Swedish Hip Arthroplasty Register

Annual Report 2013

FOR YEAR 2013

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Footnote. A number of descriptive tables have been moved from our printed annual report and are published only on our website. This also applies to the chapter "Environmental and Technology Profile". The register's website is at www.shpr.se.

Introduction

The Swedish Hip Arthroplasty Register is the fusion of two registers: one for surgery with total hip replacement with arthrosis/arthritis as the primary indication, and one for surgery with so-called hemi-arthroplasty with hip 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.

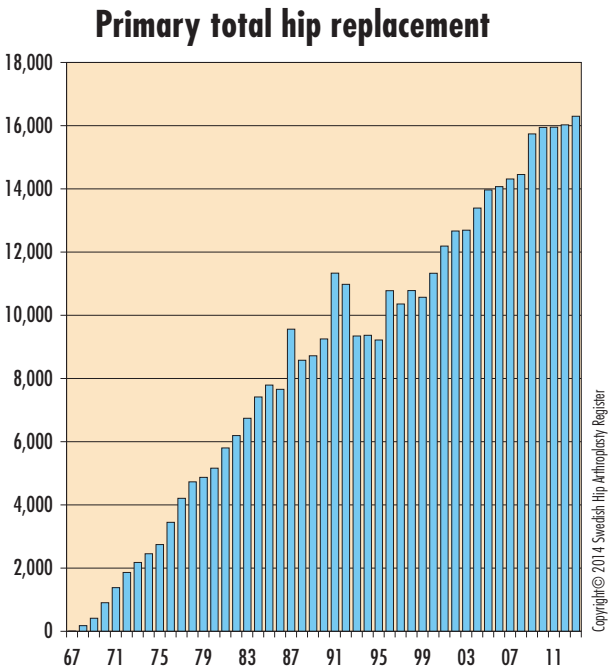
National Quality Registers have three main tasks: 1. analyses of institutions and their activities, 2. continuous improvement projects and 3. clinical research. However, the oldest arthroplasty-related registers – the Swedish Knee Arthroplasty Register and the Swedish Hip Arthroplasty Register – have a fourth and just as important assignment: implant surveillance ("post market surveillance"). This fourth task is not described as a task of the Swedish Association of Local Authorities and Regions, but paradoxally, 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 types of prostheses, resulting in continually improved implant survival. In Sweden, only a limited number of different types of prosthetics are used for about 95% of all operations. This could be compared to the situation in England-Wales, which has corresponding number of about 260 different types of prostheses, many of which have been introduced without an extended clinical documentation.

The Swedish Hip Arthroplasty Register has been active for almost 35 years. Analyzing the importance of different types of prostheses 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 analyze 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 probably 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.

This year's news

Last year's annual report was delayed for two months mainly because the information from Swedish National Board of Health and Welfare was delivered too late. About 30% of the content of the Register's report is now based on interconnections with the previously named register: coverage analyses, "adverse events within 30 days and 90 days", etc. These variables are also included in our so-called value compasses. In order for the clinics to begin with local level analyses and possible improvement projects earlier, we published a preliminary report, which included our standard tables, although without in-depth analyses or text, in June. A number of units got in touch for an early analysis.



Number of primary total hip replacements carried out in Sweden from 1967 (6 operations) to 2013 (16,330 operations).

Our operational analyses with value compasses have previously included a dimension concerning 90-day mortality. Since mortality after an elective total arthroplasty is low (<1.0%), we have replaced this dimension with an "adverse events" after 90 days. These expanded parameters of complication have a mean value of about 6% with a relatively broad distribution between the different relevant units. This new dimension (points of the compass) has more effect with higher potential for improvement compared to reports, which include only 90-day mortality.

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

National Quality Registers have long been poorly exploited in clinical research. We now see a shift within register research towards an increased interest in observational studies from the remainder of the medical research world. The Register's research activity is more extensive than ever before with 15 doctoral students from 4 universities. In order to broaden research

fields and operational analyses, we have, throughout the year, implemented a number of interconnecting projects with health data registers at the National Board of Health and Welfare and Statistics Sweden. During 2013 and 2014, the Register has published 35 articles with 5 in press in peer-reviewed journals. Three doctoral theses are planned for 2014.

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 2014 when ISAR organized the 3rd International Congress for Arthroplasty Registries in Boston with 200 participants from around the world. The fourth meeting will take place in May 2015 in Gothenburg.

User Questionnaire

In autumn 2013, a questionnaire was initiated in co-operation with the Swedish Association of Local Authorities and Regions and aims to identify the utility of the Register's results of operational analyses, improvement and clinical research. A majority of the nation's orthopedic clinics have responded. It is very gratifying for the Register management to see that the majority of the country's arthroplasty heads of department report using register data several times yearly for local in-depth analyses. A more specific description of the questionnaire and its results are published in the report.

Coverage

All units, public and private, that carry out total hip replacement are included in the Register. All hospitals where hemiarthroplasty is carried out also report to 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 98% for total hip replacement and for hemiarthroplasty 96.8%.

Patient-reported outcome measures

Patient-reported outcome measures were reported from all hospitals during 2013. 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%. This report contains a more thorough overview.

Reporting

Most of the clinics report via the web application. Medical record copies from reoperations are sent during the year with varying delay. Reviews of journal copies and systematic central 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. A number of "site visits" are carried out during the year.

Local activity analysis and development

The Register has, throughout the years, worked for feedback and transparency to stimulate participating units to local activity analyses to lead to measures of improvement.

This year's production

During 2013, the annual production of total hip replacements remained unchanged compared to 2012. Approximately 16,330 operations were carried out, which is 169/100,000 inhabitants. The production of hemiarthroplasties remained unchanged as well with approximately 4,370 operations. The number of reoperations was 2,353 and 313 respectively. In 2013, a total of 23,366 operations were reported to the Swedish Hip Arthroplasty Register.

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! The Register would also like to express its thanks for the tremendous support from the region of Western Götaland and The Register Center of the region of Western Götaland.

Gothenburg in September 2014

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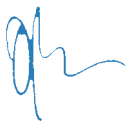
Professor, Senior Physician

Johan Kärrholm
Professor, Senior Physician



Ola Rolfson
Senior Physician

Cecilia Rogmark
Associate professor, Senior Physician

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

After combining the Register's databases with the Patient Register (PAR) (Code: NFB29, 39, 49, 62 for total hip replacement; NFB09 and NFB19 for hemiarthroplasty) on an individual level (personal identity number) results in three outcomes:

1. Matching of individuals, i.e., patients found in both registers.
2. Individuals only registered in the Swedish Hip Arthroplasty Register.
3. Individuals only registered in the PAR.

The completeness of the Swedish Hip Arthroplasty Register is presented in the following table as the sum of outcomes 1+2 and the completeness for PAR as the sum of 1+3. We do not know whether these results reflect true completeness since patients may have undergone hip arthroplasty without the unit in question entering data in either register. The number of such cases should be very low in Sweden in 2013.

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, as in the Hip Arthroplasty Register. Patients operated with one-stage or two-stage bilateral total hip replacement during 2013 may 'drop out' of the patient register with the selection criteria chosen for matching.

   In 2013, 84 patients were operated on in Sweden, with one-stage bilateral total hip arthroplasty. These 168 operations were registered as such in the Register but only as 84 procedures in PAR. The Register's leadership 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.

2. *Lag in registration*. Certain units are 'chronic' laggards – 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. This is to enable analyses of complications.

Results

Total hip replacements. Coverage for the country at large for 2013 was 98%. 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 (97.8%) are marked with red in the table. The limits for marking a clinic red have been somewhat tightened compared to the previous year. 20 clinics received this marking regarding degree of coverage in the register during 2013 – despite the high national average, there is potential for improvement. Most of the clinics, which were marked as red, have a value right below the limit but two clinics differ greatly: Växjö 67.2% and Frölunda Specialist Hospital 89.8% – we hope that these clinics carry out an improvement project concerning their reporting system.

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 9 years and coverage on a national level is relatively unchanged at 96.8% (lower confidence interval of 96.3%). 13 clinics were marked red and the lowest coverage for hemiarthroplasties is found in Visby 54.1% and Växjö 75.5%.

Reoperations and revisions. A high degree of coverage for this type of intervention register naturally includes completeness for reporting possible reoperations/revisions. The analysis of secondary interventions, however, proves to be much more difficult owing to the poor quality of coding; both for diagnosis and for reoperation measures. The Register now maintains a strategy that includes several methods of checking incomplete registration of reoperations (please see page 64 under the heading "Underreporting").

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 analyze complications. The Register's goal is not to illustrate productivity figures from an organizational unit.

Completeness for THRs 2013

Hospital	Number[1)]	SHAR[2)]	PAR[3)]
University/Regional hospitals			
Karolinska/Huddinge	248	98.8	98.8
Karolinska/Solna	182	99.4	98.3
Linköping	65	94.2	97.1
SU/Mölndal	461	96	94
SUS/Lund-SUS/Malmö	221	95.6	96.9
Umeå	64	98.4	95.3
Uppsala	260	94.6	99
Örebro	107	100	100
Central hospitals			
Borås-Skene	293	97.4	96.4
Danderyd	327	97.9	98.2
Eksjö	191	97.9	100
Eskilstuna	134	100	97.8
Falun	352	95.4	96.7
Gävle	254	97.7	96.5
Halmstad	243	97.2	99.2
Helsingborg	259	97	97
Hässleholm-Kristianstad	777	100	99.2
Jönköping	165	98.2	98.2
Kalmar	145	96.7	98
Karlskrona-Karlshamn	262	97.4	99.3
Karlstad	252	98.9	98.5
Lidköping-Skövde	401	98.7	96.5
Norrköping	253	99.2	99.2
Sunderbyn	32	100	96.9
Sundsvall	204	98.1	99
Södersjukhuset	429	97.5	98.6
Uddevalla	386	97.5	97.7
Varberg	238	100	99.6
Västerås	476	96.7	98.4
Växjö	86	67.2	98.4
Ystad	1	100	100
Östersund	310	99	96.8
Rural hospitals			
Alingsås	252	98.1	98.8
Arvika	138	97.8	97.8
Enköping	320	100	100
Frölunda Specialistsjukhus	80	89.8	97.7
Gällivare	91	100	100
Hudiksvall	146	99.3	98
Karlskoga	173	99.5	99.5
Katrineholm	241	100	100
Kungälv	165	98.2	98.8
Lindesberg	228	100	99.6
Ljungby	151	98	98
Lycksele	290	99.3	99.3
Mora	219	99.1	99.1
Norrtälje	129	98.5	100
Nyköping	138	98.6	97.1
Oskarshamn	286	100	100
Piteå	367	99.7	99.5
SUS/Trelleborg	587	100	99.5
Skellefteå	133	97.8	97.1
Sollefteå	126	95.5	100
Södertälje	92	95.9	98
Torsby	107	100	99.1
Visby	124	93.2	98.5
Värnamo	148	96.1	98.7
Västervik	121	97.6	98.4
Örnsköldsvik	132	100	100
Private hospitals			
Aleris Spec.vård i Motala	491	98.2	99.2
Aleris Specialistvård Elisabethsjukhuset	46	100	100
Aleris Specialistvård Nacka	112	99.1	98.2
Aleris Specialistvård Sabbatsberg	175	97.2	95
Art Clinic	6	100	0
Bollnäs-Aleris Specialistvård Bollnäs	268	97.1	96.4
Capio S:t Göran	465	99.2	98.8
Carema Ortopediska Huset	371	98.1	74.9
Carlanderska	109	100	100
Movement	127	100	0
Ortho Center Stockholm	396	98.7	98.7
OrthoCenter IFK-kliniken	128	100	0
Sensia Spec. Vård	6	100	0
Sophiahemmet	212	98.2	98.7
Spenshult	240	99.6	100
Nation	16,214	98	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 2013

Hospital	Number[1)]	SHAR[2)]	PAR[3)]
University/Regional hospitals			
Karolinska/Huddinge	115	96.6	**91.6**
Karolinska/Solna	58	100	94.8
Linköping	80	97.6	93.9
SU/Mölndal	311	**94.0**	**85.8**
SUS/Lund-SUS/Malmö	384	98.3	95.2
Umeå	87	**93.6**	99.0
Uppsala	100	**90.1**	95.5
Örebro	74	98.7	97.3
Central hospitals			
Borås-Skene	100	**91.7**	92.7
Danderyd	167	97.7	95.3
Eksjö	56	98.2	93.0
Eskilstuna	52	**94.6**	92.8
Falun	130	97.7	94.0
Gävle	78	**94.0**	95.2
Halmstad	61	98.4	96.8
Helsingborg	151	98.1	**92.2**
Hässleholm-Kristianstad	159	98.2	**90.8**
Jönköping	51	98.1	**90.4**
Kalmar	71	100	94.4
Karlskrona-Karlshamn	89	97.8	**87.9**
Karlstad	93	96.9	94.8
Lidköping-Skövde	110	**95.6**	94.7
Norrköping	56	**93.3**	100
Sunderbyn	137	100	99.3
Sundsvall	87	97.7	97.7
Södersjukhuset	271	98.2	95.3
Uddevalla	185	99.5	97.8
Varberg	66	100	**92.4**
Västerås	19	**90.5**	**61.9**
Växjö	43	**75.5**	98.3
Ystad	21	100	**90.5**
Östersund	68	97.1	94.3

Hospital	Number[1)]	SHAR[2)]	PAR[3)]
Rural hospitals			
Alingsås	34	100	100
Arvika	8	**88.9**	**88.9**
Gällivare	32	100	**90.6**
Hudiksvall	37	100	94.6
Karlskoga	24	100	100
Kungälv	64	100	98.4
Lindesberg	28	100	92.9
Ljungby	20	**90.9**	100
Lycksele	15	100	93.3
Mora	50	100	94.0
Norrtälje	23	100	100
Skellefteå	32	97.0	93.9
Sollefteå	32	97.0	**81.8**
Södertälje	33	100	97.0
Torsby	38	100	94.7
Visby	13	**54.1**	**91.6**
Värnamo	23	95.9	95.9
Västervik	48	96.0	96.0
Örnsköldsvik	34	100	100
Private hospitals			
Aleris Spec.vård i Motala	43	97.7	93.2
Capio S:t Göran	179	100	97.8
Nation	4,340	96.8	94.1

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.

Vision for the future

Background

In 2011, the state reached an agreement with the Swedish Association of Local Authorities and Regions concerning the National Quality Register's financing during the five-year period 2012–2016. 100 national registers and 6 Register centers were allocated 1.5 billion kronor for maintenance and development for the mentioned period. The financing for the Swedish Hip Arthroplasty Register involved the following agreement: a three-year allotment (2012–2014) of about 6 million kronor per year. In turn, this meant an undisturbed work environment and a possibility to make long-term action plans. From 1979 to 2012, the register survived on one-year allotments, which created an environment of continuous anxiety and difficulties concerning hiring specialist collaborators.

The previously mentioned three-year period is now coming to an end, and at the time of writing, the Register does thus not know anything about the financing situation during 2015–2016. The whole "decision hierarchy" including the Ministry of Health and Social Affairs, the Swedish Association of Local Authorities and Regions, governing group for National Quality Registers, the group of decision-makers and experts will be comprised of new individuals before the end of the year. In sum, the future is somewhat unclear for the Swedish Hip Arthroplasty Register and all other national registers.

Concerning the agreement, following outcome goals were set. By the end of 2013:

- 60% of the National Quality Registers have a coverage of at least 80%;
- 95% of the National Quality Registers present online-data to institutions;
- 100% of the National Quality Registers, which have a coverage of at least 80%, have open presentation of data of results;
- 60% of the National Quality Registers present data of patient results;
- 50% of heads of department use the quality registers in their improvement projects;
- The number of research projects supported by data from quality registers has risen to 100%.

The Swedish Hip Arthroplasty Register had reached all of the mentioned goals even before the agreement came into force – but needs to develop further. Below some of the most important projects/goals, which the management of the Register wishes to be followed through during the next year, are listed. The time perspective will, in large part, depend on the future funding.

Decision support

The register has begun developing a decision support. According to the Patient Data Act, it is not possible in a single register to develop an individual-based decision support, which could then be considered a medical record. The register intends to develop a so-called aggregated support, which will be published on our website. The system will be based on cross-referencing of about 300,000 hip operations in cooperation with Statistics Sweden and the National Patient Register. In addition to the traditional variables, like demographics, operation techniques and implant selection, the database will include also comorbidity and socioeconomic variables. The results will be satisfaction, risk for complications and revision operation. Via mathematical algorithms, an interactive module (comparing FRAX-models for prediction of fractures) is created, where both patient and doctor can add data. The development will take about two years.

Interactive statistical module for clinic-specific result

Since the register became web-based, all clinics have been able to download their raw data with a password and regardless of the time of day. In order to analyze the results in a simpler way, we plan to develop an interactive statistical module, so that one could quickly carry out local comparisons and compare these to national results. The development will probably take about a year.

Registration of individual surgeons

The Swedish Hip Arthroplasty Register has never during its 36 years of activity registered individual surgeons. Earlier, surgeons used to be rather faithful to their "home clinic" and therefore, it was easier for respective directors of operation to identify possible "outliers" concerning clinic-specific performance reports. Also, it was simple for individual surgeons to follow their own patients and look after and take care of possible complications themselves. This way, a long-term and continuous education could be secured.

As a result of restructuring in the Swedish orthopedics, the situation has largely changed during the last decade. Due to the creation of large elective units, establishing many private units, which do not carry out operations, the introduction of Care Guarantee and Free Care Choice, and that many surgeons operate at several different hospitals, more and more orthopedists do not follow-up on their cases, let alone take care of their complications – if they even know that the patient had a complication. For many years, the Register's management has discussed the possibility of starting a registration of surgeons at all operations, in addition to primary operations. We have presented these plans at the so-called user meeting at Arlanda and at two SOF-meetings. The point of registering surgeons is not to "shame" the concerned persons without, on the one hand, giving feedback on the results and, on the other hand, stimulating carrying out an in-depth analysis on their own complications as a part of a continuous improvement work. In addition, we can create a service to surgeons with a single system which includes an "on-line" access to a personal database in order to follow up on patients, concerning both complications and patient-reported outcome measures. We have just started a pilot project in Western Götaland and it is going to take some years before it can be implemented nationally – refer to page 14.

"Popular scientific" annual report/website for patients and decision-makers

Patients are using Internet more and more. The government and the Swedish Association of Local Authorities and Regions support developing E-health (E-hälsa). The aim of E-health:

"…E-health is a common term for efforts, tools and processes aimed at the right people having the right information at the right time and to create benefits for residents, patients, personnel and decision-makers. The initiative is a part of the government's efforts to achieve the objective of the digital agenda – an agenda that aims Sweden becoming the best in the world at using digitization opportunities…"

Because of this, many registers are planning to publish "popular scientific" texts as summaries on their websites and annual reports. Register's reports have traditionally been written for professionals but the pressure to make the reports more available to the public is increasing rapidly.

Improved coding and obligatory indication of laterality in patient administration systems

For many years, the Register has noted the poor quality of the surgeon's and clinic's coding concerning ICD-10 and KVÅ-codes. Poor coding results in enforcement of additional validation projects, which is both labor-intensive and costly. Each head of department should attend local coding courses, and the question is whether it should be an obligatory part of specialist trainings for orthopedic surgeons.

Lack of laterality (indicated by the right or left side) in local, regional and national patient administration systems is in 2014 still a mystery. This means that, for example, coverage analyses and cross-reference databases for research and improvement projects contain errors already from the beginning, which therefore require studies of medical records to understand the situation correctly. The Register's management strives towards introduction of laterality in previously mentioned databases.

Focus on improved research infrastructure and further research activity

All National Quality Registers have three main tasks:

- analyses of institutions and their activities
- clinical improvement projects
- clinical research

Since 2010, the focus has increased on the register-based research – refer to page 182. Paradoxically, the increasing state financing is explicitly been earmarked for maintenance and development of the registers and therefore not for research, even though the Swedish Association of Local Authorities and Regions' vision for the future contains the goal of increasing research financing. However, the research infrastructure of the Register has improved significantly in recent years. We have now had the means to hire a full-time post doctorate biostatician and the Register Center in Western Götaland has an improved infrastructure with a number of "in house" staticians and an IT-unit. At the Register Center, there are also positions for distance researchers – the Register has currently 15–17 postgraduates who are enrolled at four different universities. The governing group of the Register works intensively in order to improve the conditions (both financial and capacity wise) to increase the research activity.

Increased commitment for projects for medicine students and ST-doctors

The present mandatory projects for medicine students and ST-doctors are well suited for register-based work. In recent years, a number of similar projects have been carried out, several of which are published in the most recent annual reports. Also, in this year's report, two medical student projects are presented – refer to pages 176 and 178.

In the future, the Register management would like to work towards similar projects. However, there are issues with volume in the form of lack of supervisors and this issue must eventually be resolved.

International cooperation – harmonizing and standardizing

For several years, the Register has been involved in a fruitful and stimulating international cooperation – refer to page 15. In the Nordic cooperation, harmonization has been carried out for already 6 years, which led to a "minimal data set" that enabled comparative analyses and which resulted in about 20 publications in international journals. The broader international cooperation via ISAR (International Society of Arthroplasty Registries) develops at a fast pace. The society's most important projects are now the international harmonization of implant and outcome variables and standardizing of statistical methods. The Register participates in this process and in the near future, we must implement a new database for implants and eventually adapt to the new or changed process/outcome variables.

How can the Register's results be used locally?

Questionnaire for heads of department

In the autumn of 2013, in cooperation with the Swedish Association of Local Authorities and Regions, the Register sent a questionnaire to the 69 heads of department in orthopedic surgery clinics. The aim was to map how the register data is used and to gain awareness on the users' opionions on our work.

52 respondents gave full responses and another 3 gave partial responses. 53% were heads of department, the rest were locally responsible for the quality register and attending physicians. 55% had read the latest annual report, 35% had read a part of it. The figures show that heads of department use and are satisfied with the quality of the Register's data, but hospital management seldom ask results based on the quality register. The data was primarily used to compare similar activities, reporting results to colleagues and identifying improvement areas. In the middle group were operational statistics, improvement work, introduction of new methods and personnel training. Most frequently, the data is used for research and patient education.

42 and 38% indicated that they found the Register data very useful or quite useful in follow-up and improvement work.

There were mainly positive comments like "valuable, well-run, good" and the in-depth analyses and PROM-analyses were specifically highlighted. However, one respondent was more hesitant concerning EQ-5D as a PROM-tool and requested an equivalent condition-specific tool. The late publication of the annual report led to a couple of negative comments. Two illustrative quotes may sum up: "We are very satisfied with the Register here, but also proud of to belong and deliver data to the Register" and "When I work with improvements, I lean most on the Register and also while defending myself against all those colleagues who want to try new prostheses."

In general a positive assessment, but there is room for increased use of register data for research and patient information!

Figure 1: In your scope of practice, have you used the Quality Register data in the past 12 months?

	Number of respon-dents	Percent
Yes	53	96%
No	2	4%
Don't know	0	0%
Total	55	100%

Figure 2: Does hospital management/division management ask for the Quality Register results from your unit?

	Number of respon-dents	Percent
Yes, every year	31	56%
Yes, quarterly or more often	8	15%
No	15	27%
Don't know	1	2%
Total	55	100%

Figure 3: The Quality Register corresponds to my unit's needs concerning the content of variables.

	Number of respon-dents	Percent
Strongly agree	12	22%
	22	41%
	8	15%
	3	6%
	2	4%
Strongly disagree	0	0%
Don't know	7	13%
Total	54	100%

Figure 4: The Quality Register corresponds to my unit's needs concerning output reports.

	Number of respon-dents	Percent
Strongly agree	10	19%
	22	41%
	10	19%
	2	4%
	2	4%
Strongly disagree	1	2%
Don't know	7	13%
Total	54	100%

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. Analyzing 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. There are, however, certain problems even with the analysis of primary interventions such as the lack of laterality in PAR and above all private clinics' poor compliance to PAR.

Completeness of secondary interventions and validation of reoperations is at present the Register's "Achilles heel". Unfortunately, one of the reasons for this is the continually poor quality of the surgeons' diagnoses (ICD-10) and specification of the measure codes (KVÅ) for secondary interventions. We have made several efforts but the sources for error in PAR for such an analysis are currently all too numerous.

The Register has initiated a 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 nevertheless necessary.

How is monitoring carried out?

In the 2011 Annual Report, it was presented how monitoring is carried out, but after having finished the first test period, we chose to describe the process once again:

- The Swedish Hip Arthroplasty Register 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 Register and not vice versa. "Monitors" from the Register then gain temporary authorization for the local patient administrative and medical history systems 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 the Register 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)
- Operation date
- Diagnosis and the respective ICD-10-code
- Side (if available)
- Operations are to be presented with measuring codes (KVÅ-codes NF* and QD* = searches should be performed for all NF* and QD*)

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:

- Operation date
- 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 2–3 workplaces with computers, preferably in the same room or close to each other. Monitoring takes 1–3 days depending on the clinic's annual production.

The Register plans to carry out 6–8 local monitorings annually.

Photo: Kajsa Erikson

–35° C does not stop the Register coordinators from getting to Lycksele hospital to carry out monitoring!

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	Falu Hospital
January 2014	Lycksele Hospital and Norrland University Hospital in Umeå
April 2014	Södra Älvsborg Hospital in Borås and Skåne
June 2014	Mora Hospital

The results from monitorings to date

- Primary total hip replacement and primary hemiarthroplasty: Occasional operations were not reported to the Register, probably because the patients were relocated to a unit outside the clinic.
- Reoperation after total hip replacement and hemiarthroplasty: A number of reoperations were found, which were not reported to the Regsiter, 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.
- 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 the Register but this may cause trouble during possible cross-referencing between the Swedish Hip Arthroplasty Register and the National Board of Health and Welfare's PAR-register.

Also, 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 desirable in order to carry out regular checks.

Discussion

The above errors may be considered small but can, in a national aggregation, influence 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 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.

Photo: Karin Davidsson

But in Mora, there was a different weather – no Vasalopp in sight!

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

Background

The Swedish Hip Arthroplasty Register (SHPR), which started in 1979, has registered types of prosthesis, factors concerning the operation and the result in the form of complications. Data concerning the primary hip arthroplasties became individual-based in 1992 and has gradually expanded thereafter. The result in the form of reoperation and patient-reported outcome has since for a decade been presented openly and for the respective participating clinic. 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.

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.

Registration of the results of individual surgeons has been discussed before but it has never been done in Sweden. In SHPR, we now work with a project, the aim of which is to create a methodology which would make it possible for the individual orthopedic surgeons to follow their results systematically. Through this continuous feedback, a higher-quality work may be achieved.

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, which started in 1999. The aim was to encourage continuous improvement in the quality of prosthetic surgery. It is easy to follow identifiable endpoints of general interest (death, dislocation, wound infection, revision and deep vein thrombosis). The surgeon is notified, if he/she could be breaking the statistical tolerance limit and become an "outlier".

The used statistical model is CUSUM (cumulative sum of outcomes). It allows for quick identification of increased frequency of complication by using a diagram, which shows deviations from a specific target value. The idea is to implement something similar on the national level in Sweden.

The project aims to encourage continuous improvement through self-reflection and to generally improve the outcome of prosthetic surgery. Moreover, every surgeon is given a possibility to see how their patients are doing.

The project has been discussed on two occasions at the Swedish Orthopedic Association head of departments meeting in connection with Orthopedics week, and it has even been discussed during the yearly annual meeting in Arlanda. The information was presented and a discussion was held locally at the Sector Council for Orthopedics in Western Götaland.

Execution

As a first sub-study, we plan to analyze the data collected in 6 years (2007–2012) in Western Götaland. In order to connect individual operations to a specific surgeon, we have made withdrawals from the regions' 4 computerized operation programs (ORBIT, Operätt, OR-Suite and Operera). Then we can connect the surgeon to the patients. The experiences of the surgeon will be divided into groups, which are based on years after completing specialty training, and operations, which he or she has carried out before completing the specialty training. 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.

A natural variable to follow is Reoperation within 2 years and PROM data, such as patient satisfaction. Naturally, it is important to link the so-called "adverse events" to the evaluation. The Swedish Hip Arthroplasty Register's definition of "adverse events" after hip replacement surgery are all forms of reoperation of the respective hip, and heart attack, stroke, deep vein thrombosis, pulmonary embolism, pneumonia, urinary retention and ulcers, and whether these complications have resulted in hospitalization or death after primary total hip replacement. In order to receive this information, we must link data from the Swedish Hip Arthroplasty Register to the VEGA database, which registers all inpatient care procedures in Western Götaland.

As a second sub-study in this project, we are going to carry out an interview study in the Western Götaland region to get the opinions of orthopedic surgeons concerning such a project and find the possible pitfalls before eventual implementation.

International perspective on the Register's work

During the past seven years, the international cooperation on registers has increased. The Nordic Arthroplasty Register Association (NARA) has harmonized its outcome variables, which has resulted in a large number of scientific presentations as lectures at national and international meetings, but also in the form of peer-reviewed scientific articles, which this year culminated, with two works in the highest ranked British Medical Journal. It is gratifying that our long-standing work with registers has attracted international interest also outside the orthopedic world.

NARA has recently been awarded a major grant from the Nordic Council of Ministers. For now, we are working on how to best use these funds. One area of focus is to harmonize the generic descriptions of the used prosthetics in the four Nordic countries and to support the collection of PROM data in the Nordic region.

NARA Nordic Arthroplasty Register Association

www.nordicarthroplasty.org

The cooperation with The International Society for Arthroplasty Registries (ISAR www.isarhome.org) has also intensified. Göran Garellick resigned as president in the spring of 2014 when Martyn Porter from the English register took over. ISAR has in cooperation with the Federal Drug Administration in the USA, among others, worked towards similar projects, which have already been carried out by NARA. We hope that within a few years, ISAR will function as a global platform for both regional and international registers.

Among others, ISAR focuses on:

- International harmonization of data variables
- Development and implementation of a global implant database
- Through collaboration with international orthopedic journals, quality measures for statistical methods which we use, are defined
- Increasing the collection and use of registers' PROM data.

ISAR was the organizer of a large meeting in Boston in May 2014. The meeting had almost 200 participants and it was decided to organize another international meeting of registers for 2015 in Gothenburg.

Finally, ISAR has on-going discussions with prosthetics industry on how we can get a structured model for the introduction of new clinical treatment principles and new prosthetics. The idea is to make greater use of the well-established national registers. Through well-designed "clinical trials", we have the potential to quickly gather data from a large number of patients, which are required for statistical analysis, and then limit the spread of the new technology until preliminary results have been reported and a certain measure of safety has been documented. The idea is that this model could be based only on the data, which is found in the Register, but the more detailed PROM-data can also be included, as well as X-ray and other similar parameters. There should also be a possibility to carry out randomized studies in this system by using advanced research tools, such as RSA.

International Society of Arthroplasty Registries

www.isarhome.org

Total hip replacement in Sweden

Incidence

In June, a study from the Swedish Hip Arthroplasty Register was published, with forecasts concerning the development of hip replacement surgery in Sweden (Nemes et al, Acta Orthop 2014;85(3):238–243). Since the Register began its work, the incidence for total hip replacement operations has steadily increased in Sweden. During 2013, 16,299 total hip replacement operations were carried out in Sweden, which corresponds to 324 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 among the highest incidence. A natural explanation for the increasing incidence is that life expectancy is increasing and that the proportion of older people among the population increases. However, the last 15 years' increase in the incidence of total hip replacement cannot explain an increase in the number of operations due to acute hip fracture; the proportion of fracture patients has promptly declined. Furthermore, the proportion of operations due to inflammatory arthritis has dramatically decreased. During the same period, life expectancy has improved, but the median and mean age at surgery has dropped, with no tendency towards a change in variation in age. This suggests that the indication for hip arthroplasty has been extended for patients with hip osteoarthritis: we operate earlier in the disease process.

In 2005, a widely adopted study was published, which forecast a nearly threefold increase in the number of hip replacement operations in the USA from 2005 to 2030 (Kurtz et al, J Bone Joint Surg (Am) 2007;89(4):780–785). If this is transferred to Swedish conditions, it would mean that over 38,000 hip replacement operations are carried out in 2030, which, taking into account the changes in the population during the past 10 years, and the increase in the number of operations, does not appear likely.

In an attempt to provide a Swedish forecast, we carried out an analysis which was based on the annual number of hip arthroplasties in 1967–2012 and age grouped population data, including future forecasts from Statistics Sweden's population statistics. In the analysis, we could predict the incidence of hip arthroplasties per 100,000 aged 40 years or older. The analysis showed that the incidence is leveling off. In 2020, the incidence was estimated to reach 341 (95% CI, 327–353) and 358 in 2030, (95% CI 339–376). Table 1 shows SCB's population projections and estimated number of hip replacement operations in Sweden from 2014 to 2030.

SCBs population forecast for Sweden						
Year	Total population	Population ≥40 years	Proportion of population ≥40 years	Incidence per 100,000 inhabitants ≥40 years	95% Prediction range	Prognosis number of THRs
2014	9,737,738	4,997,390	0.513	324	291–360	16,318
2015	9,821,281	5,042,118	0.513	329	293–363	16,595
2016	9,905,548	5,082,444	0.513	334	295–366	16,854
2017	9,986,306	5,120,677	0.513	334	297–368	17,104
2018	10,063,638	5,156,449	0.512	336	299–371	17,343
2019	10,135,790	5,194,795	0.513	339	301–373	17,588
2020	10,200,459	5,234,368	0.513	341	303–376	17,834
2021	10,259,221	5,269,706	0.514	343	305–378	18,063
2022	10,314,592	5,304,478	0.514	345	306–380	18,288
2023	10,368,078	5,337,914	0.515	347	308–383	18,505
2024	10,418,813	5,372,586	0.516	349	309–385	18,725
2025	10,466,388	5,410,267	0.517	350	311–387	18,952
2026	10,511,030	5,448,911	0.518	352	312–389	19,180
2027	10,552,673	5,487,684	0.520	354	313–390	19,407
2028	10,591,303	5,531,168	0.522	355	315–393	19,648
2029	10,627,078	5,575,927	0.525	357	316–395	19,892
2030	10,660,344	5,625,711	0.528	358	317–396	20,152

Table 1. Estimated incidence and numbers of THRs in Sweden from 2014 to 2030.

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 registration started on an individual level. 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 prosthesis bearers. Prevalence is expressed as the number of prosthesis bearers per 100,000, aged 40 years or older at the end of each year.

At the end of 2013, 152,030 people had had at least one total hip replacement performed after 1991, implying 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. 37,189 (24%) of these had bilateral prostheses. In 2013, 1.6% of the Swedish population had undergone at least one total hip replacement after 1991.

Prevalence was lower for men (2.6%) compared to women (3.6%). It was slightly more common that women were operated bilaterally; 23% for men compared to 25% for women.

Of those who had undergone surgery on one hip in 1992, 24% were alive at the end of 2013. 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 2013 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 19% between 2008 and 2013.

Number per age group	1998	2003	2008	2013
<40	547	775	897	902
40–49	1,421	1,954	2,749	3,640
50–59	5,453	8,418	9,773	11,662
60–69	12,542	19,530	29,267	36,148
70–79	21,748	31,488	40,675	51,984
80–89	12,479	23,943	32,694	39,564
90 +	1,066	2,906	5,113	8,130
Total	55,256	89,014	121,168	152,030
Prevalence per 100,000 ≥40 years	1,265	1,973	2,550	3,059

Table 2. Number of individuals with at least one total hip replacement in Sweden*

**surgeries performed after 1991*

Number per age group	1998	2003	2008	2013
<40	98	169	195	198
40–49	195	338	540	720
50–59	821	1,557	2,020	2,537
60–69	1,701	3,849	6,752	8,926
70–79	2,421	5,295	9,000	13,893
80–89	923	3,119	6,171	9,382
90 +	59	254	687	1,533
Total	6,218	14,581	25,365	37,189
Prevalence per 100,000 ≥40 years	144	326	538	753

Table 3. Number of individuals with bilateral total hip replacements in Sweden*

**surgeries performed after 1991*

Primary prosthesis

Improved databases and results

In 2013, we began the work for facilitating cross-referencing between primary and reoperation databases and component databases. This means that it will be easier to analyze individual prosthetics components, like the size of the prostheses, selection of coating, type of liner and femoral head. There are also on-going efforts to simplify the registration of reoperations, which will affect the structure of the database in order to facilitate future analyses.

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 which, 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 clinical meaning of a doubled risk has an entirely different significance, if in the reference group one of a 1000 cases is revised after 10 years, compared to a reference group, in which 100 of a 1000 cases are revised after 10 years. In the first case a doubling indicates that two hips are expected to suffer a revision in the study group. In the other case, it is about 200. Risk ratio (Hazard 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.

Demography

Since 1993, the number of registered primary prostheses have more or less continuously increased from 9111 to 16,299 in 2013. Since 2009, when 15,739 operations were registered, the increase has not been as obvious. Compared to 2012, the increase has been 1.7% corresponding to 273 operations. The proportion of men has during the same period increased from 38.0% to 42.1%. Since 1993, the proportion of men over 40 in the Swedish population has increased by 1%, which partly but not entirely explains why more men are having hip replacement surgery (Figure 1 on the left). If patients, who are operated on due to a fracture, are excluded, the distribution of men and women is constant. From 2000, the proportion of men tends to increase (Figure 1 on the right).

In 2013, the average age for men was 67.3 (median 68) and for women 69.7 (median 70). Until 2010–2011 the average age has decreased. During the past 2 years, it seems that this trend of decreasing average age has been broken (Figure 2). By creating age groups, it is evident that the three younger age groups' relative proportion increased during 2000 to 2010–2011, and subsequently decreased slightly (Figure 3). In 2013, 6.5% of men were under 50 and 15% were between 50 and 59 when getting primary surgery. The corresponding proportions for women were lower 4.1% and 11.3%.

Diagnosis

The most common reason for total hip replacement is primary osteoarthritis (Table 1). Between 1994 and 2006, the proportion of who were operated due to primary osteoarthritis

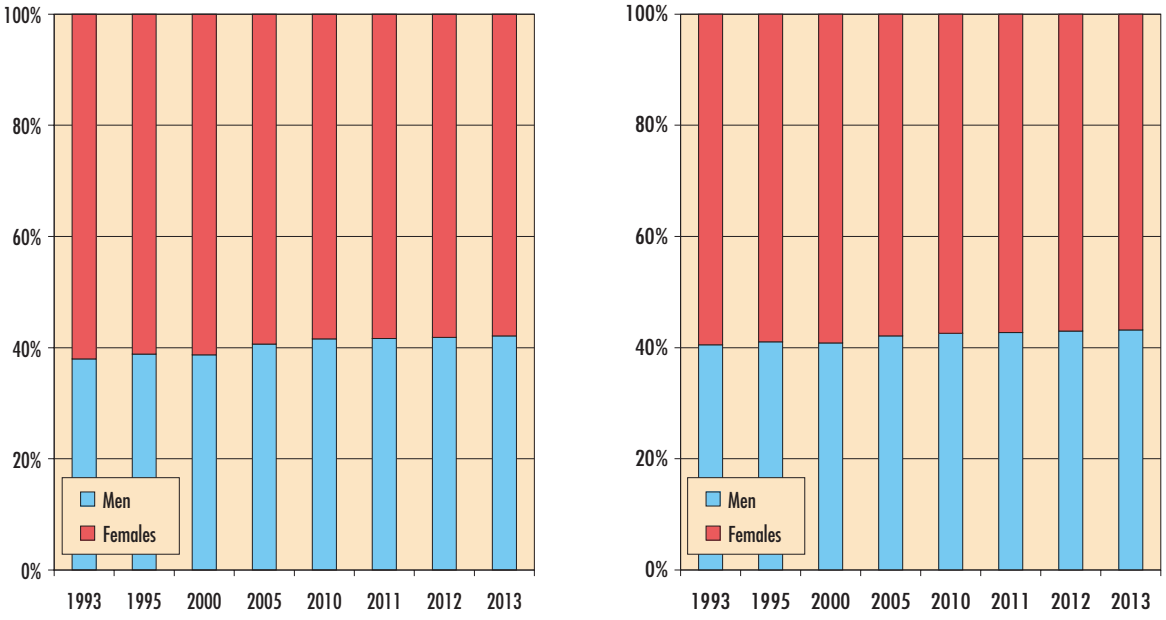


Figure 1. Proportion of men and women among patients who were operated on for a total hip arthroplasty. All diagnoses (on the left) and after the exclusion of patients who were operated on due to acute fracture or fracture sequelae (on the right).

increased from 84.1% to 87.5% among men and from 68.5% to 81.0% among women (Table 1). Subsequently, the proportion of primary osteoarthritis has been relatively constant and even tended to decrease. Men dominate this diagnostic group while the relative proportion of women is higher in all of the major groups of secondary osteoarthritis. The female predominance in these arthritic groups tended to decline during the period of 1994–2013. This could possibly be caused by the change in indication setting, but there are probably other underlying reasons that are poorly understood. The main reason why the proportion of primary osteoarthritis decreased between 2012 and 2013 is that the proportion of patients with hip fracture receiving total hip arthroplasty has increased. The relatively large number in the group "other" in 1994 consisted almost exclusively of the diagnosis of Paget's disease, a diagnosis that has been greatly reduced in the late 1990s only to almost completely disappear.

The gender distribution in the different diagnostic groups varies with age at surgery. In four out of five of the most common diagnostic groups, men dominate in the younger age groups (Figure 4). It is especially evident in the diagnostic group of idiopathic necrosis. In the group for sequelae after childhood illness, men are slightly older.

The diagnosis group "fracture" increased in absolute terms among both men and women, but in relative terms only among men. In Figure 5, only those patients are shown who have suffered from hip fracture. The total number of patients who receive a primary total hip arthroplasty has increased since 1994, and continued to increase between 2012 and 2013, both for men and for women (Figure 5).

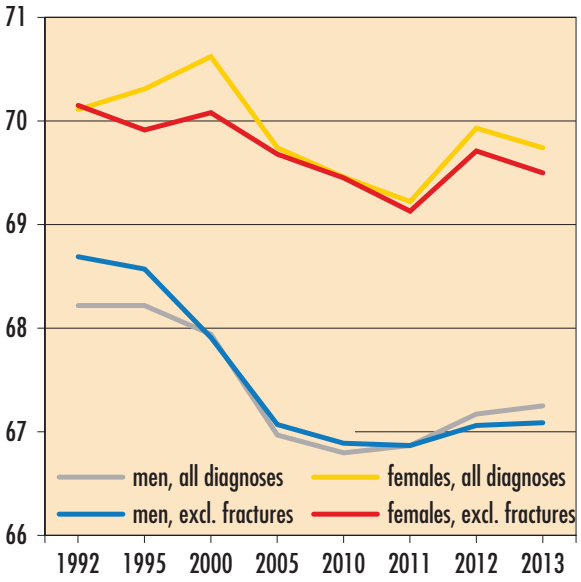


Figure 2. Mean age for men and women at primary prosthetic operation. Declining mean age has levelled off.

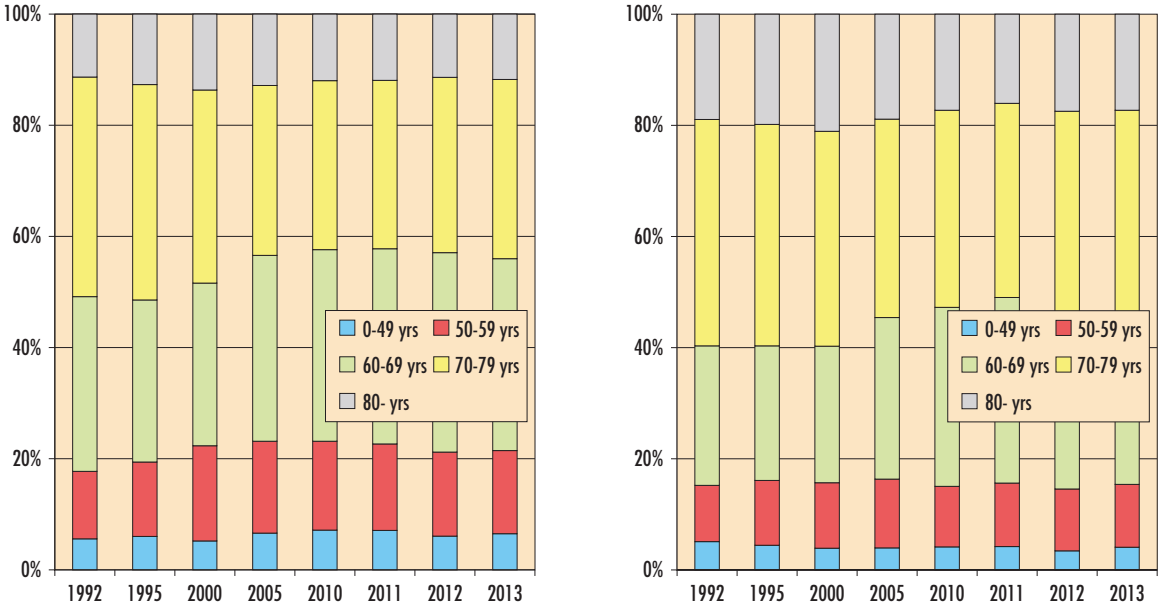


Figure 3. Grouped age distribution for men (on the left) and women, respectively. Since 1995, the proportion in the age group for 60–69 years increases while the relative proportion of those over 70 decreases. The proportion of patients under 50 has stayed relatively constant.

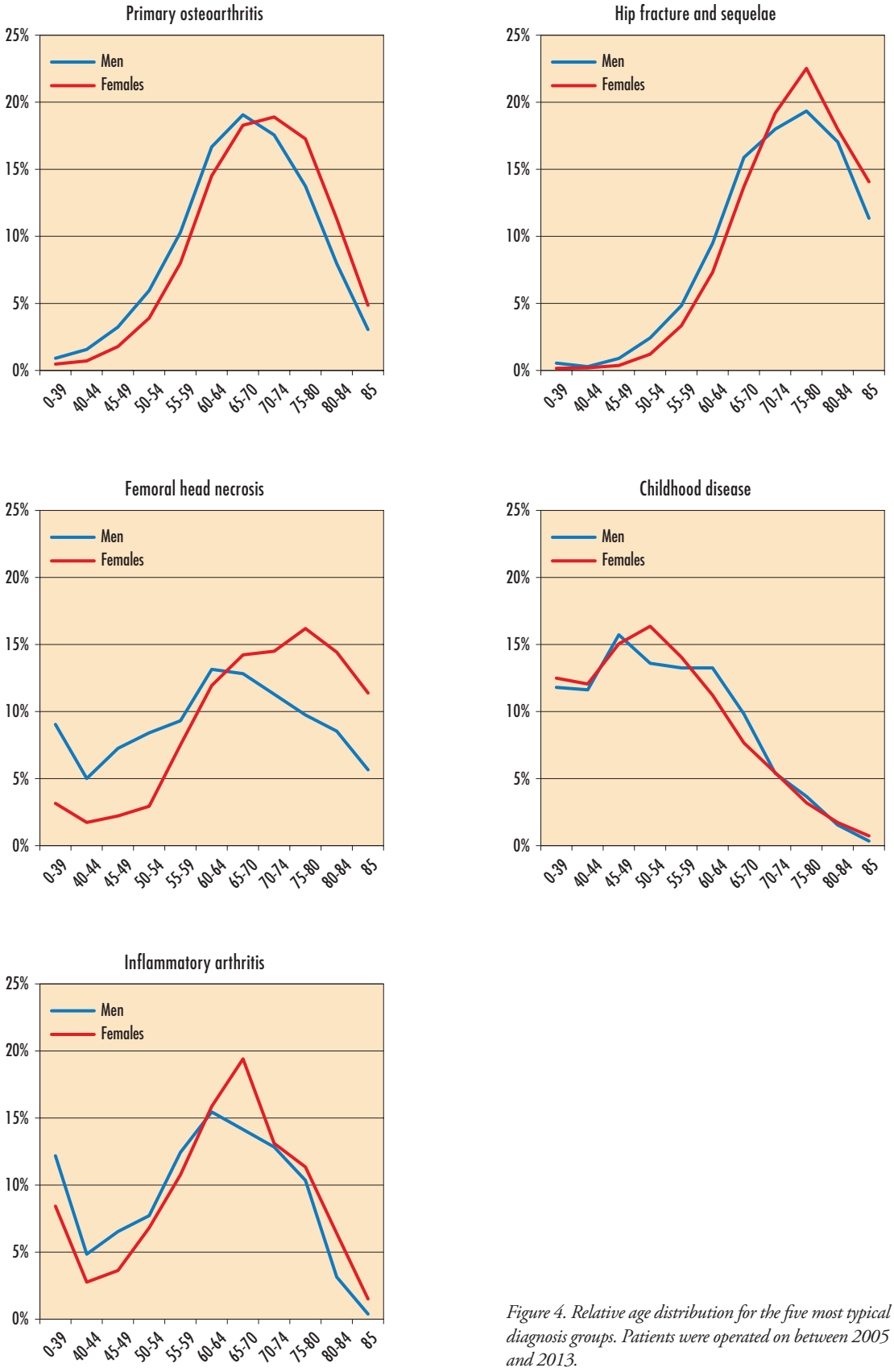


Figure 4. Relative age distribution for the five most typical diagnosis groups. Patients were operated on between 2005 and 2013.

Distribution of diagnoses for THR

	Year of surgery				
Diagnosis numbers %	**1994**	**2000**	**2006**	**2012**	**2013**
Primary osteoarthritis					
Male	2,942 *84.1*	3,706 *84.5*	5,079 *87.5*	5,750 *86.0*	5,734 *85.0*
Female	3,778 *67.6*	5,081 *73.2*	6,694 *81.0*	7,564 *81.4*	7,529 *79.8*
Inflammatory arthritis					
Male	151 *4.3*	118 *2.7*	89 *1.5*	66 *1.0*	55 *0.8*
Female	422 *7.5*	283 *4.1*	219 *2.6*	129 *1.4*	117 *1.2*
Fractures (acute or sequele)					
Male	234 *6.7*	361 *8.2*	369 *6.3*	486 *7.3*	590 *8.6*
Female	804 *14.3*	1,112 *16.0*	893 *10.8*	1,055 *11.4*	1,179 *11.4*
Childhood disease					
Male	33 *0.9*	65 *1.5*	109 *1.9*	126 *1.9*	124 *1.8*
Female	80 *1.4*	159 *2.3*	190 *2.3*	199 *2.1*	216 *2.3*
Femoral head necrosis					
Male	65 *1.9*	100 *2.3*	130 *2.2*	215 *3.2*	207 *3.0*
Female	200 *3.6*	261 *3.8*	231 *2.8*	307 *3.3*	343 *3.6*
Other diagnoses					
Male	74 *2.1**	37 *0.8*	45 *0.6*	45 *0.7*	52 *0.8*
Female	233 *4.2**	46 *0.7*	40 *0.5*	36 *0.4*	53 *0.7*

*>=90% Mb Paget

Table 1. Distribution of diagnoses during selected years from 1995 to 2012. The proportion primary osteoarthritis and sequele after childhood disease has increased and inflammatory arthritis and other diagnoses have decreased, in the latter group mainly due to the fact that the diagnosis Mb Paget almost has disappeared.

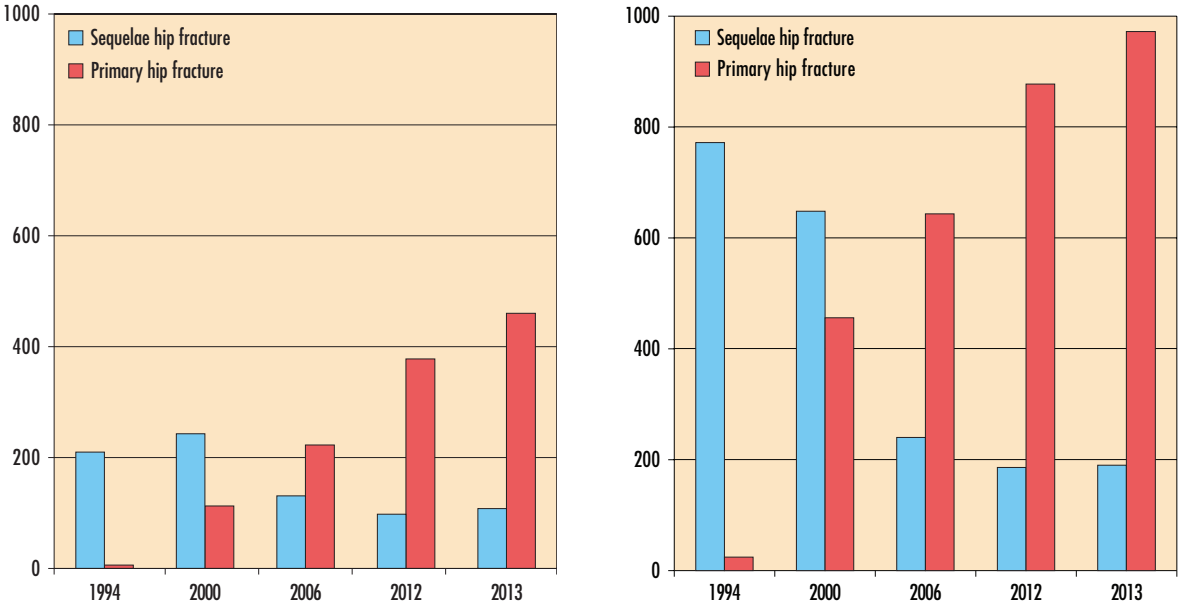


Figure 5. Number of hip arthroplasty operations carried out on men (on the left) and women (on the right), respectively, due to fracture sequelae and due to acute hip fracture during 1994–2013.

Average age per diagnosis and gender

the past 10 years

Diagnoses	Male	Female	Total
Fracture	73.1	74.9	74.3
Posttraumatic osteoarthritis	71.8	74.6	73.0
Primary osteoarthritis	67.0	69.6	68.5
Femoral head necrosis	62.3	70.0	67.2
Tumour	69.7	62.9	66.2
Other secondary osteoarthritis	57.8	66.4	61.9
Inflammatory arthritis	59.2	62.6	61.6
Childhood disease	53.8	53.3	53.5
Total	67.0	69.7	68.6

Average age per type of hospital and gender

the past 10 years

Hospital	Male	Female	Total
Central hospitals	68.0	70.6	69.5
Rural hospitals	67.9	70.0	69.1
Private hospitals	64.9	68.1	66.8
University/Regional hospitals	63.3	67.8	66.0
Total	67.0	69.7	68.6

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 2007. Since then, it has become increasingly comprehensive. In 2008, the data on BMI for 17.7% of all primary operations was missing. In 2013, this proportion dropped to 5.0%, a proportion we hope will be further reduced. Regarding ASA, reporting is more complete than BMI reporting. In 2013, data was missing for 1.8% of the operations.

Both BMI and ASA classification influence the results of total hip replacement. A high BMI and probably even limited comorbidity increase the risk for early reoperation. A high ASA classification and BMI correlate with several other factors increasing the risk of early prosthesis complications, such as infection and dislocation. Many studies indicate that one can expect that BMI influences long-term results, with possible variations for differing choices of prosthesis.

Until 2012, BMI increased for both sexes (Table 2). Data from 2013 speaks for a stabilization concerning both the average and the analysis of weight classes. This stabilization could indicate that surgeons consciously select patients and that there is an incentive for the obese to lose weight before operation.

In 2008, 27.8% of the men and 21.3% of the women were classified as healthy (ASA class I). By 2012, these proportions had been reduced with 3.5 and 1.3%, respectively. Between 2012 and 2013, there was a stable development. The proportion of "healthy" men increased slightly (0.4%) and the proportion of "healthy" women decreased by just 0.1%.

BMI and ASA-classification

	2008	2010	2011	2012	2013
BMI					
Valid obs./missing obs.	*11,896/2,559*	*14,644/1,302*	*14,930/1,022*	*15,152/874*	*15,481/818*
Mean *median*					
Male	27.3 *26.8*	27.3 *26.8*	27.5 *27.0*	27.6 *27.1*	27.4 *27.0*
Female	26.6 *26.0*	26.8 *26.1*	26.8 *26.2*	26.8 *26.2*	26.7 *26.1*
Group %					
Underweight <18.5					
Male	0.4	0.5	0.4	0.5	0.6
Female	1.9	1.8	2.1	1.6	1.8
Normal weight 18.5–24.9					
Male	28.9	28.5	27.5	26.3	28.5
Female	39.9	38.3	37.5	38.2	38.8
Overweight 25–29.9					
Male	49.0	49.2	48.0	49.0	47.4
Female	36.3	36.9	37.0	37.1	36.9
Obesity class I 30–34.9					
Male	17.0	17.2	19.3	18.9	18.9
Female	16.3	16.9	17.6	16.8	16.4
Obesity class II–III 35–					
Male	4.7	4.5	4.8	5.3	4.4
Female	5.6	6.1	5.9	6.2	6.1
ASA class					
Valid obs./missing obs.	*12,977/1,479*	*15,341/605*	*15,477/475*	*15,618/408*	*16,012/287*
Propotions					
Healthy (I)					
Male	27.8	27.2	24.8	24.3	24.7
Female	22.7	22.8	22.2	21.4	21.3
Mild systemic disease (II)					
Male	54.8	54.3	56.1	54.6	55.4
Female	60.2	60.0	60.4	60.4	60.4
Severe systemic disease (III–V)					
Male	17.3	18.5	19.1	21.0	19.9
Female	17.1	17.2	17.5	18.3	18.2

Table 2. Changes in BMI och ASA class between 2008 and 2010–2013. 34 cases with BMI 100 or more excluded (presumably error values).

Bilaterality

Patients with hip osteoarthritis have an increased likelihood to suffer from osteoarthritis of the opposite hip joint. In the Swedish Hip Arthroplasty Register's database, from 1992 17.2% (48,039) have been operated on both sides. Usually, the diagnosis for the other hip is the same as it was for the first one. If for example, the first hip joint is operated due to primary osteoarthritis, the diagnosis was the same in 96% of the cases (Figure 6). For diagnoses of inflammatory joint disease, fracture, sequelae after hip disease during childhood, and idiopathic necrosis, the diagnosis for the second operation differed from the first diagnosis in 32–41% of cases. Correct diagnosis can be difficult. It is somewhat remarkable that inflammatory joint disease and secondary osteoarthritis are not more diagnosed as bilateral disease.

Between 1992 and 2013, 3.8% (1818 patients) underwent surgery with a bilateral disease during one operation. This operation is one of the operations the health care can provide, which most improves the quality of live. Between 1993 and 2005, the number of bilateral operations increased to 115 per year. Subsequently, this type of operation has decreased (Figure 7). The vast majority of patients, who are operated bilaterally, have it done in two sessions (Table 3) due to different reasons. Most often, no symptoms are found at the same time or have different intensities on the two sides. In some cases, the patient's general condition and other illnesses make bilateral operation unsuitable. More than half of the patients are operated on both sides in five years (71.1%, Figure 8), which also concerns the group who were diagnosed with primary osteoarthritis during the first operation (70.5%).

In those cases where both hips were operated at different times, the relation between prosthesis survival for the first and the other hip shows a biphasic progression. During the first five years, survival for the first operated hip joint is numerically higher (five years: first hip = 97.9±0.1, other hip 97.3±0.1, all causes for revision). After 20 years and with all the causes for revision, as outcomes do not differ for the first and second hip (first hip: 78.0±1.0 second hip: 81.8±1.8%, p=0.08, log rank test). In the group with the diagnosis of primary osteoarthritis for the first operation, the prosthesis survival after 20 years is significantly higher for the hip that was operated last (79.0±1.0 and 83.0± 2.0, p = 0.007). There are probably several factors at work, such as new types of prosthesis and other changes in the surgical technique and selection bias. If a patient with bilateral prostheses suffers from bilateral complications, it is likely that the older hip is revised first and eventual revision of hip number two may be delayed.

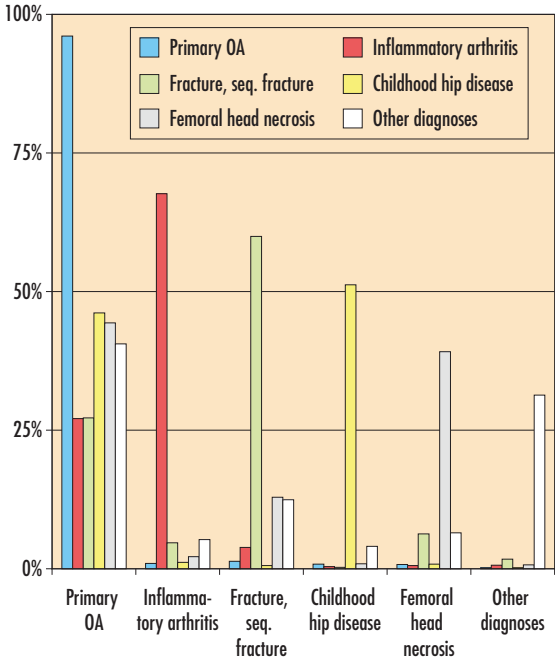


Figure 6. Diagnosis for the first operated hip (shown in different colors) and diagnosis for the other hip (shown in text on the x-axis) among the patients who were bilaterally operated. The patients who, for example, for the first operation were diagnosed with sequelae due to childhood hip disease (yellow bars) during the surgery of the other hip, just over half of the cases had the same diagnosis, in 46% of cases the diagnosis of the second hip was primary osteoarthritis and in a few cases the second hip had another diagnosis.

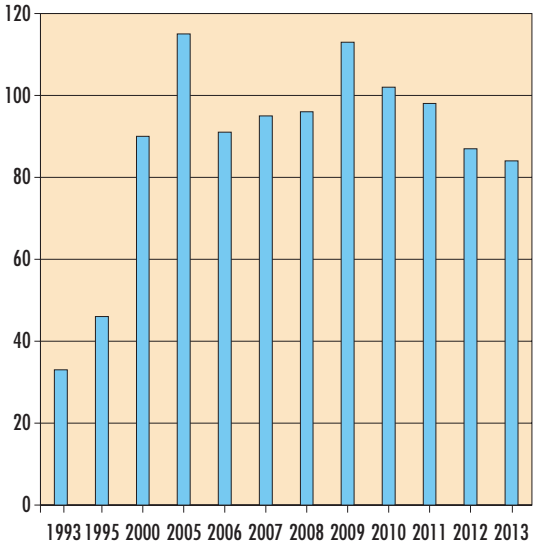


Figure 7. Number of patients who were operated bilaterally during one surgery.

Uni- and bilateral THRs

	Unilat. operation	Bilat. operation, 2-stage	Bilat. operation 1-stage
All diagnoses			
Number *%*	182,863 *79.2*	46,221 *20.0*	1,818 *0.8*
Mean age *SD*	70.0 *10.9*	65.3 *10.1*	60.4 *13.0*
Propotion female *%*	59.2	60.5	54.7
Diagnoses			
Primary osteoarthritis	75.7	88.5	79.0
Inflammatory arthritis	2.7	4.1	10.9
Acute fracture	14.7	2.8	2.1
Childhood disease	1.8	2.2	3.3
Femoral head necrosis	3.5	1.9	4.1
Others	1.6	0.5	0.6
Primary osteoarthritis only			
Number *%*	137,283 *76.5*	40,665 *22.7*	1,430 *0.8*
Mean age *SD*	69.6 *10.2*	65.7 *9.3*	62.4 *10.5*
Propotion female *%*	55.6	59.0	52.6

Table 3. Demographic data related to bilaterality and procedure of bilateral operation at one or two occasions. Data regarding bilateral operations is referred to the first operation.

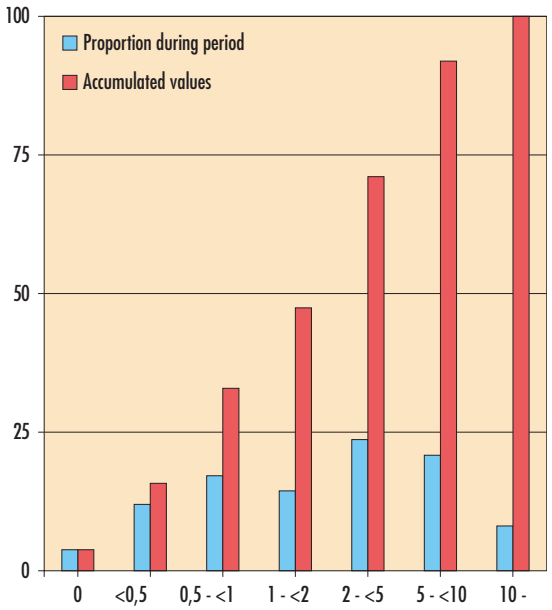


Figure 8. Number of patients who were bilaterally operated (%), who were also operated on the other hip at another time, after the operation on the first hip.

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 91.8% in 2000 (Figure 9). Hereafter, cemented fixation has declined, although more slowly than in other Nordic countries. Between 2011 and 2012, the percentage of all-cemented prostheses hardly changed, but decreased from 68.5 to 65.7% between 2012 and 2013. Since 2010, the proportion of hybrid prostheses (uncemented cup, cemented stem) has slowly increased, but made up only 2.4% of the total in 2013. The proportion of reverse hybrid prostheses (cemented cup, uncemented stem) shows an increasing popularity from the end of the 1990s, an increase that accelerated after 2005. In 2013, this trend ended. For the first time since 1997, the use of reverse hybrids decreased, although the decrease between 2012 and 2013 was a small one of 0.6%. Resurfacing prostheses are still used on individual patients. In 2013, 70 operations were reported, which is about the same as in 2012 (n=72). In that last 2 years, this type of prostheses has only been used in operation on men up to 66 years of age, which is the patient group with the smallest risk for prostheses-related complications, which are associated with resurfacing prostheses.

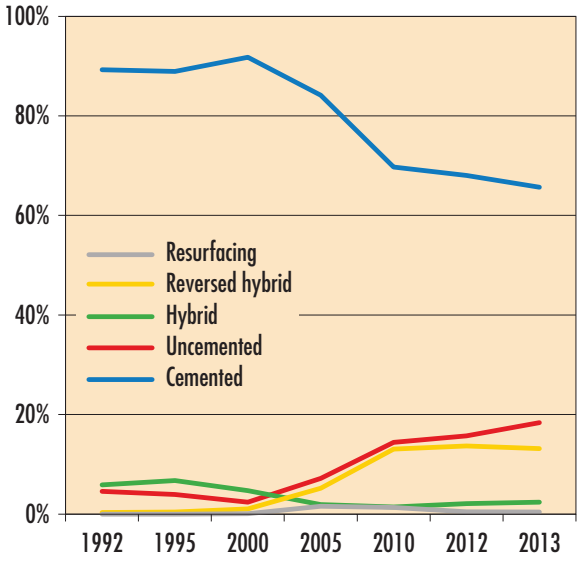


Figure 9. Distribution of primary prosthesis based on the selection of fixation. Between 2012 and 2013, all-uncemented fixation increased by 2.5% and the cemented fixation decreased by 2.6%.

Typical prostheses

Five of the most popular cemented cups take up 94% of the total number of such cups (Table 4). The use of different variants of Lubinus cups (excluding IP cup) and Exeter Rim-fit have increased during the last year. Since 2012, the majority is made of highly cross-linked polyethylene. In 2013, this proportion increased to 68.6% (Figure 10).

On the femoral side, mainly three types of prosthesis (different variants of Lubinus SP II, Exeter and MS30) and another polished stem (CPT) are used during more than 100 operations per year (see "In-depth Analysis – cemented stem"). Between 2012 and 2013, their relation was affected rather insignificantly by a slight decline for the two most common polished variants.

Selection of uncemented cup shows a greater variation, which seems to increase further. In 2012, the five typical uncemented cups accounted for 66% of the total, and this percentage drops to 61.2% in 2013. If instead the number of designs is taken into account, which makes up 90% of all uncemented bone sockets, then the number is the same, 14 for both years. The switch to the highly cross-linked polyethylene has, in comparison with many other countries, gone relatively slowly in Sweden, perhaps because the long-term performance of these polyethylenes is unknown. The switch to new liner polyethylene, concerning the use of uncemented cup, on the other hand, went faster, because the wear related problems have

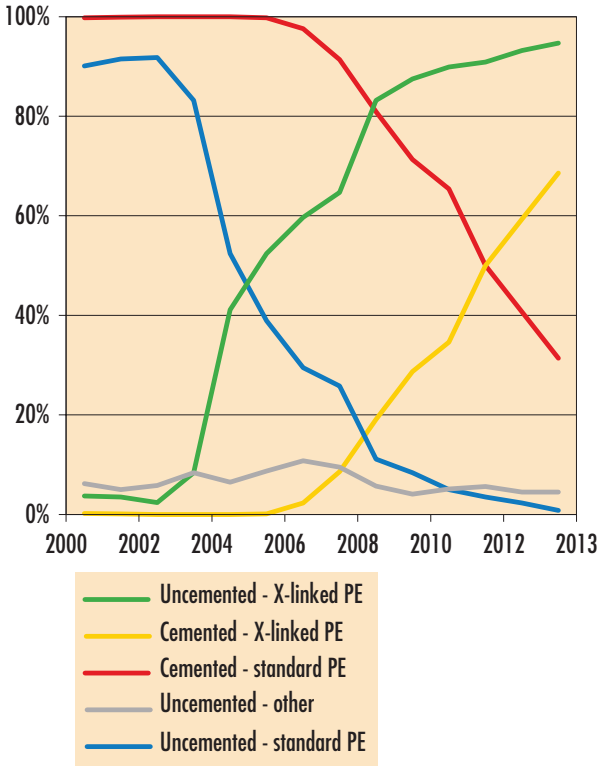


Figure 10. Switch from the older standard polyethylene to highly cross-linked polyethylene happened considerably later in the use of cemented cups. The curves intersect 6 years later for the cemented cup (green lines) in comparison to the uncemented cups (blue lines).

been more apparent. It was hoped to reduce the complications from wear and osteolysis for the majority of uncemented cups, and which may result in technically demanding revisions. In 2013, the Continuum cup became Sweden's most common uncemented cup, replacing the Trilogy cup. It is likely that this change was affected by the fact, that the manufacturer had problems delivering the Trilogy cup, and the Continuum cup was offered as an alternative.

Concerning uncemented stems, the diversification is less pronounced here than among cups. Since 2009, the Corail stem has been the most common uncemented stem. M/L Taper is a stem without extensive documentation. The stem has a proximal plasma-spray coating and is polished distally. It was first used in Sweden in 2012 and was placed in fifth place in 2013.

The three most commonly used implant combinations for all-cemented, uncemented, hybrid and reversed hybrid in 2013 and their corresponding share in the previous year (2012) are listed in Table 5. Only one type of resurfacing prosthesis (BHR) was inserted during these years.

