Clinical Applications of Computers in Office Practice

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Until recently medical office computer systems in the United States were designed to deal only with the billing and fiscal aspects of the practice. About 20 percent of physicians already use computers for billing, and another 40 percent are considering introducing a computer into their practice in the next two years.[1] These data were recently confirmed by an unpublished survey conducted by the author on computer use by physicians in the Pacific Northwest.

Little attention has been given to the potential clinical applications of the data that are so carefully and systematically coded and collected to satisfy billing requirements.

More recently various medical office software packages have also included the option of generating lists of patients who satisfy certain diagnostic, demographic, or procedure criteria or combinations of these. This capacity is an important step forward, but fails to integrate the information toward creating an ongoing integrated patient surveillance and outreach program or monitoring the practice profiles.

On the other extreme, several large real-time systems have attempted to computerize the medical record, with the billing and fiscal reports as a spinoff of the clinical function. Some examples of these systems are COSTAR,[2] EPIC,[3] and TMR.[4] These systems may be suitable for the large multispecialty clinic, but they are rather expensive and have not yet been adapted to the smaller office setting.

Even physicians who are satisfied with their manual billing system might still wish to consider purchasing a microcomputer for clinical applications in their medical practice.

In the United States, unlike Britain,[5] there has not been a systematic definition of the data elements or system requirements that would best satisfy the needs of practicing physicians. A large number of business software packages abound, but no consensus has been reached to permit the development of a practical and integrated medical office package that would provide both the business functions and the clinical applications at reasonable cost. The American Academy of Family Physicians is starting to take some steps in this direction with the formation of a computer task force.

This paper will describe the clinical applications of microcomputers on the basis of recent site visits to two family practices pioneering in this uncharted area.

Index Practices

Since no ideal package has been developed to date, many practicing family physicians who are also computer enthusiasts have written programs that meet their own particular needs. The author recently visited several of these practices to attempt to determine the common elements that might be generalizable to all family physicians. Two of these systems will be described in some detail, since they represent two extremes of the spectrum and demonstrate the principles inherent in defining an all-purpose integrated system.

Practice A

Dr. William Jones* is in solo practice in Austin, Texas. He sees about 20 to 30 patients each day

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and is satisfied with a manual pegboard system used for bookkeeping. Statements are not mailed, and patients either pay at the time of service or are provided with a bill before leaving the office. Since billing was not a prime consideration, he decided that a microcomputer would meet his desire to monitor his practice and provide better health care through outreach and patient reminders regarding preventive care.

Three years ago he invested in a Radio Shack TRS-80 Model II microcomputer. Initially floppy disks were used for data storage, but more recently, a more convenient 8-megabyte hard disk was added. As most software available at that time was billing oriented, he wrote his own programs to provide the desired clinical applications. (He was self-taught, using the manuals provided by the manufacturer.) The following elements are routinely collected on all patients in addition to the patient name, address, telephone number, date of birth, and sex: (1) chronic diagnoses (20 categories), (2) chronic medications, (3) allergies to medications, (4) date of last health maintenance visit, (5) date of last Papanicolaou smear, (6) date of last office visit, (7) date of immunizations (influenza, pneumococcal, tetanus), and (8) additional comments (eg, cigarette smoking, seasonal allergy). The computer record is updated each day from the encounter form, which is designed to capture all the data elements needed in the system. The office manager takes about 30 minutes a day to enter the daily information. Any time a change in the demographic data is entered (eg, address, telephone number), two new self-adhesive labels are generated to be affixed to the patient's chart and ledger card. Thus, the manual records always have the most up-to-date demographic information available to the office staff.

Patient diagnoses are grouped in 20 broad categories, which include hypertension, diabetes mellitus, chronic obstructive pulmonary disease, asthma, alcoholism, depression, myocardial infarction, thyroid diseases, peptic ulcer, cancer, and renal disease. These conditions are likely to require recall for follow-up or immunizations. Dr. Jones does not use a more specific coding of diagnoses, as this is not required for third-party billing in Texas.

