Scottish Arthroplasty Project.

# Table of Contents

**Foreword** .......................................................................................................................... 1

**Introduction** .......................................................................................................................... 2

*Scottish Arthroplasty Steering Committee 2014 – 2016* .................................................................. 2

**Main Points** .............................................................................................................................. 3

1. **Number of Arthroplasties** ..................................................................................................... 4

   1.1 National rates .................................................................................................................. 4

   1.2 Number of arthroplasties by NHS Board ........................................................................ 6

   1.3 Consultants performing low volumes ............................................................................ 11

2. **Patient Demographics** ......................................................................................................... 14

   2.1 Age .................................................................................................................................. 14

   2.2 Indication for surgery ....................................................................................................... 15

3. **Inpatient Episodes** .............................................................................................................. 18

   3.1 Length of stay .................................................................................................................. 18

4. **Complications arising from arthroplasty procedures** ........................................................ 21

   4.1 National trends ................................................................................................................ 21

   4.2 Complication funnel charts ........................................................................................... 25

5. **Revision Rates** .................................................................................................................... 33

   5.1 National rates - hips ...................................................................................................... 33

   5.2 Complication funnel charts – hips ................................................................................ 38

   5.3 National rates - knees .................................................................................................... 40

   5.4 Complication funnel charts - knees .............................................................................. 42

6. **Clinical Governance** .......................................................................................................... 45

   6.1 What is clinical governance? .......................................................................................... 45

   6.2 Statistical analysis of complication rates associated with arthroplasty ......................... 45

   6.3 Quality Improvement through Case Review and Action Plan ........................................ 45

**References** ............................................................................................................................... 47

**Appendix A** ................................................................................................................................ 48

**Appendix B to Section 6** ........................................................................................................... 49

**Contact** ....................................................................................................................................... 50
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 “outlies” an agreed level) are notified to the care team involved. They then review each complication case, and submit their review and remedial action plan for appraisal by the clinical members of the SAPSC. The statistical method used to rapidly identify “outliers” is the Cumulative Sum of Means (CUSUM) method. CUSUM for individual surgeons was established during the period of the previous report and has proven very successful.

Scottish Arthroplasty Steering Committee 2014 – 2016

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

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

Main Points

Number of arthroplasty operations performed in 2015:
- Hip: 7907
- Knee: 7881

Revision rate within 5 years of arthroplasty operation:
- Hip: 1.9%
- Knee: 2.4%

Average age of patients undergoing an NHS Scotland arthroplasty operation:
- Hip: 67 years
- Knee: 68 years

Average length of stay when undergoing a hip or knee arthroplasty:
- 2001: 10 days
- 2015: 5 days

Incidence of death within 90 days following a hip or knee arthroplasty in 2015:
- Hip: 0.23%
- Knee: 0.22%
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.*

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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.

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)

![Number of primary knee arthroplasties 2014-2015 by NHS Board of treatment (NHS GG&C split)](image)

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)

<table>
<thead>
<tr>
<th>NHS Board</th>
<th>Mean number of operations 2010-2013</th>
<th>Number of operations 2014</th>
<th>Number of operations 2015</th>
<th>Mean number of revisions 2010-2013</th>
<th>Number of revisions 2014</th>
<th>Number of revisions 2015</th>
</tr>
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<tbody>
<tr>
<td>Ayrshire &amp; Arran</td>
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<td>454</td>
<td>448</td>
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<td>71</td>
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<tr>
<td>Borders</td>
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<td>226</td>
<td>5</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Dumfries &amp; Galloway</td>
<td>162</td>
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</tr>
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<td><strong>913</strong></td>
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</table>

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)

<table>
<thead>
<tr>
<th>NHS Board</th>
<th>Mean number of operations 2010-2013</th>
<th>Number of operations 2014</th>
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<td>Ayrshire &amp; Arran</td>
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<td>Dumfries &amp; Galloway</td>
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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

