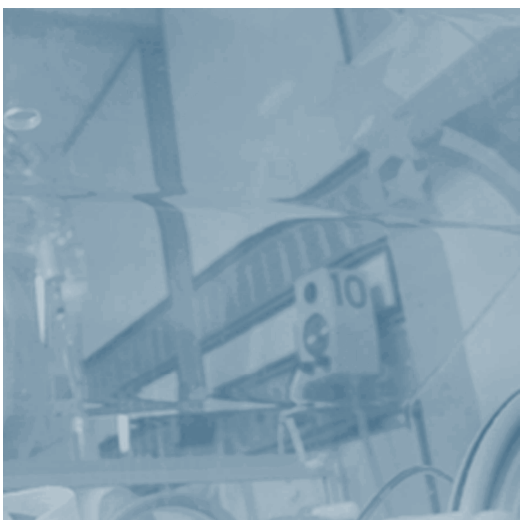
Surveillance of Surgical Site Infection in English Hospitals 1997 - 2002

A national surveillance and quality improvement programme



NINSS Partnership

Nosocomial Infection National Surveillance Service

Executive Summary

General

- Between 1st October 1997 and 30th September 2002, 168 hospitals participated in the surgical site infection (SSI) module provided by the Nosocomial Infection National Surveillance Service (NINSS). These hospitals reported 4351 infections resulting from 107492 operations in twelve categories of clinically similar surgical procedures.

- For all surgical categories, the incidence of SSI varied considerably between hospitals.

- The risk of developing SSI varies according to the type of surgery. Limb amputation and procedures on the bowel are associated with the greatest risk of SSI.

- The more serious deep or organ/space infections accounted for at least a fifth of SSIs in the majority of categories.

- Sufficient data have been accumulated to demonstrate that generally the incidence of SSI increases with the number of risk factors for most categories of surgical procedure.

- 49% of the micro-organisms identified as causing infections were staphylococci, of which 81% were *Staphylococcus aureus*. 63% of *Staphylococcus aureus* were resistant to methicillin (MRSA).

- For most categories of surgical procedure, methicillin resistant *Staphylococcus aureus* was the most common staphylococcus identified as causing SSI.

- The steady increase in participation in the SSI module has continued.

Introduction

Hospital-acquired infection

Infections acquired in hospital are likely to complicate illness, cause anxiety and discomfort, and can lead to death. Previous studies have indicated that one in ten patients will develop an infection related to their hospital stay[1]. It has been estimated that the annual cost nationally of these infections is almost £1 billion[2]

This report is a summary of the data collected and reported by hospitals participating in the surgical site infection module provided by the Nosocomial Infection National Surveillance Service (NINSS) between October 1997 and September 2002. The report reflects the enormous achievement of all the hospitals that have participated voluntarily in the scheme during this period.

NINSS was established in 1996 to provide information that would help the identification of, and reduction in, the extent of avoidable hospital-acquired infection (HAI). The use of standard surveillance methods by hospitals in England to collect information about infections acquired in hospital provides national data that could be used as a benchmark by hospitals to measure their own performance. Participation in NINSS has been both voluntary and confidential.

The surgical site infection surveillance service has now become part of the Healthcare Associated Infection and Antimicrobial Resistance Department (HCAI & AMR) within the Communicable Disease Surveillance Division of the Health Protection Agency. It will continue to offer a service to enable the surveillance of SSI in English hospitals, building on the systems already established and supporting the development of mandatory orthopaedic SSI surveillance in 2004.

Surgical site infection

Infections of the surgical wound are one of the most common HAI, and are an important cause of morbidity and mortality for patients undergoing surgery. The delay in recovery and increased hospital stay also has economic consequences. It has been estimated that each patient with a surgical site infection requires an additional hospital stay of 6.5 days, and hospital costs are doubled[2]

Surgical site infection

Hospitals taking part in the surgical site infection (SSI) module can target one or more of twelve categories of clinically similar procedures (e.g. large bowel surgery, coronary artery bypass graft procedures, hip prostheses). There is a minimum requirement to carry out surveillance for at least three consecutive months.

Risk factor data and information about infections of the surgical site which develop during the hospital stay are collected for all patients who undergo a procedure included in the categories chosen for surveillance.

In order to provide more precise estimates of the incidence of infection, data are cumulated over time. This fifth annual report for the surgical site infection module contains the combined data from the 168 hospitals that participated in the surveillance between 1st October 1997 and 30th September 2002.

References

1. Emmerson AM, Enstone JE, Griffin M *et al*. The second national prevalence survey of infection in hospitals - overview of the results. *J Hosp Inf* 1996; **32**: 175-190.

