State of the Industry Review:
Computerized Patient Record and
Electronic Medical Record

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December 15, 1994
Background
Currently the medical record process at the University of Michigan Medical Center (UMMC) involves a physical paper file that contains all medical data on a given patient. UMMC is beginning to place parts of the patient record on computer through the Patient Care Information System (PCIS). This computerized patient record (CPR) contains some elements of the paper record; however, not all aspects are included.

Discussion
Although often used synonymously, CPR and EMR (electronic medical record) are two different types of automated storage for patient records. A CPR is an on-line, real-time media for storing patient information. It specifically includes nursing notes, order entry and results reporting. In contrast, an EMR is an automated record created from optically scanning the patient's paper record.

The benefits of automation include:
• files can be viewed simultaneously by multiple users
• a reduction in incomplete and inaccurate patient information
• a reduction in labor expense
• an improvement in medical research capabilities

A CPR has benefits which an EMR does not have, including immediate access to information, clinician decision support, order entry and results reporting and scheduling.

Summary
UMMC is currently in the process of implementing a significant portion of a Computerized Patient Record through the Patient Care Information System. However, PCIS will not include physician's and nurses's notes. The issue before UMMC is whether to do nothing, to use an EMR for what is not included in the CPR, or to add the functionality to PCIS at some point in the future. It is important to note that the imaging technology of an EMR may be outdated in the future. Considering the costs and time involved to select an EMR system, implement the system, and teach the users, we recommend that UMMC add the missing functions to the computerized patient record already implemented by PCIS.
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1.0 Study Objective

The main objective of this study is to assess the current technology available for storing hospital patient information in an electronic or computerized format which would be feasible for UMMC. This also involves analyzing UMMC's current situation in order to determine structure requirements and needs regarding computerized patient records.

2.0 Background for Study

Currently the medical record process at the University of Michigan Medical Center (UMMC) involves a physical paper file that contains all medical data on a given patient. UMMC is beginning to place parts of the patient record on computer through the Patient Care Information System (PCIS). This computerized patient record contains some elements of the paper record; however, not all aspects are included. Therefore, the focus of this study is to review methods and media for storing the data that is not included in PCIS.

3.0 Study Methodology

This study began with a literature search on automated records. This search found approximately 130 articles all of which are summarized in the appendix. Secondly, we contacted hospitals and vendors that were mentioned in the literature. This involved sending letters to about 40 hospitals requesting information. The vendors were contacted by phone and subsequently sent information to us. The majority of our time was then spent in summarizing and drawing conclusions from the information not only in the literature search but also from information that which was sent to us by the hospitals. Sources that were found to be particularly helpful include: a paper on Optical Imaging at St. Vincent's Health Center in Erie, Pennsylvania and the Government Report on Computerized Records. An interview was also conducted with Linda Creps, Director of Clinical Information Systems. In this interview, she outlined the capabilities and plans for PCIS. The rest of our time was spent analyzing and concluding based on our knowledge of the industry and UMMC's current position.
4.0 Eliminating the Paper Record

Hospitals are eliminating paper records for many reasons. These include:

- A physical paper file cannot be viewed simultaneously by multiple users; this can be extremely inconvenient at teaching institutions such as UMMC. Officials at one hospital estimate that up to 22 different hospital personnel may need access to a patient medical record at any given moment (GAO 1991).

- Existing paper records require an abundance of storage space. In most hospitals, especially urban hospitals, space is at a premium.

- Replacing paper records with computerized records would allow clinical care providers to devote more time to patient care. According to Richard I. Skinner, Chief Information Officer at Sisters of Providence Health Systems in Portland, Oregon,

  It is estimated that almost forty percent (40%) of the physician's time and as much as fifty percent (50%) of the nurse's time is spent dealing with the patient record. In fact, some healthcare observers believe this demand for information may lower the quality of care by reducing the time available to physicians and staff to listen to patients and advise them (Skinner 1994).

- Maintaining a paper record requires a significant amount of labor to maintain a satisfactory service level. One of the main demands for labor in the Medical Records Department is used for meeting record requests. Fulfilling a record request involves:

  - Finding the location of the record whether it be in the file room, on microfilm, with another care giver, or in off-site storage.

  - Retrieving the record from that location.

  - Delivering the record to the requester.

  - Picking up the record when it is finished.
• Sectionalizing the record.
• Filing loose sheets of paper in the record.
• Refiling the record.

• A paper record or parts of it can be incomplete, misplaced, misfiled, illegible, or destroyed. One hospital official stated that at any moment 70% of paper medical records are incomplete. An official at another hospital stated that they can locate paper medical records only 70% of the time (GAO 1991). If the file is destroyed, there is no method available for replacing the data that was lost. The only way to safeguard against this type of situation would be to maintain a duplicate paper record.

• It is virtually impossible to transport paper records in a timely manner to offsite locations. As a result, these centers maintain duplicate copies of the paper record. This results in all of the information on a given patient not being contained in one record which causes problems in the clinical area. It also results in added medical records personnel as departments must be maintained at each of the offsite locations.

5.0 Framework Or Constructs In Industry

A 1989 National Academy of Sciences Institute of Medicine study found that patient medical record-keeping has changed little in the past two decades. However, one survey in Modern Healthcare reported that 70.1% of hospital executives felt an automated medical record system would improve operations and 50.4% said they will implement an automated medical record system by the end of 1996.

5.1 State of the Industry
Most hospitals already have the majority of their financial operations automated. Table 1. shows that over 90% of surveyed hospitals have automated financial operation. However, less than 65% of hospitals surveyed expect to have patient care automated by 1995. This automation in clinical areas is progressing slowly due to the large capital expenditures required to implement a full range of clinical information systems.
Table 1.
Projected percentage of hospitals with installed information systems
(Total number of hospitals: 5,919).

<table>
<thead>
<tr>
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</table>


5.2 Reasons for Lack of Automation within Healthcare Industry

Several industries, such as the airline and banking industries, have used automated records extensively in their normal course of business. There are several reasons that hospitals are behind these other industries as they have not fully automated records. These include:

- The necessary technology to automate seems too costly or is not presently available.

- The industry has not developed or agreed upon standards for automating patient records. These standards would allow inter-hospital sharing of patient records.

- Hospital personnel resist automated records. Personnel are familiar with paper records and may perceive automated records as difficult to use and foreign to their way of practicing medicine.

- Hospitals perceive automated records as being open to unauthorized use.

Prior to implementing any type of computerized record, most hospitals ask whether to implement a Computerized Patient Record (CPR) or an Electronic Medical Record (EMR). The main criterion for this decision is whether the hospital wants to use the
record as an interactive tool in an on-line real-time mode or as a storage method to eliminate paper, microfiche or another storage method.

Developing an automation strategy also requires an assessment of the overall institutional environment. Teaching hospitals, such as UMMC, generate much more information than community hospitals as they tend to more carefully document all aspects of patient care, use the data for research purposes and develop standardized methods. For these reasons, they may be more likely to implement an automated record as greater value is added (Bergman 1992).

6.0 Definitions

This quote from Peter Gladkin, President of Health Data Sciences, a member of Center for Healthcare Information Management (CHIM), states that changes in technology initiate changes in definitions, and that the future CPR will not look like the past medical record, or even the present.

With the development of an integrated delivery system, healthcare is moving into a regulated environment. This change resulted in a new definition for the enterprise and corresponding changes in the scope and the definition of the CPR (Hassig 1994).

In order to review the automated medical records industry, one must be familiar with industry definitions. Current literature, vendors, and industry experts use the terms computerized patient record (CPR) and electronic medical record (EMR) when describing the merger of automated technology and hospital medical records. EMR and CPR are often used synonymously when in fact these are different approaches to automating the medical record. However, we developed the following definitions as the accepted definitions as a consolidation of several industry definitions. For the rest of this review, EMR and CPR will be defined as follows. When we mention an automated record we are referring to both an EMR and a CPR.
6.1 Computerized Patient Record

There is a lack of consensus as to the formal definition of a computerized patient record (CPR). For the most part it is considered to be a database of patient information.

According to the Institute of Medicine, a CPR is

An electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts and reminders, clinical decision support systems, links to medical knowledge and other aids (Bergman 1991).

This does not require placing the record on the computer in its current paper form. A majority of the information that is found in a paper record, such as nurses notes, do not need to be retained once a patient stay is over.

Different hospitals have defined the impacts of a computerized patient record to be an increase in productivity and a decrease in administrative costs. It is clinically focused yet patient centered. The CPR should be a database for outcome measures, and it should ease labor requirements. A CPR accomplishes this as it performs basic worker functions such as tracking charts, abstracting data, and grouping DRGs.

The definition used throughout this paper includes all of the above views. Each of the above views define particular aspects of a CPR; however, in compiling them, one develops an encompassing definition of a CPR. A CPR is a longitudinal, computer record of patient information and clinical support tools that includes:

- Financial
- Staff and Resource Scheduling
- Patient Scheduling
- Admitting
- Bedside or Point of Care
- Laboratory
- Pharmacy
- Surgery
- Electronic Claims
- Nursing Notes
- Contract Management
- Materials Management
- Living Will
- Quality Assurance
- Order Entry and Results Reporting
- Clinical Decision Support
6.2 Electronic Medical Record

We have not found an exact definition of an electronic medical record (EMR). However, EMR usually indicates medical records that have been optically scanned to create an electronic image and can be viewed on a computer monitor in a variety of forms. We will equate EMR with the optical imaging of a medical record throughout this review.

Margie Hamilton, author of "Cutting Edge Technologies," provides a technical definition as follows.

Optical imaging is a composite of several advanced technologies including scanners, optical disk drives, high-performance microcomputers, high-resolution monitors, relational databases, and networking software (Majewski 2-3).

Partricia Merski, director of Medical Record Services at Saint Vincent Health Center in Erie, Pennsylvania describes an optical imaging system from the hospital's viewpoint:

A system which stores documents by scanning (optical imaging) and converting them into digital images. The images are then burned onto an optical disk by a small laser beam. Once an image is "burned", it is virtually impossible to alter. This is also known as Write-Once-Read-Many (WORM) Technology (Majewski 3).

These views explain our original definition of an EMR. In essence, an EMR takes a "snapshot" of the medical record and stores it on optical disks. A software package is necessary to allow the imaged data to be viewed.

7.0 Benefits of Automation

A computerized or electronic medical record system has many benefits to healthcare systems. For the most part, the benefits are associated with the Medical Records, Patient Care or with the hospital as a whole. These benefits include:
7.1 Medical Record Department Benefits

7.1.1 Improving Record Processing Functions
This includes reducing the filing and correspondence backlog, the manual processes required to locate record information, retrieve the information, and copy or deliver it. According to PHAMIS, a healthcare software supplier, it typically costs $3.00 to $5.00 to bring a patient chart from the medical records department to the caregiver. The cost saving for this alone should pay for implementing a CPR or EMR. An automated record also results in quicker response time as it is no longer necessary to physically retrieve and deliver files.

7.1.2 Reducing Physical Layout Problems
These benefits are a function of the floor space expense at each facility. Realization of off-site storage savings will depend on whether a facility is allowed by state code to allow replacement of the paper record and/or microfiche record with an optical disk.

7.1.3 Reducing Labor Expenses
The personnel associated with tasks to file, retrieve, transport, and copy paper and/or microfiche record documents will be reduced through the implementation of a computerized or electronic medical record.

7.1.4 Reducing the Occurrence of Incomplete and Inaccurate Information
A portion or an entire medical record in a CPR or EMR system cannot be misplaced or lost. Computerized systems can also have an embedded feature to check for data entry errors.

7.1.5 Improving the Efficiency of the Medical Records Department
The clinician data entry that is required by a CPR will allow the hospital to eliminate or reduce the number of medical records staff needed to process the record. Hospitals with an EMR system have not been able to eliminate any personnel as it still takes staff to scan, index and check the quality of the record. However, an EMR system does allow improved processes and reduced staffing at later stages in the medical records system. An example of this occurs in the correspondence department.
Creating a CPR allows a hospital to reduce the number of medical records staff as less processing and maintenance of the record is necessary.

7.2 Patient Care Benefits

7.2.1 Increasing Accessibility of Patient Records
Caregivers would be able to view information from home, ambulatory clinics, and any terminal in the network. Different caregivers would also be able to simultaneously view the same patient record. This allows them to give more efficient and effective patient care as they can reduce the lagtime between testing, diagnosis, treatment, and discharge. A physician from St. John's Hospital and Health Center in Santa Monica feels that he can make better judgments by looking at the reports himself rather than by getting the information by phone.

7.2.2 Improving the Efficiency of Patient Care
The amount of time that physicians, nurses, and healthcare workers spend on record keeping would be reduced if an automated record is implemented, and they can devote more time to patient care. For the most part, it takes less time for clinical providers to input patient data on the computer than on the paper forms. Therefore, the overall efficiency of patient care would be increased. Also, the records would be available quickly for emergency situations. Duplicative testing would also be avoided through the use of an order entry and results reporting system which would reduce the costs and risks of testing. Once an order has been performed, the results will immediately be recorded on the computer. This will result in a test not being duplicated as it is clear that it has already been performed.

7.2.3 Allowing Immediate Access
Medical clinicians would have easy and quick access to a variety of information such as lab results, medication orders, nurses notes, etc. In a CPR, this information will be available as soon as it is known at the point of care. However, this is not necessarily a benefit of an EMR as medical records departments often take fifteen days before the information is available for viewing.
7.3 Hospital Benefits

7.3.1 Improving Cash Flow
A computerized or electronic medical record should reduce the Discharge-Not-Final-Billed (DNFB) days associated with claims for Medicare and Medicaid. For example, Murray-Calloway County Hospital went on-line with their billing processes, they reduced their DNFB and saw a reduction in accounts receivable from nine million dollars to five million dollars. This was due not only to the automation of the billing process, but it was also due to the automation of the record. It made patient files easier to code and abstract, thus speeding up the billing process.

7.3.2 Improving Record Security
Electronic and computerized medical records are more secure than paper files because it is possible to build-in protection to monitor who is accessing and reviewing specific portions of records. Paper records are at the mercy of fire, flood, and theft whereas EMR and CPR, due to the small size of their storage medium, can be easily stored in a hazard-proof, locked area.

7.3.3 Improving Customer Satisfaction
The patients at William Beaumont Hospital in Troy, Michigan were impressed at how quickly physicians can access information. This shows an improvement in customer satisfaction.

7.3.4 Studying Quality
A computerized or electronic based system would make it easier to study the quality of care among large groups of patients. Also these systems would be able to provide better quality information as patients move through a network or when they relocate to another health institution.

7.3.5 Potential to Lower Malpractice Insurance Needs
Automated medical records have the potential to lower malpractice insurance because automated patient records more precisely document patient care. This provides physicians with proof of appropriate treatment.
7.3.6 Improving Medical Research Capabilities
Medical research will be easier and faster with an automated patient record. Researchers will be able to easily search fields, such as diagnoses and causes of death, and use this information to generate better research.

A summary of these benefits and the systems to which they apply is shown in Table 2.

Table 2.
Benefits of EMR and CPR

<table>
<thead>
<tr>
<th>Benefit</th>
<th>EMR</th>
<th>CPR</th>
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<tbody>
<tr>
<td>Improving Record Processing Functions</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reducing Physical Layout Problems</td>
<td>(depends)</td>
<td>X</td>
</tr>
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<td>Reducing Labor Expenses</td>
<td>X</td>
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<td>Reducing the Occurrence of Incomplete and Inaccurate Information</td>
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<td>Improving the Efficiency of the Medical Records Department</td>
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<tr>
<td>Increasing Accessibility of Patient Records</td>
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<td>Improving the Efficiency of Patient Care</td>
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<tr>
<td>Allowing Immediate Access</td>
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<td>X</td>
</tr>
<tr>
<td>Improving Cash Flow</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Improving Record Security</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Improving Customer Satisfaction</td>
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<tr>
<td>Studying Quality</td>
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<tr>
<td>Potential to Lower Malpractice Insurance Needs</td>
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<td>X</td>
</tr>
<tr>
<td>Improving Medical Research Capabilities</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

8.0 Benefits of a CPR over an EMR

According to Peter Gladkin of CHIM:

The flow of information increased dramatically over the past several years. Unfortunately, the skyrocketing diversity of available information clashed with the development of the EMR. A CPR must provide patient-centered information management in real time, in a standards-based, fault-tolerant environment (Hassig 76).
According to the above quotation, an EMR does not have the capabilities that are needed to handle the increasing amount of information that is currently required. For example, an EMR does not include clinical decision support, order entry and results reporting or scheduling.

It is also important to take note of the fact that an EMR may result in non-value added information being captured as the medical record is scanned in its entirety. For example, some say that nurse's notes are not important after a patient's stay is over and therefore should not be captured in a permanent automated record. An EMR would include this information, however, a CPR can be set up so that it initially captures the nurses' notes. However, after the stay is over, they can then be deleted and not kept in permanent storage.

