Surgical site infection surveillance in England

Key points:

- This report is a summary of data from hospitals participating in the Surgical Site Infection Surveillance Service from October 1997 to December 2003.
- Hospitals taking part are required to collect data according to a standard surveillance protocol for a minimum of three months on one or more of 13 defined categories of surgical procedure.
- There has been a steady increase in participation in the scheme since its inception with approximately 80 hospitals collecting data each quarter and a total of 178 having participated since 1997.
- Rates of surgical site infection vary by category of procedure, this is largely explained by the different risk of microbial contamination associated with different types of surgery.
- Rates of surgical site infection vary between hospitals. This may be partly explained by differences in clinical practice, but other factors including differences in case-mix, case-finding intensity, and precision with which rates can be estimated are also important.

Introduction

Healthcare associated infections (HCAI) complicate recovery, cause anxiety and discomfort, and in some cases lead to death. It has been estimated that the annual cost nationally is almost £1 billion (1). Recently, HCAI have been given a high profile and there have been a series of governmental initiatives to improve their surveillance and prevention. Surgical site infections (SSIs) are one of the most common of these infections and are an important cause of morbidity and mortality. The delay in recovery has economic consequences, each patient that develops a surgical site infection has been estimated to require an average additional hospital stay of 6.5 days.

A national programme of surgical site infection surveillance was established in 1997, the Nosocomial Infection National Surveillance Service (NINSS). Although participation in this programme was voluntary there has been a steady increase in participation in SSI surveillance, resulting in one of the largest national databases on surgical site infections outside of the United States. Changes have been made to the system to meet the requirements of mandatory surveillance, with the Surgical Site Infection Surveillance Service (SSISS) being established to meet the new demands. This is part of the Health Protection Agency's Healthcare Associated Infection and Antimicrobial Resistance Division at the Communicable Disease Surveillance Centre (CDSC), Colindale. Feedback of surveillance data to clinical staff is a key component of effective infection control programmes (2,3). An important objective of the SSISS is to enable hospitals to use data to inform local practice, and guide the review or change of practice where results indicate that quality of care may need improvement.

A detailed surveillance protocol that ensures a standard surveillance method is used to collect information about infections. This provides comparative national data that can be used as a benchmark against which hospitals can measure their own performance. Acting on this information is the responsibility of the participating hospital, ensuring completion of the surveillance cycle by careful interpretation of data, feedback to clinical staff, and using it to influence practice. This report is a summary of surgical site infection surveillance data, submitted to SSISS between October 1997 and December 2003.

Surveillance methodology

Participating hospitals are required to collect data for a minimum of three months, on all patients undergoing surgery in a chosen category. Currently, there are 13 categories of surgical procedure available (table 1). Unlike some other healthcare associated infections, *eg*, bacteraemia, which can be obtained from laboratory databases, surveillance of SSI requires assimilation of clinical and risk factor data that is not routinely held on computer. Active prospective surveillance on eligible patients is therefore required from the time of surgery until discharge. Standard case definitions and surveillance methodology are essential to enable comparable rates to be produced and these are described in the surveillance protocol (4), which is available on the Health Protection Agency (HPA) website. Personnel responsibility for data collection are provided with training in the surveillance methods and case-definitions. Data includes potential risk-factors related to the patient and the procedure, and information about infections of the surgical site. These data are transferred into an information system either electronically or using optical mark recognition software, and integrated into a central database. The option to submit data via a secure online form is a recent development. This enables errors in the data to be detected and corrected automatically at the time of submission and should greatly enhance the data quality and efficiency of surveillance. Hospitals

participating in the surveillance are sent individual reports of their data, stratified by the National Nosocomial Infections Surveillance (NNIS) system risk-index for each surgical category (5).

Recent development of mandatory surveillance

The mandatory surveillance of surgical site infection in orthopaedic surgery announced by the Chief Medical Officer in June 2003 commenced on 1 April 2004 (6). This forms part of the healthcare associated infection developments referred to in the strategy to combat infectious disease, *Getting Ahead of the Curve* (7). Under the terms of a service level agreement with the Department of Health, the Health Protection Agency (HPA) is required to support these initiatives.