Most commonly used implants 2012–2013

	2013		2012	
	number	%	number	%
Cemented cup				
Lubinus	5,908	*46.0*	5,736	*43.8*
Marathon	2,248	*17.5*	2,497	*19.1*
ZCA	1,787	*13.9*	2,012	*15.4*
Exeter Rim-fit	1,503	*11.7*	1,399	*10.7*
Contemporary Hooded Duration	577	*4.5*	656	*5.0*
Proportion cemented cups	93.6		94.0	
Cemented stem				
Lubinus SP II	6,247	*56.3*	6,169	*54.9*
Exeter polished	3,432	*30.9*	3,460	*30.8*
MS30 polished	1,252	*11.3*	1,470	*13.1*
CPT	131	*1.2*	122	*1.1*
Spectron EF	27	*0.2*	12	*0.1*
Proportion cemented stems	100.0		100.0	
Uncemented cup				
Continuum	697	*20.6*	403	*14.1*
Trilogy	443	*13.1*	710	*24.9*
Pinnacle 100	317	*9.4*	307	*10.8*
Trident hemi	314	*9.3*	248	*8.7*
Exceed Ringloc	275	*8.1*	195	*6.8*
Proportion uncemented cups	60.5		65.3	

	2013		2012	
	number	%	number	%
Uncemented stem				
Corail	2,284	*46.5*	2,277	*48.3*
Bi-Metric	849	*16.5*	769	*16.3*
CLS	645	*12.6*	734	*15.6*
Accolade	382	*5.8*	271	*5.8*
M/L Taper	235	*4.3*	44	*0.9*
Proportion uncemented stems	85.7		86.9 (90.3*)	
Bearing surfaces				
Metal-PE (highly cross-linked)	10,446	*64.1*	9,406	*58.7*
Metal-PE (conventional)	3,193	*19.6*	4,372	*27.3*
Ceramic-XLPE	1,524	*9.4*	973	*6.1*
Ceramic-PE (conventional)	856	*5.3*	1,034	*6.5*
Ceramic-ceramic	84	*0.5*	83	*0.5*
Metal-metal (incl resurfacing)	71	*0.4*	75	*0.4*
Other/missing data	119	*0.7*	83	*0.5*
Head diameter				
22	117	*0.7*	63	*0.4*
28	3,527	*21.6*	4,659	*29.1*
32	10,931	*67.1*	9,873	*61.6*
36	1,538	*9.4*	1,254	*7.8*
>36	128	*0.8*	134	*0.8*
Other/missing data	57	*0.4*	43	*0.3*

*Including ABG HA, fifth most common uncemented stem 2012

Table 4. Most commonly used implants and head during 2013. The corresponding figure regarding same prostheses during 2012 is shown for comparison.

Most commonly used implants 2012–2013

	2013		2012	
	number	%	number	%
Cemented prosthesis				
Lubinus – Lubinus	5,128	*47.9*	5,026	*46.1*
Exeter – Marathon	1,299	*12.1*	1,401	*12.9*
Exeter – Exeter Rim-fit	1,199	*11.2*	1,071	*9.8*
Uncemented prosthesis				
Corail – Pinnacle 100	311	*10.5*	302	*12.1*
CLS – Continuum	206	*7.0*	155	*6.2*
CLS – Trilogy	182	6.2	255	*10.2*
Hybrid				
Exeter – Trident hemi	104	*26.4*	83	*24.9*
Lubinus – Trilogy	50	*12.7*	68	*20.4*
MS30 – Continuum	32	*8.1*	17	*5.1*
Reversed hybrid				
Corail – Lubinus	484	*22.6*	487	*22.2*
Corail – Marathon	450	*21.0*	540	*24.6*
Corail – Contemporary Hooded Duration	186	*8.7*	151	*6.9*
Resurfacing				
BHR all variants	70	*100*	70	*97.2*

Table 5. Most commonly used implant combinations during 2013. The corresponding proportion for 2012 is shown for comparison.

Dual articular cup

Dual articular cup is used to minimize the risk for dislocation. Another alternative is to use an uncemented hip cup or a liner, which connects to the femoral head, so-called "constrained" liner. In Sweden, the first alternative is mainly used. Since 2005, only 13 cups and 23 liners of the constrained type have been registered for a primary prosthesis. Dual articular cup is becoming more common. This type of prosthesis is mainly used on patients who have a higher expected risk for dislocation. More than half (63.6%) have been diagnosed with acute hip fracture or sequelae from a previous fracture. In Sweden, the use of dual articular cups has been restrictive, probably because of the perceived risk of wear, when previous studies have stated that polyethylene on a convex surface may easily get this complication. Introduction of more wear-resistant polyethylenes has probably contributed to the fact that dual articular cups are now used more. In 2010, 132 operations were registered, which has increased to 428 in 2013 (Figure 11). During the same period, proportion of wear-resistant polyethylene has increased from 6.8 to 59.1%.

Articulation

Since 2012, the majority of all polyethylene cups and polyethylene inserts are being made of high-molecular-weight polyethylene. In 2013, the total proportion increased to 68.6% (Figure 12). The change to high-molecular-weight polyethylenes went much faster for uncemented than for cemented cups (Figure 10). It is because, the negative effects of polyethylene wear are more pronounced, and probably occur earlier. In 2013, older standard polyethylene was used in less than 1% of these cases.

In 2013, polyethylene inserts (liner) or cemented polyethylene cups/dual articular cemented cups were used in 98.6% of cases (Figure 12). In 84.0% of cases they were used in combination with a metal femoral head, and in 14.6% of cases with a ceramic femoral head. Ceramic-ceramic articulation was used only in 0.5% of cases. Other cases had to do with hip resurfacing (metal-metal) or with the fact that complete data on the material of both femoral head and cup/liner was missing.

In comparison to 2012, we see a continuous increase in the use of 32 and 36 mm femoral heads, mainly at the expense of 28 mm femoral head. In 2013, size 32 accounted for 67.3% and size 36 for 9.4% of the total cases, an increase of 5.5 and 1.6%, respectively, in comparison to 2012.

During 2011–2013, the proportion of 36 mm and larger femoral heads accounted for more than 5% of the total number of hip the haed sizes used (Table 6). During this period, large femoral heads were used more on men, more often on younger people and more in cases with secondary osteoarthritis (10.8%) and surprisingly more rarely at surgery for acute or elderly hip fracture (5.7%). One reason for this may be that, in many clinics instead of a large femoral head, a dual articular cup is selected (see above). As expected, large femoral heads were used significantly more with posterior than lateral surgical approaches.

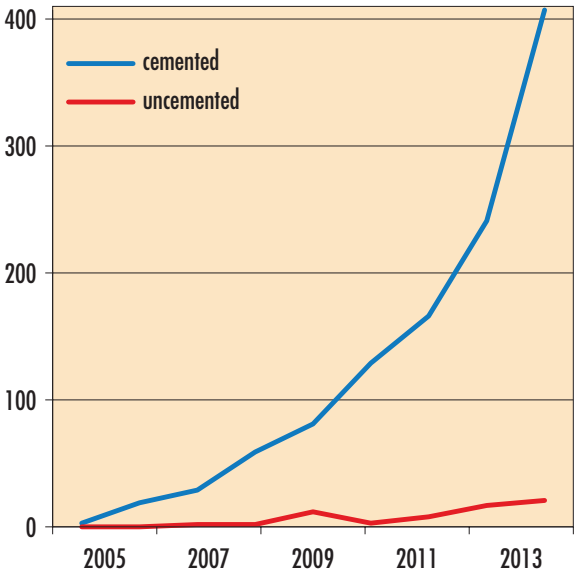


Figure 11. Number of reported operations where dual articular cups were used 2005–2013.

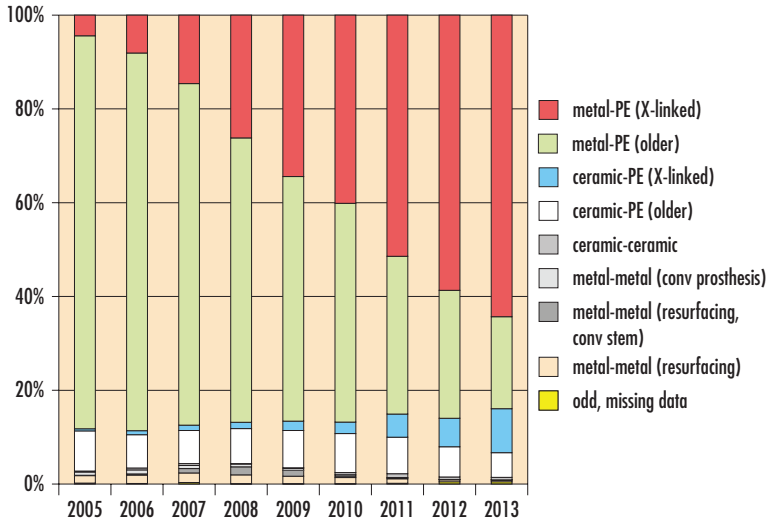


Figure 12. Type of inserted articulation since 2005–2013.

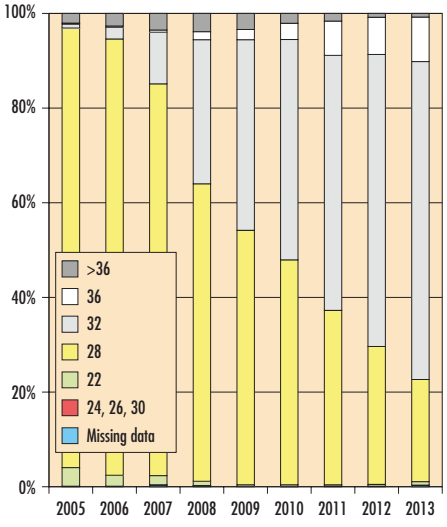


Figure 13. Selection of femoral head size 2005–2013.

Head diameter

	>=36 mm number	%	22–32 mm	data missing number	%
Gender					
Female	1,269	*4.5*	26,749 *95.4*	24	*0.1*
Male	2,881	*14.5*	16,997 *85.4*	15	*0.1*
Age					
0–49	389	*17.2*	1,867 *82.5*	8	*0.4*
50–59	715	*11.7*	5,380 *88.2*	6	*0.1*
60–69	1,499	*9.3*	14,540 *90.6*	12	*0.1*
70–79	1,039	6.3	15,359 *93.6*	6	*0.1*
>=80	508	*7.1*	6,599 *92.8*	7	*0.1*
Diagnosis					
Primary osteoarthritis	3,496	*8.8*	36,125 *91.1*	27	*0.1*
Fracture incl sequele	274	*5.7*	4,498 *94.1*	8	*0.2*
Secondary osteoarthritis	380	*10.8*	3,120 *89.0*	4	*0.1*
Surgical approach					
Anterolateral pat. on back (Hardinge)	26	*1.0*	2,524 *99.0*	0	*0.0*
Anterolateral pat. on side (Gammer)	772	*3.8*	19,505 *96.1*	16	*0.1*
Posterior	3,325	*13.5*	21,292 *86.4*	20	*0.1*
Other/missing data	27	*6.0*	422 *93.7*	3	*0.7*

Table 6. Choice of large (>=36 millimeter) and standard and small (22–32 millimeter) head during 2011–2013 related to gender, age, diagnosis and surgical approach. Resurfacing prosthesis are excluded.

Surgical approaches

Three approaches (posterior, lateral supine and on side position) were used during 1999 to 2013 at least 93.1% of cases. In 2013, these approaches made up 98.9% of the total, probably due to more accurate registration (Figure 14). The use of lateral approach on the side position increased until the period of 2008–2010. Subsequently, the division between the posterior and lateral approach remained relatively constant. Lateral (and anterior) approaches have an advantage of reducing the risk of dislocation, compared to the posterior approach. Previously, we have seen that patients, who undergo posterior approach, generally suffer less pain than those who have surgery with lateral approach. Anterior access could be an appealing compromise, but is considered to have a relatively long learning curve. Mini-invasive approach was first used in Sweden in 2003 but is now almost exclusively used at posterior access. Watson-Jones approach was first used in 2008 and, to date, only about 200 cases have been registered, with more than 50 cases that have followed for at least three years. The number of posterior mini-invasive approach cases and Watson-Jones approaches is low and the follow-up time is limited. The risk of early revision after these approaches is, however, well within expectations (Table 7).

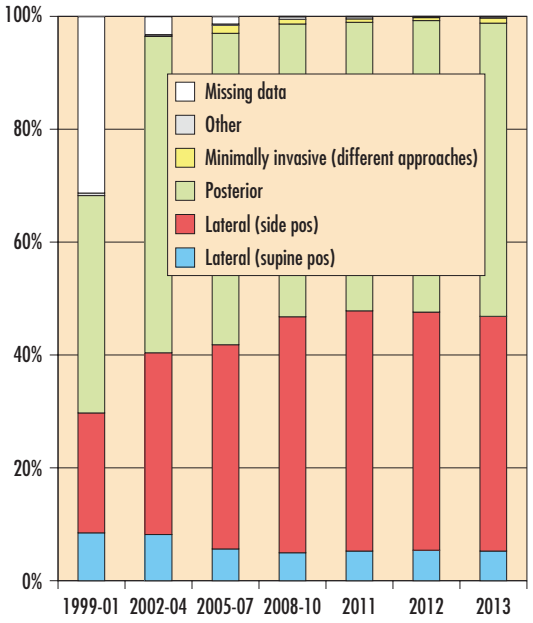


Figure 14. Relative distribution of approach 1999–2013. During the whole period, the lateral supine approach and the side position approach and posterior approach accounted for at least 98.4% of the operations where information concerning the approach was reported.

Surgical approach and survival of prosthesis

	number 1999–2013	proportion revised within 2 years %	survival of prosthesis 0–3 years average ± 95% C.I.
Anterolateral			
Patient on back (Hardinge)	13,256	1.5	98.1±0.3
Patient on side (Gammer)	74,762	1.4	98.1±0.1
Posterior	107,103	1.4	98.1±0.1
Mini-incisions			
Posterior	231	1.3	98.1±2.0
Other*	839	3.5	95.0±1.5
Watson-Jones	241	0.8	99.1±1.2
Other	641	1.6	98.0±1.4
Missing data	12,516	1.3	98.3±0.2

*anterolateral, OCM, 2-incision technique (Berger)

Table 7. Proportion revised and survival of prosthesis after three years related to surgical approach. For fair comparisons, the three-year limit was applied with regards to the follow-up time including at least 50 observations available.

In-depth analyses

Cemented stem

Although cemented stems have made a relative decline since 1997, this technique still dominates with a broad marginal in Sweden. In 1997, 97.1% of all stems were cemented. This proportion fell subsequently to 68.1% in 2013. In absolute numbers, the peak was reached in 2005, when 12,006 cemented stems were operated on. Since 1999, 36 different designs were used, if revision stems, dysplasia versions and special design (custom made) are taken into account in each main group. Half of these have been used in less than 100 operations. In 2013, 8 main types were registered, out of which four were used in less than 40 cases. The remaining four were used during the whole period of 1999–2013, but the usage varied considerably, from an average of 5798 per year (Lubinus SP II) to 195 per year (CPT, Figure 1). This analysis included these four designs (Lubinus SP II, Exeter, MS30 and CPT). Dysplasia, custom made and revision stems have been excluded using the information from the component database. Both CPT-stems, which have been made of stainless steel (n=1,206) and cobalt-chromium alloy (n=1,725) are included. For regression analyses, the ages were divided into <50, 50–59, 60–69, 70–79 and ≥80 years, diagnoses into primary osteoarthritis, acute fracture or fracture sequelae and other secondary osteoarthritis. Division of surgical approaches has been simplified to the posterior, lateral and other. In the first analysis, all femoral head sizes are included in order to present a fuller picture of respective types of prostheses. 22 mm femoral head with a potential risk for increasing the frequency of dislocations, has been used minimally with Lubinus and MS30 (0.1%), more often with Exeter (4.1%) and CPT in 6.2% of cases. In the analysis of stem revision due to dislocation, stem size and offset, only 28 and 32 mm femoral heads for all 4 stems are included. All types of cups are included in this analysis.

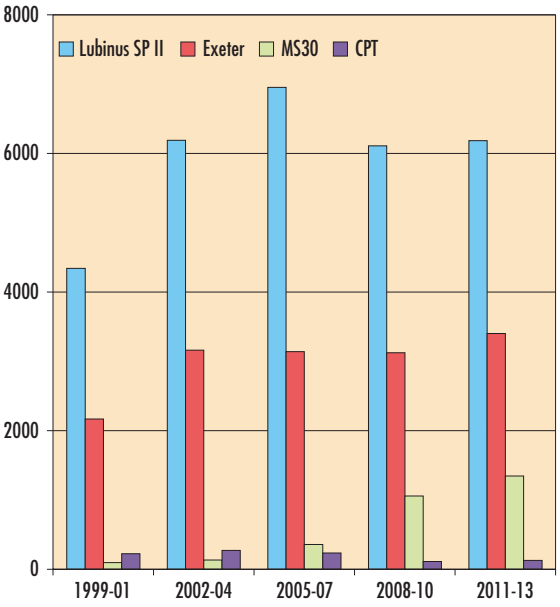


Figure 1. Number of operations per year in the period of 1999 to 2013 for most commonly used cemented stems. All were in use during 2013.

Demographics

The demographics of the patient who were operated with a cemented stem is relatively similar for the Lubinus and Exeter prostheses (Table 1). In comparison to Lubinus, Exeter stem is used more often with primary osteoarthritis, more often with the lateral approach and more of these patients are operated in private hospitals. Comparison of all four stems show that MS30 is the stem which is most often used with primary osteoarthritis and that this design has the largest proportion of patients who have been operated in private hospitals. MS30 is also the stem, which in 2008 to 2013 had the highest proportion of standard patients (standard patient is a patient with primary osteoarthritis, 55.0–84.9 years old, ASA class I-II, BMI 18.5–29.9). Patients who were operated with CPT stem have the lowest proportion of primary osteoarthritis, they have a higher mean age and consist mostly of patients with a fracture diagnosis. The proportion of standard patients who were operated with CPT stem was, during the same period, lower than for any of the other stem types, which were included in the analysis.

Implant survival, reason for revision

Prostheses, where one of the four stems have been used, show an implant survival which after five years is higher than 95%, which for Lubinus SP II, Exeter and MS30 means also a 10-year survival rate. During the first four years, risk for revision is lowest for the Lubinus stem. After four years, the survival curve for MS30 will begin, and to some extent for the Exeter stem, to converge towards the Lubinus stem, which means that the differences tend to level off. Concerning the CPT stem, the curves continue to diverge, which means that the differences remain and tend to increase over time. A similar pattern is visible if stem revision is used as an outcome and without paying attention to the causes (Table 2, Figure 2).

Demography for common stems

	Type of stem			
	Lubinus SP II	**Exeter**	**MS30**	**CPT**
*Number 1999–2013**	86,976	45,064	8,988	2,923
Proportion female %	60.2	62.7	63.1	70.8
Age average SD	71.2 *9.1*	71.2 *9.4*	71.0 *8.9*	74.7 *9.5*
Age distribution %				
<50 years	1.4	1.8	1.8	1.6
50–59 years	8.6	8.7	6.1	4.6
60–69 years	31.0	30.1	33.3	19.5
70–79 years	40.3	40.3	43.0	40.7
≥80 years	18.6	19.0	15.9	33.6
Diagnosis %				
Primary osteoarthritis	82.0	80.9	88.4	72.8
Inflammatory arthritis	2.1	2.2	2.5	1.5
Fracture/seq. fracture	12.1	10.8	5.8	19.5
Childhood disease	0.9	1.5	0.7	1.6
Femoral head necrosis	2.3	3.9	2.0	2.5
Others	0.5	0.6	0.5	2.1
Proportion standard patients				
2008–2013 %	55.5	55.2	65.9	31.6
Surgical approach				
Anterolateral (patient on back)	1.5	14.0	1.8	8.5
Anterolateral (patient on side)	32.5	39.6	42.3	25.4
Posterior	65.6	46.1	54.7	65.6
Others	0.4	0.3	1.2	0.5
Type of hospital				
University/Regional hospitals	8.0	6.9	6.2	3.5
Central hospitals	31.7	53.3	16.7	87.4
Rural hospitals	56.1	22.2	38.4	38.7
Private hospitals	4.0	17.6	38.7	7.3

*revision-, dysplasia- and other special designs are excluded

Table 1. Demography, choice of surgical approach and proportion between different types of hospitals for Lubinus SP II, Exeter, MS30 och CPT operated from 1999 and onward.

Survival of common stem types

	Type of stem			
	Lubinus SP II	**Exeter**	**MS30**	**CPT**
Proportion revised 0–10 years %	2.4	2.3	1.7	5.1
Proportion stem revised 0–10 years %	1.1	1.3	0.9	3.8
Survival of prostheses average±95% C.I.*				
5 years	98.0±*0.1*	97.7±*0.2*	98.0±*0.3*	95.2±*1.0*
10 years	95.9±*0.2*	95.5±*0.4*	96.5±*1.2*	92.4±*1.6*
*Stem survival** average±95% C.I.*				
5 years	99.1±*0.1*	98.7±*0.1*	98.9±*0.2*	96.4±*1.0*
10 years	97.7±*0.2*	97.4±*0.3*	97.9±*1.2*	94.1±*1.5*
Reason for revision %				
Loosening/osteolysis	34.0	26.2	13.4	13.5
Infection	26.4	25.3	33.1	17.6
Dislocation	29.2	23.0	34.3	34.5
Periprosthetic fracture	2.5	19.4	12.2	34.3
Other reasons	8.0	6.1	7.0	2.0
*Risk of revision**	2.0	2.2	2.5	1.5
Unadjusted				
0–4 years	1 (reference)	1.2 *1.1–1.3*¤	1.3 *1.1–1.5*	2.4 *2.0–3.0*¤
0–10 years	1 (reference)	1.2 *1.1–1.3*¤	–	2.3 *1.9–2.8*¤
Adjusted (age, gender, surgical approach, diagnosis)#				
0–4 years	1 (reference)	1.2 *1.1–1.3*¤	1.3 *1.1–1.5*	2.3 *1.9–2.8*¤
0–10 years	1 (reference)	1.2 *1.1–1.3*¤	–	2.1 *1.7–2.4*¤
*Risk of stem revision***				
Unadjusted				
0–4 years	1 (referende)	1.9 *1.6–2.1*¤	2.1 *1.6–2.6*¤	5.2 *4.1–6.7*¤
0–10 years	1 (reference)	1.3 *1.2–1.5*¤	–	3.1 *2.5–3.7*¤
Adjusted (age, gender, surgical approach, diagnosis)#				
0–4 years	1 (reference)	1.8 *1.6–2.1*¤	1.9 *1.5–2.4*¤	5.1 *4.0–6.5*¤
0–10 years	1 (reference)	1.4 *1.2–1.5*¤	–	3.4 *2.9–4.1*¤

*all procedures and reasons, ** all reasons

#to categorise variables see text

¤p<0.05

Table 2. Revisions, survival of prostheses, reason for revision and risk of revision. As survival diagrams for SP II and MS30 cross after about five years, the calculation of risk ratio (Cox regression) has been limited to the period 0–4 years.

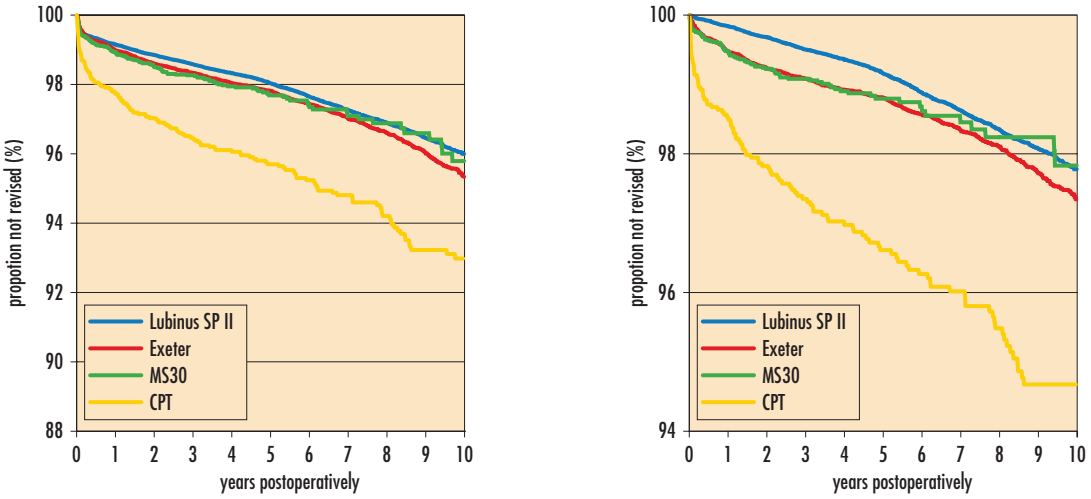


Figure 2. Implant survival based on all reasons for revision. Revision regardless of the type of measure on the left and stem revision on the right.

In comparison to the Lubinus stem, both the Exeter and MS30 stems show a lower risk for stem revision due to loosening and osteolysis (Figure 3, Table 3). After 10 years, the difference in implant survival is around 1%. As shown below ("Size of the stem and offset"), the smallest and to some extent the second smallest Lubinus stem (size 01 and 1) suffer from loosening. Data for CPT has been omitted due to lack of proportionality in relation to the reference stem over time. During the first four years, the Exeter and CPT stem were revised more often for infection. The MS30 may follow the same trend, but not significantly. It is difficult to believe that these observations could directly be related to the design of the stem. More likely, the polished stems are more often removed during infection since it is technically easier to do. In order to determine, if this theory is true or not, an extended analysis is necessary.

During evaluation of revision due to dislocation, adjustment for femoral head size is also carried out and only sizes 28 and 32 mm are included. This means that the material is reduced by 4.2% or by 6012 observations. 137,759 observations remain with 2,697 in the smallest group (CPT). Here we find that the risk for stem revision increases for the polished stems. The reason for this observation is unclear. However, one can suspect that the observation can be explained by the fact that it is relatively simpler to replace a polished stem than a matt stem, but there are also other influential factors, like selection of cup and surgical technique and factors, for which we have no data since they are not included in the Register's data capture. If we exclude the Lubinus stem from the analysis, we find that MS30 and CPT have higher risk for stem revision because of dislocation than the Exeter stem, both before and after adjustment for the possible confounding factors (adjusted RR: MS30/Exeter: 1.8 *1.1–2.9*; CPT/Exeter 3.6 *2.3–5.6*).

The polished stems have a higher risk for stem revision because of periprosthetic fracture. Also, if the increase in risk is 10 to 30 times higher, this data must be set to the proportion of the Lubinus stem (reference stem), which has an extremely low revision rate due to this complication (37 of 86,796 or 0.04% within 10 years). Furthermore, we have a reason to believe that periprosthetic fractures, which are operated without stem revision, are significantly under-reported. It is possible, that these fractures are more common if the stems are not polished. For now, a validation work is under way so, that within one or two years we are going to have a more complete data set. However, this year's analysis suggests that polished stems should be avoided in patients with more risk factors for fractures from, for example, old age, wide medullary cavity and thin cortex, severe osteoporosis and previous history of fractures.

Risk of revision for common stem types

	Type of stem			
	Lubinus SP II	Exeter	MS30	CPT
Loosening/osteolysis 0–10 years				
Unadjusted	1 (reference)	0.4 *0.3–0.5*¤	0.3 *0.1–0.6*¤	–
Adjusted (age, gender, surgical approach, diagnosis)	1 (reference)	0.4 *0.3–0.5*¤	0.3 *0.1–0.6*¤	–
Infection 0–4 years				
Unadjusted	1 (reference)	1.5 *1.2–1.9*¤	1.3 *0.9–1.9*	1.7 *0.97–3.0*
Adjusted (age, gender, surgical approach, diagnosis)	1 (reference)	1.4 *1.1–1.8*¤	1.3 *0.9–2.0*	1.9 *1.1–3.3*¤
Dislocation 0–10 years[*]				
Unadjusted	1 (reference)	2.9 *2.1–3.9*¤	4.9 *3.1–7.8*¤	13.4 *8.7–20.8*¤
Adjusted (age, gender, surgical approach, diagnosis, head diameter[*])	1 (reference)	3.2 *2.3–4.5*¤	6.5 *3.9–10.8*¤	11.4 *7.2–18.1*¤
Periprosthetic fracture 0–10 years				
Unadjusted	1 (reference)	12.2 *8.6–17.2*¤	8.5 *4.9–14.7*¤	35.3 *23.0–54.24*¤
Adjusted (age, gender, surgical approach, diagnosis)	1 (reference)	13.9 *9.8–19.7*¤	9.9 *5.7–17.1*¤	32.7 *21.3–50.4*¤

¤p<0.05

*Only 28 + 32 millimeter head is included

Table 3. Relative risk of stem revision related to reason based on Cox regression. Variable categorization for the adjusted analysis are defined in the introduction of this section. The CPT stem was not analyzed with regard to loosening/osteolysis for methodological reasons.

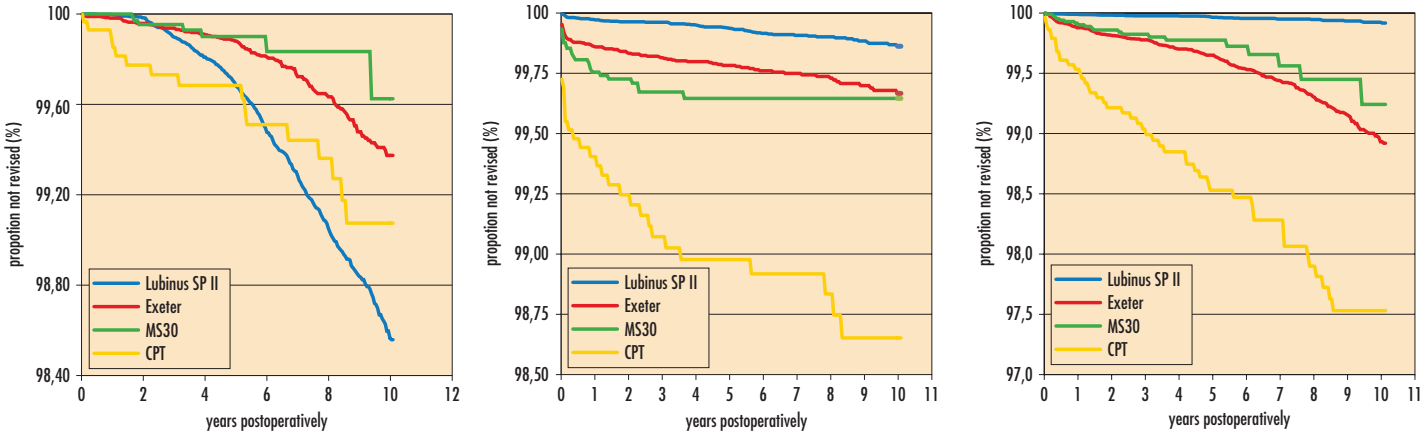


Figure 3. Stem survival based on the risk of revision for loosening/osteolysis (left), dislocation (middle) and periprosthetic fracture (right).

Size of stem and offset

In previous annual reports and in a scientific article (Thien et al, Acta Orthopaedica 2010; 81:407–412), we have showed that selection of prosthetic components may influence the outcome concerning the risk for revision. Follow-up time from 1999, this is when individual prosthetic components were beginning to be registered, was in these analyses max. 7 years and has now been extended to 2013. In a previous analysis Spectron EF Primary was included, a stem which is no longer used in Sweden in standard version. In this year's analysis, we have, in addition to Lubinus SP II and Exeter, also included MS30 and CPT. It should be noted that the size of the groups vary significantly. The Lubinus group is almost 30 times larger than the CPT group, which affects the ability to detect small differences. If a very large quantity of material is needed to show small differences, then the clinical relevance of these small differences should be taken into account. It is therefore important to assess the size of any differences and the size of the confidence interval.

This year's analysis consists of a large number of calculations, which have been concentrated so that we show only those that are statistically significant and relevant for clearer understanding of the issue. In the analysis, we have limited the materials so that only patients with primary osteoarthritis are included. In all cases, the outcome is stem revision, where all causes other than infection were included. Only operations with 28 or 32 mm femoral heads have been included in all calculations.

Lubinus SP II-stem

The analysis of Lubinus stem includes only the 150 mm long stems, which have standard and additional offset, CCD angle of 117, 126 and 135 degrees and two femoral head materials (metal or ceramic). The analysis includes offset (standard or additional offset), neck length, a combination variable of offset and neck length and finally, a constructed variable in four groups which were judged to best illustrate the effect of increased offset, whether if it is built into the stem or femoral head (Table 4).

Two of the smallest sizes of the Lubinus stem show a higher risk for stem revision because of non-infectious causes. Especially affected is size 01 (extra narrow). To get a better overview of the patients who had a revised size 01-stem, we hereby present all revisions regardless of the primary diagnosis. In this group,

Prosthetic related factors and risk of revision – Lubinus stem

	number	stem survival	RR *95% C.I.*	
		0–10 years	unadjusted	adjusted*
Stem size				
01	7,308	93.5±*0.9*	5.9 *4.7–,3*¤	8.3 *6.6–10.4*¤
1	17,810	98.2±*0.3*	1.6 *1.2–2.0*¤	1.8 *1.5–2.3*¤
2	22,601	98.9±*0.2*	1 (reference)	1 (reference)
3	15,096	99.2±*0.2*	0.9 *0.6–1.1*	0.8 *0.6–1.1*
4	6,752	99.2±*0.4*	0.8 *0.5–1.2*	0.6 *0.4–1.0*
5+6	756	99.1±*0.2*	0.8 *0.2–3.4*	0.6 *0.1–2.4*
Offset (stem offset+neck lengts)				
1 (standard+short)	17,407	98.0±*0.3*	1.1 *0.9–1.3*	1.0 *0.8–1.2*
2 (standard+medium/x-offset +short)	33,993	98.4±*0.2*	1 (reference)	1 (reference)
3 (standard+long/x-offset +medium)	17,654	98.2±*0.3*	1.1 *0.9–1.3*	1.1 *0.9–1.3*
4 (standard+x-long/x-offset +long/x-long)	1,342	95.7±*1.5*	2.6 *1.8–3.6*¤	2.6 *1.8–3.6*¤
Head material				
Metal	58,451	98.2±*0.3*	1 (reference)	1 (reference)
Ceramic	11,945	98.1±*0.2*	0.9 *0.7–1.1*	0.6 *0.5–0.7*¤

*adjusted for age, gender, surgical approach, head size and variables according to table.

¤p≤0.05

Table 4. Prosthetic related factors that affect the risk of stem revision (infection as reason is excluded) of the Lubinus stem.

81.9% are under 70 years old and 50.3% are men. 70.1% of the cases are caused by loosening of the stem and 21.2% of cases (61 prostheses) are caused by implant fracture. When problem occurs with 01-stem, younger men are overrepresented and the cause is mainly stem failure and stem fracture. Concerning size 1, the data must be viewed keeping in mind that the 10-year survival is 98.2% and the reference group (size 2) has a 10-year survival of over 98.9%. 83.2% of stem revisions for size 1 (narrow) are caused by loosening/osteolysis, and implant fracture plays little part here (1.5%, three cases). 82.7% are under 70 years old by the primary operation and 60.7% are men.

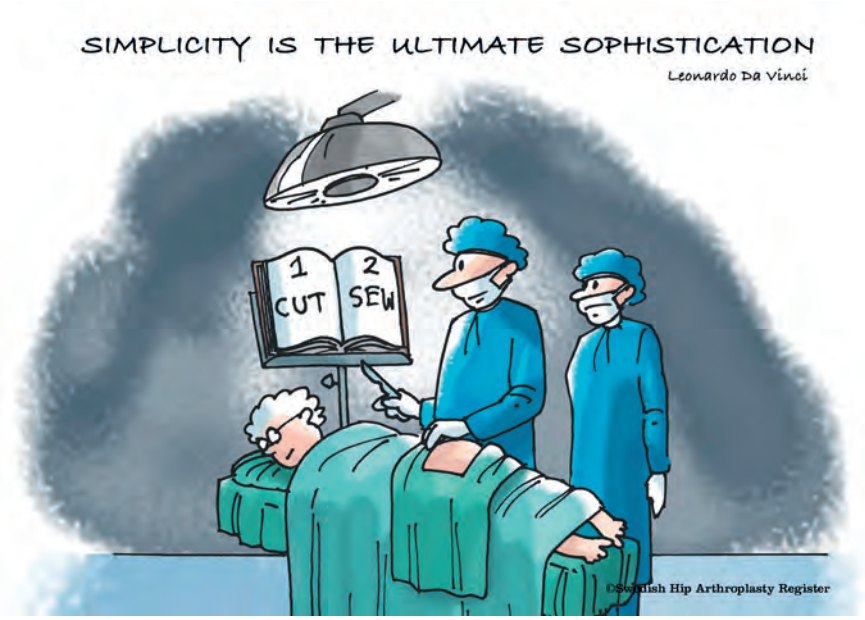
In addition to the fact that the two smallest stems have increased risk for revision, we also find, that the group for standard offset/extra long neck, additional offset stem/long or extra-long neck (group number 4 in Table 3), have an increased risk for stem revision. These revisions occur at any age, mainly concerning men (82.7%) and are carried out due to loosening (69.2%) and dislocation (15.4%). It should be noted that this group is small and in the current situation it is not possible to determine whether an alternative prosthesis selection could had been able to give a better outcome, especially regarding the risk of loosening.

Ceramic femoral head tends to give a better outcome than a head of metal. The differences come to light first after adjusting for the demographic factors, approach and selection of other prosthetic components, which makes it difficult to assess, not least against the context that highly cross-linked polyethylenes are now becoming more common, which perhaps, may compensate for the differences in wear between metal and ceramic femoral heads.

Exeter stem

When analyzing the offset and stem size, the selection criteria were set as equal as possible in terms of the Lubinus stem. This means that the diagnosis of primary osteoarthritis is included, but the stems with a 22 mm head (which is widely used with the Exeter stem) were excluded (4.1% in comparison to 0.1% for Lubinus). Ceramic femoral head have only been used in 277 cases with complete data and these cases have also been excluded. In only 120 cases, coned femoral heads, which provide an extra-long neck, have been used and these cases have therefore been combined with the femoral head, which provides a long neck. The use of a combination variable (offset*caput size) does not provide any additional information and is therefore not included.

Generally, the 10-year survival for the Exeter stem is high, although data is broken down to individual components (Table 5). The largest stems, such as those with a long neck (femoral head size in Table 4), tend to be associated with more regular stem revisions due to non-infectious causes (the table shows that 37.5 have a significantly lower risk than the reference stem 44). Concerning sizes 4–6, the difference disappears after the adjustment for age, gender, approach and caput size, which may indicate that the increased risk for revision is an effect of these stems having been selected for patients with an increased risk for revision due to periprosthetic fracture. Among the revised cases with these stem sizes, the cause for more than half of the cases (52.5%) was periprosthetic fracture after loosening/osteolysis (24.5%). Stems with the largest offset were revised in 70.6% of cases due to periprosthetic fracture, which was also the most common cause for revision in cases, where a long and extra-long femoral head had been used (51.5%). In the total group of revised Exeter stems, which were operated during the same time, was the frequency for stem revision, due to periprosthetic fracture, 45.5% after exclusion of revision due to infection.



Prosthetic related factors and risk of revision – Exeter stem

	number	stem survival	RR *95% C.I.*	
		0–10 years	unudjusted	adjusted*
Stem size				
0	8,955	98.3±*0.6*	1.0 *0.7–1.4*	1.1 *0.9–1.6*¤
1	12,754	98.2±*0.3*	1 (referens)	1 (referens)
2	9,726	97.9±*0.5*	1.1 *0.8–1.3*	0.9 *0.7–1.2*
3	4,297	97.1±*0.9*	1.2 *0.9–1.6*	0.9 *0.7–1.3*
4–6	1,776	96.9±*0.3*	1.9 *1.3–2.8*¤	1.4 *0.9–2.0*
Offset				
37.5	17,407	98.2±*0.5*	0.7 *0.5–0.9*¤	0.8 *0.6–0.99*¤
44	33,993	97.8±*0.5*	1 (referens)	1 (referens)
50	17,654	97.4±*1.4*	1.3 *0.8–2.1*	1.1 *0.6–1.8*
Head lengths				
short	7,475	98.4±*0.5*	0.8 *0.6–1.1*	1.0 *0.8–1.2*
medium	23,834	97.9±*0.3*	1 (referens)	1 (referens)
long + extralong	6,199 (6,073+126)	97.3±*0.6*	1.6 *1.3–2.1*¤	1.4 *1.1–1.8*¤

*adjusted for age, gender, surgical approach, head size and variables according to table.
¤p≤0.05

Table 5. Prosthetic related factors that affects risk of stem revision (infection as reason is excluded) of the Exeter stem.

MS30 and CPT stems

Regarding MS30 and CPT, we find no obvious relation between stem size, offset and risk for stem revision due to non-infectious causes. CPT stems, which have been made of stainless steel (n=964) and cobalt-chromium alloy (n=1,000) show no differences concerning stem survival (stainless steel: 95.9±1.4; cobalt-chromium alloy 95.0±2.0, p=0.9, log rank test).

The three most commonly used cemented stems in Sweden, Lubinus SP II, Exeter and MS30, generally have a high 10-year survival. Lubinus stem size 01 should be avoided, especially among physically active patients in light of the increased risk of loosening and stem fracture. If possible, avoid polished standard stems for patients with osteoporosis and wide medullary cavity because of the risk of periprosthetic fracture. CPT stem, compared with the reference stem, has an increased risk for revision. Since large offset has an increased risk for revision for these types of prosthesis, the preoperative planning is important to avoid using additional offset and long neck, in cases other than the patient's normal anatomical requirements. Future prospective randomized studies are required to determine whether reducing the offset can also reduce the risk of revision without compromising the function of the joint.

Highly cross-linked polyethylene

Polyethylene which is radiated with a high dosage in order to induce additional cross-linkages between molecular chains, and is subsequently heat-treated in order to reduce the amount of free radicals, is called a highly cross-linked polyethylene in analogy with the English term "highly cross-linked". The term "high-molecular-weight polyethylene" has also been used, but was actually introduced during the 1970s, when the molecular weight of polyethylene was gradually increased in order to improve its wear resistance. In Sweden, the first operation with highly cross-linked polyethylene cup was carried out in 1998. Until 2003, this type of polyethylene was used in cemented cups or liners in less than 100 cases per year. After 2004, highly cross-linked polyethylene was used more and more and in 2013, it was used in 73.5% of all hip arthroplasty operations (Figure 1). Today, there is an excellent documentation, which shows that the new polyethylene really does reduce wear in a 10-year perspective for many of the different types of polyethylene, which can be found on the Swedish market. However, the majority of these versions lack extensive documentation. There is hope, that the reduced wear of the polyethylene may mean a reduction of secondary effects, such as inflammation and osteolysis. However, the documentation is even worse here. Data from the Australian and the English hip arthroplasty registers indicate that the new polyethylene reduces the risk for revision, but until the last report, we at the Swedish Hip Arthroplasty Register have not found any significant differences, perhaps because we have used different selection criteria in the analyses to reduce the risk of bias.

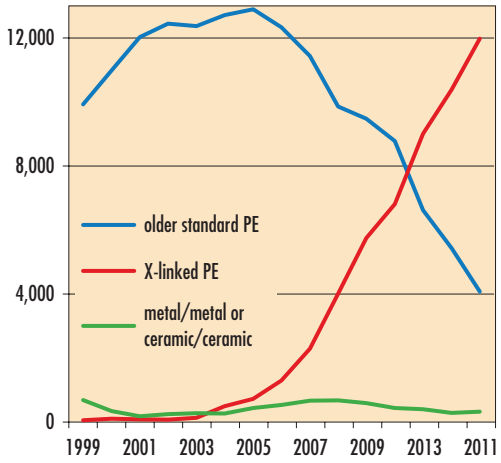


Figure 1. Number of operations where the cup or liner manufactured by older standard polyethylene or with highly cross-linked polyethylene

This year's analysis is slightly different from the previous one. To increase the number of observations, it has not been required that the operations must have occurred during the exact same period. The analysis of cemented cups has included two new designs, Lubinus with highly cross-linked polyethylene and Exeter Rimfit. The last design does not only differ due to the polyethylene but also due to design and to some extent due to the surgical technique. Additionally, the time of observation is short and data is reported separately. Since both of these cups are used often, we believe that a simple reporting of revisions is important to rule out the possibility that the material or design changes, which goes for the Exeter cup, have any unwanted effects.

Among the uncemented cups, the Trilogy cup was used, which was used with the new polyethylene quite early, but many clinics still kept using the previous generation's polyethylene. The majority of the other uncemented cups, which are in use in Sweden today, have been used almost exclusively with the new polyethylene. However, there are three designs that have been used with both the new and the old polyethylene – Allofit, Trident Hemi and Ranawat-Burstein. Each design was used during at least 414 operations and at least a quarter of these used a liner of somewhat older or newer polyethylene. In order to gain an accurate idea of the situation, every individual comparison is based on a period, which ended when the number of standard polyethylene or highly cross-linked polyethylene groups went up at least to 50 observations. For example, the ZCA cup revisions, which were carried out later than 7.5 years after the index operation, are neglected, in an effort to reduce the risk of influence from the fact that observation time is always longer for the older types of polyethylene.

Unlike previous years, we now see, when the observation time has increased, a trend towards reduced number of cup/liner revisions concerning the use of highly cross-linked polyethylene (Table 1). Significant difference exists in the comparison between the Elite Ogee and Marathon if the cup revision due to loosening/osteolysis within 5 years is used as an outcome. After adjusting for age, gender, diagnosis and femoral head size in a Cox regression, this difference, however, disappears (older/new polyethylene RR: 2.3 *0.8–6.4*). The difference according to the log rank test is probably somewhat dependent on, or perhaps not at all, the use of different polyethylene materials.

When comparing the selection of different polyethylene liners for the Trilogy cup, there is also a difference in the occurrence of cup/liner revisions due to loosening/osteolysis, in the advantage of the new polyethylene. Further analysis, with adjustment for the variables mentioned above, shows that the group with liner of older polyethylene has an increased risk of revision (RR, older/new polyethylene: 2.6 *1.3 to 5.2*). If the other uncemented cup types are also included, the risk increases a bit more (2.9 *1.5 to 5.9*).

Cup revision – conventional and highly crosslinked polyethylene

	Number at start	Number*/total obs. time	Cup-/liner revision all reasons n, %	Cup-/liner revision loosening – lysis n, %	Log Rank test all reasons/ loosening–lysis
Cemented cup					
ZCA					
conventional PE	1,304	735/7.5 yrs	24 *1.8*	12 *0.9*	0.4/0.08
XLPE	12,553	108/7.5 yrs	157 *1.3*	23 *0.2*	
Reflection all-poly					
conventional PE	6,469	4,429/6.5 yrs	223 *3.4*	132 *2.0*	0.07/0.07
XLPE	1,719	114/6.5 yrs	29 *1.7*	11 *0.6*	
Elite Ogee/Marathon					
conventional PE	11,514	8,667/5.0 yrs	119 *1.0*	42 *0.4*	0.14/0.007
XLPE	7,524	66/5.0 yrs	47 *0.5*	4 *0.04*	
Lubinus					
conventional PE	60,790	47,972/2.8 yrs	424 *0.7*	65 *0.7*	0.60/0.27
XLPE	4481	137/2.8 yrs	14 *0.3*	0 *0.0*	
Exeter/Exeter Rim-fit					
conventional PE	12,824	11,621/3 yrs	133 *1.0*	35 *0.3*	0.03/0.34
XLPE	3,236	121/3 yrs	9 *0.3*	2 *0.1*	
Uncemented cup					
Trilogy#					
conventional PE	2,039	660/12 yrs	92 *4.5*	45 *2.2*	0.53/0.003
XLPE	6,861	50/12 yrs	137 *2.0*	15 *0.2*	
Trilogy, Allofit, Trident hemi, Ranawat-Burstein					
conventional PE	2,497	676/12 yrs	105 *4.2*	50 *2.0*	0.38/0.002
XLPE	8,388	50/12 yrs	153 *1.8*	18 *0.2*	

*at end of observation time #excluding IT variants

Table 1. Frequency of cup revision by use of conventional and highly cross-linked PE. Log Rank test based on time of observation according to column 3 (number/total observation time). Allofit, Trident hemi and Ranawat-Burstein are not shown separately due to too few observations in each subgroup (see text).

The use of highly cross-linked polyethylene is expected to reduce the risk for cup/liner revisions after a period of 5 to 12 years, the time in which osteolysis and/or loosening tends to result in a higher number of cup revisions when using the older type of polyethylene.
Trilogy cup with a highly cross-linked polyethylene liner have a reduced risk for revision after 12-year observation. There are many indications that the same is also true for other uncemented designs, but you cannot take it for granted that these results can be generalized to all types of highly cross-linked polyethylenes available on the market. We also see a trend towards a reduced risk of revision for cemented cups but longer follow-up is required to determine, if highly cross-linked polyethylene is preferable also with this technique.

"New" primary prosthetics

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, including the Australian register, the English and Welsh register and the Scottish Hip Arthroplasty Project (de Steiger et al. *Acta Orthopaedica*, Vol. 84 (4): 348–352, 2013; Annual Report from the National Joint Register for England, Wales and Northern Ireland 2013, www.njrcentre.org.uk, ISSN 2054-183X).

The restrictions for new implants in Sweden are well founded. In a review of the new hip and knee prosthetics, which was introduced in Australia in 2003–2007, it was found that none of the new implants have a lower risk for revision and almost 30% of them had a higher frequency of revisions (Anand et al. *J Bone Joint Surg Am*, 2011 Dec 21;93(Supplement 3):51–54). Focusing on a small number of implants meant for Sweden that very large groups of implants with different designs could be compared. This means that even small differences between groups gain a statistical significance and it is often difficult or even impossible, based on the Register's data, to determine whether the detected difference can be attributed to the indication setting, surgical technique, patient care or to the implant itself.

During the past decade, at least three important factors have influenced the selection of implant and contributed to the replacement of older implants and to the arrival of new types of implants on the Swedish market. The introduction of highly cross-linked polyethylene with the potential to reduce wear-related complications has meant that virtually all the cups and liners are now available and are generally used with the new polyethylene, sometimes in combination with extensive changes in the design of the implant. In the 2000s, there was a shift from cemented to uncemented fixation, which meant that many new implants made their way on the market. Additionally, most of the suppliers of uncemented cups introduced a trabecular metal, primarily with the aim of achieving a better fixation. Finally, the awareness among patients concerning the selection of prostheses became greater through direct marketing and more detailed information on the Internet. This effect was particularly evident when the resurfacing prostheses were launched.

A pronounced restrictiveness against new implants also has a downside, because prostheses with the potential to provide better functionality and durability are tardily put to use on the Swedish market. However, taking into account the history, it is vital that new implants are introduced in a responsible manner and are monitored. In the current situation, it can only be done via the Register, if it concerns revisions. Patient-reported outcomes can also be registered, but may be difficult to interpret in small patient groups, where different prostheses combinations are used and which have varying patient demographics. In the future, we hope to establish a more advanced service, where interested clinics can take part in multi-center studies with higher data capture.

Assessment of the number of revisions and implant survival should be carried out by taking into account the length of observation time. Prostheses, which have a shorter observation, time than the group "other", should have fewer revisions and higher implant survival after 2 years. Our choice of the control group may be questioned, since many of the no longer used implants are included. However, we have chosen not to change this group before the next annual report when the follow-up time for many of the most used implants reaches 10 years. In this year's review of new implants, we have, in comparison to the previous annual report, broadened the inclusion criteria. In order to include an implant, the year for the first operation must be 2003 or one year later, at least 60 prostheses must have been used during 2011–2013 and the prosthesis must have been in use in 2012–2013. For two of the stems with less than 5905 observations, a separate analysis was carried out for variations of the same design. This concerns Bi-Metric X Por HA and Corail. Concerning the cemented stems, none of them met the inclusion criteria. Instead, four of the most used stems became the subjects for a separate in-depth analysis.

Implant survival for different types of new cups

	First year*	Number		Follow-up (years)	Cup revisions, all reasons, number %		Implant survival¤ cup/ liner, SE	
		Total	2-yr f.u.	mean, max	Total	≤ 2 years	2 years	5 years
Cup cemented								
Avantage	2006	863	293	1.8 *10.8*	29 *3.4*	26 *4.6*	**96.8 *1.0***	**95.0 *1.1***
Exceed ABT#	2011	211	46	1.3 *2.8*	0 *0*	0 *0*	–	–
Exeter Rim-fit	2010	4,300	1,341	1.4 *3.4*	12 *0.3*	12 *0.3*	99.6 *0.1*	–
FAL x-link	2011	180	64	1.5 *2.8*	0 *0*	0 *0*	100 *0.0*	–
Lubinus x-link	2010	5,188	682	1.0 *3.1*	17 *0.3*	17 *0.3*	99.4 *0.2*	–
Lubinus IP x-link	2011	142	29	1.3 *2.8*	1 *0.7*	1 *0.7*	–	–
Marathon	2008	10,148	5,043	2.1 *7.7*	47 *0.5*	43 *0.4*	99.4 *0.1*	99.3 *1.5*
Polarcup	2010	249	68	1.4 *4.6*	5 *2.0*	4 *1.6*	**98.3 *0.8***	–
Reflexion XLPE	2007	1,725	1,630	4.5 *8.0*	29 *1.7*	13 *0.8*	99.1 *0.2*	98.1 *0.2*
ZCA XLPE	2006	12,573	8,227	3.1 *8.6*	157 *1.2*	154 *0.8*	**99.0 *0.1***	**98.0 *0.4***
Others	2006	65,512	53,337	4.3 *7.9*	807 *1.2*	399 *0.6*	99.3 *0.0*	98.6 *0.1*
Cup uncemented								
Allofit Alloclastic	2011	126	46	1.5 *2.9*	1 *0.8*	1 *0.8*	–	–
Continuum	2010	1,393	280	1.2 *4.2*	30 *2.2*	30 *2.2*	**97.3 *0.5***	–
Delta Motion	2011	127	54	1.7 *3.2*	1 *0.8*	1 *0.8*	99.2 *0.1*	–
Delta TT	2012	83	1	0.7 *2.1*	1 *1.2*	1 *1.2*	–	–
Exceed Ringloc	2011	584	114	1.1 *3.3*	4 *0.7*	3 *0.5*	99.5 *0.3*	–
Full Hemisphere	2007	232	204	4.5 *9.1*	1 *0.4*	0 *0.0*	100 *0.0*	99.5 *0.5*
Furlong H-AC. CSF	2012	70	0	0.9 *1.7*	0 *0.0*	0 *0.0*	–	–
Pinnacle 100	2007	1,210	573	2.1 *9.8*	11 *0.9*	6 *0.5*	99.3 *0.3*	97.8 *0.9*
Pinnacle sector	2006	461	290	3.2 *8.0*	12 *2.6*	5 *1.1*	98.7 *0.6*	96.9 *1.1*
Pinnacle W/Cripton 100	2011	243	11	0.8 *2.3*	2 *0.8*	2 *0.8*	–	–
Ranawat- Burstein	2005	712	638	4.2 *8.7*	9 *1.3*	6 *0.8*	99.2 *0.3*	98.7 *0.5*
Reflection HA	2004	167	131	4.2 *9.8*	3 *1.8*	2 *1.2*	98.7 *0.9*	98.7 *0.9*
Regenerex	2008	390	229	2.4 *5.6*	4 *1.0*	1 *0.3*	98.8 *0.7*	–
TMT modular	2006	543	372	3.3 *7.7*	9 *1.9*	9 *1.7*	98.3 *0.6*	98.3 *0.6*
TMT revision	2008	289	133	2.1 *8.1*	7 *2.4*	7 *2.4*	**97.3 *1.0***	–
Trident AD LW	2004	637	491	4.1 *9.9*	15 *2.4*	10 *1.6*	98.0 *0.6*	97.2 *0.8*
Trident AD WHA	2004	1,141	916	4.6 *9.8*	26 *2.3*	15 *1.3*	98.6 *0.4*	97.9 0.5
Trident hemi	2005	1,532	933	3.1 *8.6*	23 *1.5*	13 *0.9*	98.8 *0.3*	97.9 0.5
Tritanium	2010	373	172	1.9 *4.1*	8 *2.1*	6 *1.6*	97.4 *1.0*	–
Others	2004	11,554	9,508	4.9 *9.8*	263 *2.3*	149 *1.3*	98.6 *0.1*	97.9 *0.1*

* First year when more than 10 implantats were used, first year for the groups "Others" are the same as the earliest year in the observation groups.

non- flanged

¤ data has been calculated if the number of operations exceed 50.

Table 1. Cups that have been introduced in Sweden since 2003 and have been used at more than 60 THRs during the last three years, and also have been used in 2013. Implant survival has been calculated if the numbers of observation at two respectively five years exceed 50. Bold text indicates that the outcome deviates for the worse from the group "Others" (log rank test).

In the group of cemented cups, 10 versions meet the input criteria (Table 1). This year, we have also included previous well-documented designs, where the only difference is that the quality of the older polyethylene is changed into the highly cross-linked polyethylene (refer to the previous section). This data has been included so that the comparison is not identical to the one, which was used, in the section "Highly cross-linked polyethylene". Based on cup revisions, three of the 10 cups, which were analyzed, show a lower implant survival, regardless of the cause after two years, and one version also after 5 years. Two cases are concerned with dual articular cups (Avantage and Polarcup). In both cases, the mean age of the patients during the time of operation is higher; more patients with hip fracture are included, which suggests that there is a connection to a selected group of patients with a higher risk for complications (Table 2). The reason for revision has in large part to do with infection, which supports this hypothesis. In the third case (ZCA cup), the demographics does not differ much from the control group and the difference compared to the control group is small.

However, the distribution of causes differs because the ZCA cup is more often revised due to dislocation, and less often due to loosening. Upon review of the proportion of revision due to dislocation in relation to the primary clinic, there is no significant variation (data not shown), which means that the results can hardly be related to the small number of underperforming clinics. Although the cause for the dislocation problem is not found in our analysis, it appears that the problem may not be related to surgical technique.

In the analysis of the uncemented cups, the Continuum cup shows a shorter survival rate after two years, in comparison to the control group. The majority of the cases were revised due to infection and dislocation. Although there is relatively little material, it is possible to state that these cases often occur in clinics, which, in the overall analysis, have had a growing number of reoperations within 2 years. This may suggest either that the cups' design could or could not have influenced the outcome, but the observation is in itself valuable to the extended analysis. The revision versions of TMT cup's (TMT revision) 2-year survival is placed just above the control group (p=0,047). In this group, secondary osteoarthritis is more common and in five of the cases, which were revised due to dislocation, the diagnosis is sequelae after childhood disease or fracture sequelae.

Many of the new uncemented stems were introduced in Sweden during the past decade. Some have been well documented in previous versions and in other countries. Concerning versions of the best-documented stems, which have been used in large numbers and during a relatively long time, show that the implant survival in Sweden corresponds to the expected. No stems show a 2- or 5-year survival, which without adjustment for a different demographic, have a significantly abnormal 2- or 5- year survival rate compared to the lower ranked control group (Table 3).

Demography for cups with non-conforming implant survival

	Age	Gender	Diagnosis %	Reason for revision numbers % #				
	Mean SD	Female %	Primary OA/ fracture/other secondary OA	Loosening/ osteolysis	Infection	Dislocation	Peri-prosthetic fracture	Others
Cemented								
Avantage	74.9 *11.7*	61.7	21.4/62.6/17.0	1 *(3.6)*	19 *(67.9)*	3 *(10.7)*	3 *(10.7)*	2 *(7.1)*
Polarcup	76.2 *10.0*	64.3	10.8/73.1/16.1	0 *(0)*	3 *(60)*	1 *(20)*	1 *(20)*	0 *(0)*
ZCA	71.0 *9.1*	63.9	84.6/10.2/6.2	23 *14.6*	33 *21.0*	77 *49.0*	7 *4.5*	17 *10.8*
Others	70.8 *9.1*	61.1	84.0/10.4/5.6	258 *32.0*	196 *24.3*	265 *32.8*	22 *2.7*	66 *8.2*
Uncemented								
Continuum	58.9 *12.0*	49.0	85.0/2.3/12.7	0 *(0)*	14 *(46.7)*	14 *(46.7)*	0 *(0)*	2 *(6.7)*
TMT revision	59.0 *12.6*	45.3	68.5/2.8/29	0 *(0)*	1 *(14.3)*	6 *(85.7)*	0 *(0)*	0 *(0)*
Others	56.1 *10.7*	49.0	79.7/3.4/16.9	49 1 *18.6*	83 *31.6*	90 *34.2*	9 *3.4*	32 *12.2*

percentage in brackets when numbers <100

Table 2. Demography and reason for revision for implantats analysed in Table 1 that signifi-cantly differ through poorer implant survival regarding cup/liner revision.

Implant survival for different types of new stems

	First year*	Number		Follow-up mean max	Stem revisions, all reasons, number %		Implant survival¤ stem, SE	
		total	2-yr f.u.	year	total	< 2 years	2 years	5 years
Stem uncemented								
Accolade straight	2004	1,740	1,295	3.8 *9.9*	30 *1.7*	21 *1.2*	98.6 *0.3*	98.2 *0.4*
Accolade II	2012	259	–	0.6 *1.9*	1 *0.4*	1 *0.4*	–	–
Bi-Metric X Por HA *all*	2003	5,905	4,162	3.8 *10.1*	88 *1.5*	72 *1.2*	98.6 *0.2*	98.3 *0.2*
Standard	2004	3,367	2,408	3.8 *10.9*	46 *1.4*	40 *1.2*	98.7 *0.2*	98.4 *0.2*
Lateralise	2003	2,538	1,754	3.8 *10.8*	42 *1.7*	32 *1.3*	98.5 *0.3*	98.1 *0.3*
Corail *all*	2005	10,572	5,667	2.4 *10.4*	117 *1.1*	96 *0.9*	98.9 *0.1*	98.3 *0.2*
Standard	2006	6,965	3,712	2.4 *10.4*	77 *1.1*	67 *1.0*	98.9 *0.1*	98.4 *0.3*
Coxa vara	2006	1,520	801	2.5 *8.6*	14 *0.9*	12 *0.8*	99.0 *0.3*	98.9 *0.3*
High offset	2006	2,087	1,154	2.5 *9.1*	26 *1.2*	17 *0.8*	99.1 *0.2*	97.6 *0.6*
Fitmore	2009	235	114	1.9 *5.0*	6 *2.6*	5 *2.1*	97.7 *1.0*	–
Furlong evolution HA C	2012	70	–	0.9 *1.7*	1 *1.4*	1 *1.4*	–	–
M/S Taper	2012	279	–	0.6 *1.8*	0 *0.0*	0 *0.0*	–	–
Symax	2005	407	292	4.8 *8.6*	6 *1.5*	1 *0.2*	99.8 *0.2*	98.3 *0.7*
Taperloc#	2012	83	2	0.9 *2.9*	0 *0.0*	0 *0.0*	–	–
Others	2003	16,068	13,224	5.1 *11.0*	303 *1.9*	210 *1.3*	98.5 *0.1*	98.1 *0.1*

*First year when more than 10 implants were used. First year for the groups "Others" has arbitrarily been set to the earliest of the other groups. #different variations are included, although not Microplasty, ¤data has been calculated if the number of operations exceed 50.

Table 3. Stems that have been introduced in Sweden since 2003 and been used at more than 60 THRs during the last three years, and also have been used in 2013. Implant survival has been calculated if the numbers of observation at two respectibvely five years exceed 50. Bold text indicates that the outcome deviates for the worse from the group Others (log rank test).

Conclusion. Three cemented and two uncemented cups, which have been introduced to the Swedish market since 2003, show an implant survival after two years, which is worse than was expected. The demographic differences and the differences in indications, and to a smaller extent the difference in surgical technique, can probably explain this observation. Concerning the ZCA cup, continued monitoring and a deeper analysis is desirable, despite the fact that the deviation of the cup is small. None of the analyzed stems showed a significant deviation for the worse in comparison to the control group.