Every month the computer identifies those patients who require evaluation of chronic disease or health maintenance follow-up according to established protocols. Personalized reminder letters specifying the reason for the recommended follow-up are generated on a letter-quality printer and presorted by ZIP code to reduce mailing costs. According to a standard programmed format, patients are sent three to four reminders over as many months and finally, if they have still not responded, contacted by telephone before being dropped from the active patient file. The computer is used to generate mailing labels, presorted by ZIP code, for other mailings, such as the practice newsletter.

Each month the system performs an analysis of the practice activity according to selected demographic and diagnostic variables. The system also monitors outstanding balances to be reconciled daily with the pegboard, which provides a daily bookkeeping cross-check. In addition, weekly accounts receivable and aging of accounts are generated. The date of last payment and any outstanding balances are included in the patient's computer record and updated daily.

Each patient record is stored in a highly compressed format and occupies about 125 bytes. With an active patient population of about 3,000, the 8-megabyte hard disk is more than adequate.

Comment. Although the system has been custom designed for the needs of this particular practice, the outreach and surveillance concepts could be integrated into the daily operations of most family physician offices.

Practice B

The practice of Drs. Bryan Stone and Rod Ryan* in Hewitt, Texas, is at the other end of the spectrum. Dr. Stone has virtually automated his office with a computer system that he designed and programmed. The program is called MOSTAR (medical office data system). He and his partner see about 40 patients a day, but only one of the physicians is in the office on any given day. Technical details of the system have been reported elsewhere.[6]

The system was designed to reduce paperwork and assist the physician in recording patient information. There is a cathode ray terminal (CRT)

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in each examination room, at the front desk, at the nurses' station, and in the laboratory. Each staff member may enter particular patient information at any terminal. These data are immediately available to authorized users at their locations. The software protects against conflicts resulting from concurrent access of the same patient's data by different staff members.

The system is best described through following the sequence of a patient visit:

The patient is checked in at the front desk and a two-part arrival form is generated. The first part is given to the patient to review for accuracy of the address, telephone number, etc; it also indicates the account balance. The second part is attached to the patient's record, which accompanies the patient to the examining room. It contains the same information as the first part plus a summary of the preventive care status. In addition to age, sex, and family history, certain data are routinely collected to facilitate the production of the health surveillance summary as follows: (1) diagnoses (ICD-9-CM), (2) medications (and allergies to medications), (3) history of hysterectomy, (4) history of splenectomy (requires pneumococcal vaccine), (5) immunizations (influenza, pneumococcal, childhood vaccinations, tetanus), (6) Papanicolaou smear (women aged over 18 years with no history of hysterectomy), (7) sigmoidoscopic examination (all patients aged over 50 years or over 35 years with family history of colon cancer), (8) mammography (American Cancer Society guidelines), (9) complete blood count (annually for all patients aged over 18 years), and (10) chemistry screen (annually for all patients aged over 18 years).

Review of preventive care provided with the second part of the arrival ticket points out whether certain procedures have not been carried out according to the practice protocols delineated above. These protocols are defined by the practice physicians and can be entered directly into the system without the need for additional programming. (These protocols were established by this particular practice and may not reflect the protocols other physicians may choose to follow.)

The nurse enters the vital signs, reason for visit, comments, and date of last menstruation for female patients of childbearing potential.

Using the CRT in the examination room, the physician can call up the most recent clinical data entered, appropriately dividing his attention between the computer and the patient, as one would with a paper record.

In the case of children aged less than 16 years, the computer displays the percentile for height and weight, and in the case of menstruating women, indicates whether their menstrual period is late.

The progress note for that visit is entered by the physician on the CRT, using abbreviations and predesigned menus for diagnoses or symptoms. These menus can be readily designed and changed by the physician. Minimal keyboard strokes are needed to create a detailed problem-oriented record. Free text is also possible. Medications to be prescribed are entered, and the computer can be used to calculate and display the appropriate dosage and dispensing information for review. Laboratory tests or x-ray tests ordered generate a signal on the nurses' or laboratory technician's CRT.

