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NHS National Services Scotland

Scottish Arthroplasty Project.

Annual Report 2018.

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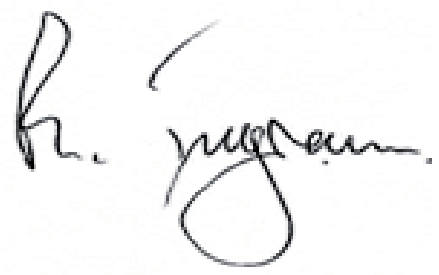
Foreword

Data presented in the Scottish Arthroplasty Project Annual Report 2018 continues to demonstrate high standards of arthroplasty care and outcomes generally across Scotland. Many surgeons will already know this with the system that the Scottish Arthroplasty Project have organised facilitating access to their individual data online. There is a clear interest in this access with large numbers of “hits” recorded at the site. We remain well ahead of many other surgical sub specialties with respect to our data access and reporting capabilities. This does not mean of course that it cannot be improved, and many other changes are likely to be coming in the next year or two.

Initiatives commenced in 2016/17 are ongoing. The topic of low volume surgeons is gathering interest at an international level with registry data now being used to help provide a clearer understanding of the issues. The Scottish Arthroplasty Project plans to continue providing surgeons with relevant data on this subject.

The Scottish Government remains behind plans to record arthroplasty implant details and the Scottish Arthroplasty Project looks forward to being able to access and link this data to our current data set and provide a more complete picture of arthroplasty care across the nation.

Scotland remains a member of the International Society of Arthroplasty Registries, with this years annual meeting in Reykjavik where data on shoulder replacements in Scotland was presented. It remains important that the Scottish Arthroplasty Project continues to look not only at the large volume joint replacements of hip and knee but also shoulder, elbow and ankle, as these procedures come under increased scrutiny in coming years.



Mr R Ingram
Chair, Scottish Arthroplasty Project Steering Committee

Introduction

The Scottish Arthroplasty Project Annual Report 2018 continues to present data relating to arthroplasty procedures including hip, knee, shoulder, elbow and ankle replacements. We hope that the data is more accurate than ever having provided surgeons with electronic access to their own data over the course of the last year, and a simple route to correct any obvious errors. High quality and accurate data is clearly very important to maintain standards and we thank the Orthopaedic community for their ongoing support and engagement with the Scottish Arthroplasty Project.

This year's report should provide reassurance with respect to complication rates nationally for major joint replacement but may raise issues related to some aspects of care, particularly low volume surgeons. Again, we seek to provide the data to enable the surgical community to see the "bigger picture", and where improvement/rationalisation/organisation can be bettered, encourage that to happen.

Scottish Arthroplasty Steering Committee 2017 – 2018

Clinical	Non-Clinical
Mr Roland Ingram (Chairman)	Mr Sandy Shirra (Lay member)
Mr James Bidwell	Mr Robert Frame (Lay member)
Mr Ben Clift	Mr Thomas Ferguson (Lay member)
Dr Karen Cranfield	Mr Martin Paton (Info. Analyst)
Mr William MacLeod	Mr Martin O'Neill (Principal Info. Analyst)
Mr Matthew Moran	Mrs Kate James
Mr Martin Sarungi	Mr Stuart Baird (Service Manager)

Key points

Number of arthroplasty operations performed in 2017

hip - 7786

knee - 7282

Average age of patients undergoing an NHS Scotland arthroplasty operation

hip - 67 yrs

knee - 68 yrs

Incidence of death within 90 days following a hip or knee arthroplasty

hip - 0.22 %

knee - 0.22 %

Average length of stay when undergoing a hip or knee arthroplasty

2001 - 10 days

2017 - 4 days

Revision rate within 5 years of arthroplasty operation

hip - 2.12 %

knee - 2.51 %

1. Number of Arthroplasties

1.1 National rates

The number of hip and knee arthroplasties performed remains relatively static over the last few years however we have observed a slight decline in both 2016 and 2017. During 2017 there were a total of 7786 and 7282 primary hip and knee procedures performed respectively (Figure 1a). Other joint replacement registries report that the number of knee arthroplasties significantly exceeds the number of hip arthroplasties performed on an annual basis. It is probable that, in Scotland, less knee arthroplasties are performed than in other countries with similar population demographics.

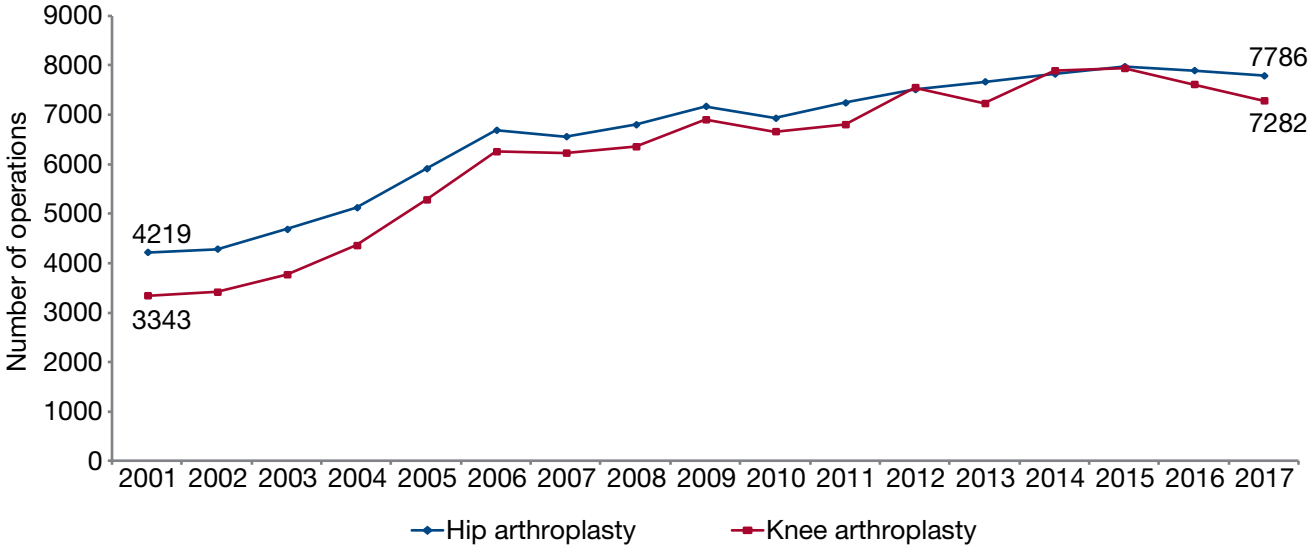
The number of elbow arthroplasties has remained stable over the last 16 years with levels seen close to that performed back in 2001 and compared to other types of arthroplasty has seen less variability year-on-year. The trend for shoulder arthroplasty shows a similar pattern to that of hip and knee arthroplasty with an increase in numbers over the period 2003 to 2012 and then a levelling off in activity (458 in 2017). The greatest percentage increase in arthroplasty activity is seen in ankle arthroplasty, with just 14 ankle arthroplasties performed in 2001 and 101 in 2017 (Figure 1b). The reasons for this are likely to be multifactorial and may include improved prosthesis and instrument design, increasing surgeon specialisation and patient and surgeon preferences.

The proportion of primary arthroplasties performed as an emergency has remained static over time, with a significant proportion of hip, shoulder and elbow arthroplasties being performed as emergencies (mostly for treatment of fractures) and low numbers of ankle and knee arthroplasties performed on an emergency basis (Figures 1e and 1f). Overall there is a significant resource requirement for non-elective arthroplasty surgery to be performed. The adequate organisation of theatre time, referral pathways and surgical expertise to deal with emergency hip, shoulder and elbow arthroplasty should be considered.

The number of hip revisions in 2017 continues to decrease, with 963 and 777 hip revisions carried out in 2013 and 2017 respectively (Figure 1c). This may reflect the early failure rate of certain metal-on-metal hip implants that were used and have now been revised. The number of knee revisions remains approximately level since 2013 with 463 procedures in 2017. There has been an increase in the number of shoulder and ankle revision operations. Shoulder revisions are up to 42, from 25 in 2013 and ankle revisions up to 11, from 5 in 2013. Overall the revision burden for 2017 (number of revision operations divided by total number of arthroplasties)is for hip arthroplasty 9.07%, knee arthroplasty 5.98%, shoulder arthroplasty 8.40%, elbow arthroplasty 15.52% and ankle arthroplasty 9.82%.

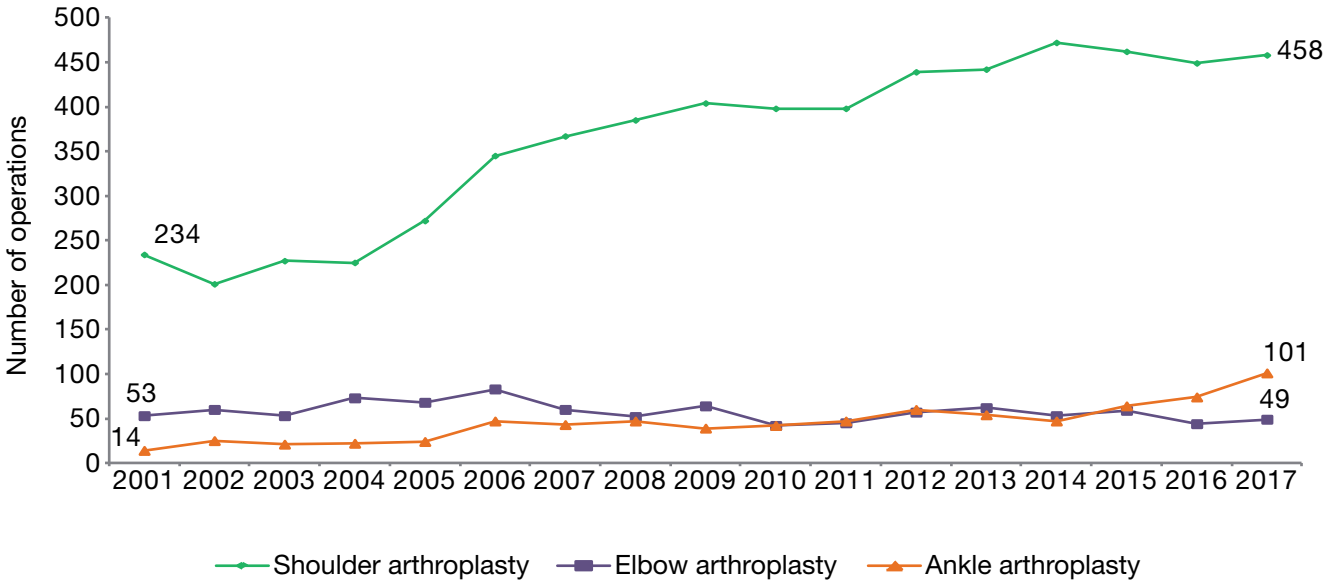
The proportion of hip revisions performed as an emergency has been steadily increasing from to reach 20.4% in 2001 to 36.2%% in 2017. This may reflect a reduction in the number of planned revisions (with the number of at risk metal-on-metal hips reducing) and an increase in the number of periprosthetic fracture revisions. We do not have the data to analyse this further. The absolute numbers of shoulder, elbow and ankle revisions performed as an emergency is low so care must be taken interpreting Figure 1f).

Figure 1a — Primary hip and knee arthroplasties per year (2001 - 2017)



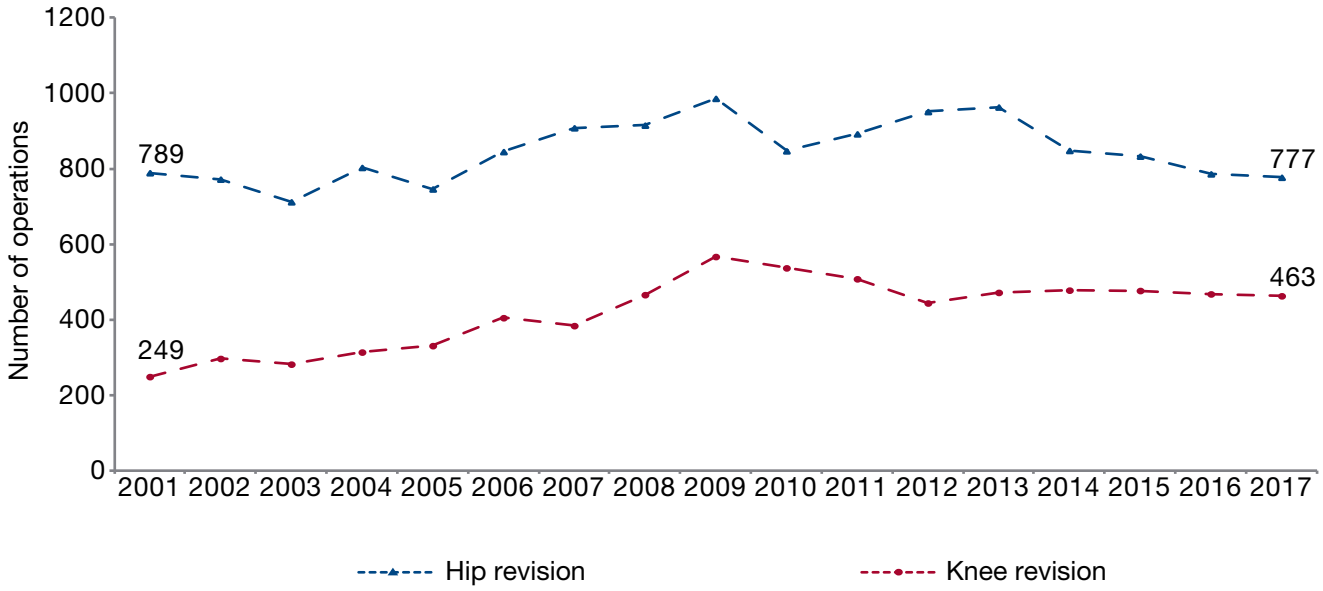
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 1b — Primary shoulder, elbow and ankle arthroplasties per year (2001 - 2017)



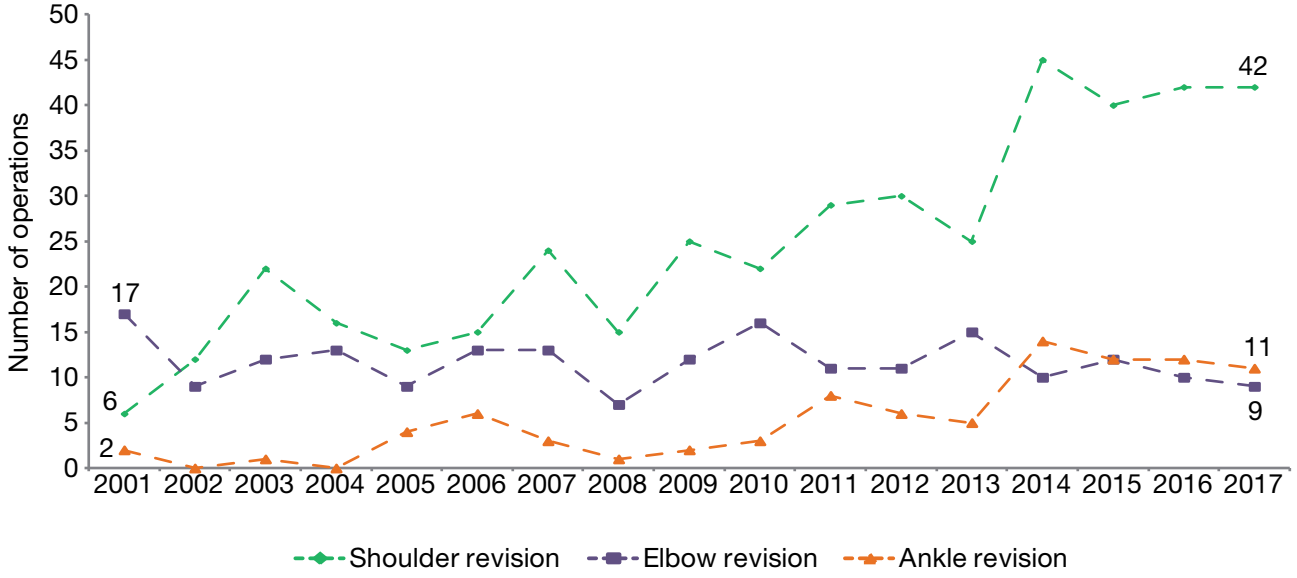
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 1c — Revision hip and knee arthroplasties per year (2001 - 2017)



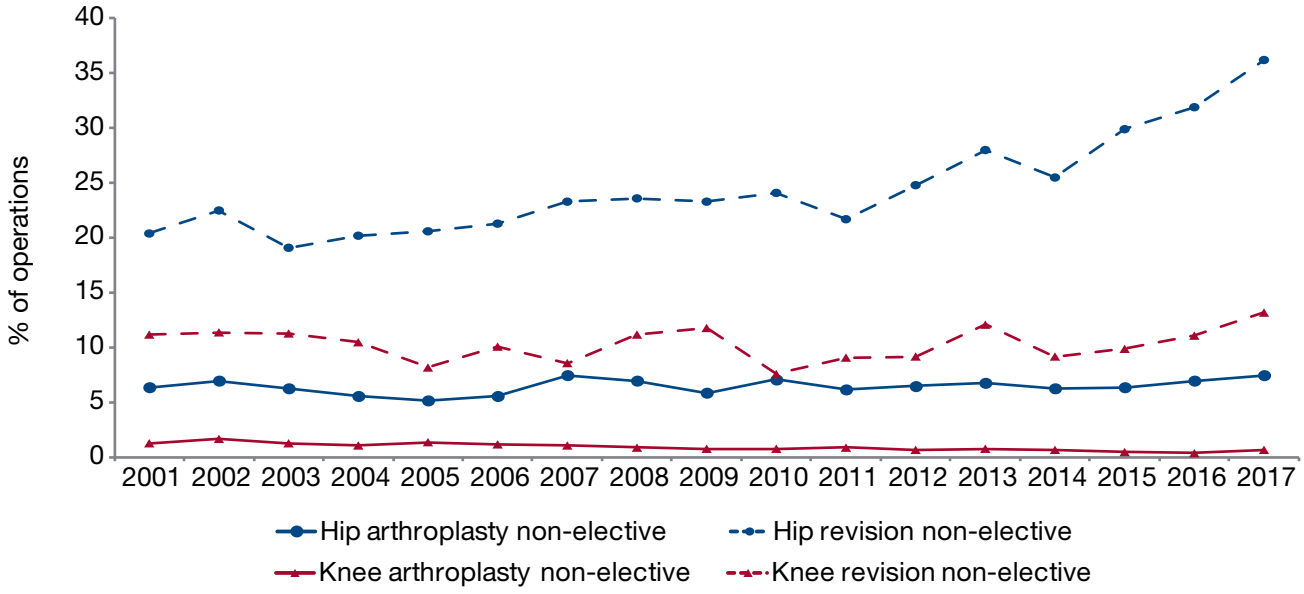
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 1d — Revision shoulder, elbow and ankle arthroplasties per year (2001 - 2017)



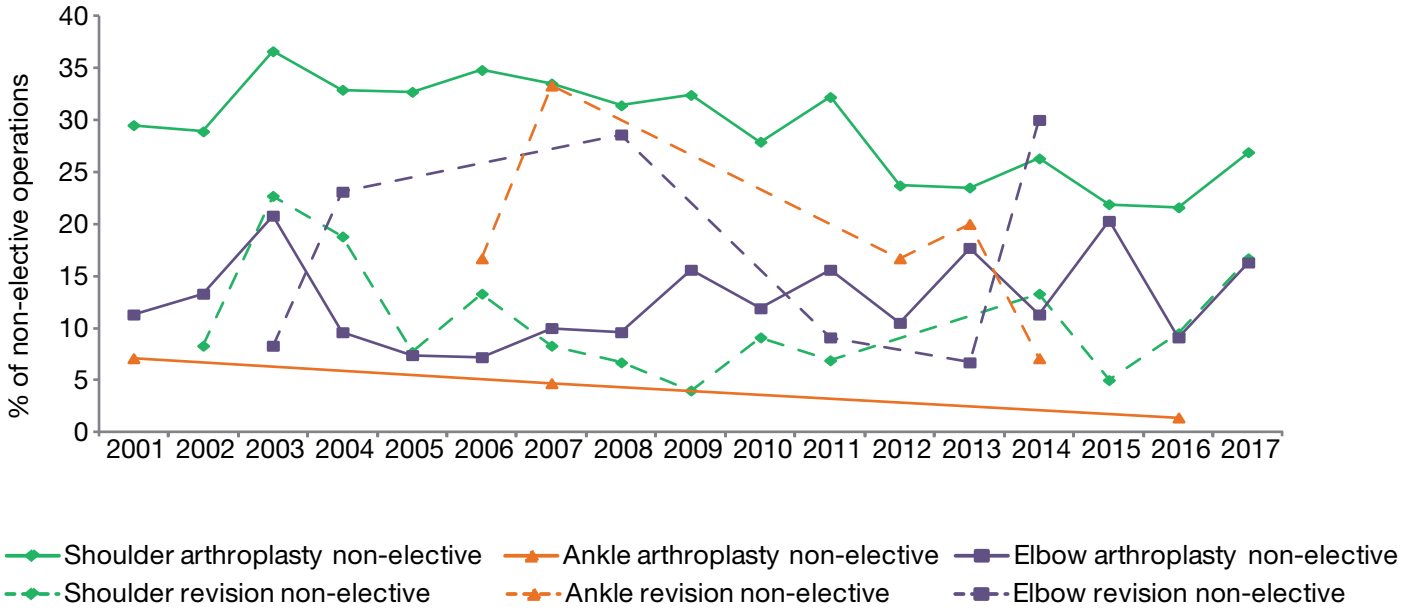
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 1e — Hip and knee arthroplasty, primary and revision: incidence of non-elective surgery per year (2001 - 2017)



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

Figure 1f — Shoulder, elbow and ankle arthroplasty, primary and revision: incidence of non-elective surgery per year (2001 - 2017)



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

1.2 Number of arthroplasties by Health Board

The numbers of patients undergoing primary joint arthroplasty by Health Board of treatment is given in Figures 2a to 2e. Tables 1a to 1j show the figures for primary and revision joint replacement for Health Board of treatment and Health Board of residence.

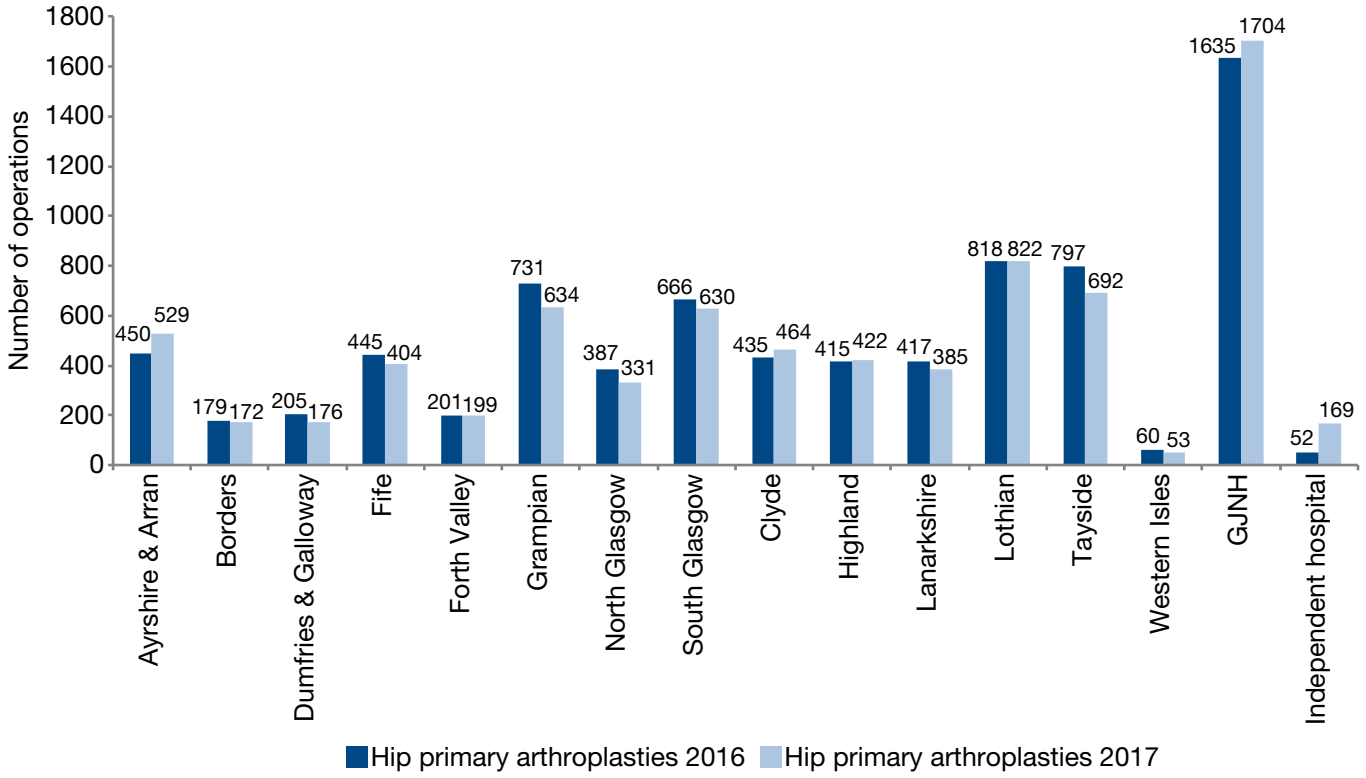
A large number of patients undergoing primary hip or knee arthroplasty are treated out with their Health Board of residence (Tables 1a, 1f, 1b, 1g). This affects some Health Boards much more than others. In some Health Boards it is possible that this change, which has occurred over time, will have significantly altered the workload. This may have implications for staffing in certain Health Boards, in terms of the ability to recruit consultants and the expertise that is required. This trend is not seen in shoulder, ankle or elbow replacement (Tables 1c,1h,1d,1i,1e,1j).

The migration patterns seen for primary hip and knee replacement are not replicated in the figures for revision hip and knee replacement. For example some Health Boards perform considerably less primary hip and knee replacement than would be expected given the number of hip and knee replacements performed by place of residence but perform more revisions than would be expected. This may be due to Health Boards referring primary arthroplasty procedures to the NHS National Waiting Times Centre (GJNH) whereas there is a rising trend for hip and knee revisions to be performed as an emergency procedure.

The impact of referrals to the NHS National Waiting Times Centre (GJNH) is not evenly distributed across Scotland. For example, the data suggests that NHS Fife and NHS Tayside export very few primary hip and knee arthroplasties (the number of patients by health board of residence approximately matches the number treated). Other Health Boards have much greater variation; over 50% of patients that live in NHS Lanarkshire and NHS Forth Valley have a primary hip or knee arthroplasty outwith their Health Board. This discrepancy in Health Board of residence versus treatment is not seen for shoulder arthroplasty (Figure 1c and 1h). For arthroplasty operations performed in low volumes (ankle and elbow) there are a number of Health Boards where very low numbers are performed (Table 1d and 1e). Provision of these operations may be best arranged in a few centres across Scotland.

