Computers in the doctor's office. *It was Fred's long-held conviction that much of the information gathered at the point where physician and patient interact is lost, and that leaps of improvement in patient care can stem from retaining and retrieving that information. Computers are necessary to accomplish this. If retrieval is made easy, dozens of questions important to one's own patients can be answered, and it helps to stimulate and excite a practice that might otherwise seem repetitive and humdrum.*

The following paper describes one of many possible approaches to organizing and simplifying daily practice while bursting into the wondrous world of continuous learning that lies beyond case remembrance. A surge of effort is required to develop the template. Once done, the rocket soars into exciting new territory, needing only minor directional adjustments. With Dr Gilbert's constant encouragement and involvement, we have accumulated a computerized data base containing detailed information on patients with thyroid disease. It has become a gold mine, allowing constant improvement in the care of patients. The best time to start this kind of activity was 35 years ago. The second best time is now. And it's fun!

Summary

Using the Computer in the Doctor's Office to Enhance the Quality of Patient Care

Robert A. Nordyke MD, Fred I. Gilbert, Jr, MD

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"Science is built up with facts as a house with stones. But a collection of facts is no more a science than a heap of stone is a house."

—Jules Henri Poincare, 1908

Information gathered during office visits can be a powerful force for practice evaluation, education, and research. However, unless this information is stored and retrievable, access to it is lost. We describe a simple, inexpensive computer model we have developed over the past 30 years that has enabled us to organize, store, and retrieve data on more than 14,000 patients.

Much of the information collected routinely during office visits has potential value far beyond the management of the immediate medical problems. Most of this information is lost because it is neither gathered nor stored to make retrieval and analysis feasible. Physicians' records reflect their efforts to diagnose and treat individual patients. Neglected is the wealth of data on groups of patients, their trends, their outcomes, and alternative approaches to diagnosis and treatment. Patient records are rarely organized to permit administrative and quality control, clinical research, physician education, and continuous quality improvement in patient care.

To use all the information gathered, records must be retrievable. We describe our experience with a simple and inexpensive way to obtain, store, retrieve, sort, and use clinical data collected by the physician. Our method combines a paper worksheet with a desktop microcomputer and commercial software to retrieve otherwise inaccessible clinical information.

How Can the Computer Help?

Handwriting has the advantage of rapid turnaround time. The typewriter delays turnaround time but its advantage is "fierce legibility" that Henry James noted at the turn of the century. The typewriter's successor, the word processer, retains rapid turnaround and legibility. The computer adds completeness and retrievability. These features open up new possibilities for quality control and clinical research.

Thyroid Clinic Example

Since 1960 we have recorded history, physical examination, laboratory studies, clinical impression, and final diagnosis on a standardized worksheet for more than 14,000 patients referred for suspected thyroid disease. Subgroups of these patients have been followed for up to 30 years. In 1972, these data were computerized. Our model is for a physician's office seeing from five to 50 patients a day. These patients have similar problems that can be described in a relatively brief report. Such conditions are best found in the office of the subspecialist who sees patients for upper respiratory and GU infections, diabetes, arthritis, coronary artery disease, neurologic disorders, neck-back pain, peptic ulcer, pregnancy, and hypertension, and in such areas as periodic health appraisal. The model can be used in almost any practice but it is easier when much of the data is repetitive. It is more difficult when many of the workups are more complex. The model excels in long-term follow-up of chronic diseases which are becoming more frequent in medical care.

Worksheet.—The primary document is a printed worksheet with a follow-up flowsheet the physician takes into the examining room. This doesn't change the normal way of practice or the physician's relationship with the patient. The technique of gathering information and the computer do not intrude. The record may be organized in any way, including the problem-oriented medical record. The special characteristics of this worksheet are shorthand notations, completeness, flexibility, and flow-charting.

