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Post-discharge surveillance: can patients reliably diagnose surgical wound infections?

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Summary: Post-discharge surgical wound infection surveillance is an important part of many infection control programs. It is frequently undertaken by patient self-assessment, prompted either by a telephone or postal questionnaire. To assess the reliability of this method, 290 patients were followed for six weeks post-operatively. Their wounds were photographed and also covertly assessed for signs of infection by two experienced infection control nurses (ICN). Patients also responded to a postal questionnaire seeking evidence of infection at both week four and week six post-surgery. Correlation between the patient's assessment of their wound and the ICN diagnosis was poor ($r = 0.37$) with a low positive predictive value (28.7%), although negative predictive value was high (98.2%). Assessment of photos for signs of infection by two experienced clinicians also correlated poorly with the ICNs diagnosis of infection ($r = 0.54$). The patient's recall of prescription of an antibiotic by their general practitioner (GP) for wound infection during the postoperative period correlated best with the ICNs diagnosis ($r = 0.76$). This latter measure, particularly when confirmed by the GP in those patients reporting an infection, appears to provide the most valid and resource efficient marker of post-discharge surgical wound infection.

Keywords: Infection; post-discharge; self-assessment; surgical wound.

Introduction

Assessment of surgical-site infection (SSI), a leading cause of healthcare related morbidity and cost, is an established and pivotal part of many infection control programs. With increasing surgery carried out as day procedures and with shorter lengths of stay after inpatient procedures, much surgical infection occurs after discharge.[1] Unless these post-discharge infections are reliably identified, calculated rates of SSI will not represent an accurate assessment.

A number of techniques for determining post-discharge infection have been described. One of the most common is patient self-assessment of the wound, prompted by either a telephone[2–4] or postal questionnaire.[5,6] This low-cost methodology is useful where the patient is unlikely to, or is unable to, be reviewed postoperatively by the surgeon or in the institution where the surgery was undertaken. However, no assessment of the reliability and validity of patient self-review of major wounds in an SSI surveillance program has been published.

Princess Alexandra Hospital is an 800-bed University tertiary referral hospital with almost 40 years experience in SSI surveillance.[7] Post-discharge

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surveillance has been undertaken in our hospital for over 20 years, utilizing a standard questionnaire mailed to patients to arrive five weeks after the operative procedure. Evidence suggests that this timing will capture over 95% of infections manifesting after discharge.[8] A reply-paid envelope is enclosed and a response rate of over 70% has been consistently achieved. This study was designed to assess validity and reliability of patient self-assessment of their wound by postal post-discharge surveillance.

Methods

To determine the validity of patient self-assessment of an SSI, a nurse (author S.D. or B.H.) visited patients at their home post-discharge. Patients were included in the study if the surgical wound could be easily observed after discharge by the patient, and the surgical procedure had an expected risk of infection that was of moderate to high probability.

The study design and assessment strategy was approved by the local Ethics Committee.

Patients were informed that the project was being undertaken by the Department of Plastic Surgery, Princess Alexandra Hospital, to assess the cosmetic outcome of surgical procedures and that the nurse would examine their wound each week (Figure 1). No mention of infection or of assessment by the infection control team was made, in an endeavour to eliminate the potential bias that a weekly visit by a nurse might engender. However, staff employed to visit patients post-discharge were experienced infection control nurses (ICNs). Verbal consent was obtained during inpatient stay and subsequent mutually convenient visits were confirmed by telephone. Patients were reviewed each week by the same ICN until week six postoperation. Weekly review by the nurse consisted of visual inspection and photographs of the wound. The photographs were subsequently used for additional independent assessment of SSI (by authors B.C. or D.L.). A covert standardized written assessment by the ICNs as to whether signs and symptoms of infection were present was then recorded on a survey form used routinely for post-discharge surveillance at Princess Alexandra Hospital for the previous decade.

Before discharge all postoperative patients were routinely advised that they would be included in a postoperative SSI survey following discharge. Patients received in the mail at week four post-discharge the same questionnaire used by the nurses (Appendix 1). This was overtly sent by the Infection Control Service and is normal practice for the SSI surveillance program in the hospital. As 80–90% of SSIs manifest by week three,[8] week four was chosen to maximize the numbers of patients with infection. The same questionnaire was also mailed to arrive at week six post-operation. Patients were told that the second questionnaire was required to assist in rectifying computer problems associated with the recording of the initial questionnaire responses. A two-week retest period was deliberately chosen to reduce the burden of recall. A third questionnaire was mailed to all patients who replied to the week four questionnaire, but who did not respond to the final questionnaire at week six. Questionnaires completed by the patient at weeks four and six were used to test the reliability of their reporting of signs and symptoms. The questionnaire did not assess the ability of the patient to accurately localize the anatomical location of SSI, i.e., superficial/deep/organ space. Assessment for anatomical location by the surgeon and the ID physician/microbiologist from

