

more females chose the correct definition of "heartburn" ($P < 0.05$), and more males the correct meaning of "piles" ($P < 0.05$). More females than males thought that "flatulence" meant "stomach ache—usually after eating food" ($P < 0.025$) and that the "heart" occupied almost the entire thorax ($P < 0.025$). Age alone did not appear to affect ability to define terms correctly.

Discussion

In the rapidly advancing field of medical computer technology, with the ultimate aim of "diagnosis by computer," it is mandatory to have either a vocabulary of totally unambiguous medical terms or a knowledge of the syntactic, semantic, or pragmatic limitations of our existing medical terminology. It would seem that the latter alternative is more practicable, and questionnaire surveys of the present type might well have a part to play in defining these limitations.

Romano (1941) was the first to consider this subject when he asked 50 patients to define 60 medical terms and abbreviations often used in bedside conferences. Many of these terms, however, were highly technical and no detailed analysis was presented. Others (Redlich, 1945; Pratt *et al.*, 1957; Seligmann *et al.*, 1957; Samora *et al.*, 1961; Riley, 1966; Ley and Spelman, 1967; Plaja *et al.*, 1968) have conducted statistical studies of patients' understanding of medical terms and diseases, but many of these tended to concentrate more on patients' knowledge of the aetiology, treatment, and prognosis of certain diseases than on their ability to agree with the majority of doctors over the more basic issue of definition. Samora *et al.* (1961) concluded that 92.8% of their group of patients had an "adequate" knowledge of the word "constipated," and Riley (1966) found that 57% of his sample correctly identified 7 or more of 12 foods containing sugar or starch. In another series (Plaja *et al.*, 1968) 94.9% of outpatients had "exact knowledge" of the meaning of "a drug or remedy" and 79.8% had "exact knowledge" of the term "diarrhoea." In Ley and Spelman's 1967 study 96.5% chose the correct multiple-choice definition of "arthritis" and 86.1% correctly identified one of the early symptoms of "chronic bronchitis" as "a persistent cough during winter."

In the present survey significant differences were found between patients' and doctors' interpretation of all terms and illustrations except the term "a good appetite." Perhaps some

form of "reliability factor" will have to be constructed for each medical term in common usage before any significance can be attached to it. In addition, the educational level of the patient must be considered, as relationships between vocabulary performance and educational attainment have been reported (Seligmann *et al.*, 1957; Samora *et al.*, 1961). In his small study of neuropsychiatric patients, however, Redlich (1945) found the correlation between knowledge of terms and I.Q. to be poor.

For the clinician the results probably do no more than formalize and lend statistical verification to his impression that clinical interrogation often reveals large areas of misunderstanding between conventional medical opinion and the vagaries of the lay mind. This misunderstanding, however, must be identified and evaluated scientifically if techniques such as self-completion medical questionnaires or patient-activated computer programmes are to play a reliable part in clinical medicine.

It is a pleasure to thank Dr. J. F. Adams and Dr. J. T. Ireland for their unflinching co-operation and constructive criticism. Professor Bernard Lennox, Dr. Christopher Evans (National Physical Laboratory), Dr. Sheila K. Ross, and Dr. Victor Hawthorne made helpful suggestions regarding the questionnaires, the cost of which was met by a grant from the Board of Management for Glasgow South-Western Hospitals. Illustrations were prepared by the department of medical photography and illustrations, Southern General Hospital, for the questionnaires, and by Mr. Gabriel Donald of the Western Infirmary for the article.

The survey would not have been possible without the co-operation of Dr. R. G. H. Cunningham, medical superintendent of the Southern General Hospital, sister and staff of the outpatient department and the physicians and surgeons who kindly agreed to participate.

