



# **Scottish Arthroplasty Project**

**Annual Report May 2003**

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## **1. Introduction**

### **1.1 Overview**

The Scottish Arthroplasty Project was set up in 1999. The key aim of the Project is to encourage continual improvement in the quality of care provided to joint replacement surgery (arthroplasty) patients through the auditing of routinely collected national data in Scotland. This national data collection creates an 'administrative database' rather than a dedicated and detailed arthroplasty audit. It therefore identifies areas where there are variations from the national norm, but it does not identify the specific causes of these variations.

The Project provides quarterly feedback to consultant orthopaedic surgeons in the form of a list of patients undergoing joint replacement surgery under their care, so that consultant surgeons can check that the Scottish Morbidity Record (SMR01) data submitted by their NHS Trust to the Information and Statistics Division of NHSScotland (ISD) is correct. Based on SMR01, the Project also provides annual audit data, which is presented in this report.

In April 2003, a National Joint Registry was launched in England and Wales. The aim is to collect data pertaining to hip and knee replacements, including detailed information about the types of prosthetic joint implants used. Building upon current data collection, the Scottish Arthroplasty Project is currently investigating the best way forward for the collection of joint implant data in Scotland.

There is a need to ensure that replication of data collection in Scotland is kept to a minimum, and that the usefulness of the SMR01 dataset is maintained. A preliminary scoping study was carried out in March 2003 in collaboration with Scottish Trauma Audit staff, to investigate the possibility of collecting extra data from hospital theatre systems. A further, detailed technical study is soon to be embarked upon to assess how this data may be best extracted, so that Scotland can develop and maintain a National Joint Registry that can be linked to the routine data collected through SMR01.

When analysing the annual audit data, it is important to recognise that any variation in care is likely to represent a system (or team) difference rather than any one individual's effect on the outcome. Effective risk management depends on establishing a reporting structure (Reason, 1997). It is hoped that detailed meaningful analysis of these reports, which can only be carried out at a local level by individuals and groups, will lead to an understanding

of the distinction between blameless and blameworthy actions (Marx D, 1999) and that this will lead to the creation of a 'high reliability organisation' (Reason, 2000) which patients expect and consultant surgeons aspire to.

## **1.2. Methods**

### **1.2.1 Data**

The Scottish Arthroplasty Project uses the SMR01 dataset held by ISD as the source for all data analysis. This dataset contains demographic and clinical information, which is recorded each time a patient is admitted to hospital. The data in SMR01 is submitted to ISD by NHSScotland Trusts, who are responsible for the coding of each patient episode. This system therefore relies on hospital coding systems and variations in any of the final figures represented in this report may in some cases be related to local coding issues. Hospitals are responsible for correcting identified errors and resubmitting the correct data to ISD.

The SMR01 dataset is linked by ISD to Scottish Cancer Registry records, psychiatric admissions and the General Registrar's Office death records. This enables analysis of the whole patient journey, from admission for surgery through perhaps several transfers to different hospitals and ultimately discharge home. If a patient is readmitted to hospital for further treatment or dies (at home or in hospital), this information is also recorded and collated.

The Scottish Arthroplasty Project identifies all patients on the SMR01 dataset who have undergone surgery for joint replacement (primary or revision surgery), with the exception of those patients undergoing emergency hemi-arthroplasty. Hemi-arthroplasty of the hip is usually carried out for fracture and has not been included in these figures.

### **1.2.2 Analyses**

One of the aims of the project is to measure health outcomes that are easily understood by the public: death, dislocation of the joint, infection of the joint and deep vein thrombosis or pulmonary embolus (Heaton et al, 1995). With the exception of the death of the patient, these outcomes will usually result in the patient being admitted to hospital for further treatment (a readmission). We therefore use the SMR01 dataset to identify readmissions to any hospital in Scotland and link this back to the original operation. Analysis of the clinical details recorded is then used to decide if the patient was readmitted due to a complication of the original surgery. Complication rates for the health outcomes (dislocation, infection and DVT/pulmonary embolus) can then be produced for individual consultant surgeons, which present the number of complications a consultant surgeon's patients have experienced against the number of operations the consultant surgeon performed. By using a similar process for death records, death rates can also be calculated.

Using the SMR01 dataset, the following analyses are produced:

### ***Individual consultant surgeon feedback***

Each consultant surgeon is sent a quarterly list of patients recorded as having undergone joint surgery under their care. This list is taken from the SMR01 dataset, and consultant surgeons are asked to check this list against their own records, to make sure that the SMR01 data are correct.

Each consultant surgeon has been issued with lists of their patients thought to have been readmitted with dislocation, infection, or DVT following an elective joint replacement operation between April 2000 and March 2001.

Consultants were invited to participate in a national audit of the accuracy of this complication data, and the lists were checked against patients' medical records. The results of this audit will be available in Autumn 2003. Where errors have been identified hospitals should correct their data and resubmit it to ISD.

### ***National datasets***

Trends in the numbers of consultants performing hip and knee joint replacement surgery and in the number of operations performed are produced (see sections 2.2, 2.3).

### ***Regional and consultant level complication rates***

Complication rates for those patients undergoing elective joint replacement surgery are produced. These are produced for both individual consultant surgeons and for NHS Board areas, together with comparisons with the Scottish national average for the time period April 1996 – March 2001 (see section 2.5 ).

### ***Reports to the Scottish Committee for Orthopaedics and Trauma***

The analyses in this report and further analyses have been discussed annually at the annual Scottish Orthopaedic meeting. The annual results and proposals for future analysis have also been discussed and agreed.

## **1.3 Consent and Confidentiality**

### **1.3.1 Consent**

Consent issues for patients and participants have been discussed and opinion has been widely canvassed. The SMR01 dataset is a database firmly embedded in the administrative structure of NHSScotland and is used for audit and demographic description. Specific written consent is not formally required provided the rules for confidentiality and anonymity are rigorously applied. However, we have a duty to inform patients that this process is being carried out and that they have the right to refuse to take part. Trusts have already begun providing generic information to patients about this. As part of the evolving process we have included in the appendix a poster to inform patients about the Scottish Arthroplasty Project and a brief pamphlet will be produced to expand on this. Both the poster and pamphlet will be available electronically for use throughout Trusts where required.

### **1.3.2 Confidentiality**

Throughout the process, no identifiable data linkable to individual consultant surgeons has been produced or reviewed outside ISD. Only the consultant surgeon concerned has the right to review this data in line with the guidelines on data access which apply equally to the patient and consultant surgeon. The project management team have no access to any individually identifiable data and therefore cannot comment or release information on individuals. While this should reassure participants it also places considerable responsibilities on consultant surgeons to respond to the data supplied.

