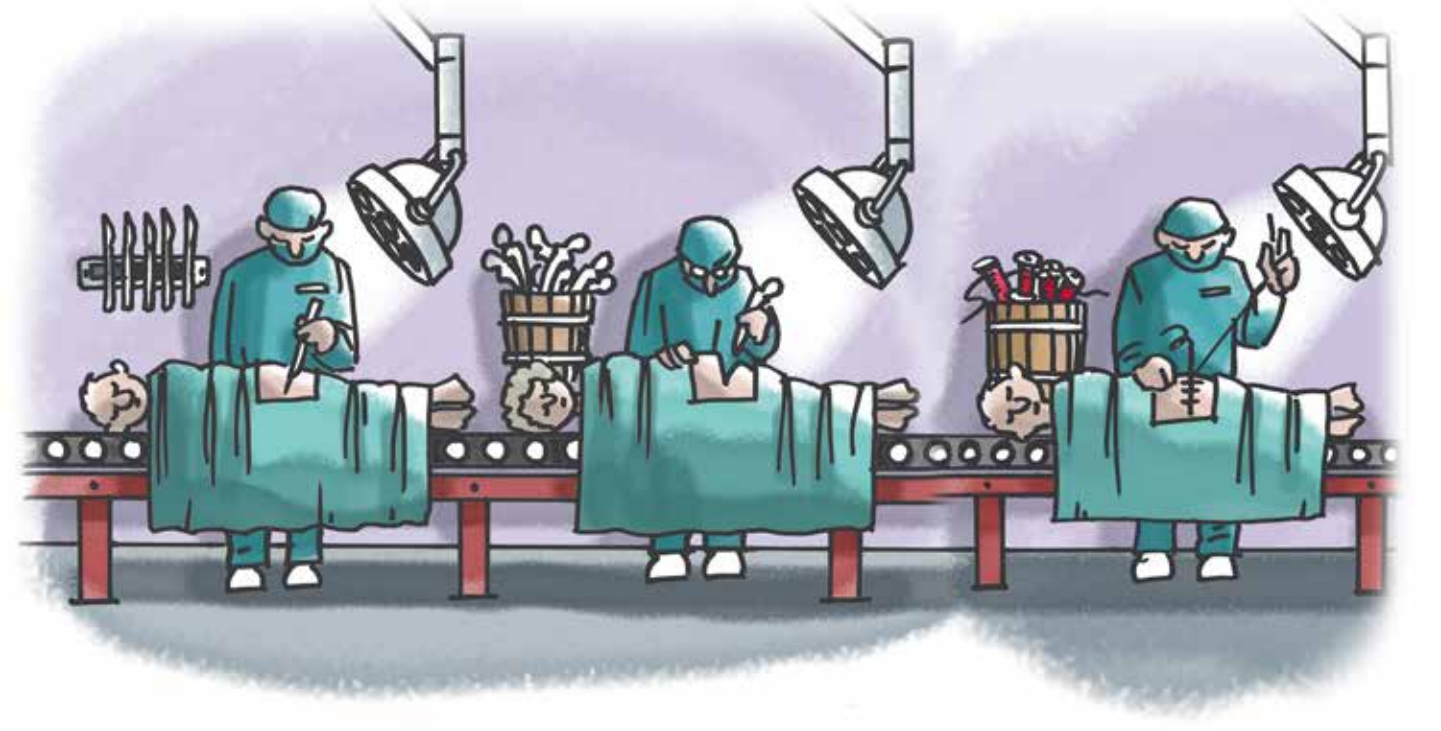
The Swedish Hip Arthroplasty Register

Annual Report 2014

FOR YEAR 2014



The Swedish Hip Arthroplasty Register

Annual Report 2014

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Contents

Footnote. A number of descriptive tables have been removed from our printed annual report and are published only on our website. See "Tabellverk", www.shpr.se/sv/Publications/DocumentsReports.aspx

Introduction

In September 2011, the state (Ministry of Health and Social Affairs) and the Swedish Association of Local Authorities and Regions (SALAR) signed an agreement on the development and financing of the National Quality Register. The agreement is financed by the state and the local authorities and concerns the period of 2012–2016. In total, the investment is 1,540 million SEK, which is a breathtakingly large sum of money. However, the sum constitutes only 0.7‰ of the estimated total cost for the Swedish healthcare during the period in question. It should also be taken into account that the healthcare authorities in general, have not created a structured follow-up system for measuring the results and patient satisfaction with the healthcare measures, this has been a goal for the National Quality Register since the mid-1970s, when the Register first began to operate.

For the Swedish Hip Arthroplasty Register and many other established registers, the investment means that, for the first time, the activities are on a large scale fully financed. Multiannual contracts have also led to a better future planning and to a "calm" regarding the continued development of the register. Unfortunately, the management of the register is experiencing problems in the wake of the generous investment. The new decision-making hierarchy is acting without representatives from the register and the level of bureaucracy has increased. A major focus is on the diagnosis registers, which has given a poorer understanding and knowledge of the intervention registers. This means that many annual reports and requests to the Swedish Association of Local Authorities and Regions (SALAR) are almost completely formed according to a matrix regarding follow-up of chronic conditions (diagnosis registers) and is less applicable for a register, which follows an elective and regular surgical intervention.

The contract mentioned above, expires at the end of 2016, this is to say that at the moment, we do not know what is going to happen in 15 months' time. This impedes the continued development of the register and possibilities to hire competent employees, which is necessary, if a well-established level 1 register is to continue to develop further.

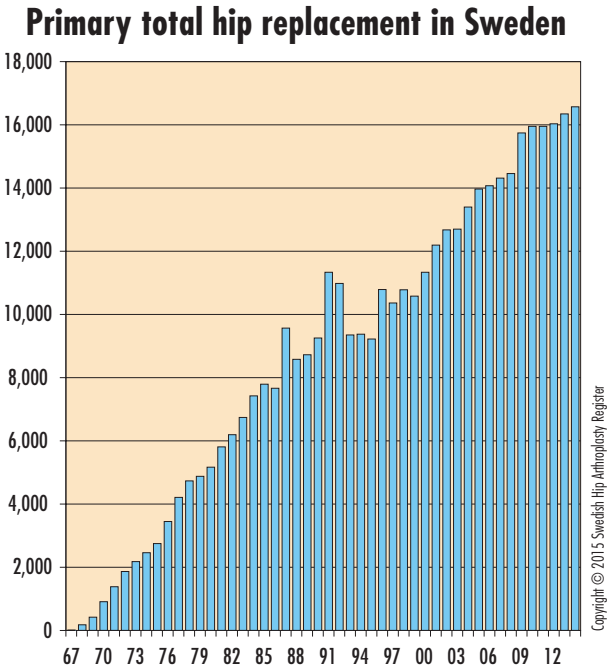
Mission

The Swedish Hip Arthroplasty Register is a fusion of two registers: one for surgery with total hip replacement with osteoarthritis as the primary indication, and one for surgery with so-called hemiarthroplasty with femoral neck fracture as the main indication. Patient groups vary considerably: a relatively healthy population with an average age of just under 70, and a group of patients with a mean age of approximately 85, with severe medical comorbidity and short expected survival.

National Quality Registers have three main tasks:

1. analyses of institutions and their activities,
2. continuous improvement projects and
3. clinical research.

However, the oldest arthroplasty-related registers – the Swedish Knee Arthroplasty Register and the Swedish Hip Arthroplasty Register – have a fourth and just as important assignment:



Number of primary total hip replacements carried out in Sweden from 1967 (6 operations) to 2014 (16,565 operations).

implant surveillance ("post market surveillance"). This fourth task is not described as a task of the Swedish Association of Local Authorities and Regions, but paradoxically, it is the task, which gains most international recognition. The Register's continual feedback to the profession has led to a nationwide adjustment of optimal technique and the use of few but well documented implants, resulting in continually improved implant survival. In Sweden, only a limited number of different implants are used for about 95% of all operations. This could be compared to the situation in England-Wales, which has corresponding number of about 100-200 different implants, many of which have been introduced without an extended clinical documentation.

The Swedish Hip Arthroplasty Register has been active for almost 36 years. Analysing the importance of different implants and techniques concerning reoperation frequency, in both the short and long run remain a central task of the Register. The Register's main task, however, is to analyse the entire process surrounding hip replacement surgery – that is, to identify predictors of both good and poor outcomes in a multidimensional and individual-based manner. The 10-year survival of our most common and well-documented implants is currently over 95%, and the potential for improvement exists chiefly within certain patient groups. There is a greater possibility for outcome improvement from a patient perspective through optimizing indications, care processes, pre- and postoperative information, rehabilitation and implementation of non-surgical, early management of patients with osteoarthritis of the hip – in other words, surgery for the right patient at the right time with the right technique.

Validation process

Every year, the Register carries out a comprehensive external and internal validation of data with the aim of continuously improve the data quality of the Register. The process takes about four months and, in addition, an annual completeness analysis is conducted via an interconnection with the Patient Register at the National Board of Health and Welfare. This analysis is delivered to the register in September. The entire validation process takes eight months, which in turn means that this report is published nine months after the end of the fiscal year. Over the years, there has been some criticism, especially from decision makers, regarding this "delay". However, the Register management focuses on the quality of the data before the desire to report in "real-time" and/or via interim reports.

In-depth analyses

The register's ongoing registration and regular reporting of standard results are important for maintaining high quality hip arthroplasty. We have, for several years, also carried out and reported a number of in-depth analyses from different perspectives. These analyses are not only intended for clinical improvement but for new developments and publication of scientific reports as well. The road to scientific publication often takes years, and does not always reach all colleagues. A carefully considered alternative to both these reporting systems would probably provide the optimal means of spreading register results.

The Swedish Hip Arthroplasty Register and clinical research

The Register's research activity is more extensive than ever before with 13 (four more are being worked on) doctoral students from 4 universities. In order to broaden research fields and operational analyses, we have, throughout the year, implemented a number of projects merging hip arthroplasty register data with other health data registers at the National Board of Health and Welfare and Statistics Sweden. During 2014 the Register has published 22 articles in "peer-reviewed journals". Three doctoral theses were defended during 2014.

Ongoing development project

In the last year's report, a number of planned and multiannual projects were described, which all are dependent on future financing:

- Transition to a new portal/system: Stratum. This laborious process will be completed in 2016, after several years of work.
- Popular scientific summary of the annual report with patients and decision-makers as a target group.
- Interactive statistics module for participating units. This project cannot be finished before the register has transitioned to the new portal.
- Aggregated decision support for patients and surgeons. It is likely to be published in 2016 and is based on 300,000 operations with long-term follow-up and coordination with the health data register and Statistics Sweden (socio-economic variables).
- Registration of results for individual surgeons.

International cooperation

The Register's international collaboration has intensified during the year. The Register is a member of two international associations, which concurrently run their databases with the goal of creating common research databases. International cooperation culminated in May 2015 when ISAR, with the cooperation of the Swedish Hip Arthroplasty Register organized the 4th International Congress of Arthroplasty Registries in Gothenburg with 200 participants from 22 countries. The international cooperation is described in detail in the report.

Coverage

All units, public and private, that carry out total hip replacement are included in the Register. The Swedish Hip Arthroplasty Register thus has a 100% degree of coverage for hospitals. Coverage for primary hip replacement on an individual basis (completeness) has also been controlled by co-processing with the National Patient Register at the Swedish National Board of Health and Welfare, and is accounted for in detail in a later chapter. The degree of coverage on a national level was in 2014 98.1% for total hip replacement and for hemiarthroplasty 96.8%.

Patient-reported outcome measures – PROM

Patient-reported outcome measures were reported from all hospitals during 2014. The Register now has a nationwide system to prospectively and longitudinally capture patient-reported outcomes for all patients with total hip replacement. The response frequency for one-year follow-ups is slightly higher than 90%. In 2014, a total of 38,808 PROM surveys was registered as a part of the on-going follow-up routine.

Reporting

Most of the clinics report via a web application. Medical record copies from reoperations are sent throughout the year with varying delay. Central reviews of journal copies and systematic data collection are a necessity for register analyses regarding reoperations and revisions.

Feedback data

All publications, annual reports and scientific reports are presented on our website. The Swedish Hip Arthroplasty Register calls, in cooperation with the Swedish Knee Arthroplasty Register all clinics to a yearly user meeting in Arlanda.

This year's production

During 2014, the annual production of total hip replacements rose only marginally compared to 2013. 16,566 operations were carried out, which is 170/100,000 inhabitants. The production of hemiarthroplasties remained unchanged as well with approximately 4,240 operations. The number of reoperations was 2,420 and 292 respectively. In 2014, a total of 23,518 operations were reported to the Swedish Hip Arthroplasty Register.

Structural change in the Swedish orthopedics

This year's cover image was developed with the aim of symbolizing the structural change, which is under way in elective hip replacement surgery in Sweden. The production of this year's total arthroplasties was carried out at 79 units. Several major elective units were created and as the care periods are becoming shorter, 1/3 of the yearly production is produced at 10 hospitals. The number of private units has increased during 2014 to 15/79. It will take a number of years before we can say what this change means in long-term results and patients-reported outcomes.

Our thanks to all contributors!

The Swedish Hip Arthroplasty Register is based on decentralized data capture, which is why the clinics' contact secretary and physician contributions are highly necessary to the Register's function. Many thanks for all contributions during the past year!

Gothenburg in September 2015

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Professor, Senior Physician

Johan Kärrholm
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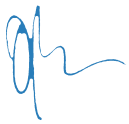

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Degree of coverage and completeness

A high degree of coverage is one of the most important factors for a register's data quality and the possibility to carry out operational analyses and clinical research. Coverage should be indicated on an individual level (*completeness*). Coverage concerning participating units is an important variable, but if each participating unit underreports on an individual basis, analyses and feedback will be misleading. All hip arthroplasty-producing units in Sweden have participated for many years by reporting to the Register, so that the primary goal of current analyses is to illuminate completeness.

Method

For many years now, the Register has, every year reported on completeness regarding primary total and hemiarthroplasties at hospital level. The analysis is based on coordination with the National Patient Register, which is one of many health data registers of the National Board of Health and Welfare. The method is presented in several consecutive annual reports; for details, refer to the previous reports.

Weaknesses in the analyses:

1. *Laterality.* In most cases, the patient register lacks laterality, i.e. right or left is not indicated as a unique variable. Patients operated with one-stage or two-stage bilateral total hip replacement during 2014 "are considered" as one operation in PAR. In 2014, 482 patients were operated with one-stage bilateral total hip replacement, which is why a number of procedures are not covered by the analysis.
   The Register's management has for many years wondered at the fact that more or less all of Sweden's PAS-systems lack the laterality variable, subsequently leading to suboptimal statistical utility of these databases for illnesses involving paired organs. This applies particularly in the analysis of secondary interventions and complications.
2. *Lag in registration.* Certain units have a certain amount of lag – not so seldom after New Year, which is a great disadvantage with this type of necessary quality control. Experience has shown that another 0.5% to 1.0% are reported to the Register during the subsequent year.
3. *Administrative fusions of hospitals as well as the opposite, i.e. operations carried out at "satellite hospitals".* As described earlier both these examples of structural change in orthopedics represent a future 'threat' to fair and open reporting. Differences in completeness may consequently have non-medical logistical causes; e.g. that hospitals report to the PAR via 'the principal hospital' and to the Register via the unit where the operation was performed. The Swedish Hip Arthroplasty Register has always and will always state hospital affiliation to the hospital/operational environment where the actual intervention is performed.

Results

Total hip replacements. Coverage for the country at large for 2014 was 98.1%. Should the analysis be repeated, the regular lag of 0.5-1.0% would probably mean that over 98-99% of all primary total hip replacements are registered in Sweden, which is very satisfying. Departments with values less than one standard deviation below the national mean are marked with red in the table. 25 units received this marking regarding degree of coverage in the register during 2014, which is a slight rise compared to last year. The deviations for most of the hospitals are small, but despite the high national average, there is always room for improvement.

Similarly, to the previous analyses, the private entities were worse at PAR-reporting. It is a fact worth mentioning since PAR-reporting is obligatory by law.

Hemiarthroplasties. Hemiarthroplasty registration has been going on for 10 years and coverage on a national level is relatively unchanged at 96.8%. Eight units were marked red, which is a decrease compared to the previous year and the lowest coverage for hemiarthroplasties is at Visby 82.7%, Västerås 84.6% and Värnamo 73.5%. Remarkably, there are 14 public hospitals, whose numbers have been marked red regarding reporting to PAR!

Reporting

For several years, we have published our annual completeness analysis, which does not include secondary interventions. Unfortunately, the reason lies with the continuously low quality of surgeons' diagnosis coding (ICD-10) and specification of the intervention code (KVÅ) during secondary intervention. We have made several attempts, but have found up to 30 different (and often inadequate) intervention codes, which are used for different types of reoperations. Furthermore, since the Patient Register lacks laterality in their database, a comprehensive system development is required before a similar coverage analysis of secondary interventions.

Register works with the following strategy in order to improve the analysis of secondary interventions.

- Monitoring of the hospitals. Refer to the respective chapter!
- A continuous appeal to all operational managers to work locally towards a better code-setting culture in their units, via meetings or even local courses on the subject.
- Each and every unit should review its routines for reporting reoperations, which is a **broader concept than revision** – "any kind of further surgery".
- Actively work towards an obligatory addition to the country's local, regional and national patient administrative systems (PAS). It is a mystery that this has not been done already (for example, it is obligatory in Finland). Any national shift towards bundled payment and outcome-based health care (refer to Appendix) instead towards financial management of the healthcare system based on process measures and budgets, will require the introduction of laterality in all PAS-databases.
- Targeted validations regarding registrations of, for example: deep infections via data-base merges with the Prescribed Drug Register and periprosthetic fractures via merges with PAR (two ongoing projects).

Completeness for THRs 2014

Hospital	Number[1]	SHAR[2]	PAR[3]
University/Regional hospitals			
Karolinska/Huddinge	265	97.4	99.6
Karolinska/Solna	182	95.3	98.4
Linköping	67	89.3	94.7
SU/Mölndal	589	96.7	95.4
SUS/Lund-SUS/Malmö	236	100.0	96.2
Umeå	97	97.0	96.0
Uppsala	276	97.5	97.9
Örebro	151	99.3	98.0
Central hospitals			
Borås-Skene	322	98.5	96.6
Danderyd	343	98.6	97.7
Eksjö	207	98.6	98.1
Eskilstuna	96	97.0	97.0
Falun	325	95.3	99.7
Gävle	222	96.1	96.5
Halmstad	240	99.6	99.6
Helsingborg	288	95.7	95.3
Hässleholm-Kristianstad	844	100.0	98.3
Jönköping	204	97.6	99.5
Kalmar	160	98.8	98.8
Karlskrona-Karlshamn	268	99.6	99.3
Karlstad	242	96.0	96.8
Lidköping-Skövde	417	98.8	96.7
Norrköping	257	98.8	96.2
Sunderbyn	34	97.1	97.1
Sundsvall	157	97.5	98.1
Södersjukhuset	420	98.4	98.6
Uddevalla	387	99.7	99.0
Varberg	213	99.5	98.6
Västerås	436	97.1	98.0
Växjö	151	99.3	98.0
Östersund	260	95.9	96.3
Rural hospitals			
Alingsås	178	98.9	98.9
Arvika	216	96.0	98.7
Enköping	340	100.0	100.0
Frölunda Specialistsjukhus	97	94.2	100.0
Gällivare	96	100.0	97.9
Hudiksvall	144	99.3	98.6
Karlskoga	162	98.8	98.8
Katrineholm	258	98.1	99.6
Kungälv	205	99.5	99.0
Lindesberg	200	100.0	99.5
Ljungby	172	98.3	98.9
Lycksele	302	100.0	99.7
Mora	207	98.1	99.5
Norrtälje	115	100.0	100.0
Nyköping	158	98.1	96.9
Oskarshamn	233	99.6	99.1
Piteå	337	98.5	100.0
SUS/Trelleborg	616	99.8	100.0
Skellefteå	122	96.1	100.0
Sollefteå	108	93.9	96.5
Södertälje	97	96.0	99.0
Torsby	97	98.0	98.0
Visby	118	92.9	97.6
Värnamo	122	93.1	97.7
Västervik	109	98.2	100.0
Örnsköldsvik	143	98.6	95.9
Private hospitals			
Aleris Specialistvård Bollnäs	312	98.7	99.7
Aleris Specialistvård Elisabethsjukhuset	2	100.0	100.0
Aleris Specialistvård Motala	520	97.6	99.2
Aleris Specialistvård Nacka	118	98.3	98.3
Aleris Specialistvård Sabbatsberg	141	98.6	83.9
Art Clinic Jönköping	14	100.0	0
Capio Movement	229	94.2	100.0
Capio Ortopediska Huset	375	98.2	72.8
Capio S:t Göran	420	98.8	98.6
Carlanderska	156	98.1	99.4
Hermelinen Spec.vård	7	100.0	0
Ortho Center Stockholm	442	99.3	98.7
Ortho Center IFK-kliniken	132	98.5	96.3
Sophiahemmet	213	100.0	0
Spenshult	97	99.0	100.0
Country	16,486	98.1	96.3

Red marking indicates values one standard deviation below national average.

[1] Refers to the number of registrations in the Swedish Hip Arthroplasty Register.
[2] Refers to the proportion of registrations in both registers or only in the Swedish Hip Ar-throplasty Register.
[3] Refers to propotion of registrations in both registers or only in the National Patient Register.

Completeness for hemi-arthroplasties 2014

Hospital	Number[1]	SHAR[2]	PAR[3]
University/Regional hospitals			
Karolinska/Huddinge	87	97.8	**92.1**
Karolinska/Solna	73	98.6	**91.9**
Linköping	88	95.7	96.7
SU/Mölndal	329	**94.8**	**87.3**
SUS/Lund-SUS/Malmö	316	98.1	94.4
Umeå	47	95.9	98.0
Uppsala	118	97.5	95.9
Örebro	68	98.5	**89.8**
Central hospitals			
Borås-Skene	102	**92.8**	94.6
Danderyd	141	96.6	95.2
Eksjö	59	98.3	96.7
Eskilstuna	56	100	92.9
Falun	114	100	97.4
Gävle	80	96.3	**87.9**
Halmstad	65	98.4	95.4
Helsingborg	177	97.8	95.6
Hässleholm-Kristianstad	150	98.0	92.8
Jönköping	56	100	**87.5**
Kalmar	49	98.0	94.0
Karlskrona-Karlshamn	96	97.0	**91.9**
Karlstad	75	**93.8**	96.3
Lidköping-Skövde	137	96.4	94.3
Norrköping	52	**94.6**	92.8
Sunderbyn	145	96.0	98.7
Sundsvall	75	**92.6**	95.1
Södersjukhuset	264	98.2	97.1
Uddevalla	171	98.9	94.3
Varberg	75	97.4	96.1
Västerås	11	**84.6**	**69.2**
Växjö	30	96.7	**83.8**
Östersund	70	95.9	**84.9**

Hospital	Number[1]	SHAR[2]	PAR[3]
Rural hospitals			
Alingsås	37	97.4	94.7
Gällivare	44	100	97.7
Hudiksvall	54	100	92.6
Karlskoga	41	100	100
Kungälv	73	98.6	**89.2**
Lindesberg	21	100	100
Ljungby	26	100	92.3
Lycksele	27	100	96.3
Mora	46	100	97.8
Norrtälje	21	100	100
Skellefteå	31	100	**90.3**
Sollefteå	26	100	92.3
Södertälje	38	97.4	92.3
Torsby	19	100	100
Visby	24	**82.7**	**82.7**
Värnamo	36	**73.5**	**85.7**
Västervik	42	97.6	97.6
Örnsköldsvik	36	100	100
Private hospitals			
Aleris Specialistvård Motala	34	97.1	94.3
Capio S:t Göran	178	99.4	97.8
Country	4,230	96.8	93.8

Red marking indicates values one standard deviation below national average.

[1] Refers to the number of registrations in the Swedish Hip Arthroplasty Register.
[2] Refers to the proportion of registrations in both registers or only in the Swedish Hip Ar-throplasty Register.
[3] Refers to the propotion of registrations in both registers or only in the National Patient Register.

The fact that more or less all of Sweden's PAS-systems lack the laterality variable, subsequently leads to suboptimal statistical utility of these databases for illnesses involving paired organs. This applies particularly in the analysis of secondary interventions and complications.

The Swedish Hip Arthroplasty Register has always and will always state hospital affiliation to the hospital body/operational environment where the intervention in question has been carried out. This is to enable us to analyse complications. The Register's goal is not to illustrate productivity figures from an organizational unit.

Reporting of periprosthetic fractures

Introduction

A 71-year old woman gets a primary hip arthroplasty and there are no complications preoperatively and postoperatively. About three years after the operation, she falls and gets a low-impact fracture in the distal femur on the same side as the prosthesis. The fracture is fixed with a distal femur plate, which extends proximally a little below the stem tip. Two years later, she gets an increasing pain in the thigh and x-ray verifies a non-displaced transverse fracture between the plate and the stem tip. This is treated with a new anterior femur plate, which bridges the distal stem and the proximal part of the old plate. During a five-year check-up, after the latest operation, the patient complains of pain in the thigh/groin and x-ray examination shows stem loosening. She undergoes stem revision. In this case, one can assume that the previous fracture affected the risk for loosening. It is therefore important that fracture treatment is known. This is one reason why periprosthetic fractures should be reported. Unfortunately, the registration of periprosthetic fractures is flawed and especially in cases where the prosthesis is not revised.

We want to improve this registration. In an ongoing project, we study registration of reoperations due to periprosthetic femur fractures in Sweden. To do this, the Swedish Hip Arthroplasty Register has been matched against the Patient Register. This has been done to investigate how many patients with implanted hip prosthesis there are, who have been reoperated due to periprosthetic femur fracture between 2001 and 2011.

At the matching, we found 1,012 reoperations, which were not reported to SHAR. After going through the medical records of those 1,012 reoperations, 119 of them could be excluded. Among others, those were reoperations, pathological fractures and preoperative fractures. 893 reoperations were left, which were not reported to SHAR.

Choice of operation method

Stem revision was used as a treatment method in 24 cases (2.7%). In connection with the stem revision, the fracture was fixed with only one plate in one case, with both a plate and a cerclage in four cases and with only a cerclage in 16 cases.

Description of classification of records	A_G	B1	B2	B3	C
Detailed	6	123	36	3	559
Unclear	0	77	24	0	37

Table 2. Vancouver classification of periprosthetic, who underwent operation without stem revision.

In the rest of the 869 (97.3%) procedures, operation was carried out with a form of osteosynthesis or another method. A patient underwent operation with recementing of the same stem and plate fixation, 8 patients underwent amputation above the knee, in nine cases a prosthesis extraction was carried out, one patient got a primary knee prosthesis and two got secondary knee prostheses. In 848 cases of periprosthetic femur fracture (PNFF), osteosynthesis without stem revision was selected as the operation method (Table 1). In 21 cases, cement was used as a reinforcement to osteosynthesis; there were 18 cases in combination with plate, two in combination with a nail and one in combination with both a plate and a nail. Ten PNFF were treated with only a screw fixation and one with a temporary external fixation.

Vancouver classification and surgical method

All periprosthetic femur fractures, which underwent an operation with a stem revision, belonged to Vancouver B category, except for one case, where the stem was loose and the fracture was a replaced greater trochanter (category AG). In order to assess Vancouver classification, we have used information from the registration note, the operation report and the discharge note. In four cases, it was impossible to assess the localization of the fracture and if the stem was stuck of loose. In several cases, we could assess the localization of the fracture, but not if the stem was loose and vice versa. In case of doubt, we are going to inspect the x-ray examinations,

	Osteosynthesis 2					
	None	Plate	Wire/cable	Nail	Pin/K-wire	Total
Osteosynthesis 1						
Plate	362	54	323	3	5	747
Wire/cable	11	323	0	2	0	336
Nail	57	3	2	0	1	63
Pin/K-wire	2	5	0	1	0	8

Table 1. Combinations of osteosynthesis to treat periprosthetic fractures without stem revision. (For example, only one plate has been used in 362 of 747 cases with plate fixation, double plates in 54 cases, a plate with wire/cable in 323 cases, combination of plate and nail fixation in three cases and pin in five cases.)

which were carried out in connection to the hospital stay by contacting the respective unit. Table 2 shows Vancouver classification of the 869 PNFF, which were operated on without stem revision.

Discussion

In the Swedish Hip Arthroplasty Register, there were 3,190 reoperations due to periprosthetic femur fracture registered between 2001 and 2011. In this study, we have found 1,012 reoperations, which were carried out during the same period and for the same reason, but were not reported to the SHAR. This study demonstrates that 24% of periprosthetic femur fractures were not reported, which means that one in four reoperations for a fracture during this time period has not been reported. The biggest proportion of these reoperations (97.3%) is non-revision surgery and at least 63% (559 of 893) concern fractures distally to the prosthesis stem. Do patients with a hip prosthesis have an increased risk for distal femur fracture? Is Vancouver C fracture itself a risk factor for a worse implant survival for the patients with hip prosthesis in comparison with individuals who have a hip prosthesis and do not have a femur fracture? Which method is best for treating a Vancouver B1 fracture given the large variations in treatment, from using only wires to stem revision? A better registration of these, in some cases, difficult complications, may help arthroplasty surgeons to get answers for previously named questions and make an analysis on the national register's level more precise and reliable.

Value-based health care

Over the past two decades, the number of hip replacement surgery has increased in Sweden. According to the data from the Swedish Hip Arthroplasty Register, the number of primary hip replacement surgeries at Swedish hospitals increased nearly 80% during 1992-2013. The increasing demand for hip replacement surgeries began in the beginning of 2000s with long queues for operations at several hospitals. In an attempt to meet the increasing demand, increase the availability, shorten the waiting lists and reduce waiting times, a common care guarantee was established in November 2005.

As health care had been traditionally organized, most hospitals, among those Sahlgrenska University Hospital (SU), did not have the capacity to meet the increased demand for hip replacement surgeries within the care guarantee. It was costly for a hospital to hire other health care providers to take care of patients from the hospitals catchment area and resulted in a significant administrative burden. Further, the care guarantee reform in some cases meant that patients needed to travel long distances in order to get health care needs satisfied. While procuring other health care providers, county councils and regions had focused only on the process and cost measures, since waiting times and health care costs had been essential in choosing the alternative health care provider.

In an attempt to meet the increasing number of patients and improve the outcomes after arthroplasty, in 2013, a methodical improvement work was initiated on processes regarding elective prosthetic surgery for a more effective and better management of hip and knee replacement patients at SU. During the latter part of 2013, a project for value-based management of care for hip replacement patients was started.

Value-based management is described as a shift in paradigm, where not only costs and processes, but also quality measures, like patient outcomes, are included in the management of the health care. The term is described in "Redefining Health Care", which is written by two American economists, Michael Porter and Elizabeth Tiesberg. The great advantage of this work method is that health care receives continuous feedback regarding cost, process and quality measures. Furthermore, consequences of changes in one dimension and their possible impact on other measures, is illustrated in a clear manner. In order to pursue value-based health care, a continuous monitoring of the three previously mentioned measures is needed. Swedish health care in general and joint arthroplasty in particular, have a great advantage in this approach and with a tradition for quality register. During the last decade, the Swedish Hip Arthroplasty Register has collected patient-reported outcome measures. These measures have been used to pursue local improvement work at certain hospitals. Data, which was collected via the Swedish Hip Arthroplasty Register and the databases from the local hospitals, can serve as a remarkable platform for improving the quality of the Swedish health care.

Since the introduction of value-based health care at the Sahlgrenska University Hospital, several projects have been initiated and a number of those have been implemented.

The visitation procedures before the operation were restructured to reduce the number of occasions the patient needed to come to the hospital. The preoperative information brochure was re-worked and workflow of the operation unit was optimized. In order to increase the transparency for patients, an activity scheme was created to clarify what happens during hospital stay. A new routine for blood transfusions was introduced. In 2014, it was noted that several patients waited for a care plan after operation. When our patients arrive for a planned operation, a form has been drawn up, so that it is possible to assess the need for a care plan. This was done to create the possibility for local municipalities to plan care for our patients beforehand and reduce the risks, which arise when patients are at the hospital longer than necessary.

In 2014, the Orthopedics Clinic at SU/Mölndal had increased the number of arthroplasties by 44%. The average hospital stay had been reduced by 15%. The workflow at the surgical department had been streamlined, which means that every patient spent 20% less time at the surgical department. The proportion of adverse events, like infections, bed sores and falling had been reduced by 20%, while readmissions in 30 days had been halved. Furthermore, there was a 20% reduction of the proportion of patients who needed to undergo a reoperation in two years. Analysis of one-year PROMs data for patients who were operated in the first half of 2014 shows, that more patients report that they are satisfied with the outcome after surgery in comparison with patients who were operated during a corresponding period in 2013 (89% and 86%, respectively).

In summary, the implementation of a structured and multidisciplinary care for patients at the Orthopedics Clinic SU/Mölndal has led to a reduction of complications, increased production and there are more satisfied patients. Through a continuous monitoring of patient-related outcomes, processes and costs and feedback to individual employees, we have encouraged the initiation of improvement work by individual employees in health care.

Quality improvements to primary hip arthroplasty through feedback of individual surgery results

Background

The Swedish Hip Arthroplasty Register (SHAR), which started in 1979, has registered types of prosthesis, factors concerning the operation and the results in the form of complications. Since 1992, the data collection has been based on individuals. Result in the form of reoperation and patient-reported outcomes have been openly reported for each participating unit for ten years now. This report is a relevant process measurement and until now, the surgeons were stationery at the same clinic, and individual problems could be identified easily. During recent years, it has become increasingly common for a single orthopedic surgeon to change workplaces or occasionally carry out operations in another clinic, often in private capacity. This means that it is increasingly difficult for the surgeon to follow up on his or her own performance. Further, follow-up visits to the surgeon has declined.

Registration of the results of individual surgeons may resolve the problem and has some potential advantages because the outcome of the operation and at least important complications may automatically become known to the surgeon, and may eventually contribute to a continuous improvement.

The Swedish Hip Arthroplasty Register is working on a project, which aims to create a methodology, which allows individual surgeon to follow his results in a systematic way, and the continuous feedback provides an opportunity to improve the quality of work.

For follow-up of individual results, different models are used in the national hip registers in, amongst others, England/ Wales and Australia. For a role model, we have considered the Scottish Arthroplasty Project. The goal of this project was to encourage the continuous improvement of quality after joint arthroplasty by engaging the individual surgeon. It is possible to easily follow identifiable results, like death, dislocation, wound infection and revision.

It also follows medical complications, such as heart attack, kidney failure and stroke. Individual surgeons are notified if he/she would break through a predetermined statistical tolerance limit of acceptable complications levels and will be a so-called outlier.

The Swedish Hip Arthroplasty Register aims to introduce something similar on the national level, but first, the SHAR will test it on a local level in Western Götaland region as a pilot.

Execution

To be able to identify "normal complication rates", we are going to analyse the collected data from 2007-2012 in Region Västra Götaland by merging the SHAR and the Health Care Database VEGA. In order to connect individual operations to a specific surgeon, we have made extracts from the region's different computerized operation programs. The relevant patients are those whose cause for operation is osteoarthritis (M16.0-M16.7 and M16.9) and who underwent operation for total hip replacement with a cementless (NFB29), hybrid (NFB39) or cemented technique (NFB49).

During 2007-2012, 8,300 total hip replacement operations were carried out every year according to Figure 1.

The experiences of the individual surgeon are going to be grouped in a cluster of seven years after receiving the specialist diploma or if it is a resident physician who is the main surgeon according to operations program at the hospital. A possible source for errors is in actually knowing who carried out the operation, however, the main surgeon is always given in the operation program and he/she is used as a basis for creating clusters of surgeons. The largest volume of primary hip replacement operations lies the group who have worked for 16 years or more (Figure 2). 333 operations lack main surgeon, but that decreased after an additional review of medical records, after which, 8 of the total 8,300 were missing a main surgeon.

The data which has been extracted from operations program shows that primary unilateral osteoarthritis (M16.1) is a cause for operation in 7,155 (86.2%) cases, regardless of gender.

Out of the 8,300 total hip replacement operations, the cemented hip prosthesis accounted for the majority of cases, 74.4%.

Mean time for the operation in the region for the same period was 106 minutes, and the time spent in the operating room was 192 minutes, regardless of operation method.

Interview study

To map the views of orthopedics professionals regarding the individual feedback system, we plan to carry out a qualitative interview study with orthopedics specialists and resident physicians, who work at orthopedics clinics in Region Västra Götaland, in order to capture their thoughts regarding the benefits of a feedback system, but also find out whether they see any risks, which can be eliminated before the introduction of the pilot in Region Västra Götaland.

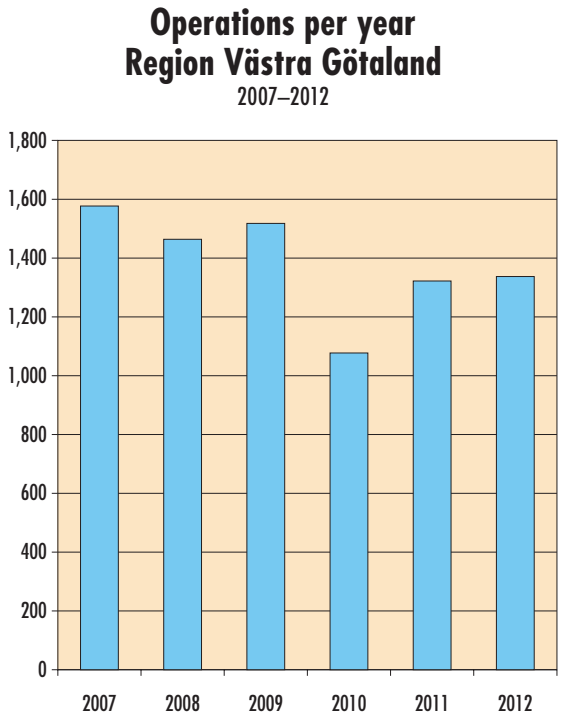


Figure 1. Data from operation planning system in Region Västra Götaland

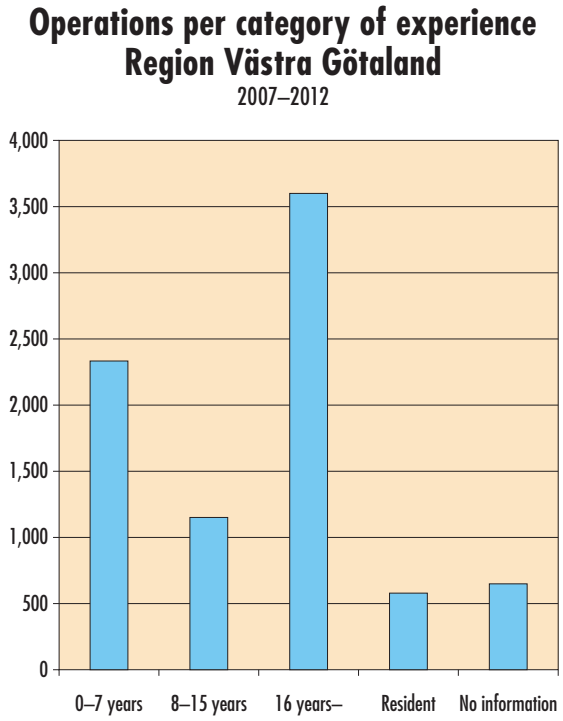


Figure 2. Data from operation planning system in Region Västra Götaland

Monitoring – a validation process

For a number of years, the Register has annually published the level of completeness that does not, however, include secondary interventions. Analysing the completeness of primary hip replacements with the aid of the Patient Register (PAR) is relatively easy whereby all primary interventions are encompassed within five measure codes.

The Register has continued the plan of action intended to capture hidden statistics and validate clinics' registration, and monitoring individual clinics is a part of this plan of action. Such a measure is resource-intensive, both economically and in terms of staff, but necessary.

How is monitoring carried out?

In the 2011 and 2013 annual report it was presented how monitoring is carried out, but we chose to describe the process once again:

- The Swedish Hip Arthroplasty Register (SHAR) sends a letter for signature to the head of department concerning monitoring and a request for access to the clinic's diverse computer systems used by the Register's coordinators when visiting the clinic. This modus operandi has been approved by the Data Inspection Board – in other words the clinic requests monitoring by the SHAR and not vice versa. "Monitors" from the Register then gain temporary authorization for the local patient administrative and medical history system without violating the Patient Data Act.
- Selection: only the previous year's "settled" productions (the procedures which are included in an Annual Report).
- Aim: to check that all primary operations and reoperations are registered, to ensure correct registration, and to document clinical logistics concerning reporting to the Register.

Upon the return of the signed letter, a requirement specification is sent to the clinic enabling SHAR to acquire a database prior

to monitoring. All this is to facilitate our coordinator's visit to the clinic and save the clinic time as well. The database is requested in Excel, must be password-protected, and sent as a special delivery on a memory stick to the Register.

The database should include the following data for patients operated during the year when monitoring was called for (from the operation planning system) for primary total hip arthroplasty and primary hemiarthroplasty and re-operation following total and hemiarthroplasty and should be sorted according to operation date:

- Personal identity number (preferably 12 digits with a hyphen)
- Date of surgery
- Diagnosis and the respective ICD-10-code
- Side (if available)
- Operations are to be presented with measure codes (KVÅ-codes NF* and QD* = searches should be performed for all NF* and QD*) (when these codes are used for both classifying of operations on the hip joint, both primary and secondary interventions)

The following is checked at the visit: A production year is scrutinized in both the medical journals and local PAS-system or other administrative system checking the following:

- Date of surgery
- Side
- Diagnosis in the operation report and discharge report with codes according to ICD-10
- Measure (KVÅ) codes in the operation report
- Eventual reoperations after unreported primary operations

It is desirable during monitoring that a contact person (preferably a contact secretary) is available during the visit as well as a contact person capable of performing searches/statistics. During the visit, the Register's staff requires two to three workplaces with computers, preferably in the same room. Monitoring takes one to three days depending on the clinic's annual production. The idea is that the units' staff will not be burdened during monitoring visit, but they are only available for questions and help in the beginning with a short introduction to the computer system.

The Register plans to carry out six to eight local monitorings annually.

Performed monitorings to date

May 2012 Kungälv Hospital
June 2012 OrthoCenter IFK clinic in Gothenburg.
November 2012 Central Hospital Växjö
September 2013 Sahlgrenska University Hospital/Mölndal and Sahlgrenska
December 2013 Falun Hospital
January 2014 Lycksele Hospital and Norrland University Hospital in Umeå
April 2014 Södra Älvsborg Hospital in Borås and Skene
June 2014 Mora Hospital
December 2014 Lidköping hospital
June 2015 Capio Movement, Halmstad
August 2015 Visby Hospital – postponed following a decision from Visby Hospital
September 2015 University Hospital in Linköping

The results from monitorings to date

- Primary total hip replacement and primary hemiarthroplasty: Occasional operations were not reported to SHAR, probably because the patients were relocated to a department outside the unit.
- Reoperation after total hip replacement and hemiarthroplasty: A number of reoperations were found, which were not reported to SHAR, partly because the patients were relocated to a unit outside the clinic, but also because it was not known that some types of reoperations should be registered (for example, wound revision/lavage, fracture reconstruction without replacement of prosthesis components).
- Incorrect registration of side: Occasional incorrect registrations were found.
- Incorrect registration of operation date: Occasional incorrect registrations were found.

Also, during monitoring incorrect ICD10- and KVÅ-codes were found in medical records system, which had not influenced reporting to SHAR but this, may cause trouble during possible cross-referencing between SHAR and National Board of Health and Welfare's PAR-register.

In addition, from the review of clinics' reporting procedures it has emerged, that some of the contact secretaries have not had access to the clinic's operation planning program, which is necessary to carry out regular checks.

Discussion

The above errors may be considered small but can, in a national aggregation, affect statistical results. It is very surprising to the Register that local, regional and national patient administration systems (PAS) lack laterality. It is, of course, important to know which of paired organs are operated on or successively reoperated. This sad fact has been pointed out by us for many years without any results! It is also surprising that a hospital has different PAS-systems that do not communicate with each other; thus, there is a tremendous potential for administrative improvement!

In conclusion, we ask that, with these forthcoming monitorings, contact secretaries and physicians take up registration logistics at their "clinic meetings".

What proportion uses Artrosskola?

In 2012, a question was added to the preoperative PROM questionnaire concerning the contact with a physiotherapist and participation in Artrosskola (a standardized patient education and training program). The questions sounded as follows: "Have You during the period of hip problems been to see a physiotherapist for your hip?" and "Have You during the period of hip problems taken part in a so-called Artrosskola (may have been many years before the operation for a shorter period of time)?" This year's analysis, which includes 2014, shows striking differences. The proportion of patients who had contact with a physiotherapist ranges from 24% (Karolinska/Huddinge) to 90% (Aleris Specialistvård Nacka). For Artrosskola, the numbers vary from 11% (Karolinska/Huddinge and Sophiahemmet) to 65% (Torsby). At national level, 28% of all patients responding to the survey indicated that they participated in Artrosskola and 66% said they had had contact with a physiotherapist. From 2012 to 2014, there has been a steady increase in the use of physiotherapy and Artrosskola. Given that the National Board of Health and Welfare's guidelines for treatment of hip and knee osteoarthritis advocates for a prolonged supervised training, information and pain relief as primary treatment strategy the national rate of 28 % of patients who report they have attended artrosskola before surgery could be considered quite bad. However, the institution is young and in many aspects, has not had the time to establish to such an extent that all patients can be offered this help. However, a preliminary analysis shows no associations between preoperative pain level and whether the patient has had contact with a physiotherapist/gone to Artrosskola or not. There appeared to be no association between contact with a physiotherapist or Artrosskola and patient-reported outcomes after one year.

Physiotherapy and Artrosskola

2014

Unit	Number (Diagnosis M16.0–M16.9)	Proportion of physiotherapy	Proportion of Artrosskola	Response rate
Aleris Spec vård Bollnäs	282	64%	25%	95%
Aleris Spec vård Motala	448	64%	40%	86%
Aleris Spec vård Nacka	114	90%	14%	97%
Aleris Spec vård Sabbatsberg	140	66%	23%	99%
Aleris Spec vård Ängelholm	72	64%	33%	88%
Alingsås	161	70%	47%	96%
Arvika	184	85%	60%	87%
Borås	92	67%	14%	81%
Capio Movement	208	75%	29%	92%
Capio Ortopediska Huset	354	66%	22%	97%
Capio S:t Göran	276	60%	23%	73%
Carlanderska	148	76%	22%	96%
Danderyd	219	70%	23%	85%
Eksjö	163	53%	17%	89%
Enköping	140	66%	27%	44%
Eskilstuna	40	50%	18%	82%
Falun	282	53%	22%	94%
Frölunda Specialistsjukhus	95	76%	19%	99%
Gällivare	45	58%	13%	62%
Gävle	105	70%	30%	91%
Halmstad	159	59%	18%	79%
Helsingborg	64	56%	17%	88%
Hudiksvall	84	66%	21%	89%
Hässleholm-Kristianstad	724	62%	13%	97%
Jönköping	163	71%	34%	96%
Kalmar	122	74%	35%	100%
Karlshamn	216	65%	38%	96%

(Continued on next page.)

Physiotherapy and Artrosskola (cont.)

2014

Unit	Number (Diagnosis M16.0–M16.9)	Proportion of physiotherapy	Proportion of Artrosskola	Response rate
Karlskoga	137	66%	30%	91%
Karlstad	158	73%	48%	90%
Karolinska/Huddinge	140	24%	11%	77%
Karolinska/Solna	86	66%	15%	84%
Katrineholm	255	66%	18%	100%
Kungälv	168	66%	29%	90%
Lidköping	234	69%	28%	91%
Lindesberg	156	78%	24%	100%
Ljungby	142	62%	16%	99%
Lycksele	191	70%	51%	65%
Mora	154	62%	12%	81%
Norrköping	179	57%	43%	91%
Norrtälje	91	62%	24%	94%
Nyköping	103	68%	50%	93%
Ortho Center IFK-kliniken	127	82%	16%	97%
Ortho Center Stockholm	421	77%	24%	98%
Oskarshamn	216	69%	39%	96%
Piteå	187	72%	22%	57%
Skellefteå	98	65%	41%	93%
Skene	131	59%	24%	86%
Skövde	104	79%	24%	94%
Sollefteå	90	68%	30%	97%
Sophiahemmet	176	67%	11%	83%
SU/Mölndal	349	64%	25%	80%
Sundsvall	81	58%	51%	71%
SUS/Lund	58	48%	21%	78%
Södersjukhuset	243	64%	17%	85%
Södertälje	77	77%	49%	87%
Torsby	88	66%	65%	95%
Trelleborg	576	64%	26%	96%
Uddevalla	276	72%	49%	88%
Uppsala	134	72%	26%	81%
Varberg	199	68%	24%	96%
Visby	91	46%	24%	91%
Värnamo	108	48%	14%	95%
Västervik	80	56%	34%	81%
Västerås	241	61%	34%	88%
Växjö	98	63%	22%	91%
Ängelholm	74	61%	24%	93%
Örebro	104	67%	24%	96%
Örnsköldsvik	123	71%	35%	94%
Östersund	195	73%	53%	96%
Country	12,133	66%	28%	87%

International registry perspectives

International perspective on the registry work

The Swedish Hip Arthroplasty Register has continued its close cooperation with International Society of Arthroplasty Registries (ISAR – www.isarhome.org). During the general assembly, with the leadership of Göran Garellick and with exceptional contribution from Kajsa, Karin D, Karin L, Karin P and Szilárd, ISAR had its fourth international meeting in Gothenburg on May 23-25, 2015. The meeting had about 200 participants from 20 countries. The meeting focused on:

- Launch and maintenance of a register
- Data collection and statistical methods
- Validation and quality issues
- International harmonization of data
- Interpretation and publishing of Register's data

About 100 podium presentations and 30 posters were presented during the meeting. Acta Orthopaedica will publish works from the meeting after the customary peer-review. ISAR's leadership has decided that, also in the future annual international ISAR meetings will be organized. In 2016, the meeting will be held in Wrightington, a holy land from the standpoint of arthroplasty, and Manchester, England. Continued focus for ISAR work includes harmonization of international data variables and development and implementation of a global implant database.

Cooperation with the Nordic Arthroplasty Register Association (NARA) has intensified in respect to the economic support from the Nordic Council of Ministers. After intensive discussions, it was decided that Denmark and Finland get a relatively larger proportion of funds to get their registers on par with the registers in Norway and Sweden. Additionally, some 20 specific projects got support so they would be published faster.

With considerable apprehension, it was decided, in connection with the EFORT meeting in Prague, June 2015, to create a new platform for the European cooperation between registers. On the background, there was an undemocratic leadership of the European Arthroplasty Register (EAR). At the Prague meeting, Network of Orthopaedic Registries of Europe (NORE) was founded with Rob Nelissen from the Netherlands as spokesperson. NORE has the full support from EFORT's management, which also has a representative in NORE's executive committee. NORE's first priority is training with a specific focus on having more register presentations at the annual EFORT meeting.

Discussions between ISAR and the implant industry have continued. ISAR's position has been reflected in an "editorial" in Acta Orthopaedica: The next critical role of orthopedic registries (Henrik Malchau, Stephen E Graves, Martyn Porter, William H Harris & Anders Troelsen, Acta Orthop 2015;86(1):3-4). In the next article, a model was presented on how new techniques and implants can be introduced and documented by performing "nested studies" in countries which have well-functioning registers. There is still a lot of work to be done, but hopefully, we can start the first study in 2016.

International Society of Arthroplasty Registries

NARA Nordic Arthroplasty Register Association

5th International
Congress of Arthroplasty Registries
Manchester, England, May 28-30, 2016

ISAR's work with patient-reported outcomes in quality register

In the beginning of 2014, ISAR's management established five working groups with the aim of intensifying efforts towards organization's overall objectives. The five respective groups work with issues relating to:

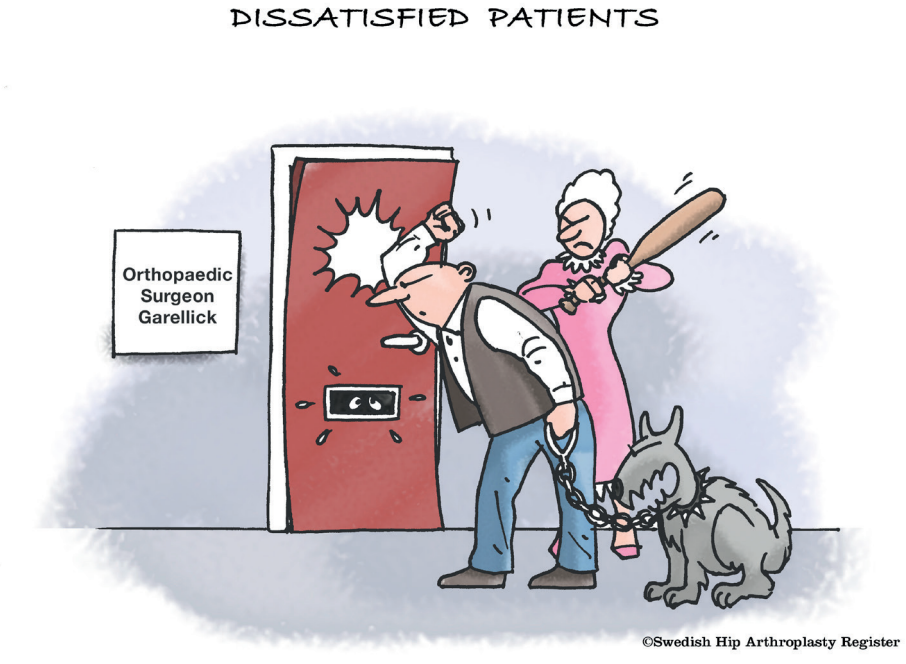
- statutes and financing,
- data quality and data harmonization;
- scientific issues,
- quality improvement,
- patient-reported outcomes.

The group responsible for patient-reported outcomes in quality register (the PROM group) aim to give recommendations and advice regarding the use of patient-reported measures in arthroplasty registers. The PROM group has twelve members who represent different registers and professions globally, which in turn, corresponds register's activities in different parts of the world. From Sweden, Göran Garellick and Ola Rolfson (chairman and convener) have been involved in the group's work. Regular discussions at phone conferences and compilation of relevant literature has resulted in a comprehensive report, which was presented at ISAR congress in Gothenburg in May.

The group has surveyd the arthroplasty registers around the world about PROM data collection. At present, there are seven national registers and six local registers, which have some form of collection of PROM data. Additionally, there is a register in the USA (FORCE-TJR), which runs a PROMs programme, where a large number of hospitals from several states are participating. Although not started yet, the American Joint Replacement Register prepares a program to invite participating hospitals to register PROM. The Swedish Hip Arthroplasty Register is the register, which has the longest experience of PROM collection. According to the survey, the most commonly used measures for general health status were EQ-5D and SF-12, and among the disease-specific measures OHS/OKS, HOOS/KOOS, WOMAC, UCLA and different separate measures for pain and satisfaction were most commonly used.

There are pros and cons to the different instruments. There is no single measure among the most common measures, which can be said to have crucial advantages regarding the use in arthroplasy register compared to all others. The general recommendation from the group is to use one disease-specific and one generic instrument. Questionnaire should not be too extensive. Questionnaires, which are too long, tend to receive a lower response frequency than the short ones. As a result of its work, the group concluded that the response rate should be over 60%, at least, to be considered acceptable, and that the non-response demographics should be reported and compared with those answers.

Additionally to what was mentioned above, the report includes statements and recommendations for a methodological standard for the PROMs instrument, logistics regarding PROM data collection in quality register, how to adjust for case-mix and risk factors, interpretation and statistical analysis of PROMs data and a review of the knowledge register PROMs data have provided. The internal report has been revised into two articles, which have been accepted for publication in Acta Orthopaedica.



Total hip replacement in Sweden

Incidence

Since the Register began its work, the incidences for total hip replacement operations have steadily increased in Sweden. During 2014, 16,565 total hip replacement operations were carried out in Sweden, which corresponds to 331 procedures per 100,000 inhabitants aged 40 years or older. In an international comparison of the countries reporting procedure frequency in national quality registers, Sweden has one of the highest incidences. A natural explanation for the increasing incidence is that life expectancy is increasing and that the proportion of older people among the population increases.

Number of people in Sweden with at least one total hip replacement*				
Number per age group	**1999**	**2004**	**2009**	**2014**
All				
<40	538	756	835	838
40–49	1,413	2,000	2,771	3,432
50–59	5,763	8,220	9,523	11,455
60–69	13,261	20,798	30,024	34,522
70–79	23,936	32,872	42,631	55,419
80–89	15,340	27,144	35,558	42,418
90 +	1,669	3,911	6,471	9,745
Total	61,920	95,701	127,813	157,829
Prevalence per 100,000 ≥ 40 years	1,424	2,117	2,685	3,158
Women				
<40	331	436	451	441
40–49	751	1,033	1,342	1,604
50–59	3,074	4,249	4,705	5,457
60–69	7,296	11,437	16,224	18,337
70–79	14,637	19,667	25,231	32,322
80–89	10,561	18,425	23,858	27,709
90 +	1,358	3,063	4,920	7,340
Total	38,008	58,310	76,731	93,210
Prevalence per 100,000 ≥ 40 years	1,668	2,480	3,123	3,637
Men				
<40	207	320	384	397
40–49	662	967	1,429	1,828
50–59	2,689	3,971	4,818	5,998
60–69	5,965	9,361	13,800	16,185
70–79	9,299	13,205	17,400	23,097
80–89	4,779	8,719	11,700	14,709
90 +	311	848	1,551	2,405
Total	23,912	37,391	51,082	64,619
Prevalence per 100,000 ≥ 40 years	1,155	1,723	2,217	2,654

**who were operated on after 1991*

Prevalence

We have also studied how prevalence has changed over the years. Since calculation requires information on the possible death date, we have not been able to include those who had surgery before 1992 when individual level registration started. In the analysis, we have therefore included all patients with total hip replacement since 1992. We present partly the prevalence of prosthesis bearers either unilaterally or bilaterally and partly the prevalence of bilateral total hip replacement bearers. Prevalence is expressed as the number of total hip replacement bearers per 100,000, aged 40 years or older at the end of each year.

At the end of 2014, 157,829 people had had at least one total hip replacement performed after 1991. This implies that 3.1% of the population aged 40 years or older had total hip replacement, which is an increase of 0.1% compared to the previous year. 39,504 (25%) of these had bilateral prostheses. In 2014, 1.6% of the Swedish population had undergone at least one total hip replacement after 1991.

Prevalence was lower for men (2.7%) compared to women (3.6%). It was slightly more common that women were operated bilaterally, 26% for women compared to 24% for men.

Of those who had undergone surgery on one hip in 1992, 22% were alive at the end of 2014. The later the years studied the more accurately the numbers reflect the "true" prevalence. The number of people who had surgery before 1992 and were still alive in the late 2014 was, if not negligible, relatively low. Since the incidence has steadily increased prevalence has also increased. As an example, the prevalence per 100,000, aged 40 years or older has increased by 18% between 2009 and 2014.

Number of people in Sweden with bilateral total hip replacements*				
Number per age group	**1999**	**2004**	**2009**	**2014**
Bilateral				
<40	102	165	201	187
40–49	196	358	544	686
50–59	925	1,552	1,924	2,559
60–69	2,008	4,263	7,070	8,464
70–79	2,925	5,991	10,084	15,012
80–89	1,321	3,930	7,088	10,630
90 +	89	365	949	1,966
Total	7,566	16,624	27,860	39,504
Prevalence per 100,000 ≥ 40 years	174	368	585	791

**who were operated on after 1991*

Primary total hip replacement

Improved databases and results

The Swedish Hip Arthroplasty Register is developing a new database structure, which involves a simplified procedure. All data is collected in a common database, which will simplify the various types of analyses. Currently, data from the primary hip arthroplasties is divided into two databases (total hip replacement and hemiarthroplasty) and patient-reported data gathered into a third database, also reoperations/revisions are gathered into two databases. The new common database will extend back to 1999. After conversion to the new format, older data will also be available. The data structure will be simplified, subject to certain changes in procedures regarding data reporting. Our plan is that the new database will be implemented during 2016.

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 the results from different regression analyses, most commonly Cox-regressions that, under ideal circumstances, require that the implant survival for the groups recede from each other. Risk ratio describes the degree of increased or decreased risk of the selected outcome (typically revision) compared to the reference group. Risk ratio 2 corresponds to the fact that risk for revision is doubled for the group in question. Risk ratio should be related to implant survival of the reference group. The risk for the reference group is routinely set to 1.0. The clinical meaning of a doubled risk has an entirely different significance, if in one case, the reference group is revised by a 1000 cases after 10 years, compared to a reference group, which is revised, by a 1 of a 1000 cases after 10 years. The first case 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.

Demographics

Since 1993, the number of registered primary total hip replacements has more or less continuously increased from 9113 to 16,565 in 2014. During 2010-2012, a plateau was reached, but in 2013 and 2014, the increase continued with 2% per year. The number for men has since 1993 more or less continuously increased and in 2014, constituted 42.9%, which is an increase of 0.8% in comparison with the previous year (Figure 1). If patients, who had undergone an operation for hip replacement due to fracture are excluded (Figure 1), the corresponding increase is slightly lower, 4.2% in the group where fracture diagnosis was excluded, in comparison to 4.9% in the group, which included all diagnoses. The proportion of men who undergo operation for hip replacement due to fracture has also increased, from 22.6 to 33.3%, which is partially an effect of the fact that the incidence for hip fracture has increased more among men than among women. The proportion of men in the Swedish population has increased in the age group 65-79 and mostly during the 2000s, corresponding to the age at which incidence of hip replacement surgery is highest. In the age group 80 and over, the increase has been more modest, and in the age groups for 65 and under, the relation between men and women has been relatively constant since 1980s.

In 2014, the average age for men was 67.2 (median 68) and for women 69.9 (71). From 2000 until 2010-2011, the average age has decreased for both genders. Between 2013 and 2014, the mean age fell slightly for men (from 67.3 to 67.2) and

Figure 1. Proportion of men and women among patients who were operated with total hip arthroplasty. All diagnoses (on the left) and after the exclusion of patients who were operated on due to acute fracture or fracture sequelae (on the right).

increased somewhat for women (from 69.7 to 69.9, Figure 2). If fracture diagnosis is excluded, the mean age fell for both men and women, of about five months for men and four months for women. By creating age groups where fracture diagnosis is excluded (Figure 3) it is evident that the three younger age groups' relative proportion increased during 2000 to 2010. The somewhat lower mean age for both men and women during 2014 may depend on the fact that somewhat more men were operated in the age group 50–59 years and more women were operated on who were younger than 50 and that the relative proportion of women in the group 70-79 had increased.

If fracture group is excluded, we see that the mean age during hip replacement surgery continuous to fall slowly for both men and women.

Diagnosis

The most common reason for total hip replacement is primary osteoarthritis (Table 1). Between 1994 and 2007, the proportion of those operated due to primary osteoarthritis increased from 83.1 to 86.8% among men and from 67.5 to 80.1% among women (Table 1). Subsequently, the proportion of primary osteoarthritis has been relatively constant. Men dominate this diagnostic group while the relative proportion of women is higher in all of the major groups of secondary osteoarthritis. The proportion of patients with an inflammatory joint disease has been substantially reduced since 1994 and lies now between 1 and 2% for both genders. The diagnosis group for acute fracture has increased both in relative and absolute terms among both men and women, while the surgery for total hip replacement due to sequelae after hip fracture moves in an opposite direction. This is completely in line with the changed indication setting which has occurred for this diagnosis.

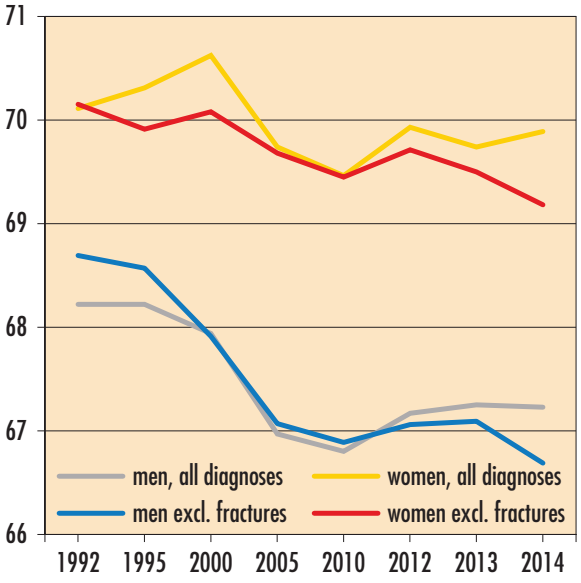


Figure 2. Mean age for men and women at primary prosthetic operation. The mean age has continued to decline between 2013 and 2014 if patients who underwent operation due to fracture, were excluded.

Between 2013 and 2014, there was a slight change with a trend towards a lower proportion of hip arthroplasties due to acute fracture. However, there is a relatively large variation between different units regarding treatment of acute hip fracture. To get a complete picture, one must pay attention to patient-related factors (for example, comorbidities) and alternative treatments (total-/hemiarthroplasty and osteosynthesis) (refer also to section "Hip replacement as fracture treatment").

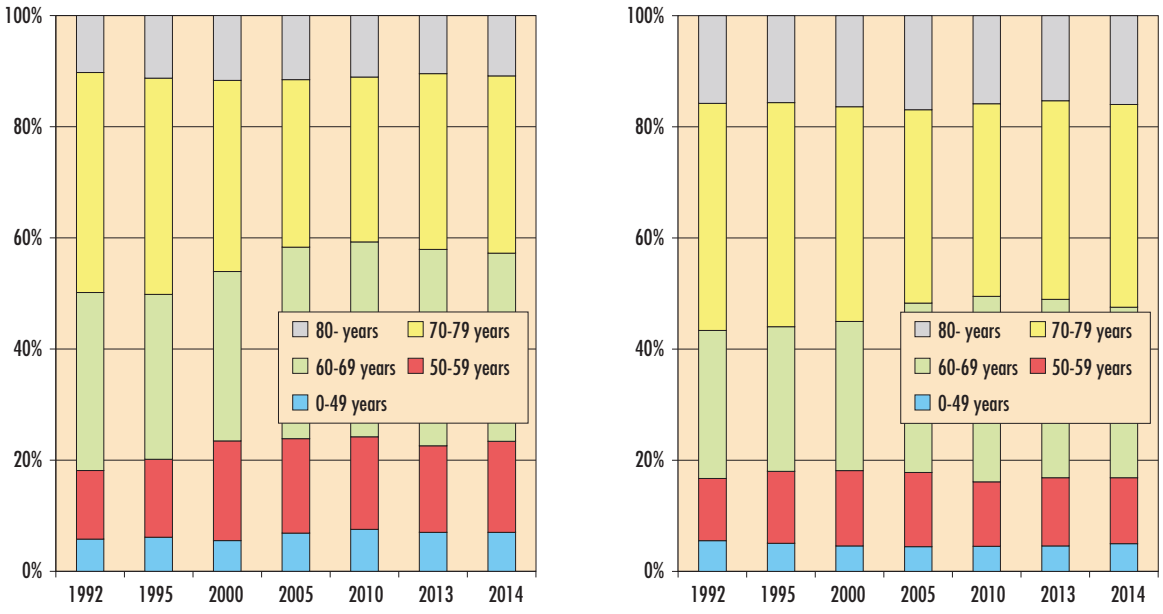


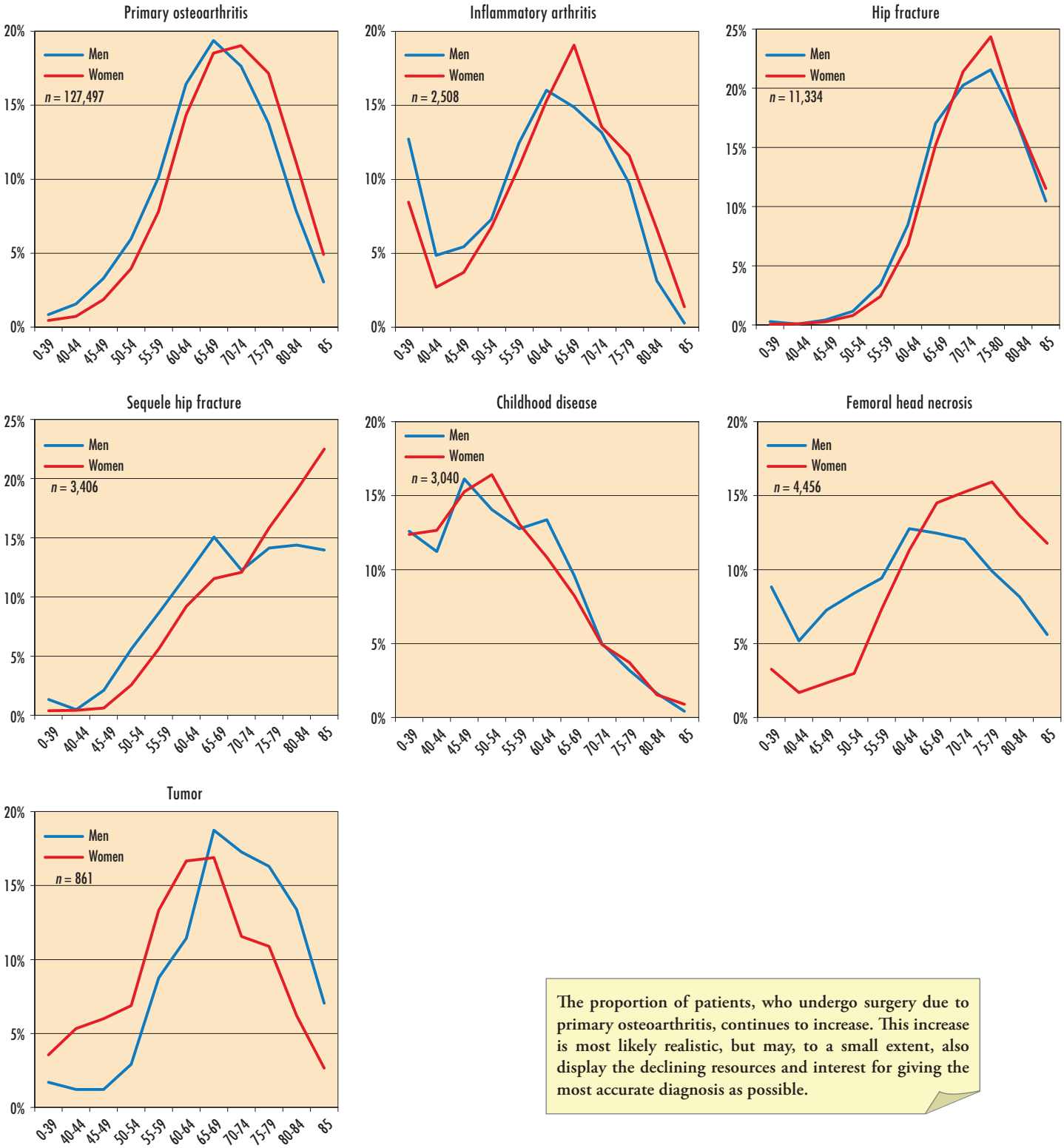
Figure 3. Grouped age distribution for men (on the left) and women (on the right), respectively. Since 1995, the proportion in the age group for 60-69 years increases while the relative proportion of those over 70 decreases. The proportion of patients under 50 has stayed relatively constant, but increased somewhat for women during 2014.

Diagnosis for 1994–2014

	Operationsyears				
Number of diagnosis %	**1994**	**2000**	**2007**	**2013**	**2014**
Primary osteoarthritis					
Men	2,943 *83.0*	3,707 *84.5*	5,108 *86.8*	5,847 *85.0*	6,084 *85.6*
Women	3,780 *67.5*	5,080 *73.2*	6,746 *80.1*	7,547 *79.7*	7,614 *80.5*
Inflammatory joint disease					
Men	151 *4.3*	118 *2.7*	89 *1.5*	55 *0.8*	44 *0.6*
Women	422 *7.5*	284 *4.1*	210 *2.5*	118 *1.2*	131 *1.4*
Acute hip fracture					
Men	6 *0.2*	113 *2.6*	270 *4.6*	463 *6.7*	457 *6.4*
Women	24 *0.4*	456 *6.6*	734 *8.7*	978 *10.3*	956 *10.1*
Hip fracture sequelae					
Men	211 *6.0*	243 *5.5*	135 *2.3*	108 *1.6*	106 *1.5*
Women	772 *13.8*	648 *9.3*	275 *3.3*	192 *2.0*	177 *1.9*
Sequelae after childhood hip disorder					
Men	34 *1.0*	65 *1.5*	112 *1.9*	124 *1.8*	105 *1.5*
Women	82 *1.5*	160 *2.3*	182 *2.2*	216 *2.3*	181 *1.9*
Femoral head necrosis					
Men	65 *1.8*	100 *2.3*	118 *2.0*	207 *3.0*	235 *3.3*
Women	200 *3.6*	261 *3.8*	223 *2.6*	346 *3.7*	332 *3.5*
Tumor					
Men	5 *0.1*	37 *0.8*	13 *0.2*	51 *0.7*	57 *0.8*
Women	10 *0.2*	45 *0.6*	49 *0.6*	53 *0.6*	48 *0.5*
Other					
Men	87 *2.5*	5 *0.1*	13 *0.2*	23 *0.3*	21 *0.3*
Women	231 *4.1*	9 *0.1*	8 *0.1*	17 *0.2*	17 *0.2*
No information					
Men	42 *1.2*	–	1 *0.0*	–	–
Women	75 *1.3*	–	–	–	–

Table 1. Distribution of diagnoses for selected years from 1994 to 2014. The proportion of primary osteoarthritis, acute hip fracture and, to a lesser extent, diagnosis group for tumour has grown. Inflammatory diseases of the joints have been decreased. During the early 1990s, Mb Paget (Other) was not entirely uncommon, but has now almost completely disappeared.

In Figure 4, the age distribution for the most common diagnostic groups are illustrated. In general, the mean age at surgery is higher among women than in men, at surgery for total hip arthroplasty. The only exception is the sequelae after hip disease during adolescence (childhood sequelae), which is the diagnostic group with the lowest mean age (just over 53 years) and similar for both genders. Patients who undergo operation due to inflammatory arthritis are about six (men) or 10 years (women) older, but in these groups, the spread is largest with a relatively large proportion of those who are 39 or younger. The mean age at surgery due to acute hip fracture is 73.8 (mean 74) and 74.7 (mean 75) for men and women, respectively. Among men, the mean age at surgery due to sequelae after hip fracture is 70.9 (mean 71) years, three years lower than at surgery due to acute fracture. However, the mean age among women is about the same at surgery due to sequelae after an earlier fracture fixation, similar to prosthesis fitting for acute fracture (75.1 years, mean 77). The cause for the difference between genders cannot be specified here, but may depend on the fact, that for men, who get a hip fracture at a relatively early age, osteosynthesis is chosen more often for treatment.



The proportion of patients, who undergo surgery due to primary osteoarthritis, continues to increase. This increase is most likely realistic, but may, to a small extent, also display the declining resources and interest for giving the most accurate diagnosis as possible.

Figure 4. Relative age distribution for the five most typical diagnosis groups. Patients were operated on between 2005 and 2014.

BMI and ASA classification

Reporting of BMI (Body Mass Index) and ASA class (American Society of Anaestesiology Physical Status Classification System) to the Swedish Hip Arthroplasty Register began in 2008. For the first year, there was data for 82.3 and 89.9% of cases regarding BMI and ASA, respectively. Reporting has continued to improve. In 2014, BMI was reported in 94.9 and ASA class in 97.9% of cases.

Between 2008 and 2014, the mean value for BMI was relatively constant (Table 2). Possibly, there is a slight tendency towards increasing proportion of patients with different degrees of overweight, but fluctuations between years are small and difficult to assess. Regarding ASA class, the proportion which are considered to be healthy (class I) has continuously fallen during the period, from 27.8 to 23.0% for men and 22.7 to 20.8% for women, respectively. Corresponding increase is mainly in classes III-V (dangerous or life-threatening illness). In class II, there is a slight increase among men, but not among women.

