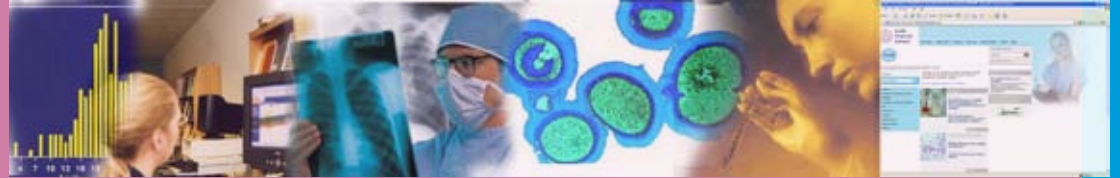




Health
Protection
Scotland

NHS
National
Services
Scotland



Surveillance of Surgical Site Infection

For procedures carried out from: 1/04/02 - 30/06/07



Scottish Surveillance
of Healthcare Associated Infection
Programme
(SSHAIP)

2007

Executive Summary

The Scottish Surveillance of Healthcare Associated Infection Programme (SSHAIP) team on behalf of Health Protection Scotland (HPS) continue to facilitate national surveillance of surgical site infection (SSI). All of the NHS boards in Scotland participate in the SSI programme. For the period April 2002 – June 2007, 1232 in patient SSIs, resulting from 82160 operations in 10 categories of surgical procedures have been reported to SSHAIP. In the last year 01/7/2006 to 30/06/2007 241 in patient SSIs resulting from 22830 operations have been reported to SSHAIP.

The incidence of in patient SSI varied by surgical category. In patient SSI rates for six of the 10 categories of surgery, where there were enough data to perform these analyses*, ranged from 0.6% (0.5%, 0.8%) for knee arthroplasty to 2.4% (2.1%, 2.8%) for open reduction of long bone fracture.

The SSI rates in Scotland over the duration of the SSI surveillance programme have been relatively stable for most categories of surgery. The published rates for the last year are lower than the previous year for all categories of surgery, indicating a downward trend in SSI in Scotland. There is a significant reduction in in patient SSI rates for hip arthroplasty, knee arthroplasty and caesarean section procedures for the last year of surveillance.

The incidence of SSI increased with the number of risk factors present for most categories of surgery where there were sufficient data to perform these analyses*.

The incidence of SSI varied by NHS board performing the surgery. This variation may be attributable to the number of operations performed, case mix of the patient population and length of stay variations.

As per the mandatory requirements of HDL (2006) 38¹ post discharge surveillance of SSI until day 30 post operatively has been implemented within all NHS boards for caesarean section procedures. Readmission surveillance until day 30 post operatively for hip arthroplasty procedures has been implemented within all NHS boards and in the last six months (01/01/2006 to 30/06/2007) 35.2% of SSIs in hip arthroplasty procedures have been detected on readmission to hospital.

SSHAIP have developed an online web reporting system for SSI surveillance, this system was launched in June 2007. An online web data entry system is currently in development will be rolled out to all NHS boards in 2008.

The results from the surveillance have been used by NHS boards at a local level to review clinical practice and have resulted in improvements in performance, both in terms of the process of care, e.g., antibiotic prophylaxis compliance and in terms of outcome, i.e., reduction in SSI rates. In 2007 SSHAIP produced a SSI supplementary report for Sharing Best Practice² from this programme of surveillance which highlighted NHS boards that have been identified as having significant reductions in in patient SSI rates by category of surgery since commencing SSI surveillance.

* Procedures were considered to be appropriate for analysis where there are more than three NHS boards performing more than 100 procedures within the period of analysis. This resulted in six procedures being included in the analysis of the data from the full period (April 2002 to June 2007) and five procedures being included in the analysis of data from the past year (July 2006 to June 2007). Cranial Surgery is not included in the report as currently no NHS boards conduct surveillance for this procedure category.

SECTION 1: INTRODUCTION

1.1 Introduction

- 1.1.1 SSI are one of the most common HAI accounting for 15.9% of all HAI which cost the NHS in Scotland £183 million per year. SSI, also referred to as infection of the surgical wound, result in a national average additional hospital stay of 5.7 days and cost of treatment of £1755 per patient³. The consequences for the patient include longer time in hospital, pain and suffering and possible further surgical intervention. SSI is therefore an important outcome measure for surgical procedures.
- 1.1.2 The Scottish Surveillance of HAI programme (SSHAIP) within Health Protection Scotland (HPS) runs a surgical site infection surveillance programme that is mandatory in all NHS boards in Scotland.
- 1.1.3 This is the fifth national report from this programme of surveillance and presents the results of the analysis of both the cumulative data from 1/4/2002 to 30/6/2007 and also focuses on data from the last year of reporting. However it must be emphasized that the results provided in this paper do not represent infection rates in Scotland as a whole. Some NHS boards have participated in the SSI programme for shorter periods of time due to changes in service provision or adding further categories of surgery to their local programme of surveillance. The data are heavily biased towards results from those NHS boards that have contributed large numbers of reports, thus these data should be interpreted with due caution.
- 1.1.4 All NHS boards are required to undertake surveillance for hip arthroplasty and caesarean section procedures as per the mandatory requirements of HDL (2006)³⁸¹. Additional categories can be selected from a list of eight commonly performed ‘clean’ surgical procedures.
- 1.1.5 Readmission surveillance is now undertaken using prospective readmission data for all hip arthroplasty procedures under in patient surveillance up to day 30 post operatively. Post discharge surveillance until day 30 post operatively must now be undertaken for all caesarean sections performed. SSHAIP are currently conducting a comprehensive review of post discharge data collection methods across Scotland for caesarean section procedures. The report indicates where hip arthroplasty readmission surveillance and post discharge surveillance for caesarean section procedures data are included in analyses.

1.2 Surveillance methodology

- 1.2.1 In order to obtain robust national data, surveillance in Scotland is conducted according to the SSHAIP standard national protocol⁴, with adherence to the definitions for SSI, which are internationally comparable, within that protocol. Each NHS board has a nominated SSI surveillance coordinator who is responsible for providing overall coordination and liaison with SSHAIP, ensuring continuing involvement of the clinical teams and that mechanisms are in place for data collection, collation, transfer and dissemination on a quarterly basis. The SSHAIP team provide personnel involved in data collection with training in the data definitions and methods for the surveillance programme.

- 1.2.2 Data are collected prospectively on eligible patients as per the SSHAIP protocol⁴, from the time of surgery to discharge, death or 30 days post operatively, whichever occurs soonest. An SSI is considered healthcare associated if it occurs within 30 days of surgery.
- 1.2.3 Data are routinely quality assured by SSHAIP. The results indicate that the data within the SSI programme are robust⁵.
- 1.2.4 Since 2002 NHS boards have collected data continuously on two categories of surgery from a list of 10 (Table 1). From January 2007 all NHS boards collected data on hip arthroplasty and caesarean section SSI, as a minimum, in line with the requirements of HDL (38) 2006¹.