9.0 Barriers/Disadvantages

The main barriers and disadvantages in industry to computer-based patient records are shown in Figure 1. (This is based on responses from 571 healthcare information management professionals.)

Additional barriers and disadvantages may exist with a computerized or electronic medical record system. These barriers
and disadvantages fall into the three main categories of Medical Records, Patient Care, and the hospital as a whole like the benefits. It is important to note that the majority of the barriers are associated with the hospital as a whole or with patient care as opposed to with the Medical Records Department. These barriers include:

9.1 Medical Record Department Obstacles

9.1.1 No Standardized Guidelines
There are no standardized guidelines of what data should be included or the format that should be used for a patient record.

9.1.2 Vendor Difficulties
Hospitals must be cautious when selecting an appropriate vendor. Difficulties can include slow and unreliable hardware, incompatible software upgrades, functional limitations, obsolescence, high maintenance systems, and vendor instability. When selecting a vendor, it is important to realize that the company can be purchased by or merged with another company.

9.1.3 Lack of Vendor-Hospital Collaboration
Vendor technology development needs reassurance from the healthcare industry that demand exists for new products.

9.1.4 Non Value-Added Information
EMR duplicates the paper record and does not add benefits such as clinical decision support and automatic coding. Hospitals could avoid this by only placing information in the EMR that is needed and will be utilized.

9.2 Patient Care Obstacles

9.2.1 High Initial Learning Curve
The steep slope of the initial learning curve of using a computerized medical system prevents caregivers and personnel from embracing these systems. This is based on a fear of technology, a resistance to change, and computer illiteracy.
9.2.2 Re-Engineering of Workplace and Clinical Practices
It will be necessary to change the way clinicians process orders and test results and document patient care. This may involve steps to re-engineer the workplace.

9.3 Hospital Obstacles

9.3.1 High Initial Investment
There is a high cost when implementing a CPR or an EMR as it involves investment in significant amounts of hardware and software, training, and on-going operations. The costs may range from four million to forty million dollars.

9.3.2 Legal Uncertainties
Laws and regulations governing patient records must be given consideration. State regulations usually indicate how computerized records must be created and signed. They may not address how they must be stored and retrieved, or they require written records.

9.3.3 Hospital Politics
In some hospitals the information departments have little power and therefore integrated information technology is not a top priority. Many hospital departments, such as radiology, may have pre-existing computer information systems and may not be amenable to integrating to a hospital-wide computer system.

9.3.4 Security Difficulties
Central storage and easy accessibility of automated patient records can increase the potential for abuse of information unless they are locked with changing passwords or other access features.

9.3.5 Privacy Problems
The printouts produced from CPR and EMR can violate a patient's privacy as hospital personnel may leave the printouts lying near printers or on desks. One option may be to mandate shredding of printouts.

A summary of these barriers/disadvantages and the systems to which they apply is shown in the Table 3.
Table 3. Barriers/Disadvantages of EMR and CPR

<table>
<thead>
<tr>
<th>Barrier/Disadvantage</th>
<th>EMR</th>
<th>CPR</th>
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<td>Vendor Difficulties</td>
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<td>Lack of Vendor-Hospital Collaboration</td>
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<tr>
<td>Non Value-Added Information</td>
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<td>High Initial Learning Curve</td>
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<td>Reengineering of Workplace and Clinical Practices</td>
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<tr>
<td>High Initial Investment</td>
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<td>Legal Uncertainties</td>
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<td>Hospital Politics</td>
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<td>X</td>
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<tr>
<td>Privacy Problems</td>
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</table>

10.0 Options

Given the evolving healthcare environment of long-term cost containment, quality improvement, and integration of independent providers into healthcare networks, it is inevitable that leading healthcare providers will install a CPR. Those organizations that cannot afford to do so will be left behind by those who can. The decision presented to a healthcare provider is whether to implement an EMR, a CPR, or some combination.

Many hospitals have chosen an automated record that is a combination of both an electronic and a computerized medical record. For example, Beth Israel Medical Center, a teaching hospital in Manhattan, uses an automated chart that is a combination of computer data and scanned data. They feel that a fully computerized record will make the image technology obsolete, but that this will not be ready for another twenty years (Gardner 34).

Options also exist in other aspects of an automated medical record as follows:
10.1 Options Regarding Record Processing

10.1.1 Where should the record be stored?

Within the systems for storing data, one of the modes is optical disks. Hospitals, such as St. Vincent Health Center in Erie, Pennsylvania, store both computerized and scanned data on optical disk. It is merged just before storage. This again is an example of a hospital that chose to do a combination of a CPR and an EMR.

10.1.2 How should the data be stored?

There are two main options for storing data: a data repository or a data dictionary that uses a computerized master patient index to retrieve information from various systems. In the first scenario, all of the data is kept in one location in a repository. While in the second scenario, each application or system such as radiology or surgery maintains their own systems. When a particular patient's record is requested, the information is retrieved from the different systems on which the patient has information stored.

10.1.3 How is the data entered?

10.1.3.1 CPR

Columbia HealthCare and other hospitals utilize units which the nurses carry with them to enter and access information. Applications available on these hand units include ordering tests, checking a patient's medical history and reading lab results. When the hand held units are full they are downloaded to the main computer. These units are about the size of a television remote control and are therefore easy to use and carry. They cost approximately $500 and are powered by AA batteries. Due to the small size of the units, the nurses can hold the unit in one hand and take vitals with the other.

Another option is bedside terminals. However, many feel that this would disturb the patient through the light from the screen or by the nurses using the terminals. An similar option is to have the computer terminals in the hallways
outside of the patient rooms. The final option is to have computers at a central location on the unit such as the nurse's desk or the doctor's office.

10.1.3.2 EMR

If the hospital chooses to use an EMR, an option exists as to whether to scan in a centralized or a decentralized location. Basically, scanners can be located in each unit for example or just in the Medical Records department.

If the scanners are located on the unit, the record will be scanned in to an electronic format much sooner; however, the medical record staff will still have to process it centrally before it is available to be viewed. If the record is scanned centrally, less equipment will need to be bought, thus resulting in potential cost savings. Unless all of the equipment and staff that are needed to develop an EMR are moved to the unit, an EMR will take the same amount of time to create with centralized or decentralized scanning.

10.1.4 How will the automated record be viewed?

The options that exist are basically the same as those for a CPR data entry as discussed in 10.1.3.1. Terminals can be available in a variety of locations. These include bedside terminals, terminals in the hallway outside of the patient room or terminals at a central location such as the nurse's desk or the doctor's office on the unit. Also, for a CPR, data may be viewed on the handheld units.

10.1.5 Should the paper records be retained?

This question applies to an EMR as a paper record is never created with a CPR. Many hospitals archive paper patient records after a certain period of time. Hospitals may place these archived records on microfiche, and store the records off-site. A CPR or EMR system could replace the microfiche system. The question posed to hospitals that use an EMR is the length of time to retain the paper records. At Frye Regional Medical Center in Hickory, North Carolina, the paper records, which are still generated in each department, are kept in boxes as insurance for only one year (Palmisano 96). Hospitals must
also meet state requirements concerning retention of paper records.

10.2 Options regarding Choosing a Vendor

The Methodist Hospital of Indiana decided to install the Information Exchange Platform, a project that connects and integrates its current computer systems as opposed to "pillaging and burning" its installed base of computerization.

However, Sharp Healthcare chose an opposite approach than Methodist Hospital's approach. They chose one vendor to supply all of the components of an integrated information system. "We are not into the plug-and-play concept of buying components separately," said Mr. Kopetsky of Methodist Hospital. The information system staff of 100 full time employees would double if Sharp had to keep resident experts for each system. With a common system, it is possible to have a very lean staff. The value of this is that they can begin to model the patient care process as it occurs, and that is essential to handling managed care.

10.3 Technological Options

10.3.1 Voice Recognition

True voice recognition occurs when the computer can translate spoken words into digitized text without the intervention of a human transcriptionist. Voice recognition trains the computer to match words to certain patterns of sounds. The computer displays a word on the screen, the user reads it aloud and the computer digitizes the user's voice and stores it. When the user speaks the word again, the computer finds the voice pattern associated with it and records the word as text. By reading a series of words that the computer recognizes, the user can generate a complete report that the computer can print out or store. Most observers think that voice recognition technology will have to accommodate normal speech patterns and larger vocabularies before it can be used by all hospital departments.
10.3.2 Fault Tolerance

Fault tolerant computers never fail. They are always "up." They contain two processors operating simultaneously so one can cover while the other is being repaired. However, it is recommended that hospitals ask vendors to guarantee availability for all components of their system rather focusing on fault tolerance as such.

Industry watchers are advising hospitals to focus on flexibility when they buy their basic systems in order to take maximum advantage of new products when they become available.

10.3.3 Reduced Instruction Set Computing (RISC) chip

This is a type of microprocessor and a method of programming that makes for faster, more powerful, cheaper computers. For the same price, it is possible to have four to ten times the processing power of the traditional computers. This will mean major changes in the way industry develops its product. Hardware has gotten ahead of software. One difficulty with software is that it has to be designed specifically to take advantage of RISC architecture. Processing power is a small part of the cost of a hospital information system, usually ten to twenty-five percent depending on the configuration. The savings from these processes will not necessarily translate to dramatic savings on the total cost of the system.

10.3.4 Workstations vs. Dumb Terminals

The workstations are geniuses. They have as much processing power as mainframe computers did ten years ago, and they give their users control over what information they see and how they see it. Unlike solitary personal computers, sociable workstations can be linked to form powerful networks that share information among many computers. They are the backbone of distributed processing. Henry Ford Health System's Al Sinisi said "If you gave me all of the money I wanted, basic dumb terminals would not exist." The "garden-variety" workstations cost ten to twenty thousand dollars although complicated ones can cost as much as fifty thousand dollars.
10.3.5 Radio Frequency

Technology now exists to allow transmissions to take place within a large facility. Previously, dead spots which hindered reliable transmission of data existed throughout the medical centers (Gardner 29-48).

10.4 Options regarding System Contents

An automated medical record normally contains the information that is in a medical record. However, some hospitals, such as Group Health Cooperative, disagree with the practice of duplicating the medical record electronically. Group Health Cooperative feels that the automated record should contain the information that the staff really needs and serve the purpose that it is meant to serve as opposed to just eliminating paper.

In addition, the automated record often holds other information, such as drug interactions, the terms of a patient's living will, cost information (so that the physician knows the cost of what he is ordering), social services, food services, and housekeeping.

An automated system may also include clinical decision support tools such as Medline Abstracts or the Health Evaluation through Logical Processing (HELP) system that is used by Intermountain Healthcare in Salt Lake City. This system not only fulfills all of the duties of an automated record, but it also alerts the staff when care decisions or patient conditions fall outside of predetermined bounds. This system alerts physicians and nurses to the most critical problems and suggestions. This results in a reduction in post-surgical infection rates, medication errors, adverse drug reactions and lengths of stay (Lumsdon 1992).

11.0 Comparison With Planned Activities At UMMC

The Clinical Informations Systems division at the University of Michigan Medical Center is currently implementing the TDS 7000 Series for its Patient Care Information System. The system provides an on-line computer-based patient record which is called the Permanent Patient Record (PPR). Instead of receiving information only through the Health Information Services, all clinical and demographic data and administrative information can be accessed 24 hours a day through this system.
Some of the components of the paper record will be included in PCIS. However, a gap of information still exists as to what will not be included as shown below.

![Diagram showing EMR/Paper, PCIS, and Physician/Nurses Notes]

Figure 2. EMR/PCIS Relationship

With the PPR, clinicians view and compare clinical data from a patient's past and current episodes of care at the time that clinical decisions are being made. Patient information can be accessed at any point in the care-delivery process, from pre-admission to the post-discharge settings. This patient centered computer network includes:

- Order entry and results reporting
- Admission profiles
- Food and nutrition services
- Respiratory Care
- Narrative
- Careminder
- Nurse to nurse orders
- Consults
- Kardex
- Clinical graphics
- Social work
However, certain elements, such as physician process notes, are not included in this system. This results in the need for another medium to handle the missing information. Other divisions, such as Radiology, are not included in the PCIS system. They are setting up their own systems and will eventually need to be interfaced with PCIS. Currently the system does not have a clinical decision support system. However, it is felt that it will be possible in the future.

12.0 Conclusions

The use of an automated patient record will speed physicians' access to data, thus providing more accurate and complete records, and allowing them to make decisions quicker.

In order to automate the data that is not currently included in PCIS, the UMMC needs to decide which mode of storage to use.

The main decision is whether to place the data on the computer using a PCIS system or to revert to scanned images. It is important to note that the imaging technology of an EMR may be outdated in the future. Therefore, UMMC needs to decide if it wants to implement an EMR as a bridge to a complete CPR, or if it wants to go straight to a CPR as depicted in the figure shown below:

![Figure 3. Automated Record Evolution Process](image)

Given the time to select, implement, and train users in an EMR, we recommend that the sections of the record that are not currently planned for PCIS not be put in an Electronic Medical Record in the form of a scanned image. The information should be left in paper
form until the PCIS capabilities increase to be able to handle it. The main reason for this recommendation is that we feel that EMR technology will be outdated in the future. Also, we feel that the EMR does not add as much value to the information system as would a CPR.

It is also important to realize that a computerized record may be more flexible in the future as the government is becoming involved. The government is tending to lean more toward a CPR and may be developing standards in the future.

The main question that the hospital needs to ask, is whether or not they are willing to invest both time and money in a system, that may be not only outdated in the future, but may also not meet future government standards of an ideal CPR.
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Baystate Health System, Inc.

Bergman, Rhonda. "Where there's a will......," Hospital and Health Networks. May 5, 1994, pp. 36-42. (JU03)

This hospital is implementing a CPR. More than 65% of physicians use the CPR. One reason for this high utilization rate is that a physician assisted the Information Services department directly in the CPR development. He also worked directly with physicians by attempting to evaluate what they are doing in their practice.

As of May 1994, the CPR has been installed at two of the three hospitals in the system, and it is now being moved to outlying physician offices. The CPR is about forty percent complete and is expected to be finished in the next three or four years.

The CPR holds demographic information on a single database for both hospitals. In addition, major ancillary departments can feed orders and results into it. The CPR still needs a larger text volume, imaging capabilities and ambulatory care applications. At this point, the system has invested over fifteen million dollars and expects to invest much more.
This article concerns the Division of General Medicine and Primary Medicine in the Department of Medicine where clinical AIDS specialists participate in the care of patients. In 2/91, 1/5 of this practice moved to a location outside the hospital, making it impossible to transport the hospital's paper medical record. The department then went in search of an online medical record (OMR) system.

In 1989 they introduced a prototype of the OMR system that gave associates who practiced at the satellite clinic the ability to keep a problem list and a medication list on the computer. In 7/90, the OMR system included the ability to document health promotion and disease prevention on screening sheets, to generate problem-oriented notes, and to keep flowsheets. Today the system is one of the most widely used in the U.S. It is available from more the 2,000 terminals in both impatient and outpatient settings. Physicians use it to look up the results of all diagnostic studies, to send and receive e-mail and to perform a variety of decision support tasks, including online literature searches via PaperChase, clinical data retrieval, computer-assisted expert consolation, and online clinical calculation.

How the System Works

The system consists of a network of mini-computers, some based on RISC architecture, connects via an Ethernet backbone to terminal servers, that connect to terminal on patient floors and in examination rooms. The system connect to automated laboratory systems through standard interfaces. The hospital is currently migrating to an open architecture based on RISC technology, employing MEDITECH's MAGIC - a structured programming language.
This new platform is based on a client-server architecture, built on an Ethernet backbone using TCP/IP communication protocols.

The system stores all patient data for a minimum of 400 days after the patient's 1st contact with the hospital. In addition to a centralized patient database, which stores registration information on more than one million patients in perpetuity, a B-tree file structure sorts 200Gb of patient data over the distributed network. Fewer than 8 hours of unscheduled down time per year since 1978 have been recorded.

Clinicians view their appointments for the day. Clinicians can select a specific patient and display a summary of the patient's diagnosis, medications, and recent appointments. Entries on the problem list are typed in full by the clinician. Problems can be entered as active or inactive, and additional comment of any length can be included. To protect patient confidentiality, a clinician can restrict access to a specific group of providers.

The system provides easy access to prescribing information. Patient education monographs can also be printed along with printed prescriptions. Both databases were purchased by the hospital (at an annual cost of $14,000) for other functions in the computing system.