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 acute hip fracture or sequelae after such injury (Table 3). According to ASA, the healthiest patients 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 hip fracture. The trend towards an increasing ASA class over time (Table 2) could partially be explained by the fact that the proportion of patients with hip fracture is increasing, although it is also possible that there are other causes, which could be taken as indicators for this change.

BMI and ASA class differ to a certain extent depending on the diagnosis, completely or partially dependent on other demographic differences between these groups, for example age. 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 can be found in the fracture group, and the lowest proportion in the group with sequelae after hip disease during childhood.

Bilaterality

Patients with osteoarthritis in one hip have an increased likelihood to suffer from osteoarthritis of the opposite hip joint. In the Swedish Hip Arthroplasty Register's database, from 1992 51,729 patients (21.2% of all patients) have been operated on both sides (Table 3). Patients who are operated on both hips tend to be younger than those who are operated only on one hip. Partially, this is caused by the fact that this group makes up a smaller part of patients with hip fracture and a somewhat larger part of patients with inflammatory joint disease and sequelae after hip disease during childhood. Patients who are operated bilaterally at different times tend to be healthier than those who are operated unilaterally, probably and at least partially, because they are younger. One-stage bilateral hip replacement has a palpable effect on the patients' quality of life. For example, the gain in health-related quality of life one year after bilateral operation in one session due to primary osteoarthritis, is about 0.52 (SD=0.35, n= 433). In the group primary osteoarthritis, who undergo operation on only one side and with no registered operation on the opposite side, the corresponding gain increases in EQ-5D index is 0.36 (SD=0.34, n=52,606). The group of patients, who undergo one-stage bilateral operation, is distinguishable in many ways. The patients are often younger men with a lower ASA class in comparison to the other two groups (Table 3), which is also relevant, if the same analysis is limited only to those, who undergo operation due to primary osteoarthritis (data not shown).

Typically, the diagnosis for the other hip is the same as for the first one. If the first hip is operated due to primary osteoarthritis, then the diagnosis is the same for the operation on the other hip in 96.1% of cases. Patients with inflammatory joint disease and fracture diagnosis get the diagnosis for primary osteoarthritis for the second hip in about 27% of cases. There is an even smaller consistency between diagnosis for the first and last operated hip in cases, where the first hip was operated due to sequelae after childhood disease and idiopathic necrosis (Figure 5). The extent, to which this discrepancy accurately reflects actual conditions, is difficult to assess. Proper diagnosis setting can be difficult, especially in advanced hip disease with severe destruction.

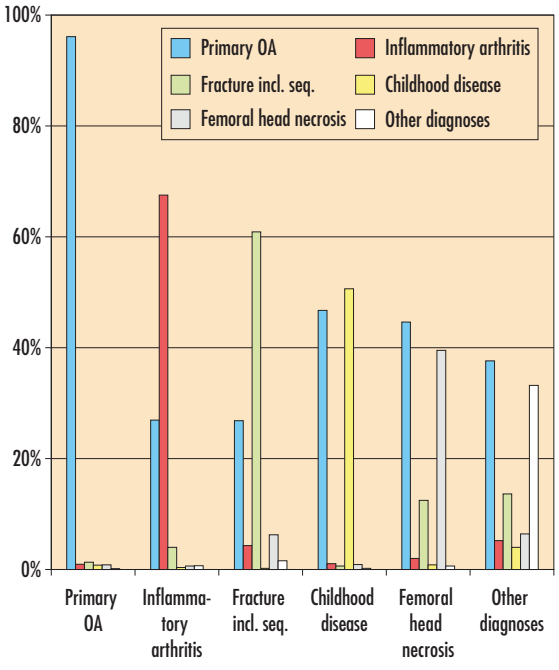


Figure 5. Diagnosis for the first operated hip (x-axis) and diagnosis for the other hip (height of the column) among 51,437 patients who underwent bilateral operation.

BMI and ASA class

2008–2014

	2008	2010	2012	2013	2014
BMI					
Valid obs./missing obs.	*11,896/2,559*	*14,644/1,302*	*15,152/874*	*15,481/818*	*15,746/819*
Mean value *median*					
Men	27.3 *26.8*	27.3 *26.8*	27.6 *27.1*	27.4 *27.0*	27.5 *26.9*
Women	26.6 *26.0*	26.8 *26.1*	26.8 *26.2*	26.7 *26.1*	26.7 *26.1*
Percentage distribution					
Underweight <18.5					
Men	0.4	0.5	0.5	0.6	0.4
Women	1.9	1.8	1.6	1.8	1.8
Normal weight 18.5–24.9					
Men	28.9	28.5	26.3	28.5	28.0
Women	39.9	38.3	38.2	38.8	38.7
Overweight 25–29.9					
Men	49.0	49.2	49.0	47.4	47.9
Women	36.3	36.9	37.1	36.9	36.6
Obesity grade I 30–34.9					
Men	17.0	17.2	18.9	18.9	18.9
Women	16.3	16.9	16.8	16.4	16.8
Obesity grade II–III 35–					
Men	4.7	4.5	5.3	4.4	4.7
Women	5.6	6.1	6.2	6.1	6.2
ASA					
Valid obs./missing obs.	*12,977/1,479*	*15,341/605*	*15,618/408*	*16,012/287*	*16,212/353*
Percentage distribution					
Healthy (I)					
Men	27.8	27.2	24.3	24.7	23.0
Women	22.7	22.8	21.4	21.3	20.8
Mild systemic disease (II)					
Men	54.8	54.3	54.6	55.4	56.4
Women	60.2	60.0	60.4	60.4	60.2
Serious/life threatening systemic conditions (III–V)					
Men	17.3	18.5	21.0	19.9	20.6
Women	17.1	17.2	18.3	18.2	18.9

Table 2. Change in BMI and ASA class between 2008–2014. BMI >100 have been excluded (n=24).

BMI and ASA class in relation to diagnosis

	Primary osteoarthritis	Inflammatory osteoarthritis	Sequelae after childhood hip disorder	Femoral head necrosis	Acute/sequelae hip fracture
BMI *percentage distribution*					
Underweight <18.5					
Men	***0.2***	1.8	0.6	1.6	**3.6**
Women	***1.1***	3.7	2.0	5.0	**6.9**
Normal weight 18.5–24.9					
Men	***25.6***	38.0	30.5	37.7	**53.7**
Women	***36.2***	43.3	40.0	47.9	**55.2**
Overweight 25–29.9					
Men	**49.9**	44.3	48.5	40.4	***34.6***
Women	**38.1**	33.2	33.6	29.6	***28.0***
Obesity grade I 30–34.9					
Men	**19.4**	11.6	15.4	13.7	***6.8***
Women	**18.0**	14.1	17.3	13.1	***7.9***
Obesity grade II–III 35–					
Men	4.9	4.3	4.9	**6.6**	***1.2***
Women	6.5	5.7	**7.1**	4.4	***2.0***
ASA *percentage distribution*					
Healthy (I)					
Men	27.2	***9.0***	**44.3**	19.6	9.6
Women	23.8	***4.3***	**44.6**	14.4	10.8
Mild systemic disease (II)					
Men	56.3	**59.7**	***46.0***	48.6	47.7
Women	61.7	**67.1**	***45.8***	57.9	53.6
Serious/life threatening systemic condition (III–V)					
Men	16.6	31.3	***9.7***	31.8	**42.7**
Women	14.5	28.6	***9.6***	27.8	**35.6**

Table 3. Distribution of BMI and ASA class from selected diagnostic groups during 2008-2014. 43,061 hip replacement surgeries among men and 58,719 among women with the specified BMI and 44,591 surgeries among men and 62,018 among women with reported ASA class have been included. Highest value indicated in bold, the lowest in bold italics within each group of BMI and ASA class for men and women.

Between 1992 and 2014 0.8% (n=1,892) underwent one-stage bilateral hip replacement. In the bilaterally operated group, these patients constituted for 3.7%. If only those patients are counted who underwent surgery on the other hip in a year after the first, the number increases and constitutes 11.7%. If we limit the analysis to patients who underwent surgery on the first hip because of primary osteoarthritis, the respective proportion is somewhat lower (10.7%).

Since 2009, one-stage bilateral operation has decreased in frequency, even though we operate on more and more patients with total hip replacement (Figure 6). In addition to the occurrence of bilateral hip disease, it is also required that patients have significant symptoms from both hips. Furthermore, a bilateral intervention requires the patient to be medically fit and not only preferring one-stage procedures. Since we lack detailed knowledge concerning optimal balancing between these factors and the choice of one- and two-stage bilateral intervention, it is not possible to say for sure, that the observed decrease of bilateral operations is motivated or not. The maximum theoretical proportion, which can be relevant for bilateral operation in one session, cannot be said to be based on the register data. However,

Demographic data, BMI and ASA class in relation to bilaterality

	Unilat. operation	Bilat. operation, 2-stage	Bilat. operation 1-stage
All diagnoses			
Number *%*	191,550 *78.7*	49,837 *20.5*	1,892 *0.8*
Mean age *SD,*	70.0 *10.9*	65.2 *10.1*	60.3 *12.9*
Number of women %	59.1	60.4	54.3
Diagnosis *%*			
Primary osteoarthritis	75.8	88.7	79.0
Inflammatory joint disease	2.5	3.9	10.6
Acute fracture, sequelae after trauma	14.8	2.8	2.2
Sequelae after childhood hip disorder	1.8	2.2	3.4
Femoral head necrosis	3.5	1.9	4.2
Other	1.5	0.5	0.6
BMI			
Number	68,000	10,574	608
Mean value, *SD*	27.0 *5.4*	27.3 *4.9*	26.9 *4.7*
ASA			
Number	71,797	19,883	633
Healthy (I) *%*	23.4	28.0	34.8
Mild systemic disease (II) *%*	57.3	58.4	51.8
Serious/life threatening systemic condition (III–V) *%*	19.3	13.6	13.4

Table 3. Demographic data related to the incidence of bilaterality and the implementation of one-or twostage bilateral procedures. Data for bilateral operations applies to the first operation.

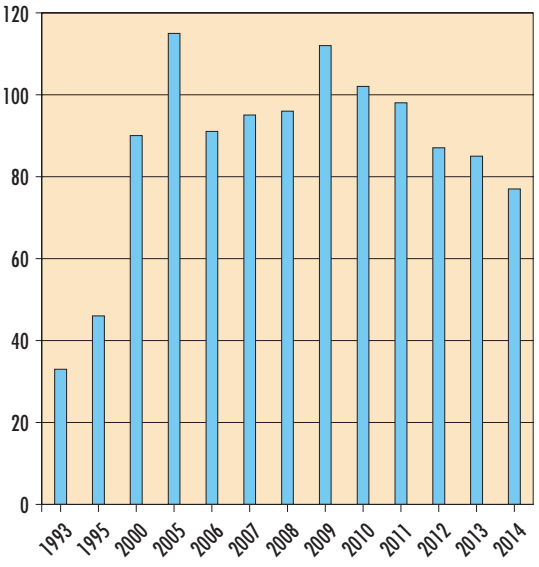


Figure 6. Number of patients who one-stage bilateral surgery during 1993–2014.

should more patients be recruited for one-stage bilateral hip arthroplasty, these patients would most probably be found among those operated on the opposite side within one year after their first hip replacement. A large part of these is not suitable for this type of intervention due to previously stated reasons.

1992–2014, the risk for reoperation in 2 years in the group who underwent unilateral operation was 2.7%, in the group for bilateral operation, the risk was 1.7 for the first and 2.2% for the second hip. Respective survival rate in the group was 97.1 ± 0.1, 98.2 ± 0.1 and 97.7 ± 0.1% (Figure 8). After adjusting for differences in age, gender and diagnosis between groups, the risk for early reoperation is lower for the first, but not for the second hip prosthesis in comparison with the unilateral operation group (risk ratio, *95% KI*, first hip – bilaterally operated/unilaterally operated: 0.75 *0.69–0.81*; second hip – bilaterally operated/unilaterally operated: 0.99 *0.93–1.06*). In the group where patients were operated bilaterally in one stage, the proportion of reoperations within two years is about as large as in the group operated bilaterally at two occasions and constitute to 2.2 and 1.8% (prosthesis survival: 97.7 ± 0.8 and 98.1 ± 0.6 for the first and second hip, respectively). We do not have the data on early complications, which can be a subject for future in-depth studies based on linkage to other databases.

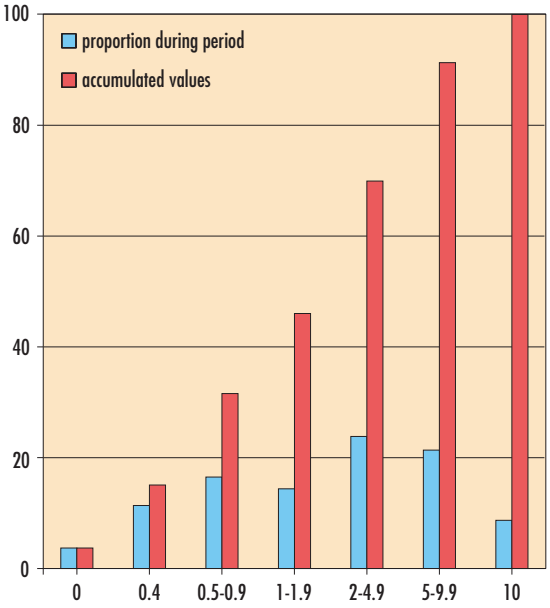


Figure 7. Number of patients who were bilaterally operated (%), who were also operated on the other hip at another time, after the operation on the first hip.

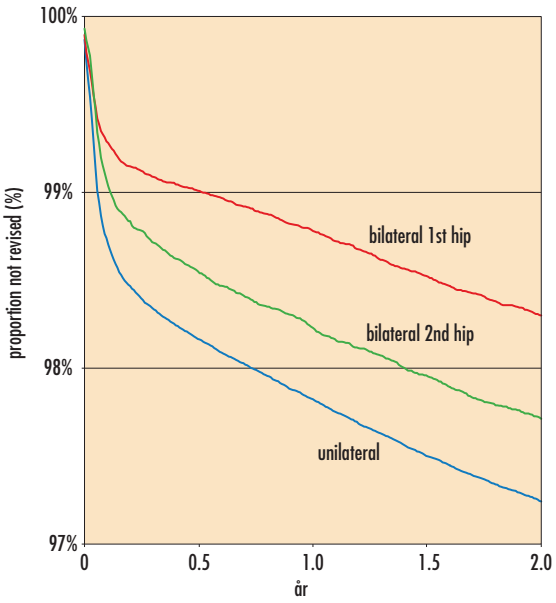


Figure 8. Implant survival up to two years based on reoperation as an outcome in groups that were unilaterally operated without a subsequent operation on the opposite side, and the first and the second hip in cases that were operated on both sides during 1992–2014.

Our analysis suggests that there is no reason to refrain from performing a bilateral operation in one session due to increased risk of early prosthetic complications. Other aspects, such as degree of symptoms and degree of comorbidity are more crucial to the decision to implement this type of surgery.

Prosthesis selection

Cemented fixation is more common than in other Scandinavian countries. Poor results with uncemented fixation during the 1990s resulted in totally cemented fixation reaching a peak of 92–93% during 1998–2000 (Figure 9). Hereafter, cemented fixation has declined every year. Between 2011 and 2012, the decrease for all-cemented prostheses was only 0.1%, but hereafter has the use of cemented fixation decreased to 64.6% during 2014. Completely uncemented fixation has instead become ever more common. In 2000, the uncemented prosthesis constituted for 2.4% and afterwards the percentage has risen about 1.3% per year. Between 2013 and 2014, this increase accelerated to 2.6%, which means that more than every fifth hip prosthesis (20.9%) which was reported, was completely uncemented. The increase of uncemented fixation has mainly occurred in under 60 age groups, but also in groups 60–74 and over 75 years (Figure 10).

Since 2012, the proportion of reversed hybrid prostheses (cemented cup, uncemented stem) decreased from 13.7 to 11.2% during 2014. 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 3.0% during 2014. In 2014, resurfacing prostheses were used in 37 men, aged 30–68 years, of which 35 had primary osteoarthritis. The previous year, 70 operations were reported.

Most common prostheses

In 2014, five of the most popular cemented cups take up 93% of the total number of such cups (Table 4). In 2014, Contemporary Hooded Duration has been replaced with a cemented Avantage cup. Older standard polyethylene is still used in almost 30% of cases of the cemented fixations (Figure 11). Looking at the age groups 50–59 and the under 50-year olds, the proportions are 26.5 and 20.2%, which is slightly below the average. Two clinics do not use the new polyethylene at all with the cemented fixation and, additionally, four use it only in isolated cases.

Regarding stems, Lubinus SP II, Exeter and MS 30 dominate. Together, they constitute more than 99% of all cemented stems. Use of CPT decreases and Spectron EF has been replaced with Sirius. CPT and Sirius constitute less than 1% of all stems.

Selection of uncemented cup shows a greater variation, five typical uncemented cups accounted for 64% of the total. Pinnacle W/ Gription is now used far more often than Pinnacle 100, which has disappeared from the list of the five most used cups. Given the uncertainty, which arose when individual studies have noted development of radiological zones around certain cups with trabecular titanium coating, it is recommended that the

change to trabecular metal does not accelerate until, the results from the long-term follow-up are available. Additionally, one cup, Exceed Ringloc, has been replaced by a cup with trabecular metal coating, Trilogy IT. Even there, we are waiting for a longer follow-up. Change to highly cross-linked polyethylene has gone considerably faster for uncemented cups. In 2010, the proportion for highly cross-linked polyethylene was 95% and in 2014, almost all cups had this type of polyethylene (98.2%).

Concerning uncemented stems, the diversification is less pronounced here than among cups. Since 2009, the Corail stem has been the most common uncemented stem. In comparison to 2013, the changes among the most popular are small. M/L Taper, which was taken into use in Sweden for the first time in 2012, shows a slight increase.

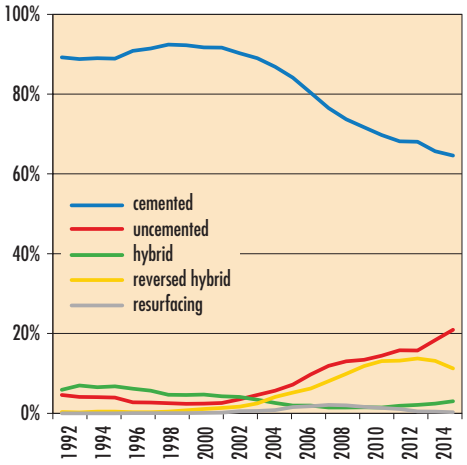


Figure 9. Distribution of primary prosthesis based on the selection of fixation. Between 2013 and 2014 all-uncemented fixation increased by 2.6% and the cemented fixation decreased by 1.1%.

Articulation

Use of highly cross-linked polyethylene increased also between 2013 and 2014 (Table 4, Figure 11). The combination of ceramic femoral head-polyethylene insert/polyethylene cup increased also somewhat, from 14.7 to 15.2%. The combination of ceramic femoral head-ceramic insert shows also a small increase, from 0.4 to 0.5%. Only 37 cases with metal-on-metal articulation were reported. All of these were resurfacing prostheses. Most often, femoral head with a diameter of 32 mm is used. Even the use of femoral head with a diameter of 36 mm has increased, although the increase has been slower. The trends regarding the choice of the femoral head and its size during the last decade are visualized in Figure 12 and 13.

Implant combinations

The three most common implant combinations for every type of fixation are shown in Table 5. The biggest changes compared to 2013 are found in the group for completely uncemented prostheses. CLS-Trilogy and CLS-Continuum have been replaced with Corail-Pinnacle W/Gription 100 and Bimetric-Exceed ABT Ringloc. In the group for cemented prosthesis, the combination Exeter – Exeter X3 RimFit has increased. RimFit cup has also replaced Contemporary Duration in the group for reverse hybrid prostheses.

In many of these combinations, implants from different manufacturers have been used. This practice has existed for a long time despite the fact that this practice is not recommended by most of the manufacturers. There is also long-term data for multiple implant combinations that have been proven to function well. On the Swedish market, there are even manufacturers/importers who only provide cups from a specific manufacturer but do not provide stems from

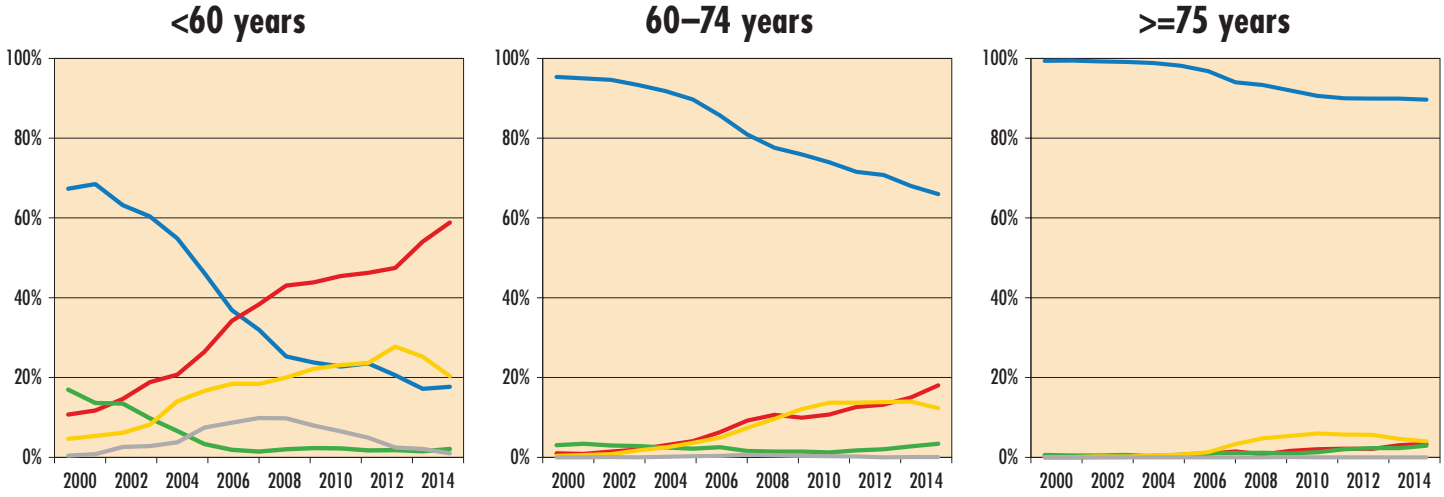


Figure 10. Distribution of primary prosthesis based on the selection of fixation among different age groups during 2000–2014. In the group of the over 75-year olds, uncemented were used during operation in 2000 and for 383 cases (7.4%) in 2014. Colour codes for the different types of fixation are shown in Figure 9.

Most common implants in 2013 and 2014

	2014		2013	
	Number	%	Number	%
Cemented cup				
Lubinus	6,113	*48.8*	5,908	*46.0*
Exeter X3 RimFit	1,970	*15.7*	1,503	*11.7*
Marathon	1,883	*15.0*	2,248	*17.5*
ZCA	1,310	*10.5*	1,787	*13.9*
Avantage	351	*2.8*	304	*2.4*
Number of cemented cups	***92.8***		***91.5 (93.6*)***	
Cemented stem				
Lubinus SP II	6,520	*58.2*	6,247	*56.3*
Exeter polished	3,419	*30.5*	3,432	*30.9*
MS30 polished	1,177	*10.5*	1,252	*11.3*
Sirius	41	*0.4*	2	*0.0*
CPT	30	*0.3*	131	*1.2*
Number of cemented stems	***99.9***		***99.7 (100**)***	
Uncemented cup				
Continuum	765	*19.2*	697	*20.6*
Trilogy HA	690	*17.4*	443	*13.1*
Trident hemi	506	*12.7*	314	*9.3*
Pinnacle W/Gription 100	430	*10.8*	165	*4.9*
Trilogy IT	289	7.3	222	*6.6*
Number of uncemented cups	***64.3***		***54.5 (60.5#)***	

	2014		2013	
	Number	%	Number	%
Uncemented stem				
Corail	2,385	*46.4*	2,284	*46.5*
Bi-Metric	835	*16.3*	849	*16.5*
CLS	645	*12.6*	645	*12.6*
M/L Taper	235	*4.6*	235	*4.3*
Accolade II	211	*4.1*	382	*5.8*
Number of uncemented stems	***84.0***		***85.7***	
Joint				
Metal-polyethylene (highly cross-linked)	10,920	*65.9*	10,446	*64.1*
Metal-polyethylene (older standard)	2,864	*17.3*	3,193	*19.6*
Ceramic-polyethylene (highly cross-linked)	1,806	*10.9*	1,524	*9.4*
Ceramic-polyethylene (older standard)	718	*4.3*	856	*5.3*
Ceramic-ceramic	106	*0.6*	84	*0.5*
Metal-metal (includes resurfacing)	37	*0.2*	71	*0.4*
Other/no data	114	*0.7*	119	*0.7*
Femoral head's diameter				
22	123	*0.7*	117	*0.7*
28	2,756	*16.6*	3,527	*21.6*
32	11,903	*71.9*	10,931	*67.1*
36	1,687	*10.2*	1,538	*9.4*
>36	48	*0.3*	128	*0.8*
Other/no data	47	*0.4*	57	*0.4*

**Includes Contemporary Hooded Duration, which was one of the five most common implants in 2013*
*** Includes Spectron EF which was one of the five most common implants in 2013*
 # Includes Pinnacle 100 and Exceed ABT which were among the five most common implants in 2013

Table 4. Most used implants and femoral heads during 2014. The corresponding proportion for the same prostheses during 2013 is shown for comparison.

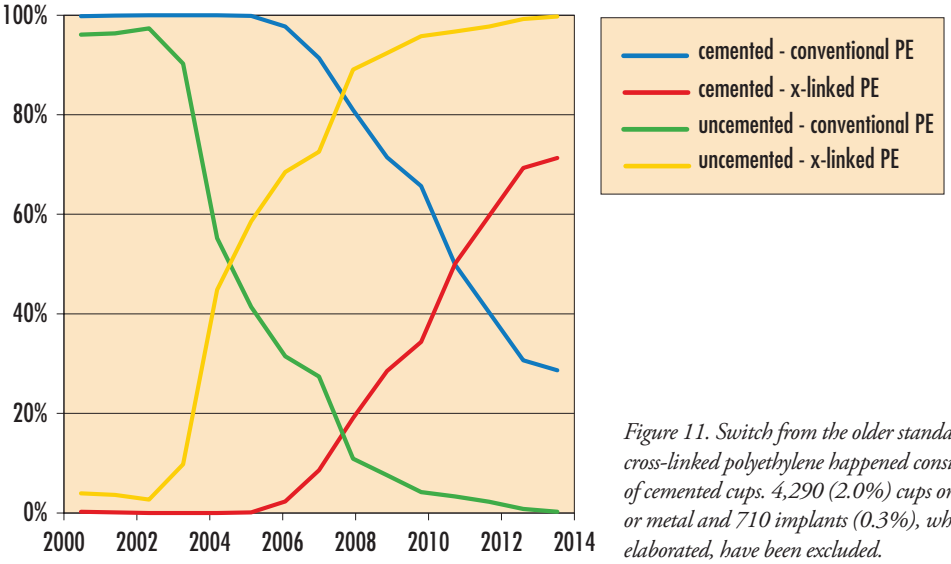


Figure 11. Switch from the older standard polyethylene to highly cross-linked polyethylene happened considerably later in the use of cemented cups. 4,290 (2.0%) cups or inserts made of ceramics or metal and 710 implants (0.3%), where details have not been elaborated, have been excluded.

Most common implant combinations
2013–2014

	2014		2013	
	Number	%	Number	%
Cemented prosthesis				
Lubinus – Lubinus	5,398	*50.6*	5,128	*47.9*
Exeter – Exeter X3 RimFit	1,599	*15.0*	1,199	*11.2*
Exeter – Marathon	1,089	*10.2*	1,299	*12.1*
Uncemented prosthesis				
Corail – Pinnacle W/Gription 100	413	*12.0*	149	*5.0*
Corail – Pinnacle 100	242	*7.0*	311	*10.5*
Bimetric – Exceed ABT Ringloc	242	*7.0*	233	*7.8*
Hybrid				
Exeter – Trident hemi	155	*31.0*	104	*26.4*
Lubinus – Trilogy	109	*21.8*	50	*12.7*
MS30 – Continuum	35	*7.0*	32	*8.1*
Reverse hybrid prosthesis				
Corail – Marathon	393	*21.2*	450	*21.0*
Corail – Lubinus	269	*14.5*	484	*22.6*
Corail – Exeter X3 RimFit	194	*10.5*	80	*3.7*
Resurfacing				
BHR and all variations	37	*100*	70	*100*

Table 5. Most common implant combinations in 2013 and 2014.

the same producer. In Britain, the phenomenon of "mix and match" has been discussed. In Sweden, this phenomenon is common. In 2014, 4728 (28.6%) of all hip arthroplasty cases were performed with the combination of cups and stems from different manufacturers. Especially common is the combination of stem from Stryker and cup from DePuy (1261 operations in 2014), and usually Exeter stem with Marathon Cup (1110 operations). Rarely, a femoral head from one manufacturer is combined with a stem from another manufacturer. In 2014, 37 cases were reported.

Proportion of uncemented hip arthroplasties is increasing and, on a small scale, the proportion of hybrid prostheses is also increasing. The use of reversed hybrid prostheses and all-cemented prostheses are decreasing. Upon insertion of uncemented cups, almost exclusively polyethylene inserts of highly cross-linked polyethylene are used. Upon insertion of cemented cup, this type of polyethylene is used in just over 70% of cases.

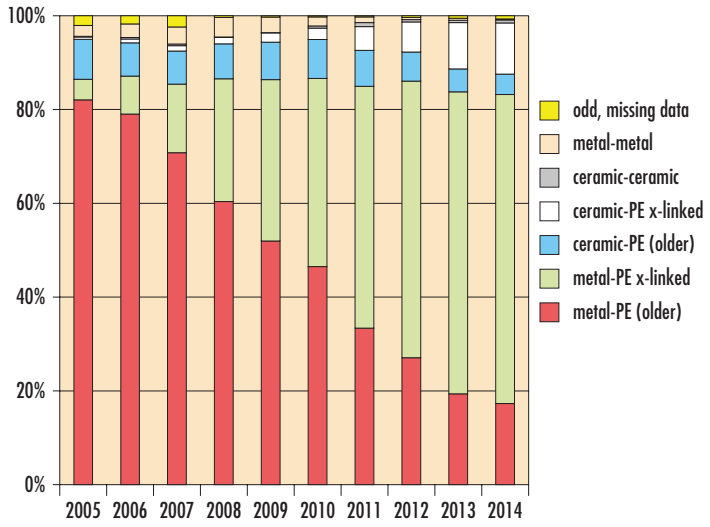


Figure 12. Type of inserted articulation since 2005–2014.

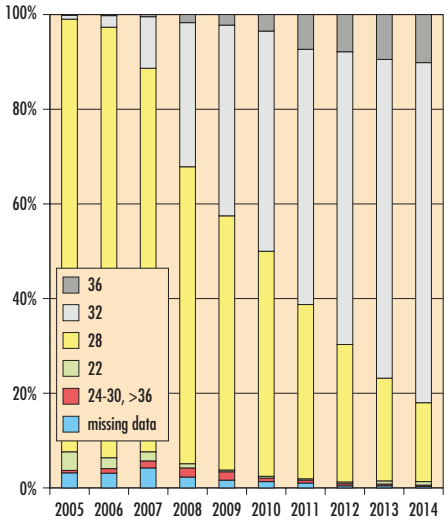


Figure 13. Selection of femoral head size between 2005 and 2014. The trend to select a larger diameter is based on the creation of the new more wear-resistant polyethylene and the possibility to reduce the risk of dislocation.

Surgical approach

Since 2000, posterior and lateral supine or side position approaches have dominated in Sweden. In 2014, these were used in almost 99% of all total hip replacements. The posterior approach is still the most common (51%), but decreased somewhat in comparison to 2013 (–1%). Direct lateral approach in lateral position increased at the same time from 41.7 to 42.6% while the proportion for direct lateral approach in supine position was 5.2% during both years. Mini-incision and Watson-Jones approach are used only sporadically, 68 cases were reported in 2014 for each of these approaches.

The division between the three most used surgical approaches shows no significant variation during the last five years (Figure 14) and also no variation regarding age groups (no data is shown). However, the proportion of patients with a hip fracture, who were operated with a direct lateral approach between 2005 and 2010, has increased, in the same way as at operation for hemiarthroplasty. Between 2013 and 2014, the proportion of patients with hip fracture who were operated with a posterior approach increased by 4.1% (Refer to Hip replacement as fracture treatment.)

Table 6 shows the number of operations within three years, and implant survival related to the selection of the surgical approach. Here, instead of revision, reoperation has been used to include only open reposition in case of dislocation and fractures, which have been treated with only osteosynthesis. The highest frequency for reoperations is found in two group, which underwent operation with a mini-incision. In both groups, the proportion of uncemented implants is high, which is likely to affect the results (Table 7). The slightly lower risk of reoperation within three years in the group for posterior approach may be explained by the fact that more patients with secondary osteoarthritis and especially with hip fracture undergo operation with a direct 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.

Just under 94% of all total hip arthroplasties are performed via a posterior or a direct lateral approach in lateral position. The risk for reoperation does not appear to be affected, depending on the choice of these two approaches, if all operations are included. However, the choice of surgical approach may play a role for different subgroups and exhibit different risk profile, something we witnessed earlier regarding surgery on patients with fracture diagnosis.

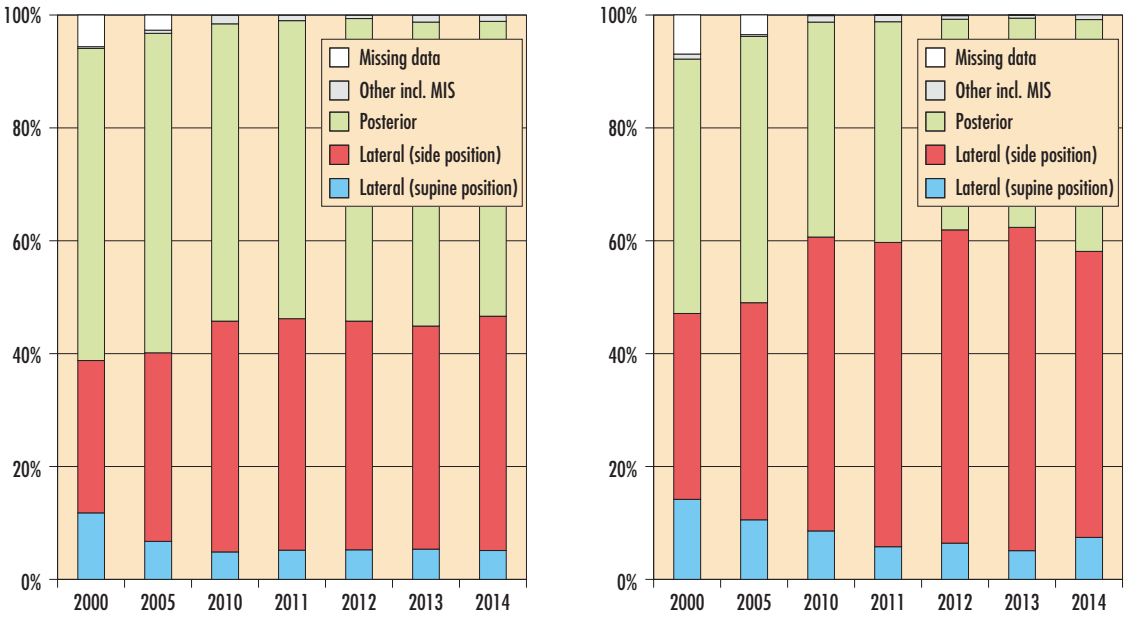


Figure 14. Relative distribution of surgical approach in 2000–2014. The right column shows diagnoses of primary osteoarthritis and the left column shows diagnoses of hip fracture.

Reoperation in three years in relation to the choice of surgical approach

	Number 2000–2014	Proportion reoperated in 3 years %	Survival 0–3 years mean ± 95% C.I.
Direct lateral			
Supine position (Hardinge)	14,033	2.4	97.1±0.3
Lateral position (Gammer)	81,451	2.4	96.9±0.1
Posterior	115,208	2.3	97.1±0.1
Mini-incision			
Posterior	298	2.3	96.1±2.8
Front	778	4.9	94.3±1.7
Other	95	5.3	93.6±5.0
Watson-Jones	311	1.6	98.2±1.6
Trochanter osteotomy			
Lateral	392	3.1	96.2±2.0
Posterior	288	1.4	98.6±1.4
No data	2,820	2.9	96.4±0.7

Table 6. Number of hip prosthesis operations, which were reoperated in three years in relation to surgical approach. In all the groups, 50 observations remain after three years.

Reoperation in three years in relation to the choice of surgical approach

	Number of women	Proportion of primary osteoarthritis	Number of operations with uncemented cup	Number of operations with uncemented stem
Lateral				
Supine position (Hardinge)	63.6	77.3	4.3	21.3
Lateral position (Gammer)	60.0	79.7	17.6	22.2
Posterior	57.6	84.6	11.4	17.3
Mini-incision				
Posterior	53.7	81.9	36.6	45.3
Front	63.1	88.8	70.1	67.0
Other	40.0	89.5	74.7	78.9
Watson-Jones	53.7	85.2	46.6	56.9
Trochanter osteotomy				
Lateral	62.5	73.2	24.6	32.1
Posterior	57.6	74.0	17.0	22.0
No data	60.5	70.4	10.7	19.7

Table 7. Demography and the choice of fixation method in relation to surgical approach. Data presented in order to facilitate interpretation of Table 6.

15 most common components

(most used the past 10 years)

Cup (Stem)	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Lubinus all-poly (Lubinus SP II)	77,236	5,168	4,347	3,611	2,625	2,319	95,306	29.0%
Contemporary Hooded Duration (Exeter Polished)	6,504	1,490	632	565	414	200	9,805	5.5%
Lubinus X-linked (Lubinus SP II)	0	23	686	1,463	2,571	3,246	7,989	5.2%
ZCA XLPE (MS30 Polished)	2,491	1,155	1,150	1,225	1,008	524	7,553	4.9%
Marathon XLPE (Exeter Polished)	737	1,105	1,260	1,401	1,301	1,110	6,914	4.5%
Charnley Elite (Exeter Polished)	9,324	133	49	6	0	4	9,516	3.3%
Exeter X3 RimFit (Exeter Polished)	0	106	1,021	1,070	1,200	1,604	5,001	3.3%
Exeter Duration (Exeter Polished)	11,532	183	72	0	0	0	11,787	2.4%
FAL (Lubinus SP II)	5,372	397	266	163	109	43	6,350	2.2%
Trilogy HA (CLS Spotorno)	1,702	379	372	255	183	221	3,112	1.9%
ZCA XLPE (Lubinus SP II)	847	480	334	352	355	64	2,432	1.6%
Lubinus all-poly (Corail collarless)	665	401	356	317	195	143	2,077	1.4%
Reflection (Spectron EF Primary)	7,493	29	4	3	7	3	7,539	1.4%
Marathon XLPE (Corail collarless)	201	382	387	422	303	265	1,960	1.3%
Reflection XLPE (Spectron EF Primary)	1,217	220	97	0	0	0	1,534	1.0%
Others (1,561)	190,038	4,295	4,920	5,176	6,074	6,819	217,322	
Total	315,359	15,946	15,953	16,029	16,345	16,565	396,197	

1) *Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.*

15 most common cemented components

(most used the past 10 years)

Cup (Stem)	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Lubinus all-poly (Lubinus SP II)	77,236	5,168	4,347	3,611	2,625	2,319	95,306	40.5%
Contemporary Hooded Duration (Exeter Polished)	6,504	1,490	632	565	414	200	9,805	7.7%
Lubinus X-linked (Lubinus SP II)	0	23	686	1,463	2,571	3,246	7,989	7.3%
ZCA XLPE (MS30 Polished)	2,491	1,155	1,150	1,225	1,008	524	7,553	6.9%
Marathon XLPE (Exeter Polished)	737	1,105	1,260	1,401	1,301	1,110	6,914	6.3%
Charnley Elite (Exeter Polished)	9,324	133	49	6	0	4	9,516	4.7%
Exeter X3 RimFit (Exeter Polished)	0	106	1,021	1,070	1,200	1,604	5,001	4.6%
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FAL (Lubinus SP II)	5,372	397	266	163	109	43	6,350	3.1%
ZCA XLPE (Lubinus SP II)	847	480	334	352	355	64	2,432	2.2%
Reflection (Spectron EF Primary)	7,493	29	4	3	7	3	7,539	1.9%
Reflection XLPE (Spectron EF Primary)	1,217	220	97	0	0	0	1,534	1.4%
Charnley (Exeter Polished)	2,621	3	0	0	0	0	2,624	1.0%
ZCA XLPE (Exeter Polished)	179	141	237	225	209	100	1,091	1.0%
Avantage Cemented (Lubinus SP II)	102	53	74	113	202	277	821	0.7%
Others (357)	153,037	397	631	707	735	1,201	156,708	
Total	278,692	11,083	10,860	10,904	10,736	10,695	332,970	

1) *Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.*

15 most common uncemented components

(most used the past 10 years)

Cup (Stem)	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Trilogy HA (CLS Spotorno)	1,702	379	372	255	183	221	3,112	13.7%
Trident HA (Accolade)	782	201	201	178	120	44	1,526	6.9%
Allofit (CLS Spotorno)	1,209	140	80	43	52	61	1,585	5.9%
Pinnacle HA (Corail collarless)	217	130	123	189	221	131	1,011	4.6%
Trilogy HA (Corail collarless)	284	212	160	83	47	104	890	4.1%
Continuum (CLS Spotorno)	0	37	94	156	206	212	705	3.2%
CLS Spotorno (CLS Spotorno)	1,213	36	38	27	9	0	1,323	3.2%
Trident HA (ABG II HA)	347	70	83	49	40	43	632	2.9%
Exceed ABT (Bi-Metric HA std)	1	1	85	140	163	179	569	2.6%
Pinnacle Gription (Corail collarless)	0	0	10	66	98	369	543	2.5%
Trident HA (AccoladeII)	0	0	0	44	160	302	506	2.3%
Trilogy HA (Bi-Metric HA std)	256	68	53	50	38	40	505	2.3%
Pinnacle (Corail collarless)	85	49	79	90	89	83	475	2.2%
Ranawat-Burstein (Bi-Metric HA std)	241	134	44	32	11	0	462	2.1%
Trilogy (CLS Spotorno)	585	4	0	0	0	0	589	1.7%
Others (408)	9,405	828	1,088	1,114	1,554	1,676	15,665	
Total	16,327	2,289	2,510	2,516	2,991	3,465	30,098	

1) Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.

15 most common hybrid components

(most used the past 10 years)

Uncemented cup (Cemented stem)	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Trilogy HA (Lubinus SP II)	1,150	47	70	68	50	109	1,494	22.0%
Trident HA (Exeter Polished)	24	56	82	92	115	171	540	18.2%
Trilogy HA (Spectron EF Primary)	1,243	2	2	0	0	0	1,247	8.3%
Trilogy HA (Exeter Polished)	99	23	7	1	1	6	137	3.8%
Ranawat-Burstein (Lubinus SP II)	62	12	18	15	1	0	108	3.7%
Trilogy HA (MS30 Polished)	67	17	15	4	3	1	107	3.6%
Continuum (MS30 Polished)	0	0	5	17	32	35	89	3.0%
Trident HA (Lubinus SP II)	43	6	5	3	10	16	83	2.8%
Tritanium (Exeter Polished)	0	0	9	13	30	28	80	2.7%
Trident HA (ABG II Cemented)	61	2	0	0	0	0	63	2.1%
Trilogy HA (CPT (CoCr))	19	12	15	17	0	0	63	2.1%
Continuum (Lubinus SP II)	0	0	4	7	22	14	47	1.6%
TM revision (Lubinus SP II)	6	4	2	10	10	14	46	1.6%
TOP Pressfit HA (Lubinus SP II)	155	3	1	3	0	0	162	1.4%
Exceed ABT (Exeter Polished)	0	0	6	6	14	10	36	1.2%
Others (281)	6,660	47	55	78	106	98	7,044	
Total	9,589	231	296	334	394	502	11,346	

1) Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.

15 most common reversed hybrid components

(most used the past 10 years)

Cemented cup (Uncemented stem)	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Lubinus all-poly (Corail collarless)	665	401	356	317	195	143	2,077	12.7%
Marathon XLPE (Corail collarless)	201	382	387	422	303	265	1,960	12.0%
Contemporary Hooded Duration (ABG II HA)	492	123	25	6	0	0	646	3.9%
Marathon XLPE (Corail Krage)	1	42	104	117	147	128	539	3.3%
Marathon XLPE (ABG II HA)	21	74	85	115	124	116	535	3.3%
Lubinus all-poly (CLS Spotorno)	330	68	34	47	36	18	533	3.2%
ZCA XLPE (Corail collarless)	108	106	51	84	114	59	522	3.2%
Contemporary Hooded Duration (Corail collarless)	35	25	105	146	183	22	516	3.2%
Lubinus all-poly (Corail Krage)	0	41	104	79	110	126	460	2.8%
Marathon XLPE (Bi-Metric HA std)	58	76	102	101	72	51	460	2.8%
ZCA XLPE (CLS Spotorno)	226	60	66	60	14	8	434	2.7%
Charnley Elite (Corail collarless)	356	60	20	5	1	0	442	2.6%
Lubinus all-poly (Bi-Metric HA lat)	251	72	81	22	1	3	430	2.5%
Charnley Elite (CLS Spotorno)	394	4	3	3	5	1	410	2.1%
Exeter X3 RimFit (Corail collarless)	0	8	54	59	51	166	338	2.1%
Others (313)	4,522	534	521	613	790	752	7,732	
Total	7,660	2,076	2,098	2,196	2,146	1,858	18,034	

[1)] *Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.*

15 most common resurfacing components

(most used the past 10 years)

Cup (Stem)	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
BHR Acetabular Cup (BHR Femoral Head)	784	137	125	60	61	33	1,200	54.6%
ASR Cup (ASR Head)	368	28	0	0	0	0	396	21.3%
Durom (Durom)	357	5	0	0	0	0	362	15.0%
Adept (Adept Resurfacing Head)	15	34	25	1	0	0	75	4.0%
BHR Acetabular Cup (BMHR VS)	2	6	11	9	9	4	41	2.2%
Durom studiecup (Durom)	15	0	0	0	0	0	15	0.8%
BHR Dysplasia Cup (BHR Femoral Head)	11	1	3	1	0	0	16	0.8%
ReCap Cup (ReCap Head)	7	2	0	0	0	0	9	0.5%
BHR Acetabular Cup (BMHR)	5	0	0	0	0	0	5	0.3%
Zimmer MMC Cup (Durom)	0	0	3	1	0	0	4	0.2%
ReCap HA Cup (ReCap Head)	3	0	0	0	0	0	3	0.2%
ASR Cup (BHR Femoral Head)	1	0	0	0	0	0	1	0.1%
BHR Dysplasia Cup (BMHR VS)	0	1	0	0	0	0	1	0.1%
Okänd ytersättning cup (Okänd ytersättning head)	1	0	0	0	0	0	1	0.1%
Cormet 2000 resurf (Cormet 2000 HA resurf)	2	0	0	0	0	0	2	0%
Others (2)	11	0	0	0	0	0	11	
Total	1,582	214	167	72	70	37	2,142	

[1)] *Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.*

15 most common cup components

Cup	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Lubinus all-poly	101,043	5,844	5,006	4,147	3,014	2,657	121,711	31.7%
ZCA XLPE	4,745	2,120	1,912	2,012	1,786	786	13,361	8.7%
Marathon XLPE	1,181	1,928	2,295	2,497	2,250	1,883	12,034	7.8%
Contemporary Hooded Duration	7,610	1,701	802	752	618	229	11,712	6.7%
Lubinus X-linked	0	24	734	1,640	2,969	3,650	9,017	5.9%
Charnley Elite	15,319	284	172	82	43	21	15,921	4.9%
Trilogy HA	6,086	979	933	710	444	572	9,724	4.5%
Exeter X3 RimFit	0	138	1,258	1,400	1,504	1,970	6,270	4.1%
Exeter Duration	12,512	189	79	0	0	0	12,780	2.7%
Trident HA	1,643	372	407	386	484	690	3,982	2.6%
FAL	5,546	448	290	170	117	52	6,623	2.4%
Reflection	9,097	44	8	10	9	3	9,171	1.5%
Continuum	2	66	229	403	700	765	2,165	1.4%
Reflection XLPE	1,322	276	123	1	2	1	1,725	1.1%
Pinnacle HA	244	177	211	275	321	229	1,457	0.9%
Others (204)	149,009	1,356	1,494	1,544	2,084	3,057	158,544	
Total	315,359	15,946	15,953	16,029	16,345	16,565	396,197	

[1)] *Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.*

15 most common stem components

Stam	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Lubinus SP II	92,060	6,380	6,146	6,175	6,284	6,520	123,565	41.0%
Exeter Polished	48,334	3,273	3,415	3,459	3,435	3,419	65,335	21.3%
Corail collarless	2,238	1,493	1,527	1,672	1,562	1,734	10,226	6.7%
MS30 Polished	3,628	1,213	1,324	1,470	1,252	1,177	10,064	6.2%
CLS Spotorno	6,901	914	861	735	645	631	10,687	5.8%
Spectron EF Primary	11,226	319	132	8	9	3	11,697	2.8%
Bi-Metric HA std	1,619	443	424	429	452	433	3,800	2.5%
Bi-Metric HA lat	1,534	280	309	338	381	429	3,271	2.0%
Corail Krage	5	183	500	603	824	826	2,941	1.9%
ABG II HA	1,637	370	277	201	186	193	2,864	1.7%
Accolade	863	231	252	224	170	72	1,812	1.2%
CPT (CoCr)	1,225	115	130	121	131	30	1,752	1.0%
Wagner Cone Prosthesis	707	165	135	128	156	203	1,494	0.8%
BHR Femoral Head	796	138	128	61	61	33	1,217	0.7%
Straight-stem standard	1,461	0	0	0	0	0	1,461	0.4%
Others (208)	141,125	429	393	405	797	862	144,011	
Total	315,359	15,953	16,029	16,345	16,565	15,946	396,197	

[1)] *Refers to the proportion of the total number primary total hip replacements performed during the last 10 years.*

Number of primary THRs per hospital and year

Hospital	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Aleris Specialistvård Bollnäs	0	0	0	241	268	312	821	0.2%
Aleris Specialistvård Elisabethsjukhuset	989	70	60	65	46	2	1,232	0.3%
Aleris Specialistvård Motala	0	437	429	438	491	520	2,315	0.6%
Aleris Specialistvård Nacka	220	121	133	134	112	118	838	0.2%
Aleris Specialistvård Sabbatsberg	1,648	150	145	160	175	141	2,419	0.6%
Aleris Specialistvård Ängelholm	0	0	2	5	9	83	99	0%
Alingsås	2,519	201	210	209	252	178	3,569	0.9%
Art Clinic Jönköping	0	0	0	10	6	14	30	0%
Arvika	1,676	182	184	190	140	217	2,589	0.7%
Borås	5,706	172	188	180	167	170	6,583	1.7%
Capio Movement	697	256	253	176	127	229	1,738	0.4%
Capio Ortopediska Huset	3,061	342	316	332	370	375	4,796	1.2%
Capio S:t Göran	10,213	422	454	405	472	423	12,389	3.1%
Carlanderska	1,373	118	158	120	113	157	2,039	0.5%
Danderyd	7,957	299	338	306	327	343	9,570	2.4%
Eksjö	4,796	194	183	216	191	207	5,787	1.5%
Enköping	2,230	257	295	327	320	342	3,771	1.0%
Eskilstuna	4,232	110	128	129	136	97	4,832	1.2%
Falun	6,375	322	367	397	353	325	8,139	2.1%
Frölunda Specialistsjukhus	431	78	82	85	80	97	853	0.2%
Gällivare	2,517	105	86	111	92	96	3,007	0.8%
Gävle	5,522	164	203	198	257	224	6,568	1.7%
Halmstad	4,467	229	227	238	243	240	5,644	1.4%
Helsingborg	3,909	70	59	69	76	109	4,292	1.1%
Hermelinen Spec.vård	0	0	0	2	6	7	15	0%
Hudiksvall	3,105	138	129	100	147	146	3,765	1.0%
Hässleholm-Kristianstad	10,219	797	775	675	777	847	14,090	3.6%
Jönköping	4,588	210	211	195	167	210	5,581	1.4%
Kalmar	4,693	165	184	122	146	160	5,470	1.4%
Karlshamn	2,557	188	235	217	230	240	3,667	0.9%
Karlskoga	2,654	138	120	166	173	162	3,413	0.9%
Karlskrona	2,391	46	36	36	32	28	2,569	0.6%
Karlstad	5,137	287	260	238	265	249	6,436	1.6%
Karolinska/Huddinge	5,986	234	283	241	251	265	7,260	1.8%
Karolinska/Solna	4,683	208	206	198	182	184	5,661	1.4%
Katrineholm	2,696	239	239	208	242	260	3,884	1.0%
Kungälv	2,903	193	171	135	165	205	3,772	1.0%
Lidköping	2,359	123	186	196	238	281	3,383	0.9%
Lindesberg	2,518	210	234	211	230	202	3,605	0.9%
Linköping	5,386	58	68	58	65	67	5,702	1.4%
Ljungby	2,508	164	165	175	151	172	3,335	0.8%

(Continued on next page.)

Number of primary THRs per hospital and year (cont.)

Hospital	1992–2009	2010	2011	2012	2013	2014	Total	Proportion[1)]
Lycksele	3,272	330	308	276	290	302	4,778	1.2%
Mora	3,285	216	222	203	219	207	4,352	1.1%
Norrköping	5,446	238	245	230	253	259	6,671	1.7%
Norrtälje	1,697	118	101	106	129	115	2,266	0.6%
Nyköping	3,036	184	171	167	143	159	3,860	1.0%
Ortho Center IFK-kliniken	215	117	150	131	128	133	874	0.2%
Ortho Center Stockholm	2,048	432	400	435	396	442	4,153	1.0%
Oskarshamn	2,645	198	210	204	286	233	3,776	1.0%
Piteå	2,518	373	373	389	367	337	4,357	1.1%
SU/Mölndal	2,015	444	406	416	469	594	4,344	1.1%
SU/Sahlgrenska	4,966	8	4	3	6	6	4,993	1.3%
SUS/Lund	4,616	114	100	140	195	203	5,368	1.4%
SUS/Malmö	6,134	109	83	74	27	34	6,461	1.6%
Skellefteå	2,595	94	79	98	133	122	3,121	0.8%
Skene	1,266	105	106	113	126	152	1,868	0.5%
Skövde	5,624	134	198	243	162	136	6,497	1.6%
Sollefteå	2,095	123	125	123	126	109	2,701	0.7%
Sophiahemmet	5,409	175	166	193	211	213	6,367	1.6%
Spenshult	332	184	156	317	240	97	1,326	0.3%
Sunderby (incl. Boden)	4,825	38	30	36	32	34	4,995	1.3%
Sundsvall	5,723	203	229	185	208	157	6,705	1.7%
Södersjukhuset	7,970	387	337	416	430	420	9,960	2.5%
Södertälje	1,498	118	119	109	92	97	2,033	0.5%
Torsby	1,627	105	106	122	107	97	2,164	0.5%
Trelleborg	5,540	572	598	643	594	627	8,574	2.2%
Uddevalla	6,067	285	337	342	389	391	7,811	2.0%
Umeå	4,358	95	63	64	64	98	4,742	1.2%
Uppsala	6,785	370	257	229	270	284	8,195	2.1%
Varberg	4,607	193	241	242	239	213	5,735	1.4%
Visby	2,440	105	118	121	125	120	3,029	0.8%
Värnamo	2,776	124	146	148	148	122	3,464	0.9%
Västervik	2,863	113	120	109	121	109	3,435	0.9%
Västerås	4,212	416	461	513	476	436	6,514	1.6%
Växjö	3,563	127	146	154	125	151	4,266	1.1%
Ängelholm	2,885	143	156	166	174	96	3,620	0.9%
Örebro	5,423	184	177	116	107	151	6,158	1.6%
Örnsköldsvik	2,965	185	140	140	133	144	3,707	0.9%
Östersund	4,621	234	278	301	314	261	6,009	1.5%
Others	40,476	556	289	98	1	0	41,420	10.5%
Total	315,359	15,946	15,953	16,029	16,345	16,565	396,197	

[1)] *Refers to the proportion of the total number of total hip replacements performed 1979–2013.*

Number of primary THRs per diagnosis and year

Diagnosis	1992–2009	2010	2011	2012	2013	2014	Total	Proportion
Primary osteoarthritis	168,604	13,370	13,256	13,338	13,394	13,698	235,660	79.7%
Fracture	23,319	1,475	1,509	1,542	1,742	1,701	31,288	10.6%
Inflammatory arthritis	8,015	234	242	194	173	175	9,033	3.1%
Femoral head necrosis	6,066	449	508	528	553	567	8,671	2.9%
Childhood disease	3,985	308	339	323	340	286	5,581	1.9%
Tumour	1,148	81	76	79	104	105	1,593	0.5%
Other secondary osteoarthritis	1,298	3	2	1	1	0	1,305	0.4%
Posttraumatic osteoarthritis	475	26	21	24	38	33	617	0.2%
(missing)	1,840	0	0	0	0	0	1,840	0.6%
Total	214,750	15,946	15,953	16,029	16,345	16,565	295,588	100%

Number of primary THRs per diagnosis and age group

(1992–2014)

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Primary osteoarthritis	8,935	61.2%	32,370	82.9%	130,183	84.4%	64,172	73.2%	235,660	79.7%
Fracture	373	2.6%	1,560	4.0%	12,623	8.2%	16,732	19.1%	31,288	10.6%
Inflammatory arthritis	1,630	11.2%	1,702	4.4%	4,295	2.8%	1,406	1.6%	9,033	3.1%
Femoral head necrosis	1,004	6.9%	1,118	2.9%	3,376	2.2%	3,173	3.6%	8,671	2.9%
Childhood disease	2,227	15.2%	1,651	4.2%	1,422	0.9%	281	0.3%	5,581	1.9%
Tumour	166	1.1%	303	0.8%	738	0.5%	386	0.4%	1,593	0.5%
Other secondary osteoarthritis	99	0.7%	112	0.3%	475	0.3%	619	0.7%	1,305	0.4%
Posttraumatic osteoarthritis	76	0.5%	73	0.2%	220	0.1%	248	0.3%	617	0.2%
(missing)	100	0.7%	164	0.4%	875	0.6%	701	0.8%	1,840	0.6%
Total	14,610	100%	39,053	100%	154,207	100%	87,718	100%	295,588	100%

Number of primary uncemented THRs per diagnosis and age group

(1992–2014)

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Primary osteoarthritis	3,968	64.5%	8,899	88.2%	8,995	92%	604	81.2%	22,466	83.9%
Childhood disease	1,126	18.3%	607	6.0%	224	2.3%	16	2.2%	1,973	7.4%
Femoral head necrosis	454	7.4%	255	2.5%	183	1.9%	23	3.1%	915	3.4%
Inflammatory arthritis	429	7.0%	157	1.6%	147	1.5%	16	2.2%	749	2.8%
Fracture	84	1.4%	130	1.3%	199	2.0%	80	10.8%	493	1.8%
Posttraumatic osteoarthritis	29	0.5%	7	0.1%	5	0.1%	3	0.4%	44	0.2%
Other secondary osteoarthritis	32	0.5%	7	0.1%	4	0%	1	0.1%	44	0.2%
Tumour	7	0.1%	8	0.1%	4	0%	1	0.1%	20	0.1%
(missing)	27	0.4%	20	0.2%	11	0.1%	0	0%	58	0.2%
Total	6,156	100%	10,090	100%	9,772	100%	744	100%	26,762	100%

Number of primary THRs per type of fixation and age group
(1992–2014)

Type of fixation	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Cemented	3,800	26.0%	19,126	49.0%	130,721	84.8%	84,095	95.9%	237,742	80.4%
Uncemented	6,156	42.1%	10,090	25.8%	9,772	6.3%	744	0.8%	26,762	9.1%
Reversed hybrid	1,809	12.4%	5,302	13.6%	9,090	5.9%	1,788	2.0%	17,989	6.1%
Hybrid	1,495	10.2%	3,332	8.5%	4,130	2.7%	976	1.1%	9,933	3.4%
Resurfacing implants	1,003	6.9%	877	2.2%	260	0.2%	2	0%	2,142	0.7%
(missing)	347	2.4%	326	0.8%	234	0.2%	113	0.1%	1,020	0.3%
Total	14,610	100%	39,053	100%	154,207	100%	87,718	100%	295,588	100%

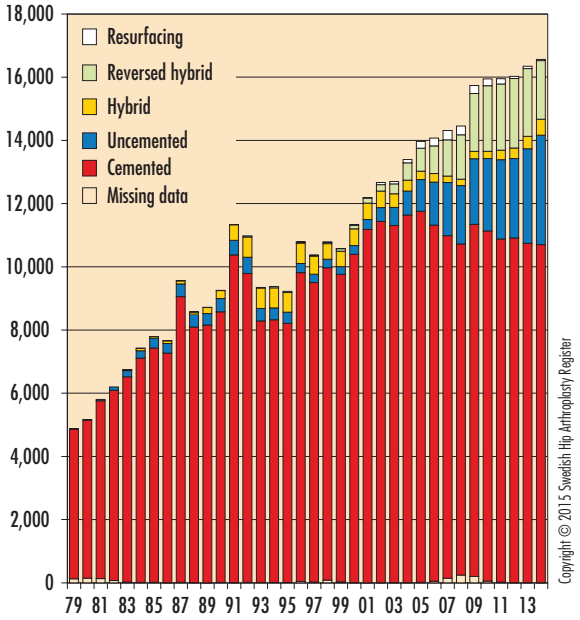
Number of primary THRs per type of surgical approach and year
1992–2014

Surgical approach	1992–2009	2010	2011	2012	2013	2014	Total	Proportion
Posterior approach (Moore)	74,093	8,129	8,161	8,287	8,492	8,452	115,614	39.1%
Direct lateral approach, lateral position (Gammer)	47,659	6,750	6,794	6,776	6,813	7,059	81,851	27.7%
Direct lateral approach, supine position (Hardinge)	9,877	830	839	860	852	866	14,124	4.8%
Others	1,314	231	155	101	183	186	2,170	0.7%
(missing)	81,807	6	4	5	5	2	81,829	27.7%
Total	214,750	15,946	15,953	16,029	16,345	16,565	295,588	100%

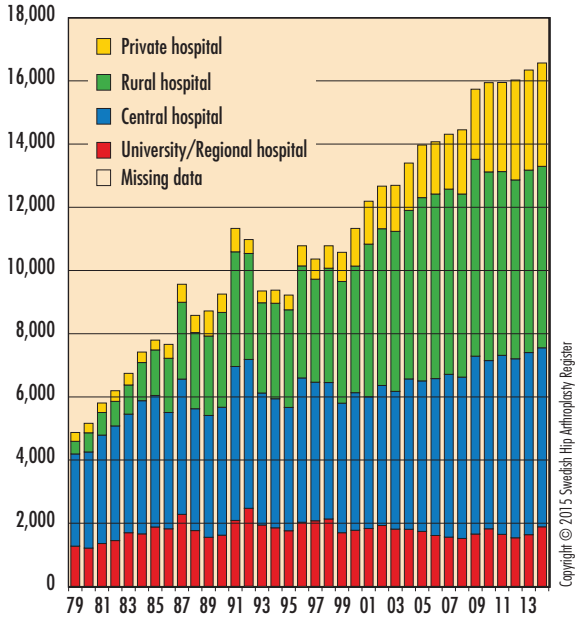
Number of primary THRs per type of cement and year
1992–2014

Type of cement	1992–2009	2010	2011	2012	2013	2014	Total	Proportion
Palacos cum Gentamycin	101,795	0	0	0	0	0	101,795	34.4%
Palacos R+G	20,834	5,062	5,375	5,260	3,990	3,506	44,027	14.9%
Refobacin Palacos R	19,613	0	0	0	0	0	19,613	6.6%
Refobacin Bone Cement	20,488	5,347	5,056	5,260	6,014	5,868	48,033	16.2%
Cemex Genta System Fast	1,559	429	247	225	3	0	2,463	0.8%
Cemex Genta System	236	0	1	0	0	0	237	0.1%
Others	13,720	34	21	36	602	1,195	15,608	5.3%
(all or partly uncemented)	33,556	5,074	5,253	5,248	5,736	5,996	60,863	20.6%
(missing)	2,949	0	0	0	0	0	2,949	1.0%
Total	214,750	15,946	15,953	16,029	16,345	16,565	295,588	100%

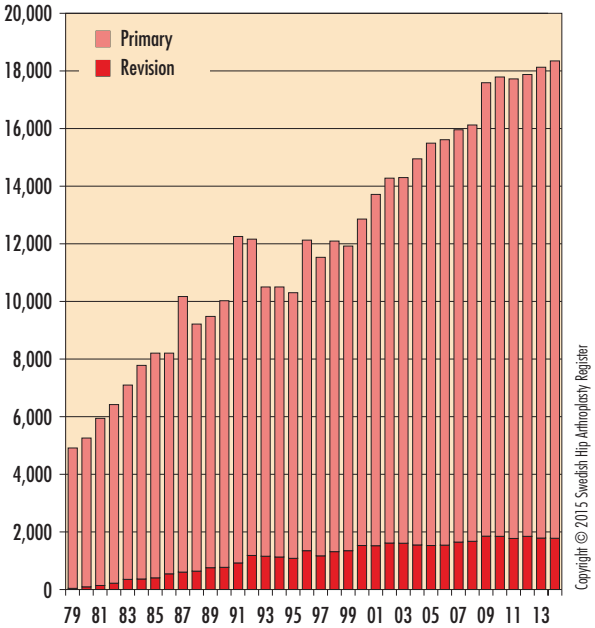
Number of primary THRs
per type of fixation, 1979–2014



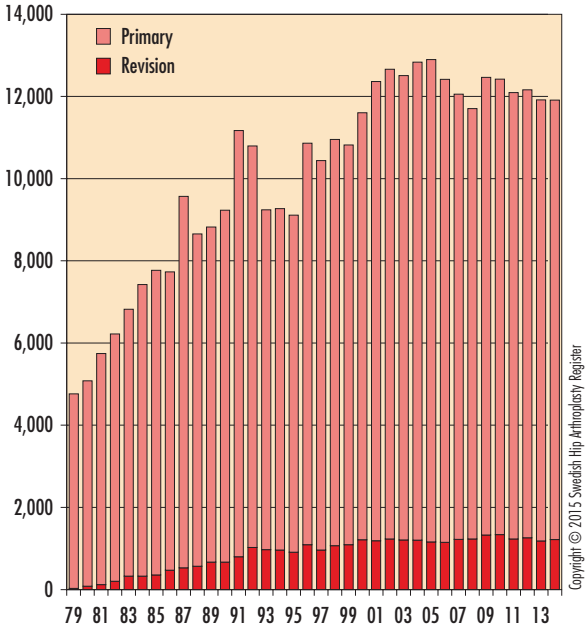
Number of primary THRs
per type of hospital, 1979–2014



All THRs
396,197 primary THRs, 40,549 revisions, 1979–2014

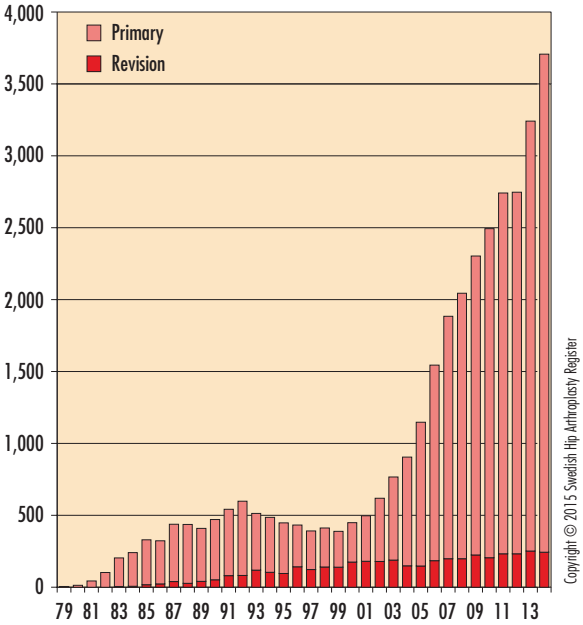


THRs with cemented implants
332,970 primary THRs, 31,666 revisions, 1979–2014



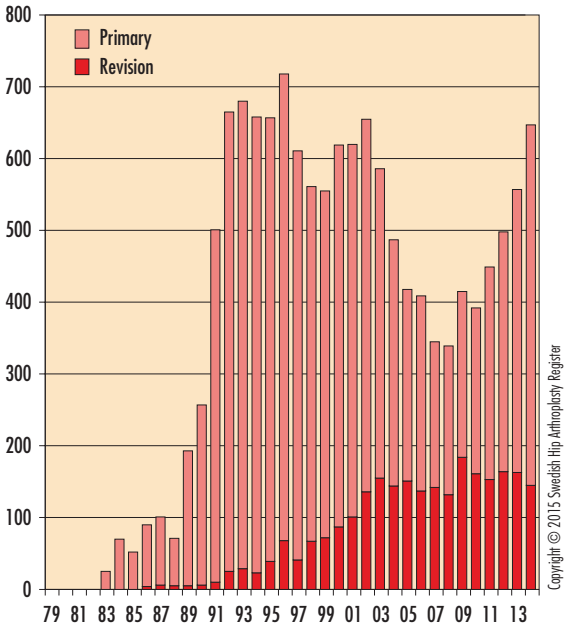
THRs with uncemented implants

30,098 primary THRs, 4,217 revisions, 1979–2014



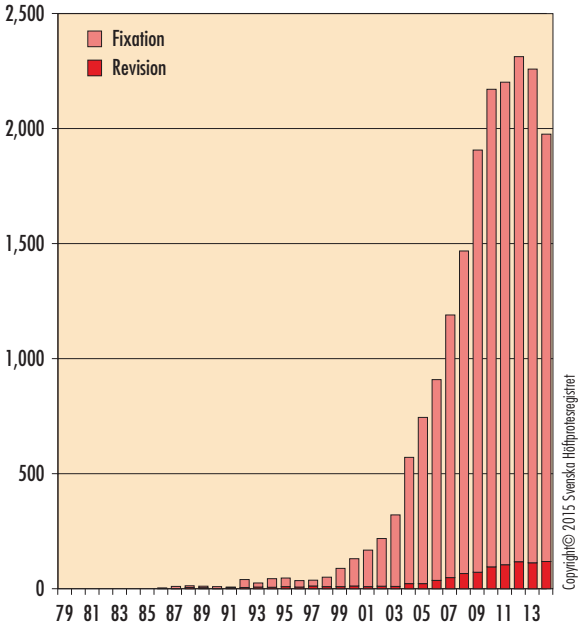
THRs with hybrid implants

11,346 primary THRs, 2,555 revisions, 1979–2014



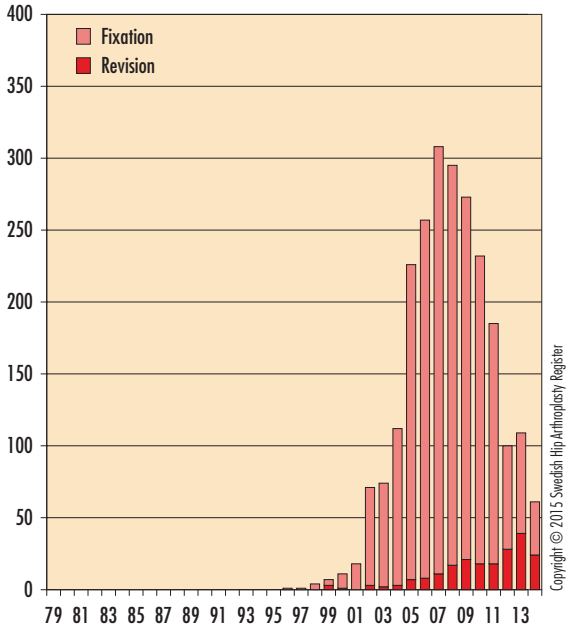
THRs with reversed hybrid implants

18,034 primary THRs, 934 revisions, 1979–2014

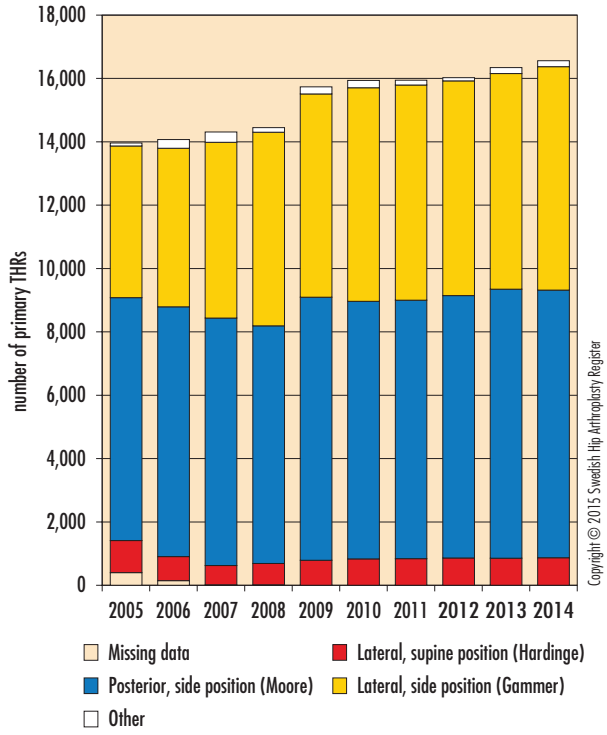


THRs with resurfacing implants

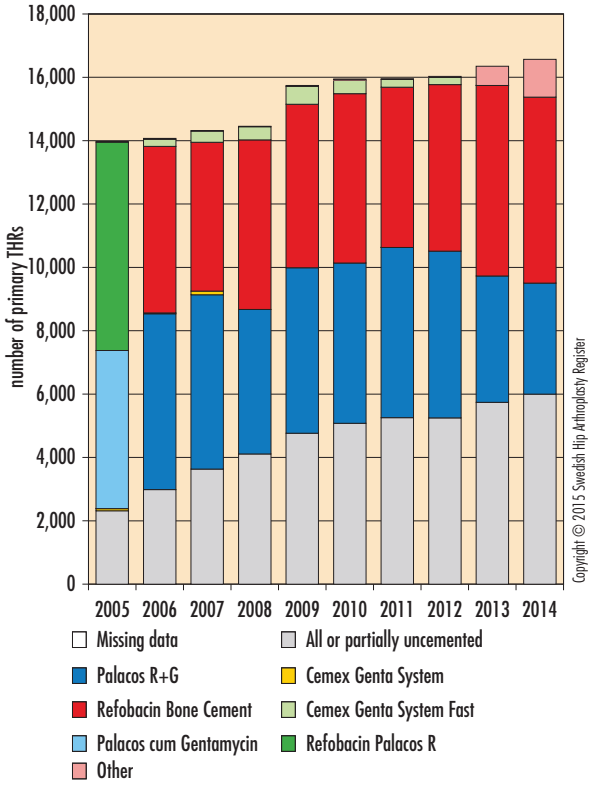
2,142 primary THRs, 203 revisions, 1979–2014



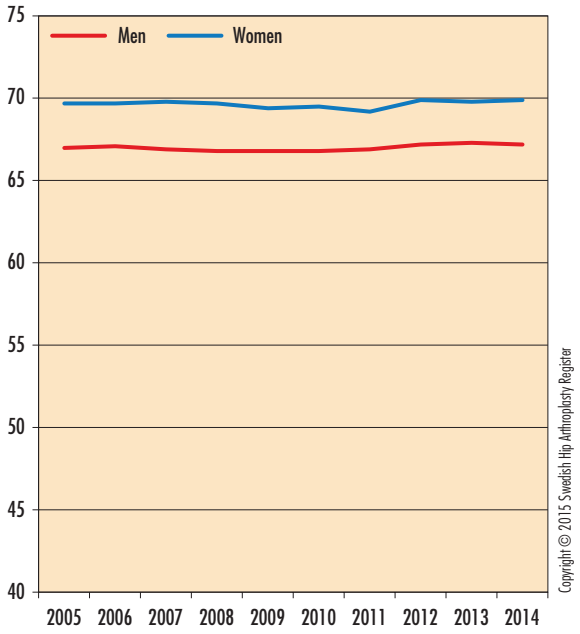
Surgical approach
2003–2014



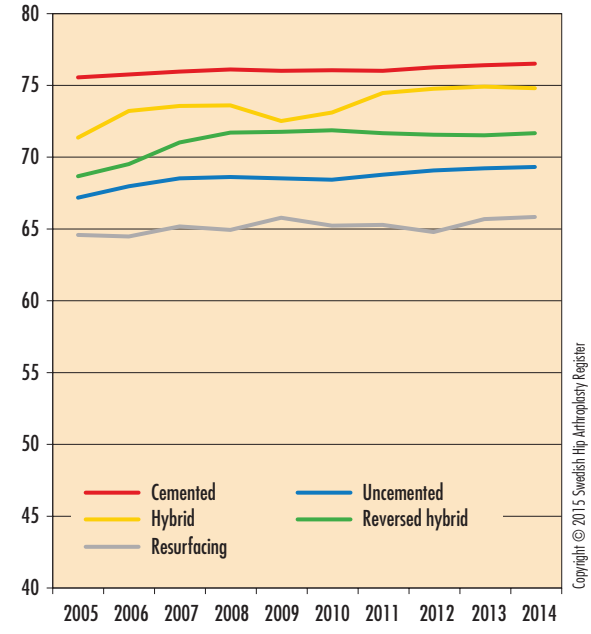
Type of cement
2003–2014



Mean age per gender
the past 10 years, 153,385 primary THRs

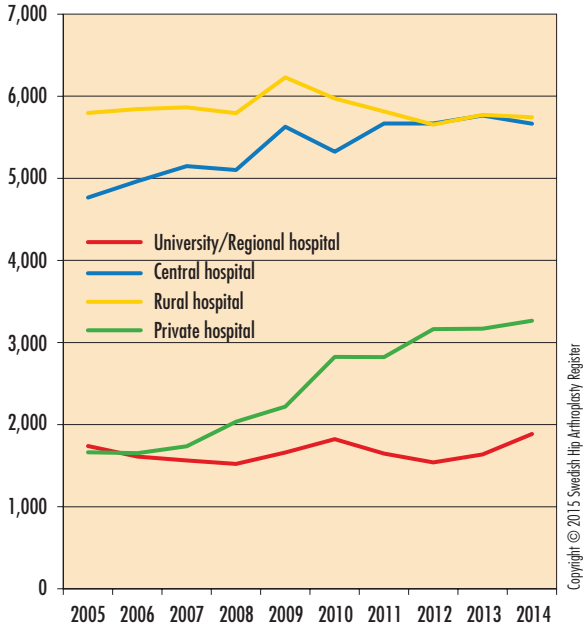


Mean age per type of fixation
the past 10 years, 153,385 primary THRs



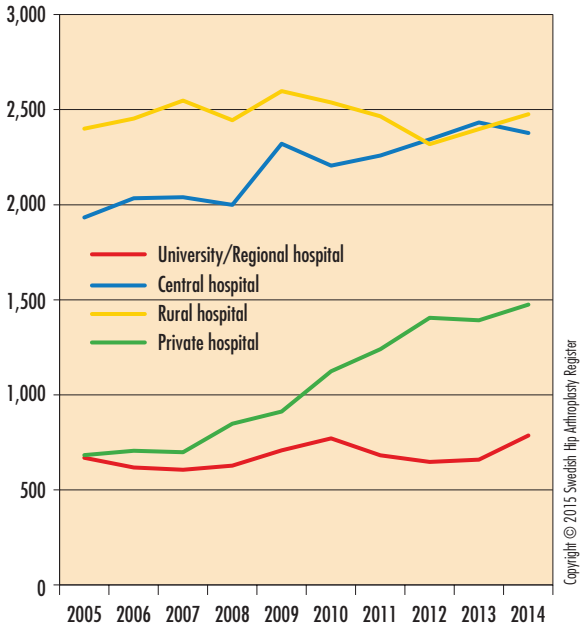
Trend in number of primary THRs

the past 10 years, per type of hospital



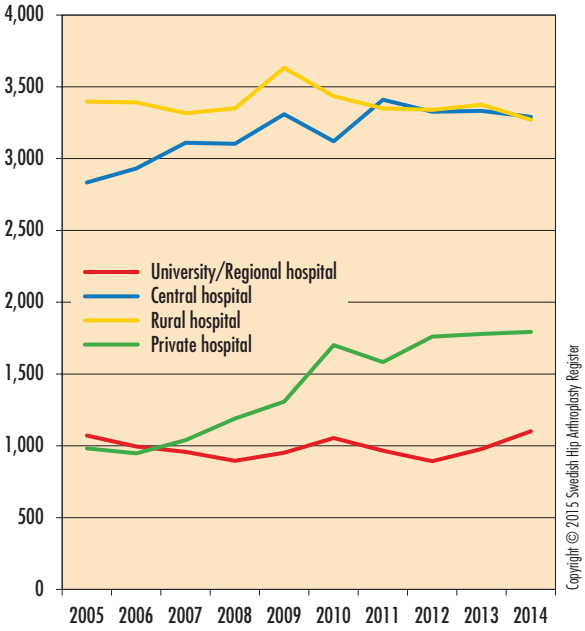
Trend in number of primary THRs

the past 10 years, men only



Trend in number of primary THRs

the past 10 years – women only



Primary prosthesis – in-depth analyses

"New" primary prosthesis

In the 1980s, the Swedish Hip Arthroplasty Register won international recognition due to the possibility to track deviations on both the level of clinics and implants. In the end, this means a development of a more streamlined process concerning operations and a more rigorous selection of implants. The possibilities to identify deviations with a well-functioning register have been developed by many other registers. In Britain, an expert group "the Orthopaedic Data Evaluation Panel" (ODEP) was formed to formulate new guidelines for assessment of new implants. The developed criteria have received international acclaim. A similar organization can also be found in the Australian National Joint Replacement Registry. In ODEP, the degree of evidence is divided into several classes. The highest level (10A) in this rating means that at least 500 hip replacement surgeries were performed in more than three centres, or by more than three different surgeons and those, who had not been involved in prosthetic development should be followed up after 10 years. Information should be known on all revisions, the number that could not be followed up and the number of deaths. Loss ("lost to follow-up") must not exceed 20%. After at least 10 years of follow-up, the proportion of revisions must be less than 5% or the implant survival must be 90% or higher according to Kaplan-Meier. A similar system exists in the Australian National Joint Replacement Registry where you divide the evaluation in three stages. The first stage consists of an automated screening, where the prostheses, which are compared with all others in the same group, and present a double risk of revision, are identified. In the second stage, those prostheses are examined, which have been discarded as deviant regarding possible causes for worse outcomes, for example abnormal patient selection. If this examination and a detailed statistical analysis do not fully explain the cause for the increased frequency of revisions, data from an expert panel will carry out further analyses and decide if a specific implant should be considered as inferior or not. (For details, refer to www.odep.org.uk and Acta Orthop. 2013 Aug; 84(4): 348–352).

