

# Mandatory surveillance of surgical site infection in orthopaedic surgery

April 2004 to March 2005



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# Mandatory surveillance of surgical site infection in orthopaedic surgery

Report of data collected between April 2004 and March 2005

## Key points

- Data on 41 242 procedures has been collected by 146 Trusts in this first year of mandatory surveillance of surgical site infection.
- Most Trusts have undertaken surveillance in the hip and knee replacement categories of procedure, and a quarter of Trusts collected data throughout the whole year
- The average number of procedures per Trust per quarter varies between 50 and 100 depending on the category of procedures
- In most Trusts the rates of SSI in orthopaedic surgery are low
- The rates of SSI increase with the number of risk factors present in the patient
- Rates of SSI are higher in hip hemiarthroplasty. This is partly explained by patients undergoing these procedures being at greater risk of infection and because they tend to have a longer post-operative stay in hospital, increasing the chance that SSIs will be detected
- Most of the SSIs reported affected the superficial layers of the wound, but approximately a quarter involved the deeper tissues
- *S.aureus* is recognised as a major cause of SSI and was responsible for half of the infections. Nearly a third of SSI were due to methicillin resistant *S.aureus*.

# **MANDATORY SURVEILLANCE OF SURGICAL SITE INFECTION IN ORTHOPAEDIC SURGERY**

**Data collected between April 2004 and March 2005**

## **Introduction**

This report contains data collected by NHS Trusts in England during the first year of the mandatory surveillance of surgical site infection (SSI) in orthopaedic surgery. A scheme enabling hospitals in England to undertake surveillance of SSI was established by the Public Health Laboratory Service and Department of Health in 1997. This has subsequently been developed as the Surgical Site Infection Surveillance Service (SSISS) under the Health Protection Agency. Although participation in the scheme has been voluntary there has been a steady increase in hospitals participating since its inception.<sup>1</sup>

In June 2003 the Chief Medical Officer announced that surveillance of SSI in orthopaedic surgery would become mandatory from April 2004.<sup>2</sup> The surveillance co-ordinated by SSISS was developed to accommodate the requirements of the mandatory orthopaedic surveillance. Since these results of the first year of mandatory SSI surveillance are based on relatively small numbers of procedures, Trusts that have participated previously in SSISS may have more robust information about their rates of SSI based on data they have collected over several years.

## **Requirements of the mandatory surveillance of SSI in orthopaedic surgery**

All NHS Trusts where orthopaedic surgical procedures are performed are expected to carry out a minimum of three months surveillance in at least one of the four orthopaedic categories.<sup>3</sup>

- Total hip (prosthesis) replacement
- Knee (prosthesis) replacement
- Hip hemiarthroplasty
- Open reduction of long bone fracture

A hip hemiarthroplasty is a surgical procedure in which the damaged or diseased head and neck of the femur are removed and replaced with a prosthesis. The procedure is commonly carried out on elderly patients who have fractured the neck of femur as a result of a fall. Open reduction of fracture is a surgical procedure to repair a fractured bone using plates, screws or rods to stabilise the bone.

Some Trusts include more than one acute hospital and may have chosen to collect data at one hospital only. Some Trusts, in particular paediatric specialist hospitals, only carry out procedures in the open reduction of long bone fracture category and the throughput was too small to enable them to participate in the surveillance.

## **Surveillance methods**

Surgical site infections are defined as infections related to a surgical procedure that affect the surgical wound or deeper tissues handled during the procedure. SSI

cannot be reliably identified from laboratory data alone as the diagnosis depends on the presence of signs and symptoms of infection in the wound. The surveillance to detect SSI therefore requires active monitoring of patients from the time of their operation until they are discharged from hospital.

The SSISS surveillance is focused on categories of surgical procedure, with each category containing a defined set of similar procedures. All patients undergoing a procedure in the chosen category during the selected surveillance period are included in the surveillance. A basic set of demographic data e.g. age, sex of the patient, together with some details about the operation itself e.g. duration of operation, are then collected for each eligible procedure. These patients are then followed up throughout their hospital stay to discover whether they develop an infection of their surgical wound that meets the criteria for a SSI. Currently there is no requirement to continue surveillance once the patient has been discharged from hospital and SSI that develop after the patient has been discharged from hospital are not included in these rates.