2. Plowman R, Graves N, Griffin M *et al*. *The socio-economic burden of hospital acquired infection.* London: Public Health Laboratory Service, 2000.

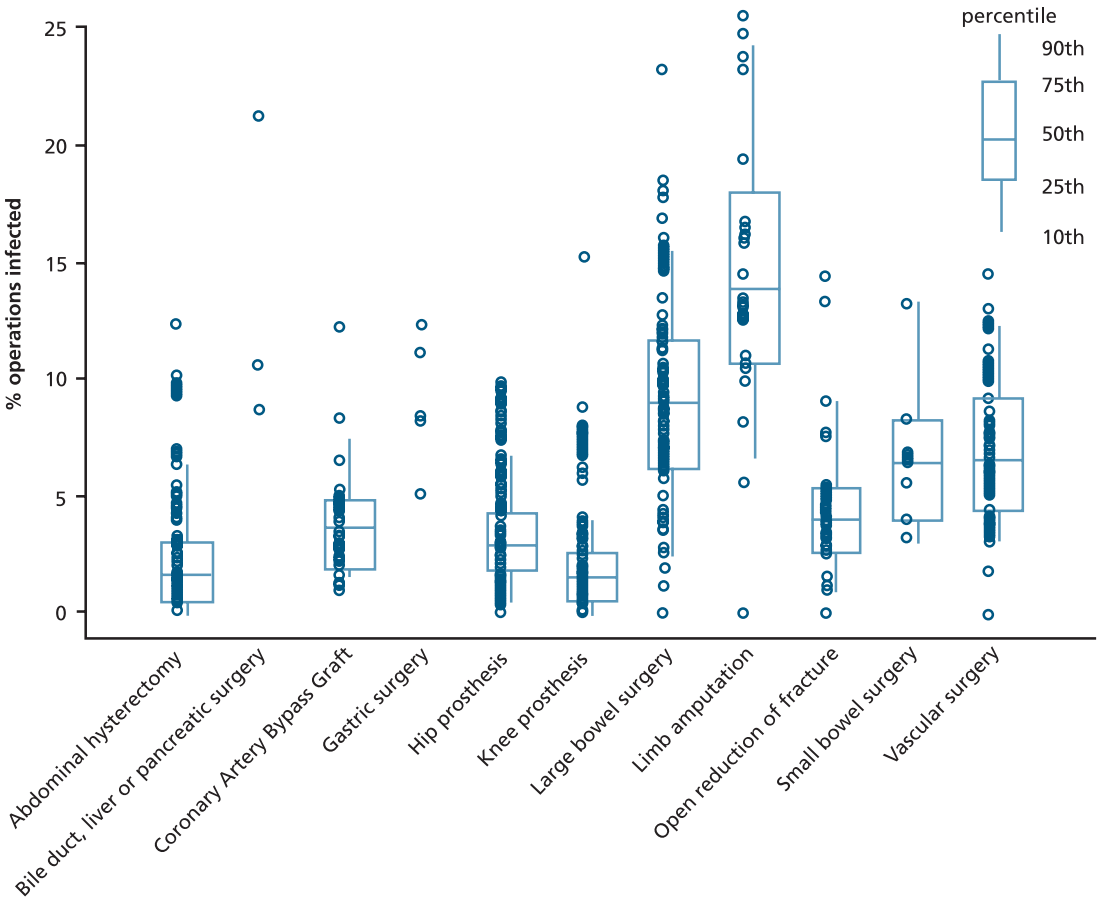
Incidence of surgical site infection by category of surgical procedure

This section gives information about the number of participating hospitals, operations, and surgical site infections (SSIs); the percentage of operations that were associated with SSI (incidence of SSI); and the type of surgical site infection identified. The results are reported by category of surgical procedure, with each category including a set of clinically similar procedures. Hospitals collected data in one or more of the categories for varying periods of time, with a minimum requirement of three months.

Only those categories of surgical site procedure where three or more hospitals each collected data for at least 30 patients during the period under review have been included in the figure below. The only category where these criteria were not met was cholecystectomy.

The incidence of SSI for the remaining categories is given in Figure 1.1. Hospitals that lie above the 90th percentile or below the 10th percentile may have a true high or low incidence of infection respectively, but the results should be interpreted with care because the number of operations may be small and no account has been taken of major risk factors.

