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Clinical Computer Applications in Mental Health

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Direct patient-computer interviews were among the earliest applications of computing in medicine. Yet patient interviewing and other clinical applications have lagged behind fiscal, administrative, and research uses. Several reasons for delays in the development and implementation of clinical computing programs are discussed. Patient interviewing, clinician consultation, and other applications of clinical computing in mental health are reviewed, as well as changes that will facilitate their appropriate use.

HISTORICAL OVERVIEW

In 1967, Howard Rome[1] predicted: "Psychiatry is now on the threshold of a fourth quantum advance. Automation in information processing will achieve what never has been available heretofore—a valid data-base for psychiatry's assumptions, treatments, logistics, and at the same time it offers a potential solution for psychiatry's administrative complexities."

Because early programs commonly were time-consuming to prepare and often operated in batch mode, clinical computing mostly emphasized computing—often at the expense of clinical realities requiring more flexibility than computers and those programming them could provide. Data-processing departments sprang up and their territory seemed foreign and forbidding to most clinicians. Programming staffs naturally cast their allegiance with whichever group used their products: administrators, managers, researchers, and only rarely clinicians.

The development and spread of on-line computing and better programming languages has made innovative applications of computers in clinical settings possible, so that the boundary lines between clinical and management, administrative, educational,

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and research computer applications are constantly being blurred, bent, and at risk of being broken. Data collected directly from patients by computer interview can serve administrative, research, and proper clinical functions ("pertaining to a clinic or bed side . . . or founded on actual observation and treatment of patients"[2]). Service utilization, educational experience, billing, accounts receivable, planning, identification of subjects suitable for particular experiments, and many other functions may all be provided by the same data base. Actual measurement of patient change may satisfy goals of treatment selection and modification, accountability and clinical research. The artificial barriers separating administrative, research, educational, and clinical functions are beginning to disappear in settings where workers are learning to use sophisticated patient interviewing and data base management systems. Programs for consultation, scheduling, word processing, and bibliographic work are also being integrated, evaluated, and implemented in clinical settings.

CLINICAL COMPUTING

Computer Interviewing

Even before Rome's prediction, Slack and his colleagues[3] had programmed a computer to conduct direct patient interviews. Slack clearly recognized the revolutionary prospects of patient-computer interviewing and the potential effects of computer applications on physicians.[4] His group also anticipated questions about nonverbal communication[5] and struggled with ways to facilitate oral expression about emotional problems.[6]

Many of the fundamental issues surrounding direct patient interviewing by computer have been clear for several years: patient acceptance of the technique[7] and patient characteristics that interfere with its use[8]; reliability and validity of data[3]; confidentiality[9]; cost; and problems of acceptance by clinicians.[4]

Subsequent work on computer interviews has consistently confirmed and extended early findings. Patients do, with few exceptions, find computer interviews acceptable,[10–20] often preferring to give information to the computer rather than a doctor. Preference for a nonhuman interviewer seems particularly strong when the subject matter is sensitive.[15,21,22] Most patients, even those with major psychiatric disorders including some who are mute, can be interviewed by computer. With the exception of some patients with severe organic brain syndrome, with florid mania, or with antisocial personality disorder, they give data that are at least as reliable and valid and far more complete than those obtained by clinicians.[3,6,23–26]

Confidentiality can be carefully protected, and some interviews permit patients to decide after giving their information what uses will be made of it. Thus, a patient might decide to allow use of data for clinical purposes but not for research or might choose to delete the interview altogether.

Costs continue to decline because of less expensive and more powerful hardware and, more important, better programming languages and more efficient and effective interview driver programs,[27] which permit nonprogrammers to construct and conduct computer interviews. A sophisticated single-terminal interview system can now be purchased for $6,200 and additional stations added for $1,650.

Clinician acceptance of computer interviews has been slower than expected. This lag is less related to the quality of the programs available than to factors of marketing (researchers in academic institutions who predominantly develop, evaluate, and describe clinical programs are reinforced most for those activities—not for marketing them) and problems involved in making changes within conservative professions.

Consultations

It has long been a goal of computer *mavens* to provide computer consultations to clinicians. Mathematical predictions regarding diagnosis, prognosis, treatment selection, and patient outcomes have virtually always surpassed clinical predictions.[28-30] Bleich's elegant early work on the problems of fluid, electrolyte, and acid-base abnormalities[31] provided an indication both of the potential of consultations and the problems of gaining clinician acceptance and of evaluating the impact of consultation programs.[32] The prospect of providing tertiary-level consultation in secondary and primary settings remains attractive.

