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Report to the Chairman, Committee on Governmental Affairs, U.S. Senate

January 1991

MEDICAL ADP SYSTEMS

Automated Medical Records Hold Promise to Improve Patient Care

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Information Management and
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The Honorable John Glenn
Chairman, Committee on Governmental Affairs
United States Senate

Dear Mr. Chairman:

In response to your request of December 4, 1990, we are reporting to you the results of our review of automated medical records. The report discusses the potential benefits that automation could make to the quality of patient care and the factors that impede its use. We are making recommendations to the Secretary of Health and Human Services to support automated medical records as part of the Department's mandate to conduct research on outcomes of health care services.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 30 days from the date of this letter. At that time we will send copies to the Secretary of Health and Human Services; the Director, Office of Management and Budget; appropriate congressional committees; and other interested parties.

This work was performed under the direction of Frank Reilly, Director, Human Resources Information Systems, who can be reached at (202) 275-3462 if you or your staff have any questions. Other major contributors are listed in appendix II.

Sincerely yours,

Ralph V. Carlone
Assistant Comptroller General

Executive Summary

Purpose

While the nation spends more than half a trillion dollars a year on health care, the use of automation in the health care industry lags behind other industries. Many health care organizations are currently planning or implementing large-scale automated information systems, but no organization has fully automated one of the most critical types of information, patient medical records. The patient medical record provides a chronology of a patient's medical history, including symptoms, diagnoses, and treatments. At present, most medical organizations keep these records in manual, paper-intensive systems, which, when compared to automated systems used by the banking and airlines industries, are often slow in retrieving and transferring information, are labor intensive, and require huge amounts of storage space.

Because of the Committee's continuing interest in efforts to improve the provision of medical care, the Chairman, Senate Committee on Governmental Affairs, asked GAO to report to him on its review of automated medical records. GAO's objectives in this study were to identify the (1) benefits of automating patient records and (2) factors that impede automation.

Background

In September 1989 the National Academy of Sciences' Institute of Medicine began a study of automated medical record systems, noting that patient medical record-keeping has changed little over the last two decades. Although hospitals have had automated financial data for some time, they have been slow in using automation to maintain patient medical data. No hospital has yet automated all aspects of a patient's medical record such as laboratory services, medical diagnoses, treatment plans, and treatment outcomes. A 1990 survey conducted by a private consulting firm found that, although hospital expenditures for automation increased from $1 billion in 1979 to over $3.9 billion at the end of 1989, the overwhelming portion of these funds had been directed to financial activities.

The Departments of Defense and Veterans Affairs are currently developing automated information systems for the broad support of medical care. These systems, which will provide support for both outpatient and inpatient services, are intended to replace manual systems and provide physicians with immediate access to data in patient medical records obtained from such departments as laboratory, pharmacy, and radiology. When complete, these efforts will provide automated information services to more medical facilities than any other hospital information system.

Both private and public organizations are also currently measuring outcomes, that is, the quality and effectiveness of medical practice, an area known as outcomes research. The Joint Commission on Accreditation of Healthcare Organizations is collecting such data, as is the Department of Health and Human Services (HHS). In the Omnibus Budget Reconciliation Act of 1989, the Congress established within HHS the Agency for Health Care Policy and Research, and authorized nearly $600 million over 5 years for research of outcomes, effectiveness, and appropriateness of health care services and procedures. All of these efforts require effective management of the data collected on health care.

Results in Brief

Health care organizations see the need to automate much more intensively than they have in the past. GAO found that automated medical records offer the potential for great improvements in the management of patient care. Automated records are far more accessible than paper records, more complete and accurate, can increase staff productivity, and may reduce operating costs. A number of factors have impeded progress, however. These include technology that is not fully developed or is considered too costly, potential misuse of automated information, and user resistance to automated systems.

In addition, there are other factors that need to be addressed. At present, there is a lack of standardization in the ways data are collected and processed, which limits their usefulness for research. Automated records also raise questions about the security and privacy of sensitive information. In addition, the legal implications of automated patient records are still not clearly defined.

In spite of these problems, there are significant benefits with automation. The health care community needs to find solutions to the problems associated with automating medical records. Whether computers can support medical practice seems less the issue than how to bring about the development and use of the technology to do so.

Principal Findings

Automated Medical Records Can Improve Care and Increase Hospital Efficiency

Better information and better access to this information gives health care providers and managers powerful tools. Automated patient medical records improve upon paper medical records through better organization, presentation, and accessibility of data. Such records are uniform in format, are less likely to be misplaced or misread because of illegibility, and are available to many health care providers simultaneously. Health care providers can readily retrieve past clinical data for assistance in diagnosis and treatment, and may also display and manipulate data more easily to distinguish trends. Automation can supply computer-based reminders for providing care, generate alerts such as possible adverse reactions to drug interactions, and help to eliminate duplicative clinical procedures. Automated records, with their large data bases of patient information, may also support outcomes research in efforts that measure the quality of care and effectiveness of treatments.

