Scottish Arthroplasty Project

Annual Report 2005

Contents

1. Key Points

1. The number of primary hip and knee replacements continues to rise with primary knee replacement increasing by 23% over 4 years in the National Health Service. While it is anticipated that the number of total hip replacements (THR) will continue to rise slowly matching demographic changes total knee replacement will become more common than THR within the next three years as the UK catches up with trends in other developed countries. **Section 3.2**

1.a. The number of knee and hip and revision surgeries (8% of total joint surgeries) may be reaching a plateau and is comparable with other countries. **Section 3.2**

2. The mean length of stay for primary hip replacements has gone from 16 days to 9.8 days and primary knee replacements from 17.9 days to 9.4 days in 10 years. As a result, while the number of arthroplasty operations has increased by 44%, the total bed days occupied by arthroplasty patients have reduced by 17%. **Section 3.3**

3. If all hospitals achieved their objective for submitting SMR01 records this report would be six months more up-to-date and complete. **Section 3.1.1**

4. No records from the private sector have been captured. Data capture arrangements have not worked for NHS waiting list patients in the private sector (however, such cases are being submitted by the Golden Jubilee Hospital). **Section 3.1.2**

5. The percentage of primary and revision surgeries carried out by surgeons who perform appreciable numbers of arthroplasty continues to improve and compares favourably with the USA. **Sections 3.4 and 7.10**

6. Complication rates following surgery remain low and are comparable with other countries. The project continues to develop its approach to this analysis. **Section 6**

7. A formal Clinical Governance structure has been developed and all results reviewed. No surgeon has refused to take part. **Section 3.5**

8. New analyses, including acute myocardial infarct, gastro intestinal bleed and stroke following surgery have been explored and accepted as indicators of patient selection and as markers of perioperative management These additions reflect the contributions of the wider arthroplasty team, in particular the anaesthetic contribution. **Section 3.6**

9. Further detailed analysis of shoulder and elbow replacement has shown a surgeon volume effect for elbow replacement but not for shoulder replacement. More detail on both procedures will be sought. **Section 7.2**

9.a. Further analysis of dislocation following hip replacement for fracture has shown the Scottish rate to be 3.9%, twice that following THR for OA (1.9%). **Section 7.3**

10. Work on creating a national joint registry continues but progress has been slow. **Section 4**

2. Introduction

In 2005, the Scottish Arthroplasty Report concentrates on the analysis of routine data as in previous years and introduces some new studies on activity and long-term results. Reference should be made to the more comprehensive 2004 report if more explanatory or background material is required. Complete versions of this report and all previous reports can be found at (www.show.scot.nhs.uk/arthro).

The Scottish Arthroplasty Project's principle aim is to encourage continual improvement in the quality of care provided to arthroplasty surgery patients through the auditing of routinely collected national data in Scotland. The data are collated and analysed centrally, then returned to the individual surgeon or hospital to allow local investigation and interpretation to be carried out; and to feed into the local and national audit process. At an individual level we advise that patients can ask their surgeon to reveal his own results during the process of consultation. This will allow both parties to discuss the implications of surgery for the patient using the surgeon's own results and the patients medical condition(s), a basic tenet of consent. The Project itself does not disclose individual surgeons (or patients) identity at any stage. Any results which vary significantly from the expected high level of care are reviewed through a process of local consultation and central anonymous reporting. This year we have formalised this reporting structure.

The Freedom of Information (Scotland) Act 2002 came into force on 1st January 2005. The Act has important implications for all projects that gather data for the purpose of improving safety and quality of health care. The Act aims to increase openness and give everyone the right to access information which is held by Scottish Public Authorities. Data gathering for audit in the NHS in Scotland is, legitimately, undertaken on the basis of implied consent and patients are now being provided with much more information on how their data are used to improve the quality and safety of the health care they receive. It is very important that the Annual Report, which is published in the public domain, does not undermine the rules of confidentiality and anonymity for patients and consultants. These rules have been rigorously applied throughout this project. In keeping with progress towards the open publication of information, NHS Board-level data is identifiable this year.

This year the NHS Board and consultant level charts in the 2005 Annual Report have taken some account of case-mix. This allows more meaningful comparisons to be made by acknowledging some of the complexity of the cases. The initial case-mix adjusters used in the Annual Report are: age; sex; admission from home or other place of residence (e.g. nursing home); rheumatoid arthritis; and deprivation. The results are therefore presented as complication rates rather than actual numbers of complication. Further improvement will require additional clinical information. This will be addressed by the new comprehensive data set we are seeking, so far unsuccessfully, from operating theatre systems.

We recognise that arthroplasty surgery relies on a team to achieve good results. Outcomes, good or bad, result from many individuals actions throughout an episode of care. This year we have included some preliminary work with our anaesthetic colleagues looking at post-operative morbidity. This section should be seen as work in progress. Next year, following feedback on the analysis this year, we hope to produce information which will prove helpful in audits of perioperative medical care.

3. Data Analysis

3.1. *Data Completeness*

3.1.1. SMR01 Data Completeness

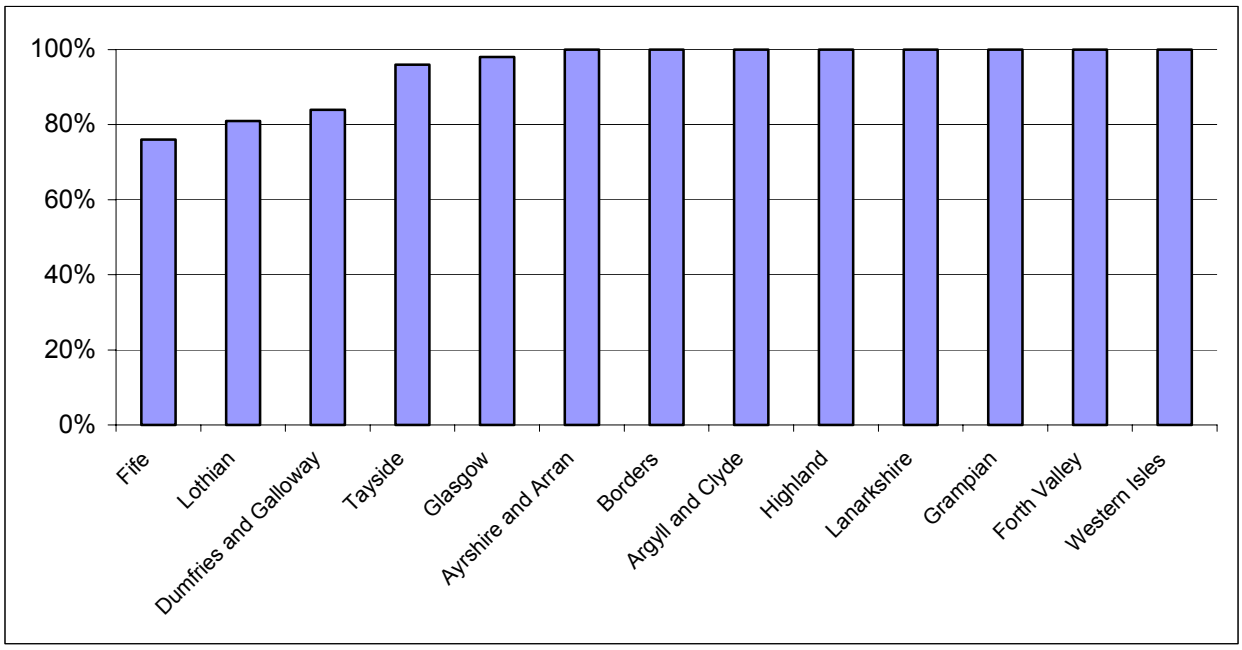
Hospitals send the SMR01 records, used by the Scottish Arthroplasty Project to the Information Services Division (ISD) retrospectively. The national standard states that these records should be sent to ISD within 3 months of a patient's discharge from hospital. In practice, the majority of SMR01 records are submitted within 6 – 9 months of a patient's discharge. Details about how data completeness is determined can be found in section 4.2 of the 2004 annual report.

The latest data in this report are for patients treated in hospital between 1st April 2003 and 31st March 2004.

Figure 1 illustrates why more up to date orthopaedic data cannot be used. Orthopaedic data from April - June 2004 from several NHS Boards are not complete enough to make the use of this data viable.

ISD conducts a routine 2% case note review to ensure that the quality of coding remains high. We are confident that the record sets that are used are sufficiently complete and accurate to make statistically valid conclusions.

Figure 1 – NHS Board data completeness for orthopaedic SMR01 episodes occurring between April 2004 and June 2004 (as at February 2005).



3.1.2. Data from Private Hospitals

It is disappointing that we are unable to monitor results in this growing sector. We believe that private patients would want to ensure that their surgeon's performance is monitored in the same rigorous way as the NHS monitors performance. We hope that the private sector will submit meaningful data to the Scottish Arthroplasty project in the near future.

There are a growing number of patients who have their hip or knee replacement carried out at a private hospital. This is either as a private patient, or as an NHS patient being treated under a waiting list initiative. The NHS Board that contracts out the operations to the private sector is responsible for submitting the SMR01 records of those patients who are treated under the waiting list initiative. These records are not reliably returned at present. ISD and the National Waiting Times Unit at the Scottish Executive have taken up this issue. ISD has reminded NHS Board Chief Executives of the requirement to submit SMR01 and an updated Health Department Letter (HDL) is planned to restate the requirement on NHS Boards to submit these records. The private hospitals will be expected to produce routine counts of NHS patients treated in order to enable the volumes of SMR01 forms submitted to ISD to be monitored.

Ultimately, patient referral communication from NHS to private hospitals is likely to become electronic and provide an opportunity to establish direct submission of SMR data from private hospitals to ISD. The private sector is already beginning to become involved in thinking about submitting SMR01 records to ISD electronically. As a first step towards this, one private hospital will soon begin collecting the Scottish Joint Registry dataset on all hip and knee patients that they operate on, both through the NHS and privately using an Access database.

3.2. *National Trends in Numbers of Operations*

Figure 2 to 5 represent the numbers of elective and emergency joint replacement operations (both primary and revision for hip and knee) recorded as performed in NHS Scotland in each of the last 13 years (1992 to 2004). The vast majority of operations were performed as an elective procedure. (Around 94% of primary hip replacements, 98% of primary knee replacements, 78% of revision hip replacements and 89% of revision knee replacements). All numbers are displayed by year ending March.

There was a steady increase in volumes of primary and revision hip procedures performed from 1992 to 1999. Since that time, the volumes of primary hip procedures have increased only slowly (approximately 4500), but the number of revision hip procedures has shown a slight but consistent fall (870 to 760). (It is likely that there have been a significant number of primary hips carried out for the NHS in the private sector but we have no knowledge of the absolute number or their outcomes). The total activity in the private sector may account for twenty percent of the arthroplasties performed annually in Scotland.

The number of primary knee procedures continues to rise year on year. Primary knee replacements have increased by 23% since 2000 (2967 to 3875). There was a steady increase in the number of revision of knee replacements from 2000 until 2003 (237 to 306) with a slight fall in 2004 (275); we hope that this reduction will be maintained in future years.

It is good to see a continuing downward trend in the revision of hip replacements. The majority of arthroplasty revisions are carried out many years after the initial procedure, therefore the rise in knee revisions (and fall in hip revisions) reflects the number of primary procedures carried out several years ago. Scotland's knee revision rate (8%) is comparable with other countries (Swedish Knee Register, 2004).

Further arthroplasty activity trend charts can be found in Appendix 2 (shoulders and elbows) and Appendix 9 (fingers, wrists, thumbs, toes and ankles) at (www.show.scot.nhs.uk/arthro).

Figure 2 - Primary Hip Replacements by year ending March

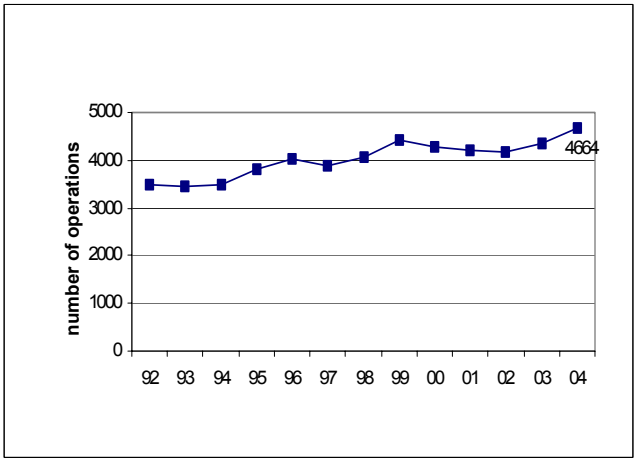


Figure 3 - Primary Knee Replacements by year ending March

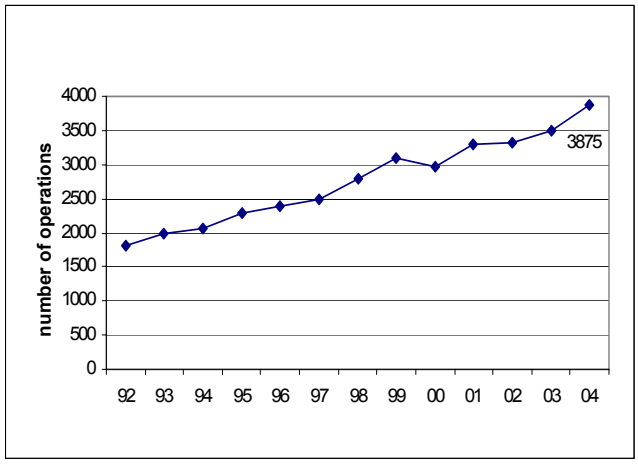


Figure 4- Revision Hip Replacements by year ending March

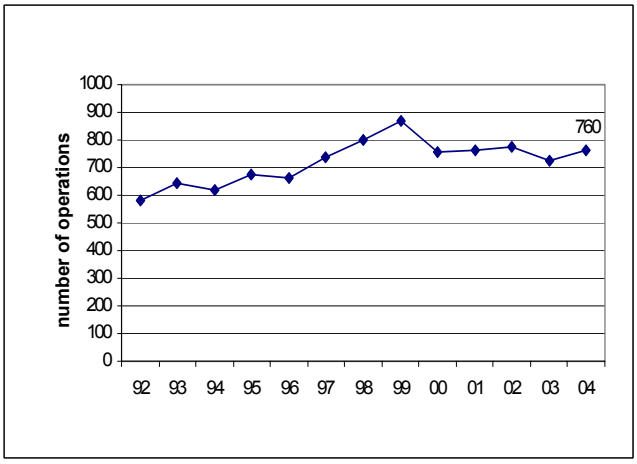
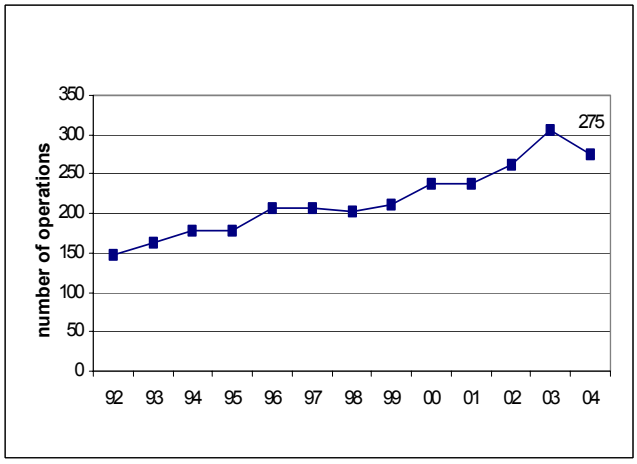


Figure 5 – Revision Knee Replacements by year ending March



3.3. *Average Length of Stay Analysis*

Figure 6 and 7 show the average length of stay for elective primary hip and elective primary knee replacements respectively in each of the last ten years (1995 to 2004). All numbers are displayed by year ending March.

