

Scottish Arthroplasty Project



Biennial Report 2014

A summary of procedures and outcomes for patients undergoing arthroplasty operations during 2012 - 2013

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Foreword

This is the second SAP Biennial Report, presenting the numbers of arthroplasties for 2012-2013 and subsequent medical complications for these patients. The report includes named NHS Health Board data and is available, with all previous reports, on the SAP website at www.arthro.scot.nhs.uk.

We are grateful for the continued support of the surgeons and NHS Health Boards in both the provision and checking of the quality of data and for their participation in the governance process. Summary data for individual surgeons is now provided directly to them in a tabular format. This information provides an important resource in helping in the continued improvement in patient care and for individual surgeon's revalidation procedures. Graphs showing surgeon outcomes are no longer included directly in the Biennial Report.

Work is now underway to develop the means to identify the different implant types used in individual patients with the aim to include this in the patient electronic record. Work is also ongoing to allow the collection of data required for monitoring of complications and outcome from the variety of routine electronic data currently collected by the NHS Health Boards in Scotland. We hope this will increase the breadth of data collected whilst retaining the feedback process.

Over the next year we hope to work with the orthopaedic surgeons of Scotland to agree the rationalisation of codes used for clinical diagnoses and operation to further improve the quality of this data.

Introduction

The Scottish Arthroplasty Project (SAP) analyses hospital inpatient information to link joint replacement surgery (arthroplasty) patients with subsequent medical complications resulting from each operation. Hip and knee replacements are by far the most numerous type of arthroplasty carried out in Scotland although a range of other joint replacements are performed.

The SAP is administrated by the Information Services Division (ISD) of National Services Scotland (NSS), a special NHS Health Board which provides national strategic support services and expert advice to NHS Scotland. The SAP is managed by the Scottish Arthroplasty Project Steering Committee (SAPSC). The SAP is overseen by the Scottish Committee for Orthopaedics and Trauma (SCOT).

Operations and subsequent complications are routinely monitored and any causes for concern (where the rate of incidence of complications “outlies” an agreed level) are notified to the care team involved. They then review each complication case, and submit their review and remedial action plan for appraisal by the clinical members of the SAPSC. The statistical method used to rapidly identify “outliers” is the Cumulative Sum of Means (CUSUM) method. CUSUM for individual surgeons was established during the period of the previous report and has proven very successful.

In 2013 a CUSUM for Health boards was developed to allow the identification of causes for concern within extended and multiple care teams. Having been successfully piloted, it has not been fully implemented due to funding issues.

Engagement by the orthopaedic surgery community with the clinical governance process is, with minor exceptions, excellent and data provided by SAP routinely used for surgeon appraisal and revalidation.

Within the overall results, many centres show examples of lower than expected complication rates and the potential exists for the examination and sharing of the practices of these centres with others.

The SAPSC would like to thank the orthopaedic surgery community for their ongoing support and active engagement with the SAP audit process.

Key points

- The number of NHS hip and knee arthroplasty operations in Scottish hospitals has continued to show an increase over the past 7 years. There were 7609 primary hip and 7169 primary knee arthroplasties performed in 2013 (Section 1.1).
- The number of NHS knee revision operations in Scottish hospitals has decreased from 567 to 463 during the period 2009 to 2013. The number of NHS hip revision operations has decreased from 986 to 953 over the same period. However the trend for hip revision over a longer time period shows an increase in the number of cases.
- The percentage of NHS hip revision operations undertaken as non-elective cases has increased from 23.3% to 27.6% between 2009 and 2013.
- A significant number of arthroplasty operations are being performed outwith patients' NHS Health Board of residence (Section 1.2).
- A relatively high number of NHS hip and knee revision operations are carried out by consultants who perform low volumes of these operations (Section 1.3).
- The average age of patients undergoing NHS hip arthroplasty, knee arthroplasty or hip or knee revision operations has continued to decrease since 2009 (Section 2.1).
- The average length of inpatient stay when undergoing NHS hip or knee arthroplasty continues to decrease from 10 days in 2001 to 5 in 2013 (Section 3.1).
- The incidence of death (as a recorded complication within 90 days) following NHS hip or knee arthroplasty is less than 0.5% (Section 4).
- The rates of major orthopaedic complications (dislocation, infection and DVT/PE within one year) are all less than 1.5% (Section 4).
- The rate of acute renal failure within 30 days following NHS hip arthroplasty has increased over the period 2004-2013 from 0.47% to 0.78%. The rate of acute renal failure within 30 days following NHS knee arthroplasty has increased over the same period from 0.39% to 0.75%.
- The rates of revision within 5 years of NHS hip arthroplasty remain below 2.6% and below 2.8% for revision within 5 years of NHS knee arthroplasty (Section 5).

- The quality (response incidence, timeliness, content of review and action plan) of responses to the SAP by “complication outlier” surgeons continues to improve and demonstrates their active engagement with the SAP audit process (Section 6).

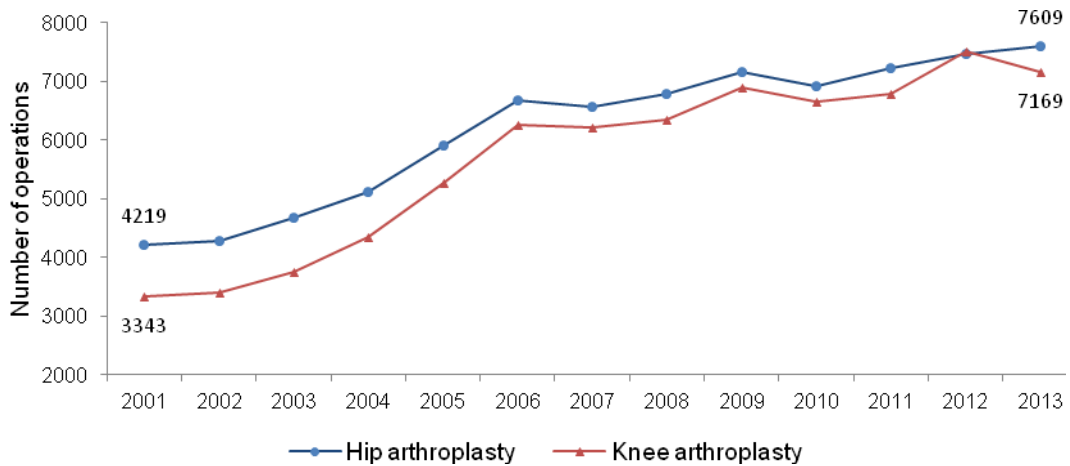
1 Number of arthroplasties

1.1 National rates

The number of NHS primary hip and knee arthroplasty operations in Scottish hospitals has continued to increase. Though the number of knee arthroplasties in 2013 was less than the number of operations in 2012, the overall trend shows an increase since 2009 (Figure 1a).

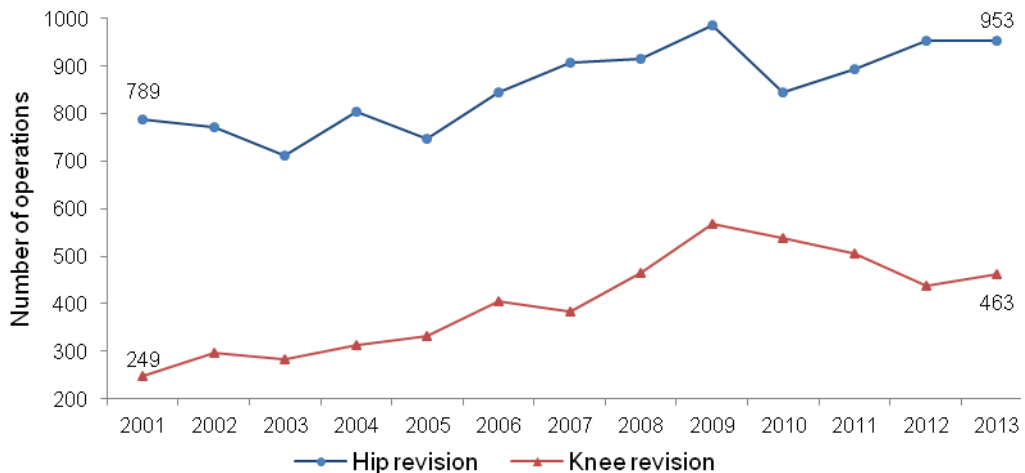
The vast majority of operations continue to be performed as an elective procedure. Since 2009, 93% to 94% of primary hip arthroplasties and 99 % of primary knee arthroplasties were elective procedures.

Figure 1a - Recent trends in numbers of primary hip and knee arthroplasty.



The number of knee revision operations has decreased over the past 5 years from 567 to 463. The number of hip revision operations has decreased from 986 to 953 over the same period (Figure 1b). However the trend for hip revision over a longer time period shows an increase from 712 cases (2003) to 953 cases (2013).

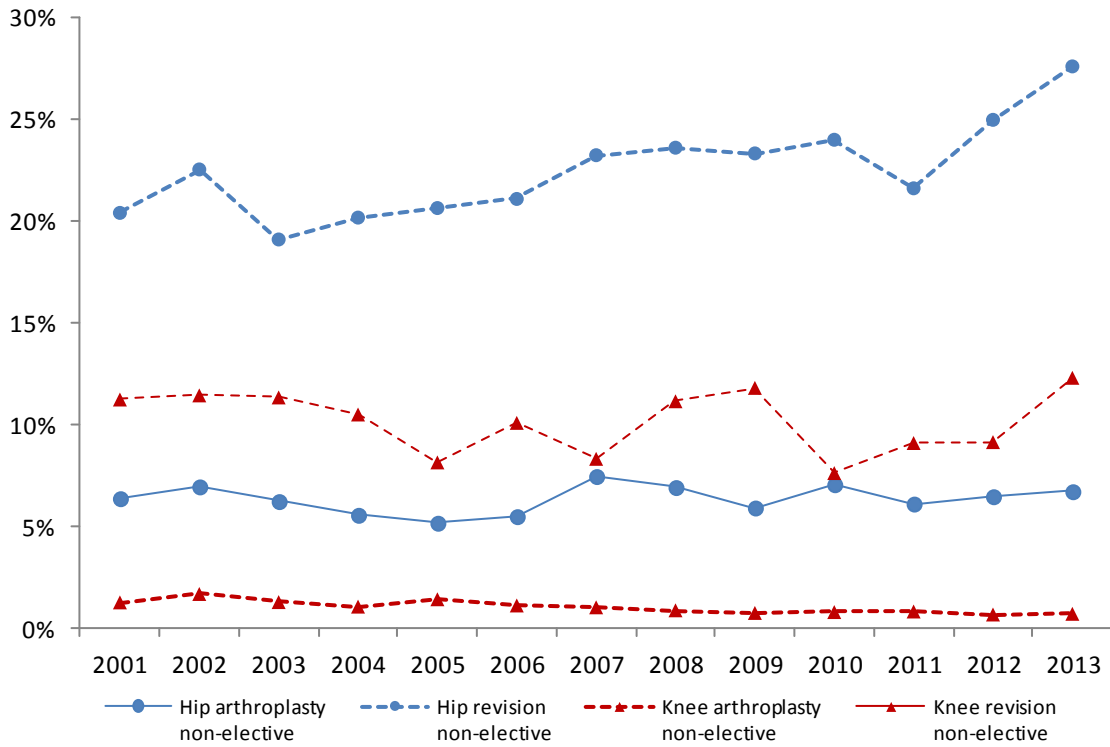
Figure 1b - Recent trends in numbers of hip and knee revision arthroplasty.



In 2013, 11 % of all hip arthroplasties were revisions and 6 % of all knee arthroplasties were revisions.

Since 2003 there are an increasing number of hip revisions being undertaken as non-elective procedures. Since 2009, the incidence of non-elective hip revisions has increased from 23.3% to 27.6% in 2013 (Figure 1c).

Figure 1c - Hip and knee arthroplasty, primary and revision: incidence of non-elective surgery.



An increasing trend in the incidence of primary hip arthroplasty, primary knee arthroplasty and knee revision as a non-elective procedure has not been observed over the same period.

1.2 Number of arthroplasties by NHS Board

The numbers of primary hip and knee arthroplasties undertaken in 2012 and 2013 within the NHS Health Board of treatment is presented in Figure 2a and Figure 2b.

Figure 2a - Number of primary hip arthroplasties 2012-2013 by NHS Board of treatment (NHS GG&C split).

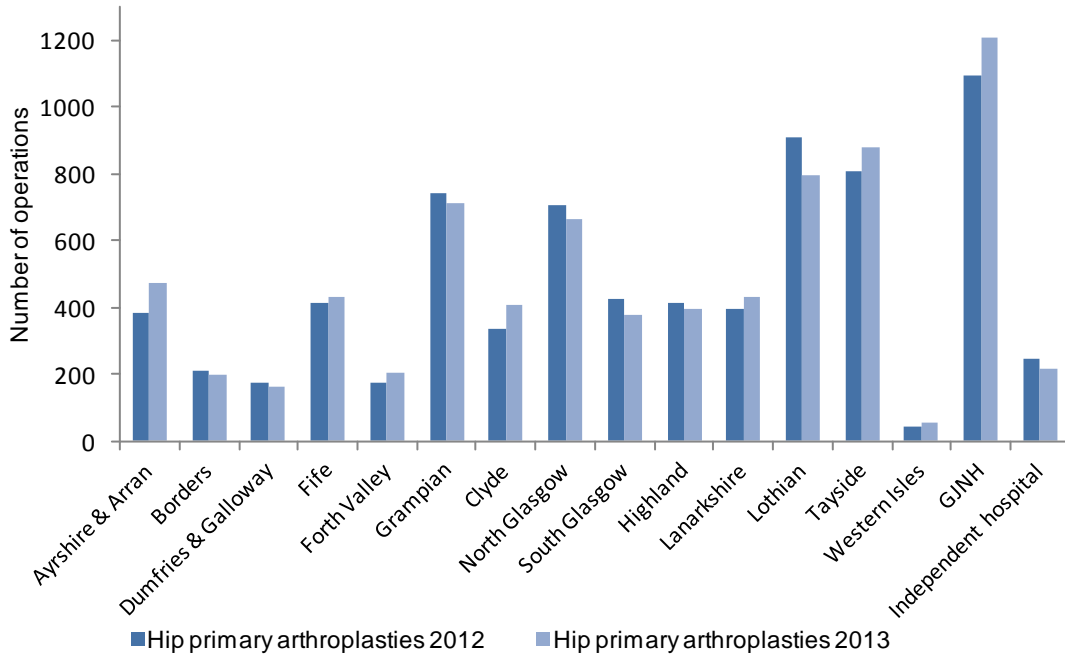
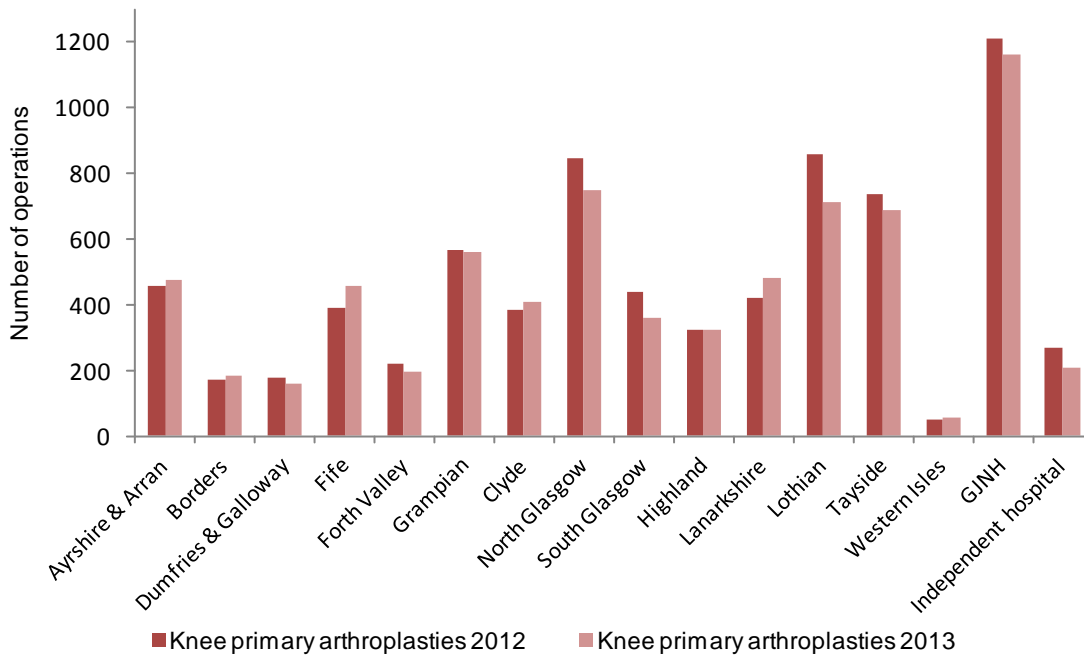


Figure 2b - Number of primary knee arthroplasties 2012-2013 by NHS Board of treatment (NHS GG&C split).



The number of primary hip and knee arthroplasty operations carried out by NHS Boards broadly reflects the population resident in each Health Board (Hip: Tables 1a/1c and Knee: Tables 1b/1d).

It is recognised that many patients are treated out with their Health Board of residence.

The Golden Jubilee National Hospital (GJNH) is a special NHS Board and accepts NHS patients from all of Scotland.

Orkney and Shetland NHS Boards do not routinely schedule arthroplasty operations, and patients requiring orthopaedic surgery are scheduled with mainland NHS Boards.

NHS patients from all of Scotland may receive NHS funded treatment in independent hospitals (at the discretion of their NHS Board).

Table 1a - Number of hip arthroplasties by NHS Board of treatment.

