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EXETER COMMUNITY HEALTH SERVICES COMPUTER PROJECT

EVALUATION OF PRIMARY CARE SYSTEMS

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CONTENTS

SUMMARY

This report deals with evaluation of the effects of computerisation on the record keeping in primary care using the concept of performance criteria. The computer system in question was developed by the Exeter Community Health Services Computer Project (ECHSCP) with the funds made available by the Department of Health and Social Security. Although the primary care system is only one part of the facilities offered by ECHSCP (the others being hospital administration and nursing systems), the author feels that it is possible to draw conclusions about the affects of computerisation which are equally applicable to other, stand-alone, computer systems.

The evaluation data was collected in the two health centres where the computerised system is currently operational and this was done, whenever possible, both before the introduction of the computer and after computerisation. Manual record systems in both locations used to be virtually identical and the respective computer systems are very similar, being based on a number of Visual Display Units (VDUs) and hard copy printers which are situated in doctors' surgeries and reception areas. The one important difference between the two computer systems lies in their usage. Whereas doctors in Ottery St. Mary keep the whole of the patient record (except for hospital letters and similar communications) on the computer, the partners in Mount Pleasant, Exeter maintain only patient summary and medication and utilise a computer printed copy of the patient record for adding handwritten notes concerning the current episode. This difference in usage leads to some differences in accrued benefits as is highlighted in the following main conclusions, which are discussed in detail in the body of the report.

1. The structure of the computerised patient record, which can only be maintained in practice on the computer leads to an improved quality of the record. In almost half of the cases (48.3%) the retrieval of information from the manual record is hampered by its lack of order and structure. No such complaints were voiced about the computer record. Almost two thirds of doctors (61.4%) considered the quality of the computer record to be better than manual records because of the more useful format, which make it more informative.

2. The computerised patient record presents a more continuous picture of the patients history than the corresponding manual record.

3. The computer record is more legible and for this reason there are virtually no occasions when the legibility is a cause of difficulties when searching for information. On the other hand, the users of manual records expressed such difficulties in some 38% of cases.

4. As a result of computerisation the time necessary to find a required piece of information from the patient record has almost been halved (the exact reduction is 45.1%).

5. Almost half of the manual records (45.8%) caused difficulties in assimilating and correlating facts that were retrieved from the record. These problems have practically disappeared with computerisation. There is a significant level of consensus that this improvement leads to a better knowledge of patient.

6. The ease with which a copy of the computerised patient record can be obtained makes for an improvement in usefulness of information communicated from primary care. As an example over a third (34.2%) of out-patient referrals might benefit from this communication.

7. Computerised patient records can easily be analysed to obtain accurate demographic data on health centre population as well as reliable information on patient throughput. Morbidity analyses, drug statistics and identification of population groups at risk can also be done with relative ease. This should improve the efficiency of primary care.

8. Computerisation helps the management of various recall schemes such as rubella, polio, tetanus, flu, cervical smears, oral contraceptives and others by automatic printing of self adhesive labels and recall letters. Although this will increase the workload of health centre staff, and therefore the cost to the NHS, it should be borne in mind that prevention is better that cure.

9. If a fully computerised patient record system is operated, as is the case in Ottery St. Mary, the overall reduction in receptionists' workload (measured against an equivalent manual system) is some 2 hours/week/1000 patients. Other computer-related effects such as an increase in the workload because of a greater number of recall schemes, make it unlikely that this reduction will be realised.

10. Job satisfaction of health centre receptionists and secretaries working with the computerised patient record system appears to be high in both health centres covered in this report. There is no indication that the staff feel that the introduction of the computer has adversely affected their working environment.

11. There is some evidence that a better control over drug prescribing enabled by the computer leads to a saving of some 2.7% of the drug bill. This reduction represents (at 1980 costs) about 54p a year for every patient on the NHS prescribing list.

12. Assuming that the mainframe is fully utilised and that the computer hardware is written off over 10 years then the notional cost of operating the fully computerised patient primary care record is £1.44 per patient per year (1980 cost levels). If the current episode is not maintained on the computer, as is currently the case in Mt. Pleasant health centre, this figure reduces to £1.15 per patient per year. If, in addition, the latter system is operated without terminals in doctors' surgeries, the notional cost is further reduced to £.99 per patient per year.

1. INTRODUCTION

1.1 GENERAL

The purpose of this document is to evaluate the effect of computerisation of primary care records as it has been realised by the Exeter Community Health Services Computer Project (ECHSCP). This project started in 1971 as a part of the experimental programme in medical computing funded by the Department of Health and Social Security. Several such projects were established in England at about the same time. The particular characteristics of this project stem from the observation that the patient should be the focus of any well directed system of medical care. As a corollary, the patient-centred medical record should be regarded as the basis of any well directed system of medical record keeping. Information relevant to the health status of an individual may come from any of his contacts with the National Health Service, such as health centres, outpatient departments of hospitals, service departments, etc. and will be supplied by different authors. This information should therefore be organised in such a way that if the patient uses several National Health Service agencies his record should appear only once in the medical record keeping system but all relevant information should be available at each point to all authorised users.

Because of different demands of various users the form in which patient information must be available should be of the utmost flexibility. For instance, during an encounter with a patient medical staff are likely to require the patient's medical record (or a part of it). For patient management purposes, such as booking of outpatient clinics and maintenance of the waiting list, quantitative information on the number of patients, rather than individual patient records, is required. Structured lists of patients must be handled for research and recall purposes. Statistics on the usage of drugs or incidence and prevalence of certain conditions may be requested by medical staff. All these varied requirements give rise to the concept of Integrated Patient Record (IPR) which should be maintained in real time via a network of terminals located in all the agencies of the NHS.

The IPR consists of two fundamental types of data: (a) base record, which contains basic patient administrative and identification details, as well as pointers to a number of (b) data chains, which hold information specific to various health care applications. A variety of indices is maintained to access this data base. As well as community index, i.e. an index of all patients in the data base arranged by surname within sex, separate indices for each NHS agency, such as hospitals and health centres, are kept. All indices of a given patient point to the base record which in turn links with data chains via data pointers.

The concept of Integrated Patient Record provides for linkage of any medical data. To date non-clinical parts of medical records have been computerised in three hospitals (Royal Devon and Exeter (Wonford), Royal Devon and Exeter (Heavitree) and Princess Elizabeth Orthopaedic Hospital). Two health centres (Ottery St. Mary and Mt. Pleasant) use a fully computerised primary care record and a number of health centres (Pinhoe, Exmouth, Barnstaple) use a partially computerised primary care record consisting of the identification details and certain clinical information. The linkage between health care agencies of information that is contained within the computer system is therefore, at present, of limited value. Patient administrative information from computerised hospitals (such as outstanding outpatient appointments, waiting list information, etc.) is available in health centres where it is found to be of value. However, the linkage in the other direction i.e. from primary care to the hospital, has not been fully utilised by the users.

There are several reasons for this, in the author's opinion, unsatisfactory state of affairs. As only administrative information has been computerised in hospitals, no terminals have been sited in hospital clinical areas where patients' primary care records would be of most use. Moreover, since only two health centres with some 27,000 patients altogether (out of hospital catchment area of some 300,000) have, at present, primary care records on the computer, the usage in hospital of the available computer linkage would mean that two sets of procedures, one corresponding with manual primary care records and the other for those with computer primary care records, would have to be in operation. The ensuing potential confusion might more than nullify any benefit which the computer linkage may have enabled. This situation has taken the edge off the necessity for the medical profession to define the procedures governing the transfer of patient medical records (apart from identification information) between various NHS agencies so that in the absence of a formalised procedure the general practitioners have decided not to make primary care records routinely available to the medical staff in hospitals.

Thus with the exception of patient identification information the effect of computerisation of medical information by ECHSCP can be evaluated by regarding the existing computer system as composed of several self-contained parts such as the primary care system, hospital administration system etc. This makes it not only easier to compare the computer system with manual procedures it replaced (provided the data is available) but also to compare Exeter computer systems with other, stand-alone as opposed to integrated computer systems in the country.

The subject of this document is the evaluation of that part of the computer system developed by Exeter Community Health Services Computer Project that deals with primary care records, as it has been implemented in Ottery St. Mary (OSM) and Mount Pleasant (MtP) Health Centres.

1.2 EVALUATION METHODOLOGY

Improvement objectives

In the period during which measurements of the "before" and "after" situations were being taken, evaluation methodology recommended by DHSS for the experimental programme in medical computing was reviewed and subsequently changed. Initially, evaluation was considered to be a cost-benefit problem, i.e. if a system is to be changed, then set out improvement objectives to be attained by that change and measure the system areas to be changed before implementation; after implementation measure the extent of the actual change, convert the improved performance into monetary units and compare the sum of all the improvements with the cost of attaining them. A simple decision on whether the investment was worthwhile should then be feasible. However, this approach is fraught with problems when trying to evaluate computer systems that make an impact on patient care areas, and also if the results of evaluation are to be used by potential computer users at a different site from the measurement site.

These problems were identified by a working group that recommended a change in the direction of the evaluation effort.

Performance criteria

The alternative methodology proposed theoretically overcame some of the problems in the above approach. It basically suggested that the performance of any one topic area, such as for instance primary care records, could be gauged by measuring a standard set of parameters called performance criteria, and that this set should be sufficient to indicate whether a system, be it manual or computer or whatever, is performing relatively better or worse than any other system in the same topic area. A project was established that identified the relevant performance criteria to be measured (1) and the methodology was adopted in the evaluation work as presented in this document.

In the area of primary care records the performance criteria thus identified more or less covered those improvement objectives that had originally been listed as being likely to be most affected by the computer system. Hence, although the change in the evaluation methodology happened fairly late in the day, no radical change in the scope of evaluation work was required and none of the work carried out prior to the change in methodology was deemed superfluous.

1.3 UNITS EVALUATED

The computerised primary care record system developed by the Exeter Community Health Services Computer Project has been implemented in two health centres: Ottery St. Mary and Mt. Pleasant, Exeter. The system has been fully operational in Ottery St. Mary health centre since 1976 (3) whilst the implementation in Mt. Pleasant health centre was finally completed in 1980.

Ottery St. Mary health centre is situated in a small town in east Devon and covers a predominantly rural population. Five general practitioners practice from a purpose built structure that houses a reception area, two surgeries, treatment room, community clinic room, as well as offices for community nurses and health visitors. The health centre was the first one to be built in Devon and since its opening the workload has increased substantially. Currently (1980) some 12,000 patients are cared for, the majority of whom attend at the health centre, resulting in over 28,000 attendances each year. Because of poor public transport and aging population the doctors make over 4,800 visits annually in addition to holding 11 branch surgeries each week at 3 locations.

Mt. Pleasant health centre is located near the centre of Exeter, in a modern purpose built building. Seven general practitioners cater for the health needs of a typical urban population. Each has his own surgery and in addition there are treatment rooms, reception area, office space, rooms for community nurses and health visitors, staff room, etc. The health centre staff operate as two separate practices of four doctors (about 8,300 patients) and 3 doctors (about 6,600 patients). Attendance rates are similar to Ottery St. Mary but there are fewer visits and no branch surgeries.

2. THE SYSTEMS

2.1 MANUAL SYSTEM

Record keeping of primary care records has changed little since the system was introduced in early 1900s. Each patient is allocated an NHS number and an approximately 7" x 4" envelope is used throughout his life to store all documents comprising the patient record. Registration departments of Family Practitioners Committees ensure that, when a patient transfers from one general practitioner to another, the envelope is sent to the new doctor with whom the patient has registered. The record of each contact with the primary care services, such as an attendance in a surgery, a consultation or a domiciliary visit, is added to continuation cards with letters from hospitals, etc. folded to fit into the envelope. Poor handwriting, crumpled paper, torn envelopes and mis-filing are all inevitable problems. Because of, at best, chronological listing of information large quantities of once needed but now largely unimportant details hide important facts.

In addition to the envelopes filed alphabetically in filing cabinets (often split by sex as was the case in both Health Centres considered in this report), many practices nowadays maintain an Age/Sex register. This usually takes the form of a binder with a page reserved for all the patients of a given sex who were born within a given year. Maintenance of such a register is reasonably straightforward but the effort required for setting it up has precluded a more widespread implementation.

2.2 COMPUTER SYSTEM

The primary objective of the computer system was to replace the inadequate record system based on the NHS envelope with a structured record maintained on the computer via Visual Display Units (VDUs) available to the doctors in the surgery. As doctors can maintain records during the surgery there is no need for the duplication of note keeping. This guarantees that the information is kept up-to-date and that it is reliable. The structured nature of the patient record highlights important events in patients' medical histories and provides a manageable and much more useful record for day-to-day consultation. In addition information held on the computer is used to provide accurate statistics, at risk registers etc., and enables full scale analysis of the clinical data to be undertaken - a feature that has become practical for the first time.

Although the patient record is structured no artificial restrictions have been imposed on the quantity or type of information entered. Facilities have been provided which enable information within a record to be re-arranged easily by the doctors thereby encouraging positive management of the records. It was of course essential that introduction of the computer should not reduce the confidentiality of patient records.

Registration

This is a basic application for entering and amending identity details of patients (complete with vetting checks) and also for marking patients who leave the practice. This information forms a basis upon which clinical and other details can be built. The actual data items are also used for age and sex analyses.

Clinical record management

Several different screen types are available to maintain clinical details for a patient. They all adopt a common processing philosophy to simplify checking and editing. Screen types consist of one or more sections, such as priority details, summary history, current episode, medication, family history, social history, obstetric history (for women), drug spectrum etc. As there is virtually no limit on the amount of information in a section, the display of a screen type for a particular patient may extend over more than one screen (page). Sophisticated line manipulation facilities for re-sequencing, deleting or editing lines are used, together with appropriate vetting checks.

Repeat medication

Repeat prescriptions are requested for automatic printing on a hard copy printer located in the practice. The prescription is produced onto pre-printed continuous stationery (FP10) and the only information that has to be entered by hand is the doctor's signature. At the same time the computer system maintains details of the pattern of prescribing and will query, but not reject, any apparent over or under prescribing request. In addition the doctor can, at the time of first prescribing a course of treatment, set limits beyond which the computer will not allow prescriptions to be issued automatically.

Printing facilities

The hard copy printer mentioned above is also used in conjunction with a flexible printing system. This system allows complete patient records, or selected information from patient records, to be printed on request. This is particularly useful when a patient leaves the practice because the whole of the record is printed and sent to the new doctor. A facility to print directly the contents of the current VDU screen is incorporated.

Reminder systems

Effective patient management requires that lists of patients due for review or regular screening should be kept. Since the doctor usually makes decisions regarding the maintenance of these lists when perusing clinical records of individual patients, these lists are automatically generated from entries in the main clinical record.

Data security

As the computer system provides a total record keeping system with the computer replacing the NHS envelope, there is a need to record all changes, deletions etc., in patient records. In the short term it is required as a means of fully re-creating the information should there be hardware failure or corruption of files. In the longer term, retaining all the states of patient record may be necessary, for instance, for medico-legal purposes.

Analyses of data

In addition to the day to day real time operation, regular analysis of the data is an important part of the overall system. The identification details provide the basis for quarterly practice statistics. Three types of patient register are produced: alphabetic, numeric and alphabetic within doctor. Separate lists can be produced for leavers and deceased patients. In order to reduce the number of duplicate records on file a program to produce a list of potential duplications is run regularly.

Clinical information is used for a large variety of both regular and "ad hoc" enquiries. Morbidity analyses, drug prescribing patterns and "at risk" registers are produced quarterly, screening and recall systems for vaccination and immunisation are operated annually and there are many specific enquiries based on combinations of clinical and identification data.

Microfiche

To ensure a means of standby when the computer system is unavailable, and to make patient records easily portable and therefore available away from the terminals (branch surgeries, home visits), copies of all patient records are available on microfiche. To this end all clinical details and registers are output to magnetic tape which is then used for the production of microfiche. Clinical records of some 200 patients are contained on one fiche. Thus with a folder and a portable hand-held viewer the doctor can carry the records of his entire practice wherever he goes.

Sign-on and confidentiality

A computer system dealing with medical information must ensure that only authorised users are allowed access to the patient records. On ECHSCP computer system it is achieved by employing an intricate system of passwords. A password not only identifies the user, so that any change made to records by him can be automatically "signed", but it also limits the range of information available. In addition a log is kept, which is available on VDU, of all recent use of the password so that checks can be made for possible abuse of the system.

