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CDS-4
HRA Contract
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SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO THE DIVISION OF IMMUNOLOGY STANFORD UNIVERSITY MEDICAL CENTER STANFORD, CALIFORNIA ON DECEMBER 4, 1974

Dr. James Fries introduced the visiting study team to the system and provided most of the material summarized in this document.

Dr. Fries is both the developer of this particular approach to the medical record and a major contributor to the overall system design used here. He is also one of the principal users, since he is responsible for the Immunology Clinic which has used this record most intensively.

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objective for the system is principally quality of care improvement in areas of chronic medicine (initially immunology and rheumatoid diseases) through increased general medical knowledge, mainly acquired through research, and consultation in response to specific questions.

These objectives have come about in response to a need felt by a clinical researcher.

The system in use here is completely new and a supplement to the existing manual system.

b. The population which is to be served by the system is selected for study purposes.

The population is special in terms of diseases presented (i.e., rheumatic diseases).

The service environment is urban and suburban.

The care provided is secondary and tertiary care.

The existing quality of health care at this institution is relatively high as judged by the visitors.

The quality of health care delivered to this disease group is, in general, adequate to low in an uneven way, as judged by the provider, because of the difficulty of managing this disease class.

The mean annual income of the institution's patient population is average for the area served.

The size of the population served by the Immunology Clinic is currently about 900. Most (785) have their records in this system. The potential population consists of the referred patients with this disease in an area of two to three million inhabitants.

About 7% of the population in the United States suffer from arthritis. We do not know how many of these require secondary or tertiary care. Other clinics using the system serve largely distinct populations. We did not evaluate the system in other clinics.

The needs for this specialty population are in the areas of chronic and acute specialty care.

Patient visits are nearly exclusively a result of appointments on doctor referral or by hospital admission on referral.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are:

to provide information primarily for clinical research activities and secondarily for training activities and quality review procedures;

to improve delivery of health care by improvements to the quality of care through organized record contents and record availability for research; and

by experience-based computer consultation.

b. The organization which has made the decision to provide automated medical record services is a specialty clinic of the Stanford University Medical Center.

Expansion of system use occurs as the demands of other clinics warrant. Use within the clinic is high and stable.

The institution is a university medical center with 500 inpatient beds and 38 outpatient clinics.

The institution is organized as a private, nonprofit corporation.

The size of the practice of the Immunology Clinic is as follows:

Number of patients is 900 (yearly average);

Records for 785 patients are on the system.

Number of patient visits per year is about 4,000;

Average time per patient visit is 3 hours for the initial visit and 30 minutes for repeat visits.

The control over the medical content of the record system is provided by an individual physician who integrates information and recommendations of a national committee of 32 members. This computer committee of the American Rheumatism Association has standardized most of the data items being collected.

The technical operation of the system is provided by three organizational levels:

The University systems component, Stanford Center for Information Processing (SCIP), which provides hardware and operating systems support. There are two people cognizant of the Medical Center use, and they spend a total of about .2 FTE's related to all Medical School support. Medical Center use comprises about 20% of the total machine usage.

The Medical Center computation group, part of SCIP (formerly ACME) maintains the software for the medical data base system, Time-Oriented Data Base (TOD), provides coordination, and currently is involved in a conversion project to move TOD from a 370/158 under IBM multiprogramming software to a 360/67 under locally developed software. Three out of the four people in this function spend about the equivalent of 2 FTE's in medical data base tasks. The TOD use amounts to about 25% of the total Medical School computer use, and Dr. Fries' project comprises about 30% of the data base usage. There are about 12 medical TOD data bases in various stage of development.

The programming staff in Dr. Fries' Immunology Clinic develops further application programs. Those programs that have general utility become part of the TOD library. One person is devoted to this task. In addition, Dr. Fries does some programming as well as program specification and checkout. There also is one data entry clerk. Two additional FTE's are working in other departments on other TOD data bases.

Consequently, the supervision of the technical operation of the system is quite divided.

The total staff effort allocable to the Immunology project is the following:

(.2 x .25 + 2) x .30 + 2 = 2.615 FTE's,

and the total hardware effort is:

.20 x .25 x .30 = 1.5% of an IBM 370/158.

3. SERVICES PROVIDED

We describe here the services provided in the Division of Immunology.

Data collection is done using single part, 13 page forms, flow sheets with numerical entries, to be entered as is (only the modified ICDA is coded by senior medical staff) using typewriter or CRT terminals. One set of forms is adequate for 14 visits.

Source data collection is done by MD's and laboratory technicians.

Data entry is done by clerical personnel familiar with the flow sheet forms.

The data are transmitted by modems and telephone to the computer.

The data are stored forever since a criterion for file purging has not yet been decided.

The entered information is used for analysis and to provide back-up for flow sheets. The flow sheets are the primary medical record for this clinic, and are the basis of the Time-Oriented-Record.

There is the capability to inquire into the files to determine a patient's medical status by any variable as well as by boolean combinations of the variables, by range, or by numerical comparison on a time-axis of the variables.

These services may be provided at any of the seven terminals within this department. The departments using TOD (8 active) use approximately 20 terminals altogether. The data on TOD can be selectively shared. All the programs are automatically shareable, unless explicitly made private.

All other relevant services are provided by other systems within Stanford, namely, conventional medical records, billing, payrolls, ledger, etc..

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through typewriter-keyboard responses (70%) or by CRT keyboard entry. New is a method of typewriter-keyboard entry of text containing multiple data elements per line. Optical reading of hand-printed characters is being developed for other clinics.

Missing data elements are explicitly skipped (if stated) and coded to a specific representation.

Verification of data entry is done by data entry limit checking and by analysis routines.

Most errors are found by data entry personnel and some by health care delivery personnel.

Error correction is done on-line.

A correction changes the entry only.

An audit trail of all errors is not maintained.

Data entry hardware and software have presented problems of cost and response time. Keyboard entry takes a significant amount of time while on-line to the time-shared system with the fairly large data entry program. The system operated by the university (SCIP) is not well suited to this type of application. Pricing has been arranged to compensate for some of these problems.

b. Data Storage

File Updating:

Additional data entries are reflected in the files immediately.

Changed data entries are reflected in the files immediately.

The data invalidated can be retrieved from an audit run.

File Storage:

The data which are entered into the file are kept permanently.

File Usage:

Obtaining a current record from the file requires less than 10 seconds; but delays of 10 minutes do occur due to interference from other jobs in the university computer, and the weaknesses of the vendor (IBM) provided scheduler.

Determining whether a patient has a record in the file requires the same time.

The search can be done by unit number or by exact name.

The file is generally abstracted when research questions have to be answered to provide more selected patient categories and faster access.

File Size:

The required file space now is 8M characters, and is expected to grow.

When a shortage of file space occurs, then old records will be purged.

The files are compressed, variable length, indexed, and linked. Space is dynamically allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available for on-line use anytime:

Individual Patient Record:

Retrieval of complete patient record, retrieval of abstract of of patient record, retrieval of last patient visit, or re-creation of flow sheet for patient (rarely).

Selection of Patients:

Selection of all patients with a given problem or diagnosis, value of sign or symptom, treatment modality, or combination of the above is done several times per week.

This selection is made on the basis of single visit records or across a time axis.

Tabulation of Provided Services:

This is done by diagnosis or problem, by patient category, by patient address or location (address labels), and by services rendered (done regularly).

Comparison of Selected Patient Groups:

This includes descriptive statistics (e.g., tables, histograms, means, and standard deviations); inferential statistics (e.g., t-tests and analysis of variance); actuarial statistics (e.g., survival rates, morbidity rates, and mortality rates), and graphical presentations (scatterplots and bargraphs).

Prognostic Summary:

A special service is a computer prognostic summary, ordered like a lab test at a price of $18.75, which selects a comparable population to the patient and displays the experience with this group.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by professional programmers and by clinical research personnel.

The routines are specified by clinical research personnel.

Their operation is verified by the above through pilot operation.

The routines are kept either on a general library file, on user-specific library files, or by the individual user.

Their documentation is kept on paper.

The principal programming language is a PL/1 dialect, PL/ACME. Programs are being converted to PL/C, a subset of PL/1.

e. Protection of Data

The Data Base System has three levels of data protection.

A password system permits user access to the computer system. This password can be changed by the user at will. It is not available to the system staff. It is known to all computer users and programmers in the clinic.

A protection mechanism exists for files. Files can only be written or added by their owner. Optionally, read protection can be specified for any file by the owner which prevents the reading of data from these files by other system users.

Individual data element types can be specified to be cryptographically encoded using an owner supplied character string.

Only the first level of protection is currently in use. It is felt that no sensitive data are being collected and that protection is adequate. If the system use is to be expanded, more protection may have to be used.

f. Training

New medical users of an existing data base system are given demonstration and documentation in order to learn to use the system. The training period is one day; and after an additional two weeks, they are fully proficient.

New clerical users of the system are given instruction, demonstration and documentation in order to operate the system. The training period is one week; and after an additional two weeks, they are fully proficient,

g. Presentation of Results

The means for producing output are hard-copy terminals and CRT's.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The patient record system stores its data into two data files per clinic. One file contains identification records for the patients and the other file contains visit data.

The size of the identification record is variable, up to 1,280 characters.

The size of a visit record is variable; up to 486 entries may be collected. At the initial visit about 60% of the items are actually collected.

Ninety percent of the information is medical.

b. Patient Identification

I.D. numbers: sequence number specific to the clinic,
medical record number (unit number) of the hospital
Name (full)
Address
Phone (home)
Sex
Date of birth or age
Marital status
Race
Occupation (free text)
Date when this information was collected

c. Financial and Economic Information

An additional option, added subsequent to our visit, provides the "cost per visit" based on the diagnostic tests and treatments recorded during the patient visit.

d. Data Base: History of Present Illness

(Collected at any visit by the physician.)

Chief complaint: Severity, symptoms (descriptive, not entered), and detail (location, spread).

Many symptoms specific to this disease category are collected and coded as to presence and severity of symptoms.

No active problems; no risk factors.

The collector of information is identified by code.

e. Data Base: Past Medical History

Family history: Family detail for unidentified blood relations refers to this chronic disease class only (rheumatic disease).

No past diseases.

Hospitalizations are recorded as one clinic visit.

Previous diagnostic tests and observations relevant to this disease are entered and this information is retained forever to the same extent and in the same format as visit data. The data of onset (prior to any visits) is also recorded.

No immunizations are recorded.

No allergies are recorded.

Current medication, by code, with quantity and frequency are recorded.

Past medications ordered are recorded by quantity and frequency, for visits to this clinic.

No diet is recorded.

Psychiatric, only general attitudinal data are recorded.

Collector is identified by code.

f. Data Base: Social History

No social history is collected.

g. Data Base: Review of Systems

System name: Positive findings are coded 1+ to 4+ or zero, if observed.

h. Physical examination:

Date
Height
Weight
Vital signs

Now have an extensive physical exam specifically for this disease category, with special emphasis on the musculo-skeletal system, with examination results. Coded as the presence and severity of signs. Past data is retained.

i. Data Base: Objective Findings of Past Medical History

Routine laboratory specific findings;

Special laboratory findings for immunologic tests;

X-rays: linked anatomical sites normal or abnormal (as pertain to arthritis);

EKG's, finding normal or abnormal;

Pulmonary function test findings;

Other medical tests: renal function, liver, skin tests, biopsies;

No past memos are recorded.

j. Problem List

On manual face sheet only with ICDA code for general problems. Immunologic diseases are coded within the automated system.

k. Plans, Diagnostic Orders

No plans are kept on the system. Some specific diagnostic orders are maintained in the system. Orders are not transmitted from the system to the laboratories.

l. Plans, Therapeutic Orders

Medications and surgery as specific to rheumatology and immunology are kept.

m. Follow-ip

Specific follow-up protocols may be indicated.

n. Progress notes are not encoded. Only coded data as shown is put into the data base, only items examined or done at each visit.

o. No patient services management data are entered into the computer.

p. No practice information outside of the strict medical record is collected.

q. Research Oriented Data

Many of the data categories are collected for research purposes.

r. Other Comments

The decision to include a variable is based on its power and its frequency of use when describing patients. The system is also able to make predictions on mortality, morbidity of patient with immunologic diseases.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computer(s):

Now: 1 IBM 370/158, 512K, installed in 1973, on a 10-year purchase.

Future: 1 IBM 360/67, 2M, installed in 1967, purchased.

The computing services are provided through an associated organization, SCIP, the computer service group at Stanford University.

Most of the equipment is purchased, the processor by SCIP, the terminals by the Immunology Clinic. Disks are leased.

Maintenance is by vendor.

Approximately 1.5% of the processing capability is used for the Ambulatory Medical Record Application.

Approximately 1.5% of the file capability is used for the Ambulatory Medical Record Application.

The files are stored on any of 11 Ampex 2314 type disk drives.

Terminals used are hardcopy:

Printers: 14 units of the types:

2 IBM 2741
8 GE Terminet (300 and 1200)
3 Execuports
1 IBM MCST

They all have 132 characters per line, with upper and lower case,

Speeds from 15 to 120 cps,

Noise level: medium to low,

Print mechanism: impact,

Cost: $3,500 to $4,000,

Reliability: medium to good.

And CRT Softcopy: 4 units of the type

Super Bee with upper and lower case,

Speed: 120 cps,

Screen size 80 Characters x 24 lines,

Cost: $3,500.

There legibility is adequate, their interface options have given problems.

The terminals are local to the users; the Immunology Clinic has seven terminals (2 Terminets, 2 Execuports, 1 IBM 2741, and 2 Super Bees).

Archival storage is tape (system provides back-up).

b. The system uses timesharing in one partition of IBM's VS. It is a multiprogramming system, which is supported by paging.

Currently, production in this clinic occupies four hours per week of the machine, and development requires 20 hours of terminal usage per week. Other clinics do less development, and the total development may amount to 40 hours of use per week.

Of the production load 85% is data entry and 15% is data analysis or report preparation. File maintenance is done at night by the system.

c. The operating system (ACME) was designed and written for general medical purposes and is superimposed on a system for general commercial purposes.

The ACME System is still understood by the local staff, but ignored by the supplier of the computing service; thus the system is decaying.

The file system is characterized by indexed files with linked records.

The implementation of the AAMRS requires two distinct files and two distinct record types per clinic. A schema allows each clinic to specify its own record size and content.

d. When there is a computer failure, then the failed computer is restarted as fast as possible, or the problem is analyzed and systems personnel keep the computer until it is fixed. There is no backup.

A noticeable (to the user) failure happens about once per week and that number has been steady.

When there is heavy usage of the Automated Ambulatory Medical Record System, no effect is felt by other AAMRS users.

When there is other heavy use of the computer system, then there will be a terrible slowdown.

e. The staff concerned with data processing in the Immunology Clinic consists of:

1 medical specialist (Dr. Fries)
1 systems analyst
1 programmer
1 data entry clerk

The staff of the university computer center is very large; it reports to the provost of the institution.

The university does not respond well to requests for changes, but most work can be done by local staff.

f. The costs of the computer operation are charged to the clinic according to usage.

The investment in the clinic system is about $100,000 and the operational cost incurred by the Division of Immunology is about $33,000 per year.

g. The ambulatory record system is intended only for this institution; it could be used remotely on a national scale if an adequate level of service and a communication net were available.

To move TOD as it exists either the ACME system on the 158 or the ORVYL system would have to move along. The ACME system will operate as a subsystem on any IBM 370 virtual system, but would imply a system maintenance commitment. The SCIP ORVYL system is currently only available on 360/67 equipment, but is being adapted to work also on 370 machines.

6. FORMAT OF THE MEDICAL RECORD

The record available to a physician when he sees a patient contains:

The manually filled-in flow sheet of 13 or more pages, giving the record of previous visits. Such a sheet could be generated automatically if lost or destroyed. The entries for this visit are made on the flow sheet and subsequently entered into the computer. Instructions for the physician making the entries are printed on the reverse side of the preceeding page. Diagnostic findings between visits have also been entered.

The traditional record is also available. Data are not obtained on-line during a patient visit.

The traditional paper record for most clinics is kept in the hospital medical record room. This record is generally available for patients with appointments and always used.

The flow sheets are kept within the clinic.

Continuity of one provider-patient combination is not strictly maintained due to the teaching environment.

Other computer outputs available to the provider are an amazing variety of consultation aids and data base searches. The consultation is based on experience collected by the system with past patients. The system presents this data in a readable and informative fashion.

The first and portions of some successive flowsheet pages are attached, as is a partial printout of the computer stored medical record and the request and result for a consultation.

AMERICAN RHEUMATISM ASSOCIATION (2)

STANDARD DATABASE FOR RHEUMATIC DISEASE

BACKGROUND INFORMATION

addressograph stamp

RDC VII

Patient Identification:

(ENTER IF NOT PRESENT ON ADDRESSOGRAPH ABOVE)

16. Index No: ______

1. Name: ______
2. Medical Record Number: __ __ __ __ __ __ __
3. Birthdate: ____ Day ____ Month ____ Year
4. Address: ______
5. City, State, Zip: ______
6. Telephone: (___) ___ - ____
7. Soc. Sec. No.: ___ - __ - ____
8. Ethnic Origin: ______:
   (1) Cauc (4) Indian (7) Other
   (2) Black (5) Mexican
   (3) Oriental (6) Puerto Rican
9. Occupation: ______
10. Height: ______ cm.
11. Sex: ______
12. Referring Physician: ______
13. Address: ______
14. City, State, Zip: ______
15. Telephone: (___) ___ - ____
22. Marital Status (Single, married, separated, divorced) ______

Dates of Onset of Disease:

SPECIFY ADDITIONAL SYMPTOMS AS THEY ARISE

		DATE	
		MONTH	YEAR
17.	First Symptom of Disease	____	____
19.	Diagnosis	____	____
21.	Joints	____	____
23.	Skin	____	____
25.	Renal	____	____
27.	G-I Tract	____	____
29.	Neuropsych.	____	____
31.	Muscle	____	____

Family History

(INCLUDE FIRST DEGREE RELATIVES, OTHER BLOOD RELATIVES, SPOUSES. SPECIFY EXACT RELATIONSHIP OF POSITIVE RESPONSES.)

33. Rheumatoid Arthritis ______
34. Systemic Lupus ______
35. Spondylitis ______
36. Gout ______
37. Psoriasis ______

Past Medical History

General:

Operations:

Hospitalizations:

Allergies: (Enter drug allergies of significance on Problem List, Page 1.)

Childhood Diseases:

Habits
- Alcohol
- Tobacco
- Drugs
- Toxic Exposure

Financial Information:

Insurance

MAB-KC

Disability

Return to Work Date:

Other

BACKGROUND INFORMATION

CDS

AMERICAN RHEUMATISM ASSOCIATION (13)

STANDARD DATABASE FOR RHEUMATIC DISEASE

TREATMENT PROGRAM

addressograph stamp

RDC VII

NOTE: List ENTIRE program, including ancillary and supportive treatment. Units (e.g. [mgm/day]) should be written following the drug name. Numbers representing the dosage should appear in the flow sheet.

THERAPY		PRESCRIBED DOSAGE														
DRUG	Units	Past	1	2	3	4	5	6	7	8	9	10	11	12	13	14

AMERICAN RHEUMATISM ASSOCIATION (11)

STANDARD DATABASE FOR RHEUMATIC DISEASE

SERIAL LABORATORY INFORMATION

Chemical and Hematological Data

addressograph stamp

RDC VII

	VISIT NUMBER	Past	1	2	3	4	5	6	7	8	9	10	11	12	13	14
260	Calcium (8.5 – 10.5)															
261	Phosphorus (2.5 – 4.5)															
262	Glucose (Random) (mgm%)															
263	BUN (10-20)															
264	Uric Acid (2.5 8)															

AMERICAN RHEUMATISM ASSOCIATION (9)

STANDARD DATABASE FOR RHEUMATIC DISEASE

SPECIALTY PAGE – JOINT HISTORY

addressograph stamp

RDC VII

INSTRUCTIONS: Units as listed. (blank) = Not Asked or Observed. S = Unchanged
Use first initial of descriptive words to indicate choice.

	VISIT NUMBER	Past	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	ARTICULAR HISTORY															
190	Onset (Insidious, Abrupt, Other)															
191	Severity, Overall (0 - 3+)															
192	Number of Involved Joints															
193	Morning Stiffness (Hours)															

AMERICAN RHEUMATISM ASSOCIATION (5)

STANDARD DATABASE FOR RHEUMATIC DISEASE

SELECTED SERIAL SYMPTOM REVIEW

addressograph stamp

RDC VII

INSTRUCTIONS: Check symptoms present since last recorded observation. If an entire system is the "same" or "normal" then "S" or "O" may be placed in the system box (pink) and will apply to all subheadings under the system.

KEY: S .... Unchanged; O .... Normal; (blank) .... Not Asked; ±, 1, 2, 3 .... Degrees of Abnormal

	VISIT NUMBER	Past	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	GENERAL:															
3	Fatigability															
4	Fever															
5	Shaking Chills															
6	Recurrent Infections															
7	Weight Loss															
8	Photosensitivity															

P

IDENTIFICATION OMITTED

?78767

Stanford University Hospital (I)
Stanford, California 94305
TIME ORIENTED RECORD
Summary of Patient Chart
Parameters with Positive Values

H14 City, State,
H15 Telephone
H17 First Symptom of Disease date 30JUL1956
H40 Chief Complaint: Arthritis

VISIT NUMBER	24 4JAN 1972	25 1MAR 1972	26 30MAY 1972	27 11JUL 1972	28 21SEP 1972	29 16AUG 1973	30 26SEP 1974	31 24OCT 1974
3 Fatigability +	+1	+1	+1	+1	+1	+1	+1	+1
4 Fever +	+3	+3	+3	+3	+3	+3	+3	+3
5 Shaking Chills +	+1	+1	+1	+1	+1	+1	+1	+1
15 Other Rash +	+0	+1	+1	+0	+0	+0	+0	+0
18 Alopecia (disease or drug)	+4	+4	+4	+4	+4	+4	+4	+4
24 Conjunctivitis +	+1	+1	+1	+1	+1	+2	+0	+0
42 Nasal Complaints +	+1	+1	+1	+1	+1	+1	+0	+0
35 Edema, Dependent +	+0	+0	+0	+0	+0	+1	+1	+1
54 Abdominal Pain, Other +	+0	+0	+0	+0	+0	+1	+1	+1
61 Seizures +	+1	+0	+0	+0	+0	+0	+0	+0
95 Weight kg	94.30	93.00	96.40	97.60	97.00	92.50	97.40	94.60
96 BP - Systolic mmHg	130.0	130.0		120.0	125.0	120.0	120.0	120.0
97 BP - Diastolic mmHg	80.00	85.00		80.00	80.00	90.00	80.00	80.00
98 Temperature deg C				37.30	37.20	37.40		
99 Respirations /min	14.00	20.00	14.00		14.00	16.00		
101 Telangiectasia +	+1	+1	+1	+1	+1	+1	+1	+1
Dry Rales +	+1	+1	+1	+1	+1	+1	+1	+1
	+1	+1	+1	+1	+1	+1	+1	+1
	20.00	20.00	20.00	20.00	20.00	2.000	2.000	2.000
				0	0	0.300	0.300	0.300
						Adequ	Adequ	Adequ
								+1

?PROGRAM AUTOSET NOLIST
RUN?

Standard options (Y or N)=?Y
Specify Diagnosis, or 0 for Diagnosis list, or carriage return for "none":=?SLE
Diagnosis 1: SLE
205 patients found with Diagnosis of SLE .
Specify element number or name, 0 to start over, carriage return when done.
Specify descriptor 1:=?PCV
Enter value for PCV (286): =?42
Specify descriptor 2:=?SED_RATE
Enter value for SED_RATE (298): =?12
Specify descriptor 3:=?PROTEIN
Enter value for PROTEIN (360): =?0
Specify descriptor 4:=?

A set of 30 patients has been assembled with the following clinical features:
Diagnosis: SLE
Hematocrit (42.0) : 40.9 to 42.9 (%)
Wintrobe Sedimentation Rate (12.0) : 8.74 to 15.2 (mm/hr)
Further specification was not possible because of number of available patients.
Do you want to save this subset for analysis (Y or N)=?Y
Name of target patient # 1:=?WOLK, GENEVA
Is this a formal consultation (Y or N)=?Y
Medical Record #=?364604
Referring Physician=?FRIES
Ward or Clinic=?IMMUNOLOGY
Specify 0 if done, 1 for new patient, 2 to change options=?0
Specify 0 to postpone analysis, 1 for one-page report, 2 to make slides=?1
0 for Standard, 1 for CRT, 2 for Portable=?0
LOGOFF when done (Y or N)=?N
Analysis takes a little while, please be patient.
Now adjust paper to exact top of next page.

CDS

[redacted]

Medical Record Number: [redacted]
Date: DEC 4, 1974
Referring Physician: FRIES
Ward or Clinic: IMMUNOLOGY

Stanford University Hospital
Stanford, California 94305
COMPUTER PROGNOSTIC ANALYSIS

30 patients have been selected with the following criteria:

Diagnosis: SLE	Patient value	Range used for selection
Hematocrit	42.0	40.9 to 42.9 (%)
Wintrobe Sedimentation Rate	12.0	8.74 to 15.2 (mm/hr)

Clinical Findings

Age (mean) 36.7 years
Sex: 5 male, 25 female

Rash (% of patients)	73.3	%	
Pleurisy (% of patients)	53.3	%	
Arthritis (% of patients)	73.3	%	
Proteinuria (% of patients)	46.7	%	
Hematocrit (mean)	40.7	%	(+/- 3.73)
White blood count (mean)	6.67	x1000/cumm	(+/- 2.04)
Sedimentation rate (mean)	20.5	mm/hr	(+/- 10.9)
Creatinine (mean)	0.909	mgm %	(+/- 0.232)
Complement (mean)	102	mgm %	(+/- 29.3)
FANA: % patients	73.3	%	mean titer 1:207
Anti-DNA: % patients	30.0	%	mean titer 1:48
Anti-ENA: % patients	30.0	%	mean titer 1:2755
Latex Fixation: % patients	6.7	%	mean titer 1:1407

Prognosis

Per cent of patients experiencing each event.
Analysis begins at the point where defining criteria were met.

End Event (Months)	1	2	4	6	8	10	12	14	16	18
Death (cumulative %)	0	0	0	0	0	0	0	0	0	0
Arthritis, remission (%)	0	0	0	0	0	0	0	0	0	0
Skin Rash, increase by 1+ (%)	3	3	3	10	10	17	17	17	17	17
Pleurisy, increase by 1+ (%)	0	4	4	4	4	4	4	4	4	4
Proteinuria, increase by 1+ (%)	3	3	9	9	23	23	30	30	30	36
Creatinine, increase by .2 (%)	0	0	6	12	12	12	20	20	20	27
Patients followed (number)	30	19	17	14	12	11	11	11	11	10

Therapy

Drug	# of Patients	Mean Dose	Associated Therapy	Response Index
Prednisone	16	13.3 mgm/day	Plaq(6),ASA(4),Indo(1)	+ 2.6
ASA Equivalent	8	11.4 tabs/day	Pred(4),Plaq(1),Indo(1)	- 20.3
OH-Chloroquin	6	233 mgm/day	Pred(6),ASA(1),Indo(1)	- 9.4
Indomethacin	4	62.5 mgm/day	ASA(1),Plaq(1),Pred(1)	NONE
Colchicine	1	1.2 mgm/day		NONE

Comments and Interpretation of this study
on the reverse side.

7. INTEGRATION OF FUNCTIONS

a. The computer operation by SCIP and ACME is a service to the ambulatory health care delivery service, the Immunology Clinic.

Administratively and technically the computer service is directed by the university administration. There is a faculty advisory committee.

The financial resources for the development of SCIP and ACME have come from recharges and grants, and the cost of its operation is paid by recharges to the clinics and other users.

Within the clinic, priorities for applications are determined by the clinic director and programmed by his staff.

The funds for the development of the AAMRS, TOD, have come from general grants and other academic resources. There is now specific grant support to further TOD development in Immunology as well as some income from services.

b. Other automated services used by the ambulatory health care delivery system, such as billing, payroll, and financial (e.g., accounts and ledger), are provided by hospital computing under SCIP. None of these would be replaced with this system.

c. In summary, this computer system is best viewed as a research project with clinical impact.

8. INFORMATION DISTRIBUTION

a. No reports are received regularly by administrative management.

b. No reports are received regularly by clinical personnel.

On-line requests by clinical personnel are for data analyses (1,500 per year) and occasionally for individual records.

c. Special requests are made to the data processing staff for items such as research studies.

9. INFORMATION UTILIZATION

a. The system provides information for medical researchers and clinical physicians. Training of physicians is a by-product. The system has been used to demonstrate its potential usefulness in quality of care review. This has been done by looking at the appropriateness and freqeuncy of physical, diagnostic, and therapeutic parameters for a given diagnosis.

The system also is able to make predictions about mortality and morbidity of patients with immunologic diseases based on experience with past patients. It is able to present these data to physicians when requested through a laboratory order, in a readable and informative presentation.

The information is intended to assist in the delivery of chronic disease maintenance and research regarding such diseases.

In order to make more intensive use of the system, data have to be collected from more sites; and costs have to be reduced. A cooperative network of centers of activity in the area of rheumatic diseases has been proposed.

b. The group which currently depends on the outputs from the automated system are the medical researchers.

If the system does not work, then operations in the clinic are not held up since the paper record is used there. Specific problems in that case are a waste of time of professional personnel.

If changes in the system are required, then a decision to implement them is made in one day to three months (depending on the operational level: clinic, TOD, or SCIP); and it typically takes another one day to one year to actually change the computer system.

An example of a change which was desirable, a better accounting algorithm for the operating system, took nine months implementation time; a change in the AAMRS which was cosmetic (e.g., the use of words to replace small integers, "1 day" changed to "one day") was done in one day.

10. EVALUATION OF EFFECT OF AMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the quality of care. This has been due to some increased services and better quality of services through advances in technology. The clinical attention to accurate data is also considered to have improved care.

Findings resulting from long-term studies of many variables (history, physical, laboratory) in patients with immunologic diseases have been published. These provide a means to improve the quality of care for this disease in general.

Sufficient data has been collected to form the basis of a monograph:

> James F. Fries and Halsted R. Holman
> Systemic Lupus Erythematosus: A Clinical Analysis
> Saunders 1975

b. The change in the quality of care is considered to have been improved by the health care provider. Subjective estimations have been used to judge the medical record for accuracy and completeness for research purposes.

The technology used has been evaluated through a consultant's opinion (Dr. Ed. Hammond of Duke University). Measures used have included the time taken for specific tasks, as the update of the medical record, etc.. The system approach has been evaluated by Dr. Alvan Feinstein of Yale as part of a Health Care Technology Study Section Site Review.

11. ECONOMIC INFORMATION

a. The total annual operating budget of the parent organization, the Stanford University Medical Center, is about $90 million, and the annual operating budget of the AAMRS user, the Division of Immunology is about **$600,000 of which the clinic managed by Dr. Fries is allocated** $200,000.

The major sources of operating funds for the parent organization are fee-for-service revenues, direct appropriation from the university, subsidies, and grants. The Division of Immunology is supported by the same sources, and the major sources may be considered grants and fee-for-service income.

The cost of patient services, the fee structure, is determined by the parent organization, with some special fees being determined by the Division of Immunology. The cost of services to the patients has increased since the introduction of the AAMRS due to a special annual fee for the service, the fee charged for the computer consultation service, and some increase in the number of laboratory tests ordered. Offsetting benefits for patients are discussed on Page 30.

b. The AAMRS is a supplement to the medical record system of the parent institution, and **replaces a great deal of the content or format of the central record.**

The patients' medical records are primarily handwritten and stored centrally in the parent institution. A unique identification number is used for each patient's medical record. The medical record format is considered to be a disorganized collection of information. The AAMRS medical record uses the same patient identification number and is filed within the Division of Immunology rather than centrally.

c. Cost Analysis: Development Costs

The development of the AAMRS involved about 8 man-years of effort at an estimated cost of $100,000. While the AAMRS is considered operational, developmental work is continuing at a cost of about $1,900 per month ($2,500 with indirect costs). Additionally, work is being done in order to transfer the system to another SCIP computer, pursuant to university policy; SCIP is supporting one FTE programmer for this effort.

Expected future changes in the AAMRS operations include the addition of additional services as necessary and the expansion the system to other geographical sites. The expansion to other sites is intended to increase the size of the data base for research activities and to test the feasibility of multiple sites contributing to the same data base. The timing of the expansion is dependent upon outside grant support.

Cost Analysis: Operating Costs

The current total direct operating costs for the AAMRS system support and ongoing development is about $62,000 (including indirect costs about $81,000) and the total AAMRS costs incurred by the Division of Immunology as a user is about $20,000 ($23,000 with indirect costs).

The Division of Immunology represents about 30 percent of the total AAMRS user activity; thus the total cost of the division's AAMRS use is about $38,000 annually ($20,000 plus 30 percent of system support and development, with indirect costs about $47,000).

The major sources of funds supporting the AAMRS in the Division of Immunology are as follows:

4%	Patient fees
54%	Grants: Arthritis Foundation, NIH, American Society of Internal Medicine, regional medical programs for quality assurance
6%	Parent organization: Professional salaries and paper for forms
36%	Central computing facility support (SCIP) in consideration for computer time purchased and conversion.

The primary fiscal decision makers with respect to the AAMRS user budget (AAMRS user - the Division of Immunology) are the clinic director and administrators within the medical center.

The primary decision makers with respect to the computer use charges are the computer facility administrators and the university administrators. The AAMRS user has no control over the computer use charges other than the quantity of services consumed.

Considering that a major system objective of the AAMRS is to support research, it is unlikely that the AAMRS will ever become self-supporting. Thus the system will be heavily dependent upon research funding to remain viable. **Consultation charges, if marketed on a sufficient scale, could alter this conclusion.**

Cost Analysis: Investment Costs

The investment costs incurred by a new user of the AAMRS within the parent institution is about \$7,200 (\$10,000 with indirect costs).

The major effort required is approximately a half-time physician (resident or post doctoral) for 6 months to be responsible for the planning and design of the data base and the forms needed for the collection of data. AAMRS staff provides consultation and advice as necessary.

The minimum equipment requirement for a user is considered to be 1 hard-copy terminal that prints 30 characters per second. **Such terminals can be leased or purchased.**

The training of a data entry clerk and professional users of the system once the system is established is considered to be minimal.

Constraints that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

The current system is required to use the university's central computing facility. Since the system was originally developed on ACME, an independent medical center research computing facility, the AAMRS staff currently is converting the software for use on the central facility.

The current system is heavily subsidized through research grant funds. It is unlikely that the system would be considered cost effective at sites where it would be used only for direct patient care; **again, depending upon the market for consultation services. In addition, funding of a multi-center network as a national resource is feasible and such funding might be stable and long term.**

d. Benefit Analysis: Tangible Benefits

System Cost Savings

Because the AAMRS is a supplement to the existing medical record system, there are no system cost savings. The Department of Medicine pays \$60,000 annually to the Medical Record Department. The Division of Immunology now does not utilize its share (15%) of this service. There may be some savings in the Medical Records Department.

	Estimated Amount
Health Manpower Savings:	
Physician time: The speed of physician access to information has decreased, resulting in a reduction of patient visit time from 30 minutes to about 22 minutes; 8 minutes x 4,000 visits per year = 32,000 minutes per year or about 66 days per year. Resident/graduate standardized cost per day = $83. 66 x 83 = $5,480	$ 5,480
Clerical time: Estimated at 3/4 FTE (standardized salary $6,200 per year). Staff was not increased while patient load was doubled. ($6,200 x .75) plus fringe benefits and overhead = $8,000	8,000
Patient costs:	
Fee increase (adverse benefit)	(2,400)
Visit time saving - 66 days- $20 per day (standardized earnings) = $1,320	1,320
It is believed that the number of tests performed have increased, but no estimate of this cost is possible; it may be offset, however, with potential hospitalization costs avoided. No change in number of visits per patient.	
Total estimated tangible benefits (current year)	$12,400

Benefit Analysis: Provider Intangible Benefits	Estimate of Benefit Analysis
Direct Patient Care (Quality of Care) - Major Impact:	++
Patient management is improved through availability and organization of the medical record. Additionally, the AAMRS provides a consultation service which helps treatment planning (potential impact of this service is unknown); it was just introduced at the time of the site visit).	
Patient compliance appears improved, due to a positive reaction toward more information available about the patient. The patient perceives that the physician knows more about his problem and progress, so he believes he is getting better care.	
Various studies have been performed with respect to specific medical problems.	
Access to Care - Marginal Improvement:	+
Access to care was not a primary system objective.	

Estimate of Benefit Analysis

Management Improvements: +

There have been some improvements in the management of the clinic.

Benefit Analysis: Societal Intangible Benefits

Quality of care review methodology: +

Various methodological studies are underway, primarily oriented toward the use of decision analysis.

Research activities: +++

The focus is to improve patient care by improvement of the clinical decision-making process. One of the major factors affecting clinical decision making is education and published research. Accordingly, research is a primary objective of this AAMRS.

Training: ++

It is bel~~ieved that~~ a dramatic impact has been made upon clinical training. It has become more data-oriented. The clinics training program has actually increased in size and scope.

Planning: potential

The system has potential for contributions toward long-range planning.

Other Benefits:

A major potential benefit is for patients and physicians outside of the current system. It is expected that private physicians will be offered the consultation services for a fee. The value of this benefit may change significantly in the future, as utilization of this feature increases. +

There also has been an impact upon the development of a standard data base for rheumatic disease. Material has been published relating to quality of care, patient management, and teaching. +++

12. COMMENTS

The group of researchers uses the medical record to further their understanding of diseases processes of complex etiology. The main benefits are the increase in medical knowledge. This gain is achieved by a powerful capability for analysis and hypothesis verification. The flow sheet approach to record keeping, apart from the automated system, allows better review of disease progress, specifically for chronic ailments. This manual system does aid the patient care process. It provides better manual data retrieval, more thorough data acquisition, and a "time-oriented" approach to data recording. There is additional work involved in this method of record keeping. Dr. Fries used residents on rotation who do the work as part of their training. In Cardiology MD's are reimbursed $2.00 per TOD chart completed. The data quality in the manual record is probably enhanced due to its relation to the computerized system.

A traditional record is also maintained.

Acceptance of the system is difficult to assess. Because of its benefits to research oriented physicians, it has been adopted by other clinics. The other physicians involved without are in training and have a limited commitment.

The approach is limited to the one point of view of the medical record.

The general atmosphere is very decentralized. The researcher do fairly well as long as he can pay for the services.

The programming system is very flexible. The cost is high for entry and retrieval, the utilization is high by the originator for research. Use is widespread but not as intense in other clinics.

The desire for national compatability by specialty is great.

The technical support does not favor transportability of the automated system outside of Stanford. Use at Stanford is afflicted with an excessive organizational overhead and may discourage increased use at Stanford. Dr. Fries is evaluating other means of computational support for TOD for the long range.

It is, in the research context, possible to use the system from remote locations.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDI-3
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO A USER OF THE CLAIMS DIRECTOR SYSTEM OF INSURANCE TECHNOLOGY CORPORATION 2118 MILVIA STREET BERKELEY, CALIFORNIA

Dr. Stephen S. Leavitt from Insurance Technology Co. (ITC), Berkeley, introduced the visiting study team to the manager of the group using the Claims Director System. He presented the background of the system. Operational data were provided. Mr. Emmett Burns and Mr. Jim Raphael of ITC described the technical aspects of the system. Mr. Tom L. Johnston of ITC provided data regarding the earlier statistical evaluations. Additional information was obtained from a number of publications presented by ITC. For commercial reasons the AAMRS user prefers to be unidentified.

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The primary outcome objective for the insurance companies using this system is reduction in dollar reserves that the users have to set aside as required by law to pay future life-time benefits to awardees of workman's compensation.

The related societal outcome objective for the system is principally quality of care improvement in the area of acute medicine and the prevention of recurrence of disability through better communication among personnel and better feedback.

Access to care improvement is achieved by contact with appropriate providers and simplified administrative barriers.

Cost minimization is achieved by better use of resources. This may well involve increased costs of care to be offset by a shorter disability.

These objectives have come about in response to a need felt by a psychiatric researcher who is now the president of ITC, and have been seconded by the administrative director of the claims processing group.

b. The population which is to be served by the system is selected by the availability of financial coverage through workman's compensation insurance paid for by employers.

The population is special in terms of diseases presented (trauma cases causing disability), social category (employed), age distribution (adult), and geographic distribution (San Francisco, Marin, and San Mateo Counties).

The service environment is urban and suburban. The care required is secondary or tertiary care.

The quality of health care delivered to the same type of population served here is adequate in a somewhat uneven way as judged by the claims managers.

The average per capita annual income of the institution's patient population is $175 per week(as obtained by on-line inquiry during our visit).

The size of the insured population served by this system currently is about 100,00; this company experiences 5% to 10% growth per year.

The needs for this population are in the area of acute and supportive care or specialty therapeutic care resulting from work-related injuries (trauma).

Patient contacts are a result of workmen's insurance claims.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Quality of care as reflected in feedback to physicians regarding achievement of desired outcomes, patient compliance with physician orders because of continuity of care, problem identification, and treatment planning.

Access to care as reflected by patient follow-up, referrals to providers, appointment scheduling, and insurance record availability.

Resource utilization, namely, control of patient services achieved through better referral.

Very important are management aspects (secondary cost factors) aimed at:

improving management and operations of the facility by the provision of management with information and analytical tools for manpower scheduling, budgeting, and planning;

faster processing in payee claims handling; and

increased productivity of claims handling manpower, faster claims processing, and cost control.

Other specific objectives unique to the facility are as follows:

The workmen's compensation insurance company has follow-up

-liabilities which exceed the obligations of health care providers. There is a positive payoff in the use of medical and patient management resources when it leads to an earlier return to work. Until that time income compensating benefits have to be paid and life-time benefits have to be set aside as reserves to cover partially or totally, permanently,disabled cases.

b. The organization which has made the decision to provide automated record services is the home office of an insurance company, which is a wholly owned subsidiary of a private profit-making corporation. Expansion of use will depend on management decisions.

The size of the clientele entered into the system is the following:

Number of patients = 1,200 (yearly average), or about 600 current active;
Number of patient contacts per case= 2 to 15 (3.5 average);
Average time per case is 8 months and response time is 24 hours.

Cases with less than three days disability are not entered. Their records are managed manually.

The control over the medical content of the record system is established by the user through his contract with the vendor.

The technical operation of the system is in the hands of the vendor of computer services and under supervision of the administration of the insurance company.

3. SERVICES PROVIDED

Data collection is done using forms with text (10%), special marks, and codes, to be entered as is, using a CRT keyboard.

Source data collection is by the claims adjusters, They have some medical knowledge.

Data entry is by clerical personnel.

The data are transmitted by direct connection to the computer.

The data are stored selectively using the closing date as a criterion, and then archived.

The entered information is used to provide daily work lists, to make schedules for claims follow-up, and to generate reports such as client profiles and financial status reports as needed. A daily four-page management report is also generated.

There is the capability to inquire into the files to determine a patient's medical status (to the extent stored on file), financial status, and appointments by any variable using range indications and boolean combinations of variables.

These services are provided at a central site.

Other relevant services provided by other systems are the manual handling of claims. Financial services and policy records are handled by the central organization.

4. TASKS REQUIRED

a. Data Entry Tasks

Data entry is accomplished through CRT keyboard entry; missing data elements are coded to a specific representation.

Verification of data entry is done by data entry context checking, by data entry limit checking, and by output scanning. Most errors are found by other clerical personnel (90%) and by billing personnel (10%).

Error correction is done on-line. A correction automatically changes the entry only. An audit trail of all errors is not maintained.

Data entry hardware has given very few problems. The disk is the least reliable unit. Data entry software has given few problems after the first year.

b. Data Storage

File Updating

Additional data entries are reflected in the files immediately; changed data entries are reflected in the files immediately. The data invalidated are not kept.

File Storage

The data which are entered into the file are moved to archival storage several months after the last visit and kept on an archival disk.

File Usage

To obtain a current record from the file requires less than 10 seconds; to determine whether a patient has a record in the file requires less than 10 seconds. The search can be done by unit number or exact name.

The file also is used directly to answer research questions or abstracted when research questions have to be answered.

File Size

The required file space is now 900,000 characters, and is expected to grow to 2M characters. When a shortage of file space occurs, then old records will be deleted and archived. The files are indexed and dynamically allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available:

Individual patient record by retrieval of complete patient record, retrieval of abstract of patient record, generation of flow sheet for patient, generation of worksheet for patient, generation of financial history of patient, and generation of claims payment forms.

Selection of Patients

Selection of all patients with a given problem or diagnosis, value of sign of symptom, treatment modality, financial classification, and any combination of the above is possible.

This selection is made on the basis of singled visit records or across a time axis. Selection of patients due for a visit or review is done regularly.

Tabulation of provided services by diagnosis or problem, patient category (age, sex, etc.), provider, or services rendered is done regularly.

Comparison of selected patient groups includes descriptive statistics (e.g., tables, histograms, scatter plots, means, and standard deviations).

Scheduling procedures are utilized for patients through prediction of need.

6) Financial management includes claims processing, payouts, accounts payable to claimants, and cost analysis.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by the vendor.

The routines are specified by the vendor.

Their operation is verified by the vendor through pilot operation.

The routines are kept on a user-specific library file.

Their documentation is kept on paper in user-specific files.

The principal programming language is Assembler.

e. Protection of Data

Access to the computer system is physically controlled. There are no remote stations. The system is locked with a key when the facilities are unattended.

f. Training

New claims adjusters are given formal instruction, demonstration, and documentation in order to learn how to use the system. The training period is two days, and after two weeks they are fully proficient in using the system for retrieval.

New clerical users of the system are given instruction, demonstration, and documentation in order to operate the system. The training period is a week, and after an additional two weeks they are fully proficient in entering data into the system.

g. Presentation of Results

The means for producing output are hard-copy printers and soft-copy CRT's.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient record is variable. A limited number of data elements describing the patient are collected into groups which are used to track the patient:

The work track,
The impairment track (physical and psychological status),
The medical care track (MD, psychological, surgical),
The life support track (use of hospital, etc.),
The insurance track (use of benefits), and
The legal track.

In addition, all encounters, including telephone inquiries, responses, and payments are logged.

b. Patient Identification

I.D. number: Social Security Number
Name (full)
Phone (home and business)
Sex
Date of birth or age
Marital status
Language spoken
Occupation, free-text (optional) and coded
Date when this information was collected.

c. Financial and Economic Information

Total payments made
This visit (line itemized amounts)
Payment detail is retained (date, provider, date paid)
Guarantor (relationship, amount)
Insurance carriers (name, type, code, date insured)

d. Data Base: History of Present Illness

Chief complaint (coded): Date of onset; severity; symptoms (coded); and detail on location, spread, onset type, and quality.

Collector of information (adjuster) is identified.

e. Data Base: Past Medical History

No family history is collected.

Past diseases are coded.

Hospitalizations for current case: Number, type of operation or illness (free text), date, and location.

Current medications: Total cost only, no detail.

Psychiatric: General attitudinal, detail of encounters.

f. Data Base: Social History

Employment, income source, primary language, ability to speak English are collected.

g. Data Base: Review of Systems

No review of systems.

h. Data Base: Physical Examination

Physical Examination (text only) is recorded.

i. Data Base
No objective findings of past medical history.

j. Problem List for Current Case

Active problems - date of onset, date of entry, problem name and code, diagnosis code, severity, and status.

Temporary problems.

Inactive problems - date of onset, date of entry, problem code, and diagnosis code.

k. Plans, Diagnostic Orders

Laboratory orders; X-Ray orders (anatomical site); EKG's, other cardiac test orders; EEG's, other neurological test orders; pulmonary function test orders; and other medical tests. Physician is identified.

l. Plans, Therapeutic Orders

Physical therapy, occupational therapy, activity orders (descriptive), and nursing orders. Physician is identified.

m. Follow-up

Prognosis - recovery time, functional effectiveness, and long-term care requirement. Disposition is coded. Physician is identified.

n. Progress Notes

Encounter forms are coded for all accidents and illnesses.

o. Patient Services Management

Action plan with schedules for patient, visit reminders for patient via claims adjuster dependent on diagnostic results, and auxiliary service schedules. Patient compliance is measured indirectly.

p. Management Information

First contact with this practice or agency; encounter sites by type, code, and mode of arrival; referral - self, MD, or other; providers at encounter - MD, nurse, PA, other; encounter duration and frequency; use of other facilities, providers, hospital, ER; and audit-oriented data.

q. Research-oriented data are available.

r. Other Comments

Despite the intended design purposes, this system obviously is applicable to clinically oriented AAMRS's.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computer:

1 ITC, Model 1850 was purchased for $175,000, installed in 1973. The cost covers the hardware and the software. The machine is assembled by ITC from components of various suppliers. The software is proprietary to ITC.

The computing services are provided through the vendor but completely installed in-house. The equipment may be leased or purchased for approximately $150,000 to $180,000. Support is by vendor and costs $875 per month for hardware maintenance and software maintenance and upgrading.

All of the processing capability is used for the claims adjusting application. All of the file capability is used for the claims adjusting application.

The processing unit is one 8K Data General Nova. The files are stored on two Diablo 33 disks. Other important equipment is one Centronix printer (165 char./sec.). Archival storage is kept on 2315 type disks. Retrieval response time is a few seconds. The terminal is a TEC CRT, 50 ch. x 20 lines, upper case only, with good legibility.

b. The system uses monoprocessing with paging for its transaction processing. Production occupies 100% of the machine. Of the production load 50% is data entry, 5% is file maintenance, 30% is data analysis, and 15% is report preparation. Development is carried out on machines in-house at ITL.

c. The system was designed and written for this application. It requires no attention by the local staff, but is further developed and maintained by the original supplier.

A simple, tabular language is provided by ITC for the user to allow storage and recall of search and reporting requests of regular interest to the user.

The file system is characterized by indexed sequential files with linked records. The implementation of the AAMRS requires seven distinct files and seven distinct record types.

d. When there is a computer failure, then the problem is analyzed, initially by phone, and systems personnel keep the computer until it is fixed. A noticeable (to the user) failure happens about three times per year, and that number has been steady.

e. The data processing staff consists of two data entry clerks.

The data processing staff reports to the claims manager of the institution.

The response to request for changes in system output is one month to three months.

f. The costs of the computer operation are fixed and budgeted. The investment in the system is about $25,000; in addition, the hardware and the operational cost is about $900 per month exclusive of personnel.

g. The ambulatory record system is intended for distribution. It is currently used at about 25 sites and supported by the venfor (ITC).

6. FORMAT OF THE MEDICAL RECORD

The record used by the claims adjustor when discussing a case is a specially designed folder. Before initiating a contact, or when questions arise, an inquiry may be made into the system to obtain a verification of the most recent status or a case summary can be obtained.

One side of the chart contains traditional documentation, the other side a continuous right folding sheet displaying a time scale. The data for various tracks of follow-up are charted using symbols to indicate achieved goals, prognoses, follow-up actions, etc..

The paper record is kept on-site and is always available.

Continuity of the claims adjustor to patient combination is strictly maintained.

Other outputs available to the provider are case lists requiring attention (surveillance), special reports on grouped cases for follow-up requirement determination, and various case load statistics.

Attached are printouts of the 9 screen images which are used to collect and display the tracking data.

```
PAGE 1      @04/02/74
NAME:DOE, JOHN D.                            CASE#AA11111
------CDS------ MOD:- STATUS:-----------  --/--/--
AGE:--        SEX:------         MARITAL:---------
PHONE:(---)-------
IC:-- PC:---- WAGE/WEEK$------- LANGUAGE:--------
EMPLOYED BY:-----                UNION:-----

CR:--                                    SINCE:--/--/--
LAST CONTACT:--/--/--  QUAL LC:-----------  NC:--
                   NEXT REVIEWS
MC @ --/--/--     1L @ --/--/--     ER @ --/--/--

DOI --/--/-- TOT. ACT. DAYS:---- LAST ACT:--/--/--
   DOA --/--/--                 DOR --/--/--
   DOD --/--/--                 DOC --/--/--
   DOK --/--/--                 DOT --/--/--
 * -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- *
 * -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- *
```

```
PAGE 2      @04/02/74
NAME:DOE, JOHN D.                           CASE#AA11111
REPRESENTED BY:-----
                    INJURY
CAUSE OF:---- ---- ----   NATURE OF:------ ------
TREATING MD:-----            #PRIOR MD'S:--
SINCE:--/--/--               PROCEDURES:------
HOSPITAL:-----               ON --/--/--
DIAGNOSTICS:------------------
                  PD START @--/--/--
       PREDICTED PD RATING:---%  @--/--/--
   FINAL PD RATING:---%  $---------  @--/--/--

    MD $ MIN:--------- MAX:---------  @--/--/--
    TD $ MIN:--------- MAX:---------  @--/--/--
    PD $ MIN:--------- MAX:---------  @--/--/--
TOTAL(+LE)MIN:--------- MAX:---------  @--/--/--

       TOTAL PAID $---------  @ --/--/--
```

```
PAGE 3      @04/02/74
NAME:DOE, JOHN D.                            CASE#AA11111
CURRENT STATE     ENTERED      OBSERVED
WORK:----         --/--/--    @--/--/--
INJ/EMP:---------------------
              PREDICTIONS
W-1:----    ON --/--/--   --%   -?   @ --/--/--
W-2:----    ON --/--/--   --%   -?   @ --/--/--
W-3:----    ON --/--/--   --%   -?   @ --/--/--

W AP#----   @ --/--/--    W AP#----  @ --/--/--
W AP#----   @ --/--/--    W AP#----  @ --/--/--

            TD START  --/--/--  ----
TD RATE $--------         TD PAID THRU:--/--/--
TD$PAID:---------  @ --/--/--  LAST AMT$--------
RH$PAID:---------  @ --/--/--  LAST AMT$--------

TOTAL LOST WORK DAYS:----   #RTW FAILURES:--
```

```
PAGE 7     @04/02/74
NAME:DOE, JOHN D.                          CASE#AA11111
                   SOC. SEC. #----------
     POLICY#------ ---- ------ MO:-- YR:--

                    MED. HIST.
        ------  -----          ------  -----
        ------  -----          ------  -----
        ------  -----          ------  -----
        ------  -----          ------  -----

                    CASE HIST.
     ----  ------  -----  ------  ----  ----
     ----  ------  -----  ------  ----  ----

                    AP HIST.
        ---     ---     ---     ---     ---
        ---     ---     ---     ---     ---
        ---     ---     ---     ---     ---
```

```
PAGE 8     @04/02/74
NAME:DOE, JOHN D.                          CASE#AA11111
DOI --/--/--  CK:--  --/--/-- STATUS:-----------
LAST CONTACT:--/--/--  QUAL LC:-----------  NC:--
MC @ --/--/--     IL @ --/--/--     ER @ --/--/--
                      INJURY
CAUSE OF:---- ---- ----   NATURE OF:------ ------

WORK      --/--/--  FROM:----     TD$PAID:---------
L. S. EV  --/--/--  FROM:------   RH$PAID:---------
L. S. FN  --/--/--  FROM:-----    LS$PAID:---------
MED       --/--/--  FROM:------   MT$PAID:---------
MEDNC     --/--/--  FROM:----     RX$PAID:---------
IMP       --/--/--  FROM:------   PD$PAID:---------
INSUR     --/--/--  FROM:----     LE$PAID:---------
LEGAL     --/--/--  FROM:----     MD LEG$:---------

          TOTAL PAID $---------  @ --/--/--
TOTAL(+LE)MIN:--------- MAX:---------  @--/--/--
```

```
PAGE 9     @04/02/74
NAME:DOE, JOHN D.                          CASE#AA11111

TD THRU --/--/-- M --/--/-- I --/--/-- E --/--/--

MAX EST--------- --/--/-- TOT $--------- --/--/--

CP EST--------- MD EST--------- MAX EST---------

MDX--------- TDX--------- PDX--------- T---------

MD PAID---------     MD EST---------     --/--/--

CP PAID---------     CP EST---------     --/--/--
```

```
PAGE 4      @04/02/74
NAME:DOE, JOHN D.                              CASE#AA11111
CURRENT STATE      ENTERED          OBSERVED
ENVIRON:------     --/--/--        @--/--/--
FUNCTION:-----     --/--/--        @--/--/--

                 PREDICTIONS
EV1:------  ON --/--/--    --%    -?    @ --/--/--
EV2:------  ON --/--/--    --%    -?    @ --/--/--
EV3:------  ON --/--/--    --%    -?    @ --/--/--
FN1:-----   ON --/--/--    --%    -?    @ --/--/--
FN2:-----   ON --/--/--    --%    -?    @ --/--/--
FN3:-----   ON --/--/--    --%    -?    @ --/--/--

LS AP#----   @ --/--/--    LS AP#----   @ --/--/--
LS AP#----   @ --/--/--    LS AP#----   @ --/--/--
LS$PAID:---------  @ --/--/--  LAST AMT$--------
TOTAL HSPE DAYS:----        TOTAL ECE DAYS:----
#REHSPE:--
```

```
PAGE 5      @04/02/74
NAME:DOE, JOHN D.                              CASE#AA11111
CURRENT STATE      ENTERED          OBSERVED
MED:------         --/--/--        @--/--/--
MEDUC:----         --/--/--        @--/--/--
IMP:------         --/--/--        @--/--/--
INJ/MC(SX+C)---------------------
                 PREDICTIONS
M-1:------  ON --/--/--    --%    -?    @ --/--/--
M-2:------  ON --/--/--    --%    -?    @ --/--/--
M-3 ------  ON --/--/--    --%    -?    @ --/--/--
IM1:------  ON --/--/--    --%    -?    @ --/--/--
IM2:------  ON --/--/--    --%    -?    @ --/--/--
IM3:------  ON --/--/--    --%    -?    @ --/--/--

M AP#----    @ --/--/--    M AP#----    @ --/--/--
M AP#----    @ --/--/--    M AP#----    @ --/--/--
MT$PAID---------  @ --/--/--  LAST AMT$--------
RX$PAID---------  @ --/--/--  LAST AMT$--------
```

```
PAGE 6      @04/02/74
NAME:DOE, JOHN D.                              CASE#AA11111
CURRENT STATE      ENTERED          OBSERVED
INSUR:----         --/--/--        @--/--/--
LEGAL:----         --/--/--        @--/--/--
INJ/MCS:----------------------
                 PREDICTIONS
IN1:----    ON --/--/--    --%    -?    @ --/--/--
IN2:----    ON --/--/--    --%    -?    @ --/--/--
IN3:----    ON --/--/--    --%    -?    @ --/--/--
L-1:----    ON --/--/--    --%    -?    @ --/--/--
L-2:----    ON --/--/--    --%    -?    @ --/--/--
L-3:----    ON --/--/--    --%    -?    @ --/--/--
L AP#----    @ --/--/--    IN AP#----   @ --/--/--
L AP#----    @ --/--/--    IN AP#----   @ --/--/--
PD RATE $--------          IN AP#----   @ --/--/--
PD$PAID ---------  @ --/--/--  LAST AMT$--------
LE$PAID ---------  @ --/--/--  LAST AMT$--------
MD LEG$ ---------  @ --/--/--  LAST AMT$--------
```

7. INTEGRATION OF FUNCTIONS

a. The computer operation is an integral part of the claims adjusting group. Administratively, the computer service is directed by the claims department. Technically, the computer service is directed by the claims department.

The financial resources for its development have come from the vendor, and the cost of its operation is paid by the corporate management of the user. The priority of new tasks for the system is determined by the corporate management.

b. The automated medical record system supports the manual medical claims records. Its outputs are inserted into the paper system. Information from the paper system is taken into the automatic system continuously.

c. Other automated services performed by the insurance services, such as check generation, could be added to this system.

d. In summary, this computer system is best viewed as a production service.

8. INFORMATION DISTRIBUTION

a. Reports received frequently, on demand, by administrative management aggregate cost by case, by type of cases, by insured, and provide personnel statistics. On-line use by administrative management is for cost control.

b. Special requests are made to data processing staff for items such as research studies. This happens about one to three times per month.

9. INFORMATION UTILIZATION

a. The system provides information for the administrative staff, the claims adjustors, and a rehabilitation nurse. In addition, it is used to generate management reports and by management for review of patient follow-up. It provides some information for actuaries, underwriters, and medical researchers.

The information is intended to assist in the management of claims and the delivery of acute care, preventive secondary care, and chronic disease maintenance.

In order to make more intensive use of the system, more hardware is required if reimbursement check writing is to be done, more communication gear is required if integration with the central system is required, and more software is required to automate letter writing. It is not felt that more data have to be collected nor that data have to be stored longer.

b. There is the primary paper document so that no one depends on continuous operation of the system.

If the system does not work for 10 minutes, then operations are held up.

If changes in the system are required, then a decision to implement them is made in three months to one year; and it typically takes another month to actually change the computer system.

Examples of changes which were necessary are the addition of further coding fields. A desirable change was the storing of report generator prototypes for frequent searches. A cosmetic change was the storing of the names of the claims adjusting team.

10. EVALUATION OF EFFECT OF AMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the quality of care to increase the access to care, and to decrease the cost disability claims. This has been due generally to better utilization of services and fewer errors on referrals through advances in technology.

b. Evaluations have been performed to other users than the one visited. Reports are available documenting these studies. The change in the quality of care has been evaluated through measurement of factors relating to the patients and administrators. These measurements were obtained by objective measurements (surveys, questionnaires). Measurement methods used have been patients' response to treatment and studies of closed cases for timeliness, patient compliance, and outcome.

The cost factors affecting health care delivery have been evaluated through measurement of factors relating to the administrators. These measurements were obtained by sample studies of closed claims. Measures used have been evaluation of health manpower utilization (i.e., total staff cost per patient case) and time taken for specific tasks (i.e., scheduling of patient visits and correctness of triage).

Availability of information for facility operations has provided better financial management, analysis of financial needs, and cost reduction due to better coordination and psychological support of patients.

c. The results of the evaluations could be an information source for medical economists, health care planners, and health care system administrators.

11. ECONOMIC INFORMATION

a. The major source of operating funds for the parent organization are workman's compenstion insurance premiums. The AAMRS user visited is the claims processing division of the San Francisco office of a nationwide insurance company.

Financial data on operating costs was not made available.

b. The AAMRS is a replacement of the old claims record system and also supplements the management reporting system of the company.

Prior to the introduction of the AAMRS, the insurance claims record system consisted of lengthy handwritten and typed information. A unique identification number was used for each worker (patient). The record format was considered to be somewhat standardized, but it was difficult to review and extract information quickly.

c. Cost Analysis: Development Costs

The AAMRS was developed by Teknekron, a Berkeley based consulting and development company, and the State Compensation Fund (SCIF). Ongoing performed by the Insurance Technology Company, a subsidiary of Teknekron. An estimate of the development cost was not provided by the vendor.

Funding sources for the AAMRS development were Teknekron corporate funds, California state funds, and a small grant from NSF. The NSF grant supported the writing of a paper on the effects of the system on patient care.

The AAMRS is considered operational and is currently installed at 24 sites throughout Oregon and California. Most of the sites are within SCIF, while the site visited was not. Each site is an independent user of the AAMRS. The AAMRS was purchased by the site visited in 1970 and was installed and became operational in January, 1973.

Cost Analysis: Operating Costs

An estimate of the operating direct costs for the user is about $60,000 per year. Special reprogramming requested by a user is added to the annual charges established by ITC. Operation costs support one FTE data entry clerk, with some supervisory time, equipment costs (rent or amortization and supplies).
The source of the AAMRS user operating funds is the parent organization's overhead. The AAMRS user has no control over the AAMRS system charges. The AAMRS user budget is under the control of the management of the insurance company's home office.

Cost Analysis: Investment Costs

The investment costs incurred by a new user of the AAMRS would be about $200,000 for a purchased system or about $30,000 for a leased system (direct costs).

The investment effort is primarily the training of personnel to use the system, including the new paper record. A new site of the size visited would have from 10 to 12 people trained.

Constraints that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

Relative size: the system has a capacity of about 2,000 cases. Normally only multi-day disability cases are entered and followed.

Geographical location: currently the vendor is selling only in the California-Oregon region in order to provide system maintenance. Sites outside this region may be considered if proper system support and maintenance can be arranged.

The vendor has complete proprietary rights to the system.

It appears that the system may be adaptable to applications other than the processing of insurance claims, such as follow-up of chronic or difficult-to-manage diseases. The potential for new applications of the system may be subject to restrictions by the vendor, although the vendor is interested in exploring this area.

d. Benefit Analysis

All of the following benefits relate to the entire claims adjusting process, which is aided by the AAMRS but is not dependent upon it. The paper record system was redesigned and reformatted as part of the AAMRS installation.

Benefit Analysis: Tangible Benefits

System Cost Savings: The major savings noted is in the labor costs. The introduction of the automated system permits the use of less skilled labor than was necessary with the old system. Additionally, personnel could be trained in a shorter period of time.

Supervision of personnel has also become more efficient. The time to review a claims adjustor's record has been decreased by about 25 minutes per record.

Health Manpower Savings (Claims Adjustors): The system permits a better allocation of work effort in that the data can be used to identify the types of cases that should have more personal attention, in order to achieve a timely closure and settlement. The record keeping task is performed much faster due to the simplified notation and symbols used in the paper record, and the automated system which relieves clerical personnel from accuracy checks and corrections.

Patient Cost Savings (Primary Cost Savings): In one sense, the actual cost of medical care may not be reduced. It appears that an earlier large investment in medical care results in significant savings in long term disability settlements. The patient does benefit directly from returning to work sooner than what was the normal expectation prior to the introduction of the system. Additionally, the system may have a potential benefit to the employee (patient) through increased value of the employment fringe benefit package.

Management Cost Savings (Secondary Cost Savings): It was indicated by management personnel, that there may be a significant reduction in the amount of claims paid and in long run reserves. Additionally claims were being settled faster and a greater volume of claims were being processed. The AAMRS system was under evaluation at the time of our visit, and management personnel were reluctant to reveal any specific data. The evaluation was to determine whether or not the system would be retained and was initiated due to a change in management of the company.

Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement
Quality of Health Care	++

The provider believes that there has been a significant improvement in patient management and patient compliance.

The record content, organization and goal setting process permit improved problem identification, feedback to the physician, and better referrals.

The continuous contact with the patient, where the claims adjustor assumes a role of patient advocate, results in continuity of care and in improved patient compliance. The traditional adversary relationship between patient and adjustor has been eliminated.

Access to Health Care	++

The claims adjustor is motivated to see that the patient receives proper and timely health care in order to close the case and settle the claim.

Management Aspects of Health Care	+++

Within the claims division, management benefits are considered a major benefit of the system. The entire operation works more smoothly and employee morale is good.

While the division could continue to function without the computer, the computer plays an important role in keeping work up to date. The necessity to have data ready for computer input, and the generation of computer status reports result in better work discipline.

The claims adjustor supervisor believes improvements to his operations alone provide a substantial justification for the cost of the system, and he would be very unhappy if the computer were removed. If the computer were removed, the division would continue to use the new paper record system.

Benefit Analysis: Societal Intangible Benefits

	Estimate of Benefit Achievement
Technological Advancement in AAMRS	++
The computer is presented as a very acceptable, untechnical, device. It is regarded as a desk with a memory. The human interface is carefully designed so that the user, clerk or management feels that he is in control of the system. There exists the capability to request special reports without programming effort. No on-site technical staff is required.	
Quality of Care Review Methodology	+
A potential benefit, not currently utilized.	
Health Planning	+
With respect to the insurance industry - yes.	

12. COMMENTS

This system provides a rare example of a system which is designed to produce direct economic benefits (for the insurance company) and in the process serves the well-being of the patient. The insurance company can take a broader view in this case and can consider many aspects of a patient case which remain untouched by the fragmented health care delivery system.

The design of the system is an application of crisis intervention theory and provides strong support to motivate the patient to get better. This is achieved by breaking chains of crises and by mitigating the impact of crises through intervention. The patient is characterized by a number of states, categorized into tracks, and predictions are required from the claims adjuster with regard to potential changes of state.

The claims adjuster is supported by the system in the management of the claimant. The AAMRS system which supports this application is simple and straightforward, providing encouragement and support for the claims adjuster's actions and his accuracy and responsiveness.

The user we review is probably better managed than the users which are part of the state system.

A problem of the insurance industry is that rates are regulated and based on loss experience, so that reduced losses, especially when partially offset by increased management costs, do not improve in the long term the profitability of the insurance company. Reduced rates will increase the competitive ability of the company.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDL-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO THE DEPARTMENT OF HEALTH SERVICES COUNTY OF LOS ANGELES LOS ANGELES, CALIFORNIA ON DECEMBER 6, 1974

Mr. Gene Thompson, Chief, Health Information Systems, introduced the team to the various activities of the department in the area of automated health records. This report covers the county-wide system that performs registration and scheduling. All other medical record systems of the county have only local relevance.

The information provided by Mr. Gene Thompson, Mr. Andy Bliss, and Mr. Pat Brothers, as well as data from reports and forms, comprise the material on which this report is based.

Because Los Angeles County presented multiple systems, only half of the visiting team participated in this analysis (Kuhn, Mesel, Miller, and Wiederhold).

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objective for the system is principally access to care improvement achieved by decreased delay; cost containment; and quality of care improvement and maintenance in the area of chronic, acute, and emergency medicine through better communication among personnel. Cost containment was not a concern when the system was expanded to more sites.

These objectives have come about in response to patient demand and resulting administrative direction leading to a study in 1962, which was adopted in 1965.

The systems in use here are a replacement of a manual registration and a replacement for a number of scheduling systems.

b. The population which is to be served by the system is the general population in an area.

The population is special in terms of social category (40% Medicaid). Special data is maintained for patients with cardiac prosthetic devices and severe diabetes.

The ethnic distribution is predominantly composed of minorities, black and Chicano.

The service environment is urban.
The health care delivered is primary through tertiary.

The existing quality of this health care institution is judged by the providers to be relatively high for serious episodes, but uneven and low overall. The delivery is prioritized by medical need.

The average annual income of the institution's patient population is low.

The size of the population served by this system currently is two million; the potential population is 7.5 million.

The needs for this population are in the areas of primary care and specialty care.

Patient visits are primarily a result of appointments on internal doctor referral (60%), patient initiative via the emergency room (10%), and a few private physicians referrals. There also are drop-ins (30%).

2. PROVIDER OBJECTIVES (The provider here is the Department of Health Services)

a. The objectives of the Automated Medical Record System are to improve delivery of health care by:

improvements to access to care via appointment scheduling and availability of the traditional record;

qualtiy of care as reflected in patient management through problem identification of a limited nature; and

resource utilization by providing the medical record and a clinic schedule to the provider and availability of clerical personnel for registration.

Management aspects of the objectives are aimed at improving management and operations of the facility by:

better retrieval of medical records;

reduction of operating costs resulting from increased productivity of manpower in registration at the original site; and

the provision of management with information for long-range manpower planning and long-range facility planning.

Other specific objectives unique to the facility are reduction of patient waiting time for registration only.

b. The organization which has made the decision to provide automated record services is the entire institution.

Expansion of use will occur as user demands warrant in regard to scheduling of clinic visits. A general plan (Master Plan) is being developed to integrate registration, scheduling, and new services and to meet management needs. Recently, subsequent to our visit, Los Angeles County has contracted with McAuto in St. Louis, Missouri to implement improved services.

The institution operates 160 clinics (hospital based and neighborhood) and 2,000 hospital beds in the Central Region out of the 5,000 for all the hospitals in the county system.

The institution is part of the county government. Two departments share responsibility for this system:

Los Angeles County Department of Health Services (LACDHS), and
Los Angeles County Data Processing Department.

