4.

IMPLICATIONS

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IMPLICATIONS

Medical information systems have important implications for the quality of patient care. Institutional errors can be substantially reduced and coordination improved. Clinicians can obtain guidance on appropriate diagnostic and therapeutic regimens while patients are still under care. Physicians can be freed from the burden of relying on fallible memory. Other medical professionals may perform new duties or acquire added responsibilities because they have been relieved of routine paperwork.

The extensive data base in medical information systems could supply aggregate health data collection systems with more accurate, easily accessible data than are now available. In addition, medical information systems could provide a new mechanism for assessing the quality of medical services provided, evaluating and planning medical care resources, and conducting epidemiological research.

Because medical information systems are designed for different kinds of settings and vary in scope and objectives, not all implications apply to all systems. Examples from the systems described in chapter 3 are given when possible to illustrate benefits and drawbacks and to differentiate between the proven performance of medical information systems and benefits that might be expected if the computer systems are developed further and become widely accepted.

INSTITUTIONAL DELIVERY OF PATIENT CARE

Evidence indicates that by facilitating communication and reducing errors, medical information systems improve the patient care delivered in medical care institutions. Some errors are reduced because computer systems help ensure that data about a patient are accurate, available, legible, complete, timely, and organized. Through *their mechanisms to check whether orders have been carried out, medical information systems also monitor performance and prevent some errors of omission.*

Avoiding Errors

Accuracy of patient data can be ensured by having the provider or ancillary service originating them verify all entries. Errors can thus be detected and corrected immediately at the source. Detecting an error later is more difficult because the relevant data are not readily available.

In TMIS and PROMIS, patient care providers and technicians enter data through videoscreen terminals and thus communicate directly with the computer system. After being typed in or selected by light-pen or touch, data are displayed on

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the videoscreen a second time for verification before being entered into the computer record. After the implementation of TMIS at El Camino Hospital, accuracy of medical orders and test results improved (7).

In the COSTAR system, clerks in the medical record department enter data into the computer from preceded sheets called encounter forms. An inhouse study at the Harvard Community Health Plan estimated the rate of transcription errors to be very low, less than 1 percent of the data items (5).

Availability of information can be ensured by giving many providers simultaneous access to the patient record from different locations. A manual medical record can be in only one place at one time. The three medical information systems described in this report make patient data available on videoscreen terminals located in various patient care areas. Printer terminals also produce and duplicate paper records.

Lost or mislaid records are a problem in ambulatory care settings. Records are estimated to be unavailable for as many as 10 to **20** percent of patient visits in some ambulatory care facilities (5). COSTAR eliminates this problem by providing a summary record in advance of each scheduled patient visit. Videoscreen terminals can give information to providers when they see patients with unscheduled visits, answer telephone inquiries, or need to review a complete patient record. In some areas of HCHP, however, a single terminal serves three physicians, three nurses and a receptionist, sometimes resulting in a queuing problem. At El Camino Hospital, one video terminal and sometimes two are located at every nursing station. Hospital staff did not indicate any problem regarding access to the terminals.

Legibility is an obvious advantage of medical information systems over manual medical records. Typed copy available on terminal screens or in computer printouts is easier to read than the typical handwritten note. Illegible handwritten entries in the paper medical record can cause delay or, if read inaccurately, may lead to inappropriate action.

Completeness of information can be ensured by entering all data that may be needed into a central computer patient file. In COSTAR and PROMIS, all data that are generated during the care of a patient are entered into the computer record. In addition, PROMIS automatically reminds providers to enter information essential to diagnosing a problem or carrying out orders. Questions and choices for answers are displayed in a sequence determined by answers to previous questions.

Computerized information about the patient is more limited in TMIS than in COSTAR and PROMIS. TMIS does, however, computerize all physician orders and the resulting reports from ancillary services. The frames used to write orders remind physicians to make their orders complete. After implementation of TMIS at El Camino Hospital, the number of medication orders that omitted site, scheduling, and method of administration decreased (7).

Timeliness of information can be ensured by entering patient data into the computer record as soon as procedures are performed or observations made. As hospitals have become more complex, the demands placed on ancillary services have increased, and communicating all the latest information has grown more difficult.