SECTION 2 RESULTS: RATES OF SSI

2.1 Incidence of SSI by category of surgery

TABLE 1: Contribution of NHS boards by categories of surgery and duration of data collection to end June 2007

Category of surgery	Date started data collection	No of NHS boards contributing data	No of reports submitted
Abdominal hysterectomy	08/04/2002	10	4106
Breast surgery	02/04/2002	3	2581
Caesarean section	10/04/2002	14	23396
Open reduction of long bone fracture	18/04/2002	9	9312
Hip arthroplasty	02/04/2002	14	21623
Knee arthroplasty	04/04/2002	11	16404
Vascular surgery	11/04/2002	3	868
Coronary Artery Bypass Graft (CABG)	06/06/2002	1	1508
Cardiac surgery	09/06/2004	1	87
Cranial surgery+	15/08/2002	4	2275
Totals		*70	82160

* Some NHS boards are carrying out surveillance on multiple categories of surgery
 + currently no NHS boards are performing surveillance for cranial surgery procedures

2.1.1 All NHS boards in Scotland have contributed surveillance data of specified surgical procedures, taken from the aforementioned list of categories of surgery, for different periods up to end June 2007. Table 1 shows the earliest date that data collection started, the number of NHS boards contributing data for each category and the number of reports received. It illustrates that for some categories of surgery the results presented later in this report are based on only small numbers of reports and sometimes from only a small number of NHS boards. It should also be noted that even where large numbers of reports have been received the majority of these might have come from two or three NHS boards.

2.1.2 In patient SSI rates and confidence intervals for six categories of surgery for the period 01/04/2002 to 30/06/2007 are provided in Figure 1. The SSI rates are given as percentages. With each rate, Figure 1 provides the 'confidence interval', that is the range within which the true value of the infection rate is likely to fall. Smaller samples give rise to larger confidence intervals and are more subject to influence from a small number of unusual events, therefore only those categories of surgical procedure where three or more NHS boards each collected data for at least 100 procedures during the period under review have been included. The categories of surgery where these criteria were not met were cardiac, coronary bypass graft (CABG), vascular and cranial surgery, these categories of surgery are therefore excluded from further analyses within this report. The number of reports on which the rates are based is given. In total 82160 procedures with 1232 in patient infections are included in these analyses. As noted previously, these rates are not representative of the rate in Scotland as a whole, but are biased by the varying numbers of reports contributed by those NHS boards, that have undertaken surveillance of each procedure.

FIGURE 1: In patient SSI rate with 95% confidence interval by procedure 1/4/2002 to 30/7/2007

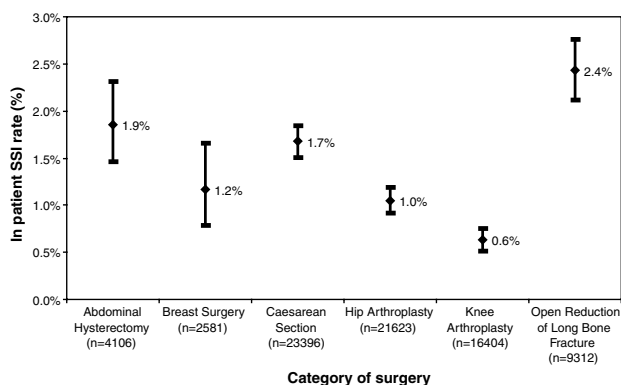
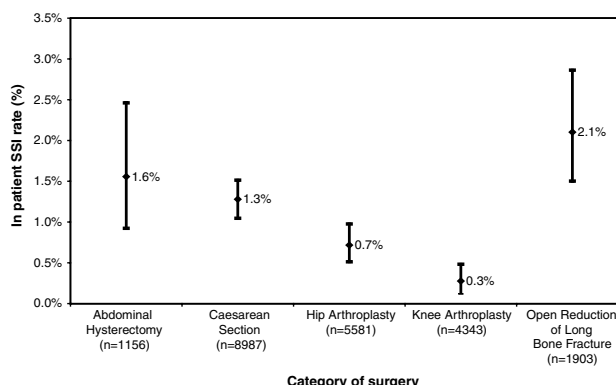


FIGURE 2: In patient SSI rate with 95% confidence interval by procedure 1/7/2006 to 30/6/2007



2.1.3 Figure 2 shows in patient SSI rates with confidence intervals for the period 01/07/2006 to 30/06/2007, the categories that did not meet the criteria for analysis of three NHS boards contributing at least 100 procedures during this period were breast surgery, vascular surgery, CABG, cardiac surgery and cranial surgery.

2.1.4 In patient SSI rates with 95% confidence intervals for the six procedure categories which have sufficient data for analysis are given in Table 2 for the period 01/04/2002 to 30/06/2007, there is a total of 77422 procedures. Table 3 shows the in patient SSI rates with 95% confidence intervals for the period 01/07/2006 to 30/06/2007 for the five procedure categories with sufficient data to be included in further analysis 21970 procedures are included.

TABLE 2: In patient SSI rate with 95% confidence interval by procedure 1/4/2002 to 30/6/2007

Category of surgery	Number of operations	Number of in patient SSIs	In patient SSI rate	95% confidence interval
Abdominal Hysterectomy	4106	76	1.9%	1.5%-2.3%
Breast Surgery	2581	30	1.2%	0.8%-1.7%
Caesarean Section	23396	392	1.7%	1.5%-1.8%
Hip Arthroplasty	21623	227	1.0%	0.9%-1.2%
Knee Arthroplasty	16404	104	0.6%	0.5%-0.8%
Open Reduction of Long Bone Fracture	9312	227	2.4%	2.1%-2.8%
Total	77422	1056	1.4%	1.3%-1.4%

TABLE 3: In patient SSI rate with 95% confidence interval by procedure 1/7/2006 to 30/6/2007

Category of surgery	Number of operations	Number of in patient SSIs	In patient SSI rate	95% confidence interval
Abdominal Hysterectomy	1156	18	1.6%	0.9%-2.5%
Caesarean Section	8987	115	1.3%	1.0%-1.5%
Hip Arthroplasty	5581	40	0.7%	0.5%-1.0%
Knee Arthroplasty	4343	12	0.3%	0.1%-0.5%
Open Reduction of Long Bone Fracture	1903	40	2.1%	1.5%-2.9%
Total	21970	225	1.0%	0.9%-1.2%

TABLE 4: In patient SSI rates for hip arthroplasty procedures with 95% confidence intervals 01/01/2007 to 30/06/2007

Category of surgery	Number of operations	Number of in patient SSIs	In patient SSI rate	95% confidence interval
Primary Hip Hemi Arthroplasty	772	16	2.1%	(1.2-3.4%)
Revision of Hip Hemi Arthroplasty	45	3	6.7%	(1.4-19.5%)
Primary Total Hip Arthroplasty	2482	11	0.4%	(0.2-0.8%)
Revision of Total Hip Arthroplasty	335	5	1.5%	(0.5-3.5%)
Total	3634	35	1.0%	(0.7-1.3%)

Key summary point:

The incidence of SSI varies by category of surgery. Open reduction of long bone fracture most frequently (2.4%) and knee arthroplasty least frequently (0.6%), led to infection in the six categories of surgery included in these analyses. The published SSI rates for the period 01/07/2006 to 30/06/2007 were lower than those for the whole period (01/04/2002 to 30/06/2007) in all procedure categories, suggesting a downward trend and three of the five procedures showed a significant reduction in SSI rates for the period 01/07/2006 to 30/06/2007 when compared to the period 01/04/2002 to 30/06/2006. These were hip arthroplasty ($p = 0.011$), caesarean section ($p = 0.001$) and knee arthroplasty ($p = 0.013$). The incidence of SSI varied for hip arthroplasty procedure categories dependent on the type of procedure carried out. Operations for primary total hip arthroplasty had the lowest in patient SSI rate (0.4%), compared with 6.7% for revisions of hip hemi arthroplasty. Specific risk factors might account for higher infection rates with specific procedures, thus crude rates should always be interpreted with care.