The LACDHS is organized into 5 geographical regions; our host, Gene Thompson is on the administrative staff of the Central Region.

The Data Processing Department has a separate unit, with separate hardware systems to provide support for health services, the Health Care Computer Center.

The size of the practice is the following:

Number of patients is 2 million (yearly average);
Number of patient visits per year is 2 million,
  but only 550,000 visits per year are recorded;
Average time per patient visit is:
  waiting time is 1/2 to 3 hours,
  service times vary greatly.

The control over the medical content of the automated record system is provided by a committee of physicians.

The technical operation of the system is in the hands of an in-house staff of 222 under the supervision of the administration.

3. SERVICES PROVIDED

There are two distinct services; registration and clinic scheduling.

Data collection for the registration system is done directly and entered as is using CRT-keyboard entry.

Source data collection is by admitting personnel. Data for medic-alert, the registration of patients requiring special attention, is provided by MD's in the two specialties (cardiac protheses and diabetes).

Data entry is by admitting and computer facility personnel.

The data are transmitted by modems and telephone lines to the computer. Registration data are kept 10 years beyond last encounter.

Data collection for the clinic scheduling system is done using mark sense card forms which are keypunched and entered using computer facility personnel. The cards are transmitted by messenger and in-house mail.

The entered information is used to generate the medical record cover sheet and admission form, and to provide work lists for medical record retrieval. Reports produced independently of the scheduling and registration system include eligibility data, emergency room records, and occupational and physical therapy utilization reports.

There is the capability to inquire into the registration files to determine a patient's medical status for two specific conditions (cardiac protheses and diabetes).

These services are provided at all of the 48 sites where terminals are located in county hospitals and clinics. The medical data are derived from four clinics only.

Other relevant services provided by other systems are the following:

The Community Health Service System which produces statistical reports for manpower allocation on mandated preventive programs. This system is locally written and uses an in-house IBM System 3/10.

The East Los Angeles Child and Youth Clinic which is discussed separately (see report CDE).

A clinic scheduling system at Harbor General Hospital.

A hospital system at Martin Luther King Hospital which is managed by the hospital (Bill Delgardo, associate administrator) and uses an IBM 1800 with terminals.

A card-oriented scheduling system for rehabilitation patients at Rancho Los Amigos.

Accounts payable, payroll, and similar operations for the Department of Health Services use the same computers as the registration and scheduling systems, but are otherwise completely independent.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through keypunch (15%), mark sense (15%), and CRT keyboard entry (70%).

Missing data elements are ignored.

Verification of data entry is done by data entry checking for alphabetic or numeric characters only.

Most errors are found by data entry personnel on a second visit and by medical record personnel (about 500 per month).

Error correction is done on-line from a special form. A correction changes the entry only. An audit trail of all errors is maintained.

Data entry hardware has given few problems. Data entry software has given problems when changed. Maintenance cost is a problem. The man-machine interface is judged to be very easy.

b. Data Storage

File Updating

Additional data entries are reflected in the files immediately; changed data entries are reflected in the files immediately. The data invalidated are not kept, except for name changes which are logged. Two names are shown routinely.

File Storage

The data which are entered into the file are deleted from the file 10 years after the last visit, and converted to a printed record.

File Usage

To obtain a current record from the file requires less than 10 seconds; to determine whether a patient has a record in the file requires less than 10 seconds. The search can be done by unit number, exact name, and approximate name (Soundex).

The file is only used for patient care.

File Size

The required file space is now 2 billion characters. When a shortage of file space occurs, then more files will be purchased. The files are indexed and pre-allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available:

Individual patient record: retrieval of complete patient registration record and retrieval of last patient visit as a hospital inpatient only.

Selection of Patients

Selection of all patients within a given census tract is done for reports.

Scheduling procedures for patients into two daily blocks, morning and afternoon, is provided by the scheduling system. This application initiates retrieval of the medical record chart.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by professional programmers.

The routines are specified by medical records personnel.

Their operation is verified by professional data-processing staff through a formal check-out procedure and pilot operation.

The routines are kept on a general library file.

Their documentation is kept on paper in a general library.

The principal programming language is Assembler.

e. Training

New medical users of the system (only two specialties) are given instruction in order to learn how to use the system.

New clerical users of the system are given instruction and documentation in order to operate the system. The training period is a few days, and then they are fully proficient after one week.

f. Presentation of Results

The means for producing output are hard-copy terminals and soft-copy CRT's.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient registration record is fixed at 235 bytes.

Another 133 byte social service data segment is entered at the time of registration, but not kept. No individual records are kept of the scheduled visits that are handled by the scheduling system.

A drop-in visit generates a record entry due to the registration procedure. These additional records are collected in blocks of 235 bytes.

b. Patient Identification (All data are recorded and entered by the registration clerk)

I.D. number: Unit number; also Social Security Number or health insurance claim number
Name (full, with Soundex)
Address (census tract - determined by the registration clerk)
Phone (home)
Sex
Date of birth
Marital status
Religion
Race
Date when the I.D. number is first issued.

c. Financial and Economic Information

Insurance carriers are billed only if the patient is eligible for for Medicaid or Medicare.

d. Date Base: History of Present Illness

Risk factors are entered only for cardiac prothesis (pacemaker, cardiac valve) and diabetes (yes or no), with telephone number of specialty M.D. responsible for 24-hour coverage. This data is only collected in four sites, which take care of these cases.

e. Data Base: Past Medical History

Past hospitalization (last only) is entered by date of admission, discharge, and service code.

f. Data Base: Social History

Social history is entered by the following categories: Place of birth, census tract, other surnames used, and name of probation agency (if any). No other information is entered into the computer files.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computers:

4 IBM 360/50's installed in 1968. One is used for the registration system exclusively. These were replaced by two IBM 370/158's effective March 1, 1975.

The computing services are provided through a subsidiary organization, viz., the Health Care Computer Center. The equipment is leased. Maintenance is by vendor and covers 24 hours.

All of the processing capability of one IBM 360/50 is used for the ambulatory medical record application. All of the file capability is used for the ambulatory medical record application.

The files are stored on 3330 disks. Other important equipment is non-IBM modems. Archival storage is paper. Retrieval response time is a few seconds.

Terminals used are
Hardcopy:

35 IBM 2740 printers, 130 characters per line, with upper and lower case, speed - 15 cps, mechanism - impact. The reliability of older printers is not very good. They were chosen for their relative quietness.

And CRT for softcopy:

64 IBM 3270 CRT's. Their reliability has been good, and the legibility is better than the IBM 2260's used previously.

b. The system uses transaction processing. Currently, production occupies 100% of the machine. Of the production load 100% is data entry except for two hours of file maintenance at night. Report preparation is done at data entry time.

c. The operating system was designed and written for general commercial purposes (DOS, with the FASTER teleprocessing monitor). It is now understood by the local staff, and maintained by the county data processing staff.

The file system is characterized by indexed files and direct access files. The implementation of the ambulatory AMRS requires 28 distinct files and five distinct record types.

d. When there is a computer failure, then the failed computer is restarted as fast as possible; and if this fails, then a backup computer is put into service. A noticeable (to the user) failure happens about once per month, and that number has been steady.

When there is heavy usage of the ambulatory medical record system, then there will be a noticeable slowdown.

e. The data processing staff for the registration system consists of

1 manager
1 systems analyst
2 programmers.

They are supported by a total staff of about 220.

The data processing staff reports to the director of the Data Processing Department (see section 2b).

The response to request for changes in system output is from one month to one year.

f. The costs of the computer operation are charged according to usage, but budgeted. The operational cost is about $5,000,000 per year.

g. The ambulatory record system is intended only for this institution, to be used remotely on a county-wide scale. Transfer of the system is unlikely due to its limited applicability, size, specificness of objective and approach. There does not seem to be the level of documentation required for effective transplantation.

6. THE FORMAT OF THE MEDICAL RECORD

This system does not effect the contents of the medical record at all; it only increases the probability of the record being present. The data collection form used follows this page.

7. INTEGRATION OF FUNCTIONS

a. The computer operation is a service to the ambulatory health care delivery system. Administratively, the computer service is directed by the county data processing component. Technically, the computer service is directed by the county data processing component.

The financial resources for its development have come from the Department of Health Services budget, and the cost of its operation is paid by this same department million per year). The priority of new tasks for the system is determined by the hospital executive committee and the data processing staff.

b. The automated registration system supports the manual medical records. Its output is inserted into the paper system.

Information from the paper system is taken into the automatic system in case of inpatient stay. The automated system contents are accessed by the medical records librarian.

COUNTY OF LOS ANGELES
DEPARTMENT OF HEALTH SERVICES

APPLICATION RECORD

CHART COMPLETE | MED. EXAM. COMPLETE | ARR. MEDICAL EXAM. | IDENT. COMPLETE | ARR. RECEPTION DESK

ARR. FOR SOCIAL SERVICE | SOCIAL SERVICE COMPLETE | TAKEN TO WARD | CLINIC CARD COMPLETE

PERSON TO NOTIFY

Person Accompanying Patient	Relationship	Phone
Address of Person Accompanying Patient	City	State
Person to Notify (preferably next of kin)	Relationship	Phone
Address of Person to Notify	City, State	Papers Attchd. ☐ Yes ☐ No
Referred Here By	Address	Phone

TRANSPORTATION TO HOSPITAL

Came to Hospital Via	Taxi-Bus-Walked-In Arms (CIRCLE)	Sheriff's-Police-Private Automobile	County-Police-Private Ambulance

(If Industrial Accident notify Ind. Accd. Clerk)

PATIENT INFORMATION

P F Number	Surname	First Name	Middle Name
Address of Patient			
City	State/Zip Code	RDR. STR.	Return
Birthdate	Age	Sex	Race	Birthplace	Mother's Maiden Name
Ward	Admit Date	Serial No.	TAB CODE: State Aid - A, Hosp. Emp. - H, Probation - P ☐	State Aid Number
HEALTH INSURANCE CLAIM NO. or SOCIAL SECURITY NO. →		RDR. STR.	Return
Name of Probation Facility	Patient Phone	Mother's First Name	Return
Religion	Marital Status CIRCLE S. M. Wid. Div. Sep.	Other Surname Used	First Name	Middle Name	Return

Code

Full Name of Husband or Wife	Information Form	Written by	Identified by
Father's Full Name	Return		
Ward, Last Discharge, Date	Driver's License Number	Return	
INITIAL AND RDR START			
Here Last 5 Years ☐ Yes ☐ No	New P F NO. ☐ Yes ☐ No		

NAME

P. F. #

WARD

APPLICATION RECORD

76A654-260D - 1/74 CHART COPY

1

c. Other automated services, used by the ambulatory health care delivery services, such as census, billing, payroll, financial (accounts and ledger), scheduling, inventory, and management reports could be integrated with this system. A plan for integration is currently being studied.

d. In summary, this computer system is best viewed as a production service.

8. INFORMATION DISTRIBUTION

a. The registration and the scheduling systems provide a partial data base for various reports received regularly by administrative management. On-line use by administrative management is for medical record number determination.

9. INFORMATION UTILIZATION

a. The system provides information for the medical records department and for admitting. A fallout is some information for institutional management.

The information is intended to assist in the delivery of emergency care and acute care. Some information to improve chronic disease maintenance is included.

In order to make more intensive use of the system, more hardware is required (conversion to two IBM 370/158's is in progress), more software is required (conversion to CICS under VS is planned), and new report formats and new reports are required due to new state and Federal regulations.

More important from the overall point of view is that the various systems have to be integrated and more data have to be collected before this system can be properly called an automated ambulatory medical record system.

b. The group which currently depends on the outputs from the automated system is the medical records department.
If the system does not work for 10 minutes, then manual backup procedures are instituted and administrative action is initiated.

If changes in the system are required, then a decision to implement them takes years, and it typically takes another month to a year to actually change the computer system.

10. EVALUATION OF EFFECT OF AMRS ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the access to care. This has been generally due to advances in technology.

b. The change in the access to care has been evaluated through measurement of factors relating to the patient. These measurements were obtained by objective measurement, a survey lasting one week. measure used has been the registration waiting time. The availability of the medical record is subjectively judged, by the medical records librarian, to be improved. This improvement has not otherwise changed the time required for health care delivery.

c. Evaluation of management aspects of health care delivery collected include a current study (Master Plan) directed towards integration of the services.

Results of the evaluation are an information source for health care system administrators.

11. ECONOMIC INFORMATION

a. The total annual operating budget for the parent organization, the Los Angeles County Department of Health Services, is about $533 million, and the annual operating budget of the AAMRS user, the Hospitals and Clinics, Central Region, is about $426 million.

The department employs about 23,500 persons of which about 22,200 work for hospitals and clinics.

The major sources of operating funds for both the parent organization and the AAMRS user are direct appropriations in the county budget. Additionally, about 20% of patient care services are billed.

The cost of patient services, the fee structure, is determined by the parent organization. There has been no change to the fees for medical services as a result of the introduction of the AAMRS.

b. The AAMRS is a supplement to the medical record system and it does not replace any of the content or format of the medical record. The patient's medical record is primarily handwritten and stored in various locations.

The medical record system uses a unique patient identification number for storage and retrieval of patient records for each patient visit. The medical record format is considered to be a disorganized collection of information.

The cost of the traditional medical record system is about $900,000 per year.

c. Cost Analysis; Development Costs

The development of the AAMRS began in 1966, and the system was installed at the initial site in 1968. From 1968 to 1971 the system was expanded to include all hospitals and clinics. The total development cost for the admissions system and the special Medic-Alert applications is estimated at $4.4 million.
The major source of development funds was the L.A. County budget.

Future changes will be made to the system after the Master Plan is completed. New hardware is expected in 1977. It is estimated that about $200,000 per year is currently being devoted to the development of the Master Plan and a scheduling system. Grants are the major source of the development effort.

Cost Analysis: Operating Costs

The current total operating costs for the medical center's admission system is over $2 million per year (excluding indirect costs). The actual cost of the AAMRS is much greater than originally anticipated due to the ultimate size of the system (multiple terminal sites rather than just one). Future operating costs will increase as a result of the introduction of the Master Plan and the installation of new hardware in 1977.

The primary source of operating funds is from the L.A. County budget.

The primary fiscal decision maker with respect to the AAMRS user budget (the admissions system budget) is the L.A. County Department of Health Services (the parent organization) and the administrators of the medical center (hospitals and clinics). The primary decision makers with respect to the computer use charges are the administrators of the Department of Data Processing, Health Care Computer Center. The AAMRS user has no control of the computer use charges.

It does not appear that the AAMRS is intended to be cost beneficial in terms of cost savings in the direct provision of medical care, or for the maintenance of medical records. The sysem is necessitated by the magnitude of patient registration data that need to be managed in a timely manner. The system makes it easier to transport the paper medical record to the encounter site. Thus the system appears to be justified primarily to meet administrative needs.

Cost Analysis: Investment Costs

There are no significant investment or conversion costs to bring on a new user site to the system.

Constraints that may affect the transferability of the AAMRS to other settings, or the attainment of provider objectives are:

The size of the organization. The size of the patient population makes this system unique. Additionally, the size makes it possible for small benefits in the aggregate to be a significant justification for the system.

There appears to be a lack of integration among the several computer projects/applications, and little concern is given to quality control.

The user has no control over computer use charges and equipment acquisition. It is not clear whether the charges have a direct relation to the activities served, or whether they are some arbitrary allocation of costs.

It is not clear that this system is documented to an extent which would allow transferability.

d. Benefit Analysis: Tangible Benefits

System Cost Savings: Because the AAMRS is a supplement to the existing medical record system, there are no system cost savings.

Health Manpower Savings: Savings were claimed, but not quantified, for the time spent by the physician in treatment planning and record review. The availability of the record gives the physician information on prior tests which eliminates the need for unnecessary duplication, due to the reocrd not being available at the time of the patient visit. The probable use of this savings is that more patients are seen during the clinic hours.

Savings were claimed and quantified for clerical personnel. At the initial installation, savings for the admissions process was estimated to be $500,000 per year. This was primarily due to a decrease in personnel. Similar savings were not realized as the system was extended to other sites. The cost of the system for the initial site was also $500,000 per year, so the net operating benefit at the first site was zero.

Management Cost Savings (secondary cost savings): Some savings are realized as a result of increased accuracy in admissions and from the validity and checkability of the statistics for claims processing. These benefits are not considered a major system benefit and have not been quantified.

Benefit Analysis; Provider Intangible Benefits

	Estimate of Benefit Achievement
Quality of Health Care:	+

There may be some improvement to patient management as a result of the availability of the medical record at the time of the visit, Potential benefits in the quality of health care are offset however by the very high noshow rate for appointments, Many of the records retrieved are hence not used.

Access to Health Care:	++

The administrative procedures for admissions have been improved by increased accuracy and shortening the time required for the registration process. In addition to the clerical personnel savings and patient waiting time savings, the provider has realized an intangible benefit for the ability to serve more patients and a 35% reduction in errors when the admission system became automated.

Management Aspects of Health Care:	+++

The benefits derived for record communication among sites is considered to be the major benefit and justification for the AAMRS, The major system features are accuracy, speed, and availability of information,

Benefit Analysis: Societal Intangible Benefits

Health Planning:	+

The availability of patient census and admission information should provide some input to planning regional health needs, The lack of longitudinal data on patients limits the benefit.

Changes to benefits are expected as services are expanded as a result of the implementation of the new Master Plan (still under development) and other services.

12. COMMENTS

The size of the patient population makes it possible for small improvements to add up to a significant change in aggregate health care delivery. The registration systems depicted are basically an admitting system which provides ambulatory AMRS services of the most rudimentary type. The various projects have not been well integrated and do not produce anywhere near their ultimate potential.

The information collected by the scheduling system is not patient specific for patients making appointments. The data is hence of very limited longrange value and not kept.

A Master Plan, now under development, will be limited due to the large body of existing software and procedure, and the incompatibilities among these elements. Relatively little concern has been given to quality control, which may also impact on successful integration. Many requirements are developed administratively or are occasioned by statutory reporting demands.

Detailed information on costs is not kept, and the County charges both hospital inpatient days and clinic visits at fixed rates. Because the population is largely indigent and the records are often inadequate for cost reimbursement, only about 20 percent of the health care costs are being reimbursed. Better data collection and processing systems undoubtedly could improve the situation. Their deployment is hindered by the magnitude of the operation, which makes any change a major project.

The two improvements seen were:

Reduction of time required to be admitted, achieved by the registration system.

Better record availability for scheduled patients achieved by the scheduling system.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDE-3
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO THE EAST LOS ANGELES CHILD AND YOUTH CLINIC LOS ANGELES, CALIFORNIA ON DECEMBER 6, 1974

Mr. Gene Thompson of the Department of Health Services, County of Los Angeles, introduced us to Mr. Gonzales and Mrs. of the East Los Angeles Child and Youth Clinic. The information and sample reports provided by them are the basis for this report.

Because Los Angeles County presented multiple systems, only half of the visiting team participated in this analysis (Drs. Dervin, Henley, and Ramsey-Klee).

The summary contains the following sections: **page**

1. OUTCOME OBJECTIVES

a. The intended societal outcome objective for the system is principally cost containment achieved indirectly by increase of productivity and better use of resources.

These objectives have come about in response to legal obligations.

The system in use here is a supplement to the existing manual system.

b. The population which is to be served by the system is a child and youth population in an area.

The population is special in terms of age distribution (0-19 years) and geographic distribution (seven East Los Angeles census tracts).

The ethnic distribution is mixed, markedly Chicano.

The service environment is urban primary care.

The existing quality of this health care institution is judged relatively average by the providers.

The quality of health care delivered to the same type of population served here is average in an uneven way as judged by the providers.

The average annual income of the institution's patient population is $1,500 per capita and $5,000 per family.

The size of the population served by this system currently is 10,000; the potential population is 450,000 to 600,000, that is, all the individuals below 20 years of age out of a population of 1.5 million.

The needs for this population are in the area of primary preventive pediatric care.

Patient visits are primarily a result of appointments on patient initiative (80%) and drop-ins (20%).

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve management and operations of the facility by long-range manpower and facility planning; faster processing and increased accuracy in accounting procedures, billing, and claims processing; and reduction of operating costs resulting from increased productivity of manpower.

b. The organization which has made the decision to provide automated record services is the Federal government.

Expansion of use occurs according to a general plan.

The institution is a clinic manned by five teams of ten people each.

The institution is organized as a county government institution supported by the Federal government.

The size of the practice is the following:

Number of patients = 10,000 active (yearly average),
Number of patient visits per year = 32,000,
Average time per patient visit:
waiting time is 15-20 minutes;
service time is 70-90 minutes for an initial visit,
15 minutes for a repeat visit.

The technical operation of the system is in the hands of an in-house staff of five people under the supervision of the administration.

3. SERVICES PROVIDED

Data collection is done using forms with text (100%) to be coded by a medical technician and entered using keypunching.

Source data collection is by the nursing staff and MD's.

Data entry is by computer facility personnel.

The data are transmitted by direct connection to the computer.

The data are stored forever presently since a criterion is not yet decided.

The entered information is used to prepare Federally required reports, to prepare third party bills, and to provide work lists for registration and encounter sites.

These services are provided at a central site.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through keypunch (100%) with a volume of 30,000 per month.

Missing data elements are not allowed.

Verification of data entry is done by duplicate entry and an edit program. Most errors are found by the editing routine.

Error correction is done with a special batch program. An audit trail of all errors is not maintained.

Data entry has given few problems because of good keypunching.

b. Data Storage

1) File Updating

Additional data entries are reflected in the files after a batch or background run; changed data entries are reflected in the files after a batch or background run. The data invalidated are not kept.

2) File Storage

The data which are entered into the file are kept permanently.

3) File Size

The required file space is now 5M characters. When a shortage of file space occurs, then old records will be deleted and stored on magnetic tape as backup. The files are sequential; certain fields are packed.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available:

1) Individual patient record by retrieval of abstract of patient record (four times per year) and generation of monthly billing statements.

2) Tabulation of provided services by medical status, diagnosis (ICDA code), patient category (age, sex, ethnic group, family income), provider teams, and functional areas (6) of service rendered is done regularly.

3) Comparison of selected patient groups within provider teams includes descriptive statistics (e.g., cross tabulations, tables, means, and standard deviations). Other statistics are generated rarely only upon administrative request.

4) Some procedures for scheduling clinic personnel are utilized.

5) Financial management is accomplished by budgeting and planning, some billing, and some claims processing.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by professional programmers.

The routines are specified by professional data-processing staff.

Their operation is verified by professional data-processing staff through a formal balancing procedure and pilot operation.

The routines are kept on a general disk library file.

Their documentation is kept on paper in a general library.

The principal programming language is RPG 2 and COBOL.

e. Protection of Privacy

Since this is a dedicated system, protection can be achieved through limited physical access. We did not visit the computer site itself. The protection was considered adequate.

f, Training

New users of the system are given minimal on-the-job training.

f. Presentation of Results

The means for producing output are hard-copy printers.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

This is a batch-oriented system with sequential, fixed-length records. All data are recorded by clerks and entered by data clerks, except for the ICDA code.

b. Patient Identification

I.D. number: Sequential family number
Name (full)
Address
Phone (home)
Sex
Date of birth or age
Marital Status
Race
Education
Occupation, free-text
Date when this information was collected.

c. Financial and Economic Information

Recently some procedures reimbursable by Medicaid have been billed.

d. Data Base: History of Present Illness is not entered int the computer.

e. Data Base: Past Medical History is not entered into the computer.

f. Data Base: Social History is not entered intothe computer.

g. Data Base: Review of Systems is not entered into the system.

h. Data Base: Physical Examination data are not entered into the computer.

i. Data Base: No objective findings of past medical history are entered.

j. Problem List

Up to two diagnoses, assigned an ICDA code by a medical technician, are recorded.

k. Plans, Diagnostic Orders are not entered into the computer.

l. Plans, Therapeutic Orders are not entered into the computer.

m. Follow-up data are not entered into the computer.

n. Progress Notes are not entered into the computer.

o. Patient Services Management:

No-show rates and cancellation rates are produced.

p. Practice Information:

Encounter sites type, code, mode of arrival; providers at encounter; encounter duration and frequency; and use of other facilities are recorded.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computer:

1 IBM System 3/10, 12K, at a cost of $3,448 per month, installed in 1971.

The computing services are provided in-house. The equipment is leased. Maintenance is by vendor and costs $631 per month in addition.

Approximately 60-75% of the day-shift processing capability is used for the ambulatory medical record application. Approximately 1-1/2M bytes of the file capability is used for the ambulatory medical record application.

The files are stored on two 5444 disks. Other important equipment is one 5424 MFCU and one 5203 printer. Archival storage is cards and magnetic tape (written on another system).

b. The system uses batch for all of its processing. Currently, production occupies 90% of the machine, and development 10%. Of the production load most is file maintenance and report preparation.

c. The operating system was designed and written for general commercial purposes.

d. When there is a computer failure, then the failed computer is restarted as fast as possible. A failure has happened on three days in two years.

e. The data processing staff consists of

1 manager
1 programmer
3 data entry clerks (keypunchers)

all local to the clinic.

The data processing staff reports to the administrator of the institution.

f. The costs of the computer operation are fixed and budgeted. The operational cost is about $98,600 per year (rent = $41,376 per year and salaries = $57,210 per year).

g. The ambulatory record system is intended only for this institution.

The system may be transferable due to its limited size and independence of operation. No documentation, however, seems to be available which would help with the installation of the system at another site.

6. FORMAT OF THE MEDICAL RECORD

This system produces no data for the provider when they encounter a patient. The traditional medical records are maintained as before.

7. INTEGRATION OF FUNCTIONS

a. The computer operation is an integral part of the ambulatory health care delivery service. Administratively, the computer service is directed by the clinic. Technically, the computer service is directed by the clinic.

The financial resources for its development have come from Federal and County funds, and the cost of its operation (computer and personnel) are paid by Los Angeles County (25%) and Federal support (75%). The priority of new tasks for the system is determined by the department head.

b. The automated medical record system ignores the manual medical records. Its outputs are kept separately from the paper system.

c. Other automated services, used by the ambulatory health care delivery services, such as billing, could be replaced with this system.

d. In summary, this computer system is best viewed as a production service.

8. INFORMATION DISTRIBUTION

a. Reports are produced quarterly for the Federal government showing aggregate services provided.

b. Some third-party billings are produced.

c. Special requests are made to data processing staff for items such as research studies (rarely).

9. INFORMATION UTILIZATION

a. The system provides information for Federal health care planners, administrative staff (practice profiles and no-show rates), and clinical physicians.

The information is intended to assist in the delivery of preventive care and health maintenance.

b. The group which currently depends on the outputs from the automated system are health care planners, administrative staff, and clinical physicians.

If the system does not work for two to three days, then operations are held up.

If changes in the system are required, then a decision to implement them is made in one day, and it typically takes up to one month to actually change the computer system.

10. EVALUATION OF EFFECT OF AMR ON SERVICES AND OUTCOME

No evaluation of the system has been made. The system is heavily subsidized by the Federal government and produces information required by HEW. The data requirements for child and youth programs are specified through a contract with the School of Public Health, University of Minnesota.

11. ECONOMIC INFORMATION

We did not obtain , during our visit, sufficient data to provide a analysis of the cost benefit of the system. Since this application is not an actual AAMRS, no further follow-up was made.

The cost of this operation is estimated at $98,600/32,000 = $3.08 per visit. No significant offsetting financial benefits are seen, but the provision of the information is a federal funding requirement. We do not know how the cost of providing this information through automation compares with the cost of manual report preparation.

12. COMMENTS

This system was developed and exists to produce health care information about a pediatric and youth population in East Los Angeles for the Federal government. Minimal medical information is available in the computer system. Practice profiles provide useful information for manpower planning within the Clinic.

The system is transportable to other sites given adequate documentation; it operates relatively independently from the manual medical record system and county health care services.

Gio Wiederhold
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University of California
San Francisco, California

CDR-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
ON
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
THE RESEARCH CENTER
ROCKLAND PSYCHIATRIC CENTER
ORANGEBURG, NEW YORK 10962
ON
JANUARY 6, 1974

Dr. Jeffrey Crawford and Mrs. Rheta Bank described the history, operation, and goals of the Information Sciences Division of the Research Center (ISDRC) at Rockland Psychiatric Center.* Dr. Eugene Laska, the Director of the division, unfortunately, was ill on the day of the visit by the study team.

The division operates a computer service. The principal component of this service and the system of major interest to the study team was the Multi-State Information System (MSIS). The team was able to discuss various aspects of the system with other staff members at Rockland Research Center (Mr. Peter Dannenberg, Mr. Stanley Wasylyk, and Mr. William Zeitz).

Several members of the study team visited two institutions that are users of the system:

> Pomona Outpatient Clinic of the Rockland County Community Mental Health Center, Orangeburg, New York, and
>
> Connecticut Mental Health Center (CMHC), New Haven, Connecticut

The information at these sites was provided by Dr. William Block and Mr. Gerrard Hynes (Pomona), and Mr. Michael Levine (CMHC). We are describing in this report the operations as they pertain to these users. Many other facilities are available within the MSIS system and are being used or evaluated for use by the other dozen sites.

* As of April, 1975 the Research Center, of which ISD is a part, became an independent facility and was renamed the Rockland Research Institute.

The summary contains the following sections: page

1. OUTCOME OBJECTIVES

a. The intended societal outcome objectives for the system as stated by the users at Pomona and CMHC are:

principally institutional cost management achieved by better use of resources by future increase of productivity;

access to care improvement achieved by increased visit frequency, decreased delay, better availability of providers, contact with appropriate provider, and simplified administrative barriers; and

quality of care improvement in the area of mental health through increased general knowledge of disease patterns and better feedback.

These objectives have come about in response to administrative direction related to reporting requirements for funding.

The Mulit-State Information System (MSIS) in use here is completely new to these users; it is used together with the existing manual systems. It was selected by CMHC after a study of alternatives. The MSIS system itself began with an automated system which primarily supported inpatient records and developed into a management and clinical information system suitable to both inpatient and outpatient service.

This original system was developed in response to needs in the psychiatric care area perceived by a medical researcher. The objectives of users are less in the research area than the original direction of the system. MSIS now concentrates on clinical and management services.

b. The population which is to be served by the system is the general population in an area. The services made available by the users of this system are psychiatric.

The ethnic distribution for Pomona is predominantly white suburban; but at CMHC the ethnic distribution of the Hill-West Haven catchment area is predominantly white, with 15% black. Less comprehensive services are also provided to a larger area.

The service environment for both institutions is urban and suburban.

The existing quality of these health care institutions is judged high to average by the providers (a mandate of the NIMH).

Pomona:

The average annual income of the patient population of the Pomona Outpatient Clinic is $13,700 per family, or $3,840 per capita.

The size of the population served by this system currently is 7,000 patients of which 2,500 are children. The area population is 230,000 (Rockland County).

The needs for this population are in the area of primary care for mental patients. Patient visits are primarily a result of appointments on patient initiative (80%). Drop-ins comprise 5 to 10%.

Connecticut:

The average annual income of the patient population of the Connecticut Mental Health Center is low.

The size of the population served by this clinic is 416,000, of which 74,500 (in the Hill-West Haven area) are eligible for comprehensive care.

This population generates 4,600 admissions (1,100 from Hill-West Haven). One admission consists of an initial visit and all return visits for this problem until explicit termination.

The needs for this population are in the area of primary (chronic, acute, and emergency) mental care.

Patient visits are primarily a result of appointments on patient initiative (80%) and doctor referral (15%). Drop-ins comprise less than 14%.

The total number of patients for which data are stored in the MSIS system is 300,000 of which an estimated 150,000 are outpatients. This number includes all registrations for the seven years of operation from multiple sites, including inpatient facilities.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System in Pomona and at CMHC are to improve delivery of health care by improvements to:

resource utilization, improved health manpower utilization in the area of medical/paramedical personnel (referred to as clinicians) through feedback to Program Management.

access to care through visit registration and feedback to clinicians on number and types of visits. The direct clinical benefit of the system was considered to be minimal.

quality of care concerns are reflected, to a limited extent, in information collection using the mental status form. This provides feedback for program evaluation.

The collection of patient care data to meet administrative needs are of primary concern and involve:

the provision of management with information and analytical tools for regional, state, and national report requirements,

long-range manpower and facility planning,

utilization review procedures,

program evaluation,

budgeting and planning (limited),

budget justification and some cost finding, and

manpower scheduling (an example is the establishment of a service to the Spanish-speaking population in Connecticut).

Further administrative objectives are to improve the delivery of health care by improvements to:

access to care as reflected in visit registration and patient follow-up (termination lists on patients who have not required services for 90 days); and

quality of care through feedback to clinicians regarding achievement of desired outcomes and data base acquisitions.

A specific objective unique to this facility in New York State is in the planning stage. The system will help fulfill the "unified service requirements" of the State of New York, which provides for increased reimbursement from the state. A general problem is occasioned by legal restrictions on patient follow-up in the mental health area.

b. The organizations which have made the decision to provide automated record services were the entire institutions (Pomona and CMHC).

Expansion of use will occur as user demands warrant. This is also the mode of operation for the supplier (ISDRC).

The institutions visited are specialty clinics in mental health with a small capacity for inpatients. Pomona is a Rockland County (New York) agency and CMHC is an agency of the South Central Region of the Department of Mental Health of the State of Connecticut.

Other institutions served by MSIS include the entire range of psychiatric facilities from halfway houses to multi-program centers.

The size of the practice in Pomona is the following:

Number of patients is 9,000 active (yearly average);

There were 3,200 admissions, 1,700 terminations, and 200,000 patient visits in 1972;

Half of the patients and a quarter of the visits are due to the Youth Drug Abuse Program. **A portion of the admissions reflect inpatients, day camp, etc.**

Most of these patients are seen by paramedical personnel (clinicians).

The size of the practice at CMHC is the following:

There are 3,000 active cases; 22,000 patients have been served by CMHC since its opening in 1966.
Number of patient admissions is 4,600 per year;

Number of patient contacts per year is 60,000.

The population and their use of the services has been described in depth by Carole Siege, Ph.D., of ISDRC in "Evaluating the Attainment of Process Objectives of Community Mental Health Centers Using an Automated Patient Data System (MSIS): Methodology and Application", a report to the National Institute of Mental Health HSM-42-72-212, 1974.

The control over the medical content of both record systems is provided by a director and the medical records committee. It is, in practice, limited by the availability of fields provided on the MSIS forms and on specially designed forms. Occasionally, coded input fields are used for other than the preprogrammed purpose. Most nonstandard data is added to the data base using specially designed forms. A Generalized Application System (GAS) is available to handle those data.

The technical operation of the system is largely in the hands of the supplier (ISDRC) who maintains and schedules computer services and provides consulting for the user sites. At the user sites we visited, there was one technically knowledgeable person as well as a number of data entry personnel. These report to the administration of the clinic.

3. SERVICES PROVIDED

At both locations source data collection is by clerical medical personnel and MD's

Data collection is done using forms with check marks to be coded by a clinician (MD, psychologist, mental social worker, nurse, etc.). Both mark sense as well as keypunch forms are available. Most forms are one or four pages long. The forms are converted to cards using an optical reader-cardpunch combination (30%) or keypunched.

Data entry is by the user's computer facility personnel or medical records personnel.

The data are transmitted from remote batch stations with a card reader by modems and telephone lines.

The data are stored forever; aged data is placed in an archive to reduce the size of the active file. The entry of data from each form into computer storage is noted on a report.

The entered information is used to generate reports such as lists of patients, amount of services rendered, and special reports. Practice profiles or patient profiles can be prepared. At CMHC the data are also used to prepare bills and eligibility status reports.

There is the capability to inquire into the files to determine the patient's medical status or past encounters at both institutions. Inquiry can be made for any of the 34 variables routinely collected on the admissions form , for most other variables collected on other forms, and for boolean combinations of these variables.

These services are provided at one terminal each in Pomona and CMHC. Some other institutions share terminals. A total of 15 terminals are operational among all user institutions.

Budgeting is assisted by MSIS in Pomona by early 1975. All other services (billing, payroll, etc.) are provided by local county data processing services.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

At CMHC data entry is accomplished through keypunch (70%) and mark sense (30%). The volume is approximately 80,000 cards yearly.

Six data elements are required for admission. Other missing data elements are ignored and not distinguished; However, the fact that data are missing is noted on an Error Analysis report prepared by the computer.

Verification of data entry is done by punch/read verification in the batch station and by MSIS analysis routines in the IBM 360 computer.

Most errors are corrected by data entry personnel using the computer produced error analysis reports.

Error correction is done using the same forms as the original input.

Data entry hardware has given some problems in the optical scanning area. The teleprocessing is reliable; there is on the average one service interrruption every six months without loss of data. Data entry software (HASP) has not given problems.

b. Data Storage

File Updating:

Additional data entries are reflected in the files after an overnight batch update run; changed data entries are reflected in the files after an overnight batch update run. A separate set of batch runs is made for each facility.

The data invalidated can be retrieved from an audit run by systems staff; the audit data are kept for a minimum of one fiscal year beyond the current year.

There is a nightly run to generate a backup copy plus a monthly run to generate a complete logical copy in DL/1 format.

File Storage:

The data which are entered into the file are kept permanently; data on inactive patients are moved to archival storage six or more months after the last visit, as determined by the user.

File Usage:

To obtain a current record from the file under current routine procedure requires 10 minutes elapsed time, but excludes the changes of the day. To determine whether a patient has a record in the file requires an elapsed time of half an hour to two hours, and requires running of a batch program and mounting of the appropriate disk packs. This period can be reduced when the request is urgent. The search can be done by state, facility, and case number. Secondary case numbers can be linked, and are linked within some states. We estimate the file space for the two users visited at 700M characters total.

The file is also used to answer research questions. Often data must be abstracted when research questions have to be ansereed.

File Size:

The required file space is now about 7,500 M characters. When a shortage of file space occurs, then more disk packs will be purchased. The files are compressed, of variable length, indexed, and pre-allocated, using IBM file software and utilities.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available:

Individual patient record by retrieval of complete patient record and by retrieval of abstract of patient record.

Selection of all patients with a given problem or diagnosis, value of sign or symptom, treatment modality, and financial classification is possible. These programs are not run on MSIS master files, because of the unsuitability of the DL/1 hierarchical structure, but rather on extract files containing about 120 preselected data elements per patient episode. Selection can be based on any of these items. A special selective retrieval program allows access to the second level data in the DL/1 hierarchy when this is necessary.

Tabulation of provided services is available by a very flexible report generator.

Comparison of selected patient groups includes descriptive statistics (e.g., tables and histograms) and rarely used inferential statistics (e.g., t-tests and analysis of variance).

One user has implemented scheduling procedures for patients and clinic personnel.

In the area of financial management, inventory control is a new program.

Cost finding and rate setting programs are available for facilities which collect adequate data.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by research personnel and professional programmers.

The routines are specified by clinical personnel.

Their operation is verified by the supplier and then through pilot operation at a test site.

The routines are kept on a general library file, or on a user specific library file or by the individual user. Some states have a users' group.

Their documentation is kept on paper and is distributed.

The principal programming languages are PL/1 (98%) and Assembler (2%).

e. Protection of Data

Data are protected through limited physical access to the terminal sites, codes, jobnames, and passwords. The passwords are known to the users and to only two individuals at the central site, and an audit trail of all terminal transactions is kept. Physical access is easily controlled because of the fact that there is only one terminal at each institution. Data, even on the same patient, cannot be shared by two facilities via MSIS. Systems staff can cause data to be transmitted if required.

A special protective statue of New York State prohibits access to MSIS data. No subpoena is possible and searches by governmental or other agencies are not allowed.

This protection is considered adequate.

f. Training

New medical users of the system are given a formal course, demonstration, and documentation in order to learn how to use the system. The training period is two to three days, and after and additional two days, they can be proficient. It then takes about five to six minutes to complete a Mental Status Examination Record (MSER) form of four pages with up to approximately 100 variables. **The completion of 20 forms assures familiarity.**

New clerical users of the system are given instruction and demonstration in order to operate the system. The training period is one day.

For a new installation of MSIS on another computer, there are four days of technical training, a 7-volume installation manual, and 10 days of non-technical training to acquaint the users with the forms and procedures. ISDRC maintains a permanent training staff to support users.

A technical support staff is also available via the telephone to assist users with technical problems encountered while using ISDRC.

g. Presentation of Results

The means for producing output are hard-copy printers at the user sites.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of all records is fixed and matches that of the corresponding input form. The one-page admission form contains 37 items. There are a variety of encounter forms; most facilities use only a few types. Their size ranges from a dozen to more than one hundred data items. One-page forms are prevalent. The extent to which forms are completed depends on the user's facility.

The major forms used by the sites visited are the following:

Admission (identification, facility, complaint and diagnosis data)

Patient service (facility, provider, appointment, type of service, time spent)

Change in status

Termination form

Also used are a Periodic Evaluation Record, Problem Appraisal Scales, but are found on less than 10% of the charts.

Other forms available include:

Indirect Service (consultation, education)

Diagnosis Recording Form

Mental Status Examination Record

Psychiatric Anamnesic Record

Incident Report

Problem-Oriented Record

Cost Finding and Rate Setting

The last two forms take about 15 minutes to complete; the others considerably less.

No free-text data can be entered from standard forms. Such applications can be developed using available software.

b. Patient Identification

I.D. number, facility, and unit number. A variety of additional numbers may be assigned.
Name (full, but not required)
Address, census tract and block, distance to facility (used specifically by CMHC)
Sex
Legal status
Date of birth
Marital status
Religion
Citizenship
Ethnic group
Environment (weekly family income, size of household)
Education (level)
Occupation (coded by some users)
Source of referral (last facility or service)
Date of admission

Most of these elements are not required.

All of these data are collected by the admission clerk.

c. Financial and Economic Information

Weekly family income may be entered. Other financial and economic information is not collected as such. Some relevant information is part of other data forms.

d. Data Base: History of Present Illness

Chief complaint (coded using the American Psychiatric Association's diagnostic codes and nomenclature): Problem duration and severity.

An appraisal form includes symptoms (coded) and detail on quality, frequency, and 40 related items.

Active problems.

In addition, a more detailed psychiatric and social history can be encoded on a Psychiatric Anamnestic Record Form, but this form is not commonly used in the ambulatory setting.

The collector of information is identified.

e. Data Base: Past Medical History

Family history for parents and siblings, relationship, and mental health status.

Past hospitalizations or other mental health encounters. (These are based on the forms collected on previous encounters with the same facility and unit number, or with a statewide identification number.)

f. Data Base: Social History

At admission the following data may be collected:

amount of family income,
size of household,
level of education (last grade completed), and
census tract (block)
citizenship

Special forms, not commonly used in ambulatory care, collect:

employment,
income source,
number of children,
primary language, and
ability to speak English.

The collector is identified.

g. Data Base: Review of Systems

Review of systems is done for psychiatry only. Recorded are positive findings and overall impression. Much coded detail is possible.

The collector is identified.

h. Data Base: Physical Examination

Only subjective impressions and values are stored such as height, weight, posture, tec.. Risk factors for suicide and accidents are indicated.

In addition, a complete mental status exam can be encoded on a separate form, but this is again not commonly done in the ambulatory setting.

The collector is identified.

i. Data Base: Objective Findings are not stored.

j. Problem List

No problem list is maintained at the sites visited.

One psychiatric diagnosis or impression is entered. Recently, a POPR, Problem Oriented Psychiatric Record form,has been developed for MSIS users.

k. Plans, Diagnostic Orders

Diagnostic orders are not collected for outpatients at the sites visited. This may also be done on the POPR.

1. Plans, Therapeutic Orders

One institution collects psychotropic drug orders; they have 170 choices of drugs. Data collected here are:

Date,
Drug name (12 characters)
Drug code
Dosage, form of administration
Frequency
Reason for discontinuation
Date of discontinuation
Number of PRN administrations at discontinuation

The physician is identified.

m. Follow-up

The disposition is coded and stored.

The physician is identified.

n. Progress Notes

Encounter forms can be coded and stored for mental status reports only. Two forms are available. They are used inconsistently and appear on less than 10 percent of the charts in the system.

The clinician is identified.

o. Patient Services Management

Data are available to make up staff schedules according to demand.

p. Practice Information

First contact with this practice or agency
Encounter sites types, code, mode of arrival
Referral - self, M.D., or other
Providers at encounter
Encounter duration and frequency
Previous use of other treatment facilities - hospital, ER by type

q. Research-Oriented Data

Many of the data categories listed above are collected primarily in order to obtain service statistics and research data. These are important because of the large fraction of government reimbursable services in the mental health area.

r. Other Comments

There is relatively little feedback for individual patient care at the sites visited, at these sites MSIS is used primarily as a management information system.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computer:

1 IBM 360/67, 1.5M bytes with 3 selector channels, at a purchase price of $350,000 plus $5,140 per month for additional memory, installed in 1974 (November). This equipment configuration replaced a 360/50. The new system is only lightly loaded (25% CPU usage).

The computing services are provided through a supplier (ISDRC). The equipment is mainly purchased. Maintenance of the computer is by the manufacturers and costs ISDRC $4,000 per month.

Approximately 70% of the processing capability is used for the ambulatory medical record application. There are 600 hours of connect time per month. Approximately 20% (daytime) to 50% (at night) of the file capability is used for the ambulatory medical record application. Services began in 1969.

The files are stored on 16 IBM 2314 disks and 4 Calcomp 1015 disks (dual density). There also is one IBM 2301 drum. There are 6 IBM 3420-III tape drives. Communications are provided by an IBM 3750 with 8 ports. Archival storage is tape. Retrieval response time is normally overnight but can be less than one hour. This is adequate at the sites visited.

Terminals are remote entry stations. There is either one IBM System 3, one IBM 2780, or one DATA 100 per site. These terminals have upper case only and are 120 characters per line printers that print 200 lines per minute. The rental cost of the IBM 2780 is about $1,000 per month; the cost of the DATA 100 is $605 per month. Most sites also have an IBM 1232 scanner at a rental cost of $340 per month to convert the mark sense sheets to cards, and one or more keypunches at a cost each of $73 to $100 per month. The modems transmit at 2,000 baud and cost $100 per month. **A total installation may cost $1466/month if it uses IBM equipment and $1070/month if it use Data 100 equipment.**

b. The system uses multiprogramming (five initiators) providing multiple batch operation for most of its processing. The programs are designed to fit into 150K of core. Currently, production occupies 70% of the machine time used and development 30%. Of the production load, much is updating of the master files with data received from the users.

c. The operating system was designed and written for general commercial purposes. It is now being further maintained by the staff of ISDRC and ignored by the original supplier.

The file system is characterized by hierarchical files with fixed segments (IBM DL/1) on three to four levels, based on indexed sequential files. The implementation of the AAMRS for one user or user group requires two distinct files and many distinct record types. Each of these forms on DL/1 data base. There are 74 such data bases.

d. When there is a computer failure, then the failed computer is restarted as fast as possible. A restore and rerun is rarely required to avoid loss of spooled data. A noticeable (to the user) failure happens about twice per week, and that number has been steady. When there is heavy usage of the ambulatory medical record system, then there will be a noticeable slowdown resulting in overnight turnaround. With the new equipment the users have perceived fewer slowdowns from other use of the system.

e. The data processing staff of ISDRC consists of:

2 managers
6 statistical specialists
1 systems analyst
3 systems programmers
17 programmers
8 operators
1 data entry clerk

The typical user has one manager, one secretary, one clerk, one or two keypunch operators, and help from the medical records staff.

The response to a request for a change in system output is about one month, but varies of course a great deal depending on the type of the request.

f. The costs of the computer operation are charged according to estimated usage, generally fixed and budgeted for one year. The investment in the system varies with user facility size, but is mainly confined to training and terminal equipment installation. The operational cost is about $5.75 per patient per episode, including full use of all optional subsystems.

g. The ambulatory record system software is intended both for distribution (currently to four sites) with support by the supplier. It is used remotely on a national scale (currently 15 sites), principally in the Northeast.

6. THE FORMAT OF THE MEDICAL RECORD

The record available to the clinician when he/she sees the patient is the traditional record. At some sites a printout obtained from the forms entered into the computer is merged into this record. Since at the sites visited few medical forms were completed for outpatients, this system did not effect the medical content of the record.

A general encounter form is filled out by the provider indicating the type of service performed.

No data are obtained on-line during the encounter.

The paper records are kept on-site. Their availability varies with the site, but is mostly fair since psychiatric records are kept separate from medical records and treated with more care.

In some local mental health clinics, there is no traditional record.

The continuity of one provider patient combination is maintained to the extent possible given the team approach to care and the use of various levels of clinical personnel.

No other computer outputs are used by the providers for individual care. Utilization reports provide data in terms of number and type of visits.

At other sites flowsheets and problem lists are available.

Three data collection forms most frequently used, and the resulting summary follow. Included is also a psychotropic drug order form and an evaluation form, together with the resulting report.

FORM MS 5 (5-70)

ADMISSION FORM*

1. ADMISSION OR ACTION: FIRST | RE | U | C | D Form
2. FACILITY NAME
3. FAC. CODE
4a. WARD/UNIT
4b. STATUS
5. CONSECUTIVE NO.
6. CASE NUMBER OR ID NUMBER
7. SEX
8. AGE
9. DATE OF BIRTH month-day-year
10. LEGAL STATUS (inpatients only)
11. LEGAL STATUS DATE month-day-year
12. ADMISSION DATE month-day-year
13. NAME last | first | middle initial | maiden name
14a. CATCH. AREA
14b. USUAL ADDRESS no. and street or rd. | city, town or village | state | zip code | county
14c. ADDRESS CODE
15. SOCIAL SECURITY NO.
16. OCCUPATION
17. NAME AND LOCATION OF LAST PSYCHIATRIC OR RETARDATION FACILITY OR SERVICE

MARK ONLY ONE CHOICE EXCEPT AS SPECIFIED—USE ONLY NO. 2 PENCIL

18. CONSECUTIVE NUMBER

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

19. ACTION CODE: RE | U | C | D Form

20. EMERGENCY: Yes | No

21. Yes | No

22. CITIZENSHIP: U. S. | Other

23. Farm | City/Village | Rural Non-farm | Unknown

24. RELIGION
Protestant | Roman Catholic | Jewish
None | Other | Unknown

25. ETHNIC GROUP
White | Negro | American Indian | Puerto Rican
Oriental | Other | Unknown | (1) See Instructions

26. PRESENT MARITAL STATUS
Never Married | Married | Remarried | Separated
Divorced/Annulled | Widowed | Unknown

27. HOUSEHOLD COMPOSITION (Mark ALL which apply)
Lives Alone | With Children | With Others
With Spouse | With Siblings | In Institution
With Parents | With Other Relatives | Unknown

28. EDUCATION—HIGHEST GRADE COMPLETED
0 | UNGRADED | 1-2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
10 | 11 | 12 | VOC., BUS. OR TECH. | COLL. 1 | COLL. 2 | COLL. 3 | COLL. 4 | GRAD. SCHOOL | UNKNOWN

29. WEEKLY FAMILY INCOME (Average Net Dollars)
WELFARE | BELOW 50 | 50-99 | 100-149 | 150-199 | 200-299 | 300 AND OVER | UNKNOWN

NO. OF INDIVIDUALS ON FAMILY INCOME
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 AND OVER | UNKNOWN

30. FACILITY CODE

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

31. SOURCE OF REFERRAL
Self | Mental Health Center | Institution for Retarded
Family or Friend | Mental Hospital | Other Retardation Facility
Clergy | General Hosp.–Psychiatric Unit | Court or Correction Agency
School | General Hosp.–Other Unit | Public Health or Welfare Agency
Police (Excluding Court or Correction Agency) | Nursing Home | Division of Vocational Rehabilitation
Private Psychiatrist | Psychiatric Clinic | Voluntary Agency
Other Private Physician | Other Psychiatric Facility | Other

32. TIME SINCE LAST PSYCHIATRIC OR RETARDATION SERVICE
NO PRIOR SERVICE | WITHIN SAME DAY | WITHIN 7 DAYS | WITHIN 30 DAYS | WITHIN 6 MOS. | WITHIN 1 YEAR | OVER 1 YEAR

LAST SERVICE WAS— IN-PATIENT | OTHER

CODE FOR LAST FACILITY OR SERVICE

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

33. PRIOR PSYCHIATRIC OR RETARDATION FACILITY OR SERVICE (Mark ALL which apply) NONE | UN-KNOWN

INPATIENT:
This Facility
Mental Hospital
Mental Health Center
General Hospital
V. A. Hospital
Institution for Retarded
Other

ALL OTHER:
This Facility | Private Psychiatrist
Mental Health Center | Other Private Therapist
Nursing Home | Retardation Facility
Residential Treatment Center | School, Special Class
Partial Hosp. | Hostel or Halfway House
Psychiatric Clinic | Penal Institution
Other Psychiatric Facility | Other

34. PROBLEM APPRAISAL (Mark ALL which apply)
Consider 2 wks. preceding interview

PHYSICAL FUNCTION DISTURBANCE
Sleep Problems
Eating Problems
Enuresis, Soiling
Seizures, Convulsions
Speech Articulation Problems
Other Physical Problems

INTELLECTUAL DEVELOPMENT
Inadequate

SOCIAL RELATIONS DISTURBANCE
With Child
With Mate, Spouse
With Other Family
With Other People

SOCIAL PERFORMANCE DISTURBANCE
Job
School
Housekeeping

OTHER SIGNS AND SYMPTOMS
Suicidal Thoughts
Suicidal Acts, Gestures
Anxiety, Fears, Phobias
Obsessions, Compulsions
Depressed Mood, Inferiority
Somatic Concerns, Hypochondriasis
Social Withdrawal, Isolation
Dependency, Clinging
Grandiosity

Suspicion, Persecution
Delusions
Hallucinations
Anger, Belligerence, Negativism
Assaultive Acts
Alcohol Abuse
Sexual Problems
Narcotics, Other Drugs
Anti-Social Attitudes, Acts
Agitation, Hyperactivity
Disorientation, Impaired Memory
Speech Disorg., Incoherence
Slowed up, Lack of Emotion
Inappropriate Affect, Appearance, Behavior
Daily Routine, Leisure Time Impair.

35. OVERALL SEVERITY OF CONDITION
NOT ILL | SLIGHT | MILD | MODERATE | SEVERE

36. PROBLEM DURATION LESS THAN
WEEK | MONTH | 1 YEAR | 2 YEARS | 2 YEARS & OVER

37. WRITE PSYCHIATRIC DIAGNOSIS OR IMPRESSION (Include Code, Use APA Manual II, 1968)

COMPLETED BY | DATE

IBM H08637

*Supported in part by NIMH Grant No. 14934 to Multi-State Information System for Psychiatric Patients

MS 06* (7/71)

MSIS DIRECT PATIENT SERVICE FORM

PATIENT NAME	CONSECUTIVE NUMBER	UNIT RENDERING SERVICE
CONTACT CLINICIAN	OTHER CLINICIAN	

CONSECUTIVE NUMBER

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

ACTION CODE

NEW   DELETE

APPOINTMENT TYPE

SCHEDULED   UNSCHEDULED

CANCELLATION

PATIENT CANCELLED   CLINICIAN CANCELLED   NOT KEPT NOT CANCELLED

MANNER OF CONTACT

IN FACILITY   IN FIELD   TELEPHONE

EMERGENCY

EMERGENCY   NON-EMERGENCY

TYPE OF SERVICE (1)

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

TYPE OF SERVICE (2)

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

PERSON(S) SEEN (mark ALL which apply)

PATIENT   SPOUSE   PARENT

OTHER MEMBER OF PATIENT'S FAMILY   OTHER

NUMBER OF PATIENTS SEEN

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

NUMBER OF NON-PATIENTS SEEN

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

FACILITY CODE

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

UNIT RENDERING SERVICE

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

DATE OF CONTACT

~~JAN~~	~~FEB~~	~~MAR~~	~~APR~~	~~MAY~~	~~JUN~~	~~JUL~~	~~AUG~~	~~SEPT~~	~~OCT~~
1	~~71~~	~~72~~	~~73~~	~~74~~	~~75~~	~~76~~	~~77~~	NOV	DEC
2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21
22	23	24	25	26	27	28	29	30	31

TIME SPENT (minutes)

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

GROUP NUMBER

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

INTENDED DISPOSITION (mark ALL which apply)

DISCONTINUE SERVICE   REFER   HOLD

UNIT REFERRED TO

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

CONTACT CLINICIAN

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

OTHER CLINICIAN

0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9
0 1 2 3 4 | 5 6 7 8 9

* Supported in part by NIMH Grant No. 14934, a Multi-State Information System for Psychiatric Patients

M. S. I. S.

MS* DS-2 7/71

DIRECT PATIENT SERVICE FORM

1. Facility Code ______ 2. Date __/__/__ (mo. day yr.) 3. Unit Rendering Service ______

5. Consecutive Number	6. Patient Name	4. Manner of Contact			7. Appointment Type		8. Emergency		9. Cancellation			10. Type of Service (1)	11. Type of Service (2)	12. Group Number	13. Persons Seen					14. Number of Patients Seen	15. Number of Non-patients Seen	16. Time Spent (minutes)	17. Intended Disposition			18. Unit Referred to	19. Contact Clinician	20. Other Clinician
	(last) (first)	In Facility (1)	In Field (2)	Telephone (3)	Scheduled (1)	Unscheduled (2)	Emergency (1)	Non-emergency (2)	Patient Cancelled (1)	Clinician Cancelled (2)	Not Kept, Not Cancelled (3)				Patient (1)	Spouse (2)	Parent (3)	Other Member of Patient's Family (4)	Other (5)				Discontinue Service (1)	Refer (2)	Hold (3)			

CDR

*Supported in part by NIMH grant No. 14934, a Multi-State Information System for Psychiatric Patients.

PATIENT SUMMARY OF DIRECT SERVICE RECEIVED

FROM: JAN. 3,1972 TO: JUNE 1,1972

PATIENT NAME: STEWART,NANCY
CASE NUMBER: 123456

DATE OF CONTACT	TYPE OF SERVICE	TIME SPENT HR:MIN	CONTACT CLINICIAN	UNIT RENDERING SERVICE	INTENDED DISPOSITION
01/03/72	CRISIS INTERVEN.	2:00	7-M.BROWN	OUTPATIENT CLINIC	HOLD
01/03/72	MEDICATION (CHEMOTHERAPY)	:05	7-M.BROWN	OUTPATIENT CLINIC	HOLD
01/10/72	PSYCHIATRIC, PSYCHOLOGICAL AND SOCIAL EVAL.	2:30	7-M.BROWN	OUTPATIENT CLINIC	HOLD
01/15/72	INDIVIDUAL THERAPY	1:15	7-M BROWN	OUTPATIENT CLINIC	HOLD
02/06/72	CRISIS INTERVEN.	1:00	9-L.PARK	OUTPATIENT CLINIC	REFER TO INPATIENT UNIT
02/06/72	MEDICATION (CHEMOTHERAPY)	:05	4-G.LORNE	WARD 215	HOLD
02/25/72	INPATIENT CARE		6-F.POUND	WARD 215	HOLD
03/02/72	GROUP THERAPY	1:00	6-F.POUND	WARD 215	HOLD
03/06/72	MEDICATION (CHEMOTHERAPY)	:05	4-G.LORNE	WARD 215	HOLD
03/20/72	INDIVIDUAL THERAPY	1:00	4-G.LORNE	WARD 215	HOLD
04/01/72	MEDICATION (CHEMOTHERAPY)	:05	4-G.LORNE	WARD 215	REFER TO OUTPATIENT CLINIC
04/07/72	INDIVIDUAL THERAPY	1:00	2-P.FITCH	OUTPATIENT CLINIC	HOLD
04/25/72	MEDICATION (CHEMOTHERAPY)	:05	2-P.FITCH	OUTPATIENT CLINIC	HOLD
05/15/72	MEDICATION (CHEMOTHERAPY)	:10	2-P.FITCH	OUYPATIENT CLINIC	HOLD
06/01/72	INDIVIDUAL THERAPY	1:05	2-P.FITCH	OUTPATIENT CLINIC	DISCONTINUE SERVICE

PSYCHOTROPIC DRUG ORDER *

INSTRUCTIONS:
1. COMPLETE INFORMATION ON LEFT SIDE TO START AN ORDER.
2. SEND PART 2 (COPY S) TO DATA PROCESSING.
3. ATTACH FIRST AND THIRD COPIES TO PATIENT'S RECORD.
4. TO DISCONTINUE, FILL OUT INFORMATION ON RIGHT HAND SIDE. DETACH PART 3 (COPY D), SEND TO DATA PROCESSING.

FORM MS PD

NAME: LAST , FIRST , MIDDLE INITIAL

WARD NO.

PRINT FIRST 3 LETTERS OF LAST NAME IN BOXES

CASE/CONSECUTIVE NO.

FACILITY CODE

DOCTOR NO.

DRUG CODE

FORM AND ROUTE
MARK (x) ONLY ONE

- TABLET
- CAPSULE
- SUSTAINED RELEASE (SPANSULE)
- ORAL LIQUID (CONCENTRATE)
- SUPPOSITORY
- IM
- IV
- SUBCUTANEOUS

DATE OF ORDER

MO. DAY YR.

SIGNATURE M.D.

DRUG NAME

DOSAGE IN MG.

FREQUENCY

REASON FOR DISCONTINUANCE
MARK (X) ALL WHICH APPLY

- REGRESSED
- NO IMPROVEMENT
- SLIGHT IMPROVEMENT
- SUBSTANTIAL IMPROVEMENT
- BEHAVIORAL SIDE EFFECT
- PHYSICAL SIDE EFFECT
- LAB ABNORMALITY
- SOMATIC ILLNESS
- TREATMENT PLAN

DOCTOR NO.

NO. OF PRN ADMINISTRATIONS

SIGNATURE M.D.

DISCONTINUE DATE

MO. DAY YR.

*SUPPORTED IN PART BY NIMH GRANT NO 14934

CDR

rm MS 03 (9/69)

ERIODIC EVALUATION RECORD — Community Version (PER-C)*

Read instructions on reverse side.

Patient's last name | First name | M.I. | Facility | Ward

IDENTIFICATION

Case or consecutive no.

0 1 2 3 4 | 5 6 7 8 9 (seven rows)

Facility Code

0 1 2 3 4 | 5 6 7 8 9 (three rows)

Rater code

0 1 2 3 4 | 5 6 7 8 9 (three rows)

Last day of week being evaluated

Jan	Feb	Mar	Apr	May	Month	Jun	Jul	Aug	Sep	Oct
1	69	70	71	72	Year	73	74	75	Nov	Dec
2	3	4	5	6		7	8	9	10	11
12	13	14	15	16	Day	17	18	19	20	21
22	23	24	25	26		27	28	29	30	31

Sex: male / female

TRANSACTION: initial evaluation / reeval-uation / partial reeval / correc-tion / dele-tion

APPEARANCE Unkempt: (neat) none / slight / mild / mod / marked

Weight: under-weight / average / over-weight | gaining / losing

PSYCHOMOTOR ACTIVITY: very retarded / retard-ed / aver-age / accel-erated / very accel

GENERAL ATTITUDE, BEHAVIOR: cheerful / pleas-ant / like-able

(none / slight / mild / mod / marked: 1 2 3 4 5)

- Uncooperative
- Withdrawn
- Inappropriate
- Impaired functioning in goal directed activities
- Suspicious
- Antisocial
- Alcohol abuse (suspected)
- Drug abuse (suspected)

Anger (overt): none / slight / mild / mod / marked | physically destructive / assaul-tive

MOOD AND AFFECT

Depression: none / slight / mild / mod / marked | inappro-priate / euphoric

Anxiety: 1 2 3 4 5 | flat / labile

QUALITY OF SPEECH, THOUGHT

Productivity: mark reduc / reduc-ed / aver-age / incr-eased / marked increase

Incoherence: none / slight / mild / mod / mark | evasive / blocking

Irrelevance: 1 2 3 4 5 | loosening of associations

CONTENT OF SPEECH AND THOUGHT

grandiosity / inadequacy / phobia

obsessions / compulsions / suicidal ideation

distrustfulness / bizarre thoughts / ideas of reference

Delusions: none / slight / mild / mod / marked | perse-cutory / so-matic

SOMATIC FUNCTIONING AND CONCERN

Physical health: very good / good / only fair / poor / very poor

Appetite: very poor / poor / normal / exces-sive / very exces | to eat requires urging / help

Insomnia: none / slight / mild / mod / marked | sleeps excessively

Severe sensory impairment (organic): visual / hearing

Other symptoms: psycho-physiological / incon-tinence / sei-zures

Unwarranted concern with physical health: none / slight / mild / mod / mark

HALLUCI-NATIONS: none / slight / mild / mod / marked | audi-tory / visual

ORIENTATION DISTURBANCE: ? / none / slight / mild / mod / mark

MEMORY DISTURBANCE: ? / none / slight / mild / mod / mark

JUDGMENT ABOUT FUTURE PLANS: no plans (or) very good / good / only fair / poor / very poor

POTENTIAL FOR Suicide: unsure / not sig-nificant / low / mod / high / very high

Physical violence: unsure / not sig-nificant / low / mod / high / very high

ACTIVITIES: goes to school / keeps house

Works (hours/week): 1-5 / 6-10 / 11-20 / 21-30 / 31+ | for pay / no pay

Work performance (if working): very good / good / only fair / poor / very poor

Doesn't work at all because of (or) Amount of time working limited by

physical illness / psychopathology / looking for work

household responsibilities / going to school / his retirement

Involvement in voluntary leisure time activities: consid erable / mod erate / only fair / little / none

Good friends: many / several / a few / only one / none | prefers being alone

Heterosexual adjustment: very good / good / only fair / poor / very poor

frigidity / potency disturbance / homosexual behavior

Marital adjustment (if married): very good / good / only fair / poor / very poor

Pleasure out of life: a great deal / consid erable / mod erate / little / none

ADEQUACY OF HOUSING: ? / very good / good / only fair / poor / very poor

FINANCIAL PROBLEMS: ? / none / slight / mild / mod / mark

OVERALL SEVERITY: not ill / slight / mild / mod / mark / severe / among most extreme

CHANGE IN CONDITION: marked impr / Im-proved / stable / vari-able / worse | during week / past month

RATER HAS WRITTEN COMMENTS ELSEWHERE

Signature | Date

Periodic Evaluation Record - Community Version

PERIODIC EVALUATION RECORD
COMMUNITY VERSION

THE FOLLOWING COMPUTER GENERATED REPORT IS BASED ON INFORMATICN NOTED ON A PERIODIC EVALUATION RECORD - COMMUNITY VERSION (PER-C). (STATEMENTS NOTING MISSING INFORMATION THAT THE RATER WAS EXPECTED TO PROVIDE, OR INCONSISTENCIES BETWEEN RATINGS, ARE ENCLOSED IN PARENTHESES).

IDENTIFICATION:
PATIENT'S CASE NUMBER 123456
FACILITY CODE 16
RATER CODE 7
LAST DAY OF WEEK BEING EVALUATED MAY 25, 1972
SEX FEMALE

TRANSACTION:
INITIAL EVALUATION.

APPEARANCE:
NEAT. AVERAGE WEIGHT.

PSYCHOMOTOR ACTIVITY:
AVERAGE.

GENERAL ATTITUDE AND BEHAVIOR:
SLIGHTLY UNCOOPERATIVE.
SLIGHTLY IMPAIRED FUNCTIONING IN GOAL DIRECTED ACTIVITIES.
SLIGHTLY SUSPICIOUS.

NOT WITHDRAWN OR INAPPROPRIATE. NO OVERT ANGER. NOT ANTISOCIAL. NO ALCOHOL OR DRUG ABUSE.

MOOD AND AFFECT:
SLIGHT DEPRESSION.

NO ANXIETY.

QUALITY OF SPEECH AND THOUGHT:
AVERAGE PRODUCTIVITY. NO INCOHERENCE OR IRRELEVANCE.

CONTENT OF SPEECH AND THOUGHT:
NO DELUSIONS.

SOMATIC FUNCTIONING AND CONCERN:
GOOD PHYSICAL HEALTH. NORMAL APPETITE. NO INSOMNIA. NO UNWARRANTED CONCERN WITH PHYSICAL HEALTH.

HALLUCINATIONS: NONE.

ORIENTATION DISTURBANCE: NONE.

MEMORY DISTURBANCE: NONE.

JUDGMENT ABOUT FUTURE PLANS:
POOR JUDGMENT ABOUT FUTURE PLANS.

POTENTIAL FOR SUICIDE, PHYSICAL VIOLENCE:
LOW POTENTIAL FOR SUICIDE.

POTENTIAL FOR PHYSICAL VIOLENCE NOT SIGNIFICANT.

ACTIVITIES:
ONLY FAIR INVOLVEMENT IN VOLUNTARY LEISURE TIME ACTIVITIES.
HAS ONLY ONE GOOD FRIEND.
SEXUALLY PROMISCUOUS
LITTLE PLEASURE OUT OF LIFE.

WORKS 31+ HOURS PER WEEK FOR PAY. GOOD WORK PERFORMANCE.

ADEQUACY OF HOUSING:
GOOD HOUSING.

FINANCIAL PROBLEMS: NONE.

OVERALL SEVERITY OF ILLNESS:
MILDLY ILL.

CHANGE IN CONDITION:
IMPROVED.

SIGNATURE: DATE:

7. INTEGRATION OF FUNCTIONS

a. At a user's site the computer operation is a service to the ambulatory health care delivery service.

The financial resources for its development have come from Federal mental health grants ($10 million over 7 years), and the cost of its operation are paid by recharges which are often met by appropriations from the user states.

b. At the user's site the automated medical record system supports the manual medical records. Its outputs are inserted into the paper system. Information from the inpatient stay is integrated with the ambulatory history.

Some of the data are not stored, but are used to produce, immediately after entry, printed statements based on the checked fields of the form. The automated system contents are not accessed by the medical records librarian at the sites visited although this is possible.

c. In summary, this computer system is best viewed as a production service.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by administrative management aggregate services provided and provide patient and personnel statistics.

b. Special requests are made to data processing staff for items such as research studies. This happens frequently at CMHC where the director, Dr. Boris Astrachan , is very interested in the management of the patient population.

9. INFORMATION UTILIZATION

a. The system primarily provides information for administrative staff, institutional management, health care planners; and secondarily provides information for medical researchers, clinicians and paramedical personnel.

The information is intended to assist in the administration of the delivery of chronic disease maintenance (mental health).

In order to make more intensive use of the system, users observed that forms have to be designed to deal with the typical outpatient (neurotic) rather than with inpatients (typically severely disturbed). In addition, more training and personnel is desired. More medical content is needed to make this an AAMRS. The installation of new equipment allows cheaper terminals to be supported; more software allows time-sharing and better inquiry capability which is felt needed by ISDRC.

b. The group which currently depends on the outputs from the automated system is the administrative staff.

If the system does not work for one day, it is not noticed; if it does not work for a week, operations are held up. Monthly reporting requirements have to be met within a few days.

If changes in the system are required, then a decision to implement them is made in one week to six months, and it typically takes another one week to one month to actually change the computer system.

10. EVALUATION OF EFFECT OF AAMRS ON SERVICES AND OUTCOME

a. The effect of the automated system has been to manage the access to care and to manage the cost of health care delivery in the county. At CMHC the quality of care has also improved. This has been generally due to better understanding of service needs, and consequently, better utilization of services. Fewer errors have been found and increased fee-for-service collection has been achieved at Pomona.

b. The change in the access to care has been evaluated through measurement of factors relating to the patients, providers, and administrators. These measurements were obtained by counting and by objective measurements (surveys, questionnaires). Measures used have been demographic patient distribution, continuity of care, appointments initiated by patients, patients referred by physicians, and missed appointments.