To ensure that as far as possible data collected in different Trusts are comparable, Trusts are expected to adhere to the standard method of collecting and reporting data described in the SSI surveillance protocol. They are required to participate in the surveillance for minimum three-month periods although they can choose to collect data for more than one period.

### **Using the data to inform practice**

A key aim of the surveillance is to encourage Trusts to use the data to evaluate local practice and institute changes where the results indicate this may be necessary. At the end of each surveillance period, participating Trusts receive an individual report that contains their results compared to the data aggregated from all participating hospitals. They use this data to monitor local practice and initiate further investigation and action should the results indicate that rates are unusual.

Some additional analyses are undertaken by SSISS for those Trusts with a rate of SSI in the highest ten percent and these Trusts are contacted to ensure that they are aware of the potential problem. Summary data for each Trust is sent to the relevant Regional Epidemiology Unit of the HPA which provides local support if required.

## SECTION 1

### Rates of surgical site infection in orthopaedic surgery

#### Participation in the surveillance between April 2004 and March 2005

A total of 146 NHS Trusts have participated in the mandatory surveillance of SSI in orthopaedic surgery between April 2004 and March 2005. Most Trusts have chosen to undertake surveillance in the categories for total hip and knee prosthesis (see Table 1). Ten Trusts were unable to provide data for this surveillance year.

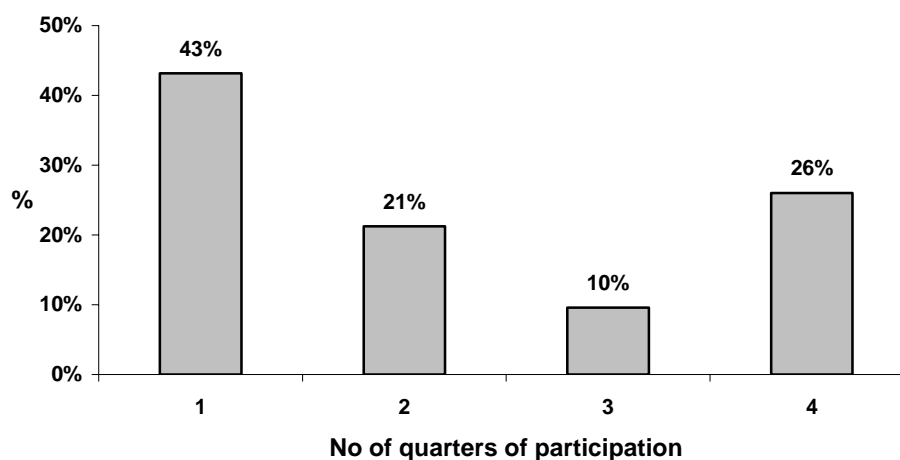
**Table 1: Participation in mandatory surveillance of SSI in orthopaedics,**

	Total no. Trusts	Total no. procedures	no. SSI	% infected
<b>Total procedures</b>	<b>146</b>	<b>41242</b>	<b>593</b>	<b>1.44</b>
Total hip prosthesis	109	16809	208	1.24
Hip hemiarthroplasty	71	5364	217	4.05
Knee prosthesis	96	15792	102	0.65
Open reduction long bone fracture	26	3277	66	2.01

Note: 90 Trusts participated in more than one category of procedure

The throughput of surgical procedures in each category varied by Trust (see Table 1) but for many was less than 100 procedures per quarter. This is an important consideration when comparing rates for individual Trusts since the volume of data may be relatively small and the rates correspondingly imprecise. The number of procedures included in the first year of mandatory surveillance by each Trust also depends on how many quarterly surveillance periods they participated in. This is summarised in Figure 1.