NHS Board	Average number of operations 2008-2011	Number of operations 2012	Number of operations 2013	Average number of revisions 2008-2011	Number of revisions 2012	Number of revisions 2013
Ayrshire & Arran	387	382	473	48	52	70
Borders	180	210	196	5	7	6
Dumfries & Galloway	150	172	165	8	17	4
Fife	405	415	430	45	51	46
Forth Valley	181	177	205	33	35	34
Grampian	714	743	713	101	97	77
Clyde	369	339	407	55	59	54
North Glasgow	689	708	663	114	117	132
South Glasgow	427	425	376	109	107	96
Highland	396	411	396	36	53	37
Lanarkshire	371	396	433	46	43	48
Lothian	904	908	797	151	141	160
Tayside	757	810	880	90	107	103
Western Isles	37	42	53	0	1	10
GJNH	1000	1094	1207	77	65	74
Independent hospital	238	249	215	2	1	2
Total	7204	7481	7609	920	953	953

Table 1b - Number of knee arthroplasties by NHS Board of treatment.

NHS Board	Average number of operations 2008-2011	Number of operations 2012	Number of operations 2013	Average number of revisions 2008-2011	Number of revisions 2012	Number of revisions 2013
Ayrshire & Arran	420	459	477	30	32	50
Borders	154	169	184	9	5	3
Dumfries & Galloway	135	177	156	2	2	1
Fife	375	389	455	46	27	27
Forth Valley	193	222	193	20	18	24
Grampian	596	563	561	50	34	39
Clyde	400	383	409	40	35	28
North Glasgow	794	848	748	57	39	59
South Glasgow	384	441	358	36	34	34
Highland	278	326	320	20	15	21
Lanarkshire	422	423	483	34	34	27
Lothian	771	859	713	70	64	51
Tayside	645	737	690	46	46	51
Western Isles	24	49	57	0	0	0
GJNH	1138	1208	1159	51	51	47
Independent hospital	240	267	206	1	1	1
Total	6967	7520	7169	512	437	463

Table 1c - Number of hip arthroplasties by NHS Board of residence.

NHS Board of residence	Average number of operations 2008-2011	Number of operations 2012	Number of operations 2013	Average number of revisions 2008-2011	Number of revisions 2012	Number of revisions 2013
Ayrshire & Arran	490	573	681	62	77	86
Borders	213	232	243	19	22	32
Dumfries & Galloway	277	232	243	38	47	31
Fife	523	529	543	53	59	57
Forth Valley	382	391	422	58	60	50
Grampian	745	841	758	100	87	71
NGG&C	1309	1318	1299	211	203	206
Highland	551	606	587	52	71	62
Lanarkshire	645	731	739	90	80	95
Lothian	1038	1164	1140	130	120	131
Orkney	44	37	52	5	6	8
Shetland	46	51	35	7	4	5
Tayside	669	664	751	73	103	91
Western Isles	70	72	67	8	12	20
England/Wales/NI	26	22	14	4	1	3
Unknown	1	15	28	0	1	4
Outside UK	5	3	7	0	0	1
Total	7033	7481	7609	910	953	953

Table 1d - Number of knee arthroplasties by NHS Board of residence.

NHS Board of residence	Average number of operations 2008-2011	Number of operations 2012	Number of operations 2013	Average number of revisions 2008-2011	Number of revisions 2012	Number of revisions 2013
Ayrshire & Arran	484	661	683	36	38	52
Borders	178	186	197	15	8	6
Dumfries & Galloway	258	240	227	18	16	20
Fife	457	489	531	54	33	30
Forth Valley	417	463	390	33	26	30
Grampian	629	648	609	45	33	30
GG&C	1488	1633	1466	118	85	108
Highland	401	465	505	33	28	30
Lanarkshire	747	783	793	55	62	44
Lothian	923	1153	1009	61	62	48
Orkney	33	22	38	3	0	3
Shetland	41	40	38	3	1	6
Tayside	564	639	587	41	39	49
Western Isles	44	69	72	3	4	4
England/Wales/NI	10	10	8	2	1	1
Unknown	2	16	16	0	1	2
Outside UK	1	3	0	0	0	0
Total	6675	7520	7169	519	437	463

Table 2 - Number of arthroplasties and operative consultants in 2012 and 2013.

	Average number of operations 2008-2011	Number of operations 2012	Number of operations 2013		Average number of consultants performing operations 2008-2011	Number of consultants performing operations 2012	Number of consultants performing operations 2013
Hip arthroplasty	7204	7481	7609		221	227	216
Hip revision	920	953	953		143	148	153
Knee arthroplasty	6967	7520	7169		203	209	195
Knee revision	512	437	463		102	100	101
Shoulder arthroplasty	410	439	439		98	92	85
Shoulder revision	26	29	26		14	16	15
Elbow arthroplasty	18	7	9		8	6	5
Elbow revision	3	3	2		3	3	2
Ankle arthroplasty	47	59	53		12	12	11
Wrist arthroplasty	17	15	27		8	8	9
Finger arthroplasty	71	77	62		20	19	16
Thumb arthroplasty	48	52	41		13	14	13
Toe arthroplasty	44	45	22		16	15	16
Excision *	294	270	336		116	111	111
Resurf. Of Patella *	28	36	32		20	24	20
Other knee resurfacing *	32	20	28		21	14	18
Other resurfacing *	18	16	16		13	10	11
Other	145	117	102		69	65	69
Total	16802	17576	17389		1099	1093	1066

*Limited SMR01 coding generating a generalised description of clinical procedure

The Scottish Arthroplasty Project monitors rates for all types of arthroplasty; although hip and knee are by far the most common, other orthopaedic procedures routinely undertaken in Scotland. Table 2 presents the number and type of arthroplasty carried out upon patients within NHS Scotland.

The number of consultants performing operations is included as a guide to operational requirements through-out Scotland; it is not comprehensive and does not reflect the complex factors involved in workforce planning.

1.3 Consultants performing low volumes

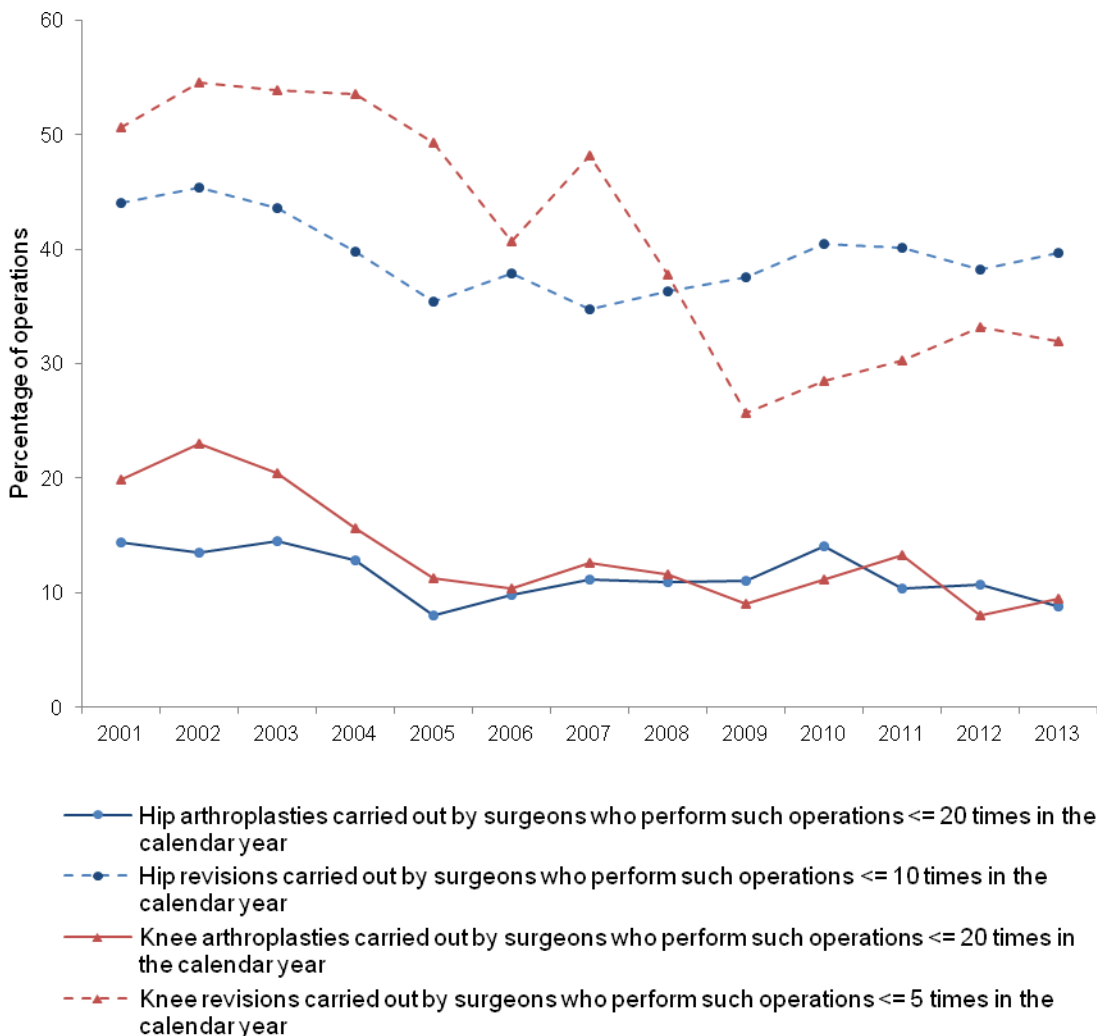
There remain a relatively high number of hip and knee arthroplasties being carried out by consultants who perform low volumes of these operations. Consultants who carry out a relatively low volume of orthopaedic surgical operations may be at risk of a higher rate of complication due to relatively lower levels of experience and knowledge.

The data presented in Figure 3 shows that from 2001 to 2008 the percentage of primary arthroplasty undertaken by surgeons who performed less than 20 hip or 20 knee operations per year has declined and since 2009 the incidence has been within the range of 9%-11% (Hip) and 8%-13% (Knee).

From 2001 to 2008 the percentage of hip revisions carried out by surgeons who performed less than 10 operations per year decreased from 44% to 36%; since 2009 there has not been a measurable reduction in the percentage of hip revisions undertaken by surgeons who perform less than 10 operations per year (Figure 3).

Over the same period (2001 to 2008), the proportion of knee revisions carried out by surgeons who performed less than 5 operations per year decreased from 51.0% to 38% and is currently at 32.0% in 2013 (Figure 3).

Figure 3 - Recent trends in operations carried out by low volume operators



Though the percentage of primary hip and knee operations being conducted by “low volume surgeons” is decreasing the data in Table 3a and Table 3b show that within the reporting period (2012-2013) almost 50% of surgeons providing hip arthroplasty and 40% of surgeons providing knee arthroplasty undertake 20 or less operations per year.

Within the reporting period approximately 40% of hip revisions are provided by a significant proportion (81%) of surgeons who conduct less than 10 hip revisions per year (Table 3c).

Similarly, within the reporting period almost one third of knee revisions are performed by a significant proportion (70% - 73%) of surgeons who conduct less than 5 knee revisions per year (Table 3d).

Each hospital and consultant will have a unique work pattern and in many cases arthroplasty represents only a small part of the overall surgical workload. However, operating teams are encouraged to promote the use of specialist arthroplasty surgeons to improve the quality of patient care.

Table 3a - The number and percentage of hip arthroplasties by surgeon and performance activity. 2009-2013.

Year	Number of hip arthroplasty	Number of surgeons	Performing = < 20 operations (%age)	%age of operations	Performing 21-40 operations (%age)	%age of operations	Performing 41-60 operations (%age)	%age of operations	Performing 61-80 operations (%age)	%age of operations	Performing 81-100 operations (%age)	%age of operations	Performing >101 operations (%age)	%age of operations
2009	7168	219	49.8	11.0	19.2	17.3	12.8	18.6	6.8	14.8	5.0	13.5	6.4	24.7
2010	6930	219	53.4	14.0	19.2	18.9	8.7	13.4	9.1	19.2	3.2	8.9	6.4	25.5
2011	7237	220	48.6	10.4	21.8	19.3	10.9	16.1	7.7	16.3	3.6	9.9	7.3	27.9
2012	7481	227	50.2	10.7	20.7	19.1	10.6	14.9	5.3	11.0	5.7	15.8	7.5	28.5
2013	7609	216	48.1	8.8	19.4	16.8	11.1	15.1	7.9	15.7	4.6	11.6	8.8	32.0

Table 3b - The number and percentage of knee arthroplasties by surgeon and performance activity. 2009-2013.

Year	Number of knee arthroplasty	Number of surgeons	Performing = < 20 operations (%age)	%age of operations	Performing 21-40 operations (%age)	%age of operations	Performing 41-60 operations (%age)	%age of operations	Performing 61-80 operations (%age)	%age of operations	Performing 81-100 operations (%age)	%age of operations	Performing >101 operations (%age)	%age of operations
2009	6897	200	38.0	9.1	33.0	29.2	14.0	19.9	5.5	11.3	4.0	10.6	5.5	20.0
2010	6656	203	41.9	11.2	29.1	25.8	15.8	23.3	5.4	11.5	2.5	6.6	5.4	21.6
2011	6795	198	43.4	13.3	26.3	22.3	13.6	20.1	8.1	16.5	3.0	7.9	5.6	19.9
2012	7520	209	38.3	8.1	30.1	25.2	12.9	17.6	7.7	14.7	2.9	6.8	8.1	27.6
2013	7169	195	40.0	9.4	26.2	21.1	12.8	17.2	8.2	15.6	7.2	17.5	5.6	19.2

Table 3c - The number and percentage of hip revision by surgeon and performance activity. 2009-2013.

Year	Number of hip revision	Number of surgeons	Performing = < 10 operations (%age)	%age of operations	Performing 11-20 operations (%age)	%age of operations	Performing 21-80 operations (%age)	%age of operations
2009	986	147	79.6	37.5	13.6	31.4	6.8	31.0
2010	846	137	80.3	40.4	13.9	31.4	5.8	28.1
2011	893	139	80.6	40.1	12.9	29.5	6.5	30.5
2012	953	148	81.1	38.2	10.8	25.1	8.1	36.7
2013	953	153	81.0	39.7	11.1	26.1	7.8	34.2

Table 3d - The number and percentage of knee revision by surgeon and performance activity. 2009-2013.

Year	Number of knee revision	Number of surgeons	Performing = < 5 operations (%age)	%age of operations	Performing 6-20 operations (%age)	%age of operations	Performing 21-80 operations (%age)	%age of operations
2009	567	109	67.9	25.7	29.4	58.9	2.8	15.3
2010	537	97	64.9	28.5	33.0	59.2	2.1	12.3
2011	505	103	72.8	30.3	23.3	48.3	3.9	21.4
2012	437	100	70.0	33.2	28.0	56.5	2.0	10.3
2013	463	101	73.3	32.0	24.8	57.5	2.0	10.6

2 Patient Demographics

2.1 Age

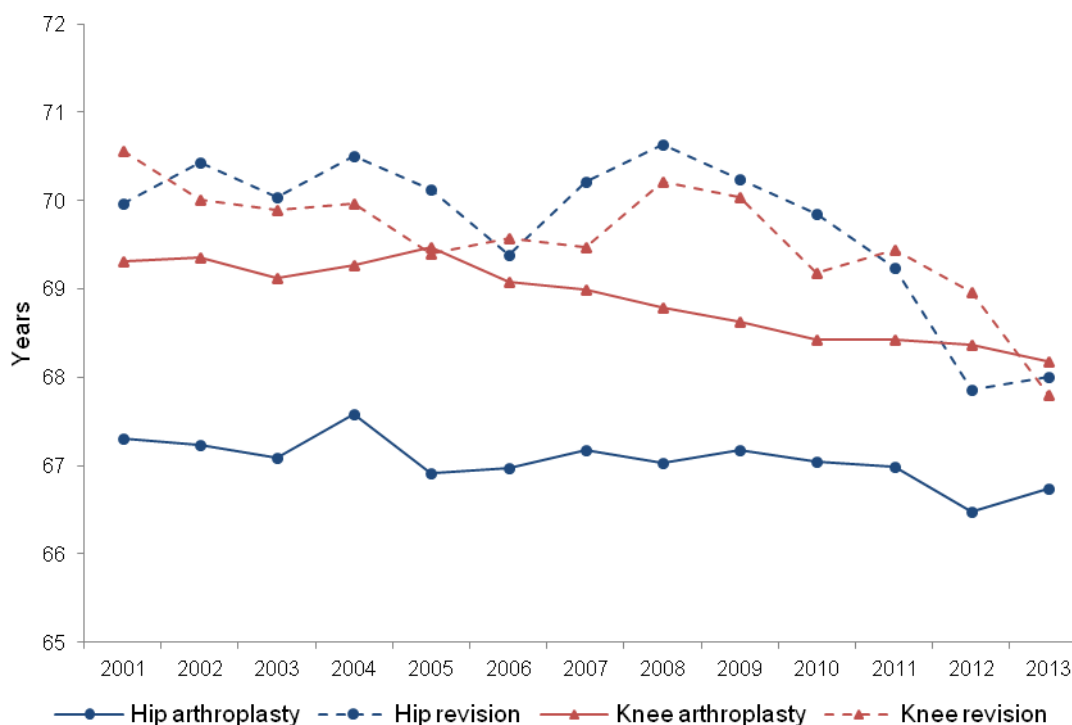
Orthopaedic patients are, by the nature of the medical conditions requiring arthroplasty, relatively older inpatients. In 2001, the mean age for primary hip arthroplasty was 67.3 years and has decreased gradually to 66.4 years in 2013. Similarly, the mean age for knee hip arthroplasty has decreased over the same time period from 69.3 years to 68.2 years. This may be due to improvements in orthopaedic sport-related treatments allowing their increased provision to younger age groups. Figure 4 shows the recent trends in the average (mean) ages of patient undergoing hip and knee arthroplasty.