All hospitals where orthopaedic surgery is performed are expected to carry out a minimum of three months surveillance in, at least, one of the four orthopaedic categories: total hip replacements, knee replacements, hip hemiarthroplasties, or open reduction of long bone fractures. Hospitals can choose to collect data continuously if they prefer and are advised to collect for longer periods if their throughput of procedures is too small to obtain meaningful results in a single quarter. This flexible approach should enable hospitals to balance the requirements of the surveillance with local resources and priorities. It is, however, important that there is clinical ownership of this surveillance, and infection control teams are encouraged to liaise with orthopaedic colleagues about how it is undertaken locally. Individual reports for each participating hospital will be provided at the end of each surveillance period and data shared with the relevant regional epidemiology unit

Hospital participation

There has been a steady increase in participation in SSI surveillance since its inception in October 1997. Up to December 2003, 178 hospitals have participated in the scheme. There are more than 140,000 records in the database and approximately 8000 are added quarterly.

Figure 1 shows the participation of hospitals by quarter, from 1997 (quarter 4) to 2003 (quarter 4). The increase in participation between 2000 and 2001 may be due to an announcement by the Minister of Health in autumn 2000 of the intention to implement mandatory surveillance of orthopaedic surgery. Although the number of hospitals participating in the surveillance scheme has remained between 70 and 80 each quarter since October 2000, there has been an increase in the number of surgical procedures from 6700 (in the last quarter of 2000) to over 9500 in the same time period in 2003.

Hospital participation in orthopaedic categories has increased fourfold from 22 hospitals in 1997 to 86 hospitals in 2003. Since the inception of the surveillance scheme, participation has been greatest in hip and knee prosthesis in each period, followed by abdominal hysterectomy and large bowel surgery. Participation was lowest for operations on the bile duct and liver, or pancreatic surgery, and cholecystectomy (table 1).

Table 2 shows that the number of eligible procedures for surveillance in each surgical category is relatively small in a single three month surveillance period. Hospitals collecting data on less than 50 operations in a quarter need to cumulate data over more than one period to obtain a reasonably precise estimate of their rate of SSI.

The range in the number of procedures performed in hospitals, by quarter, varied between one and 20 for cholecystectomy, and between 25 and 391 for coronary artery bypass graft surgery (CABG). The majority of procedures included in the surveillance were in orthopaedic categories (hip and knee prosthesis and open reduction of long bone fracture). These

Figure 1 Hospital participation in surgical site infection surveillance by quarter