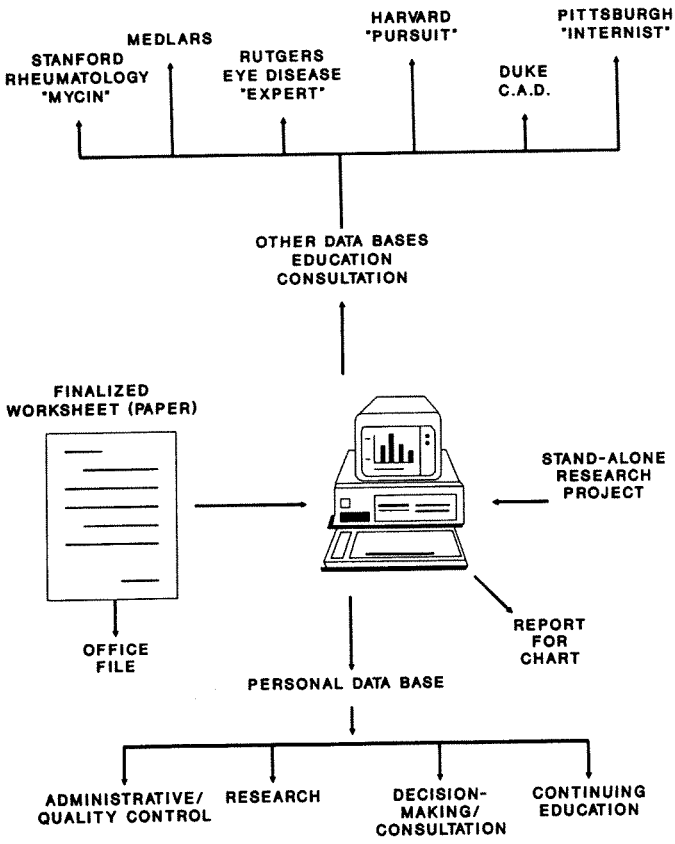
Shorthand notations are faster to use and simplify data entry into the computer. Examples are a line through a number if the item is negative, a circle if it is positive, and a modifier if it is needed.

Completeness is illustrated in the sector on thyroid palpation: if an abnormality is felt, the size, consistency, form, tenderness, and the presence or absence of nodules must be recorded. If there is a nodule, its size, consistency, form, mobility, and tenderness are recorded.

The ability to insert free-language at any point provides flexibility. Free-language is used routinely in the "chief complaint" and "comment" positions, but can be used throughout the sheet.

Flow-charting formats the follow-up records so the information can be checked at a glance-major problems and diagnoses, as well as each item of the patient's progress. A study by Freis measured the time it took to thumb through a standard chart versus a flowchart. The study showed the time was reduced from seven to two minutes for each patient.

The combined effect of these qualities is a reasonably complete data set organized to make storage and retrieval by computer possible.



Hardware.—From 1960 to 1972, information was transcribed to the patient's chart from the worksheets. From 1972 to 1987 we used HP 2000, 3000, and 4400 minicomputers. Recently all data, including free-language and codes, were shifted to an IBM-PC-AT microcomputer with a 60 megabyte hard disk.

Software.—The original programming was in BASIC, which required a trained
programmer to make necessary modifications. This was slow and costly. Later we changed to dbase Ill Plus which greatly simplified the process.

Reports.—Coded and free-language data are entered into the computer by an aide. Data are used to produce a typed copy report for the patient's chart (Fig. 5), ready within a few minutes, and are also stored for administrative control, research, and self-education.

Usefulness of the System

Data base.—The worksheet is fundamental to the success of the system because it provides the input to the data base for later retrieval. Care must be taken in its development. Usually, modifications are necessary before the worksheet is sufficiently complete and comfortable to use. The process of developing the worksheet improves recordkeeping and patient care because it requires decisions about what information is important to gather and retain and what is not.

Retrieval and sorting. This is the heart of the system. After data are entered into the computer they can be retrieved, sorted, and plotted. The physician may wish to do this or may prefer to use another person to extract needed information regularly.

Administrative efficiencies—Much of the immediate gain derives from administrative improvements: dictation is rarely needed, charts are not transported for transcription, patient information is always available, review of past history time is shortened, reports can be complete and typed within minutes, and the record is in the patient's chart promptly. Charges can be attached to each office visit and procedure to determine cost per visit, per year, per patient, or per group of patients with similar diagnoses and similar severity. Potentially, these data can be compared to data of other physicians.

Education and research—Both education and research are sharply expanded by the ability to review one's own data. We have answered a number of questions from our own practice. For example: Can the sensitive TSH (IRMA) be used as a first-line test to detect hyperthyroidism as well as hypothyroidism? What additional information is gained by the FT4? What is the best use of the laboratory for monitoring patients with primary hypothyroidism? What is the optimal dose of ^{131}I for a single-dose cure of hyperthyroidism? Is the cure rate affected by post-treatment use of antithyroid drugs? How do the signs and symptoms of hyperthyroidism change by age decade? What are the clinical characteristics and course of subacute thyroiditis in Hawaii?

Possibly, access to other data bases can be added to the system. However, the gains derived from observation of one's own patients will remain more important for a long time.

Comment

Most physicians believe the quality of their patient care is high, but few have measured it or objectively compared it with that of their peers.

No matter how quality in the doctor's office is defined, its improvement depends on easy access to information about the outcome of their efforts—individual patients, groups of patients, at the first visit, and over time. Records are the storehouse of that information but the records of most doctors are inaccessible. Practicing physicians rarely review records of groups of patients. If such a review is done, it is time-consuming, costly, and usually a one-shot effort that is soon out of date. This leads to nothing more than sporadic bursts of change.