Hospitals now using automated portions of patient medical records have reported both increased staff productivity and potential reductions in operating costs. Staff spend less time maintaining records, which allows more time for other duties. There are also indications that automated medical records have the potential to lower malpractice insurance premiums because the improved medical records more precisely document patient care, providing the physician with proof of appropriate treatment.

Several Factors Impede Greater Use of Automated Medical Records

Automated medical records are not yet fully used within the profession, partly because (1) the necessary technology for completely automated records seems too costly or is not now available, (2) standards for automating these records have not yet been developed or agreed upon within the medical community, and (3) some medical staff resist using automated systems that they perceive as hard to operate and foreign to their usual practice of medicine.

Also, concerns that data in automated records will not be safe from unauthorized use or from alteration are only partially alleviated by existing safeguards. In addition to unauthorized users, authorized personnel could use information in ways that are questionable or intrusive,

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Abbreviations

AHCPR	Agency for Health Care Policy and Research
DOD	Department of Defense
GAO	General Accounting Office
HCFA	Health Care Financing Administration
HHS	Department of Health and Human Services
IMTEC	Information Management and Technology Division
IOM	National Academy of Sciences' Institute of Medicine
VA	Department of Veteran Affairs

Chapter 1

Introduction

Government and private organizations across the nation are undertaking large-scale initiatives to automate health care information. The practice of medicine is an information-dependent industry in which hospitals, health care providers, and administrators face the formidable task of gathering and exchanging massive amounts of patient information fully, accurately, and quickly. How well the medical community manages this information can contribute to its success in providing medical care at an acceptable cost.

Medical records provide a history of each patient's medical condition and treatment, as well as insurance and payment status. They constitute a vital link between patients, doctors, and departments within a hospital. Because physicians need to be aware of an abundance of medical data in order to provide the most informed patient care, these data need to be timely, accurate, complete, and accessible. Since medical records are central to the health care process, the way in which this information is managed is a subject of immediate and ongoing concern both to the medical profession and the public it serves.

The United States is spending over a half a trillion dollars each year on health care, more than 40 percent of it publicly financed. Health care expenditures have grown from 6 percent of the gross national product in 1965 to about 12 percent today. They are expected to reach 15 percent in the next decade. U.S. health care costs, the highest among industrialized countries, have risen more than double the rate of general inflation for nearly three decades.

Automation may help reduce some of these costs, and provide managers with solutions to many of the other problems confronting hospitals in their supervision of patient care. Several industries, such as airlines and banking, have used automated systems extensively to store and maintain their records. However, although automation has been used for some purposes in the health care industry for several decades, hospitals still rely heavily on paper-intensive systems to maintain medical records.

Although there are currently several initiatives to modernize medical record-keeping, none addresses the full picture of who uses this information and how they use it. Plans for automating medical data may focus on the needs of nurses and physicians or even the needs of an entire hospital, but no plan at present incorporates the whole network, from medical staff who treat patients to top-level officials who oversee multiple institutions. The problem of managing medical information

begins at the patient's bedside and persists through wards and hospitals, peer-review groups, and on through national health care organizations. If all of these different groups are to work together to provide high-quality health care, they will need automated systems that are capable of producing comprehensive medical records, rather than a series of unconnected and nontransferable data.

Demands for Medical Data Increase

Several organizations in the private and public sectors are collecting large amounts of information on health care, and could benefit directly from comprehensive, automated records. In the private sector, the Joint Commission on Accreditation of Healthcare Organizations has an ongoing program to evaluate the appropriateness and quality of care provided by health care organizations. The program, called the Agenda for Change, has a goal to develop an accreditation system that fosters improvements in medical care. The success of this program depends on the ability of hospital information systems to collect and process data efficiently and cost-effectively.

In the public sector the Department of Health and Human Services (HHS) has a research program to determine the appropriateness, necessity, and effectiveness of selected medical treatments and surgical procedures. The Congress has authorized for this purpose nearly $600 million over 5 years, and established within HHS the Agency for Health Care Policy and Research. The degree to which this program succeeds depends on its ability to efficiently and cost-effectively access, collect, and process large volumes of patient data from medical records.

Fully Automated Patient Medical Records Have Not Yet Been Developed

While several health care organizations have made steps in automating portions of medical records to better manage the patient care process, these efforts remain piecemeal. Some hospitals have been successful in automating various portions of the medical record to collect, process, and analyze patient data. The most comprehensive hospital information systems have features that automate a set of functions in ancillary departments—such as radiology, laboratory, and pharmacy—in addition to patient registration and scheduling, and finance and accounts receivable. Some systems have features that remind physicians to provide certain types of care, allow users to query the system for data on patients, and summarize key clinical information to streamline patient visits. However, no organization is providing the leadership needed to oversee a comprehensive effort to automate medical information.

