Computers in Family Practice

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Health Maintenance and the Personal Computer

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The personal computer utilizing general-purpose (or "canned") software can assume the task of monitoring routine health-screening procedures. Traditional methods, such as relying on patient compliance and maintaining mechanical data storage and retrieval systems, have proven to be inadequate. Ethically and legally, health maintenance is the physician's responsibility. With the current availability of inexpensive computers and professionally written general-purpose software, the practicing physician has tools that can be applied effectively to health maintenance practices. Presented in this paper are some major considerations involved in constructing a patient records data base for a personal computer along with a few representative applications of the data base in the arena of preventive medicine.

Procedure

To examine the factors involved when applying the personal computer to health maintenance practices, a data base was created and procedures for accessing and manipulating the accumulated data were implemented. The computing system chosen for the implementation is typical of many personal computers that use the CP/M operating system. This operating system was preferred because it has extensive, currently available software.

The software package used was dBase II,* an application support package that features numerous general-purpose capabilities for creating, managing, and accessing multiple data files. Many of the dBase II features are available only on comprehensive data base systems that run on large computers, yet this package runs effectively on many types of personal computers.

The application area chosen for this study was the maintenance and access of patient records typical to a group family practice office. Information was captured from an office fee sheet using ICHPPC (International Classification of Health Problems in Primary Care) codes for diagnoses encountered and CPT codes for procedures performed.

Data Structure

Data structure refers to the way in which data are arranged to facilitate access. The term *access* refers to both data storage and data retrieval. Each data item is characterized both by the class to which it belongs and by the data it contains. The *class* defines the context for interpretation of a data item. As an example, the class of a data item may be "street address" and the data itself could be "17 Spruce Street."

Data items for each particular entity are grouped into units referred to as logical records or simply records. An *entity* is anything about which

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*dBase II. Ashton-Tate, Inc, 9929 West Jefferson Blvd, Culver City, CA 90230.

data can be gathered and accessed. Entities include persons, things, and events. For example, a patient, a particular visit to the physician, a prescribed medication, and the physician himself are all entities.

Records for any given entity are grouped together, and each such group of records is called a file. A *file,* then, is a collection of records having the same format and referring to the same entity. Individual records of a file are identified for access by one or several keys. A *key* is one or more data items used to characterize a particular record or group of records within a file. Examples of keys include patient name, area of residence, age group, and sex. Keys need not be unique for each record of a file. For example, a file keyed on patient name may include data for more than one patient having the name John J. Jones. A key that by nature is unique for each record of a file is termed an *identifier.* Examples of identifiers include patient chart number, social security number, and equipment type and serial number.

A *data base* is a collection of files and procedures for interrelating and accessing records contained in the files. Normally all of the files that make up a given data base are associated in that they pertain to or are used to support a particular application or group of applications. The data base that was implemented for this study consists of the files listed in Table 1. Figure 1 is an example of the structure of the individual record format that makes up these files.

The primary means used to interrelate the records of various files is to key all records to patient chart number. Notice that the patient chart number is an identifier for records of the patient file, but is a key (and not an identifier) for records of other files. In other words, patient chart number uniquely identifies each record of the patient file, but each patient will probably make numerous visits to the physician's office and so will have numerous associated records within the visit file. The overall logical structure of the data base depends on how the records of the various files are interrelated for access. For this study, a hierarchical tree structure was used (Figure 2).

Table 1. Files Contained in Health Maintenance Data Base

File	Description
Patient	One record for each patient, keyed to chart number
Visit	One record for each visit. Multiple visits are allowed for each patient, keyed to chart number and date of visit
Diagnosis	One record for each diagnosis. Multiple diagnoses are allowed for each patient visit, keyed to chart number and date
Procedures	One record for each procedure. Multiple procedures are allowed for each patient visit, keyed to chart number and date
Medications	One record for each active medication. Multiple medications are allowed per patient, keyed to chart number

Results

The current data base contains clinical data accumulated over approximately one year for more than 400 patients. There are numerous ways in which the data base can be used, two of which are described.

Figure 3 shows a current medication list for a particular patient. The patient is identified by a specific chart identification number (907999). The appended digit (-7) is a check digit used for redundancy checking. A medication list is generated for each patient visit by executing a data base utility program. The list is then attached to the patient's records for use by the physician during the visit. It provides an accurate summary of the patient's current medications and serves as a work sheet for adding, deleting, and changing medications. Subsequent to the visit, any modifications to the patient's medication schedule are entered into the data base.