In Sweden, we have had a restrictive approach towards replacement of standard implants for more than 20 years. This has been a very successful approach even if, in isolated cases, the introduction of new, and in some cases better materials or implants has been delayed. Today, there are no preclinical tests that can safely determine, whether a new prosthesis functions better or worse that the existing. The prostheses currently used in Sweden are of a very high standard, and in only selected patient groups could further implant development make a difference. Change of a standard implant also means taking a certain risk, because new procedures need to be learned. Against this background, it seems obvious that the replacement of implants should only be done in cases where there is a clinical need and the replacement implant has documented benefits. Service and price also play a role, though usually the price represents a small part of the total cost.

The procedure surrounding the implant evaluation is not simple and obvious. Most registers use revision for any reason and regardless of which component should be revised as an outcome. Some registers multiply the number of observed components with the number of observation years, which means that no attention is paid to the fact that causes for revision vary over time. Considering the way comparison with other prostheses is made, the comparison group can be comprised of all other implants, all other implants in the same product category or a selected reference group. So far, there has been no established standard. Such a standard is also not easy to achieve because the circumstances vary greatly between different registers with respect to the total number of observations, the number of implants used in the register's coverage area, the monitoring of the follow-up duration, and the extent of the individual register's data capture.

This year's follow-up of "new" implants differs somewhat from previous year's analysis. Similarly, to previous analysis, the outcome is not all types of revision, but only cup revision or extraction, or stem revision or extraction. Unlike previous years, the revision due to infection is excluded, since this outcome mainly reflects the care process and patient composition. Unlike previous years, a specific control group has been identified for the three implant groups, which have been studied (cemented and uncemented cup, uncemented stem). To be included in the control group, at least 50 implants must be followed up in at least 10 years and at least 50 of the same type must have been used in the last two years. The implants, which are included in the respective control group, are presented in Table 1. An implant is defined as new if less than 50 implants are reported in a 10-year follow-up period. Additionally, the number of prostheses, which were reported to the register in 2013-2014, must exceed 50. Several of these implants have a longer documentation abroad, but because the coverage and the risk of revisions can vary between countries, we believe that a domestic analysis is interesting and of value. Regarding cemented stems, there is no design that meets the criteria for the "new" prosthesis. The starting year, as indicated in Table 2 and 4, corresponds to the first year when more than 10 prostheses of the relevant type were inserted. All data is applicable from this year. Single prostheses inserted before "starting year" have thus been excluded. In the control group, the starting year has been set according to the first year of the observation group under the heading "new" implant. In the control group for "cemented cup", all implants are manufactured of older polyethylene. In the group for "uncemented cup", the corresponding proportion of older standard polyethylene is significantly lower (6.8%). Table 5 indicates the number of units that use a specific implant in the observation group at more than 10 and 50 hip replacement surgeries, respectively, to get an idea of the implant distribution in the country (only published digitally).

The majority of the cemented cups in the observation group shows an early implant survival with respect to the cup revision, which is comparable to the control group and in some cases slightly higher numerically. Two of the implants (Avantage, ZCA XLPE) differ significantly for the worse in terms of both two- and five-year survival. In the Avantage group, the cause for revision is dislocation in half the cases, which may seem surprising. The proportion of revision due to periprosthetic fracture is also relatively high. This complication

pattern fits well with a large proportion of patients with hip fracture in this group (62.5%, Table 3). The slightly worse result for Avantage could thus be explained by the fact that a large proportion of these patients has received dual articular cup because preoperative assessment concluded that the risk of dislocation is increased (see also in-depth analysis "Dual articular cup as primary prosthesis").

As in previous years, ZCA XLPE shows an increased risk for revision. Compared with the control group, the implant survival is only 0.4% lower, resulting in a statistical significance due to the large number of observations in both groups. Table 3 shows that this implant has a relatively high proportion of revision for dislocation. In the control group, 0.4% of the cups, which were inserted from 2006, were revised due to dislocation. In the ZCA XLPE group, the corresponding proportion was 0.7%. Regarding the proportion of revision for loosening, the relationship was exactly the opposite with 0.4% in the control group and 0.2% in the ZCA XLPE group. If the apparently increased risk of revision for dislocation in the ZCA XLPE group has something to do with its design, cannot be made on the basis of register data, but the occurrence of a greater proportion of revisions for dislocation may be of value to know for those who use this cup.

Among the uncemented cups, several designs have disappeared from the analysis, because the use of those cups had decreased to under 50 cups during the past two years. This applies for Furlong, Full Hemisphere, Ranawat-Burstein and Reflection HA. The majority of the uncemented cups, which were introduced since 2004, have so far shown an incidence of short-term complication in line with the reference group. As in last year's analysis, Continuum and TM modular differ significantly from the control group, even though the revision cause infection in this year's analysis, is excluded. In both cases, the cause is undoubtedly an increased number of revisions due to dislocation, usually an early complication in which the surgical technique and the ability to place the cup in the desired position can play a major role. Trilogy IT, also a cup with the surface of trabecular metal, shows a high number of revisions due to dislocation. The follow-up time is short, only 39 cases were observed in two years, so no survival analysis has been carried out.

Internationally, the separate studies have expressed some concern about the occurrence of clearing zones around cups of trabecular metal. This has mainly concerned design with trabecular titanium surface, like Pinnacle/Gription, Regenerex and Tritanium. However, in our analysis, the implant survival is within expected levels, although the follow-up time is still very short.

In this year's analysis of "new" stems, similarly to previous analysis, only uncemented variations are included, because no new cemented stems have been added, where the number has exceeded the arbitrarily set limit of 50 operations, in 2013-2014. In the group for uncemented stems, the latest modification of the Bi-Metric stem (Bi-Metric X Por HA) was moved from the observation group to the control group, where follow-up time for more than 50 implants exceeds 10 years. At 10 years, the stem survival is based on stem revision due to all types of non-infectious causes for this implant 98.2±0.5%. Symax and Taperloc have been removed from the list only because of decreased usage (<50 operations 2013–2014). Of the stems, which are still found in the observation group, none has an implant survival, which would significantly differ from the control group. The lowest value at five years was noted for CFP and the highest for Corail (all versions). The number of inserted CFP stems, which were followed for five years, is however, still relatively low (n=168).

During the past decade, mostly new uncemented cups and stems have been introduced in Sweden. Regarding the cemented cups, this has mainly been a transition to modern highly cross-linked polyethylene, which in single cases, also involved changes in the cup design. The majority of the new implants have a short follow-up and the implant survival is comparable to the control group. Two cemented (Avantage, ZCA XLPE) and two uncemented cups (Continuum, TM revision) have a significantly lower survival rate, where increased risk for revision due to dislocation seems to be main reason at least in three cases. If the worse outcome for these four implants are determined by patients' composition, inadequate surgical technique or implant design and inherent properties cannot be assessed in this analysis.

Composition of control groups

Cemented cup	Number	Uncemented cup	Number	Uncemented stem	Number
Contemporary	2,962	Allofit	1,520	ABG II HA	2,691
Contemporary Hooded Duration	6,634	Trilogy±HA	8,033	Bi-Metric X Por HA	6,733
Elite Ogee	5,479			CLS	9,382
FAL	3,029			Wagner Cone	1,204
Lubinus	42,778				
ZCA	966				
Total	61,848		9,553		20,010

Table 1. Implant in the control groups in the analysis of "new" implants in Table s 2 and 4.

Follow-up, number of revisions and implant survival for "new" cups

	Starting year*	Number		Follow-up in number of years	Cup revisions#, number %		Implant survival# cup/liner, 95 % ± C.I.	
		Total	after 2 years	mean, max	Total	≤ 2 years	2 years	5 years
Cup cementerad								
Avantage	**2006**	**1,225**	**412**	**1.9** 8.7	**20** 1.6	**17** 1.4	**97.9** 1.0	**97.4** 1.5
Exceed ABT no flange	2011	305	121	1.7 *3.8*	0 *0*	0 *0*	–	–
Exeter X3 RimFit	2010	6,269	2,653	1.8 *4.4*	13 *0.2*	11 *0.2*	99.9 *0.1*	–
FAL x-link	2011	249	122	1.9 *3.8*	0 *0*	0 *0*	100 *0.0*	–
Lubinus x-link	2010	8,680	2,187	1.4 *4.1*	22 *0.3*	21 *0.2*	99.7 *0.2*	–
Lubinus IP x-link	2011	336	81	1.2 *3.8*	2 *0.6*	2 *0.6*	99.2 *1.2*	–
Marathon	2008	12,033	7,393	2.6 *6.2*	42 *0.3*	28 *0.2*	99.6 *0.1*	99.5 *0.2*
Polarcup	2010	330	120	1.7 *5.6*	2 *0.6*	1 *0.3*	99.7 *0.6*	–
ZCA XLPE	**2006**	**13,347**	**10,127**	**3.7** 9.0	**147** 1.1	**93** 0.7	**99.1** 0.2	**98.6** 0.3
Control group	2006	61,848	51,584	4.8 *9.0*	597 *1.0*	245 *0.4*	99.5 *0.1*	99.0 *0.1*
Cup uncemented								
Allofit Alloclastic	2011	142	89	2.3 *3.9*	2 *1.4*	2 *1.4*	98.5 *0.2*	–
Continuum	**2010**	**2,155**	**662**	**1.6** 4.9	**23** 1.1	**23** 1.1	**98.6** 0.6	**–**
Delta Motion	2011	158	83	2.1 *3.9*	0 *0*	0 *0*	100 *0.0*	–
Delta TT	2012	167	21	1.1 *2.9*	2 *1.2*	2 *1.2*	–	–
Exceed Ringloc	2011	843	304	1.6 *3.8*	1 *0.1*	1 *0.1*	99.9 *0.2*	–
Pinnacle 100	2007	1,455	871	2.7 *7.9*	13 *0.9*	6 *0.4*	99.3 *0.5*	98.3 *1.1*
Pinnacle sector	2006	528	351	3.7 *9.0*	8 *1.5*	2 *0.4*	99.3 *0.8*	98.5 *1.4*
Pinnacle W/Gription 100	2011	243	11	0.8 *2.3*	2 *0.8*	2 *0.8*	–	–
Pinnacle W/Gription sector	2014	57	–	0.2 *1.0*	0 *0*	0 *0*	–	–
Regenerex	2008	523	300	2.6 *6.6*	3 *0.5*	0 *0*	100 *0.0*	98.9 *1.2*
TM modular	2006	550	450	4.1 *8.7*	4 *0.7*	4 *0.7*	99.3 *0.7*	99.3 *0.7*
TM revision	**2008**	**332**	**199**	**2.5** 7.0	**7** 2.1	**7** 2.1	**97.7** 1.7	**–**
Trident AD LW	2004	715	541	4.5 *10.8*	12 *1.7*	7 *1.0*	98.9 *0.8*	97.9 *1.2*
Trident AD WHA	2004	1,244	993	5.1 *10.8*	25 *2.0*	14 *1.1*	98.6 *0.4*	97.9 *0.5*
Trident hemi	2005	2,028	1,174	3.2 *9.6*	17 *0.8*	6 *0.3*	99.5 *0.4*	98.8 *0.7*
Trilogy IT	2013	554	39	1.0 *3.2*	12 *2.2*	12 *2.2*	–	–
Tritanium	2010	464	271	2.4 *5.0*	4 *0.9*	2 *0.4*	99.5 *0.7*	–
Control group	2004	9,553	8,110	5.4 *11.0*	61 *0.6*	106 *1.1*	99.3 *0.2*	98.9 *0.2*

** The first year when more than 10 implants were used. #all causes apart from infection, data is presented only for at least 50 observations.*

Table 2. Cups which were introduced on the Swedish market from 2004 and onwards 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 2014. Bold text indicates that the outcome differs from the worse outcome in the group "other" (log rank test).

Demographics and cause for revision for "new" cups and their control groups

	Age	Gender	Diagnosis %	Cause for revision Number % #			
	Mean SD	Women %	Primary osteoarthritis/ fracture/ Other secondary osteoarthritis	Loosening/ osteolysis	Dislocation	Periprosthetic fracture	Other*
Cemented							
Avantage	75.4 *11.5*	63.3	21.3/62.5/16.2	1 *(5.0)*	10 *(50.0)*	5 *(25.0)*	4 *(20.0)*
ZCA	71.0 *9.1*	63.4	84.8/10.1/5.1	28 *19.2*	90 *61.6*	7 *4.8*	21 *14.4*
Control	71.0 *9.0*	61.0	84.1/10.6/5.4	246 *41.2*	266 *44.6*	20 *3.4*	60 *10.1*
Uncemented							
Continuum	60.6 *10.7*	49.0	86.3/2.3/11.4	0 *(0)*	21 *(91.3)*	0 *(0)*	4 *(17.4)*
TM revision	58.7 *12.8*	44.9	68.4/3.9/27.7	0 *(0)*	7 *(100)*	0 *(0)*	0 *(0)*
Trilogy IT	64.0 *11.4*	49.3	85.4/3.6/11.0	0 *(0)*	10 *(83.3)*	2 *(16.7)*	0 *(0)*
Control	58.2 *10.8*	48.4	82.0/4.4/13.9	24 *22.6*	58 *54.7*	8 *7.5*	16 *15.1*

*# percentage in parenthesis when the number is <100, * excluding infection*

Table 3. Demographic data and the cause for the revision of the implants were analysed in Table 1 and have a significantly different or inferior implant survival or they are distinguished by a high number of the cup/liner revisions.

Follow-up, number of revisions and prosthesis survival for "new" stems

	Starting year*	Number		Follow-up mean max	Stem revisions#, number %		Implant survival¤ stem, 95% ± C.I.	
		Total	after 2 years	years	Total	< 2 years	2 years	5 years
Stem uncemented								
Accolade straight	2004	1,812	1,510	4.6 *10.8*	26 *1.4*	18 *1.0*	99.0 *0.5*	98.5 *0.6*
Accolade II	2012	621	45	0.9 *2.9*	1 *0.2*	1 *0.2*	99.8 *0.3*	–
CFP	2005	400	294	4.1 *9.9*	11 *2.8*	7 *1.8*	98.0 *1.5*	97.1 *0.2*
Corail *all*	2005	13,124	7,850	2.8 *10.0*	122 *0.9*	100 *0.8*	99.1 *0.2*	98.7 *0.3*
Standard	2006	8,618	5,136	2.8 *9.0*	82 *1.0*	73 *0.8*	99.9 *0.1*	98.7 *0.4*
Coxa vara	2006	1,915	1,088	2.8 *8.9*	15 *0.8*	11 *0.6*	99.3 *0.4*	99.0 *0.6*
High offset	2006	2,576	1,611	2.9 *9.0*	25 *1.0*	16 *0.6*	99.3 *0.4*	98.4 *0.7*
Fitmore	2009	280	168	2.5 *6.0*	6 *2.1*	5 *1.8*	98.1 *1.6*	–
M/L Taper	2012	521	42	1.1 *2.8*	0 *0.0*	0 *0.0*	–	–
Control	2004	20,010	15,783	4.8 *10.9*	285 *1.4*	208 *1.0*	98.9 *0.2*	98.5 *0.2*

** The first year when more than 10 implants were used, for other groups, the starting year is arbitrarily set at 2004 corresponding the earliest of the other groups. #all causes excluding infection, data is presented only for at least 50 observations.*

Table 4. Stems, which were introduced on the Swedish, market from 2004 and onwards 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 2014. The implant survival has been calculated on the number of observations at two and five years, respectively, exceeds 50. No stems differ significantly for the worse in comparison with the group "other" (log rank test).*

Reoperation

Reoperation includes all kinds of surgical intervention that can be directly related to an inserted hip arthroplasty irrespective of whether the prosthesis or one of its parts has been exchanged, extracted or left untouched. The proportion of reoperations in relation to the total number of primary total hip replacements performed and the number of reoperations has since 1992 stayed relatively stable and constituted about 12–13% (Figure 1). The number of performed operations has thus followed the increase of primary hip arthroplasty (Figure 2). The relation between reoperations and primary operations gives some idea of the extent of the burden reoperations put on health care resources for hip arthroplasty in one country or in one area, but it is not suitable to use for other purposes due to its sensitivity to fluctuations in the number of performed primary operations. The quota is also affected by many other factors such as patient flow between healthcare departments, the medical professionals' attitude to performing revision surgery as well as the period of time that total hip replacement has been practiced in a certain healthcare department. The reporting of reoperations is probably inferior to that of primary operations. This particularly applies to the operations where the implant is left untouched, such as the irrigation and debridement of infection and plate osteosynthesis due to periprosthetic fracture. In previous annual reports, we have highlighted this problem, which is being studied in Viktor Lindgrens thesis. A similar report on the under-reporting of periprosthetic fractures, which is also based on combining the Patient Register, is currently being worked on by Georgios Chatziagorou.

Restructuring of healthcare has led to the situation where the quota for reoperations/primary operations at mainly university and to some extent at regional hospitals has increased (refer to the previous annual report). The breakdown of reoperations between the four different types of hospitals has been more constant. During the past three years, however, there was a weak trend that the university hospitals performing more and central hospitals slightly fewer operations (Figure 3).

The demographics for patients who undergo reoperation has changed over time. Proportion for women has increased marginally. Compared with the period 1979-1992, the mean age has increased by about four years. Above all, the proportion of patients over 85 years has become larger. From 1979 to 1993, when their proportion was 2.7%, there has been an increase, which over the past seven years constituted 11.5% of all reoperations. The proportion of primary osteoarthritis has remained relatively unchanged at just over 70%, while the proportion who were operated primarily due to fracture or fracture sequelae has declined and the group that primarily underwent surgery because of inflammatory osteoarthrosis has increased.

Compared to the group of primary surgeries performed from 2008 to 2014, the proportion of women who underwent reoperation during the same time was smaller, and these patients were on average just over three years older, which is apparent, if one looks at the percentage breakdown of the age groups. BMI is about the same in the reoperation group as in the group for primary operations, but significantly greater proportion of patients, who underwent reoperation, has been classified as ASA class III or higher (42.5%) compared with the group of primary operations (18.4%). Patients undergoing

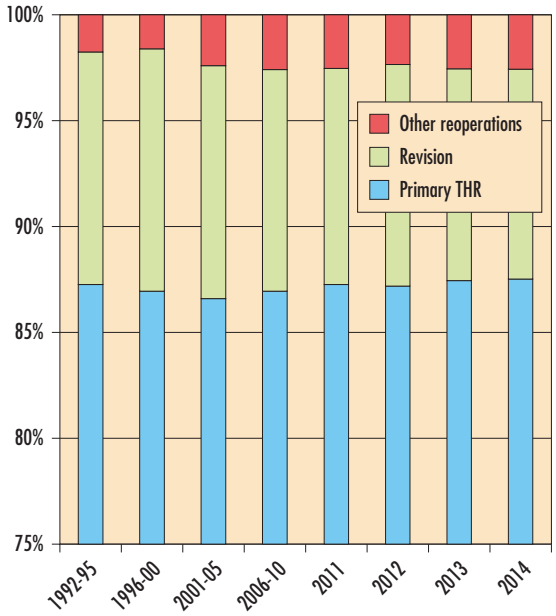


Figure 1. Proportion of the re-reoperated (revision + other reoperation) relative to the total hip arthroplasty-related operations during selected years 1992–2014. Note that the y-axis scale is adjusted and starts at 75%.

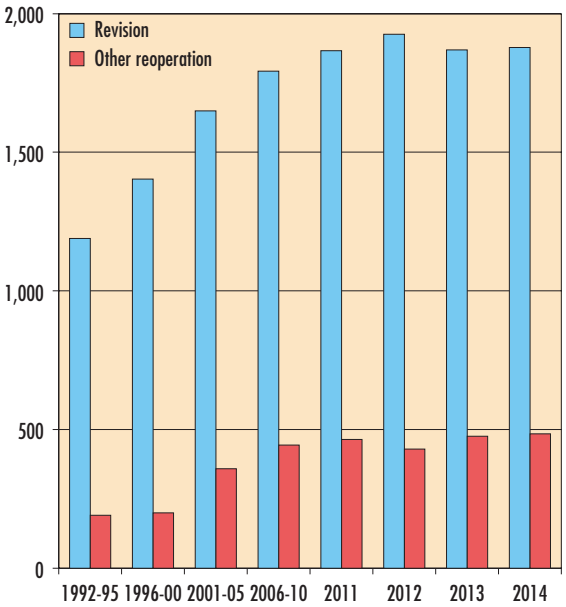


Figure 2. The total number of reoperations in the period 1992–2014. For intervals spanning several years, an average is presented.

reoperation are also considerably more likely to have some form of secondary osteoarthritis. This is especially true for the group for inflammatory joint disease, sequelae hip disease during childhood and, to a lesser extent, in patients with idiopathic femoral head necrosis, but not for the fracture group. This, compared to primary operations' low proportion of fracture diagnosis in reoperations group, should be weighed against the fact that these patients have a high mortality.

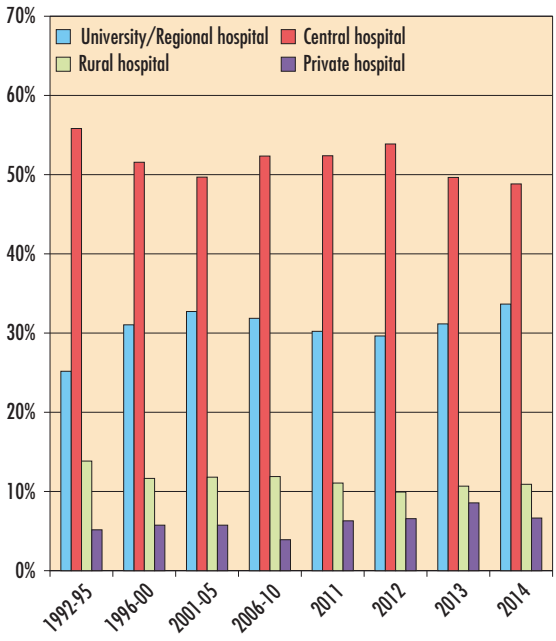


Figure 3. Distribution of reoperations between different types of hospitals between 1992 and 2014.

Reoperation without changing the implant/extraction

The most common reason for surgery without replacement or extraction of all or part of the implant has since 2012 been infection followed by fracture. During the early 2000s, dislocation was the third most common cause (Figure 4), but is listed as the cause in only 11 cases (2.3%) in 2014. The reason for this may be that, today, some type of revision is performed, which means replacing some or several parts of the prosthesis. Under-reporting can also play a role but this is probably a general problem regarding reoperations without implant influence. Exploration of the joint with or without soft tissue measures because of pain was reported in 34 cases during 2014 (7.1%). During the three preceding years, only 10 to 13 cases per year were reported.

The usual approach in surgery, where the implant is left untouched, were different types of wound revision, a relatively heterogeneous group that includes fistula extraction and synovectomy (approximately 30-40 cases of 200 to 250 wound revisions per year during 2011-2014, Figure 5). The second most common measure has been fracture reconstruction, during the last three years about 100 cases per year were reported. The five most common stems, which were then left in connection with fracture construction, have during 2001 to 2014 been Exeter (28.2%), Lubinus (25.8%), Charnley (13.3%), CPT (4.7%) and Spectron EF (4.1%). The same five cemented stems topped the list during the period 2011-2014, probably because these designs have been used for a long time for a large number of patients. Operations with socket wall addition in order to counteract the dislocation, were reported in approximately 40-50 cases per year, between 1990 and 2005, but have since been phased out and replaced by an increased use of alternative measures, like large femoral head and dual articular cup (see also "Revision").

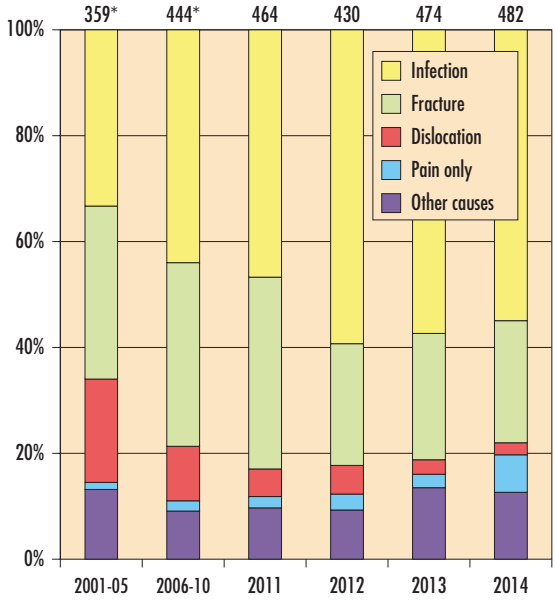


Figure 4. The most common reasons for reoperation in which the implant is left untouched during the periods 2001 to 2005 and 2006 to 2010 and subsequently annually. The reported number of reoperations without implant influences mentioned at the top of the average figures for the first two periods (*) and subsequently annually.

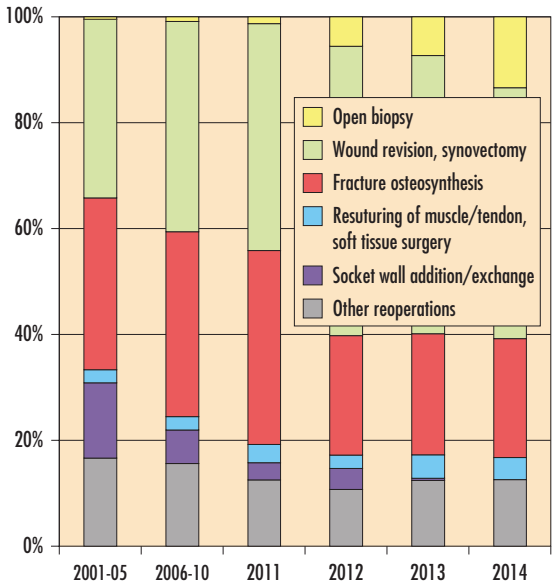


Figure 5. The most common measures at reoperation where the implant is left untouched during the periods 2001 to 2005 and from 2006 to 2010 and subsequently annually.

Demographics during reoperation (different periods) and primary operation (2008–2014)

	Reopereration			Primary operation
	1979–1993	1994–2007	2008–2014	2008–2014
Number	10,323	24,861	16,427	111,030
Gender				
Proportion of women %	50.8	53.2	52.0	58.2
Age				
Mean value *SD*	67.9 *11.1*	70.6 *11.6*	71.7 *11.4*	68.5 *10.8*
<55 years %	11.4	9.6	7.7	10.0
55–69 years %	37.2	30.2	31.1	41.1
70–84 years %	48.7	51.8	49.8	43.9
>=85 years	2.7	8.5	11.5	5.0
BMI %	–	–		
Mean value *SD*			27.2* *5.6*	27.1* *5.3*
<18.5	–	–	1.9	1.3
18.5–24.9	–	–	33.7	34.0
25–29.9	–	–	40.4	41.7
>=30	–	–	24.0	23.0
ASA %				
I	–	–	11.0	23.5¤
II	–	–	46.5	58.1
III-	–	–	42.5	18.4
Diagnosis during primary operation				
Primary osteoarthritis	73.0#	71.3#	74.1#	83.1
Fracture including sequelae	11.7	10.7	6.1	9.7
Inflammatory joint disease	7.9	8.5	9.0	1.4
Sequelae after childhood hip disorder	4.5	5.2	4.9	2.0
Femoral head necrosis	1.4	2.6	4.2	3.1
Other secondary osteoarthritis	1.5	1.7	1.7	0.7

**BMI: data for 3,327 reoperations and 9,213 primary operations is missing, ¤ ASA: all reoperations were reported but the data for 4,421 primary operations is missing, #15,245 and 125 observations are missing for the same interval for reoperations.*

Table 1. Gender and age distribution at reoperation for three periods and BMI and ASA class for the last period. Data for primary surgery is shown for the last period (2008-2014) for comparison. BMI and ASA class is registered only for the period 2008-2014.

Since 1979, reoperation patients have become older and the proportion of women has increased. These patients are also sicker than the patients undergoing primary surgery and have to a greater extent been operated on due to inflammatory joint disease, sequelae after childhood illness and femoral head necrosis.

Number of reoperations per procedure and year

primary THRs performed 1979–2014

Procedure at reoperation	1979–2009	2010	2011	2012	2013	2014	Total	Proportion
Revision	33,157	1,942	1,866	1,926	1,869	1,878	42,638	82.6%
Major surgical intervention	4,482	277	264	184	200	196	5,603	10.9%
Minor surgical intervention	2,175	184	200	246	276	289	3,370	6.5%
Missing	2	1	0	1	0	2	6	0%
Total	39,816	2,404	2,330	2,357	2,345	2,365	51,617	100%

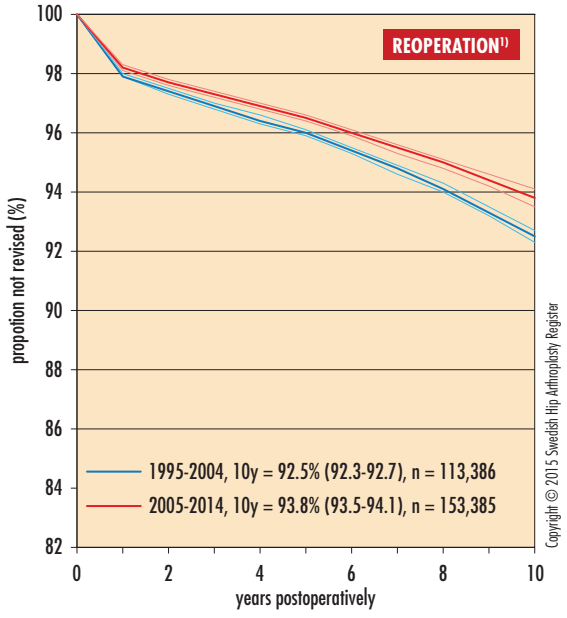
Number of reoperations per reason and year

primary THRs performed 1979–2014

Reason for reoperation	1979–2009	2010	2011	2012	2013	2014	Total	Proportion
Aseptic loosening	22,232	1,068	989	977	918	853	27,037	52.4%
Deep infection	4,510	429	485	553	577	624	7,178	13.9%
Dislocation	4,637	298	255	282	283	294	6,049	11.7%
Fracture	3,747	371	345	288	292	300	5,343	10.4%
2-stage procedure	1,648	103	97	83	85	101	2,117	4.1%
Technical error	1,059	61	70	65	50	61	1,366	2.6%
Others	1,013	32	37	51	92	59	1,284	2.5%
Implant fracture	543	23	32	27	20	21	666	1.3%
Pain only	386	19	18	29	21	46	519	1.0%
Secondary infection	5	0	1	0	0	1	7	0%
Missing	36	0	1	2	7	5	51	0.1%
Total	39,816	2,404	2,330	2,357	2,345	2,365	51,617	100%

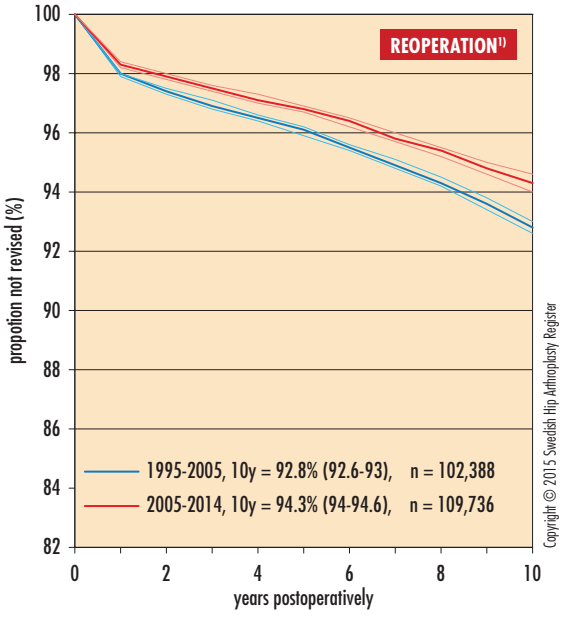
All implants

All diagnoses and all reasons



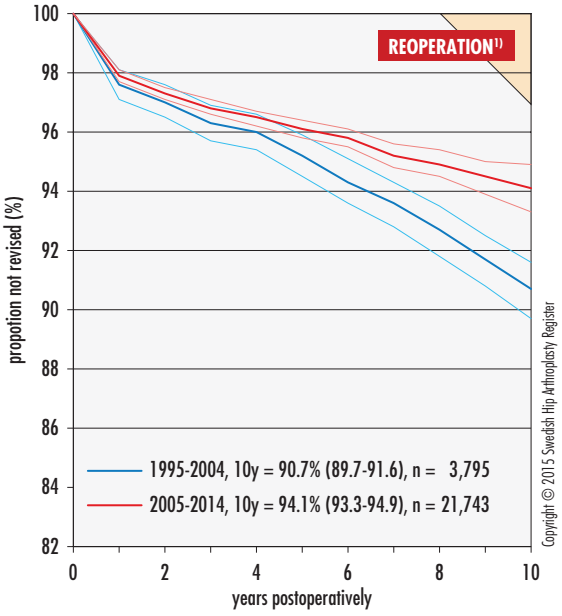
All cemented implants

All diagnoses and all reasons



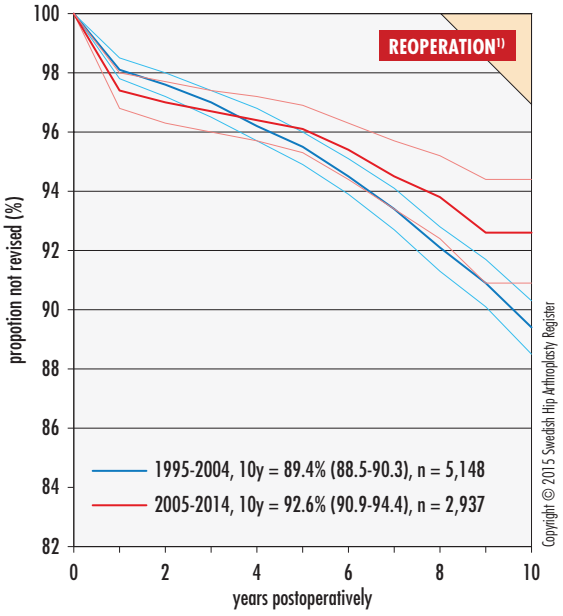
All uncemented implants

All diagnoses and all reasons



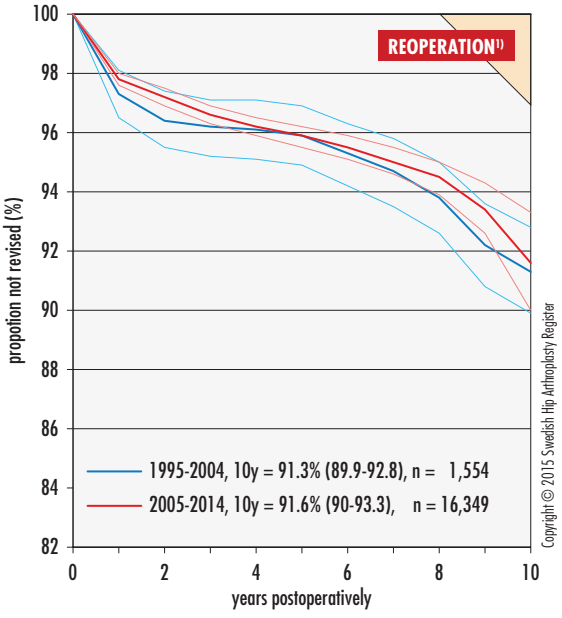
All hybrid implants

All diagnoses and all reasons



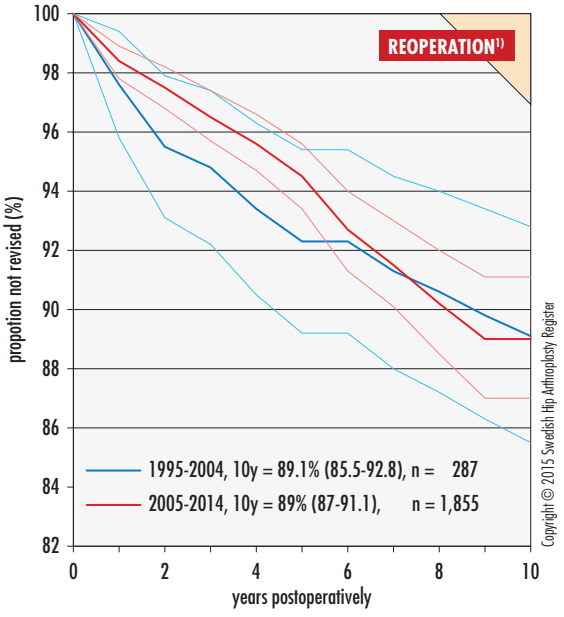
All reversed hybrid implants

All diagnoses and all reasons



All resurfacing implants

All diagnoses and all reasons



[1)] Survival statistics according to Kaplan-Meier with reoperation (all form of further surgery, including revision) as end-point definition.

Short-term complications – reoperations within 2 years

Reoperation within 2 years

Reoperation within two years is used as a quality indicator for primary hip arthroplasty. The background to this is that the most common causes for reoperation are mainly infection and dislocation. The distribution of the cause for early reoperation, and especially during the first year after primary surgery, has varied (Figure 6, left). In the 1990s, the most common causes for reoperation during the first year were dislocation and early loosening. Especially recently, early loosenings have been classified as "technical" errors, which is why this cause group has been merged with loosenings. The closer we get to the present, the more the situation will be dominated by infections. Most probably, the increased proportion of reoperations due to infection reflects a more active attitude towards surgical treatment. Moreover, if there is an increased incidence, it is not safe to make any assumptions, but it cannot be excluded either. During the second year after index operation, infection continued to dominate during the past three years (Figure 6, middle). The trend shows that infection causes are becoming more common even during the three years, between a three-year period 2006-2008 to 2012-2014, the proportion of infections has increased from 17.5 to 32.1% (Figure 6, right).

The proportion reopererated within two years, during the periods studied here varied between 1.9 and 3.5%. If also the third year is included, the limits increase so that they lie at 2.0 and 4.1% (Figure 7). It should be noted that all the patients who underwent operation between 2012 and 2014 have not passed two- and three-year limit and the proportion of patients, who were operated within two or three years, will increase. Until the period 2000–2005, the proportion of early reoperations decreased, from 3.5% in two years during the first period 1992-1995 down to 1.9%. Hereafter, the number rises, but appears to stay on a constant level just over 2%. Since reoperation in two years is a quality parameter, there may also be a reason to study whether there is any drift in indications, so that the problem, which could qualify for a surgical measure, is postponed. The existing data suggests a trend in the opposite direction. The proportion of reoperations carried out during the third year after primary operations, tends to decrease during the last period (2009-2011), where all patients were followed up in three years.

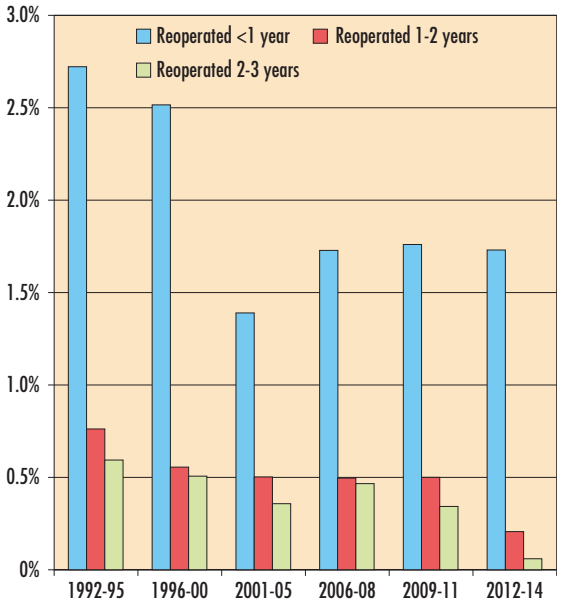


Figure 7. Proportion of reoperations in the first three years after the primary operation.

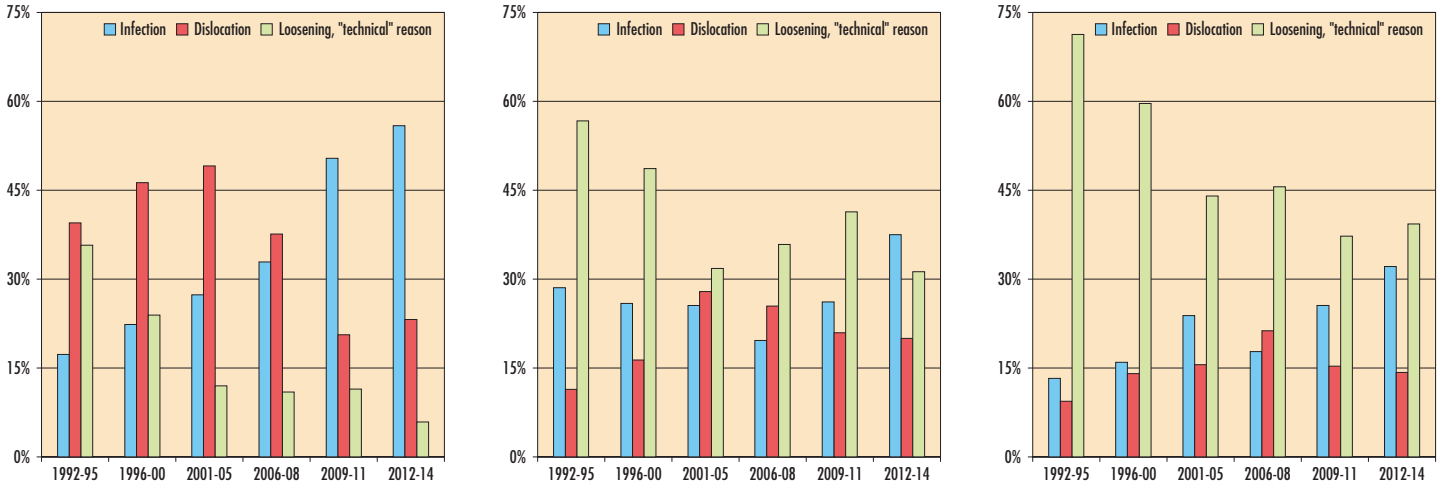


Figure 6. Distribution of the three most common causes for reoperation in the first, second and third year after primary operation, is divided into six periods between 1992 and 2014. Other causes (between 3 and 22%) were excluded for greater lucidity. The sum of the percentages in the diagrams is lower than 100.

Reoperation within 2 years refers to all forms of subsequent surgery to the hip after initiating total hip replacement. This variable reflects mainly early and serious complications such as deep infection and dislocation. This variable is therefore a faster indicator and easier to use for working on clinical improvement compared with 10-year survival, which is important, but a slow and, to some extent, historical indicator.

Reoperation within 2 years has been selected by SALAR and the Swedish National Board of Health and Welfare as a national quality indicator for this type of surgery and it has been included in Regional comparisons (Öppna jämförelser). This indicator should be seen as one of the most important and most responsive endpoints reported by the Swedish Hip Arthroplasty Register.

Definition

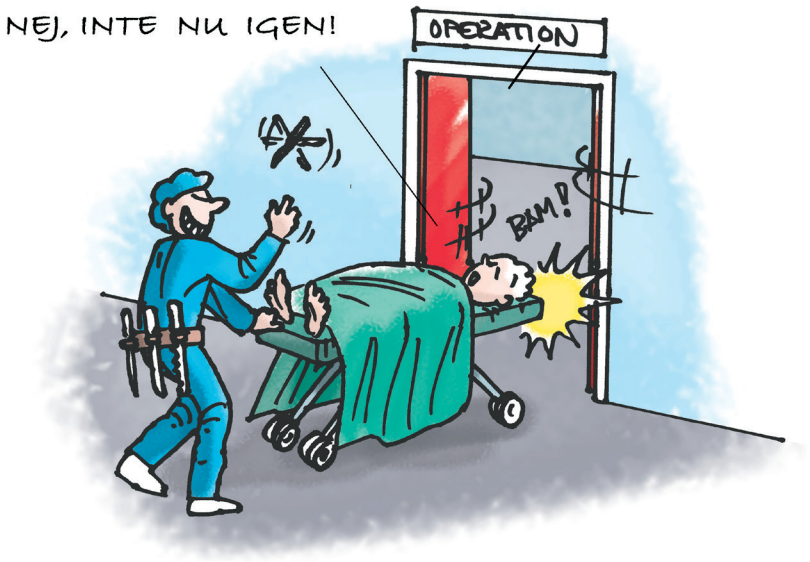
By short-term complication, we mean all forms of open surgery within two years after the primary operation. The latest 4-year period has been studied. Please note that the report only concerns complications that have been surgically dealt with. Infections treated with antibiotics and non-surgically treated dislocations are not captured in the Register. Patients who have been repeatedly operated on because of the same complication are presented as one complication. A number of patients are, however, operated on for different reasons within a short time (registered in those cases as several complications). Patients who undergo reoperation at a clinic that is not the primary clinic are counted as belonging to the primary clinic.

When interpreting results one should only compare units from the same type of hospital due to different patient demographics. Clinics that operate the more difficult cases with the greatest risk for complications may, of course, have a higher frequency. Apart from the hospitals' different risk profiles, the following factors must also be weighed into the interpretation of these results:

- Underreporting!
- The number of complications is generally low with chance variability having great impact on the results. This variable can really only be evaluated over time, that is to say if distinct trends exist – see separate trend table!
- Clinics that take a cautious stance (non-surgical treatment of for example infection and dislocation), which is to say that they avoid operation for these complications, are not registered in the database.
- Conversely, clinics that are surgically "aggressive" both at the suspicion of early infection and on initial dislocation, have high frequencies of early complications. The treatment algorithm in case of early suspicion of deep infection has changed during recent years, for both knee and hip arthroplasty. It is more and more common to intervene surgically.

The Register's management has completely avoided ranking and will never rank the various hospitals with consideration to this important result indicator. Since the number of complications in general is so low, a loss in registration can powerfully affect a unit's ranking position. Irrespective of hospital category and result, clinics should analyse their own complications (without sneaking a peek at the national average) and investigate whether or not systematic deficiencies exist – all to avoid serious complications for the individual patients.

All units should/must annually carry out in-depth analyses on all cases of reoperation in two years' time. Please contact the management of the Register before such analyses are carried out!



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Reoperations within 2 years per hospital[1)]

2011–2014

Hospital	Prim THRs	Patientes [2)]		Infection		Dislocation		Loosening		Others		Proportion with data on ASA&BMI
	Number	Number	%	Number	%	Number	%	Number	%	Number	%	
University/Regional hospitals												
Karolinska/Huddinge	1,040	17	1.6%	6	0.6%	2	0.2%	0	0	10	1.0%	98.5%
Karolinska/Solna	770	24	3.1%	14	1.8%	5	0.6%	0	0	8	1.0%	97.3%
Linköping	258	5	1.9%	4	1.6%	3	1.2%	0	0	3	1.2%	77.5%
SU/Mölndal	1,885	38	2.0%	25	1.3%	5	0.3%	0	0	16	0.8%	94.2%
SUS/Lund	638	18	2.8%	9	1.4%	5	0.8%	3	0.5%	5	0.8%	90.8%
SUS/Malmö	218	3	1.4%	1	0.5%	0	0%	0	0	2	0.9%	51.4%
Umeå	289	15	5.2%	9	3.1%	1	0.3%	0	0	6	2.1%	65.1%
Uppsala	1,040	36	3.5%	16	1.5%	8	0.8%	0	0	16	1.5%	95.5%
Örebro	551	11	2.0%	8	1.5%	0	0%	0	0	4	0.7%	98.5%
Central hospitals												
Borås	705	22	3.1%	12	1.7%	1	0.1%	0	0%	10	1.4%	98.6%
Danderyd	1,314	47	3.6%	20	1.5%	11	0.8%	0	0%	22	1.7%	98.1%
Eksjö	797	16	2.0%	13	1.6%	0	0%	0	0%	5	0.6%	89.2%
Eskilstuna	490	15	3.1%	7	1.4%	4	0.8%	0	0%	5	1.0%	99.8%
Falun	1,442	22	1.5%	16	1.1%	2	0.1%	0	0%	7	0.5%	98.9%
Gävle	882	37	4.2%	15	1.7%	6	0.7%	3	0.3%	16	1.8%	92.2%
Halmstad	948	18	1.9%	12	1.3%	4	0.4%	1	0.1%	4	0.4%	92.7%
Helsingborg	313	8	2.6%	4	1.3%	4	1.3%	0	0%	0	0%	91.7%
Hässleholm-Kristianstad	3,074	53	1.7%	41	1.3%	2	0.1%	1	0%	20	0.7%	89.7%
Jönköping	783	10	1.3%	7	0.9%	1	0.1%	0	0%	6	0.8%	98.7%
Kalmar	612	7	1.1%	3	0.5%	1	0.2%	0	0%	2	0.3%	98.0%
Karlskrona	132	4	3.0%	0	0%	4	3.0%	0	0%	0	0%	98.5%
Karlstad	1,012	46	4.5%	35	3.5%	4	0.4%	1	0.1%	7	0.7%	87.1%
Norrköping	987	10	1.0%	6	0.6%	1	0.1%	0	0%	5	0.5%	87.0%
Skövde	739	12	1.6%	10	1.4%	1	0.1%	0	0%	3	0.4%	91.1%
Sunderby (incl. Boden)	132	3	2.3%	2	1.5%	1	0.8%	0	0%	0	0%	31.8%
Sundsvall	779	28	3.6%	18	2.3%	9	1.2%	1	0.1%	8	1.0%	89.5%
Södersjukhuset	1,603	44	2.7%	22	1.4%	4	0.2%	2	0.1%	24	1.5%	99.1%
Uddevalla	1,459	17	1.2%	7	0.5%	4	0.3%	0	0%	6	0.4%	82.7%
Varberg	935	12	1.3%	5	0.5%	4	0.4%	0	0%	5	0.5%	91.0%
Västerås	1,886	67	3.6%	39	2.1%	15	0.8%	0	0%	20	1.1%	86.8%
Växjö	576	10	1.7%	5	0.9%	5	0.9%	0	0%	2	0.3%	96.2%
Östersund	1,154	27	2.3%	16	1.4%	3	0.3%	1	0.1%	8	0.7%	93.7%

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Reoperations within 2 years per hospital[1] (cont.)

2011–2014

Hospital	Prim THRs	Patientes [2]		Infection		Dislocation		Loosening		Others		Proportion with data on ASA&BMI
	Number	Number	%	Number	%	Number	%	Number	%	Number	%	
Rural hospitals												
Alingsås	849	15	1.8%	10	1.2%	3	0.4%	0	0	3	0.4%	100%
Arvika	731	12	1.6%	12	1.6%	0	0%	0	0	2	0.3%	91.8%
Bollnäs	371	9	2.4%	6	1.6%	1	0.3%	0	0	2	0.5%	100%
Enköping	1,284	26	2.0%	14	1.1%	8	0.6%	1	0.1%	13	1.0%	99.8%
Frölunda Specialistsjukhus	344	2	0.6%	0	0%	2	0.6%	0	0	0	0%	0%
Gällivare	385	3	0.8%	2	0.5%	1	0.3%	0	0	1	0.3%	93.2%
Hudiksvall	522	11	2.1%	7	1.3%	0	0%	0	0	6	1.1%	94.8%
Karlshamn	922	14	1.5%	5	0.5%	6	0.7%	0	0	3	0.3%	100%
Karlskoga	621	7	1.1%	4	0.6%	2	0.3%	0	0	3	0.5%	96.1%
Katrineholm	949	17	1.8%	12	1.3%	1	0.1%	0	0	5	0.5%	100%
Kungälv	676	18	2.7%	11	1.6%	1	0.1%	0	0	9	1.3%	99.4%
Lidköping	901	7	0.8%	4	0.4%	0	0%	0	0	4	0.4%	98.9%
Lindesberg	877	7	0.8%	2	0.2%	2	0.2%	0	0	3	0.3%	97.8%
Ljungby	663	9	1.4%	2	0.3%	3	0.5%	0	0	7	1.1%	99.7%
Lycksele	1,176	18	1.5%	7	0.6%	4	0.3%	0	0	8	0.7%	93.9%
Mora	851	9	1.1%	6	0.7%	4	0.5%	0	0	3	0.4%	91.8%
Norrtälje	451	12	2.7%	6	1.3%	4	0.9%	1	0.2%	3	0.7%	99.6%
Nyköping	640	39	6.1%	34	5.3%	7	1.1%	0	0	8	1.3%	90.9%
Oskarshamn	933	6	0.6%	6	0.6%	0	0%	0	0	0	0%	99.8%
Piteå	1,466	14	1.0%	10	0.7%	3	0.2%	0	0	3	0.2%	100%
Skellefteå	432	5	1.2%	2	0.5%	1	0.2%	1	0.2%	1	0.2%	98.8%
Skene	497	7	1.4%	1	0.2%	3	0.6%	0	0	3	0.6%	99.6%
Sollefteå	483	4	0.8%	1	0.2%	3	0.6%	0	0	1	0.2%	94.4%
Södertälje	417	19	4.6%	10	2.4%	3	0.7%	1	0.2%	7	1.7%	96.6%
Torsby	432	8	1.9%	6	1.4%	1	0.2%	0	0	4	0.9%	98.6%
Trelleborg	2,462	29	1.2%	15	0.6%	4	0.2%	2	0.1%	10	0.4%	93.9%
Visby	484	12	2.5%	1	0.2%	4	0.8%	1	0.2%	7	1.4%	94.4%
Värnamo	564	7	1.2%	4	0.7%	2	0.4%	0	0	3	0.5%	78.5%
Västervik	459	10	2.2%	6	1.3%	1	0.2%	0	0	3	0.7%	89.8%
Ängelholm	592	6	1.0%	1	0.2%	2	0.3%	0	0	3	0.5%	98.1%
Örnsköldsvik	557	5	0.9%	3	0.5%	1	0.2%	0	0	1	0.2%	92.3%

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Reoperationer inom 2 years per enhet[1] (cont.)

2010–2013

Hospital	Prim THRs	Patientes [2]		Infection		Dislocation		Loosening		Others		Proportion with data on ASA&BMI
	Number	Number	%	Number	%	Number	%	Number	%	Number	%	
Private hospitals												
Aleris Specialistvård Bollnäs	821	14	1.7%	11	1.3%	1	0.1%	0	0	4	0.5%	99.9%
Aleris Specialistvård Elisabethsjukhuset	173	2	1.2%	1	0.6%	1	0.6%	0	0	0	0%	99.4%
Aleris Specialistvård Motala	1,878	37	2.0%	25	1.3%	6	0.3%	0	0	11	0.6%	78.6%
Aleris Specialistvård Nacka	497	12	2.4%	8	1.6%	1	0.2%	0	0	4	0.8%	99.6%
Aleris Specialistvård Sabbatsberg	621	5	0.8%	5	0.8%	1	0.2%	0	0	2	0.3%	99.5%
Aleris Specialistvård Ängelholm	99	0	0%	0	0%	0	0%	0	0	0	0%	99.0%
Capio Movement	785	21	2.7%	6	0.8%	8	1.0%	0	0	8	1.0%	98.9%
Capio Ortopediska Huset	1,393	10	0.7%	5	0.4%	1	0.1%	1	0.1%	4	0.3%	99.6%
Capio S:t Göran	1,754	57	3.2%	34	1.9%	7	0.4%	1	0.1%	24	1.4%	98.1%
Carlanderska	548	11	2.0%	5	0.9%	1	0.2%	0	0	5	0.9%	96.2%
Ortho Center IFK-kliniken	542	1	0.2%	1	0.2%	0	0%	0	0	0	0%	100%
Ortho Center Stockholm	1,673	42	2.5%	28	1.7%	5	0.3%	1	0.1%	16	1.0%	99.9%
Sophiahemmet	783	12	1.5%	7	0.9%	1	0.1%	0	0	5	0.6%	99.1%
Spenshult	810	24	3.0%	7	0.9%	13	1.6%	0	0	6	0.7%	98.5%
Others	81	2	2.5%	1	1.2%	1	1.2%	0	0	0	0%	65.6%
Country	64,892	1,319	2.0%	761	1.2%	244	0.4%	23	0	473	0.7%	93.7%

Red marking denotes values one standard deviation above the national average.

[1] *Hermelinen Spec.vård, Art Clinic Jönköping, SU/Sahlgrenska and Ystad have been excluded due to too few operations performed or discontinued activity.*

[2] *Refers to number of patients with short-term complications which may differ from the sum of complications since each patient may have more than one type of complication.*

Reoperations within 2 years per hospital[1] – trend

primary operation 2007–2014

Hospital	2007–2010	2008–2011	2009–2012	2010–2013	2011–2014[2]
University/Regional hospitals					
Karolinska/Huddinge	2.6%	2.3%	2.1%	2.0%	1.6%
Karolinska/Solna	4.3%	3.0%	2.6%	3.1%	3.1%
Linköping	1.3%	1.6%	2.0%	2.4%	1.9%
SU/Mölndal	3.8%	3.6%	2.7%	2.4%	2.0%
SUS/Lund	3.1%	3.0%	2.7%	2.9%	2.8%
SUS/Malmö	2.2%	1.8%	1.7%	2.0%	1.4%
Umeå	2.2%	3.4%	3.6%	4.5%	5.2%
Uppsala	3.2%	3.2%	3.2%	2.8%	3.5%
Örebro	1.9%	1.9%	2.4%	2.4%	2.0
Central hospitals					
Borås	2.7%	3.1%	3.1%	2.8%	3.1%
Danderyd	4.0%	4.4%	3.7%	3.8%	3.6%
Eksjö	2.5%	2.3%	2.5%	2.0%	2.0%
Eskilstuna	2.0%	2.0%	2.5%	3.4%	3.1%
Falun	2.3%	2.1%	2.1%	2.0%	1.5%
Gävle	5.3%	6.0%	5.5%	4.6%	4.2%
Halmstad	2.8%	3.3%	3.1%	2.6%	1.9%
Helsingborg	2.0%	1.6%	1.8%	2.9%	2.6%
Hässleholm-Kristianstad	2.0%	2.0%	2.0%	1.8%	1.7%
Jönköping	1.6%	1.7%	1.6%	1.4%	1.3%
Kalmar	2.2%	1.8%	1.7%	1.1%	1.1%
Karlskrona	1.8%	0.9%	2.2%	2.0%	3.0%
Karlstad	3.8%	4.8%	5.2%	5.5%	4.5%
Norrköping	1.3%	1.3%	1.1%	0.8%	1.0%
Skövde	1.3%	0.8%	1.3%	1.4%	1.6%
Sunderby (incl. Boden)	4.4%	3.9%	4.1%	1.5%	2.3%
Sundsvall	4.3%	4.7%	3.4%	3.3%	3.6%
Södersjukhuset	2.9%	2.7%	3.0%	3.0%	2.7%
Uddevalla	2.2%	1.8%	1.7%	1.5%	1.2%
Varberg	1.7%	1.6%	1.5%	1.4%	1.3%
Västerås	4.2%	4.1%	3.9%	3.8%	3.6%
Växjö	0.8%	2.1%	2.3%	2.4%	1.7%
Östersund	2.8%	2.8%	2.9%	2.8%	2.3%

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Reoperations within 2 years per hospital[1)] – trend (cont.)

primary operation 2007–2014

Hospital	2007–2010	2008–2011	2009–2012	2010–2013	2011–2014[2)]
Rural hospitals					
Alingsås	2.0%	2.4%	2.0%	1.9%	1.8%
Arvika	2.9%	2.8%	2.1%	2.3%	1.6%
Bollnäs	1.2%	1.3%	1.4%	1.7%	2.4%
Enköping	3.3%	2.7%	2.0%	2.2%	2.0%
Frölunda Specialistsjukhus	3.5%	2.2%	1.8%	1.5%	0.6%
Gällivare	0.8%	1.3%	1.3%	1.3%	0.8%
Hudiksvall	2.9%	2.5%	2.6%	2.7%	2.1%
Karlshamn	1.3%	1.1%	1.3%	1.5%	1.5%
Karlskoga	1.0%	1.0%	0.9%	1.0%	1.1%
Katrineholm	1.4%	1.8%	2.0%	1.9%	1.8%
Kungälv	1.8%	1.8%	2.2%	2.4%	2.7%
Lidköping	0.4%	0.7%	1.0%	0.8%	0.8%
Lindesberg	1.8%	1.0%	1.0%	0.8%	0.8%
Ljungby	1.2%	1.1%	1.0%	1.1%	1.4%
Lycksele	1.6%	1.7%	1.8%	1.8%	1.5%
Mora	1.4%	1.1%	0.8%	0.9%	1.1%
Norrtälje	2.3%	3.4%	3.5%	3.1%	2.7%
Nyköping	3.8%	5.1%	6.3%	6.9%	6.1%
Oskarshamn	1.7%	1.7%	1.4%	1.0%	0.6%
Piteå	1.4%	1.2%	1.3%	0.9%	1.0%
Skellefteå	1.1%	1.1%	1.1%	1.2%	1.2%
Skene	2.2%	1.6%	1.9%	2.4%	1.4%
Sollefteå	1.3%	1.0%	0.6%	0.6%	0.8%
Södertälje	1.0%	1.0%	1.5%	3.9%	4.6%
Torsby	2.4%	1.3%	1.8%	1.8%	1.9%
Trelleborg	1.6%	1.6%	1.6%	1.5%	1.2%
Visby	1.2%	2.2%	1.2%	2.3%	2.5%
Värnamo	1.3%	1.1%	1.6%	1.4%	1.2%
Västervik	3.8%	4.2%	3.3%	2.4%	2.2%
Ängelholm	1.0%	0.9%	0.8%	0.5%	1.0%
Örnsköldsvik	1.0%	0.7%	0.6%	0.8%	0.9%

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Reoperations within 2 years per hospital[1)] – trend (cont.)

primary operation 2007–2014

Hospital	2007–2010	2008–2011	2009–2012	2010–2013	2011–2014[2)]
Private hospitals					
Aleris Specialistvård Bollnäs	0%	0%	2.5%	2.2%	1.7%
Aleris Specialistvård Elisabethsjukhuset	1.1%	0.8%	1.4%	1.7%	1.2%
Aleris Specialistvård Motala	2.5%	2.7%	2.4%	2.3%	2.0%
Aleris Specialistvård Nacka	0.7%	0.8%	1.0%	1.8%	2.4%
Aleris Specialistvård Sabbatsberg	1.8%	1.4%	1.4%	1.4%	0.8%
Capio Movement	2.6%	2.8%	3.4%	3.6%	2.7%
Capio Ortopediska Huset	2.4%	2.1%	1.6%	1.0%	0.7%
Capio S:t Göran	1.8%	2.4%	3.2%	3.3%	3.2%
Carlanderska	1.2%	1.9%	1.6%	1.8%	2.0%
Ortho Center IFK-kliniken	0.9%	0.6%	0.8%	0.4%	0.2%
Ortho Center Stockholm	2.3%	2.4%	2.7%	2.9%	2.5%
Sophiahemmet	2.2%	1.9%	1.7%	1.7%	1.5%
Spenshult	2.9%	2.8%	3.4%	3.3%	3.0%
Others	2.7%	2.8%	3.4%	3.6%	1.1%
Country	2.3%	2.3%	2.2%	2.2%	2.0

[1)] *Köping, Motala (to 2009), Ystad, Aleris Specialistvård Ängelholm, Art Clinic Jönköping, GMC, Sensia Spec.vård, SU/Östra and SU/Sahlgrenska have been excluded due to too few operations performed during 2007–2014 or discontinued activity.*

[2)] *N.B. Shorter than 2 years follow up.!*

Reoperations, "standard patient", within 2 years per hospital[1)]

2011–2014

	Prim THRs	Patients[2)]		Infection		Dislocation		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
University/Regional hospitals											
Karolinska/Huddinge	258	3	1.2%	1	0.4%	0	0%	0	0%	2	0.8%
Karolinska/Solna	146	2	1.4%	1	0.7%	0	0%	1	0.7%	1	0.7%
SU/Mölndal	604	9	1.5%	3	0.5%	0	0%	0	0%	6	1.0%
Uppsala	237	3	1.3%	0	0%	1	0.4%	0	0%	2	0.8%
Örebro	174	2	1.1%	2	1.1%	1	0.6%	0	0%	0	0%
Central hospitals											
Borås	217	6	2.8%	1	0.5%	1	0.5%	0	0%	4	1.8%
Danderyd	413	11	2.7%	4	1.0%	3	0.7%	0	0%	6	1.5%
Eksjö	394	7	1.8%	6	1.5%	0	0%	0	0%	1	0.3%
Eskilstuna	92	1	1.1%	0	0%	0	0%	0	0%	1	1.1%
Falun	717	9	1.3%	4	0.6%	0	0%	0	0%	5	0.7%
Gävle	272	9	3.3%	5	1.8%	1	0.4%	1	0.4%	4	1.5%
Halmstad	460	6	1.3%	3	0.7%	2	0.4%	0	0%	1	0.2%
Helsingborg	67	2	3.0%	1	1.5%	1	1.5%	0	0%	1	1.5%
Hässleholm-Kristianstad	1,397	12	0.9%	14	1.0%	0	0%	0	0%	1	0.1%
Jönköping	339	5	1.5%	3	0.9%	1	0.3%	0	0%	2	0.6%
Kalmar	291	1	0.3%	1	0.3%	0	0%	0	0%	1	0.3%
Karlstad	286	8	2.8%	7	2.4%	0	0%	0	0%	1	0.3%
Norrköping	372	3	0.8%	1	0.3%	0	0%	0	0%	2	0.5%
Skövde	312	3	1.0%	1	0.3%	1	0.3%	0	0%	1	0.3%
Sundsvall	338	9	2.7%	5	1.5%	2	0.6%	0	0%	2	0.6%
Södersjukhuset	450	12	2.7%	8	1.8%	0	0%	0	0%	6	1.3%
Uddevalla	573	1	0.2%	1	0.2%	0	0%	0	0%	0	0%
Varberg	502	6	1.2%	2	0.4%	2	0.4%	0	0%	2	0.4%
Västerås	522	12	2.3%	7	1.3%	1	0.2%	0	0%	5	1.0%
Växjö	237	1	0.4%	1	0.4%	0	0%	0	0%	0	0%
Östersund	466	9	1.9%	3	0.6%	1	0.2%	0	0%	5	1.1%
Rural hospitals											
Alingsås	524	8	1.5%	4	0.8%	3	0.6%	0	0%	1	0.2%
Arvika	352	5	1.4%	5	1.4%	0	0%	1	0.3%	1	0.3%
Bollnäs	201	1	0.5%	1	0.5%	0	0%	1	0.5%	0	0%
Enköping	703	12	1.7%	6	0.9%	1	0.1%	0	0%	6	0.9%
Gällivare	159	1	0.6%	0	0%	0	0%	0	0%	1	0.6%
Hudiksvall	218	4	1.8%	3	1.4%	0	0%	0	0%	1	0.5%
Karlshamn	520	4	0.8%	1	0.2%	4	0.8%	0	0%	1	0.2%
Karlskoga	307	1	0.3%	1	0.3%	0	0%	0	0%	0	0%
Katrineholm	648	12	1.9%	8	1.2%	1	0.2%	0	0%	6	0.9%
Kungälv	343	8	2.3%	4	1.2%	1	0.3%	0	0%	3	0.9%
Lidköping	526	0	0%	0	0%	0	0%	0	0%	0	0%

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Reoperations, "standard patient", within 2 years per hospital[1] (cont.)