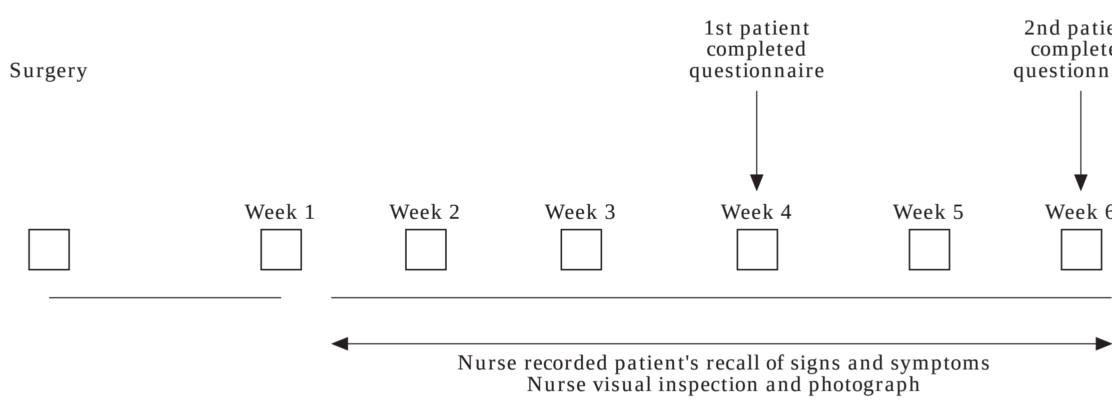

Figure 1 Activities Time Line.

photographic images was considered to be too difficult and was not undertaken.

Inclusion criteria for SSI

The diagnosis of SSI by the two research nurses was considered the most reliable method as it is on this basis that inpatient SSI is routinely diagnosed. It was also considered that prospective assessment of patients would be more reliable than retrospective assessment with photographic images by surgeons who were unavailable for weekly review. Criteria for diagnosis were:

1. Presence or recall of yellow discharge (with the appearance of pus) alone or
2 a. Presence or recall of fever and
 b. Redness or swelling and/or
3. Recall by the patient of antibiotics prescribed by a General Practitioner (GP) for purported SSI.

The above criteria were used to identify an SSI from patient self-assessment at week four. A surgeon (B.C.) and an infection diseases physician/microbiologist (D.L.) made independent assessments of the photographic images, assigning a diagnosis of infection according to the criteria 1 and 2(b) above. They classified SSI by degree of certainty, namely definite SSI (B.C. $N=21$; D.L. $N=13$) and possible SSI (B.C. $N=85$; D.L. $N=77$). These were then collapsed into a single category to conform with the SSI reporting stratum required of the ICNs.

Where a patient was readmitted to hospital during the survey period, the ICN reviewed the patient in the same way as if they had not been admitted. These patients received both survey letters at their home address.

Analyses for correlation using Pearson's correlation coefficient (r), the standard error of the correlation coefficient, the frequencies, standard deviations and 95% confidence intervals around proportions were performed using SPSS for Windows, Version 10.0.7 (SPSS Inc, Chicago, USA). The 95% confidence intervals around the correlations were estimated from the standard error of the correlation.

Results

Three hundred and forty-three patients consented before discharge to follow-up for the six-week survey period. Before discharge, 12 were assessed as being ineligible for follow-up: three died, seven developed an SSI before discharge and two remained hospitalized. After discharge but prior to the first home visit, 15 patients refused to participate. Of the initial 316 eligible patients who agreed to participate, 290 (290/316, 91.8%) patients were followed weekly, 225 (225/316, 71.2%) completed the questionnaire at week four and 190 (190/316, 60.1%) completed a second questionnaire at week six. More male than female surgical patients ($P=0.003$) were followed weekly (Table I) and the median age of the study group was 59 years, with an inter-quartile range of less than 10 years. Time of diagnosis of infection post-discharge is illustrated in Figure 2.