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GENERAL PRACTICE OBSERVED

Livingston New Town—Use of Computer in General Practice Medical Recording

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British Medical Journal, 1970, **2**, 289–291

Summary: An account is given of the use of a computer in general practice medical recording. The general practitioners who are involved work from a health centre and each one holds a hospital appointment in addition to his general practice commitment. The most effective practical assistance so far provided by the computer is in the preventive field of the practitioner's work. The additional but equally important potential use is in the processing of data in such a way as to allow the doctor to assess his methods of work, and to provide information of statistical and epidemiological value.

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Introduction

In November 1964 the Scottish Home and Health Department recommended that the medical services in Livingston New Town should be developed on the basis of a centrally placed district general hospital having a number of health centres closely associated with it, from which the hospital services, the preventive services, and the general practitioners could operate in close association. In addition, it was intended that joint staffing arrangements should be considered whereby general practitioners would practise part-time in general practice and part-time in hospital. These recommendations have since been implemented. The first health centre is now in operation and each general-practitioner principal, with a list restricted to a

present maximum of 1,500 patients, holds an appointment in a specialty in the district general hospital. The project has been described in detail elsewhere (Duncan, 1969).

Research Objectives

Within this framework a research study has been devised. The objectives are: (1) to observe and measure the effects on the personnel involved of the introduction of an experimental system of medical care, and (2) to establish a computer-assisted system of medical records which might eventually provide a single integrated medical record for each patient, available to all branches of the service; in the development of this system two essential requirements would be the provision of adequate methods of population surveillance and the facility to enable epidemiological studies to be made from the basic data.

This paper describes the design, the function, and the practical applications of the records system.

Concept of a New Medical Record

Before planning began the decision was reached that for at least some years to come it would be necessary for a written record to be held for each patient on the list of a general practitioner. In the Livingston context this record would be so planned as to contain information obtained from all medical services with which the individual had been in contact. This integrated record would, in turn, be available to all medical workers requiring access to the information within it. The problems that such access would present in terms of maintaining acceptable levels of confidentiality would have to be solved. Experiments would be carried out in the use of the computer to allow quick access to relevant records or parts of a record, to facilitate specific screening procedures and patient surveillance, and to provide opportunities for evaluation of all aspects of the doctor's work by highlighting relevant parts of it as they appear in his patient's records. The essential purpose of the computer would be to provide an index to the written medical records of the community, and, in addition, a monitoring facility for various screening purposes.

In contrast, Abrams *et al.* (1968), in their Thamesmead project, planned to create for each patient a single integrated health record on computer file containing information of all health care outside hospital. No written record will be held, but the doctor will have rapid access to the automated record both for the adding of fresh clinical data and for the obtaining of information he may require. Clarke *et al.* (1969) in Sheffield, described a method of inputting general practice clinical data to a computer and providing, by way of computer print-out, a continuing updated medical record for each patient. Dinwoodie (1969), in Edinburgh, is experimenting in continuous morbidity recording in a small general practice, using a computer for data storage and processing. Hodes (1968a, 1968b) in a group practice in Hertfordshire, described the structure and function of a file of patient health data and its uses for multiple screening purposes.

Medical Record Folder and Episode Sheet

In a health centre setting, and particularly in a situation where the ultimate objective is to have a single record for the patient which will be used by all branches of the service, a standard size of folder which will be universally acceptable is clearly indicated. For this reason, a 12 by 9 in. (30 by 23 cm) folder was chosen, identical to that used by the district general hospital. The general practice clinical record is contained on continuation sheets of International A4 size paper, which are retained by clips in the folder, as are hospital summaries, consultant letters, laboratory reports, and other relevant data. For the sake of legibility the practitioners are encouraged to record on portable dictating machines all clinical data they wish to have retained. The practice secretaries transcribe from

the tapes by typing on to the appropriate medical record, and extract the relevant information for computer purposes.

Computer Files

In the Livingston project, which is at present based on one health centre, five doctors, and about 7,500 patients, a general purpose (Elliott 803) computer is used. It does not provide on-line facilities and is based in Edinburgh, some 18 miles (29 km) from Livingston. Data are input to two files.