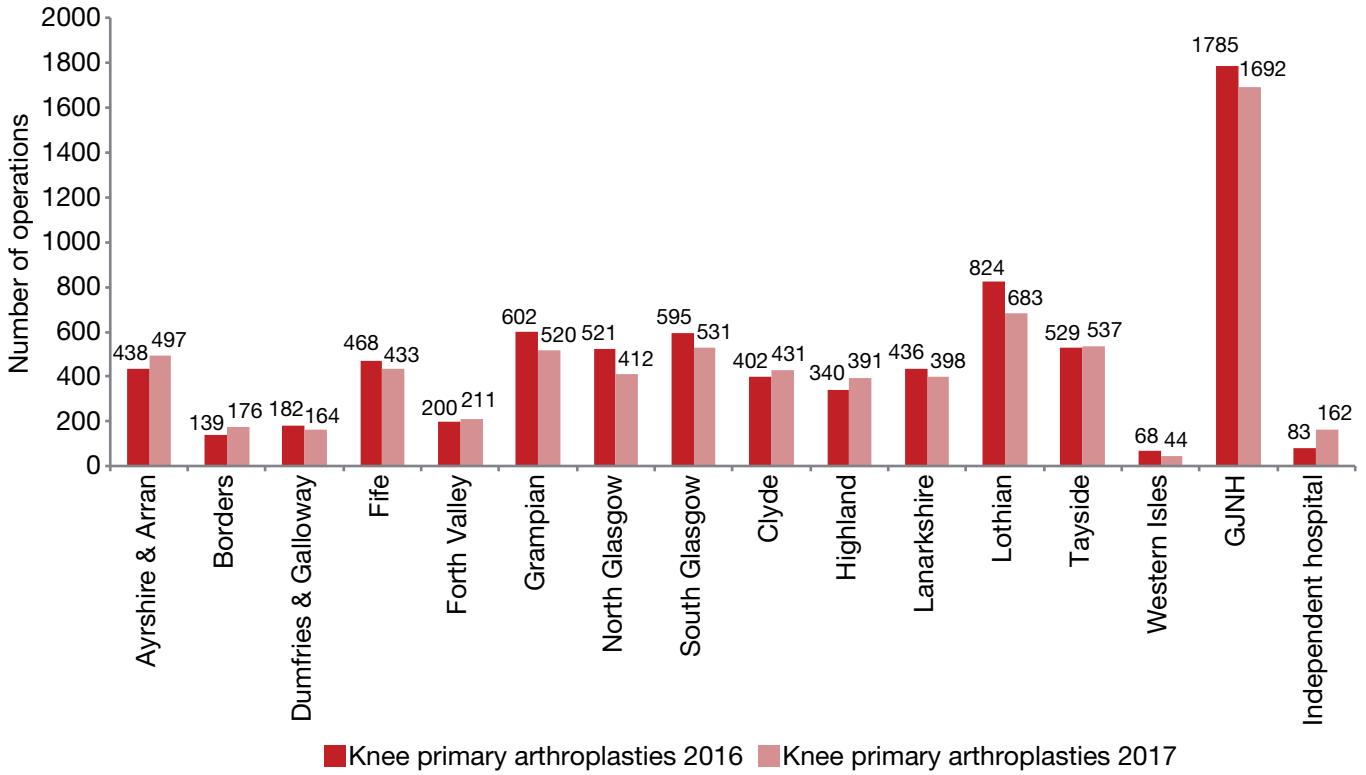
Please note that no arthroplasty procedures are undertaken within NHS Orkney and NHS Shetland therefore they do not appear in the tables that follow. Patients who require joint replacement surgery and who live within these two boards have surgery under the care of a mainland Health Board.

Figure 2a — Number of primary hip arthroplasties 2016-2017 by Health Board of treatment (NHS GG&C split)



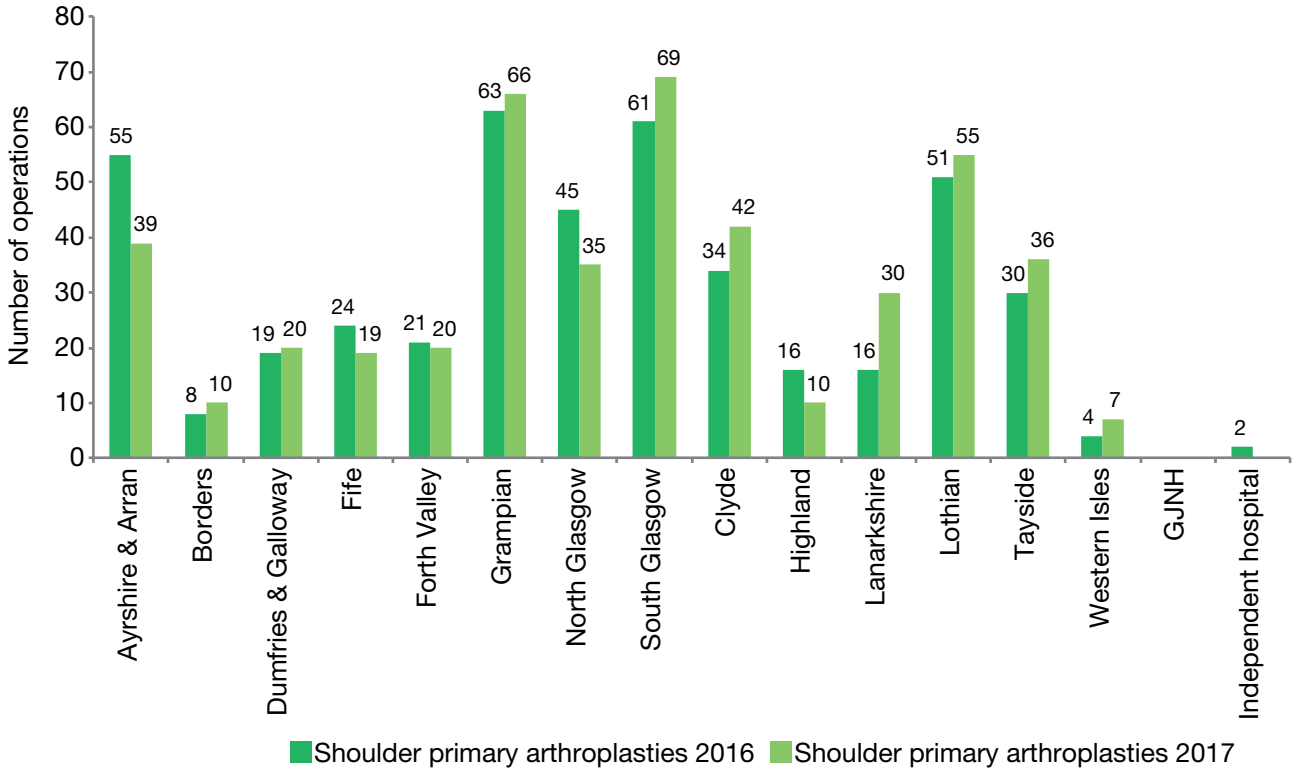
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 2b — Number of primary knee arthroplasties 2016-2017 by Health Board of treatment (NHS GG&C split)



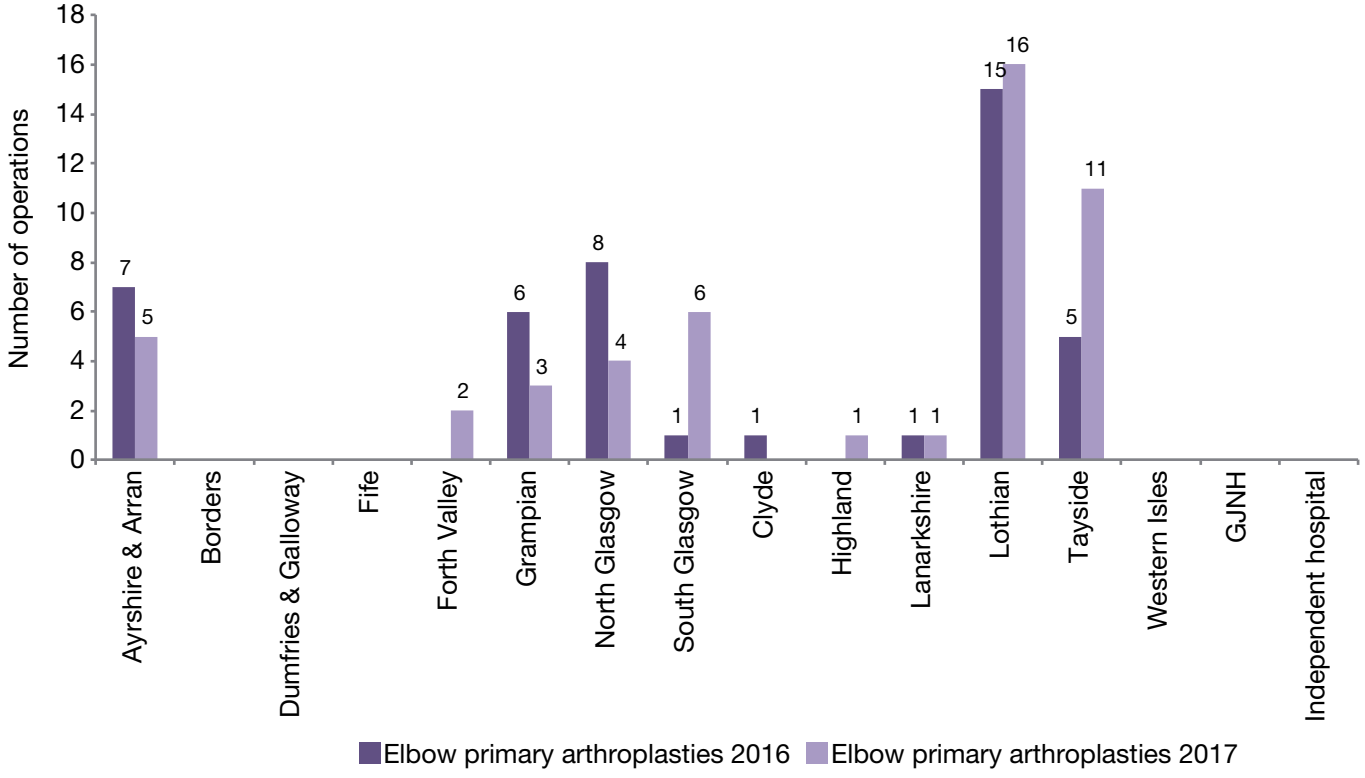
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 2c — Number of primary shoulder arthroplasties 2016-2017 by Health Board of treatment (NHS GG&C split)



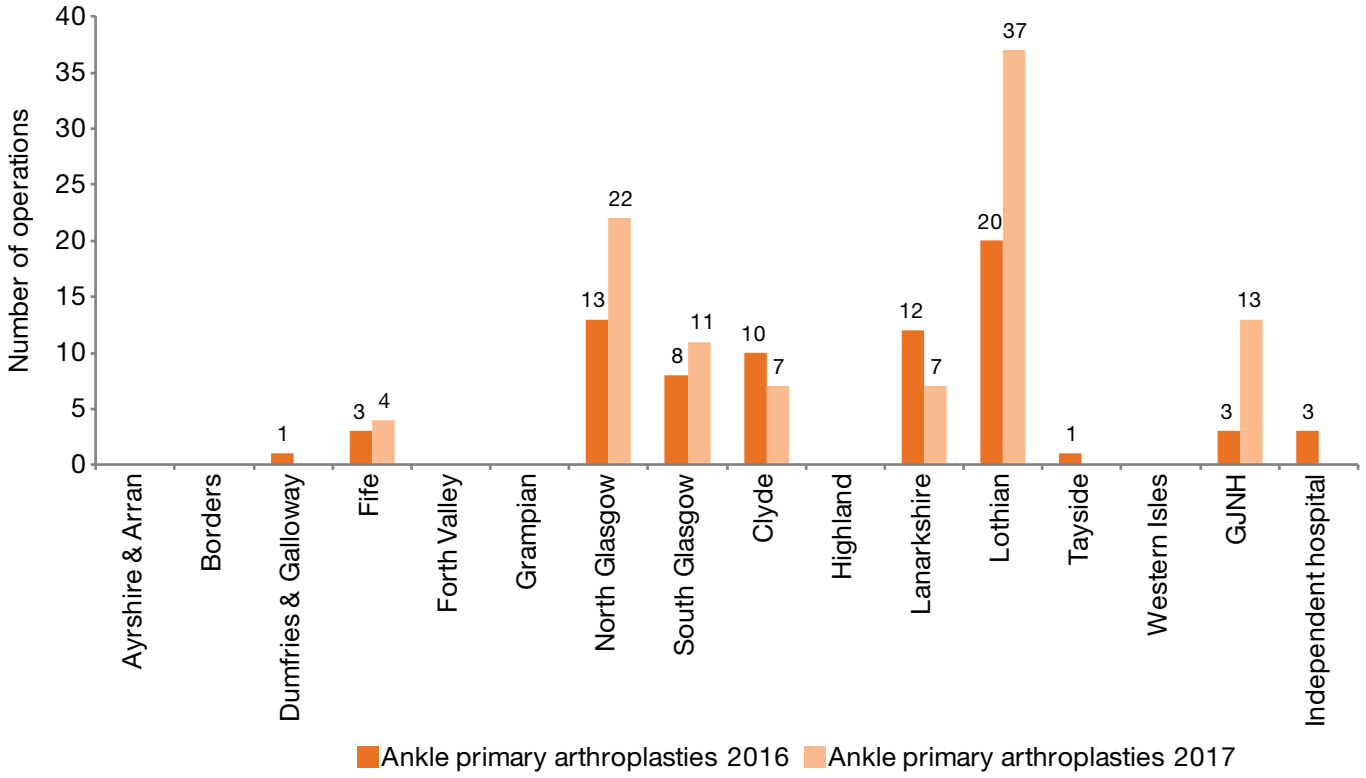
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 2d — Number of primary elbow arthroplasties 2016-2017 by Health Board of treatment (NHS GG&C split)



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

Figure 2e — Number of primary ankle arthroplasties 2016-2017 by Health Board of treatment (NHS GG&C split)



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

Table 1a — Number of hip arthroplasties by Health Board of treatment (NHS GG&C split)

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	439	450	529	59	36	47
Borders	204	179	172	8	6	5
Dumfries & Galloway	174	205	176	6	2	4
Fife	467	445	404	48	37	39
Forth Valley	211	201	199	34	29	36
Grampian	724	731	634	89	72	47
North Glasgow	612	387	331	98	33	39
South Glasgow	445	666	630	99	123	124
Clyde	390	435	464	47	41	53
Highland	353	415	422	35	36	28
Lanarkshire	410	417	385	52	42	54
Lothian	851	818	822	154	166	164
Tayside	793	797	692	90	67	65
Western Isles	53	60	53	3	2	0
GJNH	1316	1635	1704	75	94	72
Independent hospital	304	52	169	1	0	0
Total	**7743**	**7893**	**7786**	**899**	**786**	**777**

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

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

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	460	438	497	42	28	25
Borders	176	139	176	6	3	4
Dumfries & Galloway	174	182	164	1	1	1
Fife	483	468	433	38	38	41
Forth Valley	225	200	211	18	24	17
Grampian	593	602	520	45	50	32
North Glasgow	714	521	412	51	38	48
South Glasgow	404	595	531	32	36	26
Clyde	444	402	431	28	23	32
Highland	302	340	391	14	20	19
Lanarkshire	484	436	398	36	37	37
Lothian	802	824	683	65	73	81
Tayside	657	529	537	46	35	38
Western Isles	53	68	44	1	1	0
GJNH	1378	1785	1692	46	61	62
Independent hospital	303	83	162	2	0	0
Total	**7650**	**7612**	**7282**	**468**	**468**	**463**

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

Table 1c — Number of shoulder arthroplasties by Health Board of treatment (NHS GG&C split)

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	60	55	39	6	6	4
Borders	4	8	10	0	0	0
Dumfries & Galloway	20	19	20	0	0	0
Fife	17	24	19	0	3	1
Forth Valley	19	21	20	1	2	1
Grampian	56	63	66	6	9	8
North Glasgow	57	45	35	5	4	5
South Glasgow	32	61	69	4	4	4
Clyde	34	34	42	4	1	3
Highland	19	16	10	1	1	3
Lanarkshire	21	16	30	1	3	3
Lothian	69	51	55	3	8	7
Tayside	33	30	36	3	1	3
Western Isles	7	4	7	1	0	0
GJNH	0	0	0	0	0	0
Independent hospital	8	2	0	1	0	0
Total	**454**	**449**	**458**	**35**	**42**	**42**

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

Table 1d — Number of elbow arthroplasties by Health Board of treatment (NHS GG&C split)

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	6	7	5	0	0	0
Borders	0	0	0	0	0	0
Dumfries & Galloway	0	0	0	0	0	0
Fife	1	0	0	0	0	0
Forth Valley	1	0	2	1	0	0
Grampian	7	6	3	2	2	1
North Glasgow	7	8	4	3	0	1
South Glasgow	6	1	6	2	1	1
Clyde	2	1	0	0	0	0
Highland	3	0	1	1	0	1
Lanarkshire	2	1	1	0	0	0
Lothian	18	15	16	4	7	3
Tayside	6	5	11	1	0	2
Western Isles	0	0	0	0	0	0
GJNH	0	0	0	0	0	0
Independent hospital	1	0	0	0	0	0
Total	**58**	**44**	**49**	**12**	**10**	**9**

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

Table 1e — Number of ankle arthroplasties by Health Board of treatment (NHS GG&C split)

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	0	0	0	0	0	0
Borders	1	0	0	0	0	0
Dumfries & Galloway	2	1	0	0	0	1
Fife	5	3	4	1	0	0
Forth Valley	0	0	0	0	0	0
Grampian	1	0	0	0	0	0
North Glasgow	16	13	22	5	7	5
South Glasgow	4	8	11	1	1	1
Clyde	2	10	7	0	0	1
Highland	0	0	0	0	0	0
Lanarkshire	6	12	7	1	3	0
Lothian	13	20	37	2	1	2
Tayside	2	1	0	0	0	0
Western Isles	0	0	0	0	0	0
GJNH	2	3	13	0	0	1
Independent hospital	4	3	0	0	0	0
Total	**56**	**74**	**101**	**9**	**12**	**11**

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

Table 1f — Number of hip arthroplasties by Health Board of residence

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	641	652	714	76	47	52
Borders	250	237	235	26	26	24
Dumfries & Galloway	254	306	289	35	39	30
Fife	561	513	462	59	53	50
Forth Valley	438	400	503	49	35	53
Grampian	838	807	724	80	70	42
GG&C	1258	1330	1224	176	145	159
Highland	550	611	668	56	53	51
Lanarkshire	865	953	936	101	92	98
Lothian	1209	1192	1216	130	142	145
Orkney	48	40	34	9	4	5
Shetland	49	52	41	5	3	5
Tayside	682	706	637	85	56	58
Western Isles	72	73	73	11	12	3
England/Wales/NI	20	14	18	3	8	2
Unknown	3	2		1	1	0
Outside UK	5	5	12	1	0	0
Total	**7743**	**7893**	**7786**	**899**	**786**	**777**

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

Table 1g — Number of knee arthroplasties by Health Board of residence

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	691	684	702	46	44	36
Borders	207	189	210	11	10	12
Dumfries & Galloway	239	279	261	18	12	13
Fife	574	497	487	44	42	46
Forth Valley	465	476	546	25	34	27
Grampian	691	654	583	42	46	29
GG&C	1431	1370	1206	87	74	75
Highland	493	564	602	25	34	32
Lanarkshire	997	1043	945	60	61	62
Lothian	1132	1197	1098	61	67	80
Orkney	38	34	26	3	5	2
Shetland	46	51	43	4	2	4
Tayside	564	479	500	40	33	36
Western Isles	70	85	61	4	4	9
England/Wales/NI	9	9	7	1	0	0
Unknown	4	0	2	0	0	0
Outside UK	3	1	3	0	0	0
Total	**7650**	**7612**	**7282**	**468**	**468**	**463**

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

Table 1h — Number of shoulder arthroplasties by Health Board of residence

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	62	55	42	7	6	7
Borders	9	9	11	0	0	1
Dumfries & Galloway	23	23	25	1	1	2
Fife	22	26	24	1	4	1
Forth Valley	24	21	20	2	3	1
Grampian	48	54	59	6	6	5
GG&C	92	109	114	9	7	6
Highland	32	29	24	3	3	5
Lanarkshire	31	33	42	2	3	5
Lothian	63	49	54	3	7	5
Orkney	4	3	2	0	0	0
Shetland	2	5	3	0	0	0
Tayside	31	28	28	3	2	4
Western Isles	9	4	8	1	0	0
England/Wales/NI	2	1	2	0	0	0
Unknown	0	0	0	0	0	0
Outside UK	0	0	0	0	0	0
Total	**454**	**449**	**458**	**35**	**42**	**42**

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

Table 1i — Number of elbow arthroplasties by Health Board of residence

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	7	7	5	0	0	1
Borders	2	1	1	0	0	0
Dumfries & Galloway	1	1	0	1	0	1
Fife	3	1	2	1	1	1
Forth Valley	2	3	2	1	0	1
Grampian	7	6	3	1	2	1
GG&C	9	6	7	2	1	0
Highland	3	1	1	1	0	1
Lanarkshire	5	2	4	2	0	0
Lothian	14	11	14	3	6	1
Orkney	0	0	0	0	0	0
Shetland	0	0	0	0	0	0
Tayside	6	5	10	1	0	2
Western Isles	0	0	0	0	0	0
England/Wales/NI	0	0	0	0	0	0
Unknown	0	0	0	0	0	0
Outside UK	0	0	0	0	0	0
Total	**58**	**44**	**49**	**12**	**10**	**9**

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

Table 1j — Number of ankle arthroplasties by Health Board of residence

NHS Board	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of revisions 2012-2015	Number of revisions 2016	Number of revisions 2017
Ayrshire & Arran	4	2	8	1	1	2
Borders	2	2	1	1	0	0
Dumfries & Galloway	2	2	1	0	1	2
Fife	5	3	4	1	0	0
Forth Valley	1	2	7	0	0	0
Grampian	1	1		0	0	0
GG&C	12	18	22	2	0	1
Highland	3	5	6	1	1	1
Lanarkshire	10	19	9	3	6	3
Lothian	17	18	36	2	1	2
Orkney	0	0	0	0	0	0
Shetland	0	0	0	0	0	0
Tayside	2	2	6	0	1	0
Western Isles	1	0	1	0	1	0
England/Wales/NI	0	0	0	1	0	0
Unknown	0	0	0	0	0	0
Outside UK	0	0	0	0	0	0
Total	**56**	**74**	**101**	**9**	**12**	**11**

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

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 gives data on the total number of arthroplasties performed and the number of consultants recorded over the same time period that have performed at least one procedure. For joint replacements performed at low volumes it can be seen that there is an increasing trend for multiple surgeons to perform low volumes of these operations, however the issue of low annual numbers of joint replacement for an individual consultant is not limited to arthroplasties performed in low volumes.

The issue of low volume arthroplasty surgery is dealt with separately in Section 1.3.

Table 2 — Number of arthroplasties and operative consultants in 2016 and 2017

	Mean number of operations 2012-2015	Number of operations 2016	Number of operations 2017	Mean number of consultants performing operations 2012-2015	Number of consultants performing operations 2016	Number of consultants performing operations 2017
Hip arthroplasty	7743	7893	7786	227	226	233
Hip revision	899	786	777	147	140	135
Knee arthroplasty	7650	7612	7282	200	189	190
Knee revision	468	468	463	100	93	96
Shoulder arthroplasty	454	449	458	91	88	90
Shoulder revision	35	42	42	19	20	25
Elbow arthroplasty	58	44	49	24	16	20
Elbow revision	12	10	9	7	4	8
Ankle arthroplasty	56	74	101	11	11	9
Ankle revision	9	12	11	4	4	7
Wrist arthroplasty	16	9	1	8	8	1
Wrist revision	3	1	0	2	1	0
Radial head replacement	41	53	48	28	42	30
Radial head revision	2	2	1	2	2	1
Finger arthroplasty	72	80	85	19	21	23
Finger revision	4	5	4	4	4	4
Thumb arthroplasty	43	36	30	13	5	8
Thumb revision	0	0	0	0	0	0
Toe arthroplasty	26	11	16	13	9	8
Excision*	339	428	380	118	125	117
Resurf. Of Patella*	37	44	43	23	27	25
Other knee resurfacing*	22	44	38	14	23	16
Other resurfacing*	11	1	9	8	1	6
Other	83	55	53	51	42	36
Total	**18079**	**18159**	**17686**	**1130**	**1101**	**1088**

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

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

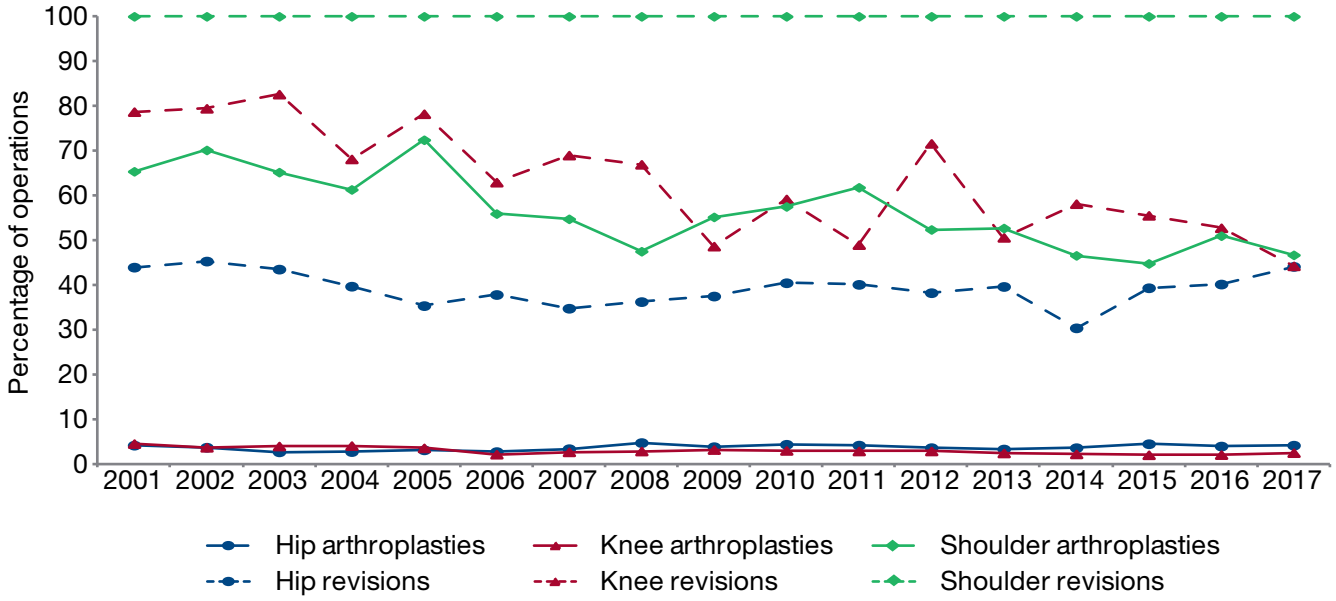
1.3 Consultants performing low volumes

Evidence continues to emerge, including from registry data, that low volume surgeons performing procedures are associated with poorer outcomes. At the 7th International Society of Arthroplasty Registries Congress (Reykjavik, 2018) there were 2 presentations that highlighted the issue. Data from the National Joint Registry of England, Wales, Northern Ireland and the Isle of Man was presented showing a strong volume association related to failure of primary total hip replacement.[1] Similarly, data from Sweden demonstrated a reduction in adverse events within 90 days of primary hip replacement with increasing numbers of primary hips performed.[2]

We believe that it is important to continue to present data from Scotland that looks at surgeon/hospital volume.

Figure 3 demonstrates a downward trend in low volume operators performing primary shoulder replacements and knee revisions, but not for other joints. Again, it is noteworthy that all shoulder joint revisions are performed by surgeons doing less than 10 per annum.

Figure 3 — Recent trends in operations carried out by low-volume operators (i.e. surgeons who perform such operations <=10 times in the calendar year)



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

Table 3a demonstrates that 40.3% of surgeons performing primary hip replacement in Scotland do less than ten per annum and contribute to only 4.2% of the hips done in Scotland (327 hips).