Figure 1.1 *Distribution of the incidence of surgical site infection by category of surgical procedure.*



Note: *Each point in the above figure represents the incidence of surgical site infection for a participating hospital. Boxes placed on the sets of points for each category give the estimates of the 25th, 50th, and 75th percentiles of the incidence of SSI and the ends of the vertical lines the 10th and 90th percentiles. The percentiles are only shown where at least 10 hospitals contributed sufficient data.*

Key summary point

For all surgical categories the incidence of SSI varied considerably between hospitals.

Table 1.1 shows the number of operations and infections reported to NINSS and, unlike Figure 1.1, contains data for all categories of surgical procedure, regardless of the number of operations or participating hospitals.

Table 1.1 *Surgical site infection by category of surgical procedure.*

Category	No. of hospitals	No. of operations	No. of SSIs	% infected
Abdominal hysterectomy	74	8796	209	2.4
Bile duct, liver, pancreas surgery	10	203	25	12.3
Cholecystectomy	12	139	8	5.8
Coronary artery bypass graft	21	15473	663	4.3
Gastric surgery	12	402	39	9.7
Hip prosthesis	133	40060	1247	3.1
Knee prosthesis	113	20625	352	1.7
Large bowel surgery	62	9195	869	9.5
Limb amputation	37	1568	244	15.6
Open reduction of long bone fracture	28	4645	199	4.3
Small bowel surgery	20	1084	99	9.1
Vascular surgery	45	5302	397	7.5

Key summary point

The risk of developing SSI varies according to the type of surgery. Limb amputation and procedures on the bowel are associated with the greatest risk of SSI.

The criteria used to identify SSI distinguish between three types of infection depending on whether only the skin layer was involved (superficial), or the deeper tissues (deep), or other structures (organ or space). Table 1.2 gives the proportions of these for each category of surgical procedure.

Table 1.2 *Surgical site infection by category and type.*

Category	Total No. of SSI	Type of SSI						
		Superficial		Deep		Organ or space		Unknown
		No.	%	No.	%	No.	%	No.
Abdominal hysterectomy	209	158	79.0	28	14.0	14	7.0	9
Bile duct, liver, pancreas surgery	25	13	52.0	6	24.0	6	24.0	0
Cholecystectomy	8	4	66.7	0	0.0	2	33.3	2
Coronary artery bypass graft	663	441	69.2	152	23.9	44	6.9	26
Gastric surgery	39	26	68.4	8	21.1	4	10.5	1
Hip prosthesis	1247	914	74.7	213	17.4	96	7.8	24
Knee prosthesis	352	265	78.2	52	15.3	22	6.5	13
Large bowel surgery	869	507	59.6	215	25.3	128	15.1	19
Limb amputation	244	166	69.7	68	28.6	4	1.7	6
Open reduction of long bone fracture	199	162	82.2	24	12.2	11	5.6	2
Small bowel surgery	99	54	56.8	30	31.6	11	11.6	4
Vascular surgery	397	314	80.5	61	15.6	15	3.8	7

Note: *Percentages calculated after excluding SSI's where type of infection unknown.*

Key summary point

The more serious deep or organ/space infections accounted for at least a fifth of SSIs in the majority of categories.

Incidence of surgical site infection by risk index and category of surgical procedure

Although the results in the previous section are grouped by category of clinically similar procedures, they do not take into account other factors that may influence the risk of infection. In this section, the data have been stratified using the US National Nosocomial Infections Surveillance (NNIS) system risk index, which combines three major risk factors. One is related to the state of health of the patient before surgery, the American Society of Anesthesiologists' (ASA) score, and the other two to the operation itself - how long the surgery took, and the likelihood of micro-organisms being present in the wound at the time of surgery (the wound class).

Each operation is scored from 0 to 3 according to how many of the factors were present at the time of surgery.

Figures 2.1 to 2.9 show the incidence of SSI stratified by risk index for the nine categories of surgical procedure where a minimum of 50 infections was reported. The risk index for operations has been classified as unknown where data on one or more of the three risk factors were unavailable or incomplete. Most commonly, ASA score was not recorded.

Incidence of SSI by risk index.

