Computers in Medicine

Microcomputer system in an accident unit

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Abstract

A microcomputer-based records system has been developed for use in the accident unit of a district general hospital. Patient details are entered directly at the reception desk and the computer generates a casualty card that is updated after the patient has been seen by the doctor, who determines the diagnosis to be recorded and specifies the injury coding. Information is stored on floppy discs, each holding the details of 3400 patients. The computer is used to produce a daily log-book of attendances, including revisits. The stored data may be examined and analysed for both administrative and medical purposes. The work load can be rapidly analysed according to various options that include the nature, type, and site of injuries. The system was introduced in December 1980. Location within the unit allows control over its operation, and many of the limitations of a manual system have been overcome.

Introduction

The accident unit at the Caernarfon and Anglesey Hospital, Bangor, is the major accident centre for the county of Gwynedd and comprises a casualty department, 19 accident beds, and an operating theatre. The unit deals with about 20 000 patients a year and serves a population of 230 000, but tourists and visitors can double this number.

The traditional manual records system was found to be unsatisfactory from the points of view of legibility, work load analysis, and retrieval of medical information. The present project was undertaken to investigate the use of a computer to overcome some of these limitations. We rejected an off-line system with the computer remote from the unit as it would not help in preparing the casualty card, would be inflexible, and there would be a delay in retrieving information. An analysis of the problem showed that a microcomputer with a floppy disc storage unit would be sufficiently powerful, have enough storage capacity, and be of modest cost. The project had other aims apart from the production of a legible casualty card and the development of a storage and retrieval system of information for the unit. One of these was to incorporate the ability to carry out detailed investigations of particular clinical problems

on a prospective basis; another was to develop a medical diagnostic coding system that was comprehensive yet could be used routinely by junior medical staff in a busy unit.

Equipment

The system was developed on a 3032 series Commodore PET microcomputer, Computhink 1.6 Mb dual floppy disc drive, and a Diablo 1620 daisy-wheel printer (fig 1). A dual IEEE to RS 232 interface is available to drive up to two printers. The total cost was roughly £4500.

The data on each patient occupies 233 bytes of storage (table); thus one disc holds the details of 3400 patients, 1700 on each side. Programming was carried out using BASIC language, and in normal operation one disc drive houses the disc containing the program, the other the current patient data disc. For analysis, however, both drives may be occupied by data discs, thereby allowing data from 6800 patients to be examined together.

FIG 1—Microcomputer system at reception desk showing computer, dual floppy disc drive, and printer.

Operation of system

PRODUCTION OF CASUALTY CARD

The system is located at the reception desk of the accident unit and is available around the clock for entering patient information, except when printing the daily log-book or when running analysis programs; during these times preprinted casualty cards are available for retrospective entry into the system. Each day the machine is updated with the consultant on duty, date, and time of day. The internal clock in the computer thereafter allows the time of arrival of patients to be recorded automatically. These three items of information are shown on the visual display unit (VDU) when the system is in quiescent mode awaiting new patient allocation or other function.

A unique casualty number is generated for each new patient. A numeric 4 digit number in the range of 1-3400 is prefixed by an identifying alphabetic character such as A, B, C, to distinguish the floppy disc being used for storage. Patient details are entered directly into the computer by the receptionist (table). The computer stores the information and also prints it on to a blank flimsy sheet attached

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Information stored on each patient. (One byte roughly represents a character (a-z, 1-9, etc))