There was a steady decrease over the decade in both median (mid-value) and mean (average) for each type of replacement. The median length of stay for hip replacements decreased from 14 in 1995 to 8 days in 2004 and the mean decreased from 14.7 to 9.1 during the same period. The median length of stay for knee replacements decreased from 15 in 1995 to 8 days in 2004 and the mean decreased from 16.2 to 8.9 during the same period. The higher mean relative to the median for both hip and knee replacements is indicative of skewed longer length of stay when a patients discharge is delayed by the development of medical or social problems. The data presented are at national level. For information at NHS board level please consult Appendix 11 in the full report.

Figure 6- Average Length of Stay per Continuous Inpatient Stay for Hip Replacements by year ending March

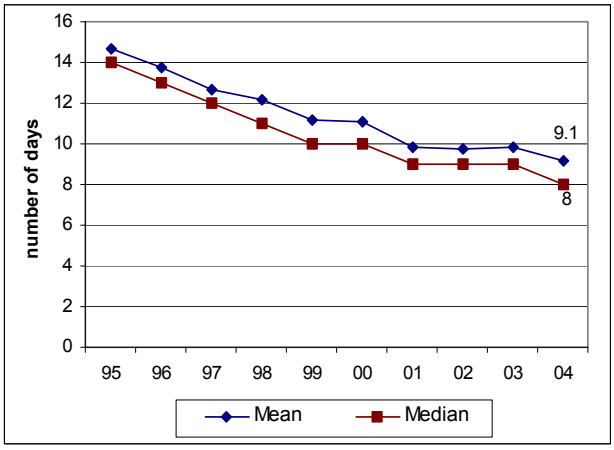
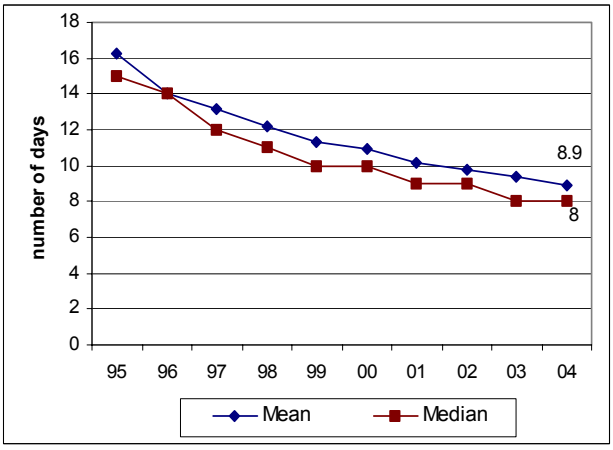


Figure 7 - Average Length of Stay per Continuous Inpatient Stay for Knee Replacements by year ending March



3.4. *Operations performed by Surgeons Carrying Out Small Volumes of Procedures per Year*

Figure 8 and 9 represent the number of primary and revision operations carried out by a surgeon doing less than a specified number of similar operations. This year the limits are 20 and under for primary hip and knee replacements, 10 and under for revision hip replacements and 5 and under for revision knee replacements.

There was a minor increase in the percentage of primary hip replacements being done by a surgeon carrying out 20 or less similar procedures per year since 1999 (11.3% to 14.5%) but overall the numbers of consultants performing this number are low. During the same period the percentage of primary knee replacements being done by surgeons carrying out 20 or less similar operations per year has fallen overall (27.1% to 20.6%) perhaps reflecting greater specialisation.

The percentage of surgeons performing 10 or less revision hip replacements and 5 or less revision knee replacements per year has remained fairly stable for the last 5 years (approximately 45% for hips and 55% for knees).

These charts do not take account of surgeons who are not operating throughout the year e.g. retrials, new appointments, and sabbaticals. If there is a change in the numbers joining and leaving each year this may have an effect on the comparison between years. It is proposed to investigate this further next year. Further analysis showing the number of arthroplasty procedures performed per surgeon for the year ending March 2004 can be found in Appendix 10.

Figure 8 - % of hip replacements by surgeons carrying out small volumes of procedures per year

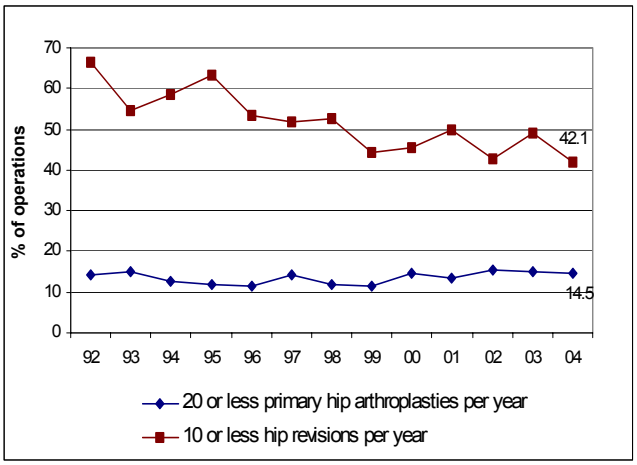
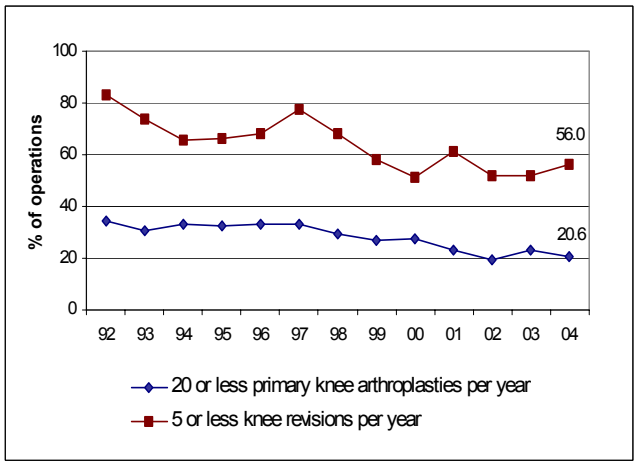


Figure 9 - % of knee replacements by surgeons carrying out small volumes of procedures per year



3.5. *Clinical Governance Policy and Results*

The Scottish Arthroplasty project uses routinely collected data, in a confidential way to inform change through local review and appraisal. Confidentiality brings with it responsibility. The Arthroplasty Project together with the orthopaedic community (SCOT) has developed a process of review to ensure that any results which appear to vary from normal are interpreted at a local level to apply appropriate knowledge and ensure local action. All outlying results are followed up and local review requested. This constitutes the Clinical governance policy.

Data regarding volume and type of activity is augmented by rates for complications including deaths, revisions, infections, venous thrombo-embolism and dislocation over a rolling five-year period. The aim is to provide centrally collated data of all activity in Scotland with identifiable limits of performance to enable local investigation of results which lie out-with agreed levels.

The process has undergone continued development since its inception. Initially crude rates of complications were provided but they are of limited use in comparing individuals, or groups of individuals each with varying practices. Initially Shewhart control charts and now Standardised Complication rates (Funnel Plots) are employed to make more accurate assessments.

To date, data has been reviewed for revision, dislocation, infection and thrombo-embolism. Mortality following surgery is appropriately investigated by The Scottish Audit of Surgical Mortality (www.sasm.org.uk).

Since 2003, consultants and NHS boards identified with rates outlying “normal” variation have been contacted and asked to investigate all possible causes for these apparent anomalies at a local level. The process is entirely anonymous (protocol in the 2004 Annual Report – section 6.1). The outliers are provided with a summary of the cases contributing to their outlying data to enable local review. The Arthroplasty Project then expects that a thorough local investigation to be instituted to review the information, reasons for any apparent variation to be identified and an action plan written to address any issues arising. The response is then co-signed by an appropriate local medically qualified colleague who accepts responsibility for its accuracy and appropriateness.

It is important to emphasise that the techniques used to identify outlying results are statistical. Therefore a number of individuals will always be asked to review their data. This does not mean that the individual results are necessarily poor. A detailed paper on this issue has recently been published (Harley et al, 2005)

Table 1: Summary of Consultant Outliers

Report Year	Outlying Points	Outlying Consultants	Retired or Elsewhere	Mortality Outliers SASM	Also Outliers in 2003	Also Outliers in 2004	New Consultant Outliers
2003	33	32	15	2			15
2004	33	32	13	5	4		10
2005	26	24	7	6	4	11	7

In the first two completed audits the medically qualified staff on the Steering group together with data staff reviewed the responses, including any action plan. A formal reply was then sent to the outliers with an indication to its appropriateness. Anyone with an unacceptable response was required to review the information and provide a further response. Often data corrections were accepted, additional information provided or indications given regarding the process. Less than satisfactory responses were usually due to the lack of a co-signatory or inadequate review of the data provided. In all cases a copy of the committees response was forwarded to the co-signatory.

Table 2: Summary of Consultant Outlier Responses

Report Year	New Consultant Outliers	Outlying Points	Response	Less than Satisfactory	Better than Satisfactory
2003	15	16	15	1	14
2004	10	11	10	3	7
2005	7	8	tba	tba	tba

The results of the initial cycles were extremely useful in refining the process. It should be noted that in four cases consultants recorded a change in practice as a result. Additionally, it became clear that the process of review could be formalised. Detailed review of individual medical practice was not as important as the response to, and action arising from, our enquiries. This suggests that the audit process and the orthopaedic community is progressing towards accepting "The burden of improvement"

"Burden of Improvement": Illustration

Four Stages of Facing Reality – Outliers Response

- Stage 1 - "The data are wrong"
- Stage 2 - "The data are right, but it's not a problem"
- Stage 3 - "The data are right; it is a problem; but it's not my problem."
- Stage 4 - "I accept the burden of improvement"

(Institute of Healthcare Improvement Boston Mass)

In the current audit, a more formal assessment and outcome reply from the committee is proposed. It is also thought appropriate that the whole committee (including lay members) should review the responses from the consultant and board outliers in open forum. The process will remain anonymous with no members of the committee knowing the source of any response or the recipients of the committee's replies.

Proposed Assessment of Response by Outliers

- Promptness of Response
- Presence of:
    a) Assessment of data quality
    b) Informed criticism of results through local audit
    c) Appropriate action plan to address issues arising from analysis
- Document Co-signed by Consultant Colleague

Proposed Outcomes to Response by Outliers

- Exemplary - Constructive response with evidence of progress
- Excellent - Constructive response
- Satisfactory - Minimum requirement
- Less than satisfactory - Unacceptable

A similar process occurs with NHS Board data but the information is sent to the Chief Executive. Following an appropriate investigation the Action Plan is co-signed by the Chief Executive and the appropriate Clinical Director (further information in the 2004 Annual Report – section 6.2.2).

Table 3: Summary of NHS Board Outliers

Report Year	Outlying Points	Outlying Boards	Also Outliers in 2003	Also Outliers in 2004	New Board Outliers
2003	7	4			4
2004	6	5	3		2
2005	5	4	3	3	1

The initial response to the 2003 data was disappointing; with only one board responding within the time frame, and one has not responded to date. In keeping with the previous structure created to deal with non-compliance the Chief Executive was informed and action taken. Two of the three responses were regarded as less than satisfactory. In 2004, both boards responded and they were classified as satisfactory. NHS QIS has shown interest in formalising the use of this data as part of a hospital governance process. The process for 2005 has been initiated and will follow the procedures outlined above.

Table 4: Distribution of Outlying Points in Seven New Consultant Outliers - 2005

Dislocation within 365 days following THR	1
Infected prosthesis within 365 days following THR	3
DVT/PTE within 90 days following THR	2
Infected prosthesis within 365 days following TKR	1
DVT/PTE within 90 days following TKR	1

It is envisaged that there will be further development of the process. It is limited by the necessity to use a rolling five years of historical data for each consultant to obtain statistical validity. As a result, once identified as an outlier, it will take some time to observe change. The use of run charts to identify the presence and timing of any peaks in outlying activity, and hopefully any response to change, may be more useful and act as an early warning system for system failure. These and other statistical methods will be explored to review, and report on, outstanding results.

The Clinical Governance process enables units and individuals to investigate their results at a local level. Certain themes and misconceptions have been identified and have been recurring.

- Data Quality is often questioned. Effectively this is a local issue and must be addressed at that level. The project can only work with the information provided via the SMR01 system. Errors at this level do reflect on the performance of the individual unit and require remedy.

- Consultants or units solely identify data errors then claim that their figures now lie within the control levels. While data errors are important, this is unhelpful. There are likely to be as many false positives in the general dataset providing the mean as false negatives in the individual results (because of the poor data recording at a local level identified by the reporting group). It is essential that all cases be reviewed to maximise the potential benefit of the audit.

- Case mix issues will often have an impact on the number of complications arising. This has been addressed partially in the Standardised Funnel Charts in the current report. These are corrected for age, sex, domicile, rheumatoid arthritis and deprivation. It is important that any other factors are identified during the review procedure to help explain any variance.

- Changes in practice were cited in a number of responses. Introducing a new element to the operation may result in an increase or decrease in the complication rate. This may relate to the surgical technique, type of implant, anaesthetic care, or peri- and postoperative care. Supervised and unsupervised non-consultant operations may have an impact but are a reflection on an area of the consultant or unit practice. Often a problem has been identified prior to the provision of the data and this often means that there is a clear action plan and

evidence given of progress subsequent to its implementation. While this level of detail is of interest in the response, the SAP takes the view that the patient wants the result to be good whatever the package of care and that the reporting unit is responsible for the total package of care.

- A small number have used the data to support cessation of arthroplasty surgery to devote their time to a different specialist interest. Most surgeons now use the data as part of the appraisal process.

It is hoped that the governance process will spur all surgeons to review their practice and that this process will have a beneficial effect on the care of all patients.

3.6. *Investigation into Anaesthetic Complications*

The Scottish Society of Anaesthetists has agreed to participate in the Scottish Arthroplasty Project. A multidisciplinary approach to the perioperative care of patients undergoing joint replacement is instrumental to their optimal management. Perioperative complications are usually multi-factorial but there is no doubt that pre operative assessment of risk and anaesthesia are a key contribution to outcome

The anaesthetic assessment of patients undergoing joint replacement may be very difficult. The nature of their orthopaedic problems (and resultant limitations in mobility) may render accurate assessment of their cardio-respiratory function impossible. This makes the pre-operative discussion of "risk" for the individual patient difficult and confusing. It is in the area of risk assessment and perioperative cardiovascular health that the influence of the anaesthetist is greatest. At present there are no reliable figures for complication rates relating to cardiovascular events (one of the commonest perioperative problems which are life threatening) following orthopaedic surgery for Scotland as a whole or for individual units.

The analysis of complication rates in this report and previous reports has mainly concentrated on complications arising from the actual type of surgery undertaken (dislocation, infection or revision). This year complications which may be more closely associated with pre-operative assessment or perioperative care have been investigated. We have concentrated on the following conditions following hip or knee replacement

- acute myocardial infarction (AMI) within 30 days following surgery;
- stroke within 30 days following surgery; and
- gastro-intestinal bleeds within 30 days following surgery.

These complications were chosen because they reflect the complications which cause most concern to the patients (AMI and stroke) or which may result from analgesic use or anticoagulation (gastro-intestinal haemorrhage). The control charts in sections 6.1 and 6.2 showing standardised rates for mortality and DVT/PE are also relevant to the investigations of anaesthetic complications. Further work in examining other complications (e.g. renal failure) or relating the type of anaesthesia provided to outcome may also be relevant and will be investigated in later years.

For each of these outcomes, Shewhart control charts are presented for both elective primary hip and elective primary knee replacements. Each cross in Figure 10 to 15 shows the actual number of complications for an NHS Board in Scotland. The upper control limit is taken to be 3 standard deviations above the expected complication rate. We have chosen Shewhart charts, as we did originally for the other complications following joint replacement, because they have given us a clear indication of general levels of problems. Further work could be to adjust for case mix and examine complication rates, however we have investigated other ways of presenting the data.

"Run charts" allow analysis by NHS Board over time (local factors may lead to clusters of complications at particular periods even though overall complication rates are well within "accepted" limits).

Figure 16 and 17 show the proportion of hip replacements, in each quarter over the five years April 1998-March 2003, where the patient had an AMI up to 30 days following surgery. The charts also include the actual number of AMIs that occurred to show the trend. Using this type of data presentation small clusters of events could be investigated looking for a recent change in practice to explain the figures. Only a few cases would have to be reviewed.