TMIS and PROMIS automatically update the patient's record so that it reflects the most current status. Reports and results are entered directly into the computer

system from ancillary services. With electronic transfer, orders and tests need not be repeated because of poor communications. In addition, if the time between entering orders and learning results of tests and procedures is reduced, physicians can proceed quickly with further appropriate diagnostic or therapeutic procedures. The average length of stay at El Camino Hospital has been shorter since the introduction of TMIS. Staff have attributed this reduction to improved communications made possible by TMIS. Other factors, however, may also have contributed.

In COSTAR, new encounter data are usually entered into the system within **24** hours of a patient visit. Data are therefore available for the patient's next visit to the ambulatory care facility.

Organization of patient data enables providers to find necessary information more easily. In a manual medical record, information is often scattered among many pages of a chart that is usually arranged in chronological order and separated by source. Computerization allows a flexible arrangement of data, permitting the most effective use of patient data by the provider.

At El Camino Hospital, for example, a physician can retrieve the results of all laboratory tests on the video terminal. Cumulative results of tests are also available in paper printout. Because all information in PRO MIS is associated with a patient's particular problem, the physician can review progress notes, medications, laboratory results, and vital signs over time to determine if therapy is effective. At HCHP, a standard format used to provide a summary is routinely supplemented by flow charts and extensive visit notes on major problems of patients.

Monitoring for Errors

By monitoring for institutional errors, medical information systems further ensure that orders for the patient's care will be carried out. Noncompliance with physicians' orders is a severe problem in U.S. hospitals. An estimated 13 to 15 percent of all medications are not administered exactly as the physician ordered **(so).** A study in one hospital found that 15 percent of ordered laboratory tests were never performed (45).

Each of the computer systems described in this report has mechanisms to monitor whether orders for procedures or medications have been carried out. If they have not, reminders are displayed or printed. Under TMIS, for example, lists of "medications due" are printed out hourly, and nurses must record in the system whether or not the medications are administered. After installation of the computer system at the hospital, total errors in administering medications were reduced about **SO** percent from the pre-TMIS period (7). Failures to give medications were almost completely eliminated. After TM IS, discrepancies between the orders for and actual scheduling of laboratory and radiological procedures were also reduced. No evaluations of other medical information systems have yet been conducted.

SUPPORT OF CLINICAL DECISIONMAKING AND PHYSICIAN EDUCATION

Medical information systems can offer support for clinical decision making, provide continuing medical education, and facilitate the spread of new medical knowledge. Several studies *indicate that er-*

rors of omission by physicians are reduced if timely reminders are provided by the computer systems, This capability has been more fully developed in one system than in others.

Supporting Clinical Decisionmaking

As students, physicians must memorize enormous numbers of facts. Throughout their careers, they are expected not only to remember this information, but also, as medical knowledge increases and grows more complex to add new information. The quality of clinical care often depends on the accuracy and completeness of the physician's memory.

Computer systems can assist physicians by reducing the amount of material to be memorized. During clinical care, computer systems can instantaneously supply physicians with information about individual patients and medical knowledge from the literature.

The role of medical information systems in supporting clinical decisionmaking and continuing medical education may be either *passive* or *interventionist.* In a passive system, information stored in the computer is made available to physicians when they take the initiative to ask for it. Interventionist systems automatically supply appropriate information to physicians and other medical professionals.

The "mini-library" of frames displaying medical information incorporated into TMIS at El Camino Hospital exemplifies a medical information system taking a passive role in continuing education. Medical information frames in TMIS are independent of data entry and retrieval frames. They may be reviewed whenever, but only when, the physician chooses to do so.

Computer systems have been developed to support some kinds of clinical decisions. Such subsystems could be integrated into medical information systems like TMIS. For example, a system developed at Beth Israel Hospital in Boston can classify a patient's acid-base abnormality and through a series of questions to the physician, recommend appropriate therapy. Another computer project called HELP (Health Evaluation through Logical Processing) has been developed by the Biophysics Department at the University of Utah (43). HELP stores data about patients from terminals in such areas as the coronary care unit, the postoperative intensive care unit, and the pulmonary function laboratory as well as data from a computerized patient history and laboratory screening. Using these data and algorithms based on arithmetic and logic statements, HELP can automatically generate a list of options for treating an individual patient, Other projects include computerized protocols for managing on an outpatient basis certain diseases, such as hypertension, diabetes, and kidney stones (49). These systems to support clinical decisionmaking use a computer's capacity for complex analysis and manipulation of data, but they are nonetheless passive systems because the physician must elect to review the medical information they have stored.