2011–2014

	Prim THRs	Patients[2]		Infection		Dislocation		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Lindesberg	484	3	0.6%	1	0.2%	1	0.2%	0	0%%	2	0.4%
Ljungby	325	2	0.6%	1	0.3%	0	0%	0	0%	1	0.3%
Lycksele	657	7	1.1%	1	0.2%	3	0.5%	0	0%	4	0.6%
Mora	455	4	0.9%	2	0.4%	1	0.2%	0	0%	1	0.2%
Norrtälje	139	3	2.2%	0	0%	1	0.7%	0	0%	2	1.4%
Nyköping	250	8	3.2%	6	2.4%	2	0.8%	0	0%	1	0.4%
Oskarshamn	508	3	0.6%	3	0.6%	0	0%	0	0%	0	0%
Piteå	747	4	0.5%	3	0.4%	2	0.3%	0	0%	1	0.1%
Skellefteå	165	1	0.6%	1	0.6%	0	0%	0	0%	0	0%
Skene	325	2	0.6%	0	0%	1	0.3%	0	0%	1	0.3%
Sollefteå	258	0	0%	1	0.4%	0	0%	0	0%	0	0%
Södertälje	171	7	4.1%	2	1.2%	1	0.6%	0	0%	4	2.3%
Torsby	166	1	0.6%	1	0.6%	0	0%	1	0.6%	0	0%
Trelleborg	1,305	10	0.8%	6	0.5%	1	0.1%	0	0%	5	0.4%
Visby	255	4	1.6%	0	0%	1	0.4%	1	0.4%	3	1.2%
Värnamo	241	3	1.2%	2	0.8%	1	0.4%	0	0%	1	0.4%
Västervik	226	3	1.3%	1	0.4%	0	0%	0	0%	3	1.3%
Ängelholm	368	5	1.4%	1	0.3%	2	0.5%	0	0%	2	0.5%
Örnsköldsvik	253	1	0.4%	1	0.4%	0	0%	0	0%	0	0%
Private hospitals											
Aleris Specialistvård Bollnäs	492	3	0.6%	3	0.6%	0	0%	0	0%	0	0%
Aleris Specialistvård Elisabethsjukhuset	131	1	0.8%	1	0.8%	0	0%	0	0%	0	0%
Aleris Specialistvård Motala	852	13	1.5%	10	1.2%	3	0.4%	0	0%	2	0.2%
Aleris Specialistvård Nacka	358	11	3.1%	8	2.2%	1	0.3%	0	0%	2	0.6%
Aleris Specialistvård Sabbatsberg	448	2	0.4%	2	0.4%	0	0%	0	0%	0	0%
Aleris Specialistvård Ängelholm	60	0	0%	0	0%	0	0%	0	0%	0	0%
Capio Movement	479	9	1.9%	1	0.2%	5	1.0%	0	0%	4	0.8%
Capio Ortopediska Huset	944	7	0.7%	3	0.3%	1	0.1%	1	0.1%	3	0.3%
Capio S:t Göran	733	14	1.9%	8	1.1%	2	0.3%	0	0%	4	0.5%
Carlanderska	332	3	0.9%	2	0.6%	0	0%	0	0%	1	0.3%
Ortho Center IFK-kliniken	312	1	0.3%	1	0.3%	0	0%	0	0%	1	0.3%
Ortho Center Stockholm	1,154	20	1.7%	11	1.0%	2	0.2%	1	0.1%	9	0.8%
Sophiahemmet	460	8	1.7%	5	1.1%	0	0%	1	0.2%	4	0.9%
Spenshult	465	13	2.8%	3	0.6%	6	1.3%	0	0%	4	0.9%
Others	168	2	1.2%	0	0%	0	0%	0	0%	2	1.2%
Country	29,323	386	1.3%	209	0.7%	65	0.2%	9	0%	149	0.5%

[1] *Hermelinen Spec.vård, Karlskrona, Sunderby (incl. Boden), Umeå, Art Clinic Jönköping, Linköping, SUS/Lund, SUS/Malmö have been included in the group "Others" due to too few operations performed.*

[2] *Refers to number of patients with short-term complications, which may differ from the sum of complications since each patient may have more than one type of complication.*

Red marking denotes values one standard deviation above the national average.

"Adverse events" within 30 days and 90 days

The Swedish Hip Arthroplasty Register has, in recent years, established continuous cooperation with the Patient Register at the Swedish National Board of Health and Welfare. In *Regional Comparisons (Öppna jämförelser)* a national quality indicator has been created via the Patient Register: "Adverse events after total hip or knee arthroplasty". The Register has used this analysis to carry out a separate analysis for total hip replacement alone. This has now been published at hospital level for the second time.

Since the care period for a total hip replacement has been considerably reduced, nationally as well as internationally, during the most recent ten-year period, the focus on adverse events after this elected intervention has increased. By the concept, "adverse events" is meant all forms of rehospitalization that may have depended upon the intervention that was carried out – and in that case not only local complications but general medical complications and death as well.

The Register's and the Swedish National Board of Health and Welfare's definition of "adverse events" after hip arthroplasty surgery: all forms of reoperation of the hip in question as well as cardiovascular, cerebrovascular and thromboembolic complications, pneumonia, ulcers if these complications have resulted in hospitalization, plus death. From the patient's standpoint, this type of analyses are more relevant compared to analyses of only prosthesis-related events/complications.

To partially adjust different case-mix of hospitals, we report adverse events three different groups: all patients, standard patients and patients who underwent operation due to hip fracture (acute and sequelae after fracture).

Results

All patients. The analysis took as its point of departure the register's database for primary total hip replacements during 2012 up to and including September 2014 (44,162 operations) and this database was merged with the National Patient Register. The national average is 3.38%, after 30 days and 5.42% after 90 days. These national averages are marginally lower in comparison to previous year's analysis. The frequency of adverse events varies considerably between hospitals. 30 days: 0.0–12.9%. 90 days: 0.0–20.4%. Hospitals differing from the average with a standard deviation or more are marked in red in the table.

The "standard" patient. Analysis similar to the above, only with a smaller number of patients: 20,004 operations. The definition for the "standard patient" can be found on page 136. The national average is 1.9%, after 30 days and 3.06% after 90 days. This "healthier" patient group had thus, as expected, less adverse events compared to the whole national total hip arthroplasty population. However, the frequency varies between different hospitals concerning this more homogeneous patient group, and there is room for improvement. 30 days: 0.0–5.49%. 90 days: 0.0–8.26%.

Fracture patients. Analysis similar to the above, only now with 16,078 operations. The national average is 14.71%, after 30 days and 22.91% after 90 days. This group (higher mean age and more expressed comorbity) is analysed for the first time and as expected, the frequency of adverse events is remarkably higher than in the groups above. The frequency of adverse events varies considerably between hospitals. 30 days: 0.0–33.33%. 90 days: 12.50–36.84%.

Problems and discussion

This type of analysis from the Patient Register (PAR) may in the future be of great significance for continued development of quality for hip replacement surgery in Sweded. We can capture variables in PAR that our ordinary routines do not register. At present, there are however, a number of sources of error described in the section entitled "Degree of coverage and completeness". A number of hospital amalgamations have been carried out with shared reporting to the Patient Register despite the surgery being performed at different hospitals. The greatest source of error, however, is probably sub-optimal coding, and that many patients have a large number of secondary diagnoses when discharged, where the most relevant diagnosis for that particular care occurrence is not always the primary diagnosis in the report. These factors give rise to the probability that the analysis will present values that are too low.

The great variation in the frequency of adverse events between hospitals suggests an improvement potential within this area. Of course, various case-mixes can explain some of the differences, but differences in preoperative medical assessment/optimization, et cetera, should also be discussed at clinics when these figures are interpreted locally.

Adverse events, all patients

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
University/Regional hospitals							
Karolinska/Huddinge	684	18	2.63	1.22	41	5.99	1.82
Karolinska/Solna	513	34	6.63	2.20	54	10.53	2.71
Linköping	164	9	5.49	3.56	16	9.76	4.63
SU/Mölndal	1,282	42	3.28	0.99	70	5.46	1.27
SU/Sahlgrenska*	13	2	15.38	20.01	4	30.77	25.60
SUS/Lund	487	30	6.16	2.18	59	12.11	2.96
SUS/Malmö	121	5	4.13	3.62	9	7.44	4.77
Umeå	200	9	4.50	2.93	20	10.00	4.24
Uppsala	684	26	3.80	1.46	51	7.46	2.01
Örebro	341	7	2.05	1.54	17	4.99	2.36
Central hospitals							
Borås	467	25	5.35	2.08	37	7.92	2.50
Danderyd	871	46	5.28	1.52	66	7.58	1.79
Eksjö	556	28	5.04	1.85	43	7.73	2.27
Eskilstuna	337	27	8.01	2.96	39	11.57	3.49
Falun	989	24	2.43	0.98	37	3.74	1.21
Gävle	615	25	4.07	1.59	35	5.69	1.87
Halmstad	647	22	3.40	1.43	31	4.79	1.68
Helsingborg	209	8	3.83	2.65	16	7.66	3.68
Hässleholm-Kristianstad	2,099	74	3.53	0.81	115	5.48	0.99
Jönköping	513	10	1.95	1.22	20	3.90	1.71
Kalmar	377	13	3.45	1.88	18	4.77	2.20
Karlskrona	87	6	6.90	5.43	14	16.09	7.88
Karlstad	654	28	4.28	1.58	50	7.65	2.08
Norrköping	678	26	3.83	1.48	44	6.49	1.89
Skövde	498	19	3.82	1.72	27	5.42	2.03
Sunderby (incl. Boden)	93	12	12.90	6.95	19	20.43	8.36
Sundsvall	506	33	6.52	2.20	41	8.10	2.43
Södersjukhuset	1,146	47	4.10	1.17	70	6.11	1.41
Uddevalla	1,013	31	3.06	1.08	52	5.13	1.39
Varberg	623	19	3.05	1.38	34	5.46	1.82
Västerås	1,300	84	6.46	1.36	140	10.77	1.72
Växjö	385	12	3.12	1.77	24	6.23	2.46
Ystad	9	–	–	–	1	–	–
Östersund	783	23	2.94	1.21	32	4.09	1.42

** Only tumor cases*

(Continued on next page.)

Adverse events, all patients (cont.)

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	593	29	4.89	1.77	42	7.08	2.11
Arvika	488	21	4.30	1.84	31	6.35	2.21
Bollnäs	90	0	0	0	1	1.11	2.21
Enköping	903	39	4.32	1.35	56	6.20	1.61
Frölunda Specialistsjukhus	241	3	1.24	1.43	5	2.07	1.84
Gällivare	272	13	4.78	2.59	18	6.62	3.01
Hudiksvall	346	13	3.76	2.04	24	6.94	2.73
Karlshamn	620	24	3.87	1.55	38	6.13	1.93
Karlskoga	446	19	4.26	1.91	28	6.28	2.30
Katrineholm	647	10	1.55	0.97	20	3.09	1.36
Kungälv	450	18	4.00	1.85	25	5.56	2.16
Lidköping	641	11	1.72	1.03	20	3.12	1.37
Lindesberg	573	13	2.27	1.24	14	2.44	1.29
Ljungby	449	14	3.12	1.64	28	6.24	2.28
Lycksele	770	20	2.60	1.15	35	4.55	1.50
Mora	571	11	1.93	1.15	25	4.38	1.71
Norrtälje	321	13	4.05	2.20	24	7.48	2.94
Nyköping	425	33	7.76	2.60	44	10.35	2.96
Oskarshamn	652	8	1.23	0.86	15	2.30	1.17
Piteå	1,012	16	1.58	0.78	33	3.26	1.12
Skellefteå	321	12	3.74	2.12	15	4.67	2.36
Skene	355	4	1.13	1.12	11	3.10	1.84
Sollefteå	329	8	2.43	1.70	13	3.95	2.15
Södertälje	269	21	7.81	3.27	27	10.04	3.66
Torsby	291	9	3.09	2.03	15	5.15	2.59
Trelleborg	1,654	25	1.51	0.60	37	2.24	0.73
Visby	332	12	3.61	2.05	19	5.72	2.55
Värnamo	378	15	3.97	2.01	22	5.82	2.41
Västervik	309	8	2.59	1.81	13	4.21	2.28
Ängelholm	436	15	3.44	1.75	23	5.28	2.14
Örnsköldsvik	380	6	1.58	1.28	14	3.68	1.93

(Continued on next page.)

Adverse events, all patients (cont.)

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Private hospitals							
Aleris Specialistvård Bollnäs	738	8	1.08	0.76	15	2.03	1.04
Aleris Specialistvård Elisabethsjukhuset	113	1	0.88	1.76	3	2.65	3.02
Aleris Specialistvård Motala	1,305	37	2.84	0.92	63	4.83	1.19
Aleris Specialistvård Nacka	343	14	4.08	2.14	16	4.66	2.28
Aleris Specialistvård Sabbatsberg	442	2	0.45	0.64	3	0.68	0.78
Aleris Specialistvård Ängelholm	71	3	4.23	4.77	3	4.23	4.77
Art Clinic Jönköping	23	1	4.35	8.50	1	4.35	8.50
Capio Movement	447	15	3.36	1.70	26	5.82	2.21
Capio Ortopediska Huset	967	16	1.65	0.82	21	2.17	0.94
Capio S:t Göran	1,146	57	4.97	1.28	78	6.81	1.49
Carlanderska	335	6	1.79	1.45	11	3.28	1.95
Hermelinen Spec.vård	15	0	0	0	0	0	0
Ortho Center IFK-kliniken	349	1	0.29	0.57	2	0.57	0.81
Ortho Center Stockholm	1,152	18	1.56	0.73	32	2.78	0.97
Sophiahemmet	555	7	1.26	0.95	12	2.16	1.23
Spenshult	653	18	2.76	1.28	28	4.29	1.59
Country	44,162	1,492	3.38	0.17	2395	5.42	0.22

Adverse events, "standard patient"

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	**Number**	**Number**	**%**	**±**	**Number**	**%**	**±**
University/Regional hospitals							
Karolinska/Huddinge	174	3	1.72	1.97	6	3.45	2.77
Karolinska/Solna	94	4	4.26	4.16	4	4.26	4.16
Linköping	28	0	0	0	3	10.71	11.69
SU/Mölndal	415	6	1.45	1.17	12	2.89	1.65
SUS/Lund	34	0	0	0	0	0	0
SUS/Malmö	1	0	–	–	0	–	–
Umeå	28	1	3.57	7.01	2	7.14	9.73
Uppsala	162	1	0.62	1.23	3	1.85	2.12
Örebro	105	3	2.86	3.25	4	3.81	3.74
Central hospitals							
Borås	154	10	6.49	3.97	11	7.14	4.15
Danderyd	279	6	2.15	1.74	12	4.30	2.43
Eksjö	286	10	3.50	2.17	16	5.59	2.72
Eskilstuna	51	1	1.96	3.88	2	3.92	5.44
Falun	503	8	1.59	1.12	12	2.39	1.36
Gävle	178	1	0.56	1.12	3	1.69	1.93
Halmstad	296	8	2.70	1.89	10	3.38	2.10
Helsingborg	36	1	2.78	5.48	1	2.78	5.48
Hässleholm-Kristianstad	934	20	2.14	0.95	29	3.10	1.14
Jönköping	217	2	0.92	1.30	4	1.84	1.83
Kalmar	188	2	1.06	1.50	3	1.60	1.83
Karlskrona	6	0	–	–	0	–	–
Karlstad	182	3	1.65	1.89	5	2.75	2.42
Norrköping	256	3	1.17	1.35	7	2.73	2.04
Skövde	213	5	2.35	2.07	7	3.29	2.44
Sunderby (incl. Boden)	3	0	–	–	0	–	–
Sundsvall	219	11	5.02	2.95	13	5.94	3.19
Södersjukhuset	321	10	3.12	1.94	11	3.43	2.03
Uddevalla	406	7	1.72	1.29	10	2.46	1.54
Varberg	341	6	1.76	1.42	10	2.93	1.83
Västerås	359	6	1.67	1.35	12	3.34	1.90
Växjö	155	1	0.65	1.29	3	1.94	2.21
Östersund	319	7	2.19	1.64	11	3.45	2.04

(Continued on next page.)

Adverse events, "standard patient" (cont.)

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	371	16	4.31	2.11	19	5.12	2.29
Arvika	244	9	3.69	2.41	11	4.51	2.66
Bollnäs	52	0	0	0	0	0	0
Enköping	471	11	2.34	1.39	19	4.03	1.81
Gällivare	115	2	1.74	2.44	3	2.61	2.97
Hudiksvall	141	2	1.42	1.99	3	2.13	2.43
Karlshamn	335	7	2.09	1.56	15	4.48	2.26
Karlskoga	214	4	1.87	1.85	9	4.21	2.74
Katrineholm	457	5	1.09	0.97	12	2.63	1.50
Kungälv	224	3	1.34	1.54	3	1.34	1.54
Lidköping	383	4	1.04	1.04	7	1.83	1.37
Lindesberg	322	5	1.55	1.38	5	1.55	1.38
Ljungby	216	5	2.31	2.05	10	4.63	2.86
Lycksele	427	7	1.64	1.23	13	3.04	1.66
Mora	312	5	1.60	1.42	9	2.88	1.90
Norrtälje	104	1	0.96	1.91	3	2.88	3.28
Nyköping	159	6	3.77	3.02	7	4.40	3.25
Oskarshamn	357	2	0.56	0.79	6	1.68	1.36
Piteå	518	2	0.39	0.54	11	2.12	1.27
Skellefteå	118	3	2.54	2.90	5	4.24	3.71
Skene	227	1	0.44	0.88	6	2.64	2.13
Sollefteå	181	2	1.10	1.55	4	2.21	2.19
Södertälje	109	5	4.59	4.01	9	8.26	5.27
Torsby	107	3	2.80	3.19	4	3.74	3.67
Trelleborg	889	8	0.90	0.63	14	1.57	0.84
Visby	180	5	2.78	2.45	6	3.33	2.68
Värnamo	168	4	2.38	2.35	7	4.17	3.08
Västervik	155	5	3.23	2.84	5	3.23	2.84
Ängelholm	280	10	3.57	2.22	12	4.29	2.42
Örnsköldsvik	180	3	1.67	1.91	5	2.78	2.45

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Adverse events, "standard patient" (cont.)

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Private hospitals							
Aleris Specialistvård Bollnäs	446	5	1.12	1.00	9	2.02	1.33
Aleris Specialistvård Elisabethsjukhuset	84	0	0	0	1	1.19	2.37
Aleris Specialistvård Motala	590	10	1.69	1.06	16	2.71	1.34
Aleris Specialistvård Nacka	255	14	5.49	2.85	16	6.27	3.04
Aleris Specialistvård Sabbatsberg	317	2	0.63	0.89	3	0.95	1.09
Aleris Specialistvård Ängelholm	41	2	4.88	6.73	2	4.88	6.73
Art Clinic Jönköping	11	0	0	0	0	0	0
Capio Movement	268	5	1.87	1.65	12	4.48	2.53
Capio Ortopediska Huset	649	10	1.54	0.97	14	2.16	1.14
Capio S:t Göran	466	14	3.00	1.58	23	4.94	2.01
Carlanderska	210	2	0.95	1.34	3	1.43	1.64
Hermelinen Spec.vård	4	0	–	–	0	–	–
Ortho Center IFK-kliniken	198	0	0	0	1	0.51	1.01
Ortho Center Stockholm	801	9	1.12	0.74	19	2.37	1.08
Sophiahemmet	328	6	1.83	1.48	8	2.44	1.70
Spenshult	377	10	2.65	1.66	17	4.51	2.14
Country	20,004	380	1.90	0.19	612	3.06	0.24

Adverse events, fracture patients

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
University/Regional hospitals							
Karolinska/Huddinge	367	46	12.53	3.46	87	23.71	4.44
Karolinska/Solna	185	30	16.22	5.42	49	26.49	6.49
Linköping	249	44	17.67	4.83	63	25.30	5.51
SU/Mölndal	1,080	127	11.76	1.96	222	20.56	2.46
SU/Sahlgrenska*	13	4	30.77	25.6	6	46.15	27.65
SUS/Lund	554	68	12.27	2.79	111	20.04	3.40
SUS/Malmö	642	102	15.89	2.89	154	23.99	3.37
Umeå	263	44	16.73	4.60	66	25.10	5.35
Uppsala	528	81	15.34	3.14	120	22.73	3.65
Örebro	235	32	13.62	4.47	53	22.55	5.45
Central hospitals							
Borås	344	40	11.63	3.46	72	20.93	4.39
Danderyd	562	86	15.30	3.04	136	24.20	3.61
Eksjö	153	31	20.26	6.50	41	26.8	7.16
Eskilstuna	311	55	17.68	4.33	77	24.76	4.89
Falun	366	44	12.02	3.40	75	20.49	4.22
Gävle	410	59	14.39	3.47	80	19.51	3.91
Halmstad	251	42	16.73	4.71	60	23.90	5.38
Helsingborg	523	90	17.21	3.30	136	26.00	3.84
Hässleholm-Kristianstad	448	82	18.30	3.65	116	25.89	4.14
Jönköping	205	30	14.63	4.94	41	20.00	5.59
Kalmar	216	17	7.87	3.66	37	17.13	5.13
Karlskrona	307	46	14.98	4.07	80	26.06	5.01
Karlstad	383	72	18.80	3.99	106	27.68	4.57
Norrköping	273	40	14.65	4.28	63	23.08	5.10
Skövde	308	38	12.34	3.75	58	18.83	4.46
Sunderby (incl. Boden)	448	76	16.96	3.55	122	27.23	4.21
Sundsvall	286	49	17.13	4.46	70	24.48	5.08
Södersjukhuset	965	127	13.16	2.18	204	21.14	2.63
Uddevalla	628	77	12.26	2.62	128	20.38	3.21
Varberg	250	21	8.40	3.51	46	18.40	4.90
Västerås	430	65	15.12	3.45	111	25.81	4.22
Växjö	206	18	8.74	3.93	40	19.42	5.51
Ystad	95	28	29.47	9.36	35	36.84	9.90
Östersund	268	27	10.07	3.68	44	16.42	4.53

** Only tumor cases*

(Continued on next page.)

Adverse events, fracturepatients (cont.)

2012–2014

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	105	18	17.14	7.36	33	31.43	9.06
Arvika	32	5	15.63	12.84	9	28.13	15.9
Frölunda Specialistsjukhus	1	0	–	–	0	–	–
Gällivare	145	23	15.86	6.07	33	22.76	6.96
Hudiksvall	212	41	19.34	5.43	55	25.94	6.02
Karlshamn	8	0	–	–	1	–	–
Karlskoga	116	22	18.97	7.28	31	26.72	8.22
Katrineholm	1	0	–	–	0	–	–
Kungälv	219	24	10.96	4.22	43	19.63	5.37
Lidköping	149	20	13.42	5.59	32	21.48	6.73
Lindesberg	92	13	14.13	7.26	21	22.83	8.75
Ljungby	104	19	18.27	7.58	24	23.08	8.26
Lycksele	43	6	13.95	10.57	13	30.23	14.01
Mora	172	28	16.28	5.63	49	28.49	6.88
Norrtälje	121	22	18.18	7.01	29	23.97	7.76
Nyköping	121	14	11.57	5.82	20	16.53	6.75
Piteå	3	1	–	–	1	–	–
Skellefteå	134	20	14.93	6.16	26	19.40	6.83
Sollefteå	114	13	11.40	5.95	20	17.54	7.12
Södertälje	115	25	21.74	7.69	34	29.57	8.51
Torsby	107	26	24.30	8.29	29	27.10	8.59
Trelleborg	7	1	–	–	1	–	–
Visby	79	12	15.19	8.08	18	22.78	9.44
Värnamo	95	8	8.42	5.70	14	14.74	7.27
Västervik	143	27	18.88	6.55	37	25.87	7.32
Ängelholm	1	0	–	–	0	–	–
Örnsköldsvik	122	19	15.57	6.57	28	22.95	7.61
Private hospitals							
Aleris Specialistvård Motala	131	14	10.69	5.40	25	19.08	6.87
Capio S:t Göran	638	106	16.61	2.95	149	23.35	3.35
Carlanderska	2	0	–	–	0	–	–
Ortho Center IFK-kliniken	1	0	–	–	0	–	–
Ortho Center Stockholm	4	1	–	–	1	–	–
Spenshult	1	1	–	–	1	–	–
Country	16,090	2367	14.71	0.56	3686	22.91	0.66

Revision

Revision means that a hip arthroplasty-operated patient undergoes a further operation in which a part of or the whole prosthesis is replaced or extracted. Since 1979, revisions (and other reoperations) were reported on the individual level, which gives the possibility to extract more complete data from the start as opposed to data from the database of primary total hip replacements that first started using personal identity number in 1992. Until 1991, only aggregated data per clinic for primary operations were registered. From 1979-2009, the number of revisions have increased, with exceptions for a few periods with temporary falls. Thereafter, a small reduction can be seen (Figure 1). Registration of revision or other type of reoperation requires that the primary prosthesis is also registered, which is important to bear in mind when interpreting the chart's left side. During the past decade, four out of five of reoperations (79-82%) have been a revisions.

From the Register's starting year 1979, the number of multiple-time revisions increased until the early 2000s (refer to the previous annual report). Over the past 15 years, the division between initial revision (no previous revision = 0 in Figure 2), and multiple-time revisions has been relatively constant with no sign that either the total number or the number of multiple-time revisions increases, even though the population is aging and more and more people have one or two implanted hip prostheses. There are only a few patients who underwent revision for the fourth time. Between 2000 and 2013, this applied to 15 and 28 operations per year. In 2014, the number increased to 44. There are even less of those who were affected by a fifth or possibly even more revisions. During the period, between 4 and 16 cases were reported per year (Figure 2). Although the number of patients who have undergone multiple-time revisions is few, an additional revision is still a large burden on the individual patient. It is often about engaging the high degree of complexity from the surgical and anesthetic point of view. Approximately half of the patients who underwent more than one previous revision, were rated as ASA class III or higher at revision (Figure 3).

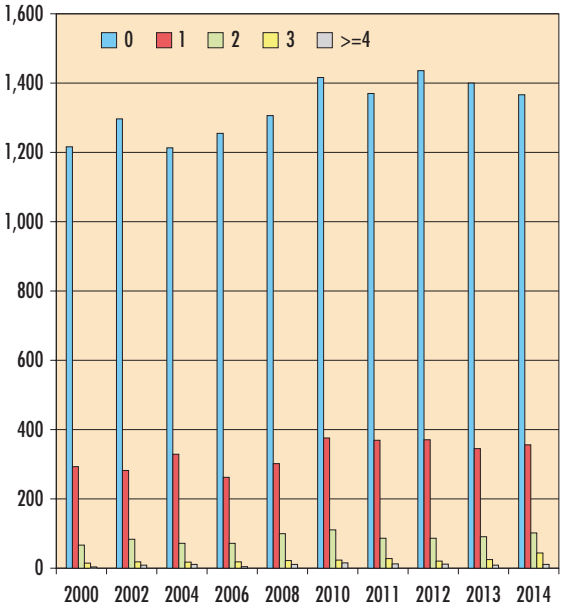

Figure 2. Distribution of initial and multiple-time revisions between 2000 and 2014. During the first 10 years, only the data for every second year is shown. The number of patients who have had more than two earlier revisions is relatively small.

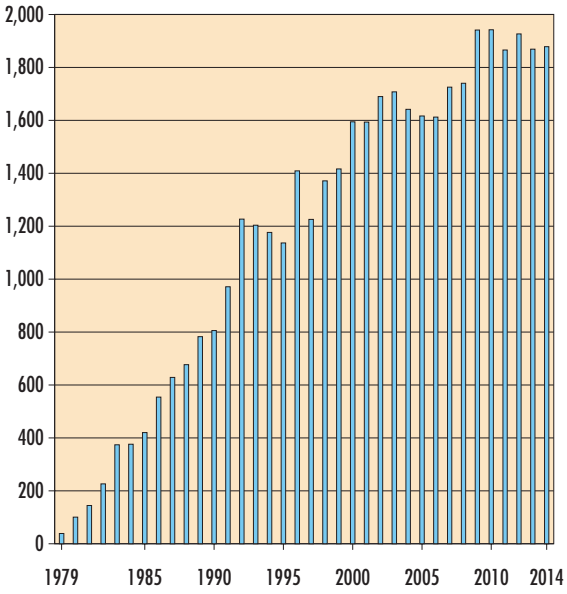

Figure 1. Number of revisions 1979–2014.

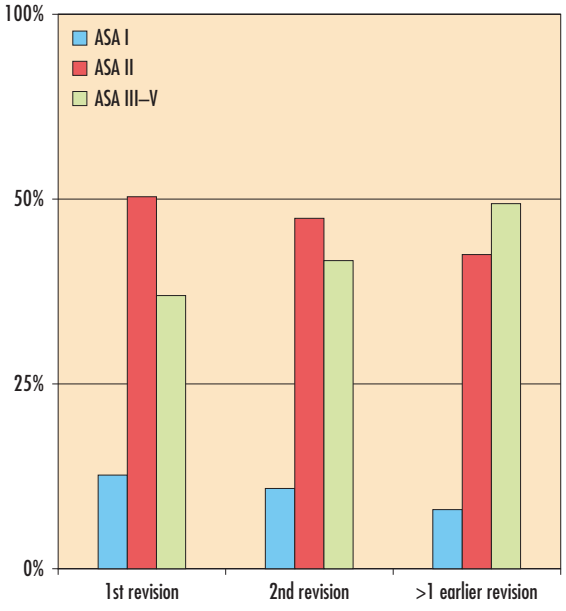

Figure 3. Distribution of ASA class for initial and multiple-time revisions between 2008 and 2014. The proportion of patients belonging to ASA class III increases with the number previously undertaken revisions on the same hip.

Almost 80% of all revisions carried out during the period 2012-2014, were performed at hospitals that performed at least 100 revisions during the same period. 515 revisions (9.1%) were carried out at a hospital, which performed less than 50 during the period corresponding to less than 17 revisions per year and unit. In over half of these cases, cup or stem revisions were carried out (51.8%), in less than a third cases (32.6%), both components were changed and in 16 cases, prosthesis was extracted. The most common measure among "other measures" (13.8%) was the change of femoral head in connection to debridement due to infection or open reposition due to dislocation.

In some cases, such as the transfer of revisions from Malmö to Lund because of structural changes or when a competent surgeon, for various reasons, is responsible for all revisions, a relatively low volume may be justified. However, it can be regarded as remarkable that as many as 17 units carried out less than 10 revisions over a three-year period.

The restructuring of health care has meant that some units and above all university/regional hospitals do fewer and fewer primary operations and in particular fewer standard operations. This has implications for education and opportunities to pursue studies. Although research and training can be outsourced, there are many advantages to a cohesion of this activity for better resource utilization, optimal infrastructure and to create effective teamwork. Table 2 shows the number of primary arthroplasties for units which conducted more than 100 revisions between 2012 and 2014, and where all university/regional hospitals are included. For some units, the number of performed primary arthroplasties is small, especially due to a large proportion of patients who receive primary prosthesis due to hip fracture, anatomical abnormalities and/or have a high degree of comorbidity.

The number of revisions over the past three years has been relatively constant and has been just below 2000 per year. There are not many patients who are revised more than two times in Sweden, but they constitute a group with high comorbidity, which puts high demands on medical resources and surgical expertise. Almost every tenth revision in Sweden is performed at units, which perform 17 or less revisions per year.

Volume of primary and revision arthroplasty

2012–2014

		Revision		
	Primary prosthesis	First revision	≥ 1 earlier revision(s)	Regardless of the earlier number
Number	48,939	4,199	1,474	5,673
Volume 2012–14, *2011–2013*				
1– 24	3 *5*	24 *24*	30 *33*	23 *26*
25–49	1 *0*	11 *10*	11 *12*	10 *7*
50–99	3 *0*	17 *19*	10 *8*	7 *10*
100–149	1	6 *6*	1 *1*	12 *12*
150–199	3 *4*	6 *4*	–	5 *5*
200–299	4 *3*	2 *3*	–	6 *5*
300–499	21 *16*	–	–	2 *2*
500–999	32 *29*	–	–	–
1,000–1,499	8 *10*	–	–	–
1,500–2,499	3 *2*	–	–	–

Table 1. Number of hospitals, which carry out first-time and multiple-time revisions, is presented in groups for the period 2012–2014. Numbers for previous periods (2011–2013) are presented in italic.

Revisions and primary prosthesis

Clinic	Revisions	Primary prosthesis
Aleris Specialistvård Motala	111	1,449
Borås	116	517
Capio S:t Göran	190	1,300
Danderyd	245	976
Falun	105	1,075
Gävle	233	679
Halmstad	105	721
Helsingborg	119	254
Hässleholm-Kristianstad	271	2,299
Karlstad	212	752
Karolinska/Huddinge	196	757
Karolinska/Solna	191	564
Linköping	116	190
Skövde	124	541
SU/Mölndal	423	1,479
Sundsvall	133	550
SUS/Lund	358	538
Södersjukhuset	204	1,266
Uddevalla	132	1,122
Umeå	165	226
Uppsala	280	783
Varberg	103	694
Västerås	170	1,425
Örebro	120	374
Östersund	101	876

Table 2. Number of reported revisions and primary hip replacement operations for clinics, which have carried out 100 revisions or more in 2012–2014.

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Cause for revision

In Sweden, aseptic loosening, also including osteolysis, is the most common cause of first-time as well as multiple-time revisions. The reason why osteolysis is not specified further, is because this indication is only sporadically noted in records, which were reviewed by the register's coordinator, and this data is not sufficiently reliable. The relative proportion who were revised due to loosening/osteolysis, has since the beginning of 2000s (period 2001-2005) gradually reduced from 72.3 to 52.2% for first-time revisions (Figure 4 left) and from 56.3 to 34.2% for multiple-time revisions (Figure 4 right).

During the five-year period 2001-2005, the second most common cause was dislocation, whether it was first or multiple-time revision. In the following years, infection has become increasingly more common as cause of revision. In 2012, dislocation exchanged places with infection and the relative proportion of infections increased further in 2013 from 13.9 to 14.6% at first-time revisions and from 23.9 to 25.6% at multiple-time revisions. The relative increase in infection as revision cause corresponds to a rise between 2011 and 2014 from 194 to 226 infections cases in the group mentioned first and from 75 to 132 in the second group.

Revision due to technical reasons accounted for 1.7% in both groups. In 2014, their proportion was 2.3% for the first-time and 4.4% for multiple-time revisions. Throughout the period 2001-2014, these cases of early revisions constituted two-thirds of first-time revisions (66.6%) and over three quarters of multiple-time revisions (76.1%). Incorrectly inserted parts of prosthesis were the second most common cause in both groups (14.8 and 10.1%, respectively). In 25 (7.8%) and five cases (4.6%), respectively, one first and one multiple-time revision was performed to adjust different leg lengths.

The group "other causes" is for first time revision dominated by "high level of metals" and "pseudotumours" (40%), which are complications related to metal-metal-joint and/or corrosion. Revision due to unclear pain comes in second (36.8%) at the first-time revision and in first place at the multiple-time revision (49.2%). High levels of metals/pseudo tumours takes second place at multiple-time revision (22%).

The cause of revision varies depending on age. At the first-time revision, the proportion of revision due to loosening/osteolysis is relatively constant and constitutes two-thirds (about 66%) of cases up to 84 years of age. Thereafter, this proportion drops to about half of the cases (50.1%). At multiple-time revisions, the proportion (and number) or revisions due to loosening/osteolysis reduces relatively linearly with age. In both groups, revision due to dislocation and periprosthetic fracture increases with age. The increase is particularly evident for the group 85 years and older. Infections are more evenly distributed, possibly with a tendency to take up a larger proportion with decreasing age in both groups.

The cause for revision has varied over time, which likely reflects several factors, such as changes in indication setting, changes in the distribution of cemented/uncemented fixation, implant selection, surgical technique and other less known factors. The cause of the revision varies depending on demographic factors, as has been illustrated with age. Presence of previously completed revision also plays a role. Dislocation and infection are more common during multiple-time revisions.

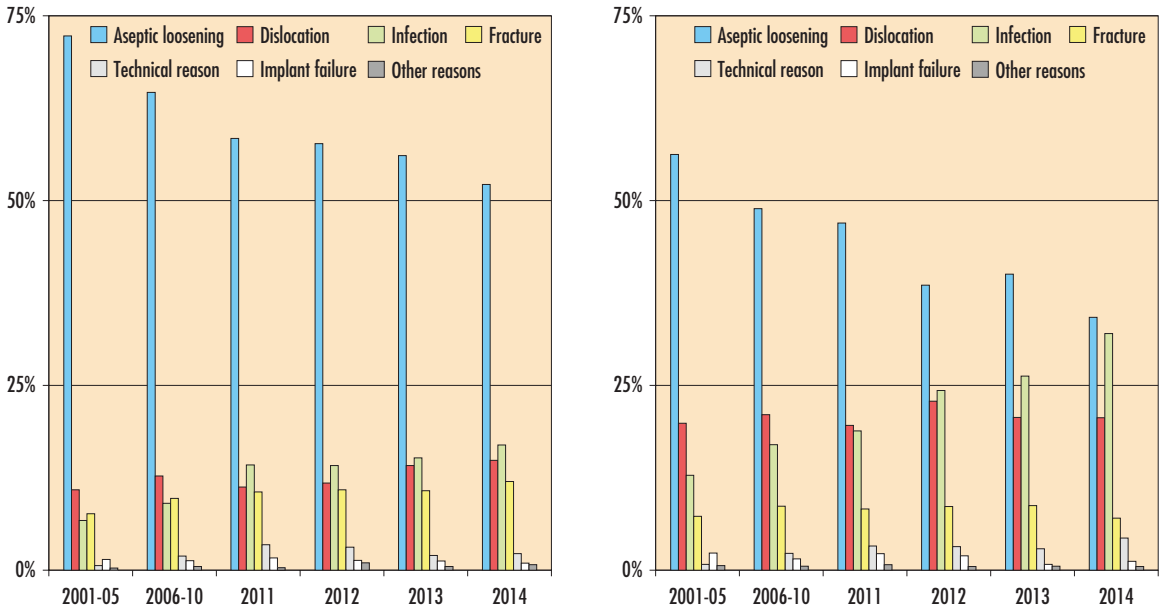


Figure 4. Distribution of causes for revision at first-time (left) and multiple-time revisions (right) between 2003 and 2013. During multiple-time revision, "insertion of prosthesis after previous extraction" has been excluded.

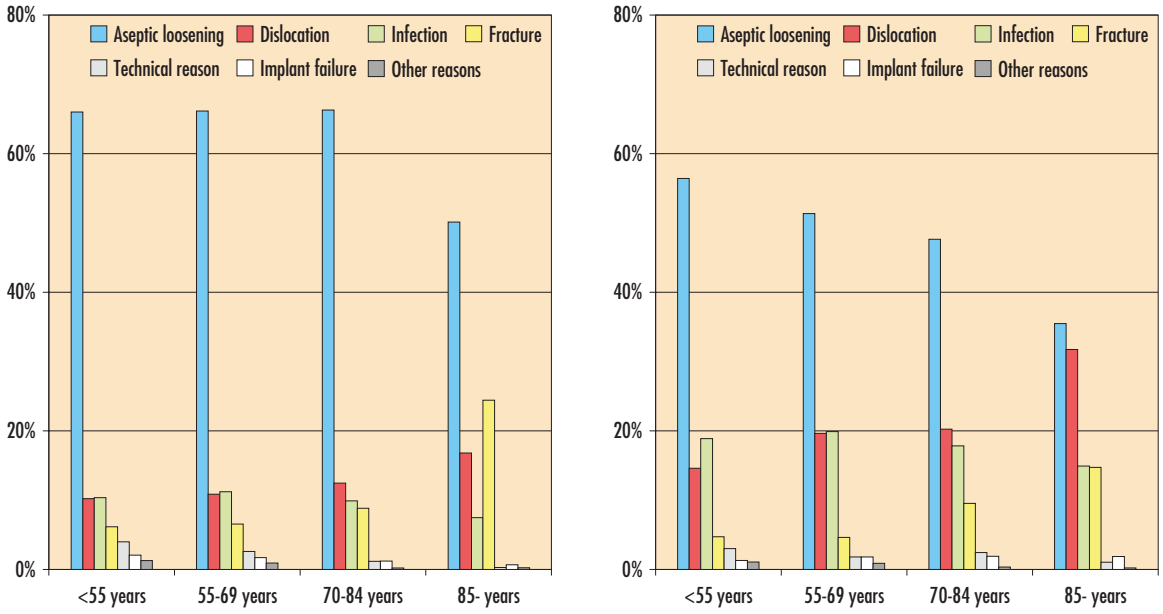


Figure 5. Distribution of causes for revision relative to four age groups at first-time (left) and multiple-time revisions (right). The entire period 2001–2014 is included in order to have a sufficiently large baseline.

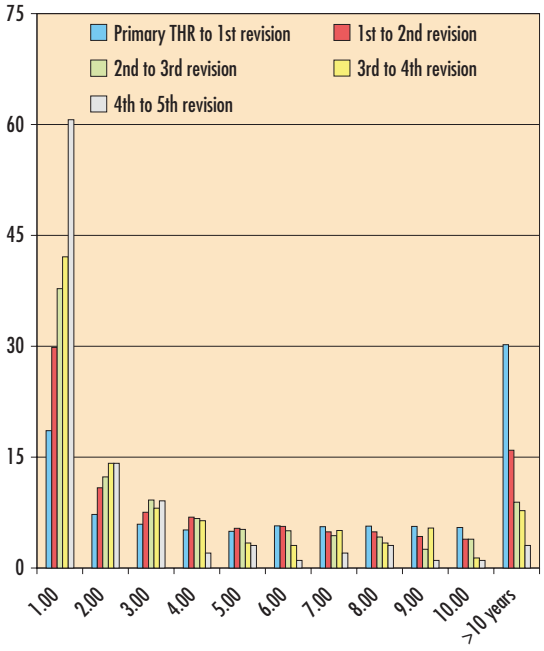


Figure 6. Time to first, second, and third revision of primary arthroplasty or previous revision. During insertion of the prosthesis after previous extraction, the time interval from the session 2 corresponding to the day when the patient has a complete prosthesis, is estimated.

Multiple-time revisions

Out of the first-time revisions carried out between 1979 and 2014, 18.8% were revised once again at another point in time, if two-step intervention is counted as a measure. If the selection is limited to those who were revised until 2001, the proportion increases to 21.6%. If two-step intervention is counted as two measures, the corresponding proportions are 22.7 and 25.5%, respectively. If the years after the revision are divided, we see that the risk for rerevisions, regardless of cause, is greatest during the first year and then declines gradually until 4-5 years and then tends to increase slightly. The situation becomes complicated by the fact that patients who have undergone many revisions, is relatively small. The trend that revisions are most common during the first year after index operation (=the revision which is being studied), becomes more evident the more revisions have been performed earlier (Figure 6). For example, about 17% of the primary operations, which are affected by revision, will be subjected to this measure in the first year, while more than half of the fourth-time revisions, which are rerevised, are affected by this measure one year after the index operation. As with the analysis of all reoperations, we find that demographics and causes vary depending the number of previously performed revisions (Figure 4 and 5, Table 3). Data in Table 3 may show that it is much more difficult for us to solve infection and dislocation problems than loosening problems, partly due to the high degree of comorbidity (see above). Not unexpectedly, the proportion of younger patients in the group, which underwent multiple operations, is greater than among those who have not been revised earlier or have been revised only once.

The reason for patient's first-time revision affects the cause profile for a possible secondary revision (Table 4). A patient

Demography and causes at first-time and multiple-time revisions
(2001–2014)

	Number of earlier revisions		
	None	*One #*	*Two or more #*
Number	18,445	3,818	1,253
Gender			
Proportion of women %	52.7	51.0	55.1
Age			
Mean value *SD*	71.3 *11.4*	71.2 *11.6*	69.9 *11.5*
<55 years %	7.9	8.9	10.6
55–69 years %	31.1	30.6	32.7
70–84 years %	51.3	50.3	49.1
>=85 years	9.7	10.1	7.6
Diagnosis			
Primary osteoarthritis	74.7	70.1	62.5
Fracture, including sequelae	7.9	7.9	7.1
Inflammatory joint disease	6.5	8.9	14.3
Sequelae after childhood hip disorder	5.1	7.5	8.8
Femoral head necrosis	3.5	3.4	3.7
Other secondary osteoarthritis	1.3	2.2	3.6
Cause for revision/rerevision*			
Loosening/osteolysis	64.1	51.5	37.7
Infection	10.0	16.3	24.0
Dislocation	12.1	18.7	26.1
Periprosthetic fracture	9.3	8.4	6.9
Technical cause	1.7	2.1	2.2
Implant fracture	1.4	1.7	2.0
Other	1.4	1.3	0.9

*# insertion of prosthesis after extraction has been excluded; *refer to Figure 3 and 4*

Table 3. Demographic data and cause for revision at first, second and multiple-time revisions between 2001 and 2014.

who undergoes a primary revision due to loosening/osteolysis, infection and dislocation, has a high probability that if he has to undergo another revision, he will be revised because of the same reason. The same applies to patients who suffer a secondary revision. If a patient is operated due to periprosthetic fracture at initial revision, then this is the most common cause for a possible rerevision due to dislocation. If rectification of a periprosthetic fracture is performed as a secondary revision and eventually this results in a new revision, there is a great possibility that this is carried out due to loosening of one or both components (38.8%), followed by dislocation (31.8%).

The more revisions a patient has undergone the more likely it is that any subsequent revision occurs within the first two years, postoperatively. If the first revision was conducted on the basis of one of the three most common causes of revision, which are loosening/osteolysis, infection and dislocation, in most cases, the cause for the next revision is the same as at the primary revision. If a patient is revised due to periprosthetic fracture during the primary revision, there is a great probability that the next revision will be done due to dislocation. If it concerns the secondary revision, the likely cause is prosthesis loosening/osteolysis. This can be useful to know in order to prepare for possible change of both cups and stems on these patients.

	First-time revision				
	Loosening/osteolysis	*Infection*	*Periprosthetic fracture*	*Dislocation*	*Other*
Second revision					
Loosening/osteolysis	47.1	12.1	23.0	9.6	24.0
Infection	14.7	68.2	20.2	27.2	31.0
Periprosthetic fracture	9.8	3.9	9.6	5.1	9.0
Dislocation	21.1	14.2	33.1	54.2	22.0
Other	7.3	1.5	14.0	3.5	14.0
	Second revision				
	Loosening/osteolysis	*Infection*	*Periprosthetic fracture*	*Dislocation*	*Other*
Third revision					
Loosening/osteolysis	63.7	20.9	38.8	22.5	33.9
Infection	9.3	56.6	9.4	21.4	17.7
Periprosthetic fracture	9.7	5.6	11.8	6.4	3.2
Dislocation	12.2	15.3	31.8	46.0	27.4
Other	5.1	1.5	8.2	3.7	17.7

Table 4. Distribution of causes for second and third time revision according to cause closest to the previous revision. Only patients who were revised for the first time in 2001–2014 and who, since then, have undergone at least one other revision, have included. Two-step revisions have been classified under one term.

Measures at revision

The most common measures at revision, regardless of whether or not the prosthesis has been revised earlier, are change of stem and cup or liner, as well as change of cup alone (Figure 7). During multiple-time revision, measures, such as change of liner and femoral head, extraction without subsequent prosthesis insertion, and two-session operation are more common than during primary revisions. It is not possible to determine from the register data when a prosthesis extraction has been definitive or not. This is illustrated by the fact that there were more of definitive extractions in 2014 in comparison to the previous year, definitely dependent on the fact that several patients underwent their first session in 2014, with the other session planned for 2015. During the period 2001 to 2013, 28 prostheses extractions per year were carried out without inserting a new prosthesis, which corresponds to 2.1% of all first-time revisions. The corresponding number for multiple-time revisions was 21 per year, equivalent to 5.9% of all multiple-time revisions.

The type of measure varies depending on reasons for revision (Figure 8). It is most common, that at loosening/osteolysis both components are replaced, the second most common is the replacement of cup/liner while isolated stem revision is carried out only at every tenth case during first-time revision and at every fifth case at multiple-time revisions. In almost half of infection cases during first-time revision, the prosthesis is extracted and prosthesis is extracted slightly more frequently, if hip has been revised previously. Replacement of femoral head with or without a liner replacement, has been the second most common and significantly more frequent measure, if the hip prosthesis has undergone a previous revision. However, during the last 14 years, there has been a change in treatment strategy for infected prosthesis (Figure 9), which meant that the prosthesis conserving surgery has now become the most common measure for first revision due to deep infection. In more than half of periprosthetic fracture cases, only the stem is revised, regardless of the number of previous revisions. In cases, which are revised for the first time due to dislocation, cup revision is usually carried out. In case of multiple-time revisions, the choice of measures is more diversified. Replacement of only one component is more common, if the patient has been revised for the same hip due to loosening/osteolysis and periprosthetic fracture before. In case of causes regarding infection or dislocation, the proportion for cup/liner combined with stem revision is roughly the same, regardless of whether it is a first-time or multiple-time revision.

During the early 2000s, revision due to infection became more common with prosthesis-conserving surgery (Figure 9). Instead of extracting the prosthesis, a wound revision, a synovectomy and a change of modular parts, like head and also liner in the case of uncemented cup, were performed. Over the past three years, 53-58% of first-time and 36–46% of multiple-time revisions have consisted of these types interventions. If the group "replacement of cup/liner and stem" is looked at in detail, it is evident that on 70% of these interventions consist of complete prostheses replacement, which may mean

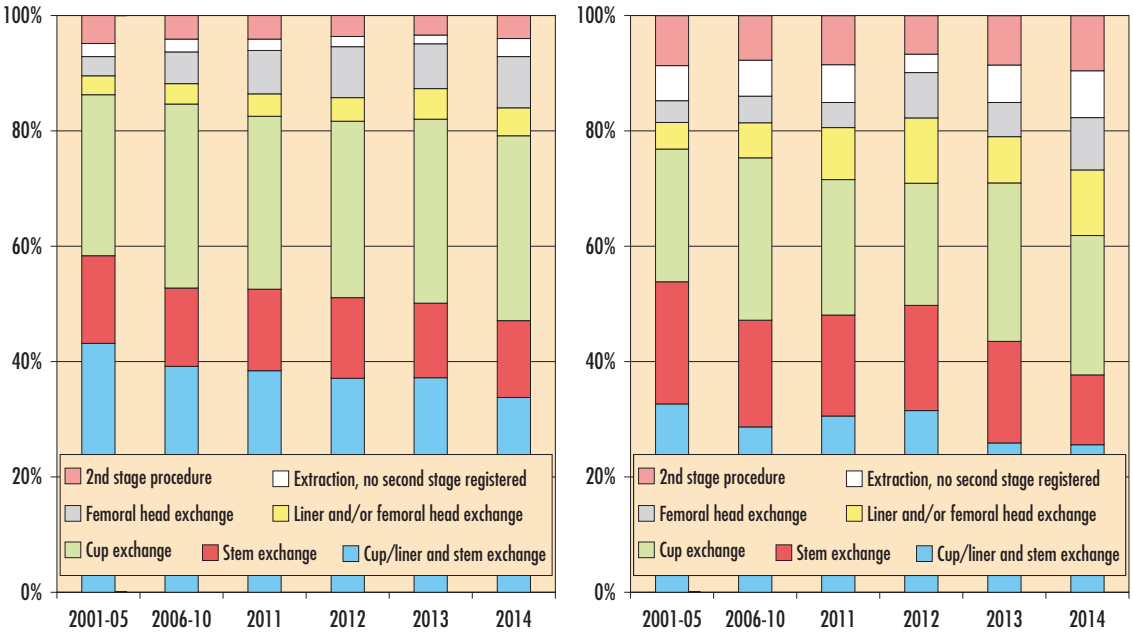


Figure 7. Distribution of measures at first-time (left) and multiple-time revisions (right).

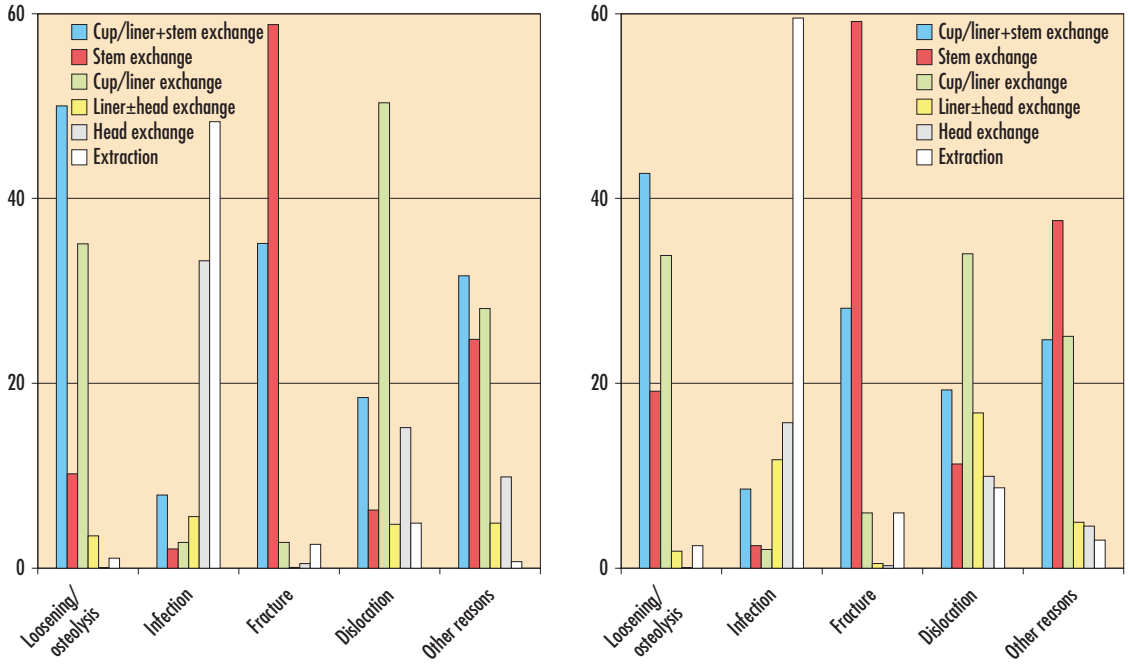


Figure 8. Measures during revision related to the revision cause (left) and to the multiple-time revisions (right) during 2001–2014. Insertion of prosthesis after previous extraction is excluded.

that they may be considered textbook one-session revisions. In other cases, the entire or parts of the femoral cement mantle, the shell of an uncemented cup or the distal part of the stem have been left on a modular femoral prosthesis. Only in 13 cases (3.4% of all revisions due to infection) of the 29 "cup/liner+stem" replacements, which were carried out in 2014, all parts of the prosthesis and all of the cement was taken out and a new prosthesis was inserted in the same session.

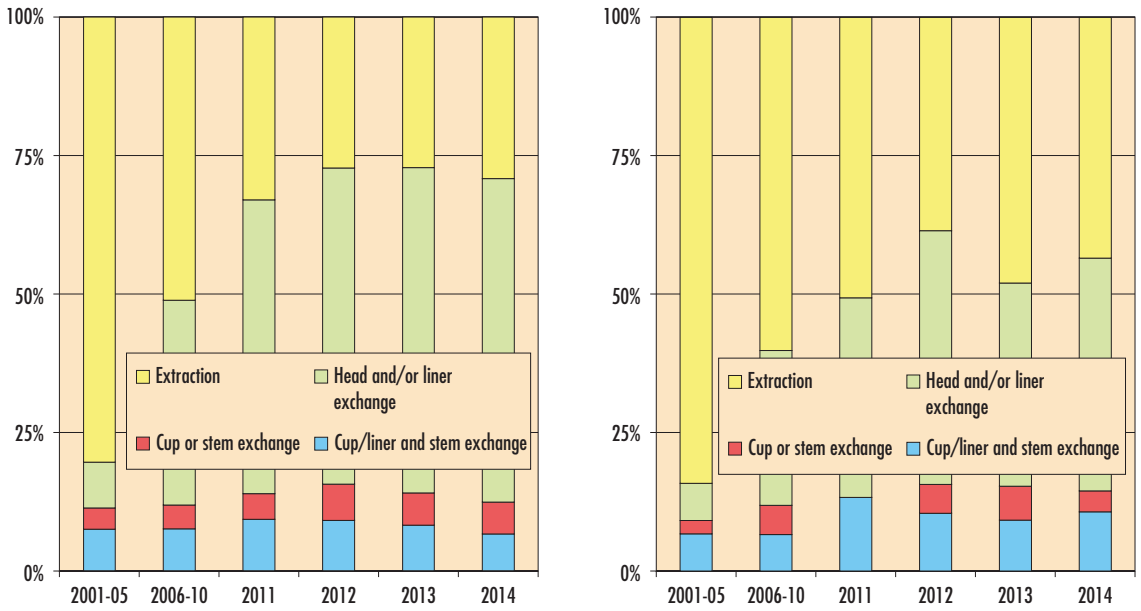


Figure 9. Measures during revision (first-time and multiple-time revisions) due to infection in 2001–2010 in a five-year period and every year in 2011–2014.

The outcome for each intervention is of major interest for the guidelines for future treatment strategy. However, the register is missing important data, such as culture results, the time between infection and performed surgical intervention, comorbidity, and tendency to perform additional surgery in case of an accident. Some of these factors can be addressed in future studies. Despite these limitations, it may be interesting to get a rough idea of the extent to which a prosthesis conserving procedure apparently protects the patient from a rerevision due to infection. We find that after the revision with prosthesis conserving surgery, which here corresponds to the replacement of the femoral head and/or liner, the implant survival after four years is based on the outcome of the new revision due to infection 80.5±3.2% in case of first-time revision and 69.5±6.6% if the patient has previously been revised (Figure 10).

Prosthesis conserving surgery in case of infections has become increasingly common. The risk of rerevision due to infection is significantly lower at first-time revisions compared to multiple-time revisions.

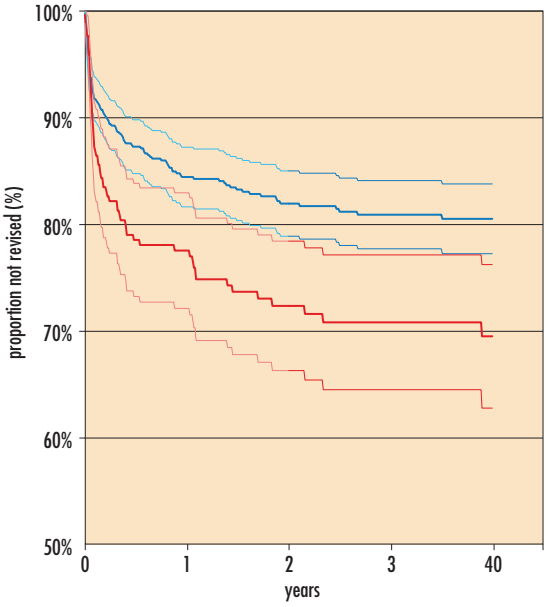


Figure 10. Implant survival following revision due to infection, which carried out the change of femoral head and/or polyethylene insert. The outcome is a new revision due to infection, regardless of measure. At the first-time revision (blue line), the implant survival during the first four years is better, than if the patient has been revised before (red line).

Selection of implant

Selection of uncemented fixation has a longer tradition in revision than in operations with primary prostheses. In the period 2001-2005, four out of five cups were revised during primary revision. During this period, recementing of the stem was more uncommon, but was still carried out in two out of three cases during multiple-time revision. Thereafter, the uncemented cup fixation has become more common and is now used in almost half of the cases during both first-time and multiple-time revisions. Between 2011 and 2014, the relation between cemented and uncemented fixation of the cup has been relatively unchanged. During the past ten years, the use of dual articular cup has become more common. This implant is usually fixed with cement (Figure 11).

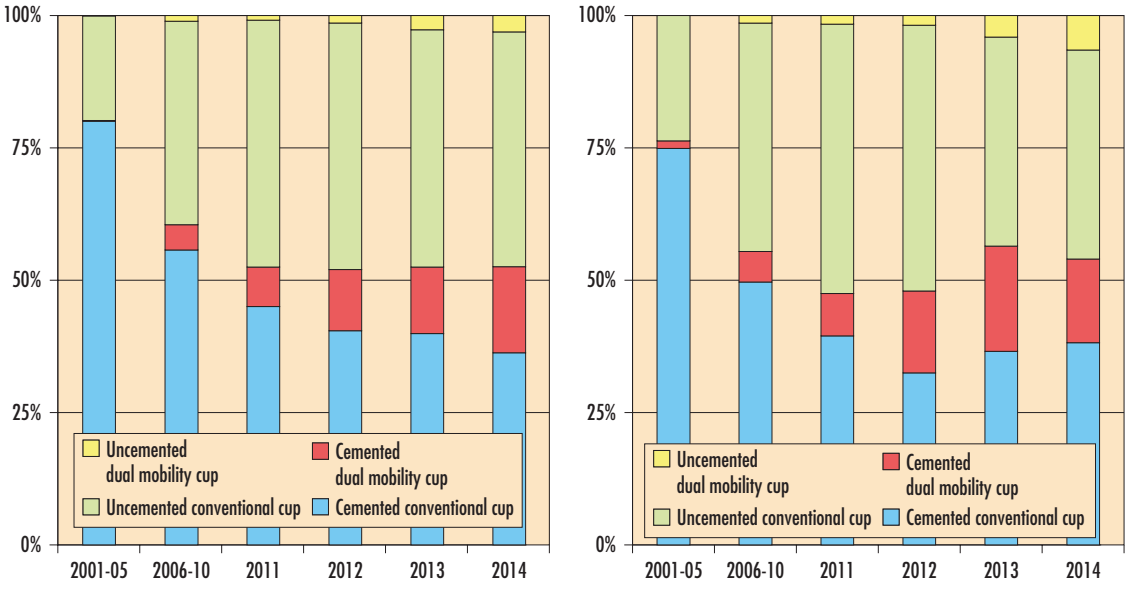


Figure 11. Distribution of cemented and uncemented cup. First-time revisions on the left and multiple-time revisions on the right. In recent years, the division between cemented /uncemented fixation has remained relatively unchanged.

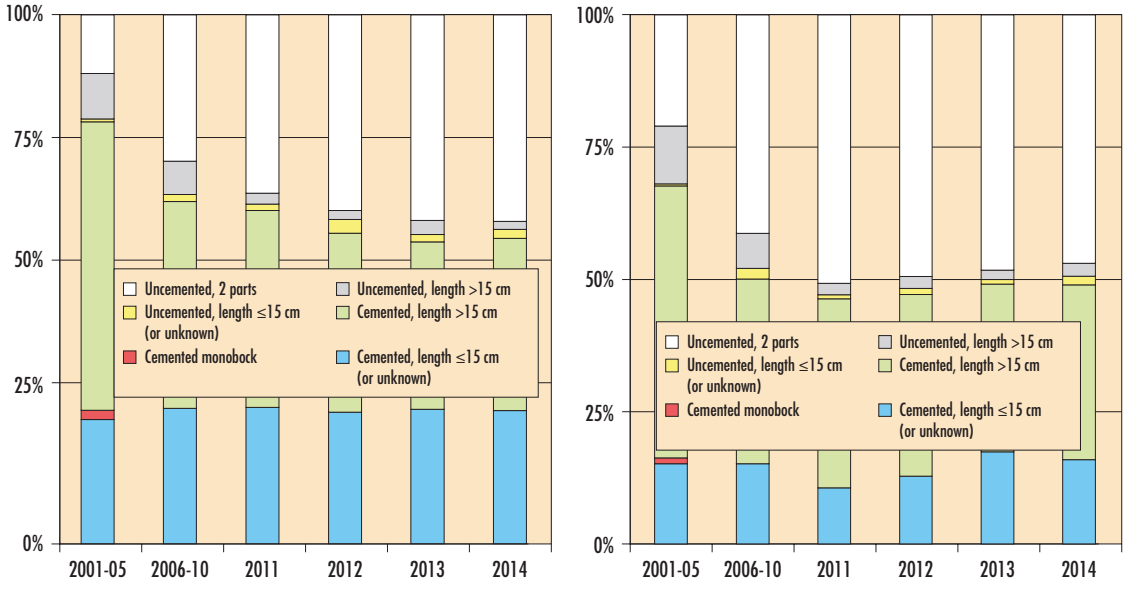


Figure 12. Distribution of the selection of fixation at the first-time revision (left) and multiple-time revision (right) during 2001–2014.

Concerning the stem, we see a similar trend towards the use of increasingly uncemented fixation during the first decade of the 2000s, followed by a more stable situation in which cemented and uncemented fixations account for about half the cases, each with a trend to prefer uncemented fixation at multiple-time revisions. In case of uncemented fixation, preferably a modular stem is chosen, probably because these provide greater flexibility in the attempt to correct leg length. Moreover, these implants have relatively good documentation regarding its fixation. In recent years, this type of implant was used in more than 90% of all cases in the uncemented group.

Cemented monoblock stems are reported until 2005 but have subsequently ceased to be used. In most cases, a stem longer than 15 centimetres is cemented (Figure 12). In 10% of cases (regardless of the number of previous revisions), the stem length is not recorded in the database for components. Probably and in the majority of cases these patients have been operated with a standard stem according to the definition in the component data base.

2004		2013		2014	
Cup at revision					
***Cemented** Number*	**833**		**642**		**621**
Lubinus	23.8	Avantage	24.1	Avantage	26.2
Elite Ogee	17.0	Exeter X3 RimFit	22.9	Exeter X3 RimFit	25.0
Exeter	16.4	Lubinus	17.4	Lubinus	14.9
CHD*	6.4	Marathon	14.2	Marathon	11.9
Reflection	5.4	ZCA	5.0	CHD*	5.6
Other	**25.0**	Others	**16.4**	Others	**16.4**
***Uncemented** Number*	**282**		**493**		**553**
Trilogy±HA	71.3	TM revision	30.4	TM revision	35.3
Mallory Head	9.6	Continuum	20.5	Continuum	17.0
Reflection SP3 HA	3.9	Trilogy±HA	9.9	Delta TT+One TT	7.4
ABG 2	2.5	Mallory head	6.3	Trident AD LW+Hemi	6.3
TOP Pressfit	2.5	TM modular	6.1	Trilogy±HA	6.0
Other	**10.3**	Others	**26.8**	Others	**28.0**
Stem at revision					
***Cemented** Number*	**621**		**463**		**463**
SP II standard	33.0	Exeter standard	33.0	Exeter standard	35.6
Exeter standard	27.2	SP II standard	28.1	SP II standard	26.9
CPT	15.3	Exeter short revision stem	14.9	Exeter short revision stem	15.9
Exeter long	11.0	CPT	8.6	Exeter long	7.3
Specton EF long	3.2	Exeter long	6.7	CPT	6.9
Other	**10.3**	Others	**8.6**	Others	**7.4**
***Uncemented** Number*	**272**		**451**		**449**
MP	39.7	MP	45.0	MP	42.3
Wagner SL Revision	21.7	Restoration	20.2	Restoration	20.7
Revitan cylinder	12.5	Revitan cylinder	13.5	Revitan	17.0
Revitan spout	4.8	Arcos	4.2	Corail Revision	5.3
Restoration	4.0	Bimetric X Por HA	4.0	Corail standard±collar	4.0
Other	**17.3**	Others	**13.1**	Others	**10.7**

**Contemporary Hooded Duration*

Table 4. The five most used cemented and uncemented cups and stems at revision surgery have been presented in percentages of the total number, which was reported during 2004, 2013 and 2014. Both first-time and multiple-time revisions are included.

During the past 10 years, the choice of specific implants for revision has a slightly greater variation than that for primary prosthesis. The picture is somewhat clouded by the fact that revision prostheses often have a greater degree of modularity and can be varied in a number of ways, which makes accurate classification difficult. Also, in the last 10 years, the picture has been changed by the introductiomn of dual articular cup design and cups with trabecular metal in combination with a trend to abandon cemented fixation in favour of uncemented fixation. Some uncemented cup shells, which usually are used with a liner of a conventional type, can also be combined with a metal insert with a polished inside and can function as a dual articular cup. This type of combination is much more common in revision than primary arthroplasty.

In this year's report, we show the choice of implant (cemented and uncemented cup and stem, respectively) for years 2004, 2013 and 2014. The number of inserted implants per year is substantially smaller than in the case of primary operation and the initial and multiple-time revisions have therefore been merged into one group. The relatively small amount in every group means that relatively small changes in the number of used implants is required to bring about changes. For example, standard type Corail stem was used during 16 operations in 2014 (4%). In the sixth place is Acros, which was used in 14 operations. The tables should mainly be seen informative and conclusions about trends should be made with caution, at least for those implants that are used in less than 10% of cases. In this context, one can conclude that between 2013 and 2014, the choice of revision's implant has stayed relatively the same. This applies to the uncemented cups, where we can see that, like at primary arthroplasty, the use of Trilogy cup with porous surface with or without hydroxyapatite coating decreases in favour of newer designs like the Delta and Trident cups.

Over the past four years, the choice between cemented and uncemented fixation has been relatively constant, both regarding cups and stems. During the period, the use of dual articular cup has increased. Most of these implants are fixed with cement, but the use of uncemented fixation is also increasing.

Measures not presented above

Treatment of dislocation by screwing a semicircle cutout (sector addition) from a cup was introduced in Sweden in 1983 (Olerud S, Karlstrom G. J Bone Joint Surg Br 1985; 67(3):402–5.) Later, there were also commercially manufactured socket wall additions. The operation quickly became popular because it is relatively simple compared to the component replacement, and was considered to have a more limited strain on the patient. In 2004, when the use of socket wall additions was most popular, 99 operations were carried out. As a measure, insertion of a socket wall addition is not classified as a revision. In about a third of the cases, this intervention has been combined with replacement of all or some components and has so been included in revision. The most common cause for reoperation/revision in these cases was, as expected, dislocation (82%), followed by technical

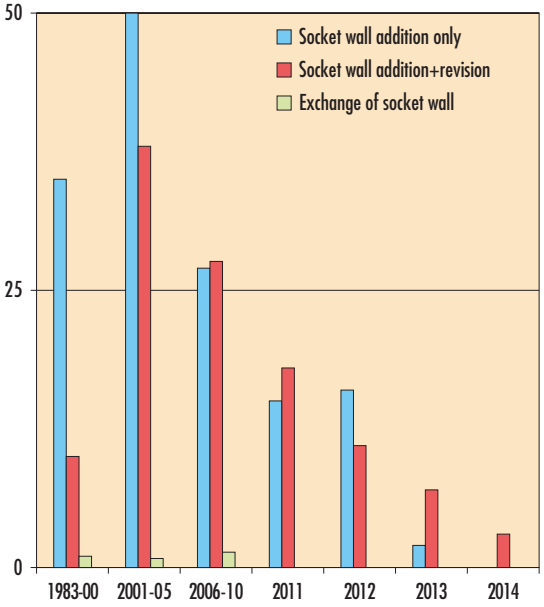


Figure 13. Number of operations where a socket wall addition was inserted or replacement. Operations, where the whole prosthesis or some of its components are replaced, are presented separately.

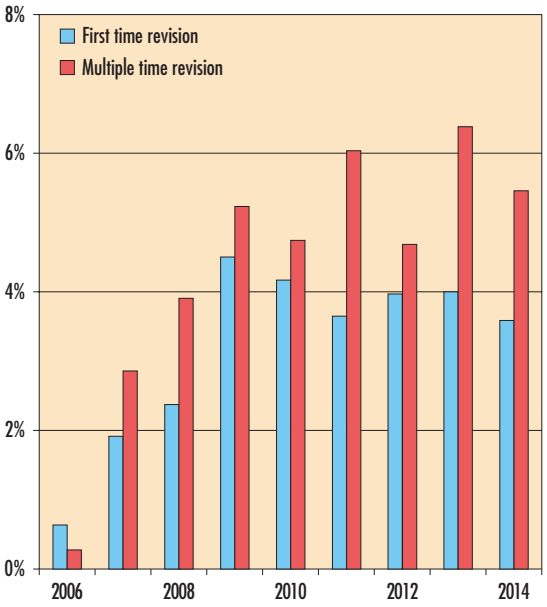


Figure 14. Percentage of first and multiple revisions where the porous metal augmentation is used.

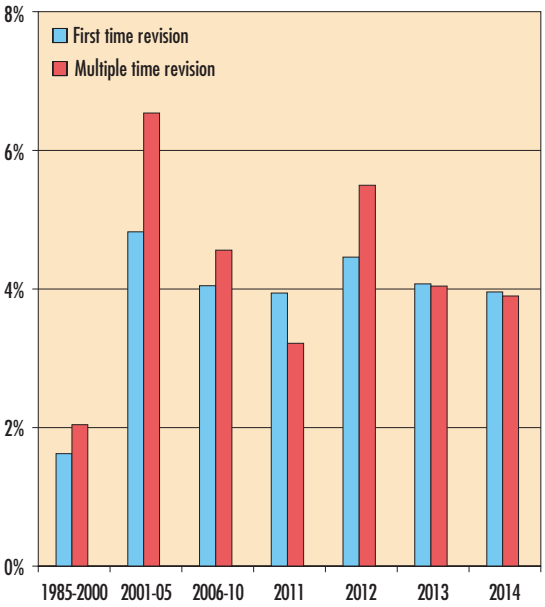


Figure 15. Percentage of first and multiple revisions where the reinforcement ring is used.

causes (6.1%). After the peak year 2004, the use of socket wall additions has decreased, in part probably as an effect of the increased use of large femoral heads and introduction of dual articular cup in Sweden. In 2014, only three operations were carried out, in all cases this was combined with replacement of other prosthesis components (Figure 13).

Bone defects in the acetabulum can be treated with bone grafting, with specially designed cups or by milling off the defect and using an extra-large cup (megacup). During the mid-2010s, porous metal implants in different forms (so-called augments) were introduced for filling defects in the acetabulum. In Sweden, such augment was used for the first time in 2006 (Figure 14). At the moment, the type of the used augment is not registered, but since it is in contact with the implant, we are planning to make such registration available in connection with the introduction of a new database. We believe that this should be done, not least against the background of the fact that augments from a specific manufacturer is sometimes used during insertion of cups, which have been produced by another manufacturer. 25 different cups (five different manufacturers) have been used at 592 operations, which are registered, with at least one inserted augment. In 52.5% of these cases, a cup meant for cemented fixation was used. As expected, augments are used somewhat more often during multiple-time revisions.

Another possibility to strengthen the acetabulum at cup revisions is to use a metal reinforcement ring. The ring can be used to improve load distribution, compress bone graft that is placed behind the ring against pelvis and/or to fix parts of acetabulum, which are separated from each other at a so-called pelvic dissociation. In certain cases, modified reinforcements are used to relieve a cemented cup and can be combined with an augment.

The use of reinforcement ring was registered in the hip arthroplasty register for the first time in 1985 (Figure 15). During the past two years, those have been used just as often during first-time and multiple-time revisions. Of the 685 cases, which have been registered, 25 have been inserted without cement. In all cases, this applies to TM or Continuum-cups, where a modified reinforcement ring was inserted, which is presented above.

Since 2005, use of socket wall additions to prevent dislocation declined gradually by 2013. Insertion of porous metal augments and reinforcement rings has during the past years been carried out at 4–6% of all revisions. The most common cause for revision in these cases is loosening or osteolysis (87.3 and 80%, respectively).