In the sample charts Board X remains "in control" throughout but the warning trigger is broached in quarter 18. We would expect the notes of those patients to be reviewed. Board Y has a period (Quarter 8) when the upper control limit is broken. We would consider requesting information on the investigation of the anomaly forwarded as part of the governance process.
Unfortunately the data is historical but clear lessons may be deduced at a local level for limited audit effort. SAP is investigating other statistical techniques to give a more up to date record of events (see Section 3.7).

More detailed information on the use and interpretation of run charts can be found on the Clinical Indicators Support Team's website at
www.show.scot.nhs.uk/indicators/Tutorial/TUTORIAL_GUIDE_V4.pdf

Figure 10 - Observed and expected number of AMIs in NHS Boards within 30 days following primary hip replacements

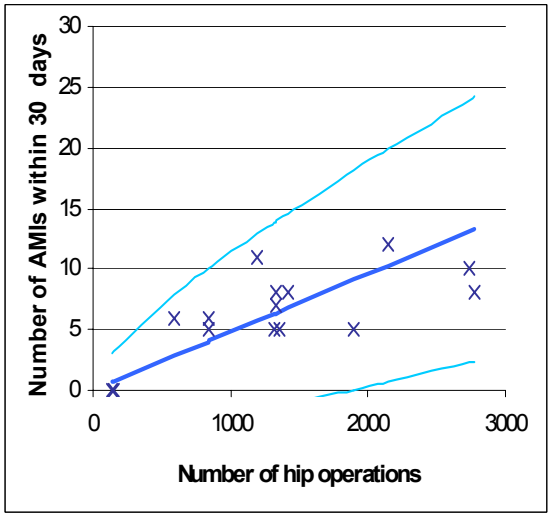


Figure 11 - Observed and expected number of AMIs in NHS Boards within 30 days following primary knee replacements

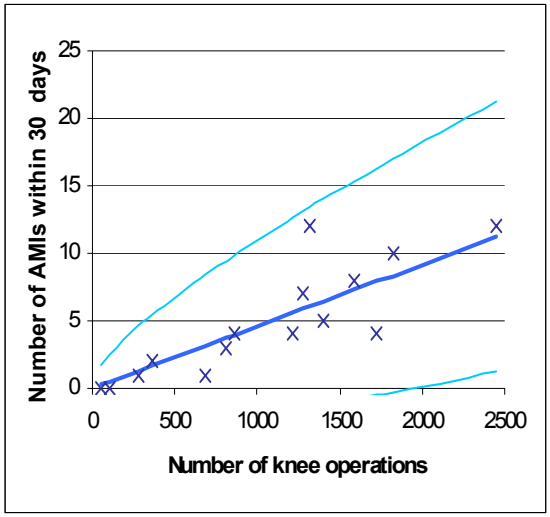


Figure 12 - Observed and expected number of strokes in NHS Boards within 30 days following primary hip replacements

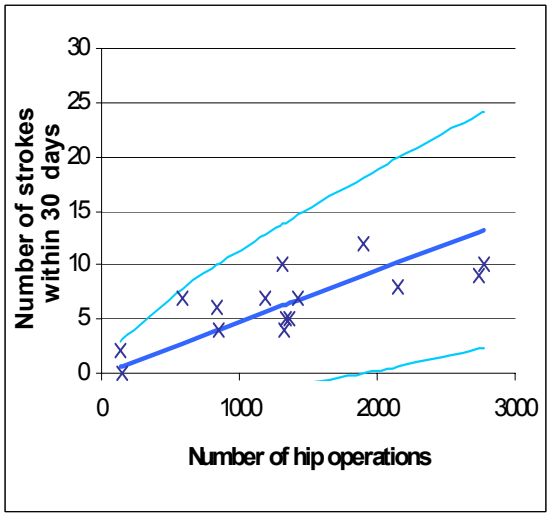


Figure 13 - Observed and expected number of strokes in NHS Boards within 30 days following primary knee replacements

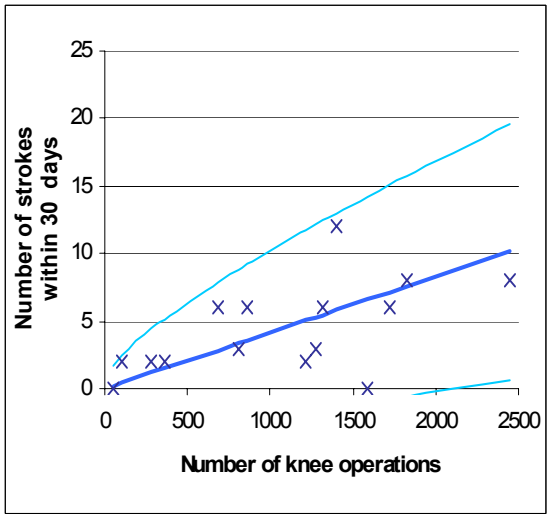


Figure 14 - Observed and expected number of GI bleeds in NHS Boards within 30 days following primary hip replacements

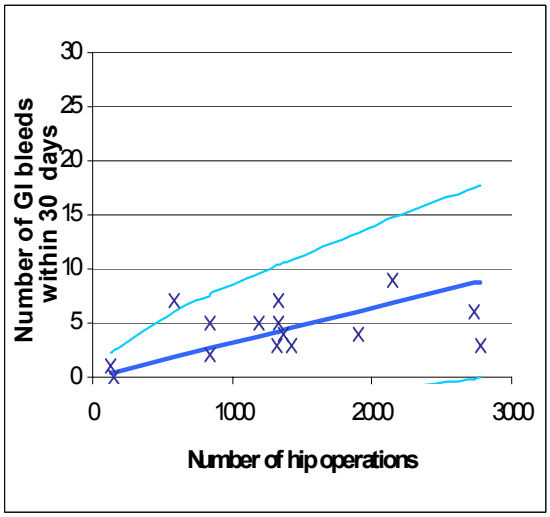


Figure 15 - Observed and expected number of GI bleeds in NHS Boards within 30 days following primary knee replacements

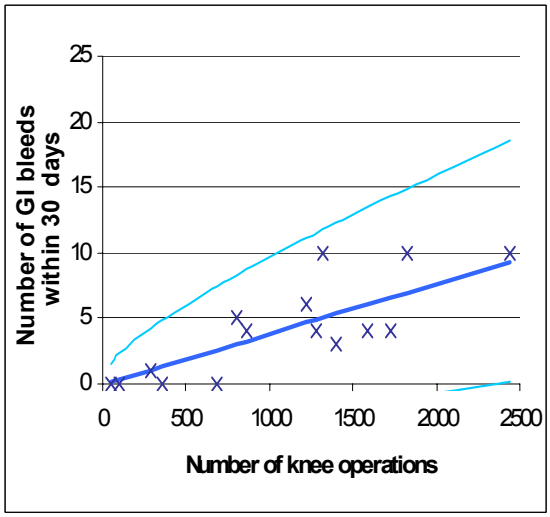


Figure 16 – Proportion of AMIs within 30 days following hip replacements in April 1998-March 2003 Board X

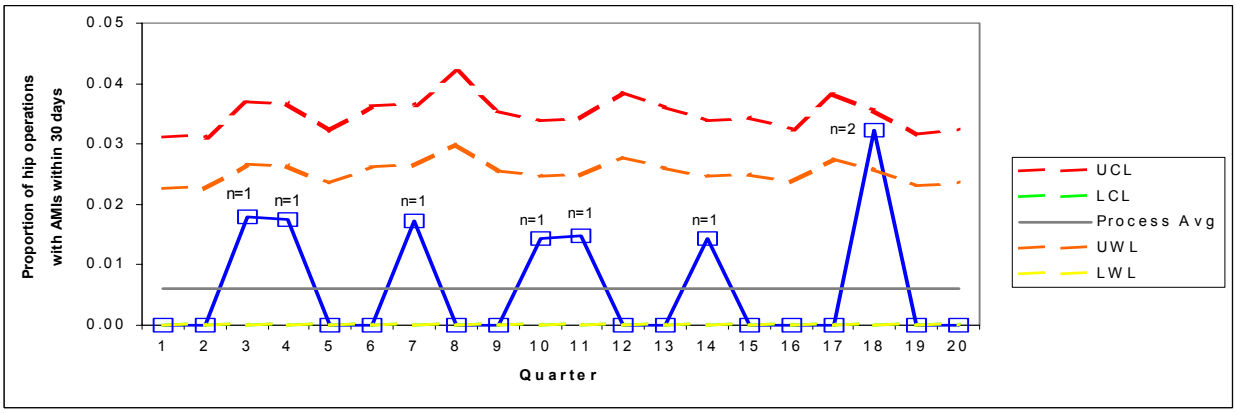
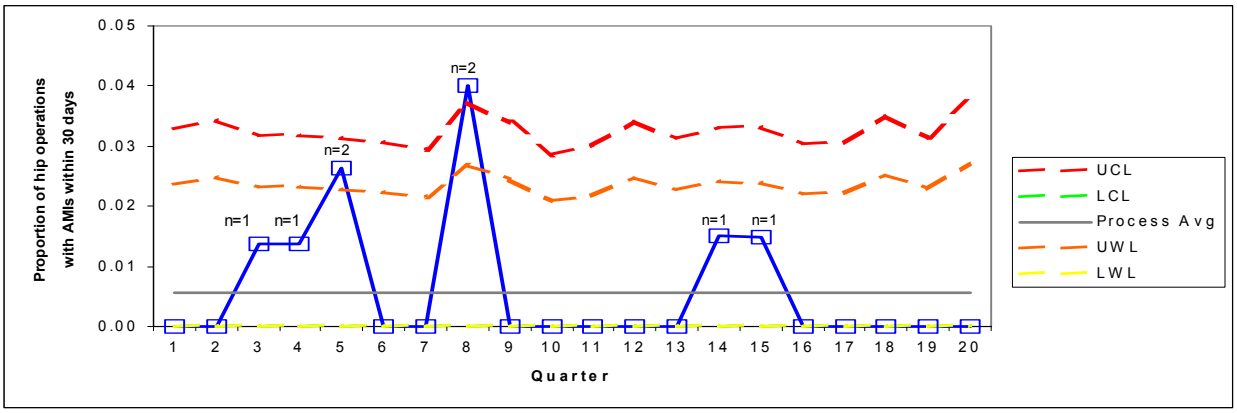


Figure 17– Proportion of AMIs within 30 days following hip replacements in April 1998-March 2003 Board Y



3.7. *Work being undertaken to further investigate complications – The Sequential Probability Ratio Test*

Previous analyses have presented complication rates using control charts. With this approach however, due to the small number of complications, five year's worth of data needs to be considered to discover anything of significance. This means that surgery that occurred any time up to 7 years ago is being focused upon (allowing for the fact that the complications are anytime up to a year after surgery and allowing time for the analysis and publication of the reports).

Wald's Sequential Probability Ratio Test (SPRT)[1] takes a different approach and allows consultants to monitor their own performance in real time. Operations are arranged in chronological order. Those for which there was a complication of interest are flagged. The cumulative number of complications versus the number of operations in sequence are then plotted. An alert line is added to the chart and if the alert line is crossed this should act as an early warning that a review may be needed.

It is hoped that a tool can be built to allow consultants to monitor their own performance prospectively. Work is ongoing to produce a tool for SPRT similar to that available on the Clinical Indicators Support Team's website for run and control charts at http://www.show.scot.nhs.uk/indicators/Tutorial/Main.htm.

[1] Wald, Abraham (1947) 'Testing the mean of a binomial distribution' in Sequential Analysis, Dover Publications, Chapter 5 pp 88-105.

4. An update on the Progress Towards a Scottish Joint Registry

The Scottish Arthroplasty Project's (SAP) current aim is to develop a more clinically detailed dataset that can be used both nationally and locally – a Scottish Joint register (SJR). In keeping with previous work, the aim is to utilise existing information stored as part of the care process on theatre management systems across NHSScotland. Taking the English National Joint Register (NJR) dataset as a basis, SAP have developed a SJR dataset that can be collected from local theatre systems and electronically sent to the Information Services Division (ISD). Here this dataset will be linked to the national SMR01 database, to produce a powerful, clinically useful dataset.

Pilot sites are being sought to test the collection of the SJR dataset before it is rolled out to the rest of NHSScotland. A previous scoping study in 2003 showed that the majority of the data points are currently collected electronically in Scotland (but not at all sites or using common definitions, see SAP report 2004). Currently, three sites have agreed to pilot the project, and are working towards being able to collect the data and transmit it to ISD.

Progress so far has been limited to approval by the orthopaedic community; development of defined, centrally approved dataset; a process of data collection, integration and verification centrally and contact with three sites where the theatre groups are interested in co-operating. However, with the many conflicting pressures inherent in the NHS we have been unable, despite some available start up funds and local enthusiasm, to progress beyond expressions of interest.

5. Acknowledgements

The Scottish Arthroplasty Steering Committee would like to thank; Miss Harriet Hughes of ISD, for coordinating the Scottish Arthroplasty Project for over 2 years; and Ms Fiona Campbell, for her statistical advice especially on the subjects of standardisation and Kaplan-Meier survival curves.
In addition, the Committee would like to acknowledge the helpful contributions of Ms Katy Duff and Ms Claire Williams who have stepped into the breach and supported the Project while a new project manager is sought.

6. Complication Rates

For the third year, complication data are presented for four different outcomes following elective primary hip or knee replacement:

- dislocation of the joint within 365 days following surgery (for hips only);
- infection (both superficial and deep) of the joint within 365 days following surgery;
- death within 90 days following surgery; and
- deep vein thrombosis/pulmonary embolism (DVT/PE) within 90 days following surgery.

The diagnostic code used to identify an infected prosthesis does not differentiate between deep and superficial infection. This can often be difficult to determine clinically. The International Classification of Diseases (ICD10) codes used to code medical records do not distinguish the severity of an infection.

In previous years, these data have been presented using control charts (see section 5.1.3. 2004 annual report) which displayed the complication data simply by plotting the number of complications against the number of procedures performed. It was decided to develop this analysis by standardising the data for case mix, using all the possible variables available on the national dataset. This method was investigated last year and an example presented in section 6.3 of the 2004 annual report. This year, all the data have been standardised for;

- age;
- sex;
- admission from home or other place of residence (e.g. nursing home);
- rheumatoid arthritis; and
- deprivation.

The standardised data are now presented as complication rates, not as actual numbers of complications. This results in control charts that have a funnel shape to them (funnel plots).

This year, those consultants and NHS Boards who lie outside the upper control limit for the first time (three standard deviations above the expected complication rate) and those who have been outlying for 3 years in a row will be invited to participate in a review of the cases making up this year's outlying number. The purpose of this is to review these figures under the umbrella of clinical governance, with the emphasis on quality improvement and not on attributing blame. Indeed, although we appear to analyse to a surgeon level, the data represents the whole process of care not just the actions of one individual. In many cases the issues may relate to coding problems rather than actual complications.

6.1. NHS Board Data for Complications Following Elective Primary Hip Replacement

Figure 18 to 21 represent the complication rates for patients following elective hip replacement between April 1998 and March 2003. Each cross represents the complication rate for an NHS Board in Scotland (for the label key and explanation of features see page 26). Those Boards that are outlying for the first time and those outlying for a third year in a row will be contacted to explore the reasons for these complication rates. Those boards that are outlying for a second year will not be asked to reinvestigate the data, but will be monitored over the forthcoming years. This is due to the historical nature of the data and the fact that it is 5 years aggregated data which would take some time to show change in complication rates.

NHS Board Data for Complications Following Elective Primary Hip Replacement (April 1998 – March 2003)

NHS Boards who were outlying both last year and this year have been marked with a circle and will not be asked to repeat the governance process.