2.2 Trends in SSI Rates

2.2.1 Although Figures 1 and 2 give an indication of the SSI rate for a given time period they do not indicate the trend in the SSI rates over time. Figures 3-8 show the trends in in patient SSI rates for six categories of surgery by month over the 5 year period surveillance has been carried out in Scotland. These data are presented in Statistical Process Control charts (SPCs). SPCs present the rates of occurrence of any event (in this instance the rate of occurrence of SSI) in relation to what would be expected (the average or mean rate) and what is unusual. What is unusual includes what is outside a 'statistical process control limit'. 'Control limits' (technically defined as plus or minus three standard deviations from the mean) represent the range of variation in SSI rates that might be expected to occur due to chance alone*.

* See appendix 1 for detailed criteria for interpretation of SPCs

FIGURE 3: Statistical process control chart of in patient SSI rate for abdominal hysterectomy procedures during the period July 2002 to June 2007**

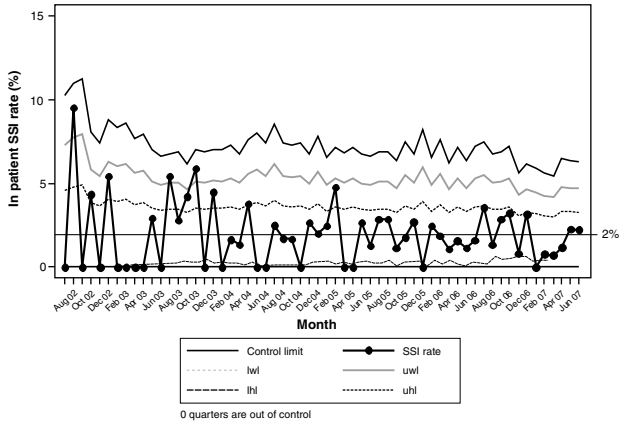
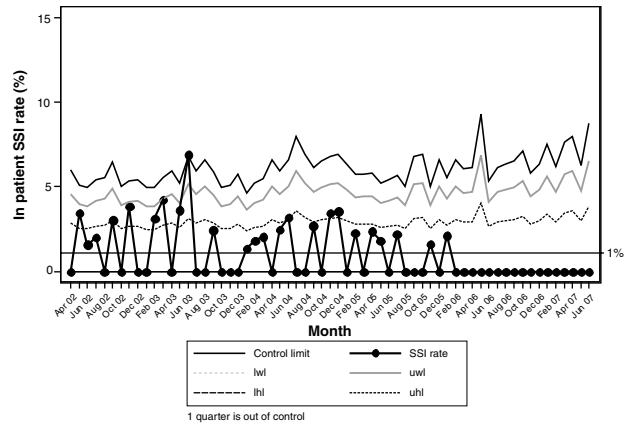


FIGURE 4: Statistical process control chart of in patient SSI rate for breast surgery procedures during the period April 2002 to June 2007



** Months April 2002 to June 2002 were removed due to the small number of operations during this period

FIGURE 5: Statistical process control chart of in patient SSI rate for caesarean section procedures during the period September 2002 to June 2007***

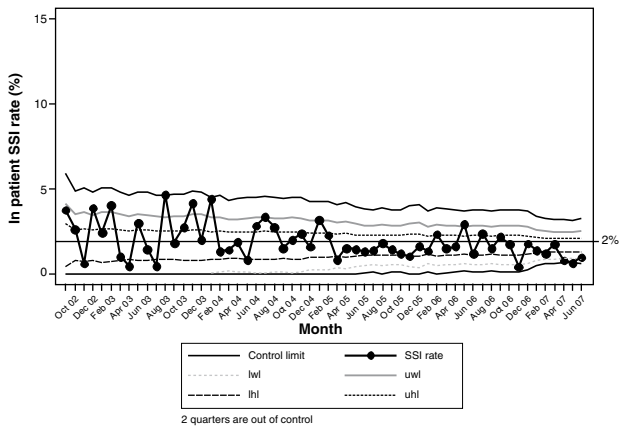
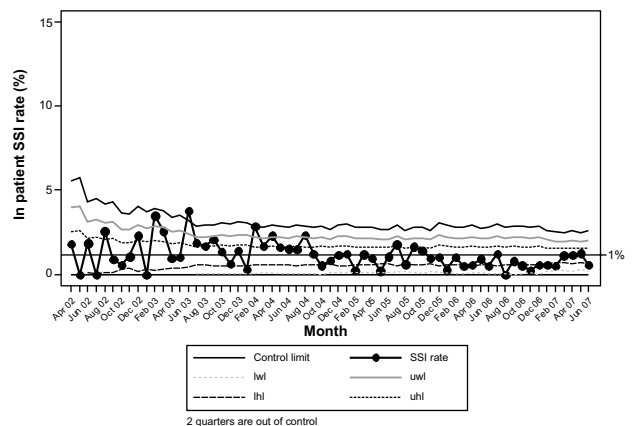


FIGURE 6: Statistical process control chart of in patient SSI rate for hip arthroplasty procedures during the period April 2002 to June 2007



*** Months April 2002 to August 2002 were removed due to the small number of operations during this period

FIGURE 7: Statistical process control chart of in patient SSI rate for knee arthroplasty procedures during the period April 2002 to June 2007

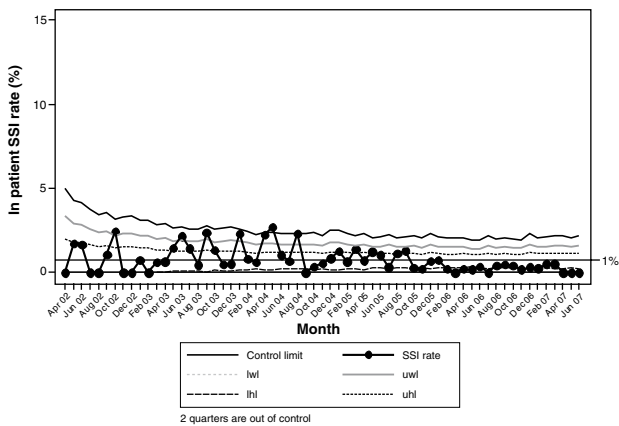
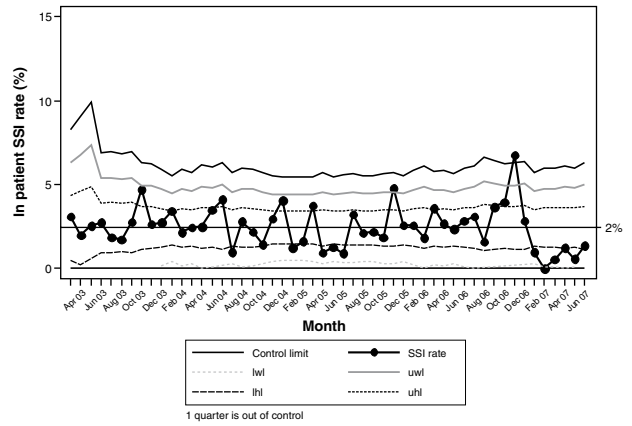