Interventionist systems, in contrast, are programed to provide medical data automatically when they are needed for patient care. Such systems monitor the acceptability of care while the patient is being treated. They are based on an assumption that physicians are not likely to stop and ask a computer for information, but would use information automatically supplied.

This capacity exists to some extent in all three of the computer systems described in this report.

. In TMIS, computer printouts highlight abnormal laboratory test results in heavier ink and large characters.

. In COSTAR, computer programs for selected diseases or clinical symptoms identify followup care that has been omitted. These programs automatically notify physicians of the recommended procedure for their patients.

. In PROMIS, medical content frames are combined with data entry frames. Drug sequences provide information on specific drugs. Test or procedures frames include such information as cost, limits of normal, and producibility. "Rule-out" frames show why and how certain diagnoses can be ruled out as causes. Decision trees, which physicians are required to use, incorporate the entire spectrum of medical knowledge.

This capability of the computer systems to supply appropriate medical information frees the physician from reliance on memory and allows concentration on tasks that are uniquely human. Although the computer may be better suited to processing the multitudinous data necessary for diagnosis and treatment, the physician is responsible ultimately for decisions on patients' care.

Interventionist systems might be expected to improve the quality of patient care by reminding physicians of relevant data and facts. Results of the experimental program at the' Harvard Community Health Plan are encouraging **(6).** After implementation of the program providing automatic feedback, there was a statistically significant improvement in followup treatment of patients with sore throats. Improvement in the followup care of hypertensive patients occurred when repeated reminders were sent.

Several other studies conducted at Indiana University by the Regenstrief Institute indicate that *use* of computer protocols in ambulatory care reduces errors of omission by physicians. One study, conducted in an adult diabetes clinic, evaluated the effect of computer intervention to several medication-related clinical events (31). It found that physicians responded to **36** percent of the clinical events with computer reminders and only 11 percent without. A second, more extensive study, using 390 computer protocols dealing with conditions managed by drugs or induced by drugs, was conducted in a general-medicine clinic of the same outpatient department (30). This study analyzed physicians' responses to computer recommendations for courses of action following certain clinical events. It found that those physicians given computer recommendations detected and responded to twice as many events as the control group of physicians. Further, physicians' response rate fell when they left the group receiving computer recommendations and joined the control group. The study thus concluded that the difference in response rate was due not to ignorance of appropriate procedure, but rather to the difficulty of contending with the informational loads of busy practice settings.

These studies give a preliminary indication that computer protocols for the clinical management of certain problems influence physicians' behavior. Further evaluations are needed to confirm these results.

If the role of computer systems in clinical decisionmaking increases in the future, medical education will change. Without the need to accumulate facts, students' education could emphasize the study of the processes involved in decision making, as well as the social and psychological aspects of medical care (48). Such an educational experience would prepare students to take a new role as clinicians.

Dissemination of New Medical Knowledge

Scientific journals report research on new therapies, procedures, and drugs. Incorporate ion of this "new" medical knowledge into the everyday practice of medicine depends in part upon physicians' reading journals and remembering results of studies at appropriate moments of medical intervention. As a result, medical *practice* does not always reflect current medical knowledge.

Medical information systems can disseminate new medical knowledge by incorporating the most recent medical information into computer programs. The burden of reading myriad journals shifts from busy practitioners to those responsible for maintaining and updating a medical information system's "library" of medical knowledge. In PROMIS, for example, new medical knowledge is added to the system as studies appear in the literature and is presented to physicians in the context of related problems, procedures, or drugs. The information is carefully researched before its entry into the system, and references to the source journal are given on the display frame.

The entry of new medical information that has not been carefully evaluated is a problem that may arise in the future. At present, developers of systems determine what information is entered in the prototype systems. As medical information systems are "packaged" for mass marketing, such control will be more difficult. If in every hospital, for example, unproven or experimental therapies were entered as options for medical care, regardless of their efficacy, the credibility of the medical information system would be considerably downgraded.