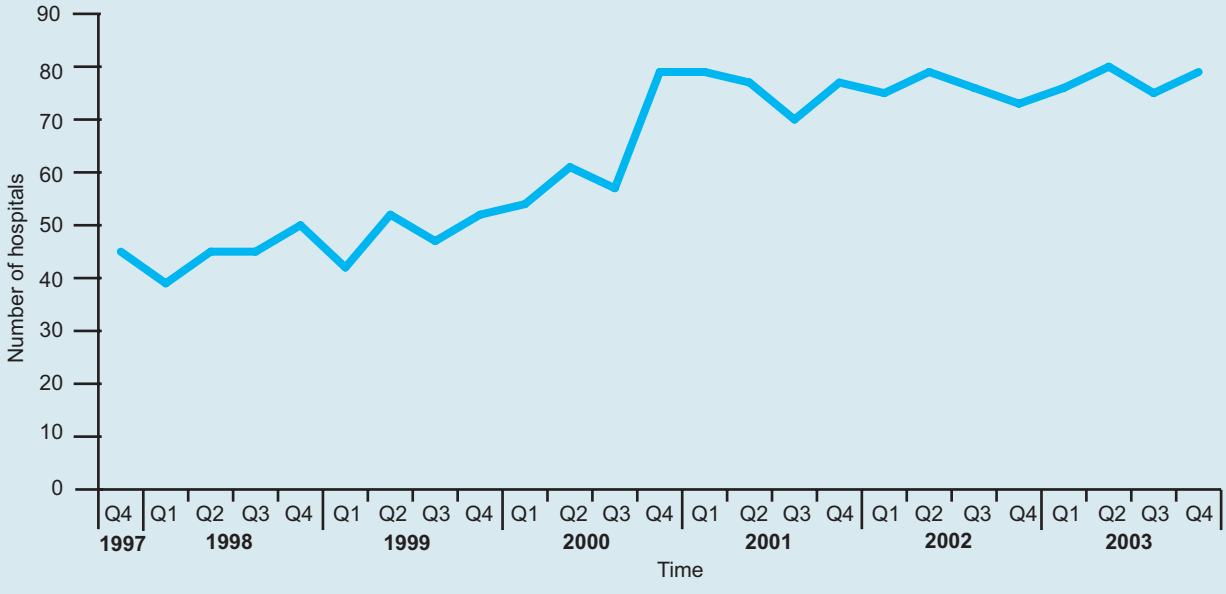


Table 1 Participation of hospitals by category of surgical procedure by year: October 1997 to December 2003

Surgical procedure	1997*	1998	1999	2000	2001	2002	2003	Total number of hospitals participating
Abdominal hysterectomy	11	22	30	25	25	21	17	**76**
Bile duct, liver, or pancreatic surgery	2	3	–	2	2	2	2	**9**
Cholecystecomy	2	3	2	3	4	2	2	**12**
Coronary artery bypass graft	3	10	7	9	9	9	10	**24**
Gastric surgery	2	3	2	2	5	2	2	**11**
Total hip replacement	16	35	37	65	77	79	74	**140**
Hip hemiarthroplasty	10	23	28	49	62	67	58	**121**
Knee prosthesis	18	27	36	53	64	67	70	**127**
Large bowel surgery	6	19	20	29	30	19	22	**67**
Limb amputation	5	11	11	15	12	10	11	**44**
Open reduction of fracture	5	6	7	12	12	13	11	**29**
Small bowel surgery	3	6	7	7	6	5	6	**23**
Vascular surgery	7	13	19	24	15	16	15	**48**
Total number of hospitals	**45**	**72**	**76**	**104**	**116**	**107**	**102**	**178**

accounted for 65% of operations reported. In some categories, the throughput of procedures is small and only few hospitals collected surveillance data. In the case of cholecystectomy, this surveillance only applies to patients having open procedures. Since many of these procedures are now performed endoscopically, data is not captured on them as part of this surveillance.

Although only a total of 23 hospitals participated in the CABG surgical category, a high number of procedures (19,438) were reported. This represents over half of hospitals that perform cardiac operations (43 hospitals) in England. The number of procedures also reflects the high throughput of coronary artery bypass graft services in these specialist centres.

Surgical site infection rates

Rates of SSI infection vary by category of procedure, reflecting the different risks associated with different types of surgery (table 3). Surgical wounds can be classified according to the likelihood and degree of microbial contamination of the wound at the time of operation (5,8). As expected, clean operations, associated with minimal risk of contamination, had the lowest rates of infection, *eg*, hip and knee prosthesis. Operations where the risk of contamination is higher, *eg*, involving the large bowel, have a higher rate of infection. The highest rate was reported in association with limb amputations.

Figure 2 shows the categories of surgical site procedures where three or more hospitals each collected data for at least 30 patients during the period October 1997 to December 2003. Cholecystectomy surgery was excluded from this figure as less than three hospitals had collected sufficient data.

Rates of SSI vary considerably between hospitals. These data, however, have not been adjusted for case mix and in some hospitals may be based on small numbers of procedures. Apparent differences may not

Table 2 Number and category of procedures collected quarterly: October 1997 to December 2003

Surgical procedure	Total number of procedures	Median number of procedures per period per hospital	range
Abdominal hysterectomy	10,716	32	3-99
Bile duct, liver, or pancreatic surgery	195	5	1-25
Cholecystecomy	123	4	1-20
Coronary artery bypass graft	19,438	136	25-391
Gastric surgery	373	10	1-36
Total hip replacement	43,805	45	1-249
Hip hemiarthroplasty	14751	21	1-125
Knee prosthesis	32,790	37	2-199
Large bowel surgery	11,446	36	1-110
Limb amputation	1908	12	1-63
Open reduction of fracture	6095	45	2-144
Small bowel surgery	1429	14	1-63
Vascular surgery	6676	27	2-126
Total	**149,745**	**33**	**1-391**