FIGURE 8: Statistical process control chart of in patient SSI rate for open reduction of long bone fracture procedures during the period March 2003 to June 2007****



**** Months April 2002 to February 2003 were removed due to the small number of operations during this period

TABLE 5: In patient SSI rates by category of surgery and year of surveillance with 95% confidence intervals

	2002/03	2003/04	2004/05	2005/06	2006/07
Category of Surgery	In patient SSI rate	In patient SSI rate	In patient SSI rate	In patient SSI rate	In patient SSI rate
Abdominal Hysterectomy	1.5% (0.6-2.9%)	2.6% (1.6-4.0%)	1.8% (1.0-3.0%)	1.8% (1.0-2.9%)	1.6% (1.0-2.5%)
Breast Surgery	2.0% (1.0-3.5%)	1.1% (0.4-2.3%)	1.4% (0.5-3.0%)	0.6% (0.1-1.9%)	0.0% (0.0-1.0%)
Caesarean Section	2.3% (1.7-3.0%)	2.3% (1.8-2.9%)	1.9% (1.5-2.4%)	1.6% (1.3-2.0%)	1.3% (1.0-1.5%)
Hip Arthroplasty	1.9% (1.3-2.6%)	1.8% (1.5-2.3%)	1.4% (1.1-1.7%)	1.3% (1.1-1.7%)	1.1% (0.9-1.4%)
Knee Arthroplasty	0.9% (0.5-1.5%)	1.1% (0.8-1.6%)	0.7% (0.5-1.0%)	0.5% (0.3-0.7%)	0.3% (0.1-0.5%)
Open Reduction of Long Bone Fracture	2.2% (0.8-4.7%)	2.3% (1.5-3.3%)	1.4% (0.8-2.2%)	2.5% (1.7-3.5%)	0.9% (0.4-1.7%)

Key summary point:

For abdominal hysterectomy procedures (Figure 3) performed in the contributing NHS boards, SSI rates were stable over the period April 2002 to June 2007, with no ‘signals’ being shown and all values within the statistical process control limits.

SSI rates following hip arthroplasty (Figure 6) signalled an increase in June 2003 and February 2004 by rising above the upper control limit. Since then the rate has remained below the upper control limit and has shown no further signals. When we compare the in patient SSI rates for 2003/04 and 2006/07 we find a statistically significant reduction ($\chi^2 = 6.724$, $df = 1$, $p = 0.01$)

SSI rates following breast surgery (Figure 4) signalled in September 2006, with the eighth month in a row where the rate was below the centre line, indicating that the in patient SSI rate had decreased significantly, this was followed by a further nine months with an in patient SSI rate of 0%. In May 2007 the in patient SSI rate for caesarean sections (Figure 5) signalled by eight monthly rates being below the centre line, indicating that a significant reduction in SSI rates had been achieved. Similarly the in patient SSI rate for knee arthroplasty (Figure 7) demonstrated a significant reduction in September 2006 with eight months having a rate below the centre line, following this the rate has remained below the centre line for a further nine months.

In contrast to this the in patient SSI rate for open reduction of long bone fracture (Figure 8) signalled an increase in November 2006 with one monthly rate rising above the upper control limit. The rate in the following months returned to within the control limits.

2.3 Risk adjusted SSI rates

2.3.1 Although the results in Figures 1 to 8 are grouped by clinically similar procedure, they do not take into account factors, which may influence the risk of infection. The US Centers for Disease Control's (CDC) NNIS (National Nosocomial Infections Surveillance) risk index⁷, is the method of risk adjustment most widely used internationally. Risk adjustment is based on three major risk factors, namely Anaesthetics Society of America (ASA) score, reflecting the patients' state of health before surgery, wound class, reflecting the state of contamination of the wound, and the duration of operation, reflecting technical aspects of the surgery. The risk index is scored as zero, one, two or three according to the number of aforementioned risks present. The CDC's experience is that the infection rate increases with increasing risk score. Figures 9 to 14 show the in patient incidence of SSI stratified by the NNIS risk index for the six categories of surgical procedures, where sufficient data were available to perform these analyses for the period 1/7/2006 to 30/6/2007.

FIGURE 9: In patient SSI rate by NNIS risk score for abdominal hysterectomy procedures: 1/7/2006 to 30/6/2007

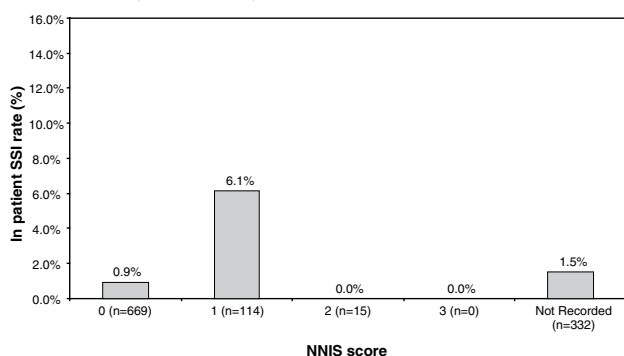


FIGURE 10: In patient SSI rate by NNIS risk score for caesarean section procedures: 1/7/2006 to 30/6/2007

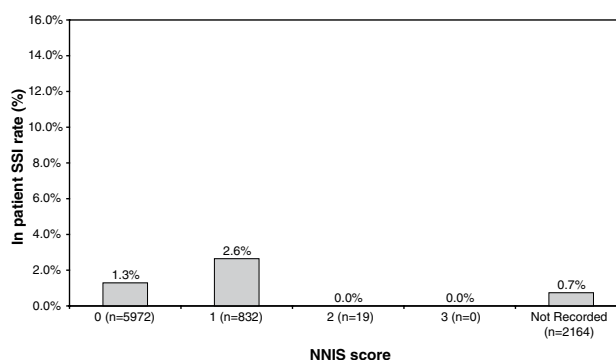


FIGURE 11: In patient SSI rate by NNIS risk score for hip hemi arthroplasty: 1/7/2006 to 30/6/2007