After the visit note is completed, the physician instructs the system to print a series of documents, which are run off the printer at the front desk. These documents include a computer-generated prescription, which the physician signs; the visit note, which is glued onto the patient's record; a health insurance claim form in the standard American Medical Association format; an updated summary of all pertinent clinical information, including diagnoses and medications, to be filed in the record; and a letter to the patient detailing the advice given relative to the particular diagnosis. A prompt can be given to the receptionist to include preprinted patient education materials. In addition, where appropriate, there may be letters to the employer or school nurse.

The system also generates monthly statements and monitors patient flow in the office.

A daily financial summary of receipts and charges, as well as a telephone list of patients seen, is provided to the physician. This list includes diagnoses recorded at that visit for easy follow-up.

Clinical data are available to the physicians at home via telephone linkup to the computer.

The computer also has full search and reporting capabilities based on any combination of criteria, including age, sex, date range, diagnoses, medications, and procedures.

Comment. This system represents a comprehensive integrated medical record and financial and patient monitoring system for small or medium-sized practices. It is available to other

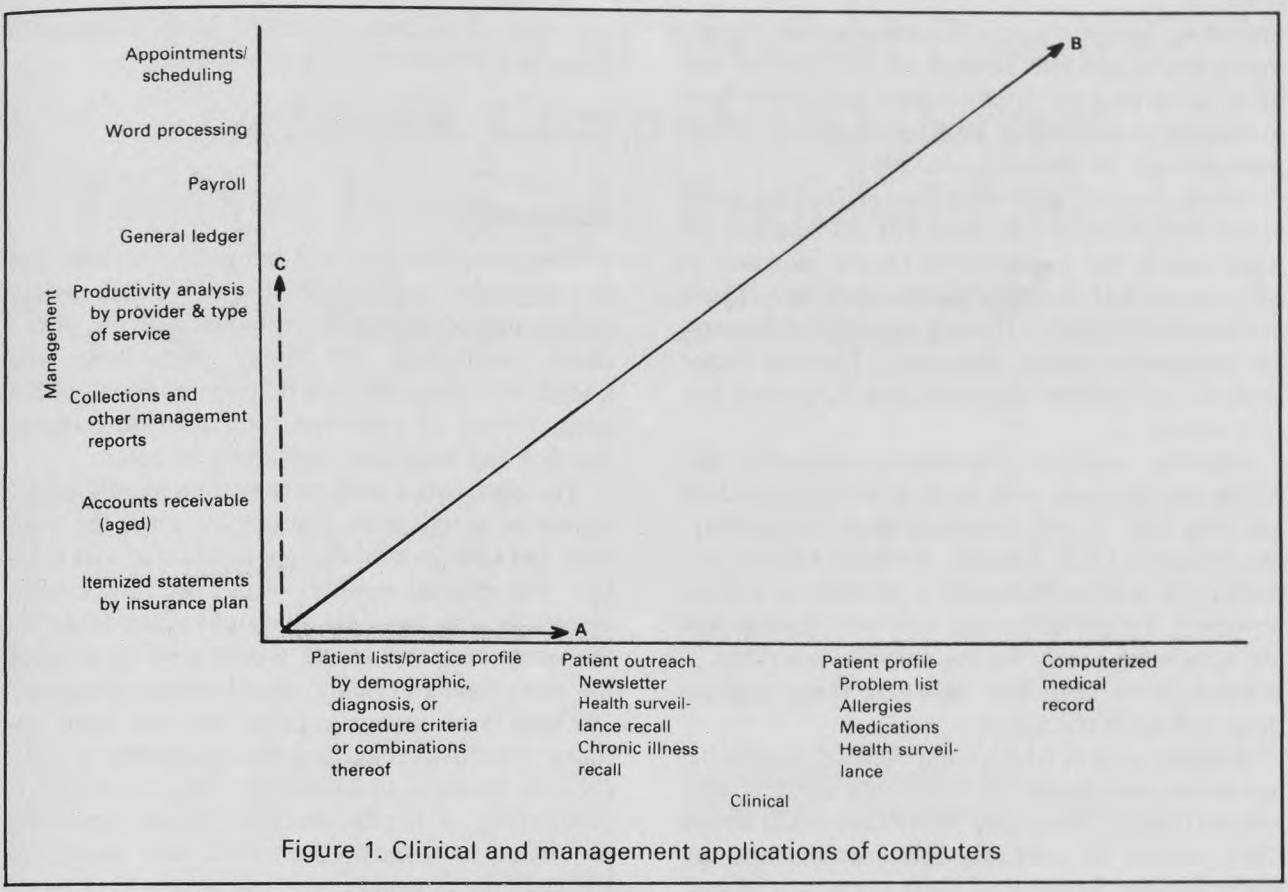

Figure 1. Clinical and management applications of computers

users either as a billing system with some search capabilities at an estimated cost of $13,000 or a complete clinical system with eight terminals for about $27,000 including hardware and software.* The clinical system works best if the physician enters the clinical data directly as described above.

Discussion

Figure 1 illustrates the balance between management and clinical applications in an office practice. Presently, most available systems (C) are heavily weighted toward the management axis, although the pendulum is moving toward expanded clinical applications. The two practices, A and B, described in this article demonstrate those clinical applications that could readily be integrated with the usual billing functions. Any practice considering a computer system should determine how far along each axis they would like to be and at what cost. The clinical applications that are clearly helpful include (1) monitoring patients with chronic diseases, (2) monitoring preventive health maintenance according to age- and sex-specific protocols, (3) recording chronic medications and drug allergies, and (4) maintaining an immunization record.

