Challenges in reporting surgical site infections to the national surgical site infection surveillance and suggestions for improvement

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ABSTRACT

INTRODUCTION Mandatory orthopaedic surgical site infection (SSI) data in England are used as a benchmark to compare infection rates between participating hospitals. According to the national guidelines, trusts are required to submit their data for at least one quarter of the year but they are free to report for all quarters. Owing to this ambiguity, there is a concern about robust reporting across trusts and therefore the accuracy of these data. There is also concern about the accuracy of collection methods. The aim of this five-year retrospective study was to assess the accuracy of SSI reporting at two hospitals in South East England under the same trust.

METHODS A retrospective review was carried out of five years of electronic medical records, microbiology data and readmission data of all patients who underwent hip and knee replacement surgery at these hospitals. These data were validated with the data submitted to Public Health England (PHE) and any discrepancy between the two was noted.

RESULTS A significant difference was found in the SSI rates reported by the surveillance staff and our retrospective method.

CONCLUSIONS Our study confirms the findings of a national survey, which raised concerns about the quality of SSI reporting and the usefulness of PHE SSI data for benchmarking purposes. To our knowledge, there are no previously published studies that have looked at the accuracy of the English orthopaedic SSI surveillance. In the light of our findings, there is an urgent need for external validation studies to identify the extent of the problem in the surveillance scheme. The governing bodies should also issue clear guidelines for reporting SSIs to maintain homogeneity and to present the true incidence of SSI. We suggest some measures that we have instituted to address these inadequacies that have led to significant improvements in reporting at our trust.

KEYWORDS

Surgical site infection – Healthcare associated infection – National surgical site infection surveillance – Public Health England

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Surgical site infections (SSIs) account for at least 15.7% of healthcare associated infections (HCAs) according to an English national survey on HCAs.¹ Surveillance of SSIs with feedback of results to the staff has been shown to reduce infection rates.² The Department of Health and Public Health England (PHE) have established a SSI surveillance service with guidelines to provide national data for use in benchmarking rates of SSI.

Surveillance of SSI in orthopaedic surgery for National Health Service hospitals in England has been mandatory since 2004. This is done by a surveillance administrator (SA) based at each hospital site. The SA is trained in the surveillance methodology by attending a PHE SSI training day. The mandatory requirement is to undertake three months (one quarter) of surveillance in at least one of the four orthopaedic categories, which include hip replacement, knee replacement, repair of neck of femur and

reduction of long bone fracture. The protocol was amended in 2008 to have systems in place for identifying all patients readmitted with SSIs.³ Two optional surveillance methods for patients following discharge were added to identify cases in the outpatient clinic setting and patient reported SSIs using a 30-day wound healing questionnaire.

The quality of mandatory orthopaedic SSI surveillance is dependent on the use of a standardised data collection process, adherence to SSI case definitions and protocols as described in the PHE SSI surveillance protocol.³ The accuracy of this protocol is necessary as it has long-term impact on the policy making, funding and quality of healthcare in England.

There are a few studies in the literature on SSI validation. Two US hospitals showed a sensitivity of up to 80%,^{4,5} and Dutch and German nosocomial infection surveillance showed differences in the accuracy of reporting among the

participating hospitals.^{6,7} To our knowledge, no such study has been performed in England looking at the mandatory orthopaedic SSI surveillance.

Methods

Retrospective analysis was carried out of all hip and knee replacements including revision procedures performed between April 2008 and April 2013 at two different sites (Hospitals A and B). PHE SSI surveillance was undertaken by the two different SAs at these sites. The data were collected in accordance with the case definitions for superficial and deep SSI following implant surgery as described in the PHE SSI surveillance protocol.⁵

Data extraction

Figure 1 describes the systematic data extraction from the different data sources. All hip and knee replacements carried out at both sites during the study period ($n=8,280$) were identified from the hospital coding database based on relevant procedure codes in the SSI protocol Office of Population Censuses and Surveys (OPCS) codes supplement.⁸ A list was extracted of all patients whose inpatient stay following their index joint replacement surgery was greater than 7 days ($n=1,806$) and of those who were readmitted to hospital within 12 months following their procedure ($n=2,292$).