Notes

15 most common components

(most used the past 10 years)

Cup (Stem)	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Lubinus all-poly (Lubinus SP II)	72,291	4,943	5,167	4,347	3,608	2,625	92,981	31.6%
Contemporary Hooded Duration (Exeter Polished)	4,770	1,734	1,490	632	565	414	9,605	5.8%
ZCA XLPE (MS30 Polished)	1,497	994	1,155	1,150	1,225	1,008	7,029	4.7%
Charnley Elite (Exeter Polished)	8,805	520	133	49	6	0	9,513	4.1%
Marathon XLPE (Exeter Polished)	47	690	1,105	1,260	1,401	1,299	5,802	3.9%
Exeter Duration (Exeter Polished)	11,323	208	183	72	0	0	11,786	3.4%
Lubinus X-linked (Lubinus SP II)	1	0	23	686	1,462	2,539	4,711	3.1%
FAL (Lubinus SP II)	4,934	438	397	266	163	109	6,307	2.7%
Exeter X3 Rim Fit (Exeter Polished)	0	0	106	1,021	1,071	1,199	3,397	2.3%
Reflection (Spectron EF Primary)	7,365	127	29	4	3	7	7,535	2.0%
Trilogy HA (CLS Spotorno)	1,323	379	380	372	255	182	2,891	1.9%
ZCA XLPE (Lubinus SP II)	385	462	480	334	352	355	2,368	1.6%
Lubinus all-poly (Corail collarless)	258	406	401	356	317	195	1,933	1.3%
Marathon XLPE (Corail collarless)	15	186	382	387	422	303	1,695	1.1%
Charnley (Exeter Polished)	2,618	2	3	0	0	0	2,623	1.0%
Others (1,518)	183,956	4,650	4,512	5,016	5,176	6,064	209,374	
Total	299,588	15,739	15,946	15,952	16,026	16,299	379,550	

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)	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Lubinus all-poly (Lubinus SP II)	72,291	4,943	5,167	4,347	3,608	2,625	92,981	43.0%
Contemporary Hooded Duration (Exeter Polished)	4,770	1,734	1,490	632	565	414	9,605	7.9%
ZCA XLPE (MS30 Polished)	1,497	994	1,155	1,150	1,225	1,008	7,029	6.4%
Charnley Elite (Exeter Polished)	8,805	520	133	49	6	0	9,513	5.5%
Marathon XLPE (Exeter Polished)	47	690	1,105	1,260	1,401	1,299	5,802	5.2%
Exeter Duration (Exeter Polished)	11,323	208	183	72	0	0	11,786	4.6%
Lubinus X-linked (Lubinus SP II)	1	0	23	686	1,462	2,539	4,711	4.3%
FAL (Lubinus SP II)	4,934	438	397	266	163	109	6,307	3.7%
Exeter X3 Rim Fit (Exeter Polished)	0	0	106	1,021	1,071	1,199	3,397	3.1%
Reflection (Spectron EF Primary)	7,365	127	29	4	3	7	7,535	2.7%
ZCA XLPE (Lubinus SP II)	385	462	480	334	352	355	2,368	2.1%
Charnley (Exeter Polished)	2,618	2	3	0	0	0	2,623	1.4%
Reflection XLPE (Spectron EF Primary)	711	507	220	97	0	0	1,535	1.4%
ZCA XLPE (Exeter Polished)	101	78	141	237	225	209	991	0.9%
Charnley Elite (Lubinus SP II)	1,281	21	58	95	63	37	1,555	0.8%
Others (353)	151,405	416	392	610	757	896	154,476	
Total	267,534	11,140	11,082	10,860	10,901	10,697	322,214	

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)	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Trilogy HA (CLS Spotorno)	1,323	379	380	372	255	182	2,891	14.9%
Trident HA (Accolade)	547	235	201	201	178	120	1,482	7.8%
Allofit (CLS Spotorno)	988	221	140	80	43	52	1,524	6.9%
Pinnacle HA (Corail Collarless)	117	100	130	123	189	221	880	4.6%
Trilogy HA (Corail Collarless)	129	155	212	160	83	47	786	4.1%
CLS Spotorno (CLS Spotorno)	1,168	45	36	38	27	9	1,323	4.0%
Trident HA (ABG II HA)	240	107	70	83	49	40	589	3.1%
Continuum (CLS Spotorno)	0	0	37	94	156	206	493	2.6%
Trilogy HA (Bi-Metric HA std)	195	61	68	53	50	38	465	2.4%
Ranawat/Burstein (Bi-Metric HA std)	114	127	134	44	32	11	462	2.4%
Trilogy (CLS Spotorno)	558	27	4	0	0	0	589	2.4%
Pinnacle (Corail Collarless)	58	27	49	79	90	89	392	2.1%
Exceed ABT (Bi-Metric HA std)	1	0	1	85	140	163	390	2.0%
Trilogy HA (Wagner Cone Prosthesis)	63	71	96	70	27	7	334	1.7%
Trilogy HA (Corail Collared)	0	0	50	89	119	64	322	1.7%
Others (394)	8,740	524	682	939	1,078	1,740	13,703	
Total	14,241	2,079	2,290	2,510	2,516	2,989	26,625	

[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)	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Trilogy HA (Lubinus SP II)	1,093	56	47	70	68	50	1,384	23.4%
Trident HA (Exeter Polished)	9	15	56	82	92	115	369	13.2%
Trilogy HA (Spectron EF Primary)	1,234	8	2	2	0	0	1,246	12.6%
Trilogy HA (Exeter Polished)	71	28	23	7	1	1	131	3.9%
Ranawat/Burstein (Lubinus SP II)	46	16	12	18	15	1	108	3.9%
Trilogy HA (MS30 Polished)	48	19	17	15	4	3	106	3.8%
TOP Pressfit HA (Lubinus SP II)	146	9	3	1	3	0	162	2.6%
Trident HA (Lubinus SP II)	29	14	6	5	3	10	67	2.4%
Trident HA (ABG II Cemented)	61	0	2	0	0	0	63	2.3%
Trilogy HA (CPT (CoCr))	13	6	12	15	17	0	63	2.2%
Continuum (MS30 Polished)	0	0	0	5	17	32	54	1.9%
Reflection HA (Lubinus SP II)	204	3	0	1	1	0	209	1.9%
Tritanium (Exeter Polished)	0	0	0	9	13	30	52	1.9%
Trilogy HA (Stanmore mod)	96	1	0	0	0	0	97	1.3%
Continuum (Lubinus SP II)	0	0	0	4	7	22	33	1.2%
Others (273)	6,305	56	51	62	93	130	6,697	
Total	9,355	231	231	296	334	394	10,841	

[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)	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Lubinus all-poly (Corail Collarless)	258	406	401	356	317	195	1,933	12.9%
Marathon XLPE (Corail Collarless)	15	186	382	387	422	303	1,695	11.3%
Contemporary Hooded Duration (ABG II HA)	336	156	123	25	6	0	646	4.3%
Lubinus all-poly (CLS Spotorno)	276	54	68	34	47	36	515	3.4%
Contemporary Hooded Duration (Corail Collarless)	13	22	25	105	146	183	494	3.3%
ZCA XLPE (Corail Collarless)	40	68	106	51	84	115	464	3.1%
Charnley Elite (Corail Collarless)	277	79	60	20	5	1	442	2.9%
Lubinus all-poly (Bi-Metric HA lat)	179	72	72	81	22	1	427	2.8%
ZCA XLPE (CLS Spotorno)	167	59	60	66	60	14	426	2.8%
Marathon XLPE (ABG II HA)	0	21	74	85	115	124	419	2.8%
Marathon XLPE (Corail Collared)	0	1	42	104	117	147	411	2.7%
Marathon XLPE (Bi-Metric HA std)	5	53	76	102	101	72	409	2.7%
Charnley Elite (CLS Spotorno)	375	19	4	3	3	5	409	2.6%
Lubinus all-poly (Corail Collared)	0	0	41	104	79	110	334	2.2%
Marathon XLPE (CLS Spotorno)	10	84	79	57	51	30	311	2.1%
Others (299)	3,873	555	463	518	621	805	6,835	
Total	5,824	1,835	2,076	2,098	2,196	2,141	16,170	

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)	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
BHR Acetabular Cup (BHR Femoral Head)	647	137	137	125	60	61	1,167	54.6%
ASR Cup (ASR Head)	286	82	28	0	0	0	396	20.6%
Durom (Durom)	329	28	5	0	0	0	362	16.2%
Adept (Adept Resurfacing Head)	15	0	34	25	1	0	75	3.9%
BHR Acetabular Cup (BMHR VS)	0	2	6	11	9	9	37	1.9%
Durom studiecup (Durom)	13	2	0	0	0	0	15	0.8%
BHR Dysplasia Cup (BHR Femoral Head)	10	1	1	3	1	0	16	0.7%
ReCap Cup (ReCap Head)	7	0	2	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	0	3	1	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	0	1	0	0	0	1	0.1%
Unknown resurfacing cup (Unknown resurfacing 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	1,330	252	214	167	72	70	2,105	

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

15 most common cup components
(most used the past 10 years)

Cup	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Lubinus all-poly	95,479	5,561	5,843	5,006	4,144	3,013	119,046	34.2%
ZCA XLPE	2,743	2,002	2,120	1,912	2,012	1,787	12,576	8.4%
Contemporary Hooded Duration	5,621	1,989	1,701	802	752	618	11,483	7.1%
Marathon XLPE	82	1,099	1,928	2,295	2,497	2,248	10,149	6.8%
Charnley Elite	14,603	716	284	172	82	43	15,900	6.0%
Trilogy HA	5,257	827	980	933	710	443	9,150	4.5%
Exeter Duration	12,281	230	189	79	0	0	12,779	3.8%
Lubinus X-linked	1	0	24	734	1,639	2,934	5,332	3.6%
FAL	5,066	480	448	290	170	117	6,571	2.9%
Exeter X3 RimFit	0	0	138	1,258	1,401	1,503	4,300	2.9%
Trident HA	1,202	440	372	407	386	485	3,292	2.2%
Reflection	8,930	167	44	8	10	9	9,168	2.1%
Charnley	61,469	4	3	0	0	0	61,476	1.3%
Reflection XLPE	752	571	276	123	1	2	1,725	1.1%
Allofit	1,164	242	169	88	46	62	1,771	1.0%
Others (201)	84,938	1,411	1,427	1,845	2,176	3,035	94,832	
Totalt	299,588	15,739	15,946	15,952	16,026	16,299	379,550	

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

15 most common stem components
(most used the past 10 years)

Stem	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Lubinus SP II	85,929	6,248	6,125	6,379	6,146	6,171	116,998	42.0%
Exeter Polished	45,031	3,432	3,298	3,273	3,414	3,460	61,908	21.7%
CLS Spotorno	5,891	645	1,010	915	861	735	10,057	5.8%
Corail Collarless	1,034	1,560	1,203	1,493	1,527	1,672	8,489	5.6%
MS30 Polished	2,593	1,252	1,035	1,213	1,324	1,470	8,887	5.6%
Spectron EF Primary	10,486	9	739	319	132	8	11,693	3.6%
Bi-Metric HA std	1,153	452	466	443	424	429	3,367	2.2%
Bi-Metric HA lat	1,175	382	359	280	309	338	2,843	1.9%
ABG II HA	1,266	186	371	370	277	201	2,671	1.7%
Corail Collared	3	823	2	183	500	603	2,114	1.4%
Accolade	605	170	258	231	252	224	1,740	1.2%
CPT (CoCr)	1,097	131	128	115	130	121	1,722	1.1%
BHR Femoral Head	658	61	138	138	128	61	1,184	0.7%
Wagner Cone Prosthesis	588	152	119	165	135	128	1,287	0.7%
Straight-stem standard	1,461	0	0	0	0	0	1,461	0.6%
Others (203)	140,618	796	488	429	393	405	143,129	
Totalt	299,588	16,299	15,739	15,946	15,952	16,026	379,550	

[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	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Aleris Specialistvård Bollnäs	0	0	0	0	241	268	509	0.1%
Aleris Specialistvård Elisabethsjukhuset	905	84	70	60	65	46	1,230	0.3%
Aleris Specialistvård Motala	0	0	437	429	438	491	1,795	0.5%
Aleris Specialistvård Nacka	120	100	121	133	134	112	720	0.2%
Aleris Specialistvård Sabbatsberg	1,517	131	150	145	160	175	2,278	0.6%
Aleris Specialistvård Ängelholm	0	0	0	2	5	9	16	0%
Alingsås	2,296	223	201	210	209	252	3,391	0.9%
Art Clinic	0	0	0	0	10	6	16	0%
Arvika	1,510	166	182	184	190	139	2,371	0.6%
Borås	5,504	202	172	188	180	167	6,413	1.7%
Capio Movement	504	193	256	253	176	127	1,509	0.4%
Capio Ortopediska Huset	2,620	441	342	316	332	371	4,422	1.2%
Capio S:t Göran	9,925	418	422	454	405	472	12,096	3.2%
Carlanderska	1,329	44	118	158	120	112	1,881	0.5%
Danderyd	7,579	377	299	338	306	327	9,226	2.4%
Eksjö	4,585	211	193	183	216	191	5,579	1.5%
Enköping	1,995	235	257	295	327	320	3,429	0.9%
Eskilstuna	4,122	110	110	128	129	136	4,735	1.2%
Falun	6,045	326	322	367	398	352	7,810	2.1%
Frölunda Specialistsjukhus	350	81	78	82	85	80	756	0.2%
Gällivare	2,431	86	105	86	111	92	2,911	0.8%
Gävle	5,344	175	164	203	198	257	6,341	1.7%
Halmstad	4,249	218	229	227	238	243	5,404	1.4%
Helsingborg	3,835	73	70	59	69	76	4,182	1.1%
Hudiksvall	2,967	138	138	129	100	147	3,619	1.0%
Hässleholm-Kristianstad	9,324	894	797	775	675	777	13,242	3.5%
Jönköping	4,379	208	210	211	194	167	5,369	1.4%
Kalmar	4,500	193	165	184	122	146	5,310	1.4%
Karlshamn	2,336	221	188	235	217	230	3,427	0.9%
Karlskoga	2,513	141	138	120	166	173	3,251	0.9%
Karlskrona	2,375	16	46	36	36	32	2,541	0.7%
Karlstad	4,885	252	287	259	238	265	6,186	1.6%
Karolinska/Huddinge	5,733	253	234	283	241	252	6,996	1.8%
Karolinska/Solna	4,722	185	208	206	198	182	5,701	1.5%
Katrineholm	2,462	234	239	239	208	242	3,624	1.0%
Kungälv	2,725	178	193	171	135	165	3,567	0.9%
Lidköping	2,236	123	123	186	196	239	3,103	0.8%
Lindesberg	2,309	208	210	234	211	230	3,402	0.9%
Linköping	5,315	70	58	68	58	65	5,634	1.5%
Ljungby	2,314	194	164	165	175	151	3,163	0.8%
Lycksele	2,951	322	330	308	276	290	4,477	1.2%

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

Hospital	1979–2008	2009	2010	2011	2012	2013	Total	Proportion[1)]
Mora	3,068	217	216	222	203	219	4,145	1.1%
Norrköping	5,212	234	238	245	230	253	6,412	1.7%
Norrtälje	1,566	131	118	101	106	129	2,151	0.6%
Nyköping	2,878	158	184	171	167	143	3,701	1.0%
Ortho Center Stockholm	1,277	411	432	400	435	396	3,351	0.9%
OrthoCenter IFK-kliniken	112	103	117	150	131	128	741	0.2%
Oskarshamn	2,447	198	198	210	204	286	3,543	0.9%
Piteå	2,166	352	373	373	389	367	4,020	1.1%
SU/Mölndal	1,670	343	444	406	416	469	3,748	1.0%
SU/Sahlgrenska	4,962	4	8	4	3	6	4,987	1.3%
SUS/Lund	4,529	85	114	100	140	195	5,163	1.4%
SUS/Malmö	6,042	92	109	83	74	27	6,427	1.7%
Sensia Spec.vård	0	0	0	0	2	6	8	0%
Skellefteå	2,498	94	94	79	98	133	2,996	0.8%
Skene	1,179	87	105	106	113	126	1,716	0.5%
Skövde	5,524	100	134	198	243	162	6,361	1.7%
Sollefteå	1,979	116	123	125	123	126	2,592	0.7%
Sophiahemmet	5,237	173	175	166	193	212	6,156	1.6%
Spenshult	228	104	184	156	317	240	1,229	0.3%
Sunderby (incl Boden)	4,784	42	38	30	36	32	4,962	1.3%
Sundsvall	5,506	216	203	229	184	208	6,546	1.7%
Södersjukhuset	7,588	383	387	337	416	430	9,541	2.5%
Södertälje	1,362	136	118	119	109	92	1,936	0.5%
Torsby	1,527	100	105	106	122	107	2,067	0.5%
Trelleborg	4,958	582	572	598	643	594	7,947	2.1%
Uddevalla	5,703	364	285	337	342	389	7,420	2.0%
Umeå	4,251	107	95	63	64	64	4,644	1.2%
Uppsala	6,464	321	371	257	227	263	7,903	2.1%
Varberg	4,344	263	193	241	242	239	5,522	1.5%
Visby	2,301	139	105	118	121	125	2,909	0.8%
Värnamo	2,632	144	124	146	148	148	3,342	0.9%
Västervik	2,754	109	113	120	109	121	3,326	0.9%
Västerås	3,779	433	416	461	513	476	6,078	1.6%
Växjö	3,463	100	127	146	154	86	4,076	1.1%
Ystad	2,441	3	5	8	8	1	2,466	0.6%
Ängelholm	2,838	46	143	156	166	174	3,523	0.9%
Örebro	5,247	177	184	177	116	107	6,008	1.6%
Örnsköldsvik	2,799	166	185	140	140	133	3,563	0.9%
Östersund	4,385	237	234	278	301	313	5,748	1.5%
Others	37,077	945	551	281	90	0	38,944	10.3%
Total	299,588	15,739	15,946	15,952	16,026	16,299	379,550	

[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	1992–2008	2009	2010	2011	2012	2013	Totalt	Proportion
Primary osteoarthritis	155,349	13,243	13,372	13,256	13,336	13,363	221,919	79.6%
Fracture	21,894	1,422	1,473	1,509	1,540	1,731	29,569	10.6%
Inflammatory arthritis	7,722	285	234	242	194	172	8,849	3.2%
Femoral head necrosis	5,650	409	449	508	527	550	8,093	2.9%
Childhood disease	3,689	287	308	339	324	340	5,287	1.9%
Tumour	1,070	78	81	75	80	104	1,488	0.5%
Other secondary osteoarthritis	1,294	4	3	2	1	1	1,305	0.5%
Posttraumatic osteoarthritis	464	11	26	21	24	38	584	0.2%
(missing)	1,847	0	0	0	0	0	1,847	0.7%
Total	198,979	15,739	15,946	15,952	16,026	16,299	278,941	100%

Number of primary THRs per diagnosis and age group
(1992–2013)

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Primary osteoarthritis	8,315	60.6%	30,497	82.6%	122,387	84.3%	60,720	73%	221,919	79.6%
Fracture	363	2.6%	1,487	4%	11,801	8.1%	15,918	19.1%	29,569	10.6%
Inflammatory arthritis	1,591	11.6%	1,669	4.5%	4,211	2.9%	1,378	1.7%	8,849	3.2%
Femoral head necrosis	923	6.7%	1,042	2.8%	3,136	2.2%	2,992	3.6%	8,093	2.9%
Childhood disease	2,091	15.2%	1,587	4.3%	1,346	0.9%	263	0.3%	5,287	1.9%
Tumour	158	1.2%	282	0.8%	691	0.5%	357	0.4%	1,488	0.5%
Other secondary osteoart-hritis	99	0.7%	112	0.3%	475	0.3%	619	0.7%	1,305	0.5%
Posttraumatic osteoarthritis	74	0.5%	72	0.2%	207	0.1%	231	0.3%	584	0.2%
(missing)	101	0.7%	166	0.4%	877	0.6%	703	0.8%	1,847	0.7%
Total	13,715	100%	36,914	100%	145,131	100%	83,181	100%	278,941	100%

Number of primary uncemented THRs per diagnosis and age group
(1992–2013)

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Totalt	Proportion
Primary osteoarthritis	3,515	63.8%	7,865	87.7%	7,524	91.6%	481	79.4%	19,385	83.2%
Childhood disease	1,019	18.5%	566	6.3%	199	2.4%	14	2.3%	1,798	7.7%
Femoral head necrosis	399	7.2%	227	2.5%	163	2%	20	3.3%	809	3.5%
Inflammatory arthritis	400	7.3%	148	1.7%	138	1.7%	14	2.3%	700	3.0%
Fracture	78	1.4%	115	1.3%	167	2%	72	11.9%	432	1.9%
Other secondary osteoarthritis	34	0.6%	7	0.1%	4	0%	1	0.2%	46	0.2%
Posttraumatic osteoarthritis	28	0.5%	7	0.1%	4	0%	3	0.5%	42	0.2%
Tumour	6	0.1%	8	0.1%	4	0%	1	0.2%	19	0.1%
(missing)	27	0.5%	20	0.2%	11	0.1%	0	0%	58	0.2%
Total	5,506	100%	8,963	100%	8,214	100%	606	100%	23,289	100%

Number of primary THRs per type of fixation and age group
(1992–2013)

Type of fixation	<50 yrs		50–59 yrs		60–75 yrs		>75 yrs		Total	Proportion
Cemented	3,738	27.3%	18,648	50.5%	124,603	85.9%	79,997	96.2%	226,986	81.4%
Uncemented	5,506	40.1%	8,963	24.3%	8,214	5.7%	606	0.7%	23,289	8.3%
Reversed hybrid	1,666	12.1%	4,832	13.1%	8,010	5.5%	1,617	1.9%	16,125	5.8%
Hybrid	1,480	10.8%	3,283	8.9%	3,818	2.6%	847	1%	9,428	3.4%
Resurfacing implants	985	7.2%	864	2.3%	254	0.2%	2	0%	2,105	0.8%
(missing)	340	2.5%	324	0.9%	232	0.2%	112%	0.1%	1,008	0.4%
Total	13,715	100%	36,914	100%	145,131	100%	83,181	100%	278,941	100%

Number of primary THRs per type of surgical approach and year

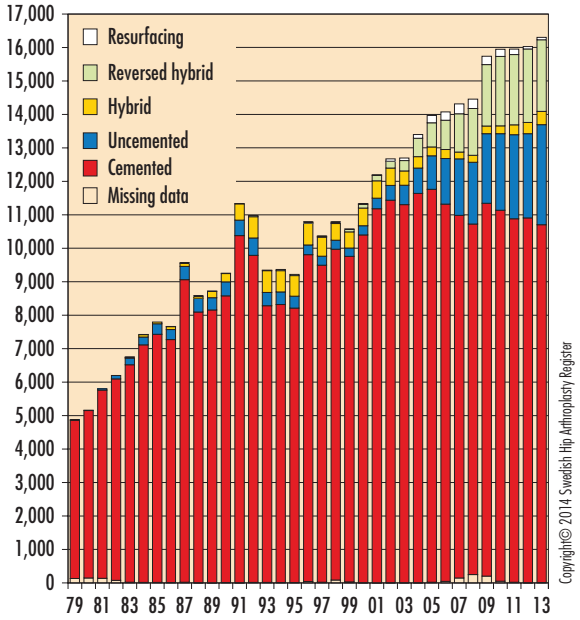
Surgical approach	2000–2008	2009	2010	2011	2012	2013	Total	Proportion
Posterior approach (Moore)	65,778	8,302	8,128	8,160	8,285	8,470	107,123	38.4%
Direct lateral approach, lateral position (Gammer)	41,240	6,423	6,751	6,794	6,771	6,789	74,768	26.8%
Direct lateral approach, supine position (Hardinge)	9,085	793	830	839	860	853	13,260	4.8%
Others	1,094	220	231	155	105	182	1,987	0.7%
(missing)	81,782	1	6	4	5	5	81,803	29.3%
Total	198,979	15,739	15,946	15,952	16,026	16,299	278,941	100%

Number of primary THRs per type of cement and year

Type of cement	1999–2008	2009	2010	2011	2012	2013	Total	Proportion
Palacos cum Gentamycin	101,775	0	0	0	0	0	101,775	36.5%
Palacos R+G	15,612	5,221	5,062	5,375	5,258	3,985	40,513	14.5%
Refobacin Palacos R	19,613	0	0	0	0	0	19,613	7.0%
Refobacin Bone Cement	15,324	5,165	5,346	5,056	5,258	5,980	42,129	15.1%
Cemex Genta System Fast	990	569	429	247	225	3	2,463	0.9%
Cemex Genta System	236	0	0	1	0	0	237	0.1%
Others	13,695	21	34	21	36	601	14,408	5.2%
(all or partly uncemented)	28,782	4,763	5,075	5,252	5,249	5,730	54,851	19.7%
(missing)	2,952	0	0	0	0	0	2,952	1.1%
Total	198,979	15,739	15,946	15,952	16,026	16,299	278,941	100%

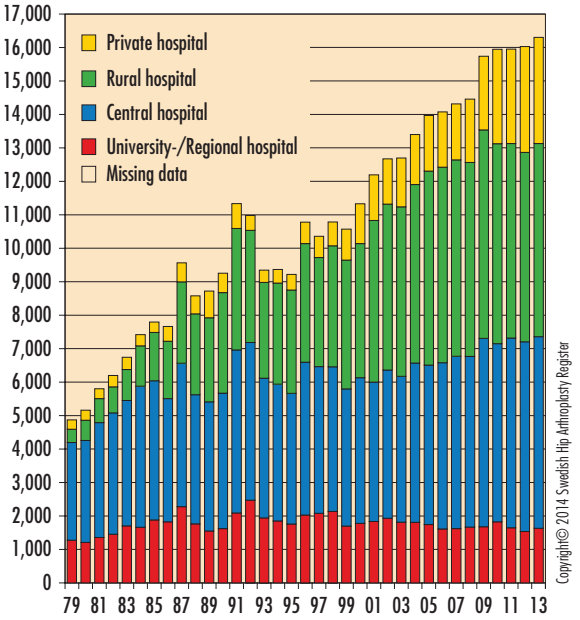
Number of primary THRs

per type of fixation, 1979–2013



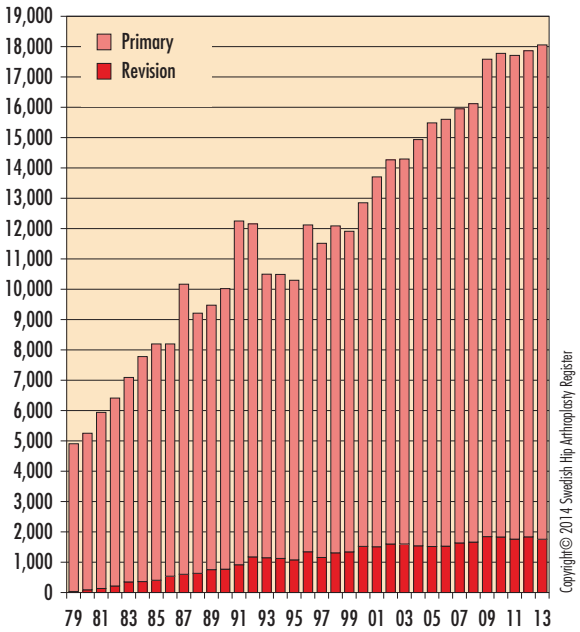
Number of primary THRs

per type of hospital, 1979–2013



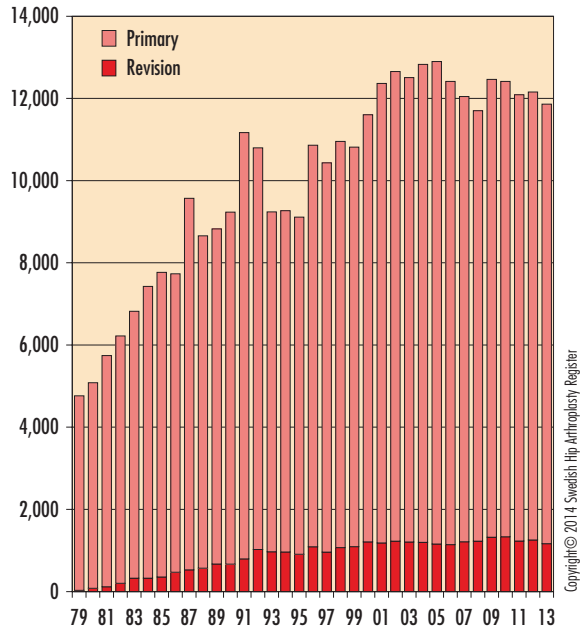
All THRs

379,550 primary THRs, 38,670 revisions, 1979–2013



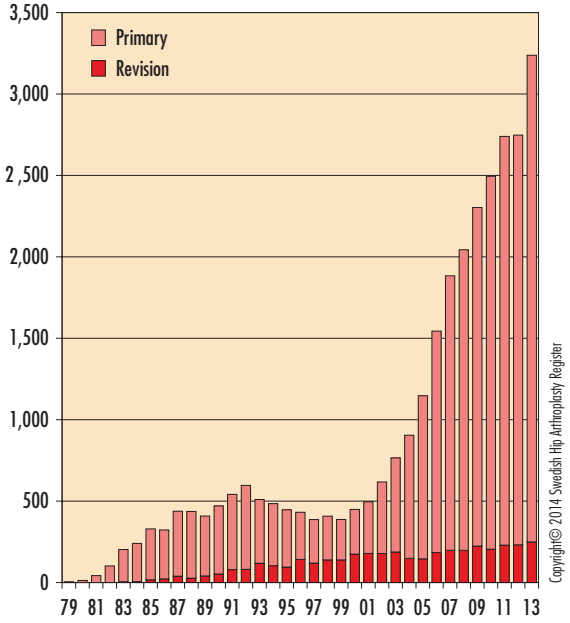
THRs with cemented implants

322,214 primary THRs, 30,370 revisions, 1979–2013



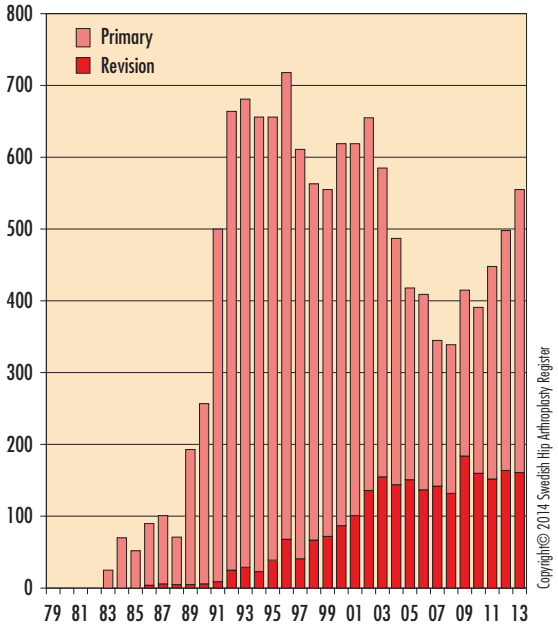
THRs with uncemented implants

26,625 primary THRs, 3,963 revisions, 1979–2013



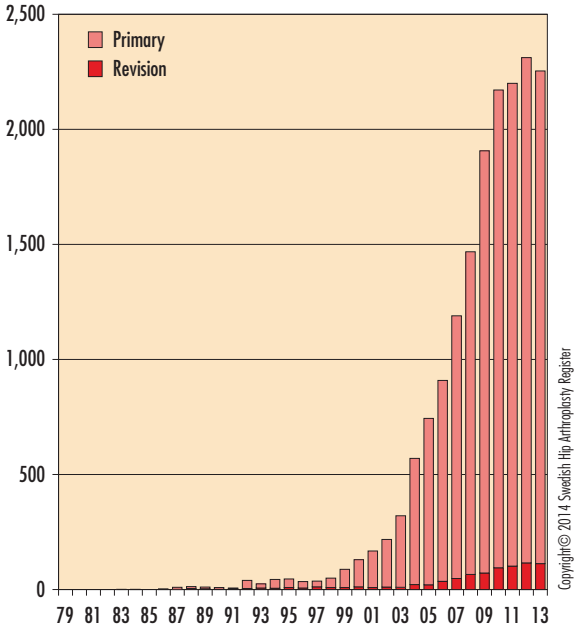
THRs with hybrid implants

10,841 primary THRs, 2,405 revisions, 1979–2013



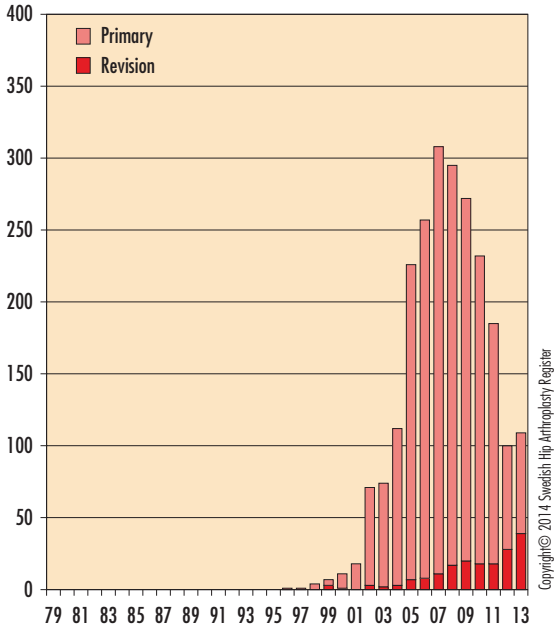
THRs with reversed hybrid implants

16,170 primary THRs, 812 revisions, 1979–2013

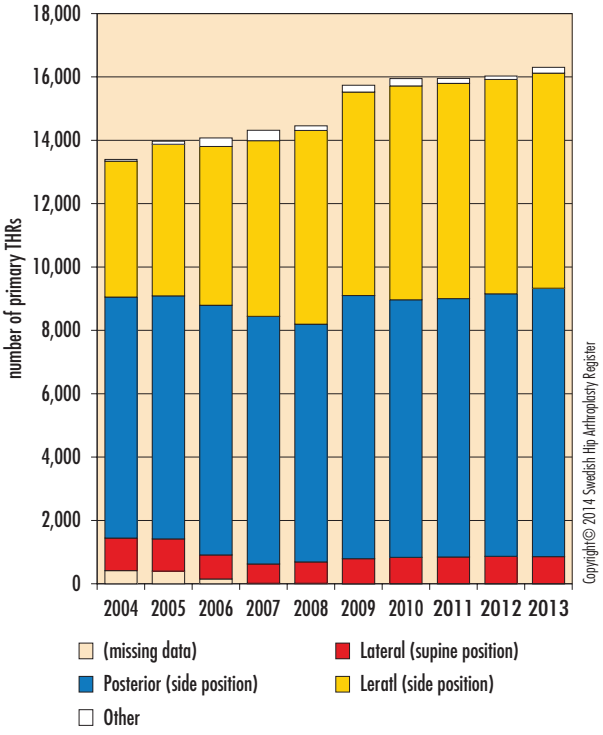


THRs with resurfacing implants

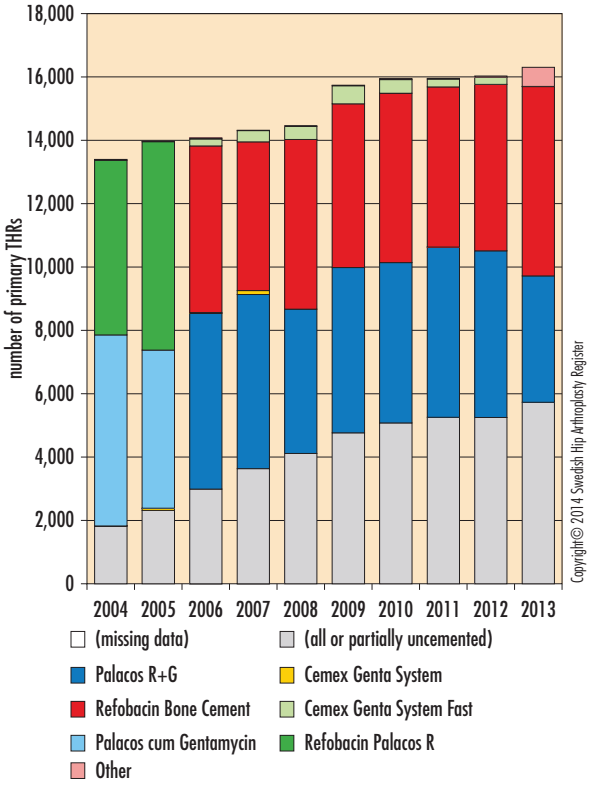
2,105 primary THRs, 178 revisions, 1979–2013



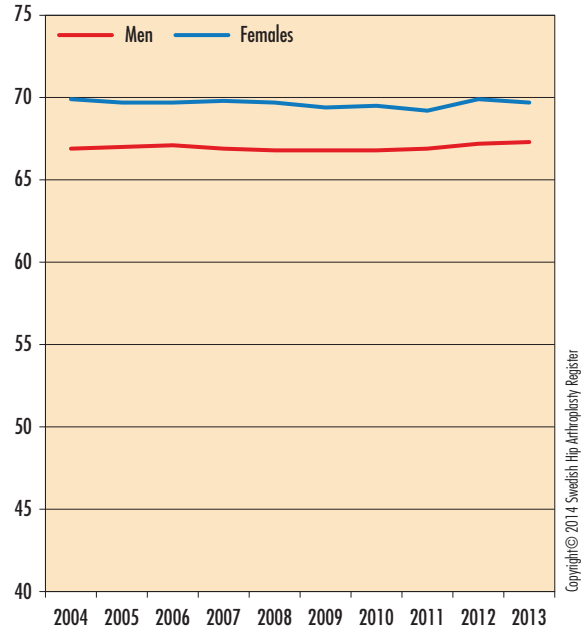
Surgical approach
2003–2013



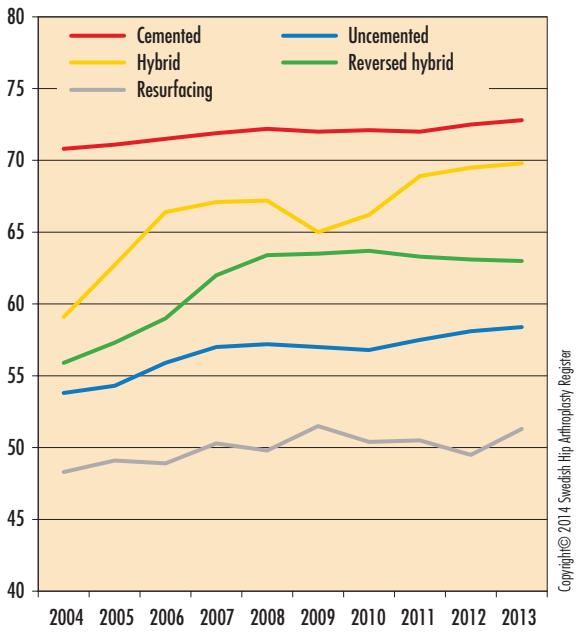
Type of cement
2003–2013



Mean age per gender
the past 10 years, 150,168 primary THRs

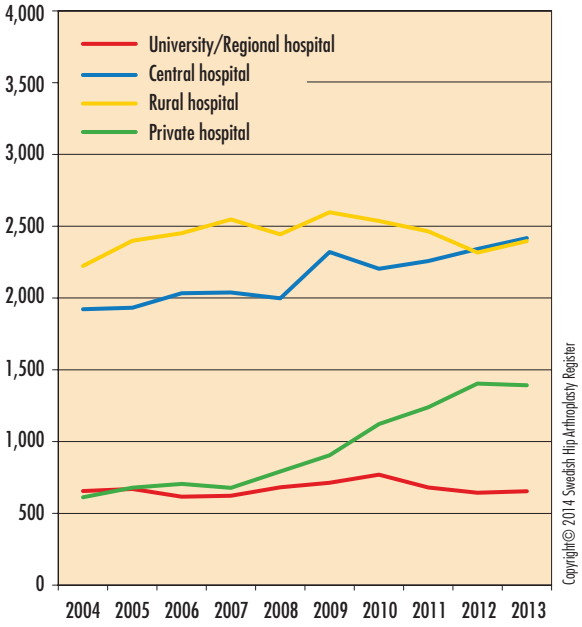


Mean age per type of fixation
the past 10 years, 150,168 primary THRs



Trend in number of primary THRs

the past 10 years, per type of hospital



The effects of an increased proportion of private operations

In 2007, for the first time, Swedish private hospitals performed comparatively more primary total hip replacements than the university and regional hospitals.

In 2013, this difference has been further accentuated.

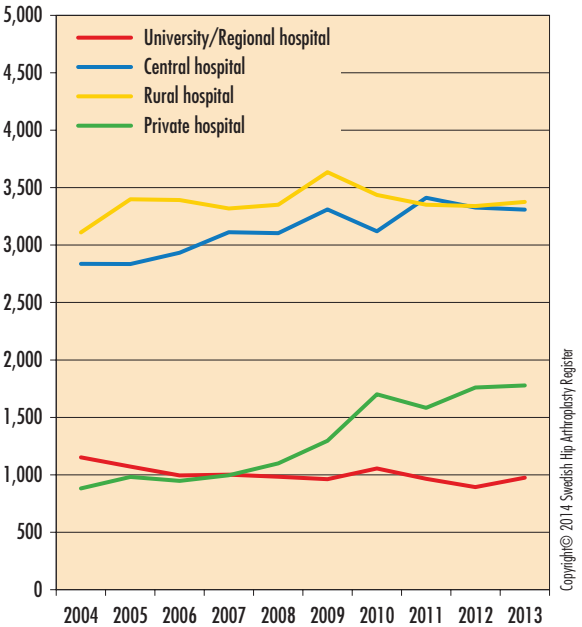
Since sub-county hospitals and above all private hospitals operate on "healthier" patients with less comorbidity and on technically simpler cases, mean that accessibility for the "sicker" and more complicated cases deteriorates, and a displacement effect may arise. Other obvious disadvantages in the near future are:

- Possibilities for continuously training doctors and surgical staff deteriorate since training is concentrated to university and regional hospitals.
- The base for clinical studies of primary total hip replacements is radically diminished

In the near future, this may affect the possibilities of transferring competence to doctors during their specialist education and the trend must absolutely be broken. One demand is for private operators to undertake responsibility for medical education and be paid for it.

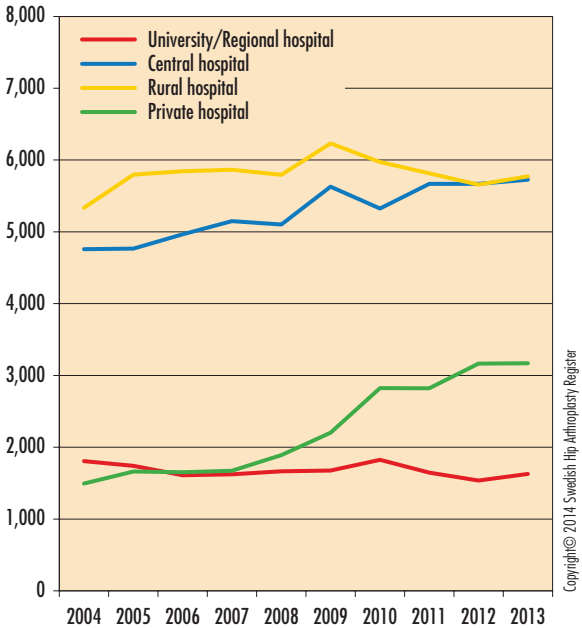
Trend in number of primary THRs

the past 10 years – males only



Trend in number of primary THRs

the past 10 years – females only



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 during one year has in the past 20 years stayed relatively stable. In 1992 and 2013, reoperations made up 12.0% and 12.4%, respectively (Figure 1). The quota indicates the extent to which reoperations burden healthcare resources for total hip replacement in a country or within a region, but it is not suitable for other purposes because of its sensitivity to occasional fluctuations in the number of primary operations performed. It 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, which is now highlighted concerning infections in Viktor Lindgren's doctoral thesis. There is every reason to suspect a considerable underreporting of certain periprosthetic fractures, not least of those that are not revised but treated with internal fixation. Currently, there is another doctoral thesis in work (postgraduate student Georgios Chatziagorou) where the Hip Arthroplasty Register is cross-referenced with the Patient Register in order to identify the occurrences of periprosthetic fractures.

Restructuring of healthcare has led to the situation where reoperations are mainly carried out at university and to some extent at central hospitals. Since 1992–1995, the percentage of reoperations at university/regional hospitals increased from 14.8 to 30.1%. At central hospitals, the increase is significantly lower from 16.1 to 17.3%. On private and rural hospitals, the corresponding proportions decreased from 14.4 to 3.7 and 6.0 to 4.0% (Figure 2).

The demographics for patients who undergo reoperation differs from those who undergo primary operation. Men, patients under 50 and 80 and older are overrepresented. Among patients with secondary osteoarthritis, the cases with mainly inflammatory joint disease and sequelae after a hip disease during childhood and adolescence are overrepresented. If only those patients are selected who had undergone primary prosthesis in 1992–2013 (column 2 in Table 1), then the proportion of patients with fracture and idiopathic necrosis increases. Improved medical treatment of inflammatory joint diseases, increased number of hip fractures, which undergo a total hip arthroplasty and change in the surgical technique, can be possible causes for this change.

Reoperation without changing the implant/extraction

During the past three years, infection has been the most common cause for reoperation without changing the implant (Figure 3). These measures were dominated by different types of wound revisions (86.2%), followed by an open biopsy (4.1%) and change, insertion or extraction of spacer (2.9%). Fractures are dominated by completely different types of

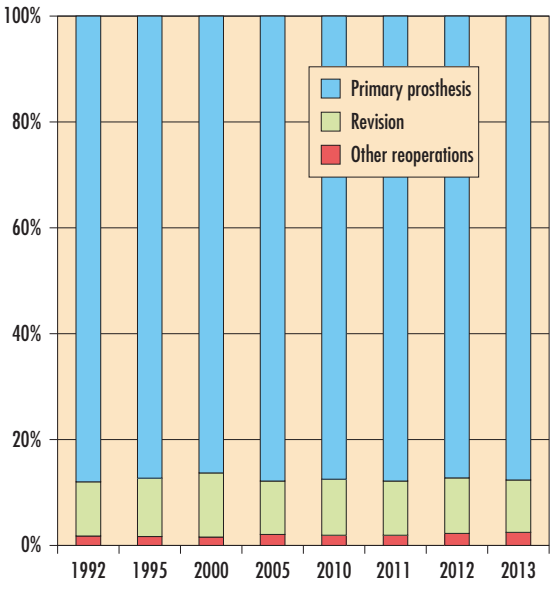


Figure 1. Proportion of the re-reoperated (revision + other reoperation) relative to the total hip arthroplasty-related operations during selected years 1992–2013.

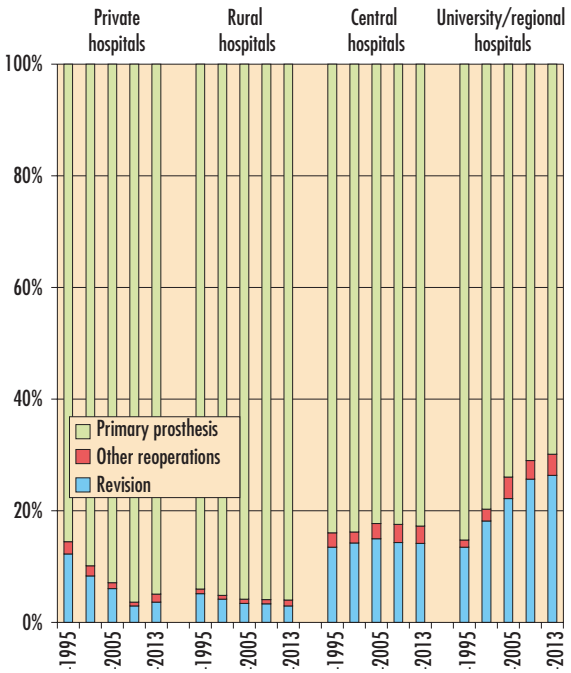


Figure 2. Distribution of reoperations and primary arthroplasties among different types of hospitals.

Demography for patients with reoperation

	All reoperations		All primary THRs
	Primary THRs performed 1979–2013	Primary THRs performed 1992–2013	1992–2013
	proportion %		proportion %
Gender			
Female	21,277 *52.3*	12,200 *51.4*	166,214 *59.6*
Male	19,417 *47.7*	11,553 *48.6*	112,726 *40.4*
Age years			
0–49	2,104 *5.2*	1,299 *5.5*	13,715 *4.9*
50–59	4,272 *10.5*	2,777 *11.7*	36,914 *13.2*
60–69	9,990 *24.5*	6,336 *26.7*	83,283 *29.9*
70–79	15,169 *37.2*	8,483 *35.7*	99,703 *35.7*
>=80	9,203 *22.6*	4,861 *20.5*	45,326 *16.2*
Diagnosis			
Primary osteoarthritis	29,397 *72.2*	17,248 *72.6*	221,919 *79.6*
Fracture incl sequele	4,306 *10.6*	3,019 *12.7*	30,153 *10.2*
Inflammatory arthritis	3,092 *7.6*	1,374 *5.8*	8,849 *3.2*
Childhood disease	2,080 *5.1*	893 *3.8*	5,287 *1.9*
Femoral head necrosis	1,214 *3.0*	895 *3.8*	8,093 *2.9*
Other secondary osteoarthritis	293 *0.7*	235 *1.0*	2,793 *1.0*
Missing	356 *0.9*	92 *0.4*	1,847 *0.7*

Table 1. Distribution of age, gender, and diagnosis for patients reoperated during two different time periods and data for all primary THRs from 1992–2013. Individual-based data for pri-mary THRs are not available in the register from 1979–1991.

fracture surgery, during which the implant is left untouched (96.6%). During operations due to dislocation, socket wall addition is still used as the only measure and accounted for 56.0% of the cases. 33.9% of cases were carried out with an open reposition. In the group "other", a large number of different operations are presented. During the past three years, three of the most common measures were different types of soft-tissue surgery (25.1%), evacuation of hematoma/wound revision (19.6%) and biopsy (16.4%). Unspecified exploration has been registered as the only measure in 15 cases (8.2%).

Resuturing or muscle surgery because gluteus medius is released after a previous hip arthroplasty, is not registered in SHPR. However, "muscle suturing" and "soft-tissue surgery" have been registered in 55 cases between 2011 and 2013. In six cases, this operation is combined with the change of the femoral head and is registered as a revision. Trochanteric pains are a common problem mainly after lateral approach and it is probably underreported. In connection to the restructuring of the data capture concerning reoperations, this operation will be identified in an improved way. We also hope that internal reporting will improve about reoperations and about those incidences where no implant parts are changed or extracted.

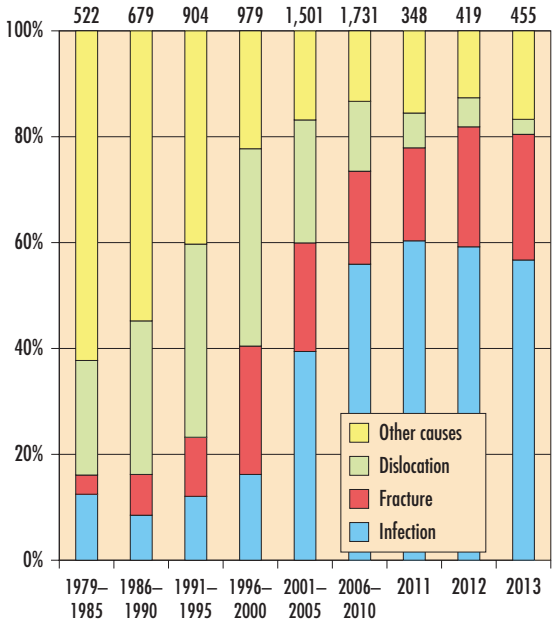


Figure 3. The three most common reasons for reoperation where that the implant is left untouched during selected periods of three years up to 2010 and subsequently annually. Infection has become the most common cause of these operations. The total number is listed at the top.

Number of reoperations per procedure and year

primary THRs performed 1979–2013

Procedure at reoperation	1979–2008	2009	2010	2011	2012	2013	Total	Proportion
Revision	31,160	1,938	1,936	1,858	1,920	1,843	40,655	84.3%
Major surgical intervention	3,629	181	166	155	180	195	4,506	9.3%
Minor surgical intervention	1,968	193	178	193	239	260	3,031	6.3%
Missing	2	0	2	0	4	1	9	0%
Total	36,759	2,312	2,282	2,206	2,343	2,299	48,201	100%

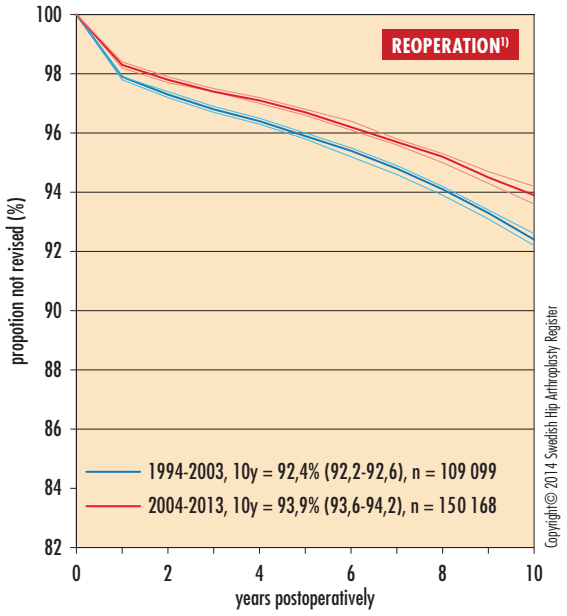
Number of reoperations per reason and year

primary THRs performed 1979–2013

Reason for reoperation	1979–2008	2009	2010	2011	2012	2013	Total	Proportion
Aseptic loosening	21,093	1,116	1,068	988	976	909	26,150	54.3%
Deep infection	4,060	431	421	475	544	557	6,488	13.5%
Dislocation	4,339	289	299	252	281	281	5,741	11.9%
Fracture	2,842	233	259	235	285	283	4,137	8.6%
2-stage procedure	1,550	97	103	97	83	82	2,012	4.2%
Technical error	999	58	61	70	65	50	1,303	2.7%
Others	974	35	31	37	51	90	1,218	2.5%
Implant fracture	495	38	22	32	27	20	634	1.3%
Pain only	366	15	18	18	29	20	466	1.0%
Secondary infection	5	0	0	1	0	0	6	0%
Missing	36	0	0	1	2	7	46	0.1%
Total	36,759	2,312	2,282	2,206	2,343	2,299	48,201	100%

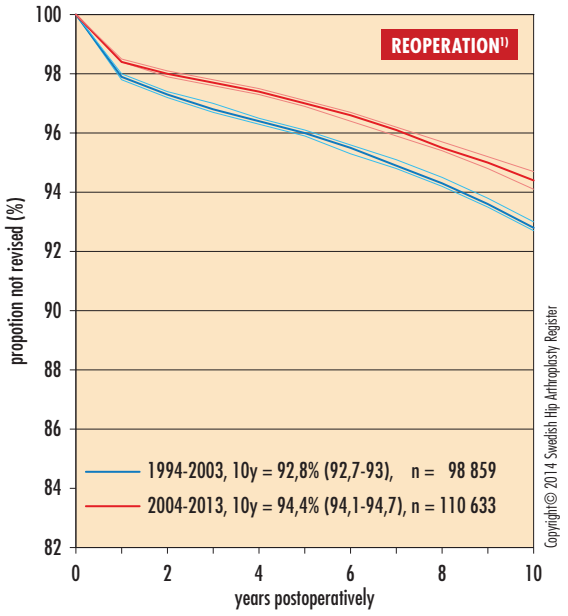
All implants

All diagnoses and all reasons



All cemented implants

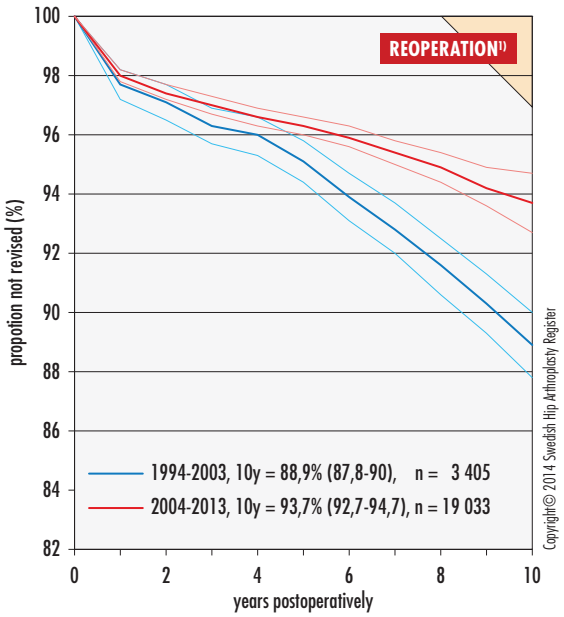
All diagnoses and all reasons



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

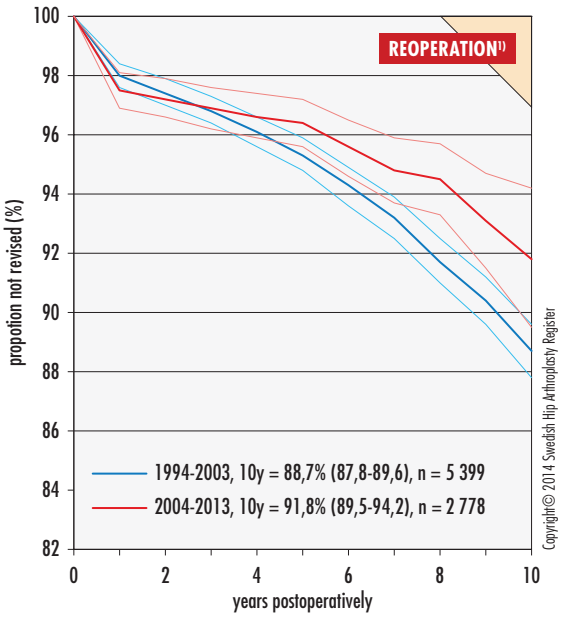
All uncemented implants

All diagnoses and all reasons



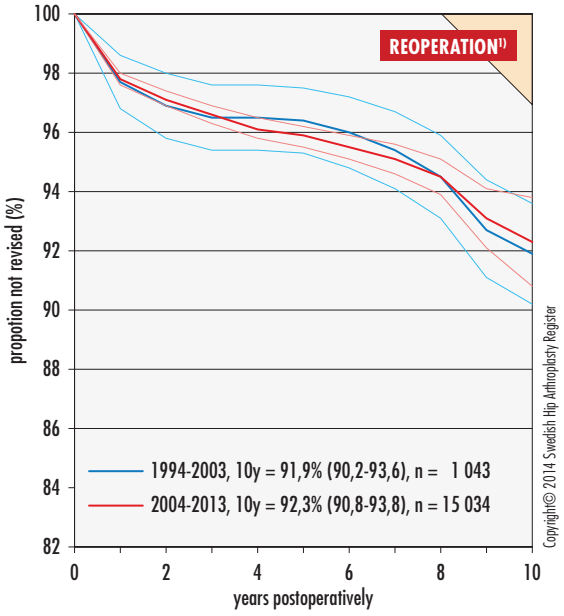
All hybrid implants

All diagnoses and all reasons



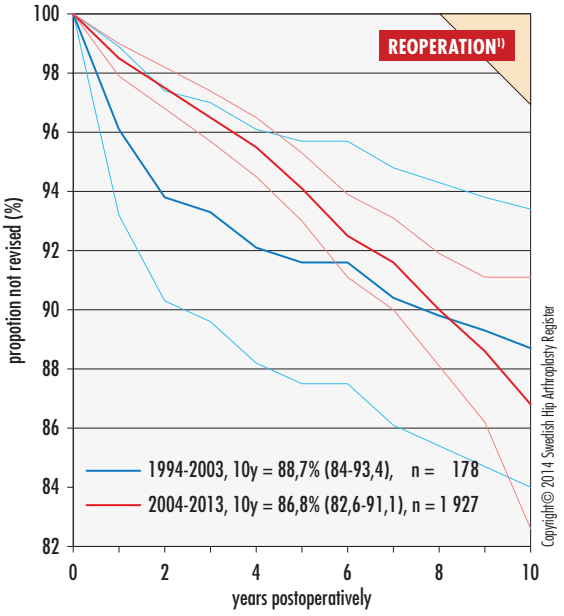
All reversed hybrid implants

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 – reoperation within 2 years

In traditional survival statistics (Kaplan-Meier), the exchange of any prosthesis component or removal of the entire prosthesis is the definition of failure. Five or ten year survival denotes long-term results with respect to aseptic loosening first and foremost. Long term follow-up with "survival" technique is the most common result variable in scientific reports and also is used in the so-called "post market surveillance" (monitoring of medical products after selling), like for example, the Medical Products Agency and Food and Drug Administration are interested in their role as monitoring institutions for medical-technical products.

Reoperation within 2 years refers to all forms of subsequent surgery (not only interventions to replace prosthesis components) 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 – in this report 2009 up to and including 2013. 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.**

Results

The results per clinic are presented in the following table. Type of hospital, number of primary operation patients during the observation period and number of reoperations is presented. The national average during the observation period was 1.9% (no change compared to the previous year). Complication figures vary from 0.2 to 6.5%. Clinics with frequencies that are a standard deviation over the average rates are designated in red. Twelve clinics out of 77 exceeded this rate. However, we invite all clinics to analyze their short-term complications – the national averages should not be considered as targets – probably, all units have possibilities to improve their results. In previous years, above all the dislocation problem has been dominant among the hospitals with high figures for complications but it is now more common for infections to dominate. A number of local undertakings for improvement have during recent years been directed towards dislocation problems.

Under-reporting

For several years, we have published our annual coverage analysis, which does not, however, include secondary interventions. This fact is disturbing in respect to the Register's data quality. The reason is unfortunately the remaining low quality of the surgeons' diagnoses (ICD-10) and specification of the classification and treatment procedure codes in secondary interventions. We have made several attempts but found up to 30 different (and often inadequate) intervention codes used for different types of reoperation. Since the Patient Register also lacks laterality in its database, comprehensive system development is necessary to do a coverage analysis of secondary interventions and at present neither we nor the Swedish National Board of Health and Welfare have the resources required for such development.

For 2010–2013, a number of units report extremely low complication numbers. It is unlikely, that high-producing units could not have more separate complications according to the definition above and during four years. Last year, the Register carried out and published a comparative study with the Medical Products Agency, and unfortunately, found a large number of unrecorded numbers regarding the clinics' reports on prosthesis-related infections.

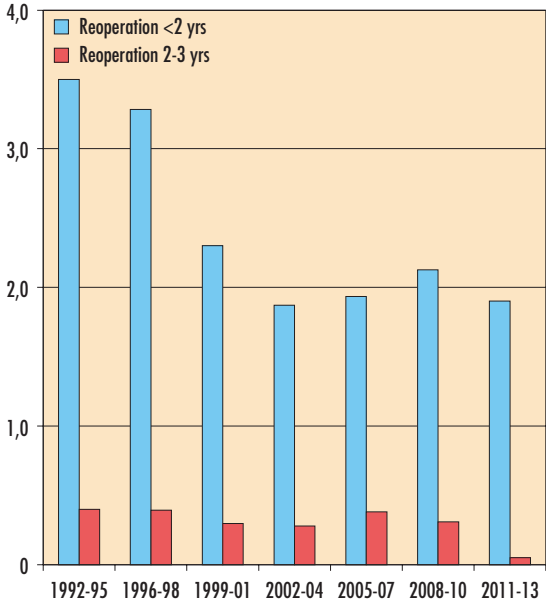
The following plan of action was undertaken by the register in order to gain better coverage with respect to secondary interventions:

- Monitoring of the hospitals. Refer to the respective chapter!
- Open publishing of infection studies.
- A renewed appeal to all operational managers to work locally towards a better code-setting culture in our units, via meetings or even local courses in 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".
- A renewed appeal to first and foremost the country's private operators to follow the law and report not only to the Swedish Hip Arthroplasty Register (voluntary) but also to the Patient Register at the Swedish National Board of Health and Welfare (this is statutory!).
- 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 shift from the state towards care episode compensation (refer to Appendix) instead towards financial management of the healthcare system, will require the introduction of laterality in all PAS-databases.

Discussion

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 – see above!
- 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 with debridement with or without exchanging modular components. It is therefore of great importance not only to report classical revisions but also reoperation of all types.



Proportion of reoperations within 2 years, and two to three years after surgery during 1992–2013 divided into three periods (except the period 1992–1995 that covers four years).

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 analyze 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.

Reoperation within 2 years in the "standard patient" group

Similarly to last year, we publish these important outcome indicators concerning the partially case-mix-adjusted group which we call "the standard patient". This analysis gives a more fair comparison between the clinics.

Results

The results per clinic are presented in the following table. The national average during the observation period was 1.2% that is lower than expected when compared to the whole implant population. Complication figures vary from 0.2 to 3.7%. Clinics with frequencies that are considered standard deviations over the average are designated in red. Eleven clinics exceeded this rate. Notably, no university or regional hospitals received "red figures", but had relatively low complication numbers; this is definitely an effect of risk adjustment.

Last year's report had similar results/table with a number of smaller errors, which resulted from faulty calculation syntax. Therefore, we have decided to publish a corrected table in this year's report (concerning 2009–2012) on page 74.

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!

Reoperations within 2 years per hospital[1)]

2010–2013

Hospital	Prim THRs	Patientes [2)]		Infection		Dislocation		Loosening		Others		Proportion with data on ASA&BMI
	Number	Number	Number	Number	%	Number	%	Number	%	Number	%	
University/Regional hospitals												
Karolinska/Huddinge	1,010	15	1.5%	3	0.3%	3	0.3%	1	0.1%	8	0.8%	98.6%
Karolinska/Solna	794	24	3.0%	10	1.3%	4	0.5%	3	0.4%	12	1.5%	94.6%
Linköping	249	6	2.4%	4	1.6%	3	1.2%	0	0%	2	0.8%	74.7%
SU/Mölndal	1,735	37	2.1%	20	1.2%	7	0.4%	1	0.1%	13	0.7%	93.8%
SUS/Lund	549	13	2.4%	6	1.1%	2	0.4%	3	0.5%	4	0.7%	89.1%
SUS/Malmö	293	6	2.0%	3	1.0%	0	0%	0	0%	3	1.0%	44.4%
Umeå	286	11	3.8%	7	2.4%	0	0%	0	0%	5	1.7%	72.0%
Uppsala	1,118	24	2.1%	9	0.8%	5	0.4%	0	0%	14	1.3%	94.1%
Örebro	584	11	1.9%	7	1.2%	2	0.3%	0	0%	3	0.5%	99.0%
Central hospitals												
Borås	707	17	2.4%	9	1.3%	2	0.3%	0	0%	7	1.0%	97.6%
Danderyd	1,270	43	3.4%	21	1.7%	11	0.9%	0	0%	21	1.7%	98.0%
Eksjö	783	15	1.9%	14	1.8%	0	0%	0	0%	2	0.3%	81.2%
Eskilstuna	503	14	2.8%	8	1.6%	4	0.8%	0	0%	3	0.6%	99.8%
Falun	1,439	24	1.7%	20	1.4%	3	0.2%	0	0%	4	0.3%	98.2%
Gävle	822	35	4.3%	13	1.6%	7	0.9%	1	0.1%	15	1.8%	92.6%
Halmstad	937	23	2.5%	13	1.4%	5	0.5%	1	0.1%	7	0.7%	91.9%
Helsingborg	274	6	2.2%	3	1.1%	3	1.1%	0	0%	0	0%	86.1%
Hässleholm-Kristianstad	3,024	49	1.6%	38	1.3%	3	0.1%	3	0.1%	17	0.6%	91.4%
Jönköping	782	11	1.4%	8	1.0%	2	0.3%	0	0%	3	0.4%	97.4%
Kalmar	617	7	1.1%	3	0.5%	2	0.3%	0	0%	1	0.2%	96.8%
Karlskrona	150	3	2.0%	0	0%	3	2.0%	0	0%	0	0%	99.3%
Karlstad	1,049	52	5.0%	43	4.1%	1	0.1%	0	0%	8	0.8%	83.3%
Norrköping	966	7	0.7%	4	0.4%	1	0.1%	0	0%	3	0.3%	86.3%
Skövde	737	10	1.4%	9	1.2%	1	0.1%	0	0%	1	0.1%	89.4%
Sunderby (incl Boden)	136	2	1.5%	1	0.7%	1	0.7%	0	0%	0	0%	28.7%
Sundsvall	824	24	2.9%	16	1.9%	7	0.8%	1	0.1%	6	0.7%	89.9%
Södersjukhuset	1,570	37	2.4%	17	1.1%	3	0.2%	1	0.1%	24	1.5%	99.0%
Uddevalla	1,353	17	1.3%	9	0.7%	4	0.3%	0	0%	5	0.4%	74.8%
Varberg	915	9	1.0%	4	0.4%	3	0.3%	0	0%	4	0.4%	91.7%
Västerås	1,866	63	3.4%	38	2.0%	11	0.6%	0	0%	24	1.3%	86.0%
Växjö	513	9	1.8%	2	0.4%	6	1.2%	0	0%	2	0.4%	96.5%
Östersund	1,126	27	2.4%	15	1.3%	2	0.2%	0	0%	13	1.2%	95.0%

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Reoperations within 2 years per hospital[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	%	
Rural hospitals											
Alingsås	872	16	1.8%	11	1.3%	3	0.3%	0	0%	3	0.3%	99.7%
Arvika	695	16	2.3%	10	1.4%	2	0.3%	1	0.1%	5	0.7%	89.4%
Bollnäs	702	12	1.7%	9	1.3%	1	0.1%	0	0%	2	0.3%	99.6%
Enköping	1,199	23	1.9%	13	1.1%	8	0.7%	0	0%	10	0.8%	99.7%
Falköping	220	1	0.5%	0	0%	1	0.5%	0	0%	0	0%	99.1%
Frölunda Specialistsjukhus	325	5	1.5%	1	0.3%	2	0.6%	0	0%	2	0.6%	0%
Gällivare	394	5	1.3%	3	0.8%	2	0.5%	0	0%	1	0.3%	91.9%
Hudiksvall	514	11	2.1%	10	1.9%	1	0.2%	0	0%	3	0.6%	94.2%
Karlshamn	870	12	1.4%	5	0.6%	5	0.6%	0	0%	2	0.2%	100%
Karlskoga	597	6	1.0%	5	0.8%	1	0.2%	0	0%	1	0.2%	97.8%
Katrineholm	928	18	1.9%	13	1.4%	2	0.2%	1	0.1%	6	0.6%	100%
Kungälv	664	15	2.3%	10	1.5%	0	0%	0	0%	8	1.2%	98.9%
Lidköping	744	6	0.8%	4	0.5%	0	0%	0	0%	3	0.4%	98.5%
Lindesberg	885	7	0.8%	1	0.1%	3	0.3%	0	0%	3	0.3%	98.6%
Ljungby	655	6	0.9%	1	0.2%	3	0.5%	0	0%	4	0.6%	99.7%
Lycksele	1,204	16	1.3%	9	0.7%	2	0.2%	1	0.1%	5	0.4%	94.4%
Mora	860	6	0.7%	3	0.3%	5	0.6%	0	0%	1	0.1%	91.5%
Norrtälje	454	14	3.1%	7	1.5%	4	0.9%	1	0.2%	4	0.9%	98.9%
Nyköping	665	43	6.5%	38	5.7%	6	0.9%	0	0%	7	1.1%	86.0%
Oskarshamn	898	9	1.0%	8	0.9%	1	0.1%	0	0%	0	0%	99.9%
Piteå	1,502	14	0.9%	9	0.6%	3	0.2%	0	0%	4	0.3%	100%
Skellefteå	404	5	1.2%	3	0.7%	0	0%	1	0.2%	2	0.5%	98.5%
Skene	450	10	2.2%	2	0.4%	2	0.4%	0	0%	7	1.6%	99.1%
Sollefteå	497	3	0.6%	1	0.2%	2	0.4%	0	0%	1	0.2%	85.3%
Södertälje	438	15	3.4%	8	1.8%	2	0.5%	0	0%	6	1.4%	95.9%
Torsby	440	6	1.4%	5	1.1%	2	0.5%	0	0%	4	0.9%	98.0%
Trelleborg	2,407	30	1.2%	15	0.6%	2	0.1%	2	0.1%	14	0.6%	89.9%
Visby	469	6	1.3%	0	0%	3	0.6%	1	0.2%	2	0.4%	94.9%
Värnamo	566	7	1.2%	3	0.5%	2	0.4%	0	0%	4	0.7%	77.2%
Västervik	463	9	1.9%	6	1.3%	1	0.2%	0	0%	2	0.4%	90.5%
Ängelholm	639	2	0.3%	0	0%	0	0%	0	0%	2	0.3%	97.5%
Örnsköldsvik	598	4	0.7%	3	0.5%	1	0.2%	0	0%	1	0.2%	88.5%

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Reoperations within 2 years per hospital[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	%	Number	%	
Private hospitals												
Aleris Specialistvård Bollnäs	509	8	1.6%	7	1.4%	0	0%	0	0%	2	0.4%	99.8%
Aleris Specialistvård Elisabethsjukhuset	241	4	1.7%	3	1.2%	1	0.4%	0	0%	0	0%	99.6%
Aleris Specialistvård Motala	1,795	37	2.1%	24	1.3%	6	0.3%	0	0%	12	0.7%	76.0%
Aleris Specialistvård Nacka	500	9	1.8%	7	1.4%	1	0.2%	0	0%	2	0.4%	98.8%
Aleris Specialistvård Sabbatsberg	630	6	1.0%	5	0.8%	0	0%	0	0%	3	0.5%	97.9%
Capio Movement	812	27	3.3%	7	0.9%	7	0.9%	0	0%	15	1.8%	98.8%
Capio Ortopediska Huset	1,361	9	0.7%	4	0.3%	1	0.1%	0	0%	5	0.4%	99.0%
Capio S:t Göran	1,753	54	3.1%	34	1.9%	7	0.4%	1	0.1%	23	1.3%	97.1%
Carlanderska	508	6	1.2%	2	0.4%	0	0%	0	0%	4	0.8%	96.9%
Ortho Center Stockholm	1,663	42	2.5%	27	1.6%	8	0.5%	1	0.1%	15	0.9%	99.9%
OrthoCenter IFK-kliniken	526	1	0.2%	0	0%	0	0%	0	0%	1	0.2%	99.6%
Sophiahemmet	746	12	1.6%	6	0.8%	2	0.3%	0	0%	4	0.5%	98.9%
Spenshult	897	24	2.7%	10	1.1%	12	1.3%	0	0%	6	0.7%	98.4%
Others	83	3	3.6%	2	2.4%	1	1.2%	0	0%	1	1.2%	68.7%
Nation	64,223	1,251	1.9%	731	1.1%	229	0.4%	25	0%	446	0.7%	92.8%

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

[1] *Some hospitals 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

Hospital	2006–2009	2007–2010	2008–2011	2009–2012	2010–2013
University/Regional hospitals					
Karolinska/Huddinge	3.0%	2.5%	2.2%	1.8%	1.5%
Karolinska/Solna	3.6%	3.4%	2.7%	2.6%	3.0%
Linköping	1.4%	1.3%	1.6%	2.0%	2.4%
SU/Mölndal	4.4%	3.7%	3.4%	2.5%	2.1%
SUS/Lund	4.0%	3.1%	3.0%	2.7%	2.4%
SUS/Malmö	1.5%	2.2%	1.8%	1.7%	2.0%
Umeå	1.4%	1.9%	3.2%	3.3%	3.8%
Uppsala	3.0%	2.8%	2.9%	2.9%	2.1%
Örebro	1.4%	1.8%	1.7%	2.0%	1.9%
Central hospitals					
Borås	2.7%	2.4%	2.9%	3.1%	2.4%
Danderyd	3.3%	3.7%	3.9%	3.3%	3.4%
Eksjö	2.9%	2.5%	2.3%	2.4%	1.9%
Eskilstuna	1.5%	2.0%	2.0%	2.5%	2.8%
Falun	1.6%	2.2%	2.1%	1.9%	1.7%
Gävle	5.4%	5.3%	6.0%	5.3%	4.3%
Halmstad	2.6%	2.7%	3.2%	3.1%	2.5%
Helsingborg	3.7%	2.0%	1.2%	1.1%	2.2%
Hässleholm-Kristianstad	2.1%	2.0%	2.0%	1.9%	1.6%
Jönköping	1.8%	1.5%	1.6%	1.6%	1.4%
Kalmar	2.9%	1.9%	1.7%	1.5%	1.1%
Karlskrona	2.9%	1.8%	0.9%	2.2%	2.0%
Karlstad	3.1%	3.8%	4.7%	5.0%	5.0%
Norrköping	1.3%	1.1%	1.2%	1.0%	0.7%
Skövde	1.0%	1.1%	0.8%	1.3%	1.4%
Sunderby (incl Boden)	5.7%	4.4%	3.9%	4.1%	1.5%
Sundsvall	4.5%	4.2%	4.5%	3.1%	2.9%
Södersjukhuset	2.1%	2.3%	2.1%	2.5%	2.4%
Uddevalla	1.9%	2.0%	1.6%	1.5%	1.3%
Varberg	2.0%	1.5%	1.3%	1.3%	1.0%
Västerås	3.4%	4.0%	4.0%	3.8%	3.4%
Växjö	0.2%	0.8%	1.4%	1.5%	1.8%
Östersund	2.1%	2.8%	2.8%	2.6%	2.4%

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

Hospital	2006–2009	2007–2010	2008–2011	2009–2012	2010–2013
Rural hospitals					
Alingsås	1.9%	1.9%	2.4%	2.0%	1.8%
Arvika	2.0%	2.9%	2.8%	2.1%	2.3%
Bollnäs	1.3%	1.2%	1.3%	1.4%	1.7%
Enköping	3.3%	3.3%	2.7%	1.9%	1.9%
Falköping	0.5%	0.5%	0.7%	0.6%	0.5%
Frölunda Specialistsjukhus	2.8%	3.5%	2.2%	1.8%	1.5%
Gällivare	0.8%	0.8%	1.3%	1.3%	1.3%
Hudiksvall	3.1%	2.9%	2.5%	2.4%	2.1%
Karlshamn	1.6%	1.3%	1.1%	1.3%	1.4%
Karlskoga	1.1%	1.0%	1.0%	0.9%	1.0%
Katrineholm	1.0%	1.4%	1.8%	2.0%	1.9%
Kungälv	2.0%	1.8%	1.8%	2.2%	2.3%
Lidköping	0.6%	0.2%	0.5%	0.8%	0.8%
Lindesberg	2.1%	1.7%	0.9%	0.9%	0.8%
Ljungby	1.1%	1.2%	1.1%	1.0%	0.9%
Lycksele	1.1%	1.4%	1.4%	1.5%	1.3%
Mora	1.6%	1.3%	1.1%	0.7%	0.7%
Norrtälje	2.3%	2.3%	3.4%	3.5%	3.1%
Nyköping	1.7%	3.5%	4.8%	5.9%	6.5%
Oskarshamn	1.1%	1.5%	1.6%	1.4%	1.0%
Piteå	1.5%	1.2%	1.0%	1.1%	0.9%
Skellefteå	0.5%	0.5%	0.8%	0.8%	1.2%
Skene	1.9%	2.2%	1.6%	1.9%	2.2%
Sollefteå	1.2%	1.3%	1.0%	0.6%	0.6%
Södertälje	1.0%	0.8%	0.8%	1.2%	3.4%
Torsby	2.9%	2.4%	1.3%	1.8%	1.4%
Trelleborg	1.6%	1.6%	1.6%	1.5%	1.2%
Visby	2.1%	1.2%	2.0%	0.8%	1.3%
Värnamo	1.0%	1.1%	1.1%	1.6%	1.2%
Västervik	3.7%	3.8%	4.0%	3.1%	1.9%
Ängelholm	3.8%	1.0%	0.9%	0.8%	0.3%
Örnsköldsvik	0.7%	0.8%	0.7%	0.6%	0.7%

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

Hospital	2006–2009	2007–2010	2008–2011	2009–2012	2010–2013
Private hospitals					
Aleris Specialistvård Bollnäs	Fanns ej	Fanns ej	Fanns ej	2.1%	1.6%
Aleris Specialistvård Elisabethsjukhuset	0.5%	1.1%	0.8%	1.4%	1.7%
Aleris Specialistvård Motala	Fanns ej	2.3%	2.5%	2.2%	2.1%
Aleris Specialistvård Nacka	2.5%	0.7%	0.8%	1.0%	1.8%
Aleris Specialistvård Sabbatsberg	0.8%	1.4%	1.2%	1.2%	1.0%
Capio Movement	2.0%	2.4%	2.7%	3.2%	3.3%
Capio Ortopediska Huset	2.5%	2.4%	2.1%	1.5%	0.7%
Capio S:t Göran	1.2%	1.3%	1.9%	2.8%	3.1%
Carlanderska	1.9%	1.2%	1.9%	1.4%	1.2%
Ortho Center Stockholm	2.9%	2.6%	2.5%	2.4%	2.5%
OrthoCenter IFK-kliniken	0.9%	0.9%	0.6%	0.6%	0.2%
Sophiahemmet	2.1%	2.1%	1.7%	1.6%	1.6%
Spenshult	2.4%	2.7%	2.7%	2.9%	2.7%
Others	2.4%	2.6%	2.8%	3.4%	3.6%
Nation	2.1%	2.1%	2.2%	2.1%	1.9%

1) Some hospitals have been excluded due to too few operations performed during 2010–2013 or discontinued activity.