A major study has been conducted by Carole Siegel entitled, "Evaluating the Attainment of Process Objectives of Community Mental Health Centers Using an Automated Patient Data System (MSIS)", published by ISDRC in 1974 and supported by NIMH under HSM-42-72-212.

Evaluation of management aspects of health care delivery collected include number of visits per patient. Availability of information for planning has been achieved for manpower and facility planning. Availability of information for facility operations has provided increased cost recovery from state and federal sources and provided data for utilization review procedures.

Another evaluation has been made on the accuracy of the psychiatric evaluation at New York State Psychiatric Institute. Appropriate codes were not available or were coded erroneously in 25% of the forms.

c. The results of the evaluations are an information source for regional health care planners program evaluators and medical researchers.

11. ECONOMIC INFORMATION

a. Pomona:

The total annual operating budget of one user organization, the Rockland County Community Health Center is about $4.3 million. The major sources of operating funds are as follows:

Federal funds (NIMH)	30%
State funds	32%
County funds	19%
Agency contributions	14%
Fee-for-service, county charges	4%
Volunteer contributions	1%

The Center employs about ______personnel on a full and part time basis, and _____ persons are clinicians engaged in direct patient care.

The cost of patient services is based upon a sliding scale based on ability to pay and is determined by the Center's administration. There has been no change to the patient service costs as a result of the AAMRS.

The MSIS is complimentary to the patient record and thus it does not replace any of the manual record. The manual patient record is primarily handwritten and stored in a central location. A unique patient ID number is used for each patient's medical record. It does replace some nonmedical uses of the medical record.

b. CMHC:

The total annual operating budget of the other user organization, the Connecticut Mental Health Center, is about $6.2 million. The major sources of operating funds are state funds (about 65%) and federal funds (about 32%). About 10% of the state funds are derived from fees-for-services.

The Center employs 285 personnel on a full and part time basis, and 185 of the persons are engaged in direct patient care.

The cost of patient services is based upon a sliding scale based on ability to pay. The fee structure is determined by the state administration. There has been no change to patient service cost as a result of the AAMRS.

Since the MSIS is a compliment to the manual patient record, there have been no changes to the existing system as a result of the AAMRS. It has reduced load on the manual medical record.

c. Cost Analysis: Development Costs

The development of the MSIS by the Information Sciences Division Research Center of the Rockland State Hospital began in 1967. The cost for the development of the system over seven years is estimated at $10 million. While the MSIS is operational, ongoing MSIS development work is continuing at a cost of about $557,000 per year.

Expected future system additions include reporting of shared staff activities, the problem-oriented psychiatric record (now completed) and the goal-oriented record for the developmentally disabled.

The primary source of development funds has been federal research grants. Additionally, the state provided facilities and IBM provided some subsidies on the equipment acquisition in the early years.

Cost Analysis: Operating Costs

An estimate of the current MSIS direct operating cost is $950,000 per year,(with indirect costs about $ 1,300,000 per year),of which $394,000 is for routine MSIS services. The primary source of operating funds are user charges (40%), other grants (38%), and state appropriations (22%). The primary decision maker with respect to the MSIS user charges is the ISDR.

Pomona:

The development of the MSIS at Pomona began in 1974 with entering of data into the system. Actual use of the data in the system began 2 years later. The current annual service contract for MSIS is $25,000. Since the Pomona site cooperated in the initial development effort, the service contract does not recover full costs.

In addition to the annual service contract, direct costs incurred at Pomona include personnel (a data processing manager and data input personnel), terminal rent,forms, and transmission costs. Total direct costs of the MSIS incurred by the Center at Pomona are estimated to be about $80,000 to $100,000 per year.

The Pomona utilization of the total MSIS system is estimated to be about 10 %. Based on the percentage of total system utilization, the total actual costs of the MSIS at Pomona are estimated to be $80,000 for total MSIS costs, including development, or $25,000 for routine service only.

The primary decision makers with respect to the MSIS budget at Pomona are the data processing manager and center director, subject to the approval of the county government.

Note: at Pomona, if actual costs were being charged, it is not clear that the MSIS is considered worth the benefits derived from it to date. However, use of the system is increasing, particularly with respect to manpower utilization reports and the development of uniform service charges. The major use of the MSIS at Pomona is to satisfy administrative needs.

CMHC:

The MSIS became operational at the Connecticut Mental Health Center in July, 1969. The current annual MSIS user charge is about \$43,000. Additional direct costs include personnel (3 FTE, a manager and two clerical personnel), terminal rent (2 card punches, 1 optical reader), communications costs, and forms. The total annual direct costs for the MSIS at the Center is estimated to be about \$108,000.

The Center's utilization of the total MSIS system is estimated to be about 10 %. Based on the percentage of total system utilization, the total actual costs of the MSIS at the Connecticut Center is estimated to be \$25,000 routine service and \$80,000 total per year. CMHC was characterized by ISDRC as a high utilization facility.

The primary decision makers with respect to the MSIS budget at the Center are the facility manager and state administration.

At the Connecticut Mental Health Center, it is the opinion of the facility manager that the MSIS is definitely worth the costs that are being incurred for it. The funds for the MSIS are primarily from state appropriations that are subject to the usual funding controls and budget decision making found in state government. The MSIS provides administrative data necessary to justify budget requests to support the Mental Health Center.

Cost Analysis: Investment Costs

The investment costs incurred by a new user of the MSIS are limited. The major efforts required are:

Familiarization with the available services;

Decision making on which services to use;

Design of any specialized forms;

Installation of the remote station;

Training of clinical personnel;

Training of clerical personnel.

Factors that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

The system is readily adaptable to other settings as an administrative tool. Organizations that require the accumulation of data on patients and utilization of services and that have a large volume of patient contacts could find the system useful.

The hardware used for the MSIS represents a constraint in that data entry is indirect; there is no on-line capability now. Such a capability is planned.

The system is limited in billing and accounting capability and also limited in the depth of recorded medical data.

Financial viability of the MSIS operations has been dependent upon grant support. The user fee structure does not appear to recover costs.

State legal requirements affect the transferability of patient data from one institution to another (this is true in New York, not as much in Connecticut.)

d. Benefit Analysis: Tangible Benefits

System Costs Savings: Because the MSIS is a supplement to the existing medical record systems, there are no system cost savings with respect to the medical record at Pomona.

At the Connecticut Mental Health Center, minor savings have been realized in the substitution of equipment for labor and filing supplies no longer required by diagnostic and clinical files. The amount of these savings have not been quantified.

Health Manpower Savings: At Pomona, it is expected that some savings will be realized from improved management of clinical manpower after manpower utilization reports are analyzed. Additionally at Pomona, the admissions process has experienced some minor savings in the use of clerical personnel.

At the Connecticut Center, there are no clinical manpower savings relating to the use of the medical record.

Patient Cost Savings; At the Connecticut Center a review of the utilization data resulted in improved, greater, utilization of patient facilities, The amount of savings from increased utilization has not been quantified.

Management Benefits: The major cost benefit for both user sites has been with respect to management benefits.

At Pomona these include increased accuracy with respect to recording services provided, billing procedures, and claims processing, For 1972 increased accuracy in third party payment processing resulted in increased income of $100,000 and for 1973 and for 1974 the additional collections ranged from $150,000 to $200,000. Thus it is clear that from a collection point of view the system pays for itself at the present MSIS contract cost, since the data processing budget is about $80,000 to $100,000 per year.

Similar benefits have been realized at the Connecticut Center. The use of patient contact forms has reduced the number of lost charges and increased speed in billing has saved state processing time. The reduction of lost charges and information on eligibility on the patient contract forms has contributed to an estimated increase in billings of $100,000 over a 4 month period. Thus the system is also paying for itself at Connecticut. In addition to the additional income from improved billing procedures, the Connecticut Center has made more efficient use of its resources through manpower scheduling. These benefits have not been quantified in dollar terms, but can be seen through improvements to access to care.

Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement	
	Pomona	Connecticut
Direct Patient Care:	0	++

At Connecticut Center the utilization review process has improved treatment planning and provided feedback to the clinicians. These improvements have been measured through increased information in the medical record and an examination of the length of the treatment period. The benefit is considered very positive which could not be realized without MSIS.

Access to Care:	+	++

At Pomona some improvements in access to care have been attributed to the MSIS, since the system provided data for special studies on services to catchment areas. Measures of change were number of patient visits, referrals to other providers and frequency of appointments.

At the Connecticut Center access to care has also improved through program evaluation studies of MSIS output on patient services. The catchment analysis in the special study mentioned above led to the establishment of a clinic for Spanish speaking families.

Management Aspects of Health Care:	+++	+++

In addition to the quantified savings described under the tangible benefits, both users have realized significant intangible benefits with respect to financial and operating management. Specifically, the utilization reports provide data on services provided which are important inputs to the budgeting and planning for mental health services. The MSIS provides information and analytical tools necessary for the management of and justification for the operations of the mental health centers.

Other benefits realized from participation in MSIS and other computing services include:

1) **the participants have access to the results of research into new applications for the MSIS system.**

2) **The expertise of the MSIS professional staff is available to users for consultation, and**

3) **For many users the cost of sharing the MSIS is less than the cost of an independent internal system providing the same services.**

Benefit Analysis: Societal Intangible Benefits	MSIS System
Technological Advancement in AAMRS:	+
Early large scale user of mark sense forms and optical scanners. Widespread use of system; multiple state users.	
Quality of Care Review Methodology:	+
Utilization review procedures.	
Research Activities:	++
Many publications regarding MSIS. Research in privacy area.	
Training Activities:	+
Health Planning:	++
MSIS has provided extensive data for regional and national mental health planning.	

12. COMMENTS

The use of this system in the outpatient area concentrates on administrative reporting requirements. The computer records indicate patient continuity and printouts are routinely produced from each form entered and printed at the institution. This computerized information is not filed in the charts at the sites visited and hence not made available routinely to the health care providers at the time of the patient encounter. Printed reports derived from the checked forms are filed in the local medical record. Legal restrictions inhibit the sharing of the stored medical record among facilities by electronic means.

The system provides a major research resource, describing the mental health population in demographic and utilization terms. For outpatients the medical information is too sparse for general studies, although the system provides facilities to support specific research initiated by a user at his site on his population.

It is clear that to the Pomona Clinic users that this is not an automated ambulatory medical record system. The clinicians on the staff do not consider the "mental status" and "psych history" parts of the system to be useful. The time required to fill out forms requires too large a fraction of the available time. Administrators here obviously like the ability to spin off county, state, and federal reports. Marked increase in recovery of fee-for-service income is a major factor for using the system.

The users are reasonably satisfied with the system because it adequately fulfills their administrative reporting needs. New application systems are being developed, but their acceptance has not been tested.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDY-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO THE SECTION OF MEDICAL COMPUTER SCIENCES (SMCS) YALE UNIVERSITY SCHOOL OF MEDICINE NEW HAVEN, CONNECTICUT ON JANUARY 7, 1975

Dr. Shannon Brunjes introduced the visiting study team to the project. SMCS has been serving and HMO operation in New Haven, Connecticut, the Community Health Care Center Plan, Inc. (CHCP), for more than three years. The study team was able to meet most of the staff of Dr. Brunjes' group, and some members of the team also visited the offices of the CHCP, and spoke to Dr. Baker of CHCP.

This service to CHCP is due to terminate in the near future. However, it is expected that other sites will use the service after it has undergone a period of re-evaluation and a change of hardware systems.

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objective as seen by SMCS for the system is principally quality of care improvement through better communication among medical personnel.

Dr. Brunjes stated that:

> "The overall objective was to develop a complete, total, automated medical record system, which would replace the traditional medical record, and allow research based on the data and their utility."

A key element in Dr. Brunjes' research is the concept of the coded clinical event which is thought to be fundamental to what they are doing and is felt to be an essential component of a record system that will meet all of the objectives considered. The evaluation of the utility of the coded clinical event as the fundamental unit for the automated medical record is a key objective.

These objectives have come about in response to a need felt by a medical researcher and through direction from the dean of the medical school and the support of the director of the CHCP. The collection of medical research information was seen as a benefit to SMCS and the health services data collected were seen useful for the CHCP.

The system in use here is completely new and was intended to replace the manual system to the extent feasible.

b. The population which is served by the system is the membership of the CHCP, a prepaid health plan, which is available as an employee group benefit in the New Haven area.

The ethnic distribution is mixed. The age distribution and the social category of the population is affected by the fact that all subscribers are employed.

The service environment is mainly urban.

The care provided is mainly primary care, but capability for secondary care exists due to the qualifications of the CHCP staff.

The quality of the health care institution served is judged to be relatively high by the interviewers.

The average annual income of the institution's patient population was not available.

The size of the population served by the CHCP using this system currently is 15,000; the target population is 30,000.

The needs for this population are mainly in the area of primary care. Patient visits are primarily a result of appointments.

2. PROVIDER OBJECTIVES

a. The objective of the Automated Medical Record System at CHCP is to improve the delivery of health care by improvements to quality of care in the areas of patient management (i.e., data base acquisition and feedback to physicians), and quality of care review procedures.

The management aspect objectives of health care are to improve management and operations of the facility by the provision of management with information and analytical tools for cost control, drug inventory control, planning, and utilization review procedures. A government grant supported data collection for health planning at CHCP.

An objective here and shared by many facilities is the collection of data to support government funding of the CHCP. Totally automated records were seen as desirable for an HMO. This approach is attributable to the founder of the CHCP.

Dr. Brunjes sees potential conflicts in the competition for grants at CHCP and SMCS. Work at CHCP and work at SMCS was supported by different agencies.

b. The organization which has made the decision to develop and provide automated record services is the SMCS. It has provided these services to CHCP free, except for data entry costs.

The management of the CHCP originally made the decision to use the AAMRS. The CHCP has now decided to discontinue their use of the service. CHCP will continue to provide enrollment, pharmacy, and encounter data on their equipment. It is expected that other sites will be serviced in the future by SMCS.

The institution, the Section of Medical Computer Sciences (SMCS), providing the service is an academic unit of Yale University's Medical Center.

The service is used by a prepaid community group practice with about 14 FTE physicians.

The institutions are private, non-profit corporations.

The size of the practice at CHCP is the following:

Number of patients is 15,000 (enrollment)
Number of patient visits per year is 150,000 **was given by CHCP, or 10 per enrollee**

These were distributed as follows:

physicians	3.2
other providers	2.3
support visits	4.5

The daily clinical visit rate was given by Dr. Brunjes to be 300 per day or about 78,000 per year.

About 33,000 major **visits were recorded into the AAMRS. Dr. Brunjes states that from the period of March 1973 through December 1974 every single visit at CHCP was recorded into the AAMRS.**

The control over the format and intended medical content of the record system is provided by a committee of physicians with strong influence by the SMCS. The actual content was strongly affected by physicians' cooperation.

The technical operation of the system is in the hands of a research staff of 10 individuals and is under supervision of the director of the SMCS and the academic administration.

3. SERVICES PROVIDED

Data collection is done using single part, 16 page forms with check marks and a small amount of text. Numerical 5-digit codes printed next to the boxes to be check-marked are entered using keypunching.

Source data collection is mainly by MD's and other providers. Identification data is entered by medical clerical personnel prior to the encounter.

Data entry is by CHCP and SMCS clerical personnel at the user's facility.

The CHCP's IBM System 3 computer system was used for the editing and correction of all of the clinical visit data, both checking for correctness of name and number, but also checking for gross errors.

The data cards are transmitted by messenger.

The data are stored forever.

The entered information is used to prepare medical record entries and also patient progress reports as well as flow sheets for vital signs. The entered information also is used to generate reports such as patient profiles, disease profiles, and practice profiles.

There is capability to inquire into the files to determine a patient's medical status by any variable and boolean combinations of variables.

These services are provided by batch programs at a central site only.

The CHCP maintains its own separate and largely incompatible computer for administrative purposes. This IBM System 3 maintains an enrollment file, and this file is used to update the medical record system. Billing for the fee-for-service patients is done manually, since the volume is small.

Processing of research data is done using the Yale University Computing Center batch services.

4. TASKS REQUIRED

a. Data Entry Tasks

Data entry is accomplished through keypunch (300 visits per day with somewhere between five and ten cards per visit.)

Missing data elements in the fixed format portion of the records are identified and obtained, other missing data elements are ignored and not distinguished.

Verification of data entry is performed by matching the I.D. number with the patient's name. Data entry is verified in that the system checks to make sure that all codes that are entered are valid codes and checks field by field for reasonableness of data. If it is invalid it is returned for correction before it enters permanently into the patient record. Most errors are found by data entry personnel.

Currently, the original forms remain in the chart. It is the intention to remove old forms once the physician has indicated that the computer report corresponds to the data on the forms.

Error correction is currently done only for patient identification errors. A paper audit trail of all errors is maintained.

b. Data Storage

1) File Updating

Additional data entries are reflected in the files after an overnight batch update run.

2) File Storage

The data which are entered into the file are kept permanently.

3) File Usage

To obtain a current record from the file requires ten minutes at the central site; to determine whether a patient has a record in the file requires ten minutes. The search can be done only by enrollment number.
The file also is used directly to answer research questions, or transmitted to a larger computer where analyses for research purposes can be done.

4) File Size

The required file space is now 150M characters, and is not expected to grow. When a shortage of file space occurred, then more files were purchased. The files are sequential and contain the codes corresponding to the check marks only. These codes for each clinical event include problem number, date recorded, onset, severity and optimally duration, and various modifiers. Each patient record is a separate sequential file consisting of any number of 20-character blocks.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available:

1) Individual patient record by generation of a cumulative patient report; a problem list with the date, problem number, and action taken for every problem at each encounter (status of the problems not given); report for last patient visit; retrieval of abstract of patient record; and generation of flow sheet for a patient. Such use of the stored data is infrequent.

2) Selection of Patients

   Selection of all patients with given codes is made occasionally for research purposes.

3) Tabulation of provided services by diagnosis or problem, signs and symptoms, patient category (age, sex, enrollee group), patient address or location, provider, and services rendered (drugs) is done regularly using the collected data, transferred to tape, on the Yale University computer (IBM 370/158).

4) Comparison of selected patient groups includes descriptive statistics (e.g., tables, histograms, means, and standard deviations); and inferential statistics (e.g., t-tests, analysis of variance); and other programs available on the University computer.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by research personnel and professional programmers.

The routines are specified by research personnel.

Their operation is verified by research personnel through pilot operation.

The routines are kept on a general library file.

Their documentation is kept on paper in a general library.

The principal programming language is FORTRAN.

e. Protection of Data

No extensive protection mechanism exists since the service is a batch operation. Professional systems personnel have access to the data base.

f. Training

New medical users of the system are given demonstration and documentation in order to learn how to use the system. After about a week they can be fully proficient according to the developer; at the CHCP it is felt that it takes much longer. There is a users manual for physicians and other providers.

g. Presentation of Results

The means for producing output are printers.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient identification record is fixed at 96 characters. The size of a visit record is variable, with an average length of 20 characters. During a visit very many parameters may be collected; the average is five coded clinical events. Approximately half of the information stored is medical in nature.

b. Patient Identification

(The following data are obtained from the enrollment file on the administrative computer.)

I.D. number: Unit number, enrollment, group number
Name (full)

(The following data are available only by linkage to the enrollment file.)

Address
Phone (home and business)
Sex
Date of birth
Marital status

c. Financial and Economic Information

Financial and economic information is not kept by SMCS for CHCP.

d. Data Base: History of Present Illness

These data are collected on a 16-page form by the physician at any visit. The identification section on the form is prepared by clerical staff for scheduled patients whether they show or not, and for unscheduled patients prior to the physician encounter.

Each clinical event is described in detail including an assignment of a problem.

Only data not yet in the cumulative report (to be put in the chart subsequent to any encounter, while the previous one is removed) has to be entered on the form. This cumulative report is not now routinely available for all patients.

Chief complaint (problem number flagged) and symptoms (coded or descriptive) are recorded.

Active problems are recorded by date of onset, date of entry, problem name (problem code is not entered now), and severity.

There is considerable detail possible regarding location, quality, and frequency of signs and symptoms. For several frequent complaints much data in coded form (e.g., associated with..., preceded by...(time), relieved, made worse by..., etc.) can be collected.

Instead of detailed entry on the form, a check is made frequently to indicate dictation. Dictated text is not entered into the automated record.

Risk factors are evaluated for smoking, alcohol, and accidents.

The collector of the information is identified.

e. Data Base: Past Medical History

The past medical history is not stored.

Past diseases within the health plan history are coded as a problem list and fully retained. Previous problems are not entered.

Past hospitalizations, only within the health plan history, are retained as collected on a clinical visit form.

Data on previous diagnostic tests, immunizations, and allergies are not collected.

Current medications are recorded by name, code name from formulary, problem number prescribed for, quantity, form, units, frequency, period, and source (health plan pharmacy or other). These data are entered by the CHCP pharmacy.

Past medications are recorded only within health plan history. A special study collected more extensive data.

No diet data are collected.

Psychiatric - general attitudinal and behavior evaluation data are recorded.

f. Data Base: Social History

Some social history is available in the enrollment file as follows:

Date of birth
Place of birth
Employment
Size of household
Names of other beneficiaries
Number of children

These data are collected when an individual enrolls in the plan.

g. Data Base: Review of Systems

A review of systems is collected occasionally when necessary by problem number and system name. Positive findings, duration, frequency, and severity are coded and recorded as free text.

The collector is identified.

h. Data Base: Physical Examination

A full physical examination can be recorded. All entered physical examination data are retained which include date, weight (occasionally), height, sex, risk factors (for smoking and alcohol), impression, and vital signs, and positive findings for each system which are coded for position, severity, etc.. Free text can be added.

The collector is identified.

i. Data Base: Objective Findings of past medical history are not stored.

j. Problem List

A problem list is entered as free text and stored. A new problem number is assigned by the computer system if no previous problem number is entered. The problem list is produced from the previous encounters. Each and every coded clinical event is linked to a problem definition by number.

Temporary problems are not indicated except as a general category: as trauma.

Inactive problems can be indicated as resolved.

Since the time of our visit our natural language program for analyzing and classifying problem definitions has been put into use and we now have a detailed breakdown of the problem definitions for research use.

k. Plans, Diagnostic Orders

Diagnostic orders are only stored, if entered, as free text.

l. Plans, Therapeutic Orders

Problem number always is to be given.

Medications are recorded by Rx, quantity, and frequency. These data are coded and recorded in the health plan pharmacy.

Diet information consists of a single check mark only.

Patient education includes checks for rest, aspirin, observation, and reassurance.

Orthopedic, gynecologic and optometric treatments can be entered extensively with coded choices.

Physical therapy includes checks for heat, crutch, elevation, and stocking.

Activity orders are indicated by dates of stop and return to work.

m. Follow-up

Follow-up data are not stored, except that disposition is coded, and on a subsequent visit a physician can indicate a problem to be resolved (no merge or delete capability, however). No diagnostic results (lab, etc.) are collected.

n. Progress Notes

Progress notes are stored in the form of encounter forms (coded and free text) for all diseases, signs, and symptoms as described in the data base as clinical events.

o. Patient Services Management

Patient services management is not provided.

No-show is indicated on forms for scheduled patients only. It also can be indicated whether the encounter was a prior scheduled visit, a drop-in (day or night), or an urgent visit.

p. Practice Information

The practice information that is provided includes the following:

Enrollment group
First contact with this practice or agency
Referral (self, M.D., or other), reason for visit, and disposition
Providers at encounter (M.D., nurse, P.A., other)
Use of other facilities (for a hospital emergency room the same encounter form can be completed)
Audit-oriented data

q. Research-oriented Data

Many of the data categories listed above may be collected for research purposes. Studies have been made on drug interactions and quality of care. Detailed data are available for all the clinical events entered.

r. Comments

The encounter form provides for the recording of a very extensive set of medical observations. All frequent choices are precoded and options exist for free-text entry of choices or expansions not provided for.

In practice only a minimal number of checks are made by CHCP physicians, even though the form provides for all of the medical record data to be kept. The placement of check marks provides also an indication of severity, problem number, onsets etc.

Most visits may not require many checks.

Alternate forms of input are currently being considered at SMCS.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computers:

1 DEC PDP 11/20, 28K, estimated cost = $100,000, installed in 1971;
1 DEC PDP 11/10, 28K, estimated cost = $20,000, installed in 1971.

The computing services to CHCP are provided by the developer, SMCS, The equipment there is purchased. Maintenance is by vendor and costs $10,000 per year,

Approximately 90% of the processing capability of the PDP 11/20 at SMCS is used for the ambulatory medical record application. Approximately 90% if the file capability is used for the ambulatory medical record application. The development and support of CHCP has been the major effort at SMCS.

The files are stored on two DEC RK05 single, movable-arm disks(2.4M char each) (PDP 11/20) and one DEC RK05 single, movable arm disk (PDP 11/10). Other important equipment is one 9-track tape and one Decision Data card reader purchased and interfaced for $8,000 included in the price above. Archival storage is 60 disk packs and tapes.

Keypunches are used at CHCP for data recording.
Terminals are not used in routine services. Hard-copy output is produced by one DEC printer, 132 char. per line, upper case only, 300 lines per minute, mechanism - impact.

For new developments and research there are five Hazeltine CRT's (80 char. x 24 lines, upper case, 2400 baud, rented). They are considered to be reliable; their legibility is marginally adequate.

b. The system uses batch operation (DEC DOS) for most of its processing. Currently, production occupies 50% of the machine, and development 50%. Of the production load 20% is data entry, 40% is file maintenance, and 40% is report preparation. Data analysis is done outside of production times.

c. The operating system was designed and written for general purposes. It is understood by the local staff, and maintained by the original supplier.

The file system is characterized by sequential files with linked records. These files are organized into a 1-level hierarchical structure based on patient identification.

The implementation of the AMRS requires one main and many subsidiary files and seven distinct record types.

d. When there is a computer failure, then the vendor is called and he/she keeps the computer until it is fixed.

A failure happens about once or twice per month and that number has been steady. It is not noticed by the user since there is only overnight operation.

e. The data processing staff consists of

3 keypunchers at the user's facility (CHCP), one supported by CHCP and two by SMCS.

and at SMCS

1 manager
2 medical specialists
1/2 systems analyst
3-1/2 FTE programmers
2 operators.

Dr. Baker from CHCP spends one half day per week at SMCS. The data processing staff reports to the Director of SMCS.

The response to request for changes in system output is one week to three months.

f. The costs of the computer operation are not charged. The investment in the system is about $120,000 to $150,000, and the operational cost is about $ per month.

g. The ambulatory record system is intended for future distribution. If it is going to be distributed, it will be supported directly by SMCS.

6. THE FORMAT OF THE MEDICAL RECORD

The record available to the physician is a traditional medical record, filled with the bulky and often largely empty input forms, and the printouts resulting from the encounter. Due to the few items entered on the form during an encounter, there is often only a single line on a computer printout sheet. The delays which have occurred in the data entry and in the filing of the encounter output form into the record have further discouraged the use of the computer output. These delays have been due to a strike of CHCP employees and are also related to the limited resources of CHCP and the unwillingness of CHCP to include laboratory and drug data on the computer generated reports which would have eliminated large amounts of filing of prescription copies and individual lab slips.

The data is presented by problem, but not in the SOAP format and mixes historical and physical data. This unconventional format was felt hard to used by our reviewers.

The available data is presented using a cumulative patient report. This report consists of a problem summary using all notes referring to a problem and a chronologically arranged visit list with dates and diagnoses.

The encounter form consists of 16 pages, with the essential entries concentrated on the first page.

No data can be obtained on-line in the clinic.

The patper record is kept on-site in the clinic. It is generally available on short notice.

Continuity of one provider-patient combination is maintained except for emergencies.

Other outputs available to the providers are flowsheets.

A sample with the initial and one inside page of the form is attached, and the resulting encounter report to be verified by the physician. This is followed by the first page and portions of the final two pages of a patient summary for a patient who had many problems.

COMMUNITY HEALTH CARE CENTER PLAN, INC. ADPLG

CLINICAL VISIT FORM

Nº 118960

enter recid room

DATE: ___ / ___ / ___
HOUR: ___ : ___ ☐AM ☐PM
PROVIDER CODE: ______
SITE OF VISIT: ☐CHCP ☐HOME ☐PHONE ☐______
PATIENT PHONE: ______ EXT: ______

VITAL SIGNS

	LINE #	PROB. #	QUANTITY
B.P. STANDING	20016		/
B.P. SITTING	20018		/
B.P. LYING	20020		/
PULSE	20022		/MIN.
RESP.	20024		/MIN.
TEMP.	20026		°F
HEIGHT	20028		IN.
WEIGHT	20030		LBS.

APPOINTMENT STATUS

20019	☐ PRIOR APPOINTMENT	20029	☐ SAME DAY APPT.	20027	☐ NO APPOINTMENT
20023	☐ DAY	20031	☐ NIGHT	20033	☐ URGENT VISIT
20035	☐ MET	20036	☐ NO SHOW	20038	☐ CANCELLED

REASON FOR VISIT

20000	☐ INITIAL ASSESS.	20009		☐ PRE/ POSTNATAL	20012		☐ ALLERGY SHOT
20006	☐ DISCUSSION	20011		☐ WELL CHILD	20014		☐ IMMUNIZATION
20008	☐ B.P. CHECK				20015		☐ RETURN

PRINT ONLY ADDITIONS OR CHANGES TO CURRENT REPORT LIST.

LINE #	PROB. #	WORSE	NO CHG.	IMP.	RESOL	DICT.	PROBLEM NAME/DIAGNOSIS	P/D	CODE
20150		☐	☐	☐	☐	☐	GENERAL CARE		
20152		☐	☐	☐	☐	☐	HYPERTENSION		
20154		☐	☐	☐	☐	☐	RESPIRATORY INFECTION		
20156		☐	☐	☐	☐	☐	OTITIS		
20158		☐	☐	☐	☐	☐	TRAUMA		
20160		☐	☐	☐	☐	☐	DIABETES		
20162		☐	☐	☐	☐	☐	OBESITY		
20164		☐	☐	☐	☐	☐	EMOTIONAL PROBLEM		
20032		☐	☐	☐	☐	☐			
20032		☐	☐	☐	☐	☐			
20032		☐	☐	☐	☐	☐			
20032		☐	☐	☐	☐	☐			

PLAN OF ACTION

20058		☐ __/__/__ STOPPED WORK	20070		☐ APPLY HEAT
20060		☐ __/__/__ RETURN TO WORK	20172		☐ CRUTCH
20062		☐ REST	20174		☐ ELEVATION
20064		☐ ASPIRIN	20176		☐ ELASTIC STOCKING
20066		☐ OBSERVATION	20178		☐ DIET
20068		☐ REASSURANCE			

	PROB #	GIVEN AT CHCP	CH NG	RX STOP	MEDICATION NAME STRENGTH FORM QUANTITY UNITS "Q" FOR
99983		☐	☐	☐	
99984		☐	☐	☐	
99985		☐	☐	☐	

NOTE FOR STORAGE

99986 ☐ MESSAGE TO:

DISPOSITION

20040		☐ PATIENT WILL PHONE	20046		☐ HOSPITALIZE
20042		☐ WE WILL PHONE	20048		☐ SKILLED NURSING HOME:
20044		☐ RETURN AS NECESSARY	20050		☐ REFER TO NON CHCP-MD:
20052		☐ CHCP APPOINTMENT W/ME	20054		☐ CHCP APPOINTMENT WITH: ___ ON __/__/__

PHYSICAL EXAM

	LINE #	PROB. #	
COMPLETE P.E. NORMAL	20072		☐
PE NORMAL EXCEPT AS NOTED	20074		☐
EMOTIONAL BEHAV. EVAL. NML	20076		☐
SKIN NORMAL	20078		☐
HEENT NORMAL	20080		☐
EYE EXAM NORMAL	20082		☐
INTRAOCULAR PRESSURE NML	20084		☐
OPHTHALMOSCOPIC EXAM NML	20086		☐
VISUAL SCREENING NML	20088		☐
AUDIOMETRIC EXAM NML	20090		☐
EAR EXAM NORMAL	20092		☐
TEETH AND GUMS NORMAL	20094		☐
THYROID EXAM NORMAL	20096		☐
RESPIRATORY EXAM NORMAL	20098		☐
NOSE NORMAL	20100		☐
PHARYNX NORMAL	20102		☐
ANT. CERVICAL NODES NML	20104		☐
POST.CERV.OCCIP.NODES NML	20106		☐
LUNG EXAM NORMAL	20108		☐
BREAST EXAM NORMAL	20110		☐
BREAST SELF EXAM DEMONSTR.	20112		☐
HEART COMPLETE EXAM NML	20114		☐
HEART AUSCULTATION NML	20116		☐
PERIPH. PULSES, CAROTIDS NML	20118		☐
AXILLARY NODES NORMAL	20120		☐
ABDOMINAL PALPATION NML	20122		☐
INGUINAL NODES NML	20124		☐
GENITAL EXAM NML	20126		☐
PELVIC EXAM NML	20128		☐
PAP SMEAR DONE	20130		☐
RECTAL EXAM NML	20132		☐
STOOL OCCULT BLOOD ABSENT	20134		☐
SIGMOIDOSCOPY NORMAL	20136		☐
BRIEF NEUROLOGIC EXAM NML	20138		☐
COMPLETE NEURO. EXAM NML	20140		☐
NECK SUPPLE	20142		☐
SPINE, BACK, C-V ANGLE NML	20144		☐
JOINTS NORMAL	20146		☐
MUSCLES NORMAL	20148		☐

CONTENTS - 3 - SKIN
BACK - 5 - TRAUMA
CRANIAL - 7 - NERVE
RESP. - 11 - CARDIO
GI - 13 - GYN
15

☐ OTHER COVERAGE

PHYSICIAN / PROVIDER'S SIGNATURE

10

KEYPUNCH IN COLS. 10-14 15-17 56 →

EAR

THYROID

RESPIRATORY

CARDIOVASCULAR

TB

99994 PROB #

CHEST PAIN

HOW OFTEN	[ ] 1st TIME	LONG STANDING
	[ ] OCCASIONALLY IN THE PAST	
ONSET:	[ ] SUDDEN ONSET	[ ] GRADUAL ONSET
LOCATION:	[ ] MID-SUBSTERNAL PAIN	[ ] R. SIDE PAIN
	[ ] LOW-SUBSTERNAL PAIN	[ ] BACK PAIN
	[ ] R. LATERAL MIDBACK PAIN	[ ] SHOULDER PAIN
	[ ] L. LATERAL MIDBACK PAIN	[ ] PRECORDIAL PAIN
	[ ] R. SCAPULAR PAIN	[ ] L. SCAPULAR PAIN
TYPE:	[ ] SHARP	[ ] PRESSING
	[ ] VAGUE	[ ] FLEETING
	[ ] BURNING	[ ] CRAMPY
NIGHT WAKING:	[ ] NIGHT WAKING	[ ] NO NIGHT WAKING
RADIATION:	RADIATES TO:	
	[ ] R. LATERAL MIDBACK	[ ] JAW
	[ ] L. LATERAL MIDBACK	[ ] BACK
	[ ] R. SCAPULAR	[ ] ABDOMEN
	[ ] L. SCAPULAR	[ ] L. ARM
	[ ] SHOULDER	[ ] NO RADIATION
INITIATED BY:	INITIATED BY:	
	[ ] DEEP BREATHING	[ ] TRAUMA
	[ ] SUPINE POSITION	[ ] EATING
	[ ] COUGHING	[ ] EXERTION
AGGRAVATED BY:	AGGRAVATED BY	
	[ ] ARM/SHOULDER MOVEMENT	[ ] EXERTION
	[ ] SUPINE POSITION	[ ] ANXIETY
	[ ] DEEP BREATHING	
RELIEVED BY:	RELIEVED BY:	
	[ ] SITTING UP	[ ] REST
	[ ] BELCHING	[ ] ANTACIDS

SEVERITY CODE

** SYSTOLIC MURMERS, DIASTOLIC MURMERS	*PULSES	STANDARD
1+ = NOT HEARD IMMEDIATELY WITH STETHOSCOPE	0 ABSENT	0 = ABSENT
2+ = FAINTEST MURMUR HEARD IMMEDIATELY	1 = DECREASED	1 = MILD
3+ = EASILY HEARD BUT NOT ASSOCIATED WITH THRILL	2 = NORMAL	2 = MODERATE
4+ = USUALLY ASSOCIATED WITH THRILL	3 = INCREASED	3 = SEVERE
5+ = ALWAYS ASSOCIATED WITH THRILL, NOT HEARD WITH STETHOSCOPE OFF CHEST		
6+ = HEARD WITH STETHOSCOPE OFF CHEST WALL		

COLS. 10-14 15-17 18 21-22 | 10-14 15-17 | 10-14 15-17 18

LINE # | PROB # | R/L | SEV

PULSES

CAROTID	20700	R	
	20700	L	
BRACHIAL	20701	R	
	20701	L	
RADIAL	20702	R	
	20702	L	
FEMORAL	20703	R	
	20703	L	
POPLITEAL	20704	R	
	20704	L	
DORSAL-PEDAL	20705	R	
	20705	L	
POST.-TIBIAL	20706	R	
	20706	L	

HEART SOUND

1st SOUND ↑	[ ]	20710
1st SOUND ↓	[ ]	20711
2nd SOUND ↑	[ ]	20712
2nd SOUND ↓	[ ]	20713
2nd NML SPLIT	[ ]	20714
2nd WIDE SPLIT	[ ]	20715
2nd FIXED SPLIT	[ ]	20716
2nd ABSENT SPLIT	[ ]	20717
3rd SOUND PRESENT	[ ]	20718
4th SOUND PRESENT	[ ]	20719

VASCULAR BRUIT

CAROTID	[ ]	20725	R
	[ ]	20725	L
CRANIAL	[ ]	20726	
THYROID	[ ]	20727	
FEMORAL	[ ]	20728	R
	[ ]	20728	L
POPLITEAL	[ ]	20729	R
	[ ]	20729	L
ABDOMINAL	[ ]	20730	
LIVER	[ ]	20731	

10-14 15-17 56 →

TUBERCULIN TEST

20732 PROB #	MM INDURATION
	TEST NAME:

10-14 15-17 18-20 21-22

PHYSICAL EXAM | LINE # | PROB # | RESULT/SEV

EAR EXAM

CERUMEN IN CANAL	20600
WAX REMOVED [ ]	20601
EXUDATE IN CANAL	20602
LOSS OF BONY LANDMARKS	20604
CONGESTION OF TM	20606
THICKENING OF TM	20608
BULGING TM	20610
RIGIDITY OF TM	20612
PERFORATION OF TM	20614
RETRACTION OF TM	20616
SCARRED TM	20618
PE TUBES PRESENT	20620
MYRINGITIS	20622
BULLOUS MYRINGITIS	20624
FLUID IN MIDDLE EAR	20626

THYROID EXAM

THYROID EXAM NML	20734
THYROID ENLARGED	20736
THYROID NODULES	20738

RESPIRATORY EXAM

NASAL MUCOSA—PALLOR	20740
" " —REDNESS	20742
" " —BOGGY	20744
NASAL TURBINATES—SWOLLEN	20746
PHARYNGEAL INJECTION	20630
PHARYNGEAL EXUDATE	20632
TONSILITIS	20634
WHEEZES ON AUSC.	20636
DULLNESS TO PERCUS.	20638
TACHYPNEA	20640
HYPERPNEA	20642
RALES	20644
RHONCHI	20646
BRONCHIAL BREATHING	20648
↓ BREATH SOUNDS	20650
↓ RESP. EXCURSION	20652
HYPERRESONANCE	20654
PLEURAL FRICT. RUB	20656
ADENOPATHY	20658
SPLENOMEGALY	20660

CARDIOVASCULAR EXAM

NECK VEIN DISTENTION	20666
PEDAL EDEMA	20668
VARICOSE VEINS	20670
PULSE ABNORMALITY *	20672
CLUBBING	20674
PRECORDIAL THRUST	20676
CARDIOMEGALY	20678
THRILL	20680
VENOUS HUM	20682
BRUIT	20684
PERICARDIAL FRICT. RUB	20686
ARRHYTHMIA	20688
GALLOP—S-3	20690
GALLOP—S-4	20692
MURMUR—CONTINUOUS	20694
MURMUR DIASTOLIC**	20696
MURMUR SYSTOLIC**	20698

RECORDED
1/14/72

```
****************************************
*  CHCP SINGLE VISIT PATIENT REPORT   *
*          PERMANENT RECORD           *
*  REPORT WILL REMAIN IN CHART        *
****************************************
        1/14/72   CHCP        APL,JWD
```

NAME:
CHCP#   001014
PRINTED: 12/17/74

PAGE 1

************************* VITAL SIGNS ***********************************

************************* PROBLEM/DIAGNOSIS ****************************

5 CHRONIC EAR DISEASE

************************* NOTES **

5 CHRONIC SUPPURATIVE OTITIS MEDIA

************************* SIGNS AND SYMPTOMS **************************

SIGNS AND SYMPTOMS SEVERITY ONSET PER. DURA

****

1. VERIFY THIS SINGLE VISIT REPORT AGAINST ITS CLINICAL VISIT FORM.
2. .... INITIAL HERE IF THIS REPORT IS COMPLETE AND ACCURATE.
3. CORRECT THIS SINGLE VISIT REPORT IF THERE ARE ERRORS.
4. .... INITIAL HERE IF THIS REPORT IS ACCURATE BUT INCOMPLETE.
   PLACE ADDITIONAL INFORMATION ON A NEW CVF.

CDY

CHCP CUMULATIVE' PATIENT REPORT
FOR TEMPORARY' USE ONLY

20 VISITS FROM: 8/ 4/72 TO: 6/28/74

NAME:
CHCP #: 009317
DATE: 12/17/74 PAGE 1

*********************** PROBLEM SUMMARY ********************************

```
 8/ 4/72  2  INSECT BITES
10/ 6/72  3  URI
 5/ 3/74  3  URI
11/ 3/72  4  RINGWORM
 6/10/73  5  TRAUMA
12/19/73  6  VIRAL EXANTHEN
 2/ 6/74  7  RECTAL BLEEDING
 2/ 7/74  7  RECTAL BLEEDING
 2/12/74  7  RECTAL BLEEDING: DICT
 3/ 8/74  7  RECTAL BLEEDING: NO CHG.
 4/16/74  7  COLITIS
 3/ 8/74  8  OTITIS MEDIA
 3/ 3/74  9  S/P COLOSTOMY
 3/ 8/74  9  COLOSTOMY
 4/11/74  9  S/P COLOSTOMY
 3/ 3/74 10  FEVER
 4/24/74 11  VARICELLA
 6/24/74 12  LEG PAIN
 6/28/74 12  FOOT PAIN  ;NO CHANGE
```

*********************** PROGRESS NOTES ********************************

```
1
        1/11/73              CHCP   CVF,BLW
                           IMMUNIZATION;
1
        1/11/73              CHCP   CVF,BLW
                            ** NOTE ** OPV 0.5 CC AND MMR 0.5 CC.
1
        11/14/73             CHCP   CVF,BLW
                           WELL CHILD;
1
        11/14/73             CHCP   CVF,BLW
                   44LBS   WEIGHT;
1
        11/14/73             CHCP   CVF,BLW
                    42IN   HEIGHT;
2  - INSECT BITES
        8/ 4/72              CHCP   CVF,ANS
                            ** NOTE ** TRUNK AND EXTREMITIES. RX : KEEP
                                       CLEAN AND OBSERVE.
3  - URI
        10/ 6/72             CHCP   CVF,BLW
                      1+   COUGH ; ONSET  9/29/72;
3  - URI
        10/ 6/72             CHCP   CVF,BLW
                      1+   RHINORRHEA, WATERY; ONSET  9/29/72;
```

CHCP CUMULATIVE' PATIENT REPORT
FOR TEMPORARY' USE ONLY

20 VISITS FROM: 8/ 4/72 TO: 6/28/74

NAME:
CHCP #: 009317
DATE: 12/17/74

PAGE 8

*********************** PROGRESS NOTES--NO PROBLEM NUMBER ************

*********************** PROGRESS NOTES--NO PROBLEM NUMBER ***********

8/ 4/72 CHCP CVF,ANS
DAY VISIT ;
NO APPOINTMENT;
DISPOSITION: RETURN AS NECES -/28/74

PAGE 9

10/ 6/72 CHCP CVF,BLW
DAY VISIT ;
NO APPOINTMENT;
MET ;
DISPOSITION .SS NOTES--NO PROBLEM NUMBER ************
98.8 F TEMPERAT
DAY VISIT ;
11/ 3/72 C WEIGHT;

CHCP CVF,ANS
MET ;
0102.0 F TEMPERATURE ;

1/11 5/ 3/74 CHCP CVF,SAR
NIGHT VISIT ;
URGENT VISIT;
0102.4 F TEMPERATURE ;

5/15/74 CHCP CVF,ANS
PRIOR APPOINTMENT ;
DAY VISIT ;
DISPOSITION: NO SHOW;

********************** VITAL SIGN SUMMARY ****************************

TIME RECORDED	STAND. B.P.	SITTING B.P.	LYING B.P.	TEMP.	WEIGHT	PULSE	RESP.	HEIGHT
11/14/73					44LBS			42IN
3/ 8/74		126/070		97.6 F	44LBS			
3/ 3/74				0103.6 F				
10/ 6/72				98.8 F				
12/19/73				0100.4 F	43LBS			
4/16/74					47LBS			
4/24/74				0102.0 F				
5/ 3/74				0102.4 F				

END OF REPORT 12/17/74

7. INTEGRATION OF FUNCTIONS

a. The computer operation is a project of the ambulatory health care delivery service. Administratively, the computer service is directed by a research group. Technically, the computer service is directed by an academic group.

The financial resources for its development have come from research grants ($), and the cost of its operation is paid mainly by grants. The priority of new tasks for the system is determined by the researchers.

b. The automated medical record system supplements, but is intended to replace the manual medical records except for graphic data, e.g., EKG tracings. Its outputs are inserted into the paper system. Information from the paper system is taken into the automatic system in case of inpatient stay. Laboratory findings are not entered by CHCP into the automated system. The automated system contents are not accessed by the medical records librarian.

c. Other automated services used by the ambulatory health care delivery services are not to be replaced with this system. The dichotomy of responsibility for services at CHCP is a major liability.

d. In summary, this computer system is best viewed as a pilot effort for evaluation of a research concept, namely the coded clinical event.

8. INFORMATION DISTRIBUTION

a. A report received regularly by administrative management lists aggregate services provided. There is no on-line use by administrative management.

b. A report received regularly by clinical personnel provides practice profiles. There are no on-line requests by clinical personnel.

c. Special requests have been made for items such as research studies on drug profiles. This required additional data collection from patients preceding the encounter. These requests happen regularly, depending on the needs of the research staff.

9. INFORMATION UTILIZATION

a. The system provides information for clinical physicians, medical researchers, institutional management, and quality of care review. The information is intended to assist in the delivery of comprehensive health care.

In order to make more intensive use of the system at a new location, the goals of the clinic and the system developers have to be more compatible, the interfaces have to be more carefully defined, better means for comprehensive medical data collection have to be developed, more data have to be collected (specifically, laboratory and radiology results) and such data have to be collected at more points, and better output response is needed. The developer sees that more hardware is required (a powerful new computer is on order), inquiry capability is required, and better education of users will have to be carried out. The current system design would also require more data entry personnel to avoid the excessive entry lag.

b. The individuals who depend on the outputs from the automated system are the medical researchers. Studies correlating drug prescription with the later development of symptoms have been undertaken. The system was intended to be routinely used by clinical physicians, paramedical personnel, and administrative staff. Since the source documents are retained in the manual chart, it is possible for CHCP to discontinue the use of the automated system.

If the system does not work for several days, then operations are frustrated but still tolerable.

If changes in the system are required, then a decision to implement them is made in one day to one week; and it typically takes another one week to one month to actually change the computer system. The system has been frozen for the last half year.

Examples of changes which were desirable are changes of report formats to problem orientation. A necessary change to be made is a major conversion to on-line operation using CRT's. The precise design of such a change is yet undermined.

10. EVALUATION OF EFFECT OF THE AAMRS ON SERVICES AND OUTCOME

a. Evaluations are currently in progress. The effect of the automated system has been to probably increase the quality of care. This has been due generally to better quality of services, fewer errors, and reduced inter-MD differences.

The costs incurred at SMCS are to be considered to be part of the departmental research effort, and not now a factor in health care delivery.

It is interesting that CHCP is maintaining the quite sophisticated encounter system and drug and enrollment system using their own computer to the extent that the system cost is picked up and carried out of their own budget does indicate a success. The failure of the joint effort with SMCS was the failure in not developing a complete system to replace the record system.

b. The change in the quality of care has been evaluated relating to the health care providers. These measurements were obtained by subjective judgement (Drs. Baker and Brunjes). The medical records generated by the system were examined for accuracy and completeness.

Availability of information for planning has been intended but had not been achieved during our visit. A recent MDA thesis provides data on differences between groups of HMO users.

The results of the evaluation should be an information source for system designers.

11. ECONOMIC INFORMATION

a. The total annual operating budget of the user organization, the Community Health Care Center Plan, Inc. (CHCP) is about $2.5 million. The major sources of operating funds for the CHCP are prepaid medical care plans (66%), fee-for-service (11%), and gifts and grants (23%). The CHCP employs about 100 persons, of which about 13% are physicians and 15% are nurses or other types of medical care providers.

The cost of patient services, the prepayment amounts and fee structure is determined by the management of the health plan. There has been no change to patient service costs as a result of the AAMRS.

b. Some aspect of the AAMRS was in existence since the health plan began operations and a manual medical record system has also always been maintained. As time progresses, some of the entries in the medical record were computer outputs. The manual medical record may be characterized as primarily hand written with some standardization. A unique patient identification number was used and the medical records were stored centrally within the health plan facilities. No cost estimate was obtained for the maintenance of the manual record system.

c. Cost Analysis: Development Costs

The development of the AAMRS with the CHCP began in 1972. The development has been an ongoing effort and the system has never been considered fully operational. The development costs of the AAMRS are estimated at $1,000,000 over a three year period. It should be noted that the cooperative effort between the AAMRS developer and the CHCP is being terminated; thus the AAMRS reviewed will never become operational at the CHCP. The major source of development funds for the AAMRS was federal research grants.

Cost Analysis: Operating Costs

An estimate of the current AAMRS direct operating cost to the user (CHCP) is about $32,000 annually ($22,000 for the salaries of two keypunch operators and $10,000 for input forms). All other system costs have become borne by the developer. The total direct operating cost of the AAMRS is estimated at $314,000 per year, including those expenses paid by the CHCP. About 32% of the total direct operating costs was for routine services ($99,500); the remaining 68% was for research and development ($214,500). The source of the developers funds has been primarily the federal research grants. (Total cost, including indirect costs are estimated at $432,000 per year, of which $43,000 is funded by CHCP.)

The primary fiscal decision makers with respect to the AAMRS system budget are the AAMRS facility manager (Brunjes) and his administration (Yale academic administrators). The primary decision makers for the CHCP support of the AAMRS has been CHCP management. The actual amount of support provided was determined through negotiations. Essentially total AAMRS system costs have been under the control of the developer and the user support has been nominal.

Since the AAMRS is being withdrawn from the CHCP, there is no likelihood that the present form of the system will ever become self supporting.

Cost Analysis: Investment Costs

Considering that this AAMRS is being withdrawn from its present application and will be subject to considerable revision, the investment costs for any new user or new application of the current system were not discussed.

Factors which affected the attainment of provider objectives were:

A separate computing system was used for administrative and business needs of the CHCP. Thus the AAMRS was not used to support administrative needs. It should be noted that at other AAMRS sites where the system has been accepted by management, acceptance has generally been due to the management contributions of the AAMRS.

An initial objective was to develop a complete automated medical record system covering every aspect of health care. However, from a technological point of view it was necessary to approach the problem by developing one aspect at a time. Thus the user was not getting what was originally envisioned.

The entire development effort was dependent upon grant support. The user had no obligation to support the effort. The CHCP administration did not feel it was in their interest to become dependent upon the AAMRS.

While the objective was to automate the medical record, the CHCP legal advisors did not permit the disposal of original input forms. Thus it was necessary to retain a paper record and include bulky input forms.

Some of the problems with the application development of this AAMRS were the inadequate funding plans and rather loosely defined objectives. The CHCP had no financial investment in the development of the system and therefore had little incentive to get fully involved in the development of the system. Essentially the CHCP involvement was a cost (extra manpower effort, extra procedures) for which they realized little benefit. These costs are not considered reimbursable as HMO expenses.

d. Benefit Analysis: Tangible Benefits

Note: Only one representative of the CHCP was briefly interviewed; he is one of the physicians that was a strong supporter of the AAMRS development. Additionally, the time available for the interview was extremely limited; thus a detailed coverage of system benefits was not possible. Additionally, the data obtained is limited in that other representatives of the CHCP, particularly the management were not interviewed.

Considering that the AAMRS is being withdrawn upon the CHCP's request, it seems reasonable to conclude that the CHCP management believes that benefits, if any, did not warrant continued involvement at this time with the AAMRS. It should be noted that the CHCP is still in the process of its own development and is not as yet on sound financial footing. The current enrollment of the CHCP is below its break-even point, so that the plan is operating at a deficit.

The specific benfits cited during the interview with the CHCP physician were health provider savings and improved quality of care.

After a long learning period, the physician can save time in the recording of information for the medical record by using the 16 page encounter form. This, however, required the cooperation of the physician and the benefit achieved is minor.

The quality of care is improved as a result of the quantity of data recorded on the encounter form. When the form is used as intended, the physician is likely to record more information per patient visit than without the use of the form, which results in better feedback to the physician and facilitates problem identification.

No benefits were cited with respect to the cost of care and access to health care. The AAMRS did provide some information for management, but the overall impact is considered negative since the system did not meet management expectations.

Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement
Quality of Health Care Improvement	+
Access to Health Care:	0
Management Aspect of Health Care:	-

The system was able to produce some management data. Even though individual aspects may be positive, overall assessment is negative due to the fact that the CHCP is withdrawing from its AAMRS involvement.

Benefit Analysis: Societal Intangible Benefits

Technological Advancement in AAMRS:	+

Considerable effort has been spent on determining ideal record content and record presentation format.

Quality of Care Review Methodology:	+

Study of prescription patterns.

Research Activities:	+

Some publications describing the conceptual approach to the organization of medical data. Since our visit, additional material is being prepared for publication.

Training Activities:	0
Health Planning:	+

System provided data for a masters thesis on prevalence of medical problems in an HMO population.

12. COMMENTS

Considerable effort has been made to determine record content, organization, and format. Early results presented by Dr. Brunjes show a strong preference for the problem-oriented format. Much difficulty has been encountered in getting physicians to use the form, notwithstanding the loose affiliation of CHCP with Yale University, a factor which could encourage commonality of objectives. Only three out of fifteen physicians use the form intensely and it may take months to learn to use the form quickly. The available alternative is dictation. All of the physicians at CHCP have used the form to some extent since it was the major form of medical record available.

There was inadequate financial planning and lack of clearly defined objectives at the beginning of the venture. CHCP had no stake in the system.

The fact that SMCS was only seen as a supplier of some part of the system has hindered the relationship.

There was inadequate communication between CHCP staff and the developer.

Grant funds were generous,but short term and with conflicting objectives. The developer could not develop a plan to meet long term objectives within time limits and specific funds.

Dr. Brunjes stated that on-line input has been both required and forbidden by the same funding agency, and that there have been multiple changing objectives imposed externally. This greatly increased his costs.

While the intent was to learn from the health care environment during the development of the system, it appears that the learning was after the fact rather than prior. Rather than listening and learning first, ideas were developed and implemented, and then the developers waited for the reaction. Lack of funding prior to the implementation of CHCP has caused undue pressures so that operation and design were continuously intermingled.

Not enough of an attempt was and is being made to learn from other efforts on this and related fields. There has been little support from the computer scientists and medical taxonomists at Yale.

The time involved in bringing the system up probably seemed very long to the CHCP management.

There also have been problems in entering the data from the forms into the computer. At times entry has lagged several months due to a strike by CHCP employees. The hiring and training of good data entry clerks has also been a problem. Currently, these data are entered within a few days.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDH-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO THE LABORATORY OF COMPUTER SCIENCE MASSACHUSETTS GENERAL HOSPITAL

AND THE HARVARD COMMUNITY HEALTH PLAN BOSTON, MASSACHUSETTS 02114 ON JANUARY 8, 1975

We were received by Dr. G. Octo Barnett of the Laboratory of Computer Science (LCS). At various times we were joined by Mr. R. Lurie from the Harvard Community Health Plan (HCHP), Dr. Joseph Dorsey (Medical Director, HCHP), and Dr. G. Plotkin. (HCHP), all of the Kenmore program of the plan.

Technical information was provided by Norma Justice (LCS).

This report is based on the information presented during this visit and on reports and forms made available by Dr. Barnett and Mr. Lurie. Additional data was provided by Dr. Barnett during his review of the draft of our report.

The summary contains the following sections:

1. OUTCOME OBJECTIVES (as described by Mr. Lurie and Dr. Barnett)

a. The initial objective was to test innovative technology and its impact upon comprehensive health care delivery. As the system developed, the validity of other objectives was recognized.

The objectives for the system are now principally quality of care improvement in the area of comprehensive health care through better communication among personnel and better feedback.

Cost management as achieved by efficient management of all information required for the administration of an HMO.

These objectives have come about in response to direction of the organizers of the HMO, the expectation of future legal obligations (PSRO), and the need felt by the health services researchers and and the management and providers of the plan.

The system in use here is intended as a replacement of a manual system.

b. The population which is to be served by the system is selected by the availability of financial backing such as employers.

The population is special in terms of age distribution (disproportionally single young adults of working age and dependents).

The ethnic distribution is predominantly white middle class. There is a definite low income group including white, black, and Spanish-speaking as well.

The service environment is generally urban. Primary care is the major service provided within the facility.
The existing quality of this health care institution is judged relatively high and evidenced by a rapid growth of subscribers.

The quality of health care delivered to the same type of population served here by other institutions is high to average.

The institution's patient population is skewed towards middle class, with some lower to middle income blue collar, a significant Medicaid and welfare group and a few Medicare patients.

The size of the population served by this system currently is 37,000; the potential population is the same due to the limited capacity of HCHP. There is, however, a 40% annual turnover in the population. A sister plan, the Cambridge Community Health Plan, has now 8,000 subscribers and a potential capacity for 40,000. Cambridge does not now use an automated record system, but is at this time actively considering adoption of the AAMRS.

The needs for this population are in the area of comprehensive, mainly primary care.

Patient visits are primarily a result of appointments on patient initiative with about 15% drop-ins.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Quality of care as reflected

in patient management through data base acquisition problem identification and feedback to physicians regarding achievement of desired outcomes due to problem-oriented data presentation;

in patient compliance with physician orders because of continuity of care;

in experimental quality of care review procedures; and

in increased communication among health care providers because of improved legibility, availability, and standardization of the record.

Access to care improvement resulting from record availability and patient follow-up.

Resource utilization improvement, namely, better health manpower utilization of medical and paramedical personnel, and reduction of clerical personnel in medical records.

Better referral of patients due to better data availability, leading to a lower rate of hospitalization and hence reducing the cost of patient services.

Management aspects of health care aimed at improving management and operations of the facility by the provision of management with information and analytical tools for utilization review procedures, resource utilization, budgeting and planning of services; faster processing in claims handling, done by capitation billing to Blue Cross; and improved management of enrollment and management records. Some patients (3 to 5%, mostly former members) are billed using fee-for-service.

Other specific objectives unique to the facility are as follows: Good data on services rendered is important to a health maintenance organization (HMO) both for rate-setting and cost control purposes.

b. The organization which has made the decision to provide automated record services is the institution visited here (Kenmore). However, a new health plan at another location, sponsored by the same organization is in the process of deciding whether to automate its records.

Expansion of use occurs as user demands warrant.

The institution is an HMO with 75 participating MD's (33 FTE).

The institution is organized as a private, non-profit corporation.

The size of the practice is the following:

Number of members is 36,000 (yearly average),

Number of patient visits per year is 145,000,

Average time per patient visit:

waiting time is 10 to 30 minutes if scheduled, about 30 minutes if drop-in with advance notice, up to 1-1/2 hours without; the wait is 2 months an initial health assessment;

service time is 30 minutes for an initial visit,
15 minutes for a repeat visit.

The control over the medical content of the record system is provided by two committees of users (medical records and administration) and the Laboratory of Computer Science.

The technical operation of the system is in the hands of the staff of LCS (8-1/2 FTE).

3. SERVICES PROVIDED

Data collection is done using forms with checkmarks and optional free text. Text is found on about 50% of the forms and comprises 10 to 20% of the data. Some (20%) of the visits also generate dictation. There are 15 different forms corresponding to 15 specialties. The forms are single part and one or two pages long, printed on two sides.
The forms are entered as is, using CRT-keyboard entry, by clerical personnel.

Items not precoded on the form (other) are coded by the data entry clerk. All codes are 4 character codes developed by LCS for its files.

Source data collection is by the provider, generally the MD or nutsing staff. In the laboratory, data are entered by the clerical staff.

Data entry is by clerical medical personnel. The data are transmitted by modems and telephone.

The data are stored on-line indefinitly for all active members; otherwise put on archival files 6 months after terminating membership with the HCHD.

The entered information is used

to generate medical record summaries, encounter documents, patient progress reports, and flow sheets;

to provide data for the membership enrollment file, fee-for-service bills and payments for outside services;

to generate reports such as practice profile, patient profiles, and some treatment and disease profiles. Utilization data is important for rate-setting.

There is the capability to inquire into the files to determine patient's medical status and past activities by most variables (not text or dictation) and boolean combinations of these variables.

The services are provided at a central site in the medical record room of the clinic, and on terminals located in each care area.

Other relevant services provided by other systems or vendors are:

capitation billing,
payroll,
general ledger,
accounts payable, and
accounts receivable.

4. TASKS REQUIRED

a. Data Entry Tasks

Data entry is accomplished through CRT keyboard entry. There are about 600 encounters per day, with an average of 40 characters per encounter to be entered. About 100 encounters per day have dictated notes of about 6 to 8 lines (360 to 500 characters). A laboratory entry (typically one per encounter) generates 14 characters (identification code 4, result 10), an X-ray 5 (4+1).

Missing data elements are ignored and not distinguished except for some entries where they are not allowed.

Verification of data entry is done by data entry limit checking and by output scanning using expanded codes.

Most errors are found by data entry personnel (95%). Quality control of input is done regularly on a random basis. The error rate found at input is less than 1% of data items.

Error correction is done on-line. A detailed audit trail of all errors is not maintained, but changed fields are flagged as such.

Data entry hardware has not given much problems in the area of reliability (1 failure/week for all devices together). The man-machine interface is adequate for the mainly clerical use.

Data entry software has given no problems in the area of reliability. The interpretive approach simplifies the man-machine interface. Batch operations are very time consuming.

b. Data Storage

File Updating:

Additional data entries are reflected in the files immediately after entry.

Changed data entries are reflected in the files immediately after entry.

The data invalidated are not kept.

File Storage:

The data which are entered into the file are kept indefinitly for active patients, but moved to archival storage 6 months after termination from the plan if there are no subsequent visits.

File Usage:

To obtain a current record from the file requires a few seconds, from a computer standpoint. Updates should be on the file within 6 to 36 hours after the encounter, delays of 48 hours have occurred.

To determine whether a patient has a record in the file requires about 10 seconds.

The search can be done by unit number (fast), family number, social security number, exact name, or approximate name (Soundex).

The file is also mainly used for patient care, but also important for membership verfication, for conditional enrollment, for claims checking, and for quality of care experimentation.

File Size:

The required file space is now 120 million characters and is growing at 20 million characters per year.

When a shortage of file space occurs, then more files will be purchased.

The files are hierarchical. All entries are variable length, in the top levels relatively fixed length elements are kept.

Storage is dynamically allocated. The file structure (MUMPS globals) avoids storing empty fields through the use of labelled entries and pointers.

c. Data Analysis Procedures Used

For the analysis of the stored data, the following classes of routines are available (frequency of use):

Individual patient record by

retrieval of summary of patient record (for most visits 1 to 2 pages, 600/day) and reports of recent patient visits specifically formatted for the clinic to be visited.

retrieval of complete patient record (30 per day)

generation of flow sheet for patient for all pediatric and prenatal visits (200/day).

generation of worksheet for patient (limited),

generation of monthly billing statement (for fee-for-service visits, 500/month).
generation of third party bills (claims) (for medicare visits, 200 month).

Selection is done for all patients with given

problem or diagnosis,
value of sign or symptom if coded,
treatment modality,
laboratory test occurance and result, and
combination of the above.

This selection is made on the basis of single visit records or across time axis.

Selection of patients due for a visit or review is done.

Tabulation of provided services is done by

diagnosis or problem,
patient category (age, sex, insurance group),
patient address (zip code),
provider (single or multiple),
services rendered (if coded)

monthly tape to tape comparision of HCHP membership files with those of the insurance carriers is done to maintain accurate membership records.

Comparison of selected patient groups includes descriptive statistics (e.g. tables, histograms, means and standard deviations). Other statistics are rarely used.

Financial management is aided by programs which do billing for fee-for-service patients, and generate tapes for processing by service bureaus for other financial functions.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by research personnel and professional programmers at LCS.

The routines are specified by LCS research and HCHP clinical personnel with the aid of a professional data processing staff at LCS

Their operation is verified by LCS data processing staff through an informal check-out procedure.

The routines are kept on a general library file on the machine dedicated to HCHP. Their documentation is kept on paper.

The sole programming language is MUMPS.

e. Protection of Data

Access to restricted data e.g. employee health records is restricted by a password (changed daily) known to the systems staff for the entire data base. Access to other data is restricted only by control of access to terminals. Terminals are hardwired and data availability is controlled selectively for each terminal. Violations of access are not reported by the system.

Personnel which have access to the data in the computer are all medical professionals and clerical personnel.

The protection provided is considered adequate.

f. Training

New medical users of the system are given instruction and demonstration in order to learn how to use the system. The training time is less than one hour, and after an additional month, they are fully proficient. The documentation is of limited use due to the dynamic nature of the system. Additional documentation is being developed.

New clerical users of the system (in the medical records area) are given instruction, demonstration, and documentation in order to operate the system. The training period is short. They can handle data entry, but were not yet proficient in the use of the report generating facilities at the time of our visit. This has since been achieved.

g. Presentation of Results

The means for producing output are mainly hardcopy produced on printers on a scheduled basis or on request and softcopy access to the data on CRT terminals.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient identification record has a fixed number of items, no medical data.

The size of a visit record is variable up to any number of characters.

At the health assessment visit, any number of parameters may be collected, the average is about 8. At follow-up visits, any number of parameters may be collected, the average is 4. Most of the information stored is medical in nature.

b. Patient Identification

I.D. number: Unit number with family linkage
Social Security number
Name (full) and soundex
Address
Phone (home)
Employee group
Date of membership
Primary physician
Primary nurse
Sex
Date of birth
Marital status, through the family code (subscriber of dependent)
Race (optional, not in identification record)
Education, years (optional, not in identification record)
Occupation, free-text (optional, not maintained)

c. Financial and Economic Information

This information is structured to serve the needs of this HMO.

This visit (providers)
Employer (through group code)
Insurance carriers (name, type, code, date insured, only for the capitation patients, not for fee-for-service patients)

d. Data Base: History of Present Illness (Collected at any visit)

Chief complaint(not coded): problem or diagnosis for the chief complaint is coded. Common symptoms coded; detail limited to few lines of free text or dictation, linked to proglem or diagnosis.

Active problems: Date of onset; problem name; problem code; status (major, minor, presumptive).

Collector of information is identified.

e. Data Base: Past Medical History

This is collected (once) via patient administered questionnaire prior to a health assessment visit. This data is entered by physician summerization.

Family history: Specific diseases are coded. At the health assessment visit, the physician may enter significant findings. The data are kept as free text under a diagnostic code.

Past diseases: Coded as problem list; description kept as free text; date of onset; diagnosis coded.

Hospitalizations during plan membership are entered via a special form: Date of diagnoses; procedure; outcome.

Immunizations: Coded via encounter form and on pediatrics flowsheets with date, height, weight, head circumference, and milestones.

Allergies to: Medicines by name; environmental agents, pets at home (pediatric)(text).

Current medications: Coded (not problem linked); frequency; amount duration.

Past medications with health plan history.

Diet: Major varieties coded with free text expansion.

Psychiatric: Some codes and free text.

Nutritional (if therapeutic): Type of diet coded.

Collector identified.

f. Data Base: Social History (Collected at health assessment or any other visit)

Number of children
Level of education
Ability to speak English
Background information up to three lines of free text can be recorded at the initial health assessment. Additional information can be included on dictation linked to the visit.

g. Data Base: Review of Systems

Stored as free text under a problem number if significant.

h. Data Base: Physical Examination (At first visit)

Date
Height
Weight
Sex
Race
Risk factors: Smoking; alcohol

Certain positive findings are coded as problems or diagnoses (i.e., rhinitis, breast nodule, or hip click).

Further description of these findings would be as free text.

Other data are not coded and not searchable.

Vital signs can be collected at any visit, but always collected at a health assessment visit.

Collector identified.

i. Data Base: Objective Findings of Past Medical History

Laboratory orders and findings: They are entered by the laboratory technicians.

X-rays: Anatomical site, normal or abnormal.
Chest X-ray interpretations are entered on a pre-coded check list.

EKGs: Orders, interpretation entered in coded form.

EEGs: Orders, normal or abnormal.

Pathology reports: entered on a pre-coded form.

Past memos: As text only.

Source of order is identified.

j. Problem List

Active problems: Date of entry; problem name (code); diagnosis name (code) and status (major, minor, presumptive, inactive).

Temporary problems e.g. 'abrasion' are coded and considered as active problems and display as such.

Inactive problems: Date of entry, problem name (code), diagnosis name (code), final date.

k. Plans, Diagnostic Orders

Diagnostic orders are not entered into the computer until the result is entered from the laboratory or appropriate service unit. Free text may be used.to supplement the numerical values.

1. Plans, Therapeutic Orders

Medications: Rx; quantity, frequency. The prescription is written in the traditional way (not linked to problems) if a new prescription is required.

Diet (if therapeutic): Type.

Office procedures: Skin tests, immunizations, orthopedic appliances (all coded)

Physical therapy: Can be indicated, but are not ordered through the system.

Nursing or home-care orders.

Physician or nurse is identified.

m. Follow-up

Laboratory findings up to 180 characters, 10 characters is average.

Other medical tests: Findings are only indicated normal or abnormal with free text giving detail.

Reassessment of problems: Problems can be omitted, or changed to inactive, or status can be changed in terms of major, minor, etc. Disposition is coded.

The physician or nurse is identified.

n. Progress Notes

Encounter forms are for the above stored coded with up to 60 characters of free text with each problem. More than that has to be dictated, the dictation is stored in the computer system linked to the problem and encounter date. There are 15 forms of varying complexity. The physician and/or nurse are identified.

o. Patient Services Management

Two way communication system to facilitate interaction between referring physician and consultant (new?)

No-show rates, cancellation rates.

Medication schedules for patient.

Visit reminders for patient can be based on various criteria.

List of patients not returning for physician.

Physician can be reminded regarding certain follow-up needs: untreated strep throat, iron-anemia, urinary tract infection, positive serology, abnormal pap smears, or extended (3 months) high (100) diastolic blood pressure.

Chart review schedules.

p. Practice Information (Recorded by the provider)

First contact with this practice or agency.

Encounter sites.

Referral.

Providers at encounter.

Use of other facilities: Hospital, ER.

Audit oriented data are being implemented.

q. Research Oriented Data.

There are some special studies in progress for welfare and near-welfare patients. The data collected for these groups are identical with the data for the other groups.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through the following computers:

1 DEC PDP-15 with 32K installed in 1970 for a cost of $260,000 for a complete system. (16K memory at $12,000 is being added.