Number of revisions per diagnosis and number of previous revisions

primary THR 1979–2014

Diagnosis at primary THR	0		1		2		>2		Total	Proportion
Primary osteoarthritis	24,451	74.4%	4,198	70.4%	823	65.4%	253	61.0%	29,725	73.4%
Fracture	2,844	8.7%	478	8.0%	93	7.4%	23	5.5%	3,438	8.5%
Inflammatory arthritis	2,403	7.3%	538	9.0%	159	12.6%	61	14.7%	3,161	7.8%
Childhood disease	1,626	4.9%	426	7.1%	99	7.9%	43	10.4%	2,194	5.4%
Femoral head necrosis	834	2.5%	164	2.8%	42	3.3%	12	2.9%	1,052	2.6%
Posttraumatic osteoarthritis	252	0.8%	81	1.4%	28	2.2%	20	4.8%	381	0.9%
Other secondary osteoarthritis	115	0.3%	22	0.4%	4	0.3%	2	0.5%	143	0.4%
Tumour	74	0.2%	17	0.3%	5	0.4%	1	0.2%	97	0.2%
(missing)	279	0.8%	35	0.6%	5	0.4%	0	0%	319	0.8%
Total	32,878	100%	5,959	100%	1,258	100%	415	100%	40,510	100%

Number of revisions per reason and number of previous revisions

primary THR 1979–2014

Reason for revision	0		1		2		>2		Total	Proportion
Aseptic loosening	22,847	69.5%	3,347	56.2%	578	45.9%	144	34.7%	26,916	66.4%
Dislocation	3,077	9.4%	935	15.7%	255	20.3%	117	28.2%	4,384	10.8%
Deep infection	2,949	9.0%	881	14.8%	255	20.3%	113	27.2%	4,198	10.4%
Fracture	2,461	7.5%	490	8.2%	103	8.2%	20	4.8%	3,074	7.6%
Technical error	739	2.2%	144	2.4%	33	2.6%	11	2.7%	927	2.3%
Implant fracture	471	1.4%	99	1.7%	22	1.7%	8	1.9%	600	1.5%
Others	196	0.6%	30	0.5%	6	0.5%	1	0.2%	233	0.6%
Pain only	138	0.4%	30	0.5%	6	0.5%	1	0.2%	175	0.4%
Secondary infection	0	0%	3	0.1%	0	0%	0	0%	3	0%
Total	32,878	100%	5,959	100%	1,258	100%	415	100%	40,510	100%

Number of revisions per revision year and number of previous revisions

primary THR 1979–2014

Year of revison	0		1		2		>2		Total	Proportion
1979–2009	25,899	78.8%	4,428	74.3%	898	71.4%	268	64.6%	31,493	77.7%
2010	1,415	4.3%	312	5.2%	82	6.5%	31	7.5%	1,840	4.5%
2011	1,369	4.2%	309	5.2%	64	5.1%	28	6.7%	1,770	4.4%
2012	1,434	4.4%	317	5.3%	68	5.4%	26	6.3%	1,845	4.6%
2013	1,398	4.3%	295	5.0%	68	5.4%	22	5.3%	1,783	4.4%
2014	1,363	4.1%	298	5.0%	78	6.2%	40	9.6%	1,779	4.4%
Total	32,878	100%	5,959	100%	1,258	100%	415	100%	40,510	100%

Number of revisions per reason and revision year

first revision only, primary THR 1979–2014

Reason for revision	1979–2009	2010	2011	2012	2013	2014	Total	Proportion
Aseptic loosening	18,911	877	794	811	759	695	22,847	69.5%
Dislocation	2,206	162	153	166	192	198	3,077	9.4%
Deep infection	1,971	153	194	199	206	226	2,949	9.0%
Fracture	1,706	152	144	153	146	160	2,461	7.5%
Technical error	554	37	47	44	27	30	739	2.2%
Implant fracture	382	17	23	19	17	13	471	1.4%
Others	73	11	9	28	44	31	196	0.6%
Pain only	96	6	5	14	7	10	138	0.4%
Total	25,899	1,415	1,369	1,434	1,398	1,363	32,878	100%

Number of revisions per type of fixation at primary THR and revision year

first revision only, primary THR 1979–2014

Type of fixation at primary THR	1979–2009	2010	2011	2012	2013	2014	Total	Proportion
Cemented	21,119	1,055	978	999	952	948	26,051	79.2%
Uncemented	2,372	145	162	173	181	180	3,213	9.8%
Hybrid	1,427	113	108	108	117	102	1,975	6.0%
Reversed hybrid	317	75	90	94	98	93	767	2.3%
Resurfacing implants	69	15	14	24	29	17	168	0.5%
(missing)	595	12	17	36	21	23	704	2.1%
Total	25,899	1,415	1,369	1,434	1,398	1,363	32,878	100%

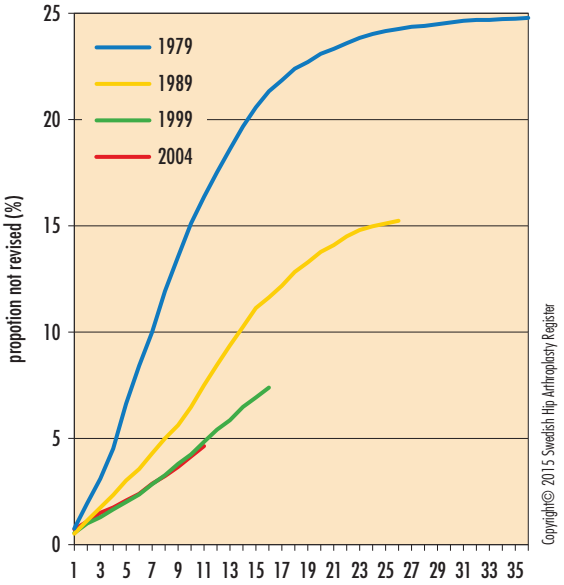
Number of revisions per reason and time to revision

first revision only, primary THR 1979–2014

Reason for revision	0–3 years		4–6 years		7–10 years		>10 years		Total	Proportion
Aseptic loosening	3,124	35.3%	4,116	76.7%	6,173	83.0%	9,434	84.0%	22,847	69.5%
Dislocation	1,812	20.5%	379	7.1%	362	4.9%	524	4.7%	3,077	9.4%
Deep infection	2,256	25.5%	284	5.3%	204	2.7%	205	1.8%	2,949	9.0%
Fracture	721	8.2%	349	6.5%	513	6.9%	878	7.8%	2,461	7.5%
Technical error	673	7.6%	29	0.5%	21	0.3%	16	0.1%	739	2.2%
Implant fracture	73	0.8%	120	2.2%	134	1.8%	144	1.3%	471	1.4%
Others	86	1.0%	67	1.2%	22	0.3%	21	0.2%	196	0.6%
Pain only	98	1.1%	22	0.4%	5	0.1%	13	0.1%	138	0.4%
Total	8,843	100%	5,366	100%	7,434	100%	11,235	100%	32,878	100%

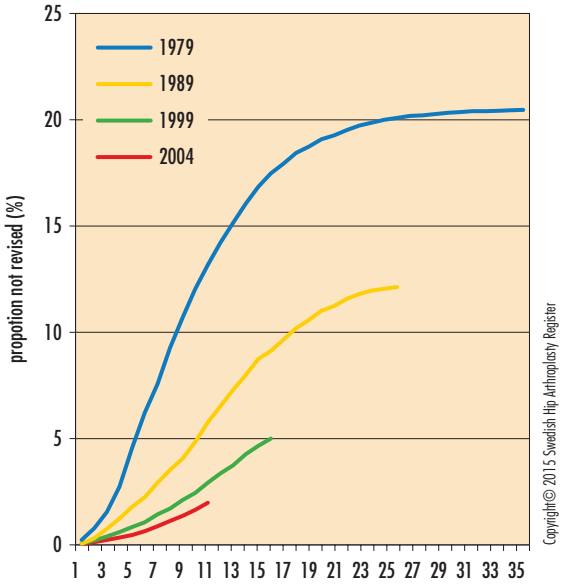
All diagnoses and all reasons

cumulative revision frequency



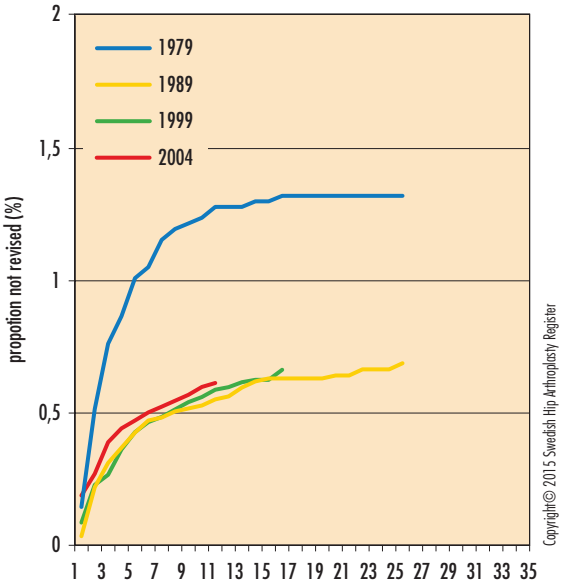
Aseptic loosening

cumulative revision frequency



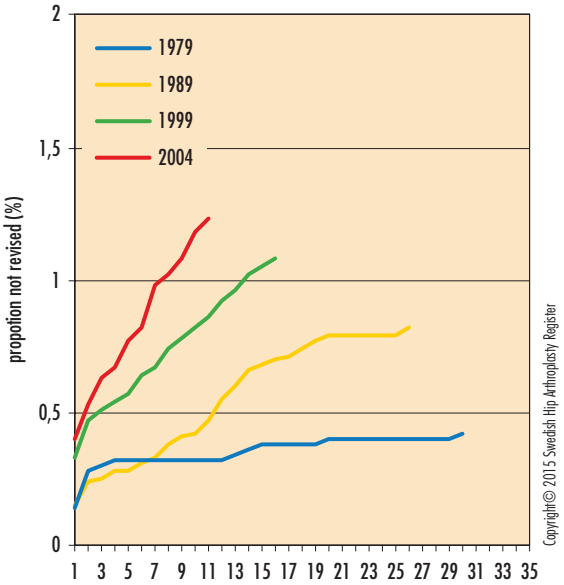
Deep infection

cumulativ revision frequency



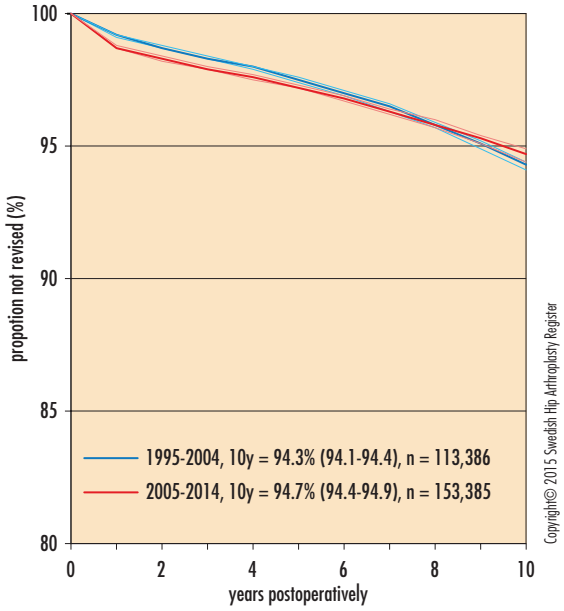
Dislocation

cumulativ revision frequency



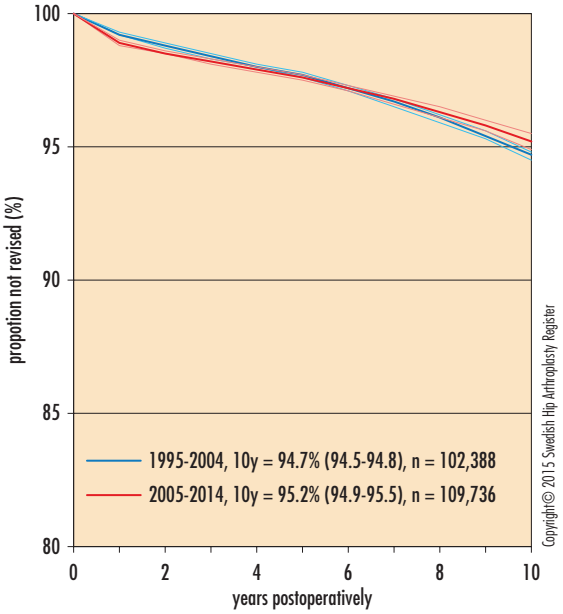
All implants

All diagnoses and all reasons



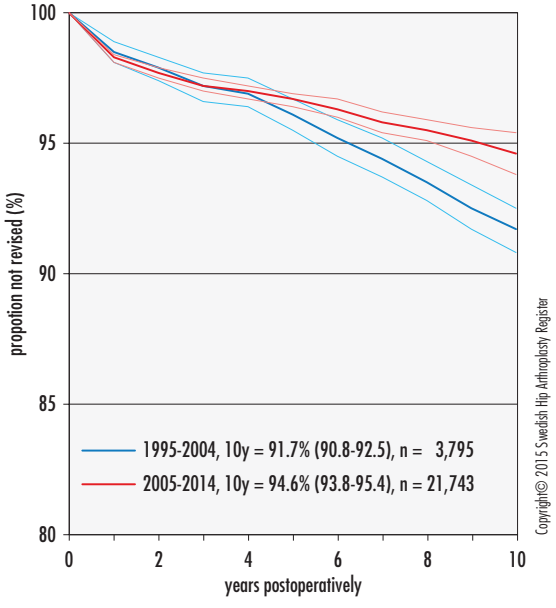
All cemented implants

All diagnoses and all reasons



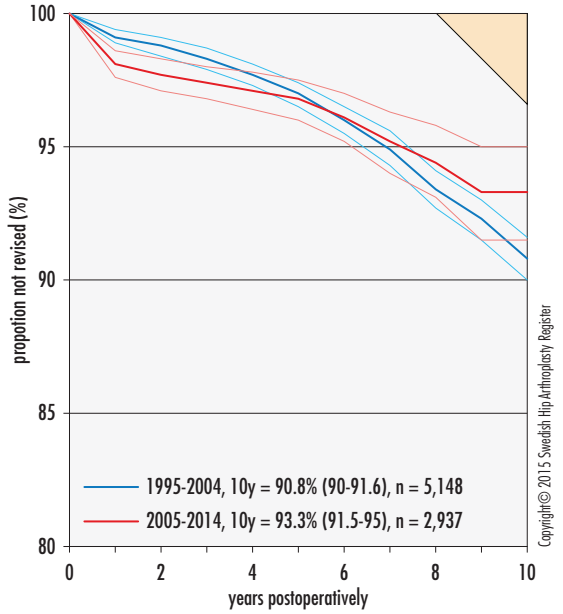
All uncemented implants

All diagnoses and all reasons



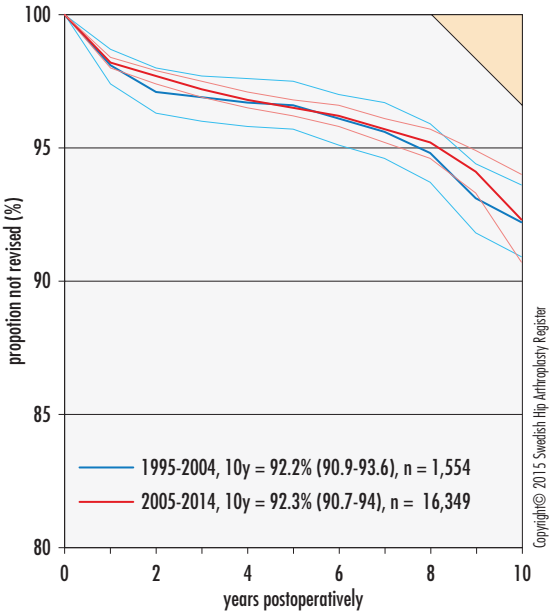
All hybrid implants

All diagnoses and all reasons



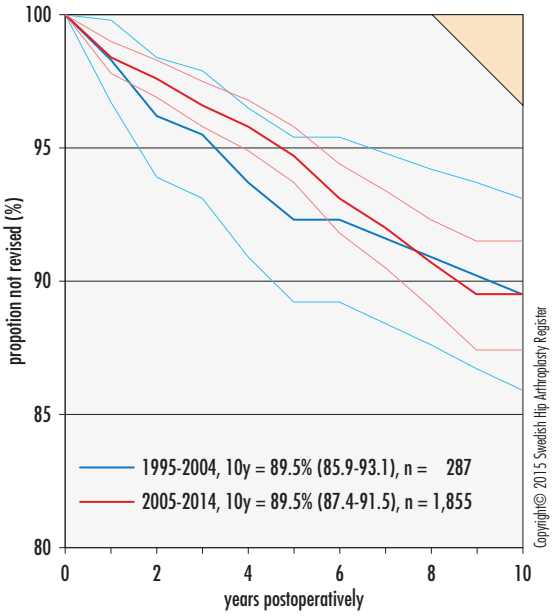
All reversed hybrid implants

All diagnoses and all reasons



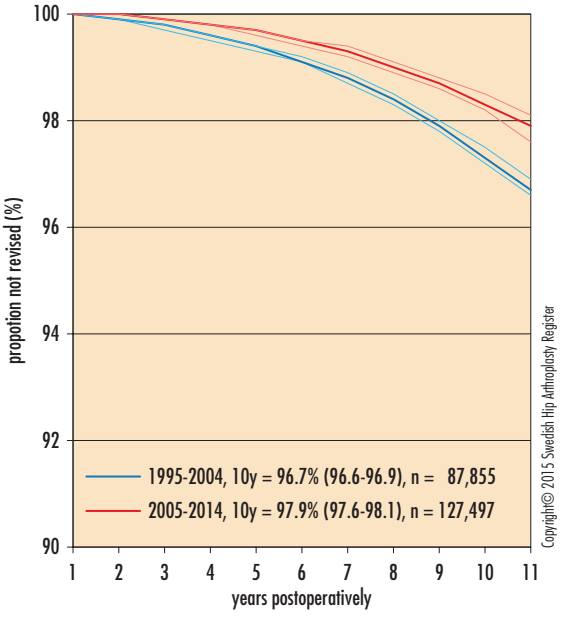
All resurfacing implants

All diagnoses and all reasons



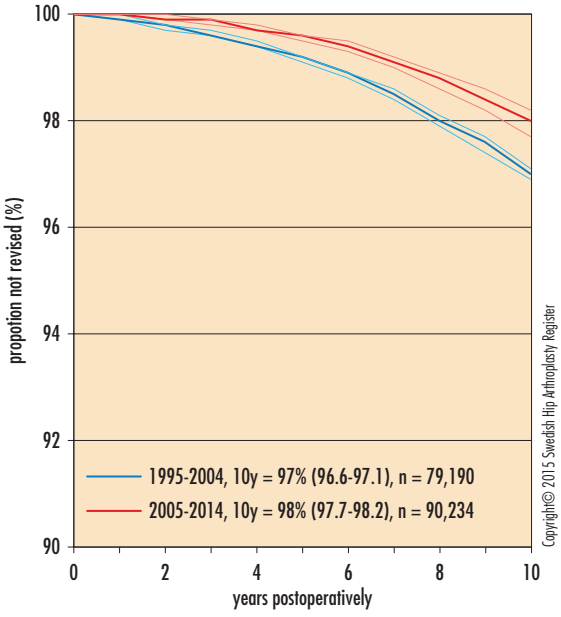
All implants

Primary osteoarthritis and aseptic loosening



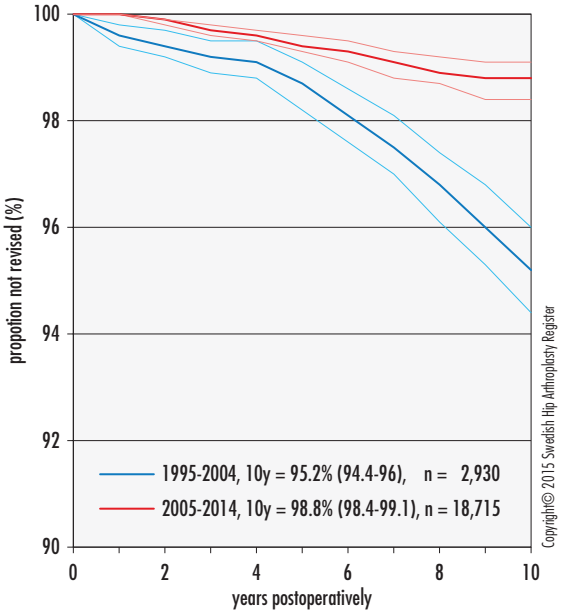
All cemented implants

Primary osteoarthritis and aseptic loosening



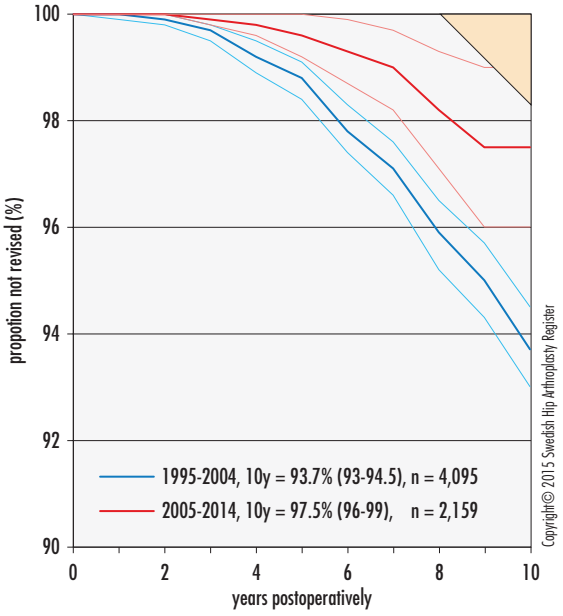
All uncemented implants

Primary osteoarthritis and aseptic loosening



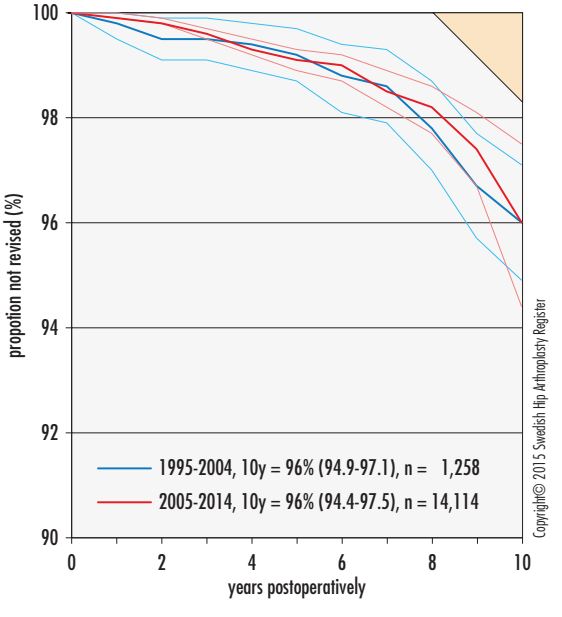
All hybrid implants

Primary osteoarthritis and aseptic loosening



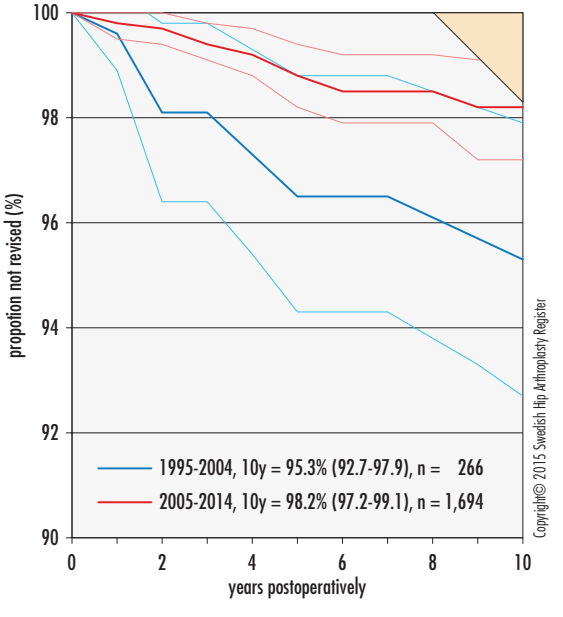
All reversed hybrid implants

Primary osteoarthritis and aseptic loosening



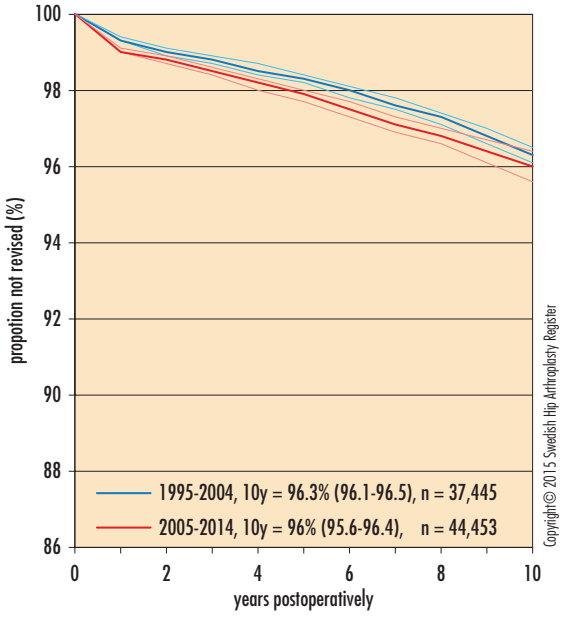
All resurfacing implants

Primary osteoarthritis and aseptic loosening



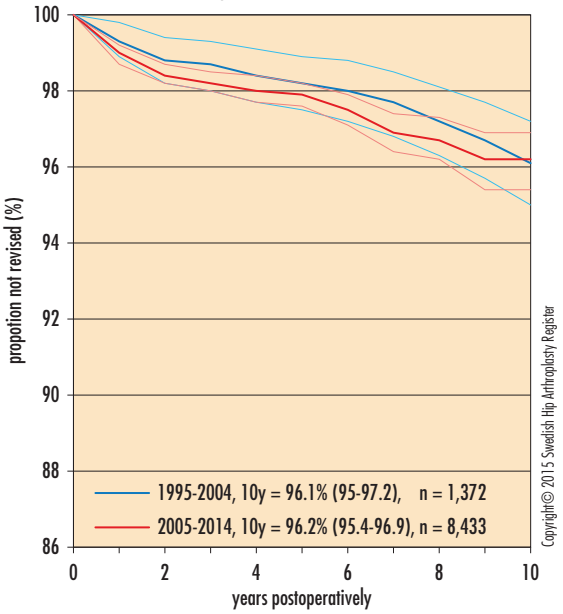
Lubinus all-poly (Lubinus SP II)

All diagnoses and all reasons



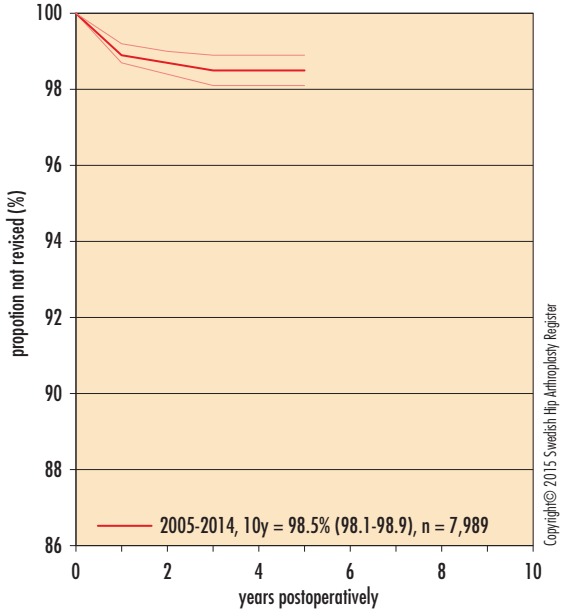
Contemporary Hooded Duration (Exeter Polished)

All diagnoses and all reasons



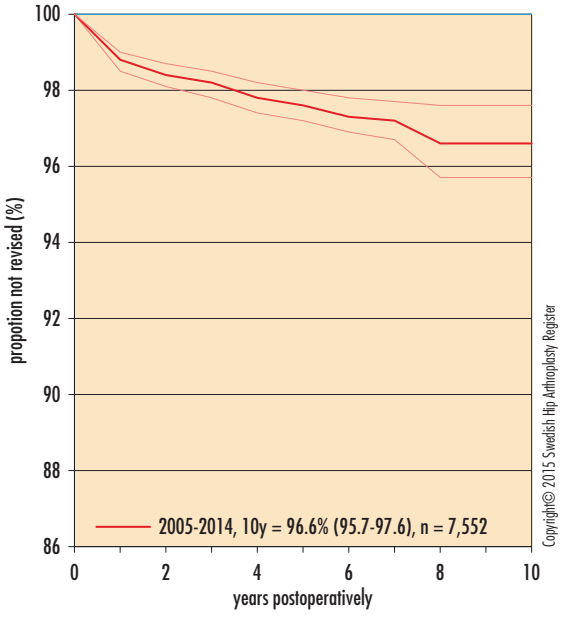
Lubinus X-linked Lubinus SP II

All diagnoses and all reasons



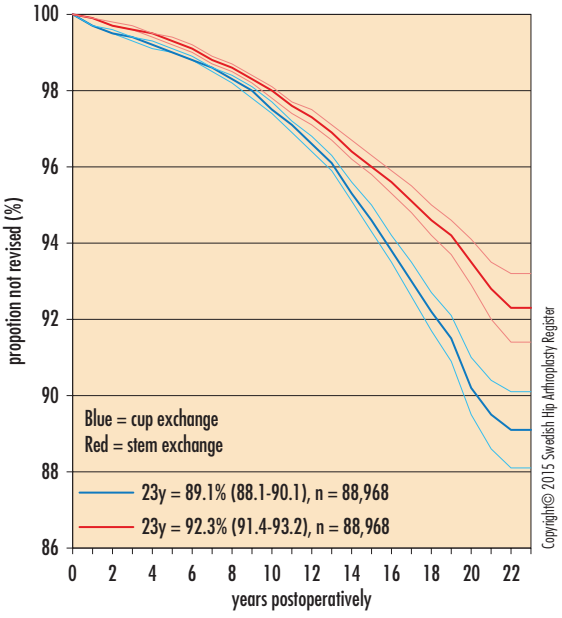
ZCA XLPE (MS30 Polished)

All diagnoses and all reasons



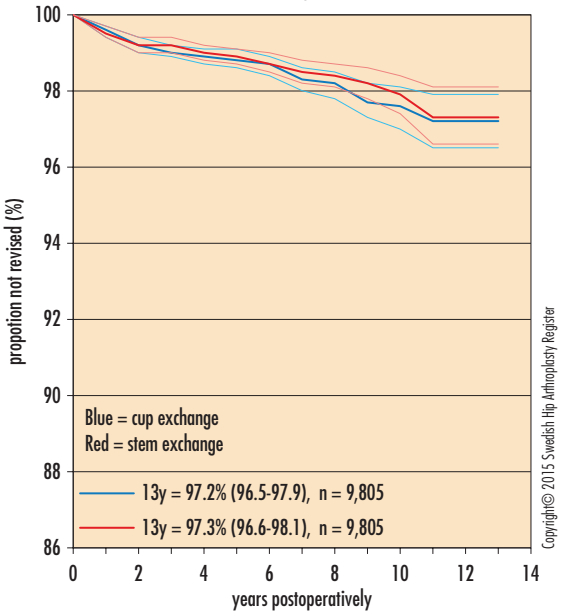
Lubinus all-poly (Lubinus SP II)

cup-/stem revision – all diagnoses and all reasons



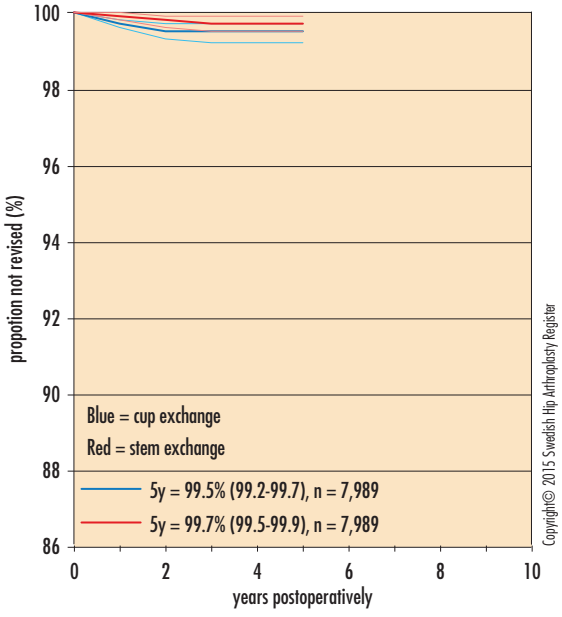
Contemporary Hooded Duration (Exeter Polished)

cup-/stem revision – all diagnoses and all reasons



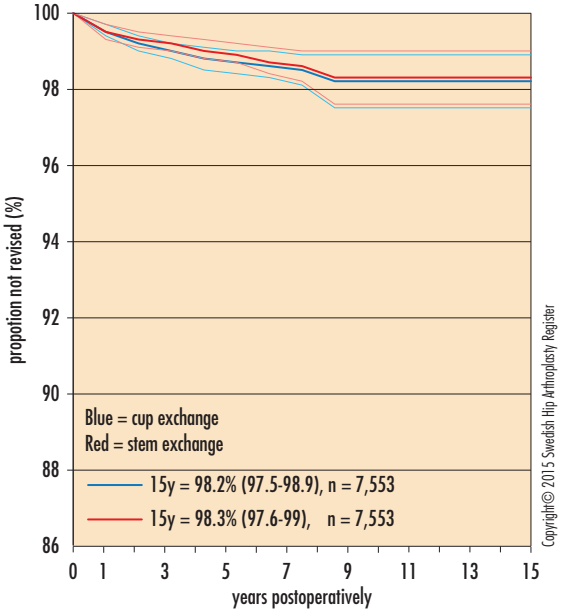
Lubinus X-linked (Lubinus SP II)

cup-/stem revision – all diagnoses and all reasons



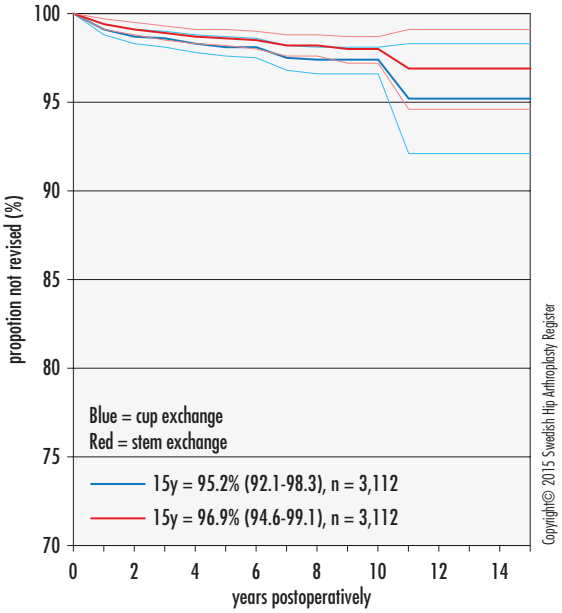
ZCA XLPE (MS30 Polished)

cup-/stem revision – all diagnoses and all reasons



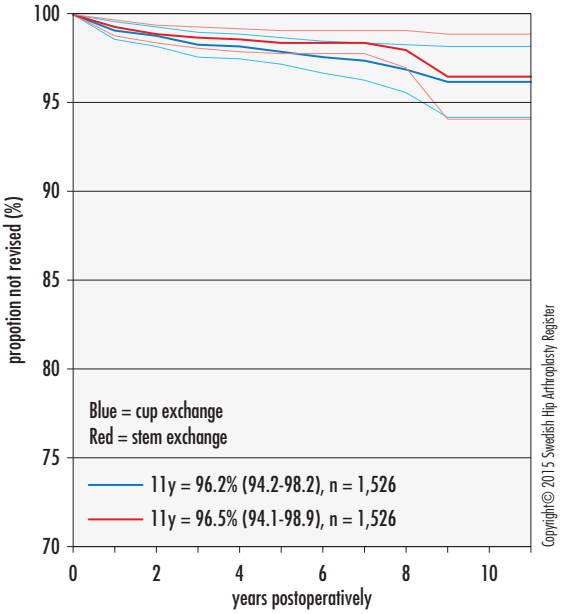
Trilogy HA (CLS Spotorno)

cup-/stem revision – all diagnoses and all reasons



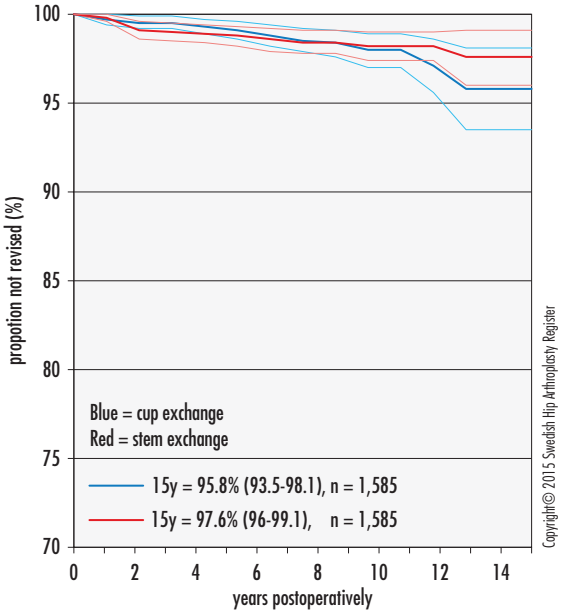
Trident HA (Accolade)

cup-/stem revision – all diagnoses and all reasons



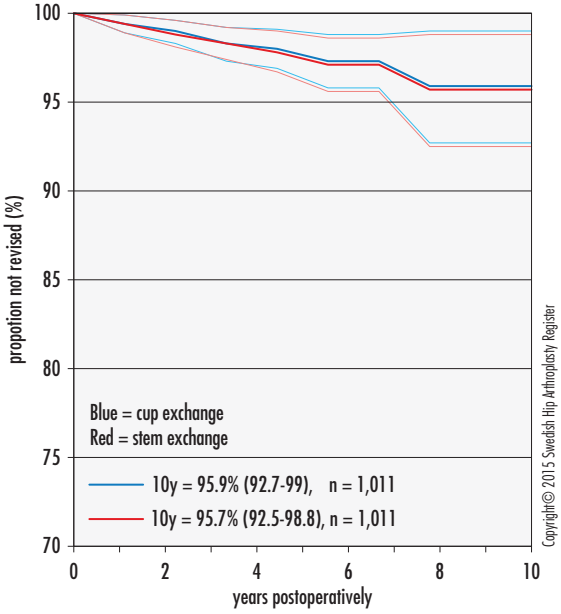
Allofit (CLS Spotorno)

cup-/stem revision – all diagnoses and all reasons



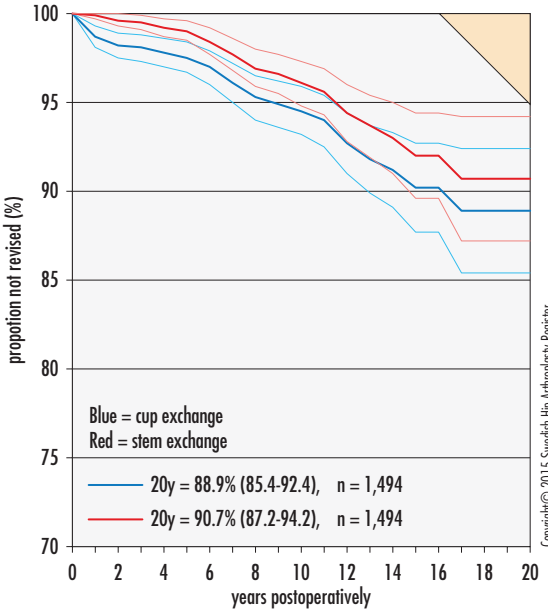
Pinnacle HA (Corail Collarless)

cup-/stem revision – all diagnoses and all reasons



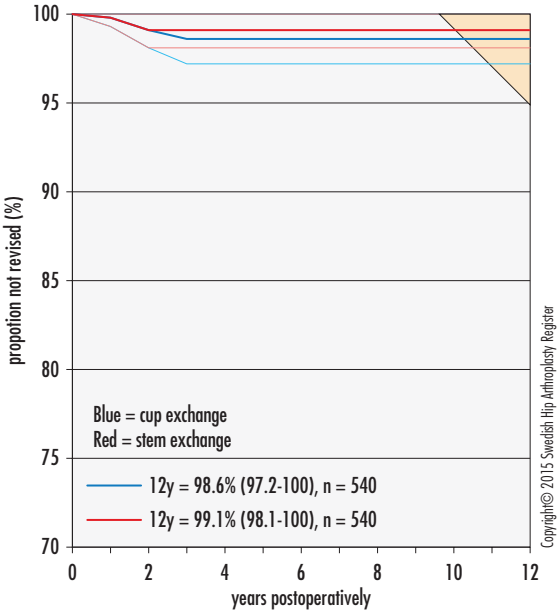
Trilogy HA (Lubinus SP II)

cup-/stem revision – all diagnoses and all reasons



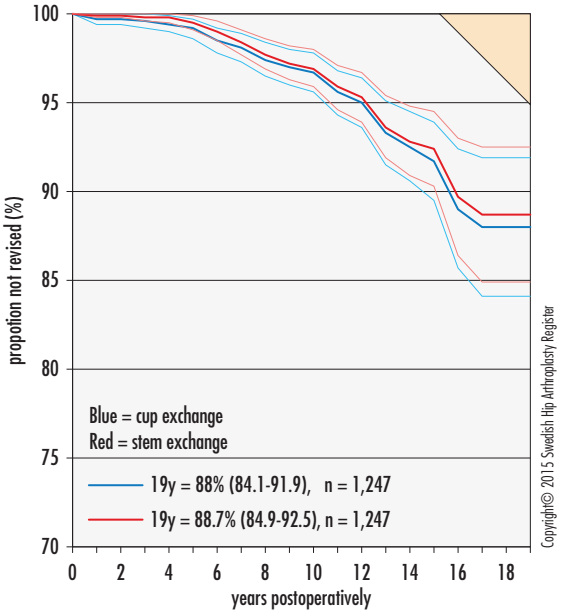
Trident HA (Exeter Polished)

cup-/stem revision – all diagnoses and all reasons



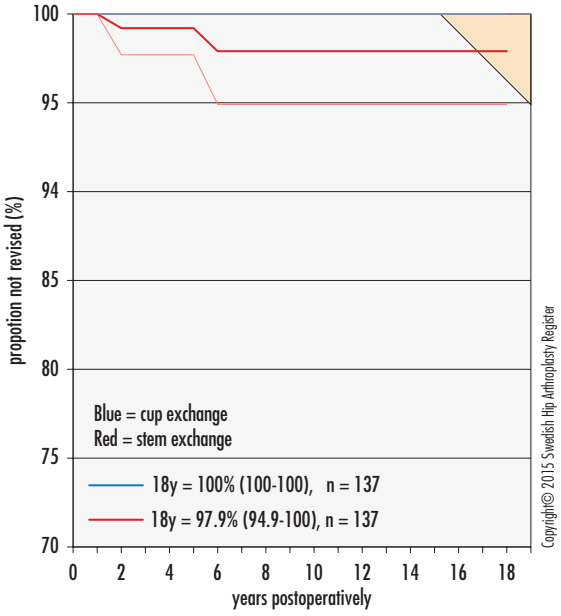
Trilogy HA (Spectron EF Primary)

cup-/stem revision – all diagnoses and all reasons



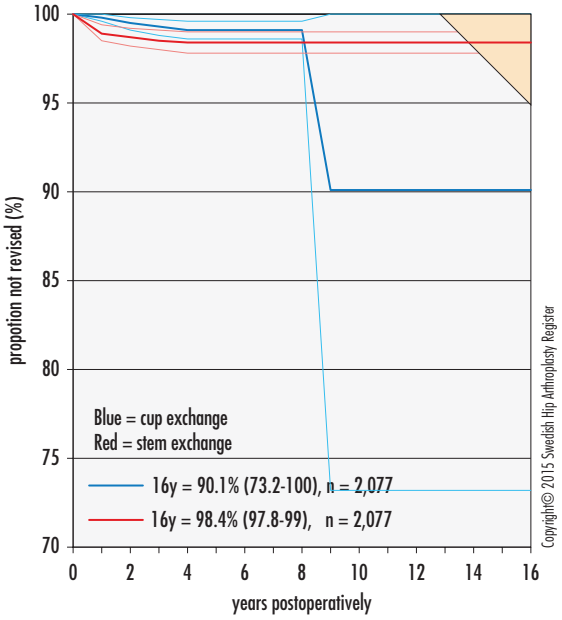
Trilogy HA (Exeter Polished)

cup-/stem revision – all diagnoses and all reasons



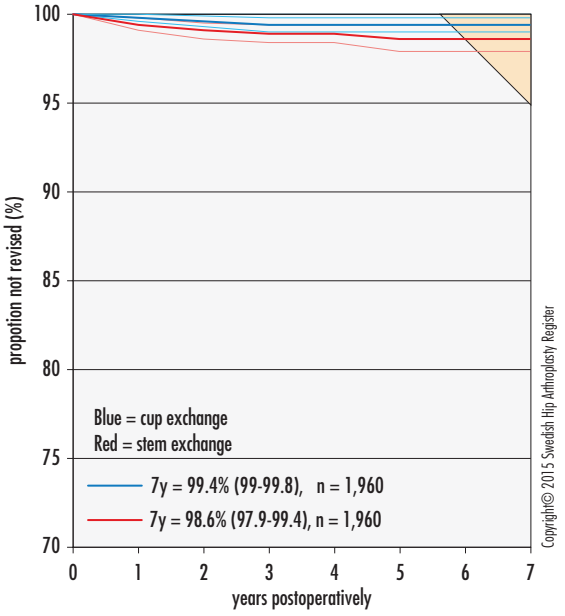
Lubinus all-poly (Corail Collarless)

cup-/stem revision – all diagnoses and all reasons



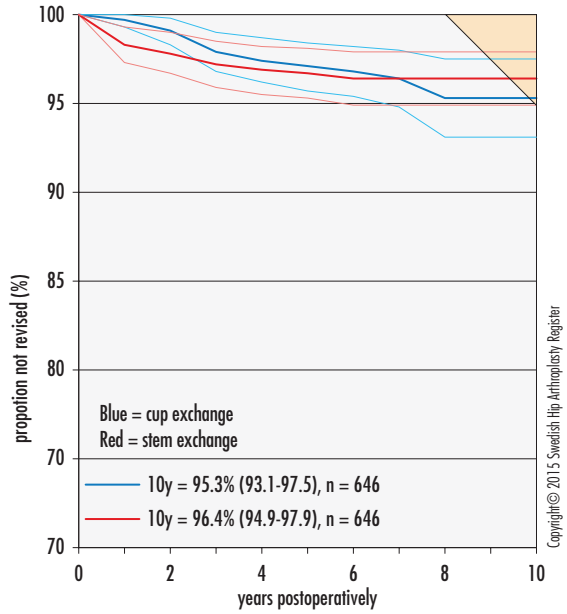
Marathon XLPE (Corail Collarless)

cup-/stem revision – all diagnoses and all reasons



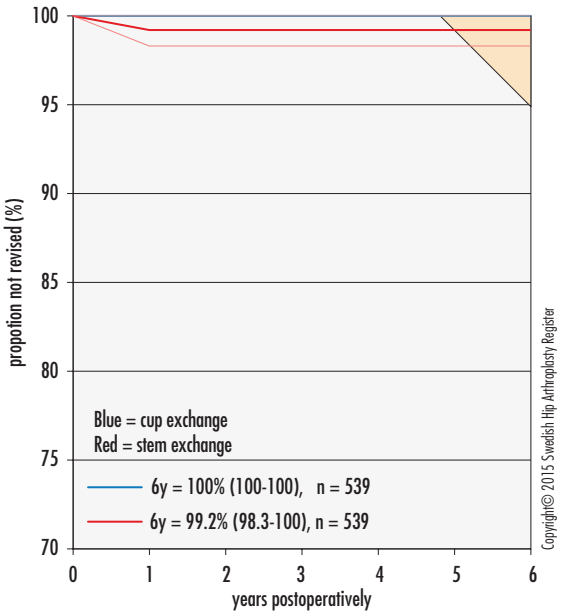
Contemporary Hooded Duration (ABG II HA)

cup-/stem revision – all diagnoses and all reasons



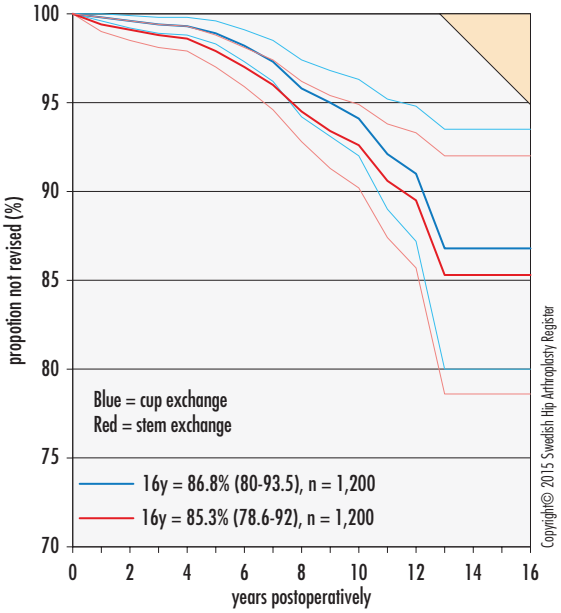
Marathon XLPE (Corail Collared)

cup-/stem revision – all diagnoses and all reasons



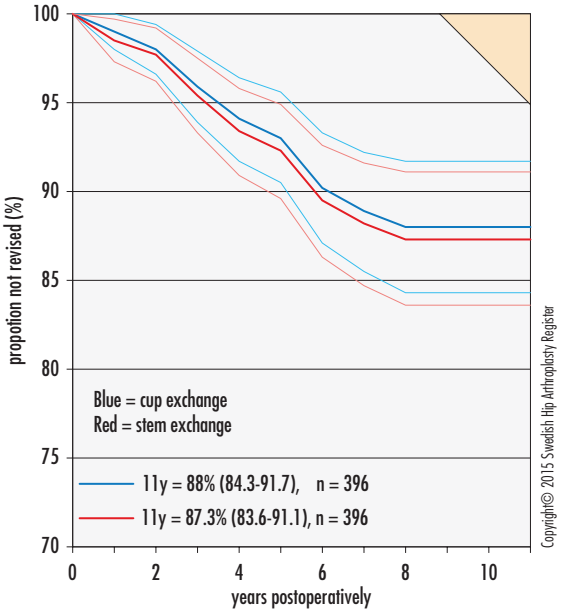
BHR Acetabular Cup (BHR Femoral Head)

cup-/stem revision – all diagnoses and all reasons



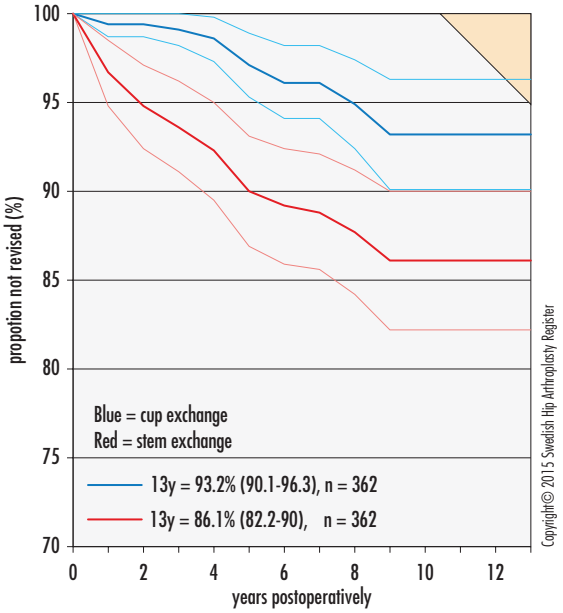
ASR Cup (ASR Head)

cup-/stem revision – all diagnoses and all reasons



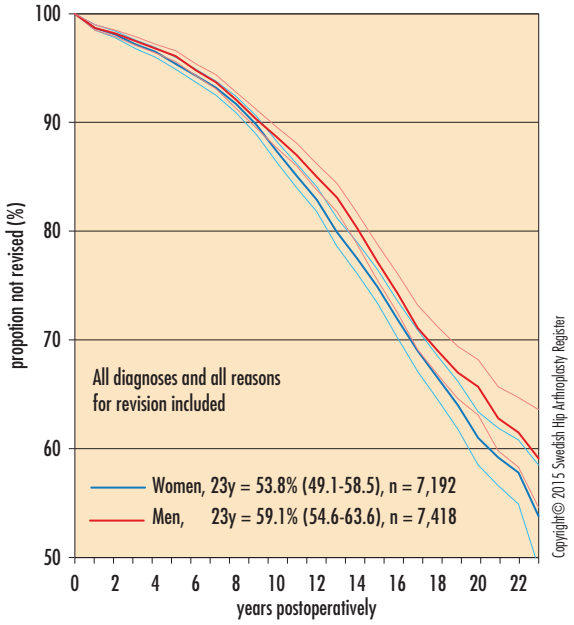
Durom-Durom

cup-/stem revision – all diagnoses and all reasons



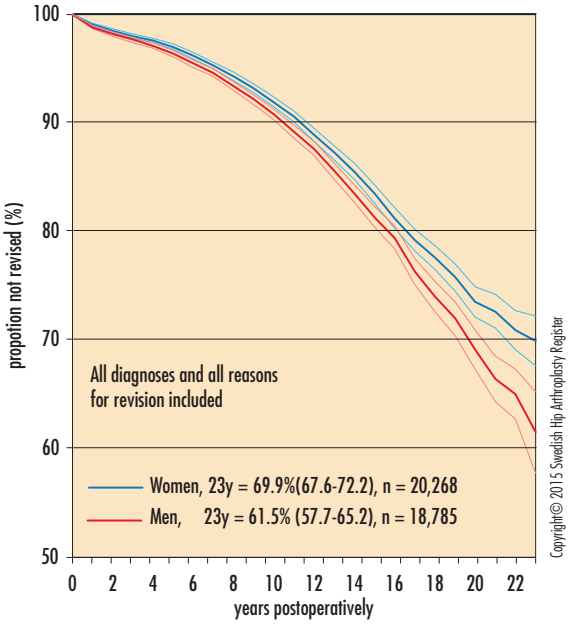
Younger than 50 years

all observations, 1992–2014



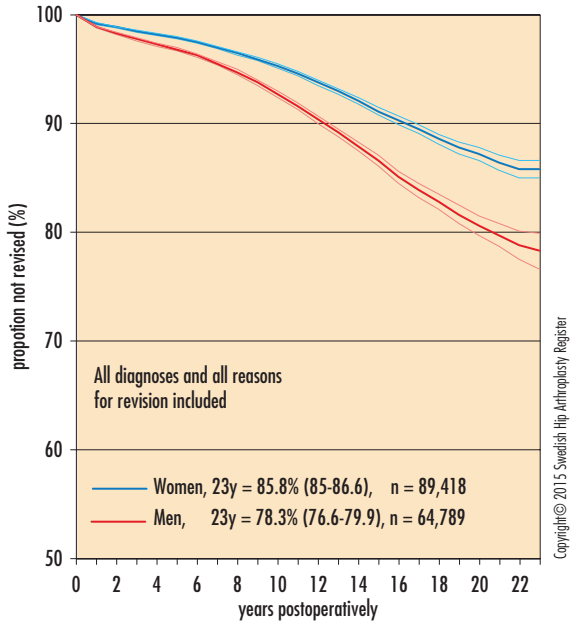
Between 50 and 59 years

all observations, 1992–2014



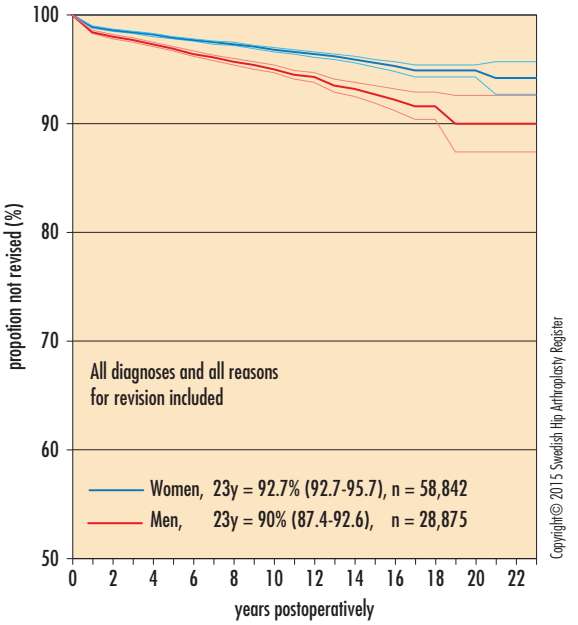
Between 60 and 75 years

all observations, 1992–2014



Older than 75 years

all observations, 1992–2014



Implant survival within ten years

Implant survival within ten years is based on total hip replacements performed during the past ten years. This means that the observation period attains a nine- to ten-year interval only for patients operated in the first year of observation. Since more and more total hip replacements were performed during 2005–2014, the average observation period is shorter than five years. During this time, 153,385 operations were registered. During the period, 22,591 were reported as reoperations. Most common cause for reoperation is aseptic loosening with 44.1%. Second most common cause are infection (19.5%), followed by fracture (13.6%) and then dislocation (12.6%).

This variable is of great value especially for those clinics with a relatively intact organization without extensive changes in the operation process including selection of standard prosthesis during the past ten years. The outcomes dislocation and infection reflect both the process surrounding primary total hip replacement and the clinic's case-mix. Revision due to periprosthetic fracture has doubled compared with the previous ten-year period (1993–2002) from 6.8 to 13.6%. This may depend upon an increased use of uncemented stems, which have a greater risk for periprosthetic fracture in the postoperative phase. The frequency of revision due to loosening provides relatively good information about how prosthesis selection and surgical technology/technique influence outcome. For clinics that have undergone organizational transformations during the past ten years or that have changed their standard prosthesis, implant survival within ten years becomes more difficult to interpret since it reflects to a lesser extent the current organization and current prosthesis selection.

In this year's analysis, six clinics (SU/Mölndal, Södertälje, KS/Solna, Helsingborg, Danderyd and Gävle) display a significantly lower implant survival rate compared to the national average. As mentioned in earlier annual reports, there is an overrepresentation of patients with secondary osteoarthritis (36–74% as opposed to the national average of 17%). Other risk factors, such as high ASA designation and high or low BMI have not been registered for the entire period and thus cannot be correctly assessed. Those two university hospitals have used prosthetic systems with expected inferior outcomes (Spectron EF Primary, Durom, ASR), which may have influenced the results. Nonetheless, this data should give rise to an in-depth study of the outcome and its possible causes.

Units with high frequency of revisions, even if not differing significantly from the national average, should also take the opportunity of carrying out an operative analysis. The first step is to select data published here and thereafter decide whether further improvement measures are motivated.

Implant survival after various periods

Period	Number of observation years	Implant survival	Negative error value	Positive error value
1994–1996	10	92.2%	0.4%	0.3%
1997–1999	10	93.8%	0.3%	0.3%
2000–2002	10	95.3%	0.3%	0.2%
2003–2005	10	94.8%	0.2%	0.3%
2006–2008	9	95.3%	0.3%	0.3%
2009–2011	6	97.2%	0.2%	0.2%
2012–2014	3	97.6%	0.2%	0.2%

Average implant survival after 10 years for all clinics, which have been active in the respective period. Each period includes all primary total hip arthroplasties performed during the three-year period. All revisions of these primary operations are included. The table shows the values behind the bar graph above. The last three periods, however, have a variable follow-up of 9, 6 and 3 years. The values are included to show the trend over the last 10 years.

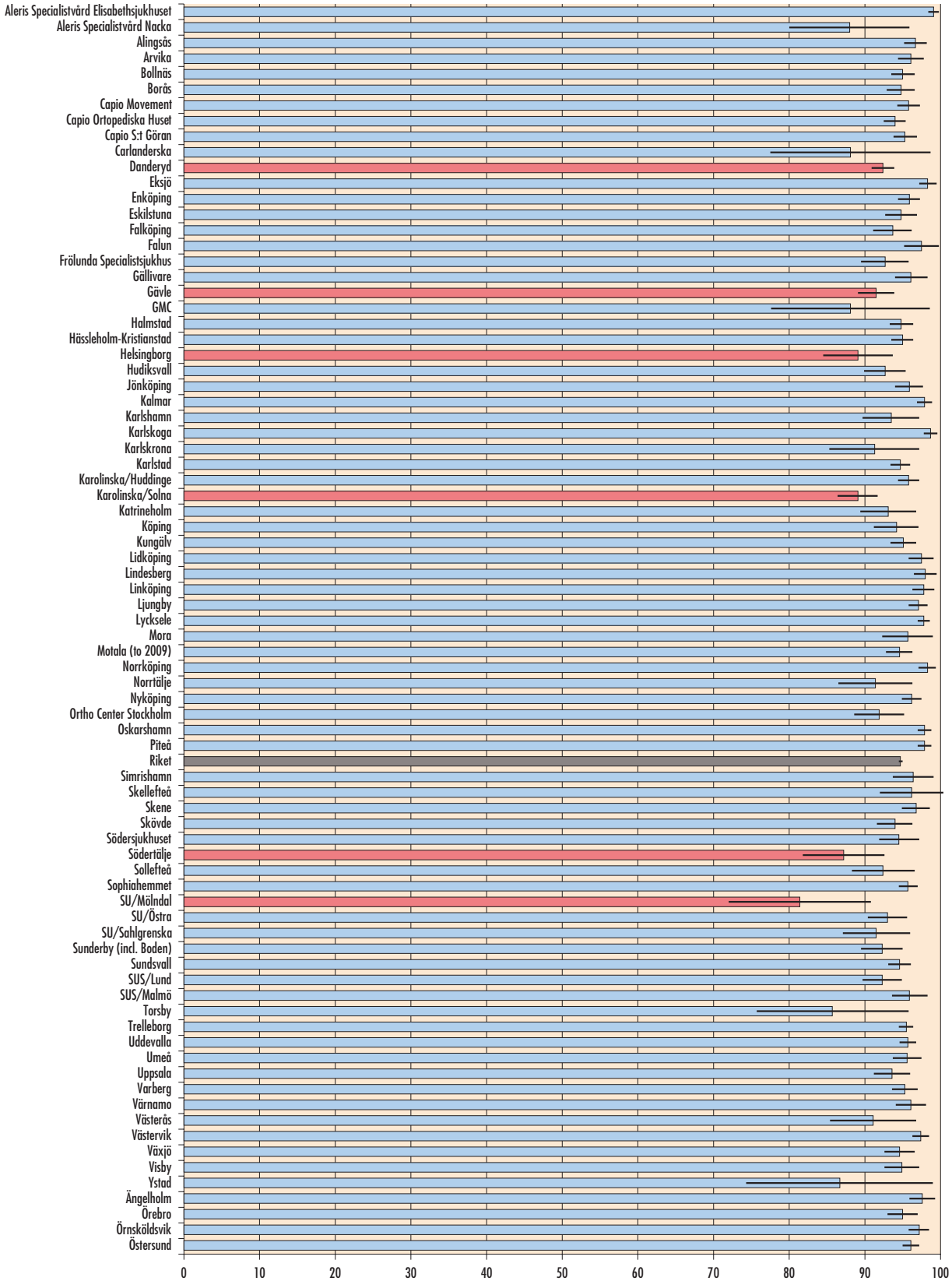
In the beginning of 2000s, a number of Stockholm's hospitals carried out prosthesis operations at Löwenströmska/Ortho Center Stockholm. Despite of protests from the register, the managing directors acted against the register rules and reported that the operations had taken place at their "home clinics". This was the reason why Ortho Center Stockholm was previously charged with a "faulty" 10-year survival in the latest annual reports. Register measures outcomes and has never been obligated to measure production!

Previously, we have not been able to present all primary operations because we did not know which they were. Since September 2011, the register has at a number of occasions asked Ortho Center Stockholm and other hospitals in Stockholm to send files with personal identity numbers, the side on which they were operated on and the day of the operation. In 2014, we received a data file; however, it does not contain complete data for all years.

After manual labour, we have at least to some extent corrected the issue. We encourage all units, which rent out operating theatres and care wards to other parties, to record such activities accurately in an easily accessible digital form, specifying the personal identification code, the day of the operation and the side they were operated on. All to avoid such problems. In the present case, it led to a debate in Läkartidningen: (http://www.lakartidningen.se/Opinion/Debatt/2015/02/Man-kan-lita-pa-registret--om-klinikerna-registrerar-ratt/).

Implant survival after 10 years

Each bar represents one unit, primary THR 2005–2014



Implant survival after 10 years shown according to clinics. The gray bar represents the national average. Red bars represent clinics, whose upper confidence interval is below the national lower confidence interval, i.e. clinics with 95% certainty to have poorer implant survival after 10 years than the national average. Primary operations were conducted during the past 10 years.

Clinics with less than 10 operations are not included.

Notes

Patient-reported outcomes

The PROMs Programme

In recent years, the concept of "value-based health care" has been introduced in healthcare. The idea is to organize, control and manage the operations with a focus on increasing value for patients. Value is defined as the relationship between outcomes and costs where the outcome is assumed to be what is directly or indirectly related to the patient's symptoms and health condition. If the outcome is constant while costs decrease, it means that the value will increase as resources can then be used for something else. One can simultaneously defend the increased costs of new or alternative treatments, provided they give a proportionately improved outcome. The essence of value-based health care is that it is based on the patient's needs and preferences. To do so, it is required that the patient's symptoms, health condition and assessment of the outcomes of given measures are to acquire by means of validated instruments. Interest in value-based health care is one of several reasons why patient-reported outcomes are attracting growing interest among politicians, policy makers, healthcare staff and researchers.

The well-established structure that exists for reporting to the Swedish Hip Arthroplasty Register has made it possible for the Register to be able to introduce a unique nationwide follow-up programme for patient-reported outcomes. The Programme was launched under the name *Höftdispensären* (The Hip Dispensary) but we have now come to calling it the *PROMs Programme*. Since 2008, all clinics report patient-reported variables where the response frequency is 85% preoperatively, and almost 90% at the one-year follow-up.

Logistics and goals

Prior to surgery, all patients are requested to respond voluntarily to a form containing twelve questions. The survey includes questions about comorbidity and walking capacity in order to decide musculoskeletal comorbidity according to the Charnley classification, a Visual Analogue Scale (VAS) for pain estimation and the EQ-5D instrument that measures health-related quality of life. The EQ-5D consists of two parts. The first of five general questions each with three alternatives providing a health profile that can be translated into an index. The other part consists of a thermometer, the EQ VAS, where the patient marks her/his current health status on a 100-degree scale. Since 2012, a question has been included asking whether or not the patient has participated in an osteoarthritis training preoperatively, and this year a question was included about smoking. The same PROM form with a complementary estimation of satisfaction according to VAS is sent to patients after one, six and ten years. The Register's coordinators send out a list every month to all clinics for the patients who are to be followed up. Thereafter the follow-up routine is managed by local administrators who send out the forms, enter survey responses to the PROM database and send out reminders about missing responses within about two months.

The PROMs Programme's three overall objectives are:

- to complement the traditional outcome variables with PROMs in order to make a multidimensional analysis of total hip replacement possible;
- to create an opportunity for clinics to analyse their activities and improvements with a focus on the patient's needs and their reported outcomes;
- to create a methodologically adequate health-economic instrument for cost effectiveness analyses and resource allocation.

This is how PROM results are presented

PROM results which are presented in the table "Patient reported outcome per unit" includes all PROM results with mean values for the EQ-5D index EQ VAS, pain and satisfaction for each measurement time and the clinic. If there are fewer than 40 registrations, we have chosen not to report the results in view of patient privacy but also so as random variation did not mislead the reader. The preoperative values represent operated patients during the years 2013–2014, one-year results 2012–2013, six-year results 2007–2008 and ten-year results 2003–2004. Note that these tables only describe the cross-sectional results and not the prospective change.

Patient demographics partly decisive for results

Since patient demographics varies between clinics, the PROM results have been difficult to interpret and compare. Certain clinics perform surgery on a relatively large proportion of healthy patients who have only been partly affected, and where pain has been manageable, perhaps because of thorough care during the course of the joint disease. For such patients, the difference between the pre- and postoperative measurements is generally not that large. The patients are, however, often completely pain-free, and their health-related quality of life is completely restored as measured with the instruments used by us. For a clinic that has a large proportion of such patients, the average improvement may be lower than the national average, and there is a danger that this is interpreted as a problem relating to quality. The instrument's nature with a distinct ceiling effect must be taken in consideration. Other clinics have a greater proportion of patients with Charnley Class C or patients with complications to earlier hip fractures and patients with avascular necrosis. One would then expect these clinics to have a worse average outcome at follow-ups, but since the space for improvement is large, the average improvement with respect to pain and health-related quality of life may be as great as or even greater than the national average. There may be faults or weaknesses in health-care quality concealed here. The objective for care of patients with hip illness should be to minimize pain and effects on health-related quality of life before as well as after a possible arthroplasty.

Adjusted PROM values – deviation from expected values

We present the extent of each clinic's deviation from the expected values with respect to each of the four PROM variables: EQ-5D index, EQ VAS, pain and satisfaction. At a clinical level the expected average values for the PROM variables at the one-, six- and ten-year follow-up have been estimated by adjusting for age, gender, Charnley class and diagnosis. The estimate is based on regression models that include all patients nationwide with PROM values for 2012–2013 (for one-year results), 2007–2008 (six-year results) and

2003–2004 (ten-year result) and are presented in the tables with the title "Improvement index and deviation from expected value". By producing regression coefficients for age, gender, the three Charnley classes and six diagnosis groups (those operated due to acute fracture or tumor have been excluded) one can then estimate expected values for every patient after one year. Since the input values for the EQ-5D index, EQ VAS and pain best explain how one is expected to improve in health-related quality of life; these baseline values have been included in each respective regression model. At the clinical level, one can then decide the difference between the expected average value and the actual average value. In this way we can present how much each clinic deviates from the expected average value in Sweden based on the clinic's case-mix. For the EQ-5D index and the EQ VAS, deviations exceeding zero indicate that the result is better than expected, and for pain and satisfaction negative values are better than expected. One can say in any case that a clinic's deviation does not depend on any difference in case-mix with regard to age, gender, Charnley class distribution, diagnoses or preoperative values.

Large differences between various units despite adjustment

When studying the sets of tables for the PROM results, one will find that the adjusted deviations for the EQ-5D index at one-year span from –0.10 to 0.12 and for the EQ VAS from –5.7 to 9.8. The adjusted difference between best and worst clinics is thus 0.22 and 15 units, respectively, for the one-year values for the EQ-5D index and the EQ VAS. This can, of course, be seen as a large variation considering the fact that the average improvement is 0.37 and 19, respectively. Furthermore, the breadth of the interval for deviations from pain after one year is 18 VAS units, and for satisfaction 18 VAS units. It is thus other factors than demographic variables we can adjust for that decide patient-reported results after one year.

Improvement index

Another variable that takes into account the size of the average improvement relative to baseline is the "Improvement index". The columns presenting the improvement percentage per clinic take consideration to the preoperative values. The percentage must be compared with the national average. We refer to Annual Report 2013 for details on how the improvement index is calculated. In short, one can say that the average improvement is divided by the total space for improvement.

Units with particularly food PROM results

Here is the place to highlight some clinics that constantly show advantageous patient-reported results for the fiscal years 2012–2013. The private clinics Aleris Elisabethsjukhuset, Aleris Nacka, Aleris Sabbatsberg, Carlanderska, Danderyd, Ortho Center IFK clinic and Sophiahemmet all have constantly better outcomes for pain, health-related quality of life and satisfaction than the country as a whole when one adjusts for case-mix. Likewise, Hässleholm-Kristianstad, Kalmar, Oskarshamn, Umeå and Västervik show constantly advantageous results. These clinics are encouraged to share their experiences of how the process around arthroplasty is organized.

Units with improvement potential

This year's altered form of auditing from the Register's PROM Programme should give rise to in-depth analyses for many clinics and that measures are taken to improve patient-reported results. Hospitals of Alingsås, Borås, Karolinska Huddinge and Solna, Kungälv, Norrtälje, Nyköping, Skene, SU/Mölndal, SUS/Lund, Södertälje, Uppsala, Visby and Växjö constantly deviate for the worse.

What does presentation of improvement index and deviation from expected value contribute to?

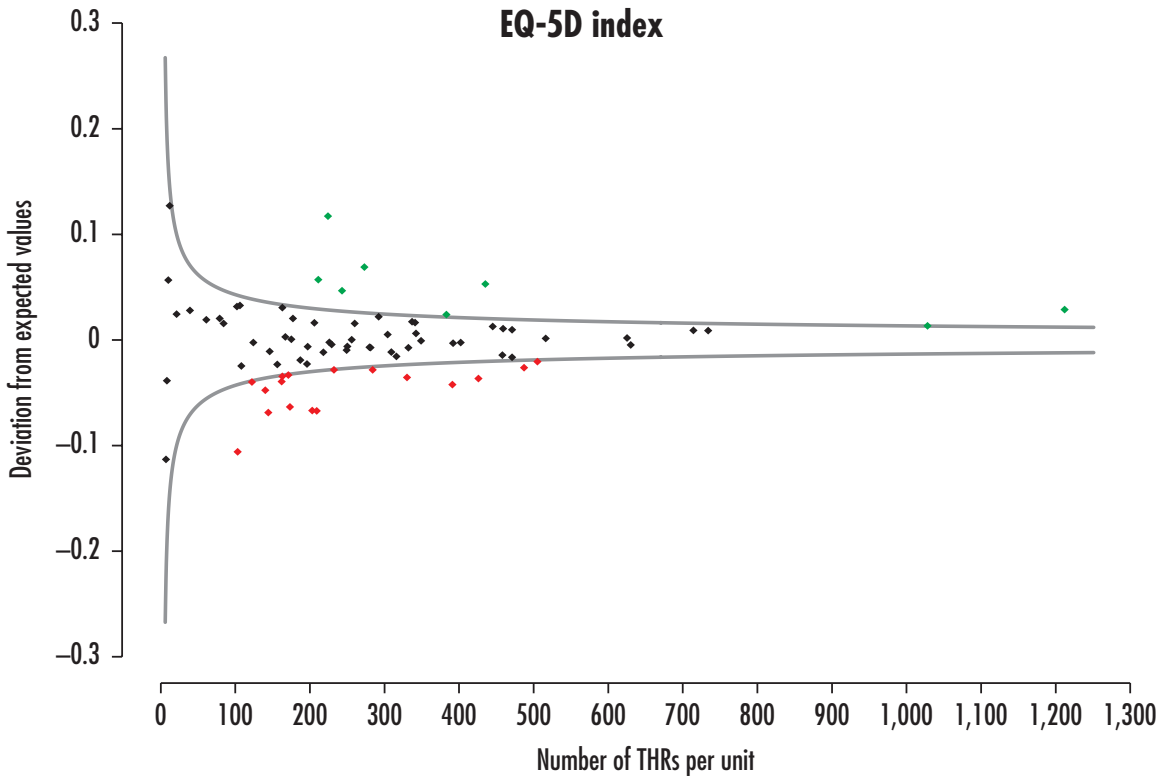
One can gain a deeper understanding of individual clinics' results by giving an account of deviation from expected profits. Naturally, the analysis does not adjust for all differences in patient demographics between clinics. We know that level of education, cultural factors, other socioeconomic factors and medical comorbidity not covered by the Charnley classification all have an impact on the outcome. Furthermore, there are probably regional differences in responses to the PROMs instruments.