Figure 2.1 *Abdominal Hysterectomy*

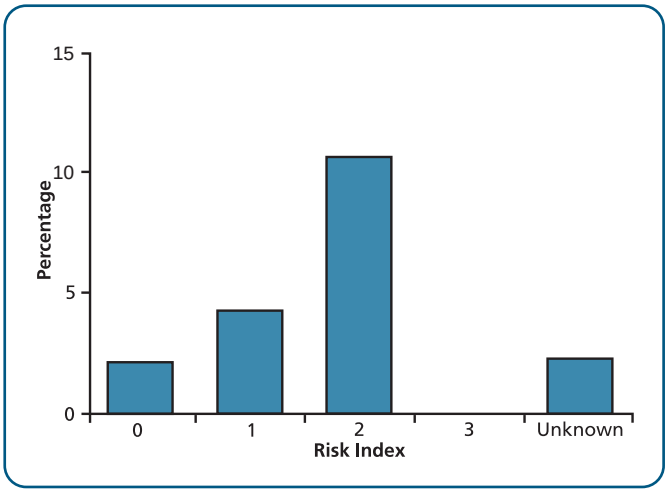
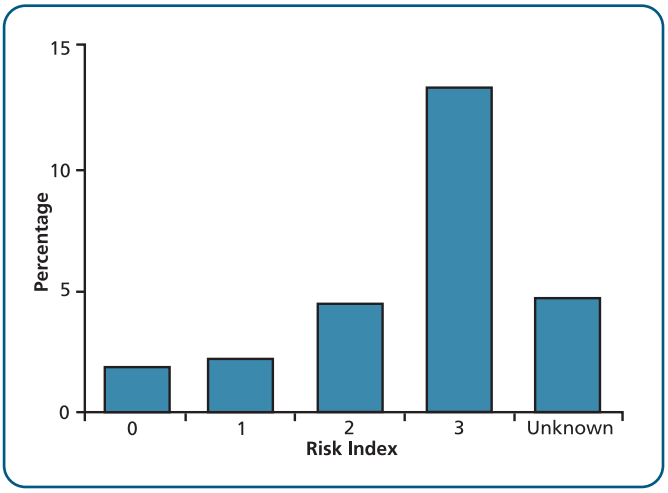


Figure 2.2 *Coronary Artery Bypass Graft*



Note: *Insufficient data collected for Risk Index 3. One SSI in four operations.*