Table 3a — The number and percentage of hip arthroplasties by surgeon and performance activity 2013-2017

Year	Total number of hip arthroplasties	Total number of surgeons	Percentage of surgeons performing <=10 operations per year	Percentage of operations by surgeons performing <=10 operations per year	Percentage of surgeons performing 11-30 operations per year	Percentage of operations by surgeons performing 11-30 operations per year	Percentage of surgeons performing 31-50 operations per year	Percentage of operations by surgeons performing 31-50 operations per year	Percentage of surgeons performing 51-80 operations per year	Percentage of operations by surgeons performing 51-80 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
2013	7666	217	35.9%	3.4%	21.2%	11.8%	17.5%	19.3%	11.5%	21.0%	5.1%	12.6%	8.8%	31.9%
2014	7823	232	36.6%	3.7%	27.2%	15.9%	12.1%	14.0%	10.8%	21.2%	6.5%	17.1%	6.9%	28.2%
2015	7972	231	39.8%	4.5%	19.5%	11.3%	17.7%	20.8%	11.7%	23.0%	4.3%	10.9%	6.9%	29.6%
2016	7893	226	39.4%	4.0%	16.4%	9.0%	18.6%	21.2%	11.5%	20.7%	6.2%	15.6%	8.0%	29.4%
2017	7786	233	40.3%	4.2%	18.0%	10.9%	15.5%	17.8%	14.6%	27.7%	4.7%	12.7%	6.9%	26.7%

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

Table 3b demonstrates that the issue is less marked in primary knee replacement with 21.1% of surgeons performing less than 10 per annum with a downward trend over the last 5 years (24.5% in 2013).

Table 3b — The number and percentage of knee arthroplasties by surgeon and performance activity 2013-2017

Year	Total number of knee arthroplasties	Total number of surgeons	Percentage of surgeons performing <=10 operations per year	Percentage of operations by surgeons performing <=10 operations per year	Percentage of surgeons performing 11-30 operations per year	Percentage of operations by surgeons performing 11-30 operations per year	Percentage of surgeons performing 31-50 operations per year	Percentage of operations by surgeons performing 31-50 operations per year	Percentage of surgeons performing 51-80 operations per year	Percentage of operations by surgeons performing 51-80 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
2013	7227	196	24.5%	2.5%	29.6%	16.7%	19.9%	21.0%	13.3%	23.2%	7.1%	17.4%	5.6%	19.2%
2014	7889	201	21.9%	2.3%	31.3%	16.6%	19.4%	20.0%	13.9%	22.1%	6.0%	13.7%	7.5%	25.3%
2015	7936	195	19.5%	2.1%	30.3%	15.5%	22.1%	21.2%	14.4%	21.7%	6.2%	13.3%	7.7%	26.2%
2016	7612	189	19.6%	2.1%	32.8%	17.6%	18.5%	18.5%	16.9%	27.3%	5.8%	12.4%	6.3%	22.1%
2017	7282	190	21.1%	2.6%	31.6%	18.6%	22.6%	23.4%	14.7%	24.6%	4.2%	10.4%	5.8%	20.6%

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

Table 3c demonstrates that 90 surgeons in Scotland who perform shoulder arthroplasty do only 458 shoulder replacements between them. Only 16.7 % of surgeons doing this operation do between 11 and 30 procedures and nobody does more than 30.

Table 3c — The number and percentage of shoulder arthroplasties by surgeon and performance activity 2013-2017

Year	Total number of shoulder arthroplasties	Total number of surgeons	Percentage of surgeons performing <=10 operations per year	Percentage of operations by surgeons performing <=10 operations per year	Percentage of surgeons performing 11-30 operations per year	Percentage of operations by surgeons performing 11-30 operations per year	Percentage of surgeons performing 31-50 operations per year	Percentage of operations by surgeons performing 31-50 operations per year	Percentage of surgeons performing 51-80 operations per year	Percentage of operations by surgeons performing 51-80 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
2013	442	85	87.1%	52.7%	11.8%	38.2%	1.2%	9.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2014	472	95	85.3%	46.6%	12.6%	38.8%	2.1%	14.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2015	462	91	85.7%	44.8%	12.1%	40.5%	2.2%	14.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2016	449	88	86.4%	51.0%	13.6%	49.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2017	458	90	83.3%	46.7%	16.7%	53.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

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

Table 3d shows that while there may be a downward trend in the number of surgeons performing any revision hip replacements, of those that do, the majority are low volume surgeons doing less than 10.

Table 3d — The number and percentage of hip revisions by surgeon and performance activity 2013-2017

Year	Total number of hip revisions	Total number of surgeons	Percentage of surgeons performing <=10 operations per year	Percentage of operations by surgeons performing <=10 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of operations by surgeons performing 11-20 operations per year	Percentage of surgeons performing 21-80 operations per year	Percentage of operations by surgeons performing 21-80 operations per year
2013	963	152	80.9%	39.7%	11.2%	26.5%	7.9%	33.9%
2014	848	138	78.3%	30.4%	15.9%	40.9%	5.8%	28.7%
2015	833	148	82.4%	39.4%	12.2%	32.9%	5.4%	27.7%
2016	786	140	81.4%	40.2%	12.1%	29.6%	6.4%	30.2%
2017	777	135	82.2%	44.1%	12.6%	31.1%	5.2%	24.7%

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

Table 3e demonstrates that 96 surgeons did 463 revision knee replacements with only 14.6% of surgeons being high volume (more than 10 knee revisions).

Table 3e — The number and percentage of knee revisions by surgeon and performance activity 2013-2017

Year	Total number of knee revisions	Total number of surgeons	Percentage of surgeons performing <=10 operations per year	Percentage of operations by surgeons performing <=10 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of operations by surgeons performing 11-20 operations per year	Percentage of surgeons performing 21-80 operations per year	Percentage of operations by surgeons performing 21-80 operations per year
2013	472	103	84.5%	50.6%	12.6%	34.5%	2.9%	14.8%
2014	478	101	88.1%	58.2%	9.9%	31.6%	2.0%	10.3%
2015	477	94	87.2%	55.6%	11.7%	37.3%	1.1%	7.1%
2016	468	93	86.0%	52.8%	9.7%	28.4%	4.3%	18.8%
2017	463	96	85.4%	44.3%	11.5%	36.9%	3.1%	18.8%

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

Table 3f shows that 25 surgeons performed 42 revision shoulder procedures.

Table 3f — The number and percentage of shoulder revisions by surgeon and performance activity 2013-2017

Year	Total number of shoulder revisions	Total number of surgeons	Percentage of surgeons performing <=10 operations per year	Percentage of operations by surgeons performing <=10 operations per year	Percentage of surgeons performing 11-20 operations per year	Percentage of operations by surgeons performing 11-20 operations per year	Percentage of surgeons performing 21-80 operations per year	Percentage of operations by surgeons performing 21-80 operations per year
2013	25	15	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
2014	45	25	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
2015	40	18	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
2016	42	20	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
2017	42	25	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%

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

Map 1 below shows the numbers of surgeons performing low volume arthroplasty surgery by individual hospital and joint for both 2016 and 2017. We have adopted a colour coding for each procedure at each hospital by net difference from 2016 and 2017. We should make it clear that this is **NOT** Scottish Arthroplasty Project data. This is consultants own individual hospital data which we have asked individual consultants to verify and correct in the process. We at the Scottish Arthroplasty Project cannot correct it. Any corrections must be done within each hospital coding department which will then become evident and visible to the Scottish Arthroplasty Project the following month. Whilst going through this process we have had much communication from individual consultants, most of which had been extremely helpful and encouraging. This data should be interpreted with caution - we recognise that there are ongoing coding issues, cases being wrongly attributed to consultants etc. all of which contribute to the picture presented. We have decided to publish the map to provide a reference which is visible and will hopefully change/improve as we move forward with a new process described at the end of this section.

Map 1 provides visual feedback by hospital demonstrating change in the number of low volume surgeons performing joint replacement in comparison to the previous year.

Map 1—Number of low volume surgeons (10 or fewer) by hospital during 2016 and 2017 (caution advised in interpreting data – see text)

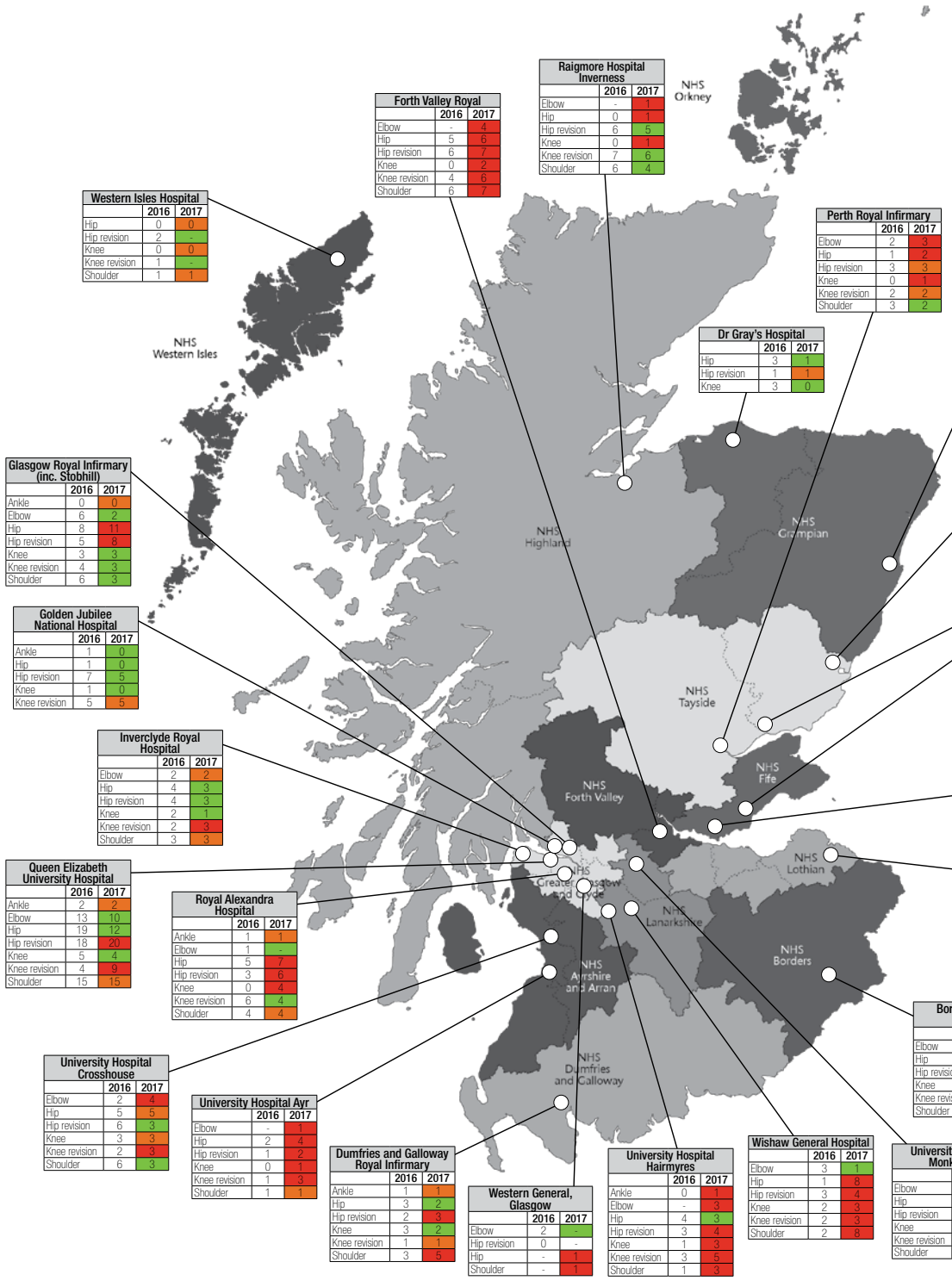
Key

Decrease in number of low volume surgeons from 2016 to 2017

No change in number of low volume surgeons from 2016 to 2017

Incease in number of low volume surgeons from 2016 to 2017

Dash means no operation was performed



Raigmore Hospital Inverness	2016	2017
Elbow	-	1
Hip	0	1
Hip revision	6	5
Knee	0	1
Knee revision	7	6
Shoulder	6	4

Forth Valley Royal	2016	2017
Elbow	-	4
Hip	5	6
Hip revision	6	7
Knee	0	2
Knee revision	4	6
Shoulder	6	7

Western Isles Hospital	2016	2017
Hip	0	0
Hip revision	2	-
Knee	0	0
Knee revision	1	-
Shoulder	1	1

Perth Royal Infirmary	2016	2017
Elbow	2	3
Hip	1	2
Hip revision	3	3
Knee	0	1
Knee revision	2	2
Shoulder	3	2

Aberdeen Royal Infirmary and Woodend General Hospital	2016	2017
Elbow	7	3
Hip	10	8
Hip revision	12	11
Knee	3	4
Knee revision	14	10
Shoulder	7	8

Dr Gray's Hospital	2016	2017
Hip	3	1
Hip revision	1	1
Knee	3	0

Stracathro Hospital	2016	2017
Elbow	-	1
Hip	1	1
Knee	0	0
Knee revision	-	1
Shoulder	2	1

Glasgow Royal Infirmary (inc. Stobhill)	2016	2017
Ankle	0	0
Elbow	6	2
Hip	8	11
Hip revision	5	8
Knee	3	3
Knee revision	4	3
Shoulder	6	3

Ninewells Hospital Dundee	2016	2017
Ankle	1	-
Elbow	4	6
Hip	3	4
Hip revision	8	8
Knee	0	0
Knee revision	4	4
Shoulder	2	3

Golden Jubilee National Hospital	2016	2017
Ankle	1	0
Hip	1	0
Hip revision	7	5
Knee	1	0
Knee revision	5	5

Victoria Hospital, Kirkcaldy	2016	2017
Ankle	1	1
Elbow	2	1
Hip	3	7
Hip revision	5	4
Knee	3	3
Knee revision	7	2
Shoulder	2	3

Inverclyde Royal Hospital	2016	2017
Elbow	2	2
Hip	4	3
Hip revision	4	3
Knee	2	1
Knee revision	2	3
Shoulder	3	3

Queen Margaret Hospital, Dunfermline	2016	2017
Elbow	1	-
Shoulder	0	-

Queen Elizabeth University Hospital	2016	2017
Ankle	2	2
Elbow	13	10
Hip	19	12
Hip revision	18	20
Knee	5	4
Knee revision	4	9
Shoulder	15	15

Royal Alexandra Hospital	2016	2017
Ankle	1	1
Elbow	1	-
Hip	5	7
Hip revision	3	6
Knee	0	4
Knee revision	6	4
Shoulder	4	4

Edinburgh Royal Infirmary	2016	2017
Ankle	1	1
Elbow	8	7
Hip	7	7
Hip revision	11	13
Knee	0	2
Knee revision	10	10
Shoulder	4	2

Borders General Hospital	2016	2017
Elbow	1	-
Hip	4	2
Hip revision	3	3
Knee	4	2
Knee revision	1	3
Shoulder	1	1

University Hospital Crosshouse	2016	2017
Elbow	2	4
Hip	5	5
Hip revision	6	3
Knee	3	3
Knee revision	2	3
Shoulder	6	3

University Hospital Ayr	2016	2017
Elbow	-	1
Hip	2	4
Hip revision	1	2
Knee	0	1
Knee revision	1	3
Shoulder	1	1

Dumfries and Galloway Royal Infirmary	2016	2017
Ankle	1	1
Hip	3	2
Hip revision	2	3
Knee	3	2
Knee revision	1	1
Shoulder	3	5

Western General, Glasgow	2016	2017
Elbow	2	-
Hip revision	0	-
Hip	-	1
Shoulder	-	1

University Hospital Hairmyres	2016	2017
Ankle	0	1
Elbow	-	3
Hip	4	3
Hip revision	3	4
Knee	1	3
Knee revision	3	5
Shoulder	1	3

Wishaw General Hospital	2016	2017
Elbow	3	1
Hip	1	8
Hip revision	3	4
Knee	2	3
Knee revision	2	3
Shoulder	2	8

University Hospital Monklands	2016	2017
Elbow	1	-
Hip	2	-
Hip revision	3	-
Knee	3	-
Knee revision	1	-
Shoulder	2	-

The future

It remains clear that many surgeons in Scotland perform low volumes of joint replacements and much could be done to change this scenario. Publishing this data should highlight this issue in Scotland, much as is happening across other countries, particularly those involved in the International Society of Arthroplasty Registries. We hope this will continue to fuel the debate and where appropriate provide impetus for change/re-organisation.

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, and as such, these operations tend to be generally performed for the elderly population. It is interesting that the mean age for primary hip arthroplasty between 2001 and 2017 has remained relatively static (67.2 and 67.3 years old in 2001 and 2017 respectively). The same cannot be said for primary knee arthroplasty where there has been a decrease in mean age (69.2 and 68.2 in 2001 and 2017 respectively) although this appears to have reached a plateau in the last few years. Back in 2001 there was a difference of 2 years in mean age between those undergoing primary hip and knee replacement procedures however this difference continues to decrease as people are undergoing primary knee procedures earlier in life than that observed previously.

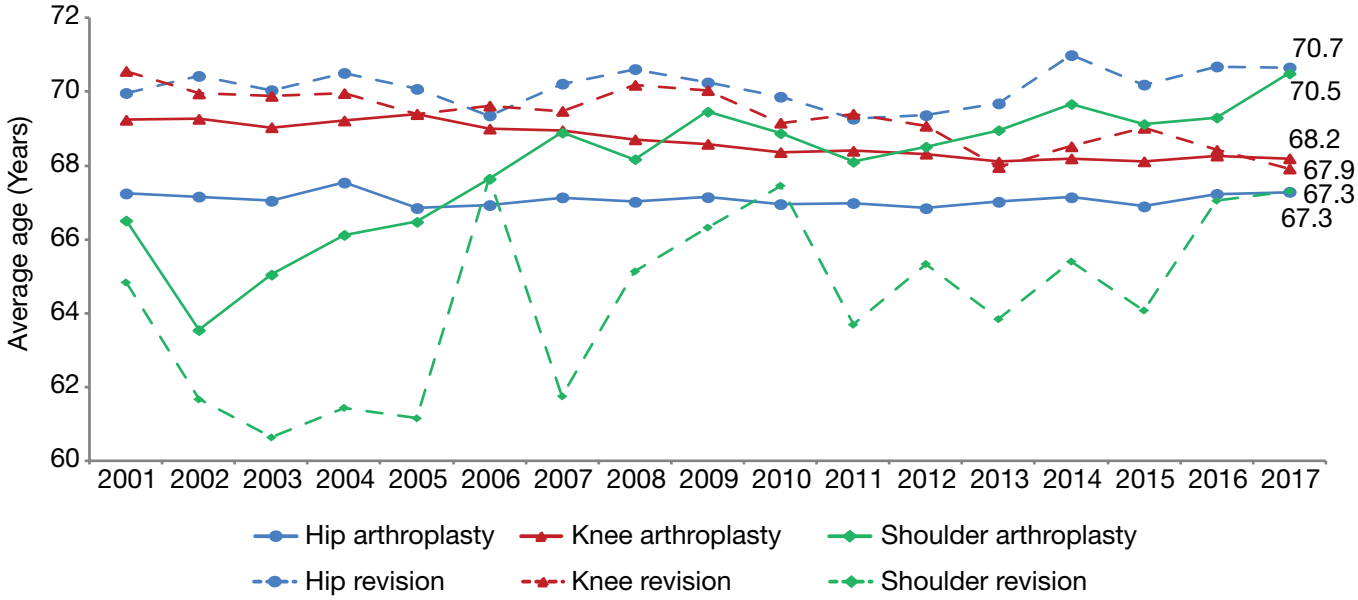
The mean age of patients who had revision hip or revision knee procedures performed show opposite direction of change compared to the primary procedures. This year the mean age for revision hip was 70.7 years and mean age for revision knee was 67.9 years a net difference of 2.8 years in the opposite direction observed in primary hip and primary knee. This year we have also observed (similar to 2013) that the mean age for patients undergoing revision knee surgery is lower than the mean age for patients undergoing a primary knee procedure (primary knee 68.2 years; revision knee 67.9 years). Whilst it is possible that one contributing factor to this in the revision knee group patients are those cases when unicompartmental knee replacements are converted to total knee replacements, but it is also recognised that early failures tends to be more frequent in knee replacements compared to hip replacement (see reports and charts for 3 and 5 years national revision rates for hips and knees – figures 22a DATA and 23a DATA in supplementary tables).

The mean age for those undergoing primary shoulder arthroplasty was 66.5 and 70.5 years old in 2001 and 2017 respectively representing an increase of 4 years. The biggest increase in mean age of 6 years was observed in those undergoing a primary elbow arthroplasty (63.5 and 69.7 years old in 2001 and 2017 respectively). These changes in these 2 groups seem to reflect the general changes in practice over the years.

The mean age for revision shoulder arthroplasty was 64.8 and 67.3 years in 2001 and 2017 respectively. Similarly to previous years, the mean age of patients who undergo revision shoulder replacement is younger than the mean age of patients who have primary shoulder replacements, which may indicate the presence of relatively early postoperative problems that lead to revision surgery in younger patients.

As mentioned in the last 2 reports, recording other demographic data such as body mass index (BMI) would be very useful to include and analyse but this data is still currently unavailable.

Figure 4 — Recent trends in average age of hip, knee and shoulder arthroplasty patients



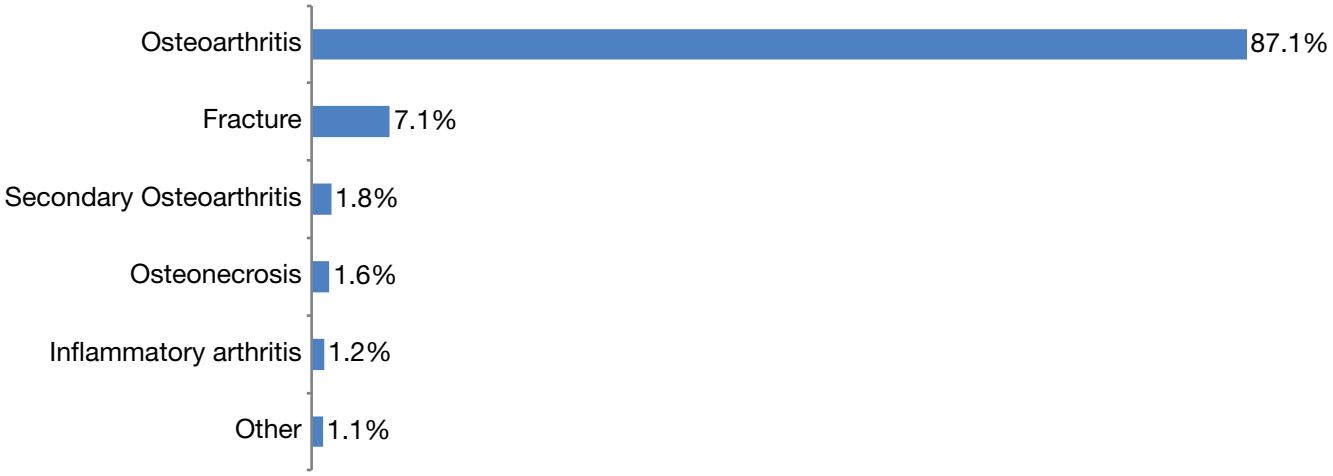
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals

2.2 Indication for surgery

Figure 5a, 5b and 5c give more detailed information on the principal diagnosis/indication for surgery. The 'Other' category for indication accounts for indications with counts of less than 5 which have been aggregated together.

The biggest single indicator for primary procedures across hips, knees and shoulders was osteoarthritis (87.1%, 97.2% and 32.1% for hip, knee and shoulder respectively) – as was similarly the case last year. It is perhaps interesting to see that fracture accounts for 7.1% and 12.4% of primary hip and primary shoulder procedures but only 0.6% of primary knee procedures. It is clear to see that inflammatory arthritis is present across all primary procedures although far more common in primary shoulder procedure at 10.9%.

Figure 5a — Principal pre-operative conditions: primary hip arthroplasties in 2017

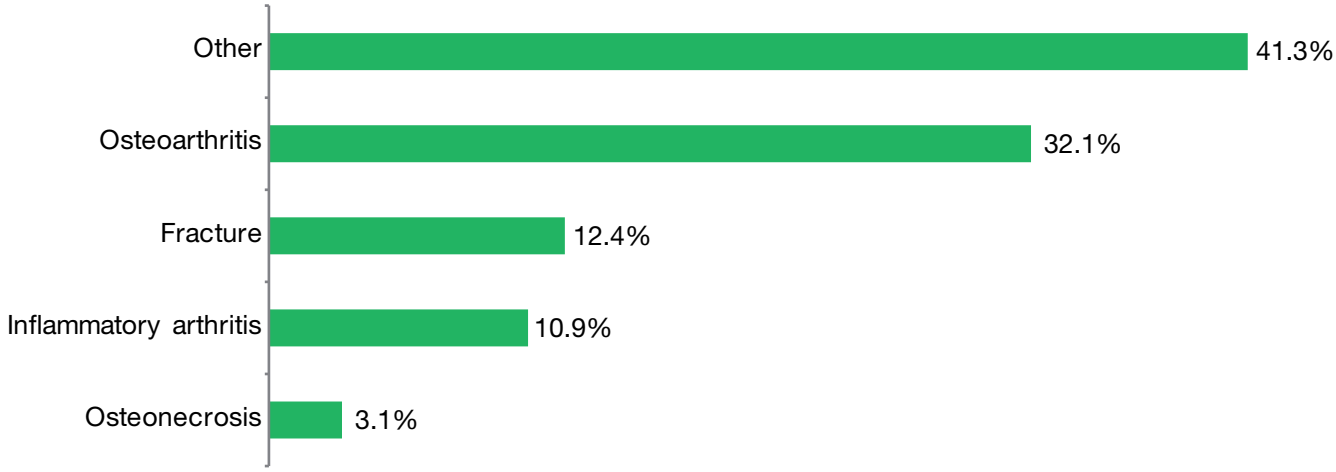


Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 5b — Principal pre-operative conditions: primary knee arthroplasties in 2017

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

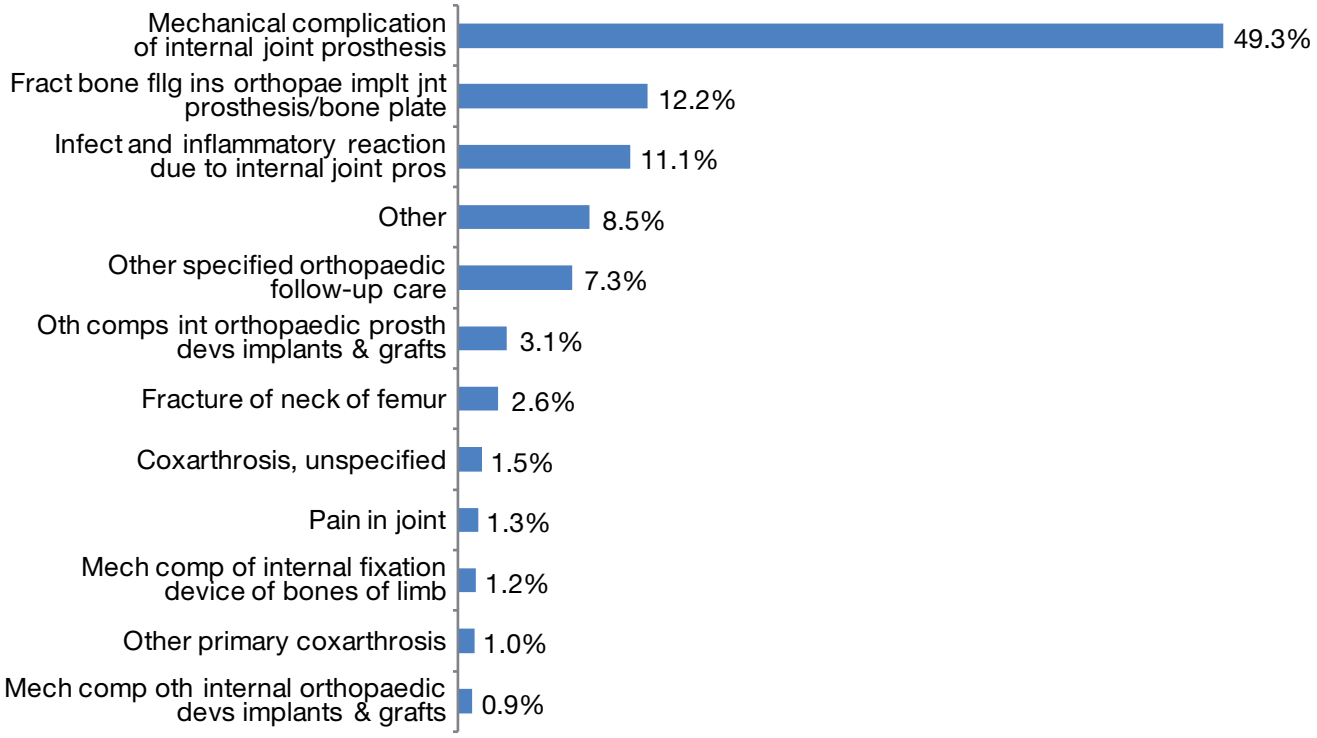
Figure 5c — Principal pre-operative conditions: primary shoulder arthroplasties in 2017