A system such as PROMIS, which attempts to incorporate the whole spectrum of medical knowledge into its guidance system, particularly runs this risk. To guard against it, the PROMIS Laboratory has suggested the establishment of "a central organization with the mandate to coordinate, control, and certify developmental and deployed systems" (54). The central organization, or "national repository of display frames," would be charged with developing, validating, and maintaining a library for medical content display frames. It would also offer technical assistance and supply updated display frames to user medical care institutions. One example of a public organization that might perform this function is the National Library of Medicine,

ASSESSMENT OF THE QUALITY AND UTILIZATION OF MEDICAL CARE

Medical information systems can *be programed to* help assess *the quality* of *medical* **care** *in terms of the care process. Appropriateness of inpatient facility use can also be monitored. These legally manda fed /uric/ions* could *be accomplished without the expense of an additional data collection system. No medical information system, however, is programed as yet for these purposes.*

Quality of care is usually assessed by judging the process of care, or those diagnostic and therapeutic services ordered for a particular problem, against an agreed upon minimum standard for acceptable care. Hospital peer review committees have carried out this retrospective monitoring of care for years.

The **1972** Amendments to the Social Security Act mandated that Professional Standards Review Organizations (PSROs) be established nationwide to review the quality and utilization of medical services provided to Medicare, Medicaid, and Maternal and Child Health patients. The PSROs are required to conduct studies of

processes of care. In such a study, called a medical care evaluation, a diagnosis or procedure is chosen for study, a sample of patients selected, and the patients' records examined to determine if the care as recorded meets minimum standards established by the PSRO. Determining an appropriate patient sample and carefully examining records in a manual system can be time consuming and costly. A medical information system with patients' diagnoses and procedures accurately recorded and coded could facilitate such retrospective review. Data in a computer record are likely to be more complete and accurate than those in a manual record. Further, a medical information system could select samples of patient records for audit and, if properly programed, examine the records for compliance with standards.

No medical information system is presently used for medical care evaluations in a PSRO program, but the computer systems described in this report have the potential to fulfill this function. At HCHP, data are collected on structured, preceded forms. Because almost all data in the computer record are coded, COSTAR can be programed to monitor the record against predetermined standards of care or to retrieve records for manual audit by a given parameter. At El Camino Hospital, the major discharge diagnoses and procedures are coded in TMIS. Computer programs permitting medical audit are in the planning stages. Audit by problem, patient, or physician could be programed in PROMIS because all activities are linked to specific problems. In addition, the logic of the patient care process, that is, the reason for a certain procedure and the relationship of that particular step to preceding and following steps, is explicit in PROMIS. Medical auditors would not need to guess about the reasons for actions.

Professional Standards Review Organizations also monitor the utilization of medical care services. If medical information systems were programed to monitor the "appropriateness" of care in accordance with the requirements of the local PSRO, physicians could automatically be notified of any failure to meet criteria that justify keeping the patient in the hospital another day. Because medical information systems can process and return data as soon as they are entered, such notification could be given in a more timely fashion than is possible with a manual system. Having medical information systems screen for appropriate utilization could therefore be more effective than manual systems and could be accomplished without the cost of an additional system to collect and process data.

MALPRACTICE LITIGATION

Whether medical information systems would increase or decrease *malpractice litigation is debatable. Computerized medical records document the conduct of medical therapy. They could eliminate some* causes of *litigation by reducing errors* in patient *care. Errors that do occur could be highlighted however, and lawsuits increased.*

A patient's record is often the most important piece of evidence in any medical professional liability suit (25). As a deviation from accepted standards for properly documenting and maintaining records of treatment, a poor record itself constitutes an act of negligence in the eyes of the court (29).

Computerization of the medical record ensures a legible, orderly, and readily available record and could, therefore, document proper and careful conduct of medical therapy. Because medical information systems tend to reduce errors in patient care, litigation may decrease. Errors caused, for example, by poor communications,

overlooked positive laboratory results, and improper administration of medications are substantially reduced through use of computer systems. Systems that incorporate medical care audit programs or guidance systems during the care process could also eliminate some causes for litigation. Adherence to the established guidelines provided in the systems might be an effective defense for physicians and a possible deterrent to the filing of suits.