Figure 2.3 *Hip Prosthesis*

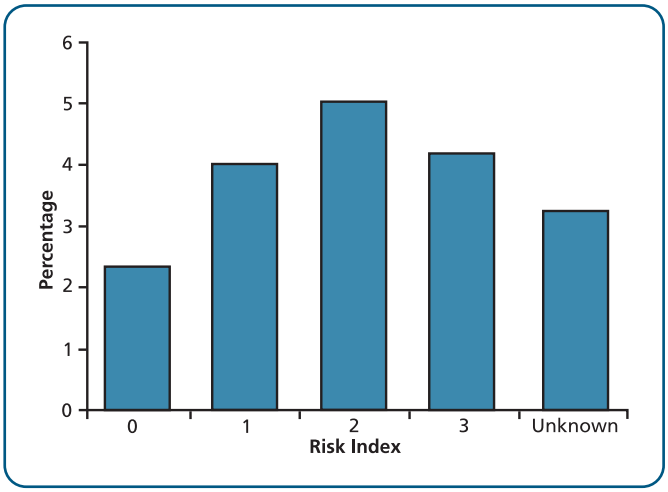


Figure 2.4 *Knee Prosthesis*

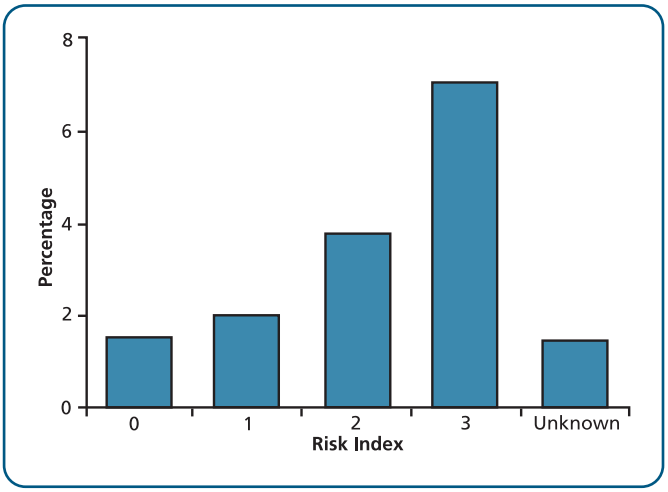


Figure 2.5 *Large Bowel Surgery*

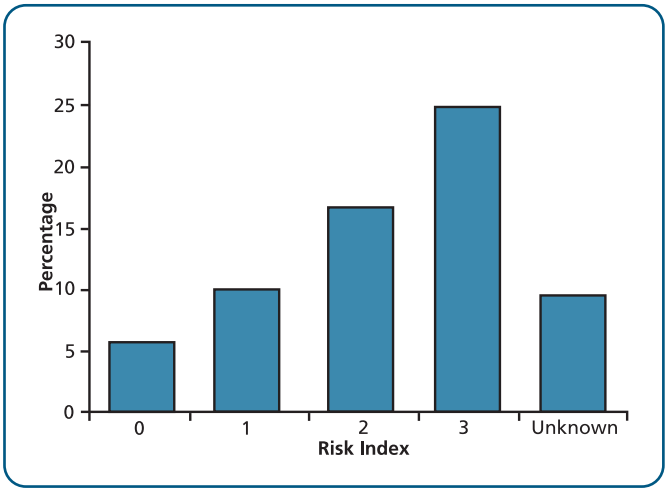


Figure 2.6 *Limb Amputation*

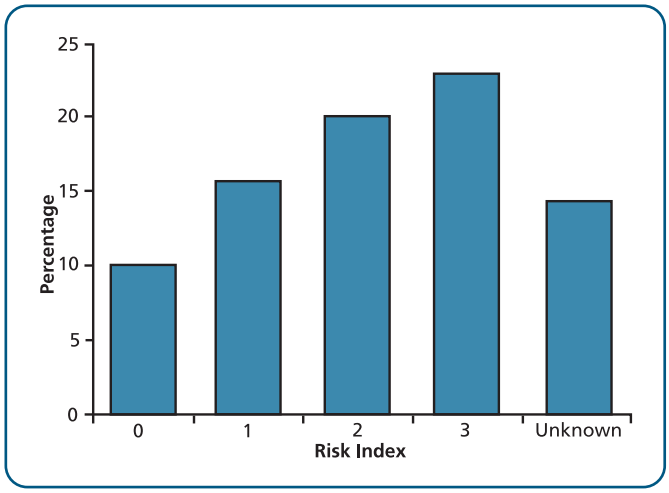


Figure 2.7 *Open Reduction of Long Bone Fracture*

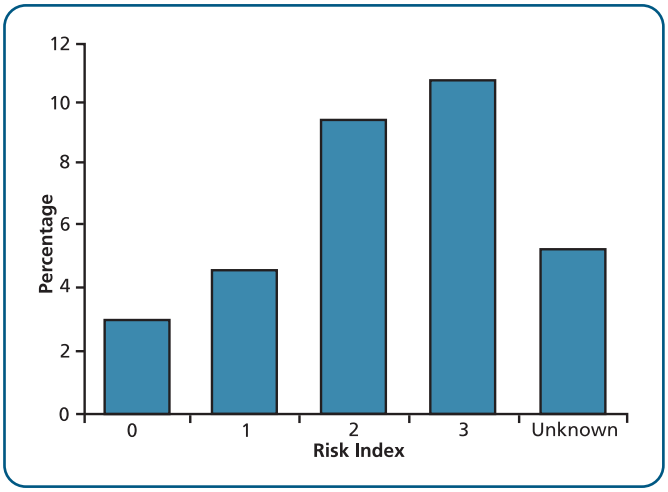


Figure 2.8 *Small Bowel Surgery*

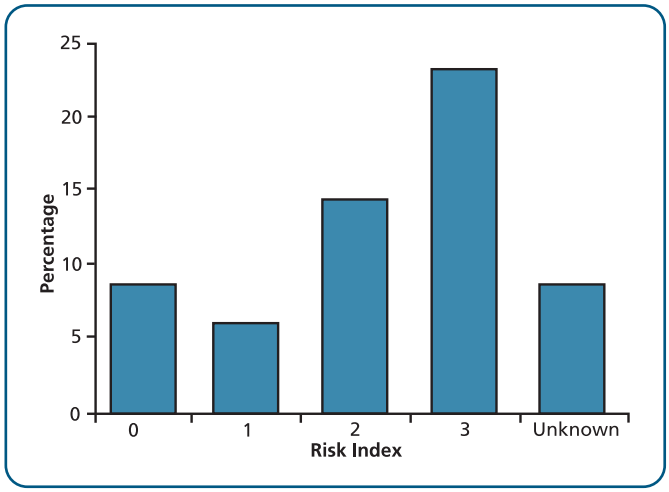
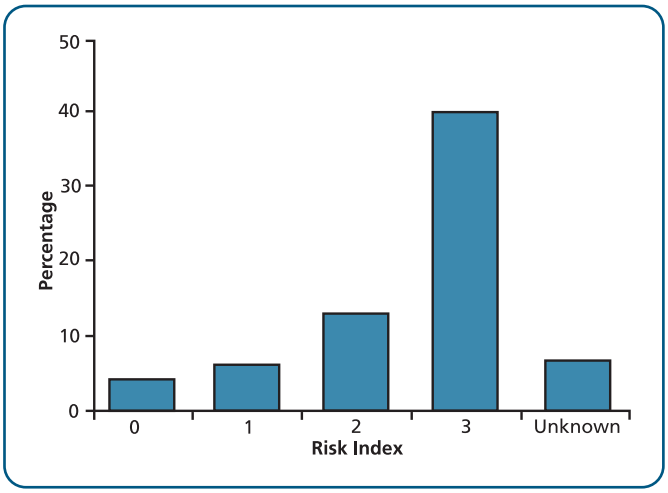