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

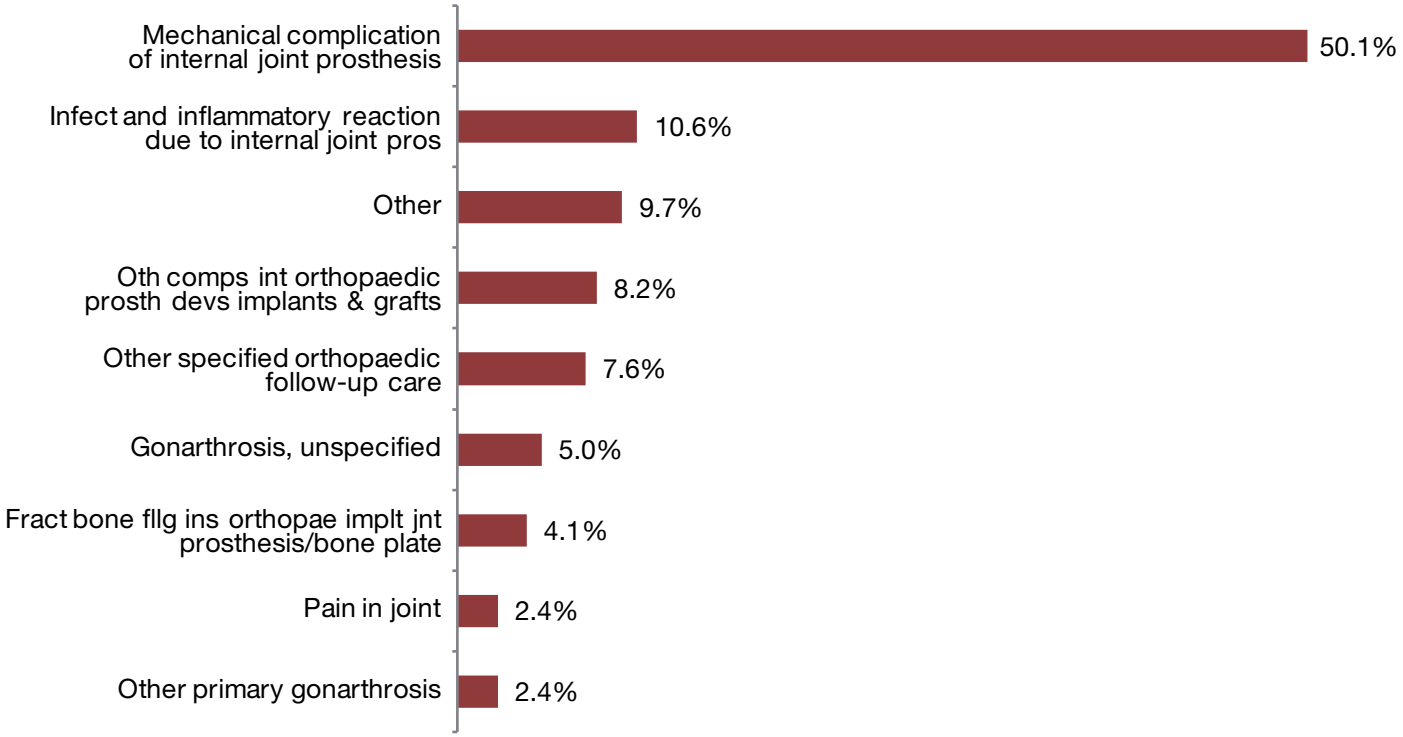
Across revision procedures for hips, knees and shoulders the biggest single indicator was found to be mechanical complications - loosening (49.3%, 50.1% and 52.4% for hip, knee and shoulder respectively). This is in line with previous publications and does not represent a significant shift from last year. It can be seen there are a number of common indications across both revision knees and revision hips such as infections, fractures and pain.

Figure 5d — Principal pre-operative conditions: hip revision in 2017



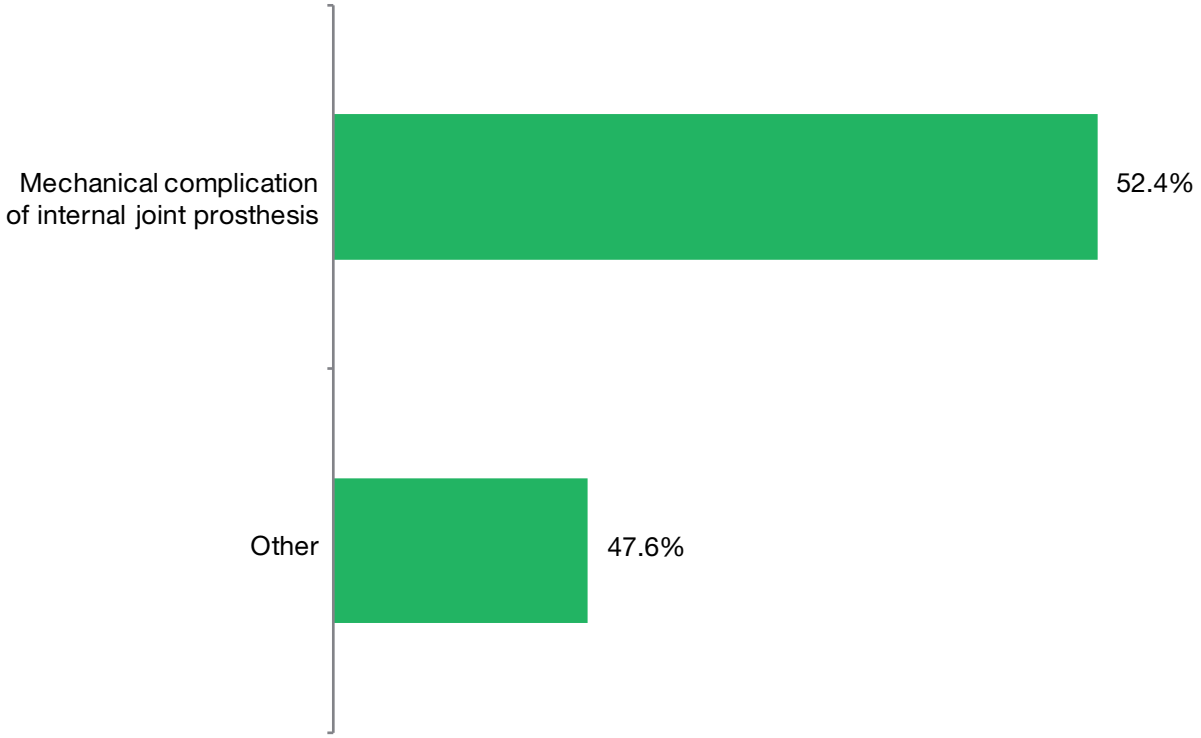
Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.

Figure 5e — Principal pre-operative conditions: knee revisions in 2016



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

Figure 5f — Principal pre-operative conditions: shoulder revisions in 2017



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

As already mentioned in previous Scottish Arthroplasty Project Annual Reports, clinical coding is extracted from local hospital's coding data. This utilises the WHO International Classification of Diseases (ICD-10) coding for indication for surgery and OPCS Classification of Interventions and Procedures (OPCS-4) coding for procedures. Due to the limitations of the available coding system, indications for surgery (especially for revisions) are not coded in such a format and terminology that most surgeons would use or would recognize. There is also an issue with potential errors in the coding especially with revision cases. This area remains particularly challenging and highlights the need for future work including closer local collaboration between surgeons and coders within every hospital. It has also been recognized and identified as an important area for future work for the Scottish Arthroplasty Project. Work is already ongoing involving the Scottish Arthroplasty Project and the recently established Scottish Revision Knee Network to make improvement in this area. It is hoped that we will be able to provide clinically relevant and meaningful indication subcategories both for primary and revision procedures in the near future.

3. Inpatient Episodes

3.1 Length of stay

Inpatient stay for the combined major primary arthroplasty groups has more than halved since 2001, resulting in a very significant reduction in bed days across NHS Scotland. Since 2001 the length of stay for patients undergoing hip and knee arthroplasty alone reduced by 60%, from a mean of 10 days to 4 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.

The variation in length of stay between Health Boards remains a clear anomaly. There is little difference between the figures for hip or knee arthroplasty, and both preoperative and postoperative stays should be considered.

Of the units performing in excess of 150 primary hip arthroplasty procedures each year, the range for preoperative stay varies from zero for North Glasgow region of NHS Greater Glasgow & Clyde to 0.63 days for NHS Grampian. Whilst differences in demographics, and geographical or travel factors, may go some way to explain the variation in preoperative stay, the savings in bed days would be significant if all Health Boards were able to move further to day of surgery admission as the default position. It is notable that the highest average for preoperative stay, 0.63 days for NHS Grampian, has reduced from 0.91 days in the 2017 report, reflecting underlying improvement. The figures for postoperative stay show much less spread across NHS Scotland, with rounded figures ranging between 3-5 days, with an average of about 4 days. The reduction of both the length of postoperative stay and the variability between units demonstrates steady improvement across NHS Scotland.

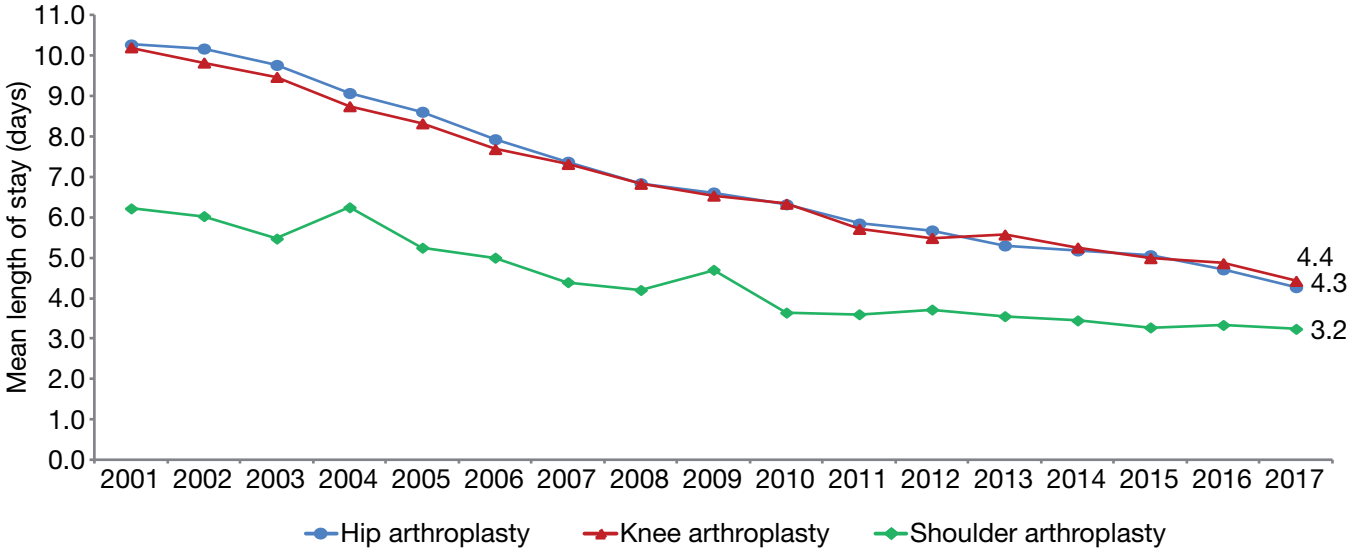
The figures for knee arthroplasty are very similar in range and distribution. There is a range of 0 to 0.6 days preoperative stay for the larger units, with an average of 0.2 days. Again, NHS Grampian is the highest at 0.6 days. Postoperative stay range is from 3.2 - 5.5 days, with an average of 4.4 days, demonstrating less variability, and continuing improvement over the last 10 years.

Of the other arthroplasty groups, shoulder arthroplasty is detailed, showing a reduction in overall inpatient stay compared with the previous report. Preoperative stay averages at 0.2 days, and postoperative stay at 3.3 days. There is wide variability across NHS Scotland, with a range for preoperative stay of 0 to 1 days, and for postoperative stay 1.6 to 5.7 days. Factors to explain this variability include the complex co-morbidities in this patient group and the relatively low numbers for this procedure in some units, along with differences in demographics and geographical spread common to all procedure groups.

As in the previous report, the category of Independent Hospitals is included, and shows a uniformly low total length of stay for both hip and knee replacement.

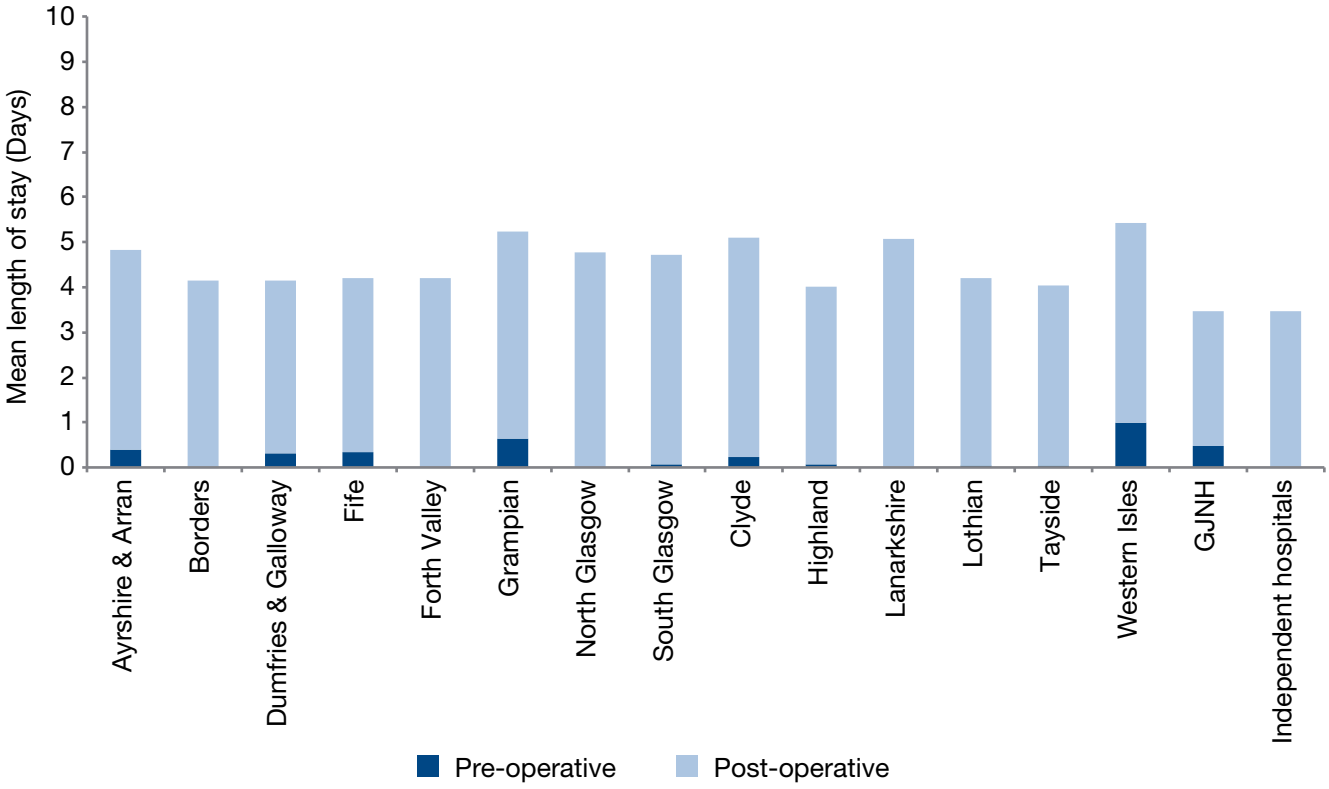
It is noted that most units have shown improvement in this area with a decline in total length of stay for both hip and knee arthroplasty procedures.

Figure 6 — Recent trends in overall length of stay for elective hip, knee and shoulder arthroplasty



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

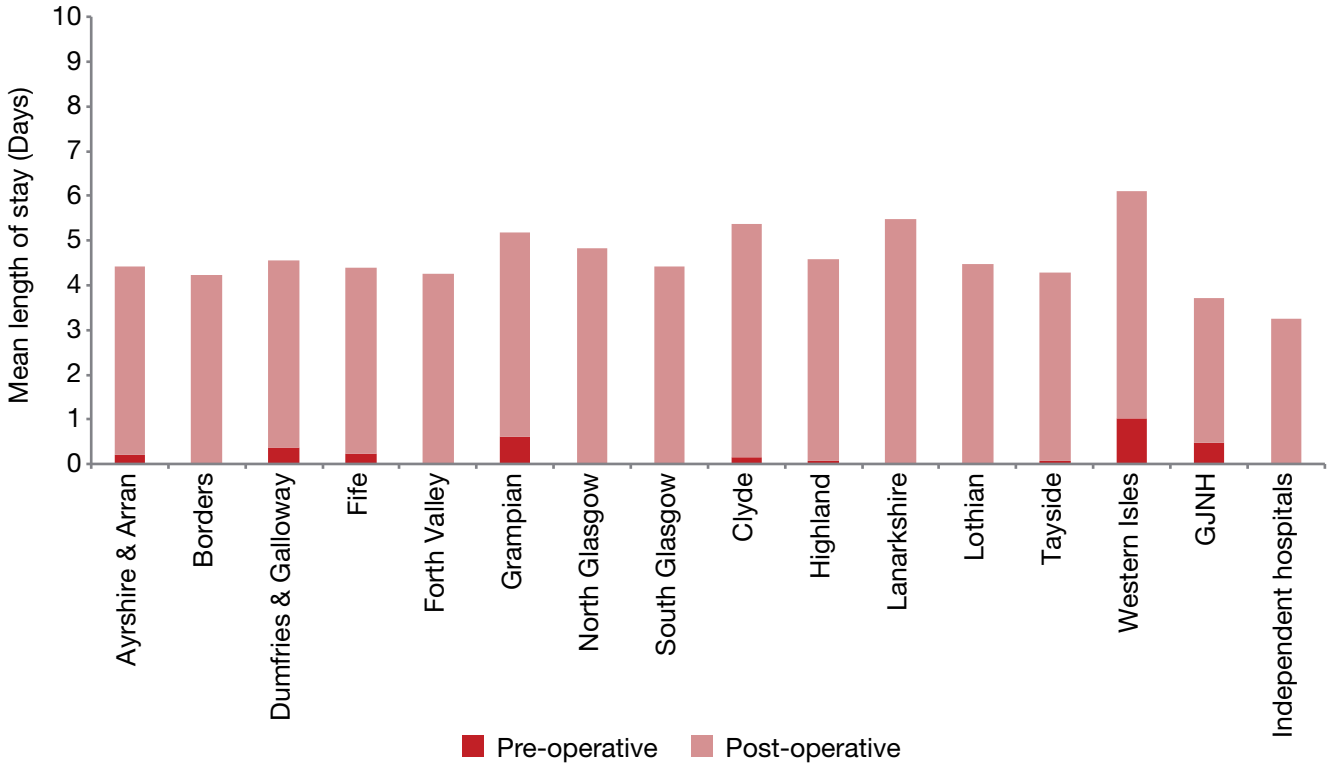
Figure 7a — Mean length of stay for hip arthroplasty in 2017 by Health Board of treatment (NHS GG&C split) (elective patients only)



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.

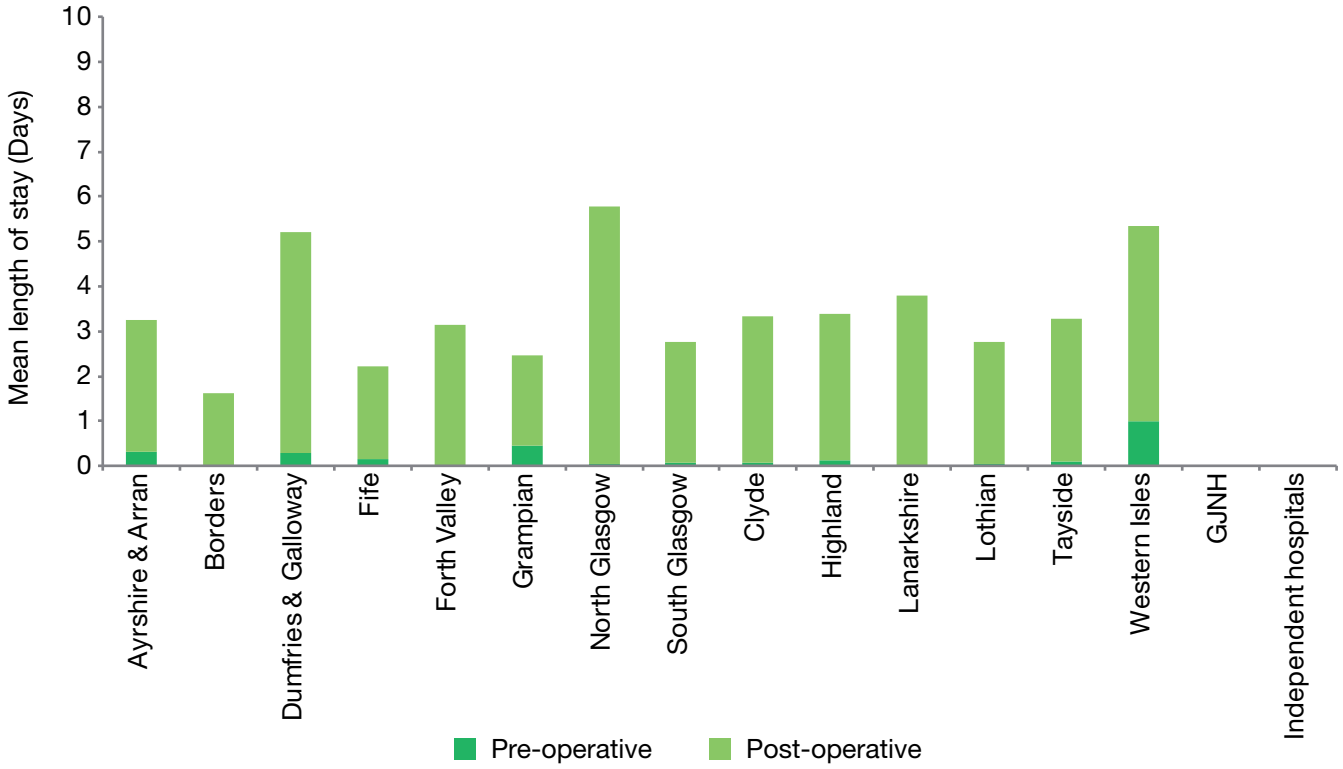
Figure 7b — Mean length of stay for knee arthroplasty in 2017 by Health Board of treatment (NHS GG&C split) (elective patients only)



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.

Figure 7c — Mean length of stay for shoulder arthroplasty in 2017 by NHS board of treatment (NHS GG&C split) (elective patients only)



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.

4. Complications arising from arthroplasty procedures

The major complications covered in this report are:

- Deep Vein Thrombosis/Pulmonary Embolism (DVT/PE)
- Death
- Dislocation of Hip
- Infection
- Acute Myocardial Infarction (AMI)
- Acute Renal Failure
- Cerebrovascular Accident (CVA) or Stroke

Complication rates have been standardised for the type of operation and the report covers the years from 2000-2017.

4.1 National trends

DVT/PE

The national rate for DVT/PE has fallen from 1.4% in 2000 to 0.8% in 2017 for hip arthroplasty. This is shown in Figure 8a and appears to have reached a plateau. The rates are the same for knee arthroplasty in 2017 and again it is good to see the rates reducing.

Death Rate

The rate of death following hip and knee arthroplasty continues to be low at less than 0.5% as in the last report. The rate following hip arthroplasty in 2017 was 0.2% and following knee arthroplasty was 0.2% in 2017. This has fallen since 2000 from 0.8% and 0.6% respectively which is great progress (Figures 8a and 8c).

Dislocation after Hip Arthroplasty

Dislocation within one year of hip arthroplasty has been falling since the beginning of data collection in 2000. The rate of dislocation in 2016 was 0.6% and in 2000 was 1.2%, so the overall trend is continuing to fall which is very pleasing (Figure 8b).

Infection

The rates of infection following hip arthroplasty remain low at less than 1%, but the 2015 figures were the lowest recorded since the beginning of the data collection, at 0.7%. 2017 figures show a slight rise to 0.9% but still under the 1% mark. Following knee arthroplasty, the incidence of infection within a year also remains at less than 1%, and has fallen to the lowest rate recorded of 0.8% in 2016 data, again with a slight rise to 0.9% in 2017. The standardised complication rate in 2000 was 1.4% (Figure 8b).

Acute Myocardial Infarction (AMI)

The rate of AMI after hip and knee arthroplasty remains very low in Scotland and data is comparable to the last report.

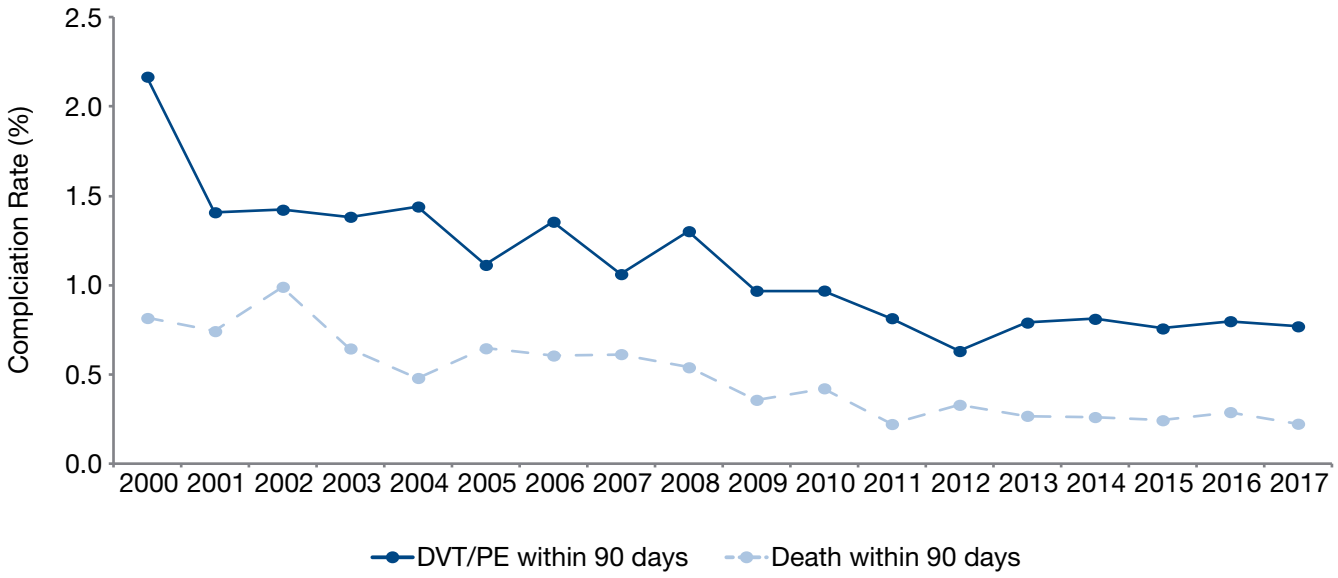
Acute Renal Failure

The last two reports have highlighted the rising incidence of acute renal failure following hip and knee arthroplasty. The national data presented in Figure 8e shows the gradual rise in incidence from 2000, with a definite change from 2009 onwards. Rates are now at around 2% nationally, which is still concerning. There has been a slight fall in the percentage since the last report, so this may be due to an increased awareness and action being taken at Health Board level. Rates for acute renal failure following hip arthroplasty are 2.2% (2.3% in 2016) and following knee arthroplasty are 2.1% (2.4% in 2016). In 2000 the figures were 0.2% and 0.3% respectively.