3. PATIENT RECORD

3.1 GENERAL

As shown in the Chapter 1 the main objective of the Exeter Community Health Services Computer Project has been to improve patient care through an improved system o medical record keeping. In the primary care area this has led to the computerisation of the whole of the patient primary care record. It is therefore natural that a close look should be taken at the performance criteria that deal with various aspects of the individual patient record.

For the purpose of this evaluation patient record is assumed to consist of two kinds of information: identification and clinical. Within a health centre, identification information is primarily used for the retrieval of patient record, as well as for the production of lists and statistics for practice management. Once the patient record has successfully been located doctors use clinical information contained within it for the individual case management. It is in the area of clinical information that computerisation is expected to have made a great impact, and for this reason the performance criteria dealing with patient record were mainly applied to this part of the patient record.

Three different instruments were used to measure the performance criteria describing patient record. Quantitative measures were obtained by designing a number of questionnaires, each of which contained the questions relating to a specific patient primary care record (Controlled trial of patient records, see below). Two sets of subjective measures resulted from the administration of another two questionnaires. One was filled in by doctors in Ottery St. Mary and Mt. Pleasant Health Centres (Medical records in general practice, see Appendix A) and the other by general practitioners from other health centres who received a hard copy of the computer patient record after the patient had left one of the computer health centres and registered with them (Other GPs' opinions, see Appendix B).

Controlled trial of patient records

This trial was staged shortly after the transfer of manual records (held in NHS envelopes) to the computer. Both forms of the patient record therefore contained approximately the same information. Two doctors from Ottery St. Mary Health Centre were involved in the trial. The first selected 20 patient records, made sure that the information both in the NHS envelope and on the computer was equivalent, set up 10 factual questions per record (later found to yield approximately 14 items of information per record) and randomly assigned the records between the computer and manual mode of retrieval. The other doctor then attempted to answer the questions in as short a time as possible. The patients, and therefore the records, were unknown to this doctor.

Records were obtained for both the manual and the computer patient record.

Medical records in general practice

This was a questionnaire that the doctors were asked to fill in after every consultation during which they used a patient record. Questions related specifically to that record (see Appendix A). Every doctor in the two computerised practices was asked to answer 40 questions (about the size of two surgeries).

All 5 partners from Ottery St. Mary and 3 out of 4 partners from the Mt. Pleasant practice that had been computerised at the time took part, bringing the total to 320 returns. The subjects were mostly computer records, however, as one partner had joined the Mt. Pleasant practice a short time before the

study began (bringing with him manually kept records which had not yet been computerised), comparative figures for manual records were also obtained, albeit based on a very small sample.

The first question of the questionnaire sought to establish whether the subject of that questionnaire was the respondent's own patient or whether he usually saw one of the respondent's partners. The second question asked whether the patient was a clinically complex or simple case. The answers to these questions were used to find out whether there was any significant difference between these values and the responses to the remaining questions that dealt with performance criteria. No statistically significant difference (at 95% level) was found and therefore all the results presented in the following sections are based on the combined sample of all patients' records belonging to either the computer or the manual category.

Other GPs' opinions

When a patient leaves a computerised health centre a computer printed copy of the record together with an explanatory letter is enclosed in the NHS envelope (which incidentally still contains the manually kept record covering the patient history till the time of computerisation) and sent to the next doctor. For about a year a questionnaire, together with a stamped addressed envelope (see Appendix B), was enclosed in the NHS envelope. In this questionnaire, which the doctor was asked to fill in after a consultation in which he had used the patient record, was measured the responding doctor's perception of the difference between the hard copy of the structured record and the traditional manual record. More than 500 questionnaires were sent but only 45 received (with 44 being applicable for analysis) over the period of some 3 years. Even if we allow for the fact that some of the 500 patient records have not yet been used because the patients have not yet presented it is hard to explain this very disappointing response rate.

As opposed to the other two instruments described above where the participating doctors were using computer terminals and structured records in day-to-day operation, this study involved a self selected sample of doctors who had no previous experience of computer maintained primary care records. Judging from the comments they made all general practitioners but one used the traditional chronological record kept in the NHS envelope. The one exception manually kept problem orientated records.

The first question of this questionnaire asked the respondents to classify the patient's medical history as complex, average or simple. Although it was intended to check the correlation, if any, between these answers and the measures of individual performance criteria, the small sample size made it impractical. The results in the following sections are therefore based on the total sample.

Performance criteria

Five performance criteria describe various aspects of the patient record and its effect on the process of care. They can be thought of as belonging to three conceptual groupings. Firstly there are those criteria that attempt to measure the content of information in the record, i.e. whether the required information is actually there. It is generally accepted that a patient's primary care record should give a picture of the whole person, i.e. that it should contain the relevant medical, psychological, emotional, social, etc. details. Continuous development and/or management of various problems should also be described and important details should stand out clearly. These aspects

of the record are referred to below as the Quality of information and Continuity of record.

The mere fact that information is contained in the record is not sufficient. It must be stored in such a way that it can easily be used. Thus all the details must be legible and they must be arranged so that the user can quickly find any item he may be looking for. The second conceptual group of performance criteria, viz. Legibility of information and Information retrieval, describes these features.

Thirdly, one of the most important aspects of the patient record is the degree of knowledge of the patient that is gained by a quick perusal of it. Since general practitioners see in a surgery, on average, some 10 patients in an hour, the time for browsing through records is severely limited. It is therefore essential that the order and structure of information in the patient record is such that individual facts can easily be correlated and assimilated, i.e. that the Comprehensibility of record is high.

3.2 QUALITY OF INFORMATION

This criterion is defined in the Handbook on the Measurement of Performance Criteria (2) as "An assessment by peer audit to what extent the patient record gives a picture of the whole person, i.e. the relevant medical, psychological, emotional, social etc. details". It became obvious early on that the suggested approach of peer audit would be very difficult to undertake. Such an audit should involve in addition to the relevant general practitioner, an external auditor (a doctor). Even if the funds for the auditor could be made available it was thought unlikely that the general practitioners would be willing to sacrifice what would be a considerable amount of time in order to be subjected to the audit. For these reasons it was decided to modify the above definition into An assessment by the GP how well the patient record gives a picture of the whole person, i.e. the relevant medical, psychological, emotional, social, etc. details.

Method of measurement

This criterion was measured by two questionnaires described previously. The first questionnaire, Medical records in general practice, was identical to that recommended by the Handbook on the Measurement of Performance Criteria (see Appendix A for a summary of results). Respondents' opinions as to the Quality of information contained in the patient record can be gleaned from the answers to Question 3. If the answer was in the negative, i.e. if the record was not easy to search the respondent was asked to give a reason by ticking a checklist or specifying the reason if it was not in the checklist. The answers to the following two checklist items were taken as measurements of quality of information: (the key corresponds to the numbering in the questionnaire)

(a) important details were hidden within trivia

(c) individual parts of the record were not ordered well.

A second look at the quality of information was obtained from the answers to the questionnaire Other GPs' opinions (see Appendix B for a summary of results). In this questionnaire the respondents were asked (Question 2) whether they found the structured record (i.e. the hard copy of the computer record) an improvement on the traditional record kept on continuation cards. If the answer was in the affirmative they were asked to indicate why they thought so by ticking a checklist. Answers to the following items were all used to measure quality of information: (the key corresponds to the numbering in the questionnaire)

(b) (record) format is more useful

(c) (record) is more informative in content

(d) (record) contains only salient details.

possibly (f) other reasons.

If the answer to the Question 2 was negative the respondents were asked whether they thought the structured record was worse and, if they thought so, to elaborate why this was the case. It should be emphasised at this point, that having answered the respective questions in the two questionnaires, the respondents were free to tick any number of items from the checklist. Similarly, they could supply any number of other reasons in the space reserved for comments. This explains why in the analyses below there is a difference between the total number of reasons and the number of returned questionnaires.

Results

Only 4 out of 285 responses to the questionnaire Medical records in general practice that concerned computer records stated that it had not been easy to search the record. None of these four respondents gave a reason that could be classified as an aspect of the quality of information. In other words quality of information was not perceived as something that adversely affected the search for information.

The situation was quite different with the manually kept records. 29 replies to the question "Was it easy to search the record" were received and 15 had been answered in the negative. 14 of these gave a reason connected with the quality of information (48.3%), Of these seven (7) stated that important details were hidden within trivia and 12 claimed that individual parts of the record were not ordered well. One simply commented on the record as being "inadequate".

A somewhat less extreme picture emerged from the questionnaire Other GPs' opinions. 31 respondents out of 45 (44 applicable) i.e. 70.5% thought that the structured record was an improvement on the traditional record kept on continuous cards. 27 of these felt that the improvement was due to a factor or a combination of factors concerned with quality. Of these 15 found the format more useful, 16 felt that the structured record was more informative in content and 22 thought that it was an improvement because it contained only salient details.

On the other hand 11 respondents believed that the structured record was worse than the manual record. Of these 10 supplied further comments. The consensus of opinion among these respondents was that the structured record (computer printed) was less informative than the manual one, mainly because it lacked the "personal feel" and "personal comments".

Finally one respondent did not think that there was any difference between the two records. Another felt that the structured record was an improvement as a précis but overall it was worse because "It was only a précis and not very informative".

Discussion

The best method to evaluate quality of information contained in a patient primary care record is undoubtedly a peer audit, i.e. a critical comparison, record by record, against a predetermined set of criteria. The reasons why this path was not taken in this case were given in the beginning of this section. The author had realised that any alternative to the peer audit would only be a second best and the results of the two questionnaires bear this out.

The greatest drawback of both questionnaires is that neither of these measures quality of information directly. Thus in the questionnaire Other GPs' opinions we have concentrated on measuring perceived differences between the copy of the computer record and manually kept record. Only if the respondents felt that the computer copy was an improvement was this perception further tested by measuring specific features, such as the quality. If the opposite was the case no formal test took place and some idea of the doctors' perception of quality could only be obtained from the free comment. This does not make it possible to arrive at a common measure of quality and the conclusions have to be restricted to commenting on individual categories of responses. This imbalance in the measurement of quality of information is even more evident in the questionnaire Medical records in general practice. Here opinions about the

quality of information were only elicited if the respondents had not found it easy to search the record. This has led to an extremely small sample size (as far as quality of information is concerned) in the case of computer records where the respondents did not experience many difficulties in searching them.

It is also possible to hypothesise that simple patient records are relatively easy to search even if they lack structure so that the approach to the measurement of quality of information might have restricted the sample to complex patient records. This hypothesis was tested on the responses corresponding to manual records, which are set out in Table 1 below.

Table 1: Quality of primary care records (manual)

	Simple records	Complex records	Totals
Satisfactory	10	4	14
Not satisfactory	7	7	14
Total	17	11	28

The test for significance of the difference between simple and complex records shows $x^2 = 1.35$ corresponding to $p = .24$ and the above hypothesis was rejected.

Conclusions

The results of measurements of quality of information contained in patient primary care records allow the following conclusions to be made:

1. There are very few problems in retrieving information from computer patient primary care records. On no occasion has it been found that quality of information was the cause of such a problem.

2. There are many problems in retrieving information from manual patient primary care records. In 48.3% of cases at least one of the reasons for this is bad quality of information, particularly its order and structure.

3. When inexperienced users are presented with a hard copy of computer patient record and the manually kept patient record in some 61.4% of cases they consider the structured computer record to be an improvement on the traditional manually kept patient record because of a better quality of information. 55.6% of these found the format more useful, 59.2% felt that the structured record was more informative in content, and 81.5% thought that the improvement was due to the fact that the structured record contained only salient details.

4. A minority of 25% of inexperienced users consider the hard copy of the computer patient record to be worse than the traditional manually kept record due to a deterioration in the quality of information. The lack of personal feel and comment in the computer record makes them feel that it is less informative. It is possible that this opinion will become less stongly held in future as the personal comments build up in the computer records with the passage of time.

3.3 CONTINUITY OF RECORD

Continuity of record is defined in the Handbook as:
An assessment of the effectiveness of a record in presenting information associated with the continuous development and/or management of problems.

This assessment was performed by the administration of the questionnaire Medical records in general practice (see 3.1 for details and Appendix A for summary of results). Continuity of record is measured in this questionnaire by Question 5: "If you compare the information contained in the record with what you have learnt from the patient during this encounter, did the record present an accurate and continuous picture of the patient's history?" The respondents were asked to answer Yes or No or Not Applicable to this question. The third option would have catered, for example, for those cases where the whole of the patient record was not used during the consultation. If the answer to this question was in the negative the respondents were further asked which part of the record was at fault, by ticking a checklist. The checklist consisted of the following items: priority details, history, medication, results of test and investigations, discharge letters and other hospital communications, current episode of treatment, other. For each item the respondents were invited to indicate whether it was incomplete or inaccurate. Ample space was allowed for any comments.

Results

Out of the 29 questionnaires corresponding to manual records 8 answered Question 5 as Not Applicable and they were excluded from any further analysis. Of the remaining 21, eight were answered in the affirmative and they were therefore assumed to indicate accurate and complete information in all parts of the record, giving a continuous picture of patient problems. In the other 13 cases one or more parts of the record were at fault, i.e. they were either incomplete or inaccurate. Most of the deficiencies were due to the relevant information not being in the record. The range of incompleteness covered the whole possible spectrum, with two records being considered incomplete in all six parts presented in the checklist and another two being faulty only in one part. Table 2 below displays the deficiencies by type and part of record.

Table 2: Deficiencies of manual patient records (Sample size = 13)

	Priority	History	Medication	Tests	Hospital Letters	Current Episode	Total
Incomplete	8	8	6	6	6	3	37
Inaccurate	2	1	0	0	0	0	3
Total	10	9	6	6	6	3	40

A different picture emerged for the computer patient records. 249 questionnaires contained an answer to Question 5 concerning continuity of record. Of these answers 47 were not applicable, so that the resulting sample used in the following analysis contained 202 replies. 190 of these answered Question 5 in the affirmative and the remaining 12 corresponded to patient records that were in some way deficient. As opposed to manual records computer records never contained more than one deficiency in a given patient record. The following Table 3 demonstrates the distribution of the number of missing (incomplete records) and inaccurate items of information in various parts of the patient record.

Table 3: Deficiencies in computer patient records (Sample size = 12)

	Priority	History	Medication	Tests	Hospital Letters	Current Episode	Total
Incomplete	2	1	2	1	5	0	11
Inaccurate	0	0	1	0	0	0	1
Total	2	1	3	1	5	0	12

Discussion

The difference between the computer and manual patient records as regards their continuity is staggering. Only 8 out of 21 manual patient records (38.1%) were considered by the respondents to give an accurate and continuous picture of the patient's history, as opposed to 190 out of 202 (94.1%) computer patient records. This difference (56%) is so large that there is hardly any need for a statistical test of significance, nevertheless for the purists the test of difference between the two proportions shows $Z = 7.78$ corresponding to $p \doteq 0$. Incidentally the same statistical test also shows that the computerisation of records can be expected to lead to an actual improvement in the proportion of records that give an accurate and continuous picture of the patient lying between 34% and 78%, at the 95% confidence level.

We have also tested the significance of differences between the continuity of individual parts of patient record. In doing so the following assumption had to be made. The wording of Question 5 in the Medical records in general practice questionnaire asked the respondents to indicate whether the record was continuous. If the answer was negative they were required to elaborate and show which part of record was at fault. This means that if only certain parts of the record were used during a consultation and found to be deficient the answers given would relate only to those parts. Similarly, if only some parts were consulted and found to be in agreement with what the patient said the question would be answered positively. This would result in under-recording of deficiencies. However, the large number of "Not applicable" replies, as well as the knowledge of the way GPs use the record leads us to believe that in most cases the whole of the record was consulted so that this possibility has not been a significant problem. It has been assumed, therefore, in the following that all the parts of the record that were not put down as deficient were satisfactory.

Table 4 below summarises the differences between the continuity of individual parts of manual and computer patient records.