Figure 18- Observed and expected standardised rates of deaths within 90 days

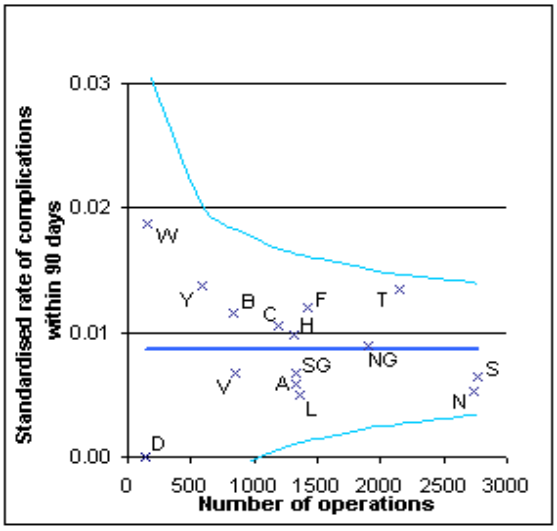


Figure 19 - Observed and expected standardised rates of hip dislocations within 365 days

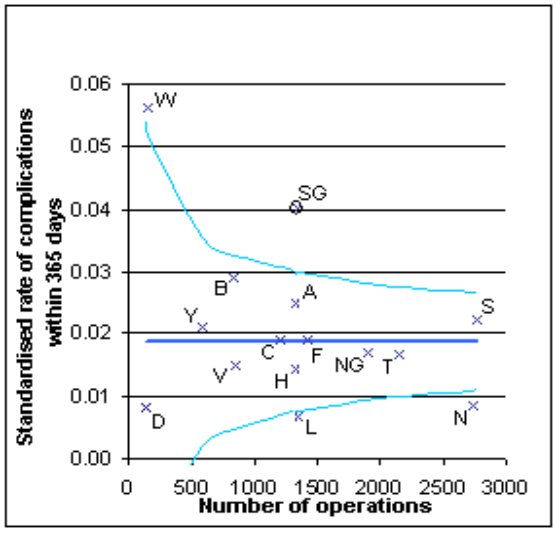


Figure 20 - Observed and expected standardised rates of joint infections within 365 days

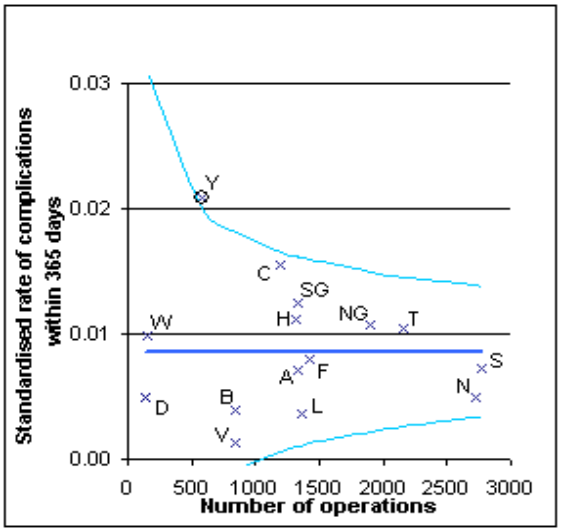
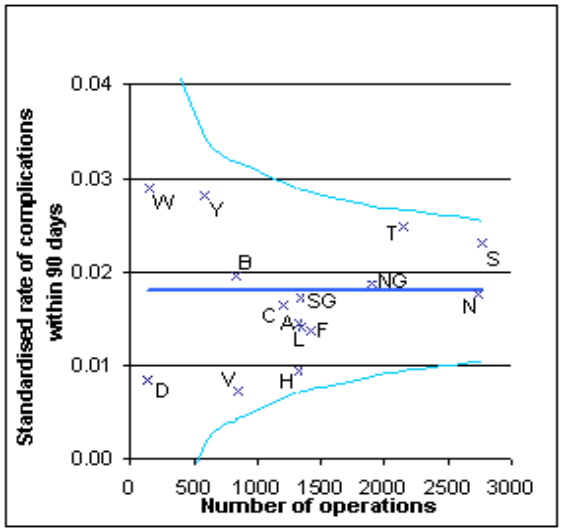


Figure 21 - Observed and expected standardised rates of DVT/PE within 90 days



Key to NHS Board Ciphers

A	Ayrshire & Arran	L	Lanarkshire
B	Borders	N	Grampian
C	Argyll & Clyde	S	Lothian
D	Golden Jubilee	T	Tayside
F	Fife	V	Forth Valley
NG	North Glasgow	W	Western Isles
SG	South Glasgow	Y	Dumfries & Galloway
H	Highland		

Orkney and Shetland are not included as their patients undergo elective arthroplasty surgery in Grampian (Aberdeen) and are included in the Grampian data

Key to the Features of the Control Charts – this applies to all Funnel Plots in this report

——	Upper and Lower Control Limits
——	Scottish Mean
X	NHS Board or Consultant
⊗	NHS Board or Consultant outlying for a second year in a row

6.2. NHS Board Data for Complications Following Elective Primary Knee Replacement

Figure 22 to 25 represent the complication rates for patients following elective knee replacement between April 1998 and March 2003. Each cross represents the complication rate for an NHS Board in Scotland (for the label key and explanation of features see page 26). Those Boards that are outlying for the first time and those outlying for a third year in a row will be contacted to explore the reasons for these complication rates. Those boards that are outlying for a second year will not be asked to reinvestigate the data, but will be monitored over the forthcoming years. This is due to the historical nature of the data and the fact that it is 5 years aggregated data which would take some time to show change in complication rates.

NHS Board Data for Complications Following Elective Primary Knee Replacement (April 1998 – March 2003)

NHS Boards who were outlying both last year and this year have been marked with a circle and will not be asked to repeat the governance process.

Figure 22 - Observed and expected standardised rates of deaths within 90 days

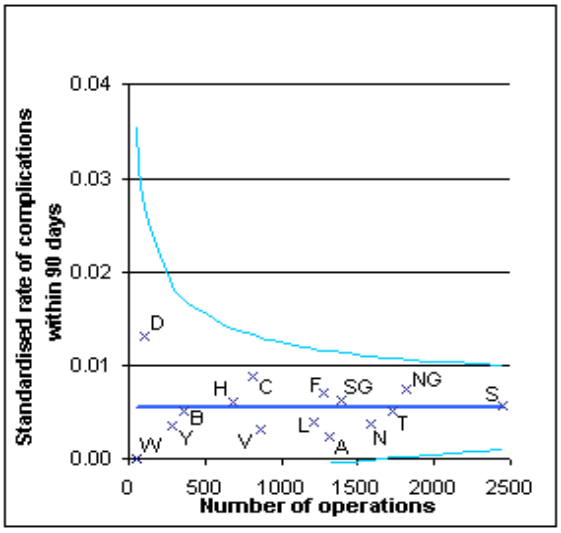


Figure 23 - Observed and expected standardised rates of knee revisions within 365 days

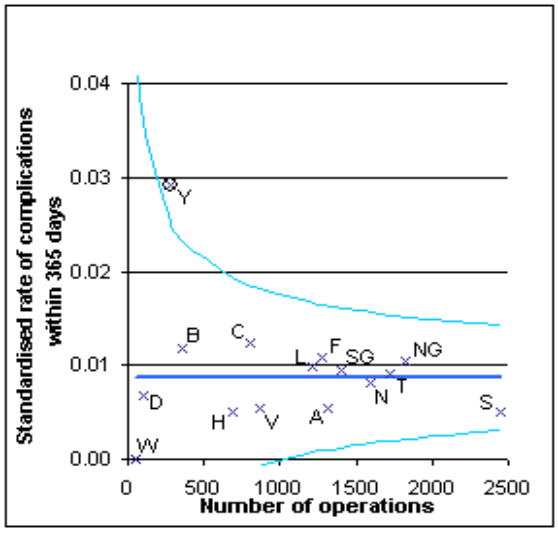


Figure 24 - Observed and expected standardised rates of joint infections within 365 days

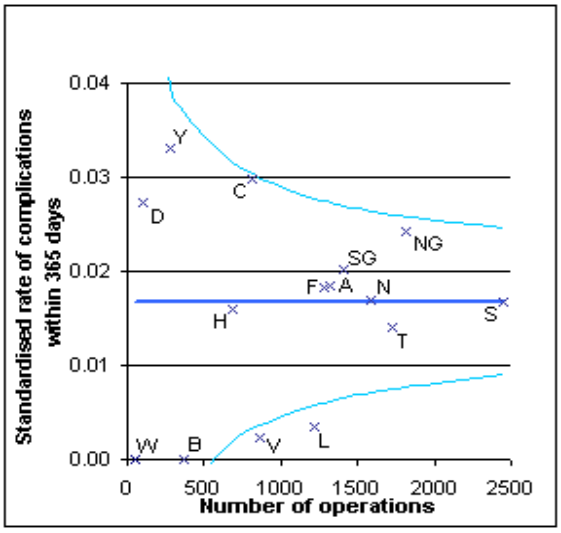
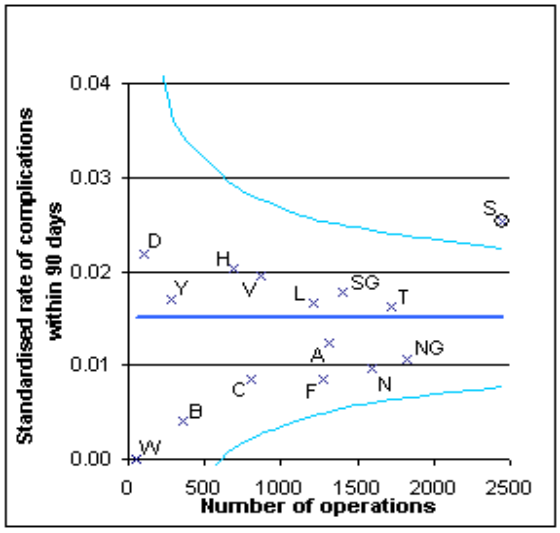


Figure 25 - Observed and expected standardised rates of DVT/PE within 90 days



6.3. Consultant Surgeon Data for Complications Following Elective Primary Hip Replacement

Figure 26 to 29 represent the complication rates for patients following elective hip replacement between April 1998 and March 2003. Each cross represents the complication rate for a consultant in Scotland. For a key to the features of the charts please see page 26. Those consultants who are outlying for the first time and those outlying for a third year in a row will be contacted to explore the reasons for these complication rates. Those consultants who are outlying for a second year in a row will not be asked to reinvestigate the data, but will be monitored over the forthcoming years. This is due to the historical nature of the data and the fact that it is 5 years aggregated data which would take some time to show change in complication rates.

Because the charts show standardised rates of complications, those surgeons with low numbers of index procedures may have only one complication but this causes a high rate. To account for this the charts show control limits within which variation is likely to be statistical due to low numbers rather than a problem with care. All surgeons (and hospitals), but particularly those with low numbers and high complication rates, should pay particular attention to each individual case.

Consultant Surgeon Data for Complications Following Elective Primary Hip Replacement (April 1998 – March 2003)

Consultants who were outlying both last year and this year have been marked with a circle and will not be asked to repeat the governance process.

Figure 26- Observed and expected standardised rates of deaths within 90 days

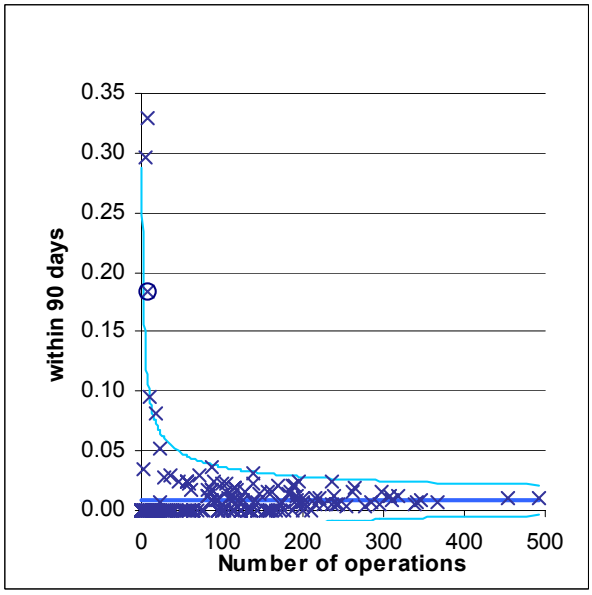


Figure 27 - Observed and expected standardised rates of hip dislocations within 365 days

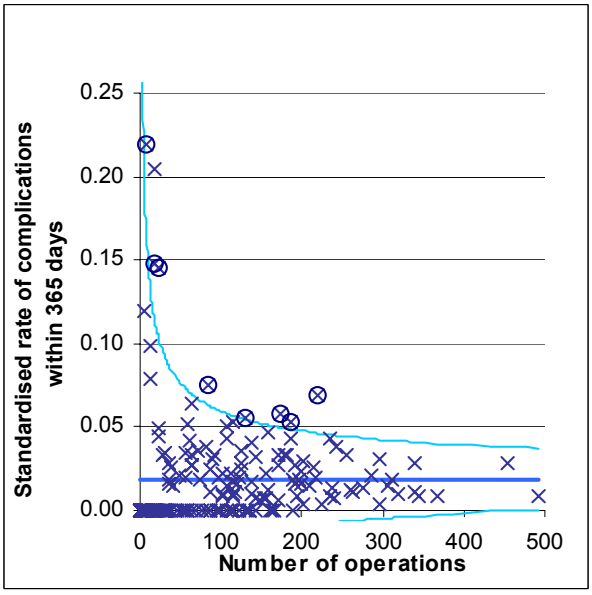


Figure 28 - Observed and expected standardised rates of joint infections within 365 days

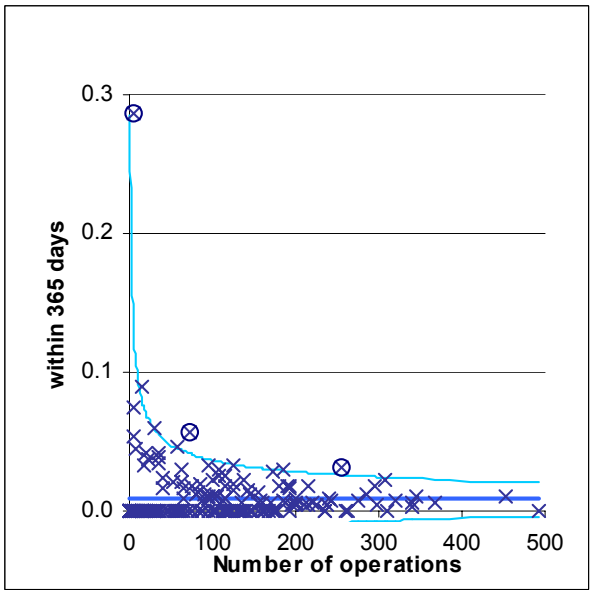
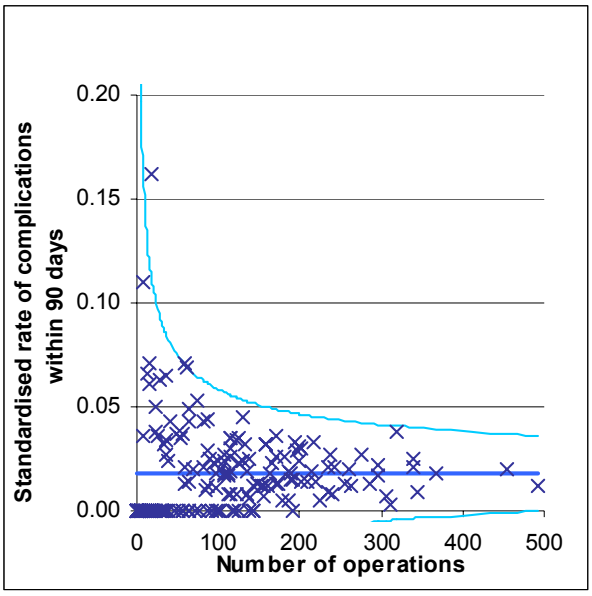


Figure 29 - Observed and expected standardised rates of DVT/PE within 90 days



6.4. Consultant Surgeon Data for Complications Following Elective Primary Knee Replacement

Figure 30 to 32 represent the complication rates for patients following elective knee replacement between April 1998 and March 2003. Each cross represents the complication rate for a consultant in Scotland. For a key to the features of the charts please see page 26. Those consultants who are outlying for the first time and those outlying for a third year in a row will be contacted to explore the reasons for these complication rates. Those consultants who are outlying for a second year in a row will not be asked to investigate the data, but will be monitored over the forthcoming years. This is due to the historical nature of the data and the fact that it is 5 years aggregated data which would take some time to show change in complication rates.