Another application of the data base is the generation of a mailing list for women who are currently due for a yearly Pap smear. This list is generated as part of the monthly preparation of patient reminder notifications. The program performs a search of the patient data base to identify all female patients aged over 25 years who have not had a Pap smear within the past year. This application illustrates the advantage of using a formally structured data base as opposed to simply a collection of patient data files. First, the

RECORD FORMAT

PATIENT

Chart #	Name	Street	City	State	Zip	Phone	Birth Date	Sex	Race	Marital Status	Occupation	Clinic Status	Family #
8	25	15	15	2	5	13	6	1	1	1	15	1	4

VISIT

Date	Physician #	Chart #	Visit Type	Height	Weight	Blood Pressure	Pulse	Temp	Date Next Visit
6	3	6	5	2	3	4	3	4	6

DIAGNOSIS

Date	Chart #	Diagnosis	Type Problem
6	8	3	1

PROCEDURES

Date	Chart #	Procedure	Result
6	8	8	16

MEDICATIONS

Date	Chart #	Medication	Strength	Frequency	Duration of R_x	Comments
6	8	10	10	6	6	8

Figure 1. Individual record formats for each file of the data base. The number below each class represents how many characters or "bytes" of information are used to store that particular data item

patient file is accessed to locate female patients aged over 25 years, then the procedure file is accessed to determine whether eligible patients have had a Pap smear within the last year. The interrelation between the two files is handled through the patient chart number. Very little time and effort are required to perform this valuable function regularly. The information obtained in this way can then be used to generate "personalized" reminders to these patients and to address the envelopes at the same time.

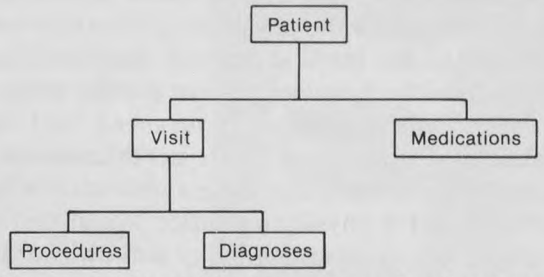

Figure 2. Hierarchical structure showing how each file is related to the other files in the data base. Information in each file is linked by keys and identifiers

Discussion

Preventive medicine has long been a major goal of health maintenance in the primary care setting. Routine examinations and screening procedures are important because they help the physician identify potentially serious, but treatable, problems at an early stage. Well-child visits with immunizations and growth and development assessment, regular Pap smears in sexually active women, annual screening for occult blood in the stool in adults aged over 35 years, and regular

CURRENT MEDICATION LIST

Append for NO: A = ADD/Dn = DELETE/Cn = CHANGE

MEDICATION LIST FOR
CHART ID = 907999-7

NO.	DATE	MEDICATION	DOSAGE	FREQ.	TIME	COMMENTS
1	830111	DIMETAPP X	1	Q 12 H	830118	
2	830111	ROBITUS AC	2 TSP	Q4-6H	830118	
3	830209	TAVIST-D	1	BID	830219	
4	830303	GAVISCON	3 TABS	PC + HS	830403	
5	830315	HYCOMINE	1 TSP	Q4-6H	830325	
6	830324	HCTZ	25 MG	Q AM	830624	
7	830505	MINIPRESS	3 MG	BID	830805	
8	830624	ANTIVERT	25 MG	TID	830704	
9	831117	VIBRATABS	100 MG	Q 24 H	831124	

Figure 3. Example of a current medication list generated from the chart number at the time of a patient visit. This also serves as a work sheet for adding, deleting, and changing medications as necessary

checks of blood pressure, weight, and ocular tonometry are common and useful health-screening procedures.

Traditional methods of monitoring health care trends are very limited. Many busy physicians either have no means of keeping a running tabulation of their patients or have simple flow sheets as part of the paper record. As a result, patients must be largely responsible for their own follow-up. Depending upon patient compliance is unreliable and does not allow the physician to have total control of his or her medical practice. Mechanical recall systems for following patient profiles generally consist of chronologically arranged card files containing reminders of future necessary evaluations. Dental offices use these systems very successfully, but a physician's office would find six or seven mechanical files bulky and awkward to maintain. The personal computer solves these problems in an efficient and relatively inexpensive way, although the cost must be considered. In addition to the acquisition of a microcomputer and general-purpose software, setting up this system required a considerable time commitment by knowledgeable professionals. The construction of the data files used here, as well as the entry and retrieval programs, consumed approximately 40 hours. The advantages of the system in this setting, however, more than compensate for this initial effort.

Personal computers and "canned" data base managers are within the economic means of most medical practices. Such a system can be specifically tailored to each individual clinical setting, has great flexibility, and can be altered or upgraded to meet future needs with a minimum of effort or disruption of existing data. Perhaps the most significant advantage is that the physician, with very little training, can manipulate the clinical data in specific ways by using a few simple commands. Such flexibility is not possible with sophisticated and "dedicated" medical packages.

Other possible uses of the data files created for this demonstration include following laboratory results, monitoring trends in weight and blood pressure, performing internal patient care audits, and having remote access to clinical records when the office is closed or the physician is at the hospital. All of these could be easily added on to or derived from the existing data base. If ICDA-9 diagnostic codes had been used instead of the ICHPPC classification, the same data could easily have been used for billing. The personal computer is a flexible, multipurpose tool with particular suitability to the implementation of an efficient health maintenance system.