

Computers in Medicine

Combined computer generated discharge documents and surgical audit

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Abstract

A computerised audit system using a commercially available database program and a word processing program was devised to produce discharge documents close to the time of discharge. The data were available for audit of the surgical unit's work. It was found that secretarial time was more efficiently used and general practitioners received more information about their patients earlier than before.

Introduction

Interest in computers in surgical practice has mainly centred around their value in audit.¹ Collecting the data and entering them into the computer system, however, take time, and in a busy clinical unit this may not be available. Time is already spent producing discharge letters and summaries, and as the data required for this include those that might be used for audit it might be advantageous to combine these two activities. We set out to produce a system that combined these two aims, to explore the potential for improving the administration of the firm, and to see whether any measurable gains resulted from the introduction of computers. This report deals with the production of discharge documents by such a system.

At the start of the project no complete surgical computer system was available. We saw potential advantages in developing a generally available commercial database program that could interact with a word processing program and use the data for producing documents. The software would be cheaper than a predesigned system and would be adaptable to local circumstance. One of us (DCD) had started using a microcomputer for surgical audit in 1982, and the experience gained helped in the choice of a new database.

Software and hardware

The program chosen was Rescue (Grade One Computing Services Ltd, Glossop, Derbyshire). This is essentially a set of programs that allows the user to write his own instructions and plan the processing of his data using a series of menu options. It can be set up by a user with little knowledge of computers and can be tailored to individual needs. Some of its characteristics are: (1) It handles fields defined by the user, which are arranged in fixed length records defined by the user. The collection of records forms a database. (2) A database can hold up to 32 760 records; the program can hold 20 databases. (3) Each record can contain up to 100 fields with a maximum of

1024 characters, but the program has considerable inbuilt facilities for compressing data. This allows 10 characters of a date, for instance, to be stored internally as three characters. (4) Up to 10 fields can be specified to be key fields, which form an index file permitting quick access. (5) The database is defined by a "description file," which holds the specific details on each field. (6) The database can have any number of description files applied to it, providing multiple screen and reporting functions. (7) Any field can be one of 19 types, many of which provide facilities for validating and compressing data.

An important feature in the program is the presence of "dictionary" fields. Entries in these fields can only be from predefined lists held in a dictionary specific to that field. A dictionary can hold up to 255 entries each of 60 characters. Each entry, however, is held in the database as only one byte. When a patient's details are being entered an individual entry can be selected using a minimum number of keystrokes (for example, "app" might select appendicitis). As only the terms in the dictionary can be entered the data are automatically validated on entry and held in a form that permits accurate analysis.

We use two dictionaries to cover diagnoses (that is, a possible 65 025 combinations) and one each to cover operations and complications. It would be possible to convert the entries for operations and complications to codes used in the International Classification of Diseases or Hospital Activity Analysis using a parallel dictionary containing the corresponding codes. This is less easy to do for diagnoses but would be possible. In common with other workers, however, we have found the Hospital Activity Analysis codes inept for our purposes and do not use them.²

A description file is created to define the database that will hold the data. The file is made up of a series of fields defined to accept the data. The definition of the fields requires careful thought. The data can be divided into several categories—namely, patient identification, admission details, diagnostic details, operation details, management details, and internal organisation.

We used a Sirius computer with an integral 10 megabyte Winchester hard disc to run the programs, but they will run equally well on an Apricot computer with a hard disc and several other types of computer. We will report separately the general features of the present system and the experience that led to its development.

Method

The system is used in a general surgical consultant unit in a busy teaching hospital that also acts as a district general hospital. Data are collected on a proforma completed by the houseman at the time the patient is discharged. The data on the proforma are then entered into the computer by a clerk, and a discharge document is produced within minutes (fig 1). Previously, discharge information was sent out on a handwritten form by the houseman. The new discharge document was designed to serve as the discharge summary for straightforward cases and can be expanded to a full discharge summary when necessary (fig 2). This compromise was struck because a lot of the details put in a full summary are not required for audit of the firm's activities. The initial discharge document is sent to the general practitioner immediately. A "skeleton" of a full discharge summary is produced at the same time. This is used by the houseman as a prompt sheet, and paragraphs to be added are dictated on to tape. These are then incorporated into the original document using the word processor. The data are verified by the consultant, who checks the proformas once a week at a ward round. The

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patient's record is then edited, and any changes are incorporated in the full discharge summary.

We compared the time taken to run the whole computerised audit/summary system with the time taken to produce a discharge summary using the conventional secretarial system. We also ascertained the reaction of general practitioners by sending out a questionnaire with the discharge document.

Results

TIME SPENT RUNNING THE SYSTEM

The data were entered by a medical clerk with no secretarial or computer training. It took her about two weeks to learn and use the system efficiently; she did not need to attend a formal course. She now spends about seven hours a week running the system. In addition, a medical secretary spends three hours a week producing the full discharge documents on the word processor. The documentation of a week's admissions to the unit thus takes 10 hours of secretarial time, with the audit produced as a bonus.