In 2013 approximately 59% of primary hip or knee arthroplasty patients were female, compared to 56% of hip or knee revisions. This trend was relatively unchanged in recent years.

Since 2009 the mean age of patients undergoing hip revision has decreased from 70.2 years to 68.0 years. Since 2009 the mean age of patients undergoing knee revision has decreased from 70.2 years to 67.8 years (Figure 4). The trend to an earlier age of revision is seen in both hip and knee revisions and may reflect a more proactive approach to failing joint replacement. A desire to avoid major operations such as revision joint replacement in the very elderly (who may have an increased number of co-morbidities) may in part account for the disparity between age at primary and revision surgery.

There are demographic factors that are not routinely recorded, such as social deprivation and obesity. Obesity is a factor that contributes to complications following hip or knee arthroplasty and consideration of this is common in the review of complications. Analysis of this on a national level would be useful, but due to the nature of nationally established data collection processes, indicators of obesity (BMI, height/weight etc.) are not available.

Figure 4 - Recent trends in average age of hip and knee arthroplasty patients



2.2 Indication for Surgery

The principal medical condition recorded for patients undergoing hip arthroplasty in 2013 was coxarthrosis (osteoarthritis of the hip) (Figure 5a). The main medical condition recorded for patients receiving knee arthroplasty in 2013 was gonarthrosis (osteoarthritis of the knee) (Figure 5b). When compared to 2011, the number of hip arthroplasties for fractured neck of femur has increased from 330 to 414

The indication for surgery is taken from local coding data and it should be noted that the principal condition is recorded as the main reason for admission/surgery, but the patient may have additional conditions which are taken into consideration by the care team; the principal condition is not the sole determinant for surgery.

The indications for revision surgery are not recorded in a format that most surgeons would recognize and this is an area where further work may be helpful, providing sub-categories of clinical relevance (Figure 5c and 5d).

Figure 5a - Principal pre-operative conditions hip arthroplasty in 2013.

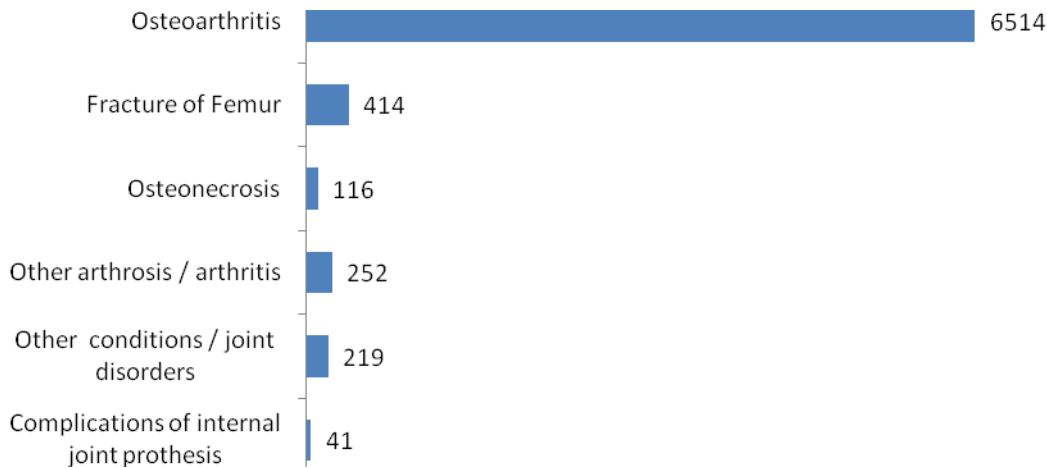


Figure 5b - Principal pre-operative conditions knee arthroplasty in 2013.

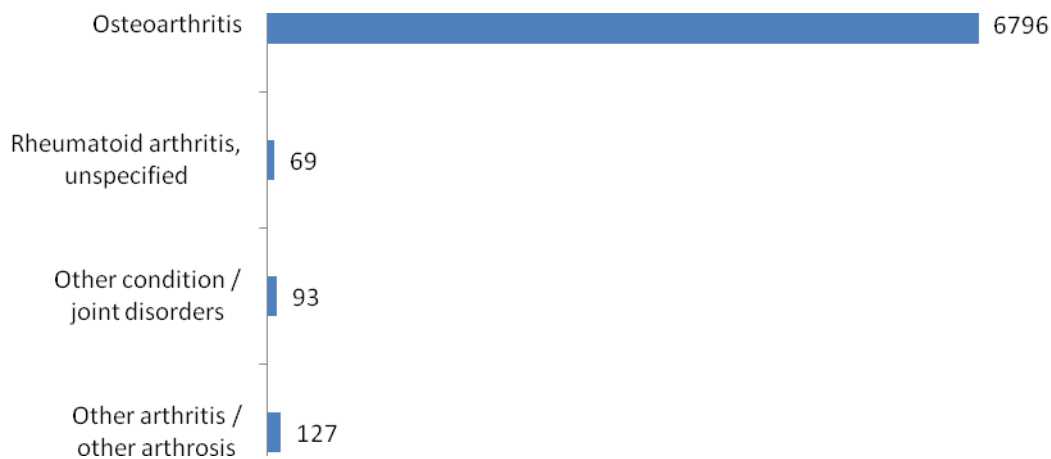


Figure 5c - Principal pre-operative conditions hip revision in 2013.

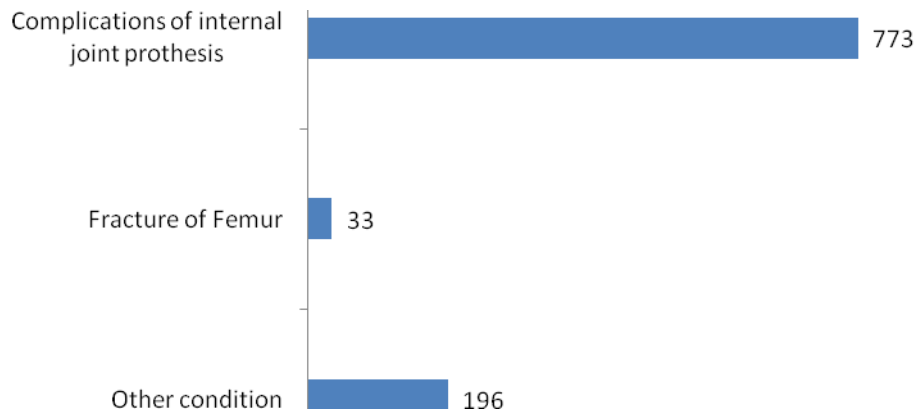
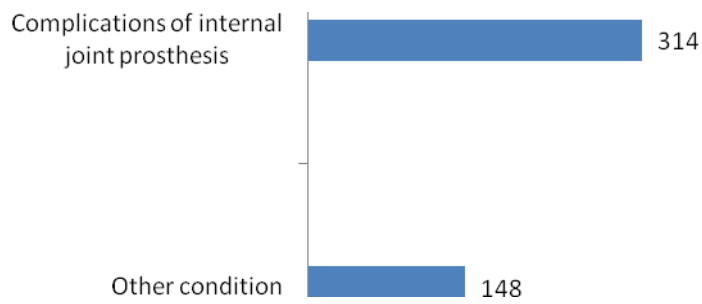


Figure 5d - Principal pre-operative conditions knee revision in 2013.



3 Inpatient Episodes

3.1 Length of stay

Since 2001 the mean length of inpatient stay for either a hip or knee arthroplasty procedure in a Scottish hospital has decreased from 10 days to 5.5 days (Figure 6). The continuing decrease in the mean length of stay may soon be stabilised by the practicalities of admission, surgery and discharge. However, the variation in the length of stay between NHS Health Boards may indicate that further reductions in mean length of stay are possible in the future.

The mean pre-operative length of stay for hip and knee arthroplasty patients in each NHS Board is less than 1 day. There is a wide variation across NHS Health Boards in the number of patients admitted on the day of surgery.

Length of post-operative care varies widely between boards from four to seven days for hips and knees. Figures 7a and 7b show the average lengths of stay (overall, pre- and post-operative) for each NHS Board.

Within NHS Board patients spend similar lengths of time in hospitals for both hip and knee replacements. This is due to similar pre-operative planning, anaesthetic regimens, analgesic regimens, care pathways, nursing and medical attitudes to both hip and knee replacement patients in each NHS Board.

Figure 6 - Recent trends in overall length of stay for elective hip and knee arthroplasty.

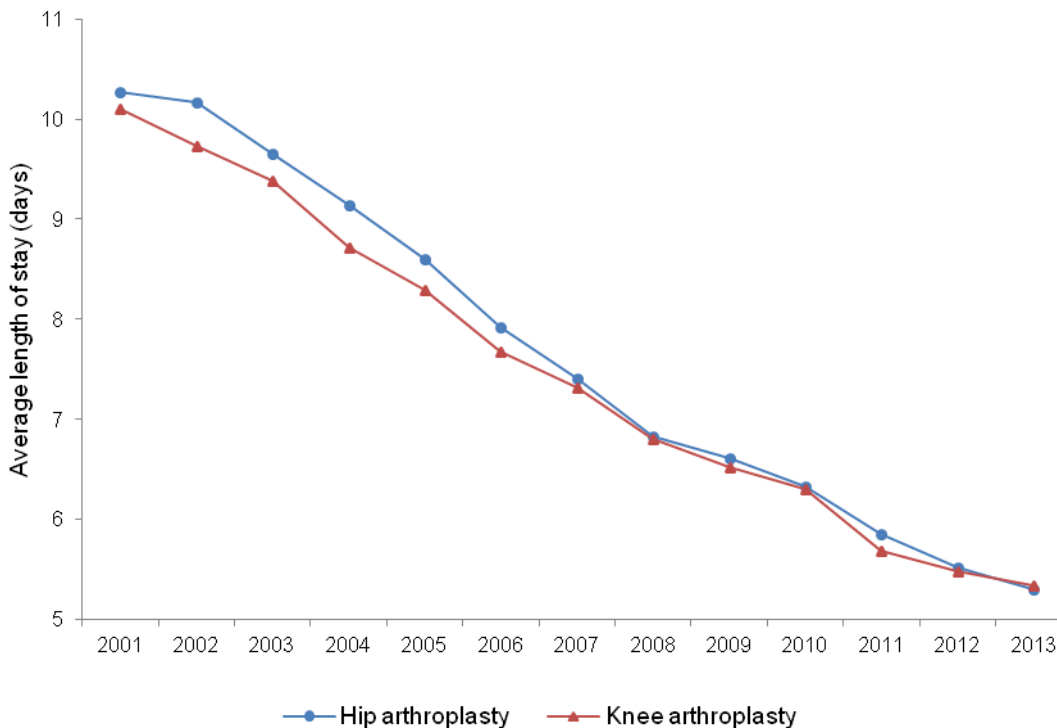


Figure 7a - Average length of stay for hip arthroplasty in 2013 by NHS Board. (NHS GG&C split).

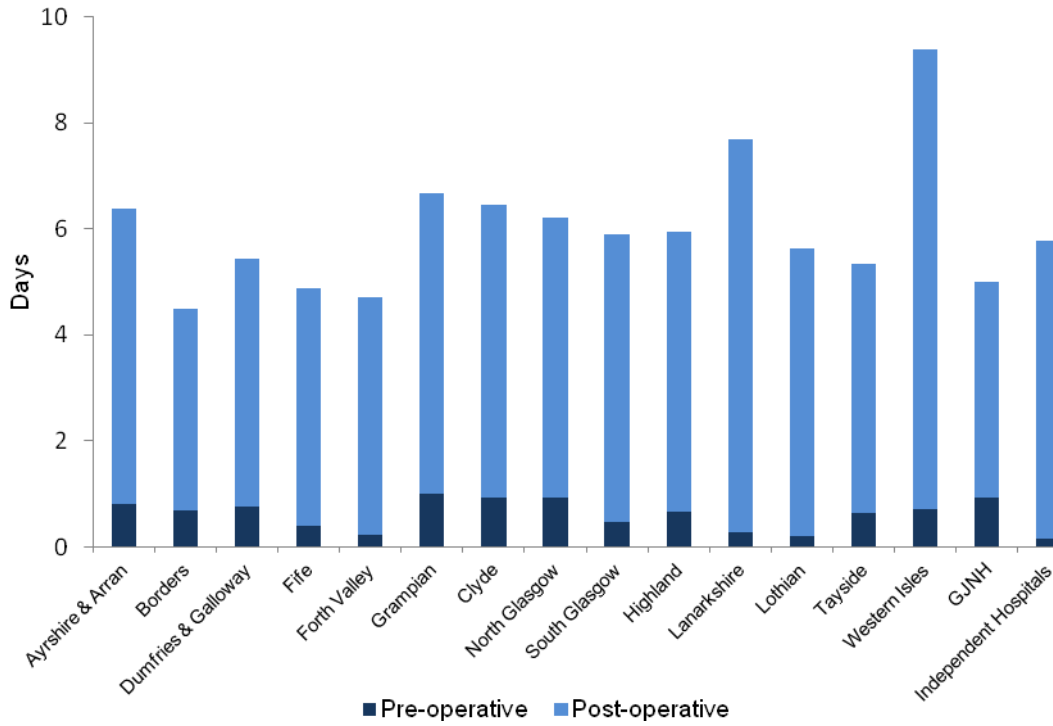
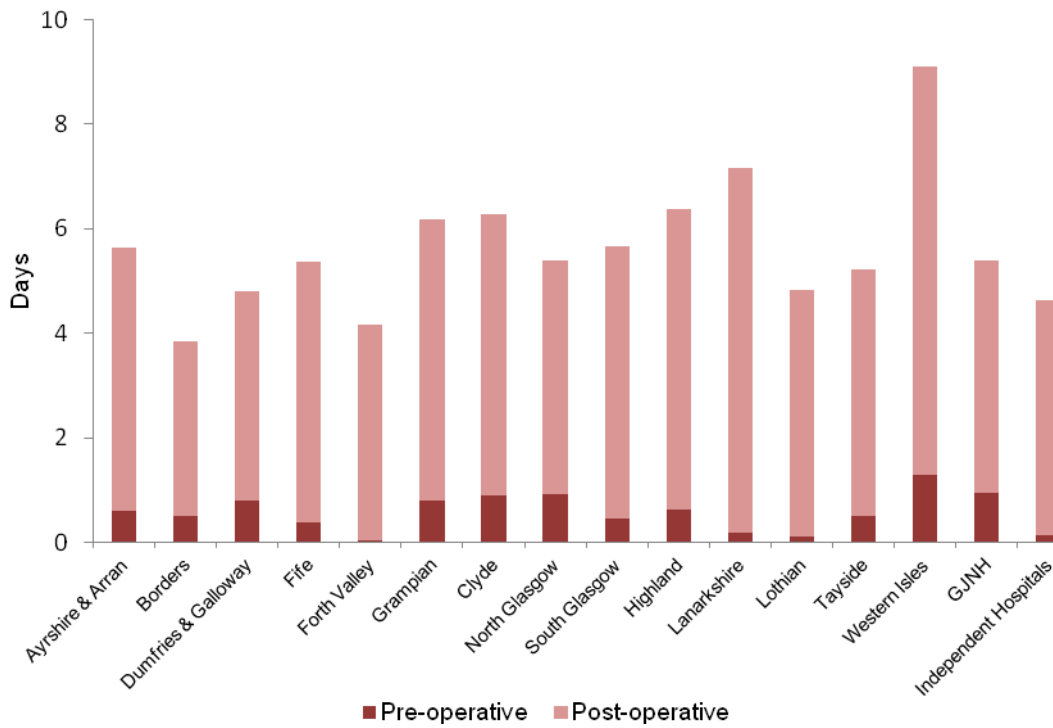


Figure 7b - Average length of stay for knee arthroplasty in 2013 by NHS Board (NHS GG&C split).



4 Complications arising from arthroplasty procedures

The major complications following elective primary hip or knee arthroplasty are:

- Dislocation (Knee dislocation is extremely rare and data is not presented)
- Infection of the operated joint
- Deep vein thrombosis / pulmonary embolism (DVT/PE)
- Death
- Acute Myocardial Infarction (AMI)
- Acute Renal Failure
- Cerebrovascular Accident (CVA) or Stroke

Complication rates have been standardised for the type of operation (primary or revision), patient age, gender, osteoarthritis and rheumatoid arthritis. Figures showing complication rates with a follow-up period of one year exclude operations carried out in 2013. Figures showing complication rates with a follow-up period of 90 days include operations carried out in 2013.

Developmental work to apply the CUSUM methodology (similar to that used to audit complication rates of individual surgeons) to NHS Boards is suspended due to financial constraints. The complication rates of Health Boards could be monitored on a quarterly basis and enable review and auditing processes to be conducted at Health Board level. On the basis of the 2012 annual rates, three Health Boards would have triggered a review of complications associated with primary hip arthroplasty and three Health Boards would have triggered a review of complications associated with primary knee arthroplasty.

4.1 National Trends

The previously observed downward trends in DVT/PE within 90 days as a complication after hip and knee arthroplasty has been maintained during the current reporting period (Figure 8a and 8c).

Infection within a year of the operated hip or knee joint has been stable at ~1% and ~1.5% respectively (Figure 8b and 8d).

The overall rate of dislocation within a year as a complication of hip arthroplasty has not increased during the reporting period (Figure 8b); dislocation of the knee after arthroplasty is very rare and data is not presented.

The national rate of death as a complication after hip or knee arthroplasty has continued to be <0.5% over the reporting period (Figure 8a, 8c).

The rate of acute myocardial infarction (AMI) and CVA/Stroke as a complication after hip arthroplasty has changed little compared to the last report.