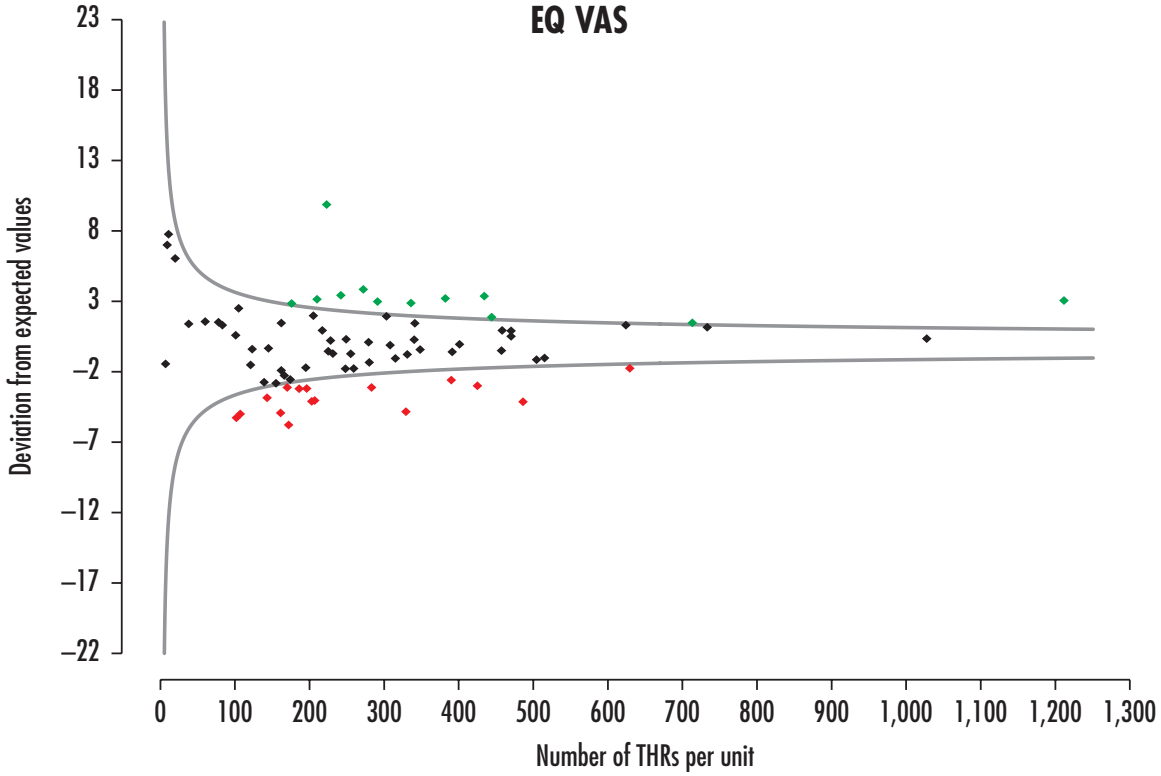
What can be improved?

How can patient-reported outcomes be improved? Inherently, register data cannot give answers to causal relationships in order to give concrete advice concerning a question. With the help of the Register's data, we have been able to show the relationship between features of surgical technique, like surgical approach and fixation, and the patient-reported outcome. The effects are not so obvious that it would lead us to recommend changing the routine surgical approach or fixation because such a change could have unintended consequences on other levels. Experiences from those who developed different programs for "*enhanced recovery*" or "*fast-track*" speak for the fact that meticulousness in decisions concerning surgery, sound preoperative information, optimization of patients, continuity in contact with physicians and other caregiver categories, a well-planned care process, ultra-early mobilization, a short length of stay and optimized pain treatment lead to better patient-reported outcomes.

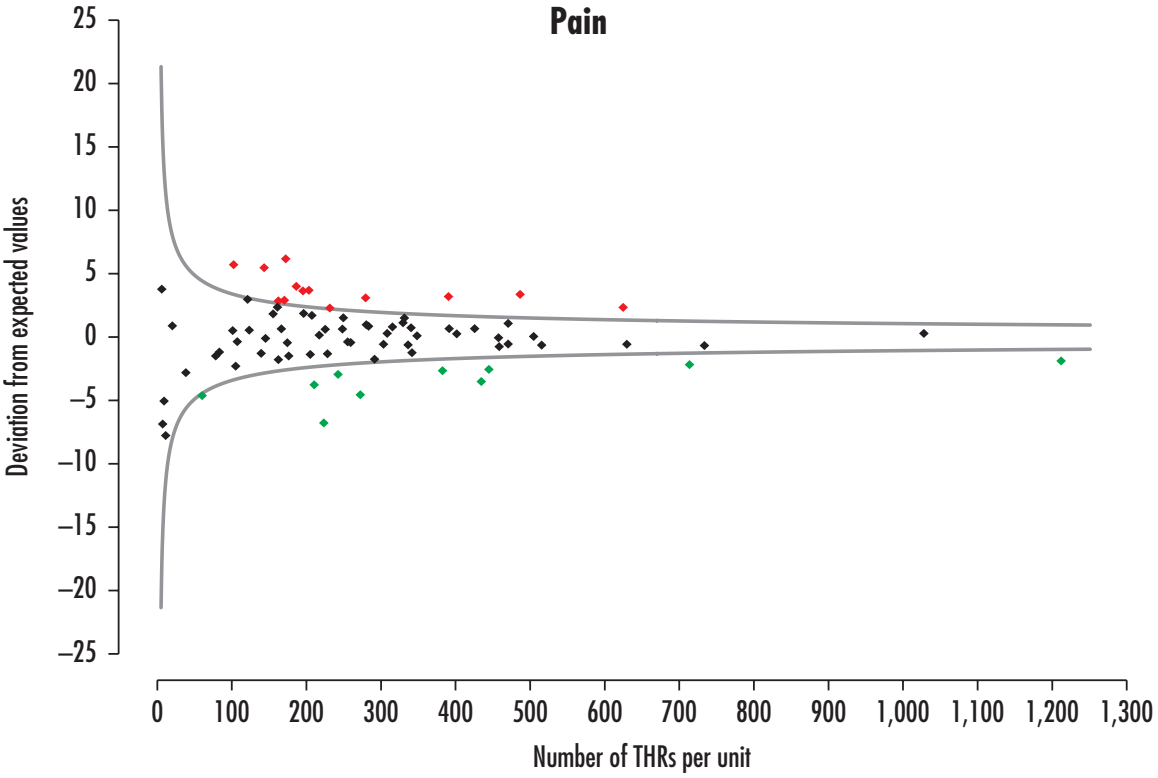
Continued positive trend in patient-reported outcomes

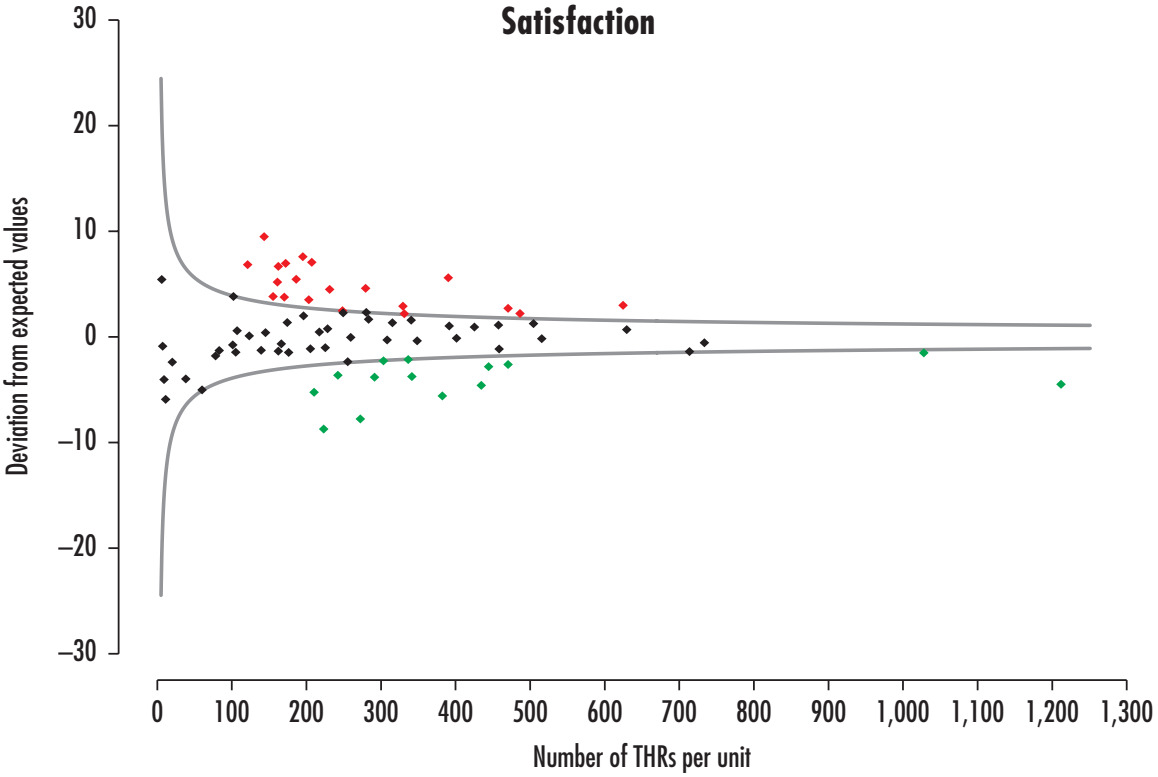
In an update of last year's new trend analysis, there is a positive development for PROM results in Sweden. A register analysis cannot, of course, provide the answer as to why we are improving, but if we had not measured, we would not have been aware of the positive trend. Treatment and care are likely to affect the patient's ability to rehabilitate themselves after prostheses surgery. Certainly, there is uncertainty on an individual level and variability in PROM variables but it is not different from the uncertainty regarding traditional variables. The risk that the patient will come up against prosthetic-related or other serious complications is small in relation to the risk of not attaining the pain relief intended, or not being pleased with the result of the operation. Multidimensional evaluation of prosthetic surgery demands patient-reported outcomes.





Funnel plots show deviation of the unit from the expected value for EQ-5D index and EQ VAS one year after surgery during 2012–2013. The values outside the funnel differ significantly (95% confidence interval) from the national average. Green marking indicates better performance and red marking worse results. The values for each unit can be found in the tables "PROM 1 year – improvement index and deviation from the expected value".





Funnel plots show deviation of the unit from the expected value for pain (VAS) and satisfaction (VAS) one year after surgery during 2012–2013. The values outside the funnel differ significantly (95% confidence interval) from the national average. Green marking indicates better performance and red marking worse results. The values for each unit can be found in the tables "PROM 1 year – improvement index and deviation from the expected value".

Development of the PROMs Programme

A new Swedish way to calculate EQ-5D index

Since PROM program began, we have used the questionnaire EQ-5D to measure health-related quality of life. The version we use is called EQ-5D-3L and contains five questions about mobility, care, usual activities, pain/discomfort and anxiety/depression. Each question has three possible answers; no problems, some/moderate problems or extreme problems. The response options give a total of 243 different medical conditions that can be weighted together using algorithms that are usually called "value set". The scale, on which one usually reports EQ-5 D index, runs between 1 representing perfect health and 0 representing death. There are many different value sets available, which have been established by allowing the study populations grade health conditions. There are also several different methods for creating value sets. One common method is based on allowing study participants rate a hypothetical state of health on a 100-point visual analog scale (VAS) A simplified description of another common method is to let the participant specify how many years of life one would be willing to trade off to avoid having to be in a certain state of health in favor of a hassle-free condition. The method is called "time-trade-off" (TTO). Common to these methods is that they are based on individuals' perceptions of hypothetical health. The idea of creating different value sets for different populations is that the value set should reflect the values and preferences that are representative of that particular population.

The value set which the register has used to calculate EQ-5D index was developed in Britain in the mid-1990s in an British population. In 2013 came the first value set that has been developed in a Swedish population. The Swedish value set is different from most others in the sense that it is developed in a Swedish normal population (> 45,000 individuals) who evaluated their existing health condition. The value set created by starting from the individual's current health status, is usually called "experience-based" value set. The new Swedish value set is available in both the TTO version and in the VAS version.

EQ-5D index with Swedish and British value sets

Primary operation 2012–2013

		Swedish value set (TTO)		British value set (TTO)	
		Preop	1 year postop	Preop	1 year postop
All		0.73	0.88	0.42	0.79
Gender	Men	0.75	0.89	0.47	0.82
	Women	0.72	0.87	0.38	0.77
Charnley class	A	0.75	0.91	0.47	0.85
	B	0.73	0.88	0.42	0.79
	C	0.71	0.84	0.36	0.72
Age	0–49	0.70	0.88	0.35	0.80
	50–59	0.72	0.89	0.40	0.81
	60–69	0.74	0.89	0.43	0.81
	70–79	0.74	0.87	0.44	0.78
	≥80	0.72	0.85	0.39	0.74
Type of hospital	Central hospital	0.73	0.88	0.40	0.78
	Rural hospitals	0.74	0.88	0.43	0.79
	Private	0.75	0.89	0.45	0.82
	University hospital	0.71	0.85	0.35	0.73
Diagnosis	Primary osteoarthritis	0.74	0.88	0.43	0.80
	Inflammatory joint disease	0.69	0.82	0.30	0.66
	Sequelae after childhood illness	0.72	0.89	0.39	0.81
	Femoral head necrosis	0.67	0.85	0.27	0.74
	Other secondary osteoarthritis	0.66	0.87	0.30	0.73

To test how the new Swedish value set functions on EQ-5D data in the registry, we conducted a study (Nemes et al. Qual Life Res. 2015), where we compared the British value set, the new Swedish value set and a provisional value set, created using register data. We analysed the correlations between the different value sets and found that there was a higher correlation between the provisional value set, based on register data, and the new Swedish value set (correlation coefficient 0.99) than between the provisional and the British value set (correlation coefficient 0.93). In this study, we investigated how well the Swedish and British value sets successfully predict the observed EQ VAS value of hip replacement patients and found that Swedish one was considerably better. We concluded that the new Swedish value set is more representative of the Swedish hip arthroplasty population.

We now intend to switch to using the Swedish value set in presentation and analysis of patients in the Swedish Hip Arthroplasty Register. However, there is a pedagogical challenge in this transition because the British and Swedish value sets have different scales. EQ-5D index of the British value set goes from minus 0.059 to 1, which means that there are medical conditions that are valued worse than being dead. The values for the Swedish value set go from 0.34 to 0.97. In the Swedish value set, which is thus based on how individuals value their current health condition, they value their worst health conditions not as low as in the British value set, which is based on the values of hypothetical health. Since the best health status has the value 0.97 in the Swedish value set, it is explained by the notion that the individuals who report "no problems" in all EQ-5D dimensions, on average, still don't experience the full health-related quality of life.

The table above illustrates how the EQ-5D index differs between the British and Swedish value set, but it should be noted that these values cannot be compared directly because the scaling differs between value sets. The table includes patients who underwent operation during 2012–2013.

For next year, we intend to switch to using the Swedish value set to develop and present the EQ-5D index. To facilitate comparisons with previous results presented from the registry (and results from other contexts), we are developing a "cross-walk" algorithm where averages produced by one value set can be transposed into the other and vice versa.

EQ-5D with five response levels – EQ-5D-5L

In the original version of the EQ-5D (EQ-5D 3L), the steps between the three response levels are large. For example, it can be illustrated with a question on mobility: "I have no problems in walking about," "I have some problems in walking about" and "I'm confined to bed." One effect of this is that the instrument has clear ceiling effect, i.e. that a large proportion of patients indicates the response option "no problem" to all questions. It also has the effect that any small changes in the health status, particularly concerning those who already have relatively good health, cannot be measured with the instrument. Therefore, a new version, EQ-5D-5L, has been developed, which measures the same five dimensions but with five possible responses; no problem, minimal problems, some/moderate problems, difficult problems or extreme problems. The idea is that more alternatives reduce the ceiling effect and give a better profile of the patients' health condition. All public hospitals in the Western Götaland region participate now in a study in which we test the new version. In short, the survey entails that all elective patients are invited to participate in the study by mail when clinics send the call letter before the operation. They are asked to fill in the longer version of the questionnaire and return it in the prepaid envelope. When they come for an admission visit or are admitted for surgery, according to standard procedures, the patients will be able to fill in PROMs programme's regular form. The patients participating in the study will at one year of follow-up, respond to both versions within around two weeks. We will then ensure that the order, in which respective questionnaires are responded to, is random.

It may be mentioned that we have been involved in a similar study conducted at the arthroplasty clinic at Massachusetts General Hospital (Greene et al, CORR 2014). The study showed that patients used the intermediate answers in a large scale, especially concerning the pain dimension. EQ-5D-5L had significantly less ceiling effects at one-year follow-up than the EQ-5D-3L (18% compared to 30%).

Patient satisfaction 1 year after total hip replacement

Primary operation 2012–2013

Unit	Number	Proportion[1)]
Aleris Specialistvård Bollnäs	478	90.2%
Aleris Specialistvård Elisabethsjukhuset	106	93.4%
Aleris Specialistvård Motala	836	92.2%
Aleris Specialistvård Nacka	229	97.8%
Aleris Specialistvård Sabbatsberg	295	94.2%
Alingsås	416	82.2%
Arvika	220	84.5%
Bollnäs	88	93.2%
Borås	207	81.2%
Capio Movement	251	87.3%
Capio Ortopediska Huset	642	87.1%
Capio S:t Göran	662	87.3%
Carlanderska	197	93.9%
Danderyd	432	89.4%
Eksjö	366	90.2%
Enköping	557	86.0%
Eskilstuna	134	88.1%
Falun	677	88.9%
Frölunda Specialistsjukhus	148	89.9%
Gällivare	155	94.2%
Gävle	299	88.0%
Halmstad	341	88.3%
Helsingborg	88	95.5%
Hudiksvall	178	89.3%
Hässleholm-Kristianstad	1,247	93.6%
Jönköping	275	86.9%
Kalmar	222	94.6%
Karlshamn	410	88.8%
Karlskoga	255	90.6%
Karlstad	314	81.5%
Karolinska/Huddinge	365	85.2%
Karolinska/Solna	266	80.8%
Katrineholm	429	88.8%
Kungälv	226	81.0%
Lidköping	369	91.6%
Lindesberg	383	94.5%
Linköping	71	90.1%
Ljungby	267	90.3%
Lycksele	481	91.3%
Mora	342	83.9%
Norrköping	344	84.6%
Norrtälje	181	82.3%
Nyköping	189	81.5%
Ortho Center IFK-kliniken	244	93.9%
Ortho Center Stockholm	739	89.0%
Oskarshamn	440	93.6%
Piteå	720	92.4%
SU/Mölndal	560	85.5%
SUS/Lund	154	85.7%
Skellefteå	176	91.5%
Skene	224	81.3%
Skövde	303	88.8%
Sollefteå	182	85.7%
Sophiahemmet	306	98.0%
Spenshult	378	90.2%
Sundsvall	237	91.6%
Södersjukhuset	529	85.8%
Södertälje	145	81.4%
Torsby	165	84.8%
Trelleborg	1,093	92.6%
Uddevalla	542	84.7%
Umeå	83	94.0%
Uppsala	264	82.6%
Varberg	409	92.7%
Visby	201	77.6%
Värnamo	231	92.2%
Västervik	195	83.6%
Västerås	608	90.3%
Växjö	204	84.8%
Ängelholm	314	93.3%
Örebro	156	89.7%
Örnsköldsvik	229	88.6%
Östersund	485	93.2%
The country	25,231	89.1%

[1)] *Proportion of patients with satisfaction value between 0 and 40 at VAS, hospitals with less than 40 reportings are not presented.*

Patient-reported outcomes per unit

	Preoperatitve, 2013–2014					Follow-up in one year, 2012–2013				
	Number	C-class[1)]	Pain	EQ VAS	EQ-5D	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D
University/Regional hospitals										
Karolinska/Huddinge	368	68	79	63	0.42	365	17	15	72	0.74
Karolinska/Solna	232	51	66	48	0.28	266	20	17	72	0.7
Linköping						71	13	14	77	0.78
SU/Mölndal	696	51	66	59	0.34	560	19	18	70	0.73
SU/Sahlgrenska										
SU/Östra										
SUS/Lund	176	54	67	48	0.27	154	19	20	67	0.61
SUS/Malmö										
Umeå	77	57	66	47	0.31	83	12	11	73	0.74
Uppsala	272	46	66	54	0.31	264	19	18	72	0.72
Örebro	191	45	62	56	0.44	156	15	13	72	0.72
Central hospitals										
Borås	190	42	64	61	0.4	207	22	16	71	0.74
Danderyd	449	41	64	52	0.37	432	14	14	77	0.78
Eksjö	338	33	60	60	0.48	366	16	14	77	0.79
Eskilstuna	98	43	64	53	0.33	134	17	14	70	0.74
Falun	598	28	62	65	0.36	677	16	13	75	0.78
Gävle	290	41	63	54	0.39	299	14	13	74	0.77
Halmstad	310	38	60	61	0.46	341	18	15	77	0.78
Helsingborg	102	46	69	54	0.26	88	17	16	73	0.72
Hässleholm-Kristianstad	1,478	44	61	62	0.38	1,247	11	11	80	0.82
Jönköping	287	45	65	52	0.38	275	18	15	74	0.77
Kalmar	252	41	66	58	0.38	222	11	11	79	0.83
Karlstad	332	47	62	56	0.33	314	20	17	74	0.74
Norrköping	390	40	66	52	0.38	344	16	14	77	0.79
Skövde	231	47	63	56	0.4	303	17	14	73	0.76
Sunderby (incl. Boden)										
Sundsvall	205	39	66	54	0.38	237	15	14	75	0.79
Södersjukhuset	534	44	60	56	0.43	529	17	14	72	0.74
Uddevalla	596	40	66	53	0.35	542	19	15	75	0.75
Varberg	359	39	58	60	0.48	409	12	12	78	0.8
Västerås	527	40	67	52	0.38	608	16	14	74	0.77
Växjö	198	38	61	58	0.47	204	20	17	74	0.76
Östersund	487	35	65	55	0.38	485	12	13	78	0.8

(Continued on next page.)

	Follow-up in six years, 2007–2008					Follow-up in ten years, 2003–2004				
	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D
University/Regional hospitals										
Karolinska/Huddinge	175	14	16	74	0.75					
Karolinska/Solna	148	21	19	66	0.69					
Linköping										
SU/Mölndal	234	21	18	68	0.68	86	20	21	64	0.65
SU/Sahlgrenska						232	17	17	71	0.71
SU/Östra	170	24	21	66	0.68	91	22	25	62	0.65
SUS/Lund	48	15	18	66	0.67	40	20	16	65	0.65
SUS/Malmö	59	27	23	65	0.63					
Umeå	105	18	16	64	0.67	44	15	14	70	0.73
Uppsala	263	19	17	69	0.72					
Örebro	284	15	15	70	0.73					
Central hospitals										
Borås	218	21	17	69	0.67	135	15	16	73	0.74
Danderyd	518	16	14	73	0.75					
Eksjö	295	16	14	73	0.76					
Eskilstuna	85	16	16	70	0.71					
Falun	419	16	14	70	0.74					
Gävle	144	19	19	67	0.71					
Halmstad	255	18	17	70	0.75					
Helsingborg										
Hässleholm-Kristianstad	1,257	14	14	75	0.78					
Jönköping	245	16	15	71	0.76					
Kalmar	233	15	14	72	0.77					
Karlstad	288	20	17	69	0.72					
Norrköping	49	19	17	68	0.69					
Skövde	119	19	19	68	0.69	113	16	16	70	0.71
Sunderby (incl. Boden)						93	13	12	70	0.78
Sundsvall	124	20	17	69	0.71	102	19	18	70	0.7
Södersjukhuset	534	19	17	69	0.7					
Uddevalla	396	19	15	71	0.74	189	17	16	67	0.7
Varberg	330	15	15	73	0.76					
Västerås	230	17	17	69	0.72					
Växjö	153	17	14	72	0.74					
Östersund	249	16	15	72	0.75	136	15	16	70	0.74

Patient-reported outcomes per unit (cont.)

	Preoperatitve, 2013–2014					Follow-up in one year, 2012–2013				
	Number	C-class[1)]	Pain	EQ VAS	EQ-5D	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D
Rural hospitals										
Alingsås	398	36	63	61	0.49	416	21	16	75	0.76
Arvika	316	34	63	58	0.43	220	18	15	74	0.79
Bollnäs						88	14	12	78	0.81
Enköping	399	42	60	53	0.42	557	18	15	74	0.77
Falköping										
Frölunda Specialistsjukhus	175	34	60	64	0.48	148	15	13	78	0.79
Gällivare	97	54	63	52	0.42	155	14	13	77	0.82
Hudiksvall	188	41	65	50	0.39	178	15	13	76	0.8
Kalix										
Karlshamn	447	37	60	57	0.44	410	16	14	76	0.79
Karlskoga	274	29	62	59	0.48	255	15	13	77	0.77
Katrineholm	494	32	56	58	0.49	429	15	13	77	0.8
Kungälv	295	69	57	62	0.46	226	24	16	72	0.7
Köping										
Landskrona										
Lidköping	449	31	62	61	0.44	369	14	12	78	0.81
Lindesberg	413	35	67	59	0.35	383	9	10	81	0.82
Ljungby	278	47	60	63	0.52	267	14	12	77	0.82
Lycksele	403	39	64	60	0.43	481	16	13	77	0.81
Mora	335	39	66	51	0.37	342	18	14	74	0.77
Motala (to 2009)										
Norrtälje	192	43	64	54	0.42	181	23	20	69	0.71
Nyköping	199	38	66	54	0.38	189	22	17	74	0.74
Oskarshamn	508	42	67	54	0.37	440	11	10	79	0.83
Piteå	420	41	69	52	0.35	720	13	11	77	0.8
Skellefteå	210	36	63	59	0.43	176	15	14	75	0.79
Skene	234	32	67	56	0.39	224	22	16	76	0.78
Sollefteå	203	40	66	59	0.43	182	16	12	75	0.8
Södertälje	149	36	65	57	0.4	145	22	16	73	0.73
Torsby	166	34	66	55	0.35	165	19	16	74	0.77
Trelleborg	1,137	33	64	62	0.45	1,093	13	13	78	0.81
Visby	194	41	64	60	0.43	201	24	19	73	0.73
Värnamo	246	35	59	62	0.48	231	13	13	78	0.81
Västervik	181	38	63	60	0.45	195	18	16	75	0.78
Ängelholm	257	38	67	59	0.39	314	13	13	79	0.8
Örnsköldsvik	232	47	66	56	0.4	229	15	13	78	0.8

(Continued on next page.)

	Follow-up in six years, 2007–2008					Follow-up in ten years, 2003–2004				
	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D
Rural hospitals										
Alingsås	329	18	14	73	0.77	158	18	17	70	0.67
Arvika	106	15	15	72	0.76					
Bollnäs	406	18	16	72	0.74					
Enköping	281	20	16	70	0.75					
Falköping	364	16	13	71	0.75	282	15	16	72	0.73
Frölunda Specialistsjukhus	127	20	18	74	0.74	63	21	21	73	0.69
Gällivare	115	19	20	72	0.71	77	16	19	72	0.75
Hudiksvall	159	20	16	71	0.75					
Kalix						48	16	17	70	0.72
Karlshamn	293	15	14	75	0.76					
Karlskoga	141	16	15	70	0.72					
Katrineholm	361	18	15	74	0.78					
Kungälv	295	19	16	71	0.74	170	15	16	69	0.71
Köping	188	18	15	73	0.75					
Landskrona						148	15	15	76	0.75
Lidköping	177	17	16	72	0.77	120	15	16	70	0.72
Lindesberg	211	11	12	74	0.77	28	8	7	75	0.83
Ljungby	153	13	12	76	0.79					
Lycksele	326	16	15	72	0.77	153	13	16	70	0.74
Mora	232	18	15	72	0.75					
Motala (to 2009)	519	18	15	72	0.75					
Norrtälje	80	23	17	69	0.69					
Nyköping										
Oskarshamn	336	13	13	75	0.78					
Piteå	551	14	12	74	0.78	109	20	16	69	0.71
Skellefteå	108	13	14	72	0.75	82	14	15	73	0.76
Skene	142	24	19	73	0.75	110	21	18	72	0.72
Sollefteå	86	16	17	73	0.76	63	14	13	68	0.74
Södertälje	142	23	21	71	0.72					
Torsby	99	19	15	67	0.71					
Trelleborg	944	17	16	74	0.77	92	18	21	66	0.64
Visby	125	24	22	71	0.72					
Värnamo	178	16	15	73	0.75					
Västervik	156	15	13	72	0.74					
Ängelholm										
Örnsköldsvik	247	20	16	71	0.74	108	14	16	71	0.72

Patient-reported outcomes per unit (cont.)

	Preoperatitve, 2013–2014					Follow-up in one year, 2012–2013				
	Number	C-class[1)]	Pain	EQ VAS	EQ-5D	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D
Private hospitals										
Aleris Specialistvård Bollnäs	559	37	65	55	0.42	478	14	13	77	0.8
Aleris Specialistvård Elisabethsjukhuset	48	29	60	64	0.46	106	11	9	83	0.87
Aleris Specialistvård Motala	857	36	65	57	0.43	836	14	12	79	0.82
Aleris Specialistvård Nacka	225	29	67	50	0.5	229	5	6	88	0.93
Aleris Specialistvård Sabbatsberg	309	32	60	62	0.45	295	10	10	82	0.84
Aleris Specialistvård Ängelholm	80	33	68	53	0.39					
Capio Movement	328	31	63	57	0.45	251	14	11	79	0.81
Capio Ortopediska Huset	718	31	62	60	0.49	642	17	15	80	0.81
Capio S:t Göran	570	43	64	59	0.41	662	17	14	75	0.76
Carlanderska	252	27	61	61	0.49	197	11	10	82	0.85
Ortho Center IFK-kliniken	256	34	63	58	0.43	244	9	9	83	0.86
Ortho Center Stockholm	809	38	65	60	0.41	739	14	11	79	0.8
Sophiahemmet	366	25	61	62	0.54	306	4	6	85	0.91
Spenshult	236	32	62	59	0.45	378	14	13	77	0.77
Country	25,421	39%	64	58	0.41	25,231	15	13	77	0.79

[1)] *Proportion of Charnley class C.*
[2)] *Satisfaction (VAS, 0 = Completely satisfied, 100 = Unsatisfied).*

The table lists result in the form of number of patients, the mean values of pain VAS, EQ VAS and EQ-5D index pre-operatively and proportion of Charnley class C patients (i.e. patients with multiple joint disease and/or co-morbidity). Generally, with a high proportion of C patients report poorer outcome both preoperatively and after a year. However, the prospectively gained values are not significantly influenced by being classified as Charnley C. Results are presented only for the units that have more than 40 registrations per period.

	Follow-up in six years, 2007–2008					Follow-up in ten years, 2003–2004				
	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D	Number	Satisfact.[2)]	Pain	EQ VAS	EQ-5D
Private hospitals										
Aleris Specialistvård Bollnäs										
Aleris Specialistvård Elisabethsjukhuset	277	12	11	79	0.81					
Aleris Specialistvård Motala										
Aleris Specialistvård Nacka	40	12	9	85	0.85					
Aleris Specialistvård Sabbatsberg										
Aleris Specialistvård Ängelholm										
Capio Movement	218	14	13	78	0.81					
Capio Ortopediska Huset	407	15	13	77	0.8					
Capio S:t Göran	368	22	18	71	0.72					
Carlanderska	71	16	13	81	0.83					
Ortho Center IFK-kliniken	92	11	9	78	0.81					
Ortho Center Stockholm	406	21	16	73	0.76					
Sophiahemmet										
Spenshult	60	14	10	79	0.84					
Country	17,594	17	15	72	0.75	3,106	16	17	70	0.72

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PROM 1 year – improvement index and deviation from the expected value

Primary operation year 2012–2013

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	1 year	Deviation from expected	Improve-ment index	Preop	1 year	Deviation from expected	Improve-ment index
Aleris Specialistvård Bollnäs	459	0.41	0.80	0.01	66	52	77	0.9	52
Aleris Specialistvård Elisabethsjukhuset	106	0.50	0.87	0.03	73	65	83	2.5	53
Aleris Specialistvård Motala	734	0.47	0.81	0.01	65	59	79	1.1	49
Aleris Specialistvård Nacka	224	0.47	0.93	0.12	87	53	88	9.8	75
Aleris Specialistvård Sabbatsberg	292	0.46	0.84	0.02	70	63	82	3.0	52
Alingsås	391	0.47	0.76	–0.04	55	61	75	–2.6	37
Arvika	197	0.44	0.79	–0.01	63	58	74	–3.2	38
Bollnäs	84	0.48	0.81	0.01	64	53	78	1.3	53
Borås	162	0.39	0.74	–0.04	58	58	71	–4.9	32
Capio Movement	229	0.43	0.80	–0.01	65	55	78	0.1	52
Capio Ortopediska Huset	625	0.50	0.81	0.00	63	60	80	1.3	50
Capio S:t Göran	505	0.41	0.76	–0.02	60	58	75	–1.2	41
Carlanderska	177	0.47	0.85	0.02	71	59	82	2.8	58
Danderyd	337	0.39	0.79	0.02	65	53	78	2.9	53
Eksjö	316	0.50	0.80	–0.02	60	61	78	–1.0	42
Enköping	458	0.42	0.76	–0.02	59	52	74	–0.5	46
Eskilstuna	108	0.33	0.73	–0.02	60	55	69	–4.9	32
Falun	630	0.41	0.79	–0.00	64	64	76	–1.7	33
Frölunda Specialistsjukhus	146	0.47	0.79	–0.01	61	65	78	–0.3	38
Gällivare	102	0.42	0.81	0.03	68	51	76	0.6	51
Gävle	256	0.43	0.78	0.00	62	54	75	–0.7	46
Halmstad	250	0.43	0.79	–0.01	63	56	77	0.3	48
Helsingborg	79	0.19	0.74	0.03	69	49	73	1.6	47
Hudiksvall	163	0.42	0.80	0.03	66	49	76	1.5	53
Hässleholm-Kristianstad	1,212	0.40	0.82	0.03	71	60	80	3.0	50
Jönköping	249	0.39	0.78	–0.01	64	56	75	–1.8	43
Kalmar	211	0.37	0.84	0.06	75	54	79	3.1	54
Karlshamn	392	0.44	0.79	–0.00	62	58	76	–0.6	44
Karlskoga	218	0.44	0.78	–0.01	61	58	78	1.0	47
Karlstad	280	0.30	0.75	–0.01	64	57	75	0.1	40
Karolinska/Huddinge	330	0.44	0.75	–0.04	55	60	72	–4.9	30,
Karolinska/Solna	232	0.32	0.72	–0.02	59	49	73	–0.7	47
Katrineholm	402	0.47	0.80	–0.00	61	57	77	–0.1	46
Kungälv	208	0.47	0.70	–0.07	45	61	71	–4.1	25

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	Pain (VAS)				Satisfaction (VAS)	
Hospital	Preop	1 year	Deviation from expected	Improve-ment index	1 year	Deviation from expected
Aleris Specialistvård Bollnäs	64	13	–0.8	80	14	–1.2
Aleris Specialistvård Elisabethsjukhuset	60	9	–2.3	85	11	–1.5
Aleris Specialistvård Motala	62	12	–0.7	81	14	–0.6
Aleris Specialistvård Nacka	66	6	–6.7	91	5	–8.7
Aleris Specialistvård Sabbatsberg	62	10	–1.7	83	10	–3.8
Alingsås	61	16	3.2	74	20	5.6
Arvika	63	15	1.9	76	17	2.0
Bollnäs	63	12	–1.1	81	14	–1.3
Borås	63	16	2.3	75	21	5.2
Capio Movement	64	11	–1.3	82	15	0.8
Capio Ortopediska Huset	62	15	2.3	76	17	3.0
Capio S:t Göran	63	14	0.1	79	17	1.2
Carlanderska	61	10	–1.5	83	11	–1.5
Danderyd	63	13	–0.6	79	14	–2.1
Eksjö	60	13	0.8	78	16	1.3
Enköping	59	14	–0.1	76	17	1.1
Eskilstuna	67	14	–0.4	79	17	0.5
Falun	60	12	–0.6	80	15	0.6
Frölunda Specialistsjukhus	60	12	–0.1	79	15	0.4
Gällivare	63	14	0.5	78	15	–0.8
Gävle	62	13	–0.4	79	13	–2.4
Halmstad	63	15	1.5	77	17	2.3
Helsingborg	72	15	–1.6	80	16	–1.9
Hudiksvall	64	12	–1.8	81	15	–1.4
Hässleholm-Kristianstad	60	11	–1.9	82	10	–4.5
Jönköping	65	14	0.7	78	18	2.5
Kalmar	65	10	–3.7	85	10	–5.2
Karlshamn	59	13	0.7	77	16	1.0
Karlskoga	65	13	0.1	79	16	0.5
Karlstad	63	18	3.1	72	21	4.6
Karolinska/Huddinge	77	15	1.1	80	17	2.9
Karolinska/Solna	65	17	2.2	74	20	4.4
Katrineholm	58	13	0.3	78	15	–0.1
Kungälv	56	16	1.7	72	23	7.1

PROM 1 year – improvement index and deviation from the expected value (cont.)

Primary operation year 2012–2013

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	1 year	Deviation from expected	Improvement index	Preop	1 year	Deviation from expected	Improvement index
Lidköping	349	0.44	0.81	–0.00	66	61	78	–0.5	44
Lindesberg	383	0.36	0.82	0.02	72	57	81	3.2	55
Ljungby	260	0.50	0.82	0.01	65	64	77	–1.8	35
Lycksele	341	0.43	0.82	0.02	68	62	79	0.3	44
Mora	281	0.41	0.78	–0.01	62	51	74	–1.3	47
Norrköping	332	0.42	0.79	–0.01	64	57	77	–0.8	45
Norrtälje	173	0.41	0.71	–0.06	51	54	70	–5.7	33
Nyköping	163	0.37	0.75	–0.03	60	52	74	–1.9	46
Ortho Center IFK-kliniken	243	0.42	0.86	0.04	76	58	83	3.4	59
Ortho Center Stockholm	714	0.43	0.80	0.01	64	60	79	1.5	46
Oskarshamn	435	0.36	0.83	0.05	74	52	79	3.4	57
Piteå	445	0.35	0.79	0.01	68	51	77	1.9	54
Skellefteå	167	0.45	0.80	0.00	64	59	75	–2.3	40
Skene	196	0.41	0.77	–0.02	61	57	75	–1.7	43
Skövde	284	0.42	0.75	–0.03	58	58	73	–3.1	35
Sollefteå	175	0.39	0.79	0.00	66	57	75	–2.5	40
Sophiahemmet	273	0.50	0.91	0.07	81	61	85	3.8	60
Spenshult	309	0.45	0.78	–0.01	61	58	77	–0.1	46
SU/Mölndal	487	0.33	0.74	–0.02	61	59	71	–4.1	30
Sundsvall	124	0.41	0.80	–0.00	65	55	77	–0.4	49
SUS/Lund	103	0.26	0.62	–0.10	49	48	67	–5.2	36
Södersjukhuset	426	0.44	0.74	–0.03	54	57	73	–2.9	36
Södertälje	122	0.39	0.74	–0.04	58	57	75	–1.5	40
Torsby	156	0.38	0.77	–0.02	63	57	74	–2.9	39
Trelleborg	1,028	0.44	0.81	0.01	67	61	78	0.3	44
Uddevalla	471	0.37	0.76	–0.02	62	54	76	0.5	48
Umeå	61	0.30	0.76	0.02	66	48	74	1.6	51
Uppsala	204	0.37	0.72	–0.07	56	59	73	–4.1	34
Varberg	342	0.47	0.80	0.01	63	61	79	1.5	45
Visby	144	0.46	0.73	–0.07	50	61	74	–3.9	33
Värnamo	226	0.49	0.81	–0.00	64	64	79	–0.6	41
Västervik	171	0.46	0.77	–0.03	58	62	75	–3.1	34
Västerås	516	0.38	0.77	0.00	63	53	74	–1.0	45
Växjö	187	0.52	0.79	–0.02	56	60	74	–3.2	36

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	Pain (VAS)				Satisfaction (VAS)	
Hospital	Preop	1 year	Deviation from expected	Improve-ment index	1 year	Deviation from expected
Lidköping	61	12	0.1	80	14	–0.4
Lindesberg	66	10	–2.6	84	9	–5.6
Ljungby	61	12	–0.4	80	14	–0.0
Lycksele	65	14	0.7	79	16	1.6
Mora	65	15	1.0	78	18	2.3
Norrköping	65	14	1.5	78	17	2.2
Norrtälje	64	20	6.1	69	23	6.9
Nyköping	67	16	2.9	75	22	6.7
Ortho Center IFK-kliniken	64	9	–2.9	86	9	–3.6
Ortho Center Stockholm	65	11	–2.2	83	14	–1.4
Oskarshamn	67	10	–3.5	85	11	–4.6
Piteå	70	11	–2.6	84	13	–2.8
Skellefteå	63	14	0.6	78	14	–0.7
Skene	66	17	3.6	75	22	7.6
Skövde	63	14	0.9	77	17	1.7
Sollefteå	65	13	–0.5	80	16	1.3
Sophiahemmet	60	7	–4.5	89	4	–7.8
Spenshult	63	13	0.3	79	14	–0.3
SU/Mölndal	67	18	3.3	73	18	2.2
Sundsvall	65	13	0.6	80	14	0.1
SUS/Lund	68	21	5.7	70	20	3.8
Södersjukhuset	59	14	0.6	76	17	0.9
Södertälje	63	17	2.9	74	23	6.8
Torsby	65	15	1.9	77	19	3.8
Trelleborg	64	13	0.3	79	13	–1.5
Uddevalla	65	15	1.1	77	18	2.7
Umeå	66	10	–4.6	84	11	–5.0
Uppsala	62	17	3.7	73	18	3.5
Varberg	59	12	–1.3	80	11	–3.8
Visby	62	18	5.4	70	24	9.5
Värnamo	59	13	0.6	78	13	–1.0
Västervik	62	15	2.9	75	18	3.8
Västerås	67	13	–0.6	80	16	–0.2
Växjö	58	17	4.0	71	20	5.5

PROM 1 year – improvement index and deviation from the expected value (cont.)

Primary operation year 2012–2013

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	1 year	Deviation from expected	Improve-ment index	Preop	1 year	Deviation from expected	Improve-ment index
Ängelholm	304	0.40	0.80	0.01	66	60	79	1.9	48
Örebro	140	0.39	0.74	–0.05	57	54	74	–2.7	43
Örnsköldsvik	206	0.44	0.80	0.01	65	57	78	1.9	50
Östersund	471	0.42	0.81	0.01	67	58	78	0.9	48
Country	22,273	0.42	0.79	0	64	58	77	0	45

Number = number of reports per unit with complete PROM data for patients who underwent operation during 2012–2013.

The real mean value for the EQ-5D index, EQ VAS (self-estimated health condition) and pain (VAS) preoperatively and one year postoperatively and satisfaction (VAS) with operation result after one year is presented.

Deviation from expected = difference between the actual mean value and an expected value listed in the regression models that take into account the case-mix and input value for each PROM variable.

Since EQ-5D index and EQ VAS indicate deviations, which are greater than zero, the result is better than expected and the negative values for pain and satisfaction are better than expected.

	Pain (VAS)				Satisfaction (VAS)	
Hospital	Preop	1 year	Deviation from expected	Improve-ment index	1 year	Deviation from expected
Ängelholm	67	13	–0.6	81	13	–2.3
Örebro	63	12	–1.3	81	14	–1.3
Örnsköldsvik	66	12	–1.3	81	14	–1.1
Östersund	63	12	–0.5	80	12	–2.6
Country	63	13	0	79	15	0

Improvement Index= the difference in the pre- and postoperative mean values in relation to possible room for improvement. Units with less than 40 registrations during the period are not presented.

PROM 6 years – improvement index and deviation from the expected value

Primary operation year 2008–2009

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	6 year	Deviation from expected	Improve-ment index	Preop	6 year	Deviation from expected	Improve-ment index
Aleris Specialistvård Elisabethsjukhuset	269	0.46	0.81	0.03	66	57	79	3.4	51
Alingsås	285	0.48	0.78	0.03	58	57	75	1.9	41
Arvika	95	0.44	0.75	–0.01	56	55	71	–2.7	35
Bollnäs	377	0.41	0.75	–0.00	57	50	72	0.1	44
Borås	176	0.38	0.68	–0.07	48	53	70	–2.2	35
Capio Movement	195	0.50	0.82	0.03	65	56	80	4.2	54
Capio Ortopediska Huset	383	0.43	0.80	0.04	65	55	77	3.3	49
Capio S:t Göran	272	0.41	0.74	–0.01	56	58	72	–0.7	33
Danderyd	459	0.38	0.74	0.01	59	52	73	2.2	44
Eksjö	270	0.44	0.77	–0.00	59	58	73	–1.6	36
Enköping	217	0.45	0.75	–0.01	55	53	72	–1.5	40
Eskilstuna	60	0.31	0.70	–0.00	57	54	69	0.7	33
Falköping	361	0.45	0.75	–0.01	54	58	71	–2.0	31
Falun	372	0.43	0.74	–0.02	55	53	71	–2.1	37
Frölunda Specialistsjukhus	122	0.45	0.74	–0.02	53	62	74	–0.2	31
Gällivare	80	0.45	0.73	–0.04	50	58	71	–2.8	31
Gävle	118	0.34	0.72	–0.03	58	48	66	–6.0	35
Halmstad	158	0.42	0.76	–0.00	58	56	70	–2.8	32
Hudiksvall	151	0.45	0.76	–0.00	56	48	72	–1.2	45
Hässleholm-Kristianstad	1,138	0.41	0.78	0.02	63	54	75	2.5	46
Jönköping	210	0.40	0.76	0.01	60	55	72	–0.5	37
Kalmar	212	0.46	0.77	0.00	58	57	73	–1.0	37
Karlshamn	235	0.41	0.75	0.00	58	53	75	2.3	47
Karlskoga	101	0.33	0.72	–0.01	59	48	69	–1.5	41
Karlstad	214	0.38	0.75	0.00	60	54	71	–1.2	37
Karolinska/Huddinge	127	0.45	0.76	–0.01	56	63	74	–1.5	29
Karolinska/Solna	102	0.35	0.70	–0.03	55	46	68	–3.0	40
Katrineholm	305	0.37	0.78	0.02	65	55	74	1.6	43
Kungälv	257	0.47	0.75	–0.01	53	57	72	–0.7	35
Lidköping	174	0.45	0.77	0.02	58	53	72	–0.2	40
Lindesberg	203	0.49	0.77	0.01	56	55	74	1.2	43
Ljungby	142	0.51	0.79	0.01	58	59	76	1.1	42
Lycksele	250	0.41	0.76	0.02	60	51	72	0.1	43
Mora	199	0.36	0.76	0.02	62	46	72	1.1	48
Motala (to 2009)	413	0.49	0.76	–0.00	52	57	73	–0.2	37
Norrköping	46	0.41	0.68	–0.06	46	54	67	–4.3	30

(Continued on next page.)

		Pain (VAS)				Satisfaction (VAS)	
	Hospital	Preop	6 year	Deviation from expected	Improve-ment index	6 year	Deviation from expected
	Aleris Specialistvård Elisabethsjukhuset	62	11	–3.0	82	12	–3.4
	Alingsås	58	14	–1.2	77	17	0.3
	Arvika	60	15	0.1	76	15	–1.9
	Bollnäs	64	16	0.5	76	18	0.6
	Borås	62	16	0.4	75	20	3.3
	Capio Movement	60	11	–2.1	81	13	–2.3
	Capio Ortopediska Huset	62	13	–1.3	79	15	–1.8
	Capio S:t Göran	59	17	2.0	71	21	3.8
	Danderyd	64	14	–2.5	79	16	–1.9
	Eksjö	61	14	0.4	76	16	0.1
	Enköping	61	17	2.2	73	21	4.2
	Eskilstuna	65	18	1.6	72	19	0.3
	Falköping	59	14	–0.7	77	17	0.4
	Falun	60	14	–0.6	76	15	–1.4
	Frölunda Specialistsjukhus	62	18	3.2	71	20	3.4
	Gällivare	64	19	4.9	70	19	3.0
	Gävle	65	18	2.5	73	18	1.4
	Halmstad	62	16	1.1	74	18	1.3
	Hudiksvall	60	16	1.0	73	20	3.2
	Hässleholm-Kristianstad	58	14	–0.7	76	14	–2.9
	Jönköping	61	15	–0.5	76	15	–1.7
	Kalmar	67	14	0.2	76	15	–0.9
	Karlshamn	62	13	–2.0	79	16	–1.0
	Karlskoga	65	15	–0.9	77	15	–2.6
	Karlstad	61	16	0.8	74	18	1.5
	Karolinska/Huddinge	70	16	0.6	78	14	–2.3
	Karolinska/Solna	63	17	1.7	73	19	2.4
	Katrineholm	64	15	–0.0	76	18	1.6
	Kungälv	56	16	0.7	72	19	1.7
	Lidköping	58	16	0.8	73	17	0.3
	Lindesberg	58	11	–3.0	80	10	–6.6
	Ljungby	60	12	–2.3	81	12	–3.4
	Lycksele	64	16	0.2	75	17	–0.7
	Mora	67	15	–1.1	77	18	0.4
	Motala (to 2009)	57	15	–0.1	74	18	1.0
	Norrköping	61	18	2.9	70	20	2.5

PROM 6 years – improvement index and deviation from the expected value (cont.)

Primary operation year 2008–2009

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	6 year	Deviation from expected	Improve-ment index	Preop	6 year	Deviation from expected	Improve-ment index
Norrtälje	73	0.52	0.70	–0.05	37	57	69	–3.6	27
Ortho Center IFK-kliniken	86	0.41	0.81	0.02	67	57	77	1.3	47
Ortho Center Stockholm	356	0.42	0.76	0.01	59	52	73	0.9	44
Oskarshamn	312	0.54	0.78	–0.01	52	60	74	–0.5	36
Piteå	411	0.39	0.79	0.04	66	48	75	2.4	52
Skellefteå	101	0.44	0.77	0.02	59	52	73	0.6	43
Skene	123	0.42	0.73	–0.02	54	56	72	0.3	37
Skövde	74	0.31	0.69	–0.05	55	50	72	–0.1	44
Sollefteå	44	0.46	0.73	–0.04	49	58	73	–0.1	37
Spenshult	42	0.46	0.85	0.07	72	57	80	4.6	52
SU/Mölndal	194	0.34	0.70	–0.05	54	57	69	–3.4	29
SU/Östra	153	0.43	0.69	–0.05	47	60	67	–5.3	17
Sundsvall	52	0.24	0.70	–0.02	60	46	69	–0.4	43
Södersjukhuset	394	0.43	0.72	–0.01	52	53	70	–1.1	36
Södertälje	120	0.42	0.74	–0.02	56	57	71	–2.8	33
Torsby	89	0.34	0.71	–0.03	56	52	67	–4.6	31
Trelleborg	854	0.42	0.77	0.01	60	56	74	1.2	42
Uddevalla	296	0.42	0.74	0.00	56	56	71	–0.5	35
Umeå	91	0.28	0.67	–0.08	54	43	65	–7.6	39
Uppsala	154	0.43	0.76	–0.01	59	58	72	–2.7	33
Varberg	307	0.45	0.75	–0.01	55	57	73	–0.5	38
Visby	77	0.42	0.70	–0.06	49	56	70	–4.1	31
Värnamo	157	0.49	0.75	–0.03	50	61	73	–1.5	31
Västervik	139	0.48	0.74	–0.02	49	60	73	–0.4	33
Västerås	92	0.37	0.70	–0.03	52	50	68	–2.2	37
Växjö	117	0.47	0.75	–0.01	54	58	72	–1.0	34
Örebro	186	0.43	0.75	–0.01	56	54	71	–2.1	37
Örnsköldsvik	182	0.40	0.74	0.01	57	49	70	–0.4	42
Östersund	232	0.34	0.75	0.02	62	51	72	1.2	44
Country	14,373	0.42	0.76	0	58	55	73	0	40

Number = the number of registrations per unit with full PROM data of patients operated in 2008-2009.

The actual mean values for the EQ-5D index, EQ VAS (self-estimated health condition) and pain (VAS) preoperatively and six years postoperatively as well as satisfaction (VAS) with the surgical results after six years are presented.

Deviations from expected = the difference between the actual mean value and an expected value, as calculated in the regression models that take into account the case-mix and input value for each PROM variable.

Since EQ-5D index and EQ VAS indicate deviations, which are greater than zero, the result is better than expected and the negative values for pain and satisfaction are better than expected.

		Pain (VAS)				Satisfaction (VAS)	
	Hospital	Preop	6 year	Deviation from expected	Improve-ment index	6 year	Deviation from expected
	Norrtälje	63	17	1.4	73	21	3.3
	Ortho Center IFK-kliniken	64	8	–5.2	87	11	–4.1
	Ortho Center Stockholm	63	16	1.1	74	20	3.2
	Oskarshamn	53	12	–0.9	77	13	–2.4
	Piteå	64	12	–3.0	81	14	–3.0
	Skellefteå	62	14	–1.8	78	13	–4.0
	Skene	61	20	4.8	67	25	7.3
	Skövde	64	20	4.3	69	19	2.2
	Sollefteå	62	19	4.8	69	17	0.8
	Spenshult	59	8	–4.9	86	13	–1.9
	SU/Mölndal	64	17	1.0	74	20	3.1
	SU/Östra	61	21	5.5	66	24	7.0
	Sundsvall	69	16	–1.3	77	19	0.8
	Södersjukhuset	61	16	0.2	74	18	0.6
	Södertälje	61	20	5.1	68	22	5.7
	Torsby	66	16	0.0	76	20	2.4
	Trelleborg	64	16	1.1	75	17	0.7
	Uddevalla	61	15	–0.6	76	19	1.7
	Umeå	68	16	0.7	76	17	1.0
	Uppsala	56	15	1.4	73	17	1.9
	Varberg	63	14	–0.1	77	15	–1.6
	Visby	65	22	7.4	66	25	8.3
	Värnamo	56	14	–0.2	76	15	–0.5
	Västervik	63	13	–1.8	79	15	–1.7
	Västerås	66	19	3.3	70	19	1.3
	Växjö	54	14	–0.2	74	16	–0.4
	Örebro	57	14	–0.3	75	14	–2.7
	Örnsköldsvik	67	17	0.4	75	20	2.2
	Östersund	65	15	–0.8	77	15	–2.4
	Country	61	15	0	76	17	0

Improvement Index= the difference in the preoperatively and 6 years postoperatively mean values in relation to possible room for improvement. Units with less than 40 registrations during the period are not presented.

PROM 10 years – improvement index and deviation from the expected value

Primary operation year 2003–2004

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	10 year	Deviation from expected	Improve-ment index	Preop	10 year	Deviation from expected	Improve-ment index
Alingsås	132	0.46	0.68	–0.05	41	56	71	0.1	34
Borås	118	0.47	0.76	0.03	55	57	74	2.1	39,
Falköping	280	0.45	0.73	0.00	51	56	72,	1.4	36
Frölunda Specialistsjukhus	62	0.41	0.69	–0.03	47	55	73	2.6	39,
Gällivare	73	0.45	0.75	0.06	55	49	71	3.8	44
Kalix	44	0.28	0.71	–0.01	60	50	69	–2.5	37
Kungälv	166	0.38	0.71	0.00	52	54	69	–0.8	32
Landskrona	145	0.44	0.75	–0.01	56	64	76	2.8	34
Lidköping	119	0.44	0.72	0.01	49	52	69	0.0	36
Lycksele	109	0.30	0.72	0.02	60	49	69	–0.6	39
Piteå	80	0.35	0.70	–0.01	54	48	69	0.1	40
Skellefteå	79	0.44	0.78	0.06	61,	51	75	4.4	49
Skene	88	0.48	0.71	–0.03	43	60	70	–1.6	26
Skövde	56	0.35	0.74	–0.02	61	50	73	–0.6	45
Sollefteå	58	0.45	0.75	0.02	54	56	70	–1.4	32
SU/Mölndal	59	0.39	0.68	–0.03	47	49	67	–2.7	35
SU/Sahlgrenska	197	0.36	0.72	–0.01	57	54	72	–0.1	39
SU/Östra	80	0.34	0.64	–0.06	46	47	62	–7.4	28
Sunderby (incl. Boden)	83	0.30	0.77	0.06	68	43	70	1.0	48
Sundsvall	85	0.39	0.69	–0.03	49	45	69	–0.7	44
Trelleborg	76	0.36	0.6	–0.07	41	58	64	–5.4	14
Uddevalla	159	0.39	0.71	0.01	53	53	69	0.3	34
Örnsköldsvik	95	0.40	0.73	0.01	56	52	72	1.1	43
Östersund	135	0.35	0.74	0.02	60	52	70	–0.2	37
Country	2,687	0.40	0.72	0	53	53	70	0	37

Number = the number of registrations per unit with full PROM data of patients operated in 2003–2004.

The actual mean values for the EQ-5D index, EQ VAS (self-estimated health condition) and pain (VAS) preoperatively and six years postoperatively as well as satisfaction (VAS) with the surgical results after six years are presented.

Deviations from expected = the difference between the actual mean value and an expected value, as calculated in the regression models that take into account the case-mix and input value for each PROM variable.

Since EQ-5D index and EQ VAS indicate deviations, which are greater than zero, the result is better than expected and the negative values for pain and satisfaction are better than expected.

Improvement Index= the difference in the preoperatively and 10 years postoperatively mean values in relation to possible room for improvement. Units with less than 40 registrations during the period are not presented.

		Pain (VAS)				Satisfaction (VAS)	
	Hospital	Preop	10 year	Deviation from expected	Improve-ment index	10 year	Deviation from expected
	Alingsås	59	17	1.1	71	18	1.9
	Borås	59	15	–0.9	75	15	–1.1
	Falköping	60	16	0.2	74	15	–0.2
	Frölunda Specialistsjukhus	63	21	5.0	66	21	5.3
	Gällivare	63	20	2.1	69	16	–1.2
	Kalix	65	18	1.0	73	16	0.3
	Kungälv	60	16	–0.9	73	15	–2.2
	Landskrona	64	15	–0.8	77	16	0.4
	Lidköping	57	16	–0.3	71	15	–1.2
	Lycksele	67	17	0.4	74	13	–3.6
	Piteå	64	16	–1.3	74	19	2.1
	Skellefteå	62	14	–2.4	77	13	–2.6
	Skene	58	17	1.8	70	22	5.8
	Skövde	63	15	–0.2	77	13	–1.4
	Sollefteå	64	12	–3.3	80	14	–0.8
	SU/Mölndal	62	18	1.3	71	19	2.9
	SU/Sahlgrenska	60	15	–0.4	75	15	0.3
	SU/Östra	66	26	8.7	60	23	6.0
	Sunderby (incl. Boden)	69	12	–5.0	82	13	–3.4
	Sundsvall	62	19	1.7	70	18	1.9
	Trelleborg	63	22	4.6	65	19	1.5
	Uddevalla	61	14	–2.7	78	15	–0.7
	Örnsköldsvik	64	16	–0.8	75	13	–2.2
	Östersund	63	16	–0.4	75	15	–0.9
	Country	62	16	0	74	16	0

Trend analysis PROMs

Continued improvement in patient-reported outcomes

The register's PROMs programme aims to complement the traditional outcome variables of mortality, revisions and other reoperations and adverse events. The programme started as a pilot project in 2002 but quickly came to be made permanent, and since 2008 involved all units in the country. It is very gratifying that the response rate is stable. Over 85% of all elective patients respond preoperatively and the loss is only 10% at one-year follow-up. Since the response rate is lower preoperatively, we assume that this is dependent on the fact that it is logistically more difficult to ask all patients preoperatively, because variations may occur in the process up to the operation.

With 13 years of experience in the collection of PROMs data in the Swedish Hip Arthroplasty Register (SHAR) there is now a unique opportunity to analyse how the results change over time. A quality register's primary mission is to promote the improvement of the quality of care. Historically, we have been able to show that the implant survival has gradually improved during the time the register has been operating. Patient-reported outcomes such as say pain relief, improved function and satisfaction with the results of the operation, constitute the primary outcome. For the third consecutive year, we have analysed how the results have changed over time. For this year's report we have investigated trends for how patient-reported outcomes have changed over time for those operated on in 2007 to 2013.

All reports to the PROM database are included in the analysis for those patients who were operated on during the years in question, irrespective of diagnosis. We have chosen to include only those who answered preoperatively and postoperatively after one year (n=74,592). Certain patients appear twice if they had operated both hips and responded to the surveys during this period. We used ANOVA trend analyses to test whether or not changes during the five-year period were statistically significant.

Gratifyingly enough one can establish that there was a positive trend for all PROM variables. The trend showed an improvement in the measures for health-related quality of life, EQ-5D index and EQ VAS both pre- and postoperatively. This means that patients on average have less affected health-related quality of life when they undergo surgery, and that after one year they indicate better quality of life on average. One may speculate as to the causes of these changes observed over time. Healthcare itself has undergone changes during the period with investments in accessibility and to reduce hospital waiting lists. This may in turn have led to a certain widening of indications, and that the trend is a result of our operating on more patients who do not have such pronounced hip disease.

That the pain level preoperatively has not changed speaks, however, against the idea that it is a matter of indication slippage. One can speculate on how the various efforts to improve the care of patients with osteoarthritis earlier in the course of treatment may have an impact on nationwide results. The introduction of osteoarthritis schools, the BOA Register's activities and the work of the Association of Rheumatics (Reumatikerförbundet) for patients with osteoarthritis may all have contributed to a development where more patients with osteoarthritis can better manage their disease. Furthermore, many clinics have invested in improving routines and processes around prosthetic surgery. Many clinics have worked with and introduced new health care programs, including earlier mobilization, improved patient information and active participation in rehabilitation and shorter hospital stay. Another explanation, quite independent of hip problems, is that changes in economic and social conditions in a country can lead to changes in health-related quality of life in the population at large. However, the trend towards a higher degree of patient satisfaction can probably not be explained by such a change in societal conditions. Measuring care quality, analysing the effect of different interventions and openly accounting for the results for all of the country's caregivers all propel the work of improvement and quality forward.

In conclusion, we note a statistically significant positive trend for patient-reported outcomes for total hip replacement after one year. It should be emphasized that even if the trend is statistically significant, the absolute changes are small. Hopefully, the PROM Programme contributes to facilitating analyses of the total functions and activities of caregivers, thus enabling initiation of local improvement efforts.

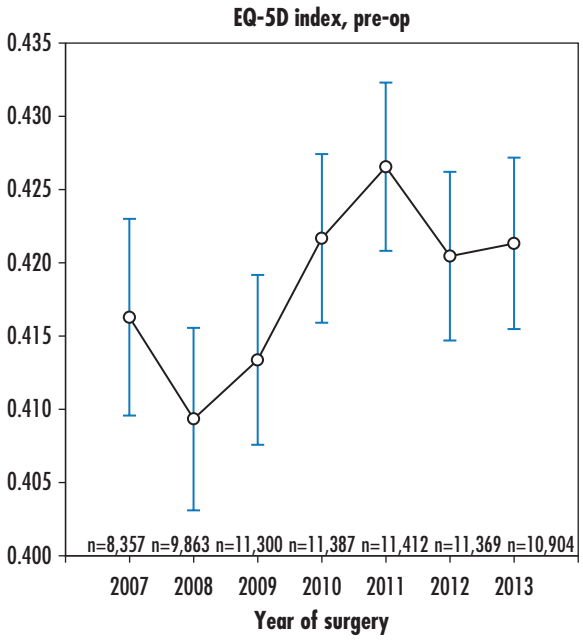


Figure 1. Evolution of the mean EQ-5D index preoperatively during the period 2007 to 2013. There is a significant trend towards a higher average.

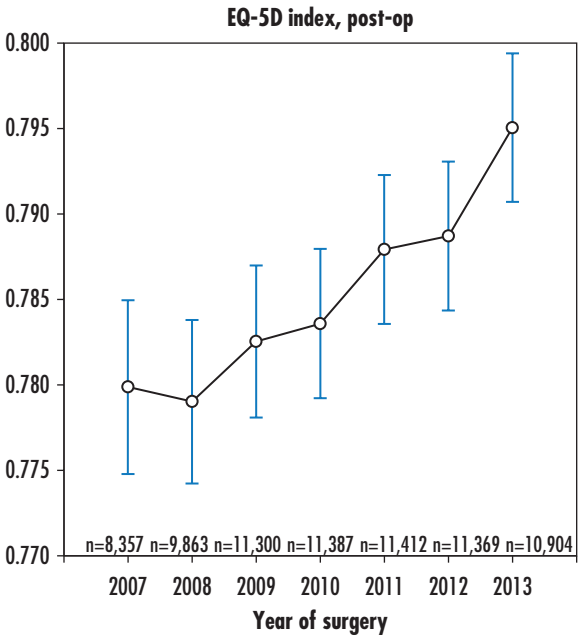


Figure 2. Evolution of the mean EQ-5D index after one year postoperatively during the period 2007 to 2013. There is a significant trend towards a higher average.

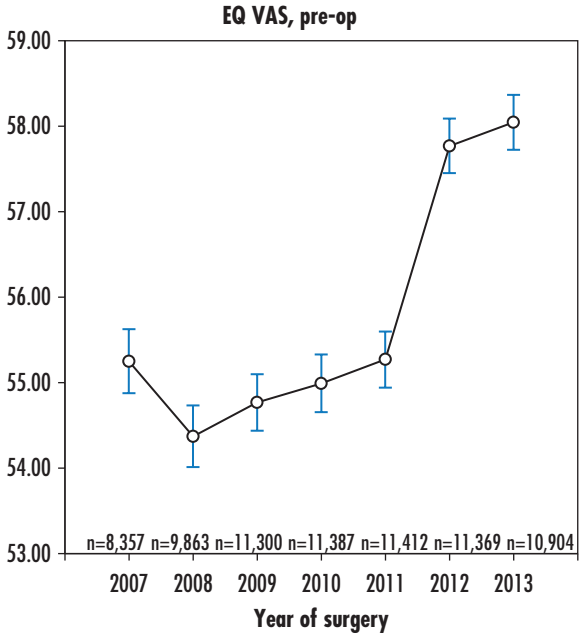


Figure 3. Evolution of the mean EQ VAS preoperatively during the period 2007 to 2013. There is a significant trend towards a higher average.

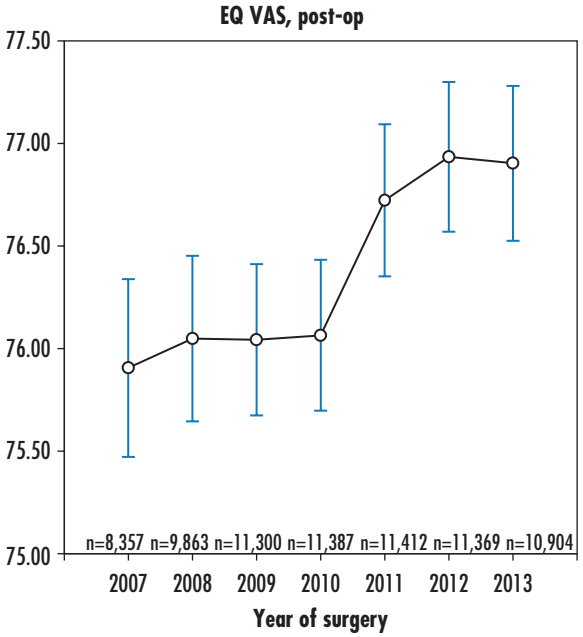


Figure 4. Evolution of the mean EQ VAS after one year post-operatively during the period 2007 to 2013. There is a significant trend towards a higher average.

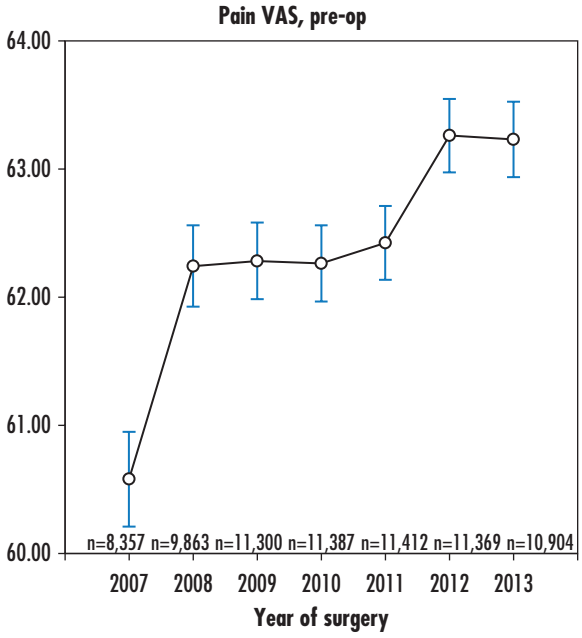


Figure 5. Evolution of the mean of pain preoperatively during the period 2007 to 2013. There is a significant trend towards a higher average (= more pain).

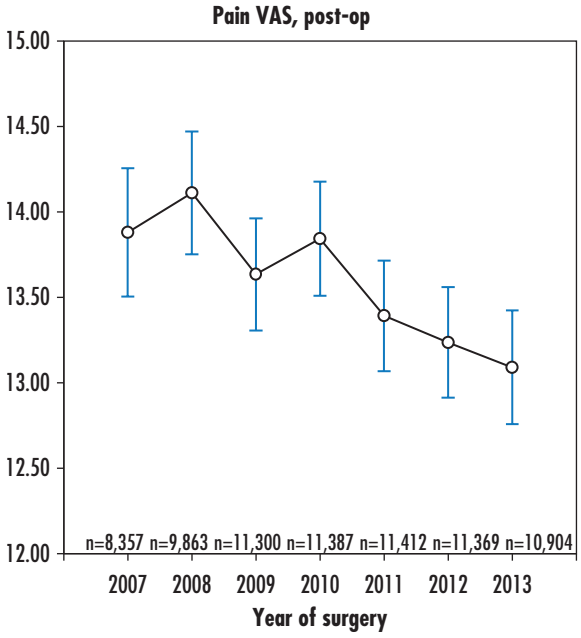


Figure 6. Evolution of the mean of pain after one year postoperatively during the period 2007 to 2013. There is a significant trend towards a lower average (= less pain).

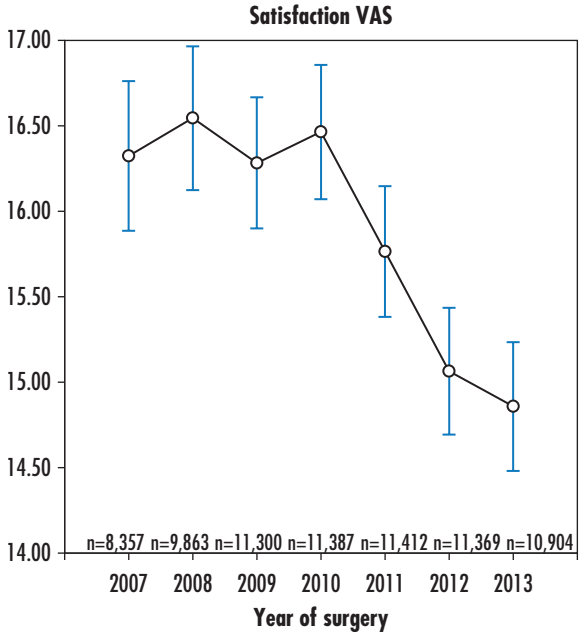


Figure 7. Evolution of the mean of satisfaction with the surgical results after one year postoperatively during the period 2007 to 2013. There is a significant trend towards a lower average (= better satisfaction).

Follow-up activities after total hip replacement

The Hip Arthroplasty Register began openly reporting hospital results in 1999. The number of variables reported in this way has increased over the years and is presented in tables in this report. These tables are of necessity comprehensive and sometimes difficult to interpret. It is also difficult to gain a fast overview of the clinics' results in several dimensions via the tables alone. This is the seventh year of using so-called value compasses consisting of eight variables (points of the compass). The compasses have been produced with the sole intention of providing a fast and pedagogical overview. A deviating result in a value compass only indicates whether a clinic has a problem area. The compass can be regarded as a simplified signal system.

With this method, results are presented for all clinics connected with the PROMs Programme for more than one year, and with at least 50 patients being followed up. The value limits have been set at the highest and lowest values, respectively, plus/minus one standard deviation for the variable in focus. This means that the norm values (red field) vary from year to year. The worst value (0.0) for variables was assigned to the origo and the best value (1.0) to the periphery.

The national average is presented in each figure and the clinic in focus can thus compare itself with the results for the entire country during the current fiscal year. Please note that the observation period for the variables varies.

Result variables:

- **Patient satisfaction.** Measured with VAS.
- **Pain relief.** Measured by subtracting the preoperative VAS value from the follow-up value, that is to say, the value gained after one year.
- **Health-related quality of life gained** (gain in EQ-5D index). This point of the compass is calculated by presenting deviation from the expected gain.
- **"Adverse events" within 90 days.** This dimension is new this year. Previously, we have reported 90-day mortality, but because mortality after mainly elective procedures is very low, we have chosen instead to report adverse events within 90 days after surgery. For definitions, see the chapter on "adverse events" on page 72. The indicator also includes mortality. Reporting 'adverse events' with greater numbers and variability gives one dimension in the compasses a greater opportunity for improvement.
- **Coverage.** Coverage (completeness) at the level of the individual according to the latest cross-referencing with the Patient Register at the Swedish National Board of Health and Welfare.
- **Reoperation within 2 years.** Lists all forms of reoperation within 2 years after primary operation and during the latest 4-year period.
- **5-year implant survival.** Prosthetic survival after 5 years with Kaplan-Meier statistics.
- **10-year implant survival.** The same variable as above but with a longer follow-up period.

Linked to each clinic's value compass is a graphic presentation of the clinic's "case-mix". This is constructed in the same way as the value compass. It includes the variables that have been shown upon analysis of the Register's database to be decisive demographic parameters for both patient-reported outcomes and long-term results with respect to revision needs. The greater the area in this figure the more favorable the patient profile of the clinic in focus.

- **Charnley classification.** The Figure shows the clinic's proportion of patients who have classified themselves as Charnley class A or B, which is to say patients without multiple joint disease and/or diseases affecting the patient's walking ability.
- **The proportion of primary osteoarthritis.** The more patients operated by the clinic for the diagnosis primary osteoarthritis the better the long-term results will be, according to the Register's regression analysis of the database.
- **The proportion of patients aged 60 or older.** Clinics that operate many patients over the age of 60 achieve better results in the same way as the variable above.
- **The proportion of women.** Women generally have better long-term results than men with respect to the need for revision depending first and foremost on aseptic loosening.

Discussion

Healthcare decision-makers express a strong wish to easily access summaries presenting clinics' and county councils' results with regard to the follow-up of the organization's total functions and activities. Another way of meeting this wish is to create an index, such as a total summing-up, to include a majority of variables. The greatest risk with indexing is that good results for one variable can be weighed up by bad results for another and vice versa. Such an index would then not provide an incentive to in-depth analysis and the work of improvement. Varying coverage of reported variables can also affect indexing with misleading results as a consequence.

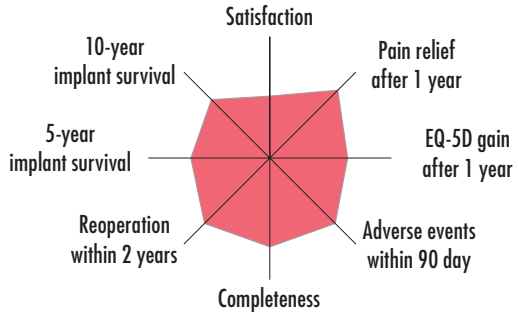
In the value compasses, the national result with respect to the eight input variables is shown in red. The corresponding values of the respective clinics are shown in green. The units with red panels have values for the variables in focus that are inferior to the national average. The outcome can be studied in detail in the respective tables.

The graphic presentation of patient demography ("case-mix") shows the national results with regard to the four input variables in red. Each respective unit's corresponding value is shown in green. The value limit is set to the highest and lowest value ±1 SD of the variable in focus. When interpreting each clinic's value compass and, above all, when making comparisons, the "case-mix" profile must be always kept in mind!

Also, this year we are also publishing value compasses for the so-called "standard" patient on page 140. Please note that these compasses only have seven "points of the compass". Since the basic selection of the "standard" patient builds on BMI and ASA grading, which we included in our data catchment five years ago, the 10-year survival of implants is not relevant. These compasses are also case-mix-adjusted via the basic selection, which is why the graphic illustration of case-mixes is also irrelevant.

Quality indicator

Value compass – national average

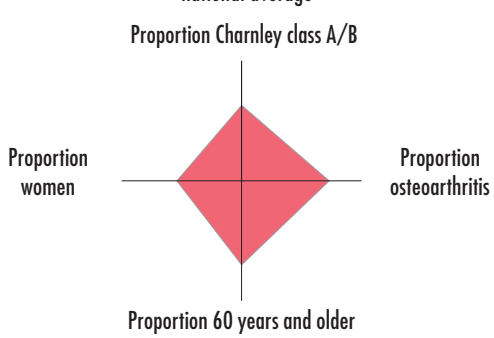


The value compasses show the national results of the five input variables in red. Each respective unit's corresponding value is shown in green. The value limit is set to the highest and lowest value ±1 SD of the variable in focus. The worst value for the variables was given as origo and the best value at the periphery.