To date no hospital has automated all aspects of the patient medical record. Hospitals in general still rely on paper medical records for a variety of reasons, including physicians' reluctance to change their ways of practicing medicine; technology that is unavailable, not fully developed, or costly; concerns with data privacy and security; concerns with the legal and regulatory acceptability of automated data; and a lack of widely accepted guidelines for standardizing data.

Interest is growing in the medical community for automated medical records. In September 1989, the National Academy of Sciences' Institute of Medicine (IOM) began a study of ways to accelerate the establishment of a computer-based patient record to be used throughout all health care organizations. IOM assembled a committee of medical experts, both public and private, to help in this effort. The committee sees automated records as a way to improve patient care and support research.

In the federal sector, the Departments of Defense (DOD) and Veterans Affairs (VA) are investing billions of dollars to develop automated medical information systems. These systems, which will provide support for both outpatient and inpatient services, are intended to replace manual systems and provide physicians with immediate access to patient medical records. When fully developed and deployed, these systems will provide automated patient services to more medical facilities and people than any other hospital information system. Currently, however, neither system includes plans for fully automated medical records. In 1988, DOD and VA established a coordination council for exchanging information on each agency's medical initiatives. A working subcommittee was established to share patient medical information between the agencies. The subcommittee will attempt to identify the information needs of both departments and the emerging technology that can automate greater portions of their patient records.

Objectives, Scope, and Methodology

Because the Senate Committee on Governmental Affairs has a continuing interest in efforts to improve the provision of medical care, the Chairman asked that we report to him on our review of automated medical records. Specifically, our objectives were to identify (1) benefits to be gained from automating records and (2) factors that have impeded the use and development of automated records.

To meet our objectives we used primarily two methodologies. First, we conducted a comprehensive literature search to obtain information on automated medical records. Second, we interviewed officials from

various public and private health care organizations that had extensive histories of developing, implementing, or using automated patient data. We also interviewed individuals from medical, regulatory, and legal organizations to identify requirements governing automated medical records. (See appendix I for a list of organizations.) Our review was conducted between April 1989 and December 1990. We obtained oral comments from HHS officials on a draft of our report, as well as the views of other public and private officials knowledgeable about the issues discussed in this report. We have incorporated their comments where appropriate.

Potential Benefits Exist in Automating Medical Records

The health care community currently relies heavily on paper medical records. As a result, it may be missing important benefits that can be offered through the use of automation. Medicine is an information-dependent field in which data are collected, analyzed, and disseminated at each point in the patient-care process, from the doctor-patient level to the senior management levels of hospitals and oversight groups.

The benefits of automated information include not only improvements in data gathering within each area of health care, but better opportunities to manage and share information throughout the health care community. These opportunities include speeding physicians' access to data on patients, providing more complete and accurate records, and giving physicians more complete information for decision-making. Maintaining manual records may cost more over time because it is labor intensive and slow. Another difficulty in using manual records becomes apparent in outcomes research, the evaluation of data on medical treatments in order to determine the most effective patient care. Such research requires that large amounts of data be analyzed, a cumbersome process if records are kept on paper and written by hand. At present, hospitals are making efforts to further automate their medical records.

Automation Can Improve Medical Personnel's Ability to Deliver Health Care

One of the most visible benefits of an automated information system is that it increases medical personnel's access to data. If this system includes automated medical records, patient information can be made available to multiple users simultaneously. Conversely, the paper record is generally available in its entirety only to a single user. Increased accessibility would help medical records staff meet competing demands from such sources as physicians, nurses, and hospital billing offices. Accessibility becomes especially important in large institutions when records have to be transported between staff members who have competing needs for the information. Officials at one hospital, for example, estimated that up to 22 different hospital personnel may need access to a patient medical record at any given time.

Information from an automated record can also be retrieved more quickly than from a paper chart. This added timeliness can be crucial in an emergency. One hospital official stated that having patient data available on terminals in the emergency room allows staff to expedite the treatment of critically injured patients. In addition to speeding retrieval of medical records, automation can dramatically increase the speed with which new information is placed in these records. Results

from laboratory and radiology tests can be directly recorded in the automated system for immediate availability to the user. This feature can save time by eliminating the need to place phone calls to these hospital departments to obtain results.

Automated Data Are of Higher Quality

Automated medical data are often better organized and more complete, accurate, and legible than data in manual records. Automated systems tend to require more standard entries of data and text, which is considered an inconvenience by some users, but tends to make the data easier to find. Data stored in a computer have the potential to be analyzed and presented in a format that is more useful to physicians and other health care workers than data stored in a paper medical record. A computer can generate special reports, graphs, and specialized displays; it can, for example, display all laboratory results for an individual patient over a designated period of time, revealing changes or progress in the patient's condition.

Automated systems can help avoid errors and validate accuracy by providing matches and checks. An automated system can, for example, identify laboratory results outside a normal range for further consideration by medical personnel.

An automated record is less likely than a paper record to be incomplete, lost, or misfiled. One hospital official stated that at any given time 7 out of 10 paper medical records are incomplete. Officials at another hospital stated that they can locate the medical records only 70 percent of the time. They believe that a completely automated medical record would increase their ability to retrieve data.