The rate of acute myocardial infarction (AMI) and CVA/Stroke as complications after knee arthroplasty have exhibited a downward trend compared to the last report.

The national rate of acute renal failure within 30 days as a complication of both hip and knee arthroplasty has, since 2009, increased steadily each year (Figure 8e). Additional information on the incidence of acute renal failure by NHS Health Board is presented in *Appendix B to Section 4*.

The ICD-10 coding which triggers a report includes renal failure and renal insufficiency. The cause of the increase in renal complications is not identifiable from SMR01, the source of SAP data sets, but is obviously multi-factorial and a cause for concern.

In 2008 the SIGN guideline (SIGN 104) for antibiotic prophylaxis recommended Gentamicin and Flucloxacillin for antibiotic prophylaxis in arthroplasty. This was revised in 2014 to Co-Amoxiclav as there was concern about Acute Kidney Injury with the Flucloxacillin/Gentamicin combination. The introduction of Enhanced Recovery Pathways which encourage early cessation of intravenous fluids could potentially be implicated, but there is insufficient detail in this data to comment with any accuracy and is speculative. Clinicians should continue to monitor and review the situation in their own hospitals. This trend will continue to be monitored carefully by the SAP Group and duly reported.

Figure 8a - National rates for complications within 90 days- hip arthroplasty.

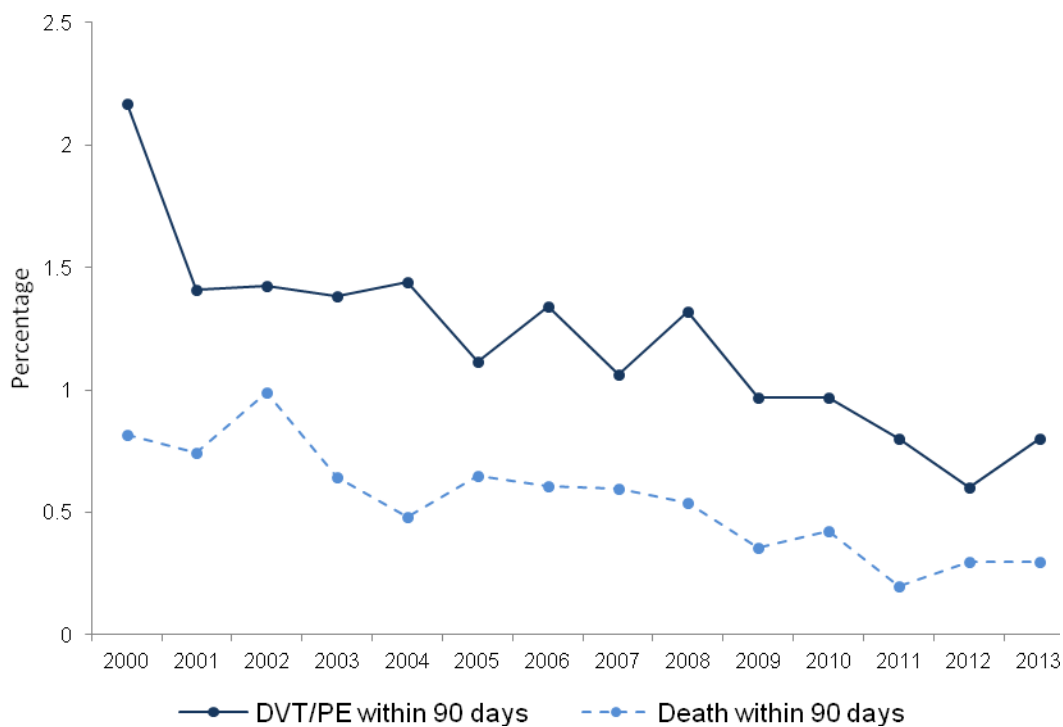


Figure 8b - National rates for complications within 1 year- hip arthroplasty.

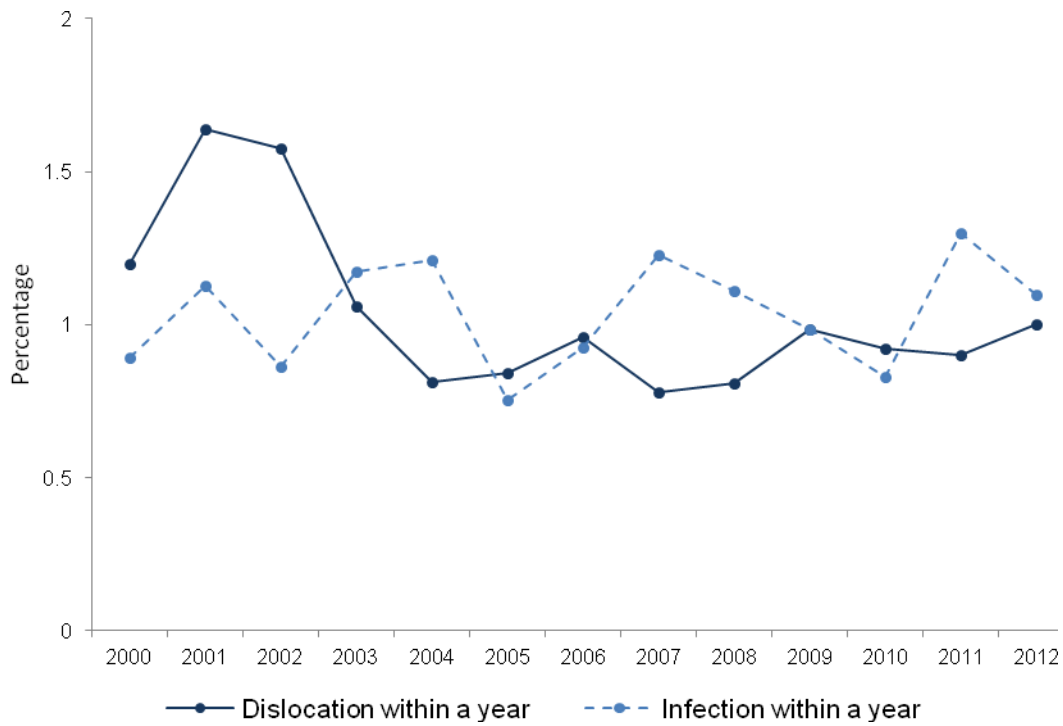


Figure 8c - National rates for complications within 90 days- knee arthroplasty.

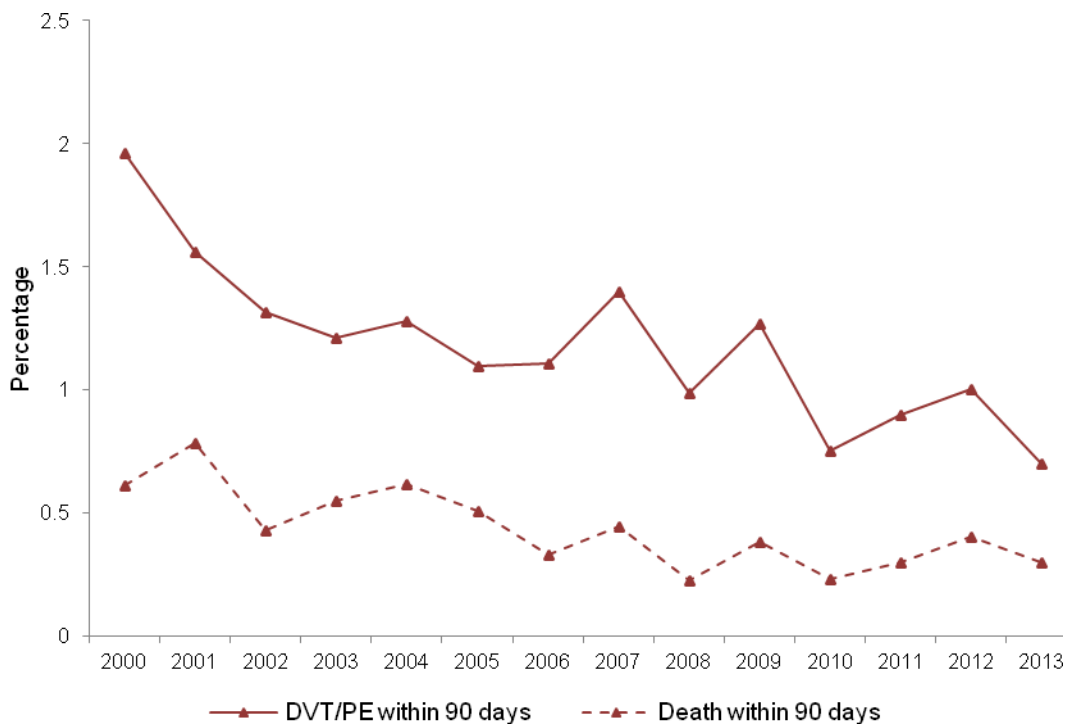


Figure 8d - National rates for complications within 1 year- knee arthroplasty.

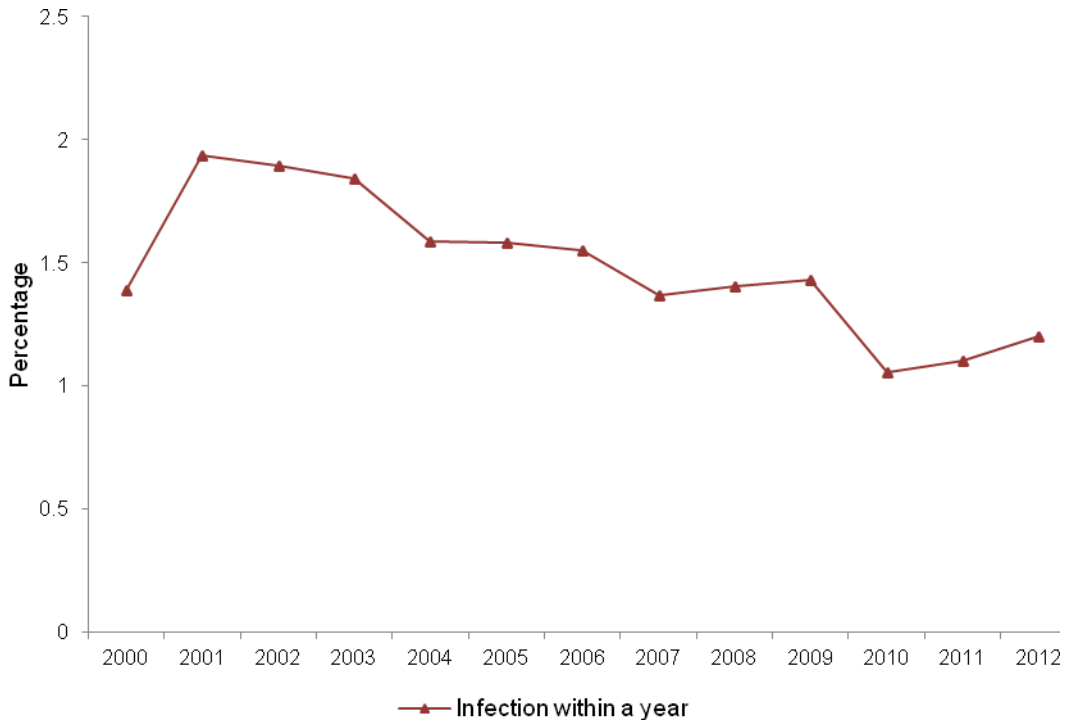
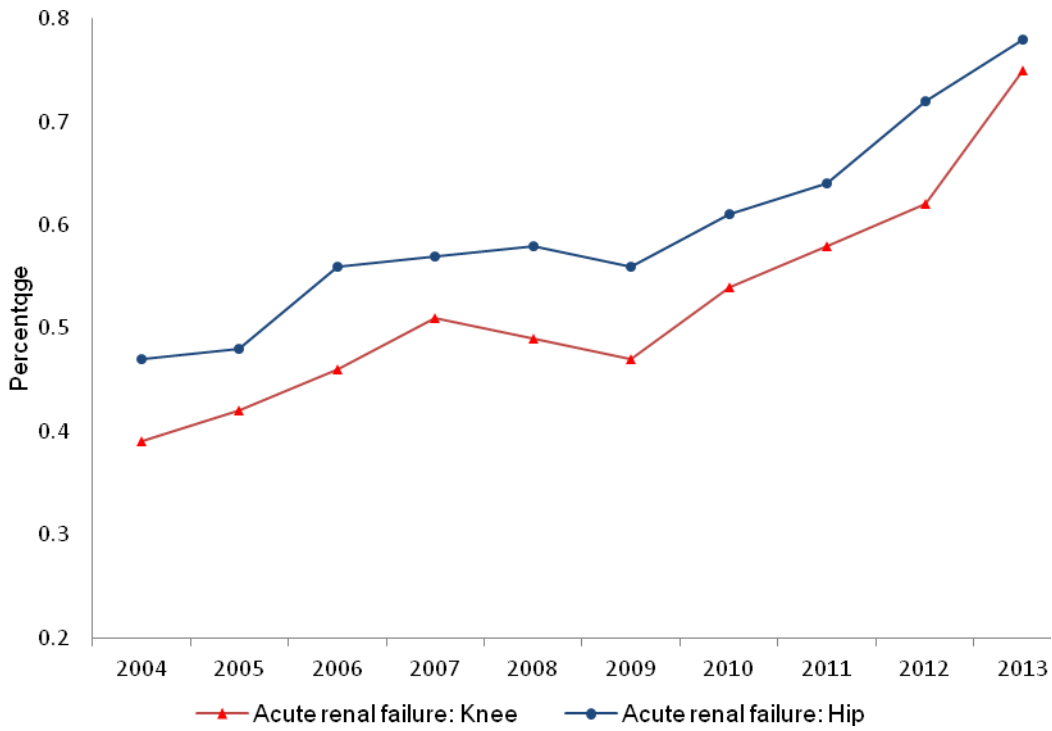


Figure 8e - Acute renal failure after 30 days- hip and knee arthroplasty.



4.2 Complication funnel charts

Where data are presented as funnel charts, the upper confidence limit shown as the upper curved line on the plot represents a warning threshold derived from the national rate and numbers of operations occurring.

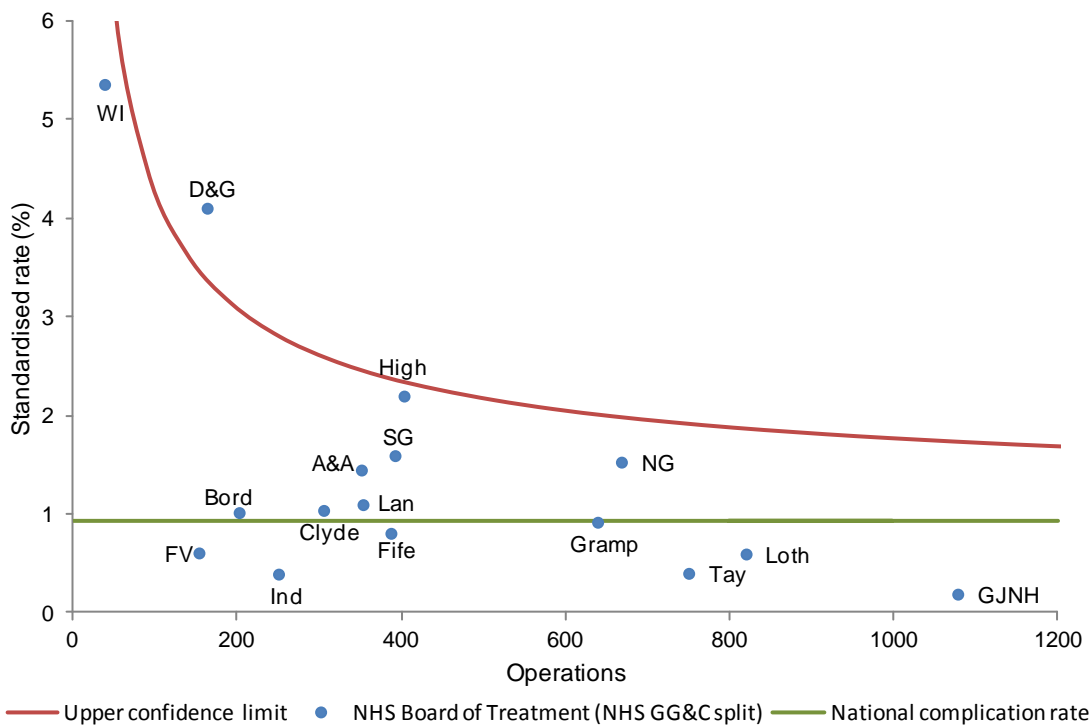
Rates of complication which appear above this line are a possible cause for concern and should be investigated where possible.

The straight line is the National rate to allow comparison between centres.

4.2.1 Dislocation within one year

One Health Board (NHS Dumfries and Galloway) was an “outlier” above the upper confidence limit for 2012. In seven other Health Boards the rates of complication were above the national rate (Figure 9). Data for dislocation of the knee is not presented as it is very rare.

Figure 9 - Percentage of 2012 hip arthroplasty patients with subsequent dislocation within one year.



