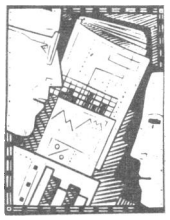

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Medical audit data: counting is not enough

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Abstract

***Objective*—To assess the meaningfulness of a year's worth of audit data relating to all the inpatients of one consultant general surgeon and to question the usefulness of certain outcome measures.**

***Design*—Analysis of records entered on to audit computer (Dunnfile) and relating to inpatient episodes for one consultant general surgeon over one year. Data obtained were compared with ward records and the patient administration system to check their accuracy.**

***Setting*—The three hospitals and 12 wards in Brighton health district where the surgeon admitted patients.**

***Subjects*—859 Records relating to inpatient episodes from 1 January to 31 December 1988. These covered 655 main procedures and 79 secondary procedures performed at the same time.**

***Main outcome measures*—Procedures were analysed by complexity of operation (BUPA code) and grade of surgeon; complications were counted and rates constructed by surgeon and by BUPA code: returns to theatre were analysed.**

***Results*—Simple counts revealed some data, such as the fact that one registrar performed more major operations (32) than the senior registrars (22 and 14), and an analysis of complications showed that he had a lower complication rate (11·4% *v* 20·0% and 19·4%). But the simple complication rate disclosed nothing about whether the complication was avoidable. Likewise, the number of returns to theatre needed further qualification. Analysis of data collection for February to April 1988 showed a 30% deficit of information on the audit system compared with ward records and prompted a re-examination of everyone's role in collecting data. After the year's audit there was still a 17% shortfall compared with the district's patient administration system, though some of this was accounted for by a backlog of work.**

***Conclusions*—It is difficult to ensure adequate data collection and entails everyone in an unfamiliar discipline. Connecting the audit system to the patient administration system would help. Despite the limitations of crude analyses of workload and complication rates, the audit data helped to measure activity and in the management of the firm. Nevertheless, time and care have to be taken in presenting and interpreting audit data carefully.**

***Implications*—Counting is not enough.**

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Introduction

Medical audit is a review of patient care.[1] It necessitates abstracting information from patient records and making judgments about the quality of care given. These judgments are made by considering indicators of structure, process, and outcome.[2,3] Conceptual problems abound, in part because we are dealing with a continuum. It is not clear where structure becomes process and process outcome. An oversimplistic, but nevertheless useful, distinction can be made. Structure audit involves analysing fixed resource inputs; process audit analysing investigations, procedures, and treatments; and outcome audit analysing the assessment of a patient's condition after an episode of treatment.

But what are these indicators of structure, process, and outcome? Can medical audit be used to judge the quality of care given? Several surgical units have reported the development of medical audit,[4-9] but little has been written about the presentation and interpretation of audit data.

Medical audit data are the product of a complicated process. They are a static representation of dynamic processes. In the case of inpatients, for instance, there are many stages between admission and discharge, and medical audit attempts to intercept patients and events at different points along the "process continuum" and make counts. Evaluating these audit data is necessarily a complex exercise. Audit data alone cannot explain: they should be seen only as indicators, not final results. They describe what is there without providing an understanding of the underlying structure.

This paper reports some of the results of the first full year's audit of all inpatients for one consultant general surgeon, drawing particular attention to the problems of interpretation and the need for the careful presentation of data.

Background and method

Since 1985 CASPE Research (clinical accountability, service planning, evalution) has worked closely with senior clinicians in Brighton on a series of projects funded by the Department of Health research management division to develop measures and information systems for quality assurance. The purpose of the research is to develop indicators of quality, tested by clinicians and other professionals, using self audit.

In September 1985 after careful evaluation of the audit software products on the market,[10] Dunnfile was chosen to help with the routine auditing of consultants' inpatient workload. Dunnfile is a surgical audit software package developed by Mr D C Dunn, a general surgeon in Cambridge. It is used to collect a set of data on every inpatient admission which are used to generate discharge summaries and for surgical audit.