Figure 2.9 *Vascular Surgery*



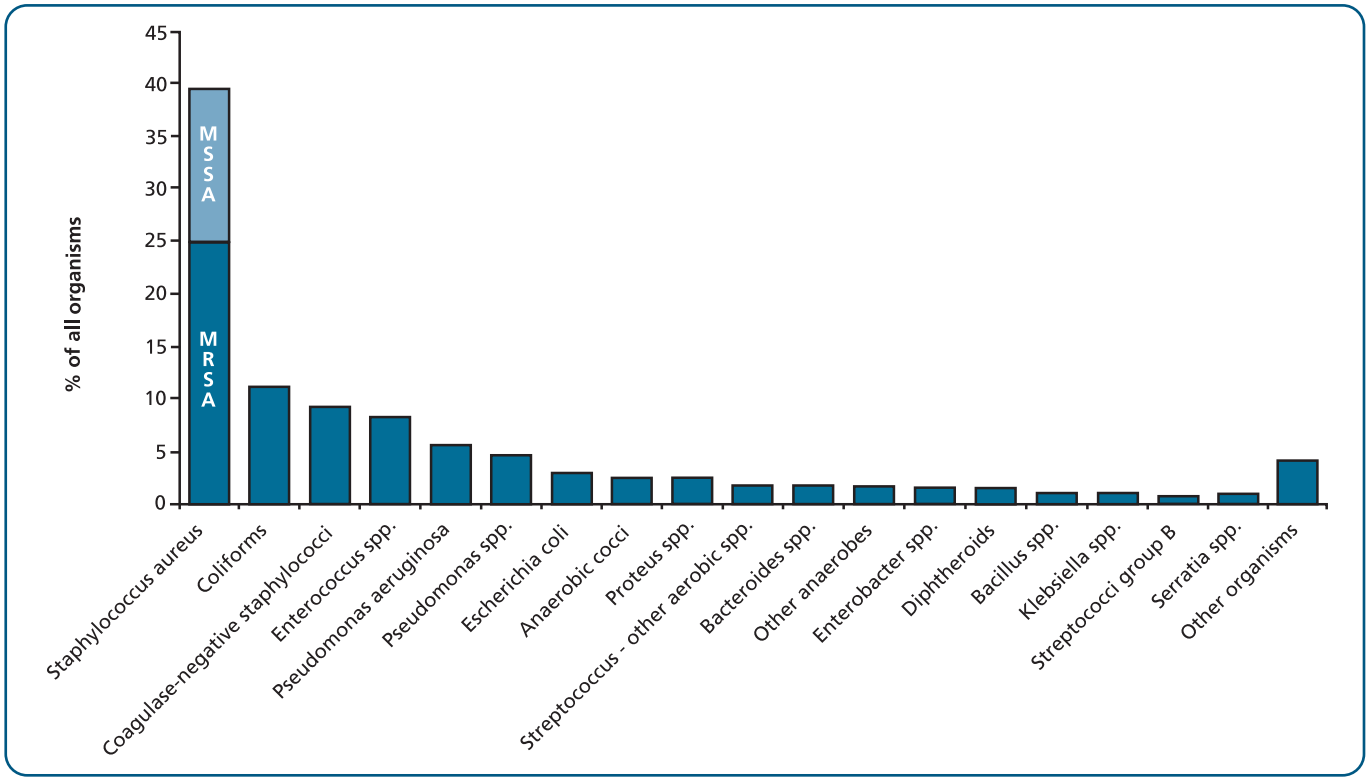
Key summary point

Sufficient data have been accumulated to demonstrate that generally the incidence of SSI increases with the number of risk factors for most categories of surgical procedure.

Micro-organisms causing surgical site infection

Figure 3.1 gives information about micro-organisms causing surgical site infections. The distribution of staphylococci causing SSIs by category of surgical procedures where 25 or more infections were reported are shown in figure 3.2.