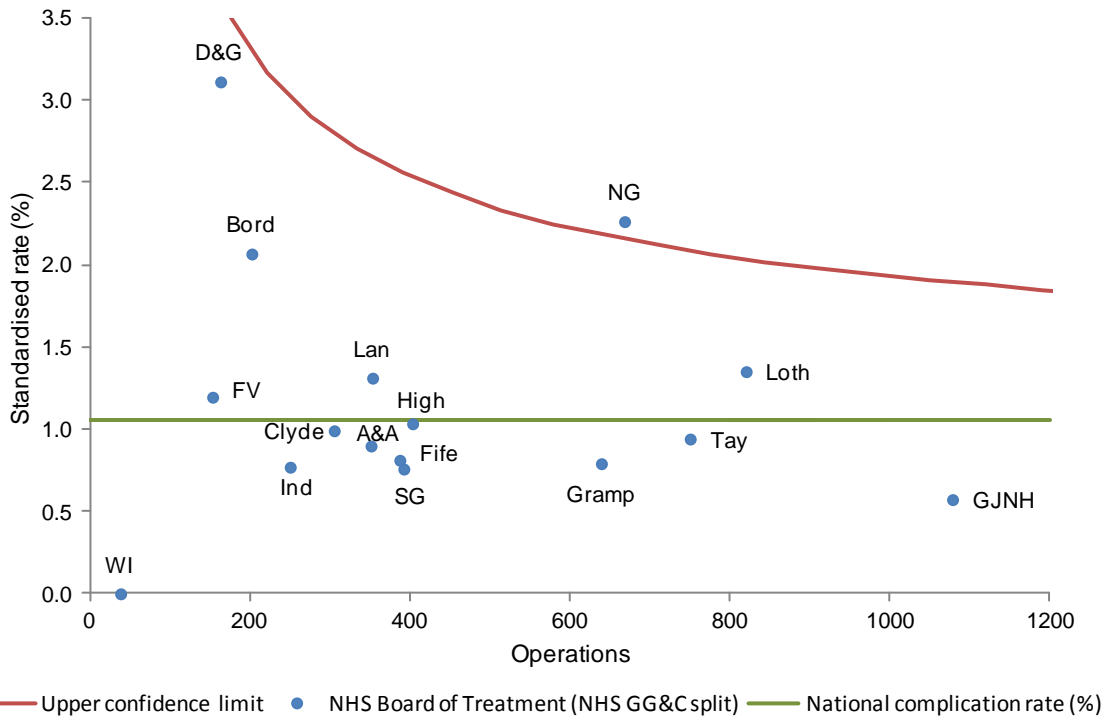
Average, funnel and standardisation calculated on 5-years data 2008 -2012.

4.2.2 Infection within one year

Infection of the hip within one year of arthroplasty. One Health Board (NHS North Glasgow) was an “outlier” above the upper confidence limit for 2012. In five other Health Boards the rates of complication were above the National rate (Figure 10).

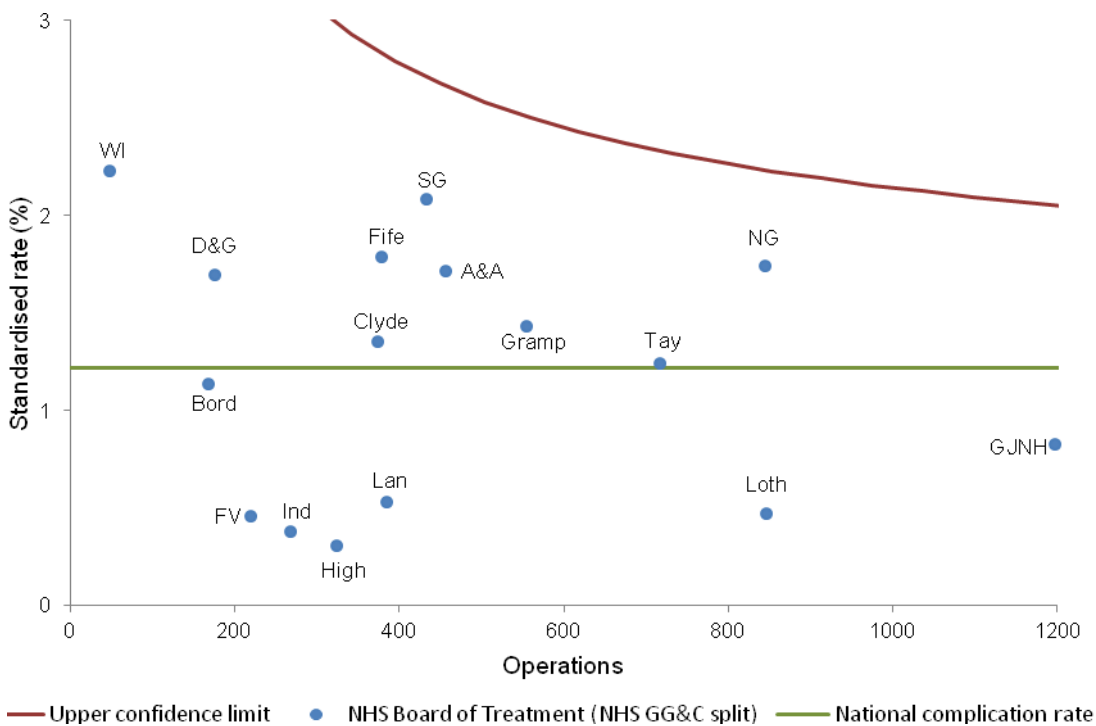
Infection of the knee within one year of arthroplasty. None of the Health Boards were an “outlier” but in nine Health Boards the rates of complication were above the National rate (Figure 11).

Figure 10 - Percentage of 2012 hip arthroplasty patients with subsequent infection within one year.



Average, funnel and standardisation calculated on 5-years data 2008 -2012

Figure 11 - Percentage of 2012 knee arthroplasty patients with subsequent infection within one year.

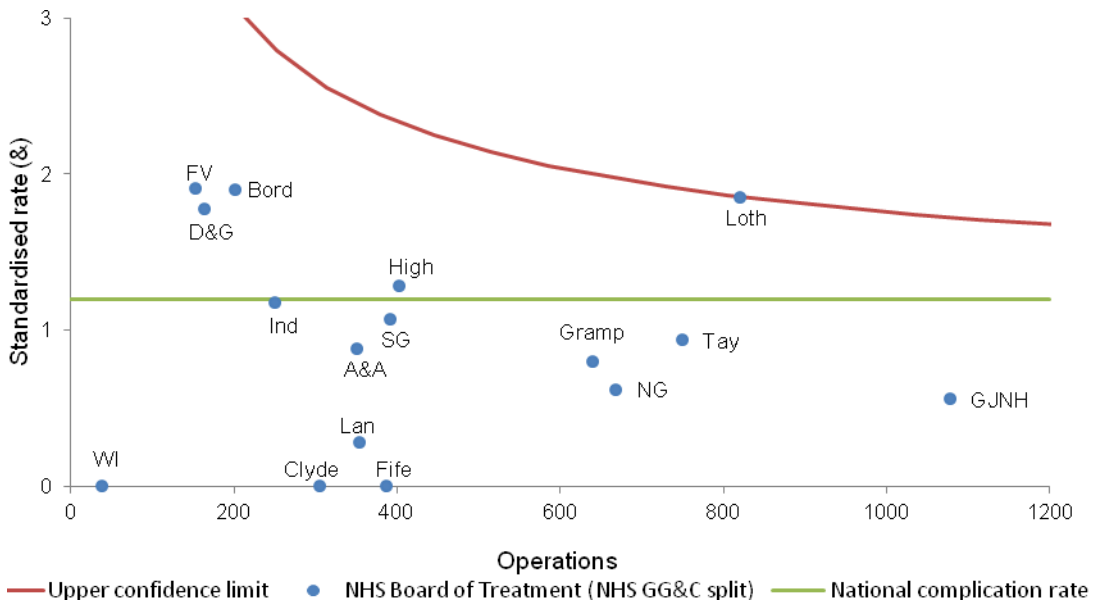


Average, funnel and standardisation calculated on 5-years data 2008-2012.

4.2.3 Deep vein thrombosis/pulmonary embolism (DVT/PE) within one year

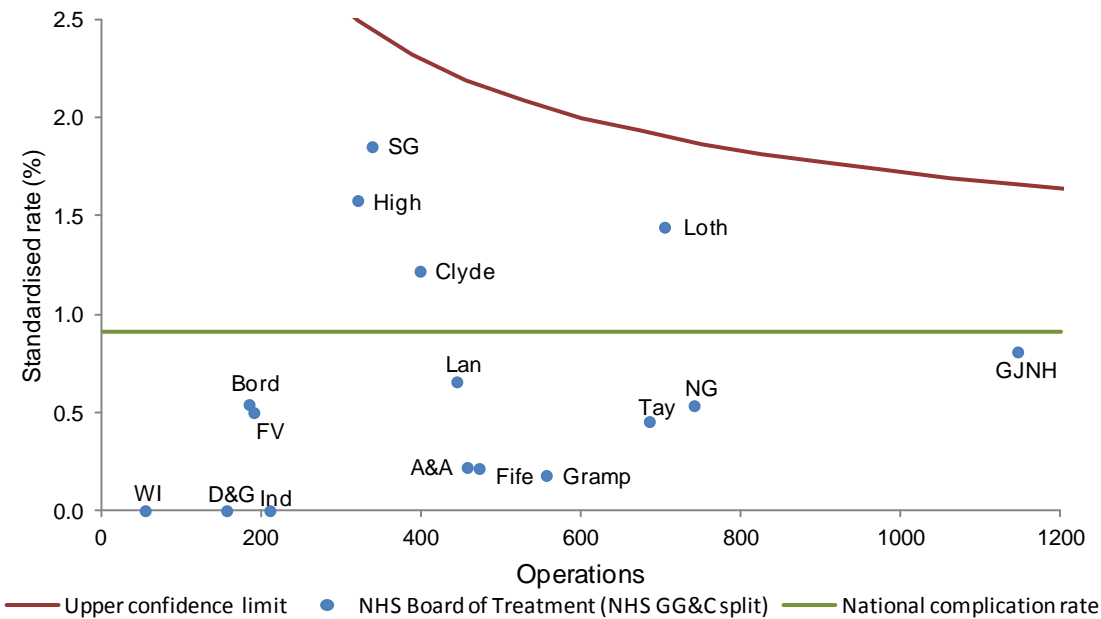
None of the Health Boards were an “outlier” but in five Health Boards (Figure 12, hip) and four Health Boards (Figure 13, knee) the rates of complication were above the National rate.

Figure 12 - Percentage of 2012 hip arthroplasty patients with subsequent DVT/PE within one year.



Average, funnel and standardisation calculated on 5-years data 2008 -2012.

Figure 13 - Percentage of 2013 knee arthroplasty patients with subsequent DVT/PE within 90 days.

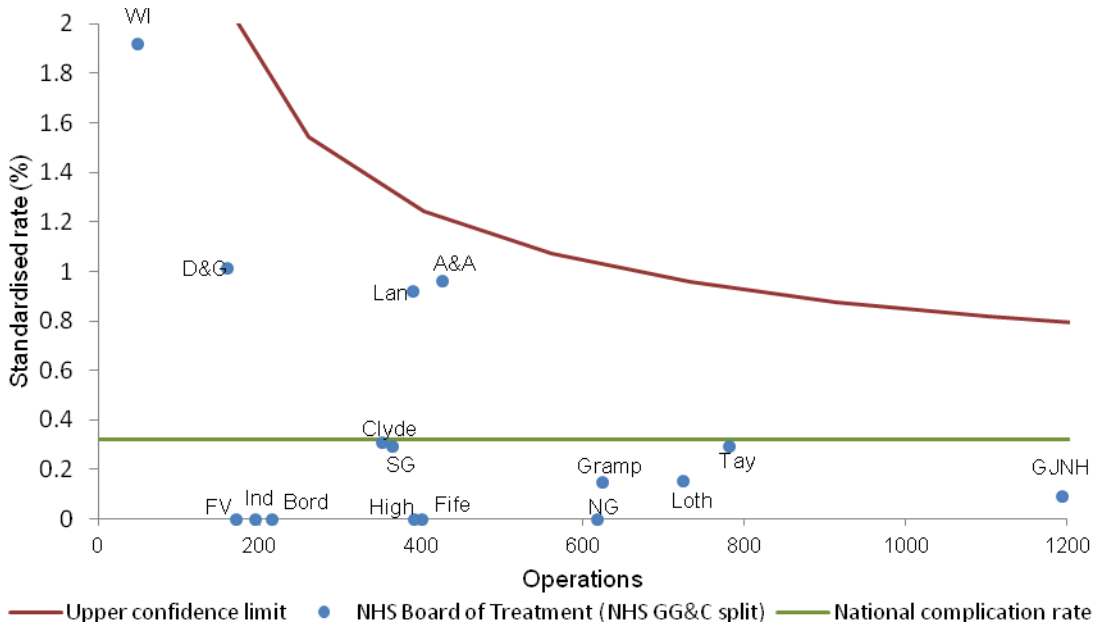


Average, funnel and standardisation calculated on 5-years data 2009-2013.

4.2.4 Death within 90 days

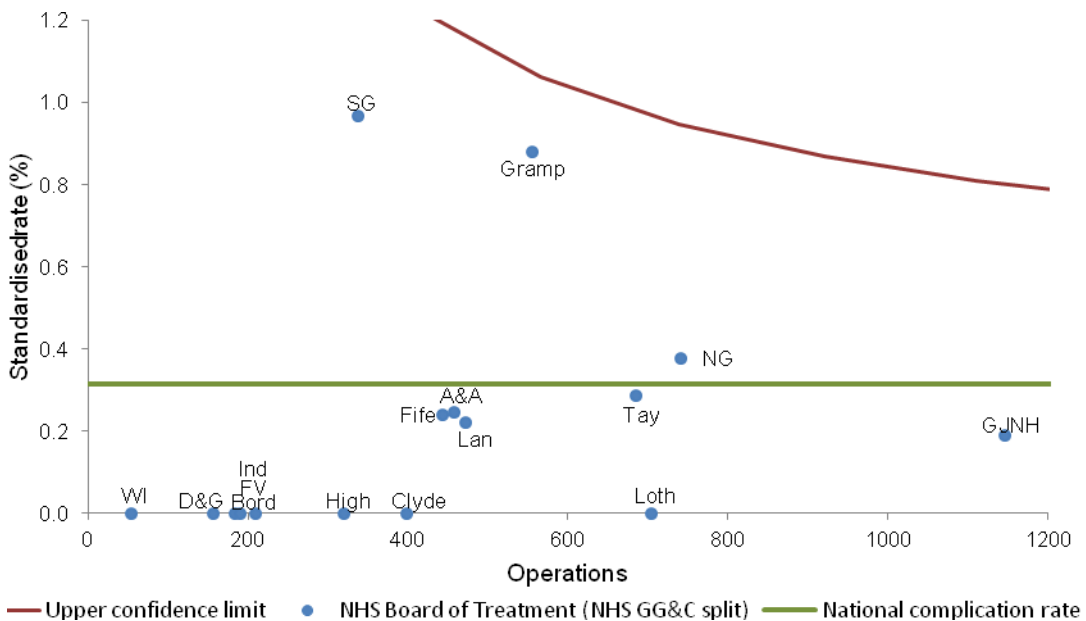
Death within 90 days of arthroplasty. None of the Health Boards were an “outlier” but in four Health Boards (Figure 14, hip) and three Health Boards (Figure 15, knee) the rates of complication were above the National rate.

Figure 14 - Percentage of 2013 hip arthroplasty patients who died within 90 days.



Average, funnel and standardisation calculated on 5-years data 2009 -2013.

Figure 15 - Percentage of 2013 knee arthroplasty patients who died within 90 days.

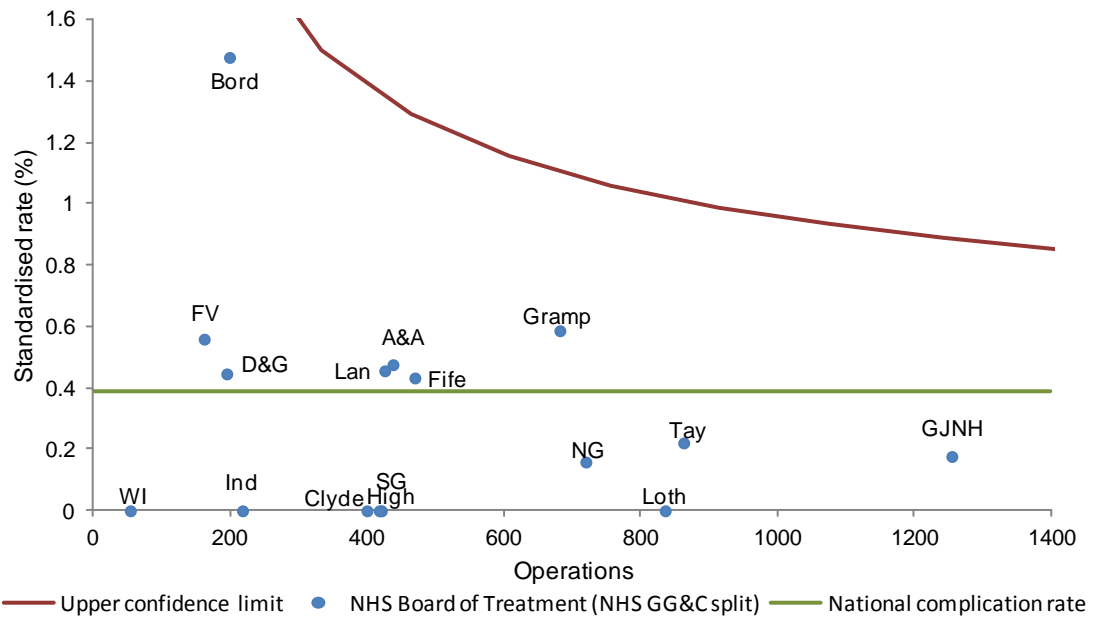


Average, funnel and standardisation calculated on 5-years data 2009-2013.