Table 4: Continuity of patient primary care records (%)

Part of patient record	Manual (sample size = 21)	Computer (sample size = 202)	Statistic
Priority details	52.4	99.0	$Z = 8.96$ $P(x \geq z) \doteq 0$
History	57.1	99.5	$Z = 8.93$ $P(x \geq z) \doteq 0$
Medication	71.4	98.5	$Z = 6.06$ $P(x \geq z) \doteq 0$
Laboratory tests	71.4	99.5	$Z = 7.10$ $P(x \geq z) \doteq 0$
Hospital letters	71.4	97.5	$Z = 5.22$ $P(x \geq z) \doteq 0$
Current episode	85.7	100.0	$Z = 5.38$ $P(x \geq z) \doteq 0$

Conclusions

The figures obtained for the measurement of continuity of record imply that the computerisation of patient primary care records results in:

1. Increase by some 56% in the proportion of records that give a continuous and accurate picture of the patient.

2. Increases ranging from 14.3% to 46.6% in the proportion of individual parts of patient record, such as priority details, history, medication, laboratory tests and investigations, discharge letters and other hospital communications and current episode of treatment that give a continuous and accurate picture of the patient.

3.4 LEGIBILITY OF INFORMATION

Definition

The Handbook on the Measurement of Performance Criteria (2) defines legibility of information as:

A statement of individual opinions as regards legibility

In the original investigation into performance criteria (1) legibility of information appeared very low on the list of respondents' priorities. The highest rank that it achieved was 10, which was given to it by general practitioners and nurses. It has been included in this report mainly because its measurement involved only one additional question in the two questionnaires.

Method of measurement

Both the Medical records in general practice questionnaire and Other GPs opinions questionnaire were used to measure legibility of information. In the former questionnaire the respondents were asked whether it had been easy to search the record (Question 3, see Appendix A). If the answer was negative they were further asked to give a reason by ticking a checklist. The number of answers to the item (b) in the checklist ("the record was difficult to read") was taken as the measure of legibility of information.

In the other questionnaire, Other GPs' opinions, the respondents were asked whether they had found the "structured" record, i.e. a hard copy of the computer record, an improvement on the "traditional" record kept on continuation cards. If they thought that this was the case they were requested to give a reason, again by ticking a checklist. The number of answers that included the first item from the list ("it is more legible", see Appendix B) give the measure of legibility of information.

If the respondents thought that the computer record was worse than the manual record they were asked to give the reason for this opinion in the space reserved for free comment. The free comments were analysed and any mention of legibility was used as a supporting measure of legibility of information.

Results

Out of 291 Medical records in general practice questionnaires corresponding to computer records 285 contained an answer to the Question 3. Four out of these 285 replies contained negative answers to this question but only one of these four gave as the reason that the record was difficult to read. Put another way, only in .35% of all cases was legibility a contributory factor to difficulties in searching the record.

The situation was not so good with manual records. Out of the 29 replies corresponding to manual records 15 stated that the record had not been easy to search. Of these 15, 11 gave as one of the reasons that the record had been difficult to read. This means that in 37.9% of all manual records legibility was one of the reasons why the record was difficult to search.

The results of Other GPs' opinions questionnaire support the evidence from the above discussed questionnaire. 28 respondents out of 31 who were of the opinion that the hard copy of computer record was an improvement on the manual record thought that one of the reasons was because the computer record was more legible. This represents 63.6% of all the applicable responses. As mentioned in the previous section there were 11 respondents who felt that the computer record was worse than the manual record. Of these 11 two (2) commented on legibility: one thought that the computer record was more legible and the other complained that the printout was very faint.

Discussion

As with the measurement of quality of information and information retrieval, the measurement of legibility suffers from the imbalance contained in both evaluation instruments. In neither the Medical records in general practice questionnaire nor in Other GPs' opinions questionnaire was legibility measured per se. Instead in the former case the question dealing with legibility was only asked after a certain threshold problem value had been reached, namely after the respondent had experienced difficulties with searching the record.

In the latter case the checklist was only presented to those respondents who had thought that the computer record was an improvement on the manual record. Those who did not think so were only invited to put down the reasons as free comment. Although these respondents could be affected, and probably were sometimes affected, by the items from the checklist in their free comments, a specific "nudge" which a proper checklist would provide was absent in their case. It is therefore advisable to keep the analysis and presentation of results separate for both types of respondents.

Conclusions

1. When retrieving information from computer held patient primary care records legibility of information is likely to be a source of difficulty only in some .35% of cases.

2. In the case of manual patient primary care records the search for information will adversely be affected for reasons of legibility in some 37.9% of cases.

3. Inexperienced users consider a hard copy of computer patient record to be an improvement on the manually kept patient record because of a better legibility in some 63.5% of cases of all responses.

4. Some inexperienced users do not think the computer record to be an improvement. One out of 11 of such users (2.3% of the total number of respondents) perceived the legibility of information to be better, however; the same number commented on a faint printout.

3.5 INFORMATION RETRIEVAL

Definition

This criterion is defined in the Handbook as:

An analysis of time spent by staff to retrieve information from records

Since the information contained in patient records is mostly used by doctors, the scope of this criterion was restricted to the measurement of time that the doctors take to find out the information they want.

Method of measurement

All three instruments described in the Introduction to this section viz. Controlled trial of patient records, Medical records in general practice and Other GPs' opinions, were used for the measurement of information retrieval.

In the Controlled trial of patient records a doctor answered 20 questionnaires each of which corresponded to a patient record (10 manual and 10 computer). Each questionnaire contained 10 factual questions concerning the patient's record and a stopwatch was used to measure the time taken to answer the whole of the questionnaire. Because the individual questions asked for different amounts of information the concept of an "information item" i.e. a simple indivisible fact was introduced. Information retrieval was therefore measured by the time necessary to obtain an item of information from the patient record. Since the distribution of the number of information items per questionnaire was known and the distribution of times necessary to answer a questionnaire was measured, it was possible to calculate the parameters of the distribution of time required to find an item of information. The parameters of all three distributions are shown in Table 5 below (the parameters of the distribution of the number of items per questionnaire were calculated from the combined sample because there was no significant difference in the relevant distributions corresponding to manual and computer records).

Table 5: Retrieval of information from patient primary care records

	Computer		Manual	
	Mean (mins)	Standard deviation	Mean (mins)	Standard deviation
Time per questionnaire (X)	4.86	1.61	8.92	2.13
Items per questionnaire (Y)	14.1	2.52	14.1	2.52
Time per item ($Z = \frac{X}{Y}$)	.346	.122	.630	.163

The two sample test of difference between the means shows $t = 4.40$ with 18 degrees of freedom which corresponds to $P<.001$, suggesting a significant difference between the retrieval of an information item from a manual and a computer record.

In the questionnaire Medical records in general practice information retrieval was measured by answers to Question 3: "Was it easy to search the record". The respondents were required to answer Yes or No to this question. 285 out of possible 291 questionnaires concerning computer records contained an answer to this question, which was also the case for all 29 questionnaires corresponding to manual records. For a given type of record no significant difference in the proportion of positive answers was found either between complex and other cases, or between respondent's own partner's patients. In Table 6 below is therefore the contingency table based on the combined sample of respondents.

Table 6: Ease of search through patient primary care records

	Manual	Computer	Total
Easy to search	15	281	296
Not easy to search	14	4	18
Total Total	29	285	314

98.6% of responses corresponding to computer records indicated that it had been easy to search the record. The corresponding proportion for manual records was 57.7%. X^2 value for this difference is 107 with 1 degree of freedom giving $P = 0$, i.e. the difference between the two proportions is highly significant.

Both the above results are supported by the data obtained from the questionnaire Other GPs' opinions (see Appendix B). The respondents were asked whether they found the hard copy of the computer record ("structured") an improvement on the manual record ("traditional"). If the answer was positive they were further asked to give the reason by ticking a checklist. The number of answers stating that the record is quicker to peruse were taken as a measure of information retrieval. 16 out of 31 respondents who thought that the structured computer record was an improvement on the manual record were of the opinion that at least one of the reasons why this was so was because it was quicker to peruse.

If the respondents felt that the hard copy of the computer record was worse than the manual record they were invited to give their reasons as a free comment.

The free comments were subsequently analysed. Out of 11 responses that fell into this category none indicated that the computer record was worse because it took more time to extract information from it. However one respondent admitted that although a deterioration on the manual record the hard copy of the computer was quick to peruse.

Discussion

The results of the above three surveys are conclusive. The belief that a better layout and a greater degree of structure, together with better legibility, will lead to a reduction of time that a doctor needs to retrieve information from the patient record, has been vindicated. The "hard" measure taken during the Controlled trial shows that compared with manual records kept in NHS envelopes on continuation cards, with at best chronological listing of the patient's history, the use of structured computer record accessed in real time will save some 45.1% of time necessary for the retrieval of an item of information. Since it can be

assumed/

assumed that the number of information items that the doctor wishes to find during an encounter with a patient is independent of the way in which records are kept, the same reduction of 45.1% will apply to the overall time spent on information retrieval. This result is supported by the evidence from the questionnaire Medical records in general practice which demonstrates that the doctors who are experienced in using computer records perceive them to be much easier to search than manual records.

The results from the third instrument, Other GPs' opinions, suffer from imbalance inherent in the design of this questionnaire. In this questionnaire only those of the inexperienced users who considered the hard copy of the computer record to be an improvement on the manual record were presented with a checklist and asked to elaborate on their reasons. 51.6% of respondents stated that one reason for this improvement was because the computer record was quicker to peruse. In addition one respondent who thought that the manual record was better and who had not therefore been given the checklist of reasons, mentioned information retrieval in the free comment and he thought that the computer record was quick to peruse. We feel, therefore, that taken as a group, these respondents also contribute to the evidence that the structured computer record leads to an easier information retrieval.

A word of warning is in place at this stage. It must be recognised that the time spent on retrieval of information from patient record is only a part of the time during which doctors are in contact with the record. The other major element is the record maintenance time. Although this latter quantity is one of the performance criteria in the original set it has not been included in this report because it had not been ranked important enough by the NHS users, From discussions with the users of the Exeter computer system as well as from free comments supplied in the above questionnaires it seems that the time required for the maintenance of computer record is greater than for its manual counterpart. It is mainly due to the need for keyboard input which the users find slower than handwriting. This time increase is not felt to be so large as the reduction in the time due to a better retrieval so that the overall nett effect should be a saving on the time doctors spend in contact with the record.

A small time saving will therefore result if the doctors maintain their records themselves. However, as it is feasible with computer records for the doctor to work from a hard copy (regularly printed) and to delegate the record maintenance to the support staff (as is the case in Mount Pleasant Health Centre), computerisation of patient records can result in the above quoted saving of medical staff's time at the expense of some increase in the workload of receptionists and secretaries.

Conclusions

a) A better layout, a greater degree of structure and better legibility make the computer record much quicker to peruse than the manual record.

b) Computerisation of patient primary care records can be expected to result in a 45.1% reduction of time that the doctors spend on getting information from the record.

3.6 COMPREHENSIBILITY OF RECORD

Definition

Comprehensibility of record is defined in the Handbook on measurement of performance criteria as:

> A measure of the knowledge of patient gained by the perusal of the patient record.

The pressure on the doctor during an average surgery is considerable and because of this the time that is spent on searching through the patient record is at a premium. It is therefore not surprising that comprehensibility of record has been ranked second in the list of criteria that GPs take into account when comparing different primary care systems (1), since it has such a great impact on the total consultation time.

Method of measurement

Because of its importance all three instruments described in the introduction (see section 3.1) were used to evaluate this criterion. In the Controlled trial of patient records a doctor answered 20 questionnaires each of which correspond to a different patient record. 10 of these records were manually kept and the other 10 were maintained on the computer. Each questionnaire contained 10 factual questions concerning a patient's record. As the individual questions asked for different amounts of information the concept of an "information item" i.e. a simple indivisible fact was introduced. Answers to the questionnaires were marked by another doctor. Comprehensibility of record was measured by the total proportion of information items that were answered correctly.

Another measure of comprehensibility of record was obtained from answers to the Question 4 in the questionnaire Medical records in general practice (see Appendix A). The doctors, who were all experienced in the use of computer records, were required to state whether the items of information that they had found in the patient record were easy to assimilate and correlate. If they disagreed with this question they were further asked whether they had not found it easy because of the way the items were recorded. In this way all the other effects not directly concerned with the record maintenance, such as for example complications in the patient's history, should have been eliminated. The proportion of replies that stated that items of information found in the record were not easy to assimilate and correlate and, at the same time, claimed that this was due to the way they were recorded is a measure how difficult the record is to understand. The complementary proportion to this "incomprehensibility ratio" can be taken as a quantity that is similar to comprehensibility as measured by the Controlled trial of patient records.

In the questionnaire Other GPs' opinions comprehensibility of record was gleaned from the answers to Question 3 (see Appendix B). In this question the inexperienced users were asked whether they felt that after a perusal of the hard copy of the computer record ("structured" record) their knowledge was better, or about the same, or worse than when searching through the manual record ("traditional" record in the questionnaire's parlance). The proportion of respondents who thought that their knowledge of the patient was better was taken as a measure of improvement in the comprehensibility of record.

Results

10 computer patient records from the Controlled trial of patient records contained 139 items of information and 126 of these (90.6%) were answered correctly. Of the 143 items of information from the 10 manual patient records correct answers were obtained for 122 (85.3%). The contingency table below was analysed to establish whether the difference between the two proportions is statistically significant.

Table 7: Comprehensibility of patient primary care records

	Manual	Computer	Total
Correct items	122	126	248
Incorrect and missing items	21	13	34
Total	143	139	282

The value of X^2 from the above table is 1.89 with 1 degree of freedom giving P = .18 which means that the observed difference in comprehensibility between the computer and the manual patient record is not significant at 95% confidence level. The sample size in the Controlled trial of patient records was not very large and it is possible that this fact has had an adverse effect on the significance of the results. The measures obtained from the other evaluation instruments have to be investigated before making a final judgement as to the difference in comprehensibility of record.

315 replies (279 of which were applicable) to Question 4 of the Medical records in general practice questionnaire were received with 254 corresponding to computer patient records and 25 to manual patient records. In two cases (1 manual record and 1 computer record) respondents experienced some difficulty in correlating and assimilating facts found in the record but this was not because of the way they were recorded. These two questionnaires were classified as "not applicable" and they were excluded from any further analysis. Only 2 computer records were considered by the respondents to have caused some difficulty in assimilating and correlating information because of the way this information was recorded. The corresponding figure for the manual patient records was 11. The results of this questionnaire are displayed in Table 8 below.

Table 8: Perception of comprehensibility

	Manual	Computer	Total
Record comprehensible	13	251	264
Difficulties in comprehending	11	2	13
Total	24	253	277

From the above table $X^2 = 99.4$ with 1 degree of freedom corresponding to P = 0. The difference in the proportion of records that caused some difficulty in correlating and assimilating facts because of the way that they were recorded is therefore highly significant. This proportion is .8% for computer records and 45.8% for manual records. Viewed from the same angle as the measure obtained from the Controlled trial of patient records the perceived comprehensibility of computer records is 99.2% whilst the corresponding value for manual records is only 54.2%. The relationship between these quantities is discussed in the next section.

Results from the questionnaire Other GPs' opinions confirm the trend of replies to the Medical records in general practice questionnaire. In Question 3 respondents were asked whether, after perusal of the computer patient record, the knowledge of the patient was better, or about the same, or worse than when compared with the manual patient record. The reader can see the results in the Table below. Not surprisingly a high correlation was found between the answers to Question 2, i.e. whether the respondents felt that the computer record was an improvement on the manual record, and the perception of the difference in knowledge of the patient. Presentation of data in Table 9 highlights this correlation.

Table 9: Knowledge of patient

	Question 2 (Improvement)			Total
Question 3 (Knowledge)	Yes	No	Neither Yes Nor No	
Better	22	-	-	22
About the same	8	4	1	13
Worse	-	7	1	8
Total	30	11	2	43

To find out whether there is a statistically significant difference in the respondents' knowledge of the patient the null hypothesis was postulated as there being no difference between the two types of record. The sign test was then applied to accept or reject this hypothesis. The X^2 value (with continuity correction) is 6.53 with 1 degree of freedom corresponding to P = .011. The null hypothesis is therefore rejected which implies that the perusal of the computer patient record ("structured") results in a better knowledge of the patient.