The laboratory also has another

1 DEC PDP-15 which allows backup and has an identical configuration, and

3 DEC PDP-9's. These machines were acquired at various times and are used for a variety or projects at LCS.

The computing services are provided through an arrangement between HCHP and the LCS with partial payment for services.

The equipment is purchased.

Maintenance is by LCS itself and is the responsibility of two FTE.

All of the processing capability of one machine is used for the ambulatory medical record application.

All of the file capability is used for the ambulatory medical record application.

The files are stored on a total of 7 Memorex 2314 type disks.

There are other 15 other disk pack drives at the laboratory.

Other important equipment are 20 Ultronics 300 baud modems ($200 purchase) on 10 private lines. There are also dial-up lines.
Archival storage is on disk packs or tapes.

Retrieval response time is 1 to 20 seconds.

Terminals used are CRT softcopy:

20 Infoton at the HCHP clinic; 80x20 screen, upper case, 30 baud speed, cost of $1400, with adequate reliability and legibility (5x7 dots).

There are 12 in other locations and 3 more high speed (2400 baud) at LCS.

There are also 3 GE Terminet terminals for hardcopy output; 72 column, upper case, 120 char/sec impact, $4,000.

b. The system uses timesharing for all of its processing.

Currently production occupies 90 to 100% of the machine, and development less than 10% and 5% of another machine.

Of the production load, 30% is data entry, 20% is data analysis, and 50% is report preparation.

c. The operating system was designed and written for general medical purposes. It is now being further developed by the staff at LCS.

The file system is characterized by hierarchical files with indexed files below the hierarchy.

The implementation of the AMRS requires 6 distinct files, including directories, and more than 9 distinct record types, one for each level in the hierarchy.

d. When there is a computer failure, then a backup computer is put into service.

A noticeable (to the user) failure happens about 4 times a year.

When there is heavy usage of the Ambulatory Medical Record System, then there is annoying slowdown.

e. The data processing staff currently involved with HCHP consists of:

1 manager at HCHP and 1/2 at LCS

2-1/2 medical specialists at LCS

1 systems analyst at LCS

5 programmers at LCS

5 operators at LCS (These also have responsibility for 4 other major systems)

6 data entry clerks at HCHP.

The data processing staff at HCHP reports to the administrative information section of the institution (HCHP).

The response to request for changes in system output is about 1 week for minor and up to 6 months for major changes.

f. The costs of the computer operation are fixed and budgeted.

The investment in the system is about $850,000 (equipment $350,000, personnel $500,000) and the operationa cost is about $100,000 per year, exclusive of costs of continuing research and development.

g. The ambulatory record system is intended primarily for this institution. Future distribution will be both in terms of concepts and methods as well as direct copying of the system, with appropriate modifications to meet local needs.

6. THE FORMAT OF THE MEDICAL RECORD

The format and the content of the record presented varies according to the particular speciality. In internal medicine the record available to the physician and nurse-practitioners when he/she sees the patient is a computer abstract of the past medical record and a subset of the recorded data from recent visits including dictation. It includes laboratory test results generated between this and the last visit. All notes pertaining to a single problem are grouped together. Each speciality has speciality oriented flow sheets prepared by the computer.

The abstract includes an identification data, up to three lines of background data, the problem list with the date of the last visit and number of visits for each problem, current therapy, past therapy, lab test results and consultations.

There are some choices for the physicians regarding the quantity of past data to be received with an encounter.

There is also a very limited and rapidly decreasing traditional record. This record is maintained but has recently not been routinely provided for encounters. It is the source for dictation prior to March, 1974, hospital discharge notes, EKG tracings, etc. The remaining paper record is kept on-site in a central repository in the basement and sometimes not available. It is delivered with a short delay.

A specialty-specific encounter form is provided for data collection. Diagnoses (or problems) and medications are selfencoded.

More data can be obtained, generally by a clerk, from the computer file. This takes typically half an hour. The printers are located in the basement.

Other computer outputs available to the provider at the encounter are flowsheets for pediatrics, obstetrics, and laboratory results.

Continuity of one physician and one nurse and patient combination is maintained except for emergencies.

On the pages following are the major portions of the header page of the encounter form for one specialty (internal medicine) and about a quarter of the choices on the remaining three pages; the resulting encounter report and a status report on the patient produced for a new visit.

PARTIAL LISTING OF ITEMS ONLY

INTERNAL MEDICINE DIAGNOSES & PROBLEMS

(M=Major, O=Omit from Status Report, P=Presumptive, S/P=Status Post, R/O=Rule Out, I=Place on Inactive List. Simple check=minor)

60.Height ______ ins. 61.Weight 118 lbs. 62.Pulse/Min. 76 63.Temp. ______

64. Blood Pressure 1. 128/84 2. ______ 3. ______ 4. ______ 5. ______
(state whether lying, standing, sitting, etc.)

GENERAL

	A600	IHA
	A800	PBR
	A998	Dx deferred (state features)
	A601	No demonstrable disease (explain)
	A802	Exam for certificate
	A128	Rx refill only
	A803	Immunization only
	A803	Test results only
	A019	Positive family Hx (specify)
	A810	Health education
	A020	Abnormal tx result (specify)
	A804	Lab test not performed (specify)
	A811	Pt. left without being seen
	A812	Pt. refused Rx (specify)

DRUG REACTIONS

	A118	Drug allergy (specify)
	A030	Drug allergy, penicillin
	A145	Drug intolerance (specify)
	A026	Drug toxicity (specify)

SYSTEMIC

✓	P666	Tobacco addiction down to less than pk/day
	A991	Fatigue
	A140	FUO
	A117	Viral Illness
	A992	Weight Loss

TRAUMA (site in free text)

	C100	Abrasion

THYROID

	B210	Goiter
	B151	Hyperthyroid
	B152	Hypothyroid
	B153	Thyroid nodules(s)

ENDOCRINE METABOLIC

	A150	Obesity
M	B120	Diabetes mellitus
	B180	Hypoglycemia
	B160	Hypercholesterolemia
	B075	Hyperlipoproteinemia
	B178	Hyperuricemia
	B011	Gout

CARDIOVASCULAR

	G991	Chest pain
	1100	Angina pectoris
	1099	Coronary artery disease
	1270	Myocardial infarction
	J110	Hypertension
	1230	Hypertensive heart disease
	1110	Aortic insufficiency
	1120	Aortic stenosis
	1211	Murmur, systolic
	1260	Mitral stenosis
	1250	Mitral insufficiency
	1131	Atrial fibrillations
	1137	Ectopic beats
	1160	Congestive heart failure

FREE TEXT COMMENTS ON DIAGNOSES, PROBLEMS & PROCEDURES

DIAGNOSTIC CODE	Comments (60 characters each)
1. B120	Urine sugars trace, irregular diet, try to decrease insulin
2. ______	
3. ______	

HCHP INTERNAL MEDICINE ENCOUNTER FORM

4) SITE
A___ MH-PH
B___ CAMBRIDGE
C ✓ KENMORE
D___ KEN. TRIAGE
E___ CHMC
F___ PBBH
G___ BLI
H___ BI
J___ HOUSE CALL
K___ OTHER___________

5) TYPE
A ✓ SCHEDULED
B___ WALK-IN
C___ TELEPHONE
D___ CANCELLED
E___ DNK
F___ CALL-IN
G___ IN-PATIENT
H___ EW
I___ NON-ENCOUNTER
J___ GROUP

NAME: Jane Public
UNIT: 88·08·08T
DATE: 3/6/74 DOB:
PROV #1: Smith
PROV #2:
(if seen)
ABOVE MUST BE COMPLETE FOR INPUT

6) Hospital or EW Visit Approved: ___Yes ___No

************ THIS INFORMATION FOR FIRST VISIT/PRIMARY PROVIDER ONLY ************

7) PRIMARY MD ______________ 8) PRIMARY RN ______________
9) RACE: A___ CAUCASIAN B___ BLACK C___ SPANISH SPKG D___ OTHER________
10) MAR.STATUS: A___ SINGLE B___ MARRIED C___ WIDOWED D___ SEPARATED E___ DIVORCED
11) # OF CHILDREN ________ 12) PT. OCCUPATION ______________

PERSONAL BACKGROUND OF PATIENT - Only for primary providers
(To change, rewrite entire section; max. three lines. Do not repeat above data.)

40) DISPOSITION
Future appt w/ Smith in
(provider's full name)
A___ DAYS B___ WEEKS C 2 MONTHS D___ PRN
E___ PT to call MD G___ PT to call RN
F___ MD to call PT H___ RN to call PT
I___ Other ______________

REFERRALS
42) INTERNAL HCHP CONSULTATION
Consultation w/ Nutrition
(enter specialty and provider's last name, if specified)

44) HOSPITAL ARRANGEMENTS (make a choice in each column)

A___ BETH ISRAEL
B___ PBBH
C___ BOSTON HOSPITAL FOR WOMEN
D___ CHMC
F___ UNAFFILIATED

1.___ EMERGENCY WARD
2.___ URGENT ADMISSION
3.___ SCHEDULED ADMISSION
Date of Admission (if known) ________

46) DICTATION ✓
47) REVIEW OF CHART ✓
48) FOLLOW-UP IMPORTANT ✓

Encounter Report Which Resulted From the Visit of March 6, 1974

ENCOUNTER REPORT---3/6/74

OBJECTIVE DATA
WEIGHT 118
PULSE 76
BP 128/84 SITTING

PROBLEMS
B12Ø--DIABETES MELLITUS MAJOR #D
URINE SUGARS TRACE, IRREGULAR DIET, TRY TO DECREASE INSULIN

HAS BEEN MISSING MEALS - RE-EMPHASIZED IMPORTANCE OF FOLLOWING DIET AND REGULAR EXERCISE. SIGNIFICANT DECREASE IN DTR SYMMETRICALLY IN LEGS. STILL HAS CONCERN ABOUT ADMINISTRATION OF INSULIN.

P666--TABACCO ADDICTION
DOWN TO LESS THAN PK/DAY

TESTS
N2Ø4--URINALYSIS INCL MICRO- WBC 2-3, GLU 1+
E315--GLUCOSE 134

THERAPIES
I122--INSULIN NPH 20 U SQ Q.D.

SITE: KENMORE
TYPE: SCHEDULED
DSP: RETURN 2 MONTHS SMITH
INTERNAL REFERRAL: NUTRITION
FOLLOW-UP IMPORTANT
DICTATION
REVIEW OF CHART
GERALD SMITH, M.D. / MEK

STATUS REPORT (8/8/74)

EFF 3/7Ø PRIMARY MD G. SMITH 12-34-57-B
GRP Ø15 PRIMARY RN J. JONES PUBLIC, JANE Q

1Ø ALBANY RD., LINCOLN, MASS Ø21ØØ TEL: 222-1234 32 YRS. - DOB: 5/18/42
RACE: CAUCASIAN
MARITAL STATUS: MARRIED
OF CHILDREN: 2
PT OCCUPATION: P.T. LEGAL AIDE

ENJOYS TENNIS, SKIING. EXTENSIVE EUROPEAN TRAVEL WITH LAWYER/HUSBAND. SINCE CHILDREN IN SCHOOL, HAS BECOME PART TIME LAW STUDENT AT BU. 11/15/73

A8ØØ PERIODIC HEALTH REVIEW 3/24/7Ø - 3 - 9/5/73 (SMITH)

MAJOR PROBLEMS
A Ø3Ø DRUG ALLERGY-PENICILLIN 3/24/7Ø (JOHNSON)
B12Ø DIABETES MELLITUS 3/24/7Ø (SMITH) #D
URINE SUGAR TRACE, IRREGULAR DIET, TRY TO DECREASE INSULIN

MINOR PROBLEMS
P666 TABACCO ADDICTION 3/6/74 (SMITH)
DOWN TO LESS THAN PACK/DAY
G27Ø UPPER RESPIRATORY INFECTION 2/25/74 (ADAMS)
M32Ø FAMILY PLANNING 1/15/72 - 2 - 12/12/73 (JONES)

PRESUMPTIVE & RULE OUT
0241 P POLYNEUROPATHY, DIABETIC 1/5/74 (THOMAS)

INACTIVE PROBLEMS
G16Ø HAYFEVER 6/24/71 - 8 - 8/17/72 (JONES)
NØ9Ø S/P FRACTURE: L ANKLE 1962
S1ØØ S/P APPENDECTOMY 1952

CURRENT THERAPY
I122 INSULIN NPH 2Ø U SQ Q.D. 5/14/70 - 9 - 3/6/74
I161 ORTHONUVUM 1/5Ø 1/18/72 - 6 - 12/12/73

THERAPY HISTORY
I121 TOLBUTAMIDE 500 MG. B.I.D. 3/24/7Ø - 2 - 4/16/7Ø

TESTS RESULTS

3/6/74	N2Ø4	URINALYSIS INCL MICRO- WBC 2-3, GLU 1+ (1Ø)
	E315	GLUCOSE- 134 (17) #A
1/5/74	A126	HEMATOCRIT- 46 (4)
9/5/73	A147	WBC- 67ØØ (3)
	F465	CHOLESTEROL- 265 (3)
	E313	SERUM CREATININE- Ø.6 (3)
	WØ18	PAP SMEAR- NEGATIVE (3)
	RØ28	CHEST, PA & LAT-CLEAR LUNGS & NORMAL HEART (3)
3/24/7Ø	B122	HINTON- NEGATIVE (1)

CONSULTATIONS
NUTRITION 3/6/74 (SMITH)

7. INTEGRATION OF FUNCTIONS

a. The computer operation is ambulatory health care delivery service. Administratively, the medical information system is directed jointly. Technically, the computer service is directed by LCS.

The financial resources for its devleopment have come from HEW grants; 2/3 of the cost of its operation are paid by HEW grants, and the remainder by HCHP. The priority of new tasks for the system is determined by joint committees.

b. The automated medical record system replaces almost completely the manual medical records. Its outputs are kept separately from the remaining paper system. Information from a paper system is taken into the automatic system in case of inpatient stay. The automated system contents is accessed by the medical records library staff for distribution to the health care providers. It is also accessed directly by the medical providers using CRT'S in the care areas.

c. Other automated services, used by the ambulatory health care delivery services, such as

capitation billing
claims
payroll
financial (accounts, ledger)
scheduling
etc.

could be replaced with this system.

d. In summary, this computer system is best viewed as a production service with an ongoing development effort.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by administrative management are:

aggregate utilization,
aggregate services provided, and
personnel statistics.

The membership file is used on-line.

These form a significant justification of the system.

b. Reports received regularly by clinical personnel are:

individual records,
practice profile, and
data analyses.

On-line requests by clinical personnel are for individual records.

c. Special requests are made to data processing staff for items such as data analyses and research studies.

9. INFORMATION UTILIZATION

a. The system provides mainly information for:

institutional managment,
administrative staff,
clinical physicians,
paramedical personnel,
quality of care review,
medical researcher, and
health care planners.

The information is intended to assist in the delivery of health maintenance and comprehensive care (except at hospitals).

In order to make more intensive use of the system,

faster inquiry capability is required,
faster communication gear is required,
more hardware is required to improve response,
some more data have to be collected, and
more direct involvement with the medical user must be developed, so that use of the system by the care providers extends beyond the use of an automated paper system replacing the traditional record.

b. The group which currently depends on the outputs from the automated system are the clinical physicians, paramedical personnel, and administrative staff.

If the system were not to work for an extended period then printouts for scheduled patients would still be available since they are printed 24 hour ahead of schedule. A back-up computer is available at LCS and would be used to avoid lack of medical records for walk-ins.

If changes in the system are required, then a decision to implement them is made in 1 month and it typically takes a day to a month to actually change the computer system. The actual time depends on the extent and urgency of the change, small changes can be made in one day.

10. EVALUATION OF EFFECT OF AAMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase or maintain the quality of care, increase the access to care, and decrease the cost of health care delivery.

This has been generally due to better availability of medical record data, fewer errors, lower service cost, and continuity of care.

b. The change in the quality of care has been evaluated by the health care providers by subjective judgement (Dr. Plotkin and Dr. Barnett), and recently by a version of the questionnaire designed as part of this study.

Measurement methods used have been examination of the medical record for accuracy and completeness, examination of the medical record for appropriateness, some assessment of quality of care review, and availability and legibility of the medical record.

Objective measures are being developed as process monitoring (hypertension) and outcome measurement (prenatal care and birth and infant problems).

The change in the access to care has been evaluated through measurement of factors relating to the health care providers and patient. These measurements were obtained by subjective judgement of a committee. Measures used were patient referred by physicians and availability of medical record.

The cost factors affecting health care delivery have been evaluated through measurement of factors relating to administration. These measurements were obtained by subjective judgement. Measures used were evaluation of health manpower personnel, primarily clerical staff, with respect to time taken for specific tasks, such as medical record retrieval for patient visit and update of the medical record by the nursing staff.

Improvement of management aspects of health care delivery is considered due to the availability of:

on-line membership file with timely updates;

costs of patient care per subscriber,per patient;

number of visits per subscriber;

number of tests per subscriber and per visit.

Availability of information for planning has been achieved for manpower planning and facility planning.

Availability of information for facility operations has provided better financial management and analysis of financial needs. It has also aided the development of utilization review procedures.

The results of the evaluations are an information source for health care system administrators, system designers, and health care providers. No formal evaluation has yet been performed.

11. ECONOMIC INFORMATION

a. The total annual operating budget of the Harvard Community Health Plan (HCHP) is $13 million, and the annual budget of the AAMRS user, the Kenmore Facility of the HCHP is $9.5 million of which about $5.3 million is for ambulatory care. The HCHP total employment is 400 persons of which 44 are physicians, and at the Kenmore Center 220 persons are employed of which 33 FTE are physicians.

The major source of operating funds for the HCHP are prepaid capitation payments from group members (about 92%), a small amount of funds are derived from fee-for-service payments (03%), and miscellaneous grants (05%).

b. Since the HCHP is a prepaid health plan, health care services are not charged on the basis of fee-for-service. The average monthly capitation payment for adults is $25 and for children is $15. The decision makers for the plan's rate structure is the HCHP management. Some aspect of the AAMRS has been in existence since the HCHP opened, and the HCHP management believes that the use of the AAMRS results in a lower cost per patient than a similar manual system (see page 28). A unique patient ID number is used for continuting health care. The medical record organization is considered to have some standardization.

Currently the AAMRS is in operation only at the Kenmore Facility of the HCHP. It was expected at the time of our visit that a decision on whether or not to extend the system to the Cambridge Facility would be made by June, 1975.

c. Cost Analysis: Development Costs

The major development of the AAMRS began in 1969 when the HCHP opened. In February, 1974 a conversion to complete dependence upon the computer was begun. The conversion of the present system was completed in February, 1975, and it is expected that a satisfactory operating system will be completed by July, 1975.

The cost of the initial developmental effort is estimated to be $2,500,000 for a 5-year period. Ongoing development effort by the LCS is estimated to be about $136,000 in direct costs per year. The major source of development funds have been government grants (HEW-HSMHA & HRA).

Cost Analysis: Operating Costs

The estimated annual direct operating costs for service and ongoing development at the HCHP and LCS is estimated at $532,000 of which $174,000 is funded by the HCHP by direct payment to the LCS ($50,000) and as regular operating costs. All other costs are funded by the LCS, primarily from research grants. (The total operating costs, with indirect costs added is about $705,000) The service component of the operating costs is estimated at $378,000 ($486,000 with indirect costs added). It is expected that as the conversion to total dependency upon the automated system is completed, the HCHP will assume a greater share of the operating costs.

The primary fiscal decision makers with respect to the AAMRS budget is the director of the LCS, and his administration. The primary fiscal decision makers with respect to the HCHP support of the AAMRS is the HCHP management. While financial and management arrangements have not been worked out, it is expected that at a minimum the service component of the AAMRS will eventually be totally supported by the HCHP (either using LCS equipment or through the acquisition of their own).

Cost Analysis: Investment Costs

The major tasks involved with a new application of the AAMRS to a similar setting would be equipement acquisition, modification of the system to unique requirements of the new setting, forms development and extensive health services provider orientation to the new system. An investment cost estimate was not developed due to the great variety of cost factors involved.

Factors that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

> The administrative motivation found in an organized group practice is necessary for general acceptance and financial support. The system provides useful data for the management of a large organization.
>
> The software should facilitate ease of transferability.
>
> Heavy grant support for development and implementation. Strong desire to accumulate data for research purposes, as well as for the managment of a health services organization.

Ultimate financial viability may be questionable without heavy academic/research grant subsidy.

Health providers (MD's, nurses) may require a long time to become at ease with the more advanced features of the system as on-line retrieval, etc., based on our interviews with a few of the individual providers.

Response time was observed to be slow (see page 31).

d. **Benefit Analysis: Tangible Benefits**

System Cost Savings: It is the opinion of the HCHP management that the AAMRS, when fully operational, will result in savings from the substitution of labor with the automated system. The HCHP estimate of net savings is $1.50 per individual plan member per year, or about $54,000 per year. It should be noted that these figures are based on rather rough estimates and could be much higher or lower (even negative) depending on the cost elements included and their valuation. Additionally, the savings is based on the AAMRS providing services in addition to the medical record, such as appointments, claims processing and statistical reporting. It is recognized that based upon the cost of the medical record alone, the AAMRS is more expensive than a manual system.

Health Manpower Savings: It is believed by the HCHP (individual physicians) that some time savings is realized in the retrieving of data from the medical record. This is particularly due to the record legibility, organization, and universality. With respect to clerical personnel, their tasks are performed faster due to the AAMRS and they can locate patient records faster. This savings has not been quantified.

Cost of Patient Services: It is believed that costs incurred by the HCHP for patient services may be less due to:

few
the availability of data in the record,

improvements to the referral process by elimination of the need to referral notes, and

access to the record by the specialists.

Management Benefits: The major benefits realized are the reduction of clerical tasks for record maintenance , enrollment procedures, and claims procedures. Additionally, there is increased accuracy and speed in the claims procedures and more efficient use of resources. It is expected that benefits will continue to be realized in this example, a study of no-show behavior could result in improvements to the appointment scheduling process and eventual increase in productivity.

Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement
Direct Delivery of Care:	++

Patient management improved through

availability organization, and completeness of medical record, and

intra-staff communication facilitated by the medical record.

Access to Health Care:	+++

Improvements resulting from using the AAMRS to

identify groups for group therapy, or special treatment requirements,

identify necessary follow-up using the encounter data,

identify persons who are enrolled and not using the system,

identify persons who need immunications, and

generate mailing lists for orientation literature.

Management Aspects of Health Care:	++

The AAMRS

facilitates the use of decentralized management within the HCHP through the production of operational service reports for individual management units,

permits the use of more highly skilled personnel, in some of the clerical tasks,

facilitates utilization reviews.

The primary measures of change are the reports generated from AAMRS data, new methods of analysis and employee morale.

Benefit Analysis: Societal Intangible Benefits

Technological Advancement in AAMRS: +

Close interface between system designers and application. This does not include the major technical efforts at LCS.

Quality of Care Review Methodology: +

This is an area of considerable interest and Dr. Barnett expects a high potential impact. During our visit, efforts in this area were just beginning.

Research Activities: +

Provides a primary source of information for health services research activities. More output can be expected in the future.

Training Activities: +

Provides feedback to preceptors for residency program in primary care.

Health Planning: +

Data used and shared with other plans.

12. COMMENTS

Due to the fact that this is an operational medical record system, we were able to perceive more about automated medical record utilization and interfacing than at most other sites.

The system is still under development and changes are occurring frequently causing some uneasiness by the providers. The capability to evolve is a strength of the system.

After recent additions of free text capability, the system seems to make good compromise of coded vs. free text information.

To select desired items on encounter document, the user must sift through many items that do not apply to his patient, and these documents are still undergoing change to improve their useability.

The user now (after our visit) gets only the output of the computer system for each patient visit. During our visit paper records were still retrieved selcctively.

There are some questions of organization of the printout.

The population does not present many problems. Average number of problems per encounter is only 1.9. Not comprehensively problem-oriented in the record POMR. Objective findings, lab, medications could be problem linked. One should be able to combine or change problem definition if a POMR is is desired. This is not an objective here.

The technical performance of the system could be improved and might help acceptance. The computing systems and the man-machine interfaces are quite restrictive.

Updating cycle time is such that the user cannot expect to see the last visit information on a printout (which is prepared prior to a visit) in less than one or two days. Data are entered into the computer record within one hour and two days.

The CRT screen filling time is noticeably long at the Kenmore Square site. Even clerical personnel is frustrated by the delays.

The printed record saves time in legibility and record retrieval.

The range in attitude is very broad. It takes time to gain user acceptance and cooperation. The continuity of care provided compensates for deficiencies in the record system. An attitude survey administered after our visit indicates a positive attitude towards continued use of the AAMRS and its improvements.

Good, straightforward use for quality review. It is relatively simple in respect to criteria and does feed back to the physicians.

Measurement of the effect of the automated record system is just beginning to take place.

There is some doubt if HCHP could justify use of the system if it were paying for the full allocation of the cost.

There is some feeling that the reason that the HCHP record is working is heavily dependent on Dr. Barnett. He is able to cajole, cohere, and convince MD's well and understands real world problems as well as most (in terms of MD's). Dr. Barnett thinks this dependency is decreasing and the situation will be different in two years.

Probably one of the most complete ambulatory medical record systems currently in use. The project could benefit from the adoption of features seen in other systems.

Apparent operational success at the present level of acceptance may be due to the organizational pressure from LCS and HCHP management. Federal funding at LCS has kept cost to HCHP low.

The management at Cambridge has quite different initial attitudes and it will be a severe test to see AAMRS acceptance there. The recent survey of the providers finds them strongly predisposed towards a slightly improved automated system of the Kenmore variety.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDM-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO MEDICAL DATA SYSTEMS CORPORATION 24541 BAGLEY ROAD OLMSTED FALLS, OHIO 44138 ON JANUARY 9, 1975

We were introduced to the facilities of Medical Data Systems (MDS) by John Fakan, president of the company. During the afternoon, we had the opportunity to visit two offices of physicians using the system, Dr. Victor Straubs and Dr. John Wido. Some further material was obtained later by telephone from Dr. Straubs.

AUTOMED is the name of the services provided by MDS.

The summary contains the following sections:

1. OUTCOME OBJECTIVES, as stated by the physicians using this system (V. Straubs,etc.)

a. Development of the system has been influenced by the objective of quality of care improvement in the area of preventive, acute, and chronic medicine through more complete records and better feedback. This objective has come about in response to organized group support (the local chapter of the American Academy of Family Physicians).

The intended outcome objective for the use of the system is secondarily cost management as acheived by better use of resources through simplified administrative tasks. This objective has come about in response to the need felt by medical staff in the private practice environment.

The system in use here is a replacement of a manual system or more frequently a supplement to the existing manual system.

b. The population which is to be served by the system is the general population in the area served by a physician subscribing to the service.

The service environment is typically urban or suburban.

The services provided by the physicians seen were primary and secondary use.

The population served by this system are the patients of about 100 physicians in 32 practices. One of these physicians (V.S.), a solo practice, has 5,700 patients.

The potential population for the current system may be 300 terminals, each terminal serving a practice of about 5,000 patients (J.F.); the market seen by AUTOMED is 5,000 to 6,000 terminals.

The needs for this population are in the area of primary or secondary care, as provided in private offices or moderate group practices. Patient visits are primarily a result of appointments on patient initiative.

2. PROVIDER OBJECTIVES.

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Management aspects of health care. These are of primary concern to physicians. Improvement of management and operations of the facility is achieved by reduced physician time in record management.

by faster processing and increased accuracy in patient accounting procedures, billing, and claims processing;

by reduction of operating costs resulting from increased productivity of manpower, no lost charges, billing accuracy, and faster claims processing (local Blue Shield accepts automated bills submitted on-line);

by the provision of management with information and analytical tools for utilization review procedures, etc., (available as of March, 1975).

Resource utilization: namely, health manpower utilization of physicians and eventually clerical personnel. Little change has been observed in the area of patient services (V.S.), but better referral has been achieved (J.W.). A record can be shipped between AUTOMED subscribers.

Quality of care: as reflected

in data base acquisition, diagnostic tests, and treatment planning through the use of memos, problem identification and some feedback to physicians regarding achievement of desired outcomes for specific conditions (V.S.);

in future quality of care review procedures; and

in record accuracy and legibility.

Access to care: as reflected by record contents. record availability. Assistance with patient follow-up is desirable, but not now possible (V.S.). New review procedures (March, 1975) should allow this given suitable data entry conventions.

b. **The organizations which make the decision to provide automated record services are primarily private physician practices (solo or group), rarely a single member of a group.** There are some units of larger organizations, specifically emergency rooms.

Expansion of use occurs as the physicians demand more services and as the number of users increases. MDS has been sensitive to the requirements of the users.

Users' institutions include:

solo general practices,
solo specialty practices,
small group practices,
4 specialty group practices in orthopedics,
3 emergency rooms of clinics, and
family practice residency programs.

The size of the practices are:

Number of patients at one practice averages yearly 5,700 (V.S.);
It is somewhat less for the average of the 100 MD users.

The aggregate number of patients in the system is 200,000.

The number of patient visits per year is about:

1,000,000 for the entire system,
30 to 40 per MD per day, or
180 per office per day.

One practice in pediatrics see 22,000 patients annually.

One terminal is adequate for 125 visits per day.

The control over the medical content of the record system is provided by an individual physician using the filing resources provided by AUTOMED.

The technical operation of the system is in the hands of a vendor of computer services and under guidance of private family practitioners and specialists. Within the office the equipment is managed by the physician personnel.

3. SERVICES PROVIDED

Data collection is done normally without forms; one physician (V.S.) uses the printer to generate patient specific encounter forms which he completes with highly structured text. These are entered using CRT-keyboard entry to complete condition-specific data formats.

Source data collection is by clerical medical personnel and MDs.

Data entry is by clerical medical personnel.

The data are transmitted by modems and leased telephone lines.

The data are stored forever, until explicitly deleted. Dr. Straubs deletes billing data after 1 year.

The entered information is used to prepare documents such as,

bills,
third party bills,
medical record entries (by some users)
encounter documents, (by one user)
patient progress reports, and
recently, flow sheets.

It is also used to generate reports such as,

daily account of office activities (day sheet),
financial status reports, by patient and by office,
patient profile,
treatment profile,

and subsequent to our visit,

disease profile,
practice profile, and
documents for accreditation as planned by the local AAFP group.

There is the capability to inquire into the files to determine patient's medical status, financial status, and appointments (if collected) by patient name or patient number, if used in the practice.

These services are provided at all 32 sites. Monthly statement preparation is done centrally at MDS. The statements can also be generated at other times.

No other relevant services are provided by other automated systems to most of the users of AUTOMED.

4. TASKS REQUIRED

a. Data Entry Tasks

Data entry is accomplished through CRT keyboard entry; missing data elements are ignored, except for a few entries for third party claims.

Verification of data entry is done by scanning of the CRT entry on the screen before the transmission and by reading printer output. Most errors are found by data entry personnel and physicians. The system provides some help in locating errors.

Error correction is done on-line. An audit trail of all errors is not maintained for medical data, but exists for financial data.

Data entry hardware has given problems in the area of cost; the vendor would like cheaper CRT's and printers. The man-machine interface could be faster, but is adequate for typed entry of data.

b. Data Storage

File Updating:

Additional data entries are reflected in the file immediately. Changed data entries are reflected in the files immediately. The data invalidated are not kept, except for billing charges.

File Storage:

Medical data which are entered into the file are kept permanently; financial data are moved to archival storage several months after the last visit and converted to a printed record at user option.

File Usage:

To get a current record from the file requires less than 10 seconds.

To determine whether a patient has a record in the file requires less than 10 seconds.

The search can be done by exact or approximate name or by number.

The file is only used for individual patient care.

Family linkages can be established.

File Size:

The required file space was 100M characters for 80 MD's and is expected to grow to 300M characters soon.

As file space is used, more files are being purchased.

The files are variable length, indexed, and dynamically allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data, the following classes or routines are available (frequency of use):

Individual patient record by:

retrieval of complete patient record,
retrieval of abstract of patient - patient resumé (every visit)
generation of financial history of patient (as needed),
generation of billing statement (monthly),
generation of third party bills directly to Ohio Blue Shield,
generation of third party payment summary report,

Selective retrieval of patient data has become available subsequent to our visit, It will depend on the degree of rigorousness of data entry.

Tabulation by problem, sign, and treatment is possible, but rarely done. It is only possible to the extent that the individual user has developed and utilized a coding method for these categories. For problem-oriented retrieval the data have only to be identified by the problem number of entry.

Financial management is aided by programs which do:

billing,
claims processing,
accounts receivable,
aged accounts receivable,
accounts payable, and
ledger.

d. Data Analysis Procedures, Source and Operation

The analysis routines were written by the vendor.

The routines are specified by the vendor.

Their operation is verified by the vendor through a formal check-out procedure.

The routines are kept on a general library file or a user specific library file.

Their documentation is kept on paper or on files.

The principal programming language is Assembler for the Univac 492(SPURT).

e. Protection of Data

Access to the data is restricted physically using closed areas and by identification and passwords known to the individual user and to the systems staff. An individual physician can protect his data to three different levels. He can change his codes and password at any time.

Personnel which have access to the data in the computer are medical professionals and their clerical personnel.

The protection provided is considered more than adequate.

f. Training

New medical users of the system are given a demonstration and documentation in order to learn how to use the system. The training period is about 1 hour and after a few days, they are fully proficienat if they wish to use the system.

New clerical users of the system are given a demonstration and documentation in order to operate the system. The manual is considered too complicated. The training period is part of a day and after 14 days, they are fully proficient.

A representative of MDS spends one half day at the initial installation; there is also later follow-up.

g. Presentation of Results

The means for producing output are softcopy CRT and hardcopy printers.

Monthly patient statements are printed centrally at MDS and are mailed directly.

Third party bills are transmitted directly to Ohio Blue Cross.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The patient identification record can be limited to name and address. In addition, there is a patient resume record.

The size of the total record is on the average 1,900 characters per patient.

At the visit, typically 5 parameters may be collected. In most practices, little of the information stored is medical in nature, but a few physicians use it extensively for medical data.

b. Patient Identification

Name, full (files are alphabetized on name)
I.D. number: Social Security number, Medicare number, or unit number is optional; an internal sequence number is assigned otherwise.
Address, zip (own and bill-to)
Phone (home and business)
Sex
Date of birth
Religion, race, or other data may be entered as Notes 1 and 2 (up to 15 characters),
Height and Weight
Payment code
Provider initials, if group practice

c. Financial and Economic Information

Total bills: computed as needed
This visit line itemized: providers, procedures, payments, amounts, diagnosis
Billing detail retained: date, procedure or payment, provider, amount, diagnosis
Guarantor: address, amount
Insurance carriers: name, code; generation of general third party bill to be stapled to carrier form.

All other data can be collected at any visit into one of 16 categories (files) provided by AUTOMED. It would be recorded mainly as free text by the physicians and entered by the office clerk.

AUTOMED imposes minimal coding requirements, although retrieval for other than individual patient care purposes will depend on coding or the use of a controlled vocabulary.

The categories used in this report do not match the categories used by AUTOMED:

Identification:	
History:	Hx
Charges:	CHx
Diagnoses:	Dx
Prescriptions and treatment:	Rx
Problems:	Px
X-ray:	Xx
Laboratory:	Lx

d. Data Base: History of Present Illness

Problems: Problem name (any new problem gets a sequence number); status (major A, or minor B); any other information is optional free text.

Risk factors: May be recorded as free text in the patient resumė,

e. Data Base: Past Medical History

Areas are provided on the patient resumė for data not related to a visit.

Family history for preventive health,

Past hospitalizations, surgeries, and consults,

Previous diagnostic tests (Lab and X-ray),

Immunizations: name, code

Allergies to medicines

Current medications (name and dose) **and last prescription**

Past medications

Collector is identified.

f. Data Base: Social History

Occupation, hobbies, education as free text on resumé heading.

g. Data Base: Review of Systems is not stored unless as free text in notes or in memo form.

h. Data Base: Physical Examination

Height
Weight

and other data as free text.

i. Data Base: Objective Findings of Past Medical History

Laboratory orders: Any findings as free text.

X-Rays: Free text.

ECGs and EEGs and other medical tests: As free text.

Source of order associated with visit.

j. Problem List

Active problems: Problem name; date of entry (only from chronological visit report); diagnosis name. (Code could be entered by physician, but usually not done); status (A or B), where A means active and B means don't print unless requested.

Temporaty problems could be coded B and won't appear on problem list.

Inactive problems could also be coded B and won't appear on problem list.

k. Plans, Diagnostic Orders is not now used.

If free text were entered, it could be scanned by the recent retrieval routines. One physician (V.S.) has to make use of this.

l. Plans, Therapeutic Orders

Medications: Rx, quantity, frequency (optional)

Other free text is optional.

m. Follow-up data is not now used.

n. Progress Notes

Condition specific progress notes have been designed by one physician and are used heavily by him (V.S.) for most chronic diseases seen in his practice.

o. Patient Services Management

Visit reminders for patient can be produced, but this was awkward. The new retrieval routines will make the collection of data for reminders possible, given consistent data entry.

p. Practice Information

First contact with this practice.

Encounter sites type, code.

Referral optional, free text.

Providers at encounter (MD, nurse, PA initials)

Use of other facilities (Hospital, ER, can be entered but only done in relation to billing, other data could be entered as visit records.

q. Research Oriented Data

No data are collected for research purposes. Available data could be analyzed.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through one UNIVAC 492 with 240K characters purchased in 1971 for a cost of $220,000 (used). The original cost of this equipment would have been $1,600,000.

The computing services are provided through a vendor,MDS. The equipment is purchased, disks are leased. Maintenance is by vendors.

All of the processing capability is used for the ambulatory medical application. All of the file capability is used for the ambulatory medical record application.

The files are stored on 4 Calcomp 2314 disks costing $1,616 per month. (Two more are on order.)

Other important equipment is:

8 Rixon 9601 2400 baud modems

4 Univac tape drives

1 High speed drive printer

1 Univac fixed head swapping drum

Retrieval response time is 3 to 10 seconds.

Terminals used are CRT softcopy:

45 Univac-100: 80x12, upper case only, 2400 baud at a cost of $230 per month to the user; reliability is good (2 service calls per year) and legibility is very good (stroke generators).

Hardcopy terminals include 35 Centronics 306 with 80 characters per line, upper case only, speed of 100 characters per second, dot matrix impact, cost of $145 per month, one service call per year.

b. The system uses monoprocessing of transactions for most of its processing.

Currently production occupies most of the machine. Development is done at night.

c. The operating system was designed and written by Univac for this 490 series of real-time computers and specially modified for medical purposes at Danderyd (Stockholm, Sweeden). It was further developed by MDS.

It is now being further maintained by the local staff.

The file system is characterized by direct access (random files) with linked records.

The implementation of the AAMRS requires 1 distinct file per physician and 16 distinct record types for the various categories of data (ID, charges, diagnosis, Rx, etc.)

d. When there is a computer failure, the failed computer is restarted as fast as possible. A significant to the user(i.e. more than a few hours) failure occurs about once a year and that number has been steady. Some failures due to power surges have not been noticeable to the user.

When there is heavy usage of the ambulatory medical record system, there will be a noticeable slowdown due to contention on the communication lines.

e. The data processing staff consists of 8 people: 1 manager, systems analysts and programmers, no operators at the vendor. There is one data entry clerk at the typical user's site.

The response to request for changes in system output is less than 1 week to 1 year, but users can control many changes themselves.

f. The cost of the computer operation is fixed ($625 for one terminal, computer time and unlimited file storage for a solo physician. There is also a charge (6 cents) per billing statement generated. Average for a group practice is $750 plus postage for statements.

The investment in the system to the user is only his training time; the operational cost range from $600 to $700 per month for a solo physician,abou $150 more per additional physician in a practice.

g. The ambulatory record system is intended for use at many (currently 32 sites) supported by the vendor, to be used remotely on a regional (5 state), but eventually on a national scale.

6. THE FORMAT OF THE MEDICAL RECORD

This description applies in particular to Dr. Straubs' office. Some other physicians also use the medical content of the record, but not the same data collection technique.

The record available by the physician is a record updated with computer printouts and an encounter form prepared for this visit, suitable for this patient's problems.

The computer printouts include a computer abstract and the complete recorded data from the last several visits and diagnostic findings between the last visit and this one.

EKG data, correspondence, etc. are kept in a supplemental paper record.

No additional data are obtained on-line during the encounter.

The peper record is kept on-site and is always available.

Continuity of one provider and patient combination is strictly maintained.

Other computer outputs available to the provider and his staff at the encounter are the billing status, immunization record, and, imminently, flowsheets.

In most settings the traditional record is maintained.

The computer stored medical record is easily accessible at any time.

On the page following are sample outputs from the system.
This is followed by a page which shows an example of the use of AUTOMED made by Dr. Straubs:

a patient resumè,

a general visit input 'memo' with new data,

the new patient resumè after entry, and

a memo for a specific problem.

MILDRED TOTH PATIENT RESUME
463 SYCAMORE STREET * F * S * SECRETARY * GOLF *
AGE:40 HT:66 WT:115 ED:REFORM SCH FV:1/73
DRUG CONTRA.:SULFA*HEPARIN*SEREX*ALDOPA*
ONGOING RX:PERIACTIN 4MG QID*
LAST RX:ACTIPHED*AMPICILLIN*
A PROBLEMS:P3:MIGRAINE*P2:ARTHRITIS*P1:DIABETES MELLITUS*
SURGERY:T&A 1965*
HOSPITALIZATIONS:2 PREG '64, '66*
CONS. OR. REF:DR MAYER*DR BARTLEY*
RISKS:NONE*
PREVENTIVE HEALTH CARE:VIS FLDS*PAP 5/73, EKG 3/73*

MILDRED TOTH CHRON. VISIT DIR. AGE:40 HT:66 WT:115

01/09/75 DX:ACUTE LOM	RX:AMPICILLIN	
FVL 125 E	RX:ACTIPHED	
01/03/75 DX:MENOPAUSE	RX:THEELIN RP	XX:C SPINE LX:PAP, OK
FVL 122		
01/02/75-B	RXD:INSULIN 17U NPH/DAY	
01/02/75-A	RXD:1800 CAL DIAB DIET	
01/02/75	RXD:SCOTCH & SODA PRN	
12/19/74 DX:SPRAINED WRIST	RX:ACE BANDAGE	XX:L WRIST
12/13/74 DX:ACUTE ASCVD	RX:DIGITOXIN PRN	LX:EKG*PAP
FVL		
12/11/74-A	RXO:SCOTCH & SODA PRN	

MEDICAL DATA SYSTEMS CORPORATION
DATE:01/09/75

NAME	DESCRIPTION	CHARGE	CREDIT	BALANCE
MILDRED TOTH	CASH		$ 10.00	$ 5.00

CHARGES:$ .00 CREDITS:$ 10.00 CHECKS:$ .00 CASH:$ 10.00

ROSE ALICE SMITH PROBLEM VISIT HISTORY
AGE:59 HT:61 LWT:147 P1:DIABETES MELLITUS

03/12/71 FVL	NO GLUCOSURIA, WEIGHT STABLE 147, LX:U A-N, S-N, SG:1.020, M-N, CEL
10/23/70 FVL	WT:147, LX:U, BS, BUN A930, S-N, SG:1.015, M-20, BS110, BUN 12, CEL
11/17/68 FVL	WT:148, NUMBNESS - RT. FOOT RXS:DBI-TD BID
11/17/67 RAK	WT:147 RX:ORINASE .5 BID

ROSE ALICE SMITH
DIABETES MELLITUS PATIENT WAS FIRST NOTED TO HAVE DIABETES IN 1966. BLOOD SUGAR WAS FOUND TO BE 232, 2 HOURS POST PRANDIAL. SHE WAS TREATED WITH ORINASE 1/2 GRAM TWICE A DAY, AND A FASTING BLOOD SUGAR WAS FOUND TO BE 138, BUN 17. THE PATIENT CONTINUED ON THIS MEDICATION UNTIL 1968 AT WHICH TIME SHE WAS HOSPITALIZED FOR ANOTHER PROBLEM. HER DIABETES WAS RE-EVALUATED AND SHE WAS CHANGED TO DYMELOR .5 EVERY MORNING. HER BLOOD SUGAR WAS ONLY 150-225 RANGE. MAY 1970, SHE WAS PLACED ON DBI-TD TWICE A DAY. 24 HR. URINE SHOWED 17.5 GRAMS OF GLUCOSE.

ELLEN LEONA RING PATIENT RESUME
2403 ANYSTREET * F * S * * *
AGE:73 HT:67 WT:130 FD: FV:6/71
ONGOING RX:DYAZIDE 1 CAPS/DAY*1200 CAL DIET*LANOXIN 0.125MG QOD*
LAST RX:RET 8 WKS
A PROBLEMS:P3:OSTEOARTHRITIS*P2:HYPERTHYROIDISM (TREATED C I-131)*P1:
ARTERIOSCLEROTIC CARDIOVASCULAR DISEASE*
SURGERY:CHOLECYSTECTOMY-AGE 69-LUTHERAN(7/5/71)*
PREVENTIVE HEALTH CARE:PHYS 04/74*PA 04/74*ECG 03/73*G9 02/73*CHEST X 12/71*
IMMUNO 09/73*FOLDER +*BLOOD TYPE ??*RH ( )*RUBELLA TITER 0/0*MENOPAUSE AGE 45
*PRINT #00-) / / *TVD*A-714-07-4076*

11/18/74 WT 146 CC: SEE PX FDX: SEE PX DX:ARTERIOSCLEROTIC CARDIOVASCULAR
DISEASE*HYPERTHYROIDISM*OSTEOARTHRITIS P1:BP150/80 , RSR 74 /MIN, LUNGS=0 P2:0
P3:SAME RX:RET 8 WKS
10/07/74 WT 147 CC: SEE PX FDX: SEE PX DX:ARTERIOSCLEROTIC CARDIOVASCULAR
DISEASE*HYPERTHYROIDISM*OSTEOARTHRITIS P1:BP180/10 , RSR 74 /MIN, LUNGS= 0 RXO:
DYAZIDE 1 CAPS/DAY P2:0 P3:0 RX:RET 4 WKS
08/12/74 WT 146 CC: SEE PX FDX: SEE PX DX:ARTERIOSCLEROTIC CARDIOVASCULAR
DISEASE*HYPERTHYROIDISM*OSTEOARTHRITIS P1:BP140/80 , RSR 74 /MIN, LUNGS=0 P2:
ASYMPT. P3:STILL SWELLING OF LEFT ANKLE RX:RET 8 WKS

Input

TM A05 wt 150 *CC: gaining wt, SEE PX
FDX:
SEE PX
DX: Overweight Rxo: #218 bid
ARTERIOSCLEROTIC CARDIOVASCULAR DISEASE*HYPERTHYROIDISM*OSTEOARTHRITIS
P1:BP 130/80 , RSR 74/MIN, LUNGS=0
P2: 0
P3:
RX:RET 3 WKS, G9 NEXT
CHX:OC8^ $4; med.

Output

01/27/75 WT 150 CC:GAINING WEIGHT, SEE PX FDX: SEE PX RXO:#218 BID DX:
OVERWEIGHT* ARTERIOSCLEROTIC CARDIOVASCULAR
DISEASE*HYPERTHYROIDISM*OSTEOARTHRITIS P1:BP130/80 , RSR 74/MIN, LUNGS= 0 P2:0
RX:RET 3 WKS, G9 NEXT

ELLEN LEONA RING PATIENT RESUME
2403 ANYSTREET * F * S * * *
AGE:73 HT:67 WT:130 FD: FV:6/71
ONGOING RX:#218 BID*DYAZIDE 1 CAPS/DAY*1200 CAL DIET*LANOXIN 0.125MG QOD*
LAST RX:RET 3 WKS, G9 NEXT*
A PROBLEMS:P3:OSTEOARTHRITIS*P2:HYPERTHYROIDISM (TREATED C I-131)*P1:
ARTERIOSCLEROTIC CARDIOVASCULAR DISEASE*
SURGERY:CHOLECYSTECTOMY-AGE 69-LUTHERAN(7/5/71)*
PREVENTIVE HEALTH CARE:PHYS 04/74*PAP 04/74*ECG 03/73*G9 02/73*CHEST X 12/71*
IMMUNO 09/73*FOLDER +*BLOOD TYPE ??*RH ( )*RUBELLA TITER 0/0*MENOPAUSE AGE 45
*PRINT #00- / / *TVD*A-714-07-4076*

Memo

BRONCHIAL ASTHMA, ACUTE

SEC.:2BAAM *
TM P06 *CC:WHEEZING, SOB, PREVIOUS HISTORY OF ASTHMA, COUGH +0
FDX:BP= / , RSR, /MIN, LUNGS= , PROLONGED EXPIRATION,
WHEEZING, RESPIRATORY DISTRESS +++
DX:BRONCHIAL ASTHMA, ACUTE

RX:AMINOPHYLLIN 0.5GM I/V RX:AMESEC 1 CAPS Q 4 HRS PRN
RX:RET WKS, NEXT, DIS: / / BTW / /
CHX:OC8-INJ4

SEC.:2BADM *
RX:DEPO-MEDROL 80MG I/M RX:PREDNISOLONE 5MG 6 TABS/DAY INITIALLY, REDUCE DOSAGE
GRADUALLY RX:AMESEC 1 CAPS Q 4 HRS PRN
RX:RET WKS, NEXT, DIS: / / BTW / /
CHX:OC8-$10,DEPO-MEDR

7. INTEGRATION OF FUNCTIONS

a. The computer operation is a service to the ambulatory health care delivery services.

Technically the computer service is directed by the vendor.

The financial resources for its development have come from private capital ($1,600,000) and the cost of its operation are paid by investors and charges (now 40%, about $300,000 per year).

The priority of new tasks for the system is determined by the vendor using input from customers.

b. The automated medical record system supplements the manual medical records in most practices and its outputs are typically inserted into the paper system.

In 3 practices (5 MD's) the system has replaced the manual medical record completely.

Some information from the paper system is taken into the automatic system in case of inpatient stay by most users.

c. Other automated services, used by other ambulatory health care delivery services such as patient history taking, payroll, and scheduling could be implemented with this system.

d. In summary, this computer system is best viewed as an evolving production service.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by the physicians for management are aggregate accounts receivable (daily and monthly).

On-line use by administrative personnel is for financial status inquiry, including current month-to-date and year-to-date totals.

b. Reports received regularly by clinical personnel are practice profile (by physicians of a group) and individual records. On-line requests by clinical personnel are for individual records.

9. INFORMATION UTILIZATION

a. The system provides information for clinical physicians and their administrative staff.

The information is intended to assist in the delivery of acute and chronic care and preventive care, and possibly emergency office care.

In order to make more intensive medical use of the system,

more data have to be collected in a well organized fashion,

more coding capability will be needed,

the flowsheets, now under test, will have to be proven,

more software is required in order to provide automatically disease oriented data collection formats on the screens. Dr. Straubs does this in his office by having his own CRT frames sent to him as memos.

some new report formats are being developed to generate disease profiles, practice profiles, documents for family practice accreditation as planned by the local AAFP group.

improved inquiry capability has recently been developed.

All of these depend, of course, on physician acceptance.

b. The group which currently depends on the outputs from the automated system are the administrative staff in the physician's office and indirectly, the clinical physicians. In some practices (V.S.) the output is used mainly by the MD.

If the system does not work for 10 minutes, all office operations using the system are held up; one day can be very serious.

If changes in the system are required, then a decision to implement them is made quickly and it typically takes another 1 day to 6 months or more to actually change the computer system.

The physicians have the ability to define their own data collection screens and store them into one of the 16 categories of data in their files.

An example of change which is desirable is a simpler way to generate these forms.

10. EVALUATION OF EFFECT OF AAMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to:

decrease the cost of health care delivery to the provider,

increase the access to care, and

increase the quality of care.

This has been generally due to:

increased services,

better quality of services,

better utilization of services, and

reduced cost of services.

b. The change in the quality of care has been evaluated by the health care providers, implicitly by their acceptance.

The measurement method used has been examination of the medical record for appropriateness.

The change in the access to care has been evaluated by health care providers. These measurements were obtained by subjective judgement (Dr. Straubs). The measure used has been the number of patients seen per day (10 to 20% more), and the availability of the medical record.

The cost factors affecting health care delivery have been evaluated by health care providers or administrators. These measurements were obtained by subjective judgement. Measures used have been evaluation of health manpower utilization (i.e. physicians and clerical staff) per time period and time taken for specific tasks such as medical record review, medical record retrieval for patient visit, and update of the medical record by MD and clerks. In a three-man group practice the system has been stated to save one clerical FTE, and similar observations were made by other providers.

Secondary cost factors are of primary importance. Availability of information for facility operations has provided better financial management (speed, accuracy, and comprehensiveness), resulting in faster collections. Collections are said to have increased by 10 to 20%.

c. The results obtained by the system should be an information source for system designers and health care providers.

11. ECONOMIC INFORMATION

a. The developer of the AAMRS (AUTOMED), Medical Data Systems Corporation (MDS), is a privately owned corporation. The major source of development and operating funds for the corporation is from the initial capital investment for the purchase of hardware and software, and system development and from the monthly fee charged to the users of the system. The AUTOMED users are sol and group practices whose primary source of income is from their patients.

The cost of patient services, the fee structure, is determined by the respective practices using the system. To date there has been no evidence of a decrease in the charges to patient as a result of AUTOMED.

b. AUTOMED may be either a supplement or a replacement of the patients medical record, and in most cases AUTOMED is a replacement of the manual patient's financial record. The extent to which the medical record is replaced by AUTOMED depends upon the individual user, and ranges from total replacement (Dr. Straubs) to no use of AUTOMED at all for patient's medical record. The nature of the medical record prior to the introduciton of AUTOMED also varies according to the user. With respect to one solo practice (Dr. Straubs) the patient's record consisted primarily of notations on 3x5 cards plus correspondence and lab results accumulated during the normal course of patient care.

c. Cost Analysis: Development Costs

The development of AUTOMED began in 1970 with an initial private investment of $1.4 million. These funds have been used for equipment and software acquisition, building construction, system development and operating expenses. The system development cost is estimated at $1,000,000. The first AUTOMED customer was brought on to the system in 1971. The system is considered operational. While some developmental effort is being directed to system refinements and additional services, the major corporate effort is being directed to system expansion.

At the time of our visit there were 32 AUTOMED terminals in operation. It was estimated by MDS that 85 terminals represented the corporation's breakeven point. Sales were ahead of schedule, but somewhat restricted by the availability of terminals for new users. It was estimated that the breakeven point would be reached before August, 1975. The current annual operating costs for MD's is about $300,000 per year.

Cost Analysis: Operating costs

At the time of our visit, the cost of AUTOMED to a user was a fixed fee of $625 per month per terminal, plus 3.9¢ for each monthly patient's statement. Additionally, the user incurs a monthly local connect charge of about $25. Extra terminals for the same user cost an additional $325 per month. It was estimated that one terminal could handle about 100 patients per day if the depth of data per patient was not too extensive.

The largest user was a 6 to 7 physician clinic with 2 terminals. A new user's fee is under consideration by MDS where the fee would relate to the number of patients on file, but be limited to a maximum of $1,000 per month. Based on the current fee structure, the cost to a user (a solo practitioner or group practice) ranges from about $8,000 (1 terminal) to $12,200 (2 terminals) per year. The cost per physician would then vary according to the number in the user group, and the cost of personnel used for data entry and retrieval.

Cost Analysis: Investment Costs

The investment cost for a new user of AUTOMED are considered minimal. The terminal equipment usually can be accomodated in the existing office space. The training of clerical personnel can be accomplished in about one half day.

The major cost of bringing in the system relates to record conversion. MDS recommends a conversion plan that takes about 3 months to complete without serious impairments to normal operations. For most applications the conversion is restricted to the patient's accounts.

d. Transferability

Factors that may affect the transferability of AUTOMED to other settings or the attainment of provider objectives are:

AUTOMED is suitable for a solo practitioner or small group practice, and installation of the system is rather simple. For a solo practitioner, however, it may be difficult to justify the cost of the system.

For a small group practice, the administrative applications of the system (patient's accounts and billing) may provide sufficient cost savings to justify the system. Additionally, clerical personnel readily adopt to AUTOMED and prefer using it for billing over traditional manual methods.

Widespread application of the system will be affected by the ability of the vendor to supply adequate service. Two major factors are involved with the ability of the vendor to supply service: (1) hardware and software capability, and (2) corporate financial viability. It is estimated that the present hardware can accomodate up to 300 terminals, but it is not clear that the quality of service in response time can be maintained as the number of terminals is increased. Future hardware replacement is planned, which will eventually handle up to 5,000 terminals. Careful planning for future expansion is required, for the costs associated with the acquisition of new equipment that is under consideration and associated software development could threaten the financial viability of the firm.

Some users are reluctant to replace the written medical record with AUTOMED due to their interpretation of legal restrictions.

The extent to which other vendors develop and offer systems based on AUTOMED will depend upon the proprietary rights claimed by MDS.

d. Benefit Analysis: Tangible Benefits

System Cost Savings: The amount of cost savings in record keeping activities will depend upon the extnet to which the individual user replaces a manual system. In most cases the patient accounts and billing is totally converted to AUTOMED, which results in clerical manpower savings. For medical record applications of the sytem, cost savings associated with the record keeping activity will probably be limited to the cost of supplies associated with the paper record.

Health Manpower Savings: It is the opinion of 1 physician user that the use of AUTOMED for his medical records has resulted in time savings for the retrieval of information from the record and for the entry of information into the record. He estimated that his use of AUTOMED for patient records permits him to see about 20% to 30% more patients per day.

It is not clear whether any clerical time is saved with respect to the medical record. The physical task of locating a record for a patient visit is replaced with terminal interaction. Some savings may be realized in the elimination of time required to search for lost or misplaced records.

Management Benefits: Most users realize management benefits in addition savings in clerical costs. AUTOMED provides increased accuracy and speed in billing and claims processing, particularly with respect to the direct Blue Cross billing. The major benefit realized is more timely collection of bills.

Benefit Analysis: Provider Intangible Benefits
(Evaluation of 1 user, Dr, Straubs)

Estimate of Benefit Achievement

Direct Patient Care: ++

Improvements to direct patient management, resulting from better organization of the patient record, comprehensibility of information in the record, special formats for recording medical data, and referral lists maintained in the system.

Access to Care: +

More patients can be seen since less time is required for patient visits, resulting from more efficient use of physician time and simplified administrative procedures.

Management Aspects of Health Care: ++

Improved office operations, better accessibility to information regarding status of patient accounts, improved clerical personnel moral,

Benefit Analysis: Intangible Societal Benefits

Technological Advancement in AAMRS: +

The system is operational and is being purchased by private practitioners.

Quality of Care Review Methodology: +

Data base shared by many private practitioners with advice from local medical association. Dr. Straubs monitors his patients' progress.

12. COMMENTS

This system is unique among the sites that we visited in that it is a service bureau which attempts to service physicians' private offices.In order to achieve acceptability, it allows exceptional freedom to the user in terms of using the system.

Most of the users have used the facilities to keep their financial records in order, and as such, the system is not unique. A few, however are using the filing capability to a much greater extent.

Due to its flexibility the system has been transportable without financial incentives.

It lacks the following aspects of an "ideal system":

1. Doesn't have rigorous problem list, classification, and problem orientation.
2. Search programs are lacking for audit capability and flow sheet preparation. It sounds that those that are being developed will not really be adequate, since they just will count one variable. (Some of this is a trade-off to give more flexibility and allow free text.) Recent (March '75) routines have multi-variable capability.
3. No 24 hour service is provided, but has not been requested by the users.
4. No good ability exists to keep tract of medication and lab data, again due to the lack of encoded information. Can be potentially partially done, but doctors and AUTOMED lack the rigorousness to do it.

Advantages are:

1. It has a good billing system, especially given the ability to feed directly into Ohio Blue Cross-Blue Shield and also in being on-line and preparing third party forms.
2. Does appear to be cost effective (especially in 3 or more man office) in terms of secretarial,billing,and doctor time saved and due to and increased collections from patients and insurance companies along with reduction of lost charges.
3. Patient resumé form and previous encounter summary are well laid out. Forms are good, at least as good as HCHP with regard to check lists.
4. Ability to get data within 5 seconds is good.
5. Extreme flexibility exists in terms of entering medical data and designing encounter forms. This is traded off for limited search and analysis capability but makes it much more appealing to doctors.

The physicians, who are all in private practice, when they use the system, tend to keep the free text notes short and concise. The data entry costs are very visible to them. This economizes on the use of the overall system.

In order to do encoding of data, however, standard terminology dictionaries might have to be made available to encourage consistency of terminology and make retrieval more powerful. This will only happen if the physician become motivated to produce medical record data which transcend individual patient care.

The system seems well capable of responding to increasing demands by physicians as their needs and sophistication increases.

Dr. Straubs is obviously a very highly motivated user of AUTOMED. He had enough insight into the way the system operates to be able to use the system in a novel way not originally intended by the system designer. He is able to use the "MEMO" function to create disease specific records with a minimal amount of data recording on his part. Having made a diagnosis, he specifies a particular screen image or "stamp" as he calls it, followed by the data elements specific to that format. This is recorded on the bottom of the patient resumé previously prepared by the computer terminal operator in anticipation of the visit. After the visit, the operator calls up the specified format and enters the data recorded by Dr. Straubs. For uncommon conditions, he uses a hardcopy of the "stamp" to prompt himself to record appropriate data, thus leading to more complete records. It is particularly impressive to see the general flexibility of AUTOMED and the responsiveness of Dr. Fakan to user needs. "Free enterprise is alive and well in Cleveland".

AUTOMED expects to break even on its operation this year. It now has a very cost effective computer operation and appears to provide a cost effective service and is to be hoped that with increased use, the unit service cost will remain as low or become lower. Unlimited storage capacity for a fixed fee is a very helpful concept to the users and their acceptance. Terminal alternatives are being investigated since cost savings here are now available. Important decisions will have to be made regarding implementation of a braoder service, if benefits of access to system developers, responsiveness of MDS, and system economy are to be maintained.

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CDG-3
HRA Contract
June 28, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
APPALACHIA II DISTRICT HEALTH DEPARTMENT
GREENVILLE, SOUTH CAROLINA

IN COLLABORATION WITH
CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA

ON
JANUARY 28, 1975

We were introduced to the objectives, organization and activities of the Health Department (PHD) by Dr. R. W. Penick, Medical Director. We then heard Mr. Francis M. Crowder of the PHD and Dr. J. Peck of Clemson University (CU) who provide the computer development and production services. We observed a number of facets of the system in operation. Technical information was provided by Dr. Peck.

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objectives for the system are principally:

Access to care improvement as achieved by:

contact with appropriate providers,
better availability of providers, and
simplified administrative barriers;

Quality of care improvement in the area of preventive and chronic medicine, through better communication among personnel and programs, and management of the quality of services provided;

Cost containment as achieved by better use of resources, through triage and preventive care.

These objectives have come about in response to the direction by the medical director of the public health district, who realized the need to tie the many federal, state, and local programs together into one health care delivery system.

The system in use here is a replacement, eventually, of a number of manual systems and is completely new.

b. The population which is to be served by the system is the population without access to private medical care in the district. The population is special in terms of social category, primarily indigent.

The ethnic distribution is predominantly (85%) white.

The service environment is light urban to rural.

The service provided is special categorical aid:

family planning,
immunization,
child and youth,
maternal and child, and
ultimately, primary care.

Date is also collected from secondary care centers.

The existing quality of this health care institution is judged relatively high by Dr. Penick compared to the quality of health care delivered to the same type of population served here, which is generally low.

The average annual income of the institution's patient population (in 1970) was $8,775 per family, or $2,940 per individual.

The size of the population entered into the file system currently is about 120,000; the potential population is 300,000 for district services and 475,000 for regional services.

The needs for this population are in the area of primary (preventive and chronic) care.

Patient visits are primarily a result of drop-ins (55%) or appointments on patient initiative (45%). There are a few doctor referrals.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are in order of emphasis, to improve delivery of health care by improvements to:

Access to care in the areas of :
provision of triage
appointment scheduling,
visit registration,
record availability,
record contents, and
patient follow-up;

Resource utilization in the areas of;

health manpower utilization through the use of paramedical personnel,

patient services by better referral and fewer redundant lab tests; and

physical resource utilization by providing routine primary care in a less expensive setting;

Quality of care in the area of:

patient management (i,e. data base acquisition, problem identification, and record accuracy),

patient compliance with physician orders because of continuity of care,

some quality of care review procedures;

Management aspects of health care are to improve management and operations of the facilities and their administration by:

the provision of management with information and analytical tools for:

utilization review procedures,
manpower scheduling,
budgeting and planning,
cost control,

There is also some long range manpower planning and facility planning and this component will increase in the future. Reports to DHEW may have an effect on national health planning.

Reduction of operating costs resulting from increased productivity of manpower and reduction of lost charges due to a good eligibility system:

Faster processing and increased accuracy in accounting procedures, billing and claims processing is seen as a future benefit.

Other specific objectives unique to the facility are the integration of contractual arrangements to provide primary health care services into an HMO-like public sector health delivery system based on the Garfield model.

b, The organization which has made the decision to provide automated record services is an agency (Appalachia District II) for a 4-county area of the South Carolina Department of Public Health.

Expansion of use occurs according to a general plan, but is dependent on subscriber agency program support and funding.

The institution is a district office of a state agency with 131 clinics, both neighborhood and hospital based (36). Data is also acquired from hospitals.

The size of the practice varies according to the service area. There are a total of 20 projects supported by 5 programs:

immunization records	:	35,000 individuals
multiphasic testing	:	1,500
laboratory data	:	4,500 individuals with 35,000 visits
family planning	:	5,670 with 22,000 visits
ante-natal well-baby pediatric	)))	are still minimal

A total of 119,800 names are now on the patient master file.

The population is quite stable (8% intake , 5% outflow/year).

The control over the medical content of the record system is provided by a committee within the agency taking into consideration program requirements.

The technical design, implementation, and operation of the system is in the hands of the provider of computer services (Clemson University) with a research staff of 4.8 FTE assisted by a local in-house staff of 1 programmer and 4 analysts and under the supervision of the administration of the PHD.

3. SERVICES PROVIDED

Data collection is done

using forms with checkmarks,
using forms with some text,
mark sense sheets, and
direct entry

to be entered as is,using

keypunch or key-to-tape,
an optical reader, and
CRT-keyboard entry.

Source data collection is done by clerical medical personnel and the nursing staff. Some data is collected by MD's in obstetrics , as the ICDA codes for problems seen.

Data entry is by computer facility personnel; some have a medical background. Administrative data is entered by clinic clerical personnel.

The data are transmitted by modems and dedicated lines to the computer.

The data are stored forever, but are to be purged after death of the patient.

The entered information is used to

provide worklists,
check for eligibility, and
makes schedules for clinics,

prepare lists for bills when items are reimbursable procedures, medical record entries, encounter documents for outreach workers, and patient progress reports,

generate reports such as patient profile, disease profile for specific programs, treatment profile, practice profile for nurse practitioners, program reports required by state and other supporting agencies.

There is the capability to inquire into the files to determine a patient's medical status using predetermined search programs. Appointments for the next 26 weeks can be displayed.
These services are provided selectively at all 6 sites with a total of 19* terminals. Relevant services provided by other systems are financial status reports and program reports produced at the central offices in Columbia, S.C.,

* More recently 27.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through

keypunch, 25%
mark sense (via tape and messenger),50%
CRT keyboard entry, 25%

Missing data elements are not allowed for some fields; otherwise they are ignored and not distinguished.

Verification of data entry is done by

data entry type checking,
data audit report reconciliation, and
analysis routines.

Most errors are found by data entry personnel and some by health care delivery personnel.

Error correction is done with a special batch program. A correction changes the entry only. On-line error correction is made by CRT operators with computer prompting.

Data entry hardware has given problems in the area of reliability of optical readers when forms were poorly printed. The man-machine interface is considered adequate. Data entry software has given problems only with multiple marked fields.

b. Data Storage

File Updating:

Additional data entries are reflected in the files immediately.

Changed data entries are reflected in the files immediately.

The data invalidated can be retrieved from printed file only.

File Storage:

The data which are entered into the file are kept permanently. Appointment data are moved to archival storage 2 weeks after the last visit and converted to tape.

File Usage:

To get a current record from the file requires less than 3 seconds.

To determine whether a patient has a record in the file requires less than 3 seconds.

The search can be done by

unit number,
agency number and agency assigned identification number,
exact or approximate name using a modified Soundex.

The file is also used directly to answer research questions.

File Size:

The required file space is now 68M characters and is expected to grow substantially.

When a shortage of file space occurs, more file space will be purchased.

The files are fixed (demographic) and variable length, indexed sequential and pre-allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available:

Individual patient record by

retrieval of complete patient record (rare),
retrieval of single agency portion of a patient record,
retrieval of last patient visit appointment,
generation of flow sheet for patient for some areas, and
generation of worksheet for patient for outreach work.

Selection of patients with given

problem or diagnosis,
value of sign or symptom,
treatment modality, and
combination of the above, if such data have been collected on the patient.

This work is done through batch programs. Selection of patients due of a visit is provided by the appointment system.

Tabulation of provided services is done regularly by

patient category (agency, age, sex),
patient address or location,
provider, and
services rendered.

Comparison of selected patient groups includes descriptive statistics (i.e. tables, histograms).

Scheduling procedures are available and utilized for patients, clinic personnel, and transportation services.

Financial management is aided by programs which do

clinic utilization,
claims processing,
accounts receivable,
inventory control for family planning supplies, and
cost analysis.

d. Data Analysis Procedures, Source and Operation

The analysis routines were written by research personnel (CU) and professional programmers.

The routines are specified by clinical personnel and their professional data processing staff.

Their operation is verified by clinical personnel through test and routine operational use.

The routines are kept on a user specific library file. All of the PHD is regarded here as one user.

Their documentation is kept on paper in user specific files both at CU and PHD. The system was well documented.

The principal programming language is COBOL. There are some interface routines which were written in Assembler.

e. Protection of Data

Access to the data is restricted by identification and passwords known to the specific user and to a few of the systems staff specifically for selected files. Violations of access are reported immediately to the director of the PHD.

Personnel which have access to the data in the computer are medical professionals, clerical personnel, and administrative personnel.

The protection provided is considered thorough and fully utilized.

f. Training

New medical users, mainly nurse practitioners, of the system are given an informal course in order to learn how to use the system. The training period is half a day and after an additional week, they are full proficient.

New clerical users of the system are given instruction and demonstration in order to operate the system. The training period is 30 minutes to 1 hour and after an additional 2 to 3 days, they are fully proficient.

g. Presentation of Results

The means for producing output are softcopy by CRT and hardcopy by printers and terminals.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient identification record is fixed at 300 characters.

The size of a visit record is variable.

The number of parameters collected varies greatly between the various services. Much of the information stored is medical in nature.

b. Patient Identification

This data is recorded and entered by a data clerk on entry into the system. There are also birth and death records available. The former can be used as a census list at immunization time, which occurs prior to entry to school.

I.D. number: unit number and agency number with its identification number
Name, full and Soundex
Address and census tract
Phone, home
Sex
Date of birth
Marital status
Number of children in home
Guarantor
Address of guarantor
Race

Education, years
Referred source
Reimbursement source
Programs enrolled in (Medicaid, etc.)
Date when this information was collected

c. Financial and Economic Information

The PHD is an intermediary for Medicaid. This data is recorded and entered by a data clerk.