On the other hand, errors that do occur could be highlighted in the computer record, and the number of malpractice lawsuits increased (34). In addition, legal problems may arise because the computerized patient record differs from that in the average medical practice. Until computer records are accepted as consistent with standards for documentation, they might not constitute legal evidence in malpractice cases. Finally, critics argue that the art of medicine cannot be confined to standardized therapies incorporated as guidelines into a medical information system. A physician who deviates from such guidelines might be in jeopardy of a lawsuit and forced to justify the actions taken.

No data are available from institutions that use medical information systems on rates of malpractice suits before and after implementation of their computer systems. Contentions that the systems would increase or decrease litigation are, therefore, speculative.

ROLES OF MEDICAL CARE PROFESSIONALS

Medical information systems allow an upgrading of job responsibilities by permitting medical care professionals to make full use of *skills. However, there is insufficient evidence to conclude that personnel actually perform new duties or that their productivity increases in activities related to patient care.*

Medical information systems reduce or eliminate paperwork at the same time that they make available information needed for optimal job performance. Pharmacists, for example, can review medication orders for potential drug interactions if they are freed from typing medication labels, have computer-produced medication schedules and worksheets, and can obtain patients' medication profiles. Nurses have the opportunity to spend more time caring for patients if they no longer must spend hours performing clerical tasks. The head nurse who has more time for administrative duties and can analyze computer-produced statistics on patient workload has the opportunity to plan for the most effective use of floor nurses.

In the ambulatory care area, medical information systems allow allied health personnel to expand upon the kinds of patient care services they provide. For example, in some experimental programs nurse practitioners and physician assistants provide primary care to patients by referring to computer protocols organized according to specific problems. Studies have indicated that physician assistants using protocols that explicitly define medical treatments provide care equivalent in quality to that of physicians in the traditional system (21,28).

A study at El Camino Hospital provides the only available data on how medical information systems affect the allocation of health professionals' time (7). An activity analysis of nursing time before and after implementation of TMIS found that:

- Time and effort allocated to clerical activities decreased across all units, from 4 percent in the coronary care unit to 47 percent in surgical units;

- The availability of information made reporting easier and less time consuming across all units;
- Time spent in direct patient care activities increased on some services (medical and intensive care) and decreased on others (surgical, orthopedic, pediatric, and coronary care).

The data show, as expected, a reduction of clerical activities. They are, however, inconsistent regarding the productivity of nursing staff in activities related to patient care. * Nurses on surgical units, for example, experienced the greatest reduction in clerical time, but they also spent less time in direct care of patients, The activity analysis at El Camino Hospital resulted in the reallocation and, in many cases, reduction of nursing staff. However, further evaluations of changes in staff productivity seem warranted.

HEALTH DATA SYSTEMS

Medical information systems could *supply health* data *systems with accurate,* easily *accessible data. If standard classifications and codes were used and if all data sent to health data systems were already in computerized form, these organizations would be likely to realize substantial cost savings. Many health* data systems *aggregate data on national or regional levels and could thus take advantage only of widespread medical information systems.*

Health data systems are collections of data organized for a variety of purposes, including reimbursement of health services, utilization review, and quality of care assurance, as well as planning, monitoring, and evaluating medical care services. Many health data systems obtain needed data from the hospital medical record. After a patient is discharged from an inpatient facility, data are abstracted from the medical record and placed on multiple forms for different purposes. The same or similar abstracted data may be used for reports to a Professional Standards Review Organization (PSRO), third-party payer claims, internal medical care audits, and institutional management reports. In an ambulatory care setting, data abstracted from the patient record may likewise be duplicated, although fewer health data systems collect ambulatory data.

The current method of abstracting data involves problems of quality as well as duplication. Error is possible each time data are transcribed to a different summary form. In addition, errors in coding can take place during the abstracting process. Patients' diagnoses and other data entered by medical providers into the medical record in words are placed by trained clerks into codes based on the international classification of diseases. This process involves interpretation of established rules as well as skill and care on the part of the clerk.

Medical information systems could provide health data systems with more accurate data in a more accessible form than is presently available. Once data are computerized, they are permanently available. Unnecessary duplication of data collection, with its attendant cost and error, could be avoided.

● In addition to the implementation of TMIS, changes in staffing patterns and other variables may have contributed to the redistribution of nursing activities.

