Computer-held Clinical Record System—II, Assessment

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Summary: A real-time medical recording system installed in two general medical wards has proved to be unacceptable to many of the ward staff. Reasons for this include operational problems, such as the impossibility of providing a 24-hour service, and conceptual problems, such as the difficulty of adapting the method for recording case histories. It is suggested that an outpatient department might have been a better site for this trial, and that deliberate instruction in medical recording should be given to students as a prerequisite to successful computer record keeping.

Introduction

In the previous paper we presented some details of phase 1 of King's College Hospital real-time medical recording project. Essentially this project provides a method for ward staff to record clinical notes in a computer medium using visual display units and allows interrogation of the computer-stored record via this same terminal. In addition, daily printed notes are produced for each patient and a ward nursing sheet is prepared by the computer from nursing treatment details entered in the patient's computer record. This system has been in operation in two medical wards for four months, and this paper attempts to assess some aspects of the project and its implementation to date.

Assessment

The two tests by which one might measure the performance of this computer project are (1) acceptability to medical and nursing staff, and (2) the attainment of objectives defined at the outset of the project. Obviously failure in (1) will almost certainly imply failure to meet any objective defined in (2), and we propose to consider this aspect first. We must conclude that, to date, the computer has not been accepted as a method of clinical recording. This is shown objectively by Table I. This shows the steady-state number of "messages" held in the computer about the current 38 inpatients. This count of held "messages" is a direct measure of the use of the system by the ward staff. Even with two specially appointed senior house officers to provide advice, example, and encouragement there has been a decline in the number of "messages" held in the computer. The nursing "messages" are recorded by ward nursing staff and patient registration is usually the responsibility of a ward clerk. These two categories of message account for about 150-250 of the total numbers of messages.

A more detailed analysis of the use of the computer system is possible by use of specially allocated files and programmes which monitor the number and nature of user responses as well as recording the amount of "traffic." Some of these data from a period starting about 10 weeks after the ward installation had taken place are presented in tabular form. Before making any deductions about these data it is necessary to define the terms used in the table headings.

A "conversation" is essentially a variable set of "messages" which have been recorded or interrogated at one sitting by one computer user and may refer to one or several patients. It signifies the number of times users logged in to the system. Each "conversation" can be patient registration or deletions, messages input about current patients, or interrogation. A "message" as explained in the previous paper is a syntactically complete string of numbers and letters (characters) and can vary from something like "PULSE 76/MIN" to a full screen of descriptive text.

"V.D.U. responses" represents the number of times displays were sent to the visual display unit screen. It is possible by using this information to estimate the time involved in message construction.

"Total V.D.U. time" is the sum of the time periods that the four visual display units were being used to record or receive messages.

"Narrative messages" are messages recorded by using the visual display unit keyboard essentially as an ordinary typewriter rather than using the display system.

"Interrogation entries" signifies the number of times that the visual display units were used to inspect a patient's record in the computer.

"Number of interrogation screens" is the total number of messages looked at during the interrogation entries.

One could interpret the data in Table II as follows:

The nursing staff recorded an average of three messages/patient admitted. The medical staff recorded an average of about five messages/patient admitted. Of all medical messages, except week 1, 30-40% were written using the "narrative" facility and bypassing the display system. Each "message" required about 12-13 visual display unit responses. If one allows 5 seconds per response this means that a message takes about 1 minute to record, though the response time, of course, varies considerably. Many will take longer than 5 seconds, for this includes the time taken to read, decide, press the keyboard, and allow the system to produce the next display. Clearly, narrative messages will take even longer.

We have observed that an "acceptable" medical history and examination requires some 25-40 messages, entailing about 400 visual display unit responses. In addition, an allowance for 10 "follow up" messages per patient per week would not represent excessive progress notes for a teaching hospital medical record. Assuming that these figures indicate proper but by no means extensive usage of the computer system to record clinical notes, one could expect on the basis of 38 patients and about 20 new admissions per week to record 900-1,000 medical messages per week. This would correspond to a steady state level of about 1,500 medical messages at any one time.

The figures in Table II indicate how far short of this expectation the usage of the system has been. This is reinforced by Table III, which is an analysis of the records of patients discharged during a one-week period and where each row shows the messages contained in a patient's record classified by type of "author."

TABLE I

Weeks since start	0	3	6	9	12	16
No. of messages current	0	622	923	617	434	426*

*Detailed usage shows 16,000 words stored, an average of 1,600 characters per patient.