SSI case identification

Multiple data sources were used to ascertain deep SSI cases (Fig 1). First, readmission diagnoses codes were reviewed to identify all patients with infected joint prostheses ($n=70$) and a detailed review was conducted of each case to identify true SSI cases ($n=43$). Second, microbiology reports of tissue, joint fluid and wound swabs were reviewed for all patients who had a length of stay greater than 7 days ($n=1,806$) and who were readmitted within 12 months ($n=2,292$). Tissue, joint fluid and/or wound swabs were sent for microbiological investigation for 751 of the 4,098 patients. Finally, electronic patient records were reviewed for these 751 patients to identify additional SSI cases that were not identified by routine hospital coding.

Hospital orthopaedic SSI surveillance team

Surveillance data collection was undertaken by a SA based at each hospital site. All SAs during the study period undertook training in the surveillance methodology by attending a PHE SSI training day.

The following data collection process was in place during the study period. The SA received a weekly list of all orthopaedic procedures including trauma related procedures from the theatre information system. The SA identified all eligible patients for surveillance purposes. The operating surgeon completed the data fields in the PHE SSI paper form for the type of procedure. These forms were collected by the SA, and any incomplete data fields were completed by the SA after review of the patient's medical notes and the theatre information system. The SA was notified of any suspected infections by the ward nurses during the inpatient stay. Readmitted patients with suspected SSIs were identified and reported to the SA by a surgical matron, who attended the daily clinical handover meetings. In addition to SAs, other staff members who have undertaken PHE SSI training include senior surgical nursing staff and infection control nurses.

PHE SSI data analysis

A list of patients who were reported as inpatient, readmission and other follow-up SSI cases was extracted from the PHE web-based system. Patient reported SSIs were excluded from this study. Electronic patient records were reviewed as described above to ensure the accuracy of the SSI cases reported to PHE and to explain any discrepant SSI cases between the two methods.

Results

SSI denominator data

Our study showed that 8,280 hip and knee replacements were performed at both hospital sites (Hospital A: 4,919, Hospital B: 3,361) although only 6,499 procedures were reported to PHE (Hospital A: 3,045, Hospital B: 3,454) (Table 1). There are several reasons for the discrepancies in the denominator data: coding errors, data extraction errors, manual errors during selection of eligible patients from the theatre procedure list using the OPCS codes

Figure 1 Data collection methods in detailed retrospective analysis of surgical site infection (SSI) prevalence

Table 1 Comparison of surgical site infection (SSI) rates at Hospitals A and B calculated using Public Health England (PHE) data and data collected retrospectively using all available hospital data sources (including review of readmissions, microbiology results of swabs or tissue and electronic patient records). Note: Readmission data until January 2013 only and follow-up not complete until March 2014

Year	PHE data			Retrospective method		
	Recorded procedures	SSI cases	SSI rate	Recorded procedures	SSI cases	SSI rate
<i>Hospital A</i>						
2008–2009	356 ^a	1 ^a	0.28% ^a	1,012	7	0.69%
2009–2010	494	5	1.01%	947	17	1.80%
2010–2011	664	11	1.66%	1,043	14	1.34%
2011–2012	812	5	0.62%	978	9	0.92%
2012–2013	719	4	0.56%	939	9	0.96%
Total	3,045^a	26^a	0.85%^a	4,919	56	1.14%
<i>Hospital B</i>						
2008–2009	280 ^b	2 ^b	0.71% ^b	587	4	0.68%
2009–2010	873	4	0.46%	631	6	0.95%
2010–2011	1,052	14	1.33%	631	10	1.58%
2011–2012	795	8	1.01%	670	7	1.04%
2012–2013	454 ^c	5 ^c	1.10% ^c	842	4	0.48%
Total	3,454^{b,c}	33^{b,c}	0.96%^{b,c}	3,361	31	0.92%
<i>Combined</i>						
2008–2009	636 ^{a,b}	3 ^{a,b}	0.47% ^{a,b}	1,599	11	0.69%
2009–2010	1,367	9	0.66%	1,578	23	1.46%
2010–2011	1,716	25	1.46%	1,674	24	1.43%
2011–2012	1,607	13	0.81%	1,648	16	0.97%
2012–2013	1,173 ^c	9 ^c	0.77% ^c	1,781	13	0.73%
Total	6,499^{a,b,c}	48^{a,b,c}	0.74%^{a,b,c}	8,280	87	1.05%