Usage

Of the 278 charts with an electronic record, 83% (231) had electronic problem lists. Of the 446 charts without an electronic record, 65% (291) had a problem list. Clinicians recorded 3.4 problems per patient on the electronic record, compared with 3.9 problems per patient on the paper record. Clinicians frequently wrote comments both in the computer and on the paper. In the computer, clinicians wrote more than twice as much - 10.9 words per problem - in contrast to 4.3 words per problem in the paper record. The analysis revealed that younger clinicians tended to write more problem.
Design Issues
The OMR was designed around three principles:
• The clinician should interact frequently with the system
• There should be no transcription from paper forms
• Data entry should be kept to a minimum and shared

The hospital tried to make it easy to use by adapting to the physician's vocabulary rather than using controlled vocabularies in other ambulatory medical record systems. The hospital observed than the clinicians who appear to be most reluctant to enter data became enthusiastic about EMR after about 6 months. Almost all clinicians at the hospital use the computer to look up test results and send an receive e-mail daily.

Registration information, test results, previous discharge summaries, and scheduling information are available for the OMR.

Barriers to Paperless Records
In 1991, nearly 2 years after the OMR system was introduced, conversion of the paperless record was only 1/2 complete. But by 1/94, 93% of all patient visits had progress notes online, and 98% had medication and problem lists.

The OMR is widely used by clinicians, who have found that computer-based records increase access and readability, and yield time savings after about six months of use. The system, with modest user support and limited dictation availabilities, took about two years to achieve full acceptance from a busy hospital-based general medical practice.


Beth Israel is a teaching hospital in the heart of Manhattan that has 200 beds. In April of 1991, they started transferring medical
records to optical disks. During the original test they will continue to keep paper records; but when the system is working, the paper version will go directly into the shredder. Eventually the system will help the hospital eliminate storage costs for four million pieces of paper per year, microfilming costs of $200,000 per year and labor costs for pulling and refiling 700 charts every day. This system is expected to pay for itself within three years.

They have been testing a system that was developed by International Business Machines Corporation (IBM), the biggest vendor of computer hardware in healthcare and almost all other industries. Their charts are a combination of images and computer data. The charts are scanned onto a disc after a patient is discharged. The medical records staff has been using the system for chart completion and coding. Eventually the paper record will not be created at all. A fully digital record will make the image technology obsolete, however, they do not feel that this will be ready for another twenty years.

Originally, only the medical records department is using the system. They still need to add many features. The basic IBM system called Medical Records Plus / 400 costs $300,000 to $400,000. It includes an AS/400 minicomputer, medical record software, a network, five workstations, a twelve inch optical disk drive, two scanners and a printer. A jukebox that can store and retrieve another 64 optical disks costs an additional $175,000 to $230,000.
Brigham and Women’s Hospital


This hospital is a teaching arm of Harvard Medical School. The hospital has successfully migrated to a LAN-based, distributed, client/server, desktop environment at the same time as dramatically increasing the availability of on-line patient information and the number of supporting applications. At the hospital’s main campus, over 3300 Intel client and 120 servers are connected via 70 4-MB Novell New Ware 3.0 token rings and two 16-Mb backbones. This infrastructure supports more than 65 applications software systems, such as Pathology laboratories, Patient Accounting, Results Retrieval, and Physician Order entry. Applications are written in resource-conserving MUMPS (Massachusetts General Hospital Utility Multi-Programming System), a client/server applications development and run-time environment.

Because it provides healthier service to clinics remote from the main campus, the Brigham has a jump on most institutions trying to develop the next generation CPR required to support a distributed healthcare delivery system.

John Glaser says that there are three basic purposes of the CPR: “[The CPR] makes data available, so that no matter where or when the data was produced, you can get at it. It helps streamline the processes that surround the provision of care. And it makes ordering care more efficient. For example, [the CPR] allows us to put logic on top of the content to guide the care-giving process.”

An example of the care-giving process can be found in the hospital’s fledging expert systems that support care givers’ planning and ordering process through protocol-based analytics: Perhaps a CPR contains recent lab data on a patient’s potassium levels and a care giver enters an order for a drug that has contraindication and ask for confirmation of
the order. If the level was normal, the order would be processes without query. Messages presented at the time of entry can also be delivered by E-mail or over the hospital’s paging system. This degree of support is not a fundamental of the CPR, but the CPR is a fundamental prerequisite to systems like this that rely on patient data to improve treatment planning, patient outcome, and quality of care.

CPR Data

For the most part, data in the CPR today at the Brigham is entered through a keyboard, although some diagnostic and laboratory devices output data via interfaces directly to workstation for ultimate inclusion in the patient record. This machine to machine interface is considered a tactic critical to reducing CPR misinformation, the vast bulk of which is induced by human error. Such linkages are not yet effectively standardized and thus require significant development effort to establish.

The radiology department at he Brigham uses these interfaces and offers a good example of how departmental data is generated, stored, and then accessed enterprise-width. The primary computer for radiological support service is a DEC VAX, but hundred of PCs and UNIX workstations provide client, server, and computational support. Links to the hospital information system transfer not only patient scheduling and billing data, but through a new system emerging from development, image data from CAT and MRI scans, as well as nuclear-medicine imagery.

A typical CAT scan results in 60 images, each 512 by 512 pixels requiring 2 bytes of storage - that’s 32 MB of data. The result is a hospital accumulation of about 3 GB of image data per day. At Brigham, primary care physicians plan treatment on Sun Microsystems’ workstation with 19-inch 1280 by 1024-pixel displays. A doctor specifies the patient images desired, and in about 5-20 seconds, images appear on the screen.
Right now there are 10 GB of storage for the Suns: three day's worth of images. While the system has been well received by clinician, storage limitations must be overcome. Plans call for an increase in storage capacity to 30 or 60 GB (two month's worth of imaging data) and an increase in the number of supporting workstations from three in the radiology department to 10 or 15 stations distributed throughout the hospital.

Remote access to the images, scheduled for more full-scale implementation in the future, has been tested in limited fashion. The Brigham is part of the LMAnet (Longwood Medical Association network), a fiber optic link connecting many healthcare institutions in the Boston area, including the radiation therapy planning lab and the Dana Farber Cancer Institute.

**CPR Challenges**

- Macintosh to Windows problems
- Establishing and evolving networks to interconnect institutions
- Buying and managing the storage systems required to keep thousand of patients' clinical information on-line for tens of years

**Trouble Ahead**

The infrastructure to support secure storage, distribution, and management of that information doesn't exist. "I think we're headed for a train wreck," observes Glaser. "The technology and the transformation of the delivery system are moving faster than the legal apparatus is moving."


809 Beds. They developed their own system which consists of an Electronic Medical Record in four clinics. The goal is to make the record the primary source of information in the clinics. They saved
money by substantially reducing the need to routinely pull files for the clinics.

The system tracks ongoing medical problems, past treatments and medications. They started the implementation in 1990 and have proceeded one clinic at a time. Physicians are using the computers in their offices, examining rooms, hospitals and homes. Some are even accessing the system while traveling by using notebook personal computers. The biggest advantages is that it is always wherever you are, and it is always organized in the same way. The physicians and the nurses anywhere in the hospital can access the data but only those working in the clinics can enter the data. Passwords are assigned to the system users and are changed every six months.

Included in the record is the "patient at a glance" section. This includes problems, medications, allergies and visit records. The system also includes electronic mail, a daily patient schedule and an electronic library of reference books. They physicians' initial concerns centered on depersonalizing patient care, and the fact that they had never used computers before. The responses from the patients have been very favorable though. The patients have been very impressed at the speed in which physicians can access data.

Brigham and Women's plans to expand to more of its thirty-five clinics. The system is adaptable to most of them.
Columbia Healthcare Corporation


This healthcare corporation includes 94 hospitals. The medical record is all computerized with the exception of physician's and nurse's notes. They are currently developing outpatient software. The physicians and nurses will soon be able to order tests, check a patient's medical history and read lab results on hand held computers that are about the size of a television remote control.

They invested thirteen million in a data center in Fort Worth, TX, in January of 1992. One by one, all of Columbia's 94 hospitals are being tied into the system of financial and clinical information. Columbia is now equipping all of its hospitals with a patient information system that has optical scanner capabilities and can be accessed by physicians at the hospitals or at their offices. Thirty-three hospitals were on line as of January, 1994 and the number was expected to double by the end of 1994.

The system contains a wide variety of information such as emergency department visits, hospital stays, drug interactions, the terms of a patient's living will and most recently the results of a blood glucose test. The system also contains cost information so that the physician knows how much what he is ordering costs.

The eleven ounce hand held units run on AA batteries and cost about five hundred dollars each. They each hold information on fifteen patients. Due to their small size, the nurses can hold the unit in one hand and take vitals with the other. When the unit is full, they download it onto the mainframe.
Columbia Presbyterian Medical Center

"Automating health care," The Economist. March 19, 1994, pp. 5-7. (DE22)

Paul Clayton is introducing an information system at this hospital. He believes that within a decade all the data generated about the 50,000 in-patients admitted each year to his hospital and its 800,000 out-patients visits will be storable on magnetic disks for $63,000 or an optical disks for as little as 445,500. Already it is cheaper to store information on optical disks than on paper.

Bergman, Rhonda. "Where there's a will...." Hospital and Health Networks. May 5, 1994, pp. 36-42. (JU03)


1425 Beds. They have been working on their own CPR, an integrated academic information management system since 1983. The goal is to provide one-stop information shopping through the extended campus of the medical center. Since June 1987, CPMC has invested the equivalent of $23 million to install a digital communications network that encompasses eighteen buildings at seven geographic locations.

The system includes

- Clinical Results Review System including laboratory data, radiology, pathology, cardiology and other text reports.

- Five Years of Medline Abstracts

- Surgical Scheduling System--This is used by the admitting department and is used by numerous other clinical departments,
clinics and doctor's private offices to review Operating Room Schedules.

- Patient abstracting and DRG coding system.
- Chart tracking system

If they were to freeze the system in its current state, amortize the development and network installation costs, and add projected maintenance costs for the clinical and library applications, their integrated information system would cost $2.8 million on an annual basis. This cost is .3 percent of the center's annual budget. These expenditures could be justified by very small improvements in time savings for personnel and/or decreased length of hospital stay and/or more efficient use of resources. In addition to the direct benefits, a major benefit is the ease with which additional computer-based applications can be incrementally added at an extremely modest cost. They have a use rate of eighty percent of their physicians.

The second article explains in more detail about the system and its associated costs.

Different applications that are included in this all encompassing system are as follows:

- A basic science researcher should be able to use the same workstation to manipulate molecular models and to request a new piece of equipment.

- A student should be able to use the same workstation to register for classes and perform literature searches or consult sections of electronic textbooks.
- A physician should be able to use the same workstation to view test results (including images) and look up a colleague's phone number or check information in the *Physician's Desk Reference*.

- Authorized administrators should be able to initiate new personnel appointments from the workstation they use to look at expenditures, budgets and resource utilization.

- Clinical researchers should be able to extract and analyze outcomes for populations of patients at the workstation that they are using for word processing or electronic mail.

The architecture of the system strongly influences how easy it is to use each of these applications, the degree to which they are integrated and their functional breadth, as well as the costs of the system and the time it takes to install and maintain it.

The continuation of this paper explains in more detail the system architecture that is used at Columbia and the advantages/disadvantages associated with it.
Frye Regional Medical Center


355 beds. 76% occupancy rate and average stay of 5.2 days. 300 outpatients per day.

This hospital began computerization with a centralized system that automated financials. In September 1991, they decided to go a distributed system based on a multiple client/server environment. In October 1991, a fiber optic backbone was installed, linking 120 workstations throughout the hospital.

When the hospital started computerization, it started with Medical Records. The first addition to the system was a 10-station, scanning, Novell-based, client/server system that hooked up to the fiber optic backbone. The purchase/lease arrangement for the initial installation was almost equal to its annual out sources microfilming costs. Two years after introducing the initial scanning operation, they are expecting to save $380,000 during the next three years.

The hospital then turned its focus to billing. The fed UB92, itemized statement, purged information, and daily report forms into the imaging system and stored them on optical disks. Documents that are generate electronically are automatically stored on optical disk, using the Courtland Group's computer output to laser disk, or COLD. Paper records still are generated in each department, but are now kept in boxes as insurance for only one year.

The hospital has 3 levels of security on the EMR.

The hospital is in the process of hooking physicians and all remote department into the network. All the physicians are offsite, though most are within close proximity to the hospital. Once they are all connected to the network, all the physicians will be able to
pre-admit patients from their office and have all of the hospital's reports automatically flow online to their offices.

A recently installed electronic signature module means that doctors can access patients' charts and add any necessary signatures. Ultimately, the hospital is planning to eliminate all storage, microfilm, and microfiche costs for the Medical Records Department. They will be able to eliminate paper storage costs and courier costs. Managers will also have personnel files online. The hospital also wants to put Radiology's x-rays online for archival purposes.
**Geisinger Healthcare System**


The goal of the system is to make Geisinger care no more than a thirty minute drive away from any patient. The system services a 22,000 square mile area. This is a lot of ground for its 46 primary care sites to cover. Putting patient information into physician's hands where and when they need it has been a priority since the mid 1980s. They now have all of the pieces in place and an Ameritech Keystone system will serve as the tie in as it debuts at two hospitals and five clinic sites.
Group Health Cooperative

Bergman, Rhonda. "Where there's a will......," Hospital and Health Networks. May 5, 1994, pp. 36-42. (JU03)

Group Health Cooperative has implemented a CPR connecting its two hospitals, five specialty clinics, and twenty nine primary care medical centers. The CPR cost 50 million dollars to implement. The focus of the project is to support care pathways, chronic care management and population and patient based medical care from ancillary departments and backbone systems such as accounting.

Originally, the main practice was to just get rid of the charts by duplicating them electronically. Instead, they are now focusing on the information that the staff really needs and the purpose that the information is really intended to serve as opposed to simply gathering all clinical data or eliminating paper.
Harvard Community Health Plan


Records for 330,000 patients are computerized which gives providers and clerks at thirteen sites access to them. Each doctor has a computer terminal at which he can access patient information. All of the data is inputted by medical personnel, clerks and transcriptionists. However, they are experimenting with a system that allows physicians to update patient information directly. This system manages referrals and includes an on-line order system.
Holzer Medical Center


249 beds.

The center implemented an optical disk-based document imaging system by LanVision (800-878-LAN2). The center installed ChartVision on a Novell-based network in 8/93. The center added 3 FTEs for the optical imaging system, and still uses the preexisting mechanical system and microfiche to keep the file predating the LanVision implementation.

Everyday the records staff scans 4,500 images with two RICOH scanners into two jukeboxes, each holding 50, 5 1/4-inch disks and using two drives. They scan charts onto magnetic disks that hold up to 75 days worth of information. As the charts are completed, files are moved to WORM optical disks. The center currently has more than a million images on file, but can store nearly 2.3 million with their current hardware.

The organization is developing a system that signals whenever patients are allergic to particular drugs and another that keeps track of recent reports on medical practice or changes in clinical guidelines.
Intermountain Healthcare


In the development stage is an enterprise wide longitudinal patient / enrollee record that IMS hospitals, clinics and managed health care organizations could access. The plant is to link an advanced clinical system that has been developed over the past twenty years. This system has a fully redundant voice and data network consisting of high speed 'T-1' lines and microwave communications. It carries images as well.

Intermountain is investing $50 million in hardware and software for overall Information System's needs. However, the Information Services division is already earning dividends. It saves over $1 million annually in long distance calls. The system that they are currently using also puts them in line for a CPR. This system, HELP, Health Evaluation through Logical Processing, brings all patient data to bedside terminals offering access to lab results, patient monitoring equipment and the notes of physicians and nurses. Also, it alerts staff when care decisions or patient conditions fall outside of predetermined bounds. It alerts physicians and nurses to the most critical problems and suggestions. It reduces post-surgical infection rates, medication errors, adverse drug reactions and lengths of stay.

They want to develop enhancements that the physicians have requested, such as intensive care physicians can dial into the system from their homes and gain access to a CPR. They used the system to develop customized medical staff round reports. Also, it is used for eliminating redundant testing by distributing critical data and results as patients move within the system.
Kaiser Permanente


Digitized patient records are shared through an information network among all of Kaiser's 400 doctors, employed in 17 health clinics. Eventually the electronic network will be linked to local chemists' shops, to labs, and to hospitals, all of which will feed data into the system.

HP, DEC, and AT&T are all working on similar networks.
La Grange Memorial Hospital


274 Beds. This hospital belongs to the Illinois Medical Information Network. The network expects a participation level of 150 physicians. According to the article, this will make the physicians more productive in their offices and improve the efficiencies of the hospital's departments. This will also decrease costs as they will no longer have to deliver the reports to the physicians.
LDS Hospital


520 Beds. LDS feels that integrating data from as many as twenty-five different sources may be necessary to appropriately care for a critically ill patient.

LDS Hospital utilizes a system known as Health Evaluation through Logical Processing (HELP). This system increases efficiency and effectiveness of patient care through clinical decision support. Medical decision making has traditionally been considered a scientific as well as an intuitive process.

