



**Scottish
Arthroplasty
Project.**

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ISD Scotland Publications

Information Services Division
NHS National Services Scotland
Gyle Square
1 South Gyle Crescent
Edinburgh EH12 9EB

phone: +44 (0)131 275 6233

email: NSS.PHIgraphics@nhs.net

Designed and typeset by

ISD Scotland Publications

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Foreword

This report presents data on the number of arthroplasties in Scotland for 2014 and 2015 and complications related to these procedures. In addition we present a wider perspective with national data for hip and knee arthroplasty over the last thirty-five years and a focus on revision arthroplasty over the last decade.

As ever we are grateful for the continued support of the orthopaedic surgeons and NHS Boards who provide data and are instrumental in checking and ensuring quality is maintained. CUSUM methodology (see appendix) is well established and supports ongoing audit of surgical complications and feedback to surgeons. In the near future individual consultants will have access on line to their own “real time” CUSUM plots for complications. Our hope is that this ready access will facilitate further improvement in data accuracy and the quality of arthroplasty surgery in Scotland.

This report demonstrates success in reduction of most complication rates after hip and knee arthroplasty over the last decade. One exception however relates to the incidence of renal failure after surgery. This has been highlighted in previous reports and the trend appears to continue upwards. The reasons for this apparent change remain unclear and may be multifactorial. We would encourage close observation and study of this complication which the Scottish Arthroplasty Project will continue to monitor.

The Scottish Arthroplasty Project Steering Committee hopes to return to the previous format of an annual report next year. Data are gathered not just on hip and knee replacements, but many other forms of arthroplasty, and we would like to be able to focus more on these areas in future reports.

Attempts made around a decade ago to gather implant data (type of hip or knee prosthesis) foundered. Renewed attempts to do this are underway with a pilot study. We hope that this time round there is a better chance of success with Scottish Government support and with new labelling of implants, known as UDI (Unique Device Identifier) which should facilitate barcode reading of individual components into a database. It is likely that this kind of data would have been helpful to explain the variation noted in revision rates between different hospitals over the last decade.

We hope to be more closely involved with the International Society of Arthroplasty Registers (ISAR) in coming years and are confident we can learn and help develop our insight into arthroplasty surgery in Scotland.

Mr R Ingram

Chair, Scottish Arthroplasty Project Steering Committee

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 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 “outliers” 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.

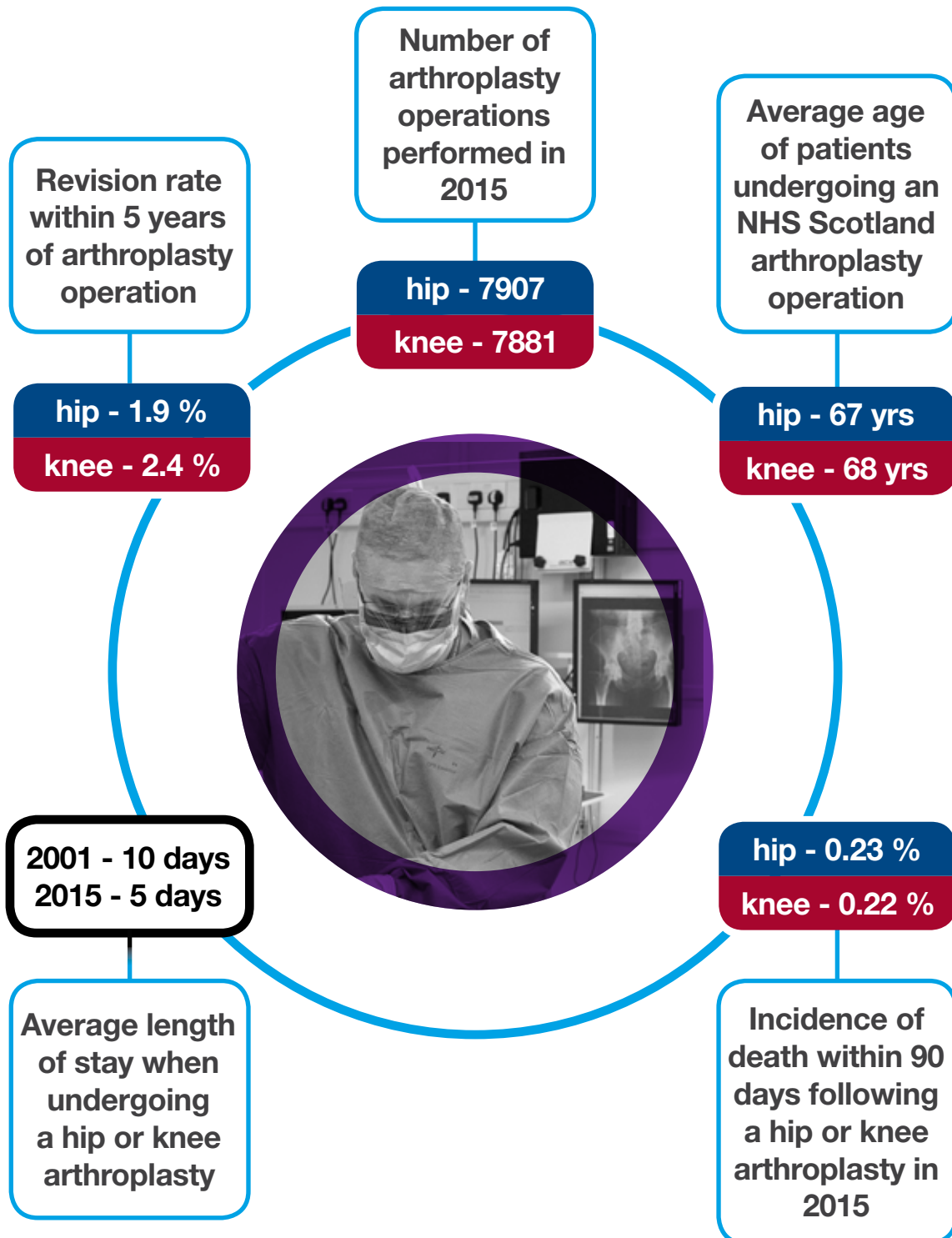
Scottish Arthroplasty Steering Committee 2014 – 2016

Clinical	Non-Clinical
Mr Roland Ingram (Chairman)	Mrs Angela Donaldson (Arthritis Care)
Mr James Bidwell	Mr Robert Frame (Lay member)
Dr Karen Cranfield	Mr Derek Murphy (Info. Analyst)
Mr William MacLeod	Mr Martin O’Neill (Principal Info. Analyst)
Mr Matthew Moran	
Mr Martin Sarungi	
Mr Brian Singer	

The committee would like to acknowledge and thank the assistance and valuable input from recent committee members :

Paddy Ashcroft, Jacqueline Campbell, Neil Perkins, Gerry O’Neil, Lesley Smith, Miriam Watts and Colin Howie.

Main Points



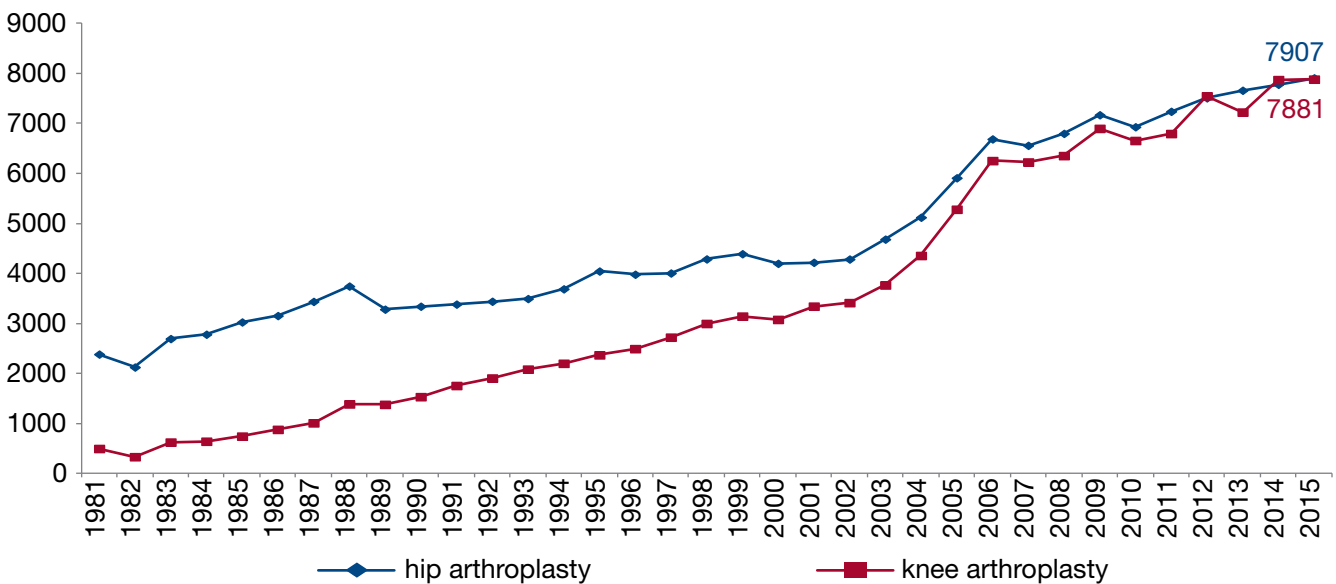
1. Number of Arthroplasties

1.1 National rates

In many countries the revision burden, defined as the ratio of the number of revision hip replacements to the number of primary hip replacements over a period of time, has decreased to between 10-12%¹. Similarly, in Scotland we have seen the revision burden fall to around 10.5%. The main reason for the reduction relates more to an annual incremental increase in the number of primary replacements rather than a fall in the number of revisions.

That said, there has in fact been a reduction in the number of revision hip replacements over the last 2 years to levels similar to or below those of a decade ago (Figure 1b). At this time, it is not clear if there is a general trend upwards in the revision hip numbers or if we have seen a bulge over the last decade for other reasons. One possible explanation relates to the well-recognised problems with hip resurfacing and large diameter metal bearing hip replacements.

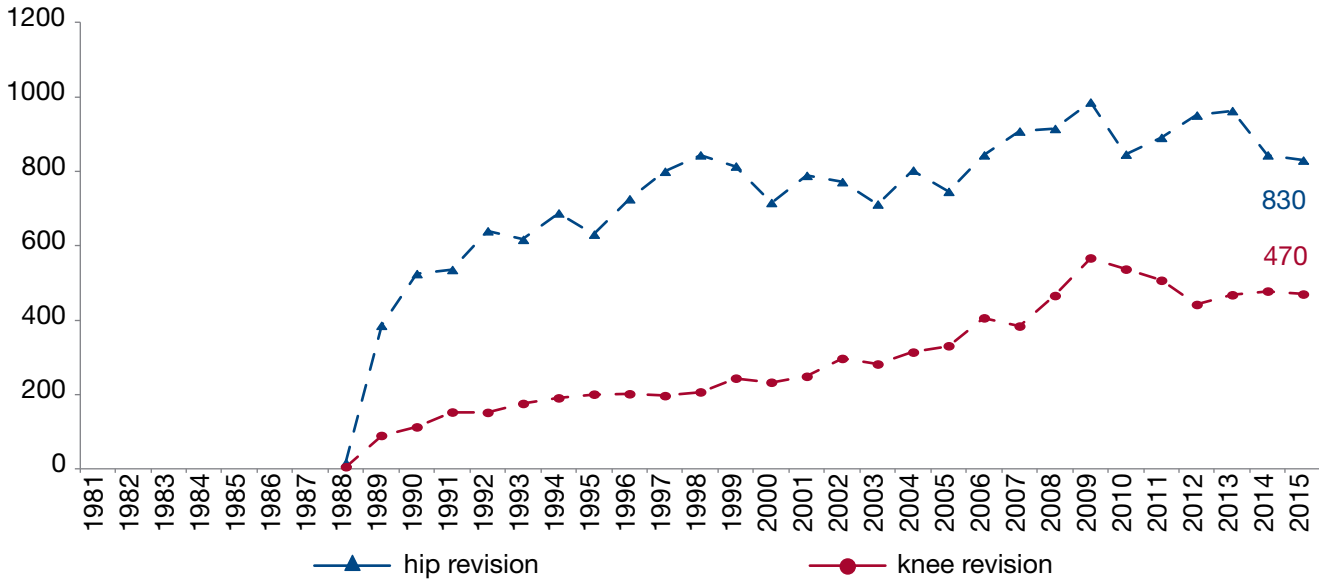
Figure 1a – Primary hip and knee arthroplasties per year (1981 - 2015)



Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

1. Comparing contemporary revision burden among hip and knee joint replacement registries. McGrory, Brian J. et al. Arthroplasty Today , Volume 2 , Issue 2 , 83 - 86.

Figure 1b – Revision hip and knee arthroplasties per year (1981 - 2015)

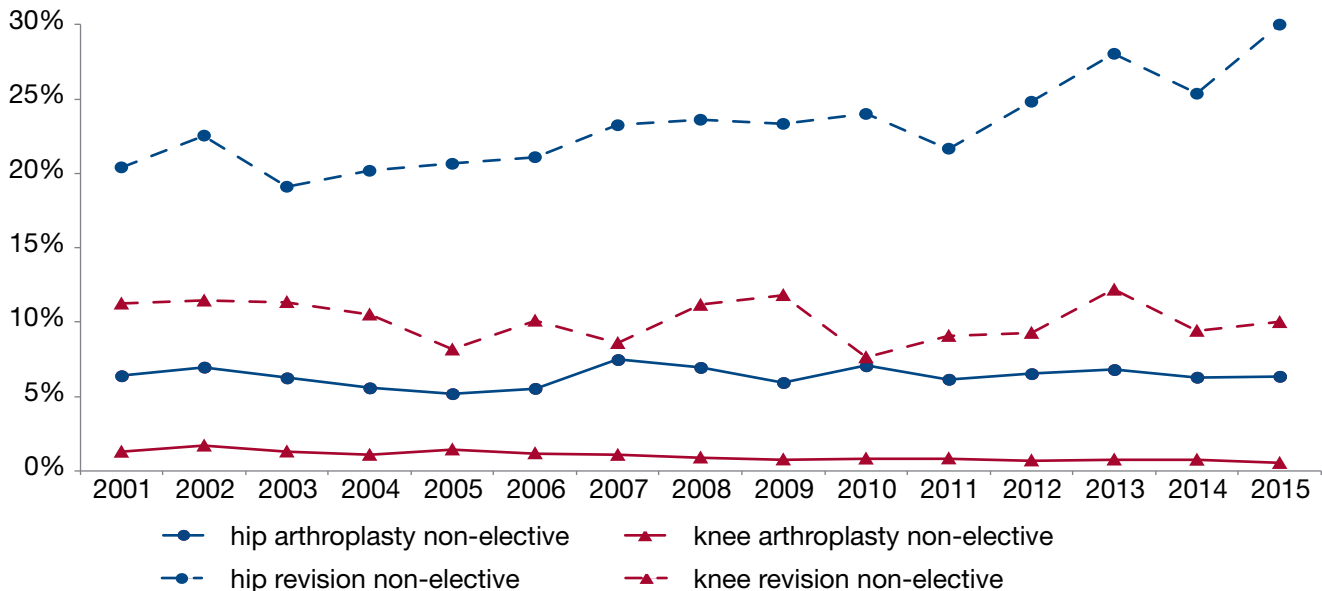


Reliable data only available from 1988 onwards for revisions

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

It is perhaps of some concern that there has been a steady rise in the percentage of hip revisions being treated as non-elective cases, rising from around 20% a decade ago to 30% recently (Figure 1c). This is with a background of data suggesting lower numbers of primary hip complications including infection and dislocation over this time period (Figure 8b). Periprosthetic fracture may be important here.

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



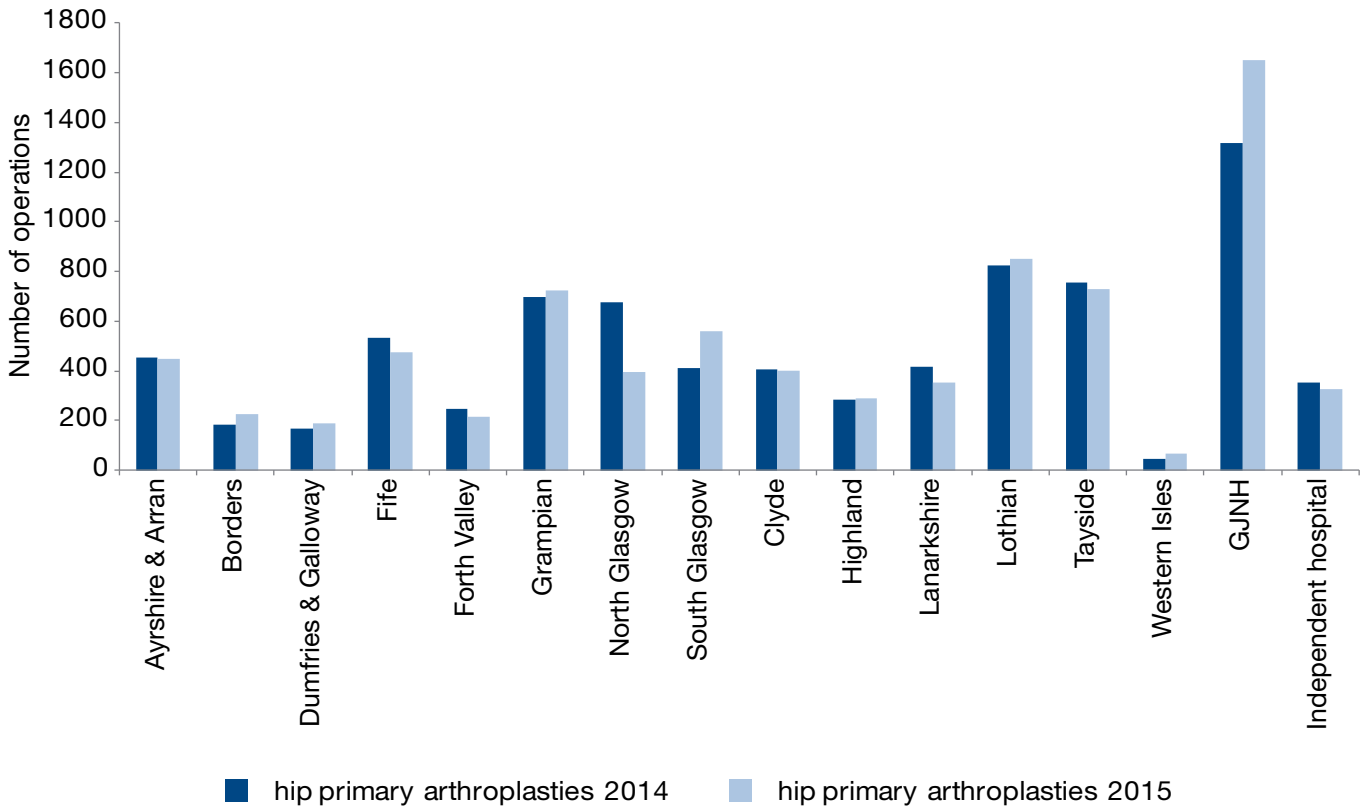
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

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

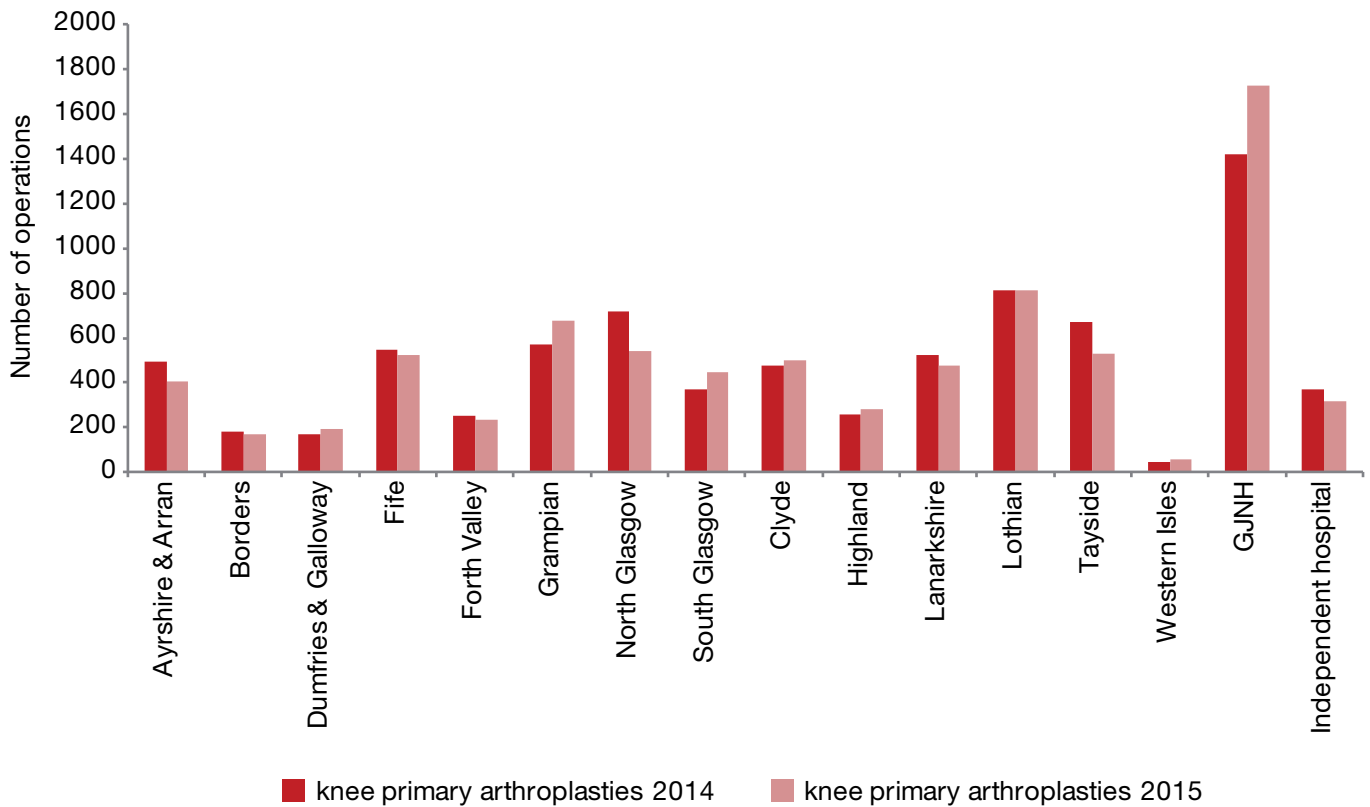
The numbers of primary hip and knee arthroplasties undertaken in 2014 and 2015 within the NHS Board of treatment is presented in Figure 2a and Figure 2b.