An analysis of all inpatient records relating to one consultant surgeon (RG) for the period 1 January 1988

TABLE I—*Grades of operation by surgeon: main procedure only*

Surgeon	Minor	Intermediate	Major	≥Major+	Total
Consultant 1	51	191	74	21	337
Other consultants	0	0	2	1	3
Senior registrar 1	9	12	22	2	45
Senior registrar 2	12	9	14	1	36
Registrar 1	9	27	32	2	70
Registrar 2	4	4	4	0	12
Other senior registrars	0	1	2	0	3
Other registrar	6	9	15	0	30
Senior house officer 1	13	34	4	0	51
Clinical assistant	2	2	0	0	4
Other senior house officers	8	8	13	0	29
House surgeon	0	1	1	0	2
Radiologist	0	13	0	0	13
Anaesthetist	0	0	2	0	2
Other	2	2	2	0	6
Locum registrar	1	8	3	0	12
Total	117	321	190	27	655

TABLE II—*Postoperative complications*

Complication	No	
Death		9
Bleeding problems		14
Wound haemorrhage	1	
Wound haematoma	9	
Gastrointestinal haemorrhage	4	
Infections		34
Chest infection	9	
Wound infection	11	
Wound dehiscence	2	
Urinary infection	3	
Pelvic abscess	1	
Fever (?cause)	5	
Other infection	3	
Thromboembolism		7
Pulmonary embolism	1	
Arterial embolism	1	
Ischaemic leg	4	
Cerebrovascular accident (stroke)	1	
Cardiac problem		5
Myocardial infarction	2	
Other	3	
Urinary problem		6
Retained stone	1	
Retention of urine	3	
Renal failure	2	
Anastomotic problems		3
Leak	2	
Fistula	1	
Other problems		14
Nerve palsy	2	
Confusion	1	
Other*	11	
Total		92

*Other includes: occlusion of graft, chest pain (?cause), pneumothorax, diarrhoea, and persistent vomiting.

to 31 December 1988 was undertaken. A total of 859 records were counted. In May 1988 we checked the adequacy of data collection by comparing the numbers of patients on the system with the manual records kept by ward clerks for the three months February to April 1988.

Results and discussion

PROCEDURES

During 1988, 655 main procedures and 79 secondary procedures were performed. (A secondary procedure is performed at the same time as a main procedure.) Knowledge of the number and type of operations performed is interesting in itself, but we also needed information about the surgeon and the complexity of the operation.

By attributing a British United Provident Association (BUPA) code to each main procedure and grouping procedures by the principal surgeon who performed them we produced table I. This shows, for example, that the consultant performed 78% of all operations classified as major+ and above. In addition, and of greater interest in the management of the firm, it shows that registrar 1 performed more major operations than the senior registrars.

TABLE III—*Complications by surgeon*

Surgeon	No of operations	No of records with a complication	Complications as % of operations
Consultant 1	337	42	12·5
Senior registrar 1	45	9	20·0
Senior registrar 2	36	7	19·4
Registrar 1	70	8	11·4
Other senior registrars	3	1	33·3
Other registrar	30	5	16·6
Senior house officer 1	51	3	5·9
Anaesthetist	2	2	100·0
Other	6	2	33·3
Locum registrar	12	1	8·3
Total	592	80	13·5

COMPLICATIONS

Eighty records (12·2%) noted postoperative complications, nine showing that the patient died. Sixty eight records showed that the patient experienced one complication, and 12 showed two complications. The total number of postoperative complications was therefore 92 (table II). The 80 records represented only 74 admissions, since four patients had two records and one patient had three records. (Dunnfile creates a patient record for each inpatient episode, plus additional records if the patient experiences a return to theatre during a single admission. A patient who experienced two returns to theatre would therefore have three records.)

But simple numerical information about the number and type of complications by itself is not very useful. Further information about the surgeon and the calculation of an overall complication rate made this more meaningful (table III).