Illegibility of medical data is cited as a major problem with current paper health records. Illegible handwriting can make information difficult to retrieve or result in misreading, which in turn can delay or compromise the proper delivery of care. An automated system does not rely on an individual's handwriting to record patient data.

Automation Can Support Decision-Making and Quality Assurance

Effective management of data can help facilities carry out effective quality-assurance programs. Through the creation of automated data bases, hospitals can more efficiently assess outcomes of treatments, identify problems in the quality of medical care, and monitor treatment options. Ultimately, automated systems can assist hospitals in performing quality-assessment reviews to analyze the care provided by

physicians, evaluate treatment options, track the incidence of certain diseases, and identify patients who might benefit from new drugs or other care.

An official of a hospital chain stated that an automated system enhances quality assurance by providing clinical information to decision-makers. The hospital chain had searched one of its hospital's data bases to identify patterns of complications and deaths among its heart patients. This search uncovered five deaths that occurred during a complicated and potentially dangerous surgical diagnostic procedure that involved threading a catheter through a patient's arteries. Staff were subsequently cautioned about the use of this procedure for some patients. The hospital chain's Director of Quality Management stated that the automated system was integral in making this discovery. Without this system the hospital would have faced the exhausting task of reviewing hundreds of charts to identify the danger. The Director estimated that about 400 patient cases can be reviewed per hour from the automated system, compared with 3 cases per hour from the paper file.

This concept has also been demonstrated by a hospital with a comprehensive inpatient and outpatient information system that had 500 million data elements available for query. The system was used to determine if a significant relationship existed between patients with spinal injuries and patients with a propensity to develop bedsores. Administrators at the hospital were concerned that additional training might be needed to instruct hospital staff on proper turning of these patients in their beds to avoid this condition. A query of the system discovered that not all spinal patients were developing bedsores, but that those patients afflicted also had urinary tract infections. Expensive remedial training was averted and the hospital gained insight into treatment.

Automated Data Are More Versatile

In addition to quick accessibility and improved accuracy, automated systems also make data more versatile. With paper medical records, data can only be retrieved in the format in which they were originally recorded. Computer-based medical records allow data to be retrieved and displayed in different ways. For example, data can be reviewed by date, provider, related problem, or most recent visit.

Automation can also provide clinical reminders that assist in patient care. These reminders can help monitor a patient's progress, detect

problems that might be overlooked, and suggest alternative treatments. The reminder capability in one automated system has reduced the percentage of overlooked positive strep throat cases from 7 to almost 0 percent. Computer reminders are also valuable in situations where physicians might overlook evidence, such as failing to notice adverse drug effects even when this evidence is present in the paper chart. In one such case, a physician prescribed a particular medication for a patient, and the pharmacist, by using an automated system, discovered that the patient was taking another medication that could cause an adverse reaction. The physician was notified and changed the medication, preventing a potentially adverse effect to the patient.

Automation Can Enhance Outcomes Research Programs

Information management is important not only for routine treatment of patients, but for the study of this treatment as well. The health care community devises measures to assess the effectiveness of treatments and procedures for a number of conditions and diseases, a process referred to as outcomes research. Leading the way in carrying out these programs are purchasers of health insurance, including both public and private organizations, that are concerned about the increasing cost of care, and whether it is effective and of high quality.

HHS has an outcomes research effort, the Medical Treatment Effectiveness Program, to determine the appropriateness and effectiveness of selected medical treatments and procedures. To carry out these objectives, the Congress created within HHS the Agency for Health Care Policy and Research (AHCPR). The Secretary of HHS, acting through this agency, is chartered with conducting and supporting research and evaluations of alternative services and procedures, demonstrations on the use of claims data, education of the health care community, and data base development to meet this mandate. The Secretary is also required to disseminate research findings and guidelines by working with professional associations, medical organizations, and other relevant groups.

The ability to manage health care information is important to the success of AHCPR and other outcomes research programs, because millions of clinical findings will need to be chronicled and evaluated. An AHCPR official stated that automated medical record systems offer great potential to assist the agency in outcomes research.

The Joint Commission on Accreditation of Healthcare Organizations is also conducting a quality review program designed to change the way hospitals are accredited. As part of the program, called the Agenda for

Change, measures will be developed for evaluating the outcomes of patients' treatments. The plan is being implemented to improve the quality of patient care by measuring the results of this care and medical organizations' compliance with accepted standards. Hospital officials agree that being able to extract information from automated data bases would be of great assistance in meeting the Joint Commission's requirements.

Automated Patient Medical Records Can Increase Hospital Efficiency

Improving the management of information can make hospitals more efficient. These benefits include improved staff productivity and the ability to access and analyze patient data more quickly, thereby reducing inpatient stays. However, because automated medical record systems are limited in number and scope, benefits have yet to be widely documented or quantified.