Item of information	Method of storage	Length (bytes)	Comment
Information entered automatically:			
Initials of consultant	C	1	Set once
Time of presentation	C	2	Set once and updated by computer
Date of presentation	C	3	Set once
Casualty number		n/a	Held in separate file
Information entered at presentation:			
Patient's name and title	T+C	25	8 Options for title
Patient's address	T	30	
Telephone number (work etc)	T(C)	13	4 Options for work, holiday, etc
Date of birth	T	4	Includes nineteenth century
Age	C	2	Codes also for neonates
General practitioner's name	T	14	
General practitioner's address	T	21	
Occupation	T	14	
Place of incident	C	1	11 options
Residential code	C	1	6 options
Referred by	C	1	8 options
Complaint	T	20	Summary by receptionist
Revisit code	C	4	
Mode of transport	C	1	4 options
Casualty officer's name	T	14	
Information entered after being seen			
by casualty officer:			
Medical code	C	12	3 separate injuries
Multiple injuries/complaints	C	1	Yes or no
Local anaesthetic	C	1	Yes or no
Diagnosis	T	37	
Follow-up	C	1	13 options
Unit number	T	4	If admitted
Clinic date	T	3	Future appointments
Spare	C	3	

C = Coded entry, T = Free text.

FIG 2—Sequence of production of final casualty card. Left, initial blank card with flimsy sheet over top half; centre, card after printing of initial patient information; and, right, final casualty card.

to the upper part of the casualty card, thus producing a provisional card (fig 2). The casualty officer uses the bottom half and reverse side for his clinical notes. He is also required to write his diagnosis and medical coding on the flimsy sheet. The card is then returned to the reception desk where the patient information in the computer is up-dated and the flimsy part removed and destroyed. Finally, a definitive print of all available details is made on the previously blank upper portion of the casualty card (fig 2). When the patient is discharged from the unit and no subsequent appointment is made, the card is folded in two and filed sequentially. Any letters or reports are inserted in the fold. If the patient is admitted or a clinic appointment made then the A4 size casualty card is placed in the notes.

REVISITS

When a patient revisits the unit in connection with his original complaint, this is recorded and added to the work load figures.

Medical codes

The simple set of codes used allows up to three separate injuries to be described. The type of hospital emergency (medical, ENT, accident, orthopaedic, etc) may be coded nine ways; the type of injury (laceration, burn, etc) eight ways; and the site of injury (head, spine, upper limb, etc) seven ways. In addition, the limbs may be divided into five subareas. There is also a code for multiple injuries.

Log-book

A daily log-book produced by the microcomputer prints out entries between inclusive casualty numbers or, alternatively, entries made on a specific day (fig 3). The print-out is normally sequential, but we can also print up to 1700 entries alphabetically.

***SUMMARY PRINTOUT FOR DATA FLOPPY OF CODE LETTER E: DATE OF ENTRIES = ***

NO.	PATIENT NAME	D.O.B.	DATE	TIME	CONS. SEEN BY	COMPLAINT	FOLLOW UP
E2959	(M)	24-11-1941	05-10-81	22.10	JMB	DR-JUDGE	ADMIT OTHER UNIT
E2960	(M)	11-09-1911	05-10-81	12.13	JMB	DR-LEE	RETURN AU DEF.
E2961	(M)	20-01-1917	05-10-81	12.22	JMB	DR-	DISCH.
E2962	(M)	29-05-1920	05-10-81	12.25	JMB	DR-	"REVISIT" E 2963
E2963	(M)	24-04-1965	05-10-81	12.27	JMB	DR-	"REVISIT" E 2965
E2964	(M)	27-10-1961	05-10-81	14.03	JMB	DR-LEE	
E2965	(M)	14-04-1965	05-10-81	13.17	JMB	DR-JUDGE	
E2966	(M)	03-01-1941	05-10-81	14.11	JMB	DR-	
E2967	(M)	27-10-1961	05-10-81	14.20	JMB	DR-LEE	
E2968	(M)	23-07-1979	05-10-81	15.34	JMB	DR-LEE	
E2969	(M)	21-12-1947	05-10-81	16.13	JMB	DR-LEE	
E2970	(M)	03-11-1939	05-10-81	16.45	JMB	DR-LEE	
E2971	(M)	22-07-1917	05-10-81	17.26	JMB	DR-AUNG	
E2972	(M)	11-08-1968	05-10-81	17.46	JMB	DR-AUNG	
E2973	(M)	30-12-1977	05-10-81	17.49	JMB	DR-AUNG	
E2974	(M)	23-06-1917	05-10-81	18.20	JMB	DR-AUNG	
E2975	(M)	04-04-1966	05-10-81	19.27	JMB	DR-AUNG	
E2976	(M)	17-07-1949	05-10-81	19.56	JMB	DR-AUNG	
E2977	(M)	18-04-1965	05-10-81	19.39	JMB	DR-AUNG	

FIG 3—An extract from daily log-book.