Table 3 Rate of surgical site infection by category of surgical procedure: October 1997 to December 2003

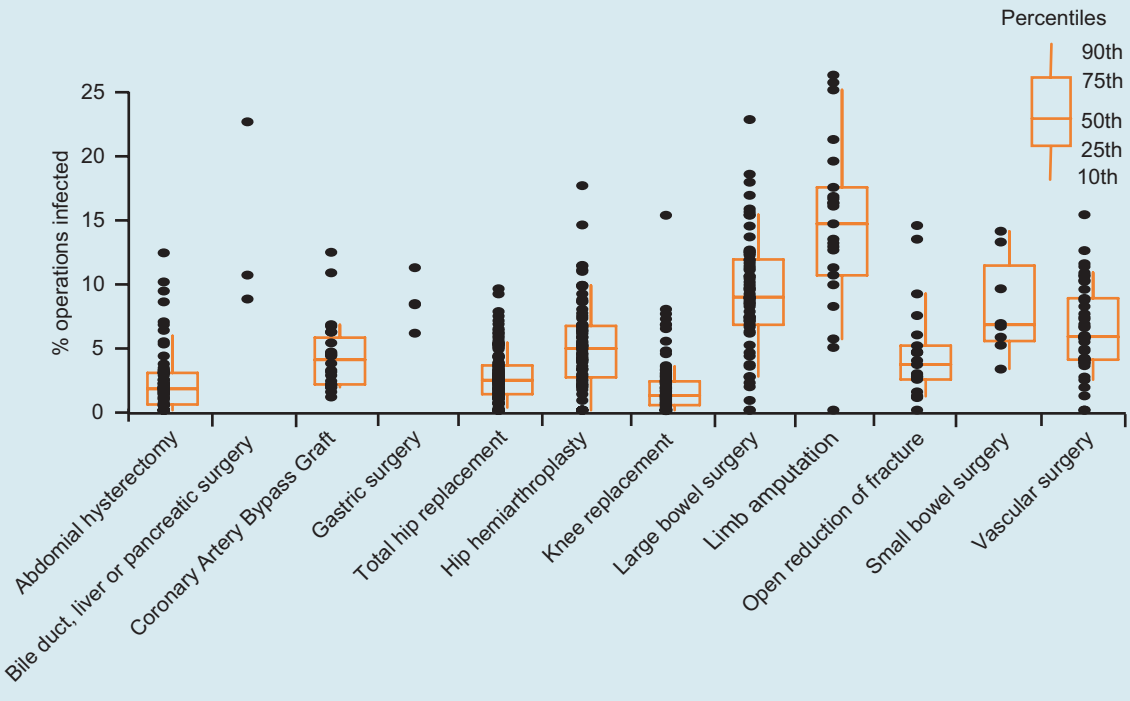
Surgical procedure	SSI	Number of operations	Rate of SSI	95% Confidence limit Lower-Upper
Abdominal hysterectomy	219	10,716	2.0	1.8-2.3
Bile duct, liver, or pancreatic surgery	22	195	11.3	7.1-17.1
Cholecystecomy	5	123	4.1	1.3-9.5
Coronary artery bypass graft	834	19438	4.3	4.0-4.6
Gastric surgery	37	373	9.9	7.0-13.7
Total hip replacement	982	43,805	2.2	2.1-2.4
Hip hemiarthroplasty	728	14751	4.9	4.6-5.3
Knee prosthesis	452	32,790	1.4	1.3-1.5
Large bowel surgery	1068	11,446	9.3	8.8-9.9
Limb amputation	285	1908	14.9	13.3-16.8
Open reduction of fracture	231	6095	3.8	3.3-4.3
Small bowel surgery	144	1429	10.1	8.5-11.9
Vascular surgery	450	6676	6.7	6.1-7.4

be statistically significant.