Before the computer was introduced a pool of secretaries produced the discharge summaries. Three secretaries worked full time (105 hours in total) to produce the summaries for the general surgeons and urologists. By using Hospital Activity Analysis data for discharges we calculated that the time they spent on our summaries was 12-14 hours a week.

REACTIONS FROM GENERAL PRACTITIONERS

Ninety three general practitioners were circulated with the questionnaire and 52 replied. Forty eight said that the communication generated by the computer had advantages over the usual discharge slip and appreciated the extra information given. The particular format we produced was found to be acceptable by 43 and tolerable by a further seven. The major objection of the two general practitioners who disliked the document was that it entailed more reading than before.

When asked for individual comments most of the general practitioners said that they liked having a discharge document that contained most if not all of the essential details of the patient's admission. They appreciated having a legible document with an outline of the diagnosis, management, and treatment produced close to the time of discharge. Most of the other comments were about the size of the paper, which many thought should fit the type of note packet used by many British general practitioners or be easily folded to fit them. Others criticised the format and thought that too much negative information was given.

The system was assessed after it had been running for six months. In view of the comments we received we changed the format of the document and the

19th August 1985		No 082576
CAMBRIDGE HEALTH AUTHORITY ADDENBROOKE'S HOSPITAL INPATIENT SUMMARY	EXAMPLE Patience 100 Any Old Road, Cambridge Date of birth: 01/01/1924 Dr G Practitioner The Surgery, 22 High Road, CAMBRIDGE, Cambs Consultant: Mr D C Dunn	Sex: female Ward: C7
Admission date: 15/08/1985		Discharge date: 19/08/1985
DIAGNOSTIC CATEGORY:	Left femoral hernia	
OPERATION:	Left femoral hernia repair	
Elective NHS admission on 15/08/1985 with left femoral hernia		
Other illnesses:	Chronic bronchitis	
Investigations:	Chest x ray: nothing abnormal detected Haemoglobin: 142 g/l White cell count: $6 \times 10^9/l$	
OPERATION:	17/08/1985	Surgeon: Mr J Registrar
Anaesthetic:	General	Anaesthetist: Dr I Snoozem Priority: Routine
Procedure:	Left femoral hernia repair	
Complications:	No complication	
Non-operative management:	Preoperative physiotherapy, postoperative bronchodilators	
19/06/1985 Mrs EXAMPLE was discharged home		
Follow up due: 6 weeks		
Treatment on discharge: Nil		
Full report to follow: YES/NO		
Signed		House Surgeon to Mr D C Dunn

FIG 1—Discharge document.

26th August 1985		No 082576
CAMBRIDGE HEALTH AUTHORITY ADDENBROOKE'S HOSPITAL INPATIENT SUMMARY	EXAMPLE Patience 100 Any Old Road, Cambridge Date of birth: 01/01/1924 Dr G Practitioner The Surgery, 22 High Road, CAMBRIDGE, Cambs Consultant: Mr D C Dunn	Sex: female Ward: C7
Admission date: 15/08/1985		Discharge date: 19/08/1985
DIAGNOSTIC CATEGORY:	Left femoral hernia	
OPERATION:	Left femoral hernia repair	
Elective NHS admission on 15/08/1985 with left femoral hernia		
HISTORY: This 61 year old woman was admitted as a routine with a 2 month history of a lump in the left groin. Occasionally it was associated with some abdominal discomfort, but there was no history of nausea or vomiting		
Other illnesses:	Chronic bronchitis	
MEDICAL HISTORY:	Ovarian cystectomy and appendicectomy 30 years ago	
FAMILY HISTORY:	Married with 3 children. No hernias in family	
SOCIAL HISTORY:	Smoked 15 cigarettes a day until 5 days before admission	
DRUGS ON ADMISSION:	None	
ALLERGIES:	Penicillin	
FUNCTIONAL INQUIRY:	Unremarkable	
ON EXAMINATION: There was no cyanosis, clubbing, pallor, or lymphadenopathy. Her blood pressure was 130/80 mm Hg and there were no abnormalities detectable in the cardiovascular system. Respiratory system—trachea central, breath sounds vesicular with occasional respiratory wheeze and a prolonged expiratory phase. Abdomen—the only abnormality was of a partially reducible left femoral hernia		
Investigations:	Chest x ray: nothing abnormal detected Haemoglobin: 142 g/l White cell count: $6 \times 10^9/l$	
OPERATION:	17/08/1985	Surgeon: Mr J Registrar
Anaesthetic:	General	Anaesthetist: Dr I Snoozem Priority: Routine
Procedure:	Left femoral hernia repair	
Complications:	No complication	
Non-operative management:	Preoperative physiotherapy, postoperative bronchodilators	
19/06/1985 Mrs EXAMPLE was discharged home		
Follow up due: 6 weeks		
Treatment on discharge: Nil		
INFORMATION GIVEN TO PATIENT OR RELATIVES: Mrs Example was advised to avoid strenuous exercise or lifting for 4 weeks and to give up smoking completely		
Signed		

FIG 2—Full discharge summary. (This would probably be superfluous in this particular patient but indicates what details would be given.)

size of paper. The fact that 92% of the general practitioners who answered were enthusiastic about the project was encouraging. By incorporating their suggestions we may win over the few who did not like it.