**Figure 1: Number of surveillance periods undertaken by NHS Trusts**

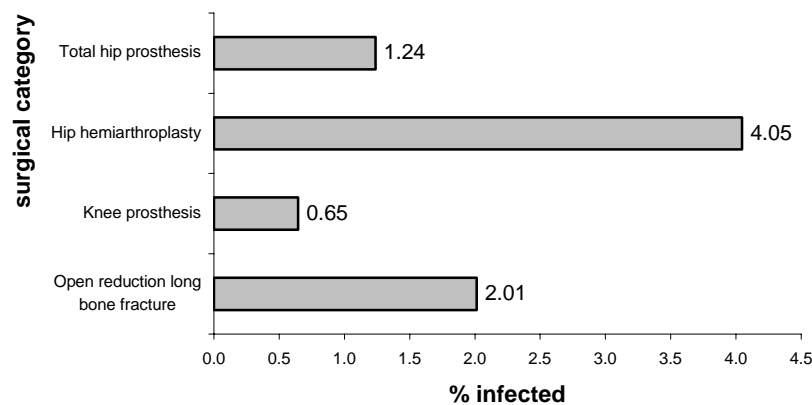


## Incidence of SSI

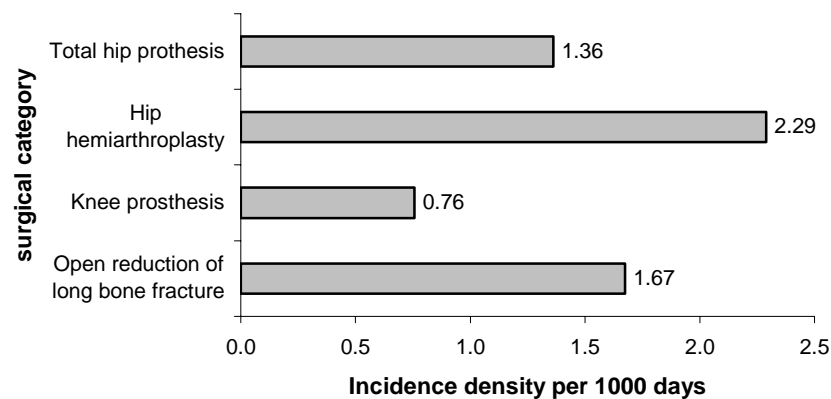
The percentage of operations that resulted in SSI (cumulative incidence) in the post-operative in-patient period for each category of surgical procedure are shown in Figure 2. These demonstrate that the rates of SSI in orthopaedic surgery are low, although they are underestimated since surveillance does not continue after the patient has been discharged from hospital.

Rates of SSI are higher following hip hemiarthroplasty procedures, which are most commonly undertaken to repair fractures to the neck of femur. This is partially explained by risk factors in these patients who are older (see Table 6) and are more likely to have underlying illness that affects their susceptibility to infection.<sup>4</sup> In addition, these more vulnerable patients tend to stay longer in hospital post-operatively; their median length of post-operative stay is 14 days compared to a median of 7 days for elective total hip prosthesis. Therefore, since the surveillance currently only detects SSI that develop whilst the patient is still in hospital, the likelihood that SSI will be identified is increased in patients undergoing hip hemiarthroplasty. It is possible to allow for length of post-operative stay by calculating the rate of SSI as an *incidence density* i.e. the number of SSI per 1000 post-operative days (see Figure 3).

**Figure 2: Cumulative incidence of SSI by category of procedure**



**Figure 3: Incidence density of in-hospital SSI per 1000 postoperative in-patients days by category of procedure.**



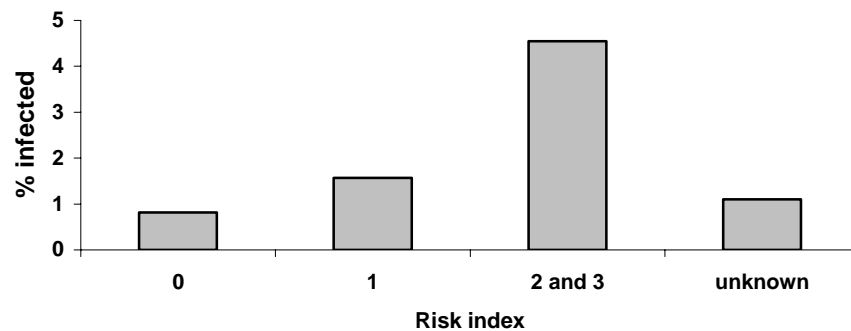
The effect that the increased length of post-operative follow-up has on the rates of SSI in hip hemiarthroplasty is demonstrated in Figure 3 where the difference in risk of SSI between total hip prosthesis and hip hemiarthroplasty is smaller compared to the difference in cumulative incidence between these categories shown in Figure 2.