Cerebrovascular Accident or Stroke

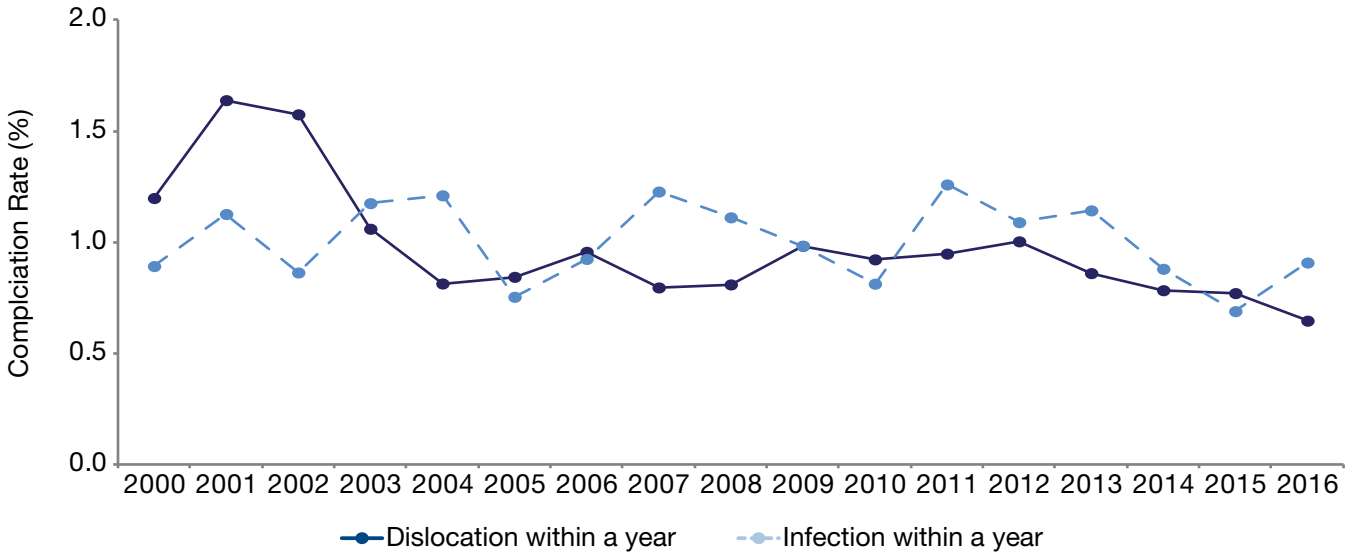
The national average of CVA or stroke following hip and knee arthroplasty remains low at less than 0.4% over the years 2013-2017.

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



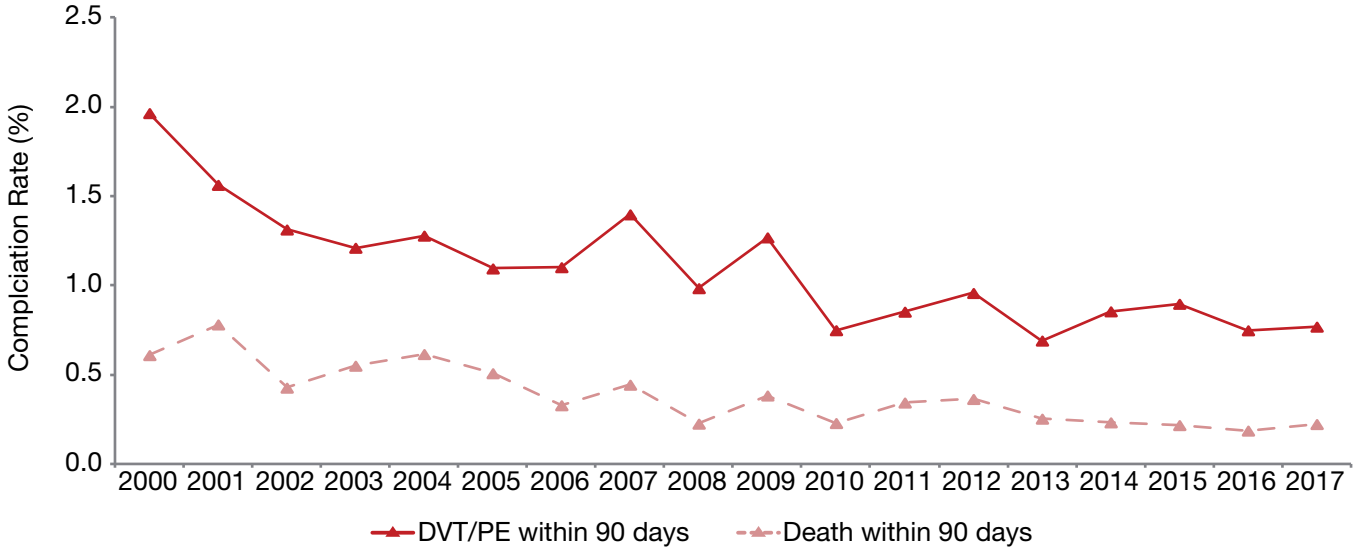
Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

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



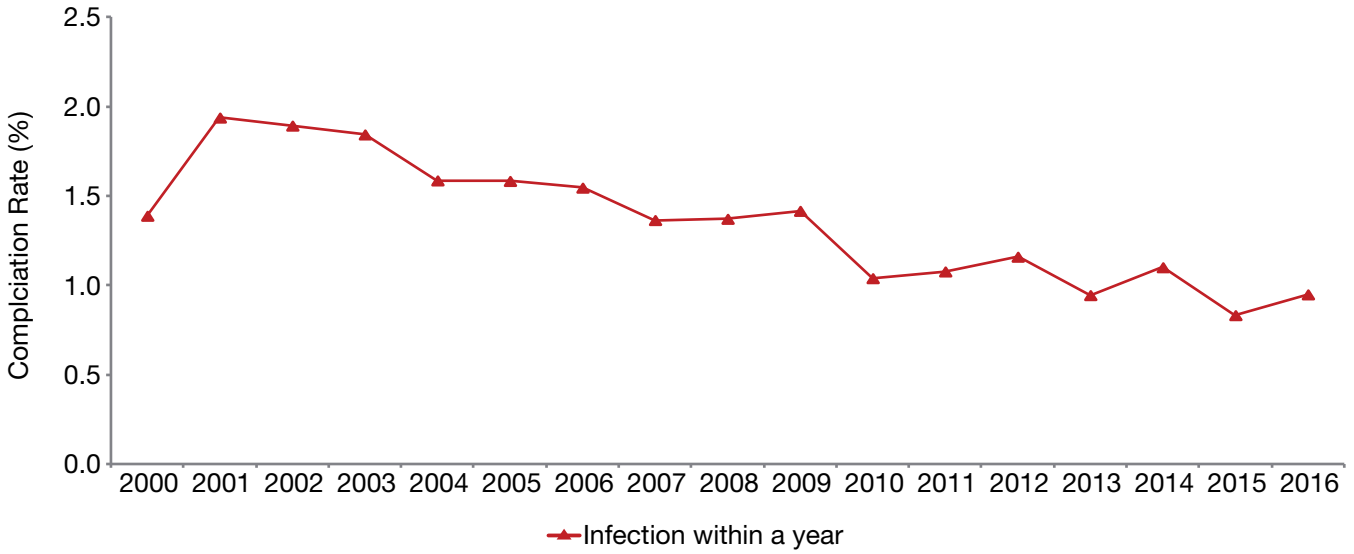
Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

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



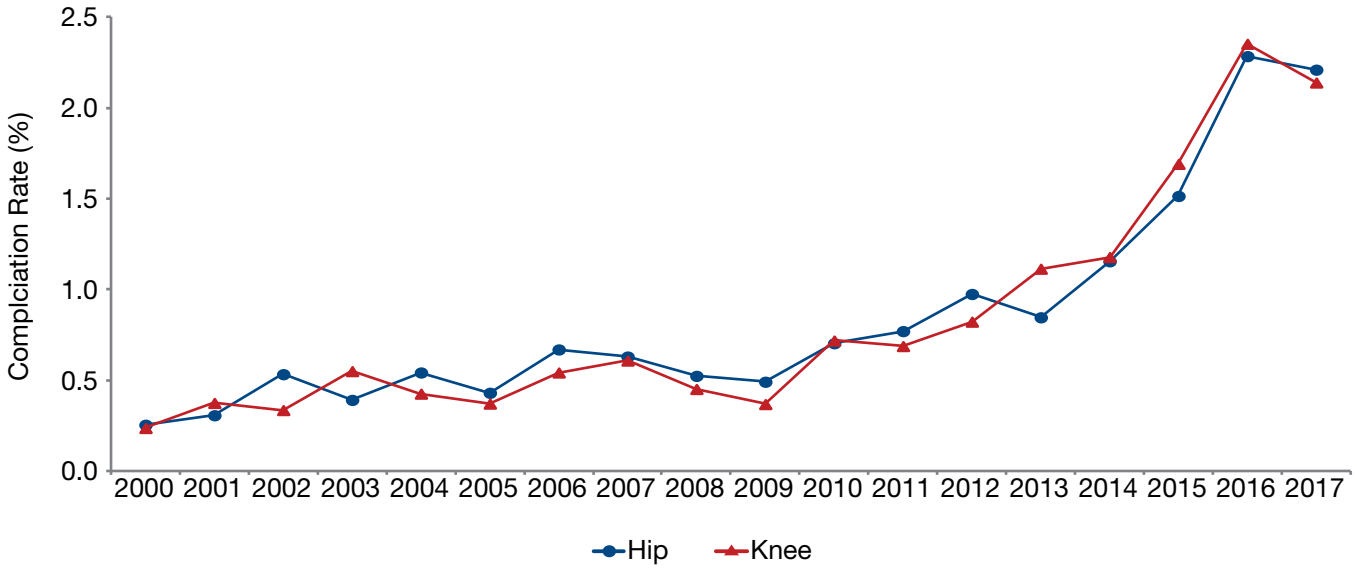
Includes emergency admissions; bilateral operations counted only once; includes known patients from independent hospitals.

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 — National rates for acute renal failure within 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

The following data are presented as funnel charts where the upper confidence limit is shown as an upper curved line on the plot, and this 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 by the health boards concerned.

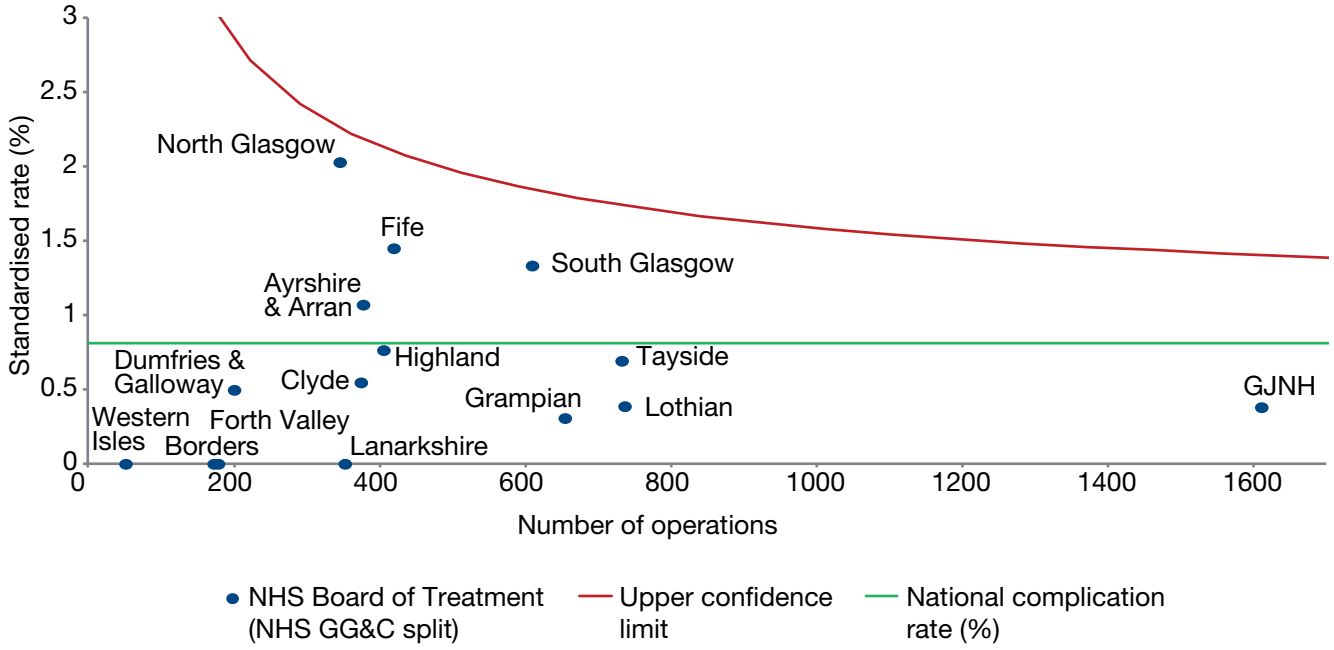
The straight line coloured in green is the national rate (averaged over a period of 5 years) to allow comparisons between centres.

Complications which relate to a one year follow up period are calculated for procedures performed during 2016. Complete data is not currently available to allow complication rates for procedures performed during 2017 to be calculated. For example, an operation performed on 31st December 2017 could have a possible complication recorded up until 31st December 2018.

4.2.1 Dislocation within one year

No Health Boards were outliers for dislocation. The national average rate from 2012 to 2016 was 0.81%.

Figure 9 — Percentage of 2016 primary hip arthroplasty patients with subsequent dislocation within 1 year



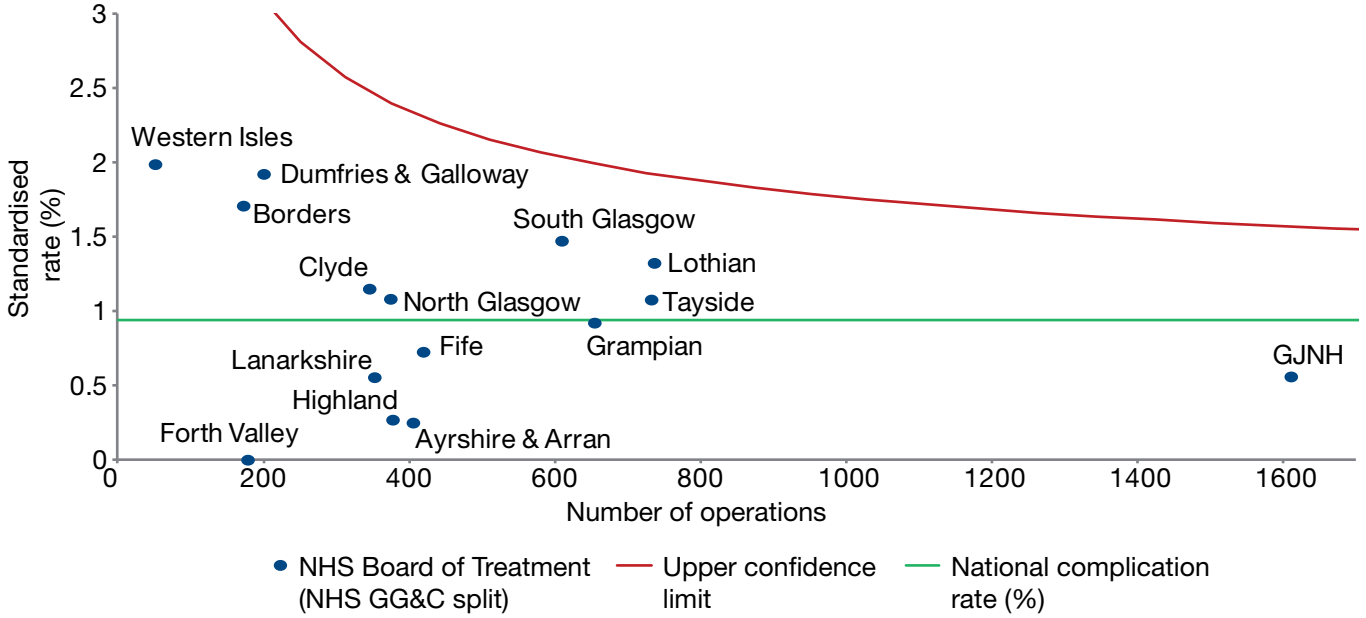
Scottish Rate averaged over 5 years 2012-2016.

4.2.2 Infection within one year

For hip arthroplasty, the national average rate from 2012 to 2016 was 0.94% for which 9 Health Boards were above the national average and 6 below. Infection of primary hip arthroplasty within one year showed no outliers during 2016. This is identical to the last report.

For knee arthroplasty, the national average rate from 2012 to 2016 was 1.00% with 10 Health Boards above the national average and 5 below. Of the Health Boards above the national average rate 1 Health Board was found to be an outlier for infection following primary knee arthroplasty.

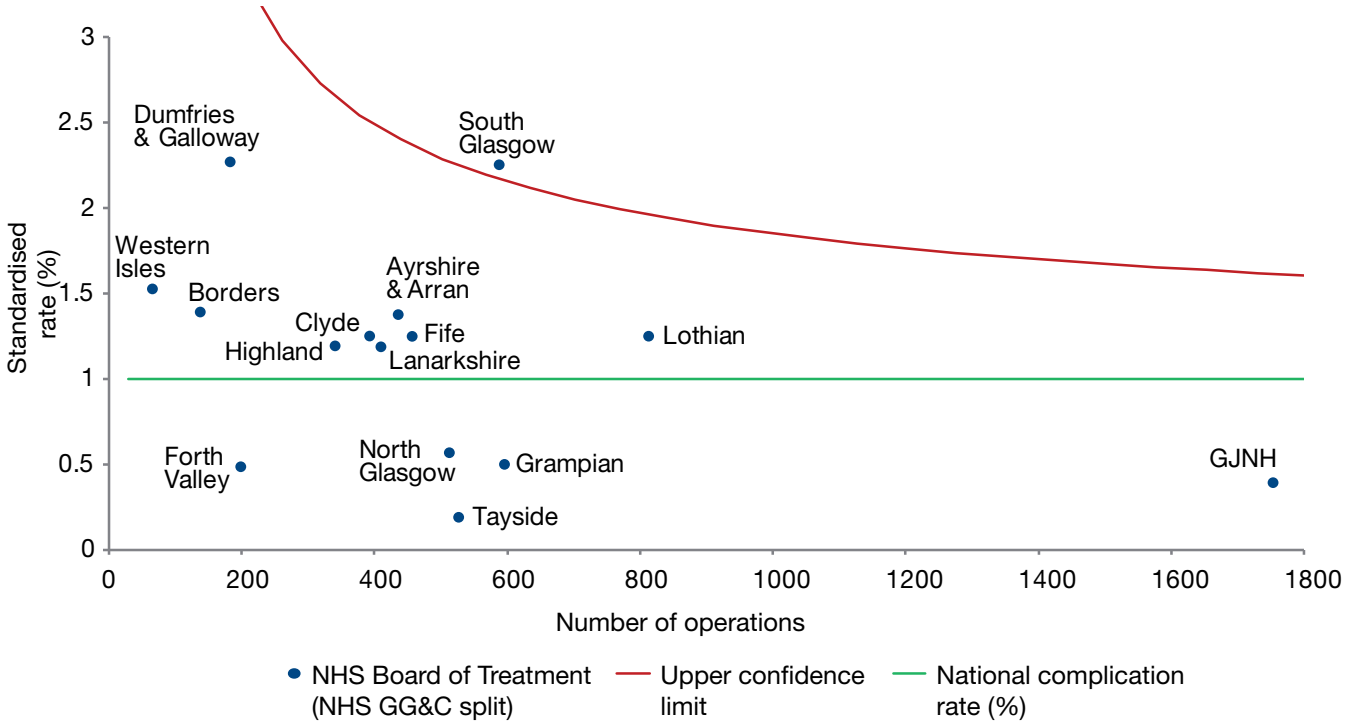
Figure 10 — Percentage of 2016 primary hip arthroplasty patients with subsequent infection within 1 year



Scottish Rate averaged over 5 years 2012-2016.

There was one outlying NHS Board for infection after primary knee arthroplasty. Ten boards were above the national average and six below. There was clustering around the national average.

Figure 11 — Percentage of 2016 primary knee arthroplasty patients with subsequent infection within 1 year

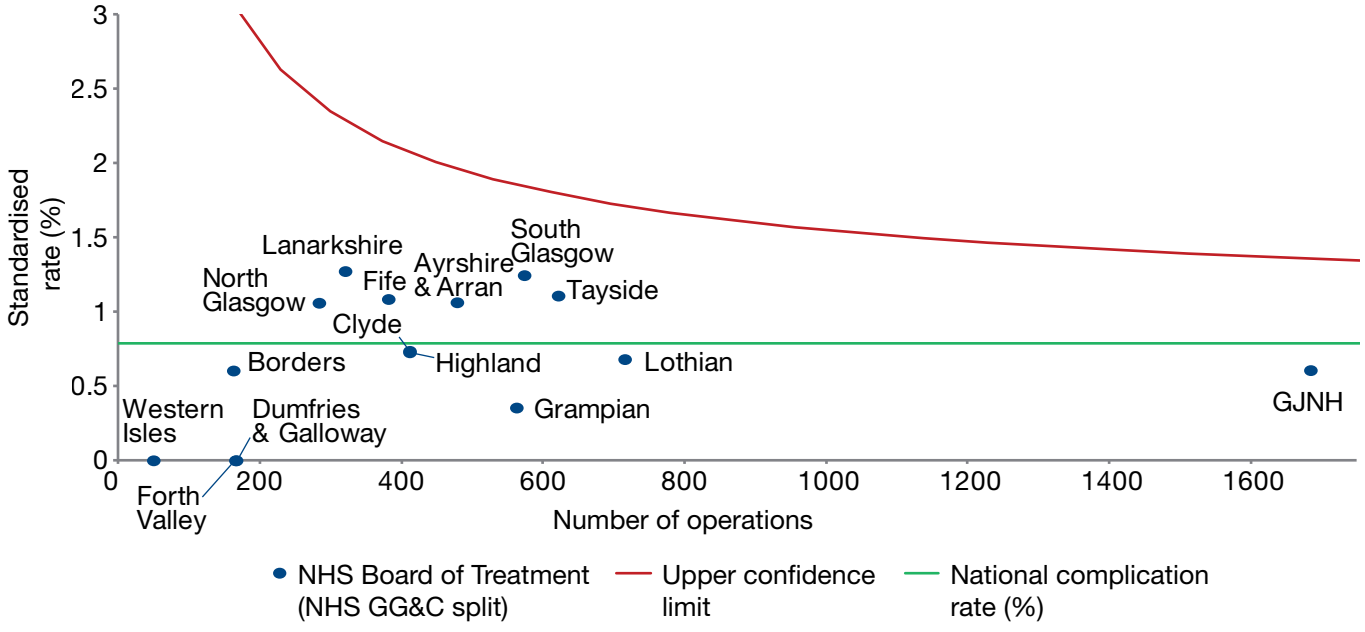


Scottish Rate averaged over 5 years 2012-2016.

4.2.3 Deep vein thrombosis/pulmonary embolism (DVT/PE) within 90 days

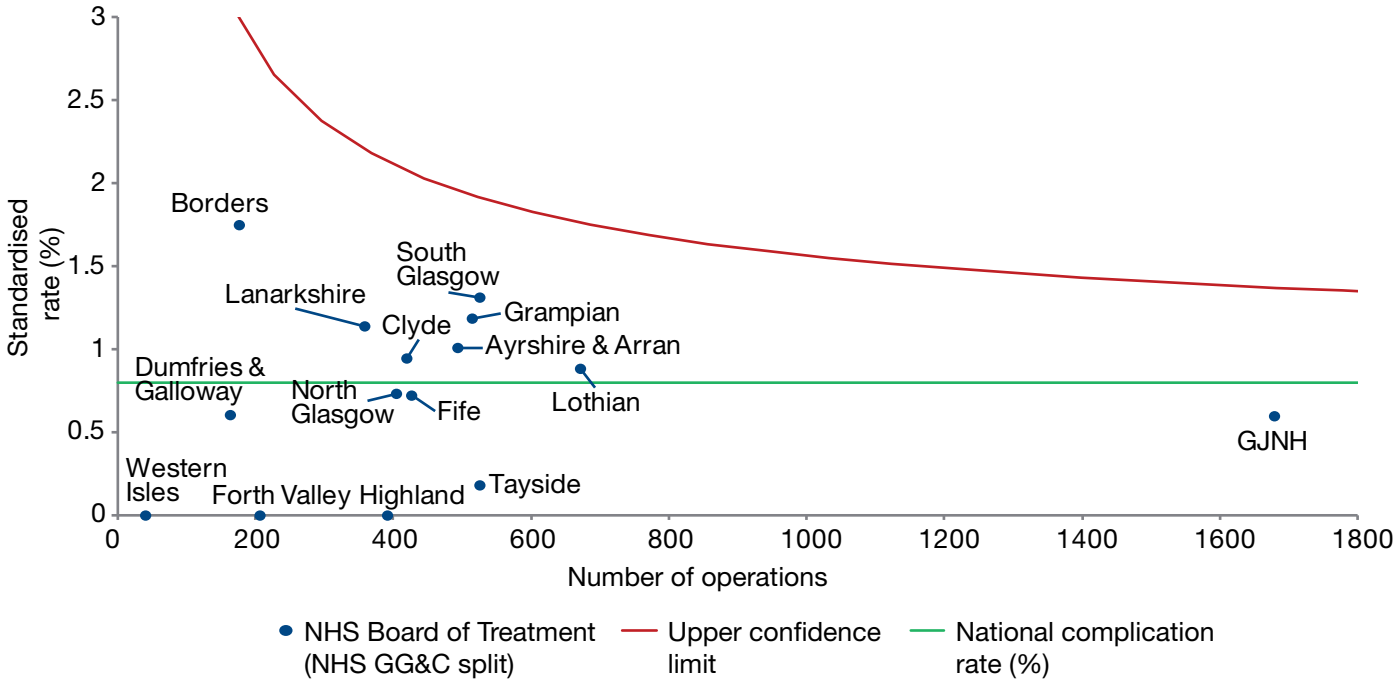
The national average rate from 2013 to 2017 was 0.79% for hip and knee arthroplasty. For primary hip arthroplasty, 6 Health Boards were above the national average, but clustered away from the upper confidence limit with no outliers – similar to what we reported last year. Likewise for primary knee arthroplasty, 8 Health Boards have complication rates above the national average with no outliers.

Figure 12 — Percentage of 2017 primary hip arthroplasty patients with subsequent DVT/PE within 90 days



Scottish Rate averaged over 5 years 2013-2017.