## **2 Data analysis**

### **2.1 Personal Data**

For reports given to each consultant surgeon, a breakdown of individual activity figures for April 2001 to March 2002 was shown in this section.



## 2.2 National trends in numbers of operations

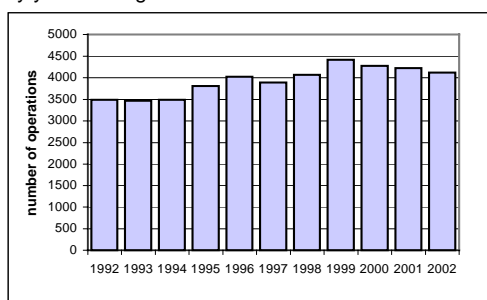
Presented below in Figures 1a to 1d, are the numbers of joint replacement operations (both primary and revision for hip and knee) recorded as performed in NHS Scotland in each of the last 11 years (1992 to 2002).

Overall, the volume of joint replacement surgery has continued to decrease since 1999, with a fall in the number of operations from 8600 to 8441 (1.4%). The largest decrease (299 operations, 6.8%) can be seen in primary hip replacement, which was partially compensated for by an increase (191 operations, 6.2%) in the volume of primary knee replacements.

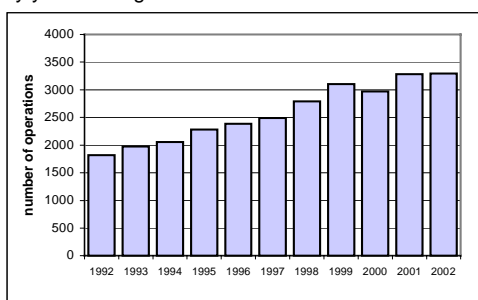
The number of revisions of hip replacements remains essentially static with a very slight increase in 2002. Once again, the number of knee revisions has increased (45 operations, 21.3%) with an increase over ten years of 109 operations, 74%.

The Scottish Waiting List Unit is currently preparing a report on the reasons behind the reduction in numbers of primary hip replacements, which has occurred despite the increase in consultant surgeon numbers.

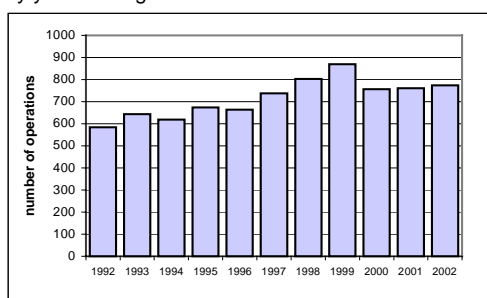
1 a  
Primary hip replacements  
by year ending March



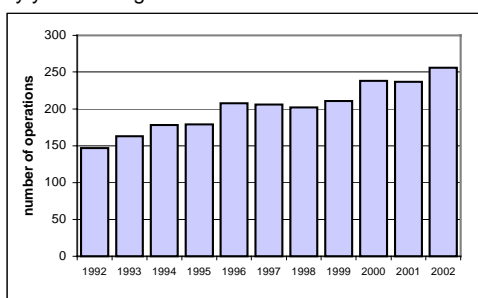
1 b  
Primary knee replacements  
by year ending March



1 c  
Revision hip replacements  
by year ending March



1 d  
Revision knee replacements  
by year ending March



### 2.3 Number of arthroplasty procedures performed per surgeon

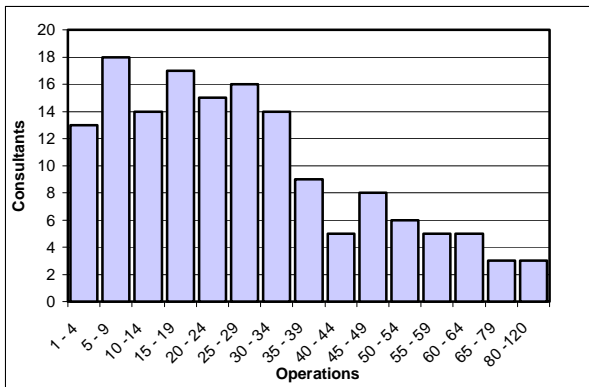
Figures 2a to 2d illustrate the number of joint replacements (primary and revision for both hip and knee) recorded as performed by each consultant surgeon operating in NHSScotland. Each consultant and hospital has a unique work pattern and case mix, and arthroplasty represents only a small part of that workload. These figures should therefore not be seen as total workload figures.

A total of 151 consultant surgeons are recorded as having performed primary hip replacements in 2002. There were 13 consultant surgeons who performed less than 5 primary hip replacements and 75 out of 122 who performed less than 5 revisions of primary hip replacements. Both these figures were similar to those for 2001.

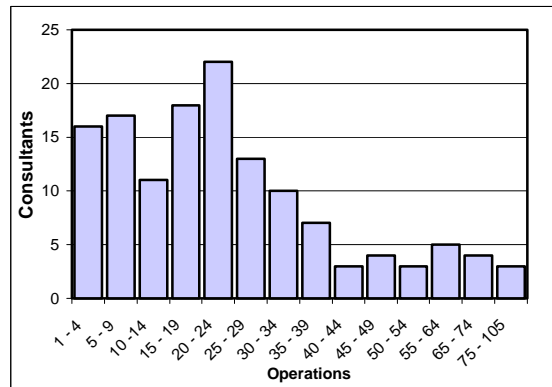
One hundred and thirty-six consultant surgeons were involved in primary knee replacements in 2002. Sixteen of these consultant surgeons (11.8%) performed less than 5 primary knee replacements, which is a similar figure to that of 2001. Of the 81 consultant surgeons who performed revisions of primary knee replacements, 35 consultant surgeons performed only one.

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 are disappointing, given that there are sufficient consultant surgeons performing more than 5 operations to cover each site in Scotland.