Guarantor, relationship
Ability to pay, employment (yes or no)
Insurance carriers, name, financial class
Data for claims reimbursement

More financial data are being added.

d. Data Base: History of Present Illness

This is only collected at visits to certain clinics:
obstetrics, pediatircs, family planning,
by nurse practitioners and entered by keypunching.

Chief complaint (coded):	severity, symptoms for certain pertinent problems. descriptive detail, some coded on specific forms, more data is collected as free text in SOAP format, but not entered.
Active problems:	date of entry problem name problem code (not yet)

Collector of information is identified.

e. Data Base: Past Medical History

This data is collected mainly at the initial visit to 1 of the above clinics, recorded by the nurse practitioner and entered by keypunching.

Family history: Family history for parents, siblings, and grandparents include relationship and specied for 15 coded diseases.

Past diseases: Specific diseases only based on the 40 disease questions from the Review of Systems by Kaiser Permanente AMHT, yes or no responses only.

On the obstetrics forms also are collected:

menstrual history,
pregnancy history,
signs and symptoms of pill toxicity,
gynecological review of systems, and
drugs that are feto toxic;

On the pediatrics forms also are collected:

delivery,
early childhood,
school and adjustment, etc.

On the Family Planning form, symptoms for oral contraceptive toxicity are collected.

Past hospitalizations: number and type of operation.

Previous diagnostic tests: name, coded for DPD, Histo, Pap smear, tox plasmosis, Rubella titer, STS, GC.

Immunizations: This is a separate and active service since the state requires certified immunizations prior to school entry; coded, all retained.

Allergies on obstetrics and pediatrics for medicines : name, code.

Current medications: name, coded , problem prescribed for, quantity , frequency

Past medications: Rx, on pediatrics and OB forms only, and injections given at the Publich Health Department.

Collector is identified by a provider code.

f. Data Base; Social History

This is collected as part of the identification data.

Place of birth
Employment, income
Size of household
Level of education (highest or current grade)
Census tract
Residency (adequacy, plumbing)

Collector site is identified.

g. Data Base: Review of Systems

Some positive findings are recorded as part of the Past History.

h. Data Base: Physical Examinations are not yet entered in detail.

Collected are data for obstetrics normal or abnormal for 17 physical areas and detail from pelvic exam. For pediatrics, also abnormal values are noted as head circumference, nutrition, Denver developmental index, vision and hearing. Routinely collected are:

Date
Height
Weight
Vital signs

Collector is identified by provider code.

i. Data Base: Objective Findings of Past Medical History

This data can be collected at any visit and is entered by clerks.

Routine laboratory orders and findings

From a multiphasic exam, chest X-ray conclusion, ECG findings, and pulmonary function test findings, risk factors.

j. Problem List

This area is projected for April 75. Data are keypunched.

Active problems : date of entry, problem or diagnosis name, code (HICDA with modifications based on the Indian Health Service at Tucson).

k. Plans, Diagnostic Orders are stored only as free text from SOAP format at encounter.

l. Plans, Therapeutic Orders

These are collected at clinic encounters and keypunched.

Medications: Rx, quantity, frequency, problem, type
Diet
Patient education
Physical therapy
Activity orders coded

The provider is identified.

m. Follow-up

Routine and special laboratory finding for 40 tests.

Free text is possible; multiphasic findings are stored, including 30 lab tests.
Medications: patient compliance only for contraceptives.

Reassessment of problems is planned.

Disposition coded with level of care, type of care, status, discharge referral.
Provider is identified.

n. Progress Notes

Encounter forms have some free from text in SOAP format for some clinics and social workers.

Provider is identified.

o. Patient Services Management

Schedules for patient visits for up to 3 clinics at one visit.

No-show rates, cancellation rates.

Visit reminders for patient using a fixed interval.

Transportation service schedules.

p. Practice Information

First contact with this practice or agency.

Encounter sites clinics

Referral (self, MD, or other).

Providers at encounter (MD, nurse, PA, other).

Reimbursement source

Patients census tract

q. Research Oriented Data

None of the data categories listed above is collected primarily for research purposes. However, many interesting results have been noted.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through 1 IBM 370/158 of 1.5M bytes, costing $350 per hour; it was installed in February 1974. The memory is being increased to 3M bytes.

The computing services are provided through a contract with an organizationally unrelated university (Clemson University).

The equipment is purchased and rented. Maintenance is by the vendor.

Approximately 5% of the processing capability is used for the ambulatory medical record application. Approximately 400M byte of the file capability is used for the ambulatory medical record application.

The files are stored on 2 IBM 3330II disks, $2,500/month, and 1 tape unit for logging.

Other important equipment is a 3705 transmission unit; PHD uses 2 ports at $166/month.

Archival storage is tape (70 reels).

Retrieval response time is about 3 seconds.

CRT softcopy include 27 IBM 3270 terminals with 24 lines of 80 characters, upper case, 4800 or 2400 baud, costing $6,500; they have adequate reliability and legibility. Compatible terminals are available (ADDS, TCI, SYCOR) at down to $3,000 with improved legibility. There are more than 36 CRT's total.

Hardcopy terminals include:

2 IBM 3286, 120 char/line, upper case, 60 char/sec impact, $8,000 poor reliability.

2 IBM 3284, 120 char/line, upper case, 40 char/sec impact, $7,000 inadequate reliability.

There is also some central printing.

b, The system uses multiprogramming and paging, transaction processing as written at CU with foreground, background for most of its processing, PHD has the highest priority.

Currently production represents 50% and development 50% of the 8 hour/month use of PHD at CU.

Of the production load,

25% is data entry and file update (5,000 transactions/day)
25% is file maintenance
15% is data analysis
35% is report preparation (40,000 lines per day)

c. The operating system (VS2) was designed and written for general commercial purposes. It is understood by the staff at CU and being further developed by the original supplier.

The current file system is characterized by individual (for each clinic), indexed sequential files, linked through the identification file. It is being replaced by Cullinane IDMS, COBOL DBTG based system, with linked records and hierarchical files.

The implementation of the AMRS requires 18 distinct files and 18 distinct record types,

d. When there is a computer failure, the problem is analyzed and systems personnel keep the computer until it is fixed. A noticeable failure happens about 6 times a month and that number has been improving.

When there is heavy usage of the ambulatory medical record system, there will be a slight slowdown largely due to interference on the multidrop lines.

When there is other heavy use of the computer system, there could be a noticeable slowdown, depending on the priority arrangements; the AAMRS has, however, highest priority and is not affected.

e. The data processing staff at Clemson associated with this application consists of:

1 manager (1/2 time)
2 systems analysts/programmers
4 graduate students

One of the programmers uses his commuting time to act as a messenger.

At the PHD there are:

1 manager
1 medical specialist
2 systems analysts
1 programmer
1 operator
9 data entry clerks

There are another 29 clerks in the various program sites who are active in data entry.
There is a daily messenger service to CU for bulk input or output.

The staff at CU reports to the Dean of Graduate Studies and University Research at CU.

The response to request for changes in system output is immediate to 1 week.

f. The costs of the computer operation are fixed and budgeted, incremental CPU charges can occur.

The investment in the computer system is about $250,000 and the operational and ongoing developmental cost is about $144,000 per year.

g. The ambulatory record system is intended for distribution to three more sites in the state. It is to be used remotely on a state-wide scale. Further distribution may require a duplicate system.

6. FORMAT OF THE MEDICAL RECORD

When clinicians see a patient, the record they use is the same, if any, that was used before introduction of the system. This computer stored information is available on a CRT in all sites. The available record contains data from the previous visits to this program, laboratory results, and references to other contacts within the public health system. Other computer outputs are flow sheets for obstetrics, immunization and family planning.

System-wide registration data will have been obtained at the entry point in the facility. Clinic specific data may be recalled during the patient interview using on-line CRT's.

Multi-page encounter forms are completed after the patient visit, Two sample pages from one of the clinics are attached. Each clinic has forms suitable for its area.

The paper records are kept on the sites of the individual programs. Paper records are not always available. The records contain copies of the encounter form, giving the non-coded information which was not entered.

Continuity of providers and patients is attempted, but not maintained because of the service environment.

Scheduling is provided for the 135 clinics in the system.

PEDIATRIC ENCOUNTER Page 4

P5 CC3 [ ] NAME ______________________ DOB [| | | | |]
1-ADD
2-CHANGE
3-DELETE CC 4-13 [| | | | | | | | |] CC 14-19 [| | | | |]
MONTH DAY YEAR

VITAL SIGNS

20-21 HEIGHT [|] INCHES
22-24 WEIGHT [| |] LBS. 25-26 [|] OZ.
27-29 BP [| |] SYS
30-32 BP [| |] DIAS
33-36 TEMP [| |].[ ]
37-39 HEAD CIR [|].[ ] INCHES

FINDINGS AND SUSPECTED FINDINGS

40 NUTRITION 4___ UNDER NOURISHED 7___ OBESITY
41 CONG. MALFORM 4___ Definite 7___ SUSPECTED
42 BIRTH INJURY 4___ Definite 7___ SUSPECTED

DENVER DEVELOPMENTAL	NORMAL (1)	ABNORMAL (2)	QUESTIONABLE (3)
43 PERSONAL-SOCIAL			
44 FINE MOTOR			
45 LANGUAGE			
46 GROSS MOTOR			

GROWTH & DEVELOPMENT PROBLEMS

47 [ ] SLEEPING
48 [ ] FEEDING
49 [ ] EMOTIONAL
50 [ ] BEHAVIOR
51 [ ] TOILETING
52 [ ] SITTING
53 [ ] WALKING
54 [ ] SPEECH
55 [ ] OTHER

SCREENING 1 2

56 VISION ____PASS ____FAIL ____TREAT
57 HEARING ____PASS ____FAIL ____TREAT

TREATMENT CODES: 3=NONE NEEDED 4=NEEDED 5=COMPLETE

DENTAL (Dental personnel only - Mark an X for services provided)

58 DENTAL [ ] CLEANING
59 DENTAL [ ] TOOTH EXTRACTION
60 DENTAL [ ] FILLINGS
61 DENTAL [ ] FLUORIDE APPLICATION
62 DENTAL [ ] SCREENING

63-80 **FAMILY PHYSICIAN:** [| | | | | | | | | | | | | | | | |]

DIRECTIONS TO HOME: (Do Not Keypunch)

____
____
____
____
____

ENCOUNTER SHEET NOTES

Page 6

P7 NAME ______ DOB

DATE OF VISIT

CC 4-13 PATIENT NUMBER

CC 14-19 MONTH DAY YEAR

	LAB TEST ORDERED	PROBLEM #
S- 2 days vomiting and diarrhea	URINALYSIS	
brother also sick	CBC	
O- 5% dehydration	HTC	
ears, throat, chest clear	HGB	
A - gastroenteritis c̄ dehydration	BLOOD LEAD	
P - clear liquids	BLOOD GROUP	
Kaopectate	HB ELECT	
Lab Work	STS	
	STOOL	
Return immediately if	BIOCHEMICAL	
dehydration increases	CYTOLOGY	

S=SUBJECTIVE
O=OBJECTIVE
A=ASSESSMENT
P=PLAN

20 ADD CHNG	21 PROBLEM NARRATIVE	66 1st	67 Rev	68-70 For Prob No	71 Change Status to Act	Inact	Re-move	72-75 Prob./Diag. (ICDA code)	Injury

PROVIDER CODE ____ CC 76-79

P8 CC 4-13 Duplicate CC 14-19 DATE Duplicate

20 OPERATIONS/PROCEDURES	66	67-69 Prob. #	70-71 OPER. DIAG.	72-75 (ICDA Code)

P9 CC 4-13 Duplicate CC 14-19 DATE Duplicate

20 MEDICATIONS, TREATMENTS	66	67 # of Refills	68-70 For Prob. No.	71-75 FORMULARY CODE	76-79 PROVIDER CODE

7. INTEGRATION OF FUNCTIONS

a. The computer operation is a service to the ambulatory health care delivery service. The computer service is contracted by PHD to Clemson University.

The financial resources for its development and the cost of its operation have come indirectly from county, state, federal funds, and from charges to the health care programs served.

The priority of new tasks for the system is determined by the director of the PHD.

b. The automated medical record system supports the manual medical records. Its outputs are kept separately from the paper system.

Information from the paper system is taken into the automatic system from inpatient stays when the PHD has the financial responsibility as a prerequisite for payment.

c. Other automated services used by the ambulatory health care delivery servies such as billing and financial (accounts, ledger) could be replaced with this system.

d. In summary, this computer system is best viewed as a production service under development.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by administrative management are: aggregate services provided (regularly) and personnel statistics (occasionally) On-line use by administrative management is for report generation.

b. Reports received regulary by clinical personnel are patient schedules and practice profile (on demand). On-line requests by clinical personnel are for individual records, data analyses, and scheduling.

c. Special requests are made to data processing staff for items such as studies to support the operations and funding of the agencies. This happens a few times a year.

9. INFORMATION UTILIZATION

a. The system provides information for

institutional management and administrative staff,
clinical paramedical personnel,
health service researchers;

It is also used for

quality of care review,
health care planning.

A number of aspects are of direct benefits to patients.

The information is intended to assist in the delivery of preventive care, chronic disease and general health maintenance (except at hospitals).

In order to make more intensive use of the system.

More data have to be collected and integrated, and data have to be collected at more points,

More communication gear is required to cope with the load, (more lines are being installed now).

New report formats are required to properly implement a problem oriented record

More flexible inquiry capability is required to make this truly an interactive medical record system,

Current plans include the expansion to 130 CRT's in clinics, health departments, hospitals, and 21 social service agencies. Many will not enter nor use medical data.

b. The group which currently depends on the outputs from the automated system are management administrative staff and paramedical personnel.

If the system does not work for 10 seconds, it is not noticed; after a minute operations are held up, and after 15 to 30 minutes, manual backup procedures are instituted. A specific problem in that case is that clinic scheduling is done on the basis of estimates and patients cannot be identified.

If changes in the system are required, a decision to implement them is made in 1 day for minor changes and it typically takes another 1 day to 3 months for a major change to actually change the computer system.

An example of a change which was necessary is a coordinated interagency referral subsystem which will take four months to implement.

10. EVALUATION OF EFFECT TO AMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the quality of care and increase the access to care. This has been generally due to

better quality of services due to uniform application of care process,

better utilization of services,

increased continuity of services, and

fewer errors.

While there are now no formal evaluation projects, data have been collected that can be used for evaluation.

b. The change in the quality of care has been evaluated through measurement of factors relating to th patients and health care providers. These measurements were obtained by subjective judgement (Dr. Penick) and counting of variances.

Measurement methods used have been examination of the medical record for accuracy and completeness and assessment of quality of care review through protocol checks.

The change in the access to care has been evaluated through measurement of factors relating to the patient, These measurements were obtained by counting, Measures used have been utilization data and appointments initiated by patients and missed appointments, Appointment scheduling and reminders have reduced the no-show rate from 50% to 10%.

The cost factors affecting health care delivery have been evaluated through measurement of factors relating to the health care providers and administrators, These measurements were obtained by subjective judgement and counting. Measures used have been evaluation of health manpower utilization in terms of total staff cost per time period and patient visit , and time taken for specific tasks as the scheduling of patient visits.

Evaluation of management aspects of health care delivery revealed the following:

costs of patient care per patient (up) per service(down),

number of visits per patient and per problem (up),

number of tests per patient and per problem (down).

Availability of information has aided management in:

manpower planning,

regional planning, and

national planning.

Availability of information for facility operations has provided for management better analysis of financial needs.

The results of the evaluation should be an information source for health care system administrators and all others engaged in ambulatory care development,

11. ECONOMIC INFORMATION

a. The developer and provider of the AAMRS services is the Appalachia II District of the South Carolina State Board of Health. While the district is the vendor of the AAMRS services to various public health clinics and programs, it is also a user of the AAMRS in its coordination of health care activities to provide primary care services to the indigent (public sector) population of the Appalachia II district.

The annual operating budget of the State Board of Health is about $70 million, and it employs about 2,800 persons. The annual operating budget of the Appalachia II District Health Department is about $6.5 million. The district employs about 390 persons, of which 200 are involved in providing medical care. The primary source of the state Board of Health's operating funds are direct appropriations from the State (40%), federal funds (40%) and fee-for-service income (primarily Medicare and Medicaid, 20%). The Appalachia II district's funding sources are federal funds (45%), state appropriations (25%), county funds (25%0 and fee-for-services (5%).

The fees-for-services provided by the various clinics are based on actual costs of services provided. A typical fee will vary according to the service from $2.50 for a routine clinic visit to $25.75 for multiphasic screening. Even though the AAMRS provides data for the establishment of fees, the existence of the AAMRS has not affected the fee structure.

Decisions concerning the Medicare and Medicaid fees are made at the state level based upon recommendations and cost data inputs from the regions. Additionally, the Appalachia II district will contract the Medicare and Medicaid to provide health care services to individuals at a capitation rate; the district then enters into direct service contracts with the health care providers (public health clinics and hospitals) to provide care to covered individuals on a cost reimbursement basis.

b. The AAMRS is intended to eventually be a complete replacement for the patient's medical record. Currently, it is a supplement. The manual medical record will vary according to the clinic or public health program with respect to content and organization. In general, it is handwritten with some standardization by clinic. Patient identification numbers are unique to each clinic. The manual record is stored separately within each program or clinic.

c. Cost Analysis: Development Costs

The development of the AAMRS began with Clemson University in mid-1972. Within one month some operations were begun; the first was the master patient file for the immunization clinic. An estimate of development costs through June 1975 is about $280,000 of which 35% was for systems development and 65% was for equipment acquisition.

Earlier development activities involved visits to various other AAMRS sites throughout the country to learn what was being done and to get ideas for the system design. Over a period of three years about $120,000 was spent for personnel and travel associated with the study of other sites.

Funds for development activities were internally generated through health management information service contracts between the district and public health clinics and programs. Each service contract provided support for development as well as information services.

Cost Analysis: Operating Costs

The current annual direct operating costs of the AAMRS system is about $520,000 ($656,000 with indirect costs added). About 19% of this amount are personnel costs directly supported by programs (e.g. receptionists). Funds for the remaining costs, about $420,000 are derived from service contracts with state and private agencies for research and development (50%) and from internally generated user charges to participating clinics for actual service provided (50%). It is expected that eventually (within a year) the routine service aspects of the AAMRS will be totally self supported from user charges. Currently about 50 to 57% of the total operating costs are for ongoing development at CU and PHD.

It was estimated by district personnel that the average per patient cost for the AAMRS is $1.13 per year. Considering the costs associated with the AAMRS and the number of patients on the master file, 119,000, it appears that this estimate may be somewhat understated.

The primary fiscal decision makers with respect to the total AAMRS budget are the district director and the director of the district's Office of Program Planning Management and Grants. The primary fiscal decision makers with respect to the computer charges are Clemson University with respect to the rates charged and the district management with respect to the amount of computer services used.

Cost Analysis: Investment Costs

The major effort associated with a new application of this system in another setting would be:

the training of personnel,

the redesigning of input documents to meet specific requirements of the new site (requiring systems analyst and programming effort as well as computer time),

the acquisition of terminal equipment, and

the acquisiton of an adequate computer equipment or identification of a source of computer services.

The total costs associated with a new application of this system would vary greatly depending upon the site and nature of available computing services. Some of the estimated component costs with a new application are:

Training		$10,000
Equipment		
Computer, IBM 370/145 or better		
Terminals,	CRT	$ 3,500 each
	printer	6,000 each
	Modems	800 each
Redesign of input documents		
System analyst/programming		$ 20 per hour
Computer time		360 per hour

d. Transferability

Factors that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

From a technical point of view, the system is easily transferable.

From a financial point of view, a setting of similar size in users and number of patients may be necessary to generate sufficient user fees to support the computing costs.

The access to public health birth and death records facilitates the accomplishment of provider objectives with respect to access to care and quality of care.

d. Benefit Analysis: Tangible Benefits

System Cost Savings: There are no cost savings with respect to the maintenance of the patients individual medical record.

Health Manpower Savings: Savings are realized for health care provider personnel as well as clerical personnel involved with direct patient care. For health provider personnel, the availability of information on prior patient workups eliminates the necessity of duplicating workups as was the case prior to the AAMRS.

Additionally, the nurse practitioners can perform some of their work more efficiently due to the protocols contained on the patient encounter/data entry form. The amount of health provider time savings has not been quantified.

The major use of the time savings is to see more patients per day. The appointment scheduling system permits health care providers to schedule their day so that more time per patient can be allowed when needed.

Clerical personnel involved with direct patient care can perform their tasks faster (appointment scheduling, patient registration), find records faster, and do their work more accurately. Additionally it has been possible to substitute clerical personnel for professional personnel to collect medical information in programs such as family planning and multiphasic screening. With respect to the appointment scheduling and patient identification at initial registration it has been possible to decrease the number of personnel required. A dollar value has not been assigned to savings in this area; however, it is one of the areas where the AAMRS has had a major impact.

Patient Cost Savings: The following savings have been realized:

Reduced charge per service;

Fewer diagnostic tests and ancillary services;

Reduced waiting time for appointments; and

Elimination of unnecessary visits due to the referral process.

These savings result in reduced costs to the health care provider with respect to the service costs and to the patient with respect to time involved in waiting for appointments and number of visits made.

Management Benefits (Secondary Cost Savings): Increased accuracy, speed and the reduction of lost charges have improved program operations such as reconciliation of billing procedures and identification of patients eligible for third party medical support.

Additionally, the overall operation of the health programs in the Appalachia II district has become more efficient in its use of resources and has increased productivity. Over a four year period the district's programs grew from an operating budget of $800,000 with a staff of 60 to an operating budget of $6,500,000 with a staff of 390. On a per person basis, this is an operating budget change from $13,000 to $17,000.

Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement
Direct Delivery of Health Care (Quality):	++

Patient management has been improved through the availability of data base content (immunization data, lab tests, multiphasic screening, history) to a variety of clinics. Additionally, patient compliance has improved through continuity of care.

The measures of change are increased information in the medical record, reduction of errors, availability of the record, ease of accessing the record and peer review on compliance with clinical algorithms.

Access to Care:	+++

The appointment scheduling system, patient followup on missed appointments and easier registration process has had a dramatic affect upon some of the participating programs. The following data is from the Family Planning Program:

	Before AAMRS	After AAMRS
Patient dropouts	25-30%	10%
Appointment no-shows	50%	18%

Management Aspects of Health Care:	++

Data from the AAMRS is being used to help in improving operating conditions; it is essential to financial planning and long-range facility and manpower planning.

Benefit Analysis: Societal Intangible Benefits

	Estimate of Benefit Achievement
Technological Advancement in AAMRS:	++
Good display: format structure of frames, able to modify rapidly.	
Program is independent of terminal type used, which provides flexibility in terminal selection.	
Quality of Care Review Methodology:	0
Research Activities:	+
The system is used to develop and demonstrate innovative concepts with respect to provision of health care to the indigent population.	
Training Activities:	+
Use and training of nurse practitioners.	
Health Planning:	++
Integration of regional services into one data base improved use of facilities.	

12. COMMENTS

A strong effort has been made here to integrate patient services and records provided under many diverse programs. The integration of the system facilities is proceeding in parallel with the organization efforts of the public health department.

We were impressed by the system and the management ingenuity in the development of the system; note that the system is totally supported (financially) by the user clinics and services.

No direct federal funding has been available, although they seem anxious to support further developments via this route. The patient ID system and the appointments system are very strong features. Aside from immunization data and family planning visit data, there is very little additional clinical data on the system at the present time, but a modified problem-oriented medical record is planned for implementation in Spring, 1975.

There is yet a hodge-podge of things; the Problem List is made up from various problems on each previous visit. Data base comes from various forms. The quality of the free text used is questionable. I can't get a clear idea of the overall record. Few physicians interact with the system. The nurse practitioners seem to be willing to fill out various forms which are of less than optimal and somewhat inconsistent design.

The level of computer science support and systems analysis is quite high, and certainly better than that seen at academic institutions with their computer science departments. The concept of a health department based primary care center is quite novel and coupled with the level of demonstrated competence in getting an information system operating in support of primary patient care to a population that is underserved should be a very strong point in their favor in obtaining additional support. They will, however, have to beef-up their competence in evaluation methods.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDD-5
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
DUKE UNIVERSITY MEDICAL CENTER
DEPARTMENT OF COMMUNITY HEALTH SCIENCES
DURHAM, NORTH CAROLINA

ON
JANUARY 30, 1975

Dr. Ed Hammond, Chief of the Division of Information Sciences (ISD) of the Department of Community Health Sciences, introduced us to the members of his staff. We also met the Chairman of the department, Dr. E. Harvey Estes, Jr., and Dr. Robert Sullivan, Vice Chairman and Research Director. Later we had the opportunity to meet Mr. Marvin Schilder, Director of the University Health Services Clinic (UHSC) and the clinic staff.

This report is based on interviews and material provided during this visit. **It has been updated with more recent status data provided by Dr. Hammond.**

The summary contains the following sections:

1. OUTCOME OBJECTIVES

These objectives are set by the Department of Community Health Sciences (DCHS).

a. The intended societal outcome objective for the system is principally access to care improvement to be achieved by:

contact with appropriate provider,
simplified administrative barriers, and
decreased delay.

Currently a prime concern is quality of care improvement in the area of primary medicine through increased

health knowledge and physician training,
better communication among personnel, and
better feedback.

A general concern is cost reduction as achieved by the substitution of equipment for labor. The development of cost effective record technology is seen as an important component of all of these objectives.

These objectives have come about in response to direction from the head of the department and have to meet both academic and operational needs.

The system in use here is to be eventually a replacement of a manual system.

b. The population which is to be served by the system here is largely selected by the availability of financial backing (students, employees, faculty, and employees of firms having health testing contracts).

The population is special in terms of age distribution, predominantly 18 to 40.

There is also a dietary clinic (3% of the total visits).

The ethnic distribution is predominantly white.

The service environment is urban and suburban. The service to be provided is primary care.

The existing quality of this health care institution is judged relatively high by the institution. The quality of health care delivered outside ot this institution to the same type of population served here is high to average, but access is low, as judged by the institution.

The average annual income of the institution's patient population is high per family; students will have limited funds. The size of the population served by this system currently is 11,000 after a half year of operation; the potential population is 40,000.

The needs for this population are in the area of primary care. Patient visits are primarily a result of drop-ins (60%), Others are based on appointments on patient initiative (35%) and doctor referral (5%).

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are currently:

Management aspects of health care in improving management and operations of the facility by:

the provision of management with information and analytical tools for:

budgeting and planning and also cost control,
utilization review procedures,
manpower scheduling, and
cost control;

and

the reduction of operating costs resulting from increased productivity of manpower and reduction of lost charges due to inadequate billing accuracy and data collection.

Quality of care improvement remains a long term objective, particularly in the area of:

patient compliance with physician orders because of satisfaction with quality of service,

quality of care review procedures,

research information collection, and

patient management such as feedback to physician regarding achievement of desired outcomes.

There is also the intent to use the system for problem identification and treatment planning.

Access to care in the way of patient follow-up and record availability;

Resource utilization is a concern, such as health manpower productivity through the use of paramedical personnel,

A specific facet unique to the facility is that the computer system itself is designed with much broader goals in mind. It is also used in some inpatient settings, and more suitable outpatient settings are being investigated. It is being marketed as a system for a variety of medical applications.

b. The organization which has made the decision to provide automated record services is a unit (UHSC) of the institution (Duke University). Expansion of use will occur according to a general plan.

The institution is a clinic associated with a university medical center. There is emphasis on job related health services for students, university and outside employees. There is also a dietary clinic. The institution is a private university.

UHSC has 11 physicians and 4 physician assistants.

The computer system activities are charged to a wholly owned for-profit corporation (Health Care Systems, Inc,) whose profits are to go to the Department of Community Health Sciences (See also Section 11).

The size of the practice is:

Number of patients = 11,000 during the last half year;
Number of patient visits per year estimated from the half year's data = 40,000 (30,000 during the academic year);
The average number of encounters in that period was 1,99 per patient;
The average time per patient visit, arrival to departure, is a total of 82 minutes.

The control over the medical content of the record system is provided by a committee of administrators, the medical records librarian, and one physician representing the total medical staff.

The technical operation of the system is in the hands of a research project staff of nine medical information scientists and under supervision of the director of ISD (Dr. Hammond) who in turn reports to the chairman of the department, Dr. Estes.

3. SERVICES PROVIDED

Data collection is done using forms with limited text to be entered as is using CRT-keyboard entry. The diet clinic, the physical exam, and the automated history use mark sense forms, and registration is done on-line using CRT-keyboard enty.

Source data collection is by

MD and physician assistants,
nursing staff, and
clerical medical personnel.

Data entry is primarily by clerical medical personnel, supported both by UHSC and ISD.

The data are transmitted by modems and direct connection to the computer. The data are stored forever.

The entered information is used to:

prepare medical record entries,

provide work lists for protocol audit,

(Since our visit the following has been achieved):

generate reports such as:

management reports,
practice profile,
disease profile for some diagnostic categories, and
treatment profile for protocol audits

and in the immediate future:

prepare documents such as bills and data sheets for third party bills.

There is the capability to inquire into the files to determine patient's financial status by any variable and boolean combinations of variables, including free text comparisons.

These services are provided at a central site on four terminals. The computer console terminal is also used for some information retrieval. No other relevant services are provided by other systems or vendors within the clinic.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through CRT keyboard entry (90%) and mark sense (10%). Optical reading of hand printed characters was tried, but not found to be satisfactory.

Missing data elements are explicitly skipped and coded to a specific representation.

Verification of data entry is done by output scanning using special verify frames on the CRT displays and by an edit program using cross verification by the data entry clerk at the end of every day. Most errors are found by data entry personnel and a few by billing personnel. There is no feedback for errors found by physicians.

Error correction is done on-line for errors found during the entry and verification process. Other critical errors are corrected with a special on-line program. A correction automatically changes all previously derived fields. An audit trail of all errors is maintained.

Data entry hardware has given few problems in the area of reliability. The mark sense unit requires regular maintenance. The man-machine interface on the CRT's is considered suitable for clerks, but not for physicians. Data entry software, written in-house, required a significant effort. The use of read-before-write interfaces in a full-duplex communication environment is important, since responses can be entered while the CRT screen is being filled.

b. Data Storage

This has been an important aspect of local development work. The resulting system is named GEMISCH.

File Updating:

Additional data entries are reflected in the files immediately in three places: a daily transaction file; a long-term, on-line file; and subsequently on an off-line detailed encounter file.

Changed data entries are also reflected in the files immediately.

The data invalidated can be retrieved from the prior transaction log.

File Storage:

The data which are entered into the file are moved to archival storage when a student leaves the university. Encounter data collected into the research files is kept forever on disk (off-line for details).

File Usage:

To get a current record from the file requires less than 10 seconds. To determine whether a patient has a record in the file requires less than 10 seconds. The search can be done by exact name or social security number.

The file is also used directly to answer research questions. Occasionally the file is abstracted when complex statistics are to be done.

File Size:

The required file space is now 7M characters and is expected to grow to 20M characters for 40,000 patients. When a shortage of file space occurs, more disk storage will be purchased.

The files are compressed using bit-coding of data (3 bits per data field). Records are variable length and dynamically allocated. Direct access is achieved by hash-coding. The total file space is pre-allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data, the following classes of routines are available:

Individual patient record summary with data from last patient visit and abstract of patient record (to be done before and after each encounter) **which includes date from the last 5 visits and retrieval of complete patient record (not now used).**

Available but unused is the generation of monthly billing statements and third party bills. Generation of worksheet for patient is being considered

Selection of all patients with given

problem or diagnosis,
value of sign or symptom (collected are only vital signs and data for some protocols),
treatment modality (drugs),
financial classification, and
combination of the above.

This selection is made on the basis of single visit records or across time axis (for the last 12 visits). Selection of patients due for a visit or review is available but not used.

Tabulation of provided services is done regularly by

diagnosis or problem,
patient category (age, sex, etc.),
patient address or location by census tract,
provider, and
services rendered.

Some reports are daily, others weekly or semi-annually.

Comparison of selected patient groups includes descriptive statistics (i.e. tables, histograms, means, and standard deviations). Inferential statistics, etc. are available in FORTRAN after data have been abstracted from Gemisch files.

Financial management is aided by programs which do

budgeting and planning,
billing,
claims processing,
accounts receivable,
aged accounts receivable, and
service reports.

d. Data Analysis Procedures, Source and Operation

The analysis routines were written by research personnel and professional programmers.

The routines are specified by research personnel and clinical personnel.

Their operation is verified by research personnel and clinical personnel through short pilot-operation for major changes, followed by routine operational use.

The routines which do the processing are kept on a general library file. Tables describing actions for a specific task are kept by the individual user on his file.

Their documentation is kept on paper and on files in a general library or by the individual user.

The principal programming language is Assembler for the underlying system (GEMISCH). This system interprets tables which are generated using a few specialized languages; ISAR is the language for data retrieval. PRINT is used to specify reports; FRAMES is the language to specify CRT frames and data entry, and MASSAGE is used to manipulate data.

e. Protection of Data

Access to the data is restricted by identification and passwords known to the users and systems staff for most of the data base. A second level password is required to gain access specifically to selected files. Printed passwords and data are shredded.

Personnel which have access to the data in the computer are medical professionals and clerical personnel. The protection provided is considered adequate and loosely utilized.

f. Training

New medical users of the system are given instruction in order to learn how to use the system. The training period is part of a regular clinic review, 1 hour per week.

New clerical users of the system are given instruction and demonstration in order to operate the system. The training period is 1 day and after an additional 4 days they are fully proficient.

g. Presentation of Results

The means for producing output are for hardcopy, printers and terminals and for softcopy, CRT displays.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient identification record is variable.

The size of a visit record is variable.

At the initial visit an average of _________ parameters is collected.
At follow-up visits an average of _________ parameters is collected.
We estimate that 70% of the information stored is medical in nature.

The current limit for an entire patient record is 16,000 characters. Data are densely stored as three bit elements or as variable length free text.

b. Patient Identification

This data is collected by the reception clerk at the first visit; 48% of the patients are new.

I.D. number: social security number
a family number is being developed
Name, full
Address
Phone, home and business
Sex
Date of birth or age
Marital status
Next of kin with address, relationship
Notify in emergency with address
Religion (no longer collected)
Race
Occupation, free-text
Mother's maiden name
Date when this information was collected

c. Financial and Economic Information

This information is collected, reviewed, and compared to manual system but is not used as primary system at this time.

Total bills: outstanding, aged, year-to-date
This visit: line itemized with providers and amount
Billing detail: line itemized with date, diagnosis, provider
(collected but now retained only as a sum total/visit).
Guarantor: relationship
Insurance carriers: name, type, plan

x. Data Base: General

Different data is stored for the various populations.

	Students Employees Faculty	Dietary Program	Protocols for Specific Complaints (UTI and sore throat)
History	No	batch	Yes (as specified by protocol)
Physical Exam (Vital Signs)	on-line	batch	Yes
Physical Exam (detail)	No	batch	Yes
Chief complaint (detail)	No	batch	on-line
Problem list	on-line	70% batch	on-line
Risk factors	No	No	for Health Hazard Appraisal
Summary	on-line	on-line	on-line
Laboratory	No	selected group batch	No
Medications	on-line	on-line	on-line
Encounter form (coded data only)	on-line	on-line	on-line
Progress notes	No	No	Yes
Number	10,700	300	50 sore throat since our visit

There is also an obstetrics clinic which we did not examine.

We will only describe the system as it pertains to the majority of the population (column 1), and not include items which are part of the dietary program or of specific protocols.

d. Data Base: History of Present Illness

Data is collected by the physicians or a physician assistant on an encounter form. The structured portion is entered into the computer from the form returned by the patient to the registration desk before he leaves the facility. The data collection encounter was observed during our visit to take up to approximately 10 to 12 minutes total. A timing study, done since our visit, shows the data entry to take approximately three minutes.

The written notes, in SOAP form, at the bottom of the encounter form are not entered.

e. Data Base: Past Medical History

Entered data from past encounters, if any, and from an Automated Initial Medical History are kept on the files. The patient summary lists if available:

Critical medical information: allergies, blood type, immunizations;

Current medication: name only; recently, dosage, date started

Past hospitalizations: year only.

f. Data Base: Social History

Employment (income source),

Census tract;

Collector is identified.

g. Data Base: Review of Systems is not stored.

h. Data Base: Physical Examinations

Only limited data are stored.

Height
Weight
Blood Pressure
Temperature

More data are stored for general physical exams (50%) and for all dietary patients.

Collector is identified.

i. Data Base: Objective findings of past medical history are not stored (except dietary).

j. Problem List

Active problems: date of entry, problem name, code (WONCA), diagnosis name, code if possible (ICDA)

k. Plans: Diagnostic Orders

This is just beginning to be used.

Laboratory orders
X-ray orders, anatomical site
Other diagnostic services.

These are ordered on the encounter form. No automatic communication of orders is done. Physician is identified.

l. Plans: Therapeutic Orders

Medications: quantity, frequency; this data is used for analysis only; a separate Rx is necessary to obtain drugs.

Physician is identified.

m. Follow-up

Laboratory findings to be collected soon.

X-rays conclusions (normal or abnormal)*

EKG's, other cardiac test findings (n, abn)*

EEG's, other neurological test findings (n, abn)*

Pulmonary function test findings (n, abn)*

Other medical tests: renal function, gastrointestinal, etc. findings(n,abn)*

* **Are not routinely entered now.**

Medications: patient compliance has been sampled by questionnaire

Reassessment of problems is available but not used (delete, merge problems)

Disposition coded for 4 variables

Physician is identified.

n. Progress Notes

An impression can be entered with a problem number. This facility is not routinely used at UHSC.

o. Patient Services Management

No-show rates, cancellation rates

p. Practice Information

First contact with this practice or agency

Encounter sites (type, code, mode of arrival)

Referral (self, MD or other)

Providers at encounter (MD, nurse, PA, other)

Encounter duration with waiting time and frequency

Audit oriented data are obtained from the practice profile.

q. Research Oriented Data

Selected or additional data may be collected primarily for research purposes. Data from the UTI and sore throat protocol have been entered to allow examination of process quality.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through 1 DEC PDP 11/45, 28K, installed in June, 1974 for $35,000. The total system cost of this primary machine was $94,000. There is also available in the department another DEC PDP 11/45 for research work and 1 DEC PDP 11/20 with much input/output equipment for development and backup.

The computing services are provided in-house. The equipment is purchased.

Maintenance is by vendor and costs $10,000 per year in addition. There is also a hardware specialist on the staff available for assistance; he also works for other projects and hardware development.

All of the processing capability of the primary machine is used for the ambulatory medical record application, but it does not occupy the full machine capability.

All of the file capability is used for the ambulatory medical record application.

The daily files are stored on 1 disk RK05 (2.4M char), $11,000; the long term files on 1 disk RP03 (48M char), $31,000. The prices include the required controllers.

Other important equipment is 1 mark sense reader OPSCAN 17 (on PDP 11/20) and communication equipment costing $7,500.

Archival storage is 4 disk packs each with 48M characters.

Terminals for softcopy are 4 Super Bee, 80 x 24 screen, upper and lower case, 9600 baud, costing $2,500. Initially there were 1 to 2 failures per week; now there is adequate reliability. Legibility is good and their features (blinking of words and reverse video) made them attractive. Additional CRT terminals are used for non-clinic functions.

Terminals for hardcopy include:

1 GE Terminet, 132 char/line, upper and lower case, 120 char/sec. impact, costing $3,600. It is very reliable but its print is not considered dark enough.

2 Teletype 33, 1 for computer operations and 1 for the clinical laboratory.

There are also 2 Dataproduct printers (300 lines/minute) which are rarely used for the clinic (their cost was not included above).

b. The system uses multiprogramming, swapping while maintaining input/output activity, and transaction processing for most of its workload.

Currently production occupies 90%* of the machine, and development 0-10% of the primary machine. The PDP 11/20 is used 15% for mark sense entry, batch and backup related to the clinic.

* These figures represent the latest values.

Of the production load,

11 hours is data entry,
1/2 hour is file maintenance,
1 to 2-1/2 hours is report preparation

c. The operating system was designed and written for this type of application and institution at Duke. It is now being replaced by a new version of the system (GEMISCH II) developed by the local staff.

The file system is characterized by tabular files with direct access. The implementation of the AAMRS requires 3 distinct files for patient data and 1 record type of different lengths. Other files are used to specify the system tasks.

All components of the patient record are interconnected via a defined hierarchical data description into a single variable length record which currently has a soft limit of 16K characters. Data may be either coded in a three bit code or stored as varibale length free text.

d. When there is a computer failure, a backup computer is put into service. A noticeable (to the user) failure happens less than once a week and that number has been steady.

When there is heavy usage of the ambulatory medical record system, there will be an annoying slowdown. It is expected that GEMISCH II will be able to handle many more (16) terminals.

e. The data processing staff consists of:

1/2	manager
1 FTE	medical specialist (3/4 + 1/4)
1	statistician
3/4	systems analyst
1	hardware specialist
5 FTE	programmers
4 FTE	data entry clerks (3 at ISD and 4 at UHSC)

Clerks at ISD are not now used by the ambulatory care project.

The data processing staff reports to the director of ISD **(except the 4 UHSC clerks).**

The response to request for changes in the system output is 1 week. **Has been done in less than 8 hours on two major price changes. Depends primarily on scheduling and ISD priorities.**

f. The cost of the computer operation are fixed and budgeted. The investment in the system is about $________ and the operational cost is about $_____/_____. **The cost objective is $1.80 per terminal hour.**

g. **The GEMISCH system including the ambulatory record application is intended for distribution. Currently,** it is used at 3 sites supported by HCS of Duke as a vendor, or it can be used remotely within the university. One of the users, Franklin Square Hospital, supported by Health Quest (**a licensee** of Health Care Systems, Inc.) is beginning to keep outpatient records using GEMISCH. Other users are in the obstetrics, **cardiology, and health questionnaire areas.**

6. FORMAT OF THE MEDICAL RECORD

When the physician or physician assistant at the UHSC sees a patient, he has available a traditional paper medical record containing a face sheet with a problem list, critical medical information, and current medications, if the patient has been seen before at the clinic. Other computer produced entries in the medical record will be encounter documents from previous visits. There may also be a computer generated medical history with a list of risk factors to be considered. The original encounter documents, containing the written SOAP narrative, are also kept in the chart.

As part of the encounter, the clinician will complete an encounter form, which will be entered into the computer files at the registration desk before the patient leaves.

The medical records for the clinic are separate from the University hospital and are kept on-site. They are available with little delay. Continuity of the patient-provider combination is maintained except for emergencies. Due to the population of the clinic, there is relatively little demand, however, for continuing care.

On the pages following are a copy of the abstract of patient summary, a printout from the most recent encounter, and a copy of a blank encounter form.

PRIMARY CARE SUMMARY RECORD

UNIVERSITY HEALTH SERVICE
GEMISCH 1974

SSN: 888-88-8888
DATE OF LAST ENTRY: 01/07/75

*HARDEE
* JOHN D
*HOSPITAL NUMBER: J95217
*OCCUPATION: STOCK BROKER
*45 YR OLD BLACK MARRIED MALE
****

WEIGHT	HEIGHT *		
[redacted]	[redacted]	TEMP	BLOOD PRESSURE
315 lb	72 in	99.8 F	180/120

************PROBLEM LIST************

PROB	STATUS	DATE ONSET	DESCRIPTION CODE	LITERAL
1	A		277	OBESITY
2	A	11/01/70	250	DIABETES
3	A	12/01/73	401	HYPERTENSION

***********CRITICAL MEDICAL INFORMATION************

Blood Type: O +
Date of last tetanus: 05/20/74
Critical Hypersensitivites: Penicillin

***********CURRENT MEDICATIONS************

INSULIN, DIURETICS

*************OTHER MEDICAL INFORMATION************

Hospitalizations: 1964, 1969
Last Chest X-RAY: 10/05/74 Normal

***********CLINICAL SUMMARY************

DATE	PROVIDER	PROCEDURE CODE	DX CODE	DESCRIPTION
01/23/75	09	040	460	SORE THROAT
01/30/75	24	040	470	INFLUENZA
			760	COUGH

* This has been fixed since our visit.

ENCOUNTER FORM

UNIVERSITY HEALTH SERVICE
GEMISCH 1974

SSN: 888-88-8888
HOSPITAL NUMBER: J95217
DATE: 01/23/75

*HARDEE
* JOHN D
*OCCUPATION: STOCK BROKER
*45 YR OLD BLACK MARRIED MALE
****

WEIGHT	HEIGHT *		
~~HEIGHT~~	~~WEIGHT~~	TEMP	BLOOD PRESSURE
315 lb	72 in	99.8 F	180/120

PROBLEMS: **
460 -SORE THROAT

TESTS:
LAB
MONO
THROAT CULTURE

DISPOSITION
Return PRN

PROVIDER: 09

* This has been fixed since our visit.

** Since our visit, this has now been updated to include the last five encounters.

MEDICAL RECORD

UNIVERSITY HEALTH SERVICES CLINIC

62791

CONVENIENCE
☐ Acute Care
☐ Acute Follow-up
☐ Chronic
☐ O.J.I./Illness

ADMINISTRATIVE
☐ Pre-employment
☐ Annual
☐ Personal
☐ Insurance Phys.

SH/ACCIDENTS
☐ Phy. Ed.
☐ Sports
☐ Vehicle
☐ Other

PLANNED APPT.
☐ Chronic
☐ Dietary
☐ Gyn
☐ Acute
☐ Acute Follow-up
☐ Physical

MISCELLANEOUS
☐ Test Only
☐ RX
☐ Immunization
☐ Other

M.D.'S NAME: ____

PATIENT CONTACT

METHOD OF PAY
☐ Contract
☐ Medicare ☐ SSA ☐ BW
☐ Medicaid ☐ EPA ☐ JM
☐ Self Pay ☐ FAA ☐ RTI
☐ Charge Care ☐ GE ☐ MON
☐ Insurance Other ____

Sub: ____
Supplementary Letter ____
Cert: ____
Group: ____

DATE: ____
S.S. # ___ – ___ – ___ HISTORY # ____
NAME: ____ LAST FIRST MIDDLE
D.O.B. ____ TEL. ____
☐ MALE M.R. PULLED ☐ YES ☐ NO
☐ FEMALE M.R. CLERK ____
CLERK: ____ STATUS: ☐ SH ☐ EH ☐ FH ☐ PVT

LAB
9 ☐ CBC Blood
3 ☐ HGB
3 ☐ HCT
3 ☐ WBC
5 ☐ DIFF.
5 ☐ Sed. Rate
6 ☐ Mono
21 ☐ 3 Hr. GTT
5 ☐ VDRL
15 ☐ Panel 1
23 ☐ Panel 2
19 ☐ Panel 3
15 ☐ Panel 6

9 ☐ RBC Indices
22 ☐ Electro Panel
19 ☐ Lipid Panel 1
15 ☐ Thyroid Panel
3 ☐ Stool Guaiac
2 ☐ UA Dipstick
3 ☐ Routine UA
4 ☐ CC UA
5 ☐ Dipslide
12 ☐ UA Culture
10 ☐ Preg. Test
5 ☐ KOH
7 ☐ Hanging Drop
7 ☐ Gram Stain

12 ☐ GC Culture
10 ☐ Pap Smear
5 ☐ Throat Culture
☐ Other ____

X-RAY
25 ☐ PA + LAT Chest
20 ☐ Finger
20 ☐ Wrist
23 ☐ Hand
26 ☐ Shoulder
25 ☐ Foot

20 ☐ Toe
26 ☐ Knee
25 ☐ Ankle
42 ☐ Ls. Spine
41 ☐ Cervical Spine
26 ☐ Abdomen (Flat)
☐ Other ____

SPECIAL SERVICES/ SUPPLIES
17.50 ☐ EKG
15 ☐ Photo
7 ☐ Ultra Sound
8 ☐ Audiogram
15 ☐ Proctoscopy
☐ Other ____
☐ Other ____

ITEM	CHARGES
Lab (Total)	$
X-Ray (Total)	
Meds. (Total)	
Injection (Total)	
Supplies/Services	
Professional Chge.	
TOTAL	
PRIOR BALANCE	
AMOUNT PAID	
NEW BALANCE	

M. D. CODE ____
P.A./NURSE CODE ____
PROCEDURE CODE NEW ☐

PRESCRIPTION	CHARGE
TOTAL	

SPECIAL INSTRUCTIONS

☐ STAT
☐ WAITING
☐ ROUTINE

IMPRESSION
DX

PROTOCOL(S)

DISPOSITION
☐ No Follow-up Planned
☐ Return P. R. N.
☐ Return to Convenience Clinic ____ Days
☐ Arrange Appointment
Date: ____ Time: ____ Phys: ____

NOT SEEN
☐ CANCEL
☐ NO-SHOW
☐ LEFT

☐ Referral To: ____
For: ____
☐ On the job illness/injury Comp. Auth. No. ____

VITAL SIGNS ☐ wt. → ☐☐☐ ☐ ☐ hgt. → ☐☐☐ ☐ ☐ temp. → ☐☐☐ ☐ ☐ press. → ☐☐☐/☐☐☐

S=SUBJECTIVE **O=OBJECTIVE** **A=ASSESSMENT** **P=PLAN**

FORM A 3016 REV. 8/74

7. INTEGRATION OF FUNCTIONS

a. The computer operation is a service which is an integral part of the ambulatory health care delivery service, Administratively and technically the computer service is directed by the chief of ISD.

The financial resources for its development have come from the Robert Wood Johnson Foundation and federal grants ($________), and the cost of its operation are paid by the clinic and a departmental subsidy ($_______/________).

The priority of new tasks for the system is determined by a committee of 2 MD's, the director of the clinic, **a senior system programmer, and the chief of ISD.**

b. The automated medical record system supplements the manual medical records. Some of its outputs are inserted into the paper system. Information from the paper system is taken into the automatic system in case of laboratory and X-ray requests. Findings are not entered. The automated system content is not accessed by the medical records librarian, **but special reports are generated daily for the MRL, Medical Records Librarian.**

c. Other automated services, used by the ambulatory health care delivery services, that could be done with this system are:

patient history taking (being done in the clinic for the dietary program on Gemisch, could also be done on this system as part of the AAMRS);

multiphasic testing and scheduling of patients and staff (in development)

billing

financial (accounts, ledger)

laboratory reporting has begune to enter development since our visit

scheduling

d. In summary, this computer system is best viewed as a development effort going into a production service for evaluation.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by administrative management are

aggregate services provided,
personnel statistics, and
income.

b. Reports received regularly by clinical personnel are

practice profile,
compliance with entering codes,
individual records, and
total billings.

These services are recent and their utility has yet to be determined.

On-line requests by research personnel are for data analyses.

c. Special requests are made to data processing staff for items such as research studies for evaluation. This happens frequently, but many of the requests involve data bases other than the clinic.

9. INFORMATION UTILIZATION

a. The system provides information for

institutional management on the clinic **and** on the departmental level,
quality care review, **on selected protocols or diagnoses,**
clinical physicians,
paramedical personnel, and
patients receive a copy of the history, when given.

Data are also used for some medical research.

The information is intended to assist in the delivery of

acute care,
preventive care (dietary clinic), and
emergency care for job-related injuries.

In order to make more intensive use of the system,

more data have to be collected,
data have to be collected at more points,
more software is required,
and
more has to be provided to the physician to motivate his use of the system.

b. The group which currently depends on the outputs from the automated system is the institutional management.

If the system does not work for 10 seconds, it is not noticed; **within 5 minutes they have switched to a back-up computer.**

Specific problems in that case are the inability to register patients into and out of the clinic.

If changes in the system are required, a decision to implement them is made in 1 day to 3 months and it typically takes another 3 months **or more** to actually change the computer system. **Note that the system hasn't been running (on-line) for a year.**

Minor changes within the tabular structure of GEMISCH can be made rapidly. A major delay is due to the ongoing development of a new operating system, which is behind schedule **due to priority selection. More of the applications will then be based on the table-oriented languages and require less effort.**

10. EVALUATION OF EFFECT OF AMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been minimal due to its recent and gradual introduction. There may be some increase in the quality of care. This has been generally due to better utilization of services and fewer errors, and to the facilitated protocol audits.

b. The change in the quality of care has been evaluated through measurement of factors relating to the administrators. These measurements were obtained by subjective judgement (Dr. Ahlers, Dr. Estes).

Measurement methods used have been examination of the medical record for accuracy and completeness for established protocols and assessment of facility of quality of care review.

A future evaluation is to be a patient's attitude questionnaire.

An earlier project, ATOPS, using GEMISCH in a batch mode to generate a medical record, evaluated management aspects of health care delivery specifically, collected payments per patient. This resulted in a new fee schedule and increased collections.

Availability of information for facility operations has provided better analysis of financial needs and utilization review procedures.

c. The results of the evaluations when the system has been operating sufficiently long should be an information source for

system designers,
health care system administrators,
health care providers, and
medical researchers.

11. ECONOMIC INFORMATION

a. The AAMRS developer is the Division of Information Sciences (ISD), and the AAMRS user is the University Health Services Clinic (UHSC). Both the ISD and the UHSC are organizational units of the Department of Community Health Services, the parent organization is the Duke Medical Center. All of the foregoing are considered as non-profit activities of a private educational institution. In order to handle some profit generating activities of the UHSC (e.g. the Dietary Clinic and employment physicals), and of the ISD (e.g. sale of systems and services to organizations outside of the university), Health Care Systems, Inc. (HCS, Inc.), was established. HCS, Inc. is totally owned by Duke University; the president and head of its's board of directors is the chairman of the Department of Community Health Sciences. All HCS, Inc. dividends are paid to the UHSC and ISD.

The total annual operating budget of the user organization, the UHSC, is about $1.5 million. The UHSC medical services are provided by 11 full and part-time physicians, 2 physician assistants, and 1 nurse practitioner. The major sources of operating funds for the UHSC are individual contracts for the provision of medical care. The largest service contract is for student health (50%); the other contracts include:

faculty,
university employees,
the dietary clinic,
other contracts with local employers for pre-employment physicals, and job related medical services.

Additionally, the Robert Wood Johnson Foundation provided grant support for the development of a system of outpatient care. The emphasis of the grant work was on the development of a general management system called ATOPS, A Total OutPatient System, to be applied in a variety of settings. The UHSC serves as a demonstration site.

Patient services are provided by two types of contracts, fixed fee and fee-for-service. The fixed fee contracts are capitation payments for student health and an hourly rate for physician services at the sites of outside employers. All other clinic services are provided on a fee-for-service basis.

Prior to the development of ATOPS, the UHSC was operating at a deficit. This was apparently primarily due to an inadequate fee schedule, which has now been revised. The current fee schedule is based on the California Relative Value Scale and a survey of local practice. In addition to a revised fee schedule, management procedures were instituted to assure that proper charges were made according to the fee schedule.

Other than provision of information for management, such as utilization of services by type of patient, the AAMRS has had to date no direct affect upon the cost of providing health care or the financial viability of the UHSC. The primary decision maker with respect to charges of patient services is the UHSC management.

b. While the AAMRS is intended to eventually replace the manual paper patient medical record, it currently servies as a supplement to the paper record. The current patient's medical record is handwritten and typed (mostly typed), uses a unique patient ID number for continuing health care, and has some standardization with a tendency toward being a disorganized collection of information. The records are stored centrally within the UHSC.

c. Cost Analysis: Development Costs

The development of the AAMRS began in late 1973, and the system became operational on-line in mid-1974. The cost of the system development is estimated at $550,000 . While certain aspects of the system are considered operational, they are somewhat limited when considered with the additions to be made in the near and more distant future. Thus there is still a significant amount of ongoing development effort. The general development of computer programs has been supported by ISD through service functions and more recently by grants from the Robert Wood Johnson Foundation and NIH.

Cost Analysis: Operating Costs

The current tototal direct annual operating costs for the AAMRS at the UHSC is about $245,000 ($338,000 with indirect costs added). Of this amount about $59,000 (about 24%) is for UHSC AAMRS research and development which is totally supported by the ISD. The cost of the UHSC AAMRS services is thus about $187,000 of which 44% is supported by the UHSC: direct salary support for data entry, computer equipment, and associated supplies; the hardware being purchased by UHSC is for their exclusive use. The source of the UHSC AAMRS support includes the Robert Wood Johnson Foundation grant funds and clinic income. The remaining support for the UHSC AAMRS costs is provided by the ISD and is primarily the cost of ISD personnel associated with the regular services of the UHSC AAMRS (e.g., analysts and systems programmers).

The total annual direct operating costs for the Information Sciences Division is about $397,000 ($565,000 with indirect costs added), of which about 41% is for the UHSC AAMRS and 43% is for other research and development efforts including AAMRS at other locations. By July, 1975 it is expected that a new operating system and $35,000 in new equipment will be added to the system. This will permit the system to serve new applications of the AAMRS and additional AAMRS services and features. Profits derived from sale of software and services go to HCS, Inc. and from there back to ISD. The source of operating funds for the ISD are:

HEW research grant (NIH Bureau of Health Resources Development)
Robert Wood Johnson Foundation
HCS, Inc. for service contracts
UHSC is leasing on a purchase contract their own computer and peripheral equipment. They also pay directly for maintenance, supplies, and data entry staff.

The primary decision makers with respect to the AAMRS budget are the UHSC manager, the head of the ISD, and the chairman of the Department of Community Health Sciences. The AAMRS service charges are at new locations under the control of the head of ISD and the department chairman.

To the extent that the full cost of equipment associated with routine services is supported by the AAMRS user, the AAMRS is considered self supporting. This does not imply, however, that the AAMRS services are financially independent, for the services could not be obtained without the existence of independently supported research and development activities. Dr. Hammond notes that actually, except for expansion of the system and development, UHSC does function as an independent user.

Cost Analysis: Investment Costs

The major effort involved with bringing on a new user to this AAMRS is the modification of AAMRS services to the needs of the new setting, the training of personnel (health care providers and clerical), and the acquisition of terminal equipment. The ISD is planning on extensions of AAMRS services to other ambulatory care settings. It is expected that new users will pay for the services. In preparation for this extension, an hourly terminal connect charge was estimated, based upon the UHSC utilization of the AAMRS. The ISD estimate is about $4.35 per hour. This figure is for the recovery of equipment costs only, and thus does not represent the full cost of the AAMRS service. Based upon the estimated ISD AAMRS operating costs, a full cost hourly connect charge may vary from $10 to $14 depending on whether or not development costs are included. For an AAMRS to become totally self supporting, the service charge eventually will have to provide for cost recovery of ongoing development and system improvements as well as the cost of routine services.

d. Transferability

Factors that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

The system has been successfully transferred to other sites, (University of Chicago and Health Quest).

Duke has developed a number of table driven programming subsystems so that the applications can be generated from descriptive specification. This technique may be more suitable than procedural specifications.

Hardware and software costs may be easily within reach of small (ten or less) group practice, we did not get precise figures. It is current equipment benefitting from large production and multi-vendor development, since it is the major product of DEC and many manufacturers are building compatible equipment.

The Gemisch users group provides a communication channel.

e. Benefit Analysis: Tangible Benefits

(Note: Only realized benefits are described; more benefits will be realized as more aspects of the system become operational.)

System Cost Savings: None

Health Manpower Savings: There has been no change with respect to the time spent by health care providers in using the patient's medical record or to time associated with patient care.

There has been an increase (negative benefit) in clerical time associated with direct patient care. The patient registration process is slower with the AAMRS than with a manual system. This is primarily due to the additional amount of data collected for the AAMRS and the time required for accuracy checks. Some of this additional time will be offset when patient bills are produced by the AAMRS (planned for the near future). There has been no quantification of the additional time required for patient registration.* There have been some time savings for clerical personnel in the time required to locate a patient's record, about 2 to 3 minutes per record.

Patient Cost Savings: There have been no savings to date with respect to the cost of providing care as a result of the AAMRS. From the patient's point of view, a savings is realized in a reduced waiting time before registration. This may be partially offset, however, by a longer time spent in the registration process. **

Management Benefits: The AAMRS has resulted in a reduction of lost charges, and the management information generated has aided improvements in the use of resources. The amount of management benefits have not been quantified.

* Subsequent to our visit this was tested as approximately one minute. It is felt that this time is more than regained on return visits.

** For the sore throat protocol it is expected that there will be a reduction of lab tests and medications.

Benefit Analysis: Provider Intangible Benefits	Estimate of Benefit Achievement
Quality of Health Care:	+
The quality of care review procedures are aided by the AAMRS in that the system facilitates the identification of records for protocol audit.	
Access to Health Care:	0
A primary system objective, but additional system features will have to become operational before benefits will be realized.	
Management Aspects of Health Care:	++
Availability of utilization data for management review.	

Benefit Analysis: Societal Intangible Benefits

Note: Many activities are in progress and have not yet been completed.

Technological Advancement in AAMRS:	++
Compressed tabular data storage and programming methodology may provide a valid alternative to procedural programs. Software system has been transferred.	
Quality of Care Review Methodology:	0
Is in planning stage; not yet demonstrated.	
Research Activities:	++
B-strep infection study (Grimm et al, NEJM 292, pages 507 to 511, 1975). Regular publication of technical progress in DECUS proceedings and GEMISCH newsletter.	
Technical Activity:	
Has been reported in the IEEE Transaction and recently at the NCC as well as in several medical journals.	
Training Activities:	0
Now adding CRT self instruction packages.	
Health Planning:	0

12. COMMENTS

The system under development here has a greater scope than is evidenced from its use with the University Health Services Clinic. The services provided now do not, in general, place a high value on the data base capabilities of a medical record system.

There is a very shallow data base on the target population and a deep data base for a small research oriented subset.

The clinic is essentially a university internists group practice which is composed of 5 to 6 separate areas - student health, pre-employment, occupational health, faculty health, employee health, contracts with industry, private practice, and a specially granted obesity clinic. All except this last service uses only the encounter form. The patient's chart is made up of a copy of each encounter form with written notes on the bottom.

The amount of present automated medical content is minimal - a coded impression, free text medicine, simple disposition, and vital signs. The system is planned to be expanded; the next addition will be to order and record lab tests.

Dietary clinic (for obesity control) uses complete history, a physical exam form, medications, weights on about 300 patients. (It is essentially the only clinic to do so.) The history and physical are collected on mark sense forms which are run in batch to give written machine printouts. This clinic is heavily research oriented, sees patients frequently, obtains much laboratory data, and gets good follow-up. They do searches, statistics, chi-squares, etc. for this clinic, similar to Fries at Stanford.

Dr. Hammond feels that the practice at UHSC is not the best setting for automation since it is a somewhat unique clinic in that it sees mostly well people for physicals, etc. and minor acute complaints. A nearby Family Practice Center now uses a similar encounter form (without the progress note format at the bottom) which is batch run to give administrative data. It appears that it will be at the Family Practice Center and not UHS where more options for a truly AAMRS will be considered. The system currently is basically on administrative system only.

In addition, there is an implementation at an OB clinic including history and physical data by mark sense check list. Lab data is also entered. This all then is printed out. Follow-up visits are added on flow sheet (computer entered) or as free text. After delivery discharge report is added to record with mark sense check list. We didn't ask to see this. Apparently the OB-GYN scheduling system is working well. Dr. Hammond reports that OB patient appointment system (PAS) decreased no-shows from 30 to 10% in three months. They are seeing 130 versus 106 patients per day due to PAS and organization of the clinic.

This group is by far the most savvy in terms of the health services research and evaluation potential of the AAMRS they are implementing. I would judge that the computer science input to the design process is superior to MUMPS/MIIS based projects. The use of a mini-computer system is a step in the right direction for those potential users who are located in remote areas and cannot afford big systems. The input mechanism seems to be mark sense (for clinicians) and CRT's for clerical persons. I am not confident that they can avoid much free text input by physicians with this method of entering data.

Evaluation is markedly different from other sites reviewed thus far. They intend to evaluate each new phase to be introduced before and after. Current evaluation, however, is heavily based on discussions with users. Because its medical content and use of the AAMRS was only beginning to be automated at the time of our visit, any comments concerning evaluation related to the limited system in use which was primarily administrative.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDC-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS OF THE VISITING STUDY TEAM ON AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO FAMILY PRACTICE CENTER DEPARTMENT OF FAMILY PRACTICE COLLEGE OF MEDICINE MEDICAL UNIVERSITY OF SOUTH CAROLINA CHARLESTON, SOUTH CAROLINA ON JANUARY 27, 1975

We were introduced to the work at the Family Practice Center by Dr. Ronnie Schneeweiss, Associate in the department. During the day we had sessions with the chairman of the department, Dr. Hiram B. Curry, and Dr. Stanley Schuman, Don James (pharmacy), Dr. Chansky and Stephen Miller (computer systems), Dr. Terry Davies, Dr. Sam Faber, Mr. James O. Smith, associate coordinator of the Statewide Family Practice Residency System, and other faculty and residents.

Dr. Rodnick of our group also had the opportunity to visit the practice of Drs. Fairey and Rowe in Mt. Pleasant, S.C., and the Family Practice Residency program in Greenville, S.C..

This report is based on the information provided during our visit and the extensive documentation folder prepared by Dr. Schneeweiss.

The summary contains the following sections: page

1. OUTCOME OBJECTIVES

a. The intended societal outcome objective for the system is quality of care improvement in the area of family medicine through

better training of physicians in the use of medical record, and also
better communication among personnel,
better feedback, and
greater efficiency in the delivery of quality medical care.

This objective has come about in response to the need felt by medical staff providing administrative direction.

The system in use here is completely new. It was initially based on a commercially available system. It replaces much of the manual record.

b. The population which is to be served by the system is selected for training purposes of the residency program.

The population is special to a slight degree in that the diseases presented and social category are distributed to provide a good mix for family practice training.

The ethnic distribution is mixed, about 45% black.

The service environment is urban and suburban.

The type of service provided is primary care.

The existing quality of this health care institution is judged relatively high, while the quality of health care delivered to the same type of population served here is otherwise average, as judged by the visiting group.

The average annual income per family of the institution's patient population is:

1/3	$5,000 or below
1/3	$5,000 to $10,000
1/3	$10,000 or more,

chosen in order to get good distribution for teaching purposes.

The size of the population served by this system statewide in May, 1975 is 15,145. The Charleston Program has about 55% of this total, limited by the center's capacity and needs; the potential population for all statewide family practice programs is 40,000 to 50,000. Currently about 20% of the patients in Charleston are faculty or employees of the Medical University of South Carolina (MUSC).

The needs for this population are in the area of primary care. Patient visits are primarily a result of appointments on doctor referrals. There are 20% drop-ins.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

quality of care as reflected in:

training activities,
patient management such as: data base acquisition, treatment planning in the medication area, drug screening, problem identification, feedback to physician regarding achievement of desired outcomes (laboratory values),
patient compliance with physician orders because of continuity of care,
quality of care review procedures for peer review and medical audit,
research information collection by some faculty members, and
record accuracy;

access to care for patients in the practice as reflected in:

patient follow-up, and
appointment scheduling;

management aspects of health care:

Management and operations of the facility are aided by the presence of the system, although this was not an objective when the system was acquired. This is achieved by the provision of management with information and analytical tools for:

utilization review procedures and budgeting and planning, and faster processing in billing and claims processing.

A unique objective is the planned expansion to the many residency programs throughout the state to achieve better coordination, and to demonstrate the usefulness of automated records in private practice settings.

b. The organization which as made the decision to provide automated record services is the statewide agency for family practice residency programs which works with the Department of Family Practice of the Medical University of South Carolina, MUSC (another state institution). Expansion of use will occur according to a general plan.

This unit is a speciality group practice in family medicine with a clinical faculty of 9 and 41 family practice residents practicing part-time. The clinical effort is approximately equal to 18 full-time physicians.

The institutions involved are part of the state government.

The size of the practice is as follows:

Number of patients is 6,975(yearly average) at Charleston.

They are all part of families of 2 or more members; the average family size is 3.6.

Number of patient visits per year is 25,000.

Average time per patient visit is:

waiting time ; 1/2 hour

service time:1 hour for an initial visit by an adult,
30 minutes for an initial visit by a child,
15 to 30 minutes for a repeat visit.

The control over the medical content of the record system is provided by the medical record committee with 2 faculty MD's, 4 residents, and the medical record administrator.

The technical operation of the system is in the hands of an in-house staff of 9 under the supervision of a member of the medical staff.

3. SERVICES PROVIDED

a. **Data collection is done mainly using dictation. There are some simple forms with checkmarks for laboratory, X-ray, and procedures, and (recently) some text. The dictation is transcribed using some standard problem oriented categories.**

Dictated and check form data are entered as is, using CRT-keyboard entry.

Source data collection is by MD's, pharmacy staff for drugs and nursing staff. Administrative data is collected by registration clerks.

Data entry is by:

computer facility personnel,
clerical medical personnel for registration and laboratory, and occasionally MD's. CRT's are available in each of the 14 examination rooms.

The data are transmitted by direct connection to the computer. There are two modems and telephone lines for outside use.

The data are stored completely during the three year patient-resident relationship. Then only a few selected data may be retained in the computer into the next three year period.

The entered information is used

to generate medical record entries,

to generate reports such as patient profile, disease profile, treatment and drug profile, practice profile,

to prepare patient progress reports and flow sheets for selected vital signs and hematology, **and all other laboratory results,**

to schedule patient return visits if within one month,

to generate patient follow-up on missed appointment,

to provide work lists and labels for the pharmacy, and

to prepare documents such as bills and third party bills.

There is the capability to inquire into the files to determine a patient's medical status, financial status (bills only), and appointments (very limited) by diagnosis, symptoms, a total of 13 variables and boolean combinations.

These services are provided at any terminal in the practice center and at 4 outside sites. The billing services are used by a 2 man private practice. Two of the other sites are at other Family Practice Centers. Only limited use was made there during the period of our visit.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through CRT keyboard entry of dictation missing data elements are not allowed although the free text content can vary greatly.

Verification of data entry is done

on input through visual scanning of responses to entered codes,

by output scanning by the residents and pharmacists (with initial entered to indicate the verifcation), and

by data entry limit checking where possible (pharmacy).

Most errors are found by data entry personnel and some by health care delivery personnel.

Error correction is done on-line, A correction automatically generates a new report! An audit trail of all errors is not maintained.

Data entry hardware has given some problems in the area of reliability; there are backup terminals. On the average 2 out of 30 are not working. The man-machine interface, keyboards with CRT screens, is not adequate for regualr direct MD data entry.

Data entry software has given few problems.

The data entry has lagged frequently, occasionally by several months. It is now about 1 week behind. Personnel is being added to cope with the workload. **It is reported that in May, 1975 lag has been eliminated and that the records are available in 4 to 12 hours.**

b. Data Storage

File Updating:

Additional data entries are reflected in the files immediately.

Changed data entries are reflected in the files immediately,

The data invalidated are not kept.

File Storage:

Individual data which are entered into the file are deleted from the file 6 months after quitting the family practice and converted to a printed record. The drug data are retained,

File Usage:

To get a current record from the file requires **1 to 10 seconds, depending on the size of the record.**

The search can be done by unit number, family number, exact or approximate name.

The file is also used directly to answer research questions.

File Size:

The required file space is now 31 M characters and is growing at a rate of 10 M to 20 M characters per year.

When a shortage of file space occurs, more file space will be purchased and old records will be deleted. A total space of 100 M characters is available now.

The files are hierarchical. All entries are variable length.

Storage is dynamically allocated. The file structure (MUMPS globals) avoids storing empty fields through the use of labelled entries and pointers.

c. Data Analysis Procedures Used

For the analysis of the stored data, the following classes of routines are available (frequency of use).

Individual patient record by:

retrieval of complete patient record (often)
retrieval of abstract of patient record (for cover page of record)
retrieval of last patient visit (after each encounter for filing)
generation of flow sheets for patient (regular)
generation of financial history of patient (as needed)
generation of monthly billing statement (each encounter)
generation of third part bills (claims)

Selection of all patients with given

problem or diagnosis,
value of sign or symptom,
value of vital sign, drugs, lab test, provider, age, sex,
financial classification, and
combinations of the 14 criteria

can be made. This selction is made on the basis of single visit records.

