The Swedish Hip Arthroplasty Register

Annual Report 2016

FOR YEAR 2016

The Swedish Hip Arthroplasty Register

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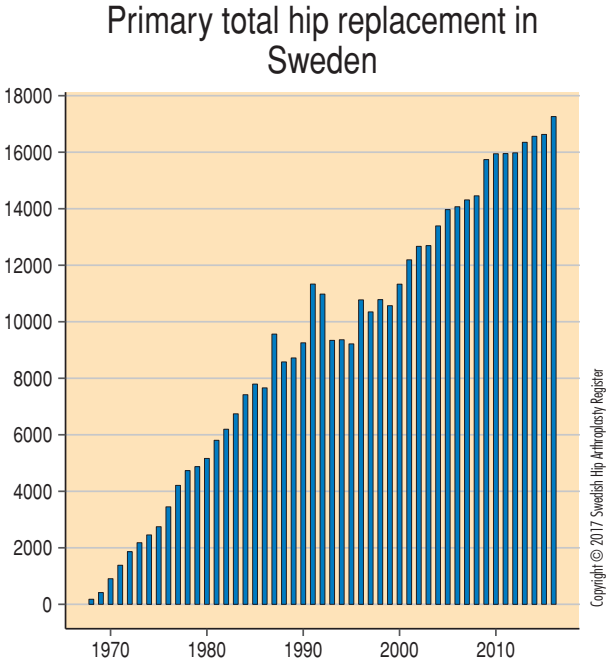
Footnote. A number of descriptive tables have been removed from our printed annual report and are published only on our website.
Refer to "Tables", www.shpr.se/sv/Publications/DocumentsReports.aspx

1 Introduction

Welcome to the Annual Report 2016 of the Swedish Hip Arthroplasty Register. Although the report looks similar to reports from recent years, the whole process of assembling the annual report has been revised. This is due to the fact that in January 2017 we launched a new version of the Register, which included, among other things, modernising the content to better describe the hip arthroplasties performed today. We moved the Register to a new IT platform which gives us several advantages, for example, better validation of entered data and simpler and faster way of presenting the register data. The move to the new IT platform meant that all the programming was carried out from scratch to obtain all the tables and graphs for the report.

The Swedish Hip Arthroplasty Register is a national quality register with the aim of improving care for patients who undergo hip replacement procedure in Sweden. The intention is to register all hip arthroplasty operations regardless whether the operation takes place in a public or private establishment and regardless of the condition which leads to the operation. The Register became active in 1979 and the report presents operations that were carried out by 31st of December 2016, which concluded the 38th operational year for the Register.



Number of primary total hip replacement operations, which have been carried out in Sweden from 1967 (6 operations) to 2016 (17 261 operations).

1.1 This year's production

During 2016, the production increased and for the first time, more than 17 000 primary total arthroplasties were performed. To be more accurate, 17 261 total arthroplasties were performed, which corresponds to 173 procedures per 100 000 inhabitants. 4 130 primary hemiarthroplasties were performed, which was slightly less than in the previous year, however, in total, 6158 hip arthroplasties were carried out due to acute hip fracture or sequelae after fracture, which together with the year 2013 is the highest level of registration in the Register's history. In total, over 2 500 reoperations were registered.

1.2 Validation process and publishing

The Register data is continuously validated and controlled for quality. We use several methods to ensure and maintain high level of data quality and to facilitate improvement work in areas with shortcomings. An important part in validation work is the annual completeness analysis which is carried out via an linkage to the Patient Register at the National Board of Health and Welfare. The analysis includes all primary surgeries, divided into total and hemiarthroplasties. Since there is often a delay during autumn before the data from the Patient Register for the previous year is ready, we have now decided to publish the completeness analysis for the year 2015. 98% of all total arthroplasties and 97% of all hemiarthroplasties have been registered in the Hip Arthroplasty Register. In the Register's follow-up routine with patient-reported outcomes, the PROM programme (patient-reported outcome measures), the response rate for patients with osteoarthritis that were operated on during 2015 was 85% both preoperatively and during one-year follow-up.

1.3 Cover image

This year's cover image illustrates our ongoing work with trying to understand how comorbidity influences patient-reported outcomes and the risk of being affected by complications. In April 2017, Anne Garland defended the Register-based thesis "Early mortality after total hip replacement in Sweden" which studies in detail how different comorbidities and comorbidity index may predict mortality. A summary of the thesis is presented in this report. Also, a ST project by Johan Larsson in Kungälv is presented, which focuses on the relationsship between anaemia and patient-reported outcomes. Successful hip replacement requires a thourough evaluation of risks and expected benefits and the identification and elimation of risk factors before the operation. Make sure the patients declare any health problems preoperatively.

1.4 In-depth analyses and improvement work

From this year's detailed in-depth analysis of new prostheses, it is possible to state that the majority of the prostheses that are in use in Sweden have a low risk of being revised. From the prostheses which have been introduced during the last decade, the majority has as good or somewhat lower risk for

revision than the control group. However, we want to point out that since there is a lack of long-term data with regard to uncemented cups with trabecular coating, caution should be taken.

This year's report presents several student works at different levels of education. In a doctoral research project, the effects of introduction of structured care processes, which include mobilisation on the day of the operation, short length of stay and functional discharge criteria (fast track) with the focus on patient safety, are analysed. Preliminary results show that complications and re-admissions within 90 days after the introduction of fast track are just as (un)common in Västra Götaland.

As part of another research project, Per Jolbäck has studied whether surgeon's experience plays a role in patient-reported outcomes. Inexperienced orthopaedists operate on older, while the more experienced orthopaedists operate largely on younger patients, but there are no differences in the results.

A master thesis studied the connection between physiotherapy/Artrosskola and PROM one year after the operation. Another student work studied if there were any differences between thromboembolic events between new oral anticoagulants and low molecular weight heparin.

1.5 The Swedish Hip Arthroplasty Register and clinical research

It is pleasing to see that the interest for researching with the Hip Arthroplasty Register is this big. We have pursued a strategic work within the Register in order to improve the infrastructure and this way to increase and strengthen the research activity. This has turned out well, which is, among other things, noticeable by the fact that we have 24 doctoral students working with the Register. The doctoral students base their research works entirely or partially on the data from the Swedish Hip Arthroplasty Register and represent seven universities (Uppsala University, Lund University, Gothenburg University, Umeå University, Linköping University, Karolinska Institute and Örebro University). In 2015 and 2016, 31 peer-reviewed articles from the Register were published. A strong contributing factor to the steadily increasing research activity is that the Register now has two biostaticians who work full-time at the Register.

Karin Lindborg, Karin Pettersson and Kajsa Erikson at the Register's 30th anniversary in 2009. At this point, Karin Davidsson had not yet started working at the Register.

1.6 Ongoing development projects

- Developing of a system for automatic monitoring of implant survival
- Developing of a system for indicating which patients should be followed up based on PROM, demographics and operation variables
- Investigating and developing of a system for allowing individual surgeons to analyse the results from their own surgeries
- Developing of a new service for the implant industry
- Continued development of an interactive statistical module for the participating clinics
- Developing of a decision support which can provide individual information about risks and expected benefits of the operation

1.7 Our thanks to all contributors

A prerequisite for a functional Hip Arthroplasty Register is that clinics register and provide necessary information. We appreciate all the dedication and work that the contact secretaries and contact doctors all over the country provide. Many thanks for all contributions during the past year.

The Register management also wants to send a sincere thank you to Karin Lindborg, Karin Davidsson and Karin Pettersson who, after many years as register coordinators, finished their work at the Hip Arthroplasty Register. Enthusiastically, the Karin trio has run the Register's daily activities and development with earnest tidiness, great patience and willingness. From now on, Karin Pettersson will keep being active within the quality register sphere as she now works fulltime with the Fracture Register.

Finally, we would like to point out that Kajsa Erikson has retired after over 30 years as a coordinator for the Register. Kajsa has had a crucial role in the Register's favourable development and continuously ensuring the high quality of data. For many years, the Register has depended on Kajsa's experience, knowledge and commitment. We are pleased that Kajsa is going to continue part-time, including with the management and training of new employees.

Gothenburg in September 2017

The Register's management

2 Data quality and the Register's validation process

The Register data is continuously validated and controlled for quality. We use several methods to ensure and maintain high level of data quality and to facilitate improvement work in areas with shortcomings.

An important part in validation work is the annual completeness analysis which is carried out via linkage to the Patient Register at the National Board of Health and Welfare. The analysis includes all primary surgeries, divided into total and hemiarthroplasties. Since there is often a delay during autumn before the data from the Patient Register for the previous year is ready, we have now decided to publish the completeness analysis for the year 2015.

Another important aspect of validation is that all registered reoperations are checked by our register coordinators who also fill in a questionnaire based on registrations (admission and discharge and surgical reports), which are sent to the Register.

In addition to coverage analysis, in this chapter, we present an analysis of PROM programme's data quality, a validation of reoperation data at three hospitals in the Västra Götaland region and an overview of our local monitoring visits.

2.1 PROM programme's data quality

From 2008, the clinics which carry out hip replacement surgeries in Sweden have taken part in the Register's follow-up routine for patient-reported outcomes – the PROMs programme. The response rate for the preoperative form, which for natural reasons is meant for elective patients, has been very high. Among osteoarthritis patients, the preoperative response rate has varied between 86% and 89% since 2011. At one-year follow-up, the response frequency for the past years has been between 87% and 92% among osteoarthritis patients. The total loss, if both the preoperative and postoperative responses are included, is around 20%. While the preoperative response rate has been fairly stable over time, there has been a slight deterioration of the response rate at one-year follow-up in recent years. We know from experience that there is some delay with the registration and reminders and therefore, the response rate may increase somewhat for 2015. The fact that this year's values differ from the previous year is due to the fact that we added a time interval in relation to the operation date for when the preoperative and postoperative questionnaire responses are considered as valid.

	2012	2013	2014	2015
All operations with a total hip replacement				
Total number of operations	16 028	16 350	16 563	16 629
Deceased within one year	345	331	330	317
Reoperated within one year	295	322	311	282
Included in the routine follow-up within one year	15 388	15 697	15 922	16 030
No preoperative response	3 333	3 497	3 661	4 014
Proportion of all (%)	21.7%	22.3%	23%	25%
No preoperative response within one year	2 042	2 316	2 646	2 948
Proportion of those who are included in the follow-up routine (%)	13.3%	14.8%	16.6%	18.4%
No preoperative or postoperative response within one year	4 626	4 953	5 309	5 830
Proportion of those who are included in the follow-up routine (%)	30.1%	31.6%	33.3%	36.4%
All operations with total hip replacement due to primary osteoarthritis				
Total number of operations	13 004	13 088	13 369	13 443
Deceased within one year	129	102	89	106
Reoperated within one year	210	222	204	195
Included in the routine follow-up within one year	12 665	12 764	13 076	13 142
No preoperative response	1 561	1 471	1 629	1 890
Proportion of all (%)	12.3%	11.5%	12.5%	14.4%
No preoperative response within one year	1 280	1 521	1 725	1 959
Proportion of those who are included in the follow-up routine (%)	10.1%	11.9%	13.2%	14.9%
No preoperative or postoperative response within one year	2 648	2 724	3 033	3 463
Proportion of those who are included in the follow-up routine (%)	20.9%	21.3%	23.2%	26.4%

Since the input mode of the PROM database requires all questions be answered, all the registered questionnaires are fully completed. Contact Secretaries can supplement incomplete surveys by contacting the patient via telephone or letter. If a response previosly were missing in a survey, none of the responseses in that form could be registered in the database. In our new platform (Stratum), which was introduced in January 2017, it is possible to register incomplete PROM questionnaires, but the system gives a warning message in case some of the questions are left unanswered.

2.2 Completeness

The Swedish Hip Arthroplasty Register has now chosen to use the data based on the Patient Register from the year which preceded the actual business year. This is due to the fact, that we have for many years received this data from the National Board of Health and Welfare with a nine to eleven-month delay. One of the reasons is that some counties have been late when reporting their data to the National Board of Health and Welfare. Therefore, we publish once again the completeness analysis based on the figures of 2015, thus a repetition of last year's chapter in order to be in line with future reports.

A high completness of registrations is one of the most important factors for a register's data quality and the possibility to carry out operational analyses and clinical research. Completness should be indicated on an individual level. 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 highlight completeness.

Method

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

Weaknesses in the analyses

1. *Laterality*. In most cases, the patient register lacks laterality, i.e. right or left is not indicated as a unique variable. Patients operated with one-stage or two-stage bilateral total hip replacement "are considered" as operations in PAR. In 2015, 475 patients were operated bilaterally (75 in one session), which is why a number of procedures are not covered by the analysis.Sweden's PAS-systems lack the laterality variable (right/left), which leads to suboptimal statistical utility of these databases for diseases involving paired organs.
2. *Lag in registration*. Certain units have a certain amount of lag – not so seldom after the New Year, which is a great disadvantage with this type of necessary quality control. Usually, another 0.5% to 1.0% are reported to the Register during the subsequent year.
3. *Administrative fusions of hospitals*. Differences in completeness may depend on the fact that hospitals report to the PAR via 'the principal hospital' and to the Register via the unit where the operation was performed or vice versa The Swedish Hip Arthroplasty Register has always and will always state hospital affiliation to the hospital/operational environment where the actual intervention is performed.

Results

Total hip replacements. Completeness for the country at large for 2015 was 98.3%. 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. Departments with values less than one standard deviation below the national mean are marked with red in the table. 20 units received this marking regarding the completeness in the register during 2015. The deviations for most of the hospitals are small, but despite the high national average, there is always room for improvement.

Hemiarthroplasties. Hemiarthroplasty registration has been going on for more than 10 years and completeness on a national level is relatively unchanged (marginal increase) at 97.5%. 12 units are marked red.

Reporting

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

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

- Monitoring of the hospitals. Refer to the respective chapter.
- A continuous appeal to all operational managers to work locally towards a better code-setting culture in their units.
- Each unit should review its routines for reporting reoperations, which is a **broader concept than revision** – "any kind of further surgery".
- Actively work towards an obligatory addition to the country's local, regional and national patient administrative systems (PAS).

The Swedish Hip Arthroplasty Register has always and always will state hospital affiliation to the hospital body/ operational environment where the intervention in question has been carried out.

Completeness for total arthroplasties in 2015

Unit	Number[1]	Hip Arthroplasty Register[2]	Patient Register[3]
University or regional hospitals			
Karolinska/Huddinge	241	98.8	94.7
Karolinska/Solna	191	97.4	99.0
Linköping	70	94.6	97.3
SU/Mölndal	593	97.2	97.4
SUS/Lund	177	97.3	97.3
SUS/Malmö	22	100.0	95.5
Umeå	103	97.2	97.2
Uppsala	233	98.7	98.3
Örebro	74	98.7	100.0
County hospitals			
Borås-Skene	283	97.9	96.2
Danderyd	329	96.5	98.8
Eksjö	244	98.0	98.4
Eskilstuna	109	99.1	98.2
Falun	254	97.3	99.2
Gävle	248	95.4	92.7
Halmstad	236	99.2	97.9
Helsingborg	181	95.3	97.9
Hässleholm-Kristianstad	804	99.6	99.4
Jönköping	160	98.2	98.8
Kalmar	174	97.8	99.4
Karlskrona-Karlshamn	289	98.6	97.6
Karlstad	195	91.1	91.6
Lidköping-Skövde	441	98.7	96.2
Norrköping	250	98.8	96.8
Sunderbyn	40	93.0	93.0
Sundsvall	84	98.8	98.8
Södersjukhuset	390	98.7	99.2
Uddevalla	373	98.7	98.7
Varberg	187	99.5	98.9
Västerås	375	97.4	97.7
Växjö	148	97.4	99.3
Östersund	257	93.8	79.2
Rural hospitals			
Alingsås	197	98.5	96.5
Arvika	192	96.0	97.5
Enköping	346	99.7	99.4
Frölunda Specialistsjukhus	83	97.6	96.5
Gällivare	93	100.0	98.9
Hudiksvall	137	100.0	99.3
Karlskoga	186	98.4	97.9
Katrineholm	219	98.6	99.1
Kungälv	185	100.0	98.4
Lindesberg	214	100.0	99.5
Ljungby	152	98.1	97.4
Lycksele	334	99.4	99.4
Mora	241	97.6	99.6
Norrtälje	128	100.0	100.0
Nyköping	147	99.3	98.6
Oskarshamn	289	99.7	100.0
Piteå	329	99.4	99.7
Skellefteå	126	100.0	100.0
Sollefteå	139	100.0	99.3
Södertälje	119	98.3	97.5
Torsby	118	100.0	95.8
Trelleborg	657	99.8	98.6
Visby	135	99.3	96.3
Värnamo	133	97.8	97.8
Västervik	97	99.0	100.0
Ängelholm	130	99.2	0.8
Örnsköldsvik	203	99.0	100.0
Private hospitals			
Aleris Specialistvård Bollnäs	306	99.4	96.4
Aleris Specialistvård Motala	579	99.7	99.8
Aleris Specialistvård Nacka	218	98.2	98.2
Aleris Specialistvård Sabbatsberg	24	100.0	75.0
Art Clinic Göteborg	25	100.0	0
Art clinic Jönköping	20	100.0	0
Capio Movement Halmstad	304	100.0	0
Capio Ortopediska Huset	472	98.3	66.7
Capio S:t Göran	506	94.1	97.4
Carlanderska	140	100.0	0
Hermelinen Spec.vård	11	100.0	0
Ortho Center IFK-klinike	127	100.0	0
Ortho Center Stockholm	495	99.6	57.9
Sophiahemmet	220	100.0	0
Country	16 531	98.3	90.0

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

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

Completeness for hemiarthroplasties in 2015

Unit	Number[1)]	Hip Arthroplasty Register[2)]	Patient Register[3)]
University or regional hospitals			
Karolinska/Huddinge	71	92.2	92.2
Karolinska/Solna	66	100	90.9
Linköping	92	98.9	96.8
SU/Mölndal	275	97.8	91.4
SUS/Lund	184	98.9	94.1
SUS/Malmö	208	99.5	96.7
Umeå	50	100	100
Uppsala	110	99.1	96.4
Örebro	48	100	91.7
County hospitals			
Borås-Skene	86	96.6	93.3
Danderyd	162	96.4	91.1
Eksjö	53	96.4	92.7
Eskilstuna	63	100	90.5
Falun	147	98.7	92.6
Gävle	64	98.4	90.7
Halmstad	66	98.5	95.5
Helsingborg	171	98.9	97.2
Hässleholm-Kristianstad	118	99.2	92.4
Jönköping	44	97.7	95.5
Kalmar	49	100	89.8
Karlskrona-Karlshamn	98	96.1	89.2
Karlstad	87	93.5	87.1
Lidköping-Skövde	121	96.1	96.1
Norrköping	64	100	96.9
Sunderbyn	119	96.8	96
Sundsvall	97	100	91.8
Södersjukhuset	237	99.5	97
Uddevalla	201	99.5	95.5
Västerås	21	100	95.2
Växjö	39	86.6	97.7
Ystad	27	100	92.6
Östersund	85	98.8	77.9

Unit	Number[1)]	Hip Arthroplasty Register[2)]	Patient Register[3)]
Rural hospitals			
Alingsås	41	97.6	88.1
Gällivare	33	100	100
Hudiksvall	42	100	97.6
Karlskoga	34	97.1	94.3
Kungälv	57	98.3	91.4
Lindesberg	11	100	100
Ljungby	29	96.6	96.6
Lycksele	20	95.3	85.8
Mora	67	100	98.5
Norrtälje	36	94.7	92.1
Skellefteå	21	91.3	91.3
Sollefteå	16	100	81.3
Södertälje	35	97.2	97.2
Torsby	34	100	97.1
Visby	14	93.3	86.7
Värnamo	25	89.3	100
Västervik	36	90	97.5
Örnsköldsvik	32	100	93.8
Private hospitals			
Aleris Specialistvård Motala	46	100	93.5
Capio S:t Göran	167	93.8	97.2
Country	4 200	97.4	93.9

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

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

2.3 Monitoring – a validation process

The aim of monitoring is to validate the unit's registrations of both primary arthroplasties and reoperations. We refer to previous annual reports for details about how the monitoring process takes place.

Monitoring has now taken place for five years and 28 units have been visited. For 2015 and 2016, we applied for financial support, but this is no longer available. Due to this, we will evaluate our activities during autumn 2017, and the management of the Register will then decide on the extent and form of the monitoring in the future. However, personal visits to different units have a significant value, but the circulation of contact secretaries is high and half of the units which were monitored have changed their contact secretaries since then.

Recently, we have experienced that it has been difficult for the units to provide us with the necessary data before the monitoring visit. The variables we request are used to simplify and speed up monitoring at the site. It is somewhat surprising that in today's information society not all units are able to provide data which may be considered rather basic, such as operation date, ICD10 and measure codes.

The results from monitoring to date

The monitoring has confirmed what we have previously pointed out through interlinking with PAR, namely that there were only a few primary operations which were not reported to the Swedish Hip Arthroplasty Register (SHAR). A reason for this may be that the patients had been relocated to a department outside their own unit.

Regarding operations, failing to report is somewhat more common. Here, the shortfall has been partially due to the fact that the staff were not aware of what types of reoperations that must be registered (for example, debridement/irrigation, secondary suture, fracture reconstruction without replacement of prosthesis components, open reduction of dislocated prosthesis).

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

Discussion

All in all, the monitoring shows that the reporting to the Register maintains a high quality. Regardless of the cause, reoperation is considered as a serious complication. However, small reporting mistakes may influence the statistics because it has to do with relatively uncommon events. Local monitoring is one way to ensure that data is as complete as possible. However, this is resource-intensive and therefore, we will evaluate the method in order to make a decision on how we can help units to continue maintaining the high quality of reporting.

3 Equality and gender equality in hip replacement

Ever since the beginning of the Hip Arthroplasty Register's activities, the incidence for total hip arthroplasty has steadily increased in Sweden, although the increase during recent years has not been as strong as previously. In 2015, 16 609 total hip arthroplasties were performed and in 2016, roughly 17 200 operations were carried out. Additional analysis is presented in chapter 3.1.

Equality in health care in Sweden is regulated by law (section 2 of the Health Care Act), and similarly to previous years, the Register focuses on this topic. Equality is primarily based on the demographic and socio-economic variables, but may also be related to where the patient is living in the country. The 21 county councils/regions have autonomy over their medical care but must follow the act mentioned above. This is analysed in chapter 3.2.

We also follow the gender equality perspective, which is presented in chapters 3.3 and 3.4 below.

3.1 Total hip replacement in Sweden

Incidence

Since the Register began its work, the incidences for total hip replacement operations have steadily increased in Sweden. During 2016, 17 261 total hip replacement operations were carried out in Sweden, which corresponds to 339 procedures per 100 000 inhabitants aged 40 and older. There is an increase by 10 units since 2015. In an international comparison of the countries reporting procedure frequency in national quality registers, Sweden has one of the highest incidences. A natural explanation for the increasing incidence is that life expectancy is increasing and that the proportion of older people among the population increases.

Prevalence

We have also studied how prevalence has changed over the years. Since calculation requires information on the possible death date, we have not been able to include those who had surgery before 1992 when individual registration begun. In the analysis, we have therefore included all patients after 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 2016, 170 530 people had had at least one total hip replacement performed after 1991. This implies that 3.3% of the population aged 40 years or older had total hip replacement, which is an increase of 0.1% compared to the previous year. 41 827 (26%) of these had bilateral prostheses. In 2016, 1.7% of the Swedish population had undergone at least one total hip replacement after 1991. Prevalence was lower for men (2.8%) compared to women (3.8%).

Of those who had undergone total hip replacement surgery in 1992, 15% were alive at the end of 2016. The later it is studied, the more accurately the figures reflect the "true" prevalence. The number of people who had surgery before 1992 and were still alive in the late 2016 was, if not negligible, relatively low. Since the incidence has steadily increased, prevalence has also increased. As an example, the prevalence per 100 000 people aged 40 years or older has increased by 16% between 2011 and 2016.

Number per age group	2001	2006	2011	2016
<40	634	783	867	839
40–49	1 599	2 330	3 252	3 393
50–59	6 922	8 704	10 314	12 407
60–69	15 943	24 899	33 061	34 283
70–79	27 456	36 395	46 483	62 137
80–89	20 713	31 048	38 214	46 047
90 +	2 495	4 874	8 226	11 424
Total	75 762	109 033	140 417	170 530
Prevalence per 100 000 >=40	1 706	2 342	2 878	3 331
Men				
<40	241	329	397	399
40–49	763	1 195	1 749	1 836
50–59	3 346	4 260	5 310	6 578
60–69	7 024	11 335	15 224	16 197
70–79	10 892	14 625	19 015	26 173
80–89	6 508	10 124	12 922	16 237
90 +	494	1 097	2 031	2 859
Total	29 268	42 965	56 648	70 279
Prevalence per 100 000 >=40	1 380	1 915	2 391	2 808
Women				
<40	393	454	470	440
40–49	836	1 135	1 503	1 557
50–59	3 576	4 444	5 004	5 829
60–69	8 919	13 564	17 837	18 086
70–79	16 564	21 770	27 468	35 964
80–89	14 205	20 924	25 292	29 810
90 +	2 001	3 777	6 195	8 565
Total	46 494	66 068	83 769	100 251
Prevalence per 100 000 >=40	2 004	2 740	3 336	3 831

Number of people in Sweden with bilateral hip prosthesis

Number per age group	2001	2006	2011	2016
<40	147	173	192	161
40–49	258	423	637	707
50–59	1 215	1 754	2 128	2 831
60–69	2 817	5 400	7 945	8 632
70–79	3 996	7 426	11 827	16 976
80–89	2 352	5 351	8 435	12 239
90 +	189	556	1 487	2 469
Total	10 974	21 083	32 651	44 015
Prevalence per 100 000 >=40	246	452	669	861

3.2 Geographic inequality

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Master Thesis in Health Economics
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The concept of equal health care is based on attitude that care and treatment is being offered on same terms to all regardless of factors, such as age, gender, level of education or place of residence. The Register has for a long time published materials and articles about the differences in patient-reported outcomes in general equality factors, such as age, gender and socio-economic status. Several years ago, the Register also presented maps of Sweden about the differences in regions with regard to production and usage. In this year's report, the maps of Sweden are presented about the differences in patient-reported outcomes for osteoarthritis patients.

The PROM programme

The Register's preoperative patient-reported outcome measures include EQ-5D, EQ VAS and pain on a visual analogue scale. The postoperative questionnaire includes also a VAS question regarding patient's satisfaction with the result of the operation. In this analysis, the mean value for years 2008 to 2012 for different regions is presented.

The results show geographic inequality

The results show that even after adjustment for gender, age, level of education, income, comorbidity, BMI, relationship status and preoperative patient-reported outcome value, the regions differ. After adjustment for the common equality factors (the Register has for a long time showed that these influence patient-reported outcomes), the geographical differences may be considered as geographical inequality on the regional level.

Variation in the procedural frequency is present on the international level

In Sweden, counties and regions are responsible for health care. With a decentralized health care, the regional differences in health care can become apparent, similarly to those presented here. Several studies from other countries have shown regional geographical variation in the number of operations. According to Mäkelä and co-authors (*Arch Orthop Trauma Surg 2010;130:633–639*), the number of total hip arthroplasties in 2005 was almost double in the Finnish region with the most operations when compared to the region with the smallest number of operations. A similar correlation is evident in England and Australia, where the geographical variation had a clear correlation with the socio-demographic variables (*Dixon et al. ANZ journal of surgery 2011;81(1–2):26–31* and *Judge et al. Journal of Public Health 2009;31(3):413–22*). If geographical inequality should be discussed, it is important to firstly remove the effect of socio-economic variables from the outcome, so that it would be possible to prove that the potential geographical variation that is left depends on something else.

Maps of Sweden illustrate the results

In the results presented here, the maps of Sweden are presented first, which only demonstrate that there are geographical differences on the regional level (maps 1–7). The maps 8–11 indicate counties' postoperative values after they have been adjusted for gender, age, level of education, income, comorbidity, BMI, relationship status and preoperative patient-reported outcome values. The counties, which are marked green on the maps, have better patient-reported outcomes than the standard deviation from the national mean value. As maps 1–7 show, the preoperative values could not predict the county values one year after hip arthroplasty. The preoperative outcomes show that patients in different counties have had different health-related life quality levels and pain levels already even before the operation. Certain counties have a low quality of life and high pain level before the operation (red counties on the map 1–3), which may indicate that patients have advanced osteoarthritis and may have waited longer with the operation than in the counties with a little bit better life quality and less pain than the national level (green counties on map 1–3). It is therefore interesting to note what patients' course of disease looks like already before they report their preoperative values.

Norrbotten and Jämtland have the best results after adjustment

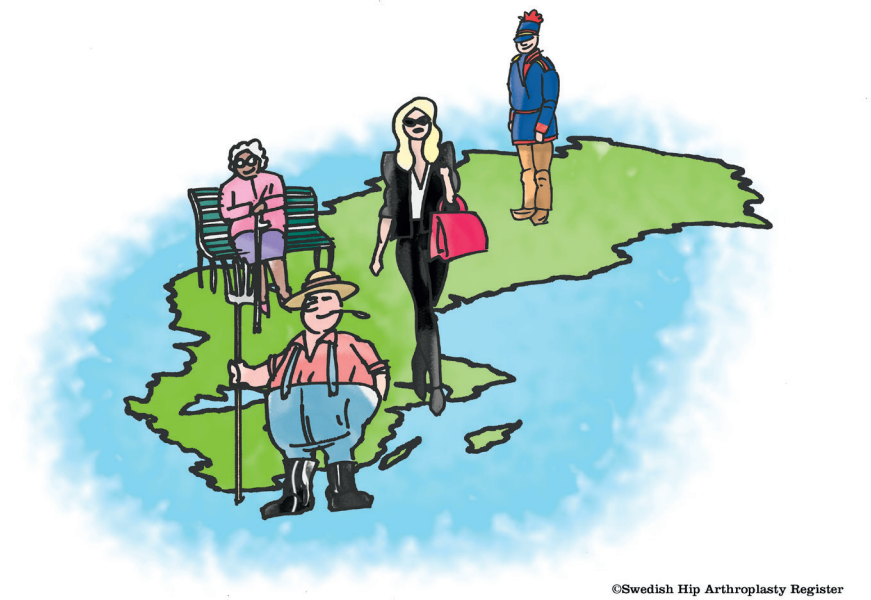
Norrbotten and Jämtland have, after adjustment, better results on all four patient-reported outcome measures. Skåne and Jämtland have better results on three of the four outcome measures. Gotland and Västra Götaland have worse results than one standard deviation from the national average on all four patient-reported outcome measures, with emphasis on patient-demographic variables. 18 of 21 counties have adjusted for postoperative values which were better than or within one standard deviation from the national average, which indicates a good hip prosthesis care, although geographic inequality is evident

Unique results

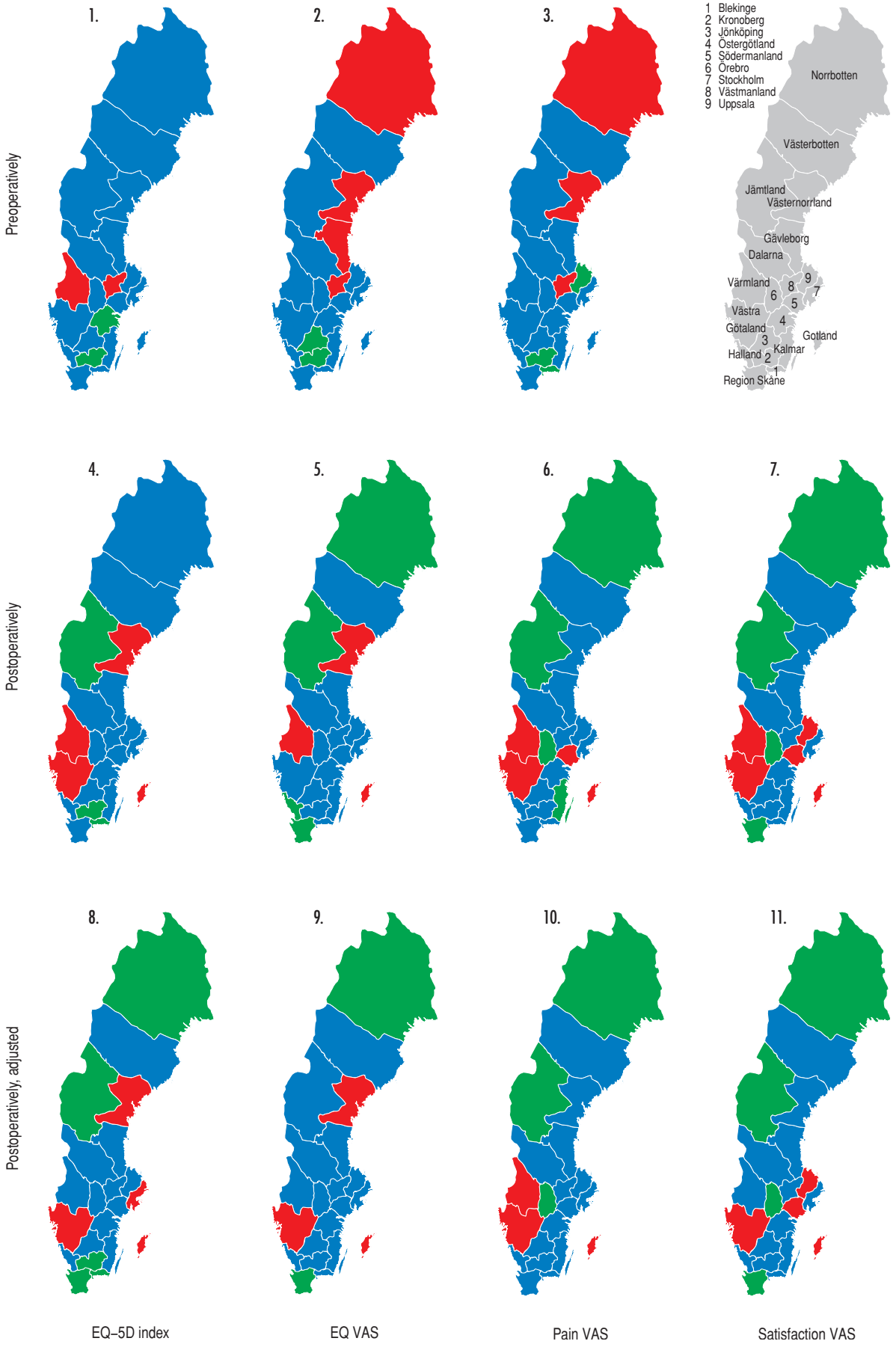
As far as we know, these are the first results of the kind, which show geographic inequality in patient-reported outcomes on county level and should therefore be of interest to decision-makers. The results indicate that the decentralised orthopaedic care in Sweden today leads to differences in the care process regarding hip arthroplasty between counties, which in turn influences the welfare of patients after the operation. For example, the patients in Norrbotten have lower health-related life quality (measured in EQ-VAS) and more pain before operation. This may depend on different patient health care seeking patterns due to distance to the nearest hospital; the patient chooses to live with pain for a longer period before visiting a doctor. Another possible reason could be that the operation is carried out sooner in the North in comparison to the South of Sweden. Conversely, the patients in Norrbotten have a better health-related life quality, less pain and were more satisfied than expected, one year after the operation. More research is necessary in order to clarify whether they experience a better recovery or whether they are more satisfied since they had so much pain before the operation took place.

Timing of surgery

Within orthopaedics, there is an on-going discussion regarding optimal timing of surgical procedure, to find the most appropriate time for the operation. The results which are presented here, may contribute to the knowledge gap by identifying those counties which have preoperative patient-reported outcome measures near the national average and better postoperative results than the national average. More research could pay attention to whether the care process in the counties differs from the care process in those counties which do not achieve the same result. On the political level, this could then contribute to standardizing the care process around hip arthroplasty in order to achieve a more equal care.



Patient-reported outcomes on county level for osteoarthritis patients



Green = better outcome than one standard deviation from the national average
Red = worse outcome than one standard deviation from the national average

3.3 Gender – osteoarthritis patients

Also in this year's report, we have chosen to continue to graphically describe the differences in the number of hip arthroplasties between men and women, in total and in different age groups. The figures 1–5 describe the proportion of women who were operated with a hip arthroplasty in comparison to men. The figures are adjusted for gender differences in the population. On the one hand, the figures describe the total number of people who have undergone hip arthroplasty, on the other hand, they describe the distribution between different age categories. It is important to note that the figures are relatively strongly magnified, due to which small changes contribute to strong changes in the data. In total, the proportion of women lies on a relatively stable level around 60%. In the group for patients younger than 55 years, it is possible to see a certain excess in men, in most of the age groups the distribution between genders lies on a relatively stable level over time. With increasing age, the proportion of women increases.

If men and women are divided into different age groups (Figure 6a and 6b), certain difference is evident. More men in the age group of <55 years and 55–64 are operated than women. In the group of women, more surgeries are carried out in the age group of >75 years in comparison to the same group among men. However, the proportion of women in this group has decreased somewhat and increased somewhat among men. In the age group of <55 years, it has been relatively stable among both men and women since 2005.

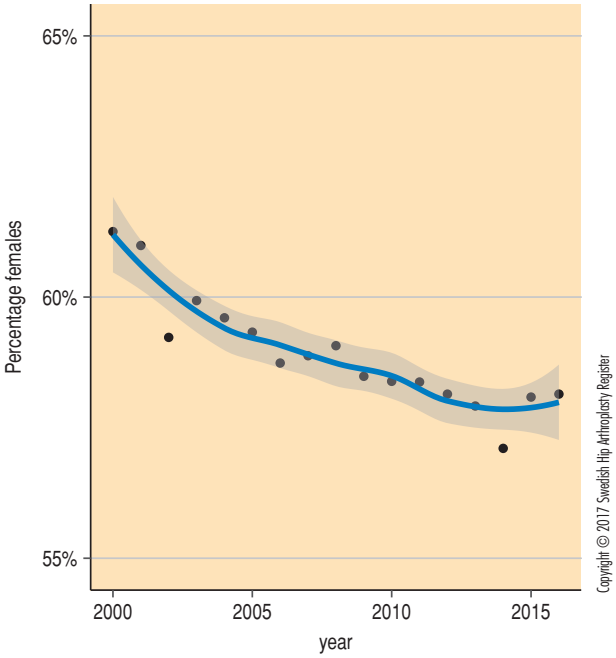


Figure 1. Total number

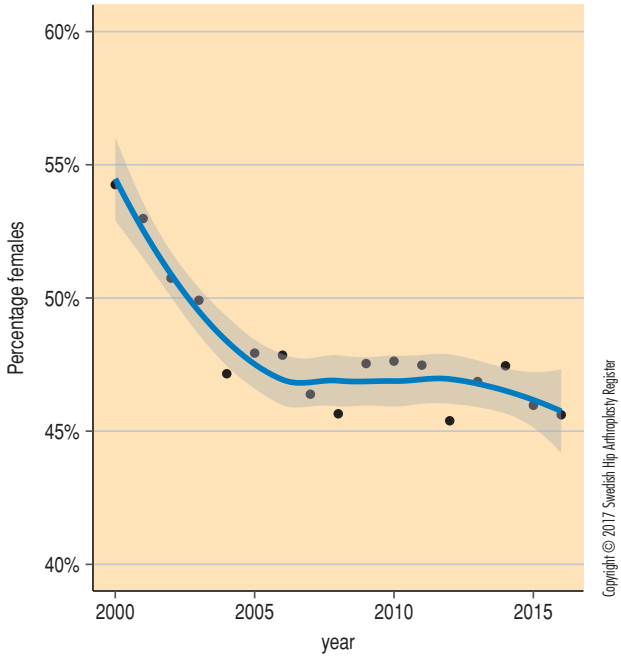


Figure 2. The age group <55 years

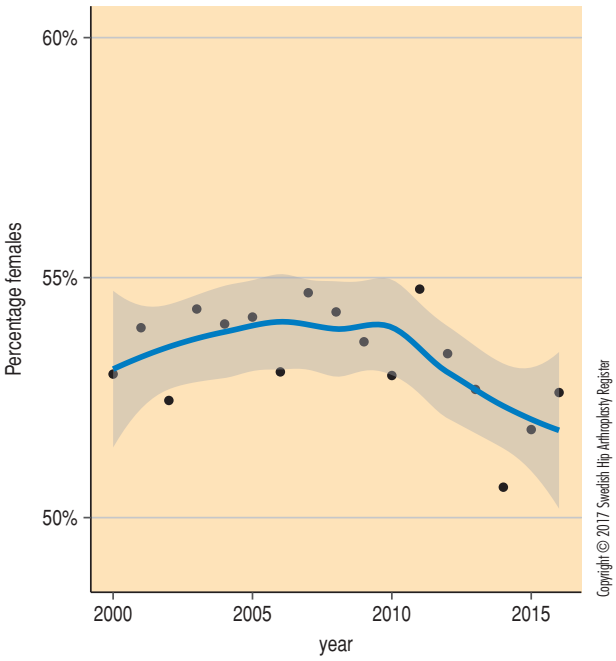


Figure 3. The age group 55–64 years

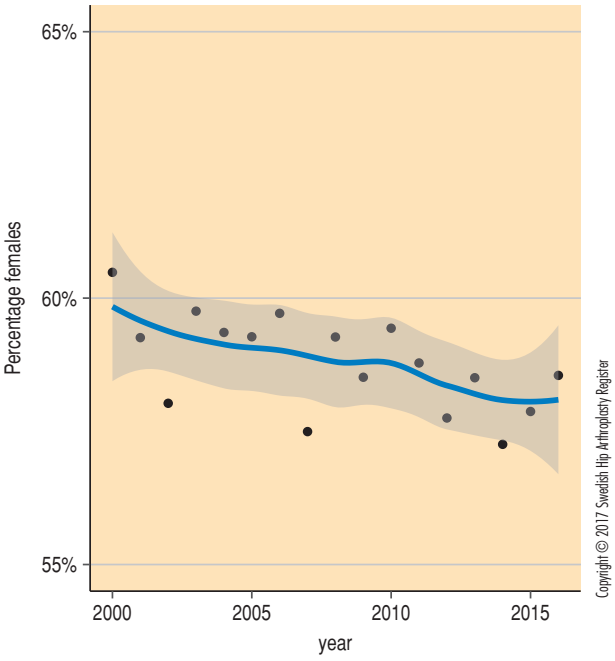


Figure 4. The age group 65–74 years

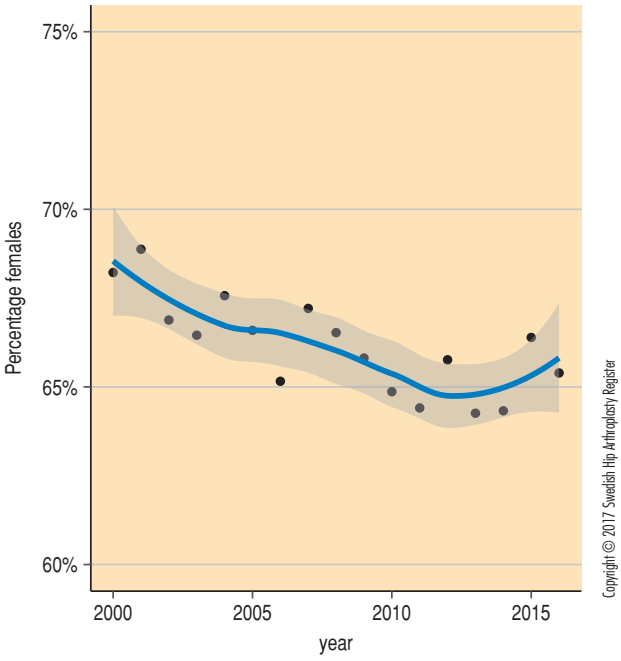


Figure 5. The age group >75 years

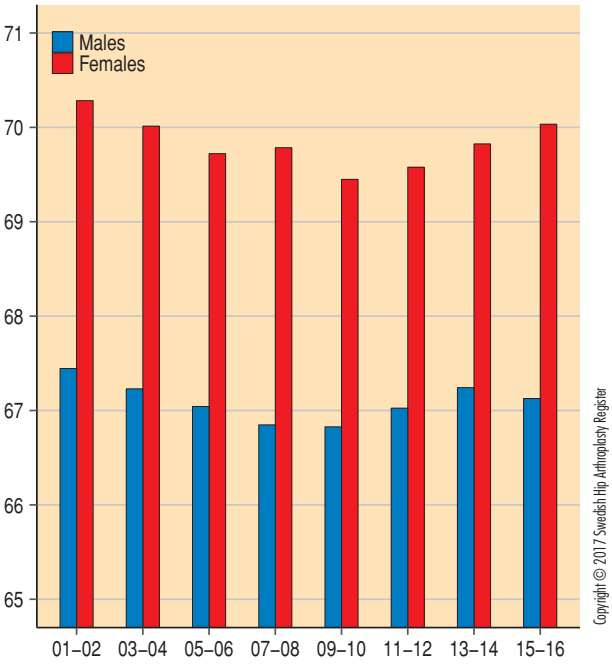
The distribution of diagnosis differs somewhat between men and women (Figure 7a and 7b). Among both men and mainly women, the diagnosis groups for sequelae and inflammatory joint diseases have decreased with an increased proportion of osteoarthritis patients. This certainly depends on the increased use of whole prosthesis in case of trauma and the advanced medical treatment of patients with rheumatoid arthritis. The group of osteoarthritis patients is clearly the most dominant.

The most common surgical approach is the posterior incision in lateral position, followed by the lateral approach.

More often, women get a cemented prosthesis and men an uncemented prosthesis (Figure 9). The fact that women receive a cemented prosthesis more often than men may depend on the fact that the mean age during the surgery is higher and that women are perceived to have a lower bone quality. It is worth pointing out that there is a small shift in the proportion of cemented and uncemented prosthesis among both men and women.

The risk factors are registered based on ASA classification (Figure 10). Similarly to previous periods, there are slightly more men in ASA class I and slightly more women in ASA class II. Generally, the changes are very small in comparison to previous periods. Possibly, the differences may depend on the fact that women have a higher mean age at the time for operation and have therefore a higher ASA class.

With regard to BMI (Figure 11), no large changes have taken place. In comparison to previous three-year period, the proportion of normal weight men has somewhat decreased and there has been a slight increase in the group Obese grade 1. As previously, the largest groups are normal weight and obese patients. Men are over-represented in the obese group and the opposite has taken place in the normal weight group.



Mean age among men and women during a 2-year period between 2001 and 2016

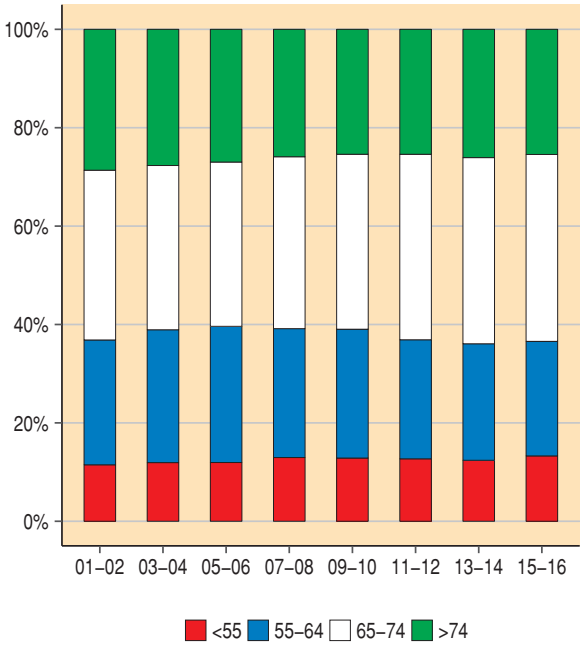


Figure 6a. Distribution of men in four groups according to age during 2001–2016.

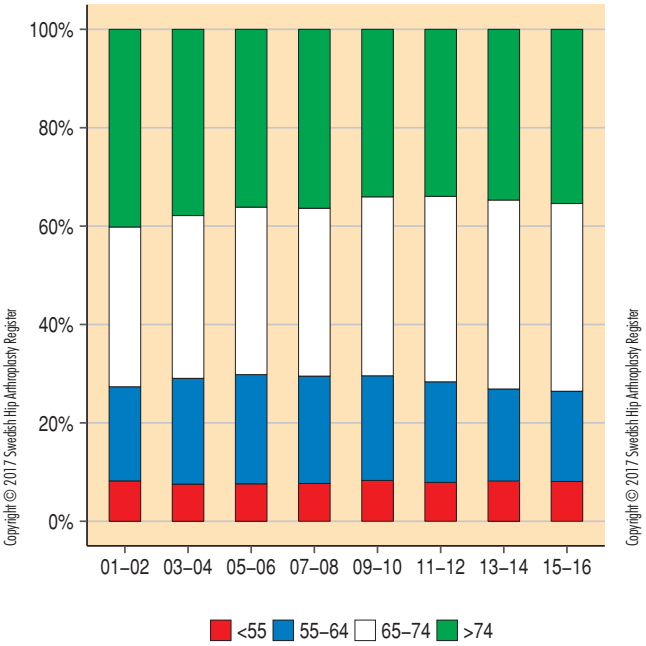


Figure 6b. Distribution of women in four groups according to age during 2001–2016.

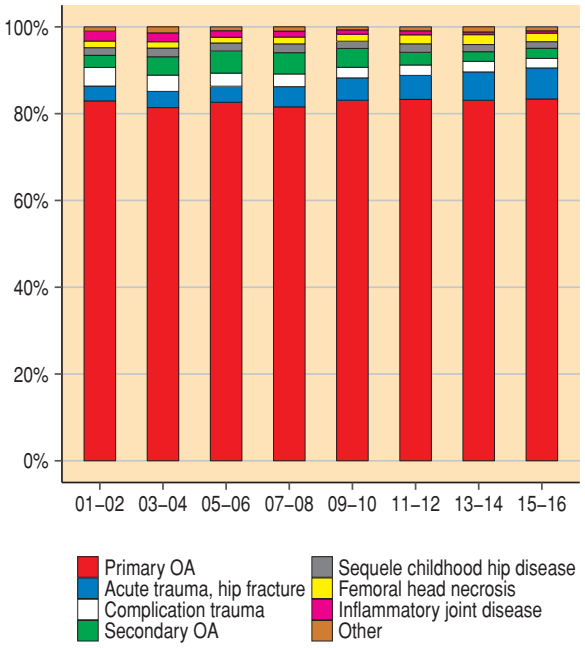


Figure 7a. Distribution of diagnosis among men.

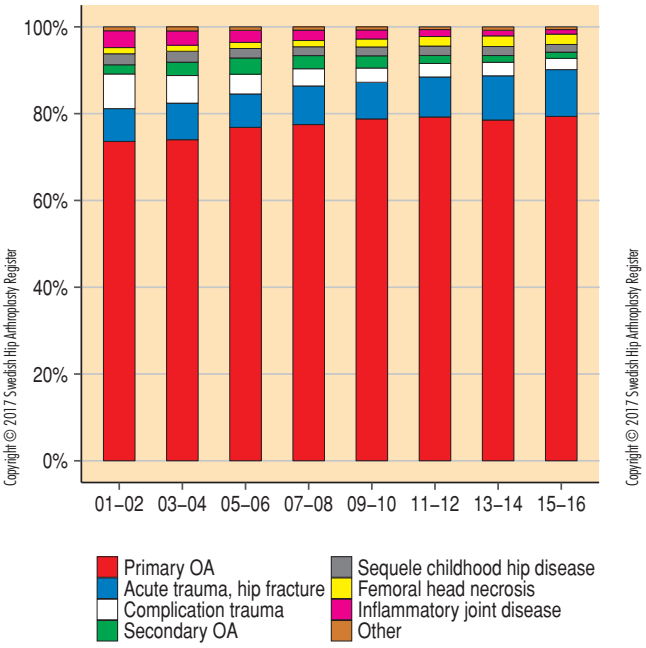


Figure 7b. Distribution of diagnosis among women.

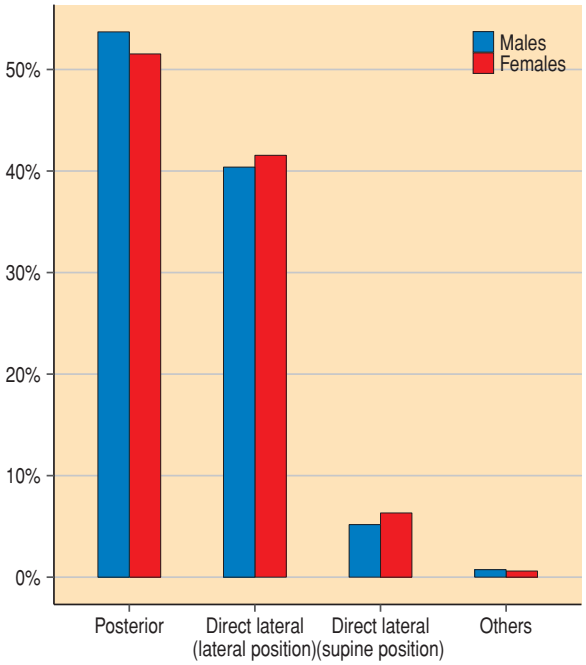


Figure 8. The distribution of incision, men compared to women during 2014–2016.

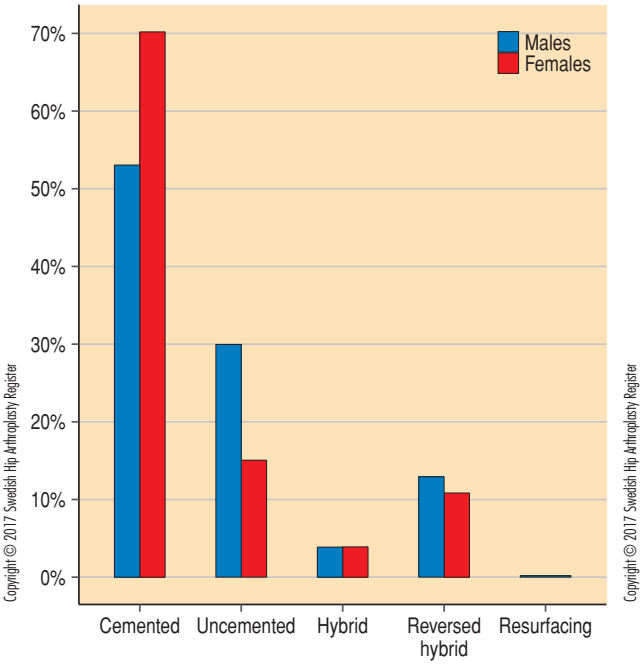


Figure 9. The distribution of type of prosthesis, men compared to women during 2014–2016.

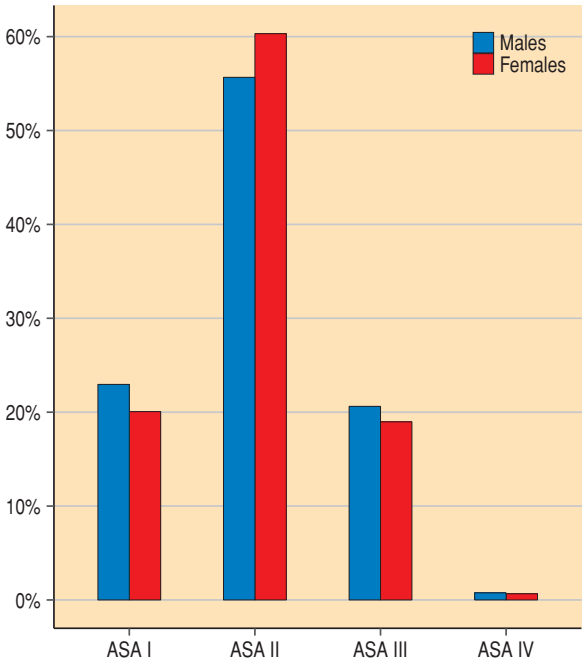


Figure 10. The distribution of ASA class, men compared to women during 2014–2016.

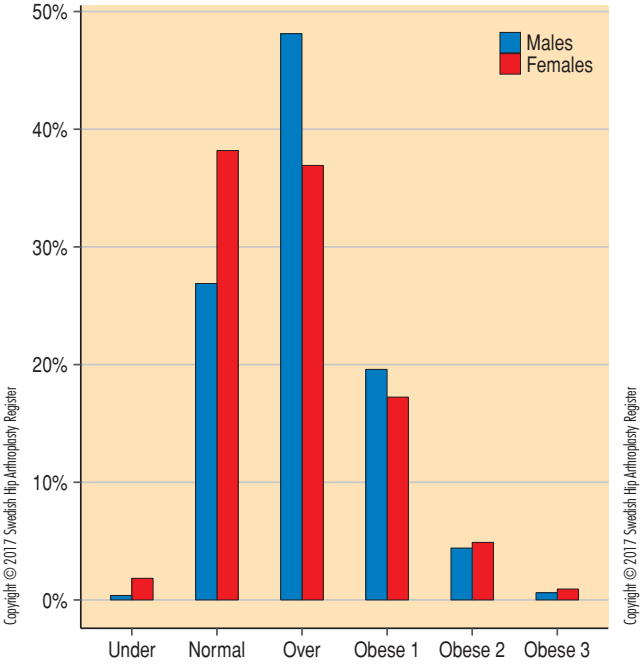


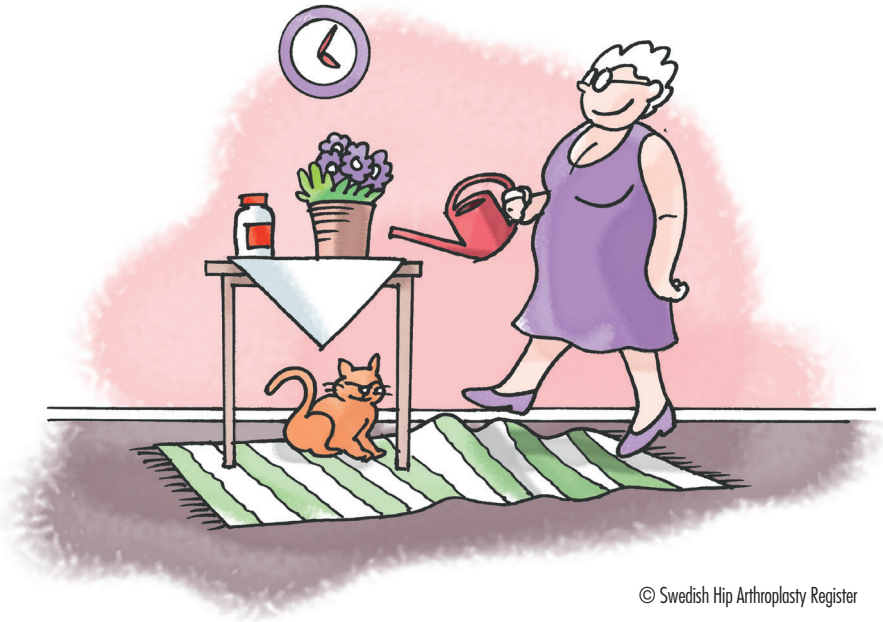
Figure 11. The distribution of BMI, men compared to women during 2014–2016. (Underweight is defined as BMI <18.5, normal weight 18.5–24.9, overweight 25.0–29.9, obese 1 30.0–34.9, obese 2 35.0–39.9, obese 3 >40.)

3.4 Gender – fracture patients

The mean age for men with hip fracture has stabilized to over 80 years, while the mean age for women lies around 82 years. The number of women over 100 who have been operated with a hip arthroplasty, was three in 2005, in comparison to 22 in the previous year. Six men were over 100 years of age last year, but there were none in 2005. In total, 138 female centenarians have received a fracture arthroplasty compared to 44 males. Hence, a small overrepresentation for men in comparison to the gender distribution among non-fractured peers.

Men have poorer prognosis after a hip fracture than women. The Register shows that 15% of men who had surgery for hip replacement because of hip fracture died within 90 days of the injury. The corresponding figure for women is 9% and applies to 2016. Similarly to previous years, these numbers stay constant. In the population, an 85-year-old has an average of 5.5 and 6.5 years to live (men and women), respectively, I.e. a hip fracture is both a sign of poor health and a real threat to life.

Men have a higher risk factor for reoperation according to analyses in chapter "Fracture treatment with total or hemiarthroplasty". The Register includes no data on functional recovery, but the literature shows that men have more difficulties in resuming "activities of daily living" (ADL), but achieve the same walking ability and return home as women. Gender differences are believed to exist, because men have a more serious comorbidity at the time of fracture than women.



4 Register development, improvement work and research

4.1 The new platform Stratum

In January 2017, a new version of the Register was launched, which included, among other things, modernization of the content in order to better describe the hip arthroplasty operations which are carried out today. The Register was a pioneer in the development of online input and now it was about time to update the system..

First in the world

The Register was the first in the world who started registering quality register data online. Since 1999, all data input has taken place via a secure login which was obtained from the Register's website. The routine was based on the fact that all data which concerned primary operations and some data from reoperations had been handled by local contact persons. The Register coordinators had handled the input of in-depth information about reoperations after the admission notes from medical records, operation report and discharge had been sent to the Register. The hospitals environmental profile, which is updated annually, had formed a separate module in the system. The platform was built by Roger Salomonsson and tailored after the Register's needs. Later on, we added new functions. In 2002, the PROM programme was introduced and then a module for PROM routine was added. In 2005, hemiarthroplasties with the corresponding registration of reoperations were added. In addition, there is a component database, which includes detailed data about attributes of the implants.

Seven different databases

The Register consisted of seven different databases (primary total arthroplasties, reoperation of total arthroplasties, the PROM programme, primary hemiarthroplasties, reoperation of hemiarthroplasties, environmental profile and component database). There has not been any automatic connection between these databases as the old system was built before it was possible to build databases with multidimensional relations. This means that the possibilities for presenting and analysing results in real-time were very limited. It required a lot of manual labour to link primary arthroplasties with components, PROM and reoperation databases.

Stratum

To say the least, the development within IT has been exponential since we, almost 20 years ago, became digital and functional online. Under Roger Salomonsson's management, the Register Centre in Västra Götaland has built up a generic platform which is called Stratum. Among others, Stratum is used by the Fracture Register, the Foot Register and the BOA Register. In the Hip Arthroplasty Register, we have during several years prepared ourselves to move to the Stratum platform. Creating a modern structure and moving to and connecting with the old databases was a delicate task. We chose to take with us only the operations from 1999 and later, as we started to register the article numbers of prosthesis then.

On the 23rd of January, the new platform was taken into use. By then, we had had a whole training day at Arlanda for all contact secretaries.

Additional development work is on-going

With the exception of several easily remedied childhood illnesses, the modernisation has gone well. However, we are not finished with all parts. We used to offer a function, with which the prosthesis company could get aggregated information about their respective implants. They could see columns per hospital divided between article numbers and even the proportion of revisions of respective implants. A new company application is under development. Stratum enables to show real-time data and we aim to develop interactive statistical functions on the website. Several functions are going to be developed afterwards.

In January, we moved to the Stratum IT platform, which is the platform usually used within the Register Centre in Västra Götaland for the National Quality Register. The new platform offers us many advantages, for example better validation of entered data and samples, faster way of presenting data from the Register. Our new website is accessible from mobile phones, tablets and computers and we can now administer the content ourselves. Today, Stratum is used by about 25 registers, developed and maintained by the IT unit at the Register Centre in Västra Götaland, which makes it possible for us to take advantage of the existing and new forthcoming joint functions. We are now better equipped for the future.

4.2 Does the surgeon's experience play any role in patient-reported outcomes?

Per Jolbäck
Doctoral project
Linköping hospital/Gothenburg University

There is an increasing interest to find out whether individual orthopaedists can follow up their own results with the help of the Hip Arthroplasty Register. A few years ago, a project which aims at thoroughly researching the prerequisites to measure and feedback surgeon specific operation results was initiated. We aim carrying out a number of studies to find out how it is possible to get accurate information on the individual level and understand the possible sources for mistakes.

One of these preliminary studies aims at finding out whether there is a realtionship between the experience of the surgeon (on the group level) and patient-reported outcomes one year after primary total hip arthroplasty. This register-based study included 6713 hip arthroplasties which were carried out due to osteoarthritis at one of the public hospitals in the Västra Götaland region during 2007–2012. The Swedish Hip Arthroplasty Register, local operation planning programmes and the public registers for certified health and hospital personnel (HoSp) of the National Board of Health and Welfare were used as sources.

The operations were divided into four experience groups based on the experience of the surgeon at the time of the actual operation. In this case, experience is defined as the number of years after receiving the certification in orthopaedics. If the HoSp register did not include a specific year for the certification, the operation was classified as being carried out by an orthopaedic residents (n=538). Orthopaedic pecialist phycisians were divided according to the following groups: less than 8 years after certification (n=2 181), 8–15 after certification (n=984) and more than 15 years after certification (n=3 010).

After adjusting for demographic differences and differences in the preoperative PROM value, the study showed that there were no differences in patient-reported outcomes in comparison between the different experience groups regarding reduction of pain and health-related quality of life. The only statistically significant difference was that patients who were operated by a resident did not rate the satisfaction with the operation result as high as the patients who were operated by the most experienced orthopaedic specialists.

We noted clear differences in patient demographics (Table 1), cause for operation (diagnosis) and choice of prosthesis type depending on the experience of the surgeon (Table 2). Patient demographics differs with regard to the age of the patient, ASA and Charnley class at one-year follow-up. More experienced surgeons had a lower mean age among patients. You can also see that the proportion of healthy (according to ASA) patients was higher among those surgeons who had more than eight years of experience. There is also a difference in Charnley class where a higher proportion of those patients who were operated on by less experiences doctors, had mobility issues due to other conditions than hip joint disorders.

The difference in patient demographics and fixation methods reflects the Swedish tradition of educating the residents. The aim is that residents can learn to handle cemented hip prosthesis. Since we did not find any remarkable differences in patient-reported outcomes which can be explained by the surgeon's experience, we interpret that the care process is designed so that the less experienced doctors in general have the necessary support. The fact that patients, who are operated on by residents, in general, do not rate their satisfaction as high, and this can show a fault in continuity, which due to logistical reasons, may often be the case for residents' hip prosthesis patients.

Patient demographics

	Resident	<8 years	8–15	>15 years	p-value
Age (mean value)	73	71	69	67	<0.001
Gender (% men)	60	57	57	58	=0.60
ASA (%)					<0.001
ASA I	17	27	33	29	
ASA II	60	55	52	51	
ASA III/IV	16	13	9	10	
BMI (kg/m2)	27	28	27	27	=0.17
Charnley class 1 year (%)					<0.001
A	43	42	47	47	
B	10	8	9	9	
C	48	49	44	43	

Table 1

Distribution of diagnosis and type of prosthesis

	Resident	<8 years	8–15	>15 years	p-value
Primary osteoarthritis (%)	100	98	98	96	<0.001
Type of prosthesis (%)					<0.001
Cemented	90	80	78	68	
Uncemented	5	11	13	19	
Hybrid	1	3	2	3	
Reversed hybrid	4	6	7	11	

Table 2.

4.3 Register-based improvement work and research

4.3.1 Preoperative blood count during elective hip arthroplasty – how does anaemia influence patient-reported outcomes and the risk for reoperation?

Johan Larsson
Orthopaedic surgeon
Kungälv hospital

Background

In order to minimize the risk for complications, a preoperative examination is performed on all patients eligible for elective hip arthroplasty. One of the many blood tests which are carried out, is haemoglobin (Hb). In case of anaemia, it is common to investigate the underlying cause and treat the patient, for example, with iron supplement, EPO or blood transfusion in order to optimize the health condition before the operation. Due to various reasons, patients go through the operation in spite of the fact that the blood count is below the normal level. This resident research project investigates how preoperative anaemia influences patient-reported outcomes (PROM) after one year and the risk for reoperation within two years.

Hypotheses

- Patients with preoperative anaemia have a higher risk for reoperation within two years than patients with normal preoperative Hb.
- Patients with preoperative anaemia do not experience the same improvement (PROM) one year after hip arthroplasty as patients with a normal preoperative Hb.

Patients and methods

We selected all patients who had undergone elective primary hip arthroplasty at Kungälv hospital during 2009–2013 and at Sahlgrenska University hospital during 2010–2013. We included patients who were operated on due to primary osteoarthritis. All fixation methods (cemented, uncemented and hybrid technique) were included. Resurfacing prostheses were excluded.

From the Swedish Hip Arthroplasty Register, personal identity number, gender, BMI, ASA class, the side on which the operation was carried out, date of the operation, diagnosis code, operation code, data on the possible reoperation within two years and preoperative and one-year registrations of PROM; EQ-5D index, EQ VAS, pain VAS and satisfaction VAS were examined.

The latest measured Hb value before the operation was registered by manual search in the laboratory program in the medical record system. We defined anaemia as Hb: <116.5 among women and < 133.5 among men. This provided a cohort (n=1 564 patients) who were used for analysis of the frequency of reoperation within two years. There were complete registrations for 1 253 patients among the 1 564 patients which were included in the study cohort above. 80% of the study population had answered to both PROM questionnaires.

Results

The mean age in our cohort (n=1 564) was 69.5 years (SD 11.5). Women constituted 61.3% of patients while men were over-represented in the anaemia group (65.6%). In total, patients with anaemia constituted 11.9% of the population. Hb mean value among women was 10 units lower than among men, 133 and 143, respectively (SD 10.9 and 12.3). The most common ASA class was II (59%) while ASA I and III constituted about 20% each.

The risk of reoperation within two years was 2.3% for the entire cohort. The most common cause for operation was deep infection (59%).

The odds ratio, which was adjusted for gender, age and BMI, for reoperation within two years was 2.37 times higher among the anaemia group than among those patients with a normal Hb level (95% confidence interval 1.02–5.53).