### Incidence of SSI by risk group

The risk of developing SSI following a surgical procedure is affected by factors related to the general health of the patient, the type of operation and the procedure itself. The risk index is used to measure variation in these major risk factors and comprises a wound class of contaminated or dirty (indicating the likely microbial contamination of the wound), an American Society of Anesthetologists (ASA) physical status classification of 3 or more (indicating the patient has a severe underlying systemic disease), and duration of operation greater than the time at the 75<sup>th</sup> percentile (based on US National Nosocomial Infection Surveillance system and UK SSISS data) indicating a more complex procedure and increased opportunity for microbial contamination of the wound. Each operation is allocated a score of between 0 and 3 depending on how many of the three risk factors are present. Those with all three risk factors are at greatest risk of developing SSI.

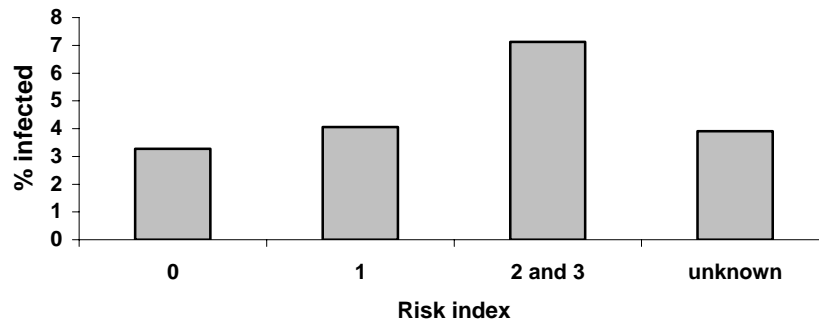
Tables 2 to 5 show the cumulative incidence of SSI by category of surgical procedures and risk index group. The incidence of SSI increases with the number of risk factors present, although the number of operations in the higher risk index groups is small and the estimates correspondingly imprecise. Where data for one or more of the risk factors included in the index has not been provided a risk score cannot be calculated.

**Table 2: Cumulative incidence (pooled mean) of SSI in total hip prosthesis by risk index.**



Risk index category	Number of Trusts	Number of operations	Number of SSI	Pooled mean
0	108	8691	71	0.8
1	106	4337	68	1.6
2 and 3	93	792	36	4.5
unknown	95	2989	33	1.1
<b>All</b>	<b>109</b>	<b>16809</b>	<b>208</b>	<b>1.2</b>

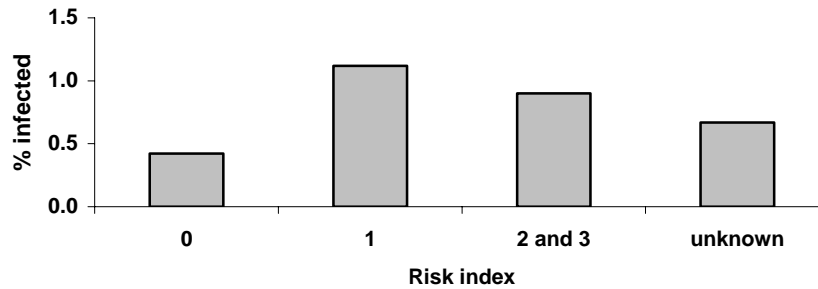
**Table 3: Cumulative incidence (pooled mean) of SSI in hip hemiarthroplasty by risk index.**



Risk index category	Number of Trusts	Number of operations	Number of SSI	Pooled mean
0	68	1437	47	3.3
1	69	2612	106	4.1
2 and 3	64	393	28	7.1
unknown	61	922	36	3.9
<b>All</b>	<b>71</b>	<b>5364</b>	<b>217</b>	<b>4.0</b>

Patients undergoing knee prosthesis are generally younger and fitter<sup>6</sup>, and SSI are less likely to be detected because their post-operative stay is short.