AGE GROUP (YEARS)	NUMBER	% OF VALID SAMPLES
0 <AGE< 5	231	7.84
5 <AGE< 10	272	9.23
10 <AGE< 15	368	12.5
15 <AGE< 20	379	12.8
20 <AGE< 25	310	10.5
25 <AGE< 30	250	8.49
30 <AGE< 35	197	6.69
35 <AGE< 40	184	6.25
40 <AGE< 45	148	5.02
45 <AGE< 50	105	3.56
50 <AGE< 55	108	3.66
55 <AGE< 60	91	3.09
60 <AGE< 65	86	2.92
65 <AGE< 70	64	2.17
70 <AGE< 75	54	1.83
75 <AGE< 80	36	1.22
80 <AGE< 85	27	.917
85 <AGE< 90	19	.645
90 <AGE< 95	10	.339
95 <AGE< 100	2	.067
100 <AGE< 105	1	.033

FIG 4—Analysis by age of patients attending unit for a two-month period.

Analysis of data

GENERAL CONSIDERATION

Rather than develop separate analysis programs for specific tasks, a single comprehensive program providing 10 analysis functions was developed and up to 6800 records may be analysed at a time. Entries for analysis are selected by casualty number or date, or by a combination of these. Another feature is that numerous separate analyses may be specified initially and carried out without any further operator action.

Option 1: RTA analysis—This routine identifies patients who have been in road traffic accidents and also distinguishes between drivers and non-drivers.

Option 2: Workload—age assessment—An analysis on the basis of age can be produced. Results are presented in terms of the number, and percentage of the total number, within age groups 0-5 years, 5-10 years, etc (fig 4).

Option 3: Under 5 years of age listing—Allows the listing of all children under 5 who have been treated in the unit.

Option 4: General work load analysis—The work load may be rapidly estimated using a routine that produces the number of patients treated and identifies revisits.

Option 5: Summary of main coded categories—The five items of information, "place of incident," "residential code," "mode of

referral," "mode of transport," and "follow up" are described as the "main coded categories." This analysis lists the number and percentage of patients within each main coded category.

Option 6: Listings on basis of main coded category—A print-out may be obtained summarising details of those patients who are coded for a particular option within one of the five main coded categories. For example, details of all patients in mountain accidents, one of the options within place of incident category, may be obtained. A total of 42 distinct analyses are available using this option.

Option 7: Injury coding—The encoded medical information is analysed with an emphasis on establishing patterns, especially in relation to trauma. The number and percentage of injuries may be listed according to the type of emergency (medical, surgical, accident, orthopaedic, etc). The category "accident" may be analysed according to the type of injury (fracture, laceration, abrasion, burn, etc). A more detailed breakdown on the basis of site of injury is available for those who have suffered any of these.

Option 8: Listings on basis of injury coding—Patients who satisfy a particular injury code can be listed. Thus patients suffering from wrist fractures can be recalled by scanning for "accident + fracture + upper limb (wrist)."

Option 9: Multiple injury list—Patients with multiple injuries can be recalled.

Option 10: Local anaesthesia listing—The number of patients receiving local anaesthesia may be obtained.

Discussion

Traditional manual records systems do not allow easy retrieval and analysis of the work load of accident and orthopaedic services. Computers have been used for retrospective analysis of patient data and the work load of departments.^{1,2} The arrival of the inexpensive yet often adequately powerful microcomputer has allowed decentralisation of computer facilities.³ Such a system has been successfully developed in response to local requirements, and rapid progress has been made in a short time. Success has been achieved by using designated equipment and close collaboration between clinical and scientific staff.