Automation Can Improve Staff Productivity

One of the primary benefits that can result from improved information management is more effective use of staff. Automated medical records can be retrieved almost instantaneously, sparing hospital staff the chore of locating and searching through documents. One hospital we visited was able to reduce its full-time admitting department staff from 22 to 13 people, and still handle increased admissions. Officials at another hospital were able to make better use of their staff because duplicate orders were eliminated and phone calls requesting lab results and other information were no longer necessary. Another hospital reported it was able to cut in half the amount of time needed to fill prescriptions. For a number of hospitals, the flow of information has become more efficient, as in one hospital that has greatly reduced the need to physically transport medical records between departments.

In addition to relieving the work load of administrative staff, automated medical records can reduce time spent by physicians and nurses on administrative tasks. In February 1989, we reported that military physicians cited a lack of clerical support as a major obstacle to the number of patients they could see.[1] A reduction in administrative and clerical tasks, such as completing laboratory slips and pulling medical charts, could increase the number of patients these physicians could treat. The same is true for nurses—the American Medical Record Association has reported that 2 to 3 hours of a nurse's shift are spent doing paper work.

[1] DOD Health Care: Extent to Which Military Physicians Perform Administrative Tasks (GAO/HRD-89-53, Feb. 13, 1989).

Computerized medical records could reduce that time because patient information would be available on-line, allowing nurses more time for direct patient care.

Automation Can Lead to Cost Savings

Better management of information can potentially help hospitals reduce spending, though opportunities in this area have not been fully examined. To date, hospitals have reported savings primarily through automating their administrative and billing functions.

Although few attempts have been made to determine whether automated medical records reduce costs, some evidence is available. An internal VA study conducted at a VA hospital compared an automated system with a paper-based system in the hospital's geriatrics clinic to measure the effects of each on costs and quality of care.[2] The study found that using the automated system reduced hospitalization costs by about $600 per patient because of reduced inpatient stay. The study also found the quality of care improved because of better organization and presentation of data on which physicians made decisions.

Another facility established a data base of patient information that can be used to distinguish between patients at high or low risk of complications from heart attacks. Using the data base, physicians identified patients at low risk and were able to discharge them within a week of admission. Before the data base was established, most heart attack patients were hospitalized for 2 to 3 weeks.

[2] A Geriatric Record and Multidisciplinary Planning System (GRAMPS), Department of Veterans Affairs (VA), Health Services Research and Development, project no. HR 84-041 (May 12, 1989).

Factors Impeding Greater Development and Use of Automated Medical Records

Automating patient records presents the medical community with compelling opportunities to improve health care, but several impediments must be overcome first. At present, no fully automated patient record system exists, so no one can list with certainty all the problems that will arise. Some impediments are apparent now, however, including user resistance, unavailable or costly technology, lack of established data standards, and concerns with security, privacy, and legal implications.

Health Care Professionals Resist Using Automation

Many hospital and medical association officials consider user resistance, primarily by physicians, the major obstacle to greater use of automated medical records. While many physicians have accepted new technologies, others have been reluctant to use or accept automated medical records because they think that entering data, such as patient progress notes, imposes structure and change in the way they practice medicine.

Hospitals have tried to ease the way in which data are added to the automated medical record by eliminating the need for doctors to type information. Some hospitals use predefined patient encounter forms for entry of patient data. These predefined forms allow patient data to be manually recorded, describing the patient's condition, diagnosis, and treatment. Clerical staff then enter the data into the automated system. Other hospitals have automated such forms to allow providers to enter data directly into the automated system. At some hospitals, providers can record patient data through dictation, which is later transcribed into the automated system by clerical staff.

While these methods allow patient data to be collected and stored in the system for ready access, they have several shortcomings. Using clerical staff (1) results in a lag between the time the information is obtained and is entered in the system, (2) can introduce possible recording errors that go unnoticed, and (3) increases costs. Some medical staff have resisted directly entering data themselves, however, because they view it as a clerical task and consider it too time-consuming.

Emerging Technology May Improve Data Entry Methods

For automated medical records to be further developed and accepted, data entry methods are needed that minimize changes in the way physicians practice medicine, while also providing a cost-effective, timely, and efficient way for hospitals to record patient data. While adequate training may help alleviate this resistance, emerging technology may also help.

Voice recognition technology may enable users to enter patient data directly into the medical record. This technology allows use of the human voice to access computers, which then translate the spoken word into printed reports. The technology is not widely used by hospitals, however, and currently is limited to certain hospital departments such as radiology, pathology, and emergency. Some hospital officials have found that current voice recognition systems are too expensive, lack sufficient vocabulary, and require altered speech patterns for proper voice recognition. An American Medical Record Association publication reported that until technology resolves physicians' data input concerns, the automated medical record will not become a reality. It sees voice recognition technology as possibly the only data input mechanism acceptable to the majority of physicians. Until further research on this technology is conducted in hospital settings, its potential benefits will not be clearly known.