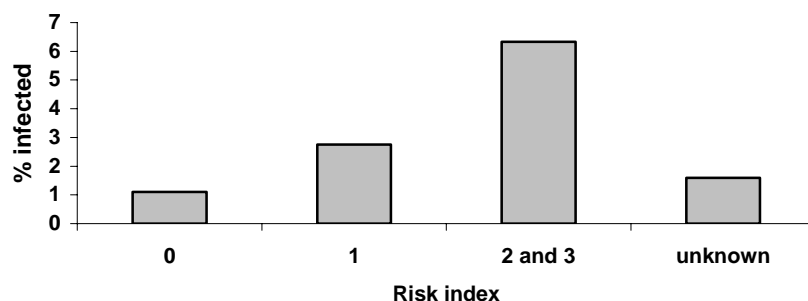
**Table 4: Cumulative incidence (pooled mean) of SSI in knee prosthesis by risk index**



Risk index category	Number of Trusts	Number of operations	Number of SSI	Pooled mean
0	94	8749	37	0.4
1	94	3756	42	1.1
2 and 3	75	444	4	0.9
unknown	91	2843	19	0.7
<b>All</b>	<b>96</b>	<b>15792</b>	<b>102</b>	<b>0.6</b>

Many open reduction of long bone fractures are also performed on elderly patients and these risks also contribute to the higher rate in this category (see Table 6).

**Table 5: Cumulative incidence (pooled mean) of SSI in open reduction of long bone fracture by risk index.**



Risk index category	Number of Trusts	Number of operations	Number of SSI	Pooled mean
0	25	1366	15	1.1
1	26	1124	31	2.8
2 and 3	22	158	10	6.3
unknown	25	629	10	1.6
<b>All</b>	<b>26</b>	<b>3277</b>	<b>66</b>	<b>2.0</b>

### Incidence of SSI by age group

The age group and median age of patients undergoing surgery is shown in Table 6. The median age for patients undergoing hip hemiarthroplasty is 14 years greater than those undergoing total hip prosthesis. The risk of SSI increases with patient age and the trend is statistically significant in total hip and knee prosthesis. However, some of the increased risk may be explained by patients in older age groups staying in hospital longer, thus increasing the possibility that SSI will be detected.

**Table 6: Cumulative incidence of SSI by category of procedure and age group**

	Age (years)					Median age
	<45	45-64	65-74	75-84	>84	
<b>Total hip prosthesis*</b>	0.5	0.7	1.1	1.8	2.3	70
<b>Hip hemiarthroplasty</b>	0.0	1.8	4.0	3.8	4.5	84
<b>Knee prosthesis**</b>	0.0	0.5	0.6	0.8	0.9	72
<b>Open reduction long bone fracture</b>	0.4	1.0	1.3	2.7	4.3	70

\* p < 0.001 for chi-square for trend test of percentage of SSI by age-group

\*\* p < 0.05 for chi-square for trend test of percentage of SSI by age-group

## SECTION 2

### Characteristics of the surgical site infections

SSI are categorised into those that affect the superficial (skin and subcutaneous) tissues of the incision, and those that affect the deeper tissues (deep incisional) or joint itself. Most infections reported are superficial, but approximately one quarter affected the deeper tissues or joint (see Table 7).

**Table 7: Type of surgical site infection by category of procedure**

Category of procedure	Type of SSI			
	Superficial		Deep or joint	
	No.	%	No.	%
Total hip prosthesis	152	72.7	57	27.3
Hip hemiarthroplasty	145	66.5	73	33.5
Knee prosthesis	79	76.0	25	24.0
Open reduction long bone fracture	54	81.8	12	18.2

Data on the micro-organisms causing SSI were available in 84% of infections. The main causative organisms are illustrated in Table 8.