Medical information systems could, for example, supply patient discharge summaries to hospital discharge abstracting services like the Professional Activity Study (PAS) or for quality assurance programs like Professional Standards Review Organizations (PSROs). If data are automatically coded as they are entered into the system by medical care personnel, computer-produced abstracts would reduce both transcription and coding errors. In addition, medical information systems could efficiently provide necessary information for payment programs such as Medicare and Medicaid. With a computer system, these payment programs would be billed only for services actually rendered.

The usefulness of medical information systems for health data systems largely depends upon the extent to which patient data are entered into the computer record and the extent to which the computerized data are structured or coded. A system such as TMIS does not computerize large parts of the patient record, and some of the computerized data (for example, dictated radiology reports) are not structured. This kind of system is less useful for health data systems than a computer system like COSTAR, in which almost all patient data are entered and coded in the computer record. In PROMIS, all data are entered, structured, and linked to a specific problem of the patient. PROMIS can thus easily retrieve all data. Health data systems, however, usually aggregate by codes based on diagnosis and procedure rather than by "problem." Some information in the PROMIS data base may not be directly transferable to aggregate data systems. However, the edition of the international classification of diseases now being developed (lCDA-9CM) includes classifications for problems, and health data systems will be using the new classification scheme in the near future.

Computer produced abstracts can be sent to health data systems on paper forms or on computer tape. Health data systems would likely realize substantial cost savings if the data they receive were already in computerized form. However, these potential cost savings would occur only if medical information systems were widely used, standardized, and coordinated with health data systems. For example, only one of 2,000 hospitals that belong to PAS puts its discharge information on computer tape. To enter this information into its computer, PAS must process the data just as if they had been received on the manual forms.

Computer systems that capture some basic patient information for use in internal utilization review are commercially available, but no medical information system is coordinated with a health data system at this time.

PLANNING AND RESEARCH

Medical information systems could provide planners and medical researchers with data that are not available from existing health data systems. The computer systems store a data base that permits detailed analysis. If medical information systems with compatible data bases using standard definitions were widely adopted, they could be used to plan medical services, to evaluate the cost and efficacy of medical care, and to conduct clinical and epidemiological research.

The expense of obtaining data on patients limits the information available in most health data systems. The specificity necessary for some kinds of research may be lost when discrete events or diagnoses are grouped into classification codes. Electronic data banks generated by medical information systems such as PROMIS and COSTAR could make large amounts of disaggregated data available to authorized

planners and researchers. Because the data are structured, patient-oriented, and accessible, they can be manipulated in an enormous number of ways.

Resource Allocation

Existing data are often inadequate to allow policy makers and planners to reach informed decisions about resource allocation. For example, little data exist about the the efficacy of medical treatments or the frequency and costs of complaints or problems that bring people to doctors. Medical information systems have the capacity to identify costs of medical services as they are provided and to relate these costs to patients' diagnoses and problems. In PROMIS, for instance, a charge is associated with every discrete unit of service, and the costs and effectiveness of medical treatment can be evaluated. Using medical information systems, costs for the treatment of a particular problem could be compared in various geographic regions, different kinds of medical care settings, or types of medical providers. Comparing one method of treatment with other modes can aid in determining efficacy. The availability of such data would support decisions about the allocation of facilities, manpower, and other medical care resources.

Institutional Planning

Presently, managers of medical care institutions use statistics based on events or activities, such as number of days in intensive care or number of electrocardiograms provided, rather than measures of productivity, efficiency, and effectiveness. Medical information systems can help to optimize the allocation of staff by supplying data on the amount of time spent by staff members on different kinds of services (41). Medical information systems can help administrators predict needs for new personnel, facilities, and supplies by providing data about the demographic and geographic distributions of individual patients being served, the kinds of problems they present, and the types of services utilized, with measures of changes in these distributions over time. Such information can now be obtained only through special studies at considerable expense.

Research

Both epidemiological and clinical research could benefit from computerized medical records that include patients' demographic characteristics and diagnostic information. Epidemiological research studies the frequency, distribution, population selectivity, and determinants of all cases of a particular disease or condition in a defined population. Clinical research experimentally tests hypotheses about diagnosis or treatment in groups of patients.