Technology Is Evolving, but Is Costly and Not Fully Developed

Further technological developments may be needed to capture and display clinical data in retrievable and easy-to-use methods. Technology has not evolved to the point where images and free text, such as physicians' and nurses' notes, can be efficiently captured and retrieved. The inability to conveniently store and retrieve large numbers of images reportedly has been a long-standing problem for the health care industry. Like paper medical records, images, such as X-rays, usually exist in only one copy that must be shared by many staff members in a hospital. As a result, these images are often not readily available when needed. The automated medical record could solve this problem by providing images and text in a single, unified record that could be displayed on several computer terminals simultaneously, if necessary.

An American Medical Record Association publication reported that the digitization of film X-ray images can provide more insight into the pictured body parts, and reduce waiting time for X-ray results. However, concerns with the quality of the computer images, the voluminous storage requirements, and the costs have inhibited its widespread use in health care facilities. Automating images would also require expensive, high-resolution monitors to retrieve the data. If these data are also maintained on-line, the result could be slow response times to data requests because of the additional information the computer would need to process. Also, concerns have been raised about abandoning film as an X-ray medium because film achieves higher visual resolution than computer images, and the benefits of digitizing X-ray images are still uncertain.

Technology Needed to Meet Storage Requirements

As computer technology allows hospitals to move away from paper-based systems to maintain medical records, greater amounts of patient data will be stored in automated systems. However, maintaining the majority of patient data in the computer record increases storage requirements above what traditional storage technology has been able to meet. Automating the entire medical record can require tremendous storage capacity, especially to maintain images such as X-rays. One official estimated that a totally automated medical record for one patient could require as much as 1 gigabyte of storage.[1]

Optical disk storage media offer a potential solution to automated records' storage needs. These systems use lasers to permanently etch computerized information on a disk. The information can be read and printed out, but the systems have the capability to prevent its being removed or written over. Some officials believe that the use of optical disk storage for automated medical records could provide benefits such as greater storage capacity, space savings, and assurances that data cannot be changed. Others, however, voiced concern about the systems' dependability, reported benefits, potential cost savings, and efficiency in retrieving data.

We visited one hospital that has been using an optical disk storage system to store information from paper records. The hospital experienced mixed results with the system's effectiveness. The system has worked well for storage and retrieval, and is far superior to microfilm storage media. However, the system does not allow data to be manipulated once retrieved. Also, the facility has experienced difficulty in keeping up with the daily work load and still retains paper copies of medical records. Nevertheless, the use of optical disk storage technology was still being considered as a viable storage alternative by several of the hospitals we visited.

Cost of Technology Limits Hospitals' Automation Efforts

As an organization makes plans to initiate or expand automation, budget considerations become a determining factor of how much, where, and how quickly automation can proceed. The financial resources of an individual hospital vary, and these resources determine what is automated first. A 1990 survey conducted by Sheldon I. Dorenfest & Associates, a consulting firm, found that hospital expenditures for automation rose during the 1980s, from less than $1 billion in 1979 to over $3.9 billion at

[1]A gigabyte is one billion bytes. Bytes are combinations of bits—the smallest units of data that a computer can process—which form numbers, letters, and symbols.

the end of 1989. The overwhelming portion of these funds has been directed to financial systems, or to areas of patient care that support financial activities. A hospital survey conducted by the Joint Commission on Accreditation of Healthcare Organizations in 1989 found that computers were used primarily for handling billing and census information, rather than collecting clinical data on patients.

The cost of automation has limited hospitals' information efforts to further automate paper medical records. A hospital information system can range in cost from several hundred thousand dollars to several million dollars, depending on the extent of automation desired. For greater use and development of automated medical records, emerging technologies will also have to be considered. However, several hospital officials consider these technologies too costly at present. For example, while voice recognition systems with limited vocabularies are moderately priced, more sophisticated systems currently are considered prohibitively expensive.

Similarly, digital imaging technology is considered too costly when compared to its purported benefits. Officials also believe that optical disk storage systems are not yet cost-effective. However, as systems become less expensive, more defined, and more widely used, they may offer viable solutions to greater automation of medical records.

Standardization of Data Needed to Automate Medical Records

Today's health care practices demand that data be shared both inside and outside a hospital. These practices require that standards be in place for recording and transmitting data inside and outside an organization.

Several organizations, including some in the international health community, are actively involved in developing standards for automated medical records. These standards will address (1) the content and structure of the medical record and (2) the capability to transfer or share information between hospitals. With standards in place, different commercial systems could produce automated records in a format compatible with any automated system in any hospital.

At the individual hospital level, the availability of widely accepted standards could ease the transfer of clinical data between individual hospital departments' information systems, and make it easier to collect and review patient data. Additionally, the adoption of a standard record content would make it easier to transfer data between hospitals. The

development of standards will allow for more efficient collection of patient data across hospitals, which will facilitate outcomes research by eliminating the need to perform extensive reviews and compilation of data from paper medical records.