The computer can be used to monitor these parameters at the time of a visit or through outreach and recall with computer-generated letters and mailing labels.

Patient lists can also be generated for research or audit purposes. Moreover, practice profiles

*MOSTAR systems are marketed by Eclectic Systems, 16260 Midway, Dallas, TX 75234, (214)661-1370. (This does not indicate endorsement of this system by the author, since no formal evaluation was conducted.)

providing insights into the demographic breakdown and diagnostic content of the practice can be of great interest to physicians and assist them in designing continuing medical education, office management, or research activities.[7]

Other clinical applications are still in the process of development and have not yet reached the point where the computer is clearly superior to existing manual methods in office practice. These applications include (1) drug interaction inquiry, (2) computer-assisted diagnoses, (3) risk factor analysis, (4) patient education,and (5) patient history taking.

National medical information computer networks already exist with medical programs including drug inquiry and literature search capability, for example, GTE Telenet. Access to these networks via microcomputers is already a reality; however, the networks are not very flexible and are somewhat costly for the services provided. It remains to be seen how practical these applications will be in the future.

Another area in which computer software is being developed rapidly is continuing medical education (CME).[8] Practicing physicians could obtain CME credits at relatively low cost through the video display terminal of their home computers. The software development in this area is expanding, and physicians surveyed have indicated a great deal of interest in the medium.

Summary

The power to store and integrate vast amounts of information and to extract selected data rapidly makes the computer an obvious tool for physicians, particularly for family physicians, who attend to a large number of patients, deal with a great variety of problems, and provide comprehensive and long-term continuity of care.

The ideal office computer system should be designed to permit each practice to select the business and clinical modules appropriate to that practice. The clinical modules would need to be sufficiently flexible to allow every physician to define the parameters he or she would wish to monitor for surveillance or health maintenance programs.

There is an urgent need to arrive at some national consensus regarding the integration of clinical and business functions for office computers, particularly in family practice. Some pioneering physicians have shown the way. It now remains to translate the concepts into a generalizable system that would be suitable for a variety of settings.

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