# A COMPREHENSIVE PATIENT CARE SYSTEM FOR THE FAMILY PRACTICE

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## Abstract

Family and Community Health Associates(FACHA) has incorporated an in-house, on-line computerized medical information system into a two office, three physician, family practice medicine group. A Basic Four System 610 minicomputer is utilized to store all the medical, pharmaceutical, financial and scheduling records. A SOAP formatted encounter form is used to collect the data. Five medical reports are printed prior to each patient encounter.

Evaluations of the use and the benefits of this system are presented. A cost study, which calculated the cost of maintaining a computer-stored patient record, showed that a patient record could be updated and maintained for $1.32. A quality of care evaluation revealed that the pre-audit of the computer-generated medical reports increased patient compliance to health maintenance suggestions. Another quality of care evaluation revealed that computer-generated flow charts did not significantly improve the diastolic blood pressure value of chronic hypertensive patients.

## Introduction

A primary goal of the health care system is to optimize the health of individuals by providing high quality care that is complete in scope and reasonable in cost. For this goal to be achieved, medical information systems must be modernized and brought to the same levels of efficiency as the advanced medical services to which it relates.[1] In the field of family and community medicine, the medical information system must have the ability to integrate data which is brief in nature and vital statistics that are traditionally unorganized. This system will have to demonstrate that the operating costs are comparable, if not less than, the current medical information system. And ultimately, this system must demonstrate an improvement in the quality of care provided.

Currently, the family physician is assuming a greater responsibility for the provision of comprehensive health care. The physician can no longer rely upon memory or a loose-leaf patient record as the primary means of managing the large amounts of data being produced. Computerized medical information systems could provide a viable alternative to the conventional systems. The insurgance of the minicomputer and the microcomputer with on-line and interactive capabilities, has eliminated frequently discouraging situations, such as time-sharing and data entry in batch mode. Computers have been improved to store sufficient volumes of prose to satisfy the needs for episodic care and continuing care. The success of computerized medical information systems lies in the ability of current users to demonstrate to other health care providers the cost benefits and the quality of care improvements realized through the use of these systems.

This paper will provide information regarding the design and the function of a computerized medical information system currently used by this family practice medical group. The results of a cost per record study and the results of two studies which evaluate the system's effect on the quality of care will be presented.

## Practice Demographics

Family and Community Health Associates (FACHA) has incorporated an in-house, on-line computer medical management system into a three physician, two office, family practice medicine group. These three physicians have practiced twenty-five years, four years and one year respectively. The offices are located five miles apart and have access to the same data files by using dedicated telephone lines and modems. Two clinical pharmacists operate a licensed pharmacy and work in close association with the physicians. They utilize the same medical records and interact with the patient in the same physical setting.

The practice encounter profile and age/sex profile is presented in Table 1. The total practice experience parallels the findings in the Robert Wood Johnson Special Report of Medical Practice in the United States.[2] The differences between male and female physicians' age/sex profiles and encounter frequency related to practice experience is demonstrated by the data. The practice data was collected for a one year period from July 1, 1981 through June 30, 1982.



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Table 1. Encounter Profile and Age/Sex Profile.

| Phys. | # Enc. | % M/F | % >65 | %65-45 | %44-20 | %19-0 |
|---|---|---|---|---|---|---|
| * 1 | 8226 | 48/52 | 21 | 38 | 30 | 11 |
| ! 2 | 5409 | 30/70 | 10 | 21 | 41 | 28 |
| + 3 | 3792 | 41/59 | 10 | 19 | 45 | 26 |
| Total | 17427 | 41/59 | 15 | 29 | 36 | 20 |
| # RWJ | 6714 | 42/58 | 21 | 22 | 33 | 24 |

* Male physician, 25 years of practice experience
! Female physician, 4 years of practice experience
\+ Male physician, 1 year of practice experience
\# Robert Wood Johnson Foundation Special Report

## System Demographics

All financial, pharmaceutical, scheduling and medical data is stored in a Basic Four System 610 minicomputer. The system consists of seven video display terminals, two dot matrix printers and two letter quality printers. It has 150 Mbytes of hard disc storage and 224 Kbytes of RAM memory. The programs are written in Business Basic II. The video display terminals at the main site transmit data at a rate of 9600 bytes/second and the video display terminals at the remote site transmit data at a rate of 1200 bytes/second. Video display terminals are located in the laboratory, business office and data entry center in both offices. These locations were selected so as to maintain an isolation of the patient from the instrumentation. This arrangement of hardware has served to maintain the traditional physician-patient interaction.