Selection of patients due for a visit or who missed visits is possible.

Tabulation of provided services is done by;

diagnosis or problem,
patient category (age, sex),
patient address (census tract),
provider,
services rendered in pharmacy or lab.

Comparison of selected patient groups includes:

descriptive statistics (such as tables) and
inferential statistics (such as T-tests, chi-squares).

Scheduling procedures are being planned.

Financial management is aided by programs which do.

billing by family
data collection for claims processing by the university
accounts receivable
aged accounts receivable
ledger for the two private physicians using the system

d. Data Analysis Procedures, Source and Operation

The analysis routines were written by research personnel, clinical personnel, the vendor, and professional programmers.

The routines are specified by research personnel and clinical personnel.

Their operation is verified by professional data processing staff and clinical personnel through pilot operation and routine operational use.

The routines are kept on a general library file. Their documentation is kept on paper in a general library and needs improvement.

The principal programming language is the Meditech dialect of MUMPS.

e. Protection of Data

Access to the data is restricted by identification and passwords known to the individual users and to the systems staff for the entire data base.

Personnel which have access to the data in the computer are medical professionals, clerical personnel, and administrative personnel.

The protection provided is considered adequate and is loosely utilized.

f. Training

New medical users of the system are given instruction and demonstration in order to learn how to use the system. Documentation is being developed.

The training period is a few days, part-time and after several weeks, most MD's are fully proficient.

New nursing and clerical users of the system are given instruction and demonstration in order to operate the system. The training period is a few days and after an additional several weeks, they are full proficient. There is very low turnover which reduces the staff training problems.

g. Presentation of Results

The means for producing output are hardcopy from printers and terminals, and softcopy by CRT.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORDS

a. Introduction

The size of the patient identification record is variable, typically 300 characters.

The size of a visit record is variable, typically 300 to 1,000 characters.

At a visit an average of 6 parameters may be collected plus free text; 90% of the information stored is medical in nature,

b. Patient Identification
(recorded and entered by receptionist)

I.D. number: unit number (as MUSC hospital)
social security number (optional)
Name, full
Address, zip and census tract
Phone, home and business
Sex
Date of birth
Marital status for linkage to head of household
Race
Social economic level
Occupation, free text (optional)
Educational level (soon)
Provider assigned

c. Financial and Economic Information

Total bills: outstanding, aged (2 months), year-to-date
This visit: line itemized providers, amount
Billing detail retained for 2 months: line itemized with date, amount
Guarantor: head of household
Insurance carriers: Medicare or Medicaid only

d. Data Base: History of Present Illness

(Collected at any visit)

Chief complaint: detail given in dictation only using SOAP format.

Active problems:

- date of entry
- problem name (both formal and informal)
- problem coding is done automatically using computer stored dictionary and RCGP codes.

Unmatched problem names are reported and coded by medical records in consulation with the physician.

e. Data Base: Past Medical History

This is collected at the initial visit using a questionnaire and dictation. The data from the questionnaire are usually not entered.

Family history: Positive findings only by dictation.

Past diseases: Are coded as problem list; problem name or diagnosis are coded; description in SOAP format as free text.

Past hospitalizations can be entered on the problem list with free text.

Previous diagnostic tests within the Family Practice Program are stored.

Immunizations were kept manually only but are now entered directly and retrieved by the nurses.

Allergies: medicines (name, code); environmental agents (name) collected at initial admission to the program, and added to the list as revealed.

Current medications: Name, code, quantity, frequency (number of refills authorized, date filled). The medications are not problem linked; on the progress plan the drugs prescribed appear with full detail.

Past medications: Rx, coded; quantity, frequency; patient compliance in obtaining drugs prescribed within the F.P.C.

Psychiatric: Detail on life-problems for patients on a research protocol for one physician is being collected.

f. Data Base: Social History

This data is collected during admission as free text:

size of household
number of children
census tract
employment, income source (not yet)
level of education, type (not yet)

g. Data Base: Review of Systems is not stored, but any positive symptom can be entered as a problem with free text.

h. Data Base: Physical Examination

Initial data kept mostly on paper. Significant findings and risk factors can be stored as free text and can be collected at any visit. Basic vital data are;

date,
height,
weight, and
vital signs (B.P., resp., temp.)

are collected at every visit.

i. Data Base: Objective Findings of Past Medical History

laboratory orders (plans and findings)
X-ray orders
EKG orders
other medical tests as free text, orders and findings

j. Problem List

Active problems, up to 27 (A to Z)

date of entry, number of visits
problem name, code (RCGP-WONCA, cross indexed to ICDA)
informal name
provider name

Other data is kept as free text under SOAP categories.

Temporary problems, numbered

date of entry , number of visits
problem name, code
descriptive text as above
merged with problem if appropriate
date of resolution
retained until review by new resident (3 year cycle)

k. Plans, Diagnostic Orders

Routine laboratory by check mark on encounter form,
All others as free text in notes under Plan.

l. Plans, Therapeutic Orders

Medications, Rx, coded; quantity, frequency,
All others as free text under Plan.

m, Follow-up

Laboratory findings are entered by clerical personnel and stored with original order.
X-ray reports and conclusions are sometimes entered as free text.

EKG findings are sometimes entered.

Other medical test findings go into the paper chart only.

Medications: Rx are entered by pharmacist when filled at FPP or when postcare is returned from community pharmacy (30% return rate). This provides indication of patient compliance in obtaining drugs.

Reassessment of problems can be done at any visit by inactivating or merging problems.

Disposition, coded: with next date, or consultant, or hospital.

n. Progress Notes

Encounter data are dictated using prescribed format. Some physicians do not dictate and their data are not entered. **Problems, medications, and laboratory data are always entered.**

o. Patient Services Management

No-show rates and cancellation rates are indicated.

Medication schedules for patients are kept by the pharmacy for refills.

p. Practice Information

First contact with this practice is known.

Providers at encounter (MD, nurse, PA, other)

Audit oriented data and practice profiles are frequently and flexibly generated since they are an important training tool.

q. Research Oriented Data

Only a few data categories listed above are collected primarily for research purposes. A life-events study collects data on social and family stress for selected families.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through 1 DEC PDP-15 with 48K; it was installed in October, 1973 for $120,000. This was preceeded by service ports leased from MEDITECH.

The computing services are provided in house. The equipment is purchased. Maintenance is by DEC and costs $1,000 per month in addition.

Approximately 90% of the processing capability is used for the ambulatory medical record applications; 25% of this is used outside of the Charleston Family Practice Center (FPC).

Approximately 90% of the file capability is used for the ambulatory medical record application; 30% of this is outside use (2 other Family Practice programs and 2 man practice_.

The files are stored on 3 ISS RP03 disks of 30M character capacity. The cost of these and the printers is included in the sum above.

Other important equipment are 2 Printec printers, being replaced by high speed terminals.

Archival storage is not used yet.

Retrieval response time is about 10 seconds.

Terminals are CRT softcopy:

26 Hazeltine CRT terminals, 27 lines x 80 characters, upper case only, 1200 baud, $1800, good legibility and reliability. There is one of these in each examination office. Being replaced are Datapoint terminals (24 x 80, 300 baud) due to lack of features and legibility.

Hardcopy terminals include:

2 GE Terminets, upper case only, 120 char/sec, impact, $3,500 and
1 GE Terminet , 30 char/sec, impact with split platen for the pharmacy. Their reliability has been good.
1 DECwriter, 30 char/sec, impact dot matrix, for program maintenance (included in above total).
There are more terminals outside of the FPC.

b. The system uses timesharing for most of its processing.

Currently production occupies 90% of the machine, and development 10%. Of the production load,

40% is data entry
10% is data analysis
50% is report preparation.

File maintenance is done at off hours, 2 hours per day.

c. The operating system (MIIS) was designed and written for general medical purposes. It is understood by the local staff, and maintained by the original supplier (Meditech).

The file system is characterized by hierarchical files.

The implementation of the AMRS requires 25 distinct files, including dictionaries and indexes,and 25 distinct record types. All dictionaries are stored also in inverted form.

d. When there is a computer failure, the problem is analyzed and systems personnel keep the computer until it is fixed.

A noticeable (to the user) failure happens about once per year.

When there is heavy usage of the ambulatory medical record system, there will be an annoying slowdown.

e. The data processing staff consists of

1 director (part time)
1 coordinator
1 computer scientist
50% of a pharmacist
1 programmer
6 data entry clerks

Additional data entry is done in reception and for lab data.

The data processing staff reports to the director of the Statewide Family Practice Residency System.

The response to request for changes in system output is less than 1 week.

f. The costs of the computer operation are budgeted. The investment in the system is about $350,000 and the operational cost is about $250,000 per year.

g. The ambulatory record system is intended for this and its sister institutions to be used remotedly on a state-wide scale. It may be available for future distribution supported by a vendor.

6. THE FORMAT OF THE MEDICAL RECORD

At an encounter, the family practice resident has available to him a paper record containing mainly computer printouts. There will be a front sheet giving a problem list, some informal information to aid patient contact and a list of medications. Other computer outputs in the medical record include a drug profile, a lab test profile, and a vital signs profile. These are essentially non-dense flow sheets.

Many encounter reports tend to be voluminous due to the training environment, but this varies a great deal. The reports are organized into problem-oriented SOAP format.

The paper record is kept on-site and retrievable on short notice, but it is also available on the CRT in every office. More data is frequently obtained on-line.

The paper record is kept onsite. It is delivered fast but sometimes not available.

Continuity of provider and patient combination is maintained except for emergencies. Due to the fewer hours that the residents practice, the probability of being unable to reach the primary care provider increases.

The pharmacy enters and keeps detailed order and filling data.

Attached are a front sheet, a patient encounter report, and the encounter form. This form has since been revised to include more service types, consultations, X-rays, and admit data.

PATIENT SUMMARY

1

PROBLEM LIST

01/23/75 SELF. K.S. PATIENT: OPD #: 208236

** PERMANENT PROBLEMS **

	DATE OF DEF	DATE OF RES	PROBLEM
A			HEALTH MAINTENANCE 0 VISITS RCGP = 511
B	08/13/73		HYPERTENSION, ESSENTIAL 6 VISITS RCGP = 218
C	08/13/73		EXCESSIVE SMOKING 1 VISIT RCGP = 123
D	08/13/73		DEPRESSION 1 VISIT RCGP = 134

** TEMPORARY PROBLEMS **

	DATE OF DEF	DATE OF RES	PROBLEM
1			CHANGED TO PERMANENT PROBLEM B
2			CHANGED TO PERMANENT PROBLEM C
3	08/13/73	08/13/73	(S/P MOLECTOMY (1940)) 1 VISIT RCGP = 399
4	08/13/73		UTERINE NEOPLASM, BENIGN (UTERINE FIBROID BY HISTORY) 1 VISIT RCGP = 71
			CHANGED TO PERMANENT PROBLEM D
6	08/13/73		(MUSCLE CRAMPS) 2 VISITS RCGP = 427
7	08/27/73		(DRY SCALY SKIN - ANTERIOR LEGS) 2 VISITS RCGP = 399
8	09/12/73		(LOOSE STOOLS) 1 VISIT RCGP = 308

ALLERGIES:
SPECIFIC DRUG(S):
CLASS(ES): PENICILLINS, ALL

ACTIVE DRUGS:

CHLORTHALIDONE MAR 27, 1974 (FIRST PRESCRIBED ON AUG 27, 1973)
DOSAGE: 50MG-ICM # PRESCRIBED: 100(100) SIC: 1 QD
REFILLS: 0

AUG 13, 1973 DOCTOR: SELF, K.S.
PATIENT:
OPD# 208236

WT: 139 1/4 HT: 66 3/4 BP: 160/98 P: 88 R: 24 T: 98.2 AGE: 60
MUSCLE CRAMPS
6:1

S: **SUBJ** HISTORY OF LEG AND FEET CRAMPS. OCCURRING AT NIGHT OR WITH EXERCISE. CAN AFFECT EITHER LEG OR FOOT. OCCURS 2-4 TIMES/WEEK. RELIEVED WITH MASSAGE OR BEARING WEIGHT OF BODY.

O: **PHYSICAL** REFLEXES WNL.

P: X-RAYS:

LAB:
PHOSPHORUS <PENDING>
CALCIUM <PENDING>
SERUM ELECTROLYTES <PENDING>

PATIENT EDUCATION: ETIOLOGY UNCLEAR.

SEEN BY: STAN SELF, M.D.

*****

DEPRESSION PERMANENT PROBLEM EVALUATION
D:1

S: **CC** I'VE BEEN DEPRESSED. **SUBJ** HISTORY OF FEELING BLUE, SAD SINCE JUNE, 1973 AT WHICH TIME SHE LOST CLOSE MALE COMPANION THAT SHE HAD BEEN LIVING WITH. FOR MANY WEEKS AFTERWARDS HAD PERIODS OF PROLONGED CRYING AND SADNESS. MOTHER DIED 2-3 YRS. AGO WHOM SHE WAS VERY CLOSE AND SHE STATES THAT IN ALL HONESTY SHE PROBABLY HASN'T GOTTEN OVER THAT LOSS YET. SHE STATES THAT SHE LOOKED AFTER HER MOTHER AND FOR THAT REASON NEVER MARRIED. ALSO PAST FEW MONTHS FINANCIAL DIFFICULTY. **RX** NONE.

PATIENT EDUCATION: NEED TO R/O PROLONGED GRIEF REACTION. OFFER PSYCHOTHERAPY. CONSIDER ANTIDEPRESSANTS LATER.

SEEN BY: STAN SELF, M.D.

*****

UTERINE NEOPLASM, BENIGN UTERINE FIBROID BY HISTORY
4:1

S: **SUBJ** TOLD THAT SHE HAD FIBROMA 10-15 YRS. AGO. ADVISED NO TREATMENT UNLESS SYMPTOMATIC. NO SYMPTOMS.

O: **PHYSICAL** ABDOMEN MINIMAL TENDERNESS IN LLQ WITHOUT REBOUND. NO MASSES PALPABLE. PELVIC TENDER IN LEFT ADNEXAL WITH ? MASS.

Family Practice Center
Department of Family Practice
College of Medicine
Medical University of S. C.
Charleston, S. C. 29401

ENCOUNTER FORM

Circle number for services scheduled   Check box when completed   Write in blank space any service, procedure or test not listed

TYPE OF SERVICE

	✓	
		—OFFICE VISITS—
01		Routine - Physician
02		Extended Routine - Physician
03		Afterhours - Physician
04		Routine - RN MSW PA MX
05		Follow-up - Physician
06		Follow-up - RN MSW PA MX
07		Obstetrical
08		Well Baby
09		Laboratory
10		
		—EVALUATION VISITS—
11		Comprehensive Initial
12		Comprehensive re-evaluation
		—HOME VISITS—
13		Routine - Physician
14		Routine - RN MSW PA MX
15		Follow-up - Physician
16		Follow-up - RN MSW PA MX
17		
		—INSTITUTION VISITS—
18		Hospital
19		Extended Care Facility
20		

RADIOLOGY

	✓		H	COST
21		Chest:		
22		Extremity:		
23				
24		GI Series:		
25		Cholecystogram		
26		Cystourethrogram		
27				
28				

PROCEDURES

	✓		COST
29		Audiogram	
30		Cervical Biopsy	
31		EKG	
32		EKG, Treadmill	
33		Endometrial Biopsy	
34		IUD Insertion	
35		Injection: Therapeutic	
		Prophylactic	
		Allergy	
36		Minor Surgery	
		cm. wound length	
		no. of sutures	
37		Pap Smear	
38		Sigmoidoscopy	
39		Tine Test	
40		Tonometry	
41		Vaginal Smear	
42		Visual Acuity	
43		Vitalometer	
44			
45			

DENTAL PROCEDURES

	✓		COST
46			
47			
48			

LABORATORY

	✓		H	COST
49		Albumin		
50		Alkaline Phosphatase		
51		Bilirubin - direct		
52		Bilirubin - indirect		
53		Bilirubin - total		

LAB continued

	✓		H	COST
54		Blood Sugar		
55		Blood Sugar, Fasting		
56		BOP		
57		BUN		
58		Calcium		
59		CBC		
60		Cholesterol		
61		Creatinine		
62		Electrolytes		
63		Globulin		
64		Glucose Tol. - 3 hr		
65		Glucose Tol. - 5 hr.		
66		G.C. Culture		
67		Group & Type		
68		Hematocrit		
69		Hemoglobin		
70		Iron Binding Cap.		
71		LDH		
72		Monospot		
73		Phosphorous		
74		Rubella Titer		
75		Sed. Rate		
76		Serum Iron		
77		Sickle Cell Prep		
78		SGOT		
79		SGPT		
80		T3-T4-T7		
81		Throat Culture		
82		Total Protein		
83		Triglycerides		
84		UCG		
85		Uric Acid		
86		Urinalysis		
87		Urine C & S		
88		VDRL		
89				
90				

✓	DISPOSITION	ADDITIONAL INSTRUCTIONS
	Next Appointment:	
	Refer/Consult:	
	Hosp. Adm.	

Signature: ______________________

PLEASE RETURN TO THE BUSINESS OFFICE

7. INTEGRATION OF FUNCTIONS

a. The computer operation is an integral part of the ambulatory health care delivery service.

Administratively and technically, the computer service is directed by Dr. Schneeweiss as **acting director of the computer project.**

The financial resources for its development have come from grants (**$429,000**), and the cost of its operation are paid by state and federal support (**$250,000 per year).**

The priority of new tasks for the system is determined by the medical director.

b. The automated medical record system supplements and supports the manual medical records. Its outputs are inserted into the paper system.

In case of inpatient stay, information from the paper system is taken into the automatic system through dictation. Data from community pharmacies and the university laboratories is also entered, as are some outside diagnostic reports.

The automated system contents is accessed by the medical records librarian when needed.

c. Other automated services used by the ambulatory health care delivery services such as billing and financial (accounts, ledger) could be replaced with this system. Patient history taking and scheduling may also be provided.

d. In summary, this computer system is best viewed as a development effort to provide a production service.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by administrative management are

aggregate services provided for activity analysis,

personnel statistics for educational feedback, and

load distribution on the residents (periodically)

On-line use by administrative management is for identification, and status determination (several per day).

b. Reports received regularly by clinical personnel (and their frequency):

Practice profiles (regularly)
Individual records (at each visit)
Data analyses (on request)
Patient identification for Grand Rounds presentation (on request)
Allergies, drug-drug interactions and drug overlap
(with each prescription filled)

On-line requests by clinical personnel are for individual records (occasional) and packaged data analysis (few physician researchers).

c. Special requests are made to data processing staff for research studies. There are about two such reports produced per day (656 last year), many of them for practice analysis purposes.

9. INFORMATION UTILIZATION

a. The system provides information for:

medical education,
clinical physicians (residents) and paramedical personnel,
quality of care review,
institutional management to distribute training opportunities,
administrative staff for billing.

The collected data base is also used by medical researchers.

The information is intended to assist in the delivery of primary care.

In order to make more intensive use of the system,

data entry has to be speeded up,
more data has to be collected and coded,
data has to be collected at more points (outside tests),
new reports are required,
more involvement by the providers will be important, and
success in the private practice could be a stimulant.

b. The group which currently depends on the outputs from the automated system are the;

medical educators,
clinical physicians, mainly indirectly through the printouts in the paper record,
administrative staff for some tasks only (routine billing), and
researchers.

If the system does not work for

10 seconds, it is not noticed; after
10 minutes, billing and data entry operations are held up; after
10 hours, manual backup procedures are instituted for billing.

Specific problems in such cases are an increase of the already difficult data entry backlog.

If changes in the system are required, a decision to implement them is made in 1 day to 1 month, and it typically takes another 1 day to 3 months to actually change the computer system.

Examples of changes made are

change of format of problem oriented files to chronological order (3 months),

develop basic billing system (3 months),

add a parameter to be collected (1 day).

10. EVALUATION OF EFFECT OF AMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the quality of care and maintain the access to care.

   This has been generally due to better management of patients, better quality of services, and increased services.

b. The change in the quality of care has been evaluated by the health care providers and administrators. A survey has been made to evaluate effects of drug followup by measuring patient compliance and response.

   Other measurements were obtained by subjective judgement, which include Drs. Curry and Schneeweiss.

   Measures used have been:

   examination of the medical record for appropriateness,
   assessment of quality of care and medical audit, and
   evaluation of training activities.

c. The results of the potential evaluations should be an information source for:

   health care providers,
   medical researchers,
   health care planners, and
   system designers.

11. ECONOMIC INFORMATION

a. The Charleston Family Practice Center is an operational component of two organizational entities; one is the Department of Family Practice, College of Medicine, Medical University of South Carolina, and the other is the Statewide Family Practice Residency System of the State of South Carolina. For the Department of Family Practice, the Charleston Center provides the clinical training facility for the department's Family Proactice Residency Training Program. For the statewide system, the center is one of the service facilities of a statewide network of family practice residency programs, serving community needs as well as training needs of medical training institutions.

The annual operating budget of the Department of Family Practice is about $1.6 million, and its source of operating funds is from state appropriations, student fees, patient service fees, grants, contracts, and gifts. The annual operating budget of the Statewide Family Practice Residency System is about $2.4 million, and its major source of operating funds is from state appropriations, with some outside grant support and service income. The Automated Medical Record System is administratively a component of the Office of the coordinator of the statewide system. The Charleston Family Practice is the largest of 5 sites served by the AAMRS. The Charleston center's annual operating budget is about $1.6 million and is funded from the following sources:

Medical University of South Carolina	20%
Statewide Family Practice Residency Program	40%
Federal Training Grant	15%
Fee-for-services	5-10%
Other (private foundations, and misc. grants)	15-20%

The cost of patient services, the fee structure, is determined by the Charleston Family Practice Center administration, and is based upon actual direct service costs, excluding all costs associated with the residency training program. Individual discounts up to 100% are applied by the physicians based on their personal assessment of the patient's ability to pay. Since the AAMRS is primarily a training tool, its costs are not considered in the development of the fee structure.

b. The AAMRS is a supplement to the medical record, but is intended to replace some of the record's content and format. The non-AAMRS part of the medical record is primarily handwritten, with some standardization to its organization. Unique patient identification numbers are used and the records are stored centrally within the Family Practice Center.

c. Cost Analysis: Development Costs

The development of the AAMRS began in 1970 and became operational in 1972 with the installation of MEDITECH. From fiscal year 1971-72 through fiscal year 1974-75 approximately $1 million has been spent for the AAMRS development and operations. These expenditures included the purchase of the computer and software. The major source of funds for the AAMRS was a federal grant for the AAMRS development (45%) and the Statewide Family Practice Residency System (49%). Other funds were provided by the Regional Medical Program (5%) and the College of Pharmacy (1%).

Cost Analysis: Operating Costs

The current direct operating costs for the AAMRS services and ongoing development is about $265,000 (with indirect costs about $324,000). The operating cost estimate includes amortization of purchased equipment and software and data entry personnel at Charleston. Currently about 78% ($208,000) of the toatl operating costs are for routine production activities, the remainder 12% ($57,000) is for ongoing development efforts. The AAMRS services are provided at no charge to the 5 user sites. Thus the only AAMRS related costs incurred by a user would be for supplemental data entry personnel and miscellaneous other incidental costs. At Charleston most of the data entry personnel are on the computer project staff which is supported by the Statewide System coordinator's office. Accordingly the direct costs incurred by the Charleston Center for AAMRS services is approximately $16,000 which is primarily for reception, billing, pharmacy and laboratory data entry activities. The Charleston site represents about 75% of the total AAMRS utilization. Accordingly, an allocated direct cost of the AAMRS for Charleston is about $203,000 ($248,700 with indirect costs added), of which 79% ($160,000) is for routine production activities and 21% ($43,000) is for developmental effort. The Statewide System's budget for AAMRS direct costs is about $200,000 per year (excluding equipment amortization, and non-project staff data entry personnel). The sources of funds for the Statewide system's support of the AAMRS is state appropriations about 50% and HEW training grant about 50%.

The primary fiscal decision makers with respect to the AAMRS budget are the director of the statewide program (who is also director of the Department of Family Practice), Dr. Curry, and the director of the AAMRS project, Dr. Schneeweiss. Since the computer is owned, there are no computer use charges from MEDITECH. MEDITECH software charges are incurred at rates set by the vendor but subject to negotiation. Since the AAMRS is primarily considered as a teaching tool, it is not expected that it will become self supporting through user charges. The AAMRS will continue to be supported as part of the residency program.

Cost Analysis: Investment Costs

The AAMRS is currently in use at 5 sites of which Charleston is the largest. It is expected that 2 more family practice residency programs will become active soon. The investment costs incurred by a new user of this system would be primarily related to manpower associated with implementation, training, and orientation. As long as the user is part of the statewide system, the AAMRS will be supported by the system's coordinator's office.

Note: The Statewide agency will fund computer AAMRS activities should grant support not come through.

d. Transferability

Factors that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

The heavy emphasis of using the system as a training tool has minimized service features and administrative benefits; thus this system may only be suitable for other training applications.

While residents are being trained with the AAMRS, a similar service may not be available to the physician in private practice.

The unique software may not be readily transferable, and the vendor proprietary rights will also influence transferability.

Slow response time.

The cost of establishing a similar system in private practice may be prohibitive to small practices.

The system to date is not complete.

But movement of personnel, i.e. Dr. Braunstein, and training of other MD's in information systems, e.e. Dr. Schneeweiss, will be positive force favoring transfer.

e. Benefit Analysis: Tangible Benefits

System Costs Savings: No saving with respect to the medical record process.

Health Manpower Savings: There are no estimated savings with respect to health service providers. The physicians record data for the medical record in the same manner as they would for a manual system. The display of the AAMRS record could result in time savings for record review, but it is not clear as to how much they are actually used. To the extent that there is some provider time savings, the time saved would be used for more time per patient.

Patient Cost Savings: Due to the structure of the fee schedule there will be no savings to charges made for patient services as a result of the AAMRS. There is a likelihood, however, that number of services ordered (e.g. diagnostic tests) may be reduced due to the availability of information in the patient's record.

Management Benefits (Secondary Cost Savings): There have been some minor savings in the billing process. Billing clerks are no longer needed; however, they have been replaced by data entry clerks. Since the usual collection rate from the center's patients is very poor, any savings resulting from improvements to the billing process in terms of speed or accuracy are minimal.

f. Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement
Direct Patient Care: Major Impact	++

Patient management is improved through the AAMRS providing information for diagnostic tests, problem identification and feedback to the physicians. Additionally, quality of care review has been implemented through peer review and self audit. The pharmacy program provides qualtiy of care control. The measures of change are primarily an assessment of direct computer usage and the case of finding data in the record. Additionally, measures are the notifications of prescriptions filled and drug interaction notices issued.

Access to Care:	0

Not a goal of the system.

Management Aspects of Health Care:	+

As indicated under tangible benefits, some savings have been realized in the billing process. Additionally information is being provided by utilization review.

Benefit Analysis: Societal Intangible Benefits

Technological Advancement in AAMRS:	0
Quality of Care Review Methodology:	+

Care review is now only oriented towards feedback as part of the training process. Interest to further develop this aspect of the system exists. The limited amount of data encoding inhibits this work. Good drug data are available though.

Training Acitvities:	++

Problem oriented record, residency training.

Health Planning:	0

12. COMMENTS

The system is primarily used and justified as a teaching tool for the residency program.

The system interfaces with medical eduation by giving detail practice profiles for audit and for assigning new patients.

There is a strong pharmacy component to the system since the program has an in-house pahrmacy which is used as a basis for pharmacists training.

Direct physician/resident acceptance and utilization are apparently low, which may be due to the fact that they realize that they won't have access to the system when they finish their training.

Contrary to what has been presented as an automated problem-oriented medical record system, this system as presently implemented falls somewhat short of this stated goal. To a large extent the computer system is used to automate the status quo (transcription of free text progress note) but despite its limitations, there are a number of good and useful features that are already being used for "peer review" and other educational purposes.

The automated system does not replace the paper record and there is no prospect that it will do this in the near future.

A 2-man private office also does general ledger, aged accounts receivable. However, this group is 2-3/4 months behind in getting progress notes transcribed and still has no Problem List output (although on computer). **It is reported that by May, 1975 this list has been brought up-to-date.**

They use 2 terminals plus 2 (1-1/2 FTE)clerks;1 to enter dictated notes and 1 to enter charges and checks, (Essentially have 2 systems). System doesn't prepare 3rd party bills for them; however, computer costs them nothing now since services are in exchanging for resident training.

The Greenville, S.C. Family Practice Residency has a direct line to computer with 1 terminal and 1 printer. Has 30 residents (3/4 of the size of Charleston), However, only 3 first year residents(15-20 patients per week total) are entering data. Have had problems - unable to retrieve record at times; claims it takes typist longer to enter into machine. Pharmacy program, lab programs and billing are not used. Aren't using it to do audit (essentially just stores progress notes). Director states if service and programs don't improve, will ask terminal to be removed.

Their concept of information system evaluation is embryonic, but they (Dr. Schuman) seem quite interested in pursuing this line of investigation.

There is some question as to whether this system could be exported because it runs to a large extent on the enthusiasm generated by Dr. Curry and the present project director of the project, Dr, Schneeweiss.

Since the system provides a useful service for the users through its capability for practice analysis, users which learn to value this are apt to make the system work.

The expected return of Dr. Mark Braunstein, the originator of the system will probably provide a new impetus to continued development of the system.

CDF

Regenstrief ~~Clinic~~ Institute

Indianapolis, Indiana

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDO-4
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
THE CARDIOVASCULAR CLINIC
OKLAHOMA CITY, OKLAHOMA

ON
FEBRUARY 26, 1975

We were received and introduced to the clinic and its system by David H. Wilson. David Wilson is a medical student who has developed the applications at the clinic. After Dr. Galen Robbins had finished seeing his patients, he joined us and described his objectives and plans for this system.

The data in this report is based on the information and documentation provided during the interviews.

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objectives for the system are principally:

Quality of care improvement in the area of chronic, acute, and emergency medicine through better communications among physicians in a group practice and better feedback.

Cost containment as achieved by increase of productivity of the physicians.

These objectives have come about in response to the need felt by the medical staff, primarily Dr. Robbins. The traditional medical record was considered inadequate for a group practice.

The system in use here is a partial replacement of a manual system.

b. The population which is to be served by the system is the general population in the state of Oklahoma. The population is special in terms of diseases presented (cardiovascular) and social category (primarily middle-upper class).

The ethnic distribution is predominantly Caucasian.

The service level is primarily secondary care.

The existing quality of this health care institution is judged relatively high and the quality of health care delivered to the same type of population served here elsewhere is also high in a consistent way as judged by Dr. Robbins and interviewers.

The average annual income of the institution's patient population is at the level of the upper half of the middle class. There are about 50% Medicare claims due to the age of the population, and 1 to 2% Medicaid.

The size of the population served by this system currently is 13,000 active cases per year; the potential population is their prorated share of the entire state (1,000,000), but limited by their ability to provide care. There are 43 board certified cardiologists in Oklahoma. Some of their patients come from outside the state.

The needs for this population are in the area of speciality (cardiovascular), diagnostic, and therapeutic care. Patient visits are primarily a result of appointments on doctor referral (95%). There are daily a few emergency drop-in visits to the clinic and some to the emergency room at the neighboring Baptist Hospital.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Quality of care in the areas of

patient management (i.e. data base acquisition, feedback to physician regarding achievement of desired outcomes in the hypertension clinic),

patient compliance with medical orders because of continuity of care,

quality of care review procedures, and

record accuracy;

Access to care by better information management and control of data flow through appointment scheduling and record availability; This objective comes through the desire of providing a good service for their patients.
Resource utilization in the area of health manpower productivity for medical personnel. Later developments have also improved productivity of clerical personnel and paramedical personnel.

Management aspects of health care are to improve practice management and operations of the clinic by the provision of management with information and analytical tools for practice analysis.

The later addition of billing functions was done to justify the cost of additions to the system through faster processing and increased accuracy in accounting procedures, billing, and claims processing.

b. The organization which has made the decision to provide automated record services is the entire group practice. Expansion of use will occur as user demands warrant and resources are available.

The institution is a speciality group practice in cardiology (7 members). The institution is organized as a private professional corporation.

The size of the practice is:

Number of patients is about 13,000 active over two years, and
about 3,000 new patients per year;
The number of patient visits per year is 20,000;
there are also about 30,000 visits to hospitalized patients;

Average time per patient visit is:

waiting time, less than half an hour,
service time, 1 to 3 hours for an initial visit,
15 to 20 minutes for a repeat visit.

The control over the medical content of the record system is provided by the individual physicians and the services available.

The technical operation of the system is in the hands of an in-house staff of 1 part time medical student and 1/3 time undergraduate student and under the supervision of the medical staff. During the development phase, David Wilson, the medical student, worked at the clinic on a full-time basis.

3. SERVICES PROVIDED

Data collection is done using forms with check circles and some text on all forms (impression, plans) to be entered as is, using CRT-keyboard entry. Text is used when there is no proper code or when an entry has to be further elaborated. Source data collection is by MD, and nursing staff for hypertension clinic.

Data entry of medical data is by medical record clerk. An encounter form takes about one minute to enter.

Data collection and data entry for scheduling is done by registration personnel, and billing data is collected and entered by accounting staff.

The data are transmitted by direct connection to the computer; there is one remote station using modems and dial-up lines.

The data are stored until superseded by later values, or for 2 years beyond the last visit. The free text is not kept after the encounter document is prepared.

The entered information is used to:

- make appointment schedules,
- prepare documents such as
  - bills,
  - third party bills,
  - medical record entries,
  - encounter documents, and
  - patient progress reports
- generate reports such as
  - patient summary,
  - disease profile,
  - treatment profile,
  - practice profile, and
  - financial status reports.

There is the capability to inquire into the files to determine patient's medical status, financial status, and appointments by diagnosis or problem and boolean combinations.

These services are provided at many points (14) within the clinic and currently at 1 hospital emergency room. (One more is to be added.) No other relevant services are provided by other systems or vendors.

4. TASKS REQUIRED TO CARRY OUT THE OBJECTIVES

a. Data Entry Tasks

Data entry is accomplished through CRT keyboard entry. Missing data elements are coded to a specific representation.

Verification of data entry is done by

output scanning on the CRT during entry,
data code validity checking,
data entry limit checking for lab data, and
verification of batch totals for financial data.

Most errors are found by data entry personnel (95%) and the remainder by health care delivery personnel (5%).

Error correction is done on-line. A correction by the physician is made through entry at the next visit. An audit trail of all errors is not maintained.

Data entry hardware has given few problems in the area of reliability. There has been about 1 terminal failure every 2 months.

Data entry software has given few problems in the area of reliability. The development of an adequate man-machine interface, including for the accounting users, has been emphasized and taken much of the effort.

b. Data Storage

File Updating:

Additional data entries are reflected in the files after a background run.

Changed data entries are reflected in the files after a background run. Accounting data update the file after the batch totals have been verified.

File Storage:

The data which are entered into the file are kept until replaced and moved to archival storage 24 months after the last visit, or 2 months after death. Values replaced are not kept on files. A paper record remains.

File Usage:

To get a current record from the file requires less than 10 seconds for retrieval and printing.
To determine whether a patient has a record in the file requires one or two seconds.

The search can be done by exact name or by unit number.

The file is also used directly to answer research questions.

File Size:

The required file space is now 29 million characters and can grow to 60 million characters, which should be adequate for 20,000 patients.

When a shortage of file space occurs, more files will be purchased.

The files are MUMPS globals: hierarchical, compressed, with variable length items dynamically allocated.

c. Data Analysis Procedures Used

For the analysis of the stored data, the following classes of routines are available:

Individual patient record by:

retrieval of last patient visit once per visit,
retrieval of abstract of patient record in emergency room and for correspondence or consultation,
generation of monthly billing statement and third party bills (about 4,000 per month),
generation of financial history of patient(on demand, about 100/month).

Selection of all patients with given

problem or diagnosis,
medication (other treatment data are planned), and
combinations of the above.

This selection is made on the basis of single visit records. Selection of patients due for a visit is done daily for each physician.

Tabulation of provided services by provider is done monthly.

Comparison of selected patient groups includes descriptive statistics (i.e. tables, up to 5-way crosstabs). Means and standard deviations are being added.

Scheduling procedures for patients are available and utilized.

Financial management is aided by programs which do

billing,
claims processing,
accounts receivable,
aged accounts receivable.

The ledger for accounts receivable is kept completely within the computer file.

d. Data Analysis Procedures, Source and Operation

The analysis routines were written initially by a vendor (Meditech). The current system is mainly written by David Wilson, a medical student working as a professional programmer.

The routines are specified by clinical personnel and Dave Wilson. Their operation is verified by clinical personnel through routine operational use, with backup capability.

The routines are kept on a general library file. The paper documentation is limited. Programs on files are extensively documented.

The principal progrmming language is MUMPS.

e. Protection of Data

Access to the data is restricted physically using closed areas and by passwords known to all users and to the systems staff for the entire data base.

Personnel which have access to the data in the computer are clerical personnel and individual MD's in an emergency, including emergency staff at Baptist hospital.

The protection provided is considered adequate and loosely utilized.

f. Training

New medical users of the system are given instruction and demonstration in order to learn how to use the system. The training period is a few minutes and after 1 month, they are fully proficient.

New clerical users of the system are given instruction and demonstration in order to operate the system. The training period is short and after a few days, they are fully proficient.

g. Presentation of Results

The means for producing output are hardcopy produced on printers and softcopy available on CRT used for scheduling and phone calls.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORDS

a. Introduction

The size of the patient identification record is variable up to about 150 characters.

There is no permanent visit record. The collated patient record is typically 700 characters.

Most of the information stored is medical in nature.

b. Patient Identificaion

This data is recorded and entered by the reception clerk.

I.D. number, unit number with check letter
Name, full
Address
Phone, home and business
Sex
Date of birth
Race (only for hypertension clinic)
Date when this information was collected (first visit)

c. Financial and Economic Information

Total bills: outstanding, aged, year-to-date
This visit: line itemized, providers, amount
Billing detail retained: date, diagnosis, provider, line itemized, amount, discount, date paid
Guarantor: address
Insurance carriers: company name, plan, type, code
Automatic generation of complete third party bill,

d. Data Base: History of Present Illness

An automated branching history at the initial visit presents prose to the physician. He may indicate certain positives as problems to be put in the permanent record. The actual data collected are not kept in the computer. Chief complaint is typically entered.

e. Data Base: Past Medical History

This is also obtained automatically for the physician.

Past diseases: problem list is kept if significant with date, diagnosis, and remarks;

Past hospitalizations: type of operation or illness are kept as problem if significant with date and remarks;

Allergies: medicine names if positive stored as problem;

Current medications: name, code, quantity, frequency;

f. Data Base: Social History is not stored.

g. Data Base: Review of Systems is obtained but not stored.

h. Data Base: Physical Examination

Retention: last value only except in hypertension clinic
Date (not printed)
Height
Weight
Risk factors (smoking)
Vital signs

i. Data Base: Objective Findings of Past Medical History

Retention: last encounter only;

Routine laboratory orders, battery or specific, findings;
Chemistry and hemotology findings are retrieved serially for one year;
Special laboratory orders, findings;

X-rays (chest only), orders, report, conclusion;

EKG's, other cardiac tests (stress), findings;

Pulmonary function tests, findings.

Laboratory findings for patients on the hypertension protocol are stored permanently.

j. Problem List
Problem lists are retained permanently.

Active problems (up to 99): date of entry, problem name, or diagnosis name, and code if possible but the original wording is retained to avoid loss of fine shadings of meaning; (own mnemonic codes now 204 oriented towards cardiology; if a problem cannot be coded (5%) it is entered only as a remark.), and remarks.

Inactive problems are not distinguished except through remarks,

Problems may be deleted.

k. Plans: Diagnostic Orders

Free form entry, but not kept. Return visit is used by rec eption clerk as input to scheduling program.

l. Plans: Therapeutic Orders

Medications: quantity, frequency; **they are retained as long as valid.**

Diet is handled as medication,

Others may be entered as free text but are not kept,

m. Follow-up

Latest values only are stored.

Routine laboratory findings
Special laboratory findings
X-ray reports, conclusions
EKG's, other cardiac tests, as stress test with findings
Pulmonary function tests, findings
Chemistry and hemotology findings are retained for one year
Findings for patients on the hypertension protocols are stored permanently

n. Progress Notes

Only notes from the last visit are kept.

Encounter forms (acute, chronic): coded as appropriate for cardiovascular diseases.

Physician is identified.

o. Patient Services Management

Schedules for patient visits; the daily schedule is printed the prior night and then used directly.

Visit reminders for patient.

Chart review schedules for patients on hypertension protocol.

Medication schedules for patient in hypertension clinic.

Patient compliance in hypertension clinic.

p. Practice Information

First contact with this practice or agency.

Providers at encounter is determined by type of visit.

Encounter frequency (total/week).

Use of other facilities, hospital

q. Research Oriented Data

None of the data categories listed above are collected primarily for research purposes.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through 1 DEC PDP 15/20, having 32 K memory, installed in January, 1971.

The computing services are provided in-house.

The equipment is purchased including the software license. Maintenance is by vendor and costs $800/month

Approximately 100% of the processing capability is used for the ambulatory medical record application. Approximately 98% of the file capability is used for the ambulatory medical record application. This includes the accounting applications.

The files are stored on 2 disks DEC RPO2 (2314 type) (30M chars/disk).

Archival storage is on DEC tapes, backup disk-packs and paper.

Retrieval response time is a few seconds or less.

Hardcopy terminals are:

1 GE Terminet, 80 character/line, upper case, 120 char/sec impact with good reliability;

1 PRINTEC 100, same specs, has not been adequately reliable and is now used for low volume and backup;

2 Teletypes, 80 char/line, upper case, 10 char/sec impact, used in the remote location and in the laboratory.

Softcopy terminals are:

10 Infoton, 24 x 80 or 16 x 63 screen, upper case, 1200 baud;

2 ADDS, 16 x 63, upper case, 1200 baud which are used by accounting due to the separate numeric keyboard. They have been very reliable.

b. The system uses for its processing:

timesharing,
transaction processing, and
a background operation for printing (spooling).

Currently production occupies most of the machine, and development 5 %. Of the production load,

most is data entry,
20 min./night is file maintenance, and
3 hrs./night is data analysis and report preparation.

At the end of the month additional time is used.

c. The operating system (MIIS) was designed and written for general medical purposes. It is ignored by the local staff, and further maintained by the original supplier (Meditech).

The file system is MUMPS characterized by hierarchical files. The implementation of the AAMRS requires 2 main and 30 auxiliary files.

d. When there is a computer failure, the computer is restarted as fast as possible. It is possible to run with one of the two disks.

A noticeable (to the user) failure happens about 4 times/year, (1 major: 6 hours, 3 minor: 1 hour) and that number has been steady.

When there is a heavy usage of the ambulatory medical record system, there will a barely noticeable slowdown.

e. The data processing staff consists of;

1 systems analyst and programmer (Dave Wilson), now part-time
1/2 operator
3 data entry clerks (1 medical record, 2 financial)

The data processing staff reports to the medical staff of the institution.

The response to request for changes in system output is often long due to limited manpower. Urgent tasks can be done in a few days.

f. The costs of the computer operation are fixed and budgeted. The investment in the system is about \$190,000 , and the operational cost is about \$_____/_____.

g. The ambulatory record system is intended only for this institution. Meditech uses a version of the system for demonstration of the capabilities of the MIIS system. The Cardiovascular Clinic has also cooperated with Meditech in demonstrating the applications.

6. THE FORMAT OF THE MEDICAL RECORD

The physician at the encounter with the patient has available to him a paper chart, which contains on the leftside material unsuitable for computerization(EKG's, referrals, etc. and a demographic form).

On the right side are printouts of clinic and hospital encounter forms, typically one page each. They contain as heading the collected free text, a printout of the coded findings from the last visit, a problem list collated from all previous diagnoses and procedures (with dates and remarks if any were entered), and a list of medications, and diagnostic findings.

When the paper chart is not available, a summary of the patient record, including all the most recent findings, can be produced. This is done at the hospital emergency room and on CRT's for telephone inquiries,

The clinic does not use the record system on-line for patient visits. The paper record is kept on-site in the clinic and pulled prior to the patient visit based on the appointment schedule for the day, Records can be made available in a few minutes.

Continuity of care is maintained except for emergencies.

Attached are an example of an encounter form and the resulting encounter report for the medical record.

CARDIOVASCULAR CLINIC ENCOUNTER #21

NOOO.. ROBBINS

NONAME, JOHN
123 NW 45
TEST CITY, OKLA 73000

11:30 O/CM DEC 27, 1974

WEIGHT(LB)	(001)	: 180
HEIGHT(IN)	(002)	: 72
BODY BUILD	(003) 1~~2~~3:	
PULSE	004	:
BP(LYING)	005L	:
	(005R)	: 190/120
BP(SIT)	(006L)	: 180/124
	(006R)	: 184/126
BP(STAND)	007L	:
	(007R)	: 166/130
TEMP	008	:

EYES-N	010	:SAME
GRADE	(011) LR~~B~~ 1~~2~~34 :	
CATARACT	012 LRB:	
OTHER	(*019)	
HENT-N	(020)	:SAME
EDENTU	021 ULB:	
OTHER	*029	
THYROID-N	(030)	:SAME
ENLARGED	031	:
NODULE	032 LRB:	
OTHER	*039	
NECK-N	040	:SAME
BRUIT	(041) ~~L~~RB: Faint	
VEINS	042 LRB:	
OTHER	*049	
BREASTS-N	050	:SAME
FIBRO	051 LRB:	
NODULE	052 LRB:	
OTHER	*059	
CHEST-N	(060)	:SAME
RALES	061 LRB:	
RHONCHI	062 LRB:	
DIM-BS	063 LRB:	
WHEEZE	064 LRB:	
DULLNESS	065 LRB:	
TENDER	066 LRB:	
OTHER	*069	

HEART-N	070	:SAME
ENLARGED	071	:
LIFT	(072) ~~L~~RB:	
EJECT CL	073 EML:	
OPEN SNAP	074	:
S1	075 ID	:
S2	076 ID	:
S3	(077) ID	: Gallop
S4	(078) ID	:
MURMURS		
SYS-APEX	091 EMLH 123456 :	
SYS-AORT	092 EMLH 123456 :	
SYS-PUL	093 EMLH 123456 :	
SYS-TRI	094 EMLH 123456 :	
DIA-APEX	095 EML 1234 :	
DIA-AORT	096 EML 1234 :	
DIA-PUL	097 EML 1234 :	
DIA-TRI	098 EML 1234 :	
OTHER	*099	
ABDOMEN-N	110	:SAME
AOR-BRU	(111)	:
FLANK-BRU	112 LRB:	
LIVER-ENL	113	:
TENDER	114 ABCDEF:	
OBESE	115	:
MASS	116 ABCDEF:	
HERNIA	(117) L~~R~~B: Small	
SCAR	(118) ABC~~D~~EF:	
OTHER	*119	
REC/GEN-N	(130)	:SAME
HEMOR	131	:
OTHER	*139	
PROSTATE-N	140	:SAME
ENL-SM	(141)	: Slightly
ENL-IRR	142	:
SOFT-BOG	143	:
NODULE	144	:
TENDER	145	:
OTHER	*149	
PELVIC-N	150	
DOCTOR	151	:
DATE	152	:
OTHER	*159	

BACK-N	160	:SAME
OTHER	*169	
LEGS-N	170	:SAME
EDEMA	171 LRB 1234 :	
FEM-PULSE	172 LRB 1234 :	
POP-PULSE	173 LRB 1234 :	
DOR-PULSE	(174) L~~R~~B ~~1~~234 :	
TIB-PULSE	(175) L~~R~~B ~~1~~234 :	
THROMBO	176 LRB :	
VARICOSE	177 LRB :	
FEM-BRU	(178) LR~~B~~ :	
OTHER	*179	
ARMS-N	(190)	:SAME
EDEMA	191 LRB 1234 :	
BRA-PULSE	192 LRB 1234 :	
RAD-PULSE	193 LRB 1234 :	
ULN-PULSE	194 LRB 1234 :	
OTHER	*199	
NEURO-N	200	:SAME
PARKINSON	201	:
PARALYSIS	202 LRB:	
OTHER	*209	
X-RAY-N	500	:SAME
CARD-ENL	501	:
RV-ENL	502	:
LA-ENL	503	:
LV-ENL	(504)	: Minimal
AO-DIL	505	:
CORARC	506	:
PA-DIL	507	:
LUNGS		
CONGEST	511 LRB:	
EFFUSION	512 LRB:	
FIBROSIS	513 LRB:	
NODULE	514 LRB:	
OTHER	*519	
TREAD-N	520	
LEVEL	521 123456789:	
ANGINA	522	:
ST-ABN	523	:
HR-MAX	524	:
BP-MAX	525	:
OTHER	*529	
PUL/FUNC-N	530	
VC-OBS	531	:
VC-PRED	532	:
BC-OBS	533	:
BC-PRED	534	:
1-VC	535	:
2-VC	536	:
3-VC	537	:
OTHER	*539	

019: Bilateral XANthelasMA
174 L2
175 L2

EKG ANALYSIS

NORMAL SAME | V-RATE: 94 | A-RATE: 94 | PM-RATE: ______ | AXIS: ______
PR: 0.13 | QRS: 0.09 | QT: 0.40 | NC: ______

RHYTHM	SR PVC	ST PJC	SB PACE-DM	JR PACE-FX	AFL	AFB	VT	PAT	PAC
AV NODE	AVB-1 TFB	AVB-2 WPW	AVG-2/1 LGL	AVB-3 MAHAIM	RBBB MOB-I	RBBB-I MOB-II	LBBB	LAHB	LPHB
HYPERTR.	LVH	RVH	CVH	LAE	RAE				
REPOLAR.	STT-DIG	STT-NS	STT-LI	STT-AI	STT-II				
INFACT.	ASMI LMI	ASMI-A LMI-A	ASMI-O LMI-O	ALMI SEMI	ALMI-A SEMI-A	ALMI-O SEMI-O	ISMI	ISMI-A	ISMI-O

FREE TEXT FTA: ______
FTB: ______

PLAN

OC CM WK: ___ MN: ___ LAB: ______
FTA: BMH for Acute M.I.

RISK FACTORS		INFARCTION 1-39	40-50	51-	CVA	HYP	HD	DM	CAB	CAC	MAL	AGES EXP	ALIVE
MOTHER	01				/	/							
FATHER	02			/								63	
BROTHERS	03			/				/				78	
SISTERS	04												3
OTHER	05												

SMOKER	11	CIG	QUIT	OTHER	NONE	WORK	15	SED	NORM	LABOR
PERSON	12:	I	II	III	IV	EXERC.PG	16	NONE	MOD	VIG
MARITAL	13	S	M	W	D	HOME	17	ALONE		N-A
ECON.	14	W	L	M	H	DISABLE	18	R ABC~~D~~ Z		123~~4~~

PROBLEMS: UGI (Duodenal ulcer 1968) DRUG (Penicillin)
HCL Hyp
EPD
MI (acute)

MEDICATIONS: ______

PRESENT ILLNESS: Acute onset of substernal burning pain 2 hours ago with radiation to left arm and associated nausea, vomiting and sweating. Definite history of anaphylaxis after Penicillin injection 3 years ago.

CARDIOVASCULAR CLINIC ENCOUNTER FORM

N00000 NONAME, JOHN O/CM DR.ROBBINS DEC 27, 1974

PRESENT ILLNESS: ACUTE ONSET OF SUBSTERNAL BURNING PAIN 2 HOURS AGO WITH RADIATION TO LEFT ARM AND ASSOCIATED NAUSEA, VOMITING, AND SWEATING. DEFINITE HISTORY OF ANAPHYLAXIS AFTER PENICILLIN INJECTION 3 YEARS AGO. PRIOR HISTORY OF HYPERTENSION.

WEIGHT: 180 LB. HEIGHT: 72 IN. BODY BUILD: MEDIUM
BLOOD PRESSURE(LYING): RIGHT ARM: 190/120
BLOOD PRESSURE(SITTING): LEFT ARM: 180/124 RIGHT ARM: 184/126
BLOOD PRESSURE(STANDING): RIGHT ARM: 160/130

EYES:	GRADE 2 BILATERAL FUNDI. BILATERAL XANTHELASMAS
THYROID:	NO THYROMEGALY.
NECK:	FAINT LEFT CAROTID BRUIT.
LUNGS AND CHEST:	NORMAL TO PERCUSSION AND AUSCULTATION.
CARDIAC EXAM:	LEFT VENTRICULAR LIFT. GALLOP S3. S4.
ABDOMEN:	AORTIC BRUIT. SMALL RIGHT INGUINAL HERNIA. RLQ ABDOMINAL SCAR.
RECTUM/GENITALIA:	NORMAL.
PROSTATE:	SLIGHTLY SMOOTH, ENLARGED PROSTATE.
LEGS:	MODERATELY DECREASED LEFT DORSALIS PULSE. NORMAL RIGHT DORSALIS PULSE. MODERATELY DECREASED LEFT TIBIAL PULSE. NORMAL RIGHT TIBIAL PULSE. BILATERAL FEMORAL BRUIT.
ARMS:	NORMAL.

CHEST X-RAY: MINIMAL LEFT VENTRICULAR ENLARGEMENT.

EKG: V-RATE: 94 A-RATE: 94 PR: .13 QRS: .09 QT: .40 ACUTE INFEROSEPTAL INFARCTION.

LAB: GLUCOSE: 130 MG%, URIC ACID: 5 MG%, UREA NITROGEN: 15 MG%, SODIUM: 150 MEQ/L, POTASSIUM: 3.9 MEQ/L, TRIGLYCERIDES: 160 MG%, CHOLESTEROL: 414 MG%, HGB: 16.1 G%, HCT: 49 %, SED RATE: 5 MM/HR, WBC: 10500 /CMM,

PLAN: BAPTIST HOSPITAL FOR ACUTE MI

PROBLEMS

DUODENAL ULCER - 1963 (UGI)	12/27/74	
HYPERCHOLESTEROLEMIA	12/27/74	
FEMORAL POPLITEAL DISEASE	12/27/74	
MYOCARDIAL INFARCTION	12/27/74	ACUTE
DRUG ALLERGY	12/27/74	PENICILLIN
HYPERTENSION	12/27/74	

MEDICATIONS

(CONTINUED)

HISTORICAL RISK FACTORS

	EXP	ALIVE	HYP	CVA	INFARCTION <39	INFARCTION 40-50	INFARCTION >50	HD	DM	CAB	CAC	MAL
MOTHER	63		1	1								
FATHER	73						1		1			
BROTHER(S)		3					1					
SISTER(S)												

MARITAL STATUS: MARRIED
WORK TYPE: SEDENTARY
HOME: LIVES WITH OTHERS

SOCIO-ECON. TYPE: MIDDLE
EXERCISE PROGRAM: NONE
DISABILITY RATING: 40

LAST DATA BASE UPDATE: DEC 27, 1974
(YEA)

7. INTEGRATION OF FUNCTIONS

a. The computer operation is an integral part of the ambulatory health care delivery service. Administratively the computer service is directed by the physicians. Technically the computer service is directed by a medical student,

The financial resources for its development have come from practice revenue and the cost of its operation are paid by practice revenue.

The priority of new tasks for the system is determined by the 7 man physician group.

b. The automated medical record system replaces partially the manual medical records. Its outputs are inserted into the paper system. Information from the paper system is taken into the computerized system in case of inpatient stay and laboratory data (lab is in-house).

c. Other automated services, used by the ambulatory health care delivery services, are patient history taking (not kept on file), and Bleich's electrolyte program. Laboratory assistance programs are now available. There are no current plans to add other services, but development of the medical record and its use will continue. Payroll services will continue to be purchased from the outside.

d. In summary, this computer system is now best viewed as a production service.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by administrative management are aggregate billings and aggregate services provided. On-line use by administrative management is for patient accounting and scheduling.

b. Reports received regularly by clinical personnel are practice profile, individual records, and data analyses. On-line requests by clinical personnel are for individual records and hypertension protocols.

c. Special requests are made to data processing staff for research studies. This happens about a few times per year.

9. INFORMATION UTILIZATION

a. The system provides information for

clinical physicians,
paramedical personnel,
administrative staff,
institutional management,

and to a limited extent for

quality of care review.

The information is intended to assist in the delivery of

chronic disease maintenance,
acute care,
preventive care, and
emergency care.

In order to make more intensive use of the system, more data have to be collected and more software is required. More involvement of the other physicians in the practice would be desirable;

b. The group which currently depends on the outputs from the automated system are the clinical physicians, the paramedical personnel, and the administrative staff.

If the system does not work for 10 seconds, it is noticed. If it cannot be restarted, possibly with only one disk, in 10 minutes, operations are held up, and manual backup procedunes are instituted. Specific problems in that case are that scheduling has to be done by estimate, telephone inquiries cannot be handled as well, and a backlog accumulates.

If changes in the system are required, then a decision to implement them is made in 1 day, but design and implementaion will take 1 week or longer due to limited manpower.

10. EVALUATION OF EFFECT OF AMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to:

increase the quality of care,
increase the access to care, and
decrease the cost of health care delivery.

This has been generally due to:

increased services rendered,

but also due to:

better quality of services,
better utilization of resources,
advances in technology (automated history), and
fewer errors.

b. The change in the quality of care has been evaluated through measurement of factors relating to the patients in the hypertension protocol by measuring the extent of control of the blood pressure. The quality was also evaluated subjectively by the provider through examination of the medical record for accuracy and completeness.

The change in the access to care has been evaluated through measurement of factors relating to the patient and health care providers. These measurements were obtained by subjective judgement. Measures used have been availability of medical record. Improved patient access to the facility has not been an objective nor an outcome of the AAMRS.
The cost factors affecting health care delivery have been evaluated through measurement of factors relating to the health care providers and administrators. These measurements were obtained by subjective judgement and timing, and confirmed by a reduction in clerical staff.

Measures used have been evaluation of health manpower utilization of physician time taken for medical record review, retrieval, and update of the medical record per patient visit, and measurement of clerical staff cost for scheduling of patient visits.

Evaluation of management aspects of health care delivery include costs of patient care (only one fee increase) and number of visits to the clinic (doubled). **There is no indication that the AAMRS is making a direct contribution.**

Availability of information for facility operations has provided better

financial management (speed and accuracy),

cost reduction due to avoidance of outside services while operating with reduced clerical personnel, and

dramatic improvement in handling insurance forms.

The amount of accounts receivable outstanding is now considered lower relative to the increased volume of the practice.

c. The results of the evaluations are an information source for health care providers and medical economists.

11. ECONOMIC INFORMATION

a. At this site the AAMRS developer and user is the same organization.

The Cardiovascular Clinic is a private group practice organized as a professional corporation. The group consists of 7 physicians, and they employ about 20 employees to support all of the clinic's medical and administrative activities. The group owns their own building which was designed and built to meet their specifications, and it is located in an area containing several medical facilities. Specific information concerning the group's operating costs was considered proprietary, and thus was not discussed. In general, it was stated that the physician's income can be considered comparable to the top 5% of U.S. physicians. The total source of operating income is from fee-for-service charges, which includes Medicare and Medicaid reimbursements as well as other third party insurers.

The primary decision makers for the clinic's budget are the 7 physicians acting as a group.

While the AAMRS may not have had a direct affect upon the fee schedule, the use of the AAMRS for third party claims has improved the collection rate. The charges for patient's services are determined by the individual members of the group. In general, patient fees are considered to be lower than the local average. The underlying philosophy in the fee structure is to serve a large segment of the population, so the fees are not set high in order to serve a large volume of patients. The groups current collection rate is about 95%.

b. The patient's medical record before the implementation of the AAMRS was primarily handwritten on 4x5 foldover cards and stored in two offices used by the group. the patient records were filed alphabetically according to their last name, and patient billing used an ID number. The patient record format was considered to be a disorganized collection of information, which was a primary motivating factor in the development of the AAMRS.

c. Cost Analysis: Development Costs

The development of the AAMRS began in 1970 and the first phase, the automated patient interview, medical record and assisted laboratory calculations became operational in 1971. **The costs to obtain and install the system are estimated at $230,000 which includes equipment and software acquisition and full time support of a systems programmer.** The source of funds for the system development was entirely from the group practice income.

Cost Analysis: Operating Costs

The ongoing direct operating costs for the AAMRS is about $93,000 per year ($107,000 with indirect), which includes equipment amortization and an allocation of business office, reception, and medical records personnel for data entry. About 20% of the operating costs support further development efforts, and the remainder is for routine services. The AAMRS operating costs are totally supported by the clinic's income. The primary fiscal decision makers with respect to the AAMRS costs are the group physicians, under a strong **persuasive** influence of Dr. Robbins.

Excluding the amortization of purchased equipment, the AAMRS annual costs are substantially less than savings realized as a result of the AAMRS in personnel and billing services. Depending upon the amount of costs allocated to the AAMRS, it is estimated that the total system costs, purchased equipment and ongoing operating costs will be cost justified in 5 to 8 years from the date of equipment acquisition. It should be noted that the decision to develop the AAMRS at the clinic was not based upon projected cost savings. The decision was essentially based upon the group's judgement that the benefits of a better organized and automated record were worth the investment in the system. significant cost savings were not realized until the billing and appointment functions were added to the system after the AAMRS had been operational for about a year.

Cost Analysis: Investment Costs

The effort involved with the application of the AAMRS at another location would be nearly the same as the initial development at the clinic. The effort involved is primarily the acquisition of suitable computer equipment and a systems analyst programmer to adapt the system to the specific needs of the new site. The costs associated with the application of the AAMRS at another location may be less than the original development costs due to decreases in equipment costs.

d. Transferability

Factors that may affect the transferability of the AAMRS to other settings or the attainment of provider objectives are:

The nature of the developer/user organization is a positive factor which has contributed toward the attainment of provider objectives. The clinic is a well organized and managed group practice, with a sense of value for information management, particularly with respect to the management of information in the medical record.

The transferability of the AAMRS would be facilitated if the organization to which the system is transferred has similar organizational characteristics as the Cardiovascular Clinic.

There are no significant technical constraints with respect to the transferability of the AAMRS. However, it should be noted that the purchased computer is somewhat outdated, which may have some affect upon transferability.

e. Benefit Analysis: Tangible Benefits

System Cost Savings: Savings have been realized in that some costs associated with the manual medical record are no longer being incurred. This is due to equipment substitution for labor. The medical records staff has been reduced by one clerk. Including indirect costs this is a savings of about $10,000 per year. Other personnel savings are cited in following sections.

Health Manpower Savings: The Automated Patient Interview (medical history and system review) has resulted in significant time savings for the group physicians in that they no longer have to use their time to get the information from the patient. The physicians have used these savings to see more patients. It is the opinion of the physicians that the AAMRS has facilitated an increase in productivity in the group practice. The amount of this benefit has not been quantified.

The appointment scheduling system permits each physician to manage his own time in that the appointment schedules are tailored to the needs of the individual physician with respect to hours and appointment time slots and the schedules can be easily revised to meet changing demands upon the physician's time.

Clerical personnel associated with appointments and registration can perform their work faster, and their work has been simplified. Additionally, the reception staff has been decreased by one person as a result of the AAMRS. A savings of about $10,000 per year (including indirect costs).

Patient Cost Savings: The AAMRS has had no direct affect upon the cost to the patient for services received. Some savings in waiting time may be realized by the patient as a result of the appointment system.

Management Benefits: Specific savings have been realized in the reduction of personnel and for billing services. Placing patient billing on the AAMRS resulted in the decrease of 3 clerical personnel as well as the elimination of an outside billing service. Total estimated cost savings is about $50,400 (includes indirect costs). In addition to these cost savings, benefits have been realized in the billing and insurance claims processes due to increased speed and accuracy resulting in faster collections.

e. Benefit Analysis: Provider Intangible Benefits

	Estimate of Benefit Achievement
Quality of Health Care:	++

Patient management has been improved in that treatment planning and problem identification has been facilitated through the AAMRS medical list, problem lists, encounter entries, and the hypertension clinic. Additionally, patient compliance has improved in response to treatment in the hypertension clinic. Measures of change are:

increased information in the medical record (a more complete data base resulting from the automated patient interview),

ease of finding data,

ease of use of information in the record,

the length of treatment period in the hypertension clinic, and

the ability to transfer medical patient information among providers.

Access to Health Care:	0

Not a specific system objective.

Management Aspects of Health Care:	++

Fiscal procedures and financial management, the system provides better data of clinic management.

Benefit Analysis: Societal Intangible Benefits

	Estimate of Benefit Achievement
Technological Advancement in AAMRS	+
Demonstrated acceptance by a group practice, and use of the teletype in the emergency room.	
Quality of Care Review Methodology:	++
Protocol update in the hypertension clinic; also the use of controls and surveillance.	
Research Activities:	+
Health services research with respect to the hypertension clinic.	
Training Activities:	0
Health Planning (Regional and national):	0

Additional benefits (tangible and intangible in all areas) will be realized as services are expanded.

12. COMMENTS

This is a well organized and managed group practice.

Operational system actually used by the physicians of their own free will with some agreement as to tangible values.

System is integral part of practice and taken for granted now. There is still lots to do.

This system is "for real". It was operating unattended during our visit providing a multitude of on-line services;

- data entry from encounter documents
- billing data,
- history taking,
- hypertension (assistance in management),
- lab calculations,
- appointments,
- preparation of patient encounter documents on printer

The flexibility of the Medical Data Systems (Cleveland) approach is missing for free text storage, but this is an intentional trade-off involving well thought out data capturing documents, viz. the PE form.

A very good system. Cost is low and economic and medical areas excellently integrated. Patient has an easy interface with computer. I feel this is ideal setup for success.

Success factors for AAMRS:

MD initated idea, and participated in development of system, Essential system conceptualized by MD and carried out by technician (in contrast to conceptual development done by technical/computer personnel first, then reacted to by MD).

Financially viable - Fiscal decison makers decided it was worth investment to manage information flow in clinic, Direct cost reduction came later, but is an important factor in keeping the system there.

Technical resources were minimal, but very effectively utilized through the use of available technology,

Good approach to system development. given limited resources (one technical person). Make small goals and evaluate as they are met,

I disagree with Mark Perlman's comment (memo of Nov. 4, 1974 to Director, BHSR). They probably have benefitted from isolation from medical computing field,although I think that MUMPS will limit the kinds of on-line searches that the system will provide, Fortunately, the care provider is completely oblivious of the slow response of the MUMPS driven system, **Dr. Robbins considers the availability of MUMPS an economic advantage.** Free enterprise also thrives in Oklahoma City.

Medical information is brief enough to offer limited information, but sufficient for most purposes.

A unique feature is the terminal in the emergency room of the main referral hospital,

The acceptance of the scheduling for the 7 physicians shows also the importance of designs which are flexible. Each of the physicians has his own matrix giving the service patterns which he prefers,

Although full financial details are not available, we learned that capitalization of hardware was balanced by reduction of

. Dr. Robbins estimates that each $500/month of personnel is equivalent to %50,000 capitalization over 5 years.

There has been no formal evaluation

based on private resources.

This would be an excellent place to conduct health services research which would evaluate impact of AAMRS on qualtiy of patient care (outcomes). Dr. Robbins claims that they are achieving control of blood pressure in hypertensions by the 4th revisit for this problem in 70% of the cases.

CDA

Casa de Amigos

Houston Texas

Benefit Analysis: Societal Intangible Benefits

	Estimate of Benefit Achievement
Technological Advancement in AAMRS: Routine operation has been achieved with minimal technical involvement by the users.	++
Quality of Care Review Methodology: Evaluations have been made earlier and data exist to continue this work.	+
Research Activities: They have documented a number of care protocols. Their operation has been described in publications and frequently visited.	++
Training Activities: The care protocols contribute to physician training. Plans exist to extend this to patients having chronic diseases such as diabetes.	+
Health Planning: The data available have not been widely used.	+

Expected changes in benefit realization. All benefits will disappear should the Navy decide to discontinue the AAMRS activity at Brunswick. Additional benefits would require a reinstatement of strong project leadership and Navy support for addition system features and improvements. A broader realization of current benefits could be realized by expansion of the system to other locations.

12. COMMENTS

In general, a sound system which comes close to totally replacing the paper record. However, definite flaws exist which jeopardize greater application.

1) Response time for physician-computer interaction can be distressingly slow, evidenced by 10-15 second waits for entry of lab tests. This is considered to be quicker though than handwriting laboratory orders.
2) Abstract of history seems somewhat cursory and much information some physicians would want at each visit is not available, i.e., current medications, latest lab results. What is perhaps more frustrating is lack of ease in adding these to abstract. The lack of these features are due to lack of current development direction and lack of need felt.
3) Free form entry makes looking back at data cumbersome.

In spite of all these problem areas, a physician visitor liked this system and feels it could be sufficiently modified to gain acceptance.

The providers interviewed felt that the system caused better care to be provided to dependents than to active duty personnel at Brunswick.

This health care facility is an interesting example of bottom-up development within the military, in contrast with top-down development at the Indian Health Service.

A great number of regular reports are prepared by the system. Their effect on the health care delivered, however, is minimized due to a number of factors:

1) The management of the clinic does not see the computer as a tool to improve health care delivery.

2) The reports are poorly formatted and do not allow convenient scanning for anomalies.

3) The reports do not present the monthly data in comparison with standards or yearly averages.

4) The routine reports go down to a level of detail which could be of interest only if an exceptional value is selected at a higher level. The number of patients in many cells of the statistical output is less than ten.

Many of these weaknesses could be resolved by an effective interaction between NAS dispensary management and Meditech.

The saving grace of an application which uses the computer as a typewriter is that the data are available on-line to the provider. Lack of structured input (except for SOAP headings) will make selective retrieval of information costly if not impossible.

There is a nice trade-off of direct MD input for ordering lab tests vs. having him fill out forms. The same gain can be expected with the new pharmacy module; but waiting time for entry is excessive.

The provider interviewed felt that he could dispense with the paper record entirely for most acute visits.

The extent to which the acceptance of the system is affected by the military environment is hard to determine. Dr. Morrison, the original developer, later obtained similar services in his private office through a project sponsored by the NCHSRD of HEW, but discontinued the use when this project was no longer funded.

The system is still operating even after the original developers have left the Navy and with the Navy providing only operational funds. This is an accomplishment in itself.

Only one of previous evaluation documents commissioned by the Navy were available at the time of the visit.

P.S. We were informed just prior to the end of our study that the Navy has made a decision to discontinue this system in favor of the TRIMIS services to be developed. It is ashame that there is so little transfer of the experience here and that there will be a discontinuity of services there at Brunswick.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDN-2
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
ON
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
PEDIATRIC DEPARTMENT
BELLEVUE HOSPITAL
NEW YORK CITY HEALTH AND HOSPITALS CORPORATION
NEW YORK CITY

ON
APRIL 1, 1975

We were received by Dr. Margaret Lyman, Director of the Health Information system and Associate Professor of Clinical Pediatrics, New York University School of Medicine, 550 First Avenue, New York City. Dr. Lyman has been for many years the director of the pediatric clinic itself and the major supporter of the AAMRS. We also were able to spend time with Dr. Leo Tick, Technical Director, Health Information System. He spends a large fraction of his time at Bellevue. The medical members of our team had the opportunity to observe the physicians during their regular clinic schedule. We spent more thant six and a half hours at Bellevue, the majority of the time with Dr. Lyman.

