Computers in Medicine: An Overview

Abdulla M. Abdulla, M.D., Cathi Chambley-Miller, M.A.

Augusta, Georgia

Abstract

The virtual explosion in the development of medical software and the advent of powerful and affordable personal computers have ensured the widespread use of personal computers by physicians and hospitals. This article provides an overview of the varied applications of computers and available software in the practice of medicine.

Key words: *Personal computers, medical applications, practice management*

For over ten years, personal computers have been making headway into the world of medicine. The early personal computers were large, slow, and less powerful by today's standards, but those computers offered a glimpse into the future of the medical practice, with the promise of information control, document retrieval and number crunching for accounting. Many physicians have been using personal computers in one way or the other since their introduction. These same physicians often had to develop their own software, since software specific to the health care industry was not widely available. One reason for the acceptance of computers in the medical field may have been the technological advances in hospitals and laboratories. The medical community has been using personal computer technology for many years as the controller units for laboratory and testing equipment. The computer's ability to record large amounts of data, then generate complex statistical information, far surpasses an individual person's ability to do the same. The same factors which make a computer the ideal unit for maintaining test data also make it suitable for use in other in-

formation intensive areas, such as patient record management and patient billing. The purpose of this article is to provide the practicing physician with an overview of the many current applications of the personal computer in medical practice.

Medical office management systems

Many of the medical office management programs which are available today combine patient record-keeping and patient billing. These programs allow the office to retrieve a patient's file quickly, and produce printed reports for review by the physician before the patient's appointment. The use of the personal computer to maintain records and produce reports can help the physician in remembering all of the facts of a patient's health status before making decisions on drug therapies or diagnostic testing. This ease of information retrieval can also help the practitioner in the event of a medical malpractice suit, as it can provide him with a complete set of information about the patient. This is especially true of those programs which identify and warn of the problems with a patient's therapeutic regimen. For example, a certain program flags drug interactions, so that the physician will immediately know if there is a potential problem with a course of drug therapy. There are programs that contain diagnostic tools which would evaluate the results of blood tests, physical examination findings, laboratory data, etc., and offer a list of differential diagnoses. Of course, with all the programs, the responsibility for their appropriate use is shouldered by the medical practitioner.

Some medical office management programs add

insurance filing, capabilities to their list of features, making claims filing and reimbursement, a much smoother and faster process. There are some office management programs which provide complete accounting features for the medical office, integrating patient billing with payroll and general ledger with accounts payable. These systems let the office manager quickly determine the financial status of the practice, including the profitable procedures and specific areas of income loss.

Word-Processing

Of course, each medical office, hospital or clinic also has need for simple word processing. While there have been many good word processors in the market, it is only recently that extensive medical dictionaries have become available to be used with these programs. Word processing programs offer the ease of generating and quickly editing office work-ups, progress notes, letters to referring physicians, communications to patients, etc. Form letters containing a normal physical examination can be created and then easily modified to incorporate a specific patient's abnormal findings. This can be done with the help of a check-list that the physician completes and the secretary uses to generate a final document. The addition of a medical dictionary/spelling checking program will greatly enhance the office's ability to quickly produce patient reports and letters of referral that are free of spelling and typographical errors.

Staff-scheduling

A relatively basic use of the computer in a medical office or clinic is patient and staff scheduling. There is software available which allows scheduling of appointments for several physicians or nurse-practitioners. There are programs that allow you to schedule staff availability around vacations or other absences as well as the expected patient load during those times. For example, a large family practice group might routinely expect a large number of emergency calls during the winter "flu" season. The program can be set up to allow fewer vacations during that time in order to ensure that a larger number of staff members is available to handle the load.

Patient-scheduling

A physician's office staff might spend many hours on the telephone scheduling upcoming patient admissions for surgeries, CT scans, thallium stress tests, cardiac catheterizations and other procedures most commonly performed outside the office. One of the newest additions in the medical computer arena is the on-line communications product which will allow the physician's office to communicate with the mainframe or mini-computer at the local hospital. This electronic link with the admissions desk and test scheduling centers will potentially allow the office to quickly schedule a patient's surgical and diagnostic appointments. The patient is able to leave the office with his/her schedule in hand. Also, the patient can be "pre-admitted" by providing demographic and medical insurance information to the hospital computer.