Discussion

At first sight the reader may be astounded by an apparent discrepancy between the values obtained for comprehensibility from the Controlled trial of patient records on one hand and Medical records questionnaire on the other. To put both results into perspective it is necessary to explain how this difference has arisen.

From the Controlled trial it has been found that the comprehensibility of computer record is 90.6% and that of manual records 85.3%. In this instrument comprehensibility was defined as the proportion of items of information that were answered correctly. The answering GP had a fairly good idea, from the way the trial had been set up, that an answer to a question should be somewhere in the record. As we were interested in establishing the difference in information retrieval, as well as the difference in comprehensibility, no "trick" questions were allowed in the questionnaires because the resulting protracted search for something that was not contained in the record without a means of checking that piece of information with the patient, would invalidate the results. This fact may have spurred the answering GP on so that a better than expected score was achieved for the manual record (at the expense, possibly, of a longer retrieval time).

Moreover, the figure of 85.3% of items answered correctly does not imply that 85.3% of manual patient records did not present difficulties in correlating and assimilating individual facts. When observing the doctor's behaviour during the Controlled trial of patient records and during discussions with him about his opinions of it, the author's attention was repeatedly drawn to the fact how much more laborious manual records were for extracting information. Long retrieval times are indicative of incessant thumbing backwards and forwards through the contents of the envelope, which is not conducive to easy correlation and assimilation of individual facts. Although these facts were, in most cases, eventually uncovered and most of the questions were answered correctly, it is likely that an administration of the questionnaire Medical records in general practice during the Controlled trial of patient records would have shown similar results for perceived comprehensibility as when this questionnaire was administered separately (i.e. 99.2% and 54.2% for computer and manual patient records respectively).

The three quantities obtained from the three evaluation instruments should not be confused with one another but they should be taken for what they are: measures of different aspects of comprehensibility of record. Thus the results of the questionnaire Medical records in general practice give a subjective measure of difficulties caused by recording that the doctors are faced with when they are trying to understand facts retrieved from the patient record during an encounter with the patient. A subjective measure of the knowledge of the patient gathered from the patient's record, i.e. the outcome of the record search and, possibly, of overcoming the above mentioned difficulties, that was acquired during an encounter with the patient is obtained from the questionnaire Other GPs' opinions. And finally from the Controlled trial of patient records one can arrive at a hard measure of the potential knowledge of the patient that can be achieved by the search through different types of patient record.

Conclusions

1. When doctors who are experienced in the use of computer patient records use these during encounters with patients they find that in 99.2% of all the cases the way that these facts are recorded does not present difficulties in correlating and assimilating them. The corresponding figure for manual records is 54.2% and this difference is statistically significant.

2. A significantly greater number of doctors who are not experienced in the use of computer records, find that their knowledge of the patient is better after the perusal of a hard copy of the computer patient record than when using the manual patient record.

3. In a controlled trial 90.6% of items were successfully retrieved from computer patient records as opposed to 85.3% for manual patient records. Although this difference is not statistically significant at 95% level, when it is taken together with the above two findings it supports the evidence that computerisation leads to a better comprehensibility of record.

4. COMMUNICATIONS

4.1 COMMUNICATIONS OUTSIDE - SPEED

Introduction

Patients are referred from primary care for a variety of reasons. For instance the patient's general practitioner may feel that the state of the patient's health necessitates an immediate admission to hospital. Alternatively a series of tests may be necessary which can only be performed in the hospital. In many cases samples of blood and tissue have to be sent to the pathology laboratory for investigation, or the general practitioner often comes to the conclusion that although the patient's condition does not warrant an admission it nevertheless requires treatment by, or an opinion of, a hospital specialist.

All these situations involve communication of information from primary care and it is essential for good delivery of care that such communications are performed speedily and accurately. Health care providers who took part in establishing the performance criteria valued greatly this aspect of primary care systems. Two performance criteria in particular have been highly rated in their list of priorities: Communications outside - speed, and Information communicated to outsiders - usefulness.

Communications outside - speed is defined in the Handbook (2) as A measurement of speed of referring patients for consultation, laboratory tests, X-rays etc. Two main elements that make up the time elapsing between the decision to communicate information and the arrival of it at the recipients office are:

(a) the time between the decision and the despatch of a letter, possibly together with samples,

and (b) time between despatch and receipt.

Of the two times the latter is by far the larger. Unless the computerised primary care system includes a means of electronic communication of information between primary care and secondary care the time is entirely dependent on external factors, such as the efficiency of the postal service or local arrangements for mail delivery between health care locations. Although the Exeter system is an integrated system which allows, in principle, automatic communication of information between health centres and hospital by physically sharing files, no such communication has been utilised in practice. The computerisation of patient primary care records has therefore made no impact on the time between the despatch of information from the health centre and its receipt at the hospital.

A similar conclusion can be drawn for the other element of the total time, viz the time between a decision to communicate information and the despatch of documentation. Although it is true that the preparation of information to be sent off can be made quicker by enclosing a computer printout of the patient primary care record (or a part of it), it is very unlikely that this comparatively small time saving could make any significant difference in the overall time between the decision to communicate information and its receipt in hospital. To put it bluntly the volume of information that the doctors feel ought to be communicated to other health care agencies is not one of the reasons why the post may sometimes be missed.

The above arguments clearly indicate that computerisation of primary care records (as currently implemented at Ottery St. Mary and Mt. Pleasant health centres) is unlikely to have any significant effect on the speed with which information is communicated outside the health centre. This criterion has therefore been left out of any further detailed analysis.

4.2 INFORMATION COMMUNICATED TO OUTSIDERS - USEFULNESS

The case for the other criterion treated in this section, Information communicated to outsiders - usefulness, is altogether different. This criterion is defined in the Handbook as:

An assessment of the usefulness of information communicated, for example, to clinicians in hospital as judged by recipients.

There is every reason to believe that a generally better quality of information contained in the computerised patient primary care record, and the ease with which any part of it can be printed on a terminal located in the health centre, make a difference to the usefulness of information sent out from the health centre. The referral letter for an outpatient consultation has been taken as a representative document for communications from the health centre, and its usefulness to hospital consultants was investigated in detail (4).

Method of measurement

A survey of contents of 215 referral letters for an outpatient appointment was undertaken. This was a systematic sample containing all the letters written by OSM general practitioners during a period of 9 months, excluding those patients who were current patients at the time of the survey. Of these 215 letters that had been sent to 23 consultants, 24 had a hard copy of the computer record (or a part of it) enclosed. It was found that the presence or absence of a copy of the computer record had no effect either on the length of the referral letter or on its contents. There was no significant difference in the distribution of referral letters with the computer record covering medical, surgical and other clinics. To establish the usefulness of information communicated from the health centre four consultants (three surgeons and one physician), who had received most of the referral letters, were approached and agreed to participate in the study. Together they accounted for 82 referrals (out of 215) and 16 copies of the computer record (out of 24). One general practitioner from OSM health centre also took part. The study was done in four separate sessions each consisting of one consultant, the general practitioner and the author of this report, who did the recording. A VDU was used to retrieve the patient health centre record and hospital case notes of all the relevant patients were made available to the consultant.

The consultant was asked to peruse the episode in the case notes and to locate the referral letter, together with any computer printed enclosures. The patient health centre record was displayed on the VDU and the consultant and the general practitioner compared the contents of the referral letter (without enclosures) with the information in the patient health centre record. A note was made of all those items that were found in the health centre record but were missing from the referral letter that the consultant would have found useful to know at the beginning of the given episode. The consultant then made an overall assessment of the usefulness of the patient health centre record to him. This has been grouped under:

(a) of benefit, i.e. when the consultant was of the opinion that a copy of the patient record was, or would have been if it had been enclosed, useful to have in addition to the referral letter.

(b) no benefit, i.e. when the consultant thought that the computer record did not provide, or would not have provided if it had been enclosed, any additional useful information to that already contained in the referral letter.

Results

Table 10 shows the distribution of assessed benefits of enclosing a copy of the patient health centre record and having, therefore, information about a patient additional to that contained in the referral letter, categorised by consultant and the fact whether or not a computer copy had been enclosed. Consultant 3 was a physician, the other three were surgeons.

Table 10: Availability of primary care records to consultants

Consultant	No enclosure		Computer enclosure	
	Benefit	No Benefit	Benefit	No Benefit
1	4	12	2	2
2	9	9	1	1
3	2	5	2	4
4	6	19	2	2
Total	21	45	7	9

No significant difference in the distribution was found either between individual consultants or between surgical and medical consultants. The data was therefore aggregated into Table 11 below.

Table 11: Benefits of primary care records to consultants (computer)

	Benefit	No Benefit	
Patient health centre record available to consultant (i.e. computer copy enclosed)	7	9	16
Patient health centre record not available to consultant (i.e. only referral letter present)	21	45	66
	28	54	82

The rows in the above table correspond to the referral letters with and without a copy of the patient primary care record, i.e. they discriminate between the following two categories of referrals: (a) those where a copy of the primary care record was thought by the general practitioner to provide a useful background, and (b) those where, in the eyes of the referring general practitioner, nothing would have been gained by enclosing a copy of the patient primary care record. The columns correspond to the consultants' perception of having the patient primary care record available at the time of referral. The first column indicates where the availability of the primary care record was (in the cases where a copy of it was enclosed), or would have been (in those cases where it was absent), of benefit. These two quantities therefore represent a measure of usefulness of information communicated from the primary care to hospital. The second column corresponds to the cases where the availability of the patient health centre record did not provide, or would not have provided, any useful information further to that already contained in the referral letter.

It can be seen from Table 11 that enclosing the patient primary care record with every referral letter would benefit 28 patients in our sample. This ideal situation could easily be achieved with computer based patient primary care records because a copy of such a record could be produced at negligible marginal cost. On the other hand, a manual record keeping system is not suitable for easy production of copies and it is reasonable to assume that no information additional to that contained in the referral letter is made available to consultants under such a system. If our sample had related to such a system Table 11 would degenerate to Table 12 below.

Table 12: Benefits of primary care records to consultants (manual)

	Benefit	No Benefit
Patient primary care record available to consultant	0	0
Patient primary care record not available to consultant	28	54

Comparison of Tables 11 and 12 suggests that the proportion of "beneficial" primary care records that are made available to consultants to the total of "beneficial" primary care records, could be taken as a measure of usefulness of information communicated from primary care in addition to the referral letter. Ideally this proportion would be equal to 100%, i.e. every "beneficial" record should be available to the consultant, which represents the potential of the computerised patient primary care records. The performance of OSM health centre obtained from our sample indicates that the operational level of usefulness of information (additional to the referral letter) communicated to hospital is 25% (7:28). The expected level of usefulness of information additional to the referral letter that is sent to the hospital from a health centre operating a manual record system is 0.

Discussion of results

The measurement of usefulness of information communicated from primary care that was described in the previous section has focused on only one aspect of such communication, viz the referral letter for outpatient appointment. The restriction was forced on the evaluation by the fact that the performance criterion in question prescribed that the assessment of this usefulness be made by the recipients of information. The author of this report has met with the utmost cooperation on the part of all medical staff who were approached but in spite of this it was not easy to arrange meetings between several members of medical staff because of their many commitments. This made it imperative to limit the number of participants to an acceptable minimum and to concentrate on one type of communication. Given this background the referral letter became a natural choice.

The usefulness of information is measured on a linearly increasing scale. Its lowest value is zero, which is the implied level for a manual patient primary care record system, and the highest value is 100, representing the maximum potential of a computer based system. It must be emphasised that this scale refers to the information additional to that contained in the referral letter (the referral letter is assumed to be independent of the system of patient record keeping). Thus the value of zero given to the manual system does not mean that the information communicated from such health centres is useless but rather

that apart from the referral letter, no other information that would be of use to the hospital consultants is communicated from health centres with manual record systems. On this scale the performance of OSM health centre at the time of the survey was put at 25.

Another interesting, albeit disappointing, conclusion can be drawn from Table 10. As mentioned earlier the rows in this Table correspond, respectively, to the referral letters with and without a copy of the patient primary care record. Since general practitioners enclose such copies only where they consider them to be useful for the consultant, these rows also present a picture of this assumed usefulness. In the ideal world this usefulness should correlate highly with what the consultants themselves find of use. The null hypothesis of there being no difference in what the consultants find useful depending on what the general practitioners think they may find useful was tested. The value of x^2 = .82 with 1 degree of freedom giving P of a greater value = .39. This null hypothesis cannot therefore be rejected which illustrates a considerable difference of opinion between hospital consultants and general practitioners regarding the usefulness of the patient health centre record for outpatient referrals.

Conclusions

1. Referral letters are used as the main means of communicating information when a patient is referred by his general practitioner for an outpatient appointment. In the case of a manual primary record system the referral letter is likely to be the sole means of such communications.

2. A computer based patient primary care record system enables a copy of the primary care record to be enclosed with the referral letter. Hospital consultants would find this useful in 28 cases out of 82 (34.2%). A quarter of this potential (7 out of 28) has been realised in one health centre with such a system.

5. STATISTICAL INFORMATION

One of the great advantages of computerisation is the ease with which patient records held on a computer can be analysed, so that meaningful statistics can be obtained. When patient records are maintained manually the amount of effort that is involved in the production or statistics normally means that the task is rarely undertaken on a regular basis. In a few cases when statistics are prepared it is done because a particular need has arisen at that point in time, and more often than not the analysis will be based on a sample of patient records. With computerised records statistical information will normally be derived from records of all the patients registered in the health centre.

As virtually no statistical information was utilised in either of the two health centres when the patient records were maintained manually, the following sections describe exclusively the situation after the introduction of the computer. All the output that is described below is printed on a line printer in the computer centre and delivered to relevant locations by hand.

5.1 MANAGEMENT INFORMATION

This criterion is defined in the Handbook (2) as

> An assessment of the availability, and use made, of information on the centre throughput

The scope of the above definition was somewhat enlarged in this report by considering in addition to throughput, also the "static" characteristics of the population, such as age distribution, geographical distribution, etc.

Information produced regularly

Health centre register, i.e. an alphabetical listing of all the patients registered with the health centre, is produced once per quarter. A general practitioner register, i.e. an alphabetical listing of all the patients registered with the individual general practitioners, is also printed at the same time. These registers provide an information base for aggregation into head count statistics which describe, for every doctor, age and sex distribution of his patients, as well as numbers of patients living within specified localities. This information can be of use, from time to time. to re-distribute the patients among the general practitioners working in the health centre in order to smooth out the workload.

If the health centre operates branch surgeries a list of patients attending at each branch surgery is also printed at this time. To facilitate the work of health visitors a list of children under five years of age and possibly of patients over sixty five and seventy five years of age are also produced. The order in which the names are presented depends on the method of working in each health centre.

As regards throughput numbers of attendances, visits and consultations are tabulated by the general practitioner who saw the patient, as well as by the general practitioner with whom the patient is registered. Similar information is also made available for patients attending at branch surgeries.

Information produced on request

Listings of patients living at the same address can easily be produced. The doctors find this useful particularly for estimating the potential and actual workload at residential schools, old people's homes, etc.

5.2 EPIDEMIOLOGICAL INFORMATION

The Handbook (2) defines this criterion as

> An assessment of availability and use made of e.g. morbidity statistics, ad hoc enquiries, etc.

The degree of structure contained in the clinical part of the computerised patient record makes it very suitable for computer analysis, which makes the provision of epidemiological information fairly straightforward. Although it would be easy to produce a distribution of diseases among health centre population, in practice the doctors tend to turn their attention to specific groups of patients.

Every six months a list of "at risk" patients is printed. These patients are defined as those suffering from conditions that require regular medical attention, e.g. hypertensives, diabetics, epileptics, etc. Another major group whose epidemiology is analysed regularly are patients on repeated medication. This analysis is currently performed quarterly when all the "repeated" drugs are listed in therapeutic groups both alphabetically and according to their popularity. This information is the subject of regular practice meetings when decisions on drug prescribing and, possibly, on the rationalisation of drug usage are made.

A variety of ad hoc analyses are undertaken from time to time. These consist mainly of correlations between various combinations of conditions, age and drugs.