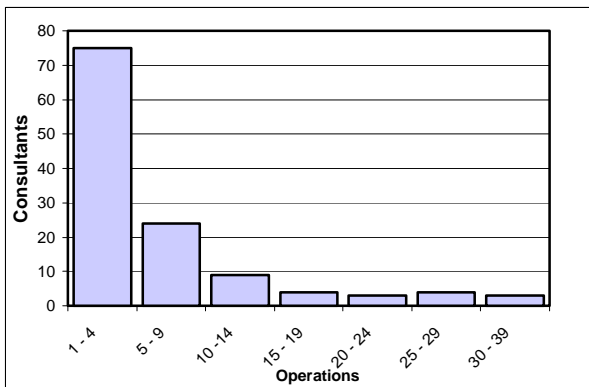
2 a  
Primary hip operations  
for year ending March 2002



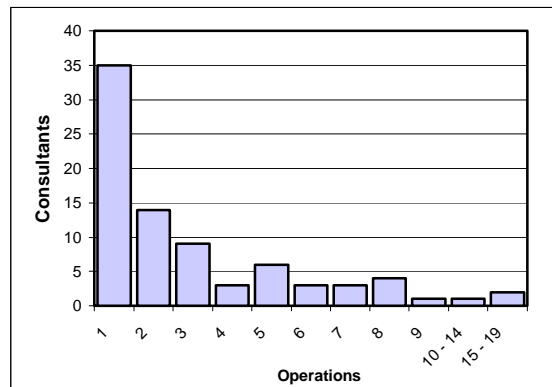
2 b  
Primary knee operations  
for year ending March 2002



2 c  
Revision hip operations  
for year ending March 2002



2 d  
Revision knee operations  
for year ending March 2002



## 2.4 NHS Board arthroplasty workload

The bar charts in 2.4.1 and 2.4.2 (see over) represent the average consultant surgeon workload by location for primary hip replacement (2.4.1) and revision of hip replacement (2.4.2). Location is based on NHS Board area with the exception of Greater Glasgow. Due to the large number of arthroplasty procedures performed in Greater Glasgow, data is presented for North and South Glasgow NHS Trusts. The NHS Board areas have been anonymised.

The denominator for these figures is the total number of consultants working in each area performing that procedure between April 1997 and March 2002 (taken from the SMR01 file). This does not therefore take account of part-time working, retirements and consultants leaving or entering posts. The line running through each set of bars represents the Scottish average number of operations per consultant surgeon. (The number of non-consultant career grade surgeons is small, and patients who have their surgery carried out by such surgeons are coded to the covering consultant in most cases.)

The NHS Boards are presented in 3 groups according to the annual volume of primary hip replacements and revision of hip replacements performed;

- Group 1 - those areas performing a total of less than 200 primary hip replacements or revision of hip replacements per year (charts 3a, 3d),
- Group 2 - those performing 200 – 299 per year (charts 3b, 3e), and
- Group 3 - those performing 300+ per year (charts 3c, 3f).

These charts are presented to give some idea of 'specialisation' by area; i.e. consultant surgeons specialising in hip replacements or revision of hip replacements.

If there is evidence of increasing specialisation, the number of cases per consultant surgeon should increase (even if the total number of cases reduces) and show an ascending gradient (area J, charts 3b and 3e). When consultant surgeons are performing fewer procedures, there is a descending gradient year on year (area H, charts 3b and 3e, or area M, charts 3c and 3f).

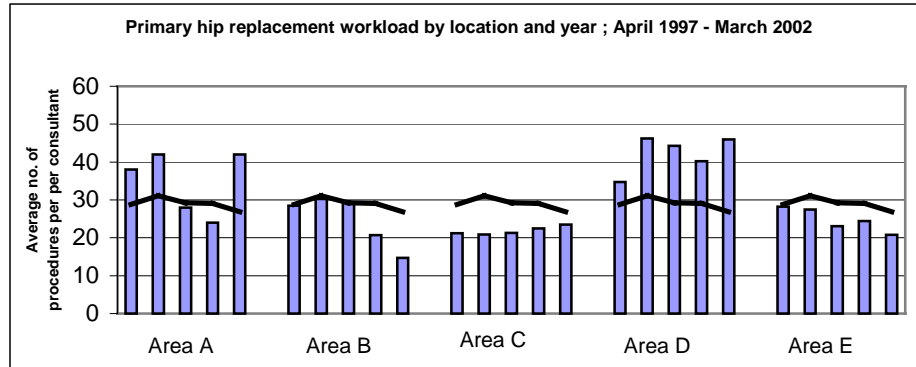
It is interesting to note that in one of the smallest areas (D, chart 3a), the average number of primary hip replacements is greater than the Scottish average while in another area (I, chart 3b) the number of primary hip and revision replacements per consultant surgeon is much

less. For revision of hip replacement in the smaller areas, only area D comes close to the Scottish average. It is unclear whether this is due to insufficient volume or insufficient specialisation.

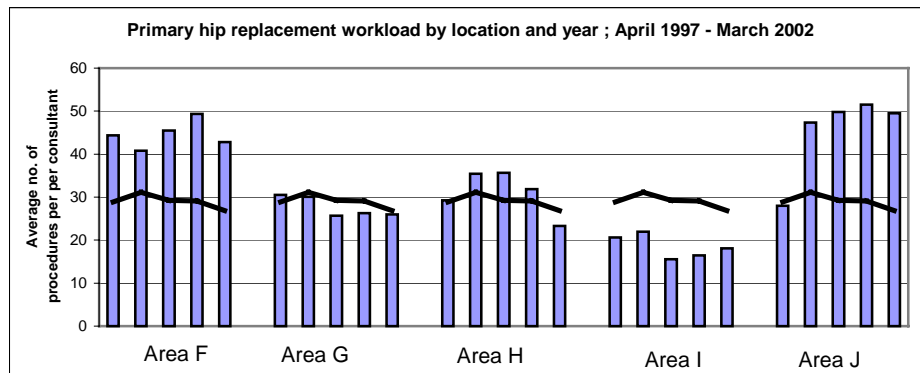
Area H is interesting in that both the primary hip replacement (chart 3b) and revision of hip replacement (chart 3e) numbers per consultant surgeon are dropping.