*Staphylococcus aureus* is a common skin commensal and patients undergoing surgery are vulnerable to micro-organisms from their skin entering the surgical site. In this surveillance *S. aureus* was responsible for 49% of SSI and, in 31% of SSI where data on the causative organism was available, the infections were caused by methicillin-resistant *S. aureus* (MRSA).

**Table 8: Micro-organisms reported as causing SSI (all categories of procedure)**

Organism	Number of infections	% of all organisms
<i>Staphylococcus aureus</i>	-	-
▪ methicillin-resistant	187	31.0
▪ methicillin-sensitive	106	17.5
Coagulase negative staphylococci	58	9.6
Coliforms	48	7.9
<i>Enterococcus spp.</i>	46	7.6
<i>Pseudomonas aeruginosa</i>	21	3.5
<i>Pseudomonas spp.</i>	20	3.3
<i>Enterococcus faecalis</i>	18	3.0
<i>Proteus spp.</i>	16	2.6
<i>Enterobacter spp.</i>	12	2.0
<i>Bacillus spp.</i>	12	2.0
<i>Corynebacterium spp.</i>	5	0.8
<i>Escherichia coli</i>	4	0.7
Other organisms	51	8.5

## SECTION 3

### Variation in rates of SSI between Trusts

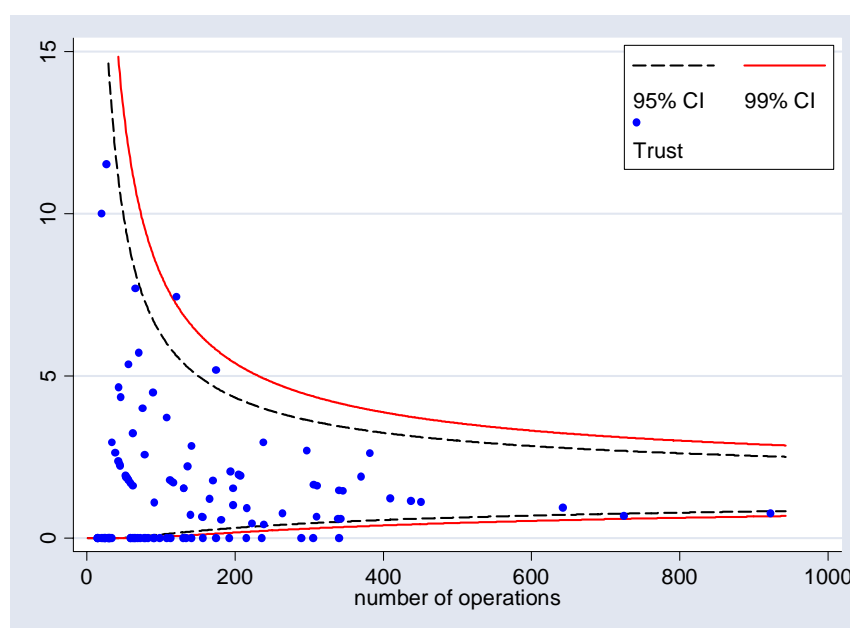
When making comparisons between Trusts it is important to take into account the precision of the estimated rate of SSI: the greater the number of procedures on which the rate is based, the more precise the estimate.

The plots shown in Figures 4 to 7 show the total rate of SSI (cumulative incidence) at each participating Trust plotted against the number of procedures on which the rate is based. The dashed (blue) lines represents the 95% control limits (95% CL) and the solid (red) lines the 99% control limits. The probability that rates above the high 95% control limit or below the low 95% control limit have occurred by chance is low.<sup>7</sup> However, these results should be interpreted with caution as no adjustment has been made for the case-mix of patients or other risk factors that may affect the rates.