Figure 2a – Number of primary hip arthroplasties 2014-2015 by NHS Board of treatment (NHS GG&C split)



Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 2b – Number of primary knee arthroplasties 2014-2015 by NHS Board of treatment (NHS GG&C split)



Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

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

It is recognised that many patients are treated outwith their NHS 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 GG&C split)

NHS Board	Mean number of operations 2010-2013	Number of operations 2014	Number of operations 2015	Mean number of revisions 2010-2013	Number of revisions 2014	Number of revisions 2015
Ayrshire & Arran	415	454	448	54	71	44
Borders	186	182	226	5	9	11
Dumfries & Galloway	162	168	190	8	*	*
Fife	436	535	476	46	50	45
Forth Valley	188	246	214	32	40	27
Grampian	726	700	723	91	86	92
North Glasgow	693	675	397	116	86	56
South Glasgow	411	414	561	100	78	116
Clyde	380	408	402	58	40	34
Highland	395	282	291	40	20	26
Lanarkshire	389	419	355	45	47	62
Lothian	882	824	851	148	159	155
Tayside	807	756	727	92	85	66
Western Isles	39	47	68	3	*	*
GJNH	1069	1315	1649	77	70	92
Independent hospital	156	353	329	2	*	*
Scotland	7333	7778	7907	913	844	830

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Note: Following ISD Statistical Disclosure Control Protocol, any cells with count values of 4 or less have been redacted in order to protect the confidentiality of potentially personally identifiable information.

Table 1b – Number of knee arthroplasties by NHS Board of treatment (NHS GG&C split)

NHS Board	Mean number of operations 2010-2013	Number of operations 2014	Number of operations 2015	Mean number of revisions 2010-2013	Number of revisions 2014	Number of revisions 2015
Ayrshire & Arran	453	493	406	37	43	41
Borders	160	179	172	7	9	7
Dumfries & Galloway	150	171	191	1	*	*
Fife	412	547	521	40	40	51
Forth Valley	195	250	234	20	20	11
Grampian	596	569	676	47	47	52
North Glasgow	784	720	539	53	54	49
South Glasgow	383	368	446	36	26	33
Clyde	397	478	498	38	27	20
Highland	284	258	283	19	8	11
Lanarkshire	443	521	475	34	37	42
Lothian	763	813	811	63	73	69
Tayside	683	670	529	47	53	31
Western Isles	35	47	57	0	*	*
GJNH	1157	1419	1725	46	36	48
Independent hospital	161	369	318	1	*	*
Scotland	7055	7872	7881	489	478	470

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Note: Following ISD Statistical Disclosure Control Protocol, any cells with count values of 4 or less have been redacted in order to protect the confidentiality of potentially personally identifiable information.

Table 1c – Number of hip arthroplasties by NHS Board of residence

NHS Board	Mean number of operations 2010-2013	Number of operations 2014	Number of operations 2015	Mean number of revisions 2010-2013	Number of revisions 2014	Number of revisions 2015
Ayrshire & Arran	569	673	628	72	87	52
Borders	234	239	286	22	23	27
Dumfries & Galloway	254	262	278	41	31	31
Fife	539	617	543	56	64	55
Forth Valley	397	432	504	54	48	39
Grampian	767	843	870	83	76	80
GG&C	1233	1294	1281	191	151	159
Highland	571	481	492	60	39	50
Lanarkshire	785	840	899	99	88	114
Lothian	1118	1237	1274	125	138	130
Orkney	43	50	51	6	7	13
Shetland	42	57	50	5	5	6
Tayside	685	664	643	84	81	62
Western Isles	66	61	86	12	6	*
England/Wales/NI	25	24	17	3	*	6
Unknown	3	*	*	1	*	*
Outside UK	5	*	*	0	*	*
Total	7333	7778	7907	913	844	830

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Note: Following ISD Statistical Disclosure Control Protocol, any cells with count values of 4 or less have been redacted in order to protect the confidentiality of potentially personally identifiable information.

Table 1d – Number of knee arthroplasties by NHS Board of residence

NHS Board	Mean number of operations 2010-2013	Number of operations 2014	Number of operations 2015	Mean number of revisions 2010-2013	Number of revisions 2014	Number of revisions 2015
Ayrshire & Arran	611	755	648	43	47	45
Borders	193	218	219	11	15	12
Dumfries & Galloway	237	236	251	18	20	17
Fife	485	662	596	44	50	56
Forth Valley	411	455	551	27	29	16
Grampian	648	659	812	43	43	52
GG&C	1416	1415	1433	99	83	82
Highland	440	470	505	32	23	16
Lanarkshire	874	1075	1057	61	49	70
Lothian	1012	1180	1178	56	62	69
Orkney	34	43	44	2	*	*
Shetland	40	51	55	4	*	*
Tayside	586	571	453	43	42	26
Western Isles	57	69	68	3	5	*
England/Wales/NI	10	9	6	2	*	*
Unknown	2	*	*	0	*	*
Outside UK	1	*	*	0	*	*
Total	7055	7872	7881	488	478	470

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Note: Following ISD Statistical Disclosure Control Protocol, any cells with count values of 4 or less have been redacted in order to protect the confidentiality of potentially personally identifiable information.

Table 2 – Number of arthroplasties and operative consultants in 2014 and 2015

	Mean number of operations 2010-2013	Number of operations 2014	Number of operations 2015	Mean number of consultants performing operations 2010-2013	Number of consultants performing operations 2014	Number of consultants performing operations 2015
Hip arthroplasty	7333	7778	7907	221	232	231
Hip revision	913	844	830	144	138	148
Knee arthroplasty	7055	7872	7881	202	200	192
Knee revision	489	478	470	101	101	93
Shoulder arthroplasty	419	470	459	94	95	90
Shoulder revision	27	44	41	15	25	18
Elbow arthroplasty	9	8	10	6	6	6
Elbow revision	2	*	*	2	*	*
Ankle arthroplasty	51	21	6	12	7	*
Ankle revision	3	5	*	3	*	*
Wrist arthroplasty	19	13	9	9	10	5
Wrist revision	2	*	*	1	*	*
Radial head replacement	3	5	*	3	5	*
Radial head revision	0	*	*	0	*	*
Finger arthroplasty	68	73	72	19	21	20
Finger revision	4	5	*	4	5	*
Thumb arthroplasty	48	40	38	13	14	11
Thumb revision	0	*	*	0	*	*
Toe arthroplasty	34	20	15	14	11	8
Excision**	309	355	374	114	116	130
Resurf. Of Patella**	29	43	34	20	28	20
Other knee resurfacing**	23	23	15	17	14	9
Other resurfacing*	16	8	*	13	6	*
Other	103	69	62	53	47	38
Total	16956	18177	18233	1076	1087	1030

**Limited SMR01 coding generating a generalised description of clinical procedure

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals

Note: Following ISD Statistical Disclosure Control Protocol, any cells with count values of 4 or less have been redacted in order to protect the confidentiality of potentially personally identifiable information.

The Scottish Arthroplasty Project monitors rates for all types of arthroplasty; although hip and knee are by far the most common, other orthopaedic procedures are 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 throughout Scotland; it is not comprehensive and does not reflect the complex factors involved in workforce planning.

1.3 Consultants performing low volumes

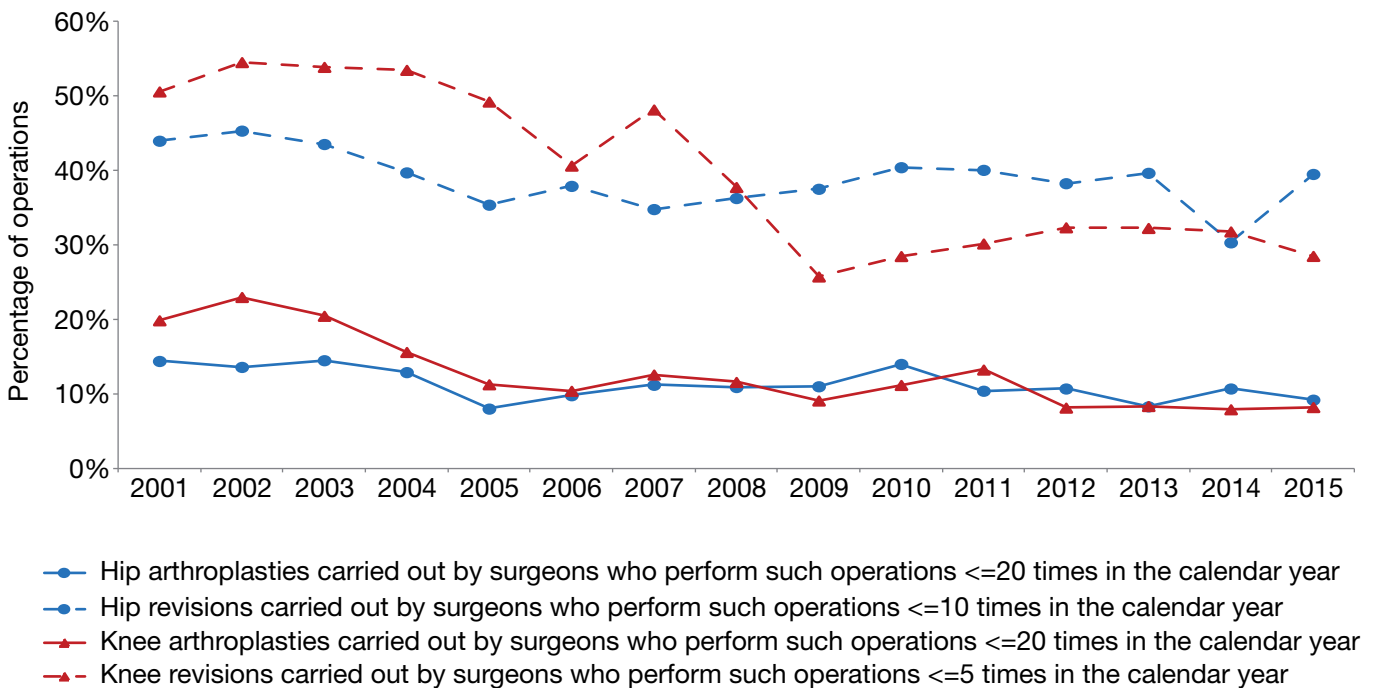
It is perhaps disappointing that there has been no great change in recent years in the number of consultants performing low volume arthroplasty procedures, particularly revision arthroplasty.

The picture is fairly static in primary total hip replacement with about 50% of surgeons who perform this procedure doing twenty or less per year. Similarly, with revision total hip replacement, apart from 2014, the picture is static with around 40% of revision surgery being undertaken by consultants doing ten or less per year.

In primary total knee replacement there may be a trend downward in the percentage of surgeons performing twenty or fewer per year but with revision total knee replacement around 70% of surgeons performing this procedure do ten or fewer revisions per year, equating to around 30% of all knee revisions.

These data strengthen the argument for surgeons keen to set up clinical networks, particularly for revision arthroplasty surgery.

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



Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Table 3a – The number and percentage of hip arthroplasties by surgeon and performance activity, 2011-2015.

Year	Total number of hip arthroplasties	Total number of surgeons	Percentage of surgeons performing <=20 operations per year	Percentage of operations by surgeons performing <=20 operations per year	Percentage of surgeons performing 21-40 operations per year	Percentage of operations by surgeons performing 21-40 operations per year	Percentage of surgeons performing 41-60 operations per year	Percentage of operations by surgeons performing 41-60 operations per year	Percentage of surgeons performing 61-80 operations per year	Percentage of operations by surgeons performing 61-80 operations per year	Percentage of surgeons performing 81-100 operations per year	Percentage of operations by surgeons performing 81-100 operations per year	Percentage of surgeons performing >100 operations per year	Percentage of operations by surgeons performing >100 operations per year
2011	7238	220	48.6%	10.4%	21.8%	19.3%	10.9%	16.1%	7.7%	16.4%	3.6%	9.9%	7.3%	27.9%
2012	7507	227	50.2%	10.7%	20.7%	19.1%	10.6%	15.0%	5.3%	11.0%	5.7%	15.8%	7.5%	28.4%
2013	7659	217	47.5%	8.3%	20.3%	17.4%	11.1%	15.1%	7.4%	14.7%	5.1%	12.6%	8.8%	31.9%
2014	7778	232	52.6%	10.7%	16.8%	14.4%	9.9%	13.8%	7.3%	15.6%	6.5%	17.2%	6.9%	28.3%
2015	7907	231	50.6%	9.2%	16.9%	14.3%	11.7%	16.2%	10.4%	21.7%	3.5%	8.9%	6.9%	29.8%

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals

Table 3b – The number and percentage of knee arthroplasties by surgeon and performance activity, 2011-2015.

Year	Total number of knee arthroplasties	Total number of surgeons	Percentage of surgeons performing <=20 operations per year	Percentage of operations by surgeons performing <=20 operations per year	Percentage of surgeons performing 21-40 operations per year	Percentage of operations by surgeons performing 21-40 operations per year	Percentage of surgeons performing 41-60 operations per year	Percentage of operations by surgeons performing 41-60 operations per year	Percentage of surgeons performing 61-80 operations per year	Percentage of operations by surgeons performing 61-80 operations per year	Percentage of surgeons performing 81-100 operations per year	Percentage of operations by surgeons performing 81-100 operations per year	Percentage of surgeons performing >100 operations per year	Percentage of operations by surgeons performing >100 operations per year
2011	6794	198	43.4%	13.2%	26.3%	22.3%	13.6%	20.1%	8.1%	16.5%	3.0%	7.9%	5.6%	19.9%
2012	7547	209	38.3%	8.1%	30.1%	25.1%	12.4%	16.9%	8.1%	15.5%	2.9%	6.7%	8.1%	27.6%
2013	7223	196	38.3%	8.3%	27.6%	21.7%	12.8%	16.9%	8.7%	16.3%	7.1%	17.4%	5.6%	19.3%
2014	7872	200	36.5%	7.9%	26.0%	19.3%	17.0%	21.2%	7.0%	12.5%	6.5%	15.0%	7.0%	24.1%
2015	7881	192	34.4%	8.2%	28.6%	20.8%	16.7%	20.7%	6.3%	10.5%	6.8%	14.7%	7.3%	25.1%

Table 3c – The number and percentage of hip revision by surgeon and performance activity. 2011-2015.

Year	Total number of hip revisions	Total number of surgeons	Percentage of surgeons performing ≤10 operations per year	Percentage of surgeons performing ≤10 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of surgeons performing 21-80 operations per year	Percentage of surgeons performing 21-80 operations per year
2011	891	139	80.6%	40.1%	12.9%	29.5%	6.5%	30.4%
2012	951	148	81.1%	38.3%	10.8%	25.0%	8.1%	36.7%
2013	963	152	80.9%	39.7%	11.2%	26.5%	7.9%	33.9%
2014	844	138	78.3%	30.3%	15.9%	40.9%	5.8%	28.8%
2015	830	148	82.4%	39.5%	12.8%	35.2%	4.7%	25.3%

Table 3d – The number and percentage of knee revision by surgeon and performance activity. 2011-2015.

Year	Total number of hip revisions	Total number of surgeons	Percentage of surgeons performing ≤10 operations per year	Percentage of surgeons performing ≤10 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of surgeons performing 21-80 operations per year	Percentage of surgeons performing 21-80 operations per year
2011	507	103	72.8%	30.2%	23.3%	48.3%	3.9%	21.5%
2012	442	101	69.3%	32.4%	28.7%	57.5%	2.0%	10.2%
2013	468	102	73.5%	32.3%	24.5%	57.3%	2.0%	10.5%
2014	478	101	73.3%	31.8%	24.8%	57.9%	2.0%	10.3%
2015	470	93	69.9%	28.5%	29.0%	64.5%	1.1%	7.0%

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals

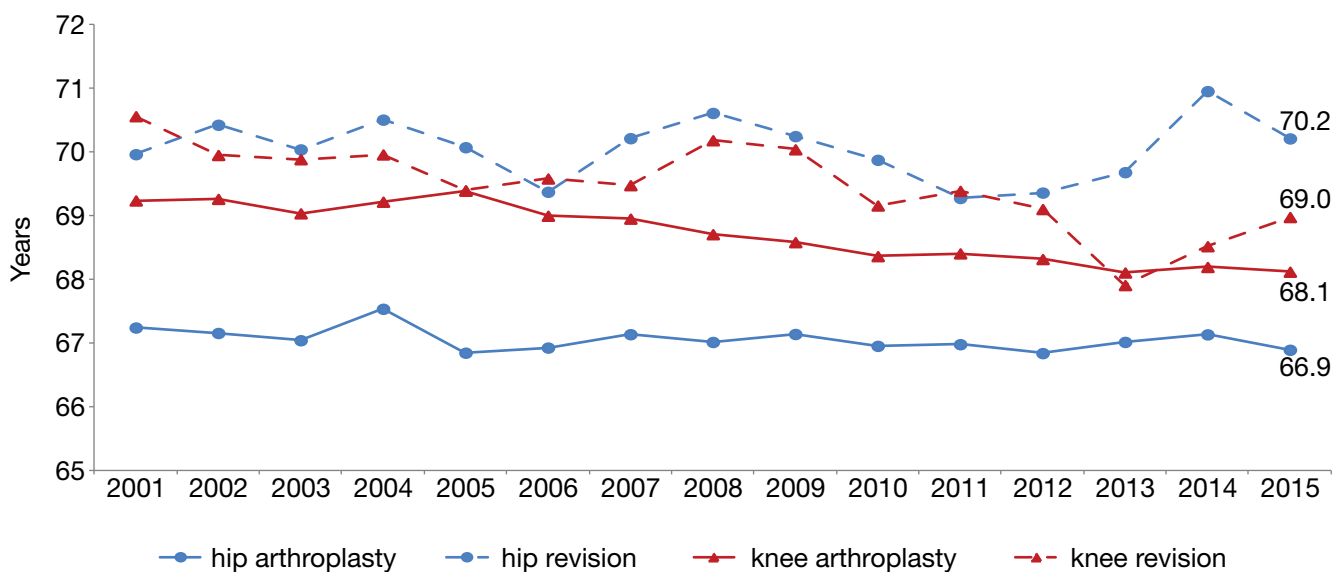
2. Patient Demographics

2.1 Age

Primary hip and knee arthroplasty operations are generally considered as a last choice in the treatment of advanced degenerative hip and knee diseases. Apart from a few conditions, the patients who need these types of surgeries tend to be relatively elderly. The mean age for primary total hip arthroplasty in 2001 was 67.2 years, and in 2015 it was 66.9 years. For primary knee arthroplasty the mean age in 2001 was 69.2 years and in 2015 it was 68.1 years. Although these are not huge differences, there appears to be a greater decrease in the mean age of primary knee arthroplasties compared to primary hip arthroplasties. In comparison, the National Joint Registry 2015 report gives the median age of patients for primary hip arthroplasty as 69 years and for primary knee arthroplasty as 70 years.

Regarding revision hip surgery, the mean age for patients was 70.0 years in 2001, and 70.2 years in 2015. There were years between 2011-2013 when the mean age for hip revisions was slightly lower – the lowest being 69.3 in 2011. This may have reflected the increase in metal-on-metal revisions associated with the early failure of that bearing surface. With the decline of metal-on-metal bearings it is anticipated that in the long term these type of revisions will further decline. The mean age for knee revisions was 70.6 years in 2001 and this reduced to 69.0 years to 2015. This is the biggest age reduction in the 4 groups. There may be many contributing factors to this, including the relatively higher revision rate in younger patients who had unicompartmental knee arthroplasties, and this also may reflect that early revisions (such as infections, or technical errors) are relatively more common following knee arthroplasty than following total hip replacement. As mentioned in the last report, recording other demographic data such as BMI or social deprivation index would be very useful in the future but still currently unavailable.

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



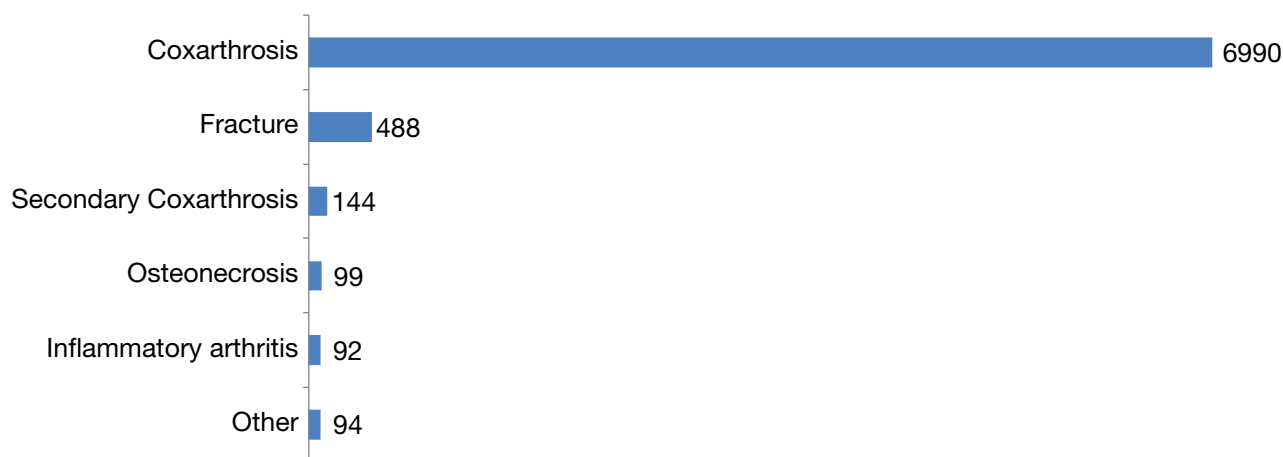
Includes elective patients only; bilateral operations counted twice; includes known patients from independent hospitals

2.2 Indication for surgery

Indications for primary total hip arthroplasties were mainly coxarthrosis (6990 cases), followed by fractures (488 cases), Figure 5a. In the primary knee arthroplasty group the main indication was also coxarthrosis (7634) followed by inflammatory knee arthritis (141). Mechanical complication of internal joint prosthesis is the most common reason for revision of both hip and knee replacements.

As mentioned in the previous report, indication for surgery both for primary and also for revision operations are taken from local coding data. Mainly for revisions, but also for primary procedures it is possible that the patient has additional diagnoses together with the main diagnosis that was coded. Indications for surgery, especially for revisions, are not recorded in a format that most surgeons would use or recognise. This area remains particularly challenging and highlights the need for future work including closer local collaboration in hospitals between surgeons and the coding departments and potential future work in providing clinically relevant and meaningful subcategories.

Figure 5a – Principal pre-operative conditions hip arthroplasty in 2015.