The hardware is operated by entry-level personnel previously not trained in the use of computers, but with proficient typing skills. The system is integrated and uses full duplex communication. The only restriction applied to the operators is that they may not use the same patient's records at more than one video display terminal. The system has been in use since September, 1980, and 29,000 patient encounters have been stored in the computer. The software is a reproduction of the manual system previously used by the physicians. The components of the software can be divided into five modules, 1. medical module, 2. financial module, 3. pharmacy module, 4. scheduling module and 5. codes maintenance module. The software is currently maintained and improved by an in-house computer programmer. This relationship is an important part of the system since changes in practice style and standards can be integrated immediately into the software.

## Data Input and Output Mechanisms

Patient encounter data is recorded on a standard SOAP formatted encounter form. Specific fields are designated for height, weight, blood pressure, pulse and temperature. Symptoms, diagnoses and laboratory data are coded using Social Security Administration codes, ICHPPC codes and practice developed laboratory codes respectively. Each encounter record has over 1300 characters available for free text. Data relating to the patient's medical history is recorded using the following categories: 1. prior medical history, 2. prior drug history, 3. allergy history, 4. immunization history, 5. social history and 6. family history. The data updates are performed in a real time mode by a data entry person, so that the updated patient records are immediately available.

Prior to each patient encounter, the following medical reports are routinely generated.

1. Patient Progress Notes
   a. Last five encounters
   b. Concurrent laboratory data and reports

2. Chart Summary
   a. Diagnosis list
   b. Medication list

3. Health Maintenance Report

4. Patient History

5. Physical Parameters Flow Chart

These reports form the medical record that the physician uses when seeing the patient.

System security and patient privacy are provided by shredding these medical reports after the data updates are performed. The encounter form is shredded after a complete system backup is performed as a precaution against the loss of patient encounter data. Original copies of resource material, such as discharge reports, referral letters and consultation letters are maintained in a hard copy filing system after they are summarized and transcribed into the computer.

## Cost

Cost containment is a stated goal of most systems, as it is for this computer system.[3] Such things as improved utilization of health manpower, the reduction of the duplication of medical data, the increase in patient record retrievability and the use of previously archived medical data to improve the quality of care can provide possible savings. This practice documented the cost of computer patient record maintenance and the cost of manual patient record maintenance to analyze the cost savings generated through the use of the computerized medical information system.

The initial cost of this computer system hardware was $80,000.00 and the software development cost $20,000.00. Annually, the computer system cost $29,000.00 to operate. This includes programmer's salary ($10,000.00), hardware depreciation ($7,500.00), hardware maintenance ($10,000.00) and paper and supplies ($1,500.00). The annual cost of the previous manual filing system was $7,200.00, which included filing equipment depreciation ($3,200.00) and paper and supplies ($4,000.00).

Table 2 displays the patient record maintenance costs associated with an average thirty patient per day work load for this family practice medicine group that averages 16,500 patient encounters per year. Since the annual operating cost of the computer system is four times greater than the manual filing system ($29,000 ÷ $7,200 = 4), the maintenance cost per computer stored record was increased to reflect this difference.

Table 2. The patient record maintenance cost for an average thirty patient per day work load.

Manual

| Activity | Time | Cost |
|---|---|---|
| Retrieve 30 medical and financial records | Recptionist 40 min.,$5.00/hour | $ 3.33 |
| Pre-audit 30 medical records | Nurse-auditor 60 min.,$8.00/hour | 8.00 |
| Data transcription including dictation, typing and chart summarizing | Physician 30 min.,$100.00/hr. | 50.00 |
| | Nurse-auditor 60 min.,$8.00/hour | 8.00 |
| | Receptionist 60 min.,$5.00/hour | 5.00 |
| Refile 30 medical and financial records | Receptionist 30 min.,$5.00/hour | 2.50 |
| Total | | *76.83 |

*Each patient record costs $2.56 to maintain.

Computer

| Activity | Time | Cost |
|---|---|---|
| Retrieve and collate 30 medical records | Receptionist 15 min.,$5.00/hour | $ 1.25 |
| Pre-audit 30 medical records | Nurse-auditor 40 min.,$8.00/hour | 5.32 |
| Data transcription | Receptionist 40 min.,$5.00/hour | 3.32 |
| Total | | * 9.89 |

*Each patient record cost $0.33 to maintain. Accounting for the difference in system operating cost, each patient record costs $1.32 to maintain.

