
André Stark, Stockholm
Per Wretenberg, Örebro
Nils Hailer, Uppsala
Rüdiger Weiss, Stockholm
Lars Weidenhielm, Stockholm
Olof Sköldenberg, Stockholm
Max Gordon, Stockholm
Kjell G Nilsson, Umeå
Clas Rehnberg, Stockholm
Viktor Lindgren, Stockholm
Anne Garland, Visby
John Timperley, Exeter, England
Ashley Blom, Bristol, England
Stephen Graves, Adelaide, Australia
Peter Cnudde, Llanelli, Wales
Anne Lübekke, Geneva Register Manager, Switzerland
Li Felländer-Tsai, Stockholm
Håkan Hedlund, Visby
Kristina Burström, Stockholm
Szilard Nemes, Gothenburg

The NARA group with representatives from the knee and hip arthroplasty registers in Finland, Norway and Denmark.

PhD students

On the back cover of the annual report there is a list of the PhD students who have, either wholly or in part, based their theses on data from the Register.

International research collaboration

The Register has intensive research collaboration within NARA (Nordic Arthroplasty Register Association), which is a collaborative register initiative between Finland, Norway, Denmark and Sweden, run since 2007, where a joint database is created each year. The group has now published 22 scientific articles and further manuscripts are in progress. The NARA database is also available to Swedish PhD students.

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17 Thank you to contact secretaries and contact doctors

2017 was a year with many major changes in the Hip Arthroplasty Register, including a change of IT platform to Stratum.

We would therefore like to take the opportunity to highlight and at the same thank our contact secretaries and contact doctors throughout Sweden for their work and involvement during the past year.

Aleris Specialistvård Bollnäs	Contact doctor	Mikael Davidsson
Aleris Specialistvård Bollnäs	Contact secretary	Helen Larsson
Aleris Specialistvård Motala	Contact doctor	Jan-Erik Bergqvist
Aleris Specialistvård Motala	Contact secretary	Anna Alsterqvist
Aleris Specialistvård Motala	Contact secretary	Annika Agerhall
Aleris Specialistvård Motala	Contact secretary	Malin Engvall
Aleris Specialistvård Motala	Contact secretary	Eva Yxne
Aleris Specialistvård Motala	Contact secretary	Lena Kling
Aleris Specialistvård Nacka	Contact doctor	Mikael Bouleau
Aleris Specialistvård Nacka	Contact secretary	Tina Sandberg
Aleris Specialistvård Nacka	Contact secretary	Annika Jepsen
Aleris Specialistvård Ängelholm	Contact doctor	Herbert Franzén
Aleris Specialistvård Ängelholm	Contact secretary	Wania Kjellberg Ivarsson
Alingsås	Contact doctor	Tarik Hamakarim
Alingsås	Contact secretary	Gunilla Gyllsdorf
Alingsås	Contact secretary	Ingela Blomgren
Alingsås	Contact secretary	Li Foss
Alingsås	Contact secretary	Joakim Blomberg
Art Clinic Göteborg	Contact doctor	Niclas Andersson
Art Clinic Göteborg	Contact secretary	Astrid Viberg
Art Clinic Jönköping	Contact doctor	Niclas Andersson
Art Clinic Jönköping	Contact secretary	Marie Claar
Arvika	Contact doctor	Karin Tholén
Arvika	Contact secretary	Anette Fröberg
Borås	Contact doctor	Christian Kopp
Borås	Contact secretary	Kristina Johansson
Borås	Contact secretary	Eva Johansson
Borås	Contact secretary	Karin Ståhl
Capio Artro Clinic	Contact doctor	Åke Johansson
Capio Artro Clinic	Contact secretary	Karin Lundh
Capio Artro Clinic	Contact secretary	Elin Karlsson
Capio Movement	Contact doctor	Linus Nilsson
Capio Movement	Contact secretary	Anna-Karin Ivansdotter
Capio Movement	Contact secretary	Maria Haglund
Capio Movement	Contact secretary	Ing-Marie Lindström
Capio Movement	Contact secretary	Linda Wirström
Capio Ortopediska huset	Contact doctor	Johan Karlsson

Capio Ortopediska huset	Contact secretary	Maria Andersson
Capio Ortopediska huset	Contact secretary	Ingra Sandell
Capio Ortopediska huset	Contact secretary	Emma Ekström
Capio Ortopediska huset	Contact secretary	Maria Engström
Capio S:t Görans sjukhus	Contact doctor	H-C Hyldahl
Capio S:t Görans sjukhus	Contact doctor	Hans Lundberg
Capio S:t Görans sjukhus	Contact secretary	Henrik Öhman
Carlanderska	Contact doctor	Reza Razaznejad
Carlanderska	Contact secretary	Helene Svedberg
Danderyd	Contact doctor	Torbjörn Ahl
Danderyd	Contact doctor	Olof Sköldenberg
Danderyd	Contact secretary	Annika Wallier
Danderyd	Contact secretary	Åsa Hugo Eriksson
Danderyd	Contact secretary	Eva Jansson
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