4.2.5 Acute Myocardial Infarction (AMI) within 30 days

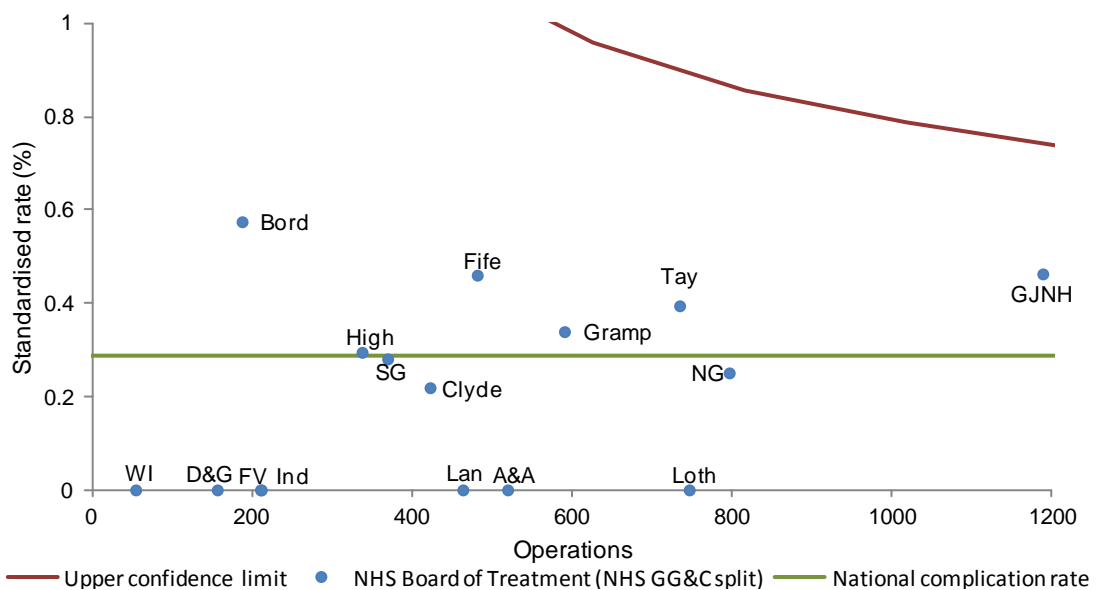
Acute Myocardial Infarction (AMI). None of the Health Boards were an “outlier” but in seven Health Boards (Figure 16, hip) and six Health Boards (Figure 17, knee) the rates of complication were above the National rate.

Figure 16 - Percentage of 2013 hip arthroplasty patients with AMI within 30 days.



Average, funnel and standardisation calculated on 5-years data 2009 -2013.

Figure 17 - Percentage of 2013 knee arthroplasty patients with AMI within 30 days.



Average, funnel and standardisation calculated on 5-years data 2009-2013.

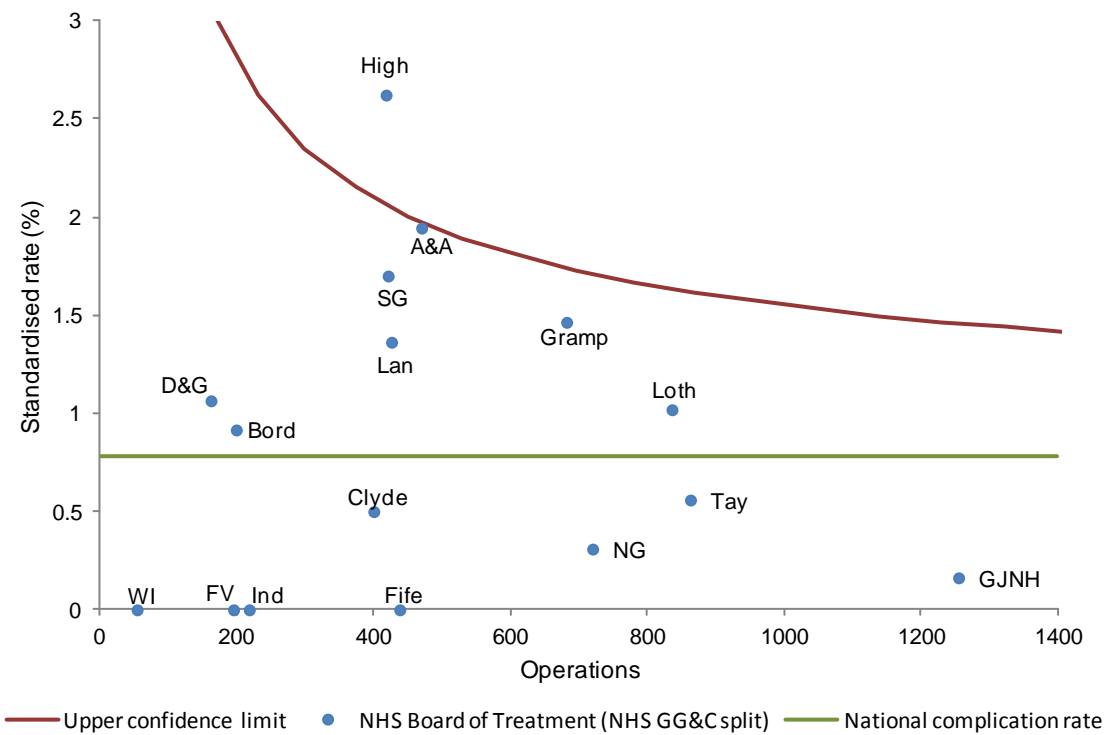
4.2.6 Acute renal failure within 30 days

There was one Health Board (NHS Highland) above the upper confidence limit for renal failure as a complication of hip arthroplasty (Figure 18) and in seven Health Boards the rates of complication were above the National rate.

There were three Health Boards (NHS Highland, NHS Tayside and NH Lothian) above the upper confidence limit for renal failure as a complication of knee arthroplasty (Figure 19) and in seven Health Boards the rates of complication were above the National rate.

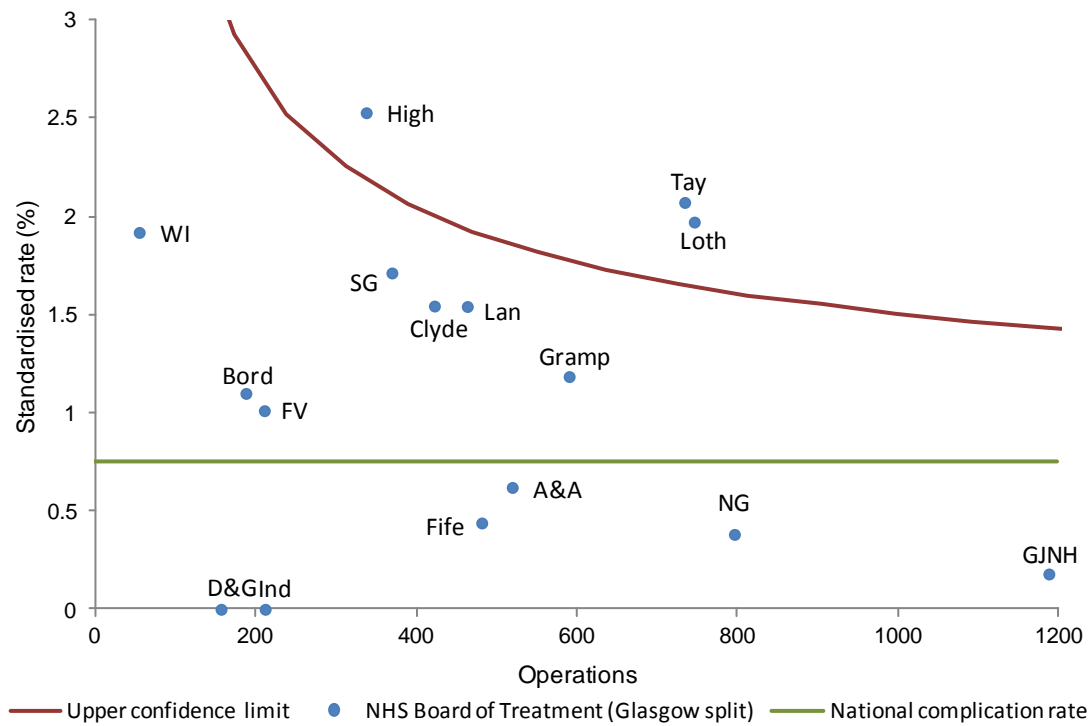
Two of these Health Boards were also above the upper confidence level during the last reporting period for Acute Renal Failure within 30 days of arthroplasty (knee) and this may warrant further detailed examination of procedures.

Figure 18 - Percentage of 2013 hip arthroplasty patients with subsequent acute renal failure within 30 days.



Average, funnel and standardisation calculated on 5-years data 2009 -2013.

Figure 19 - Percentage of 2013 knee arthroplasty patients with subsequent acute renal failure within 30 days.

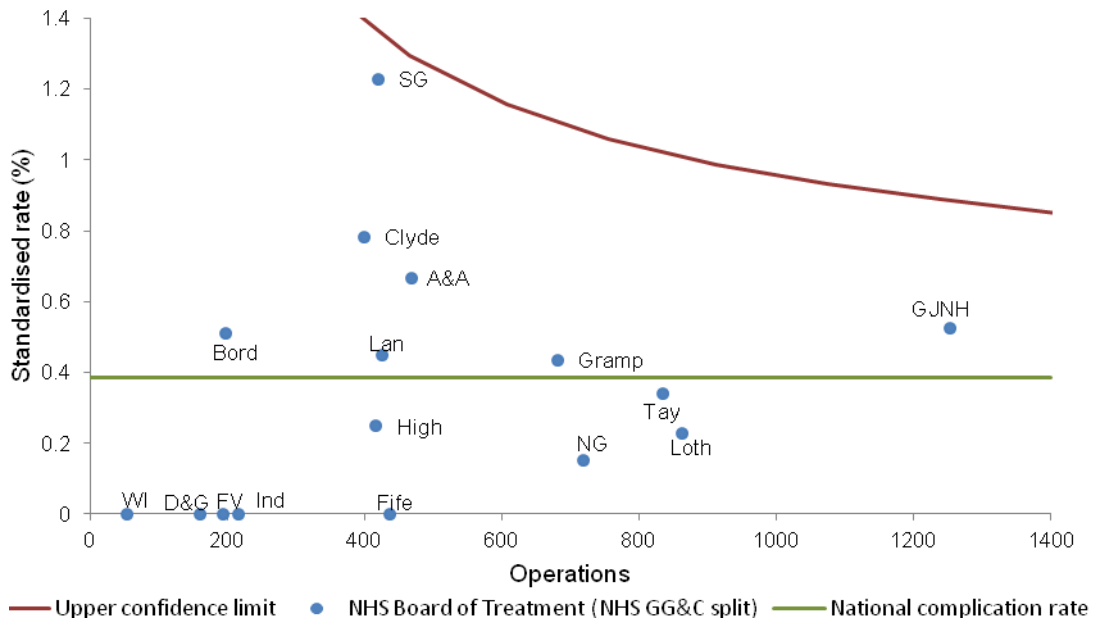


Average, funnel and standardisation calculated on 5-years data 2009-2013.

4.2.7 CVA/Stroke within 30 days

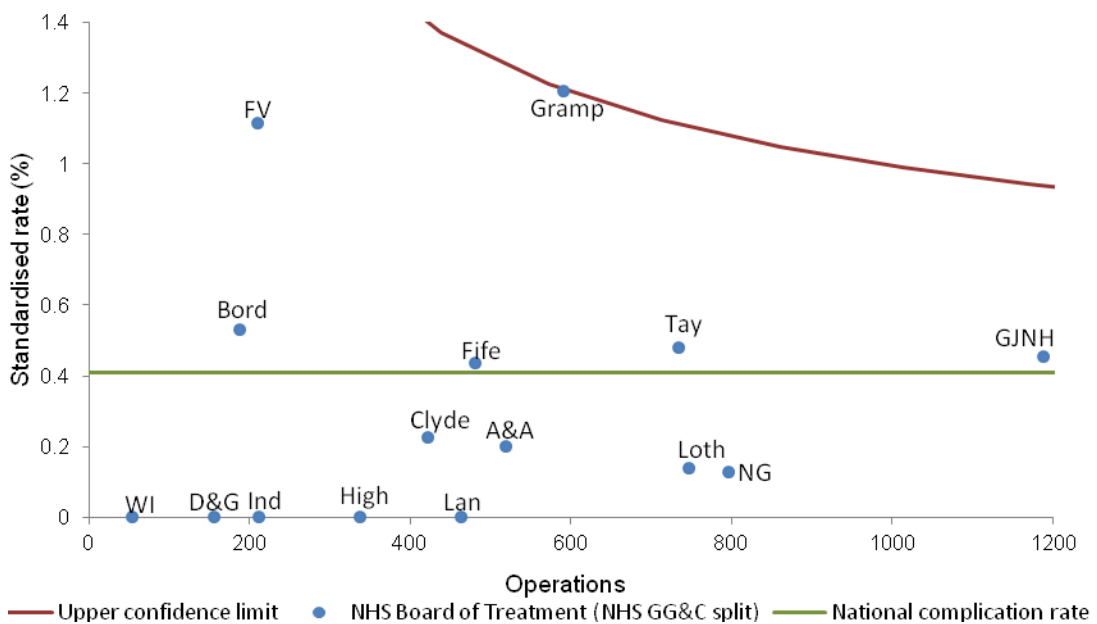
None of the Health Boards were an “outlier” but in seven Health Boards (Figure 20, hip) and six Health Boards (Figure 21, knee) the rates of complication were above the National rate.

Figure 20 - Percentage of 2013 hip arthroplasty patients with subsequent stroke within 30 days.



Average, funnel and standardisation calculated on 5-years data 2009 -2013.

Figure 21 - Percentage of 2013 knee arthroplasty patients with subsequent stroke within 30 days.



Average, funnel and standardisation calculated on 5-years data 2009-2013.

5 Revision rates

Revision rates are calculated at 90 days, 1 year, 3 years and 5 years after surgery and have been standardised for patient age, gender, osteoarthritis and rheumatoid arthritis.

The national rate for hip arthroplasty with subsequent revision shows an upward trend whereas for knee arthroplasty the rates are static. It is unclear if this reflects problems with large metal bearings including some hip resurfacing arthroplasties.

Where data are presented as funnel charts, the upper confidence limit shown as the upper curved line represents a warning threshold derived from the National rate and numbers of operations performed. Rates of complication which appear above this line are a possible cause for concern and should be investigated where possible. The straight line is the national complication rate to allow comparison between centres.

5.1 National rates

Figure 22 - National rates for hip arthroplasty with subsequent revision.

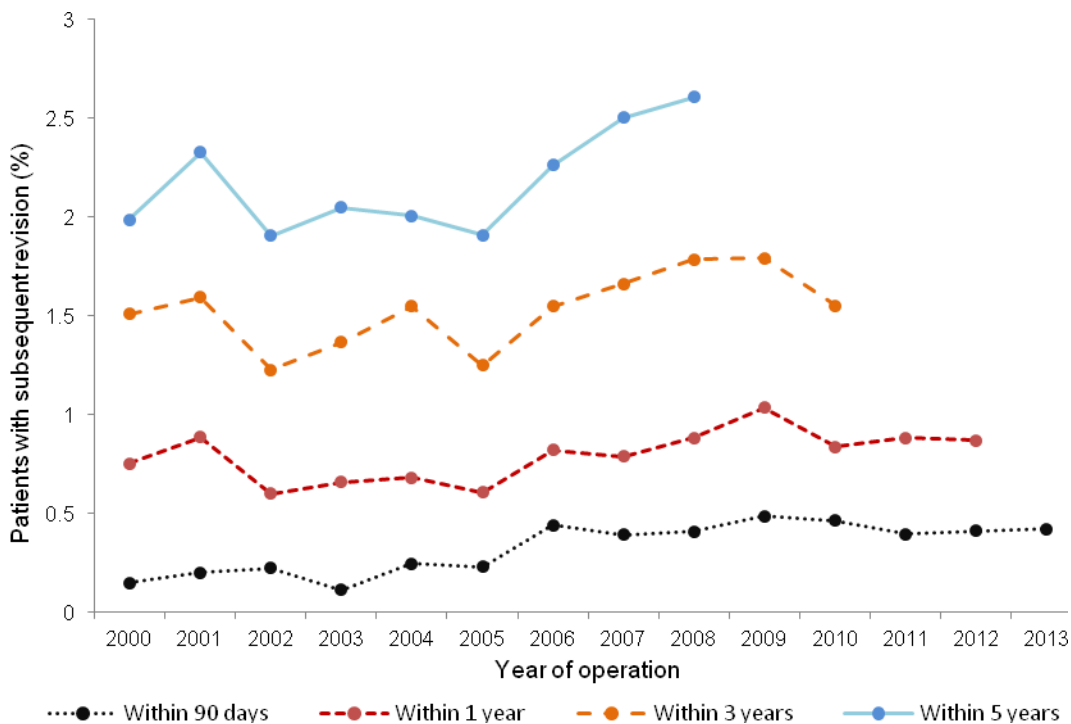
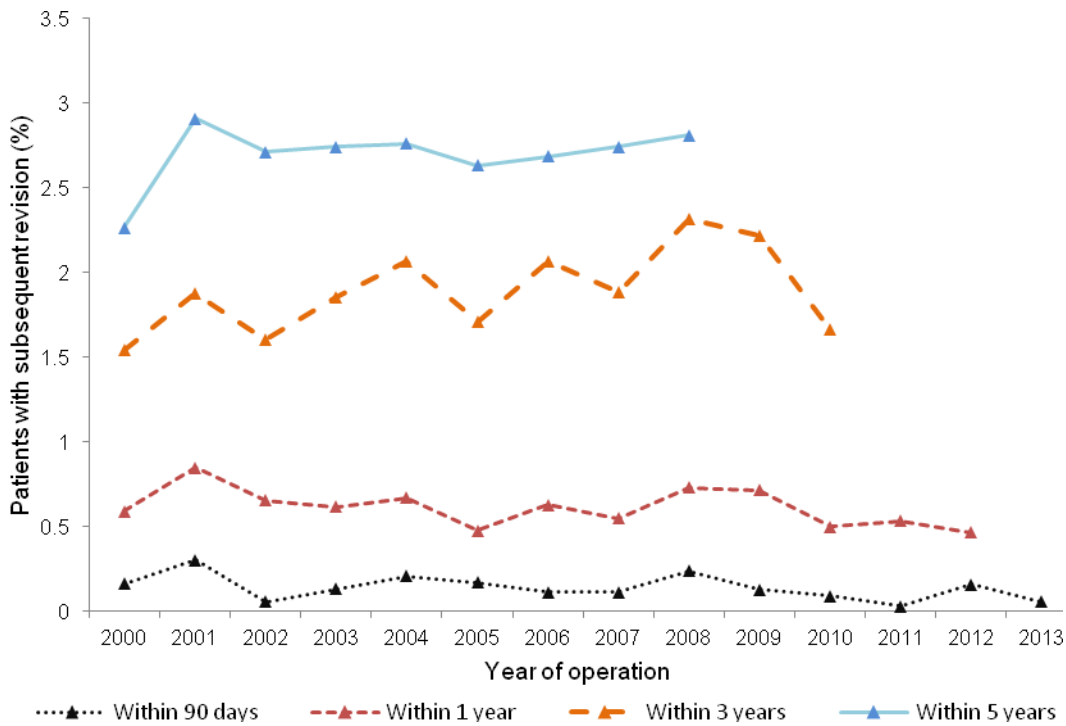


Figure 23 - National rates for knee arthroplasty with subsequent revision.