The risk for reoperation within two years all causes

	Odds ratio	95% confidence interval
Anaemia	2.373	1.019 – 5.526
Gender, woman	0.619	0.305 – 1.257
Age	1.000	0.970 – 1.031
BMI	1.008	0.934 – 1.088

Logistic regression. Abbreviation: BMI – body mass index

There are no significant differences in how much those two groups improve after one hip arthroplasty, but they have different starting levels of experienced health where patients with preoperative anaemia assess themselves lower both preoperatively and one year postoperatively concerning EQ-5D index (0.36 and 0.41 and 0.69 and 0.74).

Also, we did not find any differences in EQ VAS. The patients improve about 10–15 units on a 100-point scale one year after the operation regardless of preoperative anaemia.

Linear regression showed that anaemia was associated with more pain on the 100-point scale for pain VAS one year after operation (B=4.71, 95% confidence interval 0.94–8.48). At one-year follow-up, we also found lower satisfaction on the 100-point scale (B=6.01, 95% confidence interval 1.65–10.37).

Discussion

We found that patients with preoperative anaemia on the group level do not experience improvement to the same extent as those with a normal preoperative Hb. On average, they have 4.7 units higher pain VAS and 6.0 units lower satisfaction one year after hip arthroplasty. In addition, the study shows that preoperative anaemia is one of the risk factors for reoperation (all causes) within two years, with a 2.4 times higher risk.

The study showed that preoperative anaemia is not a predisposition for reoperation within two years due to a deep infection and neither for worse results in EQ-5D index and EQ VAS in comparison to patients with a normal preoperative Hb. The fact that we did not find any increased risk for reoperation due to deep infection, may be explained by the relatively low number of patients included.

The clinically accepted strategy to optimize patients before operation should perhaps be expanded to a complete health check-up by a specialist doctor (geriatric, endocrinologist, haematologist etc.) well ahead of the planned operation, so that the patient is in the best possible condition before the hardships that a hip arthroplasty and postoperative rehabilitation period inevitably bring along.

We found significant differences in our study group which should be a part of the preoperative discussion where hip arthroplasty is considered among patients with anaemia. Therefore, anaemia should be seen as a serious and treatable illness, rather than an abnormal laboratory result.

4.3.2 Does physiotherapy and Artrosskola before hip arthroplasty patient-reported outcomes one year postoperatively?

Christopher Torisho
Master thesis, Medical Programme

Background

Hip osteoarthritis is a large issue in the society and is becoming more common as we get older. The condition is characterized by pain and stiffness in the hip and may be treated with aiding tools, pain relief, physiotherapy and Artrosskola. Artrosskola is a patient education program in which the patients learn about their joint disease and treatment alternatives. Treatment with physiotherapy means that patients are assessed by a physiotherapist who gives advice and instructs the patient regarding physical activities and training according to the patients' individual needs. The aim of the treatment is to maintain or improve the function and reduce the pain in the hip joint. If this treatment does not ease the symptoms enough, hip arthroplasty becomes a real choice. The intervention has usually a good effect on pain and was being called "the operation of the century" in 1900s.

The intervention is followed by many months of intensive rehabilitation. There is research which indicates that physiotherapy before hip arthroplasty brings about faster recovery after the intervention. However, it has not been possible to show that the positive effect from the treatment remains for more than a couple of months after the operation. Whether Artrosskola could have a residual effect after the operation, is not clear. It is important to find out whether Artrosskola and physiotherapy before hip arthroplasty provide a benefit after the operation, so that it could be used as a basis for future recommendations on treatment.

Method

In my research, I investigated patients with osteoarhritis who had received treatment with physiotherapy or Artrosskola before hip arthroplasty, and whether their patient-reported outcomes were better one year after the intervention compared to patients who had not received neither of the treatments. The data about the patients was retrieved from the Swedish Hip Arthroplasty Register. Since 2012, the Register's follow-up routine with patient-reported outcome measure includes questions about if they had undergone Artrosskola or physiotherapy before the operation. Patient-reported outcomes one year after the intervention was measured by hip pain, health-related quality of life, health status and satisfaction with the operation.

Results

The study included 28 061 patients who underwent operation during 2012–2014. The patients who before the operation had attended Artrosskola and physiotherapy reported having a slightly better health status and life quality one year after the operation. However, the patients who had only attended Artrosskola, reported slightly lower satisfaction. Artrosskola and physiotherapy had no effect on how much pain patients had one year after the intervention. It is worth noting that there were demographic differences, for example age, gender distribution and comorbidity, between the patients who had attended Artrosskola and physiotherapy and those who had attended neither. Additionally, there were demographic differences between patients who lacked patient-reported outcome measure and those who were included in the analysis group.

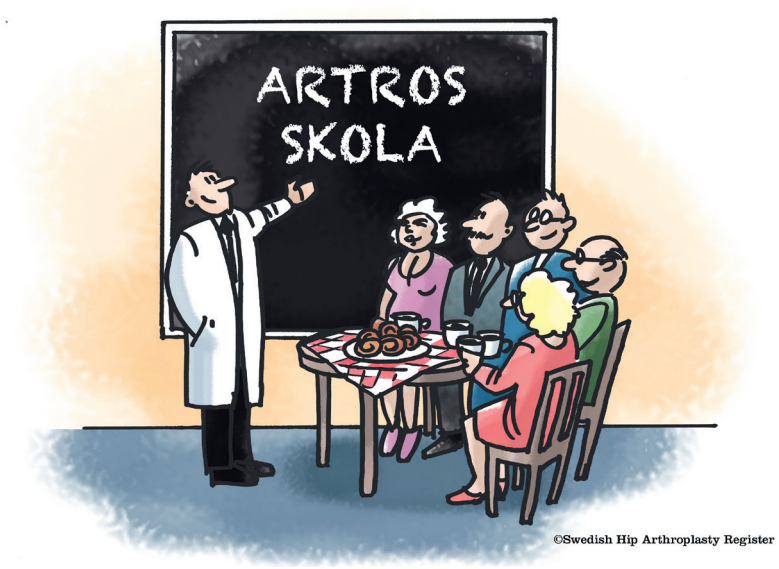
Discussion

The correlation between Artrosskola/physiotherapy and the patient-reported results one year after hip arthroplasty is weak and does not follow any pattern. Although Artrosskola and physiotherapy can be useful during the progression of the osteoarthritis disease, the remaining effect one year after the operation is interpreted as insignificant. The results agree with previous studies within the field, but in this study, should be interpreted with caution. Due to the study method, we cannot determine a causal relationship. Therefore, there may be other factors due to which we did not see the positive effect of the treatments.

Variable	All	Intervention group			
		No Artrosskola or PT	Artrosskola	PT	Artrosskola+PT
N	28 061	9 953	659	1 1823	5 626
Age, mean (SD)	68.7 (9.8)	70.3 (9.8)	70.3 (9.1)	67.7 (10.1)[1]	68.0 (8.6)[1]
Proportion of women	56%	48%	62%[2]	58%[2]	65%[2]
BMI, mean (SD)	27.3 (4.4)	27.5 (4.4)	27.5 (4.7)	27.2 (4.3)[1]	27.3 (4.4)
Proportion ASA I-II	85%	82%	86%	87%[2]	88%[2]

[1]ANOVA posthoc Tukey with "No Artrosskola/PT" as reference and p<0.05

[2]Two column Chi2 test with " No BOA/SJG" as reference and p<0.05



4.3.3 How good or safe are the new oral anticoagulans?

Alexander Wall
Master thesis, Medical Program

Introduction

Large surgical interventions like hip arthroplasty entails always a risk for the patient to suffer complications after the operation. Among short-term complications, thromboembolic events in the venous system (venous thromboembolic events = VTE) are among the most common. It is common to divide VTE into deep vein thrombosis (DVT) and the potentially life-threatening condition pulmonary embolism (PE).

A review article investigated the incidence of symptomatic VTE during hospitalization in connection with hip arthroplasty, and found it to be 0.53%. In order to prevent VTE, hip arthroplasty patients receive routine prophylactic treatment with drugs during one to several weeks after the operation. Low molecular weight heparin (LMWH) which is injected subcutaneously has been the method of choice for many years in Sweden, but during the last years, so-called NOAC (new oral anticoagulant) pills have been introduced.

In this study, we have compared the incidences of VTE up to three months after hip arthroplasty among patients treated with LMWH to the cases where NOAC had been used as thromboprophylaxis. In this study, we investigated which of the treatments was most effective in preventing VTEs. We also investigated the incidence of bleeding complications, reoperations or deaths.

Method

To answer our research questions, we used the data from the Swedish Hip Arthroplasty Register, which was linked to the Prescribed Drug Register and the Patient Register as a part of a larger research project. Data input concerns the period of 2008–2012. The variables which were included in the final database are gender, age, BMI, education, marital status, Elixhauser index (one measure for comorbidity), treatment, date of the operation, surgical approach, the fixation method of the prostheses, incidence of reoperation and mortality.

Results

In total, roughly 30 000 patients received LMWH and 5 700 patients received NOAC. The incidence of VTE in the LMWH group was 1.0% (304 patients) and 0.4% (23 patients) in the NOAC group. The odds ratio (OR) for being hit by VTE was 0.42 in the NOAC group. This means that the risk VTE if one uses NOAC as a thromboprofyxis, was about 60% lower in comparison with those who received LMWH. We found no significant difference in the frequency of bleedings, reoperations or mortality between the groups.

Discussion

Based on our results, it is possible to conclude that, when compared to LMWH, NOAC showed a higher risk reduction for VTE, both for DVT and PE. At the same time, it seems there is no increased risk of suffering complications when using NOAC. Our results correspond to what the previous studies have shown, but for the first time, it is proved with such a large number of patients.

Hopefully, this study has answered a part of the questions which have been found around the risk for thromboembolic complications and side effects after hip arthroplasty. Further clinical research is needed to determine other potential risks or side effects with the use of NOAC, which were not included in this study.

©Swedish Hip Arthroplasty Register

4.3.4 Fast-track process during elective hip arthroplasty does not lead to readmissions or more short-term complications

Urban Berg
Senior physician, Kungälv hospital

In Västra Götaland, with a population of 1.7 million inhabitants, the care process according to the "Fast-track" concept has been introduced at all public hospitals which carry out elective hip arthroplasties. The implementation took place at different times at different hospitals during the period of 1st of January 2012 until 1st of November 2014.

In a recently completed investigation, the number of readmissions and adverse effects within 30 and 90 days was analysed for patients who underwent operation at these hospitals during 2011–2015. A comparison has been made between the patient group which underwent operation after the implementation of Fast-track and the group which was operated before the concept was introduced at a respective hospital.

In order to define a care process according to Fast-track, we mapped the care process with a questionnaire for the orthopaedist responsible for the care process at every hospital. Mapping was carried out in the end of 2014 and the beginning of 2015 and aimed to clearly determine the routines which were applicable from 2011 and later, and at which time Fast-track was introduced. Frölunda Specialistsjukhus, which did not perform a specific change in the care process at a defined time during the period, was excluded from the study. The definition for care process according to Fast-track is based on the following criteria: 1) admission on the day of the operation 2) mobilisation on the day of the operation as soon as the anaesthetic has been released 3) functional discharge criteria 4) planned length of stay maximum of 3 days.

From the Swedish Hip Arthroplasty Register, the data was gathered for patients who had undergone elective total arthroplasty (NFB29, NFB39 and NFB49) with a hip osteoarthritis diagnosis (M16.0 – M16.9) during 2011–2015 at those eight hospitals which were included in the study. Altogether, 7 581 patients were included, of which 3 957 had been operated after the introduction of Fast-track and 3 824 before care process change at a respective hospital.

Data regarding all readmissions and new care contacts within three months after the operation is gathered from the regional patient database VEGA. Adverse events are defined based on diagnosis codes and intervention codes for the actual care instance, where a connection with the performed operation could not be excluded. The list for adverse events used corresponds to the list of codes, which the Swedish Knee Arthroplasty Register has developed in cooperation with the National Board of Health and Welfare. Knee-specific diagnosis and measure codes have been replaced with hip-specific codes. If codes according to this list are registered with the renewed care contact, it is perceived as an adverse event. These codes include local complications to the hip which underwent operation, but also fractures and other traumatic injuries in the operated extremity during the postoperative period. Likewise, general complications are included, such as thromboembolic and cardiovascular events, pneumonia, gastric ulcer, renal failure and urinary retention.

Demographics and surgical data

		Not Fast-track	Fast-track	P-value
Number		3 724	3 857	
Age	Mean age	69.5	69.5	0.98
Gender	Women	58.7%	57.0%	
	Men	41.3%	43.0%	0.15
ASA	I-II	84.3%	88.0%	<0.01
	III-IV	15.7%	12.0%	
BMI	Mean value	27.5	27.4	0.63
Length of stay	Mean length of stay in days	5.8	3.7	<0.01
Surgical approach	Posterior in side position	27.4%	37.4%	<0.01
	Direct lateral in side position	72.2%	62.1%	
	Other approaches	0.4%	0.5%	
Prosthesis type	Cemented	69.3%	66.8%	<0.01
	Uncemented	18.1%	18.7%	
	Hybrid	4.0%	7.0%	
	Reversed hybrid	8.5%	7.5%	

Risk for readmission and adverse events

	Odds ratio	Confidence interval	P-value
Readmission < 30 days	1.17	0.94–1.45	0.16
Readmission < 90 days	1.10	0.92–1.32	0.28
Adverse event < 30 days	1.04	0.87–1.24	0.67
Adverse event < 90 days	1.01	0.86–1.17	0.94

Odds ratio and adverse events within 30 and 90 days during the care process according to Fast-track based on multiple regression analysis

Our preliminary conclusion is that the study did not show a significantly increased risk for readmissions or short-term complications after the implementation of care process according to the Fast-track concept. The results support the fact that the concept is secure for the patient during planned total hip arthroplasty at Swedish hospitals.

4.3.5 Mortality after total hip replacement

Doctoral Thesis
Anne Garland, Consultant Orthopaedic Surgeon, Visby

Background

Today, hip arthroplasty may be seen as a routine surgery, but in fact, it is a major surgery which is not risk-free for the patient. The indications for arthroplasty have been expanded even further both nationally and internationally. This means that 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 more comorbidities. Today, and mainly at larger units, more high-risk patients undergo operation than previously.

Anne Garland, physician Visby hospital defended in spring 2017 her thesis regarding mortality after hip arthroplasty in Sweden based mostly on the data from the Swedish Hip Arthroplasty Register. In the thesis, there are four register-based papers where mortality after hip arthroplasty was studied. Information about the fixation method and surgical details were taken from the Swedish Hip Arthroplasty Register, information about the diagnoses, medicines and death circumstances were taken from the Patient Register, Prescribed Drug Register and Cause of Death Register, and information about socio-economic background from the Statistics Sweden. Data has been analysed with advanced statistical methods while the issue (choice of research design) and interpretation of the results have a clinical base.

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. The main outcome measure in the analyses has continuously been death within 90 days.

90-day mortality was introduced nine years ago as an open variable on a unit level and is one of the 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.

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 difference in mortality between types of hospitals reflects the different compositions of patients in different hospitals ("case-mix"). 90-day mortality varies between Swedish hospitals with the average value for the country of 7.1‰.

Influencing factors

The result from the study show unsurprisingly that both, preoperative comorbidity and socio-economical background have an impact, while the choice of fixation has a more doubtful clinical relevance.

Comorbidity is often measured with complex indices, which are based on registered diagnoses. Charlson's comorbidity index, Elixhauser and RXRiskV are used most often in hip arthroplasty research. These indices are not applicable to the everyday clinical work and a well-established clinical risk assessment instrument does not exist yet. In study number four, different comorbidity measures were assessed for their ability to predict death within 90 days after hip arthroplasty. With statistical assessment methods, a combination of easily accessible clinical information was tested, which in the future, could be developed into a risk assessment instrument.

Results

To conclude, the results of studies I-IV were as follows:

Study I: One-stage bilateral hip arthroplasty does not indicate a relevant difference in the risk for dying within 90 days in comparison with being operated one hip at a time.

Study II: For patients who undergo operation with hip prosthesis because of hip fracture, the risk for dying within 90 days is about double in comparison to the control group. Hip fracture patients under the age of 70 have a low risk while those over the age of 80 with multiple diseases have a high risk to die within 90 days after hip arthroplasty.

Study III: Both comorbidity and socio-economic background influence the risk for dying within 90 days after the operation while the choice of prosthesis fixation has a more marginal influence. When a cemented prosthesis is used during hip arthroplasty due to osteoarthritis, there is a slight increase in mortality during the first two weeks in comparison to a control population, who did not undergo operation. This increase corresponds to five deaths per 10 000 patients who underwent operation. Corresponding increase is not seen when an uncemented prosthesis is used.

Study IV: A small number of specific risk factors (age, gender, ASA and heart attack or kidney disease during the last 12 months) together are better in predicting death within 90 days than more complex indexes, which are commonly used.

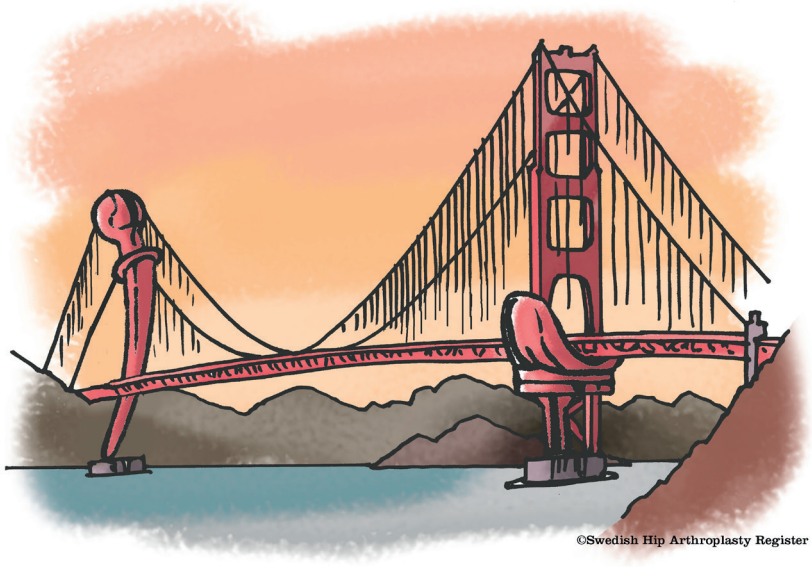
Analysing mortality at the unit is an important part of the work with patient safety. However, it is not clear that an orthopaedic units gets feedback about a patient dying of complications due to a performed hip arthroplasty. Here, the Hip Arthroplasty Register carries an important function of providing an opportunity to give feedback, at least at the level of hospital units.

5 International Register work

For the sixth consecutive year, the International Society of Arthroplasty Registries (ISAR) congress was held in San Fransisco in 2017. Kaiser Permanente hosted the meeting allowing 140 participants from 15 countries to discuss the findings, methodological issues and the future of the register-based research. There were extensive discussions about how a quality register could be used for benchmarking within and between countries. This will most probably play a significant role in the future, among others regarding the choice of implant. Today, the registers are not harmonized enough to allow outright comparisons and an important future project will try to create a more unified basis for this. In the context of international comparisons, also the role of the quality registers was discussed within value-based management, a term which has gained increased attention regarding future development and organisation of care. The American registers, among others the healthcare organisation Kaiser Permanente and the Mayo Clinic, which are active within arthroplasty, were present and shared their positive experiences in quality control with the background in the registers. New quality registers, for example from Lithuania, were represented and shared their results within hip fracture surgery and how register activity had helped them to clearly interpret recognized theory into practice. Germany presented their first results. Their register was started in 2012 and so far, they have registered about 60% (450 000) of the total volume of hip and knee arthroplasties. Also, Austria and Italy reported from their newly-started registers, but due to a strong regional management, it has been difficult to create national registers without them being limited to regions. The new registers seek more international cooperation to gain better understanding on how a register should be designed. Due to this, ISAR has developed a harmonized implant database so that it would be easier to create international comparisons.

Greg Corrado, senior researcher at Google Big Data Analytics, was invited as a guest speaker by the organisers. There is an enormous development in the Silicon Valley regarding the use of big data and deorganised data, in particular. As a step towards modernization of care and in an attempt to make it more accessible for people, steady work is carried out on how artificial intelligence and "machine learning" could be incorporated in the best possible way. It is yet to be seen how it could be used for hip and knee arthroplasty registers. Some of the contributions concerned the possibility of using the register data to predict outcomes and it may be possible for computers to detect patterns and relationships which we have not discovered yet.

The ISAR Congress strongly contributes to the international development of register research in arthroplasty surgery, This congress enables the researchers interested in register-based work statisticians and surgeons to meet from all over the world and exchange experiences and work towards standardising and harmonising methods. Next meeting will be held in Reykjavik on 9–11 June 2018 in connection to the congress of the Nordic Orthopaedic Association (NOF).



6 Primary prosthesis

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

6.1 Demographics

During recent years, the number of registered primary prostheses has, more or less, continuously increased. In 2016, 17 261 primary prostheses were reported, which is an increase of 4% in comparison to the previous year. The number for men has since 1999 more or less continuously increased until 2014. However, during the last two years, the proportion of men has somewhat decreased (Figure 6.1). In 2016, the average age for men was 67.2 and 70.0 for women. From 2000 until 2010–2011, average age has decreased for both genders. During the following years the mean age has stayed relatively unchanged among men, while there is a smaller rise in the mean age among women. The same trend is noticeable even if fracture diagnosis is excluded (Figure 6.2).

6.2 Diagnosis

The most common reason for total hip replacement is primary osteoarthritis. Between 1995 and 2010, the proportion of patients operated due to primary osteoarthritis increased, subsequently. The share of primary osteoarthritis has been relatively constant. Men dominate this diagnostic group while the relative proportion of women is higher in all the major groups of secondary osteoarthritis. The proportion of patients

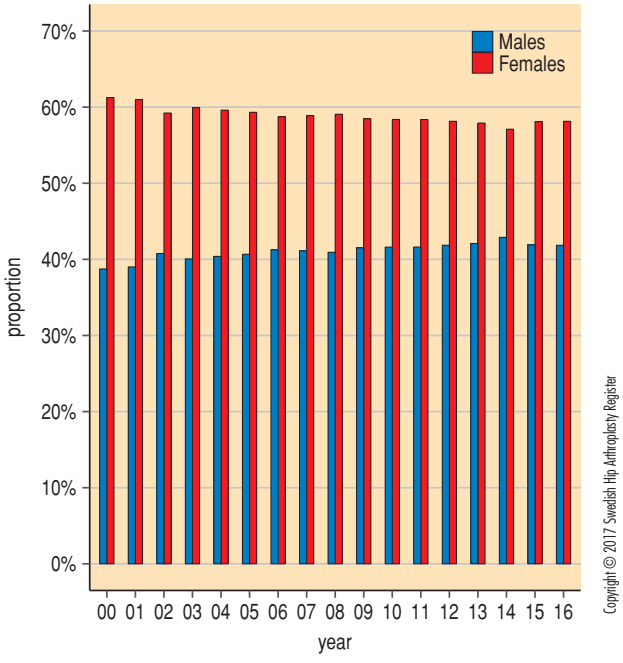


Figure 6.1

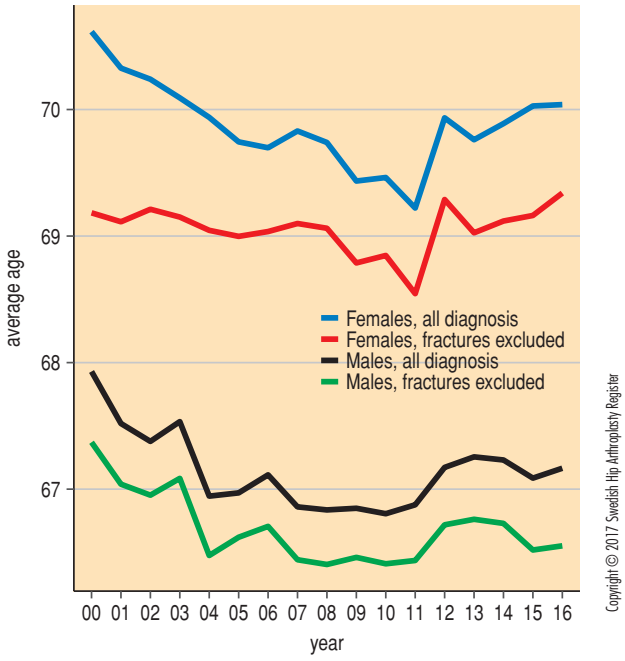


Figure 6.2

with an inflammatory joint disease has been substantially reduced since 1995, and in 2016, 0.8% were operated due to this diagnosis. Figure 6.3 illustrates the age distribution for the most common diagnosis groups. In general, the mean age at surgery is higher among women than in men. The only exception is the sequelae after hip disease during adolescence (childhood sequelae), where the mean age for both genders is rather similar.

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

6.3 BMI and ASA classification

Reporting of BMI (Body Mass Index) and ASA class (American Society of Anaesthesiology Physical Status Classification System) to the Swedish Hip Arthroplasty Register began in 2008. For the first year, there was data for 82.3% and 89.9% of cases regarding BMI and ASA, respectively, and reporting has continued to improve. In 2016, BMI was reported in 96.7% and ASA class in 98.9% of cases.

During the last five years, the mean value for BMI has stayed relatively constant (Table 6.1). Possibly, there is a slight tendency towards increasing proportion of patients with different degrees of obesity (BMI ≥30).

Comparison of BMI between diagnostic groups shows, that overweight tends to be most common in groups with primary osteoarthritis, and normal weight and underweight in groups with fracture (Table 6.2).

Regarding ASA class, the proportion of healthy patients (class I) continues to decrease as the proportion of patients mainly in class III-V (serious or life-threatening illness) increases (Table 6.1). The healthiest patients (according to ASA) can be found in the group with sequelae after hip disease during childhood and the sickest can be found in the group, which undergo operation due to fracture (Table 6.2). The trend towards an increasing number of patients with higher ASA class over time could partially be explained by the fact that the proportion of patients with fracture is increasing, although it is also possible, that there are other causes.

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

6.4 Prosthesis selection

Cemented fixation is more common in Sweden than in other Scandinavian countries. Poor results with uncemented fixation during the 1990s resulted in completely cemented fixation reaching a peak of 92–93% during 1998–2000. Hereafter, cemented fixation has declined every year (Figure 6.4). During 2016, the proportion of cemented prostheses was 61.9%. Completely uncemented fixation has instead become ever more common. In 2000, completely uncemented prostheses constituted 2.4%. The corresponding proportion in 2016 was 21.8%. The increase of uncemented fixation has mainly occurred in under 60 age groups, but also in patients who are 60 and older. Since 2012, the proportion of hybrid prostheses (cemented cup, uncemented stem) has decreased. The proportion of hybrid prosthesis (uncemented cup, cemented stem) has during a 10-year period been small and increased during 2007–2010 to about 1.5%, subsequently, a slow increase has occurred, up to 4.6% in 2016. Resurfacing prostheses were used once during surgery in 2016. The increased use of uncemented implants in Sweden, mainly among patients older than 70, may be seen as remarkable since the existing data from several international registries does not support using uncemented fixation among this patient group.

Since there is no long-term data regarding uncemented cups with trabecular coating caution should be taken when inserting these cups to patients for whom well-documented uncemented cups could be used.

6.5 Most commonly used prosthesis

In 2016, five of the most popular cemented cups account for 92.6% of the total number of cemented cups inserted in Sweden. Regarding stems, Lubinus SP II, Exeter and MS 30 together constitute more than 99.1% of all cemented stems.

Selection of uncemented cups shows a greater variation, five typical uncemented cups accounted for 62.5% of the total. The proportion of cups with trabecular coatings continues to increase. Given the uncertainty, which arose when individual studies report on formation of radiological zones around certain cups with trabecular titanium coating and the increased risk for dislocation for trabecular tantalum cups, in the Register, we would once again urge caution when using trabecular cups, if not absolutely necessary waiting studies with longer follow-ups.

Concerning uncemented stems, the diversification is less pronounced than among cups. Since 2009, the Corail stem has been the most common uncemented stem. Use of Corail stem has increased in comparison to 2015 and this stem is used in more than half of all uncemented stem designs reported to the Register during 2016.

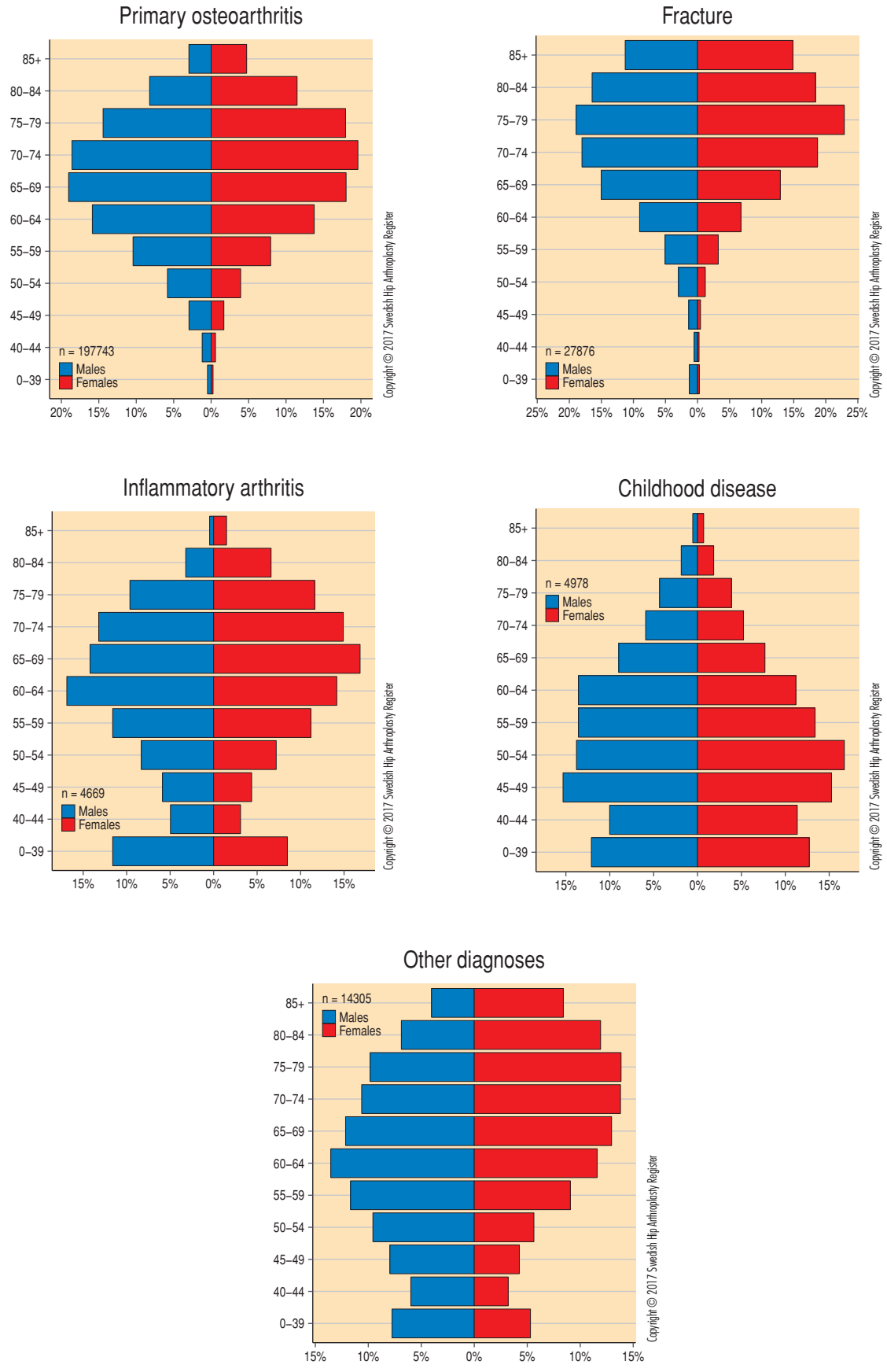


Figure 6.3. Age and gender distribution for different diagnosis groups

Change of BMI and ASA classification in selected years

2012–2016

	2012	2013	2014	2015	2016
BMI					
Existing observations/missing observations	16 028/874	16 350/824	16 563/817	16 629/598	17 261/575
Mean value median					
Men	27.8 27.1	27.6 27	27.5 26.9	27.6 27.1	27.7 27.2
Women	26.8 26.2	26.7 26.1	26.7 26.1	26.8 26.1	26.7 26.1
Proportion					
Underweight <18.5					
Men	0.5%	0.6%	0.4%	0.5%	0,3%
Women	1.6%	1.8%	1.7%	2%	1.8%
Normal weight 18.5–24.9					
Men	25.9%	28.1%	27.6%	26.2%	26.8%
Women	37.6%	38.3%	38.1%	38.2%	38.2%
Overweight 25–29.9					
Men	48.8%	47.4%	48.1%	48.8%	47.3%
Women	37.6%	37.4%	37.1%	36.7%	36.9%
Obese grade I 30–34.9					
Men	19.4%	19.3%	19%	19.6%	20%
Women	16.9%	16.5%	16.9%	17%	17.8%
Obese grade II–III 35+					
Men	5.3%	4.5%	4.7%	4.8%	5.3%
Women	6.1%	6%	6.1%	6%	5.1%
ASA class					
Existing observations/missing observations	16 028/408	16 350/285	16 563/352	16 629/232	17 261/185
Proportion					
Healthy (I)					
Men	24.3%	24.7%	23%	23.4%	22.5%
Women	21.4%	21.3%	20.8%	20%	19.4%
Mild systemic disease (II)					
Men	54.6%	55.3%	56.4%	55%	55.6%
Women	60.4%	60.4%	60.2%	60.3%	60.4%
Serious/life-threatening illness (III-V)					
Men	21.1%	20%	20.6%	21.6%	21.9%
Women	18.3%	18.3%	18.9%	19.8%	20.2%

Table 6.1.

Proportion of BMI of ASA class

selection of diagnosis groups

		Primary osteoarthritis	Acute trauma, hip fracture	Complication trauma	Femoral head necrosis	Other
BMI						
Underweight	<18.5	0.6%	5.2%	5.2%	1.1%	1.7%
Normal weight	18.5–24.9	30.7%	53.9%	51%	34.7%	37.5%
Overweight	25–29.9	42.8%	31.5%	32.7%	38.5%	36.8%
Obese grade I	30–34.9	20.1%	7.7%	8.4%	19.1%	16.9%
Obese grade II-III	35+	5.5%	1.5%	2.4%	6.4%	7.1%
ASA class						
Healthy (I)		22.5%	9.1%	11.4%	9.6%	23%
Mild systemic disease (II)		60.3%	49.4%	45.6%	55.7%	49.9%
Serious/life-threatening illness (III-V)		17.2%	41.5%	43%	34.6%	27%

Table 6.2.

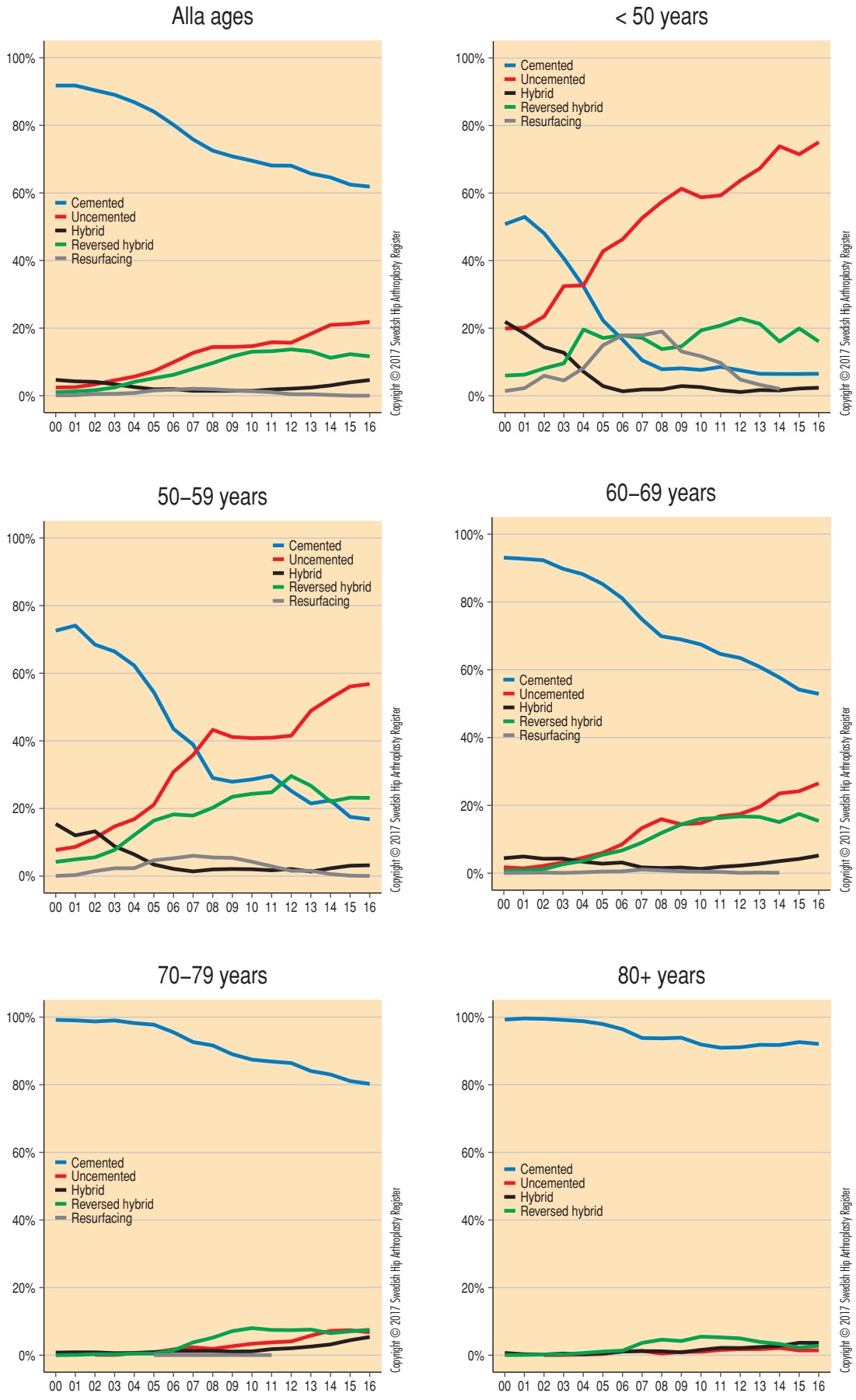


Figure 6.4 Trends for fixation methods

6.6 Articulation

For uncemented cups, almost exclusively highly cross-linked polyethylene liners are being used. With regarsds to cemented cups, highly cross-linked polyethylene is used in 82% of cases.

The proportion of cups with highly cross-linked polyethylene continues to increase (Figure 6.5). During 2016, highly cross-linked polyethylene was used at 61% of all hip replacement procedures. The combination of ceramic femoral head-ceramic insert shows also a small increase, from 15.5% in 2015 to 17.6% in 2016. Most often, femoral head with a diameter of 32 mm is used. The proportion of femoral head with 36 mm diameter continues to be at around 10%. The trends regarding the choice of the different articulations and head sizes are visualized in Figures 6.5 and 6.6.

6.7 Implant combinations

The most common implant combinations are presented in tables starting from page 40. In the cemented group the use of the combination of Lubinus SP stem and Lubinus cup is most common. In uncemented group, combination of Corail-Pinnacle and W/Griptionn 100 is increasing. There are also changes in the group for reversed hybrids and hybrids. With several of these combinations, implants from different manufacturers are used. This practise has developed over a long period of time, although it is not recommended by most of the manufacturers. There is also long-term data for several of the implant combinations which have proven to function well. On the Swedish market, there are many manufacturers/importers who provide cups only from a specific manufacturer, but do not provide a stem from the same producer.

6.8 Incision

Since 2005, posterior and lateral supine or side position incisions have dominated in Sweden and during 2016, one of these incisions was used in 99% of performed total arthroplasties. The posterior incision is still the most common (53.9%). Lateral incision on the side position was used in 39.6% of all surgeries and the proportion for lateral incision on the supine position was 6.0%. Mini-incision and Watson-Jones incision and direct lateral/posterior incision in combination with trochanteric flip osteotomy are only used sporadically. The proportion of the three most used incisions shows no significant variation during the last five years (Figure 6.7).

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

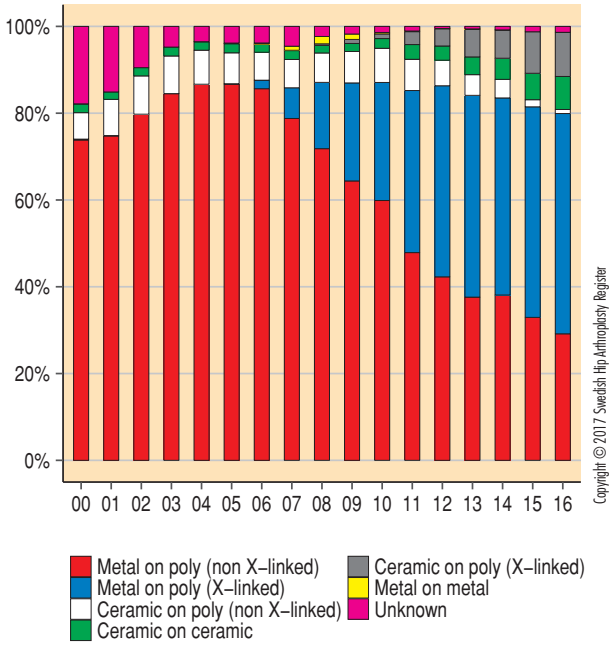


Figure 6.5 Trends for articulation

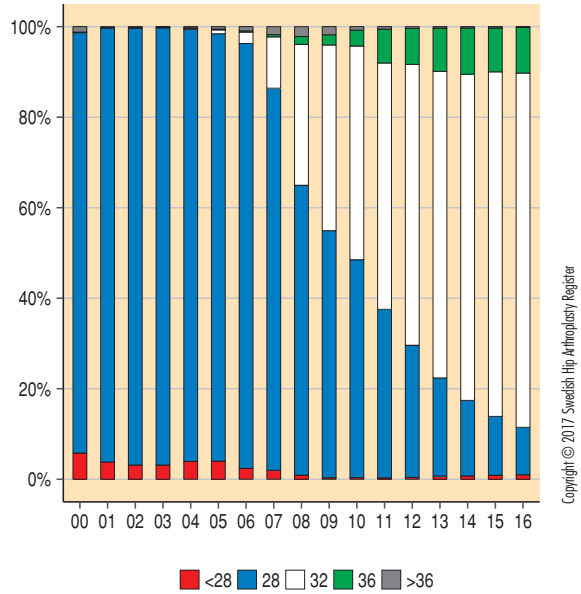


Figure 6.6 Trends for femoral head size

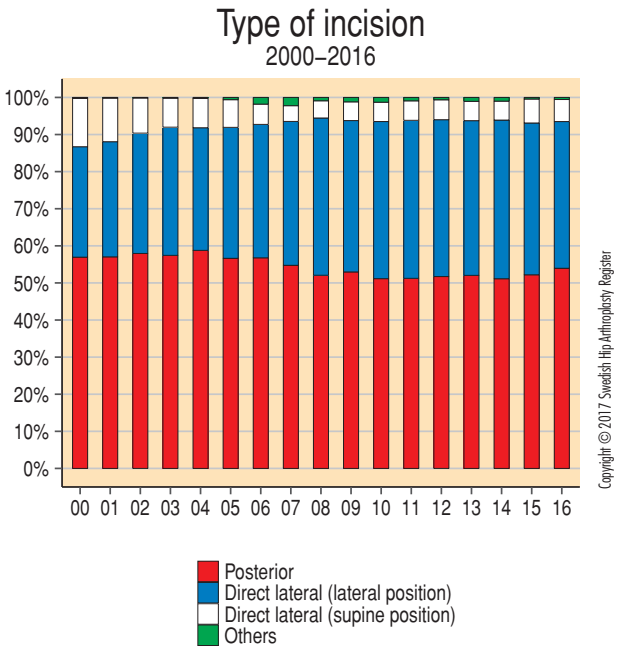


Figure 6.7 Trends for incision

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

About 93% of all total hip arthroplasties are performed through a posterior or a lateral incision in the lateral position. The risk for reoperation does not appear to be affected by the choice of these two incisions, provided that all operations are included. However, the choice of incision may play a role for different subgroups and exhibit different risk profile, something we witnessed earlier regarding surgery on patients with fracture diagnosis.

Demographics, fixation method and proportion of reoperated patients in relation to incision

2000–2016

Incision	Number	Proportion of women	Proportion of primary osteoarthritis	Proportion of operations with uncemented cup	Proportion of operations with uncemented stem	Proportion of reoperated patients
Posterior incision in lateral position (Moore)	133 489	57.5%	81.4%	15.4%	19.7%	2.1%
Direct lateral						
Lateral position (Gammer)	95 110	59.8%	77.6%	19%	23.5%	2.2%
Supine position (Hardinge)	16 108	63.6%	75.6%	4.6%	24.1%	2.2%
Mini-incision						
MIS/1-incision, front	782	62.8%	86.3%	70.3%	66.9%	3.6%
MIS/1-incision, back	365	52.9%	75.9%	47.7%	50.7%	2.2%
MIS/2-incision	45	48.9%	82.2%	55.6%	62.2%	6.7%
Watson-Jones (original)	374	52.7%	78.6%	46.8%	58.8%	2.4%
Trochanter osteotomy						
Direct lateral	416	62.7%	68.3%	24.3%	31.5%	2.9%
OCM-incision	52	30.8%	92.3%	90.4%	94.2%	1.9%
No data	2 830	60.4%	68.3%	16.5%	11.2%	2.6%

Table 6.3.

15 most common implants

Cup (Stem)	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Lubinus x-link (SPII standard)	683	1 412	2 523	3 080	4 020	4 592	15 627	18.9%
Lubinus (SPII standard)	58 280	3 609	2 626	2 316	1 447	1 024	11 022	13.3%
Exeter RimFit (Exeter standard)	1 121	1 067	1 194	1 598	1 651	1 647	7 157	8.6%
Marathon (Exeter standard)	3 058	1 388	1 272	1 088	1 000	936	5 684	6.9%
ZCA XLPE (MS-30)	4 795	1 225	1 008	524	740	358	3 855	4.7%
Marathon (Corail)	1 117	539	450	393	374	348	2 104	2.5%
Pinnacle W/Gription 100 (Corail)	11	75	149	412	568	711	1 915	2.3%
Pinnacle 100 (Corail)	543	302	311	242	237	284	1 376	1.7%
Contemporary Hoded Duration (Exeter standard)	5 040	479	383	187	147	127	1 323	1.6%
Lubinus (Corail)	1 563	396	305	269	223	110	1 303	1.6%
Avantage (SPII standard)	230	113	203	277	297	378	1 268	1.5%
Trilogy (CLS)	3 011	255	183	220	223	277	1 158	1.4%
Exceed ABT Ringlock (Bi-metric X por HA NC)	108	175	220	227	262	233	1 117	1.3%
Exeter RimFit (Corail)	74	91	80	194	277	421	1 063	1.3%
Lubinus x-link (Corail)	25	90	181	166	223	391	1 051	1.3%
Other	87 081	4 812	5 262	5 370	4 940	5 424	25 808	28.2%
Total	166 740	16 028	16 350	16 563	16 629	17 261	82 831	

1) Refers to the number of primary operations during the last five years.
2) Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common cemented implants

Cup (Stem)	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Lubinus x-link (SPII standard)	683	1 412	2 523	3 080	4 020	4 592	15 627	29.3%
Lubinus (SPII standard)	58 279	3 609	2 626	2 316	1 447	1 024	11 022	20.6%
Exeter RimFit (Exeter standard)	1 121	1 067	1 194	1 598	1 651	1 647	7 157	13.4%
Marathon (Exeter standard)	3 058	1 388	1 272	1 088	1 000	936	5 684	10.6%
ZCA XLPE (MS-30)	4 795	1 225	1 008	524	740	358	3 855	7.2%
Contemporary Hoded Duration (Exeter standard)	5 040	479	383	187	147	127	1 323	2.5%
Avantage (SPII standard)	228	113	203	277	297	378	1 268	2.4%
Exeter RimFit (MS-30)	149	200	169	120	55	478	1 022	1.9%
IP Link (SPII standard)	26	49	48	165	222	351	835	1.6%
ZCA XLPE (SPII standard)	1 660	352	355	64	15	3	789	1.5%
ZCA (MS-30)	280	0	0	338	216	118	672	1.3%
Marathon (SPII standard)	145	110	106	143	139	172	670	1.3%
ZCA XLPE (Exeter standard)	546	225	209	100	50	2	586	1.1%
Polarcup cemented (SPII standard)	80	52	65	63	87	81	348	0.7%
FAL (SPII standard)	5 997	163	109	43	3	0	318	0.6%
Other	51 239	459	475	588	289	396	2 207	3.8%
Total	133 326	10 903	10 745	10 694	10 378	10 663	53 383	

1) Refers to the number of primary operations during the last five years.
2) Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common uncemented implants

Cup (Stem)	2000–2011	2012	2013	2014	2015	2016	Totalt[1]	Proportion[2)]
Pinnacle W/Gription 100 (Corail)	11	75	149	412	568	711	1 915	11.8%
Pinnacle 100 (Corail)	543	302	311	242	237	284	1 376	8.5%
Trilogy (CLS)	3 011	255	183	220	223	277	1 158	7.1%
Exceed ABT Ringlock (Bi-metric X por HA NC)	108	175	220	227	262	233	1 117	6.9%
Continuum (CLS)	131	155	206	210	194	261	1 026	6.3%
Continuum (Corail)	34	81	152	228	236	319	1 016	6.2%
Trilogy IT (Bi-metric X por HA NC)	1	28	133	169	181	167	678	4.2%
Trident hemi (Accolade II)	0	44	123	181	146	140	634	3.9%
Trilogy (Corail)	792	202	110	145	53	10	520	3.2%
Regenerex (Bi-metric X por HA NC)	208	59	78	124	127	131	519	3.2%
Continuum (Wagner Cone)	11	43	80	134	110	78	445	2.7%
Pinnacle sector (Corail)	232	52	85	60	68	135	400	2.5%
Trident hemi (Corail)	18	1	17	87	98	124	327	2%
Allofit (CLS)	1 429	43	52	61	80	75	311	1.9%
Continuum (M/S Taper)	0	39	126	70	40	28	303	1.9%
Other	9 247	960	970	898	908	791	4 527	26.4%
Total	15 776	2 514	2 995	3 468	3 531	3 764	16 272	

1) Refers to the number of primary operations during the last five years.
2) Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common hybrid implants

Cup (Stem)	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Trident hemi (Exeter standard)	138	82	97	154	273	408	1 014	37.7%
Trilogy (SPII standard)	1 100	68	50	108	65	13	304	11.3%
Continuum (MS-30)	5	17	32	36	22	45	152	5.6%
Tritanium (Exeter standard)	9	11	29	28	31	30	129	4.8%
Pinnacle sector (SPII standard)	5	0	0	1	36	55	92	3.4%
Trilogy IT (SPII standard)	0	0	0	20	36	22	78	2.9%
Trident AD LW (Exeter standard)	16	7	11	12	17	29	76	2.8%
Continuum (SPII standard)	4	7	22	14	8	12	63	2.3%
TM revision (SPII standard)	12	10	10	14	13	9	56	2.1%
Continuum (Exeter standard)	7	7	10	3	4	17	41	1.5%
Pinnacle W/Gription Sector (Exeter standard)	0	0	0	9	13	18	40	1.5%
Exceed ABT Ringlock (Exeter standard)	6	6	14	11	4	4	39	1.4%
Pinnacle 100 (SPII standard)	7	4	4	3	23	5	39	1.4%
Trident hemi (SPII standard)	11	3	4	12	6	9	34	1.3%
Exceed ABT Ringlock (SPII standard)	0	0	2	5	15	11	33	1.2%
Other	2 741	113	110	73	92	113	501	17.2%
Total	4 061	335	395	503	658	800	2 691	

1) Refers to the number of primary operations during the last five years.
2) Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common reverse hybrid prostheses

Cup (Stem)	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Marathon (Corail)	1 117	539	450	393	374	348	2 104	20.5%
Lubinus (Corail)	1 563	396	305	269	223	110	1 303	12.7%
Exeter RimFit (Corail)	74	91	80	194	277	421	1 063	10.4%
Lubinus x-link (Corail)	25	90	181	166	223	391	1 051	10.3%
Marathon (ABG II HA)	180	115	124	116	141	152	648	6.3%
Marathon (Bi-metric X por HA NC)	377	177	134	97	77	75	560	5.5%
ZCA XLPE (Corail)	322	121	150	64	103	16	454	4.4%
Lubinus x-link (Bi-metric X por HA NC)	1	59	69	95	117	84	424	4.1%
Contemporary Hoded Duration (Corail)	155	151	186	22	23	22	404	3.9%
Lubinus x-link (M/S Taper)	0	0	34	46	96	85	261	2.5%
Exceed ABT (cem) (Bi-metric X por HA NC)	29	50	64	61	24	4	203	2%
Lubinus (CLS)	432	47	36	18	27	23	151	1.5%
ZCA (Corail)	1	0	0	56	63	8	127	1.2%
Lubinus x-link (CLS)	9	6	12	18	32	33	101	1%
Marathon (CLS)	230	51	30	5	5	3	94	0.9%
Other	6 970	304	289	237	238	234	1 302	11.3%
Total	11 485	2 197	2 144	1 857	2 043	2 009	10 250	

[1)] *Refers to the number of primary operations during the last five years.*
[2)] *Refers to the proportion of the total number of primary operations carried out during the last five years.*

15 most common cup components

Cup	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Lubinus x-link	725	1 583	2 916	3 458	4 562	5 345	17 864	21.6%
Lubinus	61 378	4 148	3 015	2 657	1 734	1 188	12 742	15.4%
Marathon	5 403	2 497	2 250	1 882	1 776	1 729	10 134	12.2%
Exeter RimFit	1 396	1 399	1 505	1 969	2 056	2 623	9 552	11.5%
ZCA XLPE	8 776	2 012	1 786	787	951	388	5 924	7.2%
Continuum	296	402	696	758	646	774	3 276	4%
Trident hemi	960	248	314	506	656	737	2 461	3%
Trilogy	8 243	710	444	570	384	312	2 420	2.9%
Pinnacle W/Gription 100	11	78	156	429	581	731	1 975	2.4%
Contemporary Hoded Duration	6 079	656	577	209	170	150	1 762	2.1%
Avantage	405	171	305	351	366	478	1 671	2%
Pinnacle 100	584	307	317	248	273	300	1 445	1.7%
Exceed ABT Ringlock	114	197	277	257	293	274	1 298	1.6%
Trilogy IT	10	34	222	289	309	283	1 137	1.4%
ZCA	1 301	0	0	523	299	135	957	1.2%
Other	71 059	1 586	1 570	1 670	1 573	1 814	8 213	9.6%
Total	166 740	16 028	16 350	16 563	16 629	17 261	82 831	

1) Refers to the number of primary operations during the last five years.
2) Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common stem components

Stem	2000–2011	2012	2013	2014	2015	2016	Totalt[1)]	Proportion[2)]
SPII standard	71 705	6 170	6 287	6 514	6 537	6 868	32 376	39.1%
Exeter standard	36 424	3 435	3 385	3 375	3 311	3 428	16 934	20.4%
Corail	5 920	2 273	2 385	2 559	2 811	3 145	13 173	15.9%
MS-30	6 169	1 470	1 252	1 178	1 095	1 063	6 058	7.3%
Bi-metric X por HA NC	4 313	765	827	861	838	727	4 018	4.9%
CLS	8 139	734	645	630	648	749	3 406	4.1%
Accolade II	0	47	211	363	349	340	1 310	1.6%
M/S Taper	0	44	235	242	254	219	994	1.2%
ABG II HA	2 182	201	186	193	188	199	967	1.2%
Wagner Cone	848	128	156	203	168	134	789	1%
Accolade straight	1 346	224	170	72	89	31	586	0.7%
CPT	2 526	122	130	30	27	39	348	0.4%
Fitmore	120	57	58	45	27	8	195	0.2%
CFP	296	41	50	46	23	4	164	0.2%
Exeter long	259	17	32	31	31	25	136	0.2%
Other	26 493	300	341	221	233	282	1 377	1.2%
Total	166 740	16 028	16 350	16 563	16 629	17 261	82 831	

1) Refers to the number of primary operations during the last five years.
2) Refers to the proportion of the total number of primary operations carried out during the last five years.

Number of primary THRs per hospital and year

Unit	2000–2011	2012	2013	2014	2015	2016	Total[1]	Proportion[2]
Aleris Specialistvård Bollnäs	0	241	268	312	306	279	1 406	1.7%
Aleris Specialistvård Elisabethsjukhuset	1 098	65	46	2	0	0	113	0.1%
Aleris Specialistvård Motala	866	438	491	520	580	586	2 615	3.2%
Aleris Specialistvård Nacka	474	134	112	119	218	244	827	1%
Aleris Specialistvård Sabbatsberg	1 710	160	175	141	24	0	500	0.6%
Aleris Specialistvård Ängelholm	2	5	9	82	131	91	318	0.4%
Alingsås	2 038	209	252	178	198	194	1 031	1.2%
Art Clinic Göteborg	0	0	0	0	25	45	70	0.1%
Art Clinic Jönköping	0	10	6	14	20	36	86	0.1%
Arvika	1 253	190	141	217	195	196	939	1.1%
Bollnäs	2 750	90	0	0	0	0	90	0.1%
Borås	2 206	180	167	170	158	133	808	1%
Capio Movement	1 206	176	127	229	304	340	1 176	1.4%
Capio Ortopediska Huset	3 619	332	370	374	477	467	2 020	2.4%
Capio S:t Göran	5 209	405	472	423	508	577	2 385	2.9%
Carlanderska	853	120	113	157	145	172	707	0.9%
Danderyd	4 199	306	327	343	331	325	1 632	2%
Eksjö	2 201	216	191	207	243	233	1 090	1.3%
Enköping	2 184	327	320	342	347	354	1 690	2%
Eskilstuna	1 172	129	136	97	109	108	579	0.7%
Falköping	2 459	0	0	0	0	0	0	0%
Falun	3 205	397	353	325	254	254	1 583	1.9%
Frölunda Specialistsjukhus	591	85	80	97	83	0	345	0.4%
Frölundaortopeden	0	0	0	0	0	4	4	0%
Gothenburg Medical Center	121	0	0	0	0	0	0	0%
Gällivare	1 189	111	92	96	93	91	483	0.6%
Gävle	2 068	198	257	223	252	251	1 181	1.4%
Halmstad	2 537	238	243	241	236	206	1 164	1.4%
Helsingborg	1 176	69	76	109	182	124	560	0.7%
Hermelinen Specialistvård	0	2	6	7	12	11	38	0%
Hudiksvall	1 683	100	148	146	138	139	671	0.8%
Hässleholm-Kristianstad	8 003	675	777	847	807	829	3 935	4.8%
Jönköping	2 314	194	167	210	160	129	860	1%
Kalix	385	0	0	0	0	0	0	0%
Kalmar	2 265	122	146	160	174	173	775	0.9%
Karlshamn	2 068	217	230	240	259	241	1 187	1.4%
Karlskoga	1 446	166	173	162	186	139	826	1%
Karlskrona	483	36	32	28	31	35	162	0.2%
Karlstad	2 670	238	265	248	219	198	1 168	1.4%

(Continued on next page.)

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

Unit	2000–2011	2012	2013	2014	2015	2016	Total[1]	Proportion[2]
Karolinska/Huddinge	2 702	241	251	265	241	189	1 187	1.4%
Karolinska/Solna	2 617	198	182	184	195	113	872	1.1%
Katrineholm	2 437	208	242	260	221	193	1 124	1.4%
Kristinehamn	61	0	0	0	0	0	0	0%
Kungälv	2 183	135	165	205	185	202	892	1.1%
Köping	1 690	0	0	0	0	0	0	0%
Landskrona	1 381	0	0	0	0	0	0	0%
Lidköping	1 573	196	238	281	280	307	1 302	1.6%
Lindesberg	1 839	211	230	202	214	426	1 283	1.5%
Linköping	1 282	58	66	67	70	63	324	0.4%
Linköping Medical Center	27	0	0	0	0	0	0	0%
Ljungby	1 547	175	151	172	152	165	815	1%
Lycksele	2 813	276	290	302	334	324	1 526	1.8%
Mora	2 011	203	219	207	241	278	1 148	1.4%
Motala	2 731	0	0	0	0	0	0	0%
Norrköping	2 418	230	253	258	248	266	1 255	1.5%
Norrtälje	1 258	106	129	115	128	159	637	0.8%
Nyköping	1 694	167	143	159	148	138	755	0.9%
NÄL	0	0	0	0	2	47	49	0.1%
Ortho Center IFK-kliniken	482	131	128	133	127	164	683	0.8%
Ortho Center Stockholm	2 890	435	396	442	495	535	2 303	2.8%
Oskarshamn	2 050	204	286	233	289	308	1 320	1.6%
Piteå	2 776	389	367	337	329	374	1 796	2.2%
Simrishamn	788	0	0	0	0	0	0	0%
Skellefteå	1 363	98	133	122	126	128	607	0.7%
Skene	1 012	113	126	152	125	118	634	0.8%
Skövde	1 739	243	162	136	162	207	910	1.1%
Sollefteå	1 433	123	126	109	139	194	691	0.8%
Sophiahemmet	2 526	193	211	213	220	221	1 058	1.3%
Spenshult	672	317	240	97	0	0	654	0.8%
SU/Mölndal	2 480	416	469	594	600	601	2 680	3.2%
SU/Sahlgrenska	1 379	3	6	6	5	2	22	0%
SU/Östra	1 191	0	0	0	0	0	0	0%
Sunderby	1 064	36	32	34	40	32	174	0.2%
Sundsvall	2 067	184	208	158	84	49	683	0.8%
SUS/Lund	1 163	140	195	203	180	205	923	1.1%
SUS/Malmö	1 472	74	27	34	22	30	187	0.2%
Säffle	338	0	0	0	0	0	0	0%
Södersjukhuset	3 868	416	430	419	391	412	2 068	2.5%

(Continued on next page.)

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

Unit	2000–2011	2012	2013	2014	2015	2016	Total[1]	Proportion[2]
Södertälje	1 482	109	92	97	119	130	547	0.7%
Torsby	1 062	122	107	97	118	129	573	0.7%
Trelleborg	4 959	643	594	627	664	724	3 252	3.9%
Uddevalla	3 627	342	390	390	374	402	1 898	2.3%
Umeå	933	64	64	98	103	96	425	0.5%
Uppsala	3 409	230	271	284	237	258	1 280	1.5%
Varberg	2 502	242	239	213	187	273	1 154	1.4%
Visby	1 221	121	125	122	136	136	640	0.8%
Värnamo	1 523	148	148	122	133	176	727	0.9%
Västervik	1 325	109	121	109	97	128	564	0.7%
Västerås	2 592	513	476	436	377	421	2 223	2.7%
Växjö	1 405	154	125	151	148	133	711	0.9%
Ystad	643	8	1	0	0	0	9	0%
Ängelholm	1 177	166	174	96	0	64	500	0.6%
Örebro	2 096	116	107	151	74	62	510	0.6%
Örnsköldsvik	1 744	140	133	144	203	183	803	1%
Östersund	2 256	301	314	261	261	292	1 429	1.7%
Total	166 676	16 028	16 350	16 563	16 629	17 261	82 831	

[1] *Refers to the number of primary operations during the last five years.*
[2] *Refers to the proportion of the total number of primary operations carried out during the last five years.*

Number of primary operations per diagnosis and year

2000–2016

Diagnosis	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Primary osteoarthritis	130 841	13 004	13 088	13 369	13 443	13 998	66 902	80.8%
Acute trauma, hip fracture	10 914	1251	1 436	1 405	1 525	1 612	7 229	8.7%
Complication or sequelae after fracture or other trauma	7 531	450	486	445	418	403	2 202	2.7%
Femoral head necrosis	2 598	347	366	416	360	389	1 878	2.3%
Other secondary osteoarthritis	5 587	329	302	302	308	305	1 546	1.9%
Sequelae after childhood disease in the hip joint	3 468	324	340	283	282	281	1 510	1.8%
Inflammatory joint disease	3 868	188	163	168	150	132	801	1%
Tumour	995	79	102	111	85	81	458	0.6%
Acute trauma, other	286	23	40	34	33	33	163	0.2%
Other	178	9	11	14	11	9	54	0.1%
(missing)	474	24	16	16	14	18	88	0.1%
Total	166 740	16 028	16 350	16 563	16 629	17 261	82 831	100%

[1)] *Refers to the number of primary operations during the last five years.*

[2)] *Refers to the proportion of the total number of primary operations carried out during the last five years.*

Number of primary operations per diagnosis and age

2000–2016

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Primary osteoarthritis	6 807	54.8%	27 226	81%	110 630	83.8%	53080	74.2%	197 743	79.2%
Acute trauma, hip fracture	100	0.8%	619	1.8%	8 519	6.5%	8905	12.5%	18 143	7.3%
Complication or sequelae after fracture or other trauma	354	2.8%	916	2.7%	3 610	2.7%	4853	6.8%	9 733	3.9%
Femoral head necrosis	1 527	12.3%	1 498	4.5%	2 777	2.1%	1331	1.9%	7 133	2.9%
Other secondary osteoarthritis	1 924	15.5%	1 449	4.3%	1 328	1.0%	277	0.4%	4 978	2.0%
Sequelae after childhood diseasein the hip joint	830	6.7%	879	2.6%	2 248	1.7%	712	1.0%	4 669	1.9%
Inflammatory joint disease	685	5.5%	686	2.0%	1 800	1.4%	1305	1.8%	4 476	1.8%
Tumour	134	1.1%	255	0.8%	698	0.5%	366	0.5%	1 453	0.6%
Acute trauma, other	20	0.2%	28	0.1%	160	0.1%	241	0.3%	449	0.2%
Other	30	0.2%	36	0.1%	84	0.1%	82	0.1%	232	0.1%
(missing)	20	0.2%	31	0.1%	158	0.1%	353	0.5%	562	0.2%
Total	12 431	100%	33 623	100%	132 012	100%	71505	100%	249 571	100%

Number of primary operations with uncemented implants per diagnosis and age

2000–2016

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Primary osteoarthritis	3 618	54.9%	9 837	84.2%	11 425	89.1%	766	79.9%	25 646	80.0%
Acute trauma, hip fracture	1 157	17.6%	644	5.5%	267	2.1%	22	2.3%	2 090	6.5%
Complication or sequelae after fracture or other trauma	879	13.3%	593	5.1%	468	3.6%	26	2.7%	1 966	6.1%
Femoral head necrosis	417	6.3%	222	1.9%	189	1.5%	18	1.9%	846	2.6%
Other secondary osteoarthritis	303	4.6%	135	1.2%	156	1.2%	15	1.6%	609	1.9%
Sequelae after childhood disease in the hip joint	162	2.5%	175	1.5%	140	1.1%	58	6.0%	535	1.7%
Inflammatory joint disease	17	0.3%	47	0.4%	158	1.2%	38	4.0%	260	0.8%
Tumour	5	0.1%	6	0.1%	8	0.1%	6	0.6%	25	0.1%
Acute trauma, other	8	0.1%	8	0.1%	4	0%	1	0.1%	21	0.1%
Other	11	0.2%	7	0.1%	2	0%	1	0.1%	21	0.1%
(missing)	10	0.2%	5	0%	6	0%	8	0.8%	29	0.1%
Total	6 587	100%	11 679	100%	12 823	100%	959	100%	32 048	100%

Number of primary operations with cemented implants per diagnosis and age

2000–2016

Diagnosis	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Primary osteoarthritis	899	41.4%	9 978	75.1%	86 104	82.8%	50 035	74.4%	147 016	78.7%
Acute trauma, hip fracture	61	2.8%	503	3.8%	7 790	7.5%	8 417	12.5%	16 771	9.0%
Complication or sequelae after fracture or other trauma	121	5.6%	594	4.5%	3 199	3.1%	4 545	6.8%	8 459	4.5%
Femoral head necrosis	264	12.2%	562	4.2%	1 891	1.8%	1 229	1.8%	3 946	2.1%
Other secondary osteoarthritis	313	14.4%	608	4.6%	1 889	1.8%	667	1.0%	3 477	1.9%
Sequelae after childhood disease in the hip joint	133	6.1%	319	2.4%	1 356	1.3%	1 205	1.8%	3 013	1.6%
Inflammatory joint disease	243	11.2%	423	3.2%	771	0.7%	224	0.3%	1 661	0.9%
Tumour	116	5.3%	239	1.8%	660	0.6%	354	0.5%	1 369	0.7%
Acute trauma, other	10	0.5%	20	0.2%	132	0.1%	207	0.3%	369	0.2%
Other	7	0.3%	27	0.2%	69	0.1%	76	0.1%	179	0.1%
(missing)	5	0.2%	18	0.1%	124	0.1%	302	0.4%	449	0.2%
Total	2 172	100%	13 291	100%	103 985	100%	67 261	100%	186 709	100%

Number of primary operations per fixation type and age
2000–2016

Fixation type	<50 years		50–59 years		60–75 years		>75 years		Total	Proportion
Cemented	2 172	17.5%	13 291	39.5%	103 985	78.8%	67 261	94.1%	186 709	74.8%
Uncemented	6 587	53.0%	11 679	34.7%	12 823	9.7%	959	1.3%	32 048	12.8%
Reverse hybrid	2 017	16.2%	6 221	18.5%	11 399	8.6%	2 098	2.9%	21 735	8.7%
Hybrid	610	4.9%	1 530	4.6%	3 475	2.6%	1 137	1.6%	6 752	2.7%
Resurfacing implant	998	8.0%	878	2.6%	258	0.2%	2	0%	2 136	0.9%
(missing)	47	0.4%	24	0.1%	72	0.1%	48	0.1%	191	0.1%
Total	12 431	100%	33 623	100%	132 012	100%	71 505	100%	249 571	100%

Number of primary operations per incision type and year
2000–2016

Type of incision	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Posterior incision in lateral position (Moore)	90 238	8 289	8 507	8 469	8 679	9 307	43 251	52.2%
Direct lateral incision in lateral position (Gammer)	60 807	6 777	6 817	7 083	6 803	6 823	34 303	41.4%
Direct lateral incision in supine position (Hardinge)	11 452	860	851	846	1 074	1 025	4 656	5.6%
Other	1 441	101	172	165	71	97	606	0.7%
(missing)	2 802	1	3	0	2	9	15	0%
Total	166 740	16 028	16 350	16 563	16 629	17 261	82 831	100%

[1)] *Refers to the number of primary operations during the last five years.*
[2)] *Refers to the proportion of the total number of primary operations carried out during the last five years.*

Number of primary operations per cement type and year
2000–2016

Type of cement	2000–2011	2012	2013	2014	2015	2016	Total[1)]	Proportion[2)]
Refobacin Bone Cement	30 907	5 258	6 022	5 886	5 931	6 333	29 430	35.8%
Palacos R+G	31 273	5 291	4 435	4 386	4 129	3 995	22 236	27.1%
Cemex Genta Green	0	0	148	224	56	0	428	0.5%
Cemex Genta System Fast	2 235	225	3	0	0	0	228	0.3%
CMW with Gentamycin	342	1	8	61	69	70	209	0.3%
Simplex with Tobramycin	43	0	0	27	45	26	98	0.1%
Other	67 127	13	21	33	42	47	156	0.2%
(completely or partially cement-free)	33 363	5 121	5 604	5 867	6 236	6 573	29 401	35.7%
Total	165 290	15 909	16 241	16 484	16 508	17 044	82 186	100%

[1)] *Refers to the number of primary operations during the last five years.*
[2)] *Refers to the proportion of the total number of primary operations carried out during the last five years.*

7 Primary prosthesis – in-depth analyses

7.1 "New" primary prostheses

In the 1980s, the Swedish Hip Arthroplasty Register won international recognition due to the possibility to track deviations on both the level of hospital and implants. In the end, this means a development of a more streamlined process concerning operations and a more rigorous selection of implants. The possibilities to identify deviations with a well-functioning register have been developed by many other registers. In Britain, an expert group the "Orthopaedic Data Evaluation Panel" (ODEP) was formed to formulate new guidelines for assessment of new implants. The developed criteria have received international acclaim. A similar organization can also be found in the Australian Arthroplasty Register. In ODEP, the degree of evidence is divided into several classes. The highest level (10A*) in this rating means that at least 500 hip replacement surgeries should be followed for at least 10 years. The operations should have been performformed in moe than three centres or by more than three different surgeons not involved in the development of the prosthesis. The proportion of revisions must be less than 5% or the implant survival must be 90% or higher according to Kaplan-Meier. Indication for revision and number of deaths should be known. Up to 20% missing observations ("lost to follow up") are accepted. A similar system exists in the Australian Arthroplasty Register where you divide the evaluation in three stages. The first stage consists of an automated screening, where the prostheses, which are compared with all others in the same group, and present a double risk of revision, are identified. In the second stage, those prostheses are examined, which have been discarded as deviant regarding possible causes for worse outcomes, for example abnormal patient selection. Detailed statistical analyses are also carried out. If necessary, an expert panel can carry out further analysis before the presentation in the register's annual report (for details, refer to www.odep.org.uk and *Acta Orthop 2013;84(4):348–352)*.