Table III shows that registrar 1 had a lower complication rate than the senior registrars, yet, as mentioned earlier (table I), registrar 1 performed more major operations than the senior registrars. It also shows that the anaesthetist had a 100% complication rate, which was misleading, because neither of the complications resulted from the procedure (lumbar sympathetic nerve block). So table III clearly still leaves out important information. The calculation of an overall complication rate does not draw attention to procedures that are particularly prone to complications for individual surgeons. The analysis of complications, taking into account the complexity of the operation, is more revealing.

Table IV was constructed by calculating a complication rate for each grade of operation the surgeon performed. The percentages are of interest because these could be used to illustrate risk per 100 for each grade of operation. The percentages may also be used to convey the distribution of risk—the relative vulnerability at each grade of operation. For example, for the consultant patients having major+ and above operations are at most risk, those having major operations the next most vulnerable, with risk declining with grade of operation, as expected. But why should 25% of intermediate operations by senior registrar 1 result in a complication? Even this complex table does not provide all the answers.

Ultimately, what may be of most interest is whether the complications were avoidable or unavoidable. But such a classification of complications is difficult, even in apparently straightforward cases. For example, the breakdown of an anastomosis between ileum and right colon is theoretically avoidable, although it is a well recognised complication. But who is to say whether or not it is avoidable in a particular case?

RETURN TO THEATRE

Eighteen (2·2%) patients experienced at least one return to theatre during a single admission. The return

TABLE IV—*Complication by grade of operation by surgeon*

	Minor		Intermediate		Major		≥Major+		Total	
	No of complications/ operations	Complication rate (%)	No of complications/ operations	Complication rate (%)	No of complications/ operations	Complication rate (%)	No of complications/ operations	Complication rate (%)	No of complications/ operations	Complication rate (%)
Consultant 1	0/51	0	12/191	6·3	20/74	27·0	10/21	47·6	42/337	12·5
Senior registrar 1	0/9	0	3/12	25·0	5/22	22·8	1/2	50·0	9/45	20·0
Senior registrar 2	0/12	0	2/9	22·2	4/14	28·6	1/1	100	7/36	19·4
Registrar 1	0/9	0	2/27	7·4	6/32	18·8	0/2	0	8/70	11·4
Other senior registrars	0		0/1	0	1/2	50·0	0		1/3	33·3
Other registrar	1/6	16·6	1/9	11·1	3/15	20·0	0		5/30	16·6
Senior house officer 1	0/13	0	3/34	8·9	0/4	0	0		3/51	5·9
Anaesthetist	0		0		2/2	100	0		2/2	100
Other	0/2	0	1/2	50·0	1/2	50	0		2/6	33·3
Locum registrar	0/1	0	1/8	12·5	0/3	0	0		1/12	8·3
Total	1/103	1·0	25/293	8·5	42/170	24·7	12/26	46·0	80/592	13·5

to theatre rate cannot be taken as an indicator of poor quality of care without considerable qualification. It is not enough even to consider only unplanned returns to theatre as an indicator. A detailed examination of the patients who experienced a return to theatre is needed. Table V, which examines six patients, is an example of the kind of analysis that is required. Each return to theatre needs to be presented with clinical information which sets it in context.

In the case of vascular surgery multiple returns to theatre during a single admission may occur as a result of occluded grafts (see case 2). The longer a vascular graft is—for example, a femorotibial bypass graft—the more likely it is to thrombose. A vascular surgeon may perform such a graft, knowing that there is a less than 50% chance that the graft will remain patent, because the alternative is a major amputation. So it is not uncommon to perform two or three (or more) operations to try to save a patient's leg but eventually, when all else fails, to amputate it. There is always a chance that the leg could be saved by a particular operation. To amputate straight away would reduce the surgeon's return to theatre rate but would be unethical. Grafts occlude for various reasons, only one of which is technical error. Who is to say, therefore, whether graft occlusion in a particular patient is or is not avoidable? So, as with complications, what may be of most interest is whether the return to theatre was avoidable or unavoidable.