TABLE II

Week	Total V.D.U. Responses	V.D.U. Active Time*	No. of Conversations	Total Messages	Doctor Messages	Nurse Messages	Narrative Messages	New Patients Added
1	1,514	4 hr. 9 min. (2·5%)	80	98	24	71	1	28
2	2,214	6 hr. 16 min. (3·0%)	78	180	111	69	42	21
3	2,228	8 hr. 32 min. (4%)	83	202	152	50	46	21
4	2,209	7 hr. 2 min. (3·5%)	57	170	126	44	77	18

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TABLE III

Case No.	Days of Stay	Doctor Messages	Nurse Messages
1	46	3	18
2	62	0	6
3	17	31	3
4	23	3	3
5	49	0	6
6	4	0	2
7	?	29	5
8	3	0	0
9	14	23	1
10	25	0	3
11	1	0	0
12	15	0	4
13	12	0	8

TABLE IV

Week	No. of Entries to Interrogation	Total No. of Screens Inspected
1	7	65
2	12	196
3	6	53
4	22	223

Interrogation

One of the projected advantages of a real-time system is that it can allow instant inspection of the patient's record without any possibility of losing case notes. The results showing the usage of interrogation presented in Table IV, however, indicate that this feature held little attraction for the clinical staff. It is quite clear that the value of interrogation is directly proportional to the amount of information put into the system; hence the very limited usage of this facility merely reinforces the lack of acceptability of the recording techniques. In the next section we attempt to analyse some causes of this failure of the system.

Operational Problems

One major problem of the system at present is that far from reducing the time spent in case recording it has increased it. As indicated earlier the record-keeping system was installed in two general medical wards and though conceived as an experiment it has been implemented in one ward as the primary method of clinical recording for all patients admitted to that ward. This has led to duplication of clinical recording for two main reasons : (1) Only two shifts of computer operators have been supplied, so that the system is available in the wards for only about eight hours a day. This ward, however, provides a 24-hour-a-day clinical service. Thus the notes of new patients or of clinical findings in patients already in the ward must be hand-written when the computer recording system is not "live." Later these notes must be transferred via a visual display unit to the computer. (2) A second problem of this sort arises when patients are admitted indirectly or transferred from other wards where no computer recording facility exists. These objections may seem trivial yet they procure considerable ill-will for the system by increasing the clerical load on the junior staff.

Display System

The technique of using visual displays and a multiple branching questionnaire has been reported by others (Kiely *et al.*, 1968; Uber *et al.*, 1968; Greenes *et al.*, 1970). Our experience in using this technique to cover a wide spectrum of medical case recording suggests that the following lessons can be learned.

Physical Examination Display System

The technique seemed acceptable to the house staff for recording the physical examination. The information acquired recorded stepwise, with little need for translation by the doctor to make it suitable for the display system.

History Display System

Less satisfaction was encountered with the technique when it was used to record the history. Three main difficulties were evident.

(1) The history record has a more ill-defined structure than the examination. The experienced clinician tends to take most of the history in one continuous interview, then condenses and rearranges the information before recording it. The more inexperienced house staff usually take and record the history stepwise. Thus a typical segment of history (taken from hand-written notes) might read: "3 a.m. in bed at home, awoke and couldn't get his breath, sat up, wife called doctor who called ambulance. Brought into casualty." To record the essential information in this history using our display tree could require the following steps: history—dyspnoea—sudden onset—"X" hours ago. Though the transposition of words in this example is not extensive this type of condensation is not liked by the house staff.

(2) The second difficulty arose from the "pointer" function of some text in the displays. As explained in our earlier paper the text directs the user to the next logical part of the structure. Because the history does not have a well-defined tree structure the doctor may need several attempts to find the symptom to be described. This is very aggravating and the user will commonly bypass the display tree and type details by hand, using the narrative facility.

(3) The third problem encountered in the use of history displays is a semantic one. Fixed text provides constraints in use of descriptive terms. In some cases these terms were not the expressions which the doctor wanted to use. This problem occurs partly because traditionally medical students are taught to use the patient's own words in describing some episode of the history. The fixed text immediately produces conflict if this aim is attempted.

Follow-up Displays

These displays proved to be unacceptable to the house staff. Basically this arose from a failure to define the scope of progress notes required for phase 1 system. Initially, a display system was designed to record only the physical examination. Before proper trials were done this was extended to include the history and finally a follow-up section was added. Though provision for investigation and treatment displays was made, these had not been designed at the time of installation in the ward, so the follow-up displays contained no reference to treatment or investigations. Because the project policy makers were isolated from the display design team the rather unfortunate decision was made to use the system as the primary clinical recording system rather than as a limited experimental technique. As a result the house staff felt they needed a display system for follow-up notes with the capacity to record orders for tests, test results, transfer notices, treatment orders, diagnosis (even though a separate complete diagnosis display system was in existence), response to treatment, and other features. For reasons outlined above, these displays did not exist and the house staff were obliged to type much of this information into the computer-held record using the narrative facility.

Though a new display system to include these features has been designed and implemented many of the problems remain because of the nature of traditional follow-up record. Much more thought needs to be given to the purposes of this progress record (Woodroffe, 1970). As in the case of the history, the traditional type of hand-written progress record seems to us to contain much that is redundant or valueless as

Diagnosis Displays

A branching questionnaire technique was adopted, the *Nomenclature of Disease* (Joint Committee of the Royal College of Physicians of London, 1961) being used as the model. This display system, too, was disliked and poorly used by the medical staff. They felt it was cumbersome, and frequently experienced difficulty in isolating a particular disease on the display tree.