^aquarter 2 not submitted for Hospital A; ^bquarters 3 and 4 not submitted for Hospital B; ^cquarter 4 not submitted for Hospital B; *11 patients excluded as they were not readmitted or did not stay for >7 days postoperatively

supplement, variation in practice among SAs and missing quarters (quarters 1 and 3 in 2008, and quarter 4 in 2012). Unfortunately, there were no clear local written protocols describing each step in the data collection process or measures to validate accuracy of data extraction.

SSI numerator data

Our study identified a total of 87 SSI cases (Hospital A = 56, Hospital B = 31) in comparison with the PHE data, which showed a total of 59 cases (Hospital A = 26, Hospital B = 33). The 28 discrepant cases were identified and further review showed that 11 cases were also found by other follow-up methods after discharge (Fig 2). Consequently, our method identified an additional 39 SSI cases.

SSI rate

Overall, according to the retrospective method, 87 patients developed SSIs following 8,280 procedures (1.05%)

compared with the 48 patients (after exclusion of 11 patients who were not readmitted or did not stay for >7 days postoperatively) out of 6,499 procedures reported to PHE (0.74%). Differences between the SSI rates reported by the two methods varied over time (Fig 3). For 2008–2009 and 2009–2010, the mean difference was 0.51 percentage points, with the PHE database recording lower infection rates. In the following three years (2010–2013), this difference fell to 0.10 percentage points per annum. The difference in SSI rates between the two methods was less pronounced at Hospital B than at Hospital A (Table 1).

Discussion

There is growing demand from patients and commissioners regarding public reporting of surgical outcomes. In July 2013 the National Joint Registry's Surgeon and Hospital Profile service published individual surgeon and hospital level data regarding the number of hip and knee

replacements performed as well as mortality rates. Benchmarking has the potential to drive quality improvement provided certain conditions are met. These include standardised case definitions, consistent application of criteria by all data collectors and a central mechanism to ensure accuracy of data submitted from all participating hospitals. Our study confirms the concerns raised by a national

survey regarding the validity of PHE SSI data for benchmarking purposes.⁹ Erroneous PHE SSI reports regarding the high SSI rate at Hospital B¹⁰ have led to unwarranted concerns about the infection rate among orthopaedic surgeons based at Hospital B and local health commissioners.

We also feel that the guidelines issued by PHE to collect SSI rates for at least one quarter are ambiguous and do not

Figure 3 Reported surgical site infection (SSI) rates across both sites

provide the true picture. The trusts could report data from one to up to four quarters. This leads to erroneous data that are not representative of the true rate of SSI. The number and time of quarters should be specified, and the trusts should be encouraged to follow this.

Data collection

Surveillance staff at Hospital A did not submit the data for 1 out of 20 quarters (quarter 2 of 2008–2009) and at Hospital B for 3 out of 20 quarters (quarters 3 and 4 of 2008–2009, and quarter 4 of 2012–2013). This was mainly due to staff leaving and the appointment of new SAs, who underwent training during those periods. Our method covered all the four quarters for all five years. Naturally, this led to identification of more cases but on further analysis, our method was also more comprehensive in terms of SSI rates, especially in 2008–2009 and 2009–2010 (Fig 3). In 2010 a weekly microbiology meeting was initiated at which a dedicated microbiology consultant discussed the individual cases with the orthopaedic consultants. Thereafter, the discrepancy between the infection rates reported by the surveillance team and those using our method reduced.

The difference in SSI rates between the two methods was less pronounced at Hospital B than at Hospital A (Table 1). This may be because of better case ascertainment at Hospital B. It is important to note that PHE had notified us about the outlier status of Hospital B compared with other English hospitals and suggested that reasons for the high infection rate were investigated.