File 1. Registration Data

This involves compiling a file, on magnetic film, of the patients in each practice participating in the scheme. For each patient a registration data form is completed in duplicate. One copy is retained in the typed patient record and the other is sent to the computer centre. The practice is identified by a number allocated to each doctor, and each patient is given a serial number which at this stage is applicable to the Livingston experiment only, but could be modified to link family groups or be changed to any other acceptable numbering system. The patient's name, address, date of birth, marital state, and parity are obtained.

Information relating to occupation, social class, and blood group may also be recorded at this stage or added at a later date. These hard data are key punched on to paper tape, input to the computer, and written to magnetic film, the file so created being maintained in serial number order. Alterations or additions to the registration data of any patient can be effected without difficulty at any time by the use of a registration amendments form.

Provision is also made for the recording, for those patients for whom it is relevant, of information relating to drug sensitivities, to cervical cytology, to immunization and vaccination procedures, and to pre-school developmental examinations. As such information accumulates, so are there created, on computer file, registers in these various categories.

File 2. Episode Data

This entails the creation of a file of clinical data extracted from the typed medical record of each patient. The system must be sufficiently flexible to allow the doctor to record all he wishes to have transcribed on to the patient record held in the health centre and at the same time sufficiently disciplined to allow easy extraction of relevant data for computer storage.

A portable dictaphone is used and data are recorded following every doctor-patient contact. At each contact the doctor records the date and site and any notes which he may wish to have included in the typed record only. This is followed by the data he wishes to have held on both the typed record in the health centre and the episode data file in the computer. A diagnosis is attempted at each contact, be it confirmed or presumptive. If this is not possible, presenting symptoms are recorded. As little or as much information is then added as the doctor wishes in the logical sequence of treatment prescribed, investigations requested, referrals made to outpatient clinics or local authority services, time off work, and whether or not a return consultation or visit is indicated. It is in this sequence that the coding clerk transcribes from the dictaphone tape to the typed record and coding sheet, and it is in this sequence that information is added to the record of the patient which is held on computer file. An expertise is soon developed in this method of systematic recording, and it is of interest to note that the average recording time by the doctor is about 45 seconds per patient seen.

Codes

The code used for diagnoses and symptoms is that of the international classification of diseases (World Health Organization, 1968). The Department of Health and Social Security Drug Index is used for the coding of treatments.

Uses Arising from Registration Data

(1) *Monitoring for immunization and vaccination procedures*, pioneered so successfully by Galloway (1966) in West Sussex, has been in use in Livingston in a less sophisticated form for the past year. The procedure which has been adopted is simple. Every four weeks the registration data file is scanned by the computer, and the age of each child is calculated, compared with the ages at which immunization and vaccination procedures were carried out, and the previous history noted. Appropriate lists of names and addresses, indicating the procedures which are due, are posted to the practices concerned. The results following these attendances are notified to the computer and the file is updated. At appropriate intervals each doctor obtains a printout of the immunization state of his practice. When group clinic sessions are more firmly established in the health centre it is the intention to programme the computer to compile the appropriate appointment lists and to notify the patients by postcard.

(2) *Routine pre-school examinations* in Livingston are now being carried out by the children's own family doctor. There are seven such examinations—at 6 weeks, 6 months, 10 months, 16 months, 2 years, 3 years, and 4½ years. At each attendance a developmental assessment and a physical examination are made. Each practice is notified at the appropriate times of children due for examination, the procedure adopted being similar to that for immunizations. The results of each examination, and any action taken, are noted on computer file. Entry to either the "at risk" or "handicap" registers is determined by specified criteria of risk or abnormality. Children on the "at risk" register come under the surveillance of the general practitioner in the health centre group who holds a hospital appointment in paediatrics, and those placed on the "handicap" register under that of the consultant paediatrician of the district general hospital.

