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Clinical Data Base Management by Microcomputer

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INTRODUCTION

The value of professional experience to physicians in general, and to surgeons in particular, cannot be overstated. Years of practice provide not only technical facility but also a great familiarity with disease processes, operative alternatives, and unusual situations. For many this experience is a part of the day-in, day-out self-education process acquired by daily practice. Ways of handling situations are developed by learning from the experience of others and by one's own trial-and-error methods. Unfortunately, the individual doctor's experience is too frequently recalled only anecdotally. Until recently, the accurate accounting of facts either observed or derived, which is vital to the employment of the scientific method, has been a laborious manual task. Automated data processing using digital computers has changed all this. Now a vast amount of data can be collected, filed, sorted, and retrieved with relative ease.

In an effort to interpret intelligently what can be a virtual mountain of data, various clinical data base management systems have been developed. Most of these systems have used large main-frame computers suitable for use by universities and medical centers. These have been too costly to install and maintain for a single private practitioner or even a small group of practitioners despite the general decline in hardware costs over the past decade.

Recent advances in miniaturization have combined to create low-cost, desktop-sized microcomputers. These miniature versions of large main-frame systems are now widely available in a large variety of system configurations.[1,2,3] We have adapted a general-purpose microcomputer for use as a clinical data base management system in a vascular surgery practice.

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SYSTEM CONFIGURATION

We have selected the Hewlett-Packard HP-85 as the microcomputer for our clinical data base management system. This desktop-sized device (16 × 42 × 45 cm) is a self-contained system (processor, typewriter keyboard with numeric pad, CRT, thermal printer, and high-speed magnetic tape storage are in one unit) and is completely portable (weight 9 kg). Our system requires the HP-IB (IEEE 488-1978) read-only memory chip as well as the full 32K bytes of random-access memory offered by the manufacturer. Although the system can interface with a flexible disk drive, a separate printer, and/or a plotter, these are not necessary for system operation. Data and the program are stored on the high-speed magnetic tape, which can hold up to 210K bytes of data per tape or up to 195K bytes of program per tape. This tape has a search speed of 152 cm/sec and can read/write at 24.5 cm/sec. Rewind time is 29 sec. The operating system and the BASIC language are stored in read-only memory as well as an unused graphics capability. Our program is a self-instructional, menu-driven system written in BASIC.[4,5]

CLINICAL DATA BASE

The source of clinical material for this operative history system belongs to a group of vascular surgeons. Their practice spans a time period of over 10 years. During this time over 3,000 patients have undergone over 2,000 operations. The raw data have been drawn from a variety of sources, including office files, hospital reports (narrative summaries, operative reports, consultation notes, and admissions examinations), state health department records, and mail or telephone contacts.

RESULTS

It would be quite expensive to completely convert paper records to electronic form on disks or even magnetic tape. Furthermore, complete data transferral without appropriate indexing would not improve data base searches. What must be done in order to expedite sorting is to define all the data in comparable terms and to otherwise group bits of data into categories that can be readily searched. In our case we selected 105 criteria concerning a patient's operation and divided them into 12 categories, of which the largest contains 21 items. These categories included such things as operation type and site and graft type and material. As a result, operations are defined by listing component parts (parameters). Parameters selected for use were included because they added definition flexibility and were relatively cheap and easy to acquire and store.

This system provides several advantages. First, it simplifies coding for the office clerk. A clerical employee can easily code an operation by selecting the component words from the operative report. This is in contrast to that same employee deciding that one operation is really the same as another operation with a slightly different name. For

example, an aorto-bi-iliac graft is the same as a bifurcated aorto-iliac graft. Second, it allows detailed analysis of aspects of one operation common to several different vascular procedures. And third, it allows direct comparisons of different operations for the same problem. For example, a search on the source of blood flow to the femoral artery can be restricted to include only that which comes from the aorta, or it can be broadened to include flow contributions from the contralateral femoral artery or the axillary artery or both.

Currently, 1,000 operations are performed each year by the group. There is anticipated growth in operative volume as the group size increases. The system has a capacity of 1,400 operations per data tape. As a result it has been convenient to assign one tape to a year. This can be a bit cumbersome when searching the entire data base because of the number of tape manipulations. However, a design feature in the system allows the system to save search results as data base subsets. These subsets can be researched in much less time than the original total data base search and they are especially useful for detailed analysis of a particular problem.

Results reported by the system are divided into two groups. The first group includes routine and frequently recurring data base searches such as operative activity and morbidity/mortality reports. These can be obtained on a week, month, or year basis at the user's request. The other group of reports consists of the special data base searches that are the main objective of this system. These searches are conducted by searching for components. Any of the 105 criteria can be used alone or in combination. The time frame of the search can be the current year to date and/or any combination of previous years. The system provides space for 20 predefined searches. These have been used to list out standard procedures. However, data base searches are user-defined and thus can just as well be for "nonstandard" procedures.

The impact of the installation of this system on the surgical group has been substantial. User acceptance has been positive and has generated suggestions for future enhancements. An important effect has been to increase the awareness for the need for uniform documentation of clinical data both in hospital reports and in the office files. To this end a vascular surgery service handbook has been prepared and is distributed not only among members of the group but also among housestaff members at the various hospitals where members of the group work. This manual clearly defines what kind of information should be included in dictated reports. Furthermore, an office follow-up data sheet has been designed to create a uniform outpatient data base. It is anticipated that these data will be linked with the current operative history information system. This outpatient form is also designed to maximize the use of paramedical personnel in the collection and transcription of clinical data.

Full effects of the data base searches have not been determined to date. The system has only recently been installed and the entire data base has not been loaded. Data initialization from old records continues and the size of the data base is growing daily. It is anticipated that special as well as routine data base searches will become at least weekly features of the group's practice. An important long-term goal of the group is to evaluate new techniques, materials, and devices in the practice of vascular surgery. Extensive use of special searches is expected in pursuit of this goal.

SUMMARY

A professional-grade, portable, desktop computer has been programmed to provide a computerized data base search of clinical material. This system provides reports detailing operative activity, morbidity, and mortality on a routine basis. Special data base searches can be performed using 1 of 20 predefined search criteria. These search criteria can be redefined at any time by the user. Data and program storage is provided by high-speed magnetic tape capable of holding up to 1,400 operation reports per tape. Uses include work load evaluation, identification of referral patterns, and operative result evaluation.

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