Consultant Surgeon Data for Complications Following Elective Primary Knee Replacement (April 1998 – March 2003)

Consultants who were outlying both last year and this year have been marked with a circle and will not be asked to repeat the governance process.

Figure 30 - Observed and expected standardised rates of deaths within 90 days

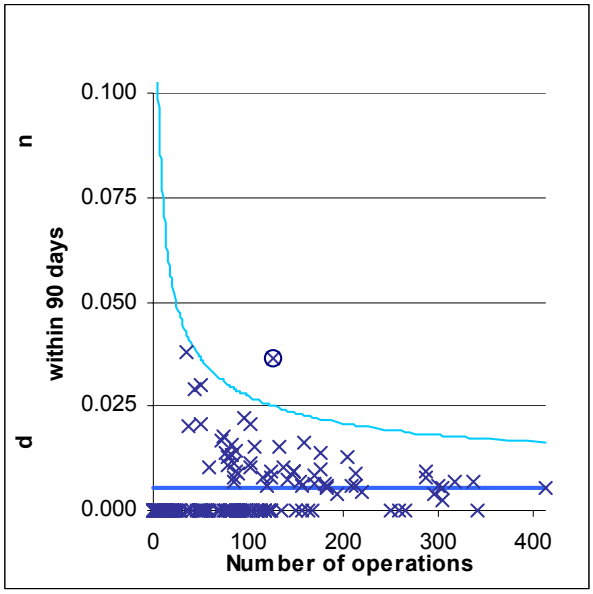


Figure 31 - Observed and expected standardised rates of joint infections within 365 days

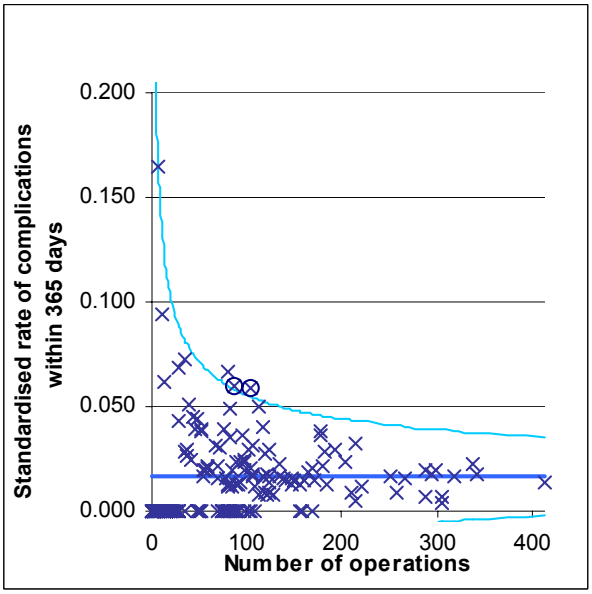
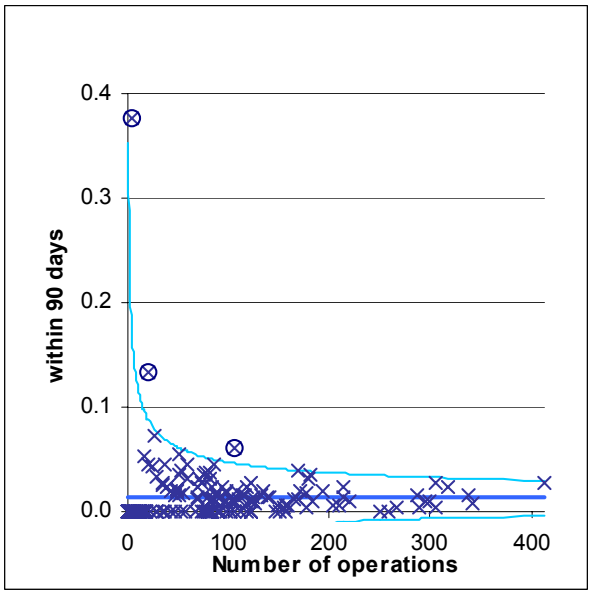


Figure 32 - Observed and expected standardised rates of DVT/PE within 90 days



7. Appendices

7.1. *Appendix 1 – Consent and Confidentiality*

Consent

Consent issues for patients and participants have been discussed and opinion has been widely canvassed. The SMR01 dataset is firmly embedded in the administrative structure of NHSScotland and is used for audit and demographic description. It is important that patients are informed of the audit and the use of their data within it. NHS Boards are already providing generic information to patients explaining how their data are used by NHSScotland and their rights with respect to this. As part of the process of improving the information available to patients a poster to inform them about the Scottish Arthroplasty Project has been prepared and is being displayed in orthopaedic departments across Scotland (The poster is available to download from http://www.show.scot.nhs.uk/arthro).

Confidentiality

To date, no identifiable data linkable to individual consultant surgeons has been produced or reviewed outside ISD. Only the consultant surgeon concerned has been asked to review these data in order to respect data protection principles (that apply equally to the patient and consultant surgeon). Other than one member of the ISD staff (and then only for administrative purposes), no-one in the project has access to individually identifiable data and therefore cannot comment on or release information on individuals. While this should reassure participants, it also places considerable responsibilities on consultant surgeons to respond to the data supplied. It must be pointed out that the relatively small size of the consultant orthopaedic community in Scotland may occasionally make absolute anonymity difficult.

This confidentiality brings with it responsibility. The Arthroplasty Project under the aegis of the orthopaedic community (SCOT) has developed a process of review to ensure that any results which appear to vary from normal are interpreted at a local level to apply appropriate knowledge and ensure local action. All outlying results are followed up and local review requested (see Section 3.5).

The advent of the Freedom of Information (Scotland) Act 2002 has led us to consider the confidentiality of our processes. A debate is currently taking place about the desirability or otherwise of publishing individual-level surgeons' audit results. While publication of named data seems superficially attractive, and has happened in other branches of surgery, it has neither informed the debate nor the individual patient. We provide all surgeons with their own results which

can be used to inform the consent process. To date we have been successful in providing information which is useful and would inform the decision making process when a patient is considering joint replacement. Individual surgeons results will require local interpretation at the time of interview between patient and surgeon.

7.2. *Appendix 2 – Shoulder and Elbow Arthroplasties: Summary*

7.2.1. Trends in Numbers of Operations

The number of elective and emergency joint replacement operations (for both primary and revision for hip and knee) can be seen in the main report and corresponding information for other upper limb arthroplasties plus toes and ankles in Appendix 9.

Figure 33 to 36 represent the numbers of elective and emergency joint replacement operations, (both primary and revision for shoulder and elbow) recorded as performed in NHS Scotland in each of the last 13 years (1992 to 2004). All numbers are displayed by year ending March.

The number of primary shoulder arthroplasties has risen steadily from 1992 to 2004 (130 to 233) with a peak of activity in 1998 (305). There was also an increase in the volume of revision shoulder arthroplasties carried out between 1992 and 2004 (2 to 23). The revision burden (no of revisions expressed as percentage of total) is currently 9.0% but may be rising.

The volume of primary elbow arthroplasties remained fairly stable until 2001 (approximately 74) and since then has fallen to 60 procedures in 2004. The number of revision elbow replacements has increased between 1992 and 2004 (7 to 13). Most elbow arthroplasties are performed for rheumatoid arthritis. The decline in the number of elbow arthroplasties mirrors the decline noted in hip and knee arthroplasty reported previously for rheumatoid patients (www.show.scot.nhs.uk/arthro). The revision burden for elbow arthroplasty is higher than for shoulders at 17.8% which is higher than other arthroplasties.

Figure 33- Primary Shoulder Arthroplasties by year ending March

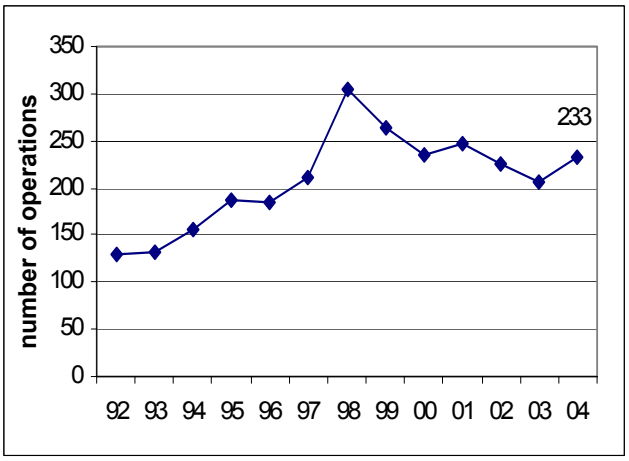


Figure 34 - Revision Shoulder Arthroplasties by year ending March

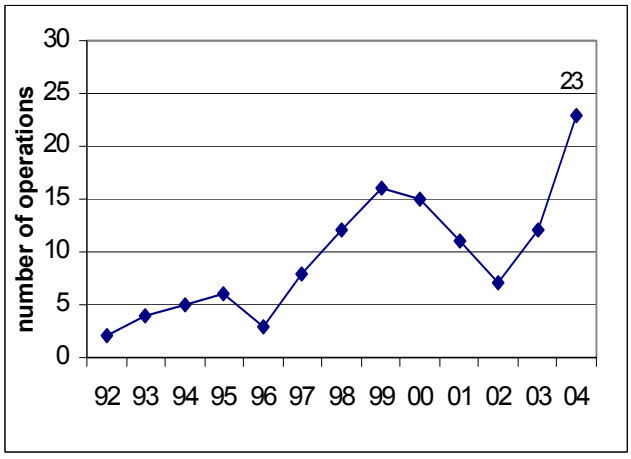


Figure 35- Primary Elbow Arthroplasties by year ending March

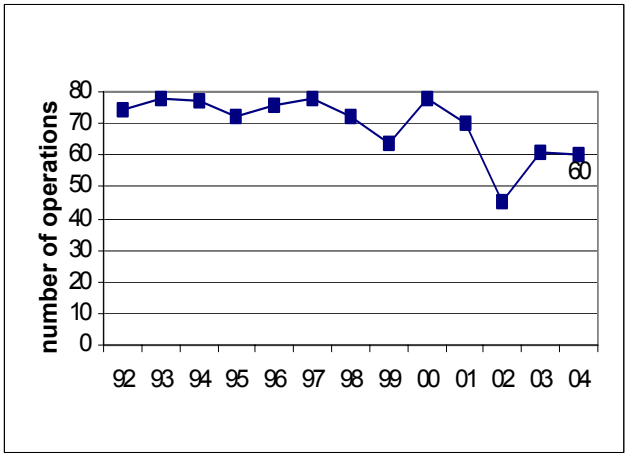
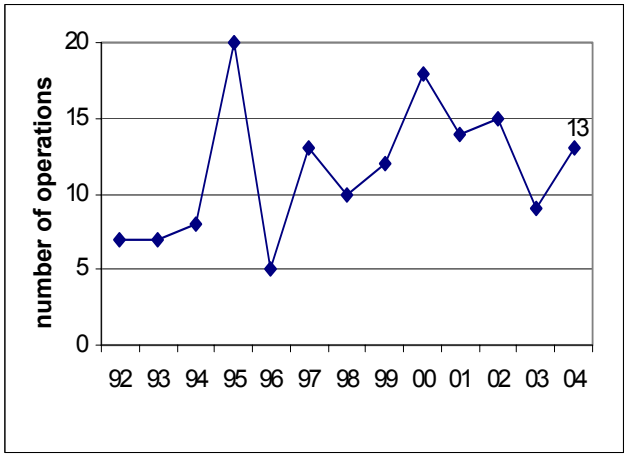


Figure 36 - Revision Elbow Arthroplasties by year ending March



7.2.2. Number of Shoulder and Elbow Arthroplasties Performed per Surgeon

Figure 37 and 38 illustrate the number of primary joint replacements for shoulders and elbows recorded as performed by each consultant surgeon operating in NHS Scotland. Each consultant and hospital has a unique work pattern and arthroplasty represents only a small part of that workload. These figures should therefore not be seen as total workload figures. It should also be noted that consultants commencing or retiring from their post during the year may well appear to be performing low volumes of procedures if they were not working for the whole year.

A total of 66 consultant surgeons are recorded as having performed primary shoulder replacements in 2004 in the NHS. There were 52 consultant surgeons (79%) who performed less than 5 primary shoulder replacements. It is probable that the majority of cases performed by small number surgeons were for traumatic rather than elective indications.

Twenty-one consultant surgeons performed primary elbow replacements in 2004. Eighteen of these consultant surgeons (86%) performed less than 5 primary elbow replacements. In the report next year we will express this as annualised results as we have done for hips and knees in the main report – section 3.4.

Figure 37 – Primary Shoulder Arthroplasties for year ending March 2004

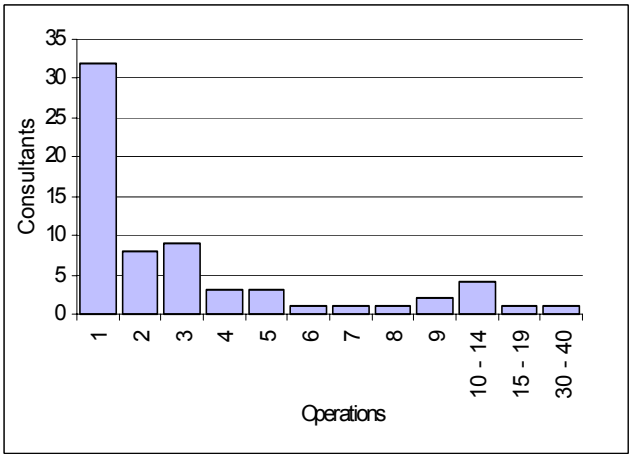
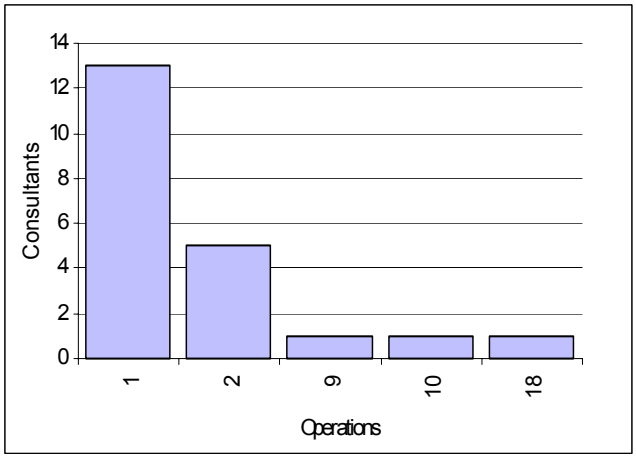


Figure 38 - Primary Elbow Arthroplasties for year ending March 2004



7.2.3. Kaplan-Meier Survival of Shoulder and Elbow Joint Replacements

We have followed patients who had their joint replaced between April 1993 – March 2004 for up to 11 years after their operation and the number of replacements and revisions included are based on 11 years of SMR01 data. However, for graphical presentation, we have truncated the survival curves at 10 years as the last year of data presented has less than 10% of the patients contributing to it and is hence the most variable.

At day 0, no patients have had their joint revised and hence the survival is always 1. When a patient has a joint revised, the survival rate drops. In this case, a higher survival rate is better.

For the comparison of survival of prosthesis by volume of procedures, we used the Log-rank test to see if there was a difference in survival between the groups of patients (Bland et al 2004).

