Handling information in general practice—using feature cards with computers

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SUMMARY. A two-tier system of handling information has been developed for use in general practice. Punched feature cards, with the conventional patients' record cards are used for the handling of primary data in the doctor's surgery. At the same time the feature cards provide an input to the computer using a feature card reader, converter, and paper-tape punch. This is especially useful where information has to be collected together centrally, for more advanced statistical analysis and where multiple searches of individual feature cards are required.

Introduction

In a recent editorial on computing (*British Medical Journal*, 1973) it was suggested that the question that needs to be answered is not what machines can do, but what it is worthwhile for them to do. This is especially true in general practice. Indeed investigating this field Hodes (1969) concluded that at present computer-assisted record keeping is not economically viable.

It is clear that in general practice for the foreseeable future, the traditional clinical notes will be the mainstay of patient record systems. With these thoughts in mind we have developed a two-tier system of handling information designed specifically to cope with the problems of collecting and storing information in general practice.

The first tier consists of a cheap, yet quick and reliable method of extracting, from the records, information which may be of immediate relevance, while the second tier provides access to more powerful and sophisticated analytical techniques. Details of the first tier of the system, in which information is collected and stored using punched feature cards, have been described in a previous paper (Harden, Harden, and Reekie, 1974). The general practice in which the system has been developed has 8,500 patients and is divided between Glasgow and Bearsden, a suburb of Glasgow. This paper describes the ways in which the information on the feature cards can be transferred to a computer and some applications.

Converting data on feature cards to paper tape

In a feature card system each card represents a characteristic or feature of the items indexed and the 2,500 numbered positions on the card the items indexed (Jolley, 1968; Harden, Harden, and Reekie, 1974). Thus a hole punched at position 1265 in the card " female " indicates that patient number 1265 is female.

The number and positions of holes on the feature cards can be transferred to paper tape using a translation unit developed for this purpose. In this way feature cards can be used as an input to the computer. The complete translation unit consists of a feature card reader, a converter, and a paper tape punch. All three devices can be accommodated comfortably on a normal office table and ordinary mains power supply is used.

The reader (JSR–1), which can also be used independently for non-computer analyses,

handles feature cards of 2,500 item capacity. It scans a card electronically by means of a travelling carriage which ' reads ' infra-red light passing through the holes. This information is fed to the converter.

The converter (JSC–1) takes the impulses received from the reader and converts them into a suitable format for subsequent computer input, feeding the result to a paper tape punch.

The paper tape punch accepts the electrical impulses from the converter and produces tape at the rate of 110 characters/second (Data Dynamics Ltd). This tape is fed directly into a computer so that the information on it may be processed further. The eight channel paper tape produced by the punch is suitable for any computer which uses a high-speed paper tape reader.

The feature card reader scans 100-hole positions as a block and the paper tape is produced before the next block on the card is scanned. Since the paper tape only records holes, the time taken to scan a card is variable and depends on the number of holes punched on the card. A fully punched feature card takes several minutes to convert to paper tape format but this is still much quicker than the manual data preparation of 2,500 items. Moreover it is most unusual to have cards fully, or almost fully, punched. The time taken to scan and count the number of holes in a card without punching paper tape is ten seconds.

The output on paper tape consists of a series of feature-card images, each image containing a header record and up to 25 records related to the 25 $\times$ 100 hole blocks into which each card is divided. Both the header and subsequent records have a common format and consist of three parts:

(1) A unique block sequence number (between 1 and 26 where 26 = header record),

(2) A count of holes punched in that 100-hole block,

(3) The code numbers (0–99) of the holes punched in the block.

From this information the feature card image can be restored by a computer program written in PLAN and run on the Western Regional Hospital Board ICL 1903T. Because of the potential number of feature cards in the system (1,000 per practice), the header record's 100-hole positions are insufficient and a binary representation of the card identifier has been devised. This can also be recoded by the computer input program so that each individual card can be identified. As each card used codes only 2,500 patients, several series of cards are required. A second program is then used to link first series (patients 1 to 2499), second series (patients 2500 to 4999) and third series (patients 5000 to 7499) cards for the same feature.