## 2.4.1 Primary hip replacement workload by location and Year; April 1997 – March 2002

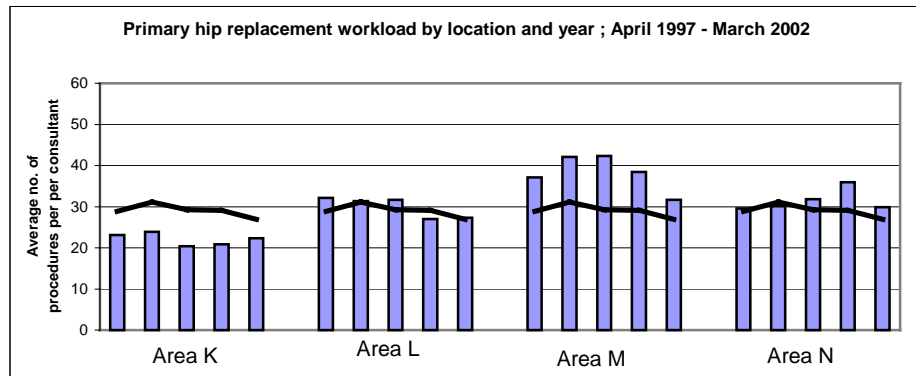
3 a Group 1



3 b Group 2

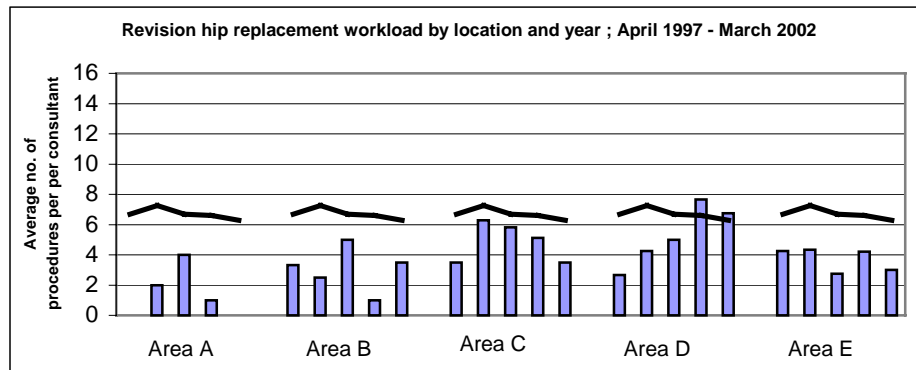


3 c Group 3

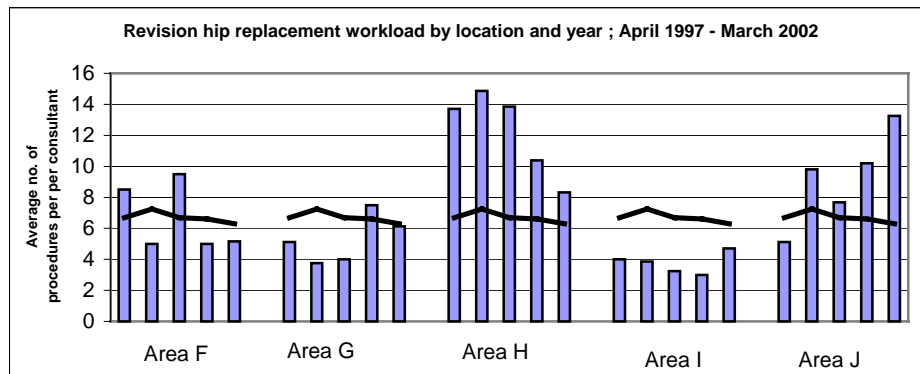


## 2.4.2 Revision of hip replacement workload by location and Year; April 1997 – March 2002

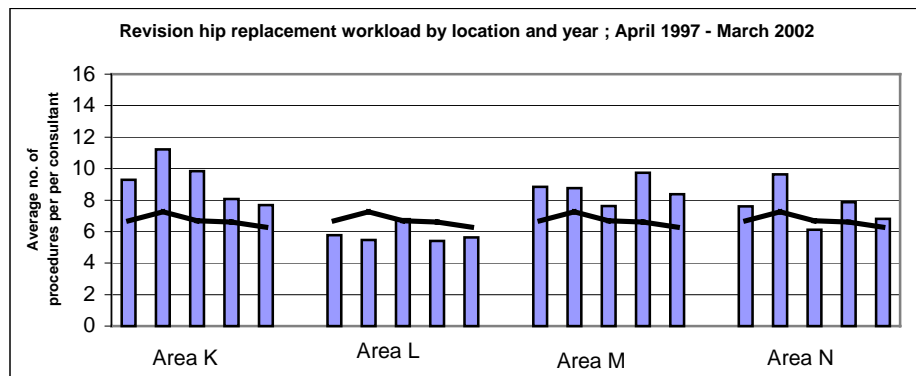
3 d Group 1



3 e Group 2



3 f Group 3



## 2.5 Analysis of complication rates

In previous years, arthroplasty complication data has been presented as bar charts, with the complication rate displayed as a percentage for each area and for consultant surgeon activity level eg rate of dislocation for consultant surgeons performing 5 – 10 primary hip replacements per year. In last year's report we demonstrated a direct relationship between volume and outcome for primary knee replacement (but not for primary hip replacement). However, this relationship is not linear (not all low volume surgeons have poor results and vice versa).

This year, Shewhart control chart methodology has been used to present complication data (Adab P et al 2002). Control charts are a simple, graphical way to display data and outcomes. The main advantage of Shewhart control charts is their simplicity – they are relatively easy both to construct and to interpret, and have been designed to identify any unusual variation in a process. In a control chart, the outcomes for different units or individuals are plotted on a chart along with a mean line. Control limits are plotted at 3 standard deviations above and below the mean line to allow for statistical variation. In the control chart, control limits are calculated around the Scottish rate and then the rates for areas and consultants are examined to see whether they fall between the 2 control limits or not.

All processes, whether industrial production lines or health care systems, have inherent random variability – known as 'common cause' variation. A system which displays only common cause variation is said to be 'in control'. An unplanned situation or unexpected event can result in 'special cause' variation. A system with 'special cause' variation is said to be 'out of control'. When a unit falls outside the control limits, it is said to be 'out of control' and a reason for the special cause variation should be sought. This may be a recording error or be indicative of a true variation in outcome. Accordingly, areas or individuals falling near to, or out with, the control limits should review their systems and results.

Complication data is presented for a specific group of patients (patients aged 60 or over suffering from osteoarthritis section 2.5.1) and also as overall complication rates for primary hip and knee replacement (sections 2.5.2, 2.5.3). The complication rates produced are based on elective primary hip and knee replacement procedures.



Adjusting for case mix by choosing to look at a specific group of patients means that all the patients in this group had hip or knee replacements for the same clinical condition (osteoarthritis) and are therefore expected to encounter similar rates of clinical complications. The group of patients aged 60 or over suffering from osteoarthritis has been chosen as it represents the most common, clinically similar group of patients who undergo primary hip or knee replacement.

Five years data (April 1996 – March 2001) have been used to reduce the variability of the results. Results for death and DVT are for 90 days as these represent the period of increased morbidity identified from previous work by the Scottish Arthroplasty Project. Complication rates for dislocation and revision are for one year.