5.3 PREVENTATIVE MEDICINE

The definition in the Handbook, viz

> An analysis of the proportion of patients covered by preventative programmes

may be taken as to imply that the aim is to find the proportion of the patients who have acquired immunity to the condition in question, out of all the patients who are eligible for the programme. As this document is concerned with the evaluation of the effect of the computerisation of patient primary care record, the sights were slightly lowered and the proportion of patients to whom are sent recall letters was selected instead.

Clearly the success ratio of selecting people according to a given criterion from a computer file is well nigh 100%, assuming that the criterion in question is properly defined. In both health centres listings of patients eligible for rubella, tetanus and polio vaccinations are produced regularly. These are accompanied by computer printed self-adhesive labels which are stuck on printed letters and sent to patients. The chances of any eligible patient slipping through this net are therefore extremely small.

Similar arrangements apply also to other recall schemes, such as cervical smear, oral contraceptives, loops and 'flu vaccinations.

The ability to easily identify patients who are becoming of retirement age in a current year has led in Ottery St. Mary to the establishment of a retirement clinic, for which the eligible patients are automatically selected by the computer with the appropriate labels printed and standard letters dispatched.

6. CONFIDENTIALITY AND SECURITY

6.1 CONFIDENTIALITY OF INFORMATION

Patient medical records are confidential and, being highly sensitive, their confidentiality is a matter of public concern. This is the reason why this criterion, defined in the Handbook as:

An analysis of opportunities for misuse of information by unauthorised users

has been ranked very highly by the majority of people who are dealing with primary care. In any system dealing with patient records assurance must be given, and shown to be worthwhile, that patient data is only accessed by those who are entitled to it. This need for assurance is particularly great in the case of computer based system. In the following paragraphs a solution to the problem of confidentiality of computer based patient records as devised by the Exeter Community Health Services Computer Project is described (5). The solution has found acceptance by both patients and users, and has won the approval of the medical profession as represented by the British Medical Association.

Real time access

There are two main methods of control of access to computer held information via a terminal: one is based on hardware and the other employs a software approach. The most common hardware approach involves the use of badges, the insertion of which "unlocks" the terminal for the bearer of the badge. This approach has been rejected by ECHSCP on the grounds that in an environment where some users change from outdoor clothes into a uniform to do their work, badges would either be left in the pocket of the uniform and become a security risk, or would be left in the outdoor clothes and would not be available when required. It was therefore decided to opt for the software approach.

To "unlock" a terminal, i.e. a VDU or a printer terminal, the user must first type in a valid password. Each password consists of 6 digits so that with fewer than 10 GPs in an average health centre, and therefore fewer than 10 valid passwords, the probability of an unauthorised person succeeding in keying in a valid password and getting hold of medical information about a patient is less than .00001. The password not only defines what kind of information its holder can access but also determines what can be done with the information when it has been accessed, i.e. whether it can be only read, or added to, or updated and deleted. The level of access is controlled by the accessibility matrix, an example of which is illustrated below.

Table 13: Access by various groups of staff to a patient's record

Part of the patient's record	Staff in the health centre where the patient is registered		Staff in other health centres	
	GPs	Receptionists	GPs	Receptionists
Registration	Total	Total	Read only	Read only
Summary of clinical data	Total	None	None	None
Extended details of clinical data	Total	None	None	None
Current and past medication	Total	Add and Read	None	None

Total access in the above means that the user can read, add to, change or delete any information in that part of the patient's record. As can be seen from Table 14 staff in the patient's own health centre have total access to the record whilst the access of other staff is severely restricted.

In general access to patient records is controlled by the above accessibility matrix. Before any action that has been requested by a user is taken by the computer the above matrix is consulted to establish whether the user is entitled to take the action. If this is not the case the action is not permitted and an appropriate message is displayed on the VDU. However, there are instances when it is desirable that certain people are allowed extended access to certain patient records. An example of this is the case of a patient who may be staying temporarily in a catchment area of another computerised health centre and who may suddenly require medical care. The patient's own general practitioner has a means of marking such a record so as to modify the accessibility matrix for this record only and allow the general practitioners in the other health centre access to the whole of the patient record.

Control of access discussed so far operates on file and record level. It is possible to refine the level of control even further and bring it down to the data item level. This facility is important in primary care because it is considered to be vital for the doctor - patient relationship that the patient should be confident that, if required, certain information is only for the eyes and ears of his own doctor. Items of data in the patient record can be labelled to allow only the author, as identified from the password, to be able to recall these for display. For any other user this data is indicated as "suppressed" and it will never appear on any terminal, neither will it be printed out nor output to microfiche.

To further safeguard against unauthorised access a log of all uses of any password is kept automatically by the computer and can be displayed on request. This facility will not prevent access if the unauthorised person has got hold of a valid password - nothing will under these circumstances - but by displaying to the user the times at which his password was used on the 20 previous occasions, it is expected that any breach of security can quickly be discovered and an appropriate action taken.

Batch operation

One of the aims of the computer based primary care system is easy provision of management and research information. Such information is usually obtained by interrogating the files containing patient records in batch mode, and printing the results on a line printer. Stringent precautions have been taken to ensure that confidential information does not get into wrong hands. The policy is not to release any data from any file containing patient information without prior written permission of the user, followed by approval of senior management. Output from such runs is kept in a safe from where it is collected by the person who has been responsible for implementing the original request; this person passes it directly to the user. Any computer output from aborted runs is shredded and incinerated.

In the event of a software error the contents of memory may have to be printed. Should files containing patient information be suspected of being in error then parts of those files may need to be printed. The cells which form patient records are structured in such a way that identifying data is in one cell whilst medical information is in others. These cells are not usually contiguous and it requires intimate knowledge of the file structure to follow the links from cell to cell. Further safeguards on the computer site include authorisation for all printouts of dumps which again are shredded and incinerated after use.

Microfiche copies of all patient records are produced regularly. In Exeter this job involves the computer reading patient records and outputting re-formatted records onto a magnetic tape which is then sent to the SWRHA Computer Centre at Bristol to be processed on their COM equipment. The resulting fiche are sent back to Exeter to be distributed among the relevant users. Confidentiality safeguards at Bristol have not been investigated but at Exeter Computer Project microfiche is subject to the same procedures as line printer output.

Discussion

Contrary to the popular belief computerisation of patient records in primary care does not result in itself in a reduction in confidentiality. If the use of computer based records was limited to those purposes for which manual records are used, i.e. if they were used mainly by the GP as an aide mémoire during an encounter with the patient, and for recording, by the GP and supporting staff, of results of this encounter, the ability to control the level of access would result in an increase in confidentiality provided that the whole of the patient record were held on computer and no other copies were in existence. These assumptions are, however, unlikely to hold for many computer based patient record systems. One of the great advantages of such systems is the ability of the computer to produce easily as many hard copies of information it stores as are required by users. Thus copies of all patient records are regularly produced on microfiche and are given to each GP thereby making the information available to them virtually at all times. If branch surgeries are held, as for example at Ottery St. Mary health centre, copies of records of patients attending at these surgeries are produced by the health centre staff whenever a GP has changed the contents of these records. Doctors at Mount Pleasant health centre do not record the current episode of treatment on the computer but work instead, during the encounter with patient, from a copy of the computer record contained in the NHS envelope. They update the patient record very rarely whilst in surgery but indicate any desired changes in the record on the printed copy which is then later used as an input document either by the GP himself or a receptionist to update the information in the computer file and to produce an up-to-date copy for insertion in the NHS envelope.

This proliferation of copies of patient records, although entirely understandable, does mean a reduction in the level of confidentiality because it increases the potential for misuse of these records. To strike the right balance between confidentiality and availability of information with respect to computer based patient record systems greater attention should be paid to, and tighter control exercised in, the following three areas.

The first of these is the actual production of copies on the printer terminal. Although this is an essentially clerical task it requires access to the whole of the patient record. It is reasonable to assume that this task would normally be delegated by GPs to support staff such as receptionists, by either allowing them to use a GP password or making use of "per pro" passwords. There ought to be firm control over the use of these passwords, by, for instance, changing them from time to time and making them available only to some members of staff, as well as a means of checking how many copies of patient records were produced.

Updating of patient records by non-medical staff is not a practice that can escape criticism. Unless there are strong reasons to the contrary, such as antipathy to typing that cannot be overcome, it would be much preferable if the information was entered into the computer file by the originator. Of equal importance is the disposal of the out-of-date copies of records that should be shredded and incinerated, not merely regarded as household refuse.

The final point to be made concerns the use of microfiche. A few fiche can contain the records of the whole practice making it very useful during visits, night calls and emergencies. It also means that the acquisition of a fiche by an unscrupulous individual would have a much more damaging effect than acquiring say, a couple of randomly selected NHS envelopes. Although the microfiche is not legible to the naked eye one does not need a specialised reader to be able to see the information - an ordinary slide projector will, unfortunately, do. For this reason it should be handled carefully and preferably kept under lock and key.

6.2 SECURITY OF DATA

This criterion is defined in the Handbook as:

> An assessment of security of records and data as regards accidental loss of information.

When the patient record keeping system is based on NHS envelopes which are filed in filing cabinets, only one person at a time has access, in general, to the information contained in a patient's record. This may have its disadvantages when another member of staff has to use that patient's record but from the point of view of this criterion it leads to a very secure system. Apart from the extremely unlikely event of filing cabinets getting irretrievably jammed or all the keys getting lost, there are only two other likely ways of losing the data: (a) by failing to record it in the first place, which includes not filing external communications in the envelope, or (b) by deleting items of data or discarding documents that may be required at a later date. As for the failure to record, any record keeping system that relies on human action to record the information, i.e. the computer based system described in this report as well as the traditional manual system, will suffer from this possibility. However once the information becomes a part of the Exeter computer based patient record it cannot accidentally be deleted.

With the computer replacing the NHS envelope it is necessary to "log" all the changes that are made to any item of information. The prime reason for this is that, as opposed to filing cabinets, computers can and do break down and a means of fully recreating the computer files in such an event must be provided. The states of the record before and after any update are recorded on a special disc file called Update Log. This logging is completed before the actual file is updated. After any system failure the "after states" on the Update Log are compared with the actual state of information in the data base starting from the end of the Update Log. When a point is reached where the information is consistent the updates are repeated from that point to the current end of the Update Log thus bringing the data base to the correct state at the time of the system failure.

To safeguard against a systems failure that makes a file unusable dumps of all relevant files are made regularly. Currently dumps are undertaken on a daily, weekly, monthly, quarterly and six-monthly basis and in each case three generations of the data base and all relevant program files are kept. Daily and weekly dumps are kept on discs, the remainder on magnetic tapes. Some of the copies are kept physically separate from the main computer room. In addition to the dumps of the data base Update Log is dumped daily and fourteen copies are kept enabling a complete recovery of the data base to be made from a copy that is up to a fortnight old.

Parallel to the dumping, which affects the whole of the data base, changes in clinical information in the patient record are also subjected to archiving. If a change is made in clinical information the existing information in the data base is not overwritten by the new data, but it is simply marked for archiving and the new data is added to the record. As a part of the data base maintenance every night the marked data is copied from the data base onto a special magnetic tape file (Previous Value Archives); from time to time this data is then deleted from the data base during its reorganisation. At the current rate of usage about one reel of magnetic tape is filled by the archived data every fortnight. The existence of Previous Value Archives more than satisfies medico-legal requirements about the retention of patient data, since none of these tapes has ever been withdrawn and this policy is to continue in the future. It is therefore possible, and will be so in the future as long as the current system operates, fully to re-create all the states of any patient clinical record from the time it was computerised.

Whereas dumping and maintenance of the Update Log may be considered, albeit with come cynicism, merely to be clever ways how to make the data held on the computer system as secure as the information in NHS envelopes, the ability to produce a complete chronological list of contents of the patient clinical record is seen by doctors to be of major benefit.

7. ECONOMIC CONSIDERATIONS

Introduction

This criterion is defined in the Handbook as:

> An analysis of various cost components, e.g. capital, revenue, salaries, including methods of funding.

This report is concerned only with those cost components which can reasonably be expected to be affected by changes in the record keeping systems. These costs fall into two basic categories: costs relating to the additional staff that is required to operate the new system (or staff savings if the new system reduces the work content of record keeping), and capital and revenue costs of equipment that comprises the new system. The equipment in this context is the computer equipment in the health centres (Visual display units and termiprinters), communications equipment that connects the terminals to the mainframe and the mainframe computer.

7.1. STAFFING

Staff changes that have been a result of the changeover from manual to computer assisted primary care record keeping system consist of the introduction of computer staff, who are employed mainly to operate the mainframe and maintain the application software, and any effect on the workload of the staff in the health centres that is directly attributable to the changeover. The former has been aggregated into the revenue cost of computing and is discussed in detail in section 7.2. Because of different methods of working in Ottery St. Mary and Mt. Pleasant health centres the latter is treated separately in the following two sections.

Effect on staff in Ottery St. Mary health centre

Doctors in Ottery St. Mary rely on the patient record held in the computer files as the main source of information during their encounters with patients. All parts of the patient record, including the current episode of treatment but excluding communications from hospital and similar documents, are maintained via the Visual Display Units by the doctors themselves. It has been shown elsewhere (see 3.5) that under these circumstances retrieval of information from the computer record takes less time than used to be the case with NHS envelopes. Recording of information, however, takes longer so that the overall effect on the doctor's time of the changeover to computer is negligible.

As for the receptionists two main areas of their work have been drastically changed by the introduction of the computer, viz filing of patient records and preparation of repeat prescriptions. Whereas under the manual system the NHS envelope of every attending patient had to be unfiled and filed, with the computer system this work has to be done only for those patients where the doctor wants to look at hospital communications (about 1 in twenty patients). Although the rest of the filing work remains unaffected by the changeover the work content of the above difference has been measured (by using Clerical Work Data system) to amount to a decrease of some 1 hour per week per 1000 patients. Manual writing of patient details and pharmaceutical information on repeat prescriptions is no longer necessary because they are printed on request by the computer on pre-printed stationery. The reduction in work content due to this activity has been measured, again using Clerical Work Data system, to be about 1 hour per week per 1000 patients on the list. In Ottery St. Mary the total of both savings represents about 24 hours per week.

Staffing level of receptionists and secretaries in Ottery St. Mary health centre has stood at $3\frac{1}{2}$ whole time equivalents (WTE) since well before the introduction of the computer system when the total NHS list was just over 10,000 patients. Since then the list size has increased by almost 20%, but the savings brought about by the computer system have made it possible to contain the staff increase to the current figure of $4\frac{1}{2}$ WTE, despite an increase in clerical workload imposed by the introduction of additional claim forms by FPC (unrelated to the computerisation).

The effect of computer procedures on the work of practice nurses and health visitors is negligible.

Effect on staff in Mt. Pleasant health centre

Doctors in Mt. Pleasant do not use the computer system for recording the current episode of treatment but maintain this part of the patient record in the same way as under the manual system. For this reason the use of NHS envelopes has not been discontinued, on the contrary the envelopes are used in much the same way as under the manual system. In addition to all the communications from hospitals, as is the case in Ottery St. Mary, they also contain the records of current episodes and a copy of the computer maintained patient medical summary. The contents of the envelope are the principal source of information during the encounter with the patient. In the main, the visual display units in the surgeries are used only for the update of the medical summary and when this happens a new copy of the summary is produced by the receptionist and filed in the envelope. This system could operate equally well without the visual display units in the surgery - indeed out of the four doctors forming the practice where the measurements discussed in section 3 of this report were taken only three have a VDU and update the record themselves, whilst the remaining partner passes a note on the necessary changes to his secretary who actions the input.

The effect of this arrangement on the retrieval time has not been investigated in detail. The presence of a copy of the structured computer maintained summary should lead to a shorter retrieval time but this saving is not so large as in Ottery St. Mary because, with the best will in the world, keeping the other contents of the NHS envelope tidy in order to locate the summary and current episode cards easily may prove something of a problem. On the other hand as the current episode is maintained manually the total recording time has not increased so much as in Ottery St. Mary (and not at all in the case of the doctor without a VDU) so that the overall effect of the introduction of computer on the doctors' time is probably negligible.

One of the consequences of this way of working is that receptionists and secretaries in Mt. Pleasant health centre still have to do the same amount of filing as before the introduction of the computer. Moreover they are involved in the printing of new copies of patient summaries (after every update of the computer record) and, particularly for the doctor without a VDU, in the input of patient clinical information that is passed to them by general practitioners. It is estimated that this additional workload significantly diminishes the reduction of work content that has been realised by the computer production of repeat prescriptions (1 hour per week per 1000 patients on the NHS list), so much so that an increase in the recording workload, should the VDUs be withdrawn from all the surgeries, and the decrease due to automation of repeat prescriptions would probably cancel out each other.