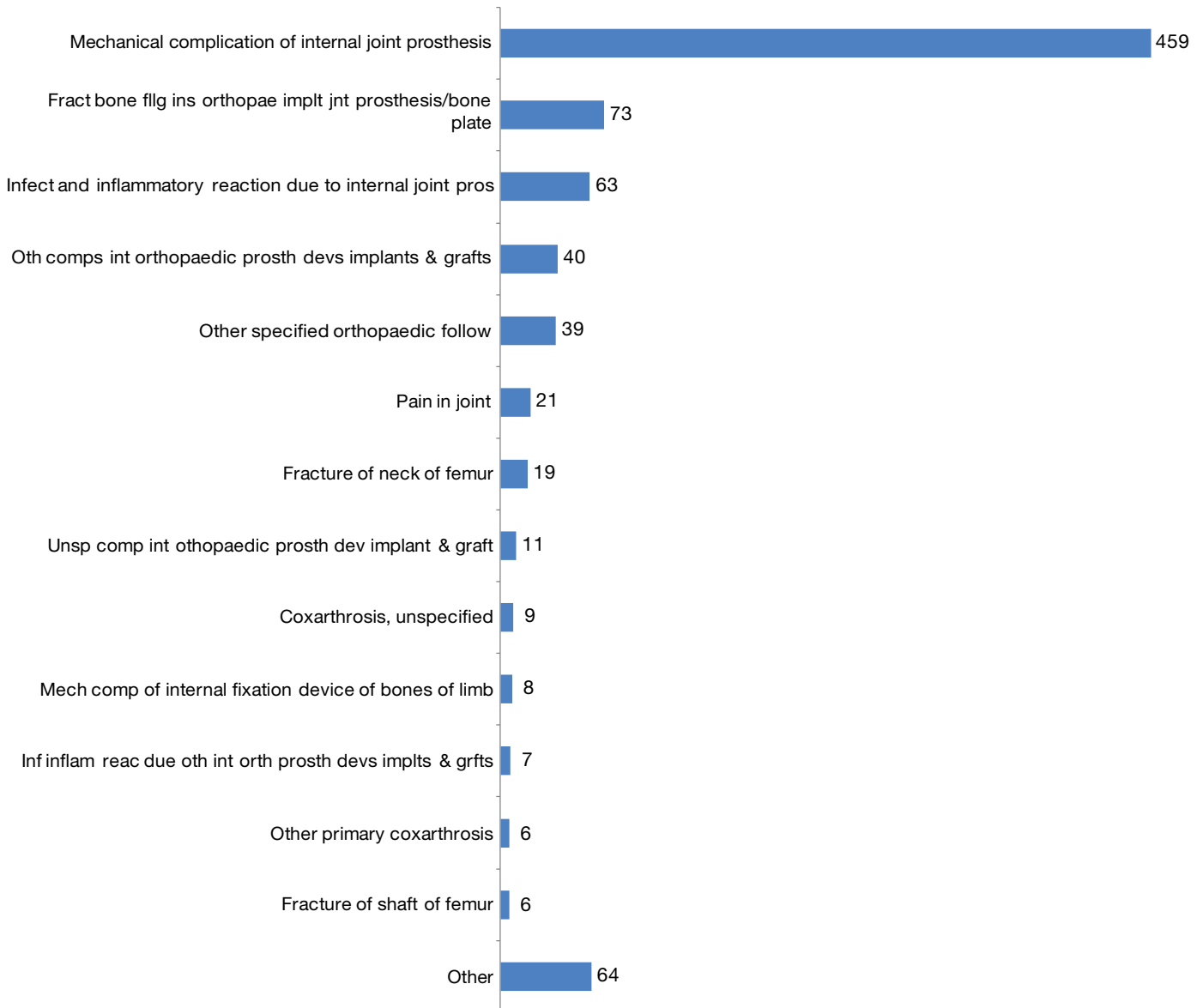
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals

Figure 5b – Principal pre-operative conditions knee arthroplasty in 2015.



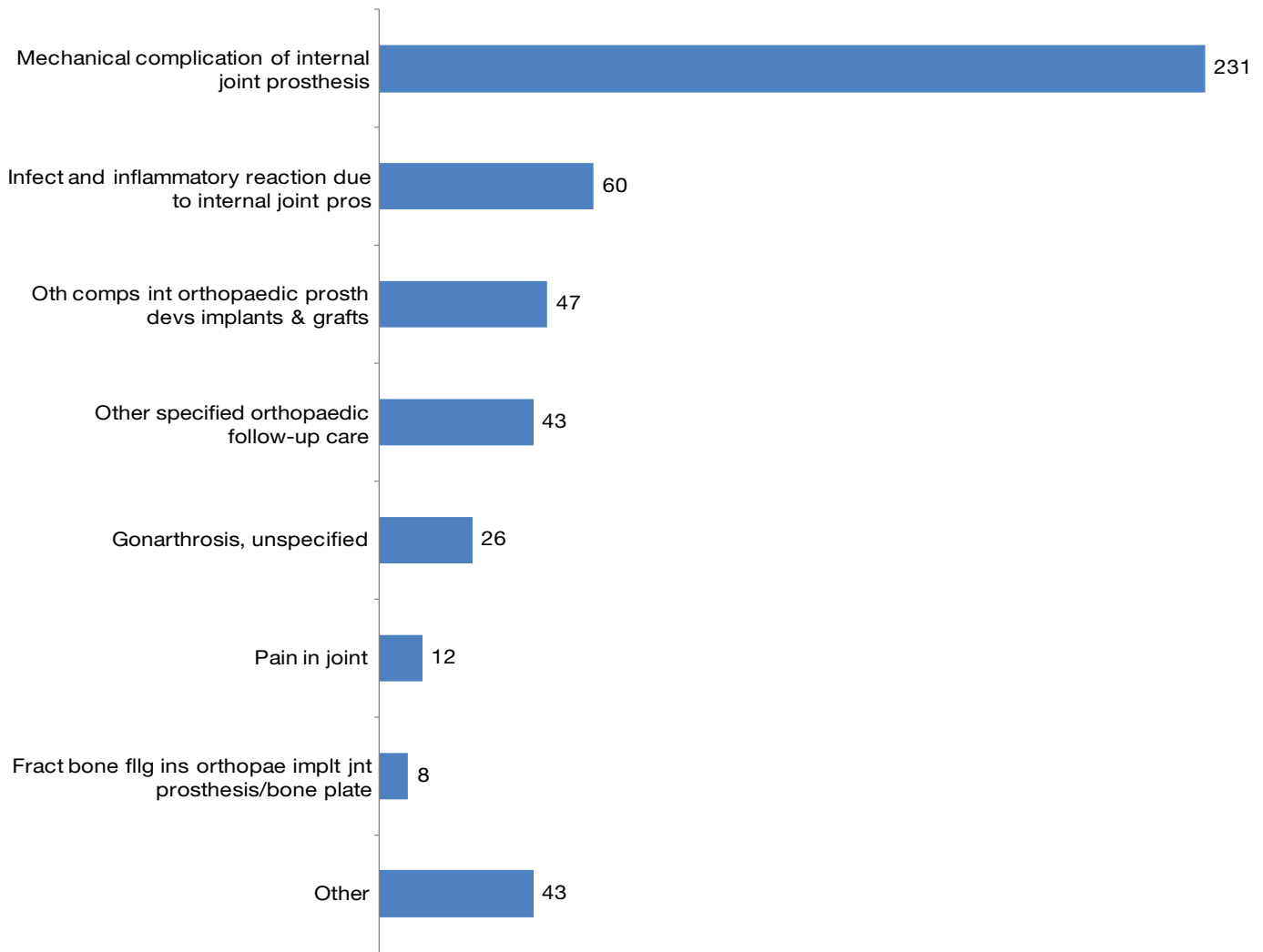
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 5c – Principal pre-operative conditions hip revision in 2015.



Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 5d – Principal pre-operative conditions knee revision in 2015.



Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

3. Inpatient Episodes

3.1 Length of stay

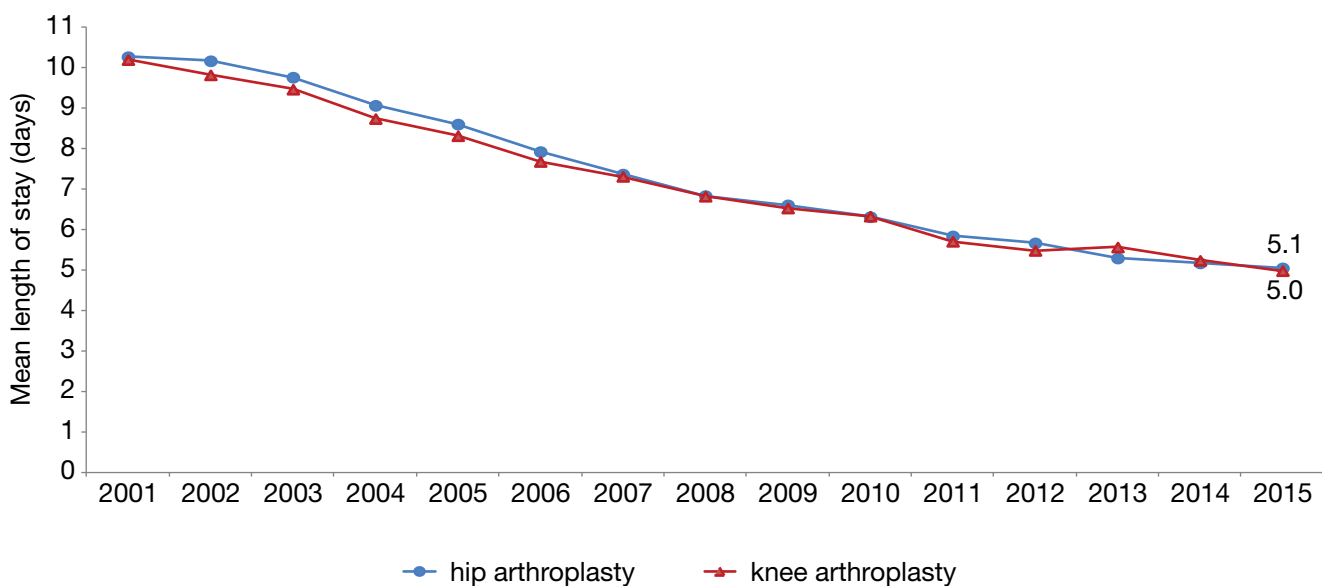
Since 2001 the length of stay for patients undergoing hip and knee arthroplasty has halved, from a mean of 10 days to 5 days. There has been a slowing down in improvements in length of stay and the graph (Figure 6) shows a gradual levelling off between 2011 and 2015.

There continues to be widespread variation across Scotland with regard to day of surgery admission to hospital (Figure 7a and 7b). Some centres, such as NHS Western Isles and NHS Grampian admitted patients to hospital on average on the day before surgery whereas other NHS Boards admitted patients on average on the day of surgery. Geographic isolation and patient travel times do not seem to fully explain this variation, which may be attributable to local arrangements. Admission to hospital on the day of surgery could save up to 5435 nights in hospital (mean pre-operative length of stay x number of arthroplasties).

There is a wide variation between NHS Boards in length of stay following hip arthroplasty (Figure 7a), with a two-fold difference in the best and worst performing NHS Boards (4 days versus 8 days total length of stay). If all NHS Boards were able to achieve a length of stay similar to the best performing centres then the mean length of stay for patients following hip arthroplasty would be further reduced. The variation in length of stay after knee arthroplasty (Figure 7b) is similar to hip arthroplasty, with the best performing NHS Boards achieving a total length of stay of 4 days (versus 7 days for the worst performing board). Again, adoption of best practice could see a significant fall in length of stay following knee arthroplasty across Scotland

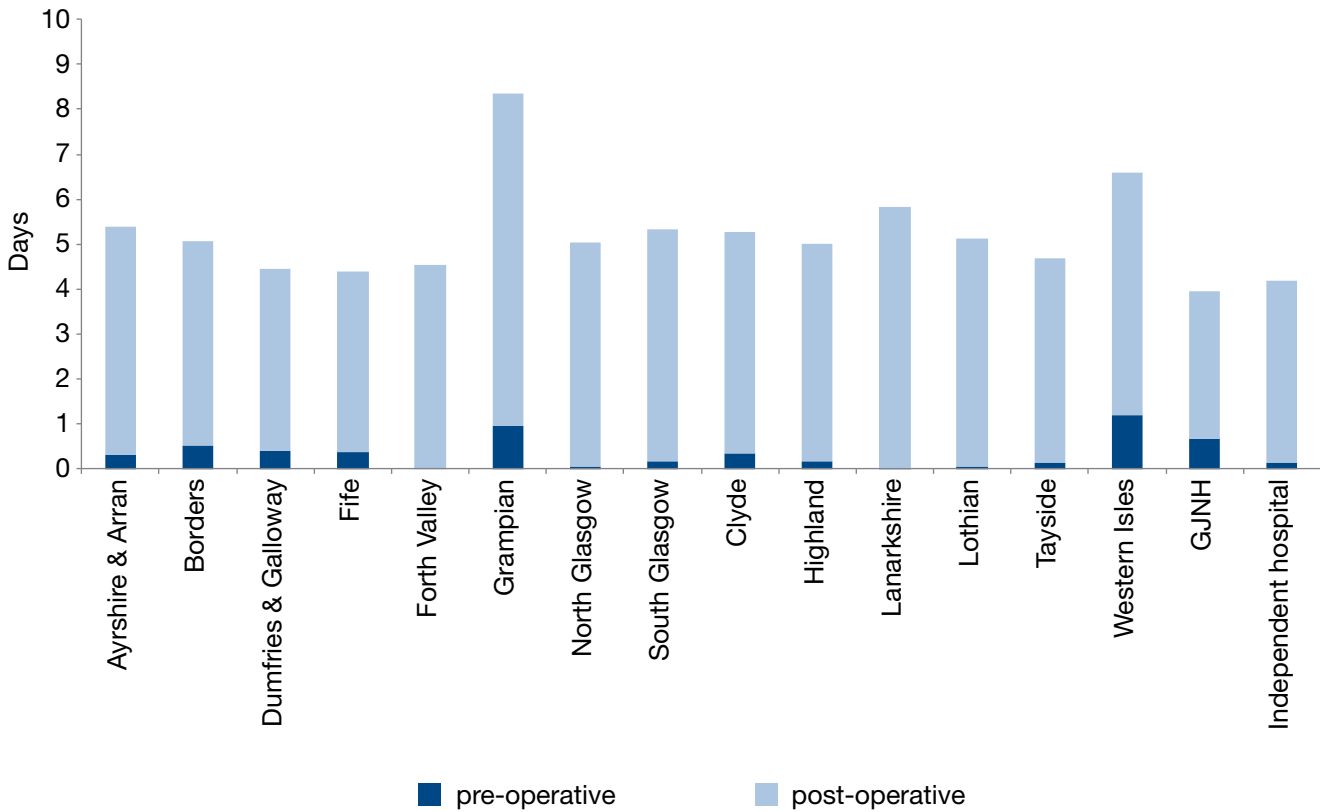
In general NHS Boards that have a longer length of stay for hip arthroplasty have a longer length of stay for knee arthroplasty. Patient Care Pathway design and setting patient/staff expectations with respect to length of stay are important factors, as are local resources such as availability of physiotherapy. If all NHS Boards were able to match the shortest length of stay then more than 15300 nights in hospital could be saved (best versus mean total length of stay x number of arthroplasties).

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



Includes elective patients only; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 7a – Average length of stay for hip arthroplasty in 2015 by NHS Board (NHS GG&C split)



Note: pre-operative days counted as days from date of admission to date of operation; post-operative days calculated as the difference between the number of pre-operative days and the total length of stay in orthopaedic care (where short (<=7 days) transfers to other facilities were not considered to end the patient’s orthopaedic care stay).

Includes elective patients only; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 7b – Average length of stay for knee arthroplasty in 2015 by NHS Board (NHS GG&C split)



Note: pre-operative days counted as days from date of admission to date of operation; post-operative days calculated as the difference between the number of pre-operative days and the total length of stay in orthopaedic care (where short (<=7 days) transfers to other facilities were not considered to end the patient’s orthopaedic care stay)

Includes elective patients only; bilateral operations counted twice; includes known patients from independent hospitals

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. Figures 8a to 8e show national complication rates over the years from 2000-2015. Figures 9 to 21 show complication rates per NHS Board from the years since the last report (2014 and 2015) in more detail.

4.1 National trends

DVT/PE

The previously observed downward trends in DVT/PE within 90 days as a complication after hip and knee arthroplasty from 2000 has been continuing but there was a slight rise in DVT/ PE after knee arthroplasty (Figures 8a and 8c).

For hip revision surgery, the DVT/PE rate has fallen since 2000. The rate following knee revision has been largely the same. However, the rate is around 0.5%, which for national figures is low (Figures 22f and 23b).

Death Rate

The rate of death following primary hip and knee replacement continues to be less than 0.5%. (Figures 8a and 8c). There is a similar death rate after hip revision surgery, but the death rate after knee revision surgery is over 1% nationally in 2015. This has risen since 2013 and is at similar levels to 2005, when there was a slight peak in incidence (Figures 22f and 23b).

Acute MI

The rate of acute MI in 2015 following primary hip and knee arthroplasty remain favourably low across Scotland, and little has changed since the last report (Figures 16 and 17).

Hip Dislocation

The rate of dislocation has fallen since 2000 nationally and now sits around 1% (Figure 8b). For hip revision surgery again the trend is downwards but with a slightly higher rate of around 2% of patients dislocating within a year of surgery (Figure 22g).

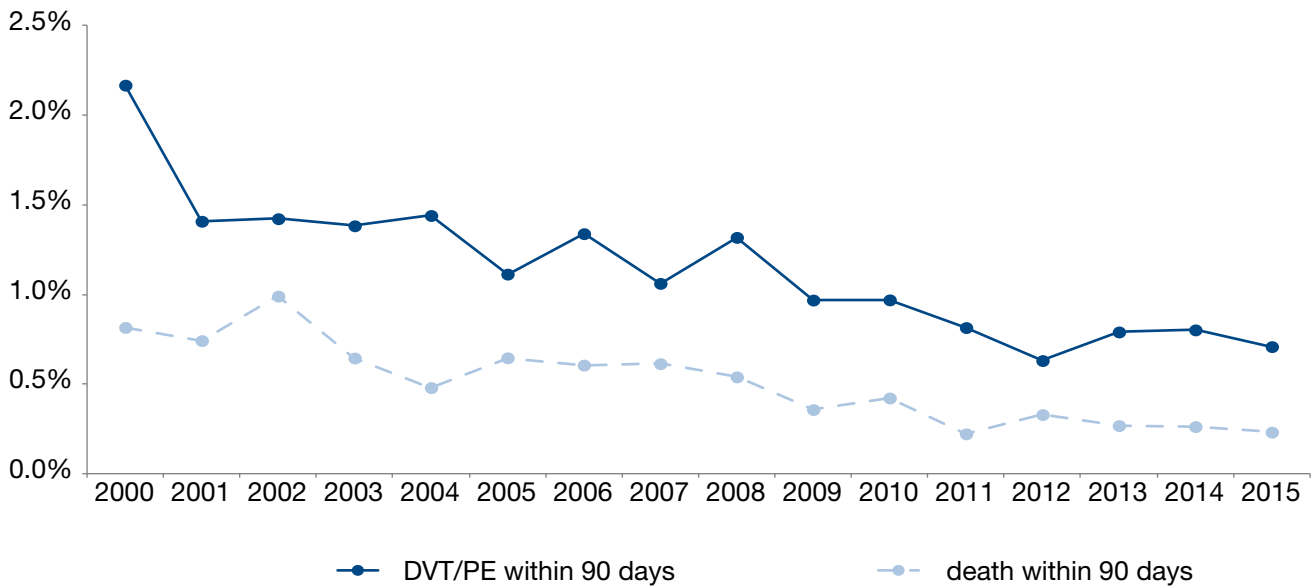
Infection Rates

Infection rates nationally for hip and knee arthroplasty have been constant at around 1-1.5% (Figure 8b and 8d). Hip revision surgery infection rate within a year has been around the 3% mark but the trend is downward from 2000. For knee revision surgery the trend is again downwards since 2000 when it was around 12% and is now around 6% (Figure 23c).

Renal Failure

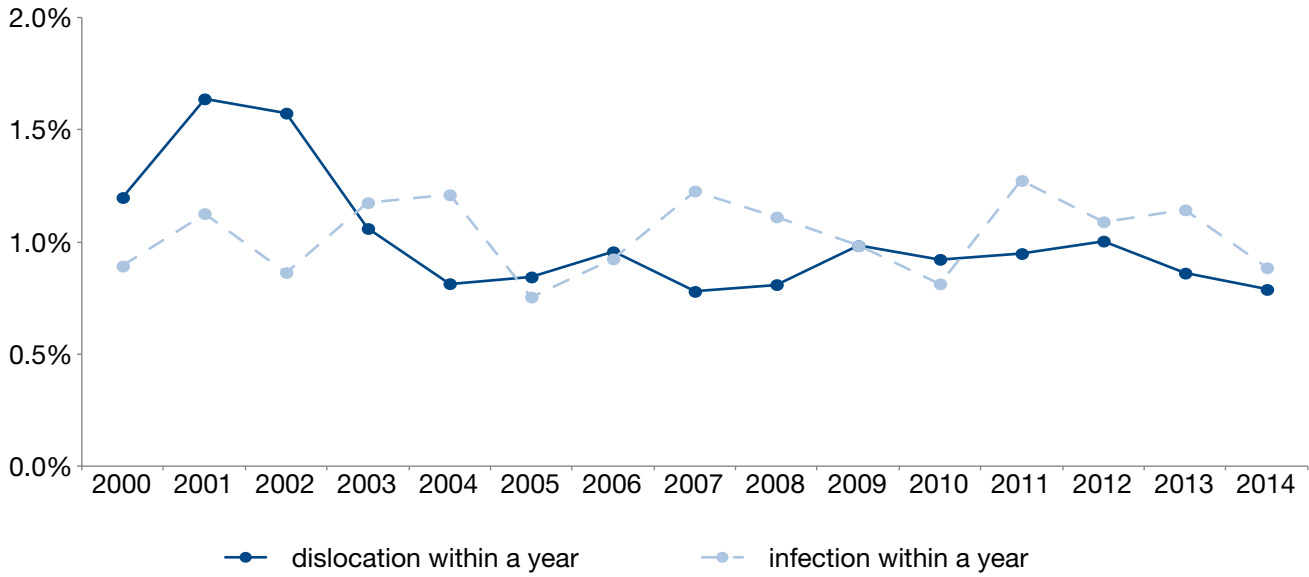
Renal failure post hip and knee arthroplasty was highlighted in the last report as there had been a steady increase nationally since 2009. Figure 8e shows that there has been a very steady increase in acute renal failure after primary joint replacement and the incidence is now nationally around 1.5%, which is concerning. There is a similar trend after revision hip and knee arthroplasty (Figure 24b) with an incidence of 1.5-2.5%. We are definitely seeing an increase in the incidence of renal impairment, although it is very difficult to pinpoint one individual cause as the current data set is not specific enough. The cause of this rise may well be multi-factorial, where contributing factors include specific antibiotic usage, enhanced recovery, co-morbidities, ACE inhibitors etc. Local NHS Boards should be made aware of this trend so that they can monitor the situation in their own unit and address any remediable causes.