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

Most registers use revision as an outcome, regardless of reason and regardless of which component should be revised. Some registers multiply the number of observed components with the number of observation years, which means that no attention is paid to the fact that causes for revision vary over time. Considering the way the comparison with other prostheses is made, the comparison group can be comprised of all other implants, all other implants in the same product category or a selected reference group. Sometimes a fixed limit is used corresponding to, for example, 90% prosthesis survival after ten years. So far, there has been no established standard. Such standard is also not easy to achieve because the circumstances vary greatly between different registers with respect to the total number of observations, the number of implants used in the register's coverage area, the monitoring of the follow-up duration, and the extent of the individual register's data capture. Additionally, the exact value limits for quality are constructed based on what is considered an "acceptable standard" at a specific time. Today's acceptable standards may not necessarily be the same in 10 or 20 years' time.

In this year's follow-up of "new" implants, we have used same selection principles for the reference group as last year. This implies a certain flexibility as the reference value in a certain extent can be changed over time depending on the outcome for the implants which meet the basic criteria.

Similarly, to previous analysis, the outcome is not all types of revision. Upon evaluation of the cup, the replacement of cup and/or liner or a definitive extraction are seen as outcomes, regardless of whether the stem is replaced or not. The same principle applies to evaluation of the stems. Revisions due to infection have been excluded, as this outcome mainly reflects the care process and case mix. It is uncertain whether the implant's surface structure or other properties may affect the risk of infection (there are studies, which indicate that this may be the case) but so far, we think that this possible effect is marginal.

In this year's analysis, only the prostheses which were inserted since 2006 have been included. The point of including only the last 11 years, is to try and carry out an analysis, which is as representative as possible for today's situation. During the past decade, the health-care processes regarding prosthesis surgery have been through extensive changes, which has also influenced the risk for complications in a way which is difficult to ignore or adjust for. By excluding operations, which were carried out more than 11 years ago, we believe that the comparison becomes fairer.

The control group consists of prosthetic components, where at least 50 cases have been followed for at least ten years. To be included in the control group, the implant survival at ten years should exceed 95%. Furthermore, at least 50 implants must have been inserted in conjunction with hip replacement surgery during the past two years, of which at least one during the latest observation year (2016).

The implants which are included in each control group are presented in Table 7.1. In comparison to previous annual reports, two cemented cups have disappeared, and they have been replaced by two new ones. Contemporary Hooded Duration falls right under 95% ten-year survival and the FAL

Composition of control groups

Type of component *period for analysis*	Number	Prosthesis survival after 10 years, 2 SEM*
Cemented cup 2006–2016		
Lubinus older type of polyethylene	45 708	97.5 0.3
ZCA older type of polyethylene	1 399	96.1 0.4
ZCA XLPE	14 687	97.9 0.2
All	**61 794**	**97.4 0.3**
Uncemented cup 2006–2016		
Allofit	1 330	99.0 0.6
Trident AD WHA	1 186	96.7 1.5
Trilogy±HA	7 433	98.4 0.5
All	**9 949**	**98.3 0.4**
Uncemented stem 2006–2016		
ABG II HA	2 708	96.1 1.2
Accolade Straight	1 822	96.7 1.8
Bi-Metric X Por HA	8 059	98.0 0.4
CLS	9 630	98.0 0.4
Corail standard	12 591	98.5 1.0
All	**34 810**	**97.8 0.3**

**Cup and stem survival, respectively, excluding the revisions due to infection*

Table 7.1. Implants in the control groups in the analysis of "new" implants in Table s 2 and 4. For cups, only cup revisions are included, and for stems, only stem revisions are included.

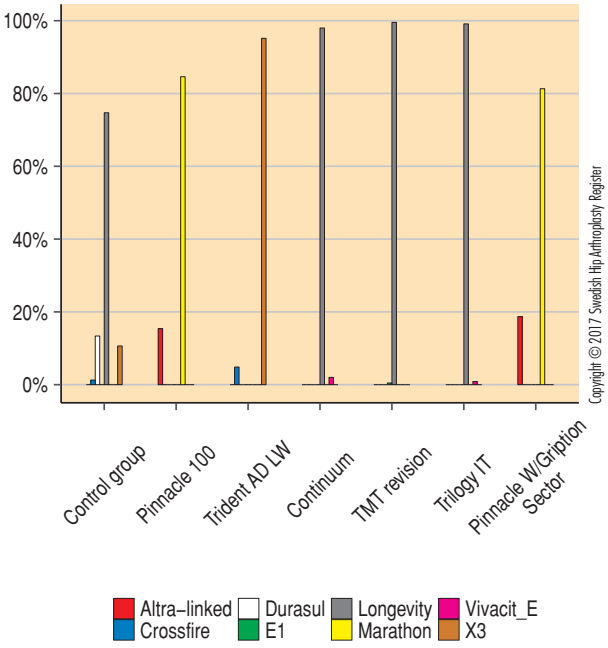


Figure 7.1. Type of polyethylene which is used in the liner in respective group of uncemented cups.

cup has only been used in three cases in 2015–2016 (FAL with XLPE was used in less than 50 cases during the same period). The ZCA cup, both with and without highly cross-linked polyethylene, is included in the control group. We have previously pointed out that this cup was revised slightly more often due to dislocation than in the actual control group. Still, dislocation is the most common revision cause for these cups, but revision due to loosening is significantly more uncommon than in the case of, for example, the Lubinus cup with older polyethylene. This may also be due to the surgical technique improving over time.

In the group for uncemented cup, all cups in the control group have highly cross-linked polyethylene in order to correspond to the modern standard, so almost all uncemented cups inserted in Sweden in 2016 have this type of polyethylene. In most cases, one type of polyethylene for one and the same cup shell dominates (Figure 7.1). In the control group for uncemented stems, five implants are included. There has been no analysis for cemented stems because no new implants meet the inclusion criteria.

An implant is defined as new, if it is introduced during the period (solitary operations performed before 2006 have been ignored) and less than 50 implants have passed 10-year follow-up. Additionally, the number of prostheses which are reported to the Register during the latest two-year period (currently 2015–2016) must exceed 50 and the prosthesis must have been in use during 2016.

Many of these prostheses have a longer documentation abroad, but since the coverage and the risk for revision can vary between countries, we think that a domestic analysis is interesting and valuable. The starting year, which is presented in Tables 7.2 and 7.3, corresponds to the first year when more than 10 prostheses of the respective type were inserted. All data is applicable from that year. Individual prostheses which were inserted before "the starting year" have therefore been excluded. In the control group, the starting year is set as 2006, which is commented above. In the control group for "cemented cup", all implants are produced of older polyethylene, on the contrary to the group for "uncemented cup", where, as mentioned above, only different versions of highly cross-linked polyethylene are included. In Table 7.5, the number of clinics, which have used one specific implant in the observation group during more than 50 hip arthroplasties, is presented to get an understanding about how these implants are handled and how extensively they are used in the country.

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

	Starting year	Number		Follow-up mean	Cup revisions#, number %		Prosthesis survival#* cup/liner, 2 SEM.	
		total	*After 2 years*	**Max years**	*total*	*≤ 2 years*	*2 years*	*5 years*
Cup cemented								
ADES Cemented	2013	198	17	2.2 *10.7*	0 *0*	0 *0*	–	–
Avantage Cemented	2006	2 059	906	2.2 *10.7*	**41** ***2.0***	**32** ***1.5***	**97.9** ***0.4***	**96.8** ***1.3***
Exceed ABT E1 no flange	2011	390	315	3.2 *5.8*	3 *0.8*	0 *0*	99.7 *0.7*	–
Exeter X3 RimFit	2010	10 946	5 929	2.5 *6.5*	31 *0.3*	23 *0.2*	99.7 *0.1*	99.5 *0.2*
Lubinus X-linked	2010	18 588	8 271	2.0 *6.1*	65 *0.3*	53 *0.3*	99.6 *0.1*	99.3 *0.3*
Concentric X-linked IP¤	2011	969	303	1.6 5.9	5 *0.5*	6 *0.6*	99.4 *0.6*	–
Marathon XLPE	2008	15 536	11 252	3.6 *10.7*	65 *0.4*	37 *0.2*	99.7 *0.1*	99.4 *0.2*
Polarcup	2010	561	252	2.2 *6.9*	5 *0.9*	4 *0.7*	99.2 *0.8*	98.8 *1.2*
Control group	2006	61 794	53 882	5.6 *11.0*	*777* *1.3*	286 *0.5*	99.5 *0.1*	98.9 *0.1*
Cup uncemented								
Continuum	2010	3 572	2 053	2.5 *7.2*	**49** ***1.4***	**38** ***1.1***	**98.6** ***0.4***	**97.9** ***0.7***
Delta TT	2012	361	163	2.0 *5.1*	2 *0.6*	2 *0.6*	99.3 *1.0*	–
Exceed ABT Ringloc	2011	1 410	830	2.6 *6.3*	8 *0.6*	7 0.5	99.4 *0.4*	99.3 *0.5*
G7 PPS	2015	210	830	0.6 *1.8*	1 *1.3*	1 *1.3*	–	–
Pinnacle 100	2007	2 027	1 421	3.6 *9.9*	20 *1.2*	9 *0.5*	99.2 *0.4*	98.3 *0.8*
Pinnacle sector	2006	844	509	3.8 *11.0*	10 *1.2*	3 *0.4*	99.4 *0.6*	98.7 *1.0*
Pinnacle W/Gription 100	2011	1 986	653	1.6 *5.3*	10 *0.5*	9 *0.5*	99.2 *0.6*	–
Pinnacle W/Gription sector	2014	301	64	1.2 *4.1*	3 *1.0*	3 *1.0*	98.9 *1.2*	–
R3	2014	91	–	1.3 *3.0*	0 *0*	0 *0*	–	–
Regenerex	2008	827	531	3.3 *8.6*	6 *0.7*	2 *0.7*	99.3 *0.7*	98.8 *1.0*
TM revision	2008	456	307	3.5 *9.8*	**11** ***2.4***	**10** ***2.2***	**97.6** ***1.4***	**96.9** ***2.0***
Trident AD LW	2006	830	642	5.1 *11.0*	12 *1.4*	8 *1.0*	98.9 *0.8*	98.1 *1.1*
Trident hemi	2006	3 392	1 947	3.3 *11.0*	28 *0.7*	8 *0.2*	99.6 *0.3*	99.1 *0.5*
Trilogy IT	2011	1 146	515	1.9 *5.2*	**26** ***2.3***	**25** ***2.2***	**97.4** ***1.0***	–
Tritanium	2010	647	451	3.4 *7.1*	7 *1.1*	2 *0.3*	99.4 *0.7*	98.5 *1.3*
Control group	2006	9 949	8 592	5.8 *11.0*	113 *1.1*	64 *0.6*	99.2 *0.2*	98.9 *0.2*

#All causes excluding infection
**Data is presented only for at least 50 observations*
¤Also known as Lubinus IP

Table 7.2. Cups, which were introduced on the Swedish market from 2006 and which have been used for more than 50 hip arthroplasties during the past two years as well as they have been in use in 2016. Bold text indicates that the outcome is worse compared to controls (log rank test). This data intends to form the basis for further evaluations because it is not possible to state in this analysis whether a worse outcome is related completely, partially or not at all to the choice of implant.

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

	Starting year	Number		Follow-up mean	Cup revisions#, number %		Prosthesis survival#* cup/liner, 2 SEM.	
		total	*After 2 years*	**Max years**	*total*	*≤ 2 years*	*2 years*	*5 years*
Stem uncemented								
Accolade II	2012	1 310	602	1.9 *4.9*	2 *0.2*	2 *0.2*	99.8 *0.3*	–
Corail coxa vara	2006	2 832	1 840	3.4 *10.9*	19 *0.7*	11 *0.4*	99.6 *0.3*	98.9 *0.6*
Corail high offset	2006	3 642	2 509	3.6 *11.0*	40 *1.1*	22 *0.6*	99.3 *0.3*	98.6 *0.5*
Echo Bi-Metric	2013	189	28	1.1 *4.0*	3 *1.6*	3 *1.6*	–	–
M/L Taper	2012	994	498	2.1 *4.8*	3 *0.3*	2 *0.2*	99.7 *0.4*	–
Control	2006	34 810	26 418	4.7 *11.0*	469 *1.3*	336 *1.0*	98.9 *0.1*	98.6 *0.2*

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

Table 7.3. Stems, which were introduced on the Swedish market from 2006 and which have been used for more than 50 hip arthroplasties during the past two years as well as they have been in use in 2016. The implant survival has been calculated if the number of observations exceeds 50. No stems differ significantly from the control group (log rank test).

Demographics and cause for revision for "new" cups and their control groups (only operations during 2000–2016)

Type of implant	Age	Gender	Diagnosis %	Cause for revision number % #			
	Mean SD	*Women %*	*Primary osteoarthritis/ fracture + sequelae/ Other secondary osteoarthritis*	*Loosening/ osteolysis*	*Dislocation*	*Periprosthetic fracture*	*Other**
Cemented cup							
Avantage Cemented	75.6 *11.4*	63.8	19.2/66.3/14.5	4 *(10.0)*	16 *(40.0)*	13 *(32.5)*	7 *(17.5)*
Control group	71.2 *8.8*	61.2	82.7/11.7/5.6	309 *39.8*	369 *47.5*	29 *3.7*	70 *9.0*
Uncemented cup							
Continuum	61.2 *10.5*	48.4	84.5/3.4/12.1	2 *(4.1)*	38 *(77.6)*	1 *(0)*	8 *(16.3)*
TM revision	59.3 *13.4*	44.0	53.2/5.7/41.1	0 *(0)*	10 *(90.9)*	0 *(0)*	1 *(9.1)*
Trilogy IT	62.7 *11.5*	45.0	82.5/4.0/13.5	0 *(0)*	21 *(80.8)*	4 *(15.4)*	1 *(3.8)*
Control group	59.1 *11.0*	48.1	78.2/5.0/16.8	21 *18.6*	58 *51.3*	13 *11.5*	21 *18.6*

#Percentage in parenthesis when the number is <100, only cup revisions
**Excluding infection*

Table 7.4. Demographic data and the cause for the revision of implants analysed in Table 1 with significantly inferior cup/liner survival.

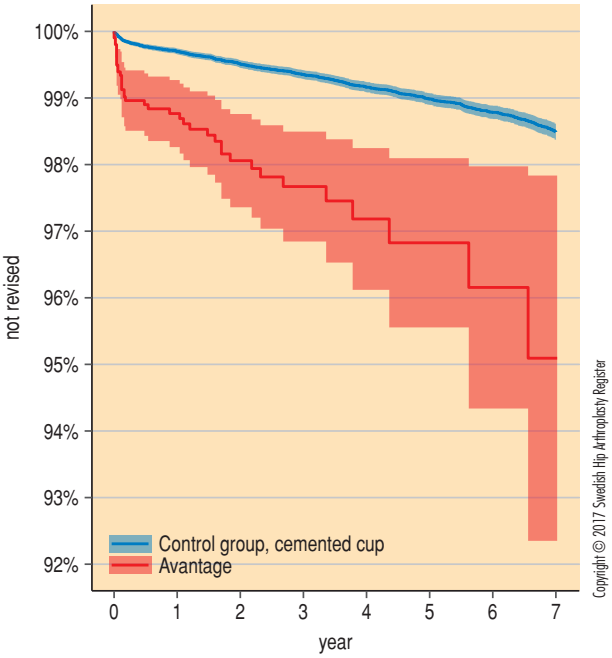


Figure 7.2. Survival diagram for cemented Avantage cup in comparison to the control group for cemented prosthesis. Revision due to infection is excluded.

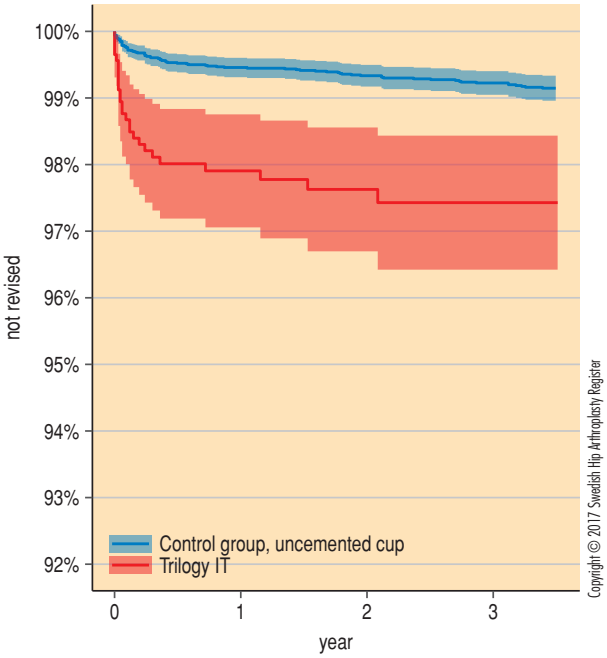


Figure 7.3. Survival diagram for uncemented Trilogy IT cup in comparison to the control group for uncemented prosthesis. Revision due to infection is excluded.

The majority of the cemented cups in the observation group shows an early prosthesis survival regarding cup revision, which is comparable with the control group and in certain instances, somewhat higher (Exeter X3 RimFit, Marathon XLPE, Lubinus X-linked). Two cups (FAL X-linked, Low Profile Cup – Müller) were excluded, since they were registered during only 31 and four operations in 2015 and 2016. In this year's analysis, only the Avantage cup shows a worsening trend (Figure 7.2, log-rank test: p<0.0005). The worse outcome may at least partially be affected by a poor case-mix, meaning an increased number of patients with secondary osteoarthritis, including fracture diagnosis and higher mean age (Table 7.4). If this is adjusted for in a Cox regression analysis, there is still more than a doubled risk for cup revision (Hazard Ratio Avantage/control group: 2.7, 95% *confidence interval: 1.9–3.7*). If this is additionally adjusted for ASA class, the result is just about the same (data from only 2008; Hazard ratio: 2.4 *1.7–3.5*).

In this year's analysis, the outcome for concentric X-linked IP cup (Lubinus IP) does not differ from the control group (log-rank test: p=0.3). The same applies to the Polarcup (p=0.3). The Contemporary Hooded Duration cup, which in previous analysis belonged to the control group, falls now under 95% prosthesis survival and therefore, also differs significantly from this (p<0.0005). At the same time, both variants of ZCA end up in the control group, due to the reduced risk of late problems related to loosening, which cannot be detected until the observation time is long enough. This suggests that a dynamic control group has advantages, since in addition to considering how complication landscape is changed with increasing observation time, factors, which in some cases are difficult to measure, are also taken into account, like time-related changes, such as use of new polyethylene qualities, changes in health-care processes and, in some cases, surgical technique and quality.

Among the uncemented cups, Delta Motion (44 inserted cups in 2015–2016) has disappeared in comparison to the previous report and G7 PPS has been added. Continuum, TM modular and Trilogy IT differ from the control group with a lower prosthesis survival (p<0.0005 for all). The surface of the first two is made of trabecular tantalum metal, while Trilogy IT has a titan surface (fibre metal). This surface was launched in 1984 in the first version of the Harris-Galante cup. The Trilogy cup replaced the Harris-Galante cup in 1993. The Trilogy cup had a thicker metal shell and the liner attachment was reconstructed to improve its fixation. The liners of the IT version and its attachment has been further modified. The manufacturer has not stated that the fibre metal surface which faces the bone, has undergone changes during this time. Table 7.4 shows that the most common cause for revision in all three cases is dislocation (82–100% of all revisions in each group). In previous reports, we have noted that the cause for this observation is unknown. Regarding the revision of Continuum and TMT, their high friction may worsen the possibilities to guide the cup to the desired location during insertion. This theory is partially contradicted by the fact that the design of the trabecular titanium surface does not seem to be associated with the same problem. Regarding Trilogy IT, it is difficult to find an implant-related explanation to the increased dislocation issues

Number of hospitals which reported <10, ≥10 and ≥ 50 inserted prosthetic components

2015–2016

Cemented cup	Number/hospital *<10/ 10–49/≥50*	Uncemented cup	Number/hospital *<10/ 10–49/≥50*
ADES, cemented	4/8/0	Continuum	8/6/8
Avantage Cemented	18/17/2	Delta TT	2/4/1
Exceed ABT E1 no flange	4/3/0	Exceed ABT Ringloc	0/1/2
Exeter X3 RimFit	2/5/13	G7 PPS	1/1/1
Lubinus X-linked	6/6/33	Pinnacle 100	2/3/4
Concentric X-linked IP	2/0/2	Pinnacle sector	2/3/1
Marathon XLPE	7/10/7	Pinnacle W/Gription 100	6/4/1
Polarcup	1/5/1	Pinnacle W/Gription sector	4/2/1
		R3	0/0/1
		Regenerex	2/3/1
		TM revision	11/1/1
		Trident AD LW	2/3/1
		Trident hemi	4/3/4
		Trilogy IT	3/0/3
		Tritanium	2/1/2
Control group	**5/5/23**	**Control group**	**4/4/6**

Uncemented stem	Number/hospital *<10/ 10–49/≥50*
Accolade II	1/2/4
Corail coxa vara	10/13/6
Corail high offset	5/23/4
Echo Bi-Metric	1/2/1
M/L Taper	3/2/2
Control group	**4/27/39**

Table 7.5. Number of hospitals which reported less than 10, 10–49 and more than 50 inserted implants during the period of 2015–2016.

in comparison to the control group, where almost 75% of cases are constituted of the earlier version of the Trilogy cup.

In this year's analysis, there are no cemented stems which are included in our definition of "new" stems and which were used in 50 operations or more. The Sirius stem, which is named in the previous report, was used in 13 cases in 2015 and it was not used at all the following year.

Concerning uncemented stems the control group consists now of Accolade Straight, Bi-metric X Por Ha, CLS, Corail standard and ABG II HA, all of which show a 10-year survival of over 95%. Since the observation time for the control group was limited to the period of 2006–2016 in order to reflect "modern" prosthesis surgery as well as possible, Wagner Cone does not reach the minimum of 50 observations during this time point. However, if all cases since 1999 (n=1674) are included, the ten-year survival is 98.6±0.7% and 98.9±0.5% (45 observations left at ten years), if only those patients who underwent operation since 2006 were included. In Sweden, Wagner Cone has been a relatively seldom used stem, often in cases with abnormal anatomy, but it has long-term documentation and high prosthesis survival rate in a ten-year perspective.

The Corail stem in standard version is now included in the control group, while the variants "coxa vara" and "high offset" do not reach 50 observations in a ten-year period. The CFP stem, which in previous year's analysis showed a worse result than the control group, does not meet the inclusion criteria this year due to little use. In 2016, only four inserted stems were registered. The Fitmore stem is also excluded due to the same reason. In 2016, eight stems were registered.

Swedish orthopaedic surgeons are known for having a conservative attitude towards new implants, something which now seems to be reflected in the choice of uncemented stems. Although, new designs have been available since 2013, these are used in a very limited numbers and mainly in on-going studies. The prosthesis survival within five years for the prosthesis, which could be evaluated, is at 98% or over after five years in 14 of the 17 cases, which have been studied during sufficient time period. The CFP stem which showed a somewhat worse result, has been phased out, which we hope reflects the fact that the annual report is being read.

In a review of the spread of the implants that are considered new and are not yet sufficiently documented in the Swedish market, we find that several clinics are using these implants, even in very small quantities. In Table 7.5, there are examples of new implants that are only used at a few clinics (for example R3 Cup), while some others are used in a few patients at many clinics (for example TM revision). However, it may be that an implant that is often used in the revision context, in individual cases and under special indication, is used in a primary operation.

If one wants to start using a new implant, a specific training should be offered in order to avoid mistakes due to lack of habit and knowledge about surgical instruments and the characteristics of the actual prosthesis and common beginner mistakes. It is also wise to conduct a systematic and expanded follow-up during the first years, not least due to the fact that the follow-ups of standard operations are usually reduced to a minimum. This is also applicable, if an implant has a solid documentation based on the data from foreign registers and studies.

The majority of the prostheses in use in Sweden today have a low risk for revision. Of the prostheses which have been introduced during the last decade, the majority have equal or a somewhat lower risk for revision than the corresponding control group.

8 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 reoperations have between 1992 and 2015 stayed between 12.7 and 13.5%. In 2016, the proportion was somewhat lower (11,9%) partially due to a lag in reporting (Figure 8.1). The number of performed operations has largely followed the increase of primary hip arthroplasty (Figure 8.2). The relation between reoperations and primary operations gives some idea of the extent of the burden of reoperations in one country or in one area, but it is not suitable to use for other purposes due to its sensitivity to fluctuations in the number of performed primary operations. The quota is also affected by many other factors, such as patient flow between healthcare departments, the medical professionals' attitude to performing reoperations, as well as the period of time that total hip replacement has been practiced in a certain healthcare area. The reporting of reoperations is probably inferior to that of primary operations. This particularly applies to the operations where the implant is left untouched, such as the irrigation and debridement of infection or osteosynthesis due to periprosthetic fracture, where prosthesis is left untouched. "Other reoperations", corresponding to those which do not interfere with the implants inserted, increased after the turn of the millennium, probably as a result of the fact that the diagnosis for periprosthetic fracture was from the year 2001 checked against the data in the Patient Register as part of a validation project.

Restructuring of healthcare has led to the situation where the quota for reoperations/primary operations at mainly university and to some extent at regional hospitals has increased (refer to Annual Report 2013). The breakdown of reoperations between the four different types of hospitals has been more constant (Figure 8.3).

The demographics for patients, who undergo reoperation, has changed over time. The changes, which have taken place since 1981, are described in the previous annual report (Annual Report 2015). We found that the mean age between periods 1981–1995 and 2011–2015 has increased by about three years and that the proportion of patients over the age of 85 has increased from 3.1% to 11.4%.

In this year's report, the three latest periods are compared (2008–2010, 2011–2013, 2014–2016). Additionally, corresponding data for primary arthroplasties operated in 2014–2016 are presented for comparison. During the past decade, the age distribution and BMI during reoperation have been relatively constant. In the beginning of the period, the proportion of women tends to decrease and the proportion with primary osteoarthritis diagnosis tends to increase. The level of comorbidity increased during the whole period which is reflected in the increasing proportion of patients who are

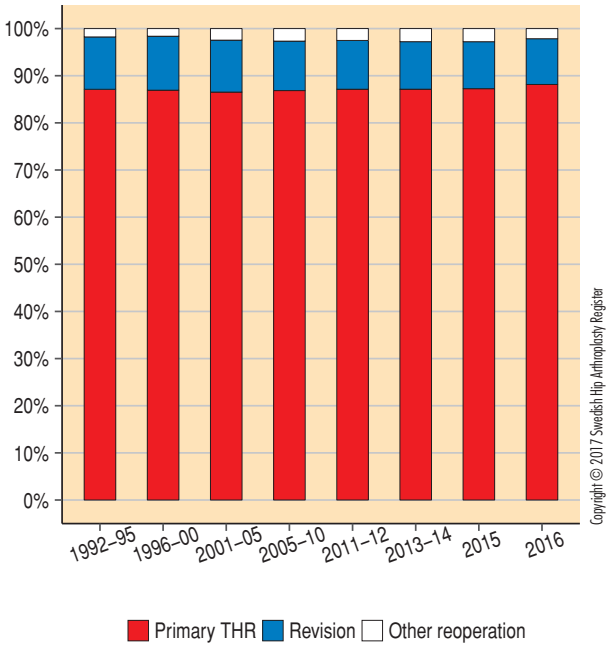


Figure 8.1. Proportion of the re-reoperated (revision + other reoperation) relative to the total number of hip arthroplasty-related operations during 1992–2016.

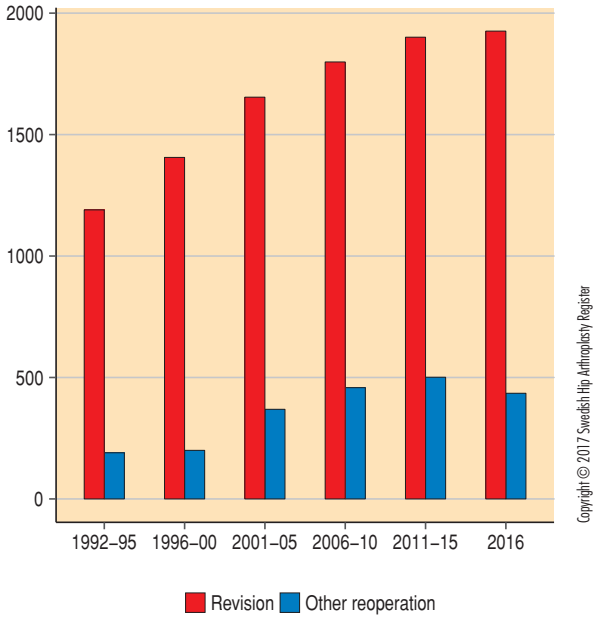


Figure 8.2. The total number of reoperations in the period 1992–2016. For intervals spanning several years, an average is presented.

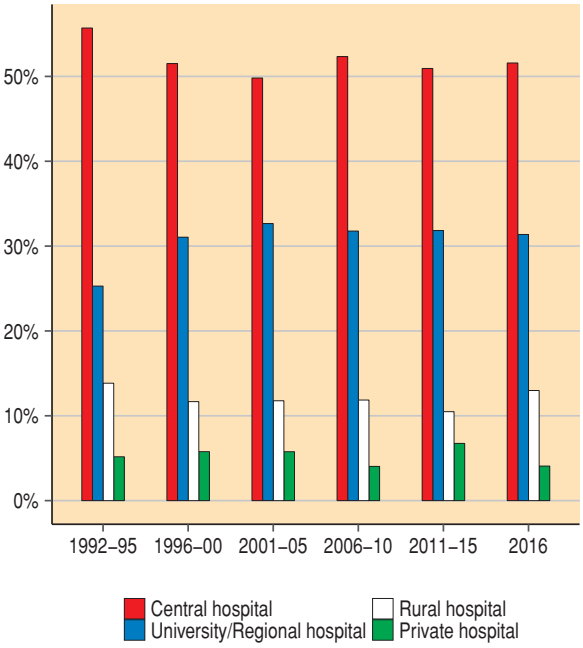


Figure 8.3. Distribution of reoperations between different types of hospitals between 1992 and 2016.

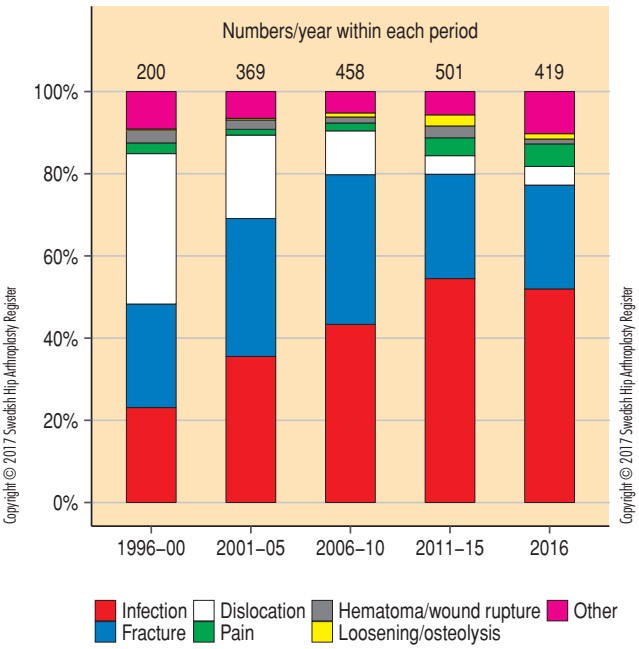


Figure 8.4. The most common reasons for reoperation in which the implant is left untouched during the period 1996–2016. The reported number of reoperations without implant influences is given as average values for periods of 4 years until 2015. Total numbers/year at the top.

classified in ASA class III or higher. The extent to which this shift is real or reflects a change in classifying, is obviously not certain, but the change is so significant that it is difficult to believe that there is no objective background.

Comparison between patients who have undergone reoperation and patients who were operated for primary hip arthroplasty during 2014–2016, show several partially expected differences. The mean age during reoperation is three years higher, the proportion of men is higher and fewer of these patients has primary osteoarthritis. Additionally, they have a higher level of comorbidity, which can partly be explained by higher mean age and higher proportion of patients with inflammatory joint disease, femoral head necrosis and other secondary osteoarthritis. However, the fracture group is not overrepresented in the reoperation group, perhaps due to high mean age, low physical activity level and high mortality in this patient group.

8.1 Reoperation without replacing or extracting the implant

From 1996, 32.2% of all reoperations were performed on patients who had previously undergone at least one previous reoperation. If revisions are excluded, this proportion rises to 48.4% for the same period. A reoperation without an implant replacement or implant extraction is repeated more often than a revision. It is probably due to the fact that the cause is most often an infection and the prognosis for healing is bad in such interventions in comparison to, when a partial or total replacement of the prosthesis is performed (refer to Annual Report 2015 and in-depth analysis). Nevertheless, the proportion of "other" reoperations (= no replacement or extraction of implant/part of implant) increased from 23% to over 50% within the period, which is illustrated in Figure 8.4. In the majority of these cases (58.0%), the hip in question was reoperated without replacing the implant/extraction during at least one previous occasion.

Fracture is the second most common cause for reoperation without replacing or extracting the prosthesis or its parts. In 34.9% of the cases, the fracture was localized in the prosthesis height (Vancover type B) and in 54.8% of the cases, the localisation was distal to the tip of the prosthesis (type C). In other cases, it has mostly to do with trochanteric fractures (2.9%). In 6.7% of the cases, the information about the localisation of the fracture is missing.

Periprosthetic fractures, which are treated without replacing the prosthesis, are underreported. There are several reasons for this, such as the contact secretaries do not know that periprosthetic fractures must be reported or they may not even be notified, when they occur. Certain typical fractures (for example, trochanteric fracture) are treated often without

operation and are thus most often treated on outpatient basis. Between 2001 and 2011, an interlinking with the Patient Register was performed to get a better picture of the correct number of periprosthetic fractures. The "missed cases" have now been added to the Swedish Hip Arthroplasty Register's (SHPR) database, which is reflected in the increasing proportion of fractures in Figure 8.4 during 2001–2005. During 2011–2015 and in 2016, this proportion was reduced, a decrease which is probably not real, but reflects the fact that several fractures are not registered. To reduce this issue, we have now begun to work with the Swedish Fracture Register, which, however, not has national coverage.

Reoperation due to dislocation/instability was relatively common during the beginning of the observation period, due to the fact that often, the joint was stabilized by use of a polyethylene augment fixed to the cup with screws (socket wall addition device) and an open reduction was performed in cases where a closed reduction was unsuccessful. In 2016, both of these interventions were uncommon (nine cases of open reduction, four cases of inserting the socket wall addition). Generally, dislocation is now treated seldom with reoperation without replacing the implant. The number of reported cases has decreased from 73 annually during 1996–2000 to 19 in 2016. It is a desired development, where dislocation issue is a serious condition, which has a significant effect on the patient's life quality. In previous reports and the present one, we have shown that insertion of socket wall addition does not bring about satisfying results. Therefore, during a reoperation, it is important to consider revision and to focus on achieving a stable joint in the best way possible, where, in particular, the risk for peroperative complications may constitute the limiting factor.

The causal group "pain" (in total, 228 operations during 1996–2016) includes patients who have undergone different types of soft tissue interventions (28.9%), biopsy (21.5%) and extraction of foreign material (pieces of cement, osteosynthetic material, socket wall addition etc.: 16.2%) and other diverse interventions. In 48 cases, only an exploration (21.1%), without registering any additional measures, was performed.

Loosening/osteolysis is a relatively uncommon cause for reoperation without affecting the implant. In these cases, mostly biopsies (62.9%) with probable negative culture results, exploration without additional measures (17.1%) and bone transplants (4.8%) have been performed.

The most common measure during reoperation, where the implant remains in the patient, is different types of wound and soft tissue revisions. In 96.1% of all cases, which underwent operation in 1996–2016, infection is the cause (Figure 8.5). The second most common measure is fracture reconstruction, where its relative proportion decreases during 2011–2015 similarly to the decrease of reported fractures both in absolute and relative figures, as shown above. During 2001–2011, we have been able, with the help of interlinking with the Patient Register, to study in detail an almost complete material of

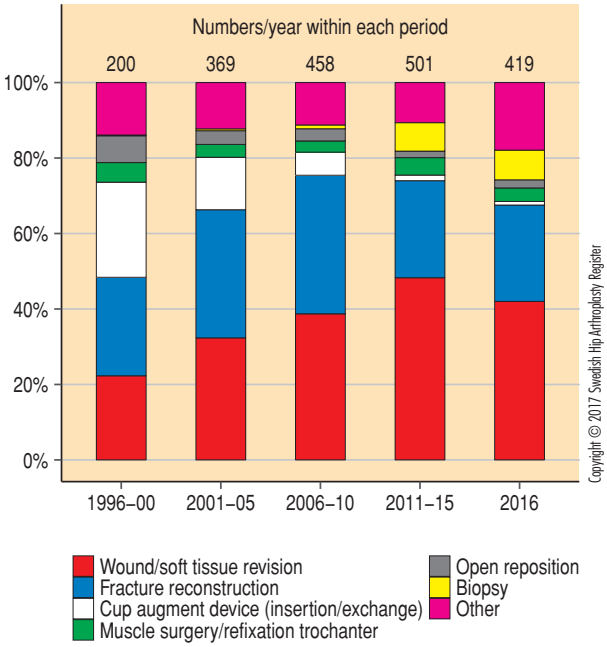


Figure 8.5. The most common measures at reoperation where the implant is left untouched during the period 1996–2016. The number at the top indicates an average number/year within each period except for 2016.

periprosthetic fractures, particularly type B and type C. Data is currently being compiled in a thesis by Georgios Chatziagorou and will be published in subsequent years.

Patients who undergo reoperation without implant replacement or implant extraction are about three years older, mostly male and have a higher level of comorbidity than those who are operated for primary hip arthroplasty. The two most common measures during reoperation without implant replacement or extraction are wound and soft tissue revision due to infection and fracture reconstruction in case of periprosthetic fracture.

Demographics during reoperation from the first year for BMI and ASA registration. Primary arthroplasties performed during the last period 2014–2016 for comparison

	Reopereration			Primary operation
	2008–2010	*2011–2013*	*2014–2016*	*2014–2016*
Number	7 222	7 104	7 092	50 450
Age				
Mean value SD	71.9 *11.3*	71.5 *11.6*	71.7 *11.1*	68.8 *10.8*
<55 years %	7.4	8.3	7.8	10.2
55–69 years %	30.7	30.9	29.6	38.4
70–84 years %	50.1	49.4	51.2	46.2
>=85 years %	11.8	11.4	11.5	5.2
Gender				
Proportion of women %	53.6	50.7	51.2	57.8
BMI	–	–		
Number, % of all in the interval	5 094 *71.8*	5 939 *83.6*	6 284 *88.6*	48 461 *96.1*
Mean value SD	27.1 *5.7*	27.3 *5.7*	27.1 *5.8*	27.1 *5.0*
<18.5 %	2.0	1.6	1.8	1.2
18.5–24.9 %	34.7	32.9	34.5	33.4
25–29.9 %	39.3	41.0	39.6	41.6
>=30 %	24.0	24.5	24.2	23.8
ASA class				
Number, % of all in the interval	6 029 *83.4*	6 567 *92.4*	6 878 *97.0*	49 682 *98.5*
I %	13.2	11.8	9.7	21.3
II %	52.6	50.8	50.7	58.3
III– %	34.2	37.4	39.6	20.4
Diagnosis during primary operation *				
Primary osteoarthritis	72.7	75.3	74.7	82.7
Fracture including sequelae	8.8	8.8	8.7	10.2
Inflammatory joint disease	6.9	5.6	5.7	1.2
Sequelae after childhood disease	5.2	4.7	4.5	1.9
Femoral head necrosis	4.6	3.8	4.4	3.3
Other secondary osteoarthritis	1.9	1.7	2.0	0.7

Table 8.1. Distribution of gender, age, BMI and ASA during all types of reoperation during the last three three-year periods. Data for patients who underwent primary operation in 2014–2016 is shown in comparison.

9 Reoperation within two years

Reoperation within two years is used as a quality indicator for primary hip arthroplasty. The background to this is that the most common causes for reoperation are mainly infection and dislocation. The distribution of the cause for early reoperation, and especially during the first year after primary surgery, has varied (Figure 9.1). At the beginning of the 2000s, dislocation and deep infection were similarly common. However, the proportion of reoperations due to dislocation has decreased, while the proportion of reoperations due to infection has increased. This may indicate that we have become better at identifying and taking measures to prevent dislocation. This also suggests that we have a more active attitude towards treating infection surgically. Moreover, if there is an increased incidence, it is not safe to make any assumptions, but it cannot be excluded either.

The proportion reoperated within two years has since 2010 varied between 2.1 and 2.4%. It should be noted that all the patients who underwent operation between 2015 and 2016 have not passed the two-year limit and the proportion of patients, who were reoperated within two or three years, will increase.

Reoperation within two years refers to all forms of subsequent surgery to the hip after inserting 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 two years has been selected by Swedish Association of Local Authorities and Regions (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 SALARs public reporting of health care quality indicators "Vården i siffror" (vardenisiffror.se). This indicator should be seen as one of the most important and most responsive endpoints reported by the Swedish Hip Arthroplasty Register.

9.1 Definition

By short-term complication, we mean all forms of open surgery within two years after the primary operation. The latest 4-year period (2013–2016) has been studied. Please note that the report only concerns complications that have been surgically treated. 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. Patients who undergo reoperation at a clinic that is not the primary clinic are counted as belonging to the primary clinic. When interpreting results, one should only compare units from the same type of hospital due to different patient demographics. Units 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:

- There is a variation in reporting of reoperation between units. Reoperation without replacing parts of the implant has a higher level of underreporting than revisions.
- The number of complications is generally low with random variability having great impact on the results. This variable can really only be evaluated over time, that is to say, if distinct trends exist. Table 9.2 shows the trends from previous years.
- Units that take a cautious stance (for example those who largely apply non-surgical treatment for infection and dislocation), have "false" low figures.
- Conversely, units that are surgically "aggressive" both at the suspicion of early infection and on initial dislocation, may have higher 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.

It is important to point out that the indicator "Reoperation within two years" will not be used to rank care providers. Random variation for all unusual complications makes it possible that a single drop in registration has a strong effect on one clinic's ranking. Irrespective of hospital category and result, clinics should analyse their own complications (without taking a peek at the national average) and investigate whether or not systematic deficiencies exist – all to avoid serious complications for the individual patients.

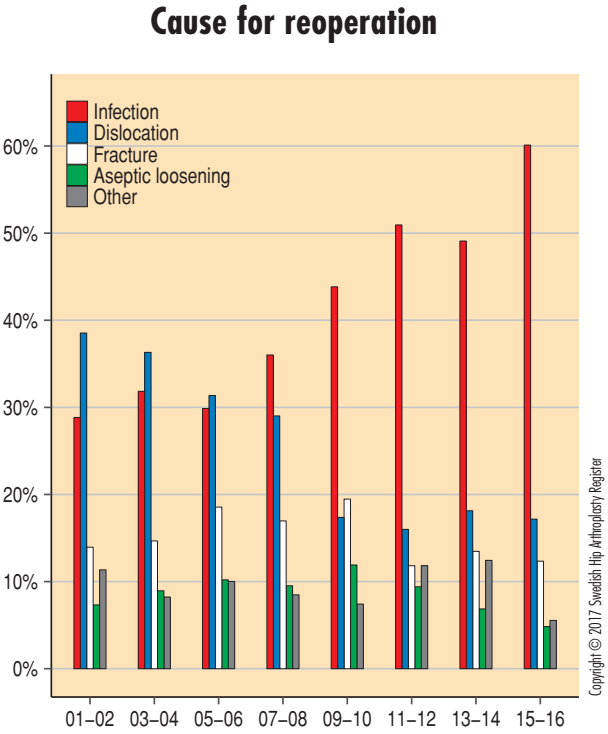


Figure 9.1. Distribution of the causes of reoperation within two years after the primary operation is divided into six time periods between 2001 and 2016.

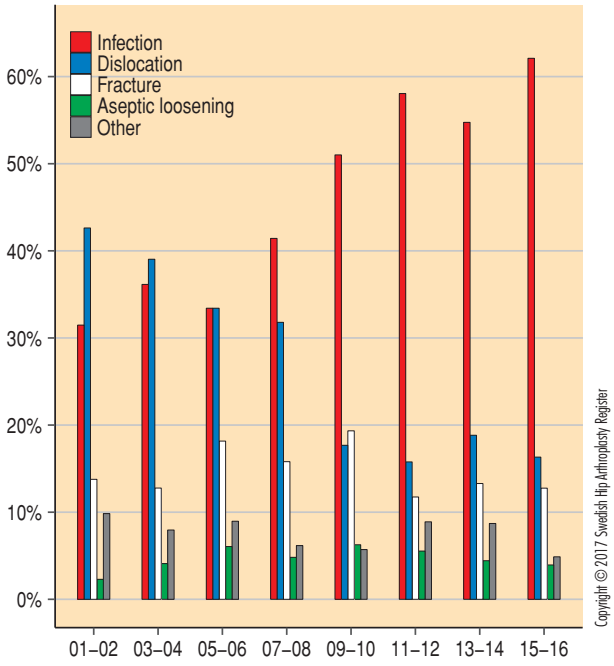


Figure 9.2. Distribution of the most common causes for reoperation during the first year after the primary operation is divided into different time periods between 2001 and 2016.

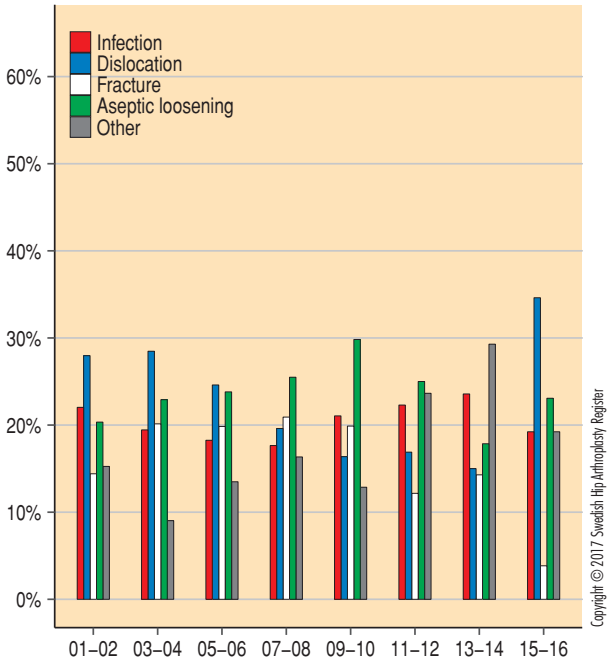


Figure 9.3. Distribution of the most common causes for reoperation during the second year after the primary operation is divided into different time periods between 2001 and 2016.

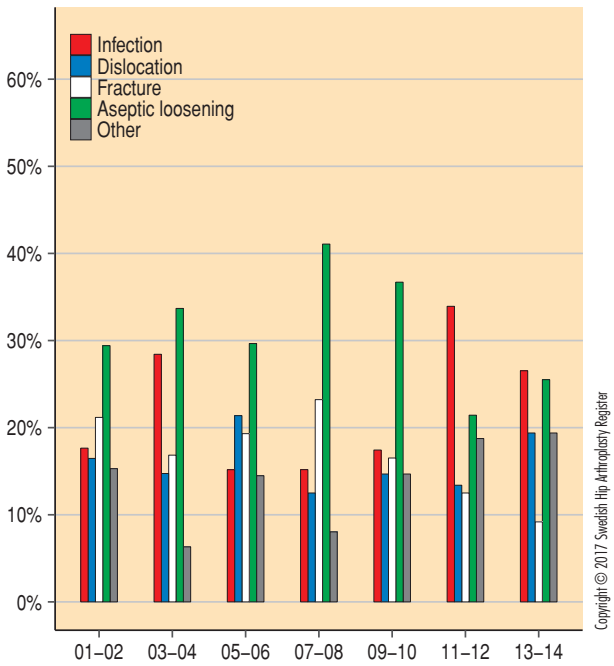


Figure 9.4. Distribution of the most common causes for reoperation during the third year after the primary operation is divided into different time periods between 2001 and 2014.

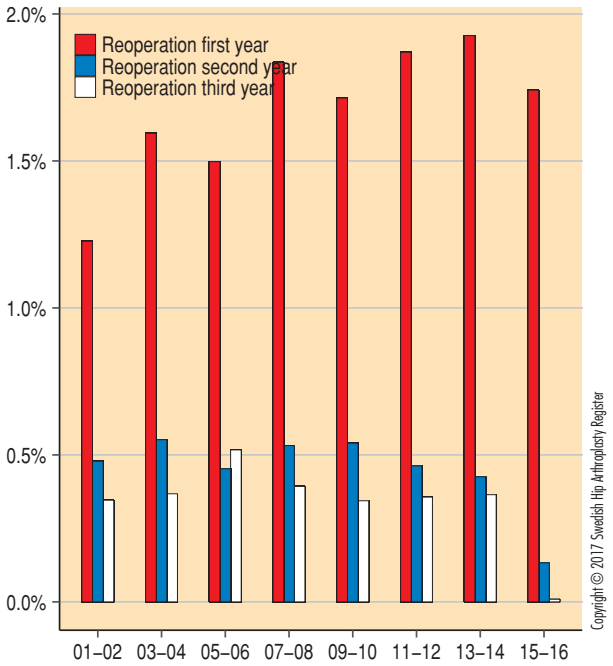


Figure 9.5. Proportion of reoperation during the first three years after primary surgery related to primary operation year. Primary operation year where the observation time has not yet reached the appointed time, has been excluded.

Reoperations within two years per unit

2012–2016

	Primary op.	Reoperation[1)]		Deep infection		Dislocation		Fracture		Other	
Unit	number	number	prop.	number	%	number	%	number	%	number	%
University or regional hospitals											
Karolinska/Huddinge	946	17	1.8%	7	0.7%	1	0.1%	5	0.5%	2	0.2%
Karolinska/Solna	674	27	4%	13	1.9%	6	0.9%	1	0.1%	7	1%
Linköping	266	9	3.4%	2	0.8%	5	1.9%	1	0.4%	1	0.4%
SU/Mölndal	2 264	49	2.2%	29	1.3%	5	0.2%	4	0.2%	8	0.4%
SU/Sahlgrenska	19	0	0%	0	0%	0	0%	0	0%	0	0%
SUS/Lund	783	21	2.7%	7	0.9%	7	0.9%	0	0%	6	0.8%
SUS/Malmö	113	2	1.8%	1	0.9%	0	0%	0	0%	0	0%
Umeå	361	15	4.2%	9	2.5%	1	0.3%	2	0.6%	3	0.8%
Uppsala	1 050	38	3.6%	17	1.6%	6	0.6%	3	0.3%	10	1%
Örebro	394	12	3%	8	2%	0	0%	3	0.8%	1	0.3%
County hospitals											
Borås	628	18	2.9%	13	2.1%	1	0.2%	3	0.5%	1	0.2%
Danderyd	1 326	53	4%	25	1.9%	14	1.1%	12	0.9%	1	0.1%
Eksjö	874	23	2.6%	18	2.1%	1	0.1%	2	0.2%	1	0.1%
Eskilstuna	450	13	2.9%	5	1.1%	3	0.7%	1	0.2%	2	0.4%
Falun	1 186	23	1.9%	12	1%	0	0%	4	0.3%	5	0.4%
Gävle	983	23	2.3%	12	1.2%	2	0.2%	1	0.1%	7	0.7%
Halmstad	926	24	2.6%	11	1.2%	3	0.3%	2	0.2%	5	0.5%
Helsingborg	491	10	2%	3	0.6%	5	1%	2	0.4%	0	0%
Hässleholm-Kristianstad	3 260	49	1.5%	33	1%	3	0.1%	5	0.2%	6	0.2%
Jönköping	666	12	1.8%	6	0.9%	1	0.2%	2	0.3%	2	0.3%
Kalmar	653	11	1.7%	4	0.6%	1	0.2%	1	0.2%	5	0.8%
Karlskrona	126	4	3.2%	0	0%	3	2.4%	0	0%	1	0.8%
Karlstad	930	35	3.8%	27	2.9%	2	0.2%	2	0.2%	2	0.2%
Norrköping	1 025	13	1.3%	7	0.7%	0	0%	1	0.1%	5	0.5%
NÄL	49	0	0%	0	0%	0	0%	0	0%	0	0%
Skövde	667	24	3.6%	19	2.8%	1	0.1%	3	0.4%	1	0.1%
Sundsvall	499	18	3.6%	11	2.2%	5	1%	0	0%	2	0.4%
Södersjukhuset	1 652	52	3.1%	23	1.4%	1	0.1%	17	1%	8	0.5%
Uddevalla	1 556	34	2.2%	16	1%	5	0.3%	5	0.3%	6	0.4%
Varberg	912	14	1.5%	5	0.5%	4	0.4%	2	0.2%	1	0.1%
Västerås	1 710	47	2.7%	22	1.3%	13	0.8%	2	0.1%	8	0.5%
Växjö	557	13	2.3%	6	1.1%	2	0.4%	1	0.2%	0	0%
Ystad	1	0	0%	0	0%	0	0%	0	0%	0	0%
Östersund	1 128	25	2.2%	17	1.5%	2	0.2%	5	0.4%	0	0%

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Reoperations within two years per unit (cont.)

2012–2016

	Primary op.	Reoperation[1)]		Deep infection		Dislocation		Fracture		Other	
Unit	number	number	prop.	number	%	number	%	number	%	number	%
Rural hospitals											
Alingsås	822	16	1.9%	14	1.7%	1	0.1%	0	0%	1	0.1%
Arvika	749	24	3.2%	17	2.3%	1	0.1%	2	0.3%	1	0.1%
Enköping	1 363	25	1.8%	8	0.6%	10	0.7%	1	0.1%	4	0.3%
Frölunda Specialistsjukhus	260	3	1.2%	1	0.4%	1	0.4%	0	0%	1	0.4%
Gällivare	372	5	1.3%	4	1.1%	1	0.3%	0	0%	0	0%
Hudiksvall	571	14	2.5%	4	0.7%	2	0.4%	3	0.5%	3	0.5%
Karlshamn	970	25	2.6%	8	0.8%	10	1%	3	0.3%	3	0.3%
Karlskoga	660	18	2.7%	11	1.7%	1	0.2%	3	0.5%	2	0.3%
Katrineholm	916	24	2.6%	15	1.6%	0	0%	1	0.1%	4	0.4%
Kungälv	757	22	2.9%	18	2.4%	1	0.1%	2	0.3%	1	0.1%
Lidköping	1 106	16	1.4%	6	0.5%	5	0.5%	1	0.1%	4	0.4%
Lindesberg	1 072	12	1.1%	6	0.6%	3	0.3%	1	0.1%	2	0.2%
Ljungby	640	17	2.7%	7	1.1%	5	0.8%	3	0.5%	2	0.3%
Lycksele	1 250	24	1.9%	11	0.9%	3	0.2%	2	0.2%	6	0.5%
Mora	945	11	1.2%	3	0.3%	3	0.3%	0	0%	4	0.4%
Norrtälje	531	12	2.3%	5	0.9%	2	0.4%	0	0%	4	0.8%
Nyköping	588	21	3.6%	17	2.9%	3	0.5%	0	0%	0	0%
Oskarshamn	1 116	9	0.8%	8	0.7%	0	0%	0	0%	1	0.1%
Piteå	1 407	7	0.5%	3	0.2%	3	0.2%	1	0.1%	0	0%
Skellefteå	509	9	1.8%	2	0.4%	3	0.6%	2	0.4%	2	0.4%
Skene	521	8	1.5%	2	0.4%	1	0.2%	2	0.4%	3	0.6%
Sollefteå	568	10	1.8%	2	0.4%	7	1.2%	1	0.2%	0	0%
Sunderby	138	4	2.9%	1	0.7%	1	0.7%	0	0%	2	1.4%
Södertälje	438	29	6.6%	19	4.3%	4	0.9%	2	0.5%	2	0.5%
Torsby	451	12	2.7%	7	1.6%	0	0%	3	0.7%	0	0%
Trelleborg	2 609	28	1.1%	9	0.3%	7	0.3%	7	0.3%	4	0.2%
Visby	519	15	2.9%	3	0.6%	6	1.2%	0	0%	6	1.2%
Värnamo	579	9	1.6%	2	0.3%	4	0.7%	1	0.2%	1	0.2%
Västervik	455	6	1.3%	6	1.3%	0	0%	0	0%	0	0%
Ängelholm	334	6	1.8%	2	0.6%	2	0.6%	1	0.3%	1	0.3%
Örnsköldsvik	663	6	0.9%	2	0.3%	2	0.3%	1	0.2%	1	0.2%

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Reoperations within two years per unit (cont.)

2012–2016

	Primary op.	Reoperation[1)]		Deep infection		Dislocation		Fracture		Other	
Unit	number	number	prop.	number	%	number	%	number	%	number	%
Private hospitals											
Aleris Specialistvård Bollnäs	1 165	14	1.2%	5	0.4%	2	0.2%	3	0.3%	3	0.3%
Aleris Specialistvård Elisabethsjukhuset	48	1	2.1%	1	2.1%	0	0%	0	0%	0	0%
Aleris Specialistvård Motala	2 177	40	1.8%	21	1%	5	0.2%	3	0.1%	9	0.4%
Aleris Specialistvård Nacka	693	15	2.2%	8	1.2%	1	0.1%	4	0.6%	1	0.1%
Aleris Specialistvård Sabbatsberg	340	2	0.6%	1	0.3%	1	0.3%	0	0%	0	0%
Aleris Specialistvård Ängelholm	313	4	1.3%	3	1%	1	0.3%	0	0%	0	0%
Art Clinic Göteborg	70	1	1.4%	0	0%	0	0%	0	0%	0	0%
Art Clinic Jönköping	76	0	0%	0	0%	0	0%	0	0%	0	0%
Capio Movement	1 000	35	3.5%	16	1.6%	11	1.1%	2	0.2%	6	0.6%
Capio Ortopediska Huset	1 688	17	1%	6	0.4%	3	0.2%	4	0.2%	3	0.2%
Capio S:t Göran	1 980	41	2.1%	20	1%	2	0.1%	5	0.3%	8	0.4%
Carlanderska	587	8	1.4%	6	1%	1	0.2%	0	0%	1	0.2%
Frölundaortopeden	4	0	0%	0	0%	0	0%	0	0%	0	0%
Hermelinen Specialistvård	36	0	0%	0	0%	0	0%	0	0%	0	0%
Ortho Center IFK-kliniken	552	2	0.4%	1	0.2%	0	0%	0	0%	0	0%
Ortho Center Stockholm	1 868	29	1.6%	14	0.7%	4	0.2%	6	0.3%	2	0.1%
Sophiahemmet	865	14	1.6%	2	0.2%	2	0.2%	9	1%	1	0.1%
Spenshult	337	11	3.3%	0	0%	8	2.4%	2	0.6%	1	0.3%
Country	66 803	1409	2.1%	715	1.1%	236	0.4%	173	0.3%	207	0.3%

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

Reoperations within two years per unit – trend

primary operation during 2009–2016

Unit	2009–2012	2010–2013	2011–2014	2012–2015	2013–2016[1)]
University or regional hospital					
Karolinska/Huddinge	2.2%	2.3%	2.0%	2.1%	1.8%
Karolinska/Solna	2.6%	3.2%	3.4%	4.5%	4.1%
Linköping	2.0%	3.2%	2.7%	2.7%	3.4%
SU/Mölndal	2.8%	2.6%	2.5%	2.1%	2.2%
SUS/Lund	3.4%	3.3%	2.9%	2.7%	2.7%
SUS/Malmö	1.7%	2.1%	1.4%	1.3%	1.8%
Umeå	3.7%	4.7%	6.0%	5.0%	4.3%
Uppsala	3.3%	2.8%	3.9%	3.8%	3.7%
Örebro	2.5%	2.4%	2.4%	3.2%	3.1%
County hospitals					
Borås	3.2%	2.9%	3.3%	2.9%	2.9%
Danderyd	3.7%	4.0%	4.0%	3.8%	4.0%
Eksjö	2.5%	2.0%	2.0%	2.5%	2.6%
Eskilstuna	2.6%	3.5%	3.4%	3.1%	3.0%
Falun	2.1%	2.2%	2.0%	2.0%	2.0%
Gävle	5.7%	4.9%	4.5%	2.8%	2.4%
Halmstad	4.3%	3.9%	3.3%	3.3%	2.6%
Helsingborg	1.9%	3.0%	2.6%	2.5%	2.1%
Hässleholm-Kristianstad	2.0%	1.8%	2.1%	1.7%	1.5%
Jönköping	1.6%	1.4%	1.4%	1.5%	1.8%
Kalmar	1.7%	1.3%	1.7%	1.5%	1.7%
Karlskrona	2.3%	2.8%	4.0%	4.2%	3.4%
Karlstad	5.4%	5.7%	5.2%	4.2%	3.8%
Norrköping	1.1%	1.2%	1.4%	1.2%	1.3%
Skövde	1.3%	1.4%	1.8%	2.9%	3.6%
Sundsvall	3.4%	3.4%	3.7%	3.0%	3.6%
Södersjukhuset	3.0%	3.1%	3.4%	3.5%	3.2%
Uddevalla	1.7%	1.5%	1.6%	2.2%	2.2%
Varberg	1.5%	1.4%	1.5%	1.5%	1.5%
Västerås	4.0%	3.9%	3.8%	3.3%	2.8%
Växjö	2.3%	2.4%	1.9%	1.4%	2.4%
Östersund	3.0%	2.9%	2.6%	2.5%	2.2%

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Reoperations within two years per unit – trend (cont.)

primary operation during 2009–2016

Unit	2009–2012	2010–2013	2011–2014	2012–2015	2013–2016[1)]
Rural hospitals					
Alingsås	2.1%	2.2%	1.9%	1.7%	2.0%
Arvika	2.2%	2.3%	1.8%	2.7%	3.2%
Enköping	2.0%	2.2%	2.3%	2.3%	1.8%
Gällivare	1.3%	1.5%	1.1%	0.8%	1.4%
Hudiksvall	2.6%	2.7%	2.5%	2.7%	2.5%
Karlshamn	1.3%	1.6%	1.9%	2.3%	2.6%
Karlskoga	0.9%	1.0%	1.5%	1.8%	2.8%
Katrineholm	2.0%	1.9%	1.8%	1.9%	2.6%
Kungälv	2.2%	2.4%	2.7%	2.9%	2.9%
Lidköping	1.0%	0.8%	1.1%	1.3%	1.5%
Lindesberg	1.1%	0.8%	0.9%	0.9%	1.1%
Ljungby	1.0%	1.2%	1.8%	2.3%	2.7%
Lycksele	1.9%	2.0%	2.0%	1.8%	1.9%
Mora	0.8%	0.9%	1.3%	1.6%	1.2%
Norrtälje	3.5%	3.1%	2.9%	2.5%	2.3%
Nyköping	6.4%	7.0%	6.2%	4.7%	3.7%
Oskarshamn	1.4%	1.1%	0.9%	0.9%	0.8%
Piteå	1.3%	0.9%	1.0%	1.0%	0.5%
Skellefteå	1.1%	1.3%	1.9%	2.1%	1.8%
Skene	2.0%	2.5%	1.6%	1.7%	1.5%
Sollefteå	0.6%	0.6%	0.8%	1.0%	1.8%
Sunderby	4.3%	2.3%	4.1%	3.8%	3.0%
Södertälje	1.5%	3.9%	5.3%	6.0%	6.6%
Torsby	2.1%	2.1%	2.3%	3.2%	2.7%
Trelleborg	1.6%	1.5%	1.4%	1.2%	1.1%
Visby	2.1%	3.3%	3.8%	3.0%	2.9%
Värnamo	1.6%	1.4%	1.4%	2.0%	1.6%
Västervik	3.6%	2.6%	2.4%	0.9%	1.3%
Ängelholm	1.0%	0.6%	1.4%	1.6%	1.8%
Örnsköldsvik	0.6%	1.0%	1.1%	1.0%	0.9%

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Reoperations within two years per unit – trend (cont.)

primary operation during 2009–2016

Unit	2009–2012	2010–2013	2011–2014	2012–2015	2013–2016[1)]
Private hospital					
Aleris Specialistvård Bollnäs	2.5%	2.2%	2.0%	1.8%	1.2%
Aleris Specialistvård Motala	2.4%	2.3%	2.2%	1.9%	1.8%
Aleris Specialistvård Nacka	1.0%	1.8%	2.4%	2.4%	2.2%
Aleris Specialistvård Ängelholm	0%	0%	1.0%	1.3%	1.3%
Art Clinic Jönköping	0%	0%	0%	0%	0%
Capio Movement	3.7%	3.8%	4.6%	4.1%	3.5%
Capio Ortopediska Huset	1.6%	1.1%	1.1%	1%	1.0%
Capio S:t Göran	3.2%	3.4%	3.5%	2.7%	2.1%
Carlanderska	1.6%	1.8%	2.0%	1.3%	1.4%
Ortho Center IFK-kliniken	0.8%	0.4%	0.2%	0.4%	0.4%
Ortho Center Stockholm	2.7%	3.0%	2.8%	2.6%	1.6%
Sophiahemmet	1.7%	1.7%	1.7%	1.9%	1.6%
Country	2.3%	2.3%	2.4%	2.2%	2.1%

[1)] *NB shorter than two-years follow-up time.*

Reoperations, "the standard patient", within two years per unit
2012–2016

	Primary op.	Reoperation[1)]		Deep infection		Dislocation		Fracture		Other	
Unit	**number**	**number**	**%**	**number**	**%**	**number**	**%**	**number**	**%**	**number**	**%**
University or regional hospital											
Karolinska/Huddinge	226	3	1.3%	1	0.4%	0	0%	1	0.4%	1	0.4%
Karolinska/Solna	97	2	2.1%	2	2.1%	0	0%	0	0%	0	0%
Linköping	35	0	0%	0	0%	0	0%	0	0%	0	0%
SU/Mölndal	765	14	1.8%	6	0.8%	1	0.1%	3	0.4%	3	0.4%
SUS/Lund	35	0	0%	0	0%	0	0%	0	0%	0	0%
Umeå	26	1	3.8%	0	0%	0	0%	1	3.8%	0	0%
Uppsala	232	4	1.7%	2	0.9%	0	0%	0	0%	2	0.9%
Örebro	105	2	1.9%	1	1%	0	0%	1	1%	0	0%
County hospitals											
Borås	174	5	2.9%	2	1.1%	1	0.6%	1	0.6%	1	0.6%
Danderyd	394	12	3%	5	1.3%	4	1%	3	0.8%	0	0%
Eksjö	439	9	2.1%	8	1.8%	0	0%	0	0%	0	0%
Eskilstuna	49	0	0%	0	0%	0	0%	0	0%	0	0%
Falun	537	10	1.9%	4	0.7%	0	0%	3	0.6%	3	0.6%
Gävle	238	5	2.1%	2	0.8%	1	0.4%	1	0.4%	1	0.4%
Halmstad	415	9	2.2%	4	1%	1	0.2%	1	0.2%	2	0.5%
Helsingborg	125	1	0.8%	1	0.8%	0	0%	0	0%	0	0%
Hässleholm-Kristianstad	1511	15	1%	11	0.7%	0	0%	1	0.1%	2	0.1%
Jönköping	248	3	1.2%	2	0.8%	0	0%	1	0.4%	0	0%
Kalmar	316	4	1.3%	1	0.3%	0	0%	0	0%	3	0.9%
Karlskrona	4	0	0%	0	0%	0	0%	0	0%	0	0%
Karlstad	264	7	2.7%	7	2.7%	0	0%	0	0%	0	0%
Norrköping	384	2	0.5%	1	0.3%	0	0%	0	0%	1	0.3%
NÄL	1	0	0%	0	0%	0	0%	0	0%	0	0%
Skövde	256	7	2.7%	5	2%	1	0.4%	0	0%	1	0.4%
Sundsvall	172	4	2.3%	2	1.2%	1	0.6%	0	0%	1	0.6%
Södersjukhuset	443	9	2%	4	0.9%	1	0.2%	3	0.7%	1	0.2%
Uddevalla	639	4	0.6%	3	0.5%	0	0%	1	0.2%	0	0%
Varberg	436	5	1.1%	1	0.2%	2	0.5%	1	0.2%	0	0%
Västerås	418	9	2.2%	6	1.4%	2	0.5%	1	0.2%	0	0%
Växjö	208	5	2.4%	1	0.5%	0	0%	0	0%	0	0%
Östersund	416	8	1.9%	5	1.2%	0	0%	2	0.5%	0	0%

(Continued on next page.)