The effect of computerisation on the workload of health visitors is negligible. The workload of practice nurses has increased because of the introduction of new recall schemes (see chapter 5).

7.2 COST OF COMPUTING

In the preceding sections dealing with other performance criteria measurements that had been taken in Ottery St. Mary and Mt. Pleasant health centre both in the pre-computer and post-computer period were described and, when possible, compared in the belief that such comparison could help in drawing conclusions about the implementation of the computer system at another health centre. Although this approach seems to be satisfactory in most cases one area where its pursuit would be likely to come unstuck is costs, and in particular costs of computing. This is mainly due to the fact that the past ten years have witnessed a dramatic decrease in the cost performance ratio of computers. A machine equivalent to ICL 1904A, which is the mainframe used by the Exeter Community Health Services Computer Project, can be purchased nowadays at a less cost than when it was acquired in 1973. Another important factor is that with the advent of minicomputers it is no longer necessary to rely on a mainframe in order to implement a real time primary care record system. It could be argued therefore that any costing which is based on computer equipment that is coming to the end of its useful life can at best be only of historical interest and at worst actually misleading.

It was felt, on the other hand, that the question of cost cannot be swept under the carpet merely because the costs of computer hardware are in a state of flux. The author of this report is of the opinion that it is far preferable to confront the reader with cost figures that are based on a working computer solution even though it may mean leaving oneself open to the charge of overstating the costs, than not to give him any warning about the very considerable capital and revenue consequences of getting computerised. This is why an attempt has been made to demonstrate what capital and revenue funding would be necessary if a health centre similar to Ottery St. Mary or Mt. Pleasant were to join a service based on the primary care record system developed by the Exeter Community Health Services Computer Project.

In doing so the following assumptions were made. Since the applications software is not directly transferable to another machine the costing was based on the existing configuration. In a few cases where the current equipment is no longer marketed historical costs were applied whilst in the other cases 1979/80 costs were used. Alternative equipment was considered provided that it was cheaper and capable of direct replacement (i.e. plug compatible). In order to arrive at a reliable basis for cost apportionment it was assumed that the existing mass storage had been enhanced to enable an increased number of users to mop up any spare capacity in processing.

It has been shown elsewhere (6) that with such comparatively little enhancement the existing mainframe ICL 1904A could cope with real time traffic of some 300,000 messages per week. This represents a twenty five fold increase on the traffic generated by the Ottery St. Mary health centre. Such a traffic would be realised if, for instance, all primary care units in the Exeter Health Care District other than single handed general practitioners were connected to the mainframe, which would establish a data base that would contain records of some 300,000 patients.

At 1979/80 prices the capital cost of central processing equipment, i.e. the enhanced 1904A, would be £668,660. The necessary communications equipment which controls the data flow at the central site, such as scanners and their controls, would cost £25,550, bringing the total capital cost of equipment at the central location to £694,210. In the following this capital cost has been apportioned among individual locations on the basis of the number of patients registered in each location.

To maintain this equipment during the hours of operation i.e. from 0800 till 2400 Monday to Saturday (excluding public holidays) would cost £60,190 per annum (including VAT at 15%). Salaries of the operations staff, programming maintenance and management would amount to £99,170 per year and other revenue costs to some £39,140. The total revenue cost attributable to the central location would therefore be £198,500 per annum.

The above costs are incurred at the central location because of the real time and batch demands of the users and for this reason they have to be apportioned amongst them. The fairest basis for this apportionment is the amount of usage of the equipment and human resources at the central location that individual health centres make, which can be measured by the number of messages as far as the real time operation is concerned, and by the length of the central processor time (CPU time) that is necessary for batch operation. Maximum sustainable level of CPU utilisation (i.e. the proportion of time used by the central processor) while the whole machine is dedicated for batch is assumed to be 30% (this is the case between 2000 and 2400 on weekdays and between 1200 and 2400 on Saturdays). At other times when both real time and batch are run concurrently the maximum sustainable level of CPU utilisation for batch jobs reduces to 15%. Under these circumstances the cost of a batch CPU hour has been calculated to be about £140 (at 1979/80 cost levels). The cost of a single message is .7p which includes not only the resource utilisation due to the processing of the message but also the batch support work which is wholly attributable to real time operation (dumps, integrity checks of the data base etc.)

In addition to a proportion of the capital and revenue costs of central computing equipment each health centre would be responsible for all the costs of hardware under its own roof, line rental and costs of microfiche consumables (60.4p per master and 6.6p per copy).

Results

Tables 14 and 15 below display the various costs involved in a health centre similar to Ottery St. Mary. Five partners are responsible for care of some 12,000 patients. Full patient record is maintained on the computer necessitating 2 VDUs in reception, 5 VDUs in surgeries and 1 for practice nurses and health visitors. Printing is done on 2 printer terminals. Two lines (and 4 modems) connect the health centre with the computer over a distance of 13 miles. Patient records are reproduced on microfiche every month.

Table 14: Capital costs of computer system (full patient record)

	£
2 printer terminals @ £1850	3,700
8 VDUs @ £1150	9,200
1 line sharing adaptor	1,000
4 modems @ £1,750	7,000
5 portable microfiche viewers	250
1 desk top viewer	150
	21,300
Central computer equipment	27,770
TOTAL	49,070

Table 15: Revenue costs of computer system (full patient record)

	£	
Maintenance: Printer terminals	505	
VDUs (@ 12% capital)	1,104	
Line Sharing Adaptor	84	
Modems (@ 5% capital)	350	
Lines	1,210	3,253
VAT (@ 15%)		488
Real time (11840 messages/week)		4,185
Batch (26.61 CPU hours/year)		3,725
Microfiche consumables		717
		12,368

Tables 16 and 17 show the costs incurred in a health centre similar to Mt. Pleasant. Seven partners, working in two separate practices, provide health care for some 15,000 patients. Only summary record is maintained on the computer (including repeat medication but excluding current episode), which requires 3 VDUs in reception, up to 7 VDUs in surgeries and one for practice nurses and health visitors. Printing is done on two printer terminals. Two lines and four modems connect the equipment with the computer centre over a distance of some 2 miles. Patient records are reproduced on microfiche every month.

Table 16: Capital costs of computer system (summary record only)

	£	
2 printer terminals @ £1,850	3,700	
11 VDUs @ £1,150	12,650	
2 line sharing adaptors @ £1000	2,000	
4 modems @ £1,750	7,000	
7 portable viewers	350	
1 desk top viewer	150	25,850
Central computer equipment		34,710
TOTAL		60,560

Table 17: Revenue costs of computer system (summary record only)

	£	
Maintenance: Printer terminals	505	
VDUs (@ 12%)	1,518	
LSAs	168	
Modems (@ 5%)	350	
Lines	370	2,911
VAT (@ 15%)		437
Real time (8150 messages/week)		2,881
Batch (28.61 CPU hours/year)		4,005
Microfiche consumables		985
		11,219

If only the summary record is maintained on the computer there is little justifications for having VDUs in surgeries and for the use of para-medical staff. Under these circumstances a health centre like Mt. Pleasant might do with 3 VDUs (requiring just one line sharing adaptor) and two hard copy printers in the reception. This would reduce capital costs to £50,310 and revenue costs to £9,852 per annum.

Discussion

To make the above figures comparable it is useful to state the notional annual cost per patient for each of the three types of health centre (i.e. Ottery St. Mary, Mt. Pleasant and modified Mt. Pleasant). If it is assumed that the life of computer equipment is, on average, 10 years the notional annual cost per patient is given by adding one tenth of the capital cost to the revenue cost and dividing the result by the number of patients on the list. For Ottery St. Mary type of health centre this cost is £1.44 whilst the corresponding figures for the two types of Mt. Pleasant health centre are £1.15 and £.99. The decrease from £1.44 to £1.15 is due mainly to three factors: firstly the line rental in Mt. Pleasant is considerably lower because of a shorter distance from the computer, secondly, due to a different method of working the cost of real time is lower because of a smaller number of messages, and finally there are certain economies of scale because the cost of hardware does not increase linearly with the number of patients (e.g. both OSM and MtP use the same number of modems). The decrease from £1.15 to £.99 that could be realised in a Mt. Pleasant type of health centre if there were no VDUs in doctors' surgeries is entirely due to the reduced cost of hardware.

It must be emphasised that the above costs will hold only if the mainframe is fully utilised. This means that a large initial capital investment is not enough, what is needed above all is a firm commitment of a large number of health centres with its attendant conversion problem, if these costs are to be realised within a realistic timescale.

One way to circumvent the inherent difficulties of a mainframe solution is to provide each health centre with its own minicomputer, which would run under practice control. Not only will, in this case, the initial investment and conversion problem be spread over a number of years but, in addition, two substantial cost items will be reduced: communications equipment and computer staff at the central location. On the debit side, however, additional (or a higher calibre of) staff may be required at the health centre to perform the computer tasks, particularly those of data security and production of microfiche.

It has to be admitted, however, that despite all these possible cost reductions the final per capita cost is still going to look high in comparison with the average £4 that the GP receives as the capitation fee for each of his patients. There is, therefore, little doubt that until general practitioners can reclaim directly the expenses incurred in running computerised systems as they do, for instance, with staff, the implementation of such systems on either mainframe or minicomputers will be severely limited.

7.3 DRUG PRESCRIBING POLICY

This performance criterion has originally been defined as:

> An assessment of adherence to, and effectiveness of, a drug prescribing policy, categorised by condition (based on peer audit).

Such a definition presupposes the existence of a drug prescribing policy, and only if this is the case can the remainder of the definition, i.e. the part concerned with the peer audit, be considered. If no such drug prescribing policy exists, which certainly was the pre-computer situation in both the health centres that are the subject of this report, this criterion cannot be used in its present form. The evaluators became aware of this problem early on in their work and an attempt was made to set up a study that would assess drug prescribing by employing a modified approach to that suggested by the above definition. In the absence of any clearly defined drug prescribing policy relating to specific medical conditions it was decided to try to analyse the pattern of repeat prescribing, as this is an area where the computer is expected to bring about substantial benefits. In the pilot study the sampling frame consisted of one doctor's patients who were administered one of two selected drugs on a repeated basis. This study was undertaken soon after the introduction of the computer with the objective to measure the amount of over and under prescribing (as established from the prescribed amount, strength and dose and the elapsed time between successive prescriptions) in the pre-computer period, when manually kept patient records were used, and after the introduction of the computer. Despite the considerable effort that was necessary to collect and analyse the data, particularly from the manually kept records, no significant difference in the prescribing patterns corresponding to the two periods was found. This somewhat disappointing finding may have been caused by several factors, such as the small size of the sample, the comparatively short period of time which the study covered, unreliability of manual record keeping etc. Although most of these points could be allowed for by careful sample selection the last point could not be rectified which meant that any full scale study would, of necessity, have to be prospective. After careful consideration of the amount of effort required for its conduct and the amount of supportive evidence as to the effects of computerisation of primary care records that was likely to be the result of its conduct it was decided not pursue this line any further.

A similar argument can be used against the application of any prospective study in this context. Since the ultimate goal is to make a judgement about the effects of computerisation the use of prospective studies implies that measurements must also be taken at other, non-computer sites, because both Ottery St. Mary and Mt. Pleasant have already been computerised. Problems of trying to allow for inherent differences between sites when comparing them for this purpose should never be underestimated. Given the available evaluation effort, the multiplication of the problems brought about by trying to draw matching samples from differing populations covered by a prospective study makes the whole idea impractical.

Attention was therefore turned to finding out what other sources could supply data that would provide some insight into drug prescribing. The obvious candidate was cost data, since every dispensed prescription issued by a general practitioner to an NHS patient finds its way eventually to the Prescription Pricing Authority who re-imburse individual chemists. In addition to this they keep various statistics on drug usage and prescribing costs by general practitioners. In particular, each year they take a month's sample of all prescriptions issued by doctors and calculate, among others, average number of prescriptions per person, average cost per prescription and average cost per person on NHS prescribing list, for every partnership in the country, as well as all FPC areas. For a given morbidity in population the last quantity, i.e. average

prescribing cost per person, seems to be the best available quantity for the purpose of comparison of prescribing in different localities, as the other two can easily be affected by, for example, changing the average number of items on a prescription. This led to the following modification of the above performance criterion.

An analysis of the average cost of prescribing per person on the NHS prescribing list.

Method of measurement

All the partners in the Ottery St. Mary health centre were asked, and consented, to allow the Prescription Pricing Authority to release the necessary data. The table below shows the average costs of prescribing per person on the NHS prescribing list for Ottery St. Mary health centre and for the whole of Devon. The figures are split in the table into the pre-computer and post-computer period.

Table 18: Monthly prescribing cost per person (£)

Pre-Computer				Post-Computer			
Year	OSM	Devon	Normalised	Year	OSM	Devon	Normalised
1969	.267	.325	82.15	1976	.66	.84	78.57
1970	.283	.354	79.94	1977	.85	1.06	80.19
1971	.32	.40	80.00	1978	1.01	1.30	77.69
1972	.36	.44	81.82	1979	1.20	1.50	80.00
1973	.41	.49	83.67	1980	1.35	1.70	79.41
1974	.45	.56	80.36				
1975	.58	.71	81.69				
Average			81.38				79.17

The figures for 1969 and 1970 were obtained by translating shillings and old pence into pence.

Besides demonstrating the ravages of inflation the per capita prescribing costs display a consistent difference between Ottery St. Mary and Devon as a whole. This difference can be caused by many factors, such as prescribing habits of general practitioners, differences in population and the resulting morbidity etc. The problem in this report is not so much to explain the reason for this difference as it is to find out whether there is any underlying trend in this difference. This can best be done by normalising the above figures.

The prescribing cost per person in Ottery St. Mary health centre is normalised by dividing it by the corresponding average cost of prescribing per person in Devon and multiplying by a hundred. The resulting figures can be seen in the above table. Apart from adjusting for inflation this process also demonstrates on which side of the prescribing cost spectrum Ottery St. Mary health centre lies. If the figures are lower than 100 the average cost of prescribing in Ottery St. Mary is lower than in Devon as a whole and vice versa. For constant differences in morbidity of population, doctors' prescribing habits, etc. the normalised figures should remain constant, apart from random variations caused

by sampling and the variability of demand for health care services. If any change had taken place in Ottery St. Mary that was particular to that locality and that could have a bearing on prescribing costs the normalised figures should deviate from constant.

Results

It can be assumed that changes in morbidity of population in Ottery St. Mary have been similar (over the studied period) to those of Devon as a whole. A similar conclusion can be drawn about most of the other possible influencing factors. The only substantial effect that distinguishes Ottery St. Mary from the rest of Devon seems to be the implementation of the computer based primary care record system which would affect the prescribing costs from 1976 onwards. This hypothesis was tested by looking at the difference between the means of the pre-computer and post-computer samples. The pre-computer mean is 81.3 with variance equal to 1.5542, whilst the post-computer mean is 79.17 and variance 1.0843. The corresponding value of $t = 3.21$ with 10 degrees of freedom; the probability of obtaining this, or a larger, value if both samples come from the same population is less than .01. The difference between the two samples is therefore statistically significant which implies that the introduction of the computer seems to have resulted in a decrease in the average cost of prescribing per person.

Discussion

A decrease from 81.38 to 79.17 in the normalised cost of prescribing represents a reduction of some 2.72% and at first sight the size of this reduction may not seem very significant. However the implications of such a reduction, if it were to be achieved throughout the whole country, are staggering. The total cost of prescriptions issued in England in March 1980 (figures supplied by courtesy of the DHSS) was £80,036,187 which suggests that the annual cost of prescribing in primary care in England in 1980 was over £960,000,000. A 2.72% saving on this figure represents over £26,000,000 and it is suggested by the above analysis that this would be one of the consequences of a wide-spread computerisation of primary care records as it has been done in Ottery St. Mary health centre.