This report is based on our findings during this visit, computer outputs and forms, and several papers and reports made available by Dr. Lyman. We also have requested a copy of a report commissioned by the New York City Health and Hospitals Corporation (HHC), the current funding intermediary for the pediatric clinic project. HHC controls most publicly funded health services in New York City. The HCC report was prepared by Arthur Anderson and Company and is intended to present the technical aspects of the system in relation to its transferability.

It should be noted that during the review of the draft of this report, deep disappointment with its content was expressed. A number of paragraphs were labelled as "nonsense" by Dr. Leo Tick. All specific corrections indicated have been inserted in this report.

The summary contains the folowing sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objectives for the system are principally,

Quality of care improvement in the area of comprehensive pediatric medicine through better communication among personnel and through better availability of the medical record;

Access to care improvement as achieved by decreased delay and better use of resources; and

Simplified administrative barriers for eligible patients.

These objectives have come about in response to a need felt by the medical staff.

The system in use here in part is a supplement to the existing manual system; the existing manual record system is inadequate.

b. The population which is to be served by the system is the general pediatric population in an area; the patient distribution is affected by the availability of free services for low income families from children and youth programs at the clinic. Some Medicare and self-patients also use the clinic.

The population is special in terms of:

social category (low income),
age distribution (pediatric), and
ethnic distribution (minority- Puerto Rican)

The ethnic distribution is predominantly Spanish speaking (64%).

The service environment is urban(very dense metropolitan area).

The type of care to be provided is primary care.

The existing quality of this health care institution in the pediatric department is judged relatively high and adequate overall by Dr. Lyman.

The quality of health care delivered to the same type of population served here is adequate in an uneven way as judged by Dr. Lyman. Services in the same, lower Manhattan, area also are provided by Beth Israel Hospital, a health station, and other facilities. The population shops around for services; a recent move of the pediatric clinic within Bellevue reduced the visit rate drastically for some time, even though the new facilities are quite attractive.

The average annual income of the institution's patient population is low.

The size of the population served by this system currently is 50,000 enrollees; the potential population in the Bellevue district is 68,000 eligible for children and youth services.

The needs for this population are in the area of comprehensive care. Patient visits to the clinic should only be a result of appointments. Occasionally some patients arrive unscheduled due to appointments made but not entered into the computer or because they want to see a particular provider.

Drop-ins go to the pediatric emergency room. Visits there are about 42% of the total pediatric outpatient load at Bellevue. The clinic is open from 8:30 am to 5:00 pm; Tuesday and Thursdays to 9:00 pm. The emergency room is open 24 hours per day.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Access to care through record availability and appointment scheduling. Prior to this system, records were available only 20 to 30% of the time. Dictation can take three months to one year before it enters the paper record at Bellevue. Also considered are:

record contents,
patient follow-up on positive lab tests and missed appointments,
visit registration, and
appointment scheduling.

Quality of care through:

patient management via data base acquisition, problem identification, and comprehensiveness of care given many different health service programs;

quality of care review procedures,

training activities, and

record accuracy.

Resource utilization through patient services such as fewer unnecessary visits and fewer redundant lab tests.

Management aspects of health care are to improve management of the facility by the provision of management with information and analytical tools for utilization review procedures and some manpower scheduling of nursing staff. Faster processing and increased accuracy in billing are considered desirable and possible now.

b. The organization which has made the decision to provide automated record services is a unit (clinic) of the institution (Bellevue Hospital). Within the pediatric clinic twenty subspecialty areas are using the system. Funding of operations at Bellevue came in July, 1974 within the purview of the New York City Health and Hospitals Corporation (HHC). Bellevue is the third largest of the 19 hospitals of New York City.

Expansion of use depends on HHC. HHC is investigating the system for conversion to its IBM equipment. The distribution of federal funds through HHC is seen as a major problem.

The unit visited is a clinic with 8 to 10 physicians, 5 residents on two to four week rotations, and 2 to 4 interns.

The institution is organized as a member of a public corporation. All physicians hold appointments at the New York University (NYU) Medical Center. The University Hospital of NYU serves private patients.

The size of the practice is:

Number of registered patients is 49,683, increasing at a rate of 500 to 700 per month; 39,354 patients have records available on-line or off-line.

Number of patient visits per year is 40,000 in the clinic and 30,000 in pediatric emergency.

Average time per patient visit:

waiting time varies depending on the appointment method selected by the physician; it could be several hours if most of the scheduled patients show up. The average no-show rate is 50%.

service time may be 20 to 30 minutes for a visit.

The control over the medical content of the record system is provided by a committee and Dr. Lyman.

The technical operation of the system is in the hands of an in-house staff under supervision of Dr. Leo Tick of NYU Medical Center.

3. SERVICE PROVIDED

Data collection is done using forms with text, organized into categories, and some check-marks to be entered as is, using terminal entry. The discharge summaries are highly coded.

Source data collection is by clerical medical personnel, nursing staff, and MD's.

Data entry is by in-house computer personnel. From the emergency room, only the diagnosis is entered.

The data are transmitted to the computer via an in-house multiplexor using leased lines.

The encounter data are stored on-line selectively, typically for six months after the last visit. Registration data are kept. Discharge summaries for Bellevue patients are kept available on-line for one year.

The entered information is used to:

provide medical record pull-lists,

appointment schedules for each clinic session, used by nurses,

provide work lists for each physician,

check eligibility,

generate a slip for the patient to direct him to the appropriate areas (buckslip).

generate medical record entries (encounter documents),

prepare information for bills, and

generate reports such as a patient profile (PCI) and utilization reports.

There is the capability to inquire into the files to determine a patient's appointments by provider or subspecialty area.

These services are provided throughout the clinic at about 30 sites.

Other relevant services provided by other systems are the billing for reimbursement and other administrative services which are provided by HHC. Billing is based on flat rates of $270 per inpatient day and $57 per outpatient visit.

4. TASKS REQUIRED

a. Data Entry Tasks

Most of the twenty subspecialty clinics have their own data collection forms. There is generally one form for an initial health assessment and a shorter form for follow-up visits.

Data entry is accomplished through entry of text on teletypes.

Missing data categories when required are sent back to be completed. The text entries are not analyzed during input, and missing data in those fields are ignored and not distinguished.

Verification of data entry is done only for the identification number by feedback of the name. Some format errors are also reported back for corrections.

Most errors are found by Dr. Lyman and the physicians.

Error correction is done only when vital. It is done by re-entry of the entire document and causes regeneration of the encounter report.

An audit trail of all errors is not maintained, and the source of the error cannot be determined.

Data entry hardware has given problems in the area of man-machine interface (noise and slow speed) and reliability (by now weak parts in all machines have been replaced). The cost of the terminals (teletypes) was very low.

Data entry software has given problems in the area of cost; a major portion of the software effort has been the programming of the PDP-8 and PDP-11 based multiplexors. A problem is the limited character code used by the UNIVAC 1100 machines (6-bit Filed-data) and the limited buffer size in the multiplexors (90x6 bits). Reliability has been affected by changes when they occurred. Dr. Tick states that programs have not changed in two years.

CDF

Indian Health Service
(IHS)

Tucson, Arizona

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDB-3

HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
ON
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
BRUNSWICK NAVAL AIR STATION DISPENSARY
BRUNSWICK, MAINE 04011
ON
MARCH 31, 1975

We were received by Lt. Cmdr. J. Craemer and were shown the operation of the system by Lt. J. Penick and HM3 Michael Thompson. We also were able to observe the encounters in the clinic and discuss the operation of the system with several providers.

The head of the dispensary, Captain W. W. Hodge was not present on the day we visited and the administrative officer of the dispensary, Lt. Cmdr. Gay, was not available to meet with us. This limited our data collection in the objective and planning areas.

The arrangements for the visit were made through the cooperation of Vice Admiral Custis and Cmdr. B. J. Dietz of the Bureau of Medicine and Surgery, Department of the Navy.

The summary contains the following sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objectives for the system are principally,

Quality of care improvement in the area of comprehensive medicine or through use of the problem-oriented medical record providing better feedback;

Access to care maintenance achieved by decreased delay, better availability of providers, and simplified administrative barriers.

These objectives have come about in response to a need felt by medical staff, specifically, Dr. Charles Morrison who is now in private practice nearby, but is no longer in regular contact with the NAS dispensary. A computer system was seen as an essential tool for the effective implementation of a problem-oriented record. Subsequent leaders of the project were Dr. David W. Schall and Dr. Edward C. Schmidt.

The system in use here is a replacement of a manual system. Experimental use was made of another system (Searle Medidata) before the current Meditech system was selected.

b. The population which is to be served by the system is determined by Navy policy. It currently consists of:

active duty female personnel,
dependents of active personnel, and
retired personnel and their dependents.

Active regular duty personnel are not included, partially due to their extreme mobility and the local nature of the system. The reduction in the availability of physicians in the volunteer services is also forcing policies which place an increasing patient load on civilian health services (CHAMPUS).

The population is special in terms of age distribution (one third retired).

The ethnic distribution is predominantly white.

The service environment is a small military base in a light urban to rural setting.

The type of care provided is primary care. Civilian facilities in Brunswick, an Air Force hospital at Pease AFB (70 miles from Brunswick), and a naval hospital at Newport, R.I. (250 miles) provide back-up.

The existing quality of this health care institution is judged relatively above average by Mrs. Craemer.

The quality of health care delivered to the same type of military population as served here is similar, in a consistent way, at other military locations.

Some of their patients come from remote areas and have difficulty in adjusting to the health care provided in the civilian sector of the economy. Military policies in the past have fostered dependence on free and comprehensive health care services.

The average annual income of the institution's patient population is typical for Navy personnel and retired personnel.

The size of the population served by this system currently is 15,776; the potential population in the area of this dispensary is 20,000. The system might be considered for other Navy and military sites.

The needs for this population are in the area of health maintenance and comprehensive care. Patient visits are primarily a result of:

appointments (70%), initially on patient initiative or repeat visits;

drop-ins (30%), worked into the daily schedule.

The no-show rate varies from 5% to 20%.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Quality of care through:

patient management via:

data base acquisition,
record content and organization,
diagnostic tests,
treatment planning,
problem identification,
feedback to physicians regarding achievement of desired outcomes,

quality of care review procedures, and some

research information collection;

Access to care through:

patient follow-up,
appointment scheduling, and
record availability;

Resource utilization through:

health manpower utilization and
increased effectiveness of paramedical personnel

patient services such as fewer redundant laboratory tests, and

screening for patients coming from outside of the designated service area was done in one instance.

Management aspects of health care which are to improve management and operations of the facility by the provision of management with information and analytical tools for utilization review procedures. A fair amount of data is available for health facility management, even though this is not a stated goal of the system.

b. The organization which has made the decision to provide automated record services is a unit of the Bureau of Medicine and Surgery of the Department of the Navy.

Expansion of use will occur according to a general plan set by the joint military services (TRIMIS).

The institution is a military outpatient clinic. There are 9 MD's, of which 6 are Flight Surgeons: two Physician Assistants, and two nurses who see patients independently. There are also 42 military corpsmen and eight civilian employees.

The institution is part of the U.S. Government, Department of the Navy.

The size of the practice is:

Number of patients is 16,000 (exclusive of the 4,000 active duty males not included in the system);

Number of patient visits per year is 24,000 (exclusive of 14,000 visits by active duty males);

Average time per patient visit is:

waiting time is generally short, the

service time is 2 hours for an initial visit with multiphasic screening, and 20 to 30 minutes for a repeat visit.

The control over the medical content of the record system is provided by the individual physician and Michael Thompson, the USN Corpsman (HM3) operationally responsible for the system.

The technical operation of the system is in the hands of a vendor of computer services (Meditech of Boston) and under daily supervision of Michael Thompson who hasthe responsibility for the smooth operation of the system and the local terminal facilities.

3. SERVICES PROVIDED

Data collection is done using dictation (3 tank-type recorders) and transcribed as is (except that complaints and diagnoses are given a modified ICDA code) using CRT-keyboard entry.

Laboratory orders are entered directly on the CRT-keyboard terminals in the physician offices. Some orders are entered on forms, mainly for transients; such lab slips are entered by laboratory personnel. Forms are used for multiphasic data collection.

Source data collection is by MD's, physician assistants, and nursing staff. Appointments are entered directly by the registration clerks.

Data entry is by clerical personnel (dictation) and providers (orders).

The data are transmitted by modems, multiplexors, and 3 leased telephone lines to the computer in Cambridge, Massachusetts.

The data are stored for one year after the sponsor and his dependents leave the base. It is planned to archive the data after two years of inactivity.

The entered information is used to:

update the computer-stored medical record,
generate medical orders, and
provide worklists for laboratory and soon the pharmacy.

Encounter documents are printed for physician verification. The data also are used to generate reports such as:

appointment schedules,
daily laboratory work review reports,
patient profiles,
disease profiles,
laboratory and medication profiles,
practice profiles by visit and patient category, and
administrative utilization and demographic reports for the Navy.

There is the capability to inquire into the files to determine a patient's medical status or appointments by date, diagnosis, problem, or laboratory test and by boolean combinations of variables to a limited extent.

These services are provided at all 17 locations in the dispensary.

Active duty personnel medical records are kept manually and carried by the individuals when transferred to other duty stations.

Payroll and supply data for the dispensary are handled through standard Navy channels.

4. TASKS REQUIRED

a. Data Entry Tasks

Data entry is accomplished through CRT-keyboard entry. Missing data elements are ignored and not distinguished.

Verification of data entry was done by data entry limit checking, but this was found not to be useful due to too many false positives, and is now done by output scanning.

Most errors are found by data entry personnel from the display returned from the computer on the CRT and some by health care delivery personnel during the daily laboratory review or when reviewing encounter reports.

Error correction is done on-line. A correction automatically changes entry only, which is adequate since all records and reports are generated later, when needed. An audit trail of all errors is not maintained, but some specific lists have an audit trail.

Data entry hardware has given problems in the area of cost, reliability, and uptime of the communication link to Boston.

Data entry software has given problems in the area of response time. The vendor tends to ascribe this problem also to the communication link.

b. Data Storage

File Updating:

Additional data entries are reflected in the files immediately after entry. Dictation is processed within one day.

Changed data entries are reflected in the files immediately.

Data invalidated are not kept.

File Storage:

The data which are entered into the file are deleted from the file 12 months after transfer of personnel and will be converted to an archival disk.

File Usage:

To get a current record from the file requires 3 or more seconds.

To determine whether a patient has a record in the file requires less than 10 seconds.

The search can be done by social security number and sponsor or dependency codes, exact name, or the first three characters of the name.

The file is only used for individual patient care.

File Size:

The required file space is now 37M characters and is expected to grow slowly.

When a shortage of file space occurs, then old records will be transferred to archival storage.

The files are of MUMPS type, variable length, dynamically allocated for assigned data values only.

c. Data Analysis Procedures Used

For the analysis of the stored data, the following classes of routines are available:

Individual patient record by:

retrieval of abstract of patient record (prior to every encounter),
generation of worksheet for patient (for all laboratory orders),
generation of flowsheet for patient (for medications),
retrieval of complete patient record (20 to 30/week for transfers), and
retrieval of last patient visit (rarely).

Listing of patients to be seen by each provider and a subsequent no-show list is done daily.

Selection of all patients is done regularly with given:

problem or diagnosis,
value of sign or symptom,
treatment modality, or
combination of the above.

This selection is made on the basis of single visit records. Selection of patients for a visit or review has not been used.

Tabulation is done regularly of:

diagnosis or problem,
patient category (age, sex, status),
provider, and
services rendered such as medications issued and lab tests performed.

Once a tabulation of patients was done by location using the patient's telephone number.

Descriptive statistics (e.g. tables, means, and standard deviations), are used in laboratory quality control.

Scheduling procedures for patients are available and utilized.

d. Data Analysis Procedures, Source, and Operation

The analysis routines were written by the vendor with some contributions by clinical personnel.

The routines are specified by the vendor and clinical personnel.

Their operation is verified by the vendor and clinical personnel through a formal check-out procedure for system changes and routine operational use for application changes.

The routines are kept on a general library file and on a user specific library file. Their documentation is kept on paper in user specific files and has not been updated regularly. The programs themselves can be retrieved directly at the terminals.

The programming language is MUMPS.

e. Protection of Data

Access to the data is restricted by identification and three passwords (two for general access and one for each user) known to all users and to the systems staff for the entire data base, and extra passwords are available specifically for selected files.

User violations of access are automatically reported to the system staff at Meditech.

Personnel who have access to the data in the computer are all medical professionals and clerical personnel.

The protection provided is considered adequate and is utilized.

When patients leave, the record is printed to be carried by them to the next duty station. This practice sometimes causes loss or violations of confidentiality. This is true as well with the traditional record. If the same record system were available at the next location, then data could be transferred directly.

f. Training

New medical users of the system are given formal instruction in order to use the system. The training period is two hours and users then can use the system. After a couple of weeks to one month, they are fully proficient, even though they may not know all options in the system. The training documentation is obsolete and hard to use.

New clerical users of the system are given instruction, demonstration, and documentation of the ICDA coding procedures in order to operate the system. The training period is two days and after an additional two to six weeks, they are fully proficient.

g. Presentation of Results

The means for producing output are:

Softcopy using CRT displays, and some

Hardcopy using printing terminals.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient identification record is variable.

The size of a visit record is variable up to 1500 lines of 82 characters maximum of free text. The average patient record occupies 3,000 characters.

At the initial visit up to _______ parameters may be collected; the average is _____. At follow-up visits up to ______ parameters may be collected; the average is _______. ______% of the information stored is medical in nature.

b. Patient Identification

I.D. number: sponsor's social security number and dependency code
I.D. expiration data
Name, full
Address
Phone, home
Sex
Date of birth
Marital status: can be inferred for dependents from dependency code
Occupation: sponsor's rank
sponsor's service branch
Date when this information was collected

c. Financial and Economic Information - none

Some questions in this area are part of the history stored outside of the computer.

d. Data Base: History of Present Illness

This is stored as text under "Subjective Findings"

The collector of information is identified on the progress notes.

e. Data Base: Past Medical History

Family history is not stored, but some questions are asked as part of the history.

Past diseases coded as problem list; description:

retention: all diseases
date of onset
diagnosis coded modified ICDA

Past hospitalizations are listed as problems.

Previous diagnostic tests: name, code, retention all as long as patient is on file.

Immunizations: name, code, retention all as long as patient is on file.

Allergies: Medicines, name, code
Environmental agents, name, code

Current medications: name, code, quantity, frequency.

Past medications:: Rx, quantity, frequency.

Diet(under comments): type, detail, patient compliance.

Psychiatric as problems with observations.

Collector is identified.

f. Data Base: Social History is not stored.

Data are collected but not retained after printout in the system.

g. Data Base: Review of Systems

It is obtained as part of multiphasic screening. The full result is available in the paper record. Problems found are listed as problems. Laboratory findings are stored and retained.

h. Data Base: Physical Examination

Height, weight, sex.

Other observations are stored as free text under, "Objective Findings".

i. Data Base: Objective Findings of Past Medical History

Laboratory orders, findings and multiphasic test battery

X-ray orders, anatomical site, report, conclusion stored as text.

EKG's, other cardiac tests, orders, findings stored;
the strip recording is kept in the paper record.

EEG's, other neurological test orders, findings are stored.

Pulmonary function tests, orders, findings are stored.

Other medical tests: renal function, gastrointestinal, etc.

Past memos, under comment in progress note.

Source of order is identified.

j. Problem List

Active problems (unlimited number): date of entry, problem name and code, diagnosis name and code if possible.

Resolved problems: date of entry, problem name and code or diagnosis name and code. The procedure for removing problems from the active list has not been applied consistently. Resolved problems are retained forever.

k. Plans: Diagnostic Orders

Most laboratory orders are transmitted directly to the laboratory. Otherwise they are entered from a laboratory slip to make reports. Other orders are stored as text. The laboratory is of a size which does not require worklists.

l. Plans: Therapeutic Orders

Medications: Rx, quantity, frequency are planned to be transmitted directly to the pharmacy. Most drugs are obtained within the dispensary. This change also will provide a current medications list on the patient's abstract.

Other orders are stored as text.

m. Follow-up

Laboratory findings are entered by the lab.

X-rays, report, conclusion

EKG's, other cardiac tests, findings

EEG's, other neurological tests, findings

Pulmonary function tests, findings

Other medical tests: renal function, gastrointestinal, etc., findings.

Medications, patient compliance general, may be entered as text.

Diet, patient compliance as text.

Reassessment of problems, resolution is possible.

Disposition as text.

Physician is identified.

n. Progress Notes

Encounter forms are not used; progress reports are stored as text. Encounter reports are prepared for physician verification.

o. Patient Services Management

Schedules for patient visits.

No-show rates, cancellation rates on special request.

Medication schedules for patients are being considered.

Visit reminders for patients are planned.

Patient waiting time is available.

p. Practice Information

First contact with this practice or agency.

Encounter sites.

Referral.

Providers at encounter: MD, nurse, PA, corpsman.

Use of other facilities: hospital, ER is stored as text.

Audit-oriented data from laboratory tests.

q. Research-Oriented Data

None of the data categories listed above are collected primarily for research purposes.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through one of seven DEC PDP-15's having 32K memory.

The computing services are provided through a vendor, Meditech, and are located about 130 miles away, services began in 1971.

The computers have been purchased by the vendor.

The dispensary leases 13 access ports into the computer, which are shared by the terminals. It also leases the terminals through Meditech. The terminal maintenance is included in the lease. Minor problems, however, are resolved by Michael Thompson.

Approximately 25% to 30%, sometimes up to 80% of the processing capability of one PDP-15 is used for the ambulatory medical record application.

Approximately 10% of the maximum file capability (1.25 out of 16) is used for the ambulatory medical record application.

The files are stored on 2 disks (2314 type).

Other important equipment are: communication equipment and multiplexors to use the three dedicated lines to Cambridge. Acoustic couplers and dial-up telephone lines are available as back-up. Important is the dictation equipment.

Archival storage is to be disk.

Retrieval response time is less than 20 seconds.

Hardcopy terminals are four UNIVAC DCT 500, upper case only, 30 char/sec, impact, $120/month; their reliability is not adequate. These terminals are used in Admissions, in the laboratory for reports for transferring personnel, and in the Pharmacy.

Softcopy terminals include 18 Datapoints 3000, upper case only, 300 baud, costing $80/month; their reliability is less than most other CRT's, perhaps due to local power problems; their legibility can be affected by dust attracted to the screen.(The old buildings used by the dispensary are dusty.) The CRT's were checked for spurious X-ray emissions and were found not to have any.

b. The system uses multiprogramming for its processing.

Currently production occupies 90% of the NAS use of the machine, and development 10%.

Of the production load, the day is used mainly for data entry and report preparation is at night. File maintenance is carried by Meditech nightly for one hour.

c. The operating system was designed and written for general medical purposes. It is generally understood by the local staff and is being further developed by the original supplier.

The file system is characterized by hierarchical files and linked records.

The implementation of the AAMRS requires many distinct files.

d. When there is a computer failure,then the failed computer is restarted as fast as possible,and if this doesn't resolve the problem then a back-up computer is put into service.

A noticeable (to the user) computer failure happens about once every two or three weeks and that number has been steady, but communication problems occur several times per day and are getting worse.

When there is heavy usage of the ambulatory medical record system, there will be an annoying slowdown, and there also may be conflicts since 22 terminals compete for 13 ports.

When there was other heavy use of the computer system, then there was an annoying slowdown, but Meditech reallocated the users of the computers and now the effect is minor.

e. The data processing staff consists of one half time medical specialist (a HM3 corpsman) and one programmer assigned by Meditech to the NAS dispensary. There are two data entry clerks for transcription, editing of lists of providers, medications, etc., and sorting of encounter reports.

The data processing staff reports to the senior medical officer, Captain Hodge, in the institution.

The response to request for changes in system output has been slow due to unavailability of programmers at Meditech. A new one has been assigned recently and is being trained.

f. The costs of the computer operation are charged according to the number of ports used.

The investment in the system is about $________ and the operational cost is about $_____/______.

g. The ambulatory record system is intended for possible future distribution to other military sites supported by the vendor (Meditech).

6. THE FORMAT OF THE MEDICAL RECORD

The record available to the provider when he sees the patient is a computer abstract of the past medical record. This abstract contains identification and appointment data, allergies, and the problem list. Diagnostic findings between this visit and the last one are reported separately to the physician.

A printed multiphasic report is available for the physician encounter subsequent to the tests.

A limited past traditional record is obtained on request only.

More medical record data frequently are obtained from the terminal during the encounter. Typically, retrievals include recent lab tests, dictated notes from the last visit, or notes pertaining to one problem.

There is no traditional record except for recent transfers to this site and material unsuitable for computer entry such as EKG tracings, X-rays, and referral letters. This paper record is maintained on-site. It can be delivered with little delay.

Continuity of one provider and patient combination is maintained except for emergencies.

The physician has access to the entire computer stored medical record during the encounter. The patient is routinely asked to verify the identification data while he waits for his appointment.

On the following pages are copies of:

- A patient abstract of a patient who had many problems; this sheet also is used by the provider to make notes during the encounter prior to dictation.
- The first and portions of the final pages of the printout of a complete patient record; the entire record comprised 18 printed pages.
- A portion of the schedule for the regular outpatient clinic.
- A laboratory order as printed in the clinical laboratory.
- The beginning of the 45-page monthly service summary, listing lab tests, and medications by problem for all providers. Similar lists are provided for each individual physician.

CDB

Barton
1030
gout

OPTION DESIRED: INDIVIDUAL BRIEF SUMMARY

PATIENT ID: 20[redacted]22 ([redacted] CLAIR)

#	TIME	DATE	CLINIC	BLOCKS
1	1500 - TUESDAY	APR 30, 1974	OPD-3	2
2	1000 - TUESDAY	OCT 1, 1974	EYE	1
3<<	1030 - FRIDAY	MAR 28, 1975	OPD-3	4

BRUNSWICK NAVAL AIR STATION - PATIENT SUMMARY
APPOINTMENT MAR 28, 1975
CLINIC: OPD-3 - TIME: 1030 CHECKED IN AT 1033
4 - 5 MINUTE BLOCKS

NAME: [redacted], CLAIR SEX: M
NUMBER: 20-[redacted]-[redacted]-[redacted] AGE: 42
ADDRESS: BOX 41 WEST END STATION, PORTLAND, ME
PHONE: 7726025
SPONSOR'S RANK: 04 ID EXPIRATION DATE: JAN 1, 1999
SPONSOR'S SERVICE: ARMY (RETIRED)

***PATIENT IS ALLERGIC TO FOLLOWING DRUGS:

**PENICILLIN (*PEN)

ACTIVE PROBLEMS

SEP 13, 1973	DATA BASE COLLECTION (D)
SEP 27, 1973	PAIN, EXTREMITY/EXTREMITIES (787.1)
SEP 27, 1973	PHYSICAL EXAMINATION, ROUTINE, ADULT (Y00.9)
FEB 22, 1974	PAIN, CHEST (783.7)
MAY 3, 1974	PAIN, ABDOMINAL (785.5)
MAY 10, 1974	FRACTURE, ULNA (813.01)
DEC 13, 1974	CONGESTION, SINUS (503.2)
JAN 24, 1975	SPRAIN, WRIST (842.0)
FEB 17, 1975	GOUT (274)

#1

meds
yes
allergies
pen

RESOLVED PROBLEMS

FEB 22, 1972	URI (R*3010)
MAR 24, 1972	SINUSITIS, CHRONIC (R*503.9)
JAN 26, 1972	OTITIS MEDIA, ACUTE (R*381.0)
JAN 26, 1972	ARTHALGIA (R*787.3)
JUN 30, 1972	PAIN, EXTREMITY/EXTREMITIES (R*787.1)
JUN 30, 1972	PAIN, BACK (R*728.9)
AUG 2, 1972	GASTRITIS, ACUTE (R*535)
SEP 22, 1972	ARTHRITIS (R*715)
OCT 3, 1972	GOUT (R*274)
APR 25, 1973	CYST, PILONIDAL (R*685)
AP"5(1973	URETHRITIS (R*597)
JUN 8, 1973	PROSTATITIS (R*601)
AUG 3, 1973	EXPOSURE TO INFECTIVE DISEASE. (R*Y04.9)
APR 25, 1974	PEDICULOSIS, PUBIS (R*134.1)

computer - communication error

ENTIRE RECORD OF - [redacted], MONA
MONDAY MARCH 31, 1975 1:24 AM

NAME: [redacted], MONA SEX: F
NUMBER: 20-[redacted] AGE: 43
ADDRESS: [redacted], BRUNSWICK, ME
PHONE: [redacted]
SPONSER'S RANK: E8 ID EXPIRATION DATE: SEP 28, 1975
SPONSOR'S SERVICE: OUS (DECEASED)

***PATIENT IS ALLERGIC TO FOLLOWING DRUGS:

MEPERIDINE HCL (DEMEROL)
DIMENHYDRINATE (DRAMAMINE)

NO HISTORIES

ACTIVE PROBLEMS

OCT 21, 1974	SUICIDAL TENDENCIES 300.90
AUG 24, 1974	GASTROENTERITIS 009.2
MAY 5, 1974	ULCER DISEASE 538
MAY 5, 1974	OBESITY 277
OCT 16, 1973	DEPRESSION 296.2

DEPRESSION 296.2

ENCOUNTER---BRUNSWICK NAVAL AIR STATION DEC 27, 1974
DR. SLESERS
SUBJECTIVE--
PT HAS BEEN DISCHARGED FROM HOSPITAL ABOUT 2 MOS AGO. ON MELLARIL, 50 MG QID, UNDER CARE OF DR. PETER EVANS. APPARENTLY DID GENERALLY FAIRLY WELL WITH OCCAS BOUTS OF INCREASED DEPRESSION & ANXIETY & OCCAS SUICIDAL IDEATION BUT NO ATTEMPTS. OVER HOLIDAYS WAS VISITING WITH MOTHER IN AUGUSTA & APPARENTLY DEVELOPED INCREASED EMOTIONAL TENSION. CALLED DR. EVANS YESTERDAY & WAS TOLD TO INCREASE HER MELLARIL TO 100 MG QID & 200 MG HS WHICH SHE DID. SHE FEELS THAT THE 200 MG DOSE AT NIGHT TIME MAY HAVE CONTRIBUTED ALTHOUGH SHE WAS UNDER SEVERE NERVOUS TENSION AT THAT TIME EVEN BEFORE HAND & FEELS THAT THIS MAY HAVE PRECIPATATED THE NAUSEA & VOMITING ATTACKS.
OBJECTIVE--
PT INTERVIEWED AND APPEARS SOMEWHAT DISTRAUGHT BUT NOT ACUTELY SUICIDAL OR OTHERWISE UNSTABLE.
PLAN-
MEDICATIONS:
PROMETHAZINE: 12.5 MG IM IN E R
COMMENTS-
PT INSTRUCTED TO CALL DR. PETER EVANS LATER TODAY & TO DISCUSS THIS VISIT, HER NAUSEA, HER STATUS & FUTURE DOSAGE OF MELLARIL OR OTHER MEDS.

ENCOUNTER---BRUNSWICK NAVAL AIR STATION OCT 21, 1974
DR. SLESERS

ENCOUNTER---BRUNSWICK NAVAL AIR STATION AUG 5, 1974
DR. KURTZ
SUBJECTIVE--
PT IRONING AND TRIPPED OVER THE BOARD, STRIKING HER LEFT TIBIA ON METAL LAMP. THIS WAS DONE YESTERDAY, AND PT WAS IN SUCH PAIN THAT SHE COULD NOT MAKE IT OUT FOR A CHECK YESTERDAY, BUT TODAY THINGS ARE IMPROVED SO SHE COMES OUT FOR US TO CHECK THE INJURY.
OBJECTIVE--
PERFECTLY NORMAL EXAM IN ALL RESPECTS OVER AREA OF CLAIMED SORENESS. NO SWELLING, DISCOLORATION,
PLAN-
COMMENTS-
REASSURED. THE FACT THAT THIS IS BETTER FROM YESTERDAY, AND THAT PT DID NOT CALL, AND HAS BEEN KNOWN IN THE PAST TO ABUSE OUR SERVICES THOSE TIMES THAT I HAVE BEEN ON DUTY, MIGHT BE GROUNDS FOR ABUSE OF MEDICAL PRIVILEGES, BUT WILL GIVE HER THE BENEFIT OF THE DOUBT SINCE THERE IS A TRAUMA HISTORY HERE. PT GIVES HX OF RECENT PSYCHIATRIC HOSPITALIZATION BY DR. EVANS FOR DEPRESSION.

EYE EXAMINATIONS

NO EYE EXAM IN RECORD

LAB TEST LIST * INDICATES ENCOUNTER

X-RAY
*MAY 17 1974 AP CHEST & AP LT SHOULDER NEG

BLOOD PRESSURE
*OCT 18 1974 100/60

MEDICATION LIST * INDICATES ENCOUNTER

PROCHLOPERAZINE

OCT 11, 1974 * SUPPOS. 1 RECTALLY Q6H PRN
JUL 14, 1974 * 10 MG IM STAT. SUPP-1 Q8H PRN.
SEP 01, 1973 * 10 MG. IM.
APR 30, 1973 * SUPPOS, 25 MG, #6, 1 Q4H PRN FOR NAUSEA

DIAZEPAM

OCT 18, 1974 * 5 MG TID
OCT 11, 1974 * FOR 21 DAYS, 1 TAB TID (CO-SIGNED BY DR. MERCEREAU)
AUG 26, 1974 * CONTINUE
DEC 21, 1973 * 5 MG. TID PRN #45 RFX3
OCT 16, 1973 * 5 MG TID, #45, RF X 3

PENTAZOCINE

DEC 21, 1973 * 50 MG. Q4H #12

SECOBARBITAL

OCT 18, 1974 * 100 MG HS PRN SLEEP
OCT 12, 1974 * 100 MG HS PRN SLEEP
JUL 10, 1974 * D/C
JUN 28, 1974 * 100 MG. HS #20
JUN 14, 1974 * 100 MG. QHS PRN SLEEP #20
MAY 30, 1974 * 100 MG. QHS #15
MAY 17, 1974 * 100 MG. #1, TAKE HS
MAY 07, 1974 * 100 MG QHS, MAY REPEAT IN 1 HR, #6 PRN SLEEP
MAY 05, 1974 * 100 MG PO QHS PRN SLEEP, MAY REPEAT 1 HR X 1, #2 etc.

SCHEDULE LISTING FOR TUESDAY JUL 31, 1973

CLINIC: OPD-2

DOCTOR: DR. MERSEREAU

TIME	PATIENT NUMBER	PATIENT NAME
0820	02-[redacted]	[redacted], RICHARD
0830	"	"
0910	03-[redacted]	[redacted], LAURIE
0920	"	"
0930	01-[redacted]	[redacted], DAVID L.
0940	"	"
0950	00-000-00-0017	PLACE, HOLDER
1050	"	"

CLINIC: OPD-2

DOCTOR: DR. MERSEREAU

TIME	PATIENT NUMBER	PATIENT NAME

CLINIC: OPD-3

DOCTOR: DR. MCNEIL

TIME	PATIENT NUMBER	PATIENT NAME
1050	"	"

CLINIC: OPD-3

DOCTOR: DR. MCNEIL

TIME	PATIENT NUMBER	PATIENT NAME
1330	00-000-00-0018	PLACE, HOLDER
1340	"	"
1400	30-[redacted]	[redacted], MYRTLE
1410	"	"
1420	"	"
1430	"	"
1510	"	"

NAS BRUNSWICK ME. 04011

WORK STATION: BACTERIOLOGY

MAR 31, 1975 TIME: 1605

TEST ORDERED ON: MAR 31, 1975 AT: 1603

PATIENT NAME: T.G , JAM [illegible]
PATIENT NUMBER: 20-374-54-45[illegible]A
AGE: 24 SEX: M

J CRA[illegible], LCDR MC
DR. CODE: 39

URINE CULTURE FIRST [illegible]

TEST DONE BY: [illegible]
WATCHING

NAS BRUNSWICK
MONTHLY ENCOUNTERS REVIEW
PAGE 1

PROBLEMS FOR 10/1-10/31 ('74) PROVIDER: ALL

```
OBESITY  277  ENC-13  PAT-12
   LAB     CHOL-1-7.6%, TRIGLYCERIDES-1-7.6%, URIC-1-7.6%,
           BP-2-15.3%, WT-8-61.5%, HT-2-15.3%, GLU-1-7.6%,
           TEMP-1-7.6%,
   MED     <NONE>

GOUT  274  ENC-4  PAT-3
   LAB     CREAT-1-25%, URIC-2-50%, CREAT CLEAR-1-25%,
   MED     BENEMID-1-25%, COLCHICINE-2-50%, ALLOPURINOL-1-25%,
           PHENYLBUTAZONE-2-50%,

DIABETES MELLITUS  250.9  ENC-25  PAT-19
   LAB     K-2-8%, NA-2-8%, CL-2-8%, CO2-2-8%, WBC-1-4%, N-1-4%,
           M-1-4%, E-1-4%, US-3-12%, URBC-3-12%, UWBC-3-12%,
           STS-1-4%, FBS-3-12%, 3 HR PP-1-4%, HCT-1-4%,
           URIC-1-4%, UC-2-8%, BUN-2-8%, UP-3-12%, BP-4-16%,
           WT-2-8%, HT-1-4%, UPH-3-12%, U MICRO-3-12%, USG-3-12%,
           B-1-4%, L-1-4%, BA-1-4%, GLU-2-8%, MICRO-1-4%,
           T3 R-1-4%, T4 U-1-4%, FTI-1-4%,
   MED     INSULIN-1-4%, NPH-2-8%, TOLBUTAMIDE-1-4%,
           DIABINESE-1-4%, TOLINASE-2-8%,

HEADACHE, MIGRAINE  346  ENC-2  PAT-2
   LAB     <NONE>
   MED     DEMEROL-1-50%, VALIUM-1-50%, CODEINE SULFATE-1-50%,
           PERCODAN-1-50%,

SINUSITIS, ACUTE  461.9  ENC-5  PAT-3
   LAB     WBC-1-20%, N-1-20%, M-1-20%, E-1-20%, HCT-1-20%,
           X-RAY-2-40%, B-1-20%, L-1-20%, BA-1-20%, MICRO-1-20%,
   MED     NEO-SYNEPHRINE-2-40%, CTM-1-20%, AMPICILLIN-2-40%,
           DIMETAPP-2-40%, PHENOXYMETHYL PENICILLIN-1-20%,

BRONCHITIS, ACUTE  466  ENC-21  PAT-18
   LAB     CHEST-6-28.5%, X-RAY-1-4.7%, TC-2-9.5%, BP-4-19.0%,
           WT-4-19.0%, HT-4-19.0%, TEMP-2-9.5%,
   MED     ERYTHROCIN-3-14.2%, ROBITUSSIN-7-33.3%, BENYLIN-1-4.7%,
           ACTIFED-2-9.5%, TCN-2-9.5%, AMPICILLIN-2-9.5%,
           ASA-1-4.7%, TEDRAL-4-19.0%, NOVAHISTINE-2-9.5%,
           DIMETAPP-1-4.7%, QUIBRON-2-9.5%, MARAX-1-4.7%,
           CODEINE SULFATE-1-4.7%,
           PHENOXYMETHYL PENICILLIN-3-14.2%,

DEPRESSION  296.2  ENC-6  PAT-5
   LAB     BP-1-16.6%,
   MED     SECONAL-1-16.6%, THORAZINE-1-16.6%, ELAVIL-2-33.3%,

DEPRESSION  296.2  ENC-6  PAT-5  (CON'T)                    PAGE 2
   MED     VALIUM-2-33.3%,

PAIN, CHEST  783.7  ENC-16  PAT-13
   LAB     ESR-2-12.5%, WBC-2-12.5%, EKG-5-31.2%, N-2-12.5%,
           CHEST-6-37.5%, M-2-12.5%, E-2-12.5%, RBC-1-6.2%,
           US-1-6.2%, URBC-1-6.2%, UWBC-1-6.2%, HCT-2-12.5%,
           X-RAY-2-12.5%, UP-1-6.2%, BP-1-6.2%, UPH-1-6.2%,
           U MICRO-1-6.2%, USG-1-6.2%, B-2-12.5%, L-2-12.5%,
           BA-2-12.5%, MICRO-2-12.5%,
   MED     ASA-5-31.2%, DARVON-1-6.2%, NITROGLYCERIN-1-6.2%,
           TYLENOL-1-6.2%, MYLANTA-1-6.2%,

DYSMENORRHEA  626.3  ENC-2  PAT-2
   LAB     <NONE>
   MED     DARVON-1-50%, ORTHO 1-80-1-50%,
```

7. INTEGRATION OF FUNCTIONS

a. The computer operation is an integral part of the ambulatory health care delivery service.

Administratively,the computer service is directed by Lt. Cmdr. Gay.

Technically,the computer service is directed by Meditech.

The financial resources for its development were supplied by the Bureau of Medicine and Surgery as a research project, and the cost of its current operation are paid by the same source.

The priority of new tasks for the system is determined by the staff jointly with Meditech.

b. The automated medical record system almost completely replaces the manual medical record.

The paper system exists separately for very few old and unsuitable items.

Information from paper systems is taken into the automatic system in case of inpatient stay or results from referrals to specialists using dictated notes.

There is no medical records librarian.

c. Other automated services used by the ambulatory health care delivery services such as multiphasic testing and patient history taking could be done with this system. Other services done by many AAMRS's are not applicable to the military setting.

d. In summary, this computer system is best viewed as a production service which began as a research project.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by management are:

aggregate services provided (monthly),
no-show lists,
laboratory tests and medications (monthly), and
provider statistics (monthly),

On-line use by management can be special queries or reports.

The available reports are not used actively.

The computer terminal is available for use as an adding machine.

b. Reports received regularly by clinical personnel are:

individual records (every visit),
practice profile (monthly, patient volume with problems,
lab tests, and medications),
(quarterly reports are made to the Navy), and
abuse of medical privileges (monthly).

On-line requests by clinical personnel are for individual record items only.

c. Few special requests are made to data processing staff for items such as research studies due to the purely clinical orientation and the remoteness of programming staff.

9. INFORMATION UTILIZATION

a. The system provides information for:

clinical physicians and paramedical personnel,
administrative staff in scheduling, etc., and
management outside of the dispensary,

Some use of the data has been made for quality of care review and medical researchers at Harvard.

Patients get the printout when they are transferred to another base.

The information is intended to assist in the delivery of primary care and health maintenance (except at hospitals).

Emergency care is often provided by civilian facilities.

In order to make more intensive use of the system,

a strong leader is needed to take charge of the project,

the pharmacy linkup needs to be completed, and

the dispensary as well as the system should be more completely utilized; there seems to be excess capacity.

Problems in this area are caused by the shortage of military physicians. Archiving of data is desirable to generate a research data base.

b. The group which currently depends on the outputs from the automated system are the:

clinical physicians,
paramedical personnel, and the
administrative staff for scheduling.

If the system does not work for 10 seconds, then it is often not noticed If it would not work for 10 days, it would be disastrous. Back-up computers, however, are available at Meditech.

A specific problem when the system is not working is inability to obtain record abstracts, further medical data, or to schedule patients.

If changes in the system are required, then a decision to implement them is made in one day to one year (pharmacy program), and it typically takes another one week to one year to actually change the computer system. There has been a shortage of staff available at Meditech.

Examples of changes which are necessary are the completion of the pharmacy program which is taking three to four months. A date field has been added to a report within a week, and a new check in a program took only ten minutes since it was done by the local corpsman.

10. EVALUATION OF EFFECT OF AAMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the quality of care and maintain the access to care. This improvement generally has been due to:

increased services,
better quality of services,
better utilization of services, and
fewer errors.

b. The change in the quality of care has been evaluated through measurement of factors relating to the patients and administrators. These measurements were obtained by subjective judgement (Mrs. Craemer) and objective measurements.

Measurement methods used by Dr. Schmidt have been:

examination of the medical record for accuracy and completeness, time spent with patients during a visit (increased from 4 out of 10 to 8 out of 12 minutes), patient's response to treatment for uninary tract infection and better adherence to protocol for strep throat),and the use of multiphasic screening.

Increased services have included well baby follow-up, juvenile exams, and adult physicals. Protocols for diagnostic procedures, treatment, and follow-up for many common problems are available.

The change in the access to care has been evaluated through measurement of factors relating to the patients. These measurements were obtained by subjective judgement and counting. Measures used have been:

missed appointments,
appointment waiting time, and
availability of medical record data (laboratory result loss was 40% in 6 months, now less than .5%).

Patient follow-up has been limited due to shortage of physicians.

The cost factors affecting health care delivery have been evaluated through measurement of factors relating to the health care providers. These measurements were obtained by objective measurements.

Studies have been sponsored by the Navy on the costs and benefits of the AAMRS; the results of one study were available for our review. This was a study performed in 1974 by the Naval Electronics Laboratory Center (John Silver). Data from this study were used in our summary of findings to the extent that it conformed with current data made available by the dispensary personnel Some of the cost and benefit figures were not used in that they included patient visit activity of the active duty male personnel which currently are not being served by the AAMRS.

Evaluation of management aspects of health care delivery collected included time spent preparing administrative reports.

Availability of information for planning has been achieved, but has not been used much.

Availability of information for facility operations has provided better analysis of financial needs and allowed utilization review procedures.

c. The results of the evaluations are and should be an information source for:

health care system administrators,
system designers, and
health care planners.

11. ECONOMIC INFORMATION

a. The total annual operating budget of the Brunswick Naval Air Station Dispensary is about $__________. The dispensary provides health care services to active duty personnel, military dependents and retired personnel. Medical services for male active duty personnel are considered a separate functional component of the dispensary and do not use the AAMRS. The AAMRS users are comprised of the outpatient clinics serving military dependents, retired personnel, and female active duty personnel. The operating budget for the AAMRS user clinics is about $________.

The dispensary is staffed as follows:

9 physicians	6 flight surgeons (on temporary rotation) 1 pediatrician 1 internist 1 general medical officer
2 physician assistants (locally trained)	1 in OBGYN 1 in pediatrics
2 nurses	
42 corpsmen	
8 civilian employees	2 appointment clerks 2 medical transcription clerks 1 receptionist 3 others

The flight surgeons and most of the corpsmen have responsibility for the active duty males' sick calls. The outpatient clinics are staffed by three to four physicians per day, plus the physician assistants, nurses, civilian personnel, and two corpsmen and women. The total operating costs for the dispensary are provided through direct appropriation of federal funds for the Navy's Bureau of Medicine and Surgery. The administrative channel for budget decision making is through the Portsmouth Naval Regional Medical clinic.

The provision of medical care to military dependents and retired personnel is considered an obligation of the Navy, and thus is provided free to all eligible persons using the dispensary.

b. Prior to the installation of the AAMRS the patient's medical record was primarily handwritten. It was stored at the dispensary as long as the patient was located in the area. Upon leaving the area, due to military transfer or other reasons, the patient is given his record and has the responsibility to give the record to the next military medical care facility he uses. (This practice continues with the AAMRS; now the patient receives a computer printout of the record.) While a unique patient identification number is used for each patient record (the sponsor's social security number), the paper record itself was considered to be a disorganized collection of information. The cost of the old manual paper record system was about $62,000 per year.

c. Cost Analysis: Development Costs

The development of the AAMRS began in March 1970; the first phase became operational in July 1971. As of July 1, 1974 the AAMRS was funded with Navy operating and maintenance funds. Prior to July 1, 1974 the AAMRS was supported as a research project. The total development costs for the AAMRS is estimated at $500,000. Ongoing development effort is minimal.

Cost Analysis: Operating Costs

The estimated annual direct operating costs for the AAMRS is about $233,000 (with indirect costs about $252,000). The Navy's estimate for direct AAMRS costs is about $215,000. The difference between the Navy estimate and the estimate for this review is that the Navy estimate does not include the following personnel costs: the appointment clerks, the technician involved with system maintenance (a medical corpsman), and administrative supervisory time from the head nurse. The total budget can be considered as supporting routine operations; and is funded as an operations and maintenance activity in the dispensary's budget. The primary decision makers with respect to the AAMRS budget and the future of the AAMRS are within the Bureau of Medicine and Surgery, Navy Department, Bethesda, Maryland. Decisions concerning the future support of the AAMRS at Brunswick have not been made. Currently the AAMRS activity is being funded with three months' allocation of funds, rather than the annual allocation. The operational costs could be reduced significantly by purchase, rather than lease of the equipment.

Cost Analysis: Transferability Costs.

The major tasks involved for a new application of the AAMRS to similar settings would be:

training of personnel, medical providers, and clerical staff (physicians require about 3 hours of programmed instruction and 6 to 8 weeks to become thoroughly familiar with the system);

modification of the system to unique requirements of a new site;

equipment or service acquisition.

Factors that may affect the transferability of the AAMRS to other settings (military or private sector) or the attainment of provider objectives are:

the system does not provide any billing or accounting functions as they are not required with this application; administrative utilization data are provided;

technically the system is easily transferable; the services are available from a private vendor.

acceptability of the on-line interaction in a private environment has yet to be proven.

d. Benefit Analysis: Tangible Benefits

System Cost Savings: There are no net cost savings with respect to the patient's medical record system. The automated system is approximately $150,000/year more than a manual record system. Even though the automated system costs more than a manual system,certain costs of a manual system are no longer being incurred. These costs include the salaries of filing clerks for the medical record and the cost of physical storage space. These cost savings have not been quantified.

Health Manpower Savings: Savings have been realized for health service provider personnel as well as for clerical personnel involved with direct patient care. For health service providers, the savings are:

Less time is required to review the medical record, a savings of two minutes of paper work time per patient visit (based upon a documented Navy study). A savings of two minutes per patient results in about one-third of an additional man-year of physician services available for patient care. This savings is used for more patient-doctor interaction time for each visit. The factors contributing to this time savings are:

the record is legible and problem-oriented,
availability of the record, and
the physician is not required to fill out lab slips.

Medical assistance personnel are no longer required to act as record and lab slip carriers. This permits better use of these personnel, nurses and medical corpsmen, in that they can devote more time to medical assistance.

For clerical personnel involved in direct patient care, time savings have been realized in appointment scheduling, ordering of lab tests, and in locating medical records. These tasks are performed faster and more accurately due to the AAMRS; additionally the tasks of record pulling and filing have been eliminated (see System Cost Savings). The time savings in clerical tasks has permitted a reduction in personnel, with an increase in patient load (specific numbers are not provided).

Patient Cost Savings: Since health care is provided free at the dispensary, the AAMRS has had no direct affect upon health care costs paid by the patient. The patients have realized a benefit, however, in that the appointment scheduling system has reduced waiting time for appointments. It appears that the patients have reacted to the improvement in scheduling services by reducing the number of after hour emergency visits and increasing scheduled visits during regular hours.

It is believed that the cost of patient care also has been affected by the AAMRS in that repeated tests due to lost data essentially have been eliminated. Prior to the installation of the AAMRS, about 40% of lab tests ordered were not on the record six months after the test was ordered. Currently,with the AAMRS less than 1% of tests ordered are not on the record 6 months after they are ordered.

The current 1% loss rate is attributed to patient no-shows, or lost transmissions on results for tests performed at other sites. There are no records available to indicate whether the earlier 40% loss rate was for lab tests not performed or lab tests performed and results lost. In either case,savings are realized in that searches for lost data are no longer required,and in the case of lost lab results duplicated tests have been eliminated.

Another potential savings with respect to the cost of providing medical care is that it appears that the use of civilian physicians in the area is decreasing as evidenced by a decrease in the annual rate of increase in payments made by CHAMPUS to area physicians. It has also been suggested that this may be an indicator of a perceived improvement in the quality of medical care at the dispensary (see Intangible Benefits).

Management Benefits: Clerical tasks associated with the preparation of monthly utilization and statistical reports have been reduced. The savings is estimated at two days per month for one person for the analysis, and some daily time (several hours) for the manual data collection.

Benefit Analysis: Societal Intangible Benefits

	Estimate of Benefit Achievement
Technological Advancement in AAMRS: Routine operation has been achieved with minimal technical involvement by the users.	++
Quality of Care Review Methodology: Evaluations have been made earlier and data exist to continue this work.	+
Research Activities: They have documented a number of care protocols. Their operation has been described in publications and frequently visited.	++
Training Activities: The care protocols contribute to physician training. Plans exist to extend this to patients having chronic diseases such as diabetes.	+
Health Planning: The data available have not been widely used.	+

Expected changes in benefit realization. All benefits will disappear should the Navy decide to discontinue the AAMRS activity at Brunswick. Additional benefits would require a reinstatement of strong project leadership and Navy support for addition system features and improvements. A broader realization of current benefits could be realized by expansion of the system to other locations.

12. COMMENTS

In general, a sound system which comes close to totally replacing the paper record. However, definite flaws exist which jeopardize greater application.

1) Response time for physician-computer interaction can be distressingly slow, evidenced by 10-15 second waits for entry of lab tests. This is considered to be quicker though than handwriting laboratory orders.
2) Abstract of history seems somewhat cursory and much information some physicians would want at each visit is not available, i.e., current medications, latest lab results. What is perhaps more frustrating is lack of ease in adding these to abstract. The lack of these features are due to lack of current development direction and lack of need felt.
3) Free form entry makes looking back at data cumbersome.

In spite of all these problem areas, a physician visitor liked this system and feels it could be sufficiently modified to gain acceptance.

The providers interviewed felt that the system caused better care to be provided to dependents than to active duty personnel at Brunswick.

This health care facility is an interesting example of bottom-up development within the military, in contrast with top-down development at the Indian Health Service.

A great number of regular reports are prepared by the system. Their effect on the health care delivered, however, is minimized due to a number of factors:

1) The management of the clinic does not see the computer as a tool to improve health care delivery.

2) The reports are poorly formatted and do not allow convenient scanning for anomalies.

3) The reports do not present the monthly data in comparison with standards or yearly averages.

4) The routine reports go down to a level of detail which could be of interest only if an exceptional value is selected at a higher level. The number of patients in many cells of the statistical output is less than ten.

Many of these weaknesses could be resolved by an effective interaction between NAS dispensary management and Meditech.

Benefit Analysis: Provider Intangible Benefits

Estimate of Benefit Achievement

Quality of Health Care: Major Impact

++

Patient management has been improved through problem identification and feedback to the physician. Laboratory data are available as soon as tests results are completed. Communications have been improved among two transient populations, the patient and the physician. Patient compliance has improved through continuity of care facilitated by a complete medical record and patient response to treatment as indicated in a patient questionnaire.

Quality of care review is not a current activity; however, some studies have been made using data in the AAMRS under the direction of former project investigators.

Measures of change are:

- increased information in the medical record,
- decrease in the number of errors in the medical record,
- availability of the medical record,
- case of finding data, readability, and comprehensibility of information in the record,
- decrease in follow-up appointments scheduled and not kept,
- patient questionnaires,
- the establishment of the well baby, juvenile and programmed patient care clinics, and
- decrease in the use of area civilian physicians.

Access to Health Care:

++

Access to health care has been improved in that the health care being provided is changing from episodic care to comprehensive care. The appointment scheduling system facilitates a better matching of patient to provider. Measures of change are reduction in after hours emergency visits, and increase in regular hours scheduled visits.

Management Aspects of Health Care:

+

The AAMRS provides data for utilization review and long range facility and manpower planning at the Bureau of Medicine and Surgery level.

Benefit Analysis: Societal Intangible Benefits

	Estimate of Benefit Achievement
Technological Advancement in AAMRS: Routine operation has been achieved with minimal technical involvement by the users.	++
Quality of Care Review Methodology: Evaluations have been made earlier and data exist to continue this work.	+
Research Activities: They have documented a number of care protocols. Their operation has been described in publications and frequently visited.	++
Training Activities: The care protocols contribute to physician training. Plans exist to extend this to patients having chronic diseases such as diabetes.	+
Health Planning: The data available have not been widely used.	+

Expected changes in benefit realization. All benefits will disappear should the Navy decide to discontinue the AAMRS activity at Brunswick. Additional benefits would require a reinstatement of strong project leadership and Navy support for addition system features and improvements. A broader realization of current benefits could be realized by expansion of the system to other locations.

12. COMMENTS

In general, a sound system which comes close to totally replacing the paper record. However, definite flaws exist which jeopardize greater application.

1) Response time for physician-computer interaction can be distressingly slow, evidenced by 10-15 second waits for entry of lab tests. This is considered to be quicker though than handwriting laboratory orders.
2) Abstract of history seems somewhat cursory and much information some physicians would want at each visit is not available, i.e., current medications, latest lab results. What is perhaps more frustrating is lack of ease in adding these to abstract. The lack of these features are due to lack of current development direction and lack of need felt.
3) Free form entry makes looking back at data cumbersome.

In spite of all these problem areas, a physician visitor liked this system and feels it could be sufficiently modified to gain acceptance.

The providers interviewed felt that the system caused better care to be provided to dependents than to active duty personnel at Brunswick.

This health care facility is an interesting example of bottom-up development within the military, in contrast with top-down development at the Indian Health Service.

A great number of regular reports are prepared by the system. Their effect on the health care delivered, however, is minimized due to a number of factors:

1) The management of the clinic does not see the computer as a tool to improve health care delivery.

2) The reports are poorly formatted and do not allow convenient scanning for anomalies.

3) The reports do not present the monthly data in comparison with standards or yearly averages.

4) The routine reports go down to a level of detail which could be of interest only if an exceptional value is selected at a higher level. The number of patients in many cells of the statistical output is less than ten.

Many of these weaknesses could be resolved by an effective interaction between NAS dispensary management and Meditech.

The saving grace of an application which uses the computer as a typewriter is that the data are available on-line to the provider. Lack of structured input (except for SOAP headings) will make selective retrieval of information costly if not impossible.

There is a nice trade-off of direct MD input for ordering lab tests vs. having him fill out forms. The same gain can be expected with the new pharmacy module; but waiting time for entry is excessive.

The provider interviewed felt that he could dispense with the paper record entirely for most acute visits.

The extent to which the acceptance of the system is affected by the military environment is hard to determine. Dr. Morrison, the original developer, later obtained similar services in his private office through a project sponsored by the NCHSRD of HEW, but discontinued the use when this project was no longer funded.

The system is still operating even after the original developers have left the Navy and with the Navy providing only operational funds. This is an accomplishment in itself.

Only one of previous evaluation documents commissioned by the Navy were available at the time of the visit.

P.S. We were informed just prior to the end of our study that the Navy has made a decision to discontinue this system in favor of the TRIMIS services to be developed. It is ashame that there is so little transfer of the experience here and that there will be a discontinuity of services there at Brunswick.

Gio Wiederhold
Medical Information Systems
University of California
San Francisco, California

CDN-2
HRA Contract
June 29, 1975

SUMMARY OF THE FINDINGS
OF
THE VISITING STUDY TEAM
ON
AUTOMATED MEDICAL RECORD SYSTEMS FOR AMBULATORY CARE

VISIT TO
PEDIATRIC DEPARTMENT
BELLEVUE HOSPITAL
NEW YORK CITY HEALTH AND HOSPITALS CORPORATION
NEW YORK CITY

ON
APRIL 1, 1975

We were received by Dr. Margaret Lyman, Director of the Health Information system and Associate Professor of Clinical Pediatrics, New York University School of Medicine, 550 First Avenue, New York City. Dr. Lyman has been for many years the director of the pediatric clinic itself and the major supporter of the AAMRS. We also were able to spend time with Dr. Leo Tick, Technical Director, Health Information System. He spends a large fraction of his time at Bellevue. The medical members of our team had the opportunity to observe the physicians during their regular clinic schedule. We spent more thant six and a half hours at Bellevue, the majority of the time with Dr. Lyman.

This report is based on our findings during this visit, computer outputs and forms, and several papers and reports made available by Dr. Lyman. We also have requested a copy of a report commissioned by the New York City Health and Hospitals Corporation (HHC), the current funding intermediary for the pediatric clinic project. HHC controls most publicly funded health services in New York City. The HCC report was prepared by Arthur Anderson and Company and is intended to present the technical aspects of the system in relation to its transferability.

It should be noted that during the review of the draft of this report, deep disappointment with its content was expressed. A number of paragraphs were labelled as "nonsense" by Dr. Leo Tick. All specific corrections indicated have been inserted in this report.

The summary contains the folowing sections:

1. OUTCOME OBJECTIVES

a. The intended societal outcome objectives for the system are principally,

Quality of care improvement in the area of comprehensive pediatric medicine through better communication among personnel and through better availability of the medical record;

Access to care improvement as achieved by decreased delay and better use of resources; and

Simplified administrative barriers for eligible patients.

These objectives have come about in response to a need felt by the medical staff.

The system in use here in part is a supplement to the existing manual system; the existing manual record system is inadequate.

b. The population which is to be served by the system is the general pediatric population in an area; the patient distribution is affected by the availability of free services for low income families from children and youth programs at the clinic. Some Medicare and self-patients also use the clinic.

The population is special in terms of:

social category (low income),
age distribution (pediatric), and
ethnic distribution (minority- Puerto Rican)

The ethnic distribution is predominantly Spanish speaking (64%).

The service environment is urban(very dense metropolitan area).

The type of care to be provided is primary care.

The existing quality of this health care institution in the pediatric department is judged relatively high and adequate overall by Dr. Lyman.

The quality of health care delivered to the same type of population served here is adequate in an uneven way as judged by Dr. Lyman. Services in the same, lower Manhattan,area also are provided by Beth Israel Hospital, a health station, and other facilities. The population shops around for services; a recent move of the pediatric clinic within Bellevue reduced the visit rate drastically for some time, even though the new facilities are quite attractive.

The average annual income of the institution's patient population is low.

The size of the population served by this system currently is 50,000 enrollees; the potential population in the Bellevue district is 68,000 eligible for children and youth services.

The needs for this population are in the area of comprehensive care. Patient visits to the clinic should only be a result of appointments. Occasionally some patients arrive unscheduled due to appointments made but not entered into the computer or because they want to see a particular provider.

Drop-ins go to the pediatric emergency room. Visits there are about 42% of the total pediatric outpatient load at Bellevue. The clinic is open from 8:30 am to 5:00 pm; Tuesday and Thursdays to 9:00 pm. The emergency room is open 24 hours per day.

2. PROVIDER OBJECTIVES

a. The objectives of the Automated Medical Record System are to improve delivery of health care by improvements to:

Access to care through record availability and appointment scheduling. Prior to this system, records were available only 20 to 30% of the time. Dictation can take three months to one year before it enters the paper record at Bellevue. Also considered are:

record contents,
patient follow-up on positive lab tests and missed appointments,
visit registration, and
appointment scheduling.

Quality of care through:

patient management via data base acquisition, problem identification, and comprehensiveness of care given many different health service programs;

quality of care review procedures,

training activities, and

record accuracy.

Resource utilization through patient services such as fewer unnecessary visits and fewer redundant lab tests.

Management aspects of health care are to improve management of the facility by the provision of management with information and analytical tools for utilization review procedures and some manpower scheduling of nursing staff. Faster processing and increased accuracy in billing are considered desirable and possible now.

b. The organization which has made the decision to provide automated record services is a unit (clinic) of the institution (Bellevue Hospital). Within the pediatric clinic twenty subspecialty areas are using the system. Funding of operations at Bellevue came in July, 1974 within the purview of the New York City Health and Hospitals Corporation (HHC). Bellevue is the third largest of the 19 hospitals of New York City.

Expansion of use depends on HHC. HHC is investigating the system for conversion to its IBM equipment. The distribution of federal funds through HHC is seen as a major problem.

The unit visited is a clinic with 8 to 10 physicians, 5 residents on two to four week rotations, and 2 to 4 interns.

The institution is organized as a member of a public corporation. All physicians hold appointments at the New York University (NYU) Medical Center. The University Hospital of NYU serves private patients.

The size of the practice is:

Number of registered patients is 49,683, increasing at a rate of 500 to 700 per month; 39,354 patients have records available on-line or off-line.

Number of patient visits per year is 40,000 in the clinic and 30,000 in pediatric emergency.

Average time per patient visit:

waiting time varies depending on the appointment method selected by the physician; it could be several hours if most of the scheduled patients show up. The average no-show rate is 50%.

service time may be 20 to 30 minutes for a visit.

The control over the medical content of the record system is provided by a committee and Dr. Lyman.

The technical operation of the system is in the hands of an in-house staff under supervision of Dr. Leo Tick of NYU Medical Center.

3. SERVICE PROVIDED

Data collection is done using forms with text, organized into categories, and some check-marks to be entered as is, using terminal entry. The discharge summaries are highly coded.

Source data collection is by clerical medical personnel, nursing staff, and MD's.

Data entry is by in-house computer personnel. From the emergency room, only the diagnosis is entered.

The data are transmitted to the computer via an in-house multiplexor using leased lines.

The encounter data are stored on-line selectively, typically for six months after the last visit. Registration data are kept. Discharge summaries for Bellevue patients are kept available on-line for one year.

The entered information is used to:

- provide medical record pull-lists,
- appointment schedules for each clinic session, used by nurses,
- provide work lists for each physician,
- check eligibility,
- generate a slip for the patient to direct him to the appropriate areas (buckslip).
- generate medical record entries (encounter documents),
- prepare information for bills, and
- generate reports such as a patient profile (PCI) and utilization reports.

There is the capability to inquire into the files to determine a patient's appointments by provider or subspecialty area.

These services are provided throughout the clinic at about 30 sites.

Other relevant services provided by other systems are the billing for reimbursement and other administrative services which are provided by HHC. Billing is based on flat rates of $270 per inpatient day and $57 per outpatient visit.

4. TASKS REQUIRED

a. Data Entry Tasks

Most of the twenty subspecialty clinics have their own data collection forms. There is generally one form for an initial health assessment and a shorter form for follow-up visits.

Data entry is accomplished through entry of text on teletypes.

Missing data categories when required are sent back to be completed. The text entries are not analyzed during input, and missing data in those fields are ignored and not distinguished.

Verification of data entry is done only for the identification number by feedback of the name. Some format errors are also reported back for corrections.

Most errors are found by Dr. Lyman and the physicians.

Error correction is done only when vital. It is done by re-entry of the entire document and causes regeneration of the encounter report.

An audit trail of all errors is not maintained, and the source of the error cannot be determined.

Data entry hardware has given problems in the area of man-machine interface (noise and slow speed) and reliability (by now weak parts in all machines have been replaced). The cost of the terminals (teletypes) was very low.

Data entry software has given problems in the area of cost; a major portion of the software effort has been the programming of the PDP-8 and PDP-11 based multiplexors. A problem is the limited character code used by the UNIVAC 1100 machines (6-bit Filed-data) and the limited buffer size in the multiplexors (90x6 bits). Reliability has been affected by changes when they occurred. Dr. Tick states that programs have not changed in two years.

b. Data Storage

File Updating:

New documents are reflected in the files after an overnight update run. Up to 300 documents per day are added to tape. Selected data from these tapes are also put onto on-line files for the patient summary. The original documents are sent to the medical record department for filing, as are copies of the encounter documents generated.

Changed documents are reflected in the files after an overnight update run. No edit capability exists. Key data (see Section 6) entered can only be changed through programmer intervention.

The data invalidated are not kept. Past valid documents can be retrieved from an audit run.

File Storage:

When a tape,after 2 or 3 months,contains about 10,000 documents, then a merge is conducted which updates the master tapes. It is desirable that merges would be done once per week. A merge generates the periodic reports and new on-line files.

The data which are entered into the on-line files are deleted from the file according to data type specific schedules. Laboratory data are kept 60 days and visit data are kept 6 months. Discharge summaries, diagnoses, and other data are kept one year. Newborn hospital records, key data, and immunization data are kept permanently on-line. A visit can generate several documents (2 average ?). Approximately 15,000 documents are available on-line. Identification data are kept as long as they are valid. The master tapes containing 250,000 documents off-line currently are kept permanently. On-line storage totals 240 M characters.

File Usage:

To get a current record from the file requires 2 to 3 seconds for data to become available on-line to begin printing; a patient summary typically takes 2 minutes to print on a teletype. It takes advance notice to retrieve past data stored on tapes.

To determine whether a patient has a record in the file requires 2 to 3 seconds by number and 30 seconds to one minute for Soundex name searches, depending on the number of false hits.

The search can be done by unit number for Bellevue Hospital, exact name, or approximate name using Soundex with sex, approximate age, and mother's first initial.

The file is abstracted when research questions have to be answered.

File Size:

The required on-line file space is now 240 M characters and is expected to double or triple before becoming stable.

When a shortage of file space occurs, then more file space will be purchased.

The files contains variable-length records on linked sector blocks, indexed using a pointer directory for the various data categories. Space is dynamically allocated. There are now more than 15 master tapes; a reduction to 10 double density tapes is foreseen. These tapes now contain 250,000 documents, and have a total capacity of 2,000 M characters or more.

c. Data Analysis Procedures Used

For the analysis of the stored data the following classes of routines are available.

Individual patient record by:

retrieval of abstract of patient record (PCI) obtained every visit both in the clinic (preprinted) and for pediatric ER visits (on-line);

generation of worksheet for patient (buckslip) printed every visit to the clinic;

retrieval of last patient visit for pediatric ER visits; and

retrieval of complete patient record has been implemented since our visit.

Selection of all patients with positive lab results on specified dates is made to check on follow-up. Selection of patients due for a visit is done whenever schedules change.

Tabulation of provided services by demographic data: patient category (age, sex, type of service, and clinic) is done regularly.

Financial management is aided by programs which produce reports of services rendered for bulk billing. These data, with ID number, sex, age, service code, and Medicare data, if applicable, are re-keypunched by HHC to prepare bills.

d. Data Analysis Procedures, Source and Operation

The analysis routines were written by professional programmers.

The routines are specified by clinical personnel, staff members, Dr. Lyman, and professional data processing staff.

Their operation is verified initially by professional data processing staff and now to a greater extent by clinical personnel through a formal check-out procedure preceding routine operational use.

The routines are kept on a user-specific library file at NYU.

The user documentation is kept on files for teaching and reference. There is no program documentation.

The principal programming language is Assembler for all programs accessed on-line and FORTRAN for the batch programs, including the tape merges.

e. Protection of Data

Access to the data is restricted by identification and passwords known to users and to the systems staff specifically for selected services. Dial-up access to the computer system is available.

Personnel who have access to the data in the computer are medical professionals and clerical personnel. The computer is shared and also used for general research support.

The protection provided is considered insufficient for sensitive data as psychiatric records, and these are not entered into the computer record. Only a flag indicating their existence is put into the computer record. Otherwise the security is considered adequate and loosely utilized, the computer record is more secure than the existing record room diles.

f. Training

New medical users of the system are given no formal instructions in order to learn how to use the system, but the clerks will help them.

New clerical users of the system are given formal instruction and system documentation in order to operate the system.

The training period is approximately two weeks and then many are considered fully proficient. There is continuous monitoring of their performance.

g. Presentation of Results

The means for producing the hardcopy output are teletype terminals and one printer.

5.A. DATA ELEMENTS REQUIRED IN THE AUTOMATED MEDICAL RECORD

a. Introduction

The size of the patient identification record is fixed at ________ characters. A patient's permanent record is estimated by us to occupy about 2,000 characters total on the average.

The size of a visit record is variable. Our estimate based on aggregate file data and visit data provided indicates it to be on the order of 7,000 characters per document total,on the average.

At the initial visit up to 100 categories with free text may be collected; the average quantity is large?. At follow-up visits up to 50 categories may be collected; the average is large?. Most of the information stored is medical in nature.

b. Patient Identification

This information is recorded by reception clerks and entered by data processing staff.

I.D. number, unit number for Bellevue
social security number can be used
Name, full and Soundex
Mother's first and maiden name
Father's first and last name if different
Address
Phone, home
Sex
Date of birth
Religion
Race
Language of choice
Date when this information was collected

c. Financial and Economic Information

This visit: subspecialty areas visited within the pediatric clinic.
Guarantor: Medicare, Medicaid, special programs, private

d. Data Base: History of Present Illness

Collected at any visit except emergency.