As intended, by purposeful choice of a high proportion of 'contaminated' and 'dirty' procedures,[9] the overall infection rate identified by the nurse, and accepted as the Gold Standard, was high at 16.6% (95% CI 12.5–21.3%) (Table II). The majority (47/48) were superficial. One (1/48) patient had deep/organ space infection and was the only patient readmitted prior to the end of the six-week study period. The estimated rate of SSI varied between the groups of assessors from 14.5% by the GP to as high as 36.6% by the surgeon (Table II). The infection rate estimated from the GP's prescription of

Table I *Demographics of study group*

Variables	No.	Percent
Male	163	56.2
Female	127	43.8
Age (years)		
Median	59	
Lower quartile	49	
Upper quartile	69	
Total length of hospitalization (days)		
Range	1–27	
Median (SD)	6.0 (4.2)	
Length of stay post-procedure (days)		
Range	1–16	
Median (SD)	5 (2.6)	
Surgical procedures		
Cardiac	92	31.7
Breast	18	6.2
Laparotomy	33	11.4
Upper gastrointestinal tract	11	3.8
Lower gastrointestinal tract	36	12.4
Hepatobiliary	30	10.3
Hernia repair	38	13.1
Orthopaedics	2	0.7
Urology	9	3.1
Gynaecology	14	4.8
Vascular	7	2.4
Total	290	100

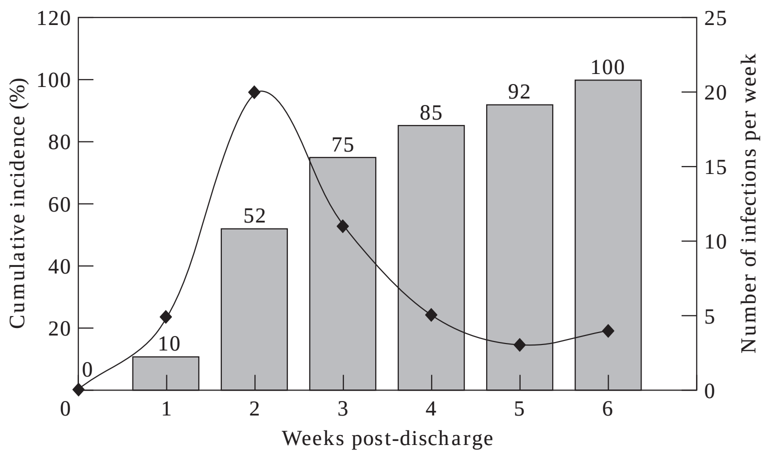

Figure 2 Time frequency of post-discharge infection.

Table II *Diagnosis of surgical-site infection (SSI) by healthcare professionals*

Assessor group	Infections/total	Percent SSI rate (95% CI)
Infection control nurse	48/290	16.6 (12.5–21.3)
General practitioner	42/290	14.5 (10.6–19.1)
ID physician/microbiologist	90/290	31.0 (25.8–36.7)
Surgeon	106/290	36.6 (31.0–42.4)

Table III *Correlation of diagnosis with Gold Standard (infection control nurse diagnosis)*

Methods of diagnosis	Correlation (*r*)	95% CI
Patient recall	0.37	0.28–0.46
General practitioner antibiotic prescription	0.76	0.66–0.87
Surgeon	0.39	0.29–0.50
ID physician/microbiologist	0.38	0.27–0.50

antibiotics (14.5%; 95% CI 10.6–19.1%) was similar to the Nurse's rate ($P = 0.49$), while the infection rate estimated by the surgeon (31.0%, 95% CI 25.8–36.7%) was not significantly different ($P = 0.16$) from those of the ID physician/microbiologist (36.6%, 95% CI 31.0–42.4%). The positive predictive value of a GP diagnosis was 75%.

The patient's ability to reliably recall signs and symptoms between week four and week six was high ($r = 0.69$; 95% CI 0.59–0.78), but the validity of their self assessment against the *n*urse diagnosis as the 'Gold Standard' was poor ($r = 0.37$; 95% CI 0.28–0.46). When the patient reported signs and symptoms in accordance with the criteria for SSI, their positive predictive value was low (28.7%), although their negative predictive value was high (98.2%). The correlation of the patient's recall of their GP's prescription of antibiotics with the *n*urse diagnosis was high ($r = 0.76$). The *s*urgeon diagnosis correlated poorly with the *n*urse diagnosis ($r = 0.39$) as did that of the Physician ($r = 0.38$) (Table III). Inter-rater reliability between the surgeon and the physician proved moderate ($r = 0.50$; 95% CI 0.41–0.62).