The crucial point for the acceptance of this conclusion is the extent to which one can be reasonably sure that the above quoted reduction is due solely to the introduction of computer. The author of this report can only re-iterate that he knows of no other single event that occurred at about that time (1976) which could explain the observed change. The number of patients registered in the health centre had been rising since the late sixties with no substantial change in demographic characteristics. This increase eventually justified an increase in the medical staff and a new partner joined the health centre in 1974. The normalised figures for 1974 and 1975 show no difference from the trend that they had displayed in previous years and it can only be concluded that the effect of this event on the per capita prescribing costs was negligible, so that the computerisation of primary care records remains the only plausible explanation.

£26,000,000 saved annually would certainly justify a great deal of expenditure on primary care computing. Unfortunately the expenditure that would have to be made across the whole country to realise this saving is much larger. In section 7.2 dealing with costs of computing it is stated that the revenue costs of computing attributable to Ottery St. Mary health centre are £12,368 per annum. Based on figures for March 1980 the estimated annual cost of prescriptions

issued by this health centre is some £192,100. Without the computer system this figure would rise to about £197,500 giving an estimated saving of £5,400 per annum. Although this saving goes some way towards recovering the revenue cost of computing it cannot justify the computerisation of primary care records on its own.

8. HUMAN ASPECTS

8.1 STAFF SATISFACTION

Definition

This performance criterion is defined in the Handbook as:

An analysis of health centre staff satisfaction based on an attitude survey

Of the many different aspects of staff satisfaction, the satisfaction with one's job was selected as the subject for this performance criterion. Changes in the way that primary care records are kept affect everyone working in the health centre and because of this they will have an impact on people's job satisfaction. These changes are likely to make the greatest impact on that group of staff for whom the maintenance of patient records and patient record system are the main part of their job, i.e. health centre receptionists and secretaries. For this reason the scope of the above criterion has been narrowed in this report into:

An analysis of the job satisfaction of health centre receptionists and secretaries based on an attitude survey.

Method of measurement

A general job satisfaction questionnaire was administered during a series of interviews each consisting of a member of the evaluation staff and a receptionist or a secretary from a health centre. The reader will find a copy of this questionnaire in Appendix C, together with the summary of results. The questionnaire consisted of three parts, the first two of which were used to measure job satisfaction. In Part I there were 37 statements that are often used to describe jobs in the health service. Beside each statement there were five columns that the respondents used to indicate the degree of agreement or disagreement with the statement. The five values given to these columns were Strongly agree, Agree, No opinion, Disagree, Strongly disagree.

Part II of the questionnaire concentrated on the respondents' perceptions of importance of various aspects of their jobs. Nine statements were presented and the respondents were asked to classify their importance into the following five categories: Vital, Very important, Important, Of little importance, Not at all important. The wording of these nine statements was either identical with, or very closely related to, nine statements describing job features in the part one. These nine pairs of responses formed the basis of the measurement of job satisfaction. The rationale for this approach is as follows.

If a person is to be satisfied with his job he must perceive, among others, that certain needs, the satisfaction of which he values highly, are fulfilled by some aspects of the job. Since in Part II of the questionnaire the respondents were presented with a number of potential needs that they were asked to value, the responses to the statements in Part I corresponding to the highly valued needs could be used as a measure of fulfilment of those needs, i.e. as a measure of job satisfaction. Thus only the response to the following statements in Part I were considered in the analysis: 33, 1, 30, 35, 34, 19, 10, 23, 22 (the numbers correspond to the needs numbered 1 to 9 in part II). Out of the nine statements in Part I, two (numbered 30 and 22) were framed negatively when compared with the corresponding needs. The responses to these statements were therefore inverted, i.e. Strongly disagree, for instance, became Strongly agree, before any further analysis was undertaken.

Numeric values of -2, -1, 0, 1, 2 were assigned, respectively, to the responses (inverted where necessary) indicated in the Part I as Strongly disagree, Disagree, No opinion, Agree, Strongly agree. For a given health centre all the values that corresponded to a particular category of need were aggregated. Only the Vital, Very important and Important Values of need were considered in the analysis because it was felt that only the satisfaction of these needs had any relevance to the job satisfaction of the staff.

Results

As mentioned above the responses from Ottery St. Mary and Mt. Pleasant health centres were analysed separately. Seven respondents from Ottery St. Mary and 6 from Mt. Pleasant took part. Table 19 below shows the characteristics of the sample. The level of job satisfaction was investigated by analysing the total scores in individual categories of need. First, the null hypothesis was formulated as the assumption that the level of satisfaction of individual needs follows the uniform distribution with values -2, -1, 0, 1, 2, i.e. with mean equal to 0 and variance equal to 2. Distribution of total scores within categories is under these circumstances given by the distribution of the sum of these random variables. For small number of variables (responses) this distribution was evaluated exactly. For a large number of response (10 or more) normal approximation was used. A two-sided test of significance was used in both cases.

In the cases where the null hypothesis was rejected, the average score was calculated. This score indicates the level of consensus about satisfaction of a given category of need. Thus, for example, one half of all Mt. Pleasant respondents strongly agree, and the other half agree, that the needs they consider very important are satisfied. The results of the above analyses are shown in the Table below.

Table 19: Perceived job satisfaction

	Category of need	Number of responses	Total score	Null hypothesis (mean = 0)		Average score
				Probability of a higher score (in absolute terms)	Conclusion	
OSM	Vital	6	5	.1120	Accept	NA
	Very important	22	30	.0000	Reject	1.36
	Important	20	24	.0002	Reject	1.20
MtP	Vital	4	6	.0160	Reject	1.50
	Very important	16	24	.0000	Reject	1.50
	Important	22	25	.0002	Reject	1.14
Total OSM		48	59	.0000	Reject	1.23
Total MtP		42	55	.0000	Reject	1.31

Discussion of results

Substitution of numeric values for ordinal data, as has been done in this questionnaire where the satisfaction of respondents' needs was analysed, is often fraught with danger. Although the five columns reserved for responses

transmit clearly the idea of a bipolar scale spreading in the opposite direction from the central value of No opinion, it is not certain that the individual values on this scale do not vary between respondents. There is one mitigating factor however. With a bipolar scale it is unlikely that there would be inconsistency in the direction of answers and since there are only two available values in each direction any inconsistency should be minimal.

Table 19 shows high level of job satisfaction of receptionists and secretaries in both health centres. This is true for all but one (vital needs in OSM) category of need. The lowest average score of the fulfilment of a perceived need is 1.14 i.e. it lies some way above the value of Agree on the scale presented in Part I of the questionnaire. In most of the categories the average score is higher, lying in most cases a quarter to half way between the values Agree and Strongly agree.

Another remarkable feature of the results is the consistency of answers between the two health centres.

8.2 WORKING ENVIRONMENT

Definition

The Handbook defines this criterion as:

> An assessment of the working environment made by health care providers, such as the level of noise, privacy etc.

Since this criterion was measured by the same questionnaire as job satisfaction (see 8.1) health care providers were limited to the same respondents, i.e. health centre receptionists and secretaries.

Method of measurement

The reader is referred to a copy of the questionnaire in Appendix C which also gives the summary of results. As mentioned in section 8.1, this questionnaire was administered during a series of interviews each consisting of a member of evaluation staff and a receptionist or a secretary from the two health centres. Seven people from Ottery St. Mary and six people from Mt. Pleasant were interviewed in all. Part III of the questionnaire was used to measure respondents' opinions about the working environment. This Part consisted of sixteen statements describing various aspects of working environment. Five columns beside each statement were used by respondents to indicate the level of agreement with each statement, labelled Strongly agree, Agree, No opinion, Disagree, Strongly disagree, were used by respondents to indicate the level of agreement with each statement.

A closer observation of the 16 statements in Part III of the questionnaire will reveal that they can be arranged into eight pairs each describing an opposite value of one aspect of working environment. For instance, statements number 2 (Hot) and 10 (Cold) can be construed as descriptions of temperature, statements 4 (Quiet) and 8 (Noisy) describe the level of noise etc. Such an arrangement will only be meaningful if there is a high degree of correlation between the corresponding answers i.e. if, for example, an agreement with the statement "Quiet" is accompanied by a disagreement with the statement "Noisy". If this is the case the responses to such a pair can be combined and the resulting value is taken as a measure of a given aspect of working environment. On the other hand, if there is no such correlation the statements must be considered on their own and the concept of a "combined aspect" should be abandoned.

To facilitate the analysis numeric values of -2, -1, 0, +1, +2 were assigned to the responses indicated respectively as Strongly disagree, Disagree, No opinion, Agree, Strongly agree. The responses were inverted where necessary and aggregated within each health centre.

Results

Tables 20 and 21 below show the arrangement of the sixteen statements into eight aspects of working environment, and present a graphical representation of the degree of correlation among the responses for each suggested aspect. The scale measures the aggregated value of responses to a given statement and runs therefore from 14 through 0 to 14 for the responses from Ottery St. Mary (seven respondents) and from 12 through 0 to 12 for the responses from Mt. Pleasant (six respondents). The figures in brackets are statement numbers in Part III of the questionnaire, lower case x stands for an aggregate value and capital X indicates that the two aggregates fall into the same point in the table.

Table 20: Working environment - Ottery St. Mary responses

	14 12 10 8 6 4 2 0 2 4 6 8 10 12 14	
(2) Hot	xx	Cold (10)
(15) Light	x x	Dark (5)
(16) Well laid out	X	Badly laid out (7)
(6) Easy to do job	xx	Difficult to do job (13)
(4) Quiet	X	Noisy (8)
(3) Secluded	xx	No privacy (11)
(12) Enough elbow room	x x	Cramped (1)
(9) Designed for people	x x	Machines first (14)

Table 21: Working environment - Mt. Pleasant responses

	12 10 8 6 4 2 0 2 4 6 8 10 12	
(2) Hot	x x	Cold (10)
(15) Light	x x	Dark (5)
(16) Well laid out	xx	Badly laid out (7)
(6) Easy to do job	xx	Difficult to do job (13)
(4) Quiet	x x	Noisy (8)
(3) Secluded	xx	No privacy (11)
(12) Enough elbow room	x x	Cramped (1)
(9) Designed for people	x x	Machines first (14)

The closer the two values for the corresponding pair of statements are, the more justification there is for combining the two statements into one aspect. The hypothesis that the corresponding values measure the same aspect, i.e. that they come from the same sample, was tested for both health centres. The rejection level was chosen as 95% for the two-sided test. This has led to the conclusion that combining the statements 1 and 12, and 9 and 14 is not justified for Ottery St. Mary responses so that the responses to these four statements were treated separately. A similar conclusion has been reached concerning the statements 2 and 10, 9 and 14 for the Mt. Pleasant responses.

The remainder of analysis follows closely the line taken in section 8.1 where the job satisfaction was analysed. A null hypothesis was formulated as the assumption that the responses to individual statements are uniformly distributed with values -2, -1, 0, 1, 2. A two sided test of significance at 95% was applied to the exact distribution when fewer than 10 responses had been aggregated; normal approximation was used in the other cases.

For those aspects where the null hypothesis was rejected the average score was calculated. The results of the above analyses are shown in Tables 22 and 23.

Table 22: Perceptions of working environment by staff at Ottery St. Mary

Aspect	Number of responses	Total score	Probability of a higher score	Actual average
Cramped	7	12	0	1.71
Enough elbow room	7	3	.361	NA
Designed for people	6	-7	.026	-1.17
Machines first	7	-8	.020	-1.14
Hot/Cold	14	15	.005	1.07
Light/Dark	14	11	.038	.79
Well/Badly laid out	13	-14	.006	-1.08
Easy/Difficult to do job	14	13	.014	.93
Quiet/Noisy	14	-22	0	-1.57
Secluded/No privacy	14	-17	.001	-1.21

Table 23: Perceptions of working environment by staff at Mt. Pleasant

Aspect	Number of responses	Total score	Probability of a higher score	Actual average
Hot	6	-4	.202	NA
Cold	6	-6	.058	NA
Designed for people	6	0	.892	NA
Machines first	6	-10	0	-1.67
Light/Dark	12	11	.025	.92
Well/Badly laid out	12	-5	.308	NA
Easy/Difficult to do job	12	9	.066	NA
Quiet/Noisy	12	-14	.004	-1.17
Secluded/No privacy	12	-11	.025	-.92
Enough room/Cramped	12	-4	.412	NA

The presence of a figure in the last column of Tables 22 and 23 indicates that there is a consensus of opinion amongst the respondents about the aspect in question. The greater the number (in absolute terms) the more strongly felt the consensus is. The sign has been taken in relation to the first statement in a given pair, with the positive sign indicating agreement with the statement and the negative sign showing disagreement. Thus the figure -1.57 entered against the aspect "Quiet/Noisy" in Table 22 implies a strong level of disagreement with the statement "Quiet" and an equally strong level of agreement with the statement "Noisy". If it is remembered that the value -1 has been assigned to the response Disagree and -2 to the response Strongly disagree the figure -1.57 indicates that approximately half of all reception and secretarial staff in Ottery St. Mary health centre agree with the statement that their working environment is noisy and the rest are in strong agreement.

Discussion of results

The most striking feature of the above two Tables are the differences between them. At the root of those differences lie different structural features of both health centres. As mentioned in the Introduction (see 1.3) Mt. Pleasant Health Centre is a purpose built structure the design of which had incorporated many lessons learnt from the operation of earlier health centres. Some criticisms still remain, in particular the staff complain about the level of noise and the lack of privacy, but these seem to be the only adverse aspects about which there is a significant level of consensus. It might have been expected that if the design had been really successful the results of the questionnaire would also show some level of consensus about the positive features, however, with the exception of lightness, this is not the case.

On the other hand, Ottery St. Mary health centre is situated in an older building that has been adapted and is now expected to cope with a much larger throughput than was originally envisaged. It is possible that during this process the quality of the working environment might have suffered and the results of the questionnaire seem to point to this conclusion. The staff feel strongly that their environment is cramped, noisy and that it lacks privacy. They do not think that it was designed with the people who are to work in it in mind, as it is hot and badly laid out. Despite all this they feel that it is easy to do their job and they are satisfied that it is light.

It is the opinion of the author of this report that none of these conclusions has been caused, directly or indirectly, by the introduction of the computer based record keeping system. The reader may therefore wonder why in a report that purports to evaluate the effects of computerisation so much space has been devoted to the discussion of structural features. This valid criticism is, unfortunately, inherent in the adoption of performance criteria as an evaluation concept. As stated in section 1 performance criteria are salient pieces of information that measure the effectiveness of systems, computer based or not. In order that a comparison of different systems can be made a certain uniformity of evaluation tools is necessary and Part III of the questionnaire has been designed with this in mind. However, one statement in this questionnaire does address the problem of computerisation, viz "Machines come before people". As can be seen from Tables 22 and 23 there is a consensus of opinion about this aspect in both health centres. The respondents disagree with this statement, the level of disagreement being particularly strong in Mt. Pleasant, so that it can be concluded that the introduction of terminals and the changeover to computer based procedures has not had an adverse effect on the working environment in the health centres.

9. CONCLUSIONS

A number of evaluation studies was discussed in the preceding sections of this report the main purpose of which was to establish what were the effects of introducing a computerised primary care system, as designed and implemented by the Exeter Community Health Services Computer Project, into two health centres. Taken as a whole these results present a comprehensive picture of many aspects of primary care systems in the two locations before and after the introduction of the computer. However, this exercise would have been only partially successful if it did not provide answers to more general questions. What is the effect on a health centre of maintaining a structured patient primary care record on the computer? Can the results from Ottery St. Mary and Mt. Pleasant be extrapolated to another location? To what extent are the results dependent on the ECHSCP approach to computerisation? An attempt to answer these questions will be made in this section.

Perhaps the most important point that has been proved in Exeter is that it is not only feasible, but perfectly practical to maintain patient primary care records on the computer, provided that the computer system is designed in such a way that it allows the doctors to use it at various levels of sophistication. It has been demonstrated that general practitioners can maintain the record on a VDU located in the surgery and that this maintenance can be done during the normal course of the surgery without any adverse effects on the doctor-patient relationship. A printed copy can be provided for those doctors who do not wish to input information during the surgery and comments that are made on this copy can later be input either by the doctors themselves or by support staff. If the computerised primary care system is supported by a mainframe the day to day operation in the health centre can be entirely the responsibility of health centre staff so that the specialist staff at the computer centre deals only with data security and supporting batch work. The need or otherwise for specialist staff if a different computer configuration is used, such as for instance a stand-alone minicomputer situated in the health centre, was not a subject of this report although it is currently under investigation by ECHSCP.