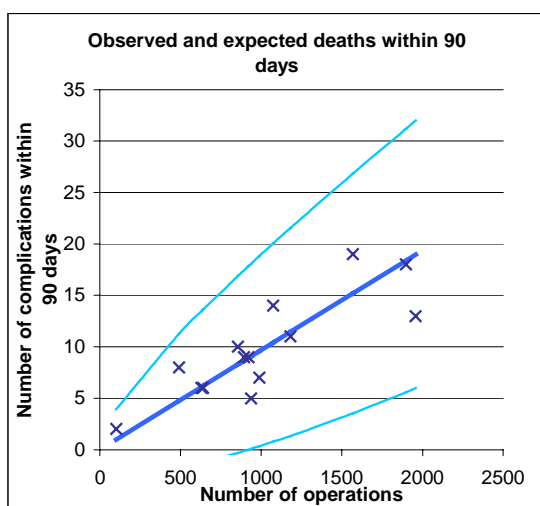
A degree of caution should be exercised when interpreting the following complication data. A recent audit of complication data by the Scottish Arthroplasty Project has indicated that the coding of complications and the linking of records to produce these figures are not entirely accurate. Detailed analysis of this complication data audit will not be available until the Autumn of 2003. However, preliminary results suggest that there are significant data problems in the identification of complications following revision of hip or knee replacement, but there are less inaccuracies regarding complication rates following primary hip or knee replacement.

### 2.5.1 Complications following elective primary hip replacement - osteoarthritis patients

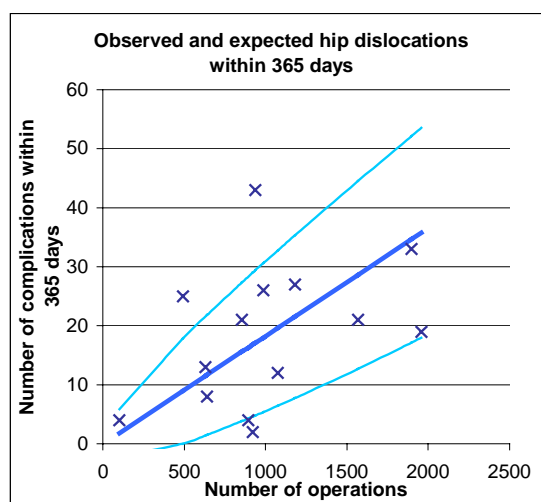
The charts below represent the complication rates for elective primary hip replacements in patients aged over 60 yrs suffering from osteoarthritis. This particular case mix has been chosen as it represents the most common, clinically similar group of patients who undergo primary hip replacement.

Each point represents the number of complications against the number of elective primary hip replacements carried out in each NHS Board area. Points lying within the control limits (the outer lines on each graph) can be said to be within control limits. Those lying outside the control limits (two areas in chart 4b and one in chart 4c) represent areas at which the complication rates are above the control limit and further investigation may be required to determine the causes of these outlying rates.

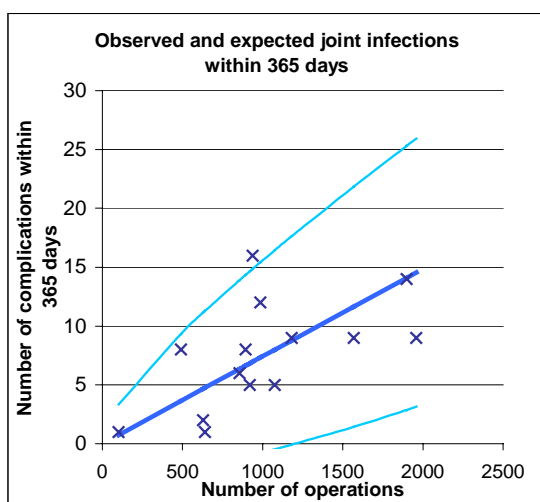
4 a



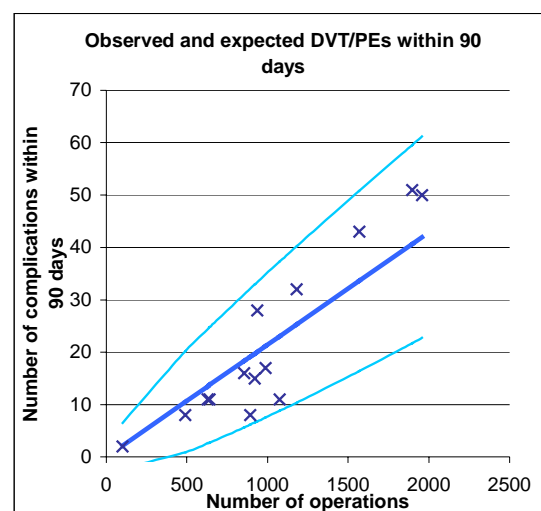
4 b



4 c



4 d

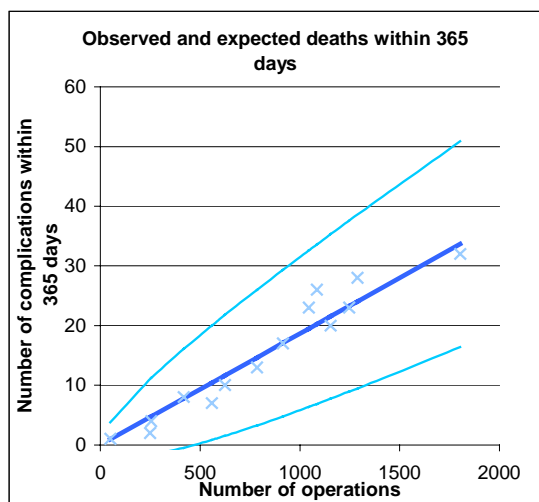


### 2.5.2 Complications following elective primary knee replacement - osteoarthritis patients

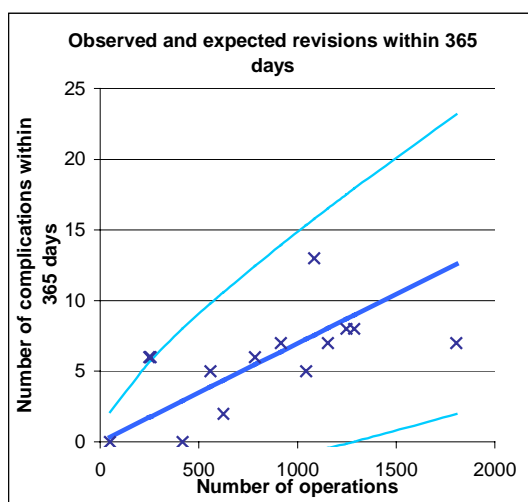
The charts below represent the complication rates for elective primary knee replacements in patients aged over 60 yrs suffering from osteoarthritis. This particular case mix has been chosen as it represents the most common, clinically similar group of patients who undergo primary knee replacement. Dislocation following an elective primary knee replacement is not included in this set of charts, as it is extremely rare and results in small numbers which are too small to be significant.