Reoperations, "the standard patient", within two years per unit (cont.)
2012–2016

	Primary op.	Reoperation[1)]		Deep infection		Dislocation		Fracture		Other	
Unit	**number**	**number**	**%**	**number**	**%**	**number**	**%**	**number**	**%**	**number**	**%**
Rural hospitals											
Alingsås	470	7	1.5%	7	1.5%	0	0%	0	0%	0	0%
Arvika	396	12	3%	8	2%	1	0.3%	1	0.3%	1	0.3%
Enköping	706	8	1.1%	2	0.3%	2	0.3%	1	0.1%	2	0.3%
Gällivare	157	0	0%	0	0%	0	0%	0	0%	0	0%
Hudiksvall	208	3	1.4%	1	0.5%	0	0%	1	0.5%	1	0.5%
Karlshamn	545	13	2.4%	3	0.6%	7	1.3%	1	0.2%	1	0.2%
Karlskoga	344	6	1.7%	4	1.2%	0	0%	1	0.3%	0	0%
Katrineholm	599	15	2.5%	8	1.3%	0	0%	1	0.2%	4	0.7%
Kungälv	374	11	2.9%	7	1.9%	1	0.3%	2	0.5%	1	0.3%
Lidköping	631	4	0.6%	1	0.2%	1	0.2%	0	0%	2	0.3%
Lindesberg	580	4	0.7%	3	0.5%	0	0%	0	0%	1	0.2%
Ljungby	275	9	3.3%	5	1.8%	2	0.7%	0	0%	2	0.7%
Lycksele	643	9	1.4%	4	0.6%	3	0.5%	0	0%	2	0.3%
Mora	502	4	0.8%	2	0.4%	0	0%	0	0%	2	0.4%
Norrtälje	190	5	2.6%	2	1.1%	1	0.5%	0	0%	2	1.1%
Nyköping	199	4	2%	4	2%	0	0%	0	0%	0	0%
Oskarshamn	608	5	0.8%	4	0.7%	0	0%	0	0%	1	0.2%
Piteå	689	2	0.3%	1	0.1%	1	0.1%	0	0%	0	0%
Skellefteå	189	5	2.6%	2	1.1%	1	0.5%	1	0.5%	1	0.5%
Skene	338	3	0.9%	0	0%	0	0%	1	0.3%	2	0.6%
Sollefteå	284	3	1.1%	0	0%	2	0.7%	1	0.4%	0	0%
Sunderby	1	0	0%	0	0%	0	0%	0	0%	0	0%
Södertälje	158	6	3.8%	3	1.9%	1	0.6%	1	0.6%	1	0.6%
Torsby	188	5	2.7%	2	1.1%	0	0%	1	0.5%	0	0%
Trelleborg	1364	8	0.6%	3	0.2%	1	0.1%	3	0.2%	1	0.1%
Visby	242	2	0.8%	1	0.4%	0	0%	0	0%	1	0.4%
Värnamo	256	3	1.2%	1	0.4%	1	0.4%	1	0.4%	0	0%
Västervik	229	3	1.3%	3	1.3%	0	0%	0	0%	0	0%
Ängelholm	199	4	2%	1	0.5%	2	1%	1	0.5%	0	0%
Örnsköldsvik	327	2	0.6%	1	0.3%	1	0.3%	0	0%	0	0%

(Continued on next page.)

Reoperations, "the standard patient", within two years per unit (cont.)
2012–2016

	Primary op.	Reoperation[1)]		Deep infection		Dislocation		Fracture		Other	
Unit	**number**	**number**	**%**	**number**	**%**	**number**	**%**	**number**	**%**	**number**	**%**
Private hospitals											
Aleris Specialistvård Bollnäs	711	6	0.8%	2	0.3%	1	0.1%	1	0.1%	2	0.3%
Aleris Specialistvård Elisabethsjukhuset	34	1	2.9%	1	2.9%	0	0%	0	0%	0	0%
Aleris Specialistvård Motala	1105	16	1.4%	10	0.9%	3	0.3%	0	0%	2	0.2%
Aleris Specialistvård Nacka	500	13	2.6%	7	1.4%	1	0.2%	3	0.6%	1	0.2%
Aleris Specialistvård Sabbatsberg	229	0	0%	0	0%	0	0%	0	0%	0	0%
Aleris Specialistvård Ängelholm	182	1	0.5%	1	0.5%	0	0%	0	0%	0	0%
Art Clinic Göteborg	51	1	2%	0	0%	0	0%	0	0%	0	0%
Art Clinic Jönköping	47	0	0%	0	0%	0	0%	0	0%	0	0%
Capio Movement	585	18	3.1%	4	0.7%	9	1.5%	1	0.2%	4	0.7%
Capio Ortopediska Huset	1067	13	1.2%	3	0.3%	2	0.2%	4	0.4%	3	0.3%
Capio S:t Göran	844	12	1.4%	5	0.6%	1	0.1%	2	0.2%	2	0.2%
Carlanderska	338	2	0.6%	1	0.3%	0	0%	0	0%	1	0.3%
Frölundaortopeden	2	0	0%	0	0%	0	0%	0	0%	0	0%
Hermelinen Specialistvård	10	0	0%	0	0%	0	0%	0	0%	0	0%
Ortho Center IFK-kliniken	311	2	0.6%	1	0.3%	0	0%	0	0%	0	0%
Ortho Center Stockholm	1229	17	1.4%	7	0.6%	3	0.2%	5	0.4%	1	0.1%
Sophiahemmet	489	9	1.8%	1	0.2%	1	0.2%	6	1.2%	1	0.2%
Spenshult	189	4	2.1%	0	0%	2	1.1%	1	0.5%	1	0.5%
Country	29422	439	1.5%	213	0.7%	66	0.2%	66	0.2%	68	0.2%

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

10 Revision

Revision means that a hip arthroplasty-operated patient undergoes a further operation in which a part or the whole prosthesis is replaced or extracted. At two-session procedures, these two interventions (unless otherwise specified) are registered as one measure. For example, if a primary arthroplasty is revised in two sessions, the insertion will be classified as index procedure for any re-revision. On the other hand, if the prosthesis is extracted for good, which means no prosthesis insertion is registered at the last observation date (in this year's report 31.12.2016), thus the prosthesis extraction will be classified as an initial revision.

10.1 Revision

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. Until 1991, only aggregated data per unit for primary operations was registered. Since 1979, the number of revisions, with an exception for periods with a short-term fall, increased. From 2009, the increase stopped (Figure 10.1). Registration of revision or other type of reoperation requires that the primary prosthesis is also registered, which is important to know when interpreting the chart's left side. Since 1992, when detailed records on the primary operations began, the proportion of revisions represented approximately 10–11%. This proportion has declined in recent periods (Figure 10.2).

From the Register's starting year 1979, the number of multiple-time revisions increased until the early 2000s (Figure 10.3, refer also to Annual Report 2013). Over the past 20 years, the division between initial revision (no previous revision = 0 in Figure 10.3) and multiple-time revisions have not showed any dramatic changes. However, there is a slight trend for the proportion of initial revisions to decline as a result of the increase of multiple-time revisions. Between periods 1991–1995 and 2016, the proportion of multiple-time revisions has increased from 19.4 to 26.5%. Given that the population is aging and more and

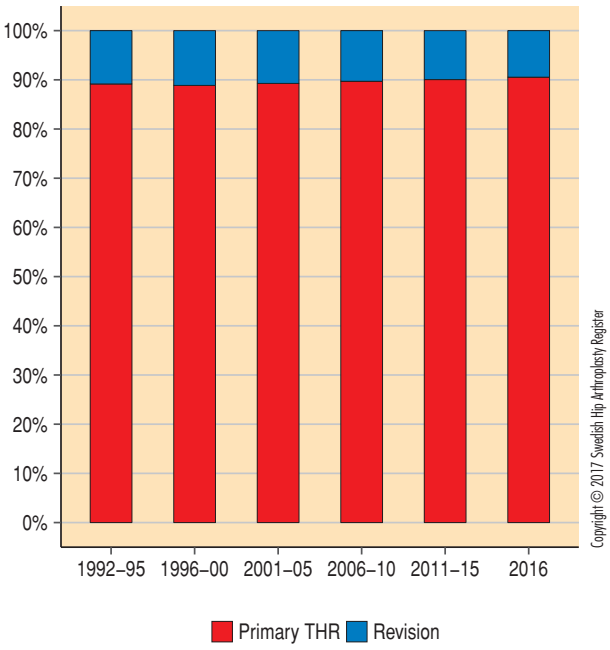


Figure 10.2. Proportion of revisions related to the total number of primary arthroplasties in different periods from 1992. Year 2016 is presented separately.

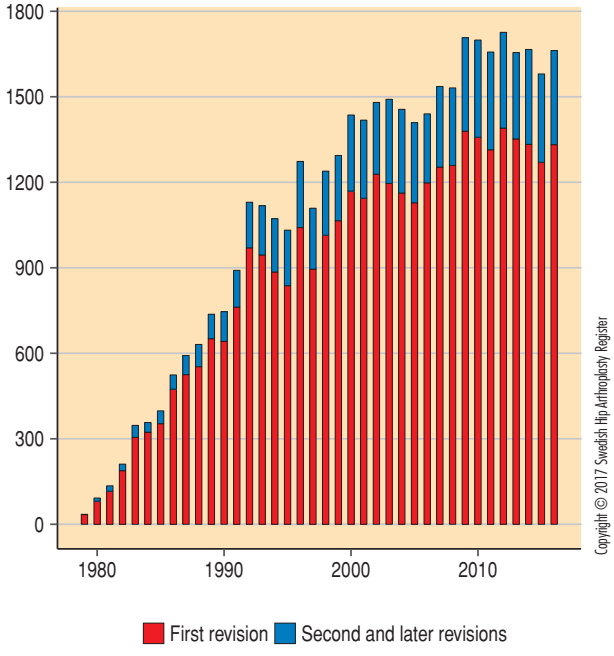


Figure 10.1. Number of revisions 1979–2016.

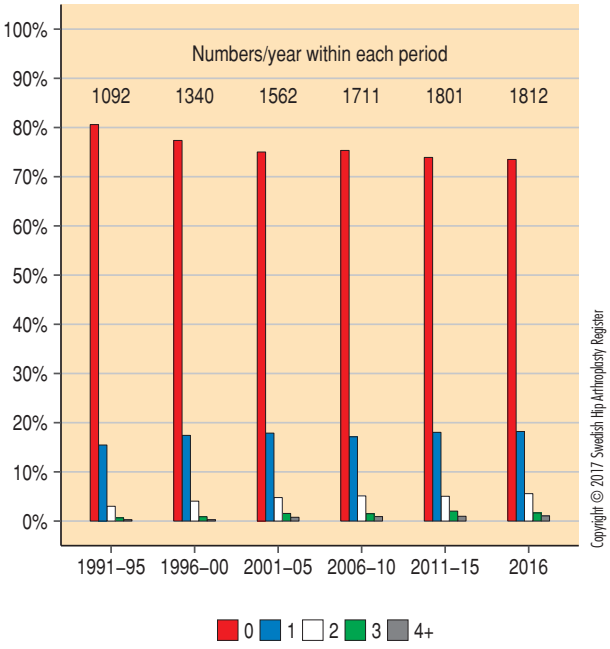


Figure 10.3. Distribution of initial and multiple-time revisions between 1991 and 2016 based on different periods.

more people have one or two implanted hip prostheses, this shift is expected. However, there are still few patients who have undergone at least three previous revisions. In 1991–1995, there were three cases per year. In 2016, it affected 19 reported cases.

Patients undergoing revision (as well as those undergoing reoperation) differ demographically from the patients who undergo surgery for primary prosthesis. Generally, they are older, more often male, have more often secondary osteoarthritis (excluding hip fracture group) and a higher degree of comorbidity (Table 10.1). Some of these tendencies are exacerbated in patients undergoing multiple revisions. Among patients who have had at least one revision and are forced to undergo another revision, the degree of comorbidity is further increased, and an even greater proportion of them had initially undergone surgery due to secondary osteoarthritis.

Demographics during initial, secondary and multiple-time revisions and during primary arthroplasty in 2008–2015

	Number of previous revisions			Primary arthroplasty
	None	*1*	*>1*	
Number	12 423	3 194	1 429	144 916
Age				
Mean value SD	71.6 *11.1*	71.1 *11.2*	70.2 *11.1*	68.6 *10.8*
<55 years %	7.4	8.7	9.9	10.0
55–69 years %	30.9	31.3	33.9	40.3
70–84 years %	51.2	50.3	48.1	44.6
>=85 years %	10.4	9.6	8.1	5.1
Gender				
Proportion of women %	52.1	47.4	49.7	58.2
BMI				
Number, % of all in the interval	10 836 *87.2*	2 754 *86.2*	829 *84.2*	134 659 *92.9*
Mean Value SD	27.2 *5.7*	27.2 *5.8*	27.2 *5.0*	27.1 *5.2*
<18.5 %	1.4	1.4	2.4	1.2
18.5–24.9 %	33.9	34.8	31.8	34.7
25–29.9 %	41.2	39.7	39.7	41.9
>=30 %	23.5	24.1	26.1	23.4
ASA class				
Number, % of all in the interval	11 730 *94.4*	3 025 *94.7*	1 310 *91.7*	140 078 *96.7*
I %	12.9	10.5	7.9	22.9
II %	53.4	50.9	47.4	58.1
III– %	33.7	38.6	44.7	18.3
Diagnosis during primary arthroplasty*				
Primary osteoarthritis	77.7	72.1	66.3	80.5
Fracture, including sequelae	7.5	7.5	7.6	10.9
Inflammatory joint disease	5.3	7.5	10.3	1.3
Sequelae after childhood disease	4.5	6.6	7.4	1.9
Femoral head necrosis	3.9	4.3	4.1	2.1
Other secondary osteoarthritis	1.2	2.0	3.9	3.3

**113, 19 and 163 observations are missing for respective intervals among revisions*

Table 10.1. Gender and age distribution during initial, secondary and multiple-time revisions from 2008, when registration of ASA class, length and weight began. Data for primary operations are presented for comparison.

Between 2014 and 2016, about 74% of all revisions were performed at units which performed at least 100 revisions annually (Table 10.2). Corresponding proportion for the period 2013–2015 was 72% and 80% for the previous period (2012–2014) (Table 10.2). The optimal volume of the number of revisions per year and per unit is not known and it is difficult to determine because comorbidity and technical difficulty may vary significantly between different types of revisions. Additionally, the same surgeon operates at several hospitals, which is why hospital volume should be seen only as a surrogate variable. On the other hand, a revision operation includes so much more than only the surgery, which is why there may be several benefits with a certain type of centralisation. Revision surgery may demand a more advanced handling before, during and after the intervention. These patients have a higher level of comorbidity (Table 10.1). Pre- and postoperative complications are significantly more common than during a primary operation. In order to optimally remedy the possible pre- and postoperative complications and issues, which may arise, access to a bone bank and a wide selection of implants and knowledgeable and experienced staff is required.

Table 10.2 shows no dramatic changes regarding the distribution of units with high and low number of revisions. Rerevised patients, corresponding to those who have previously undergone at least one revision, often face a higher operation risk. During the previous period, six hospitals in the country performed more than 50 such revisions during a three-year period (489 operations, in total). During the following period, the same six hospitals carried out slightly more multiple-time revisions (n=507) and 11 different units performed between 26 and 48 rerevisions (400 operations, in total). At 19 hospitals, between one and ten rerevisions were carried out during the same period. The volume of initial revisions at these units varied between 0 and 52 revisions. A third of these (28) were cup revisions, 18 constituted of prosthesis extractions with or without a following prosthesis insertion, 12 were cup and stem replacements, eight were only stem replacements and 20 were replacements of liner and/or femoral head.

Low volume per operation unit does not necessarily mean poorer quality of healthcare, because some units may have sold their business and moved during the period and have their short-term production spread over three years. In other cases, good skills can be available despite the fact that only a few revisions were carried out and some of them did not require high competence and experience. However, it can be regarded as remarkable, that as many as 38 units in Sweden carried out only two revisions per year during the last ten years (Figure 10.4).

The restructuring of healthcare has meant that some units, and above all, university/regional hospitals do fewer and fewer primary operations and, in particular, fewer standard operations. This has implications for education and opportunities to pursue studies. Although research and training can be outsourced, there are many advantages to a cohesion of this activity for

Number of units with different volumes of primary and revision arthroplasty 2014–2016

	Number of units			
	Primary prosthesis	Initial revision	≥ 1 previous revision(s)	Regardless of previous number of revisions
Volume per unit				
1–24	2 *3*	22 *22*	34 *35*	22 *23*
25–49	3 *4*	12 *11*	11 *12*	11 10
50–99	5 *2*	15 *14*	4 *5*	11 *12*
100–149	1 *1*	6 9	2 *1*	8 *8*
150–199	3 *3*	5 *5*	–	5 5
200–299	5 *6*	4 *2*	–	5 *5*
300–499	22 *26*	–	–	3 *2*
500–999	29 *27*	–	–	–
1 000–1 499	7 *7*	–	–	–
1 500–2 499	5 *4*	–	–	–

Table 10.2. Number of units, which carry out first-time and multiple-time revisions, is presented in groups for the period 2014–2016. Numbers for previous periods (2013–2015) are presented in italic. Note that volumes are attributed to three years and two-session procedures are counted as one revision.

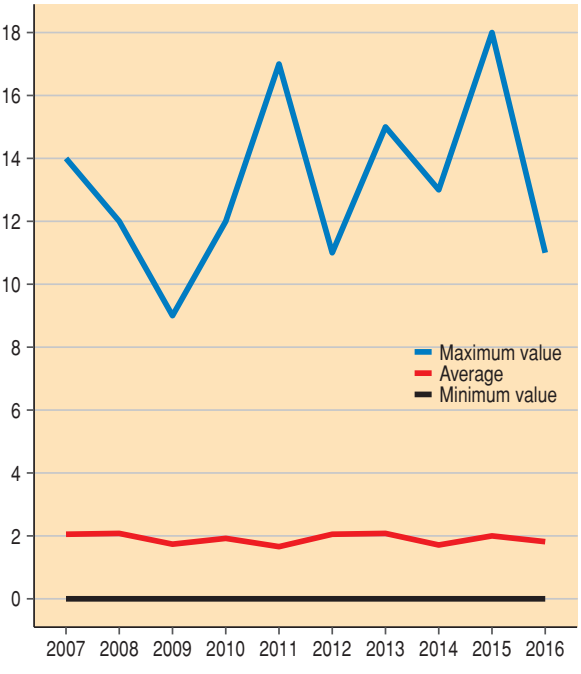


Figure 10.4. Number of revisions per year (mean, minimum and maximum value) performed at 38 units in Sweden, which during a 10-year period 2007–2016 performed between 63 and 79 revisions in total. A unit which discontinued its revision activities, has been excluded.

Revisions and primary prosthesis

Unit	Revisions	Primary prostheses
Borås	102	461
Capio S:t Göran	168	1 508
Danderyd	246	999
Gävle	214	726
Halmstad	110	683
Helsingborg	130	415
Hässleholm-Kristianstad	257	2 482
Karlstad	158	665
Karolinska/Huddinge	206	695
Karolinska/Solna	164	493
Linköping	105	200
Skövde	125	505
SU/Mölndal	431	1 795
SUS/Lund	306	588
Södersjukhuset	213	1 222
Uddevalla	140	1 166
Umeå	187	297
Uppsala	317	779
Västerås	178	1 234
Örebro	108	287
Östersund	109	814

Table 10.3. Number of reported revisions and primary hip replacement operations during a three-year period for the units which performed 100 revisions or more during 2014–2016.

better resource utilization, optimal infrastructure and to create effective teamwork. Table 10.3 shows the number of primary arthroplasties for units which conducted more than 100 revisions between 2014 and 2016. The number of performed primary arthroplasties varies a lot, between an average of 66 to over 800 per year. It is important that at least some centres and, in particular, university hospitals in Sweden, from a learning, research and development perspective, span as much know-how as possible. A coherent activity has probably been an important success factor for prosthesis surgery and contributed to the high cost efficiency, which the Swedish hip arthroplasty surgery has managed to maintain so far.

Reason for revision

The cause for carrying out a revision or other operation is determined in the Swedish Hip Arthroplasty Register (SHPR) through studying the copies of medical records, which are sent to the register's coordinators. Over the years, many causes and causal combinations have been defined, as quite often, several causes are listed. Before this year's report and the transition to a new database structure, we have seen how different causes are grouped. This has caused small adjustments with marginal effects. The given cause is regarded as the most relevant. For example, during a revision of a dislocated prosthesis, which is also found to be infected, the main cause will be infection. Between 2001 and 2016, osteolysis and/or polyethylene wear was cited as the only cause or contributing cause in 27.6% of cases classified as dislocation during initial revision and 17.1% of cases during multiple-time revision (data is missing in 33 cases). However, it is not possible to perform more comprehensive analyses with this information because it is highly likely, that the occurrence of osteolysis is not always marked down in medical records, especially in cases with an apparent loosening.

The distribution of the cause of revision has changed over time (Figure 10.5). Relatively speaking, first of all, the cause group for infection, but also dislocation and periprosthetic fracture has increased, both in terms of initial and multiple-time revisions. Meanwhile, since the period 2001–2003, the proportion of patients revised for loosening/ osteolysis/wear has gradually decreased from 74.3% in the first three-year period, to 53.9% during 2016 in the group which was revised for the first time. In the group that has undergone at least one prior revision, the relative decline is about the same (from 59.5 to 33.4%), albeit from a lower starting level. The more revisions a patient has undergone, more likely it is, that it will be done due to infection or dislocation (Figure 10.6).

The impression becomes somewhat different, if instead of the revision group, the group for all reoperations (revisions + reoperation where the implant or none of its parts are replaced or removed) is taken under observation (Figure 10.7). The proportion of reoperations due to loosening decreases, especially during multiple-time revisions. From 2007–2009, infection is the most common cause for reoperation.

Between 2001 and 2016, 379 stems were revised due to implant fracture (1.4% of all revisions). In total, there are 55 different stem types, of which four have been affected in more than ten cases. The most common are Lubinus SP II (n=134), Exeter polished (n=63), Charnley (n=27) and Spectron EF Primary (n=13). There is not information about the size of these stems in the revision database, but in occurring cases, it is possible to get certain information regarding initial revisions in the primary database, which now includes all primary arthroplasties inserted from 1999. At initial revision, of the 89 Lubinus SP II prosthesis with stem fracture, which were inserted in 1999 or later, 79 (88.8%) were size 01, the thinnest version, seven were size 1 and other three were size 2 to 5. Of the 31 revised Exeter stems in the primary arthroplasty group, 16 were size 0 or 1, seven were size 2 and others were size 3 to 5. Corresponding distribution for Spectron EF Primary was seven stems in size 1, two in size 2 and one in size 3 (in total ten initial revisions with primary arthroplasty inserted in 1999 or later). Only three of the 27 fractured Charnley stems were inserted in 1999 or later.

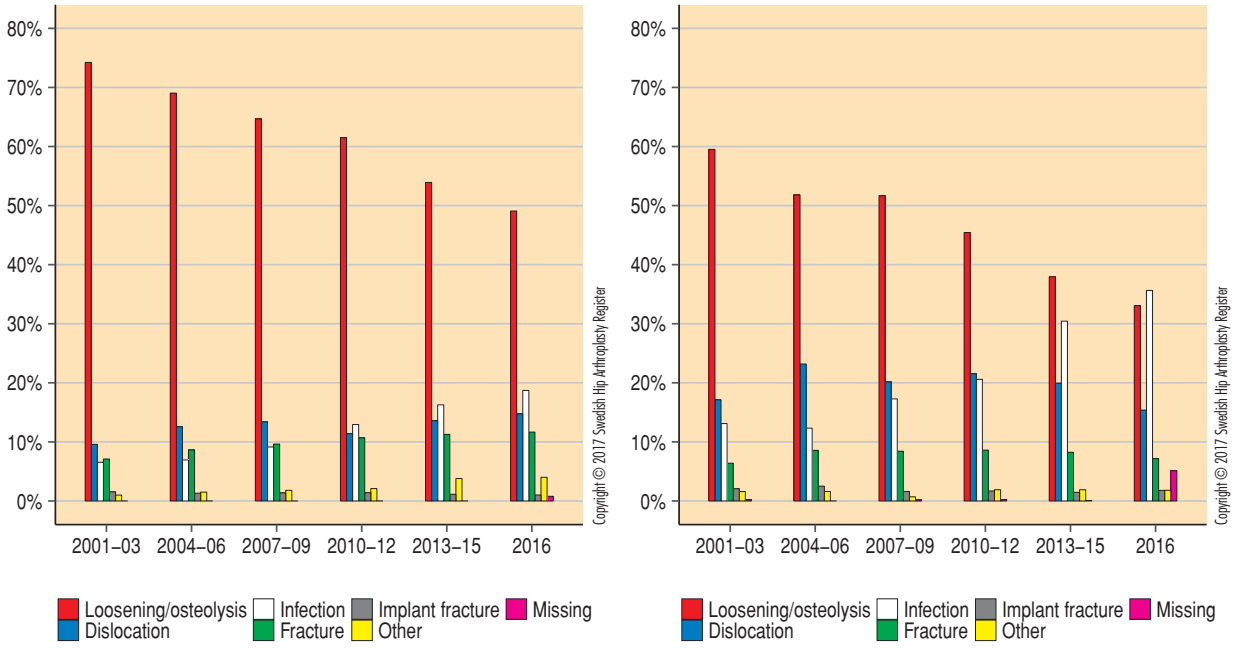


Figure 10.5. Distribution of revision causes during initial (on the left) and multiple-time (on the right) revisions between 2001 and 2016.

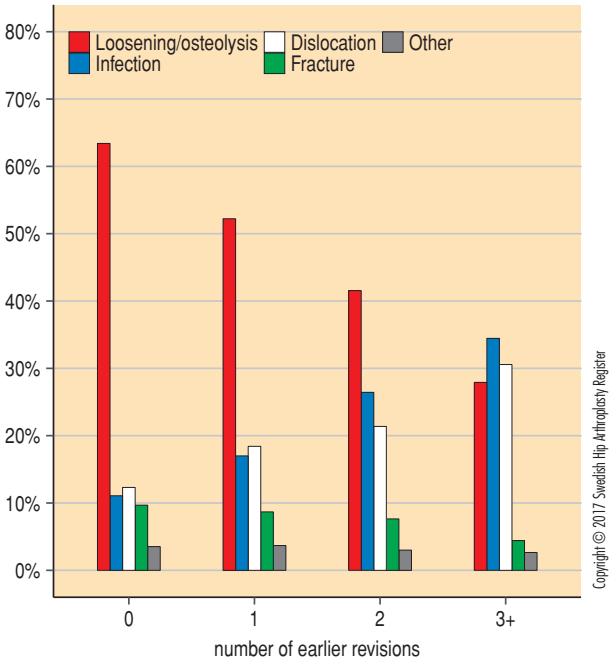


Figure 10.6. Distribution of revision causes at first-time and multiple-time revisions between 2001 and 2016. The proportion which was revised due to loosening/ osteolysis/ wear decreases with the increase in performed revisions. Instead, the proportion of dislocation and infection increases.

To sum up, the small sizes are affected by fracture, which is especially clear for Lubinus SP II. The incidence of initial revision for these three designs during 1999–2016 was 0.06% for Exeter, 0.08% for Lubinus and 0.10% for Spectron EF Primary. However, the follow-up time for Spectron EF Primary was longer (mean follow-up time: 9.2 years, Lubinus SP II and Exeter: both 6.8 years), because it was hardly used after 2011.

Unclear pain constituted as a cause for revision in 0.6% (n=156) cases during the period from 2001. The number of revisions due to problem related to metal articulations (pseudo tumour or ALVAL, Acute Lymphocytic Vasculitis Associated Lesions) or corrosion of prosthesis cone, were about the same (n=172). This problem is probably somewhat underreported, because corrosion-related complications are less known, especially at units which never use surface replacement prostheses.

The cause of revision varies depending on age. At the primary revision, the proportion of revision due to loosening/osteolysis/ wear is relatively constant and constitutes roughly about 60% of cases up to 84 years of age (Figure 10.8, on the left). In the group for 85 and older, this proportion drops to 48.9%. The pattern is similar with multiple-time revisions (Figure 10.8, on the right), but the proportion for multiple-time revisions due to loosening is about 10–15% lower. The proportion of revisions due to fracture and dislocation increases with age, while the proportion of revisions due to infection decreases. The trend is similar with initial and multiple-time revisions. Revision due to fracture is more common at first-time revisions, while revision due to dislocation and infection constitutes a larger proportion of multiple-time revisions.

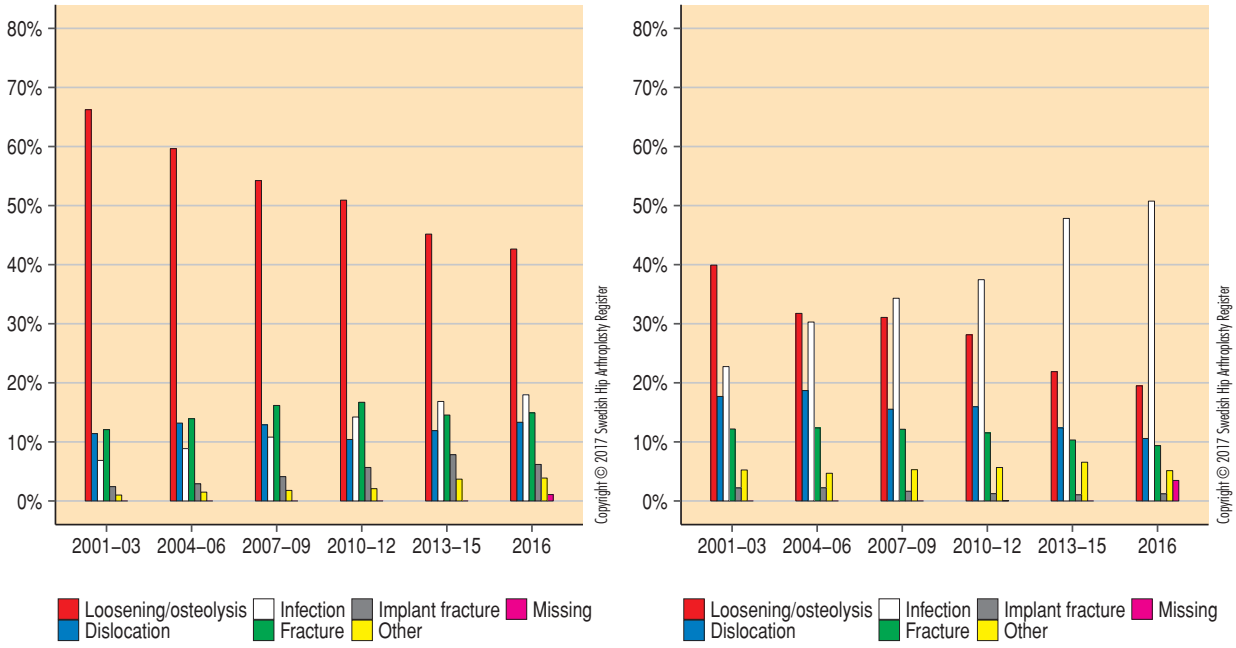


Figure 10.7. Distribution of reoperation causes (revisions and other reoperations) during initial (on the left) and multiple-time (on the right) revisions between 2001 and 2016.

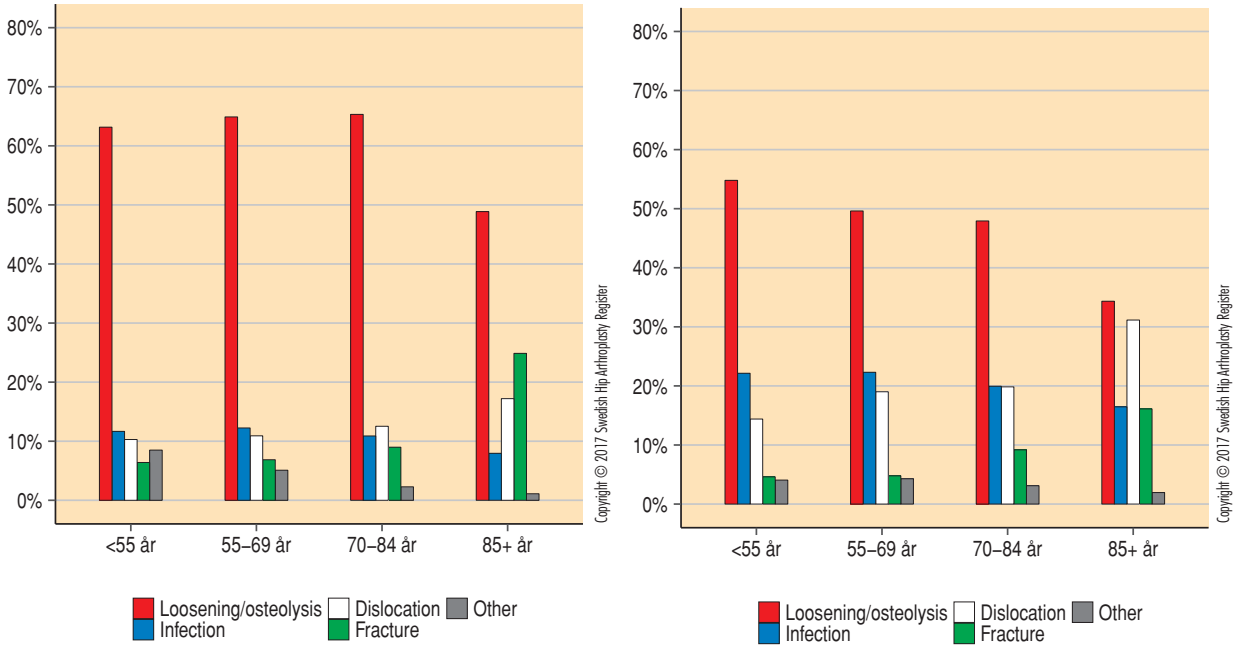


Figure 10.8. Cause for revision in relation to age group for revisions performed from 2001–2016. Initial revisions on the left and multiple-time revisions on the right.

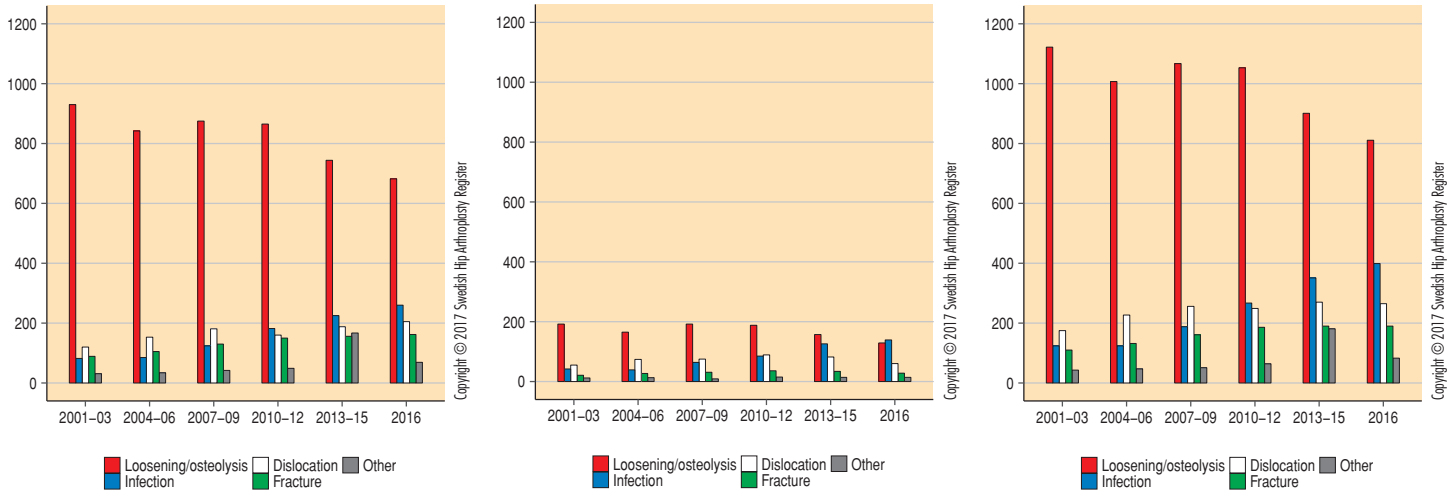


Figure 10.9. Number of revisions in 2001–2016 during initial revisions (on the left), multiple-time revisions (in the middle) and the sum of both (on the right). For three-year periods, a mean figure is presented.

The cause for revision has varied over time which is illustrated in Figure 10.5 in relative numbers and in Figure 10.9 in absolute numbers. The total number of revisions has also increased from 1 574 per year during 2001–2003 to 1 760 in 2016 (including 12 cases where no cause was specified). The increasing number of revisions due to infection, fracture and dislocation probably depends on the fact that the exposed population becomes larger and also older with regard to the increase of revision due to fracture and dislocation. The increase of these two revision causes may probably also, to a certain extent, be conditioned to the fact that uncemented fixation has become more common. On the other hand, increased use of uncemented fixation may also have contributed to the fact that the number of revisions due to loosening has decreased. Hopefully, better surgical technique and better patient selection have also contributed to this, but these hypotheses must be studied further, since the register data does not provide a safe basis for conclusions with regard to cause and effect.

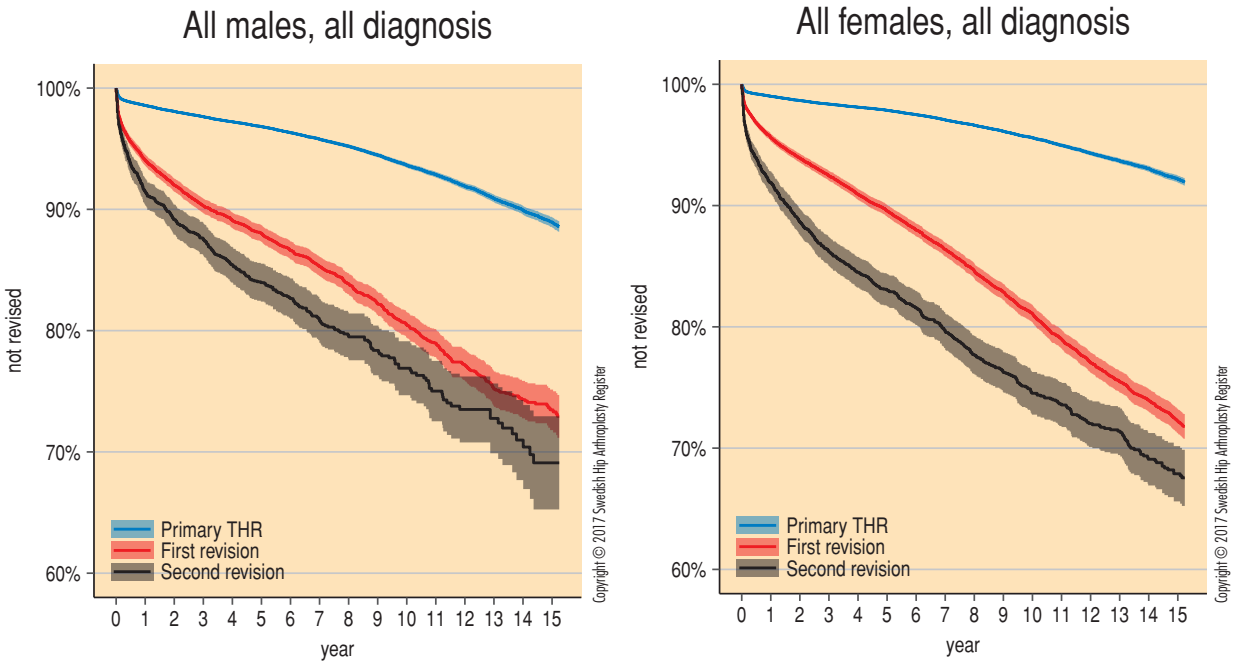


Figure 10.10. Prosthesis survival for primary arthroplasties (107 016 men, on the left; 153 116 women on the right), initial revisions (men: 10 314, women: 11 675) and secondary revisions (men: 3 586, women: 3 515) performed during 1999–2016 including all measures and all causes for revision/rerevision as outcome.

Multiple-time revisions

Of primary operations performed between 1999 and 2016, 3.9% has been revised by 31 December 2016. The corresponding figure for initial revisions performed during the same period, is 18,6% and for multiple revisions, 22.3%. Implant survival after 15 years, when at least 80 observations remained in each group, was 88.6±0.4% for men and 92.0±0.3% for women in primary implant group, 68.8±1.1, and 71.8±1 in the group for initially revised, and 64.3±2.5 and 67.5±2.4, and 64.3±2.5 for patients, who have previously undergone at least one revision (Figure 10.10). Generally, the risk for revision and rerevision is higher for men than for women, and the prognosis becomes worse for every performed revision. Analysis by using a Cox regression analysis without adjusting for age or diagnosis, shows that the risk for (re) revision is 4.0 times (*95% confidence interval: 3.8–4.1*) higher after initial revision in comparison to primary operation, and 5.2 (*5.0–5.5*) times higher if the patient is revised for the second times. Regardless if it's an initial, secondary or multiple-time revision, there is an increasing risk for men to be (re)revised (1.31, *1.27–1.34*) for the patients who have previously undergone at least one revision.

The reason for patient's initial revision affects the cause profile for a possible secondary revision (Table 10.4). A patient who undergoes a primary revision due to loosening/osteolysis, infection and dislocation, has a high probability that if he must undergo another revision, he will be revised because of the same reason. The same applies to patients who suffer a secondary revision. Exceptions are patients who, during initial

Cause for secondary and third revision grouped according to prior cause

	Primary arthroplasty 1999–2016 *n=260 134*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Initial revision %	**1.9**	0.8	0.2	0.8	0.2
No revision	96.1				
	Initial revision 1999–2016 *n=22 491*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Secondary revision n	15 083	1 578	2 211	2 826	793
Cause %					
Loosening	6.1	1.5	2.7	1.9	3.3
Infection	1.8	14.6	2.4	4.4	2.8
Periprosthetic fracture	1.2	0.5	1.3	0.9	1.9
Dislocation	2.4	1.6	3.3	8.6	2.8
Other	0.8	0.3	1.3	0.6	2.1
No rerevision	87.7	81.5	89.0	83.7	87.1
	Secondary revision *n=5 301*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Third revision n	2 506	1 365	422	829	179
Cause %					
Loosening	7.7	2.4	4.7	3.1	4.2
Infection	2.2	12.7	3.3	5.4	6.7
Periprosthetic fracture	1.5	0.5	1.7	1.2	1.8
Dislocation	3.1	3.1	6.9	9.5	4.8
Other	0.9	0.3	1.7	1.1	4.8
No rerevision	84.6	81.0	81.8	79.6	77.6

Tabell 10.4. Distribution of causes for second and third time revision in percentages according to reason for the previous revision. Patient who were primarily operated on or revised during 1999–2016, have been analysed. Two-step revisions have been classified under one term. The group for loosening includes osteolysis and wear (refer to the previous text).

revision undergo an operation due to periprosthetic fracture. In these cases, the most common cause for possible revision is dislocation, followed by loosening and infection, both after initial and secondary revisions. Unlike previous annual reports, this year we present primary and revision operations performed between 1999 and 2016. This is due to the fact that the primary database does not currently extend beyond 1999. One of the advantages might be that data becomes more current.

After an initial operation, patients revised due to infection have the worse prognosis where almost 20% are rerevised within the period (81.5% have not been rerevised, but may have died before 31.12.2016). At secondary revision, the proportion of rerevised patients lies around 19–22% in all groups, apart from the group who were revised due to loosening, where the prognosis is somewhat better. Distribution of revision causes during primary arthroplasty is presented at the top of Table 10.4 for comparison.

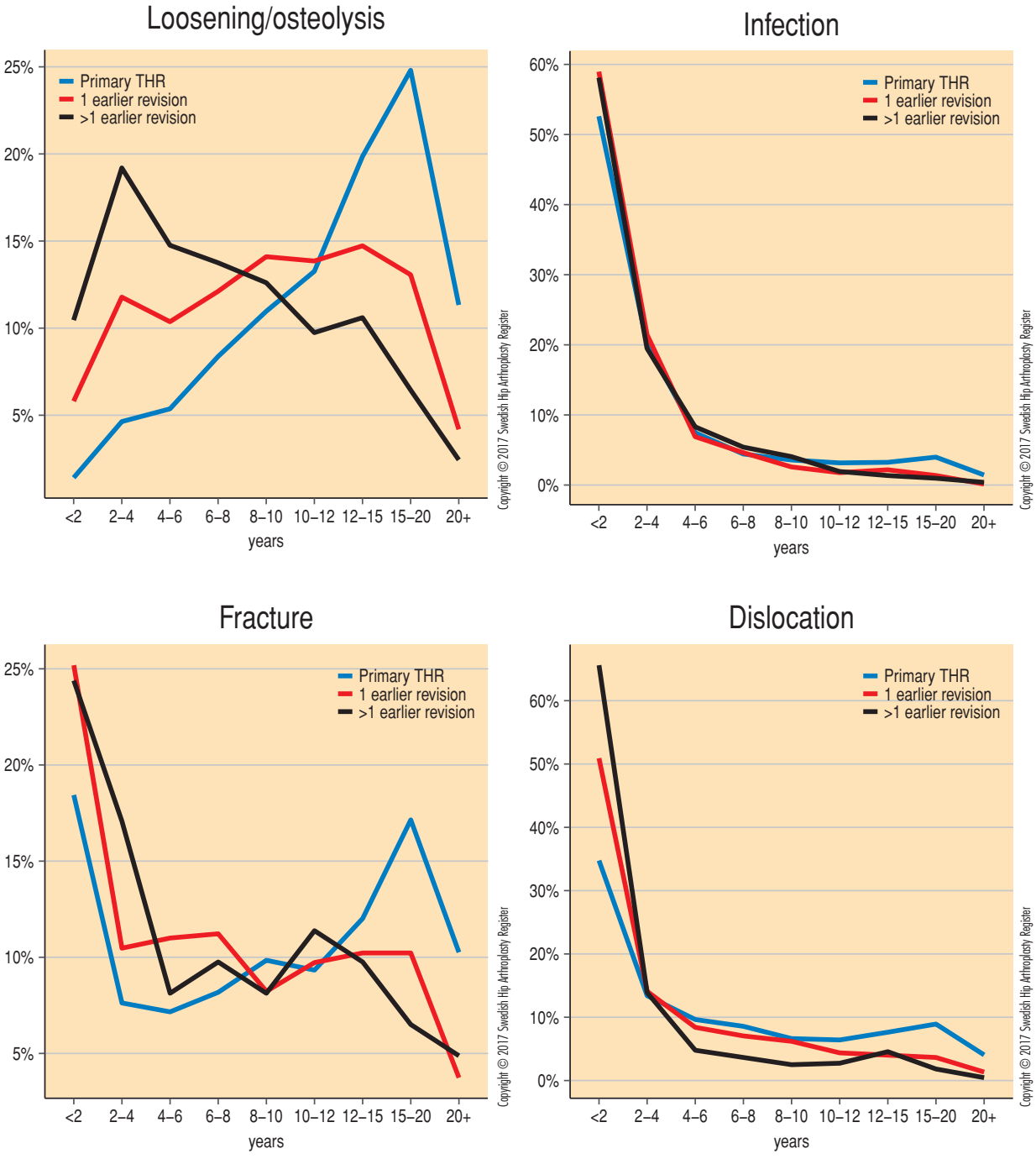


Figure 10.11. Time until possible revision or rerevision distributed in time periods with increasing length after the 10–12-year interval. The time until the next revision tends to decrease as more revisions are performed. It is especially apparent for those patients who were revised due to dislocation. The revision causes loosening/osteolysis (a), infection (b), fracture (c) and dislocation (d) are illustrated.

The more revisions a patient has undergone, the worse is the prognosis for the risk of further revisions. The likelihood that any subsequent revision will occur early increases with the number of previously completed procedures. This applies for all of the four most common revision causes (loosening/osteolysis, infection, fracture and dislocation). In Figure 10.11, the time between the nearest previous operation and revision of primary prosthesis or rerevision in the group of patients who suffered this complication after primary or revision operation, is presented. 34.8% of the patients with primary arthroplasties, who were revised within two years due to dislocation, underwent this operation within two years. In the group, who was revised more than one time previously, this proportion rises to 65.6%. The same trend exists for all of the most common revision causes. It is least pronounced with regard to revision due to infection, when on the other hand, the majority of (re)revisions is performed within two years, regardless if they occur after a primary operation, initial or multiple-time revision.

In conclusion, revision is a serious complication with a relatively high risk for being repeated. Often, the cause for a possible rerevision is the same as in the previous revision and the time interval before the next revision becomes shorter with increasing number of performed revisions.

Measures at revision

Between 2001 and 2006, replacement of cup with or without stem revision, was the most common measure during revision (Figure 10.12). In the beginning of the period, the relative proportion of stem replacement combined with cup or liner replacement during initial revision decreased, and as an effect of the fact that the replacement of femoral head/liner became more common. In comparison to initial revisions, it is more common to replace stem, extract a prosthesis for good or perform a two-session revision during multiple-time revisions. With regard to the last two interventions, they reflect that infection as a revision cause constitutes a larger proportion at multiple-time revision.

Prosthesis extraction and two-session revision

It is not possible to determine, based on the register data, that a prosthesis extraction is definitive, which is illustrated by the fact that the number of "definitive" extractions (no insertion registered in Figure 10.12) increases during 2016 in comparison to 2013–2015. This is an effect of a number of patients who, mainly during 2016, underwent stage one while they had planned to undergo stage two in 2017, had not yet managed to receive their second session or be reported, possibly combined with the fact that two-session revisions tend to increase in number. Two-session revision is generally performed due to infection (86.7% of cases operated during 2001–2016), but there are other causes as well. In 126 cases (8.5%) and 41 cases (2.8%), loosening/osteolysis and fracture have been referred as causes. During prosthesis extraction, without a registered follow-up insertion, infection cause is still the most common, but not as dominating as in stage one of a two-session revision. In 57.6% of the cases, which have undergone prosthesis extraction without a follow-up insertion, the diagnosis is infection. Dislocation (24.8%) has the second place, followed by loosening/osteolysis (10.8%) and fracture (6.0%).

Patients who undergo a two-session procedure due to infection, should have been provided with a new prosthesis

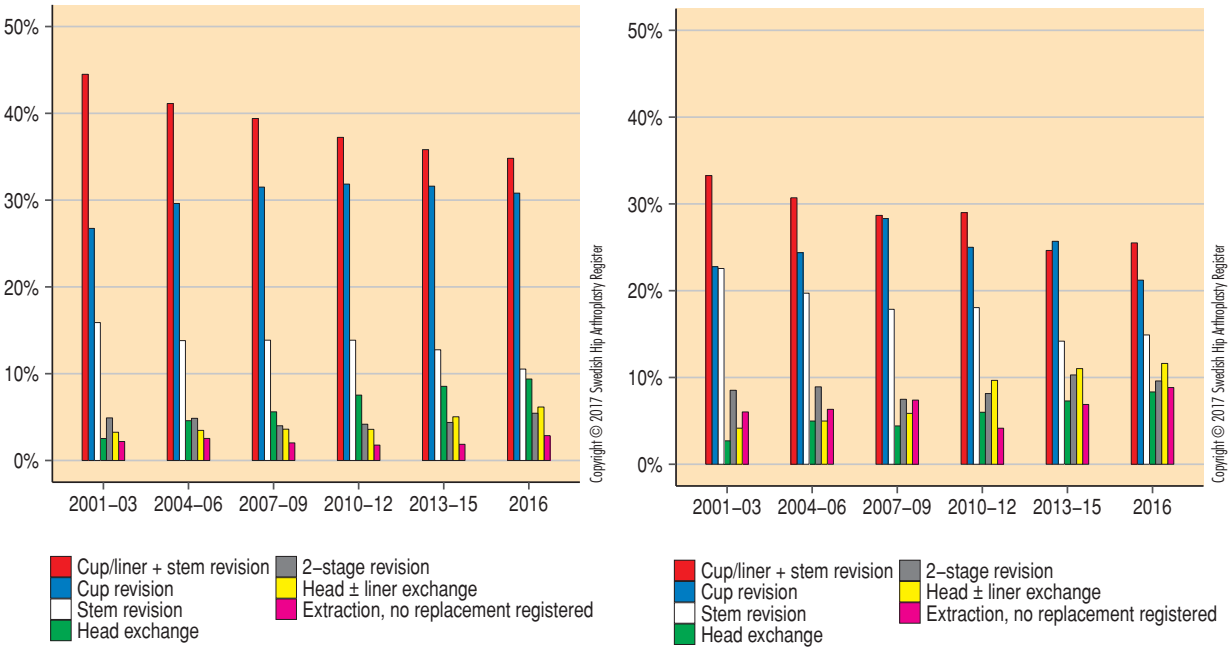


Figure 10.12. Distribution of measures for revision at initial (left) and multiple-time revisions (right). During a two-session operation, total or partial prosthesis extraction and the following insertion of new components been counted as one reoperation.

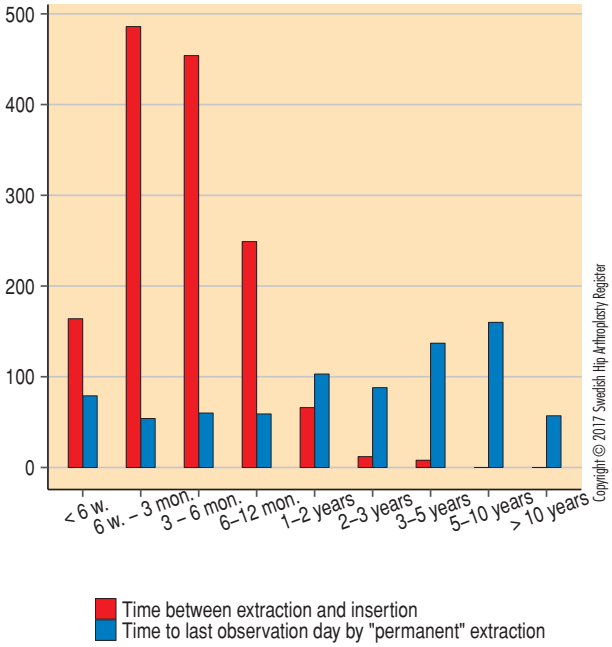


Figure 10.13. Time between step one and step two during two-session revision and observation time for those patients whose prosthesis was extracted, divided into time intervals with increasing length.

within six weeks and three months, depending on how long it takes to treat the infection. At two-session procedure, with a cause other than infection, the time period is largely the same before a prosthesis part or fracture, which initially was deemed to make it impossible to bear any load, has healed. In more than half of the cases operated in 2001–2016 (54.8%), the patient waits longer than three months and in 23.3% cases, longer than half a year (Figure 10.13). In certain cases, there may have been problems with healing of the infection, but probably, there is a cause for trying to shorten this interval as the absence of a hip prosthesis implies a pronounced disability.

The cause for carrying out a definitive extraction of a hip prosthesis may depend on not healed infection, pronounced loss of bone, high level of comorbidity or lack of cooperation, all factors which involve high risk exposure during a possible renewed attempt at prosthesis insertion. Sometimes, the patients refrain from additional attempts at prosthesis fitting after having gone through several previous unsuccessful attempts. After a prosthesis extraction, the patients' ability to move will be limited, which influences the quality of life, something which is relatively badly mapped out. Of the patients, who underwent operation during the actual period (2001–2006), 27.2% have lived without a hip prosthesis after extraction more than five years before, and 7.2% more than ten years before. Corresponding proportions in groups of

	Initial revision 2001–2016 *n=22 491*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Number	13 453	2 364	2 049	2 613	748
Replacement of cup/liner+stem	6668 (*49.6*)	178 (*7.5*)	714 (*34.8*)	480 (*18.4*)	274 (*36.6*)
Replacement of cup	4793 (*35.6*)	63 (*2.7*)	57 (*2.8*)	1357 (*51.9*)	178 (*23.8*)
Replacement of stem	1384 (*10.3*)	43 (*1.8*)	1207 (*58.9*)	157 (*6.0*)	133 (*17.8*)
Replacement of liner ± caput	454 (*3.4*)	187 (*7.9*)	3 (*0.1*)	144 (*5.5*)	53 (*7.1*)
Replacement of caput	8 (*0.1*)	821 (*34.7*)	10 (*0.5*)	357 (*13.7*)	97 (*13.0*)
Extraction. no insertion registered	56 (*0.4*)	245 (*10.4*)	34 (*1.7*)	111 (*4.2*)	3 (*0.4*)
Two-session operation	90 (*0.7*)	827 (*35.0*)	24 (*1.2*)	7 (*0.3*)	10 (*1.3*)
	Secondary revision *n=5 301*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other**
Number	2 813	1 223	477	1189	215
Replacement of cup/liner+stem	1165 (*41.4*)	110 (*9.0*)	140 (*29.4*)	222 (*18.7*)	65 (*30.2*)
Replacement of cup	994 (*35.3*)	22 (*1.8*)	27 (*5.7*)	405 (*34.1*)	34 (*15.8*)
Replacement of stem	539 (*19.2*)	37 (*3.0*)	272 (*56.9*)	137 (*11.5*)	80 (*37.2*)
Replacement of liner ± caput	47 (*1.7*)	173 (*14.1*)	3 (*0.6*)	218 (*18.3*)	15 (*7.0*)
Replacement of caput	1 (*0.0*)	198 (*16.2*)	4 (*0.8*)	106 (*8.9*)	12 (*5.6*)
Extraction. no insertion registered	31 (*1.1*)	230 (*18.8*)	14 (*2.9*)	95 (*8.0*)	3 (*1.4*)
Two-session operation	36 (*1.3*)	453 (*37.0*)	17 (*3.6*)	6 (*0.5*)	6 (*2.8*)

Table 10.5. Type of measure related to revision cause during first- and second-time revisions performed in 2001–2016. In addition to implant replacement, other measures (example: fracture reconstruction and osteosynthesis, insertion of socket wall addition, augment, reinforcement ring) had been performed.

patients who were revised with a prosthesis extraction without reinsertion in the group who underwent operation from 1979, was 36.6% (n=448) and 14.1% (n=172).

Choise of measure in relation to the cause of revision

The type of measure varies depending on causes for revision (Table 10.5). It is most common, that in the case of loosening/osteolysis both components are replaced, the second most common is the replacement of cup/liner, while isolated stem revision is carried out only at every tenth case during initial revision and at every fifth case at multiple-time revisions. With infection, replacement of femoral head and/or liner is most common during initial revision, (42.6%),followed by a two-session revision (35.0%) and extraction, without a registered following insertion of prosthesis (11.5%). Replacement of both cup/liner and stem is performed in only 7.5% of infectious cases. During multiple-time revision, two-session operation is most common (37.0%) followed by caput and/or liner replacement. Combined cup/liner and stem replacement (equivalent to a one-session revision) is a little more common as during initial revision (9.0%). As expected, at periprosthetic fracture, stem replacement with or without cup or liner replacement dominates. In the group, there is a number of isolated cup replacements. In individual cases, it is an acetabular fracture, in other cases, some form of osteosynthesis is performed, although it is not always noted in the register. With dislocation, isolated replacement of the cup is most common in both groups following cup and/or liner replacement, which in just over a quarter of cases, is combined with insertion of a socket wall addition, a measure which today is used only in isolated cases. In 112 cases (30.9% of isolated liner replacements), a ”constrained” liner has been used, and in 59 (16.3%) cases, a dual articular cup is fixed in an existing metal shell.

Choise of fixation

Selection of uncemented fixation has a longer tradition in revision than in operations with primary prostheses. However, between 2001 and 2003, about 80% of all revision cups were fixated with cement regardless of whether it concerned the initial or multiple-time revision (Figure 10.14). With regard to stems, the proportion with cemented fixation was the same size during initial revision (80.9% cemented stems, regardless of length) and somewhat lower during multiple-time revision (69.2%, Figure 10.15). Hereafter, the proportion of cemented fixation of cups had decreased to 50% during both initial and multiple-time revisions. The corresponding decline in relation to stems had resulted in the fact that roughly half of initial revisions and about 43% of multiple-time revisions were fixed with cement during 2016. Two-piece uncemented stems have successively increased in popularity during the period but have thought to have reached a stable proportion at about 40% during initial and 50% during multiple-time revisions. Two-piece cemented stems are registered only in individual cases.

From the period 2004–2006, the use of mainly cemented dual articular cups has increased. Since 2000–2012, the proportion of both cemented and uncemented standard cups decreases, which could indicate than, to a certain extent, a cemented dual articular cup is chosen instead of an uncemented standard cup. The concept of uncemented dual articular includes also conventional cup types, which can be provided with dual articular inserts (but most often, they are provided with an insert of a conventional type). Another way of minimising the risk of dislocation, is to use constrained polyethylene inserts, which “hold” the femoral head in the cup. Since 2001, 112 first- and second-time revisions were registered where such an insert had

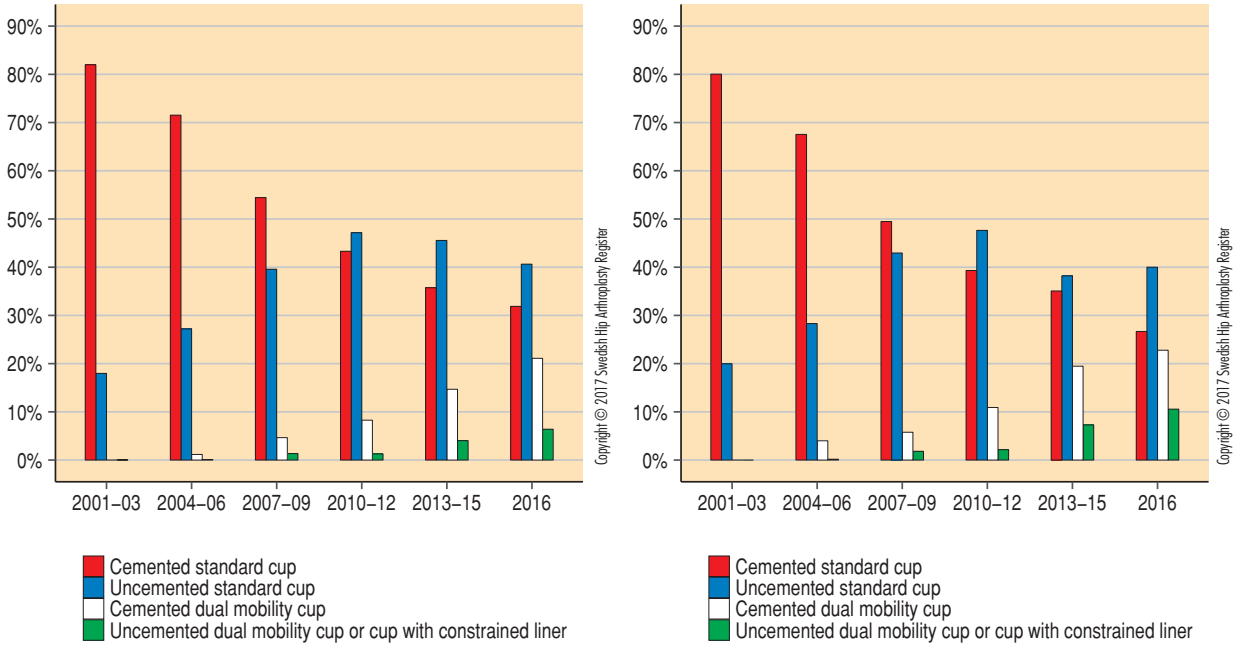


Figure 10.14. Use of cemented and uncemented cup 2001–2016. The biggest change during the last periods is a relatively significant increase of revisions with cemented dual articular cup. Initial revisions on the left and multiple-time revisions on the right.

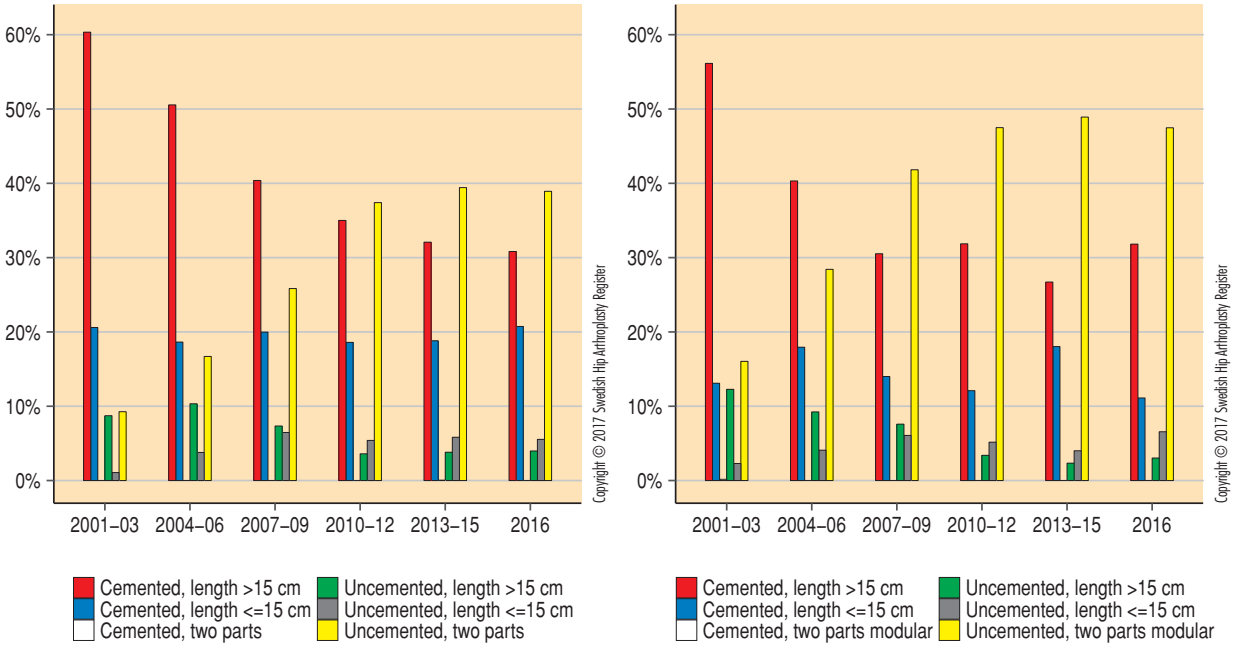


Figure 10.15. Selection of stem fixation and type of stem during initial revision (on the left) and multiple-time revisions (on the right) during 2001–2016. The differences between periods 2013–2015 and the period 2016 are relatively small.

been used. In 2016, eight such operations were reported, of which three were multiple-time revisions. In the same year, 337 revisions with dual articular cups were reported, including the cases where a dual articular cup or insert was placed in a metal shell, which is usually used with a conventional liner.