Computerisation of primary care records has no detrimental effects either on the working environment in the health centre or on the job satisfaction of the receptionists and secretaries who work there. Computerisation of repeat prescribing reduces their workload somewhat but this is more that outweighed by the tendency for the doctor to undertake more recall programmes that are monitored by the computer. The workload of attached nursing staff may slightly increase for this very reason.

As for the effects on the patient record itself, the computerised patient primary care record is more legible than its manually kept equivalent. It is also of better quality, quicker to peruse and quicker to retrieve the necessary information. It provides a better picture of the patient and allows the doctor to grasp the relevant facts more easily, thus leading to a better knowledge of the patient. All these features are primarily due to its better structure. Although it could be argued that it is not essential to have a computer in order to maintain a structured patient record experience of many people who tried to use, for example, problem orientated medical records suggests that good structure is very difficult to maintain on a manual system. To keep up a satisfactory level of structure it is probably necessary to utilise computer based editing facilities.

It is interesting to note that the investigation did not show any significant difference in quality of the patient record between the two health centres, i.e. between a fully computerised patient record on one hand and only computer held summary and medication information on the other (used mainly in hard copy). At the time of measurement the latter system had been operational for a much shorter period of time than the fully computerised one. It is therefore possible that it still may have represented the effects of the initial restructuring of information, which was done when patient records were transferred on the computer, rather than give a true picture of the operational situation when the computerised procedures have settled down. Only a repeat of the measurement at some future date can solve this problem.

Computerised records lend themselves easily for analysis. When more than ten thousand records are concerned, as is the case with many health centres, computerisation is the only sensible way to analyse them accurately and quickly. On a manual system one can, with a great deal of dedication, manage some recall schemes. If in addition to this the aim is also production of epidemiological information, statistics on patient throughput, all kinds of registers, household grouping, information on drug usage etc., any other solution but computerisation is out of the question.

It seems plausible that computerisation with its easy availability of statistics and efficient management of recalls, combined with better knowledge of patient (resulting from a better patient record) and with computer based repeat prescribing has an impact on patient care. This impact, hopefully improvement, has not been investigated in this report; indeed the author, who is not a medical practitioner, is in no position to embark on such a course. The reader is therefore left to make his own judgement using the available evidence.

There is, however, no doubt that such an improvement will not be cheap. Per capita notional annual costs range from £1.44 to £.99 per patient, depending on the sophistication of the computer system. These figures are based on the current Exeter configuration and include capital and revenue costs but take no account of the cost of conversion of manual records to the computer which may be considerable. About 54p per patient per year can be expected to be saved by the reduction in the drug bill. The remaining nett cost may be decreased further if the patient primary care record system is implemented on a minicomputer, or even a microcomputer, located in the health centre and operated by the existing health centre staff.

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APPENDIX A

MEDICAL RECORDS IN GENERAL PRACTICE

MANUAL RECORDS

Please answer the following questions only after a consultation in which you used the patient's record.

1. Was this patient (please tick the applicable)

(a)	your own patient	29
(b)	your partner's patient	-

2. By comparison with other patients in your practice was this patient a clinically complex case

Yes	No
11	18

3. Was it easy to search the record?

Yes	No
14	15

If no, was it because (please tick the applicable)

(a)	important details were hidden within trivia	7
(b)	the record was difficult to read	11
(c)	individual parts of the record were not ordered well	12
(d)	other reason(s) (please specify):	1

4. Were those items of information that you had found, easy to assimilate and correlate?

Yes	No	Not Applicable
13	12	4

If no, was it because of the way they were recorded?

Yes	No
11	1

5. If you compare the information contained in the record with what you have learnt from the patient during this encounter, did the record present an accurate and continuous picture of the patient's history?	Yes	No	Not Applicable
	8	13	8

If no, which parts of the record were incomplete or inaccurate?

	Incomplete	Inaccurate
(a) priority details (such as allergies, "at risk" conditions)	8	2
(b) history	8	1
(c) medication	6	0
(d) results of tests and investigations	6	0
(e) discharge letters and other hospital communications	6	0
(f) current episode of treatment	3	0
(g) other (please specify)		

APPENDIX A

MEDICAL RECORDS IN GENERAL PRACTICE

COMPUTER RECORDS

Please answer the following questions only after a consultation in which you used the patient's record.

1. Was this patient (please tick the applicable)

(a) your own patient [230]

(b) your partner's patient [61]

2. By comparison with other patients in your practice was this patient a clinically complex case?

Yes	No
78	213

3. Was it easy to search the record?

Yes	No
281	4

If no, was it because (please tick the applicable)

(a) important details were hidden within trivia [0]

(b) the record was difficult to read [1]

(c) individual parts of the record were not ordered well [0]

(d) other reason(s) (please specify): 2

4. Were those items of information that you had found, easy to assimilate and correlate?

Yes	No	Not Applicable
250	3	36

If no, was it because of the way they were recorded?

Yes	No
2	1

5. If you compare the information contained in the record with what you have learnt from the patient during this encounter, did the record present an accurate and continuous picture of the patient's history?

Yes	No	Not Applicable
190	12	47

If no, which parts of the record were incomplete or inaccurate?

	Incomplete	Inaccurate
(a) priority details (such as allergies, "at risk" conditions)	2	0
(b) history	1	0
(c) medication	2	1
(d) results of tests and investigations	1	0
(e) discharge letters and other hospital communications	5	0
(f) current episode	0	0
(g) other (please specify)		

APPENDIX B

OTHER GPS OPINIONS QUESTIONNAIRE

1. By comparison with all the records in your possession, would you describe this patient's medical history as:

Complex	Average	Simple
☐	☐	☐

2. Did you find the "structured" record an improvement on the "traditional" record (kept on continuous cards)?

Yes	No
31	12

If yes, is it because (please tick the applicable)

(a)	it is more legible	28
(b)	its format is more useful	15
(c)	it is more informative in content	16
(d)	it contains only salient details	22
(e)	it is quicker to peruse	26
(f)	other reason(s) (please specify):	

If no, is it worse?

Yes	No
11	1

If you think it is worse, can you give your reason(s)

3. When compared with the "traditional" record (kept on cintinuation cards), do you feel that after perusal of this "structured" record your knowledge of this patient is:

Better	Worse	About the same
22	8	13

4. Has the use of abbreviations caused you any difficulties in understanding the "structured" record:

A great deal	Some	None
6	20	18

5. Further comments:

The Health Centre,
74 Sandhill Street,
Ottery St. Mary,
Devon. EX11 1EQ

Dear Doctor,

In our health centre a computer based system of keeping patients' records has been in operation for some time now. The use of continuation cards and NHS envelopes has been discontinued. Instead a structured clinical record is maintained by ourselves on a Visual Display Unit during the surgery. The format of the structured record is explained in the enclosed letter. The paper copy of the record you now have in your possession represents the state of the computer record as the time this patient left the health centre.

We would like to know your opinion of this record and would therefore be grateful if, after you have used this patient's record, you answer the short questionnaire overleaf. It must be stressed that any information you may give us will be treated as confidential and no individual will be identifiable in any report based on this data. A stamped addressed envelope is provided.

Thank you very much for your co-operation.

Yours faithfully,

Drs Sidebotham,
Ward,
Bradshaw-Smith,
Pegg &
Ackroyd

APPENDIX C

Introduction

The questionnaire which follows consists of a number of statements sometimes used to describe jobs in health service. We would like to know how well each of the statements describes your job.

Beside each statement are five words describing varying degrees of agreement and disagreement with the statement. Please consider each statement and decide if you agree or disagree with it as a description of your job, then tick one word that corresponds with your level of agreement.

- - - - - -

Mt. Pleasant

SECTION I (Opinions)

		Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1)	Has frequent contact with patients	(6)	( )	( )	( )	( )
2)	There are few mechanical aids	( )	( )	( )	( )	( )
3)	Differs from day to day	( )	( )	( )	( )	( )
4)	Makes you fed up	( )	( )	( )	( )	( )
5)	Easy to do	( )	( )	( )	( )	( )
6)	Has to be done in a set order	( )	( )	( )	( )	( )
7)	Rewarding	( )	( )	( )	( )	( )
8)	Endless	( )	( )	( )	( )	( )
9)	There are no rules on how to do the job	( )	( )	( )	( )	( )
10)	Involves making decisions	(2)	(4)	( )	( )	( )
11)	Challenging	( )	( )	( )	( )	( )
12)	Tedious	( )	( )	( )	( )	( )
13)	Repetitious	( )	( )	( )	( )	( )
14)	Complex machines do most of the work	( )	( )	( )	( )	( )
15)	Often help patients	( )	( )	( )	( )	( )
16)	Largely done by hand	( )	( )	( )	( )	( )
17)	Can be done in several ways	( )	( )	( )	( )	( )
18)	Has opportunities for accomplishing things	( )	( )	( )	( )	( )
19)	Uncomplicated	( )	(1)	( )	(4)	(1)

Continued/...

		Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
20)	You can choose how you do the job	( )	( )	( )	( )	( )
21)	Interesting	( )	( )	( )	( )	( )
22)	The wrong sort of job for you	( )	( )	( )	(3)	(3)
23)	Has to be done according to rules	( )	(6)	( )	( )	( )
24)	Difficult	( )	( )	( )	( )	( )
25)	The same day after day	( )	( )	( )	( )	( )
26)	Inspiring	( )	( )	( )	( )	( )
27)	You rarely meet patients	( )	( )	( )	( )	( )
28)	Routine	( )	( )	( )	( )	( )
29)	Always the same	( )	( )	( )	( )	( )
30)	Automated	( )	(2)	( )	(3)	(1)
31)	Little involvement with patients	( )	( )	( )	( )	( )
32)	Boring	( )	( )	( )	( )	( )
33)	The job contributes to patient care	(2)	(4)	( )	( )	( )
34)	Has scope for achievement	(1)	(3)	( )	(2)	( )
35)	Varied	(1)	(5)	( )	( )	( )
36)	Relies upon modern technology	( )	( )	( )	( )	( )
37)	Nothing to do with patients	( )	( )	( )	( )	( )

SECTION II (Importance ratings)

How important is it for you	Vital	Very Important	Important	Of little Importance	Not at all Important
1) That you contribute to patient care	( )	(4)	(2)	( )	( )
2) That you have contact with patients	(1)	(3)	(2)	( )	( )
3) That your job is not automated	( )	(2)	(1)	(3)	( )
4) That your job is varied	(1)	(2)	(3)	( )	( )
5) That your job has scope for achievement	( )	(2)	(4)	( )	( )
6) That your job is uncomplicated	( )	( )	( )	(4)	(2)
7) That your job involves making decisions	( )	(1)	(3)	(2)	( )
8) That your job has rules on how it should be done	( )	( )	(5)	(1)	( )
9) That you are personally satisfied with your job	(2)	(2)	(2)	( )	( )

SECTION III (Working Environment)

The working environment is (or has)	Strongly	Agree	No Opinion	Disagree	Strongly Disagree
1) Cramped	( )	(5)	( )	(1)	( )
2) Hot	( )	(1)	( )	(5)	( )
3) Secluded	( )	( )	( )	(6)	( )
4) Quiet	( )	( )	( )	(2)	(4)
5) Dark	( )	( )	( )	(5)	(1)
6) Easy to do my job	(1)	(4)	( )	(1)	( )
7) Badly laid out	(1)	(3)	( )	(2)	( )
8) Noisy	(1)	(4)	( )	( )	(1)
9) Designed for the people who work in it	( )	(3)	( )	(3)	( )
10) Cold	( )	( )	( )	(6)	( )
11) No privacy	( )	(5)	(1)	( )	( )
12) Enough elbow room	( )	(3)	( )	(3)	( )
13) Difficult to do my job	( )	(1)	( )	(5)	( )
14) Machines come before people	( )	( )	( )	(2)	(4)
15) Light	( )	(5)	( )	(1)	( )
16) Well laid out	( )	(2)	( )	(4)	( )

Ottery St. Mary

SECTION I (Opinions)

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1) Has frequent contact with patients	(5)	(2)	( )	( )	( )
2) There are few mechanical aids	( )	( )	( )	( )	( )
3) Differs from day to day	( )	( )	( )	( )	( )
4) Makes you fed up	( )	( )	( )	( )	( )
5) Easy to do	( )	( )	( )	( )	( )
6) Has to be done in a set order	( )	( )	( )	( )	( )
7) Rewarding	( )	( )	( )	( )	( )
8) Endless	( )	( )	( )	( )	( )
9) There are no rules on how to do the job	( )	( )	( )	( )	( )
10) Involves making decisions	(3)	(4)	( )	( )	( )
11) Challenging	( )	( )	( )	( )	( )
12) Tedious	( )	( )	( )	( )	( )
13) Repetitious	( )	( )	( )	( )	( )
14) Complex machines do most of the work	( )	( )	( )	( )	( )
15) Often help patients	( )	( )	( )	( )	( )
16) Largely done by hand	( )	( )	( )	( )	( )
17) Can be done in several ways	( )	( )	( )	( )	( )
18) Has opportunities for accomplishing things	( )	( )	( )	( )	( )
19) Uncomplicated	( )	(2)	( )	(4)	(1)

Continued/...

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
20) You can choose how you do the job	( )	( )	( )	( )	( )
21) Interesting	( )	( )	( )	( )	( )
22) The wrong sort of job for you	( )	( )	( )	(2)	(5)
23) Has to be done according to rules	(1)	(6)	( )	( )	( )
24) Difficult	( )	( )	( )	( )	( )
25) The same day after day	( )	( )	( )	( )	( )
26) Inspiring	( )	( )	( )	( )	( )
27) You rarely meet patients	( )	( )	( )	( )	( )
28) Routine	( )	( )	( )	( )	( )
29) Always the same	( )	( )	( )	( )	( )
30) Automated	( )	(3)	( )	(4)	( )
31) Little involvement with patients	( )	( )	( )	( )	( )
32) Boring	( )	( )	( )	( )	( )
33) The job contributes to patient care	(1)	(6)	( )	( )	( )
34) Has scope for achievement	( )	(5)	(2)	( )	( )
35) Varied	( )	(7)	( )	( )	( )
36) Relies upon modern technology	( )	( )	( )	( )	( )
37) Nothing to do with patients	( )	( )	( )	( )	( )

SECTION II (Importance ratings)

How important is it for you	Vital	Very Important	Important	Of little Importance	Not at all Important
1) That you contribute to patient care	( )	(5)	(1)	(1)	( )
2) That you have contact with patients	( )	(5)	(1)	(1)	( )
3) That your job is not automated	(1)	(.)	(3)	(2)	(1)
4) That your job is varied	(1)	(4)	(2)	( )	( )
5) That your job has scope for achievement	(2)	(1)	(3)	(1)	( )
6) That your job is uncomplicated	( )	( )	(1)	(5)	(1)
7) That your job involves making decisions	( )	(3)	(2)	(2)	( )
8) That your job has rules on how it should be done	( )	(1)	(5)	(1)	( )
9) That you are personally satisfied with your job	(2)	(3)	(2)	( )	( )

SECTION III (Working Environment)

The working environment is (or has)	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1) Cramped	(5)	(2)	( )	( )	( )
2) Hot	(4)	(1)	(1)	(1)	( )
3) Secluded	( )	(2)	( )	( )	(5)
4) Quiet	( )	( )	( )	(3)	(4)
5) Dark	( )	(1)	(1)	(5)	( )
6) Easy to do my job	( )	(7)	( )	( )	( )
7) Badly laid out	(4)	(1)	( )	(2)	( )
8) Noisy	(4)	(3)	( )	( )	( )
9) Designed for the people who work in it	( )	(1)	( )	(2)	(3)
10) Cold	( )	(1)	( )	(4)	(2)
11) No privacy	(4)	(2)	( )	(1)	( )
12) Enough elbow room	(2)	(3)	( )	( )	(2)
13) Difficult to do my job	( )	(1)	( )	(5)	(1)
14) Machines come before people	( )	(1)	( )	(3)	(3)
15) Light	(1)	(5)	(1)	( )	( )
16) Well laid out	( )	(1)	( )	(2)	(3)