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

2010–2013

	Prim THRs	Patients[2)]		Infection		Dislocation		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
University/Regional hospitals											
Karolinska/Huddinge	246	3	1.2%	0	0%	0	0%	1	0.4%	2	0.8%
Karolinska/Solna	145	2	1.4%	1	0.7%	0	0%	0	0%	1	0.7%
SU/Mölndal	501	7	1.4%	1	0.2%	1	0.2%	1	0.2%	5	1.0%
Umeå	65	1	1.5%	0	0%	0	0%	0	0%	1	1.5%
Uppsala	291	3	1.0%	0	0%	1	0.3%	0	0%	2	0.7%
Örebro	177	3	1.7%	1	0.6%	0	0%	0	0%	2	1.1%
Central hospitals											
Borås	226	2	0.9%	1	0.4%	1	0.4%	0	0%	1	0.4%
Danderyd	389	6	1.5%	2	0.5%	2	0.5%	0	0%	4	1.0%
Eksjö	376	7	1.9%	6	1.6%	0	0%	0	0%	2	0.5%
Eskilstuna	108	1	0.9%	0	0%	0	0%	1	0.9%	1	0.9%
Falun	718	7	1.0%	5	0.7%	2	0.3%	0	0%	1	0.1%
Gävle	258	8	3.1%	4	1.6%	0	0%	0	0%	5	1.9%
Halmstad	454	8	1.8%	5	1.1%	1	0.2%	0	0%	2	0.4%
Helsingborg	61	2	3.3%	1	1.6%	1	1.6%	0	0%	0	0%
Hässleholm-Kristianstad	1,447	11	0.8%	10	0.7%	0	0%	0	0%	2	0.1%
Jönköping	360	6	1.7%	5	1.4%	1	0.3%	0	0%	2	0.6%
Kalmar	291	2	0.7%	1	0.3%	0	0%	0	0%	1	0.3%
Karlstad	296	11	3.7%	9	3.0%	0	0%	0	0%	2	0.7%
Norrköping	381	4	1.0%	2	0.5%	0	0%	0	0%	2	0.5%
Skövde	290	3	1.0%	2	0.7%	1	0.3%	0	0%	0	0%
Sundsvall	347	7	2.0%	4	1.2%	2	0.6%	0	0%	2	0.6%
Södersjukhuset	469	7	1.5%	5	1.1%	0	0%	0	0%	2	0.4%
Uddevalla	480	1	0.2%	1	0.2%	0	0%	0	0%	0	0%
Varberg	511	5	1.0%	3	0.6%	2	0.4%	0	0%	1	0.2%
Västerås	569	15	2.6%	7	1.2%	2	0.4%	0	0%	7	1.2%
Växjö	218	0	0%	0	0%	0	0%	0	0%	0	0%
Östersund	464	9	1.9%	4	0.9%	1	0.2%	0	0%	5	1.1%
Rural hospitals											
Alingsås	531	7	1.3%	3	0.6%	3	0.6%	0	0%	1	0.2%
Arvika	333	8	2.4%	5	1.5%	0	0%	1	0.3%	3	0.9%
Bollnäs	366	2	0.5%	4	1.1%	0	0%	0	0%	0	0%
Enköping	669	10	1.5%	7	1.0%	0	0%	0	0%	3	0.4%
Falköping	136	1	0.7%	0	0%	1	0.7%	0	0%	0	0%
Gällivare	157	2	1.3%	0	0%	1	0.6%	0	0%	1	0.6%
Hudiksvall	209	3	1.4%	3	1.4%	0	0%	0	0%	1	0.5%
Karlshamn	508	3	0.6%	1	0.2%	2	0.4%	0	0%	0	0%
Karlskoga	317	1	0.3%	1	0.3%	0	0%	0	0%	0	0%
Katrineholm	615	13	2.1%	10	1.6%	1	0.2%	0	0%	5	0.8%

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

2010–2013

	Prim THRs	Patients[2]		Infection		Dislocation		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Kungälv	319	4	1.3%	2	0.6%	0	0%	0	0%	2	0.6%
Lidköping	417	0	0%	0	0%	0	0%	0	0%	0	0%
Lindesberg	490	2	0.4%	0	0%	0	0%	0	0%	2	0.4%
Ljungby	342	0	0%	0	0%	0	0%	0	0%	0	0%
Lycksele	662	7	1.1%	3	0.5%	2	0.3%	1	0.2%	2	0.3%
Mora	463	1	0.2%	0	0%	1	0.2%	1	0.2%	0	0%
Norrtälje	152	3	2.0%	0	0%	1	0.7%	0	0%	3	2.0%
Nyköping	256	8	3.1%	6	2.3%	1	0.4%	0	0%	1	0.4%
Oskarshamn	476	4	0.8%	4	0.8%	0	0%	0	0%	0	0%
Piteå	771	3	0.4%	2	0.3%	2	0.3%	0	0%	0	0%
Skellefteå	154	1	0.6%	1	0.6%	0	0%	0	0%	0	0%
Skene	292	4	1.4%	0	0%	1	0.3%	0	0%	3	1.0%
Sollefteå	245	0	0%	0	0%	0	0%	0	0%	0	0%
Södertälje	191	6	3.1%	2	1.0%	0	0%	2	1.0%	4	2.1%
Torsby	167	2	1.2%	1	0.6%	0	0%	0	0%	1	0.6%
Trelleborg	1,193	7	0.6%	4	0.3%	0	0%	0	0%	3	0.3%
Visby	250	2	0.8%	0	0%	0	0%	1	0.4%	1	0.4%
Värnamo	235	2	0.9%	1	0.4%	1	0.4%	0	0%	1	0.4%
Västervik	230	3	1.3%	2	0.9%	1	0.4%	0	0%	1	0.4%
Ängelholm	404	1	0.2%	0	0%	0	0%	0	0%	1	0.2%
Örnsköldsvik	255	1	0.4%	1	0.4%	1	0.4%	0	0%	0	0%
Private hospitals											
Aleris Specialistvård Bollnäs	298	2	0.7%	2	0.7%	0	0%	0	0%	0	0%
Aleris Specialistvård Elisabethsjukhuset	181	3	1.7%	3	1.7%	0	0%	1	0.6%	0	0%
Aleris Specialistvård Motala	807	11	1.4%	8	1.0%	3	0.4%	1	0.1%	2	0.2%
Aleris Specialistvård Nacka	358	8	2.2%	7	2.0%	1	0.3%	0	0%	0	0%
Aleris Specialistvård Sabbatsberg	454	5	1.1%	3	0.7%	0	0%	0	0%	2	0.4%
Capio Movement	498	15	3.0%	3	0.6%	4	0.8%	0	0%	8	1.6%
Capio Ortopediska Huset	936	6	0.6%	2	0.2%	0	0%	0	0%	4	0.4%
Capio S:t Göran	730	13	1.8%	7	1.0%	1	0.1%	0	0%	5	0.7%
Carlanderska	304	2	0.7%	2	0.7%	0	0%	0	0%	0	0%
Ortho Center Stockholm	1,130	16	1.4%	9	0.8%	3	0.3%	2	0.2%	7	0.6%
OrthoCenter IFK-kliniken	316	0	0%	0	0%	0	0%	0	0%	0	0%
Sophiahemmet	444	8	1.8%	5	1.1%	2	0.5%	0	0%	3	0.7%
Spenshult	508	11	2.2%	4	0.8%	4	0.8%	0	0%	3	0.6%
Others	137	0	0%	0	0%	0	0%	0	0%	0	0%
Nation	29,044	352	1.2%	198	0.7%	55	0.2%	13	0%	128	0.4%

[1] Some hospitals 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.

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

2009–2012

Corrected version, compared to last annual report

	Prim THRs.	Patients[2)]		Infection		Dislocatin		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
University/Regional hospitals											
Karolinska/Huddinge	245	4	1.6	0	0	0	0	1	0.4	3	1.2
Karolinska/Solna	149	1	0.7	0	0	0	0	1	0.7	2	1.3
Linköping	50	0	0	0	0	0	0	0	0	0	0
SU/Mölndal	431	5	1.2	2	0.5	1	0.2	1	0.2	4	0.9
Umeå	71	0	0	0	0	0	0	0	0	0	0
Uppsala	259	6	2.3	1	0.4	2	0.8	0	0	3	1.2
Örebro	226	4	1.8	2	0.9	0	0	0	0	2	0.9
Central hospitals											
Borås	246	4	1.6	4	1.6	0	0	0	0	1	0.4
Danderyd	443	8	1.8	4	0.9	1	0.2	1	0.2	5	1.1
Eksjö	374	7	1.9	6	1.6	0	0	0	0	2	0.5
Eskilstuna	126	1	0.8	1	0.8	0	0	1	0.8	1	0.8
Falun	674	9	1.3	7	1	2	0.3	0	0	1	0.1
Gävle	220	8	3.6	2	0.9	1	0.5	0	0	7	3.2
Halmstad	449	10	2.2	6	1.3	2	0.4	0	0	3	0.7
Helsingborg	68	1	1.5	0	0	1	1.5	0	0	0	0
Hässleholm-Kristianstad	1,497	18	1.2	11	0.7	1	0.1	3	0.2	6	0.4
Jönköping	391	5	1.3	4	1	1	0.3	0	0	2	0.5
Kalmar	313	2	0.6	1	0.3	1	0.3	0	0	0	0
Karlstad	294	10	3.4	9	3.1	0	0	1	0.3	3	1
Norrköping	369	4	1.1	1	0.3	1	0.3	0	0	2	0.5
Skövde	243	2	0.8	2	0.8	0	0	0	0	0	0
Sundsvall	346	8	2.3	5	1.4	4	1.2	1	0.3	2	0.6
Södersjukhuset	484	7	1.4	4	0.8	0	0	0	0	3	0.6
Uddevalla	420	1	0.2	1	0.2	1	0.2	0	0	0	0
Varberg	544	4	0.7	2	0.4	1	0.2	1	0.2	2	0.4
Västerås	594	13	2.2	5	0.8	2	0.3	0	0	7	1.2
Växjö	209	0	0	0	0	0	0	0	0	0	0
Östersund	447	6	1.3	4	0.9	1	0.2	0	0	3	0.7

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

2009–2012

Corrected version, compared to last annual report

	Prim THRs.	Patients[2]		Infection		Dislocatin		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Rural hospitals											
Alingsås	507	8	1.6	4	0.8	3	0.6	0	0	1	0.2
Arvika	342	7	2	4	1.2	0	0	2	0.6	3	0.9
Bollnäs	547	3	0.5	5	0.9	1	0.2	0	0	0	0
Enköping	601	9	1.5	6	1	1	0.2	0	0	3	0.5
Falköping	291	2	0.7	0	0	2	0.7	0	0	0	0
Gällivare	156	2	1.3	0	0	1	0.6	0	0	1	0.6
Hudiksvall	193	2	1	2	1	0	0	0	0	1	0.5
Karlshamn	448	2	0.4	0	0	2	0.4	0	0	1	0.2
Karlskoga	316	1	0.3	0	0	1	0.3	1	0.3	0	0
Katrineholm	593	11	1.9	7	1.2	1	0.2	2	0.3	4	0.7
Kungälv	324	4	1.2	2	0.6	0	0	1	0.3	2	0.6
Lidköping	328	0	0	0	0	0	0	0	0	0	0
Lindesberg	466	4	0.9	0	0	0	0	0	0	4	0.9
Ljungby	386	2	0.5	0	0	2	0.5	1	0.3	0	0
Lycksele	677	8	1.2	2	0.3	3	0.4	3	0.4	5	0.7
Mora	459	1	0.2	0	0	1	0.2	1	0.2	0	0
Motala (up to 2009)	187	2	1.1	2	1.1	1	0.5	0	0	0	0
Norrtälje	170	4	2.4	1	0.6	0	0	0	0	4	2.4
Nyköping	258	7	2.7	5	1.9	1	0.4	0	0	1	0.4
Oskarshamn	417	5	1.2	5	1.2	0	0	0	0	0	0
Piteå	725	4	0.6	4	0.6	1	0.1	0	0	0	0
Skellefteå	144	0	0	0	0	0	0	0	0	0	0
Skene	280	5	1.8	0	0	1	0.4	0	0	4	1.4
Sollefteå	196	0	0	0	0	0	0	0	0	0	0
Södertälje	220	3	1.4	0	0	0	0	2	0.9	3	1.4
Torsby	168	2	1.2	1	0.6	0	0	1	0.6	1	0.6
Trelleborg	1,164	12	1	6	0.5	0	0	1	0.1	7	0.6
Visby	251	2	0.8	0	0	0	0	2	0.8	2	0.8
Värnamo	212	2	0.9	1	0.5	1	0.5	0	0	1	0.5
Västervik	222	3	1.4	2	0.9	1	0.5	0	0	1	0.5
Ängelholm	314	1	0.3	0	0	0	0	0	0	1	0.3
Örnsköldsvik	272	1	0.4	1	0.4	1	0.4	0	0	0	0

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

2009–2012

Corrected version, compared to last annual report

	Prim THRs.	Patients[2]		Infection		Dislocatin		Loosening		Others	
Hospital	**Number**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Private hospitals											
Aleris Specialistvård Bollnäs	136	1	0.7	1	0.7	0	0	0	0	0	0
Aleris Specialistvård Elisabethsjukhuset	205	3	1.5	2	1	0	0	1	0.5	1	0.5
Aleris Specialistvård Motala	588	10	1.7	7	1.2	3	0.5	1	0.2	2	0.3
Aleris Specialistvård Nacka	342	4	1.2	4	1.2	0	0	0	0	0	0
Aleris Specialistvård Sabbatsberg	413	6	1.5	3	0.7	1	0.2	0	0	2	0.5
Capio Movement	538	15	2.8	2	0.4	4	0.7	1	0.2	9	1.7
Capio Ortopediska Huset	999	14	1.4	4	0.4	2	0.2	2	0.2	9	0.9
Capio S:t Göran	709	12	1.7	5	0.7	1	0.1	1	0.1	7	1
Carlanderska	275	2	0.7	1	0.4	1	0.4	0	0	0	0
Ortho Center Stockholm	1,151	14	1.2	8	0.7	2	0.2	3	0.3	10	0.9
OrthoCenter IFK-kliniken	306	1	0.3	0	0	0	0	0	0	1	0.3
Sophiahemmet	432	7	1.6	5	1.2	2	0.5	0	0	2	0.5
Spenshult	412	10	2.4	4	1	4	1	0	0	2	0.5
Others	95	0	0	0	0	0	0	0	0	0	0
Nation	28,617	366	1.3	190	0.7	68	0.2	37	0.1	159	0.6

[1] *Karlskrona, Sunderby (including Boden), Aleris Specialistvård Ängelholm, Art Clinic, Sensia Spec.vård, SU/Östra, 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.*

"Adverse events" within 30 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. The analysis took as its point of departure the register's database for primary total hip replacements during 2011 up to and including September 2013 (43,464 operations) and this database was coordinated with the National Patient Register.

Results – all patients

The national average is 3.45%, after 30 days and 5.52% after 90 days. The frequency of adverse events varies considerably between hospitals; 30 days; 0.0–11.76%, 90 days; 0.0–13.95%. Hospitals differing from the average with a standard deviation or more are marked in red in the table (pages 78–80).

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 Swedish hip arthroplasty. 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 "Coverage". 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 code setting, and that many patients have a large number of side diagnoses when discharged, where the most relevant diagnosis for that particular care occurrence is not always the first diagnosis in the report. These factors give rise to the probability that the analysis will present values that are too low.

Generally speaking, the striving to shorten the length of stay for this type of surgery is ongoing. The concept "fast track" with ultra-short care periods among other thing is winning more and more attention in Europe and North America alike. However, the term "fast track" may be misleading because short treatment times are not really the main targets with this type of care process – rather, one should desire a structured and well thought-out process with increased preoperative information, including relevant patient expectations and staff continuity across the entire care episode. Short lengths of stay do not give any significant economic return in the long perspective and analyses must, however, include adverse events both in short- and long-term perspectives, which most studies of length of stay do not do. Even in Sweden, the mean length of stay during the last decade has come down from about 10 days (1998) to about five days (2013). Efforts to shorten the length of stay have both productivity and availability incentives. A possible reduction in costs, however, could disappear completely if readmissions will increase due to shorter lengths of stay. In Sweden, the halved lengths of stay have so far had no effect on the frequency of adverse events. A shortened length of stay can theoretically decrease the chance for care-related infections and such an effect has definitely a larger savings-effect than shorter lengths of stay.

The Register will in future have increased focus on adverse events after hip arthroplasty, both in its analysis of activity and clinical research after hip arthroplasty and has initiated a developmental cooperation with the National Board of Health and Welfare. From a patient's perspective, this type of analysis is probably more relevant compared to the analysis of only the prosthesis-related events/complications.

The great variation between hospitals suggests an improvement potential within this sphere. Of course, various case-mixes can explain some of the differences, but differences in preoperative medical assessment/optimization, etc. should also be discussed at clinics when these figures are interpreted locally. To partially adjust for case-mix, we have also analyzed adverse events for "the standard patient" group (definition can be found on page 144) this year. This analysis was based on the Register's database of primary total hip arthroplasties, which were carried out on the patient group from 2011 to September 2013 (19,317 operations) and in collaboration with the Patient Register.

Results – "standard" patient

The national average is 1.85%, after 30 days and 3.08% after 90 days. This "newer" 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 homogenic patient group, and there is room for improvement. For 30 days, the result is 0.0–5.28%, and for 90 days 0.0–8.13%. Hospitals, which deviate from the mean by one standard deviation, are marked red in the table (page 81–83).

In this year's value compasses, we have substituted mortality with adverse events because of generally very low mortality frequencies within 90 days. In order to report adverse events, with more figures and variation, gives the compasses another dimension concerning the potential for room of improvement.

Adverse events, all patients
2011–2013

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
University/Regional hospitals							
Karolinska/Huddinge	696	24	3.45	1.38	43	6.18	1.83
Karolinska/Solna	522	28	5.36	1.97	45	8.62	2.46
Linköping	176	10	5.68	3.49	13	7.39	3.94
SU/Mölndal	1,145	46	4.02	1.14	74	6.46	1.45
SUS/Lund	380	31	8.16	2.76	53	13.95	3.55
SUS/Malmö	176	5	2.84	2.46	13	7.39	3.94
Umeå	173	9	5.2	3.32	16	9.25	4.41
Uppsala	664	28	4.22	1.56	55	8.28	2.14
Örebro	362	10	2.76	1.69	21	5.8	2.46
Central hospitals							
Borås-Skene	806	27	3.35	1.25	51	6.33	1.72
Danderyd	880	48	5.45	1.53	68	7.73	1.8
Eksjö	539	29	5.38	1.94	43	7.98	2.33
Eskilstuna	358	22	6.15	2.54	32	8.94	3.02
Falun	1,029	21	2.04	0.87	42	4.08	1.23
Gävle	584	30	5.14	1.79	41	7.02	2.11
Halmstad	640	19	2.97	1.32	29	4.53	1.64
Helsingborg-Ängelholm	653	29	4.44	1.58	43	6.58	1.94
Hässleholm-Kristianstad	2,005	73	3.64	0.82	106	5.29	1
Jönköping	514	4	0.78	0.78	19	3.7	1.66
Kalmar	411	8	1.95	1.34	14	3.41	1.79
Karlskrona-Karlshamn	717	31	4.32	1.49	48	6.69	1.87
Karlstad	658	38	5.78	1.79	64	9.73	2.31
Norrköping	660	27	4.09	1.54	45	6.82	1.96
Skövde-Lidköping	1,126	31	2.75	0.96	49	4.35	1.22
Sunderby (incl Boden)	92	9	9.78	6.08	12	13.04	7.02
Sundsvall	556	43	7.73	2.23	55	9.89	2.53
Södersjukhuset	1,041	46	4.42	1.27	77	7.4	1.62
Uddevalla	952	25	2.63	1.02	44	4.62	1.36
Varberg	652	22	3.37	1.39	33	5.06	1.72
Västerås	1,309	93	7.10	1.39	137	10.47	1.69
Växjö	385	15	3.90	1.94	32	8.31	2.81
Ystad	17	2	11.76	15.35	2	11.76	15.63
Östersund	796	20	2.51	1.09	31	3.89	1.37

(Continued on next page.)

Adverse events, all patients (cont.)

2011–2013

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	610	30	4.92	1.72	44	7.21	2.09
Arvika	453	13	2.87	1.54	23	5.08	2.06
Enköping	842	39	4.63	1.45	52	6.18	1.66
Frölunda Specialistsjukhus	226	4	1.77	1.72	5	2.21	1.96
Gällivare	263	14	5.32	2.72	21	7.98	3.34
Hudiksvall	331	12	3.63	2.02	18	5.44	2.49
Karlskoga	410	22	5.37	2.19	32	7.8	2.65
Katrineholm	606	12	1.98	1.13	24	3.96	1.58
Kungälv	424	15	3.54	1.76	21	4.95	2.11
Lindesberg	603	12	1.99	1.12	15	2.49	1.27
Ljungby	430	15	3.49	1.74	25	5.81	2.26
Lycksele	801	20	2.50	1.08	36	4.49	1.46
Mora	575	15	2.61	1.31	28	4.87	1.8
Norrtälje	301	19	6.31	2.8	27	8.97	3.29
Nyköping	429	28	6.53	2.39	37	8.62	2.71
Oskarshamn	638	6	0.94	0.75	14	2.19	1.16
Piteå	1,051	16	1.52	0.74	29	2.76	1.01
Skellefteå	281	11	3.91	2.27	13	4.63	2.51
Sollefteå	340	7	2.06	1.51	13	3.82	2.08
Södertälje	282	18	6.38	2.91	25	8.87	3.39
Torsby	305	9	2.95	1.9	15	4.92	2.48
Trelleborg	1,625	25	1.54	0.6	40	2.46	0.77
Visby	331	14	4.23	2.17	17	5.14	2.43
Värnamo	398	17	4.27	2.03	27	6.78	2.52
Västervik	319	14	4.39	2.25	19	5.96	2.65
Örnsköldsvik	372	3	0.81	0.91	9	2.42	1.59

(Continued on next page.)

Adverse events, all patients (cont.)

2011–2013

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Private hospitals							
Aleris Specialistvård Bollnäs	782	13	1.66	0.9	23	2.94	1.21
Aleris Specialistvård Elisabethsjukhuset	166	2	1.20	1.69	6	3.61	2.9
Aleris Specialistvård Motala	1,232	38	3.08	0.99	72	5.84	1.34
Aleris Specialistvård Nacka	347	12	3.46	1.96	15	4.32	2.18
Aleris Specialistvård Sabbatsberg	428	3	0.70	0.81	5	1.17	1.04
Art Clinic	14	1	7.14	13.77	1	7.14	13.77
Capio Movement	515	16	3.11	1.5	21	4.08	1.74
Capio Ortopediska Huset	921	18	1.95	0.91	26	2.82	1.09
Capio S:t Göran	1,146	42	3.66	1.11	71	6.2	1.42
Carlanderska	350	4	1.14	1.12	9	2.57	1.69
Ortho Center Stockholm	1,111	18	1.62	0.76	34	3.06	1.03
OrthoCenter IFK-kliniken	371	2	0.54	0.75	4	1.08	1.07
Sensia Spec. Vård	7	0	0	0	0	0	0
Sophiahemmet	511	6	1.17	0.95	11	2.15	1.28
Spenshult	643	13	2.02	1.09	22	3.42	1.43
Nation	43,464	1,501	3.45	0.17	2,399	5.52	0.22

Adverse events, "standard patient"

2011–2013

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	**Number**	**Number**	**%**	**±**	**Number**	**%**	**±**
University/Regional hospitals							
Karolinska/Huddinge	164	2	1.22	1.71	4	2.44	2.41
Karolinska/Solna	99	5	5.05	4.40	5	5.05	4.4
Linköping	36	0	0	0	1	2.78	5.48
SU/Mölndal	315	5	1.59	1.41	7	2.22	1.66
SUS/Lund	25	0	0	0	0	0	0
SUS/Malmö	6	0	0	0	0	0	0
Umeå	30	0	0	0	1	3.33	6.55
Uppsala	150	1	0.67	1.33	3	2.00	2.29
Örebro	101	2	1.98	2.77	5	4.95	4.32
Central hospitals							
Borås-Skene	339	5	1.47	1.31	10	2.95	1.84
Danderyd	263	5	1.90	1.68	10	3.80	2.36
Eksjö	266	10	3.76	2.33	16	6.02	2.92
Eskilstuna	74	1	1.35	2.68	1	1.35	2.68
Falun	504	7	1.39	1.04	11	2.18	1.3
Gävle	181	3	1.66	1.90	6	3.31	2.66
Halmstad	308	7	2.27	1.70	9	2.92	1.92
Helsingborg-Ängelholm	324	13	4.01	2.18	18	5.56	2.55
Hässleholm-Kristianstad	928	23	2.48	1.02	28	3.02	1.12
Jönköping	218	2	0.92	1.29	6	2.75	2.22
Kalmar	189	2	1.06	1.49	3	1.59	1.82
Karlskrona-Karlshamn	345	6	1.74	1.41	10	2.90	1.81
Karlstad	180	4	2.22	2.20	8	4.44	3.07
Norrköping	236	2	0.85	1.19	6	2.54	2.05
Skövde-Lidköping	545	10	1.83	1.15	15	2.75	1.4
Sunderby (incl Boden)	5	0	0	0	0	0	0
Sundsvall	246	13	5.28	2.85	20	8.13	3.48
Södersjukhuset	290	8	2.76	1.92	11	3.79	2.24
Uddevalla	357	2	0.56	0.79	7	1.96	1.47
Varberg	354	11	3.11	1.84	15	4.24	2.14
Västerås	359	5	1.39	1.24	10	2.79	1.74
Växjö	160	4	2.50	2.47	10	6.25	3.83
Östersund	318	5	1.57	1.40	10	3.14	1.96

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Adverse events, "standard patient" (cont.)

2011–2013

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	367	15	4.09	2.07	18	4.90	2.25
Arvika	212	9	4.25	2.77	11	5.19	3.05
Enköping	454	13	2.86	1.57	21	4.63	1.97
Gällivare	113	2	1.77	2.48	3	2.65	3.02
Hudiksvall	134	1	0.75	1.49	1	0.75	1.49
Karlskoga	198	5	2.53	2.23	8	4.04	2.8
Katrineholm	403	7	1.74	1.30	14	3.47	1.82
Kungälv	205	2	0.98	1.37	3	1.46	1.68
Lindesberg	324	4	1.23	1.23	5	1.54	1.37
Ljungby	223	5	2.24	1.98	9	4.04	2.64
Lycksele	435	5	1.15	1.02	14	3.22	1.69
Mora	303	6	1.98	1.60	10	3.30	2.05
Norrtälje	81	1	1.23	2.45	2	2.47	3.45
Nyköping	153	4	2.61	2.58	5	3.27	2.87
Oskarshamn	342	3	0.88	1.01	8	2.34	1.63
Piteå	532	1	0.19	0.38	6	1.13	0.92
Skellefteå	106	3	2.83	3.22	4	3.77	3.7
Sollefteå	176	1	0.57	1.13	3	1.70	1.95
Södertälje	121	5	4.13	3.62	8	6.61	4.52
Torsby	114	2	1.75	2.46	3	2.63	3
Trelleborg	840	7	0.83	0.63	13	1.55	0.85
Visby	179	3	1.68	1.92	3	1.68	1.92
Värnamo	166	4	2.41	2.38	7	4.22	3.12
Västervik	147	4	2.72	2.68	5	3.40	2.99
Örnsköldsvik	160	2	1.25	1.76	3	1.88	2.14

(Continued on next page.)

Adverse events, "standard patient" (cont.)

2011–2013

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	Number	Number	%	±	Number	%	±
Private hospitals							
Aleris Specialistvård Bollnäs	437	6	1.37	1.11	12	2.75	1.56
Aleris Specialistvård Elisabethsjukhuset	126	0	0	0	3	2.38	2.72
Aleris Specialistvård Motala	522	9	1.72	1.14	17	3.26	1.55
Aleris Specialistvård Nacka	255	12	4.71	2.65	15	5.88	2.95
Aleris Specialistvård Sabbatsberg	316	3	0.95	1.09	5	1.58	1.4
Art Clinic	7	0	0	0	0	0	0
Capio Movement	306	6	1.96	1.59	8	2.61	1.82
Capio Ortopediska Huset	635	11	1.73	1.04	17	2.68	1.28
Capio S:t Göran	474	11	2.32	1.38	22	4.64	1.93
Carlanderska	207	2	0.97	1.36	4	1.93	1.91
Ortho Center Stockholm	747	5	0.67	0.60	16	2.14	1.06
OrthoCenter IFK-kliniken	213	1	0.47	0.94	2	0.94	1.32
Sensia Spec. Vård	4	0	0	0	0	0	0
Sophiahemmet	301	5	1.66	1.47	6	1.99	1.61
Spenshult	364	9	2.47	1.63	15	4.12	2.08
Nation	19,317	357	1.85	0.19	595	3.08	0.25

Revision

Revision means that a hip arthroplasty-operated patient undergoes a further operation in which a section 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 that year as opposed to getting the data from the primary database that has registered personal identification codes since 1992 and before that, only aggregated data per clinic for primary operations was registered. Since 1979, the number of revisions performed per year has increased to 2009–2012 (Figure 1). During 2013, 77 less revisions were registered compared to the previous year. However, there is a lack in reporting. Currently (June 2014), the Register is waiting for data from at least 20 cases, which thus are missing from the annual report, but which will be added to the next one. At most, this has affected about 50 cases in the previous year, which suggests that the number of revisions should have increased in 2013. However, for the sake of accurate reporting, it is necessary that reports be submitted on time. In 2013, revisions made up 9.9% of all reoperations and primary arthroplasties (refer to Figure 1, section "Reoperation").

From the Register's starting year 1979, the number of multiple-time revisions increased until the early 2000s. This is mainly due to the increased number of hip arthroplasty patients in the population, combined with increasing life expectancy. Improved ability to perform advanced prosthetic surgery has certainly had and influence too. From the period 2000–2003, the proportion of multiple-time revisions remained relatively constant around 25% (Figure 2).

From 2011 to 2013, the average age for men at the time of the revision has been 3–4 years higher than in those patients who were operated with primary prosthesis during the same period (Table 1). In women, the difference is only about two years, probably because women are more susceptible to dislocation, which in most cases is an early complication while men are overrepresented at other causes for revision. The proportion of women decreased successively in comparison of primary prostheses, first-time and multiple revisions. The more revisions performed, the more likely it concerns a man. Men are more affected by multiple-time revisions. A shift in the incidence of diagnoses occurs so that patients with sequelae following a hip disease in childhood and adolescence, inflammatory osteoarthritis and idiopathic femoral head necrosis are over-represented in the revision groups.

More than a half (53.7%) of all revisions are carried out in hospitals which perform at least 150 revisions during a three-year period (2011–2013) and 78.5% which perform at least 100 revisions during the same period. Eight revisions or fewer were carried out in one year in 26 hospitals. Together they account for 3.2% of all revisions conducted during the period. These hospitals with low frequency of revisions performed mostly cup changes (33.3%). Replacing the stem constituted for 13.4%, replacing both components 22.4% and total extraction/insertion of total hip arthroplasty after extraction accounted for 3.0%. In other cases (27.9%), liner or only femoral head was changed. There may be several different circumstances that may justify why these procedures are performed in hospitals where revision is an unusual intervention, but given that this type of operation has an increased risk of complications, often requiring special implants and instruments and often have access to bone bank, it is it seems probable that the majority of these cases should be centralized.

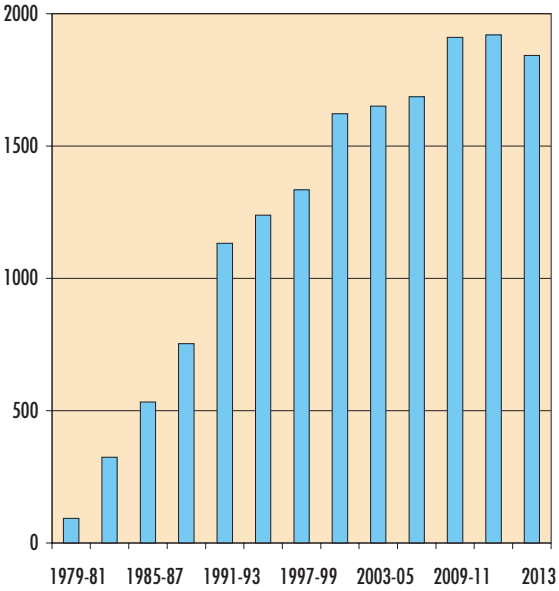


Figure 1. Number of revisions from 1979 to 2013. For the period 1979–2011, an average for the respective three-year period is indicated.

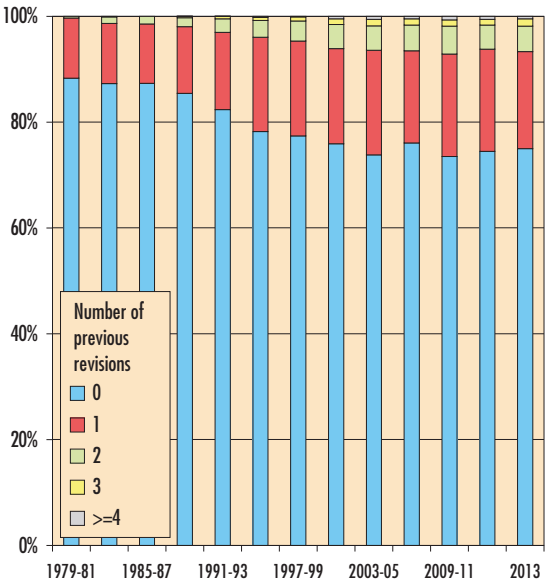


Figure 2: Distribution of primary and multiple-time revisions in three-year periods since the inception of the Swedish Hip Arthroplasty Register. The proportion of first-time revisions has reduced from over 90 to around 75% after the turn of the century, in part because the only primary operations which were carried out in 1979 and later, are included in the analysis, but also because of other reasons, like the increasing age of the population, increasing proportion of hip arthroplasty and probably also a certain shift concerning the indicators.

Demography

		Revision		
	Primary THRs	**First revision**	**≥ 1 earlier revision(s)**	**Irrespective earlier number**
Number	48,277	4,175	1,076	5,251
Age meanl SD				
Male	67.1 *10.9*	70.7 *11.3*	71.3 *10.6*	70.8 *11.1*
Female	69.6 *10.4*	71.8 *11.5*	71.0 *12.2*	71.6 *11.7*
Proportion female %	58.1	52.3	48.1	51.3
Diagnosis %				
Primary osteoarthritis	82.8	77.0	71.6	75.6
Inflammatorisk artrit	1.3	5.0	7.5	5.7
Fracture/seq. trauma	9.9	8.0	9.1	8.3
Childhood disease	2.1	4.7	6.6	5.2
Femoral head necrosis	3.3	3.9	3.6	3.8
Others	0.7	0.6	0.9	0.7
Missing	–	0.9	0.7	0.8
Volume 2011–2013 Number of hospitals				
1–24	5	24	33	26
25–49	–	10	12	7
50–99	–	19	8	10
100–149	1	6	1	12
150–199	4	4	–	5
200–299	3	3	–	5
300–499	16	–	–	2
500–999	29	–	–	–
1,000–1,499	10	–	–	–
1,500–2,499	2	–	–	–

Table 1. Demographic data and number of hospitals performing first and multiple revisions divided from less than 25 interventions during the last three years (2011–2013). Data for pri-mary THRs for comparison.

The number of revisions over the past three years has been relatively constant and been just below 2000 per year. Just under 40% of the clinics that perform revisions make less than 10 of these surgeries per year.

Causes leading to revision

In Sweden, aseptic loosening, also including osteolysis, is the commonest cause of initial as well as multiple-time revisions. The relative proportion which was revised due to these two reasons, has since 2003–2005 gradually reduced from 70 to 54.7% with regard to first-time revisions (Figure 3 on the left) and from 53.2 to 38.3% during multiple-time revision (Figure 3 on the right). During 2003–2005, dislocation was the second most common cause for both types of operations. In 2012, dislocation exchanged places with infection and the relative proportion of infection increased even more in 2013 from 13.9 to 14.6% in primary revisions and from 23.9 to 25.6% in multiple-time revisions. The relative increase of infection as a cause for revision does not correspond o an increasing number of infected patients (hips), partly because the total number of primary and multiple-time revisions decreased between 2012 and 2013. Primary revision due to dislocation peaked in 2008 (14.7%). Thereafter, this proportion decreased down to 11.2% in 2011 and then increased to 13.8% (25 cases more than in 2012). Technical reasons can in most cases be attributed to an early loosening (2011–2013: 84.7% of first-time revisions). Three of the most common causes in the group "other" were, both at primary and multiple-time revisions, made up of granuloma in relation to metal wear (ALVAL), elevated levels of metal ions or obscure pain.

The cause of revision varies depending on age. During 2004–2013, loosening/osteolysis dominates in all age groups and constitutes about 60% of the cases, but tends to decrease at 80 year olds, when dislocation and periprosthetic fracture increase as causes (Figure 4 on the left). It is more evident in multiple-time revisions. The proportion of multiple-time revisions due to loosening/osteolysis decreases with age, from 50 and upwards, and the proportion of multiple-time revision due to periprosthetic fracture increases from 70 years. The highest proportion of revisions due to dislocation can be seen from the age of 80 and upwards (Figure 4 on the right). The proportion "other causes" is highest during first-time revisions under the age of 60 and is dominated by ALVAL/high level of metal ions (38.4%), pain (22.3%) and implant fracture (19.6%).

The cause of revision varies depending on age and previously performed revisions. Dislocation and infection are most common during multiple-time revisions.

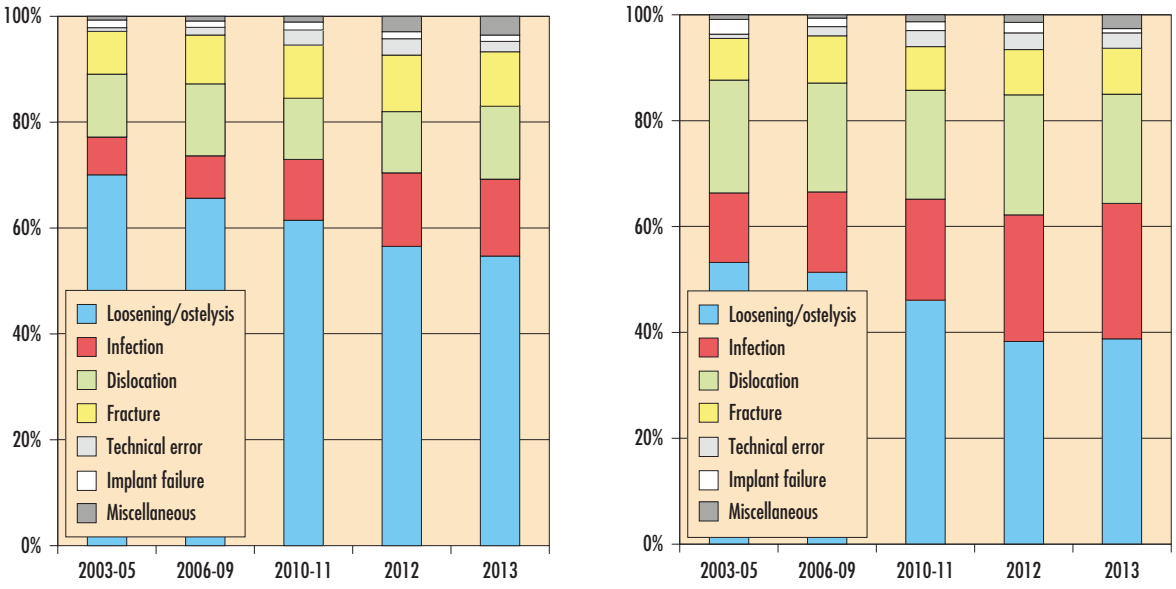


Figure 3. Distribution of causes for revision at primary (left) and multiple-time revisions (right) between 2003 and 2013. During multiple-time revision, "insertion of prosthesis after previous extraction" has been excluded.

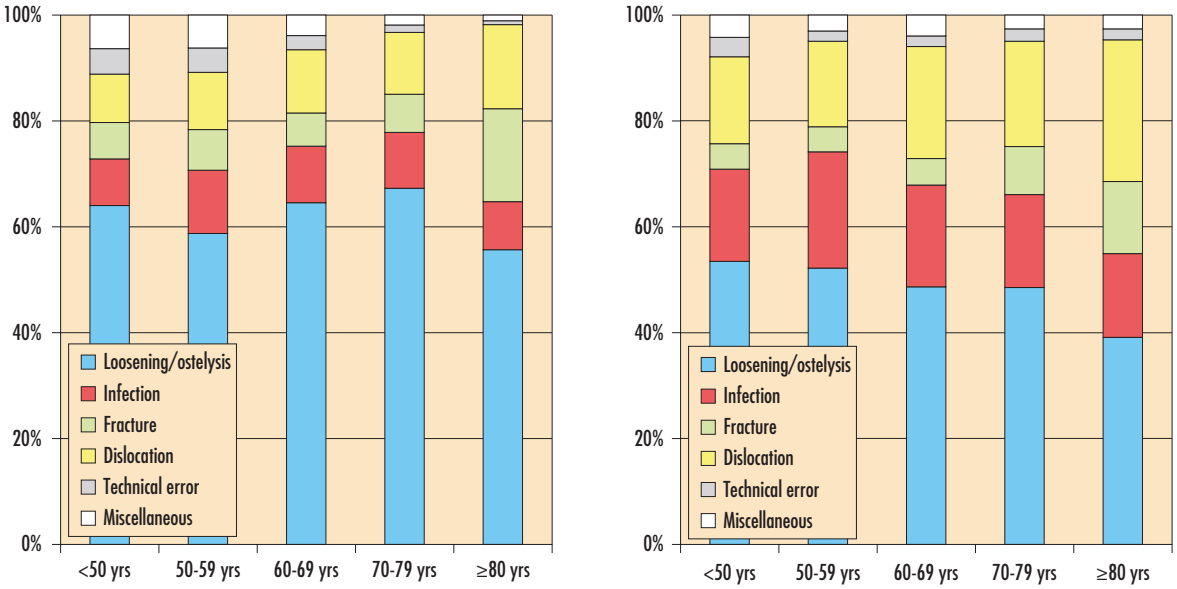


Figure 4. Distribution of causes for revision relative to age at first-time (left) and multiple-time revisions (right). The entire period 2004–2013 is included. Unlike Figure 3, here "implant fracture" is included in the group "other".

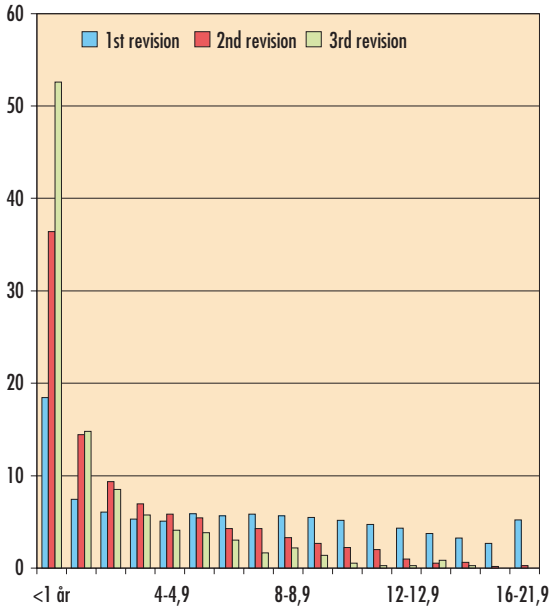


Figure 5. Time to primary, secondary, and third revision of primary arthroplasty or previous revision. The time interval from 16 years is longer than for others. Insertion of the prosthesis after previous extraction was excluded.

Multiple-time revisions

Out of the primary revisions carried out between 1979 and 2013, 21.4% were revised once again at another point of time. If the selection is limited to primary surgery in 1992 or later, the proportion falls to 19.8%. Just under a fifth of first-time revisions (18.5%) which suffered from an additional revision, were revised within one year. The more revisions the patient undergoes, the higher is the probability that the time to next revision (if it occurs) will decrease (Figure 5). Probably, this depends on the fact that infection is the most common cause for revision with an increasing number of rerevisions.

The reason for patient's primary revision affects the cause profile to a possible second time revision (Table 2). Those who undergo a primary revision due to loosening/osteolysis, infection and dislocation, have a high probability that if they have to undergo another revision, they will be revised because of the same reason. Simply put, this means that after a revision due to one of these reasons, the general risk for additional revision is about 20% and with more than 50% probability, this revision will be carried out because of the same reason. If a patient who has suffered from two consecutive revisions on the same hip, the similar pattern is evident (Table 3). It is especially clear that the reason for infection returns by the third revision. Similarly, the problem of dislocation becomes even clearer after the second revision due to periprosthetic fracture.

Reason for first and second revisions

First revision	Loosening/ osteolysis	Infection	Periprosthetic fracture	Dislocation	Others
Second revision					
Loosening/osteolysis	**63.1**	23.5	27.4	15.2	**36.2**
Infection	9.3	**56.2**	17.0	21.8	21.5
Periprosthetic fracture	9.3	4.6	11.6	5.0	10.1
Dislocation	13.7	13.1	**30.7**	**54.5**	18.8
Others	4.6	2.6	13.3	3.5	13.4

Table 2. The distribution of reason for second revision is grouped after reason to the previous first revision. Only patients revised for the first time during 1992–2013, and that have at least one more revision, have been included. After first revison due to aseptic loosening/osteolysis, infection and dislocation the reason for a second revision is most commonly the same as for the first. First revision of a periprosthetic fracture is often followed by a revision due to dislo-cation or aseptic loosening/osteolysis. 2-stage procedure after extraction has been excluded.

Reason for second and third revisions

Second revision	Loosening/ osteolysis	Infection	Periprosthetic fracture	Dislocation	Others
Third revision					
Loosening/osteolysis	**57.2**	4.2	31.7	22.3	**26.7**
Infection	11.5	**83.1**	8.3	22.3	24.4
Periprosthetic fracture	7.7	1.4	11.7	6.0	4.4
Dislocation	16.5	8.5	**41.7**	**46.4**	28.9
Others	7.1	2.8	6.7	3.0	15.6

Table 3. The distribution of reason for third revision is grouped after reason to the previous second revision. Only patients revised for the second time during 1992–2013, and that have at least one more revison have been included. As compared to the outcomes after first revision the pattern is similar for third revisions. The probability that a second revision performed due to infection at a possible third revision also caused by an infection is even higher. 2-stage procedure after extraction has been excluded.

The proportion of revisions due to infection and dislocation increases for multiple-time revisions. After initial revision, the probability is great that a possible further revision will take place during the first year after the index revision. If the first revision is performed due to loosening, infection or dislocation, then the cause for the next revision is, in most cases, the same. If the first revision is caused by periprosthetic fracture then the probability is greatest that the revision will be due to dislocation, which is important to know before making a decision on simultaneous cup revisions in these patients.

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 6). During multiple-time revision, measures such as change of liner and and femoral head and extraction, are more common than during first-time revisions. Recementing of the stem in the existing cement mantle is classified as a stem revision. The intervention was registered only on 50 cases in 1979–1999, but has subsequently become increasingly common. In 2013, 184 operations were registered.

As expected, there is a great variation concerning the selection of measures depending on the cause for revision (Figure 7). During loosening and/osteolysis, the change of cup and/or stem dominates as a measure, while these measures make up only 14.9% in cases of infection. In about a third of these cases, only one of the components is changed, perhaps depending

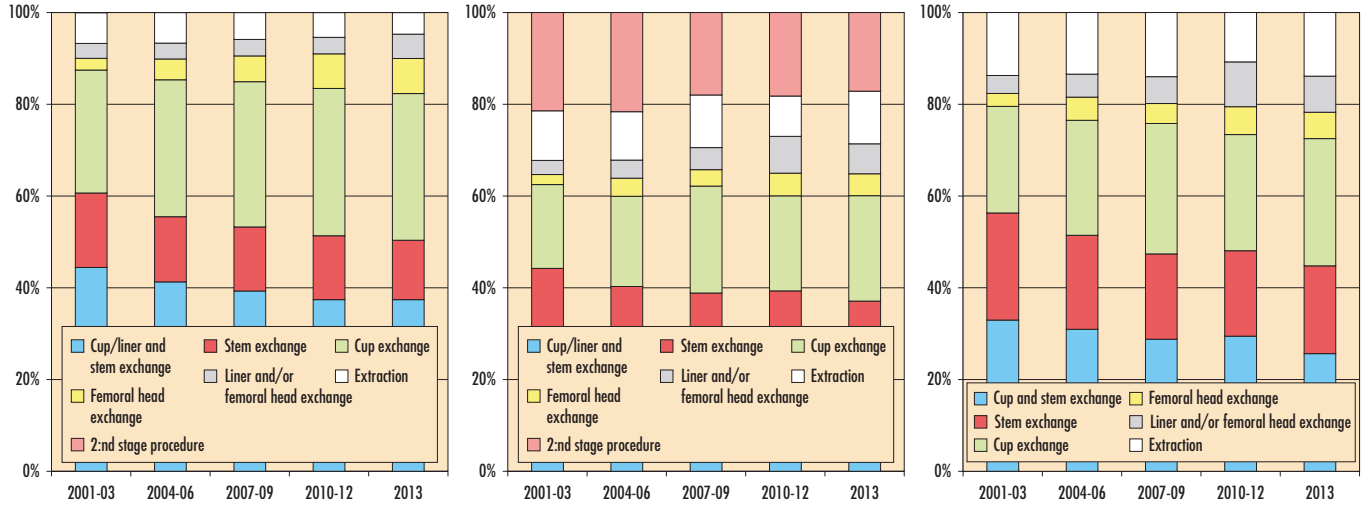


Figure 6. Distribution of measures at first-time (left) and multiple-time revisions (middle and right). The graph on the right is different from that in the middle because the measure "insertion of the prosthesis after previous extraction" has been excluded.

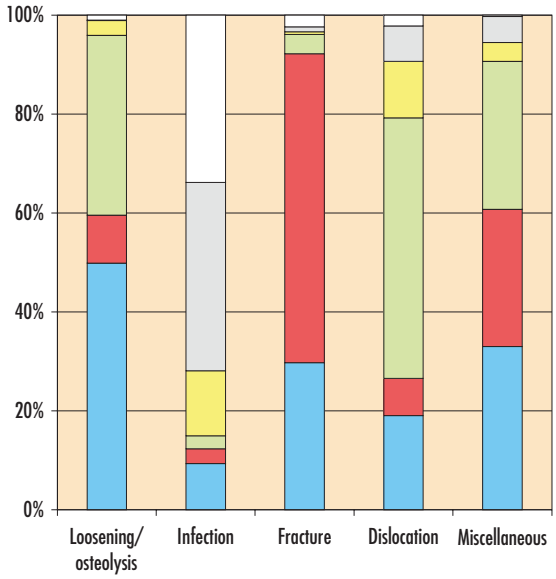


Figure 7. Measures during revision related to the revision cause regardless of the number of previous revisions during the period 2011–2013. Insertion of the prosthesis after previous extraction is excluded. For interpretation of colors, refer to Figure 8.

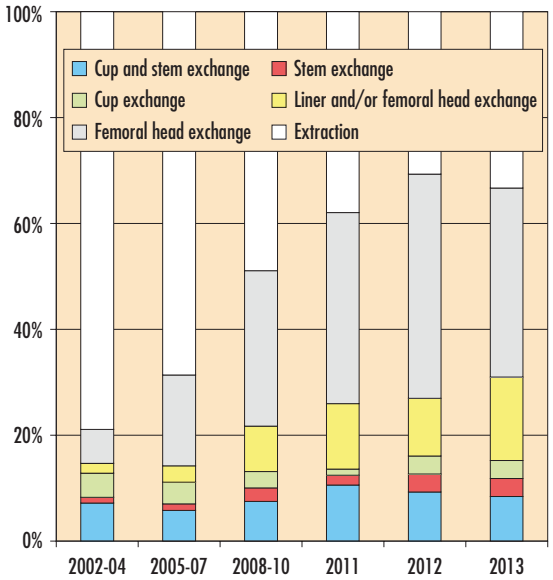


Figure 8. Measures during revision (primary and multiple-time revisions) due to infection during a three-year period in 2002–2010 and in 2011, 2012 and 2013.

on the fact that the infection was not known before surgery. As expected, stem change is the most common measure at periprosthetic fracture and cup change is the most common measure at dislocation.

During the early 2000s, revision due to infection became more common with prosthesis-conserving surgery (Figure 8). Instead of extracting the prosthesis, a wound revision, a synovectomy and a change of modular parts, like the femoral head and also liner in the case of uncemented cup, were performed. In 2013, the proportion of change of liner±femoral head increased and isolated changing of the femoral head decreased, which is probably an effect of the fact that increasing number of patients were operated with an uncemented prosthesis. Another cause may be that, as opposed to the previous year, in 2013, surgeons more frequently chose to extract the entire prosthesis instead of lavage and femoral head exchange in cases with an infected cemented prosthesis.

In 2013, a long-standing trend towards prosthesis-conserving surgery at revision due to infection was broken.

Selection of implant

Selection of uncemented fixation has a longer tradition in revision than in operations with primary prostheses. However, cemented fixation also dominated in cases of revision 10 years ago. During the last 10 years uncemented fixation has increased in first-time as well as multiple-time revisions and is now used in about half of all operations. In 2013, 30% of stems and 18% of the cups were uncemented in primary operations. The difference in the choice of fixation between the primary surgery and revision surgery can be justified by the fact that for the revision it was found easier to fix an uncemented prosthesis even if the bone was damaged. During cemented fixations, a so-called bone grafting must often be performed, a technically difficult procedure which often requires access to a well-functioning bone bank. During the past three years, it would seem that the trend towards a more uncemented fixation in revision operations has been broken (Figure 9).

Replacement of both cup and stem was performed in 39.7% of primary revisions and 23.9% of multiple-time revisions, during the period 2002–2013. If those revision procedures where both components have been replaced are analyzed, we find that completely cemented fixation is used about twice as frequently at primary operations, while the hybrid concept is used much more frequently for revision (first revision: 27.3%; at least one previous surgery: 23.5%; primary operation 2.4% in 2013). Even completely uncemented fixation and reverse

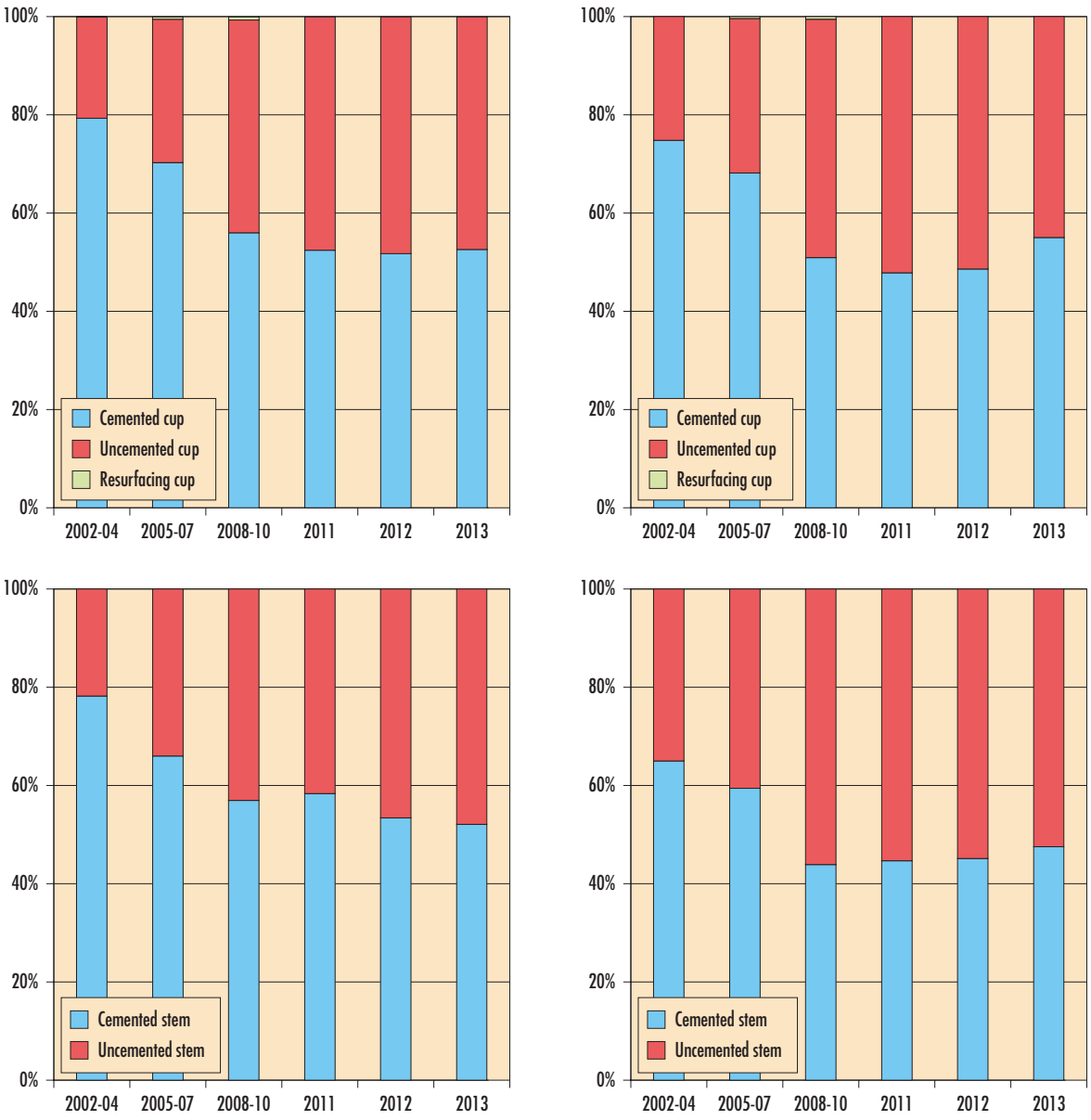


Figure 9. Distribution of cemented and uncemented cups (top) and stem (bottom). Primary revisions on the left and multiple-time revisions on the right. In recent years, the distribution of cemented/uncemented fixations has been relatively unchanged for both types of revision.

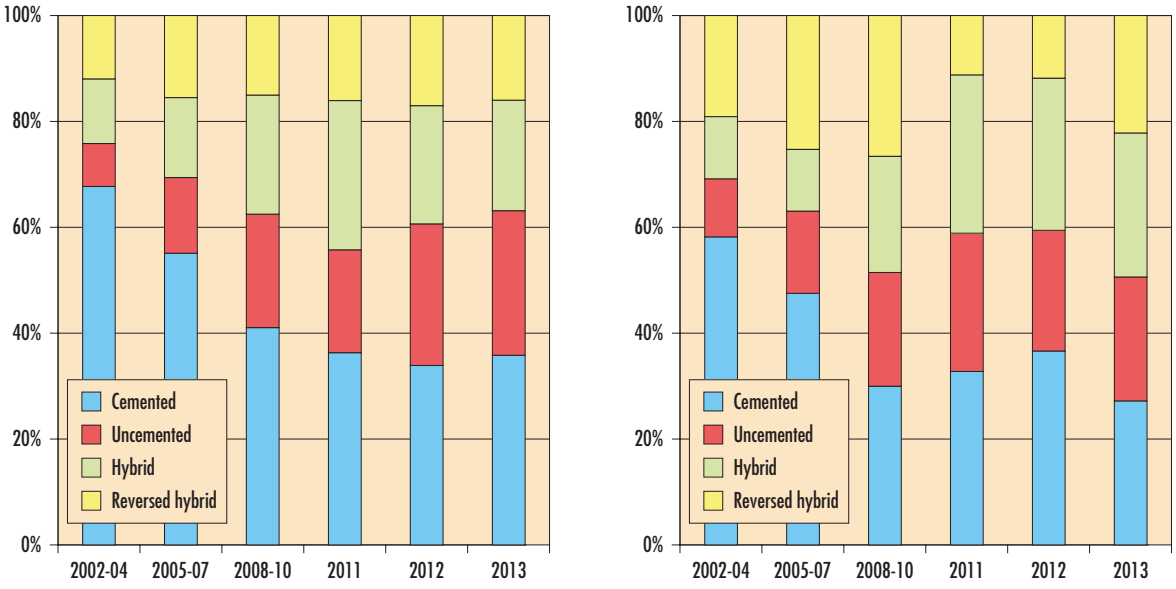


Figure 10. Distribution of the selection of fixation at the primary revision (left) and multiple-time revision (right) during the period 2002–2013. Only revisions where both cup and stem were replaced are included.

hybrid fixation are relatively common in revisions but the difference is not that significant (Figure 10, see also "Primary Prosthesis").

During the past 10 years the variation in choice of specific implants for revision has shown a slightly greater variation than that for primary prosthesis. The picture is somewhat clouded by the fact that revision prosthesis 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 creation of dual articular cup design and cups with trabecular metal in combination with a trend to abandon cemented fixation in favor of uncemented fixation. According to this year's analysis, it appears that the transition to uncemented fixation at revision slowed. To illustrate how the choice of implant changed over the past decade, we present the five most used cemented and uncemented cups and stems in 2013, and for 2008 and 2004. In the table, we have not divided the cups depending on whether they are made of older or newer polyethylene, which is highly cross-linked.

The size of the "other implants" group gives some idea of how diversified the choice of prosthesis has been, but this proportion is affected by how detailed the classification for the used implant is. In 2013, the Avantage cup was the most common cemented and TMT revision was the most common uncemented revision cup. The database states that in 50.9% of the cemented and 46% of the uncemented cup revisions, some form of bone graft was used. Since 2010, the Exeter standard has been the most used stem. Among the uncemented group, the modular uncemented stems have dominated and made up 84.3% in 2013. The MP stem has been the most used stem during the whole period. Some type of bone graft has according to the operation log been used in 28.5% of the cemented and 5.3% of the uncemented stem revisions.

Use of the hybrid prostheses for replacement of both the cup and stem are much more common at revision than at primary operation. The same applies to a lesser degree for completely uncemented prostheses and reverse hybrid prostheses.

Most common revision implants 2004, 2008 and 2013

2004		2008		2013	
Cup at revision					
Cemented number	**833**		**690**		**642**
Lubinus	23.8	Lubinus	24.5	Avantage	24.1
Elite OGEE	17.0	CHD*	15.5	Exeter Rim-fit	22.9
Exeter	16.4	ZCA	12.8	Lubinus	17.4
CHD*	6.4	Elite Ogee	10.7	Marathon	14.2
Reflection	5.4	Contemporary	8.8	ZCA	5.0
Others	**25.0**	Others	**27.7**	Others	**16.4**
Uncemented number	282		472		493
Trilogy±HA	71.3	Trilogy±HA	37.5	TMT revision	30.4
Mallory Head	9.6	TMT revision	16.9	Continuum	20.5
Reflection SP3 HA	3.9	TMT modular	14.2	Trilogy	9.9
ABG II	2.5	Trident AD LW	9.5	Mallory head	6.3
TOP Pressfit	2.5	Mallory head	7.2	TMT modular	6.1
Others	**10.3**	Others	**14.7**	Others	**26.8**
Stem at revision					
Cemented number	**621**		**534**		**463**
SP II standard	33.0	SP II standard	28.5	Exeter standard	33.0
Exeter standard	27.2	Exeter standard	28.5	SP II standard	28.1
CPT	15.3	CPT	11.8	Exeter kort rev-stam	14.9
Exeter long	11.0	Exeter kort rev-stam	8.6	CPT	8.6
Spectron EF long	3.2	Exeter long	8.4	Exeter long	6.7
Others	**10.3**	Others	**14.2**	Others	**8.6**
Uncemented number	**272**		**405**		**451**
MP	39.7	MP	44.7	MP	45.0
Wagner SL Revision	21.7	Restoration	15.3	Restoration	20.2
Revitan cylinder	12.5	Revitan cylinder	12.3	Revitan cylinder	13.5
Revitan spout	4.8	Wagner SL Revision	9.4	Arcos	4.2
Restoration	4.0	CLS	3.5	Bimetric X Por HA	4.0
Others	**17.3**	Others	**10.6**	Others	**13.1**

*Contemporary Hooded Duration

Table 4. The five most used cemented and uncemented cups and stems in revision surgery given in percentage of total number of reported revisions during 2004, 2008 and 2013.

Minor types of intervention, socket wall additions and augmentations

Treatment of dislocation by screwing a semicircle cutout 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. In the Register, the measure has not been classified as a revision, but in 31.5% of cases it is combined with cup and stem change and is thus included in a revision. In the Register's 2006 annual report, we found that about 30% of these patients were rerevised within a 10-year period. After the peak year of 2004, the use of socket wall addition has decreased, probably in part as a result of increased use of large femoral heads and the introduction of dual articular cups in Sweden. In 2013, only 7 operations were carried out (Figure 11 on the left).

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 augmentations) were introduced for filling defects in the acetabulum. In Sweden, such augmentation was used for the first time in 2006 (Figure 11, on the right). At the moment, the type of the used augmentation 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. This is important because the augmentation from a specific manufacturer is not only used for the same manufacturer's cups, but also with cups made by other manufacturers. 21 different types of cups have been used in the 500 operations that are registered, with at least one inserted augmentation. In 52.8% of these cases, a cup intended for cemented fixation was used.

Use of socket wall additions to prevent dislocation since 2005 has gradually declined and almost completely disappeared in 2013.

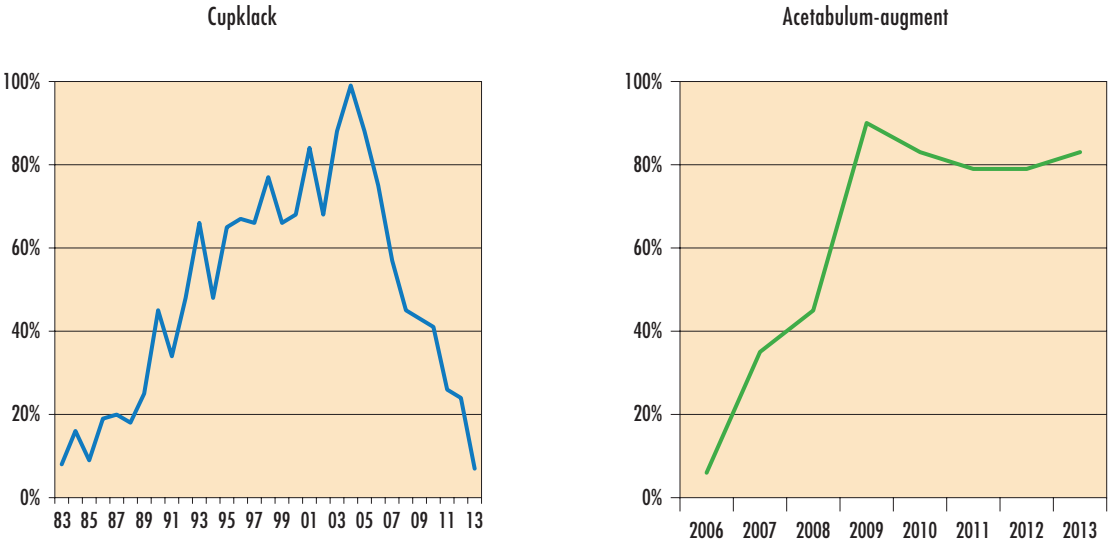


Figure 11. Use of socket wall additions at revision due to dislocation (left) and the acetabulum-augmentation to replace bone defect at revision (right).