The reduction in record retrieval time is due to the integration of the scheduling and the medical modules which eliminates the need for a receptionist to retrieve medical records. The fifteen minutes associated with the automated retrieval of records results from the collating of the computer printed medical reports. A reduction in the time used to pre-audit the medical records is attributed to the records' clarity, organization, and, in the case of the health maintenance report, computer-assisted audit. The cost associated with data transcription is drastically reduced because the physician no longer dictates the patient encounter. The encounter form serves as the source of data used by the data entry person to update the patient records. The responsibilities of the nurse-auditor are eliminated because problem lists, medication lists, immunization histories and health maintenance records are updated by the data entry person following the patient visit. The data transcription time required to record the data is reduced because the encounter form is duplicated on the video display terminal, codes are used for symptoms,diagnoses and laboratory data and data is entered in a single entry mode. Costs associated with refiling patient records are eliminated because the computer automatically refiles patient records. The maintenance cost per record using the manual filing system was $2.56. The maintenance cost per record using the computer system is $1.32 per record. The record maintenance cost using the computer system is below the cost of $2.04 calculated by the users of the Regenstrief Medical Record system.[4] It is comparable to the computer-augmented record audit cost of $1.26 or 7% of the charge calculated by the Duke University Health Services Clinic.[5]

Non-quantitated savings associated with traditional office procedures are also realized. Computer-generated receipts eliminate the process of completing insurance forms. Off-hour duties can be accomplished with fewer personnel. No longer is the patient record sequestered because it is being used for dictation, for health maintenance auditing, for insurance form processing or for use during the next office period. Individuals can retrieve the part or parts of the medical record which is relevant to their task. And finally, this practice was able to expand from a one location, one physician, one pharmacist practice to a two location, three physician, two pharmacist practice while continuing to employ only four nurses and four receptionists.

## Quality of Care

Tangible benefits, such as improved manpower utilization and increased productivity do not guarantee that the quality of care will improve.[6] This practice studied this computer system's effect on the quality of care using two different evaluations.

### Computer-assisted Medical Record Audit

The patient record provides the basic data upon which decisions regarding preventive medicine and health risk management are made. Through the use of a computerized medical information system, the encounter data can be used to create information summaries which can be used for more efficient and accurate medical record audit. A pre-audit of the five medical reports is routinely performed. Remarks relating to the patient's health maintenance needs are made on the encounter form.

An evaluation of the effects on the quality of care of the use of these computer-generated reports in the auditing process was performed. A group of one hundred patients was analyzed for compliance to health maintenance suggestions. The practice was divided into two groups of patients. The first group was composed of patients who were seen at least five times during a two year period from July, 1972 through June, 1974. The second group of patients was selected from a group of individuals who were seen at least five times during an eighteen month period from September, 1980 through March, 1982. The former group was

treated during a period prior to the installation of the computerized medical information system. The patient record during this period consisted of a narrative of the examination findings presented in chronological order. The latter group was treated following the introduction of the computerized medical information system. The areas of investigation for this study included, 1. immunization updates, 2. blood pressure recordings, 3. weight measurements, 4. historical updates, 5. hemoccult testing of stool specimens and 6. routine health maintenance physical examinations. Table 3 represents the comparison of the two test groups. A marked improvement is noted in the percentage of patients who accepted immunizations, hemoccult testing and health maintenance physical examinations. The increase in the updated histories is exceptional and can be attributed to a system which enabled data to be collected in an organized fashion.

Table 3. Percentage of 50 patients documented as having a current health maintenance status in these categories.

| | Immun. | BP | Wt. | Hx | Hclt. | Phys. Ex |
|---|---|---|---|---|---|---|
| Group I | 32 | 90 | 88 | 14 | 16 | 38 |
| Group II | 56 | 100 | 100 | 90 | 36 | 76 |

A revenue analysis shows that gross revenue was increased by $12,443.00 by using a computerized medical information system. These results are presented in Table 4. The expenses for this practice are seventy-five percent of the total gross revenue. The profit realized through the use of this computer system was $3,111.00.

Table 4. Increase in gross revenue generated from the use of the computerized medical information system in the auditing process

| Immun. | BP | Wt. | Hx | Hclt. | Phys. Ex. |
|---|---|---|---|---|---|
| $4,411.00 | 0 | 0 | 0 | $757.00 | $7,275.00 |

The simplicity of a single entry system that can produce a multiplicity of medical reports which can be used by the entire health team has increased the quality of care in this practice. The medical record audit has also increased the gross revenue of this practice.

## Computer-generated Flow Chart

Another study that evaluated the use and the benefits of a computer-generated flow chart as a tool for quality of care review and as a tool for evaluating system effectiveness was performed. All patients scheduled for an appointment have a graphical flow chart printed prior to their visit, displaying weight, systolic blood pressure, diastolic blood pressure, pulse, blood sugar and urine sugar. The date and value of each data point is noted on the graph. This report is presented by the physician to the patient during the encounter. Progress or regression are clearly demonstrated. This flow chart is given to the patients for their personal records. An evaluation of the use and the benefits of flow charts relating to the management of chronic hypertension was performed. The study period encompassed a period of ten weeks from May through July, 1982.