Table 5: National Survival of Primary Shoulder Replacements: April 1993 – March 2004

	Total primary shoulder replacements	Surviving to end point/dying before end point
Figure 39		
All shoulders	2271	2220
Figure 40: Volume of procedures performed by surgeons		
1 shoulder per year	517	509
2 to 5 shoulders per year	768	754
6+ shoulders per year	986	957

Figure 39: Revision after Primary Shoulder Replacement: April 1993 - March 2004

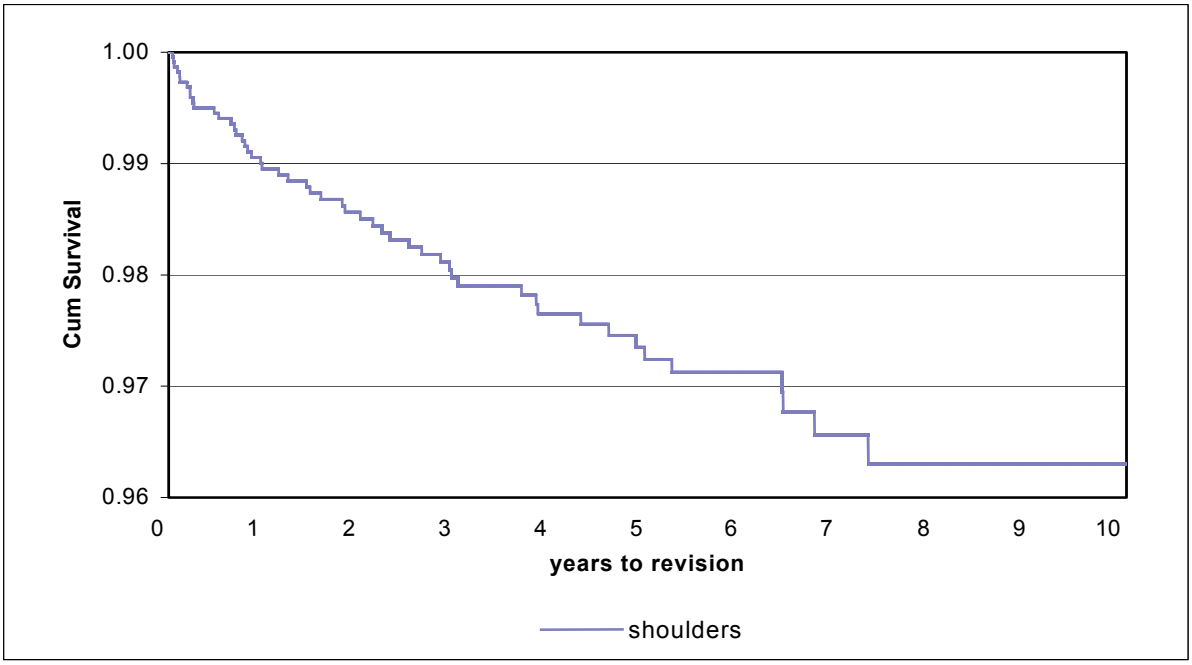
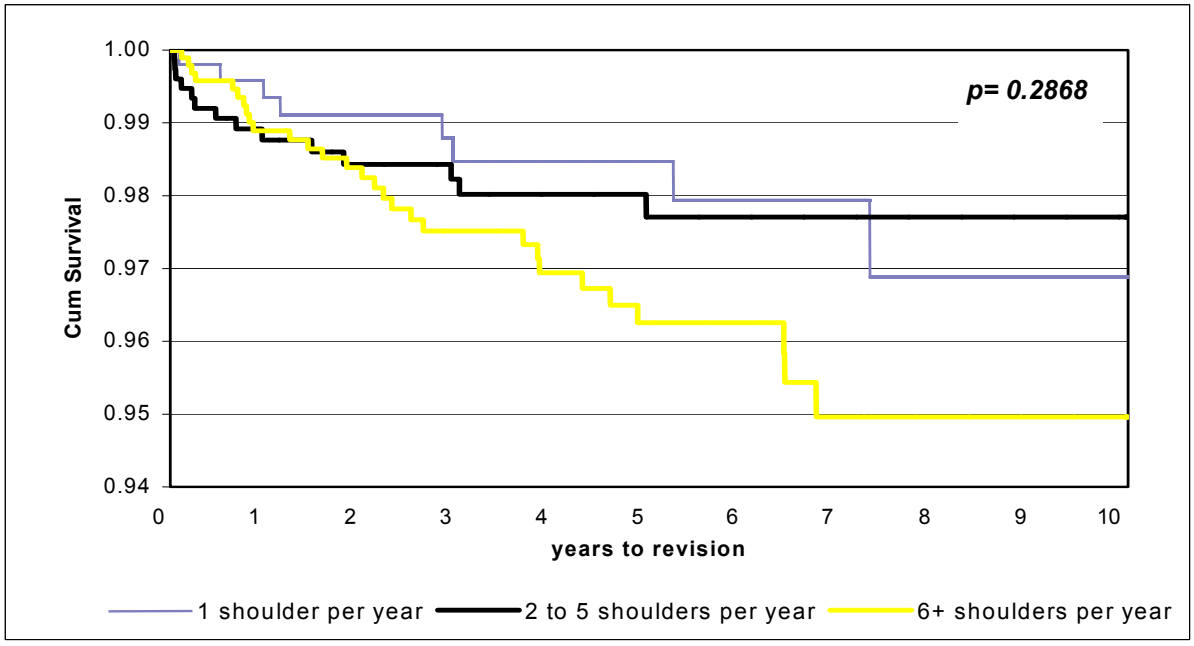


Figure 40: Revision after Primary Shoulder Replacement by Volume: April 1993 - March 2004



These graphs show that the 10-year survival of Shoulder replacement is 96.4% and that there is no statistical difference in outcome (taking revision for all causes as an endpoint) between low volume and high volume surgeons. These survival rates are difficult to compare with other studies however the overall results compare favourably with those with long follow up (Sperling et al, 2004) though it should be noted that we cannot differentiate between hemi and total joint replacement.

Table 6: National Survival of Primary Elbow Replacements: April 1993 – March 2004

	Total primary elbow replacements	Surviving to end point/dying before end point
Figure 41		
All elbows	788	738
Figure 42: Volume of procedures performed by surgeons		
1 elbow per year	145	137
2 to 5 elbows per year	159	141
6+ elbows per year	330	318

Figure 41: Revision after Primary Elbow Replacement: April 1993 - March 2004

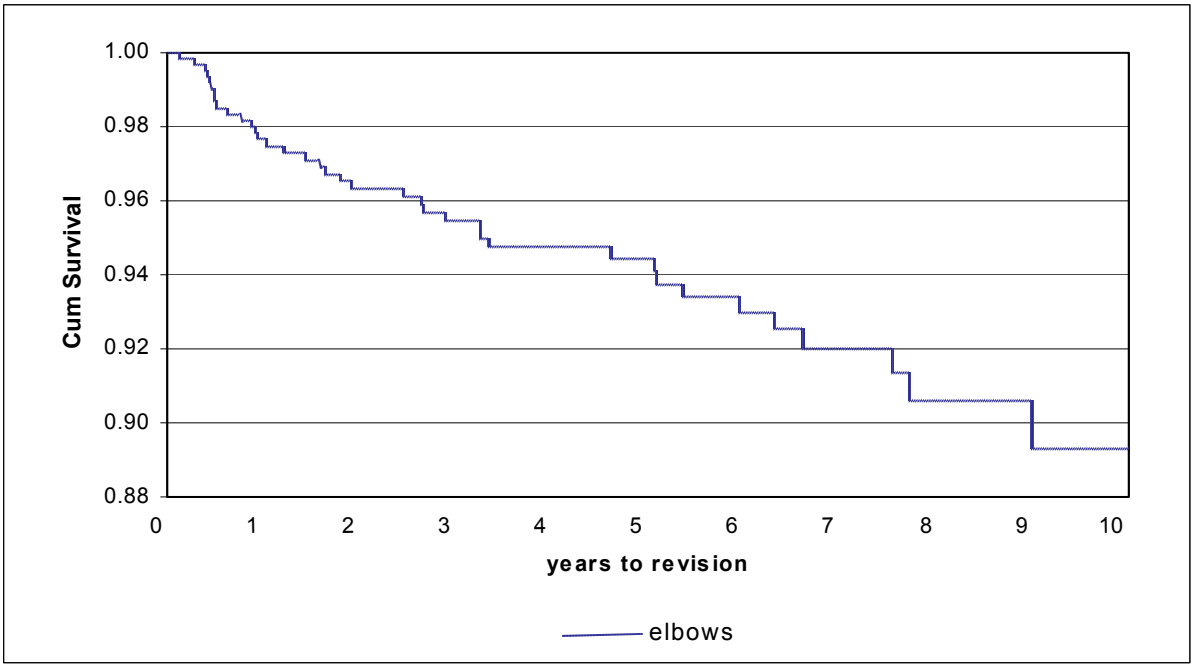
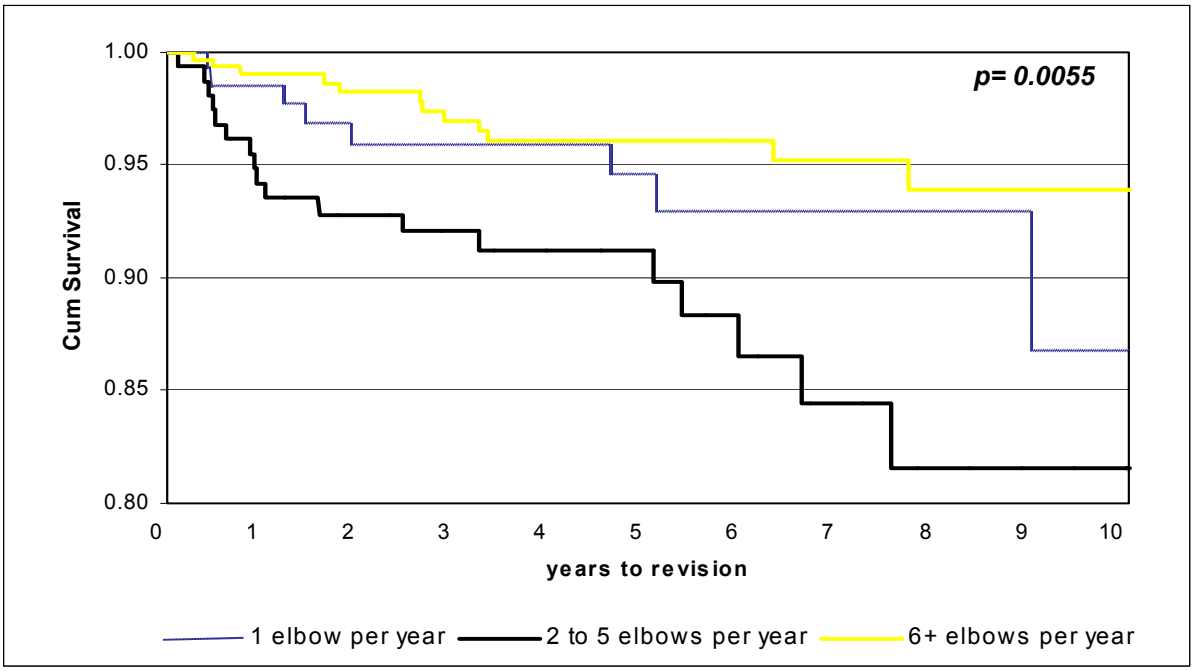


Figure 42: Revision after Primary Elbow Replacement by Volume: April 1993 - March 2004



These graphs show that the 10-year survival (taking revision for all causes as an endpoint) in Scotland is 89%. This compares well with other published studies using the same endpoints (Ikavalko et al, 2002). However there is a highly statistically significant difference in outcome between low volume and high volume surgeons. Most of these cases will have been performed for rheumatoid arthritis. Consideration should be given to the provision of these services as they appear to effect outcome. Further work is underway to review prosthesis type and diagnosis.

7.3. *Appendix 3 – Dislocation Rates Following Fractured Neck of Femur*

Table 7 shows the number of dislocations at 365 days following hip replacement surgery carried out between April 1998 and March 2003 for Scotland. During the governance process the possibility was raised that the dislocation rate was higher when replacement was carried out for fracture. The figures shown for total elective hip arthroplasties contains all patients who have had an elective hip arthroplasty so will include a small number of patients who have had an elective hip arthroplasty following a fractured neck of femur. The number of dislocations for all elective and non-elective hip arthroplasties with a fractured neck of femur contains all patients who had a fractured neck of femur and subsequently had a hip replacement, then a dislocation. All three of these events could be in the same or separate hospital admissions. Only the first episode of dislocation has been counted.

The table shows that the rate of dislocations at 365 days in patients who have had a fractured neck of femur treated by total hip replacement in Scotland is 3.4%, higher than the dislocation rate at 365 days for an elective hip arthroplasty (1.9%).

Table 7: National Dislocation Rates at 365 days following Hip Replacement Surgery (April 1998 – March 2003)

	Dislocations within 365 days following Hip Arthroplasty	Number of Hip Arthroplasties	Number of Dislocations per 1000 Arthroplasties
Total elective hip arthroplasties	376	20063	19
All hip arthroplasties (elective and non-elective) with fractured neck of femur	29	856	34

7.4. *Appendix 4 – Bed Days Used for Hip and Knee Arthroplasty Procedures*

Table 8 shows the number of primary hip and knee replacements carried out in years ending March 1993 and 2003. The table also shows the mean length of stay for each of the years from which the number of bed days used has been calculated.

Over the ten-year period from 1993 to 2003 the total number of hip and knee arthroplasties has risen by 44% (from 5443 to 7834) while during the same time period the number of bed days occupied by patients having either a hip or knee arthroplasty has fallen by 17% (from 90842 to 75377). The reduced mean length of stay means more arthroplasty operations are being carried out while occupying less bed days.

Table 8: Number of Bed Days Used for Primary Hip and Knee Replacements by year ending March

	Primary Hip Replacements			Primary Knee Replacements		
	Number of Operations	Mean Length of Stay	Total Bed Days	Number of Operations	Mean Length of Stay	Total Bed Days
1993	3467	16.0	55472	1976	17.9	35370
2003	4344	9.8	42571	3490	9.4	32806

7.5. *Appendix 5 – Distribution of Orthopaedic Consultants Across Scotland*

In this report, data covering the time period April 1998 to March 2004 are used. As at August 2004, there were 167.7 whole time equivalent (WTE) orthopaedic consultant posts in Scotland, filled by 174 orthopaedic consultants. 16 of these posts were vacant, with 7 of these vacant posts being temporarily filled by a locum consultant. These figures may seem confusing, however, each year some consultants retire and their place is taken by another which results in two consultants filling one post. In addition, one unfilled post may be filled by a number of locum consultants within the year. The data show that during the months of April and May 2004, 181 orthopaedic consultants performed elective hip and knee joint replacements. Table 9 illustrates the distribution of orthopaedic services around Scotland.

Table 9 - Distribution of orthopaedic consultants across Scotland as at 30/09/2004

Health Board	Hospital	Total number of posts	WTE posts	Vacant (filled by locum)
NHS Grampian	Aberdeen Royal Infirmary and Woodend Hospital	15	13.5	
NHS Highland	Dr Gray's	4	3.7	
	Raigmore Hospital	8	8	
NHS Western Isles	Western Isles Hospital	2	2	2(1)
NHS Tayside	Ninewells Hospital and Stracathro Hospital	13	11.5	
	Perth Royal Infirmary	4	4	
NHS Lothian	New Royal Infirmary Edinburgh and RHSC Edinburgh	20	17	
	St John's Hospital	5	5	
NHS Borders	Borders General Hospital	4	4	
NHS Fife	Queen Margaret Hospital and Victoria Hospital	8	8	1(1)
NHS Forth Valley	Stirling Royal Infirmary	4	4	
	Falkirk and District Royal Infirmary	4	4	
NHS Dumfries and Galloway	Dumfries and Galloway Royal Infirmary	7	7	
NHS Ayrshire and Arran	Crosshouse Hospital	7	7	
	Ayr Hospital	5	5	
NHS Greater Glasgow	Glasgow Royal Infirmary	9	9	3
	Western Infirmary	11	11	3(1)
	Victoria Infirmary	5	5	
	Southern General Hospital	5	5	
	RHSC Yorkhill	5	5	
NHS Inverclyde	Inverclyde Royal Hospital	5	5	
	Royal Alexandra Hospital	6	6	1
NHS Lanarkshire	Wishaw General Hospital	5	5	1(1)
	Monklands General Hospital	5	5	1(1)
	Hairmyres Hospital	5	5	2(2)
Golden Jubilee National Hospital	Golden Jubilee National Hospital	3	3	2
Scotland	**Total**	**174**	**167.7**	**16(7)**

Data source: ISD Scotland workforce statistics

7.6. *Appendix 6 – Committee Structure*

The Project is overseen by the Scottish Committee for Orthopaedics and Trauma (SCOT), who elect a chair for the Project. The Project is then managed by the Scottish Arthroplasty Steering Committee, whose membership is as follows;

Mr Colin Howie, Orthopaedic Consultant, Chair;
Mr David Allan, Orthopaedic Consultant;
Mr Ian McLean, Orthopaedic Consultant;
Dr David Semple, Anaesthetic Consultant; (Appointed by the Scottish Society of Anaesthetists)
Miss Harriet Hughes, ISD project co-ordinator (resigned 24/03/2005);
Mr Graham Mitchell, ISD senior programme lead;
Dr Rod Muir, ISD Consultant in Public Health;
Ms Christine Allen, Private hospitals representative;
Ms Angela Donaldson, patient representative; and
representative of the Scottish Association of Medical Directors acting in advisory capacity where necessary.