The introduction of the microcomputer has naturally imposed a greater discipline on the recording of information in the unit. The increased clerical effort to undertake this is off-set by using the system to print the log-book and to carry out statutory functions, such as recording attendances and road traffic accidents. When the computer is itself generating casualty cards its role becomes central to the flow of work in the department, in contrast to an off-line system.

The hardware must be reliable. Breakdowns have been rare and of short duration, but technical help needs to be quickly available.

The system has been generally accepted by staff, and few problems have been encountered in using the equipment. Nevertheless, reception staff are not available at night, when the clerking is done by nursing staff. Some nurses are apprehensive about using the system; in such cases the preprinted card is available and the data is retrospectively entered. We have had no problems related to confidentiality of patient information.

The main limitation of the system is the inability to run analysis and clerical programs simultaneously. This could be overcome either by a more advanced system or by having a duplicate system, which would also have the advantage of providing a back-up service.

Several further developments are being considered including preparation of letters to general practitioners and printing labels for x-ray and other request forms. The possibility of producing an annual patient index, possibly on microfiche, using a remote computer is being investigated. Future developments could include linking up with a central hospital computer or to designated computer systems in individual clinics.

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A 77-year-old man has developed senile chorea (continuous rolling movement of the tongue and smacking of lips with flailing movements of both legs). I have tried several drugs, including thiopropazate hydrochloride (Dartalan), which helped initially. Now the patient is very distressed by the symptoms and cannot wear a denture. What treatment is advised?

Orofacial dyskinesia with repetitive movements of the mouth, tongue, and face may occur in the elderly after long-term treatment with phenothiazines, particularly when accompanied by anti-Parkinsonian drugs, with overdosage of levodopa, after encephalitis lethargica, intorsion dystonia, and Wilson's disease, or as part of chorea.¹ The mouthings are indistinguishable from those of Huntington's chorea.² There is no single optimal treatment. The most effective drugs appear to be those that interfere with dopamine transmission. Phenothiazines that block the uptake of dopamine by the postsynaptic neurone are the drugs of first choice. Thiopropazate (Dartalan) is most popular in Britain and chlorpromazine (Largactil) in the United States. If one phenothiazine has failed another may be tried. It may even be found that increasing the dose of phenothiazine will work when reducing it does not seem to help. It is probably desirable, however, to withdraw phenothiazines in tardive dyskinesia and seek some other method of treatment. Haloperidol (Serenace), another dopamine uptake

blocker, may be tried in a dose of 1 mg twice a day, though it is likely to produce Parkinsonian symptoms in an elderly patient before long. Other drugs that may be tried include those that cause dopamine depletion—reserpine (Serpasil) 0.25 mg daily and tetrabenazine (Nitoman) 25 mg thrice daily. Tetrabenazine is more likely to control the movements but in the elderly will probably produce unacceptable degrees of lethargy, drowsiness, and depression.

There is another theory that orofacial dyskinesia is caused by an imbalance between the acetylcholine transmitter system and the dopamine system. Some patients have responded favourably to oral choline and to substances related to it, which increase the concentration of acetylcholine. I have seen one patient who responded well to dimethylaminoethanol (Deaner) in a dose of 1600 mg daily. The drug is not on sale in Britain, however, but may be obtained on special request from Riker Laboratories. There are similar anecdotal reports about the good effects of more than 20 drugs listed in a helpful review by Paulson.³—R E IRVINE, consultant physician, Hastings.

¹ Marsden CD, Parkes JE. Abnormal movement disorders. *Br J Hosp Med* 1973; 10:428-50.

² Goetz CG, Weiner WJ, Klawans HL. Treatment of the choreas. In: Barbeau A, ed. *Disorders of movement*. Lancaster: MTP Press, 1981:34.

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