Figure 8a – National rates for complications within 90 days: hip arthroplasty



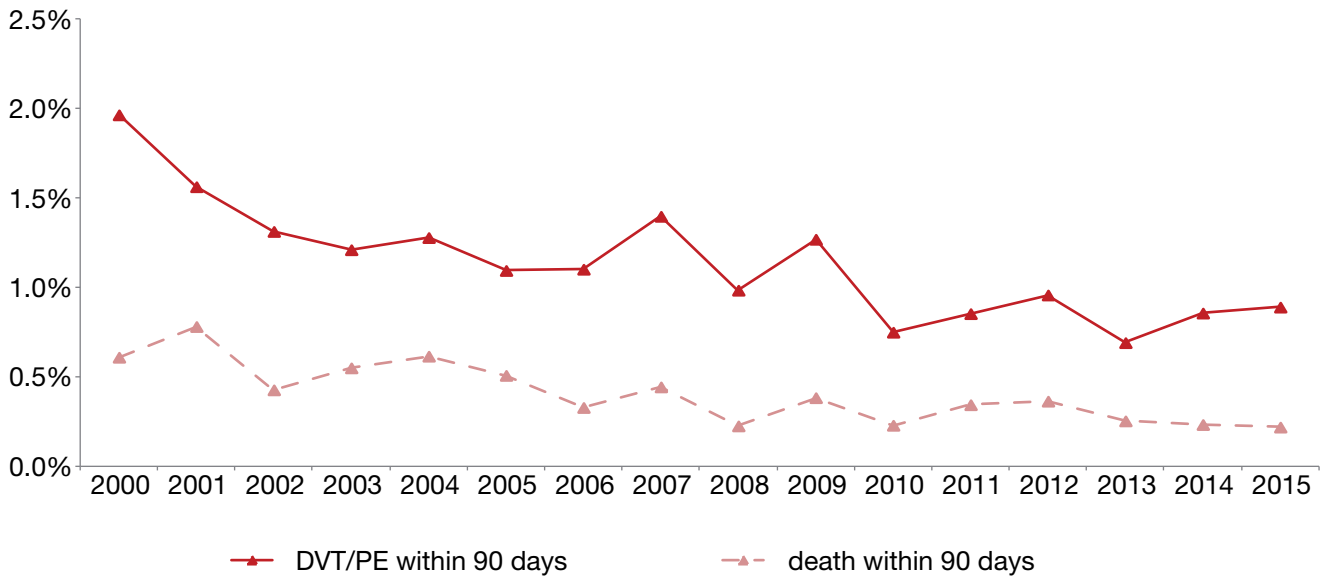
Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

Figure 8b – National rates for complications within 1 year: hip arthroplasty



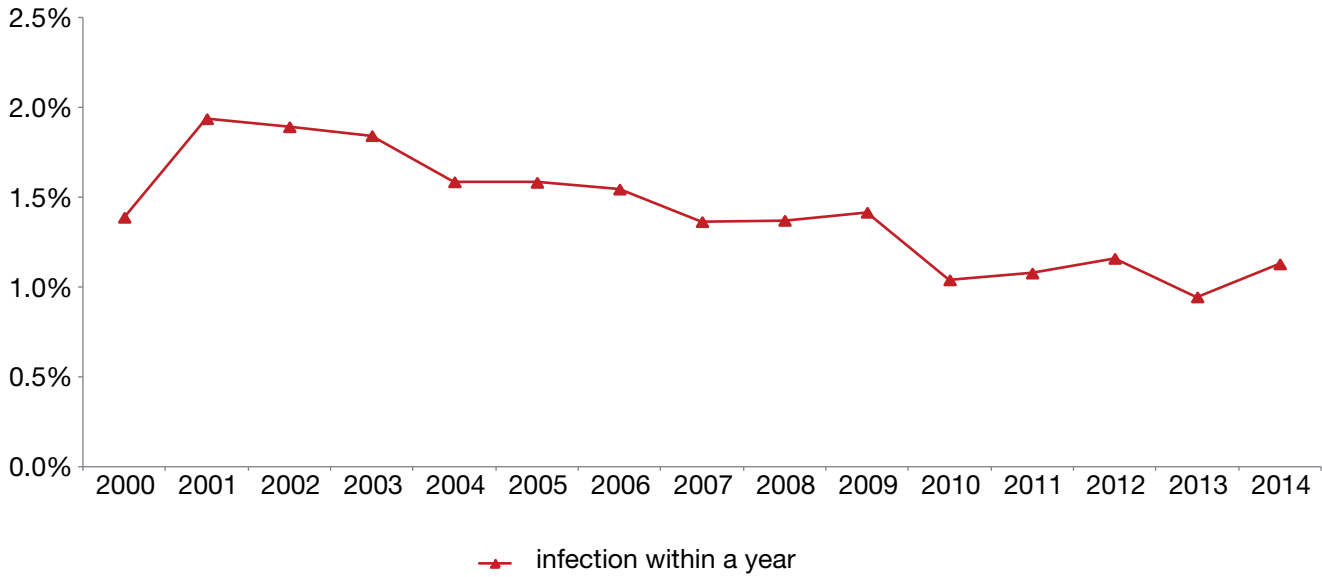
Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

Figure 8c – National rates for complications within 90 days: knee arthroplasty



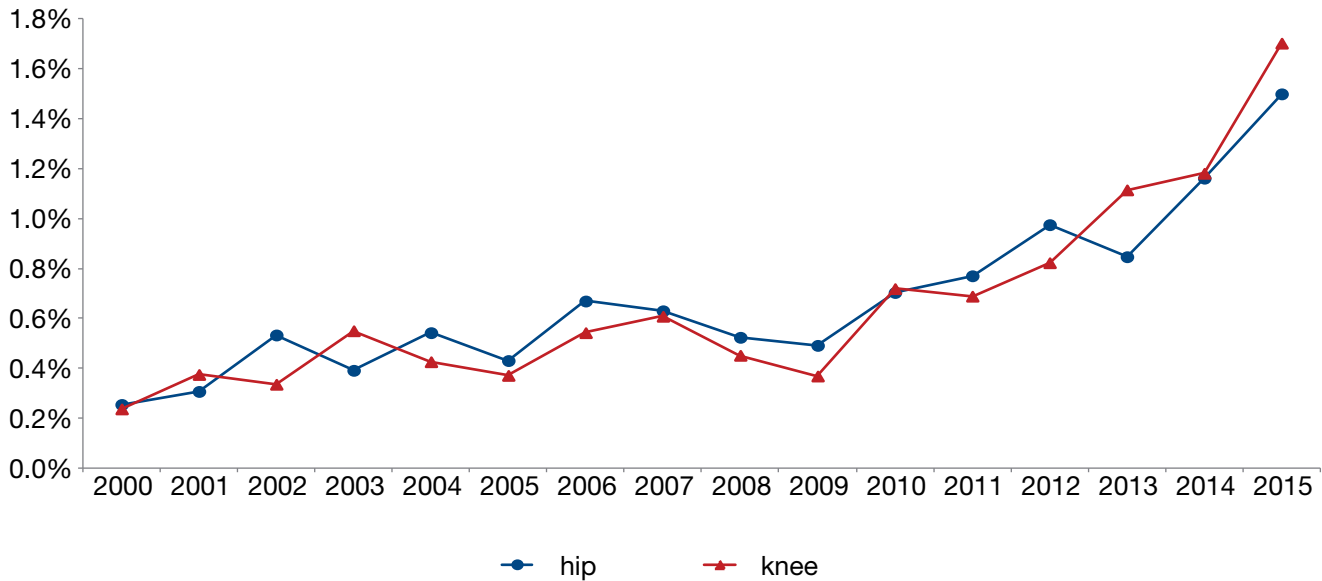
Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

Figure 8d – National rates for complications within 1 year: knee arthroplasty



Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

Figure 8e – Acute renal failure after 30 days: hip and knee arthroplasty



Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

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.

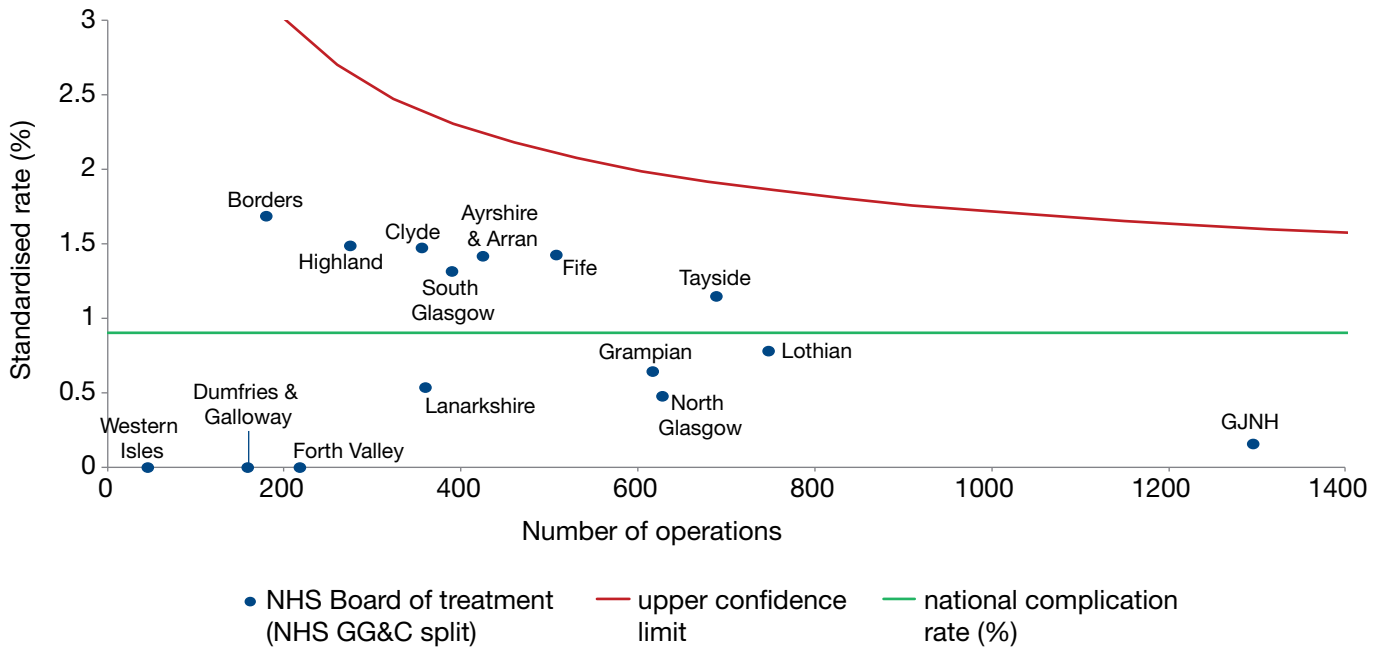
Rates of complication which appear above this line are a possible cause for concern and should be investigated where possible.

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

4.2.1 Dislocation within one year

No NHS Boards were outliers in the data from 2014. The national average rate was just under 1%.

Figure 9 – Percentage of 2014 hip arthroplasty patients with subsequent dislocation within one year

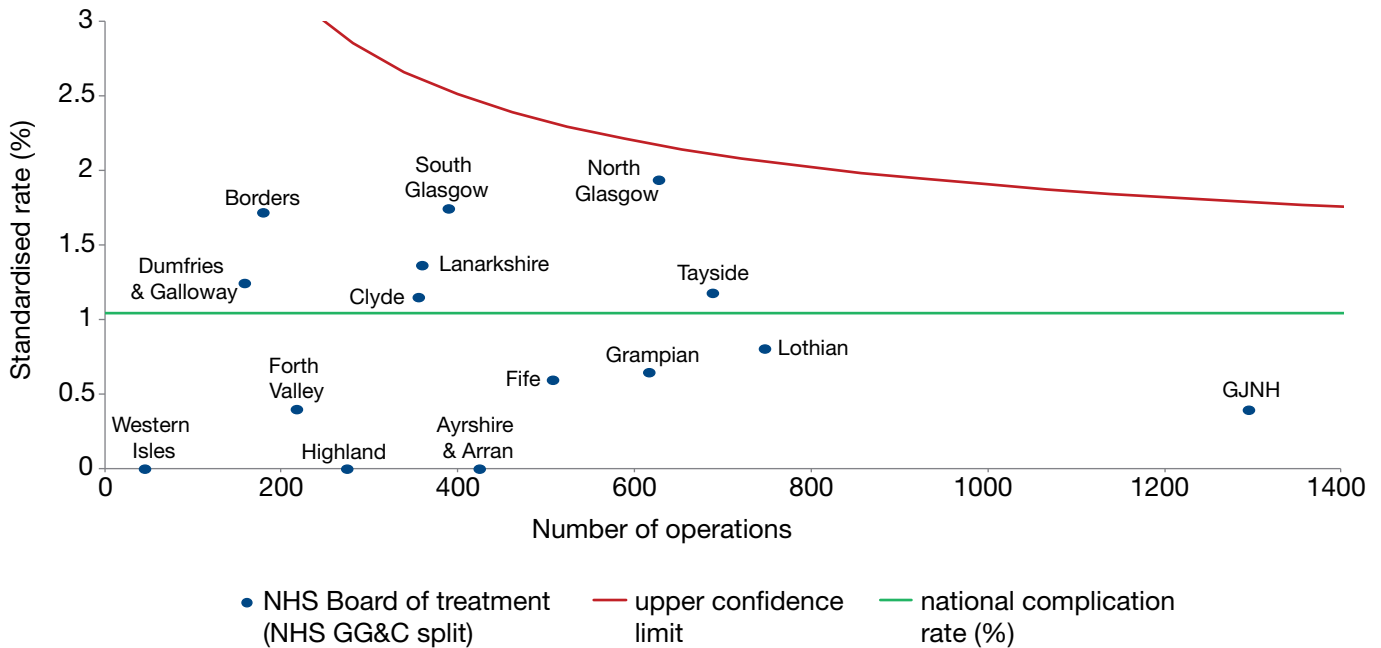


Scottish Rate averaged over 5 years 2010-2014.

4.2.2 Infection within one year

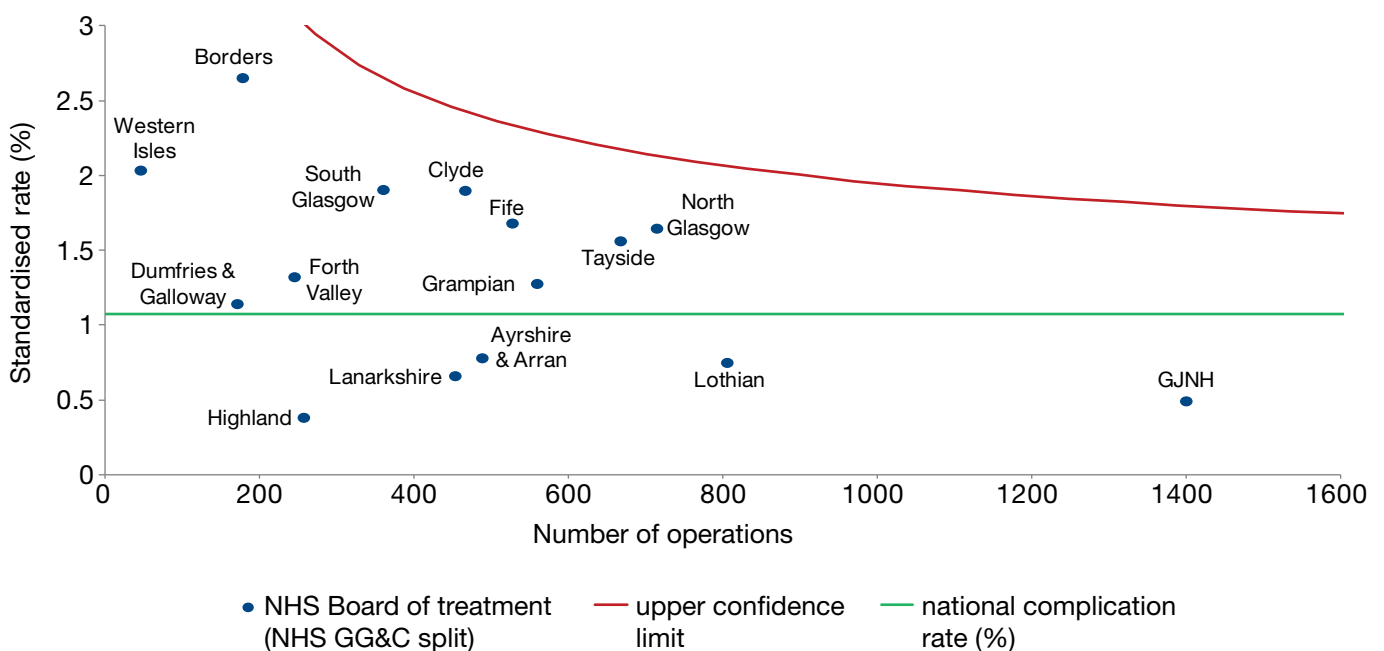
Infection of the joint within one year of arthroplasty showed no outliers from the national average for 2014 for both knee and hip arthroplasty. For knee arthroplasty, ten NHS Boards were above the national average, and for hip arthroplasty, eight NHS Boards are seen above the national average. This is very similar to the data from the last report.

Figure 10 – Percentage of 2014 hip arthroplasty patients with subsequent infection within one year



Scottish Rate averaged over 5 years 2010-2014.

Figure 11 – Percentage of 2014 knee arthroplasty patients with subsequent infection within one year

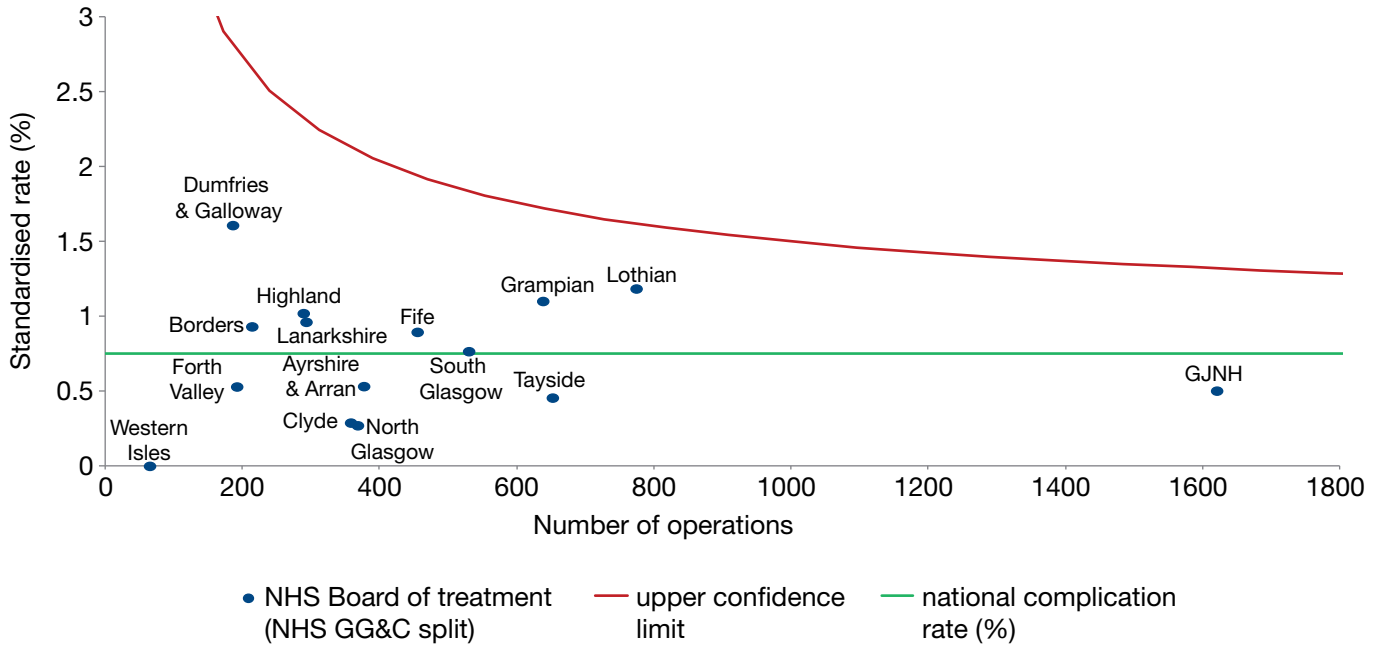


Scottish Rate averaged over 5 years 2010-2014.

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

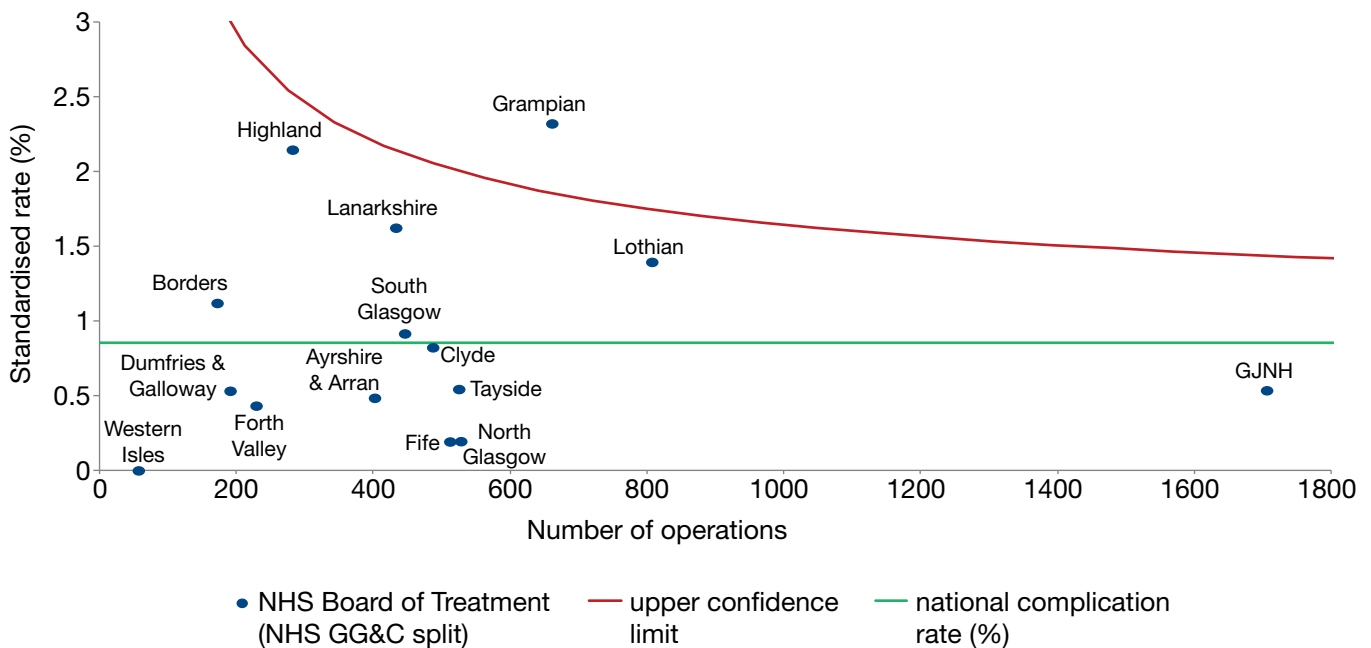
One NHS Board was an outlier for DVT/PE after knee arthroplasty, where five boards were above the national average. For hip arthroplasty, there were no outlying boards, but seven were above the national average. Overall rates were low for hip arthroplasty but slightly higher for knee arthroplasty, probably reflecting the use of tourniquets for that type of surgery.

Figure 12 – Percentage of 2015 hip arthroplasty patients with subsequent DVT/PE within one year



Scottish Rate averaged over 5 years 2011-2015.