<table>
<thead>
<tr>
<th>NHS Board</th>
<th>Mean number of operations 2010-2013</th>
<th>Number of operations 2014</th>
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<th>Number of revisions 2014</th>
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</tr>
</tbody>
</table>

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

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<th>NHS Board</th>
<th>Mean number of operations 2010-2013</th>
<th>Number of operations 2014</th>
<th>Number of operations 2015</th>
<th>Mean number of revisions 2010-2013</th>
<th>Number of revisions 2014</th>
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<td>42</td>
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<td>*</td>
</tr>
<tr>
<td>Total</td>
<td>7055</td>
<td>7872</td>
<td>7881</td>
<td>488</td>
<td>478</td>
<td>470</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Mean number of operations 2010-2013</th>
<th>Number of operations 2014</th>
<th>Number of operations 2015</th>
<th>Mean number of consultants performing operations 2010-2013</th>
<th>Number of consultants performing operations 2014</th>
<th>Number of consultants performing operations 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip arthroplasty</td>
<td>7333</td>
<td>7778</td>
<td>7907</td>
<td>221</td>
<td>232</td>
<td>231</td>
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<tr>
<td>Hip revision</td>
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<td>844</td>
<td>830</td>
<td>144</td>
<td>138</td>
<td>148</td>
</tr>
<tr>
<td>Knee arthroplasty</td>
<td>7055</td>
<td>7872</td>
<td>7881</td>
<td>202</td>
<td>200</td>
<td>192</td>
</tr>
<tr>
<td>Knee revision</td>
<td>489</td>
<td>478</td>
<td>470</td>
<td>101</td>
<td>101</td>
<td>93</td>
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<tr>
<td>Shoulder arthroplasty</td>
<td>419</td>
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<td>459</td>
<td>94</td>
<td>95</td>
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<td>Shoulder revision</td>
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<td>44</td>
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<td>18</td>
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<td>Elbow arthroplasty</td>
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<td>Ankle arthroplasty</td>
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<td>Ankle revision</td>
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<td>*</td>
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<td>*</td>
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<td>13</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Wrist revision</td>
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<td>*</td>
<td>1</td>
<td>*</td>
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<td>3</td>
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<td>*</td>
</tr>
<tr>
<td>Radial head revision</td>
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<td>*</td>
<td>*</td>
<td>0</td>
<td>*</td>
<td>*</td>
</tr>
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<td>Finger arthroplasty</td>
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<td>20</td>
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<td>Finger revision</td>
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<td>4</td>
<td>5</td>
<td>*</td>
</tr>
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<td>Thumb arthroplasty</td>
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<tr>
<td>Thumb revision</td>
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<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Toe arthroplasty</td>
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<td>20</td>
<td>15</td>
<td>14</td>
<td>11</td>
<td>8</td>
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<td>Excision**</td>
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<td>355</td>
<td>374</td>
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<tr>
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<td>43</td>
<td>34</td>
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<td>28</td>
<td>20</td>
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<tr>
<td>Other knee resurfacing**</td>
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<td>23</td>
<td>15</td>
<td>17</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Other resurfacing*</td>
<td>16</td>
<td>8</td>
<td>*</td>
<td>13</td>
<td>6</td>
<td>*</td>
</tr>
<tr>
<td>Other</td>
<td>103</td>
<td>69</td>
<td>62</td>
<td>53</td>
<td>47</td>
<td>38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16956</td>
<td>18177</td>
<td>18233</td>
<td>1076</td>
<td>1087</td>
<td>1030</td>
</tr>
</tbody>
</table>

**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 of 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

- Hip arthroplasties carried out by surgeons who perform such operations <=20 times in the calendar year
- Hip revisions carried out by surgeons who perform such operations <=10 times in the calendar year
- Knee arthroplasties carried out by surgeons who perform such operations <=20 times in the calendar year
- Knee revisions carried out by surgeons who perform such operations <=5 times in the calendar year

*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.