Each point represents the number of complications against the number of elective primary knee replacements carried out in each NHS Board area.

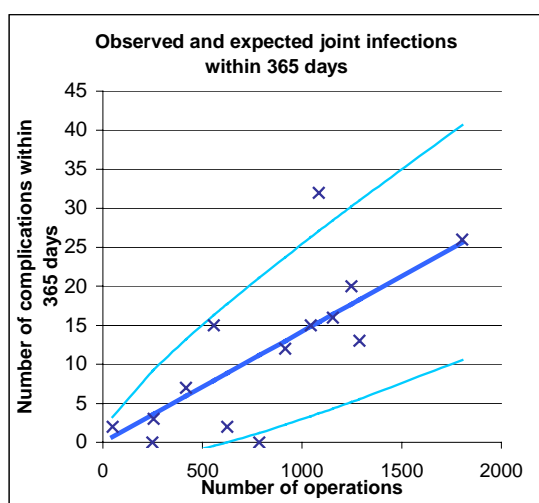
5 a



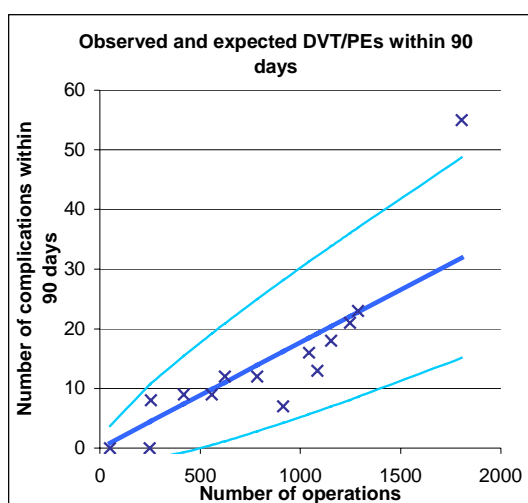
5 b



5 c



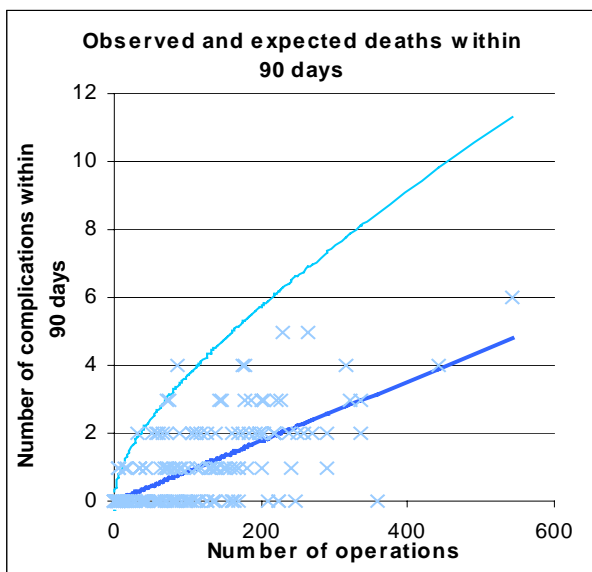
5 d



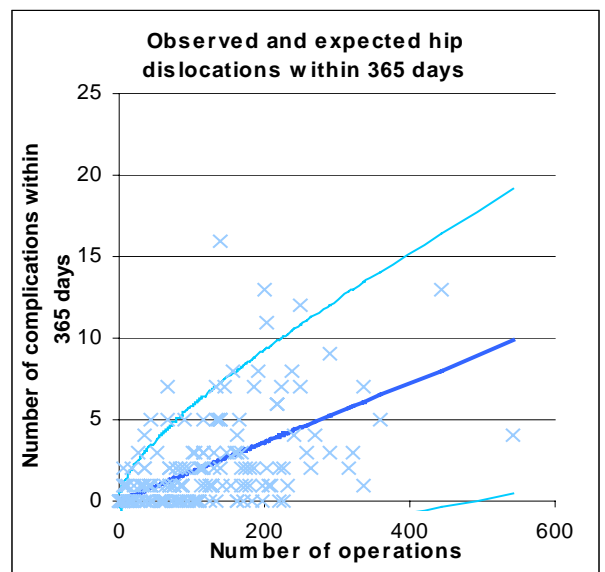
### 2.5.3 Consultant surgeon data for complications following elective primary hip replacement

The following charts represent complication rates for individual consultant surgeons for the time period April 1996 – March 2001. Each point on a chart represents the number of complications following elective primary hip replacement carried out by a particular consultant surgeon.