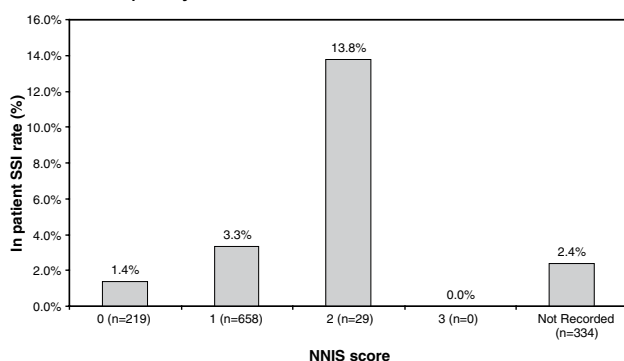


FIGURE 12: In patient SSI rate by NNIS risk score for total hip arthroplasty procedures: 1/7/2006 to 30/6/2007

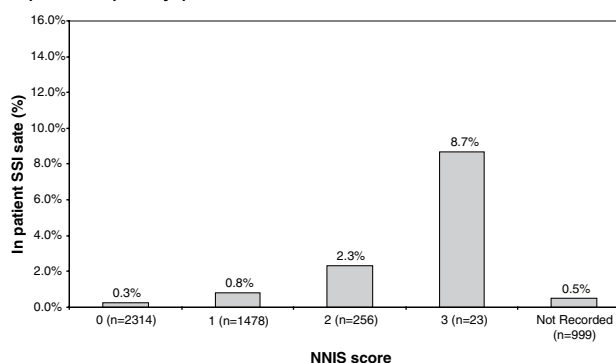


FIGURE 13: In patient SSI rate by NNIS risk score for knee arthroplasty procedures: 1/7/2006 to 30/6/2007

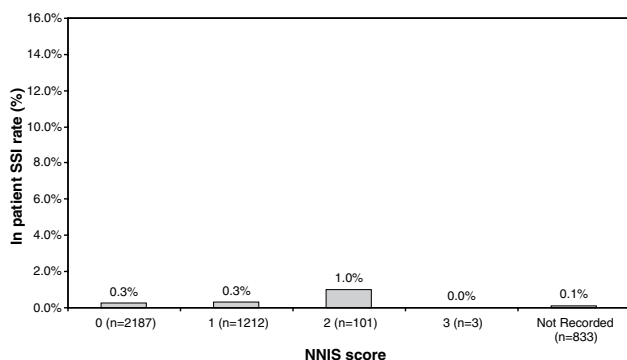
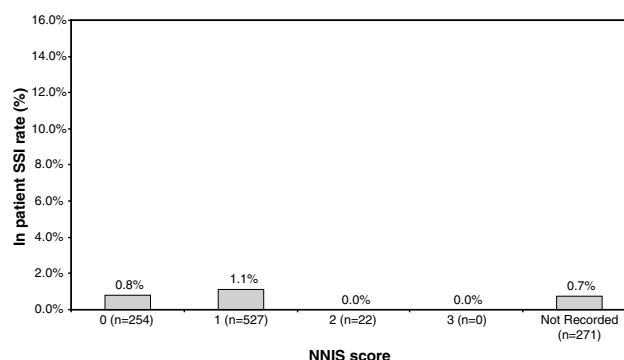


FIGURE 14: In patient SSI rate by NNIS risk score for open reduction of long bone fracture procedures: 1/7/2006 to 30/6/2007



Key summary point:

The incidence of SSI clearly increases with the number of risk factors present. Most of the categories of surgery included do not stratify for the wound class risk factor as they are principally not contaminated or dirty procedures.

Around 22% of procedures performed in the last year could not be classified and this was similar to previous years where the proportion unable to be classified ranged from 16% to 36%, 11% of these were due to ASA classification not being recorded. Higher proportions of missing data have been reported by other national surveillance systems⁶.

2.4 Duration of surveillance

2.4.1 The numbers of infections detected by surveillance will be affected by the length of the post operative stay. Patients have differing durations of post operative stay for the same procedure in different hospitals. The length of post operative in patient stay, that is the period during which the surgical site is under surveillance, will affect the numbers of infections detected. Figure 15 indicates the average length of stay (LOS) for each of the categories of surgery and the SSI rate and shows that open reduction of long bone fracture procedures have the longest average length of stay.

2.4.2 HDL (2006) 38¹ required NHS boards to undertake mandatory post discharge surveillance, using prospective readmission data to day 30 post operatively following discharge for all in patient hip arthroplasty procedures. The hip arthroplasty procedure category includes the following procedures: Primary Total Hip Replacement, Revision of Total Hip Replacement, Primary Hip Hemi Arthroplasty and Revision Hip Hemi Arthroplasty. Figure 16 indicates the number of operations, number of in patient SSIs and number of SSIs when readmission are included along with SSI rate and confidence intervals for these rates for each of the hip arthroplasty procedures.

Table 6 indicates the number of SSIs identified through readmission surveillance varied for each hip arthroplasty procedure category with an increase of 91% in identification of SSIs in total primary hip arthroplasty procedures compared to 0% of revisions of hip hemi arthroplasty procedures. This shows that performing readmission surveillance is a worthwhile exercise for hip arthroplasty procedures with a 56.7% increase in the identification of SSIs.

FIGURE 15: In patient SSI rate by average length of stay (LOS) 1/7/2006 to 30/6/2007

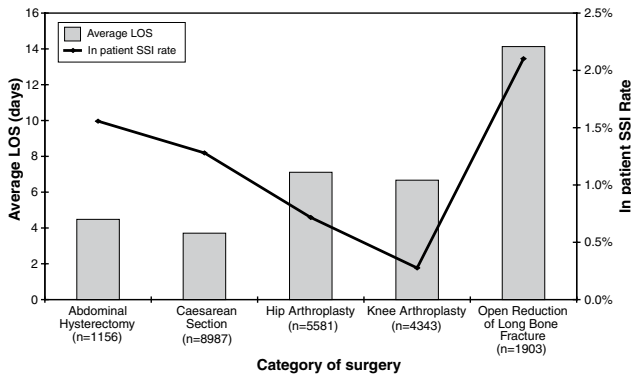
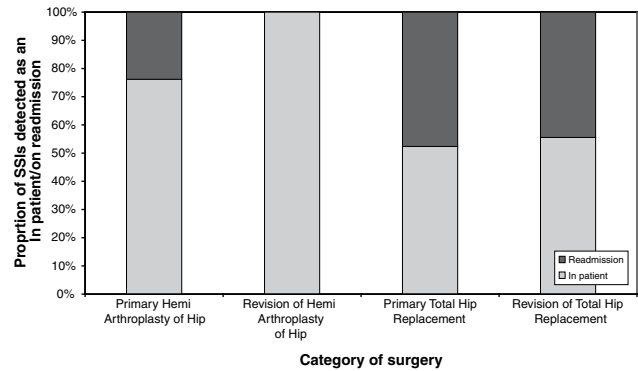


FIGURE 16: Proportion of SSIs detected as an in patient and on readmission for hip arthroplasty procedures 01/07/2006 to 30/06/2007



2.4.3 Length of stay varies by category of surgery. The average length of stay for caesarean section surgery is less than four days and thus infections occurring after this period will not be detected by in patient surveillance. As a result, post discharge surveillance until day 30 post operatively following caesarean section was made mandatory in Scotland in 2007¹.