Predictions in psychiatry have dealt with diagnoses,[33-39] medication prescription,[40,41] elopement risk,[42] interpretations of the Minnesota Multiphasic Personality Inventory,[43] and dangerousness.[44] Predictions about dangerousness have been dropped from the Missouri System because of risks of false positives prolonging incarceration and false negatives leading to premature release.

Another generic model of computer consultations is the Lithium Information Center at the University of Wisconsin.[45] The Lithium Library[46] is the cornerstone of a growing number of clinical consultations and publications on the medical uses of lithium. More than 9,000 citations are contained in the Lithium Library, and Paper Chase,[47] the bibliographic program at the core of the Lithium Library, permits searches by any combination of author, title word, subject, key or index word, journal, and/or year of publication. Because files are inverted, search times are short. The Lithium Information Center responds to written and telephone requests for information from clinicians, administrators, researchers, lawyers, and patients. In 1981, there were 624 requests from 50 states, the District of Columbia and Puerto Rico, 9 Canadian provinces, and 24 foreign countries. In 1982, requests were running at a rate of 100 per month. More than 60 sites have direct on-line access to the Lithium Library program.

Availability of the Lithium Library and a grant from the National Library of Medicine has led to study of alternative ways of providing clinical information. A cryptic listing of citations can be time-consuming to pursue and frustrating when the sources are not readily available. The Lithium Index provides synopses of important clinical subjects and, to date, more than 90 have been written. On-line access by free-text entry is rapid and cross-referencing extensive. The Lithium Consultation organizes information about a single patient regarding diagnosis, pretreatment work-up, and possible complications of lithium treatment and their management.

Access to the Lithium Library program has also facilitated publication of 4 books, 5 chapters, 15 articles, and 6 letters to editors by Lithium Information Center personnel.

Requests to the Lithium Information Center have targeted particular problem areas that have led to three focused research projects.[48–50]

Data Base Management Systems

Rome's early appreciation of the organizing potential of computers[1] was initially impeded by the complexity and idiosyncratic nature of different psychiatric settings and the consequent cost of preparing different data bases to meet their disparate needs. Since different psychiatrists treat patients with similar disorders quite differently, the data they wish to keep are also different. A standardized data base for separate sites can not be assembled easily. Widespread application of computers in the management of psychiatric data has had to await either the development of data base management systems or consensus about the basic data set, still an elusive goal. In the meantime, many mental health facilities have gone ahead to develop stand-alone information systems.[51–57] With the development of the prototype NIMH Community Mental Health Center program, a well-designed and flexible set of programs will soon be available for many administrative, fiscal, and clinical functions.[58] The outcome of this experiment will be of great interest.

Modern medical information systems have at their core a data base management sytems that permits flexible addition and deletion of data items. The most sophisticated of these data base management systems incorporate a dictionary driver concept in which the data base itself asks a series of questions about the data that, once answered, establish the "dictionary." The dictionary "drives" all other programs, i.e., enter, edit, search, report, statistics, etc. Whenever a change is made in the dictionary, it drives required changes in all other programs.

Most data base management systems have been developed to deal with single encounters.[59] Only a few have been specifically designed to deal with data that change over time, as patients change.[60] These time-oriented data base management systems permit clinicians, administrators, researchers, and educators to track patients and their progress, follow a course of treatment, keep a service history, analyze staff or trainee activities, record fees, keep inventories, etc.

The ease of establishing discrete data bases with dictionary-driven data base management systems leads to widespread use where they are available. In the Department of Psychiatry at the University of Wisconsin, we have set up seven EPIC[60] data bases (because of EPIC's generalizability, more than 100 other EPIC data bases have been created in other medical school departments and public institutions). Our outpatient data base contains on-line information about all patients seen in the clinic since 1975. Those in charge of residency education use this data base to assess the quantity and character of each trainee's clinical experience; administrators use the same data base to meet accountability requirements and for planning; clinicians have the option of using the data base to measure change in their patients; and researchers, with proper respect for confidentiality, ask and answer a variety of questions about clinical matters.

Treatment Programs

In psychiatry, work is under way to provide direct treatment services to patients using interactive computer programs. At the Institute of Psychiatry in London, England, Drs. Ghosh, Carr, and Marks have already evaluated an interactive computer program for the assessment and treatment of agoraphobia.[61,62] Comparable outcomes were obtained when this program was compared with a human therapist and with self-treatment guided by a book. At the University of Wisconsin, programs are being evaluated that provide cognitive behavior therapy to depressed patients, assist depressed patients in adhering more completely to their tricyclic antidepressant treatment regime, and generically define and manage emotional problems.