Bone graft

During revision surgery, more or less larger bone defects are common occurrence. These defects must often be treated to facilitate fixation of a new implant. One possibility might be the use of larger and/or specially designed implants, porous metal inserts (augment), bone substitutes and transplanting of autologous or homologous bones. Because of local problems in the donor's side and the limited availability of autologous bone, transplanting homologous bone is completely dominant, when it comes to major defects. Often, several approaches for replacing bone defects, are combined. In Sweden, bone transplant to the cavity, which is caused when the prosthesis and soft tissue are removed from the acetabulum and the femoral medullary canal, is a standard measure that is based on a good documentation in most studies with long follow-up. Commonly, the donor bone is used in the form of femoral head of the thigh-bone, which is removed during primary arthroplasty and which, after rigorous handling according to legislation, is stored in cold storage. In some cases, the whole implant bed is packed as a transplant, in other cases, one or more cavities are filled with the transplant. Hole bone pieces can also often be used in combination with bone pieces. The advantage with this procedure is that the transplanted bone is successfully transformed into body's own bones, which among other things, is a facilitating factor at future revisions.

During 23 285 revisions, which were performed in 2001–2016, where sockets and/or stem were replaced or inserted during an initial or multiple-time revision, some form of bone graft was registered in 10 890 cases (46.8%). During cup revision/insertion, bone graft was performed in half of the cases. There is no apparent difference between initial and multiple-time revisions (Figure 10.16). On the other hand, it appears that the use of bone graft during uncemented fixation has decreased somewhat in 2013, probably not because of increased use of augment, since the number of performed operations with this technique, which had been reported to the register, has remained relatively constant since 2009 at around 80 to 90 revisions per year.

Between 2001 and 2003, bone graft to the femur was as common or a little more common during stem revision in comparison with cup revision. Hereafter, the frequency of bone graft tends to decrease and especially during initial revision of cemented inserts. Possibly, this trend was broken in 2016, but it may also be a random variation since the total number of cemented multiple-time revisions amounted only to 85 in 2016.

In conclusion, during 2001–2016, on average 681 hip arthroplasty revisions with some sort of bone graft per year were carried out. In 2016, bone graft was used during 40.7% of all cup revisions and 14.0% of all stem revisions.

Selection of implant

Table 10.6 shows the most used cemented and uncemented cups and stems in 2006, 2015 and 2016. Most used implants

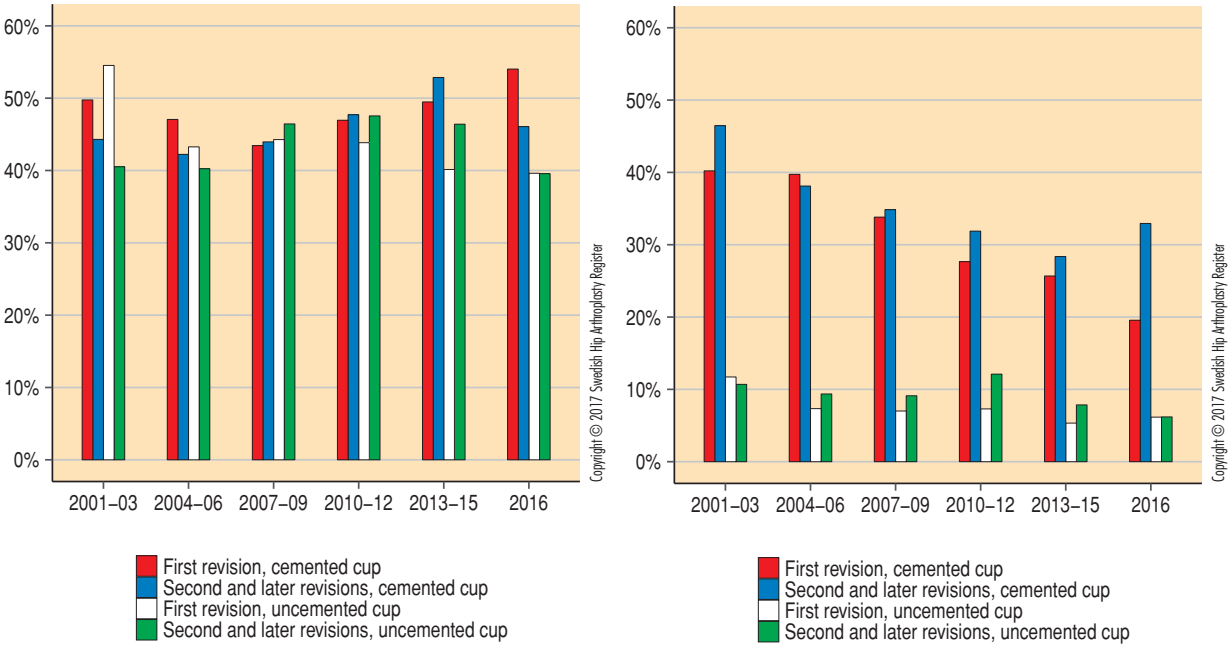


Figure 10.16. Proportion of operations where the surgery report indicated that some form of bone graft on acetabulum (left) and on femur (right) during initial and multiple-time revisions performed in 2001–2016.

for the last ten years are presented for comparison. Between 2006 and 2015, ADES DMC (Dual Mobility Cup) replaced Contemporary Hooded Duration on the fifth place and three new uncemented cups (Tritanium revision, Trilogy IT, Pinnacle W/Cripton 100) were included in the most used cups, which reflects well the variability which we have observed previously when selecting uncemented cups, especially during primary arthroplasties. Among the uncemented stems, Corail standard (including "coxa vara" and "extra-offset" variants) has replaced Arcos.

Just as in primary surgery, the rectification is greatest when selecting cemented fixation. This is most apparent in the group of cemented revision cup, where the proportion of "other" between 2015 and 2016 had decreased from 15% to 5% due to the fact that dual articular cups become more common. Between 2015 and 2016, their proportion had increased by about 10% and constituted 42.1% of all cemented revision cups in 2016.

In conclusion, in revision surgery we have seen a trend towards increased use of uncemented fixation and increased use of uncemented modular stems. This redistribution in fixation method appears to have been broken between 2015 and 2016, partially due to an increased use of cemented dual articular cups and the fact that the use of modular stems had reached a plateau.

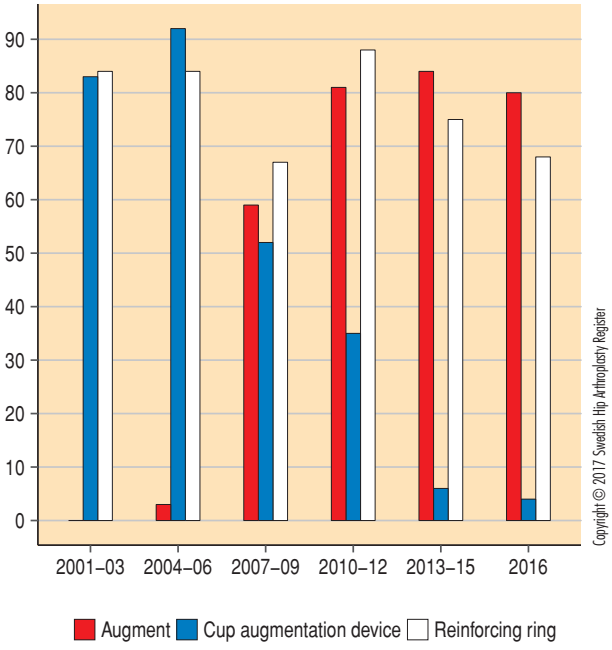


Figure 10.17. Number of operations where reinforcement ring, socket wall addition or/and augment was used during reoperation in relation to operation wound. For three-year periods, a mean value is presented. Replacement of socket wall addition has been excluded (14 cases).

Most used cups and stems during revision surgery

	2006		2015		2016
Cup during revision %					
Cemented number	**757**		**580**		**606**
Lubinus	27.6	Avantage Cemented	26.2	Avantage Cemented	34.2
Elite OGEE	15.5	Exeter X3 RimFit	23.8	Exeter X3 RimFit	22.9
Exeter	15.5	Lubinus X-linked	15.5	Lubinus X-linked	17.0
Contemporary Hooded Duration	8.6	Marathon XLPE	13.4	Marathon XLPE	11.1
FAL	5.5	Contemporary Hooded Duration	5.0	ADES DMC	5.0
Other	27.3	Other	16.0	Other	9.9
Uncemented number	**346**		**566**		**551**
Trilogy±HA	61.6	TM revision	37.2	TM revision	35.0
Mallory Head	11.6	Continuum	12.0	Continuum	9.6
TM revision	6.6	Mallory Head	4.7	Tritanium Revision	7.6
Trident AD LW	6.1	Tritanium	4.7	Trilogy IT	5.8
TM modular	2.9	Delta-ONE-TT	4.4	Pinnacle W/Cripton 100	4.4
Other	11.3	Other	36.9	Other	37.6
Stem during revision %					
Cemented number	**587**		**471**		**449**
Exeter standard	30.7	Exeter standard	38.3	Exeter standard	36.7
Lubinus SP II standard	29.0	Lubinus SP II standard	31.7	Lubinus SP II standard	29.0
CPT	13.8	Exeter short rev-stem	9.2	Exeter short rev-stem	12.0
Exeter long	8.9	Exeter long	7.3	CPT	7.8
Spectron EF long	5.3	CPT	6.4	Exeter long	6.2
Other	12.4	Other	7.1	Other	8.2
Uncemented number	**307**		**478**		**456**
MP	44.1	MP	37.9	MP	39.3
Wagner SL Revision	18.4	Restoration	19.2	Restoration	20.6
Revitan cylinder	11.9	Revitan cylinder	17.2	Revitan cylinder	16.0
Restoration	6.9	Corail Revision	3.8	Corail standard±collar	5.3
CLS	4.4	Arcos	3.6	Corail Revision	4.4
Other	14.4	Other	18.4	Other	14.4

Table 10.6. The five most used cemented and uncemented cups and stems at revision surgery have been presented in percentages of the total number, which was reported during 2006, 2015 and 2016. Both initial and multiple-time revisions are included.

Reinforcement ring, augment and socket wall addition

When revising acetabular components, reinforcement ring, which is fixed with screws in the pelvis, can be used, in order to achieve better stability. This measure is most often used at major bone defects and at a so-called pelvic dissociation, but indications for the use of a pelvic ring vary surprisingly a lot. This can partly be explained by these implants having different designs and are applied in different ways depending on the designer's understanding of its function and use. Insertion of the reinforcement ring was registered for the first time in Sweden in 1985, and got a boost in the early 2000s (Figure 10.17, refer also to Annual Report 2015). Since 2001, roughly 40 units have used reinforcement rings during at least one revision. They are most popular in South-Sweden, where Hässleholm-Kristianstad and SUS/Lund had inserted 163 and 153, respectively (67.7% of all), followed by Uddevalla (n=82) and SU/Mölndal (n=67). All of these units have a large volume of revisions, which varied between 877 and 1 620 during the actual period.

Porous augment is used to replace bone defects and improve the stability of the cup. This type of implant was used for the first time in Sweden in 2006, and has since 2009 reached a stable level of about 80 inserted and reported implants per year. Even here, there are about forty units which have inserted at least one augment. The same units presented above are also the largest users of augment and are responsible for about 60% of all inserted implants.

Use and results of operation with socket wall addition (which is classified as other operation, if it is not combined with another implant-related measure), has been discussed in several previous annual reports. Often, this measure is combined with replacement of prosthesis components, which took place in about half of the cases (47%) from 2001. In 2016, the measure is still registered in individual cases. Generally, operation with socket wall addition is not especially successful, although the prognosis during revision due to dislocation is generally seen as bad.

In the database, 1 600 reoperations with socket wall addition has been performed. In 1 051 cases, the insertion of socket wall addition is noted as the only measure. In these cases, the 15-year survival is based on the outcome of new reoperation 50.4±4.0%. The most common cause for new reoperation is dislocation, followed by loosening/osteolysis and infection. Corresponding survival rate using the same outcome (all types and causes for reoperation) after cup revision due to dislocation, regardless of stem revision, is 63.0±4.0% (Figure 10.18). In both groups, reoperation and those reoperated on previous occasions are included for the first time, and in both groups, the index operation was performed 1979–2016 so that the number of observations could be as high as possible.

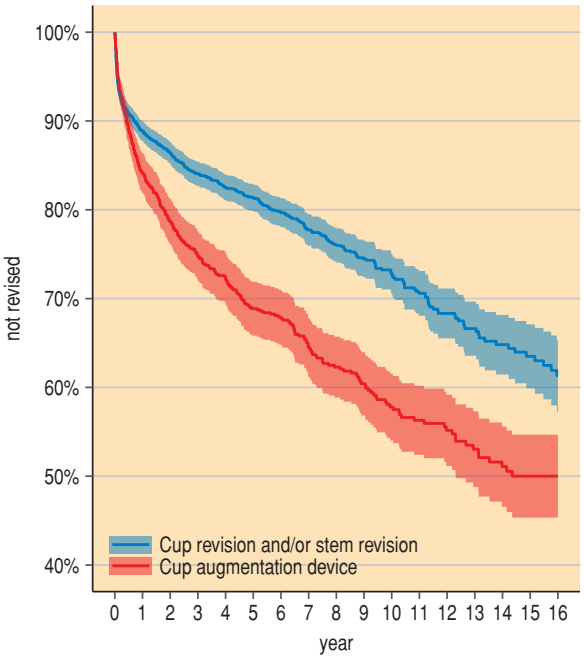


Figure 10.18. Survival diagram after cup with or without stem revision due to dislocation and after insertion of socket wall addition as the only measure. Outcome is reoperation regardless of the cause and measure. Both groups include patients who could have been reoperated several times before. At 15-year follow-up, 129 observations remain in the revision group and 82 in the group with inserted socket wall addition.

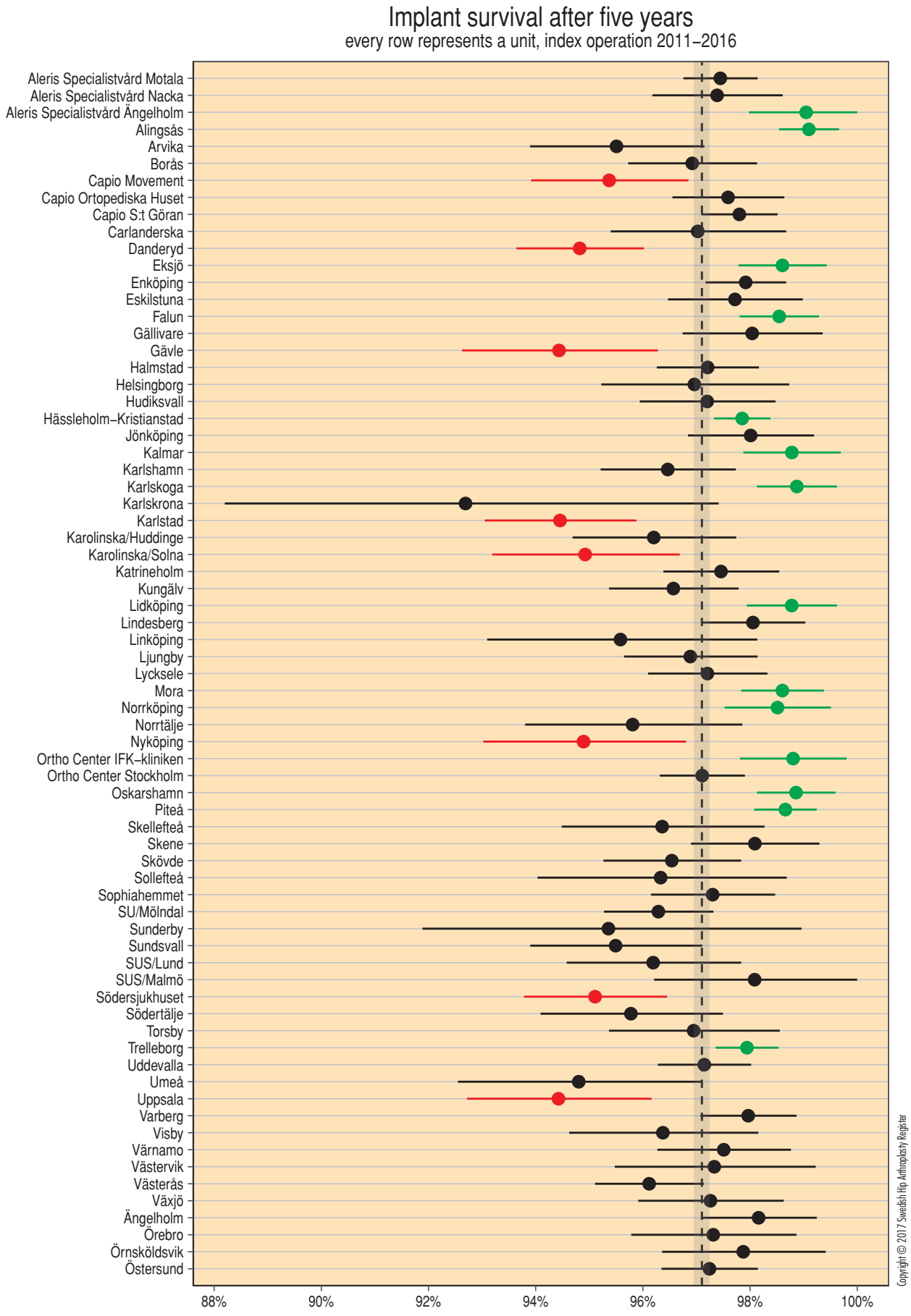
If the Cox regression analysis is adjusted for age, gender, diagnosis and the number of previous reoperations, we find that operation with insertion of socket wall addition results in a 70 percent increase in risk for additional reoperations (HR=1.68 95% confidence interval: *1.47–1.91*). Although the difference is apparent between these survival data, it should be pointed out that in this analysis, we could not completely take into account the bias caused by patient selection.

10.2 Implant survival within five and ten years

In this year's report, we have chosen to use a Forest plot to describe five- and ten-year survival. The grey line represents the national average and the green represents significantly better results, the red representing significantly worse results. It is important to remember that a very wide confidence interval shows few patients, this means that few events can cause big changes in these groups. We have decided to remove units who have operated on less than 30 patients from the five-year survival and units who have operated on less than 60 patients have been removed from ten-year survival. Implant survival within ten years is based on total hip replacements performed during the past five and 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 the latter part of 2007–2016, the average observation period is shorter than five years. Most common cause for reoperation is aseptic loosening with, followed by infection, fracture and dislocation.

This variable is of great value especially for those units 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 unit's case-mix. The frequency of revision due to loosening provides relatively good information about how prosthesis selection and surgical technique influence outcome. For units 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. Therefore, we have added five-year survival, which to a certain extent reflects the present organisation. It is possible to get an indication about a possible problem little bit earlier.

Units with high frequency of revisions, even if not differing significantly from the national average, should also take the opportunity of carrying out an operative analysis. The first step is to select data published here and thereafter decide whether further improvement measures are motivated. However, it is important to point out that we are dealing with the range of 0.950–1.000, in other words, relatively small differences.


Implant survival after five years
every row represents a unit, index operation 2011–2016
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Aleris Specialistvård Nacka
Aleris Specialistvård Ängelholm
Alingsås
Arvika
Borås
Capio Movement
Capio Ortopediska Huset
Capio S:t Göran
Carlanderska
Danderyd
Eksjö
Enköping
Eskilstuna
Falun
Gällivare
Gävle
Halmstad
Helsingborg
Hudiksvall
Hässleholm–Kristianstad
Jönköping
Kalmar
Karlshamn
Karlskoga
Karlskrona
Karlstad
Karolinska/Huddinge
Karolinska/Solna
Katrineholm
Kungälv
Lidköping
Lindesberg
Linköping
Ljungby
Lycksele
Mora
Norrköping
Norrtälje
Nyköping
Ortho Center IFK–kliniken
Ortho Center Stockholm
Oskarshamn
Piteå
Skellefteå
Skene
Skövde
Sollefteå
Sophiahemmet
SU/Mölndal
Sunderby
Sundsvall
SUS/Lund
SUS/Malmö
Södersjukhuset
Södertälje
Torsby
Trelleborg
Uddevalla
Umeå
Uppsala
Varberg
Visby
Värnamo
Västervik
Västerås
Växjö
Ängelholm
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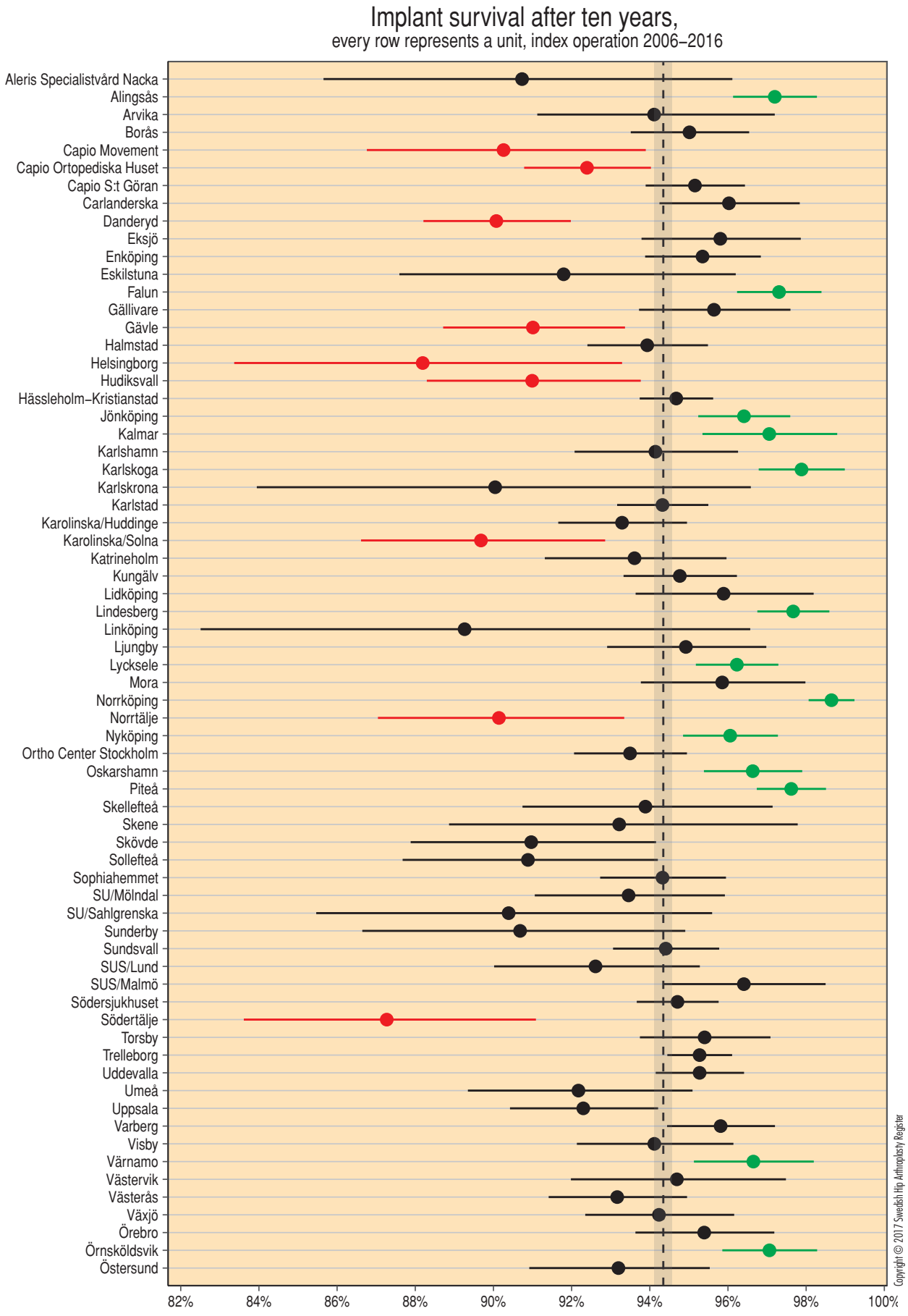
Implant survival after ten years,
every row represents a unit, index operation 2006–2016
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Alingsås
Arvika
Borås
Capio Movement
Capio Ortopediska Huset
Capio S:t Göran
Carlanderska
Danderyd
Eksjö
Enköping
Eskilstuna
Falun
Gällivare
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Halmstad
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Nyköping
Ortho Center Stockholm
Oskarshamn
Piteå
Skellefteå
Skene
Skövde
Sollefteå
Sophiahemmet
SU/Mölndal
SU/Sahlgrenska
Sunderby
Sundsvall
SUS/Lund
SUS/Malmö
Södersjukhuset
Södertälje
Torsby
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Uppsala
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11 Patient-reported outcomes

The Swedish Hip Arthroplasty Register's PROM programme

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

11.1 PROM programme's logistics

All patients who shall undergo elective surgery, are encouraged to voluntarily answer a 12-question questionnaire. 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 hip pain assessment 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 Artrosskola (patient education program and physiotherapy training) preoperatively, and in 2013, a question was included about smoking. The same PROM form with a complementary estimation of satisfaction with the result of the surgery is sent to patients after one, six and ten years. The Register's coordinators send out a list every month to all units for the patients who are to be followed up. Thereafter, the follow-up routine is managed by local administrators who send out the forms, enter survey responses to the PROM database and send out reminders about missing responses within about two months.

11.2 New in the PROM programme

Since we have modernized and transitioned to a new register platform (Stratum), several changes have been made in the PROM programme.

- A new question has been added to determine whether the patient wants to be contacted via e-mail during follow-up.

- More response alternatives has been added to the question about smoking. It is the same questions about smoking which is also used by the Swedish Fracture Register:

  Do you smoke?
  - I have never smoked ☐
  - Former smoker ☐
  - I smoke, but not every day ☐
  - Daily smoker ☐

- EQ-5D with 5 response alternatives (instead of 3) has been introduced. Below is the dimension of mobility and the difference between the two different versions to illustrate the difference.

  Old EQ-5D with 3 response levels:
  Mobility
  - I have no problems in walking about ☐
  - I have some problems in walking about ☐
  - I am confined to bed ☐

  New EQ-5D with 5 response levels:
  MOBILITY
  - I have no problems in walking about ☐
  - I have slight problems in walking about ☐
  - I have moderate problems in walking about ☐
  - I have severe problems in walking about ☐
  - I am unable to walk about ☐

  The question about hip pain has been simplified, but now we ask whether there is pain in both right and left hip. This is the same scale which is used in Oxford Hip Score. Our decision to remove the visual scale is partially due to the fact that individuals found it difficult to understand the scale and partially, because it took time and it was easy to misunderstand the scale.

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

None	Very mild	Mild	Moderate	Severe
☐	☐	☐	☐	☐

  During the last four weeks, how would you describe the pain you usually have in your left hip?

None	Very mild	Mild	Moderate	Severe
☐	☐	☐	☐	☐

  Note that the old VAS values have been transposed to the new scale. This transpose key was used.

  0–20 =>1 None
  21–40=>2 Very mild
  41–60=>3 Mild
  61–80=>4 Moderate
  81–100=>5 Servere

- The questions about how satisfied one is with the operation result was changed in a similar way. Previously, we used a VAS. However, note that we now go from "very unsatisfied" on the left to "very satisfied" on the right.

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

Very unsatisfied	Unsatisfied	Neither satisfied nor unsatisfied	Satisfied	Very satisfied
☐	☐	☐	☐	☐

The old VAS values were transposed as follows:

0–20 =>5 Very satisfied
21–40=>4 Satisfied
41–60=>3 Neither satisfied nor unsatisfied
61–80=>2 Unsatisfied
81–100=>1 Very unsatisfied

- We introduced PROM programme also for reoperations. The same form will be used before both primary operations and reoperations. This means that it is not necessary to figure out what sort of operation it is.

- Two different follow-up forms will be used; one for those who only have a prosthesis in one hip (**unilateral**) and one form for those who have prostheses in both hips (**bilateral)** The same follow-up form will be used before both primary operations and reoperations.

11.3 Improvements in handling forms

Now the 1-, 6- and 10-year follow-up is going to take place via email for those patients who wish so and who have provided their email address. The follow-up form is sent electronically and via a link, the answered form goes directly to the register database without any effort from the unit. For other patients, who have not provided their email address, the contact secretary can manually send a form via traditional mail. The system will automatically create lists of those patients who should be followed up next. One can easily monitor when the form is sent in, if a reminder has been sent out and then register when the responses come in. It is possible to see directly the patients address in the system. Logging in to the system is personal and can be done via SIHTS card or mobile banking.

11.4 Reoperations are included

Until now, the PROM programme had only primary operations included. If the patients suffered a reoperation, the patients would have left the follow-up routine. Now there is a strong preference and reason to also include revisions and other reoperations. This means that all who come in for some type of prosthesis-related operation will be registered in the PROM database. The same preoperative form is used for both primary arthroplasties and reoperations.

11.5 This is how patient-reported outcomes are presented

The graphs illustrate the development of the PROM results one year postoperatively per unit. The values are presented as mean values. The presented values refer to four two-year periods from 2008/2009 to 2014/2015. We just show values for those units that have at least 40 registrations for at least two periods. The PROM variables included, are: 1) EQ VAS indicating self-reported health status on a scale of 0–100, 2) Pain VAS indicating hip pain on a scale of 1–5 (reference above) and 3) How satisfied is the patient with the result of the surgery on a scale of 1–5 (reference above). For EQ VAS, the higher the value, the better the self-rated health status. For pain, the opposite applies: low scores indicate little pain. For satisfaction, high scores indicate positive outcome. Black dots/lines are the national average results, and are thus identical in all the graphs which show the same outcome measurements. Red dots/lines show the observed values for each unit and the blue points/lines show the expected results of the unit when adjusted for age, gender, diagnosis, Charnley class and preoperative PROM values. If the black and blue lines are close together (e.g. Falun and Halmstad), this unit's demographics are assumed to be representative of the country, but if they fall apart (e.g. SUS/Lund), there are differences in age, gender, diagnosis, Charnley class and/or preoperative PROM values.

11.6 Positive trend but great differences between units

For all PROM variables, at national level, there is a positive trend over time, which we reported on in the previous annual reports. This positive trend is of course encouraging. Since last year, we also show trends in the PROM results at the unit level. The idea is to illustrate trends, so that each unit can see how the development looks like in relation to the rest of the country and the unit's expected results.

There are some units with results that are particularly illustrative or which for some other reason, are worth commenting on. The development in Kalmar is interesting. During the entire period, the expected values are close to the national average. During 2007–2008, the observed values are almost as expected, but thereafter, there is a very positive improvement trend.

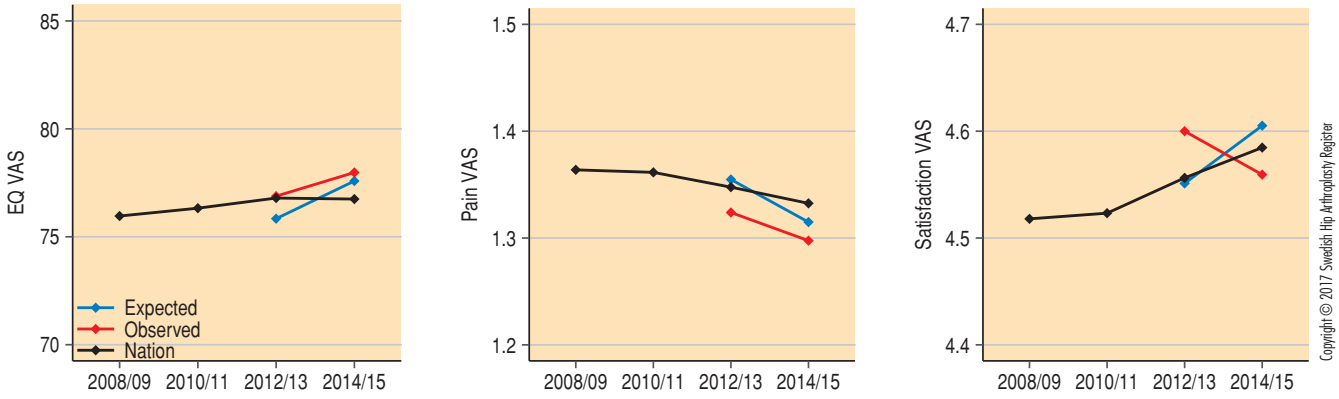
In Växjö, the results go completely against the general improvement trend in Sweden. Without any signs that the patient demographics have changed, the results have gradually deteriorated and were, in the last period, clearly worse than the national average. In Kungälv, there is also a negative trend, which led to an extensive local in-depth analysis which is presented in last year›s report. It is also evident that results have deteriorated during 2014/15 in Karlskoga and Frölunda, which ideally will lead to a further activity analysis.

Danderyd is a good example of a unit which has better outcomes than the national average and significantly better outcomes than the expected values. Hässleholm performs most elective hip prostheses in Sweden. Here, the patients report, on average, better health, less pain and more satisfaction than expected, with a significant improvement trend.

11.7 How can the PROM results be improved?

How can patient-reported outcomes be improved? Inherently, register data cannot give answers to causal relations in order to give specific 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 incision and fixation, and the patient-reported outcome. The effects are not so obvious that it would allow us to recommend changing the routine incision 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.

Aleris Specialistvård Bollnäs



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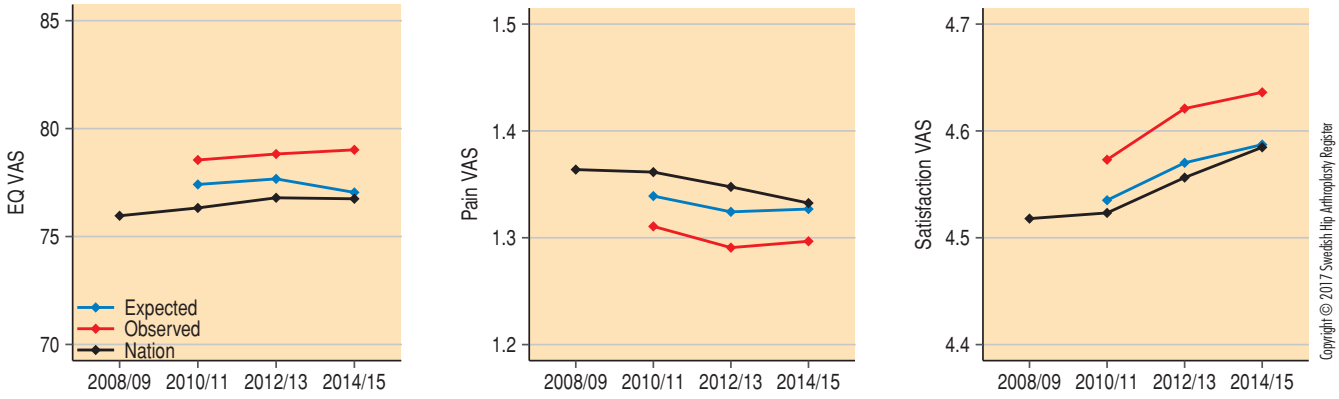

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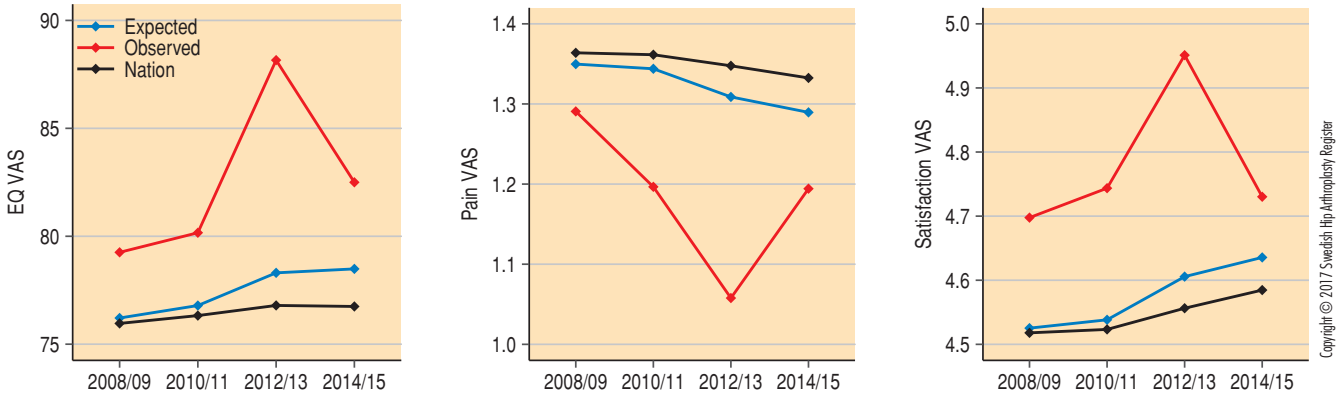

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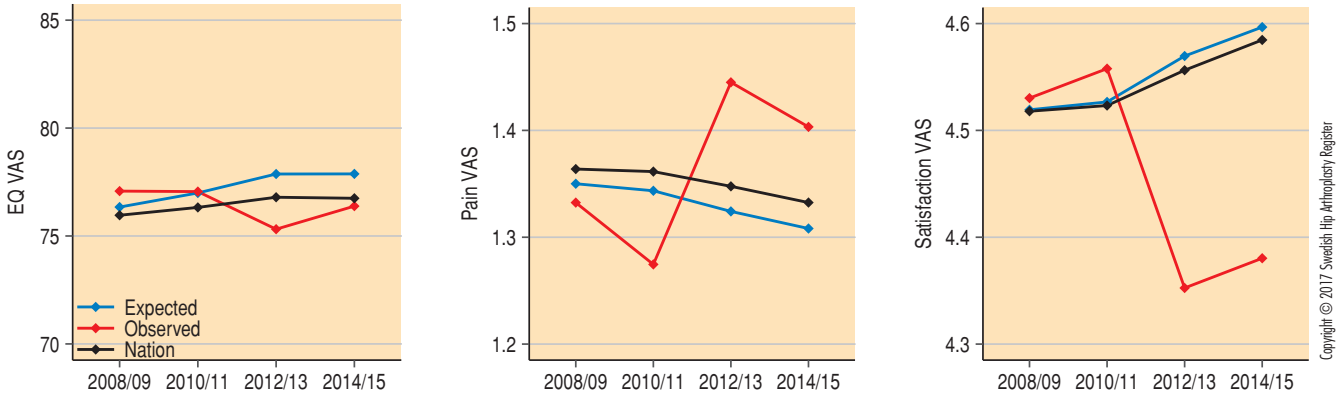

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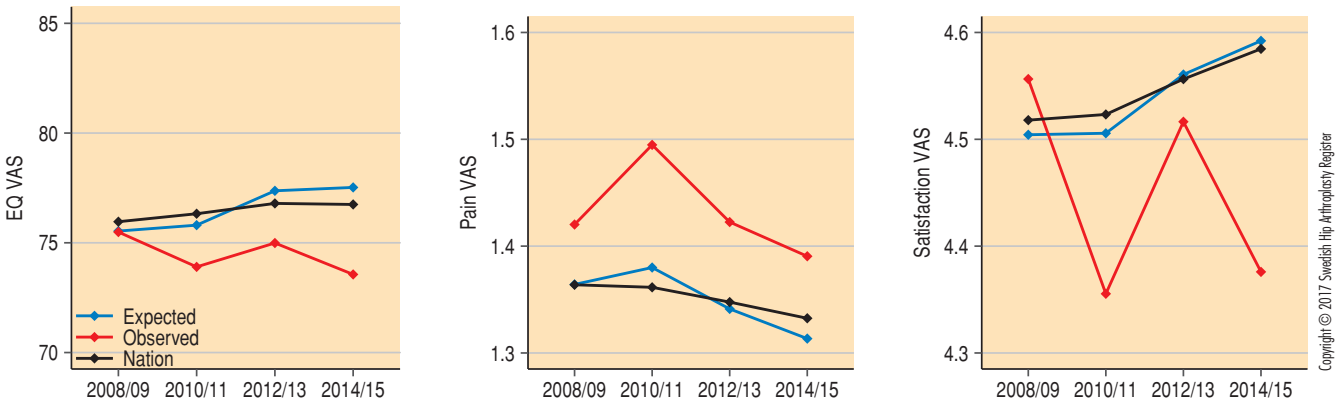

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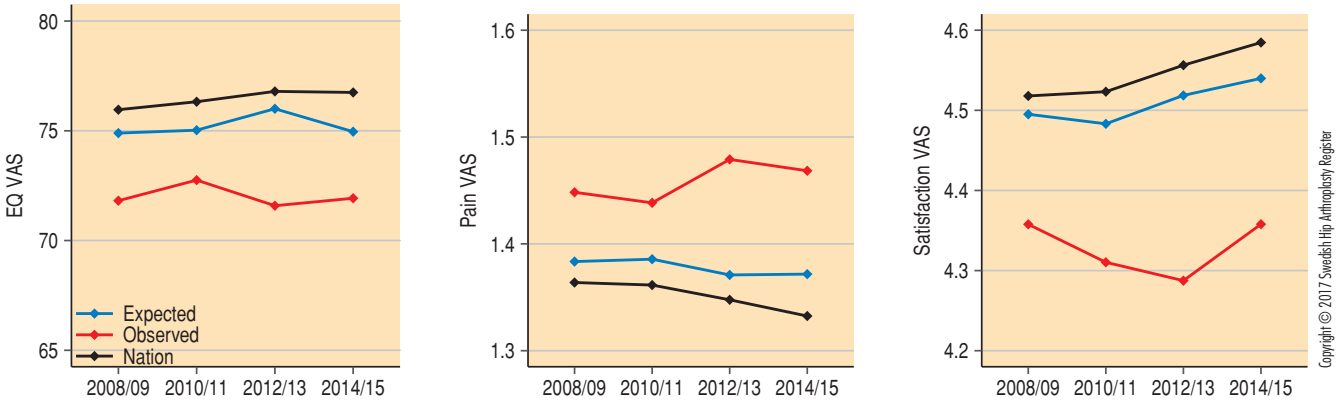

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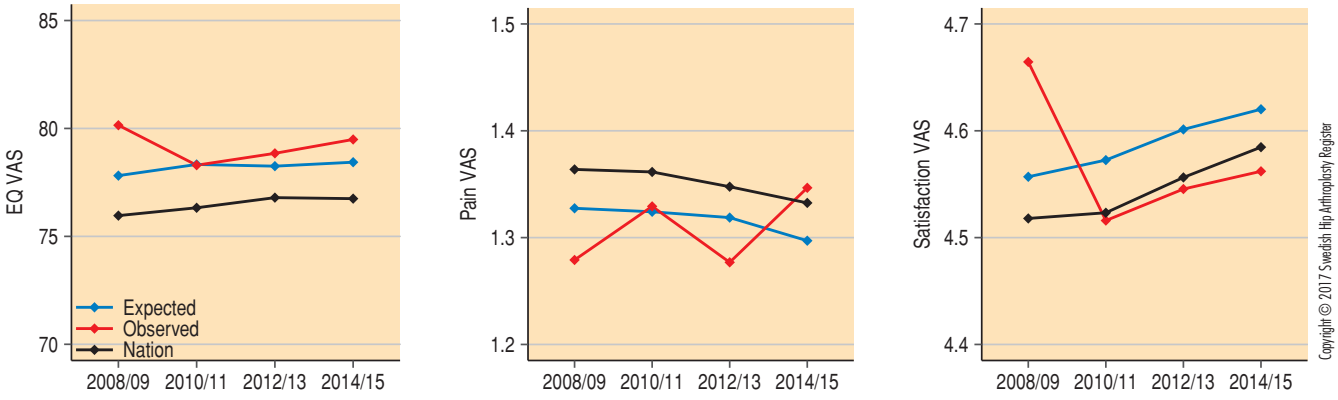

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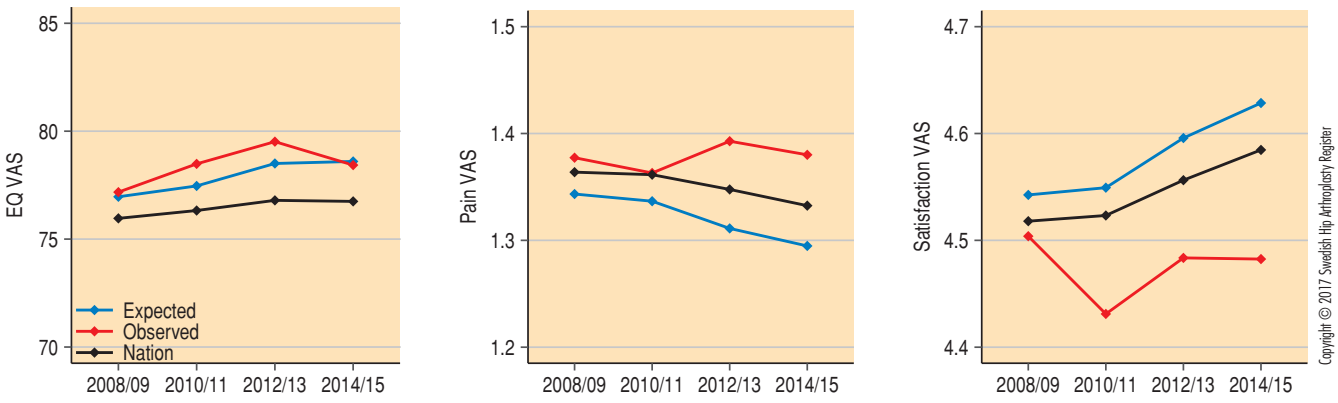

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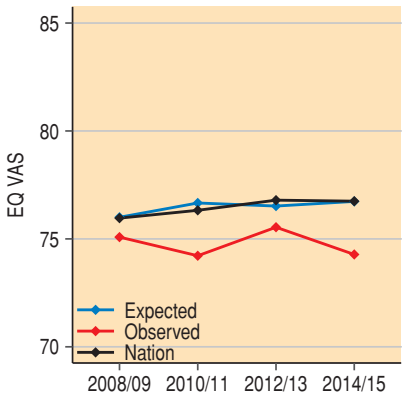

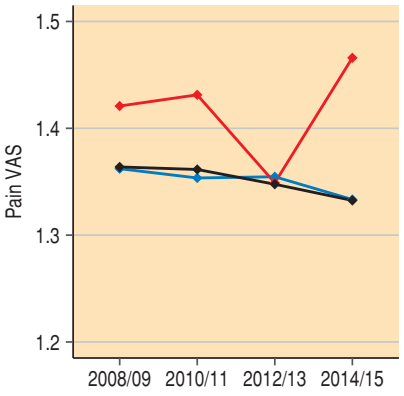

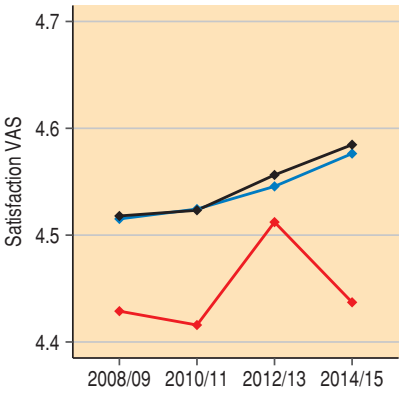

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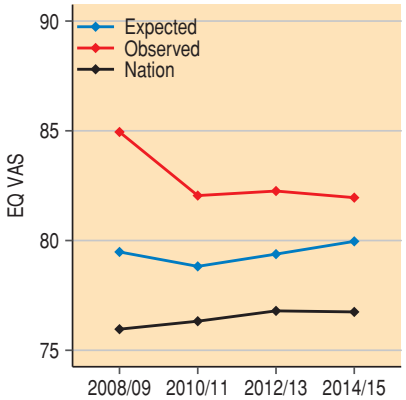
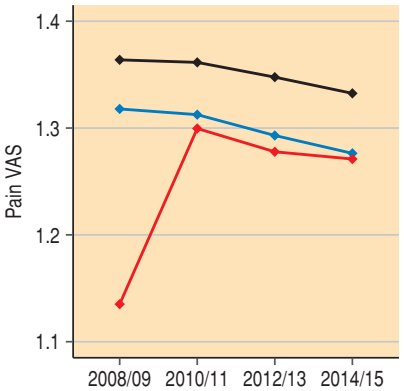
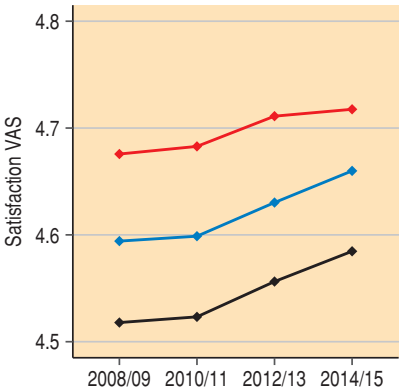
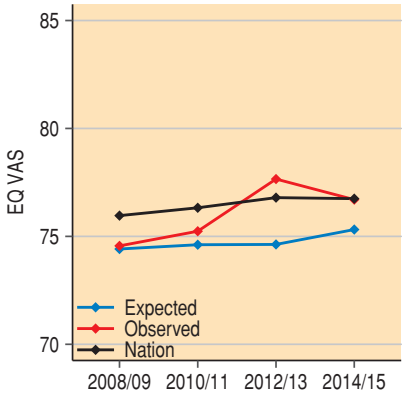
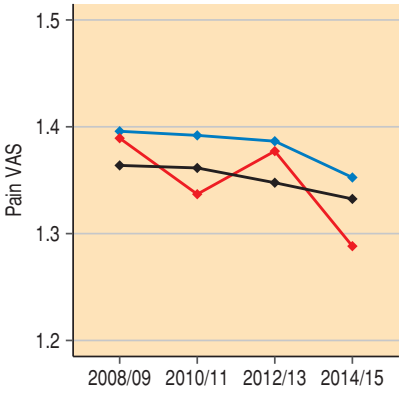


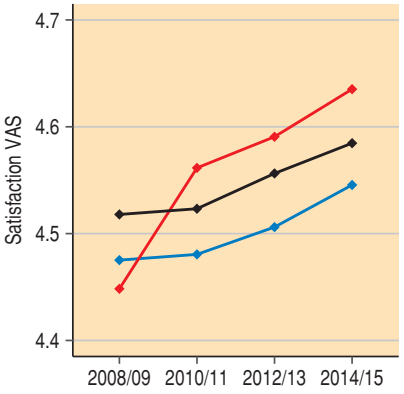




Danderyd







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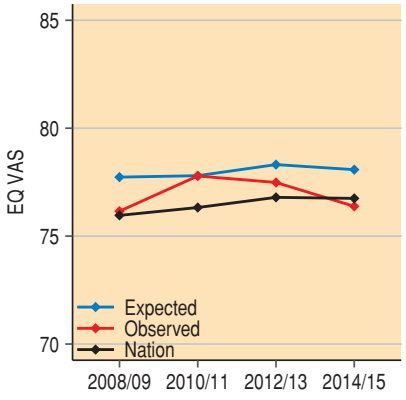

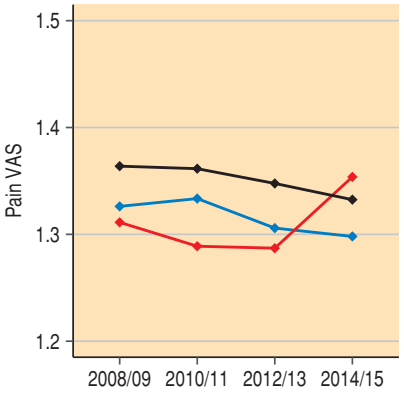

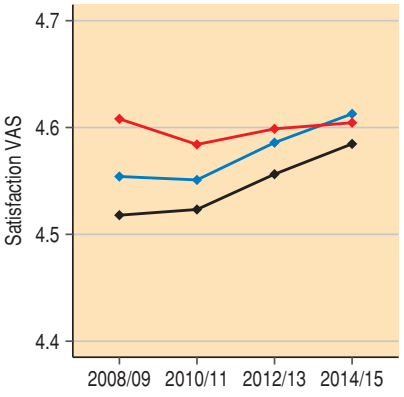

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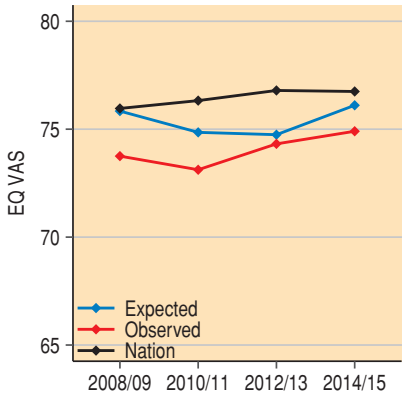

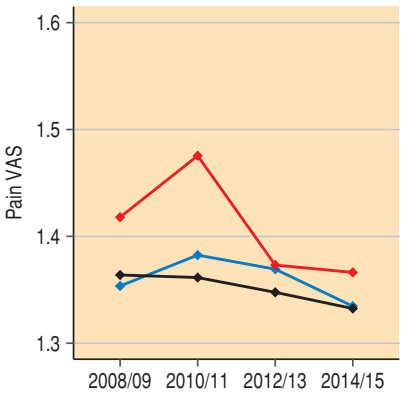

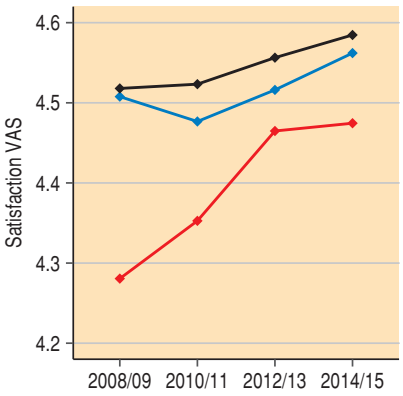

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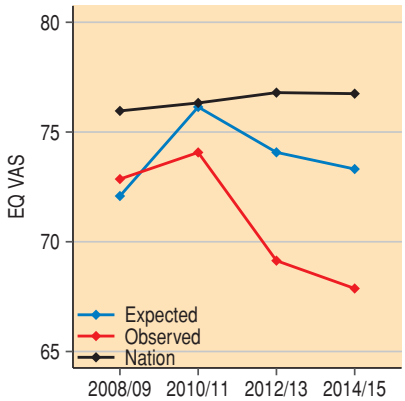

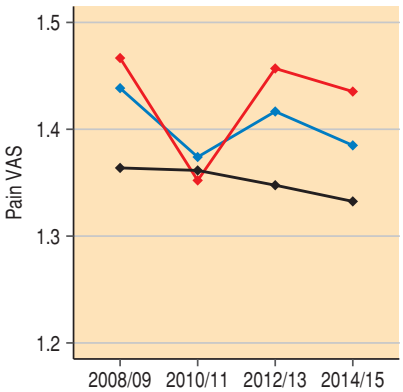

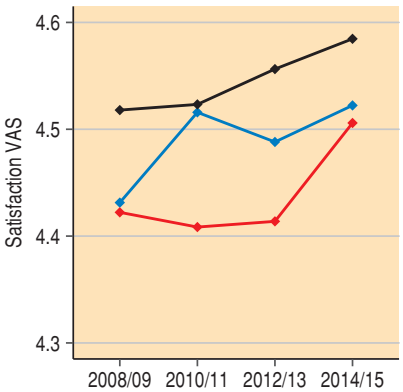

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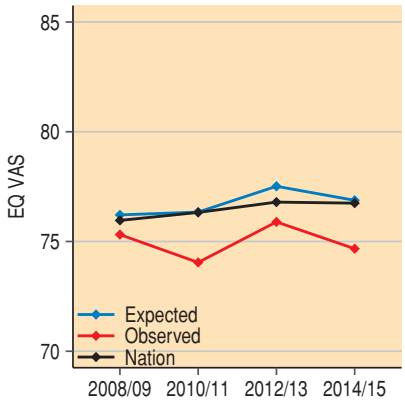
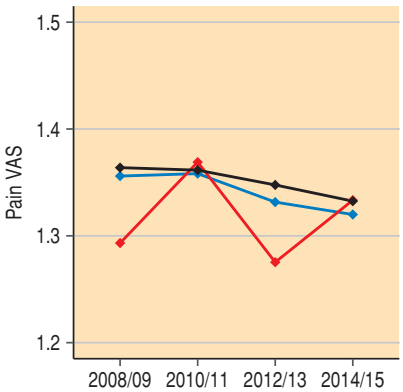
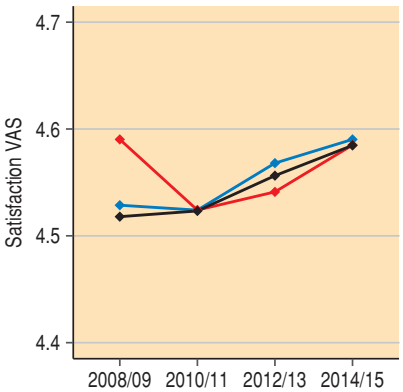
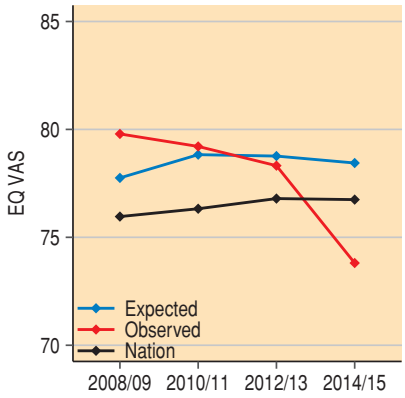
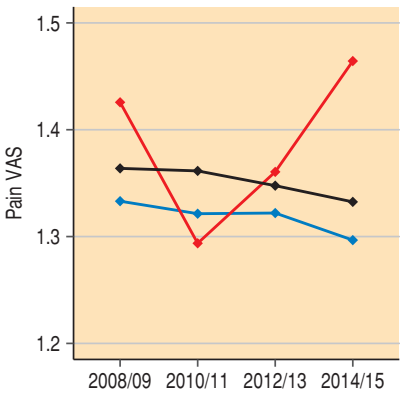


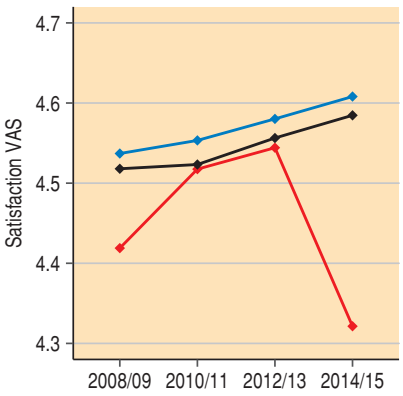




Frölunda Specialistsjukhus







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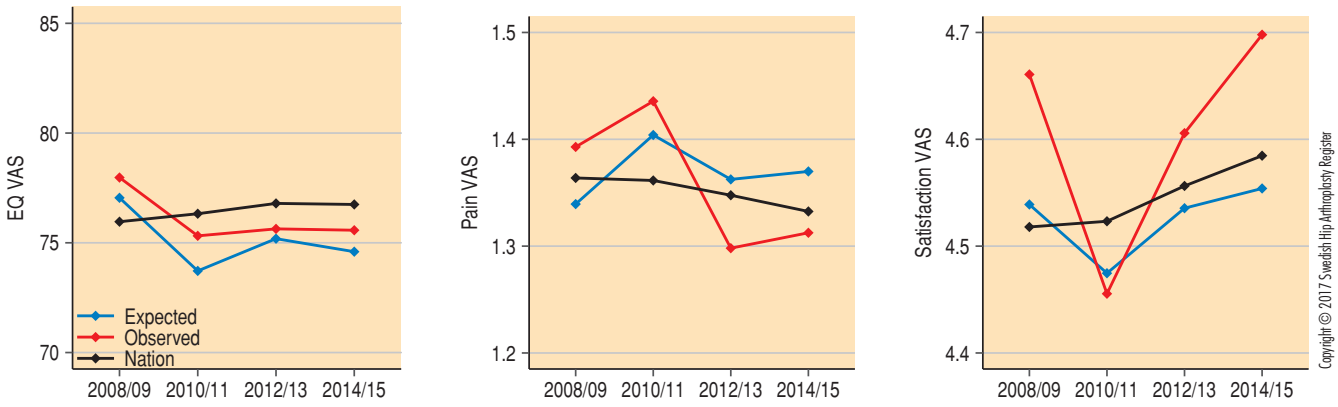

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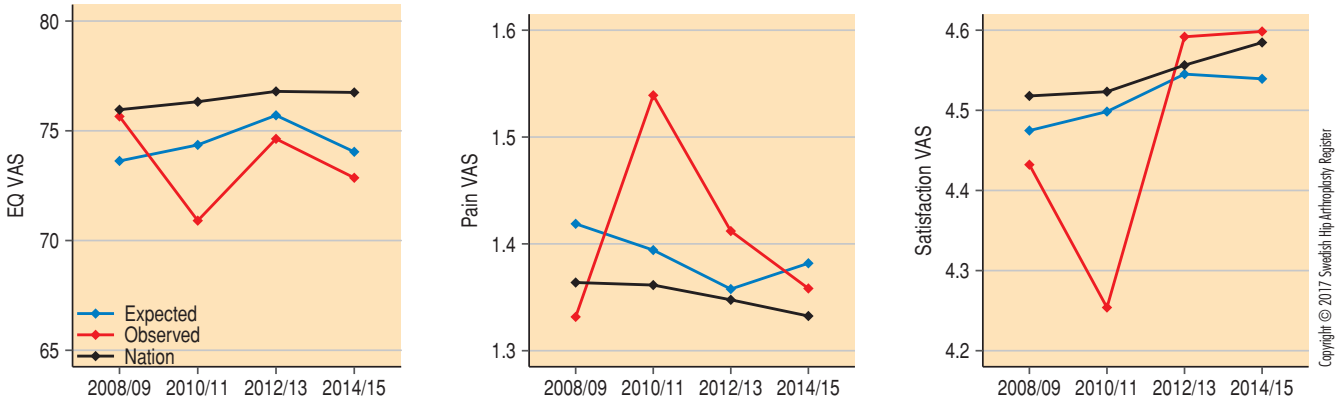

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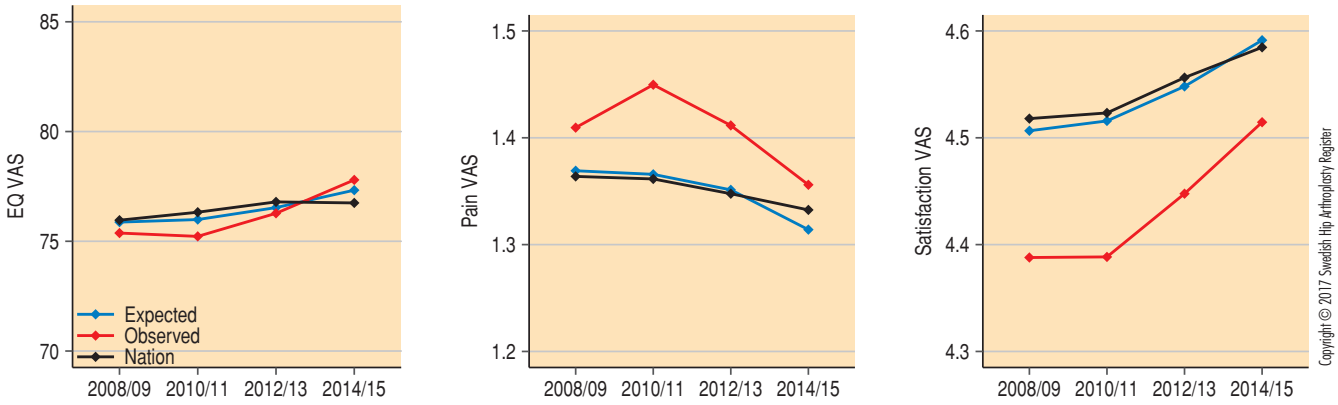

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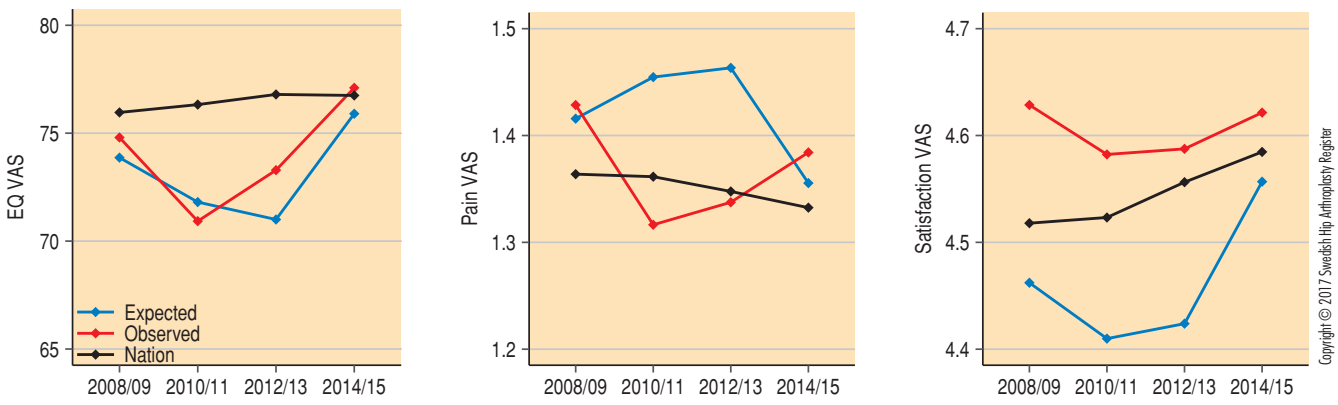

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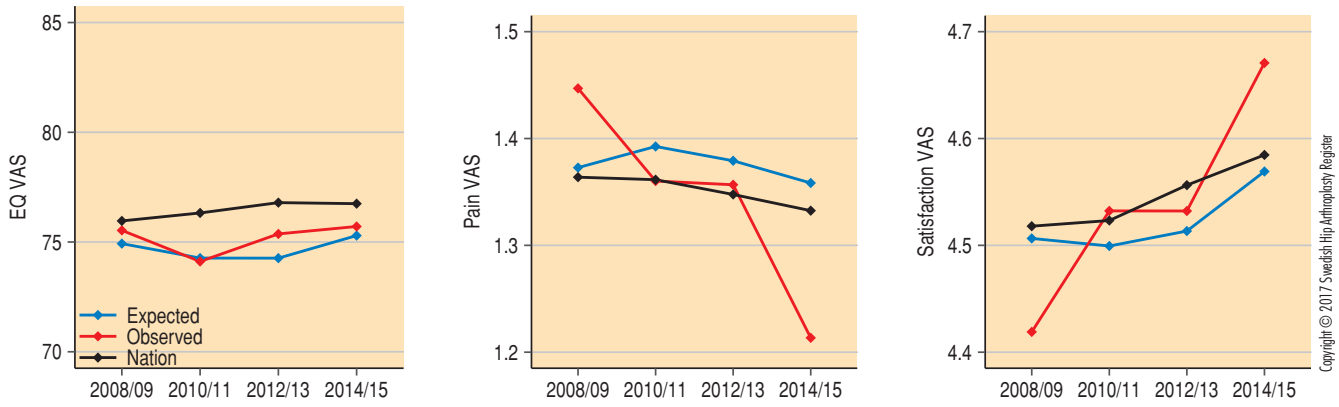
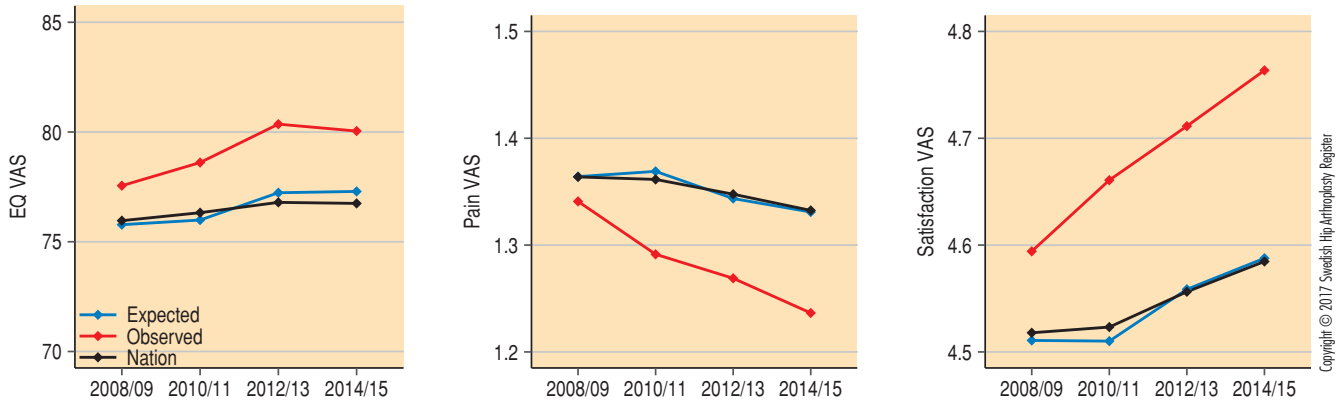


Hässleholm–Kristianstad



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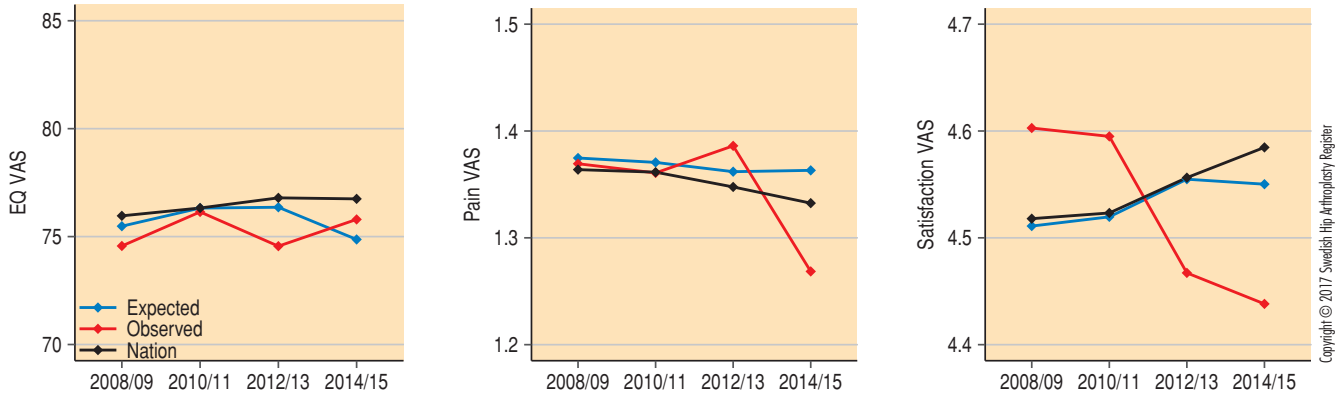