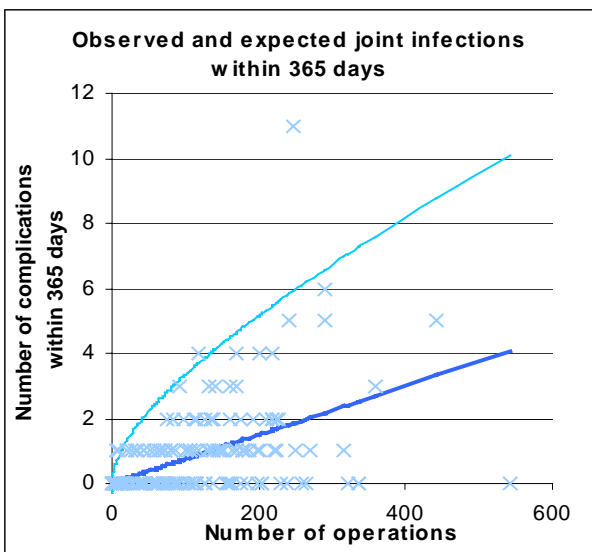
6 a



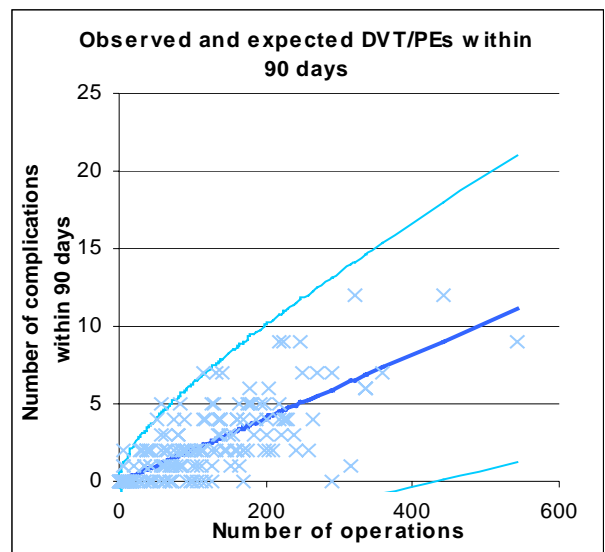
6 b



6 c



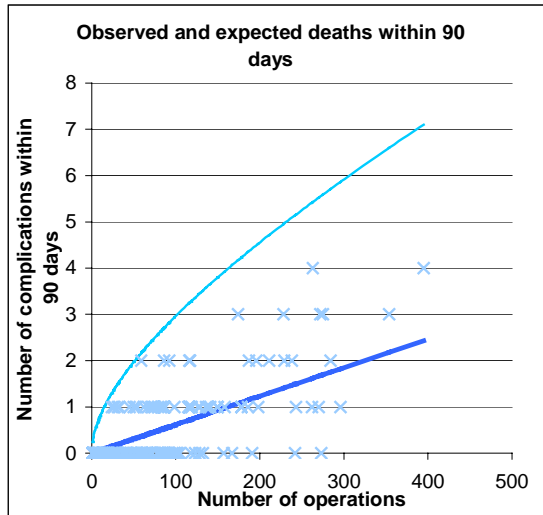
6 d



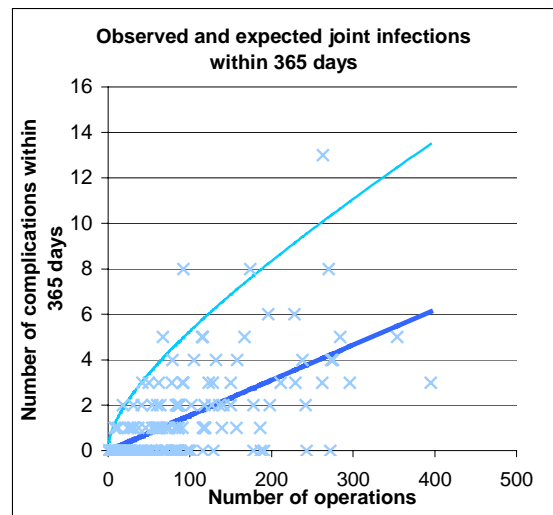
### 2.5.4 Consultant surgeon data for complications following elective primary knee replacement

The following charts represent individual consultant surgeon complication data. Each point on a chart represents the number of complications following elective primary knee replacement carried out by a particular consultant surgeon. Dislocation following an elective primary knee replacement is not included in this set of charts, as it is extremely rare and results in small numbers which are too small to be significant.

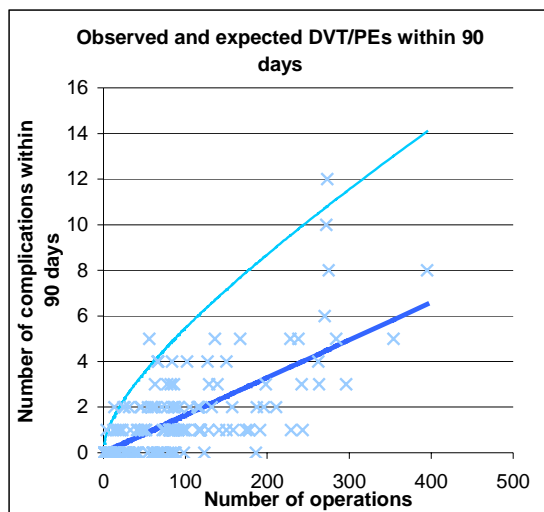
7 a



7b



7 c



## 2.6 Completeness data

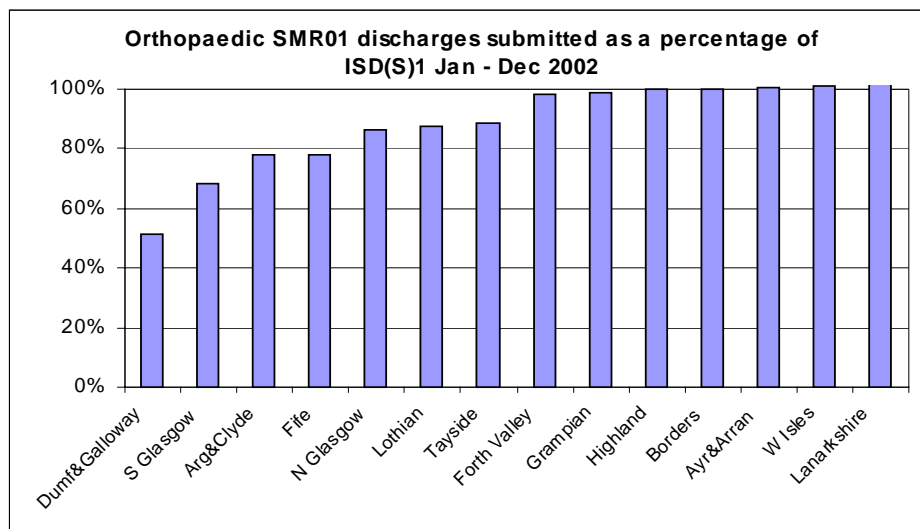
During the complication data audit carried out throughout Scotland (see methods section) it became clear that at a number of NHS Trusts the SMR01 dataset was incomplete. Generally, data is missing because it is submitted to ISD late, rather than because it is not submitted at all. The national standard is for the SMR01 episode to be submitted to ISD within 3 months of the patient's discharge home.

ISD(S)1 is a standard comprehensive set of summary statistics on resources and activity in hospitals and other healthcare settings in Scotland. It is taken to be the standard for, amongst other things, recording numbers of episodes by specialty and trust. Aggregate ISD(S)1 returns (which are much less detailed than SMR01) are submitted within a tight timescale and so are available at an earlier stage than the corresponding SMR records.

To assess data completeness/timeliness, we have compared the amount of data recorded on SMR01 with the amount of data that we would expect as recorded on ISD(S)1 for the year 2002.