5.2 Complication funnel charts

5.2.1 Revision within one year.

One Health Board (NHS Dumfries and Galloway) was an “outlier” above the upper confidence limit for 2012 for revision with one year after hip arthroplasty. In six other Health Boards the rates of complication were above the National rate (Figure 24).

None of the Health Boards were “outliers” for revision within one year after knee arthroplasty but in five Health Boards the rate was higher than the National rate (Figure 25).

5.2.2 Revision within three years.

None of the Health Boards were “outliers” for revision within three years after hip or knee arthroplasty (Figure 26, Figure 27); in both hip and knee revisions after three years the rate in 7 Health Boards was higher than the National rate.

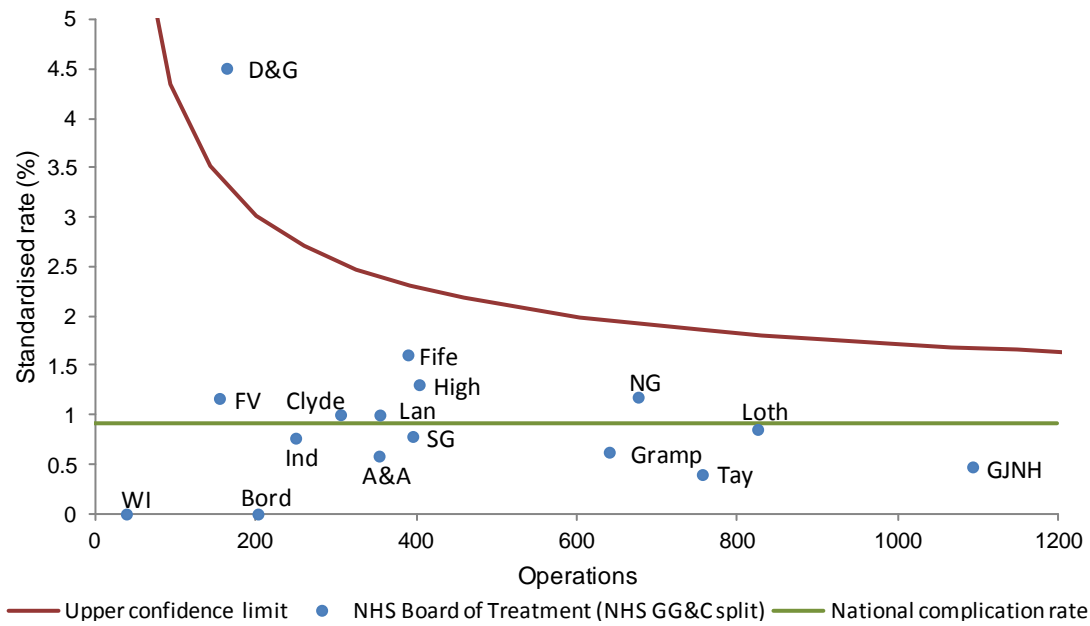
5.2.3 Revision within five years.

Two Health Boards (NHS Lanarkshire, NHS North Glasgow) were “outliers” above the upper confidence limit for 2012 for revision five years after hip arthroplasty. In six other Health Boards the rates of complication were above the National rate (Figure 28).

One Health Board (NHS Borders) was an “outlier” above the upper confidence limit for 2012 for revision five years after knee arthroplasty (Figure 29).

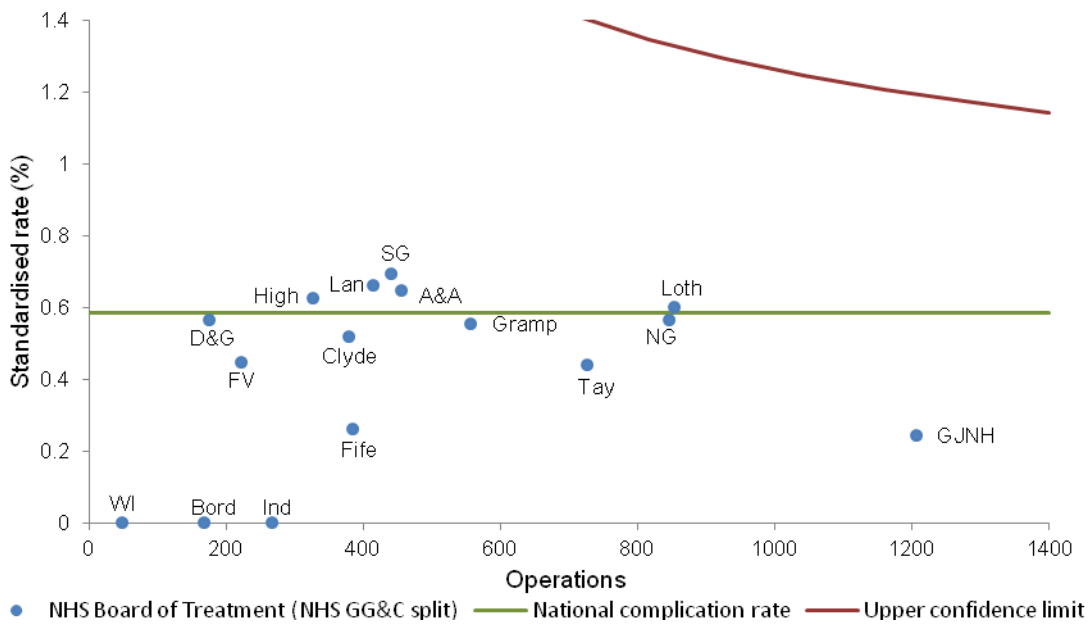
Revision within one year

Figure 24 - Percentage of 2012 hip arthroplasty patients with subsequent revision within one year.



Average, funnel and standardisation calculated on 5-years data 2008-2012.

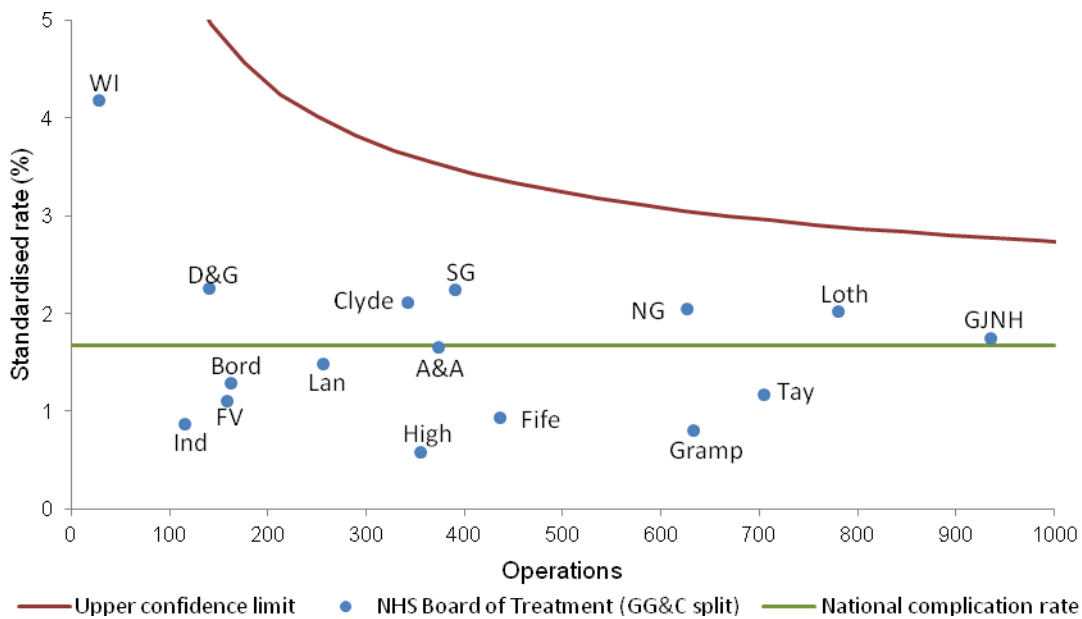
Figure 25 - Percentage of 2012 knee arthroplasty patients with subsequent revision within one year.



Average, funnel and standardisation calculated on 5-years data 2008-2012.

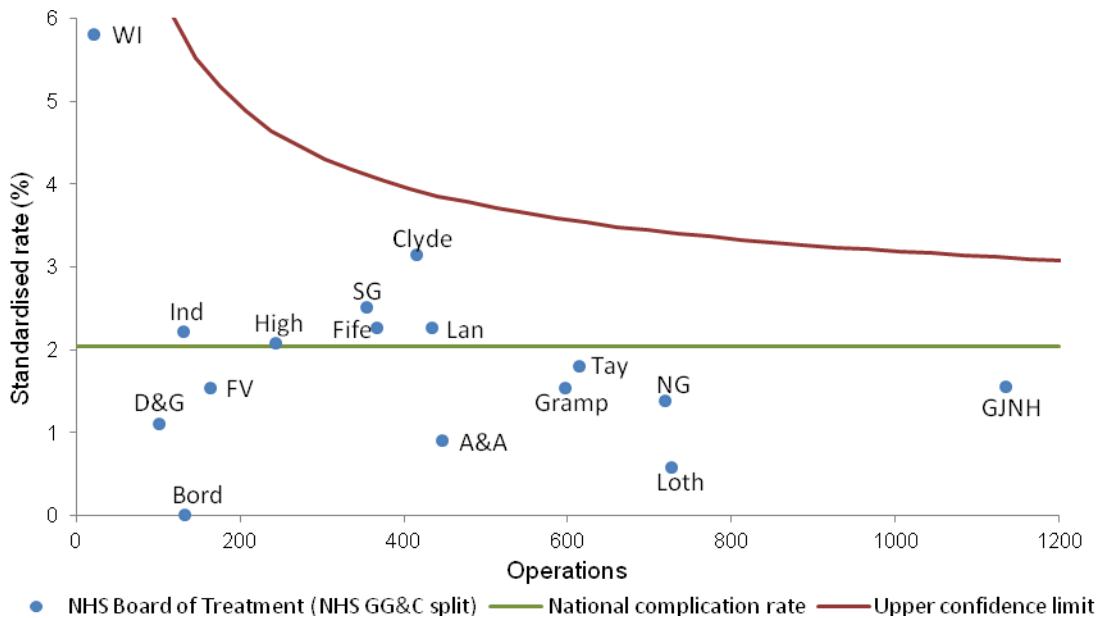
Revision within three years

Figure 26 - Percentage of 2010 hip arthroplasty patients with subsequent revision within three years.



Average, funnel and standardisation calculated on 5-years data 2006 - 2010

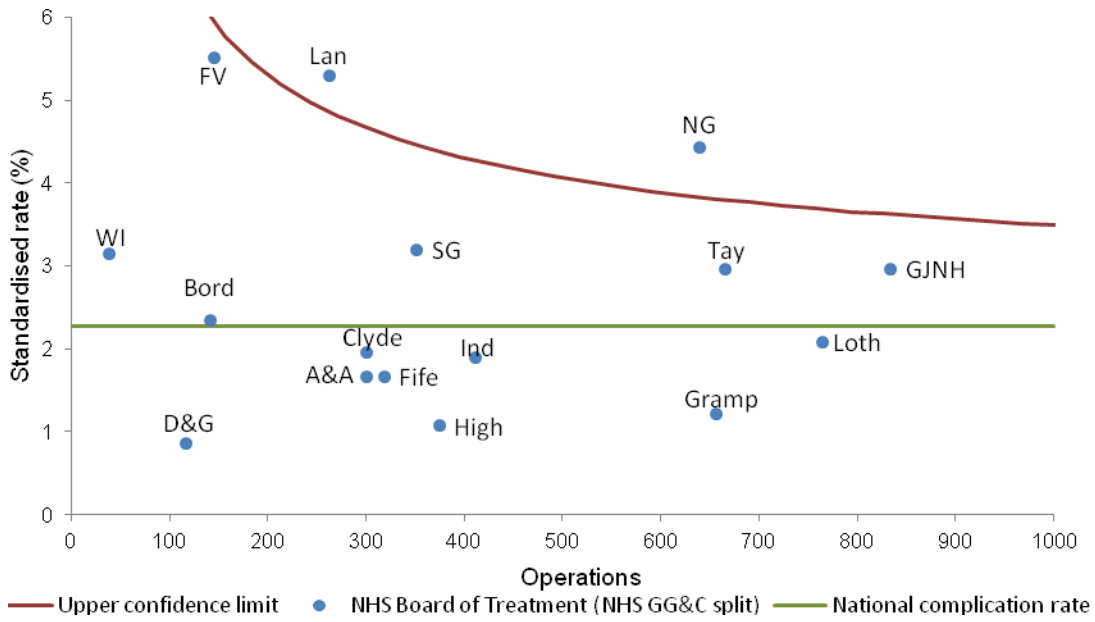
Figure 27 - Percentage of 2010 knee arthroplasty patients with subsequent revision within three years.



Average, funnel and standardisation calculated on 5-years data 2006-2010.

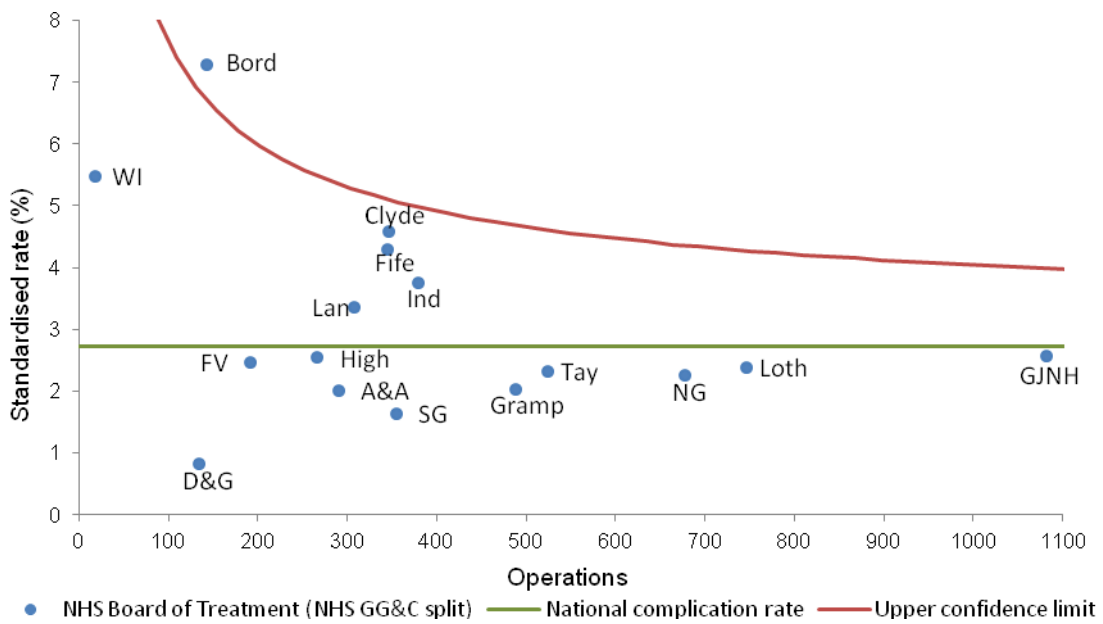
Revision within five years

Figure 28 - Percentage of 2008 hip arthroplasty patients with subsequent revision within five years.



Average, funnel and standardisation calculated on 5-years data 2004-2008.

Figure 29 - Percentage of 2010 knee arthroplasty patients with subsequent revision within 5 years.



Average, funnel and standardisation calculated on 5-years data 2004-2008.

6 Clinical Governance

6.1 What is clinical governance?

Clinical Governance: 'A framework through which NHS organisations are accountable for continually improving the quality of their services and safeguarding high standards of care by creating an environment in which excellence in clinical care will flourish.'¹

Clinical Governance is the system used by NHS organisations to monitor and review the quality of healthcare provided so that high standards of care are maintained and patient safety improved. Since 2004, with the support of the Scottish Committee for Orthopaedics and Trauma (SCOT), the policy of the Scottish Arthroplasty Project (SAP) has been to provide high quality data on activity and complications that can be used at a local level to promote quality improvement. Simple monitoring of activity and quality may influence clinical practice but can be insufficient to create significant change. With the support of the SCOT committee, the SAP operates a feedback and review system at consultant level to identify potential quality issues.