On-line diagnostic help

Another recent development in computer communications is the on-line diagnostic help service. Many major medical universities and teaching hospitals are establishing these services to provide information on various diagnostic tools and treatment plans for a wide range of injuries and illnesses. A physician in a small regional hospital can dial into the on-line database, with the use of a personal computer and a modem, and retrieve the latest information about a constellation of symptoms, a specific disease state, or a treatment modality. Thus, a small-town physician, who rarely treats gun-shot wounds or AIDS, will be able to quickly obtain the latest treatment, prescribed drug plans and dosages, and information about possible complications and recovery. Because of the availability of these services, an increasing number of hospital emergency and operating rooms are installing personal computers complete with modems and communications software. Hospitals which are active in the field of organ donation and transplantation use Personal Computers (PCs) to hook up via modem to services which match donor organs with potential recipients. The time saved in locating donor organs can make the difference in patient survival.

Use of computers by emergency physicians

Portable computers are becoming indispensable tools for medical professionals, especially for emergency medicine specialists. Many ambulance teams are now equipped with a portable computer as well as other life-support equipment. With the help of the computer, the rescue teams can retrieve dosage information on the spot, and can maintain a record of all treatment as it is being performed during transport. This information can then be given to the emergency room team. Portable computers can be used in emergency rooms and other units, so that information on patient status, drug dosage and time, vital signs and other data can be entered as the nurse or physician examines each patient. Drug-drug interactions, dosages corrected for weight, antidotes for poisoning cases, etc. can easily be retrieved. The computer can also quickly retrieve valuable information when it is attached to an on-line patient database system that contains the specific patient's medical history. The attachment of a Fax card, scanner and printer to a computer can provide the capability of transmitting and receiving graphic in-

formation, such as electrocardiograms (ECG) and CT scans of the head. The additional use of a cellular telephone line can allow an ambulance to transmit a 12-lead ECG or rhythm strip while transporting a patient to the emergency room. Although portable computers are usually more expensive than comparable desktop units, one portable unit can sometimes do the work of several desktop units.

Continuing medical education

Continuing education has become a very important topic in the medical office. A well-educated staff has become increasingly important with the specialization of the medical practice. While in the past, a physician's nurses and other assistants were expected to have little knowledge on a range of subjects, today's office staff must have a larger volume of knowledge in the specialty of the practice. For example, a nurse in an obstetrics and gynecology practice will spend more time with the obstetrical patient than the physician himself, and must therefore be more knowledgeable about diet, physical changes and complications. Many physicians have begun not only to encourage continuing education for their staff, but have also introduced personal computers and educational programs in their offices. Medical education programs, in a number of specialities, are available from many medical schools or universities, and from on-line systems offered by medical organizations. While many of the educational programs use the computer to display information, ask questions, and evaluate responses, some systems have been developed which will allow the addition of video or laser disk players to display information, including x-rays or ECG charts, angiographic data, surgical techniques, and the use of live actors to simulate a patient.

Interactive patient counselling and desk-top publishing

Patient education has also become a significant issue in the medical practice. Many physicians feel that a patient who understands his/her medical condition and its treatment plan will be more likely to follow the exercise, diet and drug program. This belief has led to the development of interactive computer-aided learning programs designed for patients and has added to the number of physicians' offices, clinics, and hospitals that use personal computer-based desktop publishing and graphics programs to produce patient information brochures and booklets. Many hospitals now maintain their own media production departments in which patient information magazines and newsletters are produced regularly. The physician's office can take advantage of this resource, or can establish powerful desktop publishing capabilities with its own computer system and laser printer. Virtually any 80286, PC-AT com-

patible computer or Macintosh computer, can be used as a desktop publishing (DTP) station, in addition to other uses, such as a patient or staff education station. The addition of a high-resolution monitor, a desktop publishing program, a graphics program and a laser printer make a basic DTP station complete. As the office's need for informational documents increases, a scanner can be added to include photographs or other prepared art to the documents. Moreover, the acquisition of an internal fax board can allow the office to transmit and receive faxed material without a dedicated fax machine.

Another aspect of patient education is encountered by pediatricians. Their young patients may be more attentive to a graphic, game-like program which uses role-playing, story-telling, and interactive techniques to interest these children in the treatment of their disease. While these programs are not readily available, much of the software developed for elementary education can be adapted for medical purposes. The many studies showing the effectiveness of computer-based educaional programs virtually guarantee the success of this type of pediatric patient education.