Discussion

The necessity to include post-discharge assessment of wound infection in an SSI surveillance program has been well established.[1,8] Reported methods to achieve this vary. Review by an ICN in the out-patient setting has proved reliable,[8,10] but this is time-consuming and often only practical if post-surgery follow-up occurs at the healthcare facility where the procedure was carried out. Questionnaires to *s*urgeons have not proved as reliable.[11,12] Other proxy markers of infection, including postoperative antibiotic usage, have been utilized in the comprehensive healthcare setting of an American Health Maintenance Organization.[13]

Self-assessment of the surgical wound, prompted by a telephone or postal questionnaire is a low-cost technique, requiring minimum resources. As there is no need for the patient to return to a specific healthcare provider, this methodology is applicable in most circumstances. To be useful, however, it does require the co-operation of the patient who must be able to recognize the clinical features of wound infection with a high degree of reliability. Our findings confirm the long experience of our hospital in that a consistently high number of patients will respond to a postal post-discharge surgical infection surveillance survey. However, we have also demonstrated that in major wounds that are clearly visible to the patient, apparent unreliable recognition of signs and symptoms occurs. The significant discrepancy of SSI diagnosis based on patient recall of clinical features compared with that of the ICN ($r = 0.37$) reveals that a diagnosis of infection made in this way appears very likely to be incorrect.

Clinical criteria for diagnosis can be difficult to judge reliably. Our two infection control survey nurses, although very experienced, underwent further intensive training and examination to ensure valid and reliable reporting of those signs and symptoms considered indicative of infection. As is widely accepted practice, the ICNs diagnosis of SSI is used to determine inpatient SSI rates in our hospital. Thus, their responses have again been taken to represent the 'Gold Standard'. Both the surgeon and the ID physician/microbiologist are very experienced in infection surveillance and were conjointly instructed in uniform interpretation of clinical features of the photos. Yet the reliability of their diagnoses, made from review of a sequential series of high-quality colour computer images, when compared with the ICNs diagnoses, was only moderate ($r = 0.54$). Agreement between the individual clinicians was also only moderate ($r = 0.51$). These findings may have occurred because both the *p*hysician and the *s*urgeon diagnosed infection post-fact and without viewing the actual wound on a progressive basis. However, such an outcome would suggest that photographic interpretation of SSI cannot be utilized as a routine technique.

Although patients can reproducibly report their signs and symptoms ($r = 0.69$), their assessment is not a valid reflection of the ICNs, interpretation of the clinical picture ($r = 0.37$). In our experience, patients frequently confuse serous discharge with pus. Therefore, this marker may considerably overestimate infection rates, particularly in vascular and lymphatic procedures. However, in spite of the apparent inability of patients to recognize those signs and symptoms that we have used to define SSI, the patient recall of GP antibiotic prescribing in the review period was the most valid proxy measure of infection ($r = 0.76$). That the patient visited their GP, in itself, would imply that the patient expressed concern about the state of their wound. The calculated positive predictive value of GP antibiotic prescribing, would suggest that patients can recognize aberrant features in their wound, if not those specific clinical features that we have used to define SSI. Why this is so is a moot point. It is well recognized that patients find medical terminology confusing.[14,15] Our survey form contained What we believed to be clear, explicit and relatively simple language (Appendix); however, it may not have been interpreted in this way by patients. The interquartile range (10 years) suggests that age did not contribute to a difference in ability to comprehend the form. The impact of type of surgery could not be assessed due to the relatively small number of infected patients (48/290) in the study. Seaman and Lammers[16] reported similar inconsistency between patient and medical officer assessment of signs of infection in simple lacerations treated in an emergency department, using a similar questionnaire.

The predictive value of diagnosis by GP antibiotic prescribing could be confounded by antibiotic treatment for infections other than SSI, or by inappropriate utilization of antibiotics for superficial infections, e.g., stitch abscess. It may also be that patients cannot discriminate antibiotics from other medications, although our experience does not suggest this is so. This correlation appears to provide a potential avenue for self-assessment of SSI by patients. By seeking only a response on antibiotic use in the survey questionnaire at four to six weeks post-discharge, the need to understand any medical terminology or to make any interpretation of presence of signs and symptoms is substantially avoided. The apparent ability of patients to recognize that their wound is not infected (predictive value 98.2%) would allow resources to be concentrated on those whose replies indicate a potential post-discharge infection Subsequent confirmation of the clinical features and determination of the reason for prescription of antibiotics with the relevant clinician in this latter group alone, would assist in further improving validity of assessment. This simple two-step procedure would appear to provide the most reliable and resource efficient method of diagnosis of SSI in a post-discharge survey, and requires further assessment.

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Appendix 1. Questionnaire mailed to patient

1. Has your wound healed completely? Yes No
2. Have you had any of the following problems with your wound? (tick all that apply)
   Redness
   Swelling
   Pain
   Yellow discharge
3. Have you had a high fever that was not due to an illness since your operation? Yes No
4. Has your doctor at any time told you that your wound was infected? Yes No

   Doctor's name: ____________________
   Phone number: ____________________

5. Has your doctor given you any antibiotics to help your wound heal? Yes No
6. Do you have any other comments about your stay at the Princess Alexandra Hospital?