Figure 13 — Percentage of 2017 primary knee arthroplasty patients with subsequent DVT/PE within 90 days

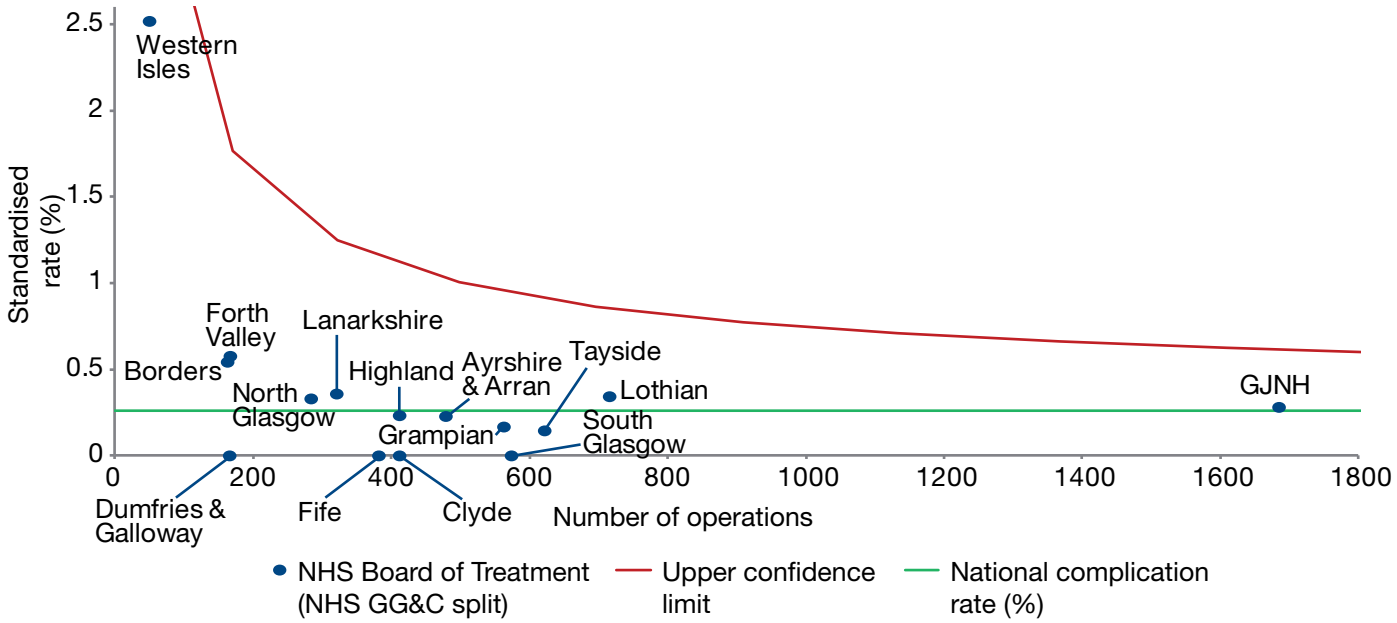


Scottish Rate averaged over 5 years 2013-2017.

4.2.4 Death within 90 days

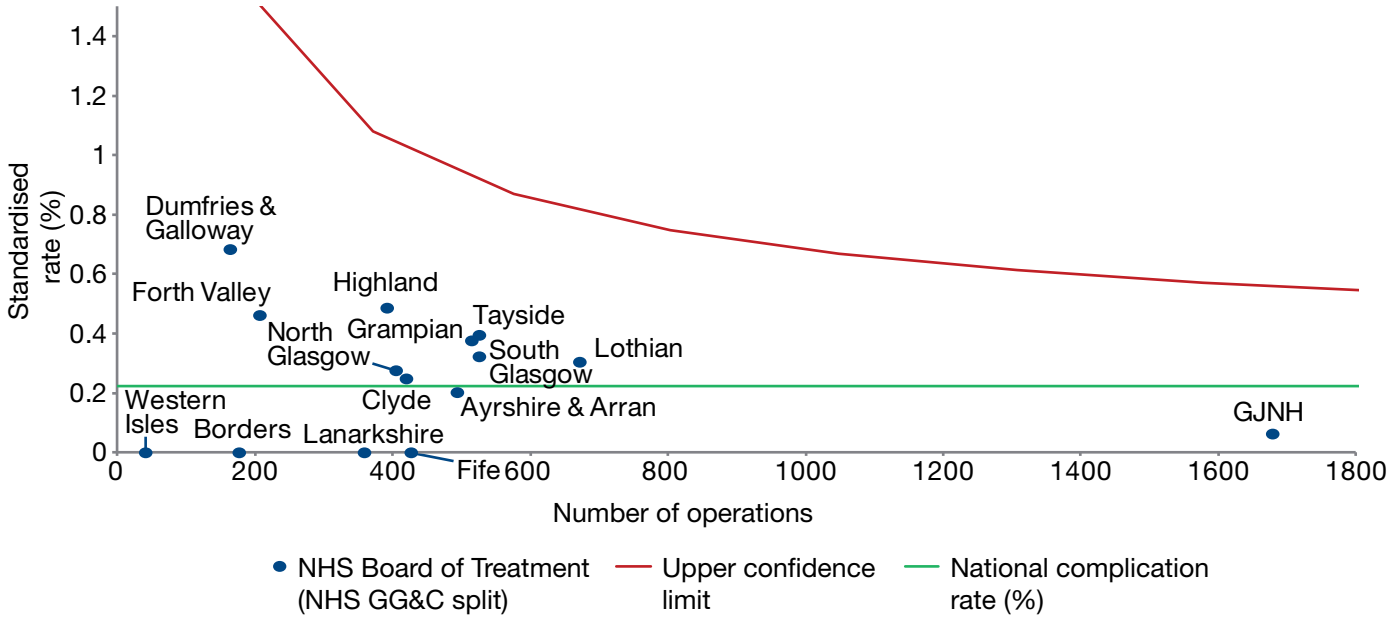
Rates remain low with an average from 2013 to 2017 of 0.26% and 0.22% for primary hip and primary knee arthroplasty respectively. For primary hip arthroplasty, there were 7 Health Boards above the national average rate but remain sufficiently far away from the upper confidence limit. Similarly, for primary knee arthroplasty, there were 9 Health Boards with above the average rate but no outliers.

Figure 14 — Percentage of 2017 primary hip arthroplasty patients who died within 90 days



Scottish Rate averaged over 5 years 2013-2017.

Figure 15 — Percentage of 2017 primary knee arthroplasty patients who died within 90 days

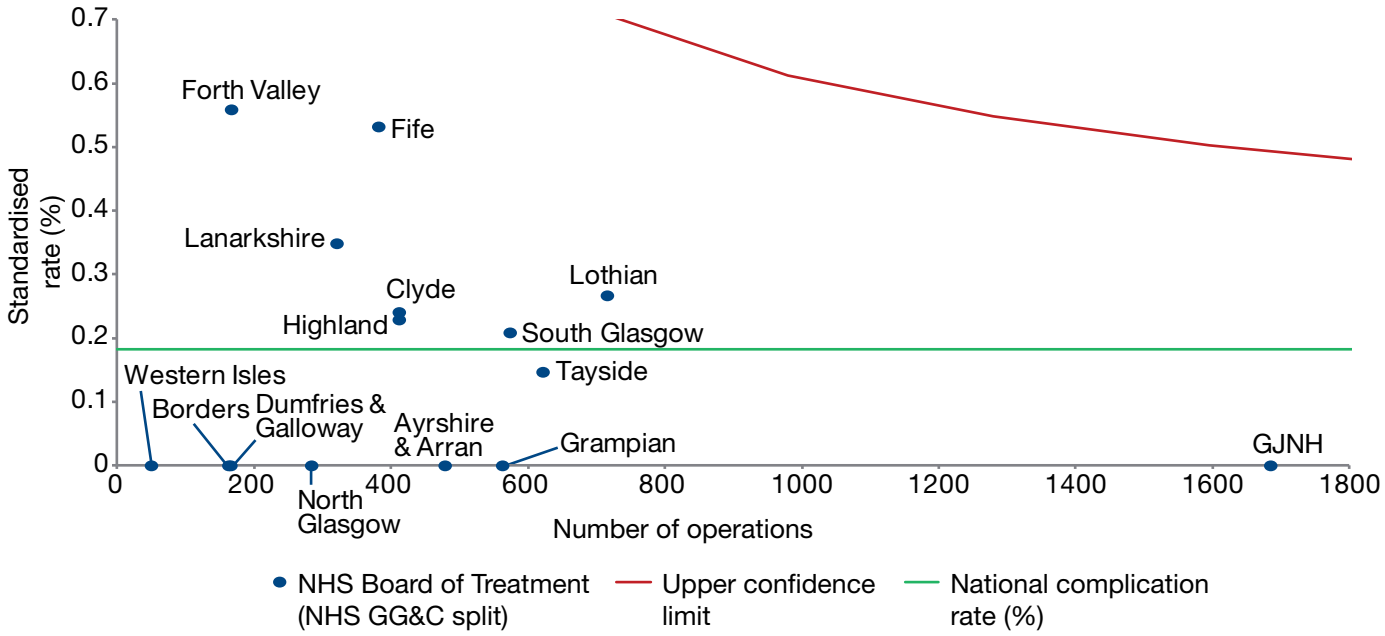


Scottish Rate averaged over 5 years 2013-2017.

4.2.5 Acute Myocardial Infarction (AMI) within 30 days

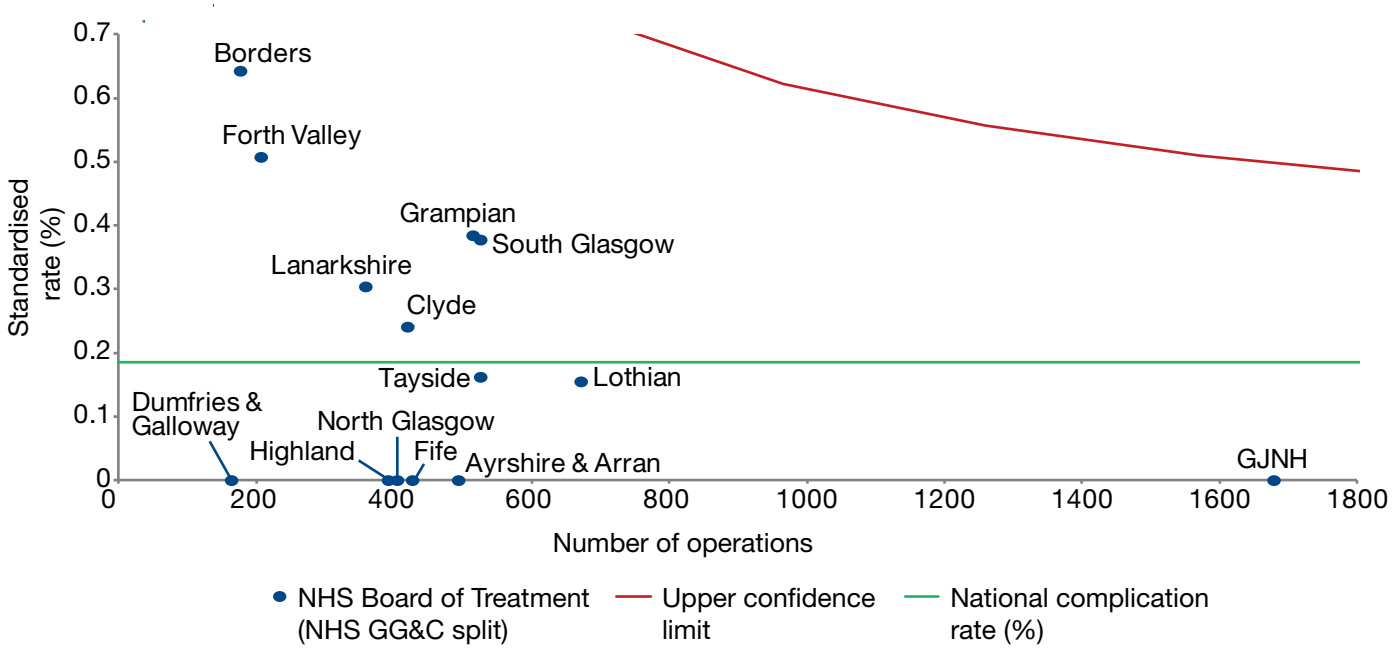
The national average rate from 2013 to 2017 has remained reassuringly low at 0.18% and 0.19% for primary hip and primary knee arthroplasty respectively. The situation is similar for both primary hip and knees procedures – there is a spread of Health Boards above and below the national average rate with no outliers in each case.

Figure 16 — Percentage of 2017 primary hip arthroplasty patients with subsequent AMI within 30 days



Scottish Rate averaged over 5 years 2013-2017.

Figure 17 — Percentage of 2017 primary knee arthroplasty patients with subsequent AMI within 30 days



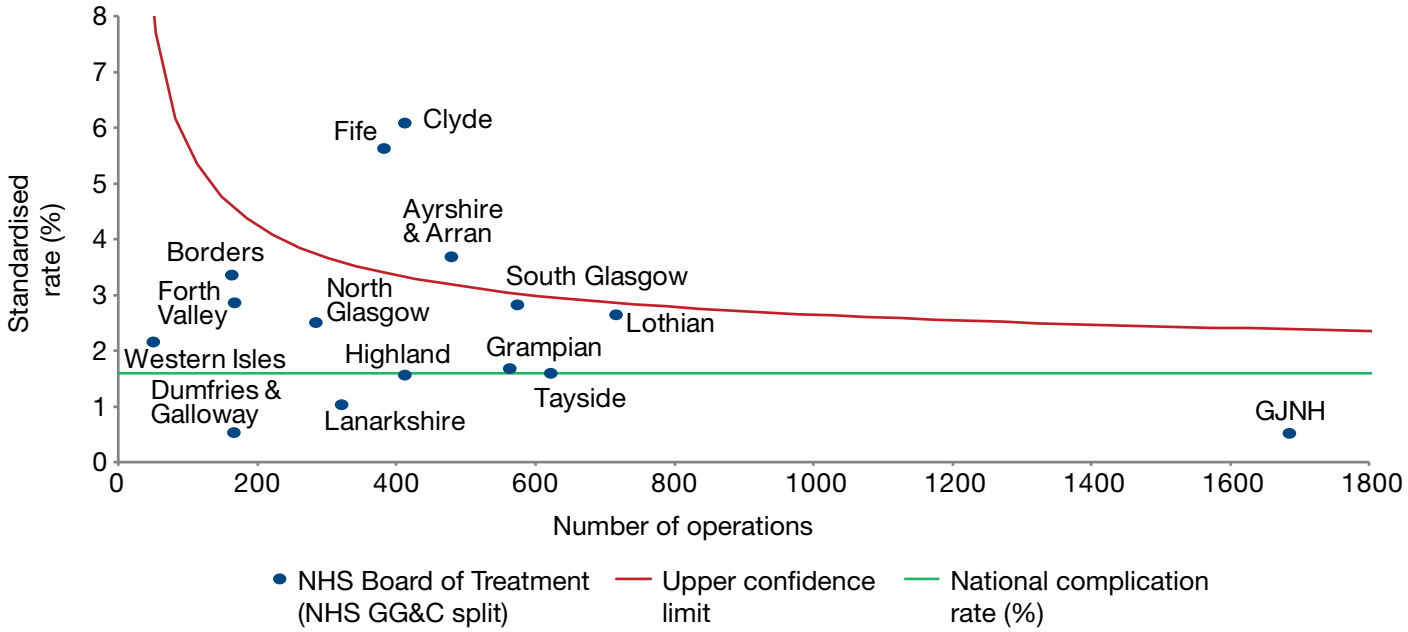
Scottish Rate averaged over 5 years 2013-2017.

4.2.6 Acute renal failure within 30 days

The incidence of acute renal failure after hip or knee arthroplasty has risen since 2009. This year's data appears to show a slight decrease which is welcome (Figure 8e). The national average rate from 2013 to 2017 was 1.60% and 1.69% for primary hip and primary knee arthroplasty respectively.

For primary hips the majority of Health Boards were shown to have rates above the national average with rates varying from a minimum of 0.52% to a maximum of 6.10%. Of the Health Boards with rates above the national average 3 were identified as outliers.

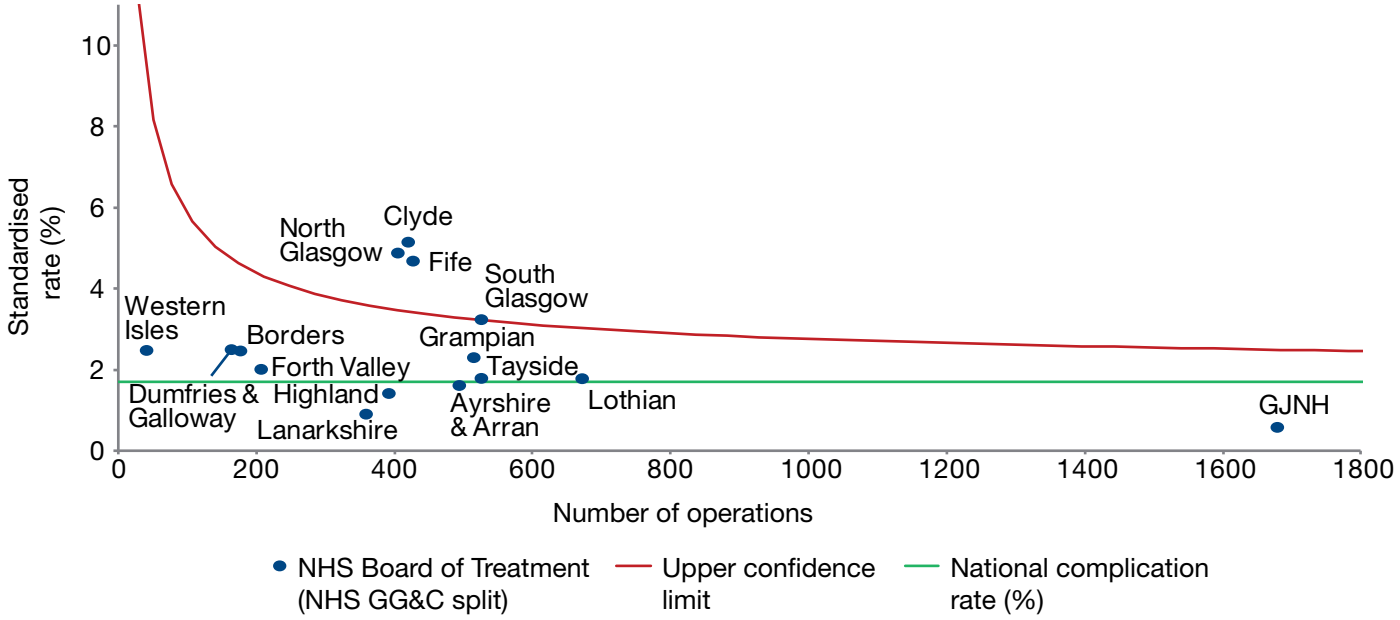
Figure 18 — Percentage of 2017 primary hip arthroplasty patients with subsequent acute renal failure within 30 days



Scottish Rate averaged over 5 years 2013-2017.

For primary knees, again, the majority of Health Boards have rates which are above the national average ranging from a minimum of 0.59% to a maximum of 5.16%. In this case, 4 Health Boards were identified as outliers although 1 is on the upper confidence limit.

Figure 19 — Percentage of 2017 primary knee arthroplasty patients with subsequent acute renal failure within 30 days

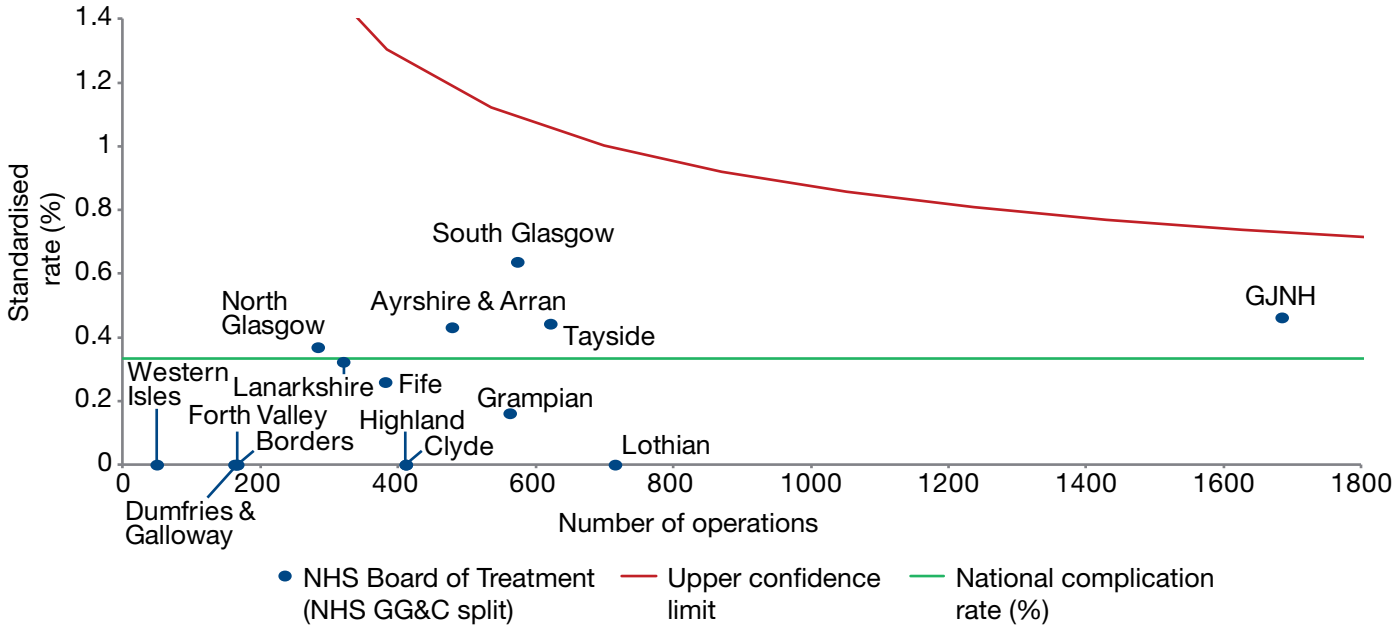


Scottish Rate averaged over 5 years 2013-2017.

4.2.7 CVA/Stroke within 30 days

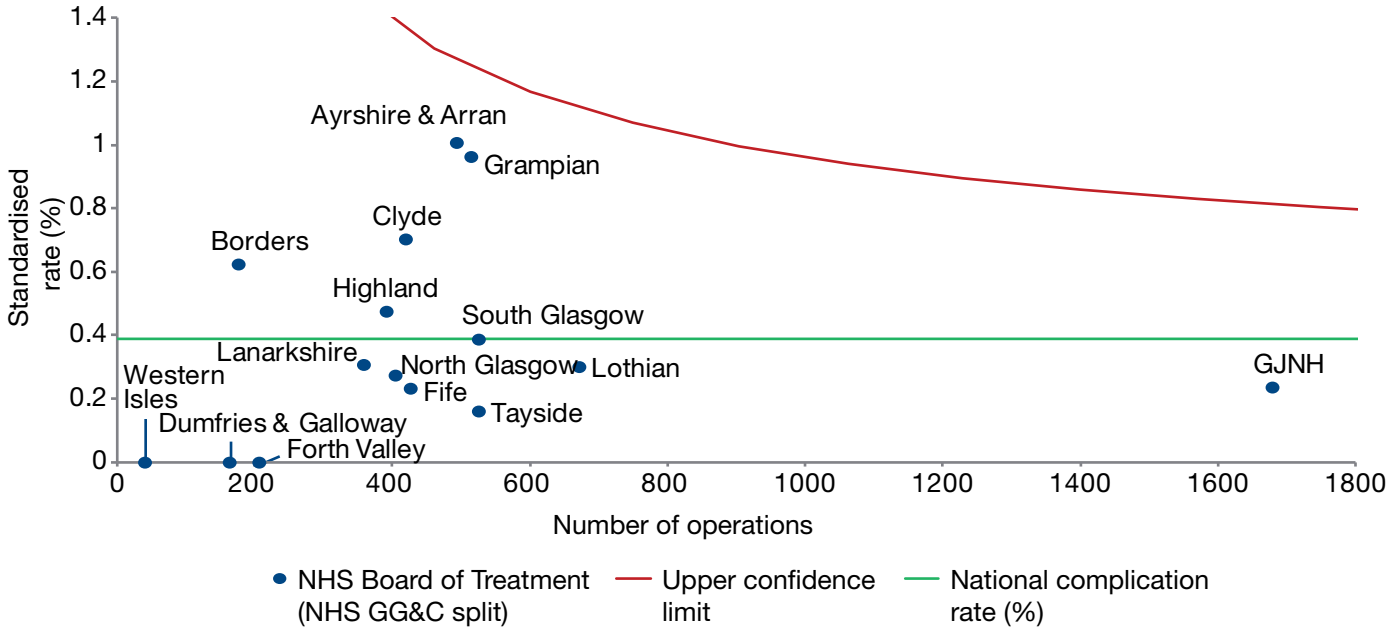
The national average rate from 2013 to 2017 was 0.33% and 0.39% for primary hip and primary knee arthroplasty respectively. There is a mix of Health Boards above and below the national average and no Health Boards identified as outliers against both procedures. Rates remain quite low, with the highest incidence being 0.64% following hip arthroplasty, and lowest 0%. Following knee arthroplasty, the highest incidence was 1.01% and the lowest 0%. These rates are to be falling year-on-year.

Figure 20 — Percentage of 2017 primary hip arthroplasty patients with subsequent stroke within 30 days



Scottish Rate averaged over 5 years 2013-2017.

Figure 21 — Percentage of 2017 primary knee arthroplasty patients with subsequent stroke within 30 days



Scottish Rate averaged over 5 years 2013-2017.

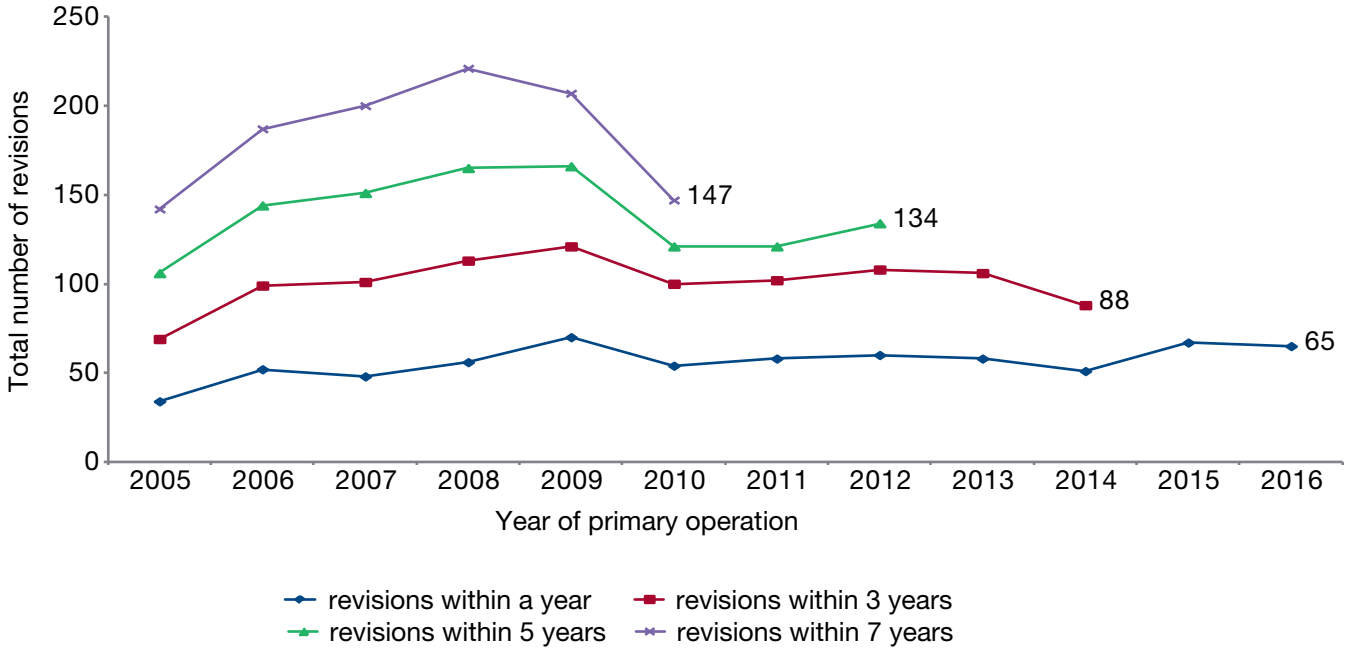
5. Revision Rates

Revisions are calculated within 1 year, 3 years, 5 years and 7 years for primary hip and primary knee arthroplasty procedures..

The national rate for hip arthroplasty with subsequent revision within 1 year shows a downward trend with an upward trend at the 5 year point. This may reflect problems with large metal on metal bearings including hip resurfacing arthroplasties. Revision of hips with these bearings may have caused a bulge in national revision numbers over the last decade (Figure 1c).