The Omnibus Budget Reconciliation Act of 1989 requires HHS to conduct research on outcomes of health care services and procedures. To carry out this mandate, the Secretary of HHS is required to develop standards for data bases. These standards are to include (1) uniform definitions of data to be collected and used in describing a patient's clinical and functional status, (2) common reporting formats and linkage for such data, and (3) standards to assure the security, confidentiality, accuracy, and appropriate maintenance of such data.

HHS has been meeting with different standards groups to determine what is being done, who is doing it, and what remains to be done. HHS officials stated that these meetings are HHS' initial effort in developing standards for data bases and that no formal plan had yet been devised.

Security and Privacy of Medical Records Need to Be Addressed

One of the persistent concerns in automating medical records is whether these confidential records will become vulnerable to unauthorized access, alteration, or destruction. No medical record, whether automated or manual, is ever entirely safe from loss, damage, or misuse. Paper records are at risk in a variety of ways, ranging from physical damage of documents to intentional misuse by unauthorized persons. Automated records suffer many of the same risks, but, because they tend to be accessible to many users in many locations and these users could potentially search thousands of files with relative ease, problems with security and privacy are magnified. One of the chief advantages of automated records, easy and widespread access, also can make them vulnerable to easy and widespread abuse.

The American Medical Association and the American Medical Record Association, which consider the confidentiality of medical records a high priority, have issued guidelines on maintaining computerized medical record confidentiality. Officials from these organizations believe adequate security measures can be built into automated systems to ensure the integrity of patient data. Hospitals have installed various security measures in their automated systems, which they believe can adequately safeguard automated patient records.

Most hospitals use passwords, which are changed periodically, to control access to information in the system as well as restrict user access to designated information. For example, at one hospital, users who attempt unauthorized access to records are locked out of the terminal and identified through an alarm. Another available control measure is an audit trail that identifies who makes changes to a patient record. For those accessing the system from outside the hospital, a telephone "dial-back" security measure can be incorporated to verify that the caller is an authorized user.

Passwords are no panacea for deliberate misuse of a system, however, nor is any other security measure. Users can and do share passwords, or write them down where they can be found by others. Security is no better than the individuals who maintain it, and some health care workers may not fully understand the importance of computer security. Organizations implementing automated records need to conduct careful initial research, anticipate the security problems they will face before these problems become painful realities, build the necessary safeguards into the system's design, and ensure that staff understand security measures and are committed to upholding them.

Additional security issues arise when automated patient data are collected within and transmitted outside of individual health care facilities. Increasing interest in outcomes research will require collecting data from hundreds of health care organizations, which could present unforeseen risks to the privacy and integrity of the information. When automated medical record systems become more fully developed and widespread, they may offer a more efficient way of collecting data, but will also raise new questions about the privacy of and access to these records. Although we did not address related risks, these concerns must be addressed as more patient information becomes automated.

Automated Medical Records Raise Legal Questions

The legal implications of automating patient records are not yet clearly defined. Questions remain about whether these records comply with accreditation standards and regulatory requirements, and the extent to which their use complies with federal and state privacy laws. Although officials from hospital and regulatory organizations with whom we spoke did not see a problem with using automated medical records in malpractice proceedings, it is not clear whether this issue has been fully analyzed.

Organizations automating medical records can draw on the experiences of the financial community and other industries that have automated sensitive customer records, but direct comparisons are not always possible. Limited statutory guidance, such as the Privacy Act of 1974, is available, which offers some direction on protecting patient data. Organizations will need to analyze for themselves the legal concerns that will arise, and develop ways of protecting the privacy and integrity of medical data. Failure to anticipate trouble could result in lessons learned the hard way, through litigation.

These cautions aside, hospitals and regulatory organizations officials with whom we spoke did not generally foresee a problem in complying with certification requirements, and believed that the automated medical record is legally defensible. They were not aware of any legal cases where the information from automated records was not admissible in court. As automated medical record systems become more advanced and widespread, hospital officials expect a reduction in malpractice claims and insurance premiums because these records should lead to better patient care and documentation of this care.

The ability of automation to increase the legibility, completeness, and accuracy of medical records could make this information more reliable in court. One hospital believed automation helped in defending against malpractice cases because of better documentation. Another health care facility received a 20-percent reduction in malpractice insurance premiums for its emergency room physicians who used a voice recognition system for documenting the care provided. DOD believes that its Composite Health Care System will reduce the number of malpractice claims filed by patients, because the system will improve medical record documentation and the quality of care. DOD expects to save legal and administrative resources in adjudicating and disposing of malpractice claims, and to reduce the total amount of money paid for settlements and awards.

Conclusions and Recommendations

The health care community has reached a crossroads in the way it handles information. Manual record-keeping systems are having increasing difficulty meeting the community's needs. Automation provides solutions to many of the problems of information gathering and dissemination that are currently confronting medical organizations. Automated systems show promise of enhancing not only the ways in which physicians and other medical workers receive information, but the information itself. The speed with which patients' medical records are updated and transferred and the accuracy of the information should improve greatly. Top-level officials responsible for health care could benefit directly from these conditions. Hospitals should benefit from improved staff productivity and better data to support their quality-assurance programs. Better management of information should improve the quality of care that patients receive. Research programs also would likely benefit from more efficient access to data.