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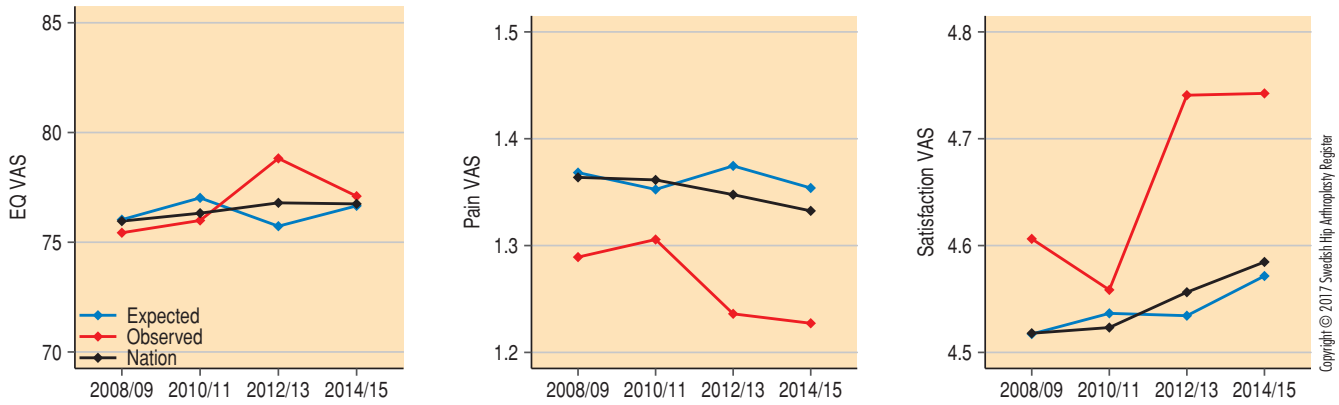

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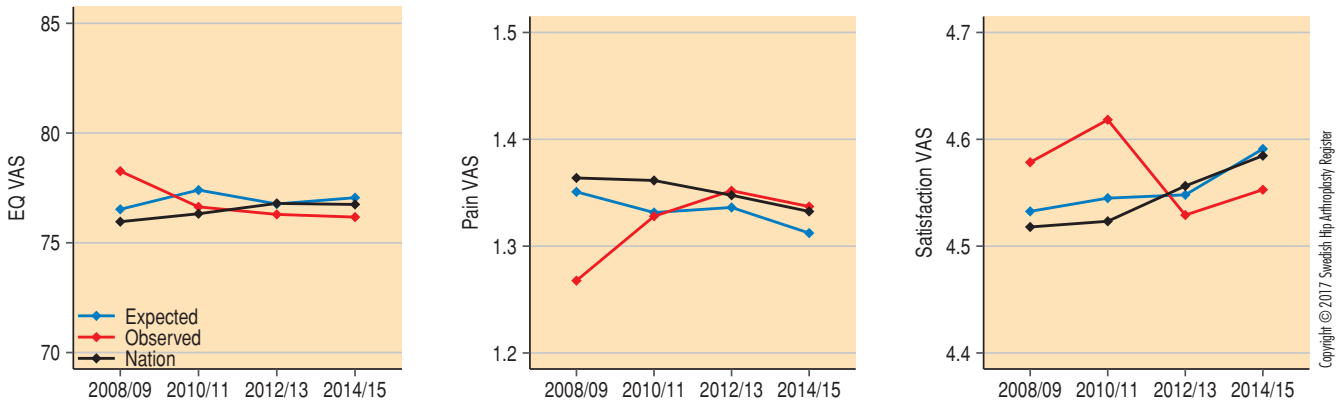

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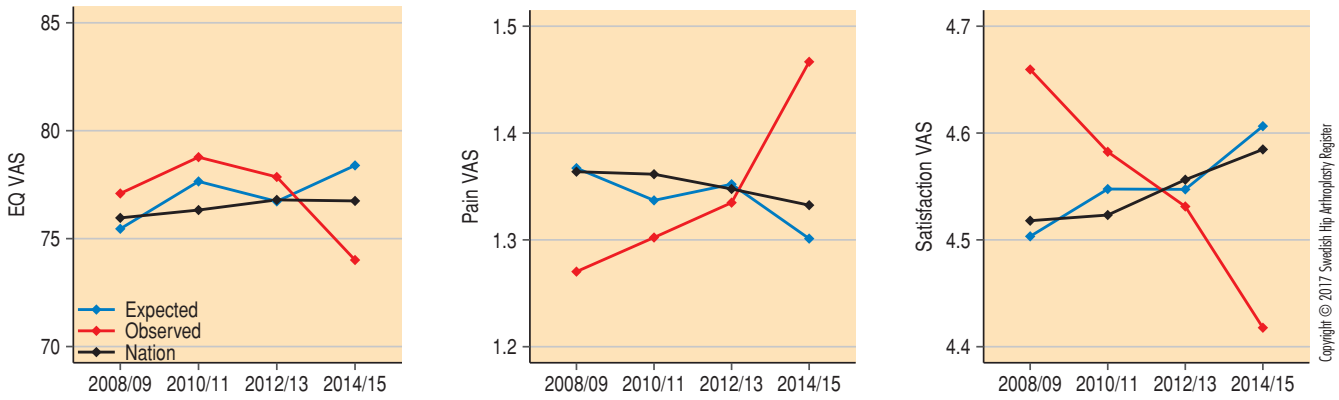

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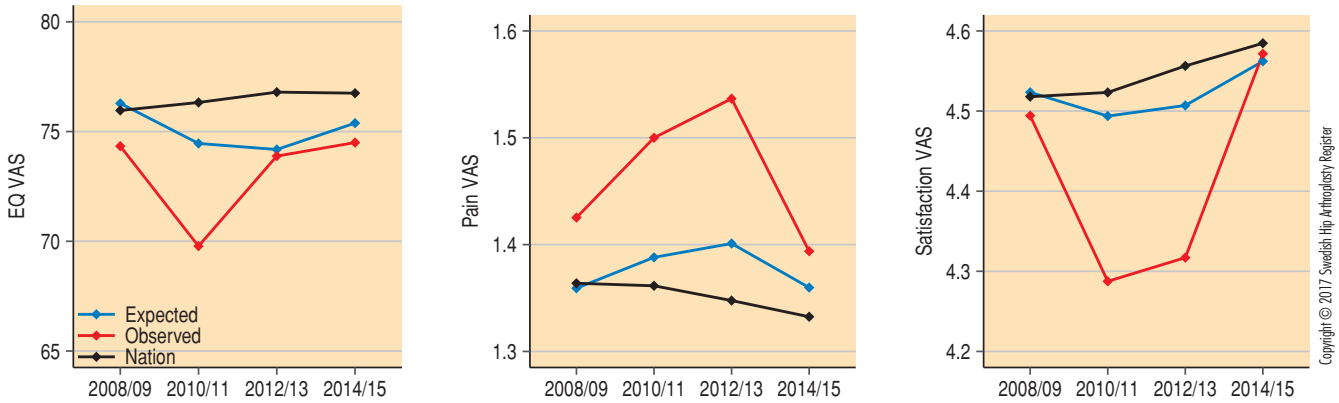

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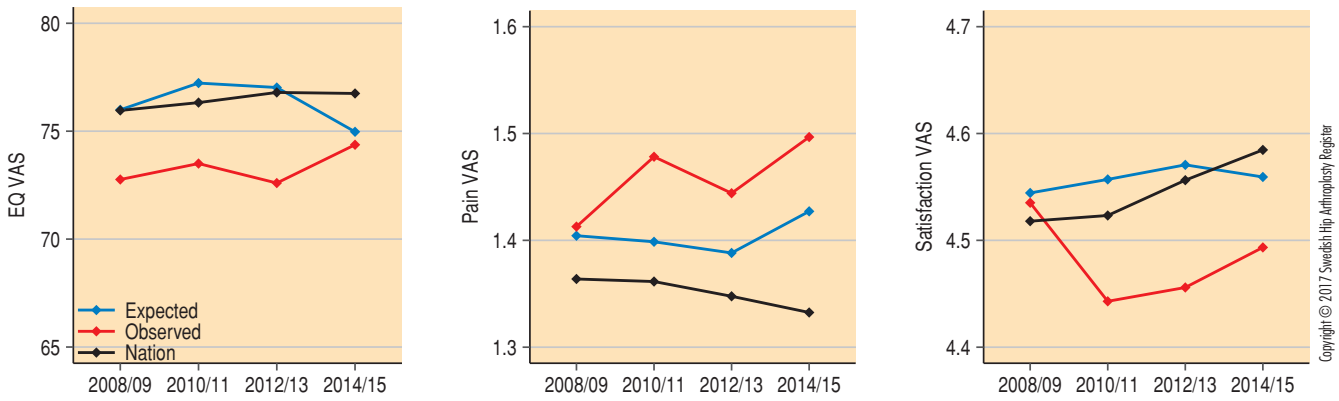

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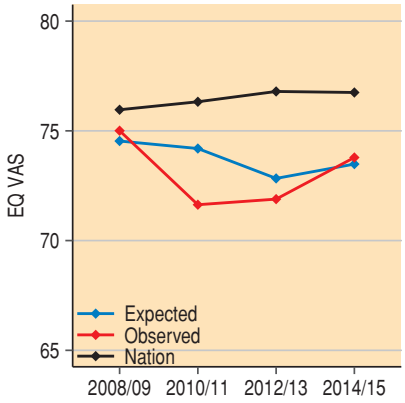

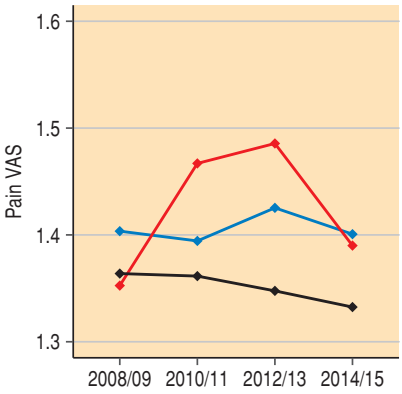

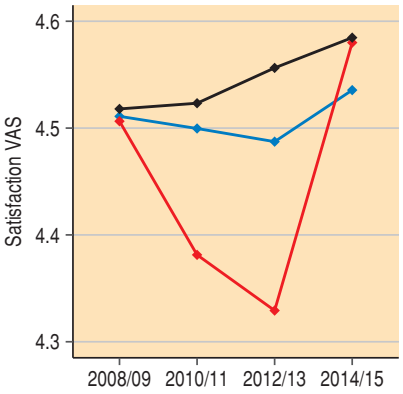

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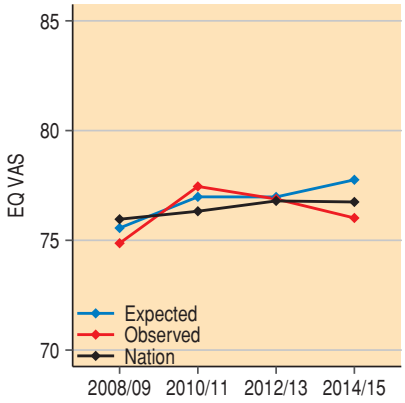

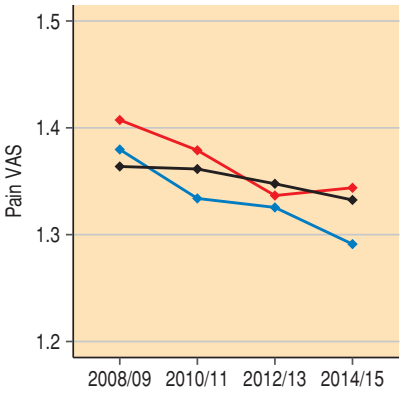

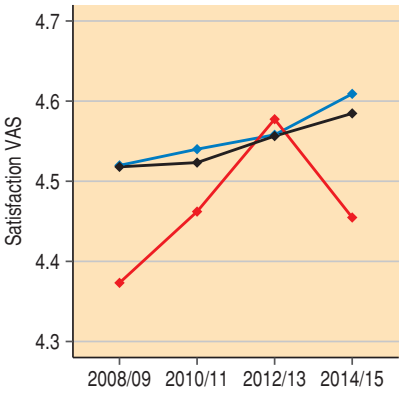

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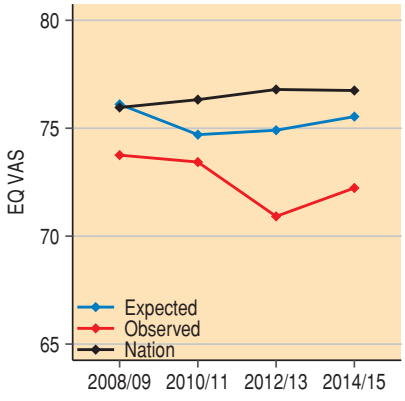

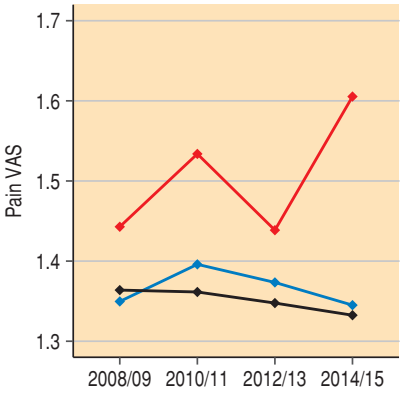

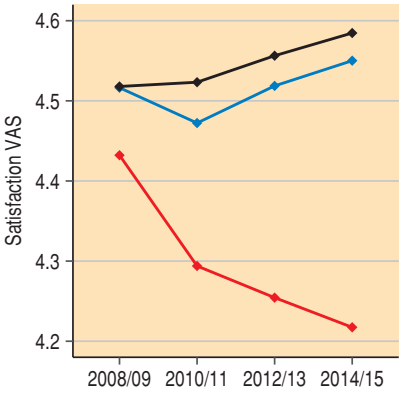

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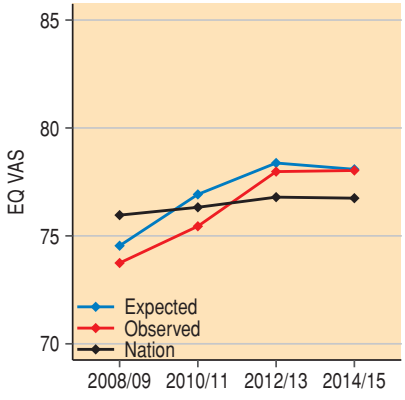

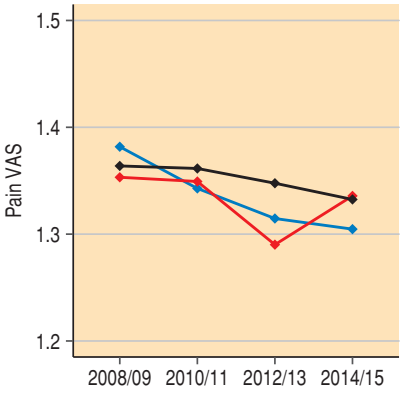

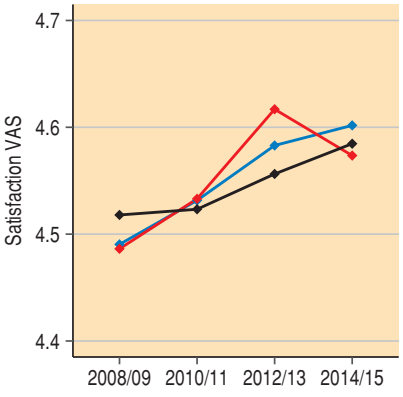

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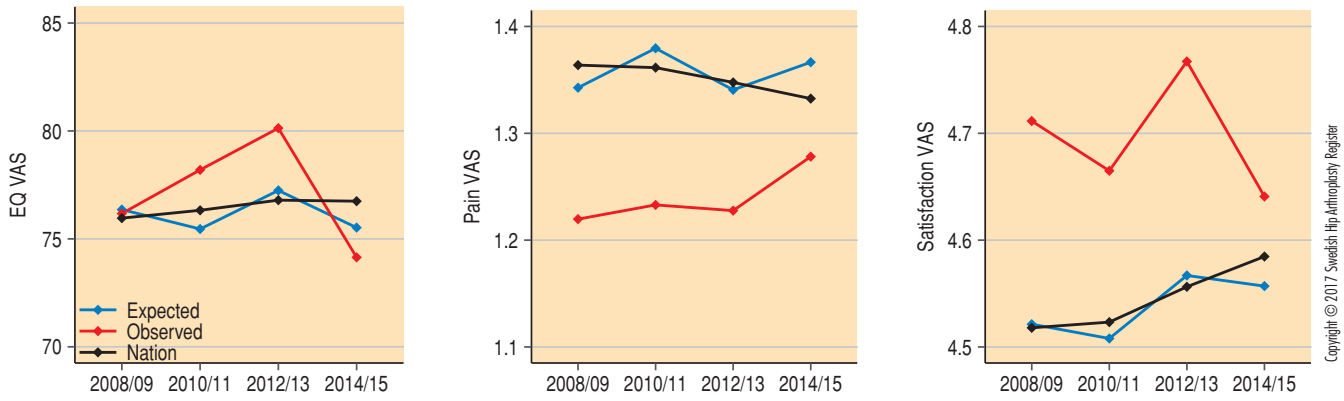

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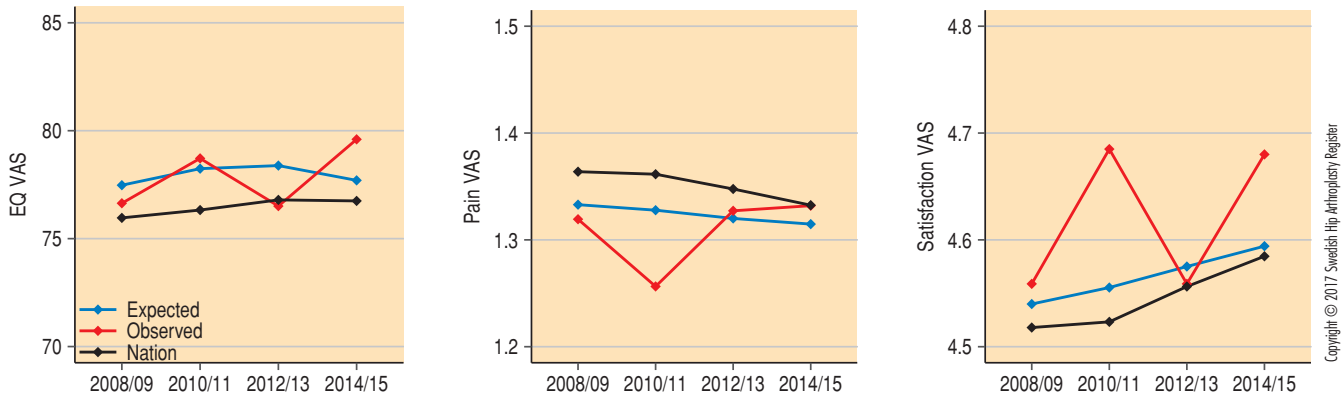

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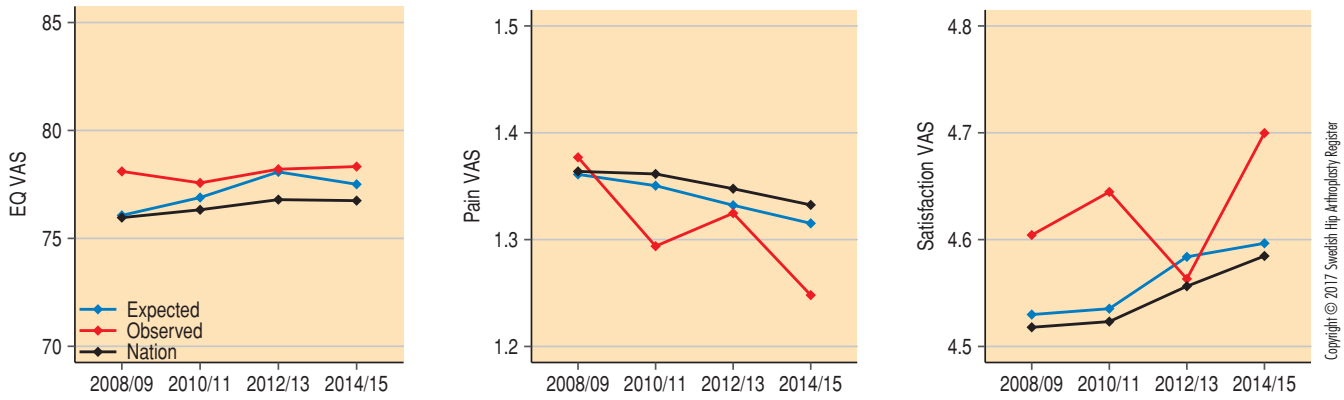

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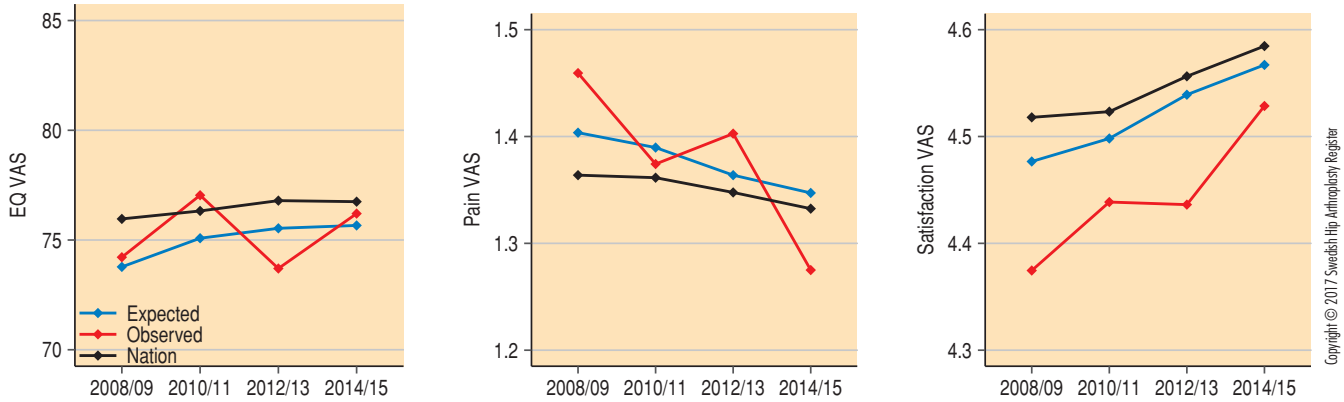

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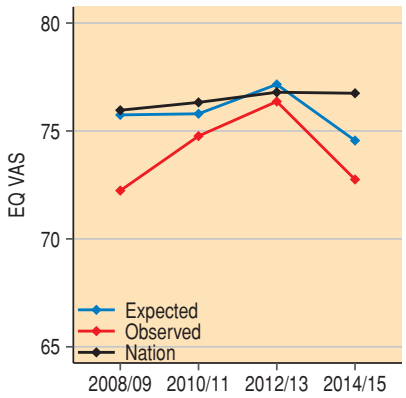

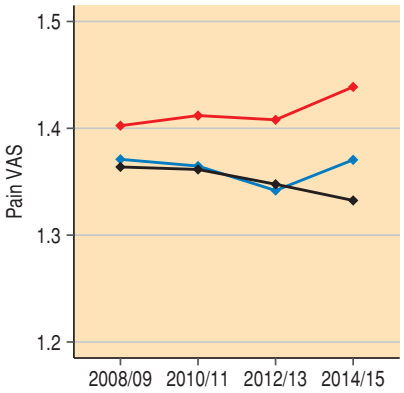

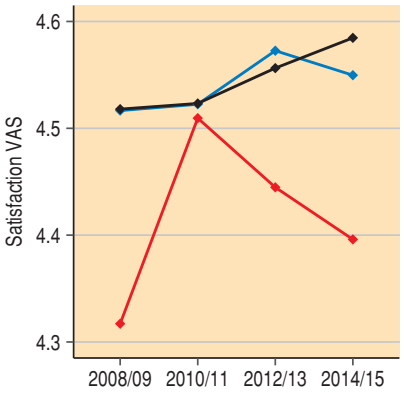

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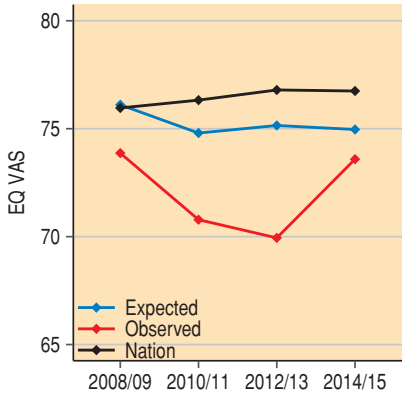

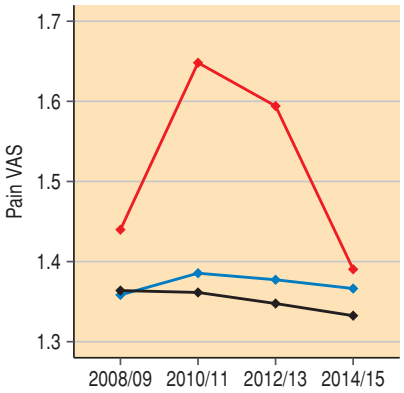

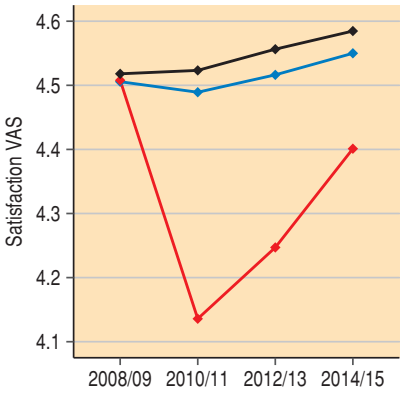

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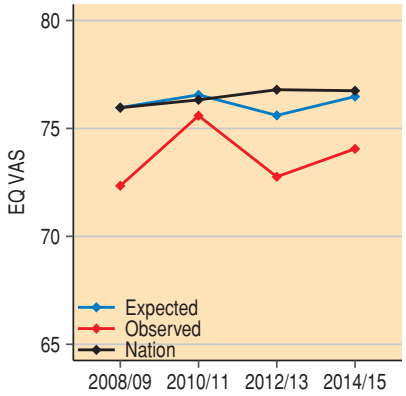
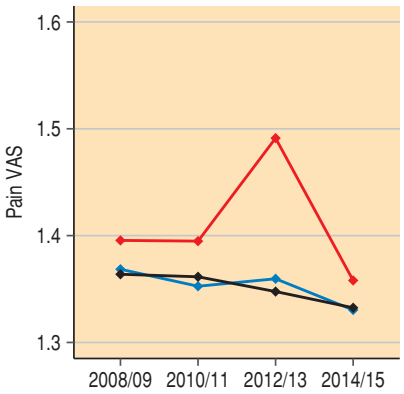
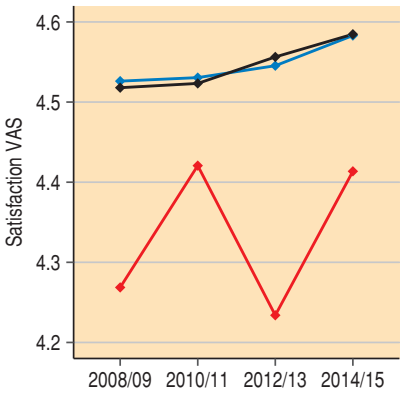
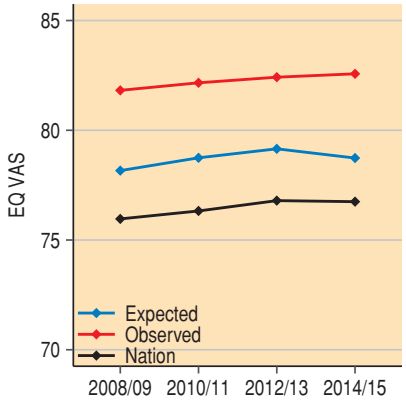
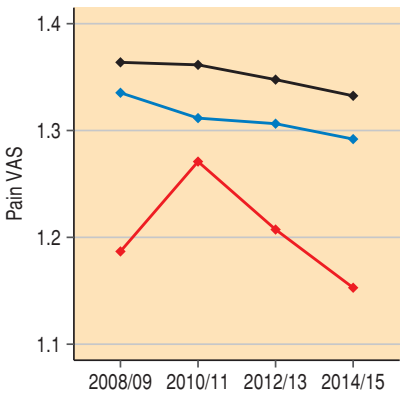


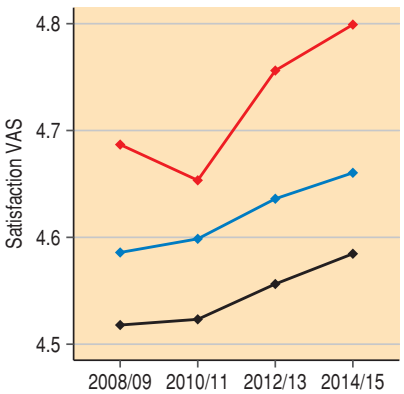




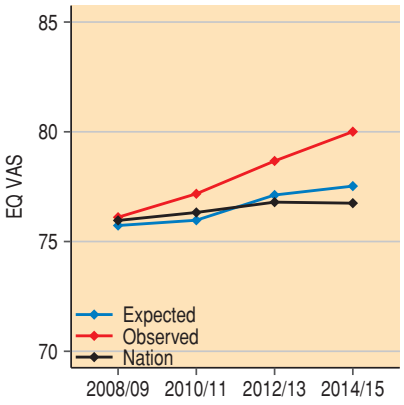
Ortho Center IFK–kliniken

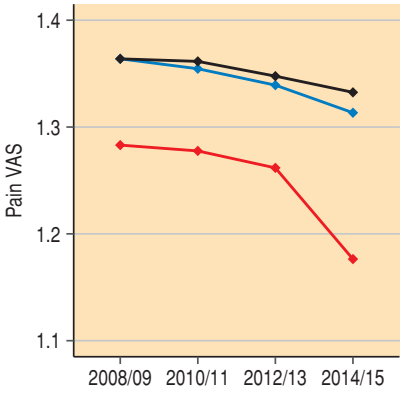


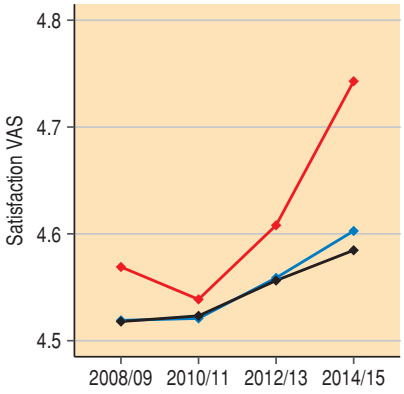




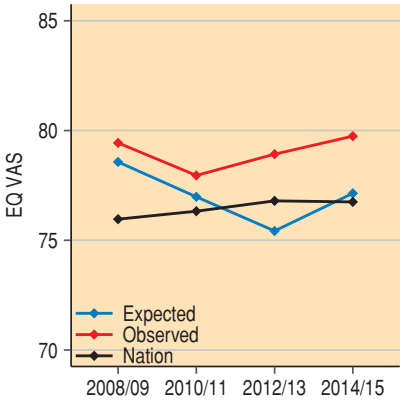
Ortho Center Stockholm

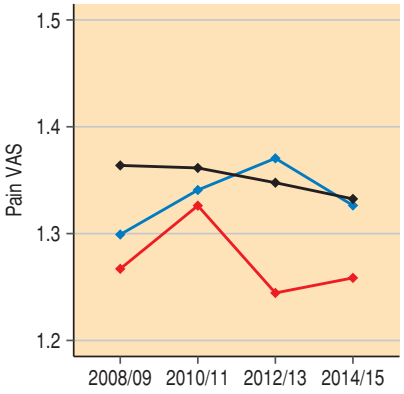


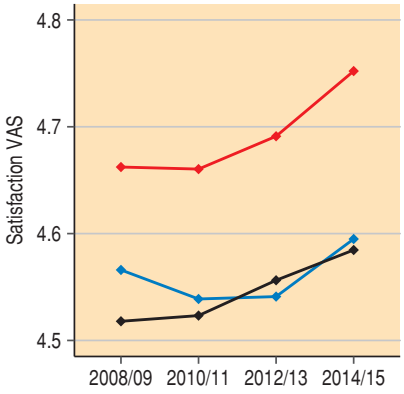




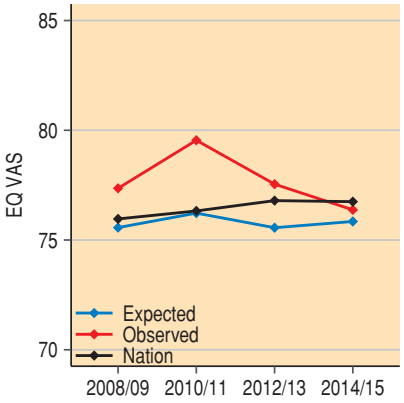
Oskarshamn

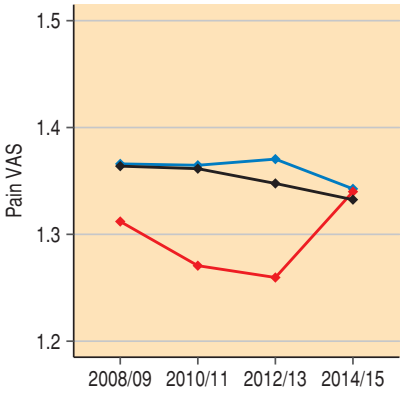


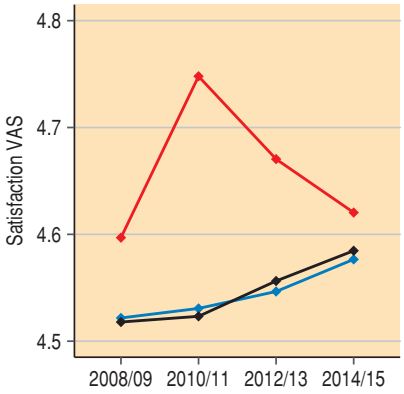




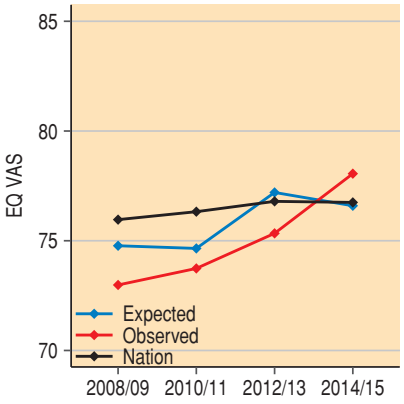
Piteå

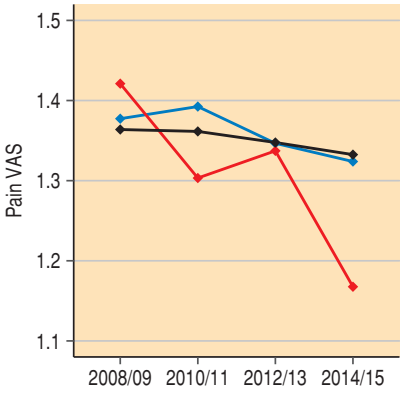


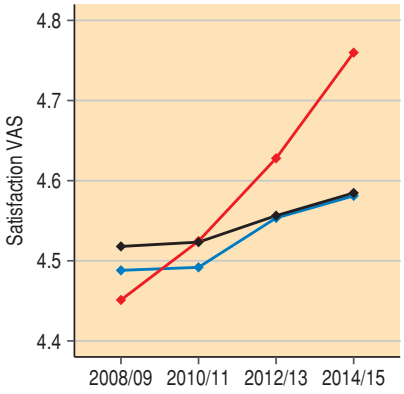




Skellefteå







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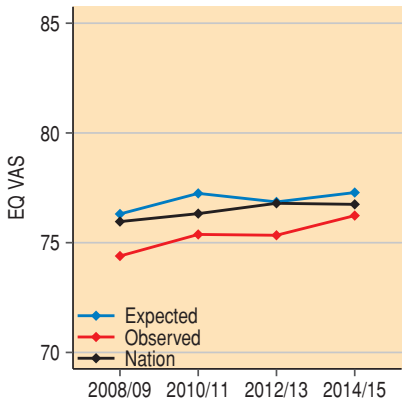
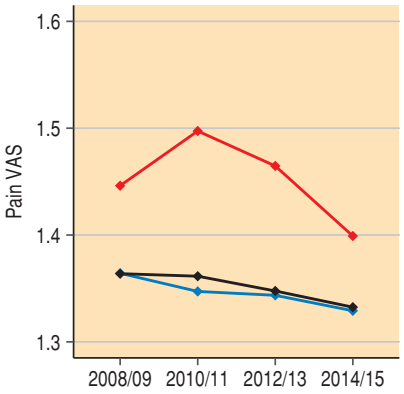
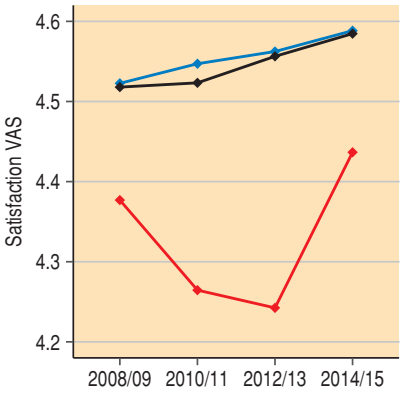
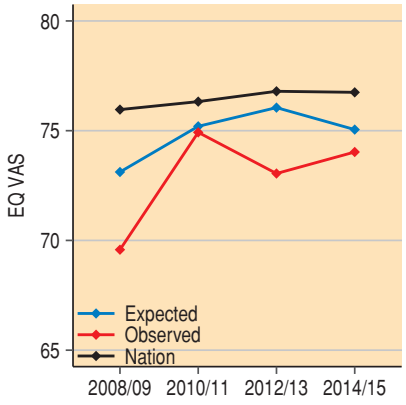
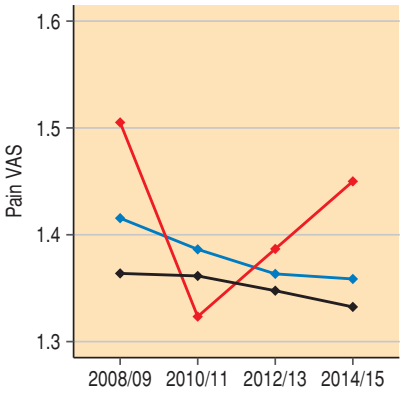


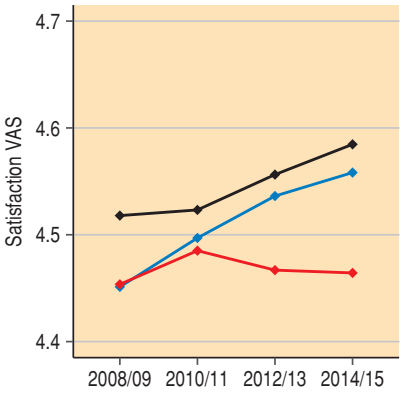




Skövde







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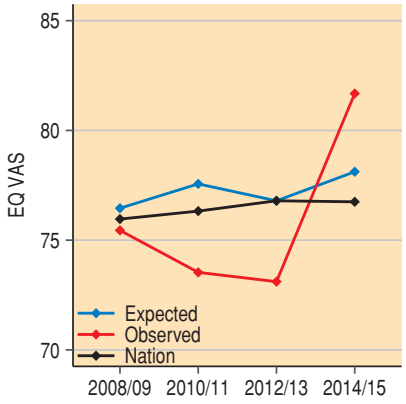

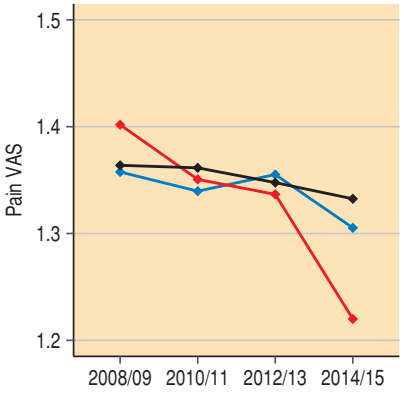

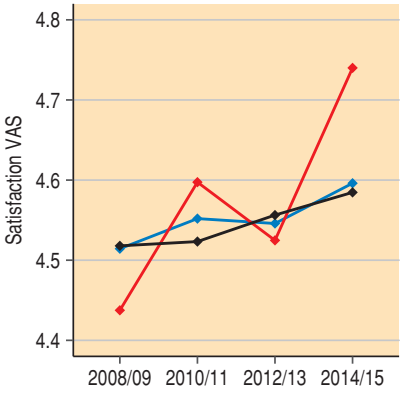

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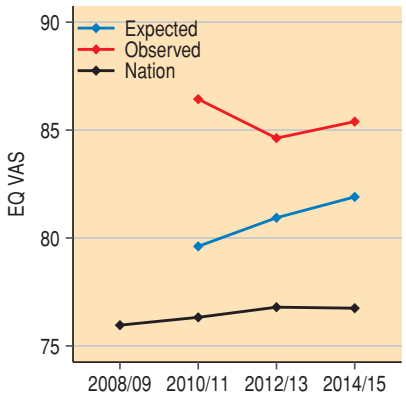

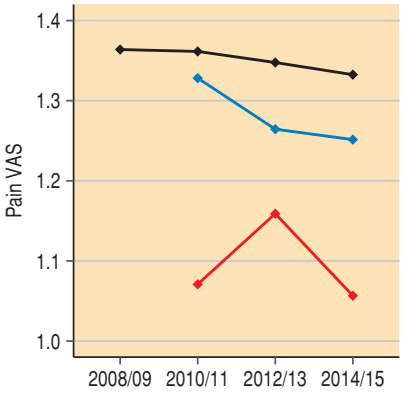

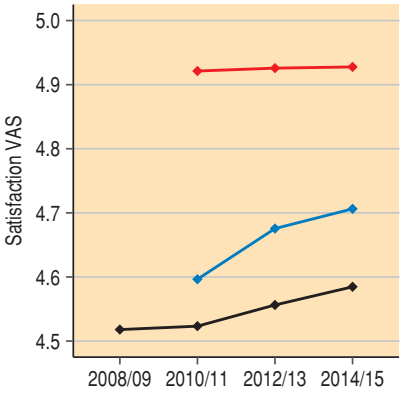

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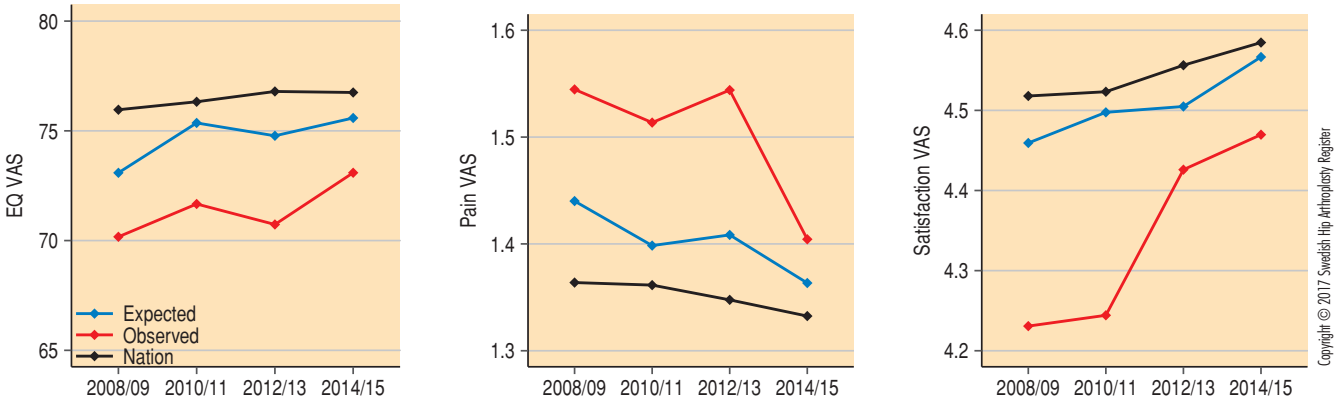
SU/Mölndal



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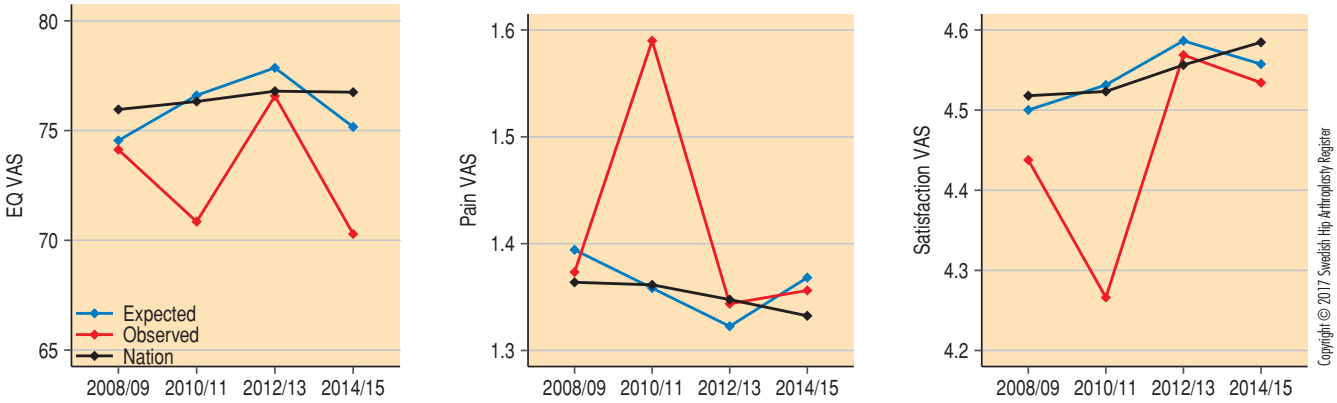

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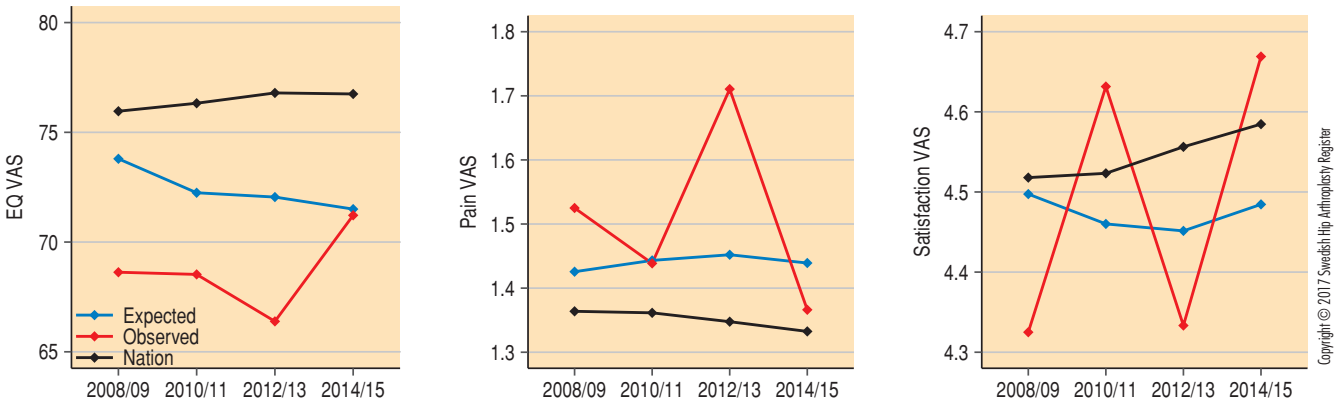

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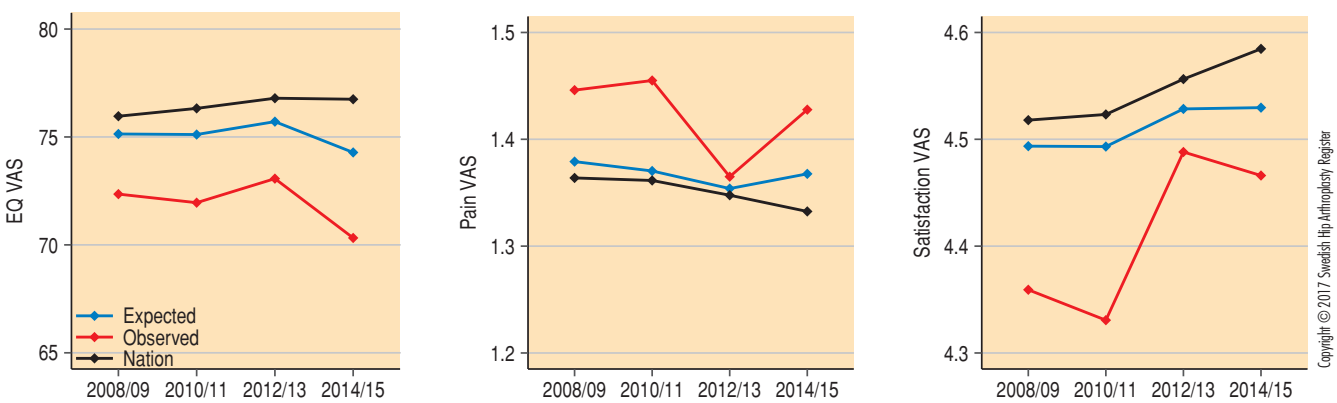

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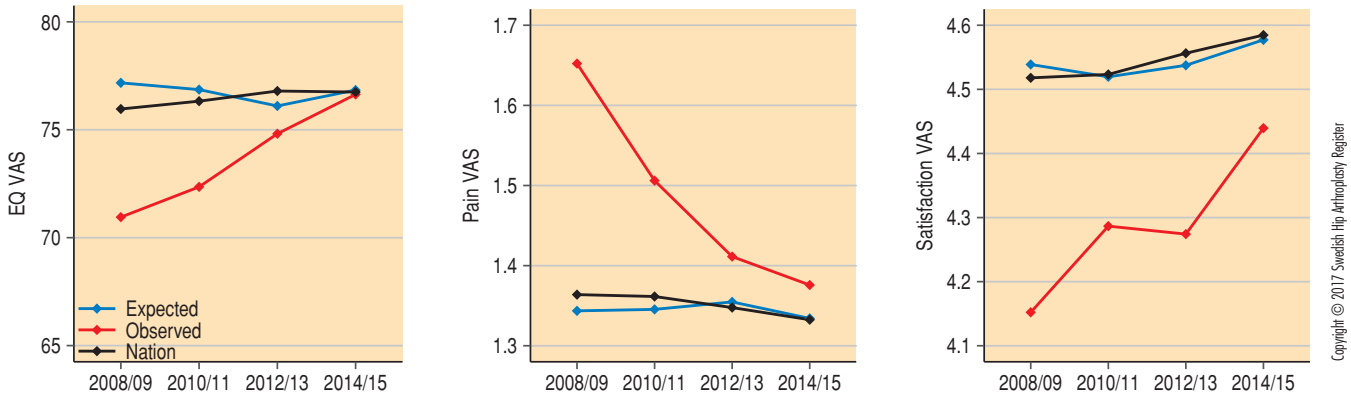

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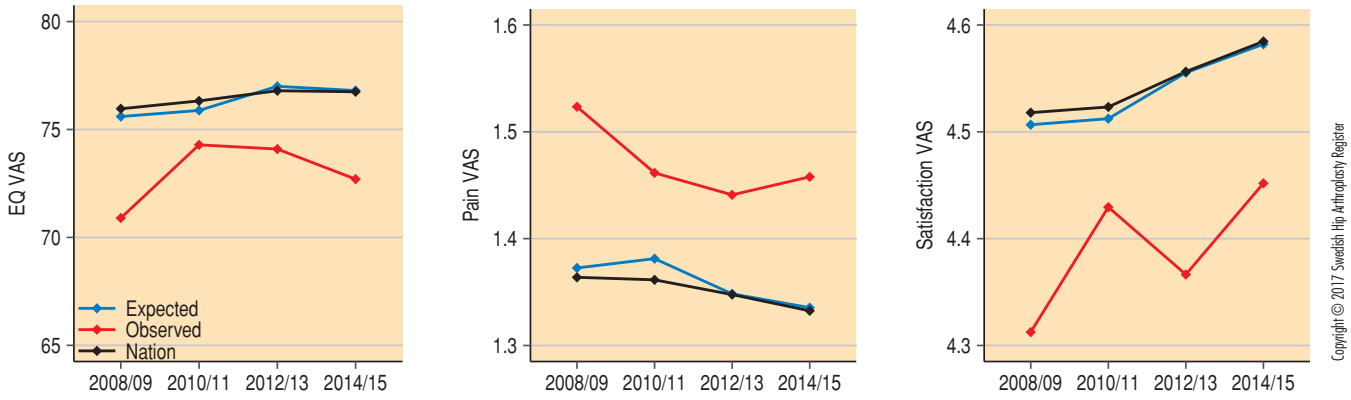

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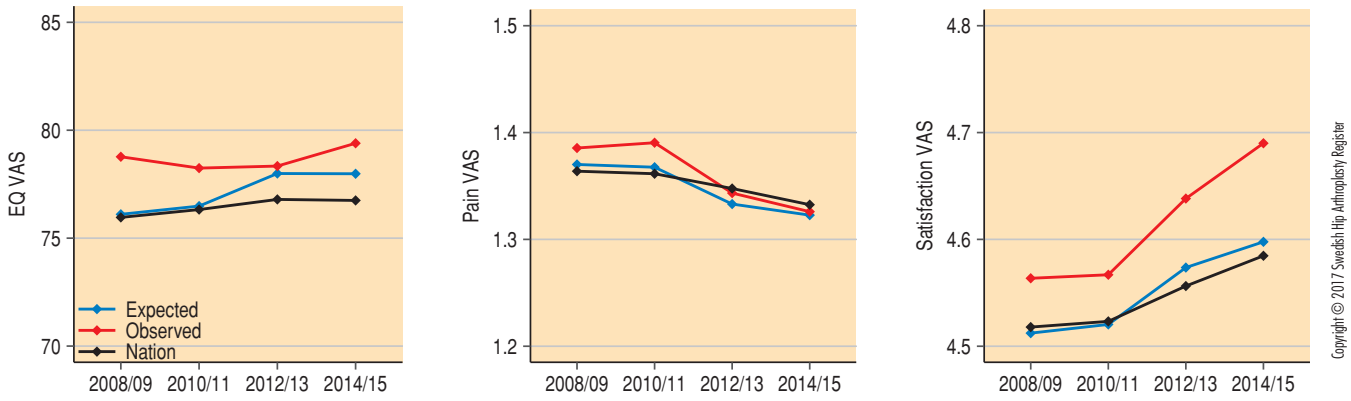

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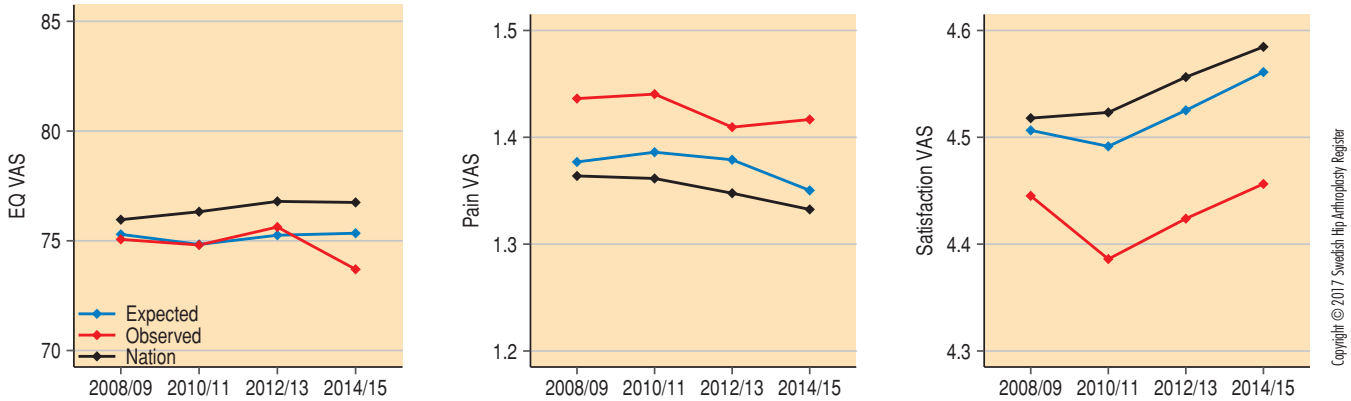

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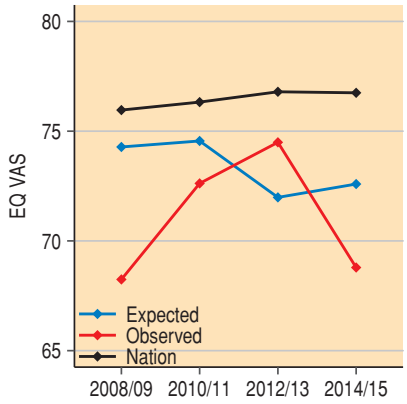
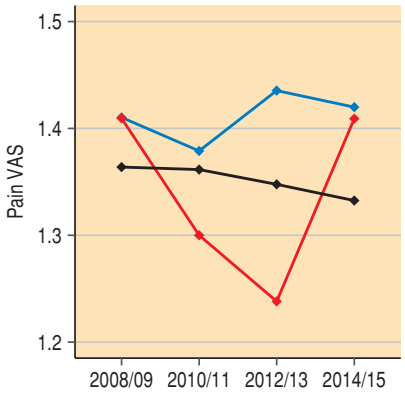
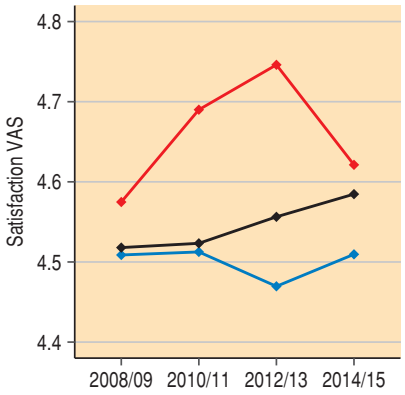
Umeå







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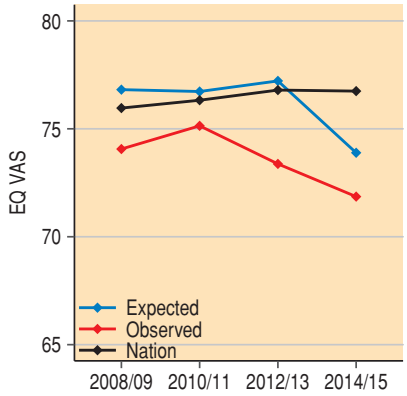

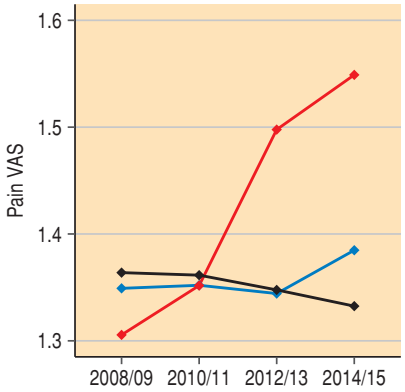

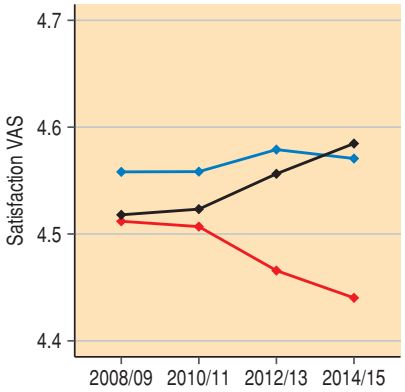

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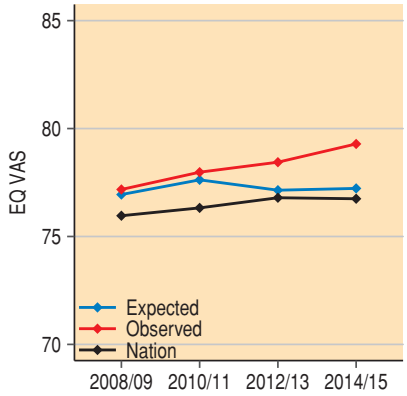

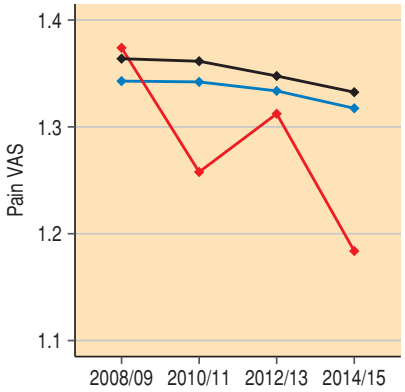

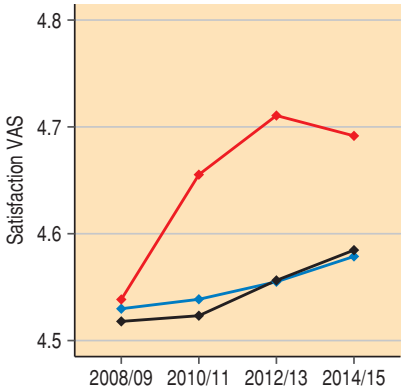

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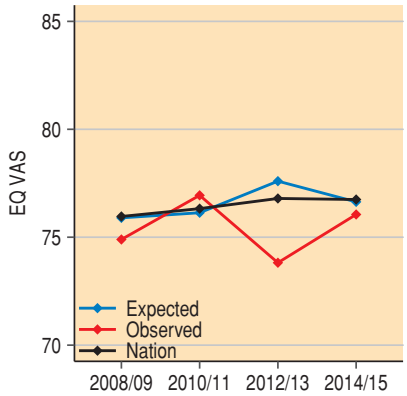

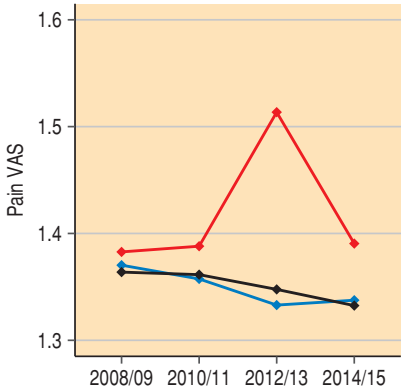

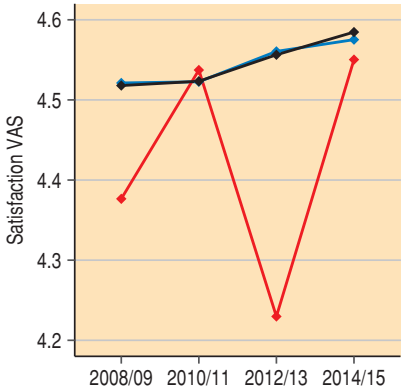

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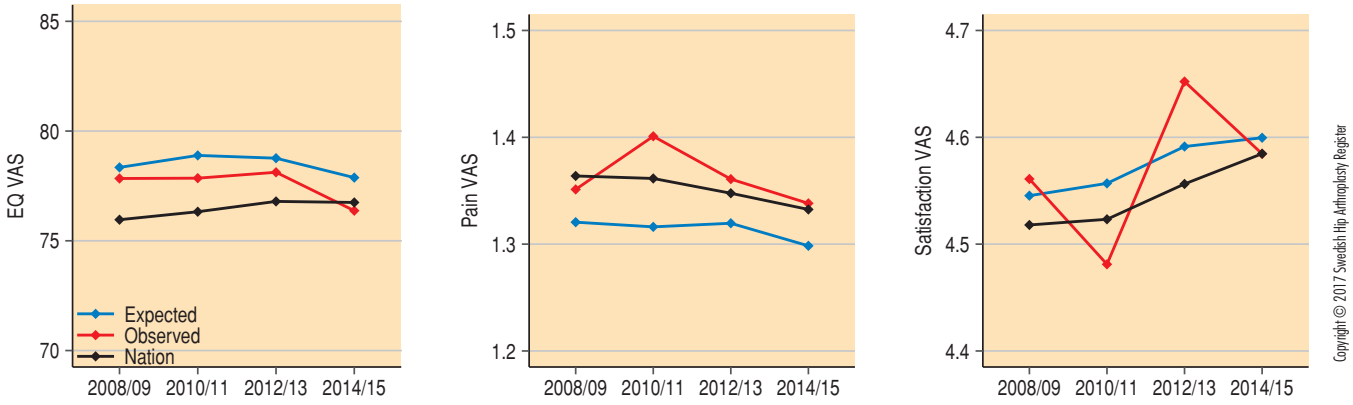

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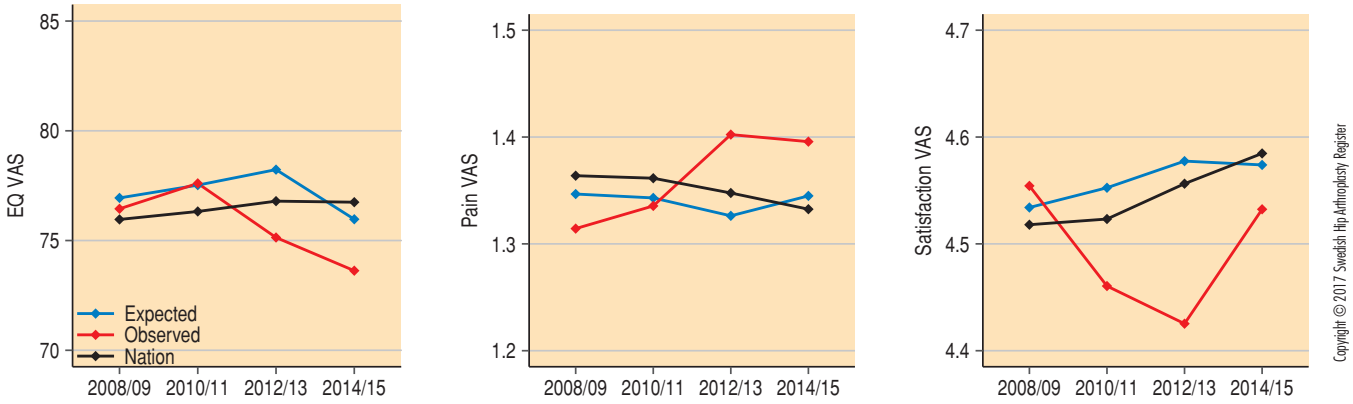

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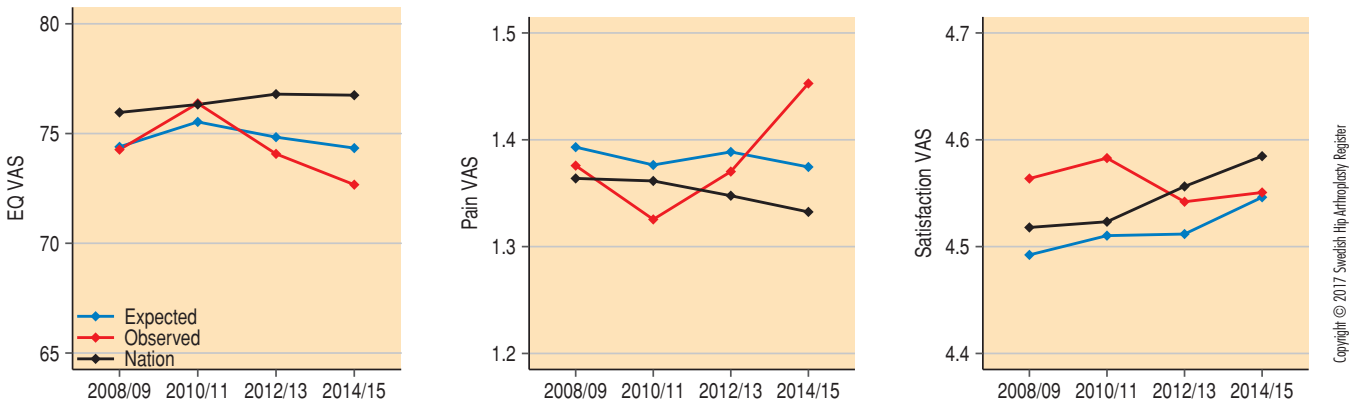

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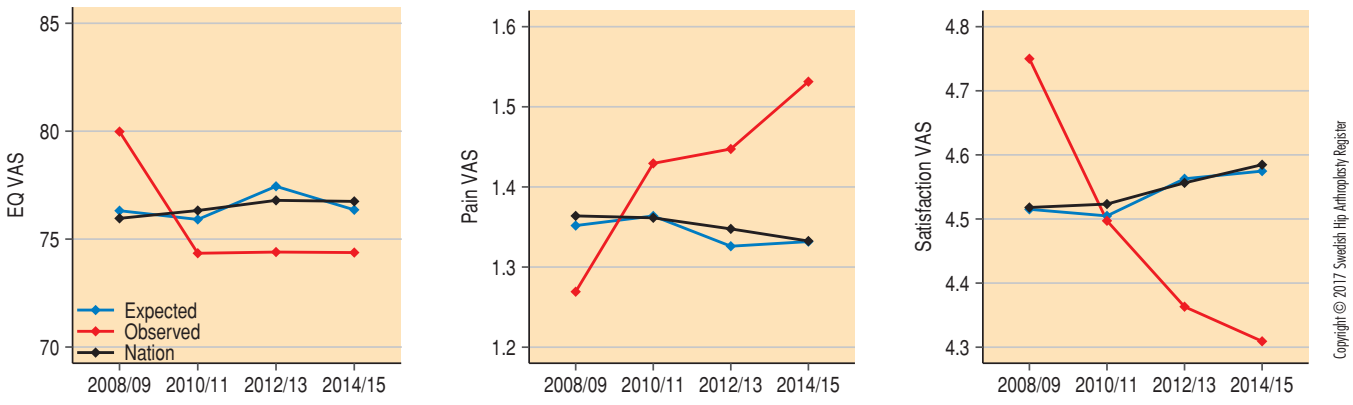

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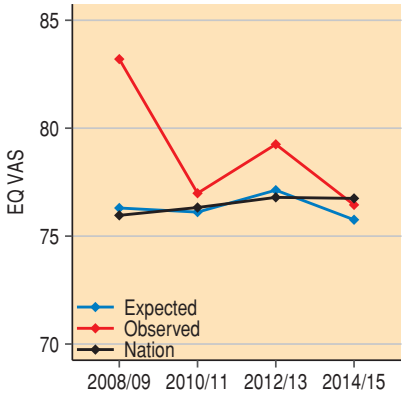

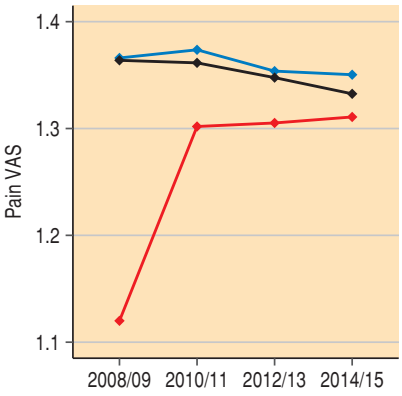

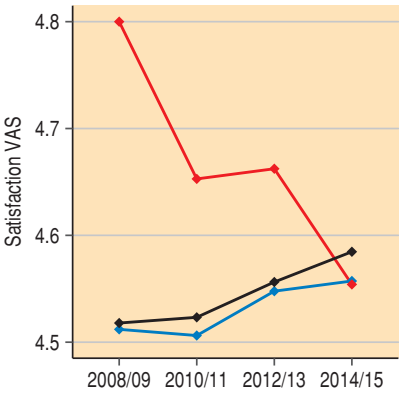

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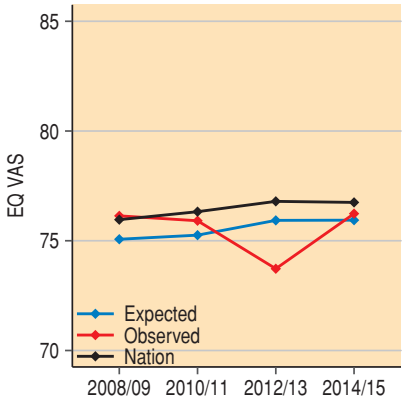

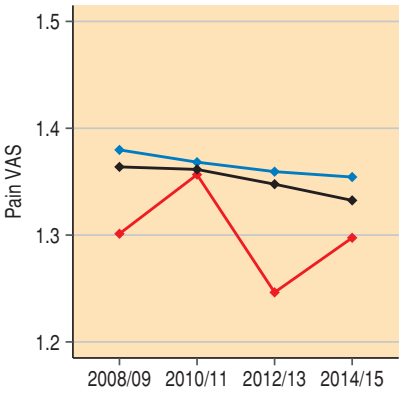

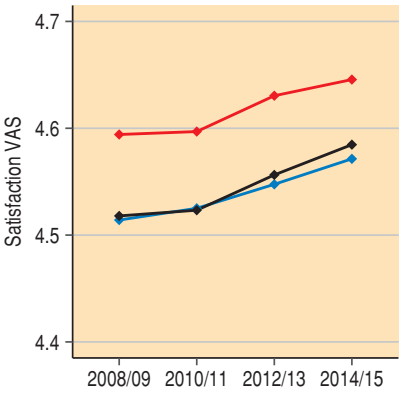

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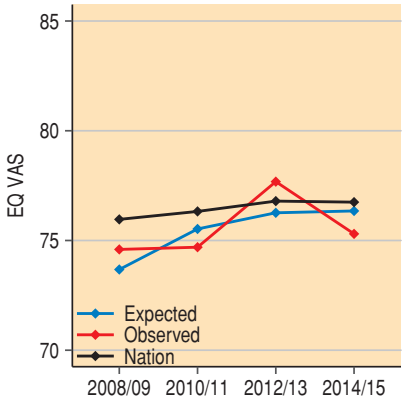

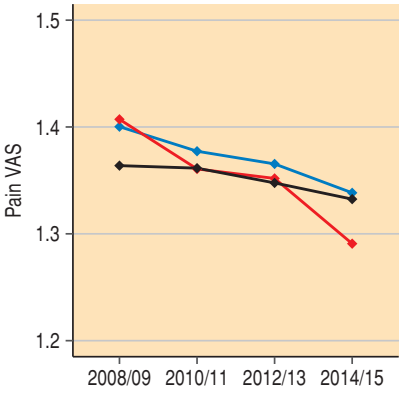

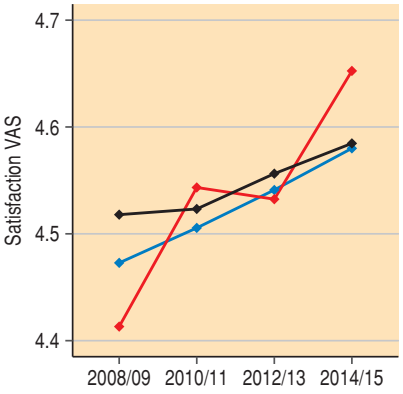

Patient satisfaction one year after total hip arthroplasty

primary arthroplasty 2014–2015

Unit	Number	Proportion
Aleris Specialistvård Bollnäs	577	87.9%
Aleris Specialistvård Motala	956	92.6%
Aleris Specialistvård Nacka	299	92.6%
Aleris Specialistvård Ängelholm	192	95.8%
Alingsås	350	83.4%
Arvika	306	82.4%
Borås	273	85.3%
Capio Movement	468	87.0%
Capio Ortopediska Huset	768	86.2%
Capio S:t Göran	716	83.1%
Carlanderska	270	92.2%
Danderyd	541	88.0%
Eksjö	416	88.9%
Enköping	608	84.0%
Eskilstuna	157	86.0%
Falun	521	89.4%
Frölunda Specialistsjukhus	85	80.0%
Gällivare	173	92.5%
Gävle	406	87.7%
Halmstad	435	88.5%
Helsingborg	249	88.8%
Hudiksvall	235	90.2%
Hässleholm-Kristianstad	1 442	93.6%
Jönköping	326	85.0%
Kalmar	314	93.9%
Karlshamn	466	90.6%
Karlskoga	265	84.2%
Karlstad	354	86.4%
Karolinska/Huddinge	430	86.5%
Karolinska/Solna	282	88.7%
Katrineholm	443	86.0%
Kungälv	358	77.7%
Lidköping	491	88.6%
Lindesberg	301	92.0%
Linköping	87	88.5%
Ljungby	280	91.4%
Lycksele	526	91.8%
Mora	368	88.9%
Norrköping	443	82.4%
Norrtälje	219	81.3%
Nyköping	258	86.0%
Ortho Center IFK-kliniken	233	95.7%
Ortho Center Stockholm	837	93.7%
Oskarshamn	490	94.3%
Piteå	628	89.8%
Skellefteå	213	94.8%
Skene	262	85.9%
Skövde	258	86.4%
Sollefteå	56	94.6%
Sophiahemmet	367	98.4%
SU/Mölndal	1 033	86.4%
Sunderby	44	77.3%
Sundsvall	122	88.5%
SUS/Lund	279	90.0%
SUS/Malmö	44	79.5%
Södersjukhuset	488	84.6%
Södertälje	186	85.5%
Torsby	183	86.9%
Trelleborg	1 182	92.6%
Uddevalla	651	86.6%
Umeå	165	85.5%
Uppsala	316	82.3%
Varberg	371	91.6%
Visby	229	86.9%
Värnamo	227	91.6%
Västervik	185	87.0%
Västerås	477	87.0%
Växjö	262	78.2%
Ängelholm	80	87.5%
Örebro	199	90.5%
Örnsköldsvik	317	91.8%
Östersund	453	90.9%
Country	27 598	88.7%

Units with less than 40 registrations during 2015–2016 have been excluded.