Number of revisions per diagnosis and number of previous revisions

primary THR 1979–2013

Diagnosis at primary THR	0		1		2		>2		Total	Proportion
Primary osteoarthritis	23,345	74.3%	3,967	70.2%	772	65.5%	230	61.5%	28,314	73.3%
Fracture	2,706	8.6%	460	8.1%	84	7.1%	17	4.5%	3,267	8.5%
Inflammatory arthritis	2,329	7.4%	514	9.1%	151	12.8%	55	14.7%	3,049	7.9%
Childhood disease	1,573	5.0%	405	7.2%	95	8.1%	40	10.7%	2,113	5.5%
Femoral head necrosis	792	2.5%	152	2.7%	37	3.1%	11	2.9%	992	2.6%
Posttraumatic osteoarthritis	242	0.8%	78	1.4%	26	2.2%	19	5.1%	365	0.9%
Other secondary osteoarthritis	112	0.4%	22	0.4%	3	0.3%	1	0.3%	138	0.4%
Tumour	68	0.2%	17	0.3%	5	0.4%	1	0.3%	91	0.2%
(missing)	263	0.8%	34	0.6%	5	0.4%	0	0%	302	0.8%
Total	31,430	100%	5,649	100%	1,178	100%	374	100%	38,631	100%

Number of revisions per reason and number of previous revisions

primary THR 1979–2013

Reason for revision	0		1		2		>2		Total	Proportion
Aseptic loosening	22,124	70.4%	3,234	57.2%	558	47.4%	132	35.3%	26,048	67.4%
Dislocation	2,874	9.1%	873	15.5%	238	20.2%	108	28.9%	4,093	10.6%
Deep infection	2,711	8.6%	791	14.0%	223	18.9%	97	25.9%	3,822	9.9%
Fracture	2,264	7.2%	466	8.2%	98	8.3%	18	4.8%	2,846	7.4%
Technical error	710	2.3%	131	2.3%	29	2.5%	10	2.7%	880	2.3%
Implant fracture	456	1.5%	96	1.7%	21	1.8%	7	1.9%	580	1.5%
Others	163	0.5%	28	0.5%	5	0.4%	1	0.3%	197	0.5%
Pain only	128	0.4%	28	0.5%	6	0.5%	1	0.3%	163	0.4%
Secondary infection	0	0%	2	0%	0	0%	0	0%	2	0%
Total	31,430	100%	5,649	100%	1,178	100%	374	100%	38,631	100%

Number of revisions per revision year and number of previous revisions

primary THR 1979–2013

Year of revison	0		1		2		>2		Total	Proportion
1979–2008	24,406	77.7%	4,120	72.9%	817	69.4%	247	66%	29,590	76.6%
2009	1,442	4.6%	303	5.4%	80	6.8%	21	5.6%	1,846	4.8%
2010	1,409	4.5%	312	5.5%	82	7.0%	31	8.3%	1,834	4.7%
2011	1,363	4.3%	307	5.4%	64	5.4%	28	7.5%	1,762	4.6%
2012	1,429	4.5%	317	5.6%	68	5.8%	25	6.7%	1,839	4.8%
2013	1,381	4.4%	290	5.1%	67	5.7%	22	5.9%	1,760	4.6%
Total	31,430	100%	5,649	100%	1,178	100%	374	100%	38,631	100%

Number of revisions per reason and revision year

first revision only, primary THR 1979–2013

Reason for revision	1979–2008	2009	2010	2011	2012	2013	Total	Proportion
Aseptic loosening	17,972	919	876	794	808	755	22,124	70.4%
Dislocation	2,033	171	162	153	165	190	2,874	9.1%
Deep infection	1,826	143	152	191	198	201	2,711	8.6%
Fracture	1,547	133	148	141	153	142	2,264	7.2%
Technical error	519	36	37	47	44	27	710	2.3%
Implant fracture	355	25	17	23	19	17	456	1.5%
Others	66	7	11	9	28	42	163	0.5%
Pain only	88	8	6	5	14	7	128	0.4%
Total	24,406	1,442	1,409	1,363	1,429	1,381	31,430	100%

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

first revision only, primary THR 1979–2013

Type of fixation at primary THR	1979–2008	2009	2010	2011	2012	2013	Total	Proportion
Cemented	20,015	1,065	1,050	976	995	940	25,041	79.7%
Uncemented	2,212	153	145	160	173	179	3,022	9.6%
Hybrid	1,282	144	112	108	108	115	1,869	5.9%
Reversed hybrid	264	52	75	88	93	98	670	2.1%
Resurfacing implants	52	16	15	14	24	29	150	0.5%
(missing)	581	12	12	17	36	20	678	2.2%
Total	24,406	1,442	1,409	1,363	1,429	1,381	31,430	100%

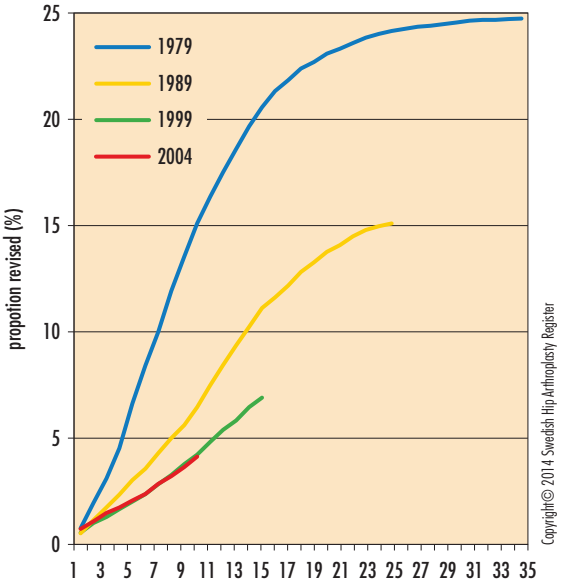
Number of revisions per reason and time to revision

first revision only, primary THR 1979–2013

Reason for revision	0–3 years		4–6 years		7–10 years		>10 years		Total	Proportion
Aseptic loosening	3,083	36.7%	4,048	77.7%	6,004	83.6%	8,989	84.6%	22,124	70.4%
Dislocation	1,719	20.4%	356	6.8%	336	4.7%	463	4.4%	2,874	9.1%
Deep infection	2,066	24.6%	271	5.2%	194	2.7%	180	1.7%	2,711	8.6%
Fracture	655	7.8%	319	6.1%	479	6.7%	811	7.6%	2,264	7.2%
Technical error	645	7.7%	28	0.5%	21	0.3%	16	0.2%	710	2.3%
Implant fracture	71	0.8%	115	2.2%	131	1.8%	139	1.3%	456	1.5%
Others	79	0.9%	51	1%	13	0.2%	20	0.2%	163	0.5%
Pain only	94	1.1%	19	0.4%	4	0.1%	11	0.1%	128	0.4%
Total	8,412	100%	5,207	100%	7,182	100%	10,629	100%	31,430	100%

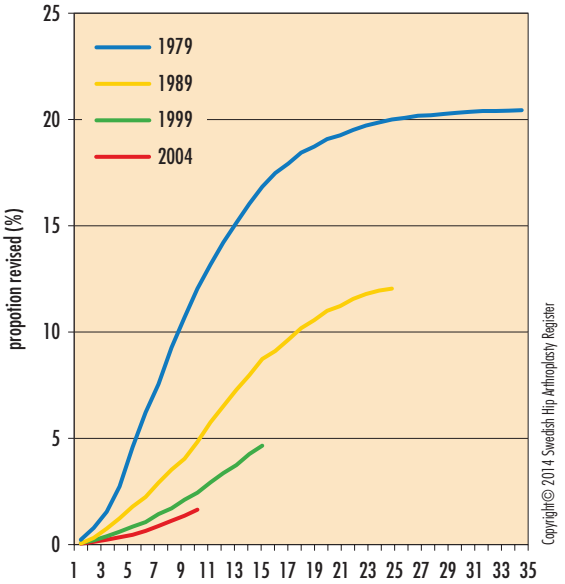
All diagnoses and all reasons

cumulative revision frequency



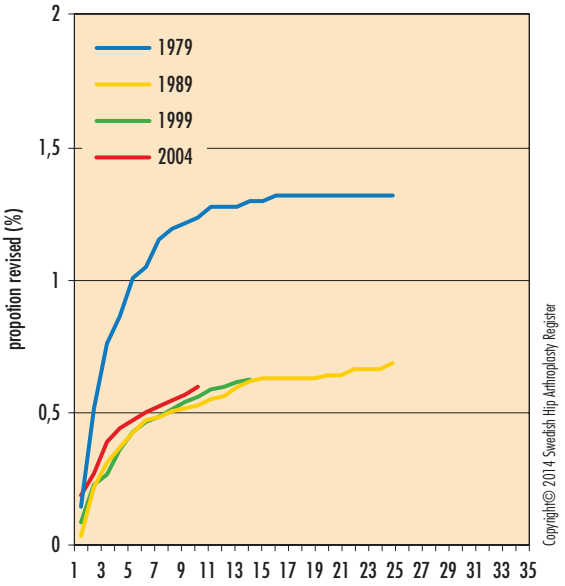
Aseptic loosening

cumulative revision frequency



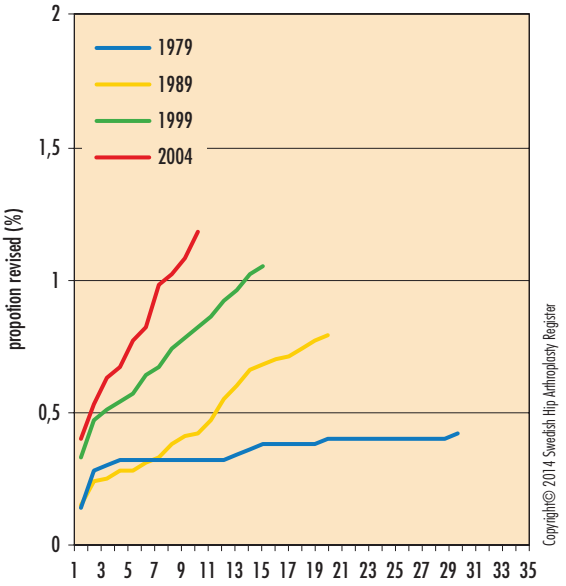
Deep infection

cumulativ revision frequency

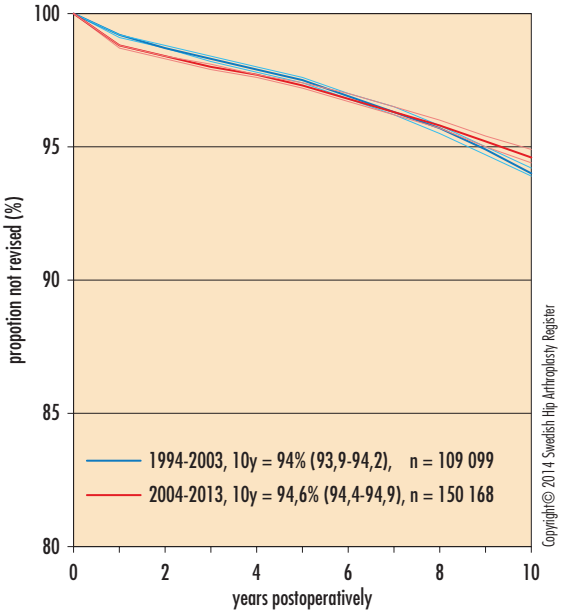


Dislocation

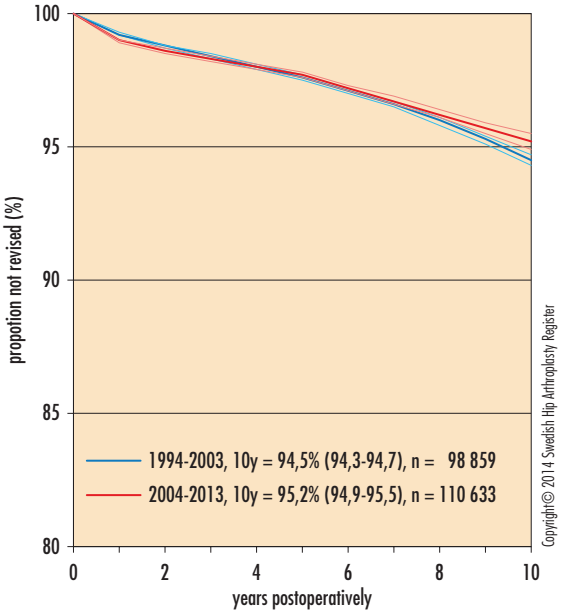
cumulativ revision frequency



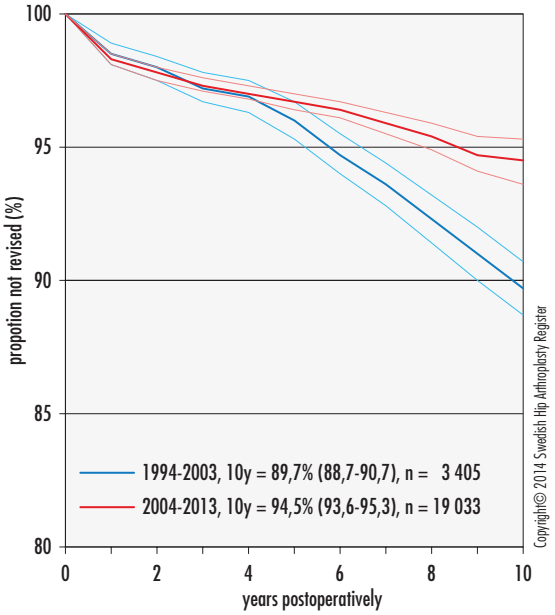
All implants
All diagnoses and all reasons



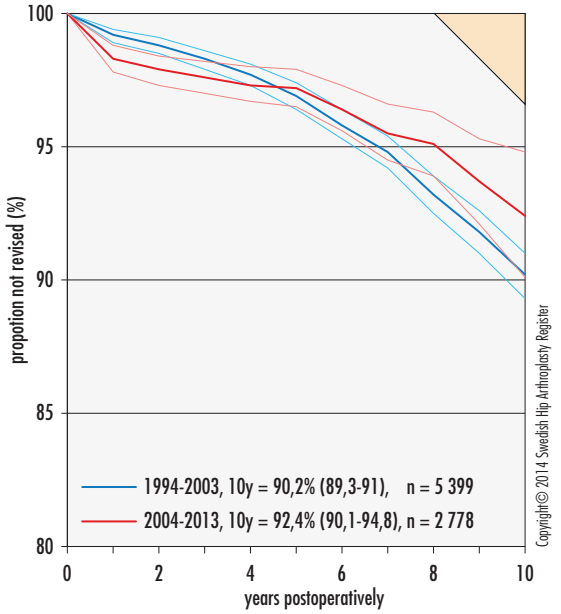
All cemented implants
All diagnoses and all reasons



All uncemented implants
All diagnoses and all reasons

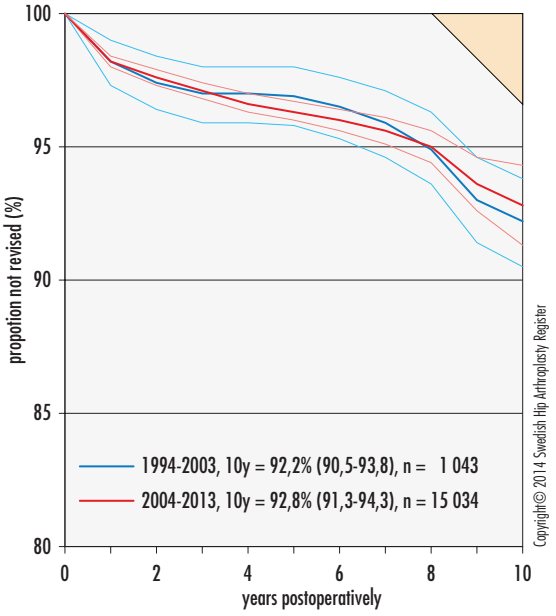


All hybrid implants
All diagnoses and all reasons



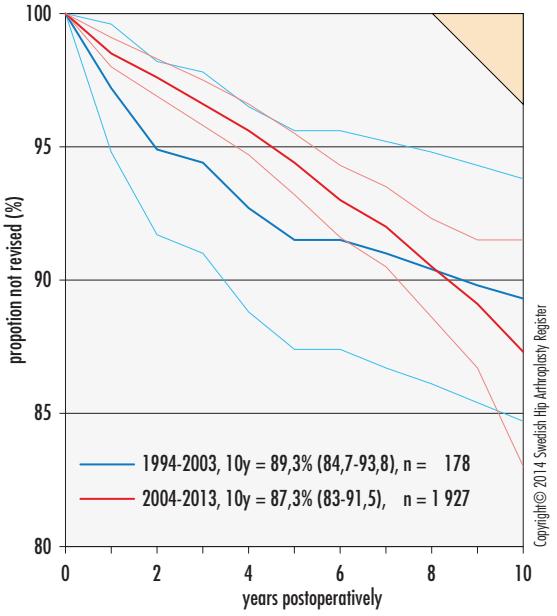
All reversed hybrids implants

All diagnoses and all reasons



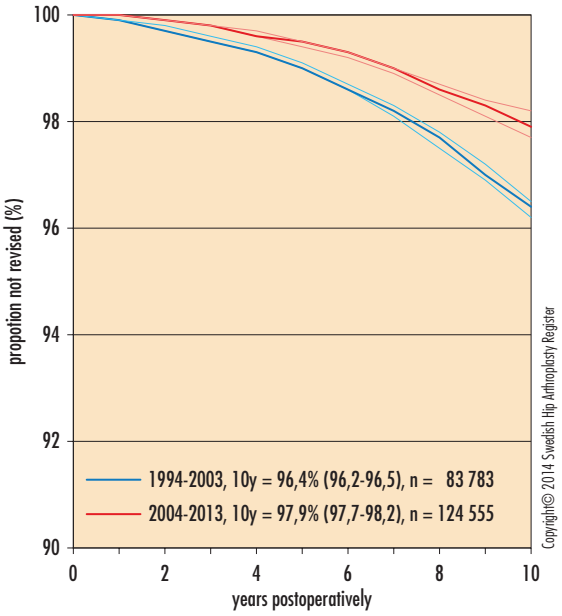
All resurfacing implants

All diagnoses and all reasons



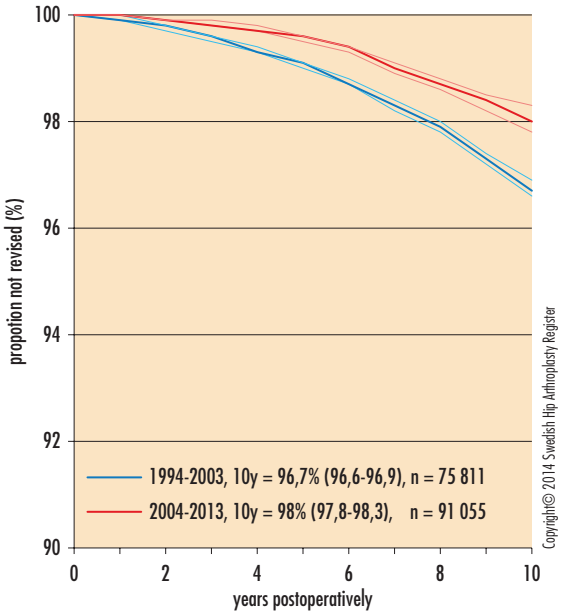
All implants

Primary osteoarthritis and aseptic loosening



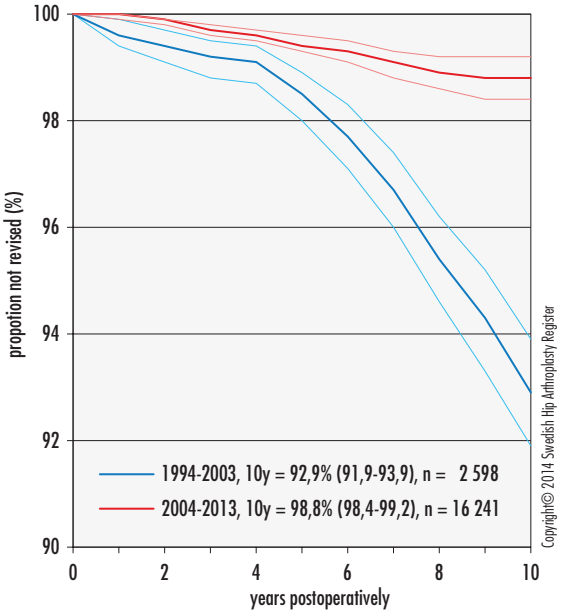
All cemented implants

Primary osteoarthritis and aseptic loosening



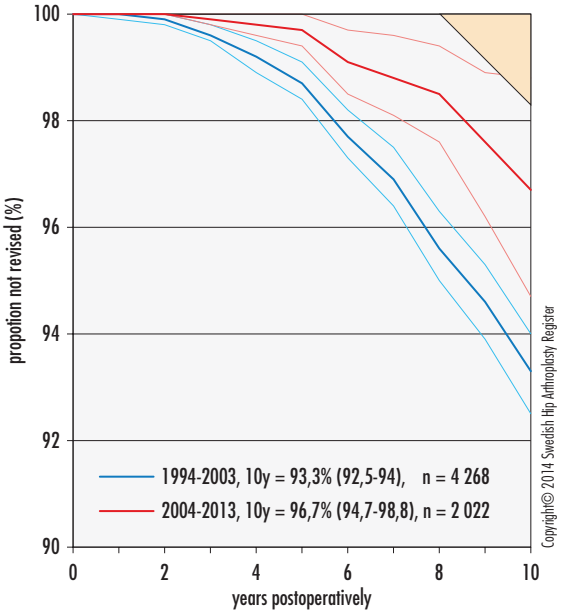
All uncemented implants

Primary osteoarthritis and aseptic loosening



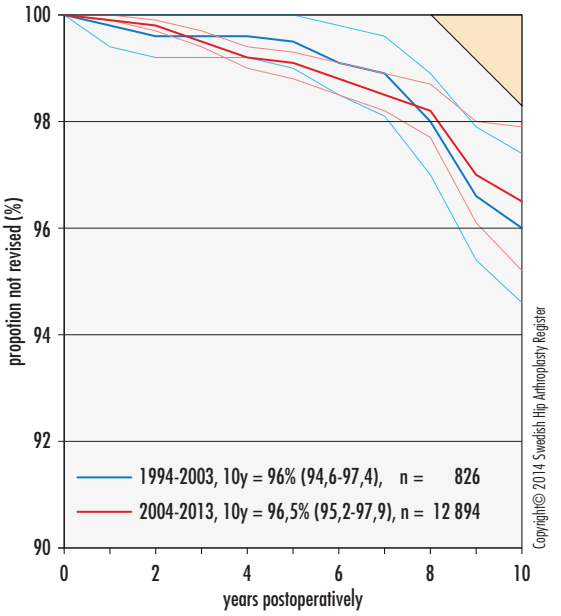
All hybrid implants

Primary osteoarthritis and aseptic loosening



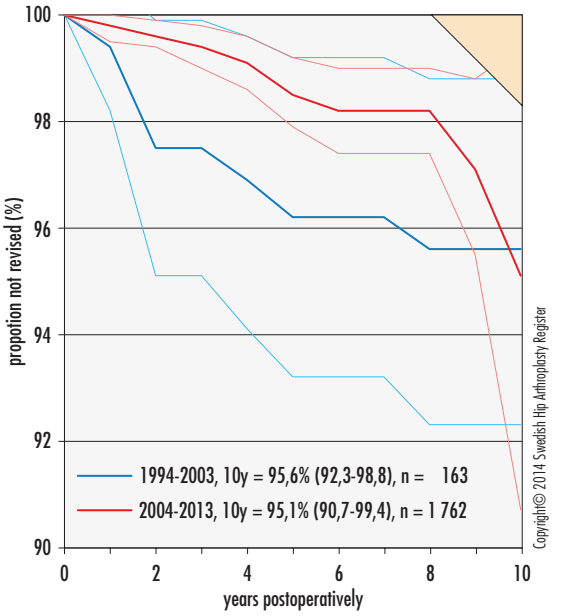
All reversed hybrid implants

Primary osteoarthritis and aseptic loosening



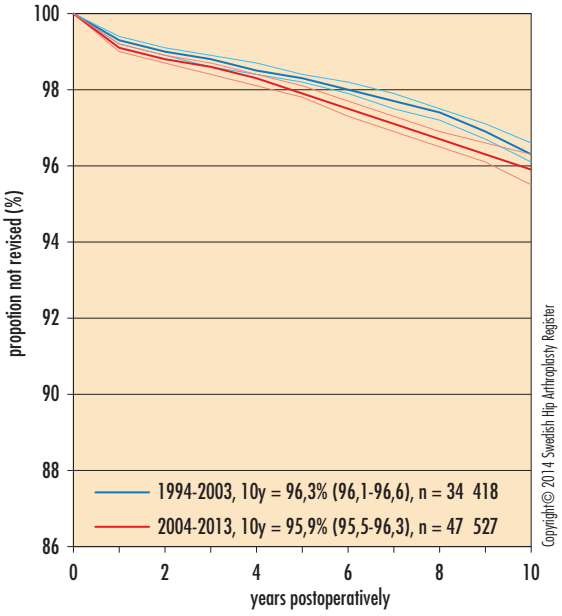
All resurfacing implants

Primary osteoarthritis and aseptic loosening



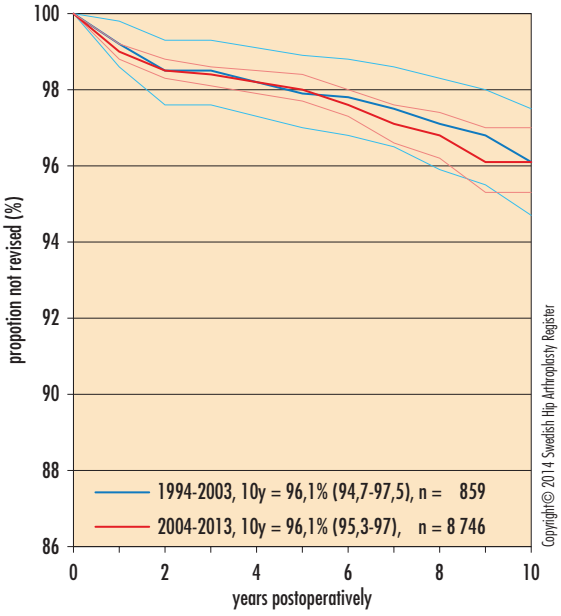
Lubinus SP II

All diagnoses and all reasons



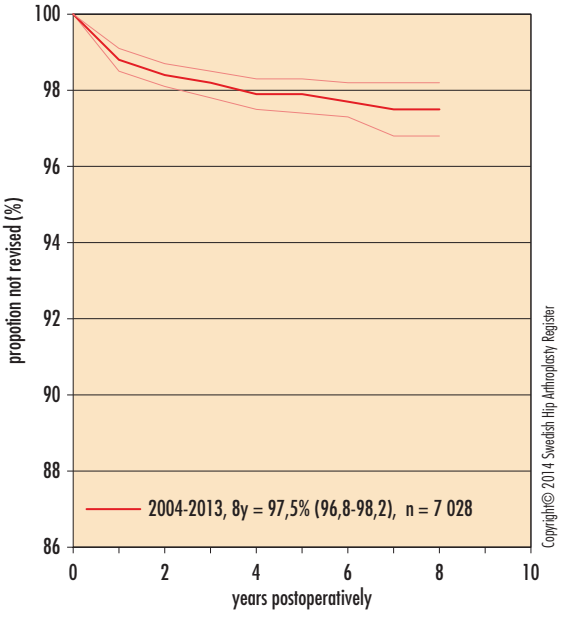
Exeter Duration (Exeter Polished)

All diagnoses and all reasons



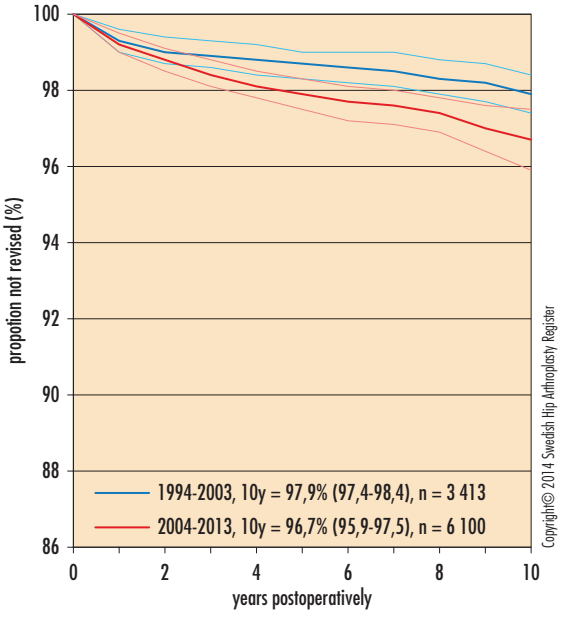
ZCA XLPE (MS30 Polished)

All diagnoses and all reasons



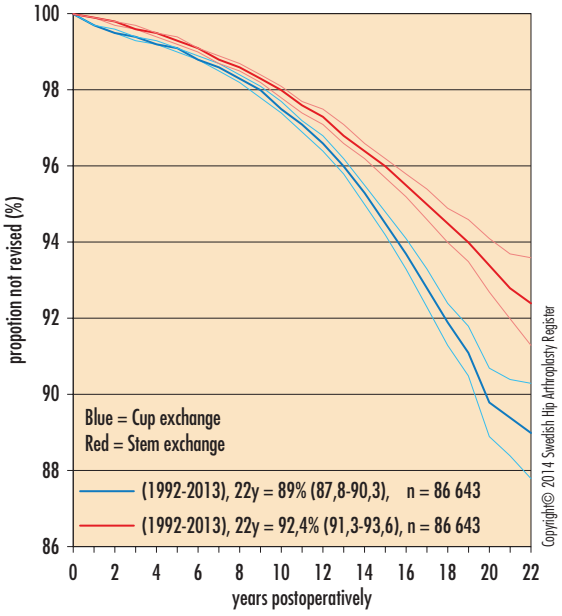
Charnley Elite (Exeter Polished)

All diagnoses and all reasons



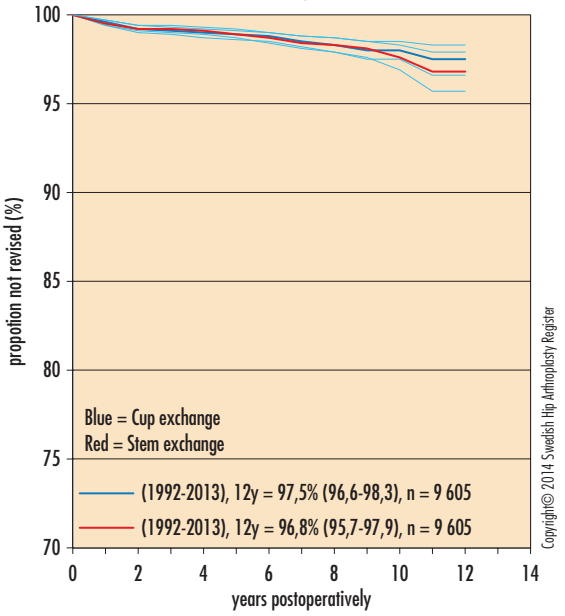
Lubinus SP II

cup-/stem revision – all diagnoses and all reasons



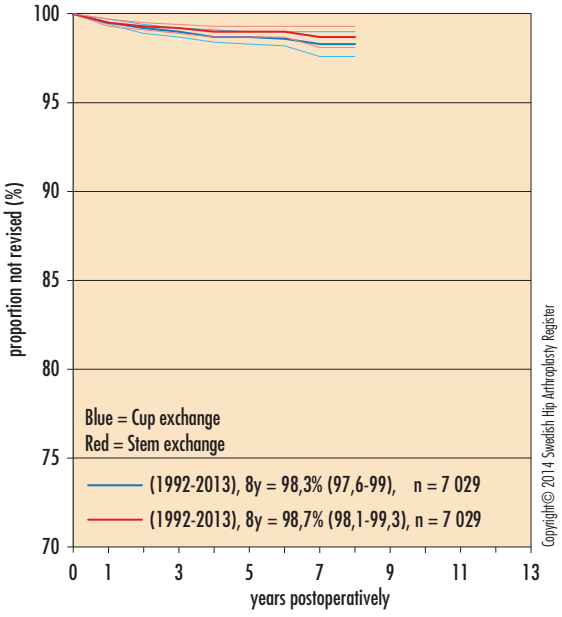
Contemporary Hooded Duration (Exeter Polished))

cup-/stem revision – all diagnoses and all reasons



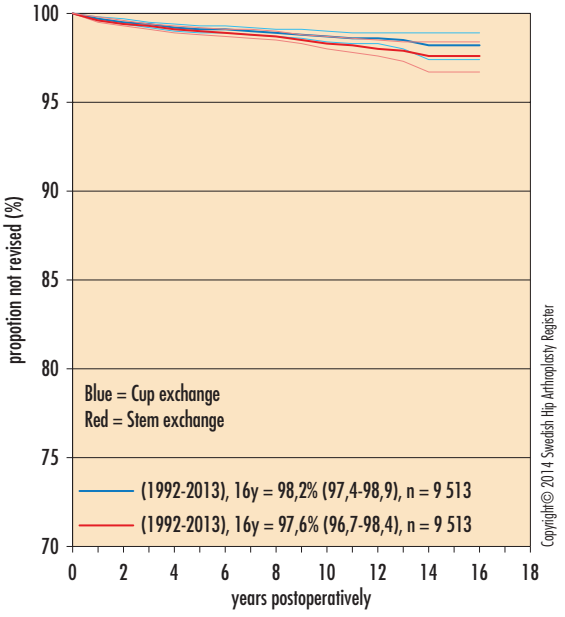
ZCA XLPE (MS30 Polished)

cup-/stem revision – all diagnoses and all reasons



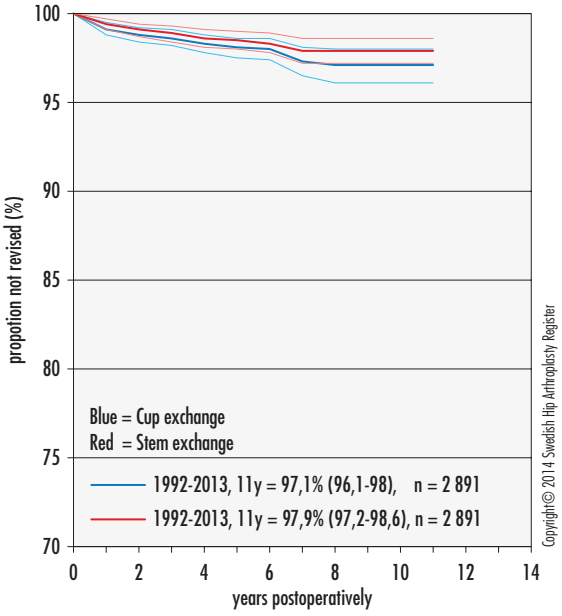
Charnley Elite (Exeter Polished)

cup-/stem revision – all diagnoses and all reasons



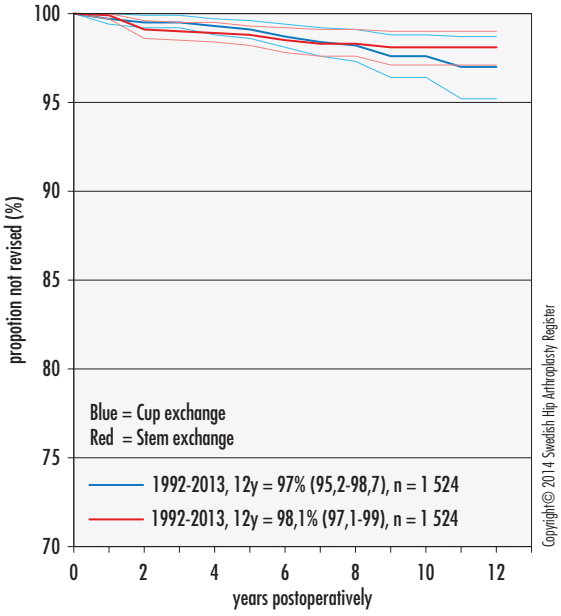
Trilogy HA (CLS Spotorno)

cup-/stem revision – all diagnoses and all reasons



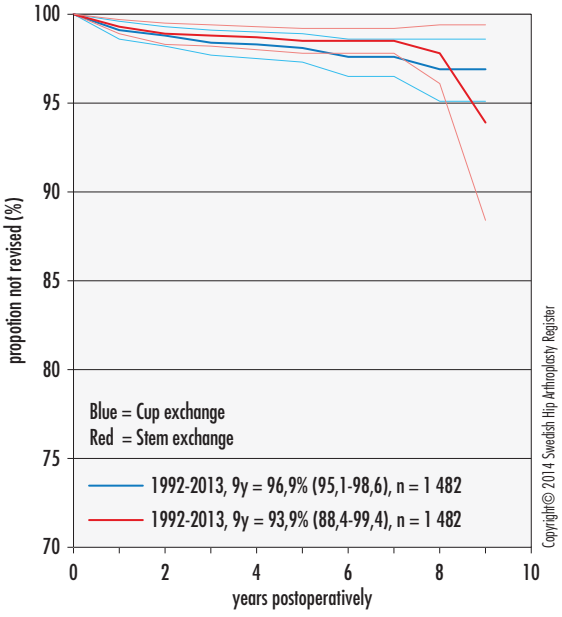
Allofit (CLS Spotorno)

cup-/stem revision – all diagnoses and all reasons



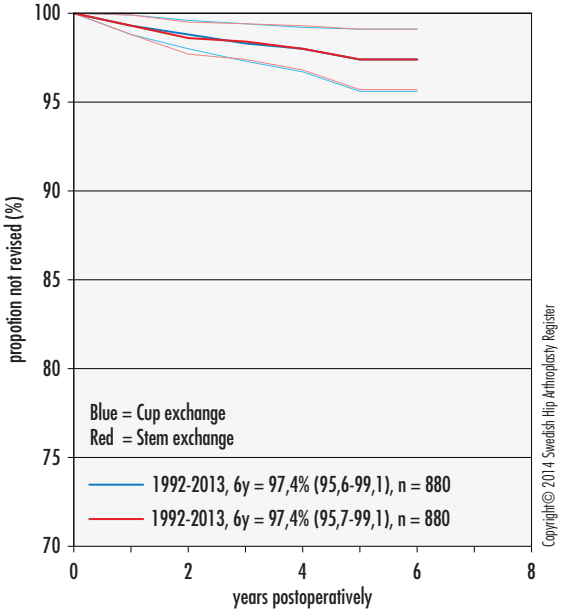
Trident HA (Accolade)

cup-/stem revision – all diagnoses and all reasons



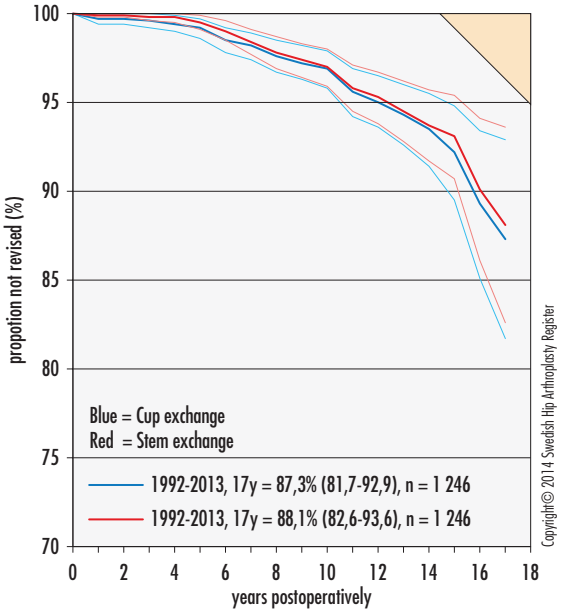
Pinnacle HA (Corail Collarless)

cup-/stem revision – all diagnoses and all reasons



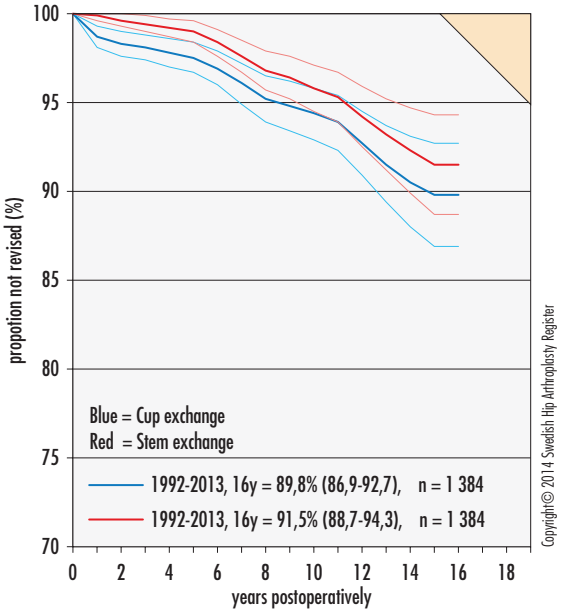
Trilogy HA (Spectron EF Primary)

cup-/stemrevision – all diagnoses and all reasons



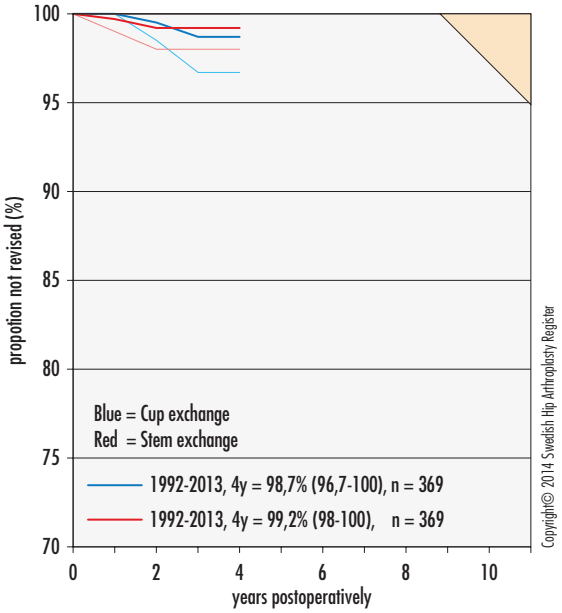
Trilogy HA (Lubinus SP II)

cup-/stemrevision – all diagnoses and all reasons



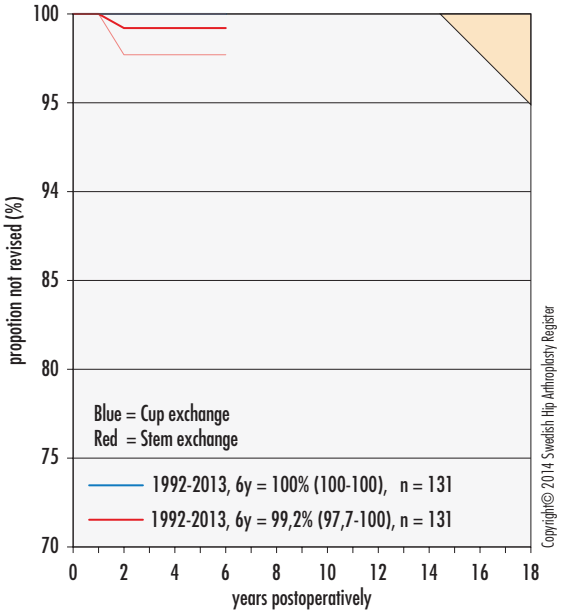
Trident HA (Exeter Polished)

cup-/stem revision – all diagnoses and all reasons



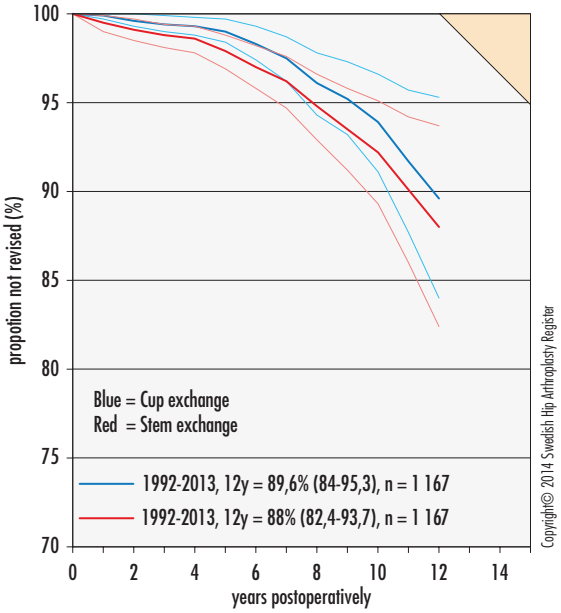
Trilogy HA (Exeter Polished)

cup-/stem revision – all diagnoses and all reasons



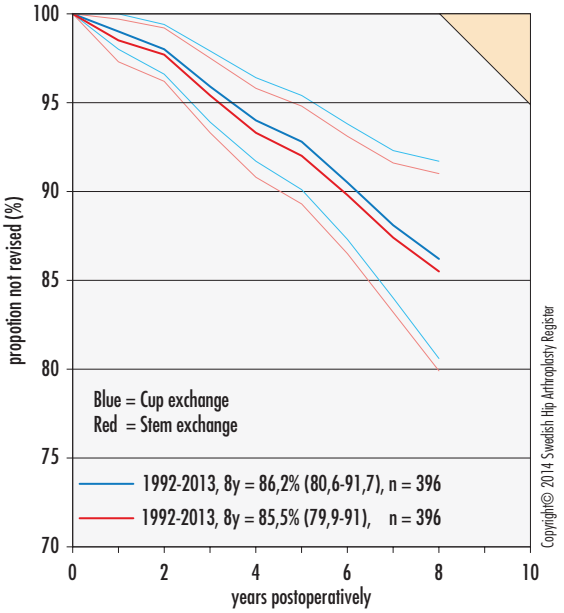
BHR

cup-/stemrevision – all diagnoses and all reasons



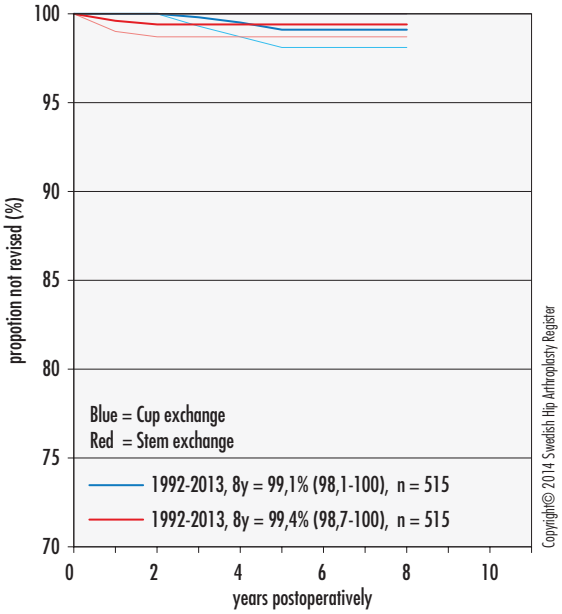
ASR

cup-/stemrevision – all diagnoses and all reasons



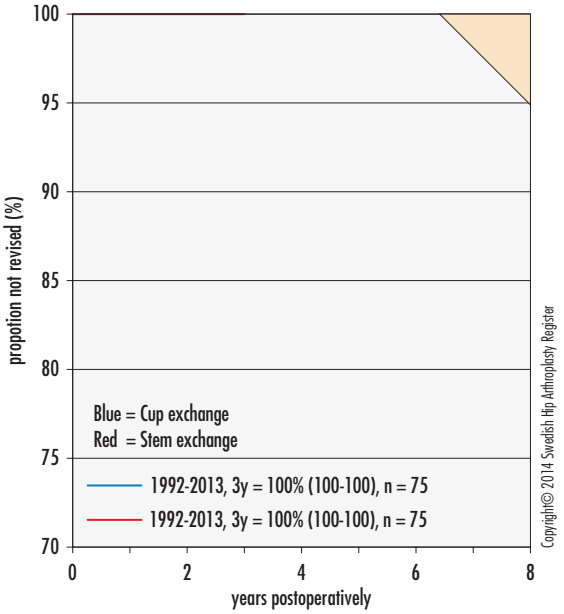
Lubinus all-poly (CLS Spotorno)

cup-/stemrevision – all diagnoses and all reasons



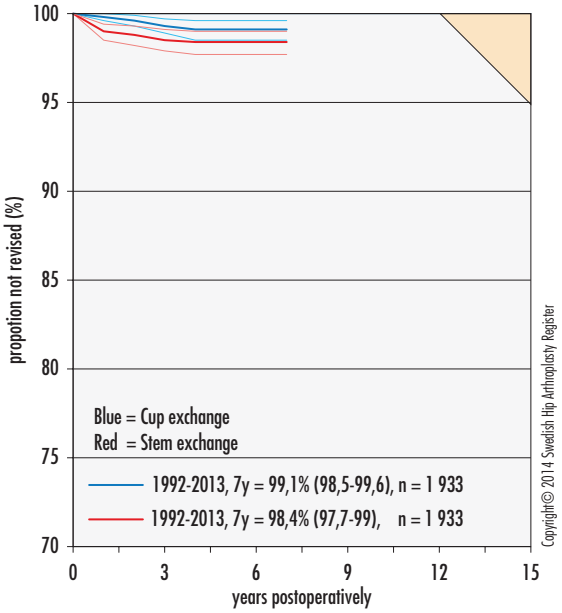
Adept (Adept Resurfacing Head)

cup-/stemrevision – all diagnoses and all reasons



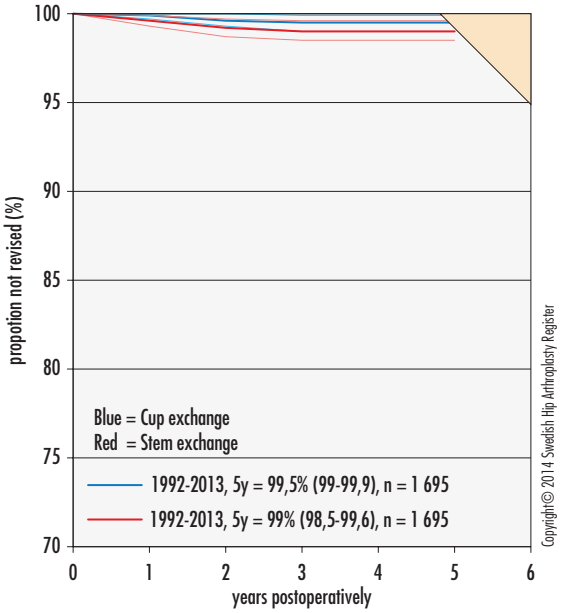
Lubinus all-poly (Corail Collarless)

cup-/stemrevision – all diagnoses and all reasons



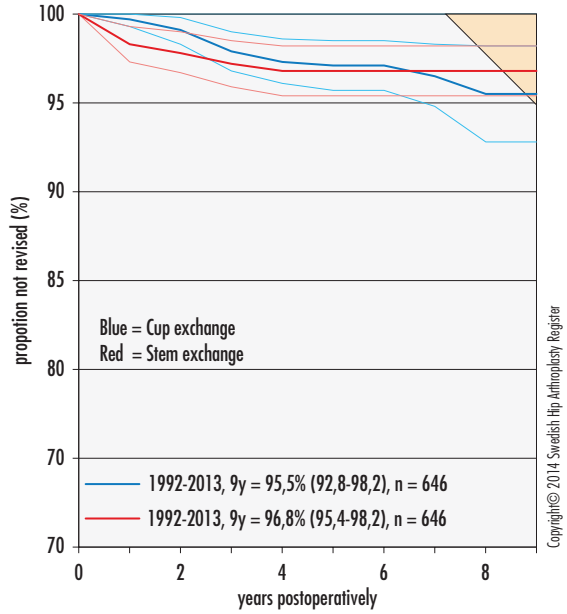
Marathon XLPE (Corail Collarless)

cup-/stemrevision – all diagnoses and all reasons



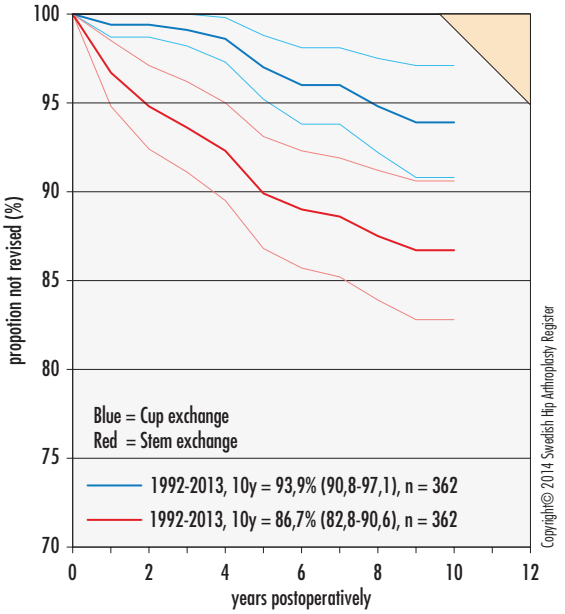
Contemporary Hooded Duration (ABG II HA)

cup-/stemrevision – all diagnoses and all reasons



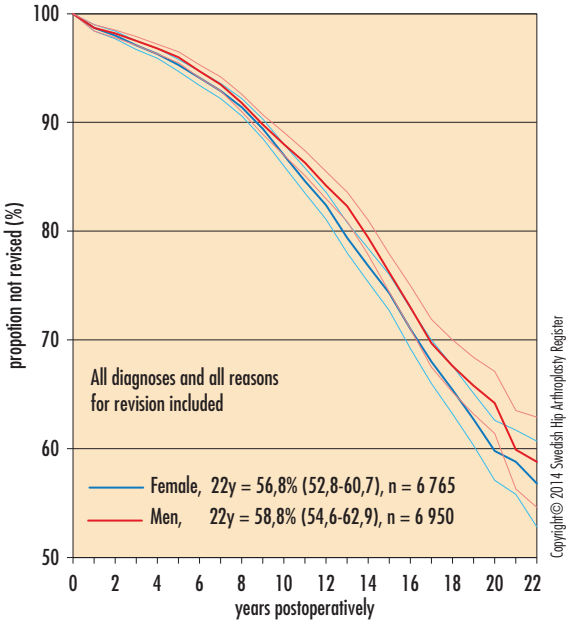
Durom (Durom)

cup-/stemrevision – all diagnoses and all reasons



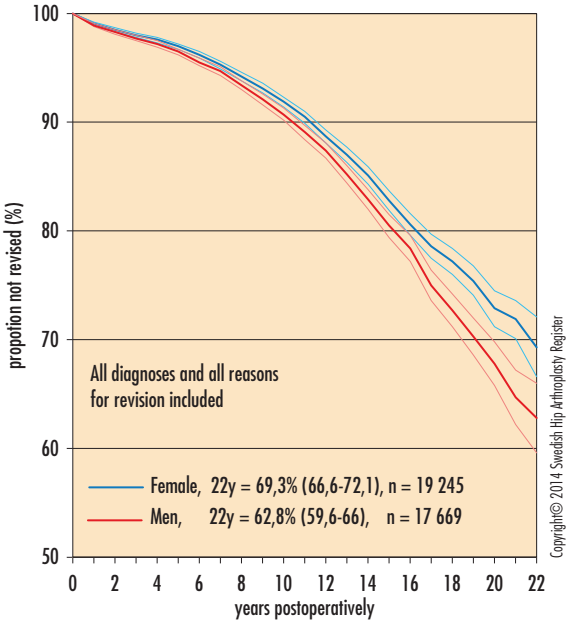
Younger than 50 years

all observations, 1992–2013



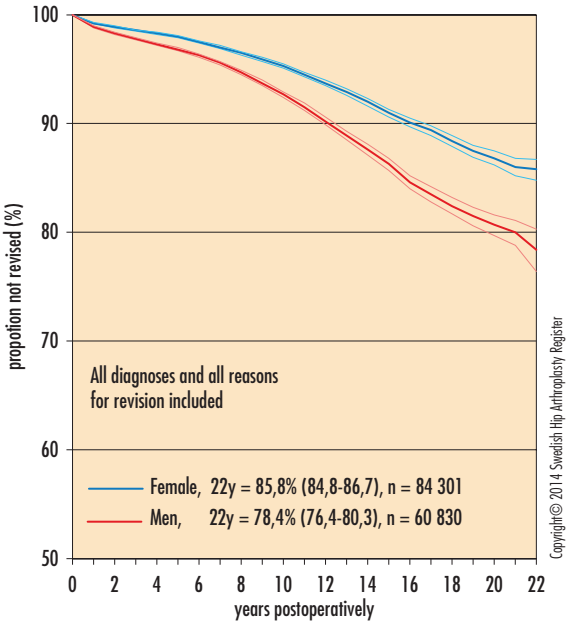
Between 50 and 59 years

all observations, 1992–2013



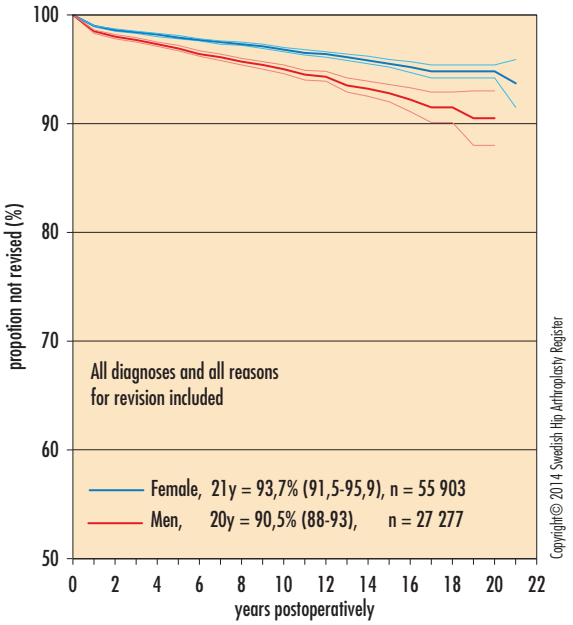
Between 60 and 75 years

all observations, 1992–2013



Older than 75 years

all observations, 1992–2013



Notes

Implant survival within ten years

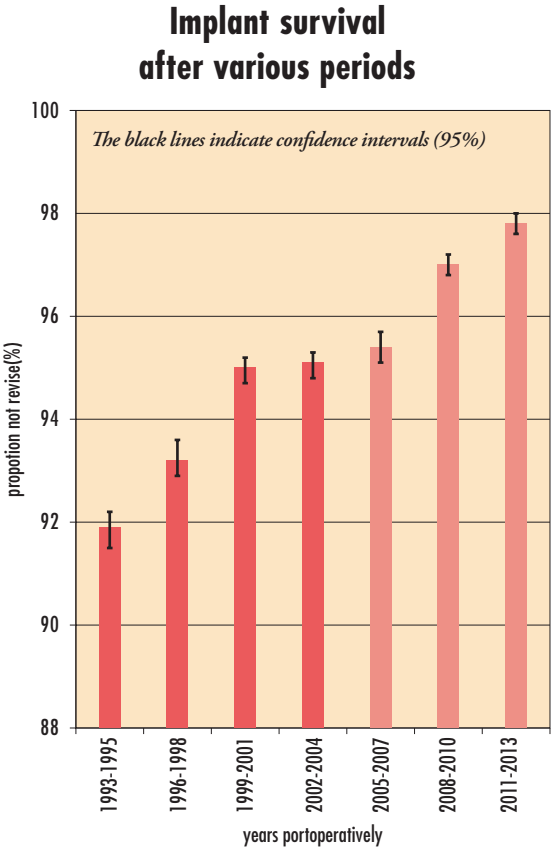
Implant survival within ten years is based on total hip replacements performed during the past ten years. This means that the observation period attains a nine- to ten-year interval only for patients operated in the first year of observation. Since more and more total hip replacements were performed during 2004–2013, the average observation period is shorter than five years. During this time, 150,168 operations were reported. 3866 of these were reported as a revision surgery. In comparison with the previous ten-year period (2003–2012), aseptic loosening has decreased from 28.7% to 24.4%. Infections, on the other hand, have increased from 24% to 27.2%. The number of dislocations has remained the same at around 24%, as have prosthetic fractures at about 12%.

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 12.4%. 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, Frölunda, Danderyd and OrthoCenter Stockholm) 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.

The following applies for OrthoCenter in Stockholm: during the observation period, surgeons from KS/Solna and St. Göran operated their "own" patients who were outsourced to OrthoCenter's surgical department with a multi-year contract. Although the patients were operated on at another hospital, operations have been registered as they were operated on at their "home hospital". This registration management violates completely the Register's rules since 1979! – Patient must always be registered in the hospital/operating room where the surgery is performed. When a patient later needs a reoperation, the patient's registration is returned to OrthoCenter via validation process, which all reoperated cases are subjected to for more than 30 years. The Register management has, insistently, for three years tried to get lists of current patients to get an adequate idea of the situation – the hospitals were not able to present the data prior to analysis and assembling of this report.

Clinics 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.



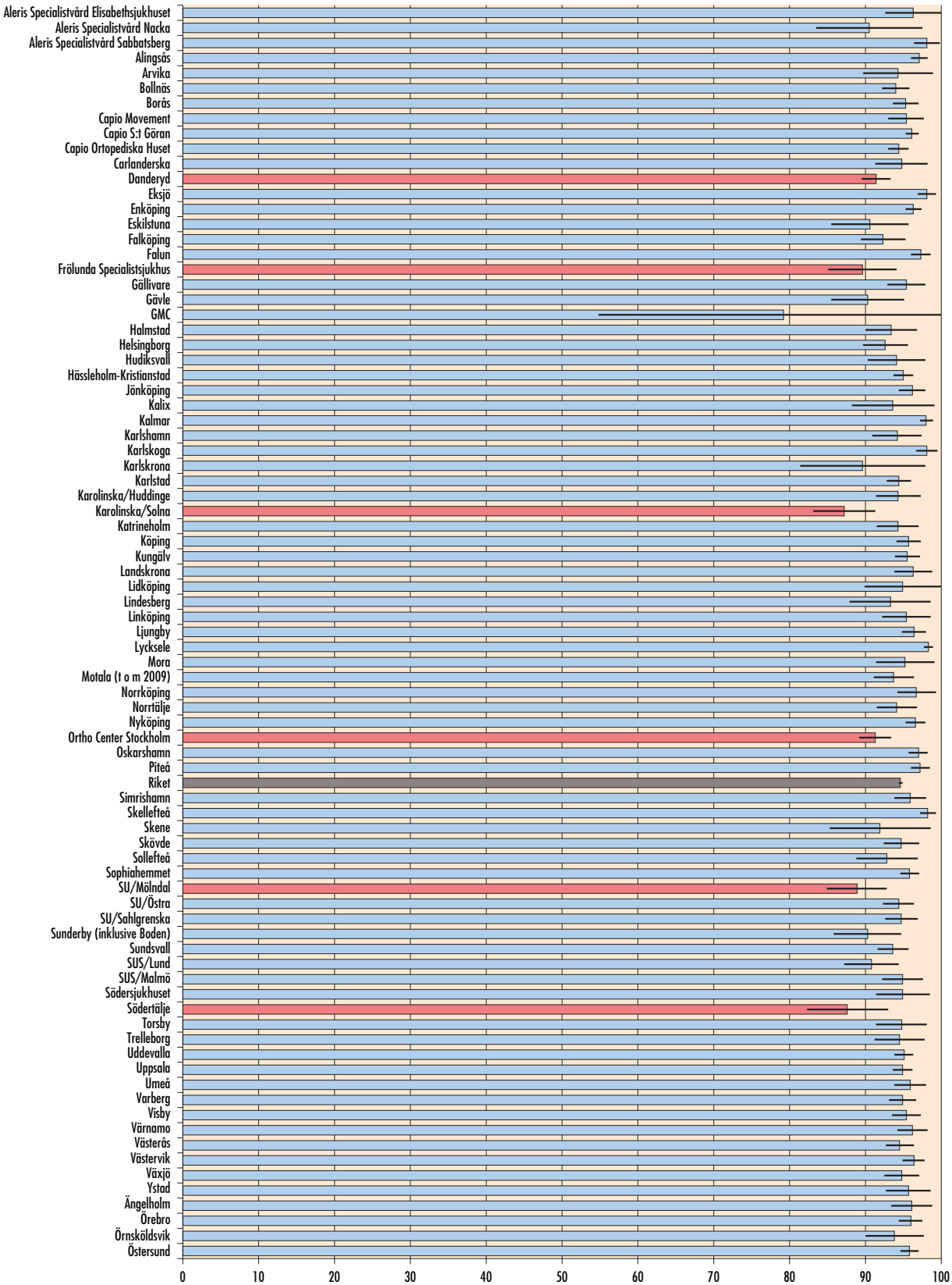
The three most recent periods have varying follow-up times of 9, 6 and 3 years. The values are included to show the trend over the last 10 years.

Period	Number of observation years	Implant survival	Negative error value	Positive error value
1993–1995	10	91.9%	0.4%	0.3%
1996–1998	10	93.2%	0.3%	0.4%
1999–2001	10	95.0%	0.3%	0.2%
2002–2004	10	95.1%	0.3%	0.2%
2005–2007	9	95.4%	0.3%	0.3%
2008–2010	6	97.0%	0.2%	0.2%
2011–2013	3	97.8%	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.

Implant survival after 10 years

Every staple represents a clinic, primary operation 2004–2013



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.

Patient-reported outcomes – the PROMs Programme

In recent years, the concept of "value-based care" has been introduced in healthcare. The idea is to organize, control and manage the care processe 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 that which 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 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 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 2010, all clinics report patient-reported variables where the response frequency is 85% preoperatively, and almost 90% at the one-year follow-up.

The PROMs Programme's logistics

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 PROMs 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 PROMs database and send out reminders about missing responses within about two months.

The objectives of the PROMs Programme

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 analyze their activities and improvements with the patient's needs and reported outcomes as their point of departure;
- to create a methodologically adequate health economic instrument for cost effectiveness analyses and resource allocation.

This year's presentation of PROMs results

In this year's report, all PROM results in the mean values for EQ-5D index, EQ VAS, pain and satisfaction for each measurement time and clinic are presented in the table "Patient-reported outcome per unit". 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 would not mislead the reader. The preoperative values represent operated patients during the years 2012–2013, one-year results 2011–2012, six-year results 2006–2007 and ten-year results 2002–2003. 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 PROMs 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 as a result 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 great. 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 makeup 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 great, 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 PROMs values – deviation from expected values

Last year we launched a new way to present PROMs 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-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 PROMs values for 2011 and 2012. 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.

Great differences between various clinics despite adjustment

When studying the sets of tables for the PROMs results one will find that the adjusted deviations for the EQ-5D index at one-year span from -0.09 to 0.1 and for the EQ VAS from -8 to 8. The adjusted difference between best and worst clinics is thus 0.19 and 16 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 0.36 and 21, respectively. Furthermore, the breadth of the interval for deviations from pain after one year is 13 VAS units, and for satisfaction 15 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. The average improvement should be divided by the total scope for improvement according to the following:

Improvement percentage EQ – 5D index =

$$= \frac{(\text{EQ} - \text{5D index}^1 - \text{EQ} - \text{5D index}^0)}{(1 - \text{EQ} - \text{5D index}^0)} \times 100$$

Improvement percentage EQ VAS =

$$= \frac{(\text{EQ VAS}^1 - \text{EQ VAS}^0)}{(100 - \text{EQ VAS}^0)} \times 100$$

Improvement percentage pain – VAS =

$$= \frac{(\text{PainVAS}^1 - \text{PainVAS}^0)}{(0 - \text{PainVAS}^0)} \times 100$$

Clinics with particularly good PROMs results

Here is the place to highlight some clinics that constantly show advantageous patient-reported results for the fiscal years 2011–2012. The private clinics Sophiahemmet, Aleris Sabbatsberg and Nacka 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, SUS/Malmö and Örnsköldsvik show constantly advantageous results. The major producer Hässleholm also shows good patient-reported results. These clinics are encouraged to share their experiences of how the process around arthroplasty is organized.

Clinics 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. It is already mentioned in the last year's annual report that Södertälje, Norrtälje, Karlstad, Borås, Södersjukhuset, SU/Mölndal and Karolinska/Huddinge constantly deviate for the worse. Gävle, SUS/Lund, Torsby, Skåne, Capio St Göran, Kungälv, Eskilstuna, Uppsala and Karolinska/Solna also have manifest improvement potential.

What can the new method of auditing contribute to PROM?

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 PROM 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 approach and fixation, and the patient-reported outcome. The effects are not so obvious that it would lead us to recommend changing the routine 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.

What proportion uses Artrosskola?

In 2012, a question was added to the preoperative PROMs questionnaire concerning the contact with a physiotherapist and participation in Artrosskola. 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 for the first time, we present how patients answered the questions. The differences are striking. The proportion of patients who had contact with a physiotherapist ranges from 3 to 76%. For Artrosskola, the numbers vary from 1% at Karolinska/Huddinge to 61% in Torsby. The fact that Artrosskola is well established in Värmland is evident. Close behind Torsby are Karlstad (58%) and Arvika (56%) at the top of the list. At national level, 19% of all patients responding to the survey indicated that they participated in Artrosskola and 59% said they had contact with a physiotherapist. 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, 19% could be considered quite bad. However, the institution is young and in many aspects, has not had the time to establish themselves to such an extent that all patients can be offered this help. However, a preliminary analysis shows nothing in connection to the degree of pain and whether the patient has had contact with a physiotherapist/gone to Artrosskola or not. There appeared to be no connection between contact with a physiotherapist or Artrosskola and patient-reported outcome after one year.

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.

Thanks to all the contributors in the PROMs Programme

Finally, the Register directors would like to address heartfelt thanks to all contact secretaries, contact physicians, institutional directors, and not least all patients who, in various ways, are participating in and contributing to the PROMs Programme.

Preoperative physiotherapy and "Artrosskola[1)]"

2012–2013

Hospital	Total number responding	Proportion physiotherapist	Proportion "artrosskola[1)]"
Aleris Specialistvård Bollnäs	484	69%	23%
Aleris Specialistvård Elisabethsjukhuset	111	66%	17%
Aleris Specialistvård Motala	785	54%	29%
Aleris Specialistvård Nacka	239	71%	13%
Aleris Specialistvård Sabbatsberg	329	65%	12%
Alingsås	418	65%	25%
Arvika	286	74%	56%
Bollnäs	67	54%	15%
Borås	194	52%	7%
Capio Movement	268	66%	16%
Capio Ortopediska Huset	681	61%	11%
Capio S:t Göran	582	59%	9%
Carlanderska	207	68%	16%
Danderyd	383	63%	8%
Eksjö	340	52%	8%
Enköping	495	44%	15%
Eskilstuna	111	53%	5%
Falun	653	49%	11%
Frölunda Specialistsjukhus	163	67%	10%
Gällivare	112	42%	16%
Gävle	281	65%	18%
Halmstad	264	57%	14%
Helsingborg	93	43%	15%
Hudiksvall	179	56%	18%
Hässleholm-Kristianstad	1,362	58%	15%
Jönköping	282	56%	24%
Kalmar	220	74%	32%
Karlshamn	421	53%	19%
Karlskoga	271	66%	21%
Karlstad	324	71%	58%
Karolinska/Huddinge	361	3%	1%
Karolinska/Solna	271	59%	6%
Katrineholm	421	61%	14%
Kungälv	239	67%	31%
Lidköping	384	55%	11%
Lindesberg	426	67%	17%
Linköping	46	72%	48%
Ljungby	293	53%	8%
Lycksele	395	68%	39%

Preoperative physiotherapy and "Artrosskola[1)]" (cont.)

2012–2013

Hospital	Total number responding	Proportion physiotherapist	Proportion "artrosskola[1)]"
Mora	295	60%	10%
Norrköping	365	54%	27%
Norrtälje	185	53%	7%
Nyköping	175	66%	29%
Ortho Center Stockholm	800	69%	12%
OrthoCenter IFK-kliniken	258	76%	26%
Oskarshamn	485	65%	27%
Piteå	457	62%	14%
Skellefteå	190	58%	28%
Skene	206	67%	19%
Skövde	313	56%	12%
Sollefteå	227	50%	16%
Sophiahemmet	350	59%	9%
Spenshult	447	67%	23%
SU/Mölndal	585	56%	15%
Sundsvall	199	66%	38%
SUS/Lund	137	45%	9%
Södersjukhuset	508	63%	17%
Södertälje	142	61%	15%
Torsby	176	70%	61%
Trelleborg	1,128	62%	23%
Uddevalla	549	64%	33%
Umeå	74	58%	27%
Uppsala	258	58%	14%
Varberg	338	64%	23%
Visby	164	46%	15%
Värnamo	262	38%	7%
Västervik	191	53%	25%
Västerås	607	62%	24%
Växjö	178	51%	9%
Ängelholm	328	68%	23%
Örebro	162	58%	14%
Örnsköldsvik	213	45%	15%
Östersund	527	60%	26%
Nation	24,920	59%	19%

*) *"Artrosskola" – Educational, self-management program for patients with osteoarthritis*

The table shows the number of patients, responding to the preoperative PROMs question-naire, on questions about previous contact with physiotherapists or participation in "Artrosskola" any time during the course of disease. The proportion of patients that did answer yes is reported in percentage. Hospitals with less than 40 registrations are not shown.

Patient satisfaction 1 year after THR

primary THR 2011–2012

Hospital	Number	Proportion[1)]
Aleris Specialistvård Bollnäs	224	90.2%
Aleris Specialistvård Elisabethsjukhuset	120	93.3%
Aleris Specialistvård Motala	796	91.3%
Aleris Specialistvård Nacka	258	96.9%
Aleris Specialistvård Sabbatsberg	281	95.7%
Alingsås	367	86.6%
Arvika	308	84.7%
Bollnäs	353	87.3%
Borås	231	82.3%
Capio Movement	357	87.4%
Capio Ortopediska Huset	613	86.9%
Capio S:t Göran	603	85.1%
Carlanderska	244	92.6%
Danderyd	445	90.6%
Eksjö	335	91.3%
Enköping	533	84.1%
Eskilstuna	153	86.3%
Falun	633	89.4%
Frölunda Specialistsjukhus	150	91.3%
Gällivare	152	91.4%
Gävle	283	84.5%
Halmstad	360	85.8%
Helsingborg	83	95.2%
Hudiksvall	168	90.5%
Hässleholm-Kristianstad	1,258	94.2%
Jönköping	310	87.4%
Kalmar	248	93.1%
Karlshamn	420	91.4%
Karlskoga	227	86.8%
Karlstad	323	80.5%
Karolinska/Huddinge	401	86.3%
Karolinska/Solna	302	83.4%
Katrineholm	428	87.1%
Kungälv	260	82.7%
Lidköping	339	90.0%
Lindesberg	334	92.8%
Linköping	76	89.5%
Ljungby	291	92.4%
Lycksele	505	93.5%
Mora	296	89.2%
Norrköping	353	85.8%
Norrtälje	149	81.2%
Nyköping	231	83.1%
Ortho Center Stockholm	748	88.4%
OrthoCenter IFK-kliniken	264	92.4%
Oskarshamn	374	92.8%
Piteå	684	92.7%
SU/Mölndal	525	83.4%
SUS/Lund	90	84.4%
SUS/Malmö	68	91.2%
Skellefteå	126	92.9%
Skene	208	82.7%
Skövde	335	91.0%
Sollefteå	149	85.9%
Sophiahemmet	287	97.6%
Spenshult	428	89.5%
Sundsvall	288	86.8%
Södersjukhuset	508	85.2%
Södertälje	164	79.3%
Torsby	172	83.1%
Trelleborg	1,076	89.8%
Uddevalla	506	86.0%
Umeå	87	96.6%
Uppsala	259	83.0%
Varberg	405	92.1%
Visby	195	83.1%
Värnamo	185	88.1%
Västervik	177	88.1%
Västerås	633	90.2%
Växjö	209	90.0%
Ängelholm	297	92.3%
Örebro	230	90.4%
Örnsköldsvik	239	91.2%
Östersund	449	93.8%
Nation	25,208	89.0%

1) Proportion of patients with satisfaction value VAS between 0 and 40. Hospitals with less than 40 registrations are not shown.