The units with red fields have a poorer value than the national average for those particular variables. The outcome can be studied in detail in the respective tables.

Case-mix-profile

national average



The graphic presentation of patient demography ("case-mix") shows the national results with regard to the four input variables in red. Each respective unit's corresponding value is shown in green. The value limit is set to the highest and lowest value ±1 SD of the variable in focus. The worst value for the variables was given as origo and the best value at the periphery.

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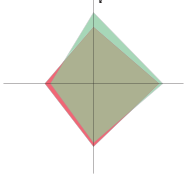
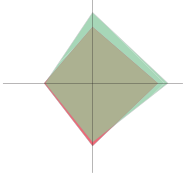


Aleris Specialistvård Nacka



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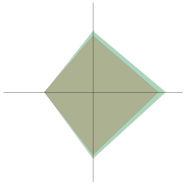

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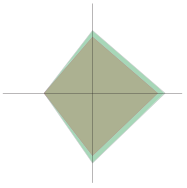

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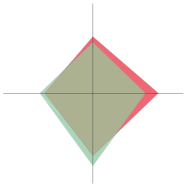
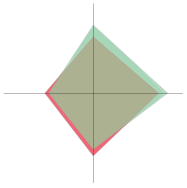


Capio Movement



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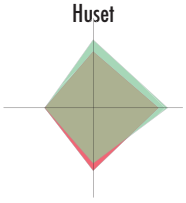

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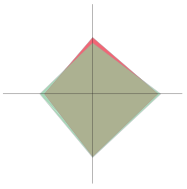

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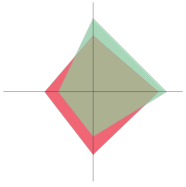

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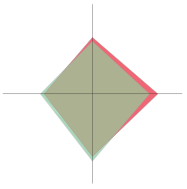

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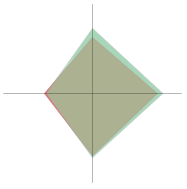

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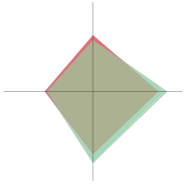

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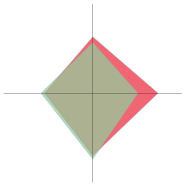

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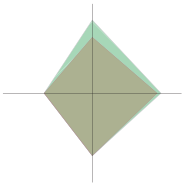
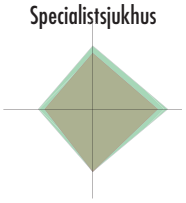


Frölunda Specialistsjukhus



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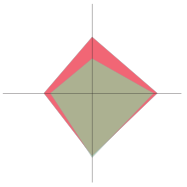

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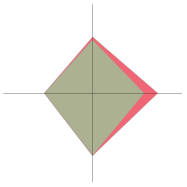

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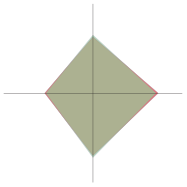

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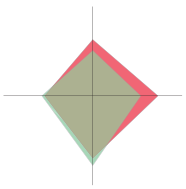

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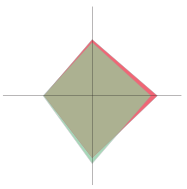

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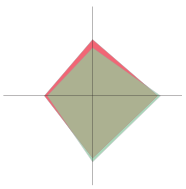

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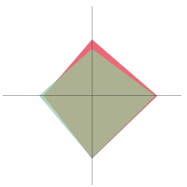

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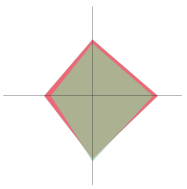

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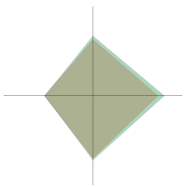

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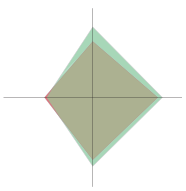

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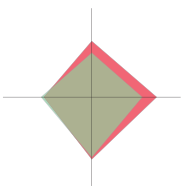

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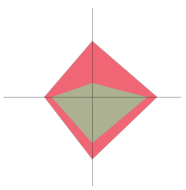

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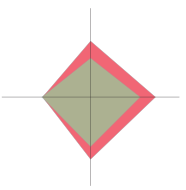

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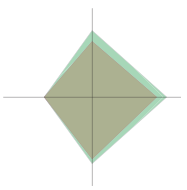

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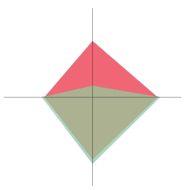

Value compasses (continued)

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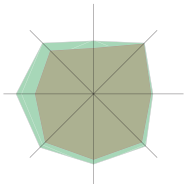

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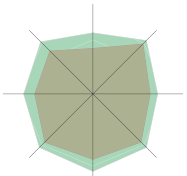

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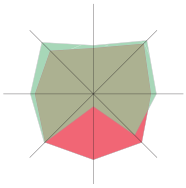

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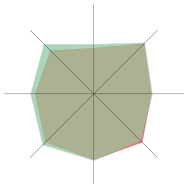

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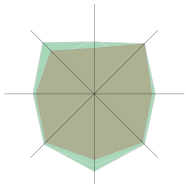

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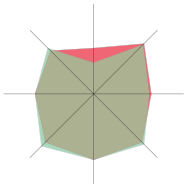

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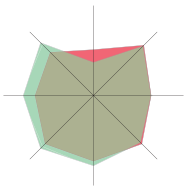

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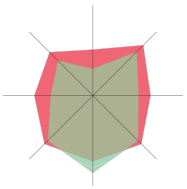

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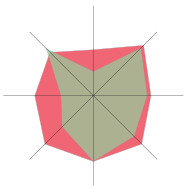
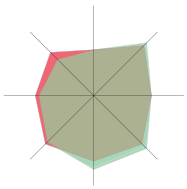


Ortho Center Stockholm



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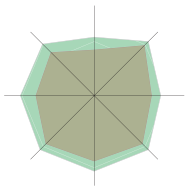

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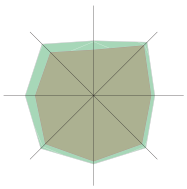

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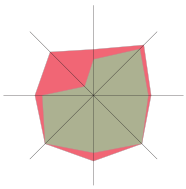
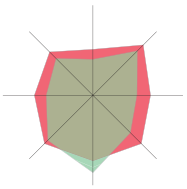
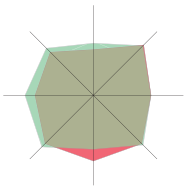


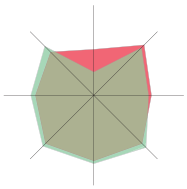
SUS/Lund



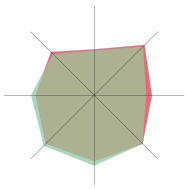
Skellefteå



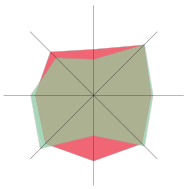
Skene



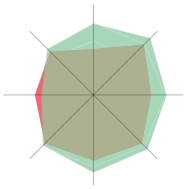
Skövde



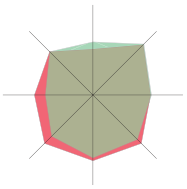
Sollefteå



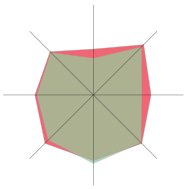
Sophiahemmet



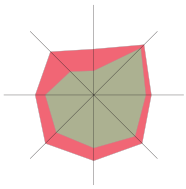
Sundsvall



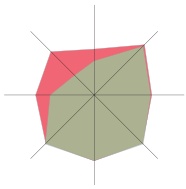
Södersjukhuset



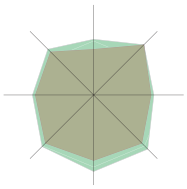
Södertälje



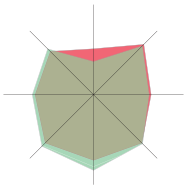
Torsby



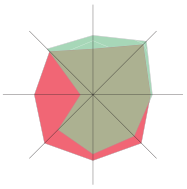
Trelleborg



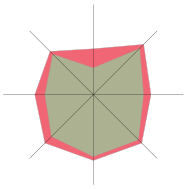
Uddevalla



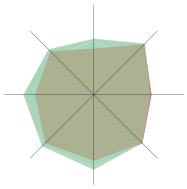
Umeå



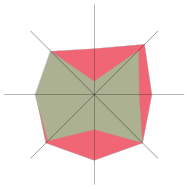
Uppsala



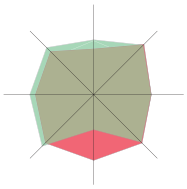
Varberg



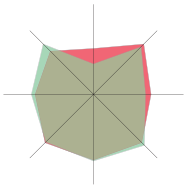
Visby



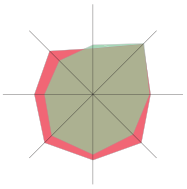
Värnamo



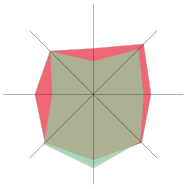
Västervik



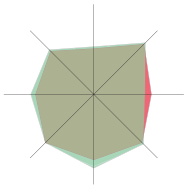
Västerås



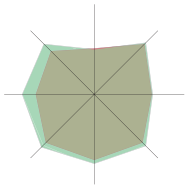
Växjö



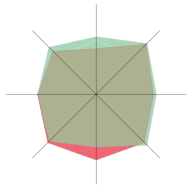
Örebro



Örnsköldsvik

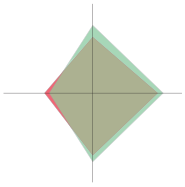


Östersund

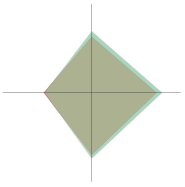


Case-mix profiles (continued)

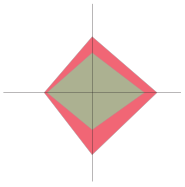
Lidköping



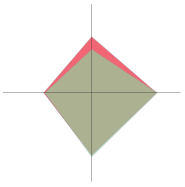
Lindesberg



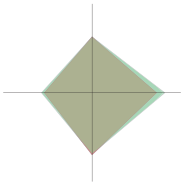
Linköping



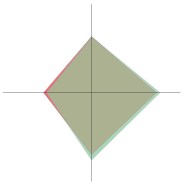
Ljungby



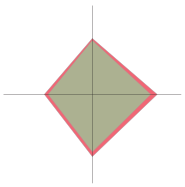
Lycksele



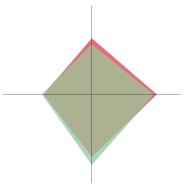
Mora



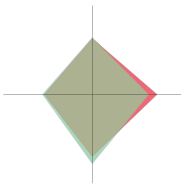
Norrköping



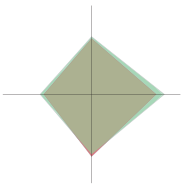
Norrtälje



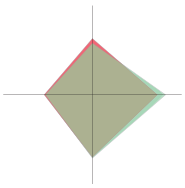
Nyköping



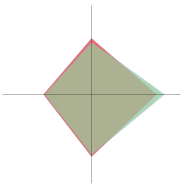
Ortho Center Stockholm



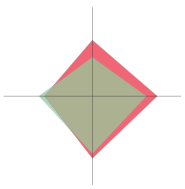
Oskarshamn



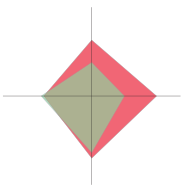
Piteå



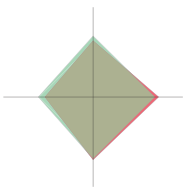
SU/Mölndal



SUS/Lund



Skellefteå



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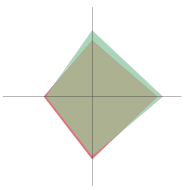
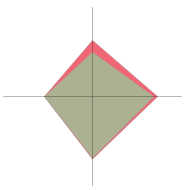
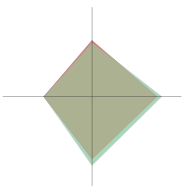


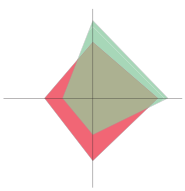
Skövde



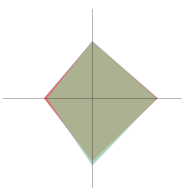
Sollefteå



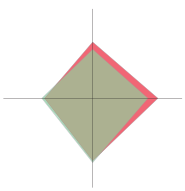
Sophiahemmet



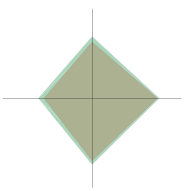
Sundsvall



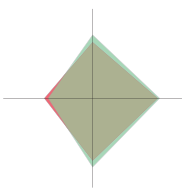
Södersjukhuset



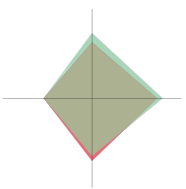
Södertälje



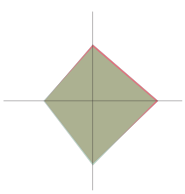
Torsby



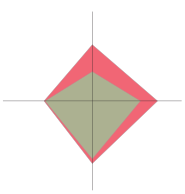
Trelleborg



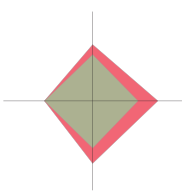
Uddevalla



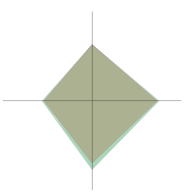
Umeå



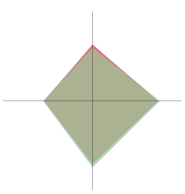
Uppsala



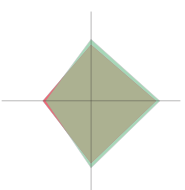
Varberg



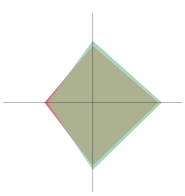
Visby



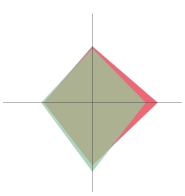
Värnamo



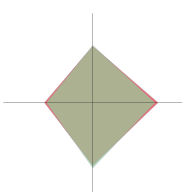
Västervik



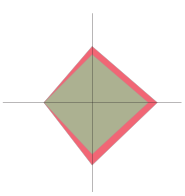
Västerås



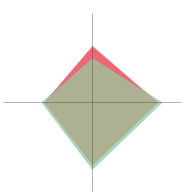
Växjö



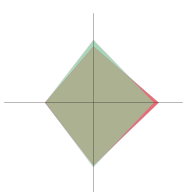
Örebro



Örnsköldsvik



Östersund



The "standard" patient

Reoperation within 2 years is one of the quality indicators of the Swedish Hip Arthroplasty Register that is used for continual work towards improvement. The risk of suffering from an early reoperation is influenced by several factors. This is relevant when complex interplay in which factors such as gender, age, diagnosis, comorbidity and social situation interact in ways that are difficult to predict. The situation is complicated by the fact that only certain factors are included in the register's data capture. In order to implement a periodic risk analysis, at least on an annual basis, it is required that the analysis of the variables also recorded continuously over time.

A risk analysis has often a high degree of complexity and may methodologically need to be varied depending on the issue, the variables' content and diversity and data's composition. For the layman, and not least for the majority of our patients, interpretation of data could easily be problem. The same applies when comparing results between different surgical units. For the professionals, it is obvious that the probability of failure is higher for units that operate on the sickest patients, which can be easily overlooked if the results are presented without relevant background data.

To facilitate comparisons and reduce the need for interpretation for the public, four years ago, we created the so-called "standard patient". The idea was that in light of the variables that affect the outcome "Reoperation within 2 years" to define thresholds, such as the age groups that represent a low risk. Such a definition involves compromises, because the line between "safe" and "unsafe" interval always becomes unclear. For the individual patient, it is important to know that even if you belong to a low-risk group, complications can occur. When this happens, it is a small consolation to know, that the risk of what actually occurred, was low.

The construction of the "standard patient" is based on the emergence of BMI and ASA class variables, which were first recorded in 2008. Already in our first analysis, we left open the possibility that the definition of the "standard patient" may need to be adjusted in the future, as the patient population which constituted the basis of assessment may have increased. The upper age limit was changed from 80 to 85 years in an early stage. Subsequently, no changes have been made.

In this year's report, we have updated the analysis of standard patient. One difference from previous analyses is that each patient is only included with the hip joint which was operated first during the period 2008 to 2014. The hip surgeries where the patient undergoes surgery for the second time in the given period are therefore excluded.

The analysis starts with 111,030 hip surgeries. About 12,000 operations are excluded since these patients already had surgery on the other side during the given period. As in previous analysis, we note that the risk of reoperation is greater for men. Continued analysis of how the diagnosis affects the outcome shows that patients with secondary osteoarthritis have an increased risk for all groups, except for those with sequelae after hip disease during adolescence. To maintain the simplicity of the definition, we have chosen to proceed by only including primary osteoarthritis in the group defined as the "standard patient". Patients with sequelae after hip disease during adolescence is also a heterogeneous group from the surgical standpoint and this group includes all diagnoses from a mild underdevelopment of the acetabulum (hip dysplasia) to severe deformities where the hip joint has since the neonatal period lied completely dislocated, a condition, which at prosthesis insertion requires great surgical skill.

Continued analysis of the primary osteoarthritis group shows that the risk is relatively evenly distributed up to 74 years of age. In the age group 75-84 years, the risk is slightly increased. This group represents approximately 25% of patients with primary osteoarthritis and must be included in order to maintain adequate representativeness. The increased risk in this group is reduced when adjusting for correlation in the final analysis (Table 2). We have chosen to exclude patients under age 55, partly because in the long run, there is a higher risk of reoperation (Figure 1). This choice can be discussed, but is based on the hope that in the future, it is possible to define a patient group, where the risk for long term complication is low and that this definition cannot differ very much from the one already used for the "standard patient".

As expected, the risk for reoperation is higher for patients who are classified as ASA II and III. Both ASA I and II are included in the definition of the "standard patient", so that the definition would not be too strict. A similar situation applies to the BMI, in which both normal weight (BMI between 18.5 and 24.9) and overweight (BMI between 25 and 29.9) are included. Patients with primary osteoarthritis and low BMI tend to have an increased risk in the initial analysis. In this year's analysis, the risk is about the same as for normal weight. Nonetheless, we have chosen to exclude this relatively small group.

Charnley class is not included in the definition of the standard patient. The loss of observations is high here and includes more than 10,000 observations. Patients with primary osteoarthritis in Charnley class C have has a slightly increased risk of reoperation. In the final adjusted analysis, it appears that the risk increase in group C may be partly explained by other factors.

Table 2 shows distribution of risks between the variables that define the "standard patient" (woman or man with primary osteoarthritis aged 55-84 with ASA class I or II and BMI between 18.5 and 29.9) and taking into account to the mutual covariance. The increased risk for men remains unchanged. Patients in ASA class II are also at a greater risk although the difference is reduced in relation to the ASA class I, compared with the unadjusted analysis in Table 1. The difference between the age groups 65-74 and 74-84 and between groups defined as normal and overweight has been reduced and is no longer significant. Analysis of the patients, about whom there is information on Charnley class, shows that the increase in risk for the Group C, which emerged in the unadjusted analysis, now in the adjusted analysis, is no longer significant. 2.8% of the patients not covered for the "standard patient", have been reoperated in two years. The corresponding proportion among patients defined as "standard" is 1.3%, representing more than a doubled risk (Table 2, Figure 2).

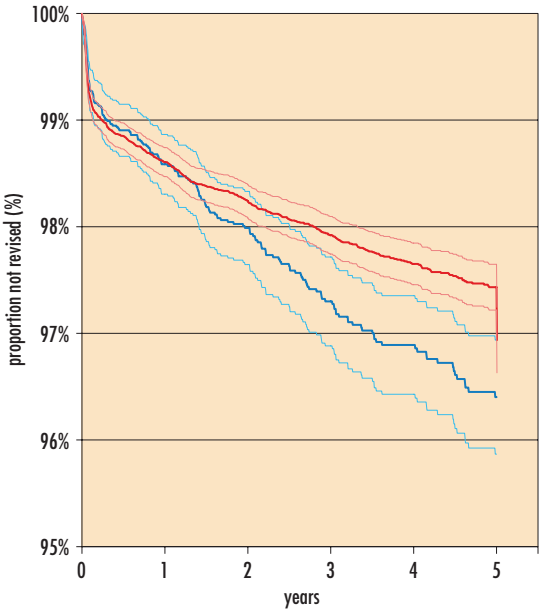


Figure 1. Survival chart based on the risk for reoperation within five years for patients under the age of 55 (blue curve) and the comparison group 65 to 75 years (red curve). After 1.5 years, the risk increases in the younger group. Patients who had surgery during the period 2008-2014 (first operated hip) were included in the analysis.

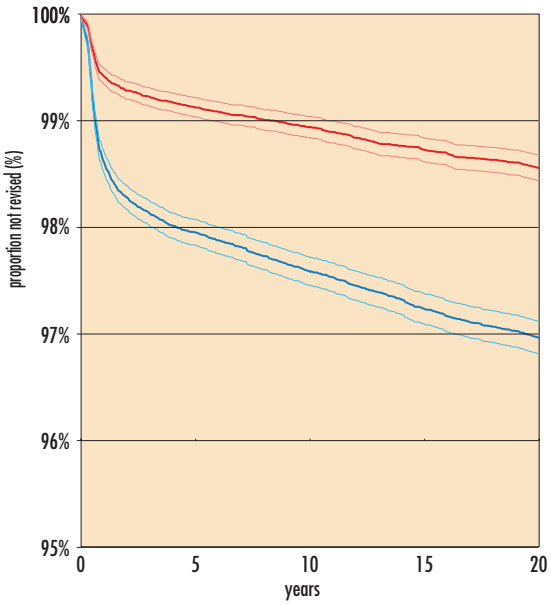


Figure 2. Survival chart based on the risk for reoperation within two years for patients who are included in the definition for the "standard patient" (red curve) and for patients who are not included by this definition (blue curve). Patients who had surgery during the period 2008-2014 (first operated hip) were included in the analysis.

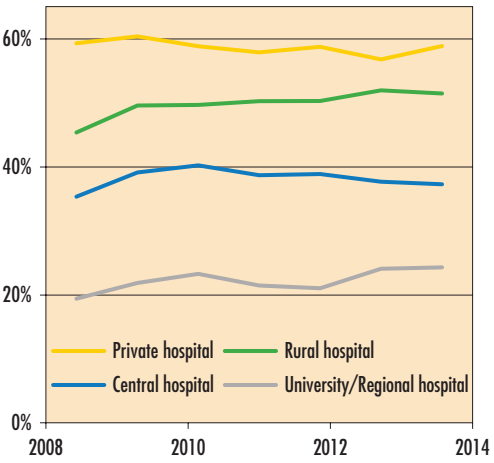


Figure 3. Proportion of patients defined as "standard" before hip arthroplasty for different types of hospitals.

Patient clientele varies between different hospitals. The majority of patients who undergo surgery at private hospitals meet the definitions for the "standard patient", at rural hospitals they constitute for about 50%, at central hospitals just under 40% and at university and regional hospitals about 25% (Figure 3).

The objective of defining a "standard patient" is an easy way to show how differences between the patient groups affect the outcome and thus facilitate making comparisons. The definition is based on statistical calculations, limitations, clinical assessments and compromises and therefore may be subject to discussion and adjustments. We have chosen to retain the definition of the "standard patient" as a woman or man, aged 55-84, with primary osteoarthritis with ASA class I or II and BMI between 18.5 and 29.9. This patient, preferably operated in private and rural hospitals, has a risk of reoperation within two years, which is less than half when compared to other patients.

Possible risk factors for reoperation in two years after hip arthroplasty

Variable, *reoperation outcome in 2 years*	*n*	*RR*	95% C.I.	*p-value*
All operations 2008–2014	***111,030***			
Bilaterality *in the period*				
First hip	99,022	1	1	
Second hip	12,008	**1.1**	0.99–1.3	*0.07*
Both genders, *only the first hip**				
Woman	57,356	1	1	
Men	41,666	**1.4**	1.3–1.5	*<0.0005*
Diagnosis				
Primary osteoarthritis	81,379	1	1	
Hip fracture, acute, sequelae	10,430	**2.5**	2.3–2.8	*<0.0005*
Inflammatory joint disease	1,371	**1.6**	1.1–2.2	*0.006*
Sequelae after childhood disorder	1,927	1.0	0.7–1.4	*0.9*
Femoral head necrosis	3,131	**2.2**	1.8–2.7	*<0.0005*
Other	784	**4.3**	3.42–5.7	*<0.0005*
Diagnosis, *simplified compromise*				
Primary osteoarthritis	81,379	1	1	
Secondary arthritis	17,643	**2.3**	2.1–2.5	*<0.0005*
Primary osteoarthritis, *first hip*	***81,379***			
Age				
<55 years	7,426	1.1	0.9–1.3	*0.3*
55–64 years	18,973	1.0	0.9–1.2	*0.6*
65–74 years	39,786	1	1	
75–84 years	20,708	**1.2**	1.05–1.4	*0.007*
85– years	3,486	**1.6**	1.3–2.0	*<0.0005*
ASA class				
I	19,769	1	1	
II	46,324	**1.4**	1.2–1.6	*<0.0005*
III–V	12,180	**2.4**	2.1–2.8	*<0.0005*
Missing	3,106			
BMI				
<18.5	561	1.0	0.5–2.1	*0.9*
18.5–24.9	24,388	1	1	
25–29.9	33,244	1.2	1.04–1.4	*0.01*
>30	18,560	**1.9**	1.7–2.2	*<0.0005*
Missing	4,626			
Charnley class				
Hip disease, one side (A)	33,476	1	1	
Hip disease, both sides (B)	8,958	1.0	0.9–1.2	*0.8*
Multiple disabilities (C)	28,662	1.2	1.03–1.3	*0.02*
Missing	10,283			

**contralateral hip excluded if patients were operated bilaterally in the period 2008-2014*

Table 1. Evaluation of the unadjusted risk ratio (RR) as the basis for the definition of the "standard patient." Data is based on first operated hip.

Risk factors which are included in the definition of the "standard patient" and the influence of Charnley class

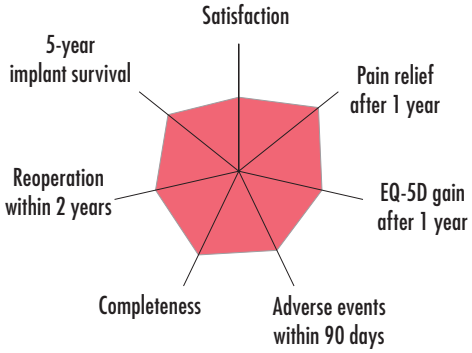
Variable, *reoperation outcome in 2 years*	*n*	*RR*	95% C.I.	*p-value*
The "standard" patient*	***43,046***			
Gender				
Woman	24,570	1	1	
Man	18,476	**1.4**	1.2–1.7	*<0.0005*
Age				
55–64 years	11,999	1.0	0.8–1.2	*0.9*
65–74 years	19,040	1	1	
75–84 years	12,007	1.2	0.96–1.4	*0.1*
ASA class				
I	12,980	1	1	
II	30,066	**1.3**	1.0–1.5	*0.02*
BMI				
18.5–24.9	18,138	1	1	
25–29.9	24,908	1.2	0.98–1.4	*0.1*
The "standard" patient*	43,046	1	1	
Other patients	55,319	**2.2**	2.0–2.4	*<0.0005*
Excluded variable				
Charnley class				
Hip disease, unilateral (A)	19,322	1	1	
Hip disease, bilateral (B)	5,086	1.0	0.7–1.3	*0.9*
Multiple disabilities (C)	13,810	1.2	0.97–1.4	*0.1*
Missing	4,828			

**data is based on the first side*

Table 2. Risk factors included in the definition of the "standard patient" and the risk increases with regard to reoperation within two years for patients not classified as falling within this definition. Influence of Charnley class is reported separately. Adjusted data based on Cox regression is presented. Only the initially operated hip has been used in the calculations.

Quality indicator for the "standard patient"

Value compass – national average



The value compasses show the national results of the eight input variables in red. Each unit's corresponding values are shown in green. The value limit is set to the highest and lowest value ±1 SD of the variable in focus. The worst value for the variables was given as origo and the best value at the periphery.

The units with red fields have a poorer value than the national average for those particular variables. The outcome can be studied in detail in the respective tables.

Value compasses (continued)

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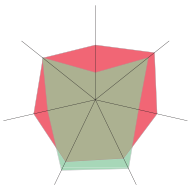

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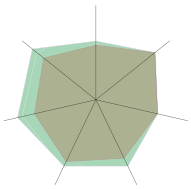

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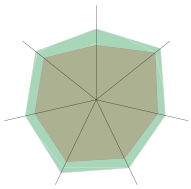

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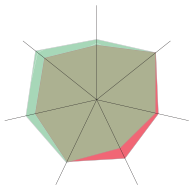

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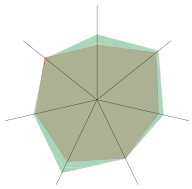

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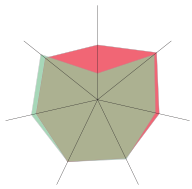

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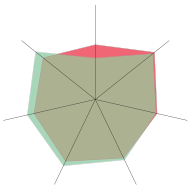

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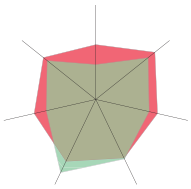

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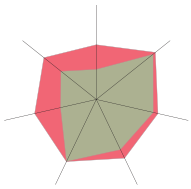

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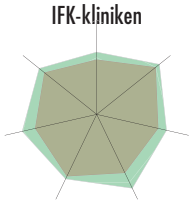

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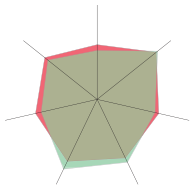

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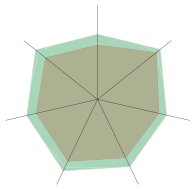

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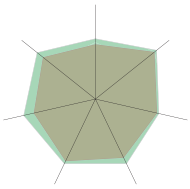

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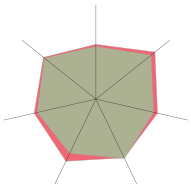

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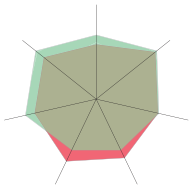

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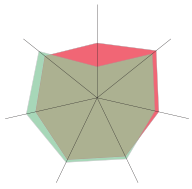

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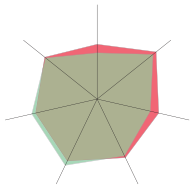

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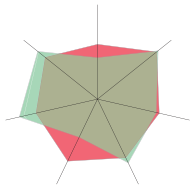

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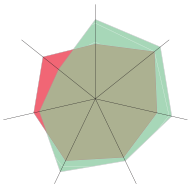

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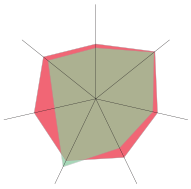

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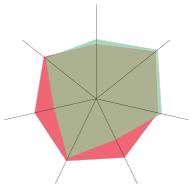

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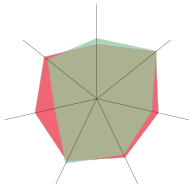

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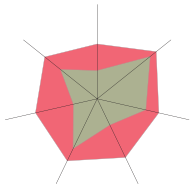

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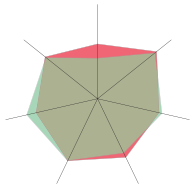

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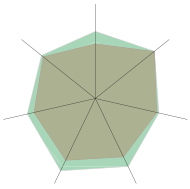

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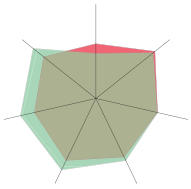

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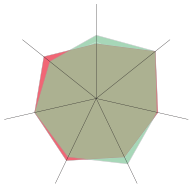

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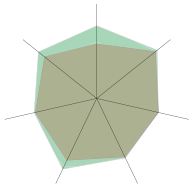

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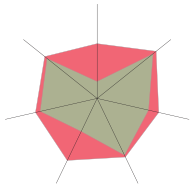

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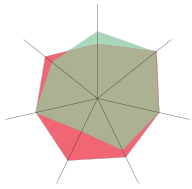

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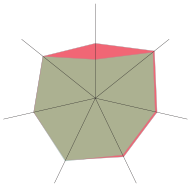

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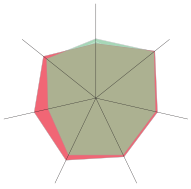

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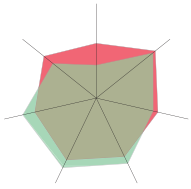

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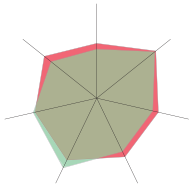
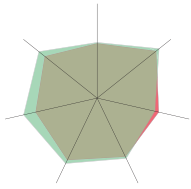
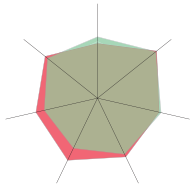


Örnsköldsvik



Östersund



Mortality after total hip replacement

Background

Today, hip arthroplasty is considered a routine surgery, but it is a major surgery, which has several risks for the patient. The indications for arthroplasty have been expanded during recent years – nationally as well as internationally. This means that more patients, both young and old, are operated now earlier than before. The latter group runs a particularly greater natural risk of serious complications while the younger group tends to have a higher comorbidity. Nowadays, and mainly at larger units, more high-risk patients undergo operation than previously.

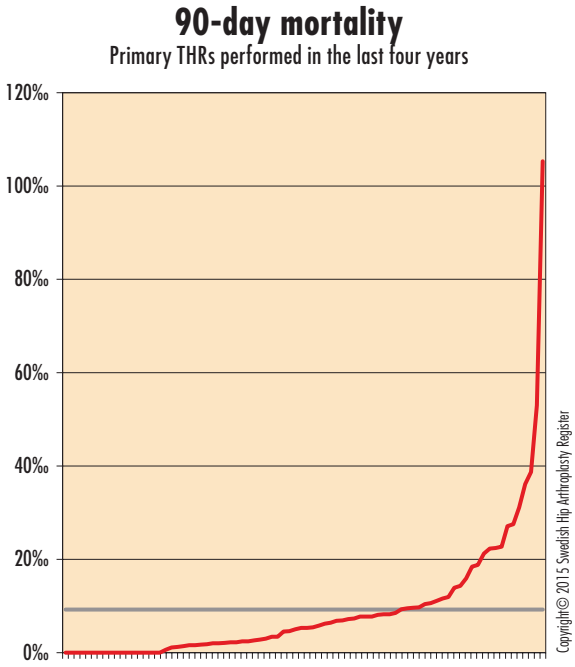
90-day mortality was introduced eight years ago as an open variable on a unit level and is also included as one of eight parameters in the value compass. The Swedish Hip Arthroplasty Register updates its database several times a year with respect to the input of dates of death via the Swedish tax authorities (Skatteverket).

Short-term mortality (90-day mortality)

90-day mortality is an indicator, which is often used in the literature of many medical fields. The causes for a patient's death in connection with or within 90 days from a hip arthroplasty (and related to the intervention) can be many, but the dominant causes seem to be cardiac, cerebrovascular or thromboembolic illnesses. Due to the low death toll, the last four years' production will be analysed to partially reduce for the risk of chance variability.

90-day mortality is higher after surgery at a university/regional hospital and central hospitals compared to rural hospitals and especially compared to private care units. This reflects the different hospitals' patient population (case mix). 90-day mortality varies between Swedish hospitals during the years of observation 2010–2014 from 0.0‰–105.3‰ with an average value for the country of 7.1‰.

We recommend clinics to analyse their deaths as a link in this work for patient safety. It is not self-evident for an orthopedic clinic to receive feedback that a patient has, for example, died of a cardiovascular condition three weeks postoperatively at another clinic or even at another hospital.



The gray line shows the national average value of 7.1 ‰.

Each line in the baseline corresponds to a unit.

The Register has started an in-depth analysis with respect to mortality after total hip replacement. Unsurprisingly, the preliminary results show, that preoperative comorbidity and socio-economic backgrounds are important, while the choice of fixation method has a more questionable clinical relevance. Regarding the patient selection, which is carried out for bilateral hip arthroplasty, no relevant difference is seen on 90-day mortality.

The figures for mortality are generally low and must be assessed with the same exactitude as the variable "reoperation within 2 years" – a possible trend over time.

90-day mortality

proportion of deceased within three months after primary surgery, 2011–2014

Unit	Number[1)]	OA[2)]	≥60[3)]	Women[4)]	Mortality[5)]
University or regional hospitals					
Karolinska/Huddinge	1,040	67	67	50	5.8‰
Karolinska/Solna	770	59	70	59	14.3‰
Linköping	258	62	59	55	**27.1‰**
SU/Mölndal	1,885	66	78	64	8.5‰
SU/Sahlgrenska*	19	5	68	39	**105.3‰**
SUS/Lund	638	31	77	61	**36.1‰**
SUS/Malmö	218	21	88	62	**27.5‰**
Umeå	289	56	78	57	**31.1‰**
Uppsala	1,040	51	68	58	21.2‰
Örebro	551	69	72	58	5.4‰
Central hospitals					
Borås	705	63	91	63	18.4‰
Danderyd	1,314	70	86	62	6.8‰
Eksjö	797	93	84	56	5.0‰
Eskilstuna	490	51	86	62	**22.4‰**
Falun	1,442	89	82	58	2.8‰
Gävle	882	62	82	58	15.9‰
Halmstad	948	81	84	57	9.5‰
Helsingborg	313	56	88	60	6.4‰
Hässleholm-Kristianstad	3,074	88	85	55	4.6‰
Jönköping	783	80	82	63	7.7‰
Kalmar	612	76	85	52	8.2‰
Karlskrona	132	11	98	63	**22.7‰**
Karlstad	1,012	60	81	61	11.9‰
Norrköping	987	73	78	55	**22.3‰**
Skövde	739	78	81	58	8.1‰
Sunderby (and Boden)	132	13	87	53	**53.0‰**
Sundsvall	779	82	86	55	7.7‰
Södersjukhuset	1,603	68	84	61	10.6‰
Uddevalla	1,459	80	83	59	8.2‰
Varberg	935	86	88	59	5.3‰
Västerås	1,886	64	88	61	**38.7‰**
Växjö	576	79	85	56	13.9‰
Ystad	17	0	94	94	0‰
Östersund	1,154	76	84	58	6.9‰

** Only tumor cases*

(Continued on next page.)

90-day mortality (cont.)

proportion deceased within 90 days after primary THR, 2011–2014

Unit	Number[1)]	OA[2)]	≥60[3)]	Women[4)]	Mortality[5)]
Rural hospitals					
Alingsås	849	95	86	58	2.4‰
Arvika	731	95	89	58	9.6‰
Bollnäs	371	93	80	56	0‰
Enköping	1,284	98	91	56	1.6‰
Frölunda Specialistsjukhus	344	99	82	65	0‰
Gällivare	385	77	84	52	2.6‰
Hudiksvall	522	73	87	58	7.7‰
Karlshamn	922	93	84	58	2.2‰
Karlskoga	621	90	88	56	9.7‰
Katrineholm	949	99	87	59	2.1‰
Kungälv	676	88	87	61	3.0‰
Lidköping	901	92	88	53	1.1‰
Lindesberg	877	91	86	57	3.4‰
Ljungby	663	85	83	57	4.5‰
Lycksele	1,176	97	81	61	3.4‰
Mora	851	89	87	55	2.4‰
Norrtälje	451	78	90	60	11.1‰
Nyköping	640	71	88	59	18.8‰
Oskarshamn	933	96	83	57	0‰
Piteå	1,466	97	81	57	2.0‰
Skellefteå	432	78	81	64	9.3‰
Skene	497	93	79	56	0‰
Sollefteå	483	91	88	58	10.4‰
Södertälje	417	86	85	63	7.2‰
Torsby	432	86	88	55	11.6‰
Trelleborg	2,462	92	78	58	2.0‰
Visby	484	86	86	59	6.2‰
Värnamo	564	89	87	56	5.3‰
Västervik	459	87	86	55	2.2‰
Ängelholm	592	98	86	65	0‰
Örnsköldsvik	557	91	86	60	0‰

(Continued on next page.)

90-day mortality (cont.)

proportion deceased within 90 days after primary THR, 2011–2014

Unit	Number[1)]	OA[2)]	≥60[3)]	Women[4)]	Mortality[5)]
Private hospitals					
Aleris Specialistvård Bollnäs	821	96	81	52	1.2‰
Aleris Specialistvård Elisabethsjukhuset	173	90	79	52	0‰
Aleris Specialistvård Motala	1,878	97	87	54	1.6‰
Aleris Specialistvård Nacka	497	100	78	58	0‰
Aleris Specialistvård Sabbatsberg	621	92	78	65	0‰
Aleris Specialistvård Ängelholm	99	96	84	48	0‰
Art Clinic Jönköping	30	97	73	57	0‰
Capio Movement	785	98	76	54	0‰
Capio Ortopediska Huset	1,393	98	76	58	1.4‰
Capio S:t Göran	1,754	87	82	63	1.7‰
Carlanderska	548	96	65	44	1.8‰
Hermelinen Spec.vård	15	87	33	14	0‰
Ortho Center IFK-kliniken	542	96	57	41	0‰
Ortho Center Stockholm	1,673	97	81	62	0.6‰
Sophiahemmet	783	100	58	39	0‰
Spenshult	810	89	78	58	0‰
Country	64,892	83	82	58	7.3‰

** Only tumor cases*

[1)] Refers to number of primary operations during the period.
[2)] Refers to proportion of primary operations carried out for primary osteoarthritis.
[3)] Refers to proportion of primary operations in age group 60 years or older (age during primary operation).
[4)] Refers to proportion of women receiving primary surgery during the period.
[5)] 90-day mortality (number of patients dying within three months of primary operation / number of primary operations during period).

For variables [2)] [3)] and [4)] higher values indicate a low risk of serious complication (death).

Equality in care

Still, more women than men undergo hip arthroplasty, but the gap is narrowing. In this annual report, we have chosen to describe the total differences in different age groups. Figures describe the percentage of women who had received a hip replacement in comparison to men, partly in total number, partly divided into age groups. The figures are adjusted for the difference in gender, in terms of population. In the group younger than 50 years, one can see a tendency towards equalization of the sexes. However, still more men undergo surgery in this age group. In other age groups, women predominate more and more with age. One can see a tendency towards leveling in some age groups. Over time, the differences are relatively constant.

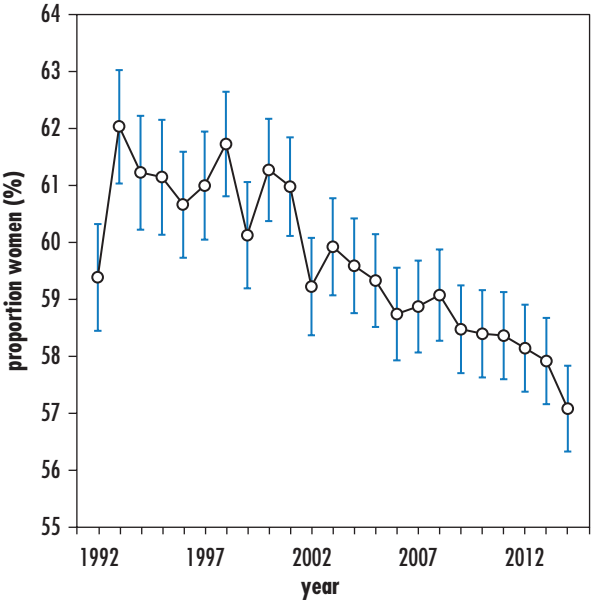


Figure 1. Percentage of women who underwent surgery for hip arthroplasty (all ages).

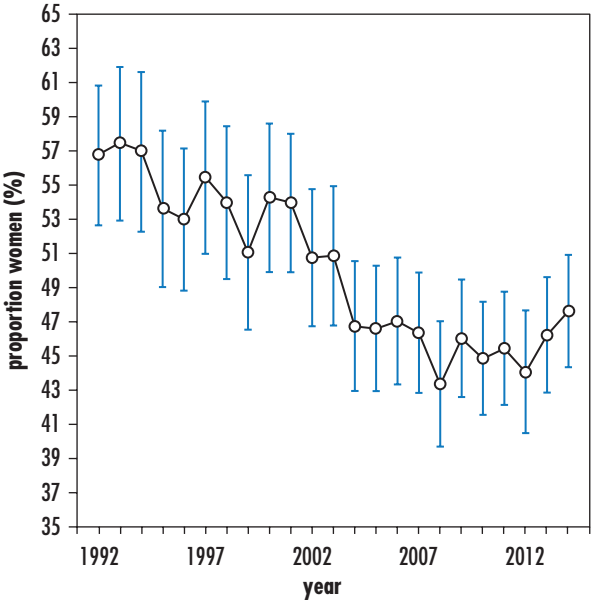


Figure 2a. Percentage of women who underwent surgery for hip arthroplasty (younger than 50 years).

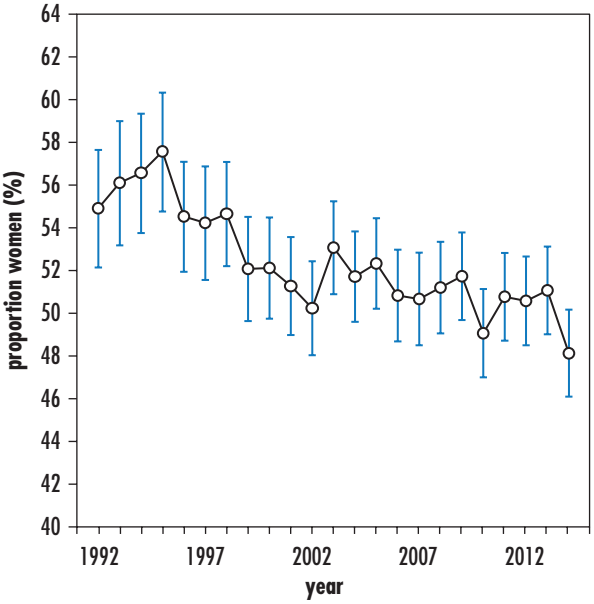


Figure 2b. Percentage of women who underwent surgery for hip arthroplasty (between 50 and 59 years).

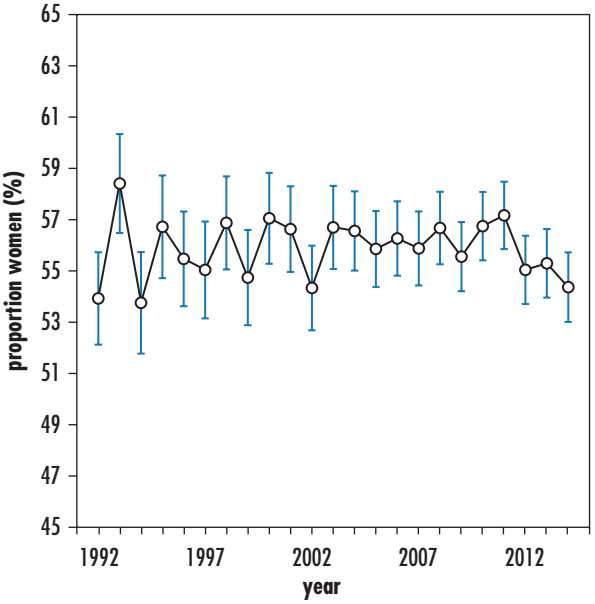


Figure 2c. Percentage of women who underwent surgery for hip arthroplasty (between 60 and 69 years).

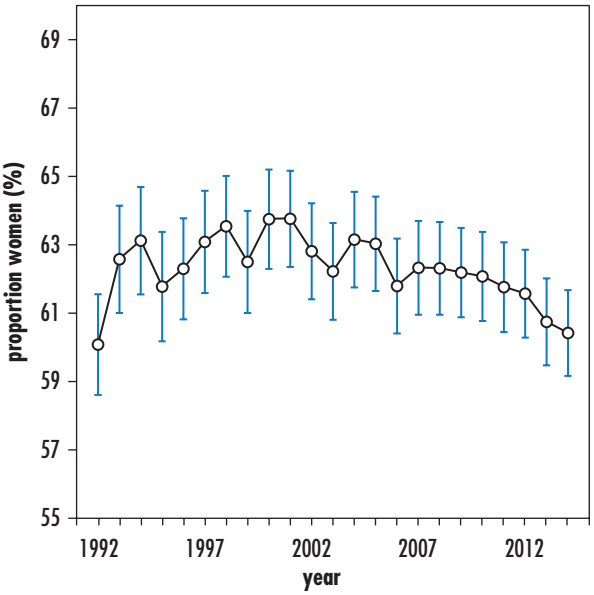


Figure 2d. Percentage of women who underwent surgery for hip arthroplasty (between 70 and 79 years).

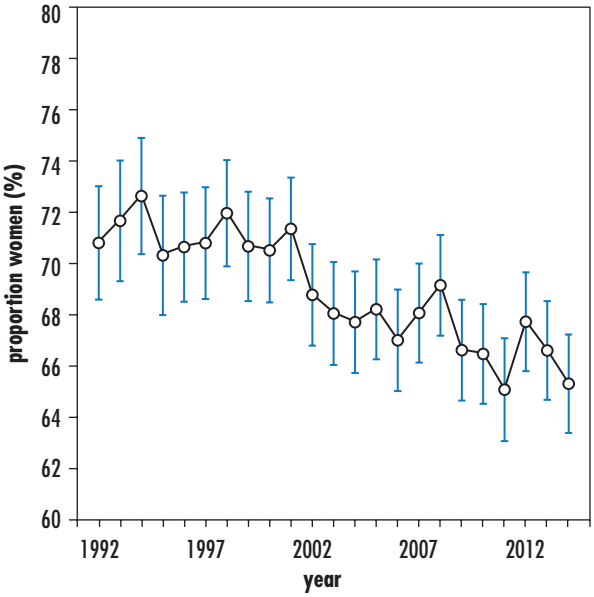


Figure 2e. Percentage of women who underwent surgery for hip arthroplasty (between 80 and 89 years).

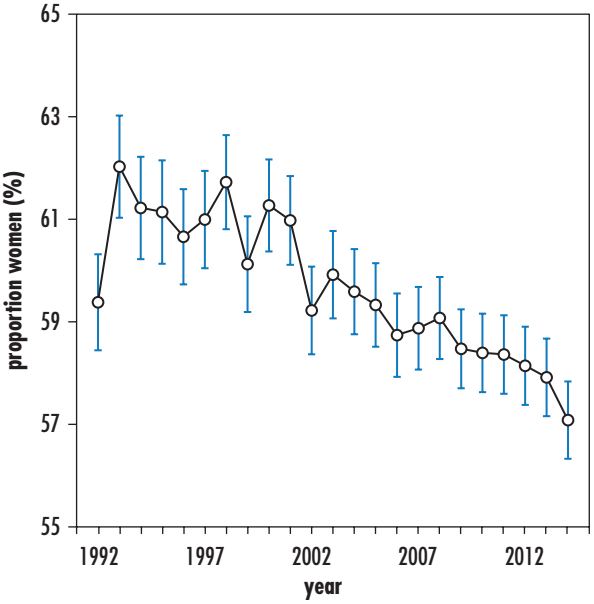


Figure 2f. Percentage of women who underwent surgery for hip arthroplasty (older than 90 years).

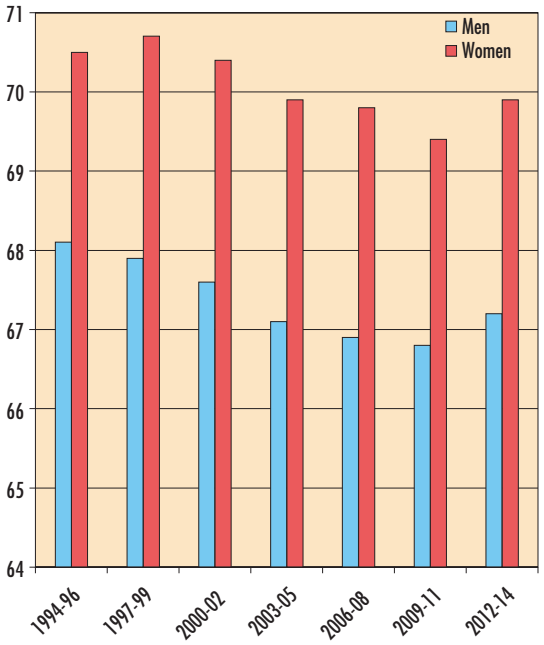


Figure 7. Mean age among men and women during 3-year periods 1994–1996 until 2012–2014. Y-axis starts at 65 years.

The mean age at surgery for men and women is described in Figure 7. Looking at the first three-year period 1994–1996 and comparing to periods until 2009–2011, the mean age decreases, for men from 68.1 years to 66.8 years and for women from 70.5 years to 69.4 years. However, it increases during the last three-year period 2012-2014, for men to 67.2 years and for women to 69.9 years. Whether this is a random variation or an effect from Artrosskola, is too early to tell.

Relatively speaking, the group under 55 is largest among men, while the group 75 years and older is largest among women (Figure 8). In the group younger than 55 years, there has previously been a relative increase in both sexes up to the last period 2012-2014, when a marginal decrease occurred (0.5% for men, 0.3% for women). The proportion of 55-64 years decreased more in the last period compared to the previous periods, for men 2.2% and women 2.5%. In groups of 65 and above, the last period has brought an increase. It may be a sign of the fact that non-operative treatment methods are tested on a larger scale and operation is postponed by a couple of years or just the fact that it is too early to comment on random variation.

The diagnosis distribution differs between men and women (Figure 9). Inflammatory arthritis has decreased steadily since the early 90s and now represent a small percentage. In the last three years, the proportion of men and women was 0.8% and 1.3%, respectively. Hip fracture and sequelae after childhood disorders are more common among women; primary osteoarthritis and femoral deah necrosis are more

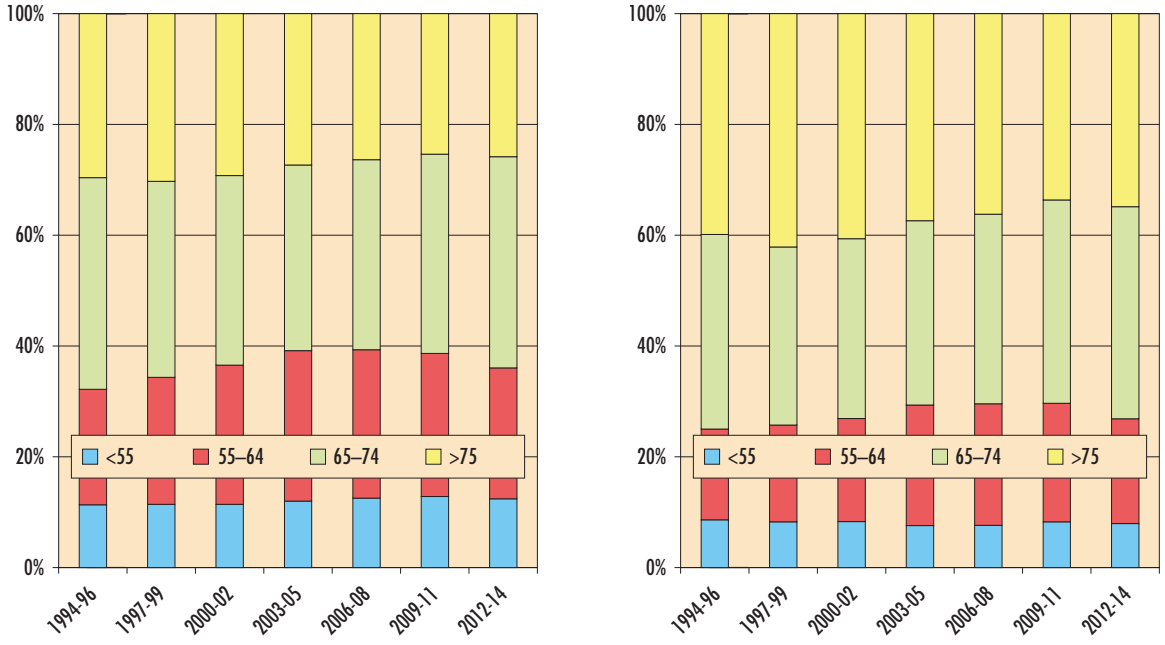


Figure 8. Distribution of male (left) and female (right) into four groups according to age for 3-year periods from 1994 to 2014.

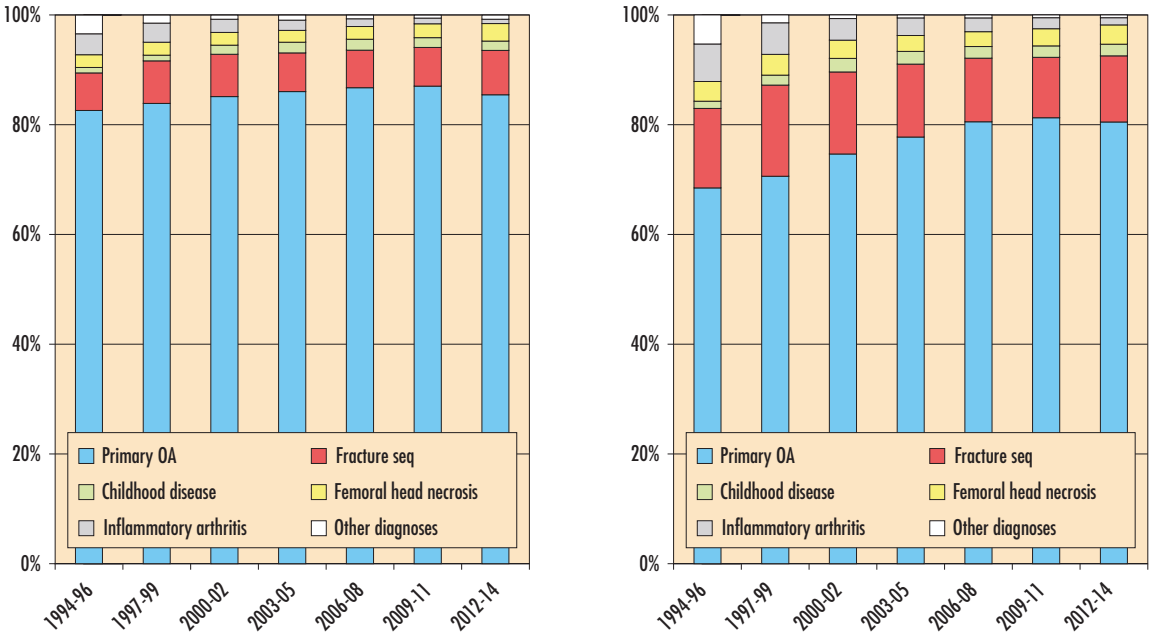


Figure 9. Distribution of diagnoses in men (left) and female (right).

common among men. However, in the last period, there is a trend towards increase of fracture diagnosis and decrease of osteoarthritis diagnosis among men. The decrease of fracture diagnoses during the first three-year period coincides with the increased use of hemiarthroplasty during the beginning of the century. However, during the last period, there has been a slight increase in the use of total hip replacement.

As previously, the most common surgical approaches are posterior in the side position and lateral approach. In recent years, direct lateral approach in the supine or side position are used most often on women, while the posterior approach is most often used on men (Figure 10). The difference is that 3% men have surgery with a posterior approach and 2.3% of women undergo surgery with a direct lateral approach. In the subgroup of primary osteoarthritis, the distribution is similar. Probably, the increased risk for dislocation among women plays a certain role in choosing the surgical approach, since the lateral approaches involve a smaller risk for this complication.

More often, women receive a cemented prosthesis and men an uncemented prosthesis (Figure 11). However, there is a small increase of uncemented prostheses compared with previous periods. The fact that women receive a cemented prosthesis more often than men may depend on the fact that the mean age at surgery is higher and that it is assumed that women's bone quality is somewhat worse. Resurfacing prostheses continue to decline. In 2012–2014, 0.9% (179) were inserted among men, but none among women.

Degree of morbidity is registered as ASA class (Figure 12). As before, men dominate in ASA I and women in ASA II. As a difference in comparison with 2011–2013, there are a little more men and women in ASA III. It may be assumed, that this is a coincidence or that we operate more on those who are more ill.

Compared to 2011–2013, there has been a slight change in BMI. There has been a shift mainly among men but to some extent among women, from the group of overweight (25.0–29.9) to obesity 1 (30.0–34.9). A small increase in obesity 2 (35.0–39.9). However, they are severely overweight, before there were not that many.

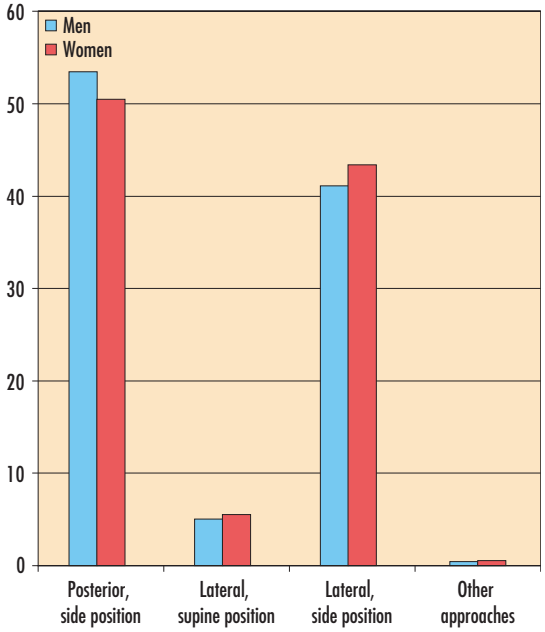


Figure 10. The percentage distribution of incision, men compared to women 2012-2014.

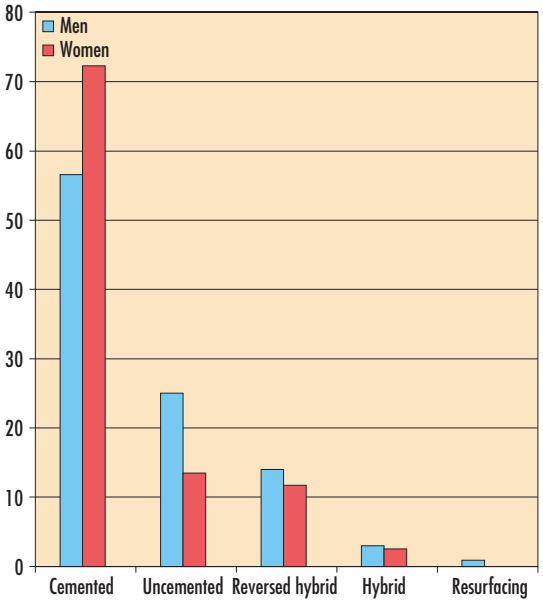


Figure 11. The percentage distribution of types of prostheses, men compared to women 2012-2014.

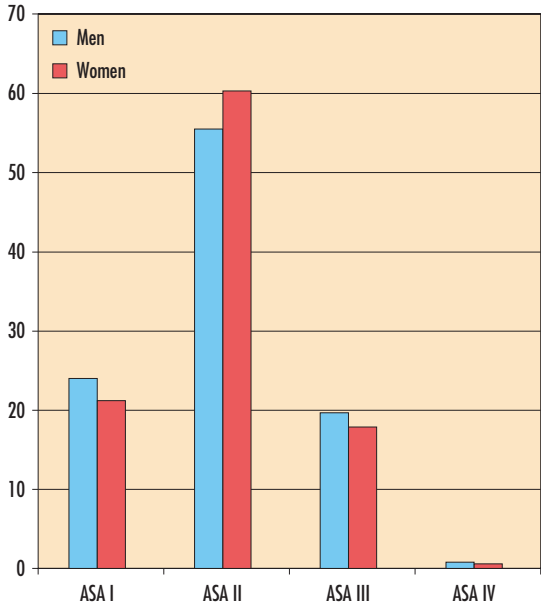


Figure 12. The percentage distribution of the ASA-class men compared with women, 2012-2014.

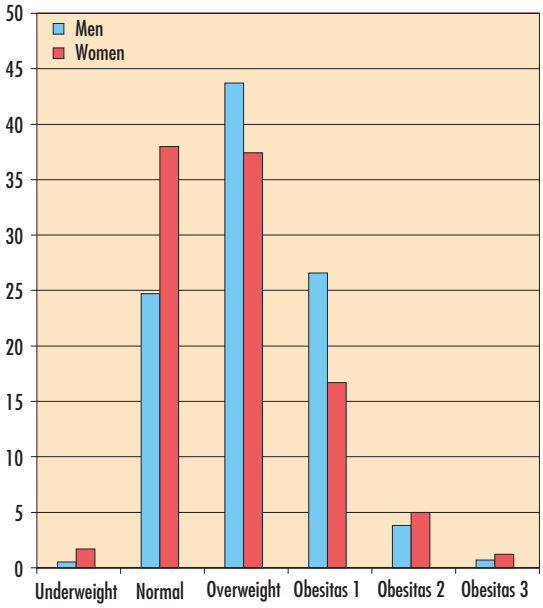


Figure 13. The percentage distribution of BMI, men compared to women 2012-2014. (During the period, BMI is defined as follow: <18.5, Normal 18.5–24.9, Over 25.0–29.9, Obes. 1 30.0–34.9, Obes. 2 35.0–39.9, Obes. 3 >40).

Gender – fracture patients

Previously, the proportion of men has increased in the group treated with hip replacement due to hip fracture. However, in 2014 the proportion was unchanged at 32%. The choice between a total and hemiarthroplasty exhibits no clear gender differences, nor does the choice of surgical approach. Men receive uncemented prosthesis stems somewhat more often than women. Women are overrepresented in the group of overweight according to the BMI values. Men have worse health status according to the ASA class; 61% of men have ASA class III or higher, compared with 51% of women. There are no great gender differences concerning dementia. The mean age continues to rise for both sexes. Women are slightly older, 82.1 years compared to 80.7 for men. Considering their burden of comorbidities, an equally high – or even higher – biological age may be attributed to men. Male gender is a risk factor for worse results in terms of increased reoperation risk. However, if the ASA class is adjusted for in analyses, this gender difference disappears, suggesting that precisely the biologically aged men are at risk of suffering from a hip fracture. This is reflected in the fact that the scientific literature suggests a higher mortality for men after hip fracture regardless of fracture type or choice of treatment. In the Register, 17% of the men died within 90 days as opposed to 10% of women.

It is uncommon for younger people to undergo hip arthroplasty due to hip fracture. Among those under 50, a secondary prostheses (inserted after a failed pinning or screwing of the fracture) is just as common as a primary prosthesis inserted in case of an acute fracture. In this group, there are also more men than women, 51%. With increasing age, the proportion of men is decreasing and constitutes only 27% of those over 85 years (Figure 14).

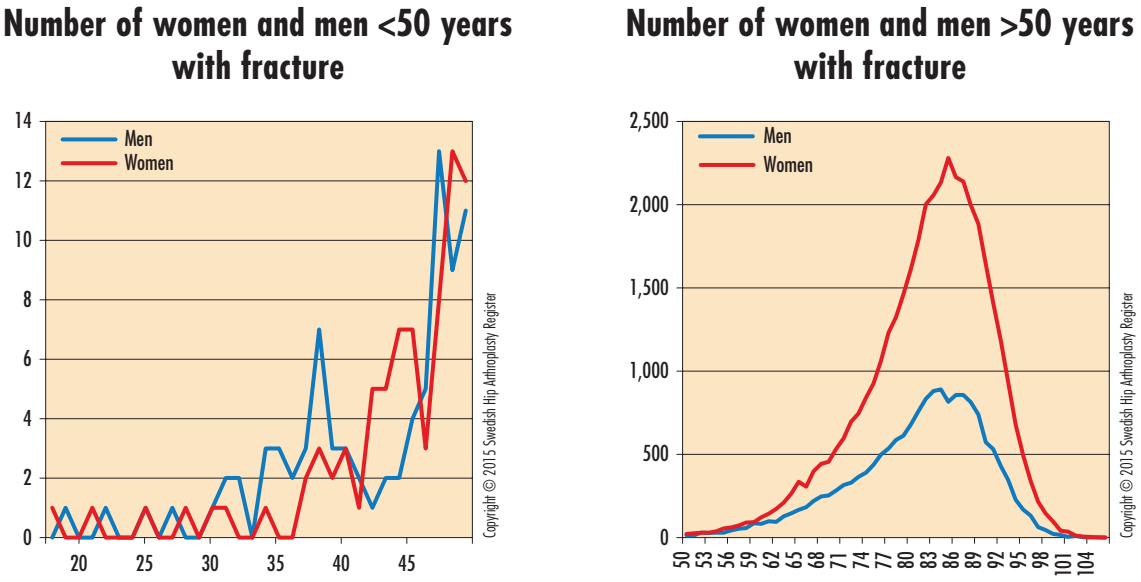


Figure 14. Number of women and men who had surgery hip arthroplasty because of hip fracture, broken down by age. Note the large difference in the y-axis graduation.

Equality in hip arthroplasty?

Procedure frequency and incidence in the country

The total output of total hip arthroplasties in 2014 in Sweden increased marginally in comparison to previous years (565, 2014 and 16,330, 2013). However, the incidence is largely unchanged: 170/100,000 inhabitants (169, 2013) and 328/100,000 over 40 years of age (327, 2013).

These figures are based on SCB's population statistics from December 31, 2014 (9,747,355 inhabitants). Note that many national and international comparative reports are based on statistics from the National Patient Board (PAR), which since 2000, has had a coverage of 3-6% less than the registry!

Production versus *consumption per 100,000 inhabitants per county*

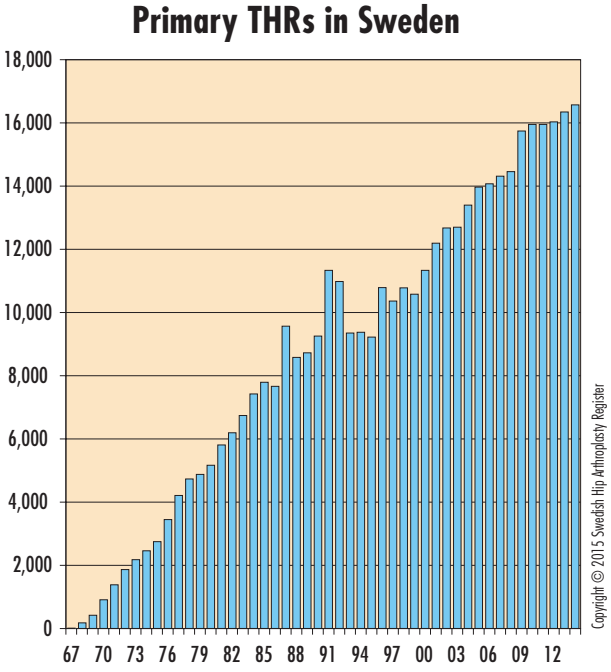
Decision-makers are primarily interested in the so-called consumption figures per county – while the professional and the quality registers (particularly the registers that control a surgical intervention) have focused on production figures.

Consumption means the residents of county councils/regions have access to hip arthroplasty regardless of the fact if the procedure is performed in the county council or elsewhere. These figures are important for the management and control but cannot be used for business analysis and clinical improvement, which is the quality registries mission.

The proliferation of both production and consumption figures per 100,000 inhabitants, shows a great variation between principal actors (the private contractors are geographically included); production: 143–244 and consumption: 124–245/100,000 inhabitants. The incidence is thus almost doubled between counties with the lowest to the counties/regions with the highest production and consumption.

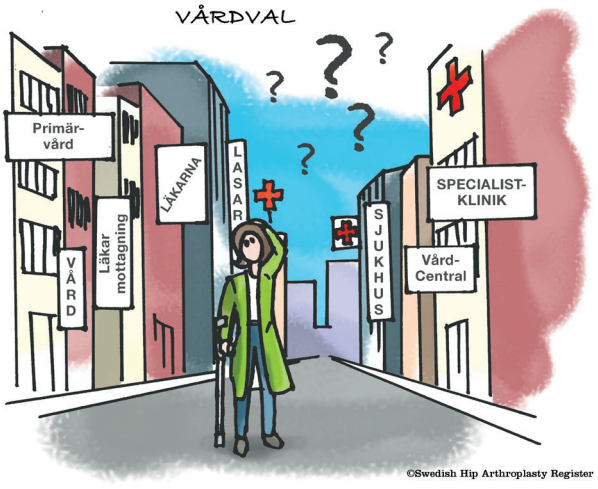
It is more sensible to compare the incidence per 100,000 inhabitants over 40 years of age, but in this analysis, the variation is equal: production: 298–462 and consumption: 259–434/100,000 inhabitants over 40.

The reason for this large variation cannot only depend on demographic and/or socio-economic differences. The present situation indicates that we have a geographically expressed unequal health care regarding treatment of the last stage of hip osteoarthritis in Sweden. Unfortunately, the register's management believes that non-medical and local "political" management decisions are one of the many causes to the large variation. Currently, the register has largely focused on the equality analysis – both in operational analyses and clinical research. The main tool for such analysis is the comprehensive crosscheck databases that we have already created and are planning to create (SHAR, SoS, SCB and FK). Such processes are slow because they require ethics review and are burdened by extensive resource consumption for the register (qualified personnel and high cost). Due to this, there is always a delay in relation to such analysis – often at least two to three years if the analysis is to include short-time results after elective operation for a total hip arthroplasty.



The number of primary total hip arthroplasties performed in Sweden in 1967 (6 operations) to 2014 (16,565 operations).

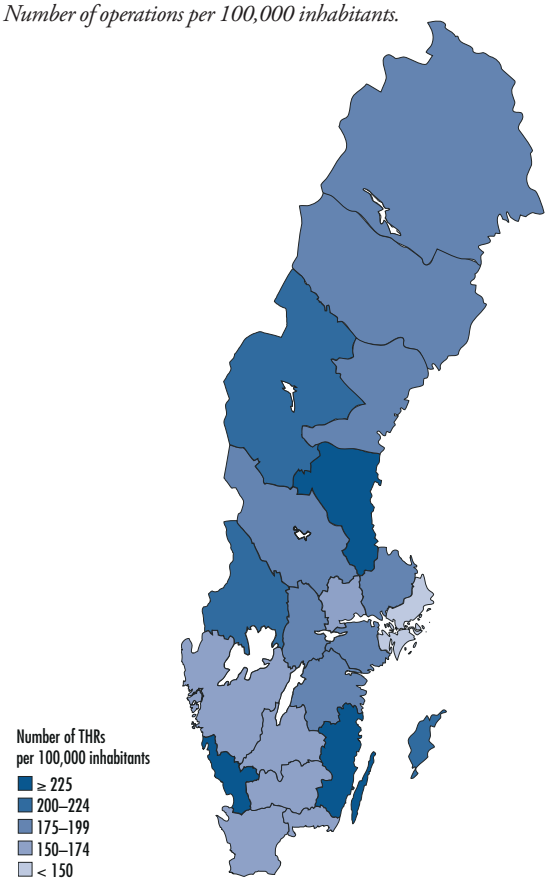
In the initiated analysis, we will have access to comorbidity, preoperative PROM and a variety of socio-economic variables at the individual level. With this data, we also have the possibility to analyse which patient groups use the national health care guarantee, and there is also an opportunity to make analysis on the individual level regarding equality in this part of the health care.