BENEFITS OF AUDIT

The benefits of the system include (1) a constant overview of what is going through the firm, which makes management much more purposeful and easier; (2) analyses that provide a basis for research projects; (3) readily available statistics about workload; (4) readily available statistics about the incidence of complications; (5) readily available statistics about junior surgeons' experience and results; and (6) easy recall of inpatient details when follow up information becomes available.

Discussion

Few reports have been published about discharge documents generated by computer,^{3,4} and as far as we are aware no one has previously assessed a working system in a general surgical practice. Our survey of the response of general practitioners showed that the computer generated discharge document has advantages over the conventional handwritten discharge slips, including legibility and the extra information given on each patient. It highlighted the need to provide essential information close to the time of discharge in a format that is easily read and filed.

Our estimates of the use of secretarial time show that the running costs can be covered within present expenditure. The cost benefit will improve further as the system expands into other areas of the firm's administration. During the present study, for instance, we also used the system to generate follow up data and admission and

operating lists, which took up only extra seconds of administrative time.

The only major change that running the system has required so far as junior staff are concerned is that the houseman now needs to fill in the proforma. This takes about three minutes for each patient. Once this has been done, however, the essential work of organising a discharge summary is already completed. Housemen who used the old and new systems in parallel found that using the proforma helped them to keep organised, and happily transferred to the new system. It is also important that the houseman contacts the secretary daily. We were able to perform a full audit of the working of the consultant unit without collecting any additional data. Details of this important aspect of computerisation will be reported separately.

Although neither of us had had any training in computer programming, we developed the software ourselves. Difficulties arose in obtaining secretarial help mainly because, in our hospital, a secretarial pool is used to type discharge summaries. If all the secretarial work on the unit had been organised in one office the introduction of the system would have been easier.

The capital costs include the purchase of a suitable micro-computer, which must include a hard disc (cost about £2000); a good printer is also necessary (cost about £1200). The software costs included the database (Rescue, about £450) and a word processing program (Wordstar, about £250). It is possible to run the system for the whole general surgical department (six consultants and their junior staff) using one secretary full time.

Conclusions

A useful and effective computer system can be developed by clinicians to produce discharge documents and provide data for audit. The system results in an improved service to the general practitioner, with more essential information getting to him early. The secretarial time required to run the system is less than that needed to produce conventional discharge summaries, which thus offers potential savings. Although the initial development of the system was time consuming, it is now running smoothly and providing useful data. We have found advantages in having a system that the user can modify easily to suit local circumstances.

We are grateful to many of our house staff and especially to Dr B Squire, Dr J Tanqueray, and Dr V Lees for their help in making the system operational. We also thank Mrs Ros Britton for typing the manuscript and Mrs A Osborne and Miss E Tabor for voluntarily entering the early data.

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Lesson of the Week

Hypomagnesaemic tetany associated with prolonged treatment with aminoglycosides

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Magnesium is essential for normal calcium metabolism, and hypomagnesaemia may lead to hypocalcaemia and tetany. Despite occasional case reports it is not widely known that hypomagnesaemia may occur after treatment with aminoglycosides.¹⁻³ We report on a patient with hypomagnesaemia, hypocalcaemia, and tetany due to a renal tubular leak of magnesium after prolonged treatment with tobramycin.

Case report

A 25 year old woman with sickle cell anaemia was admitted with a painful vaso-occlusive crisis and a fever of 38°C. She was treated with intravenous

Hypomagnesaemia should be suspected in patients with hypocalcaemia, especially after prolonged treatment with aminoglycosides

fluids and parenteral analgesia, but the pains in both thighs, back, and abdomen were slow to settle and her temperature remained raised. Twenty three days after admission she developed a tense swelling of the right thigh and clinical septicæmia. Cultures of blood, sputum, and urine showed no growth, but intravenous tobramycin and mezlocillin were started. Peak and trough concentrations of tobramycin were monitored regularly and remained within the therapeutic range during the next 31 days. She remained feverish, and on the 43rd day after her admission the swelling was incised and 1200 ml pus drained. Cultures grew *Bacteroides fragilis* sensitive to metronidazole, which was then added to the antibiotic regimen. Her condition gradually improved.

On the 50th day she developed carpopedal spasm. Serum calcium concentration was 1.19 mmol/l (4.8 mg/100 ml) (normal range 2.20-2.65 mmol/l (8.8-10.3 mg/100 ml)), serum albumin 17 g/l, serum potassium 2.2 mmol(mEq)/l, and serum creatinine 42 µmol/l (0.5 mg/100 ml). Despite treatment with bolus intravenous calcium gluconate (2.25 mmol (90 mg) calcium every six hours) intermittent tetany persisted and the serum calcium concentration remained low (figure). On the 58th day the serum magnesium

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