Patient reported outcome per hospital

	Preoperatitvely, 2012–2013					Follow-up one year, 2011–2012				
	Number	C-class[1)]	Pain	EQ VAS	EQ-5D	Number	Satisf.[2)]	Paom	EQ VAS	EQ-5D
University/Regional hospitals										
Karolinska/Huddinge	380	61%	78	59	0.43	401	19	16	72	0.74
Karolinska/Solna	260	50%	66	48	0.31	302	20	17	71	0.71
Linköping	45	38%	68	49	0.35	76	14	12	75	0.8
SU/Mölndal	567	55%	67	58	0.33	525	21	18	71	0.71
SU/Sahlgrenska										
SU/Östra										
SUS/Lund	131	50%	68	49	0.27	90	20	19	64	0.63
SUS/Malmö										
Umeå	75	60%	66	47	0.28	87	12	13	68	0.72
Uppsala	252	46%	63	58	0.35	259	19	17	73	0.72
Örebro	161	42%	63	53	0.38	230	14	13	72	0.72
Central hospitals										
Borås	196	42%	63	59	0.39	231	21	15	71	0.72
Danderyd	397	44%	64	52	0.37	445	14	12	76	0.78
Eksjö	336	29%	60	61	0.49	335	15	12	79	0.8
Eskilstuna	119	44%	68	55	0.33	153	18	14	70	0.68
Falun	672	35%	61	64	0.41	633	15	13	75	0.77
Gävle	279	42%	62	54	0.41	283	18	15	72	0.74
Halmstad	290	38%	62	57	0.43	360	18	15	76	0.78
Helsingborg	89	48%	74	48	0.14	83	13	14	75	0.75
Hässleholm-Kristianstad	1,355	42%	60	60	0.39	1,258	11	11	80	0.82
Jönköping	278	41%	66	55	0.38	310	17	15	76	0.77
Kalmar	219	41%	65	55	0.37	248	13	12	77	0.82
Karlstad	323	51%	64	57	0.28	323	21	17	73	0.73
Norrköping	367	35%	65	56	0.42	353	16	14	76	0.79
Skövde	321	47%	64	57	0.4	335	16	14	74	0.76
Sunderby (incl Boden)										
Sundsvall	196	33%	65	55	0.4	288	18	16	74	0.75
Södersjukhuset	529	43%	60	56	0.43	508	18	15	73	0.73
Uddevalla	538	46%	65	53	0.36	506	20	16	74	0.74
Varberg	339	42%	60	60	0.45	405	13	12	77	0.79
Västerås	599	42%	67	53	0.38	633	15	13	75	0.78
Växjö	174	38%	57	62	0.53	209	17	15	76	0.77
Östersund	524	35%	64	58	0.41	449	13	12	79	0.81

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	Follow-up six years, 2006–2007					Follow-up ten years, 2002–2003				
	Number	Satisf.[2)]	Pain	EQ VAS	EQ-5D	Number	Satisf.[2)]	Pain	EQ VAS	EQ-5D
University/Regional hospitals										
Karolinska/Huddinge	41	10	11	78	0.78					
Karolinska/Solna	128	22	19	68	0.74					
Linköping										
SU/Mölndal	100	21	18	70	0.71	99	21	19	64	0.64
SU/Sahlgrenska	90	19	15	68	0.67	198	17	17	69	0.71
SU/Östra	174	25	21	69	0.71	87	19	20	70	0.71
SUS/Lund	50	14	13	68	0.68					
SUS/Malmö	74	23	22	70	0.68					
Umeå	95	17	14	65	0.69					
Uppsala	131	21	18	68	0.71					
Örebro	310	15	14	71	0.74					
Central hospitals										
Borås	241	21	17	70	0.7	114	18	16	71	0.73
Danderyd	490	16	13	72	0.73					
Eksjö	267	15	15	73	0.75					
Eskilstuna	73	17	19	67	0.66					
Falun	140	18	16	67	0.7					
Gävle	146	19	19	69	0.72					
Halmstad	321	21	19	71	0.72					
Helsingborg										
Hässleholm-Kristianstad	1,210	14	14	75	0.79					
Jönköping	237	19	16	72	0.76					
Kalmar	241	16	13	72	0.75					
Karlstad	167	21	18	70	0.72					
Norrköping										
Skövde	170	18	16	71	0.73	130	16	17	68	0.69
Sunderby (incl Boden)	42	23	15	69	0.65					
Sundsvall	167	20	19	69	0.71					
Södersjukhuset	540	18	16	70	0.71					
Uddevalla	416	20	17	69	0.72	196	18	16	67	0.7
Varberg	316	15	14	75	0.78					
Västerås	157	14	15	68	0.72					
Växjö	168	19	16	70	0.73					
Östersund	291	14	14	73	0.76	54	11	15	71	0.75

Patient reported outcome per hospital (cont.)

	Preoperatitvely, 2012–2013					Follow-up one year, 2011–2012				
	Number	C-class[1)]	Pain	EQ VAS	EQ-5D	Number	Satisf.[2)]	Paom	EQ VAS	EQ-5D
Rural hospitals										
Alingsås	424	38%	61	61	0.47	367	17	13	77	0.77
Arvika	290	33%	63	57	0.44	308	18	15	74	0.79
Bollnäs	86	40%	63	53	0.48	353	16	14	76	0.78
Enköping	524	45%	59	52	0.41	533	19	16	74	0.77
Falköping										
Frölunda Specialistsjukhus	162	35%	61	65	0.47	150	14	13	80	0.78
Gällivare	110	45%	64	50	0.4	152	16	14	76	0.79
Hudiksvall	177	48%	64	50	0.41	168	15	13	74	0.78
Kalix										
Karlshamn	419	37%	59	58	0.43	420	15	13	77	0.8
Karlskoga	265	32%	64	58	0.43	227	17	14	77	0.77
Katrineholm	420	35%	58	57	0.47	428	16	14	77	0.79
Kungälv	241	72%	57	60	0.44	260	22	17	73	0.73
Köping										
Lidköping	382	31%	61	60	0.44	339	15	14	77	0.8
Lindesberg	424	31%	67	57	0.35	334	11	11	80	0.82
Ljungby	288	40%	61	64	0.51	291	12	10	77	0.84
Lycksele	396	40%	65	60	0.42	505	13	13	77	0.81
Mora	315	39%	65	51	0.4	296	17	13	78	0.8
Motala (up to 2009)										
Norrtälje	182	47%	65	55	0.41	149	22	21	70	0.71
Nyköping	182	39%	67	51	0.35	231	21	17	76	0.76
Oskarshamn	485	44%	67	51	0.36	374	12	12	78	0.8
Piteå	460	42%	71	51	0.35	684	13	11	78	0.8
Skellefteå	193	38%	63	58	0.44	126	15	13	75	0.8
Skene	208	35%	66	57	0.41	208	20	15	77	0.78
Sollefteå	225	37%	64	58	0.41	149	15	13	74	0.77
Södertälje	140	39%	64	57	0.39	164	23	17	73	0.71
Torsby	177	34%	65	57	0.38	172	20	15	74	0.75
Trelleborg	1,154	36%	64	60	0.43	1,076	15	14	78	0.79
Visby	162	34%	62	61	0.47	195	22	17	73	0.74
Värnamo	256	39%	60	65	0.48	185	15	15	79	0.81
Västervik	190	37%	62	62	0.45	177	19	14	74	0.77
Ängelholm	327	34%	67	60	0.39	297	13	13	77	0.81
Örnsköldsvik	228	46%	67	56	0.43	239	14	13	78	0.81

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	Follow-up six years, 2006–2007					Follow-up ten years, 2002–2003				
	Number	Satisf.[2)]	Pain	EQ VAS	EQ-5D	Number	Satisf.[2)]	Pain	EQ VAS	EQ-5D
Rural hospitals										
Alingsås	311	16	13	73	0.76	147	16	15	70	0.69
Arvika	56	14	13	75	0.81					
Bollnäs	418	18	16	71	0.72					
Enköping	129	21	17	72	0.75					
Falköping	413	16	13	72	0.75	324	14	15	72	0.74
Frölunda Specialistsjukhus	103	23	22	69	0.7					
Gällivare	154	19	19	71	0.74					
Hudiksvall	159	20	18	66	0.69					
Kalix										
Karlshamn	276	17	16	73	0.73					
Karlskoga	97	20	19	69	0.72					
Katrineholm	295	17	14	76	0.8					
Kungälv	279	18	15	72	0.73	226	16	18	68	0.7
Köping	251	18	14	74	0.77					
Lidköping	189	14	13	74	0.78	121	16	18	69	0.72
Lindesberg	191	13	14	73	0.74					
Ljungby	158	13	11	77	0.8					
Lycksele	349	15	14	72	0.77	46	15	15	71	0.78
Mora	87	17	15	68	0.74					
Motala (up to 2009)	378	21	17	72	0.74					
Norrtälje										
Nyköping										
Oskarshamn	399	12	12	75	0.78					
Piteå	539	13	12	74	0.77					
Skellefteå	119	15	14	72	0.76					
Skene	128	24	21	73	0.74	118	21	19	69	0.7
Sollefteå	128	16	15	71	0.75					
Södertälje	78	20	17	74	0.75					
Torsby	51	18	15	68	0.72					
Trelleborg	888	17	15	75	0.77					
Visby	43	28	26	66	0.67					
Värnamo	177	17	15	75	0.76					
Västervik	143	15	14	73	0.73					
Ängelholm										
Örnsköldsvik	196	18	14	71	0.75					

Patient reported outcome per hospital (cont.)

	Preoperatitvely, 2012–2013					Follow-up one year, 2011–2012				
	Number	C-class[1)]	Pain	EQ VAS	EQ-5D	Number	Satisf.[2)]	Paom	EQ VAS	EQ-5D
Private hospitals										
Aleris Specialistvård Bollnäs	487	41%	65	52	0.4	224	15	14	76	0.78
Aleris Specialistvård Elisabethsjukhuset	111	26%	61	64	0.5	120	12	12	82	0.85
Aleris Specialistvård Motala	803	36%	62	58	0.47	796	15	12	79	0.83
Aleris Specialistvård Nacka	241	30%	66	53	0.47	258	8	7	86	0.9
Aleris Specialistvård Sabbatsberg	329	31%	61	63	0.46	281	10	9	83	0.84
Capio Movement	275	31%	64	55	0.44	357	16	12	78	0.79
Capio Ortopediska Huset	682	31%	62	59	0.49	613	18	14	80	0.8
Capio S:t Göran	587	40%	64	58	0.41	603	19	17	73	0.74
Carlanderska	206	28%	61	58	0.48	244	13	11	82	0.85
Ortho Center Stockholm	798	39%	66	59	0.42	748	14	12	77	0.78
OrthoCenter IFK-kliniken	257	34%	63	58	0.42	264	10	9	83	0.85
Sophiahemmet	350	29%	60	60	0.52	287	5	5	86	0.91
Spenshult	447	33%	62	59	0.45	428	14	12	78	0.79
Nation	25,141	40%	64	57	0.41	25,208	16	14	76	0.78

1) Proportion Charnley class C.
2) Satisfaction (VAS, 0 = Completely satisfied, 100 = Dissatisfied).

The table presents results in the form of number of patients, mean values of pain VAS, EQ VAS and EQ-5D index preoperatively and proportion Charnley class C patients (i.e. patients with multiple joint disease and/or co-morbidity). Hospitals with high proportion of C patients most frequently show lower average values for all parameters both preoperatively and after one year. However, the prospectively gained value is most often not equally affected by C affiliation. Results are presented only for hospitals with more than 40 registrations per time period.

	Follow-up six years, 2006–2007					Follow-up ten years, 2002–2003				
	Number	Satisf.[2)]	Pain	EQ VAS	EQ-5D	Number	Satisf.[2)]	Pain	EQ VAS	EQ-5D
Private hospitals										
Aleris Specialistvård Bollnäs										
Aleris Specialistvård Elisabethsjukhuset	188	15	12	76	0.79					
Aleris Specialistvård Motala										
Aleris Specialistvård Nacka										
Aleris Specialistvård Sabbatsberg										
Capio Movement	103	13	13	81	0.82					
Capio Ortopediska Huset										
Capio S:t Göran	122	24	20	65	0.69					
Carlanderska	90	13	10	82	0.85					
Ortho Center Stockholm	47	21	14	72	0.78					
OrthoCenter IFK-kliniken										
Sophiahemmet										
Spenshult										
Nation	14,811	17	15	72	0.75	2,043	17	17	69	0.71

PROMs programme at 1 year – improvement index and deviation from expected outcome

year of primary operation 2011–2012

		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	210	0.41	0.78	–0.00	63	51	76	0.5	51
Aleris Specialistvård Elisabethsjukhuset	118	0.52	0.85	0.02	68	60	82	2.1	56
Aleris Specialistvård Motala	697	0.50	0.83	0.02	66	59	80	1.2	50
Aleris Specialistvård Nacka	248	0.45	0.90	0.10	82	49	86	8.7	72
Aleris Specialistvård Sabbatsberg	278	0.46	0.84	0.03	71	62	83	4.1	56
Alingsås	345	0.45	0.78	–0.02	60	58	77	–0.4	46
Arvika	279	0.41	0.78	–0.00	63	56	74	–2.3	41
Bollnäs	340	0.44	0.78	–0.01	61	51	76	–0.2	51
Borås	197	0.38	0.72	–0.05	56	56	71	–4.4	35
Capio Movement	318	0.43	0.79	–0.02	63	56	78	–1.0	49
Capio Ortopediska Huset	602	0.48	0.80	0.00	62	57	80	2.1	53
Capio S:t Göran	460	0.42	0.75	–0.04	57	59	75	–2.5	38
Carlanderska	215	0.46	0.85	0.03	72	55	83	3.2	62
Danderyd	341	0.39	0.79	0.02	66	52	77	1.6	51
Eksjö	286	0.46	0.80	–0.00	63	59	79	1.1	49
Enköping	490	0.42	0.77	–0.00	61	51	74	–0.8	46
Eskilstuna	90	0.34	0.70	–0.06	55	56	72	–3.3	36
Falun	595	0.43	0.77	–0.02	61	59	75	–1.9	39
Frölunda Specialistsjukhus	145	0.48	0.79	–0.02	59	64	81	1.6	46
Gällivare	99	0.41	0.80	0.02	66	49	76	0.1	52
Gävle	245	0.42	0.74	–0.03	56	50	73	–2.8	45
Halmstad	261	0.42	0.79	0.01	64	53	76	0.2	50
Helsingborg	79	0.22	0.75	0.04	69	52	74	2.6	47
Hudiksvall	155	0.42	0.78	0.01	62	52	74	–1.2	45
Hässleholm-Kristianstad	1,212	0.42	0.82	0.03	69	58	80	3.1	53
Jönköping	291	0.39	0.77	–0.01	63	55	76	–0.8	47
Kalmar	237	0.40	0.83	0.04	71	54	77	0.8	50
Karlshamn	390	0.47	0.80	0.00	62	58	77	–0.5	45
Karlskoga	191	0.41	0.79	–0.01	63	57	78	0.7	49
Karlstad	290	0.32	0.73	–0.03	61	56	74	–1.4	41
Karolinska/Huddinge	361	0.44	0.75	–0.03	55	60	73	–4.2	32
Karolinska/Solna	249	0.35	0.72	–0.03	57	49	71	–3.0	43
Katrineholm	392	0.45	0.79	0.01	63	54	77	0.7	50
Kungälv	238	0.45	0.74	–0.02	53	58	73	–2.1	35
Lidköping	326	0.44	0.80	–0.00	65	58	77	–1.4	44
Lindesberg	333	0.36	0.82	0.04	72	50	80	3.8	59
Ljungby	281	0.51	0.84	0.03	68	63	78	–1.1	39
Lycksele	377	0.42	0.82	0.03	69	57	78	1.0	50
Mora	220	0.40	0.80	0.02	66	49	78	2.1	56

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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	14	0.2	78	14	–1.6
Aleris Specialistvård Elisabethsjukhuset	60	11	–0.2	81	11	–1.8
Aleris Specialistvård Motala	60	12	–0.3	80	15	–0.3
Aleris Specialistvård Nacka	66	7	–5.9	89	8	–6.9
Aleris Specialistvård Sabbatsberg	61	9	–2.9	85	10	–4.5
Alingsås	61	13	–0.1	79	17	1.3
Arvika	65	15	1.7	76	17	1.5
Bollnäs	64	14	0.6	78	16	0.8
Borås	63	15	1.4	76	20	3.9
Capio Movement	63	13	0.1	80	17	2.4
Capio Ortopediska Huset	62	14	1.7	77	18	3.4
Capio S:t Göran	62	16	3.1	74	19	3.1
Carlanderska	62	11	–1.0	82	13	–0.6
Danderyd	63	12	–1.8	81	13	–3.5
Eksjö	62	12	–0.2	80	15	0.7
Enköping	60	15	1.2	74	19	2.2
Eskilstuna	68	14	–0.7	80	18	1.1
Falun	60	13	0.1	78	15	–0.3
Frölunda Specialistsjukhus	60	12	–0.2	80	14	–0.2
Gällivare	63	14	0.7	77	16	–0.3
Gävle	62	16	1.9	75	18	2.2
Halmstad	63	16	2.1	75	18	2.3
Helsingborg	73	14	–2.1	81	13	–4.8
Hudiksvall	63	13	–0.8	79	15	–1.1
Hässleholm-Kristianstad	60	11	–2.5	83	11	–4.5
Jönköping	66	15	1.1	77	18	2.2
Kalmar	62	11	–2.0	82	12	–3.2
Karlshamn	57	13	0.1	78	15	–0.1
Karlskoga	65	14	0.6	79	17	1.9
Karlstad	62	17	2.6	74	20	4.6
Karolinska/Huddinge	78	15	0.7	81	18	3.2
Karolinska/Solna	63	16	1.6	75	19	2.9
Katrineholm	59	13	0.1	77	16	0.3
Kungälv	58	17	2.6	71	21	4.8
Lidköping	60	14	1.1	77	15	0.3
Lindesberg	67	11	–2.9	84	11	–4.1
Ljungby	60	10	–2.8	83	12	–2.9
Lycksele	64	13	–0.5	80	13	–1.8
Mora	65	13	–0.7	79	17	0.4

PROMs programme at 1 year – improvement index and deviation from expected outcome (cont.)

year of primary operation 2011–2012

		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**
Norrköping	340	0.42	0.79	–0.01	63	56	76	–1.4	45
Norrtälje	143	0.41	0.71	–0.06	51	54	70	–5.4	34
Nyköping	204	0.38	0.76	–0.03	61	54	75	–1.1	47
Ortho Center Stockholm	722	0.42	0.78	–0.00	62	56	77	0.2	47
OrthoCenter IFK-kliniken	261	0.46	0.85	0.03	72	56	83	3.7	62
Oskarshamn	362	0.41	0.81	0.03	67	51	79	2.5	56
Piteå	421	0.40	0.81	0.02	68	52	79	2.7	56
Skellefteå	117	0.40	0.80	0.02	66	53	75	–1.5	46
Skene	197	0.47	0.78	–0.02	58	58	76	–1.3	44
Skövde	320	0.40	0.76	–0.02	60	56	75	–1.2	42
Sollefteå	133	0.42	0.76	–0.03	59	58	73	–4.0	37
Sophiahemmet	254	0.51	0.91	0.07	82	62	86	4.8	63
Spenshult	318	0.46	0.80	–0.00	62	58	78	–0.2	47
SU/Mölndal	413	0.35	0.73	–0.04	59	56	72	–4.5	35
Sundsvall	160	0.41	0.77	–0.03	61	55	75	–2.5	45
SUS/Lund	55	0.25	0.65	–0.09	53	50	65	–8.5	30
SUS/Malmö	58	0.23	0.79	0.06	73	48	77	4.3	55
Södersjukhuset	387	0.42	0.73	–0.05	53	55	73	–2.3	40
Södertälje	128	0.41	0.72	–0.06	53	57	74	–2.1	40
Torsby	167	0.38	0.75	–0.05	59	56	73	–4.0	40
Trelleborg	1,032	0.43	0.80	0.01	65	59	78	0.7	47
Uddevalla	431	0.39	0.75	–0.02	58	53	75	–0.3	46
Umeå	65	0.26	0.73	–0.01	64	46	68	–5.0	41
Uppsala	203	0.37	0.73	–0.06	58	57	74	–3.3	40
Varberg	342	0.48	0.79	–0.01	59	61	77	–1.0	40
Visby	123	0.48	0.76	–0.04	53	59	74	–3.4	37
Värnamo	180	0.50	0.81	–0.01	61	62	79	0.5	45
Västervik	154	0.43	0.77	–0.03	60	61	75	–3.2	35
Västerås	490	0.41	0.79	0.02	65	53	76	–0.1	49
Växjö	181	0.50	0.79	–0.01	59	58	77	–0.4	46
Ängelholm	290	0.40	0.81	0.03	68	58	77	0.4	46
Örebro	206	0.39	0.74	–0.04	57	52	73	–3.1	43
Örnsköldsvik	211	0.46	0.81	0.03	66	53	78	2.1	54
Östersund	442	0.42	0.82	0.02	68	58	79	1.7	50
Nation	22,056	0.42	0.79	0	63	56	77	0	47

Number = number of registrations per hospital with complete PROM data for patients oper-ated during years 2011–2012.

Actual mean values for EQ-5D index, EQ VAS and pain (VAS) preoperatively and one year postoperatively and satisfaction (VAS) with results shown one year after the operation.

Deviation from expected = difference between actual mean value and the expected value cal-culated using regression coefficients in a model that include case-mix and preoperative level of corresponding PROM variable.

For EQ-5D index och EQ VAS values above zero indicate better outcome than expected and for pain and satisfaction negative values indicated better outcomes than expected.

	Pain (VAS)				Satisfaction (VAS)	
Hospital	**Preop**	**1 year**	**Deviation from expected**	**Improve-ment index**	**1 year**	**Deviation from expected**
Norrköping	63	14	1.1	77	16	0.9
Norrtälje	63	21	7.0	66	23	6.2
Nyköping	65	16	3.0	75	21	5.5
Ortho Center Stockholm	66	12	–1.7	82	14	–1.1
OrthoCenter IFK-kliniken	62	9	–2.5	85	10	–3.4
Oskarshamn	64	12	–2.1	82	11	–4.2
Piteå	67	11	–2.8	84	12	–3.1
Skellefteå	65	13	–1.0	80	16	0.1
Skene	63	15	2.2	76	21	5.7
Skövde	63	14	0.2	78	16	0.3
Sollefteå	63	13	0.3	79	16	0.7
Sophiahemmet	58	6	–5.5	90	5	–7.6
Spenshult	62	13	0.1	79	15	0.1
SU/Mölndal	65	17	3.1	74	20	4.5
Sundsvall	64	15	2.2	76	17	1.8
SUS/Lund	69	19	3.6	73	21	3.7
SUS/Malmö	67	13	–2.1	80	13	–4.4
Södersjukhuset	60	15	1.8	74	18	1.4
Södertälje	62	17	3.7	73	22	5.9
Torsby	65	15	1.9	77	21	5.5
Trelleborg	64	14	0.9	78	15	–0.2
Uddevalla	63	16	1.8	75	19	3.0
Umeå	68	11	–3.9	84	11	–5.8
Uppsala	61	15	2.0	76	18	3.6
Varberg	60	12	–0.8	80	13	–1.9
Visby	61	16	3.2	73	21	5.3
Värnamo	58	15	2.4	75	15	0.4
Västervik	61	15	2.0	76	19	4.5
Västerås	66	12	–2.3	82	14	–1.8
Växjö	59	15	2.4	74	17	2.1
Ängelholm	67	13	–0.9	81	13	–2.4
Örebro	61	13	–0.8	79	14	–1.7
Örnsköldsvik	65	12	–1.5	81	13	–2.8
Östersund	62	12	–0.8	80	13	–2.4
Nation	63	13	0	79	15	0

Improvement index = the ratio between mean values pre- and postoperatively in relation to possible improvement. Hospitals with less than 40 registrations during the time period are not shown.

PROMs programme at 6 years – improvement index and deviation from expected outcome

year of primary operation 2007–2008

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	6 years	Deviation from expected	Improvement index	Preop	6 years	Deviation from expected	Improvement index
Aleris Specialistvård Elisabethsjukhuset	184	0.49	0.79	0.01	58	60	76	0.7	39
Alingsås	269	0.45	0.77	0.03	58	55	74	1.8	41
Arvika	52	0.48	0.81	0.03	63	59	75	–0.1	39
Bollnäs	395	0.43	0.72	–0.03	51	51	71	–0.6	42
Borås	197	0.41	0.71	–0.04	50	53	70	–1.8	37
Capio Movement	87	0.52	0.82	0.03	63	57	81	5.1	55
Capio S:t Göran	78	0.35	0.71	–0.02	55	53	66	–4.2	28
Danderyd	448	0.38	0.73	0.00	56	49	72	1.6	45
Eksjö	227	0.42	0.75	–0.01	57	55	72	–0.4	39
Enköping	109	0.42	0.76	0.00	58	51	72	–0.4	43
Eskilstuna	57	0.24	0.63	–0.06	52	52	65	–3.2	27
Falköping	413	0.48	0.75	–0.01	52	59	72	–1.7	31
Falun	120	0.44	0.70	–0.06	46	55	68	–5.3	28
Frölunda Specialistsjukhus	102	0.44	0.70	–0.07	46	59	69	–4.4	26
Gällivare	112	0.43	0.74	0.00	55	54	69	–2.8	32
Gävle	129	0.35	0.73	–0.02	58	47	69	–3.1	42
Halmstad	188	0.42	0.73	–0.03	53	55	71	–1.5	36
Hudiksvall	154	0.41	0.69	–0.04	47	46	67	–3.9	39
Hässleholm-Kristianstad	1,033	0.40	0.79	0.04	64	58	76	2.9	42
Jönköping	209	0.37	0.76	0.01	62	51	73	0.4	44
Kalmar	226	0.50	0.75	–0.01	50	58	72	–0.9	34
Karlshamn	217	0.41	0.74	–0.01	55	53	73	1.2	43
Karlskoga	71	0.37	0.74	–0.00	58	48	70	–0.8	43
Karlstad	126	0.35	0.74	0.01	60	52	71	0.3	40
Karolinska/Solna	89	0.38	0.74	0.00	57	48	68	–3.0	38
Katrineholm	242	0.39	0.79	0.04	66	55	76	2.9	47
Kungälv	258	0.47	0.74	–0.01	52	56	72	–0.0	36
Köping	179	0.44	0.77	0.01	58	55	74	1.2	42
Lidköping	188	0.48	0.78	0.02	57	55	75	1.7	43
Lindesberg	185	0.52	0.74	–0.02	46	59	73	0.5	35
Ljungby	155	0.48	0.80	0.02	61	57	77	2.4	46
Lycksele	286	0.44	0.76	0.01	58	52	71	–1.2	40
Mora	76	0.34	0.74	0.01	61	47	68	–2.8	39
Motala (up to 2009)	300	0.45	0.74	–0.01	52	57	72	–0.4	35
Ortho Center Stockholm	45	0.48	0.78	0.02	58	59	73	–0.8	35
Oskarshamn	383	0.49	0.78	0.01	57	57	75	0.6	42

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	Pain (VAS)				Satisfaction (VAS)	
Hospital	**Preop**	**6 years**	**Deviation from expected**	**Improve-ment index**	**6 years**	**Deviation from expected**
Aleris Specialistvård Elisabethsjukhuset	59	12	–1.7	80	15	–0.5
Alingsås	58	13	–1.6	77	16	–1.3
Arvika	58	11	–2.5	80	13	–2.5
Bollnäs	64	16	0.8	75	18	1.1
Borås	59	16	0.5	73	21	4.2
Capio Movement	62	13	–0.8	79	12	–3.2
Capio S:t Göran	60	20	4.0	66	23	5.0
Danderyd	63	13	–3.0	80	16	–1.7
Eksjö	63	15	0.3	76	15	–1.4
Enköping	61	18	3.2	71	22	5.5
Eskilstuna	68	18	0.6	74	17	–2.3
Falköping	57	13	–1.4	77	16	–0.9
Falun	60	16	1.5	73	18	1.2
Frölunda Specialistsjukhus	62	21	6.9	66	23	7.0
Gällivare	64	18	2.6	71	20	2.5
Gävle	65	18	2.7	73	18	1.5
Halmstad	61	16	1.6	73	19	2.4
Hudiksvall	63	17	1.4	73	20	2.9
Hässleholm-Kristianstad	56	14	–0.9	76	14	–2.6
Jönköping	62	15	0.3	75	17	0.6
Kalmar	59	14	–1.0	77	16	–0.4
Karlshamn	61	15	0.5	75	18	0.6
Karlskoga	63	18	2.9	72	19	2.2
Karlstad	64	17	1.2	74	20	2.6
Karolinska/Solna	63	19	3.2	70	20	3.0
Katrineholm	63	15	–0.2	76	18	1.8
Kungälv	54	15	–0.2	73	18	0.6
Köping	62	14	–0.4	77	18	1.2
Lidköping	56	13	–1.5	77	14	–2.8
Lindesberg	58	14	–0.8	76	13	–3.5
Ljungby	61	11	–3.3	82	13	–3.2
Lycksele	63	15	–0.2	76	15	–2.2
Mora	67	15	–0.6	78	17	–0.6
Motala (up to 2009)	59	18	2.2	70	21	3.8
Ortho Center Stockholm	62	15	0.5	76	22	5.8
Oskarshamn	54	12	–1.6	77	12	–3.9

PROMs programme at 6 years – improvement index and deviation from expected outcome (cont.)

year of primary operation 2007–2008

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	6 years	Deviation from expected	Improve-ment index	Preop	6 years	Deviation from expected	Improve-ment index
Piteå	440	0.41	0.77	0.02	61	49	74	2.2	49
Skellefteå	116	0.40	0.76	0.01	60	53	72	–0.0	41
Skene	102	0.44	0.72	–0.04	49	55	72	0.1	39
Skövde	152	0.40	0.75	–0.01	58	52	71	–2.0	40
Sollefteå	88	0.47	0.75	0.00	53	59	72	–0.6	31
SU/Mölndal	84	0.40	0.73	–0.05	54	57	72	–3.0	35
SU/Sahlgrenska	61	0.40	0.70	–0.03	50	52	68	–2.8	34
SU/Östra	165	0.44	0.73	–0.03	51	61	69	–3.9	21
Sundsvall	84	0.34	0.73	–0.02	59	49	70	–2.1	41
SUS/Malmö	47	0.37	0.72	–0.02	56	53	73	1.2	43
Södersjukhuset	447	0.41	0.73	–0.02	54	55	70	–1.7	34
Södertälje	64	0.38	0.77	0.02	62	55	75	2.7	45
Torsby	47	0.40	0.71	–0.03	51	54	67	–4.4	27
Trelleborg	851	0.43	0.77	0.01	59	57	75	1.4	41
Uddevalla	329	0.43	0.73	–0.02	52	56	69	–2.5	31
Umeå	76	0.26	0.69	–0.06	59	40	66	–6.7	43
Uppsala	65	0.39	0.75	–0.00	58	56	69	–3.4	31
Varberg	310	0.44	0.78	0.02	61	57	76	1.7	44
Värnamo	149	0.54	0.78	–0.01	52	61	75	–0.1	37
Västervik	115	0.50	0.74	–0.03	48	61	74	0.4	33
Västerås	117	0.38	0.75	0.00	59	50	69	–3.3	38
Växjö	150	0.46	0.73	–0.01	50	56	70	–1.3	32
Örebro	221	0.44	0.77	0.02	59	56	73	–0.0	37
Örnsköldsvik	150	0.34	0.75	0.03	62	46	70	0.1	44
Östersund	285	0.37	0.76	0.01	62	51	73	1.1	45
Nation	12,496	0.43	0.75	0	57	55	73	0	57

Number = number of registrations per hospital with complete PROM data for patients oper-ated during years 2007–2008.

Actual mean values for EQ-5D index, EQ VAS and pain (VAS) preoperatively and six years postoperatively and satisfaction (VAS) with results shown six years after the operation.

Deviation from expected = difference between actual mean value and the expected value cal-culated using regression coefficients in a model that include case-mix and preoperative level of corresponding PROM variable.

For EQ-5D index och EQ VAS values above zero indicate better outcome than expected and for pain and satisfaction negative values indicated better outcomes than expected.

Improvement index = the ratio between mean values pre- and six years postoperatively in relation to possible improvement. Hospitals with less than 40 registrations during the time period are not shown.

	Pain (VAS)				Satisfaction (VAS)	
Hospital	Preop	6 years	Deviation from expected	Improve-ment index	6 years	Deviation from expected
Piteå	64	11	–3.8	82	13	–3.7
Skellefteå	63	14	–1.2	78	15	–1.8
Skene	60	23	7.4	62	27	9.7
Skövde	62	16	1.1	75	17	1.3
Sollefteå	61	16	1.1	74	17	0.4
SU/Mölndal	64	15	1.0	76	18	2.6
SU/Sahlgrenska	62	14	–2.3	77	18	0.4
SU/Östra	63	21	6.1	66	25	8.4
Sundsvall	67	18	2.9	72	20	3.0
SUS/Malmö	62	23	7.2	63	25	8.4
Södersjukhuset	57	15	0.4	73	17	–0.1
Södertälje	60	15	0.6	74	18	1.7
Torsby	66	17	0.9	75	20	1.8
Trelleborg	63	15	0.6	76	17	0.2
Uddevalla	61	17	2.2	71	20	2.7
Umeå	69	15	–0.6	78	18	1.7
Uppsala	57	16	1.2	71	18	1.4
Varberg	63	14	–0.5	78	15	–1.3
Värnamo	50	14	0.7	73	18	2.7
Västervik	61	14	–0.4	77	15	–1.5
Västerås	65	15	–0.5	77	13	–3.7
Växjö	55	16	1.0	70	19	1.0
Örebro	56	12	–2.6	78	13	–3.9
Örnsköldsvik	66	15	–1.6	77	18	–0.4
Östersund	63	14	–1.2	78	14	–2.4
Nation	60	15	0	75	17	0

PROMs programme at 10 years – improvement index and deviation from expected outcome

Year of primary operation 2003–2004

		EQ-5D index				EQ VAS			
Hospital	Number	Preop	10 years	Deviation from expected	Improve-ment index	Preop	10 years	Deviation from expected	Improve-ment index
Alingsås	112	0.49	0.69	–0.04	39	56	71	0.4	34
Borås	102	0.40	0.75	0.03	59	49	71	1.5	43
Falköping	322	0.43	0.74	0.01	54	56	72	1.4	36
Kungälv	219	0.41	0.70	–0.01	49	53	68	–0.8	32
Lidköping	120	0.45	0.72	0.00	49	52	69	–0.0	36
Skene	117	0.46	0.70	–0.05	43	58	69	–2.3	27
Skövde	55	0.29	0.75	0.02	65	49	72	1.2	45
SU/Mölndal	81	0.39	0.64	–0.07	41	52	66	–3.5	29
SU/Sahlgrenska	177	0.35	0.73	–0.02	58	51	70	–2.6	39
SU/Östra	76	0.43	0.71	–0.00	49	51	70	0.5	39
Uddevalla	178	0.38	0.70	0.00	53	53	68	–1.0	31
Östersund	54	0.41	0.75	0.03	57	50	71	2.2	42
Nation	1,793	0.41	0.72	0	53	53	70	0	36

Number = number of registrations per hospital with complete PROM data for patients oper-ated during the years 2003–2004.

Actual mean values for EQ-5D index, EQ VAS and pain (VAS) preoperatively and ten years postoperatively and satisfaction (VAS) with results shown ten years after the operation.

Deviation from expected = difference between the actual mean value and the expected value calculated using regression coefficients in a model that include case-mix and preoperative level of corresponding PROM variable.

For EQ-5D index och EQ VAS values above zero indicate better outcome than expected and for pain and satisfaction negative values indicated better outcomes than expected.

Improvement index = the ratio between mean values pre- and ten years postoperatively in relation to possible improvement. Hospitals with less than 40 registrations during the time period are not shown.

	Pain (VAS)				Satisfaction (VAS)	
Hospital	Preop	10 years	Deviation from expected	Improve-ment index	10 years	Deviation from expected
Alingsås	57	15	–0.7	74	16	–0.0
Borås	61	16	–0.3	74	18	1.8
Falköping	60	15	–0.8	75	14	–2.0
Kungälv	59	17	0.8	71	16	–0.7
Lidköping	57	18	1.8	68	16	–0.2
Skene	57	19	3.1	68	21	6.0
Skövde	66	14	–2.2	79	13	–2.6
SU/Mölndal	61	17	0.3	73	20	3.6
SU/Sahlgrenska	62	16	0.6	75	16	1.3
SU/Östra	60	21	5.1	64	19	2.9
Uddevalla	61	14	–2.3	77	17	0.6
Östersund	60	15	–1.4	75	11	–5.2
Nation	60	16	0	73	16	0

Trend analysis

Continued positive trend in patient-reported outcomes

For the second year in a row, a trend analysis for all patient-reported variables is presented. PROMs program began as a pilot project in the Western Götaland region in 2002 and since 2008 all the clinics in the country participate. The response rate is high and persists from year to year. The only missing survey responses are from 15% preoperative cases and the response rate at one-year follow-up is 90%. Part of the preoperative data loss is related to faulty routines for requesting participation in the follow-up programme.

The quality register's main task is to promote the improvement of quality in healthcare. Historically we have been able to show that implant survival has been successively improved since the Register started its activities. Patient-reported outcomes such as pain relief, improved function and satisfaction with the results of the operation, constitute the main measures of outcome. How these outcome measures have changed in time was reported in last years report for the first time. For this year's report we have, expanded the analyses with data from an additional year, and we now investigate trends for how patient-reported outcomes have changed over time for those operated on in 2007 to 2012.

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. 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 six-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 range, 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 changed 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, analyzing 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. Hopefully, the PROM Programme contributes to facilitating analyses of the total functions and activities of caregivers, thus enabling initiation of local improvement efforts.

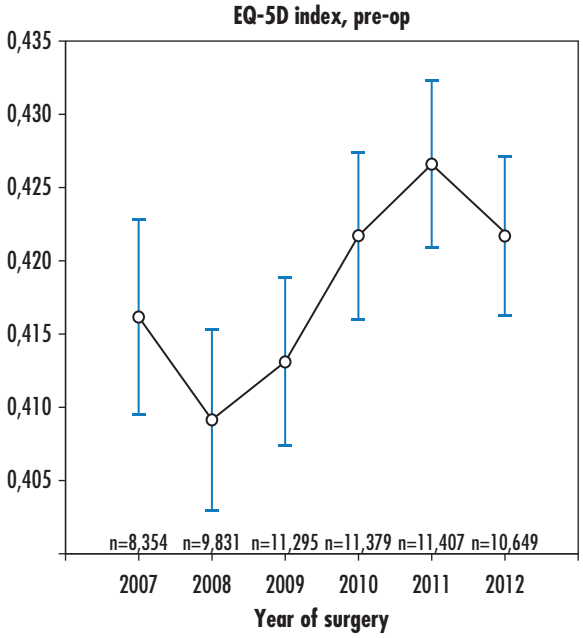


Figure 1. Evolution of the mean EQ-5D index preoperatively during the period 2007 to 2012. There is a significant trend towards a higher average.

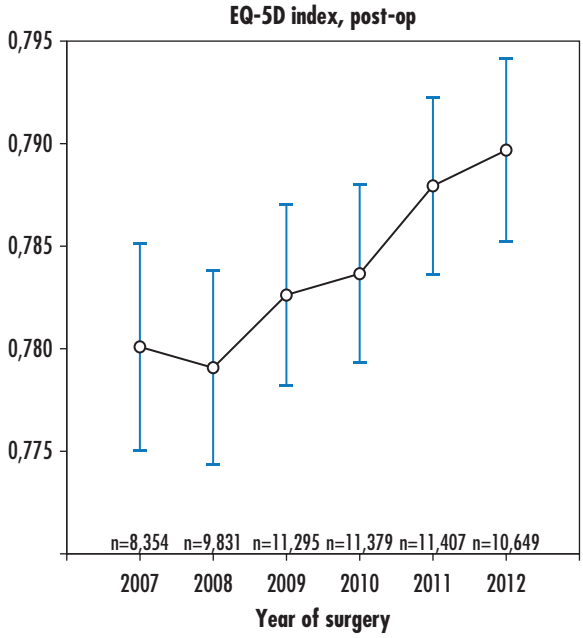


Figure 2. Evolution of the mean EQ-5D index after one year postoperatively during the period 2007 to 2012. There is a significant trend towards a higher average.

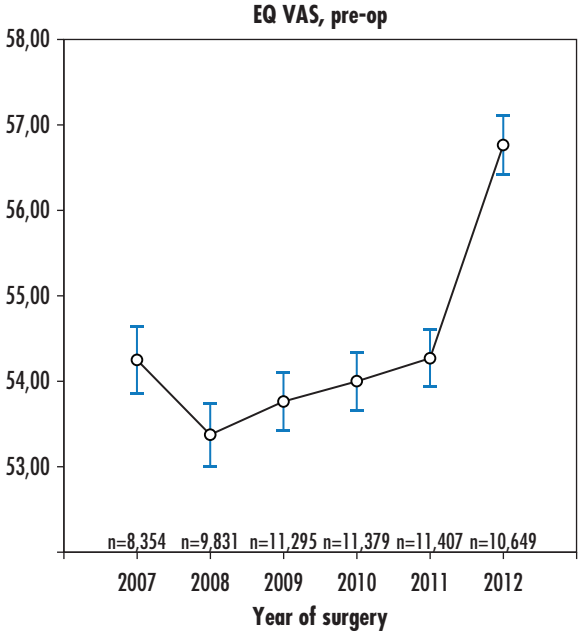


Figure 3. Evolution of the mean EQ VAS preoperatively during the period 2007 to 2012. There is a significant trend towards a higher average.

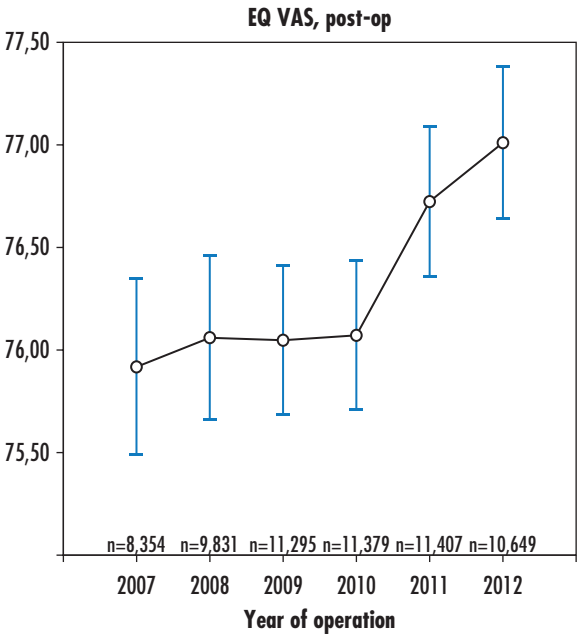


Figure 4. Evolution of the mean EQ VAS after one year postoperatively during the period 2007 to 2012. There is a significant trend towards a higher average.

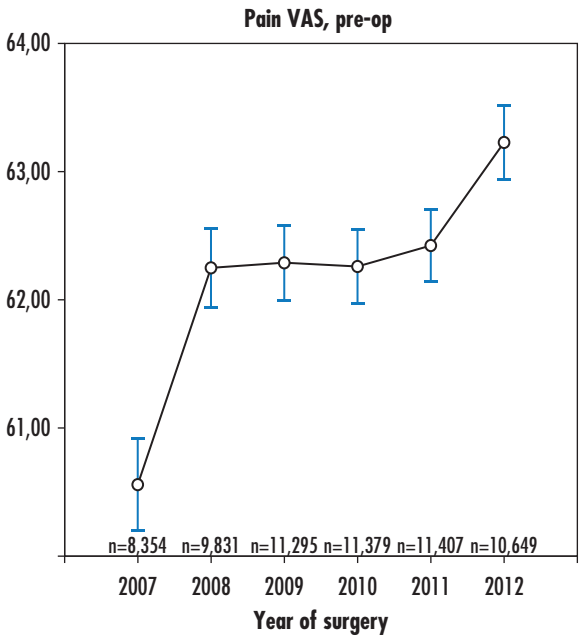


Figure 5. Evolution of the mean of pain preoperatively during the period 2007 to 2012. There is a significant trend towards a higher average (= more pain).

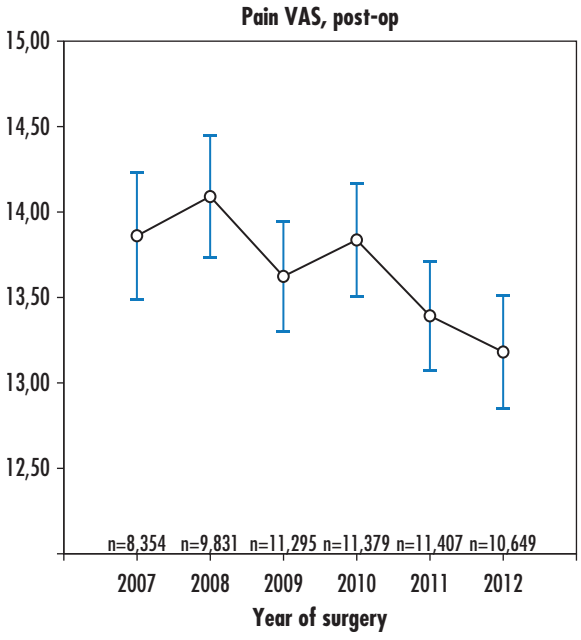


Figure 6. Evolution of the mean of pain after one year postoperatively during the period 2007 to 2012. There is a significant trend towards a lower average (= less pain).

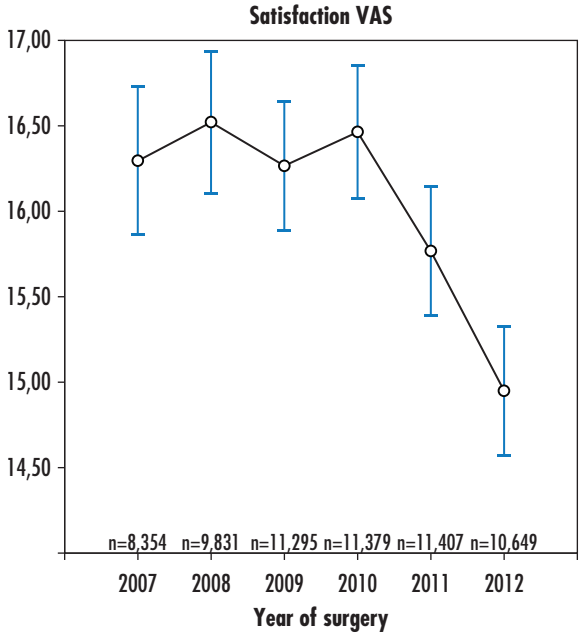


Figure 7. Evolution of the mean of satisfaction with the surgical results after one year postoperatively during the period 2007 to 2012. There is a significant trend towards a lower average (= better satisfaction).

Follow-up activities after total arthroplasty

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 PROM 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 77. The indicator also includes mortality.
- **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 owned by 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.

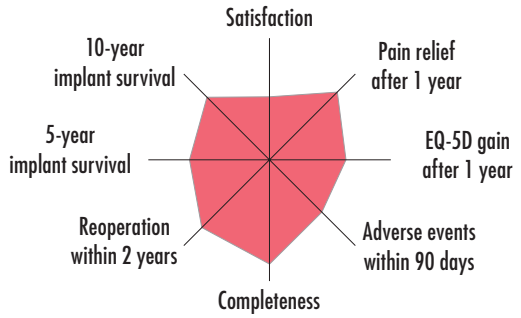
In the value compasses, the national result with respect to the eight input variables is shown in red. The corresponding values of the respective clinics are shown in green. The units with red panels have values for the variables in focus that are inferior to the national average. The outcome can be 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 pages 146–147. 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 compasses – national average

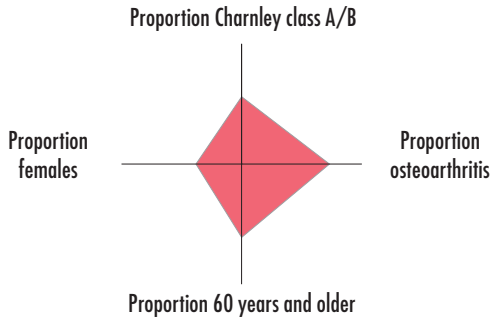


The values compasses show in red national results for the eight variables included. Each hospital's corresponding values are shown in green. Limit values are set to the highest and lowest value for each variable ±1 SD. The poorest value for the variables is at origo and the best on the periphery.

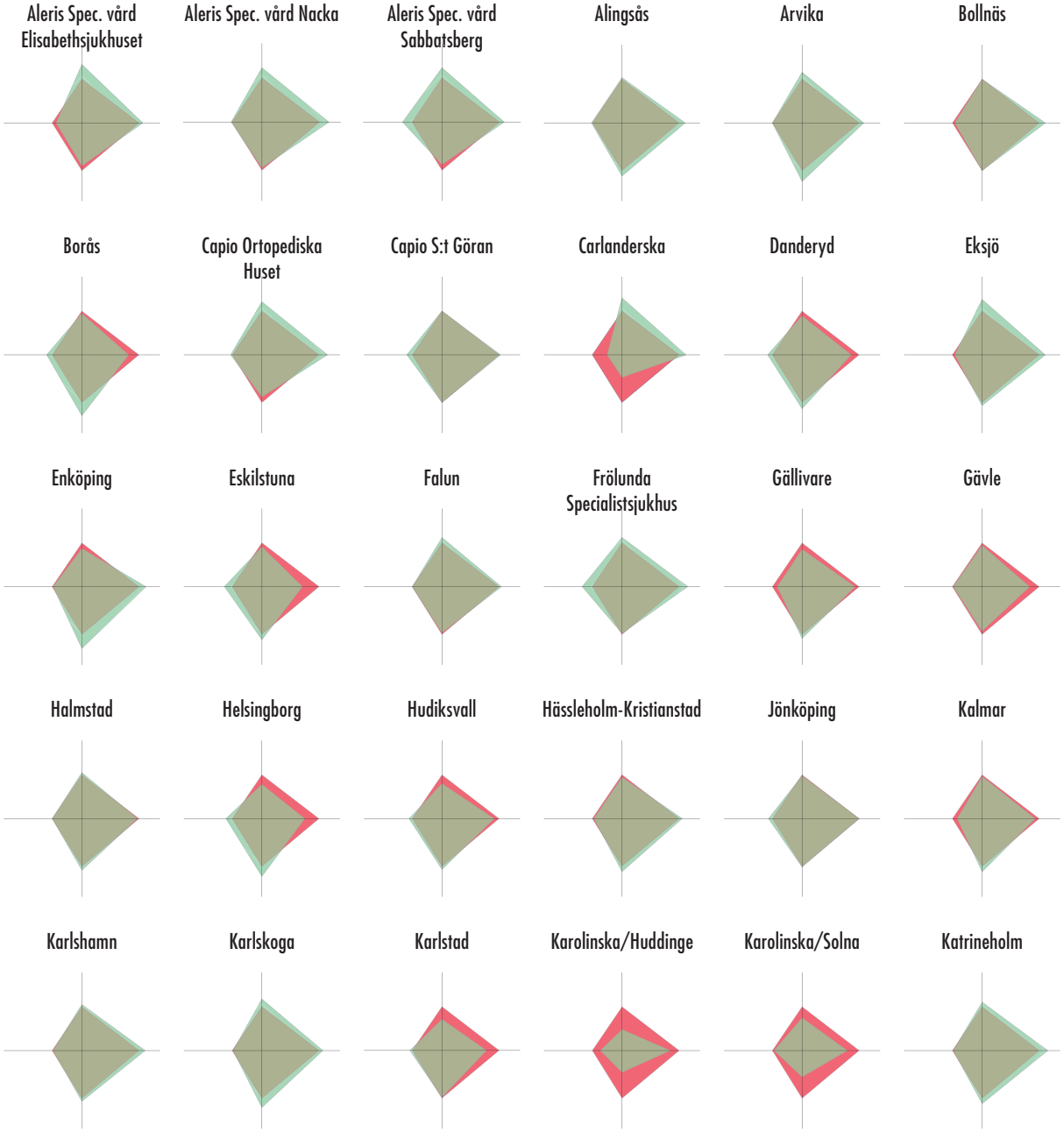
The hospitals where red fields are visible have a poorer value than the national average for that variable. The outcome can be studied in detail in each table.

Case-mix-profile

National average



In the graphic presentation of patient demographics (case-mix) the national result is shown in red regarding the four variables included. The corresponding values for each hospital are shown in green. Limit values are set to the greatest and the smallest value of each variable ±1 SD. The poorest value for the variables is at the origo and the best on the periphery.



Value compasses (continued)

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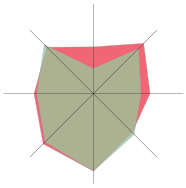
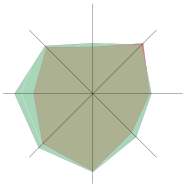
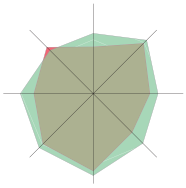


Lidköping



Lindesberg



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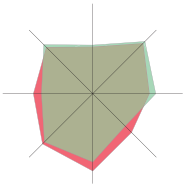
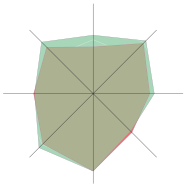


Ljungby



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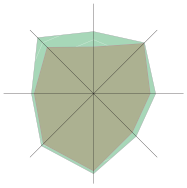

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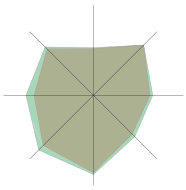

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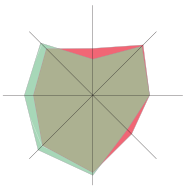

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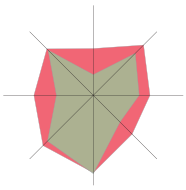
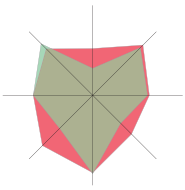
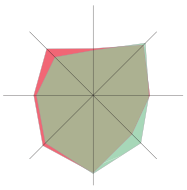


Nyköping



Ortho Center Stockholm



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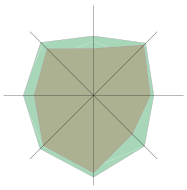

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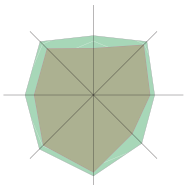
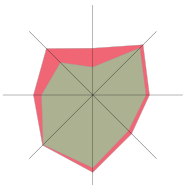


SU/Mölndal



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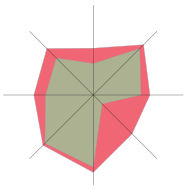

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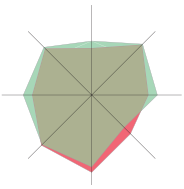

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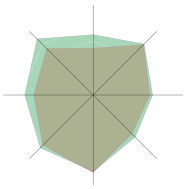

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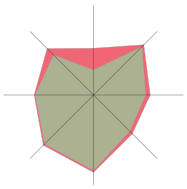

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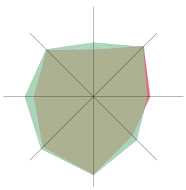

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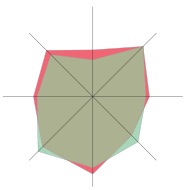

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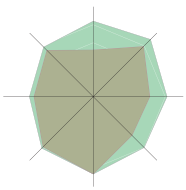

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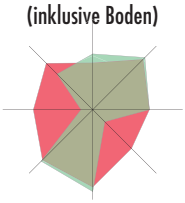

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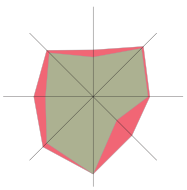
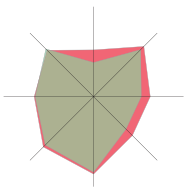
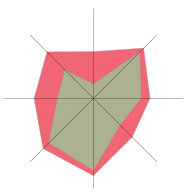


Södersjukhuset



Södertälje



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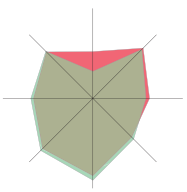

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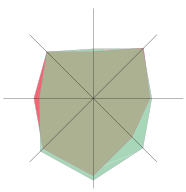
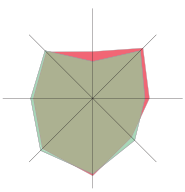
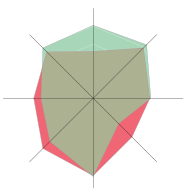


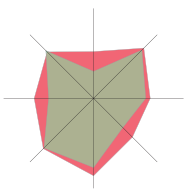
Uddevalla



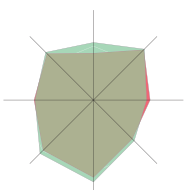
Umeå



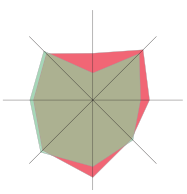
Uppsala



Varberg



Visby



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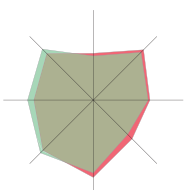
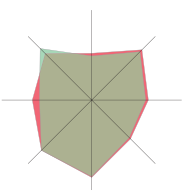


Västervik



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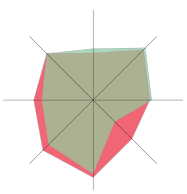

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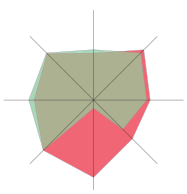

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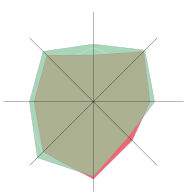

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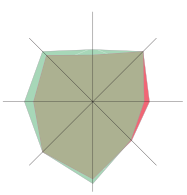

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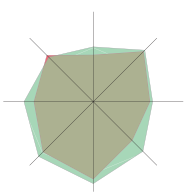

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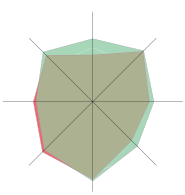

Case-mix profiles (continued)

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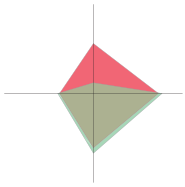

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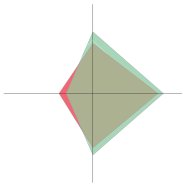

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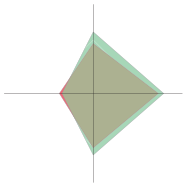

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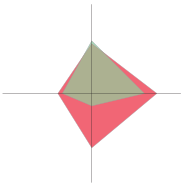

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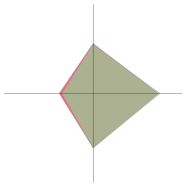

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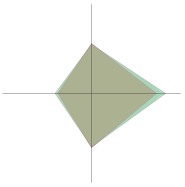

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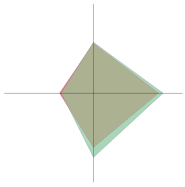

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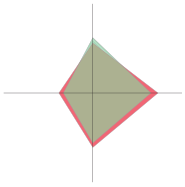

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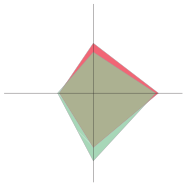

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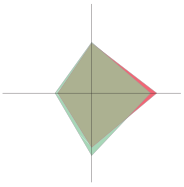

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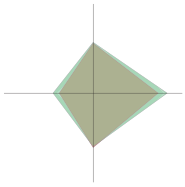

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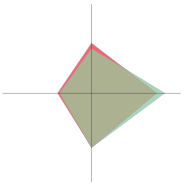

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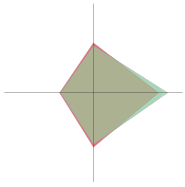

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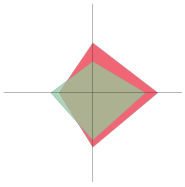

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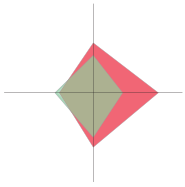

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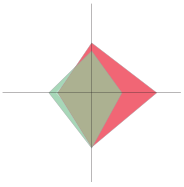

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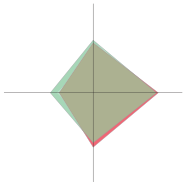

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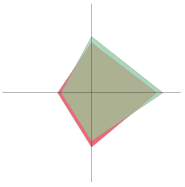

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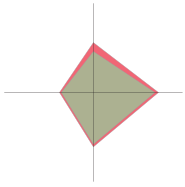

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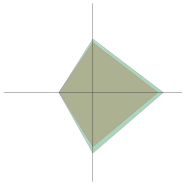

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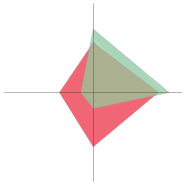

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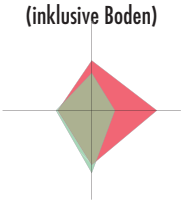

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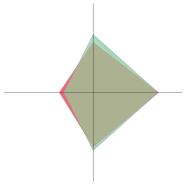

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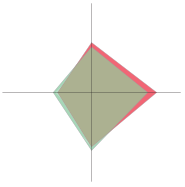

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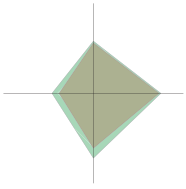

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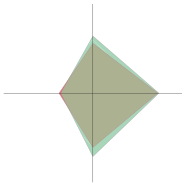

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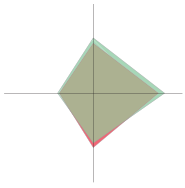

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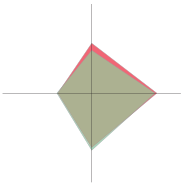

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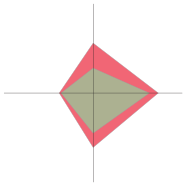

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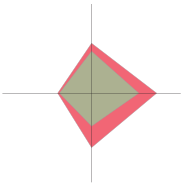

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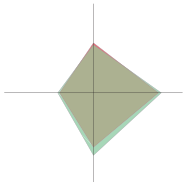

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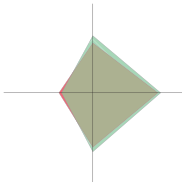

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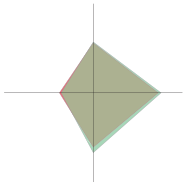

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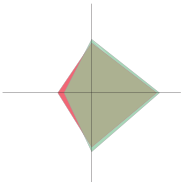

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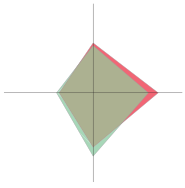

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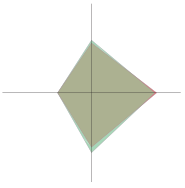

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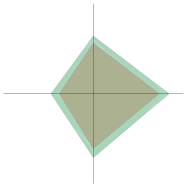

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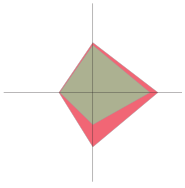

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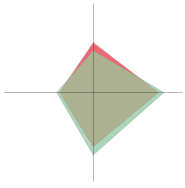

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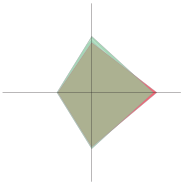


The "standard" patient

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. Especially important is the fact that patients with risk factors for early complications are concentrated to certain hospitals. These hospitals often have higher competence and better resources to deal with complications if they arise. In order to facilitate an assessment of a particular hospital's performance and possible comparisons, we have constructed the "standard" patient. The presumption has been that the "standard" patient could be a woman or a man, that about half the patients to be operated each year should be included, and that the "standard" patient should be represented at the majority of those hospitals that perform primary total hip replacement.

In the last two annual reports, we have defined a standard patient based on the data capture in the Hip Arthroplasty Register. The final definition was based on an exploratory statistical analysis combined with some compromises in order to include a sufficient number of patients and make the concept useful in clinical practice. The variables included in the final definition were age (55 to 84.9 years), diagnosis (primary osteoarthritis), BMI (18.5 to 29.9) and ASA class (I-II). Registration of height, weight and ASA class began in 2007 but during the first year the reporting was unsatisfactory, this is why reliable analyzes of only the standard patients can be carried out from 2008 (see also "Primary Prosthesis").

During the years 2008–2013, the percentage of operations where all variables were reported to the Register, increased from 80.3 to 94.4%, which is a prerequisite to define the "standard" patient. During the whole period, the corresponding proportion is 90.0% (84,986 operations). Private hospitals have the highest proportion of the "standard" patient, followed by central and rural hospitals. During the period, the proportion of standard patients generally declined from 50.6 to 47.7%, irrespective of the type of hospital (Figure 1). The decrease is primarily due to a lower proportion of these patients being operated at private and county hospitals, while sub-county hospitals and university hospitals show a slight increase between 2012 and 2013. The increase in the latter group is mainly because SU/Mölndal and Uppsala university hospital operate more on these patients. Several university hospitals (Malmö-Lund, Linköping and Umeå) operate on no or only a few such patients.

The relative risk for reoperation within two years more than doubled for those patients who do not meet all the criteria to be defined as the "standard" patient (RR: 2.1 1.9–2.4). When comparing the four different hospital types (cenral, rural, university, and private hospitals) including all patients, we find that the risk of suffering from an early reoperation is 30 to 50% higher if the surgery is not performed at a rural hospital. If the comparison is limited to those who meet the criteria for the "standard" patient, the risk reduces for those who undergo surgery at a central hospital and no significant difference could be found for those who undergo surgery at a university hospital. For standard patients in private hospitals the difference is slightly bigger. If one adjusts for any remaining differences concerning gender, age, BMI and ASA class in the group of standard patients, the result is almost the same (Table 1). It should be noted, that the breakdown of the different types of clinics is a generalization, which cannot be used to assess an individual clinic. Examples of clinics that have no or very few reoperations within two years can be found in all categories (see separate tables).

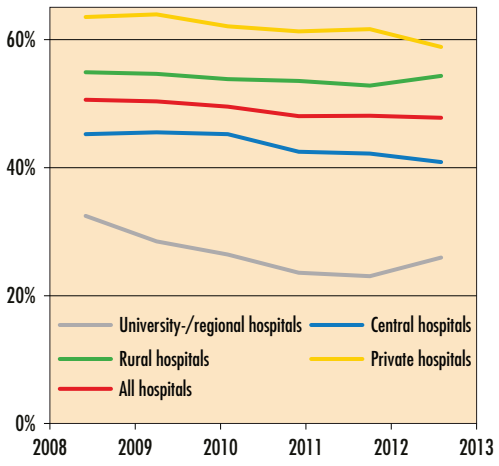


Figure 1. Percentage of operations performed on the "standard" patient in relation to the type of hospital.

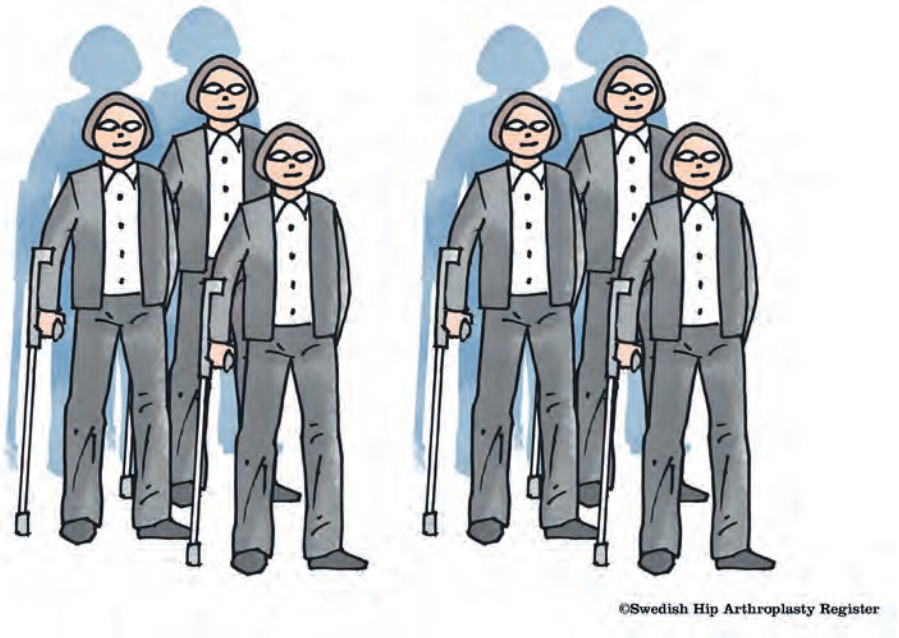
Our definition of the "standard" patient is a woman or man aged 55–84.9 with primary osteoarthritis, BMI 18.5–24.9 and ASA I or II. This group of patients has a reduced risk of complications leading to reoperation within 2 years of primary total hip replacement, compared with other patients. Comparison of the results for this group over time and between different operating healthcare units provides a fairer picture of the results.

Risk for reoperation within two years

	N	Survival based on reoperation average, *95% C.I.*	Risk ratio, 95% C.I.	p-value
Alla hip operations				
Rural hospitals*	35,244	98.5±*0.1*	1	
Central hospitals	33,117	97.8±*0.2*	1.5 *1.3–1.8*	<0.0005
University/Regional hospitals	9,981	97.6±*0.4*	1.5 *1.4–1.7*	<0.0005
Private hospitals	16,075	98.0±*0.2*	1.3 *1.1–1.5*	<0.0005
Only "standard" patients				
Unadjusted data				
Rural hospitals*	17,301	99.0±*0.2*	1	
Central hospitals	12,646	98.7±*0.2*	1.4 *1.2–1.8*	0.001
University/Regional hospitals	2,251	98.8±*0.4*	1.2 *0.8–1.8*	0.29
Private hospitals	9,388	98.6±*0.2*	1.5 *1.2–1.9*	<0.0005
Adjusted data#				
Rural hospitals*			1	
Central hospitals			1.4 *1.2–1.8*	0.001
University/Regional hospitals			1.3 *0.8–1.9*	0.26
Private hospitals			1.6 *1.3–2.0*	<0.0005

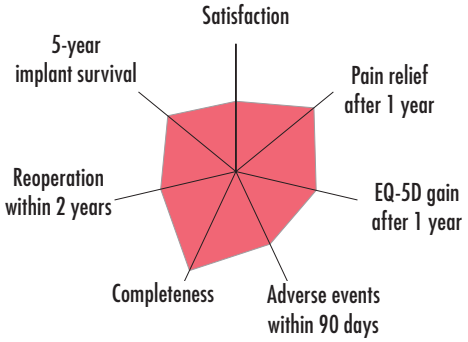
* reference group; # adjusted for variation of gender, age, BMI and ASA-class within the group the "standard patient"

Table 1. Risk of reoperation within two years for operation 2008–2013 where rural hospitals is the reference. Types of hospitals have differing proportion of "standard patients", which affects the outcomes (see Figure 1).



Quality indicator for the "standard patient"

value compass – national average

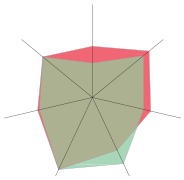


The value compasses show in red national results for the seven variables included. Each hospital's corresponding values are shown in green. Limit values are set to the highest and lowest value ±1 SD. The poorest value for the variables is at the origo and the best on the periphery.

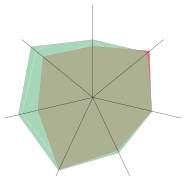
The hospitals where red fields are visible have a poorer value then the national averge for that variable. The outcome can be stud-ied in detail in each table.