Figure 13 – Percentage of 2015 knee arthroplasty patients with subsequent DVT/PE within 90 days

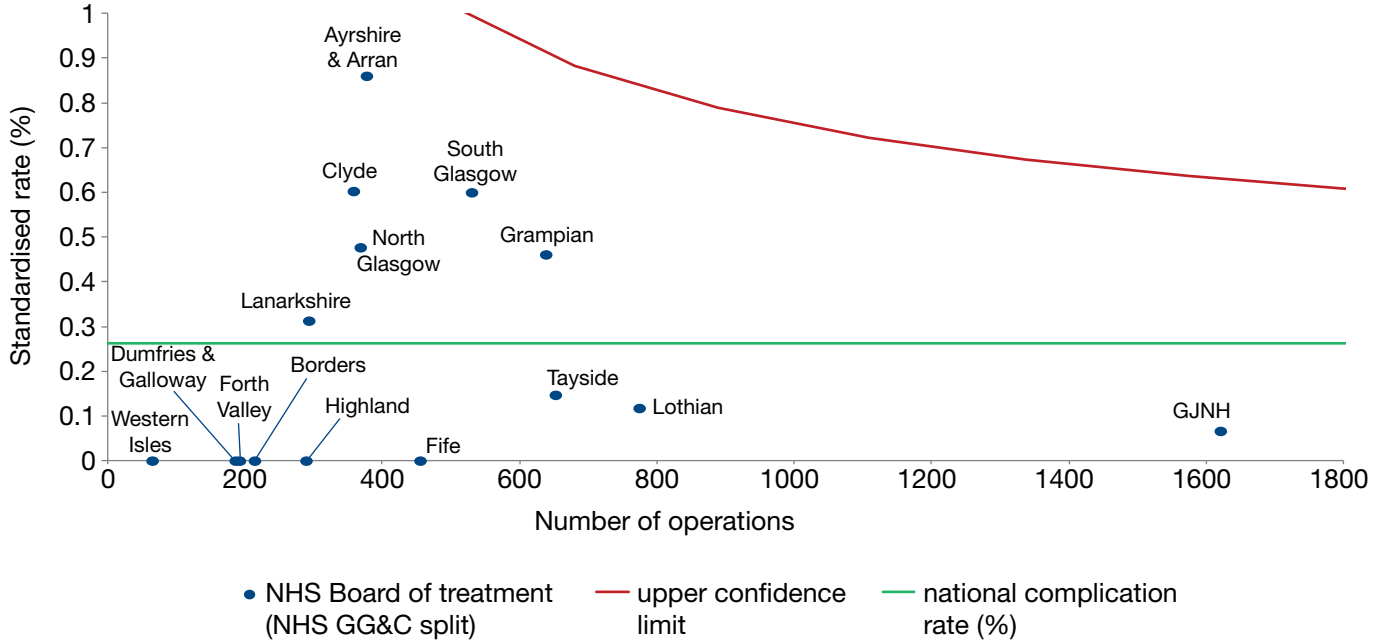


Scottish Rate averaged over 5 years 2011-2015.

4.2.4 Death within 90 days

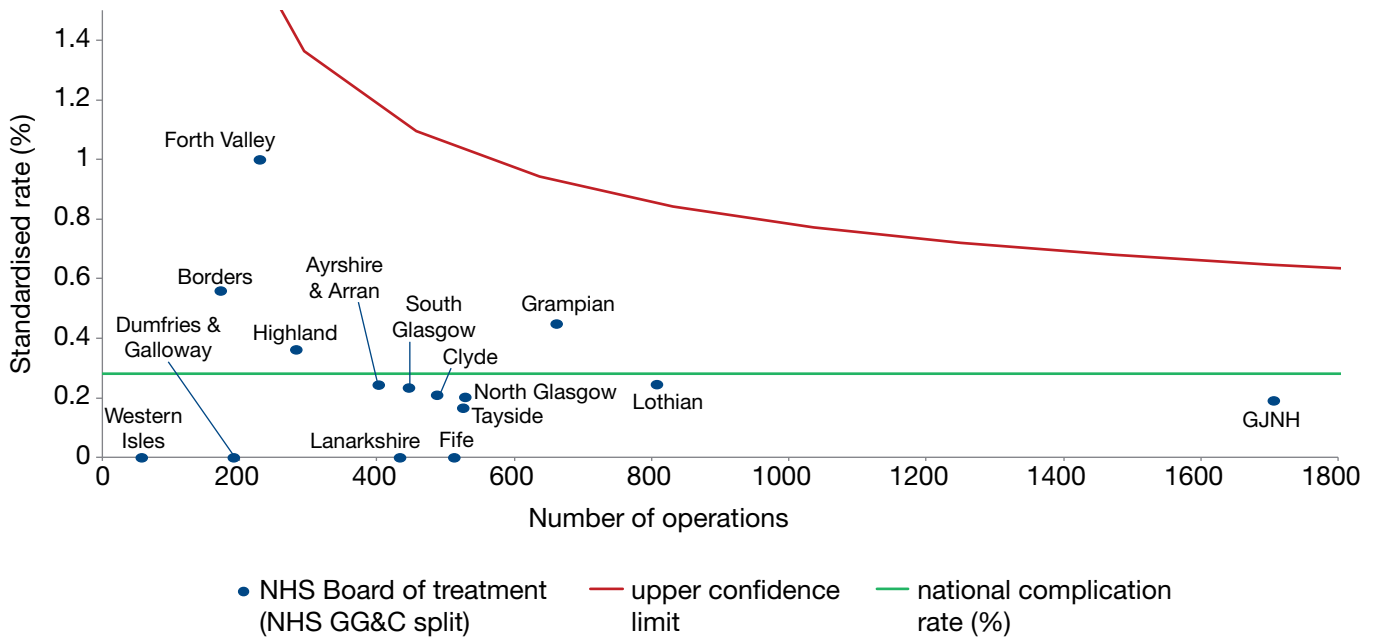
No NHS Boards were outliers and there were only four NHS Boards above the national average for knee arthroplasty. There were six NHS Boards above the national average for hip arthroplasty.

Figure 14 – Percentage of 2015 hip arthroplasty patients who died within 90 days



Scottish Rate averaged over 5 years 2011-2015.

Figure 15 – Percentage of 2015 knee arthroplasty patients who died within 90 days

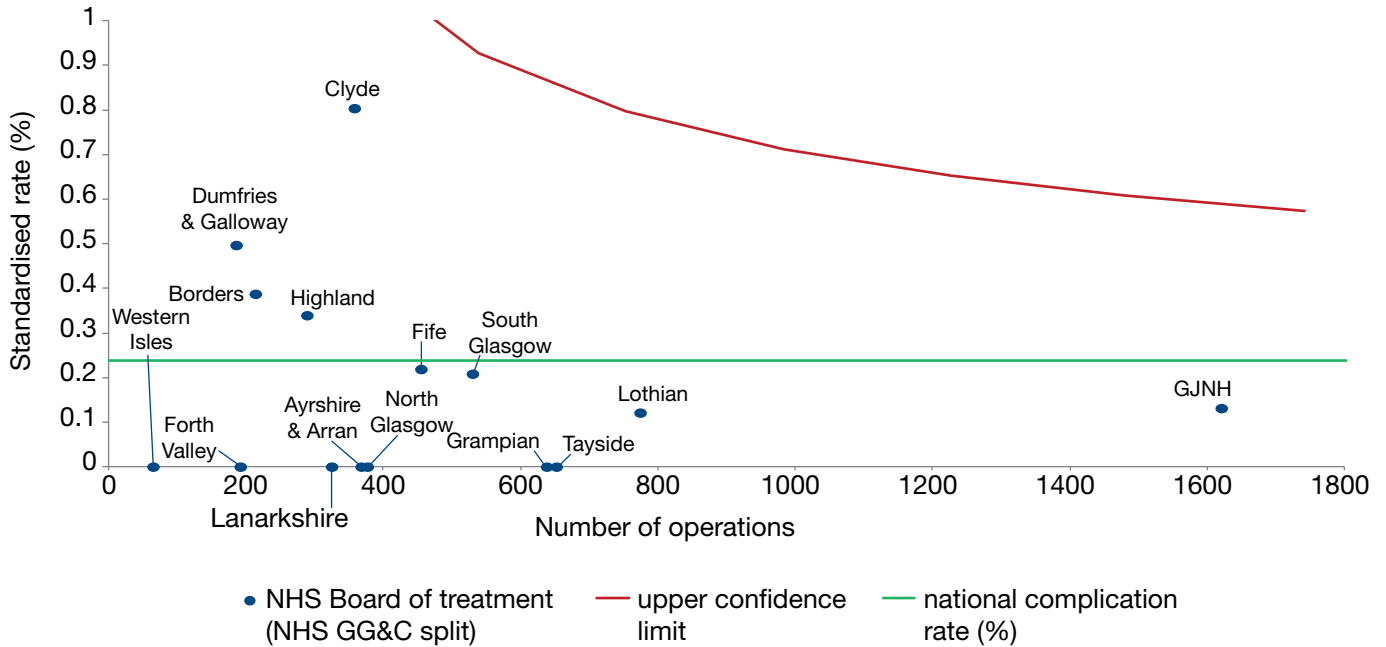


Scottish Rate averaged over 5 years 2011-2015.

4.2.5 Acute Myocardial Infarction (AMI) within 30 days

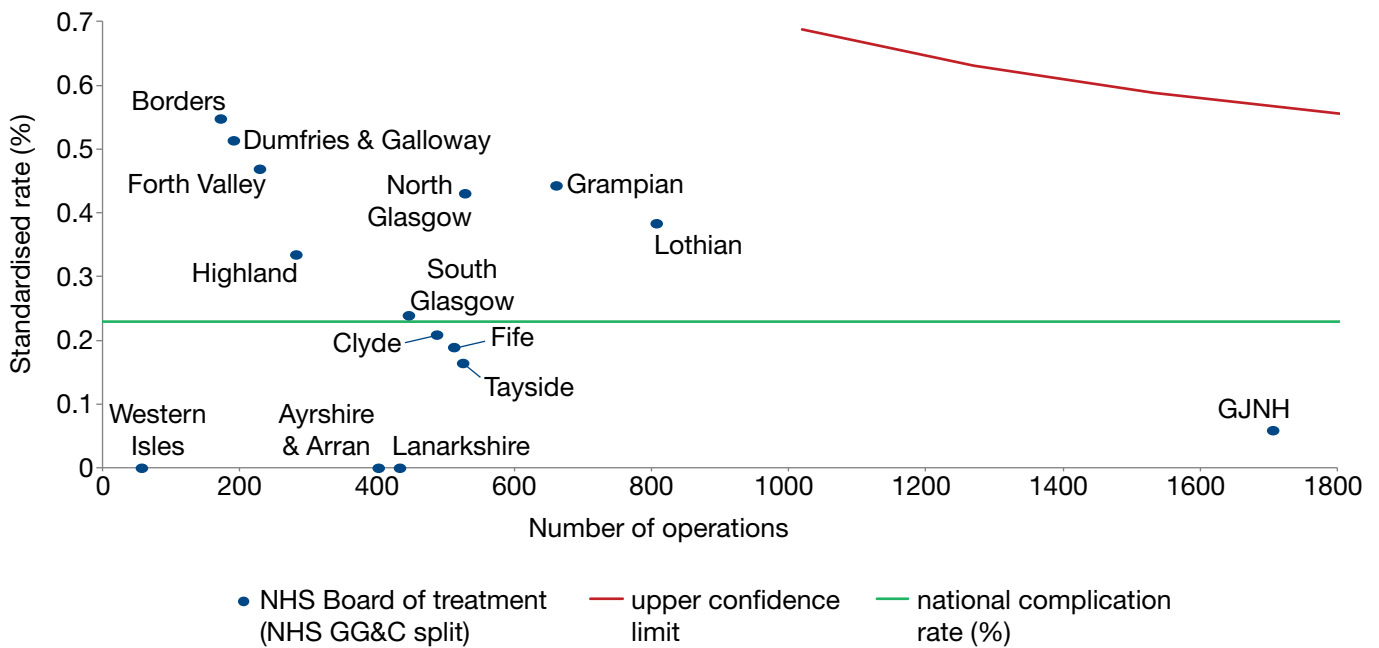
There were no outliers amongst all of the NHS Boards. Four were above the national average following hip arthroplasty, but overall rates were very low. The rate following knee arthroplasty was on average lower than following hip arthroplasty, but seven NHS Boards were above the national average.

Figure 16 – Percentage of 2015 hip arthroplasty patients with subsequent AMI within 30 days.



Scottish Rate averaged over 5 years 2011-2015.

Figure 17 – Percentage of 2015 knee arthroplasty patients with subsequent AMI within 30 days.

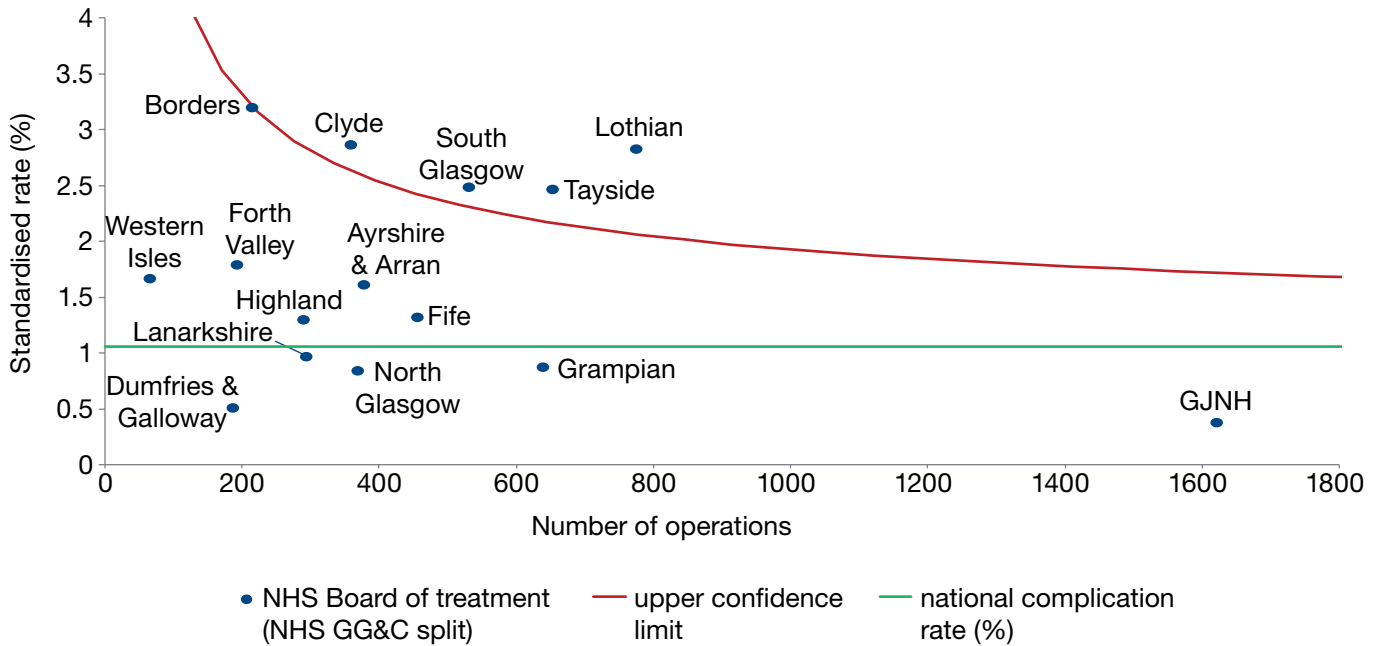


Scottish Rate averaged over 5 years 2011-2015.

4.2.6 Acute renal failure within 30 days

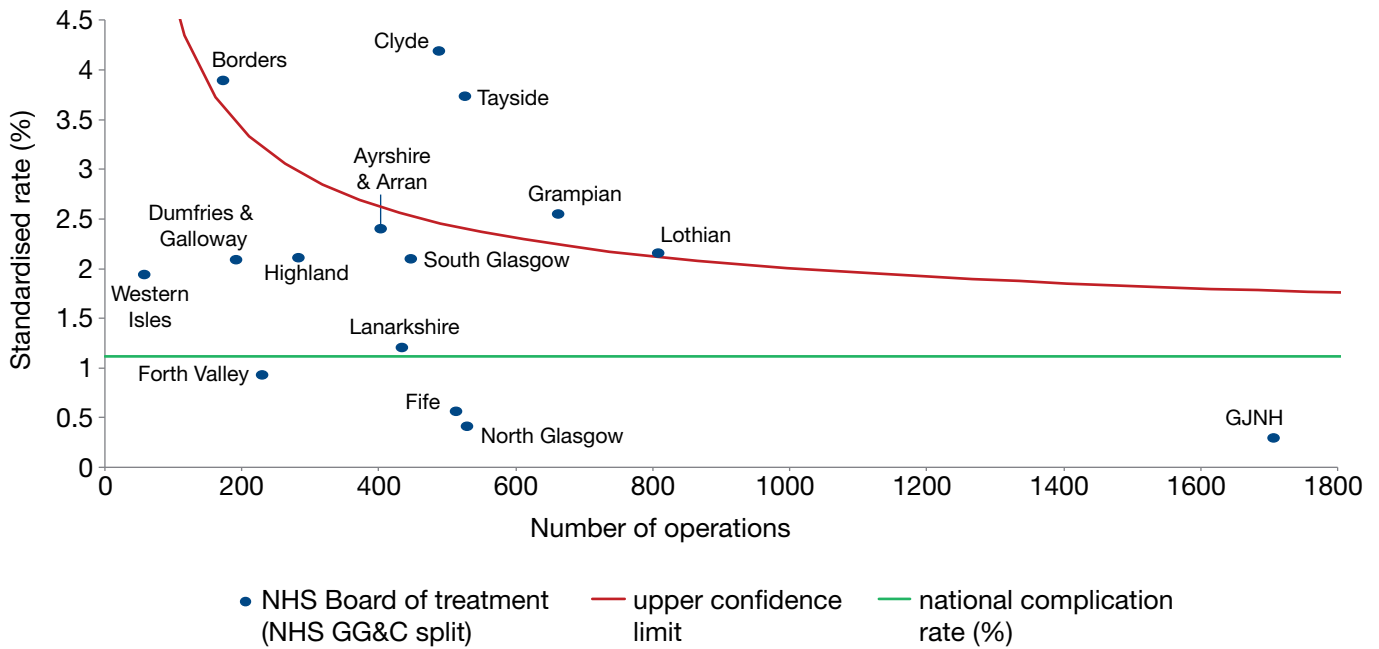
The national average for renal failure after hip arthroplasty has gone up to over 1% in the years from 2011-2015. In the last SAP report, there was only one outlier. This report shows five NHS Boards with rates of renal failure above 2.5% in 2015 which is a considerable change. Four of those NHS Boards are also outlying for renal failure after knee arthroplasty where the rates are around 2% or greater. The national average in the last report for both hip and knee arthroplasty was less than 1%, whereas this report shows a national average of over 1%. This should be closely monitored by all Scottish NHS Boards.

Figure 18 – Percentage of 2015 hip arthroplasty patients with subsequent acute renal failure within 30 days.



Scottish Rate averaged over 5 years 2011-2015.

Figure 19 – Percentage of 2015 knee arthroplasty patients with subsequent acute renal failure within 30 days.

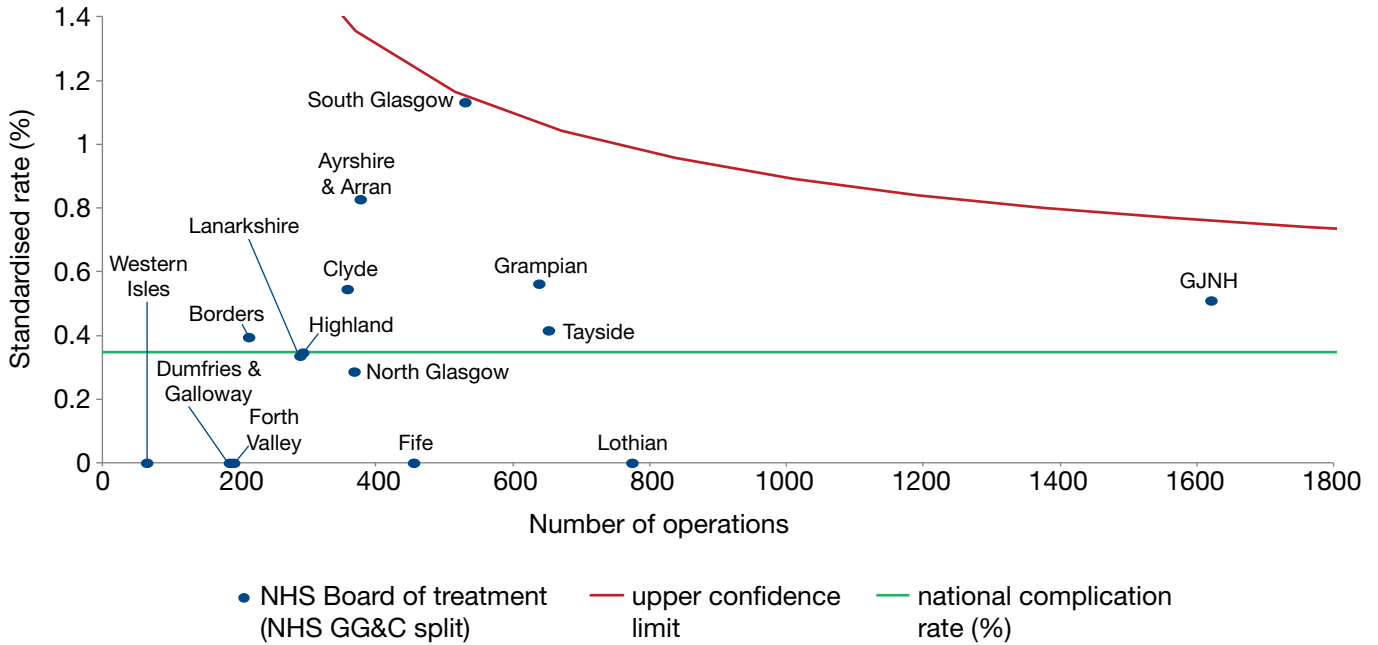


Scottish Rate averaged over 5 years 2011-2015.

4.2.7 CVA/Stroke within 30 days

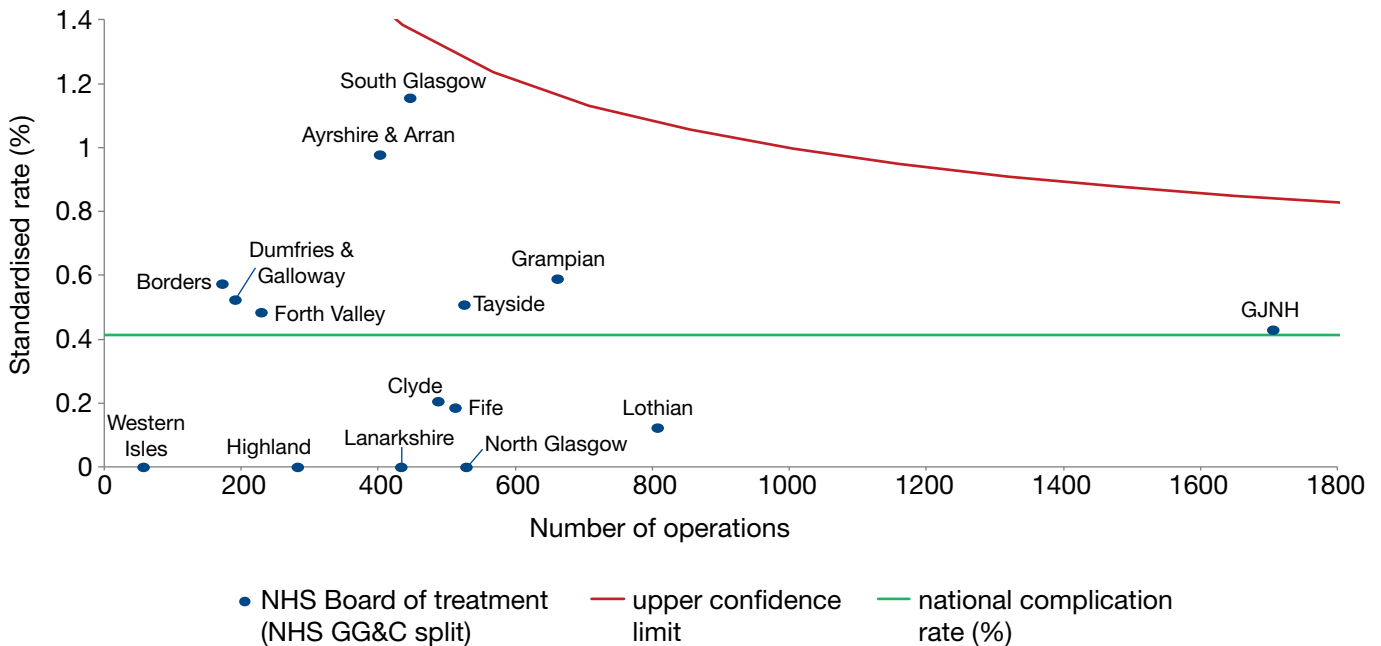
No NHS Boards were classed as outliers for CVA after hip or knee arthroplasty. Seven boards were above the national average for hip arthroplasty and a similar number following knee arthroplasty. The national average was around 0.4% with the highest incidence around 1.2% for both hip and knee arthroplasty.