5.1 Hips

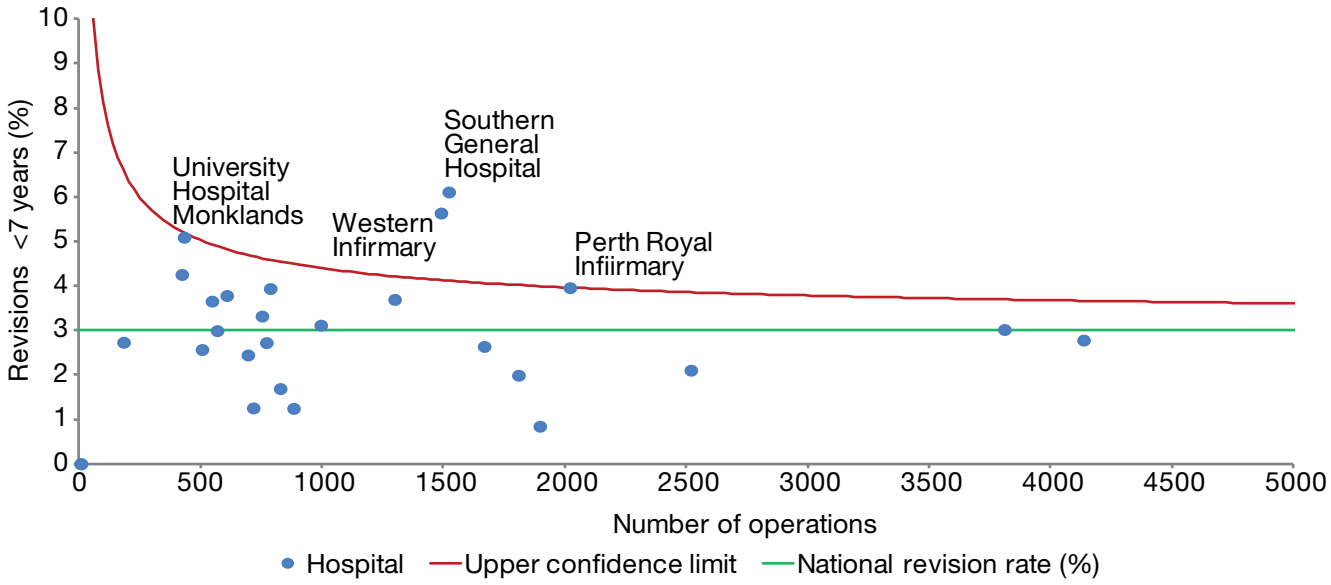
Figure 22a — Total number of revisions to primary hip arthroplasties in Scotland per year



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

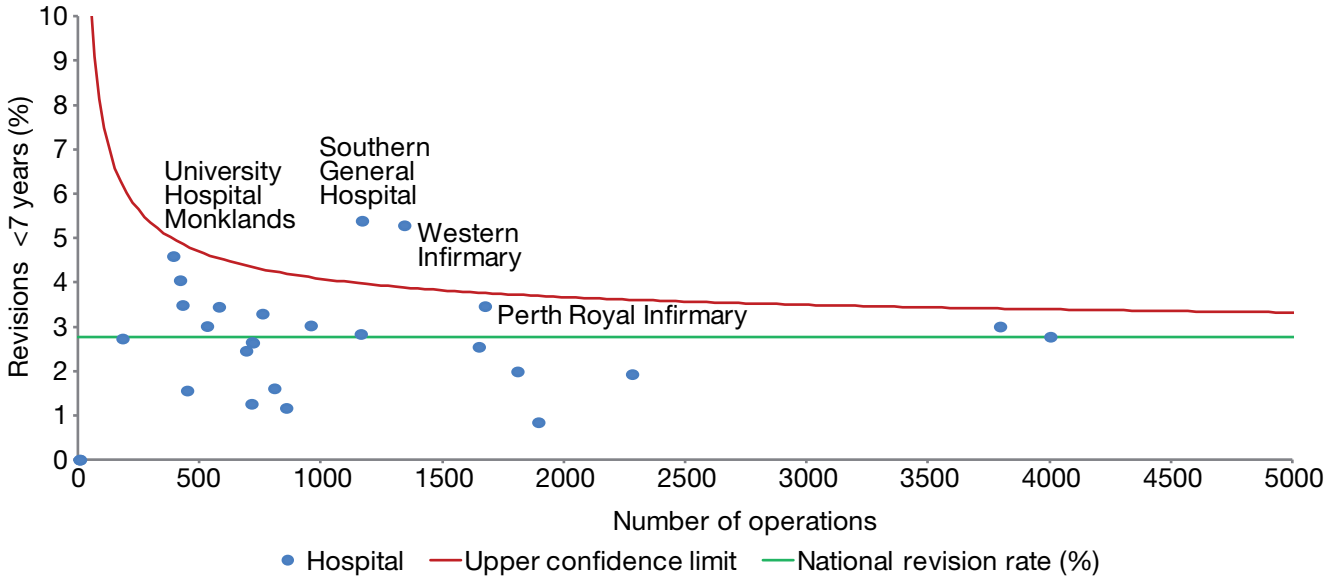
Figures 22b and 22c demonstrate the percentage of patients who underwent revision of a primary total hip replacement within 7 years. Figure 22b includes metal on metal resurfacing and 22c excludes these procedures. It is not possible to identify large head metal on metal total hip replacements which may have an impact on the figures from individual units. It will clearly take a number of years for any improvement measures which have been implemented by individual units to become apparent.

Figure 22b — Percentage of primary hip arthroplasty patients from 2006 - 2010 with subsequent revision within 7 years up to 31st December 2017: THR + resurfacing



Note: Please see supplementary excel tables for more detailed information

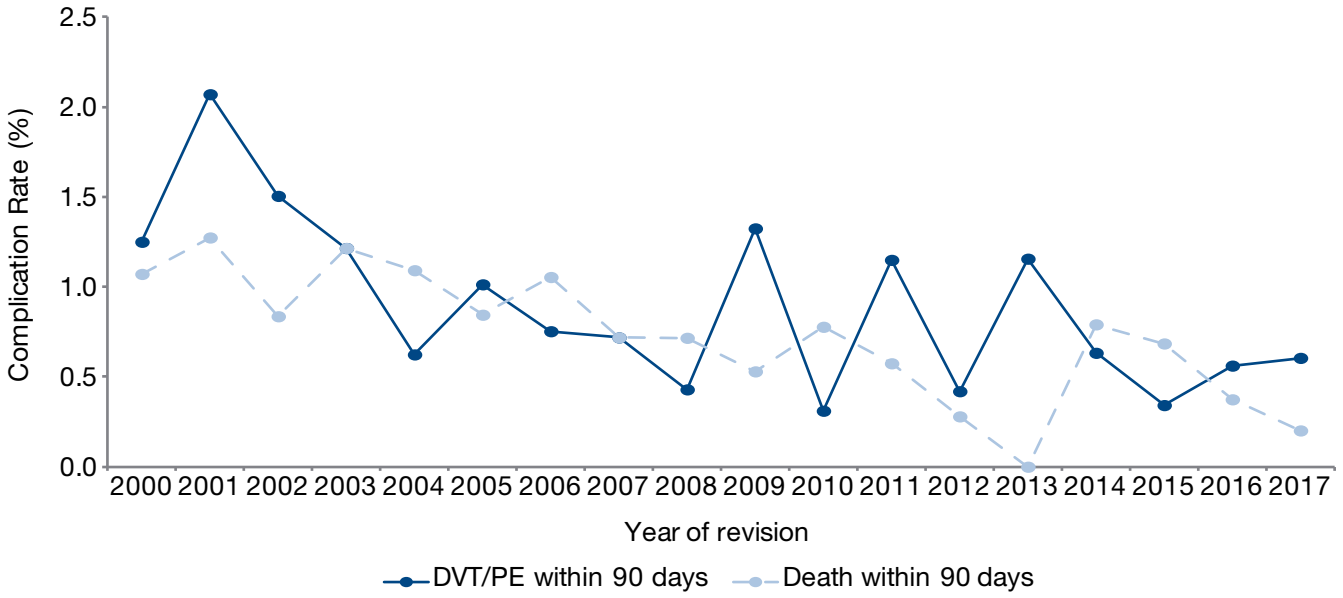
Figure 22c — Percentage of primary hip arthroplasty patients from 2006 - 2010 with subsequent revision within 7 years up to 31st December 2017: THR only



Note: Please see supplementary excel tables for more detailed information

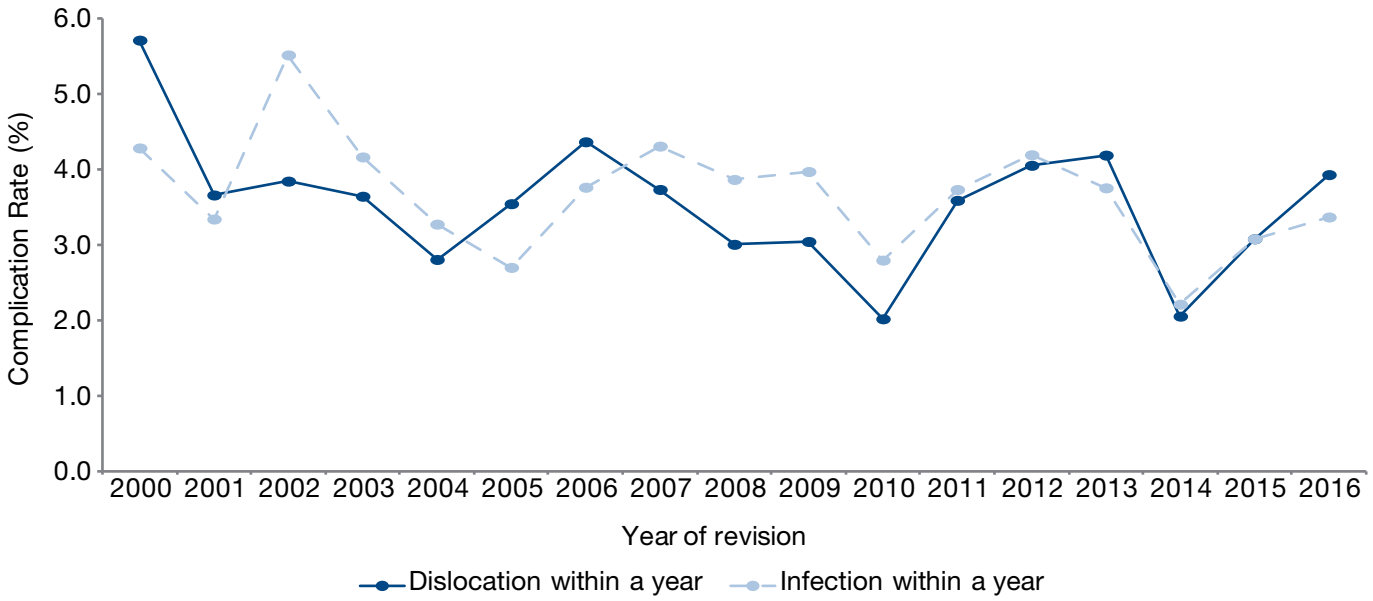
Figures 22d and 22e show an increase in complication rates (from last year) resulting from revision hip procedures nationally, other than death at 90 days, although there has been a decline from 2000.

Figure 22d — National rates for complications within 90 days: hip revisions



Bilateral operations counted only once.

Figure 22e — National rates for complications within 1 year: hip revisions



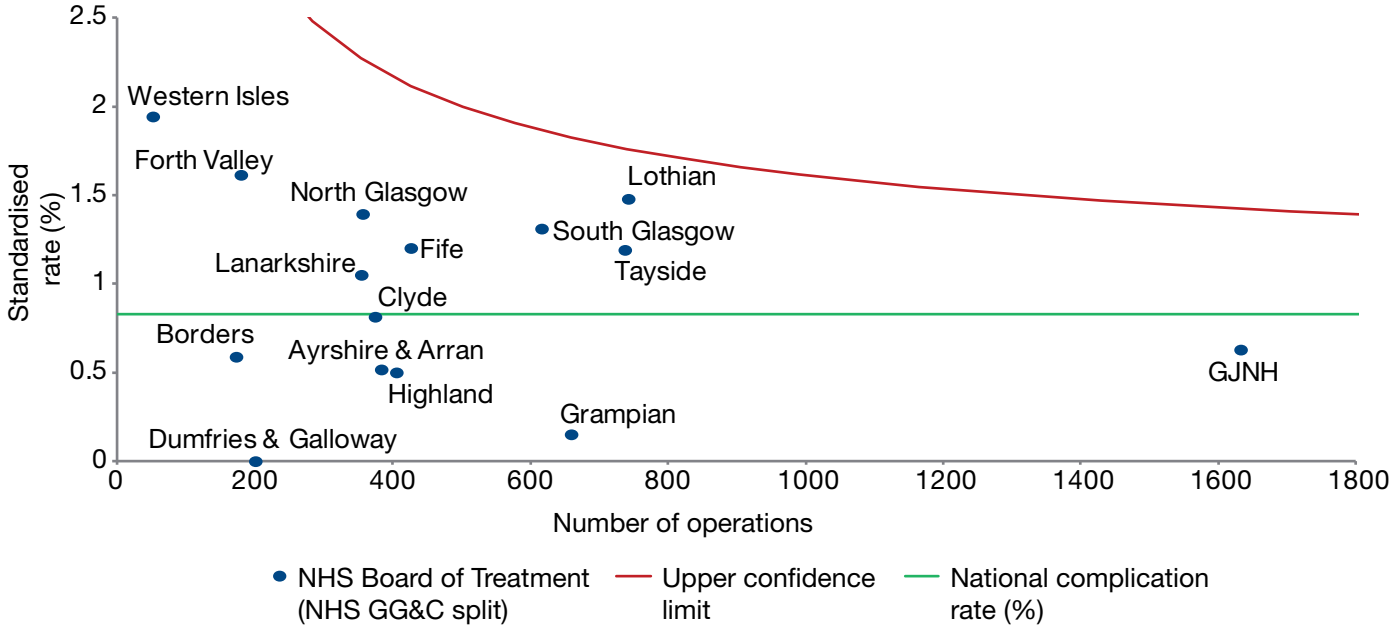
Bilateral operations counted only once

5.2 Complication funnel charts – hips

5.2.1 Revision within one year.

The national average revision rate at 1 year from 2012 to 2016 was 0.83%. No Health Boards were above the upper confidence limit and identified as an outlier (Figure 22f).

Figure 22f — Percentage of 2016 primary hip arthroplasty patients with subsequent revision within 1 year.

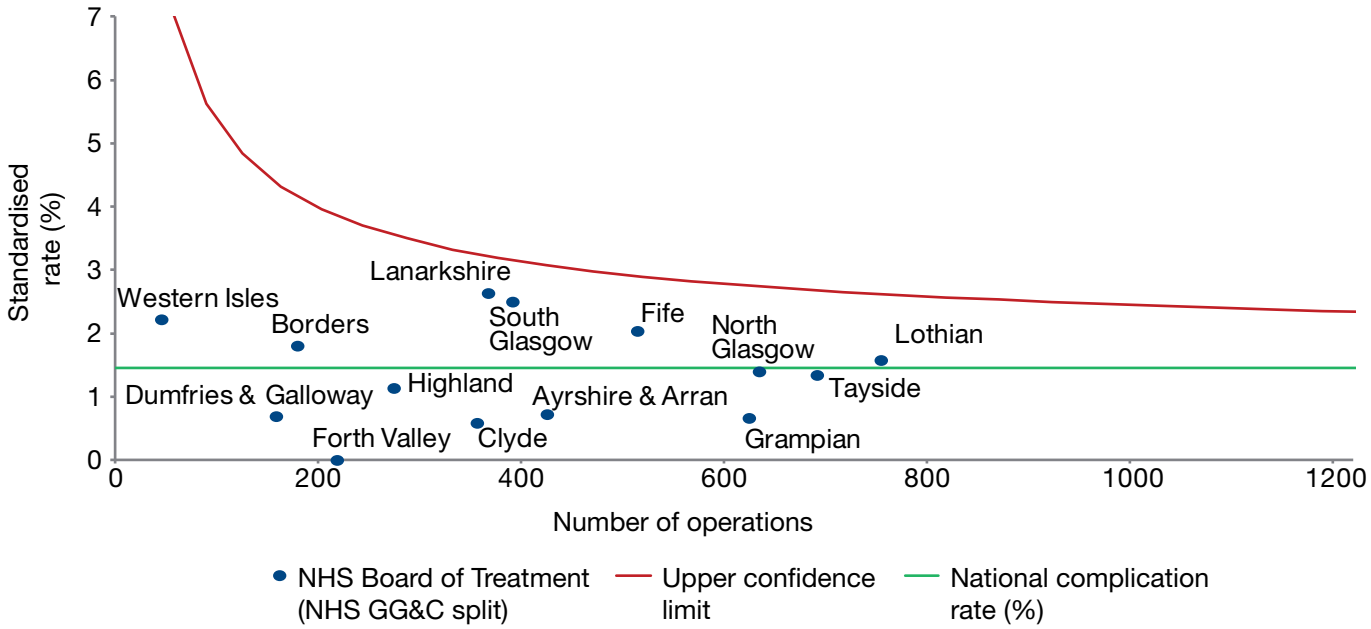


Scottish Rate averaged over 5 years 2012-2016; Bilateral operations counted twice.

5.2.2 Revision within three years.

The national average revision rate at 3 year from 2010 to 2014 was 1.45 %. No Health Boards were above the upper confidence limit and identified as an outlier (Figure 22g).

Figure 22g — Percentage of 2014 primary hip arthroplasty patients with subsequent revision within 3 years.

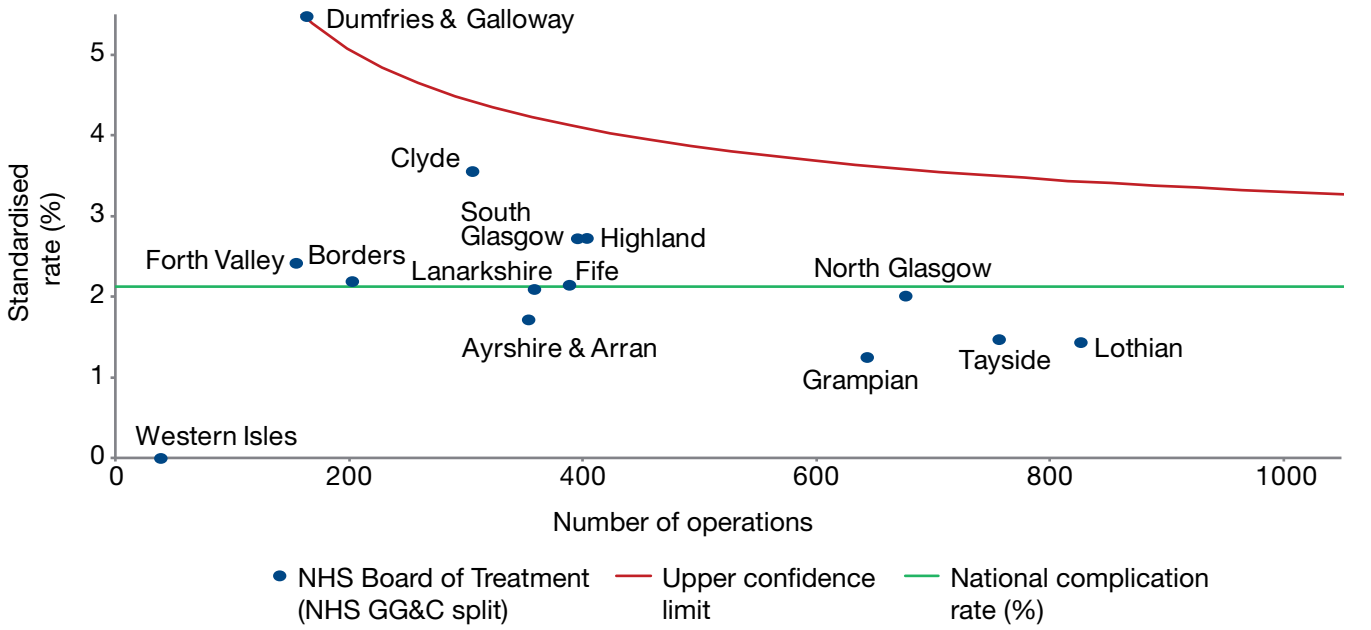


Scottish Rate averaged over 5 years 2010-2014; Bilateral operations counted twice.

5.2.3 Revision within five years.

The national average revision rate at 5 year from 2008 to 2012 was 2.12%. No Health Boards were above the upper confidence limit and identified as an outlier (Figure 22h).

Figure 22h — Percentage of 2012 primary hip arthroplasty patients with subsequent revision within 5 years.

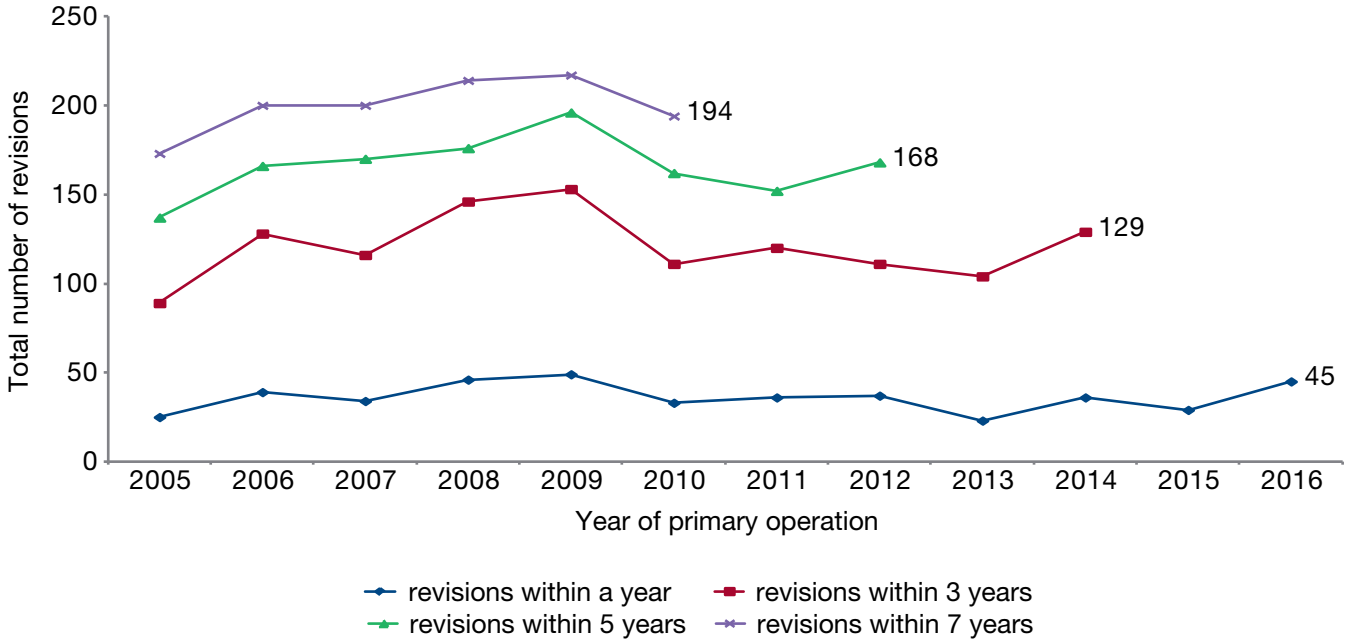


Scottish Rate averaged over 5 years 2008-2012; Bilateral operations counted twice.

5.3 Knees

The number of knee arthroplasties being revised shows an increase at 1, 3 and 5 years with a continuing downward trend at 7 years (Figure 23a).

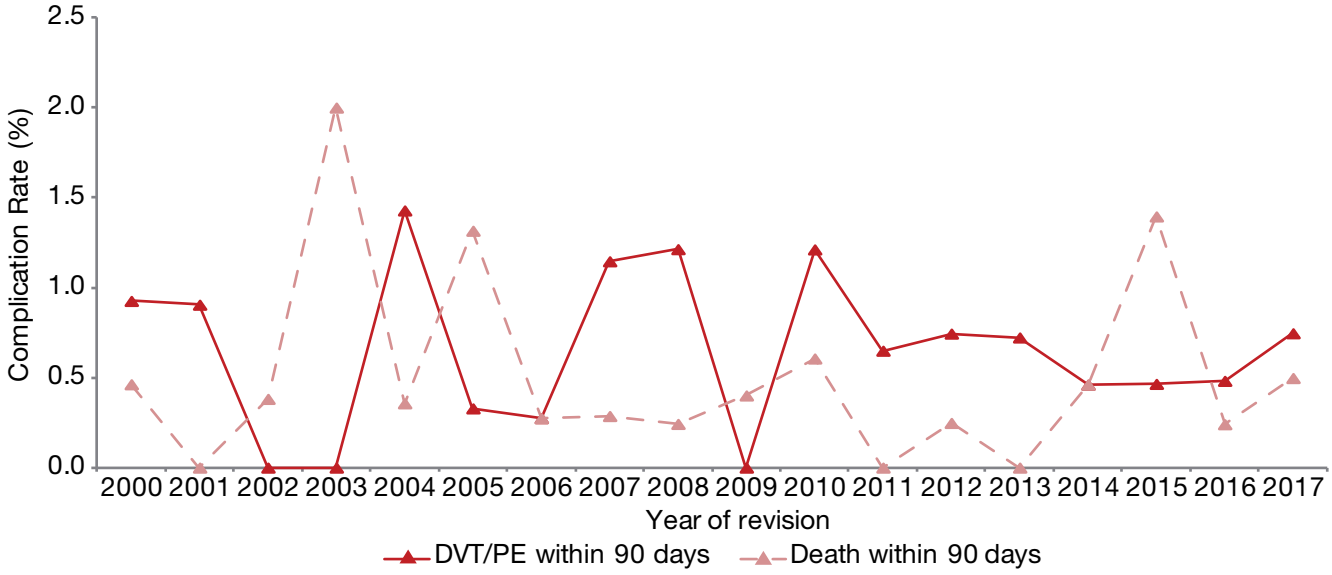
Figure 23a — Total number of revisions to primary knee arthroplasties in Scotland per year



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

Figure 23b shows an increase in both DVT/PE rates at 90 days and death rates at 90 days. These increases are however small, 0.5% to 0.7% and 0.2% to 0.5% respectively.

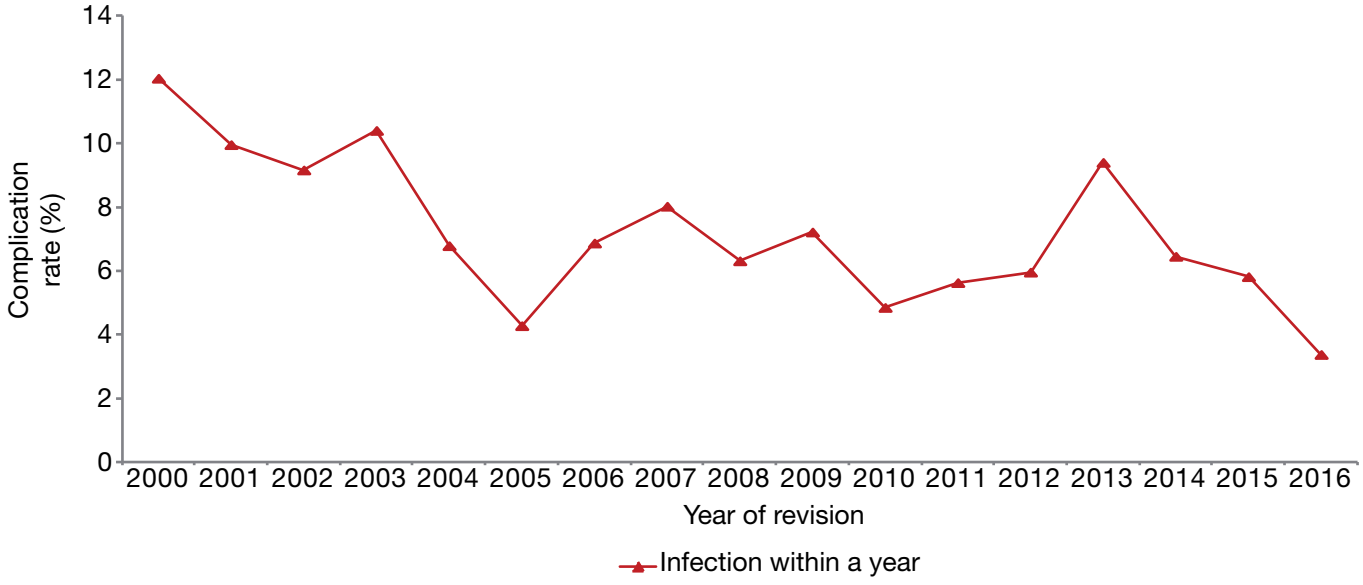
Figure 23b — National rates for complications within 90 days: knee revisions



Bilateral operations counted only once

The infection rate for knee revisions has continued to fall and is now 3.4%. This is the lowest rate since 2000.