2.4.4 NHS boards performing caesarean section and hip arthroplasty procedures are required to undertake post discharge surveillance to detect SSI¹. For caesarean section procedures, post discharge surveillance, until day 30 post operatively, can be performed through liaison with community midwives who routinely see the patient after discharge from hospital. For hip arthroplasty procedures, readmission surveillance using prospective readmission data for all in patient surveillance up to day 30 post operatively is conducted. Figure 17 gives the proportions of infections that have been recorded during the in patient period, as re-admissions for hip arthroplasty procedures and through post discharge surveillance for caesarean section procedures during the period 01/07/2006 to 30/06/2007.

FIGURE 17: Surgical site infections by category of surgery and detection method 1/07/2006 to 30/6/2007



TABLE 6: Readmission SSI rates with 95% confidence intervals by procedure and proportion detected on readmission 01/01/2007 to 30/06/2007

Category of surgery	Number of operations	Number of SSIs including readmissions	Readmission SSI rate (95% CI)	Proportion of SSIs detected as in patient	Proportion of SSIs detected on readmission
Primary Hip Hemi Arthroplasty	772	21	2.7% (1.7-4.2%)	76.2 %	27.8%
Revision of Hip Hemi Arthroplasty	45	3	6.7% (1.4-19.5%)	100.0%	0.0%
Primary Total Hip Arthroplasty	2482	21	0.8% (0.5-1.3%)	52.4%	47.6%
Revision of Total Hip Arthroplasty	335	9	2.7% (1.2-5.1%)	55.6%	44.4%
Total	3634	54	1.5% (1.1-1.9%)	64.8%	35.2%

Key summary point:

Post discharge infections accounted for 78.6% of caesarean section SSIs. This procedure results in a shorter length of stay, in general, when compared to other procedures included in the surveillance and as a result of this have greater potential for infections to present after discharge. These results reinforce the importance of post discharge surveillance in this category of surgery. SSHAIP are currently conducting a comprehensive review of local data collection methods for caesarean section post discharge surveillance.

For hip arthroplasty procedures these results indicate that in patient surveillance including readmission surveillance detects 77.6% of hip arthroplasty SSI. In 2007 readmission surveillance of SSI following hip arthroplasty procedures was made mandatory¹.

SECTION 3: Variation in SSI rate across NHS boards

3.1.1 Figures 18 and 19 indicate the variation in SSI rates by NHS board within the selected categories of surgery. Figure 18 presents the data for the whole period the surveillance programme has been in existence and Figure 19 for the last year of the surveillance programme, for categories of surgery where three or more NHS boards have contributed 100 or more procedures to the programme. The box plots indicate the median and range of SSI rates for each of the categories of surgery under surveillance and shows that open reduction of long bone fracture has the largest variability in length of stay.

FIGURE 18: Box and whisker plot of NHS board in patient SSI rates by category of surgery 01/04/2002 to 30/06/2007

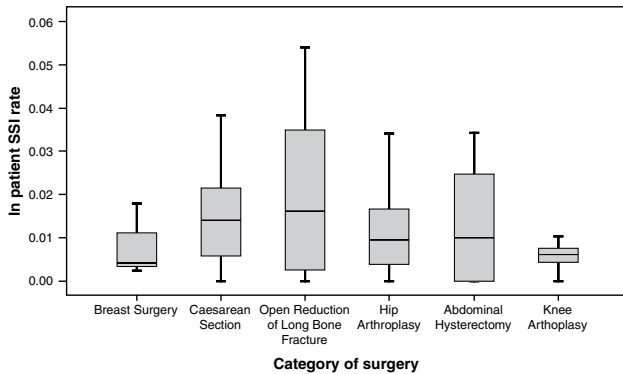
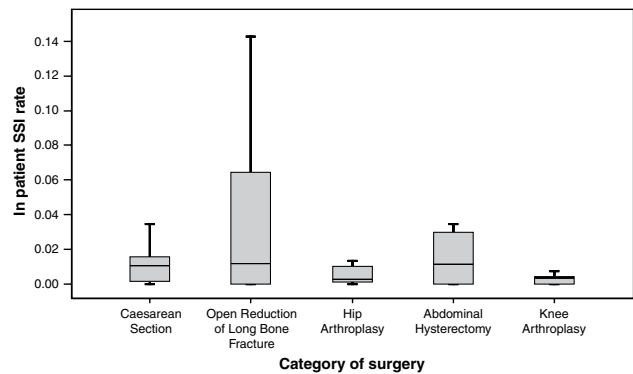


FIGURE 19: Box and whisker plot of NHS board in patient SSI rates by category of surgery 01/07/2006 to 30/06/2007



3.1.2 When making comparisons between NHS boards it is important to take into account the precision of the estimated rate of SSI: the greater the number of procedures on which the rate is based, the more precise the estimate. Funnel plot methodology has been widely used in meta analysis in order to determine if publication bias was present within published literature⁸. This methodology has been demonstrated as a way of presenting institutional comparisons without the limitation of imposing ranks onto the institutions⁹. The procedure categories; breast surgery, major vascular surgery, cardiac surgery, cranial surgery and CABG have not been included in these analyses as they do not meet the criteria for this part of the analysis which requires more than three NHS boards participating in the surveillance. The funnel plots shown in Figures 20-24 show the total risk adjusted rate of SSI within each NHS board plotted against the number of procedures on which the rate is based. The dashed lines represent the 95% control limits and the solid lines the 99% control limits. The probability that rates above the high control limit or below the low limit have occurred by chance is low. Nonetheless these results should be interpreted with due caution as not all risk factors have not been taken account of in these analyses.

FIGURE 20: Cumulative incidence (no of SSIs/no of procedures * 100) of in patient SSI for abdominal hysterectomy procedures with a NNIS score of 0 plotted against number of procedures by NHS board 01/04/2002 to 30/06/2007

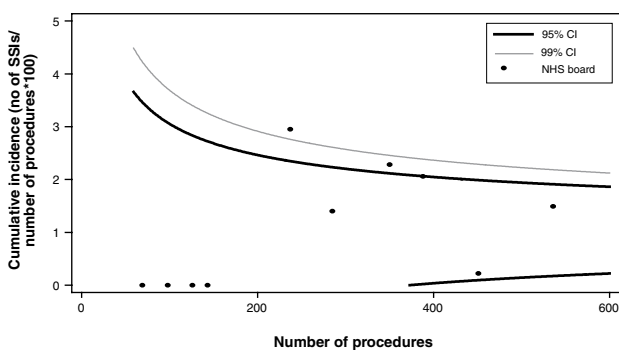


FIGURE 21: Cumulative incidence (no of SSIs/no of procedures * 100) of in patient SSI for caesarean section procedures with a NNIS score of 0 plotted against number of procedures by NHS board 01/04/2002 to 30/06/2007