Flow charts were produced for each visit for only one of the three physicians in the group. The patients cared for by the remaining two physicians had no flow charts produced. At the conclusion of the study period, the computer was programmed to search for all patients coded with ICHPPC code designation 401 (hypertension) during the study period. The computer grouped the patients by examining physician. All patients who were not seen at least twice during the study period were excluded from the study. The diastolic blood pressure value associated with the first visit during the study period was compared to the diastolic blood pressure value at the conclusion of the study period. A diastolic blood pressure value of 90mm of mercury or below was considered to be normotensive. Four categories of results were developed, 1. values that became normotensive, 2. values that became hypertensive, 3. values that remained hypertensive and 4. values that remained normotensive. The Student's t-Distribution for three variates was used to test the significance of the results.[7]

Table 5 presents the encounters for hypertension expressed as a percentage of the total encounters for the practice. It also presents the sex distribution and median age for the cases examined during the study period. The table presents the total number of patients seen at least twice during the study. Comparable data from the Robert Wood Johnson Foundation Special Report on Medical Practice in the United States is also presented.[8] The total percentage of hypertensive encounters for the practice for the period July 1, 1981 through June 30, 1982, was 13.9%.

Table 5. Percentage of hypertensive encounters, sex distribution and median age.

| Phys. | # cases | % enc. | % M/F | Median age |
|---|---|---|---|---|
| * 1 | 129 | 24.8 | 47/53 | 56 |
| ! 2 | 56 | 12.9 | 16/84 | 55 |
| + 3 | 20 | 8.2 | 50/50 | 47 |
| Total | 205 | 17.2 | 39/61 | 55 |
| # RWJ | --- | 5.1 | 41/59 | 58 |

* Physician used flow charts
! Female physician
\+ Physician with one year of practice experience
\# Robert Wood Johnson Foundation Special Report

Table 6 presents the change in diastolic blood pressure values between the initial visit and the visit at the conclusion of the study period.

Table 6. Change in the diastolic blood pressure value.

| *Phys. | # cases | Became Normo-tensive | Became Hyper-tensive | Stayed Hyper-tensive | Stayed Normo-tensive |
|---|---|---|---|---|---|
| 1 | 129 | 16(73%) | 5(23%) | 1(5%) | 107 |
| 2 | 56 | 16(59%) | 7(26%) | 4(15%) | 29 |
| 3 | 20 | 3(38%) | 0( 0%) | 5(63%) | 12 |
| Tot 2&3 | 76 | 19(54%) | 7(20%) | 9(26%) | 41 |

* See Table 5 for physician information.

It was assumed that the maintenance of a normal diastolic blood pressure value could not be attributed to the use of flow charts, since previous methods had achieved the normal state. Therefore, this group was not included in the analysis of the effect of the flow charting process. As demonstrated in Table 6, seventy-three per cent of the patients cared for by physician 1 became normotensive and comparable results for physicians 2 & 3 were fifty-nine per cent and thirty-eight per cent respectively. These results did not reveal a statistically significant improvement in the achievement of a normotensive state.

The analysis of the data indicates that computer-generated flow charts employed in the management of chronic hypertension did not improve the quality of care when judged by the lowering of the diastolic blood pressure. Jonathan Rodnick, M.D. also observed that quality of care improvements from automated medical record systems are limited and that the relationship between the quality of care and the recording of data has not been proven.[9] The use of a computerized medical record management system does however offer important advantages in the process of monitoring care. Patient acceptance of physical parameter flow charting was mostly supportive. Many patients were provided with a better understanding of the control of their disease, hypertension. The physician who used flow charts was given a quick and an accurate overview of the patient's progress toward control.

## Summary

The results presented indicate some of the unique benefits realized following the installation of this computerized medical information system. The financial, medical and quality of care reviews presented, detail the applications of this system. They address one of the major shortcomings , stated by Ingeborg Kuhn in his review of patient medical record systems, that is, the lack of formal evaluation of the effects of these systems on the quality of clinical practice.[10] These studies represent an attempt at the design and completion of prospective and retrospective studies relating to the use and management of medical record data. The advancement of family medicine into a more traditional research study mode was suggested by the Family Practice Residency at Madigan Army Medical Center in a 1978 research paper.[11]

Today's health care system, its providers and users, are demanding more data, better documentation and more flexibility from the medical record. Family physicians will be concerned with the task of maintaining these records at a reasonable cost and demonstrating the improvements in quality of care. The computerized medical information system with its reduction in maintenance cost and its contributions to the improvement of the quality of care is a viable alternative to the current medical information systems.

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