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



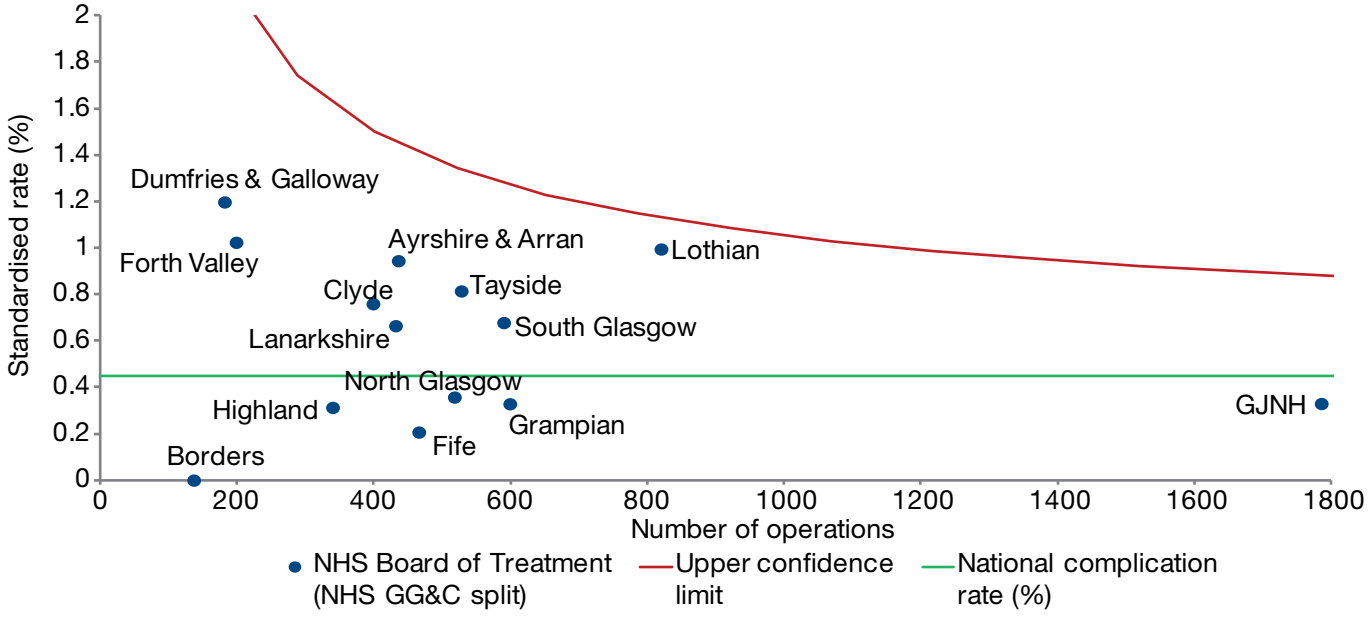
Bilateral operations counted only once.

5.4 Complication funnel charts – knees

5.4.1 Revision within one year.

The national average revision rate at 1 year from 2012 to 2016 was 0.45%. No Health Boards were above the upper confidence limit and identified as an outlier (Figure 23d).

Figure 23d — Percentage of 2016 primary knee arthroplasty patients with subsequent revision within 1 year

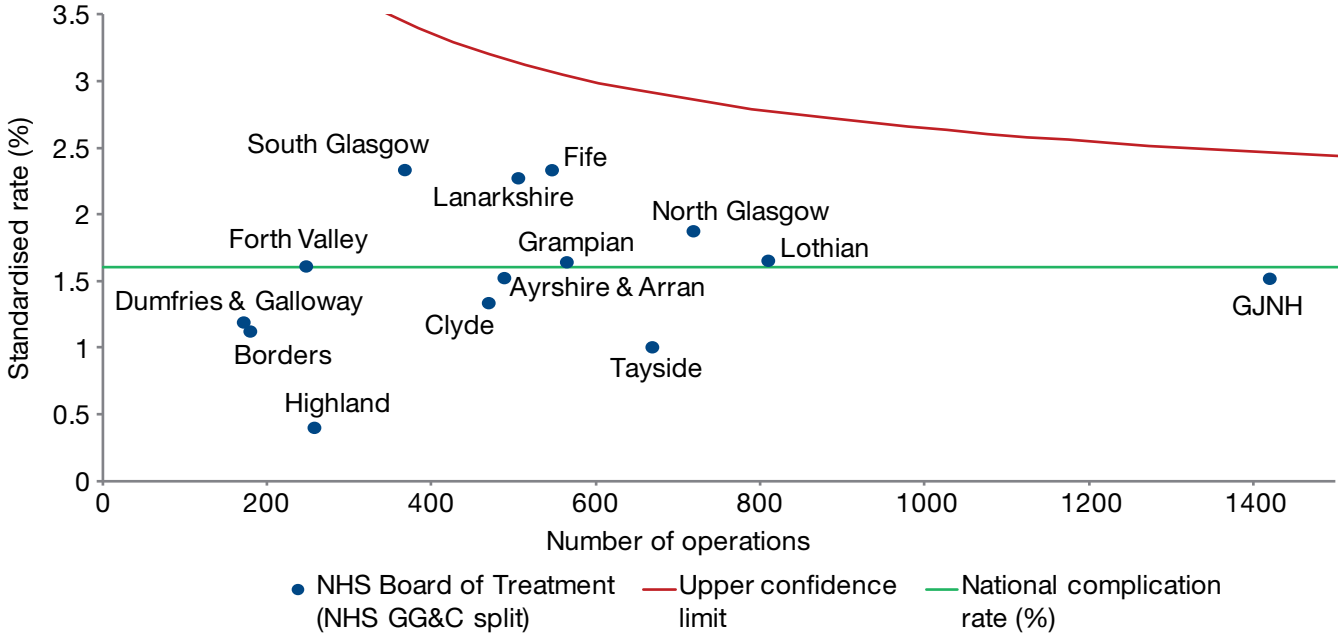


Scottish Rate averaged over 5 years 2012-2016; Bilateral operations counted twice.

5.4.2 Revision within three years.

The national average revision rate at 3 year from 2010 to 2014 was 1.60 %. No Health Boards were above the upper confidence limit and identified as an outlier (Figure 23e).

Figure 23e — Percentage of 2014 primary knee arthroplasty patients with subsequent revision within 3 years

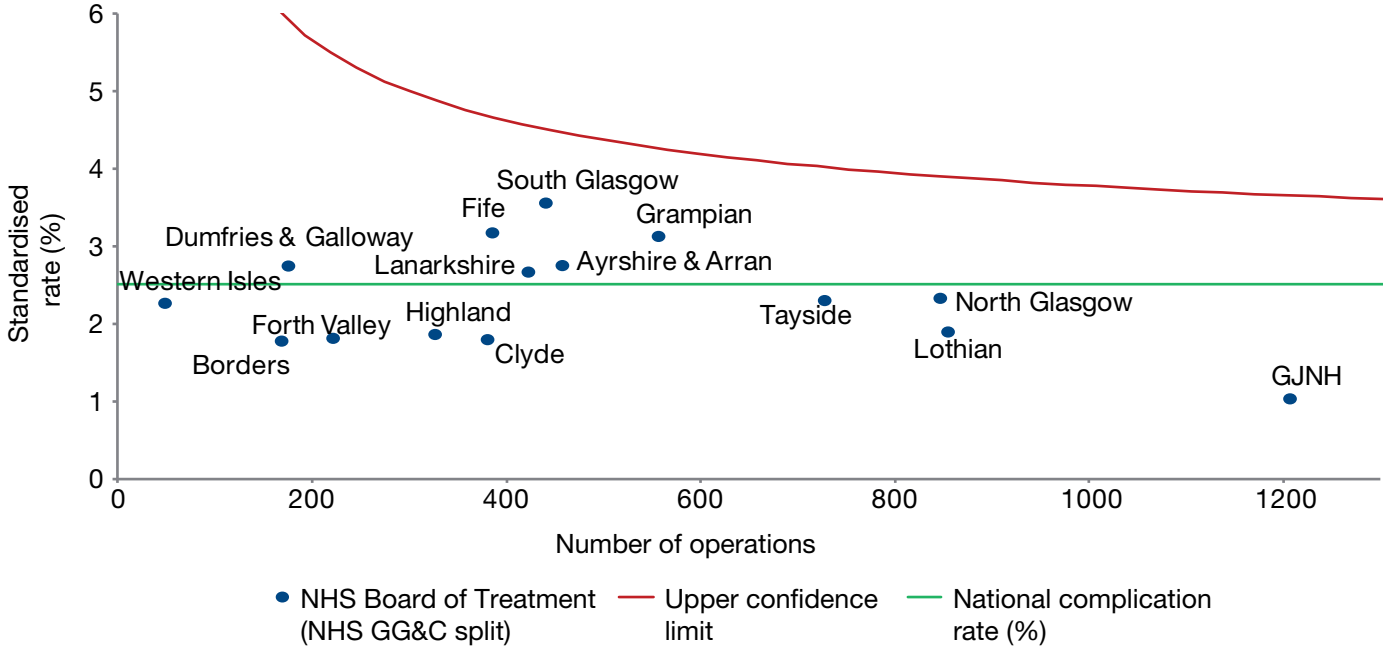


Scottish Rate averaged over 5 years 2010-2014; Bilateral operations counted twice.

5.4.3 Revision within five years (Figure 23f).

The national average revision rate at 5 year from 2008 to 2012 was 2.51%. No Health Boards were above the upper confidence limit and identified as an outlier (Figure 23f).

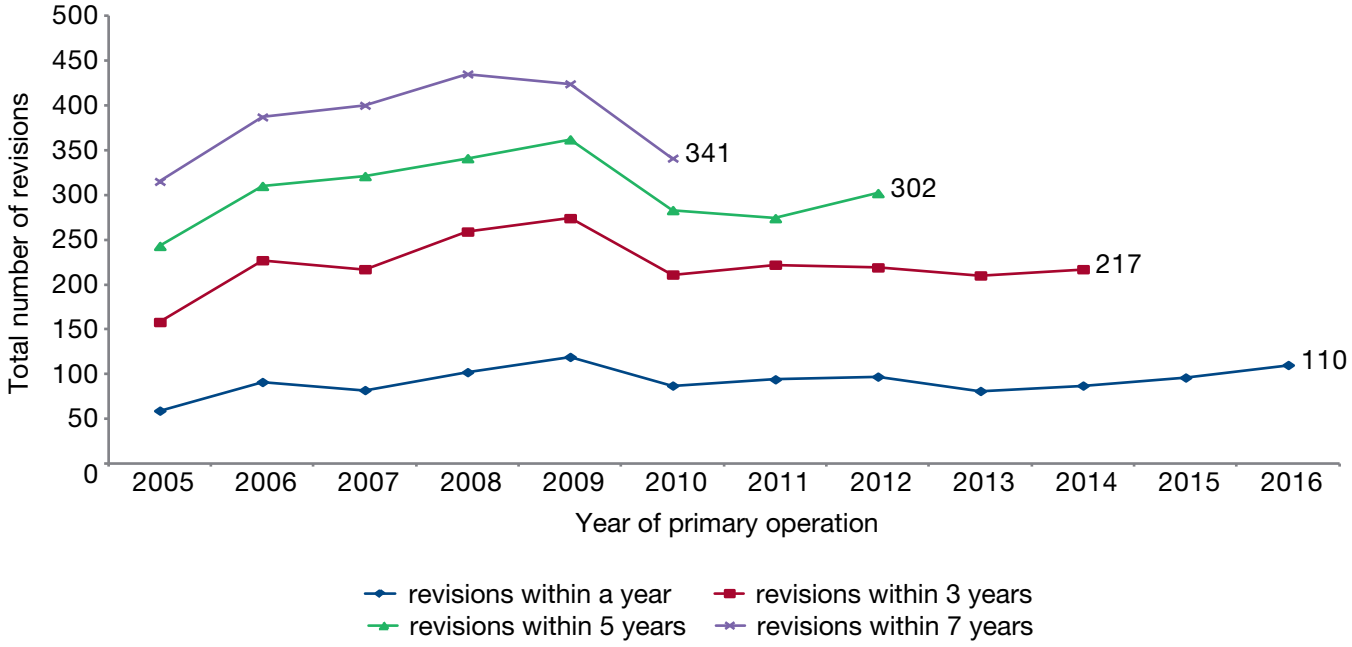
Figure 23f — Percentage of 2012 primary knee arthroplasty patients with subsequent revision within 5 years



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

When combined, the numbers of revision hip and knee arthroplasties show an upwards trend at 1, 3 and 5 years.

Figure 24a — Total number of revisions of primary hip and knee arthroplasties in Scotland per year

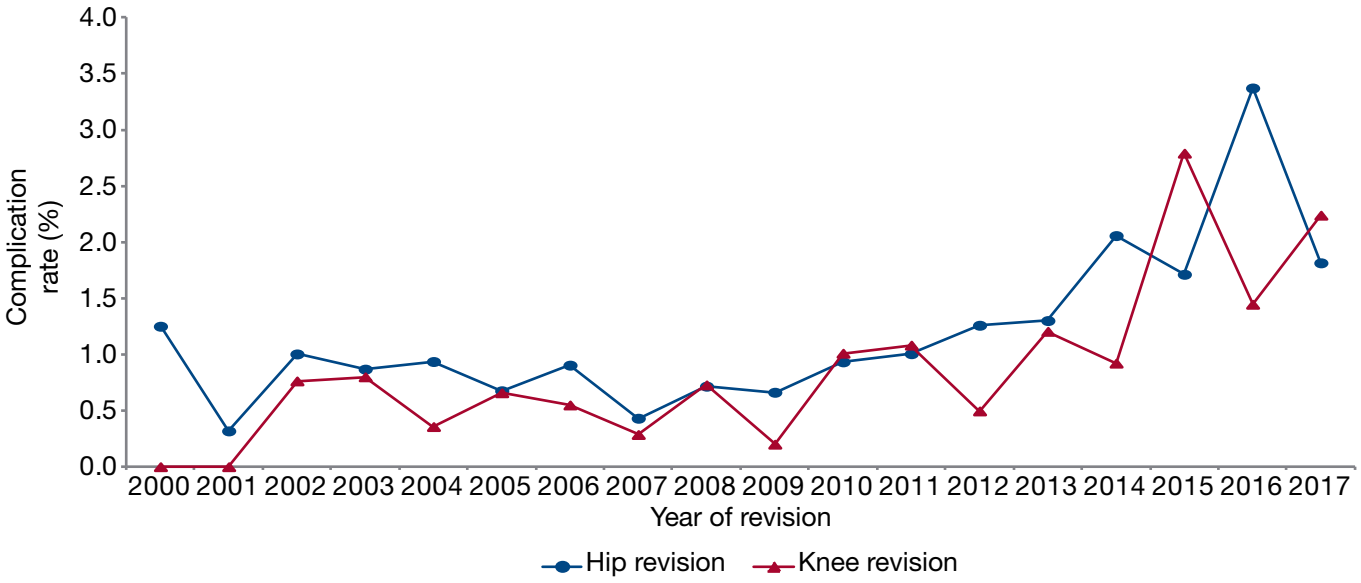


Elective patients only; Includes known patients from private hospitals; bilateral operations counted twice.

5.5 Acute Renal Failure

The rates for acute renal failure for hip revision and knee revision is around 2% (1.81% and 2.24% respectively). There is an apparent upward trend in the rate of renal failure. 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 or changes in prophylactic antibiotic usage. We will continue to observe future trends.

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



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.'[3]

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 the Information Services Division (ISD) of NHS National Services Scotland (NHS NSS) 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 analysis[4] . In clinical disciplines it has been used in cardiothoracic surgery during the past 15 years[5] and has been shown to be a superior form of statistical analysis for identifying complications[6] .

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*.

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 finding are returned to SAP analysts within ISD. 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 2015-2017.

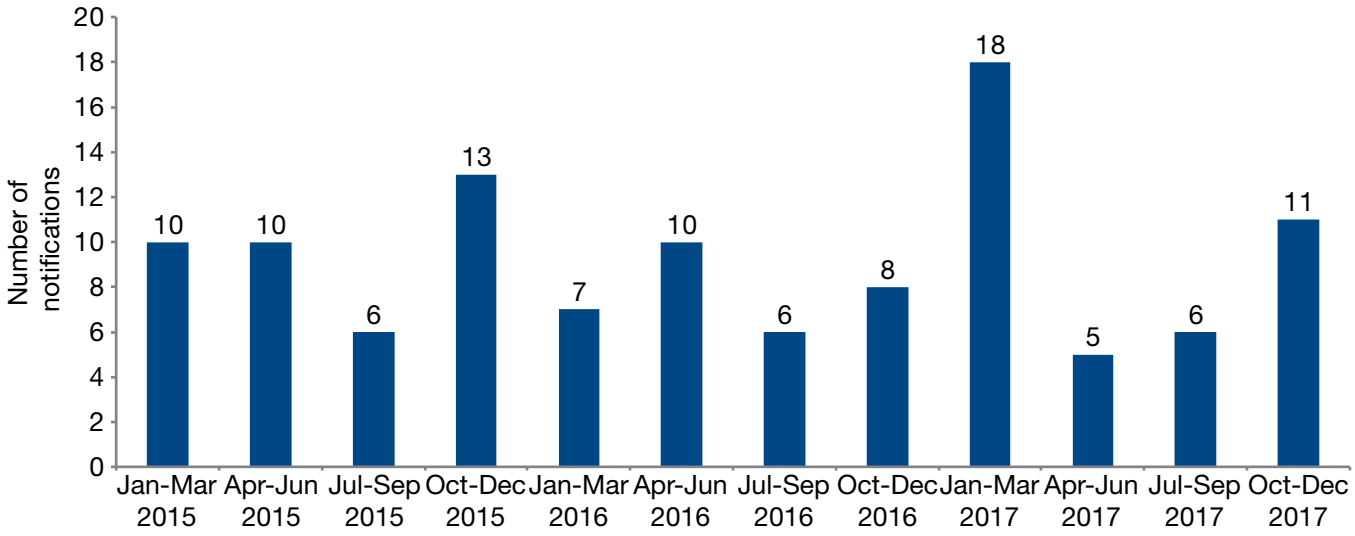
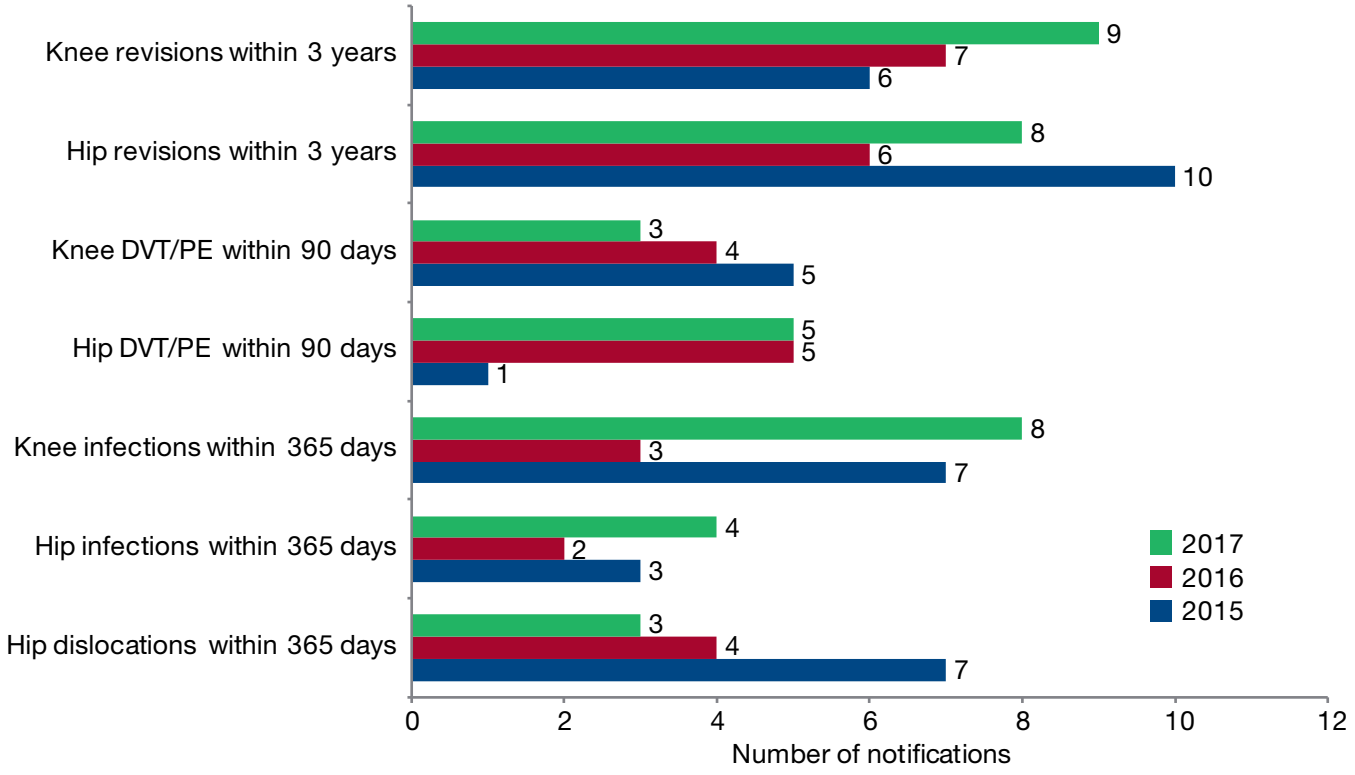


Figure 26 — CUSUM outlier notification by complication type during 2015-2017.



References

1 The association between surgical volume and failure of primary total hip replacement in England and Wales: Findings from the National Joint Registry of England, Wales, Northern Ireland and the Isle of Man. Adrian Sayers *et al*.
Presented at ISAR Congress June 18 Reykjavik

2 Higher surgeon annual volume reduces the risk for adverse events within 90-days following primary total hip arthroplasty. A registry-based study of 13,180 cases in western Sweden.
Per Jolback *et al*.
Presented at ISAR Congress June 18 Reykjavik

3 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.

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

5 de Leval MR et al. (1994). Analysis of a cluster of surgical failures. Application to a series of neonatal arterial switch operations. J Thorac Car- diovasc Surg. 107:914–24

6 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 NHS National Services Scotland (NHS 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/.

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/.

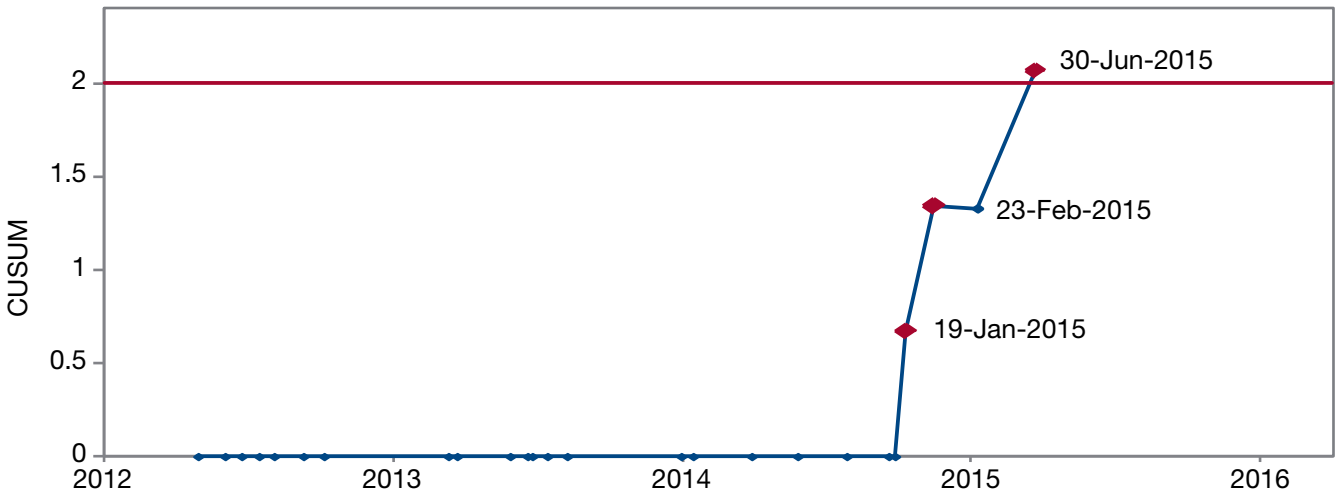
Arthroplasty coding

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

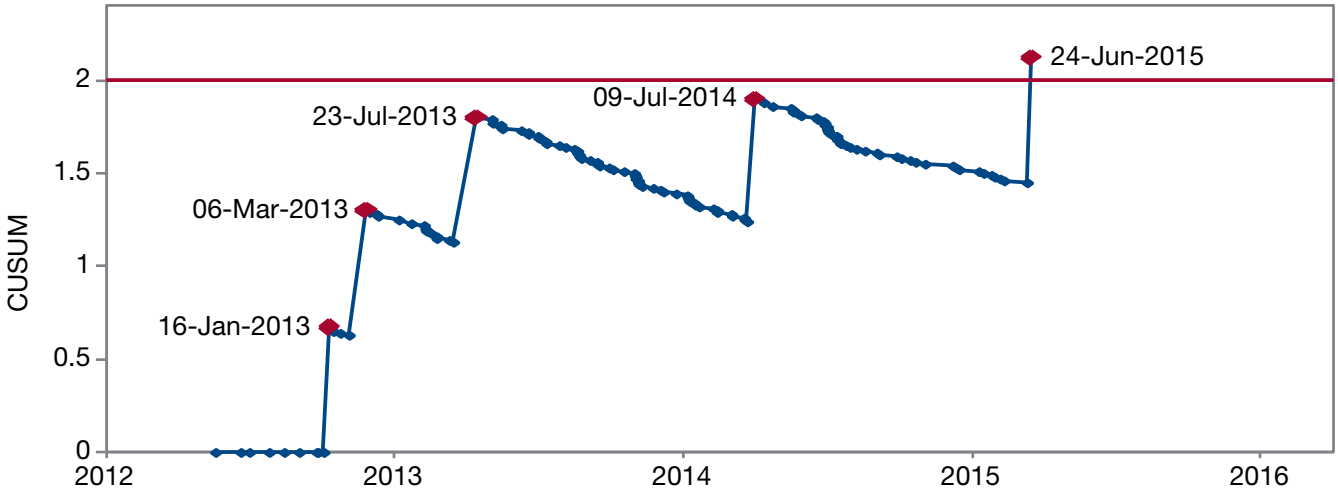
In the case below (Figure 27), CUSUM is low until it rises suddenly to the control limit in 2015. Is the rise associated with a change in practise, perhaps a new technique?

Figure 27 — CUSUM chart showing a surgeon with a higher than expected complication rate following 3 complications in quick succession



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 the consultant would be notified that their complication rate had been unusually high and asked to complete a review and Action Plan.

Figure 28 — CUSUM chart showing a surgeon with a higher than expected complication rate following 5 complications over a period of 2.5 years



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