Value compasses (continued)

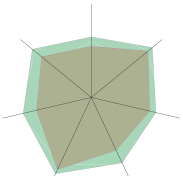
Kungälv



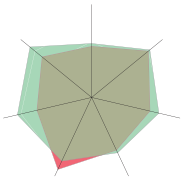
Lidköping



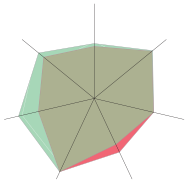
Lindesberg



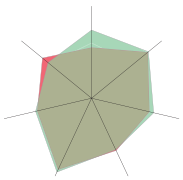
Linköping



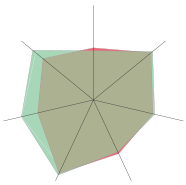
Ljungby



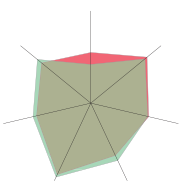
Lycksele



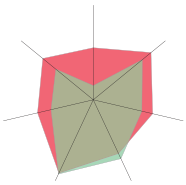
Mora



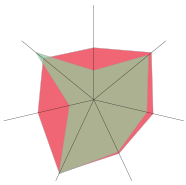
Norrköping



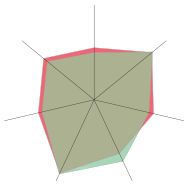
Norrtälje



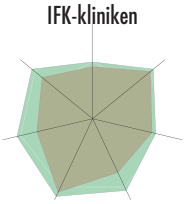
Nyköping



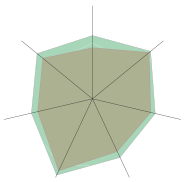
Ortho Center Stockholm



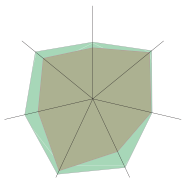
OrthoCenter IFK-kliniken



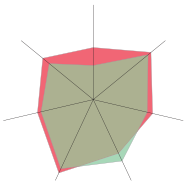
Oskarshamn



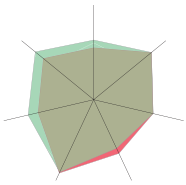
Piteå



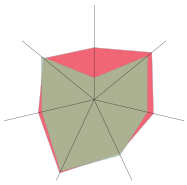
SU/Mölndal



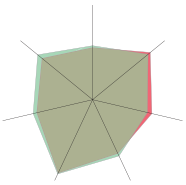
Skellefteå



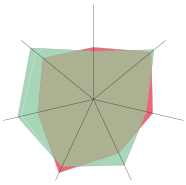
Skene



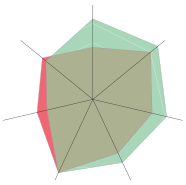
Skövde



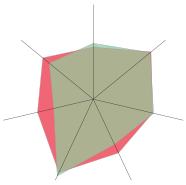
Sollefteå



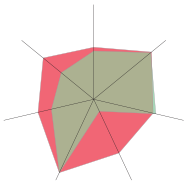
Sophiahemmet



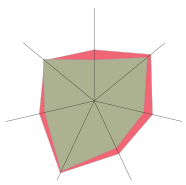
Spenshult



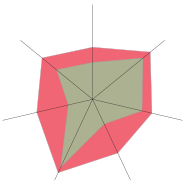
Sundsvall



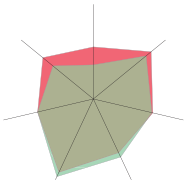
Södersjukhuset



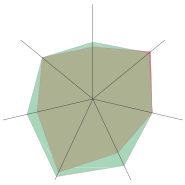
Södertälje



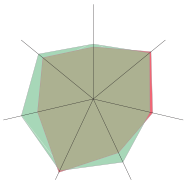
Torsby



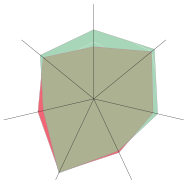
Trelleborg



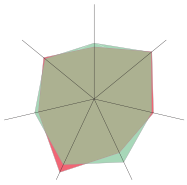
Uddevalla



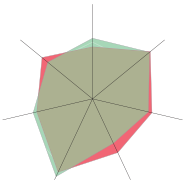
Umeå



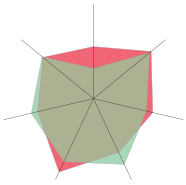
Uppsala



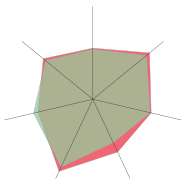
Varberg



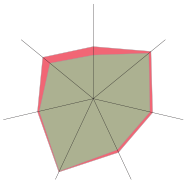
Visby



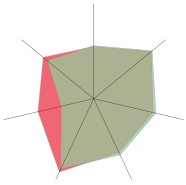
Värnamo



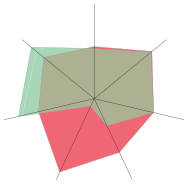
Västervik



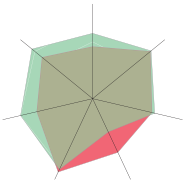
Västerås



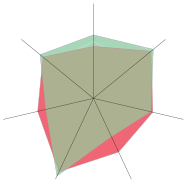
Växjö



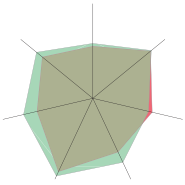
Ängelholm



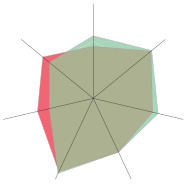
Örebro



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)

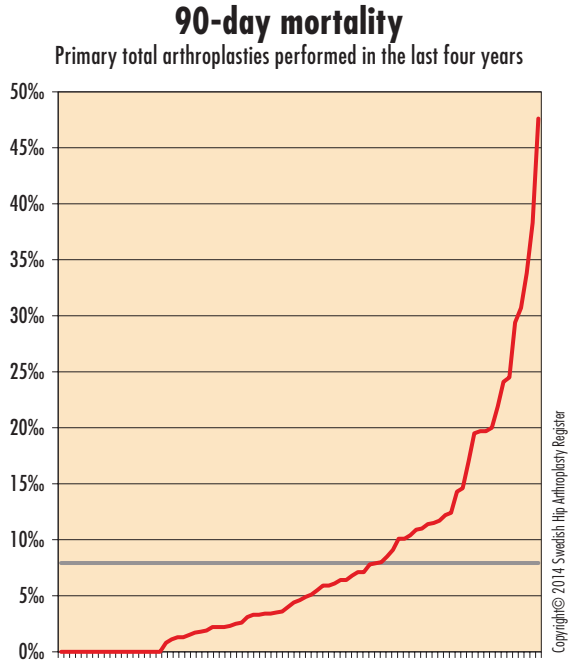
90-day mortality is an indicator, which is often used in the literature of many medical fields. The causes for a patient's death in connection with or within 90 days from a hip arthroplasty (and related to the intervention) can be many, but the dominant causes seem to be cardiac, cerebrovascular or thromboembolic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

90-day mortality is higher after surgery at a university/regional hospital and county hospitals compared to sub-county 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 2010–2013 from 0.0‰ – 47.6‰ with an average value for the country of 7.1‰.

We recommend clinics to analyze their deaths as a link in this work for patient safety. In such a development, it is important to know the number of patients who have died. 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 Register has started an in-depth analysis with respect to mortality after total hip replacement. In this study, we will include the Cause of Death Register and a number of variables such as diagnosis, gender, fixation method, preoperative comorbidity, socioeconomic variables, etc.

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



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

Each line in the baseline corresponds to a unit.

90-day mortality

proportion deceased within 90 days after primary THR, 2010–2013

Hospital	Number[1)]	OA[2)]	≥60[3)]	Females[4)]	Mortality[5)]
University/Regional hospitals					
Karolinska/Huddinge	1,010	68	65	51	5.9‰
Karolinska/Solna	794	61	68	56	10.1‰
Linköping	249	63	57	54	**24.1‰**
SU/Mölndal	1,735	63	78	65	10.4‰
SU/Sahlgrenska	21	5	71	63	**47.6‰**
SUS/Lund	549	25	76	62	**38.3‰**
SUS/Malmö	293	27	83	65	**30.7‰**
Umeå	286	68	73	56	**24.5‰**
Uppsala	1,118	55	69	57	**19.7‰**
Örebro	584	71	69	57	6.8‰
Central hospitals					
Borås	707	65	91	63	**17‰**
Danderyd	1,270	69	86	62	7.9‰
Eksjö	783	94	84	56	2.6‰
Eskilstuna	503	52	85	65	**21.9‰**
Falun	1,439	88	81	58	3.5‰
Gävle	822	66	80	57	12.2‰
Halmstad	937	81	85	58	8.5‰
Helsingborg	274	57	89	64	14.6‰
Hässleholm-Kristianstad	3,024	89	86	56	3.6‰
Jönköping	782	82	82	61	6.4‰
Kalmar	617	75	86	54	4.9‰
Karlskrona	150	23	95	55	**20.0‰**
Karlstad	1,049	60	81	60	14.3‰
Norrköping	966	72	79	54	**19.7‰**
Skövde	737	77	81	57	10.9‰
Sunderby (incl Boden)	136	15	87	59	**29.4‰**
Sundsvall	824	83	84	54	6.1‰
Södersjukhuset	1,570	68	84	62	11.5‰
Uddevalla	1,353	79	83	59	5.9‰
Varberg	915	87	87	60	5.5‰
Västerås	1,866	67	88	60	**33.8‰**
Växjö	513	80	85	58	7.8‰
Ystad	22	0	86	95	0‰
Östersund	1,126	78	83	59	4.4‰

(Continued on next page.)

90-day mortality (cont.)

proportion deceased within 90 days after primary THR, 2010–2013

Hospital	Number[1)]	OA[2)]	≥60[3)]	Females[4)]	Mortality[5)]
Rural hospitals					
Alingsås	872	94	86	59	0‰
Arvika	695	92	89	58	10.1‰
Bollnäs	702	95	82	56	0‰
Enköping	1,199	96	91	57	0.8‰
Falköping	220	91	87	60	0‰
Frölunda Specialistsjukhus	325	99	82	67	0‰
Gällivare	394	76	85	54	5.1‰
Hudiksvall	514	74	84	61	1.9‰
Karlshamn	870	94	84	57	3.4‰
Karlskoga	597	91	89	57	11.7‰
Katrineholm	928	99	86	57	1.1‰
Kungälv	664	89	85	60	1.5‰
Lidköping	744	91	86	52	1.3‰
Lindesberg	885	91	86	56	3.4‰
Ljungby	655	86	82	55	3.1‰
Lycksele	1,204	97	82	60	3.3‰
Mora	860	90	88	57	2.3‰
Norrtälje	454	79	90	60	11.0‰
Nyköping	665	72	87	60	19.5‰
Oskarshamn	898	96	82	57	2.2‰
Piteå	1,502	97	80	57	4.0‰
Skellefteå	404	79	79	65	12.4‰
Skene	450	92	78	55	0‰
Sollefteå	497	92	86	58	8.0‰
Södertälje	438	85	88	64	9.1‰
Torsby	440	84	88	57	11.4‰
Trelleborg	2,407	93	79	60	2.5‰
Visby	469	88	85	56	6.4‰
Värnamo	566	88	85	57	7.1‰
Västervik	463	87	85	53	2.2‰
Ängelholm	639	98	87	65	0‰
Örnsköldsvik	598	92	87	60	3.3‰

(Continued on next page.)

90-day mortality (cont.)

proportion deceased within 90 days after primary THR, 2010–2013

Hospital	Number[1)]	OA[2)]	≥60[3)]	Females[4)]	Mortality[5)]
Private hospitals					
Aleris Specialistvård Bollnäs	509	96	82	52	0‰
Aleris Specialistvård Elisabethsjukhuset	241	90	79	54	0‰
Aleris Specialistvård Motala	1,795	97	88	55	1.7‰
Aleris Specialistvård Nacka	500	100	81	59	0‰
Aleris Specialistvård Sabbatsberg	630	92	78	66	0‰
Aleris Specialistvård Ängelholm	16	94	69	36	0‰
Art Clinic	16	94	75	47	0‰
Capio Movement	812	98	76	55	0‰
Capio Ortopediska Huset	1,361	99	78	59	2.2‰
Capio S:t Göran	1,753	86	82	63	4.6‰
Carlanderska	508	96	65	44	0‰
Ortho Center Stockholm	1,663	97	81	63	1.8‰
OrthoCenter IFK-kliniken	526	96	63	43	0‰
Sensia Spec.vård	8	100	38	25	0‰
Sophiahemmet	746	100	59	41	1.3‰
Spenshult	897	89	77	58	0‰
Nation	64,223	83	82	58	7.1‰

[1)] Refers to number of primary operations during the period.
[2)] Refers to the proportion of primary operations with primary osteoarthritis.
[3)] Refers to the proportion of primary operations in age group 60 years and older (age at pri-mary operation).
[4)] Refers to proportion females of primary operations during the period.
[5)] 90-day mortality (number of patients deceased within three months after primary operations / number of primary operations during the period).

For variables [2)] [3)] and [4)] higher values indicate lower risk for serious complication (death).

Gender

More women than men have total hip replacement in Sweden. In 1992, the proportion of women was 59.4% but has decreased slowly to 58% in 2013. The reduction is due to the decrease in the number of women with secondary osteoarthritis, and above all on the drastic decrease in inflammatory arthritis since the 1990s. In the group for primary osteoarthritis, the proportion of women has instead increased from 54.4 to 56.8%.

Yearly incidences by gender are described in Figure 1. In order to get a description that can easily be interpreted graphically, we used risk ratio (RR). Men are used as reference. If RR is above 1, there is an increased risk for surgery. For example, if RR is 1.5, then women have 50% higher risk (or chance) to have arthroplasty compared to men. It should also be mentioned that the figures are adjusted for the difference in gender. The figure includes all age groups and you see an annual decrease in the difference between the genders. However, women are still more operated on.

In Figure 2a-e, the incidence is restricted to patients in five different age groups. In the youngest age group (50–59 years) the difference between the genders in recent years is insignificant, but women are slightly more operated on. In the group of 70–79 years, there has been an annual increase in the difference until 2013 when the difference decreases a little. Still, however, a RR of about 1.4. This RR figure remains in the following age groups.

Between 1992 and 2013, the average age for operation has been lowered by 1.1 years for men and 0.75 years for women (Figure 3). Looking at the most recent three-year period (2011–2013) compared with the previous three-year period, it is evident the decline in the average age has come to a halt.

Age changes for primary operations can be seen by studying different age groups (Figure 4 and 5). Relatively speaking, the group under 55 years of age is largest for men in comparison to women, but there has been a marginal decrease among men in the most recent three-year period. But the group aged 75 and older is largest for women. The proportion in the group 55–64 years of age also increased up until 2005–2007 after which it decreased somewhat for both men and women. This decrease has continued and in the most recent three-year period the decrease among men was 2.6% and among women 1.4%. In the group aged 65–74 we see a successive decrease up until 2008–2010, but in the period 2011–2013, there has been an increase in comparison to the previous three-year period. Among men 2.4% and among women 2.0%. Irrespective of gender, the proportion of patients aged 75 and older has previously successively decreased. This decrease has in the most recent three-year period come to a halt.

The distribution of diagnoses differs between men and women (Figures 6 and 7). Inflammatory arthritis, hip fracture and sequelae after childhood diseases are more common in women; primary osteoarthritis and avascular necrosis are more common in men. Since the early 1990s, the distribution of diagnoses has changed. This applies especially to women where the biggest changes are due to a decrease in the relative proportions of inflammatory arthritis. This decrease has in the most recent three-year period continued and now, the proportion for women is 1.5% and for men 0.9%. The proportion of osteoarthritis patients continues to decrease in the most recent three-year period with 0.7% for men and 1.2% for women. The proportion of idiopathic necrosis and post-traumatic sequelae has increased among both sexes.

During the past three years direct lateral approaches performed in supine or lateral position, have more often been used for women while the posterior approach is used most often for men (Figure 8). In the subgroup primary osteoarthritis, the distribution is similar. The increased risk for dislocation in women probably plays a role in this selection since the direct lateral approaches in themselves entail less risk of dislocation.

Still, the uncemented prostheses dominate, however, during 2011–2013, a decrease in the use of cemented prostheses was apparent and there was an increase of uncemented prostheses among both sexes. Like in earlier periods, a larger proportion of men receive uncemented prostheses. In the cemented prostheses group, women dominate. The few resurfacing prostheses, which were inserted in 2011–2013, were used mainly on men and generally, there has been a decrease in the use of this type of prostheses (Figure 9).

The registered risk factors are ASA class (Figure 10) and BMI (Figure 11). There is a certain gender difference in that there are a bit more men in ASA class I and more women in ASA class II. Regarding BMI, we see more women in the normal weight group and more men in the overweight group (25.0–29.9). In groups obesity 1 (30.0 to 34.9), obesity 2 (35.0 to 39.9) and obesity 3 (> 40.0), there is no apparent gender difference, however, there is a relatively large difference in obesity group 1.

In the comparison between genders in patient-reported outcome, there is a limitation in that only the first hip surgery is included and in order to be included, all three variables must have answers (EQ-5D, pain VAS and satisfaction). We have looked at the mean of satisfaction one year after the operation (Figure 12) and the mean difference before and one year after operation for the pain VAS and EQ-5D (Figure 13 and 14).

In terms of satisfaction, there is a difference since women are slightly more dissatisfied, except in the age group of younger than 55. There is a tendency towards slightly worse results as people get older. Concerning the mean on the difference in pain that is measured with pain VAS, women tend to have a slightly higher gain in all age groups. However, one should be aware that females, compared to males, indicates a higher value preoperatively (more pain), but this difference is not as great postoperatively. However, women estimate the pain to be bigger one year postoperatively, in comparison to men. The same reasoning can be applied to EQ-5D, women start at a lower level preoperatively and after a year, the difference is not as great. This means that at average they receive a higher value of the difference.

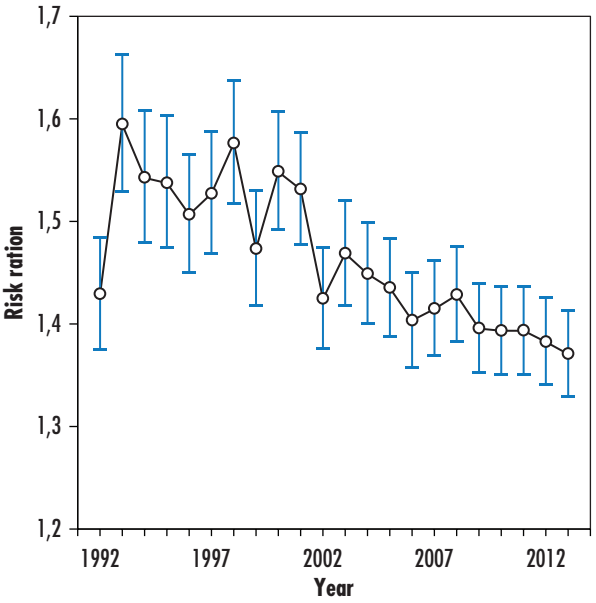


Figure 1. Annual gender distribution of patients with hip arthroplasty (total population).

Figures 1 and 2 show women's 'risk' to have hip arthroplasty compared with men.

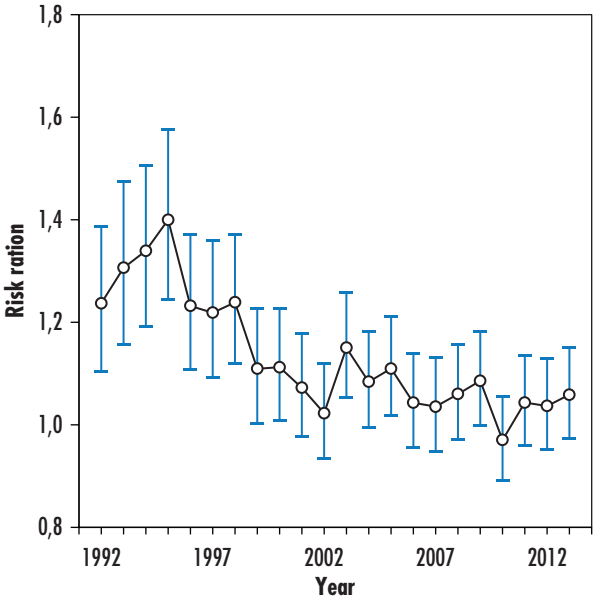


Figure 2a. Annual gender distribution of patients with hip arthroplasty (between 50 and 59 years).

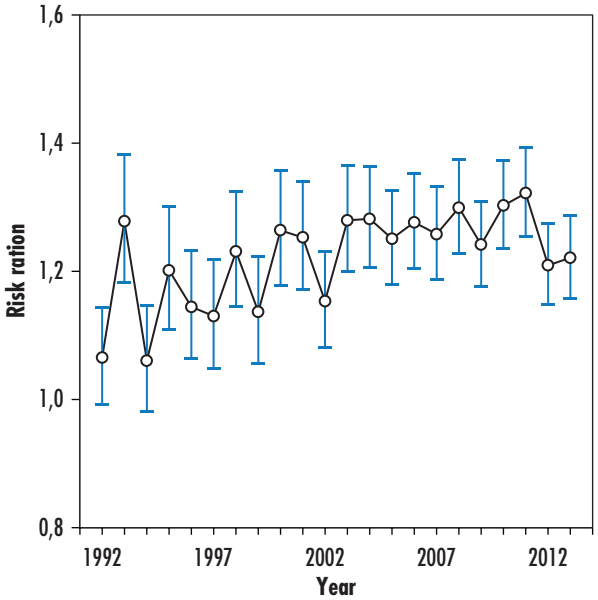


Figure 2b. Annual gender distribution of patients with hip arthroplasty (between 60 and 69 years).

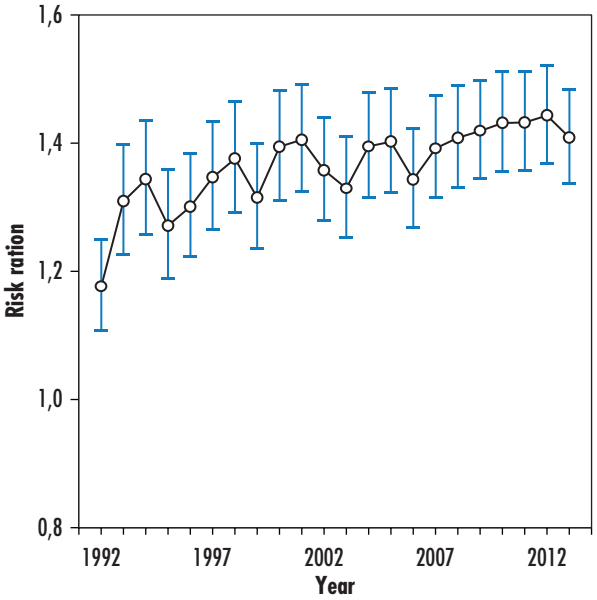


Figure 2c. Annual gender distribution of patients with hip arthroplasty (between 70 and 79 years).

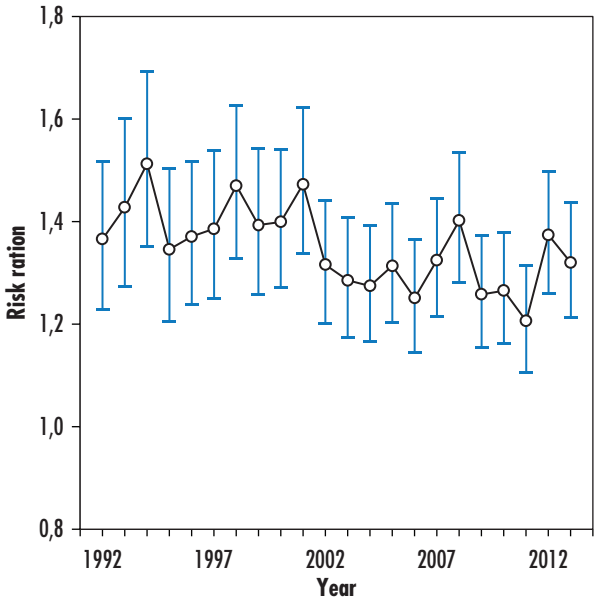


Figure 2d. Annual gender distribution of patients with hip arthroplasty (between 80 and 89 years).

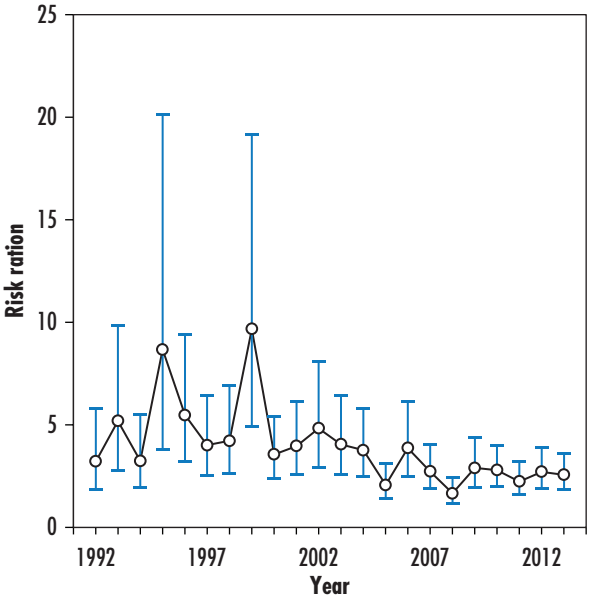


Figure 2e. Annual gender distribution of patients with hip arthroplasty (older than 90 years).

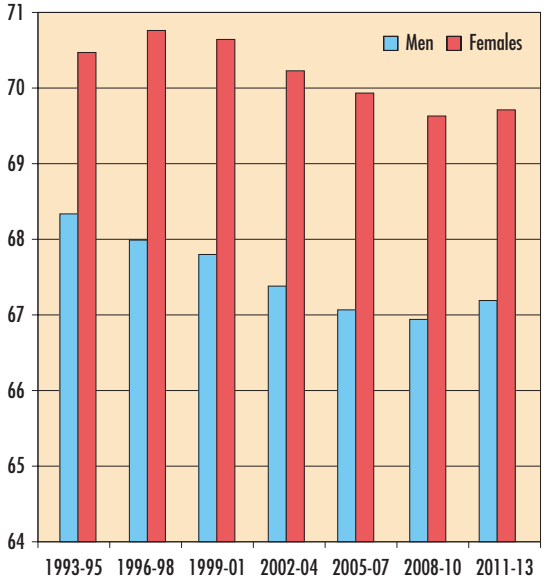


Figure 3. Average age of men and women over the three-year periods of 1993–1995 to 2011–2013. The y-axis starts at 64 years.

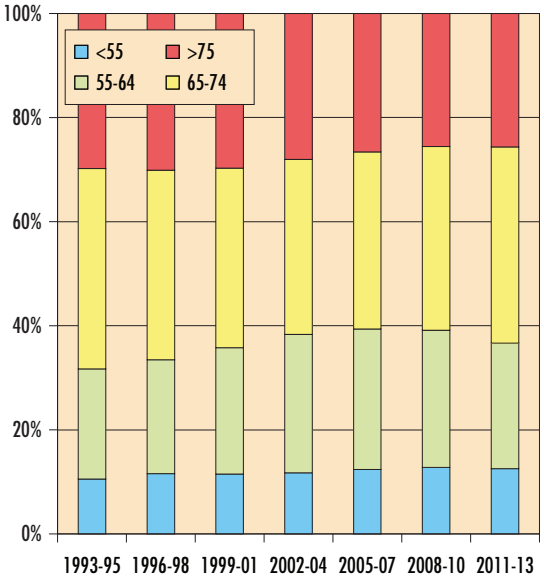


Figure 4. Distribution of men into four groups with respect to age over three-year periods of 1993–2013.

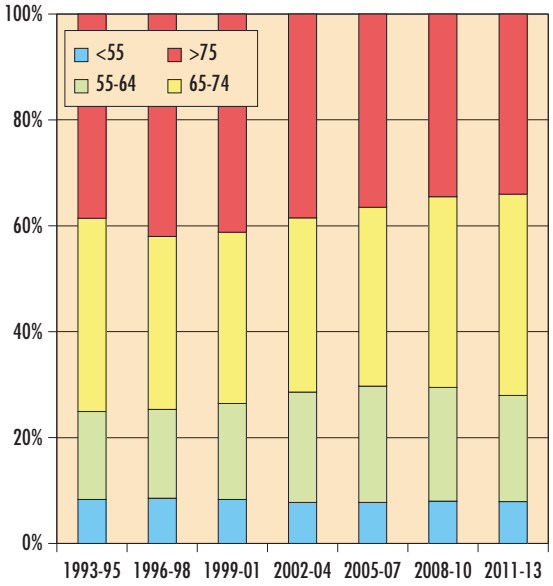


Figure 5. Distribution of women into four groups with respect to age over the three-year periods of 1993–2013.

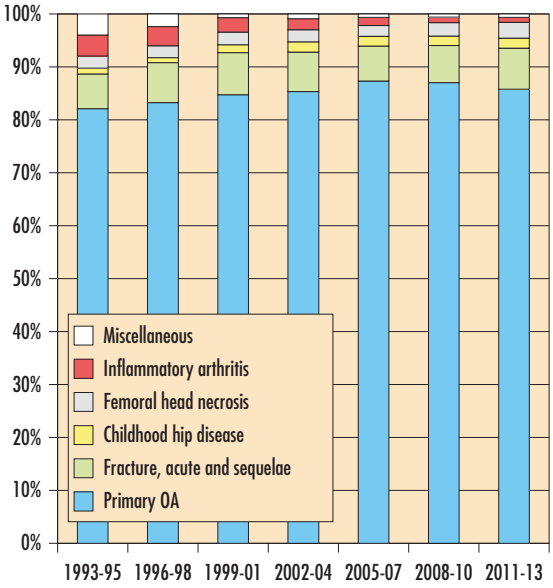


Figure 6. Distribution of diagnoses among men.

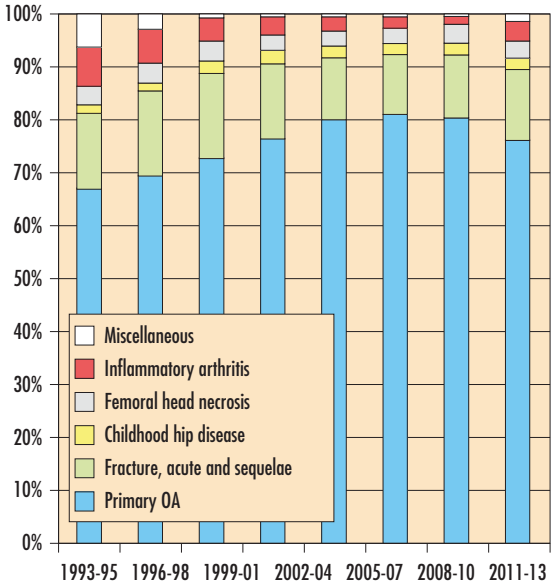


Figure 7. Distribution of diagnoses among women.

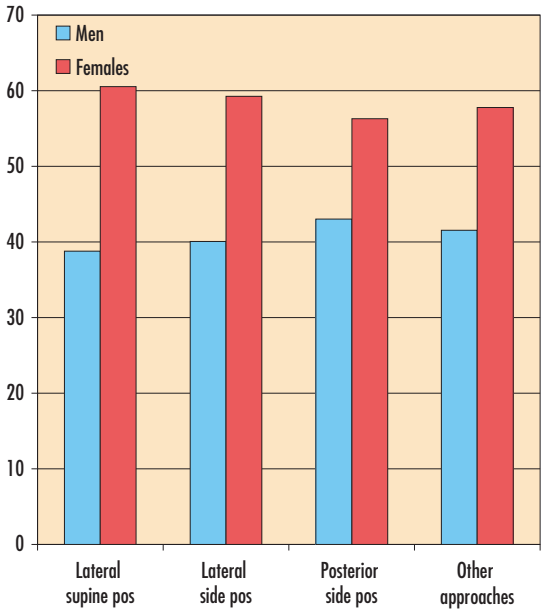


Figure 8. Percentage distribution of type of approach 2011–2013.

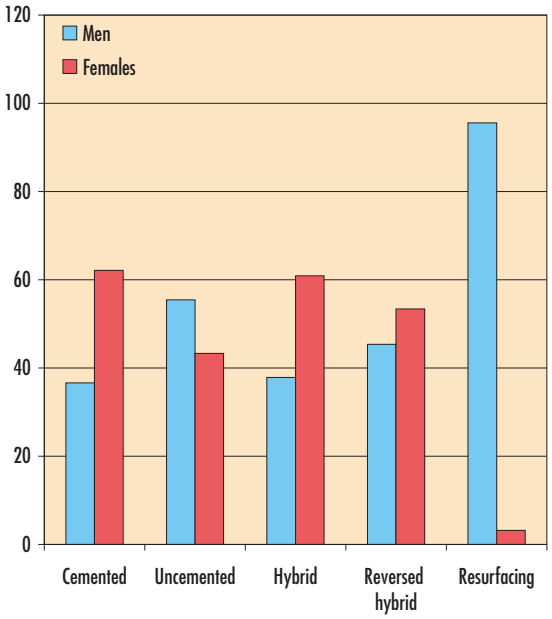


Figure 9. Percentage distribution of implant types 2011–2013.

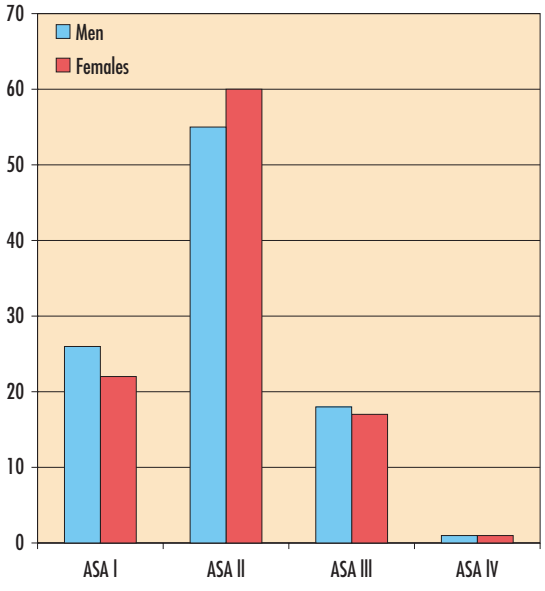


Figure 10. Percentage distribution of ASA class 2011–2013.

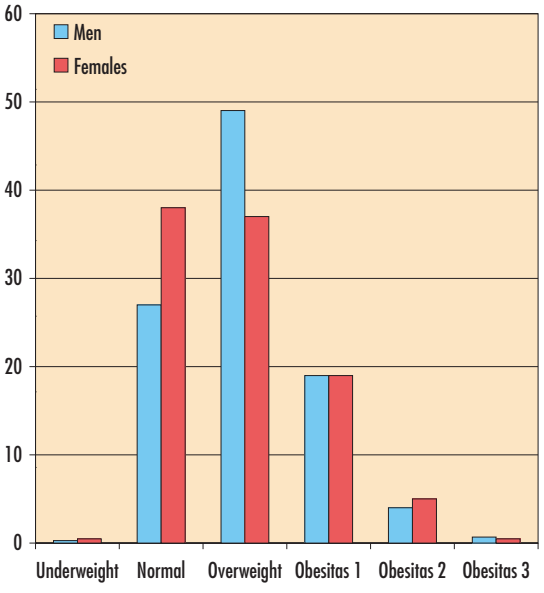


Figure 11. Percentage distribution of BMI 2011–2013.

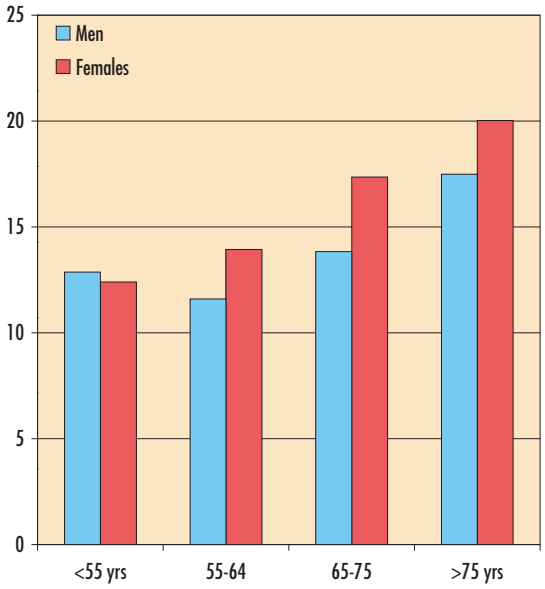


Figure 12. The mean value of satisfaction with the surgical results (lower value = better satisfaction) one year after surgery (2011–2012).

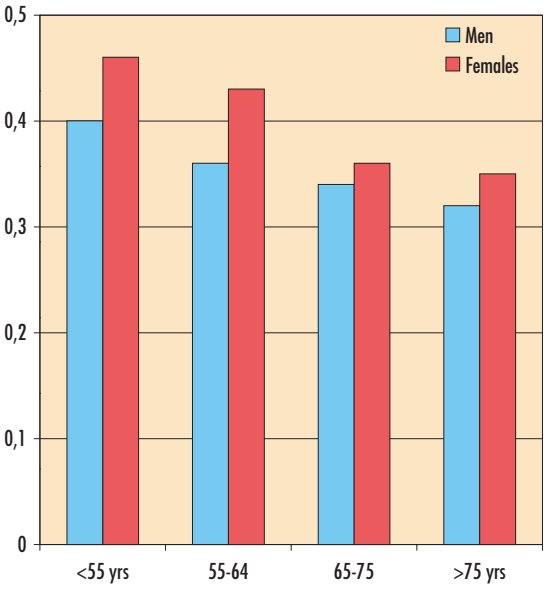


Figure 14. The mean value of difference in EQ-5D preoperatively and one year after surgery (2011–2012).

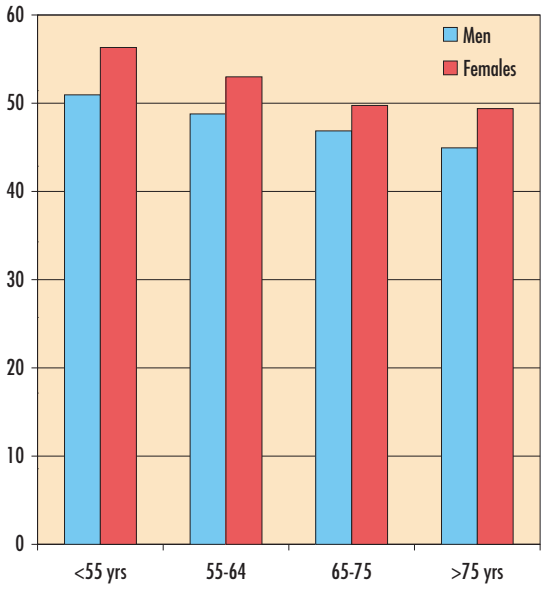


Figure 13. The mean value of difference in pain VAS preoperatively and one year after surgery (2011–2012).

Fracture patients

In the group of patients treated with a total hip arthroplasty due to hip fracture, the percentage of males increased from 27 to 32% since 2005. The choice of the total, bipolar and unipolar prosthesis exhibits no clear gender differences, nor the choice of surgical approach. Men receive uncemented prosthesis stems largely. Women are overrepresented in the group of overweight according to the BMI values, whereas men are more likely normal or malnourished. In addition, men are more often sickly 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. Women are slightly older with the mean age of 81.9 years compared to 80.6 for men. If you look at morbidity and malnutrition, men may be attributed to an equally high – or even higher – biological age. Male gender is a risk factor for worse results in terms of increased reoperation risk. However, if the precise ASA class and BMI are used in analyzes, 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, 16% of the men died within 90 days as opposed to 10% of women.

Hip arthroplasty as fracture treatment

Last year, we presented data for all patients who underwent hip arthroplasty due to hip fracture. This group includes both total and hemiarthroplasties and acute fractures and sequelae following a hip fracture. In 2013, the highest number, 6005, of patients were operated on, however it is at the same "top" level as in 2010 and 2011. Both the youngest age group (under 75) and the oldest age group (over 85) have increased in size.

Implant selection and technique

We continue to see an increasing number of total hip arthroplasties, 1730 last year, and unipolar hemiarthroplasties, 3083. The number of bipolar prosthesis has halved in comparison to 2008. Number of direct lateral approaches has increased steadily at the cost of posterior approach. 72% of patients were operated via lateral approach in 2013. The changes reflect the scientific findings in the field and show that Swedish orthopedic surgeons are willing to reconsider their treatment strategies. The recommendation from both clinical studies and Register data is that the posterior approach should be avoided because of increased risk for dislocation.

As in previous years, individual stems are represented in most of the operations (Table on page 161). In 2013, Lubinus and Exeter stems dominated, they were followed by CPT, Covison and MS30. The use of the latter has increased significantly since 2005, while Spectron and monoblock prostheses are not used anymore. Corail, the most common uncemented stem, peaked in 2010 and declined thereafter.

In 2013, primarily unipolar prostheses heads, UHR Universal Head and Unitrax were used for hemiarthroplasties, and Lubinus cup of polyethylene was used as an acetabulum cup (Table on page 161). Even here, great changes in the selection of implant are evident during the entire registration period: Unitrax, Covision Unipolar and both of the cross-linked polyethylene cups Marathon and ZCA are used more often. The use of Tandem Unipolar and Vario Cup decreases.

Reoperation and revision

2232 reoperations have been reported to the register since 2005, corresponding to reoperation frequency of 4.3%. Revision of total arthroplasty to total arthroplasty, and hemiarthroplasty to hemiarthroplasty and hemiarthroplasty to total hip arthroplasty has stayed the same – about 400–500 in each group. More than 200 excision arthroplasties were registered. In other respects, the reoperations were operations, where no prostheses were replaced, including fracture surgery, which used plates only during periprosthetic fracture. It is of utmost importance that all such operations are reported to the register, so that we can carry out accurate analyzes.

Dislocation and infection are the main causes for why the patient is forced to undergo open surgery again (closed repositioning of the dislocation is not recorded in the register), they constitute 36 and 34% of reoperations, respectively (Table on page 160). Periprosthetic fractures constitute 17% of reoperations. However, according to ongoing validation, there is a risk of under-reporting concerning this diagnosis. A number of un-reported cases are believed to concern acetabulum erosion (wear of the cartilage after hemiarthroplasty), which account for 5% of the reoperations. Erosion is a slowly progressing complication; probably many patients get it by being less active. Usually, erosion leads to pain in the hip only when moving.

In actual numbers, the frequency of reoperations varies depending on the type of prosthetics (Table on page 160), from 3.7% with unipolar prosthesis to 5.0% after a total hip arthroplasty. The difference can be largely explained by the fact that the implant is chosen based on the patient's general condition. After unipolar implant, only 46% live to the end of the follow-up time, while 72% live after total hip arthroplasty. The latter group "has therefore time" to develop more complications, and may probably go through more re-operations due to better health condition.

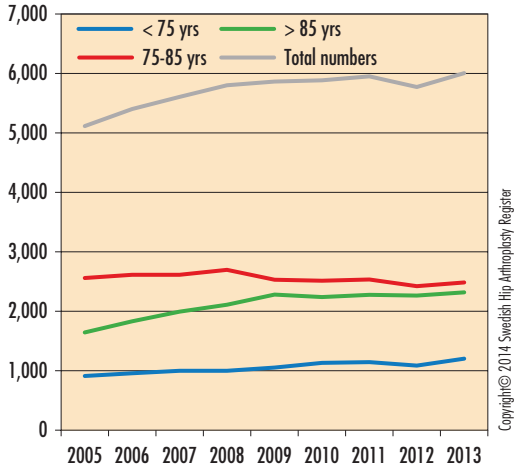
In a survival analysis, we found that younger age groups are at increased risk for reoperation of their hip implant, compared to those over 85. Although secondary prosthesis (inserted after the failure of nail or screw fixation of the fracture) leads to an increased risk. Posterior approach exhibits increased reoperation risk the first few years, but after nine years, the difference is no longer significant (Figures on page 166).

When gender, age, surgery cause, approach, use of cement and prosthesis were analyzed using Cox regression, bipolar prosthesis exhibits a significantly increased reoperation risk compared to total hip arthroplasty and unipolar implant. In addition, uncemented stem, posterior approach and male gender attribute to some risk increase, while the secondary intervention – in contrast to acute fracture surgery – represents the highest risk increase. If the material is divided into age groups, there remains a risk increase for secondary prosthesis, men and uncemented stems. Posterior approach causes only increased risk in the oldest group (over 85 years). Total hip arthroplasty has the lowest reoperation risk in all three groups. Bipolar is the worst in all groups. In addition, for patients under 75 and between 75 and 85 years, unipolar prosthesis brings about an increase in risk. The risk profile changes when ASA class and BMI are introduced into the analysis, including the disappearance of gender as a risk factor. The influence of patient characteristics suggests that careful choice of statistical method must be made in order to carry out a fair comparison of prosthetic types, and such studies are planned for the future. However, it can be noted that for those over 85, posterior and uncemented prosthesis remain clear risk factors even when we adjust for ASA, BMI and dementia.

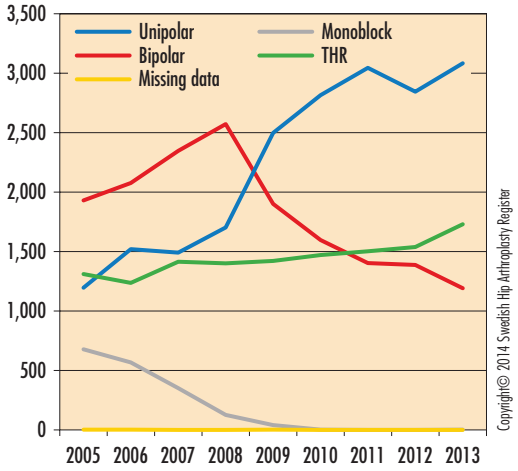
In terms of specific complications; posterior approach increases the risk of reoperation due to dislocation in all age groups, but reduces the risk of infection-related reoperations in patients under 75 and between 75 and 85 years old. High BMI and obesity increase the risk of infection in elderly patients but reduce dislocation operations among patients younger than 75 years.

The complexity is evident. We cannot influence the age, gender and health of the fracture patient, but it is important to understand how the choice of method can affect the outcome. Based on patient characteristics it is possible to create a treatment regimen with a couple of "levels", which also takes into account the clinic's competence and organization, and should provide better results for the various patient groups.

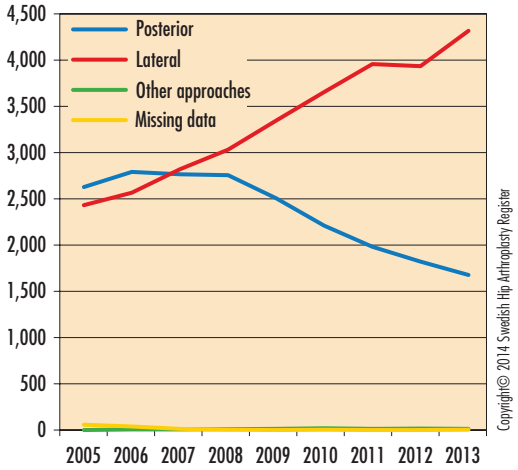
Hip fractures treated with hip replacement by age groups



Types of implant used in fracture-related hip replacement



Surgical approaches used in fracture-related hip replacement



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 generally both more ill and older than osteoarthritis patients are. Like last year, the national mean value is 13%. The distribution has not changed significantly; it is between 4 and 19% among larger units. Mortality is influenced by which patients are selected for prosthetic surgery – an alternative could be internal fixation. A number of factors that can increase the risk for early mortality are shown in the table on pages 164–165: 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 chain should be analyzed in detail.

Reoperation within 6 months

Even here, the results of clinics vary, from 0–7% among the larger units. The national average is 3.1%, slightly lower than in 2012, when the figure was 3.4 (Table on pages 162–163). The Register is working hard to investigate whether underreporting of reoperations occur. The figures must be interpreted with some caution, and even different treatment strategies affect clinics' performance. An active stance concerning dislocation and infection can lead to more reoperations compared to choosing non-surgical treatments for these conditions. A high rate of reoperation should, however, result in local analyses and improvement projects.

Type of reoperation
2005–2013

Frequency of reoperations	Number	Proportion of all operations	Proportion of all reoperations
THR; exchange to THR	426	0.8	19.1
Hemiprosthesis; exchange to THR	522	1.0	23.4
Hemiprosthesis; exchange to hemipros-thesis	417	0.8	18.7
Extraction of prosthesis	237	0.5	10.6
Other reoperations	467	0.9	20.9
Data missing	163	0.3	7.3
Total number of reoperations	2,232	4.3	100.0

Reason for revision

2005–2013

	Number	Proportion of all operations	Proportion of all reoperations
Dislocation	799	1.6	35.8
Infection	761	1.5	34.1
Periprosthetic fracture	382	0.7	17.1
Erosion and pain	115	0.2	5.2
Aseptic loosening	81	0.2	3.6
Other reasons	93	0.2	4.2
Data missing	1	0.0	0.0
Totat number of reoperations	2,232	4.3	100.0

Number of reoperations and deceased patients during observation time for different types of implants

2005–2013

Type of prosthesis	Total	Number of reoperations	%	Number deceased	%
Unipolar prosthesis	20,198	742	3.7	11,002	54.5
Bipolar prosthesis	16,407	770	4.7	10,204	62.2
Monoblock prosthesis	1,767	73	4.1	1,564	88.5
Total prosthesis	13,027	647	5.0	3,659	28.1
Data missing	4	0	0.0	1	25.0
Totalt	51,403	2,232	4.3	26,430	51.4

15 most common stem components – fracture patients

2005–2013

Stem	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	Proportion
Lubinus SP II	2,152	2,246	2,656	2,796	2,673	2,597	2,650	2,609	2,666	23,045	44.8%
Exeter Polished	1,185	1,247	1,374	1,532	1,713	1,823	1,840	1,883	2,024	14,621	28.4%
CPT (CoCr)	244	252	270	318	390	374	424	409	383	3,064	6.0%
Spectron EF Primary	466	505	240	145	233	206	173	20	5	1,993	3.9%
Covision straight	0	0	24	152	239	273	336	330	365	1,719	3.3%
MS30 Polished	3	8	163	243	219	228	236	293	315	1,708	3.3%
Thompson	354	360	243	167	44	2	0	0	0	1,170	2.3%
Corail Collarless	29	116	125	166	164	201	87	50	23	961	1.9%
Austin Moore (Anatomica)	316	214	77	22	27	2	0	0	1	659	1.3%
ETS Endo	97	101	127	47	0	0	0	0	0	372	0.7%
Müller Straight	114	99	71	33	0	0	1	0	0	318	0.6%
Corail Collared	0	0	0	0	0	44	93	62	92	291	0.6%
Basis	0	35	46	50	55	18	0	0	0	204	0.4%
Bi-Metric Fracture Stem	46	64	43	23	3	0	0	0	0	179	0.3%
CLS Spotorno	13	23	43	24	12	6	8	10	8	147	0.3%
Others	97	133	103	85	92	110	104	105	123	952	1.9%
Totalt	5,116	5,403	5,605	5,803	5,864	5,884	5,952	5,771	6,005	51,403	100%

15 most common cup or head components – fracture patients

2005–2013

Cup/Bi-/Unipolar caput	Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	Proportion
Unipolar head	Large head	458	643	667	701	1,168	1,383	1,531	1,407	1,534	9,492	18.5%
Vario Cup	Large head	990	1,034	1,293	1,349	777	529	363	356	185	6,876	13.4%
UHR Universal Head	Large head	592	575	624	696	670	671	625	641	666	5,760	11.2%
Lubinus PE	Cup	614	554	640	629	593	584	561	507	430	5,112	9.9%
V40 Uni polar	Large head	272	322	374	491	715	766	431	282	365	4,018	7.8%
Ultima Monk	Large head	311	432	381	422	319	276	268	254	213	2,876	5.6%
Unitrax	Large head	0	0	0	0	2	0	416	573	561	1,552	3.0%
Tandem Unipolar	Large head	334	438	221	141	161	130	91	2	5	1,523	3.0%
Marathon XLPE	Cup	0	0	0	9	123	279	307	321	356	1,395	2.7%
ZCA XLPE	Cup	0	9	131	190	225	219	183	163	161	1,281	2.5%
Covision unipolar head for sleeves	Large head	0	0	7	33	152	161	232	282	362	1,229	2.4%
Charnley Elite	Cup	197	223	227	231	118	47	20	6	1	1,070	2.1%
Versys endo	Large head	5	5	61	105	122	157	155	148	160	918	1.8%
Unipolar head	Large head	94	56	119	103	92	93	68	86	90	801	1.6%
Multipolar cup	Large head	0	1	37	71	70	68	87	120	127	581	1.1%
Monoblock	Large head	677	568	351	127	41	2	0	0	1	1,767	3.4%
Others		572	543	472	505	516	519	614	623	788	5,152	10.0%
Totalt		5,116	5,403	5,605	5,803	5,864	5,884	5,952	5,771	6,005	51,403	100%

Reoperation within 6 months per hospital – fracture patients
2012–2013

Hospital	Number of primary operations[1)]	Number of reoperations[2)]	Proportion[3)]
University/Regional hospitals			
Karolinska/Huddinge	286	7	2.4%
Karolinska/Solna	138	10	7.2%
Linköping	174	5	2.9%
SU/Mölndal	772	10	1.3%
SU/Sahlgrenska	8	1	12.5%
SUS/Lund	401	17	4.2%
SUS/Malmö	502	20	4.0%
Umeå	201	3	1.5%
Uppsala	360	7	1.9%
Örebro	176	9	5.1%
Central hospitals			
Borås	254	9	3.5%
Danderyd	427	25	5.9%
Eksjö	105	3	2.9%
Eskilstuna	235	6	2.6%
Falun	273	11	4.0%
Gävle	294	10	3.4%
Halmstad	181	1	0.6%
Helsingborg	367	17	4.6%
Hässleholm-Kristianstad	296	6	2.0%
Jönköping	142	6	4.2%
Kalmar	163	2	1.2%
Karlskrona	228	4	1.8%
Karlstad	291	14	4.8%
Norrköping	208	3	1.4%
Skövde	232	3	1.3%
Sunderby (incl Boden)	318	7	2.2%
Sundsvall	207	9	4.3%
Södersjukhuset	692	27	3.9%
Uddevalla	475	8	1.7%
Varberg	186	2	1.1%
Västerås	315	7	2.2%
Växjö	146	5	3.4%
Ystad	95	4	4.2%
Östersund	198	6	3.0%

(Continued on next page.)

Reoperation within 6 months per hospital – fracture patients (cont.)
2012–2013

Hospital	Number of primary operations[1)]	Number of reoperations[2)]	Proportion[3)]
Rural hospitals			
Alingsås	73	2	2.7%
Arvika	31	1	3.2%
Frölunda Specialistsjukhus	1	0	0%
Gällivare	97	2	2.1%
Hudiksvall	144	8	5.6%
Karlshamn	7	0	0%
Karlskoga	74	2	2.7%
Katrineholm	1	0	0%
Kungälv	147	2	1.4%
Lidköping	105	2	1.9%
Lindesberg	69	5	7.2%
Ljungby	74	1	1.4%
Lycksele	22	2	9.1%
Mora	127	2	1.6%
Norrtälje	93	2	2.2%
Nyköping	101	4	4.0%
Piteå	1	0	0%
Skellefteå	98	1	1.0%
Sollefteå	84	0	0%
Södertälje	90	4	4.4%
Torsby	91	2	2.2%
Trelleborg	6	1	16.7%
Visby	52	1	1.9%
Värnamo	71	3	4.2%
Västervik	106	5	4.7%
Ängelholm	1	0	0%
Örnsköldsvik	90	4	4.4%
Private hospitals			
Aleris Specialistvård Motala	98	1	1.0%
Capio S:t Göran	472	21	4.4%
Carlanderska	1	0	0%
Ortho Center Stockholm	2	0	0%
OrthoCenter IFK-kliniken	1	0	0%
Nation	11,776	362	3.1%

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, 2012–2013

Hospital	Number[1)]	>80[2)]	Males[3)]	ASA=III[4)]	ASA=IV[5)]	Fracture	Mortality[6)]
University/Regional hospitals							
Karolinska/Huddinge	286	62%	32%	64%	7%	92%	14%
Karolinska/Solna	138	50%	30%	66%	12%	83%	9%
Linköping	174	70%	32%	42%	6%	93%	14%
SU/Mölndal	772	64%	33%	44%	5%	92%	14%
SU/Sahlgrenska	8	63%	25%	43%	0%	88%	25%
SUS/Lund	401	59%	29%	60%	5%	92%	11%
SUS/Malmö	502	71%	30%	79%	5%	97%	14%
Umeå	201	58%	28%	70%	8%	94%	16%
Uppsala	360	63%	38%	60%	8%	97%	14%
Örebro	176	66%	24%	48%	2%	91%	13%
Central hospitals							
Borås	254	69%	31%	42%	3%	96%	10%
Danderyd	427	62%	30%	69%	8%	90%	9%
Eksjö	105	66%	32%	57%	1%	94%	11%
Eskilstuna	235	62%	34%	50%	3%	89%	16%
Falun	273	61%	27%	36%	3%	91%	8%
Gävle	294	58%	31%	47%	7%	94%	13%
Halmstad	181	61%	30%	46%	3%	89%	17%
Helsingborg	367	64%	32%	41%	6%	96%	15%
Hässleholm-Kristianstad	296	65%	28%	45%	1%	95%	14%
Jönköping	142	62%	36%	58%	4%	96%	8%
Kalmar	163	58%	40%	35%	4%	98%	6%
Karlskrona	228	57%	31%	36%	2%	98%	15%
Karlstad	291	60%	40%	52%	4%	95%	13%
Norrköping	208	68%	37%	44%	5%	91%	19%
Skövde	232	59%	31%	41%	3%	95%	9%
Sunderby (incl Boden)	318	60%	32%	60%	7%	97%	13%
Sundsvall	207	63%	35%	44%	3%	92%	11%
Södersjukhuset	692	61%	33%	62%	8%	95%	11%
Uddevalla	475	65%	33%	56%	2%	92%	12%
Varberg	186	62%	26%	35%	3%	91%	13%
Västerås	315	63%	34%	64%	5%	94%	15%
Växjö	146	63%	34%	52%	10%	91%	11%
Ystad	95	66%	28%	49%	5%	98%	18%
Östersund	198	63%	30%	47%	5%	97%	9%

(Continued on next page.)

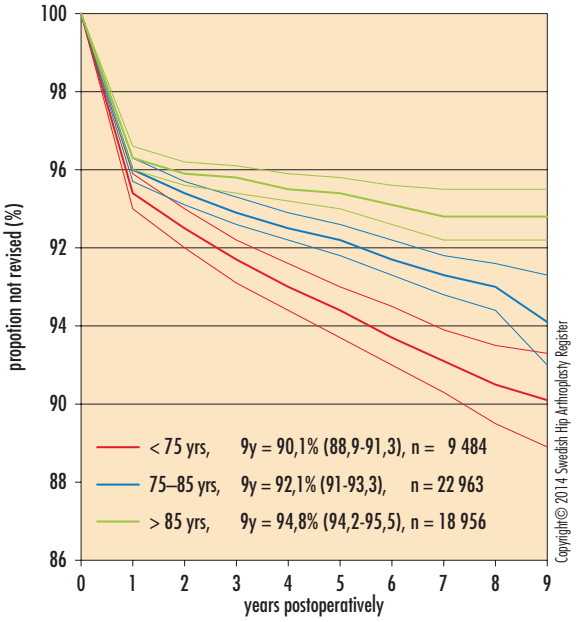
90-day mortality per hospital – fracture patients (cont.)

proportion deceased within 90 days after primary surgery, 2012–2013

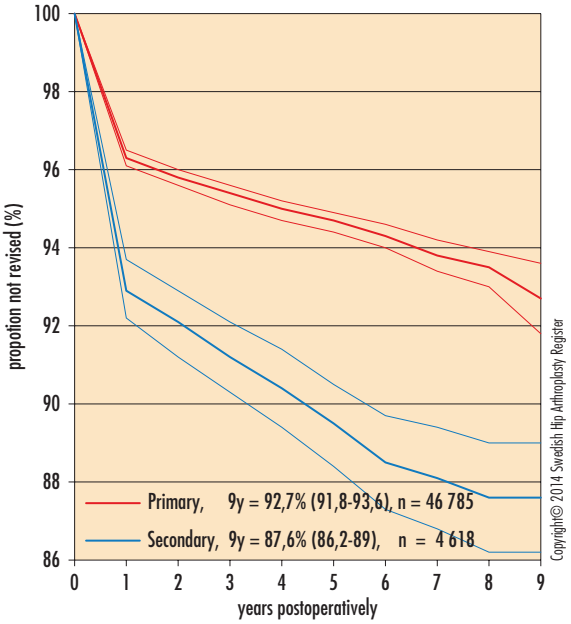
Hospital	Number[1)]	>80[2)]	Males[3)]	ASA=III[4)]	ASA=IV[5)]	Fracture	Mortality[6)]
Rural hospitals							
Alingsås	73	63%	32%	34%	4%	86%	19%
Arvika	31	71%	26%	48%	6%	87%	19%
Frölunda Specialistsjukhus	1	0%	0%	0%	0%	100%	0%
Gällivare	97	47%	33%	54%	7%	97%	11%
Hudiksvall	144	61%	37%	45%	4%	94%	14%
Karlshamn	7	43%	29%	29%	0%	0%	14%
Karlskoga	74	55%	22%	41%	7%	88%	19%
Katrineholm	1	0%	0%	0%	0%	0%	0%
Kungälv	147	68%	29%	54%	4%	95%	11%
Lidköping	105	68%	32%	34%	3%	93%	11%
Lindesberg	69	61%	23%	39%	9%	94%	16%
Ljungby	74	65%	31%	47%	1%	88%	11%
Lycksele	22	59%	36%	56%	0%	68%	9%
Mora	127	64%	29%	33%	1%	95%	17%
Norrtälje	93	63%	28%	65%	4%	92%	13%
Nyköping	101	58%	35%	44%	3%	88%	8%
Piteå	1	100%	0%	100%	0%	100%	0%
Skellefteå	98	61%	29%	52%	2%	93%	9%
Sollefteå	84	64%	32%	51%	2%	95%	8%
Södertälje	90	54%	26%	74%	7%	97%	12%
Torsby	91	64%	31%	55%	9%	93%	23%
Trelleborg	6	0%	50%	20%	0%	0%	0%
Visby	52	62%	31%	37%	0%	88%	4%
Värnamo	71	66%	23%	35%	0%	93%	1%
Västervik	106	64%	31%	32%	5%	93%	15%
Ängelholm	1	0%	0%	0%	0%	0%	0%
Örnsköldsvik	90	64%	30%	55%	6%	93%	11%
Private hospitals							
Aleris Specialistvård Motala	98	72%	30%	46%	0%	91%	10%
Capio S:t Göran	472	72%	27%	60%	7%	93%	13%
Carlanderska	1	100%	0%	0%	0%	100%	0%
Ortho Center Stockholm	2	50%	50%	0%	0%	0%	0%
OrthoCenter IFK-kliniken	1	0%	0%	0%	0%	0%	0%
Nation	11,776	63%	32%	52%	5%	93%	13%

[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)] 90-day mortality (100(number of patients deceased within three months after primary THR /number of operations during the period)).*

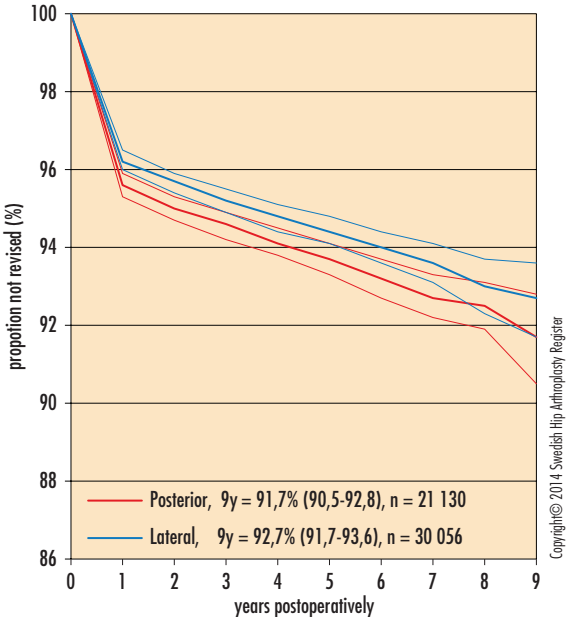
Age groups
2005–2013



Primary and secondary prosthesis
2005–2013



Surgical approach
2005–2013



Follow-up activities after hip arthroplasty as treatment for hip fracture

The value compasses, which display results for the clinics, comprise of total and hemiarthroplasties. Since many fracture patients are not included in the Register's PROM Programme, the value compasses have only four variables (points of the compass).

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.

The result is presented in this follow-up model for clinics that have performed at least 40 operations, with information on the degree of dementia during 2012–2013.

The result variables used for fracture-related prostheses are slightly different from those used for elective total prostheses. Those who suffer a hip fracture often have several other infirmities and an increased risk of death in connection with their injury /operation. Most reoperations occur within a few months and long-term complications are unusual. Observation periods for reoperation and prosthetic survival are therefore shorter than for total prostheses.

- **90-day mortality.** In international literature, this variable is used to cast light on mortality after hip arthroplasty.

- **Coverage.** Coverage (completeness) at the individual level according to the most recent cross-referencing with the Patient Register.

- **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 basic selection of fracture patients subject to hip arthroplasty (instead of internal fixation) 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. Greater 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-demented patients.** The figure shows the clinic's proportion of patients assessed as cognitively intact. Demented patients have higher mortality after hip fracture. If a clinic has a large proportion of non-demented 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.

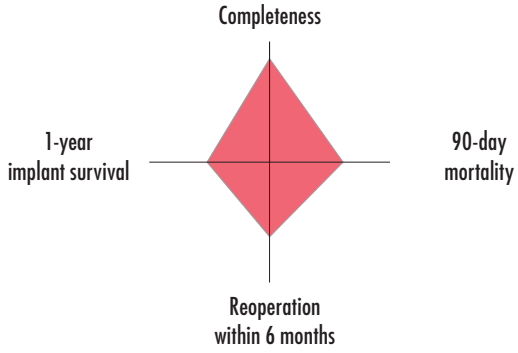
Discussion

A non-conforming 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 will gladly pass on experience acquired after corresponding analyses at other hospitals, and is prepared to assist with practical help. Several hospitals have improved their results – interpreted by the value compasses – in comparison to the previous period. These include Eksjö, Nyköping, SU/Mölndal, Skellefteå, Sundsvall, Västervik and Västerås. In several places, quality work has been carried out.

Since individuals with hip fracture most often have poorer health and are much older compared with 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. To a certain extent, a higher rate of reoperations and revisions might, on the other hand, indicate an active attitude in case of complications.

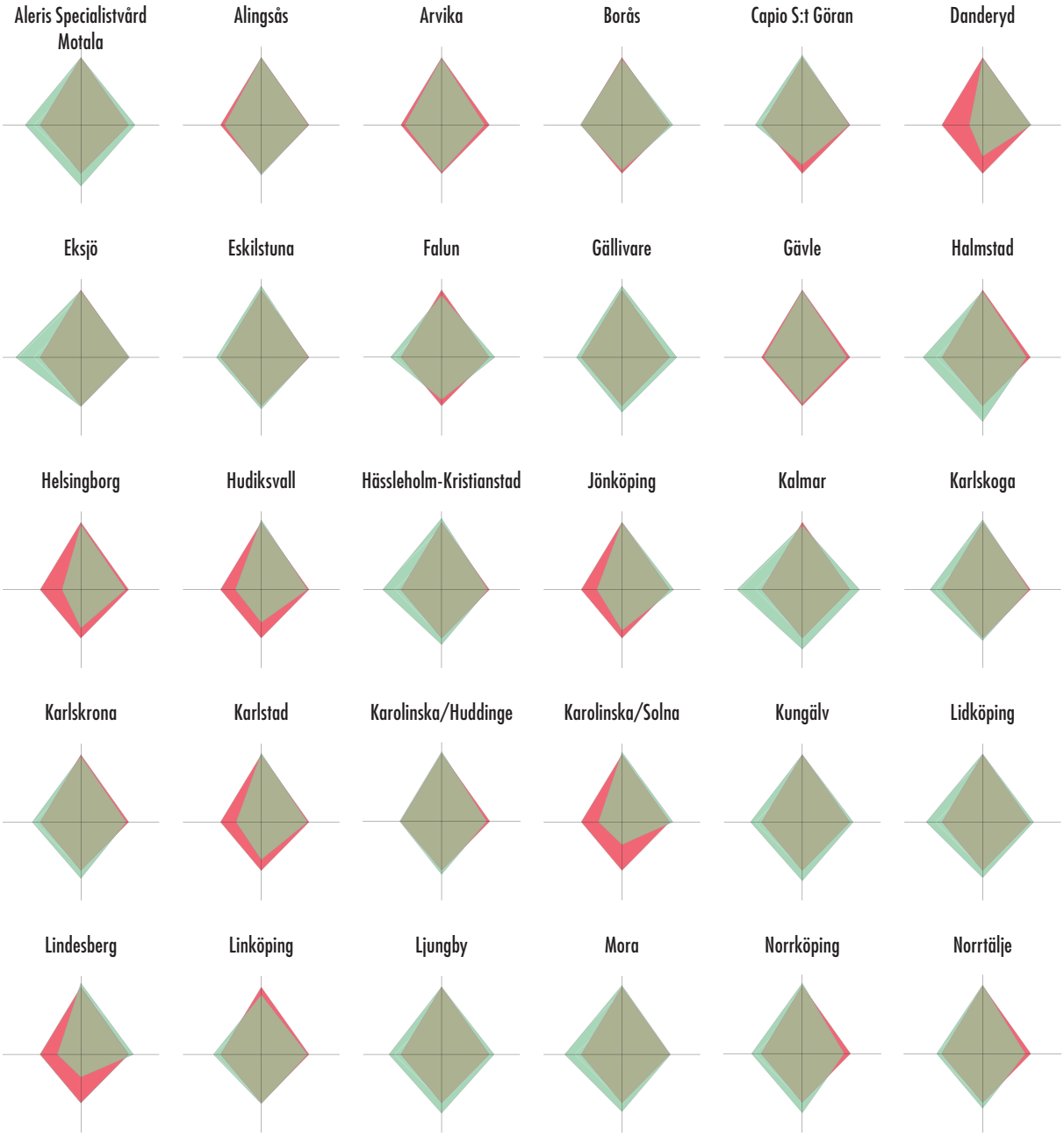
Quality indicator for hip fracture patients

value compass – national average



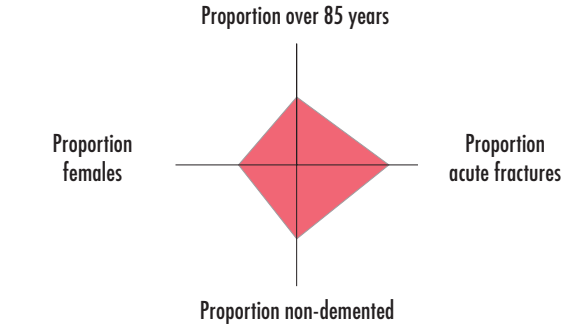
The value compasses show in red national results for the four variables included. Each hospital's corresponding values are shown in green. Limit values are set to the highest and lowest value for each variable ±1 SD. The poorest value for the variables is at the origo and the best on the periphery.

The hospitals where red are visible have a poorer value than the national average for that variable. The outcome can be studied in detail in each table.