6.2 Statistical analysis of complication rates associated with arthroplasty

Each month analysts within NSS Information and Intelligence Services calculate the complication rates for all consultants carrying out arthroplasty operations on NHS patients in Scotland.

Since 2010, SAP has used CUSUM (CUMulative SUMmation) methodology to allow us to identify increasing complication rates amongst surgeons with an excellent visual impact when displayed graphically. It has been in use in the UK from as early as 1954 for industrial quality control analysis². In clinical disciplines it has been used in cardiothoracic surgery during the past 15 years³ and has been shown to be a superior form of statistical analysis for identifying complications⁴.

In simple terms, operations are plotted on a graph as a rate over time. If an operation has an associated complication, the CUSUM rate increases markedly. Subsequent operations without known complications bring the rate down by smaller increments. Three of these 'jumps' for the same type of complication in close succession, will raise the CUSUM rate over an agreed control limit and the consultant will be identified as an "outlier". In practice the limit is usually breached over longer periods of time, which include more 'jumps' but also many incremental decreases through successful operations. Two examples are presented in *Appendix C to Section 6*.

6.3 Quality Improvement through *Case Review and Action Plan*

When outliers are identified, recipients are asked to undertake local review and audit to investigate the reasons for the increased rate in complications and to develop an action plan to reduce their recurrence. The introduction of a new technique, a new implant or particular case mix issues may be identified as reasons for an apparent rise.

Comments, case reviews and audit findings are returned to SAP analysts within NHS Information and Intelligence Services. The review process is administered by analysts within NHS Information and Intelligence Services and is subject to NHS confidentiality

policy – individual consultant responses are anonymised before being passed onto the SAP committee for review.

Clinical members of the Scottish Arthroplasty Project Steering Committee (SAPSC) grade these reviews and provide feedback. In the very rare occasions when a the response is viewed as less than satisfactory, a resubmission is requested and the issue may be transferred to senior management within the appropriate NHS Board.

The purpose of reviewing outliers is to emphasise quality improvement, rather than to attribute blame. The aim of the review process is to continue to encourage local review of clinical practice and data quality, both of which contribute to the continual improvement of patient care.

Figure 30a - CUSUM outlier notifications during 2012-2013.

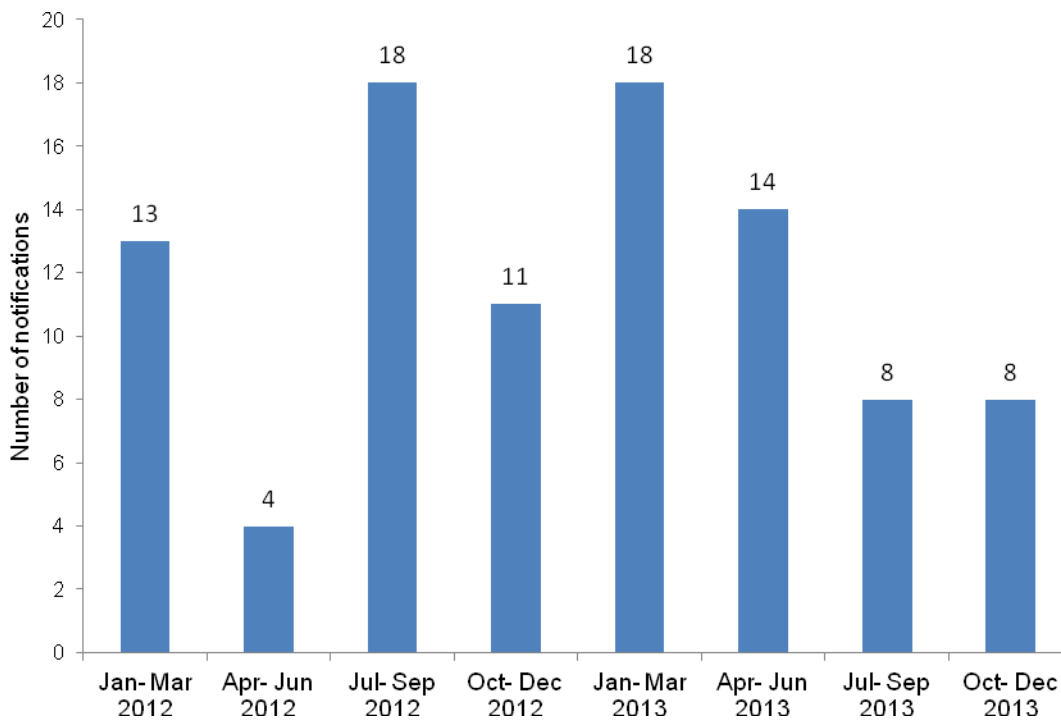
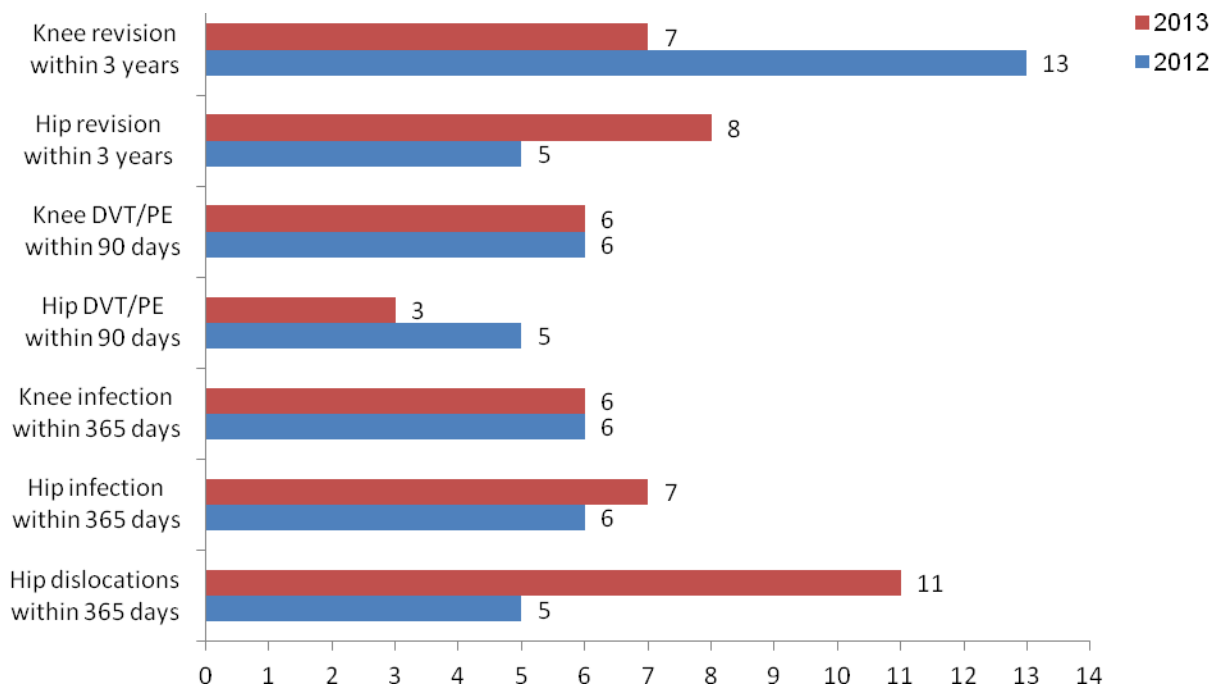


Figure 30b - CUSUM outlier notification by complication type during 2012-2013.



References

1. Scally G and Donaldson LJ (1998) Clinical governance and the drive for quality improvement in the new NHS in England. *British Medical Journal*. 317 (7150) 4 July pp.61-65.
2. Page ES (1954). Continuous inspection schemes. *Biometrika*. 41:100 –115.
3. de Leval MR et al. (1994). Analysis of a cluster of surgical failures. Application to a series of neonatal arterial switch operations. *J Thorac Cardiovasc Surg*. 107:914–24
4. Novick R, et al. (2003). Analysis of the learning curve in telerobotic, beating heart coronary artery bypass grafting: a 90 patient experience. *Ann Thor Surg*. 76:749–53.

Appendix A

Data Sources

The Scottish Arthroplasty Project is administrated by the Information Services Division (ISD) of National Services Scotland (NSS), a special NHS Health Board. ISD use information submitted by Scottish hospitals (known as SMR01 data) to calculate statistical information related to NHS arthroplasty operations in Scottish hospitals.

Information on SMR01 is available here: <http://www.isdscotland.org/Products-and-Services/Hospital-Records-Data-Monitoring/SMR-Completeness/>

Data Completeness

All SMR01 data are required to be securely submitted to ISD no later than six weeks after the end of the month of discharge. Although Medical Records departments within hospitals and NHS Boards make every effort to comply, circumstances outwith their control may mean that this target is not always met. SMR01 data required for the analyses in this report are considered to be 100% complete.

Information on SMR01 data completeness is available here: <http://www.isdscotland.org/Products-and-Services/Hospital-Records-Data-Monitoring/>

Arthroplasty coding

Information on codes used to identify arthroplasty operations is available here: Information on codes used to identify arthroplasty operations is available here:

http://www.arthro.scot.nhs.uk/OPCS_codes_summary_150710.pdf

Appendix B to Section 4

Table 4a - Percentage patients after hip arthroplasty (by Health Board) with acute renal failure within 30 days.

Health Board	2004 (%)	2005 (%)	2006 (%)	2007 (%)	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)
Ayrshire & Arran	1.01	0.33	0.26	0.8	0	1.64	0.77	0.49	1.05	1.94
Borders	0	0	0.55	0	0	1.15	0.56	1.61	0.88	0.92
Dumfries & Galloway	0	0	0.61	0.83	1.56	0	3.89	0.48	0.52	1.07
Fife	0.28	0.96	0.49	0	0	0.3	0	0.66	0.74	0
Forth Valley	0.57	0	1.02	1.17	0.62	0.52	0	0	0.57	0
Grampian	0.28	0.39	0.62	0.86	1.2	0.52	1.34	0.94	1.33	1.46
Clyde	0	0.69	0	0	0.61	0.24	0.75	0.51	0.27	0.5
North Glasgow	0.61	0.18	0.32	0.49	0.42	0.14	0.16	0.44	0.58	0.31
South Glasgow	0.56	0.21	1.39	0	0.49	0.8	0.24	0.25	0.64	1.7
Highland	0	1.09	0.91	0.24	0	0.46	0	0.82	3.17	2.62
Lanarkshire	0	0	0.82	0.35	0	0.61	1.13	1.75	0.28	1.36
Lothian	1.64	0.74	1.33	0.72	0.99	0.31	0.91	1.27	1.2	1.02
Tayside	0.73	0.16	0.38	0.98	0.71	1.25	1.32	1.02	2.18	0.56
Western Isles	0	0	2.39	0	0	0	0	2.53	2.43	0
Golden Jubilee National Hospital	0.52	1.13	0.76	1.18	0.45	0.2	0.3	0.37	0.26	0.16
Ind. Hospital	0	1.11	0	0	0	0	0	0	0.44	0
Scotland	0.47	0.48	0.56	0.57	0.58	0.56	0.61	0.64	0.72	0.78

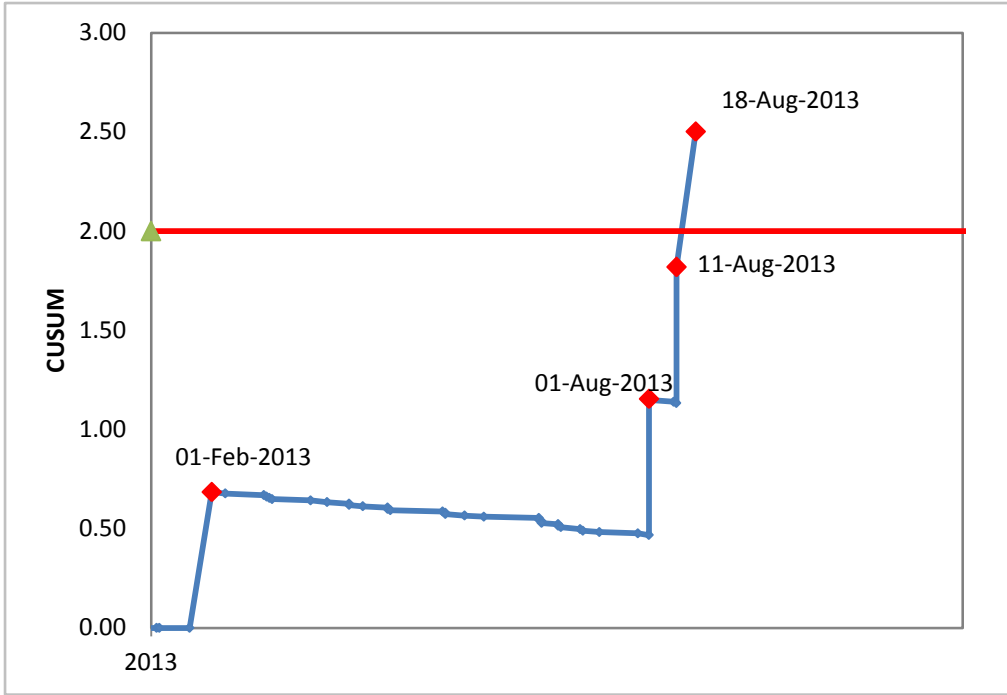
Table 4b - Percentage patients after knee arthroplasty (by Health Board) with acute renal failure within 30 days.

Health Board	2004 (%)	2005 (%)	2006 (%)	2007 (%)	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)
Ayrshire & Arran	0.29	0.29	0.34	0	0	0.62	0.43	0.68	1.05	0.62
Borders	0	0	0	0	1.66	0	0	0.7	0	1.1
Dumfries & Galloway	1.1	0	0	0.91	0.66	0.88	1.84	0	1.89	0
Fife	0	0.62	0.26	0.21	0.25	0.75	0	0.81	0.45	0.44
Forth Valley	0.82	0	0.68	0.83	1.04	1.11	0.66	0	0.41	1.01
Grampian	0	0.21	0.65	1.55	0.76	0.82	1.09	1.33	0.86	1.19
Clyde	0	0	0.27	0.63	0.52	0.45	1.36	0.49	0.53	1.54
North Glasgow	0.66	0.32	0.26	0.65	0	0.13	0.27	0	0.38	0.38
South Glasgow	0.8	1.19	0.58	0.33	0.81	0.57	0.83	0.55	1.69	1.71
Highland	0	0.71	0	0.73	0	0.32	0.82	2.31	2.61	2.53
Lanarkshire	0	0.31	0.24	0	0.59	0	1.51	0.5	0.25	1.54
Lothian	1.12	0.53	0.81	0.73	0.74	0	0.82	1.39	1.19	1.97
Tayside	0.56	0.73	0.73	0.81	0.67	0.81	1.17	0.82	1.48	2.07
Western Isles	0	0	0	4.01	0	0	0	13.12	0	1.92
Golden Jubilee National Hospital	0.23	0	1.2	0.43	0.28	0.18	0.45	0.19	0.08	0.18
Ind. Hospital	0	0	0.96	0	0	0	0.8	0	0	0
Scotland	0.39	0.42	0.46	0.51	0.49	0.47	0.54	0.58	0.62	0.75

Appendix C to Section 6

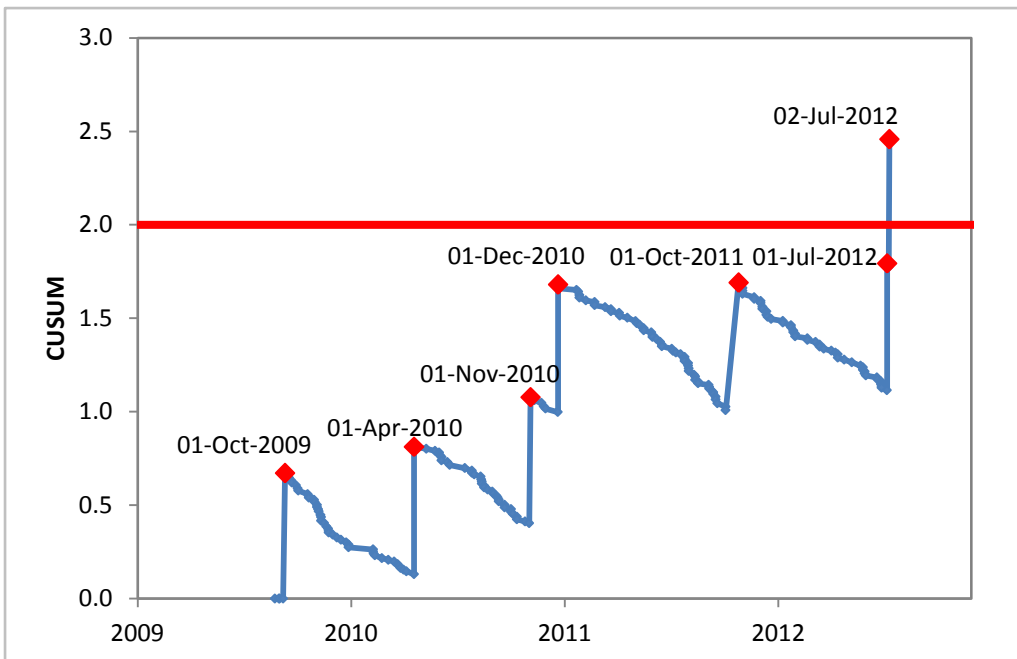
In the case below (Figure 31a), CUSUM is low until it rises suddenly to the Control Limit in 2009. Is the rise associated with a change in practise, perhaps a new technique?

Figure 31a



In the following case (Figure 31b), CUSUM rises steadily to the Control Limit (2.0). The complication rate is always slightly over average - is there an ongoing issue? When the Control Limit is reached (February 2008), the consultant would be notified that their complication rate had been unusually high and asked to complete a review and Action Plan.

Figure 31b



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