Definition of deep SSI

For deep SSI following implant, PHE recommends a follow-up duration of 12 months.⁵ This may not be adequate to identify low grade infections that occur between 12 and 24 months as the prosthetic joint infections are usually classified into early (<3 months after surgery), delayed (3–24 months) and late infections (>24 months).¹¹ Early (acute) and delayed infections (low grade) are usually due to acquisition of bacterial pathogens at the time of implant surgery. Most delayed infections are caused by coagulase negative staphylococci and *Propionibacterium* spp, which may be acquired from endogenous or exogenous sources (theatre environment or operating personnel). A 15-year survey conducted at a specialist orthopaedic unit in Birmingham showed that 36% of deep infections occurred after 12 months.¹²

The PHE SSI database was reviewed to identify the proportion of SSI cases with deep infections. This dataset was incomplete and the SAs may have had difficulties in classifying SSI cases. In our study, patients with haematogenous infections of prosthetic joints and those admitted for the second stage of a revision procedure for infected implants had been reported incorrectly as SSIs. The majority ($n=87$) of our SSI cases were deep infections requiring debridement, removal of the infected implant, prolonged antibiotic treatment and/or insertion of a new implant. We feel that there is a need to revise the current case definition of SSIs related to hip and knee replacements, and to extend the

follow-up period to 24 months so as to facilitate detection of low grade infections.

Method of surveillance to identify readmission SSIs

Orthopaedic SSIs can occur up to 24 months after the index procedure.¹¹ The PHE SSI surveillance protocol recommends 12-month follow-up review⁵ but in practice, it is difficult to conduct surveillance for such long periods with limited resources. In our experience, measures recommended by the PHE protocol for detection of readmission SSIs are difficult to implement. The majority of missed cases were patients who were readmitted several months after the primary procedure and were not identified or followed up at the time of readmission.

This is a very weak link in the data collection process and there is a need for greater involvement of consultant orthopaedic surgeons, infection specialists and senior nurses to be proactive about recognising these cases and reporting them to SAs. We have now addressed this problem by mandating attendance of SAs at our weekly multidisciplinary meetings to discuss all bone and joint infections. All suspected SSI cases are reviewed and classified into different categories before PHE data submission at this weekly meeting.

Organisation of local surveillance team

Mandatory reporting of methicillin resistant *Staphylococcus aureus* (MRSA) bacteraemia and *Clostridium difficile* infections coupled with imposition of targets has ensured that there is high level monitoring of these infections, and appropriate infection control actions are taken in a timely manner at organisation level.¹³ It is important to note that infection control staff are involved directly in the MRSA and *C. difficile* surveillance programme. The level of infection control and infection specialist involvement in SSI surveillance is not clear in the PHE protocol.⁵

In order to ensure good data quality, SSI personnel must have adequate training in reviewing patient records, understand basic medical terms, interpret clinical information and apply standardised case definitions. There is a need for standardisation of the minimum competencies that a SA should acquire before undertaking SSI data collection. It may be worthwhile to conduct a national survey to assess the level of medical and nursing staff input at participating hospitals into SSI data collection, and to correlate that with external validation studies. We have overcome this problem by ensuring that all suspected SSI cases are discussed at our weekly clinical meetings. We have also formed a local bone and joint infection working group to review SSI data, the data collection process and data validation, and to supervise and monitor orthopaedic SSI surveillance team activities. Similar measures taken nationally would make the data capture more accurate.

Study limitations

The design of our study was perhaps more suited to identifying accurately all deep or joint space infected cases requiring further surgical procedures. All existing hospital databases were used to identify all patients with a

readmission diagnosis suggestive of infected joint prosthesis and positive microbiology culture reports. It is likely that some patients may have been missed owing to coding errors, incorrect specimen labelling and incomplete electronic discharge letters and/or outpatient clinic letters. There could also have been patients who were transferred or managed elsewhere who would not have been captured by our study. Follow-up review of patients operated on in 2012–2013 is not complete but available SSI data have been included to highlight deficiencies in case ascertainment, which are being addressed locally.

Conclusions

This study confirms the findings of a national survey, which raised concerns about the quality and reliability of English SSI surveillance. It has also highlighted the need for clear guidelines and the challenges associated with collecting SSI surveillance data over a 12-month follow-up period, practical difficulties in identifying infected readmissions and the need for revised case definitions. We have implemented local measures to address these challenges. There is undoubtedly a need for revisiting the guidelines and collection methods to improve the accuracy of reporting by hospital trusts nationally.

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