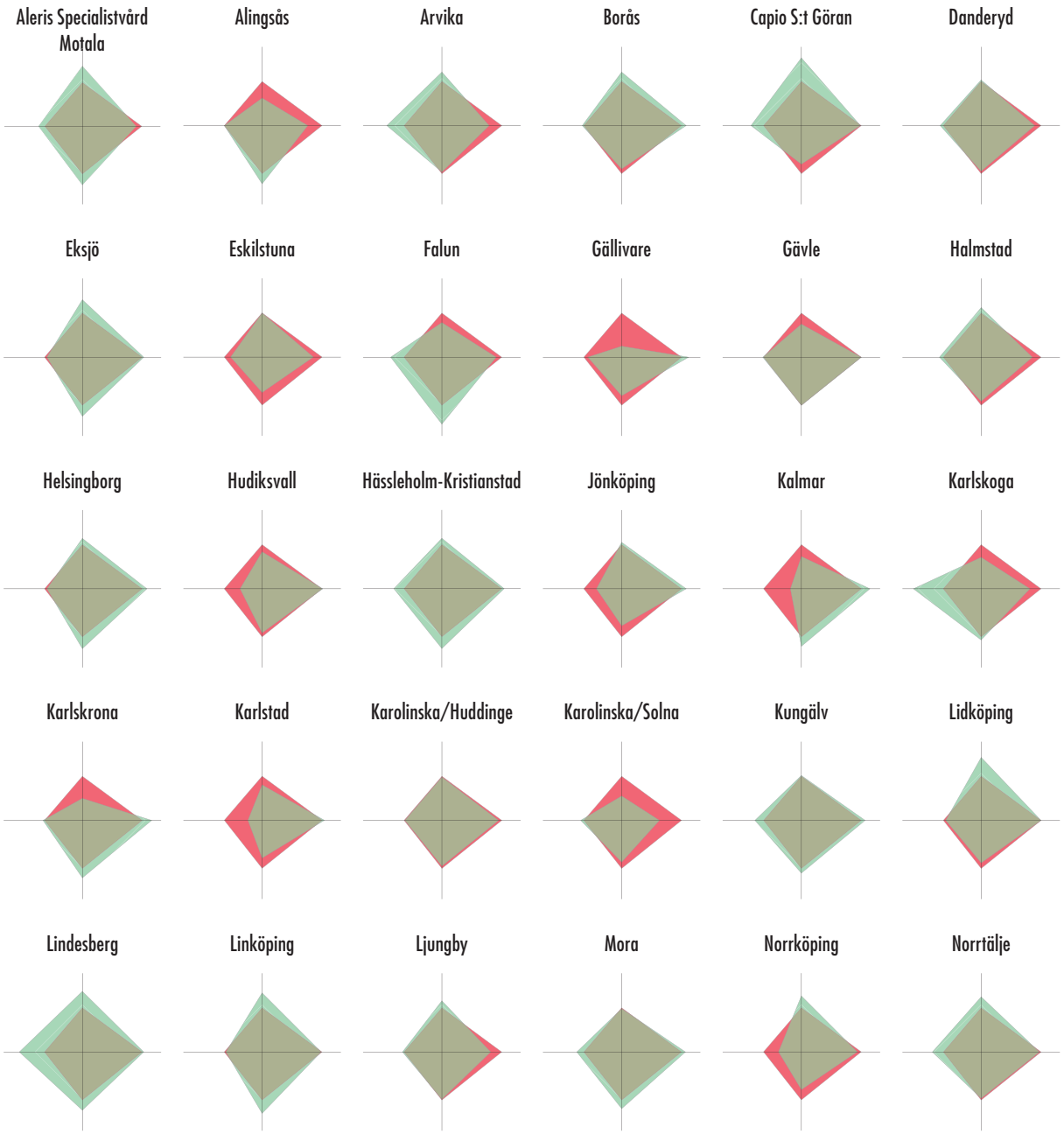
Case-mix profile for hip fracture patients

national average



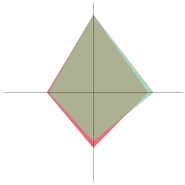
In the graphic presentation of patient demographics (case-mix) the national results is shown in red regarding the four variables. The corresponding values for each hospital are shown in green. Limit values are set to the greatest and the smallest value of each variable ±1 SD. The poorest value of the variables is at the origo and the best value on the periphery.

The case-mix profile should always be considered when interpreting and comparing different hospitals' value compasses!

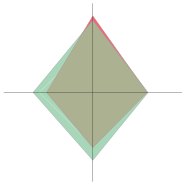


Value compasses (continued)

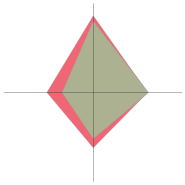
Nyköping



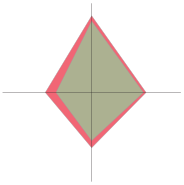
SU/Mölndal



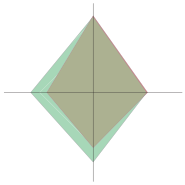
SUS/Lund



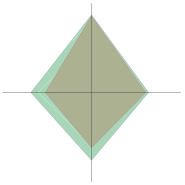
SUS/Malmö



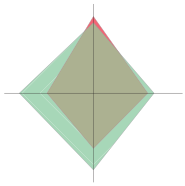
Skellefteå



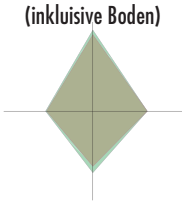
Skövde



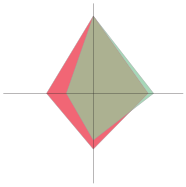
Sollefteå



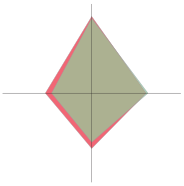
Sunderby (inkluisive Boden)



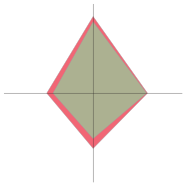
Sundsvall



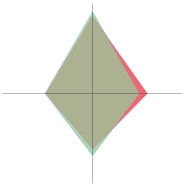
Södersjukhuset



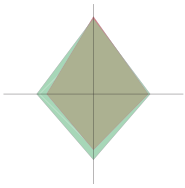
Södertälje



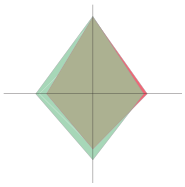
Torsby



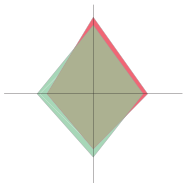
Uddevalla



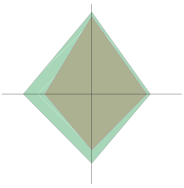
Umeå



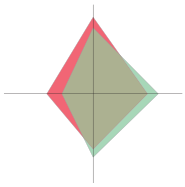
Uppsala



Varberg



Visby



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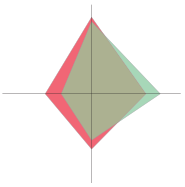

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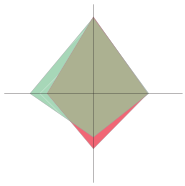
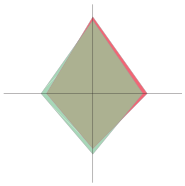


Västerås



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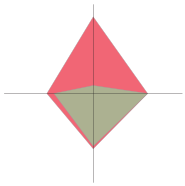

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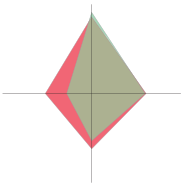

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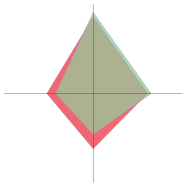

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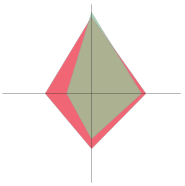
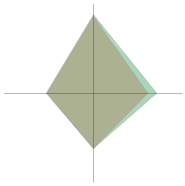
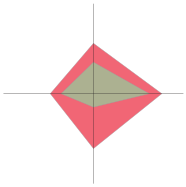


Östersund



Case-mix profiles (continued)

Nyköping



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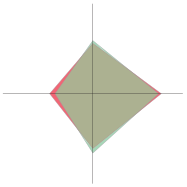

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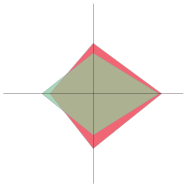

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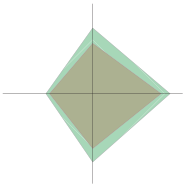
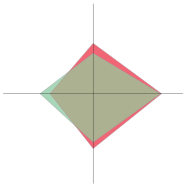
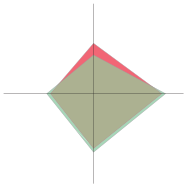


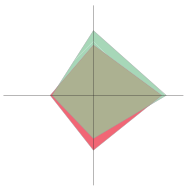
Skellefteå



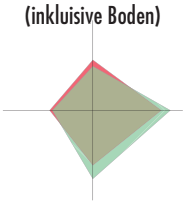
Skövde



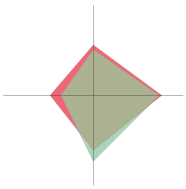
Sollefteå



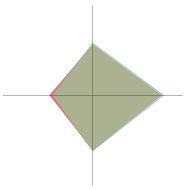
Sunderby (inkluisive Boden)



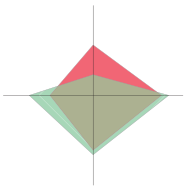
Sundsvall



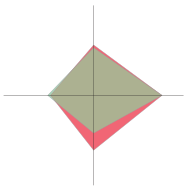
Södersjukhuset



Södertälje



Torsby



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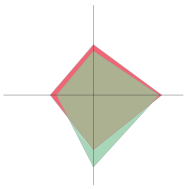
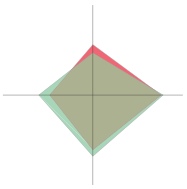


Umeå



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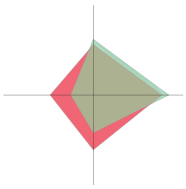
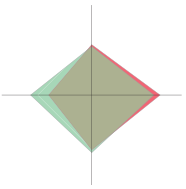
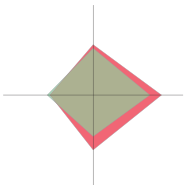


Varberg



Visby



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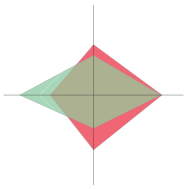
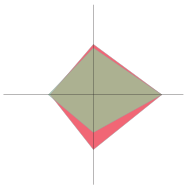
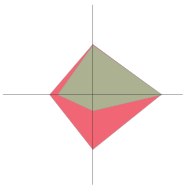


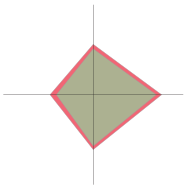
Västervik



Västerås



Växjö



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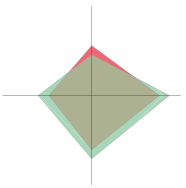

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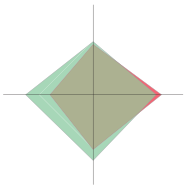
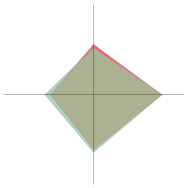


Örnsköldsvik



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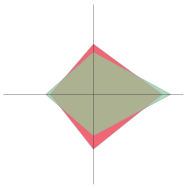


Production in various counties

Procedure frequency in the country as a whole and per county

Production of total hip replacements in 2013 in Sweden was mostly unchanged compared with 2012 but sank marginally per 100,000 inhabitants from 167 to 169. This figure is for the whole population and is based on Statistics Sweden's (SCB's) population statistics for 31 December 2013 (9,644,864 inhabitants). Please note that many national and international comparative reports are based on statistics from the Swedish National Board of Health and Welfare (PAR), which since 2000 has had a coverage 3–6% lower than the Register!

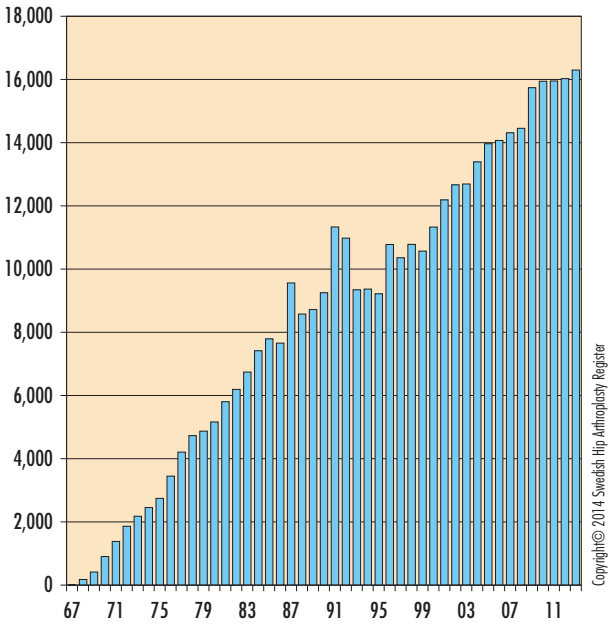
Production versus consumption per 100,000 inhabitants per county

Decision-makers are first and foremost interested in so-called consumption figures per county – while profession and quality registers (especially those registers that control surgical interventions) have their focus on so-called production figures.

Consumption means that the inhabitants of a county/region have access to hip arthroplasty irrespective of whether the intervention is performed in their home county or elsewhere. These figures are significant for directorship and governance but cannot be used for analysis of institutions and their activities or clinical improvement, which are a large part of the quality registers' assignment.

The distribution of production and consumption figures per 100,000 inhabitants shows great variation between the principals (private entrepreneurs are geographically included): production: 127–277 and consumption: 128–259/100,000 inhabitants, that is to say that consumption is almost doubled between the counties with the lowest consumption compared with the counties with the highest. The reason for this very marked variation can only be demographic differences. The present situation speaks for the fact that we have geographically speaking very unequal healthcare with respect to treatment of hip osteoarthritis in Sweden. Unfortunately, the directorship of the register believes that non-medical and local "political" administrative decisions are only one of perhaps several causes for the great variation found. The Register will focus sharply on this issue in the near future – both in regional analyses of institutions and their activities and in clinical research. The main implement for such an analysis is the comprehensive co-referencing databases that we have created and plan to create (SHPR, SoS, SCB and FK). Such processes are sluggish since they demand ethical approval and are weighed down by considerable resource consumption for the Register (competent staff and high costs). On account of this there will always be a delay with regard to this type of analysis – often at least 2–3 years if one also aims to include short-term results after elective operation with total hip replacement in the analysis.

Primary total hip replacement in Sweden



Production versus consumption per 100,000 inhabitants ≥ 40 years of age per county

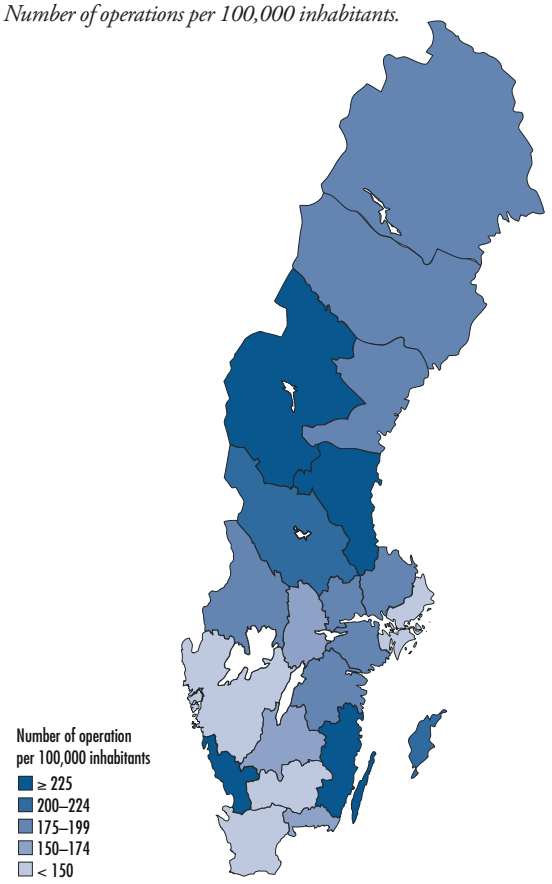
With the aim of compensating for demographic differences between different parts of the country, in this year's report we are using the same analysis per 100,000 inhabitants of ≥ 40 years of age. This analysis shows that there continue to be great differences in both production and consumption, despite adjustment for age.

The care of patients with final stage hip osteoarthritis is not equal geographically.

Production

County	Operations	Population	Number[1)]
01 Stockholm	3,150	2,163,042	146
03 Uppsala	629	345,481	182
04 Södermanland	521	277,569	188
05 Östergötland	809	437,848	185
06 Jönköping	512	341,235	150
07 Kronoberg	237	187,156	127
08 Kalmar	553	233,874	236
09 Gotland	125	57,161	219
10 Blekinge	262	152,757	172
12 Region skåne	1,853	1,274,069	145
13 Halland	849	306,840	277
14 Västra Götaland	2,295	1,615,084	142
17 Värmland	511	273,815	187
18 Örebro	510	285,395	179
19 Västmanland	476	259,054	184
20 Dalarna	571	277,349	206
21 Gävleborg	672	277,970	242
22 Västernorrland	467	242,156	193
23 Jämtland	313	126,461	248
24 Västerbotten	487	261,112	187
25 Norrbotten	497	249,436	199
Nation		9,644,864	169

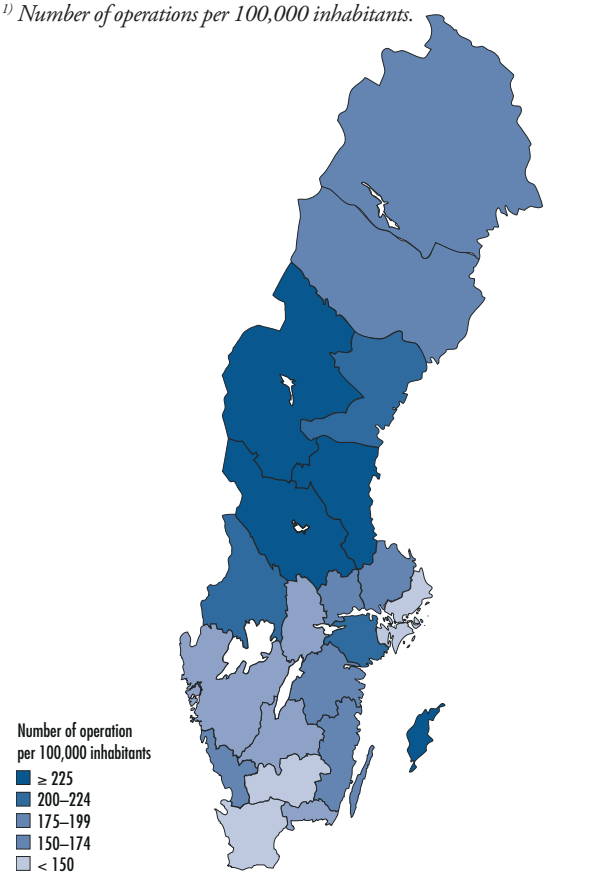
1) Number of operations per 100,000 inhabitants.



Consumtion

County	Operations	Population	Number[1)]
01 Stockholm	2,760	2,163,042	128
03 Uppsala	654	345,481	189
04 Södermanland	610	277,569	220
05 Östergötland	774	437,848	177
06 Jönköping	580	341,235	170
07 Kronoberg	277	187,156	148
08 Kalmar	425	233,874	182
09 Gotland	133	57,161	233
10 Blekinge	265	152,757	173
12 Region skåne	1,827	1,274,069	143
13 Halland	544	306,840	177
14 Västra Götaland	2,471	1,615,084	153
17 Värmland	552	273,815	202
18 Örebro	497	285,395	174
19 Västmanland	499	259,054	193
20 Dalarna	623	277,349	225
21 Gävleborg	686	277,970	247
22 Västernorrland	491	242,156	203
23 Jämtland	328	126,461	259
24 Västerbotten	495	261,112	190
25 Norrbotten	493	249,436	198
Nation		9,644,864	169

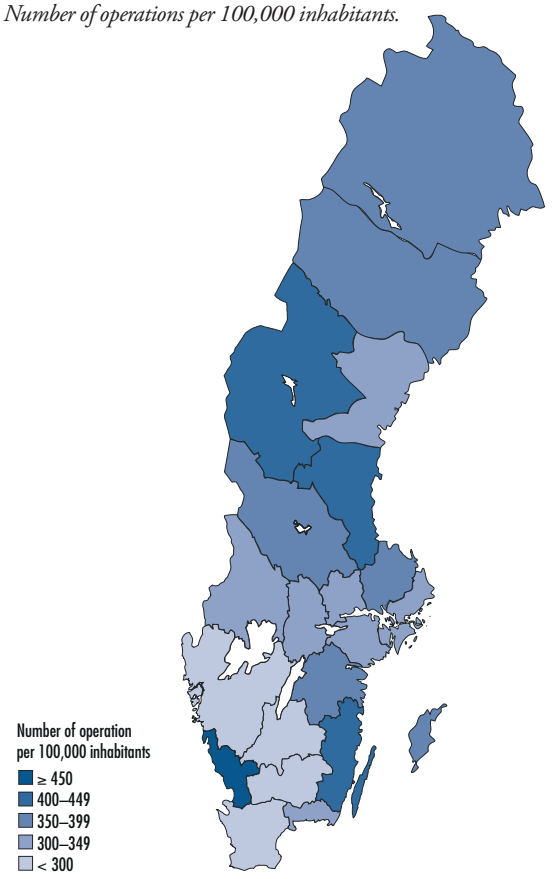
1) Number of operations per 100,000 inhabitants.



Production 40 years and older

County	Operations	Population, 40 years and older	Number[1)]
01 Stockholm	3,106	1,019,964	305
03 Uppsala	623	168,263	370
04 Södermanland	518	150,151	345
05 Östergötland	804	223,841	359
06 Jönköping	503	177,739	283
07 Kronoberg	236	97,536	242
08 Kalmar	552	132,725	416
09 Gotland	124	32,887	377
10 Blekinge	262	84,590	310
12 Region skåne	1,824	642,023	284
13 Halland	848	164,114	517
14 Västra Götaland	2,271	817,991	278
17 Värmland	508	153,098	332
18 Örebro	509	149,445	341
19 Västmanland	473	138,508	341
20 Dalarna	566	155,629	364
21 Gävleborg	668	155,812	429
22 Västernorrland	464	135,808	342
23 Jämtland	311	69,887	445
24 Västerbotten	482	133,444	361
25 Norrbotten	491	139,585	352
Nation		4,943,040	327

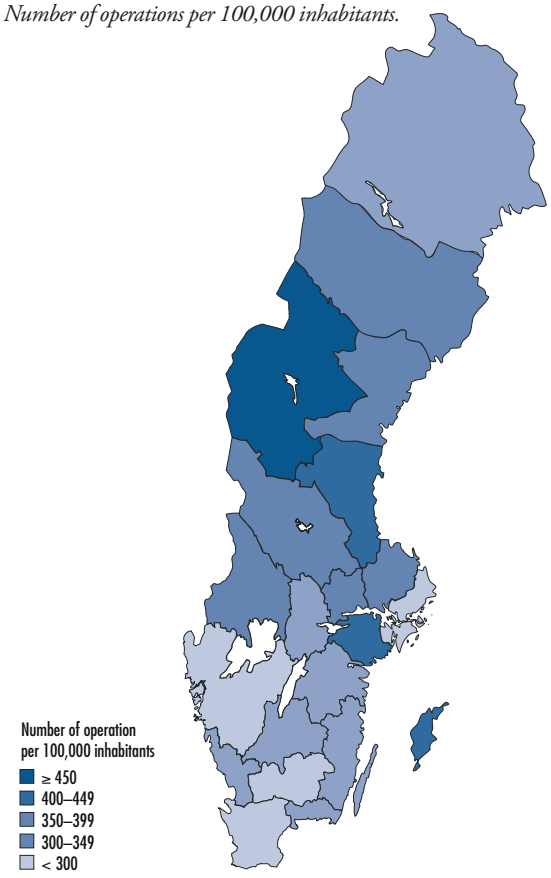
1) Number of operations per 100,000 inhabitants.



Consumtion 40 years and older

Län	Operationer	FolkMalegd, 40 år och äldre	Antal[1)]
01 Stockholm	2,725	1,019,964	267
03 Uppsala	650	168,263	386
04 Södermanland	604	150,151	402
05 Östergötland	769	223,841	344
06 Jönköping	570	177,739	321
07 Kronoberg	274	97,536	281
08 Kalmar	424	132,725	319
09 Gotland	132	32,887	401
10 Blekinge	265	84,590	313
12 Region skåne	1,801	642,023	281
13 Halland	542	164,114	330
14 Västra Götaland	2,449	817,991	299
17 Värmland	549	153,098	359
18 Örebro	493	149,445	330
19 Västmanland	494	138,508	357
20 Dalarna	616	155,629	396
21 Gävleborg	682	155,812	438
22 Västernorrland	487	135,808	359
23 Jämtland	326	69,887	466
24 Västerbotten	490	133,444	367
25 Norrbotten	487	139,585	349
Nation		4,943,040	327

1) Number of operations per 100,000 inhabitants.



Notes

Current research projects and references

The main assignments of a National Quality Register are analyses of institutions and their activities, improvement projects and clinical research. The very comprehensive databases have a large and relatively unexploited 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.

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 analyze unusual complications with great statistical power. Another great advantage is that generalizable results can be achieved – a result measured within the entire profession. In an RCT what is termed 'performance bias' can easily arise, that is, this type of study often reflects an intervention at a special unit and/or by the innovator of a method.

During the last five years, the Register has carried out several interconnecting projects, which have led to a number of publications and dissertations. Interconnection projects require that all of the register's research, ethics approval, privacy assessments, research contracts and special research withdrawal forms – it sounds complicated and bureaucratic – but are necessary for the Register to be able to follow PUL and the Patient Data Act. The entire regulatory framework for research registers can be read on http://kvalitetsregister.se/registerarbete/forskning. On its website, the Arthroplasty Register has published a so-called project database, where you can find an overview of ongoing projects. If you want to discuss research projects, you can contact the registrar. Coordinator Karin Davidsson now works full time on the Register with research questions. Phone numbers and email addresses are available on the report's cover.

13 doctoral theses and about a hundred scientific articles have been published, wholly or partly based on analyses from the Swedish Hip Arthroplasty Register. In 2014, three dissertations with register results were carried out and just as much are planned for 2015.

The register's database is well suited to ST and medical student projects and a number of these have been carried out in the past two years. Two student projects are published in this year's report.

The Register directorship wants to emphasize strongly that the Register's databases are not only available to register collaborators in Gothenburg. All researchers, within as well as outside the country, can exploit the Register for research if adequate questions are presented.

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
- Cecilia Rogmark, Malmö
- Leif Dahlberg, Malmö
- André Stark, Stockholm
- Per Wretenberg, Stockholm
- Nils Hailer, Uppsala
- Hans Lindahl, Trollhättan
- Peter Herberts, Gothenburg
- Rüdiger Weiss, Stockholm
- Lars Weidenhielm, Stockholm
- Ola Rolfson, Gothenburg
- Olof Sköldenberg , Stockholm
- Max Gordon, Stockholm

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

- Buster Sandgren, Stockholm
  Datortomography of patients who received an uncemented acetabular component in connection with hip arthroplasty.
- Ferid Krupic, Gothenburg
  Socioeconomic variables' significance for outcome after hip arthroplasty
- Viktor Lindgren, Stockholm
  Complications and outcome after hip arthroplasty with special focus on infections and the surgical approach's significance
- 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
- Anne Garland, Visby and Uppsala
  Mortality after hip arthroplasty
- Camilla Bergh, Gothenburg
  Avascular caput necrosis and prosthetic surgery
- Ted Eneqvist, Gothenburg
  Spine-hip dilemma and further development of the PROM tool
- Meridith Greene, Boston and Gothenburg
  Predictors for patient-reported outcomes after hip arthroplasty

- Georgios Chatziagorou, Gothenburg
  Early and late femur fractures in proximity of the prosthesis
- Ammar Al-Jobory, SUS
  Dislocation in fracture-related prostheses
- Susanne Hansson, SUS
  Comorbidity and outcomes in fracture-related prostheses
- Sebastian Rönnqvist, SUS
  Hip fractures and prosthetic surgery among younger patients
- Jonas Wohlin, Stockholm
  Free care choice's effects on results and costs after hip arthroplasties

At present, the Register also has intensive research projects within NARA and the group's first 20 scientific articles have now been published, and work is ongoing on several more manuscripts.

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 postgraduate students.

References

References to articles, books, thesis and exhibitions which the Registers collaborators have contributed to.

Peer-reviewed articles

Ahnfelt L, Andersson G, Herberts P. Reoperation av totala höftledsplastiker i Sverige. Läkartidningen 1980;77:2604–2607.

Strömberg C N, Herberts P, Ahnfelt L. Revision total hip arthroplasty in patients younger than 55 years old. Clinical and radiological results after 4 years. J Arthroplasty 1988;3(1):47–59.

Ahnfelt L, Herberts P, Andersson G B J. Complications in Total Hip Arthroplasties. In Proceedings of "Course on Biomaterials: part II". Acta Orthop Scand 1988;59:353–357.

Herberts P m fl. Symposiet Nya Höftleder: En explosionsartad utveckling. Läkartidningen 1988;85(38):3053–3072.

Herberts P, Ahnfelt L, Malchau H, Strömberg C, Andersson G B J. Multicenter clinical trials and their value in assessing total joint arthroplasty. Clin Orthop Relat Res 1989;249:48–55.

Ahnfelt L, Herberts P, Malchau H, Andersson G B J. Prognosis of total hip replacement. A Swedish multicenter study of 4,664 revisions. Acta Orthop Scand 1990:61(Suppl 238).

Herberts P. Assessment of Clinical Failures in Total Hip Replacement. Editors: Rydevik B, Brånemark P-I, Skalak R. International Workshop on Osseointegration in Skeletal Reconstruction and Joint Replacement April 24–27, 1990, Aruba.

Herberts P, Ahnfelt L, Andersson G B J. Reoperation for failure of total hip replacement in Sweden 1979–1983. Orthop Rel Sci 1991;2:215–225.

Herberts P. Guest editorial. Hip arthroplasty revision. Acta Orthop Scand 1992;63(2):109–110.

Strömberg C N, Herberts P, Palmertz B. Cemented revision hip arthroplasty. A multi-center 5–9 year study of 204 first revisions for loosening. Acta Orthop Scand 1992;63(2):111–119.

Malchau H, Herberts P and Ahnfelt L. Prognosis of total hip replacement in Sweden. Follow-up of 92,675 operations performed 1978–1990. Acta Orthop Scand 1993;64(5):497–506.

Strömberg C N, Herberts P. A multicenter 10 year study of cemented revision total hip replacement in patients younger than 55 years old. A follow-up report. J Arthroplasty 1994;9(6):595–601.

Herberts P and Malchau H. Indications for revision of a total hip replacement: Factors of importance for failures and overview of outcomes. NIH Consensus Development Conference on Total Hip Replacement, Bethesda, Maryland, September 12–14, 1994.

Garellick G, Malchau H, Hansson-Olofsson E, Axelsson H, Hansson T, Herberts P. Opererar vi den höftsjuke patienten för sent? Mortalitet efter totalcementerad höftplastik. En prospektiv överlevnads- och kostnads-nytto-analys. Läkartidningen, 1995;92(17):1771–1777.

Herberts P, Strömberg C N, Malchau H. Revision Hip Surgery. The Challenge. In Total Hip Revision Surgery, Raven Press Ltd., New York 1995. Galante J O, Rosengren A G, Callaghan J J. 1–19.

Herberts P. Svensk expertis till konsensusmöte i USA. Ortopediskt Magasin 1995;1:6–10.

Malchau H, Herberts P. Prognosis of total hip replacement. Int J Risk Saf Med 1996;8(1):27–45. IOS Press.

Malchau H, Herberts P. Höftledsplastik i Sverige 1974–1994. I: Vårdens kvalitet, resultat och förändringar Hälso- och sjukvårdsstatistisk årsbok, Hälso- och Sjukvård 1996;1:160–161.

Herberts P, Malchau H. How outcome studies have changed THA practices in Sweden. Clin Orthop Relat Res 1997;344:44–60.

Vingård E, Alfredsson L, Malchau H. Osteoarthrosis of the hip in women and its relation to physical load at work and in the home. Ann Rheum Dis 1997;56:293–298.

Vingård E, Alfredsson L, Malchau H. Lifestyle factors and hip arthrosis. A case referent study of body mass index, smoking and hormone therapy in 503 Swedish women. Acta Orthop Scand 1997;68:216–220.

Vingård E, Alfredsson L, Malchau H. Osteoarthrosis of the hip in women and its relation to physical load from sports activities. Am J Sports Med 1998;26(1):78–82.

Garellick G, Malchau H, Herberts P, Hansson E, Axelsson H, Hansson T. Life expectancy and cost utility after total hip replacement. Clin Orthop Relat Res 1998;346:141–151.

Garellick G, Malchau H, Herberts P. Specific or general health outcome measure in evaluation of total hip replacement. A comparison between Harris hip score and Nottingham health profile. J Bone Joint Surg (Br) 1998;80(4):600–606.

Söderman P, Malchau H. Outcome measurement in total hip replacement surgery (THR). In: Outcome measuring, SPRI, Hälso- och Sjukvårdens utvecklingsinstitut, SPRI tryck 310, 1998 pp 89–95.

Herberts P, Malchau H. Mångårig registrering har ökat kvaliteten på höftplastiker. Läkartidningen 1999;96:2469–2476.

Persson U, Persson M, Malchau H. The economic of preventing revisions in total hip replacement. Acta Orthop Scand 1999;70:163–169.

Garellick G, Malchau H, Herberts P. The value of clinical data scoring systems. Are traditional hip scoring systems adequate to use in evaluation after total hip surgery? J Arthroplasty 1999;14(8):1024–1029.

Hultmark P, Kärrholm J, Strömberg C, Herberts P, Möse C-H, Malchau H. Cemented first time revisions of the femoral component. Prospective 7 to 13 years follow-up using 2nd and 3rd generation technique. J Arthroplasty 2000;15(5):551–561.

Söderman P, Malchau H. Validity and reliability of the Swedish WOMAC osteoarthritis index. A self-administered disease-specific questionnaire (WOMAC) versus generic instruments (SF-36 and NHP). Acta Orthop Scand 2000;71(1):39–46.

Malchau H. Editorial Comments. Introduction of new technology: A stepwise algorithm. Spine 2000;25(3):285.

Herberts P, Malchau H. Long-term registration has improved the quality of hip replacement. A review of the Swedish THR Register. Acta Orthop Scand 2000;71(2):111–121.

Garellick G, Malchau H, Herberts P. Survival of total hip replacements: A comparison of a randomized trial and a Register. Clin Orthop Relat Res 2000;375:157–167.

Söderman P, Malchau H, Herberts P, Johnell O. Are the findings in the Swedish National Total Hip Arthroplasty Register valid? A comparison between the Swedish THA register, the National Discharge Register and the National Death Register. J Arthroplasty 2000;15(7):884–889.

Söderman P, Malchau H, Herberts P. Outcome after total hip arthroplasty. Part I. General health evaluation in relation to definition of failure in the Swedish National Total Hip Arthroplasty Register. Acta Orthop Scand 2000;71(4):354–359.

Oparaugo P C, Clark I C, Malchau H, Herberts P. Correlation of wear-debris induced osteolysis and revision with volumetric wear-rates of polyethylene: a survey of 8 reports in the literature. Acta Orthop Scand 2001;72(1):22–28.

Söderman P, Malchau H. Is the Harris Hip Score system useful to study the outcome of total hip replacement? Clin Orthop Relat Res 2001;384:189–197.

Söderman P, Malchau H, Herberts P. Outcome of total hip replacement. A comparison of different measurement methods. Clin Orthop Relat Res 2001;390:163–172.

Söderman P, Malchau H, Herberts P, Zügner R, Garellick G, Regnér H. Outcome after total hip arthroplasty. Part II. Disease specific questionnaires and the Swedish National Total Hip Arthroplasty Register. Acta Orthop Scand 2001;72(2):113–119.

Malchau H, Herberts P, Eisler T, Garellick G, Söderman P. The Swedish Total Hip Replacement Register. J Bone Joint Surg (Am) 2002:84(Suppl 2).

Ostendorf M, Johnell O, Malchau H, Dhert WJA, Schrijvers AJP, Verbout AJ. The epidemiology of total hip replacement in The Netherlands and Sweden: present status and future needs. Acta Orthop Scand 2002;73(3):282–286.

Järvholm B, Lundström R, Malchau H, Rehn B, Vingård E. Osteoarthritis in the hip and whole-body vibration in heavy vehicles. Int Arch Occup Environ Health 2004; 77(6):424–426.

Briggs A, Sculpher M, Dawson J, Fitzpatrick R, Murray D, Malchau H. The use of probabilistic decision models in technology assessment: the case of hip replacement. Appl Health Econ Health Policy 2004;3(2):79–89.

Sah AP, Eisler T, Kärrholm J, Malchau H. Is there still a role for the cemented stem? Orthopaedics 2004;27(9):963–964.

Lindahl H, Garellick G, Malchau H, Herberts P. Periprosthetic femoral fractures. Classification and demographics of 1,049 late periprosthetic femoral fractures from the Swedish National Hip Arthroplasty Register. J Arthroplasty 2005;20(7):857–865.

Järvholm B, Lewold S, Malchau H, Vingård E. Age, bodyweight, smoking habits and the risk of severe osteoarthritis in the hip and knee in men. Eur J Epidemiol 2005;20(6):537–542.

Malchau H, Garellick G, Eisler T, Kärrholm J, Herberts P. Presidential guest speaker: the Swedish Hip Register: Increasing the sensitivity by patient outcome data. Clin Orthop Relat Res 2005;441:19–29.

Lindahl H, Garellick G, Regnér H, Herberts P, Malchau H. Three hundred and twenty-one periprosthetic femoral fractures J Bone Joint Surg (Am) 2006;88(6):1215–1222.

Lindahl H, Malchau H, Odén A, Garellick G. Risk factors for failure after treatment of a periprosthetic fracture of the femur. J Bone Joint Surg (Br) 2006;88(1):26–30.

Kärrholm J, Herberts P, Garellick G. Tidig omoperation för luxation av primär höftprotes ökar. En analys av nationella höftprotesregistret. Läkartidningen 2006;103(36):2547–2550.

Kwon YM, Morshed S, Malchau H. Cemented or cementless stem fixation in THA: what is the current evidence? Orthopedics 2006;29(9):793–794.

Lindahl H, Odén A, Malchau H, Garellick G. The excess mortality due to periprosthetic femur fracture. A study from The Swedish National Hip Arthroplasty Register. Bone 2007;40(5):1294–1298.

Lindahl H. Epidemiology of periprosthetic femur fracture around a total hip arthroplasty. Injury 2007;38(6):651–654.

Morshed S, Bozic KJ, Ries MD, Malchau H, Colford JM Jr. Comparison of cemented and uncemented fixation in total hip replacement: a meta-analysis. Acta Orthop 2007;78(3):315–326.

Franklin J, Malchau H. Risk factors for periprosthetic femoral fracture. Injury 2007;38(6):655–660. (E-publikation 2007 apr 30 före tryckning).

Kurtz SM, Ong KL, Schmier J, Mowat F, Saleh K, Dybvik E, Kärrholm J, Garellick G, Havelin LI, Furnes O, Malchau H, Lau E. Future clinical and economic impact of revision total hip and knee arthroplasty. J Bone Joint Surg (Am) 2007;89 Suppl 3:144–151.

Slover JD, Tosteson AN, Bozic KJ, Rubash HE, Malchau H. Impact of hospital volume on the economic value of computer navigation for total knee replacement. J Bone Joint Surg Am. 2008;90(7):1492–1500.

Slover J, Hoffman MV, Malchau H, Tosteson AN, Koval KJ. A cost-effectiveness analysis of the arthroplasty options for displaced femoral neck fractures in the active, healthy, elderly population. J Arthroplasty 2009;24(6):854–860. (E-publikation 2008 aug 12 före tryckning).

Rolfson O, Dahlberg LE, Nilsson JA, Malchau H, Garellick G. Variables determining outcome in total hip replacement surgery. J Bone Joint Surg (Br) 2009;91(2):157–161.

Leonardsson O, Rogmark C, Kärrholm J, Akesson K, Garellick G. Outcome after primary and secondary replacement for subcapital fracture of the hip in 10,264 patients. J Bone Joint Surg (Br) 2009;91(5):595–600.

Ornstein E, Linder L, Ranstam J, Lewold S, Eisler T, Torper M. Femoral impaction bone grafting with the Exeter stem – the Swedish experience: survivorship analyses of 1305 revisions performed between 1989 and 2002. J Bone Joint Surg (Br) 2009;91(4):441–446.

von Knoch F, Malchau H Why do we need a national joint replacement Register in the United States? Am J Orthop (Belle Mead NJ) 2009;38(10):500–503.

Havelin LI, Fenstad AM, Salomonsson R, Mehnert F, Furnes O, Overgaard S, Pedersen AB, Herberts P, Karrholm J, Garellick G. The Nordic Arthroplasty Register Association: a unique collaboration between 3 national hip arthroplasty registries with 280,201 THRs. Acta Orthop 2009;80(4):393–401.

Garellick G, Lindahl B, Gudbjörnsdottir S, Lindblad S, Lundström M, Spångberg K, Rehnqvist N, Rolfson O. Debatten om Nationella Kvalitetsregister. Kritiken visar behov av ökade kunskaper om registrens syfte. Läkartidningen 2009;106:1749–1751.

Lazarinis S, Kärrholm J, Hailer NP. Increased risk of revision of acetabular cups coated with hydroxyapatite: A register study on 6,646 patients with total hip arthroplasty. Acta Orthop 2010;81(1):53–59.

Thien T M, Kärrholm J. Design-related risk factors for revision of primary cemented stems. Acta Orthop 2010;81(4):407–412.

Hailer NP, Garellick G, Kärrholm J. Uncemented and cemented primary total hip arthroplasty in the Swedish Hip Arthroplasty Register. Acta Orthop 2010;81(1):34–41.

Kärrholm J. The Swedish Hip Arthroplasty Register (www.shpr.se). Acta Orthop 2010;81(1):3–4.

Johanson P-E, Fenstad AM, Furnes O, Garellick G, Havelin LI, Overgaard S, Pedersen AB, Kärrholm J. Inferior outcome after hip resurfacing arthroplasty than after conventional arthroplasty. Evidence from the Nordic Arthroplasty Register Association (NARA) database, 1995 to 2007. Acta Orthop 2010;81(5):535–541.

Rogmark C, Spetz C-L, Garellick G. More intramedullary nails and arthroplasties for treatment of hip fractures in Sweden. Register analysis of 144,607 patients, 1998–2007. Acta Orthop 2010;81(5):588–592.

Rolfson O, Salomonsson R, Dahlberg LE, Garellick G. Internet-based follow-up questionnaire for measuring patient-reported outcome after total hip arthroplasty – reliability and response rate. Value Health 2011;14(2):316–321.

Malchau H, Bragdon CR, Muratoglu OK. The stepwise introduction of innovation into orthopedic surgery: the next level of dilemmas. J Arthroplasty 2011;26(6):825–831. (E-publikation 2010 okt 2 före tryckning).

Ranstam J, Kärrholm J, Pulkkinen P, Mäkelä K, Espehaug B, Pedersen AB, Mehnert F, Furnes O; NARA-study group. Statistical analysis of arthroplasty data. I. Introduction and background. Acta Orthop 2011;82(3):253–257.

Ranstam J, Kärrholm J, Pulkkinen P, Mäkelä K, Espehaug B, Pedersen AB, Mehnert F, Furnes O; NARA-study group. Statistical analysis of arthroplasty data. II. Guidelines. Acta Orthop 2011;82(3):258–267.

Hekmat K, Jacobsson L, Nilsson J-Å, Petersson I, Robertsson O, Garellick G, Turessson C. Decrease in the incidence of total hip arthroplasties in patients with rheumatoid arthritis – results from a well defined population in south Sweden. Arthritis Res Ther 2011;13(2):R67 (E-publikation före tryckning).

Weiss RJ, Stark A, Kärrholm. A modular cementless stem vs. cemented long-stems prostheses in revision surgery of the hip: a population-based study from the Swedish Hip Arthroplasty Register. Acta Orthop 2011;82(2):136–142 (E-publikation mars 2011).

Rolfson O, Kärrholm J, Dahlberg LE, Garellick G. Patient-reported outcomes in the Swedish Hip Arthroplasty Register: results of a nationwide prospective observational study. J Bone Joint Surg (Br) 2011;93;867–875.

Havelin LI, Robertsson O, Fenstad AM, Overgaard S, Garellick G, Furnes O. A Scandinavian experience of register collaboration: the Nordic Arthroplasty Register Association (NARA). J Bone Joint Surg (Am) 2011;93 Suppl 3:13–19.

Lazarinis S, Kärrholm J, Hailer NP. Effects of hydroxyapatite coating on survival of an uncemented femoral stem. A Swedish Hip Arthroplasty Register study on 4,772 hips. Acta Orthop 2011;82(4):399–404 (E-publikation 2011 jul 13 före tryckning).

Rolfson O, Rothwell A, Sedrakyan A, Chenok K E, Bohm E, Bozic K J, Garellick G. Use of patient-reported outcomes in the context of different levels of data. J Bone Joint Surg (Am) 2011;93 Suppl 3(E):66–71.

Nelissen RG, Pijls BG, Kärrholm J, Malchau H, Nieuwenhuijse MJ, Valstar ER. RSA and registries: the quest for phased introduction of new implants. J Bone Joint Surg (Am) 2011;93 Suppl 3:62–65.

Rolfson O, Ström O, Kärrholm J, Malchau H, Garellick G. Costs related to hip disease in patients eligible for total hip arthroplasty. J Arthroplasty 2012;27(7):1261–1266 (E-publikation 2011 dec 30 före tryckning).

Leonardsson O, Garellick G, Kärrholm J, Akesson K, Rogmark C. Changes in implant choice and surgical technique for hemiarthroplasty. 21,346 procedures from the Swedish Hip Arthroplasty Register 2005–2009. Acta Orthop 2012;83(1):7–13 (E-publikation 2011 nov 23 före tryckning).

Rogmark C, Leonardsson O, Garellick G, Kärrholm J. Monoblock hemiarthroplasties for femoral neck fractures – a part of orthopaedic history? Analysis of national registration of hemiarthroplasties 2005–2009. Injury 2012;43(6):946–949 (E-publikation 2011 dec 29 före tryckning).

Larsson S, Lawyer P, Garellick G, Lindahl B, Lundström M. Use of 13 disease registries in 5 countries demonstrates the potential to use outcome data to improve health care's value. Health Aff (Millwood). 2012;31(1):220–227 (E-publikation 2011 dec 7 före tryckning).

Weiss RJ, Hailer NP, Stark A, Kärrholm J. Survival of uncemented acetabular monoblock cups: evaluation of 210 hips in the Swedish Hip Arthroplasty Register. Acta Orthop 2012;83(3):214–219 (E-publikation 2012 maj 10 före tryckning).

Hailer N, Weiss RJ, Stark A, Kärrholm J. The risk of revision due to dislocation after total hip arthroplasty depends on surgical approach, femoral head size, sex, and primary diagnosis. An analysis of 78,098 operations in the Swedish Hip Arthroplasty Register. Acta Orthop 2012;83(5):442–448.

Weiss RJ, Kärrholm J, Hailer NP, Beckman MO, Stark A. Salvage of failed trochanteric and subtrochanteric fractures using a distally fixed, modular, uncemented hip revision stem. Acta Orthop 2012;83(5):488–492.

Dale H, Fenstad AM, Hallan G, Havelin LI, Furnes O, Overgaard S, Pedersen A, Kärrholm J, Garellick G, Pulkkinen P, Eskelinen A, Mäkelä K, Engesæter L. Increasing risk of prosthetic joint infection after total hip arthroplasty. 2,661 revisions due to infection after 441,706 primary THAs in the Nordic Arthroplasty Register Association. Acta Orthop 2012;83(5):449–458.

Engesæter L, Engesæter I, Fenstad AM, Havelin LI , Kärrholm J, Garellick G, Pedersen A, and Overgaard S. Low revision rate after total hip arthroplasty in patients with pediatric hip diseases. Evaluation of 14,403 THAs due to DDH, SCFE, or Perthes' disease and 288,435 THAs due to primary osteoarthritis in the

Danish, Norwegian, and Swedish Hip Arthroplasty Registers (NARA). Acta Orthop 2012;83(5):436–441.

Leonardsson O, Kärrholm J, Åkesson K, Garellick G, Rogmark C. Higher risk of reoperation for bipolar and uncemented hemiarthroplasty 23,509 procedures after femoral neck fractures from the Swedish Hip Arthroplasty Register, 2005–2010. Acta Orthop 2012;83(5):459–466.

Lazarinis S, Kärrholm J, Hailer NP. Effects of hydroxyapatite coating of cups used in hip revision arthroplasty. Acta Orthop 2012;83(5):427–435.

Lindgren V, Kärrholm J, Garellick G, Wretenberg P. The type of surgical approach influences the risk of revision in total hip arthroplasty: a study from the Swedish Hip Arthroplasty Register of 90,662 total hip replacements with 3 different cemented prostheses. Acta Orthop 2012;83(6):559–565 (E-publikation före tryckning).

Hailer NP, Weiss RJ, Stark A, Kärrholm J. Dual-mobility cups for revision due to instability are associated with a low rate of re-revisions due to dislocation 228 patients from the Swedish Hip Arthroplasty Register. Acta Orthop 2012;83(6):566–571.

Krupic F, Määttä S, Garellick G, Lyckhage ED, Kärrholm J. Preoperative information provided to Swedish and immigrant patients before total hip replacement. Med Arh. 2012;66(6):399–404.

Krupic F, Eisler T, Garellick G, Kärrholm J. Influence of ethnicity and socioeconomic factors on outcome after total hip replacement. Scand J Caring Sci 2013;27(1):139–146 (E-publikation 2012 maj 23 före tryckning).

Krupic F, Eisler T, Eliasson T, Garellick G, Gordon M, Kärrholm J. No influence of immigrant background on the outcome of total hip arthroplasty. 140,299 patients born in Sweden and 11,539 immigrants in the Swedish Hip Arthroplasty Register. Acta Orthop 2013;84(1):18–24 (E-publikation 2013 jan 23 före tryckning).

Bedair H, Lawless B, Malchau H. Are implant designer series believable? Comparison of survivorship between designer series and national registries. J Arthroplasty 2013;28(5):728–731 (E-publikation 2013 feb 13 före tryckning).

Davies C, Briggs A, Lorgelly P, Garellick G, Malchau H. The "hazards" of extrapolating survival curves. Med Decis Making 2013;33(3):369–380 (E-publikation 2013 mar 3 före tryckning).

Gordon M, Stark A, Sköldenberg OG, Kärrholm J, Garellick G. The influence of comorbidity scores on re-operations following primary total hip replacement: Comparison and validation of three comorbidity measures. Bone Joint J. 2013;95-B(9):1184–1191.

Troelsen A, Malchau E, Sillesen N, Malchau H. A review of current fixation use and Register outcomes in total hip arthroplasty: the uncemented paradox. Clin Orthop Relat Res 2013;471(7):2052–2059 (E-publikation 2013 mar 29 före tryckning).

Leonardsson O, Rolfson O, Hommel A, Garellick G, Akesson K, Rogmark C. Patient-reported outcome after displaced femoral neck fracture: a national survey of 4467 patients. J Bone Joint Surg (Am) 2013;95(18):1693–1699.

Mohaddes M, Garellick G, Kärrholm J. Method of Fixation Does Not Influence the Overall Risk of Rerevision in First-time Cup Revisions. Clin Orthop Relat Res 2013;471(12):3922–3931 (E-publikation 2013 feb 26 före tryckning).

Sandgren B, Crafoord J, Garellick G, Carlsson L, Weidenhielm L, Olivecrona H. Computed Tomography vs. Digital Radiography Assessment for Detection of Osteolysis in Asymptomatic Patients With Uncemented Cups: A Proposal for a New Classification System Based on Computer Tomography. J Arthroplasty 2013;28(9):1608–1613 (E-publikation 2013 apr 22 före tryckning).

Gordon M, Paulsen A, Overgaard S, Garellick G, Pedersen AB, Rolfson O. Factors influencing health-related quality of life after total hip replacement – a comparison of data from the Swedish and Danish hip arthroplasty registers. BMC Musculoskelet Disord 2013;14(1):316 (E-publikation före tryckning).

Bergh C, Fenstad AM, Furnes O, Garellick G, Havelin LI, Overgaard S, Pedersen AB, Mäkelä KT, Pulkkinen P, Mohaddes M, Kärrholm J: Increased risk of revision in patients with non-traumatic femoral head necrosis. Acta Orthop 2014;85(1):11–17 (E-publikation 2013 dec 20 före tryckning).

Rogmark C, Fenstad AM, Leonardsson O, Engesæter LB, Kärrholm J, Furnes O, Garellick G, Gjertsen JE. Posterior approach and uncemented stems increases the risk of reoperation after hemiarthroplasties in elderly hip fracture patients. Acta Orthop 2014;85(1):18–25 (E-publikation 2014 jan 24 före tryckning).

Mäkelä KT, Matilainen M, Pulkkinen P, Fenstad AM, Havelin L, Engesaeter L, Furnes O, Pedersen AB, Overgaard S, Kärrholm J, Malchau H, Garellick G, Ranstam J, Eskelinen A. Failure rate of cemented and uncemented total hip replacements: register study of combined Nordic database of four nations. BMJ. 2014;348:f7592.

Mäkelä K, Matilainen M, Pulkkinen P, Fenstad AM, Havelin LI, Engesaeter L, Furnes O, Overgaard S, Pedersen AB, Kärrholm J, Malchau H, Garellick G, Ranstam J, Eskelinen A. Countrywise results of total hip replacement. Acta Orthop 2014;85(2):107–116.

Lindgren JV, Wretenberg P, Kärrholm J, Garellick G, Rolfson O. Patient-reported outcome is influenced by surgical approach in total hip replacement: a study of the Swedish Hip Arthroplasty Register including 42,233 patients. Bone Joint J 2014;96-B(5):590–596.

Gjertsen JE, Fenstad AM, Leonardsson O, Engesæter LB, Kärrholm J, Furnes O, Garellick G, Rogmark C. Hemiarthroplasties after hip fractures in Norway and Sweden: a collaboration between the Norwegian and Swedish national registries. Hip Int 2014;24(3):223–230 (E-publikation 2014 feb 3 före tryckning).

Greene ME, Rolfson O, Nemes S, Gordon M, Malchau H, Garellick G. Education Attainment is Associated With Patient-reported Outcomes: Findings From the Swedish Hip Arthroplasty Register. Clin Orthop Relat Res Clin Orthop Relat Res 2014;472(6):1868–1876 (E-publikation 2014 feb 19 före tryckning).

Pedersen AB, Mehnert F, Havelin LI, Furnes O, Herberts P, Kärrholm J, Garellick G, Mäkela K, Eskelinen A, Overgaard S. Association between fixation technique and revision risk in total hip arthroplasty patients younger than 55 years of age. Results from the Nordic Arthroplasty Register Association. Osteoarthritis Cartilage 2014;22(5):659–667 (E-publikation 2014 mar 13 före tryckning).

Nemes S, Gordon M, Rogmark C, Rolfson O. Projections of total hip replacement in Sweden from 2013 to 2030. Acta Orthop 2014;85(3):238–243 (E-publikation 2014 apr 23 före tryckning).

Gordon M, Greene M, Frumento P, Rolfson O, Garellick G, Stark A. Age- and health-related quality of life after total hip replacement. Acta Orthop 2014;85(3):244–249 (E-publikation 2014 apr 30 före tryckning).

Krupic F, Garellick G, Gordon M, Kärrholm J. Different patient-reported outcomes in immigrants and patients born in Sweden. Acta Orthop 2014;85(3):221–228 (E-publikation 2014 maj 6 före tryckning).

Gordon M, Frumento P, Sköldenberg O, Greene M, Garellick G, Rolfson O. Women in Charnley class C fail to improve in mobility to a higher degree after total hip replacement. Acta Orthop 2014;85(4):335–341 (E-publikation 2014 jun 23 före tryckning).

Jansen GB, Lundblad H, Rolfson O, Brisby H, Rydevik B. Riskfaktorer för kvarstående smärta efter ortopedisk kirurgi. Läkartidningen 2014;111(25–26):1116–1119.

Hailer NP, Lazarinis S, Mäkelä KT, Eskelinen A, Fenstad AM, Hallan G, Havelin L, Overgaard S, Pedersen AB, Mehnert F, Kärrholm J. Hydroxyapatite coating does not improve uncemented stem survival after total hip arthroplasty! Acta Orthop E-publikation 2014 sep 1 före tryckning.

Thien T, Chatziagorou G, Garellick G, Furnes O, Havelin L I, Mäkelä K, Overgaard S, Kärrholm J.Risk of early periprosthetic fracture within 2 years for 437629 primary cemented and uncemented THR in the Nordic Arthroplasty Register Association database. In press J Bone Joint Surg Am.

Lindgren V, Gordon M, Wretenberg P, Kärrholm K, Garellick G. Deep infection following primary total hip replacement – a new method for national incidence surveillance. In press Infect Control Hosp Epidemiol.

Greene ME, Rolfson O, Garellick G, Gordon M, Nemes S. Improved statistical analysis of the EQ-5D index – the applicability of piecewise linear regression splines. In press Qual life res.

Lindgren V, Gordon M, Wretenberg P, Kärrholm J, Garellick G. Validation of reoperations due to infection in the Swedish Hip Arthroplasty Register by a medical records review. Accepterad

Submitted manuscripts

Greene ME, Rolfson O, Gordon M, Malchau H, Garellick G. Does the use of antidepressants predict outcomes following total hip replacement surgery?

Sandgren B, Crafoord J, Olivecrona H, Garellick G, Weidenhielm L. Risk factors for Periacetabular Osteolysis in asymptomatic patients with uncemented Total Hip Arthroplasties.

Varnum C, Pedersen AB, Overgaard S, Mäkelä K, Eskelinen A, Pulkkinen P, Furnes O, Havelin LI, Kärrholm J, Garrelick G. Risk and Causes for Revision of Cementless Stemmed Total Hip Arthroplasties with Metal-on-Metal Bearings – 19,588 Patients from the Nordic Arthroplasty Register Association.

Nemes S, Rolfson O, W-Dahl A, Garellick G, Sundberg M, Kärrholm J Robertsson O: Historical perspectives and future demand of knee arthroplasty in Sweden.

Book chapters

The Well Cemented Total Hip Arthroplasty in Theory and Practice. Editors Steffen Breusch & Henrik Malchau. Springer Verlag, Berlin, 2005.

2.1 Operative Steps: Acetabulum, sidor 16–27.
Steffen J. Breusch, Henrik Malchau, John Older

2.2 Operative Steps: Femur, sidor 28–36
Steffen J. Breusch, Henrik Malchau

6.1 Optimal Cementing Technique – The Evidence: What Is Modern Cementing Technique?, sidor 146–149
Henrik Malchau, Steffen J. Breusch

7.3 Migration Pattern and Outcome of Cemented Stems in Sweden, sidor 190–195
Jeffrey Geller, Henrik Malchau, Johan Kärrholm

11 The Evidence from the Swedish Hip Register, sidor 291–299
Henrik Malchau, Göran Garellick, Peter Herberts

19 Economic Evaluation of THA, sidor 360–366
Marieke Ostendorf, Henrik Malchau

20 The Future Role of Cemented Total Hip Arthroplasty, sidor 367–369
Henrik Malchau, Steffen J. Breusch

These – entirely or partly based on results from The Swedish Hip Arthroplasty Register

Ahnfelt L. Re-opererade totala höftledsplastiker i Sverige under åren 1979–1983. Avhandling, Göteborgs universitet, Göteborg, Sverige 1986.

Strömberg C. Cemented revision total hip replacements. Clinical and radiographic results from a Swedish Multicenter Study. Avhandling, Göteborgs universitet, Göteborg, Sverige 1995.

Malchau H. On the importance of stepwise introduction of new hip implant technology. Assessment of total hip replacement using clinical scoring, radiostereometry, digitised radiography and a National Hip Register. Avhandling, Göteborgs universitet, Göteborg, Sverige 1995.

Garellick G. On outcome assessment of total hip replacement. Avhandling, Göteborgs universitet, Sverige 1998.

Söderman P. On the validity of the results from the Swedish National Total Hip Arthroplasty Register. Avhandling, Göteborgs universitet, Göteborg, Sverige 2000.

Eisler T. On loosening and revision in total hip arthroplasty. Avhandling, Karolinska institutet, Stockholm och Göteborgs Universitet, Göteborg, Sverige 2003.

Ostendorf M. Outcome assessment of total hip arthroplasty in The Netherlands and Sweden. Avhandling, Universiteit Utrecht, Utrecht, Nederländerna 2004.

Lindahl H. The periprosthetic femur fracture. A study from the Swedish National Hip Arthroplasty Register. Avhandling, Göteborgs universitet, Göteborg, Sverige 2006.

Rolfson O. Patient-reported outcome measures and health-economic aspects of total hip arthroplasty. A study of the Swedish Hip Arthroplasty Register. Avhandling, Göteborgs universitet, Göteborg, Sverige 2010.

Leonardsson O. Arthroplasty for femoral neck fracture. Results of a nationwide implementation. Avhandling, Lunds universitet, Lund/Malmö, Sverige 2012.

Lazarinis S. Form and Finish of Implants in Uncemented Hip Arthroplasty: Effects of Different Shapes and Surface Treatments on Implant Stability. Avhandling, Uppsala Universitet, Uppsala, Sverige 2013.

Gordon M. Evaluation of patient-related factors influencing outcomes after total hip replacement. Avhandling, Karolinska Institutet, Stockholm, Sverige 2014.

Scientific articles with material from the Register

Sköldenberg O, Salemyr M, Muren O, Johansson Å, Ahl T. The Ringloc liner compared with the Hexloc liner in total hip arthroplasty. Orthopedic Reviews 2009;1:e16.

Exhibitions

Ahnfelt L, Herberts P, Malchau H, Strömberg C, Andersson G B J. Failure of THR in Sweden. A multicentric study. Vetenskaplig utställning på 56th Annual Meeting of the American Academy of Orthopaedic Surgeons, 9–14 februari, 1989, Las Vegas, USA.

Malchau H, Herberts P, Anhfelt L, Johnell O. Prognosis of Total Hip Replacement. Results from the National Register of Revised Failures 1978–1990 in Sweden – A Ten year Follow-Up of 92,675 THR. Vetenskaplig utställning på 60th Annual Meeting of the American Academy of Orthopaedic Surgeons, 18–23 februari 1993, San Francisco, USA. Även översatt till svenska, tyska, spanska, italienska och franska.

Malchau H, Herberts P. Prognosis of total hip replacement. Surgical and cementing technique in THR: A revision-risk study of 134,056 primary operations. Vetenskaplig utställning på 63rd Annual Meeting of the American Academy of Orthopaedic Surgeons, Atlanta, USA, 22–26 februari 1996. Även översatt till svenska, tyska, spanska, italienska, franska och japanska.

Malchau H, Herberts P. Prognosis of total hip replacement. Surgical and cementing technique in THR: A revision-risk study of 134,056 primary operations. Vetenskaplig utställning på Nordisk Ortopedisk förenings 48:e congress, Bergen, Norge, 12–15 juni 1996.

Söderman P, Malchau H, Herberts P. Validering av svenska nationalregistret för totala höftledsplastiker. Kvalitetsregisterdagarna–Socialstyrelsen/Landstingsförbundet, Stockholm, Sverige, 1–2 oktober, 1997. Poster.

Malchau H, Herberts P. Prognosis of total hip replacement. Revision and re-revision rate in THR: A revision-study of 148,359 primary operations. Vetenskaplig utställning på 65th Annual Meeting of the American Academy of Orthopaedic Surgeons, New Orleans, USA, 19–23 mars 1998. Även översatt till tyska, franska, spanska och italienska.

Malchau H, Herberts P, Söderman P, Odén A. Prognosis of total hip replacement. Update and validation of results from the Swedish National Hip Arthroplasty Register 1979–1998. Vetenskaplig utställning på 67th Annual Meeting of the American Academy of Orthopaedic Surgeons, Orlando, USA, 15–19 mars 2000. Även översatt till tyska, franska, spanska och italienska.

Malchau H, Herberts P, Garellick G, Söderman P, Eisler T. Prognosis of total hip replacement. Update of Results and Risk-Ratio Analysis for Revision and Re-revision from the Swedish National Hip Arthroplasty Register 1979–2000. Vetenskaplig utställning på 69th Annual Meeting of the American Academy of Orthopaedic Surgeons, Dallas, USA, 13–17 mars 2002. Även översatt till tyska, franska, spanska och italienska.

Hilmarsson S, Malchau H, Herberts P, Söderman P. Primary total hip replacement in patients below 55 years. Results from the Swedish THR Register. SICOT/SIROT 2002 XXII World Congress, San Diego, USA, 23–30 augusti 2002. Poster.

Malchau H, Herberts P, Garellick G, Söderman P, Eisler T. Prognosis of total hip replacement. Update of results and risk-ratio analysis for revision and re-revision from the Swedish National Hip Arthroplasty Register. SICOT/SIROT 2002 XXII World Congress, San Diego, USA, 23–30 augusti 2002. Poster.

Kärrholm K, Garellick G, Lindahl H, Herberts P. Improved analyses in the Swedish Hip Arthroplasty Register. Vetenskaplig utställning på 74th Annual Meeting of the American Academy of Orthopaedic Surgeons, San Diego, USA, 14–18 mars 2007.

Appendix: Care episode compensation

National collaboration for value-based compensation and monitoring in health care

In 2013, Sveus was established, which is a unique collaboration for further development of healthcare management systems. Elective hip and knee replacement is one of the eight groups of patients currently included in Sveus (www.sveus.se).

Organisation

Within Sveus, over 40 organizations collaborate, including county councils/regions, medical specialist associations, quality register, patient associations, academia and other government agencies. The development work carried out in the research project is coordinated by the R&D company IVBAR. Sveus is led by a management committee consisting of representatives from the participating counties, SKL and Ministry of Health and Social Affairs. Participating counties/regions are currently Dalarna County Council, Jämtland County Council, Stockholm County Council, Skåne region, Western Götaland, Uppsala County Council and the County Council of Östergötland.

The goal

The aim is to create better opportunities for health care providers and counties to monitor and analyze the provided care and to develop compensation systems that enable and encourage innovation and business development. In this way, the Sveus contributes towards:

- A patient-centered and equal care system, which on the basis of available resources provides the population with the best possible healthcare
- A stimulating environment for those who work in healthcare

Development team

Elective hip and knee replacement is one of the eight groups of patients who are currently part of Sveus and Sveus is creating a development group with representatives from the Swedish Orthopaedic Association, Hip and Knee Arthroplasty Registers and healthcare providers' representatives from the county councils. The work will enable:

Comparisons between county councils/healthcare providers

The development team uses existing data to define follow-up measures that are relevant and specifies how these can be measured and monitored. Based on this, analyses of differences in case-mix, health outcomes and resource utilization between counties and between healthcare providers will be carried out. The goal is to create new knowledge about how healthcare can be improved.

Automated monitoring systems

Based on the conducted analyses, new methods will be developed for continuous monitoring of health services. The aim is to facilitate both the work of healthcare providers with business development, as well as county councils' work with planning and monitoring. The systems, which are based on existing data, will among other things contribute to:

- Continuous, timely feedback and identification of anomalies
- Analysis over time and comparisons between different healthcare providers and counties
- Comparisons between healthcare providers among different populations

Value-based compensation system

The principle of value-based compensation is to reward those healthcare providers who achieve good health outcomes and patient satisfaction with as low consumption of resources as possible. This often means increased competencies and increased responsibility for healthcare providers to stimulate innovation and value creation.

Value-based monitoring and compensations of elective hip and knee implants

The development team defines 30–40 key figures that can be created from available data sources, such as patient administration systems and quality registers. In the future, the plan is to be able to integrate socio-economic variables and information from the Social Insurance Agency. The key figures are divided into:

- Patient characteristics
  - For example age, sex, comorbidity
- Health outcomes
  - For example reoperations, revisions, non-orthopedic adverse events, PROM
- Process measurement
  - For example volumes, types of prostheses, rehabilitation, geriatrics, physiotherapy, underlying diagnoses, lengths of stay and other resources

Based on the monitoring systems, that are being developed, the principles and definitions of the development team will be defined for a value-based compensation model, which is described here briefly. For elective hip and knee prostheses the preliminary model is based on case-mix-adjusted care episode compensation (bundled payment) which is also modified twelve months after surgery based on case-mix-adjusted patient-reported outcomes. In other words, each patient gets compensation based on the underlying diagnosis and other patient characteristics that influence care and surgical outcome.

Bundled payment for care provider should include all the care that the patient is expected to need over two years, including rehab, geriatrics, and physical therapy and the risk of potentially

avoidable adverse events in hospital. The healthcare provider will thus be financially responsible for defined adverse events during the length of the care episode. Therefore, healthcare providers are given more opportunities to invest in their care process and are not punished financially when eliminating unvaluable care contacts.

The key figures and evidence for the compensation model is tested and refined in a research database containing approximately 90,000 primary hip and knee arthroplasties from the participating counties.

The development work will be completed during 2014. For further information on value-based monitoring and compensation of elective hip and knee replacement, Sveus and value-based care in general, there is the possibility to visit Sveus' two-day conference (25–26 November 2014) with national and international experts on value-based care present. During the conference, the theory of value-based care, early results from Sveus' work and other interesting initiatives in Sweden and abroad will be presented and discussed. More information and contact details on www.sveus.se.

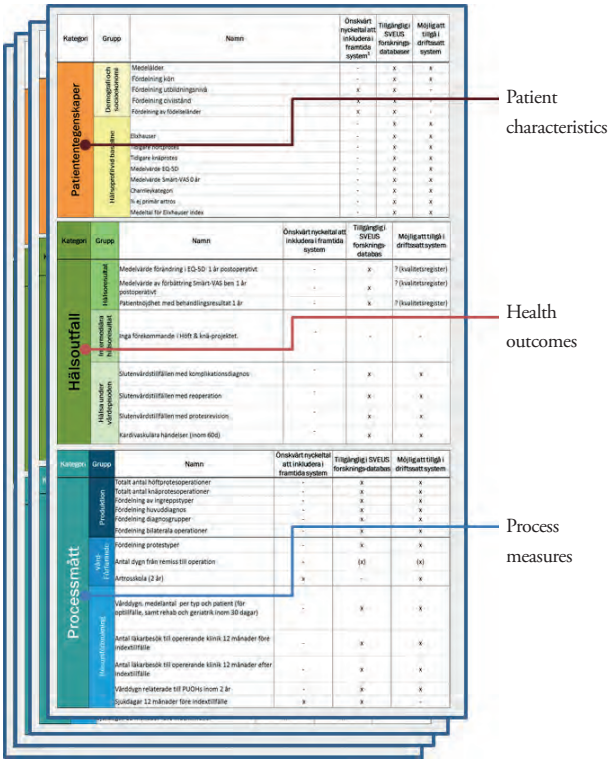


Figure 1. All development teams define key figures which are relevant to each patient.

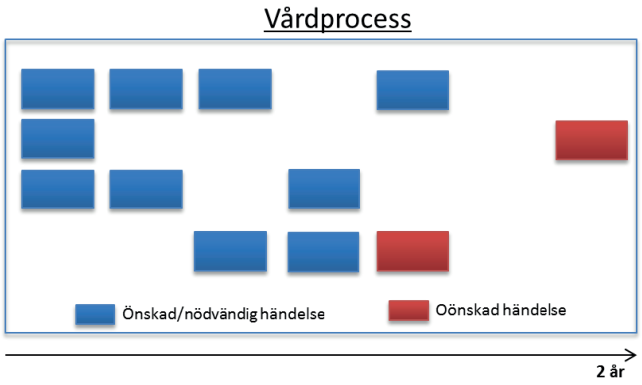


Figure 2. Scheme of the care episode compensation.

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Swedish Hip Arthroplasty Register

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