Person-Machine Interface

There is a substantial and growing literature about the problems of person-machine interface. Questions regarding keyboard design or the actual elimination of the keyboard through the substitution of a light pen or finger touch on a CRT screen are pointing the way toward an ultimate interface in which computers may be able to comprehend a number of vernaculars of human speech, "understand" the syntax and meanings expressed, and respond through voice synthesizers. While improvements in terminal design are certainly possible, particularly for those who use them for extended periods, elimination of the keyboard also largely eliminates the possibility of incorporating free-text responses. We and others have repeatedly found that patients manage quite well with standard terminal keyboards.

There is, however, a larger and more important "person-machine" interface problem: how computers are considered, evaluated, resisted, and finally integrated into clinical practice. This problem exists for many professions and businesses.[63] It is difficult for those who work closely with computers and are most aware of their strengths (and limitations) to understand some of the reservations expressed and resistances raised to clinical computing applications. Some who have encountered resistance have written about the experience.[64–70] There appears to be a general covert fear on the part of many clinicians about losing rather than gaining something as computers are introduced into clinical practice. Openly expressed concerns range from losing money or status to giving up parts of clinical practice that are most satisfying and enjoyable.

Part of the difficulty of introducing computers into clinical practice has been the limited range and utility of the programs now available. Clinicians, like most people who are laymen to computing, fantasize that computers are so powerful that they will do much more than they actually can. The beginnings we have made are modest and have been, we hope, modestly stated. Nevertheless, many clinicians find their expectations about computers frightening. Major changes are an ordeal for almost everyone and, as William Faulkner said, "What the heart loves becomes truth."

We are, perhaps, at a juncture analogous to the situation of American medical education at the end of the 19th century. Most medical schools were little more than diploma mills, teaching largely, if not exclusively, through lectures, and intent on continuing in the same manner. A few widely traveled and educated, innovative, open-minded, and determined colleagues at the Johns Hopkins Hospital and Medical School changed the program of instruction in that institution, requiring a college degree for medical school entry and emphasizing clinical work during the junior and senior years. Through the mediation of the Flexner report,[71] substantial alterations in medical education quickly followed throughout the United States. Welch, Osler, Halsted, Kelly, and Hurd changed the profession in the span of a single generation and are properly honored for that contribution.

Osler is also revered for his humanitarian side and his great affection for older physicians. But he also stood on a chair at an annual meeting of the American Medical Association and shouted: "I stand here and say plainly and honestly before Dr. Atkinson what I and many other members have said behind his back, that he is not an efficient secretary of this Association, and that we have not found him so [hisses, followed by applause]. You may hiss if you will, but I unhesitatingly say that no more important step in advance will be taken by this Association than when it changes its secretary."[72]

As psychiatrists, we know that some disorders are lifelong and wholly unresponsive to our ministrations. Darwin wrote, at the conclusion of *On the Origin of Species:* "Although I am fully convinced of the truth of the views given in this volume . . . , I by no means expect to convince experienced naturalists whose minds are stocked with a multitude of facts all viewed, during a long course of years, from a point of view directly opposite to mine. . . . But I look with confidence to the future,—to young and rising naturalists, who will be able to view both sides of the question with impartiality."[73] Some of what we advocate is clearly radical, and none of us can foresee all the consequences of the paths we have started down.

While the ethics of our profession require that we provide the best quality care to patients in sufficient quantity at a fair cost, this ideal is seldom attainable. There is often a substantial gap between what is known and what is practiced. Still, the ethics of individuals can anticipate and lead to changes in the ethics of the larger profession. There may be limits, however, to the improvement human clinicians can achieve, even when aided by computers. McDonald found that computer reminders enhanced physician compliance with their own self-prescribed practice protocols from 20 to 50% and attributed the failure to approach complete compliance with their own protocols to the "nonperfectibility of man."[74]

One indication of ways in which computers can be integrated into clinical practice has come from experience with CAT and PET scanning, which has, by and large, been introduced in departments of radiology. Radiologists are already somewhat remote from patients and accustomed to the use of technologic advances. These new scanning devices have increased radiologists' clinical effectiveness, monetary return, status in the profession, and personal satisfaction with their work. To the extent that other computer applications are responsive to these important clinician reinforcers, they will also be likely to gain acceptance by clinicians.

The growing number of mental health computer applications developed in the past two decades will probably be surpassed in both quantity and quality in the 5 years ahead. Less expensive and more powerful computing hardware running better operating systems and higher level programming languages have led to the development of driver programs that permit naive computer users to bend the computer's power to mental health computing tasks. These technical advances promise radical changes *if* the tools are simply applied and evaluated in important problem areas and if the products developed are made acceptable to the mental health professions so that they are actually used.