To correct these deficiencies, records must be organized, retrievable, and easily analyzed. These tasks are best accomplished with the help of the computer. Until recently, computers have been used almost exclusively for administrative and financial functions, rarely being applied at the professional level in the physician's office. This is unfortunate, since the doctor-patient interchange is the crux of professional quality. We agree with Houle that the "most fruitful education derives from continually monitoring one's own work, making judgments about success or failure, and altering performance accordingly."

In our model we have attempted to organize records so they lead to a continuing stream of improvements. The system is simple. Cost is reduced by using a worksheet, microcomputer, and commercial software.

Better ways to approach the problem of making information accessible will come later. For now, any physician willing to spend the time and thought on preliminary planning can develop a customized, computerized record system. The effort required to develop the system will be amply rewarded by gains accrued from easy observation of process, cost, and outcome in one's own patients. This will lead to a new and higher level of continuing education and quality of patient care. Also, it's fun.

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Nordyke RA, Gilbert FI Jr, Harada AS: Graves' disease. Influence of age on clinical findings. *Arch Intern Med.* 1988;148;626-31.

Out of the thyroid database *have come many studies, each changing the way we care for patients—diagnosis, treatment, and data-driven decisions. Brief abstracts provide the flavor.*

Summary
Graves' Disease Influence of Age on Clinical Findings

Robert A. Nordyke MD, Fred I. Gilbert, Jr, MD, Ann S. M. Harada MPH

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To determine the influence of age on the signs and symptoms of hyperthyroidism, we prospectively examined 880 patients and matched them by age, sex, race, and visit date with similarly examined euthyroid control subjects. Many signs and symptoms showed little change with age until after the fifth decade of life when they began to decrease gradually. Findings that increased with age were weight loss and atrial fibrillation, while those that decreased most markedly with age were increased appetite and weight gain. The diagnosis is more difficult as age progresses because there are fewer findings and because the significance of those present may not be appreciated. Identification of the most sensitive and specific signs and symptoms in each age decade should Improve the early detection of hyperthyroidism.

Summary
Painful Subacute Thyroiditis in Hawaii

Robert A. Nordyke MD, Fred I. Gilbert, Jr, MD, Chris Lew MD

Reprinted by permission of the *West J Med.* 1991; 7;155:61-63.

Between 1960 and 1982 we prospectively studied 269 patients with painful subacute thyroiditis to determine the demographic characteristics, seasonality, and natural course of the disease. The mean age for all patients was 37.1 years. The female:male ratio was 6.7:1. At the first visit, disease was bilateral in 69%. No epidemic or seasonal pattern was identified. The mean duration of thyroid tenderness was 2.2 months and that of palpable thyroid lumps was 2.8 months. This time difference, sometimes lasting many months, left a pain-free "window" during which the palpable hard residual mass of subacute thyroiditis may be confused with other thyroid problems, especially cancer.

The following bit of clinical research also combines the results from many patients. The questions arose during an after-hours discussion. Why are we routinely doing two tests for the detection of Hashimoto's thyroiditis?...The literature says they are both useful...So?...Nearly every laboratory routinely does two...So?... Has anybody ever considered doing just one?...Don't know.... Hundreds are done each day in Hawaii...Yes....We do them both on our own patients...Yes...Is it possible that one might be enough?...Don't know...Doing both doubles the cost, and every day hundreds of the double-testing are being done in Hawaii...Right...Let's find out if two are necessary...OK. Let's go!

In the next few months we discovered that only one is needed, cutting the cost in half.

Summary
The Superiority of Antimicrosomal Over Antithyroglobulin Antibodies for Detecting Hashimoto's Thyroiditis

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Background
Antimicrosomal (anti-M) and antithyroglobulin (anti-Tg) antibodies are commonly measured together to detect Hashimoto's thyroiditis. Since this nearly doubles the cost of testing for one antibody, we wished to determine whether significant diagnostic loss would occur if the two tests were replaced by anti-M alone.

Methods
Both tests were performed in 2030 consecutive patients referred by general internists and endocrinologists.

Results
With a positive result defined as either test being positive at a 1:100 dilution, anti-M was much more sensitive than anti-Tg. Anti-M was positive in 99% (823/831) of all patients with positive tests, while anti-Tg was positive in 36% (302/831). Anti-M was the only positive test in 64% of all patients with positive tests, while anti-Tg was the only positive test in 1%. With a cutoff point of 1:400 dilution, the results were similar.

Conclusions
Anti-M alone appears sufficient to detect autoimmune thyroid disease at about one-half the cost of routinely performing both anti-M and anti-Tg studies. The widespread practice of perform-