At present, no fully automated medical record system exists, so the strengths and weaknesses of such a system have not been documented, and are not clearly understood. Efforts to use automated medical records have been hindered by unavailable or costly computer technology, data entry methods that either are not acceptable to users or are not operationally feasible to implement, and users' resistance to change the way they practice medicine.

Concerns also exist with data security and legal implications. While security measures are available to protect the integrity and confidentiality of patient data, more analysis is needed in this area. Automated medical records provide, however, a more complete record of the patient's medical history and appear to be useful in litigation and in meeting regulatory requirements.

Uncertainties also exist in using automated records for research. Automated medical records could potentially assist outcomes research by offering more efficient access to vast amounts of data on the effects of treatments. The specific ways in which automation can be used to support this research have not, however, been fully studied.

HHS is in a position to provide leadership in automating patient records because of its mandate to facilitate and conduct outcomes research and to disseminate research findings and guidelines. As part of its outcomes research effort, HHS must analyze large amounts of data. It appears that the automated medical record can play an extremely useful role in this effort. In addition, HHS can provide the leadership necessary to establish

a widely accepted standard for collecting data, and encouraging its use by medical organizations so that the information can be easily shared.

We believe that automated medical records have the potential to improve patient care, increase efficiency, and reduce costs. More needs to be done, however, to bring these benefits to fruition. In this process, health care providers, insurers, and the government all have a role to play.

Recommendations to the Secretary of Health and Human Services

We recommend that the Secretary of Health and Human Services, as part of HHS' mandate to conduct research on outcomes of health care services, direct the Public Health Service, through its Agency for Health Care Policy and Research, to support the exploration of ways in which automated medical records can be used to more effectively and efficiently provide data for outcomes research.

We also recommend that the Secretary, as part of the effort to support outcomes research, develop a plan and a budget for consideration by the Congress, to bring about the greater use of automated medical records. This plan could include a national forum that sets goals for automating medical information, addresses individual and organizational concerns with automated records, and identifies incentives to induce health care organizations to increase their use of automation.

List of Organizations Contacted

During our review we contacted representatives from private and public health care facilities. We also interviewed representatives from medical, regulatory, and legal organizations. We did not attempt to statistically select the organizations contacted. Health care organizations contacted were subjectively selected from our literature search as having extensive experience in hospital automation. We also subjectively selected medical, regulatory, and legal organizations to get a perspective of how such organizations viewed automated medical records.

The specific organizations we contacted included:

Department of Defense (DOD) headquarters, Washington, D.C.
Ireland Army Community Hospital, Ft. Knox, Kentucky
Moody Air Force Base Hospital, Valdosta, Georgia
Langley Air Force Base Hospital, Langley, Virginia
U.S. Army Medical Materiel Development Activity, Fort Detrick, Maryland
Department of Veterans Affairs (VA) headquarters, Washington, D.C.
VA Mid-Atlantic Regional Information Systems Center, Washington, D.C.
VA Information Systems Center, Salt Lake City, Utah
VA Medical Center, Washington, D.C.
VA Medical Center, Tacoma, Washington
National Institutes of Health, Bethesda, Maryland
Institute of Medicine, National Academy of Sciences, Washington, D.C.
Grady Memorial Hospital, Atlanta, Georgia
Maine Medical Center, Portland, Maine
William Beaumont Hospital, Troy, Michigan
University of California San Francisco Hospital, San Francisco, California
Hospital Corporation of America, Nashville, Tennessee
Humana Inc., Louisville, Kentucky
Henry Ford Hospital, Detroit, Michigan
Duke University Medical Center, Durham, North Carolina
Center for Clinical Computing (at Beth Israel and Brigham and Women's hospitals), Boston, Massachusetts
Massachusetts General Hospital, Boston, Massachusetts
Harvard Community Health Plan, Boston, Massachusetts
University Health Center, Burlington, Vermont
Regenstrief Institute, Indianapolis, Indiana
Mercy Hospital, Springfield, Massachusetts

American Medical Association, Chicago, Illinois
American Medical Record Association, Chicago, Illinois
American Hospital Association, Chicago, Illinois
Joint Commission on Accreditation of Healthcare Organizations, Terrace, Illinois
Virginia Division of Licensure and Certification, Virginia Department of Health, Richmond, Virginia
North Carolina Licensure Section, Department of Human Services, Raleigh, North Carolina
Massachusetts Office of General Counsel, Department of Public Health, Boston, Massachusetts
Virginia Office of the Attorney General, Richmond, Virginia
North Carolina Attorney General Office, Raleigh, North Carolina
Massachusetts Department of the Attorney General, Boston, Massachusetts
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