In recent years, however, formal methods for decision making has been applied to medical problem solving and computer-assisted medical decision making has gained wider acceptance. eg. Computers can be used to interpret ventilatory status based on blood gas reports. eg. Computers can be used to alert when medicines are contradictory. For specific explanations of each system please see article.
Long Beach Memorial Medical Center

Hard, Rob, "Hospitals increase med staff use of IS," Hospitals, January 5, 1993, p. 43. (JE03)

They have installed eighty to ninety percent of their bedside computer system and half of the physicians are using it.
Lutheran General Health Care System


This article was written by the president and CEO of Lutheran General Health Care System. He professes that integrated information technology is not a high priority as the medical information systems staff are not computer literate which leads to very little power.
Methodist Hospital of Indiana


458 Beds. Rather than "pillage and burn" the installed base of computerization, Methodist decided in 1991 to launch what it calls the Information Exchange Platform, a project to connect and integrate what it has.

Four separate hospital systems will be on line:

1) Lab on a DEC VAX Mainframe
2) Radiology on a DEC VAX Mainframe
3) Admitting on an IBM Mainframe
4) Operating Room Schedule on a Novell LAN System
Murray-Calloway County Hospital


176 Beds. The systems available on computer include order entry on the nursing units with laboratory, cardiopulmonary, social services, radiology, food services, housekeeping, and physical therapy on-line. The same mainframe has registration, coding and billing information. They use the Lanier Voicewriter digital technology in Medical Records that can be used to transfer transcribed reports to optical disk with an add-on purchase.

Originally, the hospital was averaging thirty-nine days to process outpatient medical records. This contributed to an accounts receivable balance of nine million dollars. After participating in a benchmarking study that was conducted by Sun Health Alliance, the hospital decreased its accounts receivable balance to five million dollars by looking at other institutions successes and strategies.

In the benchmarking study, they focused on one process "how to shorten turnaround time from discharge date to billed date" with an emphasis on Medicare accounts which were identified as taking longer because of signed and dated attestation statements by physicians.

Having the information available electronically was essential for the coding activities that carried through the release of bills to third parties. It was agreed by all of the hospitals participating that the best results were obtained when all coding was done by medical record coding specialists.
Newcomb Medical Center

Bergman, Rhonda. "Where there's a will......," Hospital and Health Networks. May 5, 1994, pp. 36-42. (JU03)

264 beds. They plan to have a CPR that will interface with all clinical applications such as radiology, laboratories and pharmacy and present the information in formats of data, text, voices and images.
New York City Health and Hospital Corporation


This system hopes to track patients through New York City's public health network which handled 253,896 patient admissions and 3,454,084 outpatient visits in 1989 at eleven acute care hospitals, five neighborhood family health centers, and thirty-five satellite clinics.

If someone is treated at Metropolitan Hospital and suddenly shows up at Bellevue for an emergency, it would be nice if the resident could look up his past records. This would improve the quality of patient care and reduce paperwork for clinicians.
New York University Hospital


This is perhaps the most automated hospital in the region. Computer literacy for physicians has been required for years.
In 1993 the Institute published the results of a trial that produces savings of over $800 per hospital in-patient when doctors used computers to order tests or to receive reminders. The figures suggested that the hospital could save over $3 million a year.
Rose Medical Center


The vendor Shared Medical Systems (SMS) of Malvern, PA supplies their system. Dr. Abrams of the center says that it eliminates a lot of the time that is spent going to the hospital. He uses the system to check on patient's results so that he can take the next step. This is the most efficient way to take care of patients. It also improves patient flow through the hospital by reducing the lag times between testing, diagnosis, treatment and discharge.

Jack Ehrart of SMS says that an electronic retrieval system offers more security than do paper records because it requires users to sign on with a security code. The system also monitors who has looked at the different files.
Scott and White Memorial Hospital


Scott and White Memorial Hospital has 419 beds and a 300 physician member multi-specialty group practice that has 750,000 patient visits per year. They have contracted with Los Alamos National Lab for a prototype Electronic Medical Record system. This record will ideally impose no limitations on a physician's ability to put information in or get information out. However, the less structure that a computer record has, the more difficult it is to analyze. This is a problem as it defeats one of the main purposes of an EMR.

This is where the super computer is useful. It uses massive parallel processing which translates to 65,000 processors working at one time. These "Connection machines" are used to correlate large numbers of records and comparing dissimilar pieces of information. It can be programmed to "read" entire records and find many pieces of information simultaneously no matter where they are in the record. "Connection machines" are priced between $300,000 and $10 Million depending on their configuration. Scott and White will use the analytical abilities of the Los Alamos computer rather than buying one of its own.
St. John's Hospital and Health System-Santa Monica


551 Beds. The vendor, Meditech of Westwood, MA supplies their system. Their system allows physicians to retrieve lab results, historical patient data and radiology and microbiology reports. One of the doctors said that he can make better judgments by looking at the reports himself than by getting the information by phone.
St. Joseph's-Milwaukee


St. Joseph's will not reveal how much they spent on their bedside computer system but they say that the system will pay for itself within three years. In order to have more software modifications, they worked with Clinicom to develop their own software. The terminals are not literally at the bedside. The majority of them are mounted on the wall near the door so that sleeping patients will not be disturbed by the light from the screen and by nurses using the terminal.
St. Joseph’s Hospital and Medical Center-Paterson, NJ


Hospital administrators began putting in a new computerized hospital records network in the 792 bed hospital in April 1994. They decided early on not to require physicians to type their orders into computers. Basically, nurses and clerical workers have been saddled with the work. Because the administrators made the decision not to force doctors to use computers, the anxieties that some doctors might have in dealing with computers has been avoided as an issue. No one has asked or required them to learn even the elementary step of signing on, not to mention requiring them to type in their own orders for hospital procedures.

The $25 million network went on-line in a single weekend. One physician said, “To have ‘physician order entry,’ you have to have the physician staff capable of using the computer, and I’m not sure everyone is capable.”

St. Joseph’s is located in an area with many hospitals and that may give it less leverage in compelling doctors, who can take their business elsewhere, to use computers. The less a physician is tied to any one hospital, the less incentive to learn its computer system. The new network, essentially a nerve center for the hospital, now only allows coordination of medical supplies, lab results, admissions, transfers, and dozens of other basic functions. Add-on components scheduled for introduction in months after April of 1994 will create a whole new push into matter of medical judgment, a function called “decision support.”

Before the network cam on line, orders for things like blood test or radiology were handwritten and dispatched by messengers who roamed the hospital corridors; individual departments and labs had computers, but they were never coordinated. Under the new
regime, the connections (administrative staff to warehouse) are like nerve extending through every limb.

The computer will be able to assist doctors in diagnoses. It will schedule operating rooms by calculating how fast or slow a surgeon has performed a particular procedure in the past. It will allow administrators to know much more than they do now about who exactly does what.

One software program scheduled to come on-line in early 1995 will calculate how many days of hands-on nursing time should be required for a particular patient with a particular health problem.
St. Luke’s-Roosevelt Hospital Center


In Spring 1994 the hospital is installing a new internal records network similar to St. Joseph (see same article, St. Joseph Medical Center) but will leap directly to doctors’ typing their own orders in late 1995.
St. Mary's Hospital-Richmond, VA


This hospital successfully reduced paper consumption while significantly improving efficiency with document imaging technology. The hospital formed a task force to investigate the technology as a potential solution to paper-based frustrations. The task force listed the following as priority items for its system:

• affordability
• elimination of manual bill sorting
• easy retrieval of all item contained in patient account files
• easy access for a large number of concurrent users
• direct faxing of data on UB forms without printing the form

The hospital selected Optika Imaging Corp of Colorado Springs, Co. They use Optika's FilePower system, an integrated modular program with the capability to combine a variety of architecture to function as one system.

Optika's FilePower family of products consists of 25 software modules, each optimized to an imaging task and all operating on the latest version of Microsoft Windows. Document Access installed the FilePower system and records on a Novell network, including numerous 386 and 486 personal computers.

The system uses to Fujitsu scanners to input remittance information, indigent care documents, financial agreements, insurance information, and admittance documents. The FilePower system is connected to St. Mary's mainframe computer, from which automated logs, purge detail reports, itemized bills, and financial from sheets are downloaded and automatically indexed. Scanned and downloaded documents are archived on one Plasmon Jukebox,
with two 5 1/4-inch WORM drives and three external WORM drives. The average time for document retrieval from the jukebox is 4 seconds. Retrieval of documents from the magnetic disk cache is about one second.

At the time the system was brought online, Patient Accounting processed 110,000 accounts per year and employed 10 full-time clerks and 39 FTEs in other Patient Accounting activities. In less than one year, the file clerk staff was reduced by five with no additions to replace the reductions, even though the department now handles 117,000 accounts per year. The savings from the elimination of three file steps:

- Printing, sorting, and routing bills typically downloaded and transmitted to payors
- The transfer of the file sorting and filing from Billing to Archives
- Retrieving and Refiling old folders in the event of secondary billing or delinquent insurance payment.

Elimination of the printing, sorting, and routing of bills also allowed the hospital to reduce more than the projected one day revenue of receivables. Total receivables ready to bill and billed were reduced by more than 7 days.
Saint Vincent Health Center


This hospital, in 1988, was one of the first in the nation to use imaging technology for medical records. The hospital's data center was at a remote location so it needed to install a medium that could handle the wide bandwidth that imaging requires. Fiber was the medium it chose. It did not want to lay another cable in case of an accident or disaster (earthquake, construction accidents) affecting the ground where it laid. The tariff rates would have cost as much as $80,000 a year.

An inexpensive medium capacity microwave was selected to provide backup for the wideband capacity being used by the medical record imaging. the microwave link will provide an alternate transmission path that operated as a hot standby backup to the fiber. The entire microwave backup system cost $125,000 and the hospital retains ownership. It is also expandable. (A single repeater on a hill between the hospital and a distant site connects the two.)

Dobrynski, Kathryn, RN, BS, "Implementation of an Optical Imaging System."

St. Vincent's is a not-for-profit acute care hospital that is licensed for 584 beds. They annually see 20,000 inpatients and 200,000 outpatients. Anderson Consulting designed the system that is known as the Medical Record Imaging System (MRIS). This system has been in operation since June of 1989. They currently have over 12 million documents stored on the system. 60% are scanned documents while 40% are ASCII documents that have been downloaded from the clinical systems department.
The decision to convert

It was felt that the traditional methods to manage the medical record were becoming inadequate since the demand by all users across the United States for the medical record was growing, and St. Vincent was no exception.

Medical Records no longer sit on a shelf. They are now being requested by an increasing number of internal and external users.

System Overview

MRIS is an electronic imaging system that stores documents by two methods:

1) Scanning and converting them into digital images.

2) All of the medical information that is placed into the MIS during the patient's stay is retrieved and converted to ASCII files and then downloaded daily to MRIS. These documents do not need to be manually scanned at discharge. They electronically store patient medical records to be used by the Health Centers for areas such as coding and abstracting the bill and correspondence.

Capital Technology

The system uses an HP 9000 Series 835 Fileserver, an HP operating system and an Informix Relational Database. Sitting on top of all of this is Recognition Intent's Plexus Software product which allows them to deal with imaged data objects. Attached to the fileserver are two optical jukeboxes each holding 112 12" platters. Each 12" disk can hold approximately 60,000 images or one four drawer cabinet of 8.5" x 11" paper. They just purchased a HP 5.25" optical jukebox for future storage.
The HP operating system is known as the Advanced Image Management System (AIMS). It is located three blocks from the health center in the Information Services building. The HP fileserver and the Cygent jukebox connects with the equipment at the health center via an ethernet (fiberoptic) cable.

The fileserver retains all the scanned images for fifteen days on magnetic disk before the images are transferred to optical storage. The jukebox is a robotic device that contains four optical drives which are responsible for reading and writing optical platters. The jukebox houses the optical storage on 112 platters, which is equivalent to about four years of medical records. When information that is older than fifteen days is requested, the images are cached from the optical platter to the magnetic disk.

In the current configuration, every disk on the system has a mirror disk. Both magnetic disks are written to at the same time. During a backup, which is performed at off-peak hours, the mirror packs are taken off-line, and the information on them is written to tape. The mirror pack is then brought back on-line and any changes made on the primary disks are again mirrored.

These programs run in the Windows environment under DOS. Each workstation has an Ethernet card attaching the PC to the network and subsequently to the fileserver that is located four blocks away.

Labor

Most of the employees in the MR department are assigned to the various functions of MRIS: preppers, scanners and qa'ers. They have not been able to eliminate any of the projected people in the department by installing an imaging system. It takes about the same amount of people to create the EMR as it did to maintain the hard copy paper record. However, they are still using slow scanners that
scan at a rate of four pages / minute and have an OCR indexing rate of 60%. Therefore, a lot of time is dedicated to scanning and manually indexing forms that the CPR could not index. They plan on looking in to faster scanners and ensuring that more hospital forms have OCR numbers on them.

The biggest user of MRIS is the correspondence area of Medical Records. They have been able to increase their productivity due to the imaging system. They print 100% of all outside requests using MRIS, provided that the request is on the system.

The second biggest user of MRIS is the coding and abstracting area. All inpatient records that are scanned are automatically placed in the coding queue. This ensures that all charts are encoded in a timely manner.

There is a workstation and a printer in the Emergency Room. They do not use it too much as the printer is old and requires a lot of maintenance. They are looking into other printing solutions for the Emergency Room and other outpatient areas.

Currently, they are still pulling hard copy for Quality Assurance, Medisgroups, Utilization Review and most physicians, though occasionally medical records will print from MRIS for one of these areas. No one has forced these areas to use MRIS only. Therefore, until someone does, Medical Records will continue to pull.

Their software vendor, Plexus, filed Chapter Eleven, Bankruptcy. They have since reorganized everything satisfactorily, but for a time it was a fairly uncomfortable situation. Also the vendor who make their optical drives, Optimem, filed bankruptcy as well so they have made the move to HP's 5.25" optical drives and jukebox.

Form Requirements
- improve documentation for third-party payers
- provide a return on investment

**Nursing Administrators:**

- ensure consistent documentation
- improve the care planning process
- support nursing efforts to provide quality care
- enable the easy use of agency nurses
- improve recruitment
- reduce nursing job stress and turnover
- provide tools for quality assurance

**MIS Managers:**

- fit into the long term strategy for computerization
- provide a return on investment
- provide a reliable, supportable computer platform
- satisfy changing and expanding user needs
- extend functionality and system capacity at a reasonable cost
- fulfill ever-increasing need for information for hospital management

The current capabilities of the system are endless. The vital signs are automatically acquired from existing bedside devices and presented in graphic and flowsheet format. The system also performs calculations on items such as dose, rate, and concentration of medications and fluids.

The system also connects to bedside devices including monitors, ventilators, pumps, etc. It also has an interface with the laboratory computer system, so lab results are automatically stored in the database for use.
The System 2000 calculates fluid intake and output volumes on an appropriate form. Other necessary calculations are also performed.

Notes are directly linked to charted entries where they can be quickly reviewed in the context of the underlying form. Also the entire set of notes can be reviewed.

A Care Plan feature is provided with a library of standard care plans. Each diagnosis selected for a patient creates a list of interventions and expected outcomes.

An assessment facility allows the nurse to document patient assessment from admission through discharge.

Numeric data stored in the patient's database can be viewed in a variety of graphic formats. It is the hospital's choice of how to view the graphs. Data can also be condensed and also display it in full.

The future capabilities consist of a Task List that gives a timetable of all tasks to be accomplished during a shift. Entries will be made automatically in a Kardex system as a result of Physician Orders, Care Plans, and unit protocols.

The system will also provide a method for entering physician orders. It will be possible to configure standard order sets to meet the recurring needs of physicians in the ICUs.

When Physician Orders become available, entries for medications will be automatically generated and forwarded to the Medications Administration Record and to other forms.

The System 2000 maintains a complete audit trail of all data entered into a patient's chart. All entries are stored with
a user ID to assure accountability. The system rejects any attempted entries by a person without a valid password. This feature is being expanded so that complete or partial privileges can be assigned to user groups. A user ID and a personal password will also be used for entry into the system.

A decision support system compliments the System 2000 to gather the audit information required, to help learn about patient population, and determine patient reactions to methods or treatment. This feature can help answer questions about:

- the direction of future planning
- measuring progress toward goals
- the effects on patients of changes in care and treatment
- other data-dependent problems

The support system helps eliminate the retrieval of information from the non-automated medical record which is time consuming, expensive, and sometimes inaccurate. The Decision Support System uses the clinical data captured by the System 2000 as patient care and outcomes are documented in the automated medical record. It is an independent database designed to facilitate real-time or batch research queries without affecting the clinical information system at the patient bedside. Patient care quality analysis is greatly improved with less time spent on paperwork. Two benefits are 1) the time saved and 2) the increase in opportunity for more followup Quality Assurance and research studies to determine better methods of care.

The system can be integrated with interface software such as lab information, radiology, pharmacy, order, and the hospital's admission, deischarge, and transfer system.