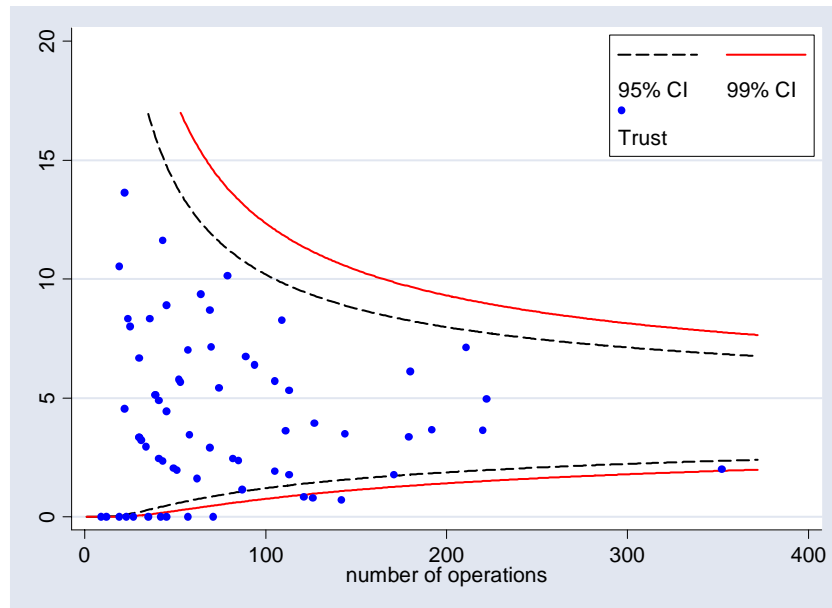
One Trust has rates above the high 95% CL in both the total hip prosthesis and knee prosthesis categories. One Trust has rates above the high 95% CL in total hip prosthesis category only, one in the knee prosthesis category only and one in open reduction of long bone fracture category only. In the hip hemiarthroplasty category there are no Trusts with rates above the 95% CL. Although these Trusts may be in this position by chance, or their rates may be explained by their mix of patients, they are aware that their rates are comparatively high and are undertaking action to investigate the possible underlying reasons and address any problems identified.

A number of Trusts have rates that fall below the lower 95% control limit. This may reflect unusually low rates of SSI, but may also be an indication of poor case ascertainment.

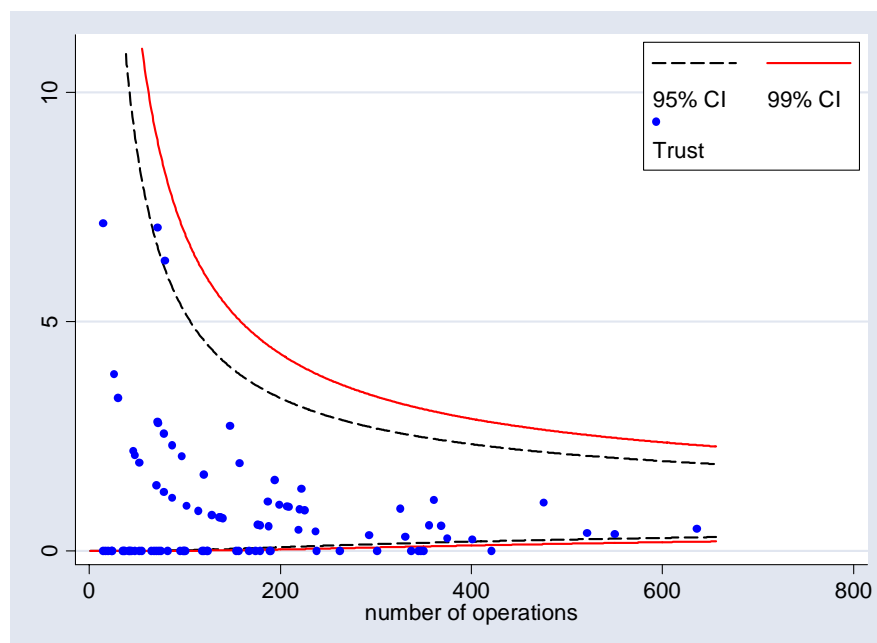
**Figure 4: Cumulative incidence of SSI in total hip prosthesis plotted against the number of operations by Trust. Data collected between April 2004 and March 2005**