Advantages of using a computer

The advantages of feature cards for handling primary data in a general practice have been discussed elsewhere and include relative simplicity, speed of information retrieval, visible statistics, flexibility, confidentiality, and acceptability to doctors and secretarial staff (Harden, Harden, and Reekie, 1974). While feature cards have these advantages there are some tasks which can be better and more efficiently done using alternative methods. Development of a technique whereby the data stored on feature cards can be transferred to paper tape for input to a computer is therefore a valuable addition in data handling technology. The information stored on punched feature cards can now be analysed using a computer where required without further hand punching or coding. This is particularly applicable in the following situations:

(1) *Central collection of information*

Punched feature-card systems work most efficiently in practices where they can be used for administrative purposes and for providing information quickly to the doctors. Much of this information, however, is also of value outside the practice and could usefully be collected centrally for comparison with data obtained from other practices. This central collection of data, e.g. in relation to total morbidity recording and treatment statistics, may highlight regional or local differences, and requirements and deficiencies in health services. Already data from two practices are being collected and compared and it is hoped to extend this to further practices. An example in which the prevalence rates for psychiatric morbidity in Woodside

(a health centre in the centre of Glasgow) and Bearsden (a residential suburb of Glasgow) have been compared is given in table 1.

TABLE 1

PSYCHIATRIC MORBIDITY

FOR TEN MONTHS (1 FEBRUARY 1973—30 NOVEMBER 1973)

Disease	*Prevalence rates per thousand patients*	
	Woodside (3,400 *patients*)	*Bearsden* (5,100 *patients*)
Schizophrenia	2·6	0·7
Endogenous depression	24·0	21·0
Senile dementia	0·6	1·0
Anxiety state	54·0	97·0
Hysterical state	4·7	5·0
Obsessive compulsive state	0·3	0·2
Phobic anxiety state	0·3	4·4
Neurotic depression	22·0	24·0
Hysterical and other personality defects	10·0	12·0
Addiction	4·4	1·5
Nervous dyspepsia	11·4	7·4
Insomnia	6·8	12·0
Tension headache	2·0	9·2
Enuresis	2·3	2·0
Transient situational problem	17·0	6·0
Consultant psychiatric referral rate	3·8	1·1

(2) *Advanced statistical analysis*

While much statistical information can be obtained by manipulation of punched feature cards, more sophisticated statistics, for example multiple correlations, and cluster analysis, are more efficiently carried out using a computer.

(3) *Adjoint feature searches*

At times feature cards may represent features which are mutually exclusive, but which have to be put together (" adjoined ") to produce a desired result. Such features cannot be put together by stacking because there would be no through holes. In this situation a computer can help although other possibilities exist which may be as effective.

This can best be illustrated with an example. In the work we have done, the patients' dates of birth are coded using one card for each decade, one card for each unit 1–9 and one card for each month. For example, all patients born between 1960 and 1969 are punched in the decade card " 1960–1969 " and the appropriate unit and month card. Thus a patient whose date of birth is December 1895 is punched on feature cards ' December,' ' 1890–1899 ' and ' 5 '.

The advantage of this scheme is twofold. Firstly, the number of cards required if one excludes the months is only 19. If, on the other hand, each year has its own card the number of cards required would be over 100. The differences are even more marked if one considers months in addition; 31 and 1,200 cards respectively.

Secondly, one can select with only one search patients born in any decade, for example 1940–1949, by looking at the ' 1940–1949 ' decade card or in a specific year for example 1945 by stacking the cards ' 1940–1949 ' and year unit ' 5.' However, if an age group does not correspond to a decade card, then a search has to be made on each separate year and the results have to be put together. Many feature card systems are designed so as to remove this necessity, but the removal calls for extra punching.

An alternative is to use the computer for adjoining the features. Another example where the computer may assist in multiple searches is where a practice increases greatly in size and the number of series of feature cards becomes cumbersome owing to each feature being represented by a fair number of cards. While cards of 10,000 patient capacity are available, 2,500 capacity

cards were chosen for the above work largely because equipment was already available for punching, counting, and reading the cards. Secondly, over our developmental period we preferred to use cards with $\frac{1}{8}''$ punched holes rather than cards with $\frac{1}{12}''$ or $\frac{1}{16}''$ holes (as found in high capacity cards). Three series of cards have been used in the present study—an A series (patients 1–2,499), a B series (patients 2,500–4,999) and a C series (patients 5,000 and over).

A third example is in workload statistics. At present these are kept on a monthly basis and the corresponding feature cards are replaced each month. Use of a computer allows three monthly or yearly figures to be produced with no additional punching or feature-card searches.

(4) *Assimilation to other detail already in store on the computer*

A potential future use is when a population is indexed for different sets of features, some of which may occur in each set. Thus a patient's records may be kept both in his doctor's files and on a computerised file in hospital. It is possible to merge systems by reading the externally-kept feature-card information into the computer, and this can be helpful when the alternative is to collect it afresh or to transfer it by way of a punch operative who, in effect, re-records it.

Conclusion

In conclusion the two-tier system described represents a method of information handling in which feature cards and computers complement each other and in which the advantages of one compensate for the disadvantages of the other. The result is a system of handling data particularly appropriate for use in general practice.

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