Figure 20 – Percentage of 2015 hip arthroplasty patients with subsequent stroke within 30 days.



Scottish Rate averaged over 5 years 2011-2015.

Figure 21 – Percentage of 2015 knee arthroplasty patients with subsequent stroke within 30 days.



Scottish Rate averaged over 5 years 2011-2015.

5. Revision Rates

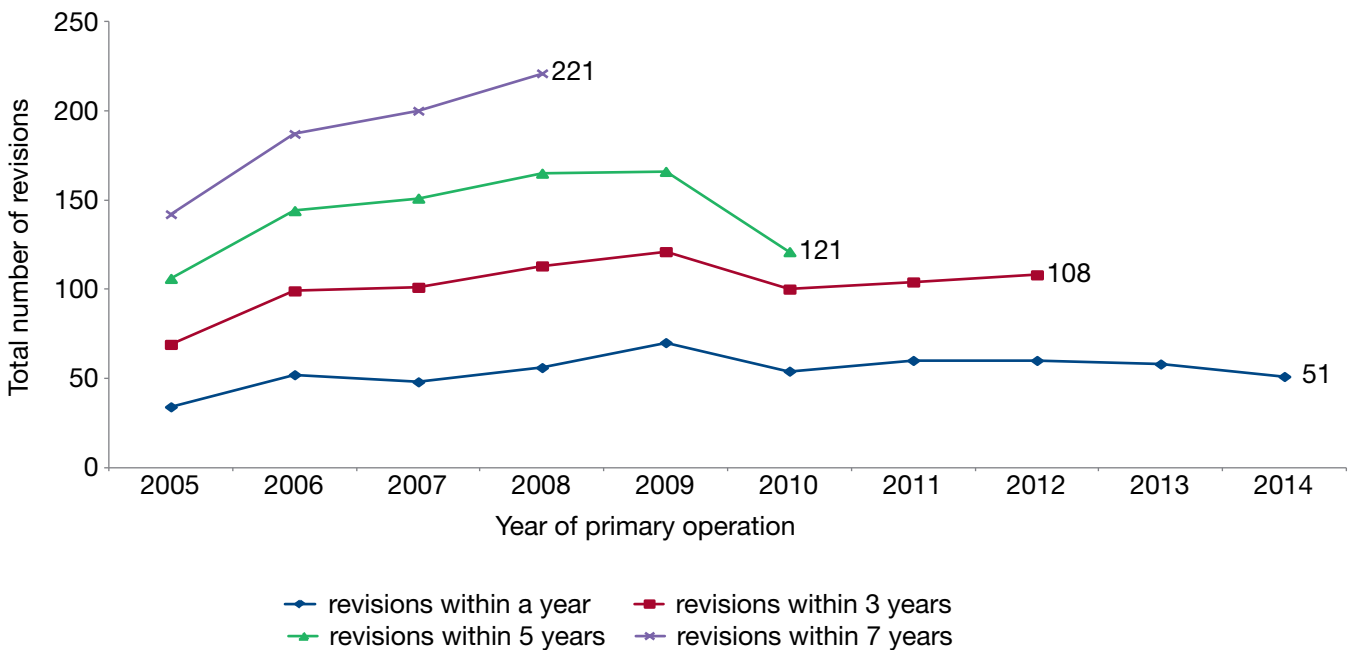
Revision rates are calculated at 1 year, 3 years, 5 years and 7 years after surgery.

The national rate for hip arthroplasty with subsequent revision within 1 year shows an upward trend whereas for knee arthroplasty the rate is static (although the difference between the trend for hips and knees is not statistically significant) (Figures 22a and 23a). It is unclear if this reflects problems with large metal bearings including some hip resurfacing arthroplasties. It is possible that revision of hips with these bearings has caused a “bulge” in national revision numbers over the last decade (Figure 1b).

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 - hips

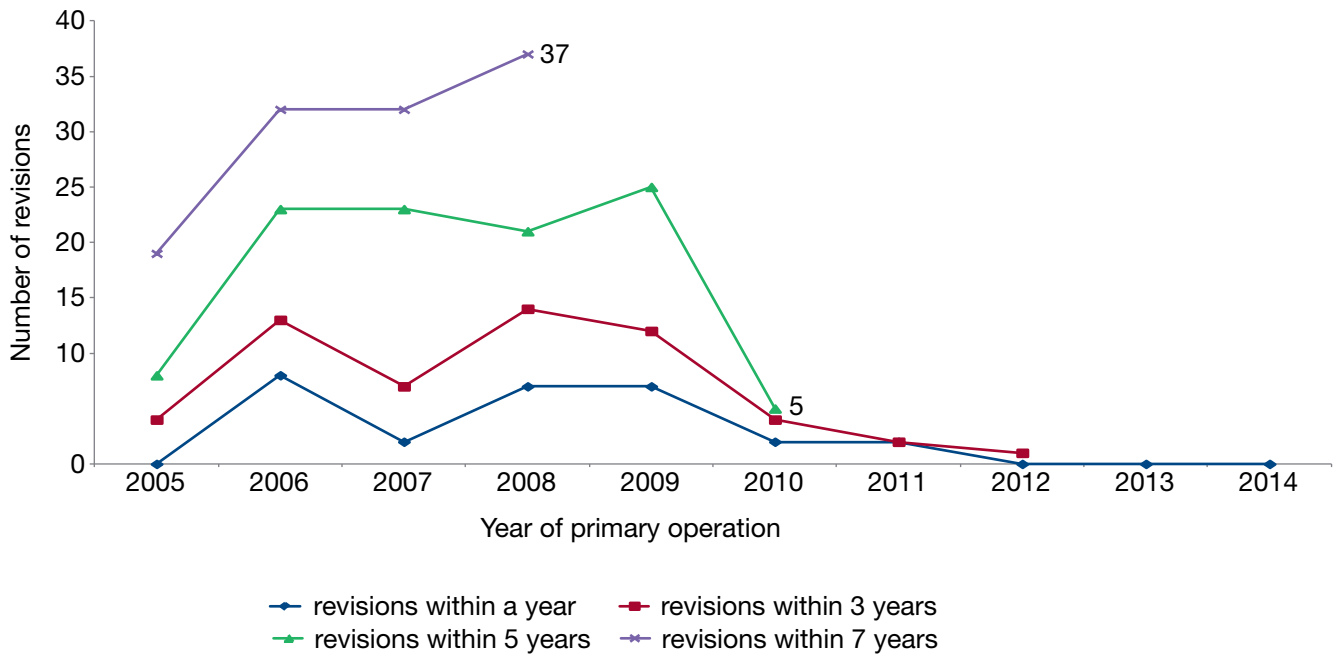
Figure 22a – National rates for hip arthroplasty with subsequent revision



Includes elective patients only; bilateral operations counted twice; includes known patients from independent hospitals

Figures 22b and 22c, below, show the total number of revisions to metal-on-metal hip resurfacings on Scotland per year and as a percentage. The number of hip resurfacing procedures peaked around 2007-8 and then declined dramatically. The number of early revisions of these implants has also fallen steadily, in keeping with the declining number performed. They accounted for 15-16% of all revisions at 5 years for primary hip replacements between 2006-9.

Figure 22b – Total number of revisions to metal-on-metal hip resurfacings* in Scotland per year.



Includes elective patients only; bilateral operations counted twice; includes known patients from independent hospitals. The number of revisions (within 1, 3, 5 and 7 years) to metal-on-metal hip resurfacings carried out between 2005 and 2015 in Scotland

* Data are based on any operation coded as “Hip resurfacing”, using the following OPCS codes:

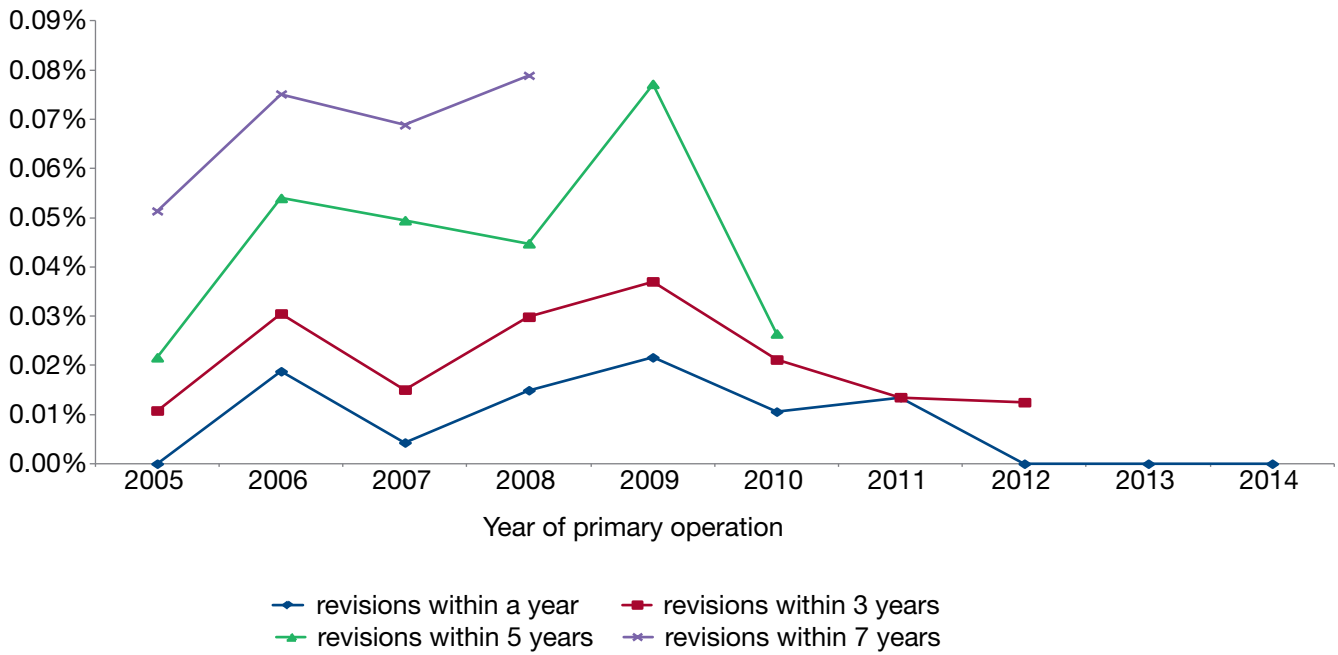
W581 paired with Y021

W581 paired with Z756

W581 paired with Z843

W582 paired with Z843

Figure 22c – Percentage of metal-on-metal hip resurfacings* in Scotland per year resulting in revisions.



The number of revisions (within 1, 3, 5 and 7 years) to metal-on-metal hip resurfacings carried out between 2005 and 2015 in Scotland

* Data are based on any operation coded as “Hip resurfacing”, using the following OPCS codes:

W581 paired with Y021

W581 paired with Z756

W581 paired with Z843

W582 paired with Z843

Revision of primary hip replacements performed within individual hospitals demonstrates wide variation in practice across the country. Data at 1, 3, 5 and 7 years give an indication of the varying revision burden individual hospitals have had to cope with (Figures 22d, e, h, i, j).

Figure 22d – Percentage of 2008 primary hip arthroplasty patients with subsequent revision within 7 years (total hip replacement and resurfacing).

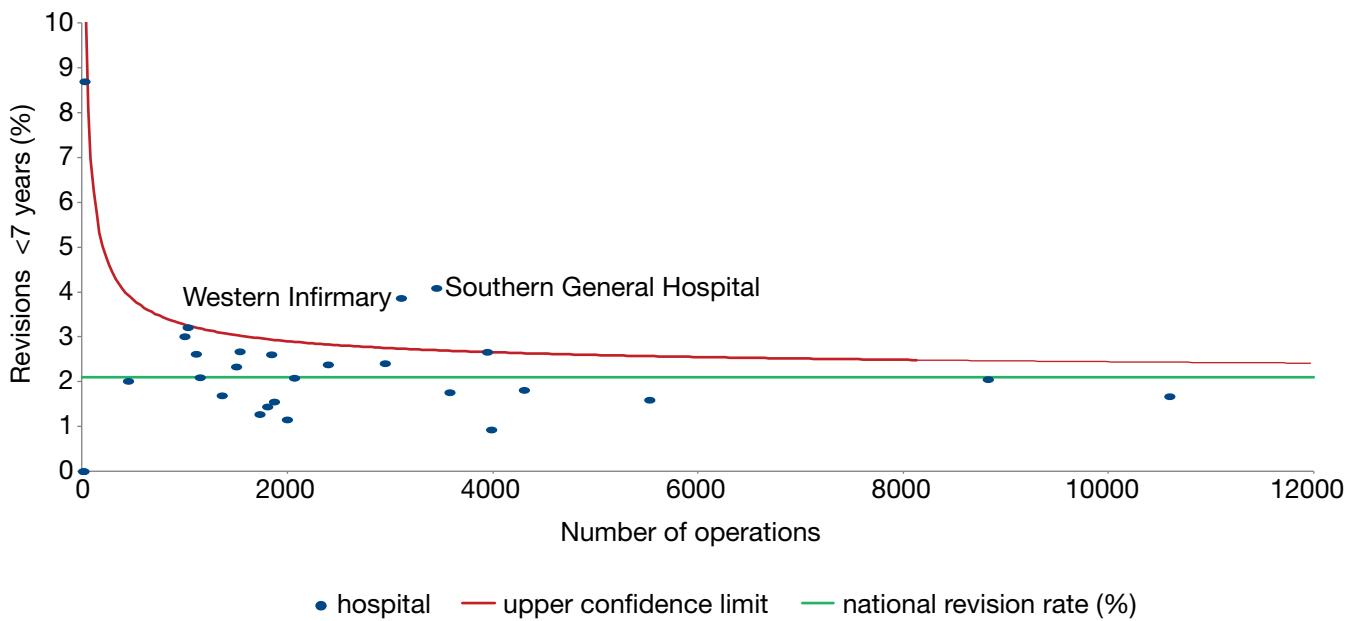
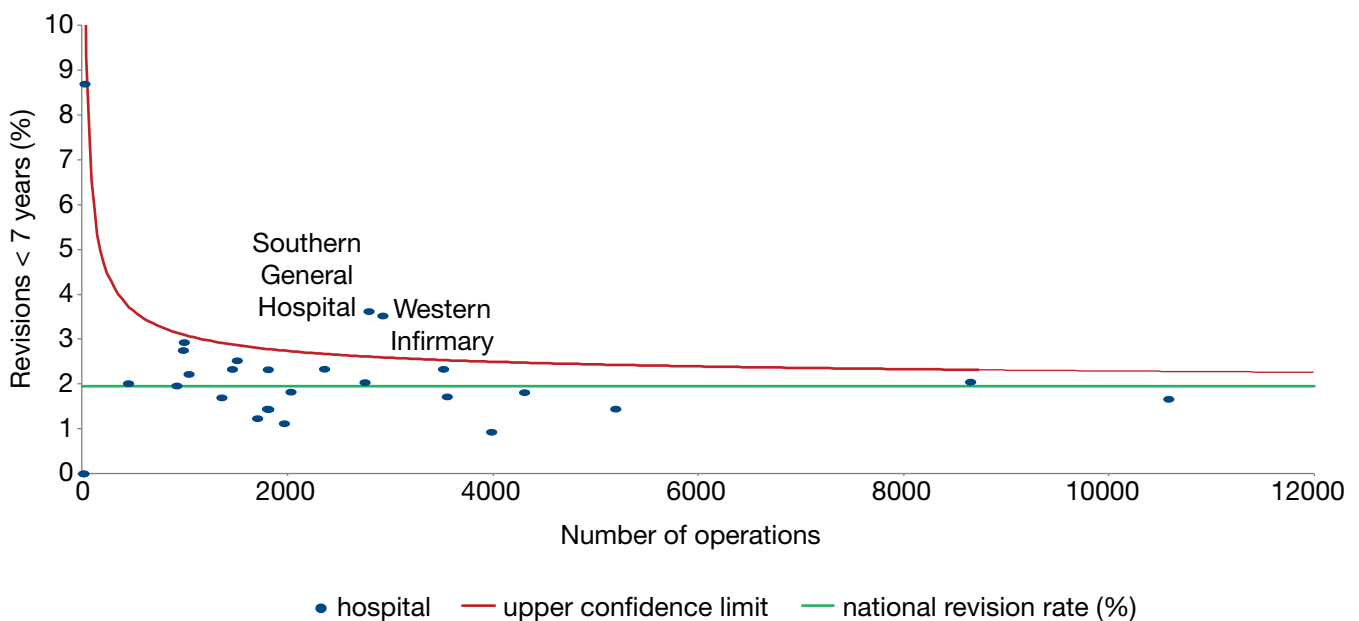
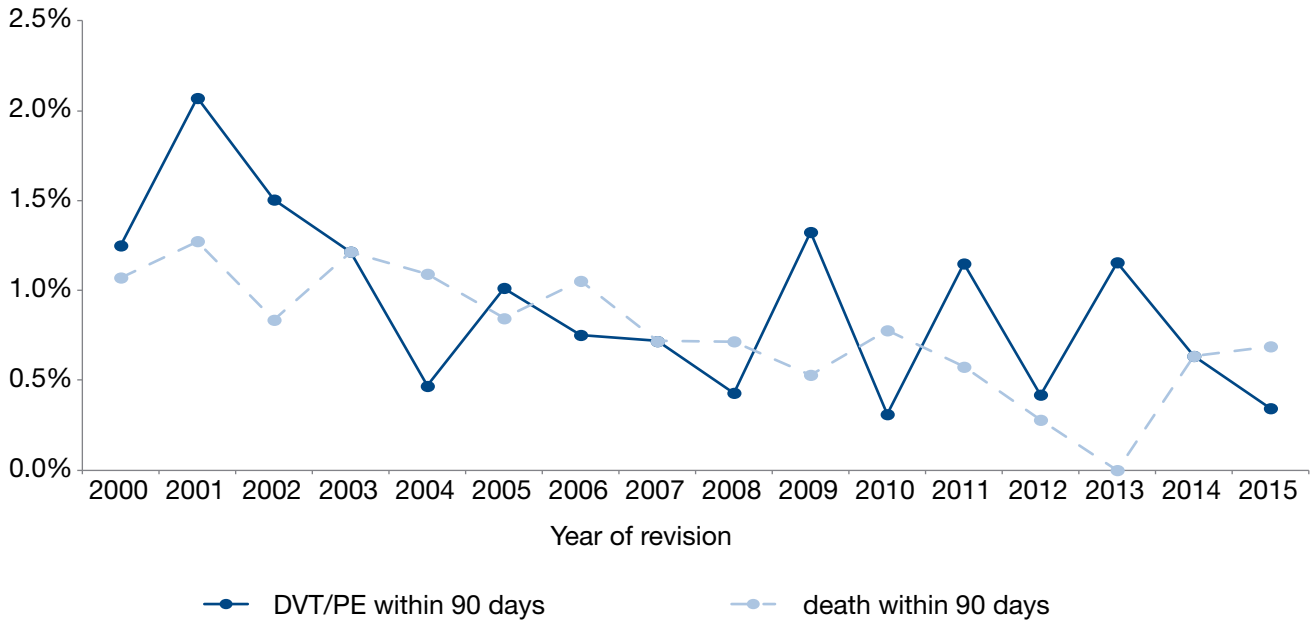


Figure 22e – Percentage of 2008 primary hip arthroplasty patients with subsequent revision within 7 years (total hip replacement).



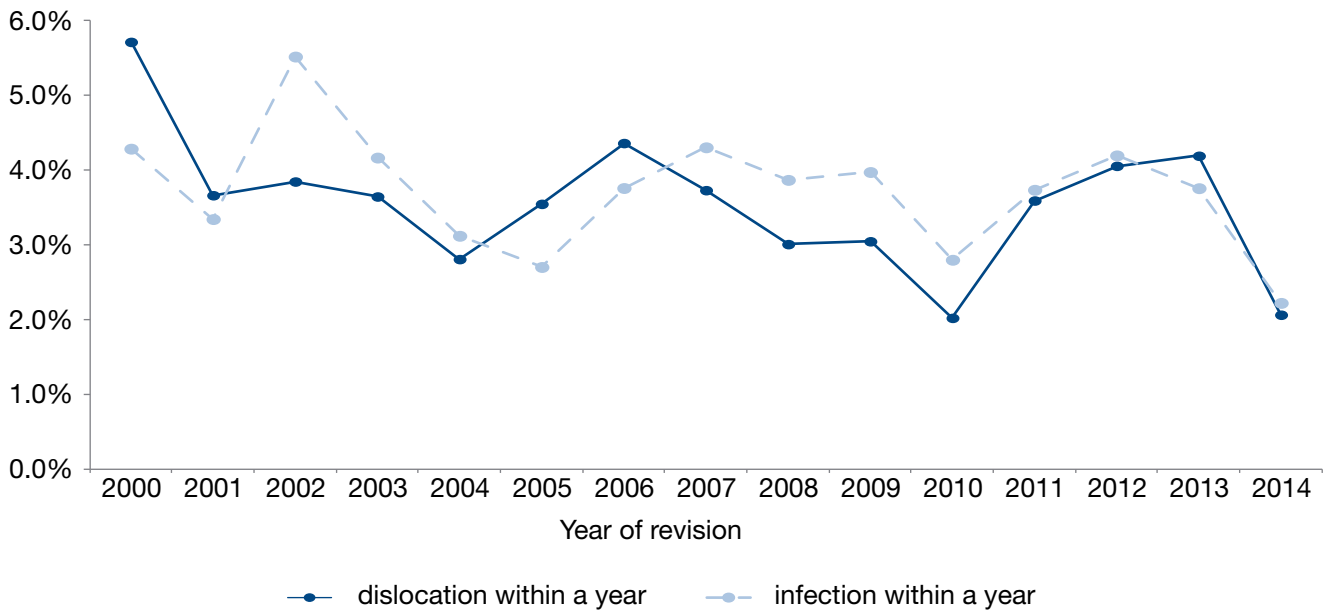
There is a large variation between the worst and best performing units (Figure 22d). In numerical terms, this amounts to the worst performing hospital (which performed 3450 hip arthroplasties) having had to revise over 100 more primary hip replacements within 7 years of implantation than the most similar (in terms of number of primary hip arthroplasties performed) best performing hospital (which performed 3985 hip arthroplasties). Even when hip resurfacing has been removed from the data (Figure 22e), there is still a large variation. Whilst this may be multifactorial, it seems likely that it is related to other poorly performing implants. This variation in practice has resulted in a large financial cost to that particular health authority.