For studies in which similar groups of patients must be matched, for example, the computer could identify control groups with appropriate characteristics. Automatic search of the extensive electronic data base would simplify retrieval of outcome data or any other variables, and the computer could test for statistically significant correlations. Followup on patients participating in prospective studies would be expedited by continually updated information on addresses maintained in the medical information systems.

Major disease patterns in this country have shifted from infectious toward chronic conditions. Because chronic diseases have such long duration, gathering valid data about the histories of patients with such diseases has been virtually im-

possible. Computer-stored data banks offer the best prospect for learning their natural histories. The use of a computerized data bank for such research has been demonstrated in an experimental program at Stanford University (18). A computer stores data on all visits of patients being treated for arthritis or related chronic diseases. With this extensive data base, researchers have conducted statistical analyses, developed experienced-based data for clinical teaching, and advised clinicians on the management of individual patients. Eventually, new interventions could be tested against accumulated clinical experience to determine the most efficacious modes of treatment.

The usefulness of medical information systems for research, however, is subject to several constraints. In most epidemiological studies, valid statistical inferences can be drawn only if the population base (denominator figure) is known. Thus medical information systems that maintain data about all people in a given locality are most valuable for epidemiological research. Some studies also require data comparable over long periods of time, that is, trend data. Because only a few medical information systems are now operating, a historical data base will not be attained for many years. Moreover, the utility of medical information systems will be determined in part by the ability of clinicians to anticipate the "right" information for tomorrow's research. On the one hand, it is possible that computerizing all recorded information may not be valuable and economical. On the other, even systems like PROMIS, in which all recorded information is stored in the computer, may fail to include data crucial for future research.

CONFIDENTIALITY OF PATIENT RECORDS

The confidentiality of sensitize medical data could be violated if computer files were infiltrated. Today *computer records are more* secure than ***manual records. However, medical information systems are not widespread, and a potential problem does exist.***

Medical information systems make large quantities of personal medical information immediately accessible. The possibility of misusing computerized data has prompted concern (33). Medical data, especially psychological and social data, can be damaging to an individual when available outside the clinical context. Computer files could be infiltrated and lists of people with certain medical and social characteristics compiled. Such possible abuse presents complex legal problems seldom encountered with manual records. Unauthorized access to an individual's manual record is possible, but sorting records according to diagnostic, social, and other criteria is difficult.

Considerable effort has gone into creating procedures to safeguard the confidentiality of computerized medical records without denying easy access to authorized users. At present, each organization using a computer system has had to develop its own security precautions. These safeguards on computerized records include such measures as having key-lock terminals, plastic identification cards, passwords, or other identification codes (38). Codes identify users and permit them access to only those parts of the medical record necessary for carrying out their duties. Entries are similarly circumscribed.

No matter how sophisticated or complicated, mechanical security measures cannot ensure the complete confidentiality of medical records. At best, unauthorized access to computer files can be made time consuming and costly. At the same time,

elaborate security systems may hinder authorized users from obtaining needed information and substantially raise the initial cost of the computer system.

A prime factor in securing the confidentiality of medical records may be adherence to professional codes of ethics by all those who work directly with patient records, automated or manual (11). Medical professionals are bound by their ethical codes not to disclose patient information. In some States, breaches of confidentiality constitute grounds for revocation of license. Similar ethical codes could be extended to nonmedical professionals, especially data processing personnel, who have access to computerized patient files (51).

Confidentiality can also be violated after the routine release of patient data to organizations outside the medical care institution. The Privacy Protection Study Commission, established by the Privacy Act of 1974, considered possible problems associated with the release of data about individuals. Its report recognized legitimate use of these data for research, auditing, and evaluation, but recommended disclosing only data necessary for a specific purpose and limiting subsequent uses and disclosures (42).

Limited access to the medical record might be more feasible in a medical information system than in a manual system. For example, identification of patients could automatically be stripped before pertinent data are released. Computerized records, however, facilitate the availability of detailed data to third parties and thus could increase the potential for misuse.

In order to control use of information within an organization and release of identified data to third parties, a report sponsored by the National Bureau of Standards suggests that precise standards be promulgated before computer systems proliferate **(56).** The report found that "computerized health records are more securely kept and processed today than manual records" and that "instances of leakage or misuse almost always take place in manual files" (56). Medical information systems are not widespread, however, and the report concludes that the main problem is one of potential harm.