Production

County	Operations	Population	Number[1)]
01 Stockholm	3,136	2,198,044	143
03 Uppsala	628	348,942	180
04 Södermanland	516	280,666	184
05 Östergötland	846	442,105	191
06 Jönköping	553	344,262	161
07 Kronoberg	323	189,128	171
08 Kalmar	502	235,598	213
09 Gotland	120	57,255	210
10 Blekinge	268	154,157	174
12 Region skåne	1,999	1,288,908	155
13 Halland	779	310,665	251
14 Västra Götaland	2,500	1,632,012	153
17 Värmland	563	274,691	205
18 Örebro	515	288,150	179
19 Västmanland	436	261,703	167
20 Dalarna	532	278,903	191
21 Gävleborg	682	279,991	244
22 Västernorrland	410	243,061	169
23 Jämtland	261	126,765	206
24 Västerbotten	522	262,362	199
25 Norrbotten	474	249,987	190
Country		9,747,355	170

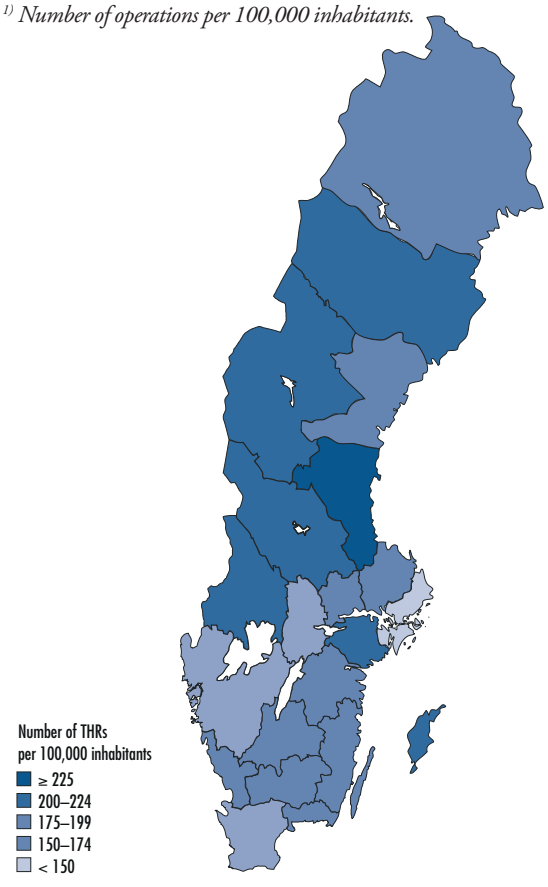
1) Number of operations per 100,000 inhabitants.



Consumption

County	Operations	Population	Number[1)]
01 Stockholm	2,721	2,198,044	124
03 Uppsala	629	348,942	180
04 Södermanland	599	280,666	213
05 Östergötland	799	442,105	181
06 Jönköping	621	344,262	180
07 Kronoberg	341	189,128	180
08 Kalmar	416	235,598	177
09 Gotland	123	57,255	215
10 Blekinge	271	154,157	176
12 Region skåne	1,975	1,288,908	153
13 Halland	598	310,665	192
14 Västra Götaland	2,557	1,632,012	157
17 Värmland	590	274,691	215
18 Örebro	502	288,150	174
19 Västmanland	514	261,703	196
20 Dalarna	599	278,903	215
21 Gävleborg	687	279,991	245
22 Västernorrland	456	243,061	188
23 Jämtland	271	126,765	214
24 Västerbotten	532	262,362	203
25 Norrbotten	465	249,987	186
Country		9,747,355	170

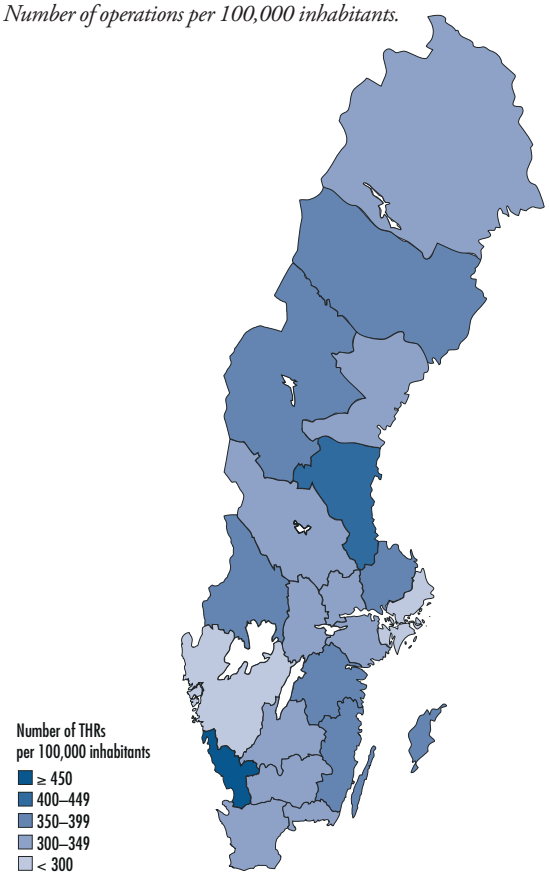
1) Number of operations per 100,000 inhabitants.



Production 40 years and older

County	Operations	Population, 40 years and older	Number[1)]
01 Stockholm	3,101	1,039,733	298
03 Uppsala	618	170,552	362
04 Södermanland	514	151,621	339
05 Östergötland	837	226,206	370
06 Jönköping	549	179,099	307
07 Kronoberg	323	98,299	329
08 Kalmar	500	133,459	375
09 Gotland	118	33,197	355
10 Blekinge	263	85,060	309
12 Region skåne	1,968	649,907	303
13 Halland	768	166,287	462
14 Västra Götaland	2,475	826,641	299
17 Värmland	561	153,583	365
18 Örebro	513	150,803	340
19 Västmanland	431	139,645	309
20 Dalarna	530	156,282	339
21 Gävleborg	675	156,544	431
22 Västernorrland	409	136,099	301
23 Jämtland	257	70,140	366
24 Västerbotten	513	134,192	382
25 Norrbotten	470	139,707	336
Country		4,997,056	328

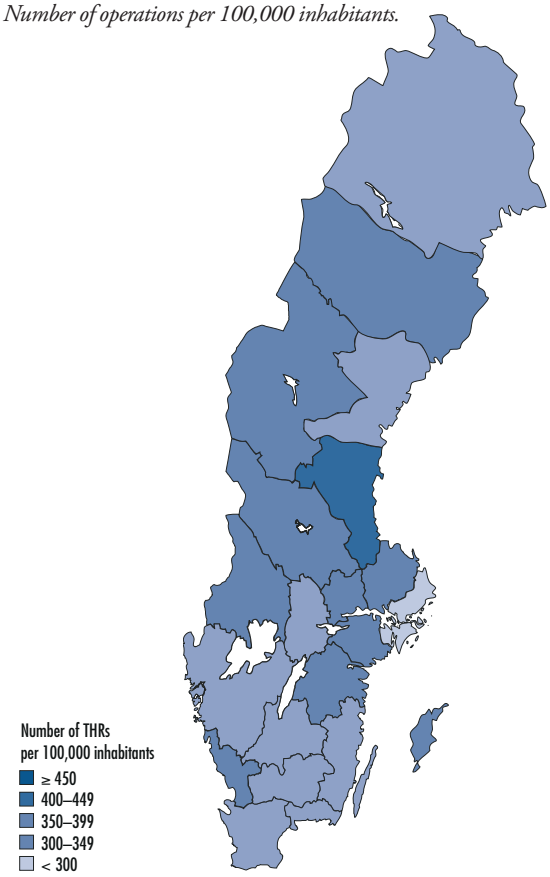
1) Number of operations per 100,000 inhabitants.



Consumption 40 years and older

County	Operations	Population, 40 years and older	Number[1)]
01 Stockholm	2,692	1,019,964	259
03 Uppsala	623	168,263	365
04 Södermanland	591	150,151	390
05 Östergötland	793	223,841	351
06 Jönköping	613	177,739	342
07 Kronoberg	339	97,536	345
08 Kalmar	414	132,725	310
09 Gotland	120	32,887	361
10 Blekinge	263	84,590	309
12 Region skåne	1,950	642,023	300
13 Halland	590	164,114	355
14 Västra Götaland	2,533	817,991	306
17 Värmland	587	153,098	382
18 Örebro	500	149,445	332
19 Västmanland	509	138,508	364
20 Dalarna	595	155,629	381
21 Gävleborg	679	155,812	434
22 Västernorrland	452	135,808	332
23 Jämtland	267	69,887	381
24 Västerbotten	525	133,444	391
25 Norrbotten	462	139,585	331
Country		4,997,056	328

1) Number of operations per 100,000 inhabitants.



Hip arthroplasty as fracture treatment

Fracture treatment with total or hemi arthroplasty

In 2014, slightly fewer patients underwent hip arthroplasty due to hip fracture. 5,835 surgeries were performed, compared to 6043 in 2013. Years before that, however, the number has stayed on a steady level of around 5,800. In terms of age groups, 1,126 patients are younger than 75, 2,422 between 75 and 85, and 2,287 over 85 years of age (Figure 1). Continuously, more and more patients, who have dementia, undergo operation, 37% in comparison to 28% in 2005. The chapter presents both total and hemi-arthroplasty performed due to acute fractures, and sequelae after previous hip fracture.

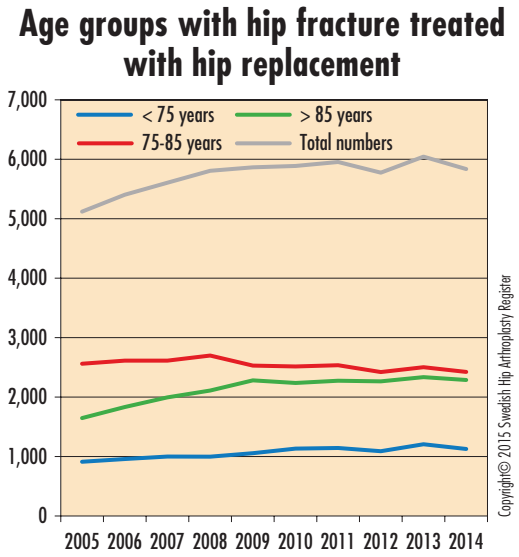


Figure 1

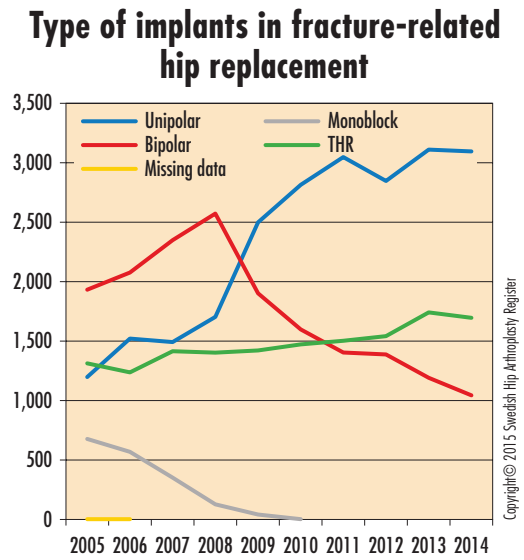


Figure 2

Implant selection and technique

The number of total hip arthroplasties, 1696 last year, and unipolar hemi-arthroplasties, 3095, seem to have found their level. The number of bipolar prosthesis has continued to decrease in comparison with 2013 (Figure 2). An interesting change can be seen regarding surgical approach. In 2014, the strong growth of direct lateral approach had been replaced by a decrease, while the number of posterior approacheshas stayed unchanged compared to 2014 (Figure 3).

In the choice of implant, the cemented Lubinus and Exeter stems dominate clearly, they are followed by Covision and MS30. The use of the previously relatively common CPT stem has virtually stopped during 2014. No monoblock prostheses were used in 2014. The proportion of uncemented stems has stayed unchanged around 3% with Corail as the most common cementless stem (Table on page 160).

In 2014, primarily unipolar prostheses heads, UHR Universal Head and Unitrax were used for hemiarthroplasties. As an acetabulum cup for total arthroplasty, Lubinus cup of polyethylene was used most often, although the number of cups has decreased in comparison to 2013 (table on page 160). The previous increase of the two cross-linked polyethylene cups Marathon and ZCA, have seen a decrease in usage in 2014, mostly regarding the latter cup. Among hemiarthroplasty cups, there is a continuous decrease in the usage of Vario Cup, Ultima Monk, Versys Endo and Tandem Unipolar. Covision unipolar head increases. Regarding the so-called dual mobility cup – see "Dislocation" below.

90-day mortality after fracture-related prosthesis

Mortality after a hip arthroplasty surgery due to hip fracture is considerably higher than after a planned operation due to, for example, osteoarthritis. Fracture patients must be dealt with urgently, regardless of their health condition, and they are

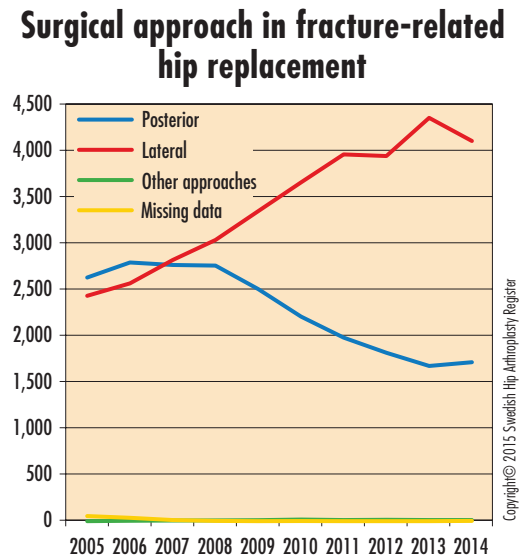


Figure 3

generally both more ill and older than osteoarthritis patients are. The year's national average fell marginally to 12.1 from 13.6% in 2012. The distribution has not changed significantly; it is between 4 and 18% among larger units. Mortality is influenced by which patients are selected for prosthetic surgery. If the sickest of patients receive osteosynthesis – in most cases, a worse alternative – mortality reduces. A number of factors that can increase the risk for early mortality are shown in the table on page 163: aged patients, male gender, infirmity and acute fracture operations (as compared to planned secondary prostheses). If the mortality rate at one's own clinic exceeds the expected rate for the risk profile in question, then the care pathway should be analysed in detail.

Reoperation and revision

Since 2005, 2,596 reoperations have been reported to the register, corresponding to reoperation frequency of 4.5%. 2,019 of these hips underwent a revision, that is, the replacement of at least one implant part. Table on page 161 lists the proportion of reoperations in six months at a participating unit as a quality indicator. For the country, the proportion is 2.8%, half of reoperations occur in this early stage after reoperation. Since 2005, the figures have varied between 2.7 and 3.9%. The report must be read with reservation. When a complication arises, perhaps the aging fracture patients are advised against further surgery for medical reasons, or decline themselves. There may also be unreported cases. The figures even mirror how offensive the individual units are at surgically treating complications. Finally, units with a small number of primary operations receive a skewed proportion, when individual patients are in need of reoperation. Nonetheless, we have chosen to present all units. A high frequency of reoperation should always prompt a local analysis and improvement work. If a reoperation is done at another hospital, it will be still be posted under the hospital that did the primary surgery.

A survival analysis shows that younger age groups have increased risk for reoperation of hip replacement compared to those over 85 years (Figure 4). Even those who receive a prosthesis after the pin or screw fixation fails (secondary prosthesis), have an increased risk (Figure 5). The same type of analysis for the surgical approach is more difficult to interpret. The first five years show the posterior approach increased reoperation risk, but then the difference is no longer significant. (Figure 6).

Risk factors for reoperation and specific complications

In Cox regression analysis, potential risk factors are weighed against each other: usually, the registers analyses include gender, age, diagnosis, type of prosthesis, surgical approach and stem. We can also adjust for the ASA class, BMI and (hemiarthroplasties only) dementia. Since this latter data is not available for all patients, the number of observations decreases. To gain a more accurate picture, it is essential to include more patient-specific factors. Nevertheless, there are unknown factors that affect the results, and the analysis therefore has its limitations. Generally, in the total patient population, male gender, young age, secondary prosthesis, uncemented stem and posterior approach increase the risk of reoperation. Total

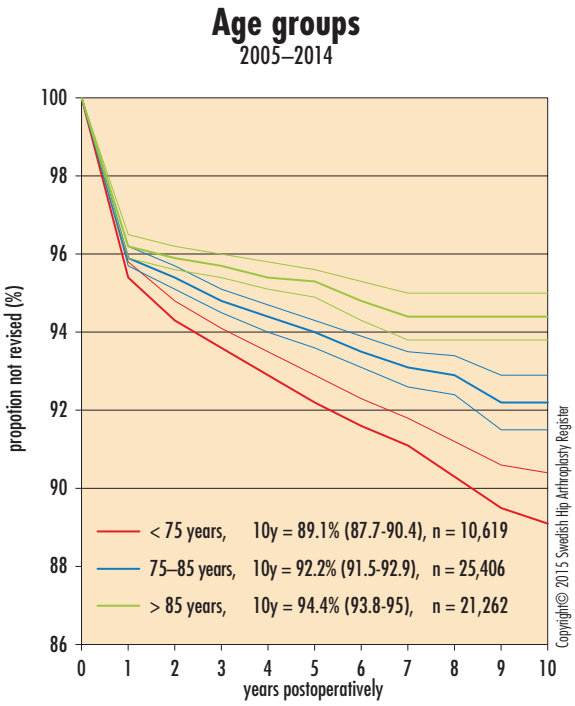


Figure 4

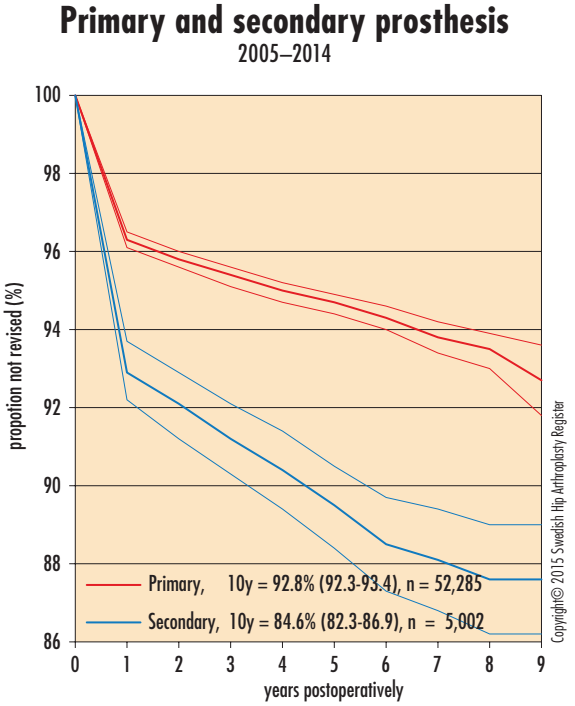


Figure 5

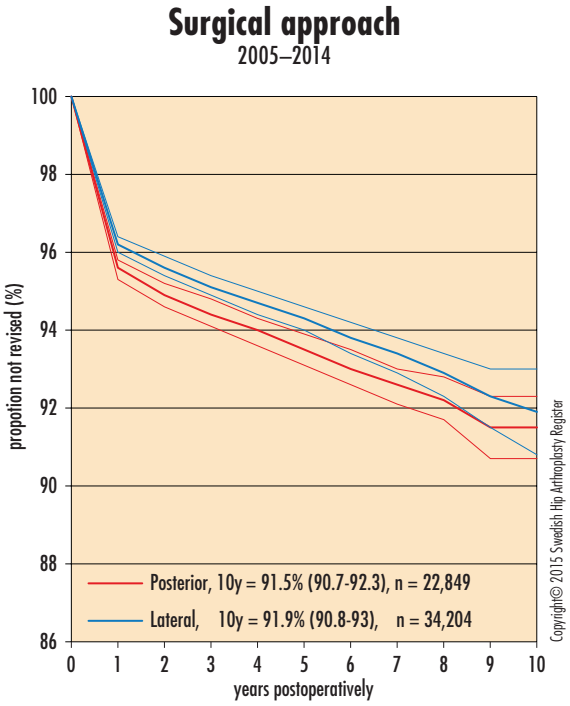


Figure 6

arthroplasty is associated with lower reoperation risk than hemiarthroplasty types. The result was changed by the division into age groups and with the addition of ASA class. For individuals under 75 years of age, uncemented stem is generally no longer associated with reoperation. For those between 75 and 85 years, the surgical approach loses its importance in this regard and for those over 85 years, there is no longer any difference between the total and hemiarthroplasty. The analyses depict the complexity behind the clinical outcome and the importance of the fact that treatment choices are made based on various patient groups' prerequisites.

Infection

Infection is the main cause for why the patient is forced to undergo open surgery again and constitutes 34% of reoperations (Table *Cause for reoperation*). Infection is more common in fracture patients than in those who undergo surgery for osteoarthritis. This may be explained by poorer nutritional status, more severe comorbidity and higher age in the fracture group, and thus increased risk of infection. On suspicion of deep periprosthetic infection, it is now common that with an acute soft tissue intervention, so including synovectomy, debridement, irrigation and tissue cultures, as to heal the infection with a more targeted treatment. This way, prosthesis does not need to be replaced. Several factors may influence the decision on such a surgery – how strong is the suspicion? Is patient's health compromised by a new operation? Who is responsible for the continuity of treatment – trauma orthopedic surgeons, arthroplasty orthopedic surgeon, infection specialist? What is the unit's tradition on how intensive the investigation and treatment of infection should be? A fracture patient with particular symptoms is likely to have a highly varying treatment at different units in the country. Consequently, the reoperation frequency varies between units, not only with the number of "true" infection cases, but also with these factors.

During the period 2005–2014, a total of 1,231 surgeries was performed because of infection among hemi-arthroplasty patients. 47% entailed only soft tissue intervention, 26% soft tissue intervention in combination with the replacement of prosthesis head and 12% resection arthroplasty. Exchange of the entire implant was uncommon. One in five patients undergoing reoperation have undergone three or more reoperations, which is a sign of how strongly a deep periprosthetic infection affects the individual – and, by extension health care. The PRISS project, with the aim of reducing the number of prosthesis-related infections in Sweden, in 2013 published recommendations for early detection of periprosthetic infection. Probably, there are a few fracture patients – in contrast to electively operated osteoarthritis patients – who receive a proposal for follow-up. PRISS recommends that "the patient is contacted actively by telephone or via return visits within 1-2 weeks of the operation" and that a return visit occurs about six weeks later. One can perhaps argue that fracture patients have more difficulty getting to the hospital for such control, and that it is more practical to allow municipal or primary health care take care of the patients. In this case, the orthopedic ward must share the knowledge about the importance of an early diagnosis, and ensure that follow-up takes place. A described above, in a Cox regression analysis, secondary prosthesis, male gender, younger age and morbidity (high ASA class) increase the risk of infection-related reoperation. Patients undergoing hemi-arthroplasty have a slightly higher risk of infection, which might reflect the degree of fragility due to which, the individual initially receives hemiarthroplasty, rather than differences between hemi- and total arthroplasty. When BMI is applied to the analysis, age loses its significance and overweight increases the risk.

Dislocation

Closed reduction of dislocation is not registered the following applies to open surgery for dislocation. Dislocation is almost as common a cause of reoperation as infection, and represents 33%. As with infection, we suspect a relatively large number of unrecorded procedures regarding the "true" number of dislocation in the fracture group. A single dislocation is treated with closed reduction and will not be known to the register. Usually, only recurrent dislocations leads to open surgery. The decision to operate or not is guided by the patient's health. It may be assumed that frail individuals are advised against futher surgery. Hip fracture patients have a higher risk ofdislocation than those treated due to osteoarthritis. It is believed that it depends on a free range of motion before the fracture (in contrast to osteoarthritis patients who become stiffer during the development of osteoarthritis) and that many patients with fracture cannot remain cautious during rehabilitation, due to dementia or abuse. It is therefore in the orthopedist's interest

to try to reduce the risk of dislocation. One method, which is based on both clinical studies and register data, is to use a direct lateral approach instead of a posterior approach. Since the beginning of 2005, the use of direct lateral approach has increased steadily until 2013, with a marginal decrease last year. It is interesting to follow how many patients underwent reoperation for dislocation in six months, in parallel with this increase in the use of the lateral approach. In 2006 it was 2.1%, 2013 0.6% and 2014 1.0%.

Another method to prevent dislocation is to use a special cup, referred to as dual mobility cup (DMC). In Sweden, the DMC has been introduced in recent years and has now increased to 294 in 2014. Because scientific studies covering fracture patients only demonstrated reduction of dislocation frequency with DMC in combination with a posterior approach, it is interesting to see that DMC is quite widely used with lateral approach (Figure 7). Oral communication with the relevant units shows that the combination is seen as double security measure in surgery of patients with elevated dislocation risk, for example in case of abuse or certain neurological illnesses. The scientific support for the DMC is limited, there are no analyses about cost-effectiveness of this more expensive prosthesis and its long-term results among fracture patients have not been mapped out.

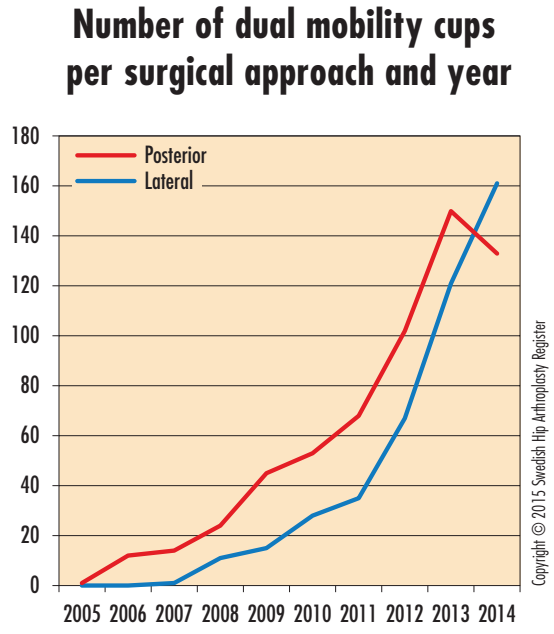
A Nordic registry study is in progress designed to identify the advantages and disadvantages of DMC among fracture patients. The register will use the study to give recommendations for its use.

In a Cox regression analysis, regarding dislocation-related reoperation, the posterior approach and secondary prosthesis represent the greatest increase of risk, then morbidity (high ASA class). Adding BMI does not affect this result.

Periprosthetic fracture

Periprosthetic fracture has increased in proportion and constitutes 19% of reoperations in 2014, in comparison with 17% in 2013. An ongoing validation work has identified non-reported reoperations for this reason. Even fracture surgery with only plates should be reported to the register so we could carry out accurate analyses. The validation has resulted in a number of reoperations registed retrospectively, which can influence future analyses. Fracture patients have two main causes for increased risk of periprosthetic fracture, in comparison to osteoarthritis patients, namely, osteoporosis and increased risk of falling. The choice of prosthesis stem becomes especially important in this group. Sweden has a uniquely low proportion of uncemented stems, which seems wise, since this stem type causes increased fracture risk. On the other hand, the cementing procedure presents a risk for circulatory disorder and death on the operating table. It is vital that the orthopedic surgeon and anesthetist prevent this risk as good as possible. Guidelines worth reading have been published in Britain (Anaesthesia. 2015;70(5):623–6).

An increased risk of fracture-related reoperation derives from uncemented stem, male gender, secondary prosthesis and morbidity. BMI of itself entails no increased risk, but when the BMI is included in the regression analysis, ASA class loses its significance.



Figur 7

Cause for reoperation
2005–2014

	Number	Proportion of all operations	Proportion of all reoperations
Dislocation	866	1.5	33.4
Infection	885	1.5	34.1
Periprosthetic fracture	501	0.9	19.3
Erosion and pain	141	0.2	5.4
Aseptic loosening	93	0.2	3.6
Other causes	108	0.2	4.2
Missing data	2	0	0.1
Total number of reoperations	2,596	4.5	100.0

Table 1

Erosion

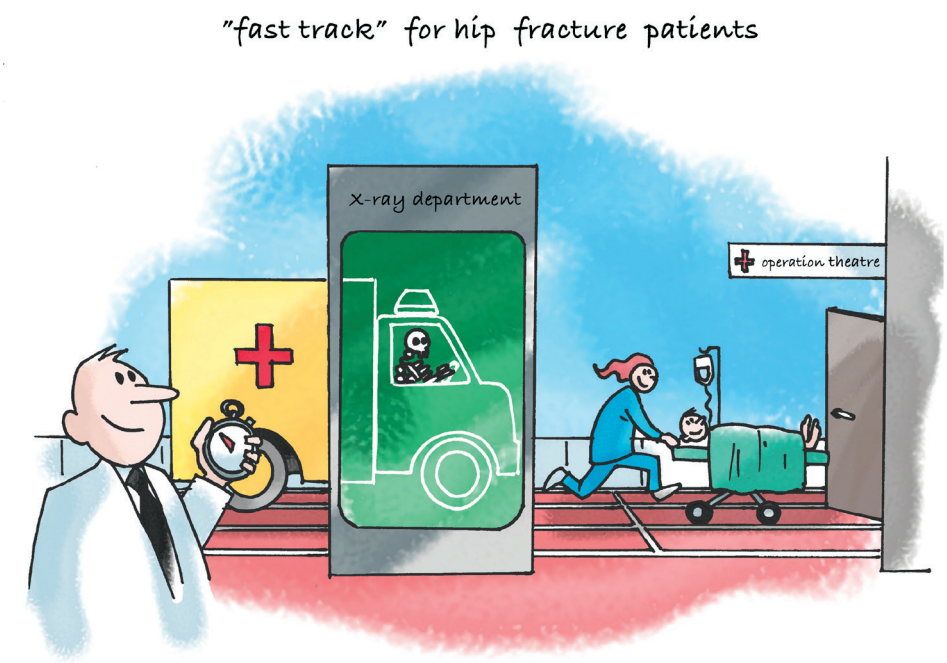
Acetabulum erosion (wear of the cartilage after insertion of hemi-arthroplasty), represent 5% of the reoperations. Erosion is a slowly progressive complication, which many patients are likely to adapt by being less active. Usually, erosion causes pain only when walking therefore we may suspect unknown cases here as well. Since it is difficult to distinguish manifested erosion from more obscure pain, both of these causes for reoperation have been grouped together in our analyses. When we analyse hemiarthroplasties with Cox regression, the unipolar head carries a very strong risk factor for reoperation due to erosion or pain. Also uncemented stem, healthy individual (low ASA class) and younger age are risk factors.

Clinical recommendations and future projects

As in previous reports, the register data shows that direct lateral approach and cemented prosthesis stem carry a lesser risk for reoperation, either generally or in any case, a risk reduction for specific complications. This year, the unipolar hemiarthroplasty head stands out as a strong risk factor for development of erosion, where younger and healthier patients also run an increased risk. The full clinical extent of erosion must be mapped in studies that include X-ray. One such study is planned. Comparisons between total and hemi-arthroplasty are complicated by the patient factors that form the basis for choosing concept to an individual. The decision is often made by considering the vitality and the probable length of the remaining life. A recent linkage study with several other national registers will lead to studies weighing in comorbidity and similar factors in the analysis. The fragility of the fracture patients becomes clear when comorbidity is a risk factor for infection, dislocation and periprosthetic fracture. It is very important to give special attention in treating the sickest patients – cemented stem, direct lateral approach and attention to infection problems. In this group, unipolar head should work well. In the group of healthier and more active patients, unipolar head should be avoided due to its risk for erosion and acetabulum. Total arthroplasty presents a lower risk of reoperation for patients younger than 85, based on register data.

Among fracture patients, direct lateral approach and uncemented stem usually present a reduced risk of reoperation.

Unipolar head increases the risk of reoperation caused by erosion/pain. This should be considered when selecting a prosthesis for active patients.



15 most common stem components – fracture patients

2005–2014

Stem	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total	Proportion
Lubinus SP II	2,153	2,246	2,657	2,797	2,673	2,598	2,651	2,610	2,693	2,886	25,964	45.3%
Exeter Polished	1,186	1,247	1,374	1,532	1,713	1,823	1,840	1,883	2,025	2,049	16,672	29.1%
CPT (CoCr)	244	252	270	318	390	374	424	409	383	10	3,074	5.4%
Covision straight	0	0	24	152	239	273	336	332	372	382	2,110	3.7%
MS30 Polished	3	8	163	243	219	228	236	293	315	320	2,028	3.5%
Spectron EF Primary	467	505	240	145	233	206	173	20	5	0	1,994	3.5%
Thompson	354	360	243	167	44	2	0	0	0	0	1,170	2.0%
Corail collarless	29	116	125	166	164	201	87	50	23	23	984	1.7%
Austin Moore (Anatomica)	316	214	77	22	27	2	0	0	1	0	659	1.2%
ETS Endo	97	101	127	47	0	0	0	0	0	0	372	0.6%
Corail Collared	0	0	0	0	0	44	93	62	92	77	368	0.6%
Müller Straight	114	99	71	33	0	0	1	0	0	0	318	0.6%
Basis	0	35	46	51	55	18	0	0	0	0	205	0.4%
Bi-Metric Fracture Stem	46	64	43	23	3	0	0	0	0	0	179	0.3%
CLS Spotorno	13	23	43	24	12	6	8	10	8	3	150	0.3%
Others	97	133	102	85	92	111	104	105	126	85	1,040	1.8%
Total	5,119	5,403	5,605	5,805	5,864	5,886	5,953	5,774	6,043	5,835	57,287	100%

15 most common cup or head components – fracture patients

2005–2014

Cup/Bi-/Unipolar caput	Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total	Proportion
Unipolar head	Large head	458	643	667	701	1,168	1,382	1,532	1,406	1,552	1,742	11,251	19.6%
Vario Cup	Large head	991	1,034	1,294	1,349	777	530	363	356	185	128	7,007	12.2%
UHR Universal Head	Large head	593	575	624	696	670	671	625	641	666	742	6,503	11.4%
Lubinus all-poly	Cup	614	554	639	630	593	585	561	508	430	349	5,463	9.5%
V40 Uni polar	Large head	272	322	374	491	715	766	431	282	366	341	4,360	7.6%
Ultima Monk	Large head	311	432	381	422	319	276	268	254	213	27	2,903	5.1%
Unitrax	Large head	0	0	0	0	2	0	416	573	561	519	2,071	3.6%
Marathon XLPE	Cup	0	0	0	9	123	279	307	321	356	294	1,689	2.9%
Covision unipolar head for sleeve	Large head	0	0	7	33	152	161	232	283	369	393	1,630	2.8%
Tandem Unipolar	Large head	334	438	221	142	161	130	91	2	5	0	1,524	2.7%
ZCA XLPE	Cup	0	9	131	190	225	219	183	163	161	61	1,342	2.3%
Charnley Elite	Cup	197	223	227	231	118	47	20	6	1	1	1,071	1.9%
Versys endo	Large head	5	5	61	105	122	157	155	148	160	3	921	1.6%
Unipolar head	Large head	94	56	119	103	92	93	68	86	90	96	897	1.6%
Monoblock	Large head	677	568	351	127	41	2	0	0	1	0	1,767	3.1%
Others		573	544	509	576	586	588	701	745	927	1,139	6,888	12.0%
Total		5,119	5,403	5,605	5,805	5,864	5,886	5,953	5,774	6,043	5,835	57,287	100%

Reoperation within 6 months per hospital – fracture patients
2013–2014

Hospital	Number of primary operations[1)]	Number of reoperations[2)]	Proportion[3)]
University/Regional hospitals			
Karolinska/Huddinge	260	5	1.9%
Karolinska/Solna	145	4	2.8%
Linköping	194	6	3.1%
SU/Mölndal	833	9	1.1%
SU/Sahlgrenska	12	1	8.3%
SUS/Lund	403	14	3.5%
SUS/Malmö	446	13	2.9%
Umeå	188	6	3.2%
Uppsala	398	11	2.8%
Örebro	180	10	5.6%
Central hospitals			
Borås	279	9	3.2%
Danderyd	417	16	3.8%
Eksjö	127	3	2.4%
Eskilstuna	217	7	3.2%
Falun	263	11	4.2%
Gävle	309	8	2.6%
Halmstad	192	2	1.0%
Helsingborg	372	13	3.5%
Hässleholm-Kristianstad	384	5	1.3%
Jönköping	160	3	1.9%
Kalmar	162	4	2.5%
Karlskrona	233	3	1.3%
Karlstad	288	12	4.2%
Norrköping	194	4	2.1%
Skövde	217	6	2.8%
Sunderby (incl. Boden)	337	5	1.5%
Sundsvall	204	7	3.4%
Södersjukhuset	713	30	4.2%
Uddevalla	432	6	1.4%
Varberg	188	4	2.1%
Västerås	328	14	4.3%
Växjö	147	7	4.8%
Ystad	20	1	5.0%
Östersund	198	8	4.0%

(Continued on next page.)

Reoperation within 6 months per hospital – fracture patients (cont.)
2013–2014

Hospital	Number of primary operations[1)]	Number of reoperations[2)]	Proportion[3)]
Rural hospitals			
Alingsås	81	3	3.7%
Arvika	13	0	0%
Frölunda Specialistsjukhus	1	0	–
Gällivare	109	2	1.8%
Hudiksvall	162	4	2.5%
Karlshamn	5	0	–
Karlskoga	89	2	2.2%
Katrineholm	1	0	–
Kungälv	179	4	2.2%
Lidköping	110	1	0.9%
Lindesberg	68	0	0%
Ljungby	85	1	1.2%
Lycksele	41	0	0%
Mora	133	3	2.3%
Norrtälje	74	2	2.7%
Nyköping	75	3	4.0%
Piteå	2	0	–
Skellefteå	97	1	1.0%
Sollefteå	80	2	2.5%
Södertälje	82	5	6.1%
Torsby	78	3	3.8%
Trelleborg	3	0	–
Visby	65	2	3.1%
Värnamo	74	0	0%
Västervik	108	4	3.7%
Örnsköldsvik	90	3	3.3%
Private hospitals			
Aleris Specialistvård Motala	84	1	1.2%
Capio S:t Göran	443	14	3.2%
Carlanderska	2	0	–
Ortho Center Stockholm	3	0	–
Spenshult	1	1	–
Country	11,878	328	2.8%

Red marking denotes values one standard deviation above national average.

[1)] Refers to the number of primary arthroplasties during the period.
[2)] Refers to the number of reoperations within 6 months among 1).
[3)] Refers to the quotient between 1) and 2) in percentage.

90-day mortality per hospital – fracture patients

proportion deceased within 90 days after primary surgery, 2013–2014

Hospital	Number[1]	>80[2]	Males[3]	ASA=III[4]	ASA=IV[5]	Fracture	Op within 24 h[6]	Mortality[7]
University/Regional hospitals								
Karolinska/Huddinge	260	64%	37%	64%	8%	93%	74%	14%
Karolinska/Solna	145	56%	31%	61%	14%	88%	0%	17%
Linköping	194	67%	29%	44%	7%	94%	78%	11%
SU/Mölndal	833	64%	33%	46%	4%	94%	50%	13%
SU/Sahlgrenska	12	42%	50%	64%	9%	92%	0%	42%
SUS/Lund	403	57%	29%	63%	5%	92%	76%	7%
SUS/Malmö	446	69%	29%	78%	4%	98%	73%	15%
Umeå	188	60%	37%	64%	5%	93%	0%	14%
Uppsala	398	57%	34%	61%	4%	95%	48%	9%
Örebro	180	65%	25%	47%	3%	88%	56%	12%
Central hospitals								
Borås	279	72%	33%	44%	3%	97%	74%	11%
Danderyd	417	60%	29%	71%	6%	89%	71%	8%
Eksjö	127	72%	37%	53%	0%	97%	66%	18%
Eskilstuna	217	59%	36%	47%	5%	90%	50%	15%
Falun	263	59%	29%	40%	5%	90%	63%	6%
Gävle	309	61%	32%	45%	8%	95%	55%	13%
Halmstad	192	66%	31%	43%	3%	93%	61%	18%
Helsingborg	372	64%	33%	45%	3%	95%	63%	15%
Hässleholm-Kristianstad	384	62%	32%	43%	4%	96%	79%	13%
Jönköping	160	66%	31%	53%	8%	97%	66%	14%
Kalmar	162	57%	35%	36%	3%	94%	70%	7%
Karlskrona	233	61%	30%	38%	3%	97%	54%	15%
Karlstad	288	64%	35%	52%	6%	97%	63%	15%
Norrköping	194	63%	34%	45%	5%	90%	59%	11%
Skövde	217	60%	31%	35%	5%	93%	60%	14%
Sunderby (incl. Boden)	337	61%	34%	62%	8%	96%	67%	16%
Sundsvall	204	58%	36%	45%	5%	96%	0%	14%
Södersjukhuset	713	63%	34%	64%	8%	92%	77%	12%
Uddevalla	432	63%	38%	52%	5%	95%	64%	10%
Varberg	188	65%	30%	35%	1%	91%	72%	13%
Västerås	328	59%	31%	64%	5%	93%	62%	12%
Växjö	147	62%	33%	48%	7%	92%	74%	8%
Ystad	20	75%	30%	45%	0%	100%	0%	15%
Östersund	198	63%	31%	49%	6%	93%	62%	13%

(Continued on next page.)

90-day mortality per hospital – fracture patients (cont.)

proportion deceased within 90 days after primary surgery, 2013–2014

Hospital	Number[1)]	>80[2)]	Males[3)]	ASA=III[4)]	ASA=IV[5)]	Fracture	Op within 24 h[6)]	Mortality[7)]
Rural hospitals								
Alingsås	81	58%	37%	40%	5%	93%	84%	15%
Arvika	13	62%	31%	46%	0%	92%	83%	23%
Frölunda Specialistsjukhus	1	0%	0%	0%	0%	100%	0%	0%
Gällivare	109	52%	30%	47%	10%	97%	56%	12%
Hudiksvall	162	56%	40%	38%	8%	92%	72%	13%
Karlshamn	5	20%	40%	60%	0%	0%	0%	0%
Karlskoga	89	61%	22%	48%	2%	88%	76%	15%
Katrineholm	1	0%	0%	0%	0%	0%	0%	0%
Kungälv	179	60%	40%	48%	6%	97%	67%	12%
Lidköping	110	69%	33%	39%	0%	95%	78%	9%
Lindesberg	68	68%	32%	49%	9%	99%	64%	13%
Ljungby	85	62%	33%	54%	0%	84%	74%	14%
Lycksele	41	54%	32%	51%	0%	95%	0%	10%
Mora	133	60%	32%	31%	3%	91%	88%	17%
Norrtälje	74	57%	27%	73%	4%	89%	77%	11%
Nyköping	75	61%	36%	47%	4%	95%	63%	11%
Piteå	2	50%	0%	50%	0%	0%	0%	0%
Skellefteå	97	64%	22%	49%	3%	93%	86%	8%
Sollefteå	80	56%	38%	43%	3%	95%	0%	14%
Södertälje	82	55%	32%	73%	9%	94%	78%	9%
Torsby	78	56%	29%	58%	8%	94%	88%	18%
Trelleborg	3	0%	67%	33%	0%	0%	0%	0%
Visby	65	60%	26%	42%	2%	92%	79%	15%
Värnamo	74	77%	24%	31%	4%	95%	59%	4%
Västervik	108	68%	27%	35%	4%	94%	82%	15%
Örnsköldsvik	90	58%	32%	53%	5%	92%	0%	16%
Private hospitals								
Aleris Specialistvård Motala	84	70%	30%	61%	0%	93%	50%	13%
Capio S:t Göran	443	69%	29%	62%	6%	93%	71%	12%
Carlanderska	2	50%	0%	0%	0%	50%	0%	0%
Ortho Center Stockholm	3	33%	67%	0%	0%	0%	0%	0%
Spenshult	1	0%	0%	0%	0%	0%	0%	0%
Country	11,878	62%	32%	52%	5%	93%	65%	12%

[1)] Refers to the number of primary operations during the period.
[2)] Refers to the number of operations on patients in age group above 80 years.
[3)] Refers to proportion of males during the period.
[4)] Proportion of patients with ASA class III.
[5)] Proportion patients with ASA class IV.
[6)] Refers to patiens operated within 24 hours (from Rikshöft).
[7)] 90-day mortality (100(number of patients deceased within three months after primary THR /number of operations during the period)).*

Follow-up activities after hip arthroplasty as fracture treatment

The value compasses, which display results for the clinics, comprise of total and hemiarthroplasties. This year, the compass contains five variables, "Adverse events" as a new addition. To avoid general complication, it is essential for these fragile patients, which is why we consider this variable valuable. Additionally, the fracture compasses is limited by the fact that many of the fracture patients are not included in the registers PROMs programme.

The objective with this account is for each hospital to be able to compare with the national average value and identify any problem zones that could lead to local improvement projects. The results must be seen in a context of many factors. The value compass can be seen as a balanced scorecard. The larger the field the better multidimensional total results achieved by each respective clinic.

We have chosen slightly different outcome variables for fracture-related prostheses compared with elective total hip arthroplasties. Observation times for reoperation and implant survival are shorter because individuals with hip fractures have a shorter remaining lifespan due to old age and disease. Most reoperations occur within a few months and long-term complications are unusual.

- **Coverage.** Coverage (completeness) at the individual level according to the most recent cross-referencing with the Patient Register.
- **Adverse events in 90 days.** Adverse events according to the latest the linkage with the National Patient Register. These are defined as cardio- and cerebrovascular events, thromboembolic disease, pneumonia and ulcers if these have led to readmission or death. Also included are all types of reoperation of the hip.
- **90-day mortality.** In international literature, this variable is used to cast light on mortality after hip arthroplasty.
- **Reoperation within 6 months.** Specifies all forms of reoperation within 6 months after primary operation.
- **1-year prosthetic survival.** Prosthetic survival after 1 year using Kaplan-Meier statistics.

The selection of fracture patients subject to hip arthroplasty (instead of osteosynthesis) may appear different at different hospitals and each clinic's "case-mix" must be read parallel to its value compass. The picture of the "case-mix" is constructed in the same way as the value compass and includes the variables that have been shown as decisive demographic parameters for risk of reoperation, and to some extent mortality. The larger the field in this figure the better the patient profile for the clinic in question.

- **The proportion of patients aged 85 or older.** Higher age protects against reoperation and revision. The reasons may be many: for example, reduced activity decreases the risk of erosion and probably even of dislocation. Short remaining length of life means that loosening does not have time to develop. On the other hand, the "risk decrease" seen may be caused by the elderly individual being affected by complications despite all, but being advised against reoperation or revision for medical reasons. Clinics that operate many patients over 85 get better results with respect to reoperation/revision, but poorer results with respect to mortality.
- **The proportion of acute fractures** (diagnosis S72.0). The more patients with the diagnosis acute fracture to be operated by the clinic the better the long-term results tend to be according to the Register's regression analysis of the database.
- **The proportion of non-dement patients.** The figure shows the clinic's proportion of patients assessed as cognitively intact. Dement patients have higher mortality after hip fracture. If a clinic has a large proportion of non-dement patients, their mortality figures improve.
- **The proportion of women.** Women generally have better results than men with respect to the need for reoperation/revision, mainly depending on the lower risk for fracture near the prosthesis.

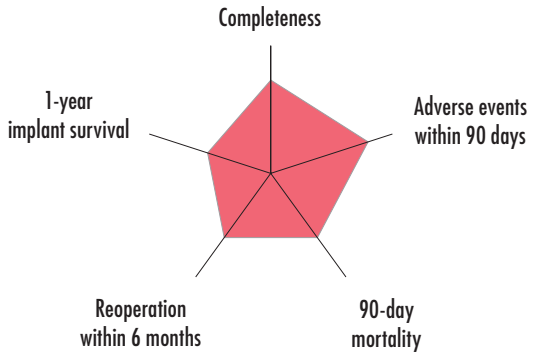
Discussion

An inferior result in the clinic's value compass should lead to a local analysis of the various factors influencing the clinical results as well as the implementation of quality improvement. The Register are ready to pass on experience acquired after corresponding analyses at other hospitals, and is prepared to assist with practical help. Some examples are also described under the heading "Registry-based improvement work and research". Compared to last year's report, for example, Hudiksvall, Jönköping, and Lindesberg have considerably improved their value compass. The units explain this with new implants and stringent infection prevention.

Since individuals with hip fracture most often have poorer health and are much older compared to osteoarthritis patients operated with total prostheses, it is possible that non-surgical treatment of complications is more common for fracture patients. Both infections and dislocations can in certain situations be treated to relieve symptoms without surgery, for example if a new operation would be linked to considerable medical risks. In that case, a non-operative treatment might be more suitable, and on assessment of the value compasses, these circumstances should be taken into account. On the other hand, a higher rate of reoperations and revisions might, on the other hand, indicate an active attitude in case of complications.

Quality indicator for hip fracture patients

Value compass – national average

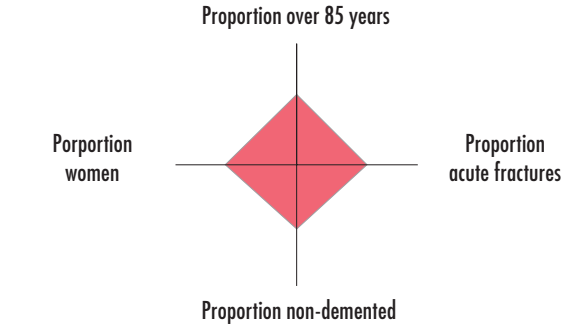


The value compasses show the national results of the five input variables in red. Each respective unit's corresponding value is shown in green. The value limit is set to the highest and lowest value ±1 SD of the variable in focus. The worst value for the variables was given as origo and the best value at the periphery.

The units with red fields have a poorer value than the national average for those particular variables. The outcome can be studied in detail in the respective tables.

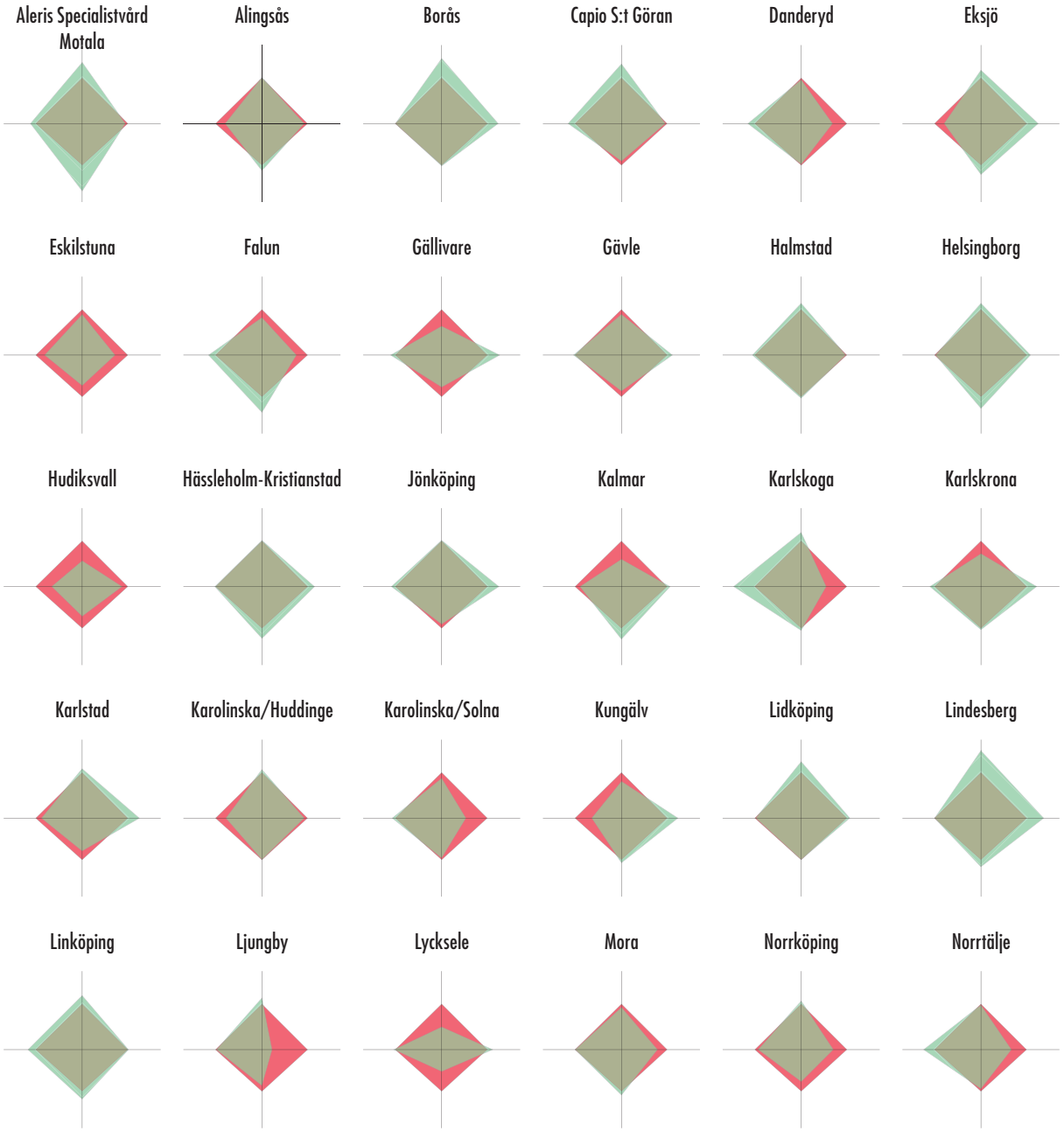
Case-mix profile for hip fracture patients

national average



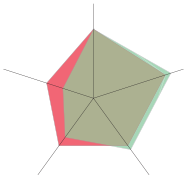
The graphic presentation of patient demography ("case-mix") shows the national results with regard to the four input variables in red. Each respective unit's corresponding value is shown in green. The value limit is set to the highest and lowest value ±1 SD of the variable in focus. The worst value for the variables was assigned to the origo and the best value to the periphery.

When interpreting each clinic's value compass and, above all, when making comparisons, the "case-mix" profile must be always kept in mind!

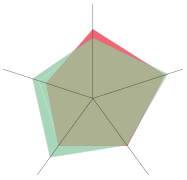


Value compasses (continued)

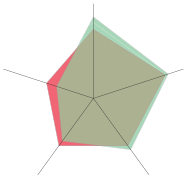
Nyköping



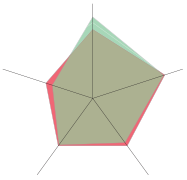
SU/Mölndal



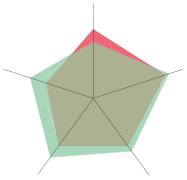
SUS/Lund



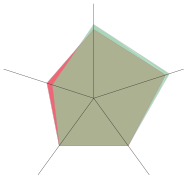
SUS/Malmö



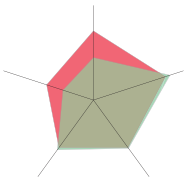
Skellefteå



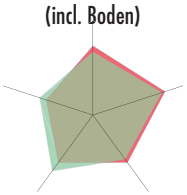
Skövde



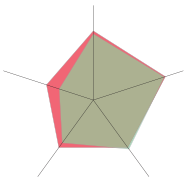
Sollefteå



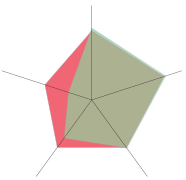
Sunderby (incl. Boden)



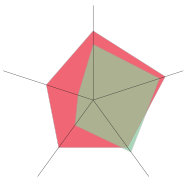
Sundsvall



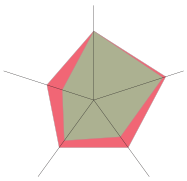
Södersjukhuset



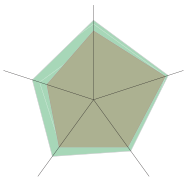
Södertälje



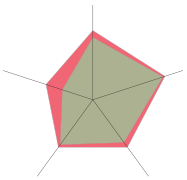
Torsby



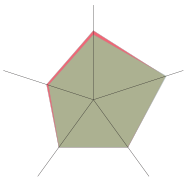
Uddevalla



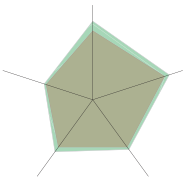
Umeå



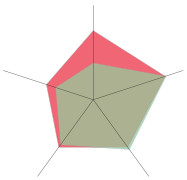
Uppsala



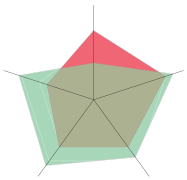
Varberg



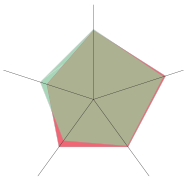
Visby



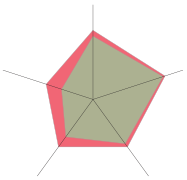
Värnamo



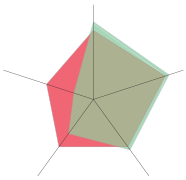
Västervik



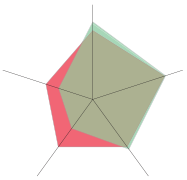
Västerås



Växjö



Örebro



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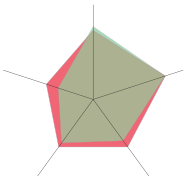

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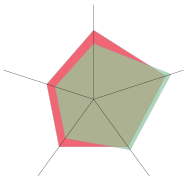
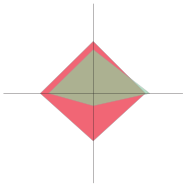


Case-mix profiles (continued)

Nyköping



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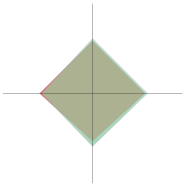
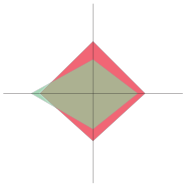
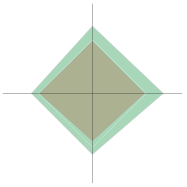


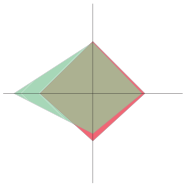
SUS/Lund



SUS/Malmö



Skellefteå



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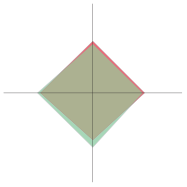

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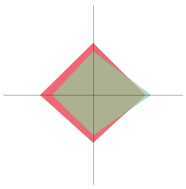
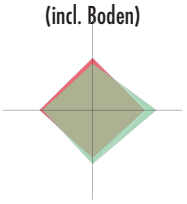


Sunderby (incl. Boden)



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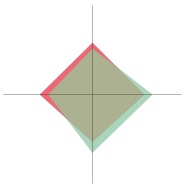

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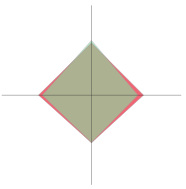

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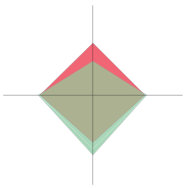
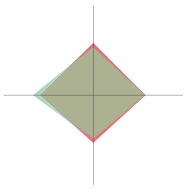
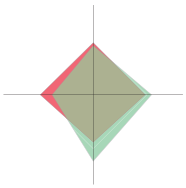


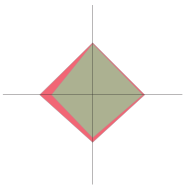
Torsby



Uddevalla



Umeå



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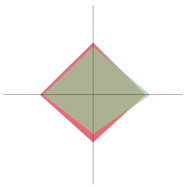
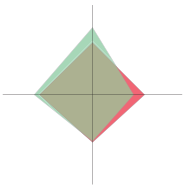


Varberg



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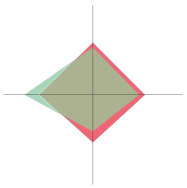

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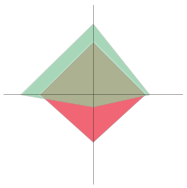

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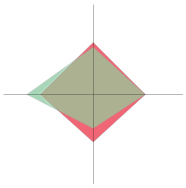
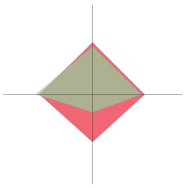


Västerås



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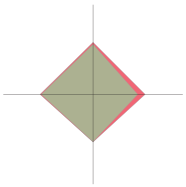

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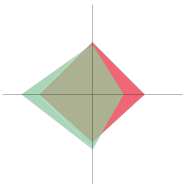

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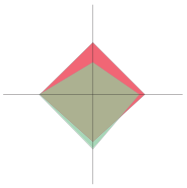
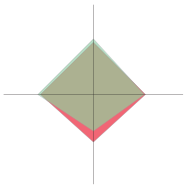


Östersund



Register-based improvement work and research

Local improvement work based on register data – Example from Capio

In Sweden, Capio has three clinics operating in hip replacement surgery, Capio St Göran's Hospital, Capio Orthopedic house and Capio Movement, which together make more than 1000 hip replacement surgeries annually. In connection with the publication of the Swedish Hip Arthroplasty Register's Annual Report 2013, we initiated a major review of our short-term complications after hip replacement surgery, since we saw potential for improvement in this area. The purpose of the review was to identify the underlying causes of the complications and use the knowledge in the clinical improvement work. The quality indicator that we were primarily focused on was reoperation within two years.

Analysis of the current situation as a basis for improvement work

We started with a survey of the current situation where we studied our outcomes regarding short-term complications in SHAR's annual report, causes for reoperation, the results developed over time and how they relate to the national average. From the annual report, we could see if the cause of reoperation were infection, dislocation, loosening, or other cause. A large part of reoperations were included in the group "others". For a better understanding of the causes of reoperation we used the statistic from SHAR regarding all primary operations, which were carried out in our clinics in 2010–2013. From this, we could identify which patients suffered complications, which led to reoperation within two years. In all, we conducted medical record reviews and cause analysis. Thanks to the survey, we were able to identify a number of areas to focus on in the clinical improvement work, were the main focus differs between clinics in Capio:

- Reduce the incidence of infection after prosthetic surgery
- Reduce reoperations due to dislocation
- Ensure the high competence of surgeons

Quality plan with specific measures

When we had mapped the current situation and identified areas of improvement we asked ourselves what were the specific measures needed to achieve improvement. To share experiences and best practices among clinicians in Capio, we organized a clinic visit and a workshop where we looked at the entire patient flow from the evaluation visits to the surgery, post-op care and follow-up. We went through care processes and procedures at each step to identify good practice. We also made a study visit to Hässleholm Hospital and brought with us the knowledge gained from a previous visit to Hvidovre Hospital. Then, each clinic produced a local quality plan, which included improvement measures. The measures are measurable and time-specific, for each measure, there is a person who is responsible for the implementation.

Several changes have been made to raise the quality of care

A central part in reducing infection is closing and dressing of surgical wounds. Capio Orthopedic house has in recent years made a number of changes in its treatment guidelines with the intention to reduce infections, which we have seen in the positive developments in SHAR. Other clinics in Capio have now implemented several of the treatment guidelines into their operation. More specifically, it handles the matter of standardization of wound closure where we largely shift from staples to the intradermal suture and careful subcutaneous closure with continuous suture with barbed suture. We have also changed to a dressing material that can be left on during the wound's healing process. This has minimized the number of wound dressings after surgery, which we believe, reduces the risk of infection. In addition to these important measures, we have changed the dosage procedure for antibiotics in connection with operation. Furthermore, we have worked hard to catch infections early. At our clinics in Stockholm, all prosthesis patients come two to three times a week after the operation to check the wound, instead of going to the local health center. This is an approach we are considering introducing even at Capio Movement.

During causal analysis, it became evident that at one of our clinics, the proportion of reoperations for dislocation was above the national average. During medical record review, it became apparent that all those patients were operated with a posterior approach. According to the existing literature, it is likely that the posterior approach may lead to increased risk of dislocation. We have considered the possibility that all surgeons are to switch to the lateral approach, but we have agree to focus on ensuring the quality of the surgical technique for those surgeons who have become used to the posterior approach, since we see that there is a greater risk in getting quality defects at retraining and change surgical approach performance. In addition, posterior approach has proved to have a positive effect on the PROMs values. Quality control includes the improvement of the preoperative planning, focusing on cup placement and the use of increased offset stem, where it is appropriate. During operations in which the posterior approach is used, nowadays, elevated liner is used with uncemented cups.

There is a correlation between the number of operations per surgeon and results/complications, where high volume is positive. After the survey, we have implemented changes towards a greater specialization of surgeons, to have only high-volume surgeons in prosthetic surgery. To a greater extent than previously, we have also begun to operate in pairs to ensure the continuous development of knowledge. One task, which remains, is to see how we ensure the continued high quality when an experienced surgeon retires and is replaced by a younger specialist.

Alexandra Martinsson, Hjalmar Thorsteinsson, Björn Waldebäck, Tobias Wirén

Resident physician project regarding fracture patients

Two ongoing resident physician medical projects are based on register results for fracture patients. As for hemi-arthroplasty patients, Falun had a reoperation frequency above the national average for a number of years. The clinic wanted to analyse the cause and initiated a resident physician project for Martin Rasböl Andersen. When there are relatively many infection cases, Martin studies whether the operating room without laminar airflow increases the risk for infection in this patient group. Half of the hemi-arthroplasty operations during this period were performed in such rooms. Furthermore, it is studied whether there is an increased risk when unexperienced surgeons perform the intervention or during operations at call hours. The results are not yet clear.

In Alingsås, uncemented stems has been used for hemi-arthroplasty patients after the anesthesiologist noticed during the operation the risk of adverse effects regarding bone cementing. On the other hand, the orthopedic doctors feared an increase of hip-related complications and wanted to assess the results. Resident physician doctor Martina Einås is the one who carries out the project. With support from the Swedish Hip Arthroplasty Register, the design of the study has been discussed. As even non-surgical complications could be included, in the end, the study was based on review of medical journals, instead of register data. The study extended to a comparison with Kungälv, a clinic with similar size and organization, where cemented stem was the standard option. The results were presented at Swedish Orthopaedic Association's annual meeting 2015. The risk of periprosthetic fracture increased with the use of uncemented prosthesis on the cervical hip fracture. There was a trend toward increased death within 24 hours after inserting an uncemented prosthesis, but after two weeks, there was no difference.

The Swedish Hip Arthroplasty Register encourages clinics to perform local in-depth analysis work based on register results, to improve the quality of care and to give resident physicians and others the possibility to carry out clinically relevant studies. In addition to the formalized process, which applies for regular register research, the register also has a possibility to give advice and support regarding such project as described above.

Cecilia Rogmark

Improvement work at the orthopedic clinic in Gävle Hospital

In Gävle, we had a high dislocation frequency, which was unsatisfactory. From the 2010 Hip Arthroplasty Register's Annual Report we saw, that the frequency for reoperation in 2 years among patients, who have undergone a surgery for primary prosthesis, was unacceptably 5%. Admittedly, we were relatively liberal with the review and we did not allow the dislocation to repeat themselves more than three or four times, but this did not explain our high reoperation frequency.

Therefore, we started to analyse medical records and x-rays for all those patients who had been reoperated. We paid attention to the surgeon, surgical technique, implant type, primary diagnosis, morbidity, x-rays with pre- and postoperative leg length, offset, implant angles and the age and sex of the patients. All of the assembled data was presented openly and discussed among colleagues in the clinic. Many reoperations occurred after the failed fracture osteosynthesis where the dislocation risk is significantly higher. We noted that method details, such as careful preparation of the joint capsule and restoration of offset, could be improved. We also replaced the 28 mm head with a 32 mm. All in all, a 10-point list was created which includes obligatory preoperative molding and preoperative control of patients. Since we used femoral heads with non-cross-linked polyethylene, several surgeons chose to switch to ceramic heads, to thereby restrict the increasing polyethylene wear that an increase in size would entail.

Automatically, the joint work, statements and discussions led to the significantly increased attention to the problem and to the daily results. The result was a rapid reduction in the dislocation frequency.

When we later discussed the cross-linked polyethylene, we started to use a 36 mm head for many patients, since theoretically, it has a lower dislocation frequency. Because of the increase of the torsion stress, which the 36 mm head gives to fastening surfaces between head and the cone, we paid attention to the various designs of taper, and avoided the 36 mm head with prostheses with short taper.

We repeated the analysis after each new annual report and focused also on other causes of reoperation within 2 years. We noted then that the behind the cause "other", and to some extent "mechanical loosening", were the metal-metal articulations that we had previously used but already stopped using. Moreover, here was also hidden the use of new implants or new implants for surgeons, thus a learning curve which entailed poorer results. It is possible that even less successful implants were tested. The realization made us more restrictive in the use of new implants, or new implants for inexperienced surgeons.

Infection rate was not significantly bad, but in our ongoing efforts to minimize the number of infections, we paid more attention now on the number of particles in the operating room air. We acquired a "ventilated" instrument table and tried to make the doorway to the operation room tighter. We tightened the rules on hygiene and cleaning in wards and toilettes and we argue (so far, unsuccessfully), that our four-bed rooms must be scrapped. To get better control over suspected wound issues at an earlier stage, the revision and risk patients may come to the orthopedic clinic for suture removal.

Currently, we make an effort to improve patient satisfaction with the surgery and the experienced surgery result (PROM). Among other things, we should improve information distribution to patients, particularly before the operation by, among other things, creating realistic expectations, but also during the hospital stay. We are working to improve both the oral and written information, at the same time we are also developing an informative film.

The concept of annual analysis and reporting of all who undergo surgery within two years is a concept I recommend to everyone.

Gösta Ullmark

Swedish Hip Arthroplasty Register and clinical research

The main tasks of a National Quality Register are analyses of institutions and their activities, improvement projects and clinical research. During 2012-2016, the Ministry of Health and Social Affairs and SALAR have invested 1.5 billion kronor for the operation and development of the presently active 106 quality registers. These funds are "earmarked" ***not*** to fund the register-based research! Paradoxically, SALAR and the Swedish Agency for Health and Care Services Analysis control the research activities of the registers in their evaluation matrix – this condition is at least somewhat contradictory but means that our research activity and infrastructure must be financed by external funds. In turn, this entails applications in a highly competitive world of research, where observational studies of musculoskeletal diseases still has a rather low status compared to basic research in other medical fields. Despite this, our research activity and infrastructure has increased substantially during the past five years. The reason for this is that the register's management contacted all universities, we now have 13 doctoral students in four Swedish universities, and more are on their way in. A major contributor to the escalating development is also the fact that the register has now, after almost two years, a full-time statistician and an additional statistician begins as a doctoral student at the turn of the year 2015/16.

The highly versatile databases still have a large and relatively untapped research potential. A database merging official databases such as the Swedish National Board of Health and Welfare's Health Data register, the National Insurance Office, Statistics Sweden and regional patient-administrative systems has resulted and can result in databases that are unique with respect to observational studies. Interconnecting of the health data register and SCB takes 8-12 months and costs about 150,000 kronor, but so far has been "cost-effective" and resulted in extensive research and high publishing rate.

In research and evidence-based medicine, the randomized controlled study (RCT) is considered the research gold standard. However, we have no possibilities of running this type of study in all areas – perhaps least of all within surgical disciplines. The randomization process does not include the role of the surgeon, her or his experience and competence. What is termed 'single-surgeon' material seldom manages to attain statistical power. A national prospective observational study (register study) has characteristics unreachable with an RCT. Large materials afford above all possibilities to analyse unusual complications with great statistical power. Another great advantage is that generalizable results can be achieved – a result measured within the entire profession. Other tangible benefits include longer follow-up times and lower cost for the observational studies. However, the two study designs are not mutually antagonistic. An RCT is primarily designed to study the effect of a treatment while an observational study is particularly effective in analysing the "adverse effects" of a treatment.

All registry-based research requires ethical approval, privacy assessment, research contracts and special research form – it sounds complicated and bureaucratic, but is necessary for the registry to be able to follow the PUL and the Patient Data Act. Full regulations concerning records research are available at http://kvalitetsregister.se/registerarbete/forskning.

The Swedish Hip Arthroplasty Register's website has published a so-called project database, where you can find an overview of ongoing projects. If you want to discuss research projects, contact the register administrator. A special research coordinator (Karin Davidsson) works full-time at register. Phone numbers and email addresses are available on the report's cover.

15 doctoral theses and about a 150 scientific articles have been published, wholly or partly based on analyses from the Swedish Hip Arthroplasty Register. In 2014 and up until September 30, 2015, 33 register-based scientific articles had been published in "peer reviewed" magazines and additional 6 have been submitted. In 2014 and 2015, four dissertations with register results were carried out and two are planned for the first week of October in 2015.

Dissertations 2014:

Max Gordon, Stockholm: *Evaluation of patient related factors influencing outcomes after total hip replacement.*

Viktor Lindgren, Stockholm: *Complications after total hip arthroplasty: register-based studies on surgical approach and infections.*

Ferid Krupic, Gothenburg: *Total hip replacement in immigrants and Swedish patients. Evaluation of preoperative care, socioeconomic background, patient-reported outcomes and risk of reoperation.*

Dissertations 2015:

Meridith Greene, Gothenburg and Boston, USA: *Who should have total hip replacement? Use of patient-reported outcome measures in identifying the indications for and assessment of total hip replacement.*

Maziar Mohaddes, Gothenburg: *Acetabular Revisions. Risk Factors and Prediction of Re-revision.*

Buster Sandgren, Stockholm: *Assessment with computed tomography of wear and osteolysis in uncemented acetabular cups.*

The register's database is well suited to resident and medical student projects and a number of these have been carried out in the past four years. Register management would like to strongly emphasize that register databases are not only meant for the register staff in Gothenburg. All researchers, both within and outside the country, if there is an adequate problem, please utilize the register for research.

Research projects involving the Register

The Register's directorship and governing group include many Swedish postgraduate researchers who are supervisors and assistant supervisors for a number of postgraduate students. Currently, within this group, research is being carried out concerning prosthesis fixation, health economy, hip fracture and prosthetic surgery, fractures close to the prosthesis, revision surgery and patient-reported outcomes after prosthetic surgery. Members of the group are:

- Johan Kärrholm, Gothenburg
- Göran Garellick, Gothenburg
- Henrik Malchau, Gothenburg
- Ola Rolfson, Gothenburg
- Szilárd Nemes, Gothenburg
- Cecilia Rogmark, Lund
- Leif Dahlberg, Lund
- André Stark, Stockholm
- Per Wretenberg, Stockholm
- Nils Hailer, Uppsala
- Hans Lindahl, Trollhättan
- Peter Herberts, Gothenburg
- Rüdiger Weiss, Stockholm
- Lars Weidenhielm, Stockholm
- Olof Leonardsson, Karlskrona
- Olof Sköldenberg, Stockholm
- Max Gordon, Stockholm
- Clas Rehnberg, Stockholm
- Viktor Lindgren, Stockholm and Boston

Postgraduate students with all or part of their dissertation material from the Register as of September 2015:

- Buster Sandgren, Stockholm
  Datortomography of patients who received an uncemented acetabular component in connection with hip arthroplasty. Defends thesis in October 2015.
- Per Jolbäck, Lidköping and Gothenburg
  Registration and results for individual surgeons.
- Per-Erik Johanson, Gothenburg
  Hip arthroplasty for the younger patient. Evaluation of different prosthetic concepts.
- Maziar Mohaddes, Gothenburg
  Cup revisions with different fixation methods. Defends thesis in October 2015.
- Ann Garland, Visby and Uppsala
  Mortality after hip arthroplasty.
- Camilla Bergh, Gothenburg
  Avascular femoral head necrosis and prosthetic surgery.
- Ted Eneqvist, Gothenburg
  Spine-hip dilemma and further development of the PROM tool.
- Georgios Chatziagorou, Gothenburg
  Early and late femur fractures in proximity of the prosthesis.
- Ammar Al-Jobory, Lund
  Dislocation in fracture-related prostheses.
- Susanne Hansson, Lund
  Comorbidity and outcomes in fracture-related prostheses.
- Sebastian Rönnqvist, Lund
  Hip fractures and prosthetic surgery among younger patients.
- Cecilia Dahlgren, Stockholm
  Health-economic aspects of hip arthroplasty.
- Fanny Goude, Stockholm
  Health-economic aspects of hip arthroplasty.

There are four more candidates interested in registration as post-graduate students.

The register has also an intensive research cooperation in the Nordic Arthroplasty Register Association (NARA) and the group has published 20 scientific articles and further more manuscripts are being prepared. NARA cooperation has now been funded through the Nordic Council of Ministers for one year.

The Swedish Hip Arthroplasty Register's databases are still underexploited in research contexts.

The Register's management invites all interested researchers with adequate hypotheses to cooperate.

The NARA database is also accessible for Swedish post-graduate students.

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Swedish Hip Arthroplasty Register

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