Remarks on Branching Questionnaire Technique

Some general observations about the problems of using branching questionnaire techniques seem relevant.

(1) One justification for using this approach for clinical recording at King's College Hospital is that it produces a record with easily identifiable text which can be searched by computer programmes for retrospective analysis of these records. Unfortunately it is immediately apparent that the objections to retrospective studies using traditional hand-written notes still exist, so that though the speed and accuracy of data search are vastly improved by this technique there is nothing to suggest that the data are any more reliable.

(2) As we pointed out in the previous paper messages must terminate automatically at certain points. The maximum possible length is determined partly by visual display unit screen size, and at King's College Hospital this is 400 characters. If a message which occupies more than one screen is constructed it cannot be verified and hence gives rise to an impossible situation for the person trying to record. On the other hand, short messages produce a disjointed, confusing text. In addition, interrogation of a patient's file using the visual display unit becomes a tedious procedure and obtaining clear association between several related messages is difficult.

(3) When designing the branching questionnaire another conflict arises between these two philosophies of design. The decision trees can be made obsessively complete, grouping together only questions which are related, producing "long" trees with many displays to be viewed (and allowing few choices for each display). Alternatively, "shorter" trees can be designed, grouping together questions which commonly occur together, using many questions on each display screen. This might be called the intuitive approach. Both techniques have advantages and disadvantages. The display file designed at King's College Hospital has examples of both types of decision tree. Inquiry has shown that house staff prefer the "intuitive" displays, though they have not used either type extensively.

Software and Hardware Problems

"Hardware" is computer jargon for the electromechanical equipment, and "software" is a term to denote the specifically designed and coded programmes which control the operation of the computer. As indicated previously the visual display unit was originally conceived as being a mobile recording unit and trolleys were built specially to achieve this. Unfortunately these trolleys were badly designed, proving heavy, cumbersome, and far too large to enable the visual display unit to be used as a bedside recording device. In addition there are two cables to be connected—one a simple three-pin 13-amp. plug, the other a multipin plug, which is difficult to manipulate. Since only a limited number of sockets are available the cables trail about the ward. After about a month of trial it was necessary to retreat from this concept and leave the visual display unit as a stationary device.

Reliability

It is difficult to measure precisely the failure rate of the visual display units since a spare was always available to replace a faulty unit. Certainly no real difficulties have yet been experienced with the care and maintenance of this unit. The computer itself has proved reliable to date, the time lost [illegible] programmes themselves have proved entirely satisfactory and no dislocation of recording has occurred through a major programme breakdown.

Conclusions

Any attempt to use a large hospital-based computer as a means of record storage and retrieval must be conceived as an experiment. There is an unfortunate tendency on the part of the enthusiasts to assume a successful outcome, even though experience elsewhere with these systems is not encouraging.

As with any scientific experiment the objectives must be defined explicitly, and though an hypothesis can be entertained it is not wise to assume the result. Though phase 1 of the King's College Hospital project was conceived initially as an experiment it was not in fact implemented as one, at least not in our opinion. The objectives were described variously as, "to facilitate clinical research," "to improve patient care," "to abolish paper records," "to provide a communication network," "to provide statistical and management information." These all seem working objectives, but as such are not sufficiently defined to enable any measure of attainment. As we indicated earlier, on a test of acceptability the real-time recording system has so far failed. Some of the problems are technical and can be overcome; others are logical, educational, political, and social, and these present much greater problems.

In a commercial application of the computer there is usually a well-defined "customer," and in medical areas such as laboratories where computer installations have succeeded there is almost always one person who sets the goals and compels action towards these goals. Unfortunately this situation does not exist in the clinical departments of many teaching hospitals. We therefore believe that it is important to implement any experimental recording system in such a way that the technical problems can be solved, administrative procedures modified, and the hospital social structures allowed to adapt without generating the user's antagonism. When this antagonism develops it can prevent even a proper determination of the outcome of the experiment.

In our opinion a busy medical ward is not the ideal site in which to install an experimental computer system. We believe that a trial installation would have been better in an outpatient clinic where "on-line" times would correspond more sensibly to clinic working times and where a gradual extension of the clinicians' involvement could be fostered by an awareness of the help a computer can offer. Finally, we believe that the experience at King's College Hospital has shown that deliberate instruction in medical recording to students might well be a necessary prerequisite to the successful installation of computer record keeping. Though three years are spent teaching students how to observe symptoms and signs and to make deductions from them, usually no effort is made to teach them how to record their findings. To do this a determined effort must be made to understand the structure and purpose of clinical records, and it may well be that this is the right starting-point for a project to store the clinical record on a computer.

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