Some of EMTEK clients include:
• St. Joseph's Hospital and Medical Center, Phoenix, Arizona
• University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania
• The New York Hospital, New York City, New York
• Johns Hopkins Hospital, Baltimore, Maryland
(see the vendor information for a complete list)

CASE STUDY:
"It is not an issue of whether it's cost-effective to go to an electronic system. It's a question of can we survive with a paper record. And the answer is clearly no."

Doctors want an information system to include improved software and interfacing, three dimensional imaging, and progress in the interpretation of data.
First Data Corporation

First Data Corp provides information systems both for outsourcing and in-house facilities to help manage day-to-day financial and patient care activities. Their systems enable their clients to participate in healthcare networks with a computer-based patient record, medical record imaging, and open architecture. Their clients include approximately 700 hospitals and medical facilities.

The Precision Alternative, one of their products, uses a central database which incorporates management tools to enable access, manipulation, and report data for quality measurement and decision making. The system operates on Digital and Hewlett-Packard platforms and is installed in more than 100 mid- to large-sized healthcare facilities.

First Inform is a system designed to assist medical groups with appointment scheduling, managed care and collection management activities.

Host Based Systems cost-effective information processing and statement production capabilities while combining real-time, interactive processing. An online financial system is included and clinical applications are available either turnkey or remote.

First Perspective is a medical record imaging and information system designed to automate the medical record department. The electronic medical record is integrated with other departments such as admitting, emergency and outpatient services. A single document can be viewed at multiple locations reducing the problem of lost or misplaced records. The user can view the entire patient chart or a user-defined subset. While viewing the charts, physicians can enter
text comments, complete deficiencies and activate an electronic signature. Reducing the turnaround time on request for information can expedite the billing process, reducing labor and storage costs. First Perspective can be linked with physician offices, outpatient facilities, other departments, and satellite patient care settings. This system is UNIX-based.

Features/Benefits of First Perspective:

- Multiple simultaneous access to records
- Faster access to chart information
- Integration with other applications in use at the hospital
- Optical disk imaging
- Standardized medical record processing
- Laser printing/fax capabilities
- Bar code recognition
- Operates with existing encoding and DRG and super software
- Multiple security levels and complete audit trail
- Interfaces to legacy systems
- Research or study
- Menu pull downs
- View across encounters
- Patient record maintenance

First Empower creates a central data repository to support a computer-based patient record. This database structure incorporates a client/server architecture. System features are a graphical user interface, multimedia capabilities to allow storage and retrieval of radiology, ultrasound, and arteriogram images, patient ID photographs and online voice annotation. Caregivers can access the system anywhere in a healthcare network to online, real-time patient records across episodes of care- eliminating the need for tracking down charts, and simultaneous access to multiple locations. This
system allows for immediate analysis and comparison of results. Extensive security is also a feature of this system to make information available only to authorized people. It supports patient-centered care with a single point of access to caregivers. Physicians can specify how they want their data presented to them. The system is also designed within industry standards to allow for options of portability and expandability.

Features/Benefits of First Empower:

- Integration of existing clinical information systems
- Graphical user interface
- Online access to quality and resource data
- Automated processing of quality studies
- Automated notification of quality and performance outliers
- Basis for JCAHO indicator monitoring
- Longitudinal storage of data
- Network-wide access to computer-based patient record
- Hospital-defined security levels
- UNIX-based client/server implementation
- Open systems architecture

The workstations include:

- Multimedia formats
- Graphical representation of patient's chart
- Patient encounter summary screen
- Orders screen
- Vitals/I&O screen
- Notes summary screen
- Lab results screen
- Radiology results screen
HBO & Company


This company has been helping hospitals with data management for twenty years. They do this by offering facilities management services and package software products.

HBO & Company’s product is a hospital-based system called HealthQuest and a STAR transaction system, a decision support system called TRENDSTAR, along with the clinician-focused Pathways products to help improve the delivery of health services. The company’s Pathways Managed Care solutions and QUANTUM Enterprise Information System provide the critical business functionality necessary to manage health networks. In addition to these products they also offer services which include planning, implementation and support, plus education and training. These products and services focus on three areas: building an information infrastructure, improving clinical practice and managing the enterprise, to provide elements for developing a lifelong patient record.

HealthQuest Patient Care 3.0 is a clinical information system designed to meet the needs of the clinician. Through the use of both physician and nurse screens displaying provider specific-census, users can quickly access patient data regardless of where they are in the healthcare organization. Patient-focused displays and standardized screen formats make the system easy to use and this system employs lightpen and/or mouse technology for easy, efficient data entry.

The HealthQuest Medical Records product line includes Medical Records Abstracting and Chart Management. These are integrated with the HealthQuest products family’s registration,
clinical and financial systems for rapid transfer of data and elimination of duplicate data entry.

The Patient Management part of HealthQuest provides a core repository of patient information, a permanent record that extends over the patient's entire stay. Its data collection and distribution capabilities ensure appropriate and accurate information is readily available for review and use by third-party payers, insurance companies, and other systems. It also functional in emergency departments and ambulatory and acute-care patients. The HealthQuest products currently run on IBM 370 hardware platforms and MVS/ESA and DOS/ESA operating systems.

The STAR products shares a single database and provides immediate access to authorized users from any workstation on the network. Also, reporting tools are provided by the report writer.

STAR Patient Care is where patient information is entered, maintained, tracked and disseminated throughout all departments. The application software supplied are:

- Patient Processing
- Patient & Resource Scheduling
- Nursing
- Order Management
- Scheduling
- Departmental Profiling
- Physician View

Along with the STAR products is a choice of hardware and operating system platforms including:

- Hewlett-Packard UNIX
- Data General UNIX and AOS/VS II
•Digital Equipment Corporation’s VMS
•IBM RISC System/6000 AIX

QUANTUM enterprise information system provides a means of up-to-date information for executives and administrative personnel. Directors of medical affairs can look to QUANTUM for comparative data to improve both clinical behavior and care delivery processes.
Health Care Expert Systems, Inc.

Video

This company's product is PACE (Patient Care Expert System). The main components of the system, which is entered through handheld penpads, are:

• Personalized patient information
• A knowledge base (This is updated every 90 days and includes both common and rare ailments.)

The system was developed at Carnegie-Mellon University and used at Creighton University. It is used at Greene County Medical Center and Iowa Methodist Medical Center. HCES bought the system and renamed it PACE.

PACE seems to be primarily targeted at nurses. Three main components of PACE are:

• Getting information
• Documenting a standard plan of care
• Providing patient documentation at the bedside

Benefits include:

• Improved efficiency
• Nurses can spend more time with patients
• Improved outcomes
• Shorter lengths of stay
• JCAHO Documentation

The video states that it only takes 1-2 hours of training to learn how to use PACE.

Brochure

PACE utilize the UNIX operating system. Features include multi-disciplinary plans of care, FLEXform Tool set, Order Management, and on-line chart access. Order-entry and the display
of results will be supported on a terminal, PC or portable RF-connected pen-based system.
Health Care Information Technology

OptiMaxx is a system of archiving data using optical disks. The user can search 8 fields. The cost of a 5 1/4” optical disk cartridge is $175.00. The user can retrieve the records in seconds. The system offers the option of centralized vs. decentralized scanning. A Novell network is need. Users can annotate free notes to archived documents. Users can fax and print on demand.

Optical Disk Storage in General

Optical storage is light and optics are methods by which information is recorded and stored. The types of optical disks are non-erasable (WORM) and erasable. According to MedPlus information, the approximate cost of a dual-sided optical disk in $150.00. The cost of equivalent storage is $465 for magnetic tape, $2000 for paper, and $3000 for microfiche. OCR identifies over 90% of words on scanned documents.
This company has been in healthcare for three decades. They feel that they can offer affordable upgrades to facilitate future growth. Hewlett Packard has been recognized around the world in computers and networking. They have a bedside ICU system on the market that costs $30,000 per bed. This includes hardware, software and interfaces to monitoring equipment and mounting devices. The equipment is HP workstations with high resolution color monitors.
Hospital Computer Systems, Inc.

Interactant is a series of on-line, real-time systems designed using a single integrated database. It has four levels of security and wireless hand held terminals. The software is written for the IBM AS/400 computer system. This vendor seems unique in that users pay a monthly fee to HCS for planning, system support, installation, training, conversion, etc. It never changes except for CPI increases. HCS services include:

- Full implementation/training and conversion
- System integration service to facilitate communication between multiple systems
- Full-time account management by programmer analysts
- Outsourcing services

Over 65 different uses are available. It appears to be very comprehensive. Some features include: patient registration in 3 minutes, physician notes, JCAHO Indicator Monitoring System, and order-entry in 3 or 4 keystrokes. It mentions radiology, but not in containing filming, but in order scheduling, etc.

The vendor has been in business 25 years and the material in the brochure seems very complete. The radiology area is lacking.
IBM's Thomas J. Watson Research Center

"Automating health care," The Economist. March 19, 1994, pp. 5-7. (DE22)

Tetzlaff is developing a system for parents who look after young children with leukemia. A computer set up at home answers such questions as how to give drugs, what to do if the child has a seizure, or simply what a seizure is. The answers are given in writing, orally, or on screen. There is interactive link with a doctor in a clinic, who is kept up to date whenever a parent logs on with trickier queries that the computer cannot answer.
LaPlante, Alice. "Imaging your Sea of Data," Forbes ASAP. October 1990, pp. 36-41. (DE18)

Imaging allows a business to take a digital snapshot of any document and sort it electronically. If the image is run through an optical character recognition program, all words and numbers can be translated into a text files. This text file can then be manipulated like any work processing document. Experts say that most OCR programs recognize 98% of the information on a scanned document.

This company’s imaging product has many applications, including healthcare. A user may search on indexes or keywords (i.e. not just patient i.d.) A user can organize data to:
• best perform any task
• look for strategic relationships in the information

The company brochure states that the product is good for a computer novice, needs Windows, and provides security.
This company has been in business for 25 years. The documentation is complete, but is centered on home health systems at this time. (This is the STAT 2 system.)
Innovative Health Systems, Inc.

This vendor's product, SoftMed, is a computer-based record management system for paper medical records. It contains the following modules:

- ChartScript - for medical transcription and document distribution
- ChartFact - for managing incomplete medical records
- ChartLocator - for record tracking
- ChartReserve - for managing record requests
- ChartStat - for clinical information management and as a TQM tool
- ChartRelease - for managing the release of information
- ChartID - the backup of master patient index
Integrated Medical Systems, Inc.


This vendor has set up twenty three information networks in 82 hospitals and planned to expand to fifty networks by the end of 1993. The prices vary by the number of physicians that are on staff and the number of beds. A 300 bed hospital with 250 physicians would be charged $190,000 per year. Integrated Medical Systems (IMS) charges health care entities that join the system based on their level of participation. Physicians are not charged.

The system can communicate clinical, financial and administrative information and send text and voice messages, clinical graphics and diagnostic images. The information is transmitted over telephone lines and can be received by modem twenty four hours a day. The system also speeds up Medicare payments because hospitals no longer have to wait for physicians to come to the to sign attestations. They can sign the forms on their office terminals by using the electronic signature feature.

IMS is designed so that every entity is on the same network and is sharing information freely. Their systems are 'store/forward' systems which means that the physicians cannot access the hospital directly but that they receive the information as it becomes available electronically.
InterPractice Systems


InterPractice Systems installed a mini computer in 1988 at a health center in Burlington, Massachusetts. The system stores all the information on the center’s 8,000 patients, from the minute they walked into the reception area. The center’s 15 doctors each need a powerful Apple computer. Computers have also been installed in the examining rooms.

MEDREC II, record management system that constantly monitors incomplete and delinquent records and improves the accuracy of chart locations. The IMS ONLINE information management system allows instant access to millions of documents and data on optical discs.
LaPlante, Alice. "Imaging your Sea of Data," *Forbes ASAP.* October 1990, pp. 36-41. (DE18)

The company has many products in its brochure, including Jukeboxes. They all seem very complicated and technical.
Microhealth Systems


Microhealth systems markets a medical-surgery bedside system known as Medtake. The cost per bed is $2,500. This includes hardware and software. The equipment includes a proprietary terminal with a simplified keyboard and a full-function computer at the nursing station. They have joint marketing agreements with IBM and American Express Health Systems. As of July 1990, they had installed 27 clients.
Document Handler Developer’s Kit provides software developers with tools to add document image management to Windows applications. It takes care of all aspects of scanning, printing, storage, and on-screen image manipulation of multiple page documents. Users can zoom, scale, rotate, and scroll page images using simple Windows menu commands. Multiple pages, and even multiple “views” of the same page, can be viewed simultaneously. Users can scan and verify single pages, or automatically scan groups of pages with an automatic document feeder. The system administrator interactively enters information to define the fields that the application will use for indexing and retrieving documents. Users can highlight in various colors and create annotations. Images can be stored on magnetic or optical (WORM) disk.

Document Handler uses the Windows Dynamic Data Exchange (DDE) protocol.

This vendor’s product is for use in many industries, but it seems that the amount of data in a patient records may be too great for this system. (It appears to be designed for invoices, etc.)
Panasonic Data Partner

Panasonic developed these hand-held collection computers that can be easily adapted to solve specific business problems. They are for use in all industries. In hospitals, they are used for doctors and nurses to track a patient's pulse, blood pressure, respiration, and other vital data. They let doctors quickly change important information about a patient's condition by uploading data from the Data Partner computer to the hospital's main computer. By downloading from the main computer, doctors can get patients' most recent medical records before they prescribe any new treatments or medications. They are also used on medical supply inventory tracking.

No prices are listed on the various models, but features and specifications are.
LaPlante, Alice. "Imaging your Sea of Data," Forbes ASAP. October 1990, pp. 36-41. (DE18)

This product does not require Windows. It can be used on a computer with MS-DOS with 640 K. It can search through up to 6 fields. Reports, handwriting, and photos can be scanned. Information can be stored on fixed or removable disks, or WORM optical drives. Users can use low cost scanners. The brochure includes a list of supported hardware/software. A demonstration disk is available.

It appears to not have the capabilities to hand large amounts of information, such as those required for a patient record.
LaPlante, Alice. "Imaging your Sea of Data," *Forbes ASAP.* October 1990, pp. 36-41. (DE18)

System requirements for this product: Computer system, Novell network, scanner or input device. Windows seems necessary.
This vendor's product is S-O-A-P. It is for a physician's office record-keeping; not a hospital. It is a database that includes demographic; acute illness; chronic problem list; drug list; characteristics affecting drugs; major procedures; hospitalizations; and surgeries; health maintenance, lab, and immunizations. The vendor has provided a demonstration disk. The price of the system is determined based on the number of patients.
The Phamis - Lastword healthcare information system is a collection of patient-centered software applications that support decision making by coordinating real-time clinical, financial, and administrative information to all points-of-care; hospitals, clinics, and patient’s. All care provider, management, and clerical interactions with the system work in a relational way to create a long-term comprehensive patient record repository.

Phamis has existed for 13 years. Its brochure states that it provides an electronic medical record, but it appears to be a CPR. The brochure focuses on the company and its support, but does no really say anything about the product.
Problem Knowledge Couplers

PKC are Windows-based point of care information tools for identifying patient problems and risk factors, eliciting and recording patient findings, and considering and refining diagnostic and management strategies. It does not keep track of a patient’s record, but is used for finding a diagnosis and often providing management information.

PKC generates a database, identifies and characterizes the patient’s problems, and identifies possible causes and management options based the individual patient.
LaPlante, Alice. "Imaging your Sea of Data," Forbes ASAP. October 1990, pp. 36-41. (DE18)

The company brochure provides prices. It only works with Windows. The company has 2 basic products:

- Mailroom for Windows. It is "the hub of the mailroom suite and represents a new class of applications that enable users to build documents from any source, whether paper, FAX, or electronic. It links with many standard applications so the Mailroom documents can be communicated by email or computer FAX. It uses client/server technology so that these documents may be shared by any used on the LAN."

- ShareScan. It "turns a scanner into a sharable network appliance as easy to use as a FAX machine or a copier. Now scanners can be shared by multiple users just like a laser printer. ShareScan automates the conversion of paper into electronic documents. Multiple documents can be scanned at one time and delivered directly to the MailRoom desktop using patent-applied for technology."
This product is a Unix-based system. It has modular, functional growth through “power levels”.

Power Level I: Financial database
Power Level II: Clinical Database (real-time)
Power Level III: Scan

The open system provides protection against obsolescence. The vendor has 200 customers in 43 states. The hospitals it serves range in size from 40 to 340 beds.

On customer mentioned in its brochure is Irving Healthcare System, a 288 bed not-for-profit center in the Dallas-Ft. Worth area. It annually sees 12,000 inpatients and 125,000 outpatients. In 9/93, the hospital installed a Unix system to collect information from existing DuPont Radiology system, SMS Allegra HIS, and surgery scheduling. Power Levels I and II are implemented at the center (this includes patient demographic and insurance information). Level III is not done yet, but is expected to be installed by 1995. SDS has conducted a survey and cost/benefit analysis for new Level III, which will include nursing notes and authorization forms.