Discussion

Increasing participation in the national surgical site infection surveillance system suggests that the surveillance of SSI is considered to be of value. A survey of hospitals using the surveillance system indicated that a key reason for participation was the ability to compare local infection rates with national data (9). These comparisons clearly require the standardised methods of surveillance and data analysis provided by the SSI surveillance service. Over half of hospitals who took part in this survey reported a change or the initiation of a practice review as a result of the surveillance (9). In terms of reducing rates of SSI there is evidence that, at least, 25 hospitals with initial high rates of SSI have seen a statistically significant decreasing trend, over time, with continued surveillance (10). Other hospitals may also have seen clinically important reduction in rates, however, where the number of operations is small and the risk of SSI low, trends are not readily detected using statistical techniques. In addition, it is important to recognise that the majority of hospitals have been able to use the surveillance to demonstrate a good quality of practice, with rates of SSI that are comparable to the

Figure 2 Distribution of the incidence of surgical site infection by category of surgical procedures



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 surgical site infection 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.

national rate. The surveillance data can therefore contribute towards effective targeting of infection prevention and control resources.

The results show marked variation in rates of SSI between categories. This is largely explained by the different risk of microbial contamination associated with different types of surgery, *eg*, large bowel surgery has a high risk of contamination, orthopaedic surgery a low risk. The results also show marked variation in rates of SSI between hospitals that may, in part, be due to differences in clinical practice. It is important, however, to consider other factors which may explain the observed variation:

- crude rates of SSI do not take account of the case-mix of patients undergoing surgery or the type and complexity of the procedure. For example, the high rates of SSI seen following limb amputation are likely to be related to underlying risk-factors that affect wound healing and vulnerability to infection, such as poor limb perfusion and diabetes. The proportion of patients with these underlying risk factors will affect the rate of SSI at participating hospitals;
- although the standardised surveillance protocol enhances the comparability of the data, the resource intensive nature of surveillance for SSI means that variation in intensity of case-finding may also have an impact on the results;
- for many categories of surgical procedures the rates for an individual hospital may be based on a small number of procedures and will therefore be imprecise.

Despite these caveats, the SSI surveillance service has a key role to play in supporting surveillance of SSI and enabling hospitals to use data to monitor rates of infection and guide the review, or change of practice, where results indicate that quality of care may need to be improved.

References

1. National Audit Office. *The management and control of hospital acquired infection in acute NHS Trust in England*. London: The Stationery office, 2000.
2. Haley RW. Surveillance by objective: A new priority – directed approach to the control of nosocomial infections. *Am J Infect Control* 1985; **13**:78-89.
3. Harbarth S, Sax H, and Gastmeier P. The preventable proportion of nosocomial infections: an overview of published reports. *J Hosp Infect* 2003; **54**:258-66.
4. HPA. Protocol for surveillance of surgical site infection. London: Health Protection Agency, 2004. Available at <http://www.hpa.org.uk/infections/topics_az/hai/menu.htm>.
5. Culver DH, Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG, *et al*. Surgical wound infection rates by wound class, operative procedure, and patient risk index. *Am J Med* 1991; **91** (Suppl 3B): 152S-7S.
6. HPA. Mandatory surveillance of surgical site infections in orthopaedic surgery. *Commun Dis Rep CDR Weekly* [serial online] 2004 [cited 1 April 2004]; **14**(4): News. Available at <http://www.hpa.org.uk/cdr/PDFfiles/2004/cdr0404.pdf>.
7. Department of Health (Chief Medical Officer). *Getting ahead of the curve: a strategy for combating infectious diseases (including other aspects of health protection)*. London: Department of Health, 2002. Available at: <http://www.doh.gov.uk/cmo/idstrategy/index.htm>.
8. Haley RW, Culver DH, Morgan WM, White JW, Emori T, Hooton TM. Identifying patients at high risk of surgical wound infection. A simple multivariate index of patient susceptibility and wound contamination. *Am J Epidemiol* 1985; **121**:206-15.
9. Wilson JA, Ward VP, Coello R, Charlett A, Pearson A. A user evaluation of the Nosocomial Infection National Surveillance System: surgical site infection module. *J Hosp Infect* 2002; **52**: 114-121.
10. Department of Health (Chief Medical Officer). Winning Ways. Working together to reduce Healthcare Associated Infection in England. London: Department of Health, 2003. Available at: <http://www.doh.gov.uk/cmo/idstrategy/index.htm>.