The orthopaedic consultants sitting on the Steering Committee, including the Committee chair, are nominated by the SCOT Committee and the organisational representative is nominated by the Scottish Association of Trust Medical Directors. The term of office for all nominees is 3 years, with an option to renew this term once. This does not apply to committee members who are not nominated, i.e. ISD staff.

Other health professionals (e.g. nurses, physiotherapists) will be invited to join the steering committee as outcome indicators develop for areas of care to which these professions directly contribute.

The function of the Steering Committee is to plan the medium and long-term strategy of the Project under the direction of SCOT. The Committee also directs the clinical content of the annual report and of any other data analyses produced and manages the clinical governance aspect of the Project.

7.7. *Appendix 7 – Funding and Staffing*

SAP is currently funded by NHS National Services Scotland (NSS) (or Common Services Agency). In 2004/2005, the project received £104,000. This money is principally to establish and run a Scottish National Joint Registry.

The project is managed on a day-to-day basis by staff at the Information Services Division, which is a division of the NSS. Two whole time equivalents are dedicated to SAP, with input from several other members of ISD staff on a consultative basis. The clinical lead and chair of the project is a consultant orthopaedic surgeon and two further consultant orthopaedic surgeons and an anaesthetic consultant sit on the Steering Committee, which meets three times per year. A member of the public and a representative from the private hospitals sector also contribute by sitting on the Steering Committee.

7.8. *Appendix 8 – Action Plan*

Scottish Arthroplasty Project:

Action Plan resulting from the identification of data outwith normal variation

Name A N Other

GMC 9999999

Outlier Indicator: dislocations within 365 days following hip arthroplasty Number of hip arthroplasties that you performed: 40 Number of expected dislocations for 40 cases: 1 +/- 2.33 Your value for 40 cases: 5 dislocations, which is greater than the upper control limit of 3.33

Comments concerning quality of information received from Scottish Arthroplasty Project pertaining to cases forming outlying data:

Have corrections been made to SMR01 records at a local level? Y/N Have these corrections been forwarded to ISD? Y/N

Action Plan following review of cases (please continue on separate sheet if necessary).

Signed:

Co-signed:	**GMC Number of Co-signatory**:
Print Name: (This signatory must be a GMC registered doctor with whom you have discussed this information and who will confirm what actions have been taken. This colleague may be your medical manager, medical director or a senior colleague and need not be employed within your Trust.)	

7.9. *Appendix 9 – Additional National Trends in Numbers of Operations*

The number of elective and emergency joint replacement operations (for both primary and revision for hip and knee) can be seen in the main report and corresponding information for shoulders and elbows is in Appendix 2.

Figure 43 to 49 represent the number of elective and emergency joint replacement operations, (primary and revision separately for finger and wrist and primary replacements for thumb, toe and ankle) recorded as performed in NHS Scotland in each of the last 13 years (1992 to 2004). All numbers are displayed by year ending March. The vast majority of operations were performed as an elective procedure. Between 94 and 100% of operations over the period were performed as elective for each of the operations presented in Figure 43 to 49.

The number of primary finger arthroplasties has been relatively stable at between 40 and 60 from 1992 to 2004. There has been little change in the number of revision finger arthroplasties with 4 in 2004. There was a steady increase in volume of primary wrist procedures performed from 1992 to 1999 (9 to 22). Between 2000 and 2004 the number was relatively static with 9 in 2004. The number of revision wrist procedures was relatively constant at around 1 over the 13 years.

There was a steady increase in the number of thumb procedures over 1992 to 2003 (6 to 28), with relatively large rises in 1996(28) and 2000(35). A fall to 15 was seen in 2004. There was a 37% decrease in toe procedures in the 13 years (46 to 17 in 1992 to 2004 respectively). The number of ankle procedures was stable at around 1 between 1992 and 1996. There has been a steady increase between 1998 and 2003 from 1 to 24, followed by a slight fall in 2004 to 19.

Figure 43- Primary Finger Arthroplasties by year ending March

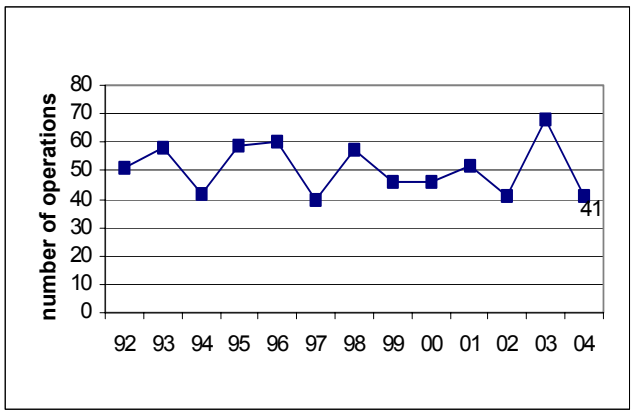


Figure 44 - Revision Finger Arthroplasties by year ending March

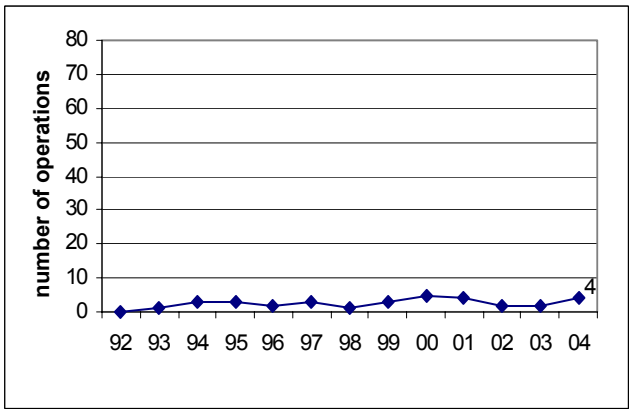


Figure 45- Primary Wrist Arthroplasties by year ending March

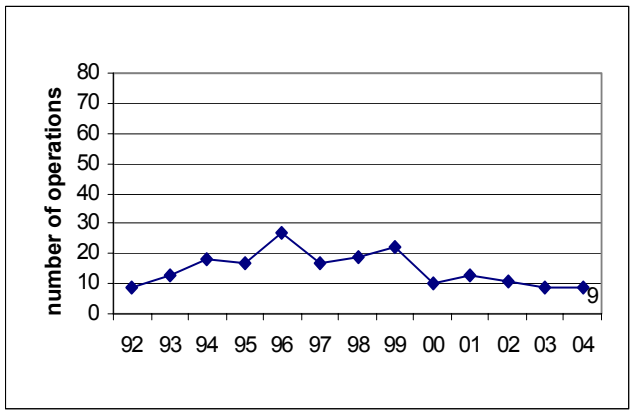


Figure 46 - Revision Wrist Arthroplasties by year ending March

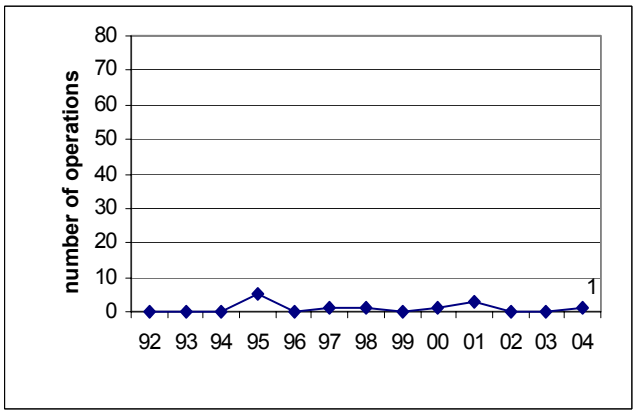


Figure 47- Thumb Arthroplasties by year ending March

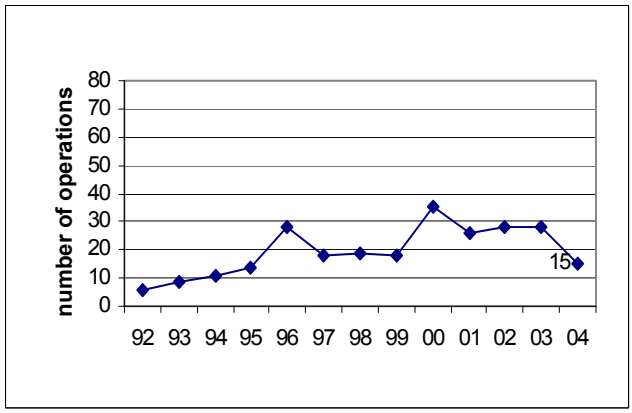


Figure 48 - Toe Arthroplasties by year ending March

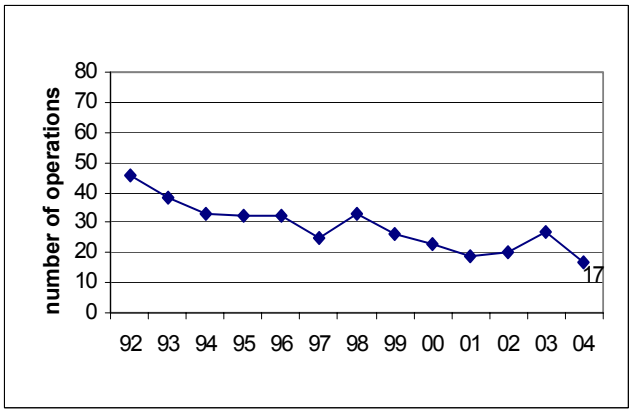
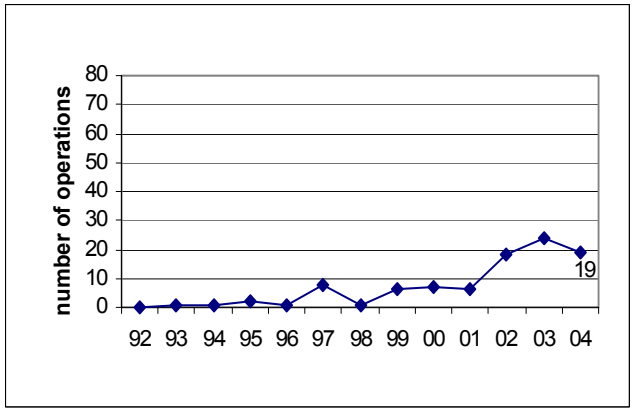


Figure 49- Ankle Arthroplasties by year ending March



7.10. *Appendix 10 – Number of Arthroplasty Procedures Performed per Surgeon*

Figure 50 to 53 illustrate the number of joint replacements (primary and revision for both hip and knee) recorded as performed by each consultant surgeon operating in NHSScotland. Each consultant and hospital has a unique work pattern and arthroplasty represents only a small part of that workload. These figures should therefore not be seen as total workload figures. It should also be noted that consultants commencing or retiring from their post during the year may well appear to be performing low volumes of procedures if they were not working for the whole year. For the 5 years from October 1999 to September 2004 approximately 10% of consultants were not in post for the full year, i.e. they either joined or left consultant posts (Source: ISD Scotland Workforce Statistics).

A total of 155 consultant surgeons are recorded as having performed primary hip replacements in 2004 in the NHS. There were 19 consultant surgeons who performed less than 5 primary hip replacements and 71 out of 121 (59%) who performed less than 5 revisions of primary hip replacements.

One hundred and forty three consultant surgeons performed primary knee replacements in 2004. Nine of these consultant surgeons (6%) performed less than 5 primary knee replacements, which is slightly less than the 8% in 2003. These 9 consultants performed 0.5% of the total number of primary knee replacements. Of the 80 consultant surgeons who performed revisions of primary knee replacements, 25 consultant surgeons performed only one. This is again a slight decrease to 31% when compared to 34% in 2003.

While the number of primary hip and knee replacements performed per consultant surgeon compares favourably with the USA (Katz et al, 2001) the numbers for revision of hip and knee replacements remain disappointing, given that there are sufficient consultant surgeons performing more than 5 operations to cover each site in Scotland. Performing a low number of procedures has been shown to have some effect on patient outcomes in several different specialties. (Birkmeyer et al 2003, Carter 2003, Kizer 2003). Previous reports (Scottish Arthroplasty Project 2003) have highlighted that performing low volumes of procedures can result in higher rates of the complications deep vein thrombosis (dvt), infected prosthesis and dislocation of prosthesis, but not in higher rates of revision surgery.

In an attempt to make the data more understandable (and to observe change) annualised figures for the percentage of arthroplasty surgery carried out by surgeons performing less than a specific number of procedures have been reported in the main report (Section 3.4). This provides another perspective on surgery being carried out by surgeons performing low numbers. However, both this analysis and the charts following are confounded by the turnover of consultant surgeons and locums noted above.