Graphic modelling

Plastic surgeons, orthodontists and oral surgeons have found that personal computers can help them display graphical representations of the patient in order to determine the best approach to a patient's problem. These physicians can use the computer to produce models which will project the look of the patient after treatment or surgery. These programs may interact with peripheral units such as scanners and Compact disk – Read only memory (CD-ROM) drive. A scanning unit made specifically for collecting scans of X-rays may be particularly useful for plastic surgeons, maxillofacial specialists and orthopedic surgeons. Other physicians will find a wealth of graphic images available in CD form for use in CD-ROM drives. These images can then be examined and compared to a patient's x-rays, photographs, bone scans, etc. Often, these same systems can be used to help the patient understand the extent of the treatment or surgery and the expected outcome. Systems such as these are an offshoot of the complex Computer Aided Design (CAD) programs used by engineers and designers for structural designing.

Data acquisition

As a physicians's practice becomes more and more specialized, many offices are using their own inhouse laboratory facilities. Data acquisition is one of the newest applications for personal computers which has a very important place in the medical practice. With the use of a personal computer and data acquisition software and hardware, a physician can

have quick, easy access to laboratory data of a given patient. Some offices might find that the same computer which is used for data acquisition can be utilized by the laboratory staff to produce database reports from that data, word process documents (including requests for testing at other laboratories, generation of reports and their interpretation that are forwarded to the referring physician, etc.), faxing of reports to the referring physician's office (if that physician has an on-line fax machine), or any other computer-based activity that does not interfere with the data acquisition. As personal computers and software becomes more powerful, this is one area in which computer use is sure to grow.

Personal information manager

A more personalized application which is finding popularity with busy professionals in many fields is the Personal Information Manager (PIM). A PIM program allows you to maintain a personal appointment calendar, list of contacts, "To Do" lists, phone numbers and addresses, and other personal information. While most physicians, and many others, have relied on a secretary to maintain these details, many physicians are finding it useful to do it themselves. Often, these are the same physicians who have bought portable computers which move with them from the office to their home and on trips. As physicians become more aware of the applications which are available for personal computers, demand for these applications will most likely surge. Physicians who have computerized their practice have gained numerous benefits in efficiency and improved patient care. Hospitals have been enjoying the benefits of computerized patient billing and scheduling for years, and the trend is spreading into the individual medical practice.

Networking of computers

Information about patients and treatment procedures can be shared between several personal computers in the same office, between two or more offices and with a hospital computer. For example, the medical office could enter patient demographic information into a hospital computer and expedite remote hospital admissions, saving time and paperwork for the hospital and patient. Information can also be shared between two offices, so that when making referral, a physician need not have to mail copies of the patient's record. This increase in speed of data sharing can allow the physician more time to review information and gather any additional data which could be vital to the care of the patient, improving the patient care, and increasing the productivity of the physician and his staff. Information is exchanged between computers by the use of communications packages and the appropriate mechanical link-up system. This system consists of a

modem and telephone lines between two computer sites, or in an office situation, can be a Local Area Network, or LAN. A LAN is composed of computers, wiring, and additional communications equipment which allows computers to share programs or data. LANs allow each computer on the network to continue to do its own processing, while adding the ability to share information between users. This means that a medical office can have one station in which the patient histories are routinely recorded, but that these histories are available to the physician on the separate computer that he works on in his office.

Electronic mail

Electronic (E-) mail system in which each user has an address and can write memos available to a particular user makes use of the LAN technology. Physicians have been able to use E- mail to enhance the quick exchange of information.

Statistical analysis

Another important ability of the personal computer, which is used most extensively by researchers, is statistical analysis. In the past, the compilation of data into statistics was a time-consuming task and created considerable anxiety over the accuracy of the final figures. Personal computers and statistical packages have greatly facilitated compiling statistics for the researcher, who can now enter his data as he gathers it, and evaluate that data using a variety of statistical methods quickly and cost-effectively.

Conclusions

The applications of personal computers in the medical field increase almost daily, as more and more health-care professionals find programs which allow them to automate one or more of their tasks. As the functions and speed of computers increase, the number of practitioners who will find them indispensable in their practice will also increase.

References

1. Abdulla AM, Miller CC, Henke JS: The Use of Personal Computers in Medicine. Textbook of Family Medicine. 4th ed. Philadelphia: WB Saunders 1990: 1779-95.
2. Argento J: DXplain: Diagnoses at Your Fingertips. Physicians and Computers. March 1988: 8-10.
3. Dejean D: This WORM Can Help Your Practice Turn. Physicians and Computers. October 1988: 9-12.
4. Dejean D: Hope and Glory: Men, Medicine, and PCs. PC Computing. September 1988: 64-79.
5. Ila R: How to Make Your History Taking Easier. Physicians and Computers. December 1987: 8-13.
6. Lant J: PaperChase: Medical Information at Your

Fingertips. Physicians and Computers. February 1988: 16-22.

7. Rasmus D: Expert Input. MacUser. January 1988: 136-50.