Unplanned returns to theatre are therefore part of the clinical course of some diseases and should not be seen as an indicator of poor quality. The numbers of returns to theatre on their own have little meaning.

ADEQUACY OF DATA COLLECTION

Even though counts alone—of complications, returns to theatre—are not enough, it is important to ensure that the counts are accurate and that data are gathered on all patients. In Brighton the completed data collection forms are sent to a central point for input to the system. But the fact that the consultant's work is spread over three sites and 12 wards makes it difficult to ensure that all inpatient episodes are recorded. When we studied the adequacy of data collection in May 1988 we uncovered a deficit of nearly 30%. We therefore re-examined everyone's role—that is, that of all medical, clerical, and administrative staff—in the whole process. It became clear that day patients, patients admitted to seldom used wards, and patients admitted during the night were being overlooked.

After the completion of the year's audit, we again checked for a shortfall in the numbers of patients entered on to the system. As we were concerned about the accuracy of the ward clerks' manual records we compared our number with the number of patients in the district's patient administration system. We discovered a shortfall of 169 (17%). The audit was carried out five weeks after the end of the year, and some patients, although admitted in 1988, may still have been in hospital. In addition, the absence of staff led to backlogs. Many of the forms would probably eventually have found their way to the computer. But the reasons why some forms never got there were unclear.

Is it worth it?

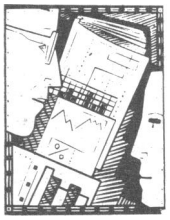
Three recent publications provide useful explanations of, and guides to, medical audit.[11-13] But it is clear, especially to those who have tried, that systematic medical audit does not come about easily. The use of a computerised audit system includes everyone in a discipline of data collection that is unfamiliar. Protocols have to be set up to ensure that the system works and that data are collected on all inpatients.

Despite our efforts we still have the problem of ensuring a 100% coverage of inpatient workload. Anything less than a 100% coverage considerably devalues the interpretation of audit data. So how, in such circumstances, can audit data be used as a working tool for managing a surgical firm? The timing of audits is only part of the answer, for some inpatient proformas, as already shown, may never get to the computer. If Dunnfile could communicate with the other hospital information systems, such as the patient administrative system, it would be easier and less time consuming to check for and chase up missing or delayed data collection forms. Communication with this system would also reduce the amount of time spent keying in patient information. Demographic details and certain details about the patient's hospital stay already entered into the patient administration system could be down loaded to Dunnfile, eliminating the need to rekey them.

Despite these problems there have been many benefits gained by incorporating routine audits into the day to day running of the surgical firm. The audit has

TABLE V—*Details of returns to theatre in six patients*

Case No	Diagnosis	1st Operation	Reason for 2nd operation	2nd Operation	Reason for 3rd operation	3rd Operation	Reason for 4th operation	4th Operation	Other details
1	Femoral embolism	Femoral embolectomy	Insufficient blood supply to leg	Femoral embolectomy + fasciotomy (calf)					Age 66. Stroke 2 weeks before admission. General condition poor. Died
2	Atherosclerosis	Femoral-popliteal bypass graft	Occluded graft	Femoral-popliteal distal bypass graft	Occluded graft	Disobliteration of femoral-popliteal graft	Occluded graft	Above knee amputation	Age 71. Smoker
3	Leg embolism	Femoral embolectomy	Insufficient blood supply to leg	Superior femoral artery vein patch + femoral embolectomy					Age 84. History of peripheral vascular disease. Ischaemic heart disease. Poor general condition. Died
4	Colonic carcinoma	Examination under anaesthesia	After initial assessment tumour removal a possibility?	Laparotomy					Age 68. Circumferential tumour around anus, therefore inoperable
5	Atherosclerosis, claudication	Femoral embolectomy	Gastrointestinal haemorrhage + ischaemic leg	Bleeding duodenal ulcer underun + vagotomy + pyloroplasty	Insufficient blood supply to leg	Femoral-femoral crossover graft			Age 68. Smoker. Alcoholic. Bleeding duodenal ulcer
6	Leg trauma	Debridement of wound	Insufficient blood supply to leg	Skin graft + debridement of wound	Insufficient blood supply to leg	Debridement of wound			Age 85. Major haematoma. Grafting of necrotic skin



recorded the throughput of the firm and allowed us to show activity objectively.