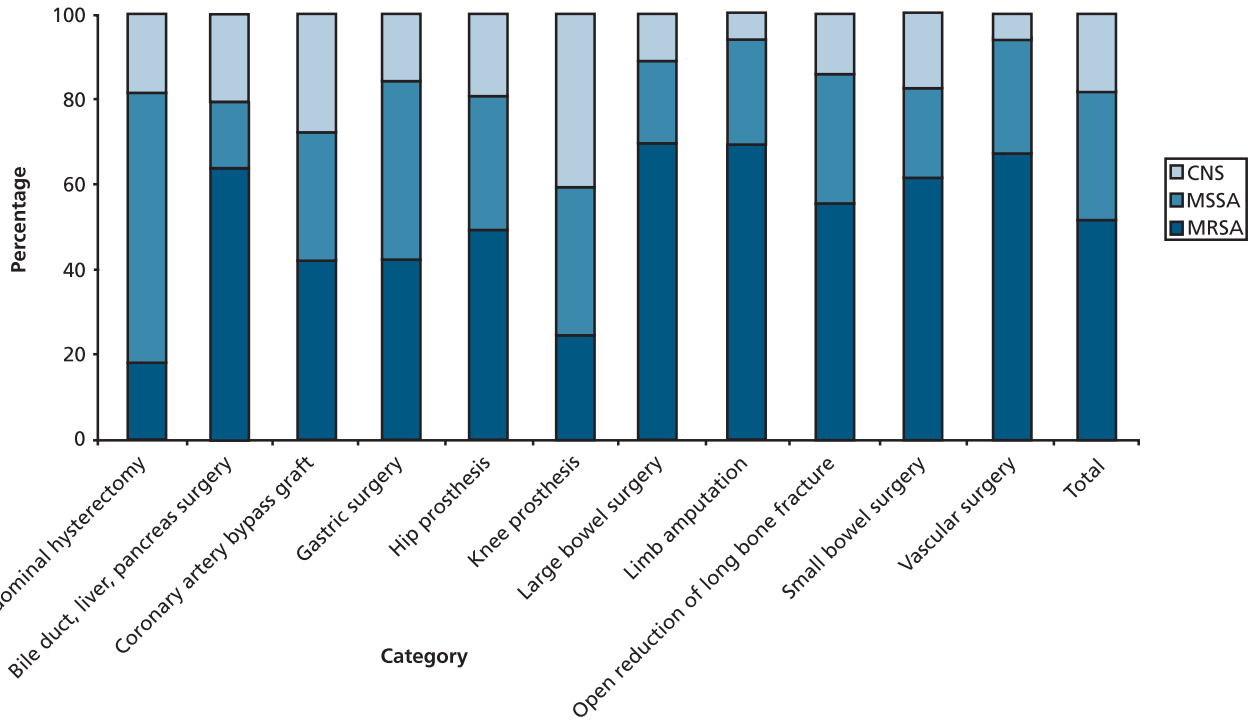
Figure 3.1 *Distribution of micro-organisms identified as causing surgical site infections for all categories of surgical procedures.*



Key summary points

49% of the micro-organisms identified as causing infections were staphylococci, of which 81% were *Staphylococcus aureus*. 63% of *Staphylococcus aureus* were resistant to methicillin (MRSA).

Figure 3.2 *Surgical site infection caused by staphylococci by category of surgical procedure.*



Note: *Cholecystectomy omitted as only three infections caused by staphylococci.*