Figure 22f – National rates for complications within 90 days: hip revisions.



Bilateral operations counted only once

Figure 22g – National rates for complications within 1 year: hip revisions



Bilateral operations counted only once

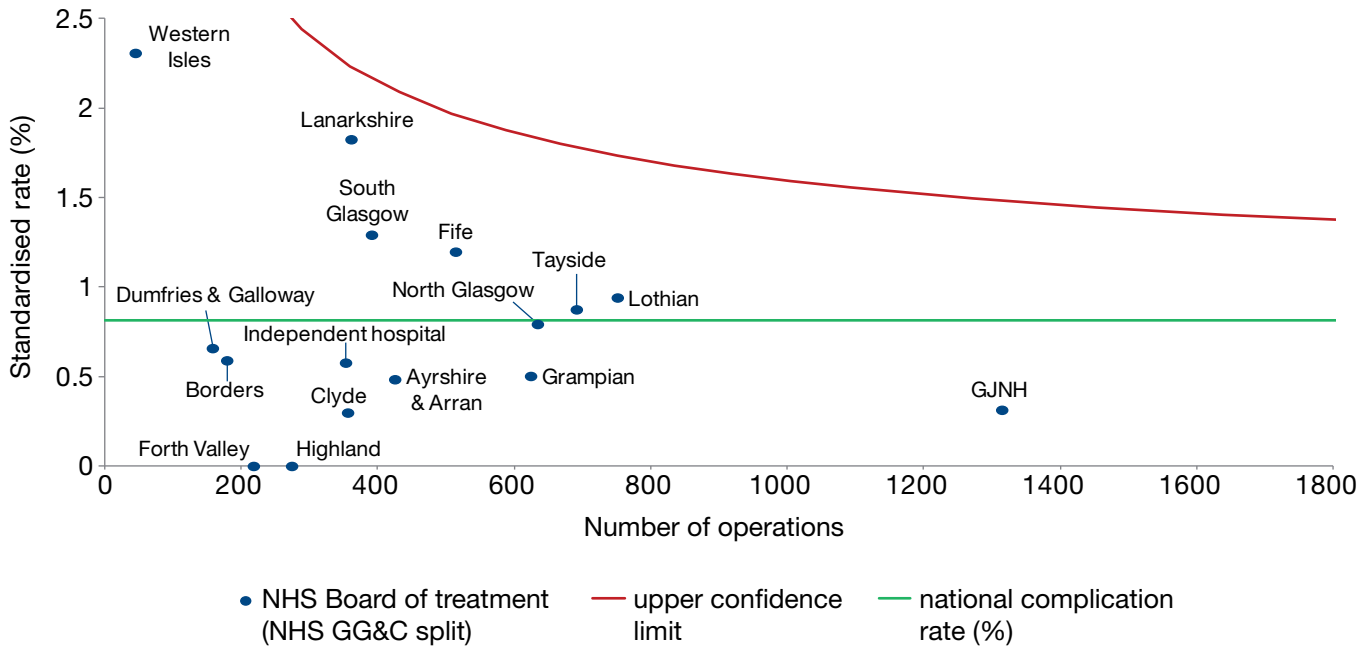
Complication rates for death, VTE, dislocation and infection after revision hip surgery have all reduced over the last 15 years.

5.2 Complication funnel charts – hips

5.2.1 Revision within one year.

No NHS Boards were above the upper confidence limit (Figure 22h).

Figure 22h – Percentage of 2014 hip arthroplasty patients with subsequent revision within one year.

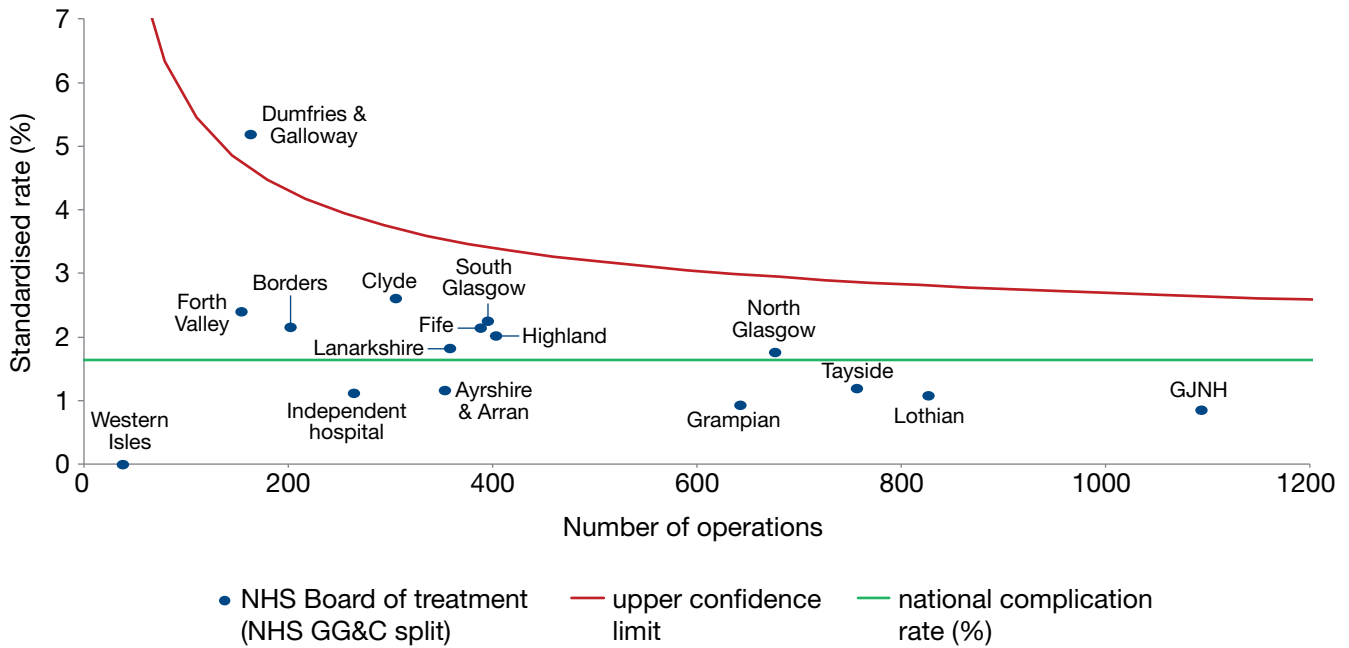


Scottish Rate averaged over 5 years 2010-2014; Bilateral operations counted twice.

5.2.2 Revision within three years.

NHS Dumfries & Galloway was an “outlier” for hip revisions within 3 years (Figure 22i).

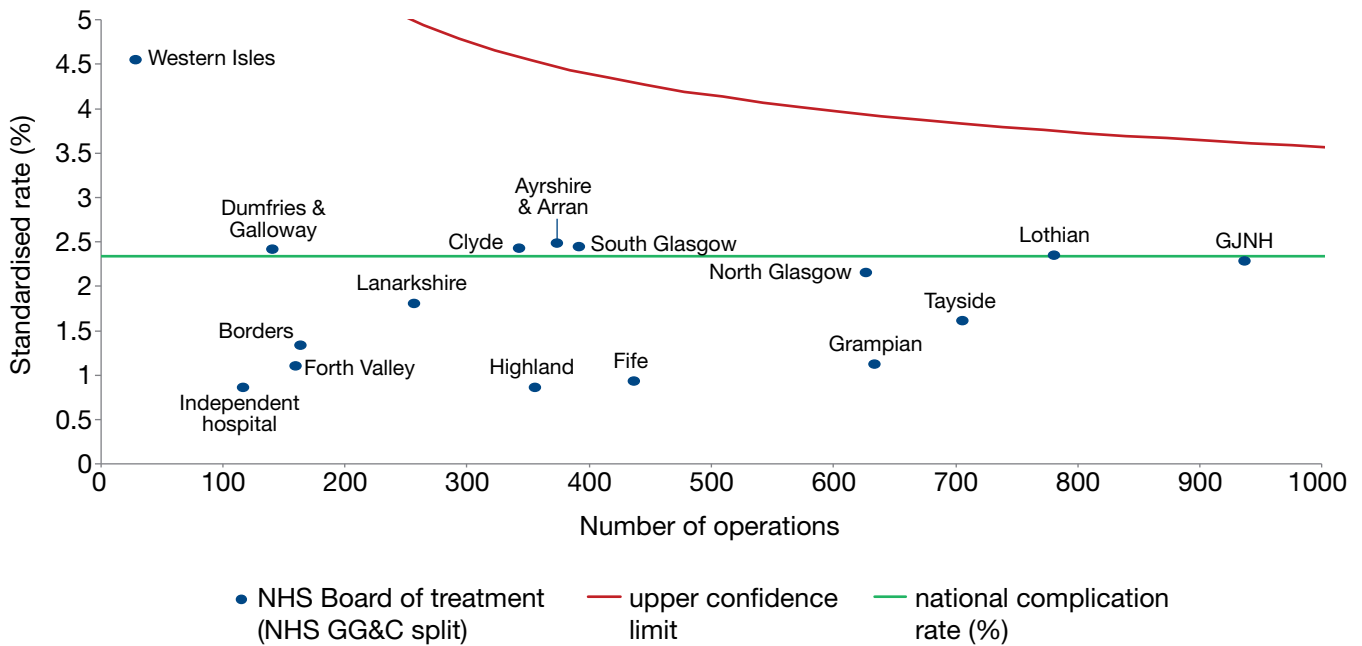
Figure 22i – Percentage of 2012 hip arthroplasty patients with subsequent revision within three years.



Scottish Rate averaged over 5 years 2008-2012; Bilateral operations counted twice.

5.2.3 Revision within five years.

Figure 22j – Percentage of 2010 hip arthroplasty patients with subsequent revision within five years.

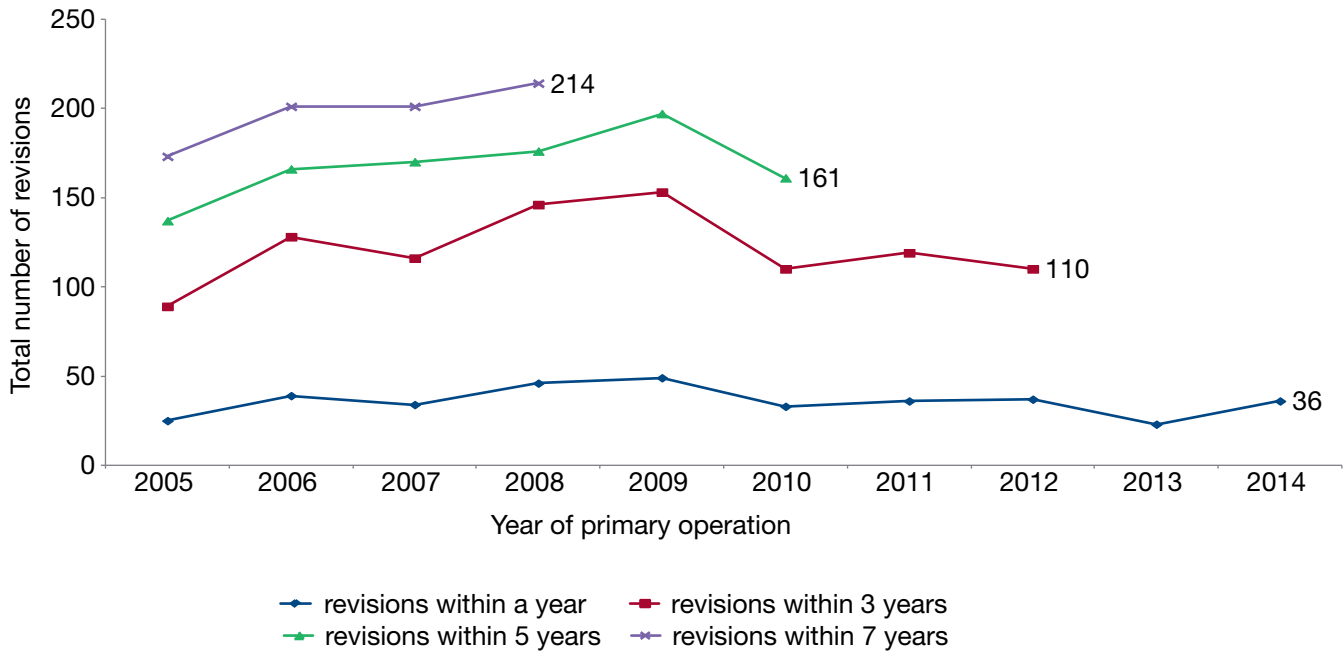


Scottish Rate averaged over 5 years 2006-2010; Bilateral operations counted twice.

5.3 National rates - knees

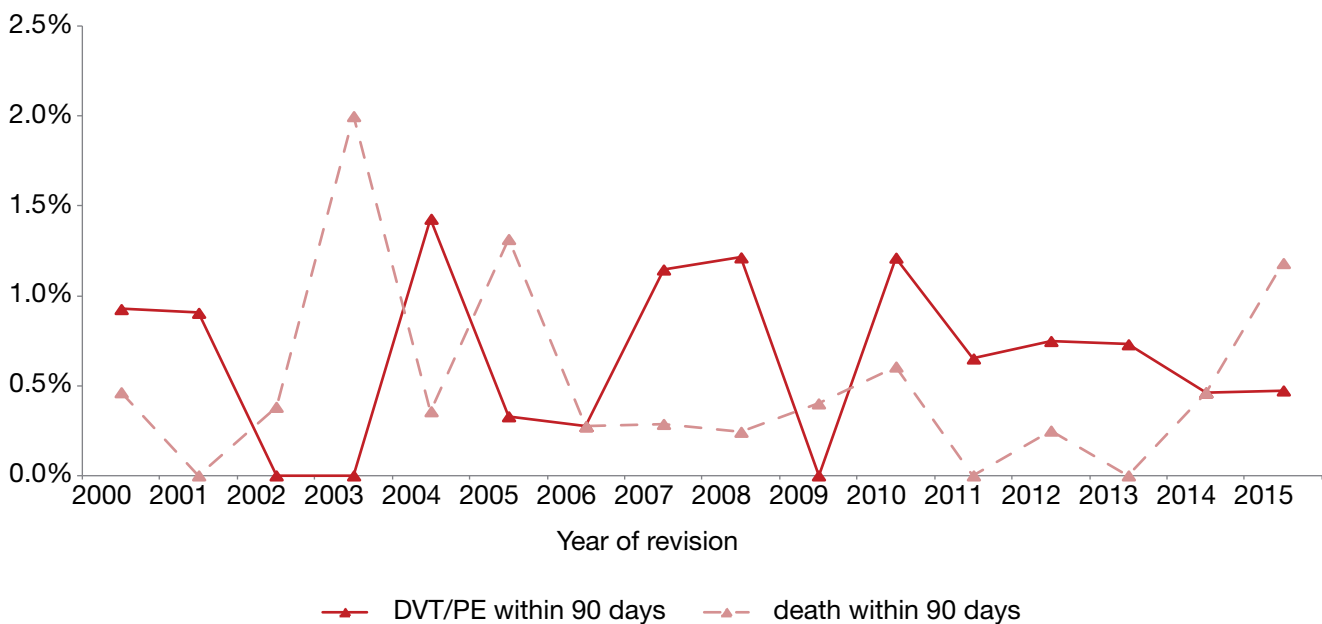
The number of arthroplasties being revised is relatively static year on year from 2005. Less than 3% of knee arthroplasties are revised within 5 years. There is a suggestion that the rate of revisions (percentage) at 3 and 5 years following primary knee arthroplasty may be showing a downward trend from 2009 onwards.

Figure 23a – National rates for knee arthroplasty with subsequent revision



Elective patients only; Includes known patients from private hospitals; bilateral operations counted twice.

Figure 23b – National rates for complications within 90 days: knee revisions

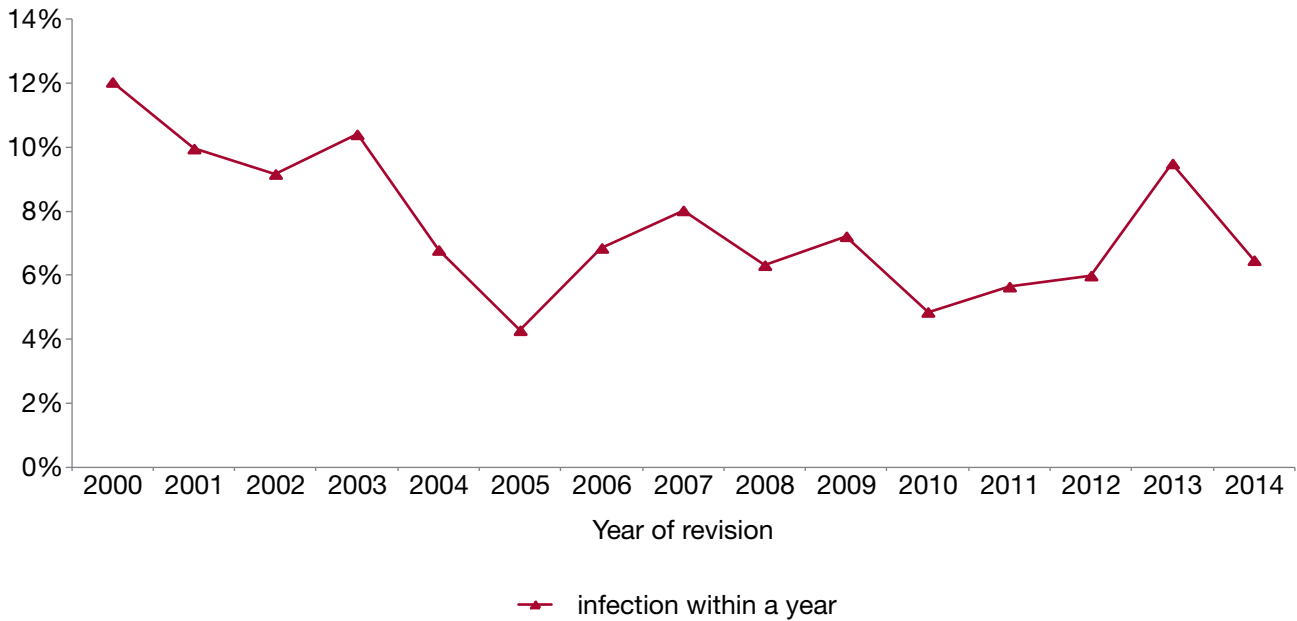


Bilateral operations counted only once

A death rate of 1% within 90 days is greater than recent years and is worthy of surveillance although it may represent normal variation.

Infection is the most common complication, with a rate of infection of around 7% following revision of a total knee arthroplasty in recent years.

Figure 23c – National rates for complications within 1 year: knee revisions



Bilateral operations counted only once

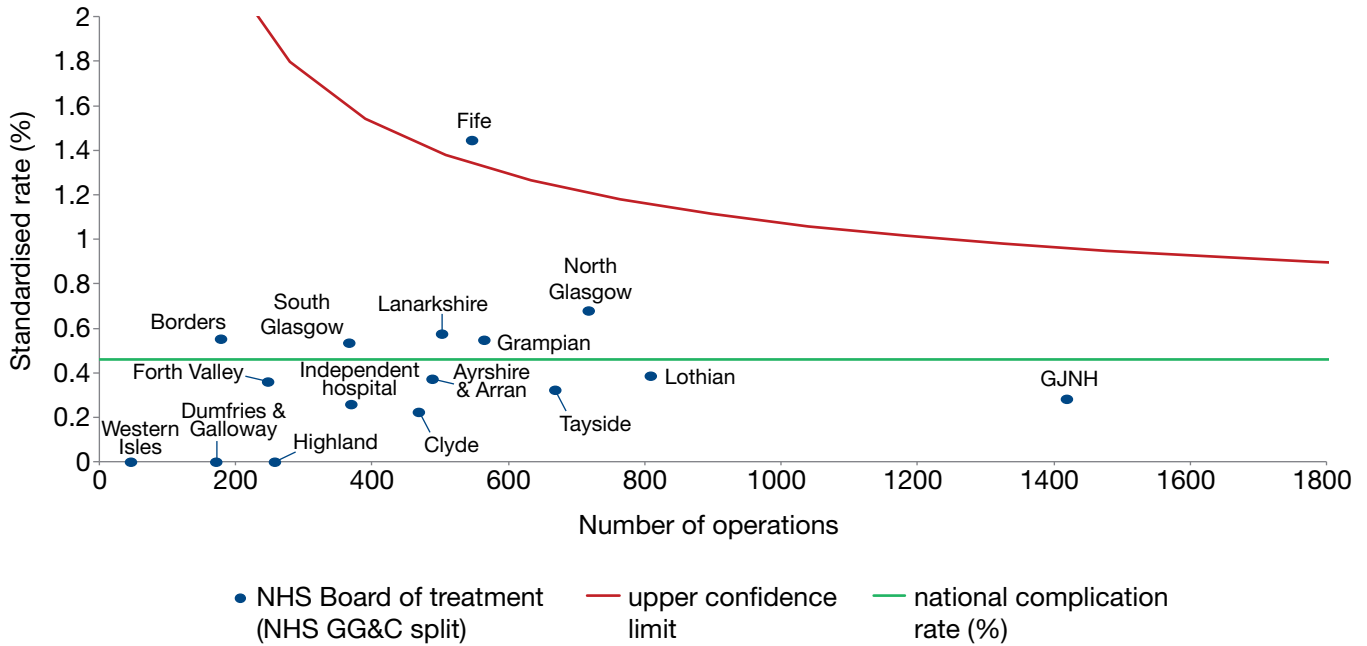
The national rate of infection within 1 year following a knee revision decreased from a high 12% in 2000 to 4.3% in 2005. However the rate of infection has remained more or less static around 7% since then.

5.4 Complication funnel charts - knees

5.4.1 Revision within one year.

One NHS Board (NHS Fife) was an “outlier” above the upper confidence limit for 2014 for revision within one year after knee arthroplasty (Figure 23d).

Figure 23d – Percentage of 2014 knee arthroplasty patients with subsequent revision within one year.