Questionnaire regarding smoking, physiotherapy and Artrosskola before hip arthroplasty

Unit	Number (diagnosis M16.0–M16.9)	Number of responses	Proportion of smokers (%)	Proportion for physiotherapy (%)	Proportion for artrosskola (%)	Response rate (%)
Aleris Specialistvård Bollnäs	273	257	5%	77%	44%	94%
Aleris Specialistvård Motala	577	483	4%	75%	57%	84%
Aleris Specialistvård Nacka	244	240	4%	84%	26%	98%
Aleris Specialistvård Ängelholm	90	81	7%	77%	35%	90%
Alingsås	186	161	0%	84%	53%	87%
Art Clinic Göteborg	45	26	0%	88%	42%	58%
Arvika	194	173	7%	82%	67%	89%
Borås	99	78	3%	65%	33%	79%
Capio Movement	339	300	5%	78%	34%	88%
Capio Ortopediska Huset	460	437	9%	79%	36%	95%
Capio S:t Göran	528	399	5%	67%	31%	76%
Carlanderska	170	166	4%	82%	36%	98%
Danderyd	250	202	8%	73%	36%	81%
Eksjö	215	213	2%	68%	28%	99%
Enköping	349	265	5%	75%	39%	76%
Eskilstuna	54	43	7%	56%	16%	80%
Falun	231	147	10%	60%	42%	64%
Gällivare	83	53	4%	62%	36%	64%
Gävle	131	121	8%	72%	46%	92%
Halmstad	166	122	11%	75%	20%	73%
Helsingborg	71	63	3%	68%	27%	89%
Hudiksvall	98	92	2%	70%	27%	94%
Hässleholm-Kristianstad	745	734	4%	71%	22%	99%
Jönköping	96	93	3%	62%	32%	97%
Kalmar	131	130	0%	71%	57%	99%
Karlshamn	224	217	2%	73%	47%	97%
Karlskoga	118	82	1%	72%	37%	69%
Karlstad	116	107	7%	73%	60%	92%
Karolinska/Huddinge	115	97	8%	78%	32%	84%
Katrineholm	190	189	4%	72%	39%	99%
Kungälv	183	162	7%	72%	40%	89%
Lidköping	283	261	5%	76%	47%	92%
Lindesberg	407	395	9%	77%	33%	97%
Ljungby	130	121	5%	61%	25%	93%
Lycksele	314	228	2%	80%	64%	73%

(Continued on next page.)

Questionnaire regarding smoking, physiotherapy and Artrosskola before hip arthroplasty (cont.)

Unit	Number (diagnosis M16.0–M16.9)	Number of responses	Proportion of smokers (%)	Proportion for physiotherapy (%)	Proportion for artrosskola (%)	Response rate (%)
Mora	258	205	2%	75%	33%	79%
Norrköping	191	173	4%	72%	63%	91%
Norrtälje	135	126	13%	65%	34%	93%
Nyköping	86	66	5%	71%	52%	77%
Ortho Center IFK-kliniken	162	142	4%	85%	29%	88%
Ortho Center Stockholm	525	496	4%	80%	36%	94%
Oskarshamn	303	285	4%	73%	45%	94%
Piteå	359	205	2%	74%	35%	57%
Skellefteå	105	95	1%	83%	59%	90%
Skene	115	89	1%	76%	31%	77%
Skövde	148	98	10%	85%	40%	66%
Sollefteå	186	174	2%	65%	51%	94%
Sophiahemmet	221	200	8%	76%	21%	90%
SU/Mölndal	444	321	3%	71%	33%	72%
Södersjukhuset	278	209	6%	75%	23%	75%
Södertälje	110	105	10%	74%	45%	95%
Torsby	114	113	7%	67%	56%	99%
Trelleborg	682	625	7%	69%	35%	92%
Uddevalla	376	322	6%	77%	50%	86%
Uppsala	146	115	3%	70%	30%	79%
Varberg	234	215	2%	74%	31%	92%
Visby	114	94	5%	62%	38%	82%
Värnamo	153	146	1%	69%	27%	95%
Västervik	115	102	3%	70%	38%	89%
Västerås	249	215	4%	75%	60%	86%
Växjö	97	85	1%	68%	26%	88%
Ängelholm	59	46	4%	67%	37%	78%
Örnsköldsvik	173	152	0%	78%	51%	88%
Östersund	222	211	2%	70%	62%	95%
Country	14566	12548	5%	74%	39%	86%

Units with less than 40 registrations during 2015–2016 have been excluded.

12 90-day mortality after hip arthroplasty

Every operative intervention brings about risks for the patient. Hip arthroplasty is no exception. Quite the opposite, an increased risk for infections and thromboembolic events are well-documented. At the same time, the intervention is seen as routine surgery, which in combination with the demands on high production and short care times in the worst cases, may lead to a situation where complications are discovered too late. Before the decision to go through with a planned operation, enough information must be given to the patient, among others that those who undergo a planned total hip arthroplasty have an increased risk for death in the first months in comparison to non-operated peers.

90-day mortality is an open variable on a unit level. 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.

The indications for arthroplasty have been expanded even further. Both young and old, are operated now earlier than before. The older 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. An important group of such risk patients are those, who receive a total arthroplasty in connection with an acute hip fracture. These individuals do not have the same possibilities for stabilising possible health problems before the operation, since fracture surgery must take place within a couple of days. This is in contrast to those who receive a planned osteoarthritis-related hip prosthesis where the date of the operation can be postponed until the health condition permits to perform it.

12.1 Death within 90 days

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.

The death toll is low – note that the results are given per thousand. Therefore, the last four years' production will be analysed 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. The differences reflect the different compositions of groups of patients who undergo surgery at each hospital. Units which operate on less than 70% of osteoarthritis patients, have a considerably higher death rate, which is explained by many fracture patients and, in some cases, also tumour cases.

90-day mortality varies between Swedish hospitals during the years of observation 2013–2016 from 0 to 158‰. Average value for the country is 7.1‰.

Regardless of whether the unit considers the mortality figures as "expected" or not, we must for patients' safety regularly analyse the mortality figures and their causes. It is also of utmost importance that other units and hospitals who care for recently operated patients with complications, inform the unit which performed the operation about these cases. If orthopaedic surgeon does not see these serious events, it is easy to believe that these do not happen.

From in-depth analyses, which are based on register data and concern mortality after total arthroplasty, we see that both preoperative comorbidity as socio-economic background, carry a meaning. It does not have a clinical relevance, if the prosthesis is cemented or not. Those with an entirely cemented arthroplasty have a mortality tendency during the first two weeks, but thereafter, they have a lower level of mortality than the non-operated control group. Today's patient selection for simultaneous bilateral hip arthroplasty, there is no relevant difference in 90-day mortality.

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

Mortality within 90 days

proportion of deceased within three months after primary surgery (per thousand), 2012–2016

Unit	Number	Primary osteoarthritis	≥ 60	Women	Mortality
University or regional hospital					
Karolinska/Huddinge	946	60%	74%	55%	11.8‰
Karolinska/Solna	674	41%	68%	59%	13.6‰
Linköping	266	48%	59%	52%	19.2‰
SU/Mölndal	2 264	66%	79%	61%	7.7‰
SU/Sahlgrenska	19	6%	79%	58%	157.9‰
SUS/Lund	783	30%	82%	61%	29.1‰
SUS/Malmö	113	1%	100%	73%	0‰
Umeå	360	29%	82%	59%	23‰
Uppsala	1 050	48%	69%	59%	17.6‰
Örebro	394	55%	74%	62%	10.2‰
County hospitals					
Borås	628	60%	89%	60%	18‰
Danderyd	1 326	68%	87%	61%	7.7‰
Eksjö	874	91%	84%	55%	4.7‰
Eskilstuna	448	41%	88%	59%	38.9‰
Falun	1 186	88%	82%	58%	5.2‰
Gävle	981	54%	85%	59%	21.7‰
Halmstad	925	78%	85%	56%	12.1‰
Helsingborg	491	62%	89%	57%	8.2‰
Hässleholm-Kristianstad	3 259	86%	85%	55%	3.2‰
Jönköping	665	75%	86%	61%	9.2‰
Kalmar	652	76%	85%	54%	6.4‰
Karlskrona	126	14%	98%	73%	33.2‰
Karlstad	930	60%	84%	60%	14.3‰
Norrköping	1 024	68%	81%	55%	18.1‰
NÄL	49	4%	98%	69%	0‰
Skövde	667	75%	81%	59%	6.1‰
Sundsvall	499	68%	84%	56%	6.1‰
Södersjukhuset	1 652	65%	85%	61%	9.3‰
Uddevalla	1 555	83%	83%	58%	8‰
Varberg	912	85%	88%	60%	3.4‰
Västerås	1 705	57%	89%	62%	35.2‰
Växjö	556	75%	84%	61%	9.1‰
Ystad	1	0%	100%	100%	0‰
Östersund	1 128	74%	86%	59%	5.4‰

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Mortality within 90 days (cont.)

proportion of deceased within three months after primary surgery (per thousand), 2012–2016

Unit	Number	Primary osteoarthritis	≥ 60	Women	Mortality
Rural hospitals					
Alingsås	822	94%	85%	60%	3.7‰
Arvika	749	96%	86%	59%	4.1‰
Enköping	1 362	97%	91%	60%	1.5‰
Frölunda Specialistsjukhus	260	98%	85%	62%	0‰
Gällivare	372	77%	82%	49%	5.5‰
Hudiksvall	570	66%	88%	59%	8.9‰
Karlshamn	970	91%	85%	57%	2.2‰
Karlskoga	660	90%	88%	58%	7.6‰
Katrineholm	916	98%	84%	58%	2.2‰
Kungälv	757	87%	87%	61%	4‰
Lidköping	1 106	92%	87%	54%	1‰
Lindesberg	1 071	90%	85%	57%	1‰
Ljungby	640	79%	85%	56%	9.6‰
Lycksele	1 250	96%	82%	57%	1.7‰
Mora	945	90%	86%	55%	2.2‰
Norrtälje	531	79%	88%	62%	1.9‰
Nyköping	587	65%	89%	61%	38‰
Oskarshamn	1 116	95%	82%	57%	0.9‰
Piteå	1 407	94%	81%	58%	1.5‰
Skellefteå	509	77%	82%	63%	7.9‰
Skene	521	89%	79%	58%	0‰
Sollefteå	568	87%	89%	58%	11.3‰
Sunderby	138	7%	93%	51%	50.8‰
Södertälje	437	83%	84%	59%	0‰
Torsby	451	87%	88%	53%	15.9‰
Trelleborg	2 609	89%	77%	58%	1.6‰
Visby	519	78%	84%	62%	5.8‰
Värnamo	579	90%	85%	57%	1.8‰
Västervik	455	88%	86%	58%	6.7‰
Ängelholm	334	96%	84%	62%	0‰
Örnsköldsvik	663	90%	85%	62%	1.5‰

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Mortality within 90 days (cont.)

proportion of deceased within three months after primary surgery (per thousand), 2012–2016

Unit	Number	Primary osteoarthritis	≥ 60	Women	Mortality
Private hospitals					
Aleris Specialistvård Bollnäs	1 165	96%	80%	54%	2.6‰
Aleris Specialistvård Elisabethsjukhuset	48	88%	88%	50%	0‰
Aleris Specialistvård Motala	2 177	96%	85%	54%	1.9‰
Aleris Specialistvård Nacka	693	99%	77%	64%	0‰
Aleris Specialistvård Sabbatsberg	340	93%	80%	62%	0‰
Aleris Specialistvård Ängelholm	313	96%	83%	59%	6.5‰
Art Clinic Göteborg	70	100%	79%	53%	0‰
Art Clinic Jönköping	76	100%	62%	45%	0‰
Capio Movement	1 000	98%	76%	55%	1.1‰
Capio Ortopediska Huset	1 688	98%	71%	58%	1.2‰
Capio S:t Göran	1 980	88%	83%	64%	2.1‰
Carlanderska	587	96%	65%	45%	0‰
Frölundaortopeden	4	100%	50%	25%	0‰
Hermelinen Specialistvård	36	81%	39%	31%	0‰
Ortho Center IFK-kliniken	552	93%	52%	37%	0‰
Ortho Center Stockholm	1 868	96%	77%	60%	0.6‰
Sophiahemmet	864	100%	54%	39%	1.2‰
Spenshult	337	87%	78%	59%	0‰
Country	66 780	81%	82%	58%	7.1‰

13 Adverse events within 30 days and 90 days

Since the data for the previous year from the Patient Register (PAR) reaches us often quite late in the year, we in the register management have decided not to wait until the data from the Swedish National Board of Health and Welfare is ready. Thus, we present adverse events for the three-year period 2013–2015, which is the same period we presented in Annual Report 2015.

13.1 Definition of adverse events

The term "adverse events" refers to all forms of readmission that may be associated with the completed procedure – and not just local complications, but also general medical complications (including death).

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

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

13.2 Results

All patients: The analysis took as its point of departure the register's database for primary total hip replacements during 2013 up to and including September 2015 (44 749 operations) and this database was coordinated with the National Patient Register. The national average is 3.15%, after 30 days and 5.16% after 90 days. These national averages are marginally lower in comparison to previous year's analysis. The frequency of adverse events varies considerably between hospitals. 30 days: 0.0–10.20%. 90 days: 0.0–18.75%. Hospitals differing from the average with a standard deviation or more are marked in red in the table.

The "standard" patient. Analysis similar to the above, only with a smaller number of patients: 20 273 operations. The definition for the "standard patient" can be found on page 63. The national average is 1.66%, after 30 days and 2.83% 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 homogeneous patient group, and there is room for improvement. 30 days: 0.0–6.62%. 90 days: 0.0–8.82%.

Fracture patients. Analysis similar to the above, only now with 16 236 operations. The national average is 14.22%, after 30 days and 22.33% after 90 days. This group (higher mean age and more expressed comorbidity) has, as expected, the frequency of adverse events is remarkably higher than in the groups above. There are very large differences between the units. There is a slight increase since last year, but local analyses and improvement are necessary.30 days: 0.0–35.48%. 90 days: 0.0–42.86%.

13.3 Problems and discussion

This type of analysis from the 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 coding, 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.

An extensive study based on marker-based reading of medical reports shows also the insecurities in the code-based method that both the Hip Arthroplasty Register and the "Vården i siffror" use with underestimation of the number of events as a consequence. The VARA study (Validation of registry data after total hip arthroplasties) is being finalised now and will be presented in the next annual report. The aim of the study is to find a safer algorithm for mapping of adverse events in the care system.

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

Adverse events for all patients within 30 and 90 days

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
University or regional hospitals							
Karolinska/Huddinge	694	19	2.74	1.24	43	6.20	1.83
Karolinska/Solna	506	29	5.73	2.07	50	9.88	2.65
Linköping	186	13	6.99	3.74	24	12.9	4.92
SU/Mölndal	1 460	44	3.01	0.89	70	4.79	1.12
SU/Sahlgrenska	16	1	6.25	12.1	3	18.75	19.52
SUS/Lund	523	25	4.78	1.87	51	9.75	2.59
SUS/Malmö	78	4	5.13	4.99	5	6.41	5.55
Umeå	231	14	6.06	3.14	26	11.26	4.16
Uppsala	713	32	4.49	1.55	61	8.56	2.10
Örebro	313	7	2.24	1.67	13	4.15	2.26
County hospitals							
Borås	456	27	5.92	2.21	39	8.55	2.62
Danderyd	902	53	5.88	1.57	70	7.76	1.78
Eksjö	571	17	2.98	1.42	29	5.08	1.84
Eskilstuna	307	31	10.10	3.44	43	14.01	3.96
Falun	864	16	1.85	0.92	24	2.78	1.12
Gävle	659	25	3.79	1.49	35	5.31	1.75
Halmstad	665	23	3.46	1.42	37	5.56	1.78
Helsingborg	319	17	5.33	2.52	29	9.09	3.22
Hässleholm-Kristianstad	2 222	51	2.30	0.64	93	4.19	0.85
Jönköping	484	12	2.48	1.41	22	4.55	1.89
Kalmar	431	12	2.78	1.58	19	4.41	1.98
Karlskrona	75	7	9.33	6.72	11	14.67	8.17
Karlstad	640	31	4.84	1.70	52	8.13	2.16
Norrköping	688	21	3.05	1.31	40	5.81	1.78
Skövde	405	13	3.21	1.75	22	5.43	2.25
Sunderbyn	98	10	10.20	6.12	16	16.33	7.47
Sundsvall	429	34	7.93	2.61	46	10.72	2.99
Södersjukhuset	1 147	45	3.92	1.15	64	5.58	1.36
Uddevalla	1 038	27	2.60	0.99	51	4.91	1.34
Varberg	584	15	2.57	1.31	30	5.14	1.83
Västerås	1 183	71	6.00	1.38	123	10.40	1.77
Växjö	387	17	4.39	2.08	28	7.24	2.63
Ystad	1	0	0	0	0	0	0
Östersund	752	15	1.99	1.02	24	3.19	1.28

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Adverse events for all patients within 30 and 90 days (cont.)

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	579	24	4.15	1.66	33	5.70	1.93
Arvika	501	18	3.59	1.66	32	6.39	2.18
Enköping	920	28	3.04	1.13	44	4.78	1.41
Frölunda Specialistsjukhus	249	2	0.80	1.13	5	2.01	1.78
Gällivare	251	9	3.59	2.35	12	4.78	2.69
Hudiksvall	378	13	3.44	1.87	25	6.61	2.56
Karlshamn	659	21	3.19	1.37	36	5.46	1.77
Karlskoga	470	14	2.98	1.57	22	4.68	1.95
Katrineholm	648	13	2.01	1.10	23	3.55	1.45
Kungälv	510	16	3.14	1.54	25	4.90	1.91
Lidköping	720	13	1.81	0.99	26	3.61	1.39
Lindesberg	585	12	2.05	1.17	14	2.39	1.26
Ljungby	434	13	3.00	1.64	25	5.76	2.24
Lycksele	837	17	2.03	0.98	28	3.35	1.24
Mora	584	9	1.54	1.02	23	3.94	1.61
Norrtälje	343	11	3.21	1.90	17	4.96	2.34
Nyköping	408	29	7.11	2.54	40	9.80	2.94
Oskarshamn	728	11	1.51	0.90	20	2.75	1.21
Piteå	929	14	1.51	0.80	28	3.01	1.12
Skellefteå	348	13	3.74	2.03	19	5.46	2.44
Skene	366	4	1.09	1.09	9	2.46	1.62
Sollefteå	325	12	3.69	2.09	19	5.85	2.60
Södertälje	272	17	6.25	2.94	27	9.93	3.63
Torsby	281	9	3.20	2.10	12	4.27	2.41
Trelleborg	1 696	28	1.65	0.62	44	2.59	0.77
Visby	344	13	3.78	2.06	21	6.10	2.58
Värnamo	367	18	4.90	2.25	24	6.54	2.58
Västervik	295	6	2.03	1.64	9	3.05	2.00
Ängelholm	270	7	2.59	1.93	11	4.07	2.41
Örnsköldsvik	411	8	1.95	1.36	18	4.38	2.02

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Adverse events for all patients within 30 and 90 days (cont.)

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
Private hospitals							
Aleris Specialistvård Bollnäs	796	8	1.01	0.71	20	2.51	1.11
Aleris Specialistvård Elisabethsjukhuset	48	0	0	0	1	2.08	4.12
Aleris Specialistvård Motala	1 433	37	2.58	0.84	53	3.70	1.00
Aleris Specialistvård Nacka	397	10	2.52	1.57	12	3.02	1.72
Aleris Specialistvård Sabbatsberg	340	0	0	0	0	0	0
Aleris Specialistvård Ängelholm	204	5	2.45	2.17	7	3.43	2.55
Art Clinic Göteborg	7	0	0	0	0	0	0
Art Clinic Jönköping	32	1	3.13	6.15	1	3.13	6.15
Capio Movement	568	25	4.40	1.72	39	6.87	2.12
Capio Ortopediska Huset	1 084	19	1.75	0.80	31	2.86	1.01
Capio S:t Göran	1 242	64	5.15	1.25	88	7.09	1.46
Carlanderska	371	7	1.89	1.41	11	2.96	1.76
Hermelinen Specialistvård	22	0	0	0	0	0	0
Ortho Center IFK-kliniken	349	1	0.29	0.57	2	0.57	0.81
Ortho Center Stockholm	1 202	14	1.16	0.62	28	2.33	0.87
Sophiahemmet	582	5	0.86	0.77	13	2.23	1.23
Spenshult	337	14	4.15	2.17	18	5.34	2.45
Country	44 749	1 410	3.15	0.17	2 308	5.16	0.21

Adverse events for the "standard patient" within 30 and 90 days

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
University or regional hospitals							
Karolinska/Huddinge	179	3	1.68	1.92	8	4.47	3.09
Karolinska/Solna	95	2	2.11	2.95	2	2.11	2.95
Linköping	34	0	0	0	3	8.82	9.73
SU/Mölndal	506	7	1.38	1.04	13	2.57	1.41
SUS/Lund	34	0	0	0	0	0	0
Umeå	27	1	3.70	7.27	1	3.70	7.27
Uppsala	168	1	0.60	1.19	4	2.38	2.35
Örebro	90	1	1.11	2.21	2	2.22	3.11
County hospitals							
Borås	136	9	6.62	4.26	10	7.35	4.48
Danderyd	292	9	3.08	2.02	12	4.11	2.32
Eksjö	290	4	1.38	1.37	12	4.14	2.34
Eskilstuna	37	0	0	0	1	2.70	5.33
Falun	425	5	1.18	1.05	7	1.65	1.23
Gävle	173	1	0.58	1.15	4	2.31	2.29
Halmstad	319	8	2.51	1.75	11	3.45	2.04
Helsingborg	82	2	2.44	3.41	3	3.66	4.15
Hässleholm-Kristianstad	1 020	12	1.18	0.68	26	2.55	0.99
Jönköping	191	2	1.05	1.47	5	2.62	2.31
Kalmar	218	1	0.46	0.92	2	0.92	1.29
Karlskrona	4	0	0	0	0	0	0
Karlstad	182	3	1.65	1.89	5	2.75	2.42
Norrköping	266	4	1.50	1.49	8	3.01	2.09
Skövde	167	3	1.80	2.06	5	2.99	2.64
Sundsvall	174	7	4.02	2.98	8	4.60	3.18
Södersjukhuset	316	10	3.16	1.97	10	3.16	1.97
Uddevalla	426	7	1.64	1.23	10	2.35	1.47
Varberg	294	5	1.70	1.51	10	3.40	2.11
Västerås	313	8	2.56	1.78	15	4.79	2.41
Växjö	156	4	2.56	2.53	7	4.49	3.32
Östersund	307	4	1.30	1.29	6	1.95	1.58

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Adverse events for the "standard patient" within 30 and 90 days (cont.)

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	355	12	3.38	1.92	14	3.94	2.07
Arvika	265	5	1.89	1.67	9	3.40	2.23
Enköping	501	8	1.60	1.12	16	3.19	1.57
Gällivare	106	1	0.94	1.88	2	1.89	2.64
Hudiksvall	148	2	1.35	1.90	3	2.03	2.32
Karlshamn	368	7	1.90	1.42	16	4.35	2.13
Karlskoga	240	1	0.42	0.83	6	2.50	2.02
Katrineholm	448	6	1.34	1.09	13	2.90	1.59
Kungälv	260	4	1.54	1.53	5	1.92	1.70
Lidköping	439	6	1.37	1.11	11	2.51	1.49
Lindesberg	328	3	0.91	1.05	4	1.22	1.21
Ljungby	192	6	3.13	2.51	7	3.65	2.71
Lycksele	463	7	1.51	1.13	12	2.59	1.48
Mora	309	5	1.62	1.44	8	2.59	1.81
Norrtälje	125	2	1.60	2.24	3	2.40	2.74
Nyköping	150	5	3.33	2.93	6	4.00	3.20
Oskarshamn	405	4	0.99	0.98	11	2.72	1.62
Piteå	482	3	0.62	0.72	9	1.87	1.23
Skellefteå	127	3	2.36	2.70	5	3.94	3.45
Skene	242	1	0.41	0.82	4	1.65	1.64
Sollefteå	170	4	2.35	2.33	4	2.35	2.33
Södertälje	103	3	2.91	3.31	8	7.77	5.27
Torsby	104	3	2.88	3.28	4	3.85	3.77
Trelleborg	929	9	0.97	0.64	15	1.61	0.83
Visby	178	3	1.69	1.93	4	2.25	2.22
Värnamo	174	7	4.02	2.98	10	5.75	3.53
Västervik	141	2	1.42	1.99	2	1.42	1.99
Ängelholm	169	4	2.37	2.34	5	2.96	2.61
Örnsköldsvik	201	4	1.99	1.97	6	2.99	2.40

(Continued on next page.)

Adverse events for the "standard patient" within 30 and 90 days (cont.)

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
Private hospitals							
Aleris Specialistvård Bollnäs	489	4	0.82	0.81	10	2.04	1.28
Aleris Specialistvård Elisabethsjukhuset	35	0	0	0	1	2.86	5.63
Aleris Specialistvård Motala	728	11	1.51	0.90	14	1.92	1.02
Aleris Specialistvård Nacka	292	10	3.42	2.13	11	3.77	2.23
Aleris Specialistvård Sabbatsberg	244	0	0	0	0	0	0
Aleris Specialistvård Ängelholm	111	2	1.80	2.53	4	3.60	3.54
Art Clinic Göteborg	6	0	0	0	0	0	0
Art Clinic Jönköping	17	0	0	0	0	0	0
Capio Movement	331	11	3.32	1.97	17	5.14	2.43
Capio Ortopediska Huset	696	11	1.58	0.95	22	3.16	1.33
Capio S:t Göran	500	15	3.00	1.53	25	5.00	1.95
Carlanderska	219	3	1.37	1.57	5	2.28	2.02
Hermelinen Specialistvård	5	0	0	0	0	0	0
Ortho Center IFK-kliniken	195	0	0	0	1	0.51	1.02
Ortho Center Stockholm	826	6	0.73	0.59	14	1.69	0.90
Sophiahemmet	341	3	0.88	1.01	7	2.05	1.54
Spenshult	195	8	4.10	2.84	10	5.13	3.16
Country	20 273	337	1.66	0.18	573	2.83	0.23

Adverse events for fracture patients within 30 and 90 days

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
University or regional hospitals							
Karolinska/Huddinge	348	44	12.64	3.56	79	22.70	4.49
Karolinska/Solna	197	34	17.26	5.38	55	27.92	6.39
Linköping	275	45	16.36	4.46	64	23.27	5.10
SU/Mölndal	1 134	131	11.55	1.90	229	20.19	2.38
SU/Sahlgrenska	14	4	28.57	24.15	6	42.86	26.45
SUS/Lund	577	50	8.67	2.34	96	16.64	3.10
SUS/Malmö	616	98	15.91	2.95	142	23.05	3.39
Umeå	255	44	17.25	4.73	66	25.88	5.49
Uppsala	529	71	13.42	2.96	107	20.23	3.49
Örebro	226	28	12.39	4.38	50	22.12	5.52
County hospitals							
Borås	369	44	11.92	3.37	81	21.95	4.31
Danderyd	568	77	13.56	2.87	122	21.48	3.45
Eksjö	175	32	18.29	5.84	45	25.71	6.61
Eskilstuna	301	56	18.60	4.49	82	27.24	5.13
Falun	376	43	11.44	3.28	74	19.68	4.10
Gävle	421	59	14.01	3.38	75	17.81	3.73
Halmstad	267	38	14.23	4.28	65	24.34	5.25
Helsingborg	520	74	14.23	3.06	121	23.27	3.71
Hässleholm-Kristianstad	497	103	20.72	3.64	142	28.57	4.05
Jönköping	209	24	11.48	4.41	40	19.14	5.44
Kalmar	215	22	10.23	4.13	47	21.86	5.64
Karlskrona	306	45	14.71	4.05	77	25.16	4.96
Karlstad	391	75	19.18	3.98	105	26.85	4.48
Norrköping	285	28	9.82	3.53	56	19.65	4.71
Skövde	299	44	14.72	4.10	60	20.07	4.63
Sunderbyn	455	72	15.82	3.42	114	25.05	4.06
Sundsvall	302	47	15.56	4.17	69	22.85	4.83
Södersjukhuset	952	126	13.24	2.20	193	20.27	2.61
Uddevalla	597	71	11.89	2.65	129	21.61	3.37
Varberg	268	33	12.31	4.01	56	20.90	4.97
Västerås	435	56	12.87	3.21	97	22.30	3.99
Växjö	196	19	9.69	4.23	34	17.35	5.41
Ystad	31	11	35.48	17.19	12	38.71	17.50
Östersund	280	23	8.21	3.28	45	16.07	4.39

(Continued on next page.)

Adverse events for fracture patients within 30 and 90 days (cont.)

2013–2015

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Unit	Number	Number	%	±	Number	%	±
Rural hospitals							
Alingsås	116	19	16.38	6.87	29	25.00	8.04
Arvika	14	4	28.57	24.15	6	42.86	26.45
Frölunda Specialistsjukhus	2	0	0	0	0	0	0
Gällivare	145	26	17.93	6.37	36	24.83	7.18
Hudiksvall	220	39	17.73	5.15	52	23.64	5.73
Karlshamn	6	0	0	0	0	0	0
Karlskoga	125	24	19.20	7.05	35	28.00	8.03
Katrineholm	1	0	0	0	0	0	0
Kungälv	238	30	12.61	4.30	50	21.01	5.28
Lidköping	146	17	11.64	5.31	32	21.92	6.85
Lindesberg	90	16	17.78	8.06	22	24.44	9.06
Ljungby	122	17	13.93	6.27	26	21.31	7.42
Lycksele	55	7	12.73	8.99	13	23.64	11.46
Mora	192	30	15.63	5.24	56	29.17	6.56
Norrtälje	106	22	20.75	7.88	28	26.42	8.56
Nyköping	121	13	10.74	5.63	21	17.36	6.89
Piteå	3	0	0	0	0	0	0
Skellefteå	126	16	12.70	5.93	20	15.87	6.51
Sollefteå	102	17	16.67	7.38	25	24.51	8.52
Södertälje	116	34	29.31	8.45	43	37.07	8.97
Torsby	113	27	23.89	8.02	32	28.32	8.48
Trelleborg	6	0	0	0	0	0	0
Visby	97	13	13.40	6.92	22	22.68	8.50
Värnamo	97	5	5.15	4.49	9	9.28	5.89
Västervik	137	22	16.06	6.27	29	21.17	6.98
Örnsköldsvik	122	16	13.11	6.11	26	21.31	7.42
Private hospitals							
Aleris Specialistvård Motala	123	15	12.20	5.90	27	21.95	7.46
Aleris Specialistvård Ängelholm	1	0	0	0	0	0	0
Capio S:t Göran	602	106	17.61	3.10	149	24.75	3.52
Carlanderska	2	0	0	0	0	0	0
Ortho Center Stockholm	3	1	33.33	54.43	1	33.33	54.43
Spenshult	1	1	100	0	1	100	0
Country	16 236	2 308	14.22	0.55	3 625	22.33	0.65

14 Fracture treatment with total or hemiarthroplasty

This chapter includes total and hemi-arthroplasties performed due to acute fractures, and sequelae after previous hip fracture. 6 158 operations were registered in 2016, which along with the year 2013 constitutes the highest level of registrations since 2005. There are an increasing number of patients under 75 years who receive an arthroplasty as fracture treatment, 1 355 in the previous year. There has been a steady increase from 2005, when there were 913. The number between 75 and 85, and over the age of 85 is unchanged (2 490 and 2 313) (Figure 14.1).

For those who receive hemiarthroplasty, dementia is registered. In 2005 28% of the cases and some degree of dementia. The proportion has increased, but during the last years it has remained stable around 36% of patients.

14.1 Implant selection and technique

Total arthroplasties have continued to increase, 2 015 fracture patients received one last year. Bipolar (1 126) and unipolar hemiarthroplasties (3 004) are used in the same extent as the year before (Figure 14.2). Direct lateral approach is clearly the most common approach, in comparison to the posterior approach (4 328 and 1 773), and neither have seen any significant changes (Figure 14.3).

The Swedish orthopaedic surgeons are considered to be conservative in their choice of implants, which, in this context, is often beneficial. Regarding stem selection, cemented Lubinus SP II has increased somewhat in 2016, at the expense of basically all other types. Barely 2% of uncemented stems was used in 2016, which is a decrease in comparison to the previous year, and probably a uniquely low number in comparison to other countries (Table on page 130). We present implant survival data for the most common stem types among fracture patients. The most popular cemented stems all have approximately the same five-year survival rate, around 94–96% (Figure 14.8–14.11). The uncemented stem Corail is presented as one group, as the different variants constitute too small a number for separate analyses. Its implant survival is somewhat lower than for the cemented stems, but the confidence interval is wide at the end of the follow-up period (Figure 14.12). Of course, all the stems' results should be interpreted with caution, because of varying levels of revision reporting, different treatment strategies in case of complications, and other factors can produce a distorted picture of the actual clinical outcome.

With the stem, a cup is used during total arthroplasties or a larger head during hemiarthroplasties. The distribution is largely unchanged. However, two changes need to be pointed out: The unipolar hemiarthroplasty head, which is usually used with SPII stem, is increasing. Avantage, a dual mobility-cup (DMC), has continuously increased and is in 2016the fifth most common alternative for fracture patients. There are now 2 002 DMC in the Register. DMC is widely used among fracture patients in some countries, with preference for the posterior approach, after the scientific studies showed that DMC can reduce the higher dislocation rate of the posterior approach. However, the Swedish DMC are in 52% of cases inserted with direct lateral approach.

14.2 Reoperation and revision

3 485 reoperations have been reported to the register since 2005, which gives a reoperation rate of 5.0%.

Cause for reoperation
2005–2016

	Number	Proportion of all operations	Proportion of all reoperations
Deep infection	1 131	1.6%	32.5%
Dislocation	1 033	1.5%	29.6%
Fracture	779	1.1%	22.4%
Aseptic loosening	179	0.3%	5.1%
Other causes	207	0.3%	5.9%
Missing data	156	0.2%	4.5%
Total	3 485	5%	100%

In a Kaplan-Meier analysis, we no longer see a difference between age groups regarding risk for revision of hip arthroplasties (Figure 14.4). Those who receive a prosthesis after internal fixation of the fracture fails (secondary prosthesis), have an increased risk (Figure 14.5). The same type of survival analysis regarding approaches shows that lateral approach is preferred – from a revision risk point of view – in the first four to six years. Thereafter, the difference is no longer significant (Figure 14.6). The prosthesis types have the same risk for revision during the whole follow-up time with one exception: bipolar hemiarthroplasty shows a higher revision risk during the first two years, in comparison with unipolar hemiarthroplasty and total arthroplasty (Figure 14.7).

During the first years of registration, the Register found an increased revision risk for the bipolar heads. With a longer follow-up, this seems to apply only to early revision. If one takes into account the protective effect regarding acetabulum erosion (see below), the bipolar prosthesis seems as a good option for individuals who are expected to live many years after their fracture. In some analyses (see below), total arthroplasty provides a reduced risk for reoperation. If the clinical studies

are taken into consideration as well, the total arthroplasty is a better alternative for the younger, healthier and more active fracture patients. However, the intervention is technically more demanding than the hemiarthroplasty, and the surgical competence for emergency procedures at each unit may be decisive when selecting a prosthesis type.

The table on page 131 presents reoperations within six months about the participating units. For the country, the proportion is 3.3% and between units, the figures vary from 0 to 9.4%. A majority of reoperations is done early. This is an important quality indicator, but the presentation should be read with caution. Unrecorded cases may exist for different reasons: in addition to underreporting, the units may be more or less likely to operate in case of complications. Maybe, one does not want to expose an aged fracture patient to a new operation, due to medical reasons or because of patient's refusal. Local treatment traditions also have an effect. In case of suspected infection, for example, surgical debridement nowadays carried out immediately together with proper antibiotic regime, in order to cure the infection without implant exchange. How aggressive this infection diagnosis and treatment is, varies between the units in the country, and may partially explain the variation in the reoperation rate.

Several of the hospitals, with high the reoperation rate, use either uncemented stems or posterior approach to a relatively large extent. Others have a larger proportion of secondary arthroplasties, an intervention associated with higher reoperation risk. If a unit chooses to use an implant or approach with a known increased risk of complications, it is appropriate to do an in-depth analysis. Alingsås acted accordingly, with both practical (abandoning uncemented stems) and scientific results (abstract presented at EFORT 2016, Genevé: Uncemented Stems in Hemiarthroplasties Increase the Risk of Periprosthetic Fractures; Einerås et al.).

As always, any reoperation is assigned to the hospital were the primary procedure was done, regardless where the reoperation was carried out.

14.3 Risk factors for reoperation

Male gender, low age, secondary prosthesis, uncemented stem and posterior approach increase the risk for reoperation. Total arthroplasty is associated with lower reoperation risk than hemiarthroplasty types. These analyses are made with Cox regression where potential risk factors, such as gender, age, diagnosis, type of prosthesis, approach and stem are weighed against each other. Reported ASA class, BMI and dementia can be used to adjust for different characteristics, which may affect a patient's reoperation risk... If age groups are analysed separately with adjustment for ASA class, the result is changed for the two younger groups. For individuals under the age of 75, uncemented stem is no longer generally associated with reoperation. There is no difference in the reoperation risk for total arthroplasty and bipolar hemiarthroplasty in this group. For those between the ages of 75 and 85, the approach is no longer a risk factor.

When the whole patient group was studied, high ASA class (sicker patient) and overweight (BMI over 30) are associated with higher risk of reoperation.

14.4 Infection

Infection constitutes 32% of reoperations. Uncemented stem, lateral approach and secondary prosthesis increases the risk for infection-related reoperation in a Cox regression analysis. Also, patient factors such as male gender, age under 75, high BMI and serious comorbidity are associated with increased infection risk. Comparison with total arthroplasty shows a higher risk for infection for both bipolar and unipolar hemiarthroplasty, assumingly due to patient selection. Older and sicker individuals, who are more susceptible to infection, receive mostly a hemiarthroplasty.

14.5 Dislocation

Dislocations constitute 30% of the reoperations. Closed repositioning of dislocation is not registered, i.e. we do not aim to describe the "true" number of dislocations. Individuals with hip fracture run the increased risk of dislocating their hip prostheses in comparison with the osteoarthritis group. It is believed that it depends on a free range of motion before the fracture (in contrast to osteoarthritis patients who become stiffer during the development of osteoarthritis) and that many patients with fracture cannot remain cautious during rehabilitation, due to dementia or abuse. It is important to reduce the risk of dislocation. One way, that the Swedish orthopaedic surgeons have embraced, is to use a direct lateral approach instead of a posterior one (Figure 14.3).

In a Cox regression analysis, regarding dislocation-related reoperation, the posterior approach doubles the risk for reoperation (confidence interval 1.6–2.1). Also, secondary arthroplasty, male gender, age younger than 75 years and high ASA class are risk factors. Adding BMI does not affect this result.

The use of dual mobility cups, as mentioned above, increase every year. In simple regression analyses, we now see that DMC is associated with lower risk for dislocation-related open surgery, in comparison to total arthroplasties with conventional articulation. Regarding reoperation in general and due to infection, DMC seems to carry the same reoperation risk as other total arthroplasties in fracture cases.

The most common cemented stem types give relatively good results, measured with implant survival. However, we must be aware that the reality for the patient may be different – all complications do not lead to revision surgery.

There is a need of clinical studies of dual mobility cups with adjustment for patient selection and other factors that may affect the outcome. It is remarkable, that in Sweden there is a large proportion of DMC inserted via direct lateral approach. Existing studies have focused on the combination with posterior approach. Question is whether DMC provides added value by inserting it via lateral approach.

14.6 Periprosthetic fracture

Periprosthetic fracture has increased in proportion and constitutes 22% of reoperations in 2016, in comparison to 17% in 2013. The increase can be explained by a validation work which has captured earlier non-reported cases. Fracture surgery with internal fixation only should also be reported to the register. Fracture patients have two main causes for increased risk of periprosthetic fracture, in comparison to osteoarthritis patients, osteoporosis and increased risk of falling. The choice of prosthesis stem becomes especially important in this group. Sweden has a uniquely low proportion of uncemented stems, which seems wise, since this stem type causes increased fracture risk. However, the cementing procedure carries a risk of bone cementing syndrome.

An increased risk of fracture-related reoperation is associated with uncemented stem, male gender and secondary arthroplasty. Uncemented stem constitutes a doubled risk in comparison to a cemented stem (confidence interval 1.8–2.9). When ASA and BMI are included, underweight and comorbidity are associated with increased risk for periprosthetic fracture.

14.7 Loosening

With longer follow-up, the incidence of aseptic loosening, as a typical long-term complication, increases. However, only 5% of reoperations are caused by loosening. After adjusting for ASA class and BMI, male gender, secondary prosthesis, low age and overweight are seen as risk factors. Most hip fracture patients live so few years after their injury, that they do not have time to develop loosening, thus the risk is reflected in age rather than in surgical techniques.

14.8 Erosion

A hemiarthroplasty articulates with the acetabular cartilage, which can lead to its abrasion. Acetabulum erosion causes 4% of reoperations and is an elusive condition. The "true" incidence of erosion is unknown. There are reasons to believe that some elderly adapt to the slowly progressive complication by being less active. Since it is difficult to distinguish manifested erosion from more obscure pain, both causes for reoperation have been grouped together in our analyses. In the analysis of hemiarthroplasties with Cox regression, we find four times greater risk of reoperation due to erosion or pain after surgery with unipolar head, when compared with bipolar head (confidence interval 2.2–7.0). Lower age is also a risk factor.

14.9 Clinical perspective

In hip fracture patients, malnutrition and its consequences is often discussed. However, similar proportions of fracture patients are obese and underweight. Obesity is associated with a higher risk of reoperation in general and also of infection and loosening in particular. The underweight patients have an increased risk for periprosthetic fracture, and the same applies to patients which serious comorbidity. Selecting uncemented stem for the most fragile patients – perhaps because of the fear of bone cementing syndrome – further tips the scales towards an unnecessarily high risk for periprosthetic fracture. Orthopaedic surgeon and anaesthetist can in cooperation, largely prevent the negative effects of the cementing (Safety guideline: reducing the risk from cemented hemiarthroplasty for hip fracture. Anaesthesia. 2015;70 (5):623–6). On the other hand, the data from the Register indicates that there is no association between cementless stems and reoperation risk in patients under the age of 75.

The direct lateral approach appears to have lower risk of reoperation caused by dislocation, but we see an indication that this approach may increase the risk for infection. Factors which, at least theoretically, may support the use of posterior approach – less limping and better function? – we cannot comment on based on the Register data. Combined with the dual mobility cup and its ability to decrease the risk of dislocation, the posterior approach may perhaps be a suitable choice for certain fracture patients as well. On the other hand, for hemiarthroplasty patients with low functional demands, muscular weakness and short survival rate, the lateral approach's will be a better choice, due to its better short-term results.

In terms of prosthesis survival rate the results for, total arthroplasty, unipolar and bipolar hemiarthroplasties are similar. The result can be interpreted that the Swedish orthopaedic surgeons choose the appropriate implant to their different patient groups, an implant which suits best the patient's functional needs.

14.10 90-day mortality after fracture-related arthroplasty

Hip fracture patients have a significantly higher risk to die than those who undergo a planned intervention, caused by, for example, osteoarthritis. Additionally, they are older and frailer than osteoarthritis patients. The fracture patient should, regardless of the health situation, be treated immediately. This year's national average for 90-day mortality was 13%, on the same level as last year. Mortality is influenced by which patients are selected for arthroplasty. If the sickest of patients receive internal fixation – mortality reduces. Mortality varies significantly between hospitals, 5 to 21% among the larger units. A number of factors that can increase the risk for early mortality are shown in the table on page 133: aged patients, male gender, infirmity and acute fracture surgery (as compared

to planned secondary arthroplasty). If the mortality rate at one's own unit exceeds the expected rate for the case mix in question, then the clinical pathway should be analysed in detail.

Uncemented stems and posterior approach increase the risk for reoperation, in general, and for periprosthetic fracture and dislocation, in particular. Given the way the Swedish orthopaedic surgeons choose to use the different types of prosthesis, the result with regard to implant survival is fairly similar. Unipolar hemiarthroplasty increases the risk for reoperation due to acetabular erosion and thus becomes less attractive alternative for the active patient with long remaining lifespan.

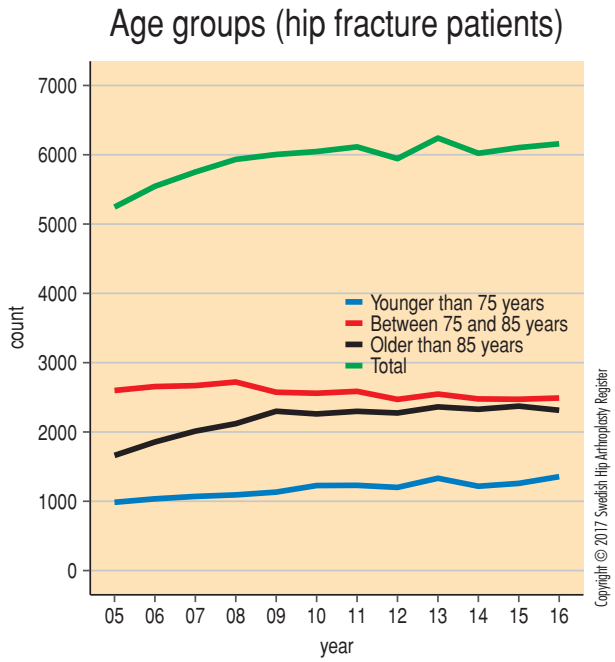


Figure 14.1.

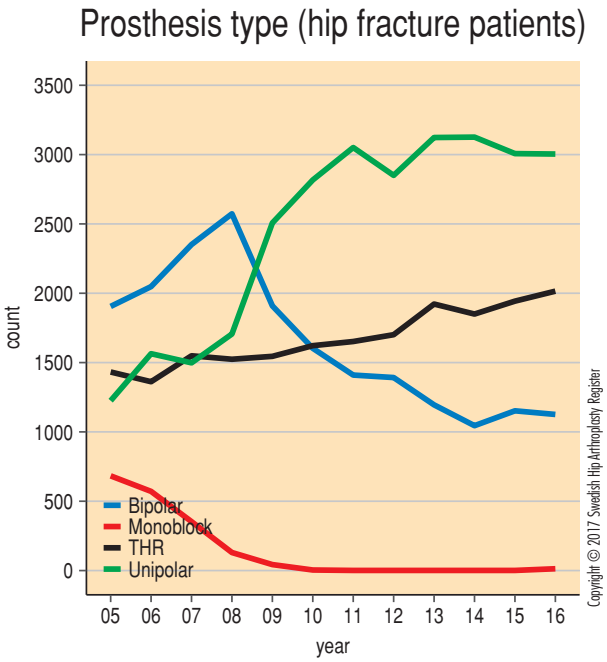


Figure 14.2.

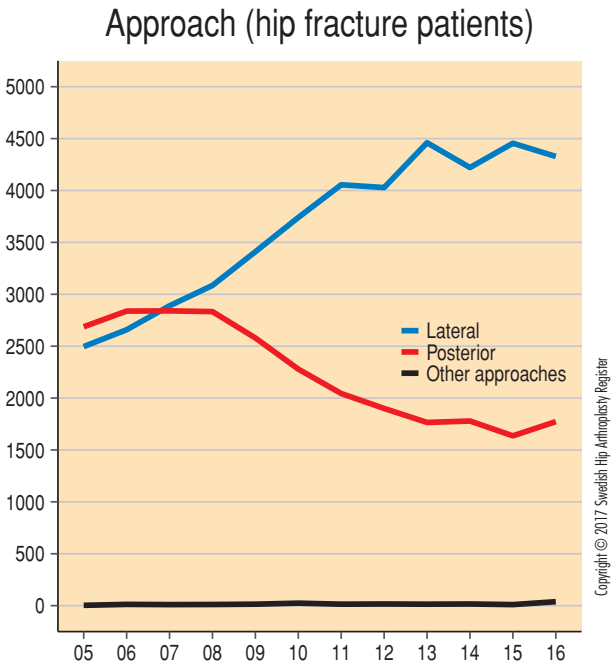


Figure 14.3.

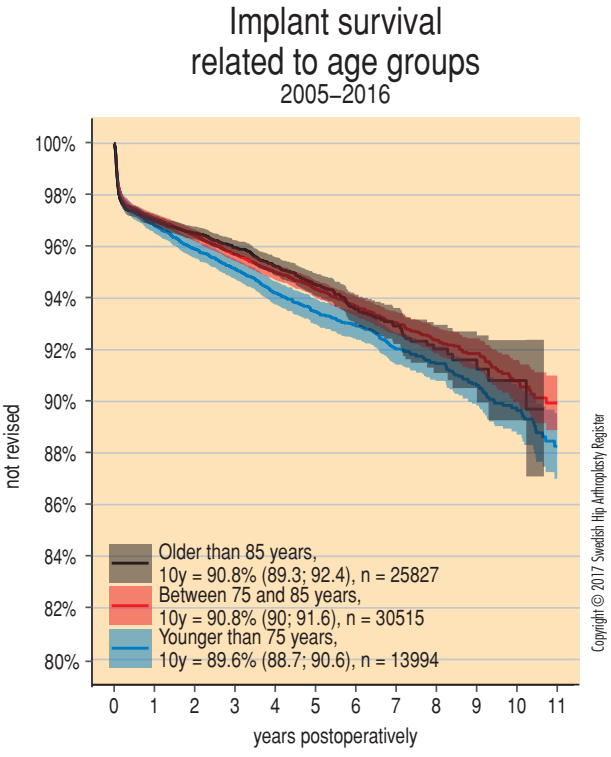


Figure 14.4.

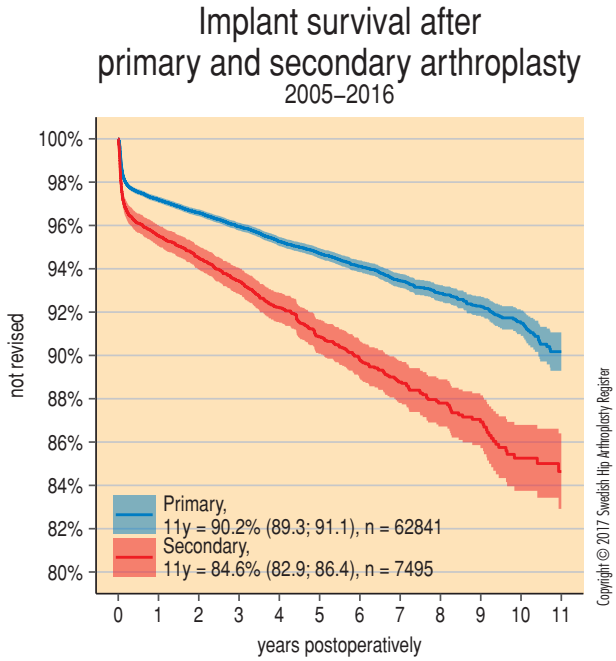


Figure 14.5.

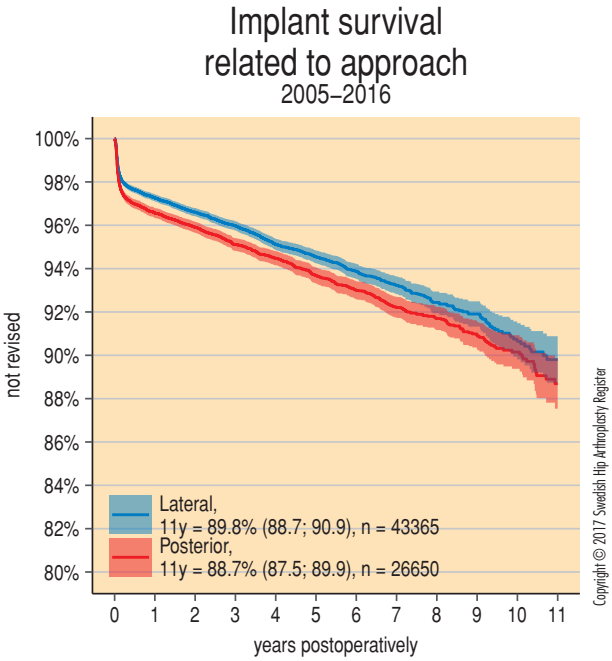


Figure 14.6.

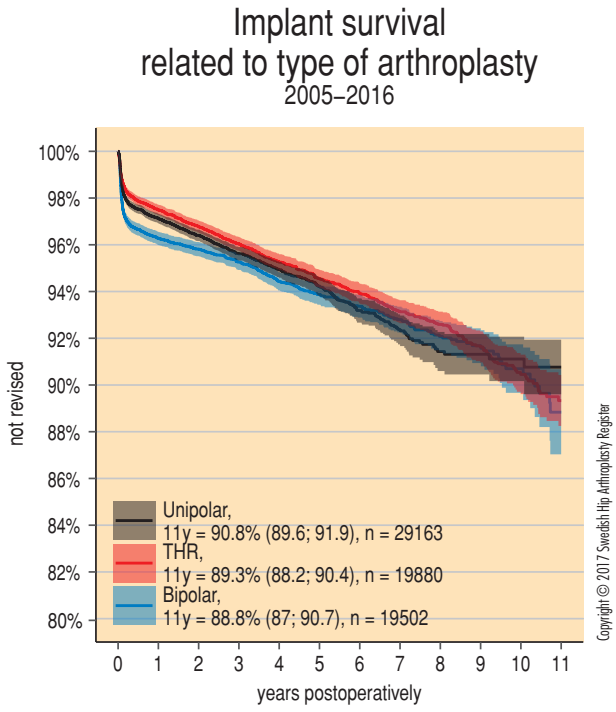


Figure 14.7.

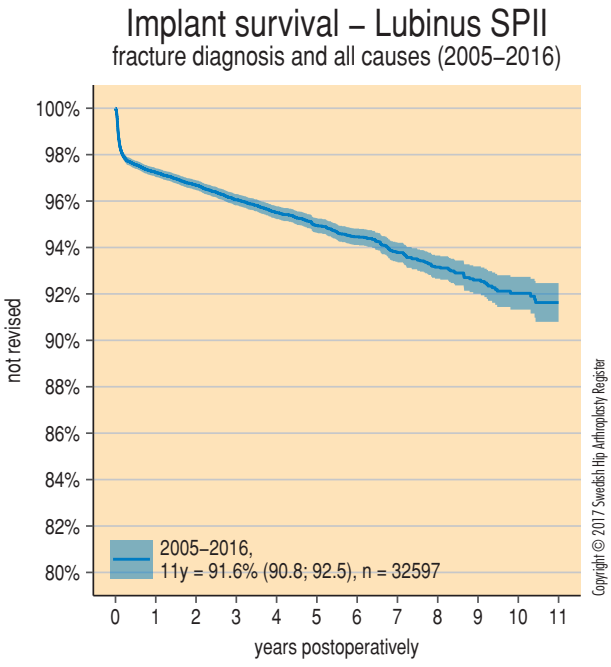


Figure 14.8.

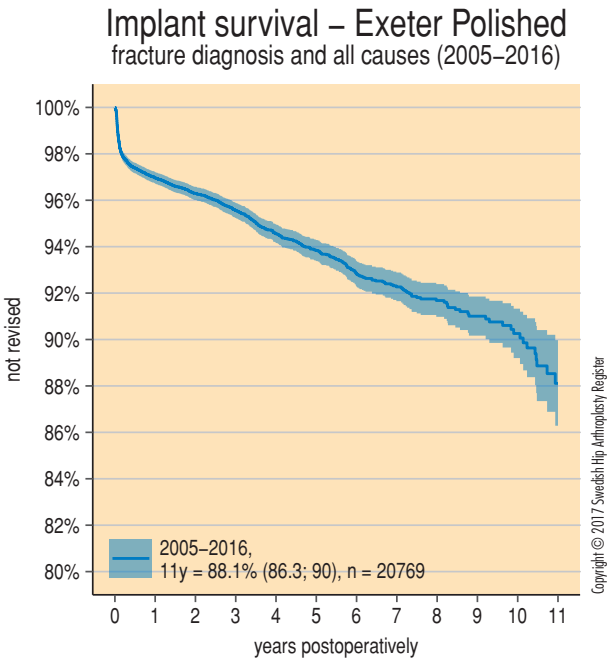


Figure 14.9.

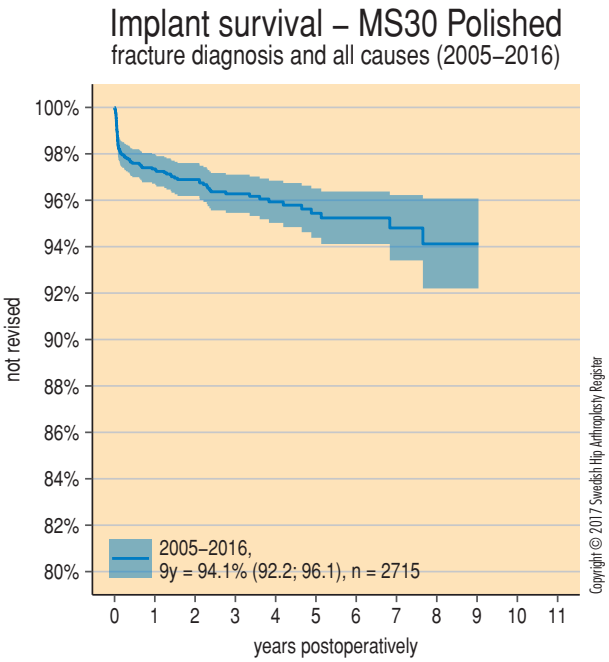


Figure 14.10.

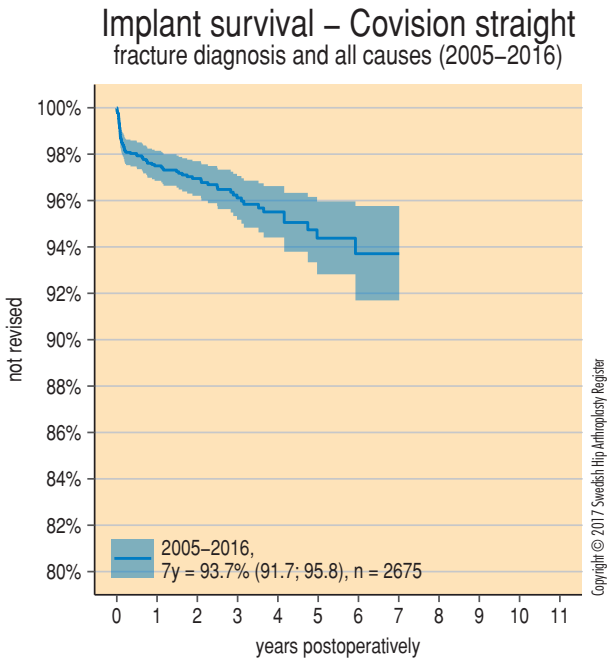


Figure 14.11.

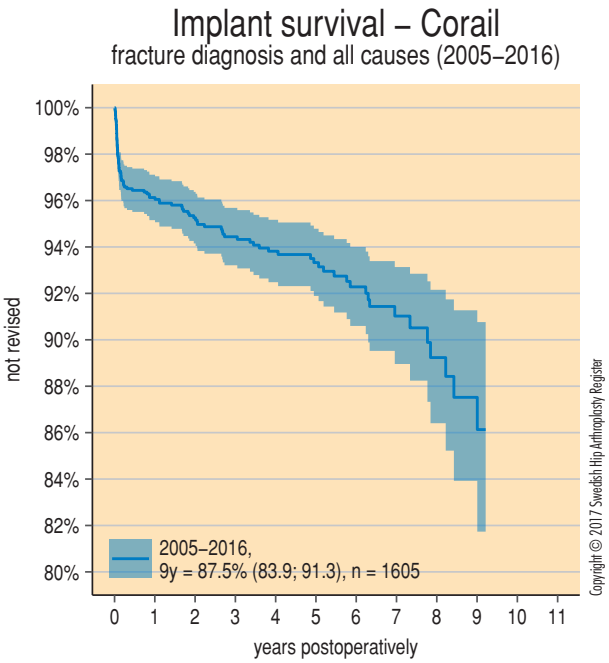


Figure 14.12.