This vendor appears to offer a comprehensive system to fit all of a hospital’s need through a combination of real-time entry and scanning. It appears to be something UMMC would be interested in, although I cannot tell if x-rays, etc. are on the system.
Vitalnet from Critkon / Johnson & Johnson


Vitalnet is a medical surgery bedside system that costs approximately $4,000 to $5,000 per bed. This includes bedside units, a personal computer at the nursing station, a network and a software license. The equipment is a proprietary, small terminal that mounts to the wall or to the bedside. It also includes a thermometer and a blood pressure cuff for taking vital signs. As of July 1990, they had seven installed clients.
LaPlante, Alice. "Imaging your Sea of Data," Forbes ASAP. October 1990, pp. 36-41. (DE18)

Windows is required for this product. The company has different editions which do different things. Prices vary depending upon the edition purchased. The various editions may route faxes, image-enable A/P, and embed scanned resumes. The company brochure provides a list of Watermark supported scanners. The system appears to be very simple in that EMR is beyond its scope.
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<td>333 West Wacker #2900</td>
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<td>AT&amp;T</td>
<td>1700 S. Patterson Blvd.</td>
<td>800-CALLNCR</td>
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<td>Bell Atlantic Health Care Systems</td>
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<td>Coopers and Lybrand</td>
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<td>Docufile Imaging</td>
<td>541 Waddell Dr. Sunnyvale, CA 94089</td>
<td>408-734-5287, FAX 408-734-2692</td>
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<td>800 E. Northwest Hwy. Ste. 500 Palatine, IL 60067</td>
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<td>EMTEK Healthcare Systems, Inc.</td>
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<td>Garber Alley</td>
<td>6575 The Corners Parkway Norcross, GA 30092</td>
<td>404-441-7793</td>
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<td>Health Care Expert Systems, Inc.</td>
<td>1025 Ashworth Road, Ste. 420 West Des Moines, IA 50265</td>
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<td>Health Data Sciences</td>
<td>268 West Hospitality Lane #300 San Bernardino, CA 92408</td>
<td>909-888-3282</td>
<td>Ralph Korpman, MD, CEO</td>
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<td>Health Information Systems</td>
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<td>3000 Hanover St. Palo Alto, CA 94304</td>
<td>800-542-2351 ext. 1267</td>
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<td>Hospital Computer Systems, Inc.</td>
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<td>Los Alamos National Lab is developing a Prototype EMR</td>
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<td>Panasonic (Data Partner Product)</td>
<td>2 Panasonic Way Secaucus, NJ 07094</td>
<td>201-392-6144</td>
<td>George V. Guzman</td>
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<td>Panasonic (Data Partner Product)</td>
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<td>Paperview, Inc.</td>
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<td>Los Alamos National Lab is developing a Prototype EMR</td>
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<td>Steven C. Cohn, MD</td>
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<td>Vitalnet from Critkon/Johnson and Johnson</td>
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<td>Watermark Software, Inc.</td>
<td>129 Middlesex Turnpike</td>
<td>617-229-2600</td>
<td>Jane Cunningham, Telasales Account Manager</td>
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Appendix C

Additional Annotated Bibliographies
TABLE OF CONTENTS


Bergman, Rhonda. "Where there's a will......," Hospital and Health Networks. May 5, 1994, pp. 36-42.


Eubanks, Paula. "Homes doubt they can computerize per HCFA’s request," Hospitals. December 5, 1990, pp. 56.


Lumsdon, Kevin. "Computerized patient records gain converts," Hospitals. April 5, 1993, pp. 44.


"America's Most Computer Advanced Healthcare Facilities,

- Henry Ford Health System
- St. Mary Medical Center--Long Beach, CA
- St. Joseph's Hospital--Phoenix, AZ
- Tripler Army Medical Center
- H. Lee Moffitt Cancer Center--Tampa, FL
- Rose Medical Center--Denver, CO
- Washoe Health System--Reno, NV
- Wausau Hospital--Wausau, WI
- University of Wisconsin Hospital and Clinics--Madison, WI
Justice William Brennan says "the central storage and easy accessibility of computerized data vastly increase the potential for abuse of that information, and I am not prepared to say that future developments will not demonstrate the necessity of some curb on such technology." The laws dealing with access to medical records by people other than the patient are considered as laws of confidentiality, privilege, and privacy. In physician-patient context, confidentiality is understood as an expressed or implied agreement that the physician will not disclose the information received from the patient to anyone not directly involved in the patient's care and treatment. Privilege is a legal rule of evidence belonging to the patient, although the hospital, physician, or data bank may have a duty to assert it on behalf of the patient. The term "data protection" is used to describe informational privacy.

When the US Congress passed the Privacy Act of 1974, medical record computerization was at it's infancy stage. There are steps that can be taken improve the quality of records, to enhance patients' awareness of their content, and to control their disclosure. Some of the commissions recommendations are:

1) Each state should enact a statute creating individual rights of access to, and correction of, medical records, and an enforceable expectation of confidentiality for medical records.

2) Federal and state penal codes should be amended to make it a criminal offense for any individual knowingly to request or obtain medical record information from a medical care provider under false pretenses or through deception.
3) On request, an individual who is the subject of a medical record maintained by a medical care provider, or another responsible person designated by the individual, should be allowed to have access to that medical record, including the opportunity to see and copy it; and have the opportunity to correct or amend the record.

4) Each medical care provider should be required to take affirmative measures to ensure that the medical records it maintains are made available only to authorized recipients and on a "need-to-know" basis.

5) Any disclosure of medical record information by a medical care provider should be limited only to information necessary to accomplish the purpose for which the disclosure is made.

6) Each medical care provider should be required to notify an individual on whom it maintains a medical record of the disclosures that may be made of information in the record without the individual's express authorization.

Modern methods of compressing huge amounts of data will permit complex pieces of information, such as x-rays, to be sent across long distance via satellites or fiber-optic cable.

Several small firms now sell do-it-yourself diagnosis software that can run on most consumers' personal computers. Managed-care information systems will generate and update the value-for-money appraisals that insurers and governments now demand.

The cottage-industry approach of most hospitals in computerization of hospitals has been the cause of enormous inefficiencies in health care. (Consider the six teaching hospitals in Boston: each has a different technique for creating medical records. Their doctors describe symptoms and remedies differently.) In 1991 the Institute of Medicine, part of the National Academy of Sciences in Washington, D.C. published a report on computer-based patient records that argues strongly for the creation of a signals medical language. It triggered a huge global effort. Europe is perhaps more advanced than America, through the Advanced Informatics in Medicine (AIM) program based in Ghent, Belgium.

The computer links between physician offices and hospitals. Participants in integrated medical information networks linking hospitals, independent labs, insurance companies, pharmacies and other entities. Doctors can find out info at the office or at home. Hospitals install the info system and then provide connections and software to the physicians at no cost. Physicians provide their own terminals and modems and pay for the phone lines, but hospitals sometimes loan the computer equipment.

Survey found that in 1992 out of 901 medical groups, 14.4% have external systems that are linked to hospitals. Systems enable them to cut down on paperwork, and eliminate trips to hospital to retrieve test results and other records. They can communicate with other physicians, which facilitates referrals or consultations without telephone tag. The survey also says that 92% have automated billing, 87% use computerized patient registration, 15.6% use computerization for referral tracking and 9.3% use for capitation management.

Hospitals commonly do pilot tests with small groups of physicians to determine the level of interest. For those with little computer experience say that ease of use is a primary selling point.

The ideal CPR will be the next generation of records that are clinically focused and patient centered. They should increase productivity, decrease administrative costs and database for outcome measurements.

An EMR is more practical if a hospital sees its future limited to acute care inpatient services or if the goal is to only save on storage space.

Must reengineer the workplace.

Changing the way clinicians process orders, test results and document patient care.

Must dedicate time, money and energy.

4 million to 40 million for a medium sized hospital, therefore an economic justification is needed.
Having all of the data in a central repository can really add value to the business process not just to the patient care process. It is essential to include the physicians from the beginning in the planning and implementation. According to this article, teaching hospitals generate much more information than do community hospitals.

**CPR**

As defined by IOM:

an electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts and reminders, clinical decision support systems, links to medical knowledge and other aids.

Cannot just put the record on the computer.

Need to generate on computer a newly structured record that will look far different and eventually lead to changes in patient care delivery.

A paper record records events that occur while a CPR includes clinical decision support, alerts and reminders. It is an interactive tool.

There is a lack of consensus over what a CPR is.

There must be an organizational wide commitment especially since it is an expensive and long-term proposition.

**Seven Questions to ponder before starting a CPR**

1) How will you input information into the CPR?

2) How will you get information out of the CPR?
3) How will you define your data security and data access policies?

4) How will you deal with the legal and regulatory ramifications?

5) How will you utilize standards?

6) What is your cost benefit?

7) How will you deal with the psychological and sociological ramifications?

Implementation steps:

1) Automating sources of patient information from departments such as laboratory, radiology and admitting

2) Integrating those systems into a single network.

3) Creating a data repository of patient’s clinical information

4) Giving clinicians access to that information

5) Allowing clinicians to enter their own observations and orders into the system.

The organization now has the ability to access all current patient information through the system.

6) Develop computer logic that provides alerts and reminders to physicians.

8) Develop the lifetime patient record. Put it all together form other organizations, eventually a nationwide network.

Investment

This depends on how many points are already automated. If do, the expense will come in planning and networking to bring the information together.
If it necessary to start from the beginning, it is necessary to make major capital investments to automate each of the departments and locations within the delivery system before they can proceed with a CPR.

**Timing**

It takes from 2 years for a well automated facility to 6 years for a less automated facility.

There seems to be an emphasis on continuous evolutions without specific end points.

**CPRI**

Attempting to develop standards for all hospitals as to what data should be included.

Do not think that a true CPR exists. At least not one defined by IOM.

In some cases a CPR tracks a physician's performance. Many provider palnas are excluding certain physicians based on their economic credentiality.

"Never again should we allow physicians to practice medicine on what they can remember off the top of their head." Lawrence L. Weed M.D.
To meet evidentiary requirement, computer-based records must record the date and time of each entry, as well as the identify of each person who makes or modifies an entry. CPR must comply with state licensure standards. Each state promulgates its own licensure laws, which govern licensure of hospitals, nursing homes, health maintenance organizations, ambulatory surgery centers, and other institutional providers. These statutes and regulations usually outline specific requirements for the creation, authentication, retention, and storage of patient records.

Unfortunately, hospital licensure laws in many states pose barriers to CPR, particularly in the area of authentication. Some states sill have "quill pen laws" which require the continued use of paper-based patient records.

To participate in the Medicare program, providers must meet application Medicare 'Conditions of Participation." Currently, the conditions require that medical records be "accurately written, promptly filed and retained, and accessible." There must be a "system of author identification" that "ensures the integrity of the authentication and protect the security of all record entries." Entries must be dated; and the offers of each entry must be identifies and must authenticate their entries. Authentication may include "signature, written initials, or computer entry."

Accredited healthcare organizations also must meet the standard of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). While accreditation is voluntary, JCAHO standards have been incorporated into some state licensure laws. Currently, JCAHO standards for hospitals require that all entries in
patient records be dates and authenticated, with a mechanism established to identify the authors of entries.

The Consumer Interest Research Institute requires a doctor to ask a patient before he or she gives anyone access to the information he or she collects from patients. This includes whether the patient will allow him or her to furnish medical data to the Physician Computer Network, which tracks the number of patients with specific diseases and assists doctors with a diagnosis.

Safeguards to make your electronic files as safe as your paper ones include:

- Use codes and locks. This includes electronic passwords. Be sure to change them when an employee leaves. Install a program to store your files in coded form; in the “encrypted” version they’ll look like gibberish to unauthorized users.
- Prohibit tinkering.
- Beware even experts. Every time a technician walks in to do work on your system, do a backup copy before he or she touches a thing.
- Prevent viruses.

Backup procedures include:

- Ensure regular routines, including an automated backup.
- Speed up and streamline the backup procedure.
- Verify the backup.
- Keep permanent copies.

Computerized records vs. paper records:

Paper files are sitting on open shelves, totally vulnerable. Paper files are at the mercy of fire, flood, and theft. They are also easily accessible to employees. Computer records make it easy to keep old records available.

All the recommendations given are from the AMRA, American Medical Record Association for using computers safely. The AMRA believes that computers can lighten the load, but legal problems may exist. There must be a way to restrict access to records, a way to correct errors if charting is done on computer, and a way to delete vital information inadvertently. Suggestions are given that if a password is used as a computer signature, don't loan it out or leave a terminal unattended. Short term password can be issued to temporary employees.

Other recommendations are that the computer should require you to repeat your password before it supplies data requested. Passwords should be changed frequently and a key-operated power switch be installed on each terminal to keep unauthorized users from tampering with confidential records. Don't delete your errors just make them clear that they are errors and sign it. A computer system should ask if you're sure you want to delete information and then it waits for a verification. Most of them make backup files of documents once they're stored, making it impossible to delete them except the current entry.

When clinical records are computerized you have to worry about information displayed on a monitor as well as data in backup files in hard copy. Printouts may prove a bigger threat to legal security than the computer files themselves. They are frequently treated casually, left lying on a desk or in the garbage. Recommends that information be shredded before disposal. A log accounting for every copy of a computerized file should be programmed into the system.

MasterCard International is contemplating an alliance with a start-up technology company to help speed the transmission of vital medical data from bank card customers to health care providers. The start up firm is Universal Medical Records Services, Rockville Center, NY. It compiles and stores medical histories on network of computers and send copies of the records to doctors in an emergency.

When consumers sign up, they receive medical history from that their doctors fill out and return to Universal. Universal enters the data and subsequent updates onto a network of computers. In an emergency, medical professions call a telephone number on a plastic card carried by customers. Universal delivers copies of medical record through facsimile machines or computer modems.

The service costs consumers an initiation fee of $25, $3 for each record update, and $10 to $11 each time records are retrieved.
An electronic medical record system can provide benefits beyond the obvious functions of efficient and less labor-intensive scanning, archiving, retrieving, and printing of patient care information. The less tangible benefit of providing record access to several users simultaneously is difficult to quantify, but can enhance operations and improve the quality of patient care throughout a healthcare facility.

An electronic medical record system provides the system architecture to maintain in a database the text and image files the represent the paper documentation in the medical file. The text file date are captured via an interface with existing hospital information systems or clinical information systems in either a cumulative format, or at patient discharge in final report form. Image file data re created by scanning paper documents. In the future, the electronic medical record also will accommodate voice and video data as part of the patient record.

A computerized medical record system receives clinical patient treatment information in an on-line real-time mode from computers and maintains a database which acts as a central access repository for graphical/trend analysis of a patient's clinical data. The information must come from either existing clinical computer systems, or from on-line entry of patient data. Computerized medical records require a large capital expenditure. According to a recent report, only 40% of hospitals will achieve the automation required for a computerized patient record system by 1995.

The system configurations necessary to scan information for hospitals with minimal clinical information systems requires larger
optical storage devices and increased scanning workstations; this drives of the cost of an EMR system. The increased use of clinical information systems and the reduction of the cost of technology will eventually bring EMR systems in line with pricing expectations. Until that time, hospitals should pursue leasing options.

GAO Report IMTEC-91-5: Medical ADP Systems: Automated Medical Records Hold Promise to Improve Patient Care (January 1991) promotes and encourages the implementation of EMR systems and endorses the Uniform Clinical Data Set as a standard for EMR systems. The Institute of Medicine (IOM), supported by the American Medical Association, endorses the CPR system and is calling for use of such systems by all hospitals by 2001. Barriers to entering the market are low, except for the cost of technology and the steep learning curve. A lot of vendors are providing systems that provide limited functions, such as scanning, archiving, and printing. They basically are designed to only replace microfiche.)

Evaluate vendors by three principles:
• Past product successes
• The architecture of their EMR system platform
• Their plans for integrating an EMR system into a healthcare facility's operations.

Legal Environment: Optical Disk storage used with an EMR systems has not been court-tested to its availability as evidence in legal proceedings, nor has the physical durability of this medium been proven. Hospitals should consult with legal counsel before undertaking a system. The use of electronic signatures by physicians has not been legally challenged. The Joint Commission on the Accreditation of Healthcare Organizations has issued its position on electronic signatures.

EMR must have the following requirements
• Security
- Multiple Access Capabilities
- Automated Indexing, either through optical character recognition codes or bar codes
- Define record subsets for access to documents specific to unique processes
- Workflow Methodology that "flags" stages of record and document completion
- Record tracking to assist in the processing of "request for information" demands and internal requests for record documents
- Print record documents both on-line and in batch modes
- Produce facsimile transmissions

EMR can reduce or eliminate filing, retrieving, and copying medical records. Time to deliver requested information can be reduced. EMR can reduce the legal exposure due to misfiled and lost medical records.