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

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.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of knee arthroplasties</th>
<th>Total number of surgeons performing &lt;=20 operations per year</th>
<th>Percentage of surgeons performing &lt;=20 operations per year</th>
<th>Percentage of surgeons performing 21-40 operations per year</th>
<th>Percentage of surgeons performing 21-40 operations per year</th>
<th>Percentage of surgeons performing 41-60 operations per year</th>
<th>Percentage of surgeons performing 41-60 operations per year</th>
<th>Percentage of surgeons performing 41-60 operations per year</th>
<th>Percentage of surgeons performing 61-80 operations per year</th>
<th>Percentage of surgeons performing 61-80 operations per year</th>
<th>Percentage of surgeons performing 81-100 operations per year</th>
<th>Percentage of surgeons performing 81-100 operations per year</th>
<th>Percentage of surgeons performing &gt;100 operations per year</th>
<th>Percentage of surgeons performing &gt;100 operations per year</th>
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<td>20.1%</td>
<td>8.1%</td>
<td>16.5%</td>
<td>3.0%</td>
<td>7.9%</td>
<td>5.6%</td>
<td>19.9%</td>
</tr>
<tr>
<td>2012</td>
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<td>38.3%</td>
<td>8.1%</td>
<td>30.1%</td>
<td>25.1%</td>
<td>12.4%</td>
<td>16.9%</td>
<td>8.1%</td>
<td>15.5%</td>
<td>2.9%</td>
<td>6.7%</td>
<td>8.1%</td>
<td>27.6%</td>
</tr>
<tr>
<td>2013</td>
<td>7223</td>
<td>196</td>
<td>38.3%</td>
<td>8.3%</td>
<td>27.6%</td>
<td>21.7%</td>
<td>12.8%</td>
<td>16.9%</td>
<td>8.7%</td>
<td>16.3%</td>
<td>7.1%</td>
<td>17.4%</td>
<td>5.6%</td>
<td>19.3%</td>
</tr>
<tr>
<td>2014</td>
<td>7872</td>
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<td>26.0%</td>
<td>19.3%</td>
<td>17.0%</td>
<td>21.2%</td>
<td>7.0%</td>
<td>12.5%</td>
<td>6.5%</td>
<td>15.0%</td>
<td>7.0%</td>
<td>24.1%</td>
</tr>
<tr>
<td>2015</td>
<td>7881</td>
<td>192</td>
<td>34.4%</td>
<td>8.2%</td>
<td>28.6%</td>
<td>20.8%</td>
<td>16.7%</td>
<td>20.7%</td>
<td>6.3%</td>
<td>10.5%</td>
<td>6.8%</td>
<td>14.7%</td>
<td>7.3%</td>
<td>25.1%</td>
</tr>
</tbody>
</table>
**Table 3c** – The number and percentage of hip revision by surgeon and performance activity. 2011-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of hip revisions</th>
<th>Total number of surgeons</th>
<th>Percentage of surgeons performing &lt;=10 operations per year</th>
<th>Percentage of operations by surgeons performing &lt;=10 operations per year</th>
<th>Percentage of surgeons performing 11-20 operations per year</th>
<th>Percentage of operations by surgeons performing 11-20 operations per year</th>
<th>Percentage of surgeons performing 21-80 operations per year</th>
<th>Percentage of operations by surgeons performing 21-80 operations per year</th>
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</thead>
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<tr>
<td>2011</td>
<td>891</td>
<td>139</td>
<td>80.6%</td>
<td>40.1%</td>
<td>12.9%</td>
<td>29.5%</td>
<td>6.5%</td>
<td>30.4%</td>
</tr>
<tr>
<td>2012</td>
<td>951</td>
<td>148</td>
<td>81.1%</td>
<td>38.3%</td>
<td>10.8%</td>
<td>25.0%</td>
<td>8.1%</td>
<td>36.7%</td>
</tr>
<tr>
<td>2013</td>
<td>963</td>
<td>152</td>
<td>80.9%</td>
<td>39.7%</td>
<td>11.2%</td>
<td>26.5%</td>
<td>7.9%</td>
<td>33.9%</td>
</tr>
<tr>
<td>2014</td>
<td>844</td>
<td>138</td>
<td>78.3%</td>
<td>30.3%</td>
<td>15.9%</td>
<td>40.9%</td>
<td>5.8%</td>
<td>28.8%</td>
</tr>
<tr>
<td>2015</td>
<td>830</td>
<td>148</td>
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<td>39.5%</td>
<td>12.8%</td>
<td>35.2%</td>
<td>4.7%</td>
<td>25.3%</td>
</tr>
</tbody>
</table>