Figure 50 - Primary hip replacements for year ending March 2004

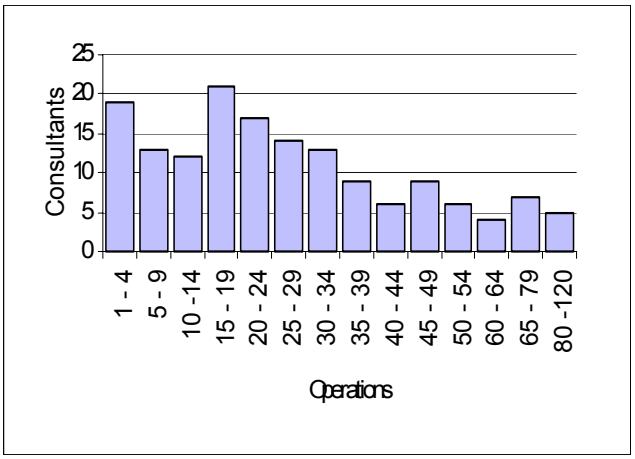


Figure 51- Primary knee replacements for year ending March 2004

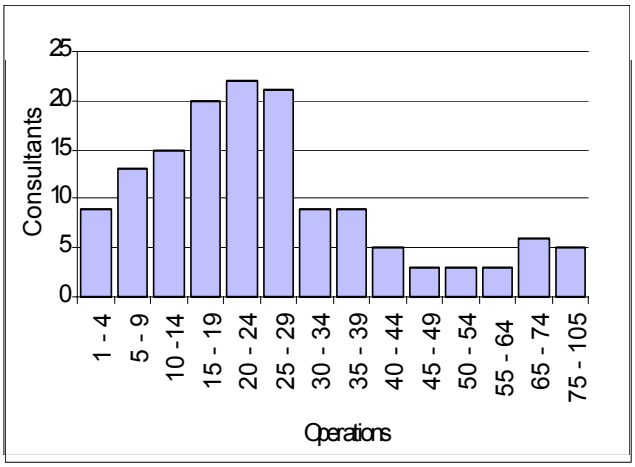


Figure 52 - Revision hip replacements for year ending March 2004

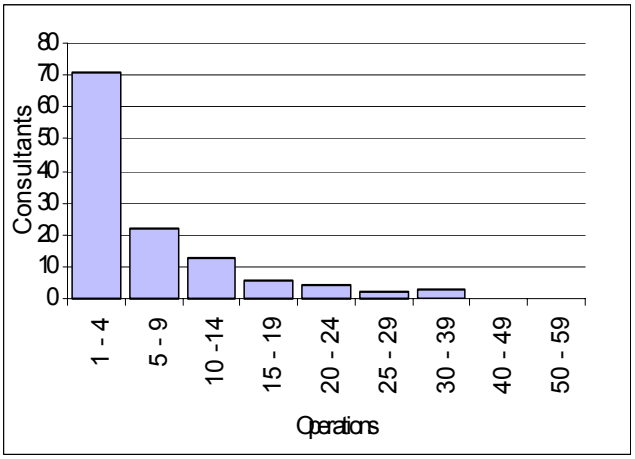
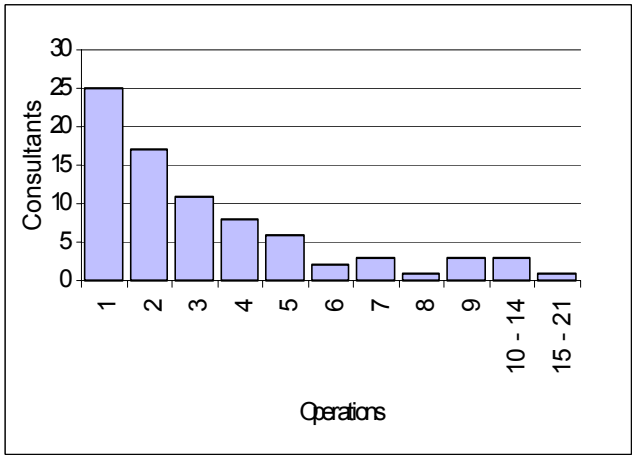


Figure 53 - Revision knee replacements for year ending March 2004



7.11. *Appendix 11 – Average Length of Stay: Additional Information By Health Board*

Table 10 and 11 show the median length of stay per continuous inpatient stay in each NHS Board for each of the ten years between 1994/95 and 2003/04 for elective primary hip and elective primary knee replacements respectively. The median length of stay is the period within which 50% of patients have gone home. This probably represents custom and practice within the health service in that area.

For hip replacements, there has been a steady drop in median over the ten years in the NHS Boards. The average decrease in median over the decade was 6 days. The largest decrease of 8 (16 to 8) occurred in both NHS Argyll & Clyde and NHS Lanarkshire. There was an increase in the median length of stay from 11 to 14 days in the decade for Western Isles NHS Board. However this was the only NHS Board where a rise was seen over the decade. There was a relatively small number of operations carried out in this Board with an average of 30 per year.

With knee replacements there was again a general downward trend in median over the ten years across the NHS Boards. The average drop in median over the decade was 7 days. The greatest impact on median was seen in NHS Lanarkshire where the median decreased by 10 from 18 to 8 days. There was a slight increase of 2 days in the median length of stay over the ten years in NHS Western Isles - from 12 in 1994/95 to 14 in 2003/04. However this was the only NHS Board where a rise was seen over the decade. There was a relatively small number of operations carried out in this Board with an average of 13 per year.

Table 10 - Median Length of Stay per Continuous Inpatient Stay for Hip Replacements

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Scotland	**14**	**13**	**12**	**11**	**10**	**10**	**9**	**9**	**9**	**8**
Argyll & Clyde	16	14	14	12	11	10	9	9	9	8
Ayrshire & Arran	12	12	12	12	12	10	9	9	9	8
Borders	12	12	11	11	10	9	9	9	9	8
Dumfries & Galloway	14	13	12	11	10	10	9	9	9	9
Fife	10	10	9	9	9	8	8	8	8	8
Forth Valley	12	12	12	12	13	12	11	10	10	9
Golden Jubilee Hospital	-	-	-	-	-	-	-	-	9	8
Grampian	13	13	12	12	11	11	10	10	10	9
Highland	13	14	12	11	11	10	8	7	7	7
Lanarkshire	16	15	15	14	11	11	10	9	9	8
Lothian	12	11	9	9	8	7	7	7	7	7
North Glasgow	15	13	10	10	9	9	8	9	8	8
South Glasgow	14	13	12	11	10	9	9	9	9	8
Tayside	14	14	13	12	11	11	10	9	9	8
Western Isles	11	11	11	11	10	14	11	11	10	14

Table 11 - Median Length of Stay per Continuous Inpatient Stay for Knee Replacements

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Scotland	**15**	**14**	**12**	**11**	**10**	**10**	**9**	**9**	**8**	**8**
Argyll & Clyde	17	14	14	12	10	10	9	9	8	8
Ayrshire & Arran	14	14	13	12	11	11	9	9	9	8
Borders	16	16	14	14	13	11	10	9	9	9
Dumfries & Galloway	16	15	14	12	12	11	11	10	10	11
Fife	14	12	10	9	9	8	8	8	8	8
Forth Valley	13	12	13	11	13	13	11	11	10	9
Golden Jubilee Hospital	-	-	-	-	-	-	-	-	9	8
Grampian	14	14	13	13	11	11	10	10	10	9
Highland	15	15	14	14	11	9	8	8	7	7
Lanarkshire	18	15	16	15	12	13	10	9	9	8
Lothian	16	12	11	9	8	8	8	7	7	7
North Glasgow	15	14	10	9	9	9	9	9	8	8
South Glasgow	14	13	12	11	10	9	9	9	8	8
Tayside	15	14	13	12	11	11	9	9	9	8
Western Isles	12	12	11	14	11	8	11	11	13	14

Table 12 and 13 show the mean length of stay per continuous inpatient stay in each NHS Board for each of the ten years between 1994/95 and 2003/04 for elective primary hip and elective primary knee replacements respectively. The means are generally higher than the medians shown in Table 10 and 11. This indicates skewed length of stay distributions with longer tails to the right. This represents the contribution of case mix and complication problems (for example heart attacks, wound problems or social issues) which cause a small number of patients to remain in hospital longer.

Table 12 - Mean Length of Stay per Continuous Inpatient Stay for Hip Replacements

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Scotland	**14.7**	**13.7**	**12.7**	**12.1**	**11.2**	**11.0**	**9.8**	**9.8**	**9.8**	**9.1**
Argyll & Clyde	18.4	14.3	14.0	12.7	11.7	11.1	10.0	9.6	8.9	8.0
Ayrshire & Arran	13.3	13.2	12.5	12.6	12.5	11.9	10.5	10.4	10.3	10.1
Borders	11.9	12.4	11.9	11.7	10.2	9.5	9.2	8.8	8.7	7.8
Dumfries & Galloway	16.0	14.9	14.5	11.8	12.2	11.9	10.4	11.0	10.9	10.6
Fife	11.9	11.3	11.2	10.2	10.2	9.8	8.7	9.1	9.1	9.3
Forth Valley	14.2	12.4	12.2	12.2	13.7	14.6	12.3	11.5	12.0	9.7
Golden Jubilee Hospital	-	-	-	-	-	-	-	-	9.8	8.8
Grampian	14.3	14.0	12.8	12.4	11.5	12.6	10.6	10.3	10.5	9.5
Highland	13.4	13.8	14.1	12.8	12.4	10.3	9.0	8.3	9.4	8.5
Lanarkshire	16.6	16.2	16.0	14.4	11.3	12.2	11.3	10.3	10.8	9.9
Lothian	14.3	13.1	10.9	10.4	8.7	8.6	8.2	7.8	8.3	7.9
North Glasgow	15.6	14.3	11.4	11.7	10.7	9.3	9.1	9.6	9.2	9.2
South Glasgow	16.3	15.0	13.9	12.2	11.0	11.0	9.8	11.4	10.7	9.5
Tayside	15.1	14.1	13.0	13.3	12.2	12.3	10.3	10.1	10.7	9.3
Western Isles	12.8	13.2	12.3	11.8	11.2	13.5	14.9	13.6	13.9	15.2

Table 13 - Mean Length of Stay per Continuous Inpatient Stay for Knee Replacements

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Scotland	**16.2**	**14.0**	**13.2**	**12.2**	**11.3**	**10.9**	**10.2**	**9.8**	**9.4**	**8.9**
Argyll & Clyde	18.9	14.2	14.0	12.8	10.9	10.4	9.3	9.3	8.8	7.7
Ayrshire & Arran	13.7	13.9	12.8	12.6	12.1	11.5	10.9	10.7	9.9	9.5
Borders	16.5	16.7	15.1	14.7	13.2	11.7	10.4	9.4	8.6	8.6
Dumfries & Galloway	16.2	15.3	13.7	13.0	12.9	11.5	12.2	10.7	10.7	12.1
Fife	14.0	12.4	10.5	10.2	9.3	9.1	9.6	8.4	8.8	9.2
Forth Valley	12.8	13.6	13.1	12.3	13.1	13.5	12.2	11.4	11.0	10.4
Golden Jubilee Hospital	-	-	-	-	-	-	-	-	9.8	8.7
Grampian	15.9	14.6	13.7	13.3	12.9	12.0	11.2	10.4	10.3	10.0
Highland	15.8	15.1	14.4	13.9	13.1	10.4	9.2	8.6	9.1	8.3
Lanarkshire	20.4	16.7	17.3	14.6	12.7	13.0	11.3	10.5	9.6	9.2
Lothian	19.1	13.5	12.0	10.2	8.9	9.0	8.3	7.7	7.7	6.9
North Glasgow	16.4	14.6	11.9	10.7	10.6	10.1	9.8	10.0	9.4	8.7
South Glasgow	14.9	13.7	13.5	12.1	11.3	10.8	10.5	12.0	10.3	9.6
Tayside	15.4	13.4	14.1	12.9	12.1	11.6	10.8	10.2	9.5	8.6
Western Isles	13.4	12.0	12.3	17.6	14.4	9.7	11.5	9.6	13.5	13.1

7.12. *Appendix 12 – NHS Board of Treatment vs. NHS Board of Residence*

Table 14 and 15 show the percentage of elective primary hip and knee replacements performed by each NHS Board in Scotland on residents from outwith their board area for the year ending 31st March 2004.

The overall percentage of non-residents treated in Scotland is very similar for both elective hip and knee replacements (17.5% and 17.2%). Glasgow carried out the highest percentage of elective primary hip replacements on non-residents (28.5%). The highest percentage of elective primary knee replacements performed on non-residents is in NHS Borders (20.6%) with a similar percentage treated in NHS Glasgow (20.2%).

A significant number of both hip and knee replacements ware carried out at the Golden Jubilee Hospital but as this hospital treats patients from all areas their procedures have been excluded from the Scotland total.

Table 14 – Percentage of Elective Primary Hip Replacements (all cases) Performed on NHS Board Residents for year ending March 2004

NHS Board of Treatment	Procedures on Board Residents	Procedures on Non-Board Residents	Percentage of Procedures on Non-Board Residents
Scotland (excluding Golden Jubilee)	**3645**	**429**	**10.5**
Argyll & Clyde	253	21	7.7
Ayrshire and Arran	287	22	7.1
Borders	129	30	18.9
Dumfries & Galloway	95	1	1.0
Fife	307	3	1.0
Forth Valley	138	5	3.5
Glasgow	446	178	28.5
Grampian	499	71	12.5
Highland	272	10	3.5
Lanarkshire	315	4	1.3
Lothian	430	46	9.7
Tayside	430	38	8.1
Western Isles	44	0	0.0
Golden Jubilee	N/A	343	N/A

Table 15 – Percentage of Elective Primary Knee Replacements Performed on NHS Board Residents for year ending March 2004

NHS Board of Treatment	Procedures on Board Residents	Procedures on Non-Board Residents	Percentage of Procedures on Non-Board Residents
Scotland (excluding Golden Jubilee)	**3178**	**335**	**9.5**
Argyll & Clyde	218	16	6.8
Ayrshire and Arran	303	11	3.5
Borders	81	21	20.6
Dumfries & Galloway	57	0	0.0
Fife	282	2	0.7
Forth Valley	137	3	2.1
Glasgow	561	142	20.2
Grampian	372	56	13.1
Highland	187	10	5.1
Lanarkshire	290	6	2.0
Lothian	359	25	6.5
Tayside	323	43	11.7
Western Isles	8	0	0.0
Golden Jubilee	N/A	327	N/A

7.13. *Appendix 13 – References*

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Scottish Arthroplasty Project. Primary Hip and Knee Replacements in Scotland; Analysis of NHS Rheumatoid Arthritis Patients

Scottish Arthroplasty Project. Scottish Arthroplasty Project Annual Report 2004

Scottish Arthroplasty Project. Scottish Arthroplasty Project Annual Report 2003

Scottish Arthroplasty Project. Scottish Arthroplasty Project Annual Report 2002

7.14. *Appendix 14 – Glossary*

Arthroplasty	Surgical remodelling of a diseased joint. To prevent the ends of the bones joining together after the operation, a large gap may be created between them (gap or excision arthroplasty), a barrier of artificial material may be inserted (interposition arthroplasty), or one or both of the bone ends may be replaced by a prosthesis of metal or plastic (replacement arthroplasty). This operation may replace both joint surfaces (total arthroplasty) or only one (hemiarthropalsty).
Complication	Unexpected event arising as a result of an operation.
Deep Vein Thrombosis (DVT)	A blood clot blocking the deep veins of the calf of the leg.
Dislocation	The separation of the ball and socket parts of a prosthesis from their normal position of meeting at a joint.
Elective surgery	Surgery that is subject to choice (election). The choice may be made by the patient or doctor. For example, the time when a surgical procedure is performed may be elective. The procedure is beneficial to the patient but does not need be done at a particular time. As opposed to urgent or emergency surgery.
ISD	The Information Services Division of NHSScotland. ISD is a national organisation that collects health service data in Scotland, and uses these data for a wide variety of purposes, including the production of national health statistics and providing feedback to health professionals.
Prosthesis	Any artificial device that is attached to the body as an aid, including joint implants.
Pulmonary Embolism (PE)	This occurs when a blood clot is carried in the circulation to lodge in an artery in the lungs (the pulmonary artery).
Revision	When an artificial joint fails, a second operation is required to replace the failing joint. This procedure is called a revision.
SAP	Scottish Arthroplasty Project.
SCOT Committee	Scottish Orthopaedics and Trauma Committee.

7.15. *Appendix 15 – Links*

Previous Scottish Arthroplasty Project Annual Reports

Scottish Arthroplasty Project. Scottish Arthroplasty Project Annual Report 2004
http://www.show.scot.nhs.uk/arthro/Reports/Scottish_Arthroplasty_Project_Report_2004.pdf

Scottish Arthroplasty Project. Scottish Arthroplasty Project Annual Report 2003
http://www.show.scot.nhs.uk/arthro/Reports/Scottish_Arthroplasty_Report_2003.pdf

Scottish Arthroplasty Project. Scottish Arthroplasty Project Annual Report 2002
http://www.show.scot.nhs.uk/arthro/Reports/Scottish_Arthroplasty_Report_2002.pdf

Adhoc Reports

Thromboprophylaxis – a comparison of practice in Scotland with England and Wales.
http://www.show.scot.nhs.uk/arthro/Reports/NJR_SAP_comparison.pdf

A comparison of patient demographic information for Scotland with England and Wales for hip and knee arthroplasty
http://www.show.scot.nhs.uk/arthro/Reports/Patient_demographic_info.pdf

Primary Hip and Knee Replacements in Scotland: Analysis of NHS rheumatoid arthritis patients
http://www.show.scot.nhs.uk/arthro/Reports/Primary_Hip_Rheumatoid.pdf

Primary Hip and Knee Replacements in Scotland: Analysis of 6 years of operations on NHS patients April 1996 - March 2002
http://www.show.scot.nhs.uk/arthro/Reports/Primary_Hip_and_Knee_Replacements.pdf

Other Websites

National Joint Registry (NJR) Website
http://www.njrcentre.org.uk/

The Journal of Bone and Joint Surgery (JBJS) Website
http://www.jbjs.org.uk/