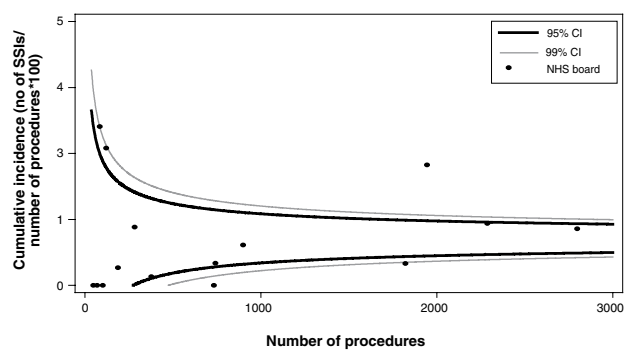


FIGURE 22: Cumulative incidence (no of SSIs/no of procedures*100) of in patient SSI for open reduction of long bone fracture procedures with a NNIS score of 0 plotted against number of procedures by NHS board April 2002 to June 2007

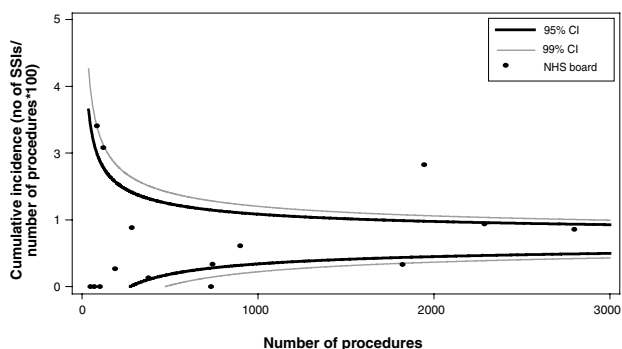


FIGURE 23: Cumulative incidence (no of SSIs/no of procedures*100) of in patient SSI for hip arthroplasty procedures with a NNIS score of 0 plotted against number of procedures by NHS board April 2002 to June 2007

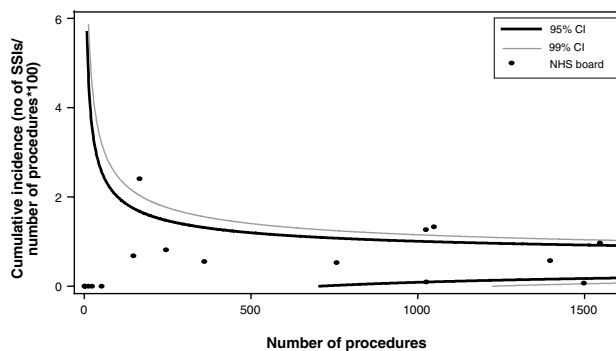
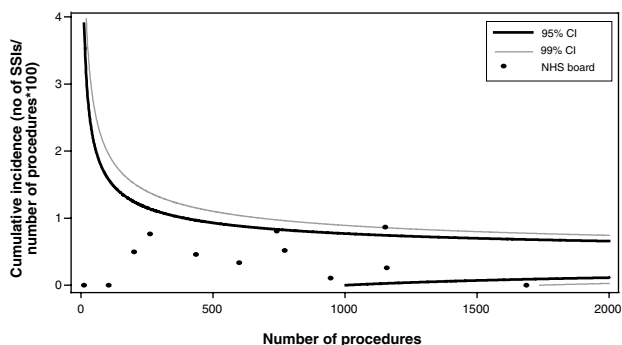


FIGURE 24: Cumulative incidence (no of SSIs/no of procedures*100) of in patient SSI for knee replacement procedures with a NNIS score of 0 plotted against number of procedures by NHS board April 2002 to June 2007



Key summary point:

The incidence of SSI varies by category of surgery and by NHS board. Some NHS boards have SSI rates higher than the 99% confidence limit within the funnel plots. Factors including the length of stay and case mix might explain some variation, however some may be explained by differing patient care practices. SSHAIP are carrying out a programme of work to address this variation (see section 4).

SECTION 4: IMPROVING PRACTICE THROUGH THE USE OF SSI SURVEILLANCE DATA

- 4.1.1 Indicators such as SSI rates after surgery are one way of assessing the quality and effectiveness of care¹⁰. The potential to improve infection rates by carrying out surveillance has been demonstrated¹¹. The SSHAIP SSI surveillance programme has a focus of local feedback of data for improvement in practice and subsequent SSI rates. SSHAIP feedback data to NHS boards on their SSI rates on a quarterly basis.
- 4.1.2 SSHAIP have developed a programme of work to reduce rates of SSI. The programme has been developed to link together all of the components within health protection in order to achieve the maximum public health benefit. SSHAIP issue quarterly SSI exception reports in conjunction with local quarterly SSI reports to all NHS boards identified as having higher than expected rates of SSI within the quarterly reporting timeframes. SSHAIP have developed the outputs of the quarterly SSI surveillance programme to facilitate improved inter and intra unit benchmarking, identification of the most useful feedback units and to identify NHS boards with the greatest potential for reduction.
- 4.1.3 As part of the programme the SSHAIP team have provided assistance to examine the reasons for the variation in SSI rates at local level. The programme is comprised of 3 levels:
- Level 1: Validation of the data to ensure the variation in SSI rates is not due to data quality issues
 - Level 2: Examination of intrinsic risks in the hospital population which may account for the variation in SSI rates
 - Level 3: Examination of patient care practices in the hospital which may account for the variation
- 4.1.4 Surveillance data can also be used for reviewing practice, e.g., relative to SIGN guideline No.45 Antibiotic Prophylaxis in Surgery¹² recommendations for practice. The guideline recommends antibiotic prophylaxis for all three of the categories of orthopaedic surgery included in the surveillance programme. It further recommends that prophylaxis should be started preoperatively in most circumstances, ideally within 30 minutes of the induction of anaesthesia. Figure 25 demonstrates compliance with antibiotic prophylaxis in orthopaedic surgery, and shows that 82.8% of patients received antibiotic prophylaxis during the recommended time period.
- 4.1.5 Prophylaxis of venous thromboembolism is an important practice within surgical care. SIGN guideline No 62 (2002) Prophylaxis of Venous Thromboembolism¹³ indicates that patients undergoing hip or knee arthroplasty procedures or those having open reduction of long bone fracture procedures should have both mechanical and chemical prophylaxis. Figure 26 indicates the proportion of patients undergoing these procedures within the SSHAIP SSI programme who have had prophylaxis of venous thromboembolism and shows that only 3% of patients did not receive thromboprophylaxis.
- 4.1.6 The individual surgeon performing the procedure can have an impact on outcome for the patient. There is evidence to suggest that grade of surgeon can have an impact on SSI rate¹⁴. This risk is related to the duration of the procedure as longer procedures have a higher risk of infection. Figure 27 indicates the SSI rate by grade of operator. Guidance from the Specialist Advisory Committee of the Joint Committee on Higher Surgical Training suggests that where

a consultant does not perform the procedure, one should be present in the operating theatre in order to minimise this risk. Figure 28 presents the proportion of procedures carried out by non-consultant staff that has a consultant present in the operating theatre and shows that in 12% of cases a consultant was not present in theatre.