EMR will:
- Reduce filing and correspondence backlog
- Reduce the manual processed required to locate record information, retrieve the information, and copy the information.
- Eliminate physical plant problems
- Reduce the Discharged-not-final-billed (DNFB) days with claims for Medicare, CHAMPUS, and Medicaid requiring attestation.
- Reduction of labor expenses
- Protections of current information system investments.

Hospitals operations with manual medical records systems may find themselves unable to meet the increased need for documentation brought on by healthcare administration developments of the 1980s. Automation can improve efficiency of coding, abstracting, chart tracking, chart deficiency analysis, and correspondence. Whether a hospital chooses a stand-alone system for medical records or opts for hospital-wide information system, automation can yield financial benefits.

Computing needs = Healthcare information system (HIS). To prepare for HIS integration, a medical records manager should conduct an analysis of procedural problems under a manual system. When hospitals are considering software vendors, they should look for a vendor that offers functionality for each department, along with the integration of a database to serve multiple departments. A department manager should be given responsibility for implementing the system in each department.

Areas are usually automated in the following order:
1. Coding and abstracting
2. Chart tracking
3. Chart deficiency
4. Correspondence

The IOM committee on Regional Health Data Networks offers recommendations for the protection of the confidentiality of personal health data held by what it calls regional health database organizations (HDOs). These entities would have access to and possibly control of health data, such as insurance claims and laboratory data, outside the care setting. As HDOs would accumulate personal information they challenge privacy principles. Electronic storage of data enables parties to compile information on individuals making computer based health data valuable to a range of groups like pharmaceutical companies and professional liability attorneys.

Confidentiality statutes vary from state to state and authorized releases of information are neither truly voluntary nor fully informed. This shows the current problems with confidentiality without computers.

Since HDOs will cross state lines, the IOM committee believes that HDOs have an obligation and an opportunity to develop well-defined privacy protection programs. The report recommends a federal statute that would override state law. Also a law to establish the right of individuals to review and challenge their information.

The committee also believes HDOs should allow access to personal health information only to a very restricted set of individuals. HDOs will not authorize access to or release of information without informed consent.

In conclusion, HDOs will improve health care and create opportunities for enhanced data protection thorough new legislation and innovative computerized security systems.
In their report, Health Data in the Information Age: Use, Disclosure, and Privacy talks of benefits of these databases and ways in which misuse can be prevented.

Nursing Homes doubt they can computerize records as the Health Care Financing Administration has suggested. Costs involved would include system design, hardware, software, staff training, and ongoing operations. Homes are starting from ground zero, but some nursing home administrators call computerization inevitable and Harvey Finkelstein, president and CEO of the Jewish Home and Hospital for Aged, New York City says computerization is "a wave of the future."
For CT and MR studies daily practices have changed dramatically. Today, almost every study is interpreted with both digital images and analog film. Film is durable, robust, relatively inexpensive and is the medium that radiologists have used for nearly a century.

Radiologists can enhance contrast and brightness levels (also known as window and level) to optimize the presentation of the structure or tissue in question. The digitized image can be transmitted easily over a network often called a picture archiving and communication system, or PACS, which allows simultaneous viewing by several radiologists and other specialists. According to a radiologist, previously, in an abdominal CT scan the technologist would first film the standard set of soft tissue windows at the setting that would show detail in the inter-abdominal organs. It would then be necessary for him or her to make an additional set of films at a setting that show details of the base of the lungs. Now PACS can focus on the most critical part of the study on film, then turn around to complete their interpretations on the workstation monitors behind them. (They do not have to request different films.)

Radiologists are also finding the resolution of computer monitors comparable to film for CT and MR images. The study images consist of 30Mb of image information, stored on a Kodak optical disk system 6800 automated disk library at NYNEX Corp., Cambridge, MA. The library holds up to 100, 10.2 Gb, 14-inch WORM optical disk platters, and stores more than one terabyte of information. Twice a day, our technologists move imaged over a NYNEX network connection to the juke boxes for permanent storage. Image retrieval can be done in a few minutes by calling it up on one of the physicians' Imagelink workstations. Some technologists have
found that dine images in electronic form are transferred easily from one computer to another, the hospital/department is able to streamline operations even with reduced staffing levels.

An internal audit of a hospital’s medical records department compares the department standards developed by the hospital and to benchmarks set by accrediting organizations. An audit can review the department’s economy and effectiveness through employee survey, direct observation, and interviews. By uncovering efficiencies and making recommendations for their correction, an internal audit can help limit a hospital’s liability exposure.

The Joint Commission of Accreditation of Healthcare Organizations (JCAHO) has standards for medical records. These include:

- A hospital should maintain medical records that are documented accurately and in a timely manners, are readily accessible, and permit prompt retrieval of information, including, statistical data.
- A medical record should contain sufficient information to identify a patient, support diagnosis, justify treatment, and document results accurately.
- Medical records should be confidential, secure, current, authenticated, legible and complete.
- A medical records department should receive adequate direction, staffing, and facilities to perform required functions.
- Medical records personnel should have a defined role in the hospital’s overall quality assurance program and in committee functions.
Technologies

Voice recognition:

True voice recognition is where the computer can translate spoken words into digitized text without the intervention of a human transcriptionist. It trains the computer to match words to certain patterns of sounds. The computer shows a word on the screen, the user reads it aloud and the computer digitizes the user's voice and stores it. When the user speaks the word again, the computer finds the voice pattern associated with it and records the word as text. By reading a series of words that the computer recognizes, the user can generate a complete report that the computer can print out or store. Most observers think that voice recognition technology will have to accommodate normal speech patterns and larger vocabularies before it can be used by all hospital departments.

Fault tolerance

Fault tolerant computers never fail. They're always "up." They have two processors operating simultaneously so one can cover while the other is being repaired. However, it is recommended that shoppers ask vendors to guarantee availability for all components of their system rather focusing on fault tolerance as such.

Industry watchers are advising shoppers to focus on flexibility when they buy their basic systems in order to take maximum advantage of new products when they become available.

Reduced Instruction Set Computing (RISC) chip
This is a type of microprocessor and a method of programming that makes for faster, more powerful, cheaper computers. For the same price, it is possible to have four to ten times the processing power of the traditional computers. This will mean major changes in the way industry develops its product. Hardware has gotten ahead of software. A difficulty is that software has to be designed specifically to take advantage of RISC architecture. Processing power is a small part of the cost of a hospital information system, usually ten to twenty-five depending on the configuration. The savings from these processes won't necessarily translate to dramatic savings on the total cost of the system.

**Workstations vs. Dumb Terminals**

The workstations are geniuses. They have as much processing power as mainframe computers did ten years ago, and they give their users control over what information they see and how they see it. Unlike solitary personal computers, sociable workstations can be linked to form powerful networks that share information among many computers. They are the backbone of distributed processing. Henry Ford Health System's Al Sinisi said that "If you gave me all of the money I wanted, basic dumb terminals would not exist." The "garden-variety" workstations cost ten to twenty thousand dollars although really fancy ones can cost as much as fifty thousand dollars.

**Radio Frequency**

They are now able to overcome a large facility and its dead spots which hinder reliable transmission of data throughout the medical centers.

**Physician Involvement**

In order to help the physician indoctrination, the system must be user friendly. For example, there needs to be in place an operating system that is intuitive and icon based.
It typically costs $3 to $5 to bring a patient’s chart from the medical records department to the caregiver. Savings on chart pulls alone could pay for a computer system.
Optical Disk Storage

Optical disks offer a method of permanent storage for both computer data and images of paper, more readable than microfilm and impossible to erase. Images of paper forms are recorded on the disks using scanners similar in size, technology and use to a facsimile machine.

Each 12-inch optical disc can hold 2 gigabytes. That's 6,000 average medical charts stored as computer data or 500 charts stored entirely as images of paper.

**Danger Zones:**

Slow or unreliable hardware. Vendors should be willing to guarantee in writing how fast the computer will respond to requests for information and how much time it will spend “down”. Some software vendors may attempt to reduce the price of a system by selling it with hardware that’s less expensive and less powerful than the institution requires. Don’t let them do it to you.

Incompatible software upgrades. Sometimes in the name of “improvement” a software vendor will release a new version of its product that can’t use data created with previous versions. Be sure that your contract provides of free conversion of your data from one software version to another for as long as the law requires you to keep the records.

Vendor instability. The loss of a vendor, big or small can strand a hospital. Be sure that your contract provides against the disappearance of a vendor.

**Legality**

There are 3 aspects to computerizing medical records: 1) the creation of an electronic “original”; 2) the use of computerized signature for authentication and 3) long term storage on magnetic tape or optical disks. Typically, state regulations do not address all three.

“Hospitals should organize through their state associations to get their legislatures moving and change the statutes,” said William Roach an attorney with Gardner, Carton & Douglas who specialize in medical records law. “They should particularly seek new statutes and
regulations that assume computer based records, rather than settling for piecemeal addendum that may further confuse the issue."

No court in the land has explicably ruled on the admissibility of computer-stored medical records as evidence, although they haven’t rejected such records either, legal experts say. Even in other industries there’s been no express test case, although copies of optical images have been admitted in court.

Patients and Physicians may want to consider an electronic card. Deciphering cryptic handwriting and requesting old medical records is a waste of a physicians time as well as a health care risk to the patient when errors occur. Paperwork could be much easier using an inexpensive computer if a reasonable set of bookkeeping standards existed. Many workers are hired to sort through and file mountains of paperwork, and months may be spent obtaining information that would otherwise be retrieved in milliseconds. Electronic standardization and automation will increase efficiency in the short term and is not exquisitely expensive to implement. "Electronic automation is key" and is realizable now says the author, but may not be the ultimate solution.

Privacy

CPRs risk invading privacy more:
- increased liability
- nurses sharing passwds because not properly trained or because technology is not adapted to their needs.----2 minutes to get on line for a 10 second operation.
- records being altered; hackers getting into the system.

CPRs are actually more secure:
- Can build in the protection to monitor who is accessing and reviewing what portions of the records.
- must develop appropriate information security practices
  - hackers would only invade the system if it was not well designed ie sharing of passwords or one single password.

A password plus another level of access should be required whether its a 2 tier password or a password and a biometric identifier like fingerprints.

Principles of reengineering:
- Organize around outcomes, not tasks
- Have those who use the output of the process perform the process
- Subsume information processing work into the real work that produces the information
- Treat geographically dispersed resources as though they were centralized
- Link parallel activities instead of integrating their results
- Put the decision point where the work is performed and build control into the process
- Capture information once and at the source
Opinions in this article are that computer system increase the amount and availability of information with patient care benefits. Yet this wider access to patient information raises concerns. It all depends on the security system of the medical record database. A database is no less of a threat than a paper record if one can access the room where physical files are kept as things can be picked up or written down. A rebuttal to this is expressed; a computer system hospitals can have a large network of terminals and anyone can go into someone else’s terminal. "Files are vulnerable to misuse unless they are locked with changing passwords and access features," says a law firm partner, Francoise Gilbert.

Steps to insure confidentiality
- Bob Buchanan, Vice President of sales and marketing at Pyramid Development Corporation

1) Gain high level of executive commitment for security.
2) Define security standards, such as passwords and other security conditions.
3) Implement the security program hospital wide.
CHIM is the Center for Healthcare Information Management. Its members include 50+ leading companies providing healthcare information technology products and services to healthcare providers. The mission is to positively impact the healthcare information systems industry through education and dissemination of information to the provider.

The most important thing for a healthcare organization is to make an informed purchase decision. One main cause of failure is a poor selection process between vendor-hospital rather than a failure to deliver on the promised vision. CHIM has developed a "Code of Conduct" that outlines standards for behavior in the marketplace that vendors and consultants agreed to, as well as typed of behavior in which they agreed to not engage.

CHIM's members are working in a number of areas to educate the industry and to support initiatives to create a standards-based CPR. Nearly all professionals in healthcare have a vested interest in a CPR so CHI believes that all constituencies be represented in its development.

Peter Gladkin, president of Health Data Sciences, San Bernardino, California, stated,

With the development of an integrated delivery system, healthcare is moving into a regulated environment. This change resulted in anew definition for the enterprise and corresponding changes in the scope and definition of a CPR.
Gladkin also stated that

the flow of information increased dramatically over the past several years. Unfortunately, the skyrocketing diversity of information clashed with the development of the electronic medical record. The CPR must provide patient-centered information management in real time, in a standards-based, fault-tolerant environment. Vendors must provide comprehensive, coordinated views of patient care delivery throughout the expanded healthcare enterprise. Providers are asking suppliers and consultant for benefit realization analyses, and how to identify and quantify benefits of a CPR. We need to be prepared to answer these questions.

Gladkin also stated that "the CPR system will have to be standards-based to enable divers vendors to participate - otherwise it will never be comprehensive."

In today's healthcare delivery systems, standards acceptance is moving forward at a snail's pace. Hospital A may code a lab test with one set of numbers, while hospital B will use a different set. If a patient is treated at Hospital A this year and needs to be admitted to Hospital B next year, Hospital B providers may needlessly expend time deciphering the patient's medical records.

Jay Toole, Atlanta-based partner with Ernst & Young, stated

I believe it is extremely important for CHIM members to be involved in and support national efforts to nurture the development of an enterprise wide, computer-based patient record. Without the involvement and the support of the supplier and consultant community, a standard CPR cannot come to fruition." CHIM is involved with the Computer-based Patient Record Institute. CPRI is also in favor of, and working toward, a national project that accelerates standards development in the U.S.
Because of the lack of standards, vendors spend valuable resources developing coding systems and meeting other site-specific needs. These efforts curtail their ability to develop innovative technologies that could help all providers.

CHIM, partnered with HIMA and CHIME, has provided information to legislators about the values and implications of simplifying administrative tasks, ensuring confidentiality of medical records, and electronically tracking subsidy payments. CHIM hopes to play a long-term educational role with members of Congress and their staffs. The mission of the HIMA, CHIM, and CHIME partnership is to promote legislation that mandates information systems technologies such as clinical data and outcomes measurements to promote impede patient care at lower cost. They agree that the system to support this process must be standards-driven and should facilitate the creation and use of standards, and the sharing and exchange of standardized data.

CHIM is located in Ann Arbor, MI. (313-973-6116 - Carla Smith)
The installation of a computer-based patient record (CPR) system represents a substantial capital investment, but the system can help provide higher quality health care at significantly lower cost. It will take years before healthcare organizations will realize the full potential of computer-based patient record systems.

The first step for a healthcare organization is to automate the clinical areas from which most information about patients is generated, for example laboratory, pharmacy, radiology, and nursing. The next step is to integrate information from these sources into a data communication network so all relevant data about a patient is available in a central repository.

A computer-based patient record system should:

- Provide complete patient information, comprehensive medical data from textbooks and databases, and sophisticated decision support tools, such as actual prices for treatment alternatives for a patient's condition
- Project the quality and cost consequences associated with treatment alternatives
- Enable providers and payers to establish direct electronic linkages for processing claims, verifying eligibility requirements, and obtaining treatment authorizations
- Enable healthcare facilities to measure the processes of care based on clinical outcome and resource use data
- Expedite the identification and selection of statistically meaningful samples of patients for research
- Enable employers to determine the value of the health services they purchase for employees by tracking the health status of employees and analyzing the performance of providers. (See

- Recreate real-life patient care scenarios to enhance the education of caregivers

Two functional requirements that a computer-based patient record system must meet in order to accomplish the above objectives:
- All stakeholders must be linked electronically and have the ability to update each patient’s longitudinal health record
- All stakeholders must use agreed-upon data communication standards, including telecommunications protocols, patient identifiers, diagnosis codes, record formats, and security mechanisms.

Below are the seven steps in the patient care process and their relationships to the computer-based patient record:

1. Fact finding The CPR should provide ready access to the patient’s lifetime health record, or offer a computerized history-taking function. It should also take in current information in a format best suited to the caregivers.

2. Diagnosis The CPR should provide easy, flexible, and comprehensive access to facts about the patient and the medical literature. Ultimately the system may have enough intelligence to suggest a probable diagnosis.

3. Care planning The CPR system should offer a care plan(s). When multiple plans are suggested the CPR should identify the advantages and disadvantage, expected outcomes, and risks/side effects. It should also be able to order and schedule all treatments. It should also print out (in layman’s language) an explanation of diagnosis, care plans, expected outcome, and special instructions.

4. Treatment The CPR system should schedule surgeries, therapies, and medication administration. It should alert caregivers to potential adverse drug reactions, etc., and remind caregivers about
the actions that must be taken at certain times, such as catheter removal.

**5. Follow-up and monitoring** The CPR system should provide for the capture of and access to progress data, including the patient’s vital signs and feeling, caregiver’s observations, and test results. It should also remind caregivers of scheduled events and alert caregivers when these events do not occur.