In general surgery in Brighton, morbidity and mortality meetings have been routine practice since 1984. By recording complications and interesting cases as they occur Dunnfile has made case selection for presentation at such meetings much easier. It has offered us the opportunity to study the incidence and pattern of complications so that any possible improvement or changes in practice can be undertaken. Junior staff are given printouts highlighting the cases they have been concerned with during their training. Information about the number and type of operations and the ensuing complications are readily available. The data generated can be used in managing the firm. A future prospect, requiring more than a year's audit data, could be the tracking of changes in the firm, such as increased specialisation.

Nevertheless, the considerable amount of time and effort that has had to be put in to garner these benefits should not be understated. The quality of the data depends on the commitment and enthusiasm of the whole firm, but in particular the consultant. The actual process of filling in forms for audit has significantly changed clinical practice. A data collection form has to be filled in for all inpatients; the surgeon performing an operation is responsible for filling in the appropriate details, and all the information on the data collection forms is then verified by the consultant before being entered on to the computer.

Consideration has to be given to the mode of presentation of audit data. Dunnfile produced most of the information we demanded of it. But only in a few cases could the information be incorporated into other reports without further work. Some tabulations had to be done manually—for example, that showing complications by grade of operation by surgeon (table IV). Other information, we decided, could be more appropriately presented in graph form.

Time spent considering the presentation of data, so that it can make apparent aspects and regularities which might otherwise be difficult to discern, is time well spent. Unless great care is taken over the presentation of audit data (and even when data presentation has been meticulous) the data are open to misuse:

The secret language of statistics, so appealing in a fact minded culture, is employed to sensationalise, inflate, confuse and oversimplify. Statistical methods and statistical terms are necessary in reporting the mass data of social and economic trends, business conditions, "opinion polls," the census. But without writers who use the words with honesty and understanding and readers who know what they mean the result can only be semantic nonsense.[14]

What we have attempted to do in this paper is to raise awareness about the problems of presenting and interpreting audit data and to illustrate this by questioning the appropriateness of using such generally accepted (but crude) indicators of quality such as the numbers of complications and returns to theatre without further qualification.

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Audit in Person

Organisation of audit in North Derbyshire District Health Authority

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In 1987 Trent Regional Health Authority decided that each district health authority should set up a quality assurance programme. The chairman and district general manager of North Derbyshire District Health Authority visited each specialty group to discuss quality assurance and ask for its cooperation. Medical audit is an essential part of quality assurance, and I was asked, as chairman of the medical staff committee, to provide a discussion document giving my view on how medical audit might be implemented throughout the district. The document explained the philosophy and process of audit and gave definitions and examples. It also suggested a structure suitable for districtwide audit, and this was debated by the consultant medical staff committee. Most consultants were enthusiastic about audit but expressed concern regarding confidentiality, lack of an accurate diagnostic index, difficulties in specialties with fewer than three consultants, and problems with allocating time for audit. I subsequently visited each specialty group to discuss the problems, and we eventually agreed on objectives, structure of the audit, and allocation of time, as follows.

Objectives of audit

Our objectives were:

- To develop a voluntary system of audit throughout the district that included all consultants and junior staff
- To have a structured audit
- To appoint a senior clinician as coordinator
- That each specialty group would set up its own methods of audit but would be helped by the coordinator when necessary.

The first specialty groups started audit in January 1988, and by the autumn of 1989 regular audit had been established in all major specialties. Only three