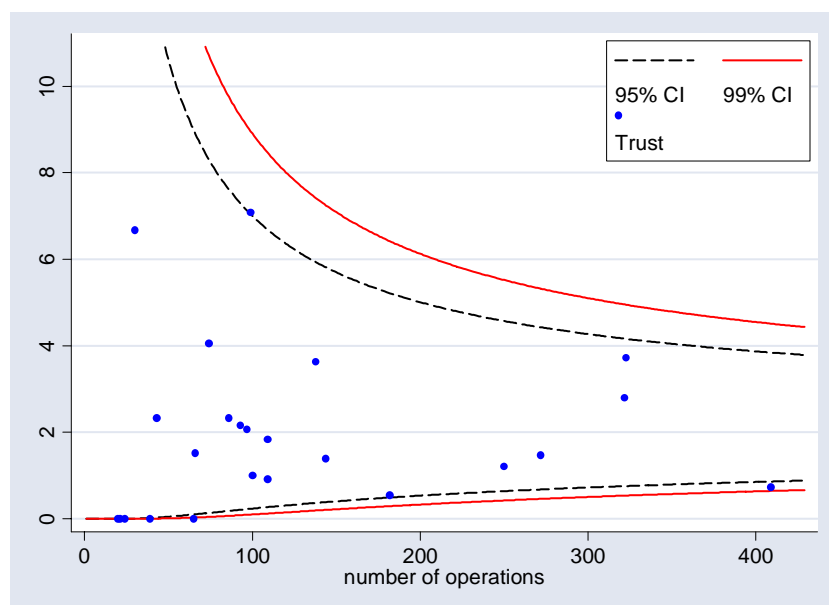
**Figure 5:** Cumulative incidence of SSI in hip hemiarthroplasty plotted against the number of operations by Trust. *Data collected between April 2004 and March 2005*



**Figure 6:** Cumulative incidence of SSI in knee prosthesis plotted against the number of operations by Trust. *Data collected between April 2004 and March 2005*



**Figure 7: Cumulative incidence of SSI in open reduction of long bone fracture plotted against the number of operations by Trust. Data collected between April 2004 and March**



## Conclusions

Most acute NHS Trusts in England that provide orthopaedic services have successfully participated in this first year of mandatory surveillance of SSI in orthopaedic surgery. They have collected data on more than 40 000 operations and a quarter of Trusts have collected data continuously throughout the year. The ability of Trusts to compare their rates of SSI with others depends on the robust application of a standard method of identifying and reporting SSI and consequently the SSISS places a high priority on Trusts adhering to the standard SSI surveillance protocol.

The average number of procedures per Trust per quarter varies but in many cases is fewer than one hundred for a particular category. Where the number of procedures is low the rate of SSI cannot be estimated precisely and this must be taken into account when comparing rates between Trusts. A more precise estimate can be obtained where the surveillance is continued for longer.

In most Trusts the rates of SSI in orthopaedic surgery were found to be low and comparable with rates reported by other countries in Europe.<sup>8</sup> However, since the surveillance detects only those SSI that develop during the post-operative hospital stay they are an underestimate. In recent years the length of post-operative stay has reduced considerably in elective procedures such as knee and total hip replacements. Changes in length of stay affect the interpretation of rates of SSI over time. Many Trusts have reported a zero rate of SSI and this emphasises the importance of ensuring data collection methods are robust if reliable inter-hospital comparisons are to be made.

Most of the SSIs reported affected the superficial layers of the wound. These are likely to resolve with minimal long-term adverse effects on the patient. Approximately

a quarter involved the deeper tissues and these infections are more difficult to treat and may require subsequent re-operation. *S.aureus* are commonly found on the skin and hence surgical wounds are vulnerable to infection caused by these micro-organisms. *S.aureus* was reported as the cause of half of the SSI and nearly two-thirds of the *S.aureus* reported SSI were methicillin-resistant strains.

Rates of SSI were higher in hip hemiarthroplasties, which are generally undertaken following a traumatic injury to the hip. This is partly explained by the patients undergoing these procedures being at greater risk of SSI due to their increased age and other underlying conditions. In addition, their post-operative stay in hospital is longer than those patients undergoing elective hip or knee replacement and therefore the chance that SSI will be detected by this surveillance is increased.

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