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

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

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.

- Coxarthrosis: 6990
- Fracture: 488
- Secondary Coxarthrosis: 144
- Osteonecrosis: 99
- Inflammatory arthritis: 92
- Other: 94

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

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

- Coxarthrosis: 7634
- Inflammatory arthritis: 141
- Other: 48
- Fracture: 46
- Osteonecrosis: 7
- Secondary Coxarthrosis: 5

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.
Figure 5c – Principal pre-operative conditions hip revision in 2015.

- Mechanical complication of internal joint prosthesis: 459
- Fracture bone flap internal joint prosthesis/bone plate: 73
- Infection and inflammatory reaction due to internal joint prosthesis: 63
- Oth comp int orthopaedic prosth devs implants & grafts: 40
- Other specified orthopaedic follow: 39
- Pain in joint: 21
- Fracture of neck of femur: 19
- Unsp comp int orthopaedic prosth dev implant & graft: 11
- Coxarthrosis, unspecified: 9
- Mech comp of internal fixation device of bones of limb: 8
- Inf inflam reac due oth int orth prosth devs impls & grfts: 7
- Other primary coxarthrosis: 6
- Fracture of shaft of femur: 6
- Other: 64

Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals.
**Figure 5d** – Principal pre-operative conditions knee revision in 2015.

- **Mechanical complication of internal joint prosthesis**: 231 cases
- **Infect and inflammatory reaction due to internal joint prosthesis**: 60 cases
- **Oth comps int orthopaedic prosth dev implants & grafts**: 47 cases
- **Other specified orthopaedic follow-up care**: 43 cases
- **Gonarthrosis, unspecified**: 26 cases
- **Pain in joint**: 12 cases
- **Fract bone flg ins orthopae impilt int prosthesis/bone plate**: 8 cases
- **Other**: 43 cases

*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

![Graph showing national rates for complications within 1 year: hip arthroplasty](image)

- **Blue line**: dislocation within a year
- **Light blue dots**: infection within a year

*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

![Graph showing national rates for complications within 90 days: knee arthroplasty](image)

- **Red line**: DVT/PE within 90 days
- **Pink dashes**: death within 90 days

*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

![Graph showing national rates for complications within 1 year: knee arthroplasty.](image)

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

![Graph showing acute renal failure after 30 days: hip and knee arthroplasty.](image)

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

**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

**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

![Graph showing percentage of 2015 hip arthroplasty patients who died within 90 days.](image)

*Scottish Rate averaged over 5 years 2011-2015.*

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

![Graph showing percentage of 2015 knee arthroplasty patients who died within 90 days.](image)

*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.

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

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.
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

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).

![Graph showing percentage of revisions within 7 years for different hospitals.](image)

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 22e—Percentage of 2008 primary hip arthroplasty patients with subsequent revision within 7 years (total hip replacement).
Figure 22f—National rates for complications within 90 days: hip revisions.

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

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

![Graph showing national rates for hip and knee arthroplasty with subsequent revision](image)

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

![Graph showing national rates for acute renal failure within 30 days](image)

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.’

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

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

6.3 Quality Improvement through Case Review and Action Plan

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

Comments, case reviews and audit 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 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


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:

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**
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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.