The rapid evolution of computing hardware and software accompanied by a steadily decreasing cost and a lower learning threshold for beginners has actually led some to delay acquisition and use of computers to solve mental health problems. Waiting for the next generation of hardware and software to solve our problems is rapidly becoming a certifiable neurosis. Present hardware and software are already cost-effective, and we would argue that there is a greater cost to mental health institutions in delaying entry into computer usage in hopes of still cheaper hardware and software than in making use of currently available equipment and programs. Better software will be created as clinical users become more involved with computing.

With the high quality of present technology, the mental health field needs continued developmental efforts that are carefully evaluated. Many different approaches seem prudent at this time in a health care area with many different professions, belief systems, service needs, and treatments. Although iterations are hard work and it would be ideal to design the ultimate system, total system designs are efficient only when one can clearly define the operations, goals, and output, a stage far away for mental health organizations and practitioners. It is time to proceed vigorously with the tools at hand. We are very much at the same stage as aviation of the 1920s when it was developing and evaluating many different airframes, engines, and instruments. In time, this process will yield the standardization in design, construction, and use of clinical computing programs that has made modern air travel so swift, safe, and economical.

Making computer applications acceptable to clinicians is a substantial problem. While the final outcome is not in doubt, the rate and extent of computer use may well be influenced by basic strategies adopted by computer developers. On the one hand, it makes sense to provide programs that fill a clearly recognized need and that make small demands for change in clinical practice. Administrative programs meet these criteria and are already in common and steadily spreading use. On the other hand, the greatest payoff from computer applications probably lies in their direct use for clinical functions such as patient interviewing, clinician consultation, and actual patient treatment. All of these uses destabilize clinical practice and require substantial changes in the beliefs, thinking, and behaviors of clinicians. Short of waiting for one or two generations of clinicians to die, attention will have to be paid to reinforcements for clinicians that will enable them to embrace clinical computing applications for mental health. The basic reinforcers appear to be status, money, clinical effectiveness, and job satisfaction.

When there is a great deal of status associated with an activity, professionals are inclined to sanctify the activity and interpose educational, training, and certification requirements between would-be practitioners and patients. Psychoanalysis, neurosurgery, and, to a lesser extent, all medical specialties are examples of this practice. When, however, a clinical service must be frequently repeated or provided to large numbers of patients, the status associated with these clinical activities is decreased and surrogates are acceptable. If insulin could be given yearly, it seems likely that the professors of medicine would retain that prerogative; if monthly, general practitioners would perform the function; with weekly administration nurses could serve; but because insulin must be administered daily and sometimes more often, patients are elevated in status and "trained" to self-administer insulin. When coronary care units were first opened in 1962 and for several years thereafter, physicians administered the antiarrhythmic drugs that yielded a reduction in hospital death rate from 30–40% to the present level of 10–20%. As the novelty of providing this treatment diminished and the status associated with staying awake all night to administer it paled, nurses were "trained" to provide this treatment.[75] Clean catch midstream urines are another low-status procedure that patients have been "trained" to perform better when instructed by computer than by nurse or doctor.[76] When systematic desensitization was first developed, clinicians flocked to apply this effective treatment for phobias. When clinicians realized how boring the treatment process was, they rapidly substituted tape recorders, nurses,[77] and computer programs.[78] When clinical procedures lose status, and/or cease to be enjoyable, clinicians become ingenious in finding and "training" surrogates to carry out the procedures.

There is legitimate concern about the effect of computers on clinician income. Present patient computer interactions can be conducted at a cost of less than $5 per hour, a far cry from the $100-per-hour rate that psychiatrists commonly charge. For the present, however, some clinicians are using this financial leverage for their benefit, conducting psychological tests and other evaluations by computer interview and charging a money-making fee for this service. At a time when the health care budget is increasing at a rate greater than the base inflation rate, the economies associated with patient computer interactions should be shared among institutions, innovative practitioners, and the public, which ultimately supports all medical care.

CONCLUSION

To the extent that computer programs can substitute for clinical functions that are low in status and tedious to perform while increasing or at least not decreasing clinician income, they are likely to win acceptance. Programs that improve clinician functioning and, through them, patient outcomes should enhance clinician status and also gain acceptance. In time, even those programs that compete directly with clinicians and surpass them in effectiveness in direct patient treatment will be used because of both economic factors and ethics.

The path of progress is often steep, twisting, and full of natural obstructions and man-made barriers. Clinical computing is a nascent force with at best a toehold on a sheer face of the clinical mountain. But the power of computing and the magnitude of mental health problems assures a steadily accelerating ascent.

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