Content is free text under one category (IH-Interval History)

The collector of the information is identified.

e. Data Base: Past Medical History

This is collected on an initial visit as free text in a number of categories. The information is also specified. Categories include:

- HN Present health
- GD Growth and development
- PN Prenatal history
- BI Birth
- NT Neonatal
- ML Medical
- IM Immunizations, subcategorized for DPT, polio, measles, and gamma globulin, smallpox, and other
- FH Family history, subcategorized for father, mother, obstetric history of mother, siblings, relatives and other.

Detailed allergy histories are collected on referral to the pediatric allergy clinic.

Current medications ordered or given,free text only.

Past medications as entered earlier.

Feeding history as a free text category.

Psychiatric clinic data are not entered, but the fact that a visit occurred is indicated.

The collector is identified.

f. Data Base: Social History

Free text in one category.

g. Data Base: Review of Systems

This data is to be collected at the initial visit and is in free text, subcategorized into 11 areas.

h. Data Base: Physical Examination

Can be collected both at initial and follow-up visit.

Date
Temperature, pulse, respiration, blood pressure
Height and percentile
Weight and percentile
Appearance and 21 physical categories
Impression as one category

The collector is identified.

i. Data Base: Objective Findings of Past Medical History

Laboratory orders, findings such as CBC, urine, tuberculin

Special laboratory orders, findings as other.

The source of an order is identified.

j. Problem List

The record is not problem-oriented. Diagnoses are stored from both the clinic and the emergency room.

k. Plans: Diagnostic Orders

Diagnostic studies as free text.

Consultations coded to 20 subspecialty clinics or other.

The physician is identified.

l. Plans: Therapeutic Orders

Medications can be entered as free text. This option seems not to be excercised consistently.

Other categories are available for subspecialty areas.

Procedures (free text)

Instructions to patient

m. Follow-up

Laboratory findings are collected.

EEG's, other neurological test findings are collected.

Pulmonary function test findings are collected.

Other medical tests: renal function, gastronintestinal, etc. findings.

Medications

Other categories applicable to subspecialty area, free text content

Prognosis, free text

Disposition, return appointment date and time

Key data to be retained as free text

The physician is identified.

n. Progress Notes

Can be stored as text.

The physician is identified.

o. Patient Services Management

Schedules for patient visits

No-show rates, cancellation rates, drop-in rates

Visit reminders for patient based on appointments or after missed appointment

Staff schedules can be altered according to demand.

p. Practice Information

First contact with this clinic

Number of documents from visits

Encounter subspecialty areas visited

Referral agencies, self, MD, or other

Providers at encounter by name

q. Research-Oriented Data

None of the data categories listed above is collected primarily for research purposes.

r. Other Comments

The quality of the entered free text varies a great deal. Much of the content in the categories may not be suitable for analysis, but will be relevant for individual patient care.

5.B. PROCESSING REQUIRED

a. The processing capability is provided through:

1 UNIVAC 1108, 262K words, installed in 1969.
Service to Bellevue began that year.

Communications multiplexing at Bellevue is done using:

1 DEC PDP-8, $60,000, and
1 DEC PDP-11/15, $16,000.

The computing services are provided through an associated organization, New York University. It is currently moving its equipment from the former Bronx campus to the Washington Square campus. **This move has been completed subsequent to our visit.**

Charges to this project are about $21,500/month. The system is available daily from 1 am to 11 pm, **except Friday when the system is available to 9 pm only.**

The central equipment is rented for $450,000 annually. Computer equipment maintenance is by the vendor. Terminal maintenance is **in-house using one 60% FTE mechanic.**

Approximately 30% of the processing **load** is used for the ambulatory medical record application. **More capability is available.**

Approximately 25% now of the file capability is used for the ambulatory medical record application.

The on-line files are stored on fixed disks, 4 UNIVAC 8440 (3330 type); four more are being added. **(This has also been done since our visit).**

Other important equipment are removable disk drives, 16 UNIVAC 8425 * (double density 2314 type); and tape drives, **five 7-track, five 9-track.**
*** Reduced to 8 since our visit.**

Archival storage is disk packs for programs and tape for medical data.

Retrieval response time is a maximum of 3 seconds, **then typing starts and several minutes may be required to type a patient profile.**

Hardcopy terminals are:

35 Teletype, model 33, 80 char/line, uppercase only, 10 char/sec, impact mechanism, cost of $800; their reliability is under control.

1 Univac 1004 remote batch station, 132 char/line, upper case only, 600 lines per minute maximum, limited to 400 lpm due to the transmission rate (4,800 baud); also card reader and punch, $27,000, reliability is considered excellent.

Two CRT displays are on loan for evaluation.

There is no local storage capability for data at Bellevue so that the system cannot function when there are telephone problems. The recent fire in the Manhattan telephone company substation disrupted one of the two lines to the Bronx and delayed entry of documents considerably. It also has delayed the move of the Univac equipment from the Bronx to Washington Square. The communications for the Washington Square campus were completely destroyed.

b. The system uses timesharing, with transaction processing for the on-line operation and batch for all other work.

Currently production occupies 80% of the machine and development 20%, but development uses daytime resources and consumes 40% of the cost.

c. The operating system used is the standard 1100 operating system (EXEC 8), with a substantial modification of the interface to the demand system. This is a proprietary software product of United Software of Minneapolis (DMI). The operating system is maintained by the Center's staff with high level support from United Software. The speed of response by Univac to operating system failure reports was not considered sufficient and the use of an outside consultant was deemed less expensive than having the technical level required for this work on the in-house staff.

NYU is developing a new communication system for remote batch terminals based on a Univac mini-computer because they are dis-satisfied with Univac's current and projected offerings.

The file system is characterized by direct access and linked records.

The implementation of the AAMRS requires 150 distinct data files.

d. When there is a computer failure then the failed computer is restarted as fast as possible.

Problems have been caused by power surges, phone problems, and malfunctioning disks.

A noticeable (to the user) failure happens about once per day, and that number has been steady.

Files are saved at 6 am, noon, 5 pm, and 10:30 pm to minimize the loss in case of major system failure.

Where there is a heavy use of the computer system, then there will be an effect only if there is trouble.

e. The staff associated with data processing in this clinic consists of:

1 medical specialist (Dr. Lyman)
1 manager (Dr. Tick, less than half time)
3 programmers, partially supported by other projects
2 production operators
11 data entry clerks

Dr. Tick feels that the programmers he manages have a high productivity and a low turnover.

The data processing staff reports to Dr. Lyman.

The response to requests for changes in system output is immediate to very long depending on the urgency and the complexity of the change.

f. The costs of the computer operation are usage charged at $100/hour, and budgeted to match.

The investment in the hardware systems here and at NYU is about $1,000,000.

g. The ambulatory record system is intended for multiple clinics at this institution. It is also used now by orthopedics and neurology, and by the clinical chemistry laboratory. Further distribution may not happen due to HHC priorities. HHC seems to be mainly concerned about non-medical services such as billing and inventory control.

Dr. Tick feels that the use of the large machine is good for development and maintenance, but he would like to see more production on mini-computers.

6. THE FORMAT OF THE MEDICAL RECORD

The record available to the physician or nurse when he/she sees the patient is:

a buckslip, specifying the patient's routing,

a complete traditional record updated with computer printouts,

a computer abstract of the past medical record (PCI), The PCI consists of selected printouts of recent document categories such as identification, references to further documents, diagnoses, recent laboratory tests, appointments (due or missed), and key data. Key data include permanent problems, hospitalizations, etc., as determined by free text physician entry.

the complete recorded data from the last visit if within 6 months,

diagnostic findings between the last visit and this one,

an encounter form designed for the subspecialty clinic and the type of encounter (initial assessment or follow-up).

More record data are obtained on-line the night before the encounter if the paper medical record has not arrived. The system also allows for retrieval of data on-line for unscheduled patients (see Section 4b).

The paper record is kept in a central repository. It is delivered only on advance notice.

In some situations, such as the emergency room (which is really a drop-in clinic), it is very difficult to get the traditional record in time; therefore the computer printed summary is all that is available to the physician. The physician decides, depending on the case presented, whether a computer chart should be printed. The physicians interviewed felt that the traditional record is still not available one third of the time. Medical records states that they deliver 90% of the deliverable records, but this does not include the records that are held for the typing of dictation (10%) or that are in other clinics (another 10%). Even for one visit the record may be required in more than one subspecialty area.

Laboratory results are often not entered into the paper medical record; after six months 40% or more are not yet filed.

Continuity of one provider and patient combination is not maintained because of a team approach to care and because of teaching environment, this makes the automated record more valuable. Nurses do follow individual patients.
Other computer outputs available for the provider are: lists of patients to be seen on the day; and for the patient, the buckslip. Future appointments are noted by the provider on the buckslip and entered into the system prior to the patient's departure from the clinic.

Data are not always entered in time or correctly and then may be missing from the computer record. Dictation, on the other hand, can take many months to enter the patient record.

On the following pages are copies of the identification data entry sheet, a chart request, and a buckslip, a record summary (PCI) with recent laboratory data, sections of an initial health assessment form, and a record of the data entry of a follow-up form using the teletype.

The symbol @ precedes the transaction command to the computer system.

The " indicates a RUBOUT of the previous character for purposes of correction.

CDR

ID NO

Indicate 'IF' work here:

Name - ______________________, ______________________
[Last] [First]

Birthdate - ______________________

Sex [circle]: male / female
Race: white / negro / other
Language: Span. / Other

Father - ______________________ ______________________
[First Name] [Last Name]

Mother - ______________________ ______________________
[First Name[[Maiden Name - "Apellido de soltera"]

Other - ______________________
[Name of guardian or person (or agency) responsible for child]

Who sent patient to Bellevue Hospital the first time he came?

Was the patient born in Bellevue Hospital? ____Yes ____No

A-Self, relative or guardian
B-Friend or acquaintance
C-Children and Youth Project
D-Personal physician or dentist
E-Referred by other hospital
F-School
G-Health Department
H-Children's Bureau Supported Activities
I-Head Start Project
J-Governmental Welfare Agencies
K-Other Governmental Agencies
L-Visiting Nurse Association
M-Other voluntary agencies
N-Referral information not available

ADDRESS - ______________________ Apt. No. ______

City - ______________ State ________ Zip Code ________

Phone- [Area Code]

If patient has MEDICAID or MEDICARE, copy information directly from card:

______________________ MA-ADC PAT-ADC MA-HR MA-BCW PA-ADC ______
[LAST NAME on MEDICAID Card] [Circle] [Other]

Period	Case Number:	Check Digit	COVERAGE Adults	Children
TO: / /		–	–	–

IDD COMPLETED: ______________ ______________
[Date] [Name]

9/73 KN

IE DONE: ______________ ______________
[Date] [Name]

CDM

CHART REQUEST 45-15-56

PEDIATRIC [redacted],SUSAN
OUTPATIENT
DEPARTMENT BIRTH DATE 5/19/74
FEMALE

PINKGROUP CLINIC APPT DATE 5/14/75
NEW BELLEVUE, 1 S EXT 6330 TIME 1:00 PM

CHI 3A

HEALTH INFORMATION SYSTEM - BELLEVUE HOSPITAL K7 OR9-3

WELCOME TO BELLEVUE'S PEDIATRIC CLINIC !

PLEASE KEEP THIS 'ROUTING SLIP' UNTIL YOU'RE READY TO
LEAVE THE CLINIC- THEN, PLEASE BRING IT TO * DESK 4 *.
PN [redacted]
MF FELICITA
RA WHITE LN SPAN.
SX MALE
BD 11/29/59
ID 110416 0 RC P

MM [redacted]
FF [redacted]
AD 55 DELANCEY ST,APT 1C
NEW YORK, N.Y. 10002
PH 212-431-3387
HC 03/31/75 PA-ADC 2494114-1
AL A-01 CH A-02

APPOINTMENTS FOR 11-04-16 [redacted]

04/01/75 1:00 PM CHI

DATED: 03/31/75 AT 07:23

IN ADDITION TO YOUR CLINIC VISIT TODAY, PLEASE SEE:
LAB (1S-41)... NURSING( )... NUTRITION(1S-13)..
SOCIAL SERVICE(1S-9A)... PSYCHIATRY(1E-6)...
BILLING INFORMATION- NUMBER OF PEOPLE IN HOUSEHOLD....
TOTAL EARNINGS PER WEEK... MONTH... YEAR...
BC = NA NB NC ND NE NF (INITIAL.........)
BLUE CROSS NUMBER.......
OTHER HEALTH INSURANCE NO'S.....

********************* DOCTOR !!! *********************
PLEASE INDICATE RETURN APPT'S (WITH DOCTOR-NAME) YOU'D
LIKE SCHEDULED. THANK YOU!
CLINIC- DOCTOR-

WHEN-

HEALTH INFORMATION SYSTEM - BELLEVUE HOSPITAL K7 OR9-3200 EXT 4171

PATIENT CARE INFORMATION 01/27/75 (DOCTOR-RETURN THIS LISTING WITH YOUR DOCUMEN

PN [redacted],LUIS
MF AIDA
RA WHITE LN SPAN.
SX MALE
BD 07/02/58
ID [redacted] D RC P

MM HUMPHREYS
FF LUIS
AD 50 AVE D,APT 11A
NEW YORK, N.Y. 10009
HC 12/31/74 PA-ADC 2632044-1
AC A-01 CH A-03
HN GONZALEZ

PN [redacted],LUIS
ID [redacted] D

DOCUMENTS AVAILABLE

PFM - CARDIAC CLINIC - 11/27/74

PN [redacted]Z,LUIS
ID [redacted] D

KEY DATA

04/15/70: AORTIC STENOSIS, POST OP.
BRONCHIAL ASTHMA.
10/24/71: POST-OP AORTIC STEMOSIS. ASTHMATIC. MENTAL RETARDATION.
11/27/74: S/P REPAIR FOR SUBVALVULAR AORTIC STENOSIS.

PN [redacted]Z,LUIS
ID [redacted] D

DIAGNOSES

11/27/74: AORTIC STENOSIS, S/P REPAIR.
ETIOLOGIC - CONGENITAL AORTIC STENOSIS.
ANATOMIC - AS.
FUNCTIONAL - 2 FLIGHT DOES.

PN [redacted]Z,LUIS
ID [redacted] D

LABORATORY REPORTS

HEALTH INFORMATION SYSTEM - BELLEVUE HOSPITAL K7 OR9-3200 EXT 4171

PN G[redacted]Z,LUIS ID 0[redacted]

01/10/75: WBC 4,150, RBC >NXT 3 MILLION, HCT 39 %, SEGS 30, BANDS 10, LYMPHS 45, MONOS 8, EOS 7, PLATELETS ADEQ, /EW/GR.

NO IMMUNIZATIONS ON FILE FOR ID# [redacted]

APPOINTMENTS FOR 03-28-56 [redacted]Z,LUIS

01/20/75 6:00 PM AMU DR. NEWPATIENTS (APPT MADE 01/13/75)

02/05/75 12:30 PM CAR (APPT MADE 12/04/74)

DATED: 01/27/75 AT 07:40

PN [redacted]Z,LUIS
ID [redacted] B

PATIENT SERVICES

DISCHARGED	G5	01/13/75 01:30PM
ADMITTED	G5	01/10/75 05:00PM
VISIT	PES	01/09/75 07:37AM
VISIT	CAR	11/27/74 01:41PM
VISIT	PES	11/25/74 09:21AM

For Babies Under 2 Years of Age

PAM - INFANTS MEDICAL CLINIC
INITIAL HEALTH ASSESSMENT
Page 1

(PAM)
IDENTIFICATION NO -
BELLEVUE HOSPITAL - INITIAL PEDIATRIC HEALTH ASSESSMENT - M

NAME - ________ [Last], ________ [First] SEX -

DATE OF VISIT -
INF LOCATION - Infants Medical

BIRTH DATE -

IF (INFORMANT) - [ ] Speaks English
[ ] Does not speak English

HI (HISTORY)

HN *Present Health -

GD *Growth and Development [List milestones with age when achieved] -

FE *Feeding History [Include formula, solids and vitamins] -

PW *Past History.

PN **Prenatal History [Include prenatal and post partum care. Illness during pregnancy],

[Continue on back of page]

PAM - INFANTS MEDICAL CLINIC
INITIAL HEALTH ASSESSMENT
Page 2

BI **Birth [Include hospital, type of delivery, complications etc.],

NT **Neonatal [Cyanosis, jaundice, birth defect, hemorrhage, infections, premature or multiple birth, etc.],

ML ** Medical [Include illnesses, childhood diseases, hospitalizations, operations, accidents, pica, etc.],

IM *Immunizations [Give dates].

DV **DPT, First ____ Second ____ Third ____

Boosters ____

PV **Polio - Vaccination Cmp. First ____ Second ____

Third ____ Booster ____

MV **Measles - Vaccine, ____ Gamma Globulin ____

SV **Smallpox vaccination, ____ Result ____

OT **[Other], ____

RV *Review of Systems.

HD **Head, ____

[Continue on back of page].

PAM - INFANTS MEDICAL CLINIC
INITIAL HEALTH ASSESSMENT
Page 6

UT *Urine Studies - ______

TB *Tuberculin Test - ______

XR *X-Ray - ______

OT *[Other] - ______

IP (IMPRESSION)
* ______
* ______
* ______

MA (MANAGEMENT)
DI *Diagnostic Studies Ordered - ______

[Ordered] [Given]

ME *Medications - ______

IM *Immunizations - ______

PR*Procedures - ______

IN*Instructions - ______

CN *Consultations - [Include date]

Allergy ______	Endocrine ______	Orthopedics ______
Cardiac ______	Hematology ______	Otolaryngology ______
Chest ______	Neurology ______	Psychiatry ______
Dental ______	Nursing ______	Social Service ______
Dermatology ______	Nutrition ______	General Medical ______
Eczema ______	Ophthalmology ______	Family Planning ______
G-U Surgical ______	Renal ______	Other ______

CM *Comments ______

RA (RETURN APPOINTMENT) [Date and time] - ______

PG (PROGNOSIS) - ______
KD (KEY DATA) [Include chronic illness, medications, allergies, etc.] -

DR (DOCTOR) - ______
DT ++++ [Typist add date typed]

1/72

@STAT,RI W33Q73
STAT 31.1.0
THURSDAY, 6 FEBRUARY, 1975

15:32:58 -RUNID W33Q73/S IS ØPEN/BATCH
@XQT PEDX.PFM
DØC TYPE PFM
ID 459318
NAM [redacted]
SX FEMALE
DAT 01/17/75
LØC INF
BIRTH 07/22/74
IH NØ PRØBE"LEMS. 32 WEEK GESTATIØN INFANT HAD EXCHANGE TRANSFUSIØN
IH FØR HYPERBILRUBENEMIA.>
IH DE FØLLØWS MØTHER WITH EYES. DØESN" NØT TURN ØVER EITHER WAY
IH DE EXCEPT ØN 2 ØCCASIØNS. SITSW" WITH SUPPØRT, RECØN"GNIZES
IH DE PARENTS DIFFERENTIATES STRANGERS>
IH FE STRAINE "D FØØDS. SIMILAC WITH IRØN.>
IH IM DPT X2, TØPV X2.>
IH 99.9, HEIGHT 65 CM, PC 50, HC 43, WEIGHT 7.7 KG, PC 50.>
WRØNG FØRMAT
IH >
EX TM @?
99.9, HEIGHT 65 CM, PC 50, HC 43, 50&"%TILE, WEIGHT 7.7 KG, PC 50.>
EX AP ALERT, ?
AP ALERT.>
EX SK CLEAR.>
EX HD AF 2 CM, NC/NS.>
EX EY PERRL.>
EX EA TMS WELL VISUALZ"IZED, GØØD LIGHT RF"EFLEX.>
EX NS WNL.>
EX MØ WNL, NØ TEETH.>
EX TH WNL.>
EX CE SYMMETRICAL.>
EX HR RR NØ MURMUR.>
EX LU CLEAR TØ P&A.>
EX AB SØFT, NØ MASSES.>
EX PU 2+.>
EX GT WNL.>
EX HP WNL, NØ DISLØCATIØN.>
EX ET WNL.>
EX NE SITS WITHØUT SUPPØRT.>
EX >
IP WELL BABY.>
MA DI NGV.>
MA ME NGV.>
MA IM DPT X3, TØPV X3, J GIGANTE.>
MA CN NURSING, J GIGANTE, REACTIØNS TØ IMMUNIZATIØNS EXPA"LAINED,
MA CN DIETARY ADVICE.>
MA >
RA 2 MØNTHS.>
KD NGV.>
DR BRITTF"/FDH.>
DT 02/06/75.>
DØC ØK RTF
DØC TYPE END

ALL O.K.-EYE

***NØRMAL EXIT
@FIN

2/6/75

7. INTEGRATION OF FUNCTIONS

a. The computer operation is a service project of the ambulatory health care delivery service.

Administratively the computer service is directed by Dr. Lyman.

Technically the computer service is directed by Dr. Tick.

The financial resources for its development have come from child and youth grants, and the cost of its operation is paid by Bellevue Hospital and child and youth grants.

The priority of new tasks for the system is determined by Dr. Lyman and the professional staff.

b. The automated medical record system supports the manual medical records.

Both its outputs as well as the handwritten originals are inserted into the paper system.

Information from the paper system is taken into the automatic system in case of an inpatient stay at Bellevue. Laboratory data are entered from the reports received from the lab. X-ray reports were entered earlier, but this practice has been discontinued due to lack of funds for a typist.
The automated system contents is only occasionally accessed by the medical records librarian.

c. Other automated services used by the ambulatory health care delivery services, such as billing, could be replaced with this system.

d. In summary, this computer system is best viewed as a production service with a substantial development component.

8. INFORMATION DISTRIBUTION

a. Reports received regularly by management are aggregate services provided.

On-line use by management is for occasional retrieval of specific patient data or a patient's location in the clinic.

b. Reports received regularly by clinical personnel are individual records as decribed, follow-up reports, appointment lists, and practice profiles.

On-line requests by clerical personnel in the clinic are for individual records prior to the patient's seeing the physician (10 to 20 day).

c. Special requests are made to data processing staff for items such as research studies. This happens infrequently for the pediatrics clinic. Other users of the system may analyze data more frequently.

9. INFORMATION UTILIZATION

a. The system provides information for:

institutional management (required service reports),
administrative staff (scheduling), and
clinical physicians.

A fallout of the system is the availability of data for quality of care review (Dr. Lyman) and medical education.

The information is intended to assist in the delivery of emergency care and comprehensive care (including care at the hospital).

In order to make intensive use of the system,

more data have to be collected (medications);

data have to be collected at more points (other clinics);

better terminals may help, but may require a better communication system in the opinion of the site visitors; and

more structure of the data is required to use it for audit and research purposes.

Most important is organizational support of the goals of this system.

b. The groups which currently depend on the outputs from the automated system are:

management,
administrative staff, and
clinical physicians and nurses.

If the system does not work for 10 seconds, then it is not noticed; after 10 minutes, operations are held up in scheduling and manual back-up procedures are instituted.

Specific problems in that case are that no feedback is provided to prevent overscheduling of a service and that data entry operations are held up.

If changes in the system are required, then a decision to implement them is made in 1 week to 1 month. Dr. Lyman states that sometimes changes take a day and others never get done.

10. EVALUATION OF EFFECT OF AAMR ON SERVICES AND OUTCOME

a. The effect of the automated system has been to increase the quality of care and to increase the access to care.

This effort has been due to increased services, better utilization of services, and fewer errors.

No formal evaluations were done by the pediatrics clinic. The funding does not provide for evaluation. The NYC Health and Hospitals Corporation has commissioned an analysis by Arthur Anderson and Company of the system in terms of transfer cost and potential. We have requested a copy of this report, but have not received an answer.

b. The change in the quality of care has been evaluated through measurement of factors relating to the health care providers and administrators. These measurements were obtained by subjective judgement (Dr. Lyman).

The change in the access to care has been evaluated through measurement of factors relating to the patient. These measurements were obtained by counting and subjective judgement. Measures used have been availability of the medical record and a review of missed appointments.

The management factors affecting health care delivery have been evaluated through measurement of factors relating to the health care providers. These measurements were obtained by subjective judgement (nurses). Measures used have been evaluation of health manpower utilization in nursing per patient visit through the time taken for the specific task of medical record retrieval for patient visit.

Evaluation of management aspects of health care delivery includes the number of visits per patient.

Availability of information for planning has been achieved for manpower planning.

Availability of information for facility operations is expected to provide better cost reduction due to utilization review procedures.

Another effect on provider objectives is that the system is stated to fulfill the child and youth reporting requirements in an effective manner. The value of this benefit has not been quantified.

c. The results of the evaluations should be an information source for health care planners, health care system administrators, and system

11. ECONOMIC INFORMATION

a. The Bellevue Hospital Information System (BHIS) was developed as part of the Comprehensive Health Care Project for children and youth, the "Pediatric Project". The Pediatric Project was started in Bellevue Hospital under the direction of members of the New York University Medical Center and funded with grant support from the Federal Government the Children's Bureau. Thus, the Bellevue Hospital Information System was developed initially to provide computerized information services to integrate information from all sources of health care for pediatric outpatients at Bellevue Hospital. Currently the BHIS also serves pediatric inpatients, the chemistry laboratory for all of Bellevue Hospital, and other adult areas such as orthopedics and neurology. The site visit was directed only to the applications in the pediatrics outpatient services, which include the clinics and pediatric emergency room services.

b. Cost information was not available as to the operating costs of the pediatric outpatient services or the detailed costs of the BHIS. The cost data contained herein were estimated on the basis of the Pediatric Project grant budget and information provided by Dr. Lyman as to the BHIS support provided by Bellevue Hospital and the professional staffing of the pediatric clinic and emergency room.

The total annual operating budget for the pediatric clinic and emergency room is estimated at $2 million, including physician services and indirect costs, but excluding costs associated with the BHIS. The clinic and emergency room is staffed with 8 to 10 physicians, 5 residents, and 2 to 4 interns. Health services are also provided by nurses (12), health assistants (4), social service personnel, and case aides (7), and a variety of other personnel including psychologists, nutritionists, recreation therapists, and lab technicians (22). Additionally about 30 persons provide support services, including appointment scheduling, escort services, translation, secretarial services, coordination of fiscal and service activities, clerical duties, and messenger services. Except for professional physician services, most of the operating costs are being directly supported by the HEW grant. The professional staff is from the New York University Medical Center. Operating costs not supported by the grant are provided by Bellevue Hospital from fees-for-service. Bellevue is an operational component of the Health and Hospitals Corporation (HHC) of New York City. Budget decisions concerning the pediatric outpatient services are made by Bellevue Hospital under the direction of the Health and Hospitals Corporation.

Fees for outpatient services are charged at a flat rate for each patient visit to the clinic, regardless of the services provided or the number of doctors or health care providers seen. The rate is set by the HHC and is the same regardless of the facility providing the service whether it be Bellevue or some other hospital. The Medicare rate for an outpatient visit is $57, for non-Medicare patients the fee may be adjusted on a sliding scale based upon ability to pay. Approximately 40% of the patients are eligible for Medicare. Thus there is no opportunity here to have changes to patient fees as a result of the AAMRS.

The AAMRS (the BHIS) is considered a supplement to the patient's paper medical record. The medical record as supplemented by the AAMRS is handwritten and typed. The outline prepared by the physician is retained and the typed portion is computer processed. The medical record is stored centrally within Bellevue Hospital, and a unique ID number is used for patient identification. As a result of the computer printouts the medical record format is considered to have some standardization.

c. Cost Analysis: Development Costs

The BHIS development began in 1966 and applications began in 1968. The cost of the development effort over a six year period was about $3.0 million, and included the purchase of a high-speed printer, a PDP-11/15,and a PDP-8. Funds for development were primarily derived from the Pediatric Project grant and Bellevue as required by the grant terms. (Bellevue was required to support half of the operational computing costs).

Cost Analysis: Operating Costs

The current annual direct operating cost of the AAMRS is estimated at $622,000 ($773,000)with indirect costs). The estimate includes amortization of purchased equipment. About 64%($393,000) is for routine production activities and 36% ($225,000) is for ongoing development. Of the routine production activities, about 99% is for the pediatric outpatient services (the clinic and emergency room)and 1% is for inpatient services. About 62% of the AAMRS operating costs are supported with the Pediatric Project grant funds. Due to limitations in the availability of grant funds, it is expected that the source of support will change significantly in the future.

As the BHIS provides more administrative services useful to Bellevue and management, it is expected that Bellevue funds will provide a greater portion of the support. It is expected that the next administrative services to be implemented will relate to the pharmacy operations and billing. The AAMRS budget is under primary control of the developer (Dr. Lyman), subject to grant regulations and cooperation from Bellevue. The AAMRS computer use charges are under the control of New York University's University Heights Medical Center computer center, but subject to negotiation with the developer.

Transferability and Accomplishment of Provider Objectives

The major tasks involved for a new application of the AAMRS to a similar setting would be:

Determination of the volume and type of services to match the scale of this system;

Software, hardware and systems changes to adapt the system.

Analysis routines to cope with free text from another environment;

and

Installation and training.

Factors that may have an affect on the transferability of the AAMRS to other settings or the attainment of provider objectives are:

The system is most suitable to settings of a similar nature, high patient volume, where timely record accession is important (e.g., a large metropolitan outpatient setting).

The lack of problem orientation may limit applications.
The lack of software documentation.
The high initial hardware investment if services cannot be purchased from a service bureau.
The dependence on free text (similar to the Automed System).

d. Benefit Analysis: Tangible Benefits

System Costs Savings: There are no cost savings with respect to the maintenance of the patient's individual medical record. In addition to the cost of the BHIS services, there may be an added cost to the record system due to the filing requirements of the computer output, as well as the outline prepared by the physician, and additional messenger costs for the transportation of the medical record to and from the BHIS work area.

Health Manpower Savings: For the physicians, the major benefit is the availability of the medical record or selected documents from the record at the time of the patient visit. This aspect may eliminate the need to duplicate inquiries of information for the record. Actual time savings for the physician is minimal.

Other health care personnel, such as the nurses, benefit from the BHIS as a result of the data and reports generated by the system which permit a better planning of their work efforts and interactions with the patients. As with the physicians' benefits in terms of time savings is minimal. The major impact of the BHIS on the health care providers is discussed under "Intangible Benefits".

Clerical personnel involved with direct patient care are most likely to realize time savings, particularly with respect to the appointment scheduling system patient identification, and medical record location. There have been no studies or data gathered that would help quantify these savings, except for statistics on record access.bility. Prior to the BHIS only 40% of the medical records were available at the time of the patient's visit; after BHIS about 90% of the records are delivered for the patient's visit.

Patient Cost Savings: Due to the nature of the financial system, it is impossible to measure the impact of the BHIS upon the cost of patient services. The individual patient, however, may realized benefits as a result of fewer delays and waiting times for clinic services, and fewer redundnat lab tests.

Management Services: While the BHIS provides information that would facilitate the billing process, it appears that the HHC management has not taken advantage of it to date. It is expected that after some system improvements and changes are made, the billing process will be directly served by the BHIS, which should eventually result in increased accuracy, speed, and the reduction of lost charges.

Currently several management-type reports are being processed, which are useful in the planning of day-to-day operations, and staffing assignments (e.g. the nursing status reports, future appointment lists, etc.)

Benefit Analysis: Provider Intangible Benefits

Measure of Benefit Achievement

Direct Delivery of Care (Quality) — +

Patient management has improved through the availability of the patient record, or abstracted information of the record at the time of the patient visit. Continuity of care is facilitated by the BHIS by giving nurses information on scheduled appointments for patients that may be following, so that follow-up contacts can be made. Additionally, the BHIS facilitates necessary follow-up on laboratory tests using the reports generated on necessary follow-up or recall. All potential benefits in this area are offset however by a no-show rate of about 50%.

Access to Health Care: — +++

A major impact. Appointment scheduling facilitates the proper matching of provider to patient and the availability of the medical record at the time of the visit. The BHIS also provides data to facilitate patient follow-up, so that access can be initiated by the health care providers. The BHIS also facilitates referrals from the pediatric emergency room to the clinic and the routing of patients within the clinic.

The availability of the patient profile in the emergency room is judged very beneficial and provides a service hard to achieve without an AAMRS.

Some analysis of patient behaviors in keeping appointments is being done.

Management Aspects of Health Care: — +

Clinic management is facilitated through the various utilization reports generated by the BHIS. The BHIS also permits new methods of analysis of data, but this work will be limited by the lack of data coding.

Benefit Analysis: Societal Intangible Benefits

	Measure of Benefit Achievement
Technological Advancement in AAMRS: The system successfully uses a generalized shared system.	+
Quality of Care Review Methodology:	0
Research Activities (Access to data and information for research):	0
Health Planning (Availability of information for regional health planning): Health care seeking behavior of urban population has been looked at.	+

12. COMMENTS

The pediatrics clinic is a fine facility in a most difficult environment. The population served is mainly Puerto Rican. The physician I met with did not speak the language, but seemed to generate real feeling for the patients. Although obviously at poverty level, the children were well scrubbed, polite, and the parents were most gracious. In my time I observed four physician-patient interactions. The physician related to me his feeling in several areas regarding the computerized records. He feels that the record is essential to compensate for the poor availability of the paper record.

We had a vivid demonstration of the value of the computerized record. A three year old Puerto Rican boy was seen in the course of the evaluation. It was noted from the computerized record that the test for lead poisoning was elevated. We searched the traditional record and could find no lab test results for this test. The physician estimated that two thirds of the lab test results are never put into the patient's chart. Officially 40% are not in after six months.

The physician next saw a patient who had been seen on two occasions in the clinic recently. Both visits should have been recorded and were not. This is due to the fire in the telephone company substation in Manhattan which caused that much input could not be entered or transmitted. There is no local memory capacity at the Bellevue multiplexing computer systems.

Given the problems of the clinic and the hospital as a whole, the computer system has been most effective. I do believe that this AAMRS would help in situations where:

the medical record is not delivered reliably and where

the laboratory data are not entered into the record in a responsible manner.

A more reliable and timely paper medical record could fulfill most care requirements. The system is applicable mainly to large centers where record retrieval for many clinics presents a problem. The physicians and patients are to be commended. I am humbled by their patience and equanimity in dealing with the health care problems.

Another example of how better availability of medical record can be achieved by organizing the patient ID function.

The provider I interviewed complained that the accuracy of the data transcribed was often doubtful, but this person did not appear to use the computer printouts in the process of providing care. In fairness, the PCI on the two patients' visits I watched was almost devoid of medical content except for the record of visits.

Apparently there is considerable variation in the capabilities of the clerks in accessing the data available and this is very frustrating to the provider when information cannot be obtained from the files.

Storage of medical content in unstructured form renders much of the information almost valueless for later analysis by machine. The fact that the text is well categorized may make some analysis of the text possible, but a considerable effort would be needed to establish adequate dictionaries for the various domains. The text data can be selectively retrieved for human analysis.

There is an impressive capability considering the problems inherent in their institutional setting and the nature and size of their patient load.

The administration of the hospital has only limited control over the physicians. While the system provides individual schedules for the physicians, it cannot control the number of patients that a physician is willing to book during a given period. Both very high (one patient per eight minutes) and very low (one patient per half hour) schedules are requested. The degree of overbooking is also not easily controlled and difficult to manage due to the inconsistent, average 50%, no-show rate. These factors limit the potential benefits of the appointment system.

The setting and relationship between the medical school and the "Health and Hospitals Corporation" is not conducive to achieving the maximum available benefits from the system. Administrative data collection and processing for insurance claims duplicates efforts already expended by the automated system.

The recent transfer of the employees of Bellevue hospital from NYU to the HHC payroll (of 800,000) has depressed morale and worsened working conditions.

The flow of funds from the federal governement through HHC has been irregular and inadequate and has forced Bellevue hospital to take on unforeseen financial commitments.

No formal evaluation has been made of the project and it does not appear to be in their plans, **due to funding difficulty.**

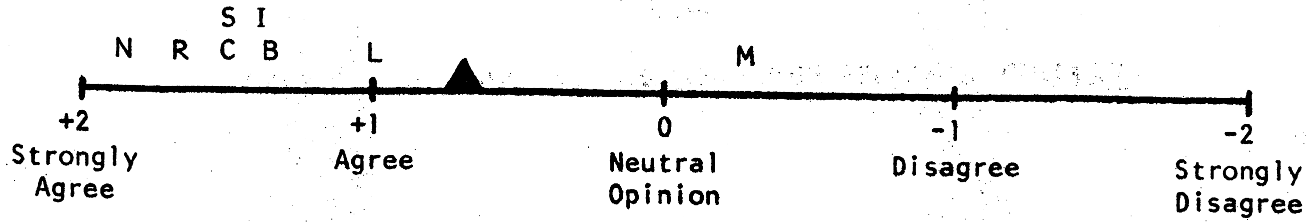
As a result of administrative pressure and funding constraints, further work will be oriented to services that will result in monetary returns and savings to Bellevue and the HHC.

Appendix F

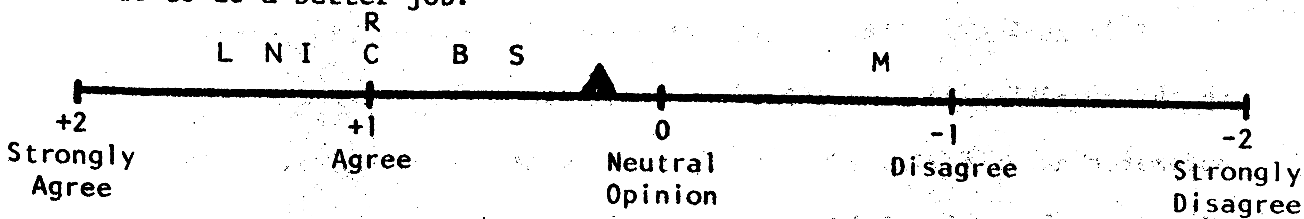
DETAILED RESPONSES FROM THE AAMRS ATTITUDE QUESTIONNAIRES

This appendix presents the responses from the various sites to the twenty questions regarding providers' attitudes towards automated ambulatory record systems. The background and analysis of this data is presented in Section 4L of Volume 1.

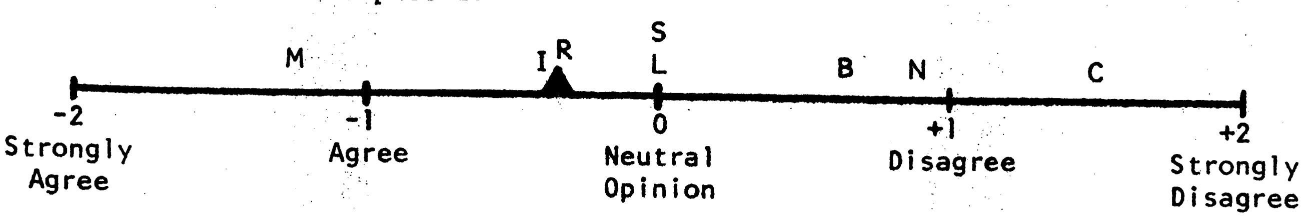
1. Medical record information is more accessible and available more quickly with the AMRS.



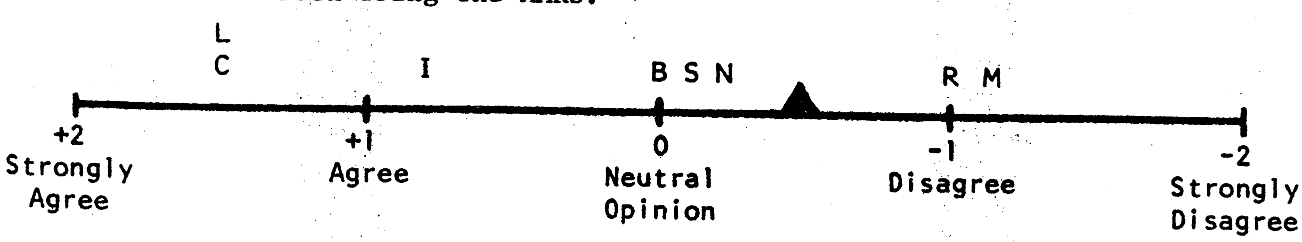
2. As a result of the AMRS, I am able to do a better job.



3. The performance of the AMRS falls short of what I expected.



4. I could never go back to using the old manual medical record system now that I have been using the AMRS.



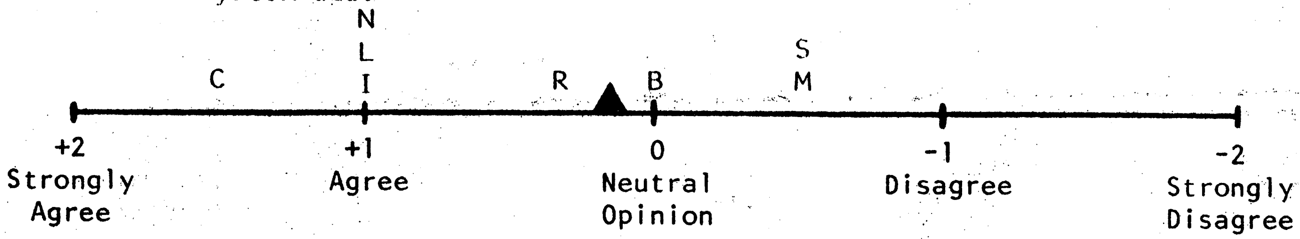
LEGEND: ▲ - Overall Mean (N=58)

B - Bellevue Hospital (N=3)
C - Casa de Amigos (N=2)
I - Indian Health Service (N=5)
L - Los Angeles County (N=2)
M - Medical University of South Carolina (N=28)
N - Naval Air Station, Brunswick, Maine (N=13)
R - Regenstrief Institute (N=3)
S - Stanford University Medical Center (N=2)

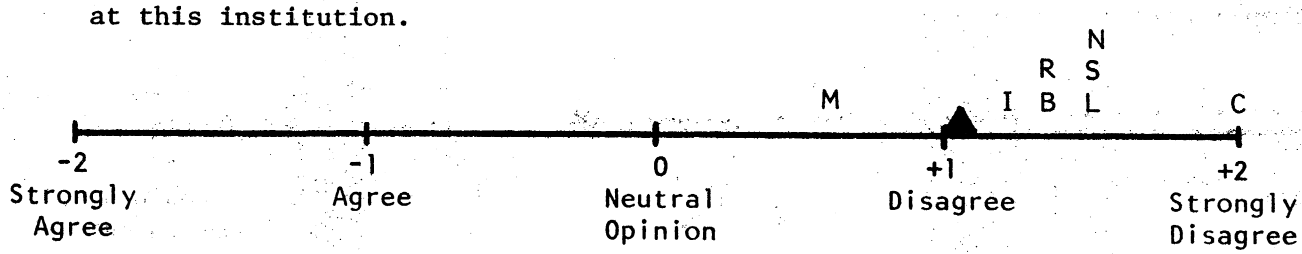
Figure 4L2 Mean Responses of Eight Institutions to Each of the 20 Statements Contained in the Attitude Questionnaire.

(Continued)

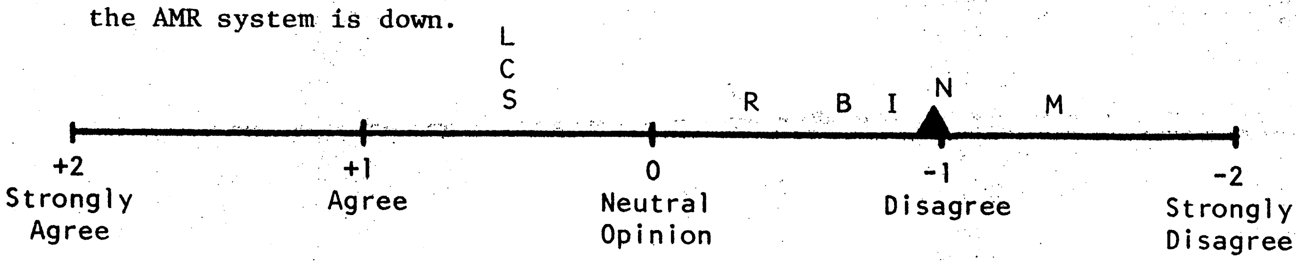
5. The AMR system catches more human errors than the old manual system did.



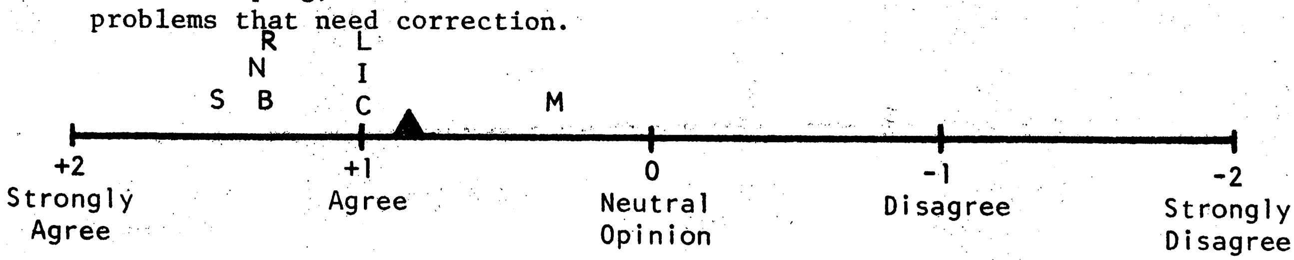
6. In my opinion the AMRS should never have been implemented at this institution.



7. I never have to wait for necessary patient record information because the AMR system is down.



8. In general, I like the AMRS better than the old system of medical record keeping, but there are some problems that need correction.



LEGEND: ▲ - Overall Mean (N=58)

B - Bellevue Hospital (N=3)

C - Casa de Amigos (N=2)

I - Indian Health Service (N=5)

L - Los Angeles County (N=2)

M - Medical University of South Carolina (N=28)

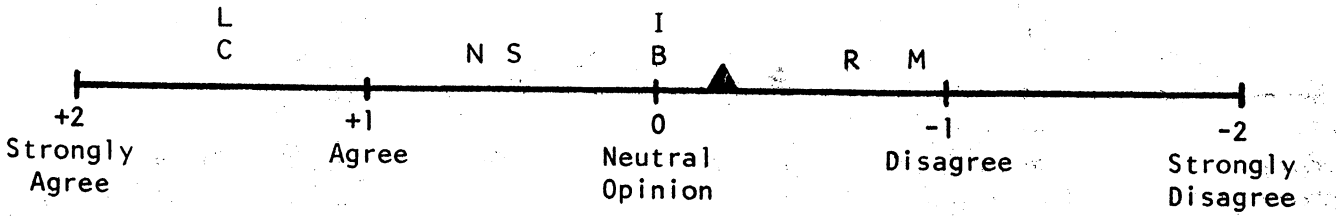
N - Naval Air Station, Brunswick, Maine (N=13)

R - Regenstrief Institute (N=3)

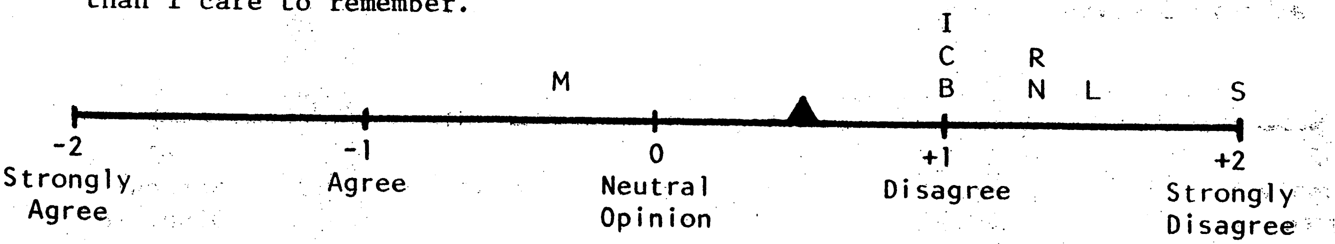
S - Stanford University Medical Center (N=2)

Figure 4L2b Mean Responses of Eight Institutions to Each of the 20 Statements Contained in the Attitude Questionnaire (Cont.).

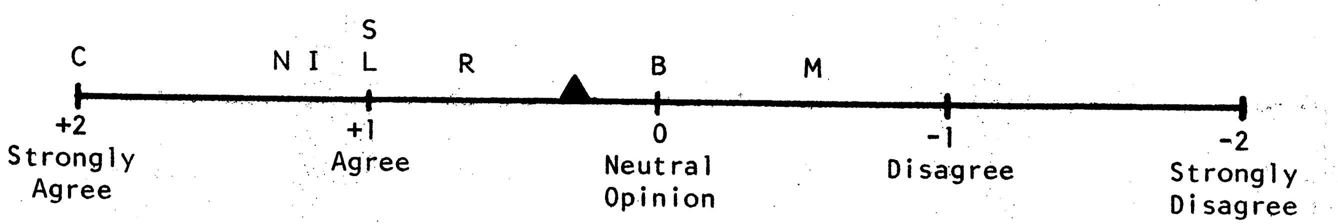
9. If there were budget cuts at this institution, I would give up other services that I need before I would want to lose the AMRS.



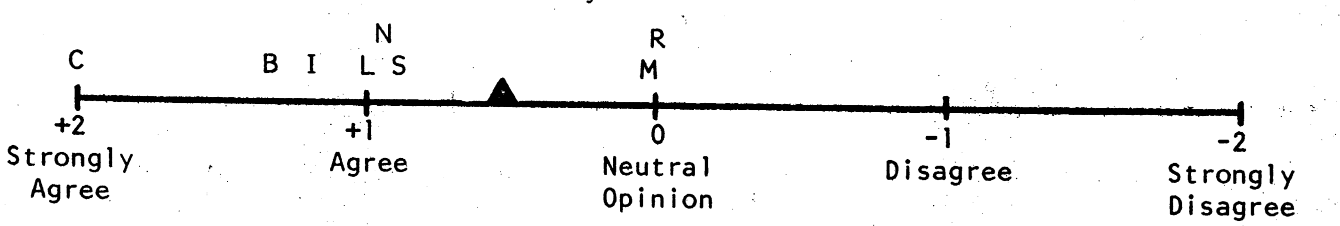
10. The AMR system has "goofed up" patient records more times than I care to remember.



11. I truly feel that the quality of patient care has been improved as a result of the AMRS.



12. From an administrative point of view, the AMRS provides timely data for making management decisions that were not available with the manual system.

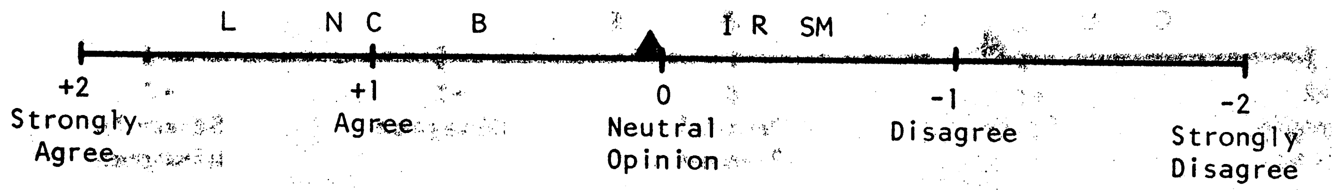


LEGEND: ▲ - Overall Mean (N=58)

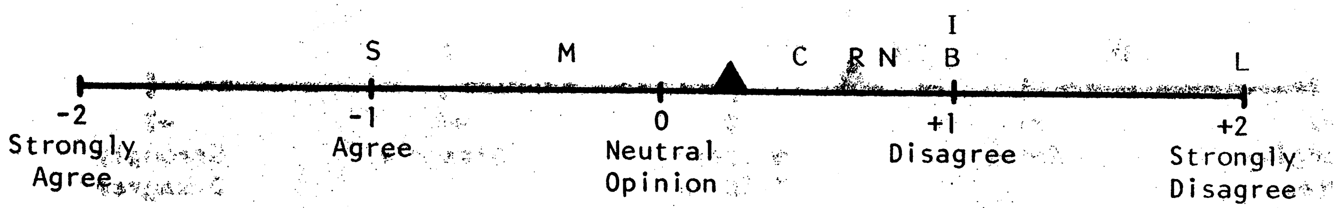
B - Bellevue Hospital (N=3)
C - Casa de Amigos (N=2)
I - Indian Health Service (N=5)
L - Los Angeles County (N=2)
M - Medical University of South Carolina (N=28)
N - Naval Air Station, Brunswick, Maine (N=13)
R - Regenstrief Institute (N=3)
S - Stanford University Medical Center (N=2)

Figure 4L2c Mean Responses of Eight Institutions to Each of the 20 Statements Contained in the Attitude Questionnaire (Cont.).

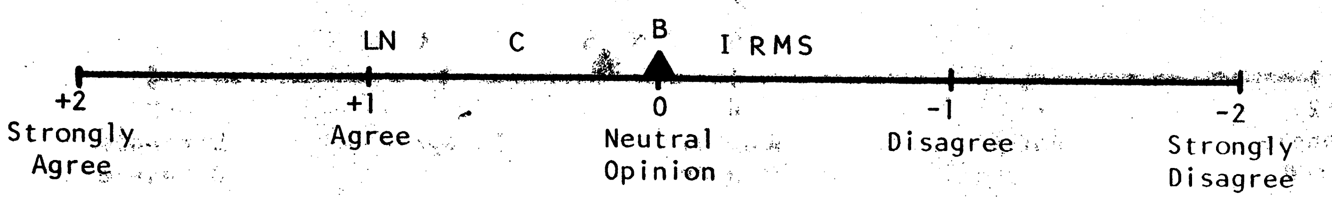
13. Patient scheduling and staffing patterns have been improved since the advent of the AMRS.



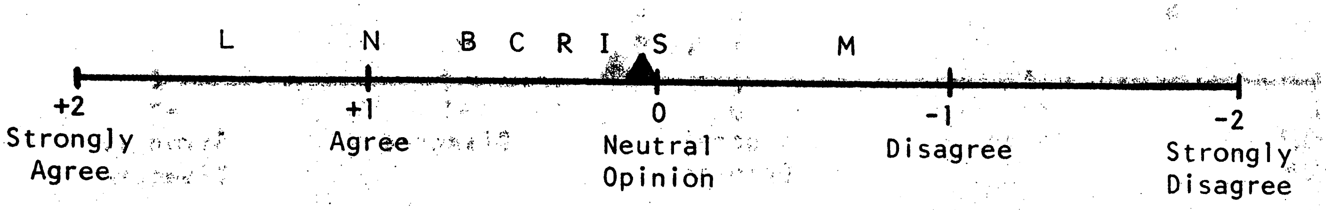
14. The AMR system doesn't benefit me very much personally, but I can see how it can be a boon to other users.



15. Patient satisfaction seems to be running higher since the AMRS was introduced.



16. With the AMRS, I am able to get more done in a day.

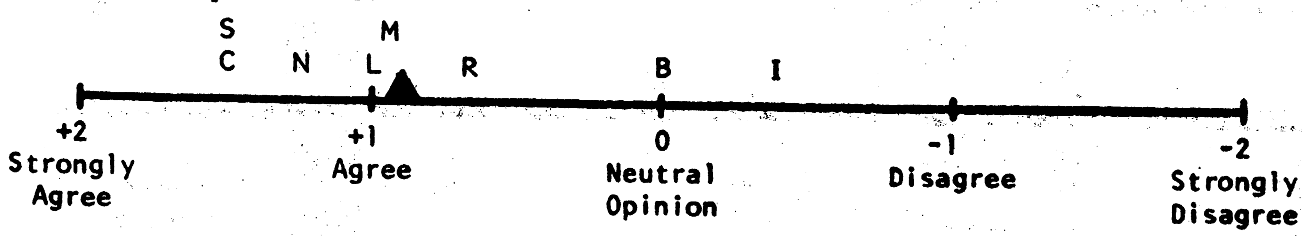


LEGEND: ▲ - Overall Mean (N=58)

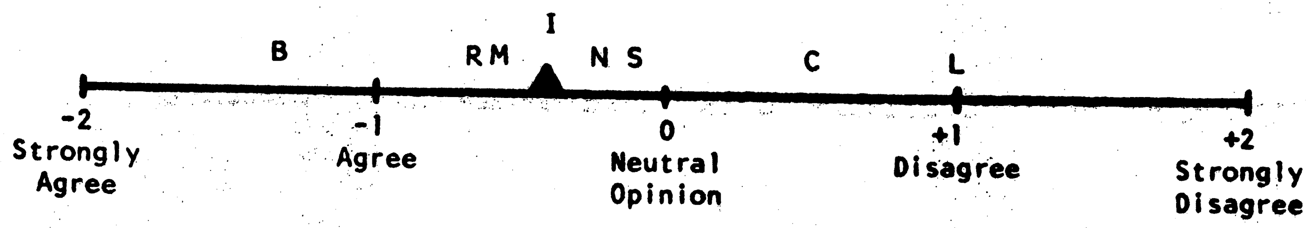
B - Bellevue Hospital (N=3)
C - Casa de Amigos (N=2)
I - Indian Health Service (N=5)
L - Los Angeles County (N=2)
M - Medical University of South Carolina (N=28)
N - Naval Air Station, Brunswick, Maine (N=13)
R - Regenstrief Institute (N=3)
S - Stanford University Medical Center (N=2)

Figure 4L2d Mean Responses of Eight Institutions to Each of the 20 Statements Contained in the Attitude Questionnaire (Cont.).

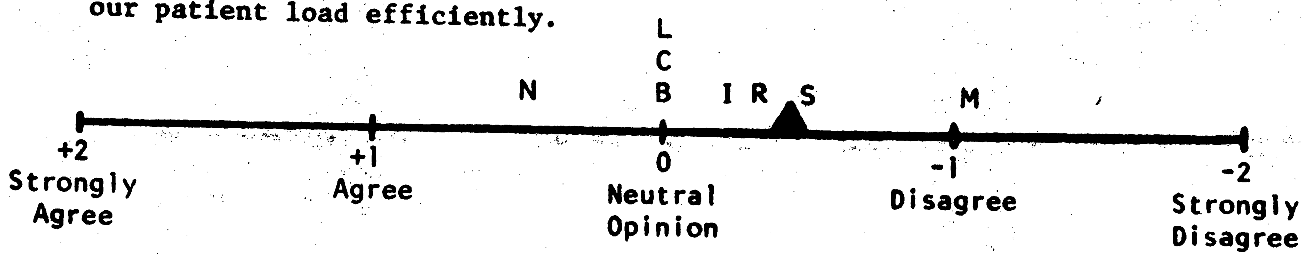
17. The medical records produced by the AMRS are more amenable to peer review and better meet PSRO requirements.



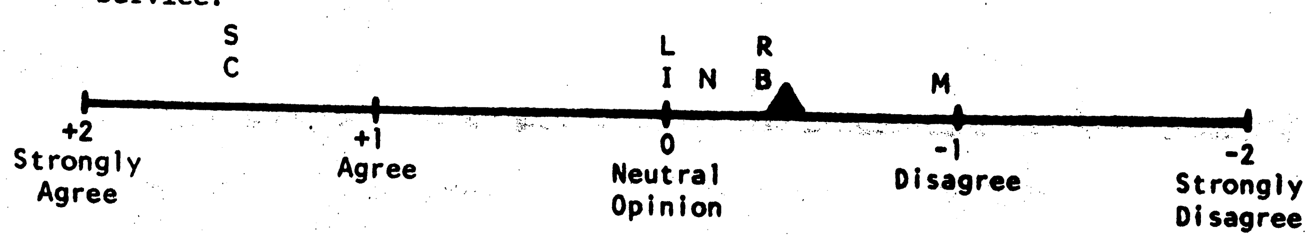
18. The confidentiality of the patient's record is more vulnerable in the AMRS than it was in the old manual system.



19. I don't care what the AMRS costs to operate; we need it to handle our patient load efficiently.



20. If the AMR system were to be taken out, I would be willing to pay a reasonable fee to get it back in service.



LEGEND: ▲ - Overall Mean (N=58)

B - Bellevue Hospital (N=3)
C - Casa de Amigos (N=2)
I - Indian Health Service (N=5)
L - Los Angeles County (N=2)
M - Medical University of South Carolina (N=28)
N - Naval Air Station, Brunswick, Maine (N=13)
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S - Stanford University Medical Center (N=2)

Figure 4L2e Mean Responses of Eight Institutions to Each of the 20 Statements Contained in the Attitude Questionnaire (Cont.).

Chapter 8

GLOSSARY

This glossary contains only selected terms in the AAMRS area. We have included those terms which required definition within our own study group, as well as some of those which had to be defined in order to communicate at the sites visited.

access: the process of finding data in a computer file.

accounts receivable: payments for services rendered not yet received from clients, measured sometimes as number of days outstanding of the average daily income.

ADAMHA: Alcoholism, Drug Abuse and Mental Health Administration of HSA.

algorithm: a set of procedural rules to find a solution to a well formulated problem, or terminate with a message if no solution is possible.

assembly language: a language close to the hardware of the computer.

asynchronous: serial data transmission of characters according to the speed of the transmitter.

background processing: processing of a low priority program taking place only when no higher priority or real-time processing function is present.

bandwidth: transmission capacity of a communication or file transfer system measured in terms of bits/second.

BASIC: a simple high-level language with some character manipulation capability available on many computers.

batch: operation of a computer where processing is performed on a substantial collection of data at a time.

baud: unit of data transmission speed, often used for video terminals; one baud is equivalent to one bit per second. To transmit one character in asynchronous mode 10 or 11 bits may be required, so that 300 baud allows 30 characters per second to be transmitted.

BHSR: Bureau of Health Services Research, earlier (1972-1974) title of the NCHSR.

binding: the process of committing a design to a firm structure; see section 6F.

bit: smallest unit of data storage or transmission; encodes a two-way choice (0 or 1).

block: a unit of file data on a disk.

buffer: temporary storage for a block in core memory.

byte: unit of 8 bits, frequently used to represent a character; allows 2^8 choices or up to 256 distinct characters and codes.

capitation: the health care service is provided for an annual fixed fee.

categorical grants: government funding to support health care for specific categories of patients.

central processing unit: main part of a computer, contains the logical and arithmetic circuits and controls connected devices.

character: basic unit of data, may require 6 to 8 bits for storage, possibly more for transmission.

character/second: unit to measure transmission or printing speed of serial devices.

COBOL: a high-level language for business problems, with character manipulation and strong file facilities, available on some mini, and on most medium size and large computers.

compiler: translator for source programs to generate directly (without an interpreter) executable computer codes.

core: primary processing memory of a computer.

cost-benefit analysis: identification, measurement and valuation of all cost and benefits over time with respect to a single project.

cost-effectiveness analysis: a comparison of the economic efficiency of alternative systems directed toward the same objective.

cost-justified: an AAMRS is justified in terms of cost-savings and other tangible benefits.

CPU: central processing unit.

CRT: Cathode Ray Tube, common name for video display terminals using a TV-like display to present computer generated data.

data: collection of symbols to represent observations or records of events.

data base (computer science): a comprehensive data file containing information in a format applicable to a user's needs and available when needed.

data base (medical): information on a patient used for clinical judgement.

disk: device for the permanent storage of data.

disk pack: a stack of removable disks, which can be used to keep data off-line.

dot matrix: presentation of characters using a matrix, generally 5x7, of dots. To increase legibility or allow lower case letters, more dots (7x9) may be used.

EMCRO: Experimental Medical Care Review Organization (see PHS 73).

family number: number assigned so that all family members are grouped together.

fee-for-service: the health care is supported by payment for every individual service provided.

feedback: the part of a closed system which is used to bring back information about the condition under control.

file maintenance: the activity of keeping a file up to date by adding, changing, or deleting data.

flag: indication in a record to watch for certain categories of problems or data, without a detailed specification.

flow chart: a description of an algorithm process in graphical form.

flow sheet: a method of presentation of clinical findings on a patient in a matrix form, where the visit dates are placed on one axis and the type of finding on the other axis.

foreground processing: the execution of computer programs that have been designed to preempt the use of the computing facilities.

FORTRAN: a high-level language available on most computers, mainly algebraically oriented.

FTE: full time equivalent effort of part time or part and full time personnel.

hardcopy: printed or micro-filmed, permanent computer output.

hardware: computer equipment.

hard-wired: connection of terminals to a CPU which avoids telephone line switching and allows definite identification of terminals.

hash coding: method to store and retrieve single data records rapidly from disks, etc.

high-level language: a computer language close to algebra, generally with extensions for character processing.

HMO: Health Maintenance Organization, specifically a prepaid health plan as defined by the HMO Act of 1973 (PL93-222).

impact printing: typing or printing process using pressure and an ink ribbon. Plain paper can by used and multiple copies can be produced with carbon paper.

information: data presented, processed, or selected so that decisions can be made or action may be taken.

interpreter: analyzer for programs; directs the CPU to carry out source program functions.

HRA: Health Resources Administration Public Health Service agency supporting research and development of health services.

HSMHA: Health Services and Mental Health Administration, earlier title of the operations of the Public Health Service now carried out by HRA and ADAMHA.

HSA: Health Services Administration,Public Health Service agency supporting delivery of health services.

joystick: small handle used to control the position of a marker on a CRT screen, used to select data elements displayed.

K: 1000 or 1024, depending on the number base (decimal or binary) used to describe parameters of a system. Often used to describe the size of primary (core) storage in binary.

key-data: relatively invariant data important for patient care as: allergies to medicines, the presence of a pace-maker, or the existence of diabetes.

keypunch: device for data recording by typing characters on a data processing card.

large computer: general purpose computer system, often shared by diverse users, system cost generally greater than $600,000, and less than $6 million. If they are larger they are called supercomputers.

lightpen: an indicator instrument available with some CRT's, used to select data elements displayed on the screen.

lines per minute: unit of measurement for the speed of high speed printing devices. Net speed in terms of characters per second depends on the actual length of the lines printed. If average lines are 60 characters long, then lines per minute are equal to characters per second.

M: 1,000,000 or 1,048,576, depending on the number base (decimal or binary) used to describe parameters of a system. Often used to describe the size of secondary (disk) storage in decimal.

magnetic tape unit: a device used to read and write on reels of tape coated with a magnetizable material.

maxi computer: see large computer.

micro computer: special purpose computer system, mainly single user oriented, system cost less than $30,000.

midi computer: combines aspects of mini computer and large computer, system cost about $300,000 to $600,000.

mini computer: limited purpose computer system, generally used on-line by one or several users with similar applications, system cost generally between $30,000 and $300,000.

MIS: Management Information System, operating systems providing a variety of file and disk organization services, as well as scheduling of file oriented programs.

monoprocessing: use of a computer to finish one task at a time.

morbidity: state of being diseased.

multiprocessing: use of computers to work on multiple tasks at a time.

multiprogramming: computer system to implement multiprocessing.

MUMPS: a computer system and a simple high-level language able to run on minicomputers.

NCHSR: National Center for Health Services Research, an agency of the HRA.

NCHSRD: National Center for Health Services Research and Development, earlier (to 1972) title of the NCHSR.

network: system of interconnected computers and terminals.

NIH: National Institutes of Health; Public Health Service agency supporting medical research.

NIMH: National Institute for Mental Health; now part of ADAMHA.

objective evaluation tools: quantitative measurement of tangibles; questionnaires or structured interviews to determine intangibles.

off-line: not physically connected to a computer.

on-line: with direct physical and operational connection to a computer.

operating costs: current costs associated with an AAMRS, includes support of developmental efforts, and user personnel interacting with production aspects of the system, e.g., data entry clerks.

operating system: integrated collection of programs for the scheduling of application programs and sharing of computer resources as CPU time, core, and disk storage.

page: a unit of program data on a disk, has to be moved to core in order to be usable.

patient profile: a concise summary of the patient's status for clinical care use.

PL/I: a high-level language with strong character manipulation and file facilities, mainly available on large IBM computers.

plasma panel: flat glass plate containing a fine matrix of gas cells which can be made to glow selectively to display letters or graphs.

POMR: problem oriented medical record.

primary care: management of the problems by primary providers: family physician, neighborhood clinic, etc.

problem oriented medical record: a format of the medical record, promulgated by Dr. Weed, which among other features, links all findings noted to problems perceived by the physician or patient.

program: algorithm coded into a computer usable form.

programming: the process of translating a problem into a language that a computer can understand and obey. The process of planning the procedure for solving a problem.

progress note: physician's statement of patients problem status after an encounter.

protocol: algorithm for medical personnel.

PSRO: Professional Standards Review Organization.

real-time system: a system where transactions are processed on-line as they occur in order to satisfy defined and rigorous time constraints.

remote batch: operation of a computer where a set of messages from a terminal is collected to be handled together as a batch.

review-of-systems: methodical review of major body systems, i.e., cardio-pulmonary, skeletal-muscular, etc.

secondary care: care given by specialist in his office in the community.

selection entry: a method to enter data by selection, with a finger-touch or lightpen, e.g., elements chosen from a table or menu presented on a CRT screen.

self-coding: the placement of a mark or a number in a specified labeled position on a form provides the coding of the response. The code corresponding to the position is either entered by a data-entry person or determined by a mark sense or optical reader.

self-encoding: data collection by placing a check mark in a labeled box. A code corresponding to the box is entered into the computer.

sequence number: number assigned to an episode, encounter, or visit, generally in chronological order of occurence at the site.

sequential file: a file on which information is stored in the same order in which it is accessed by the central processing unit.

SOAP: Subjective, Objective, Assessment, Plan: sequence of an encounter process when using the POMR.

softcopy: data presentation as a CRT image or in audio format.

software: programs to provide the required services.

source program: program as written by a programmer.

strokegenerator: CRT character generation by explicit movement of the writing beam to form the symbols to be displayed. Also: cigarette.

suboptimization: optimization of activity within a small group or function, rather than as a part of a larger system.

synchronous: data transmission according to a predetermined rate for the characters in message.

systems analyst: a person skilled in solving problems with a digital computer. He analyzes and develops information systems.

table lookup: a method of searching a table to locate items of a certain type or value.

teletype: a printing terminal originally developed for message transmission. It prints at a rate of 10 characters/second.

terminal: the point of data entry or output of a system, often an automated typewriter or CRT device.

tertiary care: in ambulatory care: office visit at a regional medical center.

thermal: printing process using heat-sensitive paper and heat-generating elements in a dot-matrix.

time-sharing: operation of a computer where multiprogramming is arranged to provide continuous service to each active terminal.

transaction processing: operation of a computer where each message entered into the computer starts a task which is processed separately and completely.

trauma: health problems related to external injuries.

triage: selection of health service level according to patient needs and health care delivery service capabilities.

TRIMIS: plan for automation of military health care delivery for the joint services, currently managed by the US Air Force in Montgomery, Alabama.

turn-around document: an output from a computer, which when appropriately completed, can serve after the encounter as an input document to computer processing.

TV-raster scan: CRT image generation, as used by TV sets, through 525 horizontal lines varying intensity.

unit number: permanent number assigned to an individual, for instance, the Social Security Number.

variable-length record file: a file whose records are not uniform in length.

virtual memory: a technique for managing a limited amount of core memory and a much larger amount of lower speed drum or disk memory in such a way that the distinction is largely transparent to a computer user.

warmstart: restart of a computer system, after a failure, with most of the data intact.

CHAPTER 9

SELECTED BIBLIOGRAPHY

This bibliography is not intended to be exhaustive. It has been compiled from two major sources:

a) References used by the members of the AAMRS study group in the preparation of this report. This includes both references cited in the text as well as significant background material;

b) References from sites surveyed as listed in the comprehensive site list. Here only one recent reference is given and only if that reference is reasonably obtainable from a good library or documentation service. For sites where no reference is listed, we advise contacting the principals directly if more information is desired.

We hope that even with these limitations this bibliography will be helpful to readers who wish to follow up on work of interest to them.

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