**6. Outcome** The CPR should include the expected clinical outcome and specify when the physician should be surveyed about the outcome and of treatments.

**7. Financial settlement** The CPR system should have interconnections between providers and payers so verification of enrollment and eligibility requirement, authorization for hospital, special tests and procedures, etc. can be accomplished electronically.

CPR system should be:
- Accessible
- Ergonomic
- Capable of real-time operations
- Easy to use
- Flexible
- Reliable
- Secure

To date, no complete CPR system as detailed above has been implemented; direct evidence regarding return on investment is not available. Some studies have indicated that the cost of retrieving a paper record and transporting it to a physician at time of treatment ranges from $3.00 to $17.00 per record. Eliminating paper records from a hospital will save costs not only on retrieval, but on storage, inventory, and overall efficiency.
Dramatic advances in computing technology, combined with efforts to control healthcare expenses, have created an environment where a patient’s sensitive health-related data can be abused. One area ripe for potential abuse is the use of information that will be gleaned from the ongoing research project to map the human genome. The genome project will tend to obliterate the issue of preexisting conditions.

The Americans with Disabilities Act states that any health information obtained by employers must be stored in separate files and treated as confidential.

"Workflow packages--programs designed to manage the flow of information among interlocking tasks in an organization--have become vital tools for cost conscious corporations. They help streamline processes by which data sources are passed along the decision-making chain."

Now more than ever, companies have options for managing how and to whom information is distributed and how it is used. The first wave of workflow software consists of image-processing products that enabled the companies to electronically store, retrieve and index scanned documents. This took care of misplaced or lost files, data-entry errors and the delays that are inherent in manually locating and sending along requested folders.

However, adding a work-flow element gives the imaging a highly beneficial option as it does more than just present the data.
Lumsdon, Kevin. "Computerized patient records gain converts," Hospitals. April 5, 1993, pp. 44.

A survey conducted by Healthcare Information and Management Systems Society (HIMSS) and hewlett packard showed respondents anticipating the implementation of CPR within next five years, 1998. Reasons given are that a hard copy patient record cannot be transported from a clinic to a hospital. Observers say that scanning the current paper record isn't a viable option and would only bog down storage capabilities and automate currently inefficient processes. "If we automate what we do today, its going to drive the cost curve even faster. We've got to find a way to reduce the complexity of our process," says 1993 president of HIMSS. Some say there is a need for federal standards on what computerized records should include, enabling hospitals and health care providers to apply the technology in a focused way rather than proceeding individually. Concerns about whether federal fiscal policies will recognize the substantial information technology investments that are needed; some say it's too early to tell.
Why convert to an EMR

In the words of Leslie Faipler, the current manager of the Medical Record Imaging System (MRIS):

Problems in the department grew to such a magnitude that we realized the potential for benefit if the medical record could be automated. We found that we currently had over 87,000 records composed of 7.6 million pieces of paper in just the on-site files of our Medical Record Services Department. We determined that we are receiving over 11,500 chart requests per month or 138,000 chart requests per year, many of which require photocopying estimated at 70,000 pages per month (8).

The author notes several other circumstances that led to the development of MRIS as he was an employee in the department since before the implementation of the system. He feels that these problems originated in two main areas: General maintenance of the hard copy file and the increasing number of services that need access to patient charts.

According to the author, the files were scattered throughout the department during the processing of the chart from the time of discharge until the patient's bill was drafted and the file was made part of the permanent record. This process sometimes required a time frame of anywhere from one month to a year. As the process time increased a definite problem was defined and researched.
The results of an Anderson Consulting study showed that the increased processing time was due to several factors which included: Misfiled charts, pages becoming loose/lost and unavailability of the chart due to being charged out to various departments or personnel.

Another reason for implementing an automated record is that microfilming has many drawbacks as follow:

The main problem which plagues most healthcare facilities is that of outgrowing the storage area allotted to the medical record department. Many have attempted to solve this problem by putting their records on microfilm. However, compared to data processing technology, microfilm is a very slow, manual process. Most records are filmed sequentially and therefore it takes long periods of time to reach the desired record. Another difficulty is that still with microfilm only one requester can view a chart at a given time.

Benefits

Combining the speed of the computer system with the historical record of patient admissions will allow for more timely and efficient record access. The physician of the future like none before him/her will have at their disposal the ability to analyze millions of medical cases (2). The healthcare facility will mainly benefit from the flexibility that an automated system provides in fast retrieval, reduction of storage space, and the elimination of incurred maintenance costs of paper files (Randall 11-12).

For additional benefits, please review the St. Vincent's abstract.

Obstacles

At this point in time, many healthcare organizations are deterred from implementing an optical imaging system due to cost. However, a pattern is currently being seen in the industry which
depicts declining system costs resulting from the release of new, faster systems as shown in the figure below.

These declining costs are expected to directly affect the expense of installing an optical imaging system as dramatic technological advancements are made.

Another problem involves the manual scanning of documents. It tends to be very tedious work. The major problem encountered was the inconsistency of paper size and weight which may cause many rescans due to feeder jams, removing staples and restapling the pages. According to Frank Moore of the IRS, "we get tax returns on toilet paper, shirts (as in 'the shirt off my back'), etc. There is no automation feed device that can handle that". (Alter 29).

Secondly, OCR is found to be less than perfect. Character recognition rates were found to vary from 50 to 90 percent. OCR also has problems in its inability to avoid reading stray marks, shading and other "noise" on pages which are scanned. This requires image enhancements to be performed as well as skew adjustment in the attempt to help the acceptance of document image processing. "Thousands of documents are scanned inadvertently at a slight angle,
and a six percent skew error can cause a 25 percent error in OCR" (Hamilton 11). As a result, some institutions are considering barcode technology as an alternative (this was not initially available).

Definitions

Optical imaging as described by Margie Hamilton, "is a composite of several advanced technologies including scanners, optical disk drives, high performance microcomputers, high-resolution monitors, relational databases and networking software.

The director Medical Record Services at Saint Vincent Health Center, Patricia Merski, describes an optical imaging system as:

A system which stores documents by scanning and converting them into digital images. The images are then burned onto an optical disk by a small laser beam. Once an image is "burned", it is virtually impossible to alter. This is also known as Write-Once-Read-Many (WORM) Technology.

Legality

Information cannot be altered or rewritten on optical disks. In terms of legality, Elizabeth Gardner states that the courts are not so much concerned with the medium chosen to store records as they are with how the records are stored and used by the facility (46).

A disk that cannot be altered would definitely decrease the likelihood of such an occurrence.

According to the Photographic Copies of Business and Public Records Act, the federal government states "Images maintained on optical disks are equally admissible as evidence, as are microfilm and computer generated records, if the appropriate audit trails are followed" (Randall 15).
In relation to St. Vincent's, Leslie Faipier states: "Title 28 of the Pennsylvania Code, Section 511.24 indicates acceptance of a secondary medium as storage for medical records, which includes optical imaging systems. Further, Section 511.26 reinforces and unambiguously encourages innovation in this area of medical records storage management and Control."

In an interview conducted by Elizabeth Gardner, the president of the Chicago consulting firm of Cohasset Associates, Robert Williams (46) states that there are three criteria which the courts have used in deciding whether to accept computer-stored records:

• **Accuracy** or safeguards which will ensure that records are stored correctly.

• **Reliability** in being able to prove that the facility uses an optical imaging system regularly and relies on it for daily business.

• **Trustworthiness** that the records stored in the system are secure and free of being altered.

**Technology**

A typical imaging system is made up of ten components as described by Kelly McLendon (32-34). These components include:

1) **Scanner** - A device which transforms paper documents into digital images through the creation of a bit-map.

2) **Workstation**- This refers to a micro or minicomputer which generally has two functions: scanning and indexing images.

3) **File Server**- A server acts very much like a "traffic cop" in that it prioritize requests, retrieves the images, and then directs them to the appropriate workstation.
4) **Optical Disks and Disk Drives** - These function in the reading and writing of data through laser technology. There are currently three different types of optical disks:

**CD ROM**--This form of media is not used in healthcare imaging systems because of the inability of the user to record information on them, thus the name CD ROM.

**Erasable Disk or Platter**--Due to the erase/rewrite capabilities, these disks are not useful in the area of healthcare due to the need for permanent storage.

**Write Once Read Many (WORM)**--This is the type of disk that is used the most often for healthcare imaging. A WORM optical disk allows the user to write to the disk once, however, it does not allow for rewrites or alterations to the data after the first writing. Another outstanding characteristic of these disks is their ability to handle high volumes of information.

The amount of information that can be stored per disk varies according to manufacturer. A 5.25 inch disk is capable of storing 940 megabytes of information whereas a 12 inch platter can store 2 to 3.2 gigabytes (billions of bytes). At this level of storage one disk is equivalent to 100,000 pages of data in image format. Information which is scanned requires 20-50 K worth of space while information is sent directly to the platter requires only 3K per page. Therefore, it is essential to keep the amount of scanned information to a minimum. The majority of the data entered should be keyed on the same system or transferred from compatible computer systems.

5) **Jukebox Drive and Disk Holder**

6) **Retrieval Workstations** - These must support windows for encoding and abstracting software, thus allowing the user to run and operate more than one application at a time.
This requires users to cache images or "the loading of as many images as possible onto the magnetic disk contained inside of the mini-computer workstation." This is done for two reasons: 1) The time required for retrieval and decompressing of images is reduced because the images are present within the memory of the workstation. Without caching, longer retrieval times would be experienced as the workstation would rely completely upon the jukebox. 2) The job workflow is streamlined, due to reducing the "network traffic" as individual image requests are initiated by multiple users.

7) Magnetic Disks- These serve as a temporary holding area for data prior to the recording of data onto the permanent optical disk.

8) Facsimile- This function allows requests to be printed directly without first being sent to the workstation. Hard copies can be sent to a variety of users outside of the healthcare facility.

9) Imaging System Software- This serves as the link between the various components allowing them to function as a system. Currently there are two types of imaging systems on the market.

A) Proprietary system which is written by a vendor for use with his or her product. The capabilities of such a system are limited and controlled by applications and hardware configurations as developed by the vendor.

B) Open Architecture which is more flexible whereby it allows the user to custom design the system by interfacing it with other systems and eliminating dependency on the vendor when making changes. The current trend is moving toward this type of system especially in the area of optical imaging.

10) Network Hardware and Software- The two most common networks used in imaging technology are Ethernet and Token Ring.
Choosing a Programming Language

1) A "high-level" language must be used, meaning that it should be easy to use and learn. It should be composed of "simple and clear English statements that incorporate computer power and are unburdened by special characters, syntax, or cryptic abbreviations."

2) Programs written must be able to look and operate the same on various computer platforms and operating systems including that of a PC, UNIX, Digital VAX/VMS, or Macintosh. The language must also be usable on a multi-user and/or multitasking operating system as well as on a stand-alone system.

3) An ASCII file structure should be implemented so that the system can take advantage of any existing programs written in various languages. The data should also be transferable between systems without needing any special modification or conversion.

4) The programs should be easy to modify and maintain at a "source code" level however, steps should be taken to make the system safe from tampering at the "object code" level.

Reasons for Vendor Rejection

1) No relational database technology integrated with the imaging system.

2) No application development system or tools for custom development.

3) Few installed sites or unproven product.

4) System configuration with respect to workstations and transmission of electronic images from other systems.
5) Proprietary product.

6) Lower compression of scanned images, thus requiring more storage capacity (Faipler 2).

Developmental Process

Phase 1--Imaging System Design

Any issue which was raised during the analysis for the need of an automated record was addressed. The requirements of the system were then defined including the method(s) of data input to be used. This phase concluded with the confirmation and finalizing of a system configuration.

Phase 2--Imaging System Installation

The interfaces between computer systems were developed, and the technical architecture was completed through programming applications. The installation of software and hardware soon followed along with system testing, writing of procedures, staff training, and the maintenance of the paper system during the conversion.

Phase 3--Imaging Conversion and Production Support

All current medical records were processed through this system. The system will then be fine tuned and monitored as necessary as production continues during the implementation of a dual system.

Can't afford to have a patient show up four different places and look like a different patient each time. An "integrated" system can't integrate clinically if its depts and facilities are set up to operate independently as the classic islands of automation. Should not make the changes until a reorienting of the institution and its employees occurs. It is said that computerizing the entire patient record is a big mistake. Most physicians only want 10% of the info that is in the chart. Don't care about nurse notes once the stay is over.

Options for storing data include: 1) data repository 2) data dictionary or index of indices that uses a computerized master patient index to retrieve information from separate systems and displays on computer terminal.
Some of the problems with EMR are:

- **Assuring Patient Confidentiality**
- **Turning Physicians into Users**
  The physician must become a cardinal user of clinical computer systems.
- **Integrating With Legacy Systems**
  Many hospitals already have a complex spaghetti network system for lab, radiology, pharmacy, etc.
- **Replacing the Paper Chart**
- **Assuring Systems Reliability**
- **To Code or Not to Code**

The question is: Should hospitals code narrative notes with an existing coding scheme, or collect narrative data in free form for human readers?
A study was performed to assess the effects of a network of microcomputer workstations for writing all inpatient orders. Workstations were linked to a comprehensive electronic medical record system. Conclusions were the network significantly lowered patient charges and hospital costs. This would amount to savings of more than $3M in charges annually for this hospital's medicine service and potentially tens of billions nationwide. However this system required more physician time than the paper chart. Research at other sites and system advances to reduce time requirements are recommended.

IOM report recommends all health care providers computerize their records by 2001. They envision a system that would include patients entire medical history and status of their health problems could be transmitted to any provider, payer, and review organization. They believe this format would cut paperwork costs and make it easier to study quality of care among large groups of patients. By linking employers, payers and providers with a common data base, such a system would facilitate eligibility certification, billing and utilization management. Patient care would be improved by providing better quality of information as patients move through parts of a health care network or when they relocate.

Before IOM's report, congress introduced a bill that would require all hospitals to computerize their records by 2000, but they realize that vendors need to see a demand to develop updated systems. IOM feels that vendors need to be assured that the commitment to computerization is real so they can meet the future needs. IOM wants to avoid another intrusion by a government act before congress decides to force on upon the industry.

The author says CEOs should band together to solve problems surrounding computerized medical records; like legal issues, including the admissibility of computerized records in legal proceedings and antiquated laws in a dozen states that make computerized records illegal. Actions should be taken within institutions to accelerate health care moves into the Information Age. It needs to be made clear that information is a top priority to break down cultural barriers to computers within the hospital environment, it will give information systems the clout they need to implement new systems and to bargain effectively with vendors. LGHCS is moving from a single vendor to an open architecture system of multiple vendors and linking them into a network. They want to
be leaders in the field, pushing vendors to accelerate technology development, enhancing the prestige of information systems.

According to a Decision Resources report, 25 cents of every hospital dollar spend in 1990 paid administrative costs (many of which are associated with the management of patient information).

In 1991 the Institute of Medicine issued a report called the Computer-Based Patient Record: An Essential Technology for Health Care. This report focused on the computerization and communication of patient and provider information. It identified five objectives. The CPR must

- Support patient care and improve quality of care
- Enhance productivity of health-care professionals and reduce administrative costs of health-care delivery and financing
- Support clinical and health services research
- Accommodate future developments in health-care technology, policy management, and finance
- Ensure patient data confidentiality at all times

Neither paper-based records not contemporary computer-based records can effectively support all these objectives today.

In December 1993, the C. Everett Koop Institute at Dartmouth sponsored a conference for health-care professionals, policy makers, and technologists to discuss the ways and means of developing an integrated health-care information network to serve the populations of Maine, New Hampshire, and Vermont.

Employers that collect employee medical claims data could inadvertently breach employee confidentiality laws if they do not carefully restrict access to such data, a panel of health experts warn. Sometimes the data is shared with benefit consultants and managed care companies. Individuals may forego care rather than have a "blot' on their medical records which keep them from obtaining new employment of being able to obtain health insurance.

Employers may be sued on invasion of privacy, defamation, slander; libel and for violations of written and implied employment contracts. Employers could face additional risks with the Americans with Disabilities Act (ADA), which prohibits employers from discriminating against qualified individuals with disabilities. The ADA bars corporate medical departments to reveal to management what is wrong with a particular employee.

A computer-based information system in a health care environment equipped with appropriate safeguards can be far better at ensuring privacy than a paper-based system. Computers must have security and control features, such as a database gatekeeper. This person could release information to physicians on a specific patient or to researchers without revealing information on the patient's identify.

EDI (Electronic Data Interchange) is a technology that allows discrete messages to be exchanged between independent organizations or trading partners. There have been no reported incidents of the confidentiality of EDI messages being compromised. With electronic-based records, systems administrators have far more numerous and powerful tools for monitoring and protecting information than they do with paper-based records. Written and carefully conceived, policies regarding access to patient records are important. The American Health Information Management Association (AHIMA) recommends that providers develop and implement confidentiality policies for staff members and develop a policy for patient access.