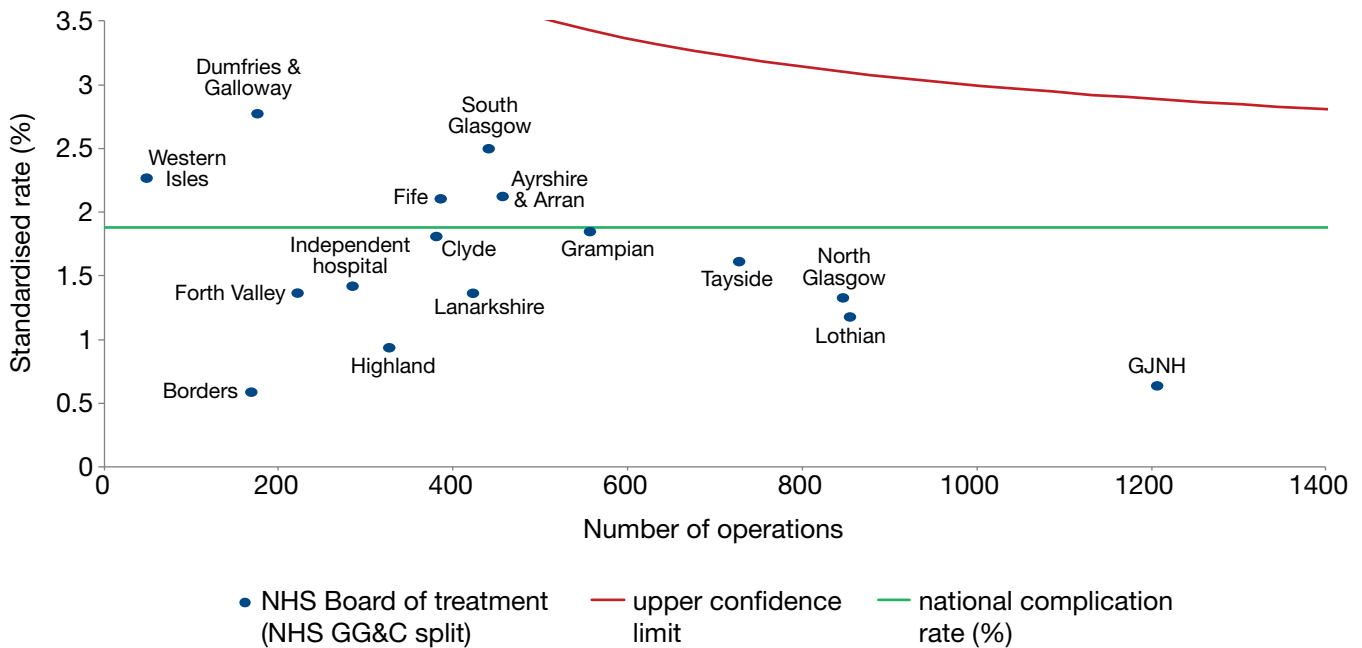


Scottish Rate averaged over 5 years 2010-2014; Bilateral operations counted twice

5.4.2 Revision within three years.

No NHS Boards were “outliers” for revision within three years after knee arthroplasty (Figure 23e).

Figure 23e – Percentage of 2012 knee arthroplasty patients with subsequent revision within three years.

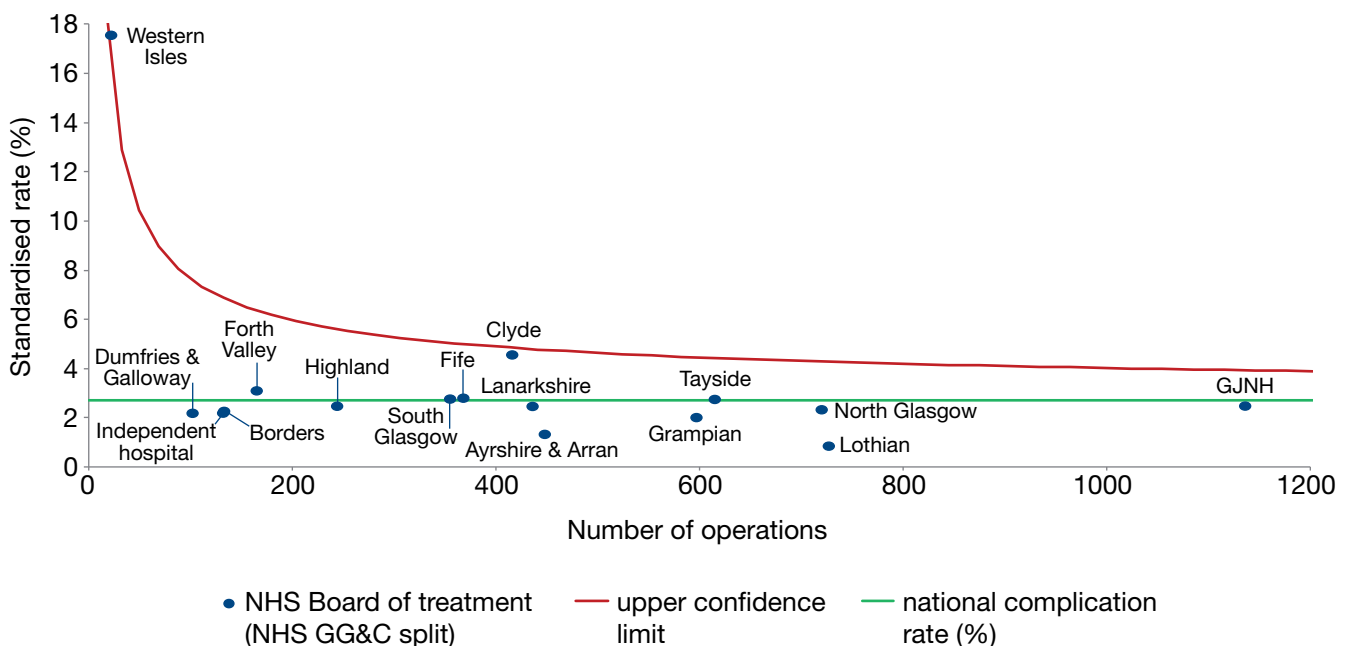


Scottish Rate averaged over 5 years 2008-2012; Bilateral operations counted twice.

5.4.3 Revision within five years (Figure 23f).

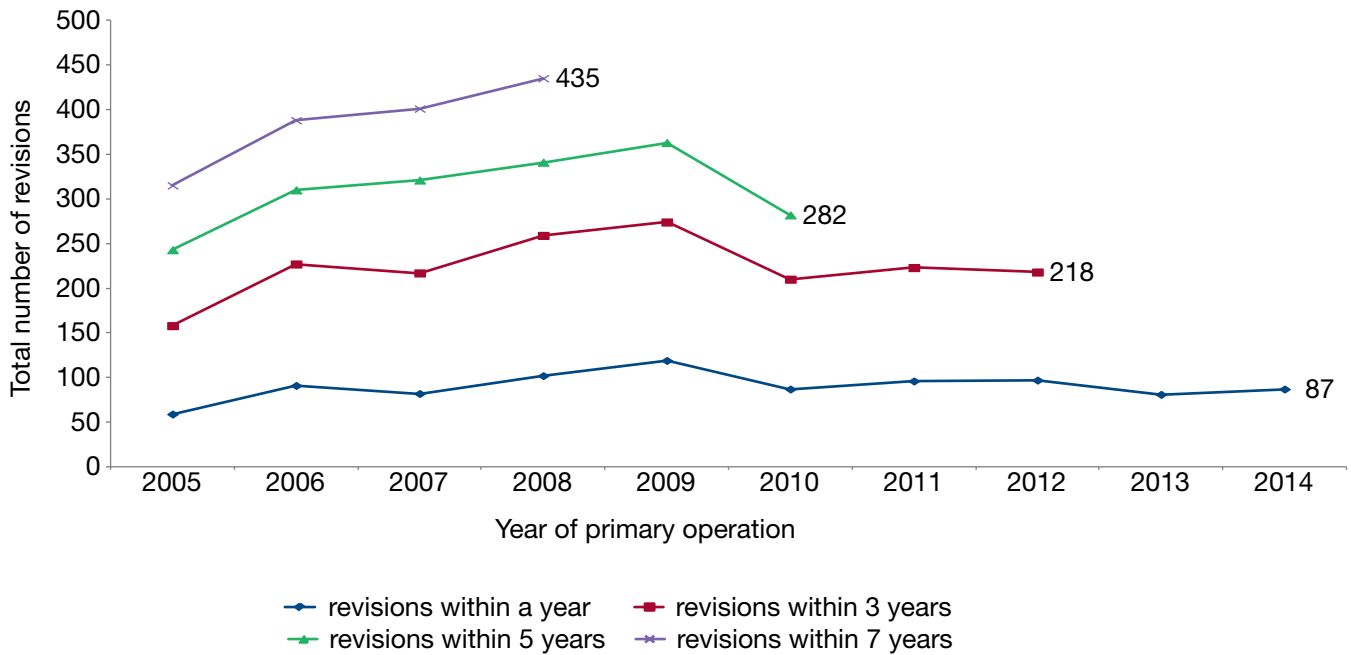
Although there were no outliers at 5 years for both hips and knees, two NHS Boards are at the upper confidence limit (NHS Western Isles & NHS Clyde) for knee arthroplasty.

Figure 23f – Percentage of 2010 knee arthroplasty patients with subsequent revision within 5 years.



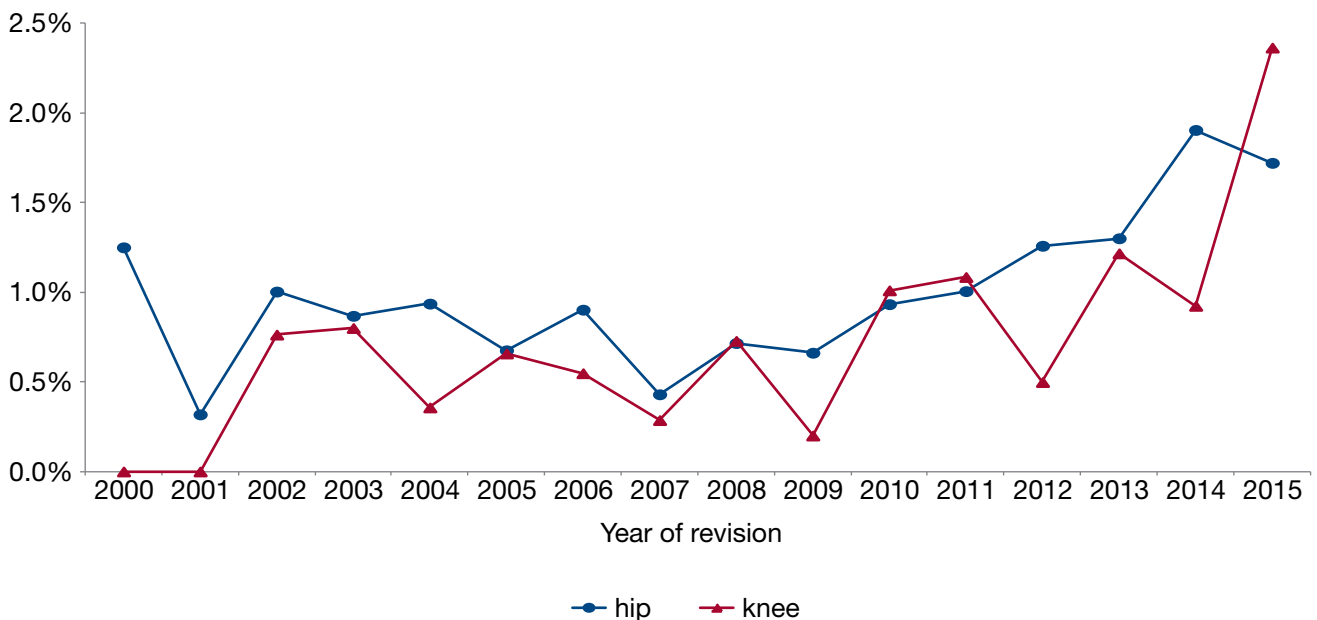
Scottish Rate averaged over 5 years 2006-2010; bilateral operations counted twice.

Figure 24a – National rates for hip and knee arthroplasty with subsequent revision



Elective patients only; Includes known patients from private hospitals; bilateral operations counted twice.

Figure 24b – National rates for acute renal failure within 30 days: hip and knee revisions



There is an apparent upward trend in the rate of renal failure after revision surgery. This should be interpreted with caution as the underlying reason is unclear and may be related to change in definition of renal failure, coding practice, enhanced recovery, changes in prophylactic antibiotic usage etc. We will continue to observe future trends.

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.'²

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 analysis³. In clinical disciplines it has been used in cardiothoracic surgery during the past 15 years⁴ and has been shown to be a superior form of statistical analysis for identifying complications⁵.

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.

2. 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.

3. Page ES (1954). Continuous inspection schemes. *Biometrika*. 41:100 –115.

4. 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.

5. 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.

Comments, case reviews and audit finding 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 25 – CUSUM outlier notifications during 2014-2015.

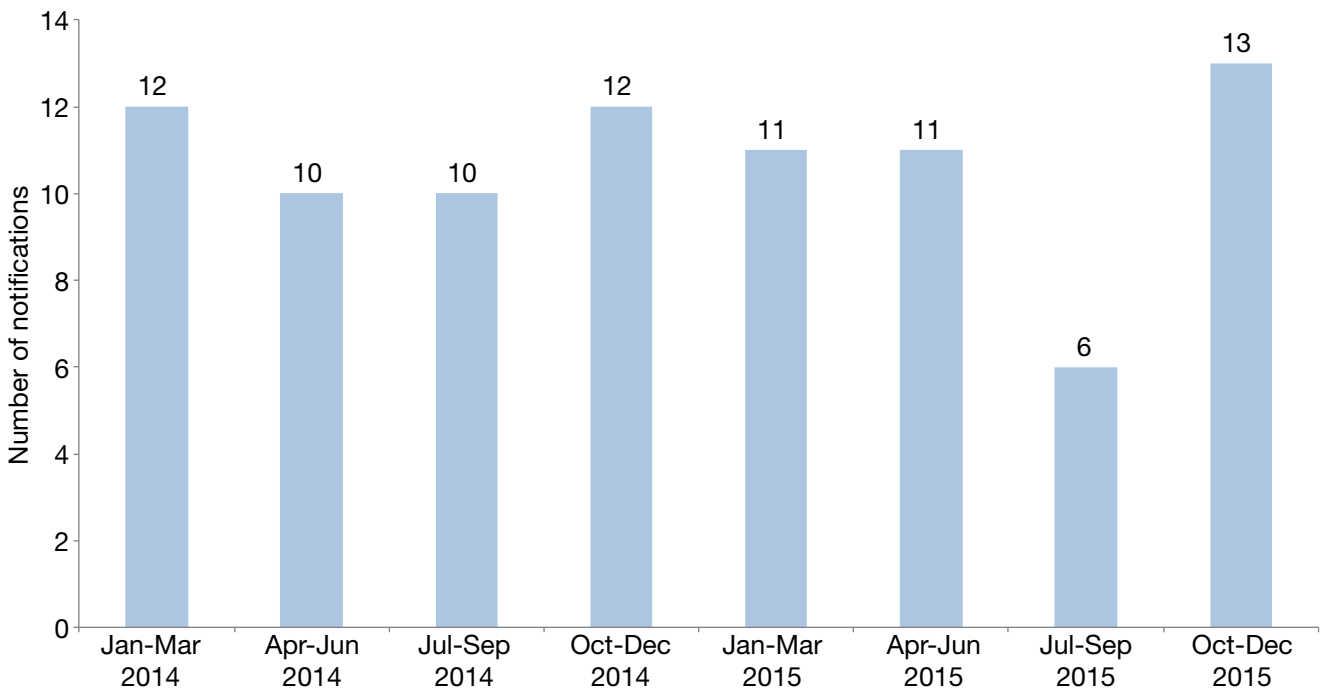
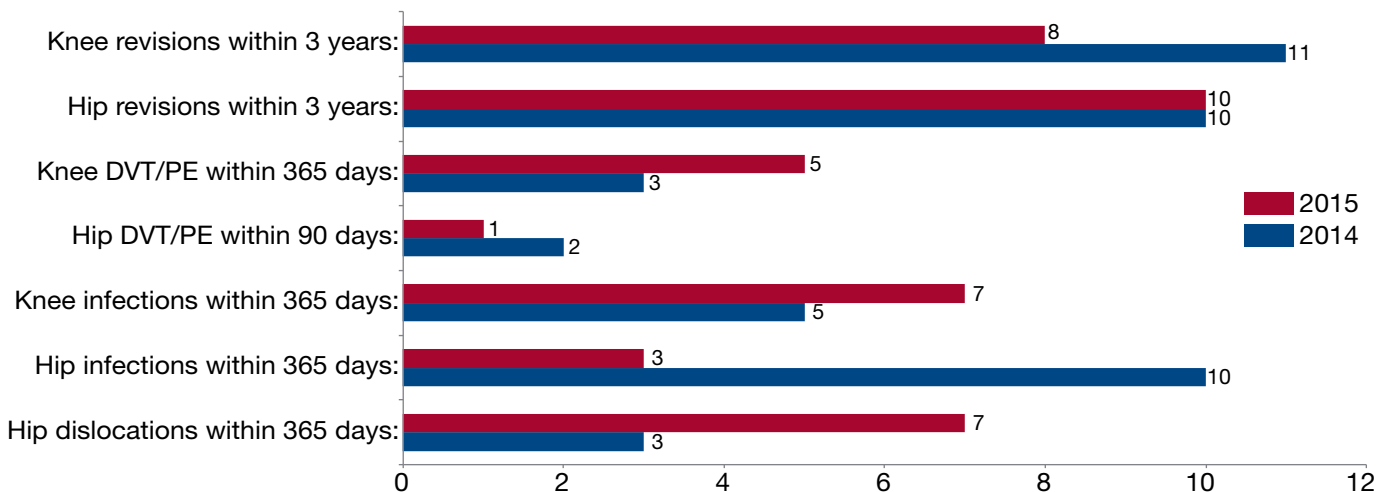


Figure 26 – CUSUM outlier notification by complication type during 2014-2015.



References

Comparing contemporary revision burden among hip and knee joint replacement registries. McGrory, Brian J. et al. *Arthroplasty Today* , Volume 2 , Issue 2 , 83 - 86.

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.

Page ES (1954). Continuous inspection schemes. *Biometrika*. 41:100 –115.

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.

Novick R, et al.(2003). Analysis of the learning curve in telebotomic, 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 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/> .

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

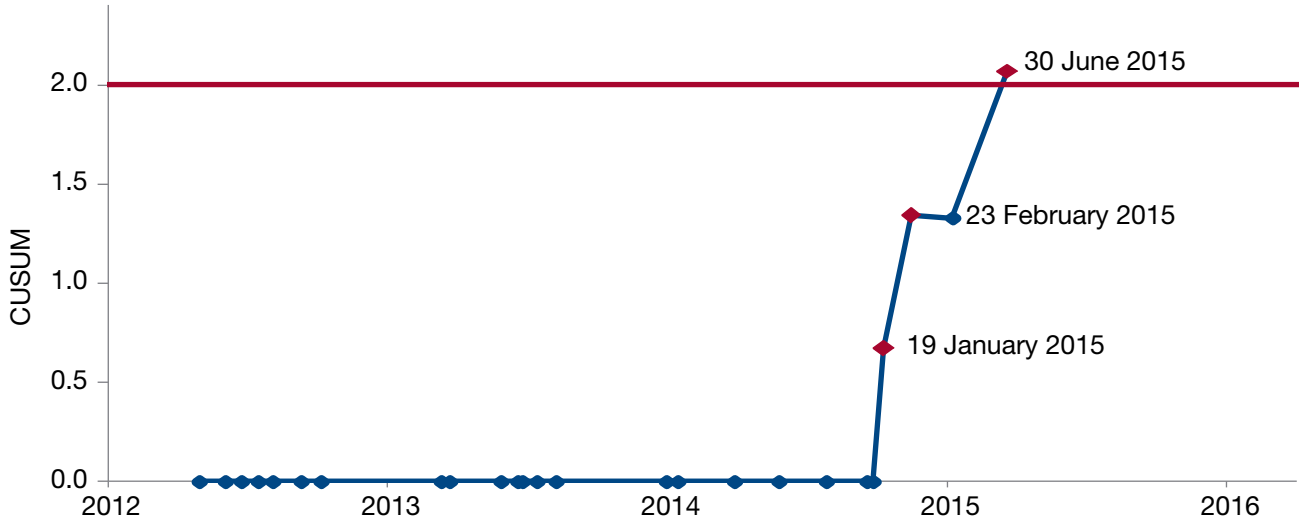
Information on codes used to identify arthroplasty operations is available here: Information on codes used to identify arthroplasty operations is available here:

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

Appendix B to Section 6

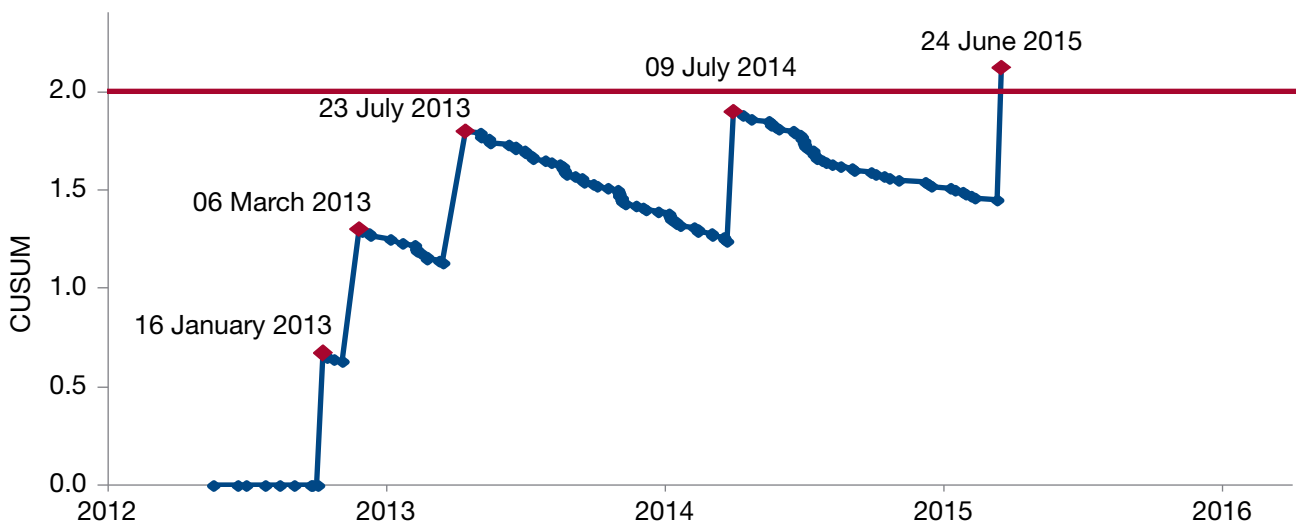
In the case below (Figure 27), CUSUM is low until it rises suddenly to the Control Limit in 2015. Is the rise associated with a change in practise, perhaps a new technique?

Figure 27



In the following case (Figure 28), 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 (June 2015), the consultant would be notified that their complication rate had been unusually high and asked to complete a review and Action Plan.

Figure 28



Contact

Martin O'Neill

Principal Information Analyst

martin.o'neill@nhs.net

0131 275 6244

Derek Murphy

Information Analyst

derek.murphy1@nhs.net

0131 314 1076

Further Information

Further information can be found on the [Scottish Arthroplasty Project website](#).

The next release of this report is expected to be published in August 2017.

The Information Services Division publishes a wide range of statistics. You can find out more by visiting our [website](#).