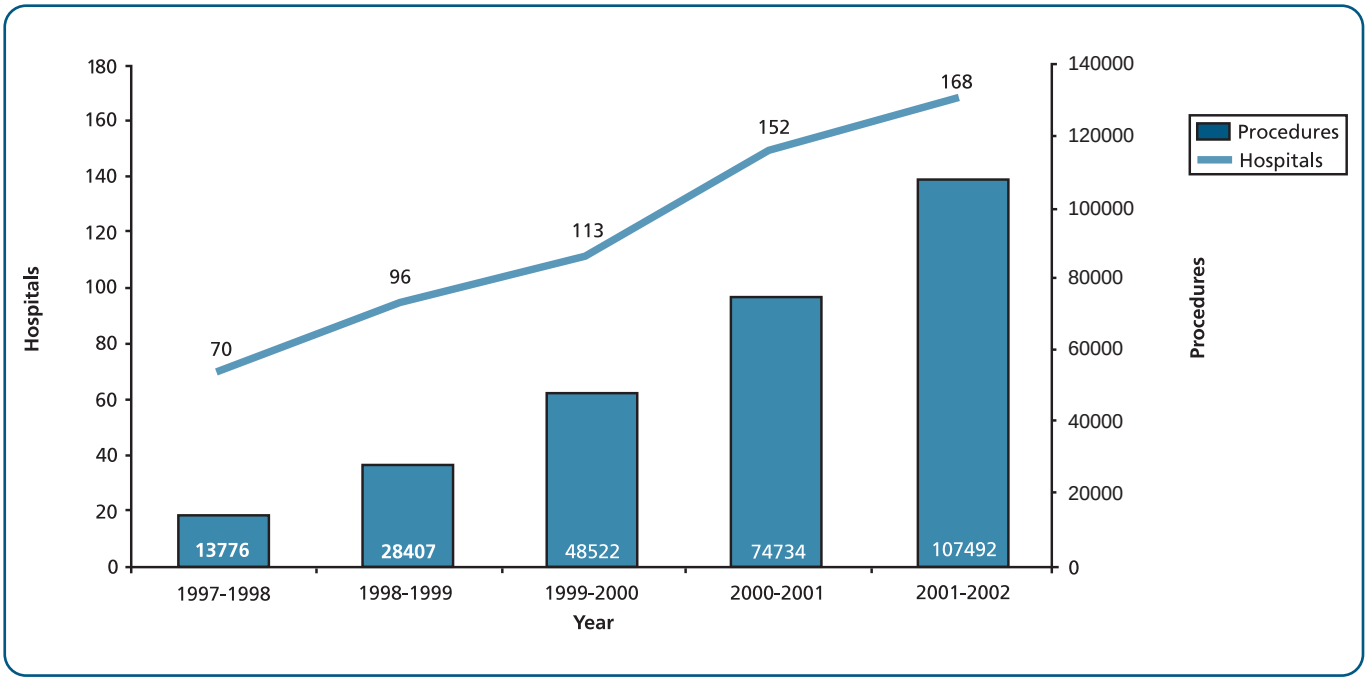
Key summary point

For most categories of surgical procedure, methicillin resistant *Staphylococcus aureus* was the most common staphylococcus identified as causing SSI.

Hospital participation in the surveillance of surgical site infection

In the five years since the module has been available, there has been a steady increase in the number of new hospitals taking part in the surgical site infection surveillance. There has also been an increase in the scope of SSI surveillance at participating hospitals, with the average number of patients included rising from 197 per hospital in 1997 to 640 per hospital in 2002.

Figure 4.1 *Cumulative number of hospitals and surgical procedures included in the SSI surveillance.*



Key summary point

The steady increase in participation in the SSI module has continued.

Definitions of terms used in this report

Incidence of surgical site infection (SSI)

This is reported as the number of surgical site infections per 100 operations, i.e. % of operations infected. Patients who had two operations in the same category of surgical procedure have been counted twice.

Percentiles

The percentiles divide a distribution into one hundred equal parts. The 10th, 25th, 50th, 75th, and 90th percentiles for the distribution of the incidence of SSI have been used in this report. These allow hospitals to see where they lie in the distribution in comparison with other participants. For example, if a hospital has an incidence that exceeds the 90th percentile, then at least 90% of the participating hospitals have a lower incidence.

Risk index

The risk index is that used in the USA by the National Nosocomial Infections Surveillance (NNIS) system. The NNIS risk index combines risk factors related to the patient's underlying condition, and those related to the surgical procedure. This stratification allows a more reasonable intra- and inter-hospital comparison of the incidence of SSI.

In the risk index, each patient undergoing surgery is scored according to the presence or absence of three risk factors at the time of surgery: (i) a patient with an American Society of Anesthesiologists' (ASA) preoperative assessment score of 3,4,or 5; (ii) an operation classified as contaminated or dirty; (iii) an operation with a duration of surgery of more than a specified period of time (T hours), where T depends on the surgical procedure performed. Each of the risk factors described contributes one point to the risk index, which ranges from 0 (none of the risk factors present) to 3 (all of the risk factors present). T hours is approximately the 75th percentile of the duration of surgery for that category of surgical procedures. That is, 75% of the operations reported for a given surgical category had a shorter duration of surgery and 25% a longer duration. Until enough UK data become available, the values of T are those used in the NNIS risk index.

Type of Infection

The criteria used to identify surgical site infection distinguished three types of infection. Superficial infections are those involving only the skin or subcutaneous tissue of the incision; deep infections involve the fascial and muscle layers of the incision; and organ or space infections are those involving any areas other than the incision opened or manipulated during the procedure.

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