(3) *A cervical cytology clinic* will be held in the health centre, though the organization and mode of operation of it has not yet been determined. Provision is made for the holding on file of the results of the three most recent smears.

(4) *A register of patients with drug sensitivities* is held on file and a printout is obtainable on request.

Uses Arising from Files

(1) (a) *Periodic recall for assessment* of patients suffering from certain specified conditions such as pernicious anaemia or diabetes, where continuing replacement therapy is necessary, can be provided. Similarly, those with chronic conditions such as rheumatoid arthritis or bronchitis, in which treatment may have to be adjusted, depending on the course of the disease, can be identified with ease and placed under surveillance. (b) *Monitoring as a preventive measure*, in which the alerting of the practitioner to recurrent attacks of certain conditions allows the early initiation of the appropriate treatment to prevent chronicity, is another valuable form of feed-back. Such monitoring would be useful, for example, in cases of urinary tract infection.

(2) *Many aspects of morbidity* as seen outside hospital can be studied. (a) Its relationship in the single practice or in the total health centre practice population to age, to sex, to marital state, to occupation, or to social class can be determined. (b) Morbidity as it relates to certain potentially "at risk" groups, such as women on oral contraceptives and patients on steroid therapy, can be observed. (c) The incidence and prevalence of specified conditions can be obtained and seasonal distribution determined. (d) Morbidity arising from the commoner types of illness and the time off work resulting from these conditions can be assessed. It would be possible, in doing so, to attempt to compare the effects of different treatments in altering the periods of incapacity.

(3) *A tabulation of drug usage* can be provided for each doctor at appropriate intervals, indicating the conditions for which drugs have been used and their effectiveness. Such information will allow each doctor to look at the total spectrum of his drug usage and to compare it with those of his colleagues. In such a way he can carry out a critical self-audit of his prescribing habits and effect changes where these appear necessary.

(4) *An assessment of working habits* can be obtained from a study of the number of ratios of consultations, home visits, and telephone contacts, the use of hospital outpatient facilities, and the use of laboratory services. Such a study over a period of time could influence the deployment of ancillary staff, the mode of access of the patient to the consultant, and the scope of provision of the laboratory services.

Conclusion

A year's experience involving one practice has shown that the computer can play a valuable part in monitoring for clinics such as those for immunization and pre-school examinations, and in storing information arising from these procedures. In addition, it is particularly suited to the task of compiling and holding registers such as the at risk and handicap registers. The data required to fulfil these services are very specific and usually easily obtainable, and the collection and coding of them at the practice end does not involve either the doctors or the coding clerk in much work.

The collecting of episode data places on the doctor the discipline of systematic recording. Apart from the computer implications, it has direct bonus effect of providing a good standardised typed record which is legible.

Episode data recording at the rate of about 150 contacts each week in a practice of 1,500 patients multiplies quite alarmingly, however, when considering a health centre population of 12,000 patients. On present experience, about one-quarter of secretarial time is devoted to coding, of which the coding of episode data provides the bulk. At the computer end input does not provide any great difficulty, but the amount of data that is continually accumulating may provide problems of processing, if only in terms of computer time.

A second paper discussing the output obtained from the system will be published in due course.

We wish to thank Mr. C. A. McLeish, systems analyst, Edinburgh Medical Computer Unit, who has been responsible for systems and programming; Dr. S. W. MacGregor and Mr. J. Conway, who were responsible for the early planning and pilot studies; Dr. J. H. Barber, who has been closely concerned with the experiment from its onset and whose practice has provided the bulk of the data; and Mrs. J. Morgan and the secretarial staff in Craigshill Health Centre, Livingston New Town, who have been responsible for the coding of the data.

Further information regarding the layout and the use of the coding forms may be obtained on application to Dr. K. T. Gruer, Research and Intelligence Unit, Scottish Home and Health Department, 79 Lauriston Place, Edinburgh EH3 9HZ.

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