FIGURE 25: Compliance with SIGN guideline recommendation on timing of administration of antibiotic prophylaxis for orthopaedic surgery 01/04/2002 to 30/06/2007

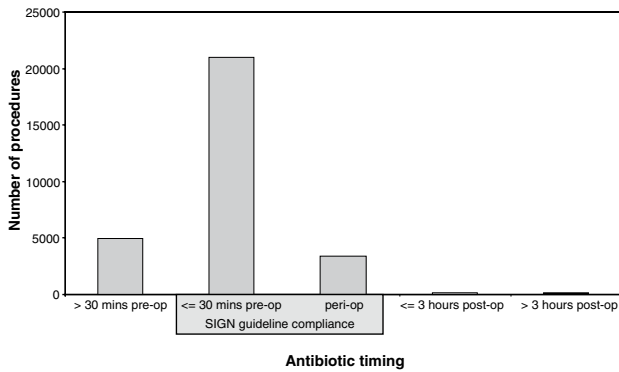


FIGURE 26: Compliance with SIGN guideline recommendation on venous thromboembolism prophylaxis for orthopaedic surgery 01/04/2002 to 30/06/2007

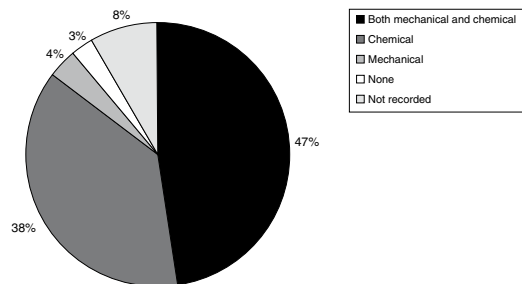


FIGURE 27: SSI rate by grade of operator for orthopaedic surgery 01/04/2002 to 30/06/2007

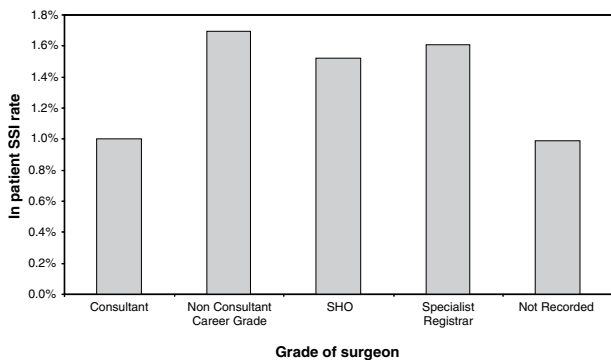
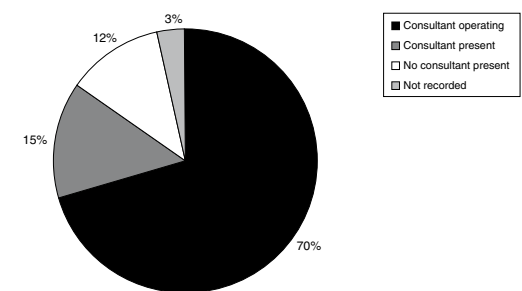


FIGURE 28: Compliance with best practice that a consultant should perform procedure or present within theatre for all orthopaedic surgery 01/04/2002 to 30/06/2007



4.1.7 The SSI programme in Scotland has been in existence for five years and some NHS boards have managed to use the surveillance programme to make a difference to patient care. Examples of activities include feeding back data utilising statistical process control charts, active feedback with the multidisciplinary team involved in the surgical patient care pathway and implementing evidence base practice. Examples of changes to practice made as a result of the programme include the introduction of non adherent dressing type, ceasing pre op hair removal and post op dressing removal time². Best practice for prevention of SSI is outlined in the literature¹⁵ and hospitals are encouraged to review surgical practice against these guidelines in order for the maximum potential to be gained from the SSI surveillance programme.

Key summary point:

Reported compliance with the SIGN guideline on antibiotic prophylaxis was very high in orthopaedic surgery, 82.8% of patients received prophylactic antibiotics and of those receiving antibiotics 82.8% received them within the SIGN guideline recommended time, i.e., within 30 minutes of induction, indicating a good level of best practice.

Compliance with SIGN guideline on prophylaxis for venous thromboembolism was also high with 97% of patients receiving some prophylaxis, where these data were recorded.

It should be noted that true compliance might be higher still, as the results are dependent on recording of these data and further there may be clinical overriding factors, which alter the normal timing of administration of antibiotics or prescription of chemical or mechanical prophylaxis for venous thromboembolism, which are not taken account of within these results.

The results also indicated that a high proportion of orthopaedic procedures were carried out by a consultant surgeon and where more junior staff were performing the procedure a consultant surgeon was present in the majority of these cases. Where a consultant was not present (12% of cases) were generally when a specialist registrar was carrying out the procedure.

SECTION 5 SUMMARY

- 5.1.1 This is the fifth annual report of SSI rates in Scotland. The trends in the SSI rates, over the period the surveillance programme has been in existence, have been relatively stable for abdominal hysterectomy procedures and appear to have reduced in the last year for breast surgery, caesarean section and knee arthroplasty procedures. SSI rates for hip arthroplasty procedures have reduced over the past five years.
- 5.1.2 The SSI rates reported vary by category of surgery and NHS board performing the surgery. SSHAIP have developed a programme of work to review this as part of the SSI reduction programme in HPS.
- 5.1.3 The incidence of SSI increased with the number of risk factors for most of the categories of surgery. Some of the risk data could not be classified due to ASA classification not being recorded.
- 5.1.4 The duration of post operative stay is an important consideration when targeting categories of surgery for surveillance of SSI. This report indicates that the duration of stay varies both within and between categories of surgery with open reduction of long bone fractures having both the longest average length of stay and the greatest variability in length of stay.
- 5.1.5 Post discharge surveillance is mandatory for caesarean section surgery. Readmission surveillance is mandatory for hip arthroplasty procedures. For caesarean section surveillance, 78.6% of all SSI were detected after discharge from hospital. For hip arthroplasty procedures, results indicate that in patient and readmission surveillance accounts for 77.6% of SSI detected.
- 5.1.7 Compliance with national SIGN guidelines on prophylactic antibiotics and prophylaxis of venous thromboembolism was high.
- 5.1.8 In some NHS boards improvements in the process of care, in terms of implementing evidence based practice, have been made and some sites are beginning to demonstrate reductions in SSI rates, these results have been shared across the NHS and have been presented in the SSI Supplementary Report².

The SSI coordinators, infection control managers, infection control teams, microbiologists, surgeons and other clinical staff are to be commended for their efforts in participating in the national SSI surveillance programme and using the data from this programme to make a difference to patient care.

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Appendix 1

Health Protection Scotland uses the following eight criteria to assess whether a statistically significant change or unnatural variation in the monthly in patient SSI rate has occurred:

1. One value either above the upper control limit or below the lower control limit.
2. Eight consecutive values on the same side of the central line (or mean).
3. Any 12 of 14 consecutive values on the same side of the central line (or mean).
4. Three consecutive values in either the top third (above uwl) or bottom third (below lwl) of the expected range.
5. Five consecutive values in the top two-thirds (above uhl) or bottom two-thirds (below lhl) of the expected range.
6. Thirteen consecutive values in the middle thirds of the expected range.
7. Eight consecutive values either increasing or decreasing.
8. Cyclic or periodic behaviour.

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