15 most common stem components for fracture patients

2005–2016

Stem	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total[1]	Proportion[2]
SPII standard	2 209	2 305	2 705	2 834	2 722	2 655	2 702	2 664	2 751	2 975	3 082	3 380	14 852	48.7%
Exeter standard	1 199	1 261	1 392	1 550	1 722	1 845	1 874	1 915	2 057	2 078	2 118	1 991	10 159	33.3%
Covision straight	0	0	24	152	239	273	336	331	373	385	345	251	1 685	5.5%
MS-30	3	12	169	256	227	238	242	301	325	323	321	318	1 588	5.2%
CPT	252	254	270	319	398	386	431	416	395	13	7	9	840	2.8%
Corail	30	116	129	171	167	253	195	131	126	110	108	79	554	1.8%
Exeter long	27	34	32	24	32	20	23	24	34	38	29	24	149	0.5%
Bi-metric X por HA NC	3	9	20	12	44	57	47	35	46	17	14	11	123	0.4%
Wagner Cone	2	4	4	5	10	10	23	18	29	21	17	12	97	0.3%
Restoration	0	0	1	1	9	11	11	21	16	7	12	19	75	0.2%
MP proximal standard	4	7	15	11	7	14	18	16	20	18	10	4	68	0.2%
CLS	20	39	49	37	16	9	11	16	13	5	12	4	50	0.2%
Spectron EF Primary	469	514	245	145	240	209	174	21	5	0	1	4	31	0.1%
Revitan cylinder	5	6	12	4	2	3	1	6	5	4	5	3	23	0.1%
Accolade straight	4	10	5	2	7	5	4	4	10	4	3	1	22	0.1%
Other	1 017	971	670	408	160	52	21	24	36	23	14	31	128	0.1%
Total	5 244	5 542	5 742	5 931	6 002	6 040	6 113	5 943	6 241	6 021	6 098	6 141	30 444	100%

1) Refers to the number of primary operations during the last five years.

2) Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common cup or head components for fracture patients

2005–2016

Cup/hemiarthroplasty head	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total[1]	Proportion[2]
Unipolar prosthesis head (Link)	457	648	669	701	1 172	1 385	1 535	1 405	1 557	1 757	1 757	1 964	8 440	27.7%
UHR Universal Head	594	576	628	702	677	674	628	644	670	743	837	831	3 725	12.2%
Unitary modular endohead	0	1	1	0	2	0	417	576	564	525	466	533	2 664	8.7%
Lubinus	667	603	684	670	626	626	591	535	446	373	296	152	1 802	5.9%
Lubinus x-link	0	0	0	0	0	2	71	131	250	338	466	608	1 793	5.9%
Covision unipolar	0	0	26	157	236	271	342	337	376	397	348	253	1 711	5.6%
Marathon	0	0	0	10	134	309	352	359	393	324	302	268	1 646	5.4%
V40 unipolar	274	328	375	495	718	766	431	285	367	348	336	157	1 493	4.9%
Avantage	1	15	16	37	58	56	70	129	203	235	232	321	1 120	3.7%
Vario cup	985	1 035	1 294	1 342	775	530	362	356	186	128	131	159	960	3.2%
Exeter RimFit	0	0	0	0	0	10	68	80	151	184	224	276	915	3%
MultiPolar Bipolar Cup	0	1	37	72	70	68	87	120	126	137	145	135	663	2.2%
Ultima Monk biarticular head	315	433	382	423	321	278	272	255	213	27	0	0	495	1.6%
ZCA XLPE	0	13	137	204	251	238	191	175	173	65	50	9	472	1.6%
Unipolar	94	56	120	104	92	93	68	86	90	96	100	97	469	1.5%
Other	1 174	1 265	1 029	886	829	736	628	470	475	344	412	377	2 078	6.8%
Total	4 561	4 974	5 398	5 803	5 961	6 042	6 113	5 943	6 240	6 021	6 102	6 140	30 446	100%

1) Refers to the number of primary operations during the last five years.

2) Refers to the proportion of the total number of primary operations carried out during the last five years.

Reoperation within six months per unit – fracture patients

2015–2016

Unit	Number of primary arthroplasties[1)]	Number of reoperations (within six months)[2)]	Proportion in percentages[3)]
University or regional hospitals			
Karolinska/Huddinge	252	9	4.4%
Karolinska/Solna	157	12	8.4%
Linköping	193	3	1.9%
SU/Mölndal	818	14	1.9%
SU/Sahlgrenska	3	0	–
SUS/Lund	469	15	3.4%
SUS/Malmö	442	16	4.1%
Umeå	216	6	3.1%
Uppsala	390	14	4.0%
Örebro	156	6	4.3%
County hospitals			
Borås	253	9	40.%
Danderyd	445	11	2.7%
Eksjö	116	8	8%
Eskilstuna	233	6	3.0%
Falun	331	12	3.9%
Gävle	304	7	2.6%
Halmstad	199	9	4.9%
Helsingborg	388	15	4.6%
Hässleholm-Kristianstad	333	5	1.7%
Jönköping	148	4	3.0%
Kalmar	177	4	2.6%
Karlskrona	239	3	1.5%
Karlstad	316	8	3.0%
Norrköping	227	3	1.5%
NÄL	246	2	0.9%
Skövde	234	13	6.0%
Sundsvall	261	7	3.2%
Södersjukhuset	669	23	3.8%
Uddevalla	229	5	2.4%
Varberg	215	4	2.0%
Västerås	326	5	1.7%
Växjö	159	3	2.0%
Ystad	81	0	0%
Östersund	239	13	5.9%

(Continued on next page.)

Reoperation within six months per unit – fracture patients (cont.)

2015–2016

Unit	Number of primary arthroplasties[1)]	Number of reoperations (within six months)[2)]	Proportion in percentages[3)]
Rural hospitals			
Alingsås	92	5	5.8%
Arvika	20	0	–
Frölunda Specialistsjukhus	1	0	–
Gällivare	92	4	4.9%
Hudiksvall	152	3	2.4%
Karlshamn	7	0	–
Karlskoga	115	8	8.4%
Katrineholm	1	0	–
Kungälv	155	9	6.9%
Lidköping	104	2	2.2%
Lindesberg	60	3	5.6%
Ljungby	103	4	4.2%
Lycksele	48	1	2.4%
Mora	145	3	2.3%
Norrtälje	105	3	3.2%
Nyköping	95	2	2.2%
Oskarshamn	6	0	–
Piteå	17	0	–
Skellefteå	108	1	1.0%
Sollefteå	53	0	0%
Sunderby	270	7	2.7%
Södertälje	94	8	9.4%
Torsby	84	0	0%
Trelleborg	23	0	0%
Visby	64	4	6.6%
Värnamo	74	3	4.6%
Västervik	102	6	6.1%
Ängelholm	1	0	–
Örnsköldsvik	104	0	0%
Private hospitals			
Aleris Specialistvård Bollnäs	1	0	–
Aleris Specialistvård Motala	107	2	1.9%
Aleris Specialistvård Ängelholm	2	0	–
Capio Movement	3	0	–
Capio S:t Göran	388	9	2.8%
Carlanderska	1	0	–
Country	12 261	361	3.3%

1) Refers to the number of primary operations during the period.
2) Refers to the number who were reoperated within six months.
3) Refers to the quota between 1) and 2) in percentages.

90-day mortality per unit – fracture patients

proportion of deaths within 90 days after primary surgery (percent)**, 2015–2016**

Unit	Number[1)]	>80[2)]	Men[3)]	ASA=III[4)]	ASA=IV[5)]	Acute fracture	Mortality[6)]
University or regional hospitals							
Karolinska/Huddinge	252	61%	39%	59%	11%	92%	10.9%
Karolinska/Solna	157	60%	34%	65%	11%	88%	14.5%
Linköping	193	65%	37%	51%	11%	92%	12.3%
SU/Mölndal	818	64%	36%	49%	6%	93%	13.8%
SU/Sahlgrenska	3	67%	33%	33%	0%	100%	33.3%
SUS/Lund	469	61%	32%	60%	5%	88%	11.9%
SUS/Malmö	442	69%	32%	79%	9%	97%	13.4%
Umeå	216	56%	28%	56%	4%	95%	11.1%
Uppsala	390	60%	34%	63%	7%	94%	14.3%
Örebro	156	63%	28%	42%	4%	88%	9.2%
County hospitals							
Borås	253	69%	33%	46%	5%	91%	10.7%
Danderyd	445	65%	30%	61%	7%	90%	10.2%
Eksjö	116	69%	30%	47%	6%	97%	13.5%
Eskilstuna	233	65%	33%	49%	9%	91%	17.8%
Falun	331	66%	37%	53%	6%	93%	14.8%
Gävle	304	67%	31%	41%	7%	94%	14.5%
Halmstad	199	63%	36%	45%	3%	87%	10%
Helsingborg	388	63%	35%	46%	5%	94%	10.7%
Hässleholm-Kristianstad	333	64%	36%	54%	5%	89%	16.6%
Jönköping	148	61%	28%	56%	5%	92%	10.5%
Kalmar	177	58%	27%	34%	2%	95%	10.6%
Karlskrona	239	70%	30%	43%	4%	96%	13%
Karlstad	316	65%	34%	61%	8%	94%	17.4%
Norrköping	227	60%	35%	45%	6%	87%	16%
NÄL	246	59%	36%	57%	11%	99%	17.1%
Skövde	234	62%	37%	50%	4%	91%	11.9%
Sundsvall	261	62%	36%	46%	3%	94%	12%
Södersjukhuset	669	65%	33%	62%	9%	88%	12.5%
Uddevalla	229	65%	36%	58%	3%	88%	15.7%
Varberg	215	66%	37%	42%	4%	93%	11.7%
Västerås	326	62%	30%	68%	5%	94%	10.3%
Växjö	159	62%	32%	55%	6%	92%	5.7%
Ystad	81	75%	23%	60%	9%	99%	16.5%
Östersund	239	65%	28%	35%	12%	95%	8.4%

(Continued on next page.)

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

andel avlidna inom 90 dagar efter primäroperation (procent)**, 2015–2016**

Unit	Number[1]	>80[2]	Men[3]	ASA=III[4]	ASA=IV[5]	Acute fracture	Mortality[6]
Rural hospitals							
Alingsås	92	59%	35%	53%	10%	93%	10.1%
Arvika	20	70%	50%	30%	10%	85%	15.3%
Frölunda Specialistsjukhus	1	0%	0%	0%	0%	100%	0%
Gällivare	92	61%	32%	47%	15%	91%	15.7%
Hudiksvall	152	59%	34%	49%	5%	91%	15.3%
Karlshamn	7	43%	29%	29%	0%	0%	0%
Karlskoga	115	60%	37%	41%	8%	96%	18.1%
Katrineholm	1	0%	100%	0%	0%	0%	0%
Kungälv	155	65%	41%	48%	5%	97%	14%
Lidköping	104	72%	30%	39%	2%	87%	13%
Lindesberg	60	58%	37%	39%	4%	88%	8.7%
Ljungby	103	71%	34%	52%	0%	87%	9.3%
Lycksele	48	58%	23%	63%	2%	94%	17.9%
Mora	145	61%	30%	44%	4%	92%	13.3%
Norrtälje	105	57%	39%	66%	6%	92%	12.2%
Nyköping	95	62%	29%	55%	1%	96%	12.7%
Oskarshamn	6	50%	33%	50%	0%	17%	0%
Piteå	17	35%	59%	47%	0%	18%	6.2%
Skellefteå	108	53%	24%	46%	7%	89%	10.4%
Sollefteå	53	58%	30%	51%	4%	94%	11.3%
Sunderby	270	62%	41%	57%	11%	99%	14.5%
Södertälje	94	51%	39%	68%	2%	95%	11.1%
Torsby	84	68%	44%	62%	4%	95%	13.5%
Trelleborg	23	17%	26%	9%	0%	0%	4.3%
Visby	64	55%	23%	41%	0%	88%	6.4%
Värnamo	74	62%	30%	45%	1%	99%	8.4%
Västervik	102	74%	30%	27%	1%	93%	9.3%
Ängelholm	1	0%	100%	0%	0%	100%	0%
Örnsköldsvik	104	67%	28%	60%	7%	97%	14.2%
Private hospitals							
Aleris Specialistvård Bollnäs	1	0%	100%	0%	0%	0%	0%
Aleris Specialistvård Motala	107	71%	35%	61%	8%	86%	21.3%
Aleris Specialistvård Ängelholm	2	50%	50%	0%	0%	0%	0%
Capio Movement	3	0%	67%	33%	0%	0%	0%
Capio S:t Göran	388	72%	33%	61%	7%	95%	15.6%
Carlanderska	1	0%	0%	0%	0%	0%	0%
Country	12 261	64%	33%	54%	6%	92%	12.9%

[1] *Refers to the number of primary operations during the period.*
[2] *Refers to the proportion of patients in the age group 80 and over.*
[3] *Refers to the proportion during the period.*
[4] *Proportion of patients with ASA class III.*
[5] *Proportion of patients with ASA class IV.*
[6] *90-day mortality (100 × (number of patients who died within three months of the primary operation / number of operations during the period)).*

15 Register development – value compasses

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 units' results in several dimensions via the tables alone. To facilitate the interpretation and quickly review units' results, we use the so-called value compass which includes seven or eight outcome variables (point 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 unit has a problem area. The compass can be regarded as a simplified signal system. We have developed value compasses for all total arthroplasty patients, the standard patient and for patients who are treated with prosthesis due to fracture.

Each variable has been rescaled to values from 0 to 1. The worst value (0.0) for the variables was given as origo and the best value (1.0) at the periphery. The limits are determined by taking the highest and the lowest mean values (on unit level) plus/minus a standard deviation. The national mean values are indicated on each point of the compass through the outer edge of the red area. The mean value of a specific unit for actual variable is indicated on each point of the compass through the outer edge of the green area. The values in the red area are worse than the national average and the values in the green area are better than the national average. The more red fields there are, the worse the results. Please note that the observation period for the variables varies.

15.1 Follow-up after total arthroplasty

Result variables:

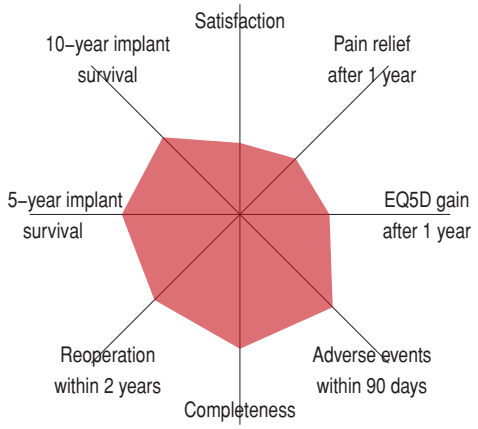
- **Patient satisfaction at one-year follow-up.**
- **Pain relief.** The value is calculated by subtracting the value of preoperative value with the value which is specified 1 year after the operation.
- **Improved health-related quality of life (gain in EQ-5D index).** The value is calculated by subtracting preoperative EQ-5D index with EQ-5D index 1 year after the operation.
- **"Adverse events" within 90 days.** For definitions, see the chapter 13 on "adverse events". The indicator also includes mortality. Reporting 'adverse events' with greater numbers and variability gives one dimension in the compasses a greater opportunity for improvement.
- **Coverage.** Coverage (completeness) at the level of the individual according to the latest cross-referencing with the Patient Register at the Swedish National Board of Health and Welfare.
- **Reoperation within 2 years.** Lists all forms of reoperation within 2 years after primary operation and during the latest 4-year period.
- **5-year implant survival.** Prosthetic survival after 5 years with Kaplan-Meier statistics.
- **10-year implant survival.** The same variable as above but with a longer follow-up period. Since the patient selection to the "standard patient" group is based, among other things, on BMI and ASA class (which we have registered since 2008), there is no data on 10-year implant survival for the standard patient.

Each unit's value compass has a graphic presentation of the unit's "case-mix" linked to it. This is constructed in the same way as the value compass and includes several of the patient-related 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 favourable the patient profile owned by the unit in focus. For the standard patient, there are no case-mix compasses because it has already been adjusted for via patient selection.

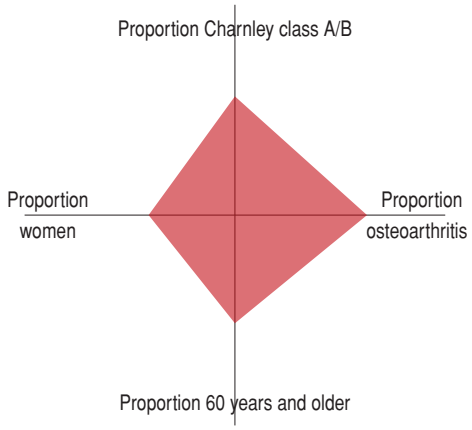
- **Charnley classification.** Patients who are classified in Charnley class A or B (without other illness and/or complaints on joints other than hips which affect the patient's mobility), have a lower risk for complications and better patient-reported outcomes.
- **The proportion of primary osteoarthritis.** Compared to other underlying joint diseases, primary osteoarthritis is associated with a lower risk for complications and better patient-reported outcomes.
- **The proportion of patients aged 60 or older.** The risk for reoperation is lower for individuals over the age of 60.
- **The proportion of women.** The risk for reoperation is lower for women.

Quality indicator

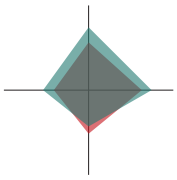
Value compass – national average



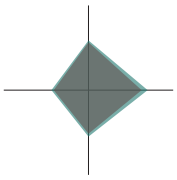
Case–mix–profile
national average



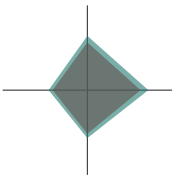
Aleris Specialistvård Nacka



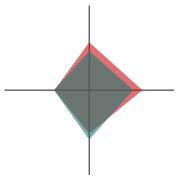
Alingsås



Arvika



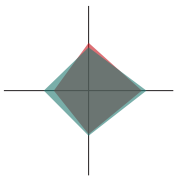
Borås



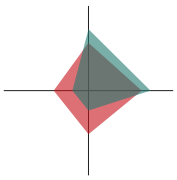
Capio Movement

Capio Ortopediska Huset

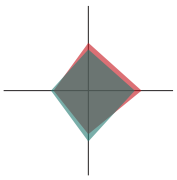
Capio S:t Göran



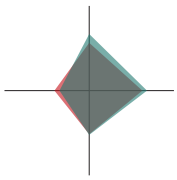
Carlanderska



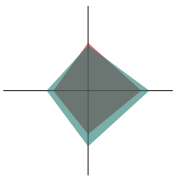
Danderyd



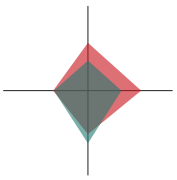
Eksjö



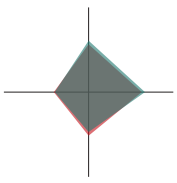
Enköping



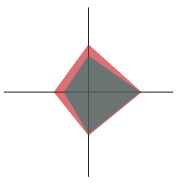
Eskilstuna



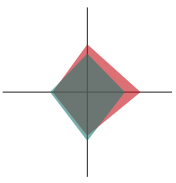
Falun



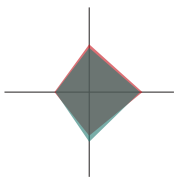
Gällivare



Gävle



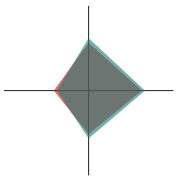
Halmstad



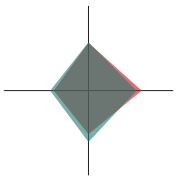
Helsingborg

Hudiksvall

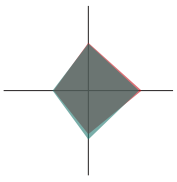
Hässleholm–Kristianstad



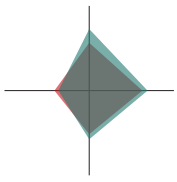
Jönköping



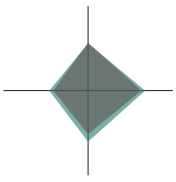
Kalmar



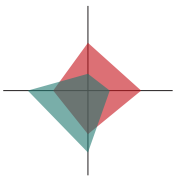
Karlshamn



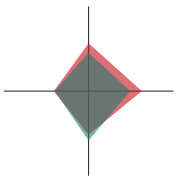
Karlskoga



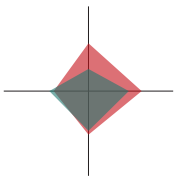
Karlskrona



Karlstad

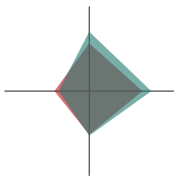


Karolinska/Huddinge

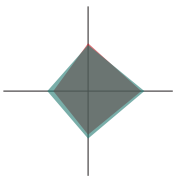


Karolinska/Solna

Katrineholm



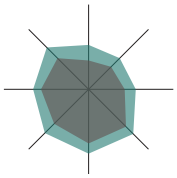
Kungälv



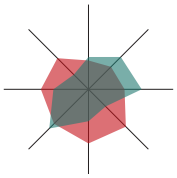
Lidköping

Value compasses (continued)

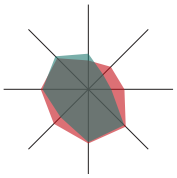
Lindesberg



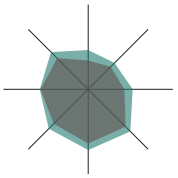
Linköping



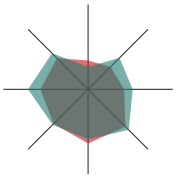
Ljungby



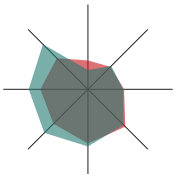
Lycksele



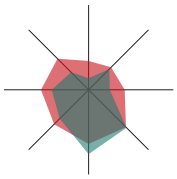
Mora



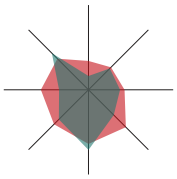
Norrköping



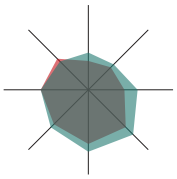
Norrtälje



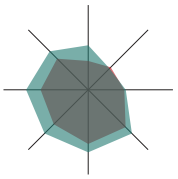
Nyköping



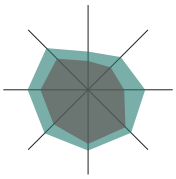
Ortho Center Stockholm



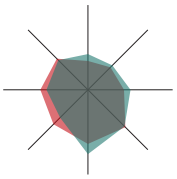
Oskarshamn



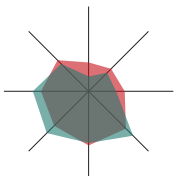
Piteå



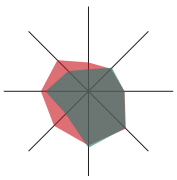
Skellefteå



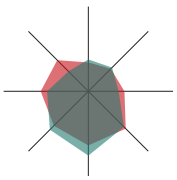
Skene



Skövde

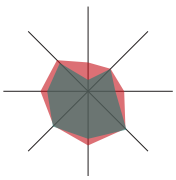


Sollefteå

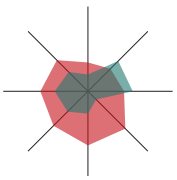


Sophiahemmet

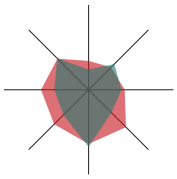
SU/Mölndal



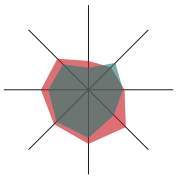
Sunderby



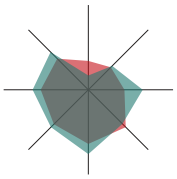
Sundsvall



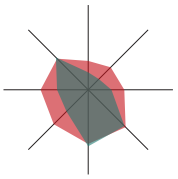
SUS/Lund



SUS/Malmö



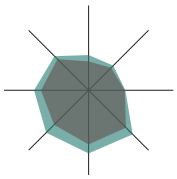
Södersjukhuset



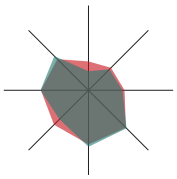
Södertälje

Torsby

Trelleborg

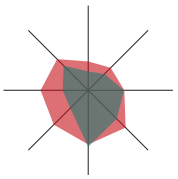


Uddevalla

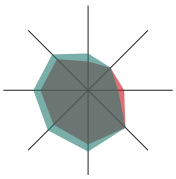


Umeå

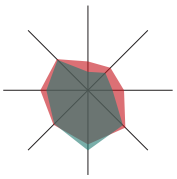
Uppsala



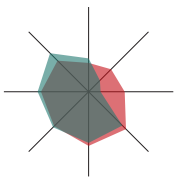
Varberg



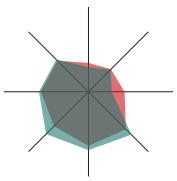
Visby



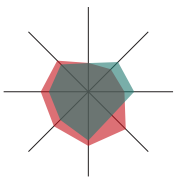
Värnamo



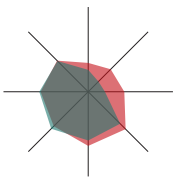
Västervik



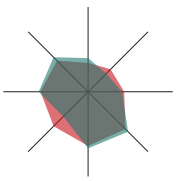
Västerås



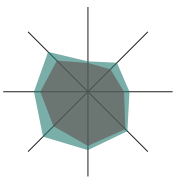
Växjö



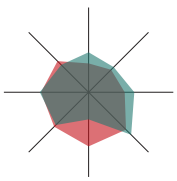
Örebro



Örnsköldsvik

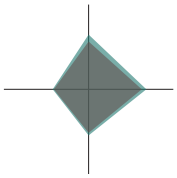


Östersund

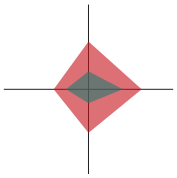


Case-mix-profiles (continued)

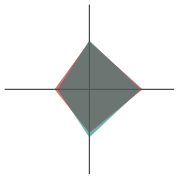
Lindesberg



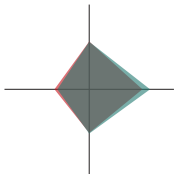
Linköping



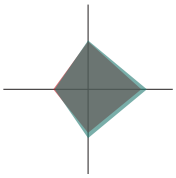
Ljungby



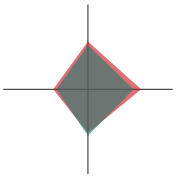
Lycksele



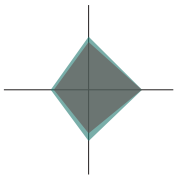
Mora



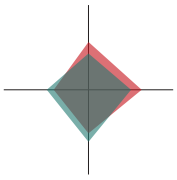
Norrköping



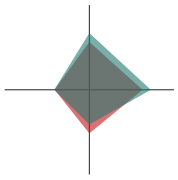
Norrtälje



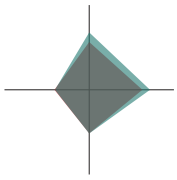
Nyköping



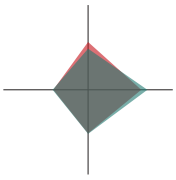
Ortho Center Stockholm



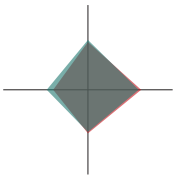
Oskarshamn



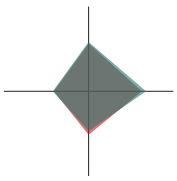
Piteå



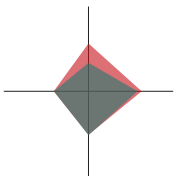
Skellefteå



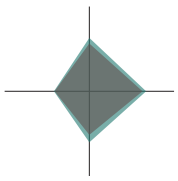
Skene



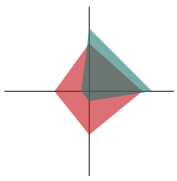
Skövde



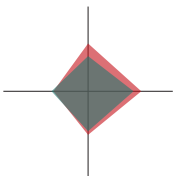
Sollefteå



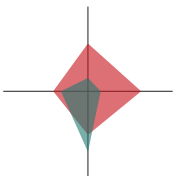
Sophiahemmet



SU/Mölndal



Sunderby



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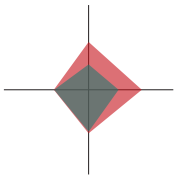
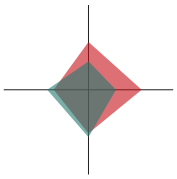


SUS/Lund



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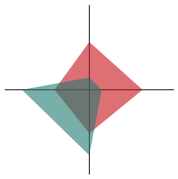

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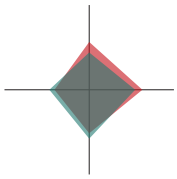
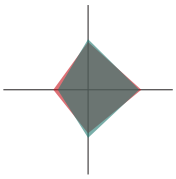
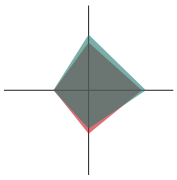


Södertälje



Torsby

Trelleborg



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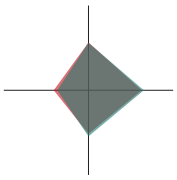
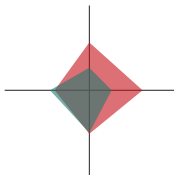


Umeå



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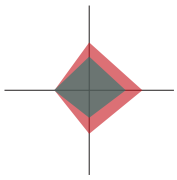
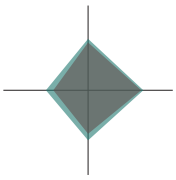
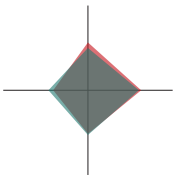


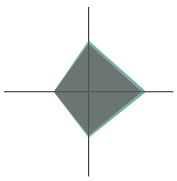
Varberg



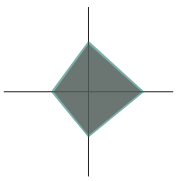
Visby



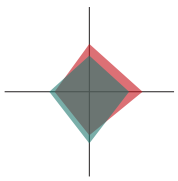
Värnamo



Västervik



Västerås



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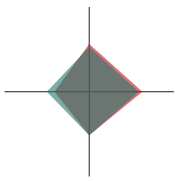
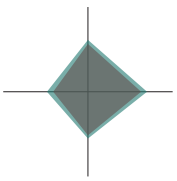
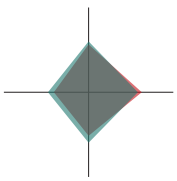


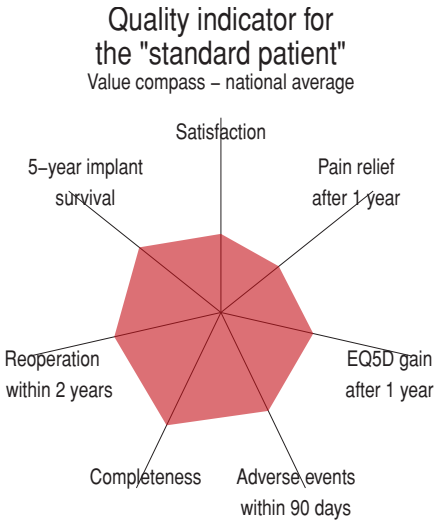
Örebro

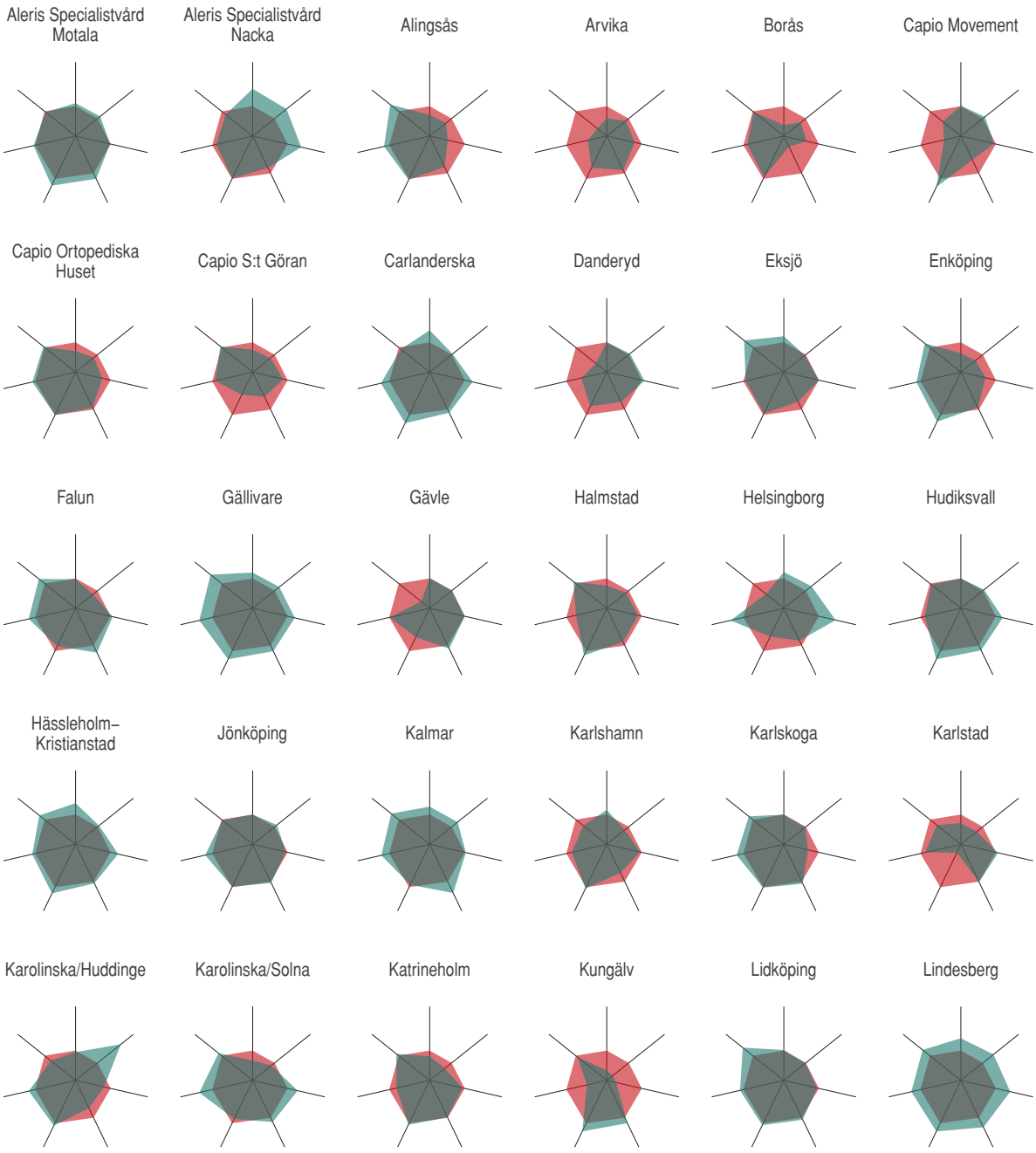
Örnsköldsvik



Östersund

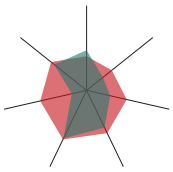



Quality indicator for
the "standard patient"
Value compass – national average
Satisfaction
Pain relief
after 1 year
EQ5D gain
after 1 year
Adverse events
within 90 days
Completeness
Reoperation
within 2 years
5–year implant
survival

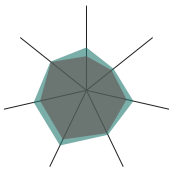

Aleris Specialistvård Motala
Aleris Specialistvård Nacka
Alingsås
Arvika
Borås
Capio Movement
Capio Ortopediska Huset
Capio S:t Göran
Carlanderska
Danderyd
Eksjö
Enköping
Falun
Gällivare
Gävle
Halmstad
Helsingborg
Hudiksvall
Hässleholm–Kristianstad
Jönköping
Kalmar
Karlshamn
Karlskoga
Karlstad
Karolinska/Huddinge
Karolinska/Solna
Katrineholm
Kungälv
Lidköping
Lindesberg

Value compasses (continued)

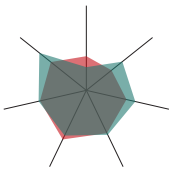
Ljungby



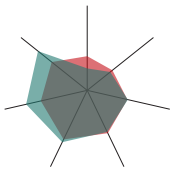
Lycksele



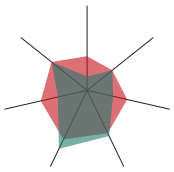
Mora



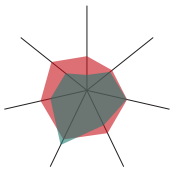
Norrköping



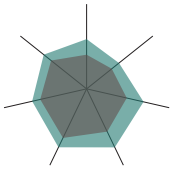
Norrtälje



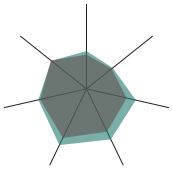
Nyköping



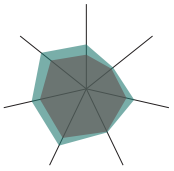
Ortho Center IFK–kliniken



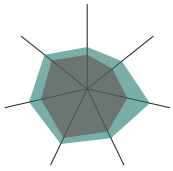
Ortho Center Stockholm



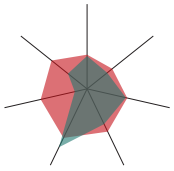
Oskarshamn



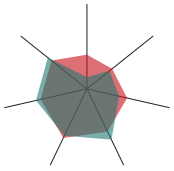
Piteå



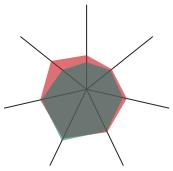
Skellefteå



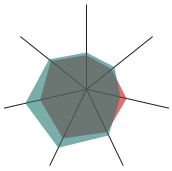
Skene



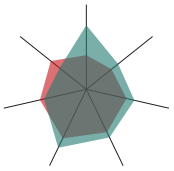
Skövde



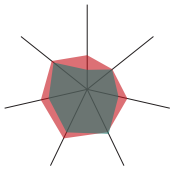
Sollefteå



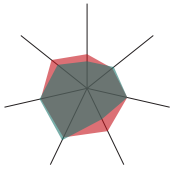
Sophiahemmet



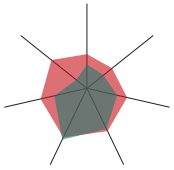
SU/Mölndal



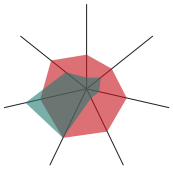
Sundsvall



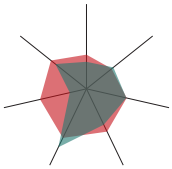
Södersjukhuset



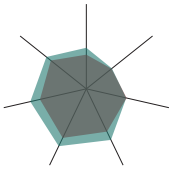
Södertälje



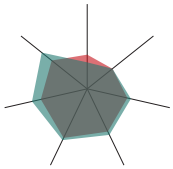
Torsby



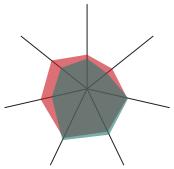
Trelleborg



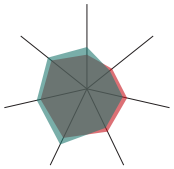
Uddevalla



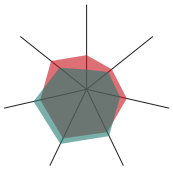
Uppsala



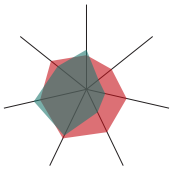
Varberg



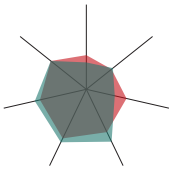
Visby



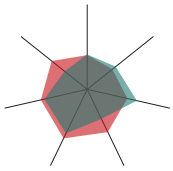
Värnamo



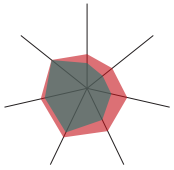
Västervik



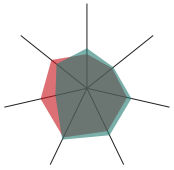
Västerås



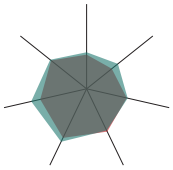
Växjö



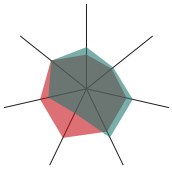
Örebro



Örnsköldsvik



Östersund



Notes

15.2 Follow-up after hip arthroplasty as fracture treatment

The value compasses, which display results for the units, comprises total and hemiarthroplasties. This year, the compass contains five variables, including "Adverse events". It is essential for these fragile patients to avoid general complication, which is why we consider this variable valuable.

The objective of this presentation is for each hospital to be able to compare with the national average value and identify any problem areas 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 unit.

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

- Coverage (completeness) at the level of the individual according to the latest cross-referencing with the Patient Register 2015).
- Adverse events within 90 days, according to the latest co-processing with the National Patient Register. These are defined as cardio- and cerebrovascular events, thromboembolic disease, pneumonia and ulcers if these have led to readmission or death. Also included are all types of reoperation of the hip.
- 90-day mortality.
- Reoperation within six months.
- Prosthetic survival after 1 years with Kaplan-Meier statistics.

The selection of fracture patients subject to hip arthroplasty (instead of internal fixation) may appear different at different hospitals and each unit'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 unit 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 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. Units 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 unit the better the long-term results tend to be according to the Register's regression analysis of the database.
- The proportion of non-dementia patients. The figure shows the unit's proportion of patients assessed as cognitively intact. Demented patients have higher mortality after hip fracture. If a unit 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 periprosthetic fracture .

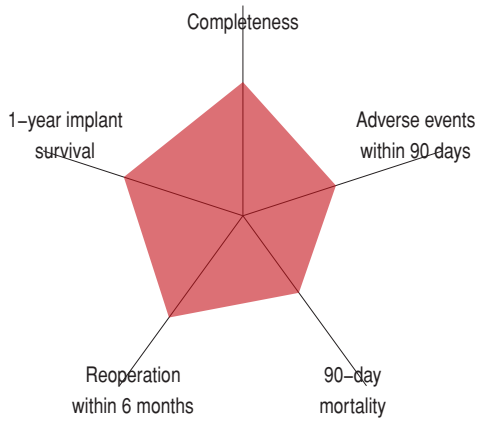
Discussion

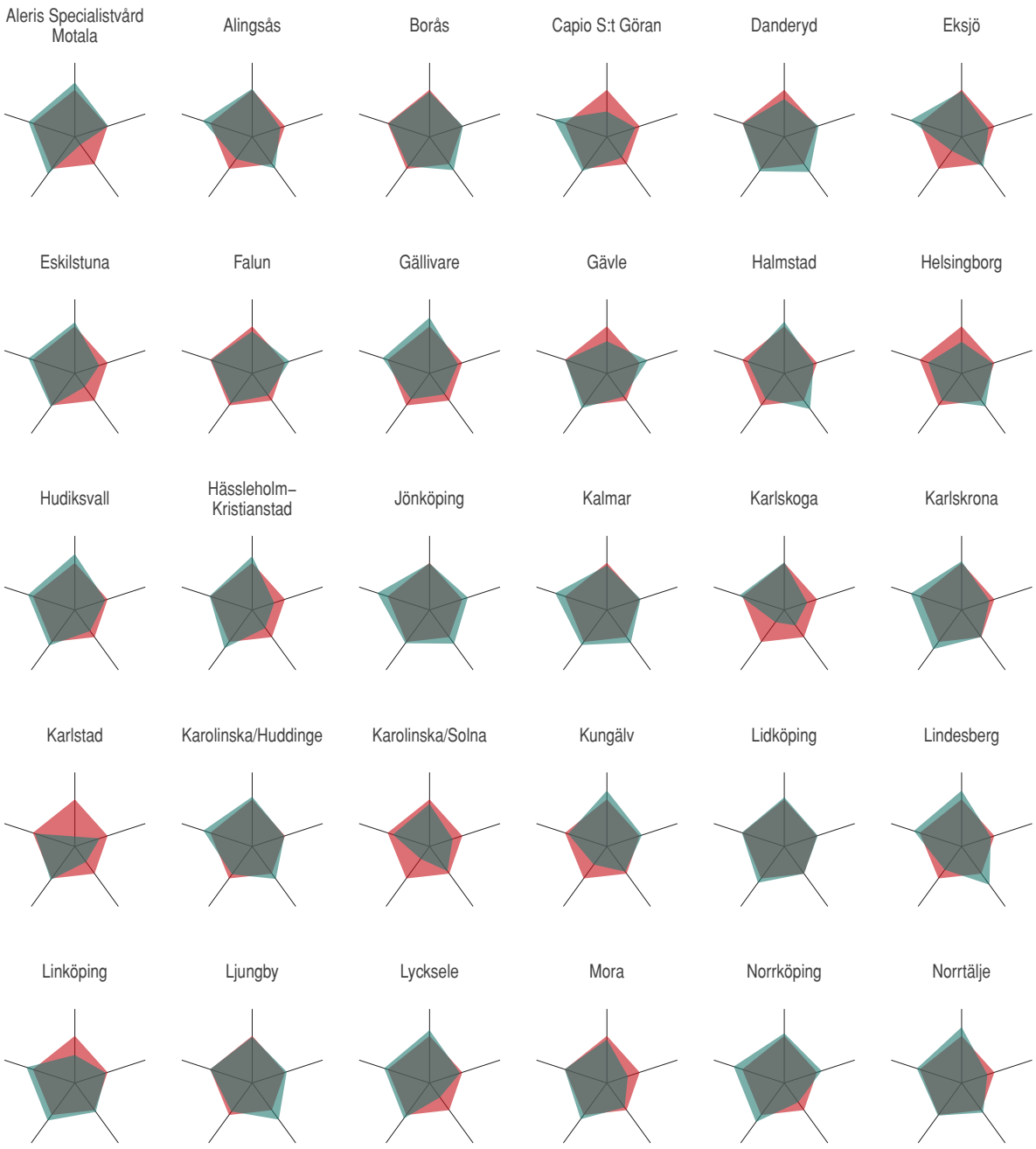
A non-conforming result in the unit's value compass should lead to a local analysis of the various factors influencing the clinical results, in order to improve quality The Register can pass on experience acquired after corresponding analyses at other hospitals, and is prepared to assist with practical help. By comparing the value compasses from previous years, a development may be observed over time. For example, we see that hospitals such as Torsby, Västerås, Växjö, Örebro and Örnsköldsvik have considerably improved their value compass in comparison to previous annual reports.

Since individuals with hip fracture most often have poorer health and are much older compared to osteoarthritis patients operated with total arthroplasty, 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 imply 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

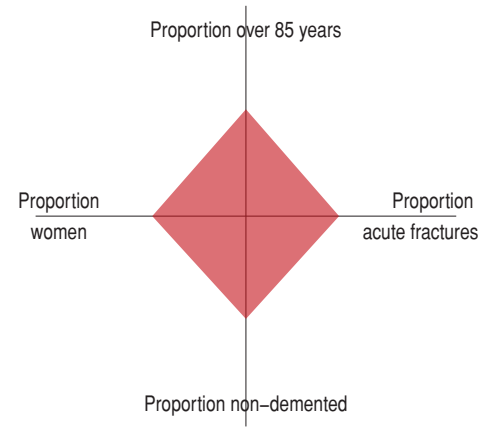
Value compass – national average



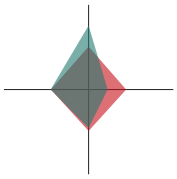


Case–mix profile for hip fracture patients

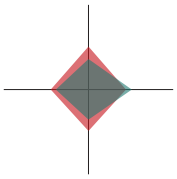
national average



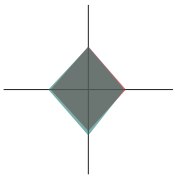
Aleris Specialistvård Motala



Alingsås



Borås



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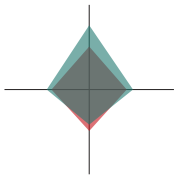
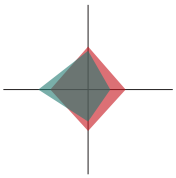
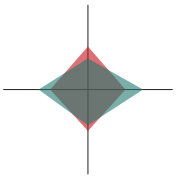


Danderyd



Eksjö



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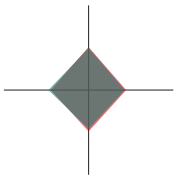
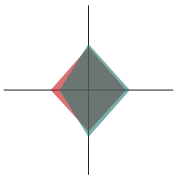
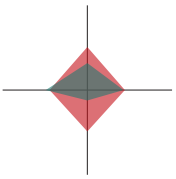


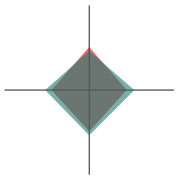
Falun



Gällivare



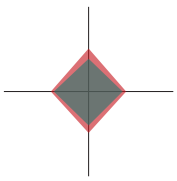
Gävle



Halmstad

Helsingborg

Hudiksvall



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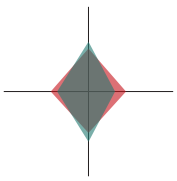
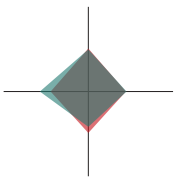
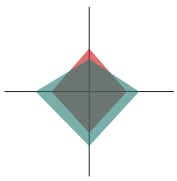


Jönköping



Kalmar



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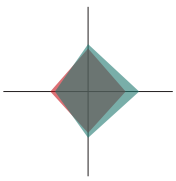

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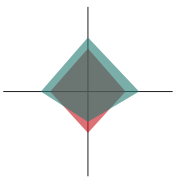
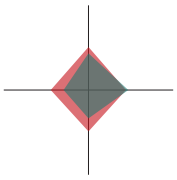
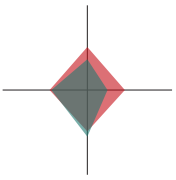


Karlstad

Karolinska/Huddinge



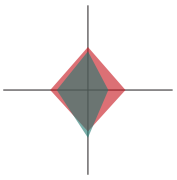
Karolinska/Solna



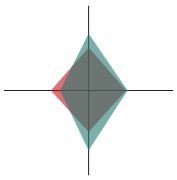
Kungälv

Lidköping

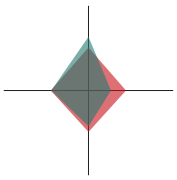
Lindesberg



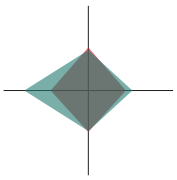
Linköping



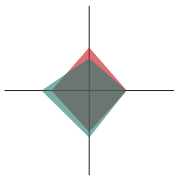
Ljungby



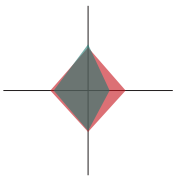
Lycksele



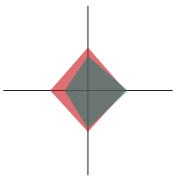
Mora



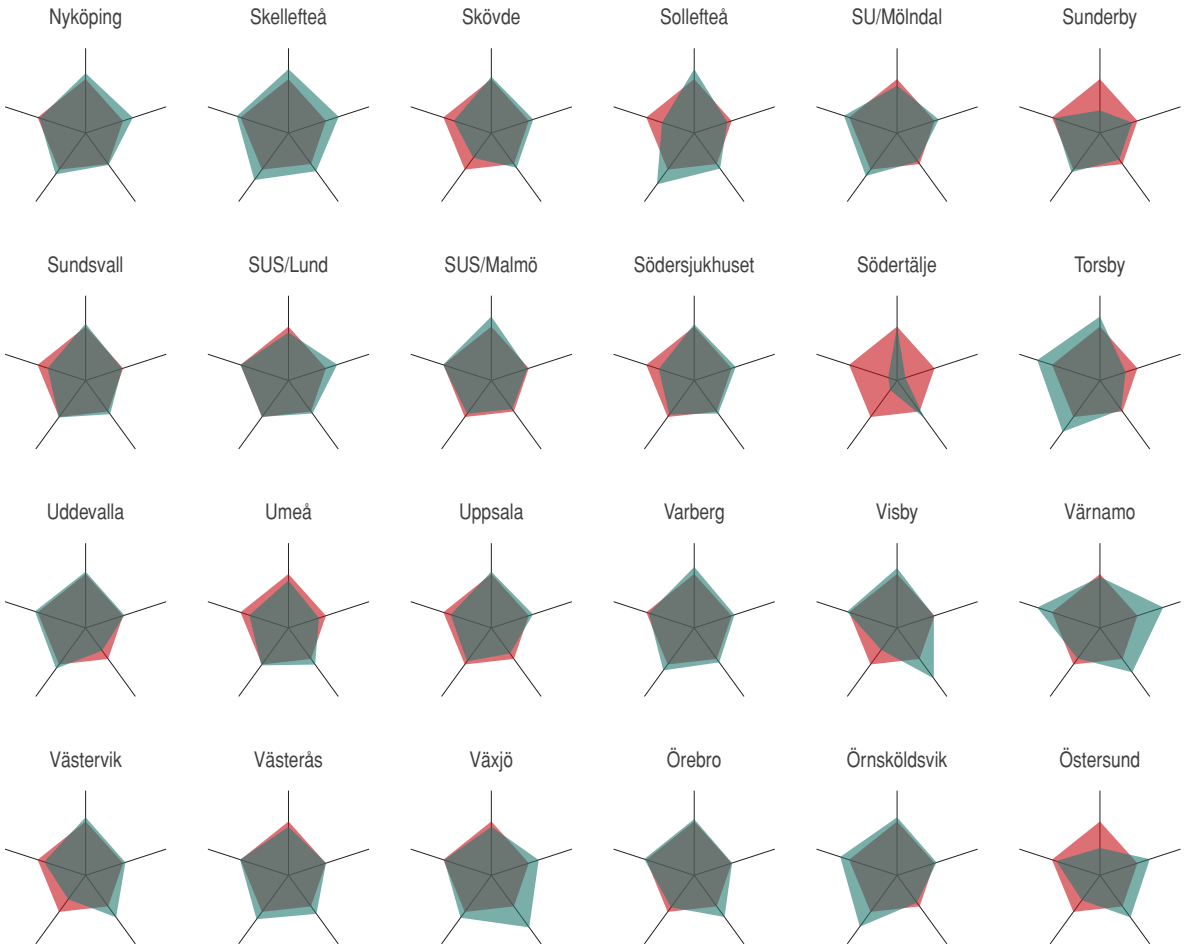
Norrköping



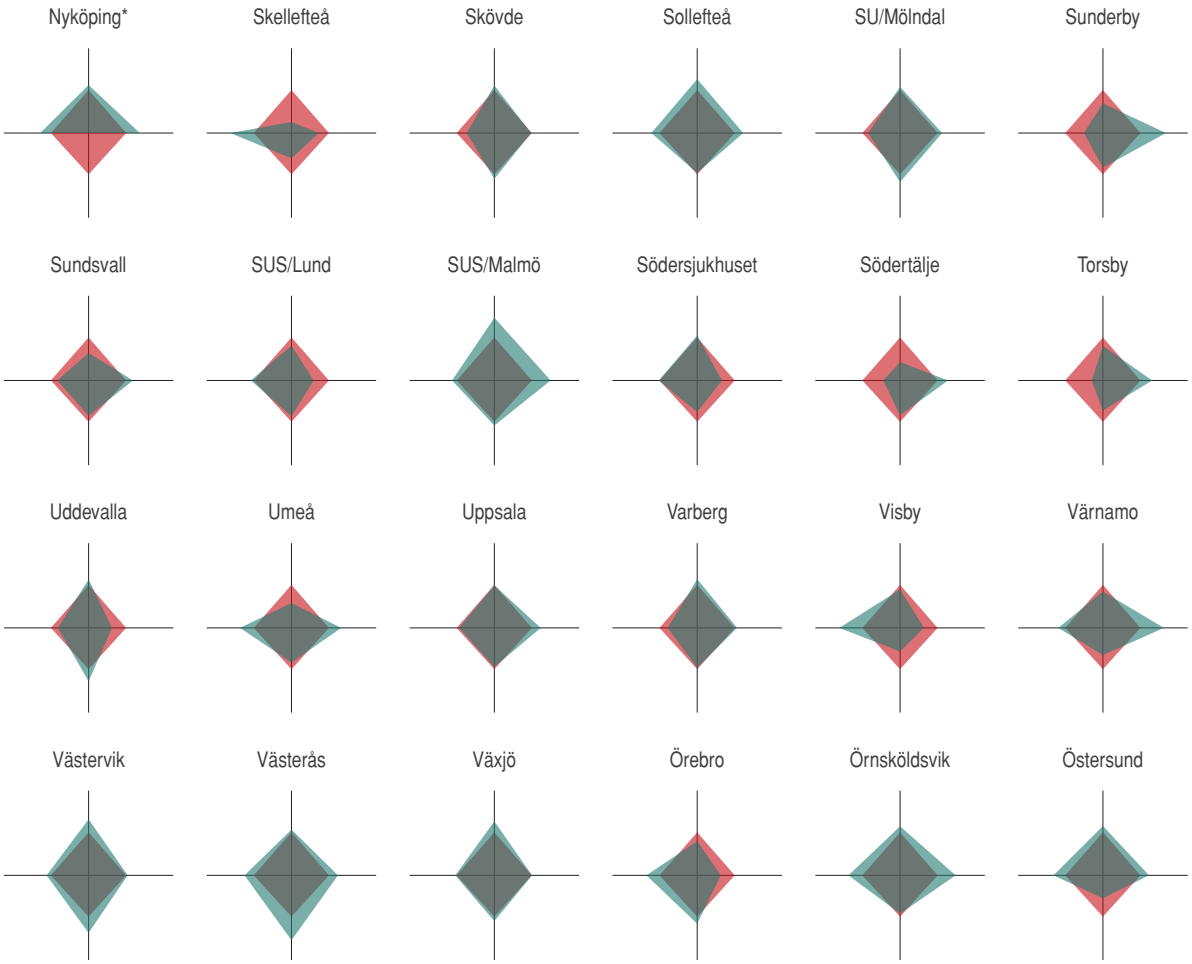
Norrtälje



Value compasses (continued)



Case-mix-profiles (continued)



** Data for dementia variables is missing*

16 Swedish Hip Arthroplasty Register and clinical research

The main tasks of a National Quality Register are analyses of institutions and their activities, improvement projects and clinical research. In addition to covering operating costs, the allocations from the Swedish Association of Local Authorities and Regions (SKL) and the Government to the first two assignments. The idea is that the register-based research will be financed by other means.

16.1 What is research and what are register activities?

However, it is unclear what is seen as the limit for clinical research and evaluation of activities and improvement work. All of the register analysis which is aimed at giving feedback about results and improving the Register activity, is based on scientific methods. In annual reports, we publish targeted in-depth analyses, validation studies and linkage of data with other health-related registers, which is carried out according to established register research methods. Ongoing work according to scientific principles takes place within the Register in order to improve and develop the methods which are used in the Register work. Although the central funding is not meant for research, the SALAR and the Office for Care Analysis regularly evaluate the Register's research activity. High research activity is a criterion for receiving the highest certification level.

16.2 Eighteen thesis from the Swedish Hip Arthroplasty Register

We have conducted strategic work within the Register to improve the infrastructure with the aim of increasing and strengthening the research activities. This has worked out well, which among other things, is signified by the fact that we have 24 ongoing theses projects connected to the Register. The students base their entire or a part of their thesis on data from the Swedish Hip Arthroplasty Register and represent seven Swedish universities (Uppsala university, Lund university, Gothenburg university, Umeå university, Linköping university, Karolinska institute and Örebro university). In 2015 and 2016, 31 peer-reviewed articles were published from the Register. Since 1986, when Lennart Ahnfelt had defended the first thesis based on the Hip Arthroplasty Register, further 17 postgraduate students have published theses based on the Register data supervised by colleagues from the Register. A strong contributor to the fact that research activity is steadily increasing, is that the Register now has two biostaticians who work full-time at the Register.

16.3 Linkage studies

Another explanation to the increasing research activity is that we now utilize other health data registers in the research to a greater extent. Since everything is based on personal identity number, linking the Register's data with other data sources, such as Statistics Sweden, regional patient registers and the National Board of Health and Welfare health data register, provides unique research possibilities. In 2016, we published a description of the process on how to work with the data from the National Board of Health and Welfare, Statistics Sweden and the Swedish Hip Arthroplasty Register (Cnudde et al, BMC Musculoskelet Disord. 2016 Oct 4;17(1):414). In 2017, we are going to update the research database so that it includes all patients who undergo operation up until 2016.

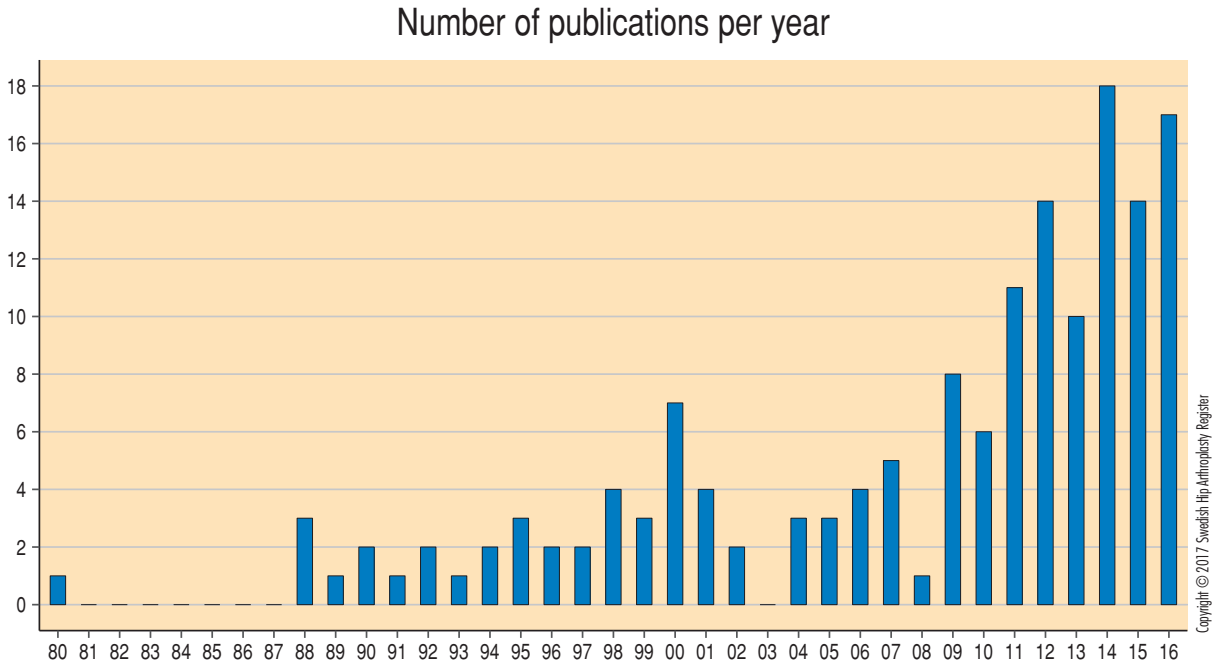
16.4 Why is observational research necessary?

Register studies and randomized clinical trials (RCT) complement each other. Research within joint prosthesis surgery demands long follow-up period and many patients. Several important outcome parameters (reoperations, implant survival and mortality) are relatively rare events. Due to this, register studies are especially good for research within joint replacement surgery. Register studies have special advantages which can be highlighted in this context:

1. Register studies represent results in practice. This means that the results have high generalisability. A registry study provides a true and fair view of how a particular treatment works in routine health care in the normal population.
2. Whether studying exposure or outcomes, the registry study allows, due to its size and long follow-up time, to study things which rarely occur.
3. Registration of an individual in a quality register does not require written informed consent form. This means that it is easier to collect complete data and that data collection can be done at low cost.
4. The continuous longitudinal collection of data allows to analyse changes in patient demographics, treatment and outcomes over time.

16.5 What is needed to use register data for research purposes?

All register-based research needs approval from a Regional Ethical Review Board (EPN). All information in the Register is regarded as official documentation, but it is protected by acts regarding publication and privacy. The register director has been delegated by Västra Götaland regions Central Data Protection Agency (CPUA) the responsibility to exercise confidentiality for requests of data disclosure. We use specific forms for data requests. In order to define roles and to publish scientific information regarding ongoing studies, we also need that the involved researchers sign a research contract according



to the Register's template.

The guidelines for register research can be found at http://kvalitetsregister.se/registerarbete/forskning

The Register has a proven template for the ethics application for research using the Hip Arthroplasty Register.

All research projects are documented in the project database and published on the website. If you want to discuss research projects, we recommend contacting the directorship. A register coordinator has particular responsibility for handling EPN applications and the applications for data disclosures.

The Register management is open for ideas, proposals and discussion regarding cooperation in new register studies.

16.6 All tools are found on SODA

To ensure maximum data security, all data which is used in research, is stored on a server (the SODA server = Secure On-line Data Access). On this server, the user gets access to a virtual computer via two-factor authentication. In the virtual computer, there are project-specific databases, all sorts of statistics programs, MS Office package and other software.

16.7 Seminars for register researchers

Since 2012, the Register organises annual two-day research seminars in January. All affiliated postgraduate students, supervisors and other researchers are invited to this seminar, which contributes to the work in the Register. Both general and specific research questions are discussed in workshop format. This year's meeting (2017) had almost 40 participants. We had specifically invited Professor Martin Bergö to lecture on the topic of "Applying for research grants". All postgraduate students held short presentations about their projects and received feedback. We also had a mini dissertation defence where Per Wretenberg opposed Anne Garland's doctoral studies.

16.8 Dissertations 2017

29th April	Anne Garland, Uppsala University Early mortality after total hip replacement in Sweden
29th September	Per-Erik Johansson. Gothenburg University Improvements in total hip arthroplasty – did they work? Evaluation of different concepts and the consequences of wear

The register's database is well suited to resident and medical student projects and a number of these have been carried out in the past four years.

16.9 Many researchers contribute to the Register's activities

Within the register management and the management group, there are senior researcher who are supervisors or secondary supervisors to the postgraduate students who are connected to the Register. The group conducts broad research in the field; here are ongoing studies about different implants and fixation types, epidemiology, health economics, equal care, hip fractures and prosthetic surgery, periprosthetic fractures, revision surgery, statistical methodology and patient-reported outcome after prosthetic surgery. Members of the group are:

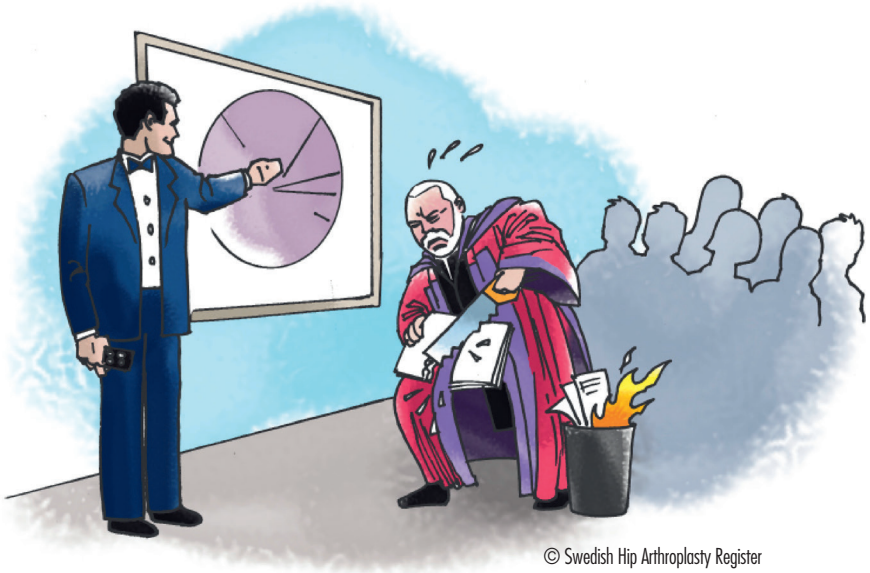
Johan Kärrholm, Gothenburg
Cecilia Rogmark, Malmö
Ola Rolfson, Gothenburg
Szilárd Nemes, Gothenburg
Henrik Malchau, Gothenburg
Maziar Mohaddes, Gothenburg
Hans Lindahl, Lidköping
Göran Garellick, Gothenburg
Leif Dahlberg, Lund
André Stark, Stockholm
Per Wretenberg, Örebro
Nils Hailer, Uppsala
Rüdiger Weiss, Stockholm
Lars Weidenhielm, Stockholm
Olof Sköldenberg, Stockholm
Max Gordon, Stockholm
Clas Rehnberg, Stockholm
Viktor Lindgren, Stockholm
Anne Garland, Visby
John Timperley, Exeter, England
Ashley Blom, Bristol, England
Stephen Graves, Adelaide, Australia
Li Felländer-Tsai, Stockholm
Håkan Hedlund, Visby
Kristina Burström, Stockholm
The NARA group with representatives from Knee and Hip Arthroplasty Registers in Finland, Norway and Denmark.

16.10 Postgraduate students

On the cover of the annual report, there is a list of postgraduate students who partly or entirely base their theses on the data from the Register.

16.11 International research cooperation

The register has also an intensive research cooperation in the NARA (Nordic Arthroplasty Register Association), which is a register cooperation between Finland, Norway, Denmark and Sweden established in 2007 and where a common database is created annually). The group has published 22 scientific articles and further manuscripts are being prepared. NARA database is also available to Swedish postgraduates.



17 References

References to articles, books, theses and exhibitions, which the Register's collaborators have contributed to.

Peer-reviewed articles

Bülow E, Rolfson O, Cnudde P, Rogmark C, Garellick G, Nemes S. Comorbidity does not predict long-term mortality after total hip arthroplasty. Acta Orthop 2017 Jun 28:1–6.

Laaksonen I, Lorimer M, Gromov K, Rolfson O, Mäkelä KT, Graves SE, Malchau H, Mohaddes M. Does the Risk of Rerevision Vary Between Porous Tantalum Cups and Other Cementless Designs After Revision Hip Arthroplasty? Clin Orthop Relat Res 2017 Jun 23.

Bengtsson A, Donahue GS, Nemes S, Garellick G, Rolfson O. Consistency in patient-reported outcomes after total hip replacement. Acta Orthop 2017 Jun 22:1–6.

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Cnudde PH, Kärrholm J, Rolfson O, Timperley AJ, Mohaddes M. Cement-in-cement revision of the femoral stem: analysis of 1179 first-time revisions in the Swedish Hip Arthroplasty Register. Bone Joint J 2017;99-B(4 Supple B):27–32.

Mohaddes M, Cnudde P, Rolfson O, Wall A, Kärrholm J. Use of dual-mobility cup in revision hip arthroplasty reduces the risk for further dislocation: analysis of seven hundred and ninety one first-time revisions performed due to dislocation, reported to the Swedish Hip Arthroplasty Register. Int Orthop 2017;41(3):583–588.

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