As explained above, it is likely that the completeness will improve over time, as all data should eventually be submitted to ISD. However, the graphs presented below represent an important measure of system performance and illustrate why it is difficult to carry out clinical audit when it can take over a year for the data to appear on the national datasets.

Missing data will affect the total number of hip and knee joint replacements recorded and the resulting complication data. Those sites with a substantial amount of missing data will obviously have less reliable results.



### 3. Conclusion

The figures and graphs presented show that the arthroplasty project has gone some way to establishing a reporting structure for variations in outcome following elective hip and knee joint replacement. The endpoints chosen are easily identifiable and are understood by surgeons, patients and managers. An individual surgeon may choose to use their own figures when explaining the risks and benefits of surgery to a patient. NHS Board area figures lying outwith system control limits should stimulate detailed local enquiry into the possible causes for such variation.

A degree of caution needs to be taken when reviewing these results, due to coding and data completeness issues identified earlier within this report. However, over one third of surgeons have used the initial data provided as a basis for local audit, and around half of those surgeons so far appraised have used this dataset as part of their appraisal (albeit corrected at a local level). It is hoped that this more structured report will prove even more useful for individual surgeons during the appraisal process.

At a time when there is considerable pressure on NHS services to increase productivity and throughput it is important to monitor the clinical effectiveness of the services they provide. Patients can be reassured that the results following arthroplasty in Scotland are reviewed and compare well to those of other countries with similar data collection systems.

## 4. Appendices

### 4.1 - Organisation, Structure and Management of the Scottish Arthroplasty Project

The aim of the committee organisation is to provide a mechanism whereby the anonymity of patient and surgeon are maintained, whilst allowing a detailed analysis of the patient's pathway through NHSScotland following joint replacement. To encourage a feeling of ownership and reliability, centrally held data on each patient have been returned quarterly to consultants throughout Scotland. Hospitals are then responsible for correcting identified errors and resubmitting the correct data to ISD.

**The executive committee** is specifically tasked with commissioning areas for reports and agreeing areas of further data management and usage. This is to ensure that meaningful and correct data is produced and to prevent mis and over interpretation, which would lead to loss of confidence in the process. The committee elects a chairman and meets quarterly to agree analysis and coding issues and subjects for detailed analysis in future years.

The executive committee consists of:

- Three orthopaedic representatives nominated by the Scottish Committee for Orthopaedics and Trauma (Mr Colin Howie, Mr Arthur Espley, Mr David Allan).
- Representatives from the Information and Statistics Division of the CSA (Mr G Mitchell, clinical governance programme lead, Dr R Muir, Consultant in Community Medicine, Ms Fiona Campbell, snr statistician, Miss Harriet Hughes snr information analyst, Ms Jennifer Bishop, snr information analyst, Mr Tim Varley, data quality advisor ).
- Representative of the private sector (Ms Alison Smith, Hospital Manager, Carrick Glen Hospital)
- Representatives of the public (Ms Angela Donaldson, Arthritis Care).
- In addition to the persons in attendance ex officio, there is a minute secretary.

**The management committee** is tasked with the day-to-day running of the project, agreeing research methodologies, practical distribution strategies and answering participant's queries. In addition, members of this group are responsible for liaison with other departments and bodies to ensure the smooth working of the system. Areas for data



analysis can be suggested and investigated but not released to third parties without the specific consideration and agreement of the executive group. The management committee consists of:

- Chairman of executive committee (plus an orthopaedic surgeon if the chair is not a practicing surgeon)
- ISD representatives to include a consultant in community medicine, staff responsible for data analysis, statisticians.
- Others co-opted for specific reasons or projects following the agreement from the executive group.

## 4.2 Reference list

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Katz et al Association Between Hospital and Surgeon Procedure Volume and Outcomes of Total Hip Replacement in the United States Medicare Population.; *Journal of Bone and Joint Surgery* 2001 83(A): 1622-29

Marx D. Maintenance error causation: Washington DC *Federal Aviation Authority Office of Aviation Medicine*. 1999

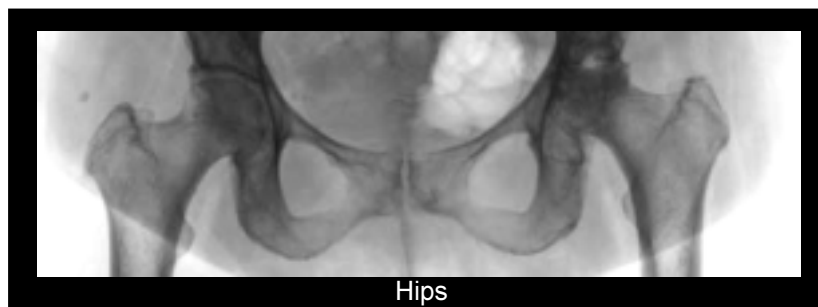
Reason J. Managing the risks of organisational accidents Aldershot: *Ashgate* 1997

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# The Scottish Arthroplasty Project

## How We Use Information

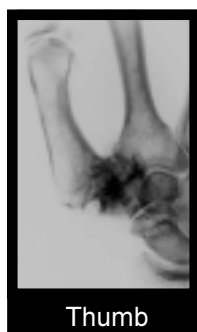
### About You and Your Treatment



#### *What is the Arthroplasty Project?*

The Scottish Arthroplasty Project was set up to help make joint operations (Arthroplasty) better and safer.

The Project uses computer-held data to give information on the results of surgery to your medical staff. In the course of your treatment we record information about you and your treatment. We use this mainly to plan and manage your care. Some of it is also used to measure the quality of care we provide and to carry out audit aimed at improving care. Your surgeon receives annual results and national outcomes are compared with other healthcare systems. Presently Scotland compares favourably with North America.



The data are controlled by the hospital providing treatment and processed for the project by the Information and Statistics Division (ISD, a part of NHSScotland). All information is handled according to the requirements and principles of the Data Protection Act 1998.

No identifiable information is passed to any individual or organisation out with the Health Service. You have the right to object to your data being used. However, the purpose of the project is to provide benefit to present and future patients, any lack of information may reduce our ability to monitor and improve the standards of care we provide.

It is important that you know that information about you is being used in this way.

Without your cooperation we would be unable to work out our success or complication rates.

*If you want to know more about the Scottish Arthroplasty Project ask your consultant.*



*If you have concerns about the use or privacy of your data ask to speak to the hospital's*

*Data Protection Officer or Records Manager.*